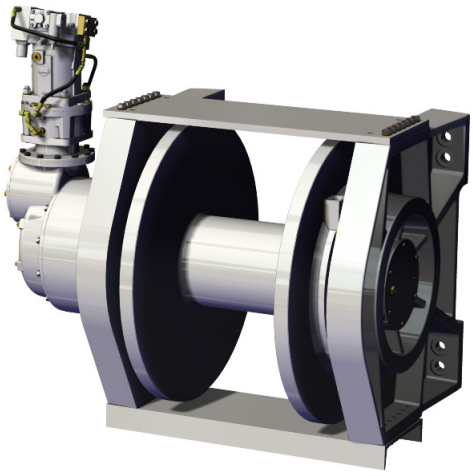
CARCO®
A PACCAR COMPANY

HCH100

SERVICE MANUAL

HCH100 Base Winch



WRITE Winch SERIAL NUMBER BELOW

First 2 numbers indicate year manufactured

For serial number location see page 3

Visit our Web site at www.paccarwinch.com for the most comprehensive collection of winch, hoist, and drive information on the Internet. Most publications and specification sheets are available for downloading.

LIT2737
October 2017
Printed in USA

BRADEN
CARCO
Gearmatic

PACCAR WINCH
800 East Dallas Street
Broken Arrow, OK 74012
www.paccarwinch.com

Table of Contents

FOREWORD

Read this entire publication and retain it for future reference.

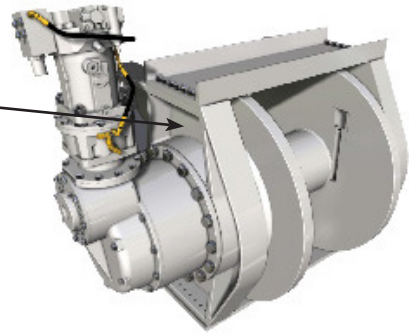
This parts list has been prepared to provide service information for the CARCO Model HCH100 tractor winch D8R and D8T tractors. Some illustrations in this manual may show details or attachments different from your unit. Some components may have been removed for illustrative purposes.

For inquiries regarding your CARCO winch or this publication, please contact the CARCO Service Department at 918-251-8511, Monday through Friday, 8:00 a.m. to 4:30 p.m. (CST).

MODEL IDENTIFICATION

Model numbers and serial numbers are located on the top of the motor-side end plate.

Always refer to the model number and serial number when requesting information or service parts.



EXPLANATION OF MODEL NUMBER

HCH	100	A	–	207	V	084
POWER DRUM	MAX RATING	MODEL SERIES		GEAR RATIO	MOTOR TYPE	MOTOR SIZE

HCH	High-capacity hydraulic winch
100	Maximum rated first-layer line pull capacity, pounds (x 1,000)
A	Model series related to design changes
207	Total gear-reduction ratio (207:1)
V	Variable displacement piston motor
084	Hydraulic motor displacement, cubic inches/revolution

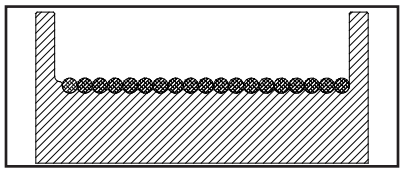
TO ORDER:

1. List model and serial numbers of the winch.
2. Refer to exploded view, select the component(s) needed, and note item number.
3. Find item number on parts list. Show part number, description, and quantity required on your order.
4. Refer to Parts List and show price for each component or assembly.

GLOSSARY

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

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



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

Static, Mechanical, or Load-holding Brake — A multidisc, spring applied, hydraulically released brake that works together with the sprag clutch to hold a suspended load. This brake is not designed to stop a load being lowered, but holds the load in place when the winch is not being operated.

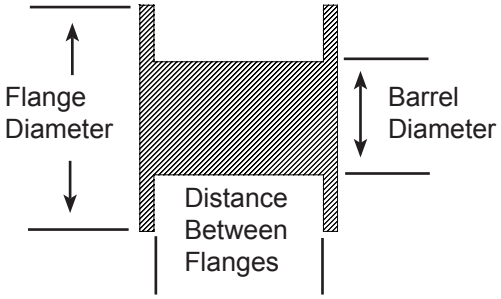
First Layer Line Pull Rating — The maximum rated line pull (in pounds or kilograms) on the first layer of cable. The maximum rating for any particular winch is based on maintaining an acceptable structural design factor and service life. Certain combinations of drum, gear ratio, motor and hydraulic pressure,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

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

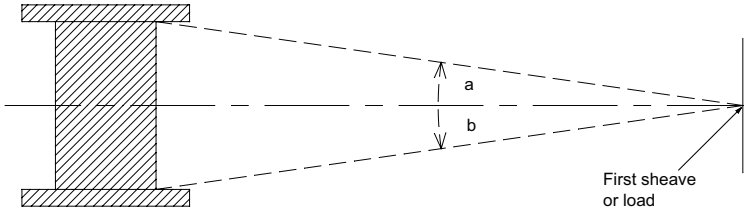
D/d Ratio — The ratio of cable drum barrel diameter (D) to wire rope diameter (d). Current ANSI standards require a minimum of 17:1.

EXAMPLES:
If you know the cable diameter you want to use, multiply it by 17 to get the MINIMUM cable drum barrel diameter (such as 1/2-inch wire rope X 17 = 8.5 inches — this is the minimum winch barrel diameter).
If you know the barrel diameter, divide it by 17 to get the MAXIMUM wire rope diameter.
(such as 10-inch barrel diameter / 17 = 0.588, or 9/16-inch — this is the maximum wire rope diameter)

Cable Drum Dimensions —



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



First sheave or load should be centered between the drum flanges, so that angle A and angle B are equal.

Angles A and B should be a minimum of 1/2 degree and a maximum of 1-1/2 degrees.

Wrap — A single coil of wire rope wound on a drum.
Layer — All wraps of wire rope on the same level between drum flanges.
Freeboard — The amount of drum flange that is exposed radially past the last layer of wire rope. Minimum freeboard varies with the regulatory organization. ASME B30.5 requires 1/2-inch minimum freeboard.

GENERAL SAFETY RECOMMENDATIONS

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

⚠ WARNING ⚠

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

1. Read all warning tag information and become familiar with all controls BEFORE operating the winch.
2. NEVER attempt to clean, oil or perform any maintenance on the winch with the engine running, unless instructed to do so in this manual.
3. Before starting the tractor, be certain all controls move freely and are placed in the "Brake-On" (neutral) position.
4. NEVER operate winch controls unless you are properly seated at the operators station on the tractor and you are sure personnel are clear of the work area.
5. NEVER attempt to handle winch cable when the hook end is not free. Keep all parts of body and clothing clear of cable rollers, cable entry area of fairleads and winch drum.
6. Ground personnel should stay in view of tractor operator and clear of winch drum. Do not allow ground personnel near winch line under tension. A safe distance of at least 1 ½ times the working length of the cable should be maintained. NEVER allow anyone to stand under a suspended load.
7. Avoid sudden "shock" loads or attempting to "jerk" a load free. This type of operation may cause heavy loads in excess of rated capacity, which may result in failure of cable and/or winch.
8. Use only GENUINE CARCO parts. Do not use parts from other winch manufacturers on your CARCO winch. Do not use CARCO parts on winches from other manufacturers.
9. Use correct size ferrule for cable and pocket in winch drum. Never use knots to secure or attach cable. The cable anchor or ferrule pocket in the cable drum is designed to provide a self release in the event a back-sliding load must be released from the tractor in an emergency situation. The cable anchor or ferrule alone will NOT support rated line pull. Therefore, a minimum of five complete wraps of cable must be maintained on the winch drum.

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

Recommended Operating Practices

1. Leather gloves should be used when handling winch cable.
2. Operate the winch to match line speeds to job conditions.
3. Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by everyone.
4. Inspect winch cable, rigging, winch and tractor at the beginning of each work shift. Defects should be corrected immediately.
5. Position tractor for straightest line of pull to reduce wear on winch cable and ensure even spooling.
6. When winding winch cable on the winch drum, never attempt to maintain tension by allowing winch cable to slip through hands. Always use "hand-over-hand" technique, being careful to keep hands and clothing away from winch drum and fairlead rollers.
7. Be sure of tractor ground stability before winching in a load.
8. Store unused chokers, slings and rigging in a neat and orderly fashion to prevent damage to equipment or injury to personnel.
9. Do not operate the winch under loads that exceed the maximum rated bare drum line pull. If excessive loads are encountered, use a multi-part line and sheave blocks. Any attempt to exceed the capacity of one winch (such as coupling 2 or more tractors together) is extremely hazardous.
10. The factory approved adaptions for CARCO winches are designed and intended for use on specific models of crawler tractors. Changing winches between tractors is not possible in some cases because of differences in tractor models. Some changes cannot be approved by CARCO because of safety limitations. Call a CARCO dealer or the CARCO factory prior to attempting winch modifications or before mounting on a different tractor.
11. CARCO H Series winches are powered by the tractor hydraulic system. Discharge all retained hydraulic system pressure before removing any hydraulic lines or fittings. Personal injury may result from sudden release of oil pressure.
12. To discharge the winch control system pressure, stop the engine and cycle the winch control lever(s) into all positions five times. Refer to the tractor manufacturers operators or service manual for additional information.
13. On machines having hydraulically, mechanically and/or cable controlled equipment, be certain the equipment is either lowered to the ground or blocked securely before servicing, adjusting and/or repairing the winch. Always apply tractor parking brakes and lower equipment before dismounting the tractor.
14. The winches described in this manual are neither designed nor intended for use or application to

equipment used in the lifting or moving of persons.

15. Install guarding to prevent personnel from getting any part of their body or clothing caught at a point where the cable is wrapped onto the drum or drawn through fairlead guide rollers.
16. Keep equipment in good operating condition. Perform scheduled servicing and adjustments listed in the “Preventive Maintenance” section of this manual. Use recommended lubricants.
17. An equipment warm-up procedure is recommended for all start-ups and essential at ambient temperatures below +40°F (5°C). Refer to “Warm-Up Procedure” listed in the “Preventive Maintenance” section of this manual.

Safety Informational callouts used in this manual include the following:

⚠ WARNING ⚠

WARNING – This emblem warns against hazards and unsafe practices which COULD result in severe personal injury or death if proper procedures are not followed.

⚠ CAUTION ⚠

CAUTION – This emblem warns against potential or unsafe practices which COULD result in personal injury and product or property damage if proper procedures are not followed.

ADDITIONAL REFERENCE PUBLICATION

For cross-section diagrams and complete list of components, please refer to **LIT2735**: Parts List for CARCO HCH100 winches.

THEORY OF OPERATION

DESCRIPTION OF WINCH

The winch is made up of the following sub-assemblies and parts:

1. Hydraulic motor and brake valve
2. Brake clutch assembly
3. Multiple disc parking brake
4. External drive assembly
5. Motor end drum and drive support
6. Drum and drum support assembly
7. Tie plates

DUAL BRAKE SYSTEM

DESCRIPTION

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

The dynamic brake system has two operating components:

1. Brake valve assembly
2. Hydraulic motor

The brake valve is basically a counterbalance valve. It contains a check valve to allow free flow of oil to the motor in the haul-in direction and a pilot operated, spring loaded 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 placed in the pay-out position, the spool valve remains closed until sufficient pilot pressure is applied to the end of the spool to shift it against spring pressure and open a passage. After the spool valve cracks open, the pilot pressure becomes flow dependent and modulates the spool valve opening which controls the lowering speed.

The static brake system has three operating components:

1. Spring applied, hydraulically released multiple friction disc brake pack
2. Brake clutch assembly
3. Hydraulic piston and cylinder

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

The friction brake is a load holding brake only and has nothing to do with dynamic braking or rate of descent of a load. The inner race of the brake clutch is a splined coupling between the motor and the primary sun gear. The outer race is splined to the friction discs in the brake pack, while steel separator plates are splined to the stationary housing. The brake clutch allows this shaft to turn freely in the haul-in direction, and locks up to force the brake discs to turn with the shaft in the pay-out direction.

Spring pressure prevents the brake discs from turning until the hydraulic cylinder and piston are pressurized releasing the brake.

OPERATION

When hauling-in cable, the motor shaft and hoist drive gears turn freely as the sprag cams lay over between the inner and outer races of the brake clutch.

The multiple disc friction brake remains fully engaged and the winch is not affected by any braking action.

When the operation is stopped, the load tries to turn the winch drum, gear train and primary sun gear in the reverse direction. This reversed input to the inner race of the brake clutch causes the sprag cams to instantly roll upward and lock the shaft to the fully engaged friction brake.

When the winch is powered in the pay-out direction, the motor cannot rotate until sufficient pilot pressure is present to release the brake and open the brake valve. The friction brake will completely release at a pressure lower than that required to open the brake valve. The extent to which the brake valve opens determines the amount of oil that can flow through the motor, which is directly related to the drum speed of the winch. Increasing the flow of oil to the winch motor causes the pilot pressure to rise which increases the opening in the brake valve, allowing more oil to flow through the motor and increasing the drum speed. Decreasing this oil flow causes the pilot pressure to drop, reducing the opening in the brake valve which slows the motor and winch speed.

The friction brake receives very little, if any, wear in the pay-out or lowering operation. All of the heat generated by lowering and stopping a load is absorbed by the hydraulic oil where it can be readily dissipated.

When the control valve is shifted to neutral, pilot pressure drops closing the brake valve spool, stopping the motor and the load. The friction brake then engages and holds the load after the brake valve has closed.

THEORY OF OPERATION

WINCH OPERATION

The input section of the drive assembly is bolted to the motor end support and cannot rotate. The drive housing is the output member of the gear set and is bolted to the winch drum. The motor shaft is directly coupled to the primary sun gear through the inner race of the brake clutch. The motor turns the primary sun gear which drives three successive planetary gear sets, turning the drive housing and the winch drum.

In the haul-in direction, hydraulic oil flows through a large check valve in the brake valve and turns the motor in the free rotating direction of the brake clutch, driving the gear train and winch drum. The friction brake remains fully engaged.

In the pay-out direction, oil flow through the motor is initially blocked by a spool in the brake valve. Oil pressure supplied to the motor through the control valve is piloted to the friction brake and the brake valve spool. The friction brake is released at a lower pressure than that required to shift the brake valve spool. When pressure is sufficient to shift the brake valve spool, oil is allowed to flow through the motor, rotating the winch gear train and drum.

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

⚠ WARNING ⚠

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

⚠ CAUTION ⚠

The hydraulic motor and gear ratio is configured to match the hydraulic system of a specific tractor. It may not be possible to mount the winch onto a different tractor model. Installation onto a tractor with a higher flow hydraulic system could result in overspeed damage to the motor and winch gear train.

WINCH INSTALLATION

High-quality hydraulic oil is essential for satisfactory performance and long life of the hydraulic system components.

Oil having 150 to 330 SUS viscosity at 100°F (38°C) and viscosity index of 100 or greater will give good results under normal temperature conditions. The use of an oil having a high viscosity index will minimize cold start trouble and reduce the length of warm-up periods. A high viscosity index will minimize changes in viscosity with corresponding changes in temperature.

Maximum cold weather start-up viscosity should not exceed 5,000 SUS with a pour point at least 20°F (11°C) lower than the minimum ambient temperature.

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

In general terms:
For continuous operation at ambient temperatures between 50°F (10°C) and 110°F (43°C) use SAE 20W; for continuous operation between 10°F (-12°C) and 90°F (32°C) use SAE 10W; for applications colder than 10°F (-12°C), contact the CARCO Service Department. The use of multiviscosity oils is generally not recommended.

For winch gear oil, refer to lubricant specifications in the Preventive Maintenance and Specifications section of this manual.

WINCH REMOVAL AND INSTALLATION

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

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

WINCH REMOVAL

⚠ WARNING ⚠

Before servicing, make sure any trapped oil pressure in the tractor hydraulic system has been relieved. Personal injury may result from a sudden release of oil pressure. Relieve trapped pressure by cycling the blade and winch control levers several times after the tractor engine has been turned off. Relieve any trapped oil pressure in the hydraulic reservoir by opening the fill cap. Be sure to activate the winch or tractor hydraulic system lock-out toggle switch(s) or as directed in the tractor service manual.

⚠ WARNING ⚠

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

Place the tractor and winch in a level position and drain the oil from the winch into a suitable container. Install the drain plug securely after oil has drained completely. Note: Due to the configuration of the cable drum, a small amount of oil will remain within the drum cavity.

Remove the winch motor hoses from the motor and brake valve. Remove the motor shift hose from the motor "X" port. Remove the motor drain hose from the motor. Remove the drum clutch hose from the elbow on the RH side of the winch case.

⚠ WARNING ⚠

Winch weighs approximately 6,750 lbs. (3,062 kg) without oil, cable and tractor adapters. Make certain the lifting equipment has adequate capacity. Attempting to lift the winch with inadequate equipment may result in personal injury or damage to the winch or property.

Support the winch with a suitable hoist or platform and remove the nuts and bolts securing the winch to the tractor adapters, and move the winch away from the tractor.

WINCH INSTALLATION

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

Align the winch mounting holes with the adapter mounting holes, and install and tighten all fasteners to the recommended torque.

⚠ CAUTION ⚠

Failure to fill the motor case with hydraulic oil before operating the winch may result in serious damage to the motor.

Fill the hydraulic motor case, through the motor case drain port, with tractor hydraulic oil. Attach the winch control hoses to the motor, as defined in the Parts and Installation Manual.

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

Start the tractor engine and operate the engine at low rpm. Alternately place the winch control in the Reel-In, then the Reel-Out position until the winch motor hydraulic circuit is filled with oil and the winch operates smoothly. Check the tractor hydraulic oil reservoir and fill to the proper level as required.

WIRE ROPE INSTALLATION

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

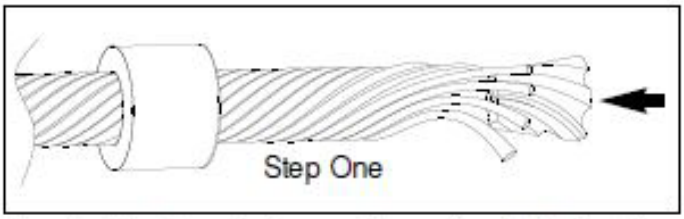
Using larger cable will not always increase strength as the larger cable may be more prone to bending fatigue failure than smaller wire rope. Consult your wire rope supplier for his recommendations for the wire rope and other rigging which best suits your application.

⚠ WARNING ⚠

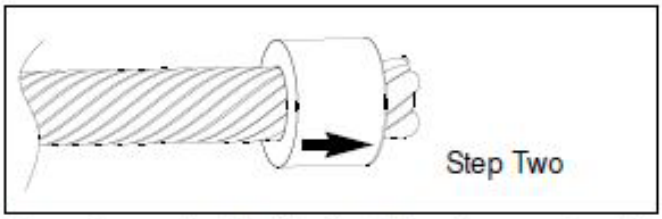
Winch cable anchors (ferrules and ferrule pocket) are **NOT** designed to hold rated loads. Winch loads applied directly to the cable anchor may cause the cable to pull free and result in the sudden loss of load control and cause property damage, injury or death. A minimum of 5 wraps of cable must be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

INSTALLATION OF SPIRAL FERRULES

Re-useable, field installed spiral ferrules are available from your CARCO or wire rope dealer. These ferrules are for use with six strand, IWRC (Independent Wire Rope Core) type wire rope. Refer to Specifications on page 9.



Insert cable through the small opening of the ferrule. Spread strands and insert spiral wedges between strands and core. Lay strands in individual grooves in spiral wedges.



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

Initially, gear oil should be changed after the first 100 hours of operation. At intervals of 1,000 hours or every six months, grease drum support at grease fitting using an NLGI #2 lithium-complex base extreme-pressure grease that meets or exceeds NLGI GC or GC/LP specifications.

1. **Vent Plug**
The vent plug is located near the top of the main gear housing, slightly to the rear of the brake motor. It is important to keep vent clean and obstructed. When changing gear oil, remove vent plug, clean in solvent, and reinstall. Do not paint over vent or replace with a solid plug.

2. **Hydraulic System**
Replace the original filter element after the first 50 hours of operation, then every 500 operating hours or 3 months according to equipment manufacturer's recommendations.

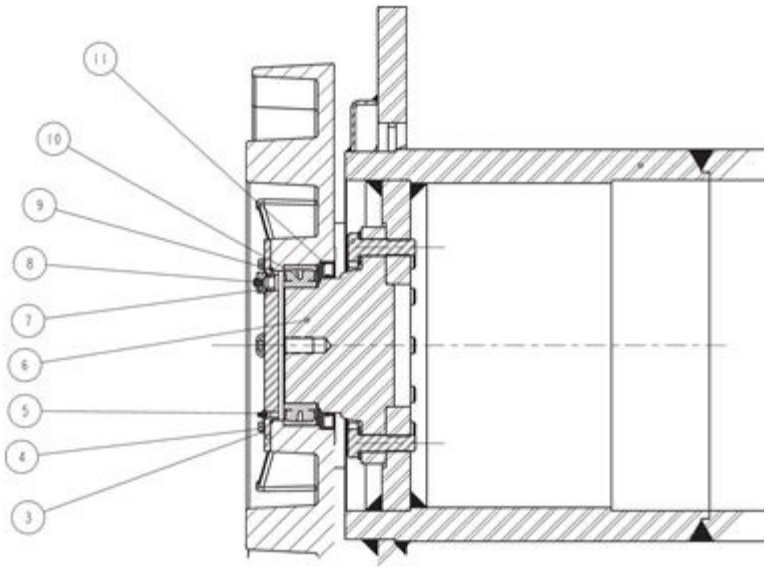
3. **Wire Rope**
Inspect entire length of wire rope according to wire rope manufacturer's recommendations.

4. **Mounting Bolts**
Tighten all winch base mounting bolts to the recommended torque after the first 100 hours of operation, then every 1,000 hours or six months, whichever occurs first.

5. **Warm-up Procedures**
A warm-up procedure is recommended at each start-up and is essential at ambient temperatures below 40 degrees F. (4 degrees C.).
The prime mover should be run at its lowest recommended RPM with the hydraulic winch control valve in neutral, allowing sufficient time to warm up the system. Operate winch several times at low speeds (forward and reverse) to prime lines with warm hydraulic oil and to circulate gear lubricant through planetary gear sets.

6. **Recommended Planetary Gear Oil**
Field experience, supported by engineering tests, indicates the use of proper planetary gear oil is essential to reliable and safe operation of the brake, obtaining long gear train life. Refer to Recommended Gear Oil section of this manual For simplicity, CARCO has listed one readily available product in each temperature range which has been tested and found to meet our specifications. This is not to say that other lubricant brands would not perform equally as well.

7. **Grease Drum Support**
Remove plug (Item no. 7).
Pump grease into grease zerk (Item 5) until new grease comes out, then reinstall plug.
Grease drum support at grease fitting using an NLGI #2 lithium-complex base extreme-pressure grease that meets or exceeds NLGI GC or GC/LP specifications.



Grease Bearing Support

PREVENTIVE MAINTENANCE

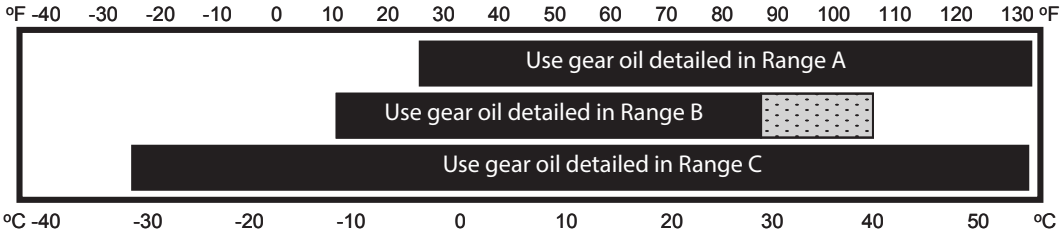
For simplicity, CARCO has listed one readily available product in each temperature range which has been tested and found to meet our specifications. This is not to say that other lubricant brands would not perform equally as well.

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.

HCH100 planetary winches are factory filled with Meropa 150 or equivalent. The gear oil should be changed whenever the ambient temperature changes significantly and an oil from a different temperature range would be more appropriate.

RECOMMENDED GEAR OIL

PREVAILING AMBIENT TEMPERATURE



SHADED TEMPERATURE RANGE IN THE CHART ABOVE NOT RECOMMENDED FOR SEVERE APPLICATIONS SUCH AS SUSTAINED FAST DUTY CYCLES OR FREQUENT WINCHING.

Winches are factory filled with Mobilgear 600 XP 150 or equivalent. Consult your oil supplier for other equivalent oils if required.

	Mobil	Shell	Chevron	Texaco
Range A	Mobilgear 600 XP 220	Omala S2 G 220	Gear Compounds EP 220	Meropa 220
Range B	Mobilgear 600 XP 150	Omala S2 G 150	Gear Compounds EP 150	Meropa 150
Range C	Mobilgear SHC 150	Omala S4 GX 150		

⚠ 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.

⚠ 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 extreme-pressure (EP) and antifriction 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. Our tests indicate 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.

Oil Capacity

Gearbox Capacity
Units with single motor input: 42 pints (19.9 liters)

Winch drums contain the following quantity of gear oil as a rust preventive:
01 drum: 8 pints (3.8 liters)
02 drum: 12 pints (5.7 liters)
21, 22, 23 drum: 14 pints (6.6 liters)

Torque Values
Drum bearing supports to drum: 600 lbs-ft (814 N-m) - Apply Loctite 242 to clean dry threads
Gearbox to sideplate: 600 lbs-ft (814 N-m) - Clean dry threads

Drum Dimensions
(barrel diameter X flange diameter X drum length)
01: 24 X 41.5 X 36.13 inches (610 X 1054 X 918 mm)

NOTE: Oil capacities are approximate. With winch drum in horizontal position, oil level should be at centerline of gearbox.

CARCO **recommends the following Inspection, Testing and Preventive Maintenance procedures. For additional details, refer to Braden publication PB-308.**

Inspection, testing and preventive maintenance requirements are divided into several categories: Pre-use, Quarterly, Semiannual and Annual as outlined below. The Installation, Maintenance and Service Manual for each model provides specific instructions for maintenance and service.

Some inspection intervals make reference to winches used in "Severe Duty Applications". Severe Duty Applications are where the winch is operated more than 12 hours per day and/or for extended periods of time at or near the rated capacity of the winch.

Anytime that the winch exhibits erratic operation and/or unusual noise(s), the winch should be taken out of service until it is inspected and serviced by a qualified technician.

REGULAR INSPECTION, TESTING & PREVENTIVE MAINTENANCE - Must include, but not be limited to the following:

PRE-USE INSPECTION (each shift the winch is used): Will be performed prior to placing machine into service and then as necessary during the day for extended operation.

1. Check for external oil leaks and repair as necessary. **This is extremely important due to the accelerated wear that can be caused by insufficient lubricating oil in the winch.** Lubricant level must be maintained. Use only the recommended type of lubricant; see Lubricant section for details. On models without a sight glass, check oil level monthly.

3. Check hydraulic plumbing for damage, such as chafed or deteriorated hoses, and repair as necessary.

4. Visually inspect for loose or missing bolts, pins, keepers or cotter pins and replace or tighten as necessary.

QUARTERLY INSPECTION (every 3 months) or monthly in Severe Duty Applications or prior to putting the machine into service if it has not been used for 3 months or more. Documentation of the inspections must be kept with the machine for a minimum of two (2) years from the date of the inspection.

Perform the PRE-USE INSPECTION plus the following:

1. Check the lubricant level in the winch and maintain it at required level. Use only recommended type of lubricant; see Lubricant section for details.

3. Inspect for corrosion of fasteners, mounting base, drum, etc. and repair/replace as necessary.

SEMI-ANNUAL INSPECTION (every 6 months), or quarterly in Severe Duty Applications. Documentation of the inspections must be kept with the machine for a minimum of two (2) years from the date of the inspection (see next page).

Perform the **PRE-USE INSPECTION** and **QUARTERLY INSPECTION** plus the following:

Take a sample of the lubricating oil from winch gearbox, following the oil sampling procedure on page 4 of publication PB-308, and analyze it for wear metals content, the correct viscosity, signs of overheating, water and other contaminates. If the oil sample contains an unusual amount of metallic particles, the hoist should be taken out of service and undergo a tear down inspection. The oil sample must be taken prior to changing the lubricating oil. The Semi-annual oil analysis can be omitted if machine has been used less than 250 hours since the previous oil sample.

ANNUAL INSPECTION, Testing & Preventive Maintenance or Semi-annually in Severe Duty Applications. Documentation of the inspections must be kept with the machine for a minimum of two (2) years from the date of the inspection (see next page). The Annual Inspection must include, but not be limited to the following:

1. Perform the **PRE-USE INSPECTION, QUARTERLY** and **SEMIANNUAL INSPECTIONS**, plus the following:

2. Change lubricating oil in winch gearbox after oil sample is taken. Refer to Recommended Gear Oil, earlier in this section. Failure to follow these recommendations may result in brake failure.

PREVENTIVE MAINTENANCE

NOTE:If the oil sampling/analysis has not been performed as required, refer to the tear down inspection section below.

The user of CARCO products is responsible for winch inspection, testing and maintenance noted above with frequency dependent upon the severity of application duty cycle and the thoroughness of the preventive maintenance program in effect.

Alternate inspection periods may be used if approved in writing by CARCO . Those that are interested in an alternate inspection period should submit a written proposal to CARCO that includes typical duty cycle for the winch along with a detailed description of the preventive maintenance program for these winches.

Inspection Records & Retention

Winch inspection reports as well as records of preventive maintenance, repairs and modifications to hoists should be available and accessible for a minimum of two years. These records should include, but not be limited to, winch model and serial number, name and employer of repair/inspection technician, date and description of preventive maintenance, functional test reports and repairs.

To provide customers with qualified outlets for hoist service and repairs, CARCO has established authorized Service Centers. These Service Centers have factory trained service technicians, up-to-date service information, extensive parts inventories, complete testing facilities, and are audited by CARCO on a regular basis for compliance. CARCO **strongly recommends the use of** CARCO **authorized Service Centers** for maintenance, repair and inspection of CARCO products. Contact the CARCO Product Support Department at 918-251-8511 for the names of current authorized Service Centers.

TEAR DOWN INSPECTION – **Any** winch **that has NOT been subject to regular oil sample analysis should undergo a tear down inspection on an annual (12 month) basis.** Also, if a winch has an unknown history of repair and/or maintenance, it is recommended that the winch undergo a tear down inspection prior to it being placed into service.

A tear down inspection should include the winch being completely disassembled, cleaned and inspected and replacement of all worn, cracked, corroded or distorted parts such as pins, bearings, shafts, gears, brake rotors, brake plates, drum and base. All seals and o-rings should be replaced during a tear down inspection.

Any deficiencies, such as those listed above shall be corrected immediately.

All of the following operations must be performed before the winch is placed back in service:

The rebuilt winch must be line pull tested to the rated load of the winch with a dynamometer or equivalent measuring device. This test load should be the maximum rating for the hoist for the specific application.

The winch must be dynamically tested by rotating the drum several times, in both the hoisting and lowering directions, while under a load of at least 30% of the hoist lifting capacity. Check for smooth operation during this procedure.

The brake should be tested per the brake test procedures on page 5 of Publication PB-308.

⚠ WARNING ⚠

If a winch exhibits any sign of erratic operation or load-control difficulties (such as 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 smoothly Reel-Out the load, or smoothly lower a suspended load.	1. The problem could be a plugged pilot orifice in the brake valve. A plugged orifice may prevent the spool from moving or prevent the spool from moving smoothly, causing jumping or chattering as the load is released.	A. Disassemble the brake valve. Clean and inspect all parts. Make certain the .020 in. (0.5 mm) pilot orifice is not obstructed.
	2. The multi disc static brake may not be releasing as a result of a defective brake cylinder seal. **NOTE:** *If the brake cylinder seal is defective, you may notice oil leaking from the winch vent plug as hydraulic oil fills the gear cavity.*	A. Check the brake cylinder seal as follows: Disconnect the small hose from the brake release port. Connect a hand pump with an accurate gauge and shut-off valve to the –4 fitting in the brake release port. Apply 1000 PSI (6900 kPa) to the brake. Close the shut-off valve and let stand for five (5) minutes. If there is any loss of pressure during the five (5) minutes, the brake housing assembly should be disassembled for inspection of the brake cylinder and piston sealing surfaces and replacement of the seals. Refer to "Brake Housing Assembly Service" for more information.
	3. The multi disc static brake will not release as a result of damaged brake discs.	A. Disassemble the brake housing assembly to inspect the brake discs. Replace the brake discs as required.

TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
B Oil leaking from the vent plug.	1. Brake assembly shaft seal may be defective as a result of high system back pressure, contaminated oil, or mechanical damage.	A. Case drain circuit back pressure must not exceed 40 PSI (2.8 kg/cm²) measured at the case drain port. Inspect the hydraulic system for a restriction. B. Oil analysis may indicate contamination, which could result in a worn motor shaft and seal. Thoroughly flush the entire hydraulic system and install new filters and oil. Install a new motor seal or replace the motor as needed. C. Remove motor and brake assembly. Inspect lip seal on output shaft and replace if needed.
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.	A. The pressure at the lowering port of the motor is also directed to the brake release port. This pressure must drop below 50 PSI (345 kPa) when the controls are returned to neutral, BRAKE-ON. Trace the hydraulic circuit back to the reservoir to locate source of back-pressure.
	2. Friction brake will not hold due to worn or damaged brake discs.	A. Same as A3A.
	3. Brake clutch may be slipping.	A. Improper planetary gear oil may cause the brake clutch to slip. Drain the old gear oil and flush the winch with a mild solvent. Thoroughly drain the cleaning solvent, and refill the winch with the recommended gear oil listed in the "Preventive Maintenance" section, of this manual. B. Overrunning brake clutch may be damaged or worn. Disassemble and inspect as described in "Overrunning Brake Clutch Service".
	4. If winch was field installed, check to see that the proper stack valve section was used (motor spool required).	

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

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

SERVICE PRECAUTIONS

1. Before any part is removed from the winch or drive gearbox, all service instructions should be understood.

2. Work in a clean, dust free area as cleanliness is of utmost importance when servicing hydraulic equipment.

3. Inspect all replacements parts, prior to installation, to detect any damage which might have occurred in shipment.

4. Use only genuine CARCO replacement parts for optimum results. Never reuse expendable parts such as O-rings and oil seals.

5. Inspect all machined surfaces for excessive wear or damage before reassembly operations are begun.

6. Lubricate all O-rings and oil seals with gear oil prior to installation.

7. Lubricate all bearings with an oil soluble grease prior to assembly.

8. Use a sealing compound on the outside surface of oil seals and a light coat of thread sealing compound on pipe threads. Avoid getting sealing compound inside parts or passages which conduct oil.

9. Thoroughly clean all parts in a good grade of safety solvent. Wear protective clothing as required.

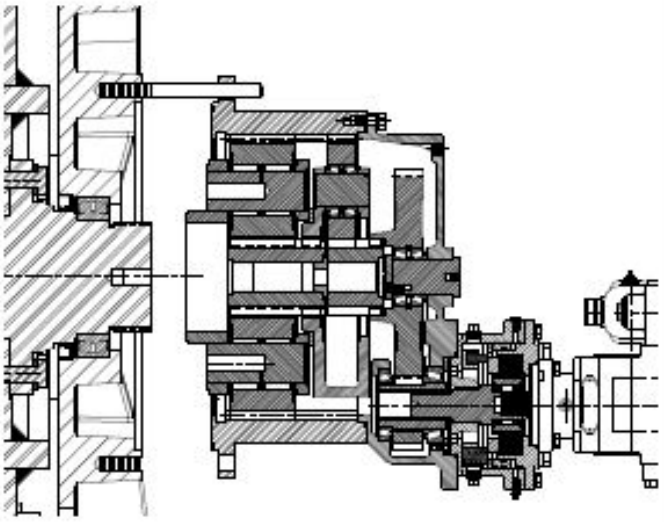
10. Item numbers shown in service procedures are referenced to the exploded-view drawings in this manual.

Gearbox Removal

Remove all cable from the drum. Drain oil from the gearbox using the drain plug(s) on the brake housing(s). Remove one of the 1/2 inch plugs in the gear housing as an air vent. Block the winch up so it is resting on the barrel of the cable drum. Be sure to secure the hoist so it cannot roll. Removing the hydraulic motor at this time will reduce the weight of the gearbox assembly and improve balance, although it is not required.

Three rods should be used to assist in the removal of the gearbox. These can be made from studs, bar stock, or long capscrews, as shown below.

Remove the top three 1" capscrews from the ring gear to sideplate joint. Insert 3 rods into the threaded holes in the sideplate.



⚠ CAUTION ⚠

The gearbox weighs approximately 1,400 pounds (635 kg). Be sure lifting equipment has adequate capacity.

Support the gearbox and remove the remaining capscrews from the ring gear flange. Separate the ring gear from the side plate and slowly slide the gearbox away from the sideplate.

Keep the output carrier firmly against the primary carrier, as shown above, so the thrust washer between the carriers does not fall out of place.

Once the output carrier spline is free from the drum drive shaft, set the gearbox assembly down.

⚠ CAUTION ⚠

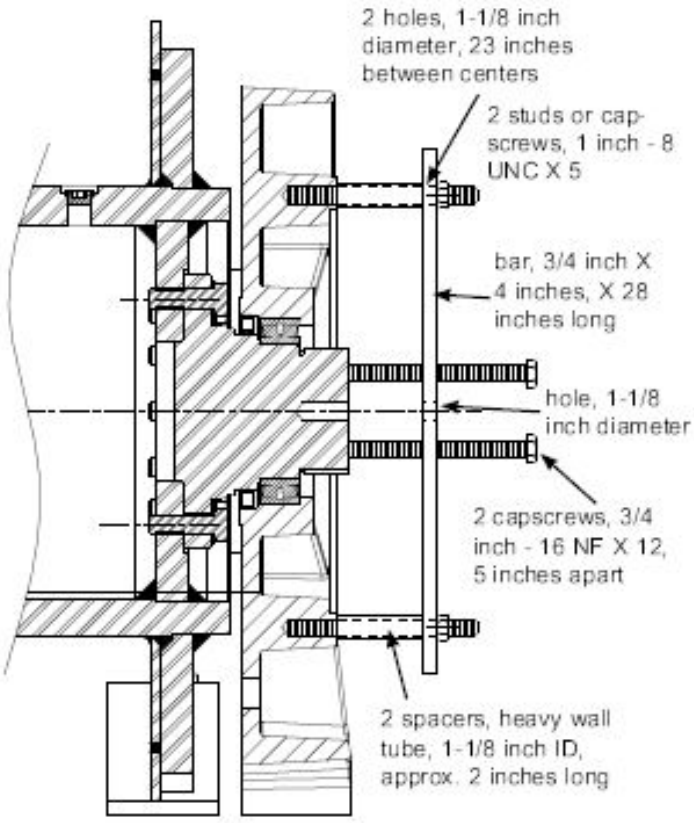
Each side plate weighs approximately 1,000 pounds (454 kg). Be sure lifting equipment has adequate capacity.

Sideplates & Drum

Motor End Disassembly

A simple fixture is required to disassemble and reassemble the sideplates to the drum support shaft and drum drive shaft. The motor end fixture is shown below.

Assemble the fixture as shown below. Slowly and evenly tighten the two 3/4 inch capscrews to disassemble the sideplate from the drum drive shaft. The bearing and seal can now be inspected and serviced as required.

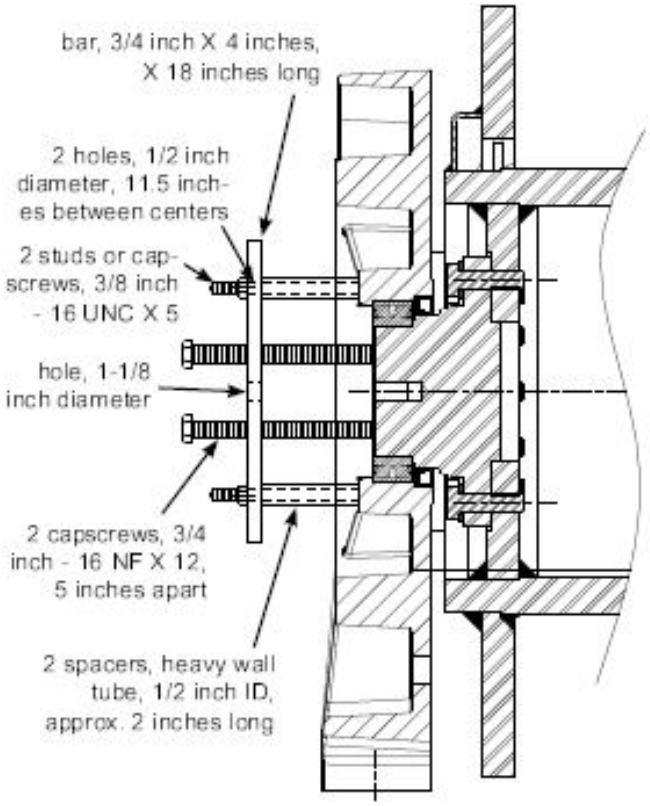


Motor End - Disassembly

Support End Disassembly

The fixture to disassemble and reassemble the sideplate to the drum support shaft is shown below.

Assemble the fixture as shown below. Slowly and evenly tighten the two 3/4 inch capscrews to disassemble the sideplate from the drum support shaft. The bearing and seal can now be inspected and serviced as required.

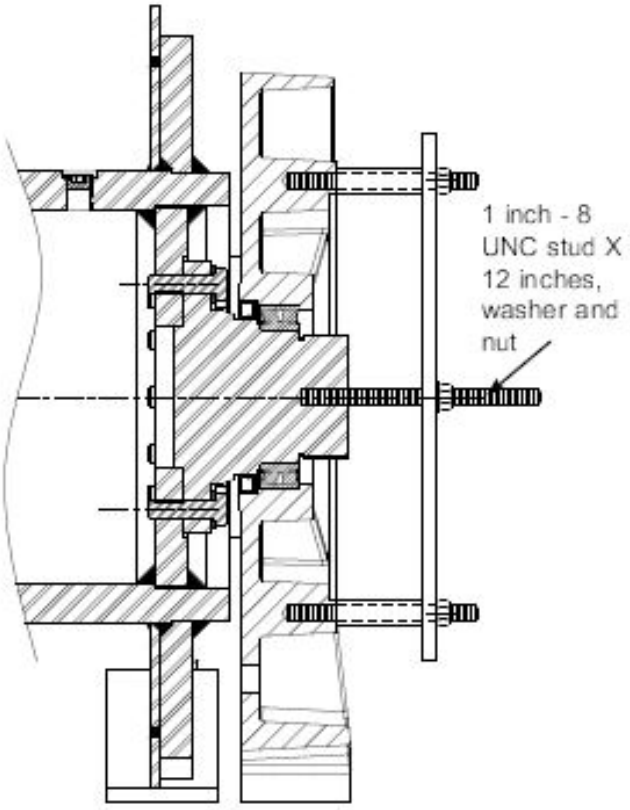


Support End - Disassembly

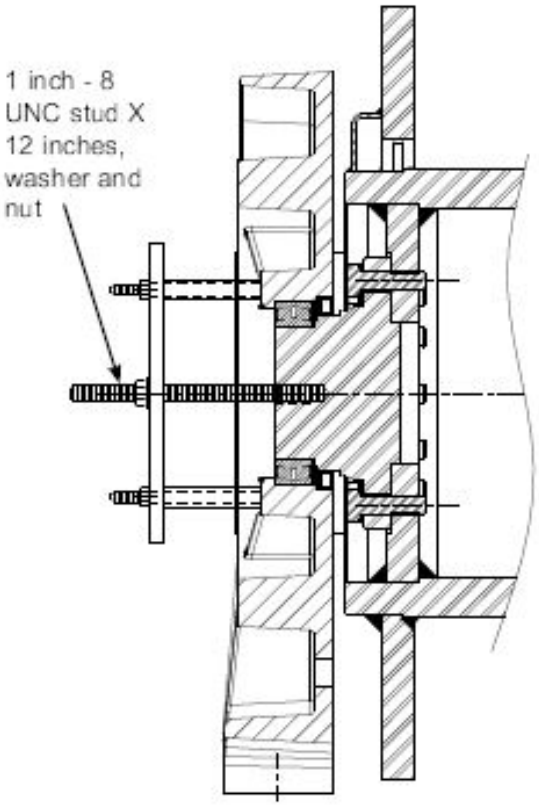
Assembly

Assembly procedure for either end of the winch will be the same. Drawings are shown for both the motor end and support end.

Assemble the fixture as shown in the appropriate drawing. Be sure all bearing and sealing surfaces are clean and dry. Apply a light coat of grease to the lip seal in the sideplate. Install a 1 inch - 8 UNC stud, washer and nut into the drum drive shaft or support shaft, as shown. Slowly tighten the nut to pull the shaft into the end sideplate. Be sure the two pieces are being drawn together in proper alignment to avoid damaging the seal or binding the bearing. When correctly assembled, the bearing will be fully seated against the shoulder on both the shaft and sideplate.

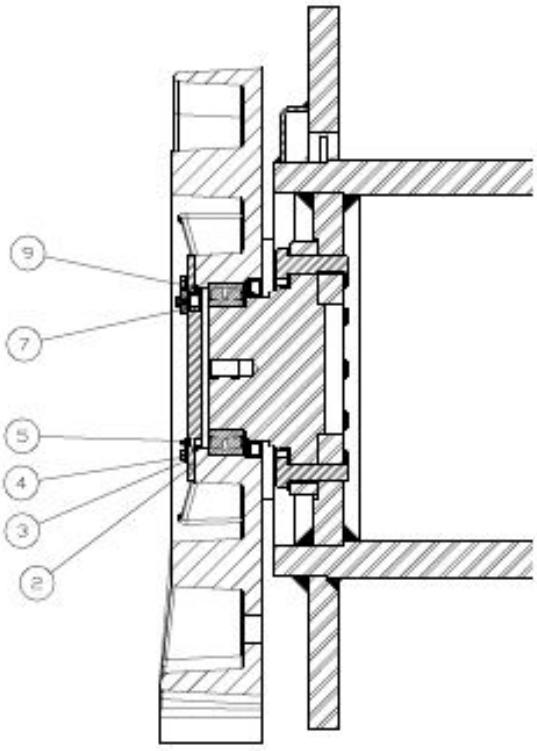


Motor End - Assembly



Support End - Assembly

After assembling the support end, remove the assembly tool. Install an O-Ring (item 9) onto the cover (item 2). Install the cover and O-Ring using capscrews and washers (items 3 & 4). Remove the plug/vent (item 7). Pump grease into fitting (item 5) until it fills the cavity. Replace the plug/vent. Use Ronex MP PT. # LU43720 grease or equivalent.



NOTE: *If either drum bearing support is removed from the drum, thoroughly clean threads in the drum and capscrews. Apply Loctite 242 to all capscrews and torque to 600 lb-ft (814 N-m). Also note that there is gear oil in the drum as a rust preventative. Refer to Preventive Maintenance and Specifications for quantity.*

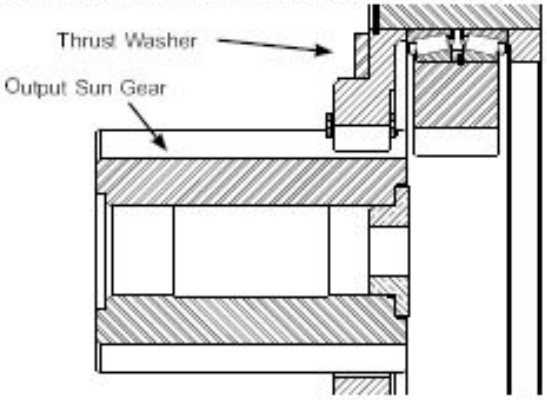
If the gearbox was not disassembled, install the three rods used to remove the gearbox into the top three holes in the side plate. Apply a liberal coating of grease or petroleum jelly to a new O-Ring and install it into the groove on the face of the ring gear.

⚠ CAUTION ⚠

Check the dimension shown above. If the two planet carrier assemblies have moved apart from each other, the thrust washer between them may have moved out of position. If the output planet carrier assembly cannot be moved into the ring gear as shown, the gearbox will have to be partially disassembled to re-position the thrust washer. If the thrust washer is out of position, the ring gear will not seat against the side plate

Slide the gearbox onto the three rods and engage the splines in the output carrier with those on the drum drive shaft. It may be necessary to slightly rotate the drum to align the splines. Install the capscrews and lockwashers fastening the ring gear to the sideplate. Evenly tighten all capscrews until the ring gear is pulled against the sideplate. Remove the three rods and replace with capscrews and lockwashers. Torque all capscrews to 600 lb-ft (814 N-m).

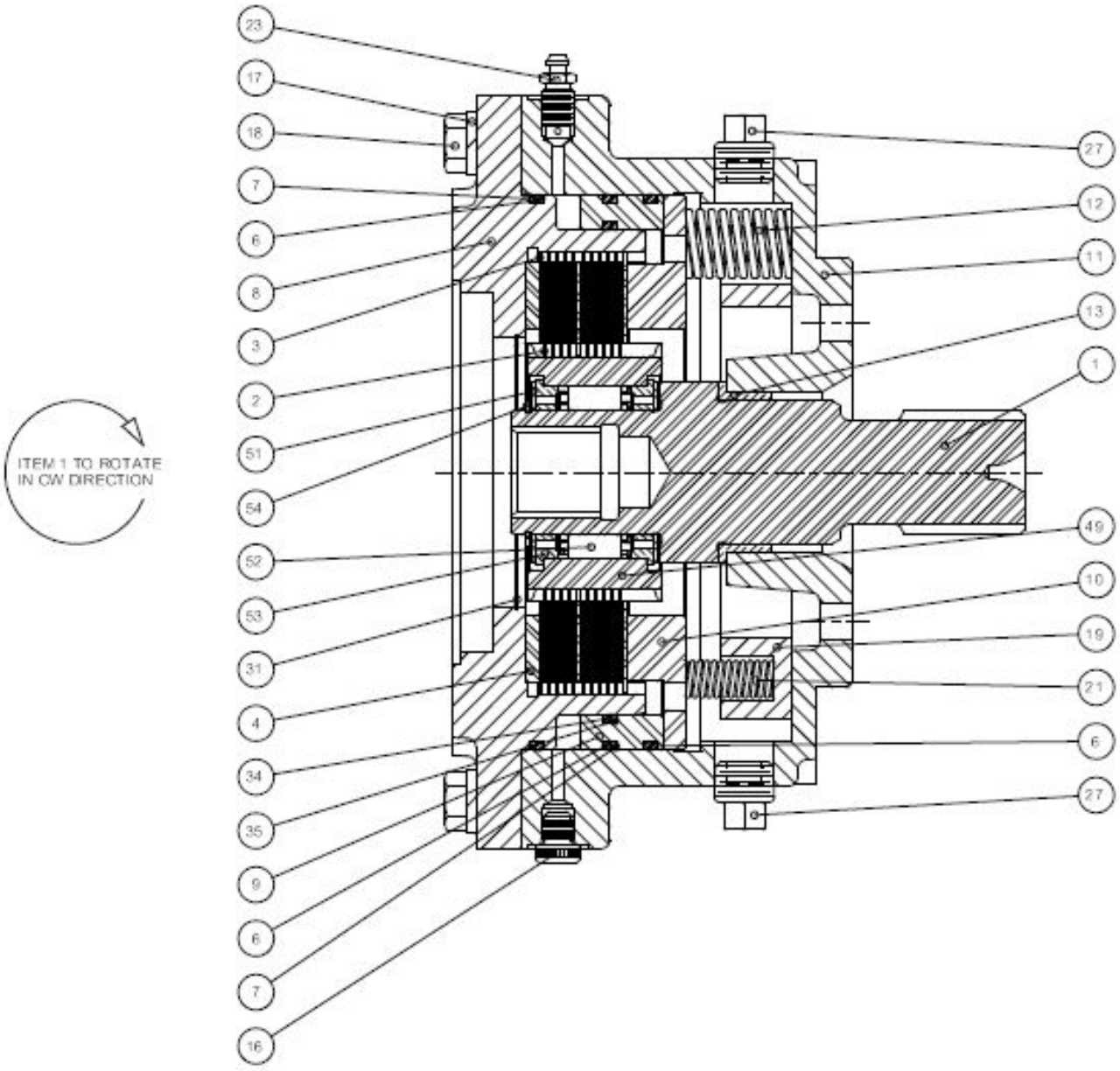
If the gearbox is disassembled, the recommended procedure is to fasten the empty ring gear to the sideplate. Be sure to install a new O-Ring on the face of the ring gear and torque all capscrews to the value shown above. Slide the output planet carrier assembly into the ring gear and engage the splines in the output carrier with those on the drum drive shaft.



Apply a liberal coating of oil soluble grease to the thrust washer and position it on the primary planet carrier as shown. Slide the planet carrier assembly into the ring gear, engaging the output sun gear with the planet gears in the output planet carrier assembly.

Install the primary sun gear into the center of the primary planet carrier assembly. Install a new O-Ring onto the spur gear assembly cover. Install the spur gear assembly onto the ring gear. It may be necessary to rotate the input pinion slightly to align the bull gear with the input sun gear. Be sure the input to the gearbox is properly oriented and install all capscrews and lockwashers fastening the cover to the ring gear. Torque all capscrews to the correct value shown in the recommended fastener torque chart.

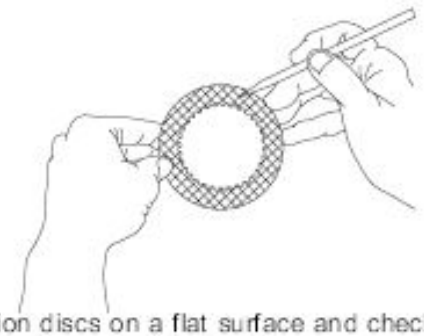
Install the brake/s and motor/s onto the gearbox cover. Connect all hoses and fittings that were previously removed.



DISASSEMBLY

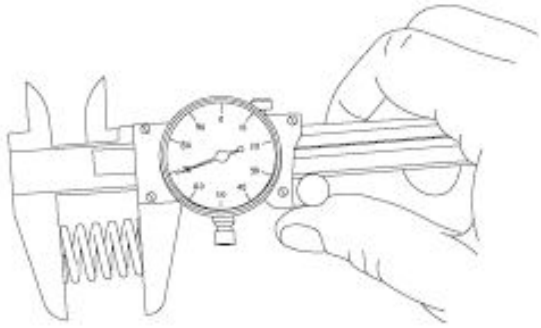
Remove the sprag clutch assembly, which is mounted to the gearbox input shaft. Place the brake assembly on a clean flat surface with the motor end up. Loosen capscrews (item 18) one turn at a time until the spring tension is released, then remove motor adapter (item 8). Remove and discard O-Ring and Backup ring (items 6 & 7) from the motor adapter. Remove spacer, friction and steel discs, piston and pressure plate.Remove and discard all O-Rings and backup rings from the piston. Remove all springs and spring spacer.

Thoroughly clean and inspect the brake housing (item 11). Pay particular attention to the sealing surfaces of the piston, and be sure the brake release port is clean and free of any contamination.



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

Place steel brake discs on a flat surface and check for distortion. Visually inspect surfaces of discs for signs of material transfer or excessive heat. Replace steel disc if splines are worn to a point, disc is distorted or heat discolored.



Check brake spring free length. There are two size springs in each brake assembly, 12 each large springs (item 12) and 3 each small springs (item 21). Minimum free length of the large springs is 1-15/16 inches (49.21 mm). Minimum free length of the small springs is 1-7/16 inches (36.51 mm). Check all springs for any signs of cracking or failure. If a brake spring must be replaced for any reason, then *ALL* brake springs must be replaced.

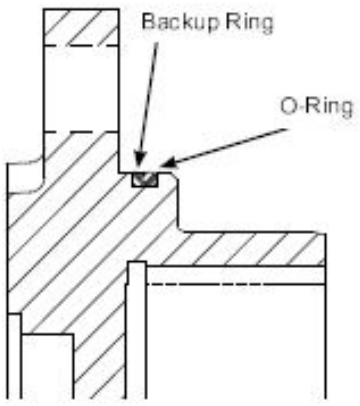
⚠ CAUTION ⚠

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

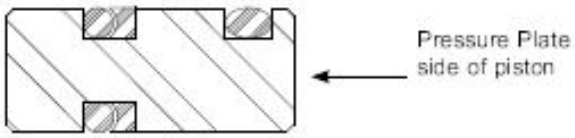
Inspect the bushing between the shaft and brake housing and replace as necessary.

ASSEMBLY

Apply a light coat of oil to a new O-Ring and Backup ring and install them onto the motor support as shown. Backup rings are always placed on the low pressure side of the O-Ring. In this case the backup ring is toward the motor mounting surface.



Apply a light coat of oil to new O-Rings and Backup rings for the brake piston and install them as shown below.



O-Rings and Backup rings should be installed at least 10 to 15 minutes before the parts are to be assembled. This time will allow them to "relax" from being stretched into their grooves and will help avoid cutting them when parts are assembled.

Place the brake housing on a clean flat work surface. Install the spring spacer into the housing. Install all 14 brake springs.

Install the pressure plate (item 10) onto the springs.

Apply a light coat of oil or petroleum jelly onto the sealing surfaces of the housing and piston and install the piston into the housing, seating it against the pressure plate.

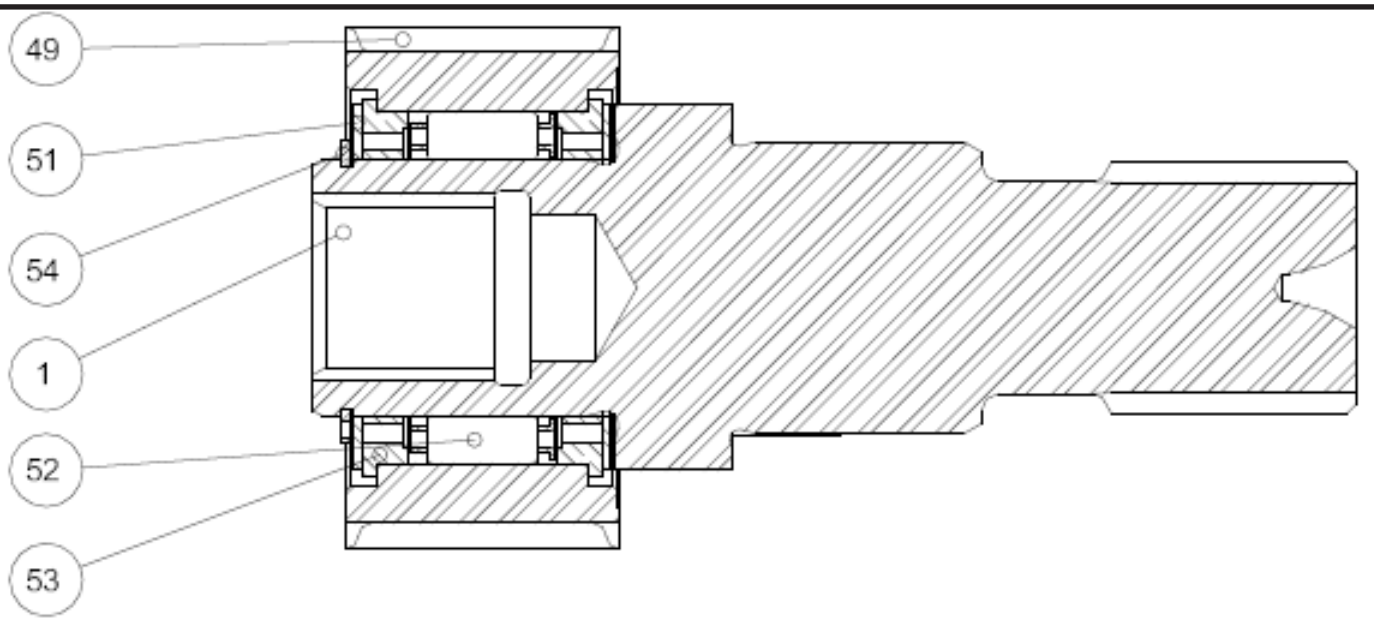
Place the motor adapter on a clean flat work surface with the motor side down. Place the brake spacer (item 4) into the motor support. Install a steel brake disc against the spacer, followed by a friction disc. Alternately install steel and friction discs until 10 friction and 11 steel discs have been installed. A steel disc will be on the top of the stack.

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

Carefully turn the motor support over, holding the discs in place through the center of the motor support. Install the motor support into the brake housing, being careful not to pinch your fingers against the pressure plate.

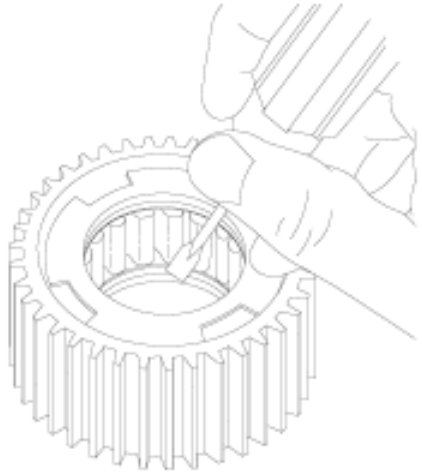
Install the eight capscrews and lockwashers (items 17 & 18), but do not tighten them enough to compress the springs. Install the assembled input shaft/sprag clutch through the center of the discs into the housing, turning the sprag back and forth to align the outer race splines with the brake disc splines. When all brake discs are properly aligned, evenly tighten the eight capscrews to compress the brake springs, and torque to the correct value.

SPRAG CLUTCH SERVICE



Before disassembling the clutch, determine which direction the outer race (item 49) rotates freely when the inner race/shaft is held firm.

Remove the retaining ring (item 54) and sprag bushing retainer (item 51). Pull the outer race (item 49) off of the inner race/shaft (item 1).



Using a screwdriver and mallet, remove the sprag bushing (item 53) from one end of the outer race. There are four special cutouts in the bushing for this purpose. Be careful not to damage the inside surface of the bushing. If the inside surface of a bushing is damaged or shows wear, replace the bushing.

Slide the sprag clutch out and inspect it very carefully for abnormal wear, cracks, pitting, corrosion or damage to the cage. Check the small clips for breakage or bright spots; the signs of excessive wear. Inspect the sprag bushing remaining in the outer race for wear or damage. If it does not need to be replaced, there is no need to remove it.

Thoroughly clean and inspect all parts before re-assembling the clutch.

⚠ WARNING ⚠

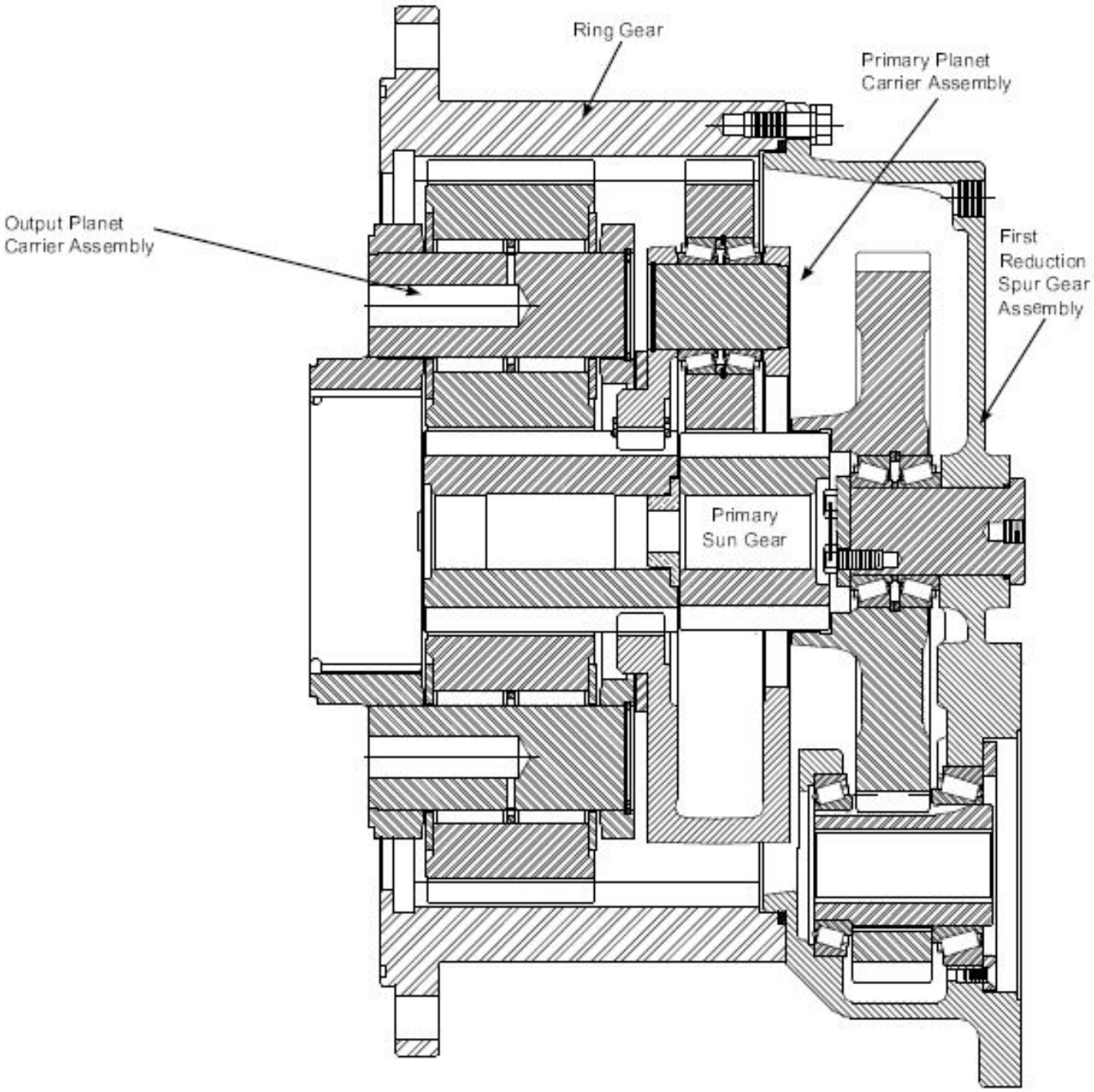
The polished surfaces of the races and sprag cams must be perfectly smooth to insure positive engagement of the clutch. The slightest defect may reduce brake clutch effectiveness, which may lead to loss of load control and result in property damage, injury or death. It is generally recommended th replace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

Install the sprag clutch into the bore of the outer race, making sure it is installed in the same direction as removed.

Press the sprag bushing (item 53) into the outer race.

Install the outer race and sprag onto the inner race/shaft. The outer race will have to rotated in the freewheeling direction to start it onto the inner race. Verify that the outer race rotates freely in the same direction as it did before disassembly.

Install the sprag bushing retainer (item 51) and retaining ring (item 54).

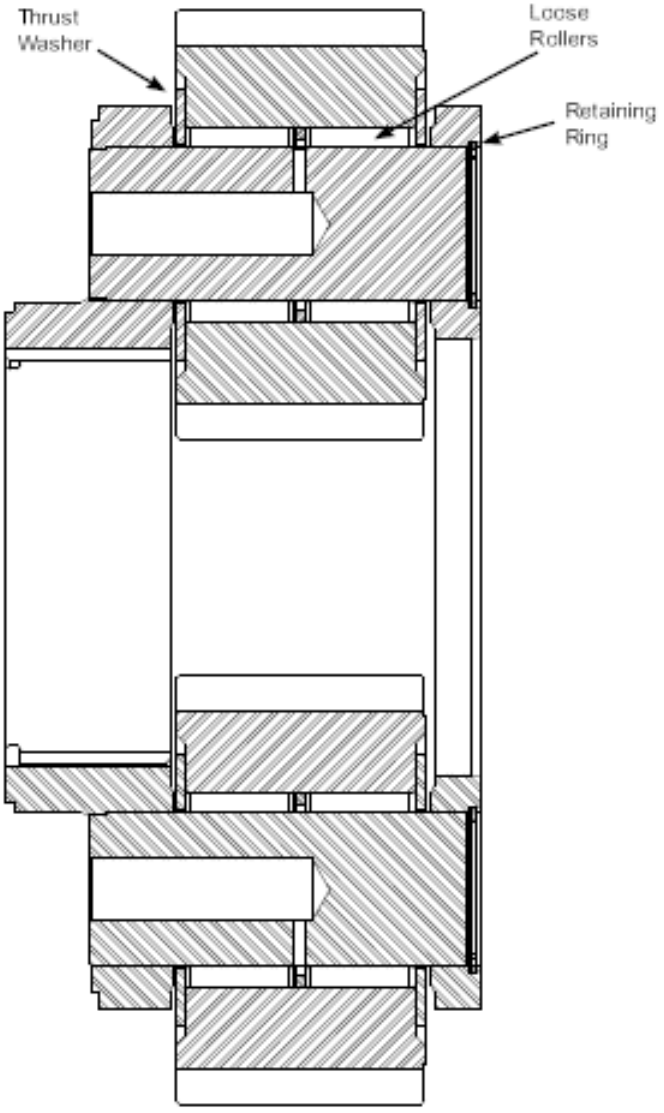


DISASSEMBLY

To disassemble the gearbox, the first reduction spur gear assembly must be separated from the ring gear. Block the assembly so it is resting on the face of the ring gear with the output planet carrier facing down, but not resting on the planet carrier. Remove all capscrews and lockwashers holding the cover to the ring gear and lift off the first reduction spur gear assembly.

Lift out the primary sun gear, the primary planet carrier assembly, thrust washer, and output planet carrier assembly.

OUTPUT PLANET CARRIER SERVICE



Disassembly

Before beginning, it is recommended that you mark each gear, pin and carrier bore so that each gear and pin is re-assembled into the same bore that it was removed from.

Remove the retaining ring holding the planet gear shaft in the carrier. Remove the planet gear shaft from the carrier.

Slide the planet gear, thrust washers and bearings out of the carrier. Remove the thrust washers, loose roller bearings and bearing spacer from the gear. Repeat this procedure for each of the planet gears.

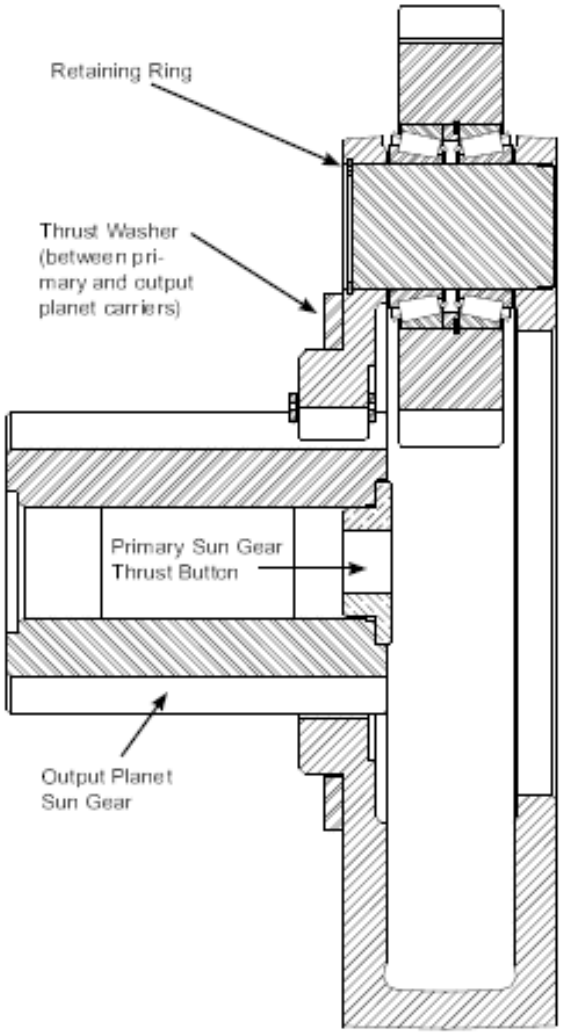
Thoroughly clean and inspect all parts for signs of abnormal wear or damage and replace as necessary. Pay particular attention to bearings and bearing surfaces. The bearing rollers should not exhibit any irregularities. If the rollers show any sign of spalling, corrosion, discoloration, material displacement or abnormal wear, the bearings should be replaced.

Assembly

Apply a liberal coat of oil soluble grease to a thrust washer and place it in the recess on a planet gear. Place the planet gear on a clean work surface with the thrust washer down. Apply a liberal coat of oil soluble grease to the bore of the gear. Stack a row of loose roller bearings into the planet gear, using the grease to hold them in position. There are 27 rollers in each row. Install a bearing spacer. Stack a second row of loose roller bearings on top of the bearing spacer. Place a second thrust washer on the planet gear. Carefully slide the planet gear and bearings into the carrier. Install a planet gear shaft into the carrier and through the planet gear bearings. The shaft may have to be driven in slightly to clear the retaining ring groove in the carrier. Install the retaining ring into the carrier.

Repeat this procedure for each of the planet gears.

PRIMARY PLANET CARRIER SERVICE



Disassembly

Remove and inspect the thrust washer that is between the primary and output planet carriers. If it exhibits any signs of excessive wear or damage, replace it.

Inspect the primary sun gear thrust button and replace it if there are signs of excessive wear or damage.

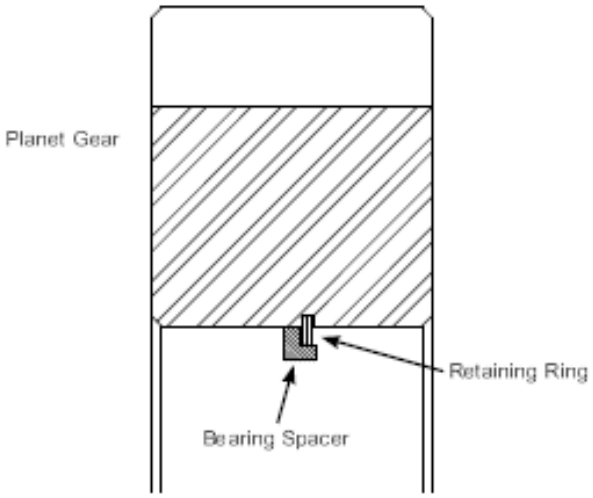
The output planet sun gear is attached to the primary planet carrier with two retaining rings. It is not necessary to remove the sun gear unless it needs to be replaced.

Before removing the planet gears, it is recommended that you mark each gear, pin and carrier bore so that each gear and pin is re-assembled into the same bore that it was removed from.

Remove the retaining ring holding the planet gear shaft in the carrier. Remove the planet gear shaft from the carrier.

Slide the planet gear and bearings out of the carrier. Remove the tapered roller bearings, bearing spacer and retaining ring from the gear. Repeat this procedure for each of the planet gears.

Thoroughly clean and inspect all parts for signs of abnormal wear or damage and replace as necessary. Pay particular attention to bearings and bearing surfaces. 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.



Assembly

Install retaining ring into the groove in the bore of a planet gear.

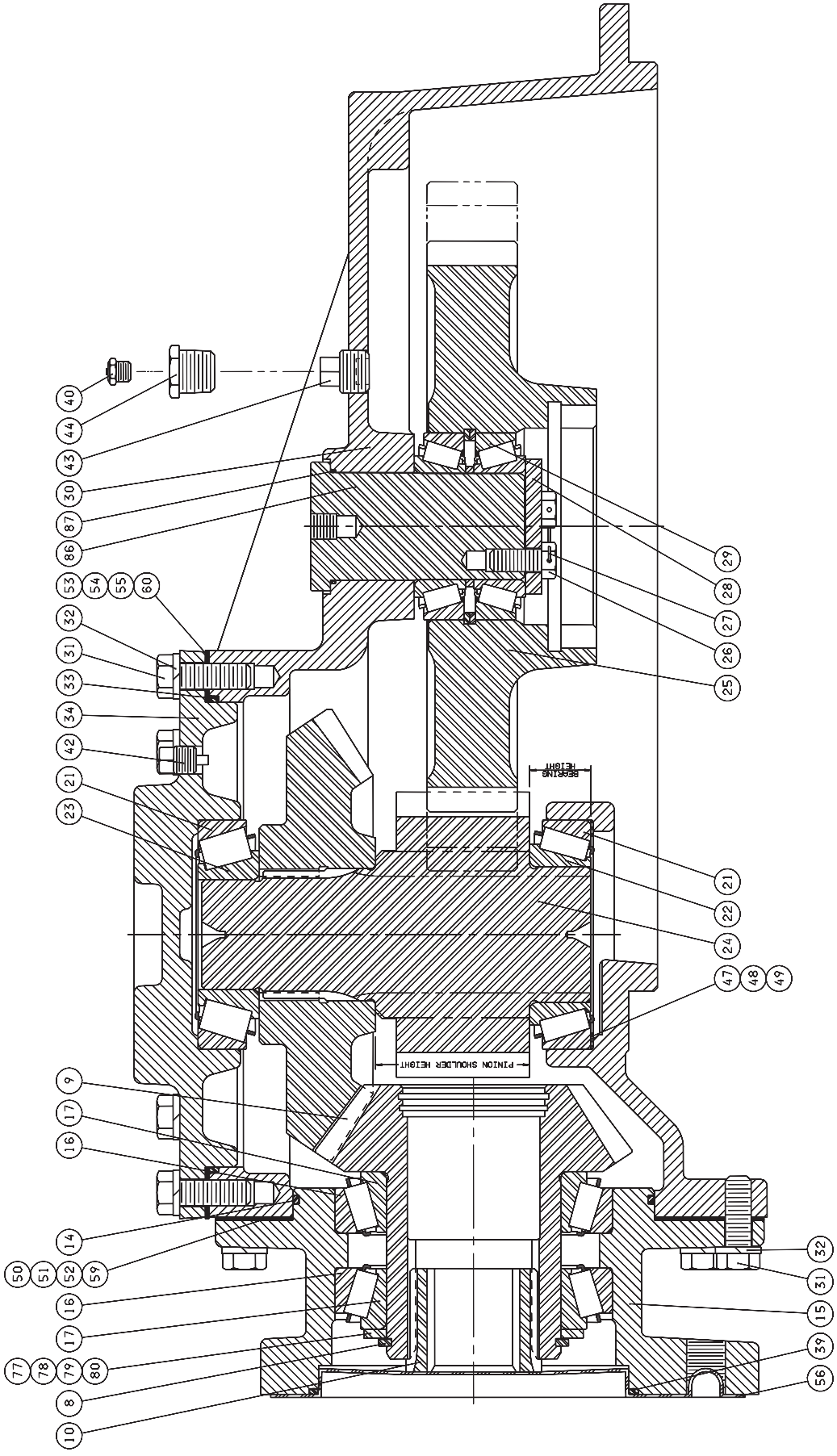
NOTE: *The groove is slightly off center in the bore of the gear. This is to allow the bearing spacer to be centered in the bore when properly installed. The distance from the outside edge of the gear to the spacer must be the same on both sides.*

Install both bearing cups into the gear, seating the firmly against the spacer. Install both bearing cones into the gear, and carefully slide the gear and bearings into the planet carrier. Install a planet gear shaft into the carrier and through the planet gear bearings. The shaft may have to be driven in slightly to clear the retaining ring groove in the carrier. Install the retaining ring into the carrier.

Repeat this procedure for each of the planet gears.

RIGHT-ANGLE INPUT ASSEMBLY CROSS-SECTION

Part number 83163



RIGHT-ANGLE INPUT ASSEMBLY SERVICE

Disassembly

> **⚠CAUTION⚠**
>
> The primary sun gear (Item 41) may come out with the input section and drop out of the input bull bear (Item 25) unexpected.

1. Remove the wire rope from the winch and drain the gear oil from the winch by removing drain plugs.
2. Take precautions to collect hydraulic oil and remove the hydraulic hoses connected to the winch motor. Disconnect the brake release line from the brake release port. Ensure there are no external hose connections to the winch motor, and then remove the motor
3. Remove the socket head capscrews (Item 125) securing the hydraulic motor assembly (Item 700) and hydraulic brake (Item 200). Remove and discard motor pilot O-ring and the O-ring between the brake assembly and the input assembly.
4. Secure the input assembly (Item 800) with an appropriate lifting strap to an overhead hoist or other adequate lifting equipment. Use caution, the unit is heavy.
5. Install a 1/2-13 eye bolt in the center of the input housing. Remove the 10 capscrews (Item 122) and lockwashers (Item 123) holding the input assembly to the planetary gear assembly (Item 500).
6. Remove and discard the O-ring (Item 7) from the input housing pilot bore. Support the input section with the pilot bore facing up.
7. Remove and discard safety wire in the 3 capscrews (Item 26) securing the bearing retainer plate (Item 28) from the input housing trunnion. Remove the outer bearing cone from the bearing trunnion. Two pry bars spread 180° across the input bull gear (Item 25) can now be used to remove. **NOTE:** The input bull gear bearing (Item 29) is a matched set and **must** be replaced as a set, including all spacers.
8. Remove the 11 capscrews and lockwashers (Items 31 and 32) bolting the brake housing to the input housing. The entire brake housing and input bevel gear can now be carefully removed. Remove and discard the O-ring (Item 14) from the brake housing pilot bore. Carefully remove and set aside the shims between the brake housing and the input housing.
9. Turn the input housing over. Remove the 8 capscrews and lockwashers (Items 31 and 32) which bolt the bearing container/cover to input housing. Remove and discard the O-ring from the input housing. Carefully remove and set aside the shims between the cover and the input housing.
10. The bevel gear and input pinion can now be removed. Thoroughly clean all parts and inspect for damage and wear. The bearing should be examined for any signs of spalling, corrosion, discoloration, material displacement, or abnormal wear. The bearing cages should be inspected for wear or deformation. If any of these conditions are found, the bearing should be needed. Gears should be inspected for abnormal wear or pitting and replaced as necessary. Inspect all machined surfaces and bearing bores for signs of damage or excessive wear.
11. If the inboard bearing needs to be replaced, remove the bearing cup (Item 21) from the input housing, along with any shims under it.

Assembly

The setup procedure in steps 1 and 2 below should be followed only if the bevel gear set (Item 9) or the inboard bearing cup and cone (Items 21 and 22) are being replaced.

1. There is a mounting dimension etched on the bevel gear, and a housing dimension stamped on the face of the pinion bore in the input housing. Using these dimensions, find the proper shim letter from Table 1 (on following page).
2. Measure and record the input pinion gear shoulder height, and the assembled height of the inboard bearing (Items 21 and 22) as shown in the diagram. Be sure the bearing is properly seated in its cone, and not resting on the roller cage. Add these two dimensions and use this total to select the shim thickness from Table 2 (on following page). Install this shim thickness using shims 47, 48 and 49 as required under the bearing cup (Item 21) in the input housing and press the cup into the bore.

Below is an example shim selection:

Bevel Gear Mounting Dimension = 1.901 inch
Housing Dimension = 2.315 inches
From Table 1, the shim letter is E

Sum of pinion gear shoulder height and bearing height = 4.178 inches
From Table 2, shim thickness is 0.032 inches

Item 47 shim is 0.003 inch
Item 48 shim is 0.005 inch
Item 49 shim is 0.015 inch

In this example, use one of item 49, one of item 48, and four of item 47 to obtain 0.032.

3. Assemble the bevel gear and input pinion gear (Item 24). Press the bearings (Items 23 and 23) onto the input pinion gear. Press the bearing cup (Item 21) into the pinion cover (Item 34).

4. Install the input pinon assembly in the housing. Set the cover (Item 34) in place on the housing without using any shims or an O-ring at this time. Rotate the input pinion gear/bevel gear assembly to remove bearing end play and measure the gap between the housing and cover. Take an average of these measurements to obtain the required shim thickness. Remove the cover and install O-ring (Item 33) into the housing counterbore. Install shim thickness measured above onto the cover using items 53, 54, 55, and 60. Install the cover using 8 capscrews and lockwashers (Items 31 and 32).

5. Using a dial indicator, check the input pinion gear end play. End play should be 0.003 to 0.006 inches. If necessary, adjust the number of shims used between the cover and housing to obtain correct end play.

6. Turn the input assembly over so the input pinion and bevel gears are accessible.

7. Slide the brake assembly into the input housing so the pinion gear fully engages the bevel gear. Measure the gap between the brake housing in several locations around the brake housing. Take an average of these measurements and add 0.003 to obtain internal shim thickness. Remove the brake housing and install O-ring (Item 14). Install the shim thickness measured above onto the brake housing using 11 capscrews and lockwashers (Items 31 and 32). Using a dial indicator on a bevel gear tooth in as close to the radial position as possible, measure the bevel gear set backlash. Backlash should be between 0.005 and 0.009 inches. If necessary, remove the brake housing and adjust the shim thickness to obtain correct backlash.

8. Turn the input housing over.

The input bull gear and bearing set will now be installed.

NOTE: Bearing (Item 19) is a matched set and must always be replaced as a set, including spacers.

9. Place one of the bearing cones on the bull gear trunnion cast into the input housing. Install the single bearing spacer onto the trunnion and seat it against the bearing.

10. The 2 split bearing spacers can now be installed in the grove machined in the bore of the input bull gear pinion (Item 24). The 2 bearing cups can then be pressed into the bull gear and seated against the bearing spacers.

11. Install the input bull gear over the bearing trunnion, mating its teeth with the input pinion gear. The pinion and bull gear should turn smoothly and freely at this point.

12. Install the final bearing cone onto the trunnion and secure the assembly with the bearing retainer plate (Item 28) and 3 capscrews (Item 26). Torque the capscrews to 55 ± 10 pound-foot of torque (7.6 ± 1.4 Kg-m) and secure with safety wire.

13. Check again to ensure the input pinion and bull gear rotate smoothly and freely.

Table 1 (all dimensions in inches)

BEVEL GEAR MOUNTING DIM.	HOUSING DIMENSION				
	2.302/2.305	2.306/2.309	2.310/2.313	2.314/2.317	2.318/2.320
1.895/1.898	A	B	C	D	E
1.899/1.902	B	C	D	E	F
1.903/1.906	C	D	E	F	G

Table 2 (all dimensions in inches)

MEASURED LENGTH (BRG. & PINION)	SHIM SELECTION CHART						
	A	B	C	D	E	F	G
4.168/4.170	0.024	0.028	0.032	0.036	0.040	0.044	0.048
4.171/4.173	0.021	0.025	0.029	0.033	0.037	0.041	0.045
4.174/4.176	0.018	0.022	0.026	0.030	0.034	0.038	0.042
4.177/4.178	0.016	0.020	0.024	0.028	0.032	0.036	0.040
4.179/4.181	0.013	0.017	0.021	0.025	0.029	0.033	0.037
4.182/4.184	0.010	0.014	0.018	0.022	0.026	0.030	0.034
4.185/4.187	0.007	0.011	0.015	0.019	0.023	0.027	0.031

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

METRIC CONVERSION TABLE

English to Metric			Metric to English		
LINEAR					
inches (in.)	X 25.4	= millimeters (mm)	millimeters (mm)	X 0.03937	= inches (in.)
feet (ft.)	X 0.3048	= meters (m)	meters (m)	X 3.281	= feet (ft.)
miles (mi.)	X 1.6093	= kilometers (km)	kilometers (km)	X 0.6214	= miles (mi.)
AREA					
$inches^2$ (sq.in.)	X 645.15	= $millimeters^2$ (mm^2)	$millimeters^2$ (mm^2)	X 0.000155	= $inches^2$ (sq.in.)
$feet^2$ (sq.ft.)	X 0.0929	= $meters^2$ (m^2)	$meters^2$ (m^2)	X 10.764	= $feet^2$ (sq.ft.)
VOLUME					
$inches^3$ (cu.in.)	X 0.01639	= liters (l)	liters (l)	X 61.024	= $inches^3$ (cu.in.)
quarts (qts.)	X 0.94635	= liters (l)	liters (l)	X 1.0567	= quarts (qts.)
gallons (gal.)	X 3.7854	= liters (l)	liters (l)	X 0.2642	= gallon (gal.)
$inches^3$ (cu.in.)	X 16.39	= $centimeters^3$ (cc)	centimeters3 (cc)	X 0.06102	= $inches^3$ (cu.in.)
$feet^3$ (cu.ft.)	X 28.317	= liters (l)	liters (l)	X 0.03531	= $feet^3$ (cu.ft.)
$feet^3$ (cu.ft.)	X 0.02832	= $meters^3$ (m^3)	meters3 (m3)	X 35.315	= $feet^3$ (cu.ft.)
fluid ounce (fl.oz.)	X 29.57	= millileters (ml)	milliliters (ml)	X 0.03381	= fluid ounce (fl.oz.)
MASS					
ounces (oz.)	X 28.35	= grams (g)	grams (g)	X 0.03527	= ounces (oz.)
pounds (lbs.)	X 0.4536	= kilograms (kg)	kilograms (kg)	X 2.2046	= pounds (lbs.)
tons (2000 lbs.)	X 907.18	= kilograms (kg)	kilograms (kg)	X 0.001102	= tons (2000 lbs.)
tons (2000 lbs.)	X 0.90718	= metric tons (t)	metric tons (t)	X 1.1023	= tons (2000 lbs.)
tons (long) (2240 lbs.)	X 1013.05	= kilograms (kg)	kilograms (kg)	X 0.000984	= tons (long) (2240 lbs.)
PRESSURE					
inches Hg (60°F)	X 3600	= kilopascals (kPa)	kilopascals (kPa)	X 0.2961	= inches Hg (60°F)
pounds/sq.in. (PSI)	X 6.895	= kilopascals (kPa)	kilopascals (kPa)	X 0.145	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.0703	= kilograms/sq.cm. (kg/cm^2)	kilograms/sq.cm. (kg/cm2)	X 14.22	= pounds/sq.in. (PSI)
pounds/sq.in. (PSI)	X 0.069	= bars	bars	X 14.5	= pounds/sq.in. (PSI)
inches H_2O (60^oF)	X 0.2488	= kilopascals (kPa)	kilopascals (kPa)	X 4.0193	= inches H_2O (60^oF)
bars	X 100	= kilopascals (kPa)	kilopascals (kPa)	X 0.01	= bars
POWER					
horsepower (hp)	X 0.746	= kilowatts (kW)	kilowatts (kW)	X 1.34	= horsepower (hp)
ft.-lbs./min.	X 0.0226	= watts (W)	watts (W)	X 44.25	= ft.-lbs./min.
TORQUE					
pound-inches (in.-lbs.)	X 0.11298	= newton-meters (N-m)	newton-meters (N-m)	X 8.851	= pound-inches (in.lbs.)
pound-feet (ft.-lbs.)	X 1.3558	= newton-meters (N-m)	newton-meters (N-m)	X 0.7376	= pound-feet (ft.-lbs.)
pound-feet (ft.-lbs.)	X .1383	= kilograms/meter (kg-m)	kilogram/meter (kg-m)	X 7.233	= pound-feet (ft.-lbs.)
VELOCITY					
miles/hour (m/h)	X 0.11298	= kilometers/hour (km/hr)	kilometers/hour (km/hr)	X 0.6214	= miles/hour (m/h)
feet/second (ft./sec.)	X 0.3048	= meter/second (m/s)	meters/second (m/s)	X 3.281	= feet/second (ft./sec.)
feet/minute (ft./min.)	X 0.3048	= meter/minute (m/min)	meters/minute (m/min)	X 3.281	= feet/minute (ft./min.)

TEMPERATURE

°Celsius = 0.556 (°F - 32) °Fahrenheit = (1.8°C) + 32

COMMON METRIC PREFIXES

mega	(M)	= 1,000,000 or 106	deci	(d)	= 0.1 or 10^{-1}
kilo	(k)	= 1,000 or 10^3	centi	(c)	= 0.01 or 10^{-2}
hecto	(h)	= 100 or 10^2	milli	(m)	= 0.001 or 10^{-3}
deka	(da)	= 10 or 10^1	micro	(m)	= 0.000.001 or 10^{-6}

LIT2737
October 2017
Printed in USA

BRADEN
CARCO
Gearmatic

PACCAR WINCH
800 East Dallas Street
Broken Arrow, OK 74012
www.paccarwinch.com