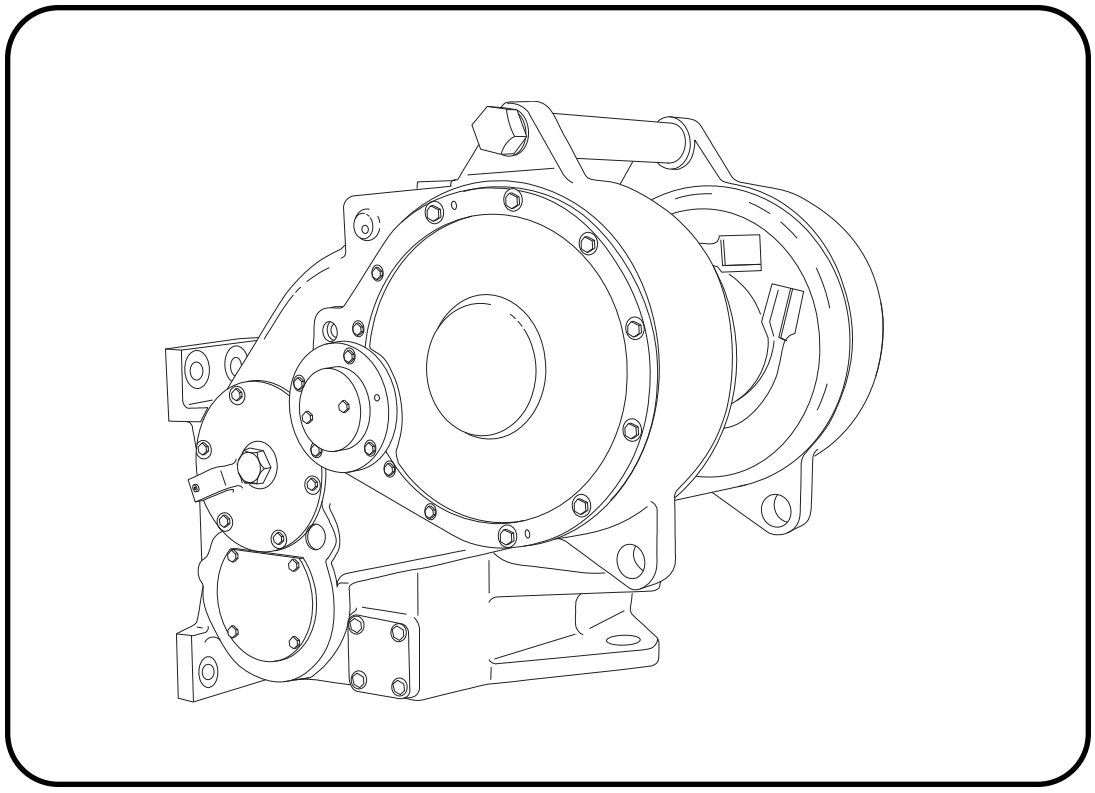
SEBU-7026

# OPERATION & PREVENTIVE MAINTENANCE MANUAL

# WINCH MODEL 527



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1/97
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# FOREWORD

This manual contains instructions for the operation and preventive maintenance of the winch Model 527.

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

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

Continuing product improvement may cause changes in your winch which may not be included in this manual. Whenever a question arises regarding your 527 winch or this manual, please contact your nearest Caterpillar dealer. Provide the complete winch MODEL NUMBER and SERIAL NUMBER when making inquiries.

# TABLE OF CONTENTS



Safety and informational callouts used in this manual include:

**⚠ WARNING ⚠**

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

**⚠ CAUTION ⚠**

**CAUTION** - This emblem is used to warn against potential or unsafe practices which COULD result in personal injury, and product or property damage 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 safety to others as well as yourself. To ensure safety, the tractor and winch must be operated with care, 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, INJURY, OR DEATH.**

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

2. Never attempt to clean, oil or perform any maintenance on a machine with the engine running, unless instructed to do so in the Service Manual.

3. Before starting 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 work area.

5. Operate winch line speeds to match job conditions.

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

7. Never attempt to handle winch cable when the hook end is not free.

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

9. 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 1½ times the length of the cable in use should be maintained.

10. When winding cable on the winch drum, never attempt to maintain tension by allowing cable to slip through hands. Always use "hand-over-hand" method.

11. Use correct size ferrule for cable and pocket in winch drum. Never use knots to secure or attach cable.

12. Inspect rigging, winch and tractor at the beginning of each work shift. Any cable with borken strands of rigging worn or damaged should be replaced.

13. Position tractor for straightest line of pull. Use fairlead if side pulls are frequently encountered.

14. 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 linepull. Therefore, a minimum of five (5) complete wraps of cable must be maintained on winch drum.

15. Be sure of tractor ground stability before winching in load.

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

17. The maximum rated bare drum line pull of the 527 is 69,200 lb (307.8 kN)*. Do not operate the winch under loads that exceed the maximum rated bare drum line pull. If excessive loads are encountered, use a multi-part line and sheave blocks. Any attempt to exceed the capabilities of one winch (such as coupling 2 or more tractors together) is extremely hazardous.

    *Breaking strength of 7/8 in. (22 mm) IPS wire rope.

18. The factory approved adaptions for 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 because of safety limitations. Contact your Caterpillar dealer prior to attempting winch modifications or before mounting on a different tractor.

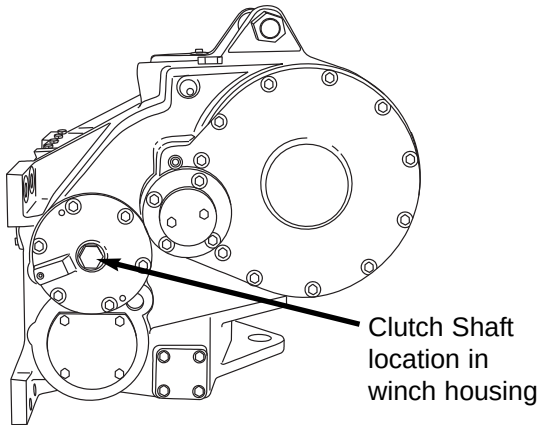
19. The 527 power shift winch is equipped with hydraulic accumulator. Discharge the accumulator stored oil supply before removing any hydraulic lines or fittings or servicing winch. Personal injury may result from the sudden release of oil pressure. To discharge the accumulator, stop the engine, slowly cycle the Power Shift control handle into full Reel-In/Reel-Out positions a minimum of five (5) times.

20. 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.

# MODEL DESCRIPTION

The 527 Power Shift Winch is a single drum unit which mounts to the rear of a crawler tractor. It is driven by engine power through the tractor PTO (Power Take-Off). The winch may be operated independently or with the tractor transmission engaged. When operated properly, it is capable of utilizing maximum engine horsepower. The winch has equal speed gearing, power-in and power-out, using multi-disc oil actuated friction clutches and a spring applied, hydraulically released multi-disc oil brake.

The winch may be manufactured as a Standard PTO or Low PTO configuration, depending on tractor application. In the Standard PTO configuration, the bevel gear group, clutch and brake components are located in the upper bores of the winch case.



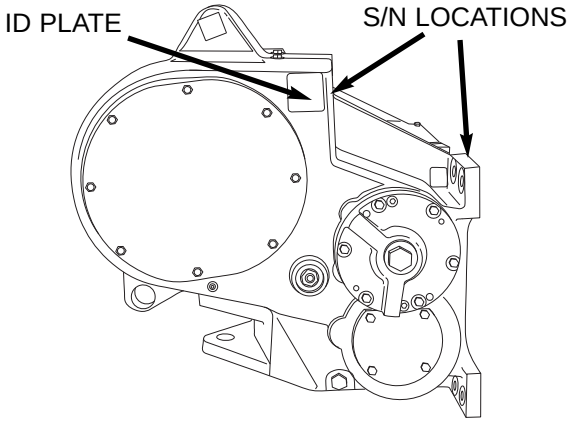

Standard PTO Shown

Standard and Low PTO configurations are available as either a standard or slow speed. The standard speed winch is primarily used in logging, land clearing and general utility applications. The standard speed model has gear ratios which match the cable drum rotation in Reel-In (forward) to reverse track speeds for optimum advantage in tractor recovery.

Optional features increase the ability of the winch to meet specific application requirements. Options available for the 527 winch includes:

- Free Spool
- Gear Ratios
- Three or Four Roller Fairlead

The winch model number is an important reference as to the optional components included when the winch was manufactured. The winch identification plate is located on the right hand side of the winch case. The serial number is also stamped into the upper right hand mounting pad.




The winch model number contains the following configuration data:

**MODEL**

**C 0 0 0 0 0**

527

Bevel Gear Ratio
- A-1:1
- B-1.27:1
- C-1.64:1
- D-2.11:1
- E-2.79:1

0-Overwind
1-Underwind

0-Standard Brake

0-Without Freespool
1-With Freespool

0-Four Shaft Winch
1-Three Shaft Winch

0-No Fairlead
3-Three Roller Fairlead
4-Four Roller Fairlead

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

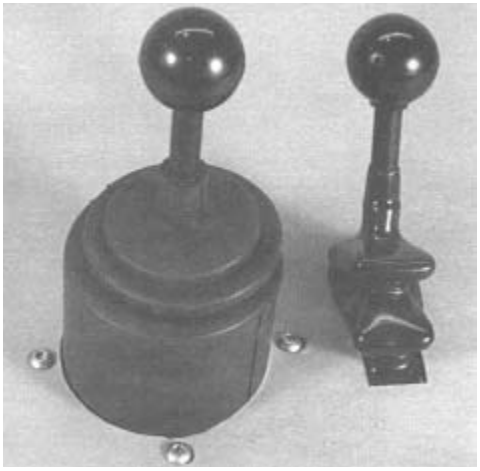
# WINCH OPERATION

## HYDRAULIC SYSTEM

The winch contains an independent, internal hydraulic system. The winch housing serves as a reservoir and stores filtered oil for the internally mounted hydraulic pump. The pump is driven by a gear pressed onto the bevel pinion gear. The pump supplies oil whenever the PTO shaft is turning. Oil from the pump is then routed through a pressure filter then directed to the control valve where a stand-by system pressure is maintained at 320-410 PSI (2210-2830 kPa).

The system oil pressure is routed through the control valve body to the Directional and Brake control cartridges. Movement of the Directional control spool opens passages which direct oil to apply the Reel-In (forward) or Reel-Out (reverse) clutches and release the spring applied multi-disc brake.

Movement of the Brake spool will direct oil to release the brake only. The movement of the spools responds to the position of the operators Power Shift control lever by means of flexible control cables.



Winch Controls with Optional Freespool

The winch hydraulic system is equipped with an accumulator. The accumulator stores a small amount of oil at system pressure to assist the application of the clutches and release the brake under all operating conditions. The stored oil supply may also be used to release the spring-applied brake whenever the tractor engine or torque converter is stalled. The accumulator-stored oil supply is continuously refilled by the winch pump and valve whenever the tractor PTO is turning.

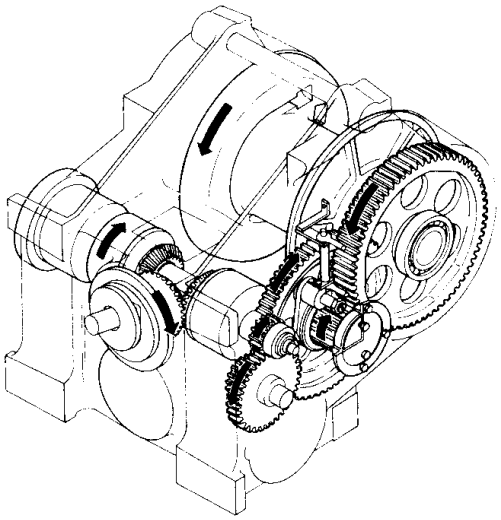
On tractors which supply PTO power through the torque converter, it is possible to cause the torque converter to stall if the tractor engine speed is too low. It is important that engine idle speed be set to factory specifications.

**⚠CAUTION⚠**

Discharge the accumulator oil supply BEFORE removing any hydraulic lines or servicing the winch. Personal injury may result from the sudden release of oil under pressure. To discharge the accumulator, stop engine, slowly cycle the Power Shift control handle into full Reel-In then Reel-Out positions a minimum of five (5) times.

## GEAR TRAIN

The winch bevel pinion, bevel gears, hydraulic pump and clutch friction discs are rotating whenever the tractor PTO shaft is rotating. Application of a clutch, Reel-In or Reel-Out, and the simultaneous release of the brake will cause the rotation of the remaining gear train and cable drum. See illustration below.



Standard PTO 3 shaft gear train CCW PTO rotation, Reel-In clutch applied.

The clutch shaft assembly (with bevel gears) must turn 22.3 times for one (1) rotation of the cable drum on a 3 shaft gear train winch.

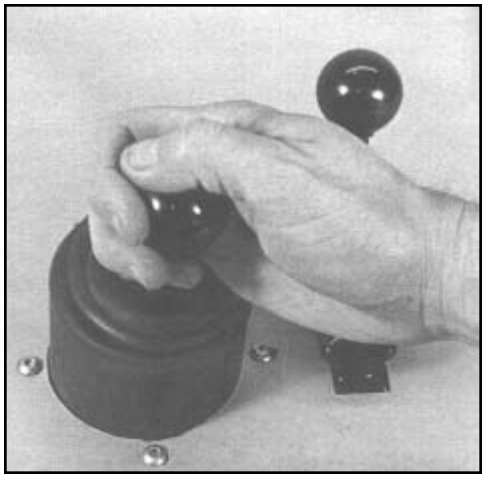
The direction of the tractor PTO shaft rotation and the right and left hand clutch location is determined by facing the rear of the tractor.

The cable drum rotation may be easily changed from overwind (standard) to underwind by reversing clutch pressure lines at the control valve ports $C_1$ and $C_2$ and installing the wire rope in the opposite cable drum ferrule pocket.

# CONTROL OPERATION

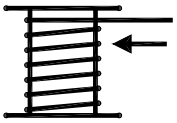
## POWER SHIFT (PS) – SINGLE LEVER

The operator's control lever must ALWAYS be moved to its full travel in Reel-In (forward) and Reel-Out (reverse). The speed of the cable drum rotation should be controlled by varying the tractor engine RPM. Sufficient hydraulic pressure will be available to fully apply the clutches at engine (PTO) speeds above low idle. The internal winch pump is only driven when the PTO shaft is turning. A continuous oil supply is needed to provide reliable clutch and brake operation.



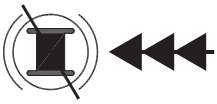
**⚠CAUTION⚠**

Any attempt to regulate drum speed (line speed) through the control lever by "feathering" clutches will cause excessive heat due to slippage and severe damage to clutch discs may result.

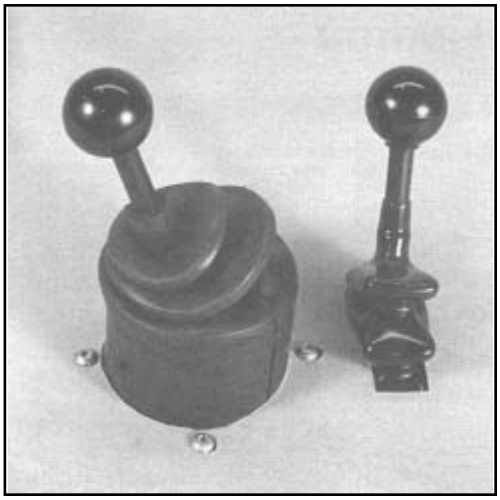


**Reel-In (forward).** The control lever is pulled toward the operator to the fully engaged position. The brake is hydraulically released and the Reel-In clutch is hydraulically applied.

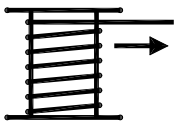
**Brake-On (neutral).** The control lever is spring centered to Brake-On. The brake is applied by spring force. The cable drum and load are held secure by the spring-applied brake.



**Brake-Off.** The brake is hydraulically released by moving the control lever to the left. Partial brake release may be achieved by slowly moving the control lever into the gate. The amount of brake release is proportional to the distance the lever moves into the gate.

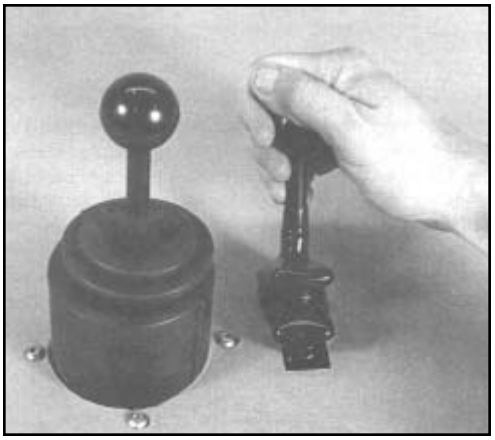


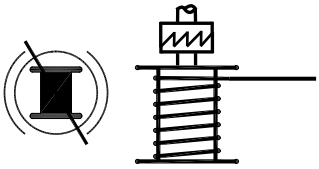
**Full Brake Release.** Full brake release is achieved by moving the lever fully to the left into the lock position. With the brake released, the tractor may walk away from the load. Always return the lever to the Brake-On (neutral) position.



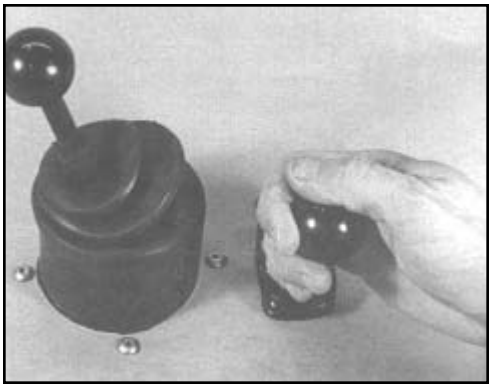
**Reel-Out (reverse).** The control lever is pushed away from the operator to the fully engaged position. The brake is hydraulically released and the Reel-Out clutch is hydraulically applied.

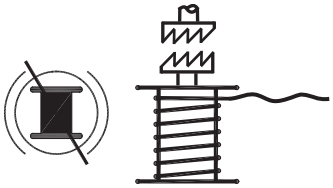
## FREESPOOL CONTROL OPERATION



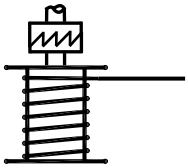


For normal winch and tractor operation, the Freespool lever should remain in the drum engaged position (away from operator).





To operate Freespool, place the Power Shift lever into the Brake-Off position, then shift the Freespool lever into the drum Disengaged position (torward the operator). This will disengage the drum drive gears from the gear train and brake, which permits the wire rope to be easily pulled off the cable drum by hand. Return the Power Shift lever to the Brake-On position to hold the gear train stationary.



To resume powered operation of the cable drum, shift the Freespool control lever to the Engaged position (away from the operator).

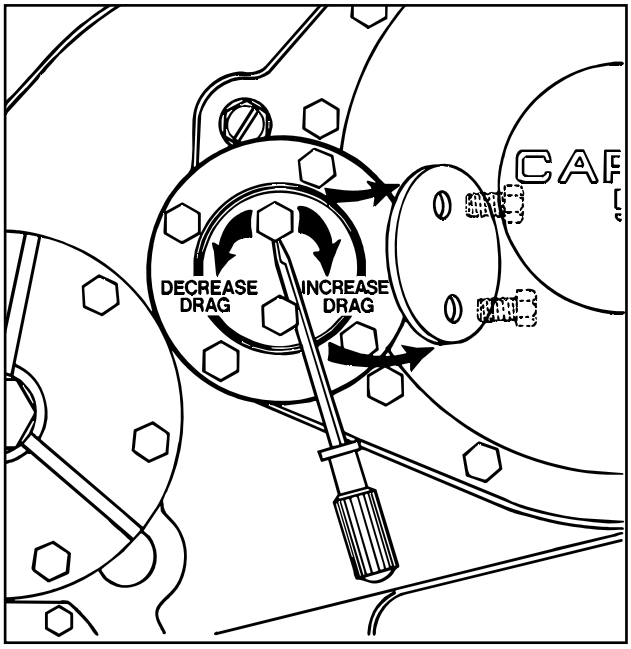
If the gear train will not engage, *momentarily* apply the Reel-In (forward) clutch to "bump" the gear train while holding slight pressure on the Freespool lever. Never force the Freespool lever. The shift will be made with ease when the gears are properly aligned.

## ⚠ CAUTION ⚠

1. Do not shift Free Spool lever and atempt to engage cable drum while the cable drum or gear train is rotating. Winch gear train damage may result.

2. Never attempt to disengage Free Spool under load. Damage to control cable and linkage may occur if lever is forced.

A cable drum drag adjustment may be made to eliminate birdnesting" caused by drum overrun. Adjustment is made by removing the lock plate and turning the threaded adjuster clockwise to increase drag; counterclockwise to decrease drag.




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

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

## ⚠ CAUTION ⚠

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

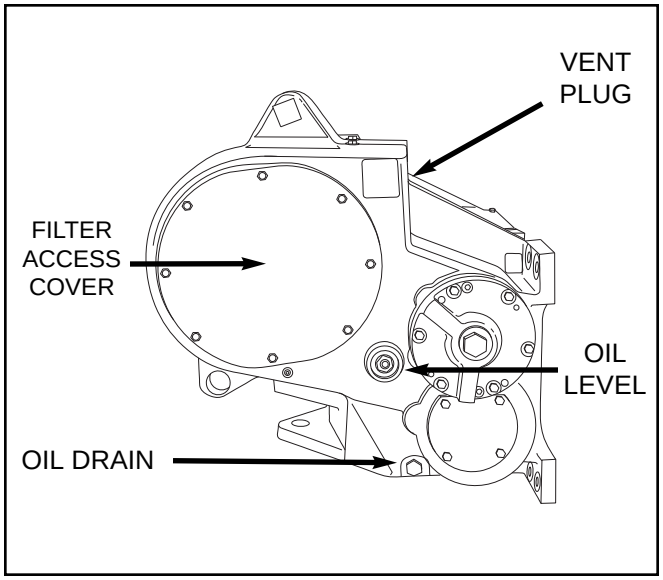
# PREVENTIVE MAINTENANCE & SPECIFICATIONS

A regular program of preventive maintenance for your 527 winch will minimize the need for emergency servicing and promote long product life and trouble-free service.

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

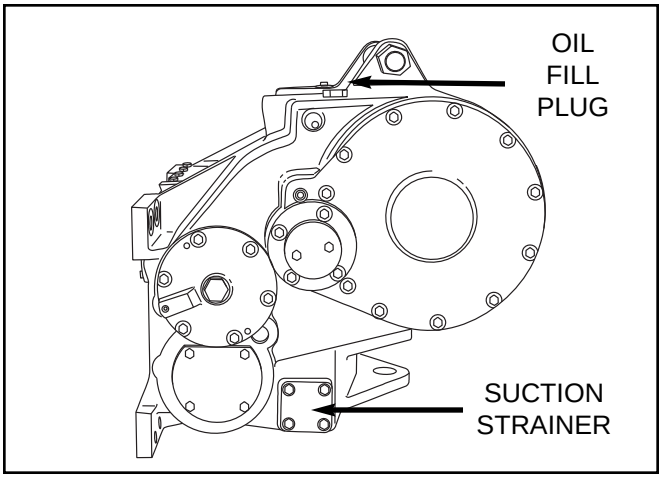
## ⚠ CAUTION ⚠

Discharge the accumulator oil supply BEFORE removing any hydraulic lines or servicing the winch. Personal injury may result from the sudden release of oil under pressure. To discharge the accumulator, shut the engine off, then slowly cycle the control lever into full Reel-In and Reel-Out positions a minimum of five (5) times.




### 1. OIL LEVEL

Check the oil level at the beginning of each work shift, with the tractor and winch in a level position. The oil must be visible in the upper half of the sight gauge. If an oil level plug is used in place of the sight gauge, the oil level should be at the bottom of the oil level port. Add oil as required through the fill port at the top of the winch case.



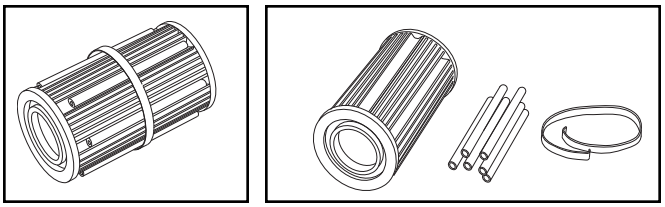

### 2. OIL CHANGE, FILTER AND STRAINER SERVICE

Under normal operating conditions, the oil and pressure circuit filter should be changed, and the suction strainer cleaned after the first 100-250 hours of operation. Follow-up oil and filter changes should occur after every 1000 hours or 6 months of operation, whichever occurs first.

## ⚠ WARNING ⚠

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

To drain the oil, place the tractor and winch in a level position and remove the drain plug located on the lower RH side of the winch case. Drain the oil into a suitable container and recycle or dispose of used oil in an environmentally responsible manner. Install the drain plug securely after all oil has been drained. Next, remove the suction strainer cover, compression spring and seal rings. Remove the suction strainer from the winch case, then remove the metal band and magnetic rods from the strainer. Thoroughly wash the strainer in clean solvent and blow dry with compressed air. Inspect the wire mesh for damage or clogging with debris. Do NOT reuse a damaged suction strainer.



Install the magnetic rods onto the strainer and secure with the metal band. Lubricate the O-ring and install the strainer, seal rings, spring and cover back into the winch.

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

OIL CAPACITY: 78 qt. (74 L)

**⚠ CAUTION ⚠**

To prevent serious damage to the winch gear train, DO NOT operate the tractor engine while the oil is drained from the winch.

The pressure filter is located behind right hand, eight bolt access cover. Remove the cover, locate the spin-on pressure filter and remove the filter element with a strap wrench.

Lubricate the filter gasket and adapter threads with hydraulic oil and install the new filter onto the filter head. Tighten the filter ½ - ¾ turn by hand after the seal ring contacts the filter head.

Start the tractor and operate the engine at low idle. BE SURE the winch has been filled with oil BEFORE starting the engine. Correct any leaks.

### 3. CONTROL CABLE AND PRESSURE ADJUSTMENT

While the access cover is removed, it is advisable to check control cable adjustment and hydraulic main relief pressure. Place the Power Shift control lever in the center “Brake-On” (neutral) position. Install the yoke pins into the cable yokes/control valve spools and secure with hitch pins. The yoke pins should slip easily into the bores without any binding. The control valve spools are spring centered. If you notice any binding, turn the cable adjusters in or out until you obtain a “free pin” condition.

Make certain accumulator stored oil supply has been discharged as described earlier. Install an accurate 0-600 PSI (4140 kPa) gauge onto thequick-connect gauge port next to the control cables. Start tractor and operate engine at approximately 800-1000 RPM until pressure stabilizes. Maximum pressure during “charging” mode should peak at 400 PSI (2760 kPa). Pressure will slowly fall back approximately 15-20% from the relief setting then quickly return to 400 PSI (2760 kPa) when the valve cycles.

If adjustment is required, locate the adjustment screw hole behind port “P” of the control valve. With a 1/4 in. Allen key, loosen the outer lock screw. Insert a 3/16 in. Allen key through the lock screw and turn the adjusting screw clockwise to increase peak pressure; counter-clockwise to decrease peak pressure. Tighten the lockscrew.

It may be helpful to place the controls in Brake-Off to use some oil in the control circuit and cause the valve to slowly “cycle” so that peak pressure may be more easily observed.

Stop engine, discharge accumulator stored oil supply as described earlier and move hydaulic gauge to the “B” test port on the brake housing. A 1/4 NPT adapter will be required.

Start tractor and operate engine at approximately 800-1000 RPM. Place Power Shift lever in the Brake-Off position and observe BRAKE-RELEASE oil pressure. Loosen cable adjuster or cable yoke jam-nut and adjust brake control cable to achieve approximately 300 PSI (2070 kPa) minimum BRAKE-RELEASE pressure.

Stand away from service access of winch and return Power Shift lever to the BRAKE-ON (neutral) position. BRAKE RELEASE pressure must return to 0 with the controls in BRAKE-ON (neutral) position.

Optimum BRAKE-RELEASE pressure is the highest pressure you can achieve while ensuring pressure ALWAYS drops to 0 when controls are returned to BRAKE-ON. Excessive heat and accelerated brake and hydraulic component wear will result if BRAKE-RELEASE pressure does not return to 0.

With controls in Brake-On (neutral) remove gauge from “B” port and securely install plug into brake housing.

Install access cover plate and tighten eight 1/2 in. cap-screws/nuts to 75 lb.ft. (102 N-m) torque.

### 4. VENT PLUG

The vent is located next to the power shift control cables. It is very important to keep this vent clean and unobstructed. When changing the winch oil, remove the vent plug and thoroughly clean in safety solvent and reinstall. Do NOT replace with a solid plug.

**5. WINCH CABLE (WIRE ROPE)**

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

**6. MOUNTING FASTENERS**

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

**7. WARM-UP PROCEDURE**

**⚠ WARNING ⚠**

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

Start the tractor engine and operate at low idle for five minutes.

Shift the Freespool lever to the disengaged position. Then, with the tractor engine at low idle, place the Power Shift lever in Reel-In (forward) position. The winch gear train will rotate and warm the oil to operating temperature.

**⚠ CAUTION ⚠**

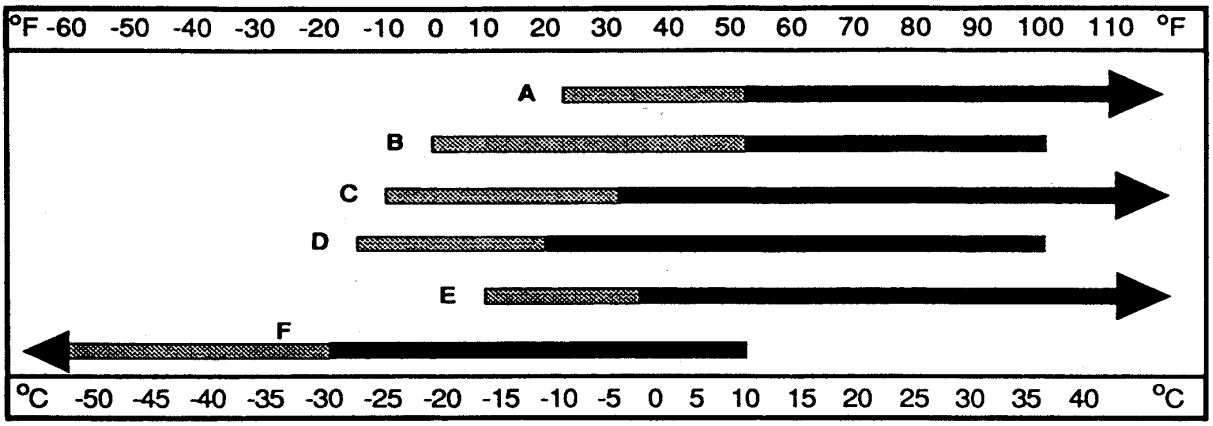
Do not shift the freespool lever and attempt to engage the cable drum while the cable drum or gear train are rotating. Winch gear train damage may result.

If not equipped with Free Spool, operate winch alternately in Reel-Out and Reel-In with little or no load to warm the oil and lubricate the gear train.

# RECOMMENDED OIL

We have published the following specification to help you determine which lubricant is best suited to your application. Your lubricant supplier should assure you that his product meets this specification. If there is still any doubt as to the suitability of a lubricant, contact the nearest Caterpillar dealer, providing a detailed copy of the product specifications.

## PREVAILING AMBIENT TEMPERATURE




**⚠ WARNING**

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

**A – Series 3 Motor Oil SAE 30 wt, MIL-L-2104D**
**B – Series 3 Motor Oil SAE 10 wt, MIL-L-2104D**
**C – Series 3 Motor Oil SAE 10w30, MIL-L-2104D**
**D – HTF Type C-3, 10 wt**
**E – CAT TO-2 and TO-4**
**F – Hydraulic Oil, MIL-H-5606**

### BASIC OIL REQUIREMENTS

20 000 SUS maximum allowed viscosity at cold start-up; requires extended equipment warm-up. 3,500 SUS maximum allowed viscosity at cold start-up; requires normal equipment warm-up. 60 SUS minimum allowed viscosity at maximum winch operating temperature assuming ambient plus 80°F (27°C).

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

# SPECIFICATIONS:

Unit Weight w/o oil, cable, or specific tractor adapters . . . . . .1960 lbs. (885 kg)

**Gear Ratios**

3 - Shaft Gear Train

Bevel Gear Ratio . . . . . .1.00:1 . . .1.27:1 . . .1.64:1 . . .2.11:1 . .2.78:1

Overall Ratio . . . . . .22.3:1 . . .28.3:1 . . .36.6:1 . . .47.0:1 . . .62.2:1

4 - Shaft Gear Train

Bevel Gear Ratio . . . . . .1.00:1 . . .1.27:1 . . .1.64:1 . . .2.11:1 . . .2.78:1

Overall Ratio. . . . . .40:4:1 . . .51.4:1 . . .66.3:1 . . .85.3:1 . .112.8:1

**Cable Drum Dimensions**

Barrel Diameter . . . . . .10 in. (254 mm)

Flange Diameter . . . . . .19 7/8 in. (504 mm)

Barrel Length . . . . . .12 3/8 in. (314 mm)

Throat Clearance . . . . .approx 9 in. (229 mm)

**Cable Ferrule Part Number - L Series**

3/4 in. (19 mm) . . . . . .118-6273

7/8 in. (22 mm) . . . . . .118-6275

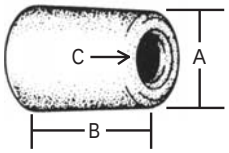
1 in. (25 mm) . . . . . .118-6276

**Cable Storage Capacity**

3/4 in. (19 mm) . . . . . .319 ft. (97 m)

7/8 in. (22 mm) . . . . . .226 ft. (69 m)

1 in. (25 mm) . . . . . .154 ft. (47 m)




A - 2.12 in. (45 mm)
B - 2.56 in. (65 mm)
C - To match cable dia.

**Hydraulic System**

Oil Capacity

Standard PTO . . . . . .78 Qts. (74 L)

Operating Pressure . . . . . .390-410 PSI (2,690-2,830 kPa)

Typical Operating Temperature . . . . . .Up To Ambient Plus 80°F (26.7°C)

## RECOMMENDED FASTENER TORQUE

The general purpose torque shown in the chart applies to SAE Grade 5 and Grade 8 bolts, studs and standard steel full, thick and high nuts.

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

Lubricated Torque values based on use of SAE 30wt engine oil applied to threads anf face of bolt or nut.

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

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

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

To convert lb ft to kg•m, multiply lb ft value by 0.1383.

# *METRIC CONVERSION TABLE*

| English to Metric | | | Metric to English | | |
|---|---|---|---|---|---|
| **LINEAR** | | | | | |
| inches (in.) | X 25.4 | = millimeters (mm) | millimeters (mm) | X 0.3937 | = inches (in.) |
| feet (ft.) | X 0.3048 | = meters (m) | meters (m) | X 3.281 | = feet (ft.) |
| miles (mi.) | X 1.6093 | = kilometers (km) | kilometers (km) | X 0.6214 | = miles (mi.) |
| **AREA** | | | | | |
| inches$^2$ (sq.in.) | X 645.15 | = millimeters$^2$ (mm$^2$) | millimeters$^2$ (mm$^2$) | X 0.000155 | = inches$^2$ (sq.in.) |
| feet$^2$ (sq.ft.) | X 0.0929 | = meters$^2$ (m$^2$) | meters$^2$ (m$^2$) | X 10.764 | = feet$^2$ (sq.ft.) |
| **VOLUME** | | | | | |
| inches$^3$ (cu.in.) | X 0.01639 | = liters (l) | liters (l) | X 61.024 | = inches$^3$ (cu.in.) |
| quarts (qts.) | X 0.94635 | = liters (l) | liters (l) | X 1.0567 | = quarts (qts.) |
| gallons (gal.) | X 3.7854 | = liters (l) | liters (l) | X 0.2642 | = gallon (gal.) |
| inches$^3$ (cu.in.) | X 16.39 | = centimeters$^3$ (cc) | centimeters3 (cc) | X 0.06102 | = inches$^3$ (cu.in.) |
| feet$^3$ (cu.ft.) | X 28.317 | = liters (l) | liters (l) | X 0.03531 | = feet$^3$ (cu.ft.) |
| feet$^3$ (cu.ft.) | X 0.02832 | = meters$^3$ (m$^3$) | meters3 (m3) | X 35.315 | = feet$^3$ (cu.ft.) |
| fluid ounce (fl.oz.) | X 29.57 | = millileters (ml) | milliliters (ml) | X 0.03381 | = fluid ounce (fl.oz.) |
| **MASS** | | | | | |
| ounces (oz.) | X 28.35 | = grams (g) | grams (g) | X 0.03527 | = ounces (oz.) |
| pounds (lbs.) | X 0.4536 | = kilograms (kg) | kilograms (kg) | X 2.2046 | = pounds (lbs.) |
| tons (2000 lbs.) | X 907.18 | = kilograms (kg) | kilograms (kg) | X 0.001102 | = tons (2000 lbs.) |
| tons (2000 lbs.) | X 0.90718 | = metric tons (t) | metric tons (t) | X 1.1023 | = tons (2000 lbs.) |
| tons (long) (2240 lbs.) | X 1013.05 | = kilograms (kg) | kilograms (kg) | X 0.000984 | = tons (long) (2240 lbs.) |
| **PRESSURE** | | | | | |
| inches Hg (60°F) | X 3600 | = kilopascals (kPa) | kilopascals (kPa) | X 0.2961 | = inches Hg (60°F) |
| pounds/sq.in. (PSI) | X 6.895 | = kilopascals (kPa) | kilopascals (kPa) | X 0.145 | = pounds/sq.in. (PSI) |
| pounds/sq.in. (PSI) | X 0.0703 | = kilograms/sq.cm. (kg/cm$^2$) | kilograms/sq.cm. (kg/cm2) | X 14.22 | = pounds/sq.in. (PSI) |
| pounds/sq.in. (PSI) | X 0.069 | = bars | bars | X 14.5 | = pounds/sq.in. (PSI) |
| inches $H_2O$ (60°F) | X 0.2488 | = kilopascals (kPa) | kilopascals (kPa) | X 4.0193 | = inches $H_2O$ (60°F) |
| bars | X 100 | = kilopascals (kPa) | kilopascals (kPa) | X 0.01 | = bars |
| **POWER** | | | | | |
| horsepower (hp) | X 0.746 | = kilowatts (kW) | kilowatts (kW) | X 1.34 | = horsepower (hp) |
| ft.-lbs./min. | X 0.0226 | = watts (W) | watts (W) | X 44.25 | = ft.-lbs./min. |
| **TORQUE** | | | | | |
| pound-inches (in.-lbs.) | X 0.11298 | = newton-meters (N-m) | newton-meters (N-m) | X 8.851 | = pound-inches (in.lbs.) |
| pound-feet (ft.-lbs.) | X 1.3558 | = newton-meters (N-m) | newton-meters (N-m) | X 0.7376 | = pound-feet (ft.-lbs.) |
| pound-feet (ft.-lbs.) | X .1383 | = kilograms/meter (kg-m) | kilogram/meter (kg-m) | X 7.233 | = pound-feet (ft.-lbs.) |
| **VELOCITY** | | | | | |
| miles/hour (m/h) | X 0.11298 | = kilometers/hour (km/hr) | kilometers/hour (km/hr) | X 0.6214 | = miles/hour (m/h) |
| feet/second (ft./sec.) | X 0.3048 | = meter/second (m/s) | meters/second (m/s) | X 3.281 | = feet/second (ft./sec.) |
| feet/minute (ft./min.) | X 0.3048 | = meter/minute (m/min) | meters/minute (m/min) | X 3.281 | = feet/minute (ft./min.) |

**TEMPERATURE**

°Celsius = 0.556 (°F - 32) °Fahrenheit = (1.8°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 $10^{-6}$ |