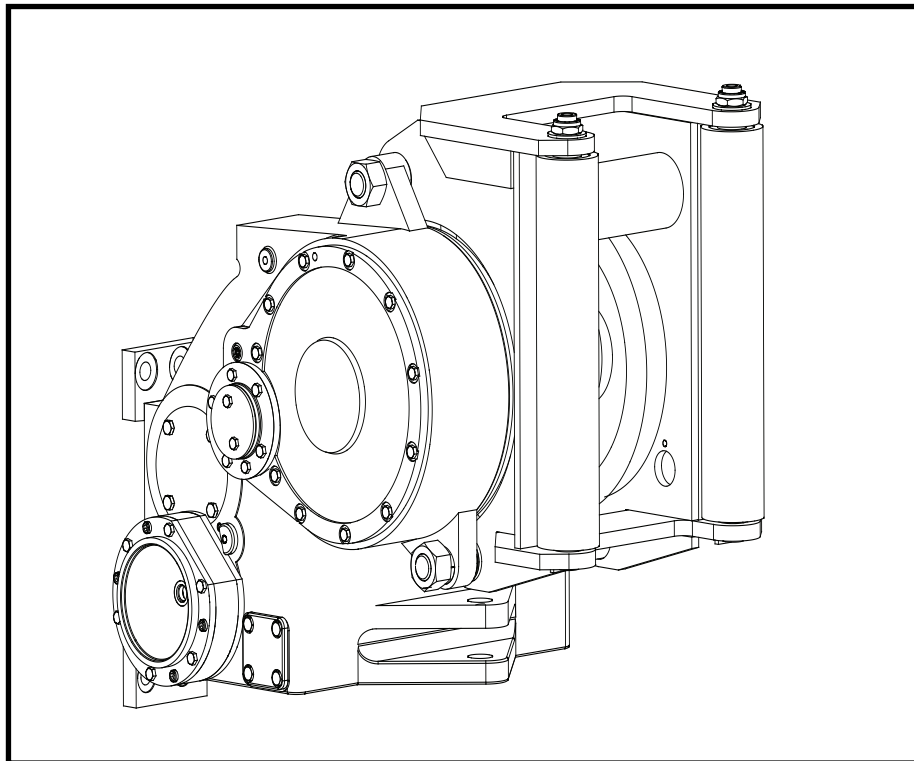


CARCO®

MODEL H60VS / H85VS SERVICE MANUAL

PRELIMINARY



PACCAR WINCH

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FOREWORD

Please read and understand this entire manual BEFORE operating or performing service on your CARCO winch. Retain this publication for future reference.

This manual contains instructions for the service and repair of CARCO Model H60VS winch.

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

Continuing product improvements may cause changes in your winch, which are not included in this manual. Whenever a questions arises regarding your CARCO winch or this publication, please contact the CARCO Winch Service Department at 1-918-251-8511, Monday - Friday, 0800 hrs - 1630 hrs CST, or by fax at 1-918-259-1575, or by e-mail at winch.service@paccar.com. Provide the complete winch MODEL NUMBER and SERIAL NUMBER when making inquiries. Refer to MODEL DESCRIPTION section for location of model and serial number.

This complete service manual is available for viewing and/or downloading as a .PDF file on our internet website - <http://www.paccarwinch.com/literaturelist.asp>

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Safety and informational callouts used in this manual include:

WARNING

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

CAUTION

CAUTION - This emblem is used to warn against POTENTIAL OR UNSAFE PRACTICES THAT could result in personal injury and product or property damage if proper procedures are not followed.



This emblem is used to indicate an informational note or service tip.

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 tractor and winch must be operated with care and concern by the operator for the equipment, and a thorough knowledge of the machine's handling and performance capabilities. The following recommendations are offered only as a guide for the operator. 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 tractor engine running, unless specifically instructed to do so in this manual.
3. Before starting the tractor engine, be certain all controls move freely and are placed in the "Brake On" (neutral) position.
4. **NEVER** operate the winch controls unless you are properly seated at the operator's station on the tractor and you are sure all 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 winch drum, cable rollers and entry area of fairleads and arches.
6. Ground personnel should stay in clear view of the tractor operator and clear of the winch drum. **DO NOT** allow ground personnel near a winch line under tension. A safe distance of 1½ 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 the rated winch capacity, which may result in the failure of the 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 the correct size ferrule for the cable and pocket in the winch drum. Never use knots to secure or attach cable to the winch drum, or the hook to the 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 the rated capacity of the winch. Therefore, a minimum of five (5) complete wraps must be maintained on the winch drum.
10. Leather gloves should be used when handling winch cable.
11. Operate the winch to match line speeds to job conditions.
12. Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by everyone.
13. Inspect winch cable, rigging, winch and tractor at the beginning of each work shift. Defects should be corrected immediately.
14. Position the tractor for the straightest line of pull to reduce the wear on the winch cable and ensure even spooling.
15. When winding winch cable on the winch drum, never attempt to maintain tension by allowing the winch cable to slip through the hands. Always use the "hand-over-hand" technique, being careful to keep hands and clothing away from winch drum and fairlead rollers.
16. Be sure of tractor ground stability before winching in a load.
17. Store unused chokers, slings and rigging in a neat and orderly fashion to prevent damage to equipment or injury to personnel.
18. The maximum rated bare drum line pull of the Model H60VS winch is 60,000 lb (267 kN).

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 two or more tractors together) is extremely hazardous.
19. The factory approved adaptations for CARCO winches are designed and intended for use on specific models of crawler tractors. Changing winches between



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

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.

20. CARCO H60VS 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.

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

21. 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 the tractor parking brakes and lower any equipment to the ground before dismounting the tractor.

22. The winches described in this manual are neither designed nor intended for use or application in the lifting or moving of persons.
23. Install guarding to prevent personnel from getting any part of their body or clothing caught at a point where the cable is wrapped onto the drum or drawn through the fairlead rollers.
24. Keep equipment in good operating condition. Perform the scheduled servicing and adjustments defined in the "Preventive Maintenance" section of this manual. Use of proper lubricants is crucial.
25. An equipment warm-up procedure is recommended for all tractor start-ups, and is essential at ambient temperatures below +40°F (+5°C). Refer to the "Warm-Up Procedure" listed in the "Preventive Maintenance" section of this manual.

WINCH DESCRIPTION

The CARCO H60VS winch is a hydraulically driven unit, fully enclosed in a rigid, cast ductile iron housing that is attached to the rear face of a crawler tractor. The winch is driven by a hydraulic motor and is fully dependent upon the tractor hydraulic system for power. The delivery of the oil supply to the winch motor varies with each specific tractor design.

The winch is equipped with equal speed gearing, power-in, power-out and freespool. The gear train and winch loads are held firm by a spring-applied, hydraulically released multi-disc static brake when the controls remain in the neutral "brake-on" position.

When operating the winch in the REEL-IN direction, the motor drives the gear train through a sprag-type over-running brake clutch. The inner race of the brake clutch serves as a coupling between the motor and the winch input shaft. The outer race of the brake clutch is connected to the friction discs of the spring-applied static brake with splines. The inner race turns freely in the REEL-IN direction, allowing the gear train to pull the load toward the winch and tractor. Immediately upon stopping, the sprag cams roll up to lock the inner race to the outer race and firmly hold the gear train. This action eliminates "load fall-back" to provide exceptionally precise load control.

When starting a REEL-OUT maneuver, the hydraulic oil enters the hydraulic motor but cannot escape as the brake valve, essentially a counterbalance valve, is closed. The pressure increases in the motor and the brake release pilot hoses forcing the brake piston against the springs causing the static load holding brake to be released. As the pressure continues to increase, the brake valve begins to meter oil flow out of the motor allowing the gear train and winch drum to rotate. The brake valve continuously modulates the oil flow to provide a smooth and controlled pay-out of the winch cable regardless of load or speed.

A patented combination spring-applied hydraulically released drum clutch and planetary gear carrier couples the winch input shaft to the remaining gear train. When a BRAKE-OFF function is performed, the drum clutch is released, allowing the idler gear, the first reduction gear and the second reduction gear to turn freely. This action enables an operator to drive away from a load utilizing the resistance of the gear train to maintain a tight wrap of cable on the drum.

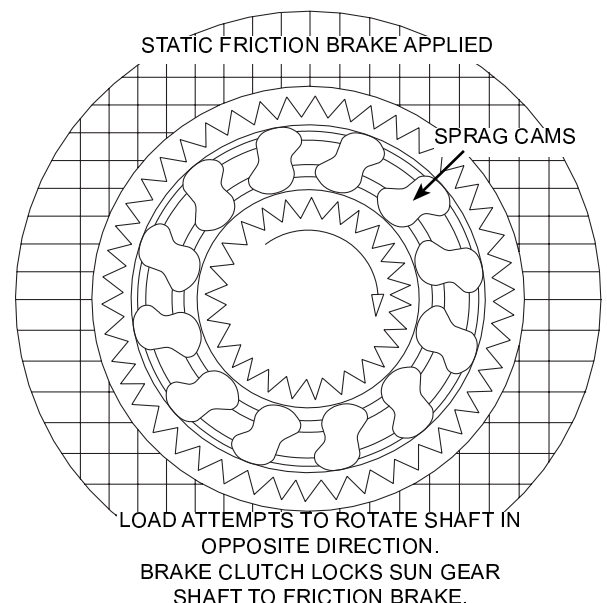
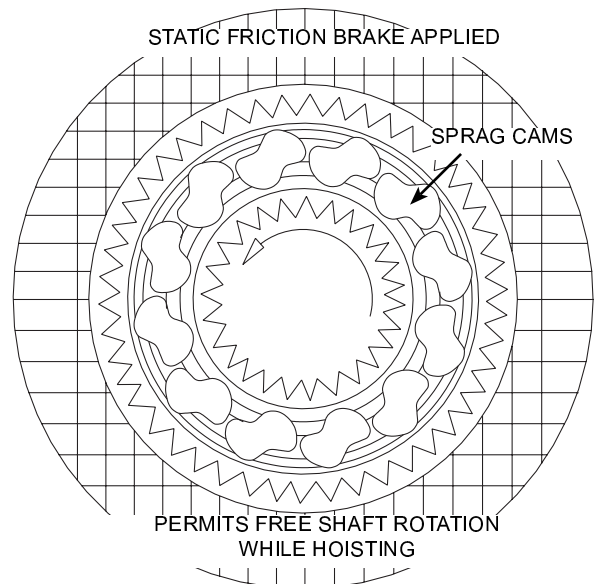
When FREESPOOL is selected, hydraulic oil is routed to the freespool cylinder which is connected to the second reduction pinion. As pressure is applied against the piston, the shifter fork, which is coupled to the clutch collar, causes the clutch collar to disengage from the pinion. This allows the pinion and the second reduction gear to turn freely without affecting the internal spring-applied brake.

i NOTE: FREESPOOL should only be used to pull wire rope off of the cable drum **by hand**, such as when hooking to a load.

An optional fairlead assembly is available for the H60VS winch. It may be ordered in either 3-roller or 4-roller design. A fourth roller kit is also available to upgrade a 3-roller assembly to a 4-roller unit. The fairlead is a "bolt-on" design, requiring no welding or special tools to install.

CAUTION

The hydraulic motor size (displacement) and winch gear ratio are matched to the specific tractor hydraulic system to maximize available power. Changes to the motor may be hazardous to the winch or personnel.



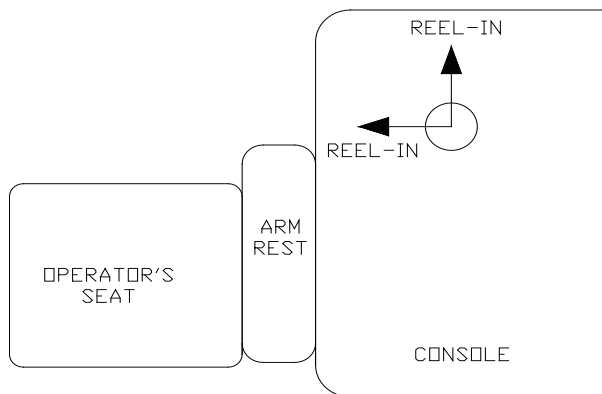
WINCH OPERATION

HYDRAULIC SYSTEM DESCRIPTION

Differential steer or hydrostatically controlled tractors are typically designed with a load sense, pressure compensating hydraulic system. These systems are usually equipped with variable displacement piston pumps, which supply oil to the implement valve only when a work function demands flow. Normally the pumps remain at approximately 300-400 PSI (2070 - 2760 kPa) in the low pressure, standby, condition. Moving the winch control lever will cause the pump displacement control system to upstroke to match the demand of the load. If the pressure starts to exceed the pump compensator setting (cylinder reaches full stroke or motor reaches maximum), the pump will destroke to decrease the flow and maintain the pressure at the compensator setting. The significance of this system is that there is no excess flow metered across a relief or partially shifted control valve spool to generate heat. Returning the control lever to BRAKE-ON (neutral) destrokes the pump to low flow, typically 0.2-0.5 GPM (.75-1.9 LPM), and returns the pump to the low standby pressure. Load sense hydraulic systems provide very precise load control while maximizing hydraulic efficiencies in the system.

The H60VS winch may be operated with a ripper controller or a CARCO supplied hydraulic joystick. The operation of the lever is dependent upon the lever used and the tractor hydraulic system. Tractor manufacturer supplied levers may be either single-axis or dual-axis joysticks. The CARCO supplied joystick is a dual-axis unit.

The mounting orientation of the control lever will determine the direction of lever actuation. However, in order to conform to current standards, the REEL-IN direction of lever movement **MUST** be either forward, toward the front end of the tractor, or left, toward the operator. The REEL-OUT direction **MUST** be directly opposite of the REEL-IN direction.



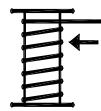
Use of the single-axis joystick requires the use of console-mounted toggle switches to activate BRAKE-OFF and FREESPOOL functions. Use of the dual-axis joystick allows these functions to be activated using the joystick, utilizing the opposite axis from REEL-IN / REEL-OUT.

CONTROL OPERATION

The following paragraphs define winch operation for each function. The joystick provides infinitely variable winch speed control. Slight movement of the joystick lever in either REEL-IN or REEL-OUT direction results in very slow and controlled drum speeds. As the lever is moved further from the center neutral position, the drum speed will increase proportionally. When the lever is released, it will spring return to the neutral BRAKE-ON position. Because there are no directional clutches the lever may be moved in very small increments, or feathered, to achieve precise load control without winch wear or damage. The drum clutch function is not variable.

BRAKE-ON (Neutral)

The control lever is spring-returned to center, or BRAKE-ON. The multi-disc, static parking brake is applied by spring force. Loads may be skidded with the lever in this position.

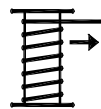


REEL-IN

With the control lever in this position, the winch drum will pull in the cable and load. Cable 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.

IMPORTANT: The control lever **MUST** be installed such the direction of movement for REEL-IN is either forward, toward the front of the tractor, or to the left, toward the operator.



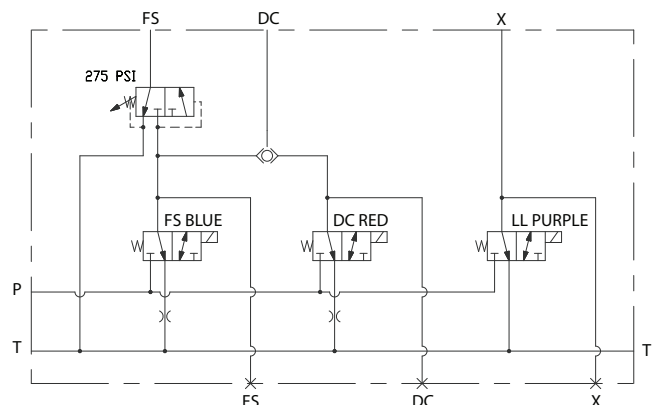
REEL-OUT

With the control lever in this position, the winch drum will rotate to power out the cable. Cable 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.

IMPORTANT: When using tractor supplied dual-axis control levers, ensure the REEL-OUT direction of movement is directly opposite of the REEL-IN direction.

The hydraulic control circuit which controls freespool, drum clutch, and low speed lock functions is described below.



Oil from the tractor pilot circuit enters the valve block at port (P) and is controlled by solenoids to actuate the drum clutch (DC), freespool (FS), and low lock (X) functions. The solenoids are usually controlled by toggle switches on the tractor console, but on some tractors the winch joystick controls the drum clutch function. When freespool is actuated, pressure is also directed to the drum clutch by a cartridge in the valve. On deactivating the functions oil returns to the tractor hydraulic tank through the valve (T) port. The return oil from the freespool and drum clutch is orificed to slow the re-engagement.



BRAKE-OFF (Drum Clutch Release)

When this function is activated, the internal drum clutch will be released with hydraulic pressure, allowing the operator to drive away from a load.

The resistance of the gear train will keep a tight wrap of cable on the drum to prevent cable over-run. It should be noted that cable **CANNOT** be pulled off the drum by hand while in BRAKE-OFF mode.

BRAKE-OFF is typically activated by pressing a toggle switch on the RH tractor console, or by moving the control lever in the proper direction when using a dual-axis control lever. When using a dual-axis lever, the lever should be “detented”, or held in position mechanically, to allow the operator to use both hands for tractor operation.

⚠ WARNING ⚠

DO NOT use BRAKE-OFF for a controlled reeling out of suspended loads. Sudden release of a load may result in property damage, injury or death. Use REEL-OUT only to lower any load.



LOW LOCK

There are two settings for the winch hydraulic motor – Auto and Low Lock. In Auto, the winch motor is in high speed (minimum motor displacement) until the hydraulic system pressure reaches the hydraulic motor compensator setting, generally about 3000 psi (20,685 kPa). When the compensator setting is reached, the hydraulic motor shifts to slow speed (maximum motor displacement) to provide more torque for heavy loads. The Low Lock switch locks the motor in slow speed (maximum displacement) for slow speed operation with lighter loads.

LOW LOCK is activated by pressing a toggle switch on the RH tractor console, forcing the variable displacement motor to shift into the maximum displacement setting, for maximum line pull and minimum line speed to enhance load control. Deactivating LOW-LOCK, by pressing the toggle switch back to the normal position, will return the winch motor to full auto-speed operation, allowing the motor to self adjust between the maximum and factory-set minimum displacements to achieve the best match of line speed and line pull for the application.

⚠ CAUTION ⚠

The H60VS hydraulic motor and gear ratio is configured to match the specific tractor hydraulic system. It may not be possible to install the winch to 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.



FREESPOOL

When activated, the winch cable drum will be disconnected from the hydraulic motor, primary gear train, and brake so that cable may be pulled off the drum by hand.

FREESPOOL is typically activated by pressing a toggle switch on the RH tractor console, or by moving the control lever in the proper direction when using a dual-axis control lever. When using a dual-axis lever, the lever should be “detented”, or held in position mechanically.



NOTE: *FREESPOOL is to be used ONLY for handling wire rope by hand. DO NOT attempt to release a load using FREESPOOL or to engage or disengage the gear train while the cable drum is rotating or when the tractor is in motion.*

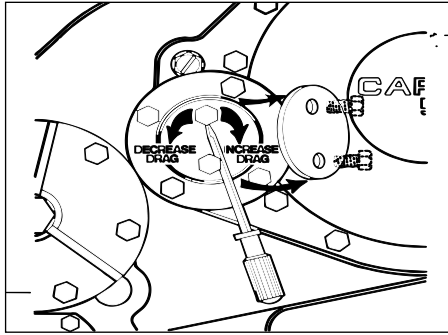
⚠ WARNING ⚠

FREESPOOL is ONLY to be used when the tractor is stopped, for pulling wire rope off the cable drum by hand. **DO NOT** use FREESPOOL when the tractor is in motion, to release a load or to move away from a load that is attached to the cable. Damage to the gear train and a loss of load control may result. Loss of load control may result in property damage, injury or death.

To release a load, or to move away from a load, the REEL-OUT function, or the BRAKE-OFF function **MUST** be used. Remove any load from the winch cable **BEFORE** selecting the FREESPOOL function.

The tractor and winch cable drum **MUST** be stopped **BEFORE** engaging the gear train. Gear train damage **WILL** result from attempting to engage the gear train while the cable drum is rotating.

FREESPOOL ADJUSTMENT



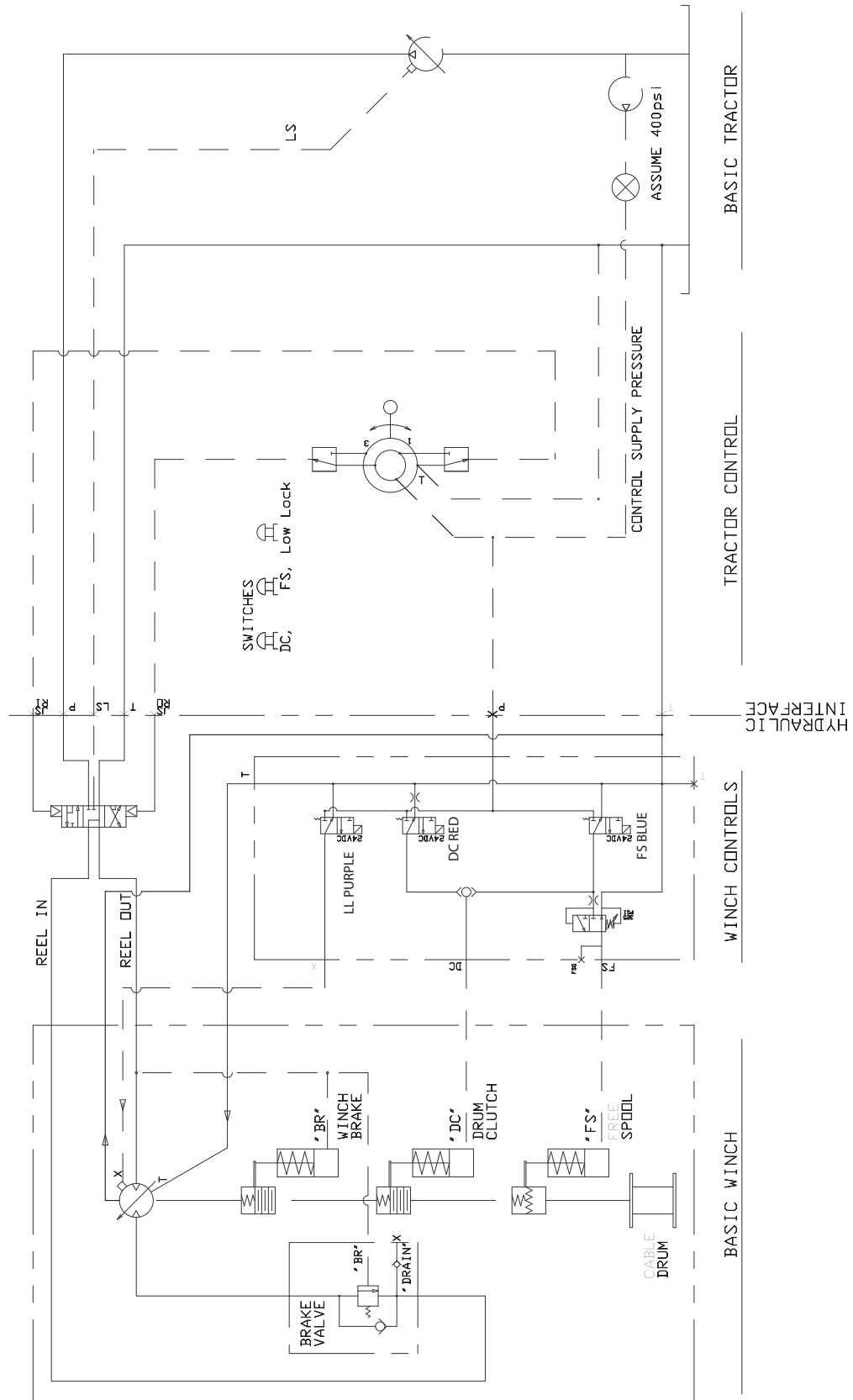
Using a long screw driver or pry bar, turn the threaded adjuster clockwise until tight. Tap the adjuster with a hammer to seat the bearing and continue turning until the adjuster can no longer be tightened. Back the adjuster out no more than 1/16 turn maximum and secure with lock plate and capscrews. Tighten the capscrews to 75 lb•ft (102 N•m) torque.

i NOTE: Tightening the threaded adjuster pushes the tapered bearing cup (outer race) into closer contact with the bearing cone and increases the bearing drag; much like tightening a wheel bearing nut on an automobile or truck. The snug fitting bearing cup will NOT move outward with the threaded adjuster when the adjuster is loosened. The winch must be operated under load for a brief period to allow the gear train load to push the outer bearing cup outward against the threaded adjuster before a reduction in bearing drag can be noticed.

CAUTION

Do not back off adjuster more than 1/16 turn as this allows excessive shaft end play and may cause gear train misalignment, accelerated wear and noise.

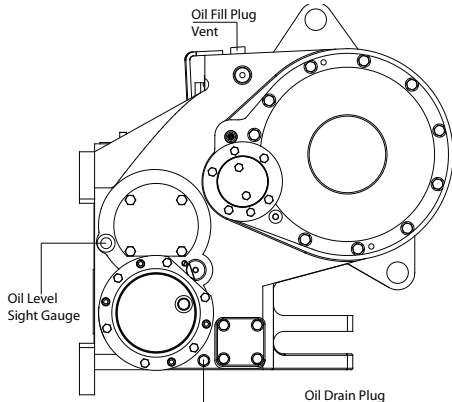
TYPICAL H60VS HYDRAULIC CIRCUIT



PREVENTIVE MAINTENANCE

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

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



GEAR CASE OIL LEVEL

Check the oil level weekly with the tractor and winch in a level position. Remove the access cover located above the clutch assembly on the LH side of the unit. The oil level should be just below the bottom of the opening. Add oil as required through the fill port on the top LH side of the winch case. On winches with a sight gauge, the oil level should be visible in the lower half of sight glass.

Refer to the page 10 for oil recommendations for your application.

GEAR CASE OIL CHANGE

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

⚠ WARNING ⚠

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

To drain the oil, place the tractor and winch in a level position and remove the drain plug located on the lower LH side of the winch case, or remove the square cover from the lower rear LH side of the winch. Drain the oil into a suitable container and recycle or dispose of used oil in an environmentally responsible manner. Install the drain plug securely after all oil has been drained.

Refill the winch to the proper level with the recommended oil. Refer to page 10 for oil recommendations.

OIL CAPACITY: Approximately 40 pints (19 L)

⚠ CAUTION ⚠

To prevent serious damage to the winch gear train, do **NOT** operate the winch while the oil is drained from the winch.

TRACTOR HYDRAULIC RESERVOIR LEVEL

The tractor hydraulic reservoir oil level should be checked daily, or in accordance with the tractor manufacturer's recommendations. Use the type of hydraulic oil recommended by the tractor manufacturer.

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

VENT PLUG

The vent is located on the LH side of the winch near the top of the winch case. It is very important to keep this vent clean and unobstructed to limit leakage and winch seal damage. When changing the winch oil, remove the vent and thoroughly clean in safety solvent and reinstall. Do **NOT** replace with a solid plug.

WINCH CABLE (WIRE ROPE)

Inspect the entire length of wire rope, and the chokers and hooks according to the wire rope and rigging manufacturer's recommendations.

MOUNTING FASTENERS

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

WARM-UP PROCEDURE

⚠ WARNING ⚠

A warm-up procedure is recommended at each start-up, and is essential at ambient temperatures below +40°F (+4°C). Failure to warm the oil and the winch hydraulic system may result in erratic clutch/brake operation which may result in property damage, personal injury or death.

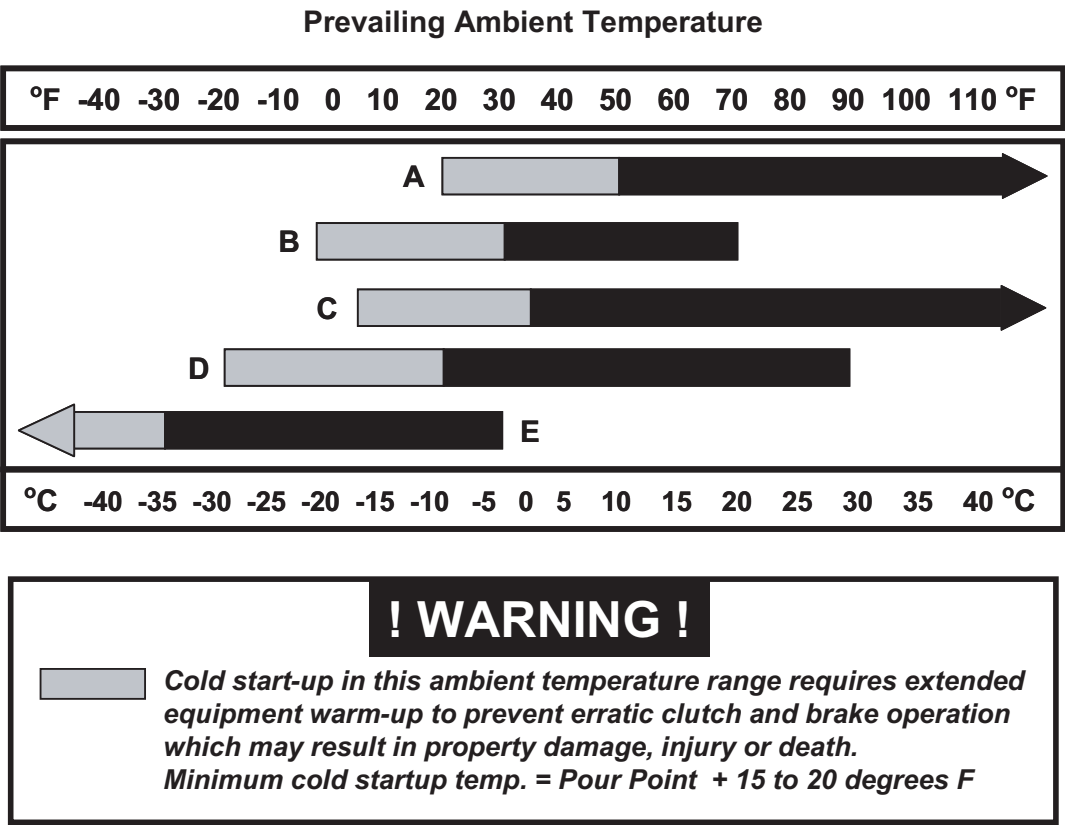
Start the tractor engine and operate at the lowest RPM setting with the winch control in BRAKE-ON (neutral), allowing sufficient time to warm the hydraulic fluid.

After initial warm-up, operate the winch under a no-load condition, in both REEL-IN and REEL-OUT directions, several times to prime the lines with warm hydraulic fluid and circulate the winch gear oil. This action will minimize the temporary increase in brake-off drag caused by cold oil.

FAIRLEAD ROLLERS

For units with the optional fairlead assembly installed, grease the rollers at the beginning of each work day. The vertical rollers have grease fittings at the top and the bottom of the shaft. The horizontal rollers have only one grease fitting located on the LH end of the shaft. Apply grease until a small amount pushes out around the shaft.

Use a high quality type 12-hydroxy stearate lithium based product, which contains an EP additive, such as Moly, and meets or exceeds an NLGI Grade 2 specification.



- 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

GENERAL SPECIFICATIONS

Unit Weight (without oil or cable)..... Approximately 2,515 lb (1,141 kg)

Gear Ratios Available :
Overall Ratio.....139.3
.....218.0

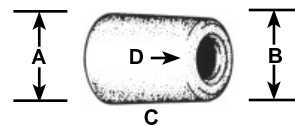
Cable Drum Dimensions :
Barrel Diameter. 10 in. (254 mm)
Flange Diameter. 19-7/8 in. (504 mm)
Barrel Length. 12-3/8 in. (314 mm)

Cable Storage Capacity:

Cable Drum Dimensions	
Barrel Diameter	10 in. (254 mm)
Flange Diameter	19-7/8 in. (504 mm)
Barrel Length	12-3/8 in. (314 mm)
Throat Clearance	approx. 9 in. (229 mm)

Cable Storage Capacity	
3/4 in. (19 mm)	319 ft (97 m)
7/8 in. (22 mm)	226 ft (69 m)
1 in. (25 mm)	154 ft (47 m)

Cable Ferrule Part Numbers	
3/4 in. (19 mm)	29424
7/8 in. (22 mm)	29425
1 in. (25 mm)	29426



Cable Ferrule Dimensions
A - 2-3/16 in. (56 mm)
B - 2-1/32 in. (52 mm)
C - 2-5/8 in. (67 mm)
D - To match cable diameter

Gear Case Oil Capacity..... 20 qt (19 L)
Static Brake Release Pressure..... approximately 400 PSI (2,760 kPa)
Brake-Off (Drum Clutch Release) Pressure approximately 320 PSI (2,205 kPa)

RECOMMENDED FASTENER TORQUE

Higher or lower torques for special applications will be specified such as the use of spanner nuts on shaft ends, jam nuts and where distortion of parts or gaskets is critical.

Lubricated torque values based on use of SAE 30 engine oil applied to threads and face of bolt or nut.

Avoid using thread lubricants as the applied torque may vary by 10-40% depending upon product used.

Bolt Dia. Inches	Thds Per Inch	Torque (LB-FT)			
		Grade 5		Grade 8	
		Dry	Lubed	Dry	Lubed
1/4	20 28	8	6	12	9
5/16	18 24	17	13	24	18
3/8	16 24	31	23	45	35
7/16	14 20	50	35	70	50
1/2	13 20	75	55	110	80
9/16	12 18	110	80	150	110
5/8	11 18	150	115	210	160

Bolt Dia. Inches	Thds Per Inch	Torque (LB-FT)			
		Grade 5		Grade 8	
		Dry	Lubed	Dry	Lubed
3/4	10 16	265	200	380	280
7/8	9 14	420	325	600	450
1	8 14	640	485	910	680
1 1/8	7 12	790	590	1290	970
1 1/4	7 12	1120	835	1820	1360
1 3/8	6 12	1460	1095	2385	1790
1 1/2	6 12	1940	1460	3160	2370

To convert LB-FT to kg-m, multiply by 0.1383

To convert LB-FT to N-m, multiply by 1.356

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 winch 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 winch **MUST** be removed from service until the problem has been corrected. If a winch has been subjected to a sudden heavy load (shock-load) or overload, it 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>	<ol style="list-style-type: none"> 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. 2. The multi-disc static brake may not be releasing as a result of a defective brake cylinder seal. <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> 3. The multi-disc static brake will not release as a result of damaged brake discs. 	<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>Remove the lower cover on the right hand side of the winch to access the hydraulic motor ports. The brake release hose connects to the adapter block on the lowering port of the motor (see drawing on p.20). Connect a hand pump with an accurate 0-2000 psi gage and an isolation valve to the brake release hose.</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 style="text-align: center;">B</p> <p>Oil leaking from the vent plug.</p>	<ol style="list-style-type: none"> 1. Defective brake cylinder seal. 2. Motor seal may be defective as a result of high system back pressure or contaminated oil. 3. The drum clutch piston seals may be leaking. 4. Freespool cylinder leak. 	<p>A. Same as A2.</p> <p>A. Motor case drain circuit pressure must not exceed 40 PSI (276 kPa). Inspect the hydraulic system for a restriction at the control return bulkhead hose.</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. The control valve located behind the large cover on the right hand side of the winch connects to hoses which supply the freespool and drum clutch cylinders. These hoses can be used to pressure check the drum clutch and freespool piston seals. Disconnect the hose at the valve for the drum clutch (DC) or freespool (FS). Connect a hand pump with an accurate 0-1000 psi gage and isolation valve to the hose.</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>A. Apply 200 psi (1379 kPa) to the freespool cylinder. Close the shut-off valve and let stand for 5 minutes.</p>
<p style="text-align: center;">C</p> <p>The brake will not hold a load with the control lever in neutral.</p>	<ol style="list-style-type: none"> 1. Excessive system back pressure acting on the brake release port. 2. Friction brake will not hold due to worn or damaged brake discs. 3. Sprag clutch failure. 4. Brake clutch may be slipping. 	<p>A. When the joystick is in neutral, the brake cylinder is connected to the tractor hydraulic oil reservoir through the directional control valve. Check for restrictions by teeing a gauge into the brake release line (drawing p.19). The pressure should be less than 50 psig.</p> <p>A. Same as A3A.</p> <p>A. Inspect sprag clutch.</p> <p>A. Improper brake disc and/or planetary gear oil may cause the brake clutch to slip. Drain the old gear oil and flush the winch gear cavity 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>

TROUBLE	PROBABLE CAUSE	REMEDY
TROUBLE "C" CONTINUED FROM PREVIOUS PAGE	5. The drum clutch rather than the brake may be slipping	B. Overrunning brake clutch may be damaged or worn. Disassemble and inspect as described in "Overrunning Brake Clutch Service". A. Ensure there is no pressure in the drum clutch cylinder by loosening the drum clutch supply hose at the control valve (the hose connected to the DC port of the valve). Disassemble the clutch and repair as necessary.
D The winch will not pull the rated load.	1. Air in hydraulic load sense line. 2. The hydraulic system relief valve may be set too low. The relief valve may need replacement or repair. 3. Be certain the hydraulic system temperature is not more than 200° F (93° C). Excessive hydraulic oil temperatures increase motor and pump internal leakage. 4. Winch line pull rating is based on 1st layer of wire rope. 5. Drum clutch discs may be worn. 6. Hydraulic motor locked in high speed, small displacement position.	A. Refer to the tractor service manual to bleed load sense hydraulic circuit. A. Check system relief pressure as follows: Install an accurate gauge into the winch reel-in pressure port with a tee adapter. Apply a stall pull load on the winch while monitoring the pressure. Compare the gauge reading to the winch specifications. NOTE: Refer to the tractor service manual for more information regarding the system relief valve. A. Check system relief valve, per D1A. B. Same as E2A. C. Make certain tractor hydraulic system heat exchanger (if equipped) is not plugged with debris, or internally restricted. A. Refer to winch performance data for more information. A. Same as C5A. A. Send motor to qualified motor service center.
E The winch runs hot.	1. Be certain the hydraulic system temperature is not more than 200° F (93° C). Excessive hydraulic oil temperatures may be caused by:	A. Check system pressure relief valve (D2A). B. Plugged heat exchanger (where used). Thoroughly clean exterior and flush interior of heat exchanger.

TROUBLE	PROBABLE CAUSE	REMEDY
<p>TROUBLE “E” CONTINUED FROM PREVIOUS PAGE</p>	<p>2. Excessively worn or damaged internal winch components.</p>	<p>C. Too low or too high oil level in hydraulic reservoir.</p> <p>Fill / drain reservoir to proper level.</p> <p>D. 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> <p>Check hydraulic pump suction line for damage.</p> <p>Pump worn or damaged. Inspect / replace pump as needed. See tractor service manual for more information.</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. The hydraulic system relief valve may be set too low.</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, D 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 rope is slack, the 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. When reeling in is resumed, the wire rope has a tendency to criss-cross and overlap on the drum. The 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>

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. Consult tractor operation and maintenance manual for more information.

⚠ 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 H60VS winch weighs approximately 2,550 lb (1,160 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 hoses from the tractor hydraulics at the winch bulkhead. Disconnect wiring harness at the winch bulkhead. Use eyebolts in 1 in. x 8 UNC tapped holes with lifting straps or chains to support the winch. Slowly remove nuts from studs securing the winch to the tractor. Ensure that the winch is supported by lifting rigging and carefully move winch away from 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 hydraulic hoses from the tractor to the winch bulkhead 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 before checking the oil level.

Note: Ensure the motor case is filled 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.

Follow the procedure in the tractor service manual to bleed air from the tractor hydraulic system.

WELDING PROCEDURE

The following specifications apply to welding ductile iron to ductile iron or steel to ductile iron when attaching arches or guarding to the winch case.

Preparation:

Attachments should be chamfered to ensure adequate penetration. Weld joints must be free of rust, scale, slag, sand, dirt, grease, oil, paint or moisture. Entire weldment should be not less than 65°F (18°C).

Procedure:

Use multi-pass welding technique (stringer bead) and follow electrode manufacturers recommendation for current, voltage, polarity and speed.

Materials:

Flux coated "stick" electrode

Composition –	Ni	43.75%	Mn	11.00%
	C	1.50%	Fe	43.75%

Mechanical properties - tensile strength	65,000 – 84,000 psi (448,000 – 579,000 kPa)
yield strength	45,000 – 65,000 psi (310,000 – 448, 000 kPa)
elongation	15-25%

Flux cored wire

Composition -	Ni	50.00%	Fe	44.00%
	C	1.00%	Si	0.60%
	Mn	4.20%		

Mechanical properties - tensile strength	64,000 – 74,000 psi (441,000 – 510,230 kPa)
yield strength	43,000 – 50,000 psi (297,000 – 345,000 kPa)
elongation	15-25%

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) as the line speed increases (larger circumference). Therefore, install the minimum length of cable possible for your application so that the winch will operate on lower layers (smaller diameter) and deliver the maximum line pull.

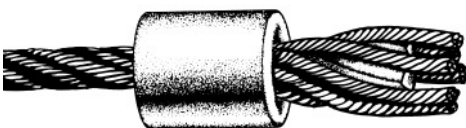
Using larger cable will not always increase strength, as the larger cable may be more prone to bending fatigue failure than smaller wire rope. Consult your wire rope supplier for his recommendations for the wire rope and other rigging which best suits your application.

⚠ WARNING ⚠

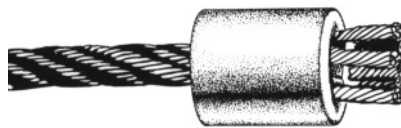
Winch cable anchors (ferrules and ferrule pocket) are **NOT** designed to hold rated loads. Winch loads applied directly to the cable anchor may cause the cable to pull free and result in the sudden loss of load control and cause property damage, personal injury or death. **A minimum of 5 wraps of cable must be left on the drum barrel to achieve rated load.** Do not use knots to secure or attach winch cable. We suggest that the last 5 wraps of cable be painted bright red to serve as a visual reminder.

INSTALLATION OF SPIRAL FERRULES

Re-usable, field-installed spiral ferrules are supplied with some Paccar winches. These ferrules are for use with standard six-strand, IWRC (Independent Wire Rope Core) type wire rope. Refer to ferrule selection chart in the "Specifications" section of this manual.



Step One



Step Two

Insert cable through the small opening of the ferrule. Spread strands and lay them in individual grooves in spiral wedges.

Tap wedges and cable into the ferrule leaving approximately 3/8 in. (10 mm) extending from the top. The first load will seat cable and wedges securely in the ferrule.

WINCH ASSEMBLY AND DISASSEMBLY

Follow the procedure in the Winch Removal and Installation section of this manual (p. 16) to remove the winch from the tractor.

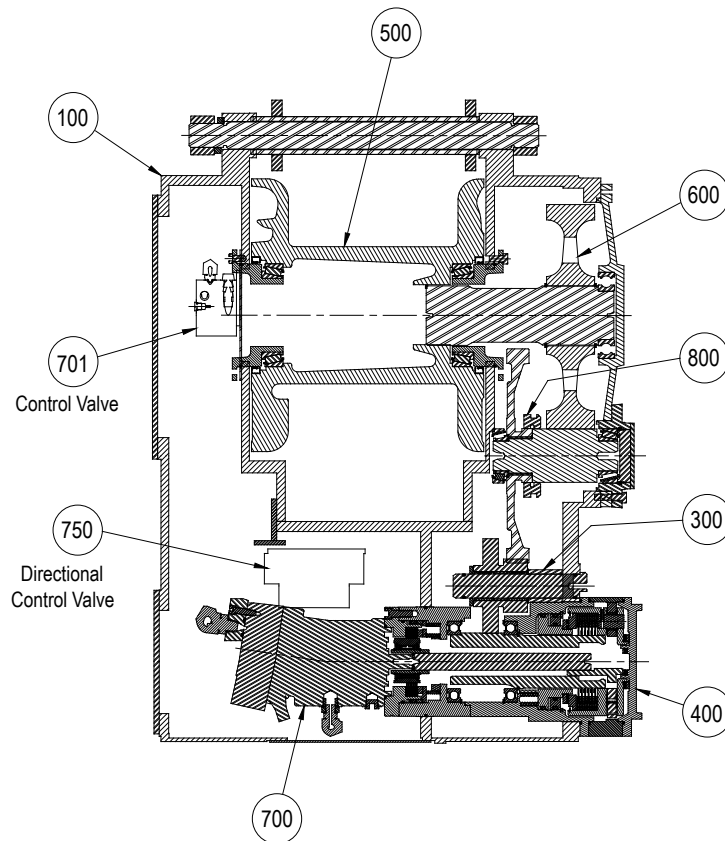
Instructions for winch installation on the tractor are in the Parts and Installation Manual for the particular tractor. This includes information specific to each tractor such as tractor hydraulic information.

The H60VS winch parts are separated into the groups below. The disassembly and assembly procedures in this manual are divided into these groups.

The general order of disassembly by group for the complete disassembly of the winch is:

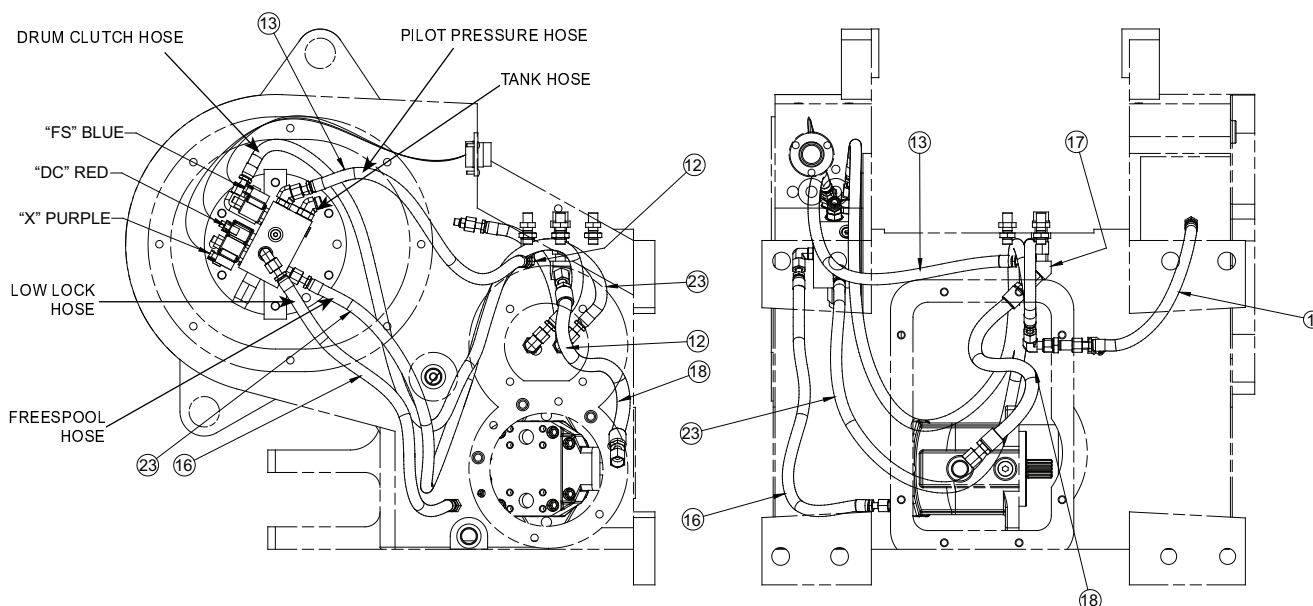
1. Hydraulic Control Group and Hydraulic Motor Group (covered in Hydraulic Group)
2. Drum Drive Group
3. Idler Shaft Group
4. Fourth Shaft Group
5. Cartridge Group
6. Drum Assembly

To remove the Cartridge group which includes the brake and drum clutch, the Idler Shaft Group, and Fourth Shaft Group must be removed because of the gear engagement between the Fourth Shaft Group and the Cartridge Group.



- 500 DRUM GROUP
- 600 DRUM DRIVE GROUP (covered in Idler Shaft Group)
- 800 IDLER SHAFT GROUP
- 300 FOURTH SHAFT GROUP
- 400 CARTRIDGE GROUP
- 700 HYD MOTOR GROUP
- 701 HYD CONTROL GROUP

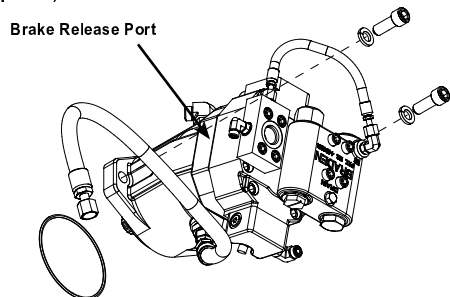
HYDRAULIC GROUP



The hydraulic group consists of the hydraulic motor, control valve, directional control valve, and hoses and fittings.

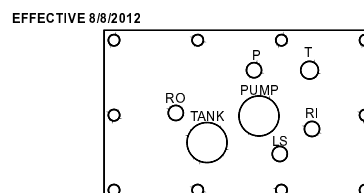
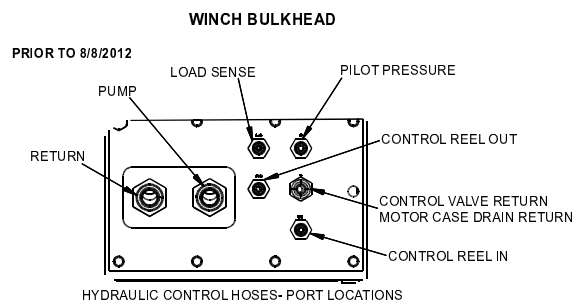
DISASSEMBLY

1. Remove the front cover and both right side covers to access the hydraulic motor group and hoses.
 2. Tag the hoses for reassembly and then disconnect hoses from the control valve, directional valve, and hydraulic motor.
 3. Remove the fittings connecting the directional valve to the winch bulkhead. To remove directional control valve, support the valve and remove bolts securing it to the winch.
 4. Remove the control valve.
 5. Remove cover (110) with bulkhead fittings for the tractor to winch connection.
 6. Remove the bolts securing the hydraulic motor to the winch and remove the hydraulic motor by pulling it straight out from the cartridge assembly. If the brake clutch comes out with the motor, refer to the assembly section for installation instructions before installing.
- Note: The clutch must be assembled in the proper orientation or the winch will not reel-in.**
7. If servicing the brake valve, remove it from the motor and refer to the brake valve service section of this manual (p.38).

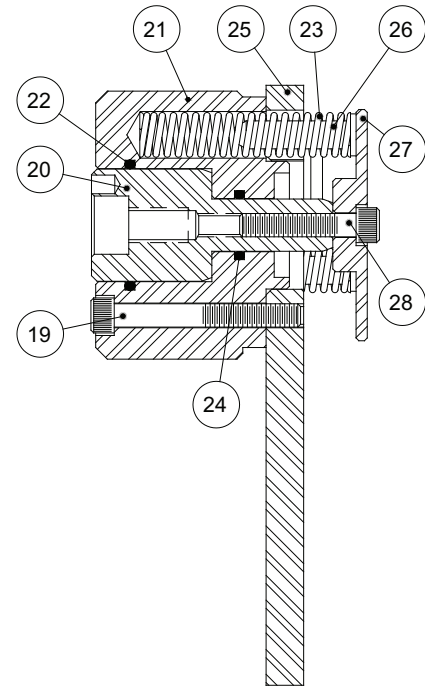
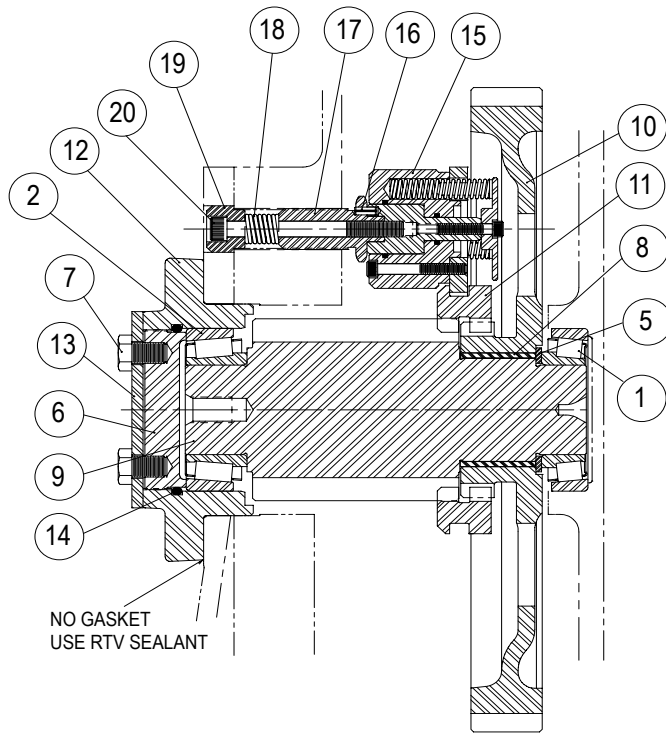


ASSEMBLY

1. Ensure the motor and valve subassemblies are assembled and ready for installation in the winch. Ensure the bulkhead fittings for winch freespool and drum clutch are installed.
 2. Install the control valve in the winch case by securing it to valve mounting plate and bolting the mounting plate to the winch.
 3. Install the directional control valve in the winch by bolting to the winch case..
- Note: Some hose connections will be difficult to tighten after the hydraulic motor is installed. Before installing the motor, check for tightness bulkhead hose fittings, brake release fitting, motor drain fitting, and others that may be hard to get tight with the motor in place.**
4. Ensure brake clutch assembly is properly installed (refer to Brake Clutch and Cartridge sections of this manual.) Install o-ring on motor pilot and install motor.
 5. Reconnect hoses to the valves and hydraulic motor.



IDLER SHAFT GROUP



ITEM	DESCRIPTION	QTY.
1	BEARING	1
2	BEARING	1
3	CAPSCREW (1/2 - 13 X 1-1/4 G8 Z)	2
4	CAPSCREW (1/2 - 13 X 2 G8 Z)	2
5	THRUST BEARING	1
6	ADJUSTER	1
7	CAPSCREW (1/2 - 13 X 3/4 G8 Z)	2
8	BUSHING	1
9	PINION	1
10	FIRST REDUCTION GEAR	1
11	CLUTCH COLLAR	1
12	BEARING CARRIER	1
13	LOCK PLATE	1
14	O-RING	1

ITEM	DESCRIPTION	QTY.
15	FREESPOOL CYLINDER ASSEMBLY	1
16	ROLL PIN	1
17	CYLINDER STUD	1
18	SPRING	1
19	CAPSCREW (1/4 NC X 2 SOC. HEAD)	3
20	CYLINDER ROD	1
21	CYLINDER	1
22	O-RING	1
23	SPRING	3
24	O-RING	1
25	YOKE	1
26	SPRING GUIDE	3
27	CYLINDER RETAINER	1
28	CAPSCREW (1/4 NC X 1-1/4 SPECIAL)	1

The idler shaft group and freespool components, which include the first reduction gear, second reduction pinion and freespool linkage, are located on the LH side of the winch, when viewed from the rear.

REMOVAL

Drain the oil from the winch as described in the "Preventive Maintenance" section of this manual.

Remove two (2) capscrews and the lock plate from the idler shaft bearing carrier and adjuster assembly.

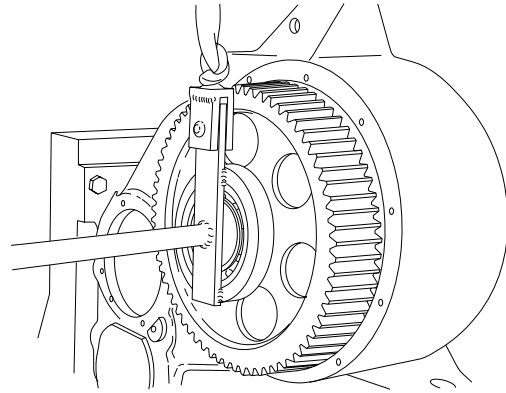
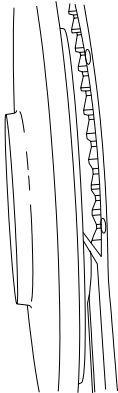
Remove the four (4) capscrews securing the idler shaft bearing carrier and adjuster assembly to the winch. Use two (2) of these capscrews as jackscrews, and remove the carrier and adjuster assembly.

Note the location of the two (2) long capscrews.

Inspect the bearing cup and replace as required.

Turn the adjuster counter-clockwise (CCW) and remove it from the bearing carrier. Remove and discard the O-ring from the carrier.

Remove the capscrews from the large diameter second reduction shaft bearing carrier cover, and carefully remove the cover.



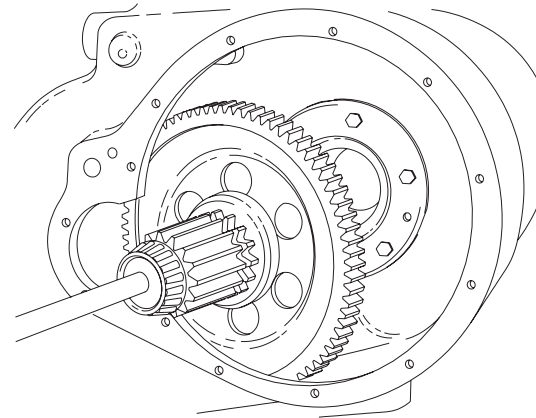
With a suitable lifting fixture or sling, remove the second reduction drum drive gear and shaft assembly from the winch case. The gear and shaft assembly weight is approximately 175 lb. (79kg).

Remove the freespool hose from the cylinder.

Remove the cylinder rod capscrew, spring and retainer washer from the winch case.

Rotate the cylinder assembly around the clutch collar toward the case wall opening and remove it from the winch case.

Remove the cylinder stud from the winch case, as required.

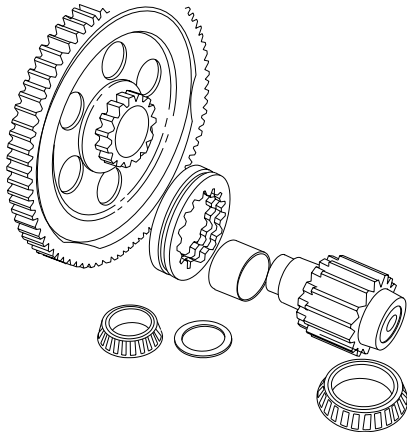


⚠ WARNING ⚠

Use a pry bar between the bearing carrier and the second reduction drum drive gear to unseat the ball bearing from the cover. DO NOT allow the cable drum drive gear to slide free of the winch case. The gear assembly may fall from the cover and cause personal injury.

Remove the second reduction pinion and first reduction gear from the winch case. Press the pinion from the gear and bearings.

Inspect the bushing in the first reduction gear for scoring or excessive wear. The bushing should fit freely over the pinion but not be excessively loose.



Inspect the bearing cup in the inner case wall and replace as required.

FREESPOOL CYLINDER ASSEMBLY SERVICE

Remove the capscrew, retainer washer, springs and spring guides.

Remove the cylinder rod from the cylinder.

Inspect the sealing surfaces for scoring or other abnormal wear and replace components as required. Use new O-rings when reassembling.

Apply Loctite 242, or equivalent, to clean, dry threads of the capscrews during reassembly.

reduction pinion with new winch oil, and install the bushing over the pinion.

Install the freespool clutch collar over the first reduction gear with the beveled side of the collar facing down toward the large end of the pinion.

Lubricate the outside diameter of the bushing and the first reduction gear bore with new winch oil. Install the first reduction gear and clutch collar assembly over the bushing, aligning the second reduction pinion teeth with the splined collar teeth. The clutch collar **MUST** be installed with the chamfered edge toward the pinion.

Install the thrust washer over the second reduction pinion and into the recess of the first reduction gear.

Press the inner bearing cone over the end of the second reduction pinion, until the bearing cone is resting firmly against the thrust washer.

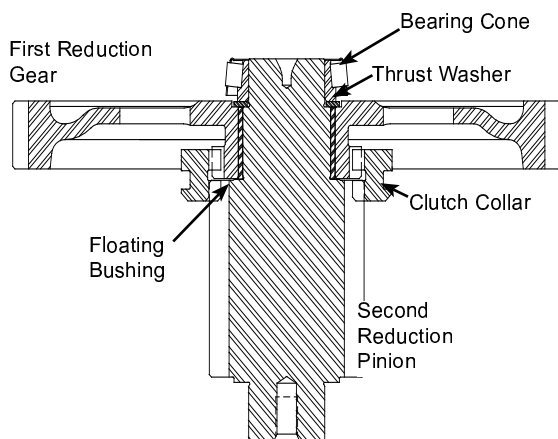
Press the outer bearing cone over the end of the second reduction pinion, until the bearing cone is resting firmly against the pinion shoulder.

If required, lubricate and install the bearing cup into bore in the inner wall of the winch case.

Place the first reduction gear and second reduction pinion assembly into the winch case opening, aligning the inner bearing cone within the bearing cup.

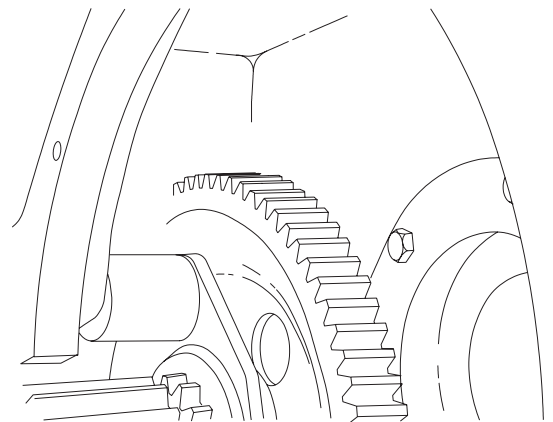
If required, install the cylinder stud into the winch case. Use Loctite 242, or equivalent, on clean, dry threads.

ASSEMBLY



Place the second reduction pinion on a flat surface with the small diameter end facing upward.

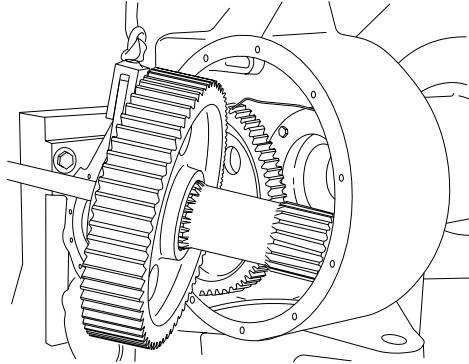
Lubricate the bushing and mating surfaces of the second



Install the freespool cylinder assembly into the winch case. Engage the clutch collar with the yoke. Rotate the cylinder assembly into alignment with the cylinder stud. **BE SURE** the roll pin in the stud engages the hole in the cylinder assembly.

Install the capscrew, spring and retainer. Apply Loctite 242, or equivalent, and torque to 45 lb•ft (61 N•m).

Temporarily install the idler shaft bearing carrier subassembly (bearing carrier, adjuster and O-ring) into the winch case to support the outer end of the second reduction pinion. Apply shop air pressure, approximately 100 PSI (69 kPa), to the freespool cylinder. Adjust the freespool cylinder stud into the winch case wall as required to allow the clutch collar to clear the edge of the pinion teeth, but still maintain maximum tooth contact while engaged.



Lubricate the splines of the second reduction gear shaft with general-purpose grease and install the second reduction drum drive gear and shaft assembly into the winch case. Firmly seat the shaft against the retaining ring in the cable drum bore.

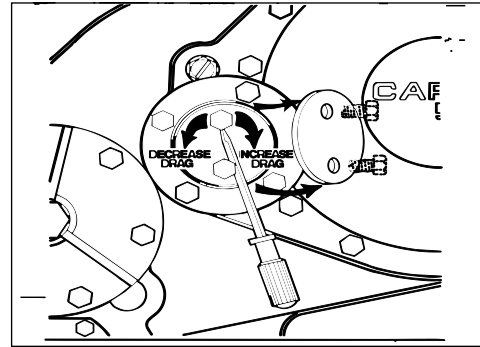
⚠ WARNING ⚠

The second reduction drum drive gear and drum drive shaft assembly weighs approximately 175 lb. (79 kg). Use a suitable lifting fixture or sling and take proper precautions when lifting this assembly to prevent possible personal injury. If the gear and shaft assembly is not seated fully into the cable drum as defined, it could become dislodged and fall from the winch case causing personal injury.

Apply silicon sealant, RTV 730 or equivalent, to the sealing surface of the large diameter second reduction gear bearing carrier cover and install it onto the winch case. Apply thread sealant to the capscrews and install them finger tight. DO NOT tighten the capscrews at this time. Lubricate and install the O-ring into the groove in the bearing carrier. Install the threaded adjuster into the bearing carrier until it is lightly seated against the bearing cup.

Apply silicon sealant, RTV 730 or equivalent, to the mounting surface of the bearing carrier.

Install the bearing carrier to the winch case. Apply thread sealant to the capscrews and torque evenly to 75 lb•ft (102 N•m). Tighten the remaining capscrews in the large second reduction gear bearing carrier cover.



Using a pry bar or a screwdriver approximately 18 in. (460 mm) in length, turn the threaded adjuster clockwise (CW) until tight. Tap the adjuster with a hammer to seat the bearing and continue turning the adjuster, then tapping with the hammer, until it can no longer be tightened. Back the adjuster out, by turning counter-clockwise (CCW), 1/16 turn maximum (22.5°) and secure in place with the lockplate and capscrews. Torque the capscrews to 75 lb•ft (102 N•m).

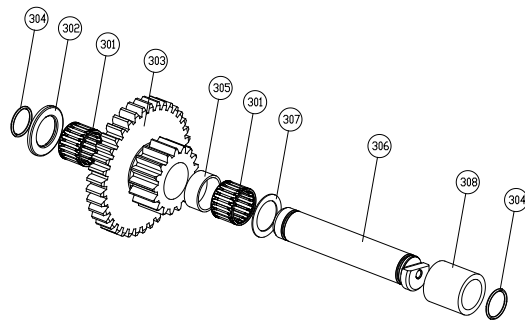
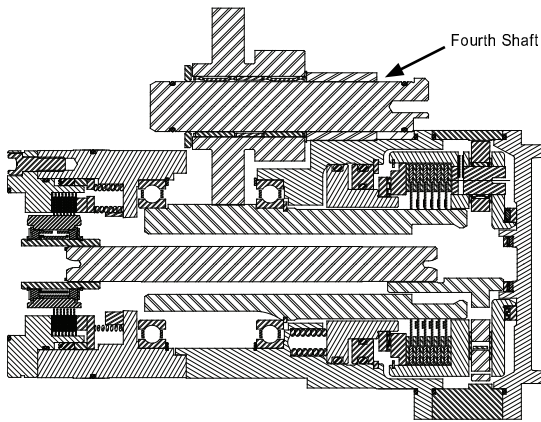


NOTE: Tightening the threaded adjuster pushes the bearing cup (outer race) into heavier contact with the bearing cone, increasing the bearing drag; much like tightening a wheel bearing nut in an automobile or truck. The snug fitting bearing cup will not move outward with the threaded adjuster when the adjuster is loosened. The winch **MUST** be operated under load for a brief period to allow the gear train load to push the bearing cup outward against the adjuster before a reduction in bearing drag is noticed.

⚠ CAUTION ⚠

DO NOT back the adjuster out more than 1/16 turn (22.5°) as this allows excessive shaft end play. Excessive end play may cause gear train misalignment, excessive noise and accelerated wear.

FOURTH SHAFT GROUP



ITEM	DESCRIPTION	QTY.
301	ROLLER BEARING	2
302	THRUST WASHER - .217 in. (5.5 mm)	1
303	CLUSTER GEAR	1
304	O-RING	2
305	SPACER	1
306	COUNTERSHAFT PIN	1
307	THRUST WASHER - .062 in. (1.58 mm)	1
308	SPACER	1

H60VS winches are equipped with the “Fourth Shaft Group”. This group contains a cluster gear which provides additional reduction in the gear train.

DISASSEMBLY

Drain oil from winch as described in the “Preventive Maintenance” section of this manual.

Remove the first reduction drum drive gear, second reduction gear and pinion, freespool shift rail and yoke, if equipped with freespool. Refer to “Idler Shaft Group” section of this manual for additional information.

Install a long, ½ in. NC, capscrew into the end of the countershaft pin (306) to serve as a handle. Support the cluster gear (303) and remove the countershaft pin.

CAUTION

The inner and outer thrust washers (302 & 307) will drop down into the winch case when the fourth shaft is removed. Be sure to retrieve them prior to assembly. Gear train damage will occur if these thrust washers are omitted or left in the bottom of the winch case.

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 cage should be inspected for unusual wear or deformation, particularly the cage bars. If there is any damage that will impair the cage’s ability to separate, retain and guide the rollers properly, the bearing should be replaced. The thrust washer contact areas should be free from any surface irregularities that may cause abrasions or friction. The gears and shaft should be inspected for abnormal wear or pitting. Replace if necessary.

ASSEMBLY

Lubricate and install new o-ring (304) into the groove on the countershaft pin (306). Lubricate and install two roller bearings (301) separated by a spacer (5) into the bore of the cluster gear (303).

Position the cluster gear (303) and outer thrust washer (302 or 307) in the winch case and at the same time, insert countershaft pin (306) through the bore into the thrust washer and cluster gear.

Position the inner thrust washer (302) in the winch case between the cluster gear and the inner case wall then fully install the countershaft pin.

Rotate the countershaft pin so that the slotted end is properly positioned to permit cartridge assembly installation.

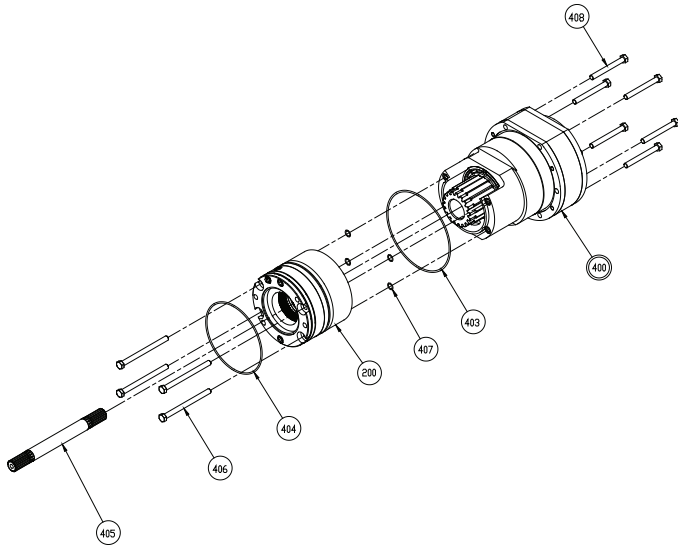
Install the first and second reduction gears and freespool linkage, if equipped. Refer to the "Idler Shaft Group" section for additional information. Install the shim set onto the clutch shaft bearing carrier and install the bearing carrier into the winch case. Tighten the capscrews to 75 lb•ft (102 N•m) torque.



NOTE: *Be careful to properly align the clutch pressure oil port in the winch case, shims and bearing carrier.*

Refill winch to the proper level with recommended oil.

CARTRIDGE ASSEMBLY SERVICE



The hydraulic motor, idler shaft group and fourth shaft group must be removed from the winch to permit removal of the cartridge assembly. The cartridge assembly consists of the winch brake assembly (200) and the clutch assembly (400).

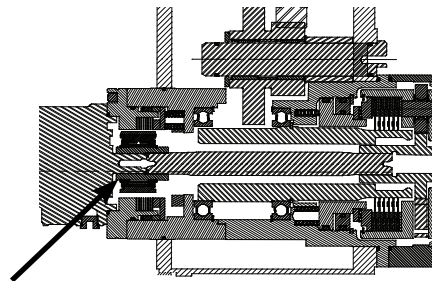
DISASSEMBLY

1. Remove the six (6) hex head bolts securing the cartridge assembly to the LH side of the winch case and slide the cartridge assembly outward.
2. Remove the clutch release hose at the bulkhead fitting inside the gear cavity on the LH side. The bulkhead fittings are located near the top of the cavity in the forward section of the winch case.
3. With the cartridge and brake disengaged from the motor, rotate the cartridge assembly CW until the clutch hose port can be accessed and remove the hose and remove the fitting from the port.
4. If not done, remove the brake release hose and fitting from the port on the end of the brake assembly. The cartridge assembly may need to be rotated slightly to get to the hose.
5. Remove the cartridge assembly. The sprag clutch assembly is inside the brake. Remove the sprag clutch assembly from the cartridge. Place the cartridge assembly on a clean work surface.
6. Stand the cartridge assembly with the brake housing up and remove the four (4) bolts securing the brake assembly to the cartridge housing and remove the brake assembly.
7. Refer to the brake assembly, clutch assembly, and sprag clutch assembly sections of this manual to service the cartridge subassemblies.

ASSEMBLY

1. Install a new o-ring (403) over the cartridge assembly pilot. Install four (4) new o-rings (407) into the grooves in the small end of the cartridge housing. Lubricate the seals with clean winch oil or petroleum jelly prior to installation.
2. Align the brake release port with left side of the gear opening on the cartridge housing (when looking from the brake end) and install the brake assembly onto the cartridge assembly, using the four (4) bolts (406) removed previously. Torque the bolts to 110 lb-ft (149 N-m).
3. Lubricate the new o-ring (404) with clean oil or petroleum jelly and install into the groove in the outside diameter of the brake housing.
4. Install sprag clutch into the brake cylinder assembly while aligning the inner splines with the input shaft splines.

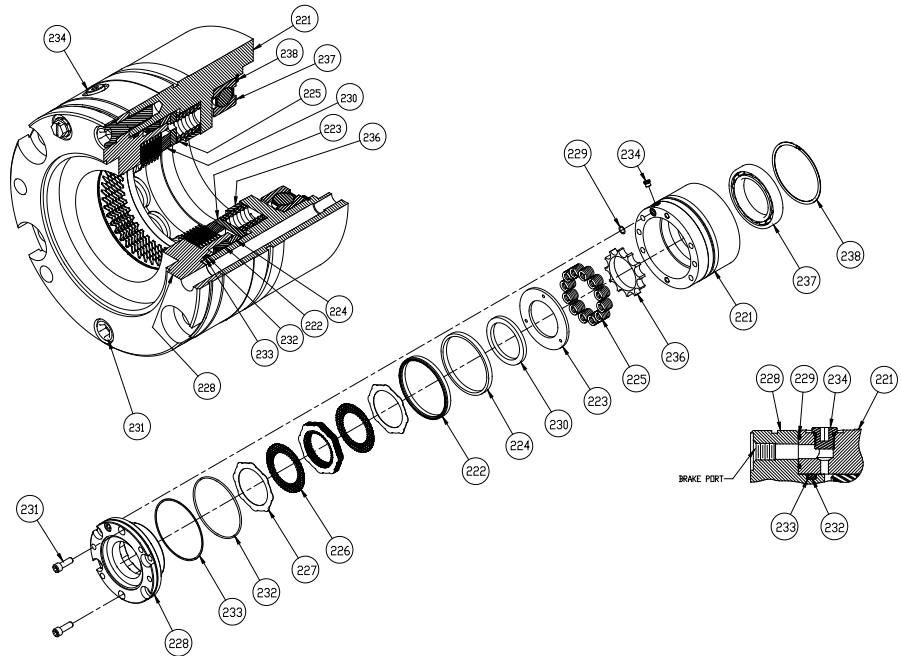
NOTE: Ensure the brake clutch assembly is installed in the cartridge assembly in the proper orientation. The inner race should rotate freely in the CCW direction when viewed from the motor side as shown below. The longer shoulder of the inner race should be toward the gears as shown below. Disassembly of the winch will be required if the sprag is improperly installed.



5. Install the cartridge assembly into the winch case and attach the brake and clutch hoses. Leave the cartridge assembly disengaged from the motor shaft during this process. Rotate the cartridge as required to attach the hoses and fittings to the cartridge and brake assembly ports.
6. After the hoses are attached and properly tightened, install a new motor pilot o-ring. Lubricate the seal with clean winch oil or petroleum jelly prior to installation.
7. Rotate the cartridge assembly into position, so that the gear opening is facing upward, and install to the motor shaft. Rotate the cartridge assembly as required to align the splines, and pry the motor upward as required to aid alignment. Install the two (2) motor bolts and torque to 110 lb-ft (149 N-m).
8. Reattach the clutch hose end to the bulkhead fitting in the winch case.

BRAKE ASSEMBLY SERVICE

Item No	Description
221	BRAKE CYLINDER
222	SEAL
223	PRESSURE PLATE
224	PISTON BACKUP RING
225	SPRING
226	DISC-FRICTION
227	BRAKE DISK
228	MOTOR SUPPORT
229	O-RING
230	SPACER
231	CAPSCREW
232	O-RING
233	BACK-UP RING
234	PLUG
236	SPRING SPACER
237	BEARING, BALL
238	RETAINING RING



DISASSEMBLY



The motor adapter is under spring tension from the brake springs. Loosen each of the capscrews one turn at a time until spring tension is released.

1. Stand the brake cylinder on a work bench with the motor adapter end facing up.
2. The motor adapter retains the force of the brake springs, so alternate between capscrews (231) loosening each 1 turn each time keeping the motor adapter level with the brake cylinder until spring force is removed.
3. Remove the motor adapter (228). Remove brake discs (227), friction discs (226), and spacer (230).
4. Remove and discard the o-ring (232) and back-up ring (233) from the motor adapter. Remove and discard the seal (222) from the brake cylinder.
5. Remove the steel back-up ring (224), pressure plate (223), springs (225), and spring spacer (236) from the brake cylinder.


Clean and Inspect


1. Thoroughly clean and inspect all parts at this time. Check sealing surfaces on both the motor adapter and brake cylinder. Ensure the brake release port is open and free of contamination.
2. Place friction disc on a flat surface and check for distortion with a straight edge. Friction material should be even across the entire surface with the groove pattern visible. Replace friction discs if the splines are worn to a point, the disc is distorted, or the friction material is burned or worn unevenly.
3. Place steel disc on a flat surface and check for flatness with a straight edge. Check surface for signs of material loss or heat damage. Replace the steel disc if bowed, heat discolored, or mechanically damaged.
4. Inspect spring for cracks and check the brake spring free length. Minimum free length is 1 3/16 in. (30.2 mm). If a brake spring must be replaced for any reason, then ALL brake springs must be replaced.



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

ASSEMBLY

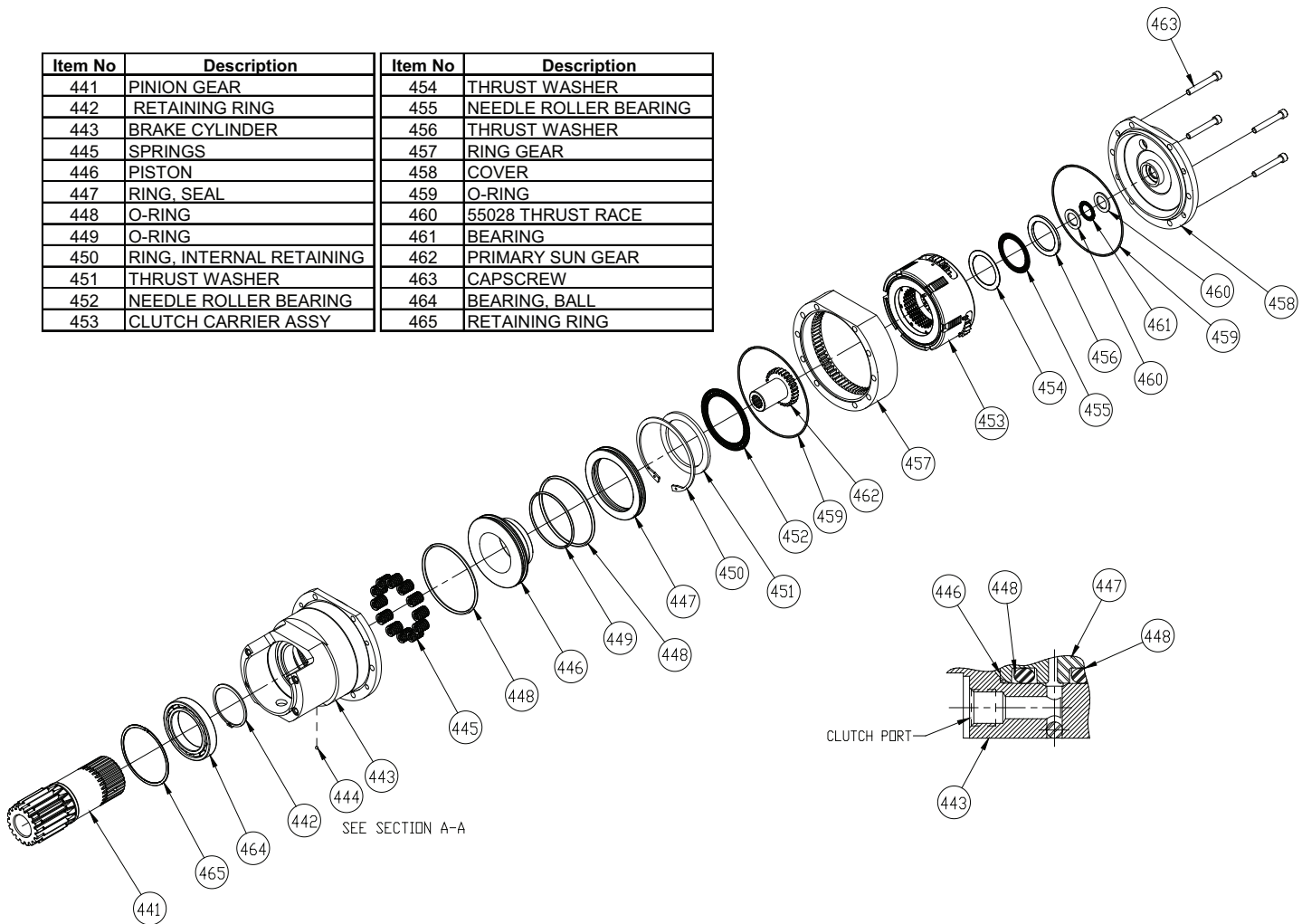
1. Press bearing (237) into brake cylinder (221) and install retaining ring (38).
 2. Set brake cylinder on bearing end and install spring spacer (236), springs (225), pressure plate (223), and piston back-up ring (224) into brake cylinder.
 3. Apply a light coat of assembly grease to the o-ring (229) for the brake release port and install into the groove around the port in the face of the brake cylinder.
 4. Place the motor adapter (228) on a table with a large diameter face down. Install the new backup ring (233) into the o-ring groove with the concave side facing away from the motor flange. Install the new o-ring (232) into the concave groove on the backup ring. Lubricate the seals with clean winch oil prior to installation.
 5. Install a new steel brake disc (227) into the bore of the motor adapter by aligning the lobes on the discs with the milled slots in the motor adapter. Install a new friction disc (226) on top of the brake disc, followed by another brake disc. Continue alternating the assembly of brake plates until all are installed. The final part should be a steel brake disc.
- **NOTE:** *Pre-soak or lubricate the new friction plates in clean oil before installing them into the Brake assembly.*
6. Lubricate the new brake seal (222) with clean oil or petroleum jelly and install the seal onto the hub of the motor adapter. Be sure to install the seal with the energizer ring facing downward, toward the motor end.
 7. Install spacer (230) in motor adapter on top of final steel brake plate.
 8. Carefully raise the motor adapter assembly and turn it over. Grab the brake spacer and plates with your fingers by reaching down through the motor adapter and brake stack from the motor side. Align the brake release port with the port in the brake cylinder and lower the motor adapter into the brake cylinder bore. Keep control of the brake stack with one hand and use the other hand to tap the motor adapter and brake plates into position with the handle of a mallet.

 **NOTE:** *During this process, make sure the brake plate spacer ring is centered on the pressure plate to ensure the motor adapter installs to the proper depth. Also, be sure to keep control of the brake plates until the entire assembly is stacked together to keep the brake plates from falling out of engagement with the motor adapter. If the last plate should come out of engagement, it could become captured under the motor adapter causing the brake to either bind up or slip under load.*

9. Align the inner splines of the brake plates. Install the sprag clutch inside the brake plates. A spacer may be required under the sprag clutch assembly to keep it in position.
10. Install the two (2) bolts (231) into the counter-bored holes in the motor adapter. Tighten the bolts slowly and in alternating fashion to compress the brake springs. Ensure the sprag clutch does not bind in the splines. Tighten the bolts to 50 lb-ft (85 N-m). Final alignment of the brake plates will be checked in step 12.
11. Install the steel plug (234) into the OD port in the brake cylinder. Install the -4 ORB / -4 JIC adapter into the brake cylinder release port.
12. With the brake assembly complete, check the brake seals using the following procedure. Connect a hand pump with a 0-2000 PSI (0- 13,800 kPa) pressure gauge and isolation valve to the brake release fitting. Apply 1000 PSI (6,900 kPa) to the brake. Close the valve and let stand for 3-5 minutes. If there is any loss of pressure, the brake must be disassembled and inspected for damaged seals and repaired as required.
13. BEFORE releasing the pressure on the brake assembly, install the brake clutch into the brake assembly to align the brake plates. Open the valve to release the pressure WHILE the sprag clutch is inserted into the brake assembly. The sprag clutch may be removed after the brake is fully applied.

CLUTCH ASSEMBLY SERVICE

Item No	Description	Item No	Description
441	PINION GEAR	454	THRUST WASHER
442	RETAINING RING	455	NEEDLE ROLLER BEARING
443	BRAKE CYLINDER	456	THRUST WASHER
445	SPRINGS	457	RING GEAR
446	PISTON	458	COVER
447	RING SEAL	459	O-RING
448	O-RING	460	55028 THRUST RACE
449	O-RING	461	BEARING
450	RING, INTERNAL RETAINING	462	PRIMARY SUN GEAR
451	THRUST WASHER	463	CAPSCREW
452	NEEDLE ROLLER BEARING	464	BEARING, BALL
453	CLUTCH CARRIER ASSY	465	RETAINING RING



DISASSEMBLY

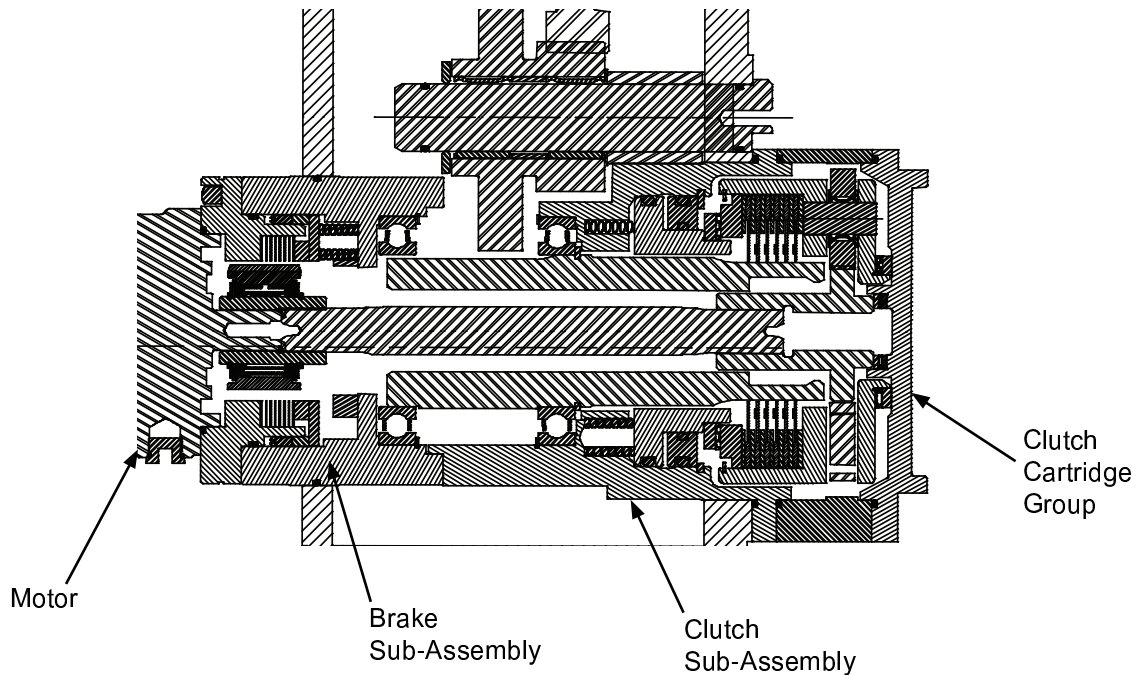
1. Remove bolts (463) 1 turn at a time in a cross pattern to evenly release spring force from cover (458). Remove cover from ring gear and clutch assembly.
2. Remove thrust races (460) and bearing (461) from cover and remove thrust races (456 and 454) and thrust bearing (455) from the top of the carrier clutch.
3. Remove the carrier clutch (453), ring gear (457), and primary sun gear (462).
4. Remove needle roller bearing (452) and thrust washer (451).
5. Remove retaining ring (450) and seal ring (447).
6. Remove piston (446) and springs (445).
7. Remove shaft (441) from clutch cylinder (443).

ASSEMBLY

The carrier clutch is a subassembly of the clutch assembly. See carrier clutch section of this manual for assembly and disassembly.

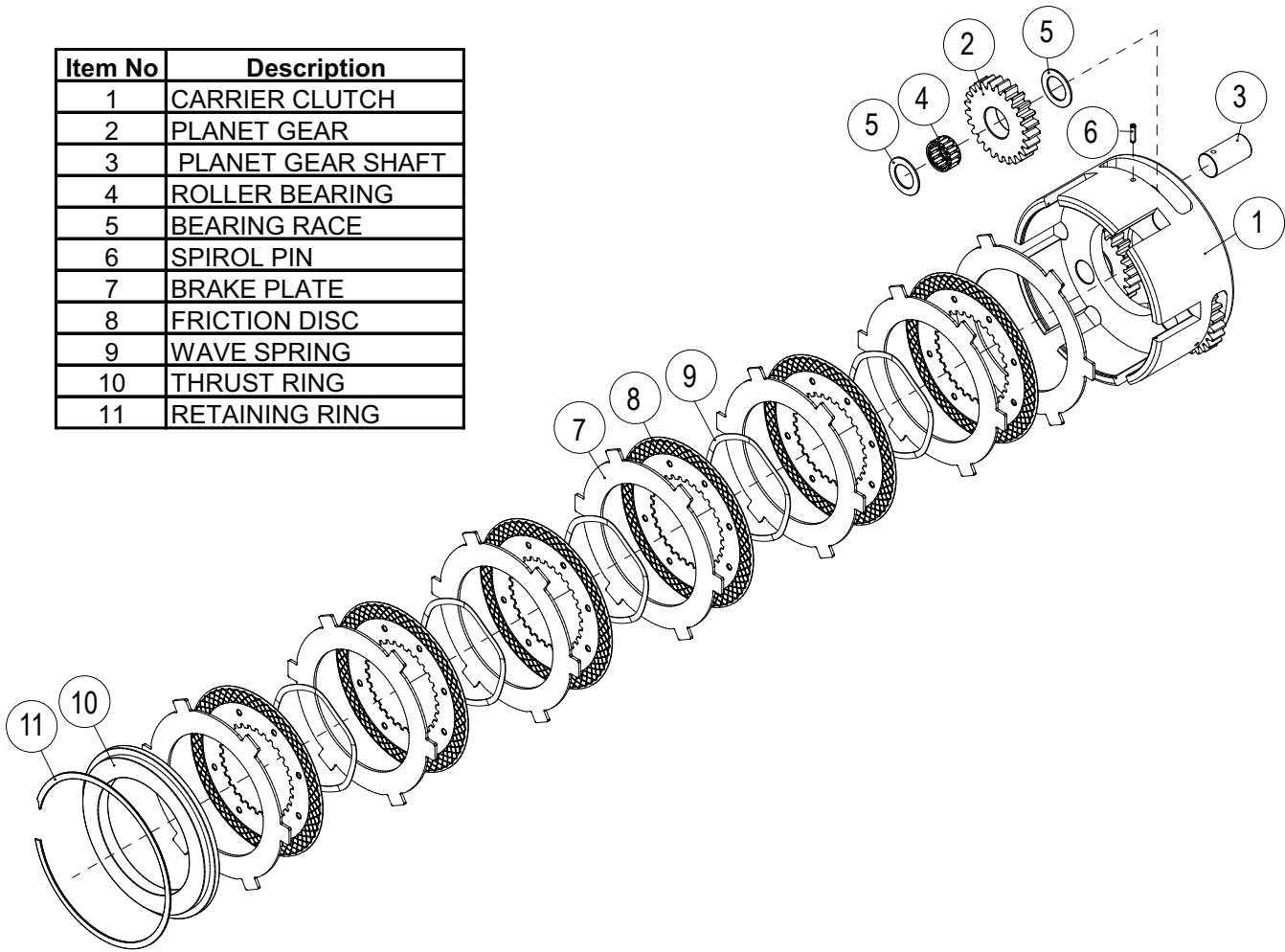
1. Press bearing (464) onto pinion gear (441) and install retaining ring (442).
2. Press pinion gear (with bearing and retaining ring installed) into clutch cylinder (443) and install retaining ring (465).
3. Stand clutch cylinder on end with spring pockets up. Place the twelve springs (445) into the recessed pockets in the clutch cylinder.
4. Install o-ring (448) onto piston (446) and lubricate with a light coat of grease. Insert piston into clutch cylinder until it contacts springs.
5. Install o-rings (448 & 449) onto seal ring and apply a light coat of grease to both o-rings. Place seal ring into clutch cylinder and install retaining ring (450).

6. Install thrust washer (451) and needle roller bearing (452) onto brake piston.
7. Place carrier clutch assembly (453) into clutch cylinder.
8. Install o-ring (459) into clutch cylinder (443) and apply a light coat of grease. Align ring gear teeth with clutch carrier teeth. Set ring gear (457) onto clutch cylinder with flat parts of the housing aligned.
9. Place primary sun gear (462) into clutch cylinder while aligning primary sun gear teeth with gear teeth on the clutch carrier.
10. Apply a light coat of grease to needle roller bearing (455). Place thrust washer (454) on carrier and place needle bearing on thrust race. Place thrust washer (456) on top of needle bearing. **Note: Thrust washer (454) is 0.030 thick and (456) is 0.220 thick.**
11. Place o-ring (459) on cover (458) and apply a light coat of grease. Position roller bearing (461) between the two thrust washers (460) and insert into center of cover. Apply enough grease to hold in place as cover is installed on clutch assembly.
12. Place cover onto ring gear and clutch assembly while ensuring roller bearings and thrust washers stay in place. Tighten bolts (463) 1 turn at a time in a cross pattern and torque to 110 lb•ft (149 N•m).



CARRIER / CLUTCH ASSEMBLY SERVICE

Item No	Description
1	CARRIER CLUTCH
2	PLANET GEAR
3	PLANET GEAR SHAFT
4	ROLLER BEARING
5	BEARING RACE
6	SPIROL PIN
7	BRAKE PLATE
8	FRICTION DISC
9	WAVE SPRING
10	THRUST RING
11	RETAINING RING



DISASSEMBLY

Apply light pressure to the thrust ring (10) and remove the retaining ring (11). Then remove the thrust ring, brake discs, friction discs, and wave springs (7,8,9) from the carrier.

Remove the planet gear shafts (3) by driving the roll pins (6) into the center of the shafts. Slide the planet gear shafts out of the carrier. Use a punch to drive the roll pins out of the gear shafts. **DO NOT** reuse the roll pins – replace with new during reassembly.

Remove the planet gears, bearings and thrust washers (2,4,5) from the carrier.

Thoroughly clean and inspect all planetary components for damage or abnormal wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement, or other abnormal wear, the bearing(s) should be replaced. Inspect the bearing cage 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, guide the rollers properly, the bearing **MUST** be replaced. The thrust washer contact areas must be free of surface irregularities

that may cause abrasion or friction. The gears and planet shafts should be inspected for abnormal wear or pitting. Replace all components as required.



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 (8) 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 disc (7) 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 (9) 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 flush with the carrier on the H60VS and recessed 0.53" on the H85VS as shown on the drawing below. Using a center-punch, stake the carrier next to the pin hole. This will distort the hole so that the roll pin will not back out in service.

Repeat for each of the planet gears.

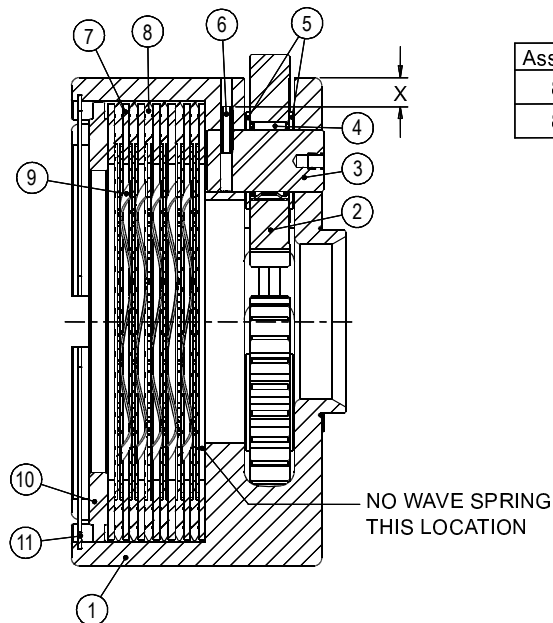
Position the carrier with the clutch end up. Lubricate the friction discs with new winch oil prior to assembly. Install a steel brake disc (7) in the bottom of the carrier, aligning the tangs on the disc with the slots in the carrier. Next, install a friction disc (8). After the first friction disc, install parts in the following sequence: steel brake disc, wave spring, 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 disc and friction disc.

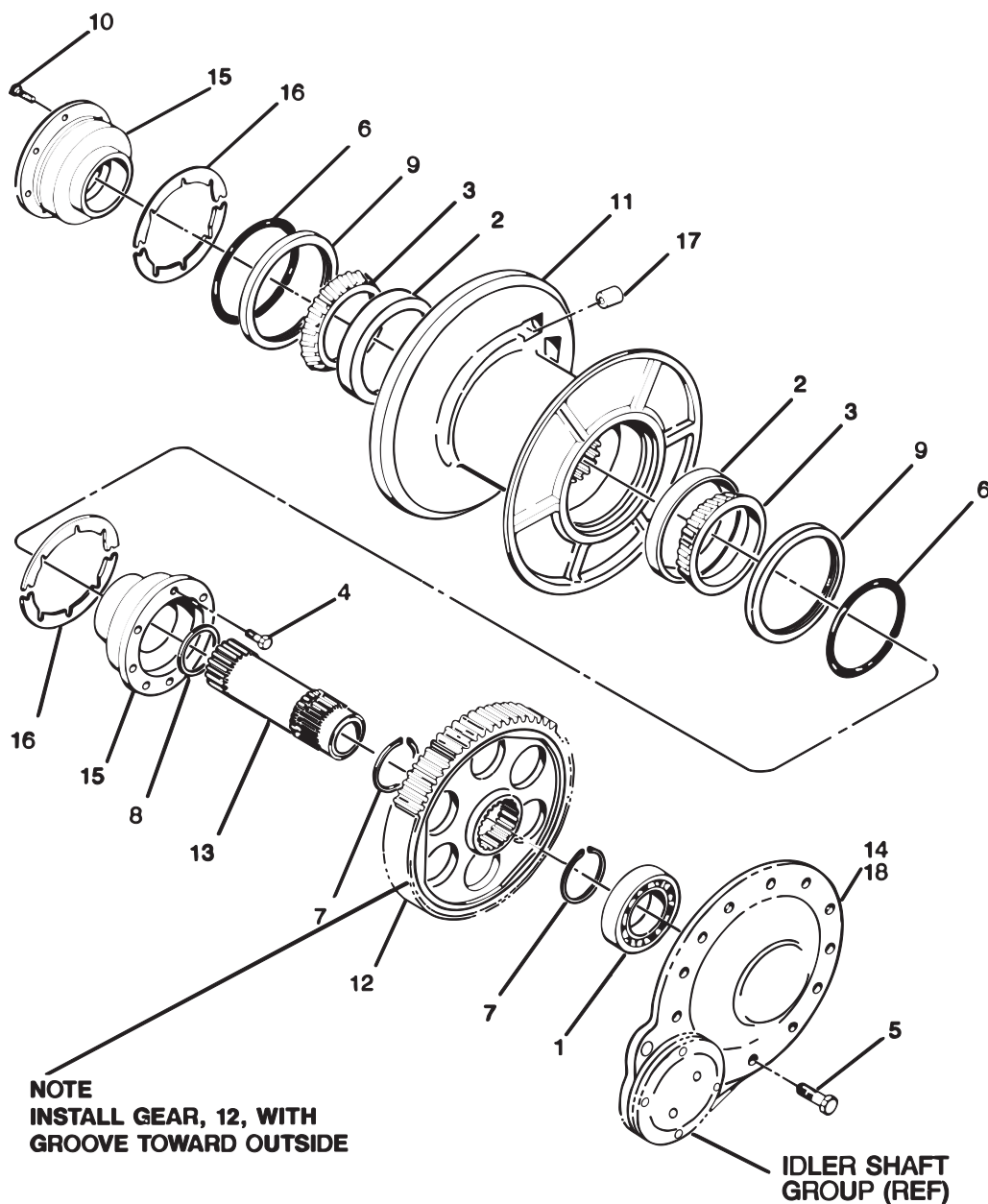
Install the thrust ring (10) into the carrier on top of the clutch pack.

Apply light pressure to the thrust ring and install the retaining ring (11). Make sure the retaining ring is seated fully in the housing groove. The ends of the retaining ring must be contained by the groove in the carrier and NOT in the slots.



Assembly No.	X	
83857	.53	← H85
83860	Flush	← H60

CABLE DRUM GROUP



ITEM	DESCRIPTION	QTY
1	BALL BEARING	1
2	BEARING CUP	2
3	BEARING CONE	2
4	CAPSCREW, HEX HEAD (1/2 - 13 X 1 G5 - SS)	10
5	CAPSCREW, HEX HEAD (1/2 - 13 X 1-1/4 G5)	11
6	O-RING	2
7	RETAINING RING, EXTERNAL	2
8	RETAINING RING, INTERNAL	1
9	OIL SEAL	2
10	CAPSCREW, SOCKET HEAD (1/2 - 13 X 1 G8 - SS)	1
11	CABLE DRUM	1
12	SECOND REDUCTION GEAR	1
13	SECOND REDUCTION GEAR SHAFT	1
14	BEARING CARRIER, COVER	1
15	BEARING CARRIER, DRUM	1
16	SHIM SET (2 pair each, .005, .007, .020 in.)	2
17	FERRULE	1
18	NO GASKET, Use RTV 730 Silicone or equivalent	--

SS - SELF SEALING

DISASSEMBLY

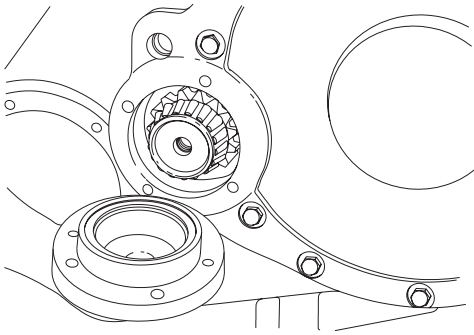
⚠ WARNING ⚠

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

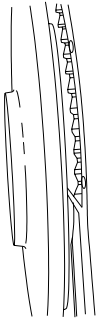
Drain oil as described in the Preventive Maintenance Section.

Remove the large right hand winch housing cover.

Remove the two capscrews and lock plate from the idler shaft bearing carrier and adjuster assembly.



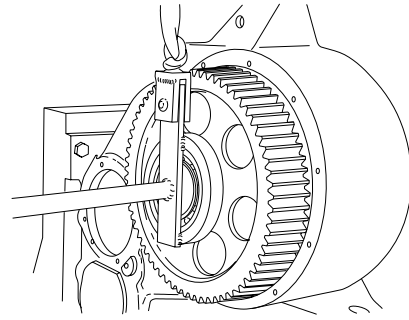
Remove the four capscrews securing the idler shaft bearing carrier and adjuster to the winch. Use two capscrews as jackscrews to remove the carrier from the winch.



Remove the capscrews (5) from the large diameter bearing carrier cover (14) and remove the cover.

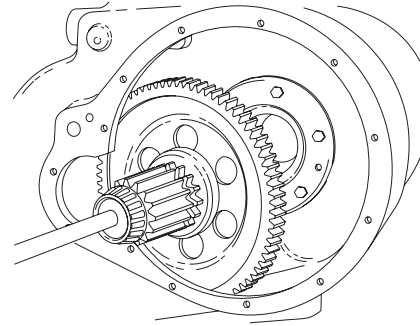
⚠ CAUTION ⚠

Use a pry bar between the bearing carrier cover and the second reduction drum drive gear to unseat the ball bearing from cover. Do not allow the cable drum drive gear to slide free of the winch case. The gear assembly may fall from the cover and cause personal injury. Gear and shaft weigh approximately 125 lb (56 kg).



Remove the 2nd reduction drum drive gear and shaft assembly (12,13) from the winch.

Remove the shift rail and freespool shift collar and yoke assembly from the first reduction gear.



Move the first reduction gear and pinion assembly outward to unseat the bearing cone from the bearing cup in the case wall. Carefully move the gear and pinion assembly into the drum drive gear opening and remove them from the winch case.

Support the cable drum with a nylon sling and remove capscrews (4) from the right hand drum bearing carrier (15). Using jackscrews, remove the drum bearing carrier.

Remove capscrews (4) from the left hand drum bearing carrier (15). Using jackscrews, remove the drum bearing carrier.



NOTE: Split shims (16) are located between bearing carriers (15) and the winch case. Retain the shims in their original location for reassembly.

Inspect bearing cones (3) and replace as required.

Remove and discard o-rings (6) from the drum bearing carriers.

Remove cable drum oil seals (9).

Inspect bearing cups (2) and replace as required.

Check the condition of snap ring (8) in the splined bore of the cable drum and replace as required.

ASSEMBLY

Install bearing cups (2) into cable drum (11). With a .002 in. (.05 mm) feeler gauge, make certain cups are fully seated against the shoulder in the cable drum bore.

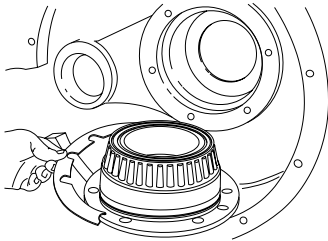
Install oil seals (9) into the cable drum with the spring side of the seal facing toward the cable drum.

If it was removed earlier, install snap ring (8) into the groove in the splined bore of cable drum with sharp edge of the snap ring toward the center of the drum.

Lubricate and install o-rings (6) onto the cable drum bearing carriers.

Lightly lubricate bearing cones (3) with multi-purpose bearing grease and install onto the bearing carriers.

Suspend the cable drum in the winch case with the cable ferrule pocket on the right hand side. Lubricate the bearing cups (2) and oil seals (9) with general purpose grease. Install the right hand bearing carrier into the winch case and cable drum using the original shim pack (16), if available. Apply non-hardening thread sealant to the capscrews and tighten to 75 lb•ft (102 N•m) torque.



Install the left hand drum bearing carrier (15) with the original shim pack, if available. Apply non-hardening thread sealant to capscrews and tighten to 75 lb•ft (102 N•m) torque.

Attach a dial indicator to the left hand bearing carrier and position the indicator stem against the retaining ring (8) in the cable drum bore. With a large screwdriver, pry drum from side to side to check for end play of .005 - .010 in. (.13 - .25 mm). Add or remove shims (16) as required, while keeping the cable drum centered in the winch case.

i NOTE: *It is best to keep the drum end play close to the minimum value given above.*

Install the first reduction gear and pinion assembly into the winch. Refer to the “Idler Shaft Group” section of this manual for additional information.

If the second reduction gear and shaft had been disassembled, install the second reduction gear (12) onto shaft (13) and secure in place with two retaining rings (7). Lightly pack bearing (1) with general purpose bearing grease and press onto shaft (13).

Install second reduction gear and shaft assembly into the winch while meshing the gear teeth with the pinion and the shaft splines with the drum.

Clean the mating surface of the winch case and bearing carrier cover (14). Apply silicone sealant 730 RTV or equivalent to the winch case.

Install the bearing carrier cover into the winch. Apply non-hardening thread sealant to the capscrews (5) and install finger tight.

Apply silicone sealant 730 RTV to the cleaned surfaces of the idler shaft bearing carrier. Install the idler shaft bearing carrier and tighten the capscrews to 75 lb•ft (102 N•m) torque. Tighten all remaining cover capscrews to 75 lb•ft (102 N•m) torque.

Adjust the idler shaft bearing adjuster per instructions found in “Idler Shaft Group” section of this manual. Install adjuster lock plate and tighten capscrews to 75 lb•ft (102 N•m) torque.

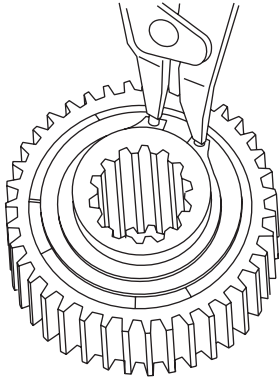
Install the solenoid valve block into the winch case.

Install the winch housing cover with a new gasket as required. Apply non-hardening thread sealant to the capscrews and tighten to 75 lb•ft (102 N•m) torque.

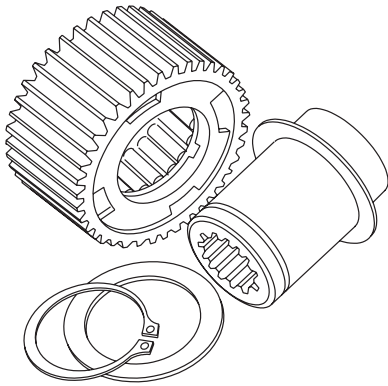
Refill winch with recommended lubricant.

BRAKE CLUTCH SERVICE

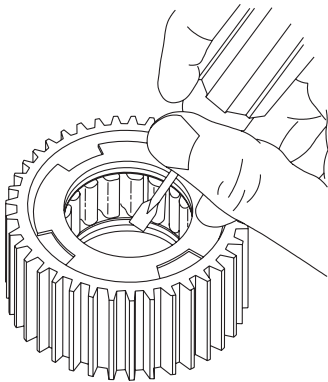
DISASSEMBLY



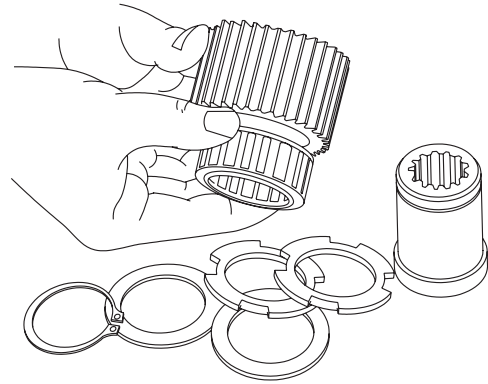
1. Remove the snap ring and sprag bushing retainer from one end only.



2. Pull the inner race out. Examine the race for scoring, wear or indentations caused by the sprag cams.



3. Use a screwdriver and mallet to remove the sprag bushing from one end of the outer race. There are four special cut-outs in the bushing for this purpose. Be careful not to damage the bushing inside surface. If a bushing's inside surface is damaged or shows wear, replace it.

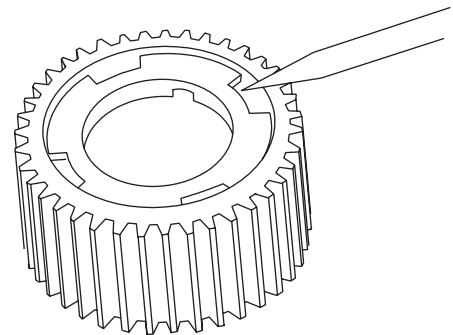


4. Next, slide the sprag clutch out, inspect the sprag clutch closely for abnormal wear, cracks, pitting or corrosion. Check small clips for breakage or bright spots; the signs of excessive wear. Unless the outer race or remaining sprag bushing is damaged or shows excessive wear, there is no need for further disassembly. If disassembly is necessary, remove the bushing according to the procedure covered in Step No. three (3). All brake clutch assembly parts should be thoroughly cleaned and inspected before assembly.

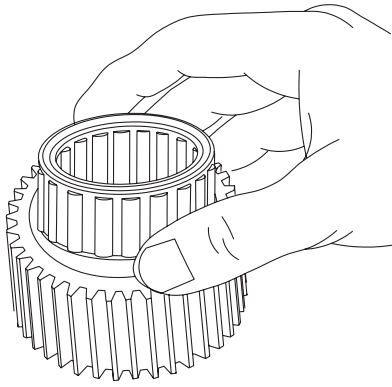
⚠ WARNING ⚠

The polished surfaces of the races and sprag cams must be perfectly smooth to insure positive engagement of the clutch. The slightest defect may reduce brake clutch effectiveness, which may lead to loss of load control and result in property damage, personal injury or death. It is generally recommended to replace the entire brake clutch assembly if any component is defective.

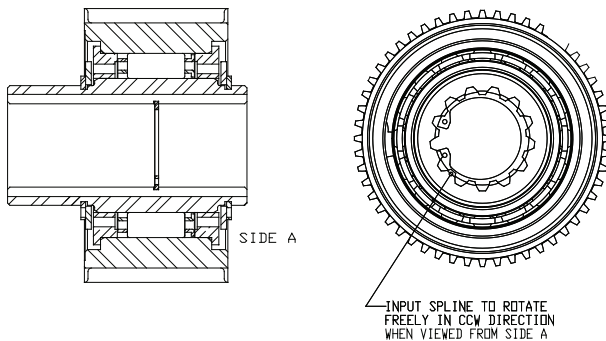
ASSEMBLY



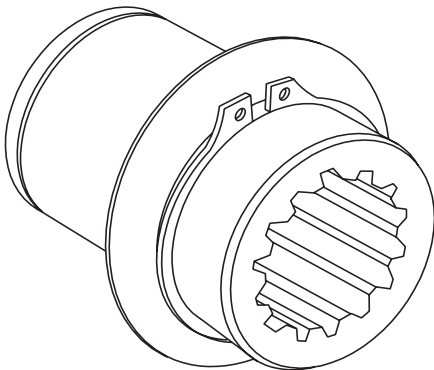
1. Press a sprag bushing into the outer race. Use a press if necessary. A flat plate of approximately the same diameter as the bushing flange outside diameter should be placed between the press and bushing during assembly to protect the bushing. Be certain the bushing flange is against the shoulder in the outer race.



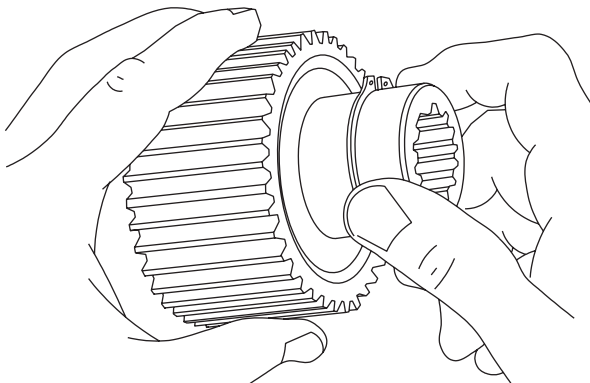
2. Turn the assembly over and install the sprag clutch in the bore of the outer race. The inner race must free turn in CCW direction looking at side "A".



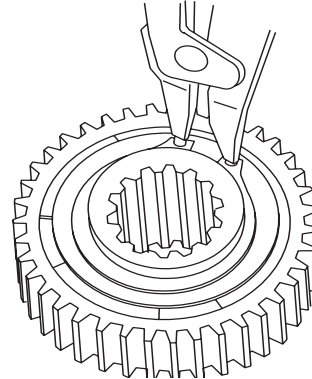
3. Press the remaining bushing into the race. Again, make sure the bushing is against the shoulder.



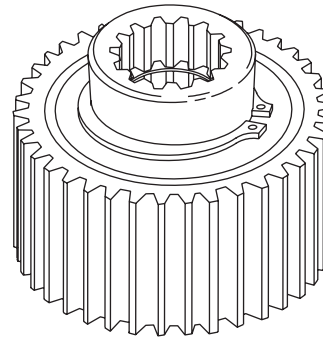
4. Next, install a sprag bushing retainer, then a snap ring on the inner race. Be sure the snap ring is seated in the snap ring groove.



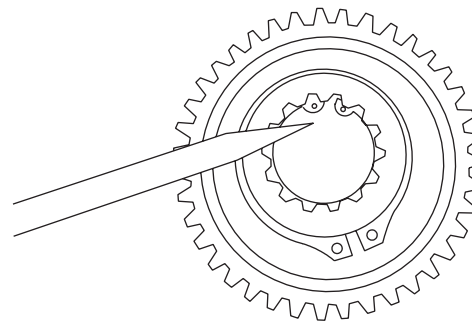
5. Slide the inner race through the bushings and sprag clutch (the race will have to be rotated in the free-wheeling direction to start it through the sprag clutch). If the inner race will not go through the bushings, the bushings have probably been damaged and should be replaced.



6. Turn the assembly over with the snap ring down. Install the second retainer and snap ring. Make certain the snap ring is seated in the groove properly.



7. This is a completed brake clutch assembly.



⚠ WARNING ⚠

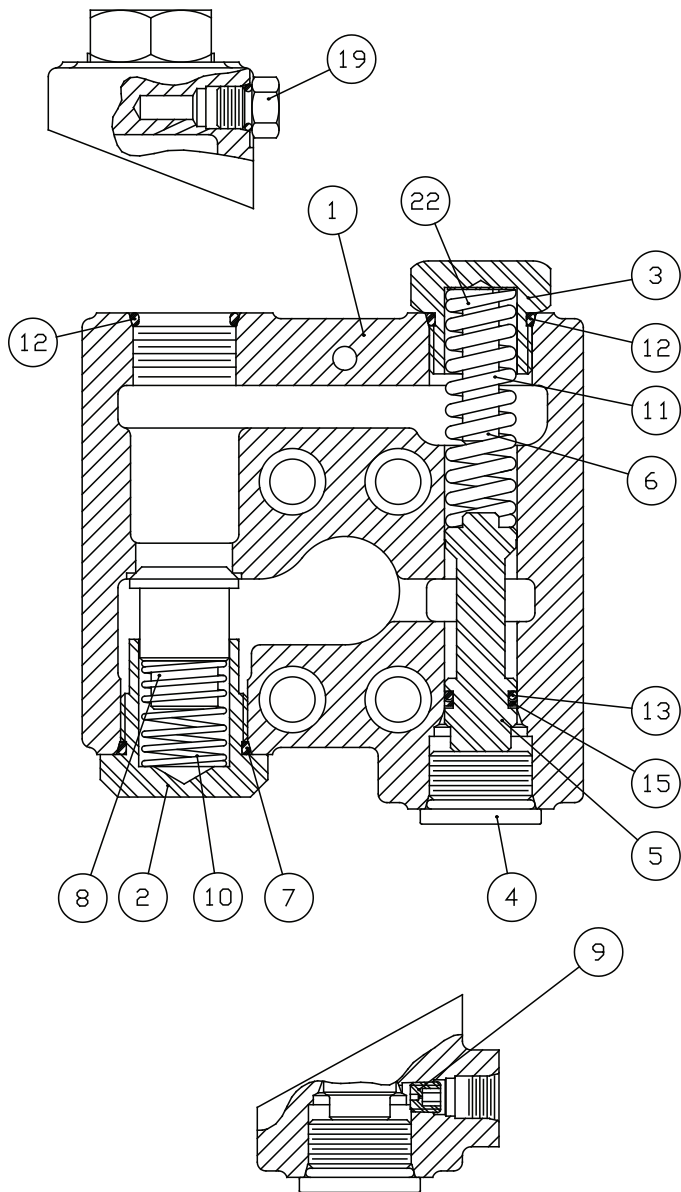
Be certain the snap ring is seated in the groove in the splined bore of the inner race. This snap ring will keep the brake clutch assembly correctly positioned in the center of the friction brake pack. Binding of the brake or brake failure may occur if this snap ring is omitted.

BRAKE VALVE SERVICE

The brake valve is a reliable hydraulic valve with internal components manufactured to close tolerances. Due to the close tolerances and mating of components, the valve housing, spool, piston and check poppet are not available as replacement parts.

Before disassembling the brake valve, be sure you have conducted all applicable troubleshooting operations and are certain the brake valve is causing the malfunction.

Thoroughly clean the outside surfaces of the valve and work in a clean dust free area, as cleanliness is of utmost importance when servicing hydraulic components.

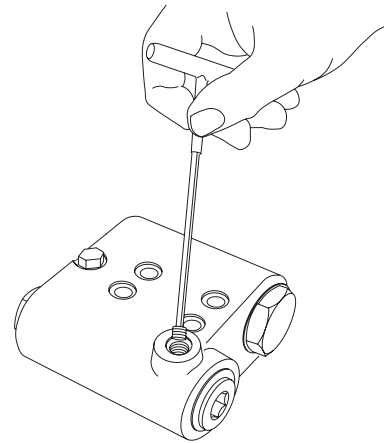


BRAKE VALVE ASSEMBLY		
ITEM	DESCRIPTION	QTY.
1	VALVE HOUSING (NSS)	1
2	CHECK VALVE RETAINER	1
3	SPRING RETAINER	1
4	PLUG	1
5	SPOOL (NSS)	1
6	DAMPER PISTON (NSS)	1
7	O-RING	1
8	CHECK VALVE POPPET (NSS)	1
9	PILOT ORIFICE	1
10	CHECK VALVE SPRING	1
11	SPOOL SPRING	1
12	O-RING	2
13	O-RING	1
14	O-RING	1
15	BACK-UP RING	1
16	BACK-UP RING	1
19	PLUG	1
22	SHIM	A-R

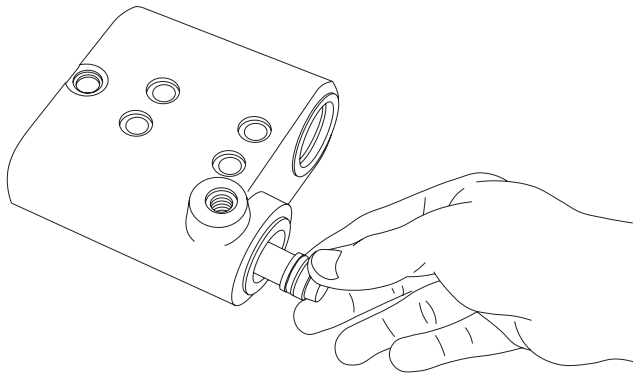
NSS - NOT SERVICED SEPARATELY. REPLACE COMPLETE VALVE ASSEMBLY.

A-R - AS REQUIRED

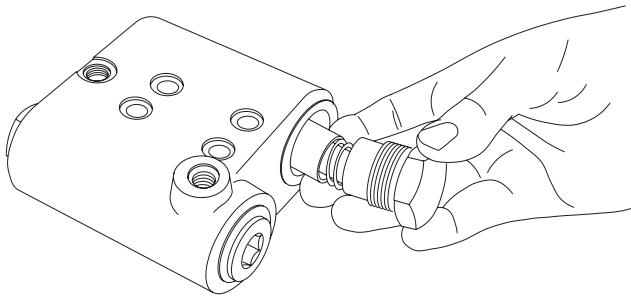
DISASSEMBLY



1. Remove the pilot orifice (9) from the brake release (BR) port using a 5/32 in. Allen wrench.
2. Remove the plug (19) from the drain port.
3. Remove the spool spring retainer (3) and spool spring (11). Check spring free length. Replace spring if less than 2 1/2 inches (63.5 mm) long.



4. Remove spool plug (4) and carefully remove spool (5).



5. Remove the check valve spring retainer (2), spring (10) and check valve poppet (8). Check spring free length. Replace spring if less than 1-1/2 in. (38.1 mm) long.

CLEAN AND INSPECT

1. Discard all O-rings and back-up rings. Clean all parts in solvent and blow dry. Inspect polished surfaces of spool for damage that may cause binding or leakage. Inspect spool bore in valve housing for damage or scoring. Inspect check valve seat in valve housing and check valve poppet. If the spools, bores or valves are damaged, the entire valve must be replaced as these parts are not serviced separately.
2. Inspect the .020 inch orifice in the pilot orifice (9) to be certain it is open.

ASSEMBLY

1. Install new O-rings on the plug and spring retainers.
2. Install new O-rings and back-up rings on the spool. It is important that the back-up ring is on the correct side of its O-ring. Take care not to cut the O-ring during assembly. Let the spool set for ten minutes before installing them in their respective bores. This will allow the O-ring to return to their original size after being stretched.
3. Lubricate the spool bore and spool O-rings with hydraulic oil. Carefully install the spool into the valve housing. Always install the spool from the plug end as shown to minimize the possibility of damaging the O-ring. Install the plug, spool spring and spring retainer.
4. Install the check valve poppet, spring and check valve spring retainer.
5. Install the solid plug into the "drain" port.
6. Install the pilot orifice into the valve housing.
7. The brake valve is complete and ready to be installed on winch motor.

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	(µ)	= 0.000.001 or 10 ⁻⁶