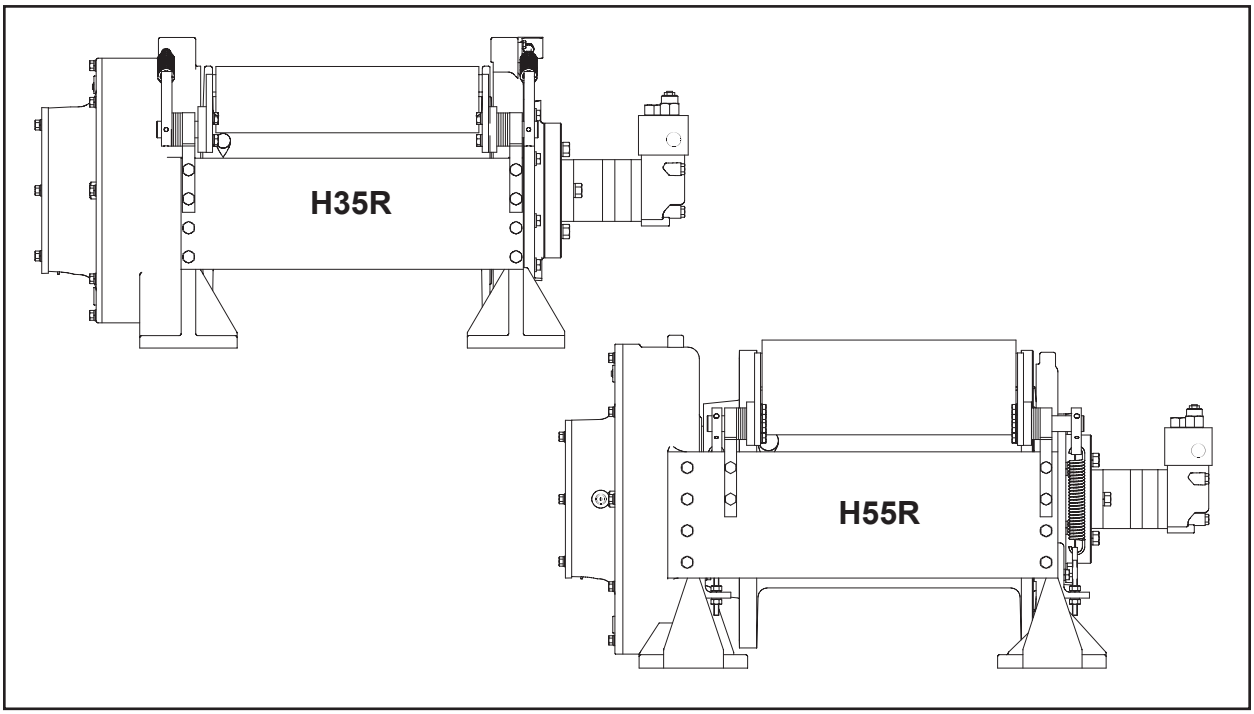
BRADEN

H35R and H55R

HYDRAULIC RECOVERY WINCHES



INSTALLATION, OPERATION, MAINTENANCE AND SERVICE MANUAL

LIT2142 R1
10/2003
Printed in U.S.A.

PACCAR WINCH DIVISION
P.O. BOX 547 BROKEN ARROW, OK U.S.A. 74013
PHONE (918) 251-8511 FAX (918) 259-1575
www.paccarwinch.com

TABLE OF CONTENTS

FOREWORD

Read and understand this manual before operating or servicing your BRADEN winch. Retain this manual for future reference.

The minimum service intervals specified are for the operating hours of the vehicle.

This manual contains installation, operation and preventive maintenance instructions for H35R and H55R model BRADEN Planetary Recovery winches. As there are many product variations, you must become familiar with your BRADEN winch to fully benefit from the information contained within this publication.

Some illustrations in this manual may show some components removed for illustrative purposes.

Whenever a question arises regarding your BRADEN winch or this manual, please contact your nearest BRADEN distributor or the PACCAR Winch Division Product Support Department at (918)-251-8511, Monday – Friday, 0800 – 1630 hours CST, by fax at (918)-259-1575, or via the internet at www.paccarwinch.com. Provide the complete winch model and serial number when making inquiries.

Parts and Service

BRADEN provides parts and service through a network of BRADEN distributors. Parts and service are not available directly from the PACCAR Winch Division. For the name of your nearest BRADEN distributor, consult your local phone directory, or contact BRADEN as defined above.

Safety informational callouts used in this manual include:

⚠ CAUTION ⚠

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

⚠ WARNING ⚠

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

GENERAL SAFETY RECOMMENDATIONS

Safety for operators and ground personnel is of prime concern. Always take the necessary precautions to ensure the safety of others as well as yourself. To properly ensure safety, the prime mover and winch **MUST** be operated with care and concern by the operator for the equipment. The operator **MUST** also have a thorough knowledge of the machine's performance capabilities.

⚠ WARNING ⚠

Failure to obey the following safety recommendations may result in property damage, injury or death.

1. Read and understand **ALL** warning tag information, and become familiar with **ALL** controls **BEFORE** operating the winch.
2. **NEVER** attempt to clean, oil or perform maintenance on a machine with the engine or prime mover running, unless instructed to do so in this manual.
3. **NEVER** operate the winch controls unless you are properly positioned at the operator's station, you are sure **ALL** personnel are clear of the work area **AND** you are properly trained in the operation of the winch.
4. Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by all involved.
5. Ground personnel should stay in view of the operator and clear of the winch drum. **DO NOT** allow ground personnel near a winch line under tension. A safe distance of at least 1½ times the length of the outstretched cable should be maintained.
6. On machines having hydraulically, mechanically and/or cable controlled equipment or attachments, ensure the equipment is blocked securely before servicing, adjusting or repairing the winch. **ALWAYS** apply the parking brakes before dismounting a vehicle.
7. Inspect the winch and rigging at the beginning of each work shift. Defects should be corrected immediately. **DO NOT** operate a defective winch.
8. Keep equipment in good operating condition. Perform scheduled service and adjustments as defined in the "Preventive Maintenance" section of this manual.
9. An equipment warm-up procedure is recommended for all 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.
10. Freespool clutches on recovery winches may disengage and drop or lose control of a load if they are not fully engaged at the beginning of a lift or pull. The freespool engaged-disengaged warning light must indicate a **fully** engaged condition before the operator begins a lift or pull.
11. The winches described in this manual are neither designed nor intended for use or application to equipment used in the lifting or moving of persons.
12. **DO NOT** exceed the maximum pressure, kPa (PSI), or flow, LPM (GPM), stated in the winch specifications.
13. Operate the winch at line speeds to match the job conditions.
14. Protective gloves should be worn when handling wire rope.
15. **NEVER** attempt to handle wire rope when the hook end is not free. Keep all parts of body and clothing clear of cable rollers, cable entry area of fairleads and winch cable drum.
16. When winding wire rope on the cable drum, **NEVER** attempt to maintain tension by allowing the wire rope to slip through hands. **ALWAYS** use the "Hand-Over-Hand" technique.
17. **NEVER** use wire rope with broken strands. Replace damaged wire rope.
18. **DO NOT** weld on any part of the winch without approval of PACCAR Winch Division Engineering.
19. Use the recommended hydraulic oil and gear lubricant. Keep the hydraulic system clean and free of contamination at all times.
20. The cable anchor or set screw is **NOT** intended to support full rated load. **ALWAYS** maintain a minimum of five (5) wraps on the drum. It is recommended the last five (5) wraps of wire rope be painted bright red to serve as a visual reminder. **DO NOT** use knots to secure or attach the wire rope to the drum or hook.
21. Install guarding to prevent personnel from getting any part of body or clothing caught at a point where the cable is wrapped onto the drum or drawn through guide rollers or other "pinch points".
22. Install switches or valves that will shut off power to the winch, in locations where they can be reached by anyone entangled in the wire rope before being drawn into the winch drum or other "pinch point".
23. "Deadman" controls, which automatically shut off power to the winch whenever the operator leaves his station, should be installed whenever possible.
24. **NEVER** allow anyone to stand or position any part of the body under a suspended load.
25. Avoid sudden "shock loads, or attempting to "jerk" a load free. This type of operation may cause heavy loads, in excess of rated capacity, which may result in a failure of the wire rope and/or the winch.

THEORY OF OPERATION

Description of Winch

The winch has four major component groups:

1. Hydraulic motor and brake valve
2. Brake cylinder with free-wheeling brake clutch assembly
3. Drum assembly with primary and secondary planetary gear sets
4. Final drive housing with freespool group

The hydraulic motor is bolted to the motor support; the outer section of the brake cylinder assembly. The motor end of the cable drum runs in a spherical bearing and is supported by the brake cylinder housing. The final drive end of the drum runs on a ball bearing and is supported by the final drive housing. The drum contains the primary and secondary planetary gear sets. The ring gear for the primary and secondary planetary gear sets is machined into the cable drum. The ring gear for the final drive planetary gear set is machined into the final drive housing. The final drive housing contains the final drive planetary gear set and the freespool group.

Operation of Winch

The hydraulic motor drives the primary sun gear through the splined inner race of the brake clutch. When driven by the sun gear, the primary planet gears walk around the ring gear machined in the cable drum and drive the primary planet carrier. The primary planet carrier drives the secondary sun gear which drives the secondary planet gears. The secondary planet gears walk around the ring gear machined in the cable drum and drive the secondary planet carrier. The secondary planet carrier drives the output shaft. The output shaft drives the output sun gear through the freespool clutch group. The output sun gear drives the output planet gears that walk around the output ring gear machined in the final drive housing and drive the output planet carrier that is splined to the cable drum.

Dual Brake System – Description

The dual brake system consists of a dynamic brake system and a static brake system.

The dynamic brake system is comprised of the hydraulic motor and brake valve assembly. The brake valve is a counterbalance valve that contains a check valve to allow free oil flow through the motor in the hoisting direction and a pilot operated spool valve that blocks the flow of oil out of the motor when the control valve is placed in neutral. When the control valve is shifted into the lowering position, the counter balance spool remains closed until sufficient pilot pressure from the lowering port pushes the spool against spring force to open a passage from the motor back through the control valve to the reservoir. After the counter balance spool cracks open, the pilot pressure becomes flow dependent and will modulate the valve opening to control the lowering. (Figures 2, 3, and 4)

The static brake system consists of the spring applied, hydraulically released multiple friction disc brake pack, the over-running brake clutch assembly and the brake cylinder that contains these parts. The static brake is released by a pilot signal to the brake at a pressure lower than that required to open the pilot operated counter balance valve. This sequence assures the dynamic braking takes place in the brake valve and motor and that little, if any, heat is absorbed by the friction discs.

The static friction brake is a load holding brake only and does not influence the rate of decent of a load.

The brake clutch is splined to the primary sun gear shaft between the motor and the primary sun gear. It will allow this shaft to turn freely in the direction to raise a load and lock up to force the brake discs to turn with the shaft in the direction to lower the load. (Figures 5 & 6)

The brake cylinder, when pressurized by the lowering pilot signal, will release the spring pressure applied to the discs and allow them to turn freely to lower the load.

Dual Brake System – Working Together

When pulling a load, the brake clutch which connects the motor shaft to the primary sun gear, allows free rotation. The sprag cams located between the inner and outer races lay over slightly to permit the inner race to turn free of the outer race. (Figure 5) The friction discs of the static brake remain fully applied. The winch, when pulling a load, is not effected by any braking action. (Figures 2 and 5)

When the pulling operation is stopped, the load attempts to turn the primary sun gear in the opposite direction. This reversed input causes the sprag cams to instantly roll upward and firmly lock the shaft to the fully applied static brake discs. (Figure 6) The load is held firm.

When the motor is powered in the pay-out (reverse) direction, the motor can not rotate until sufficient pilot pressure is present to release the static brake and open the brake valve (counter balance valve). Figures 3 and 4 The static brake will release at a lower pressure than that required to open the brake valve. The extent to which the brake valve opens will determine the amount of oil that can flow through it and the speed at which the load will be lowered or pay-out. Increasing the oil flow to the winch motor will cause the pressure to rise and the opening in the brake valve to increase, speeding up the descent of the load. Decreasing the flow causes the

pressure to lower and the opening through the brake valve to decrease thus slowing the descent of the load.

When the control valve is shifted to the center, neutral position, the pressure will drop and the brake valve will close, stopping the load. The static brake will reapply by spring force and hold the load after the brake valve has completely closed. The static brake discs receive very little wear in the lowering operation. All the heat generated by the lowering and stopping of a load is absorbed by the hydraulic oil where it can be dissipated.

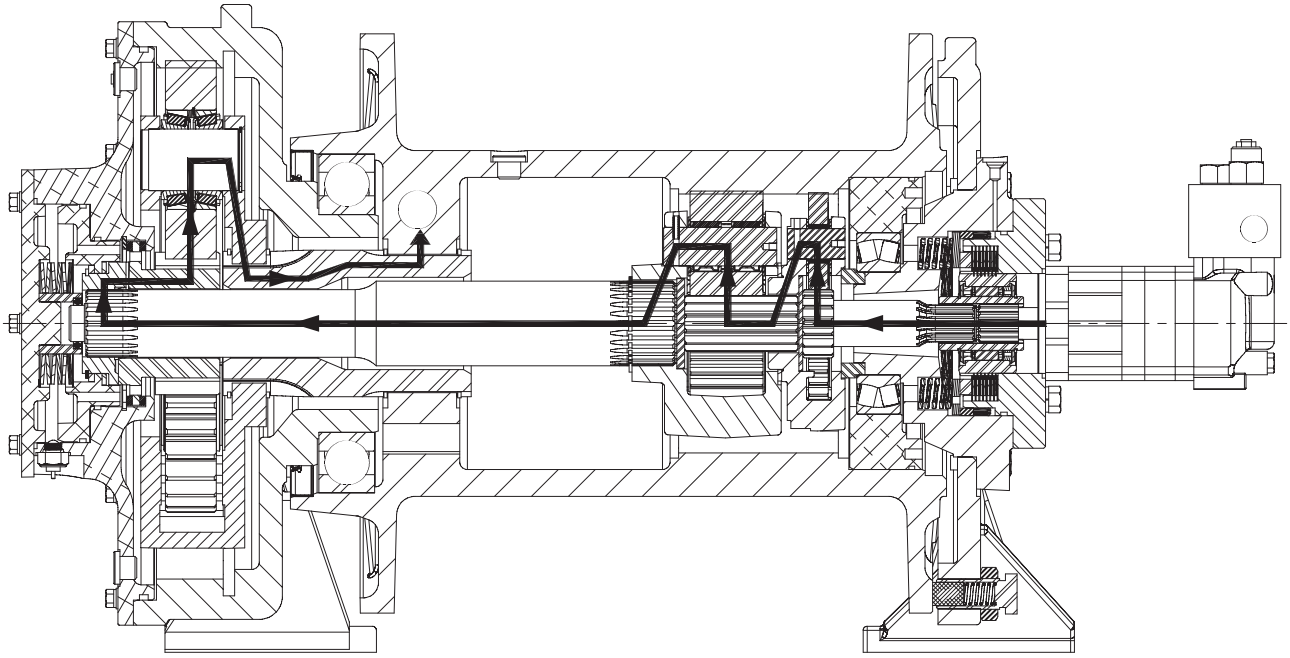


Figure 2

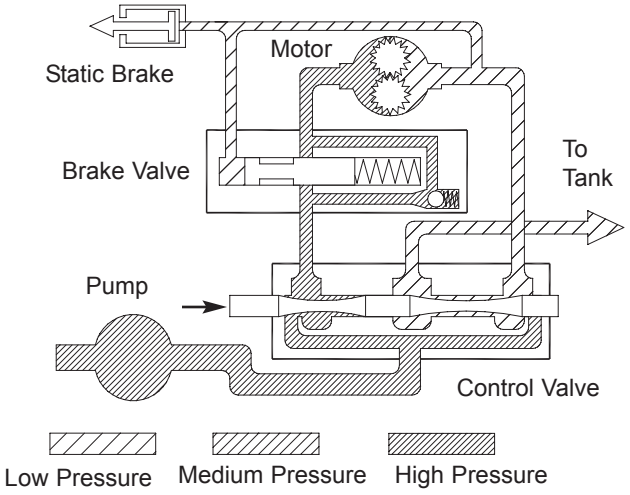


Figure 3

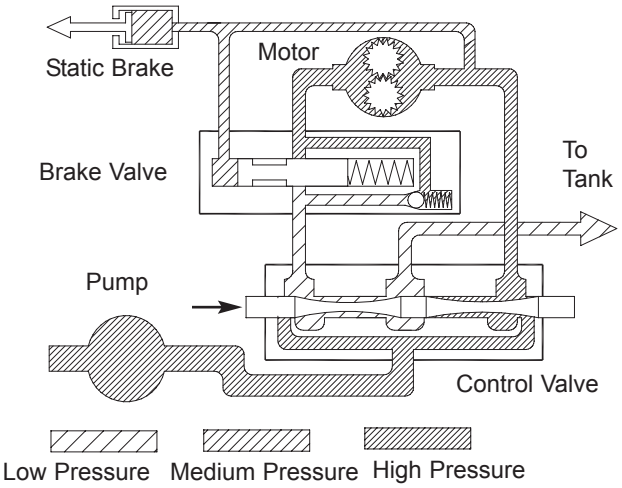


Figure 4

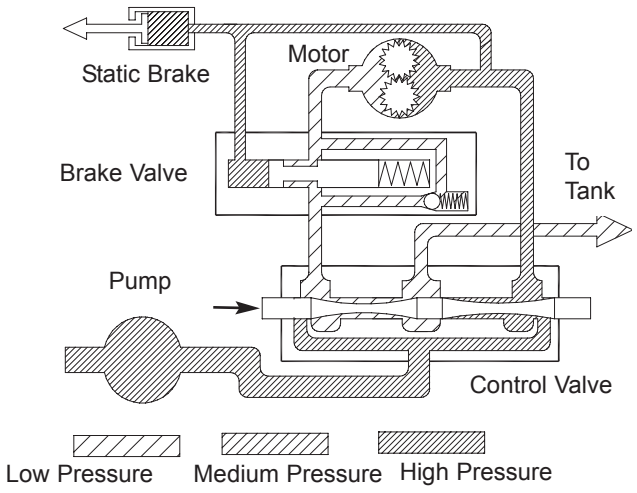


Figure 5

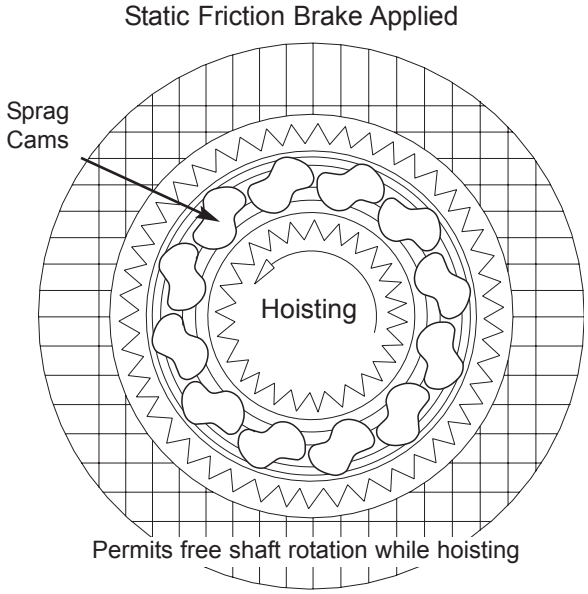
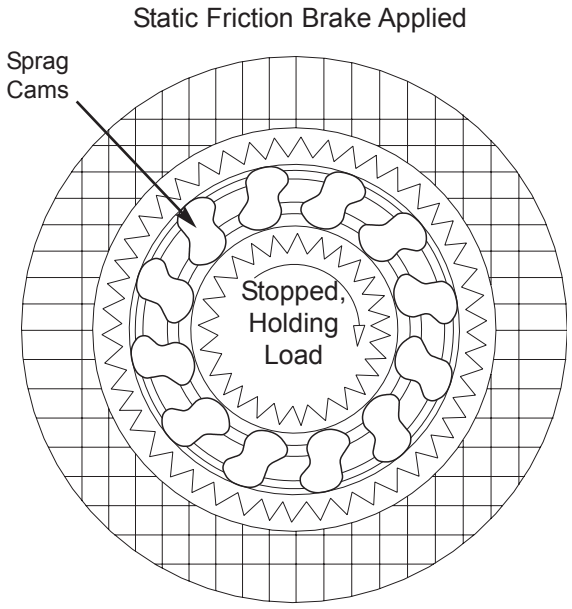


Figure 6



Load attempts to rotate shaft in opposite direction. Brake clutch locks sun gear shaft to friction brake.

WINCH INSTALLATION

1. The winch must be mounted to a flat, rigid surface which will not flex under load. The mounting surface must be flat within .05 mm (.020 in.) between mounting surfaces. If necessary, use shim stock to ensure proper mounting.

⚠ WARNING ⚠

Flexing or uneven mounting surfaces will produce internal winch distortion which may result in rapid component wear, overheating, poor winch performance or an improperly engaged drum clutch which may become disengaged and result in dropped loads or loss of load control causing property damage, severe injury or death.

2. The centerline of the cable drum must be horizontal and mounted perpendicular to the direction of pull. The fleet angle, or the angle created from an imaginary line from the center of the cable drum to the load or first sheave and from this load point back to the drum barrel intersection with the drum flange, must not exceed 1½°. Fleet angles in excess of 1½° will create uneven spooling resulting in rapid drum or wire rope wear.
3. ISO grade 10.9 (SAE Grd. 8) fasteners are recommended for mounting fasteners. The M24 -3 mounting fasteners should be tightened to 1160 Nm (855 lb ft).
4. Hydraulic lines and components to operate the winch should be of sufficient size as to minimize the backpressure at the hydraulic motor work ports. Backpressure at full flow should **NOT** exceed 690 kPa (100 psi) for maximum motor shaft seal life. The maximum allowable peak intermittent backpressure is 1,035 kPa (150 psi). For back pressures in excess of 1,035 kPa (150 psi), contact PACCAR Winch Division Engineering.
5. The winch directional control valve **MUST** be a three-position, four-way valve without detents and with a spring-centered motor spool, such that the valve returns to the center (Neutral) position whenever the handle is released, and both work ports are opened to tank (open center, open port).

⚠ WARNING ⚠

DO NOT use a control valve with any detents or latching mechanism that will hold the control valve in an actuated or running position when the operator releases the control lever. Use of the wrong type of control valve could lead to unintentional operation of the winch, which could result in property damage, injury or death.

6. The hydraulic oil filter should have a 10 micron nominal rating and be a full-flow type. Contact vehicle Original Equipment Manufacturer (OEM) for more information.
7. High quality hydraulic oil is essential for satisfactory performance and long hydraulic system component life.

Hydraulic oils having 150 – 300 SUS viscosity at 38°C (100°F) and a viscosity index (VI) of 100 or greater will provide good results under normal temperature conditions. The use of oils having a high VI will minimize cold start-up problems and reduce the length of warm-up periods. A high VI will also minimize changes in viscosity with corresponding changes in temperature.

Maximum cold weather start-up viscosity should not exceed 5000 SUS with a pour point of at least 11°C (20°F) lower than the minimum expected temperature.

Under continuous operating conditions the temperature of the oil at any point in the system should not exceed 82°C (180°F). 49°-60°C (120°-140°F) is generally considered optimum.

In general terms; for continuous operation at ambient temperatures 10°-43°C (50°-110°F), use ISO 68; for continuous operation at -12°-32°C (10°-90°F), use ISO 46; and for applications at ambient temperatures below -12°C (10°F), use ISO 32.

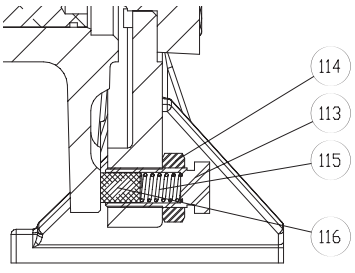
NOTE: *The use of multi-viscosity hydraulic oils is generally not recommended.*

Freespool Drag Adjustment

Do not allow the wire rope to become loose on the cable drum when pulling wire rope off the drum in freespool. Loosened wire rope may tangle and become damaged when pulling a heavy load.

The amount of resistance to rotation felt while pulling wire rope off the drum may be adjusted to prevent drum over-run and loosened wire rope.

Loosen jam nut (114) and tighten or loosen the spring housing as required to produce enough drag to prevent drum over-run but not be difficult to pull.



ITEM	DESCRIPTION
113	Spring Housing
114	Jam Nut
115	Spring
116	Drag Brake Disc

PRE-DELIVERY CHECKLIST

Before releasing the winch into service, the following checklist should be reviewed and each item verified.

INSPECTION	✓
Check gear oil and refill as needed.	
Inspect winch mounting fasteners and torque as required.	
Check for loose or missing bolts, pins, keepers and cotter pins. Replace as needed.	
Check controls - adjustment, operation, spring return to neutral	
Verify winch operating pressure and flow.	
Inspect for external oil leaks. Repair as needed.	
Verify safe condition of wire rope, rope anchor to drum and all rigging.	

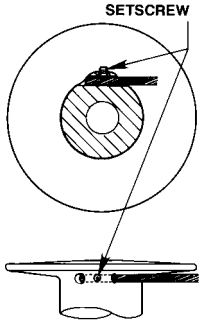
WIRE ROPE INSTALLATION

Winches are rated at bare drum line pull, meaning the maximum load capability will be reached on the first layer of wire rope. As the cable drum fills, the line pull will decrease (loss of leverage) as the line speed increases (larger circumference). Therefore, it is best to install the minimum length of wire rope possible for your application so the winch will operate on the lowest layers, delivering the maximum load capability.

Use of larger diameter wire rope will not always increase strength as the larger wire rope may be more prone to bending fatigue failure due to the drum diameter. Consult your wire rope supplier for their recommendations regarding the best wire rope and rigging for your application.

⚠ WARNING ⚠

Winch wire rope anchors or set screws are **NOT** intended to hold rated loads. Winch loads applied directly to the cable anchor may cause the wire rope to pull free and result in sudden loss of load control and cause property damage, injury or death. A minimum of five (5) wraps of wire rope must be left on the drum barrel to achieve rated load.



INSTALLATION OF SET SCREW CLAMPS:

Prepare the end of the wire rope as recommended by the wire rope manufacturer. Insert the proper size wire rope through the anchor hole until it is almost even with the other end. Apply “Loctite” or equivalent removable thread locking compound to the clean, dry threads of the setscrews and install the setscrews. Tighten the setscrews until the rope is slightly deformed and held securely.

WINCH OPERATION

The following warnings and instructions are basic to safe winch operation. Please read them carefully and follow them any time the winch is in use. These instructions are provided in addition to any information provided by the Original Equipment Manufacturer. Equipment operators should be completely familiar with the overall operation of the vehicle to which the winch is installed. If you have any questions concerning the safe operation of this winch or the equipment to which it is mounted, contact the equipment manufacturer that installed the winch, or the PACCAR Winch Division Product Support Department, as previously defined.

⚠ WARNING ⚠

Ground personnel **MUST** stay in view of the operator and clear of the load and cable drum at all times. **DO NOT** allow personnel near the winch line while under tension. **DO NOT** allow personnel near the cable drum during winch operation. **DO NOT** allow personnel to be in line with the load. **DO NOT** allow personnel to stand under a suspended load. A safe distance of 1½ times the working length of the cable should be maintained by ground personnel. A broken wire rope and/or lost load may cause property damage, injury or death.

⚠ WARNING ⚠

Failure to properly warm up the winch, particularly under low ambient temperature conditions, may result in temporary brake slippage due to high back pressures attempting to release the brake, which may result in property damage, injury or death.

⚠ WARNING ⚠

Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake clutch slippage which could result in property damage, injury or death. Some gear lubricants contain large amounts of EP (extreme pressure) and anti-friction additives which may contribute to brake slippage and damage to brake friction discs or seals. Oil viscosity with regard to ambient temperature is also critical to reliable brake operation. Testing indicates that excessively heavy or thick gear oil may contribute to intermittent brake slippage. Make certain that the gear oil viscosity used in your winch is correct for your prevailing ambient temperature.

The winch directional control valve, described earlier, controls haul-in and pay-out functions of the winch. Moving the control lever in the haul-in direction will cause the winch to pull in the load toward the vehicle. Moving the control lever in the pay-out direction will cause the winch to feed wire rope off the drum.

NOTE: *During typical winching operations, it is generally recommended to operate the vehicle engine at high idle RPM and use the winch control valve to control oil flow, and thus winch line speed as needed.*

Position the vehicle such that the centerline of the winch drum is perpendicular to the winch load whenever possible. The wire rope fleet angle must not exceed 1½°. If the fleet angle exceeds 1½°, the wire rope will not spool correctly, eventually resulting in damaged wire rope and prematurely worn winch components.

Either power out the wire rope using the hydraulic system, or disengage the drum clutch and pull the wire rope off the drum by hand (freespool).

Securely attach the wire rope to the load in such a manner as to avoid damaging the load or rigging. Fully engage the drum clutch (see Drum Clutch Operation).

Operate the winch controls smoothly to avoid “jerking” the load and maintain good load control.

Observe the winch operation carefully to make certain all ground personnel remain clear of the wire rope and load, and that the load does not shift, which may require repositioning the wire rope or the vehicle.

Once the load is positioned properly, move the lever back to neutral to stop the winch. Secure the load as required. Pay out just enough wire rope to remove all tension on the cable drum. Disengage the drum clutch and disconnect the wire rope from the load.

Re-engage the drum clutch.

Wind the wire rope onto the cable drum while maintaining sufficient tension to allow the wire rope to spool properly, being careful to keep hands and clothing away from the cable drum and/or fairlead rollers.

DRUM CLUTCH OPERATION

⚠ WARNING ⚠

Do not move the load, the winch or the vehicle BEFORE making certain the drum clutch is placed in the “ENGAGED” position and the clutch is fully engaged. A partially engaged drum clutch may “jump out” of engagement. A load or tension on the winch line may prevent a partially engaged clutch from disengaging, but any change in load condition may allow the clutch to become disengaged unexpectedly. This action may cause loss of load control which could result in property damage, injury or death.

To ENGAGE the Drum Clutch:

1. Insure the winch motor is stopped and there is no load or tension on the wire rope. The vehicle must be stopped with the park brake set.

2. Shift the freespool control to the engaged position. You may hear the gears move within the winch case. You could check that the freespool drum clutch has engaged the winch gear train by manually rocking the cable drum forward and back and feel the drum stop firmly against the gear train. The freespool indicator light will go out when the freespool piston and clutch return to the engaged position. The winch may now be operated in the haul-in or pay-out direction.

To DISENGAGE the Drum Clutch:

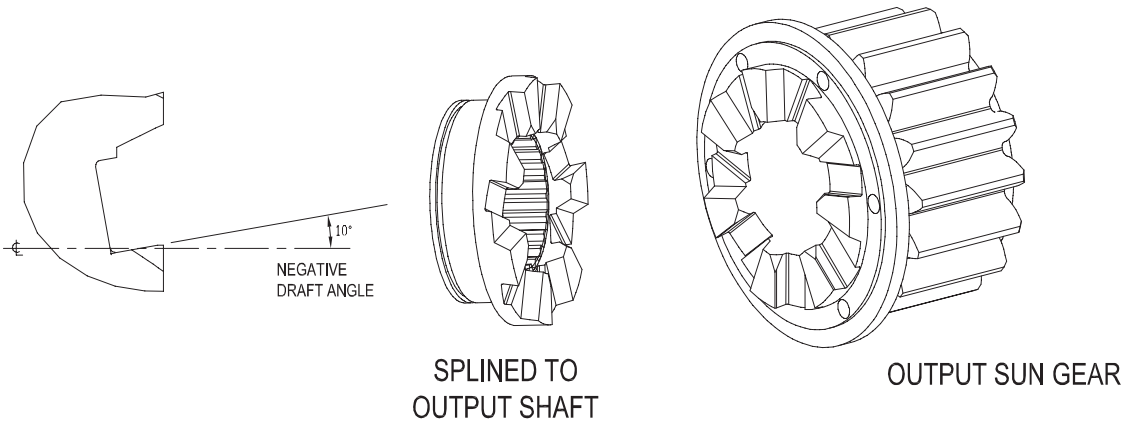
1. Make certain the winch motor is stopped and there is no load or tension on the wire rope. The vehicle must be stopped with the park brake set.

2. Shift the freespool control to the disengaged position. Again, you may hear the freespool gears move within the winch case. 6.2 bar (90 psi) air system pressure is required to shift the freespool mechanism in the winch. The freespool indicator light will be on when the piston and clutch begins to shift to the disengaged position. The cable may now be pulled off the drum by hand.

⚠ WARNING ⚠

DO NOT attempt to engage the drum clutch while the cable drum is rotating. DO NOT attempt to disengage the drum clutch with a load applied to the winch cable.

Engaging or disengaging the drum clutch while the cable drum is rotating or under load may result in damage to the drum clutch components which may allow the drum clutch to become disengaged under load and drop a load resulting in property damage, injury or death.



A negative draft angle is machined into the mating lugs of the drum clutch shown above. This feature reduces the chance of the clutch coming disengaged while under load. The greater the load, the more the negative draft draws the clutch halves together. Due to this design, ALL load or tension must be removed from the winch to separate the clutch halves to disengage the drum clutch and freespool.

AUXILIARY RIGGING

Snatch Block

An auxiliary sheave, or snatch block, may increase the versatility of the winch, and is highly recommended in the following applications:

- When winch loads exceed the safe winch or wire rope capacity.
- When slower line speeds are required for precise load control.

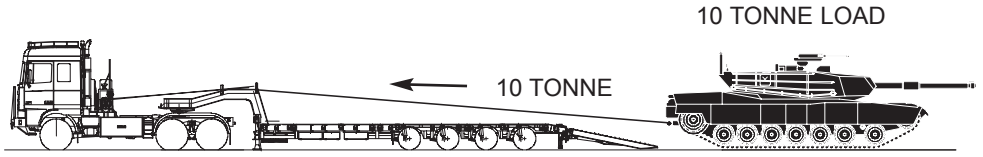
Securely attach the snatch block to the anchor point following the block manufacturer's recommendations.

Tree Protector

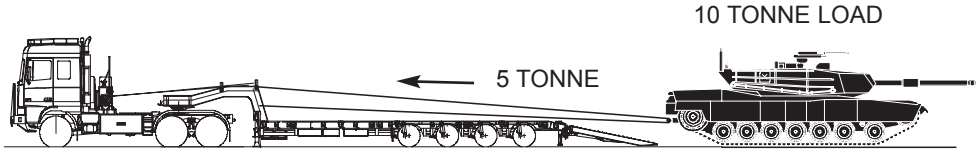
If the wire rope or a snatch block must be anchored to a tree or other structure for recovery purposes, a heavy nylon web sling of proper capacity rating should be used to avoid causing serious damage to the tree.

⚠ WARNING ⚠

A poorly attached or undersized snatch block may break loose from the anchor point and cause a sudden loss of load control, which may result in property damage, injury or death.



Single Part Line - Winch Pull = Load



Two Part Line - Winch Pull = $\frac{\text{Load}}{2}$

NOTE: Load moves at ½ the speed of a single part line.

PREVENTIVE MAINTENANCE

A regular program of preventive maintenance for your winch is required to minimize the need for emergency servicing and will promote safe, reliable winch operation.

The user of PACCAR Winch products is responsible for winch inspection, testing, operator training and the maintenance noted below, with frequency dependent on the severity of the winch duty cycle and the thoroughness of the preventive maintenance program.

Field experience, supported by engineering testing, indicate the two service procedures listed below are the most critical to safe, reliable winch operation and **MUST** be observed.

- Regular Gear Oil Changes
- Use of Proper Gear Oil – recommended type for prevailing ambient temperatures and additives.

⚠ WARNING ⚠

NEVER attempt to service a winch with the engine running as accidental engagement may result in property damage, injury or death. Make certain **ALL** load is removed from the winch cable drum **BEFORE** servicing the winch. A loaded wire rope may rapidly and unexpectedly unspool, resulting in property damage, injury or death.

Recommended Preventive Maintenance Intervals:

Daily (when winch is in use)

1. Inspect the wire rope and rigging for broken wires or other damage, as recommended by the wire rope and rigging manufacturer(s).
2. Check for external oil leaks – both hydraulic and gear oil – and repair as required. **This is extremely important due to the accelerated wear that can be caused by insufficient lubrication within the winch.** Gear oil must be maintained at the proper level. Use only recommended lubricants. (See "Recommended Lubricants" in this manual.)
3. Check hydraulic motor plumbing for damage, such as chafed or deteriorating hoses, and repair as needed.
4. Visually inspect for loose or missing bolts, pins, keepers or cotter pins, and tighten or replace as needed.

Weekly

1. Perform all daily inspections.
2. Check gear oil level to center of sight glass and refill as needed with the recommended lubricant. There are no grease fittings on the H35R and H55R.
3. Inspect the gear housing vent relief, located in the fill plug, to ensure the fitting is not clogged with dirt or grease. Clean or replace as needed. Do not paint over the vent relief plug or replace it with a solid plug.

Monthly

1. Perform all daily and weekly inspections.
2. Check the hydraulic system relief valve setting to ensure proper performance and protection of hydraulic components. Adjust or repair as required.
3. Inspect hydraulic system filters and strainers. Follow the system manufacturer's service recommendations for repair or replacement.
4. Inspect all winch mounting fasteners. Retighten or replace as required.
5. Inspect winch mounting structural welds, and repair as needed

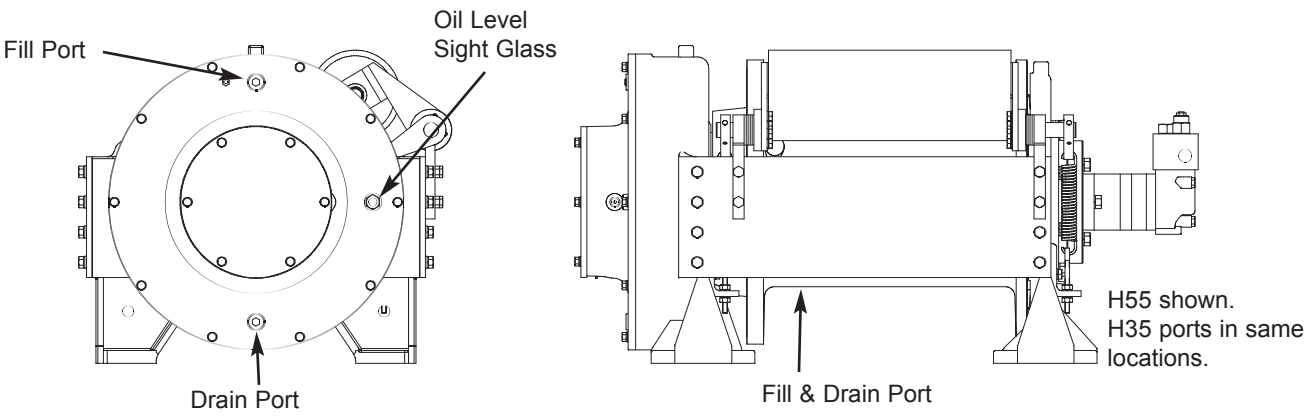
Yearly

1. Perform all daily, weekly and monthly inspections.
2. Replace gear oil.

NOTE: *If the winch is used in excess of 20 hours per week, the gear oil should be changed every 6 months.*

⚠ WARNING ⚠

Hot oil can cause severe injury. Make certain the oil and winch housing have cooled to a safe temperature before servicing.



Inspection Performed	Inspection Interval			
	Daily	Weekly	Monthly	Yearly
Inspect wire rope and rigging	X	X	X	X
Inspect drum clutch and shift mechanism for proper engagement	X	X	X	X
Inspect for external oil leaks	X	X	X	X
Check for damaged hoses / lines	X	X	X	X
Check for loose or missing bolts, pins, keepers, or cotter pins	X	X	X	X
Check gear oil level / refill		X	X	X
Inspect breather fitting		X	X	X
Inspect winch mounting fasteners - torque as required		X	X	X
Inspect structural welds			X	X
Check hydraulic relief valve setting			X	X
Check cable tension roller for free operation			X	X
Inspect hydraulic filters / strainers			X	X
Change gear oil (1) (2)				X

NOTES:

(1) Change the gear oil after the first 100 hours or 30 days of use, whichever occurs first.

(2) For winch operation in excess of 20 hours per week, oil changes should occur every 6 months instead of yearly.

SPECIFICATIONS

	H35R	H55R
Rated Bare Drum Line Pull	13,245 kg (29,230 lb)	24,494 kg (54,000 lb)
Bare Drum Line Speed	9 mpm (29 fpm)	6 mpm (19 fpm)
Cable Drum Diameter	229 mm (9.0 in)	286 mm (11.25 in)
Cable Drum Flange Diameter	381 mm (15.0 in)	478 mm (18.85 in)
Distance Between Flanges	412 mm (16.2 in)	421 mm (16.58 in)
Wire Rope Capacity - $^3/_4$ in. (19 mm)	56 m (184 ft)	
- 1.02 in. (26 mm)		53 m (174 ft)
Overall Gear Ratio	69:1	150:1
Maximum Pressure	21,170 kPa (3,070 PSI)	22,750 kPa (3,300 PSI)
Maximum Flow	90 LPM (23.7 GPM)	90 LPM (23.7 GPM)
Winch Weight	290 kg (640 lb)	431 kg (950 lb)
Gearbox Oil Capacity (liters) (quarts)	6.9 L (7.25 qt)	11.4 L (12 qt)

Fastener Torque Chart

Size	N-m	lb.ft.
6 x 1	16.5	12
8 x 1.25	40	30
10 x 1.5	79	59
12 x 1.75	138	102
24 x 3	1160	855

RECOMMENDED PLANETARY GEAR OIL

Field experience, supported by engineering endurance tests, indicates the use of the proper gear oil and a program of regular preventive maintenance will help provide extended gear train life and reliable winch brake performance. For this reason, BRADEN has published the following specifications to assist in determining which lubricant is best suited to your application.

⚠ WARNING ⚠

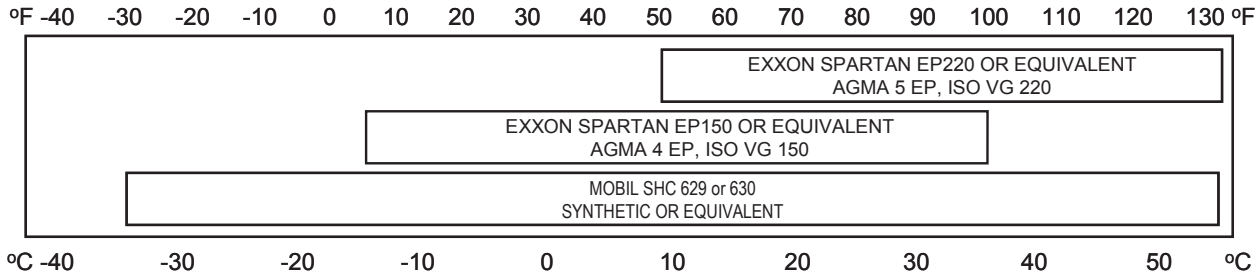
Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake clutch slippage which could result in property damage, severe personal injury or death. Some gear lubricants contain large amounts of EP (extreme pressure) and anti-friction additives which may contribute to brake clutch slippage or damage to brake friction discs or seals. Oil viscosity with regard to ambient temperature is also critical to reliable brake clutch operation. Our tests indicate that excessively heavy or thick gear oil may contribute to intermittent brake clutch slippage. Make certain that the gear oil viscosity used in your winch is correct for your prevailing ambient temperature.

For simplicity, BRADEN has listed available products in each temperature range that have been tested and found to meet our specifications. This is not to say that other lubricant brands would not perform equally as well.

If the following lubricant brands are not available in your area, make certain your lubricant vendor supplies you with oil that is equivalent to those products listed below.

RECOMMENDED PLANETARY GEAR OIL

PREVAILING AMBIENT TEMPERATURE



Texaco Meropa 150, previously used as factory fill, may no longer be widely available due to current market conditions. Braden winches are factory filled with Exxon Spartan EP150, or equivalent. Consult your oil supplier for other equivalent oils if required.

Texaco	Exxon	Mobil	Shell	Chevron
Meropa 150	Spartan EP 150	Mobilgear 629	Omala 150	Gear Compounds EP 150
Meropa 220	Spartan EP 220	Mobilgear 630	Omala 220	Gear Compounds EP 220

9/2002

Unless otherwise specified, it is recommended that the gear oil be changed after the first one hundred (100) hours or thirty (30) days of machine operation, then every one thousand (1,000) hours or twelve (12) months, whichever occurs first. The gear oil should also be changed whenever the ambient temperature changes significantly and an oil from a different temperature range would be more appropriate.

A warm-up procedure is recommended at each start-up and is essential at ambient temperatures below 4°C (+40°F) .

The engine should be run at its lowest recommended RPM with the hydraulic winch control valve in neutral allowing sufficient time to warm up the system. The winch should then be operated at low speeds, forward and reverse, several times to prime all lines with warm hydraulic oil and to circulate gear lubricant through the planetary gear sets.

⚠ WARNING ⚠

Failure to properly warm up the winch, particularly under low ambient temperature conditions, may result in temporary brake slippage due to high back pressures attempting to release the brake, which could result in property damage, severe personal injury or death.

If you have any questions regarding your BRADEN planetary winch, please contact the BRADEN Product Support Department at 1-918-251-8511, Monday through Friday from 08:00 to 16:30 hours CST, or by fax at 1-918-259-1575 or via the internet at www.paccarwinch.com.

Gear Oil Change

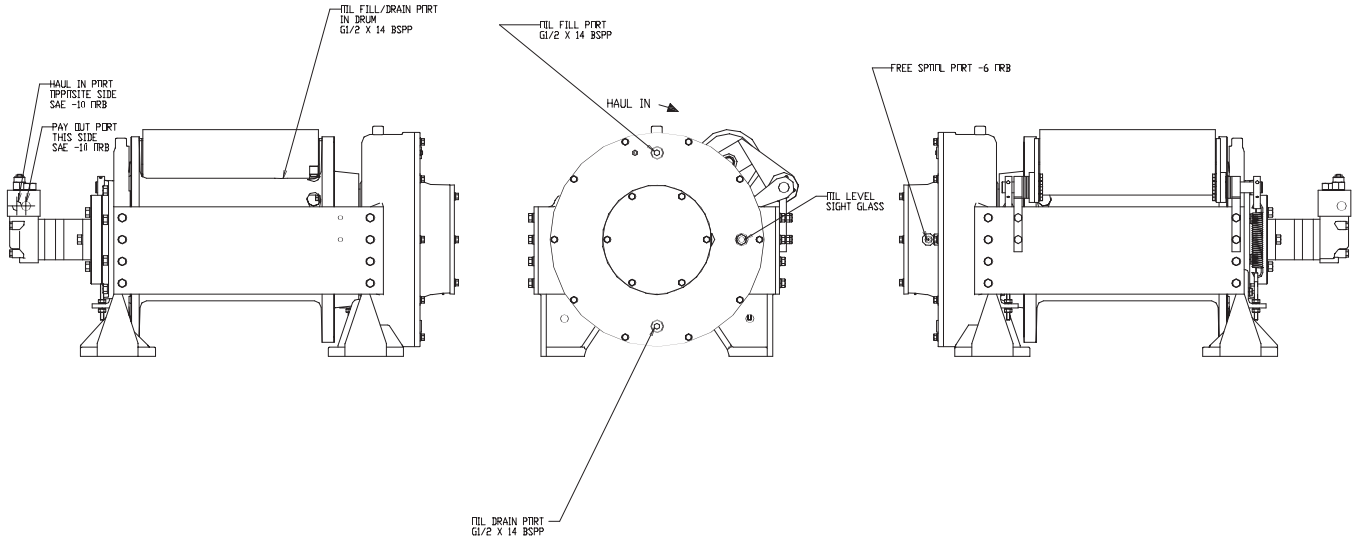
⚠ WARNING ⚠

Make certain there is no load or tension on the wire rope and the engine is stopped before working on winch. Accidental engagement of controls may result in property damage, injury or death.

⚠ WARNING ⚠

Hot oil may cause injury. Make certain winch has cooled to safe temperature before servicing.

1. Operate winch in pay-out direction until drum barrel is visible and only two wraps of wire rope remain on cable drum. Rotate drum until drain/level plug in drum barrel is located at the bottom, six o'clock position. Wind wire rope onto empty spool during winch gear oil service.
2. Place drain pan under cable drum and remove plug. Remove fill vent plug from final drive housing to speed draining of gear oil. This operation will drain only the gear oil trapped in the cable drum. After oil has drained, rotate drum 90 degrees till plug is at the three or nine o'clock position.
3. Place drain pan under the final drive housing and remove the bottom plug from the freefall housing cover. Install plug into freefall housing after oil has drained. Recycle or dispose of used oil in an environmentally responsible manner.
4. Fill gear cavity in cable drum until oil appears at drain/level plug at the horizontal centerline. Fill gear cavity in the freefall housing until oil appears in the oil level sight glass. The gear can move between the two cavities but will move slowly through the gear train and bearings.
5. Clean the breather relief plug in solvent, blow dry with compressed air and install into freespool housing cover.



TROUBLESHOOTING

⚠ WARNING ⚠ If a winch ever exhibits any sign of erratic operation, or load control difficulties (i.e. load creeping or chattering) appropriate troubleshooting tests and repairs should be performed immediately. Continued operation in this manner may result in property damage, serious personal injury or death.

TROUBLE	PROBABLE CAUSE	REMEDY
A		
The winch will not pay out the load or will not pay out the load smoothly.	1. Plugged pilot orifice in the counter balance valve cartridge.	Stop the engine and vent the pressure from the hydraulic reservoir. Remove the counter balance valve (CBV) cartridge from the manifold on the motor. Closely examine the small orifice in the side of the upper chamber. Clean the cartridge in safety solvent to remove debris. Install the cartridge into the manifold and test the winch. Replace the counter balance valve cartridge if all other tests fail to correct the problem.
	2. Counter balance valve cartridge stuck closed or opening pressure adjustment has been changed.	Install a 0-13,800 kPa (0-2000 psi) gauge into the brake release hose using a tee adapter. Start the engine and operate the winch in the pay out direction. The counter balance valve should open and the winch run in pay out at approximately 4825 kPa (700 psi) with no load on the winch. If adjustment is necessary, loosen the jam nut and turn the adjusting screw counter-clockwise (CCW) to increase the CBV opening pressure and clockwise to decrease the CBV opening pressure.
	3. The static brake will not release due to a defective brake cylinder seal. ***Note:*** *If the brake cylinder seal is defective you will usually find oil leaking from the winch vent relief plug.*	Check the brake cylinder seal as follows: A. Disconnect the brake release hose from the brake release port on the brake cylinder. Connect a hydraulic hand pump with accurate 0-13,800 kPa (0-2000 psi) gauge and shut-off valve to the brake cylinder port. B. Apply 2,000 kPa then increase to 4,000 kPa (290 then 580 psi) to the brake port. Close the shut-off valve and let stand for five minutes. C. If there is any loss of pressure in five minutes, the brake cylinder should be disassembled for inspection of the sealing surfaces and replacement of the seals. Refer to Motor Support-Brake Cylinder Service section of this manual.

TROUBLE	PROBABLE CAUSE	REMEDY
TROUBLE "A" CONTINUED FROM PREVIOUS PAGE		
	4. The static brake will not release as a result of damaged brake discs.	Disassemble the brake to inspect the brake discs. Check brake stack-up height as described in Motor Support-Brake Cylinder Service.
B		
Oil leaks from vent plug.	1. Same as A2.	Same as A2.
	2. Motor seal may be defective as a result of high system back pressure or contaminated oil.	System back pressure must not exceed 6,900 kPa (1,000 psi). Inspect hydraulic system for a restriction in the return line from the control valve to the reservoir. Be sure control valve and plumbing is properly sized to winch motor. Oil analysis may indicate contamination has worn motor shaft and seal. Thoroughly flush entire hydraulic system and install new filters and oil. Install new motor seal.
C		
The brake will not hold a load with the control lever in neutral.	1. Excessive system back pressure acting on the brake release port.	Install a hydraulic gauge in to the brake release port with a tee adapter. Operate the engine at full throttle and observe the neutral system pressure on the gauge. Operate the winch in the haul-in direction and observe the pressure on the gauge. The pressure must not be more than 6,900 kPa (100 psi). If pressure is high, inspect hydraulic system for damaged or collapsed hoses or plugged return filters. The brake will be released at approximately 2600 kPa (380 psi) with no load on the winch or approximately 2100 kPa (300 psi) with a maximum load.
	2. Friction brake will not hold due to worn or damaged discs.	Same as Remedy A4 of Trouble 4.

TROUBLE	PROBABLE CAUSE	REMEDY
TROUBLE "C" CONTINUED FROM PREVIOUS PAGE		
	3. Brake clutch is slipping.	Improper planetary gear oil may cause the brake clutch to slip. Drain old gear oil and flush winch with solvent. Thoroughly drain solvent and refill winch with recommended planetary gear oil listed in "Preventive Maintenance". Brake clutch may be damaged or worn. Disassemble and inspect brake clutch as described in "Brake Clutch Service".
D		
The winch will not pull the rated load.	1. The winch may be mounted on an uneven surface which causes distortion of the winch base and binding of the gear train. Binding in the gear train will absorb horsepower needed to hoist the rated load and cause heat.	Remove winch and clean rust and dirt from mounting surfaces. If necessary, use shim stock to level winch. Refer to "Winch Installation". First loosen, then evenly retighten all winch mounting bolts to recommended torque.
	2. System relief valve may be set too low. Relief valve needs adjustment or repair.	Check relief pressure as follows: A. Install an accurate 27,580 kPa (0-4000 psi) gauge into the haul in port of the brake valve. B. Apply a stall pull load on the winch while monitoring pressure. C. Compare gauge reading to winch specifications. Adjust relief valve as required. ***NOTE:*** *If pressure does not increase in proportion to adjustment, relief valve may be contaminated or worn out. In either case, the relief valve may require disassembly or replacement.*
	3. Be certain hydraulic system temperature is not more than 82°C (180°F). Excessive hydraulic oil temperatures increase pump and motor internal leakage and reduce motor performance.	Same as remedies for Trouble D1 and D2. Same as remedies for Trouble E2.

TROUBLE	PROBABLE CAUSE	REMEDY
TROUBLE "D" CONTINUED FROM PREVIOUS PAGE		
	4. Winch line pull rating is based on 1st layer of wire rope.	Refer to winch performance charts for additional informaiton.
	5. Rigging and sheaves not operating efficiently.	Perform rigging service.
E		
The winch runs hot.	1. Same as D1.	Same as remedies for Trouble D1.
	2. Be certain that the hydraulic system temperature is not more than 82°C (180°F). Excessive hydraulic oil temperatures may be caused by:	
	A. Plugged heat exchanger.	Thoroughly clean exterior and flush interior.
	B. Too low or too high oil level in hydraulic reservoir.	Fill/drain to proper level.
	C. Same as D2.	Same as remedies for Trouble D2.
	D. Hydraulic pump not operating efficiently.	Engine low on horsepower or R.P.M. Tune/adjust engine.
		Check suction line for damage or restriciton.
		Pump worn. Replace pump.
	3. Excessively worn or damaged internal winch parts.	Disassemble winch to inspect/ replace worn parts.
F		
Winch "chatters" while raising rated load.	1. Same as D2.	Same as remedies for Trouble D2.
	2. Hydraulic oil flow to motor may be too low.	Same as remedies for Trouble E2.
	3. Controls being operated too quickly.	Conduct operator training as required.

TROUBLE	PROBABLE CAUSE	REMEDY
G		
The wire rope does not spool smoothly on the drum.	1. Could possibly be using the wrong lay rope. There is a distinct advantage in applying rope of the proper direction of lay. When the load is slacked off, the several coils on the drum will stay closer together and maintain an even layer. If rope of improper lay is used, the coils will spread apart each time the load is removed. Then, when winding is resumed, the rope has a tendency to criss-corss and overlap on the drum. The result is apt to be a flattened and crushed rope.	Consult wire rope manufacturer for recommendation of wire rope that best suits your application.
	2. The winch may have been overloaded, causing permanent set in the wire rope.	Replace wire rope and conduct operator/rigger training as requried.
H		
Freespool mechanism does not work correctly.	1. If freespool will not disengage, load or tension on wire rope is preventing negative draft angle freespool clutch lugs from disengaging.	Operate winch in pay out direction until load or tension is removed from wire rope then disengage freespool clutch.
	2. The air pressure available at the freespool release port is too low to disengage freespool clutch and overcome clutch spring force.	620-290 kPa (90-100 psi) air system pressure is required to pull the freespool clutches apart and overcome the clutch spring force. A. Check vehicle pneumatic system pressure. B. Make certain freespool air control valve is working correctly and that sufficient pressure is reaching freespool cylinder port.
	3. The freespool clutch lugs are damaged and will not hold when winching in a load.	Remove and replace freespool gear train components as described in the “Freespool Clutch” section of this manual. ***NOTE:*** *The freespool must NEVER be shifted to engage while the drum is turning. The freespool clutch lugs will be damaged by engaging a stationary gear member with a rotating member.*

DISASSEMBLY AND ASSEMBLY PROCEDURE

This section pertains to both H55R and H35R winches. Notification in the text will appear when instructions pertain to only one model.

After performing all applicable troubleshooting procedures and a determination has been made the problem is in the winch, follow this procedure to disassemble the winch.

Service Precautions

- Before any part is removed from the winch, all service instructions should be read and understood.
- Work in a clean, dust free area as cleanliness is of utmost importance when servicing hydraulic equipment.
- Inspect all replacement parts, prior to installation, to detect any damage which might have occurred in shipment.
- Use only genuine BRADEN replacement parts for optimum results. Never reuse expendable parts such as oil seals and o-rings.
- Inspect all machined surfaces for excessive wear or damage . . . before reassembly operations are begun.
- Lubricate all o-rings and oil seals with gear oil prior to installation.
- Use a sealing compound on the outside surface of oil seals and a light coat of thread sealing compound on pipe threads. Avoid getting thread compound inside parts or passages which conduct oil.
- Thoroughly clean all parts in a good grade of non-flammable safety solvent. Wear protective clothing as required.

1. Before removing any hydraulic lines from the winch, operate the winch in the pay out direction and remove all the wire rope from the winch drum. The wire rope should be stored on a designated wire rope spool. Do not store wire rope on the ground as it may pick up abrasive material and rust.

   After the wire rope has been removed, drain the gear oil from the cable drum section and the final drive housing as described in the Preventive Maintenance section of this manual.

2. Loosen the tension spring eye-bolts from the cable roller assembly. When all spring tension has been removed, remove the four capscrews that secure the roller brackets to the winch tie plates. Set the roller assembly aside.

⚠ WARNING ⚠

The H55R winch weighs 431 kg (950 lb) and the H35R weighs 290 kg (640 lb). Make certain lifting equipment is of adequate capacity.

3. Remove the mounting bolts that secure the winch end brackets to the winch structure. Install a nylon or cable sling around the cable drum, slightly off center toward the final drive housing and hoist the winch out of the structure. Clean all outside surfaces of the winch.

4. Stand the winch up on the freespool housing with the motor end up. Secure the winch in this position to prevent it from falling and causing injury.

⚠ WARNING ⚠

The winch must always be disassembled and assembled in the vertical position to keep internal components properly aligned. A thrust plate located between the input sun gear and the primary planet carrier may become dislodged and cause serious gear train damage if the brake clutch assembly is removed from the winch in the horizontal position. Gear train damage may result in loss of load control, property damage, injury or death.

5. Remove the hydraulic hose that connects the counter balance valve manifold to the brake release port. Remove the two capscrews that secure the hydraulic motor to the motor support. Remove the motor assembly.

6. Remove the brake clutch assembly from the brake housing. Refer to Brake Clutch Service section of this manual.

7. Remove the eight capscrews that secure the brake housing to the winch end plate then lift the brake cylinder out of the end bracket and cable drum.

8. Remove the winch tie-plates then lift the motor end plate off the cable drum. Be careful not to pinch fingers between the end plate and the cable drum.

9. Clean out the threaded lifting eye holes as required then install two M10X1.5 eye-bolts into the drum closure. Lift the drum closure out of the cable drum. Inspect the condition of the drum bearing and seal and replace as required.

10. Remove the input sun gear, primary planet carrier and secondary planet carrier from the cable drum.

Refer to the Planet Carrier Service Section of this manual.

11. Remove the output shaft from the cable drum and final drive housing. Remove the retaining ring that secures the drum drive coupling to the cable drum (H55R only). Lift the cable drum off the final drive housing. Inspect the drum bearing and seal and replace as required.

12. Turn the final drive housing over with the cable drum side facing down.

13. Remove the capscrews that secure the final drive housing cover/freespool cylinder to the final drive housing then remove the cover. Refer to Freespool Cylinder Service section of this manual.

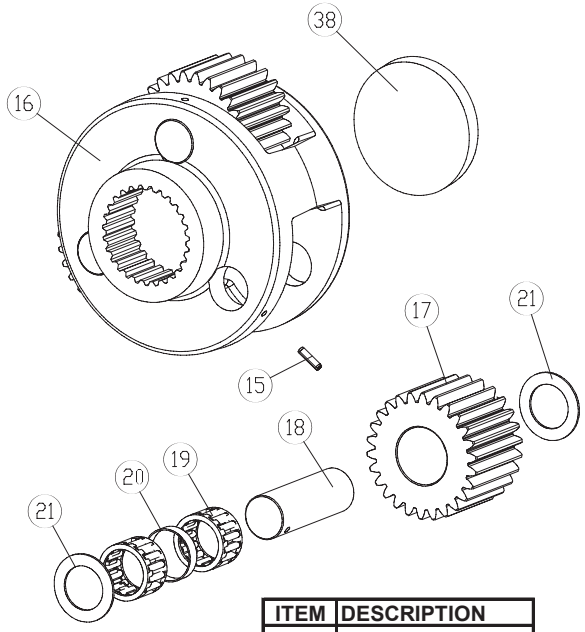
14. Remove the output planet carrier assembly from the final drive housing. Refer to Output Planet Carrier Service section of this manual.

Clean and Inspect

Thoroughly clean and inspect all components at this time. Clean parts in a safety solvent and blow dry with compressed air. Inspect the ring gear machined into the inside diameter of the final drive housing and the cable drum. Compare the area worn by the planet gear teeth to the unworn area. If the planet gear teeth have worn the ring gear teeth more than .4 mm (0.015 in.) the ring gear must be replaced.

The drum bearings must be carefully inspected for any signs of damage to the rollers, races and roller cages. If the bearing shows any sign of pitting, scoring or other abnormality, it must be replaced.

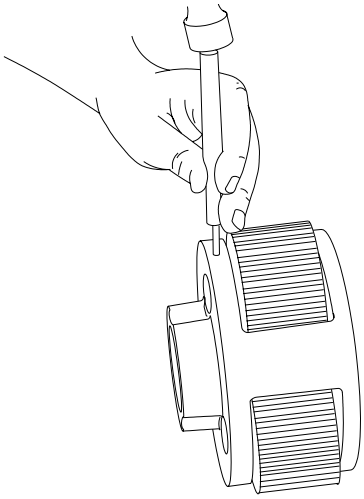
PLANET CARRIER SERVICE



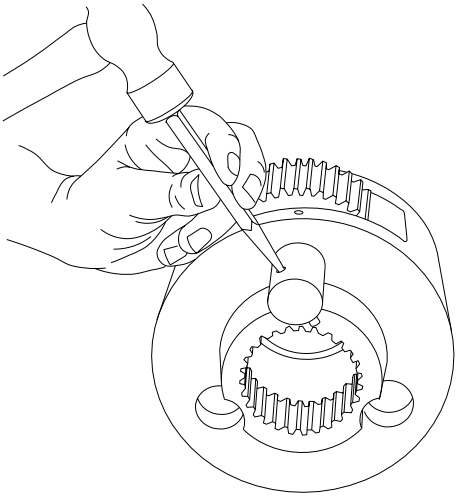
ITEM	DESCRIPTION
15	Roll Pin
16	Planet Carrier
17	Planet Gear
18	Planet Gear Shaft
19	Bearing
20	Bearing Spacer
21	Thrust Washer
38	Thrust Plate

SECONDARY PLANET CARRIER

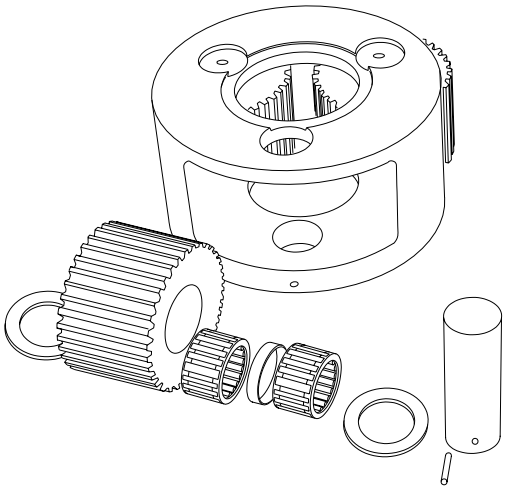
DISASSEMBLY



1. Remove the planet gears (17) by driving the roll pins (15) into the center of the planet shafts (18).

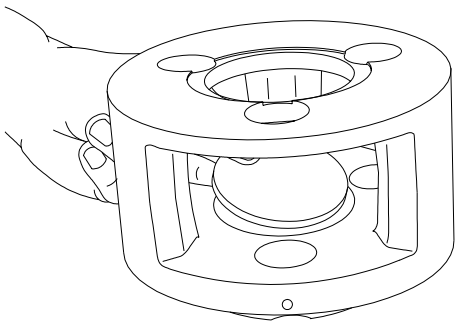


2. Use a punch to drive the roll pins from the planet shafts. Do not reuse the roll pins.

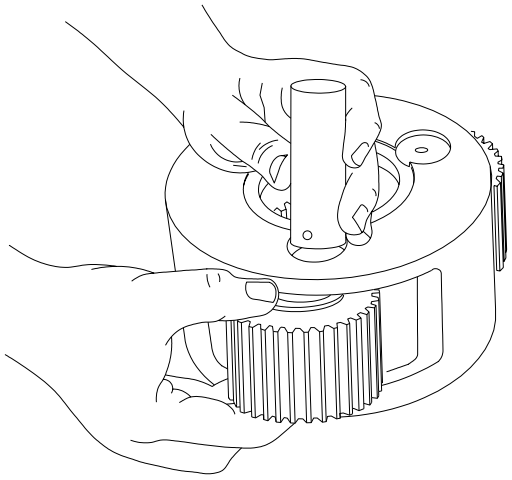


3. Now you can remove the planet shafts, bearings, spacer, thrust washers and gears. Thoroughly clean all parts and inspect for damage and wear. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement or abnormal wear, the bearing should be replaced. Likewise, the 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 shafts should be inspected for abnormal wear or pitting. Replace if necessary.

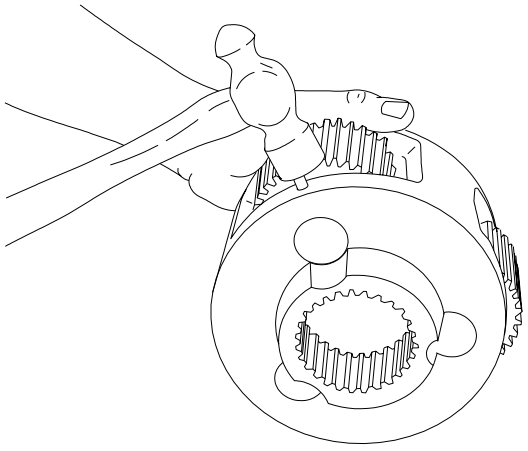
ASSEMBLY



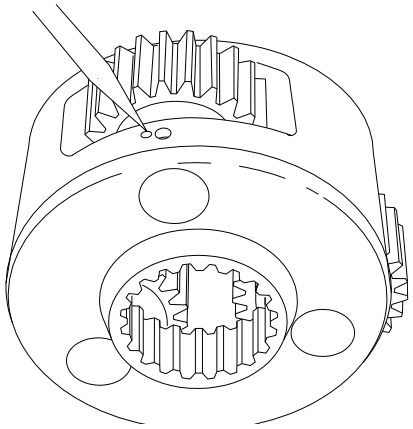
1. Place the output planet carrier on workbench with splined coupling side down. Install output thrust plate (38) in center of carrier.



2. Insert two bearings (19) and a bearing spacer (20) into a gear with the spacer between the bearings. Place a thrust washer (21) on each side of the gear and position in a carrier opening. Slide the shaft (18) through the carrier, thrust washer, bearing-gear sub-assembly and remaining thrust washer.



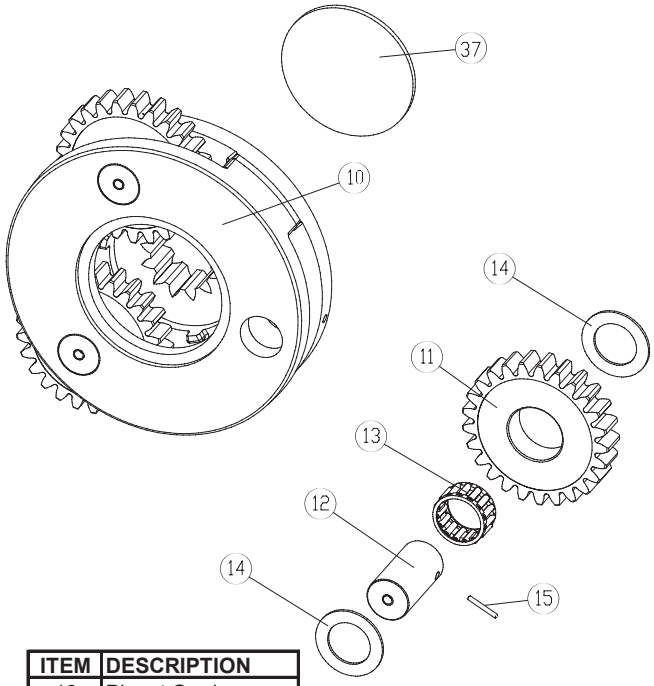
3. Carefully align the pin hole in the carrier with the hole in the planet gear shaft and drive the roll pin (15) into place. Always use NEW roll pins. When properly positioned, 50% of the roll pin will engage the planet gear shaft and 50% will remain in the planet carrier.



4. Note that the roll pin is slightly recessed in the carrier when properly installed. With a center punch, stake the carrier next to the pin hole as shown. This will distort the hole so the pin will not back out. Repeat these steps for each of the three planet gears.

PRIMARY PLANET CARRIER

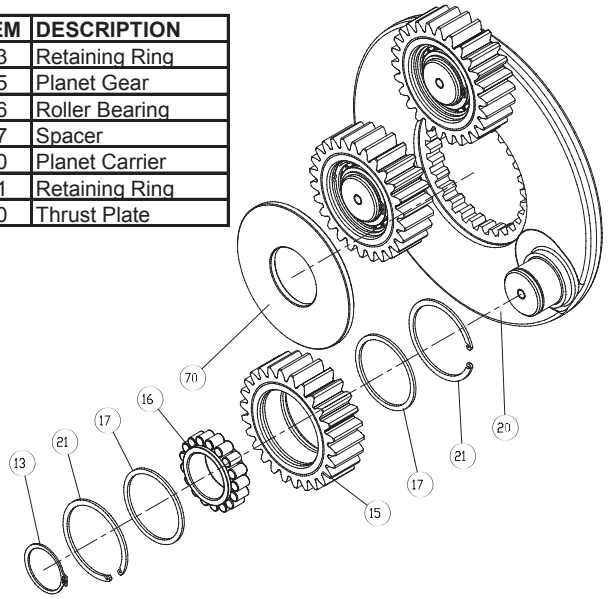
1. To service the primary planet carrier, the steps are the same as for the output carrier except there is only one bearing for each gear and no bearing spacer.



ITEM	DESCRIPTION
10	Planet Carrier
11	Planet Gear
12	Planet Gear Shaft
13	Roller Bearing
14	Thrust Washer
15	Roll Pin
37	Thrust Plate

OUTPUT PLANET CARRIER SERVICE

ITEM	DESCRIPTION
13	Retaining Ring
15	Planet Gear
16	Roller Bearing
17	Spacer
20	Planet Carrier
21	Retaining Ring
70	Thrust Plate



H35R
Disassembly

1. Place the planet carrier assembly on a clean flat work surface with the gear side up. Remove the retaining ring (13) from the planet gear support post of the planet carrier.
2. Slide the planet gear/bearing sub-assembly off the post. Remove the bearing retaining ring (21) and spacer (17) from one side of the planet gear and push the roller bearing (16) out of the gear. Repeat this operation for the remaining two gears.

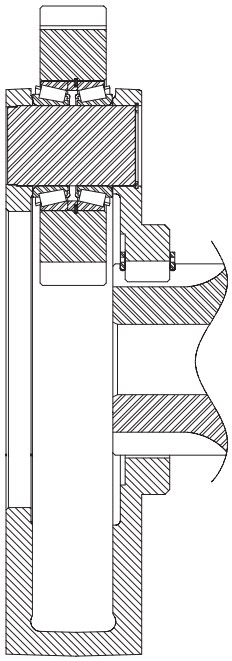
Clean and Inspect

Thoroughly clean and inspect the condition of the planet gear teeth. If there is any sign of pitting on the load carrying surfaces of the gear teeth, the gear must be replaced. Inspect the condition of the roller bearings and races. The inside of the gear is the outer race for the roller bearing. If there is any sign of pitting in the rollers or races, the bearing should all be replaced.

Assembly

1. Coat the inner race of the roller bearing (16) with light assembly grease. Place the rollers in channel in the bearing race. The grease will hold the rollers in place while you slide the race with all the rollers in place, into the planet gear (15). Install a spacer and retaining ring (17, 21) into the planet gear on both sides of the bearings.
2. Install the thrust plate (70) into the center of the planet carrier **before** installing the planet gears onto the planet carrier posts.
3. Install the planet gear/bearing assembly onto the planet carrier post then secure in place with the retaining ring (13). Repeat this operation for the remaining gears.

H55R
Disassembly



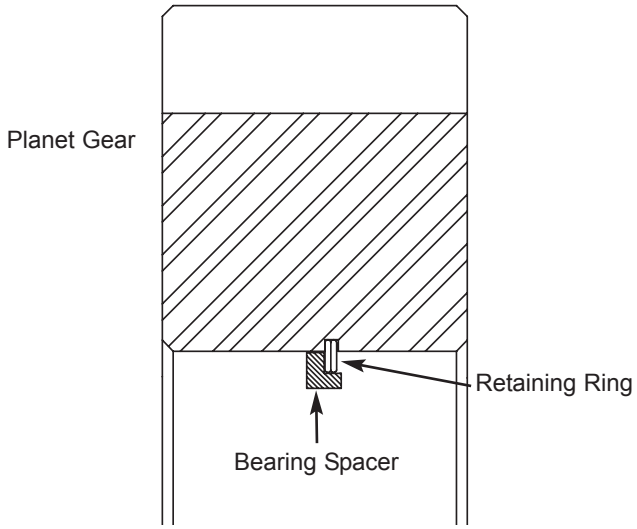
1. Place the output planet carrier on a clean flat surface with the drum coupling end facing up. Remove the retaining rings (52) from each of the planet gear shaft bores in the planet carrier. Mark each gear, pin and carrier bore so these parts can be reassembled in the same bore.
2. Place the planet carrier on the table of a 10+ ton hydraulic press with the drum coupling side facing down. The drum coupling should be located between the press table supports and not subjected to force.
3. Using the press ran, push the planet gear shafts (51) out of the planet carrier. Push pins from freespool end toward the drum coupling end. After all the planet shafts have been removed and the planet gears removed from the carrier, the drum coupling retaining rings may be removed and the coupling removed for inspection.

Clean and Inspect

Clean the gears, shafts and bearings in safety solvent and blow dry with compressed air. There are two tapered bearing cups and cones (21, 22) in each gear. If the bearing rollers or races show any sign of pitting or abnormal wear of the rollers, races or roller cages, they should be replaced.

Inspect the condition of the gear teeth. If there is any sign of pitting, the gear should be replaced.

Assembly

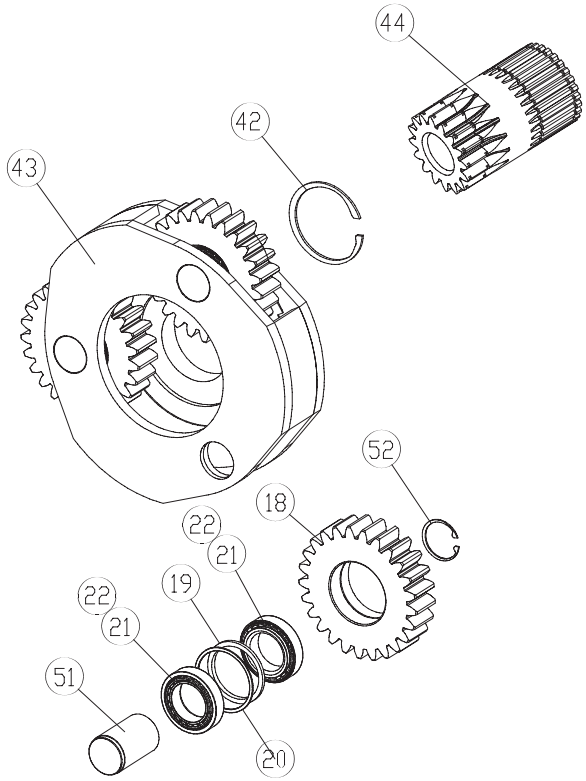


1. Install the bearing cup spacer and snap ring (19, 20) into the gear bore.

NOTE: *The groove is slightly off center in the bore of the gear. This is to allow the bearing spacer to be centered in the bore when properly installed. The distance from the outside edge of the gear to the spacer must be the same on both sides.*

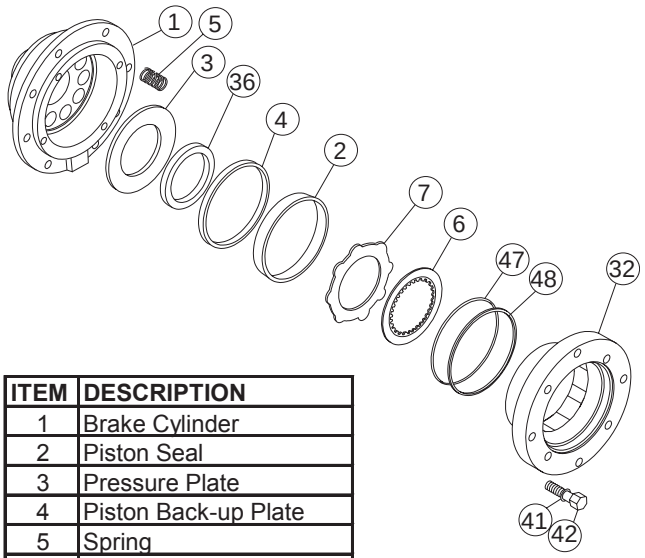
Press the bearing cups (21) into the gears.

2. If the drum coupling (44) was removed for inspection, install it into the planet carrier at this time. Secure the coupling to the carrier with the large retaining ring (42).
3. Lightly oil the tapered bearing cones, cups and shafts. Install the bearing cones into the bearing cups in the gears then slide a gear/bearing assembly in to place in the planetary carrier. Install the planet gear shafts into the planet carrier with the serrated end of the shaft away from the drum coupling.
4. It will be necessary to press the planet shafts in to the carrier as the serrated shafts form a tight, splined fit in the carrier. Install the retaining rings (52) into the planet gear shaft bores. Make certain the retaining rings are fully seated in the groove by tapping them into place with a hammer and punch.



ITEM	DESCRIPTION
18	Planet Gear
19	Bearing Spacer
20	Retaining Ring
21	Bearing Cup
22	Bearing Cone
42	Retaining Ring
43	Planet Carrier
44	Drum Drive Coupling
51	Planet Gear Shaft
52	Retaining Ring

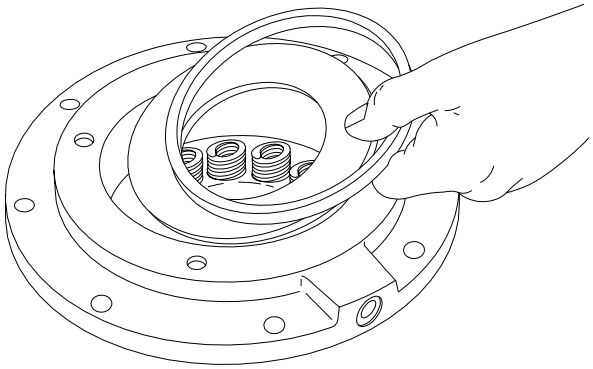
MOTOR SUPPORT-BRAKE CYLINDER SERVICE



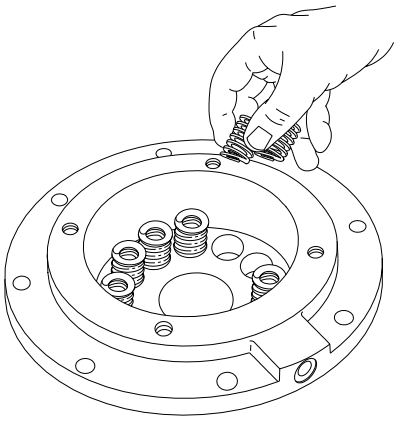
ITEM	DESCRIPTION
1	Brake Cylinder
2	Piston Seal
3	Pressure Plate
4	Piston Back-up Plate
5	Spring
6	Friction Disc
7	Steel Disc
32	Motor Adapter
36	Spacer Ring
41	Lock Washer
42	Capscrew
47	O-ring
48	Back-up Ring

Disassembly

1. Place the brake cylinder on a clean work surface with the motor support facing up. Remove the four capscrews that secure the motor support (32) to the brake cylinder. Loosen the capscrews evenly to release the brake spring force. Remove the motor support from the brake cylinder. Remove the spacer ring, friction discs and steel separator discs (6, 7, 36) from the brake cylinder.

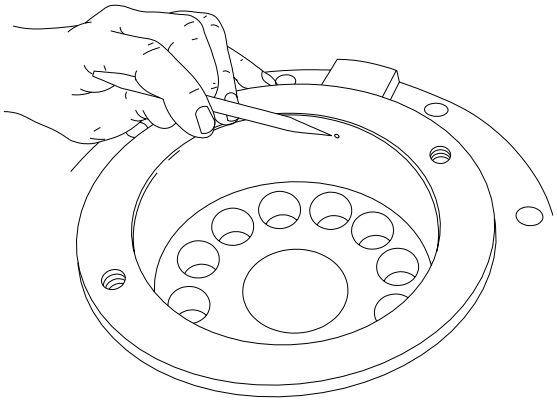


2. Remove the piston back-up ring (4) and pressure plate (3).

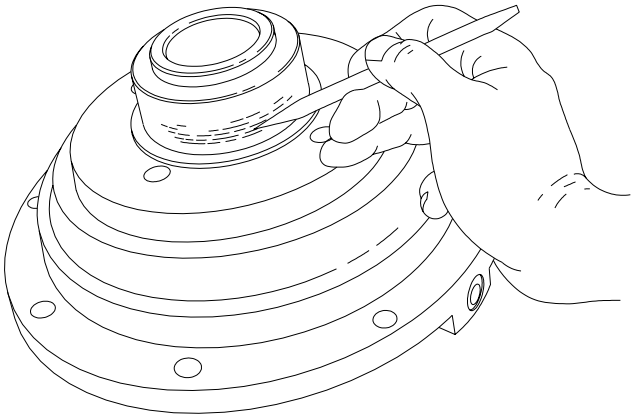


3. Remove the brake springs (5).

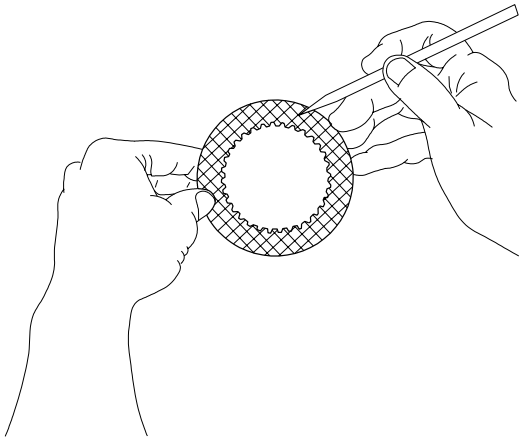
CLEAN AND INSPECT



1. Thoroughly clean and inspect all parts at this time. Check brake piston sealing surfaces on brake cylinder and motor support. Be sure brake release port is free of contamination.

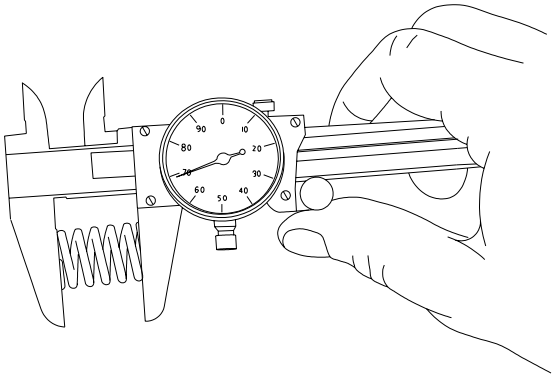


2. Check oil seal and bearing surfaces on brake cylinder for damage or wear.



3. Place friction brake disc on flat surface and check for distortion with a straight edge. Friction material should appear even across entire surface with groove pattern visible. Replace friction disc if splines are worn to a point, disc is distorted, friction material is worn unevenly, or groove pattern is worn away.

4. Place steel brake disc on flat surface and check for distortion with a straight edge. Check surface for signs of material transfer or heat. Replace steel disc if it is distorted or heat discolored.



5. Check brake spring free length; minimum free length is 30 mm (1.187 in). Check springs for any sign of cracking or failure. If a brake spring must be replaced for any reason, then ALL brake springs must be replaced.

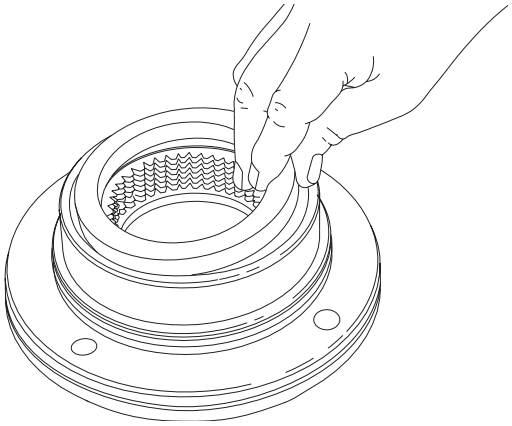
⚠ CAUTION ⚠

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

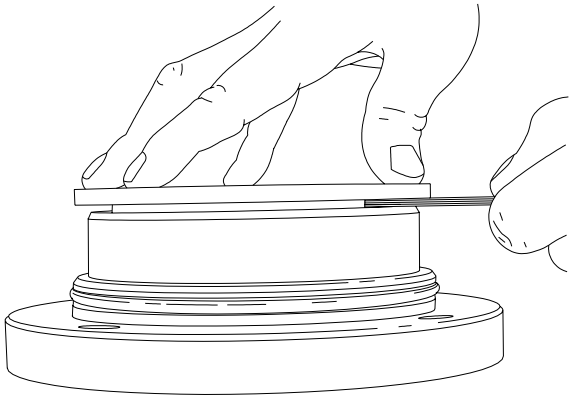
ASSEMBLY

1. Begin assembly by placing motor support on workbench with motor mounting surface down. Install new o-ring and back-up ring (47, 48). Install the back-up ring close to the motor with the cupped side away from the motor.
2. Insert first, a steel brake disc (7) into the motor support followed by a friction brake disc (6) then alternate steel and friction discs until seven friction and eight steel discs have been installed. Finish with a steel brake disc on top.

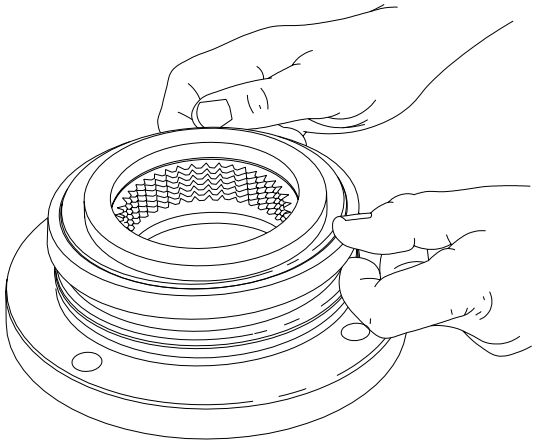
NOTE: *It is a good practice to pre-lubricate the discs in light motor oil prior to assembly.*



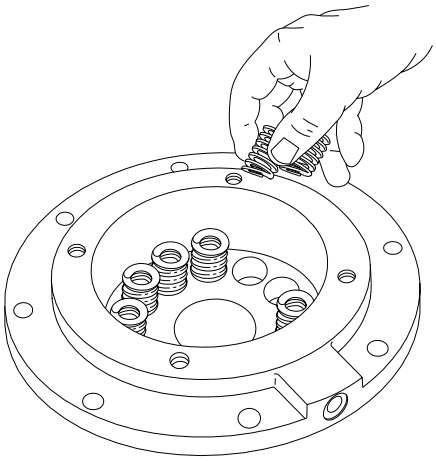
3. Install the brake spacer ring (36) on top of the last steel brake disc.



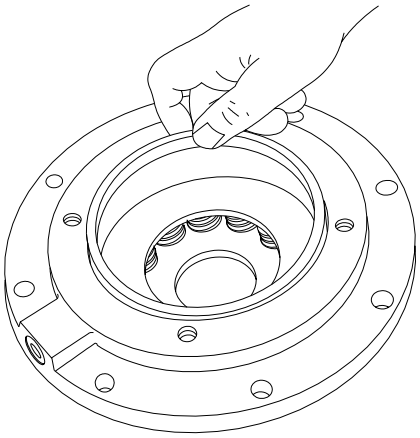
4. To check brake stack height, place the pressure plate on top of the brake spacer. Hold pressure plate down firmly by hand and measure clearance in three places between motor support and pressure plate. Average gap must measure between 4 mm (.153 in.) maximum and 2 mm (.080 in.) minimum. If the gap exceeds the maximum limit, there are too many brake discs in stack-up or the discs are distorted. If the gap is less than the minimum, there are too few discs in stack-up or the discs are worn out. When stack height is correct, remove pressure plate and continue assembly.



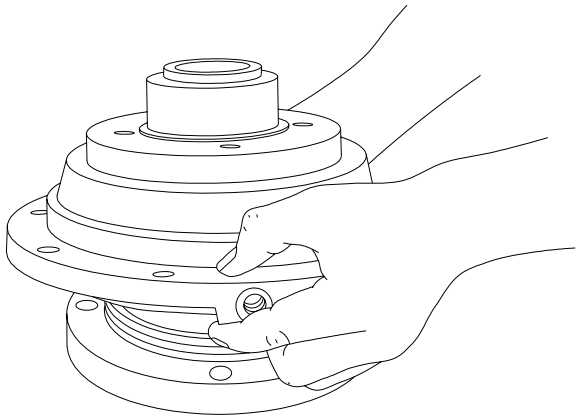
5. Lubricate the brake piston seal (2) and motor support sealing surface with petroleum jelly or hydraulic oil. Install new piston seal to motor support, **seal lip down**.



6. Install brake springs into brake cylinder



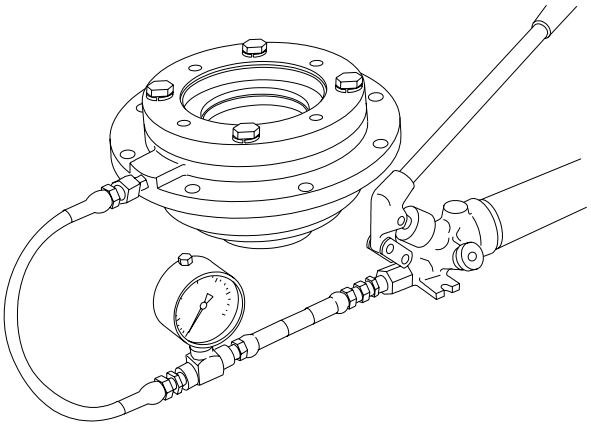
7. Install pressure plate into brake cylinder followed by the piston back-up ring. The close-fitting piston back-up ring may be depressed slightly to one side to lodge the back-up ring in the brake cylinder bore and temporarily hold the pressure plate and springs in place while you lower the brake cylinder over the motor support.



8. Apply light oil or petroleum jelly to the entire sealing surface of the brake cylinder and to the piston seal. Install the brake cylinder over the motor support being careful to avoid damaging the piston seal or motor support o-ring. (A press may be necessary to avoid cocking the brake cylinder during installation.)

9. Install motor support capscrews and evenly tighten to recommended torque.

BRAKE CYLINDER PRESSURE TEST



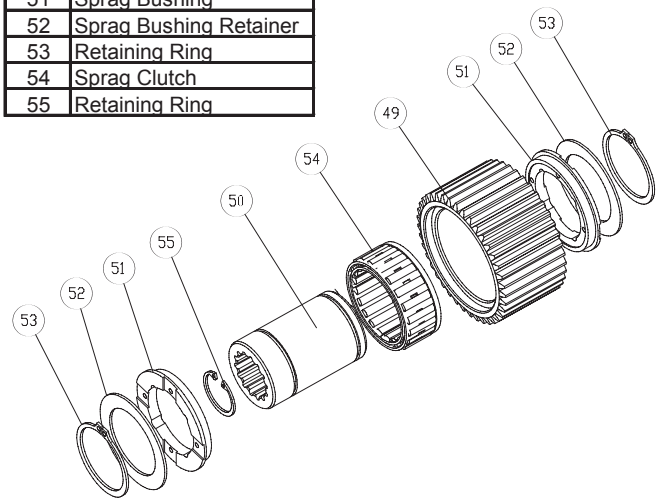
1. Install the –4 ORB ($^{7}/_{16}$ - 20 in.) fitting into the brake release port. Connect a hand pump with accurate 0-13,800 kPa (0-2000 psi) gauge and shut-off valve to this fitting. Apply 6,900 kPa (1000 psi) to the brake. Close shut-off valve and let stand for five (5) minutes. If there is any loss of pressure in five (5) minutes, the brake cylinder should be disassembled for inspection of the sealing surfaces and brake piston.

2. WHILE PRESSURE IS APPLIED AND THE BRAKE RELEASED, install the brake clutch assembly in the brake pack, short end of the inner race toward motor. Turn the clutch back and forth as you align the outer race splines with the brake disc splines.

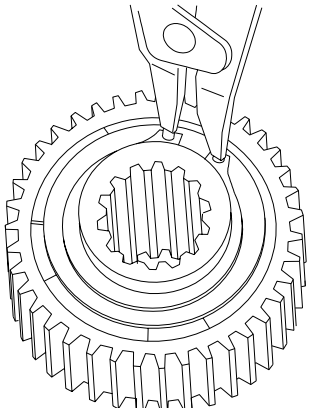
3. Release the pressure on the brake cylinder then remove the brake clutch assembly. The brake cylinder assembly is now complete and ready to be installed in the winch.

BRAKE CLUTCH SERVICE

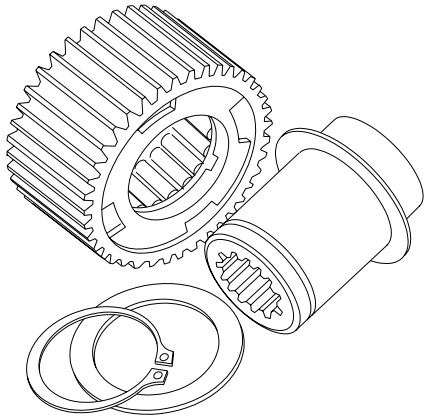
ITEM	DESCRIPTION
49	Outer Race
50	Inner Race
51	Sprag Bushing
52	Sprag Bushing Retainer
53	Retaining Ring
54	Sprag Clutch
55	Retaining Ring



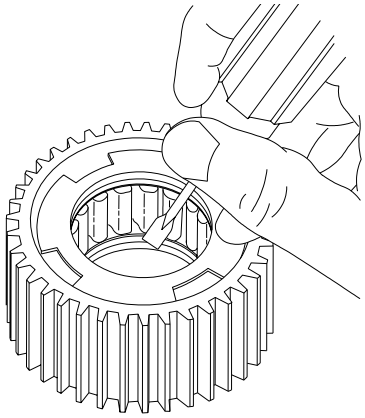
DISASSEMBLY



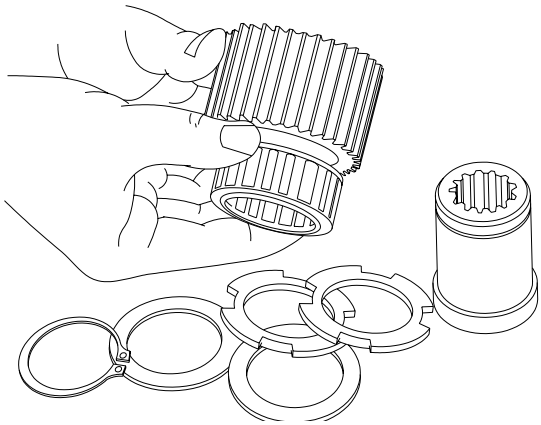
1. Remove the retaining ring (53) and sprag bushing retainer (52) from one end only.



2. Pull the inner race (50) 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 (51) 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.

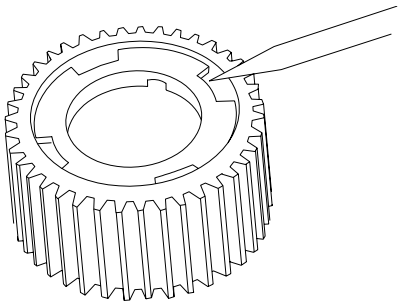


4. Next, slide the sprag clutch (54) out, inspect the sprag clutch closely for abnormal wear, cracks, pitting or corrosion. Check small clips for breakage or bright spots; the signs of excessive wear. Unless the outer race or remaining sprag bushing is damaged or shows excessive wear, there is no need for further disassembly. If disassembly is necessary, remove the bushing according to the procedure covered in Step No. 3. All brake clutch assembly parts should be thoroughly cleaned and inspected before assembly.

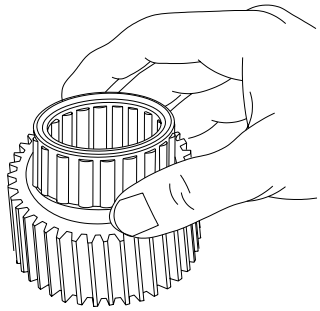
⚠ WARNING ⚠

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.

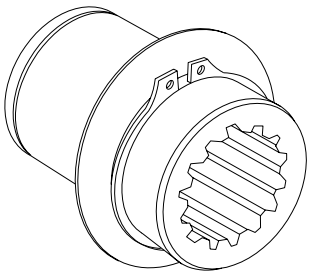
ASSEMBLY



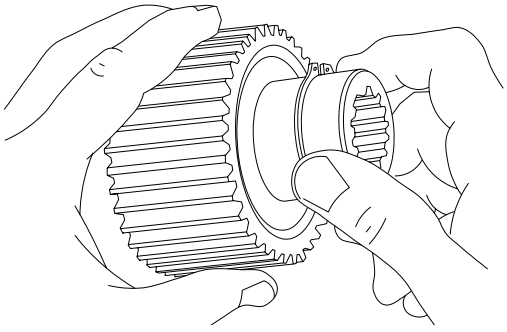
1. Press a sprag bushing (51) into the outer race, using a mechanical or hydraulic press. A flat plate of approximately the same diameter as the bushing flange outside diameter should be placed between the press and bushing during assembly to protect the bushing. Be certain the bushing flange is against the shoulder in the outer race.



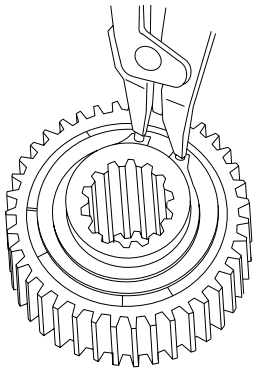
2. Turn the assembly over and install the sprag clutch (54) in the bore of the outer race. You will have to rotate the clutch as you push it into the race.
3. Press the remaining bushing into the race. Again, make sure the bushing is against the shoulder.



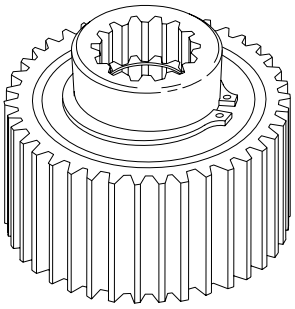
4. Next, install a sprag bushing retainer, then a snap ring on the inner race (50,52,53). Be sure the snap ring is seated in the snap ring groove.



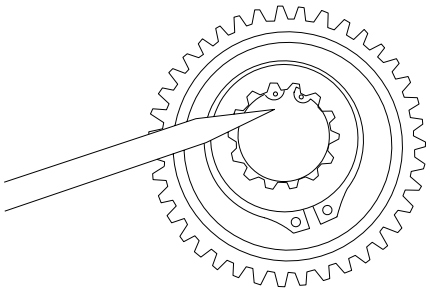
5. Slide the inner race through the bushings and sprag clutch (the race will have to be rotated in the freewheeling direction to start it through the sprag clutch). If the inner race will not go through the bushings, the bushings have probably been damaged and should be replaced.



6. Turn the assembly over with the retaining ring down. Install the second retainer and retaining ring (52,53). Make certain the snap ring is seated in the groove properly. Check the brake clutch for proper freewheel direction. Hold the outer race in your left hand with the motor side (short shoulder side) of the inner race facing you. The inner race should turn in the clockwise direction; opposite cable drum rotation to haul-in wire rope.



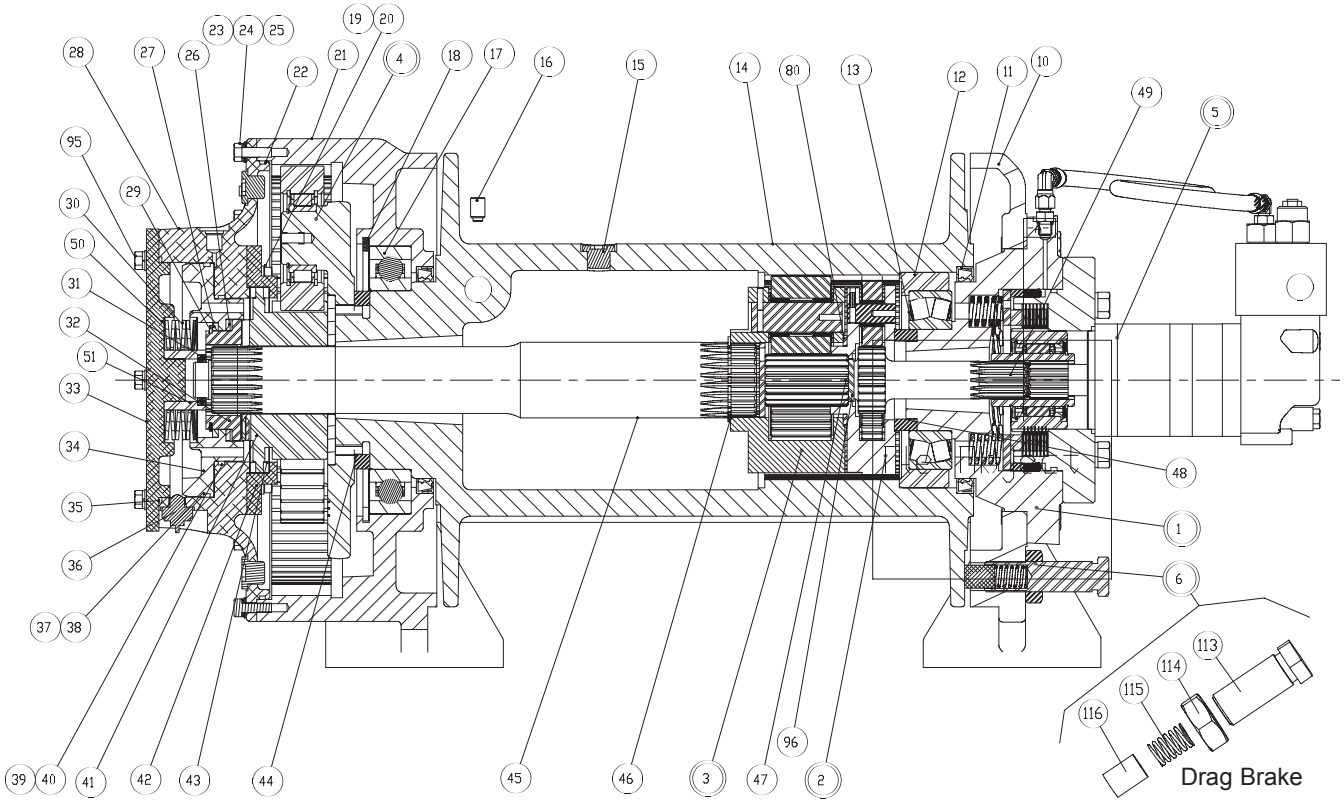
7. This is a completed brake clutch assembly.



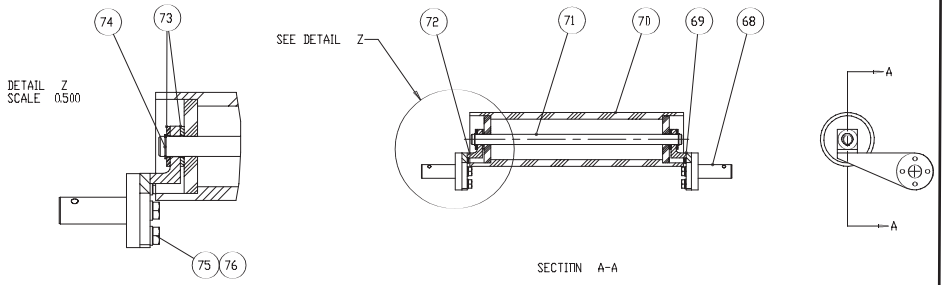
⚠ WARNING ⚠

Be certain the retaining ring (55) 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.

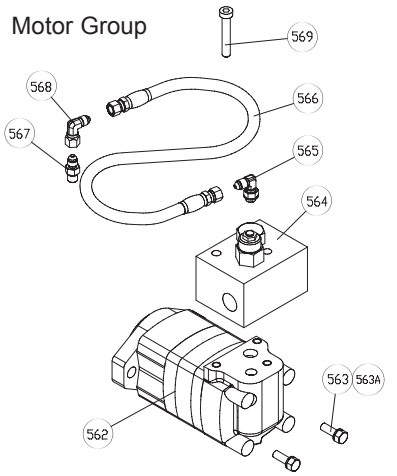
H35R

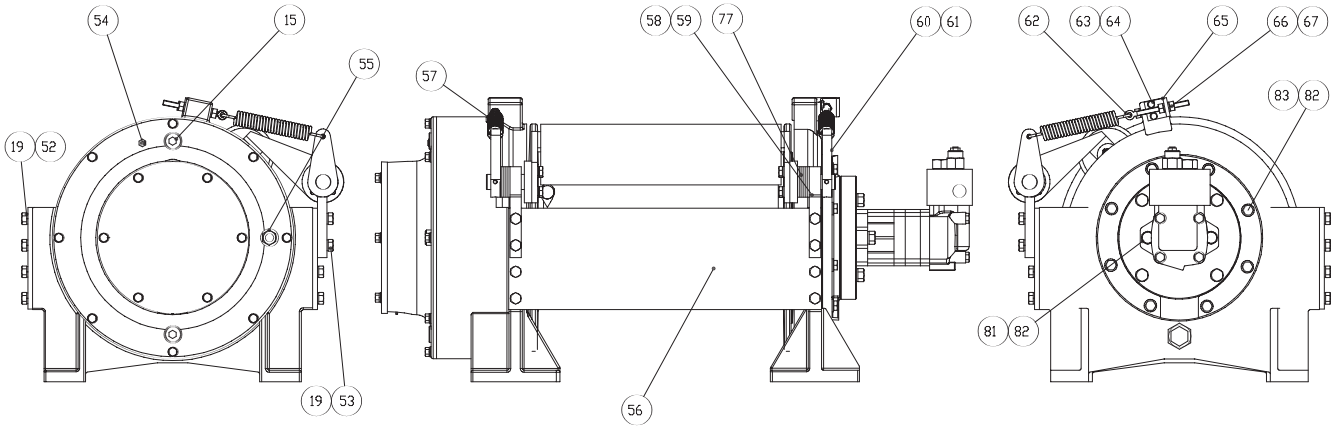


Tension Roller



Motor Group





H35R PARTS KEY

Item	Description
1	Brake Cylinder Assembly
2	Primary Planet Carrier Assembly
3	Secondary Planet Carrier Assembly
4	Output Planet Carrier Assembly
5	Hydraulic Motor Group
6	Freespool Drag Group
10	End Bracket, Motor End
11	Seal
12	Drum Closure
13	Bearing
14	Cable Drum
15	Drain Plug
16	Set Screw, Cable Anchor 12X1.75X25
17	Bearing
18	Snap Ring
19	Lock Washer, 10 mm
20	Capscrew, Hex Hd. 10X1.5X25-10.9
21	Final Drive Housing
22	O-ring
23	Capscrew, Hex Hd. 8X1.25X30-12.9 Z
24	Lock Washer, 8 mm
25	Washer, 10 mm Narrow
26	Thrust Spacer
27	Thrust Spacer
28	Freespool Housing
29	Retaining Ring
30	Belleville Spring
31	Bearing
32	Freespool Clutch
33	Spring Cover
34	Freespool Piston
35	O-ring
36	Freespool Indicator Switch
37	O-ring
38	Back-up Ring
39	O-ring
40	Back-up Ring
41	Freespool Clutch/Output Sun Gear
42	Clutch Retainer Plate
43	Thrust Washer
44	Spacer
45	Output Shaft
46	Snap Ring
47	Secondary Planet Sun Gear
48	Spacer
49	Primary Sun Gear
50	Shim
51	Spring Guide Tube
52	Capscrew, Hex Hd. 10X1.56X30-12.9 Z
53	Capscrew, Hex Hd. 10X1.5X40-112.9 Z
54	Vent Relief Valve

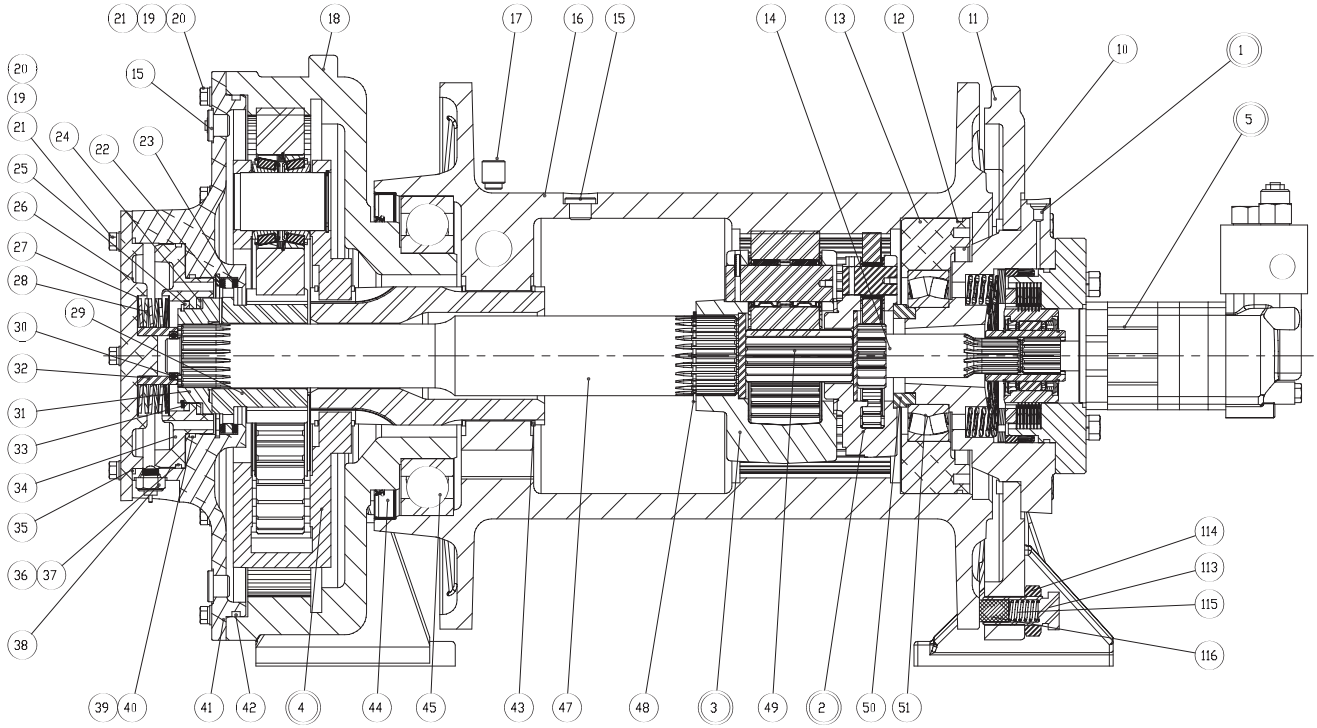
Item	Description
55	Sight Gauge
56	Tie Plate
57	Cable Roller Tension Spring
58	Tension Roller Support Bracket
59	Bushing
60	Lever Arm
61	Roll Pin
62	Rod End Eye-bolt
63	Lock Washer, 6 mm
64	Capscrew, 6X!X20-10.9 Z
65	Bracket
66	Lock Washer, 5/16 in.
67	Nut, 5/16-18
77	Washer, 1 in. Z
80	Thrust Ring, Secondary Planet Carrier
81	Capscrew, Hex Hd.
82	Lockwasher, 12 mm
83	Capscrew, Hex. Hd.12X1.75X40-10.9 Z
96	Spacer

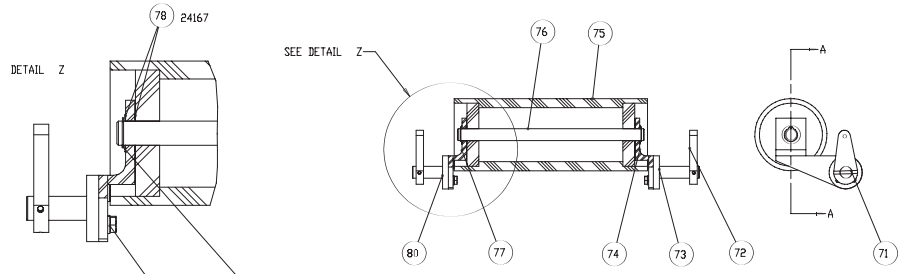
DRAG BRAKE	
113	Spring Housing
114	Jam Nut
115	Spring
116	Drag Brake Disc

TENSION ROLLER	
68	Roller Arm Shaft
69	Roller Arm
70	Roller
71	Roller Shaft
72	Roller Arm
73	Washer, 3/4 in.
74	Snap Ring
75	Lock Washer, 10 mm
76	Capscrew, 10X1.5X20-12.9 Z

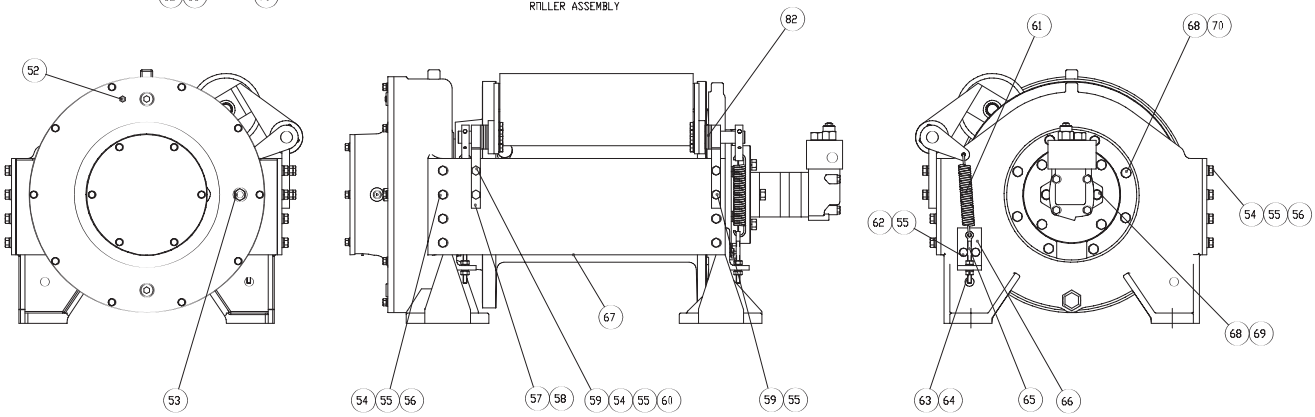
MOTOR GROUP	
562	Hydraulic Motor
563	Capscrew (12X1.75X40 -10.9 Z)
563A	Lockwasher (M12)
564	Brake Valve Assembly
565	Swivel Nut 90 Deg. Elbow
566	Hose Assembly
567	Adapter
568	Elbow Fitting
569	Capscrew

H55R





SECTION A-A
ROLLER ASSEMBLY



H55R PARTS KEY

Item	Description
1	Brake Cylinder Assembly
2	Primary Planet Carrier Assembly
3	Secondary Planet Carrier
4	Output Planet Carrier Assembly
5	Hydraulic Motor Sub-assembly
6	Drag Brake
10	Drum Seal
11	End Bracket, Motor End
12	O-ring
13	Drum Closure
14	Primary Sun Gear
15	Drain Plug
16	Cable Drum
17	Set Screw, Cable Clamp 25X2.5X25
18	Final Drive Housing
19	Lockwasher, 8mm
20	Capscrew, Hex Hd.8X1.25X30-12.9 Z
21	Washer, 10 mm narrow
22	Retaining Ring
23	Thrust Washer
24	Thrust Spacer
25	Thrust Spacer
26	Spring Cover
27	Shim
28	Belleville Spring
29	Output Sun Gear-Freespool Clutch
30	Bearing
31	Freespool Clutch
32	Spring Guide Tube
33	Retaining Ring
34	Freespool piston
35	O-ring
36	O-ring
37	Back-up Ring
38	Freespool Indicator Switch
39	O-ring
40	Back-up Ring
41	Freespool Housing
42	O-ring
43	Retaining Ring
44	Seal
45	Bearing

Item	Description
47	Output Shaft
48	Retaining Ring
49	Secondary Planet Sun Gear
50	Spacer
51	Bearing
52	Vent Relief Valve
53	Sight Gauge
54	Washer, 10 mm Hardened Z
55	Lockwasher, 10 mm
56	Capscrew, Hex Hd. 10X1.5X30-12.9 Z
57	Tension Roller Bracket
58	Bushing
59	Capscrew,Hex Hd.10X1.5X40-12.9 Z
60	Nut, Hex 10X1.5 Z
61	Tension Spring
62	Capscrew, Hex Hd.10X1.5X20-12.9 Z
63	Lockwasher, 5/16
64	Nut, Hex 5/16-18
65	Rod End
66	Bracket
67	Tie Plate
68	Lockwasher, 12 mm
69	Capscrew, Hex Hd. 12X1.75X40-10.9 Z
70	Capscrew, Hex Hd.12X1.75X40-12.9 Z
71	Roll Pin
72	Lever Arm
73	Shaft
74	Arm, Tension Roller
75	Roller
76	Shaft
77	Arm, Tension Roller
78	Thrust Bearing
79	Snap Ring
80	Shaft
82	Washer, 1 in.

113	Spring Housing
114	Jam Nut
115	Spring
116	Drag brake Disc

FREESPOOL HOUSING SERVICE

(Refer to Winch Illustrations on Pages 32 through 35)

Disassembly

1. Place the freespool housing on a clean, flat surface with the output sun gear facing down. Evenly loosen the capscrews that secure the freespool clutch spring cover to the freespool housing. Remove the cover and the Belleville springs.

2. Remove the retaining ring that secures the freespool piston to the sliding freespool clutch. Remove the freespool piston and clutch from the freespool housing.

3. **H35R only**
   Turn the freespool housing over with the output sun gear facing up. Remove the six capscrews (20) that secure the output sun gear retainer (42) to the freespool housing. Remove the retainer (42), sun gear (41) and thrust washers (43) from the freespool housing.

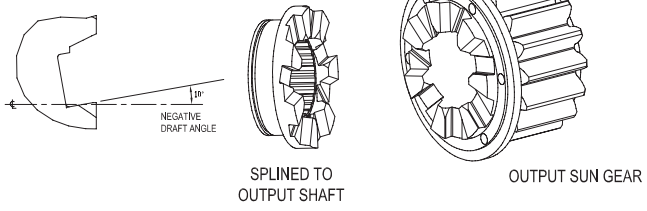
   H55R only
   Remove the retaining ring (22) that secures the output sun gear to the freespool housing. Remove the output sun gear (29) and thrust washers (23) from the housing.

Clean and Inspect

Thoroughly clean the freespool housing and components. Make certain the freespool release pressure port is clean. Wash all parts in safety solvent and blow dry with compressed air. Examine the condition of the freespool clutch lugs. They should have a slight negative draft angle the helps to keep the clutch engaged under load. If the clutch lugs are chipped or worn, they **must** be replaced.

⚠ WARNING ⚠

Attempting to engage the freespool clutch while the drum is turning or attempting to disengage the clutch with tension or a load on the winch cable will result in damaged freespool clutch lugs. Damaged freespool clutch lugs may not hold the load securely. Operating the winch with damaged clutch lugs may result in a dropped winch load, property damage, injury or death.



Assembly

H55R only *(Refer to Illustration on Page 34)*

1. Suspend the freespool housing above a clean, flat work surface using wooden blocks approximately 14 cm (5 in.) placed under the gear side of the freespool housing.

2. Lubricate two thrust washers (23) with light assembly grease and install one washer into the freespool housing against the shoulder. Install the output sun gear (29) into the housing against the thrust washer. Install the remaining thrust washer on top of the sun gear.

3. Install retaining ring (22) to secure the thrust washers and sun gear in place.

4. Install thrust washer (24) onto freespool clutch (31). Install freespool piston (34) onto freespool clutch against thrust washer (24).

5. Install thrust washer (25) onto freespool clutch against the freespool piston. Secure the piston and thrust washers to the freespool piston with retaining ring (33).

6. Install o-ring (39) and back-up ring (40) into freespool housing. Install o-ring (36) and back-up ring (37) into freespool piston. Lubricate the freespool cylinder with light assembly grease and install the freespool piston/clutch sub-assembly into the freespool housing.

7. Install a new freespool indicator light switch (38) as required.

8. Place the freespool housing cover (26) on a clean flat work surface with the spring side facing up. Install one shim (27) onto cover, over spring guide tube (32). Install Bellevillle springs (28) as follows: Place the first spring over the spring guide tube (32) with the concave side toward the cover. Place the next spring over the guide tube with the concave side facing up. The next spring goes over the tube with the concave side facing down. Place the remaining springs over the guide tube as shown until all six springs are installed. Install one shim (27) on top of the last spring. Install a new o-ring (35) over the pilot of the cover.

9. Turn the freespool housing/piston sub-assembly over and install it onto the cover/spring sub-assembly. Install 8 mm capscrews, lock washers and flat washers (19, 20 & 21). Evenly tighten the capscrews to 40 N-m (30 lb.-ft.) torque.

H35R only (*Refer to Illustration on Page 32)*

1. Place the freespool housing on a clean, flat work surface with the gear side facing up. Lubricate two thrust washers (43) with light assembly grease and place one washer on the freespool housing centered over the sun gear bore.

2. Install the output sun gear (41) into the freespool housing centering the shoulder of the gear onto the thrust washer. Install the remaining thrust washer (43) over the sun gear.

3. Install the sun gear retainer (43) over the sun gear and secure with capscrews and lock washers (19 & 20). Tighten the capscrews to 40 N-m (30 lb.-ft.) torque.

4. Place the freespool clutch (32) on a clean flat work surface with the lugs facing down. Lubricate thrust washer (26) with light assembly grease and install on freespool clutch. Install freespool piston onto clutch.

5. Lubricate thrust washer (27) and install onto clutch above the freespool piston and secure in place with retaining ring (29).

6. Install freespool piston o-ring and back-up ring (39, 40) into the freespool housing making certain back-up ring is installed with the cupped side toward the o-ring and next to the gear side of the housing. Install the freespool piston o-ring and backup ring (37,38) into the freespool piston. Make certain the cupped side of the back-up ring is toward the o-ring and next to the cover side of the piston.

7. Place the freespool spring cover (33) on a clean flat work surface with the spring side facing up. Install one shim (50) onto cover, over spring guide tube (32). Install Belleville springs (31) as follows: Place the first spring over the spring guide tube (51) with the concave side facing the cover. Place the next spring over the guide tube with the concave side facing up. The next spring goes over the guide tube with the concave side facing down. Place the remaining springs over the guide tube as shown until all six springs are installed. Install one shim (50) on top of the last spring. Install a new o-ring (35) over the pilot of the cover.

8. Turn the freespool housing/piston sub-assembly over and install it onto the cover/spring sub-assembly. Install 8 mm capscrews, lock washers and flat washers (23, 24 & 25). Evenly tighten the capscrews to 40 N-m (30 lb.-ft.) torque.

WINCH ASSEMBLY

H35R Only *(refer to Illustration on Page 32)*

1. Place the final drive housing on a clean flat work surface with the ring gear facing up. Press a new drum bearing (17) into the housing if replacement was necessary. Install retaining ring (18) into the housing to secure the bearing in place.

2. Turn the final drive housing over. Apply non-hardening sealant to the outside diameter of the drum seal (11) then press the new seal into the final drive housing with the garter spring toward the bearing.

3. Stand the cable drum on end with the motor end down. Apply light assembly grease to the seal and bearing surfaces of the cable drum. Install the final drive housing onto the cable drum being careful to avoid damaging the drum seal.

4. Install spacer (44) into the final drive housing over the drum drive splines. Install the output planet carrier assembly (4) into the final drive housing. Slowly rotate the planet carrier to align the planet gears with the ring gear and the planet carrier with the drum drive splines.

5. Install a new o-ring (22) into the groove on the outside diameter of the freespool housing. Lubricate the o-ring with light assembly grease and install the freespool housing into the final drive housing. Be careful to align the fill port at the 12 o'clock position and the level plug at the three o'clock position.

6. Install the capscrews, lock washers and flat washers (23, 24 & 25) and tighten to 40 N-m (30 lb.-ft.) torque.

7. Turn the drum and freefall housing over with the motor end of the drum facing up. Secure the drum in this position to prevent it from falling over and causing injury.

8. Install retaining ring (46) on the output shaft (45) then install the output shaft into the drum. Carefully align the small splines and bearing journal with the splines of the freespool clutch and spring guide tube bearing (31).

9. Install the secondary planet carrier assembly (3) into the drum. Rotate the planet carrier as you align the planet gears with the ring gear and the output shaft. Lubricate and install the thrust washer (80) on top of the planet carrier.

10. Install the secondary sun gear (47) into the secondary planet carrier. Rotate the sun gear to align the gear teeth. Install the thrust spacer (96) on top of the output sun gear.

11. Install the primary planet carrier assembly (2) into the drum. Rotate the planet carrier to align the planet gears with the ring gear and the secondary sun gear. Install the primary sun gear (49) into the primary planet carrier. Rotate the sun gear to align the gear teeth.

12. Install a new bearing (13) into the drum closure (12) if replacement is necessary. Lubricate the machined, load-bearing surface inside the drum barrel and install the drum closure/bearing sub-assembly into the drum barrel with the bearing facing the motor end of the drum.

13. Install the spacer (48) into the machined counterbore on top of the primary planet carrier.

14. Place the motor end-bracket of the winch (10) onto the cable drum with the mounting feet aligned with the final drive housing assembly.

15. Install the two tie-plates (56) onto the winch end-brackets. Leave the fasteners finger tight at this time. Install the cable tension roller and brackets to the tie-plates. Leave the bracket fasteners finger tight at this time.

16. Install the brake cylinder assembly (1) into the motor end bracket and cable drum. Locate the brake release port at the top, 12 o'clock position. Tighten the M12 capscrews to 138 N-m (102 lb.-ft.) torque.

17. Evenly tighten all the tie-plate and tension roller bracket capscrews at this time. Tighten the M10 capscrews to 79 N-m (59 lb.-ft.) torque.

18. Hold the cable tension roller against the cable drum barrel and adjust the spring eye-bolts (62) to take the free-play out of the levers then tighten the adjusters to pull the springs an additional 5 mm (.20 in.). Final tension adjustment must be made after the cable is installed on the drum.

19. Lay the winch assembly down to the normal, horizontal position and fill to the level sight glass with recommended gear oil.

H55R Only (*refer to Illustration on Page 34)*

1. Place the cable drum (16) on a clean flat work surface with the motor end down. Press a new drum bearing (45) into the drum if replacement was necessary. Apply non-hardening sealant to the outside diameter of a new drum seal (44) then press it into the drum with the garter spring toward the bearing.
2. Place the output planet carrier assembly (4) on wooden blocks approximately 50 mm (2 in.) thick with the drum drive coupling facing up. Install the final drive housing (18) over the output planet carrier. Rotate the housing slightly to align the planet gears with the ring gear.
3. Apply light assembly grease to the seal and bearing surfaces of the final drive housing. Lift the drum up. Turn it over with the motor side up and install the drum onto the final drive housing. Rotate the drum slightly to align the drum drive coupling with the splines in the drum. Secure the drum to the drum drive coupling with retaining ring (43).
4. Turn the drum/final drive housing sub-assembly over with the final drive facing up. Install a new o-ring (42) into groove in the pilot on the freespool housing assembly. Lubricate the o-ring with light assembly grease and install the freespool housing into the final drive housing. You will need to rotate the housing slightly to align the out put sun gear teeth with the planet gears.
5. Install capscrews, lock washers and flat washers (19, 20 & 21) and evenly tighten to 40 N-m (30 lb.-ft.) torque.
6. Stand the winch up on the freespool end and secure in this position to prevent it from falling and causing injury. Install retaining ring (43) onto drum drive coupling.
7. Install retaining ring (48) onto output shaft (47) then install the output shaft into the drum and engage the splines of the output shaft with the freespool clutch. Install the secondary planet carrier assembly (3) into the drum. Slowly rotate the planet carrier to align the planet gear teeth with the ring gear and the carrier with the output shaft splines.
8. Install the thrust washer onto the secondary planet carrier. Install the secondary planet sun gear (49) into the secondary planet gears.
9. Install the primary planet carrier assembly (2) into the cable drum. Rotate the carrier slowly to align the planet gears with the ring gear and the planet carrier with the secondary sun gear.
10. Install spacer (50) onto the primary planet carrier. Press a new drum bearing (51) into the drum closure (13) if replacement was necessary. Apply non-hardening sealant to the outside surface of the drum seal (10) and press the seal into the drum closure (13) with the garter spring side of the seal toward the bearing.
11. Install a new o-ring (12) into the groove on the outside diameter of the drum closure. Lubricate the sealing surface or the cable drum and the drum closure with light assembly grease and install the drum closure into the drum.
12. Place the winch motor end bracket (11) on top of the cable drum and align the mounting feet with the final drive housing. Install the two tie-plates (67) onto the winch end-brackets using capscrews, lock washers and flat washers (54, 55 & 56). Leave the fasteners finger tight at this time. Install the cable tension roller and brackets to the tie-plates. Leave the bracket fasteners finger tight at this time.
13. Lubricate the sealing surfaces of the brake cylinder assembly (1) with light assembly grease and install the brake cylinder into the end bracket and the drum bearing. Place the brake release port at the 12 o'clock position. Secure the brake cylinder to the end bracket with capscrews and lock washers (68 & 70). Tighten the capscrews to 138 N-m (102 lb.-ft.) torque.
14. Evenly tighten the M10 capscrews (56 & 59) in the tie plates and tension roller brackets to 79 N-m (59 lb.-ft.) torque.
15. Install a new o-ring onto the motor pilot and install the motor assembly (5) onto the motor adapter/brake cylinder (1) using capscrews and lock washers (68 & 69). Tighten the capscrews to 138 N-m (102 lb.-ft.) torque. Install the brake release hose from the counterbalance valve block on the motor to the brake release port on the brake cylinder.
16. Hold the cable tension roller against the cable drum barrel and adjust the spring eye-bolts to take the free-play out of the levers then tighten the adjusters to pull the springs an additional 5 mm (.20 in.). Final tension adjustment must be made after the cable is installed on the drum.
17. Lay the winch assembly down to the normal, horizontal position and fill to the level sight glass with recommended gear oil.