Caterpillar manual de Taller 140-H

INDICE

-pruebas y ajustes.

*Sistema de frenos:
-información tecnica.
-instrucción especial.

*Sistema de lubricación:

-las válvulas de muestreo de fluido rediseñadas están disponibles para todos los productos.
-cambios en el uso y limpieza del grupo de monitor de contaminación.
-practicas para mangueras y acoplamientos CAT.
-grupo de monitor de contaminación portátil que proporciona una alternativa económica al conteo de partículas.

Plancha y brida que se pueden usar durante las pruebas de caudal de las bombas hidráulicas principales

SMCS - 0738; 5070; 5084

Productos Caterpillar:

- **Todos**

Ver imagen

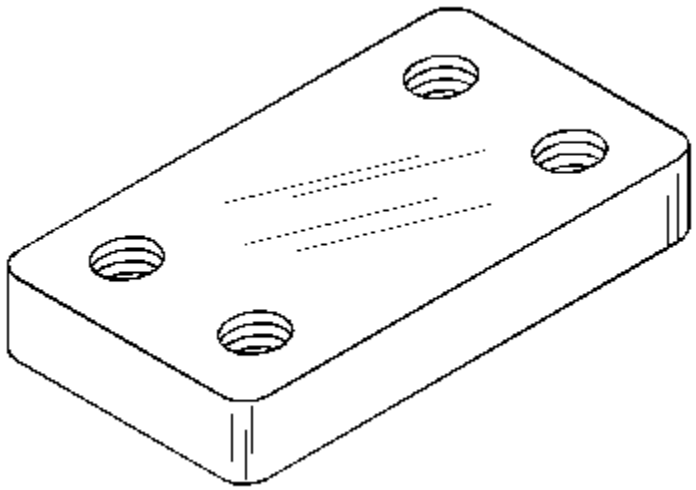

Ilustración 1 g01157067

Tapa 7I-7133

Ver imagen

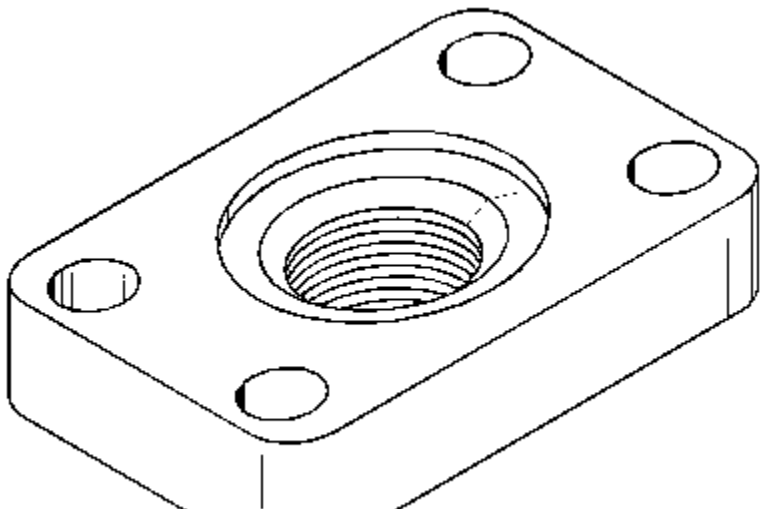

Ilustración 2 g01157068

Brida 7I-7151

El Departamento de Herramientas de Servicio al Distribuidor ofrece la Tapa 7I-7133 y la Brida 7I-7151 para utilizar durante pruebas de caudal de las bombas hidráulicas principales de la mayoría de las máquinas Caterpillar.

La Tapa 7I-7133 bloquea un orificio para la prueba. La Brida 7I-7151 tiene un orificio No. 16 que permite instalar un medidor de flujo.

Tabla 1

Especificaciones para la tapa y brida		
Dimensiones de la plancha	**Tamaño de los agujeros para los pernos**	**Especificaciones de las roscas**
Tapa 7I-7133		
96,7 X 61,8 X 18 mm (3,81 X 2,43 X 0,71 pulg)	4 agujeros con centros ubicados en las esquinas del rectángulo de 66,7 X 31,8 mm (2,63 X 1,25 pulg)	Agujeros de perno Rosca M12 X 1,75 X 6H
Brida 7I-7151		
98 X 70 X 22 mm (3,9 X 2,8 X 0,9 pulg)	4 agujeros con centros ubicados en las esquinas del rectángulo de 77,8 X 42,9 mm (3,06 X 1,69 pulg)	Los agujeros para los pernos no tienen roscas

Rotating Group Adjustment Instructions for Bosch Rexroth Pumps and Motors{3203, 4351, 5058, 5070}

SMCS - 3203; 4351; 5058; 5070

Agricultural Tractor: All
Articulated Truck:with Jake Brake Retarders Built Prior to 1999 All
Articulated Truck: All
Asphalt Paver: All
Backhoe Loader: All
Challenger: All
Cold Planer: All
Combine: All
Compact Track Loader: All
Compact Wheel Loader: ALL
Earthmoving Compactor: All
Excavator: All All Wheeled Excavators
Forest Products: All
Integrated Toolcarrier: All
Landfill Compactor: All
Load Haul Dump: All
Mini Hydraulic Excavator: All
Motor Grader: All
Multi Terrain Loader: All
Off-Highway Truck/Tractor: All
Paving Compactor: All
Pipelayer: All
Skid Steer Loader: All
Soil Compactor: All
Telehandler: All
Track Feller Buncher: Caterpillar
Track-Type Loader: All
Track-Type Skidder: All
Track-Type Tractor: All
Underground Articulated Truck: All
Wheel Dozer: All
Wheel Feller Buncher: All Caterpillar Branded
Wheel Loader: All
Wheel Skidder: All
Wheel Tractor-Scraper: All

Introduction

Table 1

Summary of Changes in REHS1607-06
Made Major changes to "Lift-Off Clearance Adjustment - A6VM/A6VE 200/250/355 cc with the Type 2 Barrel" and "Lift-Off Clearance Adjustment - A8VO" sections.

For questions or additional information concerning this guideline, submit a feedback form in the Service Information System website. In order to address an urgent need, please use the following to relay your request to Caterpillar Repair Process Engineering:

- Cat Dealer Technical Communicator
- Dealer Solution Network
- Cat Technical Representative
- Knowledge Network (on-line)

This special instruction standardizes the instructions for the adjustment of the rotating group for Bosch Rexroth piston pumps and motors. This document will be a source in order to find the instructions for the adjustment of the rotating group for all Caterpillar equipment that incorporates Bosch Rexroth piston pumps and motors.

Type Code Breakdown

Pumps manufactured by Bosch Rexroth may be labeled several different ways including: Brueninghaus Hydromatik GMBD, Mannesmann Rexroth, Rexroth Corp. the Mobile Hydraulic Division, Rexroth-Sigma, or Uchida Hydraulics Co. LTD. Bosch Rexroth has a group of numbers and letters attached to each pump known as pump identification or a pump description. The typical pump or motor description can be broken down as follows:

Table 2

	1	2	3	4	5	6		7	8	9
Type Code	A20	V	L	O	60	EP	/	61	R	V

(1) Axial Piston Unit Family

A - Metric version

AA - SAE version

(2) Displacement Type

V - Variable Displacement

F - Fixed Displacement

(3) L if Long Life Bearings, else no designation

Note: For A11 pumps, L designates with charge pump, else no designation

(4) Device and Style

M - Motor Standard Design

E - Motor Plug-In Design

G - Closed Circuit Pump

O - Open Circuit Pump

(5) Displacement in cubic centimeters

(6) Control Device

(7) Series and Index

(8) Direction of Rotation

R - Clockwise

L - Counterclockwise

W - Alternating

Note: View from the shaft end

(9) Seal Type

V - FPM Fluoro rubber

P - NBR Nitrile rubber

N - NBR, shaft seal in FPM

Access the Rexroth Mobile Hydraulics web site for more information.

http://www.boschrexroth.com

Document Coverage

Due to the extensive use of Bosch Rexroth pumps and motors in Caterpillar Equipment, it would not be feasible to list all of the associated Caterpillar part numbers. The identification refers to the family of the motor or pump, the displacement in cubic centimeters, and the series.

Table 3

Document Coverage		
Family, Device, and Style	Displacement in cc	Series and Index
A2FM	16 to 180	Series 61
A2FE	45 to 125	Series 61
A2FO	45	Series 61
A4VG	40 to 250	Series 32
A4VG	250	Series 10

A4VG	250	Series 10
A6VM	55	Series 60
A6VM	55 to 355	Series 63
A6VE	28 to 107	Series 63
A8VO	107 to 200	Series 60
A11VO	130 to 260	Series 10/11
A11VLO	130 to 260	Series 10
A20VLO	190 to 260	Series 10

Note: The A10 series of pumps requires no adjustment of the rotary group.

Fabricated Tooling

Certain tooling must be fabricated in order to perform adjustments to the rotating group for all pumps and motors.

V-Block

Ver imagen

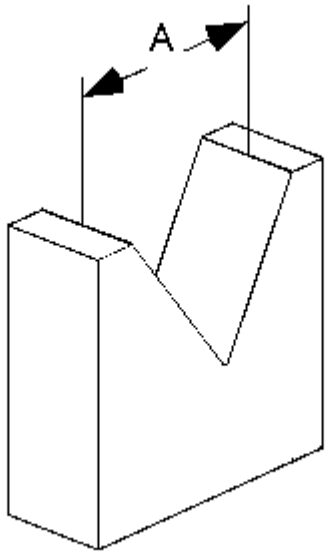

Illustration 1 g01009274

Tooling for the A2FM/A2FE/A2FO/A8VO pump and motor adjustment for the bearing preload.

1. To fabricate V-Block, cut a 90 degree vee approximately 150 mm (5.9 inch) wide into a block of wood. Call this dimension (A) .

Measuring Plate Group

Ver imagen

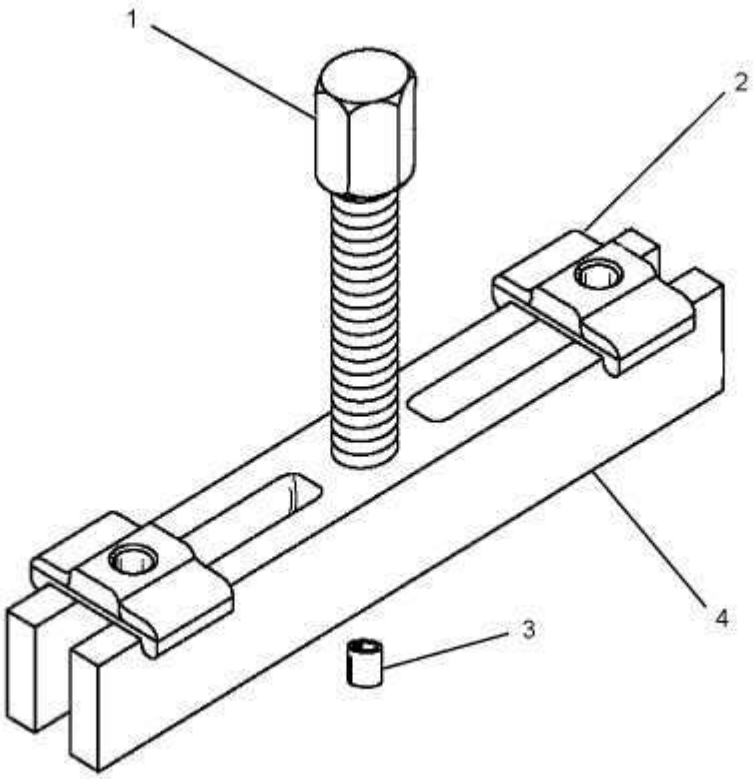

Illustration 2 g01009308

FT2739 Measuring Plate Group

Tooling for the 28-160 cc A2FM/A2FE/A2FO pump and motor adjustment for the lift-off clearance.

(1) 6V-4832 Screw

(2) 126-7181 Sliding Plate

(3) 1P-0456 Drive Plate

(4) 6V-3009 Cross Bar

1. Fabricate the measuring plate by constructing the **6V-3009** Cross Bar per instructions in print.
2. Refer to Illustration 2 in order to assemble the plate group components.

Ver imagen

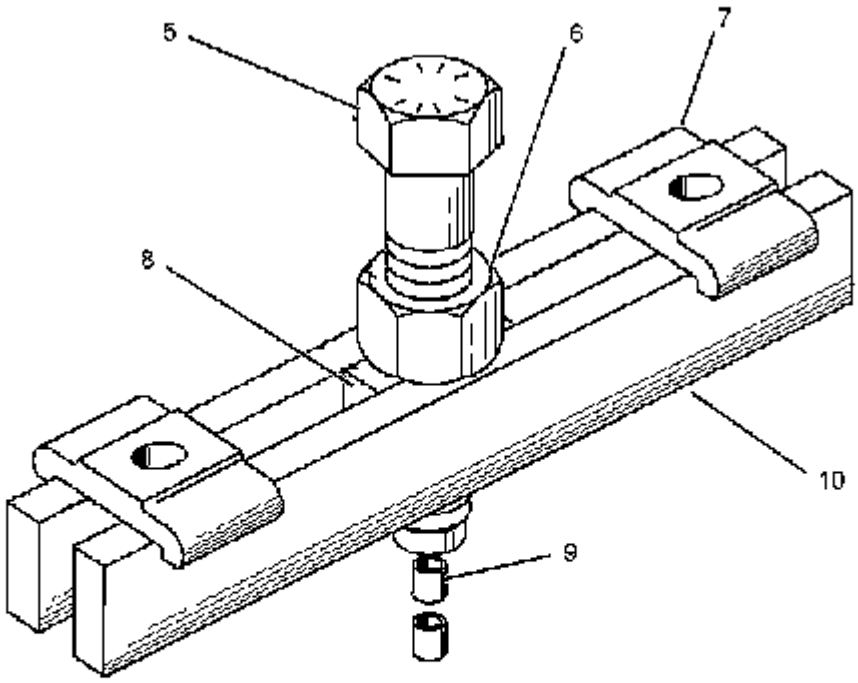

Illustration 3 g01009306

FT2786 Measuring Plate Group

Tooling for the adjustment for the lift-off clearance for the A2FM/A2FE/A2FO 180-250 cc motors and pumps.

(5) 5P-8715 Forcing Bolt

(6) 5B-0637 Nut

(7) 3H-0465 Puller Plate

(8) 1U-9895 Crossblock

(9) 1P-0456 Drive Plate

(10) FT2786 Measuring Plate Group

1. Fabricate the measuring plate by constructing the **FT2786** Measuring Plate Group per instructions in print.
2. Refer to Illustration 3 in order to assemble the plate group components.

Rotating Group Adjustments

A2FM/A2FE Motors and A2FO Pumps for "Old Style" with a Spanner Nut

Old style A2FM/A2FE motors and A2FO pumps require a spanner nut to set the bearing preload and the rotating torques. Cup springs and a shim are used to set the "lift off" clearance between the barrel and the port plate. New style A2FM/A2FE motors and A2FO pumps use a snap ring for the bearing preload and a center spring for the "lift-off" clearance.

Ver imagen

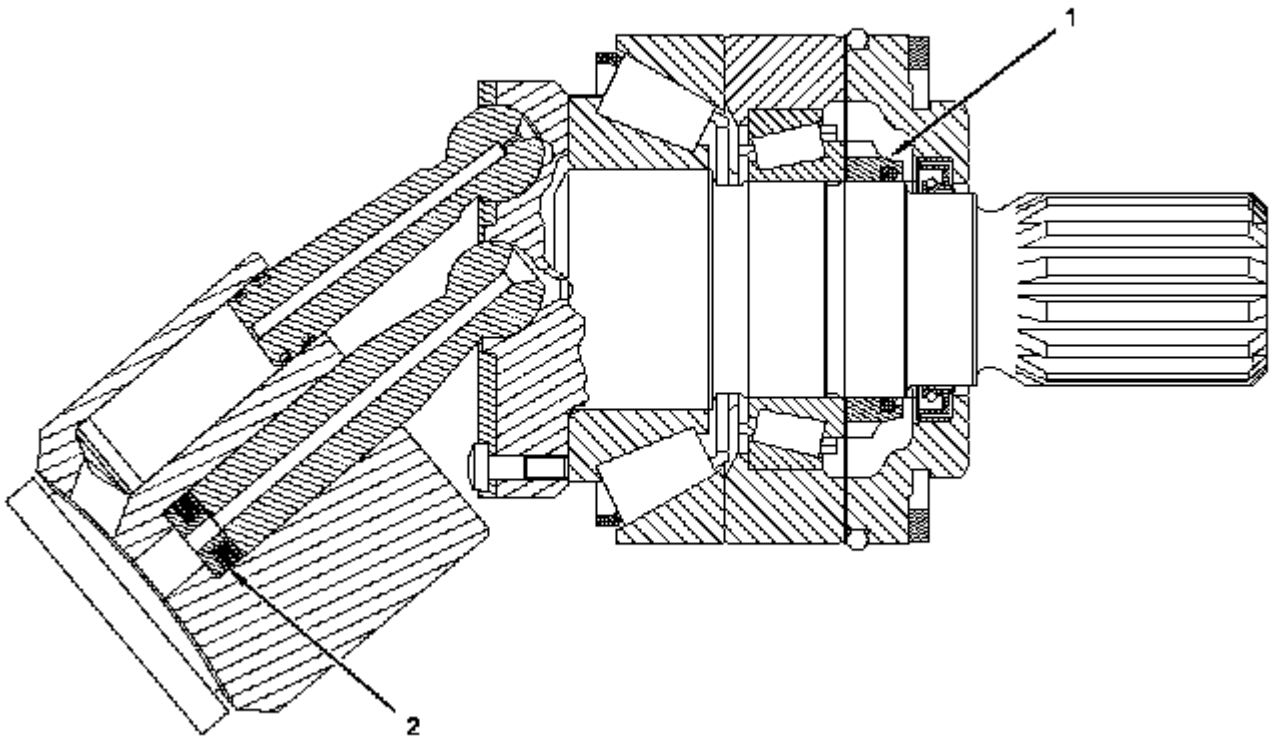

Illustration 4 g01118952

"Old Style" A2FM/A2FE Motor and A2FO Pump

(1) Spanner nut

(2) Cup springs

Bearing Preload Adjustment for the A2FM/A2FE/A2FO "Old Style"

This section shows the proper way to set the bearing preload. If bearing preload is too high or low, bearing life will be shortened due to heat generation. Additionally, if bearing preload is too high the rotating torque

life will be shortened due to heat generation. Additionally, if bearing preload is too high the rotating torque will be too high causing poor system operation.

Ver imagen

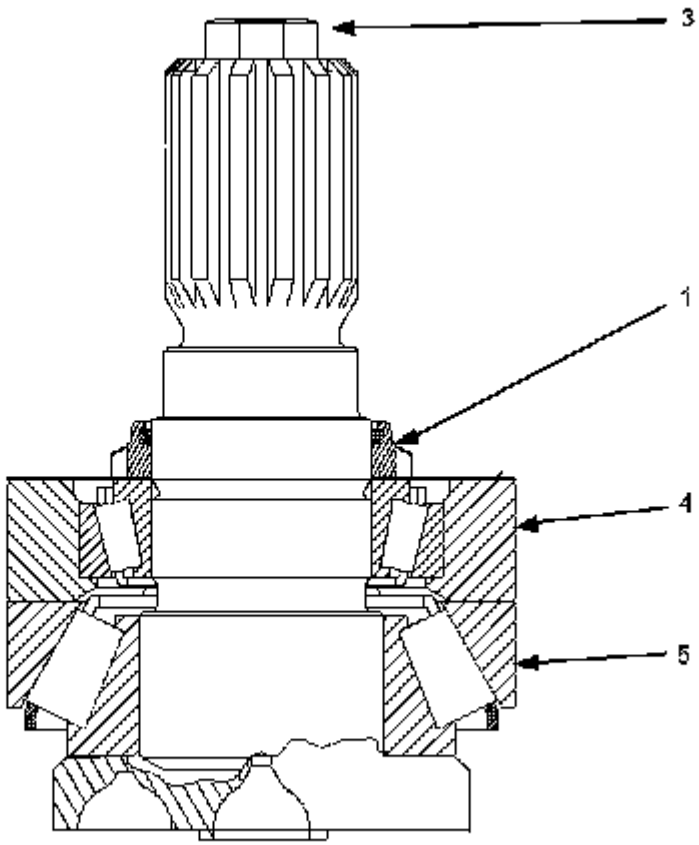

Illustration 5 g01011046

Bearing group of the "old style" A2FM/A2FE motor and A2FO pump

(1) Spanner nut

(3) Bolt

(4) Upper Bearing

(5) Lower Bearing

1. Install both bearings (4) and (5) onto the shaft.
2. Place the spanner nut on the shaft. Tighten the spanner nut by using a spanner nut wrench.
3. Place a hex head bolt (3) in the shaft end.
4. Place the shaft group in the fabricated V-Block as shown in figure 6

Ver imagen

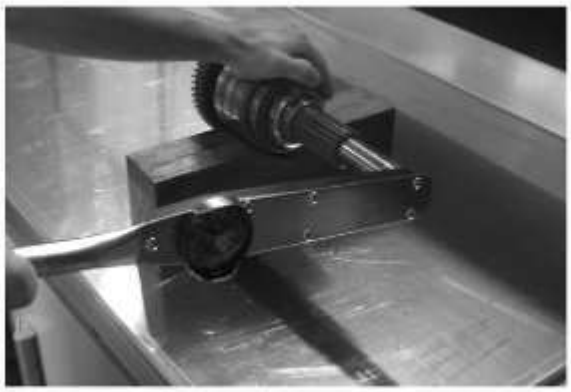

Illustration 6 g01012576

5. Place **9S-7354** dial type torque wrench on the installed bolt. Hold bearing outer races with a hand in order to prevent rotation. Turn the shaft assembly. Observe the torque that is required to turn the shaft assembly. Compare this value with the values from table 4.

6. Adjust the spanner nut in order to set the required rotating torque.

7. Remove the bolt from the shaft end.

Table 4

Bearing Preload		
Piston Diameter in (mm) (in)	Displacement in cc	Rotating torque in (Nm)(in-lb)
11.2 (0.441)	16	0.10-0.18 (0.89-1.59)
13.3 (0.524)	28	0.22-0.35 (1.95-3.10)
16 (0.630)	45	0.37-0.55 (3.27-4.87)
16.8 (.661)	56	0.45-0.70 (3.98-6.20)
17.8 (0.701)	63	0.45-0.70 (3.98-6.20)
18.9 (0.744)	80	0.75-1.10 (6.64-9.74)
20 (0.787)	90	0.75-1.10 (6.64-9.74)
20.6 (0.811)	107	1.10-1.50 (9.74-13.28)

22.3 (0.878)	125	1.10-1.50 (9.74-13.28)
23 (0.906)	131	1.10-1.50 (9.74-13.28)
23.6 (0.930)	160	1.50-1.90 (13.28-16.82)
25 (0.984)	180	1.50-1.90 (13.28-16.82)

Rotating Group Positioning for the A2FM/A2FE/A2FO "Old Style"

Ver imagen

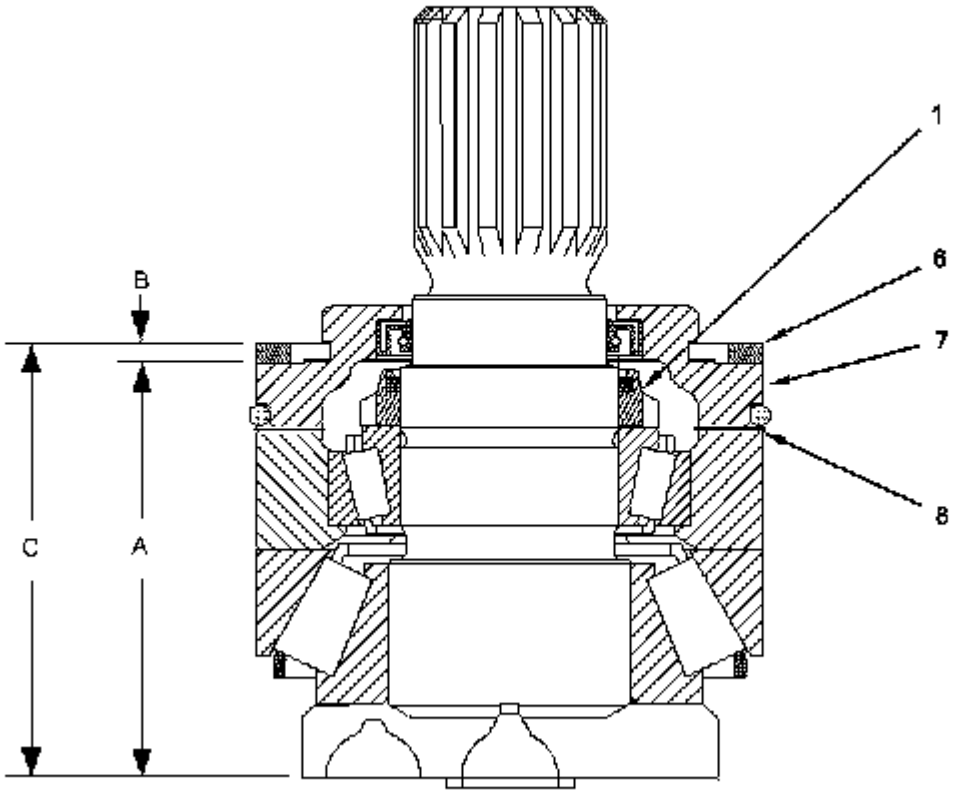

Illustration 7 g01118959

Bearing group of "old style" A2FM/A2FE motor and A2FO pump

(1) Spanner nut

(6) Snap ring

(6) Snap ring

(7) Front cover

(8) Shim

1. Place cover (7) on shaft assembly.

   Note: Measure without the adjustment shim (8)

2. Measure the distance (A) from the face of the shaft to the top of the cover.

   Note: Do not include the shaft boss in measurements.

3. Measure the thickness (B) of the snap ring (6) .

4. Use dimension (C) from the table 5 minus measured dimension (A). Then subtract measured dimension (B) from that figure. The result is the required thickness of the shim (8). Refer to table 6 for the shim sizes and the associated part number.

   Dimension (C) - dimension (A) - dimension (B) = required shim thickness.

   Note: Multiple shim combinations may be used to achieve the desired dimension (C) .

Table 5

Rotating Group Positioning	
Displacement in cc	Dimension (C) in (mm) (in)
16	76.6-76.7 (3.016-3.020)
28	76.8-76.9 (3.024-3.028)
45	83.2-83.3 (3.276-3.280)
56	89.6-89.7 (3.528-3.531)
63	89.6-89.7 (3.528-3.531)
80	99.4-99.5 (3.913-3.917)
90	99.4-99.5 (3.913-3.917)
107	111.2-111.3 (4.378-4.382)
125	111.2-111.3 (4.378-4.382)
131	111.2-111.3 (4.378-4.382)
160	120.7-120.8 (4.752-4.756)
180	120.7-120.8 (4.752-4.756)

Table 6

Adjustment Shim (8)		
Displacement in cc	Shim thickness in (mm)(in)	Part Number

Displacement in cc	Shim thickness in (mm)(in)	Part Number
16	.1 (0.004)	1447804
	.3 (0.012)	1447805
28		
45	0.1 (0.004)	1801376
	0.3 (0.012)	1801375
56	0.1 (0.004)	9T2904
	0.3 (0.012)	9T2903
63	0.1 (0.004)	9T2904
	0.3 (0.012)	9T2903
80	0.1 (0.004)	9T2582
	0.3 (0.012)	9T2581
90	0.1 (0.004)	9T2582
	0.3 (0.012)	9T2581
107	0.1 (0.004)	9T1576
	0.3 (0.012)	9T1579
125	0.1 (0.004)	9T1576
	0.3 (0.012)	9T1579
131	0.1 (0.004)	9T1576
	0.3 (0.012)	9T1579
160	0.2 (0.008)	6E1704
	0.3 (0.012)	6E1705
180	0.2 (0.008)	6E1704
	0.3 (0.012)	6E1705

Lift-Off Clearance Adjustment - A2FM/A2FE/A2FO "Old Style"

This adjustment measures the allowable separation between the port plate and the barrel. The "lift-off" clearance or the allowable separation can be adjusted by adding or removing shims from the spring cup group in the center pin bore. Excessive leakage will occur during high-pressure spikes which may lead to rotary group damage and poor system performance if the allowable separation is too large.

Ver imagen

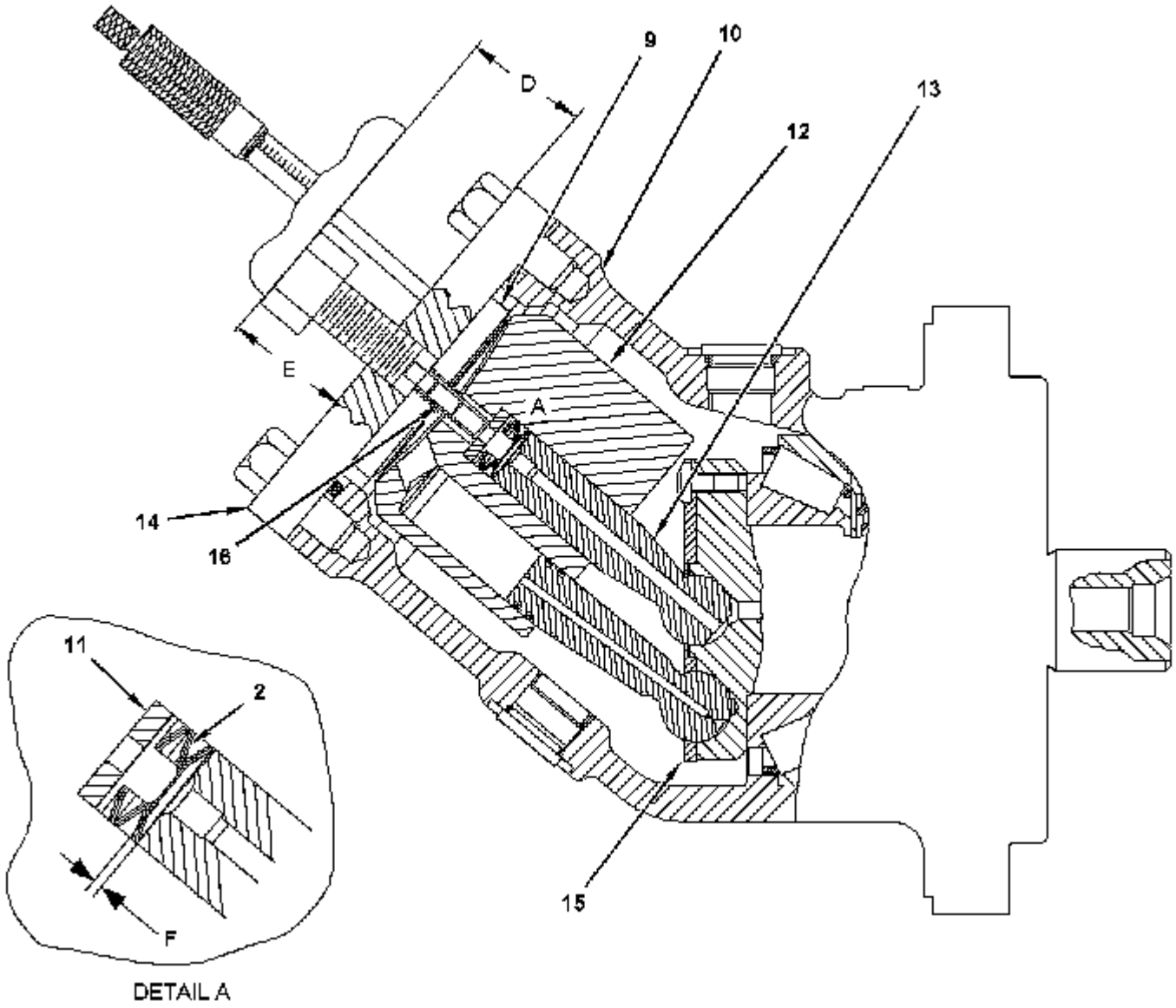

Illustration 8 g01139759

The typical lift-off clearance (F) measurement

(2) Cup spring set

(9) Port plate

(10) Housing

(11) Adjustment shim

(12) Barrel

(13) Center pin

(14) Measuring plate group

(15) Piston retaining plate

(16) Drive plates (3)

1. Insert the center pin (13). Insert the pistons. Attach the piston retaining plate (15) to the shaft group.
2. The retaining plate (15) bolts need to be tightened to the specified torque value.

Ver imagen

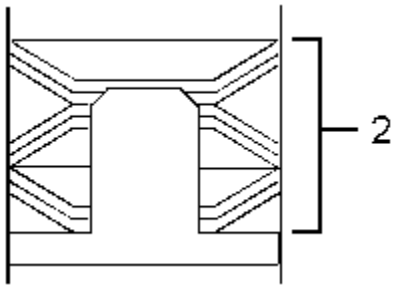

Illustration 9 g01009398

The arrangement of the 6 cup springs for A2FM/A2FE motor

Ver imagen

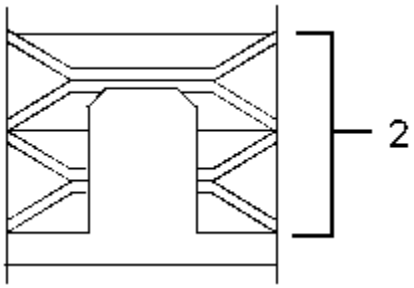

Illustration 10 g01010870

The arrangement of the 4 cup springs for A2FO pumps.

Note: For ease of installation, use a punch or wire to hold spring cups in place.

3. Refer to the Illustrations 9 and 10 in order to assemble the cup springs.
4. Install the original adjustment shim (11) .
5. Fit barrel (12) over center pin (13). Insert each piston into the barrel (12) .
6. Hold the rotating group vertically in a vice by the splined shaft.

   Note: Protect the splines of the shaft from damage.
7. Swivel barrel to the maximum angle.
8. Heat motor housing (10) to 80 ° C (176 ° F).

9. Fit the housing over the rotating group.
10. Allow the housing to cool.
11. Install the shims (8) that were selected from the Rotating Group Positioning section. Install the front cover (7) and the snap ring (6) .
12. Use a press or an extractor device to tightly pull the rotary group against the snap ring (6) .
13. Install port plate (9) in the housing.
14. Insert drive plates (16) in the center of the port plate and the barrel's center bore.
15. Bolt the appropriate tooling (14) to the housing. Tighten until the port plate is flush with the housing face.

    Note: Tooling Selection

    - for A2FM/A2FE/A2FO 28-160 cc displacement, use **FT2739** Measuring Plate Group .
    - for A2FM/A2FE/A2FO 180-250 cc displacement use **FT2786** Measuring Plate Group .
16. Tighten the forcing bolt or screw until the drive plates just contact shim (11) .
17. Measure distance (D) from the face of the top of the H-Bar to the top of the forcing bolt or screw and record.
18. Tighten the forcing bolt or screw until the cup springs (2) compress and the center pin (13) contacts the shim (11) .

    Note: Do not use excessive force once resistance is met.
19. Measure dimension (E). This is the distance from the face of the H-Bar to the top of the forcing bolt or screw after compression.
20. Dimension (D) minus dimension (E) yields the lift-off clearance (F) .

    dimension (D) - dimension (E) = dimension (F) .
21. Take the lift-off clearance (F) minus required lift-off clearance (G) from Table 7 in order to find the change in thickness of the shim.

    dimension (F) - dimension (G) = change in shim thickness needed.

    Note: Use only one shim for lift-off clearance adjustment.

Table 7

Lift-Off Clearance	
Displacement in cc	lift-off Clearance (G) in (mm) (in)
16-90	0.15-0.25 (0.006-0.010)
107-180	0.25-0.40 (0.010-0.016)

22. Select the appropriate shim from Table 8.

Table 8

Adjustment Shim (11)		
Displacement in cc	Shim thickness in (mm)(in)	Part Number
16	1.20 (0.0470)	1834001
	1.30 (0.0512)	1834002
	1.40 (0.0551)	1834003
	1.50 (0.0591)	1834000
45	3.50 (0.1378)	1801279
	3.60 (0.1417)	1801278
	3.70 (0.1457)	1801277
	3.80 (0.1496)	1801274
	3.90 (0.1535)	1801275
	4.00 (0.1575)	1801276
56	7.05 (0.2776)	1440597
	7.15 (0.2815)	1440598
	7.25 (0.2854)	1440599
	7.35 (0.2894)	1440600
63	3.60 (0.1417)	1716861
	3.70 (0.1457)	1716860
	3.80 (0.1496)	1716859
	3.90 (0.1535)	1716858
	4.00 (0.1575)	1928857
80	3.50 (0.1378)	1410247
	3.60 (0.1417)	1410248
	3.70 (0.1457)	1410249
	3.80 (0.1496)	1410250
	3.90 (0.1535)	1410251
	4.00 (0.1575)	1410252
	3.50 (0.1378)	1410247

90	3.50 (0.1378)	1410247
	3.60 (0.1417)	1410248
	3.70 (0.1457)	1410249
	3.80 (0.1496)	1410250
	3.90 (0.1535)	1410251
	4.00 (0.1575)	1410252
107	3.60 (0.1417)	1713060
	3.70 (0.1457)	1713059
	3.80 (0.1496)	1713058
	3.90 (0.1535)	1713057
	4.00 (0.1575)	1713054
125	3.60 (0.1417)	1713060
	3.70 (0.1457)	1713059
	3.80 (0.1496)	1713058
	3.90 (0.1535)	1713057
	4.00 (0.1575)	1713054
131	3.60 (0.1417)	1713060
	3.70 (0.1457)	1713059
	3.80 (0.1496)	1713058
	3.90 (0.1535)	1713057
	4.00 (0.1575)	1713054
160	3.50 (0.1378)	1249932
	3.60 (0.1417)	1249933
	3.70 (0.1457)	1249934
	3.80 (0.1496)	1249935
	3.90 (0.1535)	1249936
	4.00 (0.1575)	1249937
180	9.95 (0.3917)	6E1698
	10.05 (0.3957)	6E1699
	10.15 (0.3996)	6E1702
	10.25 (0.4035)	6E1703

	10.23 (0.4035)	6L1703

23. Disassemble the motor in order to change the shim. Reassemble the motor with the correct shim.

A2FM/A2FE Motor and A2FO Pumps - "New Style" With a Snap Ring

The new style A2FM/A2FE motors and the A2FO pumps use a snap ring and shims to set the bearing preload. A single coil spring and the shim are used to set the lift off clearance between the barrel and the port plate. Old style A2FM/A2FE motors and A2FO pumps use a spanner nut to set bearing preload and a cup spring set to adjust "lift-off" clearance.

Ver imagen

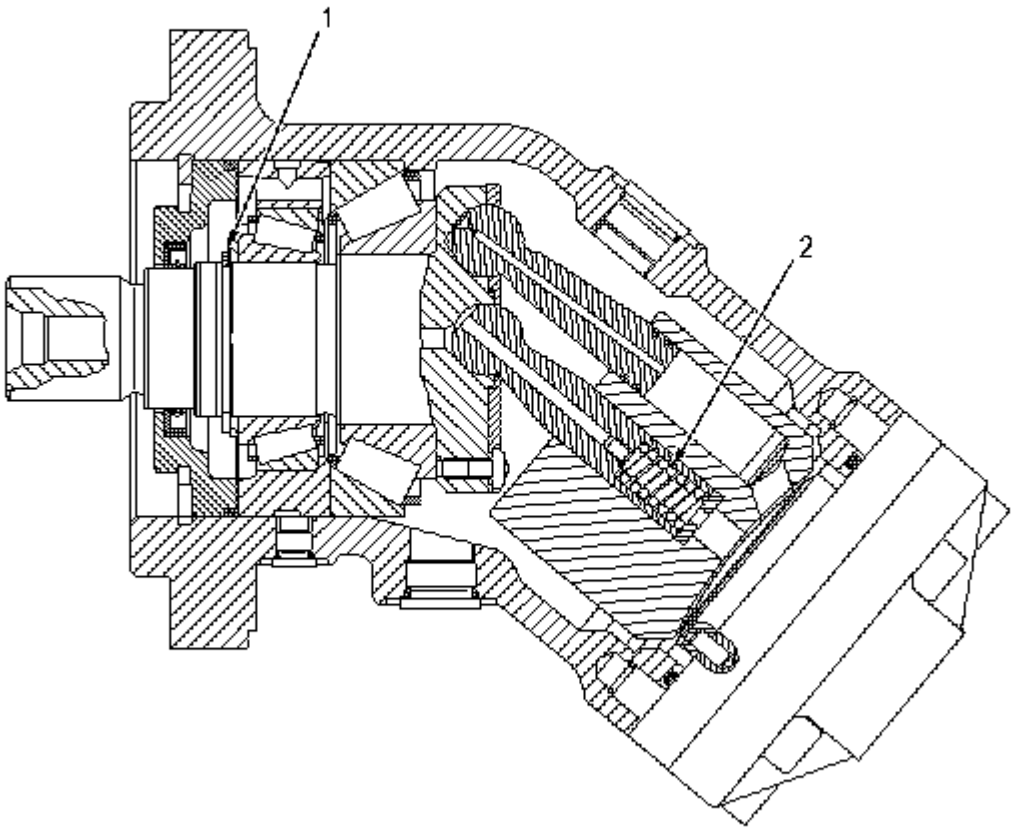

Illustration 11 g00992929

"New Style" A2FM/A2FE motor and A2FO pump

(1) Snap ring

(2) Center spring

Bearing Preload Adjustment - A2FM/A2FE/A2FO "New Style"

Bearings for the "new style" motors and the "new style" pumps are received as a kit. The kit includes bearings, adjustment shims, and a retaining clip. This kit sets the necessary bearing preload.

Rotating Group Positioning - A2FM/A2FE/A2FO "New Style"

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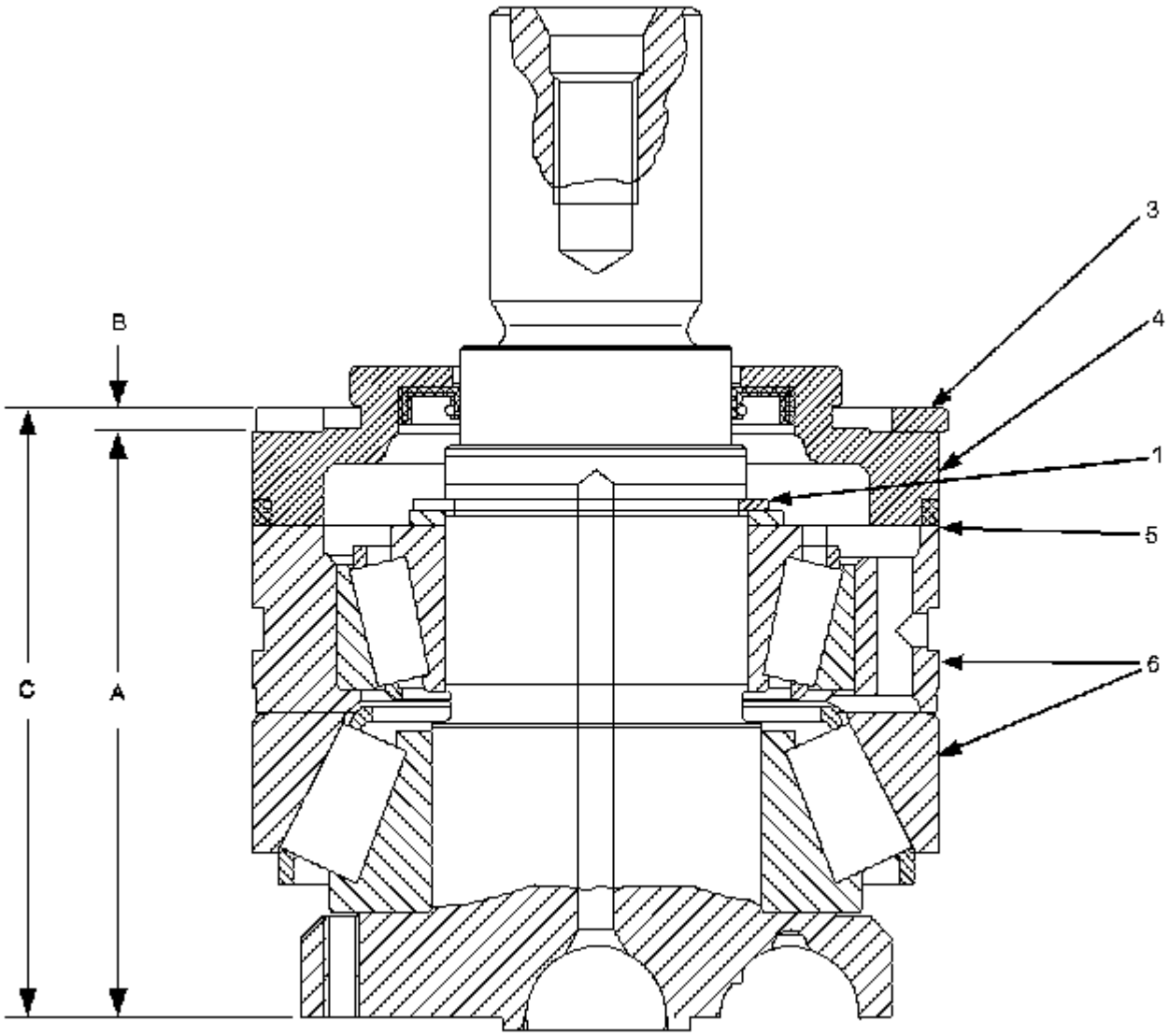

Illustration 12 g01150537

(1) Snap ring

(3) Snap ring

(3) Snap ring

(4) Front cover

(5) Adjustment shim

(6) Bearing kit

1. Install bearing kit (6) and snap ring (1) on the shaft as shown.
2. Place cover (4) on shaft assembly.

   Note: Make the measurements without the adjustment shim (5) installed.
3. Measure the distance (A) from the base of the shaft to the top of the cover (4) .
4. Measure the thickness (B) of the snap ring (3) .
5. Take dimension (C) from Table 9 minus measured dimension (A) minus measured dimension (B) in order to find the required thickness for the adjustment shim. Refer to Table 10 for the adjustment shim thickness and associated part numbers.

   Dimension (C) - dimension (A) - dimension (B) = required shim thickness (5) .

Table 9

Rotating Group Positioning	
Displacement in cc	Dimension (C) in (mm) (in)
16	76.6-76.7 (3.016-3.020)
28	76.8-76.9 (3.024-3.028)
45	83.2-83.3 (3.276-3.280)
56	89.6-89.7 (3.528-3.531)
63	89.6-89.7 (3.528-3.531)
80	99.4-99.5 (3.913-3.917)
90	99.4-99.5 (3.913-3.917)
107	111.2-111.3 (4.378-4.382)
125	111.2-111.3 (4.378-4.382)
131	111.2-111.3 (4.378-4.382)
160	120.7-120.8 (4.752-4.756)
180	120.7-120.8 (4.752-4.756)

Table 10

Adjustment Shim (5)		
Displacement in cc	Shim thickness in (mm) (in)	Part Number

16	.1 (0.004)	1447804
	.3 (0.012)	1447805
28		
45	0.1 (0.004)	1801376
	0.3 (0.012)	1801375
56	0.1 (0.004)	9T2904
	0.3 (0.012)	9T2903
63	0.1 (0.004)	9T2904
	0.3 (0.012)	9T2903
80	0.1 (0.004)	9T2582
	0.3 (0.012)	9T2581
90	0.1 (0.004)	9T2582
	0.3 (0.012)	9T2581
107	0.1 (0.004)	9T1576
	0.3 (0.012)	9T1579
125	0.1 (0.004)	9T1576
	0.3 (0.012)	9T1579
131	0.1 (0.004)	9T1576
	0.3 (0.012)	9T1579
160	0.2 (0.008)	6E1704
	0.3 (0.012)	6E1705
180	0.2 (0.008)	6E1704
	0.3 (0.012)	6E1705

Note: Multiple shim combinations may be used to achieve the desired dimension (C) .

Lift-Off Clearance Adjustment - A2FM/A2FE/A2FO "New Style"

This adjustment measures allowable separation between the port plate and the barrel. The "lift off" clearance or the allowable separation can be adjusted by adding or removing shims from the spring group in the center pin bore. Excessive leakage will occur at high-pressure spikes if the allowable separation is too large. The excessive leakage may lead to rotary group damage and poor system performance.

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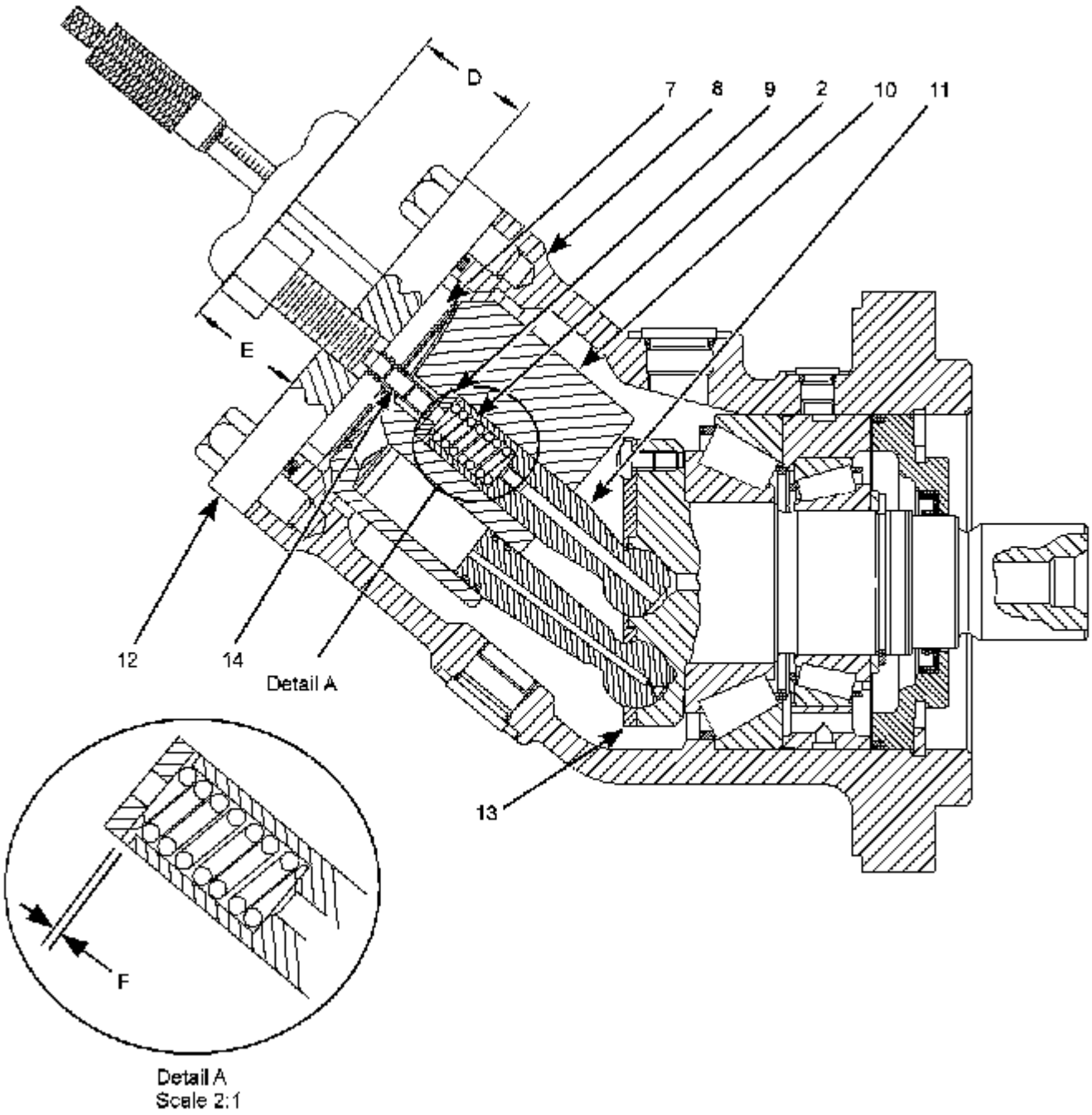

Illustration 13 g01011150

The typical lift-off clearance (F) measurement

(2) Center spring

(7) Port plate

(8) Housing

(9) Adjustment shim

(10) Barrel

(11) Center pin

(12) Measuring plate group

(13) Piston retaining plate

(14) Drive plates (3)

1. Insert the center spring (2) and the original adjustment shim (9) into the barrel's center bore.
2. Insert the center pin (11) and loosely attach the piston retaining plate (13) .
3. Insert pistons and tighten retaining plate bolts.
4. Fit barrel (10) over center pin (11). Insert each piston into the barrel.
5. Hold the rotating group vertically in a vice by the splined shaft.

   Note: Protect the splines of the shaft from damage.
6. Swivel barrel (10) to maximum angle.
7. Heat motor housing (8) to 80 ° C (176 ° F).
8. Fit housing (8) over the rotating group until seated.
9. Allow the housing to cool.
10. Install the shims (5) that were selected from the Rotating Group Positioning section Table 10. Install the front cover (4) and the snap ring (3) .
11. Pull the rotary group against the snap ring (3) by using a press or an extractor device.
12. Install port plate (7) in the housing.
13. Insert drive plates in the port plate's center or the barrel's center bore.
14. Bolt the appropriate tooling (11) to the housing. Tighten until the port plate is flush with the housing face.

    Note: Tooling Selection

    - For the A2FM/A2FE/A2FO 28-160 cc displacement, use **FT2739** Measuring Plate Group .
    - For A2FM/A2FE/A2FO 180-250 cc displacement use **FT2786** Measuring Plate Group .
15. Tighten the forcing bolt or screw until drive plates (14) just contact the adjustment shim (9) .
16. Measure distance (D) from the top of the H-Bar to the top of the forcing bolt or screw.
17. Tighten the forcing bolt until center spring (2) compresses and center pin (11) contacts the adjustment shim (9) .

    Note: Do not use excessive force once resistance is met.
18. Measure dimension (E). This is the distance from the top of the H-Bar to the top of the forcing bolt or

18. Measure dimension (E). This is the distance from the top of the H-Bar to the top of the forcing bolt or screw after compression.

19. Dimension (D) minus dimension (E) yields the lift-off clearance (F) .

    dimension (D) - dimension (E) = dimension (F) .

20. Take the lift-off clearance (F) minus the required lift-off clearance (G) from table 11 in order to find the change of the thickness of the shim.

    dimension (F) - dimension (G) = the needed change in shim thickness

    Note: Use only one shim for lift-off clearance adjustment.

Table 11

Lift-Off Clearance	
Displacement in cc	Lift-off Clearance (G) in (mm) (in)
16-90	0.15-0.25 (0.006-0.010)
107-180	0.25-0.40 (0.010-0.016)

21. Select the appropriate shim from Table 12.

Table 12

Adjustment Shim (9)		
Displacement in cc	Shim thickness in (mm)(in)	Part Number
16	1.20 (0.0470)	1834001
	1.30 (0.0512)	1834002
	1.40 (0.0551)	1834003
	1.50 (0.0591)	1834000
45	3.50 (0.1378)	1801279
	3.60 (0.1417)	1801278
	3.70 (0.1457)	1801277
	3.80 (0.1496)	1801274
	3.90 (0.1535)	1801275
	4.00 (0.1575)	1801276
56	7.05 (0.2776)	1440597
	7.15 (0.2815)	1440598
	7.25 (0.2854)	1440599
	7.35 (0.2894)	1440600

63	3.60 (0.1417)	1716861
	3.70 (0.1457)	1716860
	3.80 (0.1496)	1716859
	3.90 (0.1535)	1716858
	4.00 (0.1575)	1928857
80	3.50 (0.1378)	1410247
	3.60 (0.1417)	1410248
	3.70 (0.1457)	1410249
	3.80 (0.1496)	1410250
	3.90 (0.1535)	1410251
	4.00 (0.1575)	1410252
90	3.50 (0.1378)	1410247
	3.60 (0.1417)	1410248
	3.70 (0.1457)	1410249
	3.80 (0.1496)	1410250
	3.90 (0.1535)	1410251
	4.00 (0.1575)	1410252
107	3.60 (0.1417)	1713060
	3.70 (0.1457)	1713059
	3.80 (0.1496)	1713058
	3.90 (0.1535)	1713057
	4.00 (0.1575)	1713054
125	3.60 (0.1417)	1713060
	3.70 (0.1457)	1713059
	3.80 (0.1496)	1713058
	3.90 (0.1535)	1713057
	4.00 (0.1575)	1713054
131	3.60 (0.1417)	1713060
	3.70 (0.1457)	1713059
	3.80 (0.1496)	1713058

	3.90 (0.1535)	1713057
	4.00 (0.1575)	1713054
160	3.50 (0.1378)	1249932
	3.60 (0.1417)	1249933
	3.70 (0.1457)	1249934
	3.80 (0.1496)	1249935
	3.90 (0.1535)	1249936
	4.00 (0.1575)	1249937
180	9.95 (0.3917)	6E1698
	10.05 (0.3957)	6E1699
	10.15 (0.3996)	6E1702
	10.25 (0.4035)	6E1703

22. Disassemble to remove the shim then reassemble using the correct shim.

A4VG - Series 32

Lift-Off Clearance Adjustment - A4VG

This adjustment measures allowable separation between the port plate and the barrel. The "lift-off" clearance or the allowable separation can be adjusted by adding or removing shims from the center spring under the ball joint. Excessive leakage will occur at high-pressure spikes if the allowable separation is too large. Excessive leakage may lead to rotary group damage and poor system performance.

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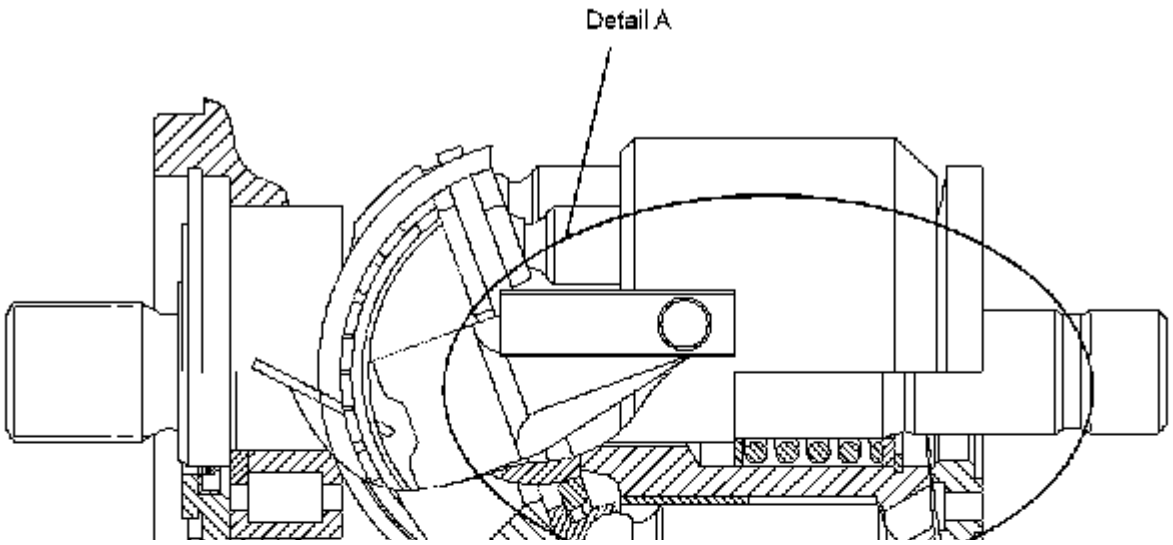

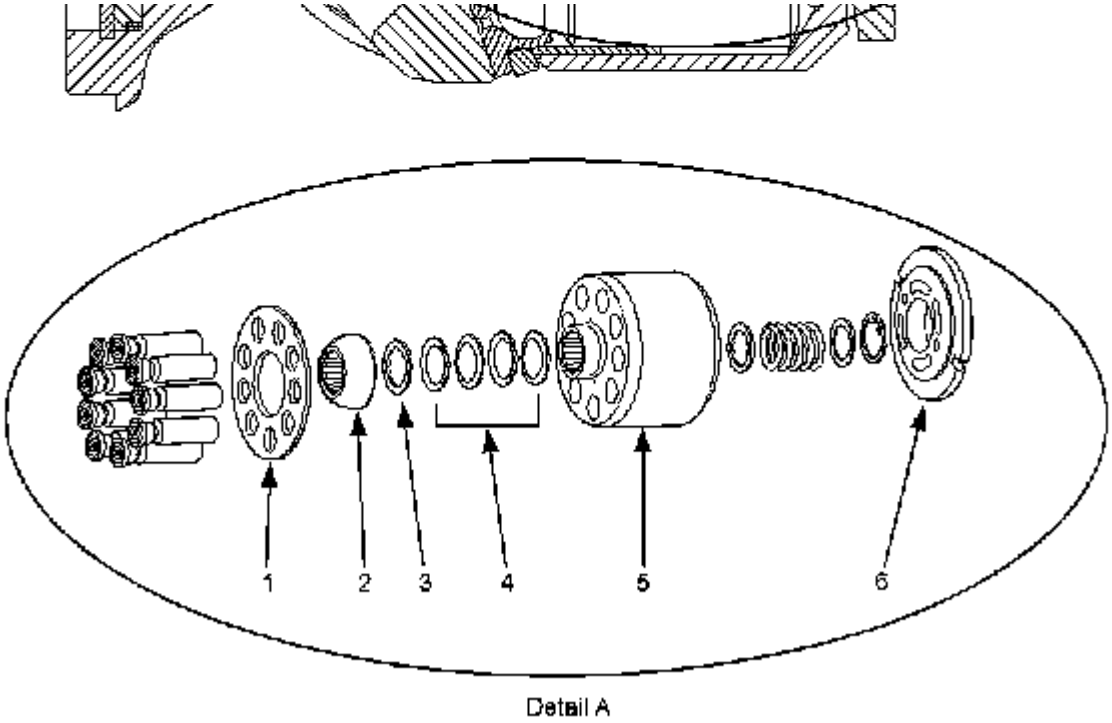

Illustration 14 g01010526

Typical A4VG pump

(1) Piston retaining ring

(2) Ball joint

(3) Adjustment shims

(4) Spring group

(5) Barrel

(6) Port Plate

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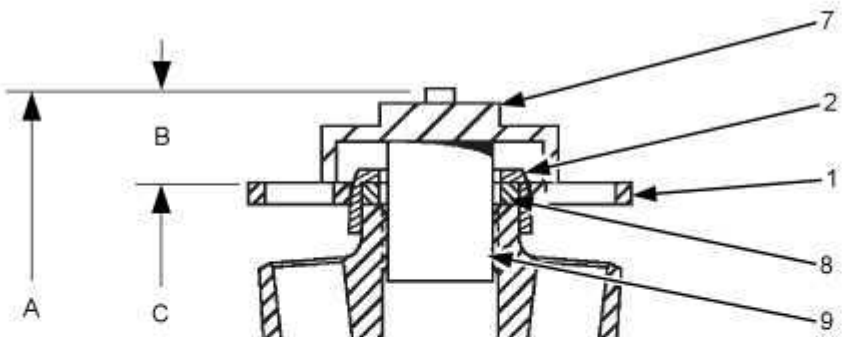

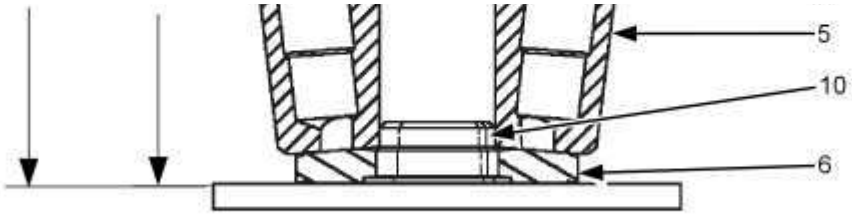

Illustration 15 g01119004

Required tooling

(1) Piston retaining ring

(2) Ball joint

(5) Barrel

(6) Port Plate

(7) Measuring bell

(8) Test ring or pins (3)

(9) Measuring hub

(10) Alignment plug

1. Select proper tooling from Table 13.

Table 13

Piston diameter in mm (in)	Displacement in cc	Hub (9) Part number	Bell (7) Part number	Test ring (8) Part number	Plug (10) Part number	Test Pins
15.2 (0.598)	40	135-8293	128-2744	135-8295	135-8291	
17 (0.669)	56	128-2743	128-2744	128-2745	128-2741	
18.4 (0.724)	71	135-8294	128-2744	135-8296	135-8292	
19.9 (0.783)	90	128-2747	128-2744	129-3877	129-3882	

22.2 (.874)	125	129-3873	129-3876	129-3878	129-3883	
25.1 (0.988)	180	129-3875	129-3876	129-3879	129-3884	
31 (1.22)	250	171-1113	129-3876		171-1114	171-1112 (1)

(1) 3 171-1112 Test Pins are needed.

2. Place the port plate (6) on the surface plate. The flat side of the port plate (6) must be facing downward.
3. Place alignment plug (10) on the port plate (6). The chamfer side of the alignment plug (10) must be facing upward.
4. Place barrel (5) on the port plate and the alignment plug.
5. Place test ring (8) on barrel in place of springs.
6. Install ball joint (2) over the test ring on barrel.
7. Place the piston retaining ring (1) over the ball joint.
8. Bolt tool (7) and tool (9) together. Refer to Illustration 15 in order to set the tool (7) and the tool (9) on the barrel.
9. Measure the distance from the surface plate to the top of the measuring bell in order to find dimension (A) .
10. Dimension (B) is scribed on the top of the measuring bell (7) .
11. Measured dimension (A) minus dimension (B) yields dimension (C) .

    Dimension (A) - dimension (B) = dimension (C)

    Note: Do not measure the distance from the surface plate to the top of the piston retaining plate in place of dimension (C). The piston retaining plate may not be square with the surface plate, and the measurement will not be accurate.
12. Required lift-off clearance (D) from table 14 minus calculated dimension (C) equals the required shim thickness (3) .

    dimension (D) - dimension (C) = required shim thickness

Table 14

Lift-Off Clearance	
Displacement in cc	Dimension (D) in (mm)(in)

40	89.40-89.60 (3.5197-3.5276)
56	99.86-100.06 (3.9315-3.9394)
71	108.50-108.70 (4.2717-4.2795)
90	117.20-117.40 (4.6142-4.6220)
125	130.80-131.00 (5.1496-5.1575)
180	148.00-148.20 (5.8268-5.8346)
250	170.95-171.20 (6.7303-6.7402)

13. Select the appropriate shim from table 15.

    Note: Use only one shim for adjustment of lift-off clearance.

Table 15

Adjustment Shim (3)		
Displacement in cc	Shim thickness in (mm) (in)	Part number
40	.60 (0.0236)	127-4198
	.80 (0.0315)	127-4197
	1.00 (0.0394)	127-4196
	1.20 (0.0472)	127-4195
56	.60 (0.0236)	117-7248
	.80 (0.0315)	117-7247
	1.00 (0.0394)	117-7246
	1.20 (0.0472)	117-7245
71	.60 (0.0236)	142-9433
	.80 (0.0315)	142-9432
	1.00 (0.0394)	142-9431
	1.20 (0.0472)	142-9430
90	.60 (0.0236)	126-1408
	.80 (0.0315)	126-1407
	1.00 (0.0394)	126-1406
	1.20 (0.0472)	126-1405
	.60 (0.0236)	6E4367
	.80 (0.0315)	6E4366

125	1.00 (0.0394)	6E4365
	1.20 (0.0472)	6E4364
180	.60 (0.0236)	6E4367
	.80 (0.0315)	6E4366
	1.00 (0.0394)	6E4365
	1.20 (0.0472)	6E4364
250	0.50 (0.0197)	164-8169
	0.75 (0.0295)	164-8170

14. Remove the tooling and install the appropriate shim between the barrel and the spring group.

A6VM/A6VE Motor

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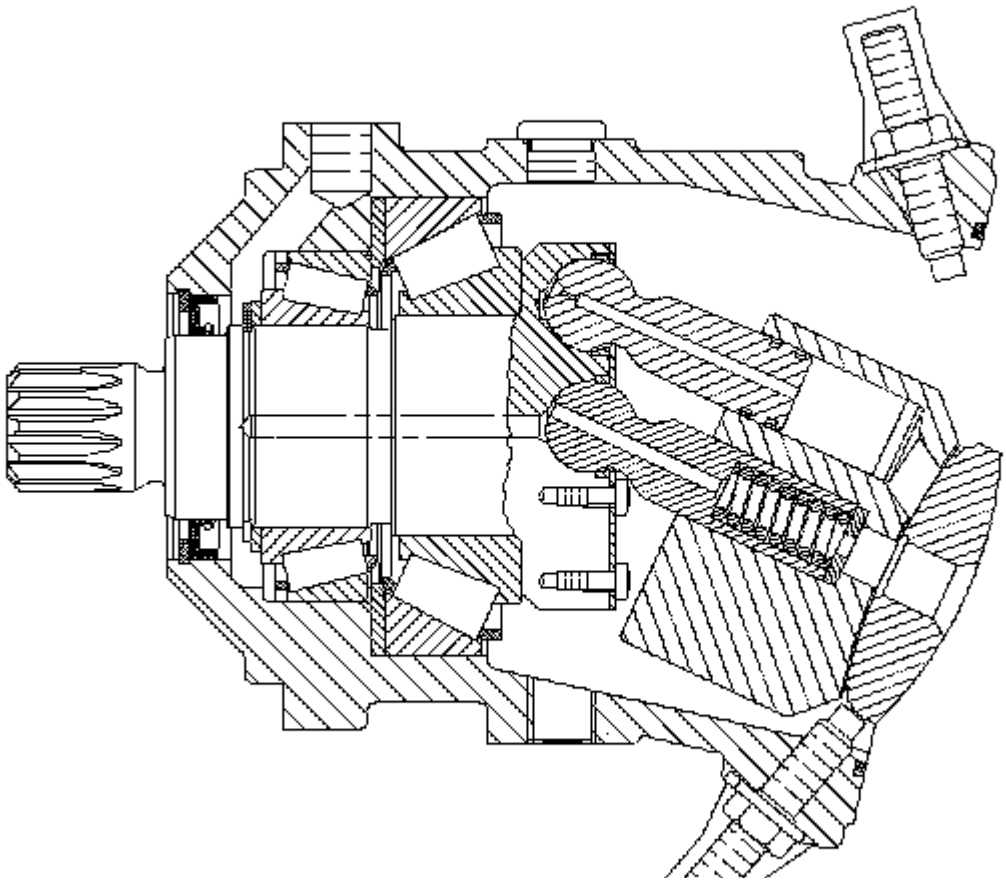

Illustration 16 g01009509

Typical A6VM motor

Bearing Preload Adjustment - A6VM/A6VE 55/140/160 cc

The bearings are received in a kit. The kit includes bearings, adjustment shim, and the retaining clip. This kit sets the necessary bearing preload.

Bearing Preload Adjustment - A6VM/A6VE 28/80/107/200 cc

This section shows the proper way to set the bearing preload. If bearing preload is too high or low, bearing life will be shortened due to heat generation. Additionally, if bearing preload is too high the rotating torque will be too high causing poor system operation.

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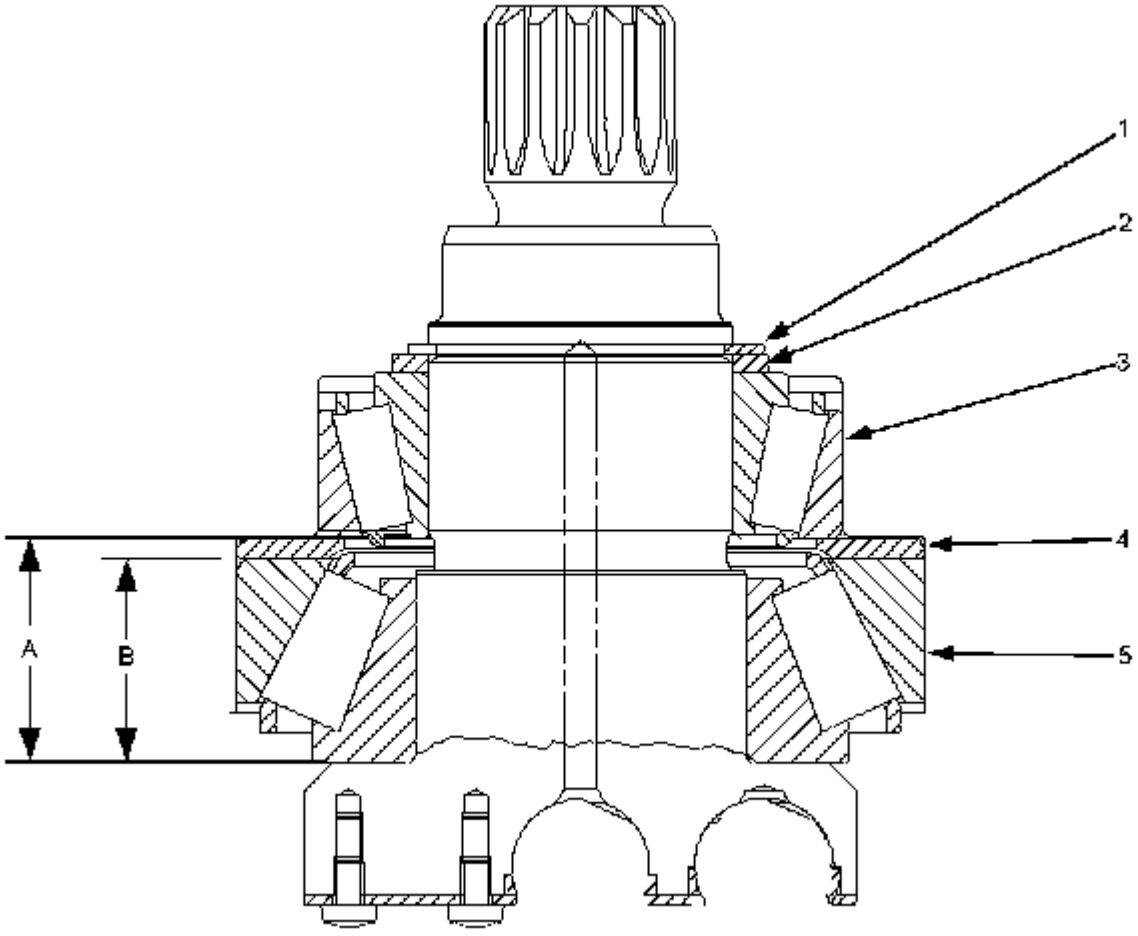

Illustration 17 g01009587

Illustration 17 g01009987

28/80/107/200 cc motor

(1) Snap ring

(2) Adjustment shim

(3) Upper bearing

(4) Adjustment shim

(5) Lower bearing

1. Install the lower bearing (5) on the shaft.
2. Measure dimension (B) and the thickness of the lower bearing.
3. Take dimension (A) from the table 16 minus the measured dimension (B) in order to find the required thickness of the shim (4) .

   dimension (A) - dimension (B) = required shim thickness

Table 16

Bearing Preload		
Piston Diameter mm (in)	Displacement in cc	Dimension (A) in (mm) (in)
16 (0.6299)	28	34.95-35.05 (1.3760-1.3800)
22.8 (0.8976)	80	40.95-41.05 (1.6122-1.6161)
25 (0.9842)	107	44.95-45.05 (1.7697-1.7736)
28.7 (1.130)	160	50.95-51.05 (2.0059-2.0098)
30.8 (1.2126)	200	52.95-53.05 (2.0846-2.0886)

4. Use Table 17 to find an appropriate adjustment shim (4).

Table 17

Adjustment Shim (4)		
Displacement in cc	Shim thickness (mm) (in)	Part number
28	5.90 (0.2323)	209-9972
	3.80 (0.1496)	123-5754
	3.85 (0.1516)	123-5755

80	3.90 (0.1535)	124-6459
	3.95 (0.1555)	123-5757
	4.00 (0.1575)	123-5758
107	5.80 (0.2283)	124-9865
	5.85 (0.2303)	124-9866
	5.90 (0.2323)	124-9867
	5.95 (0.2343)	124-9868
	6.00 (0.2362)	124-9869
200	4.80 (0.1890)	145-8429
	4.85 (0.1909)	145-8430
	4.90 (0.1929)	145-8431
	4.95 (0.1949)	145-8432
	5.00 (0.1969)	145-8433

5. Install the appropriate adjustment shim (4) and install upper bearing (3) on the shaft.

   Note: Make sure that upper bearing is fully pressed against lower bearing.

6. Place the snap ring (1) on the shaft.

   Note: For A6VM107, **142-1380** plate must be placed on the shaft before the retaining ring. This is a required shim.

7. Select an appropriate shim from the Table 18. The adjustment shim (4) should make the distance between the snap ring (1) and the upper bearing (2) less than 0.05 mm (0.0020 in).

Table 18

Adjustment Shim (2)		
Displacement in cc	Shim thickness in (mm) (in)	Part number
28	2.15 (0.0846)	209-9964
	2.20 (0.0866)	209-9965
	2.25 (0.0886)	209-9966
	2.30 (0.0906)	209-9967
	2.35 (0.0925)	209-9968
	2.40 (0.0945)	209-9969
	2.45 (0.0965)	209-9970

	2.50 (0.0984)	209-9971
80	2.65 (0.1043)	123-5763
	2.70 (0.1063)	123-5764
	2.75 (0.1083)	123-5765
	2.80 (0.1102)	123-5766
	2.85 (0.1122)	123-5767
	2.90 (0.1142)	123-5768
	2.95 (0.1161)	123-5789
	3.00 (0.1181)	123-5770
107	3.15 (0.1240)	124-9877
	3.20 (0.1260)	124-9876
	3.25 (0.1280)	124-9875
	3.30 (0.1300)	124-9874
	3.35 (0.1319)	124-9873
	3.40 (0.1339)	124-9872
	3.45 (0.1358)	124-9871
	3.50 (0.1378)	124-9870
200	3.15 (0.1240)	145-8434
	3.20 (0.1260)	145-8435
	3.25 (0.1280)	145-8436
	3.30 (0.1300)	145-8439
	3.35 (0.1319)	145-8440
	3.40 (0.1339)	145-8441
	3.45 (0.1358)	145-8442
	3.50 (0.1378)	145-8443

8. Remove the snap ring from the shaft. Install the proper adjustment shim on the shaft. Replace the snap ring on the shaft.

Bearing Preload Adjustment - A6VM/A6VE 250 cc

This section shows the proper way to set the bearing preload. The bearing life will be shortened due to the heat generation if bearing preload is too high or low. Additionally, if bearing preload is too high the rotating torque will be too high causing poor system operation.

torque will be too high causing poor system operation.

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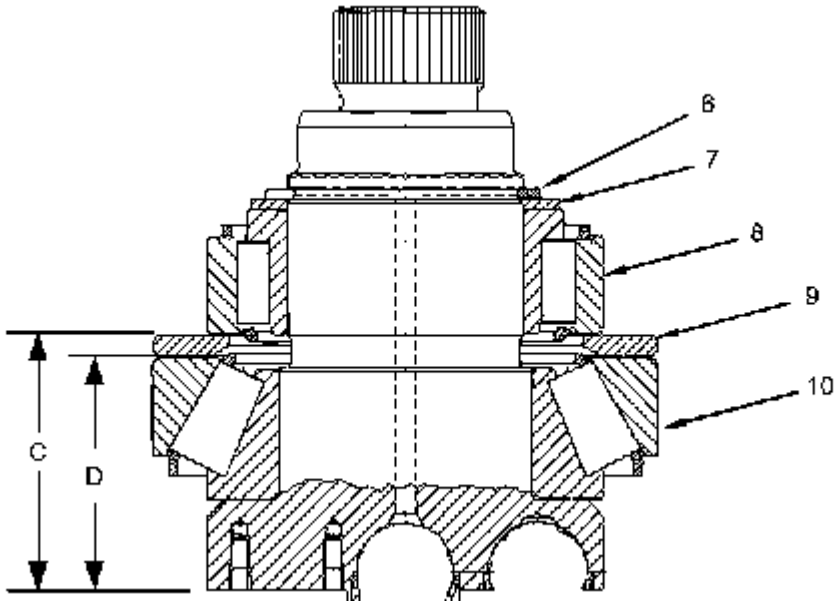

Illustration 18 g01117795

250 cc Motor

(6) Snap ring

(7) Required shim

(8) Upper bearing

(9) Adjustment shim

(10) Lower bearing

1. Press lower bearing (10) on the shaft.
2. Measure dimension (D) by measuring the distance from the shaft's base to top of the lower bearing.
3. Take dimension (C) from Table 19 minus the measured dimension (D) in order to find the required adjustment shim thickness.

   dimension (C) - dimension (D) = required shim thickness

Table 19

Bearing Preload		
Piston Diameter mm (in)	Displacement in cc	Dimension (C) in mm (in)
32 (1.2598)	250	86.0-87.0 (3.3858-3.4252)

4. Use Table 20 to find an appropriate shim (9).

Table 20

Adjustment Shim (9)		
Displacement in cc	Shim thickness in mm (in)	Part number
250	7.35 (0.2894)	9T9453 - kit
	7.40 (0.2913)	9T9453 - kit
	7.45 (0.2933)	9T9453 - kit
	7.50 (0.2953)	9T9453 - kit
	7.80 (0.3071) (1)	9T9453 - kit

(1) Can be ground to size if required.

5. Install appropriate shim (9) and press upper bearing (8) on shaft.
6. Install required shim (7) on shaft and install snap ring (6) .

Bearing Preload Adjustment - A6VM/A6VE 355 cc

This section shows the proper way to set the bearing preload. If bearing preload is too high or low, bearing life will be shortened due to heat generation. Additionally, if bearing preload is too high the rotating torque will be too high causing poor system operation.

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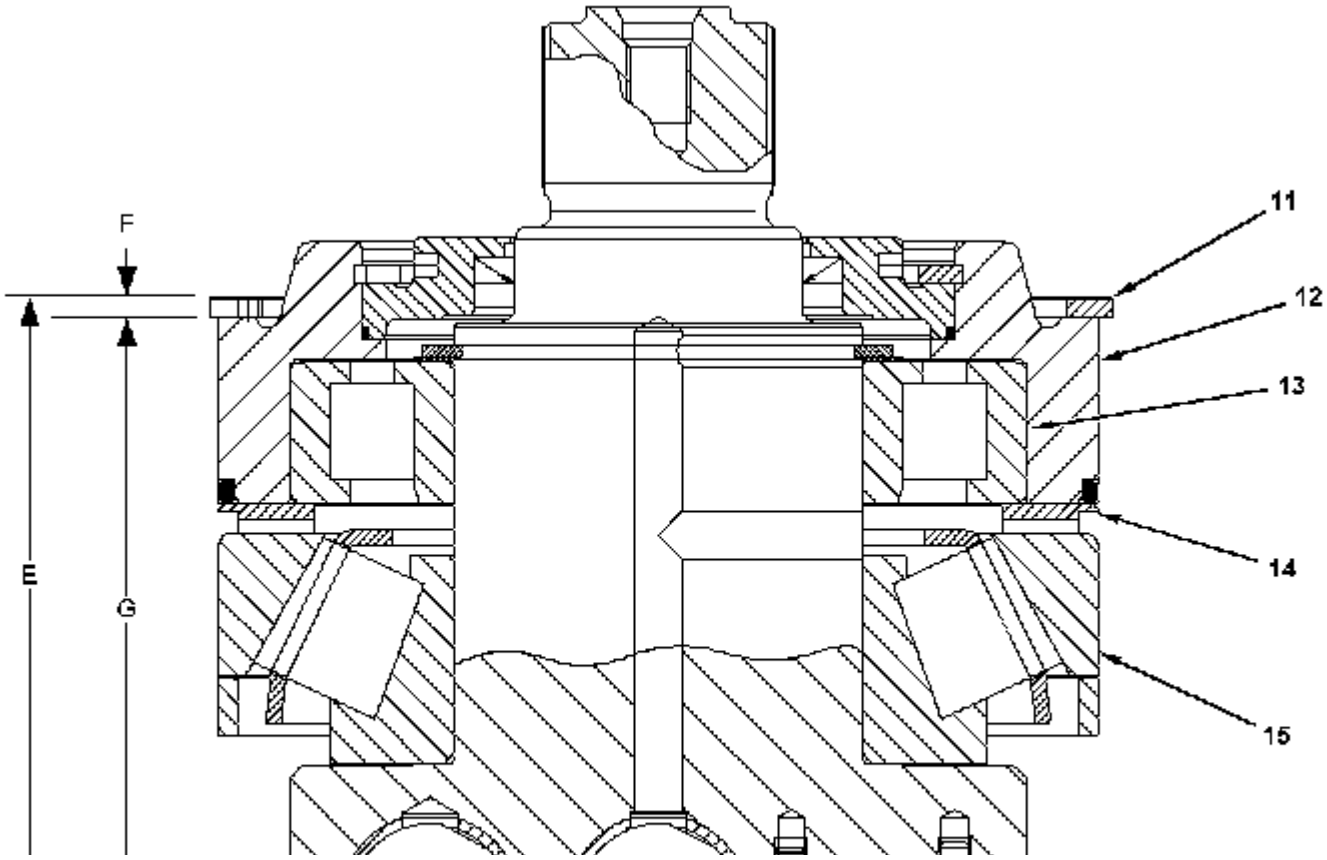


Illustration 19 g01117802

355 cc Motor

(11) Snap ring

(12) Front cover

(13) Upper bearing

(14) Adjustment shim

(15) Lower bearing

1. Install bearing (15) and shim (14) onto the shaft.
2. Place front cover (12) on the shaft.
3. Measure dimension (G). This is the distance from shaft base to the snap ring area of the front cover.
4. Measure thickness (F) of snap ring (11) .
5. Take dimension (E) from table 21 minus measured dimension (F) minus measured dimension (G) in order to find the required change in the thickness of the adjustment shim (14) .

   dimension (E) - dimension (F) = required change in shim thickness

Table 21

Bearing Preload		
Piston Diameter mm (in)	Displacement in cc	Dimension (E) in (mm) (in)
36 (1.4173)	355	147.95-148.05 (5.8248-5.8287)

6. Select appropriate adjustment shim (14) from Table 22.

Table 22

Adjustment Shim (14)		
Displacement in cc	Shim thickness (mm) (in)	Part number
355	7.30 (0.2874)	191-0678 - kit
	7.35 (0.2894)	191-0678 - kit
	7.40 (0.2913)	191-0678 - kit
	7.45 (0.2933)	191-0678 - kit

	7.90 (0.3110) (1)	191-0678 - kit

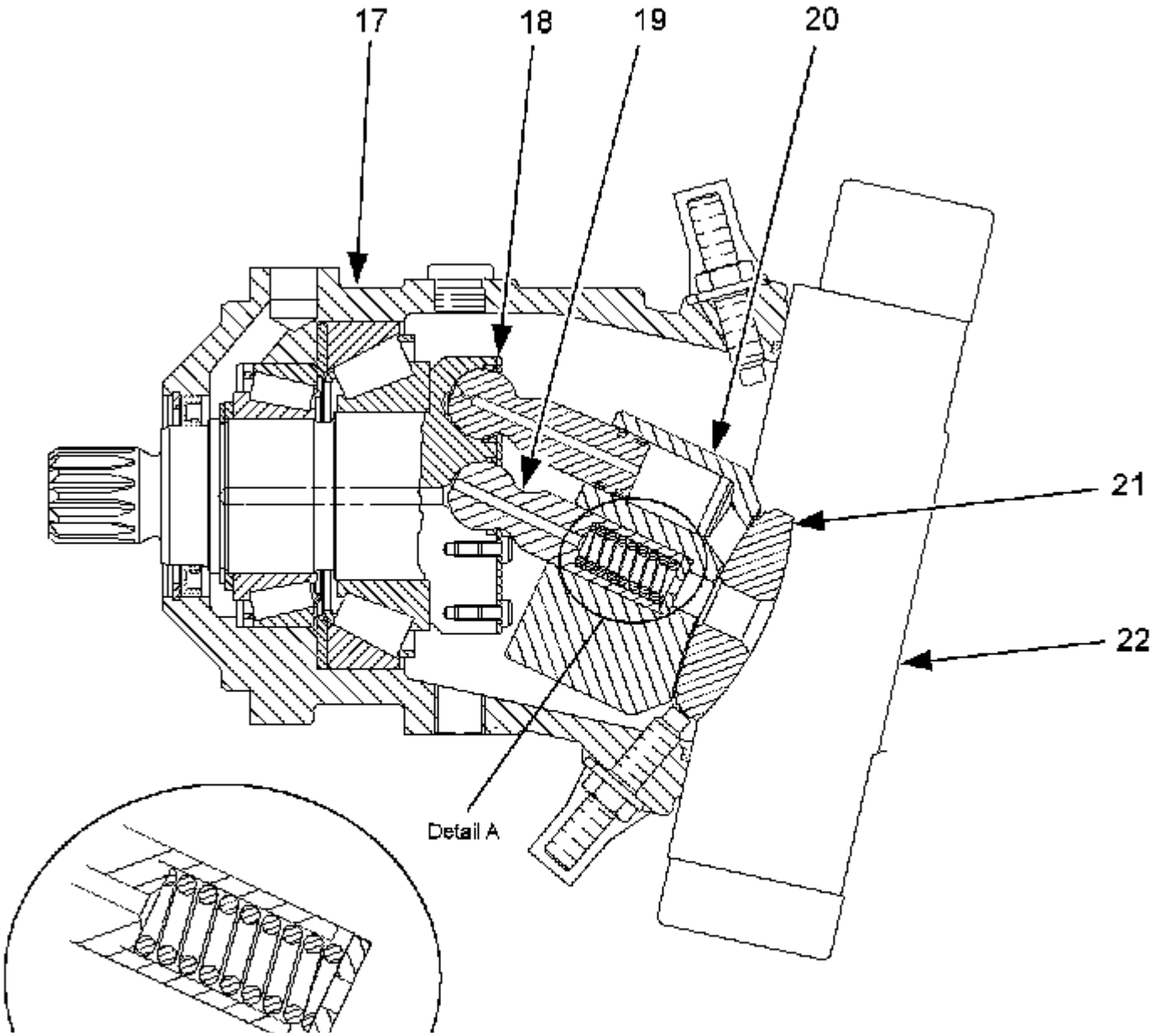
(1) Can be ground to size if required

7. Remove the front cover and the upper bearing. Insert the appropriate shim and reassemble using the upper bearing (13) .

Lift-Off Clearance Adjustment - A6VM/A6VE 28-200 cc with the Type 1 Barrel

This adjustment measures the allowable separation between the port plate and the barrel. The "lift-off" clearance or the allowable separation can be adjusted by adding or removing shims from the spring group in the center pin bore. Excessive leakage will occur at high-pressure spikes which may lead to rotary group damage and poor system performance if the allowable separation is too large.

Ver imagen



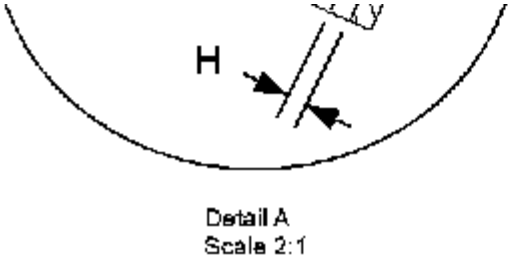


Illustration 20 g01009853

Typical lift-off clearance (H) measurement of A6VM/A6VE with type 1 barrel

(17) Housing

(18) Piston retaining plate

(19) Center pin

(20) Type 1 barrel

(21) Port plate

(22) Head group

Ver imagen

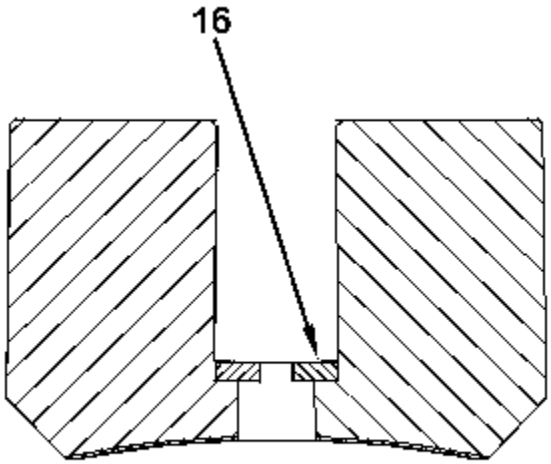


Illustration 21 g01119047

Type 1 barrel

(16) Adjustment shim

Lift-off clearance for a Type 1 barrel is adjusted via a shim (16). The shim (16) is placed in the center bore of the barrel.

Required Equipment

149-4935 Pump and Motor Measuring Group

1. Insert the complete drive shaft and the bearing assembly with the center pin (19) and the piston retaining plate (18) into the housing (17) .
2. Tightly pull the rotary group against the case cover using a press or an extractor device.
3. Select the correct gauge plate from the Table 23 to use from kit **149-4935** Pump and Motor Measuring Group .

Table 23

Gauge Plates in **149-4935** Pump and Motor Measuring Group			
Piston Diameter mm (in)	Displacement in cc	Part number	Gauge Plate Thickness mm (in)
20 (0.7874)	55	149-4928	9.10 (0.3583)
22.8 (0.8976)	80	149-4930	3.80 (0.1496)
25 (0.9843)	107	149-4931	3.50 (0.1378)
28.7 (1.1300)	160	149-4932	4.50 (0.1772)
30.8 (1.2126)	200	149-4934	4.00 (0.1575)

4. Place three **149-5141** gauge balls in the top of the gauge plate.

   Note: "TOP" is engraved on the gauge plate.

5. Press the balls gently in the gauge plate.

   Note: Do not press the balls completely in the gauge plate. Hold the balls in place by pressing firmly on the balls. Only apply enough pressure in order to hold the balls in place.

   Note: The lead balls vary in size. The lead balls must protrude from the gauge plate at least 2.1 mm (0.0827 inch) prior to Step 6 in order to ensure proper compression of the lead balls.

6. Place a small amount of grease on the top side of the gauge plate.
7. Place the "TOP" side of the gauge plate and the balls into the center pin bore of the barrel (20). The grease should hold the gauge plate in place inside the barrel.
8. Install the cylinder barrel on the center pin.

Note: Do not drop the barrel onto the center pin. This will lead to premature crushing of the lead balls.

9. Install the port plate (21) and the head group.
10. Tighten all of the head bolts to the specified torque while the pump shaft is turning.

    Note: The pump shaft must be rotated while tightening bolts in order to seat all components.
11. Loosen and remove the head group and the port plate.
12. Remove barrel from center pin.
13. Carefully remove the gauge plate and the flattened balls from the barrel.
14. Measure the thickness of the gauge plate and flattened balls at each gauge ball's location. These are dimensions (X1), (X2), and (X3) .

    Note: Repeat the procedure if the measurements at each of the three gauge ball locations are not within .05 mm (.0020 in).

Ver imagen

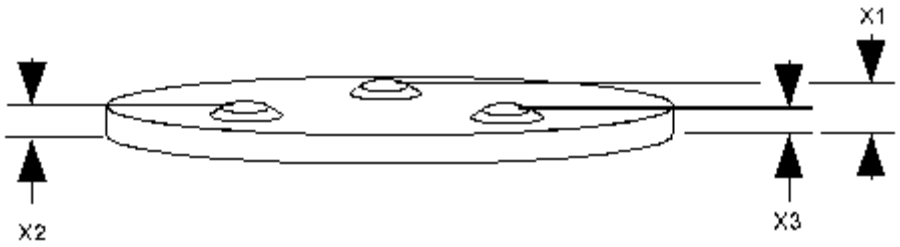


Illustration 22 g01011324

Gauge plate after removal from barrel. The lead shot compressed at each of the three ball locations.

15. Take the average value of (X1), (X2), and (X3). Call this dimension (X) .

    (dimension (X1) + dimension (X2) + dimension (X3)) / 3 = dimension (X)
16. Take dimension (X) minus the required lift-off clearance (Z) from table 24 in order to find the required thickness of the shim.

    dimension (X) - dimension (Z) = required shim thickness

Table 24

Lift-Off Clearance	
Displacement in cc	Lift-off Clearance (Z) in (mm) (in)
28	

28	0.150-0.300 (0.006-0.012)
55	0.150-0.250 (0.006-0.010)
80	0.150-0.250 (0.006-0.010)
107	0.150-0.250 (0.006-0.010)
140	0.200-0.400 (0.008-0.016)
160	0.200-0.300 (0.008-0.012)
200	0.100-0.300 (0.004-0.012)

17. Select the appropriate adjustment shim (16) from Table 25.

Table 25

Adjustment Shim (16)		
Displacement in cc	Shim thickness in (mm) (in)	Part number
28	3.50 (0.138)	180-1279
	3.60 (0.1427)	180-1278
	3.70 (0.146)	180-1277
	3.80 (0.150)	180-1274
	3.90 (0.154)	180-1275
	4.00 (0.158)	180-1276
55	3.50 (0.138)	137-4586 (kit)
	3.60 (0.141)	137-4586 (kit)
	3.70 (0.146)	137-4586 (kit)
	3.80 (0.150)	137-4586 (kit)
	3.90 (0.154)	137-4586 (kit)
	4.00 (0.158)	137-4586 (kit)
80	3.50 (0.138)	123-5773
	3.60 (0.142)	123-5774
	3.70 (0.146)	123-5775
	3.80 (0.150)	123-5776
	3.90 (0.154)	123-5777

	4.00 (0.158)	123-5778
107	3.50 (0.138)	124-9932
	3.60 (0.142)	124-9933
	3.70 (0.146)	124-9934
	3.80 (0.150)	124-9935
	3.90 (0.154)	124-9936
	4.00 (0.158)	124-9937
140	4.50 (0.177)	124-9855
	4.60 (0.181)	124-9856
	4.70 (0.185)	124-9857
	4.80 (0.189)	124-9858
	4.90 (0.193)	124-9859
	5.00 (0.197)	124-9860
160	4.50 (0.177)	124-9855
	4.60 (0.181)	124-9856
	4.70 (0.185)	124-9857
	4.80 (0.189)	124-9858
	4.90 (0.193)	124-9859
	5.00 (0.197)	124-9860
200	5.50 (0.217)	145-8452
	5.60 (0.221)	145-8453
	5.70 (0.224)	145-8454
	5.80 (0.228)	145-8455
	5.90 (0.232)	145-8456
	6.00 (0.236)	145-8457

18. Reassemble the motor with the appropriate shims.

Lift-Off Clearance Adjustment - A6VM/A6VE 200/250/355 cc with the Type 2 Barrel

This adjustment measures the allowable separation between the port plate and the barrel. The "lift-off" clearance or the allowable separation can be adjusted by placing shims of different thicknesses under the screw in the Type 2 barrel. The shim sets the depth that the screw can protrude into the center pin bore of the barrel. Excessive leakage will occur at high-pressure spikes which may lead to rotary group damage and

the barrel. Excessive leakage will occur at high-pressure spikes which may lead to rotary group damage and poor system performance if separation is too large.

Ver imagen

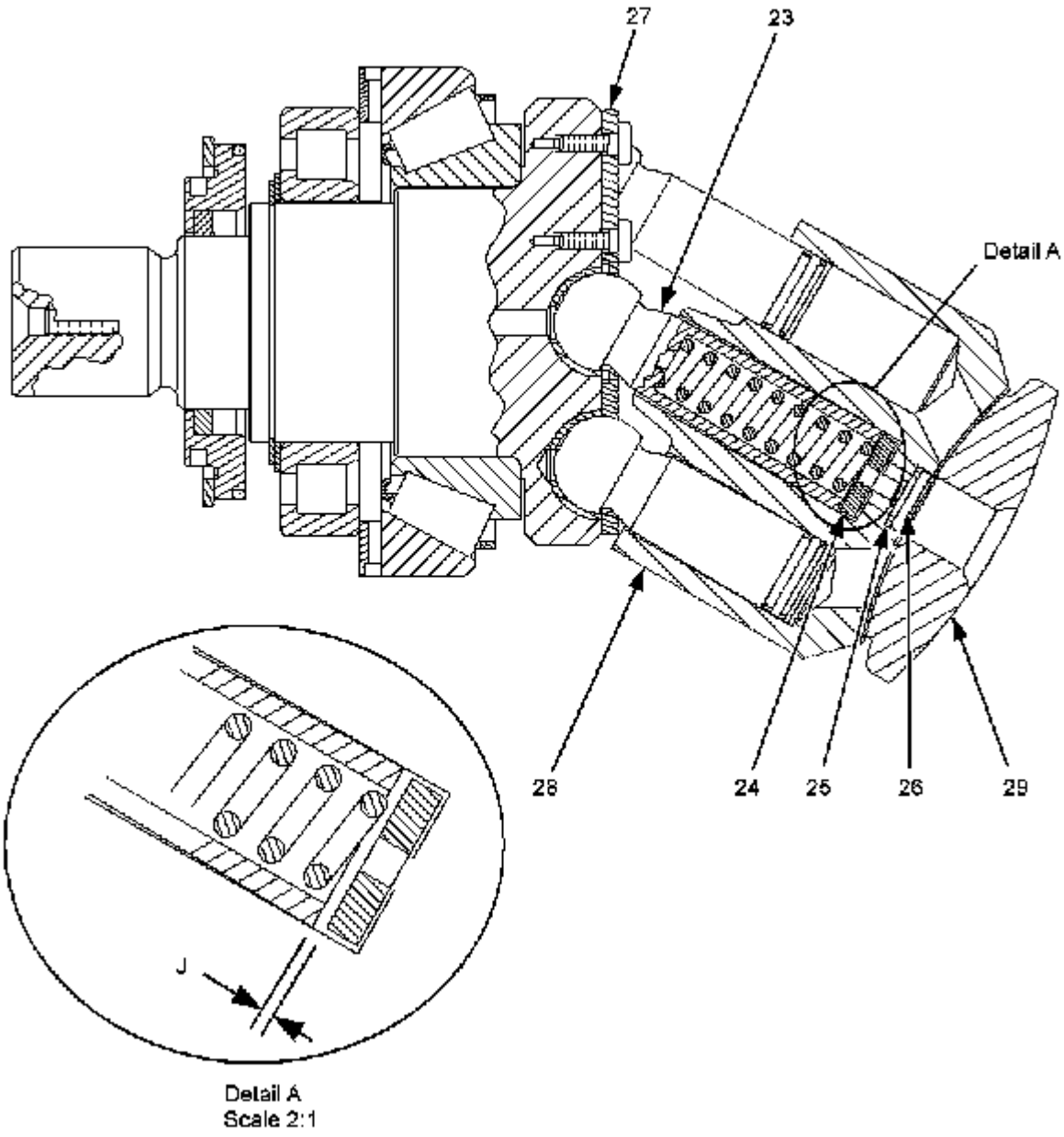


Illustration 23 g01010506

Typical lift-off clearance (J) measurement of A6VM/A6VE with type 2 barrel

(23) Center pin

(24) Center pin disk

(25) Adjustment shim

(26) Screw

(27) Piston retaining plate

(28) Type 2 barrel

(29) Port plate

Ver imagen

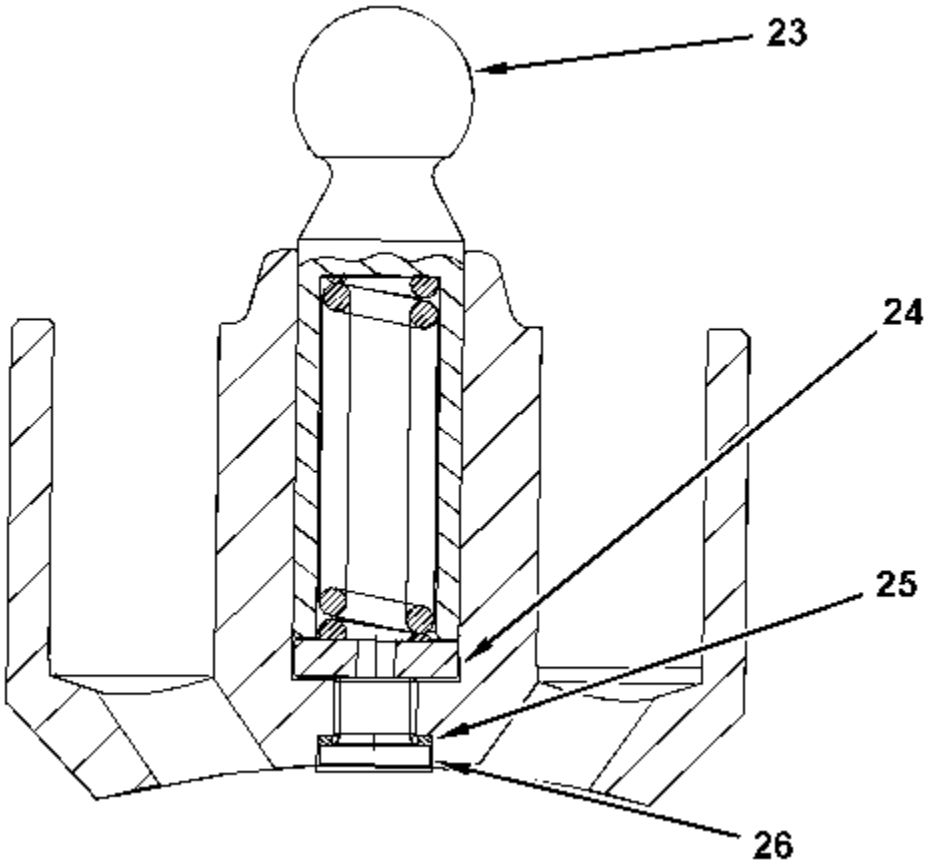


Illustration 24 g01119054

Type 2 barrel

(23) Center pin

(24) Center pin disk

(25) Adjustment shim

(26) Screw

Lift-off clearance for Type 2 barrel is adjusted via shim (25) that sets the depth screw (26) can protrude into the center pin bore of the barrel.

Required Equipment

149-4935 Pump and Motor Measuring Group

1. Insert the complete drive shaft and the bearing assembly with the center pin (23) and piston retaining plate (27) into the housing.
2. Install the front cover, the shim, and the snap ring.

   Note: Only for the 355 cc displacement pumps and motors.
3. Tightly pull the rotary group against the case cover using a press or an extractor device.
4. Tighten the barrel screw (26) with the largest shim (25) from Table 29.
5. Select the appropriate gauge group from **149-4935** Pump and Motor Measuring Group .

Table 26

Gauge groups in **149-4935** Pump and Motor Measuring Group		
Piston Diameter mm (in)	Displacement in cc	Part number
30.8 (1.2125)	200	149-4934
32 (1.2598)	250	149-4934
36 (1.4173)	355	149-4934

Ver imagen

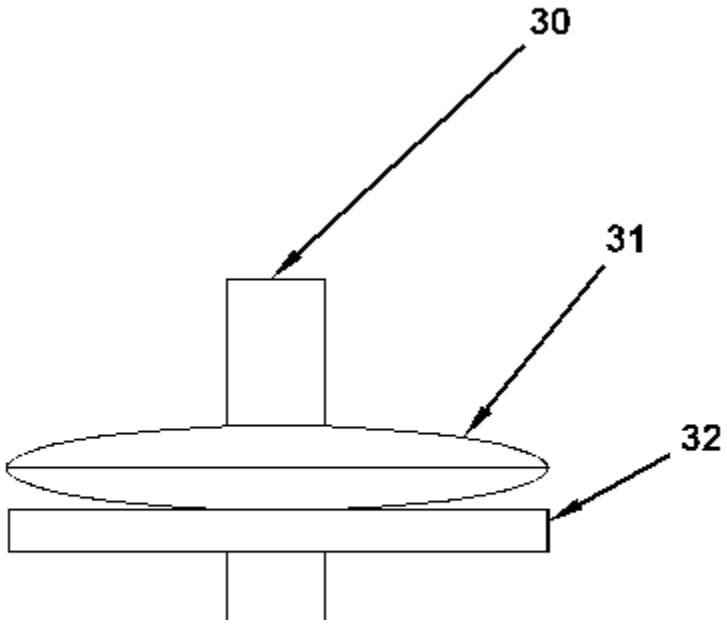


Illustration 25 g01150541

(30) Spring pin

(31) Disc springs

(32) Gauge disc

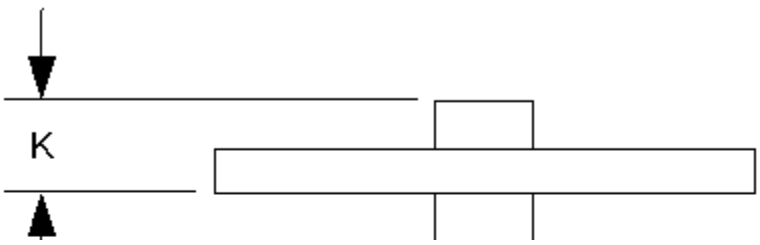
6. Refer to Illustration 25 in order to set the gauge disc (32) so that the gauge disc (32) is centered on the middle of the spring pin (30).
7. Place a small amount of grease between the disc springs (31) and the gauge disc (32). Place a small amount of grease on the side of the disc spring (31) in order to be inserted into the barrel.

   Note: Leave the center pin disc (24) out during the measurement procedure.
8. Place the gauge assembly in the center pin bore of the cylinder barrel so that the disc springs are facing toward the barrel screw. The grease should hold the gauge plate in place.
9. Install the cylinder barrel (28) on the center pin (23) .

   Note: The resulting measurement will be incorrect if the barrel is dropped onto the center pin.
10. Install the port plate (29) and the head group.
11. Tighten all of the bolts to the specified torque while the pump shaft is turning.

    Note: Tighten all of the bolts while the pump shaft is rotating in order to seat all of the components.
12. Loosen and remove the head group and the port plate (29) .
13. Remove barrel from center pin (23) .
14. Carefully remove the gauge group from the barrel cylinder.
15. Remove the disc springs (31) from the gauge group.

Ver imagen



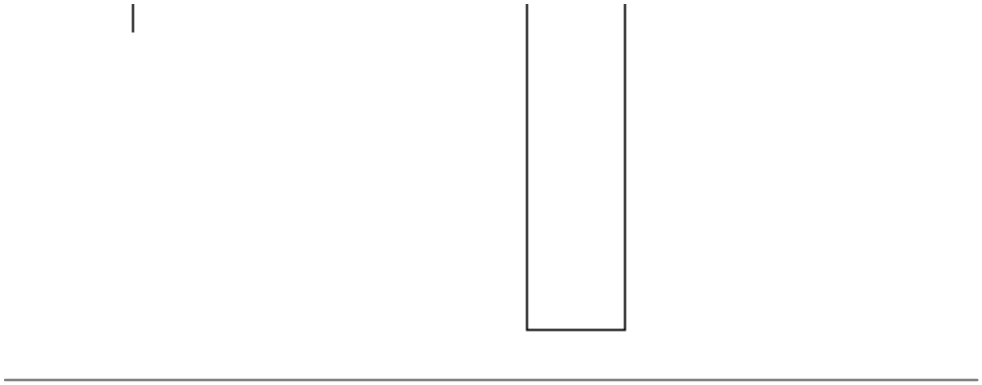


Illustration 26 g01010474

16. Measure the thickness of the gauge group (K) from the top of the spring side of the spring pin (30) to the bottom of the gauge disc (32) as in Illustration 26.

17. Use Table 27 to assist in calculating the required shim thickness.

Table 27

Explanation of Dimensions	
Dimension	Description
K	Measurement from Illustration 26
L	Lift-off clearance
M	Ideal center pin disc thickness
C	Center pin disc thickness
X	Difference between ideal center pin disc thickness (M) and center pin disc thickness (C)
S	Shim thickness used during measuring procedure (1)
Z	Required shim thickness for proper lift-off adjustment

(1) This is shim (25) from Illustration 24

Use the formulas below to calculate the required shim thickness.

K - L = M

M - C = X

S - X = Z

Note: If (M) is less than (C), you will need to add shim thickness compared to shim (25) used during testing. If (M) is greater than (C), you will need to reduce shim thickness compared to shim (25) used during testing.

Note: Be sure the difference between the shim thickness you want (Z) and the shim thickness you have to choose from Table 29 are within the tolerance given in Table 28.

Note: Use only one shim for the adjustment of the lift-off clearance.

Table 28

Lift-Off Clearance	
Displacement in cc	Dimension (L) in (mm) (in)
200	0.25 ± 0.05 (0.0098 ± 0.0020)
250	0.20 ± 0.10 (0.0079 ± 0.0039)
355	0.25 ± 0.10 (0.0098 ± 0.0039)

18. Select appropriate shim (25) from Table 29.

Table 29

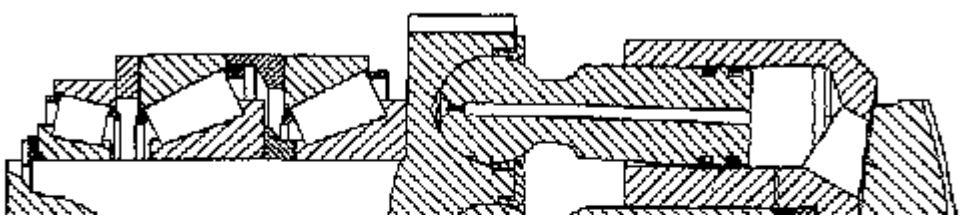
Adjustment Shim (25)		
Displacement in cc	Shim thickness in (mm) (in)	Part number
200	5.50 (0.2165)	145-8452
	5.60 (0.2205)	145-8453
	5.70 (0.2244)	145-8454
	5.80 (0.2283)	145-8455
	5.90 (0.2323)	145-8456
	6.00 (0.2362)	145-8457
250	1.70 (0.0669)	9T9450 (kit)
	1.75 (0.0689)	9T9450 (kit)
	1.80 (0.0709)	9T9450 (kit)
	1.85 (0.0728)	9T9450 (kit)
	1.90 (0.0748)	9T9450 (kit)
	1.95 (0.0768)	9T9450 (kit)
	2.00 (0.0787)	9T9450 (kit)
	2.05 (0.0807)	9T9450 (kit)
	2.10 (0.0827)	9T9450 (kit)
	2.15 (0.0846)	9T9450 (kit)
	2.20 (0.0866)	9T9450 (kit)
	2.25 (0.0886)	9T9450 (kit)
	2.30 (0.0906)	9T9450 (kit)

	2.35 (0.0925)	9T9450 (kit)
	2.40 (0.0945)	9T9450 (kit)
	2.90 (0.1142)	9T9450 (kit)
355	1.70 (0.0669)	191-0666 (kit)
	1.75 (0.0689)	191-0666 (kit)
	1.80 (0.0709)	191-0666 (kit)
	1.85 (0.0728)	191-0666 (kit)
	1.90 (0.0748)	191-0666 (kit)
	1.95 (0.0768)	191-0666 (kit)
	2.00 (0.0787)	191-0666 (kit)
	2.05 (0.0807)	191-0666 (kit)
	2.10 (0.0827)	191-0666 (kit)
	2.15 (0.0846)	191-0666 (kit)
	2.20 (0.0866)	191-0666 (kit)
	2.25 (0.0886)	191-0666 (kit)
	2.30 (0.0906)	191-0666 (kit)
	2.35 (0.0925)	191-0666 (kit)
	2.40 (0.0945)	191-0666 (kit)
	2.90 (0.1142)	191-0666 (kit)

19. Disassemble the barrel. Replace the shim. Reassemble the barrel.

A8VO Pump

Ver imagen



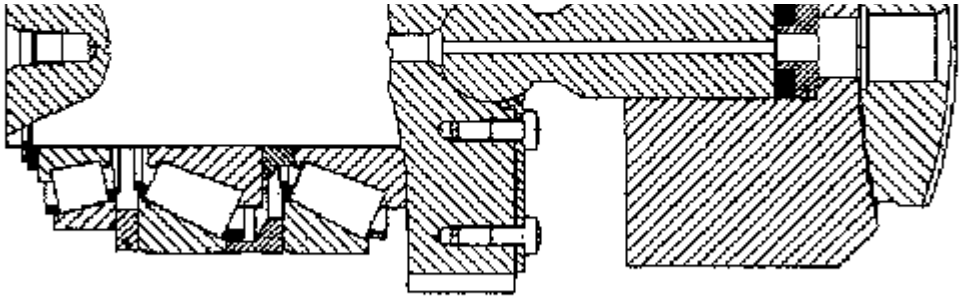


Illustration 27 g01010090

Typical A8VO motor rotating group

Bearing Preload Adjustment - A8VO 107/160 cc

This section shows the proper way to set the bearing preload. Bearing life will be shortened due to heat generation if bearing preload is too high or too too low. Additionally, if bearing preload is too high the rotating torque will be too high causing poor system operation.

Ver imagen

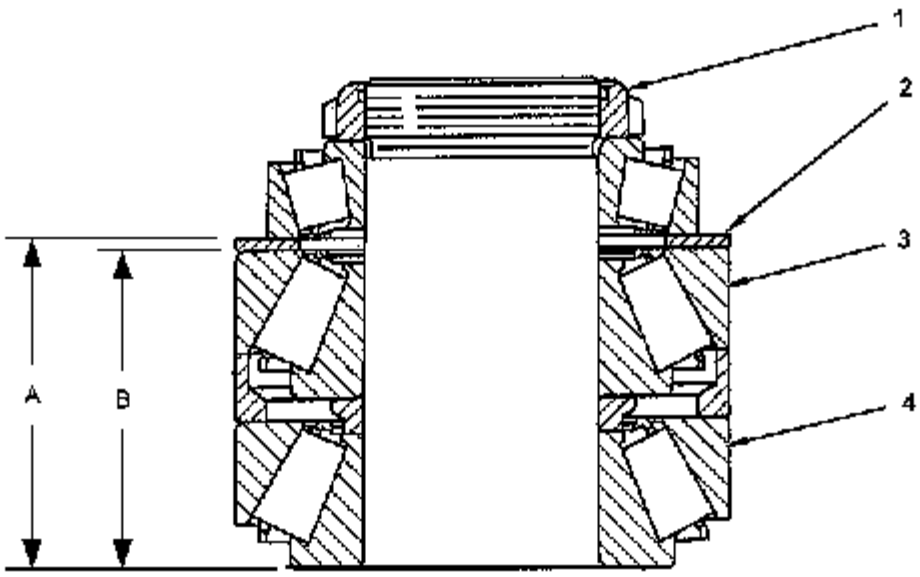


Illustration 28 g01150546

(1) Locknut

(2) Adjustment shim

(3) Middle bearing

(4) Lower bearing

1. Place both bearings on the surface plate.
2. Measure dimension (B) by measuring the distance from the surface plate to the top of the middle bearing.
3. Take dimension (A) from Table 30 minus measured dimension (B) in order to find the required thickness of the shim (8) .

   dimension (A) - dimension (B) = required shim thickness

Table 30

4.

Bearing Preload		
Piston Diameter mm (in)	Displacement in cc	Dimension (A) in (mm) (in)
25 (0.9842)	107	75.95-76.00 (2.9902-2.9921)
28.7 (1.1300)	160	86.45-86.50 (3.4035-3.4055)

5. Select the appropriate shim from Table 31.

Table 31

Adjustment Shim (2)		
Displacement in cc	Shim thickness in (mm) (in)	Part number
107	2.70 (0.1063)	9T3376
	2.80 (0.1102)	9T3377
	2.90 (0.1142)	9T3378
	3.00 (0.1181)	9T3379
	3.10 (0.1220)	9T3380
160	6.2 (0.2441)	5I4480
	6.3 (0.2480)	5I4481
	6.4 (0.2520)	5I4482
	6.5 (0.2559)	5I4483
	6.6 (0.2598)	5I4484

6. Press lower bearing (4) and middle bearing (3) on the shaft.
7. Install the adjustment shim (2) .
8. Press the upper bearing on the shaft.

9. Tighten the locknut (1) on the shaft.
10. Place a hex head bolt in the shaft end.
11. Refer to Illustration 29 to place the shaft group in the fabricated V-Block

Ver imagen

Illustration 29 g01012323

12. Place a breaker bar on the installed bolt and hold the bearing's outer races with a hand. Ensure that the shaft rotates with a slight to moderate force.
13. Remove the bolt before assembling the pump.

Bearing Preload Adjustment - A8VO 200 cc

This section shows the proper way to set the bearing preload. Bearing life will be shortened due to heat generation if bearing preload is too high or low. Additionally, if bearing preload is too high the rotating torque will be too high causing poor system operation.

Ver imagen

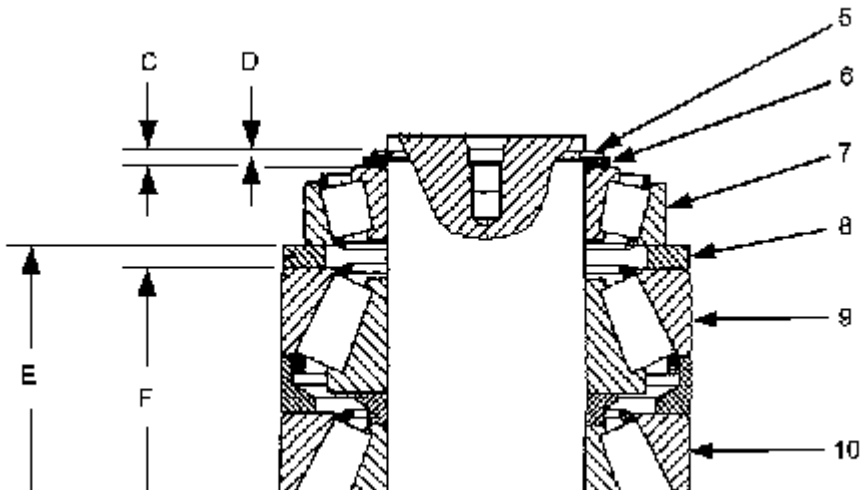


Illustration 30 g01010155

(5) Snap ring

(6) Adjustment shim

(7) Upper bearing

(8) Adjustment shim

(9) Middle bearing

(10) Lower bearing

1. Place middle bearing (9) and lower bearing (10) on the surface plate.
2. Measure dimension (F) by measuring the distance from the surface plate to the top of the middle bearing.
3. Dimension (E) from table 32 minus measured dimension (F) yields the required shim thickness.

   dimension (E) - dimension (F) = required shim thickness

Table 32

4.

Bearing Preload		
Piston Diameter mm (in)	Displacement in cc	Dimension (E) in (mm) (in)
30.8 (1.2125)	200	86.4-86.5 (3.4016-3.4055)

5. Select appropriate adjustment shim (8) from Table 33.

Table 33

Adjustment Shim (8)		
Displacement in cc	Shim thickness in (mm) (in)	Part number
200	6.20 (0.2441)	177-2513
	6.30 (0.2480)	177-2514
	6.40 (0.2520)	177-2515
	6.50 (0.2559)	177-2516
	6.60 (0.2598)	177-2517

6. Press lower bearing (10) and middle bearing (9) on the shaft.
7. Install the previously selected adjustment shim (8)

7. Install the previously selected adjustment shim (6) .

8. Press upper bearing (7) on the shaft.

9. Measure the thickness of the snap ring (5). This is dimension (D) .

10. Install the snap ring (5) on the shaft.

11. Measure the distance between the top of the upper bearing and the top of the snap ring. This is dimension (C) .

12. Take measured dimension (C) minus measured dimension (D). The result is the thickness that is required for the shim.

    dimension (C) - dimension (D) = required shim thickness

    Note: Dimension (C) must be 4.64-4.97 mm (.1827-.1957 in).

13. Select appropriate shim (6) from Table 34.

Table 34

Adjustment Shim (6)		
Displacement in cc	Shim thickness in (mm) (in)	Part number
200	2.60 (0.1024)	1772491
	2.65 (0.1043)	1772492
	2.70 (0.1063)	1772493
	2.75 (0.1083)	1772494
	2.80 (0.1102)	1772495
	2.85 (0.1122)	1772496
	2.90 (0.1142)	1772497
	2.95 (0.1161)	1772498

14. Remove the snap ring.

15. Install the required shim and replace the snap ring.

Lift-Off Clearance Adjustment - A8VO

This adjustment measures the allowable separation between the port plate and the barrel. The "lift-off" clearance, or the allowable separation can be adjusted. The "lift-off" clearance or the allowable separation is adjusted by adding or removing shims from the spring group in the center pin bore. Excessive leakage will occur at high-pressure spikes which may lead to damage to the rotary group and poor system performance if the allowable separation is too large.

Note: Perform calibration for each rotary group.

Ver imagen

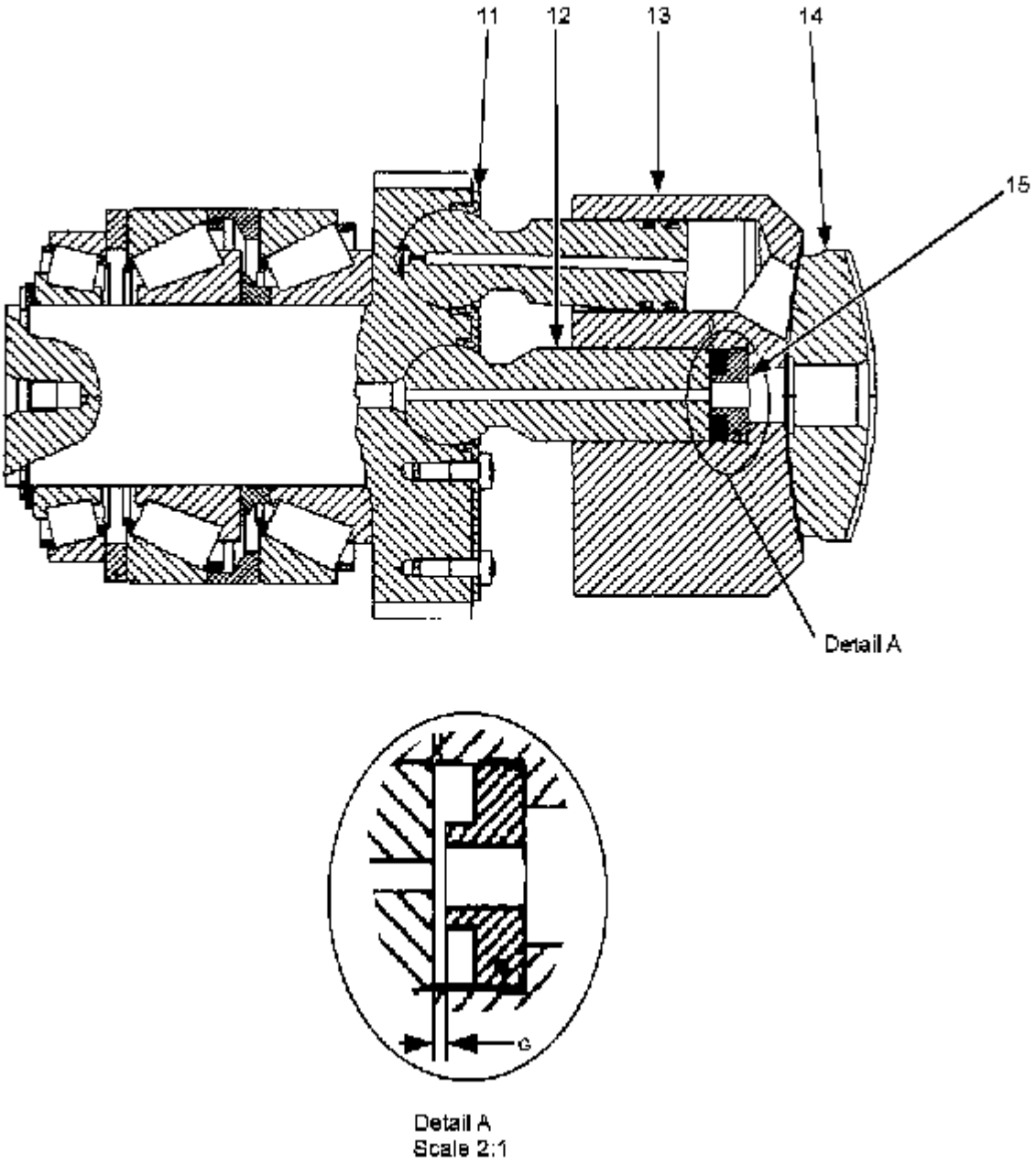


Illustration 31 g01010213

Typical lift-off clearance measurement

(11) Piston retaining plate

(12) Center pin

(13) Barrel

(14) Port plate

(15) Adjustment shim

(15) Adjustment shim

Required Equipment

149-4935 Pump and Motor Measuring Group

xxx-xxxx Gauge Plate (should be available 2nd quarter 2011)

272-1417 Gauge Plate

xxx-xxxx Gauge Plate (should be available 2nd quarter 2011)

1. Insert the complete bearing assembly into the case with the center pin (12) and the piston retaining plate (11) attached.
2. Properly seat the rotary group into the case bearing bore by using the press or the extractor device.
3. Select the correct gauge plate from table 35 to use from the kit **149-4935** Pump and Motor Measuring Group .

Table 35

Gauge Plates			
Piston Diameter mm (in)	Displacement in cc	Gauge plate part number	Gauge Plate Thickness mm (in)
25 (0.9842)	107	xxx-xxxx (1)	9.10 (0.3583)
28.7 (1.1300)	160	272-1417	9.62 (0.3787)
30.8 (1.2125)	200	xxx-xxxx (1)	12.20 (0.4803)

(1) Part should be available 2nd quarter 2011

4. Place three **149-5141** gauge balls in the top of the gauge plate.

   Note: "TOP" is engraved on the gauge plate.

5. Press the balls gently in the gauge plate.

   Note: Do not press the balls completely in the gauge plate. Only press firm enough to hold the balls in position.

   Note: The lead balls vary in size. The lead balls must protrude from the gauge plate at least 2.1 mm (0.0827 inch) prior to Step 6 in order to ensure proper compression of the lead balls.

6. Place a small amount of grease on the top side of the gauge plate to help retain the balls.

7. Place the gauge plate and the balls with the "TOP" side first into the bore.

7. Place the gauge plate and the balls with the "TOP" side first into the barrel. The grease should hold the gauge plate in place.

8. Install the cylinder barrel (13) on the center pin.

   Note: Do not drop the barrel onto the center pin. This will lead to premature crushing of the lead balls.

9. Install the port plate (14) and the head group.

10. Tighten all head bolts to the specified torque while the pump shaft is turning.

    Note: The pump shaft must be rotated while tightening bolts in order to seat all components.

11. Loosen and remove the head group and the port plate.

12. Remove barrel from center pin.

13. Carefully remove the gauge plate from the barrel.

14. Measure the thickness of the gauge plate and the flattened balls at each gauge ball location. These dimensions are (X1), (X2), and (X3) .

    Note: Repeat the procedure if the measurements of each of the three gauge ball locations are not within .05 mm (.0020 in).

Ver imagen

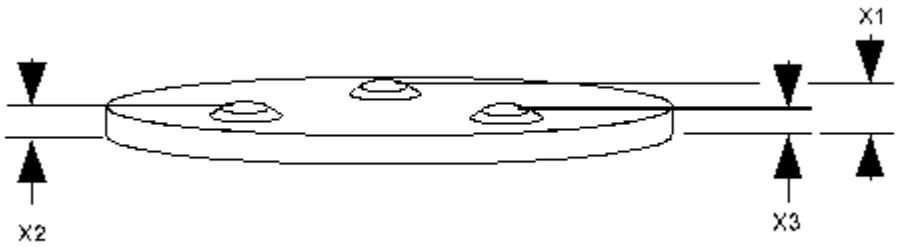


Illustration 32 g01011324

The gauge plate after removal from the barrel. The lead shot is compressed at each of the locations of the three balls.

15. Take the average value of (X1), (X2), and (X3). Call this dimension (X) .

    (dimension (X1) + dimension (X2) + dimension (X3)) / 3 = dimension (X)

16. Take calculated dimension X minus the required lift-off clearance (Z) from table 36 in order to find the required thickness of the shim.

    dimension (X) - dimension (Z) = required shim thickness

Table 36

Lift-Off Clearance	
Displacement in cc	Lift-off Dimension (Z) in (mm) (in)
107	0.300-0.500 (0.012-0.020)
160	0.300-0.500 (0.012-0.020)
200	0.300-0.500 (0.012-0.020)

Ver imagen

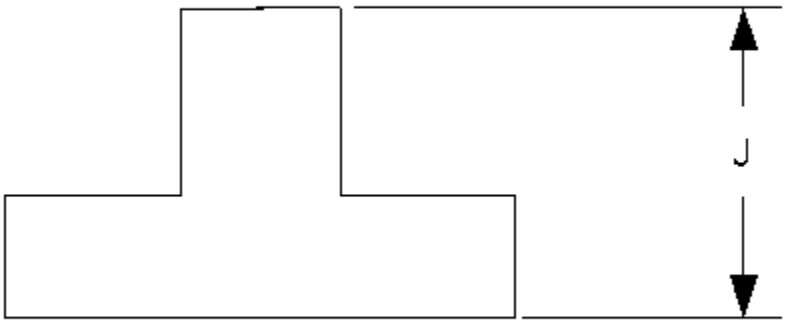


Illustration 33 g01119059

(J) The shim thickness for A8VO 107/160/200

17. Select appropriate shim (15) in Table 37.

Note: Use only one shim for adjustment of lift-off clearance.

Table 37

Adjustment Shim		
Displacement in cc	Shim thickness in (mm) (in)	Part number
	9.55 mm (0.3760 inch)	9T3391
	9.65 mm (0.3799 inch)	9T3392

107	9.75 mm (0.3839 inch)	9T3393
	9.85 mm (0.3878 inch)	9T3394
	9.95 mm (0.3917 inch)	9T3395
	10.05 mm (0.3957 inch)	9T3396
	10.15 mm (0.3996 inch)	9T3397
160	9.75 (0.3839)	5I8405
	9.85 (0.3878)	5I8406
	9.95 (0.3917)	5I8407
	10.05 (0.3957)	5I8408
	10.15 (0.3996)	5I8409
	10.25 (0.4035)	5I8410
	10.35 (0.4075)	5I8411
	10.45 (0.4114)	5I8412
	10.55 (0.4154)	8I8413
200	12.30 (0.4843)	177-2509
	12.40 (0.4882)	177-2508
	12.50 (0.4921)	177-2507 (1)
	12.60 (0.4961)	177-2506
	12.70 (0.5000)	177-2505
	12.80 (0.5039)	177-2504 (1)
	12.90 (0.5039)	- (1)
	13.00 (0.5039)	- (1)
	13.10 (0.5039)	- (1)
	13.20 (0.5039)	- (1)
	13.30 (0.5039)	- (1)
	13.40(0.5039)	- (1)

(1) Included in 247-8851 Spacer Kit

18. Reassemble the pump with the appropriate adjustment shim.

A11VO/A11VLO

Lift-off Clearance Adjustment - A11VO/A11VLO

This adjustment measures the allowable separation between the port plate and the barrel. The "lift-off" clearance or the allowable separation can be adjusted by adding or removing shims from the center spring under the ball joint. Excessive leakage will occur at high-pressure spikes which may lead to rotary group damage and poor system performance if the allowable separation is too large.

Ver imagen

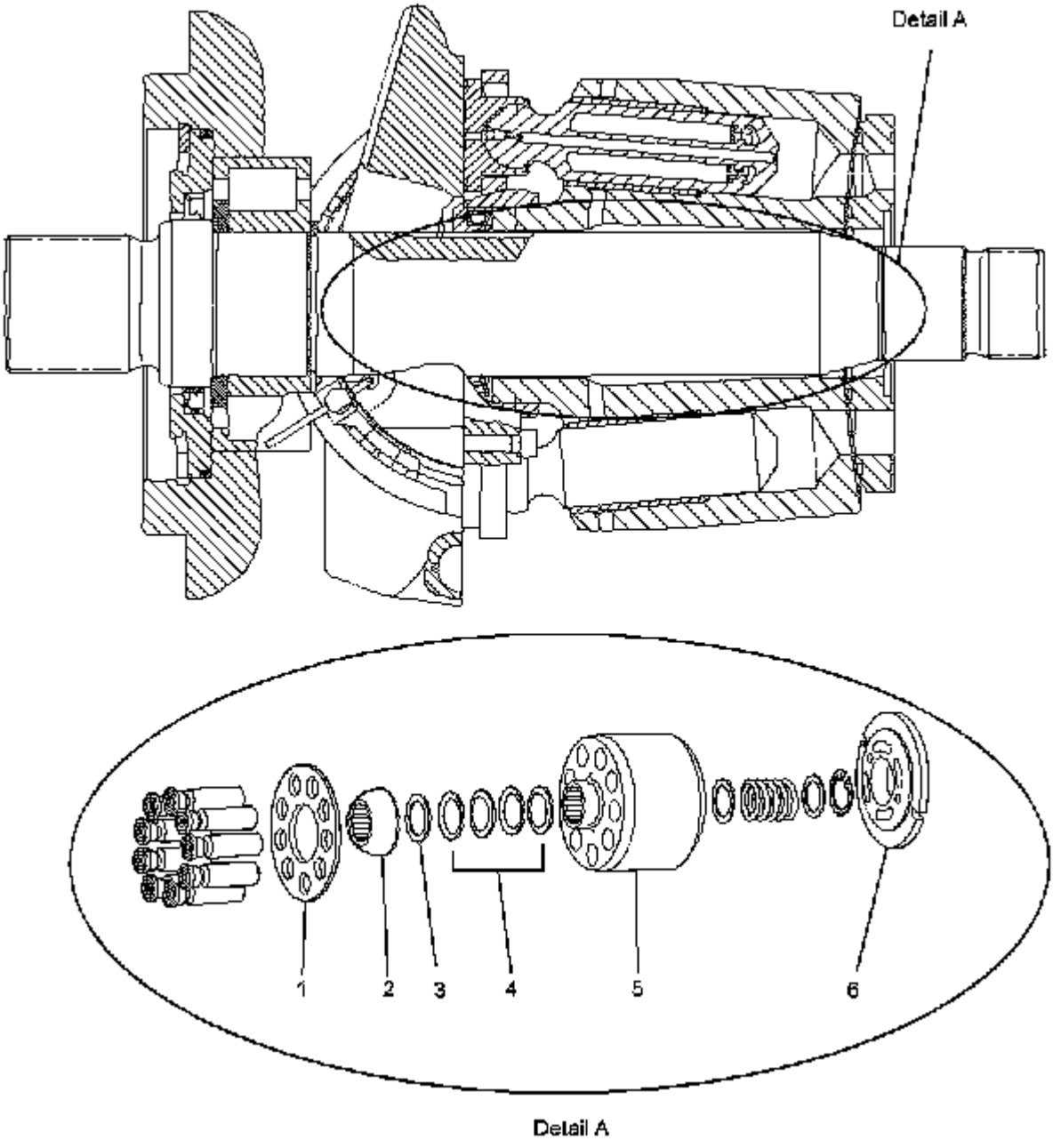


Illustration 34 g01010520

Typical A11VO pump

(1) Piston retaining ring

(2) Ball joint

(3) Adjustment shim

(4) Spring group

(5) Barrel

(6) Port Plate

Ver imagen

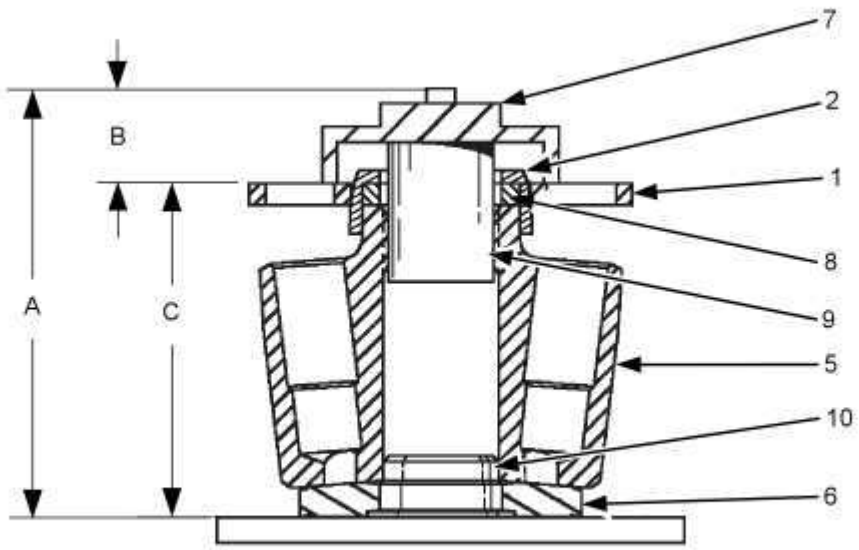


Illustration 35 g01119061

Required tooling

(1) Piston retaining plate

(2) Ball joint

(5) Barrel

(6) Port Plate

(7) Measuring bell

(7) Measuring bell

(8) Test ring or pins (3)

(9) Measuring hub

(10) Alignment plug

1. Select proper tooling from table 38.

Table 38

Piston diameter in mm (in)	Disp. in cc	Hub (9) Pt. No.	Bell (7) Pt. No.	Test ring (8) Pt. No.	Test pins (8) Pt. No.	Plug (10) Pt. No.	Additional Shim
24.8 (0.976)	130	129-3874	128-2744	128-2746		128-2742	6E-0721
26.1 (1.03)	145	-	-	-	-	-	6E-0721
28 (1.106)	190	137-1326	129-3876		137-1329 (1)	137-1331	-
29.55 (1.163)	200	129-3875	129-3876	129-3880		129-3903	-
31.8 (1.252)	250	130-9890	129-3876	129-3881		129-3904	-
31.2 (1.220)	260	171-1113	129-3876		171-1112 (1)	171-1114	-

(1) Three 137-1329 Test Pins are needed.

2. Place the port plate (6) on the surface plate. The flat side of the port plate (6) must be facing downward.

3. Install the alignment plug (10) into the port plate center bore. The chamfer side of alignment plug (10) must be facing upward.

4. Place the barrel (5) on the port plate and the alignment plug.

5. Place the test ring (8) or test pins (8) on the barrel in place of springs.

   Note: The 190cc and 260cc pumps require the use of three test pins in place of the test ring. Place the three test pins around the outside diameter of the barrel's center pin bore. The three test pins must be equally spaced around the barrel's center pin bore.

be equally spaced around the barrel's center pin bore.

6. Install the ball joint (2) over the test ring pins on the barrel.
7. Place the piston retaining plate (1) over the ball joint.
8. Bolt tool (7) and tool (9) together. Place the tool (7) and the tool (9) on the barrel. Refer to Illustration 35.
9. Measure dimension (A) by measuring the distance from the surface plate to the top of the measuring bell.
10. Dimension (B) is scribed on the tool (7) .
11. Measured dimension (A) minus dimension (B) yields dimension (C) .

    dimension (A) - dimension (B) = dimension (C)

    Note: Do not measure the distance from the surface plate to the top of the piston retaining plate in place of dimension (C). The piston retaining plate may not be square with the surface plate, and the measurement will not be accurate.
12. Take the required lift-off clearance (D) from table 39 minus the calculated dimension (C) in order to find the required thickness of the shim (3).

    Dimension (D) - dimension (C) = required shim thickness

Table 39

Lift-Off Clearance	
Displacement in cc	Dimension (D) in (mm) (in)
130	136.75-136.95 (5.3839-5.3917)
145	136.75-136.95 (5.3839-5.3917)
190	146.1-145.85 (5.75195-5.7421)
200	149.30-149.50 (5.8780-5.8858)
250	160.75-160.95 (6.3287-6.3366)
260	170.95-171.20 (6.7303-6.7402)

13. Select appropriate shim (3) from Table 40.

    Note: 130cc and 145cc pumps use one shim and one additional shim if needed for adjustment of lift-off clearance. This is shown in Table 38.

    Note: 190cc, 200cc, 150cc and 260cc pumps use the appropriate shims as shown in Table 40 in order to meet measurement (C) in Step 12.

Table 40

Adjustment Shim (3)		

Displacement in cc	Shim thickness is mm (in)	Part Number
130	0.70 (0.0276)	6E-0723
	0.90 (0.0354)	6E-0721
	1.10 ((0.0433)	6E-0720
	1.30 (0.0512)	6E-0722
	1.50 (0.0591)	6E-0724
145	0.70 (0.0276)	6E-0723
	0.90 (0.0354)	6E-0721
	1.10 ((0.0433)	6E-0720
	1.30 (0.0512)	6E-0722
	1.50 (0.0591)	6E-0724
190	0.50 (0.0197)	179-6915
	0.075 (0295)	179-6914
200	0.60 (0.0236)	5I-4271
	0.08 (0.0315)	5I-4270
	1.00 (0.0394)	5I-4269
	1.20 (0.0472)	5I-4268
250	0.60 (0.0236)	6E-3844
	0.08 (0.0315)	6E-3843
	1.00 (0.0394)	6E-3842
	1.20 (0.0472)	6E-3841
260	0.50 (0.0197)	165-9361
	0.75 (0.0295)	165-9362

14. Remove the tooling and install the appropriate shim between the barrel and the spring group.

A20VLO

Note: The A20VLO adjustment of the rotary group procedure for the bearing preload and the lift-off clearance adjustment uses the same procedure as the A11VO/A11VLO.

Note: Perform calibration for each rotary group.

Eficiencia de la bomba - Probar - Bombas de engranajes solamente

SMCS - 3115-032-ON ; 3115-032-TB

S/N - 3YK1-UP

S/N - 5AK1-UP

S/N - 4XM1-UP

S/N - 6TM1-UP

S/N - BDJ1-UP

S/N - XZK1-UP

S/N - 1AL1-UP

S/N - 9JM1-UP

S/N - 8MN1-UP

S/N - 9EJ1-UP

S/N - XZJ1-UP

S/N - 2FM1-UP

S/N - 5FM1-UP

S/N - 8KM1-393

S/N - 2LR1-294

S/N - 2ZK1-UP

S/N - 3GM1-UP

S/N - 6NM1-UP

S/N - 9ZN1-UP

S/N - 4ER1-UP

S/N - 9YR1-UP

S/N - 8JM1-UP

S/N - 2GS1-UP

S/N - 2HS1-UP

S/N - 5HM1-UP

S/N - 5ZM1-UP

S/N - 6WM1-340

S/N - 7MM1-UP

S/N - 2AN104-UP

S/N - 8WN1-UP

S/N - 9TN1-UP

S/N - 3AS1-UP

S/N - XZH1-UP

S/N - 4MK1-UP

S/N - 6YN1-UP

S/N - 2WR1-UP

ADVERTENCIA

El aceite y los componentes calientes pueden causar lesiones personales.

No deje que el aceite o los componentes calientes hagan contacto con la piel.

ATENCION

Se debe asegurar de que los fluidos están contenidos durante la inspección, mantenimiento, pruebas, ajustes y reparación de la máquina. Esté preparado para recoger el fluido con recipientes apropiados antes de abrir un compartimiento o desarmar componentes que contengan fluidos.

Vea la Publicación Especial, NENG2500, "Guía de herramientas y productos de taller Caterpillar" para obtener información sobre las herramientas y suministros adecuados para recoger y contener fluidos de los productos Caterpillar.

Deseche todos los fluidos según las regulaciones y ordenanzas locales.

Esta prueba está diseñada para determinar si una bomba está funcionando dentro de los parámetros de diseño.

Para cualquier prueba de bomba, el caudal de la bomba a 690 kPa (100 lb/pulg^2) será mayor que el caudal de la bomba a 6.900 kPa (1.000 lb/pulg^2) si la bomba está funcionando a la misma rpm. El caudal de la bomba se mide en litros/min (gal EE.UU./min).

La diferencia entre el caudal de la bomba a dos presiones de operación diferentes a la misma velocidad (rpm) es la pérdida de caudal.

Prueba en la máquina

Instale un probador del flujo hidráulico en la máquina. Registre el caudal de la bomba a 1.000 rpm y 690 kPa (100 lb/pulg^2). Registre el caudal de la bomba a 1.000 rpm y 6.900 kPa (1.000 lb/pulg^2). Para calcular la pérdida de caudal, use la fórmula de la tabla 1. Opere el motor a velocidad (rpm) de carga plena y registre el caudal de la bomba a 690 kPa (100 lb/pulg^2). Use estos valores en la siguiente fórmula.

Tabla 1

Método para determinar la pérdida de caudal
Caudal de la bomba a 1.000 rpm y 690 kPa (100 lb/pulg^2)
− Caudal de la bomba a 1.000 rpm y 6.900 kPa (1.000 lb/pulg^2)
= Pérdida de caudal (litros/min o gal EE.UU./min)

Tabla 2

Método para determinar el porcentaje de pérdida de caudal en la máquina	
Pérdida de caudal (litros/min o gal EE.UU./min)	× 100 = Pérdida de caudal en porcentaje
Caudal de la bomba a velocidad (rpm) de carga plena y 690 kPa (100 lb/pulg^2)	

Si la pérdida de caudal es mayor de 10%, el rendimiento de la bomba es insuficiente.

Prueba en banco

Registre el caudal de la bomba a 1.000 rpm y 690 kPa (100 lb/pulg^2). Registre el caudal de la bomba a 1.000 rpm y 6.900 kPa (1.000 lb/pulg^2). Para calcular la pérdida de caudal, use la fórmula de la tabla 3. Opere el banco de prueba a 2.000 rpm y registre el caudal de la bomba a 690 kPa (100 lb/pulg^2). Use estos valores en la siguiente fórmula.

Tabla 3

Método para determinar la pérdida de caudal

Caudal de la bomba a 1.000 rpm y 690 kPa (100 lb/pulg^2)
− Caudal de la bomba a 1.000 rpm y 6.900 kPa (1.000 lb/pulg^2)
= Pérdida de caudal (litros/min o gal EE.UU./min)

Tabla 4

Método para determinar el porcentaje de pérdida de caudal en el banco	
Pérdida de caudal (litros/min o gal EE.UU./min)	× 100 = Pérdida de caudal en porcentaje
Caudal de la bomba a 2.000 rpm y 690 kPa (100 lb/pulg^2)	

Si la pérdida de flujo es mayor de 10%, el rendimiento de la bomba es insuficiente.

Juego axial de los cojinetes de la bomba de pistones - Ajustar

SMCS - 4306-025; 5070-025

Tabla 1

Herramientas necesarias			
Herramienta	**Número de pieza**	**Descripción**	**Cant.**
A	8T-5096	Grupo de Indicador de dial	1

Ver imagen

GRAPHIC NOT AVAILABLE

Ilustración 1 g00012797

Bomba de pistones del sistema hidráulico y de la dirección

(1) Pernos

(2) Eje

(3) Caja

(4) Cono

(5) Resorte posicionador

(6) Grupo de rotación de la bomba

(7) Calces

(8) Taza

(9) Pistón de control

(10) Culata de cilindros

(11) Cono

(12) Taza

(13) Pistón de control

Aplique el siguiente procedimiento para ajustar el juego axial del cojinete del eje cuando se reemplace uno cualquiera de estos componentes:

- Eje (2)
- Caja (3)
- Cono (4) o (11)
- Taza (8) o (12)
- Cabezal (10)

Nota: No instale el grupo de rotación de la bomba (6) cuando efectúe este procedimiento.

1. Quite los siguientes componentes del cabezal (10) :
   - Pistón de control (9)
   - Pistón de control (13)
   - Resorte posicionador (5)

   Nota: Asegúrese de que las tazas (8) y (12) y los conos (4) y (11) estén posicionadas contra los resaltos de los componentes.
2. Instale el cono (4) en el extremo estriado del eje (2) .
3. Instale la taza (8) en la caja (3) .
4. Instale la taza (12) en el cabezal (10) .
5. Instale el eje (2) y el cono (4) en la caja (3) .
6. Instale el cono (11) sobre el eje (2) .
7. Instale el eje (2), los conos (4) y (11) y la caja (3) en el cabezal (10) sin los calces (7) .
8. Posicione la empaquetadura en la caja de la bomba (3) cuando arme el cabezal (10) a la caja de la bomba (3) .
9. Apriete los seis pernos (1) a un par de 70 ± 7 N·m (52 ± 5 lb-pie).

   Nota: Para el montaje, utilice dos prisioneros para alinear el cabezal y la caja.
10. Posicione la bomba de modo que la estría en el eje (2) esté apuntando hacia arriba.
11. Gire el eje hacia atrás y hacia adelante varias veces para asentar los conos apropiadamente.
12. Posicione la herramienta (A) de modo que el punto de contacto del indicador de dial esté en el extremo de la estría del eje.

13. Ponga el indicador de dial en cero.

14. Compruebe el juego axial de la bomba.

15. Reste el juego axial deseado del cojinete del eje de 0,010 a 0,100 mm (0,0004 a 0,0039 pulg) de la lectura del indicador de dial que se observe en el paso 14. Este es el espesor de los calces a utilizar en el conjunto de calces (7) para lograr el juego axial apropiado del cojinete del eje.

Tabla 2

Ejemplo	
Lectura del juego axial del cojinete del eje del paso 15	1,016 mm (0,0400 pulg)
Reste el juego axial deseado del cojinete del eje.	0,010 a 0,100 mm (0,0004 a 0,0039 pulg)
Grosor necesario de calces	1,006 a 0,916 mm (0,0396 a 0,0361 pulg)

16. Saque los seis pernos (1) y quite el cabezal (10) de la caja (3) .

17. Quite el cono (11) del eje (2) .

18. Instale el espesor correcto de los calces (7) del paso 15 en el eje (2) .

19. Instale el cono (11) sobre el eje (2) .

20. Repita los pasos 8 hasta 14.

21. Si el juego axial medido del cojinete del eje no es de 0,010 a 0,100 mm (0,0004 a 0,0039 pulg), repita los pasos 15 hasta 20.

Válvula de control de la bomba del sistema hidráulico y de la dirección - Probar y Ajustar

SMCS - 5455-025; 5455-081

Ajuste de la baja presión auxiliar

Nota: Antes de realizar este ajuste, vea en Pruebas y Ajustes, "Preparación de la máquina para la localización y solución de problemas".

Tabla 1

Herramientas necesarias			
Herramienta	**Número de pieza**	**Descripción**	**Cant.**
A	198-4240	Indicador Digital de Presión	1
B	1U-7563	Llave Hexagonal	1

Ver imagen

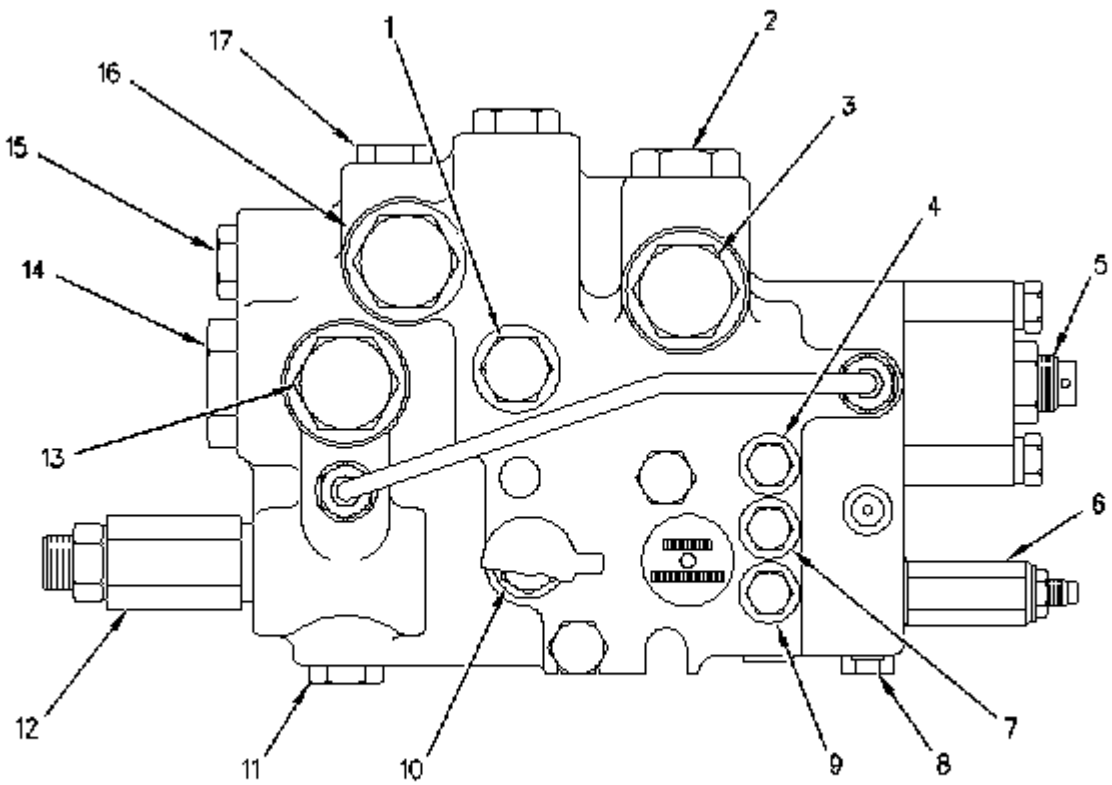


Ilustración 1 g00111739

Vista lateral de la válvula de combinación

(1) Orificio del interruptor de presión

(2) Orificio de suministro para el grupo de válvula

(3) Orificio de suministro para el grupo de válvula

(4) Señal de dirección

(5) Válvula de alivio de la dirección

(6) Válvula de alivio de la señal

(7) Señal de la bomba

(8) Válvula de purga de la señal

(9) Señal de la válvula de control

(10) Orificio de prueba de presión para la bomba hidráulica y de dirección

(11) Orificio auxiliar de retorno

(12) Válvula de alivio del accesorio

(13) Orificio de retorno del grupo de válvula

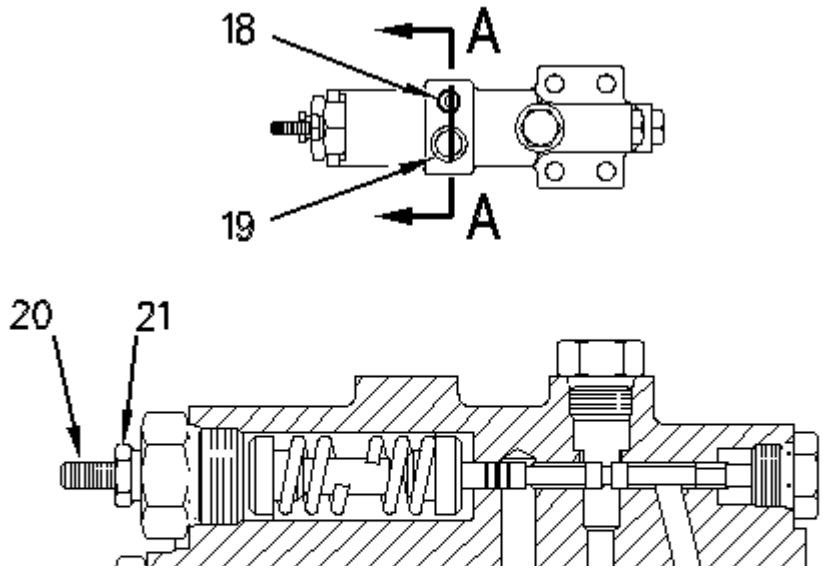
(14) Orificio de retorno al tanque hidráulico

(15) Orificio de suministro a la dirección

(16) Orificio del acumulador de la dirección

(17) Orificio de la bomba de la dirección secundaria

Ver imagen



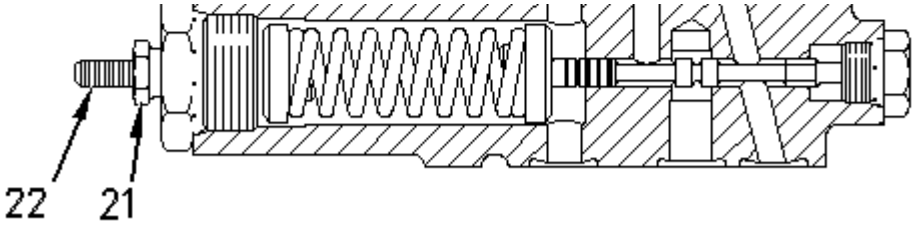


Ilustración 2 g00111740

Válvula de control de la bomba

(18) Válvula de purga del compensador de flujo

(19) Orificio

(20) Tornillo de ajuste del compensador de flujo (presión marginal)

(21) Contratuercas

(22) Tornillo de ajuste del compensador de presión (corte de presión)

Ver imagen

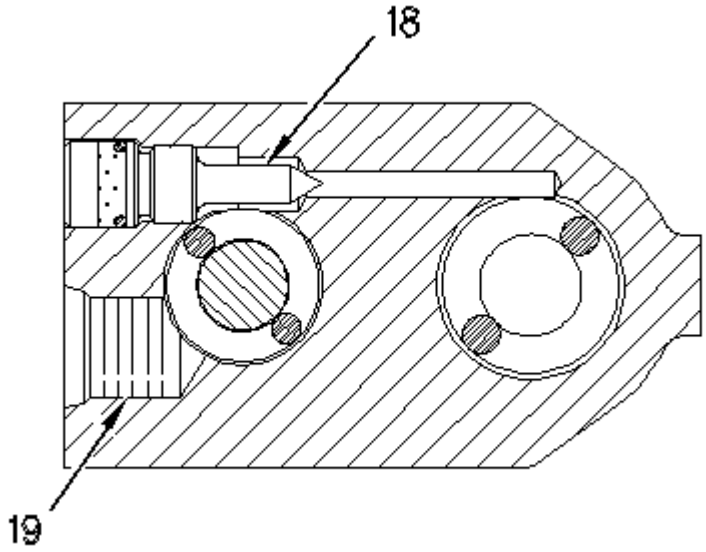


Ilustración 3 g00111741

Sección "A-A" de la válvula de control de la bomba

(18) Válvula de purga del compensador de flujo

(19) Orificio

La válvula de combinación y la válvula de control de la bomba son accesibles desde el suelo. Las válvulas están ubicadas debajo de la plataforma de la cabina y en el lado izquierdo de la máquina. Estos

componentes están cerca del soporte trasero de la cabina.

1. Arranque el motor.
2. Opere el motor a baja velocidad en vacío. Opere los controles del accesorio durante tres a diez minutos para aumentar la temperatura del aceite hidráulico hasta la gama normal de operación.
3. Pare el motor.
4. Quite la tapa contra polvo de la válvula de combinación. Instale la herramienta (A) en el orificio de pruebas de presión (10) .

   Nota: El control de levantamiento de la hoja tiene que estar en la posición neutral antes de arrancar el motor. El equipo de pruebas se dañará si la válvula de control de la hoja está en la posición libre al momento de arrancar el motor. Si la máquina cuenta con un tope hidráulico, la válvula de control de la hoja se debe mover desde la posición libre a la posición neutral cuando se apaga el motor.
5. Compruebe para asegurar que el control de levantamiento de la hoja esté en la posición neutral.
6. Arranque el motor. Opere el motor a alta velocidad en vacío. Anote la lectura de la presión del manómetro en el orificio de pruebas de presión (10). La presión debe leer 3.300 ± 689 kPa (480 ± 100 lb/pulg^2). Si la presión baja auxiliar es demasiado alta, vea el Problema: La presión baja auxiliar es demasiado alta, en el manual de Pruebas y Ajustes, "Comprobaciones de funcionamiento".
7. Utilice la herramienta (B) para abrir la válvula de purga (18) una vuelta hacia la izquierda. Puede ser que se fugue un poco de aceite por la válvula de purga durante este procedimiento.
8. Vea la lectura del manómetro. El ajuste correcto para la baja presión auxiliar verdadera es de 2.100 ± 150 kPa (305 ± 22 lb/pulg^2). Esta lectura es sin ninguna carga de los accesorios ni de la dirección en el sistema hidráulico.
9. Si la lectura de la presión es incorrecta, cierre la válvula de purga (18). Proceda a la sección "Ajuste del compensador de flujo (presión marginal)".

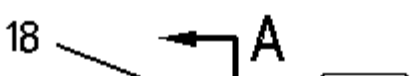
Ajuste del compensador de flujo (presión marginal)

Nota: Antes de realizar esta verificación, vea en Pruebas y Ajustes, "Preparación de la máquina para la localización y solución de problemas".

Tabla 2

Herramientas necesarias			
Herramienta	**Número de pieza**	**Descripción**	**Cant.**
C	1U-5796	Grupo de Manómetro de Presión Diferencial	1

Ver imagen



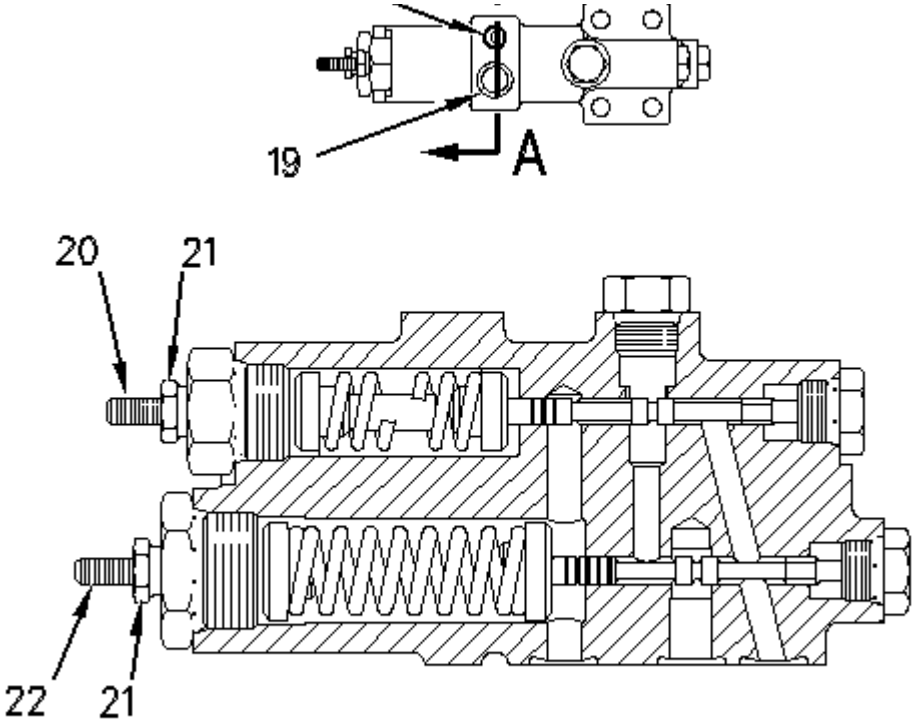


Ilustración 4 g00111740

Válvula compensadora de presión y de flujo

(18) Válvula de purga para el compensador de flujo

(19) Orificio

(20) Tornillo de ajuste para el compensador de flujo (presión marginal)

(21) Contratuercas

(22) Tornillo de ajuste para el compensador de presión (corte de presión)

1. Conecte el lado bajo de la herramienta (C) en el orificio (19). El orificio (19) recibe la señal resuelta de la válvula de combinación.
2. Conecte el lado alto de la herramienta (C) en el orificio de pruebas de presión (10) .

   Nota: El control de levantamiento de la hoja tiene que estar en la posición neutral antes de arrancar el motor. El equipo de pruebas se dañará si la válvula de control de la hoja está en la posición libre al momento de arrancar el motor. Si la máquina está equipada con un tope hidráulico, la válvula de control de la hoja se debe mover desde la posición libre a la posición neutral cuando se apague el motor.
3. Vea para asegurar que los controles de levantamiento de la hoja estén en la posición neutral.
4. Arranque el motor.
5. Opere el motor a baja velocidad en vacío. Opere los controles del accesorio durante tres a diez minutos para aumentar la temperatura del aceite hidráulico hasta la gama normal de operación.

Ver imagen

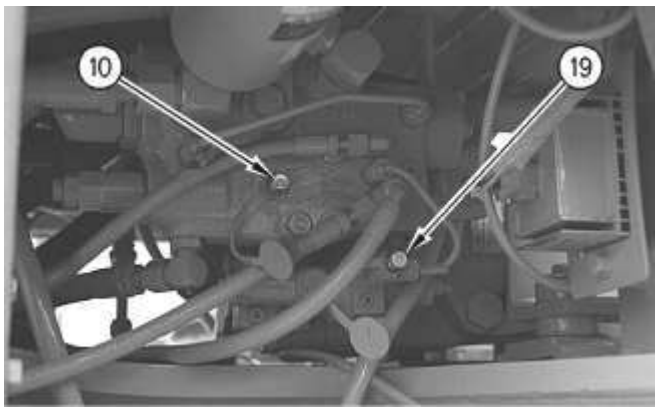


Ilustración 5 g00111748

(10) Orificio de prueba de presión para la bomba hidráulica y de dirección

(19) Orificio

6. Cuando obtenga la temperatura normal de operación del aceite hidráulico, opere el motor a alta velocidad en vacío.

7. Opere el mando del círculo y gire la hoja a plena velocidad. Anote la presión del manómetro. Mientras el círculo esté en movimiento, golpee suavemente el vidrio del manómetro para obtener una lectura precisa del manómetro.

8. Pare el motor. La lectura de la presión debe ser de 2.100 ± 150 kPa (305 ± 22 lb/pulg^2).

9. Si la lectura de la presión es incorrecta, afloje las contratuercas (21) en el tornillo regulador (20). Gire el tornillo de ajuste hacia la derecha para aumentar el ajuste. Gire el tornillo de ajuste hacia la izquierda para disminuir el ajuste.

10. Cuando apriete las contratuercas (21) sostenga firmemente el tornillo regulador (20). Repita los pasos desde 6 hasta el paso 9 hasta obtener el ajuste correcto de presión en el paso 8.

11. Quite el manómetro. Reinstale las tapas antipolvo en el orificio de pruebas de presión (10) y en el orificio (19) .

Ajuste de la presión del sistema hidráulico

Ver imagen

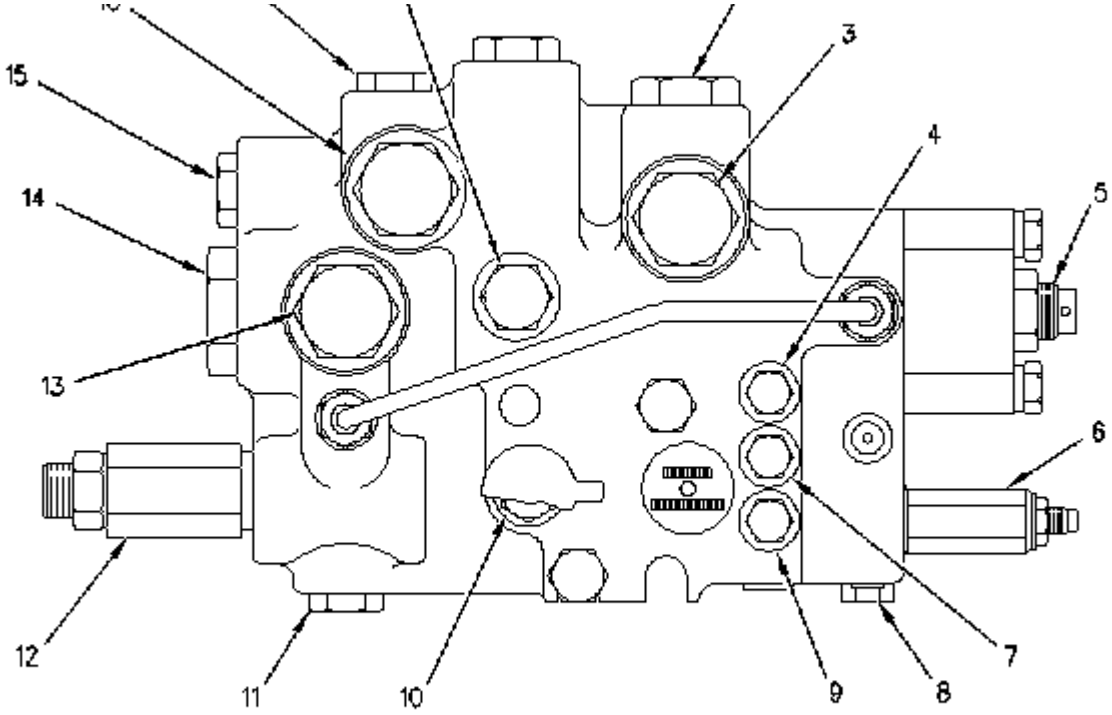


Ilustración 6 g00111739

Vista lateral de la válvula de combinación

(1) Orificio del interruptor de presión

(2) Orificio de suministro para el grupo de válvula

(3) Orificio de suministro para el grupo de válvula

(4) Señal de dirección

(5) Válvula de alivio de la dirección

(6) Válvula de alivio de la señal

(7) Señal de la bomba

(8) Válvula de purga de la señal

(9) Señal de la válvula de control

(10) Orificio de prueba de presión para la bomba hidráulica y de dirección

(11) Orificio de retorno auxiliar

(12) Válvula de alivio del accesorio

(13) Orificio de retorno del grupo de válvula

(14) Orificio de retorno al tanque hidráulico

(15) Orificio de suministro a la dirección

(16) Orificio del acumulador de la dirección

(17) Orificio de la bomba de la dirección secundaria

Nota: Antes de realizar esta verificación, vea en Pruebas y Ajustes, "Preparación de la máquina para la localización y solución de problemas".

Nota: Cuando realice este ajuste y se derrame aceite, utilice recipientes aprobados para contener el aceite. Utilice también estos recipientes aprobados para desechar el aceite.

1. Arranque el motor.
2. Opere el motor a baja velocidad en vacío. Opere los controles del accesorio durante tres a diez minutos para aumentar la temperatura del aceite hidráulico hasta la gama normal de operación.
3. Pare el motor. Quite la tapa contra polvo del orificio de pruebas de presión (10). Instale la herramienta (A) en el orificio de pruebas de presión (10) .

Ver imagen

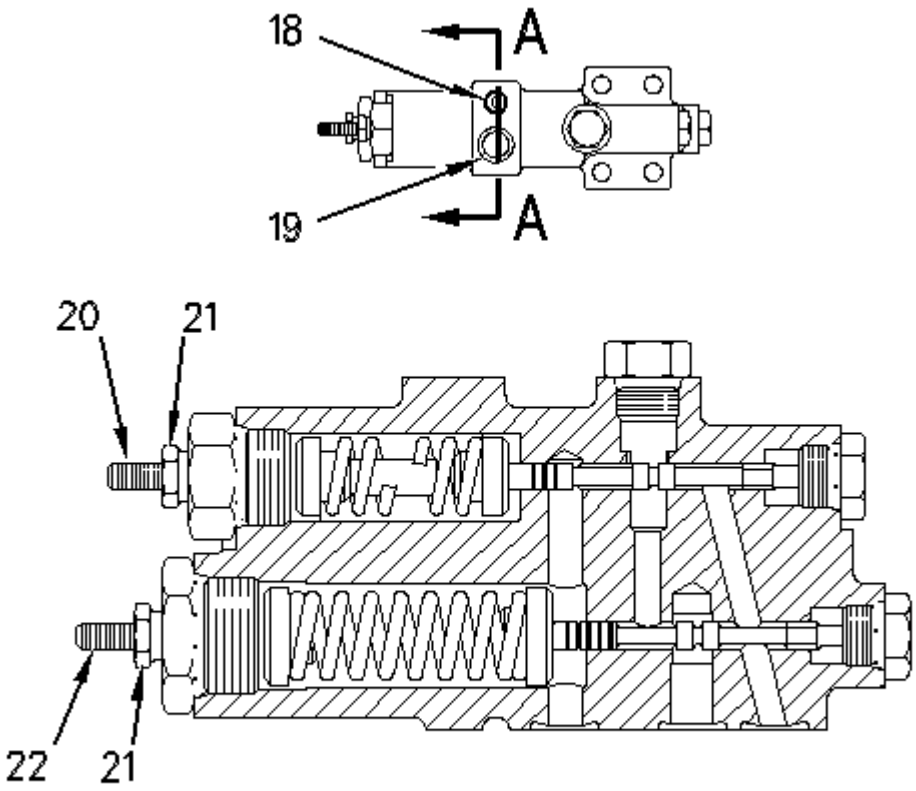


Ilustración 7 g00111740

Válvula compensadora de presión y de flujo

(18) Válvula de purga para el compensador de flujo

(19) Orificio

(20) Tornillo de ajuste para el compensador de flujo (presión marginal)

(21) Contratuercas

(22) Tornillo de ajuste para el compensador de presión (corte de presión)

4. Arranque el motor y hágalo funcionar a alta velocidad en vacío. Cuando esté comprobando la presión de calado del cilindro del accesorio, mueva el cilindro de inclinación de las ruedas hasta el extremo de la carrera. Cale entonces el cilindro de inclinación de las ruedas. La lectura correcta de presión debe ser 24.132 ± 1.034 kPa (3.500 ± 150 lb/pulg^2).

5. Pare el motor si la lectura de la presión es incorrecta. Afloje la contratuerca de la válvula de alivio de la señal (6). La contratuerca tiene una cabeza hexagonal de 9/16 pulg. Gire el tornillo de ajuste de alivio de la señal a la derecha para aumentar al máximo la presión de entrega de la bomba. Gire el tornillo de ajuste de alivio de señal a la izquierda para disminuir al máximo la presión de entrega de la bomba. Utilice una llave hexagonal de 3/16 pulg para ajustar la válvula de alivio de la señal. Una vuelta hacia la derecha del tornillo de ajuste aumentará el ajuste en aproximadamente 4.700 kPa (682 lb/pulg^2). Una vuelta a la izquierda del tornillo prisionero disminuirá el ajuste en la misma cantidad. Mientras que aprieta la contratuerca, sostenga firmemente el tornillo prisionero. Arranque el motor y verifique la lectura de la presión.

6. Pare el motor para ajustar la válvula de alivio del accesorio (12). Quite la válvula de alivio de la señal (6) de la válvula de combinación. Quite la válvula de alivio del levantamiento izquierdo de la hoja de la válvula de control de levantamiento izquierdo de la hoja. Instale la válvula de alivio de la señal (6) en la válvula izquierda del control de levantamiento de la hoja. Instale la válvula de alivio de levantamiento izquierdo de la hoja en la válvula de combinación.

7. Afloje las contratuercas (21) y haga girar el tornillo regulador (22) dos vueltas completas hacia la derecha. Utilice una llave hexagonal de 4 mm.

8. Arranque el motor y hágalo funcionar a alta velocidad en vacío. Mueva el cilindro de inclinación de las ruedas hasta el extremo de la carrera y cale el cilindro. El manómetro debe leer 27.600 ± 400 kPa (3.900 ± 60 lb/pulg^2). Este es el ajuste de presión de la válvula de alivio del accesorio (12) .

9. Si la presión es incorrecta, pare el motor. Afloje la contratuerca en la válvula de alivio del accesorio (12) .

10. Utilice una llave hexagonal de 3/8 pulg para girar el tornillo prisionero en la válvula de alivio del accesorio (12). Al girar el tornillo prisionero hacia la derecha aumentará la presión, y al girar el tornillo prisionero hacia la izquierda disminuirá la presión. Mientras aprieta la contratuerca, sostenga firmemente el tornillo prisionero. Arranque el motor y hágalo funcionar a alta velocidad en vacío. Mueva el cilindro de inclinación de las ruedas delanteras a la carrera máxima hasta que se cale. Verifique la lectura de la presión.

    Nota: Si no puede lograr 27.600 ± 400 kPa (3.900 ± 60 lb/pulg^2), reemplace la válvula de alivio del accesorio (12) .

11. Pare el motor. Gire el tornillo de ajuste (22) dos vueltas completas hacia la izquierda. Utilice una llave hexagonal de 4 mm.

llave hexagonal de 4 mm.

12. Cuando ajuste el tornillo de ajuste (22), arranque el motor. Opere el motor a alta velocidad en vacío. Mueva el cilindro de inclinación de las ruedas hasta el extremo de la carrera y cale el cilindro. El manómetro debe indicar 25.500 ± 350 (3.700 ± 70 lb/pulg^2).

13. Si la presión es incorrecta, pare el motor. Afloje las contratuercas (21) en el tornillo regulador (22) .

14. Gire el tornillo de ajuste (22) hacia la derecha para aumentar la presión. Gire el tornillo de ajuste (22) hacia la izquierda para disminuir la presión. Mientras aprieta las contratuercas (21), sostenga firmemente el tornillo regulador (22). Arranque el motor y hágalo funcionar a alta velocidad en vacío. Mueva el cilindro de inclinación de las ruedas delanteras a la carrera máxima hasta que se cale. Verifique la lectura de la presión.

15. Después de lograr la lectura de presión correcta, quite la válvula de alivio del levantamiento de la hoja izquierda de la válvula de combinación. Quite la válvula de alivio de la señal (6) de la válvula de control de levantamiento de la hoja. Instale la válvula de alivio de la señal (6) en la válvula de combinación. Instale la válvula de alivio de levantamiento del lado izquierdo de la hoja que está en la válvula de control de levantamiento de la hoja. Apriete las válvulas de alivio al par de apriete especificado.

16. Repita el paso 4.

17. Si la lectura de la presión es incorrecta, repita el paso 5.

18. Cuando la lectura de la presión sea correcta, pare el motor. Quite el manómetro. Instale la tapa contra polvo en el orificio de pruebas de presión (10) .

Ajuste de la red de señal

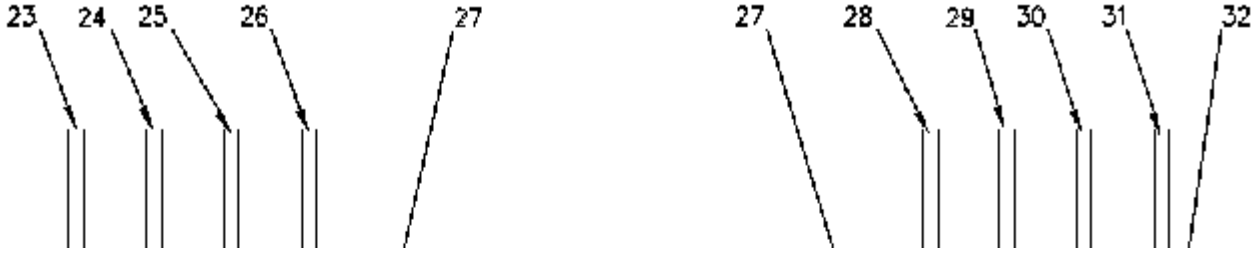
Nota: Antes de realizar esta verificación, vea en Pruebas y Ajustes, "Preparación de la máquina para la localización y solución de problemas".

Tabla 3

Herramientas necesarias			
Herramienta	**Número de pieza**	**Descripción**	**Cant.**
D	198-4238	Sensor de Presión (1)	2

(1) El sensor de la presión es parte de la herramienta (A) .

Ver imagen



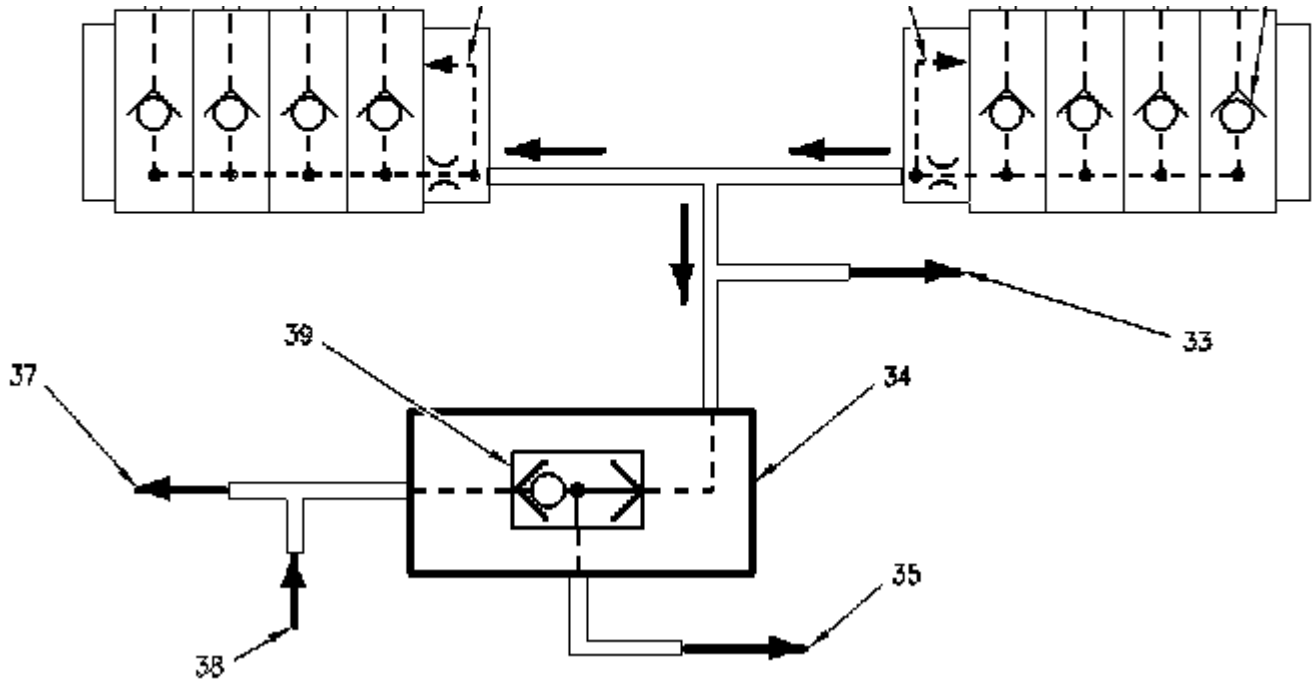


Ilustración 8 g00111754

(23) Levantamiento de la hoja hacia la izquierda

(24) Desplazamiento lateral

(25) Mando del círculo

(26) Inclinación de la hoja

(27) Tubería a las válvulas compensadoras de l accesorio

(28) Articulación

(29) Desplazador del círculo

(30) Inclinación de la rueda

(31) Levantamiento de la hoja hacia la derecha

(32) Válvula de retención de señal

(33) Tubería a la válvula de purga de la señal y la válvula de alivio de la señal

(34) Válvula de combinación

(35) Tubería a la válvula compensadora de presión y de flujo en la bomba hidráulica y de dirección

(37) Tubería a la bomba de la dirección dosificadora

(38) Tubería de la válvula de priorida de la dirección y válvula de alivio de la dirección

(39) Resolvedor de señal

Nota: La cantidad de válvulas de control en el banco de válvulas puede variar si la máquina está equipada con un equipo diferente.

1. Opere el motor a baja velocidad en vacío.
2. Opere los controles del accesorio de tres a diez minutos para aumentar la temperatura del aceite hidráulico hasta la gama normal de temperaturas de operación.
3. Pare el motor. Quite la tapa contra polvo del orificio de pruebas de presión (10). Instale la herramienta (A) y la herramienta (D) en el orificio de pruebas de presión (10) .
4. Arranque el motor y hágalo funcionar a alta velocidad en vacío. La lectura correcta de presión debe ser 3.300 ± 689 kPa (480 ± 100 lb/pulg^2).
5. Si la presión que se mide en el orificio de pruebas de presión (10) está dentro de la tolerancia que se indica en el paso 4, proceda al paso 6. Si la lectura de la presión no está dentro de la tolerancia, ajuste la presión baja auxiliar de la bomba. Vea el procedimiento que se encuentra en la sección "Ajuste de la baja presión auxiliar". Continúe entonces con la sección "Ajuste de la red de señal".
6. Pare el motor.
7. No quite la herramienta (D) del orificio (10) .
8. Para obtener la presión de señal de la bomba, instale una segunda herramienta (D) en el orificio (19). Conecte la herramienta (D) sobre la herramienta (A) .
9. Arranque el motor.
10. Mueva la palanca de control de la inclinación vertical de la hoja (26) para calar el cilindro. Lea los manómetros. El manómetro que está leyendo la señal de la bomba debe aumentar. El manómetro que está leyendo la salida de la bomba debe aumentar.
11. Si la presión de señal de la bomba aumenta y la presión de salida de la bomba no aumenta, la válvula de control de la bomba en la bomba hidráulica y de dirección ha fallado. Pare el motor.
12. Reemplace la válvula de control de la bomba.
13. Compruebe el resolvedor de señal (39) en la válvula de combinación siguiendo el paso 14 y el paso 15.
14. Arranque el motor y opérelo a baja velocidad en vacío.
15. Si la dirección está operable con al menos un accesorio en operación, el resolvedor de señal (39) en la válvula de combinación ha fallado. Cuando el accesorio deja de operar y no se está operando la dirección, el resolvedor de señal (39) en la válvula de combinación ha fallado.
16. Pare el motor. Quite el equipo de prueba. Reinstale la cubierta contra polvo.
17. Para comprobar si hay una bola de retención defectuosa o faltante en las válvulas de control del accesorio, siga los pasos desde 18 hasta 23.
18. Arranque el motor y opérelo a baja velocidad en vacío. Verifique los tiempos de ciclo del accesorio.
19. Si el tiempo de ciclo de cada uno de los accesorios es más largo que las especificaciones que se permiten excepto para un accesorio, la información siguiente es cierta. La bola de retención de señal en esa válvula de control del accesorio es defectuosa o falta.

20. La señal del banco de válvulas del lado derecho se puede aislar de la señal del banco de válvulas del lado izquierdo en la válvula de combinación. Esto localizará y solucionará el problema con la señal al banco de válvulas del lado derecho o al banco de válvulas del lado izquierdo.

21. Si un cilindro de levantamiento de la hoja se corre durante la operación de otro accesorio que esté en el mismo grupo de válvulas, la bola de retención de señal en el cilindro de levantamiento de la hoja está defectuosa. Una bola de retención de señal que falte o esté defectuosa en cualquiera de las válvulas de accesorio puede causar que uno de los accesorios de ese banco de válvulas no funcione. El accesorio que está funcionando será la válvula del accesorio que tenga una bola de retención de señal defectuosa o que falte.

22. Opere el mando del círculo. Si un circuito de bajo caudal falla durante la operación del motor a baja velocidad en vacío, vea en Pruebas y Ajustes, "Comprobaciones de funcionamiento".

23. Pare el motor.

Deslizamiento del volante de dirección - Comprobar

SMCS - 4312-535; 4343-535

Nota: Antes de realizar esta verificación, vea en la Localización y solución de problemas, "Preparación de la máquina para la localización y solución de problemas".

Para comprobar el deslizamiento del volante de dirección, haga las siguientes comprobaciones.

1. Conduzca la rueda izquierda o la rueda derecha contra los topes. La presión debe ser de 18.616 ± 689 kPa (2.700 ± 100 lb/pulg^2).
2. Compruebe las revoluciones del volante de dirección. Cuando se gire el volante de tope a tope, debe lograr un total de seis vueltas y media.
3. Gire el volante de dirección mientras opera el círculo. Compruebe si le resulta difícil conducir.

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

This special instruction provides the necessary information in order to create SIS Web Feedback. All information provided in this document is necessary in order to provide the SIS Web Feedback analyst with the necessary information to expedite the resolution. SIS Web feedback is intended to provide feedback on any discrepancies within the Service/Parts literature. The feedback system is not intended to address any problems related to machine or component performance. Refer to the Dealer Solutions Network (DSN) for any problems associated with machine or component performance.

Note: Feedback is only available through SIS Web. Feedback is not available through SIS Network or SIS DVD.

Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

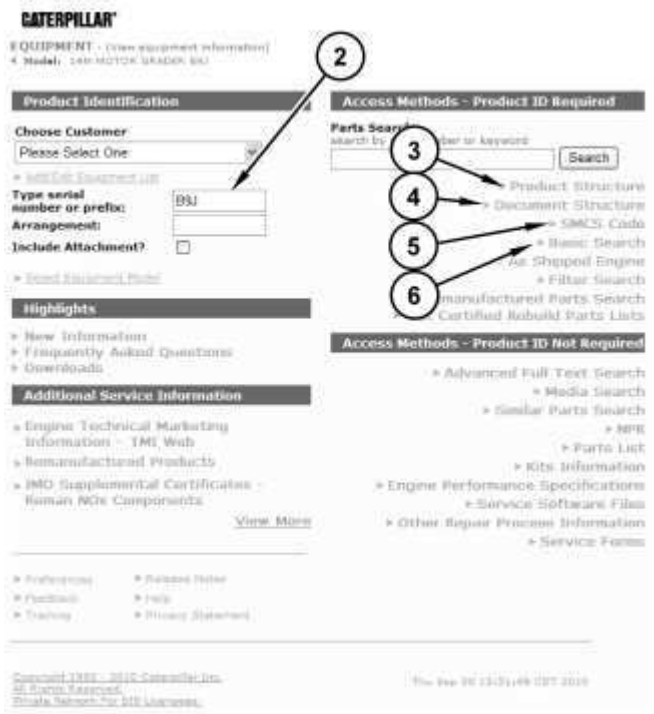


Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

   Note: Using any other method in searching for parts and service information will result in missing information in the discrepancy ticket. Any missing information may delay resolution of the discrepancy.

Ver imagen

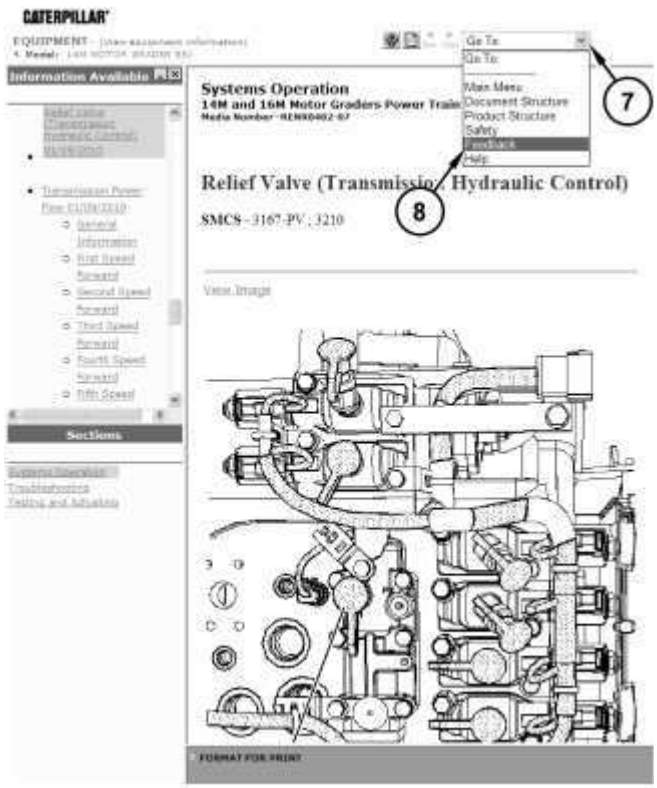


Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

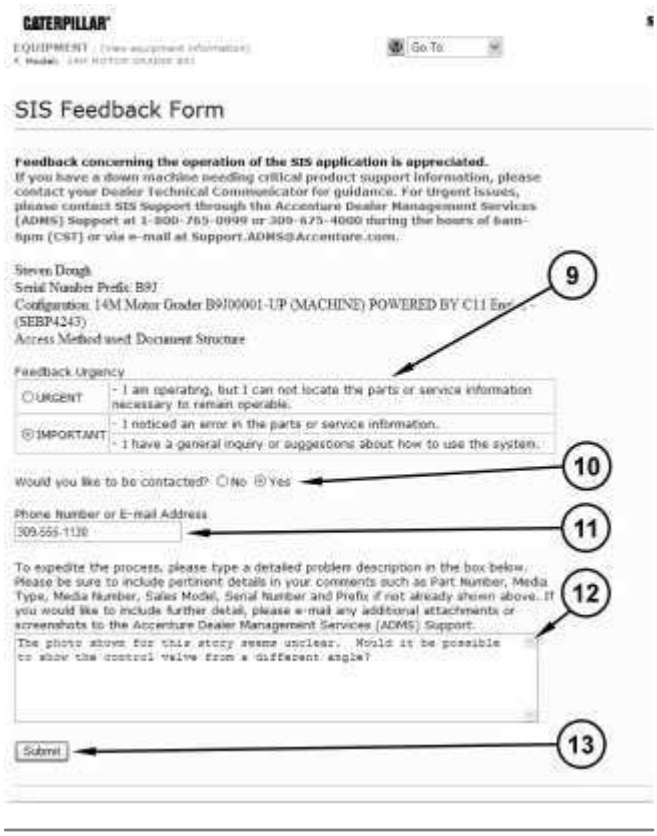


Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
7. Provide the contact information in box (11). The contact information can include an E-mail address and/or a telephone number.
8. Provide a detailed description of the discrepancy in box (12). Be sure to include pertinent details such as: part number, media type, media number, sales model, serial number and prefix. This information will expedite the resolution of the discrepancy.
9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

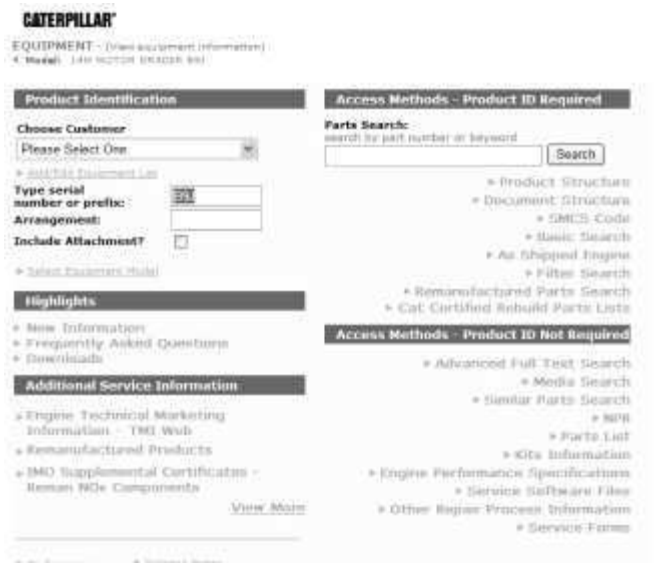
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



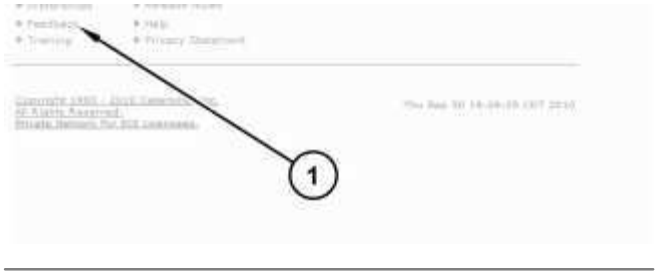


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Hose and Coupling Assembly Training Manual Contents{0684, 5057, 5057, 7554}

SMCS - 0684-QC ; 5057-QC ; 7554-QC

Agricultural Tractor: All
Articulated Truck: All
Asphalt Paver: All
Backhoe Loader: All
Challenger: All
Cold Planer: All
Combine: All
Compact Track Loader: All
Compact Wheel Loader: ALL
Earthmoving Compactor: All
Excavator: All
Felling Head: Caterpillar Branded
Forest Products: All
Integrated Toolcarrier: All
Landfill Compactor: All
Load Haul Dump: All
Mini Hydraulic Excavator: All
Motor Grader: All
Multi Terrain Loader: All
Off-Highway Truck/Tractor: All
Paving Compactor: All
Pipelayer: All
Road Reclaimer/Soil Stabilizer: All
Skid Steer Loader: All
Soil Compactor: All
Telehandler: All
Track Feller Buncher: Caterpillar
Track-Type Loader: All
Track-Type Skidder: All
Track-Type Tractor: All
Wheel Dozer: All
Wheel Feller Buncher: Caterpillar Branded
Wheel Loader: All
Wheel Skidder: All
Wheel Tractor-Scraper: All

Introduction

For questions or additional information concerning this guideline, submit a form for feedback in the Service Information System. In order to address an urgent issue, please use the following resources in order to communicate your request to Caterpillar Repair Process Engineering:

- Caterpillar Dealer Technical Communicator
- Dealer Solution Network
- Caterpillar Technical Representative
- Knowledge Network

Summary

This guideline lists the complete contents of the **Hose and Coupling Assembler Training Manual Contents, SEBF8727**. The bulletins that are listed in this guideline can be ordered separately.

Binder

Table 1

Title	Media Number
Hose and Coupling Assembler Training Manual	YEKP0625
Contents for Hose Product and Tooling Guide for Mobile Equipment Manual	SEBF8727
Hose Product and Tooling Guide for Mobile Equipment Manual Binder Only	SENR2301
Binder Label	UENR1901

Introduction Tab

Table 2

Title	Media Number
Introduction Tab	SEBF8707
Hose and Coupling Assembler Training Notes	SEBF8717

Hose Product and Tooling Guide Tab

Table 3

Title	Media Number
Hose Product and Tooling Guide Tab	SEBF8708
Hose Product and Tooling Guide for Mobile Equipment Manual	PECP5030

Hose Identification Tab

Table 4

Title	Media Number
Hose Product and Tooling Guide Tab	SEBF8709
XT-3 ES Hose	PEHP9519

Coupling Identification Tab

Table 5

Title	Media Number
Coupling Identification Tab	SEBF8710
Coupling Identification Guide	PEGP2007
"Last Coupling You'll Ever Need" for NACD dealers only	PEHP9524
"Last Coupling You'll Ever Need" for all dealers except NACD	PEHP6033
Reusable Couplings for Caterpillar XT-3, XT-5, and XT-6 Hose	SEBF8176

Hose Assembly Identification Tab

Table 6

Title	Media Number
Hose Assembly Identification Tab	SEBF8711
Caterpillar Hose and Couplings Conversion Worksheet	PEEP5210

Contamination Control Tab

Table 7

Title	Media Number
Contamination Control Tab	SEBF8712
Using the 130-6061 and 156-0058 Hose Cleaner Group	NEHS0643
Your Hydraulic Systems Management Guide	PEGP6028

Tooling

Table 8

Title	Media Number
Tooling Inspection Tab	SEBF8713

General Information for Hose Assembly	NEHS0768
Comprehensive Tooling List for Assembling and Disassembling Reusable Couplings	NEHS0750
Setup and Basic Operation of the 145-5161 Floor Model Hose Machine	NEHS0695
Use of the 9U-5792, 4C-5052, 4C-5054, 4C-3670, and 4C-3680 Hydraulic Hose Machines	NEHS0744
Setup and Basic Operation of the 139-5439 Combination Hose Machine	NEHS0686
Assembling Reusable Couplings in the 139-5439, 145-3381, and 152-3910 Combination Hose Machines	NEHS0746
Crimping Permanent Couplings Using the 136-3642 Crimp Tool Group in Combination and XT-HOSE Hose Machines	NEHS0748
Setup and Operation of the 145-7042 and 146-5861 Crimputer Groups	NEHS0754
Assembling Reusable Couplings in the 4C-9900, 150-2568, and 173-9805 Hydraulic Hose Machines	NEHS0745
150-3622 Bench Model Hose Machine Operating Instructions	NEHS0715
Crimping 1E-1028 Thermoplastic and 1E-1543 Air Conditioning Hose	NEHS0749
Repair of 139-5439 and 145-3381 Combination Hose Machines	NEHS0752
Crimping Caterpillar 1E294, 1E716, and 1E844 Hose and Couplings	NEHS0664
Using the 166-5853 Banding Tool	NEHS0727
Using the Variable Crimping Hose Machine To Crimp Permanent Couplings For All Hose Types Except 1543	NEHS0870

Hose Assembly System Tab

Table 9

Title	Media Number
Hose Assembly System Tab	SEBF8714

New Hose Couplings Are Now Used{0684, 5057, 5057, 7554}

SMCS - 0684-QC ; 5057-QC ; 7554-QC

Caterpillar Products: All

Introduction

Ver imagen

Illustration 1 g02099294

No-Skive coupling

The XN No Skive couplings are the next generation of couplings that have been developed by Caterpillar. The couplings are aimed at replacing the reusable couplings and permanent couplings. Caterpillar is introducing No-Skive couplings for only Dash 6 and Dash 8 XT hoses. No-Skive couplings for Dash 10 through Dash 32XT hoses will be phased in over the next couple years.

Ver imagen

Illustration 2 g02115054

Cover bulge (XT)

Ver imagen

Illustration 3 g02115055

No bulge (XN)

Ver imagen

Illustration 4 g02115153

Benefits

The XT No-Skive couplings provide several benefits. Dealer inventory, storage space and inventory costs are significantly reduced because each No-Skive coupling satisfies the coupling requirements for XT-3, XT-5, XT-6 ES and ToughGuard hoses. For example, some Dash 6 and Dash 8 No-Skive couplings replace as many as five couplings each. Additionally, as the name implies, the No-Skive couplings eliminate the need for the hose to be skived prior to assembly. This not only reduces labor and assembly time, it reduces the chance for installation error and system contamination from rubber particles

Identification

Ver imagen

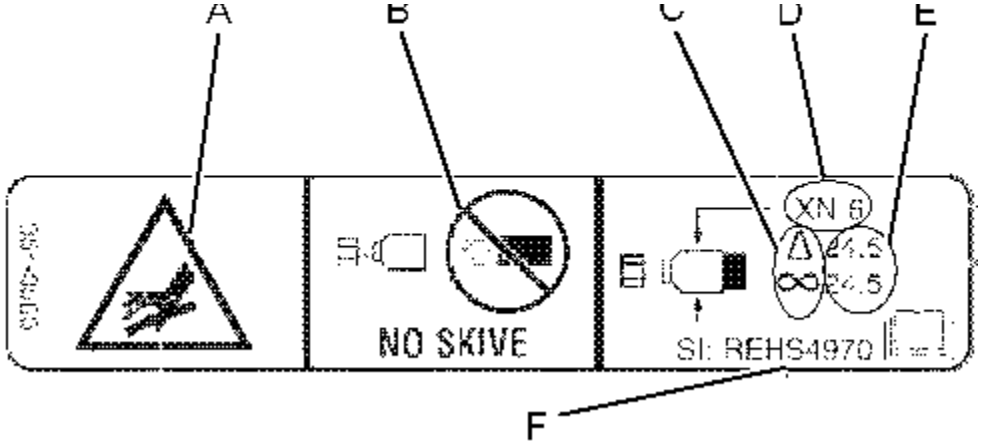


Illustration 5 g02099295

(A) International caution sign

(B) No-Skive warning

(C) Type of compatibility of the hose

(D) Coupling series and size

(E) Diameter of crimp

(F) Media number of the Special Instruction

To remind assemblers not to skive the hose, each XT No-Skive coupling is identified with a warning label on the shell. The label also includes the coupling crimp diameter in millimeters, symbols identifying hose type compatibility (ê = XT-3, + = XT-5), (XT-6) (C) .

Crimp Diameter

Diameters of crimp are listed below. The diameters of crimp will also be located on the sticker that is attached to each coupling that will be received through parts inventory. To ensure a proper diameter of crimp, measure the diameter of crimp halfway up the coupling. Take four measurements on the coupling. Next, average the four measurements and compare the measurements to the Diameters Chart.

Table 1

Diameters of Crimp	
-6	24.5 ± 0.25 mm (0.965 ± 0.00984 inch)
-8	28.5 ± 0.25 mm (1.122 ± 0.00984 inch)

Caterpillar Hose Tooling

The latest version of software that is listed in this Special Instruction needs to be installed. Communicate the change to any stores, customer sites, and second-level distributors.

These couplings use existing Caterpillar tooling and hose assemblies. No special tooling is required.

Use the NEEG3000 crimp chart for the **209-3153** Hose As Machine (Portable) and the **209-3153** Hose As Machine (Bench Model II) that are equipped with variable die bowls. You will need the smooth bore dies. The **139-5439** Hose As Machine , **145-3381** Hose As Machine , **150-2568** Hose As Machine (XT), **173-9805** Hose As Machine (XT) and **4C-9900** Hose As Machine (XT) can also be adapted for use with variable die bowl and smooth bore dies.

Refer to Table 2 for the Crimputer, Crimputer II, and Radial crimpers reference numbers.

Table 2

Description	**Media Number**
Crimputer Combo Models: 139-5439 145-3381	NEHS0745-02 NEHS0754-01
Floor Model 145-5161	NEHS0695-01 NEHS0754-01
Radial Crimpers with Crimputer II 233-8048 233-8038 233-8036 233-8034 233-8028 286-4354 286-4355 286-4353 275-6199	NEHS0870-02

The latest revision of software for the Crimputer (Version 4) and the Crimputer II (Version 5) contain the parameters needed for crimping these couplings.

Dealer Service Tool Hotline

- 1-800-542-8665 (USA)
- 1-800-541-8665 (IL)
- 1-800-523-8665 (Canada)
- 1-309-675-6277 (Outside USA)
- 1-309-494-1355 (Fax)

Non-Caterpillar Tooling

Any dealership, customer site, or second level distributors that are using a hose press from a manufacturer other than Caterpillar, please review the operating manual for your press to ensure safe operating procedures are maintained. Check to see what particular die sets to use to achieve the proper crimp diameters referenced above.

diameters referenced above.

Wall Charts for Caterpillar Hose

Table 3

Description	Media Number
Coupling Crimp Chart	NEEG2973
Hose, Die Group, Spacer Ring Selection Chart - XT Machine, Combo Machine	NEEG2737
Hose, Die Group, Spacer Ring Selection Chart - Non-Current Machines	NEEG2736
Hose, Die Group, Spacer Ring Selection Chart - Bench Model	NEEG2883
Variable Die Bowl & Smooth Bore Dies Hose, Die Group and Spacer Ring Selection Chart for 4C-3660, 4C-5052, 4C-5053, 9U-5792, and 9U-7261 Hydraulic Hose Machines	NEEG3000
Coupling Crimp Chart	NEEG2973

TOOL OPERATING MANUALS AND MISCELLANEOUS REFERENCE MATERIALS

Table 4

Description	Media Number
Use of 7S-1100 Hydraulic Press Arrangement	SEHS6880
Use of 8T-5120 and 8T-5130 Crimp Tool Groups In either 7S-1100 Press Arrangement or 4C-9900, 1U-9160, and 6V-4880 Hydraulic Hose Service Press	SEHS8587
Reusable Couplings for Caterpillar XT-3, XT-5, and XT-6 Hose	SEBF8176
Crimping Caterpillar 294, 716, and 844 Hose & Couplings	NEHS0664
Cleaning Hose & Tube Assemblies Using the 156-0058 and 130-6061 Hose Cleaner Groups	SEBF8485
Cleaning Hose & Tube Assemblies Using the 156-0058 and 130-6061 Hose Cleaner Groups	SMHS8316
Setup and Operation of the 145-7042 and 146-5861 Crimputer Groups	NEHS0754
General Information for Hose Assembly	NEHS0768
Crimping permanent couplings using the 136-3642 Crimp Tool Group in the Combination and XT Hose Machine	NEHS0748
Repair of 139-5459 and 145-3381 Combination Hose Machines	NEHS0752
Set up and Basic Operation of the 145-5161 Floor Model Hose Machine	NEHS0695

Set up and Basic Operation of the 145-5161 Floor Model Hose Machine	NEHS0695
150-3622 Bench Model Hose Machine Operating Instructions	NEHS0715
Set up and Basic Operation of the 139-5439 Combination Hose Machine	NEHS0686
Use of the 9U-5792, 4C-5052, 4C-5054, 4C-3670, and 4C-3680 Hydraulic Hose Machines	NEHS0744
Using the 130-6061 and 156-0058 Hose Cleaner Groups	NEHS0643

Part Number for Cross-Reference

Table 5

3/8"					
XT3 Reusable	**XT3 Permanent**		**XT6 Permanent**		**XN No Skive**
6V-9945	6V-9961	116-0613	153-0785	8T-7095	323-6157
	221-0537	116-0614			323-6158
					323-6159
		116-0621			323-6160
6V-9946	6V-9962		153-0786	8T-7096	323-6162
	221-0520	116-0636			323-6163
		116-0626			323-6164
		228-2971			323-6165
		230-4931			323-6166
6V-9947	6V-9963		153-0787	8T-7097	323-6167
6V-9948	6V-9964				323-6168
			153-0788	8T-7098	323-6169
	277-2053	116-0627			323-6170
					323-6171
					323-6172
	250-1092				323-6173
	187-0964	285-8045			323-6174
	290-8592				323-6175
					323-6176
	193-8590				323-6177

Index of Wall Charts for Drive Train, Hydraulics, Engine and Undercarriage{1000, 4000, 4150, 5050}

SMCS - 1000; 4000; 4150; 5050

Caterpillar Products: All
Engine:Commercial All Diesel
Engine:Truck All

Introduction

This guideline enables dealers and customers to benefit by providing an index for the current wall charts. The index will provide an easy way to locate the media numbers and the titles of the wall charts. This guideline must be used with the latest information that is available from Caterpillar Inc. in order to be sure that improvements are incorporated.

Wall charts are publications that generally contain the following items:

- Disassembly procedures
- Assembly procedures
- Special torques
- Torque sequences

The wall charts are printed on paper that is resistant to stains and tears. Wall charts cover selected models of the following items:

- Drive train
- Undercarriage
- Engines
- Hydraulics

Wall charts cannot be viewed in SIS. Caterpillar dealers can view wall charts from the Web site for your regional marketing profit center. Caterpillar customers should contact a Caterpillar dealer in order to view wall charts. You will not be able to print these wall charts. You will not be able to change these wall charts.

To view the wide range of Caterpillar wall charts, perform the following steps:

1. Go to the Web site for your regional marketing profit center.
2. Scroll down the left side and select "SERVICE OPERATIONS". A new page will be displayed.
3. Select "REPAIR PROCEDURES". A new page will be displayed.
4. Click on the link under the tab for "WALL CHARTS". A new page will be displayed.
5. Select the link that corresponds to the wall chart that suits your needs. The wall chart will be

displayed.

Wall Charts

Table 1

Drive Train		
Form Number	**Title**	**Web Address (1)**
RENR1978	"785B Final Drive Group Tapered Bearing Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349300/7/sebf1978-00.pdf
RENR5396	"797 & 797B Final Drive Group Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349301/7/senr5396-01.pdf
SENR5669	"789B Final Drive Group Straight Bearing Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349302/7/senr5669-01.pdf
SENR6235	"785 & 789 Transmission Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349303/7/senr6235-00%20assembly.pdf
SENR6235	"785 & 789 Transmission Sepcifications"	https://productsupportglobalcontent.cat.com/cda/files/349304/7/senr6235-00%20specifications.pdf
SENR6389	"785B Final Drive Group Straight Bearing Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349305/7/senr6389-01.pdf
SENR6834	"793 Transmission Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349306/7/senr6834-00%20assembly.pdf
SENR6834	"793 Transmission Specifications"	https://productsupportglobalcontent.cat.com/cda/files/349307/7/senr6834-00%20specifications.pdf
SENR8602	"793 Final Drive Group Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349308/7/senr8602-01.pdf
SENR9014	" **8W-9545** Differential and Bevel Gear Group used in 785 Trucks"	https://productsupportglobalcontent.cat.com/cda/files/349309/7/senr9014-00.pdf
SENR9015	"Assembly for **8W-9550** Differential and Bevel Gear Group Used in 793 Trucks"	https://productsupportglobalcontent.cat.com/cda/files/349315/7/senr9015-00.pdf
SENR9016	"Assembly for **8X-0243** Differential and Bevel Gear Group Used in 793 Trucks"	https://productsupportglobalcontent.cat.com/cda/files/349316/7/senr9016-00.pdf

(1) All web addresses were current at the time of publication.

Table 2

Undercarriage

Undercarriage		
Form Number	**Title**	**Web Address** (1)
RENR2052	"Disassembly and Assembly Procedures for Idlers with Inverted Duo-Cone Seals"	https://productsupportglobalcontent.cat.com/cda/files/347335/7/renr2052.pdf
RENR2059	"Disassembly and Assembly Procedures for Rollers with Inverted Duo-Cone Seals"	https://productsupportglobalcontent.cat.com/cda/files/348235/7/renr2059.pdf
RENR3960	"Disassembly and Assembly Procedures for Idlers with Conventional Duo-Cone Seals"	https://productsupportglobalcontent.cat.com/cda/files/347338/7/renr3960.pdf
RENR3961	"Disassembly and Assembly Procedures for Rollers with Conventional Duo-Cone Seals"	https://productsupportglobalcontent.cat.com/cda/files/347339/7/renr3961.pdf
RENR3962	"Disassembly and Assembly Procedures for Snap Ring and Oval Track Rollers"	https://productsupportglobalcontent.cat.com/cda/files/347340/7/renr3962.pdf
RENR3963	"Disassembly and Assembly Procedures for Hydraulic Excavator "	https://productsupportglobalcontent.cat.com/cda/files/347341/7/renr3963.pdf
RENR3964	"Disassembly and Assembly Procedures for Hydraulic Excavator Idlers"	https://productsupportglobalcontent.cat.com/cda/files/347342/7/renr3964.pdf
RENR3965	"Adjustment, Setup, and Operation Procedures for the Caterpillar Track Torque Wrench"	https://productsupportglobalcontent.cat.com/cda/files/348941/7/renr3965-00-01-all.pdf
SENR1788	"Non-PPR Sealed and Lubricated Track Reconditioning"	https://productsupportglobalcontent.cat.com/cda/files/347369/7/senr1788-03.pdf
SENR1838	"Positive Pin Retention Sealed and Lubricated Track Reconditioning"	https://productsupportglobalcontent.cat.com/cda/files/347370/7/senr1838-03.pdf

(1) All web addresses were current at the time of publication.

Table 3

Engine		
Form		

Form Number	Title	Web Address [1]
RENR1230	"In-Frame Overhaul Procedure 3116 & 3126 HEUI Diesel Truck"	https://productsupportglobalcontent.cat.com /cda/files/347333/7/renr1230-02.pdf
RENR1935	"3516 & 3516B Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347334/7/renr1935-02.pdf
RENR3731	"3512 & 3516B Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347337/7/renr3731-02.pdf
RENR3968	"C7 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347345/7/renr3968.pdf
RENR3969	"C13 On-Highway Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347346/7/renr3969.pdf
RENR3974	"In-Frame Overhaul Procedure C9 On-Highway Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347347/7/renr3974.pdf
RENR3976	"C9 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/348236/7/renr3976.pdf
RENR3977	"C15 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347349/7/renr3977.pdf
RENR3978	"C7 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347350/7/renr3978.pdf
RENR9683	"C11 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347352/7/renr9683.pdf
RENR9684	"C13 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347353/7/renr9684.pdf
RENR9686	"Major Overhaul Procedure Chart (Use Remanufactured Components) C18 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347354/7/renr9686-01-01-all.pdf
RENR9689	"Major Overhaul Procedure Chart (Use Remanufactured Components) C11 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347356/7/renr9689.pdf
RENR9690	"Major Overhaul Procedure Chart (Use Remanufactured Components) C13 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347357/7/renr9690.pdf
RENR9693	"Major Overhaul Procedure Chart (Use Remanufactured	https://productsupportglobalcontent.cat.com /cda/files/347358/7/renr9693.pdf

	Components) C15 Engine"	
RENR9696	"In-Frame Overhaul Procedure C11"	https://productsupportglobalcontent.cat.com /cda/files/347359/7/renr9696.pdf
RENR9697	"Major Overhaul Procedure Chart (Use Remanufactured Components) C27 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347360/7/renr9697-01-01-all.pdf
RENR9698	"In-Frame Overhaul Procedure C13 Truck Engines"	https://productsupportglobalcontent.cat.com /cda/files/347361/7/renr9698.pdf
RENR9699	"C18 Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/348934/7/renr9699.pdf
RENR9700	"C18 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/348935/7/renr9700.pdf
SENR1177	"In-Frame Overhaul Procedure 3306C Diesel Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347362/7/senr1177-02.pdf
SENR1182	"In-Frame Overhaul Procedure 3406C Diesel Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347363/7/senr1182-02.pdf
SENR1183	"In-Frame Overhaul Procedure 3406E & C-15 Diesel Truck Engines"	https://productsupportglobalcontent.cat.com /cda/files/347364/7/senr1183-02.pdf
SENR1198	"In-Frame Overhaul Procedure for the C-10, C-12 Truck Engines and the 3176C Engine and the 3196Engine"	https://productsupportglobalcontent.cat.com /cda/files/347365/7/senr1198-02.pdf
SENR2002	"3204 Engine Assembly Procedure (Engines with Precombustion Chambers)"	https://productsupportglobalcontent.cat.com /cda/files/347371/7/senr2002-02.pdf
SENR2027	"3304 Engine Assembly Procedure (Spacer Plate Engines)"	https://productsupportglobalcontent.cat.com /cda/files/347372/7/senr2027-02.pdf
SENR2028	"3306 Engine Assembly Procedure (Spacer Plate Engines)"	https://productsupportglobalcontent.cat.com /cda/files/347373/7/senr2028-02.pdf
SENR2030	"3204 Engine Assembly Procedure (With DI)"	https://productsupportglobalcontent.cat.com /cda/files/347374/7/senr2030-02.pdf
SENR2059	"3208 Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347375/7/senr2059-03.pdf
SENR2060	"In-Frame Overhaul Procedure 3208 Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347376/7/senr2060-02.pdf
SENR2061	"In-Frame Lower End Overhaul Procedure 3208 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347377/7/senr2061-02.pdf
SENR2181	"3406 Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347378/7/senr2181-02.pdf

	Determination Procedure	/cda/files/347378/7/senr2181-02.pdf
SENR2182	"In-Frame "Lower End" Overhaul Procedure 3406 Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347380/7/senr2182-02.pdf
SENR2183	"In-Frame Overhaul Procedure 3406 Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347381/7/senr2183-02.pdf
SENR2589	"3208 Mobile Ag Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347382/7/senr2589-02.pdf
SENR2590	"In-Frame Overhaul Procedure 3208 Mobile Ag Engine"	https://productsupportglobalcontent.cat.com /cda/files/347383/7/senr2590.pdf
SENR2591	"In-Frame "Lower End" Overhaul Procedure 3208 Mobile Ag Engine"	https://productsupportglobalcontent.cat.com /cda/files/347384/7/senr2591.pdf
SENR2743	"3306 PC/DI Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347385/7/senr2743-02.pdf
SENR2744	"In-Frame Overhaul Procedure 3306 PC/DI Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347386/7/senr2744-02.pdf
SENR2745	"In-Frame "Lower End" Overhaul Procedure 3306 PC/DI Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347387/7/senr2745-02.pdf
SENR3009	"One Day In-Frame Overhaul Procedure 3406 Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347388/7/senr3009-02.pdf
SENR3293	"Major Overhaul Procedure Chart (Use Remanufactured Components) 3208 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347389/7/senr3293.pdf
SENR3460	"In-Frame Overhaul Procedure 3406 & 3406B Truck Engines"	https://productsupportglobalcontent.cat.com /cda/files/347395/7/senr3460-02.pdf
SENR3917	"In-Frame Overhaul Procedure 3306 & 3306B Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347396/7/senr3917-02.pdf
SENR3918	"In-Frame Overhaul Procedure 3208NA & 3208T Truck Engines"	https://productsupportglobalcontent.cat.com /cda/files/347397/7/senr3918.pdf
SENR5128	"3512 & 3516 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347398/7/senr5128-03.pdf
SENR5156	"3508 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347399/7/senr5156-02.pdf
SENR6598	"3116 In-Frame Overhaul Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347400/7/senr6598-02.pdf
SENR6599	"In-Frame Overhaul Procedure 3176 Diesel Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347401/7/senr6599-02.pdf

SENR7362	"3306 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347406/7/senr7362-05.pdf
SENR7397	"D348 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347407/7/senr7397-03.pdf
SENR7412	"3406 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347408/7/senr7412-03.pdf
SENR7461	"D342 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347409/7/senr7461-04.pdf
SENR7471	"D346 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347410/7/senr7471-03.pdf
SENR7472	"D343 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347411/7/senr7472-03.pdf
SENR7473	"D353 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347412/7/senr7473-03.pdf
SENR7595	"D353 Engine Assembly Procedure (Spacer Plate Engines)"	https://productsupportglobalcontent.cat.com /cda/files/347413/7/senr7595-03.pdf
SENR7781	"D342 Engine Assembly Procedure (Spacer Plate Engines)"	https://productsupportglobalcontent.cat.com /cda/files/347414/7/senr7781-04.pdf
SENR7884	"3408 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/348936/7/senr7884-03.pdf
SENR7885	"3412 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347415/7/senr7885-02.pdf
SENR7897	"3304 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347830/7/senr7897-02.pdf
SENR7898	"3208 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347831/7/senr7898-02.pdf

(1) All web addresses were current at the time of publication.

Table 4

Hydraulics		
Form Number	**Title**	**Web Address** (1)
SENR4939	"Swing & Track Motor Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files /348334/7/senr4939-00-01-all.pdf
SENR4940	"Track Motor Assembly Procedure for 973 Track Type Loader"	https://productsupportglobalcontent.cat.com/cda/files /348335/7/senr4940-00-01-all.pdf

SENR5206	"Hydrostatic Transmission Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files/348336/7/senr5206-00-01-all.pdf
SENR5207	"Piston Pump Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files/350132/7/senr5207-00-01-all.pdf
SENR5418	"Hydraulic Cylinder Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files/350131/7/senr5418-00-01-all.pdf
SENR6084	"300 Family Excavator Hydraulic Cylinder Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files/348337/7/senr6084-00-01-all.pdf

(1) All web addresses were current at the time of publication.

Hose and Coupling Assembly and Repair Process Guide{0684, 3016, 3103, 3154, 4133, 4257, 4304, 5057, 7554}

SMCS - 0684; 3016; 3103; 3154; 4133; 4257; 4304; 5057; 7554

Caterpillar Products: All

Introduction

The following information explains the repair/assembly process for hydraulic hoses through the hose service shop. The steps follow the Caterpillar recommended best practices. Every service shop is different, but the basic workflow and process still applies to all. It is a management decision at the dealership as to what extent they follow the process. The dealer can use the Service Operation Development and Assessment (SODA), SERF8918 to access their level of compliance. The compact disc can be ordered through the media logistics system. After the assessment is completed, a plan can be developed based on the findings. Service Operation Development and Assessment (SODA), SERF8918 will help identify process and tooling gaps in operations. This document also references other supporting documents that cover the various stages of the hose repair in detail.

References

Table 1

References	
Title	Media Number
General Information for Hose Assembly	NEHS0768
Reusable Coupling Tool List	NEHS0750
Setup/Operation of **145-5161** Hose Machine	NEHS0695
Use of 9U-5792, 4C-5052, 4C-5054, 4C-3670, 4C-3680, Hose Machines	NEHS0744
Setup/Operation if **139-5439** Combine Machine	NEHS0686
Assembling Reusable Coupling in the 139-5439, 145-3381, and 152-3910 Combination Hose Machines	NEHS0746
Crimping Permanent Couplings Using the **136-3642** Crimp Tool Group in Combination and XT Hose Machines	NEHS0748
Assembling Reusable Coupling in the 4C-9900, 150-2568, and 173-9805 Hydraulic Hose Machines	NEHS0745
150-3622 Bench Model Hose Machine Operating Instruction	NEHS0715
Using the Variable Crimping Hose Machine to Crimp Permanent Coupling for All Hose Types Except 1543	NEHS0870
Setup and Operation of the 145-7042 and 146-5861 Crimputer Groups	NEHS0754

Crimping 1E1028 Thermoplastic and 1E1543 Air Conditioning Hose	NEHS0749
"Certified Clean" Sticker	NEEG2828
"Reusable Coupling" Sticker	PEEP7210
Service Operation Development and Assessment	SERF8918

Workflow

1. Customer brings in a hose to a clearly marked hose shop.
2. The work order is written.
3. Parts availability is verified.
4. New hose is cut to the correct length.
5. Clean the hose.
6. Skive the hose.
7. Reclaim the old couplings if needed for the new hose assembly.
8. Install first coupling on the new hose.
9. Crimp the first coupling onto the hose.
10. Install armor guarding if necessary.
11. Set the angle of orientation of the new couplings.
12. Crimp the second coupling onto the hose.
13. Deburr the couplings if necessary.
14. Clean the final assembly.
15. Recheck the assembly for the correct angle of orientation and overall assembly length.
16. Install caps or plus on the couplings.
17. Attach the bag containing seals to the hose assembly.
18. Apply the appropriate stickers to the finished assembly.
19. Apply the metal assembly part number band.
20. Present the final assembly to the customer or store the assembly on a shelf for the customer to pickup.

Parts Counter / Receiving Area

The first thing the customer should see is signage off of the frontage road. The sign should indicate hydraulic hose shop. Marketing literature for promoting Caterpillar hose and couplings should be on the parts counter for the customer to read. The customer should be greeted by the counterperson or hose assembler who will fill out the work order. Information required from the customer is the machine type, system pressure and temperature, and environmental conditions. This information is necessary for the identification of the proper hose components. The Caterpillar Hydraulic Information System needs to be available for cross referencing all hose product to available Caterpillar hose and coupling offering.

Work Bench

The following items should be located next to the parts counter:

- A layout bench equipped with a bench vise.
- A tape measure for checking total assembly length.
- A **7S-1125** protractor for measuring the angle of orientation of the old assembly.
- A calculator available to prevent errors when calculating the hose cut-off factor.
- An **8T-0450** thread identification kit for measurement and identification of the couplings.
- Caterpillar's Hydraulic Information System in order to identify the correct part numbers.
- A copy of Caterpillar's Product Guide, PECP5030, "Cat Hose Products & Tooling" as a back-up to Caterpillar's Hydraulic Information System is unavailable.

The parts availability must be physically verified including any seals that are required. All required seals must be kept in a clean shipping bag that will be attached to the finished assembly.

Coupling Storage Cabinets

All couplings should be stored in cabinets or drawers. The cabinets need to be labeled on the outside for easy identification of parts location. Store the low and medium pressure couplings separate from the high pressure couplings. This will ensure that the low and medium couplings aren't used on the high pressure hoses. The flow of the assembly process will be more efficient by keeping the low and medium pressure couplings near the machine that is used to crimp these couplings. Couplings are not interchangeable with different styles of high pressure hose. Reusable couplings need to be stored separately from the permanent couplings. All of the drawers or compartments need to be labeled with the correct part number of the coupling or with a bar code. This will make it easier for inventory control and ordering.

Hose Storage and Cut-off Area

The technician must cut the correct length of the proper hydraulic hose. The hose storage area should have all the hoses neatly rolled up and stored in slots or bulk hose can be stored on the shipping spools. All hoses may be run through a tubing storage/delivery system, as long as they are separated and easily accessible. Tubing takes the curl out of the bulk hose. The minimum length of the storage tubing is 3 m (10 ft.) in order to ensure the proper straightening of the hose. Utilize the **202-8559** cut-off support group in order to ensure a perpendicular hose cut. The saw needs to be equipped with a fume exhauster to draw the fumes and dust out of the area. This will cut down on the airborne contamination. Use a fine tipped gel pen to mark the cut

location on the hose. Utilize **174-8912** abrasive cut-off wheel . Proper safety equipment, such as a face shield is recommended when operating the saw. Measure the hose again to ensure the hose has been cut to the proper length.

Hose Cleaning

The inside of the hose must be cleaned after cutting to the correct length. Refer to Special Instruction, SEBF8485, "Cleaning Fluid-Carrying Hose and Tube Assemblies in Shop and Field Applications" for the complete cleaning instructions. This manual also lists the hose cleaning groups available through Caterpillar. The hose cleaning group consists of a gun, nozzles, projectiles and projectile catcher. Make sure the hose cleaning process is in sight of the customer. Cleaning the hose in front of the customer indicates a level of quality and attention to detail. A perceived contaminant free assembly establishes a differentiation between the dealer service shop and the competition. An air line will be necessary for the operation of the gun. It is also recommended that the air pressure is at least 620 kPa (90 psi) in order to ensure that the projectile will travel the entire length of the assembly without lodging the projectile in the hose. Storing the nozzles in a **156-0055** Rack-Nozzle Organizer will keep them separate and make it easier to locate the correct nozzle. Store the various sizes of projectiles in a modular drawer or other contamination free cabinet. The projectiles need to be located close to the cleaning station. Post the Projectile Selection Chart, NEEG2955 in the cleaning area for reference when locating the correct nozzle and projectile. A **130-6420** Catcher Bag needs to be utilized in order to capture the projectiles fired through the assembly. The used projectiles need to be shown to the customer in order to prove that using the hose cleaning group is providing them with a contaminate free hose. The projectile may be placed in a bag and sent with the assembly for later reference.

Skive Area

All high pressure hoses must be skived. The correct tooling must be utilized including a skive tool along with a **226-7150** hose gauge kit . A Skive Length Chart, NEEG2956 should be available for easy reference in order to identify the correct skive length. Use a fine tipped marking pen to mark the correct length on the black outer cover of the hose. A skive vise should be mounted on the workbench to help support the hose during skiving. The hose is ready to be skived after the hose is marked and the hose is clamped in the vise. Place a waste bin in the skiving area to capture the outer cover that has been removed during the skiving process to keep the areas as clean as possible. Collect the skived material. Housekeeping in this area must be managed especially if in view of the customer.

Tooling

All of the tooling required for the assembly and/or disassembly of the coupling needs to be kept on a shadow board or in labeled drawers. This will insure that all the tooling has been returned. Clean all the tooling before returning to storage. Cleaning the tooling will help prevent assembly contamination and prolong the life of the tooling.

Coupling Reclamation

Reusable couplings must be reclaimed if replacement couplings are not available. Refer to the Tool Operating Manual for the machine being used for reclaiming, Tool Operating Manual, NEHS0746, "Combination Hose Machine" or Tool Operating Manual, NEHS0745, "XT-Hose Machine" may be used. The Tool Operating Manuals provide a list of all the tooling required and a step by step process for reclaiming the couplings. The couplings need to be reclaimed, cleaned, and inspected before they can be reused. Use a filtered parts washer to maintain coupling cleanliness when required. Inspect the couplings

after cleaning. Refer to Guideline for Reusable Parts and Salvage Operations, SEBF8176 to determine the coupling reusability.

Assembly

The assembly process can be started once the hose has been cleaned and the couplings are obtained. Refer to the Tool Operating Manual of the machine being used for the tooling needed in the assembly process. Crimp one coupling. Check and record the crimp diameter to ensure the coupling is within crimp specifications. Refer to Chart of Proper Crimp Diameters and Tolerances, NEEG2746. Make any adjustments to the tooling prior to conducting the next crimp. If armor guard is needed, install the armor guard on the new hose before assembling the second coupling. The angle of orientation must be set before crimping the second coupling. Refer to the Reusable Coupling Tool List, NEHS0750 for the correct angle of orientation. Crimp the second coupling. Check the crimp diameter and record all of the values.

Final Inspection and Cleaning

Visually inspect the final assembly. Deburr any rough edges that may be on the couplings due to the crimping process. Check the final assembly for the correct assembly length and angle of orientation. The finished assembly then needs to be cleaned one last time. Obtain the correct projectile for the couplings being used. Fire the projectile through the assembly from the end with the smallest opening. After the hose is cleaned, the couplings need to be capped or plugged to keep out contaminates. A various assortment caps and plugs must be available at the cleaning station and installed immediately following the final hose cleaning. The assembly should be tagged indicating that the assembly is now contaminate free. Attach the "Certified Clean" sticker to the finished assembly. Attach the "Reuse this Coupling" sticker to any reusable couplings. Attach the identification tag to the finished assembly, if applicable. Place any saved projectiles in a bag and attach it to the assembly for customer inspection. Place the seals in a clean bag and attach the bag to the assembly. The finished assembly is now ready to be delivered to the customer. If the customer is not present at the time then store the assembly on a rack for easy retrieval when the customer arrives for pick-up.

Información general

SMCS - 4300-035; 5050-035

Las comprobaciones visuales son los primeros pasos para localizar y solucionar un problema. Si se completan las inspecciones visuales y no se comprende completamente el problema, realice las comprobaciones de operación. Si después de completar las inspecciones visuales y las comprobaciones de operación todavía no se comprende completamente el problema, realice los procedimientos de prueba. Estos procedimientos ayudarán a identificar los problemas en el sistema. Estos procedimientos se encuentran en el módulo de Pruebas y Ajustes de su máquina.

ReferenciaVea la ubicación de los componentes individuales de su sistema en el módulo Operación de Sistemas de su máquina.

ReferenciaPara obtener información adicional sobre el sistema eléctrico, vea el Diagrama Eléctrico de su máquina.

ReferenciaPara obtener información adicional sobre el sistema hidráulico, vea el Diagrama Hidráulico de su máquina.

Preparación de la máquina para localizar y solucionar problemas

SMCS - 4300-035; 5050-035

⚠ ADVERTENCIA

El movimiento repentino de la máquina puede causar lesiones graves o fatales al personal.

Un movimiento repentino de la máquina o rociado inesperado de aceite bajo presión puede causar lesiones a las personas en la máquina o cerca de ella.

Para evitar el riesgo de lesiones, siga el procedimiento siguiente antes de hacer pruebas o ajustes al sistema hidráulico y de la dirección:

⚠ ADVERTENCIA

Las válvulas de retención del sistema hidráulico pueden retener presión en las tuberías hidráulicas después de parar el motor. Se debe aliviar la presión antes de dar servicio a los componentes del sistema hidráulico. Si no se alivia la presión antes de dar servicio puede sufrir lesiones el personal.

ATENCION

Se debe asegurar de que los fluidos están contenidos durante la inspección, mantenimiento, pruebas, ajustes y reparación de la máquina. Esté preparado para recoger el fluido con recipientes apropiados antes de abrir un compartimiento o desarmar componentes que contengan fluidos.

Vea la Publicación Especial, NENG2500, "Guía de herramientas y productos de taller Caterpillar" para obtener información sobre las herramientas y suministros adecuados para recoger y contener fluidos de los productos Caterpillar.

Deseche todos los fluidos según las regulaciones y ordenanzas locales.

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1. Mueva la máquina a una superficie horizontal y uniforme. Aléjese de las demás máquinas y de todo el personal. Baje todos los accesorios al suelo. Si tiene, ponga la palanca de control de la válvula de control de levantamiento de la hoja en la posición LIBRE.

2. Instale el perno de traba de la inclinación de las ruedas en el eje delantero. Instale el pasador de traba

del bastidor. Conecte el freno de estacionamiento y pare el motor.

3. Sólo permita un operador en la máquina. Mantenga el resto del personal alejado de la máquina. Además, todo el personal debe estar a la vista del operador.
4. Coloque calces delante y detrás de las ruedas.
5. Afloje cuidadosamente la tapa del tubo de llenado del tanque hidráulico para aliviar la presión en el tanque.
6. Cerciórese que se haya liberado toda la presión hidráulica antes de realizar cualquiera de los procedimientos siguientes:
    - Aflojar cualquier conexión, manguera o componente.
    - Apretar cualquier conexión, manguera o componente.
    - Quitar cualquier conexión, manguera o componente.
    - Ajustar cualquier conexión, manguera o componente.
7. Apriete la tapa del tubo de llenado en el tanque hidráulico.
8. Después de que se haya aliviado la presión en el sistema, afloje cuidadosamente las conexiones y quite las tuberías o los componentes.

Inspección visual

SMCS - 4300-035; 5050-035

⚠ ADVERTENCIA

Cuando busque fugas utilice siempre una tabla o un cartón. El fluido que escapa bajo presión, aún la fuga más minúscula, puede penetrar la piel y causar lesiones graves o fatales. Si le penetra fluido en su piel, busque inmediatamente tratamiento de un médico especialista en este tipo de lesiones.

Cuando identifique un problema, inspeccione visualmente el sistema hidráulico, el sistema de la dirección y los diferentes componentes. Pare el motor y baje los implementos al suelo. Para quitar la tapa de llenado del tanque hidráulico, gire lentamente la tapa de llenado hasta que la tapa esté floja. Si el aceite hidráulico empieza a salpicar sobre el tanque hidráulico, deje que la presión del tanque disminuya antes de quitar la tapa de llenado. Mueva el cilindro del desplazador lateral hacia la derecha para reducir la presión en el tanque hidráulico. Además, mueva el cilindro del desplazador lateral hacia la derecha para reducir el nivel del aceite en el tanque hidráulico. Haga las siguientes inspecciones:

1. Siga todas las tuberías hidráulicas del implemento desde las conexiones en el implemento hasta las conexiones de válvula. Vea si hay daños o fugas en los siguientes componentes:
    - Todas las tuberías hidráulicas del implemento
    - Todas las conexiones de los componentes
2. Siga todas las tuberías hidráulicas del mando del ventilador desde la bomba hidráulica del ventilador hasta el motor hidráulico del ventilador. Vea si hay daños o fugas en los siguientes componentes:
    - Todas las tuberías hidráulicas del mando del ventilador
    - La bomba del ventilador hidráulico
    - El motor del ventilador hidráulico
    - Todas las conexiones de los componentes
3. Vea si hay fugas en las válvulas de control.
4. Vea si hay daños o fugas en los siguientes componentes:
    - Bomba del sistema hidráulico y de la dirección
    - Conexiones en los componentes
5. Siga las tuberías desde la bomba del sistema hidráulico y de la dirección al tanque hidráulico. Además, siga las tuberías desde la bomba del sistema hidráulico y de la dirección a las válvulas. Vea si hay daños o fugas en los siguientes componentes:

- Las tuberías desde la bomba del sistema hidráulico y de la dirección al tanque hidráulico
- Las tuberías desde la bomba del sistema hidráulico y de la dirección a las válvulas
- El tanque hidráulico
- Las conexiones en los componentes

6. Compruebe el nivel del aceite del tanque hidráulico.
7. Inmediatamente después de que la máquina se haya detenido, use una botella limpia y transparente o un recipiente limpio y transparente para obtener una muestra de aceite del tanque hidráulico. Compruebe si hay burbujas de aire en la muestra de aceite.
8. Quite el elemento de filtro y el colador. Verifique para ver si hay partículas del aceite atrapadas en el elemento de filtro. Un imán separará las partículas ferrosas de las no ferrosas. Los materiales ferrosos como anillos de pistón contienen hierro. Reemplace el filtro y limpie el colador, si es necesario.

Comprobaciones operacionales

SMCS - 4300-035; 5050-035

Las comprobaciones de operación se pueden utilizar para encontrar fugas en el sistema. Además, las comprobaciones de operación se pueden utilizar para encontrar una válvula o una bomba hidráulica y de la dirección que haya fallado.

El aceite en el sistema hidráulico tiene que estar a una temperatura de operación de 46 a 52°C (115 a 125°F).

Extienda y retraiga varias veces los cilindros del accesorio. Deje que los cilindros del accesorio se desplacen completamente en cada sentido.

1. Observe cada cilindro a medida que se extiende y retrae. El movimiento de los cilindros tiene que ser suave y uniforme.

2. Escuche la bomba hidráulica y de la dirección para ver si hace ruido.

3. Ponga cada válvula de control en la posición FIJA con el accesorio en el suelo. Observe para ver si el émbolo del cilindro tiene juego. Si el cilindro se mueve más de 19,0 mm (0,75 pulg) en 60 minutos, el corrimiento del mismo es excesivo.

El corrimiento del cilindro del accesorio es causado por fugas de aceite más allá de los pistones de cilindro, por las válvulas de alivio de la tubería o por una válvula de traba con fugas en la válvula de control del accesorio.

Sistema hidráulico y de la dirección

SMCS - 4300-035; 5050-035

La bomba hidráulica y el sistema hidráulico

Problema

La temperatura del aceite es demasiado alta.

Causa probable

- La viscosidad del aceite es incorrecta.
- El ajuste de la válvula de alivio de señal es demasiado alto.
- El ajuste de la válvula de alivio del accesorio es demasiado bajo.
- La bomba hidráulica y de la dirección tiene demasiado desgaste (demasiadas fugas).
- Hay restricción en un conducto de aceite.
- La carga del sistema es demasiado alta.
- La válvula de purga de la señal ha funcionado mal en la posición CERRADA. La válvula de purga de la señal está en la válvula de combinación.
- Aireación del aceite.
- La temperatura ambiente es demasiado alta.

Problema

La bomba hidráulica y de la dirección tiene un ruido extraño.

- Los émbolos de los cilindros no se mueven uniformemente.
- Hay burbujas de aire en el aceite.

Causa probable

- La viscosidad del aceite es incorrecta.
- La válvula de alivio del accesorio se abre a baja presión de aceite.
- Hay una conexión de la tubería de aceite floja en el lado de entrada de la bomba hidráulica y de la dirección. Aireación del aceite.
- La bomba del sistema hidráulico y de la dirección tiene demasiado desgaste.

Problema

Hay una gran cantidad de aire en el aceite.

Causa probable

- Una entrada de aire en la tubería de aceite, entre el tanque hidráulico y la bomba hidráulica y de la dirección.
- El sistema hidráulico necesita que se le purgue correctamente. Vea el tema de la sección de Pruebas y ajustes, "Purga del sistema de la dirección" en este manual. Vea el tema de la sección Pruebas y ajustes, "Procedimiento de la red de señales" en este manual.
- La válvula de alivio se abre y se cierra constantemente.
- Hay entradas de aire por los sellos y alrededor de los sellos de los cilindros.

Problema

La presión máxima de la bomba hidráulica y de dirección es demasiado baja.

Causa probable

- El ajuste de la válvula de alivio de la señal es demasiado bajo.
- Hay una fuga o una obstrucción en la red de distribución de señales.
- La válvula de presión compensadora está ajustada incorrectamente. Vea en Pruebas y ajustes, "Presión del sistema hidráulico - Probar y ajustar" en este manual.
- El ajuste de la presión de reserva es bajo. Vea el tema de la sección de Pruebas y ajustes, "Presión de reserva - Probar y ajustar" en este manual.
- La bomba hidráulica y de la dirección no aumenta su caudal. La placa oscilante está bloqueada.

Problema

La presión de la bomba hidráulica y de la dirección es demasiado alta.

Causa probable

- El ajuste de la válvula de alivio de señal es demasiado alto. Vea en Pruebas y ajustes, "Presión del sistema hidráulico - Probar y ajustar" en este manual.
- La bomba hidráulica y de la dirección no disminuye su caudal. El pistón accionador está atascado o la placa oscilante está bloqueada.

Problema

La bomba del sistema hidráulico y de la dirección no tiene presión.

Causa probable

- Le falta aceite al sistema hidráulico.
- La bomba del sistema hidráulico y de la dirección ha fallado o el eje de mando de la bomba ha fallado.
- La válvula de presión compensadora está ajustada incorrectamente

- La válvula de presión compensadora está ajustada incorrectamente.

Problema

La bomba hidráulica y de dirección permanecen en la presión auxiliar.

- Cuando se utilizan los accesorios o la dirección, la bomba no aumenta su caudal.

Causa probable

- La bomba hidráulica y de la dirección no recibe señal. Vea el tema de la sección de Pruebas y ajustes, "Red de señales - Probar" en este manual.
- La válvula compensadora de presión y de flujo no funciona.
- La bomba hidráulica y de la dirección no aumenta su caudal. La placa oscilante está bloqueada.

Problema

La presión baja auxiliar es demasiado alta.

Causa probable

- No todos los controles están en la posición FIJA. Cuando los controles están en la posición FIJA, la presión de señal debe ser menor de 690 kPa (100 lb/pulg^2).
- La presión marginal está ajustada demasiado alta. Vea el tema de la sección de Pruebas y ajustes, "Compensador de flujo (Presión marginal) - Probar y ajustar" en este manual.

Sistema de dirección

Problema

Las ruedas delanteras vibran al conducir la máquina.

Causa probable

- Hay aire en los cilindros de la dirección y en el sistema de dirección. Vea el tema de la sección Pruebas y ajustes, "Sistema de la dirección - Purgar" en este manual.
- La bomba dosificadora de la dirección ha fallado.
- Compruebe la válvula de prioridad de la dirección que está en la válvula de combinación.

Problema

Cuando se utiliza un accesorio, la respuesta del accesorio es errática.

Causa probable

- El resolvedor de señal de la válvula de combinación ha sido instalado incorrectamente.
- Está perdida la precarga de nitrógeno en el acumulador de la dirección (si tiene). Vea el tema de la sección Pruebas y ajustes, "Acumulador (Dirección) - Comprobar" en este manual.

Problema

El volante de dirección rebota cuando se gira hasta el tope.

Causa probable

- Hay aire en los cilindros de la dirección y en el sistema de dirección. Vea el tema de la sección de Pruebas y ajustes, "Sistema de la dirección - Purgar" en este manual.
- La válvula de retención falta o no funciona. Esta válvula de retención está en la bomba dosificadora de la dirección, en el orificio de presión de la bomba hidráulica.

Problema

El volante de dirección tiende a pegarse cuando se gira hasta la posición máxima de tope.

Causa probable

- La bomba dosificadora de la dirección ha fallado y hay presión atrapada en el sistema de la dirección.
- La bomba dosificadora de la dirección que se ha instalado en la máquina no es la correcta.

Problema

Cuando se suelta el volante de dirección, éste oscila más de tres veces.

Causa probable

- La bomba dosificadora de la dirección ha fallado.
- La bomba dosificadora de la dirección que se ha instalado en la máquina no es la correcta.
- El ajuste de la válvula de alivio del sistema de la dirección es demasiado alto.

Problema

Cuando se gira el volante de dirección contra el tope, éste no se detiene.

Causa probable

- El ajuste de la válvula de alivio de la dirección es demasiado alto. Esto permite que la válvula de alivio permanezca abierta. Vea en Pruebas y ajustes, "Presión máxima del sistema de la dirección - Probar y ajustar" en este manual.
- El ajuste de la válvula de alivio de la bomba dosificadora de la dirección es demasiado bajo.
- La bomba dosificadora de la dirección ha fallado. Esto permite que el volante de dirección gire continuamente.
- El cilindro de la dirección ha fallado o tiene fugas.
- El orificio de la bomba dosificadora de la dirección está bloqueado o hay una conexión floja. Esto permite la entrada de aire en el sistema de la dirección.

Problema

La dirección no funciona pero los accesorios sí.

Causa probable

- La bomba del sistema hidráulico y de la dirección no recibe una señal de presión del sistema de la dirección. Vea el tema de la sección Pruebas y ajustes, "Red de la señal - Probar" en este manual.
- La válvula de prioridad de la dirección ha fallado. Está bloqueada la presión de la bomba del sistema hidráulico y de la dirección al circuito de la dirección.
- Hay obstrucción o daños en el circuito de la dirección o en los componentes.

Problema

El volante de dirección no gira la cantidad correcta de vueltas.

Causa probable

- La bomba dosificadora de la dirección tiene fugas internas.
- Los cilindros de la dirección tienen fugas o piezas incorrectas.
- La bomba dosificadora de la dirección que se ha instalado en la máquina no es la correcta.

Sistema del accesorio

Problema

La respuesta de un accesorio es demasiado lenta.

Causa probable

- Hay una restricción en el mecanismo o en la carrera de la palanca.
- El carrete de válvula instalado en la válvula de control del accesorio es incorrecto.
- La válvula de retención de señal en la red de señales está funcionando incorrectamente. Vea el tema de la sección Pruebas y ajustes, "Red de señales - Probar" en este manual.
- La válvula de control del accesorio ha fallado.
- El ajuste de la válvula de alivio del accesorio es demasiado bajo.
- El ajuste de la válvula de alivio de la señal es demasiado bajo.

Problema

La respuesta de todos los accesorios es demasiado lenta.

Causa probable

- Hay aire en el sistema de señales. Vea el tema de la sección Pruebas y ajustes, "Red de señales - Purgar" en este manual.

- La válvula de retención tiene fugas o el resolvedor de bola en la red de señales tiene fugas. Vea el tema de la sección Pruebas y ajustes, "Red de señales - Probar" en este manual.
- Hay contaminación en alguna o algunas de las válvulas de control.
- Hay aire en el sistema.
- La válvula de purga de señales está atascada en posición abierta.
- La válvula de alivio de la señal tiene un desperfecto.
- La presión marginal está ajustada demasiado bajo.
- El ajuste de la válvula de alivio del accesorio es demasiado bajo o hay fugas por la válvula.
- Ha fallado la válvula de prioridad de la dirección que está en válvula de combinación de circuitos.

Problema

Los circuitos del accesorio no operan cuando se cala un cilindro.

Causa probable

- El compensador de presión está ajustado demasiado bajo o la válvula de alivio de la señal está ajustada demasiado alto. Vea en Pruebas y ajustes, "Presión del sistema hidráulico - Probar y ajustar" en este manual.

Problema

El rendimiento del accesorio es errático.

Causa probable

- La válvula de control del accesorio está contaminada .
- El vástago de la válvula de control para este circuito es incorrecto.
- La presión marginal está ajustada incorrectamente.

Problema

Todos los circuitos del accesorio son erráticos.

Causa probable

- El aceite en el sistema hidráulico no ha alcanzado la temperatura normal de operación.
- La bomba hidráulica y de la dirección ha fallado o la válvula compensadora de presión y de flujo ha fallado.
- Hay aire en el sistema hidráulico.

Problema

Algún accesorio se mueve con la palanca de control en la posición FIJA.

Algún accesorio se mueve con la palanca de control en la posición FIJA.

Causa probable

- Falla o desgaste de los sellos del pistón del cilindro.
- Falla de la válvula de retención de traba o de alivio del orificio.
- La válvula de alivio de la tubería del accesorio tiene un desperfecto.

Problema

El accesorio tiene una sacudida cuando se activa primero.

Causa probable

- Las ranuras del vástago de control están maquinadas incorrectamente.
- Hay aire en el circuito.
- La presión marginal está ajustada demasiado alto.
- La presión de descarga de la bomba del sistema hidráulico y de la dirección se mantiene demasiado alta después de caer la presión de la señal.

Problema

Se necesita demasiado esfuerzo para mover la palanca de control.

Causa probable

- Movimiento restringido o roce del mecanismo de la palanca con otras piezas.
- Falta el resorte posicionador en la válvula de control del accesorio o se instaló un resorte incorrecto.
- La válvula de control del accesorio tiene un vástago que se pega o que falla.

Problema

Los accesorios no funcionan, pero funciona la dirección.

Causa probable

- La válvula de combinación tiene un resolvedor de bola que falla. La válvula de combinación tiene una válvula de retención de señal que falla. Vea el tema de la sección Pruebas y ajustes, "Red de señales - Probar" en este manual.
- La válvula de prioridad de la dirección está atascada. Esto bloquea el flujo de aceite a los accesorios.
- La válvula de alivio de señal falla en la posición ABIERTA, o el ajuste de presión es incorrecto.

Problema

La respuesta de los accesorios es demasiado rápida.

Causa probable

- Se instaló un vástago de control incorrecto en la válvula de control del accesorio.
- La válvula de control del accesorio ha fallado.
- La presión marginal está ajustada demasiado alto.

Problema

La bomba del sistema hidráulico y de la dirección no regresa a la baja presión de espera después de utilizar el accesorio.

Causa probable

- La palanca de control roza con otras piezas. La palanca de control no regresa a la posición FIJA. Todavía se envía presión de señal a la válvula compensadora de presión y de flujo.
- La válvula de purga de señal ha fallado en la posición CERRADA.
- La señal de dirección de la unidad dosificadora de la dirección es mayor de 690 kPa (100 lb/pulg^2). El orificio de señal de la bomba dosificadora de la dirección está contaminado. Reemplace la válvula de prioridad de la dirección. Reemplace la bomba dosificadora de la dirección.
- La bomba hidráulica y de la dirección ha fallado o la válvula compensadora de presión y de flujo ha fallado.

Problema

Cuando se hacen giros con la máquina, los accesorios operan con lentitud o se detienen.

Causa probable

- El ajuste de presión de la bomba hidráulica y de la dirección es bajo. Vea el tema de la sección Pruebas y ajustes, "Reserva de baja presión - Probar y ajustar" en este manual.
- La válvula de prioridad de la dirección ha fallado.
- La bomba del sistema hidráulico y de la dirección tiene un flujo insuficiente.

CATERPILLAR®

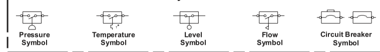
Schematic

12H, 140H, and 160H Motor Grader Electrical System

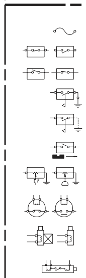
12H:	140H:	160H:
XZJ1-UP	XZH1-UP	XZK1-UP
4ER1136-UP	5HM3000-UP	2FM909-UP

Electrical Schematic Symbols And Definitions

Symbols



Symbols And Definitions



Fuse - A component in an electrical circuit that will open the circuit if too much current flows through it.

Switch (Normally Open): A switch that will close at a specified point (temp, press, etc.). The circle indicates that the component has screw terminals and a wire can be disconnected from it.

Switch (Normally Closed): A switch that will open at a specified point (temp, press, etc.). No circle indicates that the wire cannot be disconnected from the component.

Ground (Wired): This indicates that the component is connected to a grounded wire. The grounded wire is fastened to the machine.

Ground (Case): This indicates that the component does not have a wire connected to ground. It is grounded by being fastened to the machine.

Reed Switch: A switch whose contacts are controlled by a magnet. A magnet closes the contacts of a normally open reed switch; it opens the contacts of a normally closed reed switch.

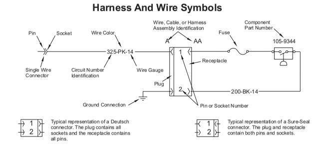
Sender: A component that is used with a temperature or pressure gauge. The sender measures the temperature or pressure. Its resistance changes to give an indication to the gauge of the temperature or pressure.

Relay (Magnetic Switch): A relay is an electrical component that is activated by electricity. It has a coil that makes an electromagnet when current flows through it. The electromagnet can open or close the switch part of the relay.

Solenoid: A solenoid is an electrical component that is activated by electricity. It has a coil that makes an electromagnet when current flows through it. The electromagnet can open or close a valve or move a piece of metal that can do work.

MAGNETIC LATCH SOLENOID - A magnetic latch solenoid is an electrical component that is activated by electricity and held latched by a permanent magnet. It has two coils (latch and unlatch) that make electromagnet when current flows through them. It also has an internal switch that places the latch coil circuit open at the time the coil latches.

Harness And Wire Symbols



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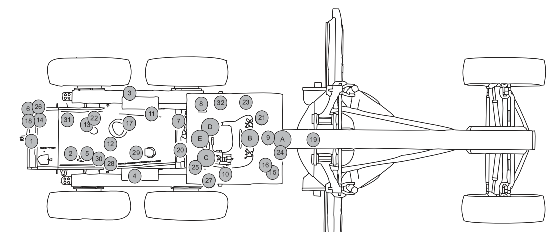
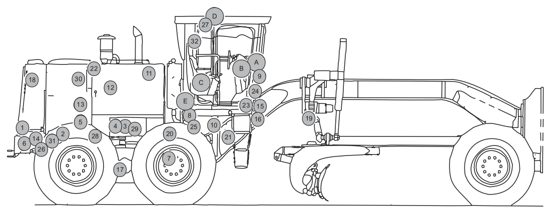




Machine Harness Connector And Component Locations

Connector Location[1]

Connector Number	Schematic Location	Machine Location
CONN 1	C-15	26
CONN 2	E-15	26
CONN 3	F-14	31
CONN 4	F-14	22
CONN 5	A-14	22
CONN 6	A-14	5
CONN 7	B-13	30
CONN 8	B-13	29
CONN 9	D-13	29
CONN 10	E-12	29
CONN 11	E-12	29
CONN 12	E-12	25
CONN 13	E-12	C
CONN 14	D-12	B
CONN 15	D-12	23
CONN 16	B-12	23
CONN 17	A-11	10
CONN 18	D-10	10
CONN 19 Service Tool	B-9	C
CONN 20	E-9	25
CONN 21	E-9	25
CONN 22	A-8	23
CONN 23	B-7	10
CONN 24	B-7	10
CONN 25	E-6	24
CONN 26	E-6	24
CONN 27	C-6	24
CONN 28	C-6	24
CONN 29	C-6	27
CONN 30	A-6	27
CONN 31	C-5	27
CONN 32	C-5	27
CONN 33	B-3	15
CONN 34	E-3	23
CONN 35	F-3	23
CONN 36	F-3	23
CONN 37	E-9	B
CONN 38	D-13	5
CONN 39	C-13	5

[1] The connectors shown in this chart are for harness to harness connectors. Connectors that join a harness to a component are generally located at or near the component. See the Component Location Chart.

Transmission Diagnostic Code Conversion

Flash Code	CID - FMI		Description
11	N/A		No diagnostics active
12	N/A		No logged diagnostic codes
21	641	F05	Transmission Solenoid A open circuit
22	642	F05	Transmission Solenoid B open circuit
23	643	F05	Transmission Solenoid C open circuit
24	644	F05	Transmission Solenoid D open circuit
25	645	F05	Transmission Solenoid E open circuit
26	646	F05	Transmission Solenoid F open circuit
27	647	F05	Transmission Solenoid G open circuit
28	648	F05	Transmission Solenoid H open circuit
31	641	F06	Transmission Solenoid A short to ground
32	642	F06	Transmission Solenoid B short to ground
33	643	F06	Transmission Solenoid C short to ground
34	644	F06	Transmission Solenoid D short to ground
35	645	F06	Transmission Solenoid E short to ground
36	646	F06	Transmission Solenoid F short to ground
37	647	F06	Transmission Solenoid G short to ground
38	648	F06	Transmission Solenoid H short to ground
41	641	F03	Transmission Solenoid A short to battery
42	642	F03	Transmission Solenoid B short to battery
43	643	F03	Transmission Solenoid C short to battery
44	644	F03	Transmission Solenoid D short to battery
45	645	F03	Transmission Solenoid E short to battery
46	646	F03	Transmission Solenoid F short to battery
47	647	F03	Transmission Solenoid G short to battery
48	648	F03	Transmission Solenoid H short to battery
52	637	F06	Backup alarm short to ground
58	688	F06	VHP solenoid short to ground
59	688	F03	VHP solenoid short to battery
61	668	F02	Shift lever input invalid
62	668	F03	Shift lever open/short to +battery
63	269	F00	Sensor supply voltage above normal
64	269	F01	Sensor supply voltage below normal
65	701	F02	Transmission output speed signal incorrect
68	168	F01	System voltage below normal
71	520	F02	Invalid transmission configuration code
72	268	F02	Check programmable parameters
73	764	F05	Transmission indicator lamp open circuit
74	764	F06	Transmission indicator lamp shortto ground
75	764	F03	Transmission indicator lamp shortto battery
76	177	F03	Transmission oil temperture sendershort to + battery or open circuit
77	177	F04	Transmission oil temperture switchshort to ground
81	868	F05	Auto/Manual lamp open circuit
82	868	F06	Auto/Manual lamp short tc ground
83	868	F03	Auto/Manual lamp short to +battery

Resistor, Sender and Solenoid Specifications

Part No.	Component Description		Resistance (Ohms)[1]
3E-5383	Sender :	Articulation Position	3 to 97
3E-6424	Solenoid :	Dual Horse Power / Shutdown	PULL 16.1 ± 1.6 PUSH 4.2 ± 0.4
7N-8532	Sender :	Engine Coolant	560 to716 @ 54°C (130°F) 72 to 82 @ 110°C (230°F)
7T-4003	Resistor :	Defroster	10.0 ± 0.5
7T-9073	Solenoid :	Differential Lock	33.6 ± 1.0
7T-9074	Solenoid :	Forward Horn Parking Brake	55.17 ± 5.77
8T-8808	Solenoid :	Centershift	34.3 ± 1.7
9G-1950	Resistor :	Blower Speed	Overall 2.0 ± .10 Tap 1.0 ± .05
9G-4365	Solenoid :	Start Aid	6
104-6387	Sender :	Transmission Speed	1000 to 1200
116-9937	Sender :	Engine Oil Pressure	21.5 to 49.5 @ 552 kPa (80.1 psi) 227 to 257 @ 21kPa (3.0 psi)
127-0574	Solenoid :	Transmission	31 ± 3

[1] At room temperature unless otherwise noted.

Off Machine Switch Specification

Part No.	Function	Actuate	Deactuate	Contact Position
2M-9346	Stop Lamp Pressure	45.0 kPa Max (6.5 psi Max)	5.0 kPa MIN (0.5 psi MIN)	Normally Open
8C-3569	Engine Coolant Temp (Start Aid)	37.8 ± 2.8°C (100 ± 5°F)	26.7°C MIN (80°F MIN)	Normally Closed
107-0611	Engine Oil Pressure	93.00 ± 21.00 kPa (13.49 ± 3.05 psi)	70.00 ± 21.00 kPa (10.15 ± 3.05 psi)	Normally Open
111-7088	Inching Pedal Pressure	75.0 kPa MAX (10.9 psi MAX)	50.0 kPa MIN (7.3 psi MIN)	Normally Open
112-2404	Brake/Park Brake Air Pressure	640 kPa MAX (92.0 psi MAX)	530 ± 40 kPa (77.0 ± 6.0 psi)	Normally Closed

Component Location

Component	Schematic Location	Machine Location	Component	Schematic Location	Machine Location
Alarm - Action	B-9	C	Resistor - Blower Speed (Heater Group)	A-10	E
Alarm - Backup	F-15	1	Sender - Articulation	C-12	7
Alternator	D-14	2	Sender - Engine Coolant Temperature	B-14	11
Arc Suppressor	E-14	17	Sender - Engine Oil Pressure	B-13	13
Battery	C-14	3	Sender - Transmission Speed	D-15	14
Battery	C-14	4	Sensor - Transmission Oil Temp	E-15	26
Breaker - Alternator	D-13	5	Solenoid - Centershift	B-3	16
Breaker - Headlamp	D-10	B	Solenoid - Differential Unlock	E-14	17
Breaker - Shutdown	D14	5	Solenoid - Dual Horsepower	A-13	5
Control - Engine Shutdown	C-14	5	Solenoid - Engine Shutdown	D-13	5
Control - Neutral Start	B-9	10	Solenoid - Forward Horn	A-3	16
Control - Transmission	A-7	E	Solenoid - Park Brake	B-12	16
Control - XMSN Direction and Speed SW	A-9	C	Solenoid - Start Aid	A-13	18
Converter - 24 To 12 Volt	F-13	8	Solenoids - Transmission Valves	E-15	14
Fuses (10A)	B-6	C	Switch - Beacon	B-6	C
Fuses Block	D-9	B	Switch - Blower (Heater Group)	A-10	C
Gauge - Cluster	F-5	A	Switch - Brake Air Pressure	A-2	16
Ground - Engine	C-13	12	Switch - Centershift Indicator	B-3	19
Ground - Frame Cab	D5,6	24	Switch - Centershift Pin	B-9	C
Ground - Front Frame	D-6	21	Switch - Coolant Temp (Start Aid)	A-14	11
Ground - Front,Rear Frame	B-12	20	Switch - Defrost, Front	A-6	C
Ground - Rear Frame	C-13	28	Switch - Defrost, Rear	B-6	C
Horn - Forward	F-3	16	Switch - Differential Unlock	D-9	B
Meter - Service	E-10	B	Switch - Disconnect	C-14	13
Motor - Blower (Heater Group)	A-10	E	Switch - Flood Lamp	D-8	B
Motor - Blower, Front Defroster	E-4	A	Switch - Forward Horn	E-9	B
Motor - Blower, Rear Defroster	A-11	E	Switch - Fuel Pressure	B-13	13
Motor - Starter	C-13	5	Switch - Head/Tail Lamp	E-8	B
Motor - Washer, Front Lower	F-6	8	Switch - Headlamp Dimmer	E-9	B
Motor - Washer, Front Upper	F-6	8	Switch - Inching Pedal Pressure	C-15	14
Motor - Washer, Rear	F-5	8	Switch - Key Start	B-9	C
Motor - Wiper, Aear	B-11	D	Switch - Park Brake Pressure	B-11	16
Motor - Wiper, Front Lower	C-4	9	Switch - Start Aid	E-8	B
Motor - Wiper, Front Upper	D-4	D	Switch - Stop Lamp Pressure	A-2	16
Port - Power +12 Volt	F-9	32	Switch - Tail Lamp	D-8	B
Relay - Start	D-13	5	Switch - Wiper, Front Lower	A-5	C
Relay - Transmission Action Lamp	C-10	8	Switch - Wiper, Front Upper	B-5	C
Resistor - Blower Speed	A-12	E	Switch - Wiper, Rear	A-5	C
Resistor - Blower Speed	E-4	E			

Machine locations are repeated for components located close together.

A = Operator's compartment (Dash).

B = Operator's compartment (Steering console).

C = Operator's compartment (Right side console).

D = Operator's compartment (Headliner).

E = Operator's compartment (Under seat).

Wire Description

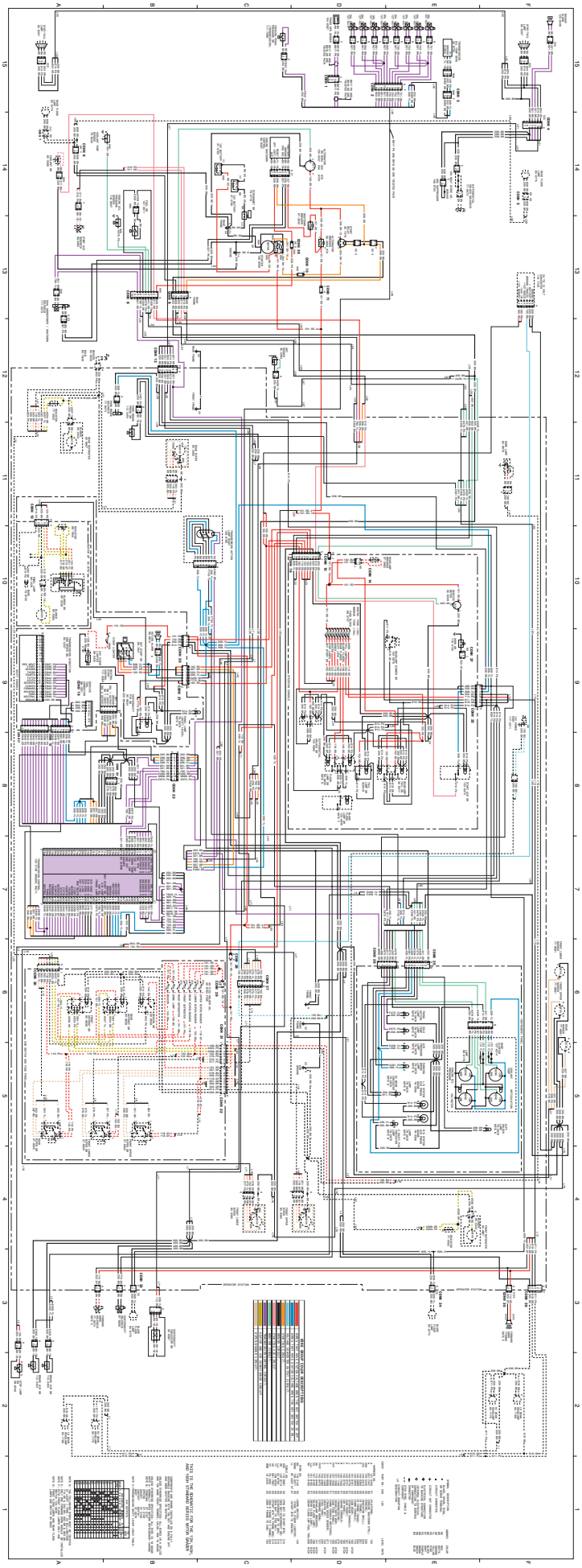
Wire Number	Wire Color	Description	Wire Number	Wire Color	Description
		Power Circuits			**Accessory Circuits (Continued)**
101	RD	Bat(+)	505	BU	Wiper - Rear (HI)
102	BU	Head Lamps	506	PU	Washer - Front
103	RD	Tail Lamps	507	WH	Washer - Rear
105	RD	Key Start Switch	515	GY	Blower Motor (HI)
107	RD	Shutdown Breaker	516	GN	Blower Motor (Medium)
108	BU	Dome Lamp	517	BU	Blower Motor (Low)
109	OR	Alt Output (+) Term.	521	YL	A/C SW To Refrigerant SW
113	RD	Gages	522	WH	A/C Clutch To Thermostat SW
114	RD	Warning Horn (Forward)	556	WH	Differential Lock
116	RD	Rear Floods	575	YL	Wiper - Aux (Park)
118	GY	Upper Wiper / Washer	576	PK	Wiper - Aux (Low)
119	PK	Rear Wiper / Washer	577	PU	Wiper - Aux (HI)
124	RD	Heaters	578	BU	Washer - Aux
126	PK	Xmsn Ctrl	584	YL	Wiper SW Jumper
129	BU	Cigar Lighter	A503	PK	Front Defroster Fan (Low)
130	RD	Stop Lamps	A504	GN	Rear Defroster Fan (Low)
135	BU	Converter Switched +12 Volt Ouptut	A506	OR	Front Defroster Fan (HI)
141	PK	Front Defroster	A507	YL	Rear Defroster Fan (HI)
144	GN	Beacon			**Lighting Circuits**
149	RD	Blade Floods	603	PK	Rotary Beacon
151	GN	Rear Defroster	604	OR	Stop Lamp
152	BU	Lower Wiper / Washer	608	GN	Flood Lamp - Rear
165	RD	Differential Lock	609	YL	Flood Lamp - Side
		Ground Circuits	611	PU	Head Lamp Hi
200	BK	Main Chassis	614	PU	Park/Tail/Dash/Lamp
202	BK	XMSN Ctrl	619	GN	Head Lamp Lo
276	BK	XMSN Ctrl dent Code 0			**Control Circuits**
277	BK	XMSN Ctrl dent Code 1	710	GN	XMSN Speed Pickup Signal
278	BK	XMSN Ctrl dent Code 2	751	GN	XMSN Shift Sol No. 1 Or 3
		Basic Machine Circuits	752	YL	XMSN Shift Sol No. 2
301	BU	Starter No. 1 Sol	754	BU	XMSN Shift Sol No. 3 Or 1
304	WH	Starter Relay No. 1 Output	755	OR	XMSN Shift Sol No. 4 Or 5
306	GN	Start Switches To Start Relay Coil	F775	BU	Centershift Solenoid
307	OR	Key Start SW To Neutral Start SW	795	YL	Dual Hp Sol
308	YL	Main Power Relay Coil	F843	YL	Inching Pedal
310	PU	Start Aid SW To Start Aid Sol	892	BR	Start Mod Right (-) Port/CAT Data Link (-)
311	WH	Start Aid Sot To Temp SW	893	GN	Start Mod Right (+) Port/CAT Data Link (+)
321	BR	Backup Alarm Lamp Travel Alarm	900	PU	XMSN Shift Sol No. 5 or 4
322	GY	Warning Horn (Forward)	901	WH	XMSN Shift Sol No. 6
326	PU	Key Start SW "C" Term.	902	BR	XMSN Shift Sol No. 7
		Monitoring Circuits	903	GY	XMSN Shift Sol No. 8
403	GN	Alternator (R) Term.	M917	PK	TOS Sensor
439	YL	Lamp Indicator	M918	ON	TOS Sensor
441	OR	Eng Coolant Temp Gauge	921	WH	XMSN Sol No 1 Or 3 Return
498	WH	Diff Lock Indicator	E937	PU	MG MESH CNTL - Redundant Neutral
A429	YL	Articulation Indicator	E938	OR	MG MESH CNTL - First Gear
A476	PU	Eng Oil Press Gauge To Sender - Eng #1	E939	WH	MG MESH CNTL - Second Gear
B476	BU	(NFND) Transmission Indicator Lamp	E940	BU	MG MESH CNTL - Third Gear
C491	PU	Park Brake Pressure	E941	YL	MG MESH CNTL - Fourth Gear
E458	YL	Low Air Pressure Lamp	E942	GN	MG MESH CNTL - Fifth Gear
E459	WH	Low AIr Pressure Alarm	E943	BR	MG MESH CNTL - Sixth Gear
E460	BR	Trans Cntl To Relay Coil	E944	GY	MG MESH CNTL - Seventh Gear
F473	YL	Transmission Warning	E945	PU	MG MESH CNTL - Eighth Gear
G460	GN	Transmission Temperature	E946	OR	MG MESH CNTL - Forward Direct
		Accessory Circuits	E947	WH	MG MESH CNTL - Reverse Direct
500	BR	Wiper - Front (Park)	E948	BU	MG MESH CNTL - Park
501	GN	Wiper - Front (Low)	E949	YL	MG MESH CNTL - Neutral
502	OR	Wiper - Front (HI)	E975	PU	MESH Lamp
503	BR	Wiper - Rear (Park)	M998	OR	Transmission Autoshift Mode
504	YL	Wiper - Rear (Low)			

Related Electrical Service Manuals

Title	Form Number
Alternator (6N-9294): Consist No. 3T-6352 Consist No. 7N-9720 Consist No. 9G-4574	SENR4978 SENR2082 SENR4130
Alternator (100-5047): Consist No. 100-5045 Consist No. 100-5046	SENR4130 SENR2082
Electronic Transmission Shift Control	SENR9167
Starting Motor (106-8558): Consist No. 106-8557 Consist No. 106-8559	SENR3559 SENR3581

RENR9540-01
20 Page

RENR9540-01
20 Page, Color 2



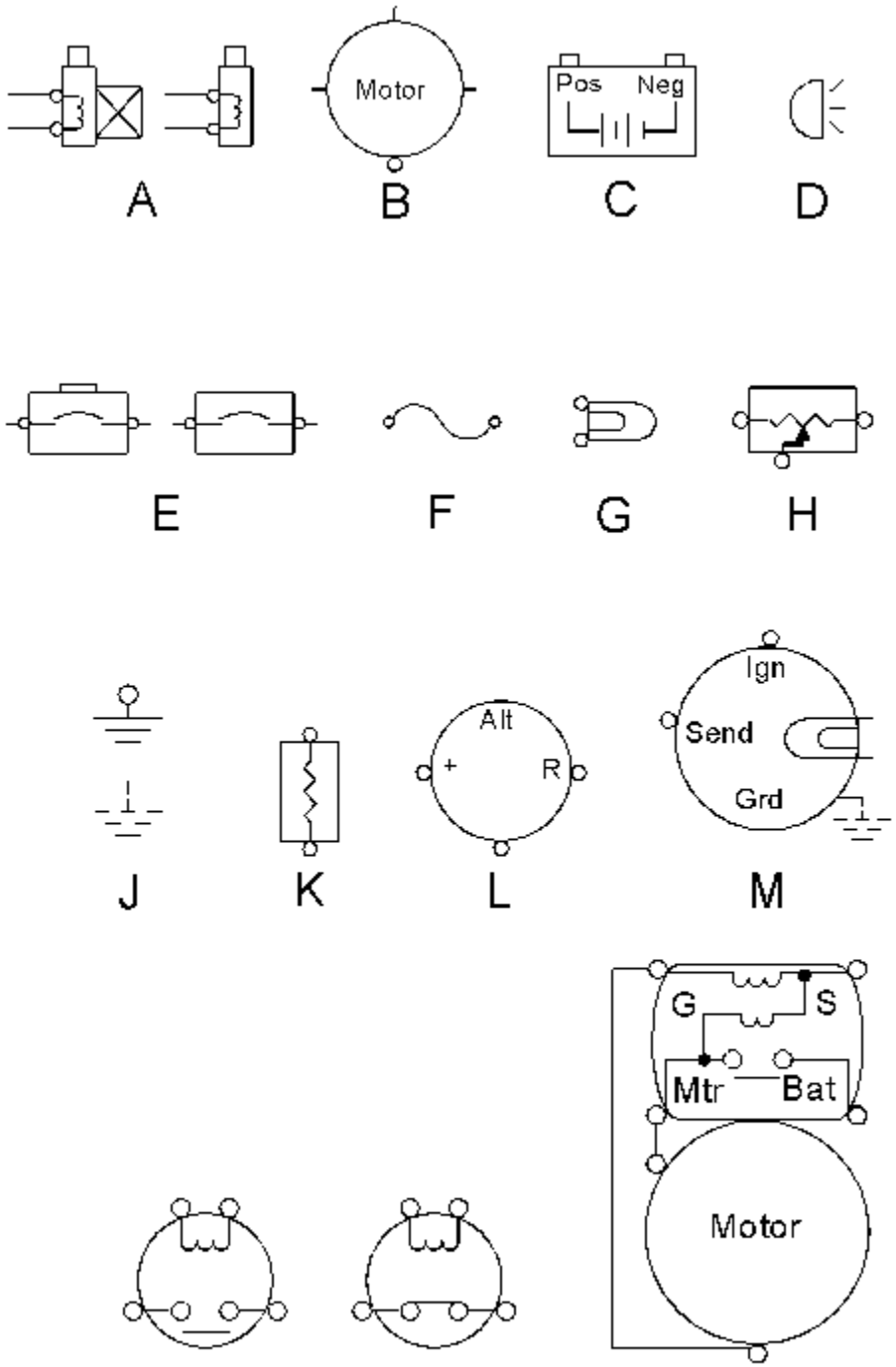
Electrical Power Graphic Symbols

SMCS - 1400

Note: Use this module as a basic reference guide for graphic symbols. Do not use this module as a comprehensive reference guide.

Basic Component Symbols

Ver imagen



N P R

Illustration 1 g01390407

(A) Solenoid

(B) Motor

(C) Battery

(D) Exterior light

(E) Circuit breaker

(F) Fuse

(G) Backlight

(H) Potentiometer

(J) Ground

(K) Resistor

(L) Alternator

(M) Gauge

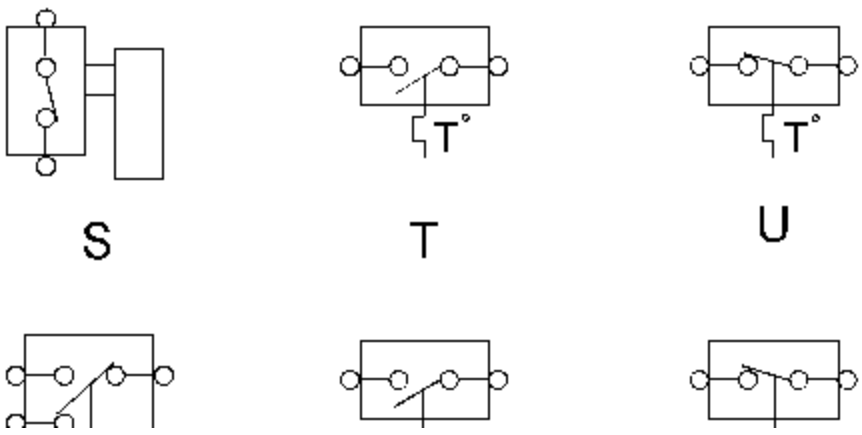
(N) Normally open relay

(P) Normally closed relay

(R) Starter

Switches

Ver imagen



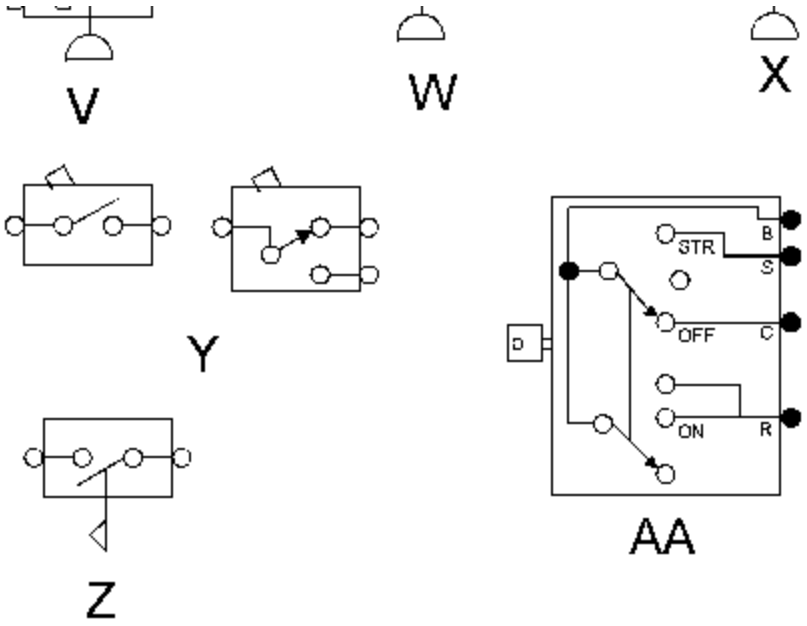


Illustration 2 g01390733

(S) Disconnect switch

(T) Normally open temperature switch

(U) Normally closed temperature switch

(V) Pressure switch

(W) Normally open pressure switch

(X) Normally closed pressure switch

(Y) Toggle switch

(Z) Flow switch

(AA) Key switch

Resistors

Ver imagen

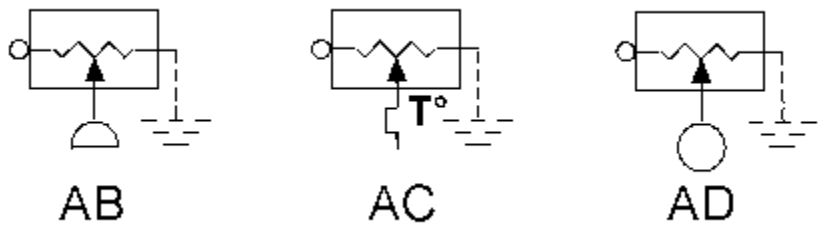


Illustration 3 g01390734

(AB) Pressure resistor

(AC) Temperature resistor

(AD) Float resistor

Wire Coloring

Red ... RD

White ... WH

Orange ... OR

Yellow ... YL

Pink ... PK

Black ... BK

Gray ... GY

Purple ... PU

Brown ... BR

Green ... GN

Blue ... BU

Wire Identification

Ver imagen

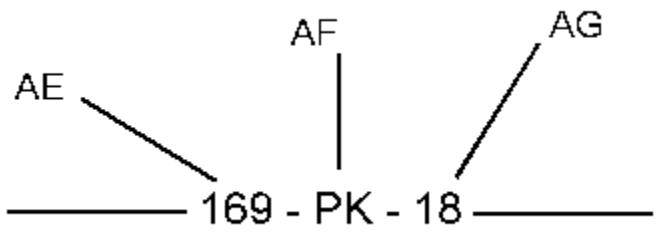


Illustration 4 g01409811

Old format

Old format

(AE) Wire label

(AF) Color code

(AG) Wire size

Ver imagen

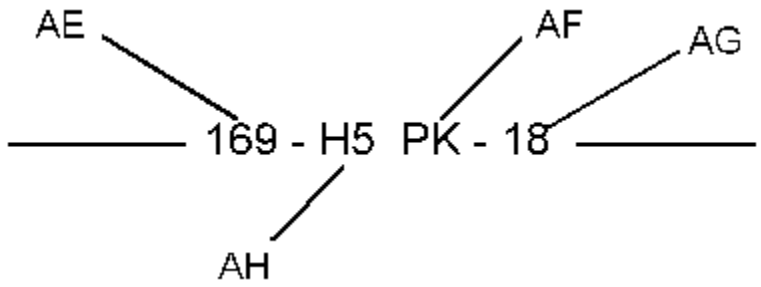


Illustration 5 g01409813

New format

(AE) Wire label

(AF) Color code

(AG) Wire size

(AH) Wire number 5 in harness "H"

Components

Ver imagen

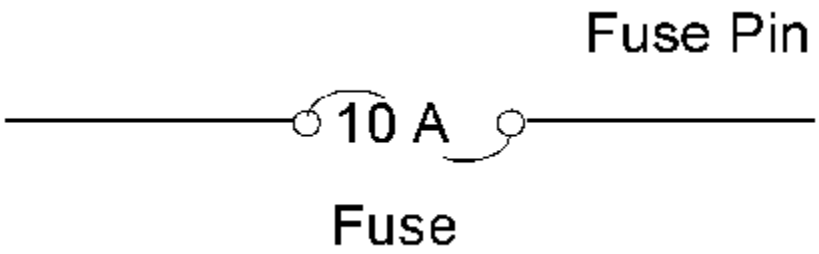


Illustration 6 g01409816

Old format

Ver imagen

Ver imagen

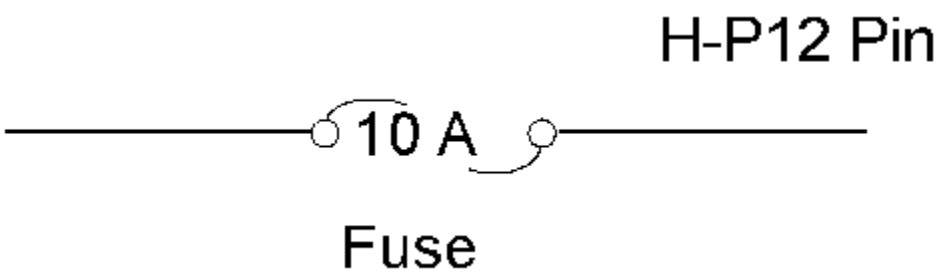


Illustration 7 g01409817

New format

Connectors

Ver imagen

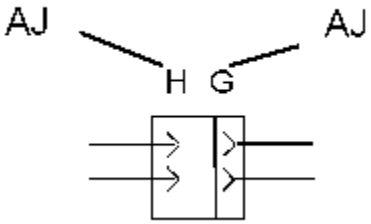


Illustration 8 g01409832

Old format

(AJ) Connector label

Ver imagen

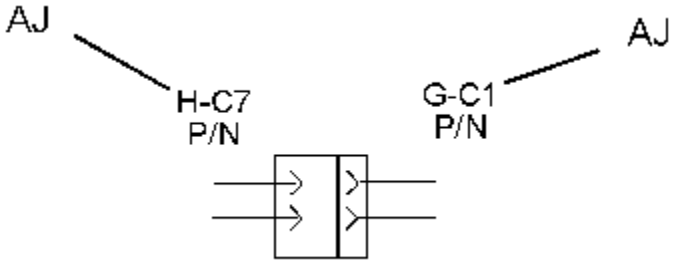


Illustration 9 g01409833

New format

(AJ) Connector label

Note: "H" is the harness identification, "C" stands for the connector, and "P/N" is the receptacle connector part number.

Splices

Ver imagen

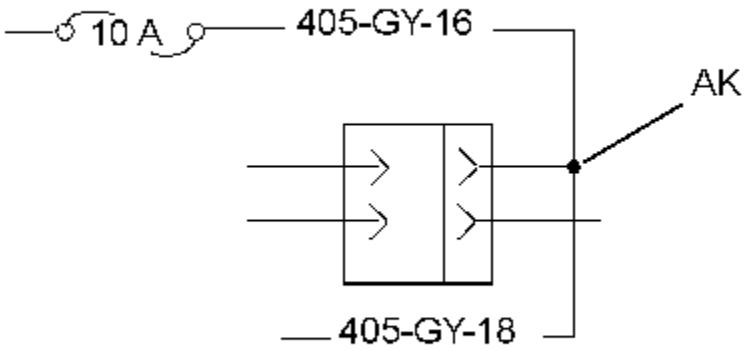
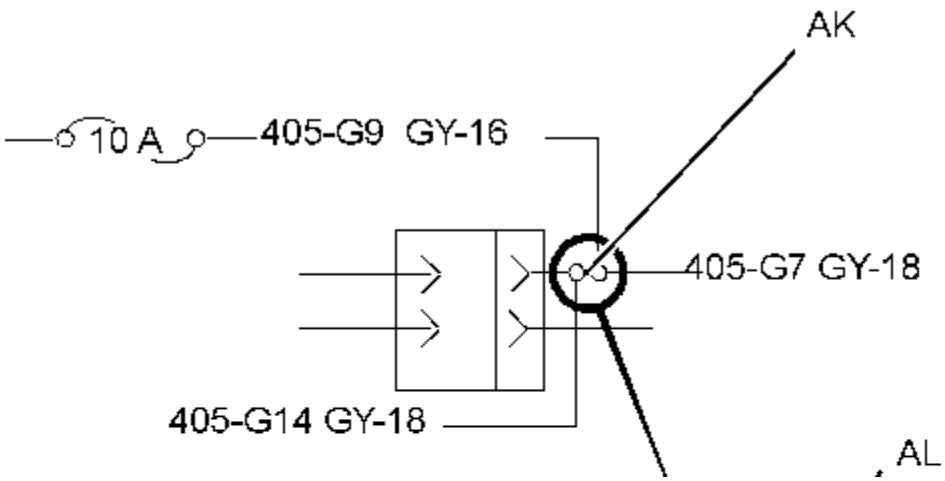


Illustration 10 g01409839

Old format

(AK) Splice

Ver imagen



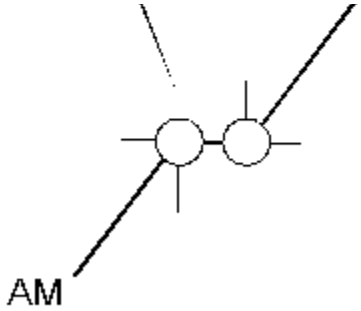


Illustration 11 g01409841

New format

(AK) Splice

(AL) Side 2 of the splice

(AM) Side 1 of the splice

Se ha introducido un nuevo sistema celular de Product Link para todos los productos Cat

SMCS - 7606

Tractor Agrícola:
- **Todos**

Camiones Articulados:
- **Todos**

Pavimentadora de asfalto:
- **Todos**

Retroexcavadora Cargadora:
- **Todos**

Challenger:
- **Todos**

Perfiladoras de Pavimento en Frío:
- **Todos**

Combinación:
- **Todos**

Cargadores de Ruedas Compactos:
- **TODOS**

Compactador de movimiento de tierras:
- **Todos**

Excavadora:
- **Todos**

Portaherramientas Integral:
- **Todos**

Compactadores de Rellenos Sanitarios:
- **Todos**

Máquinas de Carga, Acarreo y Descarga:
- **Todos**

Miniexcavadora hidráulica:
- **Todos**

Motoniveladora:
- **Todos**

Cargador todoterreno:
- **Todos**

Camiones de Obras/Tractores de Tiro:
- **Todos**

Compactadores de Pavimentación:
- **Todos**

Minicargador:
- **Serie B**

Compactadores de Suelos:
- **Todos**

Telehandler:
- **Todos**

Talador Apilador de Cadenas:
- **Caterpillar**

Cargador de Cadenas:
- **Todos**

- **Todos**

Arrastradores de Troncos de Cadenas:

- **Todos**

Tractor de cadenas:

- **Todos**

Tractores de Ruedas:

- **Todos**

Cargadores de Ruedas:

- **Todos**

Arrastrador de Troncos de Ruedas:

- **Todos**

Mototraíllas:

- **Todos**

ReferenciaManual de Operación y Mantenimiento, SEBU8142, "Product Link - 121SR/522/523".

ReferenciaInstrucción Especial, REHS2368, "Procedimiento de Instalación de Product Link PL522/523 (Celular){7606}".

ReferenciaOperación de Sistemas, RENR8143, "Product Link - PL522/523" para obtener las instrucciones para la actualización del acceso.

El nuevo Product Link de Cat Product Link tiene una nueva aplicación web fácil de usar y tecnología celular. La aplicación VisionLink reemplazará la interfaz de usuario actual de Product Link con herramientas intuitivas, nuevas opciones de hardware y funciones para procesar y proporcionar información a los clientes y distribuidores. Las demás funciones incluyen: administración de activos básicos, monitoreo de flota, mantenimiento y salud y utilización. La nueva generación de Product Link se comunica a través de la inclusión de una red celular (GSM) a la familia de hardware de habilitación que actualmente utiliza tecnología satelital. La ventaja principal de la comunicación celular (GSM) es el mayor ancho de banda que le permite a la señal transmitir más datos de manera más frecuente.

Nota: Las actualizaciones de software para la placa madre se ejecutan a través del aire por medio de Trimble y en este punto, el distribuidor no puede ejecutarlas. Los números de pieza de los archivos de actualización del acceso son: Grupo de Software de Monitor 371-5195 (Acceso PL522) y Grupo de Software de Monitor 371-5196 (Acceso 523).

Nota: Antes de realizar el servicio técnico, asegúrese de revisar el sitio web de SIS para asegurarse de que el número de pieza del archivo Flash aún sea el último número de pieza del archivo Flash. Puede haber disponible un número de pieza de archivo Flash más reciente.

Nuevo Grupo de analizador 271-8590 (24 voltios) identifica rápidamente problemas en el sistema de arranque y carga

SMCS - 0709; 1406

Productos Caterpillar:

- **Todos**

Ver imagen

Ilustración 1 g01294971

Ver imagen

Ilustración 2 g01294973

El Grupo de analizador 271-8590 (24 voltios) realiza pruebas a las baterías, el sistema eléctrico y a los diodos en sistemas eléctricos de 12 y 24 voltios para todos los productos Caterpillar.

Esta herramienta de diagnóstico de servicio pesado prueba baterías (FLA) y (AGM). Utilizando una carga de resistencia interna y diseño de algoritmos, la herramienta puede probar las siguiente configuraciones de conjunto de baterías:

- batería sencilla de 6 ó 12 voltios

- dos baterías en serie de 24 voltios
- dos, tres o cuatro baterías en paralelo de 12 voltios
- dos bancos en paralelo, cada banco con baterías en serie de 24 voltios

El analizador cuenta con una gama de corriente de arranque en frío (CCA) de 50 a 4000 CCA a 24 voltios. Un conjunto de cables de prueba de 4,6 m (15 pies) permite que el operador trabaje desde la cabina mientras el analizador está conectado al motor. Las conexiones de abrazadera permiten usar el analizador con abrazaderas de corriente optativas para hacer pruebas de drenaje de corriente y pruebas de arranque y carga.

Los circuitos digitales controlan la prueba con alta precisión. La interacción necesaria del operador es mínima. El analizador es compatible con unidades CCA, CA, AHR, MCA, JIS y DIN. El gran tamaño de la pantalla de caracteres de 4 X 20 disminuye la necesidad de desplazamientos hacia arriba o hacia abajo para ver la información. La pantalla es iluminada para facilitar su lectura en todas las condiciones.

El analizador cuenta con teclas sensibles al tacto y borde ancho para facilitar su uso con guantes en climas fríos. Una conexión para cable de seguridad permite que el operador sujete la herramienta para que evitar que caiga o para propósitos de seguridad.

La herramienta ofrece comunicaciones infrarrojas que le permiten conectarse a impresoras inalámbricas. La impresora proporciona encabezados y pies de página para personalizar los informes. Un puerto de interfaz para PC permite que el operador descargue actualizaciones al analizador.

El Grupo de analizador 271-8590 (24 voltios) incluye los siguientes componentes: el analizador de 24 voltios, un conjunto de cables de prueba de 4,6 m (15 pies), adaptadores de terminales para los bornes laterales, un estuche moldeado con un inserto de espuma de goma y el manual de operación de la herramienta.

Las opciones disponibles incluyen los siguientes productos: Conjunto de cables de prueba 271-8587 (4,6 m (15 pies)), Grupo de amperímetro de abrazaderas 225-8266 y Grupo de impresora inalámbrica 271-8585 (infrarroja).

ReferenciaManual de Operación de la herramienta, NEHS0973, "Grupo de analizador de 24 voltios".

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

This special instruction provides the necessary information in order to create SIS Web Feedback. All information provided in this document is necessary in order to provide the SIS Web Feedback analyst with the necessary information to expedite the resolution. SIS Web feedback is intended to provide feedback on any discrepancies within the Service/Parts literature. The feedback system is not intended to address any problems related to machine or component performance. Refer to the Dealer Solutions Network (DSN) for any problems associated with machine or component performance.

Note: Feedback is only available through SIS Web. Feedback is not available through SIS Network or SIS DVD.

Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

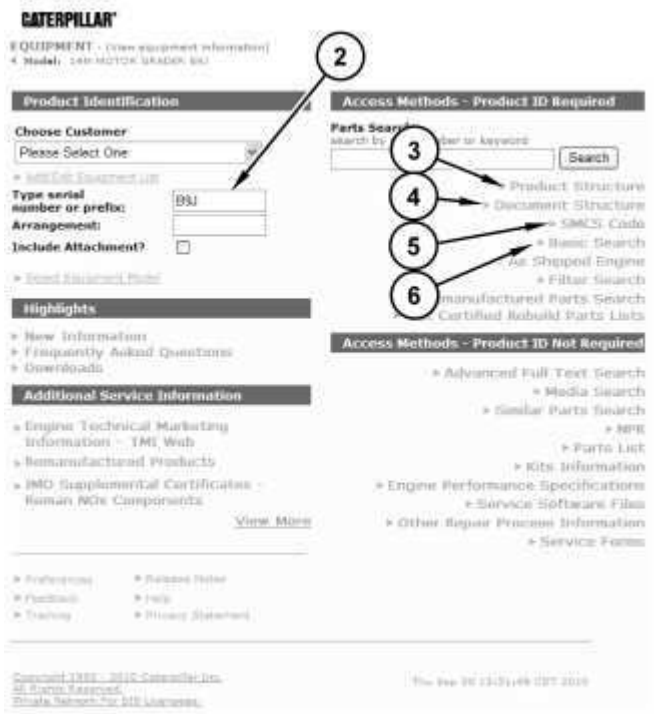


Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

   Note: Using any other method in searching for parts and service information will result in missing information in the discrepancy ticket. Any missing information may delay resolution of the discrepancy.

Ver imagen

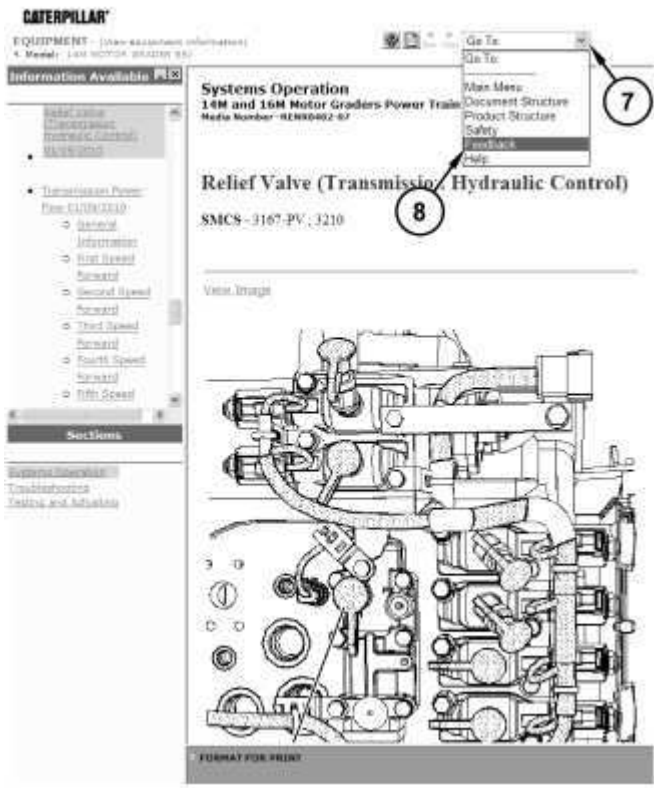


Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

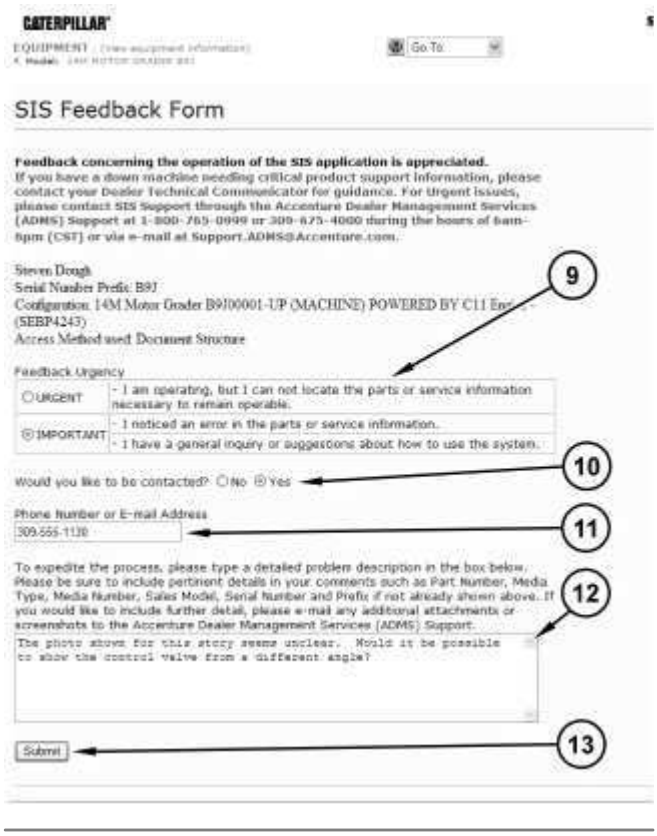


Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
7. Provide the contact information in box (11). The contact information can include an E-mail address and/or a telephone number.
8. Provide a detailed description of the discrepancy in box (12). Be sure to include pertinent details such as: part number, media type, media number, sales model, serial number and prefix. This information will expedite the resolution of the discrepancy.
9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

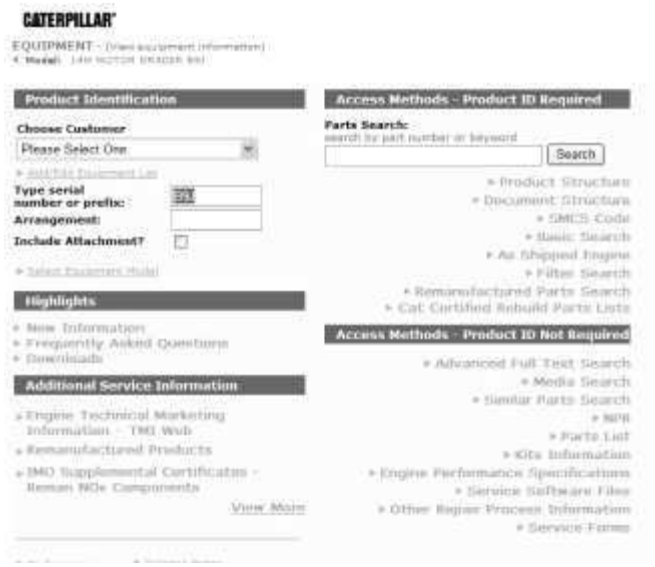
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



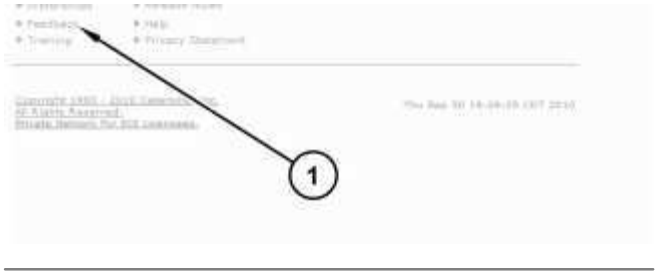


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Installation Procedure For Product Link PL522/523 (Cellular){7606}

SMCS - 7606

Agricultural Tractor: All
Articulated Truck: All
Asphalt Paver: All
Backhoe Loader: All
Challenger: All
Cold Planer: All
Combine: All
Compact Wheel Loader: ALL
Earthmoving Compactor: All
Excavator: All
Integrated Toolcarrier: All
Landfill Compactor: All
Load Haul Dump: All
Mini Hydraulic Excavator: All
Motor Grader: All
Multi Terrain Loader: All
Off-Highway Truck/Tractor: All
Paving Compactor: All
Skid Steer Loader: All
Soil Compactor: All
Telehandler: All
Track Feller Buncher: Caterpillar
Track-Type Loader: All
Track-Type Skidder: All
Track-Type Tractor: All
Wheel Dozer: All
Wheel Loader: All
Wheel Skidder: All
Wheel Tractor-Scraper: All

Introduction

This Special Instruction will provide instructions for installation and configuration of the PL522/523.

This Special Instruction also provides instructions on replacing the second generation of Product Link (PL121SR and PL300) with the PL522/523 in existing installations.

The PL522/523 product has been designed to install on three categories of machines.

One category of machines is referred to as Legacy machines. The Legacy machines are older machines that do not have a wiring harness that accommodates Product Link already installed. Connectors are not readily available to install the PL522/523 components. The PL522/523 components that are used in the Legacy machines are in the Legacy Installation Group.

The second category of machines is referred to as "Product Link Ready" machines. A machine is considered to be "Product Link Ready" if machine was assembled at factory with a wiring harness with proper connectors to install PL522/523. The "Product Link Ready" machines use the PL522/523 components that are in the Conversion Installation Group.

The third category of machines is machines that may not be Caterpillar machines. These machines can use the

Legacy installation group.

Important Safety Information

Work safely. Most accidents that involve product operation, maintenance, and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs.

A person must be alert to potential hazards. This person must also have the necessary training, skills, and tools in order to perform these functions properly.

Safety precautions and warnings are provided in this instruction and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons. Caterpillar cannot anticipate every possible circumstance of a potential hazard.

Therefore, the warnings in this publication and the warnings that are on the product are not all inclusive. Avoid using a tool, a procedure, a work method, or operating technique that is not recommended by Caterpillar. If used, ensure the safety of the operating personnel and others.

Ensure that the product will not be damaged or the product will be made unsafe by the operation, lubrication, maintenance, or the repair procedures.

WARNING

Structural damage, an overturn, modification, alteration, or improper repair can impair this structure's protection capability thereby voiding this certification. Do not weld on or drill holes in the structure. Consult a Caterpillar dealer to determine this structure's limitations without voiding its certification.

PL522/523 System Components

PL522/523 ECM

Ver imagen

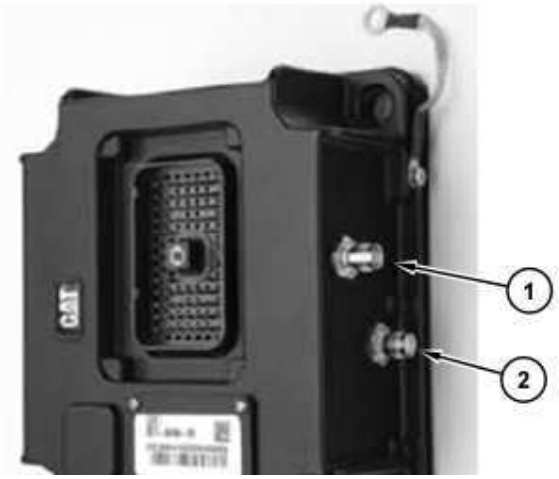


Illustration 1 g02177625

PL522/523

PL522 (351-8490), 523 (351-8492)

(1) Cellular connector

(2) GPS connector

(3) SIM card cover

Ver imagen

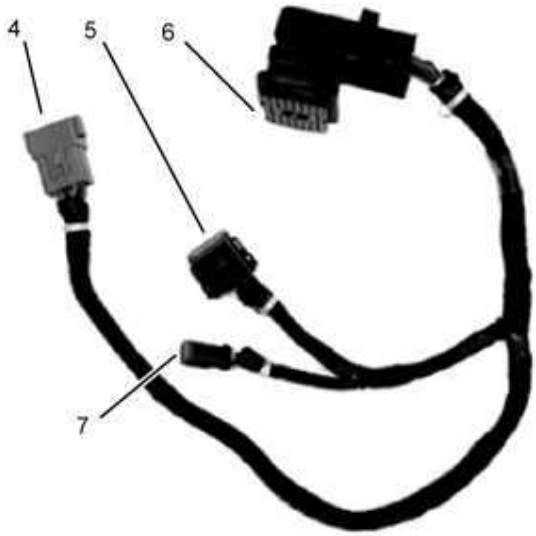


Illustration 2 g02177680

256-6804 Control Harness As

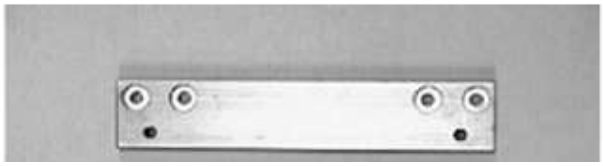
(4) 12-pin receptacle (J1)

(5) 12-pin plug (P2)

(6) 70-pin plug (P1)

(7) 2-pin plug (P3)

Ver imagen



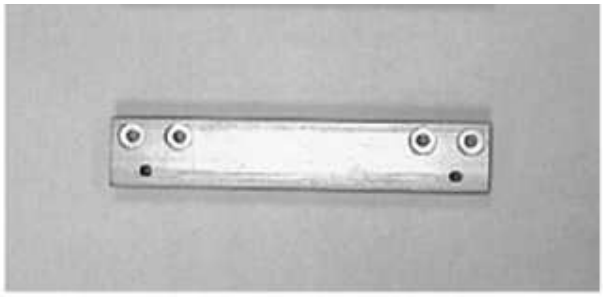


Illustration 3 g02177716

256-0501 Plate (PL Module)

Antennas and Antenna Bracket

Table 1

Available Antenna Packages		
Part Number	Description	Cable Length
293-3521	Plate	N/A
346-9376	Antenna As	0.5M

Ver imagen

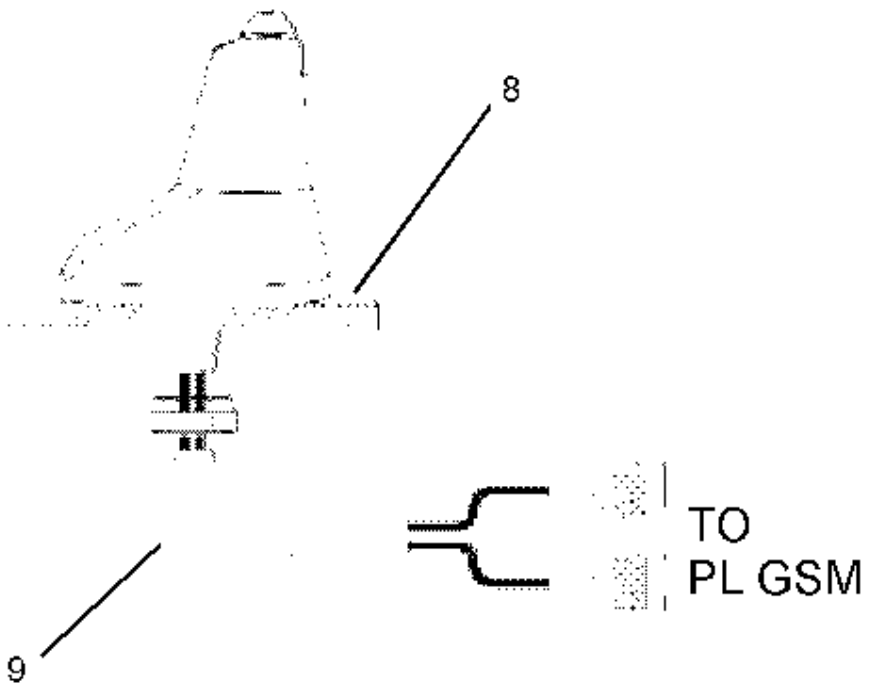


Illustration 4 g02177994

Hard mount antenna for PL522/523

(8) Mounting surface

(9) Coaxial cables

PL522/523 Installation Groups

Ver imagen

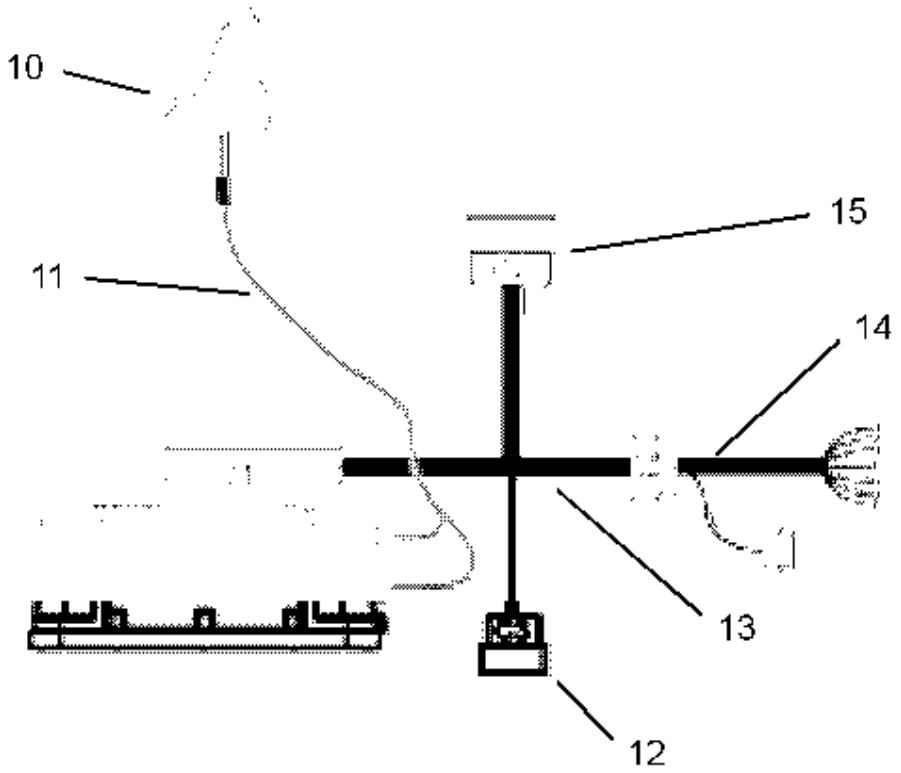


Illustration 5 g02178003

(10) PL GSM cellular/GPS antenna

(11) 353-8773 Antenna Cable AS

(12) 3E-3364 Receptacle

(13) 256-6804 Control Harness As

(14) 257-9364 Radio Harness As

(15) 3E-5179 Connector Receptacle As

Table 2

PL522 Conversion Installation Group (363-6782)		

Quantity	Part Number	Description
1	256-6804	Control Harness As
1	351-8490 (PL522)	Electronic Control Module
1	346-9376	Antenna As
1	353-8773	Antenna Cable AS

Table 3

523 Conversion Installation Group (363-6783)		
Quantity	**Part Number**	**Description**
1	256-6804	Control Harness As
1	351-8492 (523)	Electronic Control Module
1	346-9376	Antenna As
1	353-8773	Antenna Cable AS
1	257-9363	Power Harness As
2	256-0501	Plate

Table 4

PL522 Product Link Legacy Installation Group (363-6803)		
Quantity	**Part Number**	**Description**
1	256-6804	Control Harness As
1	257-9364	Radio Harness As
1	346-9376	Antenna As
1	351-8490 (PL522)	Electronic Control Module
1	353-8773	Antenna Cable AS

Table 5

523 Product Link Legacy Installation Group (363-6804)		
Quantity	**Part Number**	**Description**
1	256-6804	Control Harness As
1	257-9364	Radio Harness As
1	346-9376	Antenna As
1	351-8492 (523)	Electronic Control Module
1	353-8773	Antenna Cable AS

Table 6

Additional Parts

Quantity	Part Number	Description
4	6V-7357	Bolt
15	7K-1181	Cable Strap
4	8C-5608	Spacer
4	8C-8451	Bolt
4	9X-2546	Bolt
8	9X-6165	Washer
8	9X-8256	Washer
8	9X-9896	Mount
8	129-3178	Locknut
1	230-1340	Film (Inside US)
1	230-1341	Film (Inside US)
2	256-0501	Plate
-	8D-8719	Holder and Wire Assembly
-	115-8109	Wire Splice
-	199-9785	Wire As
-	207-3814	Wire As
-	5A-3837	Fuse
-	293-3521 (2)	Plate
	105-2797	Boss (M6X1, 20D, 9L)

(2) 293-3521 Plate is optional. The bracket is not included in any of the installation groups for the field.

Note: The additional parts that are listed in Table 6 may be needed but the parts are not included in the parts list.

Table 7

PL522/523 Blast Zone Switch (If Applicable)		
Quantity	**Part Number**	**Description**
4	8T-8729	Connector Pin
2	115-8109	Wire Splice
1	155-2267	Connector Plug As
1	155-2276	Plug Lock Wedge
2	8T-8730	Connector Socket
1	298-6019	Indicator Plate
1	260-5865	Toggle Switch

1	293-4950	Film
1	5P-9075	Electrical Wire (18 Gauge)

Installation of the Antenna (Cellular)

Location for Mounting the Antenna

Note: The hard mount antenna is preassembled with lock washer, nut, 0.5 m coaxial cable and radio connectors. The cutout for mounting hole allows the radio connectors, nut, and lock washer to pass through the optional **293-3521** Plate or through the cab. Brackets that are specific for the machine may be available for the application. Check the list of parts for the machine.

- To comply with regulations of FCC for RF human body safety, ensure that antenna is mounted more than 500 mm (19.7 inch) from machine operator.
- Orient the antenna so that the antenna is in a vertical position with a clear 360° view of the sky. The center of the cab is the ideal location in order to mount the antenna.
- Mount the antenna more than 500 mm from the PL522/523 in order to minimize interference between the radio and the antenna.
- Keep a distance between the PL522/523 antenna and other antennas that transmit a radio signal. Caterpillar recommends a distance of 1 m (3.3 ft). Keep no less than 500 mm (19.7 inch) between the PL522/523 antenna and other antennas that transmit a radio signal. The list of radio antennas to maintain a distance from include the citizen band radio, data radio and commercial communication radios.

Ver imagen

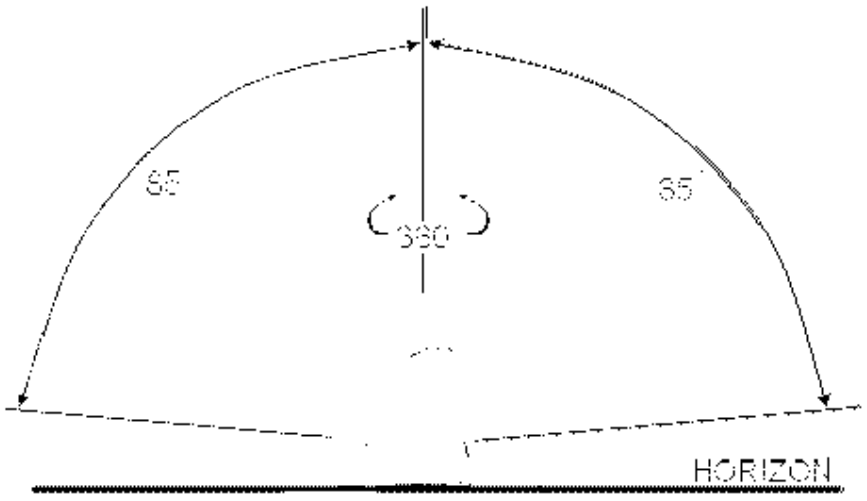


Illustration 6 g02178008

Antenna GPS signal reception pattern

- Mount the antenna no less than 500 mm (19.7 inch) from any metal surface and above the ground plane of

antenna to minimize interference. Refer to Illustration 6 for patterns of transmission and reception for the satellite antennas.

- Hard mount antenna requires a keyhole cutout for connectors, nut, and washer to pass through bracket or through roof into cab interior. The cutout is also backward compatible with the old style of antennas with the smaller mounting stud.
- Keep in mind the routing of the antenna cable. Do not route the antenna cable near any source of extreme heat (exhaust). Do not mount the antenna or the antenna cable so that the limitations of temperature −40° C (−40° F) 85° C (185.00000° F) are exceeded.
- Route the antenna cable so the cable would not be subject to abrasion or pinching.
- Route the antenna cable with a minimum bend radius of 49.5 mm. Bend radius depends on the type of cable used. Do not bend the radius any less than ten times the diameter of the cable. The cable used is LMR 200UF.
- The mounting hole diameter considered is 19mm.
- If a cellular / satellite antenna is not installed, then the grommets and button plugs can be used with a 19mm hole. The part numbers of the grommets are 6V-1626, 6P-6591, 5P-6549 and 5H-9695. The part numbers of the button plugs are 055-2102, 237-2652, 5K-3546 and 7X-1434.

Ver imagen

Illustration 7 g02206173

- Long horizontal axis of the antenna should be parallel to the vehicle. Refer to Illustration 7.
- Secure the antenna cable every 457 mm (18 inch) or shorter if necessary. Coil any excess antenna cable in a figure eight by using loops with a 200 mm (7.9 inch) diameter. This double loop prevents the antenna from being detuned. The 200 mm loop diameter prevents tight bends which cause detuning or shorting of antenna. This 200 mm loop diameter also minimizes standing waves within cable and resultant reflected energy that result in premature radio failure. Properly secure any excess antenna cable to the machine. Shortening the antenna cable could result in an inconsistent transfer of data.

Note: When selecting a location to mount the PL522/523 antenna, the single most important item to consider is

the view of the sky. The base of the PL522/523 antenna serves as the GPS antenna. The vertical stud serves as the cellular antenna for communication.

- The roof is a suitable ground plane.

Note: Do not mount the antenna horizontally.

Note: If PL321 or PL522/523 is standard on the machine, check the latest schematics for a representation of an ideal location.

Installation Of The Hard Mount Antenna

After a suitable location has been chosen to place the antenna, perform the following procedure in order to install the Hard Mount Antenna:

1. If placing the antenna on the cab roof, supply the necessary access hole or mount the optional **293-3521** Plate in a suitable location.

Ver imagen

Illustration 8 g02210493

Ver imagen

Illustration 9 g02210494

2. Feed the connectors for antenna cable, washer, locknut, and threaded part of antenna base through access hole or through hole in the bracket. Refer to Illustrations 8 and 9.

Ver imagen

Illustration 10 g02210533

3. Feed antenna base through key hole. Refer to Illustration 10.

Ver imagen

Illustration 11 g02210594

4. Place the washer and the nut on the threaded part of the antenna base. Refer to Illustration 11.

Ver imagen

Illustration 12 g02210596

5. Tighten nut to 7 N·m (5 ft). Refer to Illustration 12.

Note: The gasket for the antenna base should provide a seal that is moisture tight around the mounting hole.

Ver imagen

Illustration 13 g02210598

6. Connect the connectors for the antenna to the appropriate connectors on the coax extension. Refer to Illustration 13.

Ver imagen

Illustration 14 g02210599

7. Route the coax to the PL522/523. Refer to Illustration 14.

8. Route the coax cables without looping to take up the full length of the cable, else loop the coax cable with 200 mm diameter loops. This double loop prevents the antenna from being detuned. The 200 mm loop diameter prevents tight bends which could cause detuning or shorting of the antenna. The 200 mm loop diameter also minimizes standing waves within the cable and resultant reflected energy that could result in premature failure of the Radio.

   Note: For any machine using optional PL522/523 antenna, a two piece antenna coax is required. Depending on the machine group, space claim should be made available for future use for 3 coax cables.

   Note: An appropriate rubber grommet must be used in the access hole to protect the antenna cable from damage.

   Note: Rain, other moisture, or condensation can collect on and travel along the cable to the lowest point of the cable. If such a low point coincides with the passage of the cable into the cab, moisture will pass into the structure (even through the grommet). Hence form a drip loop of slack cable to provide for a low point at the bottom of drip loop before cable passes into structure.

Ver imagen

Illustration 15 g02210713

Ver imagen

Illustration 16 g02210733

9. Connect the connectors for the coax extension to the appropriate connectors for the PL522/523. Refer to Illustrations 15 and 16.
10. Secure the antenna cable.

    Suggested components for attaching coax cable to the machines are as follows:

    - Unslit conduit or braid is recommended for exterior applications. **289-3195** Conduit is recommended for one cable and **344-6577** Sleeve is recommended for two cables.
    - Use 2-3 wraps of **329-3724** on the cable and under wire tie for interior applications. Cushioned grip P-clip would be preferred if there is no covering for external applications.

Ver imagen

Illustration 17 g02210754

11. Do not over-tighten the tie-downs on the cable. Damage to the cable may occur. Refer to Illustration 17.

PL52X SIM card removal and replacement

Required tools

Torx Plus 8IP

Procedure for removal of PL52X SIM card

1. Deactivate currently installed SIM card in preparation for replacement (if required).

Ver imagen

Illustration 18 g02288113

2. Locate SIM card access cover on top left side of PL52X module. Refer to Illustration 18.

   Note: SIM card access cover screws are not captive (attached to cover panel) and can be lost.

Ver imagen

Illustration 19 g02288135

3. Remove the four Torx retaining screws with the TX-09 Torx tool and safeguard. Refer to Illustration 19.

Ver imagen

Illustration 20 g02288137

4. Remove SIM card access cover and set aside. Refer to Illustration 20.

Ver imagen

Illustration 21 g02288138

5. Carefully slide SIM card retainer in the direction of the arrow (embossed onto the retainer) to unlock the clip. Refer to Illustration 21.

   Note: Very little force is required to unlock the SIM card retainer. **Do not use sharp tools.**

6. Carefully pull the SIM card and retainer perpendicular to the contacts.

   Note: The SIM card contacts will push the card and retainer up to facilitate grasping of the card and retainer.

Ver imagen

Illustration 22 g02288154

7. Grasp SIM card with thumb and forefinger and pull the SIM card from the retainer. Refer to Illustration 22.

Procedure for replacement of PL52X SIM card

1. Obtain replacement SIM card from applicable carrier.

   Note: Care should be taken when the SIM Card holder is in the UP position. The holder may get damaged, if the ECM flips over with the holder in the UP position.

2. Install replacement SIM card in the reverse order that it was removed.

   Note: Inspect SIM card cover prior to installation to ensure that the gasket is still installed.

3. Reinstall SIM card access cover.

4. Reinstall the four SIM card access cover screws. Torque SIM card access cover screws to 0.96 ± 0.22 N·m (8.50 lb in).

5. Activate the new SIM card and return machine to service.

Mounting the PL522/523

Note: The use of threaded bosses or welded studs is the preferred method in order to attach the ECM to a machine.

Ensure that the PL522/523 module is installed with the available shock mount kit. All installations require shock mounting.

The mounting hardware can be purchased separately. The components are listed in tables above. A drill template for locating the hole pattern for the ECM is included at the end of this special instruction.

Note: The mounting hardware is not included as part of the ECM. The mounting hardware must be purchased separately or as part of the installation groups listed above.

Select a Location for the ECM

- Orient the ECM so that the ECM connector will not be subjected to high-pressure spray or underwater immersion. Exposure to high-pressure spray or underwater immersion may compromise the connector seal, leading to connector failure.
- Do not mount the ECM in the engine compartment or in other areas so that the ECM will be exposed to extreme heat. Exposure to extreme heat may make the ECM inoperable.
- Do not mount the ECM in an area so that the ECM could be damaged.
- The ECM must be installed on a flat surface.
- Orient the ECM to ensure proper cable routing of the main harness as well as the GSM/GPS RF Cable Assemblies.
- The desired static stiffness of the mounting points for the PL522/523 should be 1800N/mm (ten times mount stiffness). In no case should the stiffness at the mounting points be less than 540N/mm (three times the mount stiffness).

- A boss or a welded stud is the preferred mounting hardware on a machine.
- The mounting torque on the mounting bolts is (12 N·m (8.8 lb ft)).
- Do not mount on a Cantilever.
- Do not mount on a flexible area.
- Do not mount near impacts.
- Place the ECM in an area that considers serviceability.
- Place the ECM in an area that the SIM card is easily accessible/ serviceable.

Note: The PL522/523 is 0.5 in taller than the PL300 ECM. Consider the height of the PL522/523 when selecting an appropriate installation location.

Mounting the PL522/523 on Legacy Machines

After a suitable location has been chosen, perform the following in order to install the ECM.

1. Install the isolation mount parts on the ECM.
2. Place the ECM in the desired location using the mounting bosses, the studs, or the bolts that have been chosen.
3. Place the ground strap for the ECM on one of the mounting bolts.
4. Secure the ECM by tightening the ECM mounting bolts. Torque the mounting bolts to 12 N·m (8.8 lb ft).

Mounting the PL522/523 on Product Link Ready Machines

Product Link Ready Machines have existing mounting locations for the PL151/201 and PL321. If the PL151/201 or PL321 are installed, the existing Product Link system must be removed prior to installing the PL522/523. Mount the PL522/523. If the PL522/523 does not fit in the space provided for the PL151/201, Refer to Special Instruction, REHS2365, "Mounting the Product Link ECM on Legacy Machines".

If the machine is PL321 ready, then the mounting space and hardware that is provided will be appropriate. The PL522/523 footprint is identical to the PL300 footprint. Therefore, the PL300 location should adequately accommodate the PL522/523.

Instructions for Mounting

Ver imagen

Illustration 23 g02212802

1. Install the isolation mount parts on the ECM. Refer to Illustration 23.
2. Install the adapter plates if needed.

Ver imagen

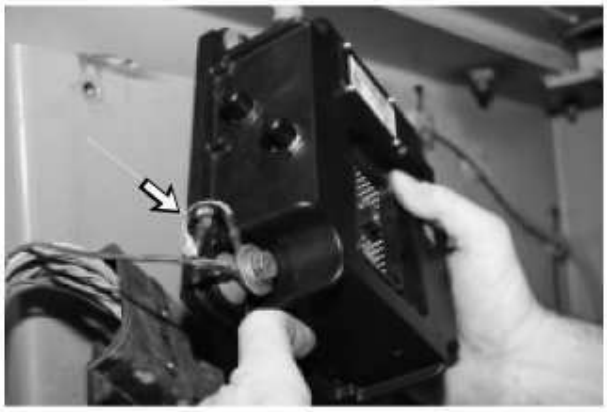


Illustration 24 g02214113

3. Place the ground strap for the ECM on one of the mounting bolts. Refer to Illustration 24.

Ver imagen

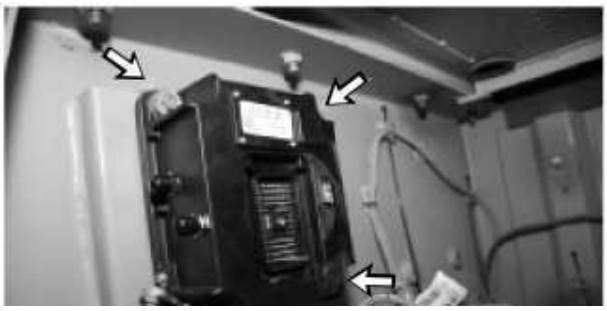


Illustration 25 g02212815

4. Install the required four mounting bolts and washers. Refer to Illustration 25.
5. Secure the ECM by tightening the ECM mounting bolts. Torque the mounting bolts to 12 N·m (8.8 lb ft).

Mounting the PL522/523 on machines with an existing PL321 System

Some machines may already have a PL321 installed. If the PL321 is installed, the existing Product Link system must be removed prior to installing the PL522/523.

If the machine is PL321 ready, then the mounting space and hardware that is provided will be appropriate. The PL522/523 footprint is identical to the PL300 footprint. Therefore, the PL300 location should adequately accommodate the PL522/523. When considering the existing PL300 mounting location, keep in mind that the PL522/523 is 0.5 in taller than the PL300. The height of the PL522/523 should not pose a problem for most installations.

Instructions for Mounting

1. Locate existing PL300 on machine. If machine was shipped from the factory with the PL321, the machine schematic could be used to help identify the location.

Ver imagen

Illustration 26 g02212956

Ver imagen

Illustration 27 g02212973

2. Remove 70-pin connector from PL300. Refer to Illustrations 26 and 27.

Ver imagen

Illustration 28 g02212993

3. Uninstall PL300 by removing the four mounting bolts. Retain hardware for use on PL522/523. Leave the harness in-place. Refer to Illustration 28.

Ver imagen

Illustration 29 g02213033

4. Install the existing isolation mount parts on the PL522/523. Refer to Illustration 29.

   Note: New isolator mounts may be required if warping has occurred.

Ver imagen

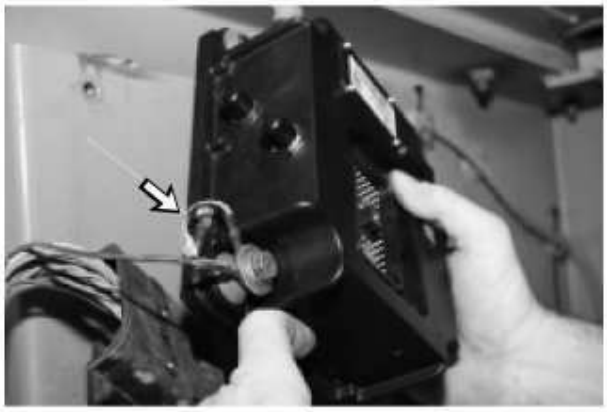


Illustration 30 g02214113

5. Place the ground strap for the ECM on one of the mounting bolts. Refer to Illustration 30.
6. Install the required four mounting bolts and washers.
7. Secure the ECM by tightening the ECM mounting bolts. Torque the mounting bolts to 12 N·m (8.8 lb ft).

Ver imagen

Illustration 31 g02213056

8. Connect 70 pin connector with 4mm hex wrench. Refer to Illustration 31.

Ver imagen

Illustration 32 g02213154

9. Locate existing PL121 radio on machine. Refer to Illustration 32.

Ver imagen

Illustration 33 g02213156

10. Remove 12pin connector from PL121. Refer to Illustration 33.
11. Remove PL121 from the machine. Leave the harness in-place.

Ver imagen

Illustration 34 g02214313

Ver imagen

Illustration 35 g02213161

12. Place cap **274-3779** Seal Cap onto 12 pin connector and secure harness with tie wraps. Refer to Illustrations 34 and 35.

Wiring The PL522/523

Harness Combinations

A connection from the machine harness to the PL522/523 must be created in order to be compatible with the new system. Whether legacy or conversion, the machine harness must be prepared to link to the PL522/523.

Refer to the Table 8 in order to determine the combination of harnesses needed for your installation.

Table 8

Installations				
New Install (Legacy)	**Replace PL321**	**Replace PL121**	**PL Ready Install**	**Replace PL151/201**
351-8490 Electronic Control Module (PL522) or **351-8492** Electronic Control Module (PL523)	**351-8490** Electronic Control Module (PL522) or **351-8492** Electronic Control Module	**351-8490** Electronic Control Module (PL522) or **351-8492** Electronic Control Module	**351-8490** Electronic Control Module (PL522) or **351-8492** Electronic Control Module	**351-8490** Electronic Control Module (PL522) or **351-8492** Electronic Control Module
256-6804 Control Harness As (PL522/523)	Antenna	**256-6804** Control Harness As (PL522/523)	**256-6804** Control Harness As (PL522/523)	**256-6804** Control Harness As (PL522/523)
257-9364 Radio Harness As	Coax cable	Antenna	**257-9363** Power Harness As	**257-9363** Power Harness As
Antenna		Coax cable	Antenna	Plates
Coax				Coax

Legacy Harness Installation

The **257-9364** Radio Harness As enables PL522/523 to be installed on machines that are not Product Link Ready. The **257-9364** Radio Harness As also enables PL522/523 to be installed on machines that have not had Product Link devices installed previously.

Perform the following steps in order to install the **257-9364** Radio Harness As :

1. Consult the electrical schematic for the machine in order to locate the connection points for the machine that mate with the Legacy Harness Wires. Refer to Table 9 for the Legacy Harness schematic.

2. Splice the wires for the Legacy harness to the connection points for the machine.
3. After the splices have been made, insert the wiring that is not braided into the supplied tubing.
4. Secure the harness with cable ties.

Note: If the machine is Product Link Ready for a PL151 or a PL201, then remove the connector from the machine harness. Then insert the proper wires that are shown in the **257-9363** Power Harness As into the harness connector for the machine.

Table 9

Legacy Harness Connections			
P1 Connector Pin Number	**Harness Wire**	**Description**	**Connection Point for the Machine**
1	125-OR	Unswitched Power	Fused (5 amp) unswitched power circuit
2	200-BK	Ground	Machine ground
3	308-YL	Keyswitch ON	Circuit that provides battery voltage only when the keyswitch is turned to the ON position
4	403-GN	R-Term	Alternator R-term circuit
5	944-OR	CAT Datalink +	CAT Datalink communications "+" circuit
6	945-BR	CAT Datalink -	CAT Datalink communications "-" circuit
7	Y975-GN	CAN LOW	CAN communications LOW circuit (If Present)
8	Y974-OR	CAN HIGH	CAN communications HIGH circuit (If Present)

Installation of Harness for Conversion

The **257-9364** Radio Harness As enables the PL522/523 to be installed on "Product Link Ready" machines or on machines that have previously had Product Link devices (PL151/201) installed.

Note: If the PL321 system is installed, ensure that the **257-9363** Power Harness As 12-pin receptacle (P1) is located within 500 mm (19.7 inch) of the PL522/523.

Perform the following steps in order to install the **257-9363** Power Harness As :

1. Consult the electrical schematic for the machine in order to locate the Product Link Connector.
2. Connect the harness receptacle for conversion 6-pin to the Product Link 6-pin connector that is part of the machine harness.
3. Secure the harness with supplied tie-wraps.

Installation of Wiring (PL522/523)

Perform the following steps in order to install the PL522/523:

1. Use a 4 mm (0.16 inch) Allen wrench in order to secure the **256-6804** Control Harness As 70-pin plug (P1) to the ECM.

Ver imagen

Illustration 36 g02212973

Ver imagen

Illustration 37 g02212956

2. Connect the PL522/523 harness 12-pin (J1) connector into the 12-pin connector of either the Conversion Harness or the Legacy Harness. Refer to Illustrations 36 and 37.

3. Secure the harness with supplied tie-wraps.

The schematic for the **256-6804** Control Harness As (PL522/523) is shown below.

Ver imagen

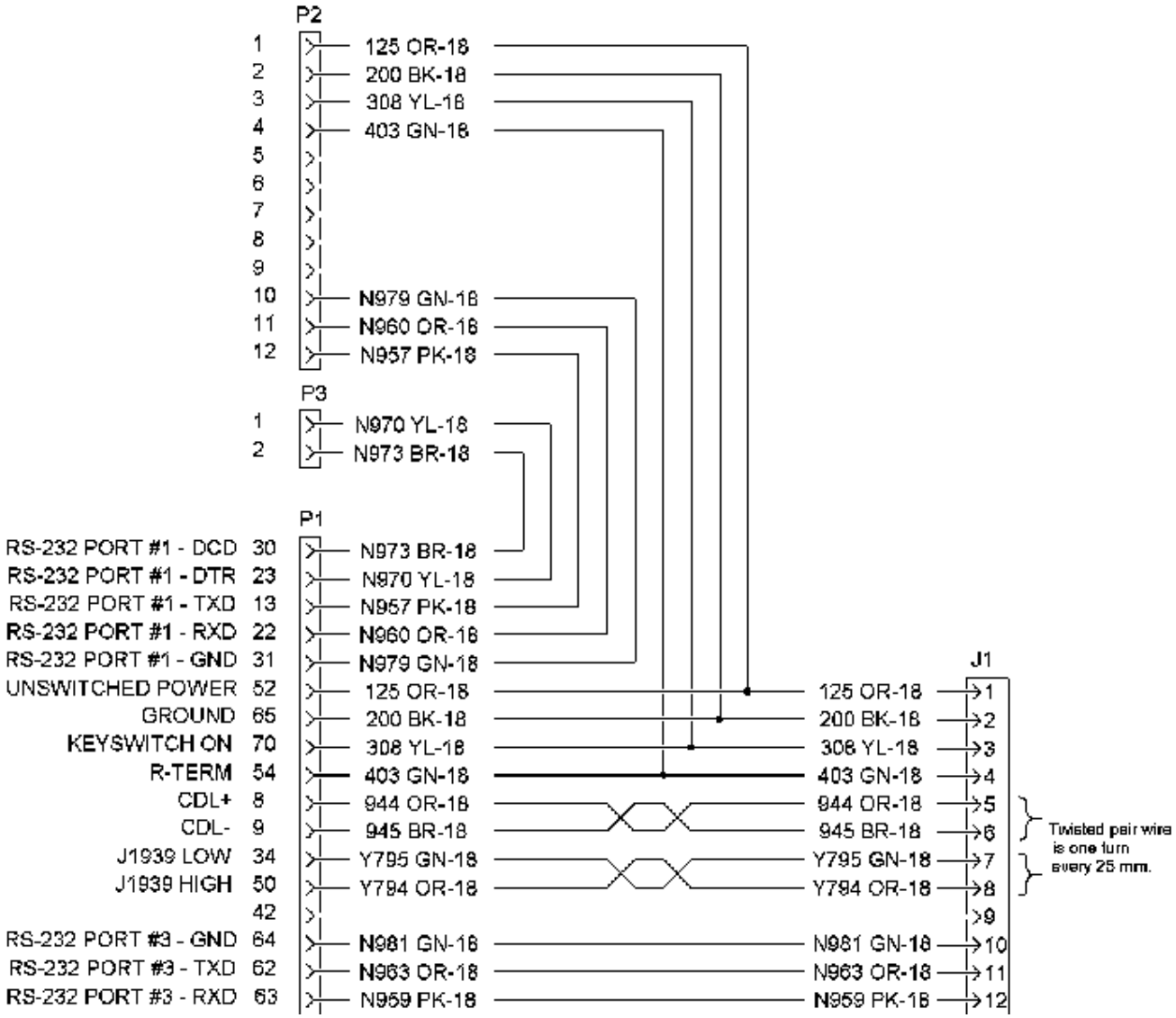


Illustration 38 g01117887

256-6804 Control Harness As

Note: The 12-pin (P2) and 2-pin (P3) connectors are not used for the PL522/523 installation and should be capped.

PL522/523 Digital Inputs

The PL522/523 ECM provides four digital switch-to-ground type inputs that can be used for alarming functions in a PL installation. This feature allows the PL522/523 to monitor a pressure, temperature, or level that is not normally provided through a machine ECM.

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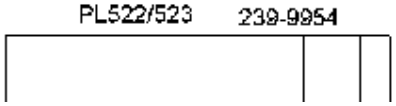


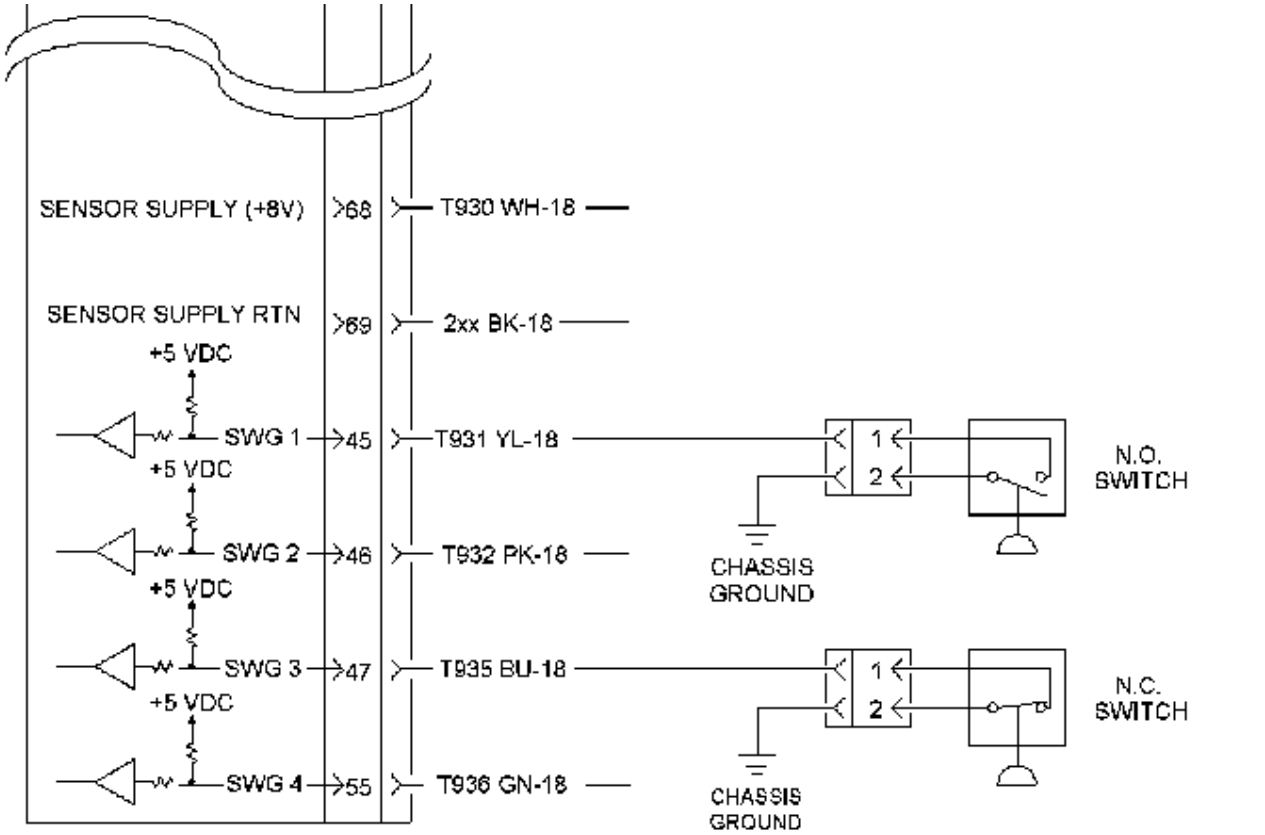


Illustration 39 g02223953

Note: Only use pressure, temperature, level, or other type switches that incorporate dry contacts for the switch output.

Table 10

Pressure Switches					
Part Number	**Actuation Pressure**	**Deactuation Pressure**	**Port Fitting**	**Connector Type**	**Normal State**
168-7557	13780 kPa (1998.6 psi)	10335 (±689) kPa	9/16 - 18 THD	2-PIN DT REC	NC
140-9669	1206 kPa (174.92 psi)	700 (±103) kPa	3/4 - 16 THD	3-PIN DT REC	NC or NO
3E-7675	2550 kPa (369.85 psi)	1800 (±175) kPa	9/16 -18 THD	3-PIN DT REC	NC
173-7252	75 kPa (10.88 psi)	35 kPa	9/16 -18 THD	2-PIN DT REC	NO
107-0611	93 ± 21 kPa (13.49 ± 3.05 psi)	70 ± 21 kPa (10.15± 3.05 psi)	1/8 - 27 NPTF THD	2-PIN DT REC	NO
3E-2033	640 kPa (92.82 psi)	530 ± 40 kPa (76.87 ±	1/4 - 18 NPTF	2-PIN DT REC	NO

3E-2033	640 kPa (92.82 psi)	330 ± 40 kPa (76.87 ± 5.8 psi)	THD		NO
3E-2026	60 kPa (8.7 psi)	38 ± 20 kPa (5.5 ± 2.9 psi)	1/4 - 18 NPTF THD	2-PIN DT REC	NO
115-7103	93 ± 20.8 kPa (13.49 ± 3 psi)	68.9 ± 20.8 kPa (10 ± 3 psi)	9/16 - 18 NPTF THD	3-PIN DT REC	NO or NC

List of Switches That Can Be Used for Input

Table 11

Level Switches						
Part Number	**Connector Type**	**Mounting Position**	**Rating**	**Mounting Fitting**	**Wire Length**	**Normal State**
146-8437	None	Top	-40-85	1/2 NPT	169 mm (6.6535 inch)	NO or NC
140-1385	DT-2	Top	-40-125C	2 11/-12 NPTF	31 mm (1.2205 inch)	NO
141-0374	DT-3	Side	-40-85	1/8 - 27 NPTF	250 mm (9.8425 inch)	
145-4552	DT-3	Side	-40-85	1/8 - 27 NPTF	250 mm (9.8425 inch)	
156-0069	DT-4REC	Top	-40-85	FLANGE	200 mm (7.87 inch)	NO
174-1821	NONE	Top	-40-85	1/8 - 27 NPTF	155 mm (6.1 inch)	NO
1V-2727	NONE	Top	-40-85	1/8 - 27 NPTF	850 mm (33.46 inch)	NO
3E-7505	DT-2	Side	-40-125C	7/8 - 14 UNF	200 mm (7.87 inch)	NO or NC
5G-0175	NONE	Top	-40-85	1/8 - 27 NPTF	635 mm (25 inch)	NC
7C-6930	NONE	Top	-40-85	1/8 - 27 NPTF	2250 mm (88.58 inch)	NC

Table 12

Temperature Switches						
Part Number	**Actuation Degrees**	**Deactuation Degrees**	**Port Fitting**	**Tube Length**	**Connector**	**Normal State**
3E-7298	21.11° C (70° F)	12.78° C (55° F)	3/8 -18 NPT	31 mm (1.22 inch)	2-PIN DT REC	NC
124-8274	25° C (77° F)	15° C (59° F)	3/4 - 16 STO	17 mm (0.67 inch)	2-PIN DT REC	NC
3E-6425	38° C (100.4° F)	27° C (80.6° F)	3/8 -18 NPT	31 mm (1.22 inch)	2-PIN DT REC	NC
3E-0014	38° C (100.4° F)	27° C (80.6° F)	1/2-14 NPT	35 mm (1.38 inch)	2-PIN DT REC	NC
104-7843	38° C (100.4° F)	27° C (80.6° F)	M16 X 1.5 STO	28 mm (1.11 inch)	2-PIN DT REC	NC
3E-6449	38° C (100.4° F)	27° C (80.6° F)	3/4 - 16 STO	28 mm (1.11 inch)	2-PIN DT REC	NC
3E-9350	52° C (125.6° F)	43° C (109.4° F)	3/4 - 16 STO	28 mm (1.11 inch)	2-PIN DT REC	NC
155-8998	65° C (149° F)	21.8° C (71.24° F)	3/4 - 16 STO	21.8 mm (0.858 inch)	2-PIN DT REC	NO
3E-6240	65° C (149° F)	57° C (134.6° F)	1/2 - 14 NPT	35 mm (1.378 inch)	2-PIN DT REC	NC
3E-3635	65° C (149° F)	57° C (134.6° F)	1/2 - 14 NPT	35 mm (1.378 inch)	2-PIN DT REC	NO
146-1762	68.3° C (155° F)	59.3° C (138.74° F)	3/4 - 16 STO	100 mm (3.94 inch)	2-PIN DT REC	NC
3E-7714	73.89° C (165° F)	65.56° C (150° F)	3/4 - 16 STO	17.5 mm (0.69 inch)	2-PIN DT REC	NC
107-4927	82° C (179.6° F)	74° C (165.2° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NO

	F)			inch)		
3E-9349	88° C (190.4° F)	79° C (174.2° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NC
184-7245	92° C (197.6° F)	83° C (181° F)	3/8 - 18 STO	18 mm (0.7 inch)	2-PIN DT REC	NO
177-2313	100° C (212° F)	92° C (197.6° F)	3/4 - 16 STO	64.3 mm (2.53 inch)	2-PIN DT REC	NC
104-3008	102° C (215.6° F)	90° C (194° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NO
131-4135	102° C (215.6° F)	90° C (194° F)	3/4 - 16 STO	18 mm (0.71 inch)	2-PIN DT REC	NC
104-3006	107° C (224.6° F)	97° C (206.6° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NO
114-9235	107° C (224.6° F)	97° C (206.6° F)	1/2-14 NPT	28 mm (1.1 inch)	2-PIN DT REC	NO
3E-6451	107° C (224.6° F)	93° C (199.4° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NC
118-5144	107° C (224.6° F)	95° C (203° F)	3/4 - 16 STO	18 mm (0.71 inch)	2-PIN DT REC	NO
177-4599	107° C (224.6° F)	95° C (203° F)	1/2-14 NPT	14.1 mm (0.56 inch)	2-PIN DT REC	NO
164-3534	107° C (224.6° F)	93° C (199.4° F)	3/4 - 16 STO	17.7 mm (0.7 inch)	2-PIN DT REC	NO
3E-2028	107° C (224.6° F)	93° C (199.4° F)	3/8 -18 NPT	31 mm (1.22 inch)	2-PIN DT REC	NC
3E-7504	107° C (224.6° F)	98° C (208.4° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NO
111-3194	108° C (226.4° F)	100° C (212° F)	1/2 - 14 NPT	28 mm (1.1 inch)	2-PIN DT REC	NO
107-4658	108° C (226.4°	100° C (212° F)	1/2 - 14	17.7 mm (0.7	2-PIN DT	NO

107-4058	108° C (226.4° F)	100° C (212° F)	NPT	17.7 mm (0.7 inch)	REC	NO
130-5453	110° C (230° F)	102° C (215.6° F)	3/4 - 16 STO	18 mm (0.71 inch)	2-PIN DT REC	NC
130-3015	110° C (230° F)	96° C (204.8° F)	3/4 - 16 STO	18 mm (0.71 inch)	2-PIN DT REC	NC
177-2314	115° C (239° F)	106° C (222.8° F)	3/4 - 16 STO	64.3 mm (2.53 inch)	2-PIN DT REC	NC
113-8240	115° C (239° F)	106° C (222.8° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NC
155-8999	124° C (255° F)	117° C (242.6° F)	3/4 - 16 STO	64.3 mm (2.53 inch)	2-PIN DT REC	NC
9X-5602	125° C (257° F)	117° C (242.6° F)	3/4 - 16 STO	64.3 mm (2.53 inch)	2-PIN DT REC	NO
104-3007	129° C (264° F)	112° C (233.6° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NO
3E-6453	129° C (264° F)	118° C (244.4° F)	3/4 - 16 STO	28 mm (1.1 inch)	2-PIN DT REC	NC
149-8292	−0.5° C (31.1° F)	−1.7° C (28.94° F)	-15.25	17.3 mm (0.68 inch)	3-PIN DT REC	NO
139-6826	65° C (149° F)	56° C (132.8° F)	3/4 - 18 THD	100 mm (3.94 inch)	3-PIN DT REC	NC

Optional Installation Of Product

Link Blast Site Switch

Local mine regulations typically require a safe blast site operating distance that exceeds the safe operating distance specified for the PL522/523. Blast site disconnect switches are normally not required. This section addresses the addition of a blast site power switch to The PL522/523 if one is required on the machine.

Note: The PL522/523 ECM will not collect any machine data when the blast zone switch is enabled.

Solution

Wiring instructions are provided in the following procedure that will allow customers to disable the PL522/523. The customer will still be able to operate the machine.

Note: While the switch is OFF, no communication to or from Off Board web application will take place.

Procedure

1. Place the main disconnect switch in the OFF position.

Ver imagen

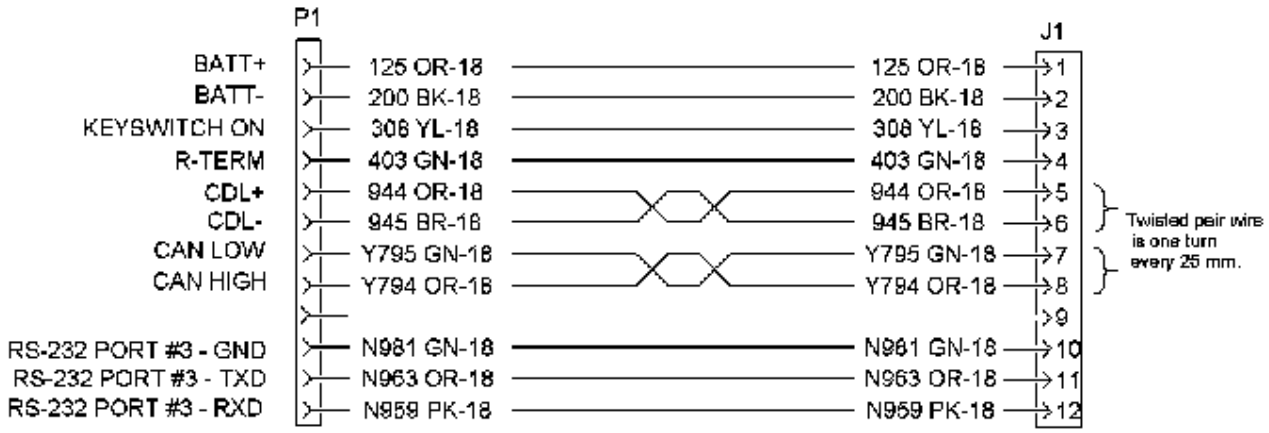
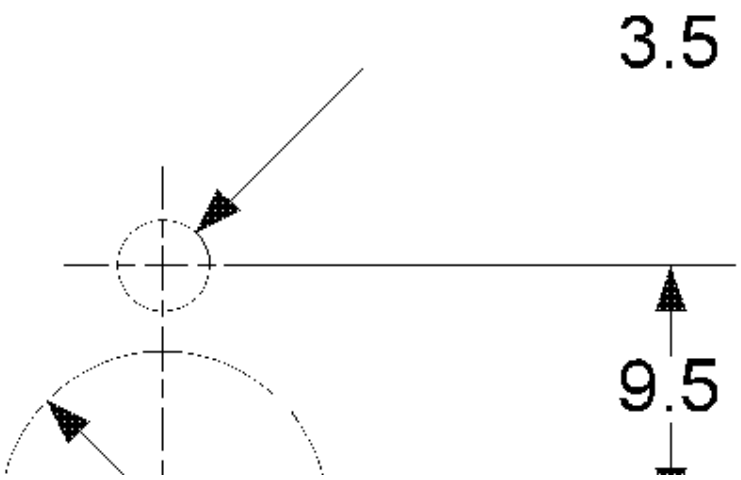


Illustration 40 g02227453

256-6804 Control Harness As (PL321)

2. Refer to Illustration 40 to locate wire 125-OR. This wire is unswitched power for PL522/523 (Pin 52).
3. Find a convenient location to cut wire 125-OR. Strip the insulation from each end of the wire. Crimp a **8T-8729** Connector Pin to each bare wire. Install one **115-8109** Wire Splice on each connector pin.

Ver imagen



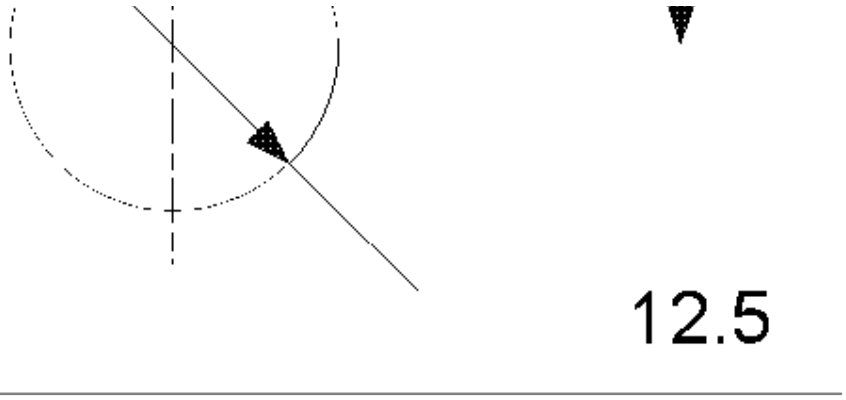


Illustration 41 g01300120

Drill pattern template for the 260-5865 Toggle Switch

4. Mount the **260-5865** Toggle Switch in a convenient location in the cab. Refer to Illustration 41. Illustration 41 is not to scale. Place the **293-4950** Film near the switch.
5. Run two lengths of **5P-9075** Electrical Wire between the splices and the toggle switch. Protect the wire and tie-wrap the wire.
6. On the splice end of the wire, strip the insulation from each end of the wire. Crimp a **8T-8729** Connector Pin to each bare wire. Insert the connectors into the open ends of the splices.
7. On the switch end of the wire, strip the insulation from each end of the wire. Crimp a **8T-8730** Connector Socket to each bare wire. Insert the two sockets into location A and location B of a **155-2267** Connector Plug As . Insert a **155-2276** Plug Lock Wedge in order to lock the sockets in place.
8. Connect the **155-2267** Connector Plug As to the **3E-3370** Connector Receptacle As on the **260-5865** Toggle Switch .
9. Place the main disconnect switch in the ON position.
10. Verify that no power is applied to the PL522/523 ECM.
11. Place the PL522/523 disconnect switch into the ON position. Verify that power is applied to the PL522/523 ECM.

Operation

In order to use the PL522/523 disconnect switch, perform the following steps:

1. From the Engine Running condition, place the keyswitch in the OFF position.
2. Wait for approximately 10 seconds for the parameters to be stored to memory.
3. Place the PL522/523 disconnect switch in the OFF position.
4. Place the PL522/523 disconnect switch in the ON position when conditions are safe.

Important Notes

Note: The keyswitch should be placed in the OFF position for a minimum of 10 seconds before placing the PL522/523 disconnect switch in the OFF position. Failure to place key in OFF position for a minimum of 10 seconds may cause current parameters of SMH, location, to be lost and/or corrupted.

Note: When the PL522/523 disconnect switch is in the OFF position, no communication between the machine and back office will take place.

Note: While the blast zone switch is in the OFF position, the PL522/523 will not track SMH hours. An SMH adjustment will be required after power is restored to PL522/523

Connecting a Computer to the PL522/523 System

Required Software

This system requires Caterpillar Electronic Technician version 2010A or later.

Note: Caterpillar recommends that CAT ET to be updated to the latest version in order to access all of the available functionality in the PL522/523.

Supported Hardware Connections

The PL522/523 ECM is configured with CAT ET using the following communications interfaces:

- The **171-4400** Communication Adapter Gp is connected between the machine service connector and the PC serial port or parallel port. The CAT ET "Communications Interface Device" is configured for "Caterpillar Communications Adapter II (RP1210)".

Note: The configuration parameters for the "Communications Interface Device" are found in CAT ET under "Utilities – Preferences".

Configure Computer Interface Communications for CAT ET

The following screen examples show how to Configure computer communications in order to use CAT ET.

1. Use the cable for **245-7310** Control Harness As to connect a computer with required CAT ET software to the serial service connector of wiring harness.

2. Select "UTILITIES" on the toolbar.

Ver imagen

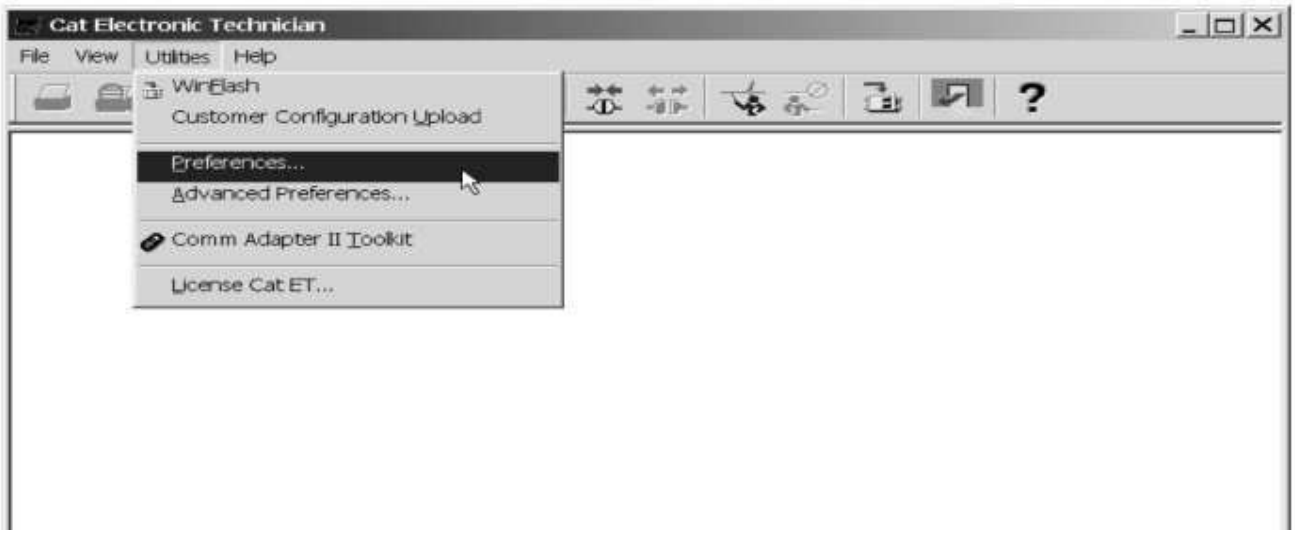


Illustration 42 g01122929

CAT ET preference screen

3. From the drop-down list, select "PREFERENCES". Refer to Illustration 42.

Ver imagen

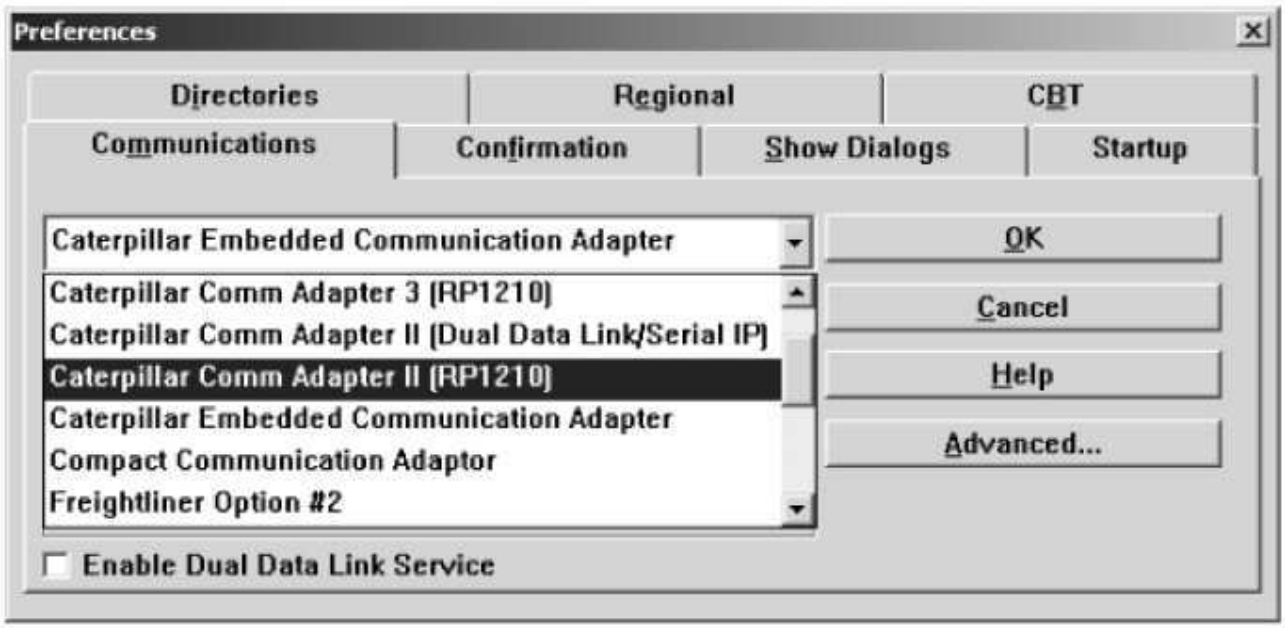


Illustration 43 g02287954

Communications tab screen

4. From the "COMMUNICATIONS" tab, click the drop-down menu and select "CATERPILLAR COMMUNICATIONS ADAPTER II (RP1210)" or the "CATERPILLAR COMMUNICATIONS ADAPTER III (RP1210)". Refer to Illustration 43.

Configure and Activate Product Link 522/523 ECM

To configure the PL522/523 system:

Note: Two communications adapters are available in order to flash program the electronic control modules. The **7X-1700** Communication Adapter Gp can be used, or the **171-4400** Communication Adapter Gp .

After the PL522/523 has been configured, the ECM must be activated with the VisionLink system.

Note: For optimal reception, place the machine outside.

Activating the System

The PL522 and 523 modules are activated over the air through Trimble Store for VisionLink™. The Trimble Store application provides an easy-to-use mechanism for dealers to add services to Product Link-enabled machines, including factory installed and aftermarket installations of Product Link.

The Trimble Store for VisionLink collects data from Cat Equipment Data (ED) and from the Cat Universal Customer ID (UCID) tools to pre-populate machine, device and ownership data for the provisioning of the VisionLink services plans and for the activation of the services on the VisionLink platform. Once the VisionLink service has been established, the Trimble Store will initiate billing services.

Refer to the below mentioned contact details for any support or additional information from Trimble Account Management:

Email: trimble_support@trimble.com

Call Trimble in the United States using the following phone numbers:

888-801-4363720-457-0189

Configuring Installation Parameters

This section allows the user to configure the parameters required for configuring the PL522/523 system during installation. Refer to "Activating the System" in order to activate the system for further information.

There are a number of parameters that are configured for the PL522/523. There are default values that are loaded, many of which are acceptable in most applications. However, care must be followed in setting these parameters to ensure proper operation and avoid increased messaging costs.

Ver imagen

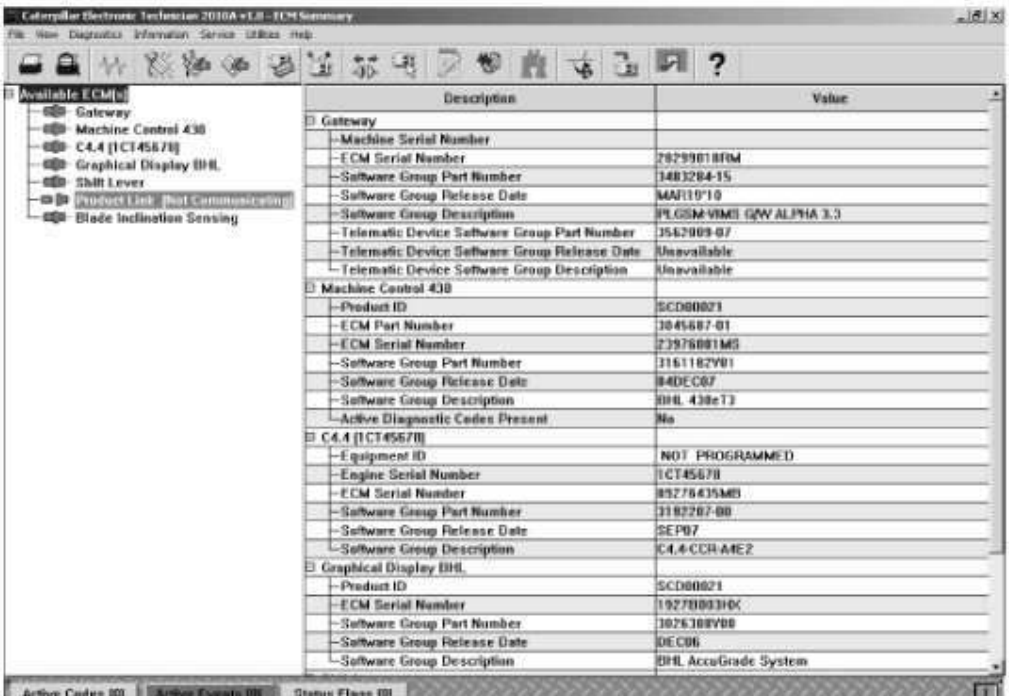


Illustration 44 g02288034

CAT ET configuration screen for Non-Caterpillar machines

Ver imagen

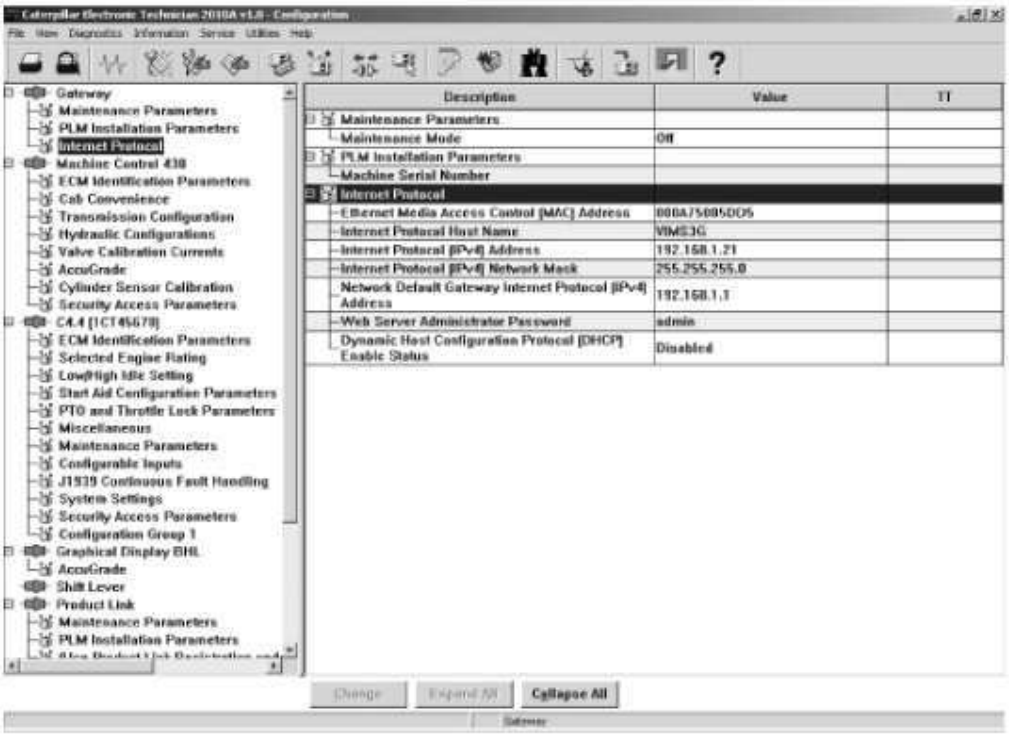


Illustration 45 g02288077

CAT ET configuration screen for-Caterpillar machines

Enter the Product Link Module (PLM) Installation Parameters last to ensure proper registration. Select the configuration screen by selecting the icon on the toolbar or by using the pull down menu as shown in Illustration 44.

There are three ways to access the configure screen:

- Select "Service" then select "Config" on the menu bar.
- Press the "F5" key.
- Select "ECM Configuration Icon" on the toolbar.

1. Ensure that steps have been taken in order to connect the computer with CAT ET software to the PL522/523 system. Refer to "Connecting a Computer to the PL522/523 System".
2. Click the "Connect" icon or click "File" on the menu bar, then click "Connect" from the pull down menu selections to establish communication with PL.
3. After the computer has connected to PL522/523 system, click the "Configuration Tool" icon or select the

"Service – Configuration" menu item to view the Configuration screen.

4. Double click the desired parameter or select the desired parameter and click "Change". A dialog box will appear, along with a scroll-down list, showing all of the possible parameter values.

   Note: The "PLM Installation Parameters" section cannot be changed in the Configuration screen. These parameters must be changed using the "Service - Product Link Registration" option.

5. Click the OK button after changing each parameter in order to return to the Configuration screen.

   Refer to Illustration 44 which shows a non-Caterpillar "DBS Machine Make Code" example.

   Note: For a non-Caterpillar machine, the serial number can be any alpha-numeric characters up to 17 characters long.

Refer to the following for information when entering information for a Caterpillar Machine. When the machine serial number is entered, only the last eight digits are to be entered.

Ver imagen

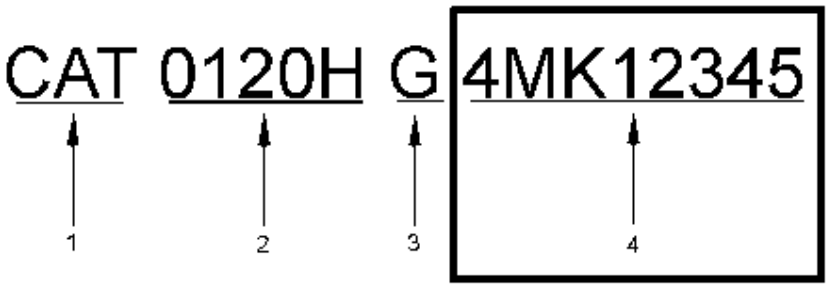


Illustration 46 g02220113

(1) Caterpillar World manufacturing code (characters 1-3)

(2) Machine description (characters 4-8)

(3) Check character (character 9)

(4) Machine Indicator Section (MIS) or Product Sequence Number (characters 10-17). These characters were previously referred to as the Serial Number.

First Quarter 2001, the Caterpillar Product Identification Number (PIN) changed from 8 characters to 17 characters. The Product ID that is required by the PL522/523 System is the last eight digits. Refer to Item 4 in Illustration 46.

Click OK after changing each parameter to return to the Configuration screen.

To configure a value, highlight the value and select "Change" at the lower left corner of the screen. The current value will appear along with a pull-down menu to select the new value.

Table 13

Parameter Table			
Parameter	**Description**	**Configuration**	**Notes**
Machine Serial Number	The Machine Serial Number is used by the PL522/523 system for routing and displaying information by machine.	For a non-Caterpillar machine, enter the machine serial number. For Caterpillar machines, enter the last eight characters of the new 17 character PIN for this value. Refer to Illustration 46.	The maximum length is 17 characters. DO NOT start the serial number with a space. DO NOT abbreviate the serial number. For example, 1AA00123 should not be shortened to 1AA123 DO NOT use uppercase "O" instead of zero "0".

Installation Parameters Configure for PL522/523 system

1. Ensure that steps have been taken in order to connect the computer with CAT ET software to the PL522/523 system. Refer to "Connecting a Computer to the PL522/523 System".
2. Click the "CONNECT" icon or click "File" on the menu bar. Then click "CONNECT" from the pull-down menu selections to establish communication with the PL522/523 system.

Ver imagen

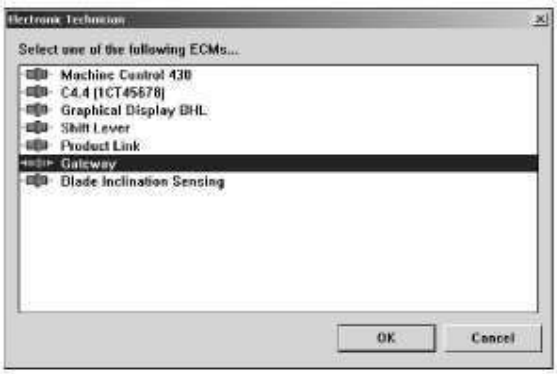


Illustration 47 g02220133

3. Select "GATEWAY" from the "select an ECM" field. Refer to Illustration 47.
4. Click "OK".
5. Once connected, click the "CONFIGURATION TOOL" icon or select the "SERVICE - CONFIGURATION" menu item to view the configuration screen.
6. Highlight "GATEWAY" and then click Expand All.
7. Double click the desired parameter or select the desired parameter and click "CHANGE". A dialog box will appear, along with a list that will show all of the possible parameter values.
8. Click "OK" after changing each parameter to return to the configuration screen. When the machine serial number is entered, only the last eight digits are to be entered. The first nine alphanumeric characters that are part of the Product Identification Number (PIN) are not needed. Only the last eight alphanumeric

part of the Product Identification Number (PIN) are not needed. Only the last eight alphanumeric characters, whether zeros, numbers, or letters are required.

Schematic Index{7566}

SMCS - 7566

Caterpillar Products: All

Introduction

This is a list of Caterpillar sales models, effectivity, and media numbers for all electrical schematics. Items in the list are categorized by product type.

Agricultural Tractors

Table 1

Agricultural Tractors		
Name	**Effectivity**	**Media Number**
Challenger 35, 45, and 55 Agricultural Tractors	8RD, ADK, ABF, 3BK, 6NN, AEN	RENR1782
Challenger 35, 45, and 55 Agricultural Tractors	1DR, 7DM, 8DN	SENR8313
Challenger 65 Agricultural Tractor	7YC1453-UP	SENR4795
Challenger 65 Agricultural Tractor	7YC 1-1452	SENR3350
Challenger 65C and 75C Agricultural Tractors	2ZJ500-UP, 2YL1-UP	SENR5313
Challenger 65C Agricultural Tractor	2ZJ1-UP, 2ZJ1-400	SENR5268
Challenger 65D Agricultural Tractor	2ZJ	SENR8318
Challenger 65E, Challenger 75E, Challenger 85E, Challenger 95E Agricultural Tractors	6GS, 6HS, 6JS, 6KS	SENR1744
Challenger 75 Agricultural Tractor	4CJ1-UP	SENR4971
Challenger 75C Agricultural Tractor	4KK1-499	SENR5269
Challenger 75C and 85C Agricultural Tractors	4KK2230-UP, 9TK1765-UP	SENR8334
Challenger 75C and 85C Agricultural Tractors	4KK,9TK	SENR5316
Challenger 75D and Challenger 85D Agricultural Tractors	4GR, 5AR	SENR9444
TA19 Agricultural Tractors	T2Z1-UP	KENR5278
TA22 Agricultural Tractors	T4W1-UP	KENR5887

Note: CHECK OUT: TA19 Agricultural Tractors, TA22 Agricultural Tractors

Note: CHECK OUT: TA19 Agricultural Tractors, TA22 Agricultural Tractors

Articulated Trucks

Table 2

Articulated Trucks		
Name	**Effectivity**	**Media Number**
D20D and D250D Articulated Trucks	6NG, 9MG	SENR8232
D250B and D300B Articulated Trucks	4SD, 5WD	SENR8185
D250E and D300E Articulated Trucks	5TN, 7FN	SENR8632
D250E and D300E Series II Articulated Trucks	4PS, 5KS	SENR8687
D25D, D30D, D350D Articulated Trucks	1HK, 3AJ, 9RF	SENR8192
D300D Articulated Truck	5MG	SENR8221
D350E and D400E Articulated Trucks	2YR, 9LR	SENR8671
D350E and D400E II Articulated Trucks	2XW, 8PS	SENR9146
D400E II Ejector Truck	APF1-273	RENR5112
D40D, D400D Articulated Trucks	2JJ, 8TF	SENR8208
D44B Articulated Trucks	5ND, 8SD	SENR8186
D550B Articulated Trucks	5ND, 8SD	SENR8187
725 and 730 Articulated Trucks	AGF, AFX	RENR3489
725 and 730 Articulated Trucks	AGF1011-UP, AFX1098-UP	RENR8032
725 and 730 Articulated Trucks	AGF, AFX	RENR2448
725, 730 and 730 Ejector Articulated Trucks	B1W321-UP, B1P622-UP, B1R194-UP	RENR6737
725, 730 and 730 Ejector Articulated Trucks	B1L505-UP, B1M411-UP, B1W185-UP	RENR6736
735, 740 and 740 Ejector Articulated Trucks	B1N1-320,B1P1-621,B1R1-193	RENR6734
725, 730 and 730E Articulated Trucks	B1L1-504, B1M1-410, B1W1-184	RENR6719
725 and 730 Articulated Trucks	AGF1092-UP, AFX1179-UP	RENR8037
735 and 740 Articulated Trucks	AWR625-UP, AXM1377-UP,	RENR8033

	AZZ340-UP	
725 and 730 Articulated Trucks	AGF1011-1091, AFX1098-1178	RENR8032
735 Articulated Truck	AWR1-UP, AYY1-UP	RENR5135
735, 740 and 740 Ejector Articulated Trucks	AWR625-UP, AXM1377-UP, AZZ340-UP	RENR8033
740 Articulated Truck	AXM, AZM	RENR5136

Asphalt Pavers

Table 3

Asphalt Pavers		
Name	**Effectivity**	**Media Number**
Asphalt Paver	A5P1-UP,B4G1-UP	KENR3725
AP-200B Asphalt Paver	2NK	KENR1865
AS351C Screed	JJN1-UP	KENR6660
Caterpillar AP-650B Asphalt Paver and Barber-Green BG-225C Asphalt Paver	5GN, 9DN	KENR3560
AP-650B and BG-225C Asphalt Paver	A7P, B6G	KENR3735
Caterpillar AP-655C and Barber-Green BG-2255C Asphalt Paver	AYP1-UP,B9G1-UP	KENR5021
Caterpillar AP-655C Asphalt Paver	CDG1-UP	KENR5023
AP655D Asphalt Paver	GNN1-UP	KENR6652
AP655D Asphalt Paver	GNZ1-UP, MAT1-UP	KENR5945
AP-800 Asphalt Paver	1BF1-UP	KENR2471
AP-800 Asphalt Paver	1BF1-UP	KEBR1253
AP-800B Asphalt Paver	1BF	KENR1503
AP-800C Asphalt Paver	1PM1-UP	KENR2594
8-16B Screed	BLK1-UP	KENR6655
816B, 1020B AND AS-2301, AS-2251 Asphalt Screed	BWL1-UP, BWN1-UP, AWC1-UP, CWF1-UP	KENR3707
AP-900B Asphalt Paver and Barber-Green BG-240C Asphalt Paver	AGJ1-UP, AGL1-UP	KENR3531

AP-1000 Asphalt Paver	1HD	KENR1848
Caterpillar AP-1000B & Barber-Green BG-260C Asphalt Paver	AGP, BYG	KENR3639
Caterpillar AP-1000D & Barber-Green BG-260D Asphalt Paver	EAD1-UP, BPW1-UP	KENR5068
Caterpillar AP-1000B Asphalt Paver Barber-Green BG-260C Asphalt Paver	7HN, 8GN	KENR3511
AP-1000D AND BG-260D Asphalt Paver	EAD1-UP, BPW1-UP	KENR5068
AP-1050 Asphalt Paver	1JG1-UP	KENR1615
AP-1050B Asphalt Paver	6ZN1-UP	KENR2894
AP-1055B Asphalt Paver	8BM1-UP	KENR2952
AP-1055B Asphalt Paver and Barber-Green BG-2455C Asphalt Paver	ABB1-UP, ACM1-UP	KENR3518
AP-1055B & BG-2455C Asphalt Paver	B2G1-UP, A3P1-UP	KENR3659
AP-1055D & BG-2455D Asphalt Paver	FAC1-UP,A6P1-UP,BNW1-UP,BXW1-UP	KENR5009
AP-1200 Asphalt Paver	2JD	KEBR1254
Asphalt Screeds, Hydraulic, Fuel Burner	1BF, 1JG, 1HD, 2JD, 2LF1-UP, 2MF1-UP, 2NF-UP, 2PF1-UP, 2RF1-UP, 2SF1-UP	KEBR1231
AS-2302 Screed	AYC1-UP	KENR5943
BG-2455C Asphalt Paver	6TN1-UP	KENR2779

Backhoe Loaders

Table 4

Backhoe Loaders		
Name	**Effectivity**	**Media Number**
414E IND Loader and 416E, 422E, 428E Backhoe Loaders	ELB1-UP, SHA1-UP, CBD1-UP, HBE1-1599, SNL1-2199	RENR6449
416B, 426B, 428B, 436B and 438B Backhoe Loaders	3KK, 5YJ, 6KL, 6MJ, 7EJ, 7FL, 8SG, 8ZK	SENR5814

438B Backhoe Loaders		
416B, 426B, 428B, 436B and 438B Backhoe Loaders With European Cab	8SG, 5YJ, 7EJ, 6MJ, 3KK	SENR5813
416C, 426C and 436C Backhoe Loader	4ZN, 1AR, 1KR, 1WR, 6XN, 1CR, 1MR, 1YR, 8TN, 1FR, 1PR, 2AR	SENR1276
416C, 426C, 428C, 436C, 438C Backhoe Loaders	5YN, 1XR, 9JN, 1GR, 2BR, 1RR, 7WN, 1ER, 1NR, 1ZR, 9KN, 1JR, 2DR, 1TR, 8RN, 2CR	RENR3529
416C, 426C, 428C, 436C and 438C Backhoe Loaders With European Cab	5YN, 1BR, 1LR, 1XR, 7WN, 1ER, 1NR, 1ZR, 8RN, 1HR, 1SR, 2CR, 9JN, 1GR, 1RR, 2BR, 9KN, 1JR, 1TR, 2DR	SENR1275
416C, 426C, 428C, 436C, 438C Backhoe Loaders	4ZN, 1AR, 1KR, 1WR, 6XN, 1CR, 1MR, 1YR, 8TN, 1FR, 1PR, 2AR	SENR1212
416C, 426C, 428C, 436C, 438C Backhoe Loaders	5YN, 1XR, 4RN, 2CR, 2BR, 9JN, 1GR, 1RR, 9KN, 2DR, 1JR, 1TR, 7WN, 1ER, 1NR, 1ZR	RENR2854
416C-426C and Backhoe 436C Loaders	4ZN16044-UP, 1FR1416-UP, 1WR8117-UP, 1YR1517-UP, 6XN3616-UP, 1MR956-UP, 8TN925-UP, 2AR1604-UP, 1PR1599-UP, 1CR864-UP	RENR2855
416C, 426C, 428C, 436C, 438C Backhoe Loaders With European Cab	5YN, 1BR, 1LR, 1XR, 7WN, 1ER, 1NR, 1ZR, ARN, 1HR, 1SR, 2CR, 9JN, 1GR, 1RR, 2BR, 9KN, 1JR, 1TR, 1DR	SENR1211
416, 426, 436 Backhoe Loaders	5PC, 7BC, 5KF	SENR3165
416, 426, 436 Backhoe Loaders	5KF1000-UP, 5PC12000-UP, 7BC4000-UP	SENR4783
416, 426, 428, 436, and 438 Backhoe Loader	5PC, 6TC, 3DJ, 7BC, 5KF	SENR5818
416, 426, 428, 436, and 438 Backhoe Loader	3DJ, 5KF, 5PC, 6TC, 7BC	SENR5811
416D, 420D, 424D, 428D, 430D, 432D, 438D, and 442D Backhoe Loaders	BKG, BGJ, BFP, BNK, BML, BKC, BMC, BLN, FDP, BLD, BGP, BKR, BPE, BPN	RENR3587
416D, 420D, 424D, 428D, 430D, 432D, 438D, and 442D Backhoe Loaders	BKG, BGJ, BFP, BKC, BMC, BLN, FDP, BKR, BGP, BNB, BLL, BNS, BMT, BNK, BMI, BLD, BPE, BPN, BRG, BRY	RENR5887
420DV Backhoe Loaders	MBH1-UP	RENR9835
420E, 430E, 432E, 434E, 442E, 444E Backhoe Loaders	KMW1-UP, HLS1-UP, DDT1-UP, EAT1-UP, FSH1-UP, GKZ1-UP, LBE1-UP, BXE1-UP	RENR6481

428, 438 Backhoe Loader	3DJ1000-UP, 6TC8000-UP	SENR4798
428, 438 Backhoe Loader	6TC7999, 3DJ999	SENR3924
428D and 438D Backhoe Loaders	BLL1-UP, BPE1-UP, BMT1-UP, BPN1-UP, BNB1-UP, BNS1-UP	RENR3568
446 Backhoe Loader	5BL, 6XF	SENR3979
446B Backhoe Loader	5BL1500-2499	SENR5852
446B Backhoe Loader	5BL727-1499	SENR1243
446B Backhoe Loader	5BL1-726	SENR5821
446B Backhoe Loader	5BL	RENR2870
Backhoe Loader	FDP, BLN10300-UP	RENR7781

Engines

Table 5

Engines		
Name	**Effectivity**	**Media Number**
797 Truck Front Engine Control	5YW	RENR2689
797 Truck Rear Engine Control	5YW	RENR2690
797 Master Engine Control	5YW	RENR2691
994 STIC Retrofit For EMS	9YF28-UP	RENR6040
3100 HEUI Diesel Truck Engine	1WM, 2CW, 4ES, 7LZ, 8HW, 8WL	SENR6567
3054 and 3056 Marine Generator Sets	CHN1-UP, TCN1-UP, SNX1-UP	RENR2408
3054E Industrial Engine	3041-UP	RENR7570
3056E Industrial Engine	3561-UP	RENR2425

3126 Truck Engine	1BW1-UP	SENR9628
3126 HEUI Industrial Engines	3TR	SENR1162
3126B Truck Engine	7AS, 8SZ, 8YL, 1AJ, BKD, 9SZ, CRP, CKM	RENR1368
3126B Marine Engine	3GS, 9ZF	RENR2242
3126B Truck Engine FMTV Military Truck	6PZ, 7JZ	SENR9525
3126B Engine for Class Combine Applications	BEJ, DCS	SENR9577
3126B Industrial Engine	BEJ1-UP, DCS1-UP	SENR9590
3126B Industrial Engine	BEJ160-UP, DCS1-UP	KENR6698
3126B Industrial Engine	Z2A	RENR8063
3126B and 3126E Truck Engines	BKD1-UP, 1AJ1-UP, 8YL1-UP, CKM1-UP, CRP1-UP, 7AS1-UP, 8SZ1-UP, 9SZ1-UP	RPNR1368
3126B and 3126E Truck Engines	BKD1-UP, 1AJ1-UP, 8YL1-UP, CKM1-UP, CRP1-UP, 7AS1-UP, 8SZ1-UP, 9SZ1-UP	RSNR1368
3126E Truck Engine	LEF1-UP	RENR7898
3126E Truck Engine	HEP1-UP	SENR9638
3176 Diesel Truck Engine	2YG	SENR3912
3176 Diesel Truck Engine	2YG1-3453	SENR5194
3176 Diesel Truck Engine	7LG	SENR5111
3176B, C-10, C-12 and 3406E Truck Engines	5EK1-UP, 9CK1-UP, 1YN1-UP, 2PN1-UP, 6TS1-UP	SENR5574
3176B Engine For Caterpillar Built	2YL, 2ZJ, 4KK, 9TK	SENR6453

Machines		
3176B Marine Engine	9WK, 1DW, 2AW	SENR6491
3176B Industrial Engine	3NL	SENR6498
3176C and 3196 Engines For Caterpillar Built Machines	2ZJ, 4GR, 5AR	RENR1241
3176C and 3196 Engines For Caterpillar Built Machines	6GS, 6HS, 6JS, 6KS	RENR1378
3176C, 3196, 3406E and 3456 Industrial Engines	6BR1-UP, 1DW1-UP, 2AW1-UP, 3LW1-UP	SENR1072
3176C and 3196 Marine Engines	2XR, 6BW	SENR1171
3406,3406C & 3456 Generator Set with EMCP II	C8G1, C2G1, C5G1, C1G1, C3G1, C4G1, C2T1, L5A1, L6B1, L7A1	RENR7916
3406B (PEEC III) Truck Engine	4CK	SENR5152
3406B (PEEC) Diesel Truck Engine	2EK, 5YG, 8TC	SENR3486
3406C Marine Generator Set	PFH1-UP, 1SS1-UP, 8LF1-UP, 9FF1-UP	RENR7919
3406C Electronic Diesel Truck Engine	4CK	SENR5509
3406C MCS Marine Auxiliary Generator Set Engine	PFH	RENR9868
3406C & 3456 Generator Set with EMCP II +	NULL	RENR8077
3406E and 3456 Engine Generator Sets	1MZZ1-UP, 3PG1-UP	RENR2311
3406E Marine		SENR1193

Engine	3LW, 6BR, 9WR	
3408E Industrial Engine	7PR	RENR8132
3408 and 3412 High Performance Marine Engines	3JK1-171, 8RG1-115	SENR5518
3408 and 3412 High Performance Marine Engines	3JK172-UP, 8RG116-UP	SENR6448
3408 and 3412 Industrial Engines	9XF, 9XM	SENR6583
3408C and 3412C Marine Gen Sets	TAM1-UP, 6DA1-UP, RLR1-UP, 9FG1-UP, 9BR1-UP, 4SJ1-UP, 1TS1-UP, 5NJ1-UP, 6EJ1-UP	RENR7926
3408E and 3412E Industrial Engines	4CR1-UP, 7PR1-UP, BDT1-UP, BFT1-UP	SENR1064
3408E and 3412E Engines	2KZ, 7BR, 7FR, 2ZR, 4FR, 6KR, 7ER, 5SS, 6YS, 7CS, 8AS, 3KR, 5TR, 6JR, 7KK, 1AB, 1BB, 1NB, 6PC, 1EB, 2PS, 1FB, 1HB, 7CB, 4YR, 5XR, 5YR, 6PR, 6TR, 7KR	SENR1026
3412 Generator Set Engine	2WJ	SENR6478
3412 Industrial Engines	9XF, 9XM	SENR4657
3412C EMCP II for MUI Engines	PTL1-UP, 9EP1-UP, BCW1-UP, 4BZ1-UP	RENR2301
3412C EMCP II for PEEC Engines	PTL1, 9EP1, BCW1, 4BZ1	RENR2342
3412C EMCP II+ for MUI Engines	PTL1, 9EP1, BCW1, 4BZ1	RENR2343
3412C EMCP II+ for PEEC Engines	PTL, 9EP, BCW, 4BZ	RENR2344
3412C MCS Marine Auxiliary Generator Set Engine	RLR	RENR9869
3412E Marine Engine	9KS, 9PW	SENR5030
3456 Generator Set with EMCP II	CCB1-UP, CAH1-UP, CBX1-UP, 8AZ1-UP	RENR2477
3456 Generator Set with EMCP II +	CCB1-UP, CAH1-UP, CBX1-UP, 8AZ1-UP	RENR2478

3456 Generator Set with EMCP II +	CCB931-UP, CBX587-UP	RENR8110
3500 Natural Gas Engines	3RC, 4KC	SENR3468
3500 Natural Gas Engines	3RC, 4KC	SENR3469
3500 Engine For EPG With EMPC	4GM, 5XM, 6PM, 7KM, 8RM175-UP, 6HM138-UP, 6PN249-UP, 6WN114-UP, 7RN428-UP, 3LS, 3MS, 3NS, 1NW, 2HW, 2JW, 4AW, 5AW	RENR1242
3500 Engines for Generator Sets	CMD, CAL	RENR4964
3500 Engine	ZAB, ZAF, ZAL	RENR7884
3500B Engine For Marine Propulsion	2BM123-UP, 7HM173-UP, 7SM77-UP, 4TN96-UP, 8CN144-UP, 8KN143-UP, 3PS1-UP, 3RS1-UP, 3SS1-UP, 1TW1-UP, 2GW1-UP, 3CW1-UP	RENR1297
3500B Industrial Engine	BPX1, CAN1	RENR4922
3500B Engine For Power Module	1FZ1-UP, BLM1-UP, 1GZ1-UP, BNR1-UP, 1HZ1-UP, BPD1-UP	RENR4930
3500B Engine For Power Generation (EPG) With Electronic Modular Control Panel (EMCP)	4GM1-170, 8RM1-174, 6HN1-137, 6PN1-248, 6WN1-113, 7RN1-427	SENR1004
3500B Engine For Power Generation (EPG) With Switchgear Conversion	4GM, 5XM, 6PM, 7KM, 8RM, 6HN, 6PN, 6WN, 7RN, 3LS, 3MS, 3NS, 1NW, 2HW, 2JW, 4AW, 5AW	RENR1243
3500B Engine For Power Generation (EPG) With Switchgear Conversion	4GM, 8RM, 6HN, 6PN, 6WN, 7RN	SENR1005
3500B Locomotive Engine	PWG1-UP, BCK1-UP, 5PS1-UP, 3ZW1-UP, 6HZ1-UP	RENR2457
3500B Engine For Marine Auxiliary Power	3DM, 8EM, 9AN, 3TS, 3WS, 3XS, 1PW, 2FW, 3DW	RENR1245

3500B Engine For Marine Auxiliary Power	3DM1-85, 8EM1-248, 9AN1-110	SENR1010
3500B Engine For Marine Propulsion	2BM117-122, 4TN79-95, 7HM172, 7SM54-76, 8CN142 and 143, 8KN109-142	RENR1244
3500B Engine For Marine Propulsion	2BM123-UP, 7HM173-UP, 7SM77-UP, 4TN96-UP, 8CN144-UP, 8KN143-UP, 3PS1-UP, 3RS1-UP, 3SS1-UP, 1TW1-UP, 2GW1-UP, 3CW1-UP	RENR1297
3500B Series II Engine For Marine Auxiliary	S2A1-UP, S2R1-UP, S2B1-UP, S2G1-UP, S2H1-UP, S2P1-UP	RENR4988
3500B Engine For Marine Propulsion	2BM1-116, 4TN1-78, 7HM1-171, 7SM1-53, 8CN1-141, 8KN1-108	SENR1009
3500B Engine with Premium Wiring Harness for Marine Propulsion	2BM, 7SM, 3PS, 1TW	RENR2250
3500B and 3500B High Displacement Generator Sets	CPA1-UP, BMB1-UP, CNB1-UP, CMC1-UP, PTC1-UP, BLF1-UP, PTF1-UP, BPJ1-UP, PTJ1-UP, BRK1-UP, PTM1-UP, FDN1-UP, PTN1-UP, BGX1-UP	RENR4955
3500B Series II Engine For Marine Propulsion	S2D1-UP, S3E1-UP, S2T1-UP, S3E1-UP, S2F1-UP, S2X1-UP, S2J1-UP, S2K1-UP, S2Y1-UP, S2L1-UP, S2M1-UP, S2N1-UP, S2S1-UP	RENR5010
3500B Series II Engine For Marine Auxiliary	S2A1-115,S2B1-165,S2G1-100,S2H1-140,S2P1-105,S2R1-142	KENR5951
3500B Engine For Electric Power Generator	LLA, CBB350, LLC, LLE, LLF, PTF157, PTJ110, LEK125, PTM435, PTN162, RMS	RENR7678
3500B Industrial Engine	BPX115, BRC164, CAN 121	RENR9871
3500B AND 3500B High Displacement Engine	CPA192-UP, BMB132-UP, CNB1189-UP, CMC1241-UP, BLF166-UP	RENR9845
3500B AND 3500B High Displacement Engine	CPA192-UP, BMB132-UP, CNB1189-UP, CMC1241-UP, BLF166-UP	RENR7885
3500B AND 3500B High Displacement Generator Sets	SYSTEM	RENR8100
3500B Generator	ZAB, ZAF, ZAL	RENR9844

3500B Generator	LAB, LAF, LAK	
3500B AND 3500C Locomotive Engine	PWG159, 5PS344, 3ZW672, T2X, 6HZ101	RENR9872
3500B/3500C Series II Engine for Marine Auxiliary and Petro	S2A128-UP,S2B269-UP,LLB1-UP,S2G107-UP,S2H208-UP,S2P108-UP	RENR8060
3500C Series II Engine	TTA, TTB, TTC, TTD, TTE, TTF, TTG, TTH, TTJ	KENR5406
3508B Engine with Premium Wiring Harness for Marine Auxiliary	3DM, 3TS, 3DW	RENR2252
3508B Industrial Engine	CBB1-UP	RENR4932
3512 Industrial Engine	1LM	SENR6499
3512B Oil Well Servicing Engine	2AF463	RENR9870
3512B and 3516B Engines with Premium Wiring Harness for Marine Propulsion	7HM, 4TN, 8CN, 8KN, 3RS, 3SS, 2GW, 3CW, 4BW, 2EZ	RENR2251
3512B Engine for Caterpillar Built SPF343 Pumper	6RZ	RENR4910
3512B and 3516B Engines with Premium Wiring Harness for Marine Auxiliary	8EM, 9AN, 3WS, 3XS, 1PW, 2FW	RENR2253
3512B Marine Auxiliary Engine	AAG	RENR4931
3512B Marine Auxiliary Engine	FFG1-UP	RENR4983
3512B Oil Well Servicing Engine	2AF	SENR5080
3512B Marine Auxiliary Engine	4DR	SENR5091

3512C Engine for CAT Built SPF343C Trailer Mounted Pumper	RTX	RENR9843
3512C Well Fracturing Engine	R1A	RENR9372
3600 Diesel Marine Monitoring	JSM1-UP	RENR2458
3606, 3608, 3612, 3616 Diesel Marine Monitoring System II Generator Monitoring System	8RB00806-UP, 6MC00624-UP, 9RC00330-UP, 1PD00375-UP, 1FN00150-UP, 9FR0021-UP, 2NZ00176-UP	RENR2459
3608 Engine	1ZD1-UP	RENR5968
G3306 Generator Set	JCA1-UP, CNR1-UP, CTT1-UP	RENR5936
G3304 and G3306 Engines	N4F1-UP, G6X1-UP, 07Y1-UP, 37Y1-UP	RENR5962
G3306 Truck Engine	4DL	SENR1088
G3406 & G3412 Generator Set	R7A102-UP, R7E103-UP, KAP232-UP, KAR280-UP	RENR8112
G3406 and G3412 Generator Sets	R7A1-UP, KAP1-UP, R7E1-UP, KAR1-UP, CTP1-UP, CTS1-UP	RENR5956
G3408C and G3412C Industrial and Gen Sets EIS	6ZM1-UP, 9RR1-UP, 3WR1-UP, 8YR1-UP, 8LW1-UP, 6FW1-UP, BAZ1-UP	RENR5900
G3408C and G3412C Industrial and Gen Sets EIS	6ZM1-UP, 9RR1-UP, 3WR1-UP, 8YR1-UP, 8LW1-UP, 6FW1-UP, BAZ1-UP	RENR5902
G3500 Engines	4EK1-410, 4WD1-UP, 5JD1-19, 7NJ1-81, 8LD1-27, 9TG1-33	SENR6438
G3500 Engines	4EK411-UP, 5JD20-UP, 7NJ82-UP, 8LD28-UP, 9TG34-UP	SENR1186
G3500 Engine	5JD20-UP, 8LD28-UP, 9TG34-UP, 2TJ1-UP, 7NJ82-UP, 4EK411-UP	RENR5924
G3500 Generator Set with EMCPII+	CPG1-UP, CPJ1-UP, CRN1-UP, CSP1-UP, CPS1-UP, CPY1-UP, CSZ1-UP, CTL1-UP, CTM1-UP, CTN1-UP	RENR5926

G3500 Generator Set with EMCPII+	NULL	RENR8104
G3500C AND G3500E Generator Set with Wall Mounted EMCPII+	GSB, TJB, TJC, MAD, TJD, GZG, GZH, GZJ, GZK, GZL, HAL, GZM, GZN, B9P201, GAS	RENR8103
G3508 A3 Engine	WPM, WPN, DLR	RENR8118
G3512 A3 Engine	WPP, WPR, GNS	KENR6310
G3512 A3 Engine	WPT1500, WPW1500	KENR8232
G3512 A3 Engine	WPP1500, WPR1500	KENR8233
G3516 A3 Engine	WPS, WPT, WPW	KENR6311
G3516B Generator Set	SCS1-UP	RENR5946
G3516B Engine	CFD1-UP, CSC1-UP, CME1-UP, CTW1-UP, CEY1-UP, 7EZ1-UP	RENR2460
G3516B Generator Set	ZBB, CSC290-UP, ZBC, CME284-UP	RENR8101
G3516C & G3516E Engines	RWA, GSB, GHG, GHP, DKR, GAS, GZZ	RENR5982
G3520B Engine	BGW1-UP, CTK1-UP, CWD1-UP	RENR2258
G3520B Generator	CWD1-UP	RENR7899
G3520B Generator	CWD212-UP	RENR8102
G3520B Industrial Engine	GET1-UP	RENR8040
G3520C Generator Set Engine with Auxiliary Sensing Module ATIC	GZM, GZN, RLP, CWW, CWY	KENR6331
G3520C Generator	CWW1-UP, CWY1-UP, B9P1-UP	RENR5981

	CWW1-UP, CWY1-UP, B9F1-UP	
G3520C Generator	GDB1-UP, GHC1-UP, GHE1-UP	RENR5955
G3606 Engine	4ZS1-UP	RENR5966
G3606 and G3608 Engines	3XF304-UP, 4WF183-UP	RENR7877
G3606 and G3608 Engines	3XF114-UP, 4WF68-UP	SENR5083
G3608 Engine	BEN1-UP	RENR5967
G3612 Engine	BKE1-UP	RENR5911
G3612 and G3616 Engines	1YG221-UP, 4CG209-UP	RENR7876
G3612 and G3616 Engines	1YG124-220, 4CG83-208	SENR5082
G3616 Engine	BLB1-UP	RENR5912
G3406 and G3412 Generator Sets	R7A1-UP, KAP1-UP, R7E1-UP, KAR1-UP, CTP1-UP, CTS1-UP	RENR5956
C1.5 AND C2.2 Generator	NCA, NCB, XYE	RENR9560
C2.2 Marine Generator Set	TAG1-UP	RENR2449
C3.3 AND C4.4 Generator Sets	N3C, NCC, N4D, NCD, N4E, NCE	RENR9561
C4.4 Industrial Engine	444	RENR9964
C4.4 Marine Generator Set (NON MCS)	L1K, S1M	RENR7695
C4.4 Marine Generator Set	(MMC1-UP)	RENR9842
C4.4 Marine Auxiliary Generator Set	S1M, L1K	RENR8052
C6.6 Industrial Engine	666	RENR9554

Engine		
C6.6 Generator Set	SDA, E6M	KENR5970
C-7 On-Highway Engine	KAL1-UP	RENR7691
C7 On-Highway Engine	NPH1-UP, LBM1-UP, SAP3956-UP, WAX1-UP	RENR7913
C7 Marine Engine	C7D, C7Z	RENR9841
C-7 On-Highway Engine	C7S1-200	KENR6278
C7 Industrial Engine	JRA, JTF	RENR7933
C7 On-Highway Engine FMTV A1 CR	FML,FMM	RENR7869
C7 On-Highway Engine	YPG, C7T	RENR7872
C7 Marine Engine	C7B, C7X	RENR8039
C-9 Urban Transit Bus Engine	MTB1-UP	RENR7560
C-9 Marine Engine	C9A1-UP	RENR8119
C-9 Marine Engine	CSN1-UP	SENR9665
C-9 Engine for Class Combine Applications	CLJ	SENR9578
C-9 Industrial Engine	CLJ1-UP	SENR9592
C-9 Truck Engine	9DG1-UP	SENR9516
C9 On-Highway Truck Engine	C9S228	KENR8241
C9 On-Highway Engine	9DG6040-UP, ETK1-UP	KENR8237
C9 On-Highway Truck Engine	C9S1-UP	RENR8054

C9 Marine Engine	X9X,Z9X	RENR9522
C9 Industrial Engine	JSC,MBD	RENR7948
C9 Marine Generator Set	SJB1-UP	RENR7947
C9 Generator Set with EMCP 3	C9E, NSE	RENR7879
C-10, C-12 and 3406E Truck Engines	1LW, 5DS, 8YS, 9NS	RENR1327
C-10, C-12 and 3406E Truck Engines	1MM1-UP, 3CS1-UP, 2KS1-UP, 2WS1-UP, 6NZ1-UP, 7CZ1-UP, CPD1-UP, EGH1-UP	RENR2237
C-12 Marine Engine	9HP1-UP	SENR9645
C-10 and C-12 Truck Engines	MBJ1-UP, MBL1-UP	SENR9667
C-12 Truck Engine	9SM	SENR9535
C-12 Engine for CLASS Combine Applications	BDL	SENR9583
C-10, C-12, C-15, and C-16 Industrial Engines	BEM1-UP, BFM1-UP, BCX1-UP, BDL1-UP	SENR9575
C11 and C13 On-Highway Engines	KCA1-UP, KCB1-UP	SENR9705
C11 & C13 Industrial Engine	LGK1-UP,GLS1-UP	RENR8045
C13 On-Highway Engine	LEE841-UP, S3C1-UP	KENR6689
C13 On-Highway Engine	LEE (ONLY AVAILABLE ELECTRONICALLY)	RENR8081
C-15 Truck Engine	MBN1-UP	SENR9690
C-15 On-Highway Engine	BXS1-UP	SENR9697

C15 On-Highway Engine	SDP1-822	KENR5895
C15 On-Highway Engine	SDP823, B5R	KENR5938
C15 On-Highway Truck Engine	MHP	RENR9873
C15 On-Highway Engine ATIC	MXS, NXS	RENR9523
C15 Generator Set with EMCP3	FSE, FFH	KENR5075
C15 & C18 Industrial Engines	JRE, WJH	RENR8046
C-16 and C-18 Truck Engines	W1A1-UP, MDP1-UP, MEP1-UP	RENR7943
C18 Marine Engine	CKH1-UP, C1J1-UP	RENR2383
C18 Marine Auxiliary Engine	KJT	KENR6336
C18 Marine Engine	J2K	KENR6335
C18 Marine Generator Set Engine	MGS	RENR8070
C18 Marine Engine	CYN	RENR7937
C18 Marine Generator Set ATIC	MGS	KENR8225
C18 Generator Set with EMCP3	DKE, EKW, EST	RENR9874
C18 Marine Generator Set	MGS	RENR9852
C18 Generator Set with EMCPII and EMCPII +	STH, PDH	RENR7934
C27 Generator Set	DWB	RENR7952
C27 AND C32 Industrial Engine	P2C, TWM, TLD, SMB	KENR5072

and C32 Petroleum Engine	B2C, TWM, TLD, SMP	
C30 Marine Engine	CLX1-UP	SENR9657
C32 Marine Engine	RND, RNE	KENR5897
C32 Petroleum Engine	SMP	RENR7856
C32 Marine Engine	RNC	RENR7914
C32 HEUI Marine Propulsion Engine	RXB	RENR8038
C32 Generator Set	SXC1-UP	RENR9855
C280-6 AND C280-8 Marine Auxiliary Engine	LDL, NDT, PKA,SCB	KENR6308
C280-6/C280-8 Marine Propulsion Engine	LDL1-UP,NDT1-UP, PKA1-UP, SCB1-UP	RENR5086
C280-12/C280-16 Marine Propulsion Engine	NKB1-UP,TSJ1-UP, RDW1-UP, TDX1-UP	RENR5087
CX31 On-Highway Engine	(B3X1-UP)OEM SOULUTIONS	KENR5109
CPT372 Truck Mounted Pumper	1WZ408-UP	SENR9608
CPT372 and CPS361 Pumper, Cement	1WZ, 9KS	SENR5176
CTS and CTSD Automatic Transfer Switch (ATS)	TSA1-UP, TSB1-UP	RENR5852
CTG and CTGD Automatic Transfer Switch (ATS)	TSG1-UP, TSH1-UP	RENR5853
SCT673 Truck Mounted Pumper	4TZ216-UP	RENR4968
SPP101 Skid Mounted Pump	9ZR1-UP, 7151-UP	RENR7586

SPS343 Skid Mounted Pumper	8ZZ	RENR4900
SPS342 Skid Mounted Pumper	2LZ219-UP	RENR4901
SPT342 Truck Mounted Pumper	3CZ419-UP	RENR4902
SPT343 Truck Mounteed Pumper	5XZ1-UP	RENR4973
SBF214 Skid Mounted Power Pack	CSB	RENR4966
SUF557 Skid Mounted Power Pack	LTF	RENR4967
SR4B Generator with EMCP II	ETH	RENR8065
SCR System for Stationary Engines	NULL	KENR5892
XQ230/XQ300 Generator Set	X3R1-UP	RENR8055
Marine Multi-Station Control	3GS1-UP, RXB1-UP, CSN1-UP, CKH1-UP, 9KS1-UP, 9ZF1-UP, CYN1-UP, 9HP1-UP, 9PW1-UP, 1ZJ1-UP, 9HP1-UP, 2XR1-UP, CLX1-UP, C1J1-UP, 9WR1-UP, C9B1-UP, 6MK1-UP	RENR7893
Marine Multi-Station Control	9ZF1-UP, 3GS1-UP, RXB1-UP, CYN1-UP, CKH1-UP, 9KS1-UP, 1ZJ1-UP, 9HP1-UP, 9PW1-UP, C1J1-UP, 2XR1-UP, CLX1-UP, 6MK1-UP, 9WR1-UP, C9B1-UP, CSN1-UP	RENR7929
PM3500 Low Voltage Power Module Enclosure	BLD1-UP, BLM1-UP, BNR1-UP	RENR5000
PM3500 Medium Voltage Power Module Enclosure	BPD1-UP, BLM1-UP, BNR1-UP	RENR5001
PM3500 Low Voltage Power Module Switch Gear	BPD1-UP, BLM1-UP, BNR1-UP	RENR5002
PM3500 Medium Voltage Power Module Switch Gear	BPD1-UP, BLM1-UP, BNR1-UP	RENR5003

Module Switch Gear		
PM3500 Medium Voltage Power Module Switch Gear	BPD1082-UP,BLM243-UP,BNR314-UP	RENR8106
PM3500 Low Voltage Power Module Switch Gear	BPD1082-UP, BLM244-UP, BNR315-UP	RENR8105
PM3516 Low Voltage Power Module Switch Gear	CFD1-UP	RENR5856
PM3516 Medium Voltage Power Module Switch Gear	CFD1-UP	RENR5857
PMG3516 Medium Voltage Power Module Switch Gear	CFD1-UP	RENR5957
PMG3516 Medium Voltage Power Module Encolsure	CFD1-UP	RENR5958
PP3516 Power Package Enclosure	PPS1-UP	RENR4982
UPS120 & UPS150 Uninterruptible Power Supply (UPS)	CPC, CNK	RENR9552
Uninterruptible Power Supply (UPS) 250	BEE1-UP	RENR2475
UPS250 - UPS900	CSE1-124, CPZ1-319, CNM1-234, CRY1-329, CPM1-159, CTX1-244	RENR5864
UPS 250 and UPS 300	CNJ1-294, APZ1-269	RENR5884
UPS 1000 AND UPS 1200 Uninterruptible Power Supply (UPS)	CZS, CZT	RENR8029

ES12F Flywheel Cabinet UPS1000S and UPS1200S Uninterruptible Power Supply (UPS)	NULL	RENR8028

Excavators

Table 6

Excavators		
Name	**Effectivity**	**Media Number**
205 and 211 Track-Type Excavators	3HC137-UP, 4DC241-UP, 4EC135-UP, 5CC193-UP	SENR3614
205 and 211 Track-Type Excavators	3HC1-136, 4DC1-240, 4EC1-134, 5CC1-192	SENR3615
205B Excavator	5ZF	SENR4320
206 and 212 Wheel-Type Excavators	3GC, 2RC, 5DC, 3JC	SENR3612
206 and 212 Wheel-Type Excavators	3GC, 2RC, 5DC, 3JC	SENR3613
206B and 212B Excavators	3PJ, 9BF	SENR4323
211B LC Excavator	6XG	SENR4347
213 Track-Type Excavator	3ZC1-UP	SENR3641
213 Track-Type Excavator	9XB1-UP	SENR3642
213B Excavator	1EJ	SENR3791
214 and 224 Wheel-Type Excavators	1KB, 5TC	SENR3639
214 and 224 Wheel-Type Excavators	2JC1-UP, 9MB1-UP	SENR3640
214B, 214B FT and 224B Excavators	4CF1-UP, 7WF1-UP, 9MF1-UP	SENR3792

215 Excavator	14Z, 57Y	SENR2489
215B Excavator	2XC, 9YB, 4JC, 4FC	SENR3044
215C and 219 Excavator	4HG,5CF	SENR3578
215D and 219D Excavator	9TF, 5XG	SENR4282
225 Excavator	76U1200-2728	SENR7879
225 Excavator Belgium Models	76U2729-4519	SENR2349
225 Excavator	51U5268-UP, 61X411-UP	SENR4033
225 Excavator	76U4520-UP	SENR4058
225 Excavator	51U4399-5267, 61X398-410	SENR2348
225 Excavator	51U2043-4398, 61X1-397	SENR7823
225B and 229 Excavators	2ZD, 1GF	SENR3874
225B and 229 Excavators	1AG, 3YD,	SENR3916
225D and 229D Excavator	2LJ, 6RG	SENR4288
225D and 231D Excavators	1NK, 2SJ	SENR4272
235 Excavator and Front Shovel	32K3578-UP, 64R1763-UP, 81X501-UP, 83X596-UP	SENR4031
235 Excavator and Front Shovel	32K1-2678, 64R1-1762, 81X1-403, 83X1-595	SENR7744
235 Excavator and Front Shovel	32K2679, 81X404	SENR2116
235B Excavator and Front Shovel	7WC, 9PC, 1FD, 4ED	SENR3277
235C Excavator and Front Shovel	5AF, 2PG, 3WG, 4DG	SENR3838

235D Excavator and Front Shovel	8KJ, 8TJ	SENR5428
245 Excavator and Front Shovel	84X497-786, 94L397-625	SENR7895
245 Excavator and Front Shovel	82X621-UP, 95V1096-UP	SENR4030
245 Excavator and Front Shovel	84X787-UP, 94L626-UP	SENR4032
245 Excavator and Front Shovel	82X474-620, 95V730-1095	SENR7882
245 Excavator and Front Shovel	84X1-496, 94L1-396	SENR7880
245 Excavator and Front Shovel	82X1-473, 95V471-729	SENR7827
245B Excavator and Front Shovel	1SJ	SENR3936
245B Excavator and Front Shovel	6MF1-UP	SENR3899
245D Excavator and Front Shovel	7ZJ	SENR5424
245D Excavator and Front Shovel	4LK	SENR5429
301.5 Excavator	3YW1-UP	SENR1279
301.5,301.6 AND 301.8 Mini Hydraulic Excavator	BFA2982-UP, BDH1031-UP, 3YW4241-UP	RENR8134
301.5,301.6,301.8 Mini Hydraulic Excavator	BFA1179-2981, BDH596-1030, 3YW2817-4240	RENR8137
301.6C,301.8C,302.5C Mini Excavator	JBB1-UP, JSB1-UP, GBB1-UP	RENR9158
302.5 Mini Hydraulic Excavator	4AZ	RENR2849
302.5 Mini Hydraulic Excavator	4AZ5769-UP	RENR8136
303 Excavator	DMA1-UP, CAR1-UP	RENR5576
303C CR Mini Hydraulic Excavator	BXT	RENR9618

303.5 CCR Mini Hydraulic Excavator	DMY	RENR9628
303.5 and 304.5 Mini Hydraulic Excavator	DCH1-UP, AFW1-UP, WAK1-UP, ANR1-UP	RENR3539
304 CR Mini Hydraulic Excavator	NAD1-UP	RENR6626
304C CR Mini Excavator	FPK1-UP	RENR9638
305 CR Mini Hydraulic Excavator	BMW1-UP, DGT1-UP, DSA1-UP	RENR5549
305C CR Mini Excavator	HWJ1-UP	RENR9648
305.5 Mini Hydraulic Excavator	DCK1-UP CXZ1-UP	RENR9438
307 Excavator	2PM1-256	SENR6193
307 Excavator	2WM500-UP	SENR9310
307 Excavator	2PM	SENR9209
307 Excavator	2PM1-256	SENR6193
307 Excavator	2WM	SENR6219
307B Excavators	5CW1-UP	RENR1092
307B Swing Boom Excavator	6KZ, 7DZ	RENR3132
307C Excavator	BCM, BAJ, BNE, BMF	RENR4044
308C CR Excavator	KCX1-UP	RENR5849
308C CR (AKASHI)	KCX282-UP	RENR5559
311 and 312 Excavators	9LJ262-UP, 6GK393-UP	SENR6236
311 and 312 Excavators	9LJ, 6GK	SENR6129

311C U Excavator	CKE1-1000, CLK1-1000	RENR5537
311C U Excavator	CKE1001-UP, CLK1001-UP	RENR6614
311C U Excavator	CKE, CLK	RENR6637
311B and 312B L Excavator	2LS, 2MS, 2NS, 3ES, 3FS, 8GR, 8JR, 9GR, 9HR, 9MR	SENR9236
312 Excavator	6BL	SENR6127
312C Excavator	BNN1-UP, CBT1-UP	RENR5836
312C Excavator	CBA1646-UP, FDS333-UP	RENR8074
312 and 317 Excavators - Attachment Quick Coupler	6BL, 4MM, 9SR	RENR3276
312 Excavator	6BL1-UP	SENR6237
312B Excavator	2KW, 6SW, 9FS, 9NW	RENR1115
312C Excavator	CAE, CBA, FDS	RENR5515
312C Excavator	BWH1-UP, DBN1-UP	RENR7681
313B Excavator	BAS, AEX	RENR4004
314 Excavator	KJA1-UP, PCA1-UP	RENR6615
315 and 315 L Excavator	4YM, 6YM	SENR6183
315 and 315B L Excavators	1SW, 3AW, 2DW	RENR1132
315, 317 L and 325 LN Excavators	3ZM, 4MM, 9SR	SENR6226
315B Excavator	5SW	RENR1149
315C Excavator	CFB, CFL, CFT	RENR5526

315C Excavator	ANF1-UP	RENR7696
M316C, M318C, and M322C Wheeled Excavator	BDX1-UP, BEB1-UP, BCZ1-UP, BDY1-UP, BDK1-UP	RENR6629
317B and 318B Excavators	9WW656-UP, 6DZ564-UP, ADC666-UP, AEJ468-UP	RENR7932
317B and 318B Excavatosr	9WW1-655, 6DZ1-563, AEJ1-467, ADC1-665	RENR3271
318B L Excavator	3LR, 9WW, 6DZ, 7KZ	RENR2922
318B L and 318B LN Excavators	3LR, 7KZ	RENR2923
318C Excavator	GPA1-UP, AWS1-UP, MDY1-UP	RENR6625
318C Excavator	FAA1-UP, DAH1-UP, BTG1-UP	RENR6633
320C Excavator	GHA, HBC	RENR3615
320 and 320 L Excavators	9KK1-UP, 2DL1-UP, 8LK, 1KL	SENR6238
320 and 320L Excavators	1TL, 7WK	SENR6014
320 and 320L Excavators	8LK1-1275, 1KL1-441	SENR6015
320, 320 N, 320 L and 320 S Excavators	9WG, 4CJ, 3XK, 6KN	SENR6242
320, 320L and 320 N Excavators	3XK1-1908, 4ZJ1-596, 6KM1-212, 9WG1-1160	SENR5459
320B and 320 BL Excavators	5BR1-UP, 6CR1-UP, 1CS1-UP, 8ES1-UP, AED, 3MR, 4MR, 4NR, 9KR, 9CS, 4XW, 5GW, 2WZ	SENR9258
320B U Excavator	BBG, 7ZZ, 8GZ, BAN	RENR3725
320B L Excavator	1XS, 2AS, 3YZ, 5MS, 6LW, 7JR, 9WS	SENR9278
320C Excavator	ANB, ALF, BCB, BEF, BDB, AKH, AMC, BER, BBC, BPR, BDC, BRX, CCD	RENR3821
320C Excavator	BEA1-UP, BDE1-UP, BBL1-UP, BCN1-UP, JPL1-UP	RENR3822

320C Excavator	MAB1-UP, RAW1-UP, PAB1-UP, SBN1-UP, GAC1-UP, FBC1-UP	RENR7090
320C U Excavator	CLM, CLZ, APA, ALX	RENR3847
320C U Excavator	MAC1-UP, PAC1-UP	RENR7088
320C Forest Machine	BGG, BKK	RENR3866
320C Excavator Attachment Combined Function	EGA, GLA, DBG, JTG, AXK, EGL	RENR7055
320C Excavator Attachment Medium Pressure	EGA, GLA, DBG, JTG, AXK, EGL	RENR7056
320C Excavator	HBC214-UP, GHA136-UP	RENR8135
320C Excavator II Medium Pressure	DBG, GLA, JTG, EGL, EGA, AXK, BMZ	KENR6305
320C Excavator	ANB3816-UP, AMC3758-UP, BPR4249-UP, BRX1007-UP	RENR7931
320D Excavator	DHK,CXY	RENR7297
320D Excavator	KGF1-UP, MCH1-UP, FAL1-UP, PHX1-UP	KENR6118
320D LRR	TAE, WFD, XCK, YDS, ZGB	KENR6633
320D LRR Excavator	FXK, EBY, GCKL	RENR9677
321D LCR Excavator	PBD, NAS, MDT	KENR5777
322 Excavator	9JL, 8ML, 4RM	SENR8738
322 and 322 L Excavators	7WL, 8CL, 9RL	SENR6153
321B CR Excavators	KGA1-UP, AKG501-UP, 9CZ1001-UP	RENR5499
322C FM and 322C LL Excavators	BPH, CAM, CBY	RENR3629
322 L, 322 N and 322 LN Excavators	9JL, 8ML, 4RM	SENR8738

322B L Excavator	1YS	RENR1023
322B and 322B L Excavators	3NR, 5CR, 8MR, 8NR, 1AS, 1BS	SENR1650
322B L and 322B LN Excavators	1ZS, 2ES	SENR1920
322B L Excavator	1YS	SENR1679
Supplement For 322B, 325B, and 330B Excavators Auxiliary Flow Control Attachment	1AS, 1BS, 1YS, 8MR, 8NR, 6DR, 2JR	SENR9215
322C Excavator	BKM1-UP, BFN1-UP, BLP1-UP, BFX1-UP, BMX1-UP, BNY1-UP	RENR3841
322C Excavator	BKF1-UP, BGR1-UP	RENR3842
322C Excavator	BKJ	RENR3867
322C Excavator	DAA1-UP, FED1-UP	RENR7085
322C Excavator	HEK1-UP	RENR7086
322C Excavator	EMR1-UP, MAR1-UP	RENR7206
323D Excavator	RAC1-UP, SED1-UP	KENR6125
323D Excavator	SDC, CYD	RENR9897
323D L Excavator	NDEP, JLG1-UP, BYM1-UP	KENR7806
324D,324D L,325D,325D L Excavator	CJX, DFP, KDG, SCR, AZP	RENR7387
324D,325D Excavator	JJG, A3R	RENR7433
325C FM & 325C LL Excavator	G1L1001-UP, M2K1001-UP, S3M1001-UP	RENR7339
325D Excavator	GPB, PKE, T2S	RENR7243

325D Excavator	C3N	KENR5972
325D, 330D, 345C, 385C Excavator	DEMOLITION CAB	KENR6290
325 Excavator	9ZK, 2SL, 3LL	SENR6213
325 and 325 L Excavators	8NL, 6RM, 9KL, 7LM	SENR6239
325, 325 L and 325 LN Excavators	9ZK, 2SL, 3LL	SENR6213
325, 325L and 325N Excavators	2JK1-UP, 2SL1-527, 2SK1-UP, 3LL1-677, 7CJ1-UP, 7LJ1-UP, 7TG1-UP, 8JG1-UP, 8NK1-UP, 9SG1-UP, 9ZK1-142	SENR5409
325B and 325B L Excavators	ABD, 5LW, 7EN, 8GM, 8PR, 8RR, 1GS, 1HS	SENR9322
325B L, 325B LL, 325B MPS, 325B MPH Forest Swing Machines	2JR	SENR9323
325B L and 325B LN Excavators	4DS, 5BS, 6DN, 8FN	SENR9293
325B L Excavator	2JR1-UP	SENR8964
325B L Material Handler	2JR1-UP	RENR1063
325C Excavator	M2K1-UP, G1L1-UP, S3M1-UP, Y4P1-UP	RENR3608
325C Excavator	BLA1-UP, BKT1-UP, BTD1-UP, BKW1-UP, AMH1-UP, BLX1-UP, BKH1-UP, BMM1-UP	RENR5369
325C Excavator	CSJ1-UP, CRB1-UP	RENR5383
325C Excavator	BFE1-UP	RENR5393
325C Material Handler Excavator	S2C1-UP	RENR5498
322C, 325C, and 330C Excavators	BFE1-UP, BKJ1-UP, HEK1-UP, DKY1-UP	RENR5489
330C Excavator	CAP1-UP, CGZ1-UP	RRNR5456

330B Excavator Material Handler	6DR, AME	RENR1064
330 and 330 L Excavators	8RL, 2ZN, 9ML, 5YM	SENR6240
330, 330 L and 330 LN Excavators	6ZK, 2EL, 8CK	SENR6243
330, 330L, 330LN Excavators	2EL1-331, 6ZK1-63, 8CK1-205	SENR6088
330, 330L, 330LN Excavators	2EL1-331, 6SK1-UP, 6WJ1-UP, 6ZK1-UP, 8CK1-UP, 8FK1-UP, 9NG1-UP, 9PJ1-UP, 9WJ1-UP	SENR5499
330B and 330B L Excavators "HE" Version	2EE, 8SR, 1JS, 1KS, 4YW, 3ZZ, 5EZ	SENR8994
330B L and 330B LN Excavators	3YR, 4RS, 5LR, 5LS	SENR1665
330B L Excavators	6DR1-UP	SENR8974
330C Excavator	B1K1-UP, B2L1-UP, B4N1-UP, B3M1-UP	RENR5346
330C Excavator	CYA1-UP, HAA1-UP, MCA1-UP, JAB1-UP, KDD1-UP, GAG1-UP, RBH1-UP, BTM1-UP, GKX1-UP	RENR5443
330C Excavator	CAP1-UP, CGZ1-UP	RENR5456
330C Excavator	DKY1-UP	RENR5457
330C Excavator with Drilling Front	MSD1-UP	RENR9535
330C MHPU	MSL1-UP	KENR7847
330D HE Excavator	MAG, NBD, MEY, EAH, FFK, JLP, EDX, MEY	RENR9587
330D Excavator	SERV MANL KENR5238 3 VOLUMES VOLI-36,VOLII-20,VOLIII-20	KENR5974
330D Excavator	GGE, THJ, ERN, HAS, RAS	RENR9599
330D L Excavator	MWP1-UP 3-VOLUME ATIC	RENR9927
345B Series II Excavator Ecomate Attachment	CC1-UP	RENR7396

345C Excavator Hydraulic system Attachment	GPH, GCL, GJR, ELS, LYS	RENR7219
345C Excavator Demolition Attachment	NULL	KENR6289
345C Excavator	GCL, ELS	RENR7337
345C Excavator	ESD168-UP, TDG250-UP, TAJ1-UP, PJW350-UP	RENR7287
345C Excavator	KBA, TBA, MDC, WDE, AYF, CWG, GBH, BZN, RFN, DHP, GJR, JAR, BWY, CPX	RENR7327
345C Excavator ATIC	TBA, WDE, BWY, DHP	KENR6573
345C, W345C, 365, and 385C Excavator Heat and Air Condition	OPTIONAL TO RENR7280, 7330, 9170, 7320, 9600, 7360, 7370, 7300, 7340	RENR7258
345B Series II Excavator	AKJ1-UP, ALT1-UP, ALD1-UP, AMD1-UP, AKX1-UP, AMN1-UP, ALL1-UP, AMJ1-UP, AMA1-UP, AYR1-UP	RENR3579
345B Series II Excavator	CCC1-UP	RENR3606
345B Series II Excavator	AKJ1-UP, ALT1-UP, ALD1-UP, AMD1-UP, AKX1-UP, AMN1-UP, ALL1-UP, AMJ1-UP, AMA1-UP, AYR1-UP	RENR3759
345B Series II Excavator	AGS, ALB	RENR3762
345B and 345B L Excavator	2ZW, 3MW, 5WS, 6MW, 6XS, 8KW, 8RW, 9CW	RENR2989
345B L Excavator Auxiliary Flow Control Attachment	2NW, 4SS, 9GS	RENR1917
345B L Excavator	2SW, 7KS, BFG	RENR1913
345B L Excavator	2NW, 4SS, 9GS	SENR1937
345B Material Handler	2NW, 4SS, 9GS	RENR1059
345B Series II Material Handler	APB	RENR4019
345B Excavator	4SS1-UP, 9GS1-UP	SENR1937

350 and 350 L Excavators	8HK, 2ZL, 3ML, 9FL	SENR6037
350 and 350 L Excavators	7RK, 9DK	SENR6119
365B and 365B II Excavators	9PZ234-UP, 9TZ325-UP	RENR3765
365B Excavator	9PZ1-233, 9TZ1-324	RENR3800
365B and 365B II Excavators	4XZ1-UP, AGD1-UP, BTH1-UP, CFJ1-UP	RENR3108
365B Material Handler	9PZ1-UP, CTY1-UP	RENR3855
365B Excavator	CTY1-UP, 9PZ234-UP, 9TZ325-UP	RENR3868
365B Series II Excavator	PEG1-UP	RENR7199
365C Excavator	NULL	RENR7307
365C MHPU Excavator	GSZ1-UP	KENR8219
365C, 385C Excavator Attachment	MEDIUM PRESSURE USE W/RENR7037 AND RENR7367	RENR7057
365C, 385C Excavator Generator Control	GWC, WAW	KENR6288
365C, 385C Excavator Magnet Control	GWC, WAW USE W/RENR7307, RENR7367	KENR6307
375 and 375 L Excavators	6NK156-UP, 9WL132-UP	SENR1903
375 and 375L Excavators	1JM1-UP, 6NK1-UP, 8WJ77-UP, 9WL1-UP	SENR6032
385B Excavator	ANS1-UP	RENR5409
385B LC Excavator	BKF1-UP, BKX1-UP, BLY1-UP	RENR5413
385B Excavator	MYA1-UP, FDL1-UP, CLS1-UP	RENR5429
385C Excavator	NULL	RENR7367

385C UHD Excavator-Tilt Cab Attachment	KGB1-UP, T2E1-UP OPTIONAL TO RENR7360	KENR6306
539 Knuckleboom Loader	1PZ	RENR3075
375 Excavator	8XG, 8WJ	SENR6029
5080 Excavator	6XK	SENR6144
5080 Excavator	8SL1-UP	SENR8939
5090B Excavator	CLD1-UP, SJY1-UP	RENR5467
5110B Mass Excavator	AAA1-UP	RENR3368
5110B, 5110B L Excavators	AAA344-UP, AAA222-UP	RENR6521
5130 Excavator	5ZL75-UP	RENR2521
5130 Excavator	5ZL1-74, 7TJ1-UP	SENR6057
5130B Excavator	4CS184-UP	RENR6543
5130B Excavator	4CS	SENR1432
5230 Excavator	7LL63-98	SENR1479
5230 Excavator	7LL1-62	SENR6107
5230 Front Shovel	7LL99-UP	RENR2697
5230B Front Shovel and Mass Excavator	4HZ1-UP	RENR3378
E70B Excavator	5TG1-234	SENR4848
E70B Excavator	5TG235-UP	SENR5414
E110B and E120B Excavators	6JF1-73, 8MF1-109	SENR4846

E110B and E120B Excavators	6JF74-UP, 8MF110-UP	SENR4847
E200B and EL200B Excavators	4SG1-5705, 5EG1-615	SENR4534
E200B and EL200B Excavators	4SG5706-UP, 5EG616-UP	SENR4535
E240B and EL240B Excavators	5WG, 8SF	SENR4806
E240C and EL240C Excavators	2RL, 9PK	SENR6064
E300B and EL300B Excavators	1WJ, 3FJ	SENR4812
M312 and M315 Excavators	6TL540-541 and 635-UP, 7ML1061-1064 and 1215-UP	RENR1196
M312 and M315 Excavators	6TL1-539, 542-634, 7ML1-1060, 1065-1214	SENR8932
M312 and M315 Excavators	8SS, 9PS	RENR1156
M312 and M315 Excavators	6TL951-UP, 7ML1647-UP	RENR4033
M313C and M315C Wheeled Excavators	BDM1-UP, BDR1-UP	RENR6975
M318 Excavator	8AL	SENR6266
M313C, M315C Excavator 2 Volume	H2A256-UP, BDR2001-UP, H2B189-UP, BDM2001-UP	RENR7417
M313C/M315C Wheeled Excavator	H2A337-UP, H2B240-UP	KENR6317
M313D, M315D, M316D, M318D, M322D Wheeled Excavators	W3H, W5M, W6A, W8P, W2S	RENR9477
M316C, M318C & M322C Wheeled Excavator	BDX2000-2281, BEB2000-2057, BCZ2000-2226, BDK2000-2087, BKY2000-2076	KENR6651
M316C, M318C, M322C Wheeled Excavator	SMAN, RENR5590, RENR5550, RENR5560 (BDX1-194, BCZ1-338, BDK1-167)	KENR6313
M316C, M318C, M322C Excavator (H2C,BDX2282-UP)	(H2D, H2F, BEB2058-UP, BCZ2227-UP) (H2E, H2G, BDK2088-UP, BDY2077-UP)	RENR9117

M316C/M318C/M322C Wheeled Excavator	BDX486-1999,BCZ585-1999,BDK255-1999	KENR6314
M316CMH & M322CMH Wheeled Excavator with Material Handler Hydraulic	SYSTEM ATIC - H2F, BDY2001-UP, H2G, BEB2001-UP	RENR9126
M318C, M322C Excavator Magnet Controller	ATIC (BEB197-245, BDK122-376, BDY234-351 12.5KW GENERATOR	RENR9513
M318C, M322C Excavator Magnet Controller	ATIC (BEB266-290, BDK431-476, BDY374-404)12.5KW GENERATOR	RENR9515
M318C, M322C Excavator Magnet Controller	ATIC (BEB254-290, BDK122-476, BDY234-404)15KW GENERATOR	RENR9517
M318C, M322C Wheeled Excavator	ATIC (BEB246-265,BDK377-430,BDY352-373)12.5KW GENERATOR	RENR9514
M318C/M322C Wheeled Excavator	BEB1-203, BDY1-270	KENR6315
M318C/M322C Wheeled Excavator	BEB204-1999, BDY271-1999 (2 VOL: 1=30, 2=16)	KENR6316
M318D, M322D Wheeled Excavator	W8R1-UP, W2T1-UP	RENR9467
M318 Wheeled Excavator	6ES1-UP, 8AL1-UP	SENR1695
M318 and M320 Excavators	6ES243-UP, 8AL2265-UP, 6WL469-UP	RENR4034
M318 and M320 Excavators	8SS470-UP, 9PS287-UP	RENR4035
M320 Wheeled Excavator	6WL1-468	RENR1166
M325B Material Handler	BGN	RENR4046
M325C Excavator Magnet Controller	XJA202-UP, PAN242-UP	RENR9519
307 Swing Boom Excavator	AFB1-UP	RENR1174
Solid State Magnetic Controller for Material Handlers M320 MH, 320B MH, 325B MH, 330 MH, 330B MH, W330B MH, 345B MH, 345B II MH, W345B MH, 350 MH, M320 MH	6ES1-UP, 6WL1-UP, 6LS1-UP, 2SL1-UP, BGN1-UP, 2JR1-UP, 5YM1-UP, 6DR1-UP, AME1-UP, 2NW1-UP, APB1-UP, ANJ1-UP, CDY1-UP, 3ML1-UP, 9FL1-UP, 8KZ1-UP, 1JM1-UP	RENR3125

Forestry Machines

Table 7

Forestry Machines		
Name	**Effectivity**	**Media Number**
227 Logger	10W1-227	SENR2275
227 Logger	10W228-UP	SENR4059
315B Forest Swing Machine	7RZ284-UP	RENR3282
315B Forest Swing Machine	7RZ284-UP	RENR2918
315B L Forest Machine	7RZ284-UP	RENR2918
315B Excavator Forest Machine Akashi	7RZ284-UP	RENR3282
Supplement For 320FB, 320LL, 325FB, 325LL, 330FB and 330LL Forest Swing Machines	8NK, 8FK, 9KK	SENR5479
320B LL Forest Swing Machine	1CS, 1DS, 1ES, 2WZ, 3MR, 4EW, 4MR, 4NR, 4XW, 5BR, 5CS, 5GW, 6CR, 6LS, 8ES, 9CS, 9JS, 9KR	RENR1058
320C Forest Swing Machine	BGG, BKK	RENR3866
320C Forest Swing Machine	SAH1-UP, TBR1-UP	RENR7089
320C Forest Machine	SAH1001-UP, TBR1001-UP	RENR7319
320C LRR Forest Machine	(GAD1-UP) USED IN SERVICE MANUAL RENR9190	RENR9197
322C Forest Machine	M2H1001-UP, BYL1001-UP, C3R1001-UP, LAR1001-UP	RENR7329
322B L Forest Swing Machine	1YS	RENR1023
322C Forest Swing Machine	M2H1-UP, C3R1-UP, LAR1-UP	RENR7084
322L, 322LL and 322FB Forest Swing	4BM, 7WL, 8GL, 8ML, 9JL, 9RL	SENR8914

Machines	4KM, 7WL, 8CL, 8ML, 9JL, 9KL	SENR8914
324D, 325D Forest Machine	(C7K, C8L, C9M, JKR, JLS) 3 VOLUMES (36PGS, 20PGS, 20PGS)	RENR9649
325B L, 325B LL, 325B MPS, and 325B MPH Forest Swing Machines	2JR	SENR9323
325C Forest Machine Excavator	M2K1-UP, G1L1-UP S3M1-UP, Y4P1-UP	RENR3608
325C and 330C Forest Machine	B2L185-UP, Y4P392-UP	RENR7873
330B L Forest Swing Machine	6DR	SENR1688
330C Forest Machine (AURORA)	(B1K1001-UP, B2L1001-UP, B3M1001-UP, B4N1001-UP) SMAN RENR5313	RENR7349
330D Forest Machine	(L2K, H3K, E4K) SMAN RENR9898-2 VOLUME (VOLI-30, VOLII-24)	RENR7217
508 Skidder and Grapple Skidder	2HD, 9NC	SENR3377
511, 521, 522 & 532 Track Feller Buncher	5111-UP, 5211-UP, 5221-UP, 5321-UP	RENR8920
517 Track-Type Skidder	6PW, 5WW	RENR2032
518 and 518 Series II Skidders 518 and 518 Series II Grapple Skidders	50S1-UP, 55U1-UP, 94U1-UP, 95U1-UP	SENR5776
518C Skidder and 518C Grapple Skidder	1CL, 9HJ	SENR5798
515 and 525 Wheel Skidder - Grapple	4LR, 1DN668-UP	SENR1360
515 and 525 Wheel Skidders	4LR, 1DN524	SENR1361
515 and 525 Wheel Skidder - Grapple	4LR306-UP, 1DN980-UP	RENR2147
525 Wheel Skidder	1DN1-523	SENR6694
525B and 535B Wheel Skidder	3KZ306-795, 3KZ797-874, AAE458-582	RENR6133
525B and 535B Wheel Skidders	AAE, 3KZ	RENR4343
525B, 535B, and 545 Wheel Skidder	3KZ796, 3KZ875-UP, AE583-UP, FZ433, 2FZ438-UP	RENR6164
528B Skidder and 530B Grapple Skidders	5BK, 8SJ	SENR5758

527 Track Skidder	2RS, 3DS, 4NS	SENR8394
541, 551 & 552 Track Feller Buncher	541 0205-UP, 551 0115-UP, 552 0145-UP	RENR8929
545 Wheel Skidder	2FZ1-356	RENR3053
545 Wheel Skidder	2FZ357-432, 2FZ434-437	RENR6134
518 Harvester	8ZC1-UP	SENR3463
HH45, HH55, HH65 and HH75 Harvester Heads	2JZ, 3MZ, 4RZ, 5WZ	RENR3008
533 and 543 Wheel Feller Bunchers	CDR1-UP, ASJ1-UP	RENR6167
574B Forwarder	CZZ1-UP	RENR6122
966G/972G EH/CCS STRG	AAH, 3ZS, 7LS, 9RS, AAW, 1EW	RENR2174
988H Steel Mill Wheel Loader	BXY1-UP	KENR6328
PRENTICE 1090, 1190, 1190T & 1290T Track Feller Buncher	HYDRAULIC SYSTEM ATIC - BZJ207-U, BZK207-U, BZL208-U, BZM209-U	RENR6392
PRENTICE 1090, 1190, 1190T & 1290T Track Feller Buncher	SYSTEM ATIC-BZJ1000-UP, BZK1000-UP, BZL1000-UP, BZM1000-UP	RENR6390
PRENTICE 1090, 1190, 1190T, 1290T Track Feller Buncher ATIC	(BJZ2110-UP, BZK2160-UP, BZL2210-UP, BZM2260-UP) HYDRAULIC	RENR8939
1090, 1190, 1190T and 1290T Track Feller Bunchers (Prentice, Hydro-Ax, CTR)	BZJ, BZK, BZL, BZM	RENR6182
PRENTICE 1390, 1490 & 1490T Track Feller Buncher	HYDRAULIC SYSTEM ATIC - B3F, B4F, B5F (4 VOLUME)	RENR8654
1390, 1490 & 1490T Track Feller Buncher	B3F2310-UP, B4F2000-UP, B5F2000-UP	RENR8948
1390, 1490, 1490T Track Feller Buncher	B3F 1-2309, B4F 1-1999, B5F 1-1999	RENR8655
Hydro-Ax 770 and 870 Wheel Feller Buncher	HAB, HAE	RENR6384
TK370 and TK380 Wheel Feller Buncher	WBD1-UP, WBE1-UP	RENR6236

TK711, TK721, TK722 and TK732 Track Feller Buncher	1011-UP, 1021-UP, 1031-UP, 1041-UP	RENR6287
TK711, TK721, TK722 & TK732 Feller Buncher	1011-UP, 1021-UP, 1031-UP, 1041-UP	KENR5905
TK711, TK721, TK722 & TK732 Track Feller Buncher	101245-UP,102345-UP,103445UP, 104545-UP	RENR6389
TK711, TK721, TK722 & TK732 Track Feller Buncher	101 210-UP, 102 211-UP, 103 206-UP, 104 194-UP	RENR6330
TK741, TK751 & TK752 Track Feller Buncher	202225-UP, 301325-UP, 302425-UP	RENR6391
TK741, TK751 & TK752 Track Feller Buncher	301 1-324, 202 1-224, 302 1-424	RENR6296
TK741, TK751 & TK752 Track Feller Buncher	301, 202, 302	RENR6295
TK1051 Track Feller Buncher	9HZ1-UP	RENR6053

Integrated Tool Carriers

Table 8

Integrated Toolcarriers		
Name	**Effectivity**	**Media Number**
IT12 Integrated Toolcarrier	2YC1-UP, 4NC1-UP	SENR4084
IT12F Integrated Toolcarrier	1KF, 4EL	SENR5964
IT12 Integrated Toolcarrier with European Roading Attachments	2YC1-UP, 4NC1-UP	SENR3232
IT12B and IT14B Integrated Toolcarrier	1KF, 3NJ	SENR4235
IT14G Integrated Toolcarrier	7ZM, 9WM, 8ZM, 1WM	SENR6777
IT14G Integrated Toolcarrier	7ZM, 9WM, 8ZM, 1WN	SENR1278
IT18F Integrated Toolcarrier Machines	5EJ, 6ZF, 8GJ	SENR5915
IT18 and IT18B Integrated Toolcarrier	1DF, 2NJ, 4ZD, 7ZB, 9NB	SENR4115

IT24F Integrated Toolcarrier	4NN, 6KN	SENR6737
IT28 and IT28B Integrated Toolcarrier	1HF, 1JK, 2KC, 5SD, 8JB	SENR4052
IT28F Integrated Toolcarrier	1JL, 3CL	SENR5985
IT28G 10K ATFL Integrated Toolcarrier	EWF508-UP	KENR6312
IT28G Integrated Toolcarrier	DDA1-UP, WGX1-UP, WAC1-UP, RTA1-UP, DFZ1-UP, DBT1-UP, RBB1-UP, DJD1-UP, WMB1-UP, WLG1-UP	RENR6434
IT28G 10K ATFL Integrated Toolcarrier	EWF1-UP	RENR7946
IT28G Integrated Toolcarrier	6XR, 7SR, 8CR, 9AR	SENR1277
IT38F Integrated Toolcarrier	1KM, 2RM, 8SM, 7SN, 5DR, 6FN	SENR6716
IT38G Integrated Toolcarrier	4SY1878-UP, 6WS2579-UP, 9HS801-UP, 7BS900-UP, 1CW391-UP	RENR4326
IT38G Series II Integrated Toolcarrier	CRD1-UP, CSX1-UP, RTB1-UP, PHN1-UP, B9Y1-UP	RENR6082
IT38G Integrated Toolcarrier	4SY1-1877, 1CW1-390, 6WS1-2578, 8RS1-UP, 9HS1-800, 7BS1-899	SENR6679
IT62G Series II Integrated Toolcarrier	AXX1-UP, AXY1-UP, AYA1-UP, AYL1-UP, BAB1-UP, AYS1-UP, BAC1-UP, BAA1-UP, BAD1-UP	RENR4324
IT62G Integrated Toolcarrier	3JW2154-UP, 4PW504-UP, AKP513-UP, 5FW2000-UP, 6EW800-UP, 8JW407-UP, 6HW415-UP, 5MW1078-UP, 7BW624-UP	RENR4328
IT62G Integraged Toolcarrier Pilot/Conv	3JW1-2153, 4PW1-503, AK1-512, 5FW1-1999, 7BW1-799, 6PS1-UP, 8JW1-406, 6EW1-414, 5MW1-1077, 6HW1-623	SENR1393

Motor Graders

Table 9

Motor Graders		
Name	**Effectivity**	**Media Number**
12H Motor Grader	CBK1-UP, AMZ1-UP, 1251-UP	RENR5739
12H 140H 160H MG Standard		

12H 140H 160H MG Standard Version	4ER500, 8JM280, 5HM1150, 9JM350, 2FM400	SCNR9149
12H Motor Grader	CBK248-UP, AMZ251-UP, 125 1-UP (2 VOLUMES)	RENR9555
12H, 140H, & 160H Standard Version Motor Grader	ATIC-2FM400-UP, 5HM1150-UP, 8JM280-UP, 9JM350-UP, 4ER500-UP	RCNR1430
14G Motor Grader	96U7046-UP	SENR3652
14H Motor Grader (NA Version)	7WJ1-663	RENR1441
14H Motor Grader	7WJ664-UP	RENR1427
14H Motor Grader	ASE1-UP	RENR4194
14H Motor Grader	7WJ	SENR6933
14M Motor Grader	(B9J1-UP)-3 VOLUMES, 36 PAGES EACH	RENR9023
16G Motor Grader	93U	SENR3653
16H Motor Grader (NA Version)	6ZJ1-330	RENR1442
16H Motor Grader (NA Version)	6ZJ	SENR6934
16H Motor Grader	6ZJ331-UP	RENR1428
16H Motor Grader	ATS1-UP	RENR4199
16M Motor Grader	B9H1-UP (3 VOLUME)	RENR9024
24H Motor Grader	7KK-UP	SENR8699
120H and 135H Motor Gradesr (Standard Version)	5FM1-799, 6TM1-365, 7MM1-248, 8WN1-349	RENR1440
120H and 135H Motor Graders (NA Version), 120H Motor Grader (Australian Version)	4MK, 2AN, 3YK	RENR1438
120H and 135H Motor Graders (Standard Version)	6TM366, 5FM800, 7MM249, 8WN350	RENR1426
120H Motor Grader (ES Version)	9YR330-UP	RENR1425
120H Motor Grader (ES Version)	6NM1-254, 9YR1-329	RENR1439

120H Motor Grader (ES Version)	6NM	SENR6984
120H A and 135H Motor Graders	1241-UP, CBC1-UP, CAF1-UP, AMX1-UP, ALZ1-UP	RENR4165
120H and 135H Motor Graders (Standard Version)	5FM, 6TM, 7MM, 8WN	SENR6986
120H, 135H Motor Graders (NA Version) 120H Motor Grader (Australian Version)	2AN, 3YK, 4MK	RENR1424
12H, 140H and 160H Motor Graders (NA Version)	9EJ, 2ZK, 3GM, 4XM, 8MN, 9TN, 9ZN, 2WR	SENR9147
12H, 140H and 160H Motor Graders (Standard Version)	5ZM, 4ER, 5HM, 8JM, 2FM, 9JM	SENR9149
12H, 140H, and 160H Motor Graders (Standard Version)	5ZM, 4ER, 5HM, 8JM, 2FM, 9JM	SENR6987
12H, 140H, and 160H Motor Graders (Standard Version)	2FM1-399, 4ER1-499, 5HM1-1149, 8JM1-279, 9JM1-349	RENR1436
12H, 140H, 160H Motor Graders (ES Version)	2GS, 3AS, 2HS	SENR9148
12H, 140H, 160H Motor Graders (ES Version)	2LR1-294, 2GS1-359, 3AS1-449, 8KM1-393, 2HS1-379, 6WM1-340	RENR1435
12H, 140H, and 160H Motor Graders (ES Version)	8KM, 6WM, 2LR	SENR6985
12H, 140H, 160H Motor Graders (NA Version)	2ZK, 3GM, 9EJ, 9TN, 9ZN, 2WR, 4XM, 8MN	RENR1434
12H, 140H, and 160H Motor Graders (Standard Version)	5ZM, 4ER, 5HM, 8JM, 2FM, 9JM	SENR9149
140G 12G, 120G, 130G, and 140G Motor Graders	3WC1067-UP, 61M12027-UP, 72V10334-UP, 74V2321-UP, 87V8360-UP, 11W1251-UP, 12W1082-UP, 13W741-UP	SENR3651
140H and 160H Motor Graders	CCA1-UP, ASD1-UP, APM1-UP, CCP1-UP, 1261-UP	RENR4128
140H & 160H Motor Grader	CCA, APM412-414, APM416-UP, 126, ASD225-UP, CCP193-UP	RENR9556
140H Motor Grader	5HM3000-UP, XZH1-UP	RCNR9540
140H Motor Grader	5HM3000-UP, XZH1-UP	RENR9540

140M & 160M Motor Grader	140M (B9D1-UP, B9M1-UP) 160M (B9E1-UP, B9L1-UP)	RENR9018
143H & 163H Motor Grader	APN227-UP, ARL262-UP	RENR9557
143H and 163H Motor Graders (NA Version)	1AL1-407, 5AK1-155	RENR1437
143H and 163H Motor Graders (NA Version)	1AL408-UP, 5AK156-UP	RENR1423
143H and 163H Motor Graders (NA Version)	5AK1-UP, 1AL1-UP	SENR6932
143H and 163H Motor Graders	APN1-UP, ARL1-UP	RENR4154

Off Highway Trucks

Table 10

Off Highway Truck		
Name	**Effectivity**	**Media Number**
768C Tractor and 769C Truck	01X6001-6599, 02X371-399	SENR6395
768C Tractor and 769C Truck	01X1966-2875, 02X341-349	SENR2316
768C Tractor and 769C Truck	01X5474-6000, 02X368-370	SENR4793
768C Tractor and 769C Truck	01X2876-5473, 02X350-367	SENR2948
768C Tractor, 769C and 771C Trucks	2X400-UP, 1X6600-UP, 3BJ200-UP	SENR6839
769D Off-Highway Truck and 771D Quarry Truck	5SS, 6YS	SENR1563
769D Truck and 771D Quarry Truck	5TR1-UP, 6JR1-UP	SENR8609
769D Off-Highway Truck and 771D Quarry Truck	BCA1-UP, BBB1-UP	RENR3381
769D Off-Highway Truck & 771D Quarry Truck	ATIC - BBB475-UP, BCA327-UP 2 VOLUMES	RENR9853
769D Off-Highway Truck & 771D Quarry Truck	ATIC - BCA173-233, BBB222-325	RENR9580

769D Off-Highway Truck & 771D Quarry Truck	ATIC - BBB326-474, BCA234-326	RENR8393
770,772 Off-Highway Truck	RLB, BZZ- 2 VOLUMES	RENR8262
771C Quarry Truck	3BJ	SENR5652
772B Tractor and 773B Truck	63W3733-4199, 64W190-299	SENR6396
772B Tractor and 773B Truck	63W3296-3732, 64W181-189	SENR4764
772B Tractor and 773B Truck	63W1221-3295, 64W168-180	SENR2926
772B Wheel Tractor and 773B Truck	64W155-UP, 63W762-UP, (EXCLUDING 63W769)	SENR2317
772B, 773B, 775B	64W, 63W, 7XJ	SENR6844
Power Train For Off Highway Tractors and Trucks With Electronic Power Shift Transmission Control For ICM 777, 776, 773B, 772B, 769C, and 768C	01X, 02X, 63W, 64W, 14H, 84A	SENR3019
773D Off-Highway Truck and 775D Quarry Truck	7CS, 8AS	SENR1585
773D Truck and 775D Quarry Truck	7ER1-UP, 6KR1-UP	SENR1418
773E Off-Highway Truck and 775E Quarry Truck	BDA1-UP, BEC1-UP	RENR6518
773D Off-Highway Truck	(NBJ)(INDIA)	RENR8413
773E & 775E Off-Highway Truck	(2 VOLUME) BDA728-UP, BEC468-UP	RENR9854
773E & 775E Off-Highway Truck	BDA259-485, BEC202-308	RENR9581
773E & 775E Off-Highway Truck	BDA486-727, BEC309-467	RENR8394
773F Quarry Truck & 775F Off-Highway Truck	ATIC - 2 VOLUME - EED, DLS	RENR8288
775B Quarry Truck	7XJ1-200	SENR5667
776 Tractor and 777 Truck	14H206-UP, 84A1284-UP	SENR2982
776D and 777D Tractor/Off-Highway Trucks	AFS, AGC	RENR3363
		RENR3364

776D and 777D	AGY	RENR3564
776 Tractor, 776 Wagon and 777 Truck	14H136-UP, 14W1-UP, 8A560-868	SENR2070
776 Tractor, 776 Wagon and 777 Truck	14H1-135, 14W1-UP, 84A1-559	SENR7221
776 Wheel Tractor and 777 Truck	14H159-UP, 84A869-UP	SENR2318
776B Tractor and 776B Truck With Neutral Start Control, Transmission Gear Indicator, and Payload Monitor	4YC, 6JC	SENR4253
776B Tractor and 777B Truck	4YC591-UP, 6JC70-UP	SENR4289
776B Tractor and 777B Truck	4YC1384-1638, 6JC84-97	SENR4796
776B Tractor and 777B Truck	4YC1-1383, 6JC1-83	SENR3154
776B Tractor and 777B Truck Power Train	4YC1-590, 6JC1-69	SENR3144
776B Wheel Tractor and 777B Truck	4YC1639-UP, 6JC98-UP	SENR5665
776C and 777C Trucks	2TK, 4WX	SENR5617
776D Tractor and 777D Truck	3PR, 5ER	SENR6910
777D Off-Highway Truck & 776D Tractor ATIC	AGC1302-UP, AFS82-UP	RENR8392
777D Truck	2YW1-UP	SENR1507
777F Off-Highway Truck (2 VOLUME)	JRP	RENR8307
784B and 785B Trucks	6HK	SENR5672
784C Tractor and 785C Truck	1HW	SENR1501
784C & 785C Off-Highway Truck	2PZ106-UP, APX451-UP (3 VOLUME)	RENR8124
785C HAA Off-Highway Truck	5AZ400-UP	RENR8126
785 and 789 Trucks	8GB223-417, 9ZC1-UP	SENR3419
785 and 789 Trucks Power Train	9ZC, 8GB	SENR3429
785 Truck	8GB1-UP	SENR4285
785 Truck	8GB1-222	SENR3097
785 Truck Power Train	8GB	SENR4009
785B Truck With VIMS	6HK523-UP	SENR1513

785B Truck With VIMS	6HK	SENR8577
785C High Altitude Truck	5AZ1-263	SENR1591
785C High Altitude Truck	5AZ264-UP	RENR2643
784C Wheel Tractor and 785 C Truck	APX	RENR2640
789 Truck	9ZC440-UP	SENR4286
789B Truck	7EK1-UP	SENR5673
789B Truck With VIMS	7EK371-UP	SENR1514
789B Truck With VIMS	7EK278-UP	SENR8578
789C Off-Highway Truck	2BW659-UP	RENR8122
789C Truck	2BW1-302	SENR1535
789C Truck	2BW303-UP	RENR2641
793 Truck	3SJ	SENR4918
793B Truck	1HL323-UP	SENR1505
793B Truck	1HL	SENR5674
793B Truck With VIMS	1HL195-322	SENR8579
793C Truck	4GZ	SENR1541
793C Truck	4AR1-217	SENR1447
793C Truck	4AR218-UP	SENR1480
793C Truck	ATY1-417	RENR2642
793C Truck	ATY418-UP	RENR2644
793D Off-Highway Truck Air System ATIC	FDB	RENR9866
793D Off-Highway Truck - Attachment - ATIC	FDB1-UP	KENR6337
793D Off-Highway Truck	FDB	RENR8333
797 Truck	5YW	RENR2570

797 Truck Power Distribution and Ground Electrical Circuits	5YW	RENR2680
797 Truck Starting Aid Electrical Circuits	5YW	RENR2681
797 Truck Integrated Brake Control Electrical Circuit	5YW	RENR2682
797 Truck Vital Information Management System (VIMS) Electrical Circuit	5YW	RENR2683
797 Truck Panel Lamp and Miscellaneous Electrical Circuits	5YW	RENR2684
797 Truck Washer/Wiper and Turn Signal Electrical Circuits	5YW	RENR2685
797 Truck Heater and Air Conditioning Electrical Circuits	5YW	RENR2686
797 Truck Chassis Control Electrical Circuit	5YW	RENR2687
797 Truck Transmission Control Electrical Circuit	5YW	RENR2688
797 Truck Front Engine Control Electrical Circuit	5YW	RENR2689
797 Truck Rear Engine Control Electrical Circuit	5YW	RENR2690
797 Truck Master Engine Control Electrical Circuit	5YW	RENR2691
797 Truck Tables and Symbol Definitions	5YW	RENR2692
797B Off-Highway Truck	JSM169-UP	RENR9542
797B Truck	JSM1-UP	RENR2620

Paving Compactors

Table 11

Paving Compactors		
Name	**Effectivity**	**Media Number**
CB-14 AND CB-14 XW Vibratory Compactors ATIC	**DST1-UP**	**KENR5949**

CB-214 and CB-224 Vibratory Compactor	6FD, 6GD, 6LF	KENR1292
CB-214B, CB-244B Vibratory Compactor	6FD, 6GD, 6LF	KENR1300
CB-214C and CB-224C Vibratory Compactor	3AL, 9XK	KENR2533
CB-535B Vibratory Compactors	3AR	KENR2756
CB-214D, CB-224D, CB-225D Vibratory Compactors	1TZ, 8RZ, 9FZ	KENR2918
CB-214E,CB-224E, & CB-225E Vibratory Compactors ATIC	2141-UP, 2241-UP, 2251-UP	KENR3679
CB-224C Combi Vibratory Compactor	3AL1-UP	KENR3069
Caterpillar AP-1055B and Barber Green BG-2455C Asphalt Pavers	ABB1-UP, ACM1-UP	KENR3518
CS-531D, CP/CS-533D Vibratory Compactors	AGH, 4MZ, AET, 5CZ, AFC, 6AZ	KENR3530
CS-663E, CP-663E, CS-683E Vibratory Compactors	AEF1-UP, AFL1-UP, AGR1-UP	KENR3579
CS-423E, CS-433E, and CP-433E Vibratory Compactors	ASH1-UP, DAC1-UP, CFK1-UP, DCL1-UP, CFP1-UP, CFX1-UP, CYE1-UP	KENR3589
CB-634D Vibratory Compactor	CDF1-UP	KENR3629
CP/CS-563D, CS-583D Vibratory Compactors	9MW, 2RZ, 1SZ, 9ZW, 5LZ, 2CZ, 3GZ	KENR7039
CB-334D and CB-335D Vibratory Compactor	3JZ, 4CZ, 5PZ, BBW	KENR7052
CB-334 and CB-335D Vibratory Compactors	4CZ249-UP, DCZ1-UP, D4E1-UP, BBW1-UP, 59Z281-UP	KENR7053
CB-334E/CB-335E Vibratory Compactor	C3A1, C3D1, C3E1, C3C1, C3F1	KENR7109
-CB-334E & CB-335E	C4F,C4J,C4X,C5F,C5J	KENR3689
CB-434 Vibratory Compactor	3TF	KENR1313
CB-434 Vibratory Compactor	2NG, 3TF218-UP	KENR1671

CB-434B Vibratory Compactor	6AL, 7YN	KENR2619
CB-434B and CB-434C Vibratory Compactors	6AL1-UP, 7YN1-UP, 4DN1-UP	KENR2618
CB-434C Vibratory Compactor	4DN	KENR2857
CB-521, CB-523, and CB-525 Vibratory Compactor	6RD, 6TD, 6XD	KENR1287
CB-534 Vibratory Compactors	2EG, 2YF	KENR1302
CB-534 Vibratory Compactor	2EG171-UP, 2YF28-UP	KENR1596
CB-534B Vibratory Compactor	4JL, 5RN	KENR2611
CB-534C Vibratory Compactor	1WS1-UP, 5HN1-UP	KENR2867
CB-535B Vibratory Compactor	3AR	KENR2766
CB-534D Vibratory Compactor	EAA1-UP, FEA1-UP, GCA1-UP, FGH1-UP	KENR3619
CB-544 Vibratory Compactor	8FM	KENR2757
CB-545 Vibratory Compactor	2FS	KENR3018
CB-634 Vibratory Compactor	5CL	KENR2579
CB-634C Vibratory Compactor	3BR	KENR2856
CP-323C and CS-323C Vibratory Compactor	1EN, 6DM	KENR2763
CP-531C, CP-533C, CS-533C, CP-565C, CS-563C, CS-573C and CS-583C Vibratory Compactors	2WN1-UP, 2XN1-UP, 3XN1-UP, 3YN1-UP, 9RN1-UP, 4KN1-UP, 4LN1-UP, 5JN1-UP, 5KN1-UP, 5ZN1-UP, 6LN1-UP, 7MN1-UP, 7NN1-UP	KENR3070
CP-563 and CS-563 Vibratory Compactors	8XF, 7GG, 1YJ, 5AJ	KENR1689
CP-563, CS-563 Vibratory Compactors	1YJ1-384, 5AJ1-105, 7GG1-399, 8XF1-778	KENR1592

CP-563E, CS-563E, CS-573E, CS-583E, CP-663E, CS-663E and CS-683E Vibratory Compactors	BWE1-UP, DAG1-UP, CNT1-UP, CEB1-UP, ASF1-UP, CNN1-UP, DAF1-UP, DAD1-UP, ASA1-UP, ASG1-UP, CNG1-UP, DAJ1-UP, ASB1-UP, CNX1-UP	KENR3609
CS-431B, CS-433B and CP-433B Vibratory Compactors	1MG, 4FK, 1XF	KENR1855
CS-431C, CP-433C, and CS-433C Vibratory Compactors	9XL, 6EN, 3WZ, 2JM, 1ZN, 4JZ, 3TM, 2TN, 5BZ	KENR2628
CS-531, CP-533, CS-533, CS-573 and CS-583 Vibratory Compactors	1EL, 8PK, 8YJ, 3BL, 3ZL, 4HL, 5AL, 3WM, 4KM	KENR1885
CS-531C, CP-533C, CS-533C, CP-563C, CS-573C, and CS-583C Vibratory Compactors	2WN1-UP, 2XN1-UP, 3XN1-UP, 3YN1-UP, 4KN1-UP, 4LN1-UP, 5JN1-UP, 5KN1-UP, 5ZN1-UP, 9RN1-UP	KENR2617
CS-551, CS-553, and CP-553 Vibratory Compactors	6ZD, 7AD, 7BD, 8AD, 8BD	KENR1595
CS-653 and CS-653 Vibratory Compactors Hydraulic	7HD, 7JD	KENR1564
PF-200 Pneumatic Compactors	7TD, 7WD, 7XD	KENR1579
PF-290B Pneumatic Compactors	1XW	KENR7007
PF-300 and PS-300 Pneumatic Compactors	7TD, 7WD, 7XD	KENR1580
PF-500 Pneumatic Compactor	7TD, 7WD, 7XD	KENR1581
PS-150B and PS-200B Pneumatic Compactors	3XR, 5JR	KENR3058
PS-150C Pneumatic Compactor	FPS1-UP	KENR7078
PS-300B and PF-300B Pneumatic Compactors	4PN, 6HM	KENR2713
PS-360B Pneumatic Compactors	9LS	KENR7017
PS-360C Pneumatic Compactor	NULL	KENR7088

Pipelayers

Table 12

Pipelayers		
Name	**Effectivity**	**Media Number**
561D Pipelayer and Hydraulics	54X	SENR7711
561M Pipelayer	1KW	SENR1761
561N Pipelayer	CPH1-UP	RENR7854
561N Pipelayer	CPH1-UP	RENR7854
572R Pipelayer	2HZ	SENR1862
572 II Pipelayer	DSC1-UP	KENR6387
572R II Pipelayer	DSC1-218	RENR7506
572R II Pipelayer	DSC219-301	RENR8194
572R II Pipelayer Power Train ATIC	DSC302-UP	KENR6384
572R II Pipelayer Power Train ATIC	DSC	RENR8193
578 Pipelayer	8HB	SENR4721
583R Pipelayer	2XS	SENR1812
583T Pipelayer	CMX1-UP	RENR8171
587R Pipelayer	BXL1-UP	RENR8213
587R Pipelayer Power Train ATIC	BXL1-UP	RENR8245
587T Pipelayer	FAT1-UP	RENR8211
587T Pipelayer Power Train ATIC	FAT1-UP	RENR8235
589 Pipelayer	31Z	SENR2502

Planers, Profilers, Reclaimers

Table 13

Planers, Profilers, Reclaimers		
Name	**Effectivity**	**Media Number**
PM-201 Pavement Profiler	**PNM**	**KENR5011**
PM-465 Cold Planer	5ZS	KENR3104
PM-565 Cold Planer	3TK119-UP	KENR3078
PM-565 Cold Planer	3TK113-118	KENR3032

PM-565 Cold Planer	3TK1-UP	KENR2523
PM-565 Cold Planer	NULL	KENR2523
PM-565B Cold Planer	3TK, 8GS	KENR3079
PR-450 Cold Planer	7DC204-314	KENR1603
PR-450 Cold Planer	7DC342, 345-355	KENR2462
PR-450 Cold Planer	7DC315-UP	KENR2474
PR-450C Cold Planer	7PJ	KENR1684
Sizer Mixer Attachment for PR-450 and PR-750B Cold Planers	7DC, 8AC	KENR1654
PR-1000C Cold Planer	5XC	KENR1648
RM-300 Rotary Mixer	BWR1-UP	KENR3149
RM-350 Reclaimer Mixer and SM-350 Stabilizer Mixer	1RM, 5FK	KENR2534
RM-350B Reclaimer Mixer	7FS	KENR3071
RM-350B Reclaimer Mixer	AXW1-UP	KENR3118
RM-500 Rotary Mixer	ASW1-UP	KENR3139
RR-250 Road Reclaimer and SS-250 Soil Stabilizer	6DD1-UP, 6ED1-UP	KENR1622
RR-250 Road Reclaimer and SS-250 Soil Stabilizer	6DD222-UP, 6ED216-UP	KENR1700
RR-250B Road Reclaimer and SS-250B Soil Stabilizer	3RR, 5GR	KENR2968

Skidders

Table 14

Skidders			
Name	**Effectivity**	**Notes**	**Media Number**
515 and 525 Wheel Skidders	1DN980-UP, 4LR306-UP		RENR2147
515 and 525 Wheel Skidders	4LR, 1DN668-UP		SENR1360
515 and 525 Wheel Skidders	4LR, 1DN524-UP		SENR1361
517 Track-Type Skidder	5WW, 6PW		RENR2032

508 Skidder and Grapper Skidder	9NC1-UP, 2HD1-UP	See also Forest Machines	SENR3377
518 and 518 Series II Skidders 518 and 518 Series II Grapple Skidders	50S1-UP, 55U1-UP, 94U1-UP, 95U1-UP	See also Forest Machines	SENR5776
518C Skidder and 518C Grapple Skidder	1CL, 9HJ	See also Forest Machines	SENR5798
525 Wheel Skidder	1DN1-523	See also Forest Machines	SENR6694
525B and 535B Wheel Skidders	AAE1-457, 3KZ1-305	See also Forest Machines	RENR4343
525B and 535B Wheel Skidders	3KZ306-795, 3KZ797-874, AAE458-582		RENR6133
525B, 535B, and 545 Wheel Skidders	3KZ796, 3KZ875-UP, AAE583-UP, 2FZ433, 2FZ438-UP		RENR6164
525C, 535C & 545C Wheel Skidders	5251-UP, 5351-UP, 5451-UP		RENR8898
525C, 535C, & 545C Wheel Skidders	525-452-UP, 535-273-UP, 545-378-UP		KENR5808
525C, 535C, & 545C Wheel Skidders	5251-451, 5351-272, 5451-377		RENR8883
527 Track Skidder	2RS, 3DS, 4NS	See also Forest Machines	SENR8394
528B Skidder and 530B Grapple Skidder	5BK, 8SJ	See also Forest Machines	SENR5758
545 Wheel Skidder	2FZ1-356		RENR3053
545 Wheel Skidder	2FZ357-432, 2FZ434-437		RENR6134
D5H Series II Tractor and Tractor Skidder	7NC4000-UP, 3MD4000-UP, 8RC4000-UP, 4KD4000-UP, 9HC4000-UP, 7EG1-UP, 1DD4000-UP, 8RJ1-UP, 1YD4000-UP, 2SD4000-UP		SENR5253

Skid Steer

Table 15

Skid Steer		
Name	**Effectivity**	**Media Number**
216, 226, 228, 236, 246 and 248 Skid Steer Loaders	4NZ1-2499, 5FZ1-5199, 6BZ1-699, 4YZ1-3999, 5SZ1-3999, 6LZ1-999	RENR2863
216, 226, 228, 248 Skid Steers	4NZ2500-UP, 5FZ5200-UP, 6BZ700-UP, 6LZ1000-UP	RENR4826
236, 246, 252, 262, 267, 277 Skid Steers	4YZ4000-UP, 5SZ4000-UP, FDG, CED, CMP, CNC	RENR4823
232B, 242B, 252B, 262B, 216B, 226B, 236B, 246B, 248B, and 268B Skid-Steer Loaders and 247B, 257B, 267B, 277B, and 287B Multi Terrain Loaders	SCH1-UP, MJH1-UP, MTL1-UP, BXM1-UP, HEN1-UP, SLK1-UP, SCP1-UP, PAT1-UP, CYC1-UP, PDT1-UP, SCL1-UP, MDH1-UP, RLL1-UP, LBA1-UP, ZSA1-UP	RENR6419

Telescopic Material Handlers

Table 16

Telescopic Material Handlers		
Name	**Effectivity**	**Media Number**
246C/256C/262C/272C SSL, 277C/287C/297C MTL	**HAY1-UP, DWS1-UP, MST1-UP, RED1-UP, JWF1-UP, MAS1-UP, GCP1-UP**	**KENR5118**
M318C, M322 Magnetic Controller (12.5 KW)	**BDY, BDK, BEB ALL=2001-UP, H2E247-UP, H2F128-UP, H2G163-UP**	**RENR9516**
M318C, M322C, M322C Magnetic Controller (15KW)	**BEB2001-UP, BDK2001-UP, BDY2001-UP, H2E247-UP, H2G163-UP, H2F128-UP**	**RENR9518**
M318D MH, M322D MH Magnetic Controller	**WT21-UP, W8R1-UP**	**KENR8222**
M318D, M322D Magnetic Controller	**W2S1-UP, W8P1-UP**	**KENR6292**
325C, 325C MH	**NULL**	**RENR7398**
M325C Material Handler	**XJA1-UP, PAN1-UP USED IN SERV MANUAL RENR6650**	**RENR7852**

M332C Material Handler	**H2E1-UP, BDK2001-UP**	**RENR9136**
330D Material Handler	**(LEM, C5K) AURORA**	**RENR9928**
345C Material Handler	**M2R1-151**	**RENR9176**
345C Material Handler, W345C Material Handler with Fixed Cab Riser	**M2R152-UP, R5K1-UP**	**KENR6664**
365C L Material Handler	**GWC1-UP**	**RENR7912**
TH48FT-E80 Transmission	**FRT**	**KENR5890**
RT50, RT50 SA, RTC60, RT60, RT80 and RT100 Telescopic Material Handlers	4XG, 5DG, 5PF, 8DJ, 1GJ	SENB8383
TH31, TH35 Well Servicing	LAD1O7-UP, TZM118-UP, PZT226-UP, SKY133-UP	KENR6699
TH35 Well Servicing	MSB1-UP, LAD1-106, TZM1-117, PZT1-225, SKY1-132	KENR5188
TH62, TH63, TH82, TH83 and TH103 Telescopic Material Handlers	3JN1-UP, 3KN1-UP, 3LN-UP, 3NN-UP, 3PN-UP, 3RN1-UP, 4TM1-UP, 5WM1-UP	SENR5847
TH62, TH63, TH82, TH83 Telescopic Material Handlers	4TM, 5WM,3JN, 3KN, 3LN, 3NN, 3RN	RENR3404
TH103 Telescopic Material Handler	3PN530-995	RENR3405
TH62, TH63, TH82, TH83 Telescopic Material Handlers	4TM, 5WM, 3JN, 3LN, 3RN	RENR3407
TH103 Telescopic Material Handler	3PN837, 3PN944, 3PN990, 3PN996-UP	RENR3413
TH62, TH63, TH82, TH83 Telescopic Material Handlers	4TM4014-UP, 5WM6021-UP, 3JN1510-UP, 3RN4015-UP	RENR3415
TH103 Telescopic Material Handler	3PN2027-UP	RENR3416
TH210 and TH215 Telescopic Material Handler	CEC1-UP, CEG1-UP	RENR5164
TH210 & TH215 Telehandler	MHT1-UP,MHS1-UP	RENR7697
TH220B,THE330B and TH340B Telehandler	SLA850-UP, SLB1500-UP, SCL850-UP	RENR9851
TH220B, TH330B and TH340B	SLA1-UP, SLB1-UP, SLC1-UP	RENR7712

Telescopic Material Handler	[illegible]	[illegible]
TH350B and TH360B Telescopic Material Handler	SLD1-UP, SLE1-UP	RENR5193
TH350B & TH360B Telehandler	SLD1440-UP, SLE4500-UP	RENR9861
TH350B, TH355B, AND TH360B Telehandler	SLD600-1399, SLE1350-4499, JRK1-UP	RENR7924
TH460B Telescopic Material Handler	SLF1-UP	RENR7925
TH460B & TH560B Telehandler	SLF2100-UP, SLG1300-UP	RENR9862
TH560B Telescopic Material Handler	SLG1-UP	RENR7744
TH580B Telehandler	SLH900-UP	RENR9863
TH580B Telehandler	SLH1-UP	RENR7761
W345C Material Handler Hydraulic Cab Riser	M3M1-UP	RENR9859

Track-Type Loader

Table 17

Track-Type Loader		
Name	**Effectivity**	**Media Number**
931C and 935C Track Loader, D3C and D4C Tractors	3DF, 5DJ, 8CF, 1RJ, 1SG, 2CJ, 2XF, 7KG, 9BG, 1PJ, 3RF, 4HJ, 5CJ, 5KG, 5ZG, 6PF, 7JF, 7JG, 8BF, 8DG, 2AK, 2BJ, 5LG, 6AJ, 6RF, 7HF, 8AF, 9AG	SENR3812
931C and 935C Series II Track Loaders, D3C, D4C Series II and D5C Tractors	2AK1-UP, 3MK1-UP, 4HJ1-UP, 5CJ1-UP, 5DJ1-UP, 5ZG1-UP, 6AJ1-UP, 6PJ1-UP, 7KG1-UP, 7JG1-UP, 8DG1-UP, 9AG1-UP, 9BG10-UP	SENR5222
933 and 939 Track Loaders, D3C, D4C and D5C Series III Tractors	6SL, 6YL, 6ZL, 7SL, 7XL, 8ZS, 9DL, 8FL, 9EL, 9GL	SENR5356
933C and 939C Hystat Track Loaders, D3C, D4C and D5C Series III Hystat Track Tractors	4KS, 4TS, 5GS, 4LS, 6BS, 8CS, 5HS, 6CS, 7PS, 4MS, 5JS, 6DS	SENR1256
935B Track Loader and D4B Tractor	3DF, 5DJ, 8CF, 1RJ, 1SG, 2CJ, 2XF, 7KG, 9BG	SENR3474
953B Track-Type Loader	5MK	SENR5282
953C Track-Type Loader	BBX1-UP	RENR5653

953C Track-Type Loader	2ZN1750-UP	SENR1774
953C Track-Type Loader	2ZN1-1749	SENR8412
953C II Track-Type Loader	BBX600-1999	RENR5887
953C II Track-Type Loader	BBX2000-UP	RENR9880
953C II Track-Type Loader	BBX2000-UP	RENR8219
953D Track-Type Loader	LBP1-UP	KENR5179
953D Track-Type Loader	LBP1-UP	KENR5173
963B Track-Type Loader	9BL	SENR5312
963C Track-Type Loader	BBD1-UP	RENR5234
963C Track-Type Loader	2DS	SENR1832
963C Track-Type Loader	2DS1-UP	SENR1832
963C II Track-Type Loader	BBD2000-UP	RENR9879
963C Track-Type Loader	BBD858-1999	RENR5998
963D Track-Type Loader	LCS1-UP	KENR6378
963D II Track-Type Loader	LCS1-UP	KENR6374
963R Track-Type Loader	9BL	SENR1818
973 Track-Type Loader	86G3000-3187	SENR5372
973 Track-Type Loader	86G3188-UP	SENR1819
973C Track-Type Loader	3RZ1-UP	RENR3994

973C III Track-Type Loader	LDX	RENR8177
973C Track-Type Loader	BCP1-UP	RENR5244
973C Track-Type Loader	BCP1-128	RENR5254

Track-Type Tractor

Table 18

Track-Type Tractor		
Name	**Effectivity**	**Media Number**
D3B Special Application	2PC	SENR3190
D3C, D4C Tractors, 931C and 935C Track Loaders	3DF, 5DJ, 8CF, 1RJ, 1SG, 2CJ, 2XF, 7KG, 9BG, 1PJ, 3RF, 4HJ, 5CJ, 5KG, 5ZG, 6PF, 7JF, 7JG, 8BF, 8DG, 2AK, 2BJ, 5LG, 6AJ, 6RF, 7HF, 8AF, 9AG	SENR3812
D3C, D4C and D5C Series III Hystat Track Tractors / 933C and 939C Hystat Track Loaders	4KS, 4TS, 5GS, 4LS, 6BS, 8CS, 5HS, 6CS, 7PS, 4MS, 5JS, 6DS	SENR1256
D3C, D4C Series II and D5C Tractors 931C and 935C Series II Track Loaders	2AK1-UP, 3MK1-UP, 4HJ1-UP, 5CJ1-UP, 5DJ1-UP, 5ZG1-UP, 6AJ1-UP, 6PJ1-UP, 7KG1-UP, 7JG1-UP, 8DG1-UP, 9AG1-UP, 9BG10-UP	SENR5222
D3C, D4C and D5C Series III Tractors 933 and 939 Track Loaders	6SL, 6YL, 6ZL, 7SL, 7XL, 8ZS, 9DL, 8FL, 9EL, 9GL	SENR5356
D3G, D4G, and D5G Hystat Tractors	CFC1-UP, CFF1-UP, FDC1-UP, CFN1-UP, FDH1-UP, FDW1-UP	RENR5807
D4B Tractor and 935B Track Loader	3DF, 5DJ, 8CF, 1RJ, 1SG, 2CJ, 2XF, 7KG, 9BG	SENR3474
D4E and D6D Tractors	36C, 37C, 38C, 7XF, 8FJ, 31C, 34C	SENR2830
D4E Tractor	27X, 28X, 50X, 51X, 52X, 68X, 69X, 71X, 72X, 76W, 77W, 29X, 2CB, 70X	SENR7635
D4H Tractor	2AG1-521, 3AG1-581, 8BB1-2080, 9DB1-962	SENR3126

D4H Tractor	2AC1-521, 3AC1-581, 8PB1-2080, 9DB1-962	
D4H Tractor	2AC522-3999, 3AC582-3999, 8PB2081-3999, 9DB963-3999	SENR4238
D4H, D4H Series II and D4H Series III Tractors	2AC, 3AC, 4NK, 7PK, 8PB, 8PJ, 8ZF, 9DB, 9GJ	SENR5252
D5H Tractor	1DD596-3999, 1YD1-3999, 2SD1-3999, 3MD1-UP, 4KD1-3999, 7NC596-3999, 8RC1477-3999, 9HC252-3999	SENR4237
D5H Tractor	1DD1-595, 7NC1-595, 8RC1-1476, 9HC252-3999	SENR3262
D5H Series II Tractor and Track Skidders	7NC4000-UP, 3MD4000-UP, 8RC4000-UP, 4KD4000-UP, 9HC4000-UP, 7EG1-UP, 1DD4000-UP, 8RJ1-UP, 1YD4000-UP, 2SD4000-UP	SENR5253
D5M Tractor	6GN1-UP, 3CR1-UP, 5ES1-UP, 6AS1-UP	SENR8492
D5M Tractor	3DR, 4BR, 4JS, 5FS	SENR9472
D5B Tractor	22X, 23X, 24X, 25X, 43X, 44X, 45X, 46X, 47X, 48X, 49X, 5LD, 8HD, 8MB, 9RG, 21Y, 26X	SENR7558
D5N Track-Type Tractor	AKD1135-1673, AGG1335-2068, CFH300-UP, CKT400-UP	RENR8190
D6D and D6E Tractors	36C, 37C, 38C, 7XF, 8FJ, 03X, 04X, 06X, 19X, 20X, 30X, 31X, 32X, 33X, 74W, 75W, 7YK, 9FK	SENR5289
D6D Tractor	03X, 04X, 06X, 19X, 20X, 30X, 31X, 32X, 33X, 74W, 75W, 7YK, 9FK, 05X, 19B	SENR7444
D6E Tractor	2MJ	SENR3934
D6F SR, D6G PS, and D6G SR Tractors	2MJ, 3SR, 5FR	SENR8379
D6G2XL Track-Type Tractor	C6G1-UP	KENR6349
D6H Series II Tractor	1FJ, 1KD, 1YL, 2BL, 2DK, 2KD, 2TG, 2TL, 3ED, 3YG, 3ZF, 4GG, 4LG, 4RC, 4YF, 5HF, 5KK, 6CF, 6CK, 6FC, 7PC, 7ZK, 8FC, 8KB, 8KK, 8SK, 8YC, 8ZJ, 9KJ, 9LK, 9RK	SENR4955
D6H Tractor	1FJ1-481, 1KD1-3999, 1YL, 2BL, 2DK, 2KD1-3999, 2TG1-524, 2TL, 3ED1-3999, 3YG, 3ZF, 4GG, 4LG1-934, 4RC1-2444, 4YF, 5HF, 5KK, 6CF, 6CK, 6FC1-691, 7PC1-UP, 7ZK, 8FC1-3999, 8KB1-UP, 8KK, 8SK, 8YC1-UP, 8ZJ, 9KJ, 9LK, 9RK	SENR3247

D6H Tractor	1FJ482-5499, 1KD4000-5499, 1YL, 2BL, 2DK1-5499, 2KD4000-5499, 2TG525-5499, 2TL, 3ED4000-5499, 3YG1-5499, 3ZF1-5499, 4GG1-5499, 4LG935-5499, 4RC2445-5499, 4YF1-5499, 5HF1-5499, 5KK, 6CF1-5499, 6CK, 6FC692-5499, 7PC, 7ZK, 8FC4000-5499, 8KB, 8KK, 8SK, 8YC, 8ZJ, 9KJ, 9LK, 9RK,	SENR4236
D6K Track-Type Tractor	DHA1-UP, FBH1-UP	KENR5155
D6K Track-Type Tractor Hydraulic and Power Train System	DHA1-UP, FBH1-UP	KENR5152
D6M Tractor	2RN, 2YS, 4GS, 5WR, 9ZM	SENR8363
D6M Tractor	3WN, 4HS, 4JN, 5NR, 6LR	SENR8392
D6N Track-Type Tractor	CBF300-UP, CCG400-UP, ALH735-UP, CBJ400-UP, ALR635-UP	RENR8188
D6N Track-Type Tractor	JAH1-UP, DJA1-UP, JAL1-UP, DJY1-UP, ERL1-UP	KENR5142
D6N Track-Type Tractor	CCK1-UP, CBL1-UP, AKM1-UP, CCS1-UP, ALY1-UP	RENR8189
D6N Track-Type Tractor Power Train System	DJA1-UP, JAH1-UP, ERL1-UP, JAL1-UP, DJY1-UP	KENR5136
D6R Series II D/S Track-Type Tractor	ADE646-UP, AFM140-UP, AEP435-UP, AAX797-UP	RENR8191
D6R Series III Track-Type Tractor Power Train System	GJB, WCB, HDC, RFC, TBC, HCD, HKE, WRG, MTJ, DMK, JDL, DLM, LFM, DPS, GMT, MRT	RENR7954
D6R Tractor (Diff Steer)	1RW, 3ZN, 4FM, 4TR, 5LN, 5PR, 5RR, 7CR, 7DR, 7GR, 7KN, 8TM, 9BM, 9MN, 9PN	SENR1729
D6R Tractor (Electronic Clutch Brake)	2HM, 2YN, 4HN, 4JR, 4MN, 4WR, 6FR, 6GR, 6HR, 6JN, 6MR, 7AR, 8LN, 6XN, 9ZS	SENR1728
D6R Tractor	1BN, 1HN, 2DM, 2DN, 2FN, 2GM, 2GN, 2HN, 2SN, 3BM, 3EN, 3FN, 3GN, 3HN, 4DM, 4EN, 4F, 4GN, 4WN, 5DM, 5SN, 5WN, 6GM, 6SN, 7DN, 7GM, 7TN, 8DM, 8HM, 8NN, 9CN, 9EN	SENR8362
D6R Series II Tractor	BLE, BMJ	RENR4263
D6R Series II Tractor	BNC, DAE, BLT, BMY	RENR4277

D6R Series II Tractor	BNC1-UP, ADE1-UP, BRE1-UP, DAE1-UP, BNL1-UP, AFM1-UP, BPM1-UP, AEP1-UP, BLT1-UP, FDT1-UP, AAX1-UP, BMY1-UP, BPZ1-UP, BRZ1-UP	RENR4277
D6R Series II Tractor	AFD1-UP, CAD1-UP, BLE1-UP, ACJ1-UP, BMJ1-UP, BRJ1-UP, BMK1-UP, AEM1-UP, AGM1-UP, BPP1-UP, BPS1-UP	RENR4263
D6T Track-Type Tractor Power Train System	JHB, ZEB, SMC, JWD, LBD, LAE, DJG, WCG, WFH, LKJ, SNK, DHL, KJL, SKL, KLM, GCT	KENR5125
D6T Track-Type Tractor with Accugrade	JHB, SMC, PEZ, DHL, LAY, GCT, LAE, KLM, SKL, LBD, RAY, KJL, LKJ, SNK, WFH, ZEB	KENR5131
D7 Series II Track-Type Tractor Power Train System	AEC1500-UP, AGN1500-UP, ABJ1500-UP	RENR7097
D7G2 XL Track-Type Tractor	C7G1000-UP	KENR6359
D7G Tractor (SA)	35N	SENR2197
D7H Tractor	2RG4000-UP, 3XG4000-UP, 4AB4000-UP, 4FG4000-UP, 5BF4000-UP, 5WB4000-UP, 79Z4000-UP, 80Z4000-UP	SENR5284
D7H Tractor	2SB1-UP, 4AB1-UP, 5WB1-UP, 77Z1-UP, 79Z1-UP, 80Z1-UP, 82Z1-UP	SENR4182
D7R Series II Tractor	AFG1-UP, ACS1-UP, ADW1-UP	RENR3662
D7R Tractor (Differential Steer)	2EN, 3DN, 5MR, 6ER	RENR2013
D7R Tractor (Electronic Clutch Brake)	2HR, 3ZR, 4SR, 9HM	RENR2012
D7R Tractor	2EN, 2HR, 3DN, 9HM	SENR1711
D8K Tractor	66V, 76V, 77V	SENR2130
D8L Tractor	4FB, 53Y, 7JC, 7YB	SENR3279
D8L Tractor	53Y	SENR2342
D8N Tractor	5TJ1-UP, 7TK1-UP	SENR5209
D8N Tractor	1XJ1-UP, 9TC1-UP	SENR3417

D8R Tractor	7XM, 9EM	SENR8332
D8R Tractor	AKA, 6YZ	RENR3682
D8T Track-Type Tractor	J8B1-UP, KPZ1-UP	RENR7530
D8T Track-Type Tractor Power Train System	KPZ1-UP, J8B1-UP	RENR7525
D9L Tractor	14Y3134-UP	SENR3221
D9L Tractor	14Y1-3133	SENR2103
D9N Tractor	6XJ1-UP	SENR5294
D9N Tractor	1JD1-UP	SENR3449
D9N Tractor	1JD1687-UP	RENR9856
D9R Tractor	7TL1-851, 8BL1-1052, 48W1-UP	SENR5392
D9R Tractor	48W1-UP, 7TL852-UP, 8BL1053-UP	SENR9414
D9R Tractor	ABK, ACL	RENR3947
D9R Tractor	ABK, ACL	RENR3948
D9R Tractor With 3408C Engine	JJB1-UP	RENR6500
D9R Tractor With 3408E Engine	7TL1-851, 8BL1-1052, 99C1-UP	SENR5315
D9R Tractor With 3408E Engine	7TL852-UP, 8BL1053-UP, 99C1-UP	SENR8459
D9R Track-Type Tractor	WDM1-UP	RENR8183
D9T Track-Type Tractor	RJS1-UP	RENR7875
D9T Track-Type Tractor		RENR8167

Power Train Oil	RJS1-UP	
D10 Tractor	76X, 84W	SENR7494
D10N Tractor	3SK1-UP	SENR5283
D10N Tractor	2YD1-UP	SENR3521
D10R Tractor	3KR939-UP	SENR1864
D10R Tractor	3KR1-UP	SENR8427
D10R Tractor	AKT1-UP	RENR3932
D10R Track-Type Tractor	AKT694-UP	RENR8195
D10T Track-Type Tractor	RJG1-UP	RENR8164
D10T Track-Type Tractor Power Train Oil	RJG1-UP	RENR8168
D11N Tractor EUI Engine Retrofit	4HK, 74Z	SENR8413
D11N Tractor	4HK, 74Z	SENR5254
D11N Tractor	1DD, 1YD, 2SD, 3MD, 4KD, 7EG, 7NC, 8RC, 8RJ, 9HC	SENR5253
D11N Tractor	74Z730-UP	SENR4706
D11N Tractor	74Z1-729	SENR3292
D11R Carrydozer Tractor	9XR	SENR9455
D11R Tractor	9TR, 9XR	SENR1787
D11R Tractor	8ZR	SENR9412
D11R and D11R Carrydozer Tractor	7PZ, AAF	RENR2047

D11R & D11R CD Track-Type Tractor	7PZ881-UP, AAF228-UP	KENR8226

Wheel Tractor Scrapers

Table 19

Wheel Tractor Scrapers		
Name	**Effectivity**	**Media Number**
613B Wheel Tractor-Scraper	38W, 72M	SENR7316
613C Wheel Tractor-Scraper	92X, 93X	SENR2786
613C Wheel Tractor-Scraper	8LJ, 93X	SENR5619
613C Series II Wheel Tractor Scraper & 613C Series II Wheel Tractor Scraper	KEH, TJK, LCZ	RENR9838
613C Series II Wheel Tractor Scraper & 613C Series II Wheel Tractor Scraper	KEH, TJK, LCZ	RENR9839
613C Series II Wheel Tractor Scraper Water Distribution	KEH,TJK,LCZ	RENR9837
615 Wheel Tractor-Scraper	46Z, 47Z	SENR2785
615C Wheel Tractor-Scraper	2XG898-UP, 9XG1-UP	SENR5694
615C Wheel Tractor-Scraper	2XG, 5TF	SENR3858
621B and 623B Tractor-Scraper	45P2474-UP, 46P1487-UP	SENR2123
621B and 623B Wheel Tractor	35V985-UP, 45P1742-2473, 46P995-1486	SENR7645
621E and 623E Wheel Tractor-Scraper	6AB1428, 6YF197	SENR8631
621E and 623E Wheel Tractor-Scraper	6AB1-UP, 6BB1-UP, 6CB1-UP, 6DB1-UP	SENR3314
621E and 623E Wheel Tractor-Scraper	6AB, 6BB, 6CB, 6DB	SENR3302

621F and 623F Wheel Tractor-Scraper	4SK, 5JK, 8PL, 9NL, 6BK, 5SG480-UP	SENR6393
621G Wheel Tractor-Scraper	CEN300-UP, CEP300-UP (2 VOLUME)	RENR8474
621G Wheel Tractor-Scraper	DBB, DBX (2 VOLUME)	RENR8491
621R Wheel Tractor-Scraper	12Y, 31V	SENR2236
621S WWheel Tractor-Scraper	2TF, 8KD	SENR3669
623F Wheel Tractor-Scraper	5EW, 3XW1-UP	RENR1447
623G Wheel Tractor-Scraper	CES500-UP, CEW500-UP	RENR8475
623G Wheel Tractor-Scraper	DBC, DBY	RENR8492
621G Wheel Tractor-Scraper	CEN1-UP, CEP1-UP	RENR4245
611 Wheel Tractor-Scraper	6SZ1, 7WZ1-UP	RENR1497
621G Wheel Tractor-Scraper	ALP1, ANG1	RENR1514
623G Wheel Tractor-Scraper	ARW1, AWB1	RENR1532
623G Wheel Tractor-Scraper	CES1-UP, CEW1-UP	RENR4246
627G Wheel Tractor-Scraper	AXF1, AYK1	RENR1542
627B Wheel Tractor-Scraper	37V1-510, 38V1-525	SENR7347
627B Wheel Tractor-Scraper	14S905-939, 15S1238-1310	SENR2000
627B Wheel Tractor-Scraper	14S940-1079, 15S1311-1550	SENR2067
627B Wheel Tractor-Scraper	14S1080-UP, 15S1551-UP	SENR2551
627B Wheel Tractor-Scraper	37V511-579, 38V525-688	SENR7348

627B Wheel Tractor-Scraper	14S703-904, 15S961-1237, 34V554-UP, 56V453-UP	SENR7646
627B Wheel Tractor-Scraper	37V521, 559, 560, 562, 563, 565, 570-574, 576, 577, 580-UP, 38V617, 627,628, 631, 640, 643, 645-648, 653, 654, 656, 657, 661, 662, 665, 666, 667, 670, 672, 675, 678, 680, 682, 684, 685, 686, 689-UP	SENR7349
627E Wheel Tractor-Scraper	7CG1-UP	SENR4787
627E Wheel Tractor-Scraper	6EB1-UP, 6FB1-UP, 6GB1-UP, 6HB1-UP	SENR3330
627E Wheel Tractor-Scraper Power Train (With Electronic Power Shift Transmission Control For ICM)	6EB, 6FB,6GB,6HB	SENR3326
627E Wheel Tractor-Scraper	6EB524-600, 6GB617-726, 6FB, 6HB	RENR7694
627E Wheel Tractor-Scraper	6EB601-UP, 6GB727-UP, 6FB, 6HB	RENR8109
627F Wheel Tractor-Scraper	4YK, 1DL	SENR6394
627G Wheel Tractor-Scraper	CEX400-UP, CEZ400-UP (2 VOLUME)	RENR8476
627G Wheel Tractor-Scraper	DBD, DBZ	RENR8493
627G Wheel Tractor-Scraper	CEX1-UP, CEZ1-UP	RENR4247
631D and 633D Wheel Tractor-Scraper	24W1355-2428, 25W498-728, 28W, 29W, 39W, 66W, 68W, 19W, 25W	SENR7647
631D and 633D Wheel Tractor-Scraper	24W2629-UP, 25W729-UP, 28W, 29W, 39W, 66W, 68W, 19W, 25W	SENR2068
631D Wheel Tractor-Scraper	24W1-UP, 28W1-UP, 29W1-UP, 39W1-UP, 66W1-UP, 68W1-UP	SENR7350
631E Wheel Tractor-Scraper	1AB, 1BB	SENR3626
631E Series II Wheel Tractor-Scraper and 631E Series II Tractor With 633E Elevating Scraper	1AB1446-1639, 1NB872-1389, 1BB1289-1539, 6PC669-1209, 1EB1-309	SENR5699
631E Series II Wheel Tractor-Scraperand 633E Series II Wheel Tractor-Scraper	1AB, 1NB, 2PS, 1BB, 6PC, 1EB	SENR9056

Tractor-Scraper		
631E Wheel Tractor-Scraper	1AB1-643, 1NB1-613, 1BB1-1288	SENR4154
631E Wheel Tractor-Scraper Power Train (Equipped With Electronic Power Shift Transmission Control For ICM Type Transmission)	1AB, 1BB	SENR4142
631G Wheel Tractor-Scraper	AWK, AXZ	RENR1597
631G Wheel Tractor-Scraper	CLR1-UP, CMT1-UP	RENR5725
631G Wheel Tractor-Scraper	DFA, DEM	RENR8494
631G Wheel Tractor-Scraper	CLR400-UP, CMT400-UP (2 VOLUME)	RENR8477
633D Tractor-Scraper	19W, 25W	SENR7351
637D Tractor-Scraper	20W, 21W, 22W, 23W, 26W488-UP, 27W1314-UP, 4JB, 70W, 71W	SENR2069
637D Wheel Tractor-Scraper	20W1-UP, 21W1-UP, 22W1-UP, 23W1-UP, 26W1-385, 27W1-651, 67W1-316, 69W1-UP, 70W1-UP, 71W1-432	SENR7352
637D Wheel Tractor-Scraper	26W386-UP, 27W652-UP, 67W317-UP, 71W433-UP	SENR7648
637D Wheel Tractor-Scraper	26W443-487, 27W1090-1313	SENR7900
637E Wheel Tractor-Scraper (With Neutral Start Control)	1FB, 1HB, 1JB, 1LB, 7CB	SENR3625
637E Series II Wheel Tractor-Scraper	1FB660, 7CB180, 1HB691	SENR9057
637E Series II Wheel Tractor-Scraper	1FB, 7CB, 1HB	SENR6374
637E Wheel Tractor-Scraper	1JB1-478, 1LB1-UP	SENR4162
637E Wheel Tractor-Scraper Power Train	1FB, 7CB, 1HB, 1JB, 1LB	SENR4159
637G Wheel Tractor-Scraper	AXT, AYN, AWE	RENR4069
637G Wheel Tractor-Scraper	CEH1-UP, CEJ1-UP, CEM1-UP	RENR5735

637G Wheel Tractor-Scraper	CEH1-UP, CEJ1-UP, CEM1-UP	
637G Wheel Tractor-Scraper	DFJ, DEX, DEY- 36 PAGES EACH	RENR8495
637G Wheel Tractor-Scraper	CEH350-UP, CEJ350-UP, CEM230-UP (2 VOLUME)	RENR8478
639D Wheel Tractor-Scraper	88X, 99X	SENR2063
641B and 651B Tractor-Scraper	18G, 22G, 42M, 43M, 45M, 8K, 65K, 67K	SENR7649
651E Wheel Tractor-Scraper	4YR, 5XR	SENR9092
651E Wheel Tractor-Scraper	88Z239-UP, 89Z271-UP	SENR6814
651E Wheel Tractor-Scraper	88Z239-UP, 89Z271-UP	SENR3092
651EWheel Tractor-Scraper Power Train Equipped With Electronic Powershift Transmission Control For ICM (Individual Clutch Modulation) Type Transmission	88Z1-UP, 89Z1-UP	SENR3057
657B Wheel Tractor-Scraper	68K1065, 68K1067, 8K1068, 68K1073, 68K1125	SENR7854
657B Wheel Tractor-Scraper	68K1126-UP	SENR7825
657B Wheel Tractor-Scraper	68K1033, 68K1039, 68K1040, 68K1043, 68K1046-1051, 68K1054-1056, 68K1058-1072	SENR7650
657B Wheel Tractor-Scraper	68K1229-UP	SENR2125
657E Wheel Tractor-Scraper Power Train Equipped With Electronic Powershift Transmission Control For ICM (Individual Clutch Modulation) Type Transmission	6MB, 86Z, 87Z, 90Z, 91Z	SENR3628
657E Wheel Tractor-Scraper	90Z, 91Z, 86Z, 6MB	SENR3627
657E Wheel Tractor-Scraper	5YR1-UP, 6TR1-UP, 6PR1-UP, 7KR1-UP	SENR9093
657E Wheel Tractor-Scraper	90Z225-UP, 91Z461-UP, 86Z428-UP, 6MB168-UP	SENR6392

657E Wheel Tractor-Scraper	86Z1-UP, 90Z1-UP, 91Z1-UP	SENR3093
657E Wheel Tractor-Scraper Power Train With Electronic Power Shift Transmission Control For ICM	6MB, 86Z, 87Z, 90Z, 91Z	SENR3058
657G Wheel Tractor-Scraper	W1B, W1C, W1E, W1F,A4G,GER,- 2 VOLS. VOL 1=42,VOL 2=36	RENR8490

Wheel Tractors

Table 20

Wheel Tractors		
Name	**Effectivity**	**Media Number**
772B Wheel Tractor and 773 Truck	64W155-UP, 63W762-UP (EXCLUDING 63W769)	SENR2317
772B Wheel Tractor and 773B Truck	64W168-64W180, 63W1221-63W3295	SENR2926
784C Wheel Tractor and 785C Truck	APX	RENR2640
814B Tractor, 815B and 816B Compactors	15Z159-UP, 16Z103-UP, 17Z97-UP	SENR2588
814B Wheel Tractor, 815B and 816B Compactors	15Z1-158, 16Z1-102, 17Z1-96	SENR2587
814F Wheel Tractor, 815F Soil Compactor and 816F Landfill Compactor	9DM, 1GN, 5FN	SENR1319
814F Wheel Tractor, 815F Soil Compactor and 816F Landfill Compactor	BGF1-UP, BKL1-UP, BMR1-UP	RENR6107
814F, 815F & 816F Series II Compactor	BXG1-UP, BYN1-UP, BZR1-UP	RENR8979
824C Tractor, 825C and 826C Compactors	85X763-1193, 86X507-730, 87X249-586	SENR2586
824C Wheel Tractor, 825C and 826C Compactors	85X564-762, 86X430-506, 87X183-248	SENR2585
824C Tractor and 825C Compactor	85X, 86X	SENR4731
824C Tractor, 825C and 826C		SENR2552

824C Tractor, 825C and 826C Compactors	85X1-563, 86X1-429, 87X1-182	SENR2592
824G Series II Wheel Tractor, 825G Series II Soil Compactor and 826G Series II Landfill Compactor	AWW1-UP, AXB1-UP, AYH1-UP	RENR4374
824G Wheel Tractor, 825G Soil Compactor and 826G Landfill Compactor	4SN, 6RN, 7LN	SENR1339
824H/825/826H	ASX1-UP, ZBD1-UP, AZW1-UP, ZHC1-UP, AWF1-UP, ZXT1-UP	RENR6374
826C Compactor	87X587-UP	SENR4732
844 Wheel Tractor	2KZ	RENR2138
834B Wheel Tractor and 836 Landfill Compactor	7BR1-UP, 7FR1-UP	SENR5897
834B Wheel Tractor	3RL, 92Z	SENR2617
834B Wheel Tractor and 836 Landfill Compactor	7BR1-UP, 7FR1-UP	SENR5897
834G Wheel Tractor, 836G Landfill Compactor, and 988G Wheel Loader (2 vol.)	6GZ1-UP, 7MZ1-UP, 2TW1-UP	RENR2195
834G Wheel Tractor, 836 Landfill Compactor, and 988G Wheel Loader	BPC1-UP, BRL1-UP, BNH1-UP	RENR6268
834G Wheel Tractor, 836G Landfill Compactor, 988G Wheel Loader	BPC1-UP, BRL479-UP, BNH1-UP	KENR6291
834H Wheel Dozer and 836H Landfill Compactor	BXD, BTX, XDC,XTR	RENR6369
834H/836H/988H	XDC, BTX, BXD, XTR, 409, BXY	RENR6223
844H Wheel Dozer & 990H Wheel Loader	BTW1-UP,BWX1-UP	RENR8827
854G Wheel Dozer & 992G Wheel Loader	A4W1-UP, AZX1-UP	RENR6317
854G Wheel Tractor	1JW	RENR2130
902 and 906 Compact Wheel Loader	6ZS, 7ES	SENR1295

902, 906, and 908 Compact Wheel Loaders	7ES1-1112, 6ZS1-2443, 8BS1-1206	RENR4805
902, 906 and 908 Compact Wheel Loader	7ES1113-UP, 6ZS2444-UP, 8BS1207-UP	RENR4860
902, 906, 908 Compact Wheel Loader	7ES1200, 6ZS2900, 8BS1400	RENR9860
904B Compact Wheel Loader	B4L1-UP	RENR9763
906 & 908 Compact Wheel Loader	MER1-UP, TAR1-UP	RENR6463
908 Compact Wheel Loader	8BS1	RENR2838
910F Wheel Loader	1SF	SENR5945
910G Hystat Wheel Loader	AKR	RENR3561
914G & IT14G	NULL	RENR6499
914G Wheel Loader and IT14G Integrated Toolcarrier	1WN, 7ZM, 8ZM, 9WM	SENR1278
914G Wheel Loader and IT14G Integrated Toolcarrier	7ZM, 9WM, 8ZM, 1WM	SENR6777
916 Wheel Loader	5KC1-UP	SENR4164
916 Wheel Loader	9WB1-UP	SENR4134
916 Wheel Loader with Roading Arrangement	9WB1-UP	SENR4163
918F Wheel Loader	2CK, 3TJ, 5DL	SENR5775
922G Wheel Loader and 854G Wheel Tractor	ADZ, AMP	RENR4300
924F Wheel Loader	4YN, 5NN, 6MN, 7PN	SENR6735
924G, 924GZ Wheel Loaders	AAB, AAN, 3DZ, 3PZ, 6YW, 9SW	RENR3514
924G and 928G Wheel Loader and	DDA1-UP, WGX1-UP, WAC1-UP, RTA1-UP, DFZ1-UP, DBT1-UP, RBB1-UP, DJD1-UP	RENR6434

1T28G Integrated Toolcarrier	WMB1-UP, WLG1-UP	
924G/924GZ, 928G, 930G Wheel Loader	DDA1623-UP, RBB734-UP, RTA325-UP, DJD1547-UP, TWR1-UP	RENR8733
924G/924GZ/928G/930G Wheel Loader & IT28G Integrated Tool	WMB655-UP, WLG590-UP, WAC494-UP, TFW1-UP	RENR9695
926 and 926E Wheel Loaders	4NB1-UP	SENR4124
926 and 926E Wheel Loaders	4NB1-UP	SENR4125
926 and 926E Wheel Loaders	94Z1-UP	SENR3075
928F Wheel Loader	2XL, 8AK	SENR5969
928G Wheel Loader and IT28G Integrated Toolcarrier	6XR, 7SR, 8CR, 9AR	SENR1229
928G Wheel Loader and IT28G Integrated Toolcarrier	6XR, 7SR, 8CR, 9AR	SENR1277
936 and 936E Wheel Loaders	33Z586-UP	SENR4128
936 Wheel Loader	33Z1-585	SENR2922
936F Wheel Loader	8AJ	SENR5245
936F Wheel Loader	4TK	SENR5246
936F Wheel Loader	4TK	SENR6736
938G Wheel Loader and IT38G Integrated Toolcarrier	4SY1878-UP, 6WS2579-UP, 9HS801-UP, 7BS900-UP, 1CW391-UP	RENR4326
938G A Wheel Loader and IT38G Integrated Toolcarrier	CRD1-UP, CSX1-UP, RTB1-UP, PHN1-UP, B9Y1-UP	RENR6082
938G A Wheel Loader and IT38G Integrated Toolcarrier	4SY1-1877, 1CW1-390, 6WS1-2578, 8RS1-UP, 9HS1-800, 7BS1-899	SENR6679
938F Wheel Loader and IT38F Integrated Toolcarrier	1KM, 2RM, 8SM, 7SN, 5DR, 6FN	SENR6716
950F Wheel Loader	4DJ, 6YG, 7ZF	SENR4935
		SENR6695

950F Series II Wheel Loader	8TK2704-UP	SENR6695
950F Series II Wheel Loader	4DJ, 5SK, 8TK	SENR5919
950 Series II Wheel Loader	8TK, 5SK, 4DJ, 2LM, 9ZJ, 4CL, 6XL, 1YM	SENR6676
950F Series II and 960F Wheel Loaders	4DJ, 5SK, 8TK, 2LM, 9ZJ, 4CL, 6XL, 1YM	SENR6677
950G/962G Wheel Loaders EH/CCS STRG	2JS1-1499, 6NS1-399, 3BS1-799, 4BS1-706, 5AS1-400, 5RS1-402	RENR2140
950G and 962G Wheel Loaders	2JS1500-UP, 4BS707-UP, 6NS400-UP, 3BS800-UP, 5AS401-UP, 5RS403-UP	RENR4327
950G and 962G Wheel Loaders and IT62G Integrated Toolcarrier	3JW2154-UP, 4PW504-UP, AKP513-UP, 5FW2000-UP, 6EW800-UP, 8JW407-UP, 6HW415-UP, 5MW1078-UP, 7BW624-UP	RENR4328
950G and 962G Wheel Loaders and IT62G Integrated Toolcarrier	3JW1-2153, 4PW1-503, AK1-512, 5FW1-1999, 7BW1-799, 6PS1-UP, 8JW1-406, 6EW1-414, 5MW1-1077, 6HW1-623	SENR1393
950G and 962G Wheel Loaders	AYB-UP, AYD1-UP, AXR1-UP, AYE1-UP, AYG1-UP, AXS1-UP,	RENR4362
950G and 962G Series II Wheel Loaders and IT62G Series II Integrated Toolcarrier	AXX1-UP, AXY1-UP, AYA1-UP, AYL1-UP, BAB1-UP, AYS1-UP, BAC1-UP, BAA1-UP, BAD1-UP	RENR4324
950G and 962G Series II Wheel Loaders	AYB1-UP, AYE1-UP	RENR4362
950H, 962H, AND IT62H Wheel Loader	N1A, M1G, J5J, K5K, N4A, M3G, J6J, K6K, M5G	RENR8882
966F Wheel Loader	4YG, 3XJ, 8BG	SENR4759
966F Wheel Loader	8BG2000-2339, 9YJ1-1077, ISL1-506	SENR5919
966F Wheel Loader	8BG2000-2339, 9YJ1-1077, ISL1-506	SENR5924
966F Series II and 970F Wheel Loader	8BG2340-2680, 7S5224-545, 9YJ1078-2123, 9JK359-470, 1SL507-1343, 7PL139-195	SENR6637
966F Series II and 970F Wheel Loaders	9YJ, 1SL, 8BG, 7SK, 9JK, 7PL	SENR6678
966G, 972G Wheel Loaders Pilot/Converter STRG	3PW, 3SW, 4WW, 6AW, 8XW, 9GW	RENR2118

966G, 972G Wheel Loaders EH/CCS STRG	AAH, 3ZS, 7LS, 9RS, AAW, 1EW	RENR2174
966G and 972G Wheel Loaders	AAH511-UP, 3ZS709-UP, 7LS405-UP, 9RS1400-UP, 1EW700-UP, AAW402-UP	RENR4329
966G and 972G Series II Wheel Loaders	ANT1-UP, AWY1-UP, AXC1-UP, ANY1-UP	RENR4363
966G and 972G Series II Wheel Loaders	3PW1100-UP, 3SW1225-UP, 4WW720-UP, 6AW500-UP, 8XW756-UP, 9GW508-UP	RENR4375
966G and 972G Series II Wheel Loaders	AXJ1-UP, AXN1-UP, AXL1-UP, AXP1-UP, ANZ1-UP, AWP1-UP	RENR4399
966H/972H Wheel Loader	A6D1-UP, A7D1-UP, A6G1-UP, A7G1-UP, A6J1-UP, A7J1-UP	RENR6332
970F Wheel Loader	7SK1-223, 9JK1-358, 7PL1-138	SENR6636
972G Series II Custom Transmission and Parking Brake Override	AXN, AWP, AXP	RENR6329
980C Wheel Loader	2XD1703-UP, 63X9120-UP	SENR1397
980F Wheel Loader	3HK, 8CJ, 5XJ1-587	SENR5225
980F Series II Wheel Loader	5XJ588-UP	SENR6658
980 Series II Wheel Loader	4RN	SENR6758
980F Series II Wheel Loader	8JN	SENR6759
980G Wheel Loader	9CM1-1759, 2KR1-3721, 2SR1-820	SENR5886
980G Wheel Loader	9CM17600-UP, 2KR3722-UP	RENR4301
980G Wheel Loader	9CM2034-UP, 2KR4553-UP, 2SR821-UP	RENR4376
980G Series II Wheel Loader	AWH1-UP, AXG1-UP, AYT1-UP	RENR4361
980G Series II Wheel Loader	AXG1-UP	RENR9858
980H Wheel Loader	MHG1-UP, A8J1-UP, JMS1-UP	RENR8682

988B Wheel Loader	50W1-50W6040 (EXCLUDING 50W6013)	SENR7333
988F Wheel Loader	8YG1-UP	SENR5738
988F Series II Wheel Loader	2ZR	SENR5887
990 Wheel Loader	7HK	SENR6656
990 Series II Wheel Loader and 844 Wheel Tractor	BCR, BBN	RENR6263
990 Series II Wheel Loader	4FR	SENR1302
990H Wheel Loader Hydraulic System	BWX1-UP	RENR8824
992 Wheel Loader	7MJ1-UP	SENR5718
992C Wheel Loader	49Z932-UP	SENR4761
992G Wheel Loader	7HR	SENR1343
994 Wheel Loader	9YF28-UP	SENR5929
994D Wheel Loader (2 vol.)	3TZ1-UP	RENR2516
994 Wheel Loader VIMS	9YF56-UP	SENR1439
994 Wheel Loader (2 vol.)	9YF	RENR3307
994F Wheel Loader	4421-UP	RENR6322

Event Code List

SMCS - 7569

Event codes alert the operator or the technician that an abnormal operating condition exists in one of the machine systems.

When an Electronic Control Module (ECM) activates an event code, the operator or the technician will be alerted by the Messenger. Most active events will be logged by the ECM. Some events are active only. Active only events are not logged. The events that are active and the events that are logged can be viewed with the following equipment:

- Messenger
- Caterpillar Electronic Technician (Cat ET)

Warning Levels

The ECM will assign a warning level to an active event code. Event codes are one of three levels. The level is according to the severity of the abnormal condition. Each warning level requires a specific response from the operator. The warning levels and the required operator response are listed below.

Warning Level 1

Warning level 1 alerts the operator that a machine system requires attention. The operator should check the involved system condition or the operator should perform maintenance on the involved system at the earliest possible time.

Warning Level 2

Warning level 2 requires changing the operation of the machine or performing a maintenance procedure. Failure to correct a problem that has caused this warning may result in damage to the components that are involved in the system.

Warning Level 2S

Warning level 2S requires an immediate change in machine operation in order to avoid possible damage to the system.

Warning Level 3

Warning level 3 requires an immediate safe shutdown of the machine in order to avoid damage to the machine or injury to personnel around the machine. The problem that caused the event must be corrected before machine operation can resume.

Indications and System Response

Caterpillar Electronic Technician (Cat ET) Service Tool

When an abnormal operating condition occurs, the status screen on the Cat ET indicates that there is an active event.

Event codes are displayed on Cat ET in the following format:

EXXXX Description of the code

The "E" means that the code is an event code. The "XXXX" is a numeric identifier. The numeric identifier is followed by a description of the code.

Active event codes are listed in ascending numerical order. The code with the lowest number is listed first. The active event code is removed from the list when the condition is no longer present.

Logged Event Codes

Some event codes are logged in the ECM memory. Some event codes are active only. The logged event codes are listed in chronological order. The most recent code is listed first.

A logged code is cleared from memory when one of the following conditions occur:

- The service technician manually clears the code.
- The code does not reoccur for 1000 hours.
- A new code is logged and there are already ten logged codes in memory. In this case, the oldest logged code is cleared.

Note: Always clear logged event codes after investigating and correcting the problem which generated the code.

List of Event Codes

The following table lists event codes and the recommended responses. Use the Cat ET service tool in order to determine the event codes that are active or logged.

Table 1

List of Event Codes (EID)			
EID	**Level**	**Description**	**Possible Cause and Recommended Response**
861	1	Synchronized clock notification of manual synch required	In a PL321 system using sync-clock and Product Link is not the master ECM, the Product Link module will automatically sync to the master ECM hours if the difference is not greater than 50 hours. If the difference is greater than 50 hours, a diagnostic will be generated in Cat ET that indicates that a manual sync is required. In that instance, sync the hours. In Cat ET, use "Service/Synchronize Service Meter Hours".
2131	2	Inclusion Geo-Fencing boundary violated	Inclusive Geo-Fence sets up a "virtual fence" around a work site. Once Inclusive Geo-Fence is activated, a report is generated if the machine leaves the work site area. No repair or service is required.

2132	2	Exclusion Geo-Fencing boundary violated	Exclusive Geo-Fence sets up a "virtual fence" around areas that the machine is not allowed to enter. A report is generated if a machine enters a restricted area. No repair or service is required.
2133	2	Time-Fencing boundary violated	Time Based Fence allows the owner of a machine to choose the time that a machine can be operated. A report is generated if the machine is operated outside of the time that is set for machine operation. No repair or service is required.
630	2	Switched Sensor #1 trip condition is activated	The Product Link PL300 has four additional inputs that can be configured in order to monitor switches on the machine. These inputs can be configured by using Caterpillar Electronic Technician (Cat ET service tool). Troubleshoot input as setup by the dealer.
631	2	Switched Sensor #2 trip condition is activated	The Product Link PL300 has four additional inputs that can be configured in order to monitor switches on the machine. These inputs can be configured by using Caterpillar Electronic Technician (Cat ET service tool). Troubleshoot input as setup by the dealer.
632	2	Switched Sensor #3 trip condition is activated	The Product Link PL300 has four additional inputs that can be configured in order to monitor switches on the machine. These inputs can be configured by using Caterpillar Electronic Technician (Cat ET service tool). Troubleshoot input as setup by the dealer.
633	2	Switched Sensor #4 trip condition is activated	The Product Link PL300 has four additional inputs that can be configured in order to monitor switches on the machine. These inputs can be configured by using Caterpillar Electronic Technician (Cat ET service tool). Troubleshoot input as setup by the dealer.

Event Code List

SMCS - 7569

Event codes alert the operator or the technician that an abnormal operating condition exists in one of the machine systems.

When an Electronic Control Module (ECM) activates an event code, the operator or the technician will be alerted by the Messenger. Most active events will be logged by the ECM. Some events are active only. Active only events are not logged. The events that are active and the events that are logged can be viewed with the following equipment:

- Messenger
- Caterpillar Electronic Technician (Cat ET)

Warning Levels

The ECM will assign a warning level to an active event code. Event codes are one of three levels. The level represents the severity of the abnormal condition. Each warning level requires a specific response from the operator. The warning levels and the required operator response are listed below.

Warning Level 1

Warning level 1 alerts the operator that a machine system requires attention. The operator should check the system condition or perform maintenance on the involved system at the earliest possible time.

Warning Level 2

Warning level 2 requires changing the operation of the machine or performing a maintenance procedure. Failure to correct the problem that caused this warning may damage the components that are involved in the system.

Warning Level 3

Warning level 3 requires an immediate safe shutdown of the machine in order to avoid damage to the machine or injury to personnel. The problem that caused the event must be corrected before machine operation can resume.

Indications and System Response

Caterpillar Electronic Technician (Cat ET) Service Tool

When an abnormal operating condition occurs, the status screen on the Cat ET indicates that there is an active event.

Event codes are displayed on Cat ET in the following format:

EXXXX Description of the code

The "E" means that the code is an event code. The "XXXX" is a numeric identifier. The numeric identifier is followed by a description of the code.

Active event codes are listed in ascending numerical order. The code with the lowest number is listed first. The active event code is removed from the list when the condition is no longer present.

Logged Event Codes

Some event codes are logged in the ECM memory. Some event codes are active only. The logged event codes are listed in chronological order. The most recent code is listed first.

A logged code is cleared from memory when one of the following conditions occur:

- The service technician manually clears the code.
- The code does not reoccur after a number of hours determined by each ECM.
- A new code is logged and there are already ten logged codes in memory. In this case, the oldest logged code is cleared.

Note: Always clear logged event codes after investigating and correcting the problem which generated the code.

List of Event Codes

The following table lists event codes and the recommended responses. Use the Cat ET service tool in order to determine the event codes that are active or logged.

Table 1

List of Event Codes (EID)			
EID	**Level**	**Description**	**Possible Cause and Recommended Response**
861	1	Synchronized clock notification of manual synch required	In a PL522 or 523 system using sync-clock and Product Link that is not the master ECM, the Product Link module will automatically sync to the master ECM hours if the difference is not greater than 50 hours. If the difference is greater than 50 hours, a diagnostic will be generated in Cat ET that indicates that a manual sync is required. In that instance, sync the hours. In Cat ET, use "Service/Synchronize Service Meter Hours".
630	2	Switched Sensor #1 trip condition is activated	The PL522 or 523 has four additional inputs that can be configured in order to monitor switches on the machine. These inputs can be configured by using Caterpillar Electronic Technician (Cat ET service tool). Troubleshoot input as setup by the dealer.
631	2	Switched Sensor #2 trip condition is activated	The PL522 or 523 has four additional inputs that can be configured in order to monitor switches on the machine. These inputs can be configured by using Caterpillar Electronic Technician (Cat ET service tool). Troubleshoot input as setup by the dealer.
		Switched Sensor	The PL522 or 523 has four additional inputs that can be configured

632	2	Switched Sensor #3 trip condition is activated	in order to monitor switches on the machine. These inputs can be configured by using Caterpillar Electronic Technician (Cat ET service tool). Troubleshoot input as setup by the dealer.
633	2	Switched Sensor #4 trip condition is activated	The PL522 or 523 has four additional inputs that can be configured in order to monitor switches on the machine. These inputs can be configured by using Caterpillar Electronic Technician (Cat ET service tool). Troubleshoot input as setup by the dealer.

System Schematic

SMCS - 7566

Ver imagen

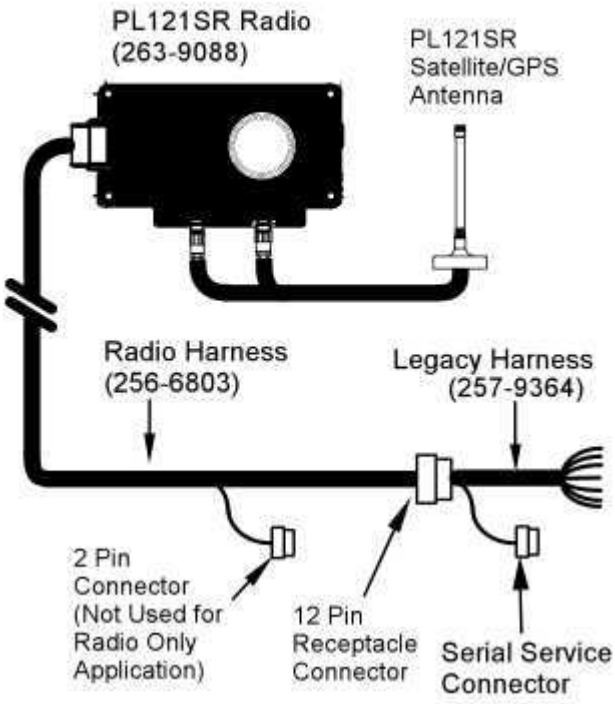
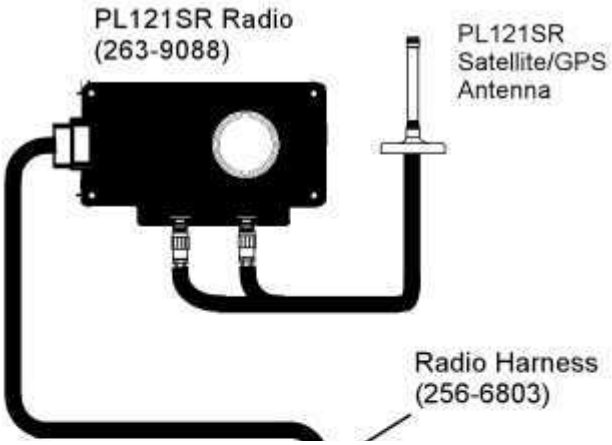


Illustration 1 g01130135

Overview of the Connection of the PL121SR Radio Only Legacy Field Installation Group

Note: For radio only applications, do not remove the plug in the two-pin connector of the radio harness.

Ver imagen



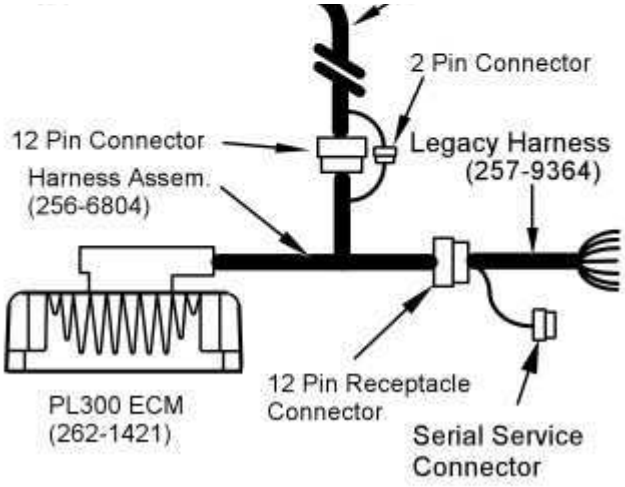


Illustration 2 g01130138

Overview of the Connection of the PL321SR Legacy Field Installation Group

Ver imagen

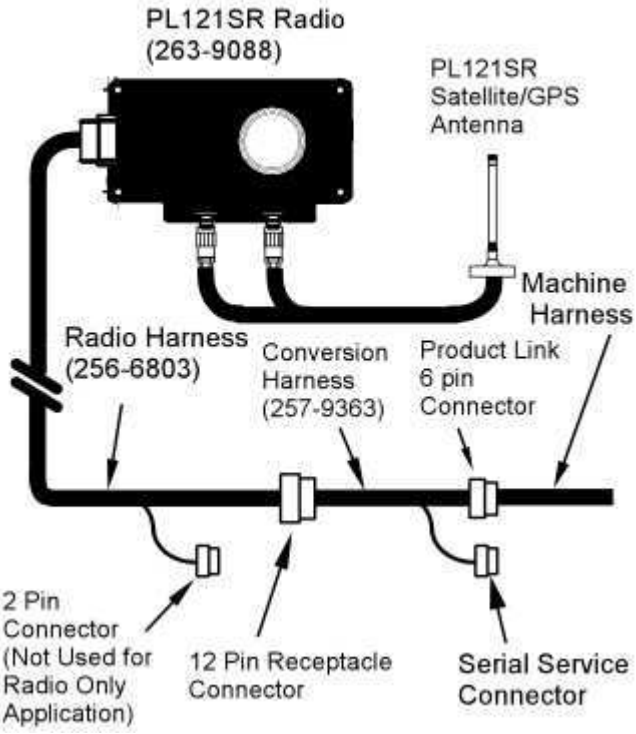


Illustration 3 g01130141

Overview of the connection of the PL121SR G1/G2 Radio Only Conversion Field Installation Group

Note: For radio only applications, do not remove the plug in the two-pin connector of the radio harness.

Ver imagen

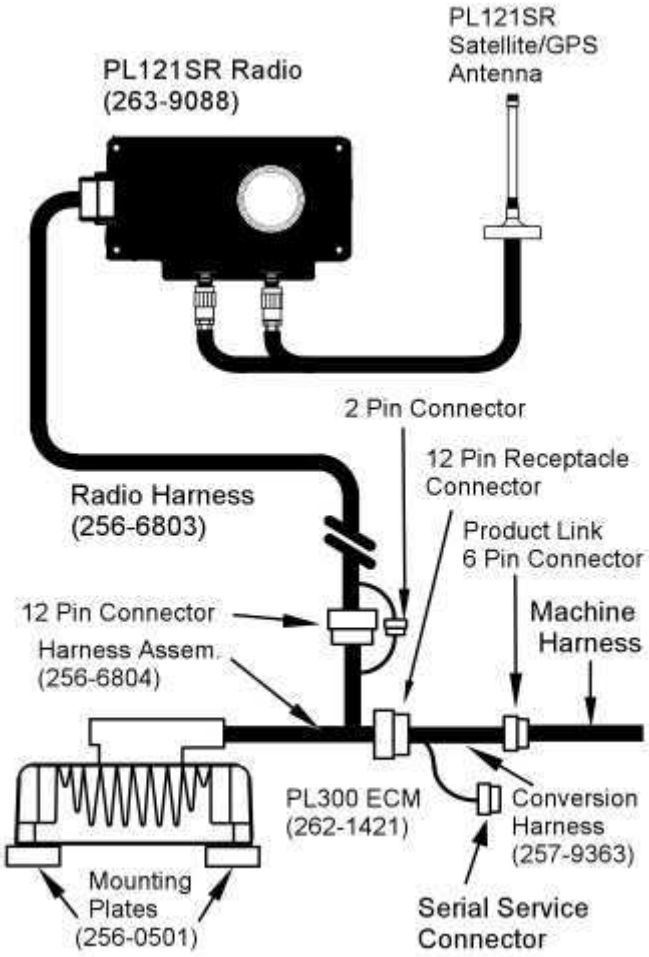


Illustration 4 g01130146

Overview of the connection of the PL321SR Field Installation Group (Conversion)

PL121SR (Radio Only) Installation on Machines Other than Caterpillar Products

Table 1

Legacy Harness Connections for Generic Applications			
P1 Connector to Radio Pin Number	**Harness Wire**	**Description**	**Connection Point for the Machine**
1	125-OR	Unswitched Power	Fused (5 amp) unswitched
2	200-BK	Ground	Machine ground
3	308-YL	Keyswitch On	Circuit that provides battery voltage only when the keyswitch is turned to the ON position

4	403-GN	R-term	Alternator R-term circuit (1) (2)

(1) If an R-term input is not available, a DC voltage that goes high when the engine in running may be used.

(2) The DC voltage to pins 1 and 4 should be 12 or 24 VDC.

Ver imagen

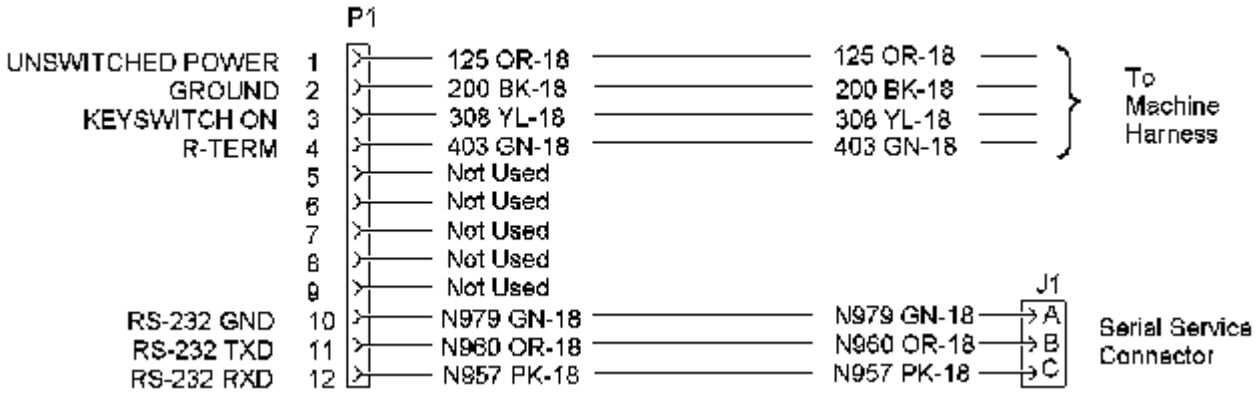


Illustration 5 g01120403

Generic Legacy Harness Wiring Connections See footnotes of Table 1 for more information.

Ver imagen

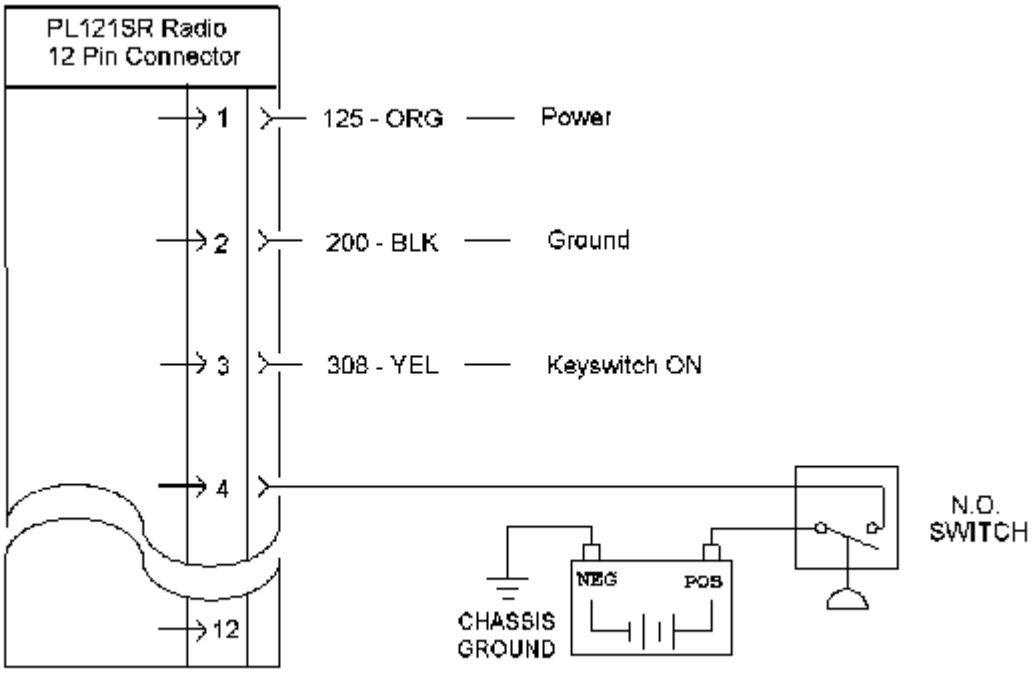


Illustration 6 g01122031

Generic Wiring Example for an Input that Goes High When Engine is Running

Legacy Harness For Caterpillar Machines

Table 2

Legacy Harness Connections			
P1 Connector Pin Number	**Harness Wire**	**Description**	**Connection Point for the Machine**
1	125-OR	Unswitched Power	Fused (5 amp) unswitched power circuit (1)
2	200-BK	Ground	Machine ground
3	308-YL	Keyswitch On	Circuit that provides battery voltage only when the keyswitch is turned to the ON position
4	403-GN	R-term	Alternator R-term circuit (2)
5	944-OR	CAT Data link +	CAT Data link communications "+" circuit
6	945-BR	CAT Data link -	CAT Data link communications "+" circuit
7	Y795-GN	CAN LOW	CAN communications LOW circuit (if present)
8	Y794-OR	CAN HIGH	CAN communications HIGH circuit (if present)

(1) The supply voltage must be 12 VDC or 24 VDC.

(2) If an R-term input is not available, a DC voltage that goes high when the engine in running may be used.

Ver imagen

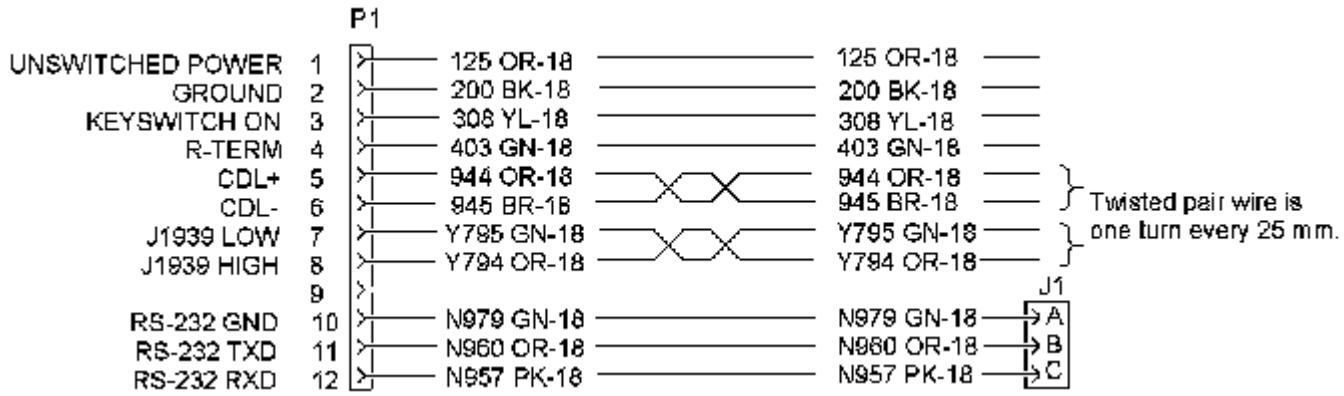


Illustration 7 g01117777

Legacy Harness Schematic

Conversion Harness for Caterpillar Machines

Ver imagen

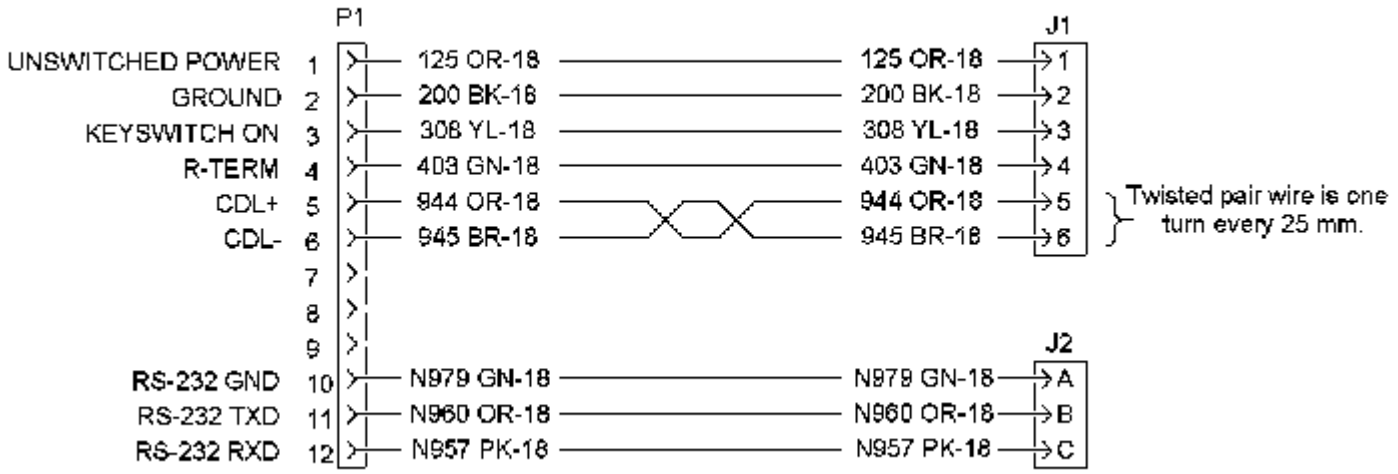
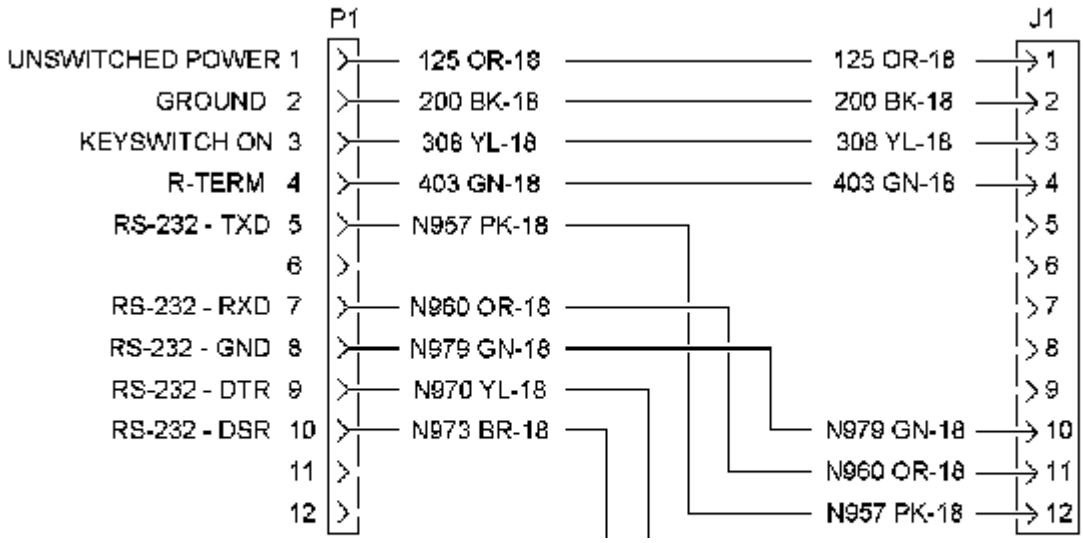


Illustration 8 g01117845

Conversion Harness Schematic

PL121SR System (Radio Only) Wiring Harness

Ver imagen



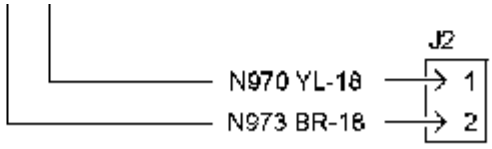


Illustration 9 g01117846

Radio Harness Schematic

PL321SR System (PL121SR plus the PL300 System) Harness Wiring

Ver imagen

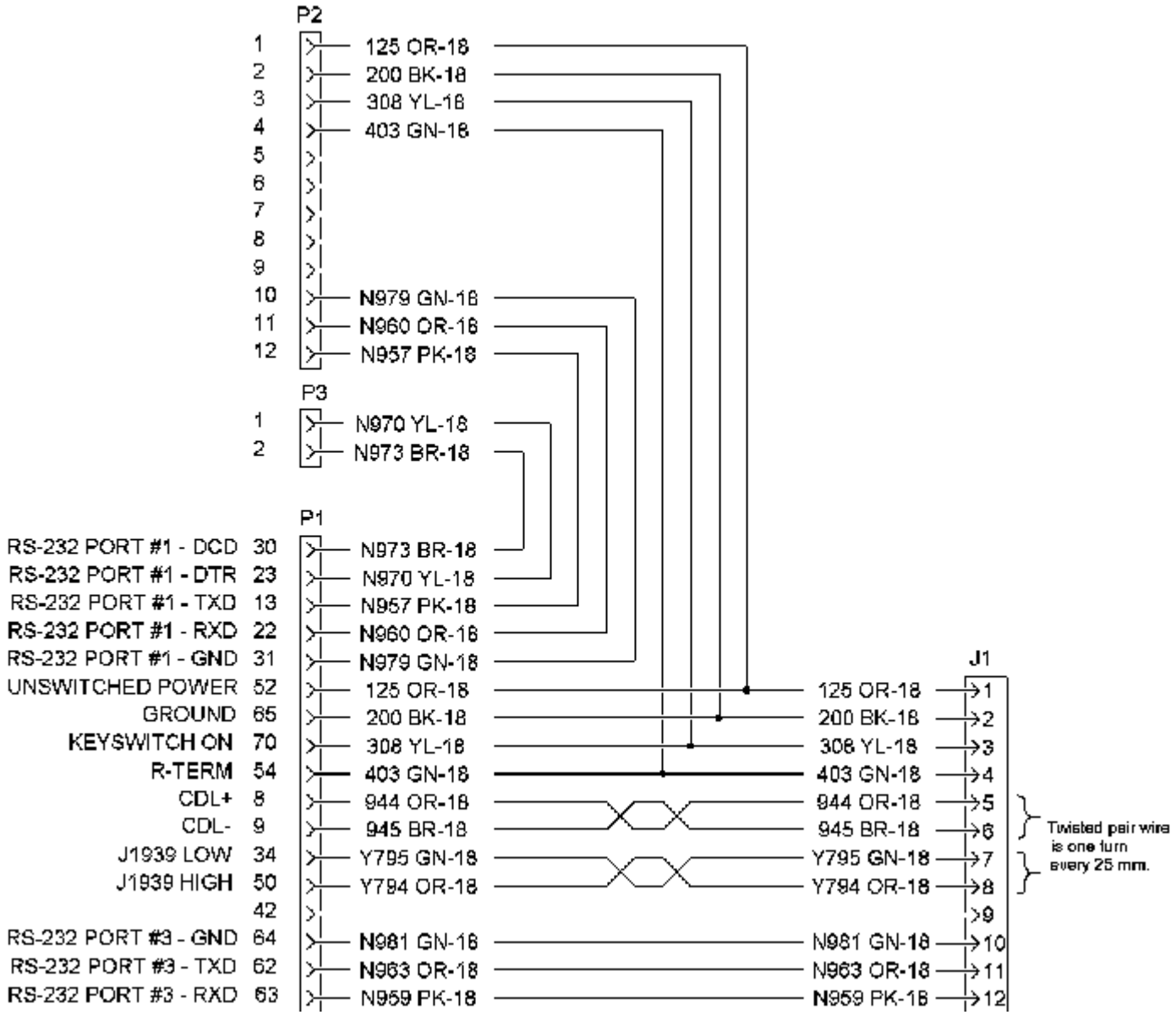


Illustration 10 g01117887

PL321 Harness Schematic

PL300 Digital Inputs

Ver imagen

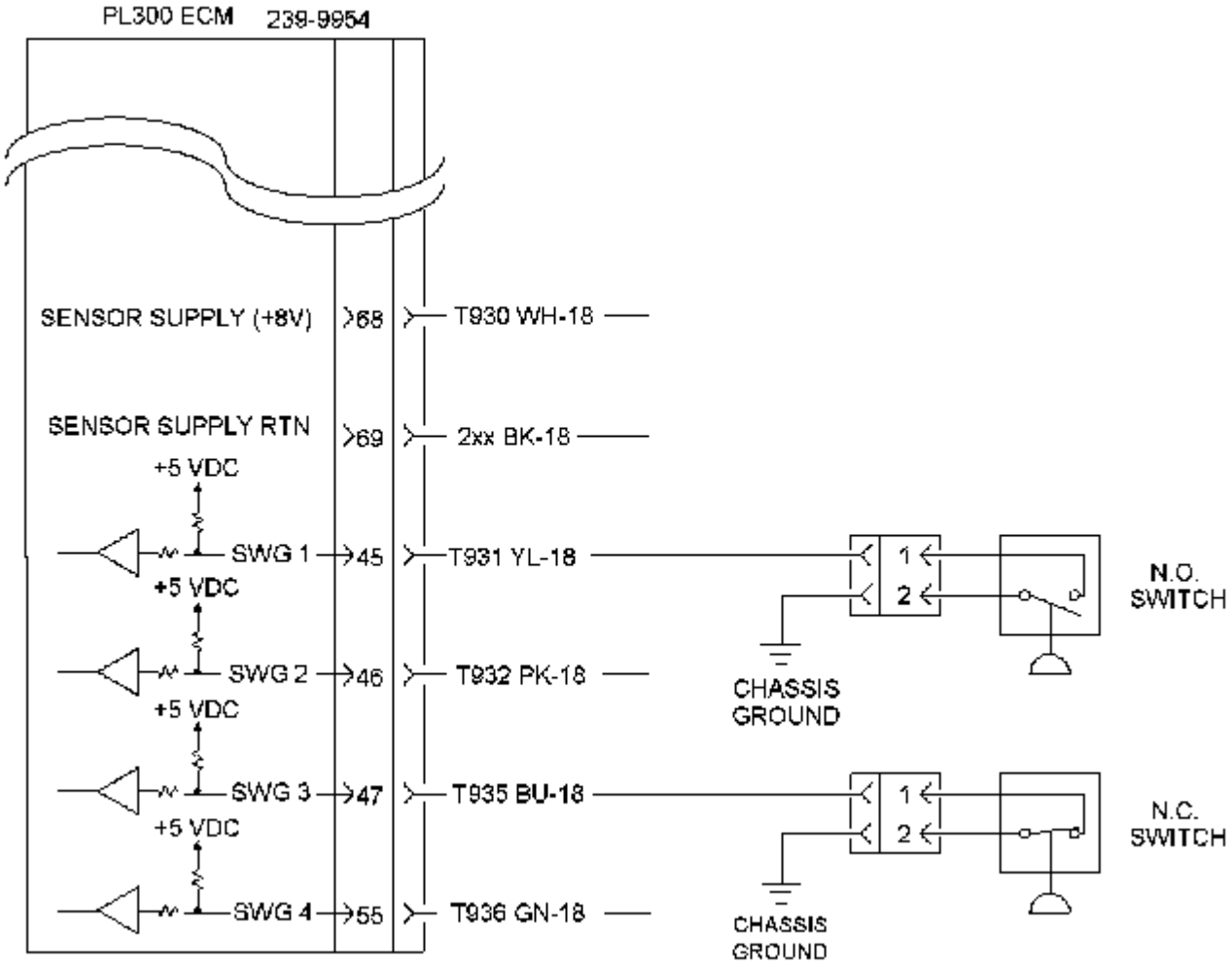


Illustration 11 g01118620

Example of PL300 Digital Input Schematic

For a list of switches that may be used, refer to Special Instruction, REHS2365.

System Level Schematic

Ver imagen

Ver imagen

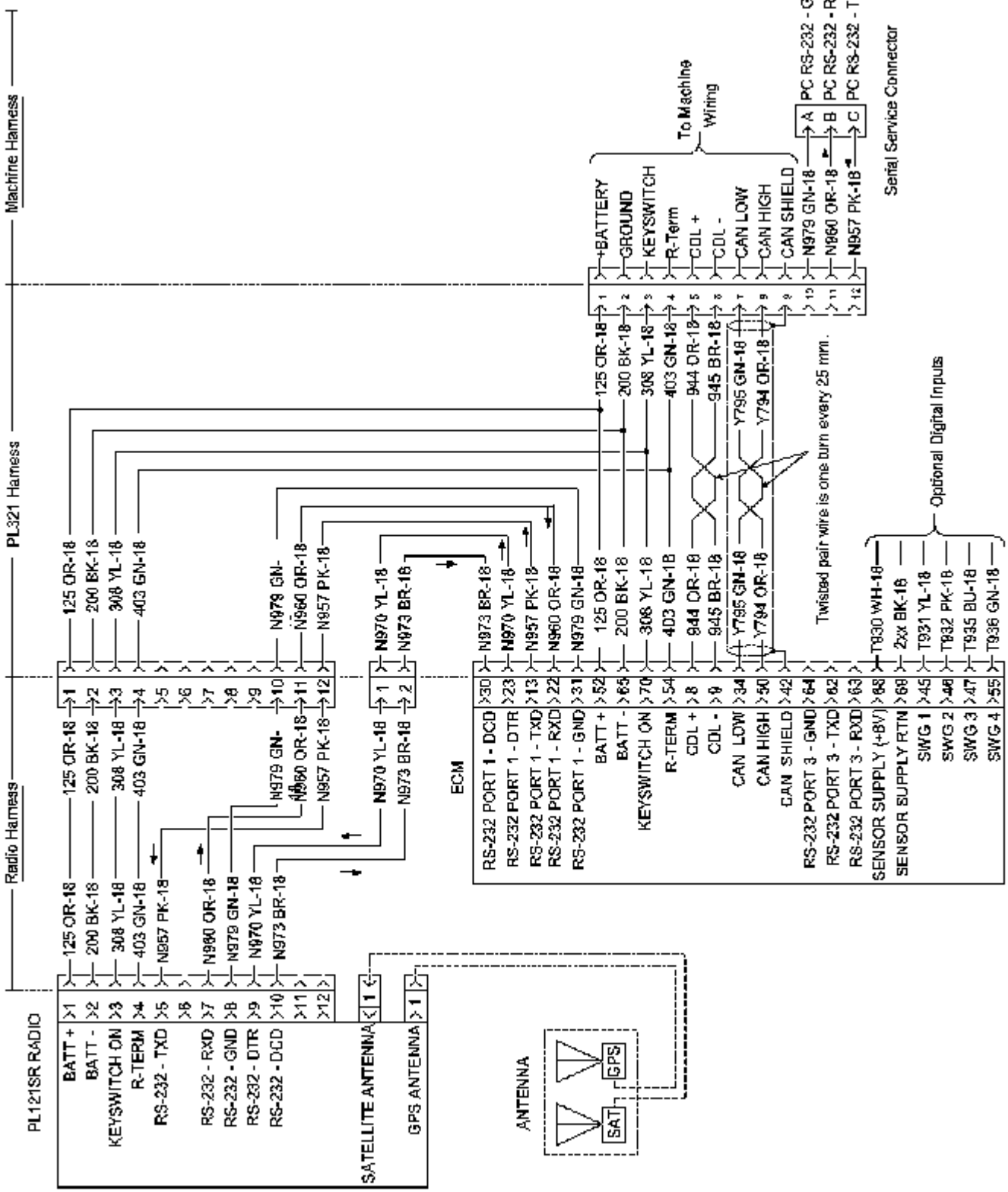


Illustration 12 g01135158

System Level Schematic

PL121SR System Schematic

Ver imagen

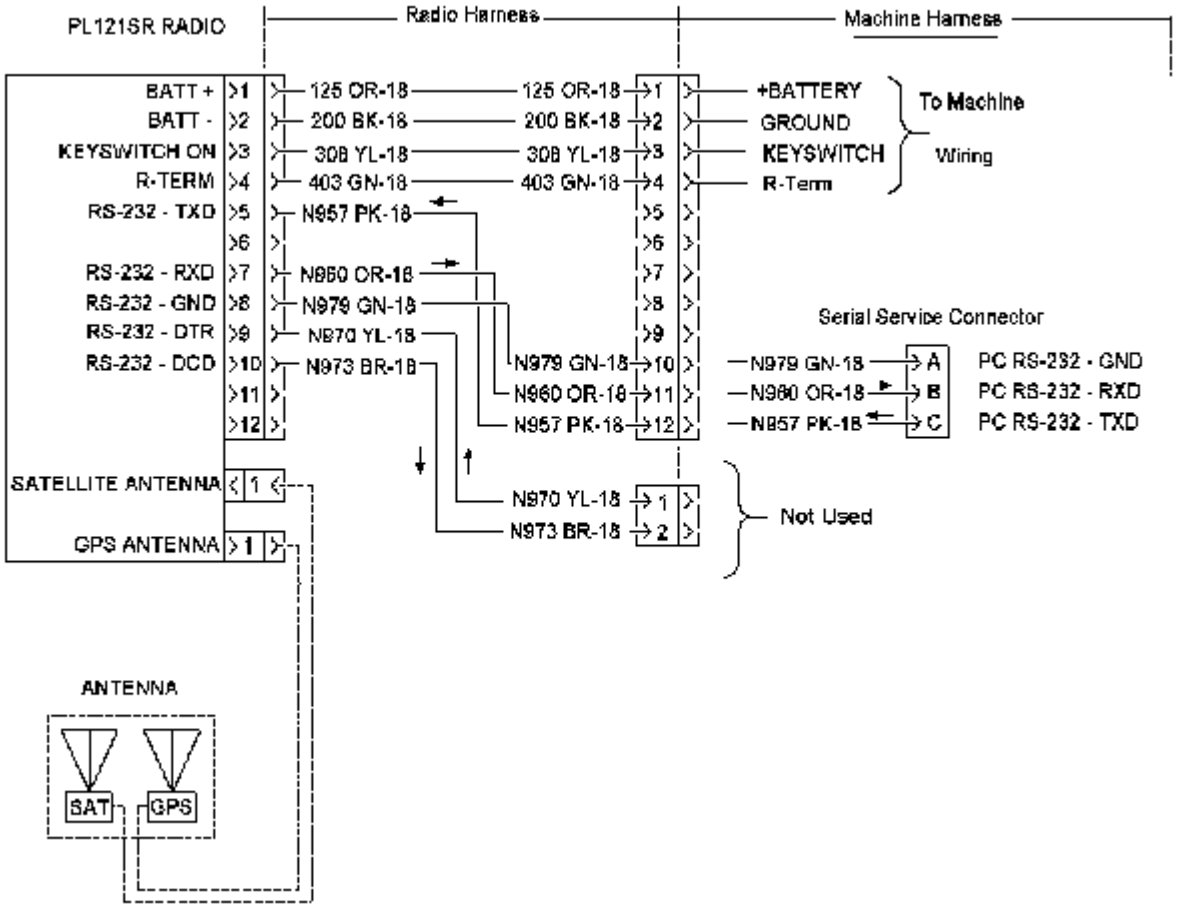


Illustration 13 g01135366

PL121SR System Schematic

System Schematic

SMCS - 7566

Ver imagen

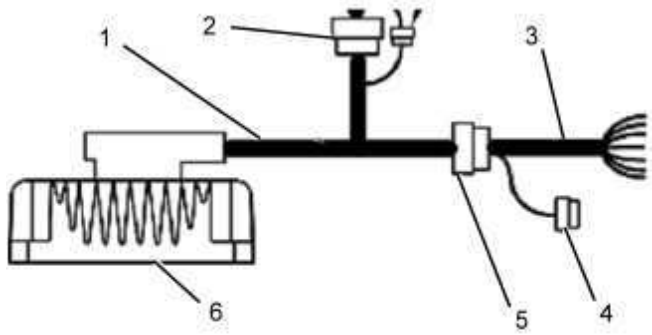


Illustration 1 g02173500

Overview of the connection of the PL522 or 523 legacy field installation group

(1) 256-6804 Control Harness As

(2) 12 pin connector

(3) 257-9364 Radio Harness As

(4) Serial service connector

(5) 12 pin receptacle connector

(6) PL52 or 523 ECM

Ver imagen

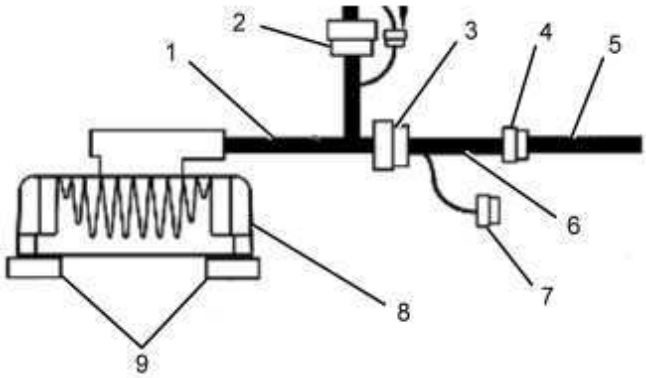


Illustration 2 g02173503

Overview of the connection of the PL522 or 523 field installation group (rear version)

Overview of the connection of the PL522 or 523 field installation group (conversion)

(1) 256-6804 Control Harness As

(2) 12 pin connector

(3) 12 pin receptacle connector

(4) 6 pin product link connector

(5) Machine harness

(6) 257-9163 Adapter

(7) Serial service connector

(8) PL522 or 523 ECM

(9) 256-0501 Plate

Legacy Harness for Caterpillar Machines

Table 1

Legacy Harness Connections			
P1 Connector Pin Number	**Harness Wire**	**Description**	**Connection Point for the Machine**
1	125-OR	Unswitched Power	Fused (5 amp) unswitched power circuit (1)
2	200-BK	Ground	Machine Ground
3	308-YL	Keyswitch On	Circuit that provides battery voltage only when the keyswitch is turned to the ON position
4	403-GN	R-terminal	Alternator R-terminal circuit (2)
5	944-OR	CAT Data Link (+)	CAT Data Link communications (+) circuit
6	945-BR	CAT Data Link (-)	CAT Data Link communications (-) circuit
7	Y795-GN	CAN Low	CAN communications LOW circuit (if present)
8	Y794-OR	CAN High	CAN communications HIGH circuit (if present)

(1) The supply voltage must be 12 VDC or 24 VDC.

(2) If an R-terminal input is not available, a DC voltage that goes high when the engine is running may be used.

Ver imagen

P1

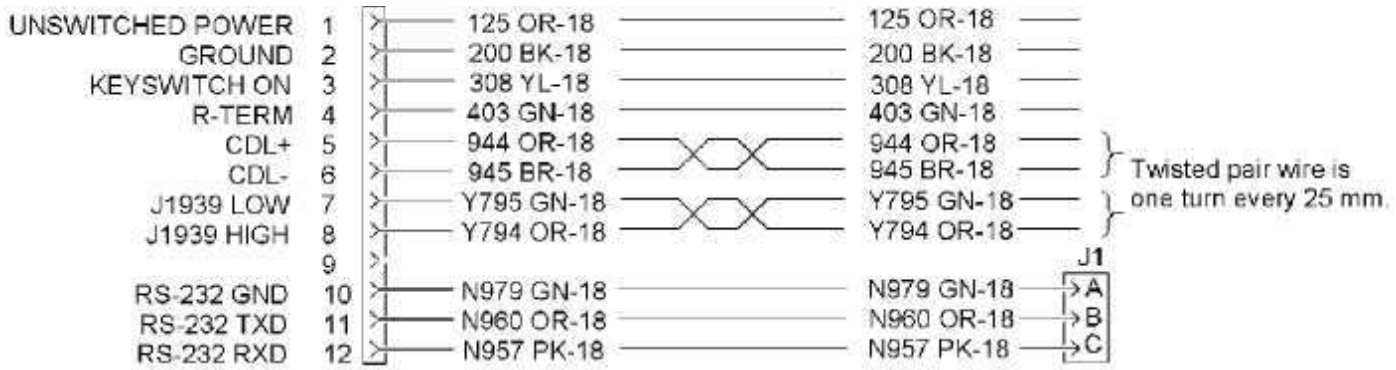


Illustration 3 g02173519

Legacy harness schematic

Conversion Harness for Caterpillar Machines

Ver imagen

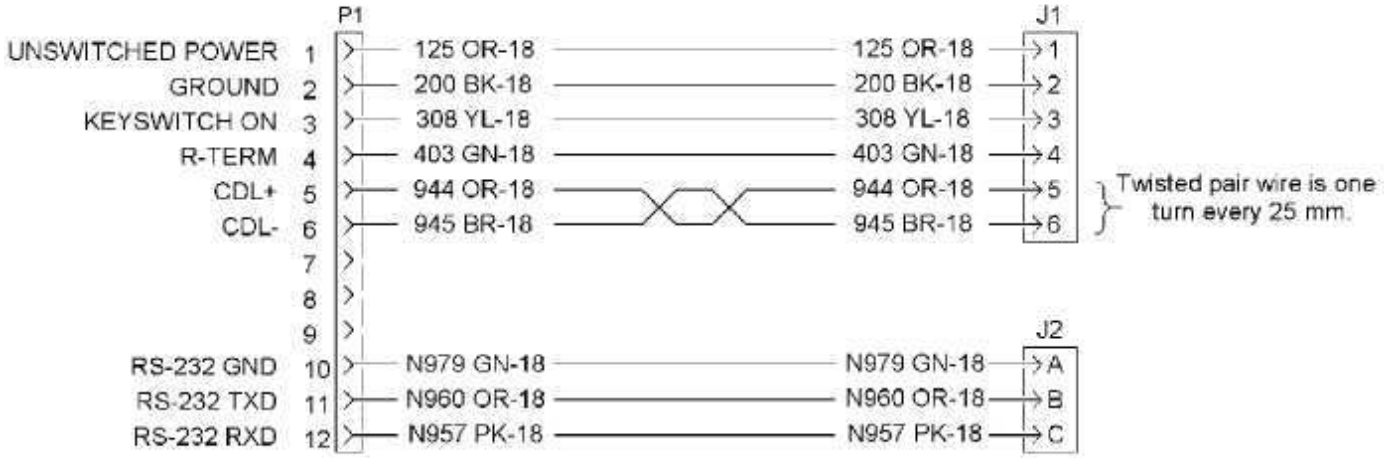


Illustration 4 g02173520

Conversion harness schematic

PL522 or 523 System Harness Wiring

Ver imagen

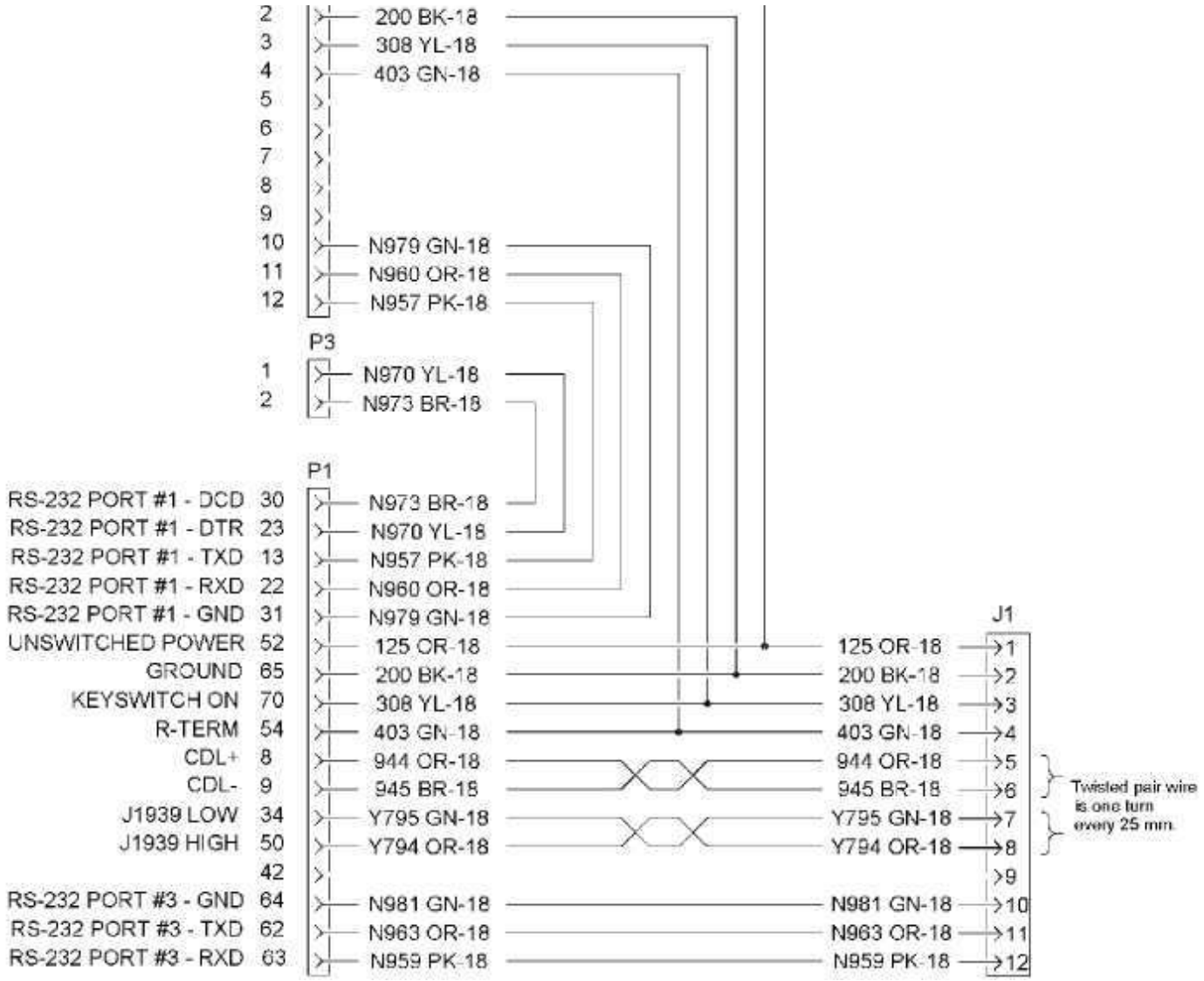


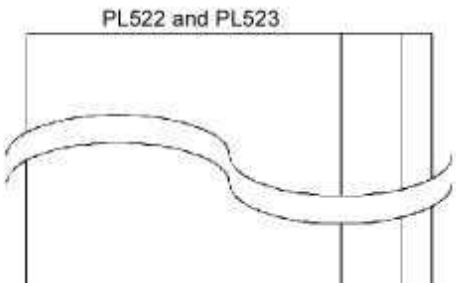
Illustration 5 g02173523

PL522 or 523 harness schematic

Note: Connectors "P2" and "P3" are not used in a PL522 or 523 installation and should be capped.

PL522 or 523 Digital Inputs

Ver imagen



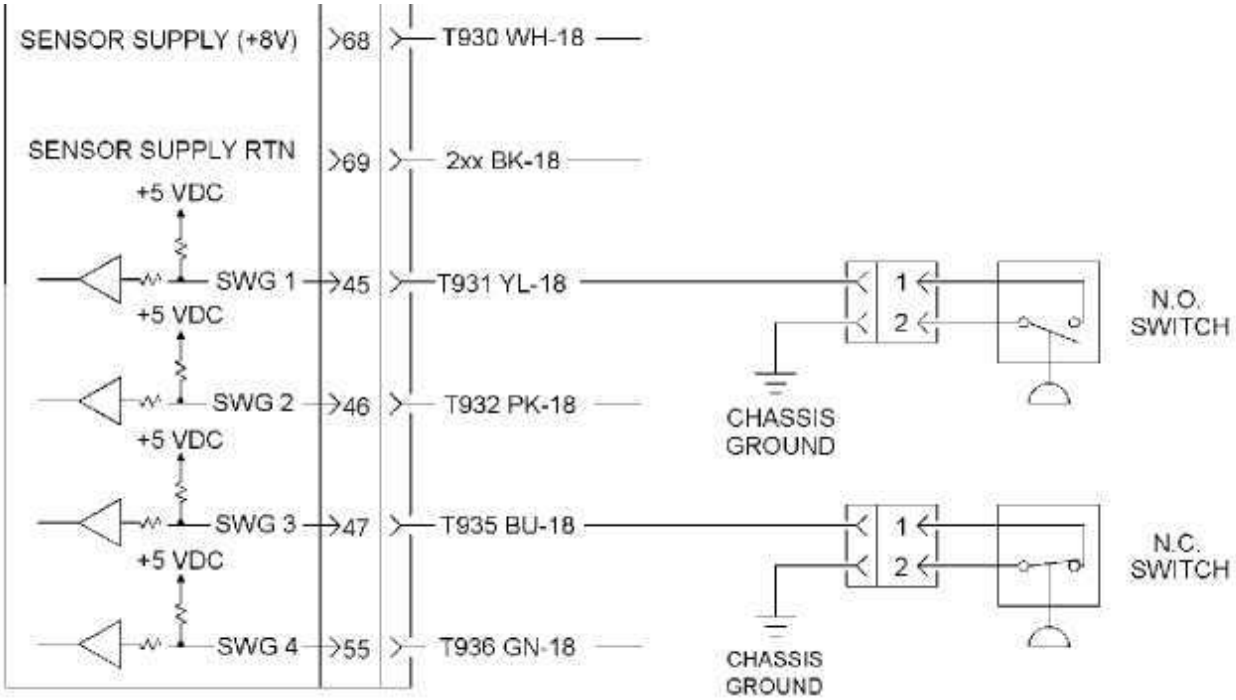


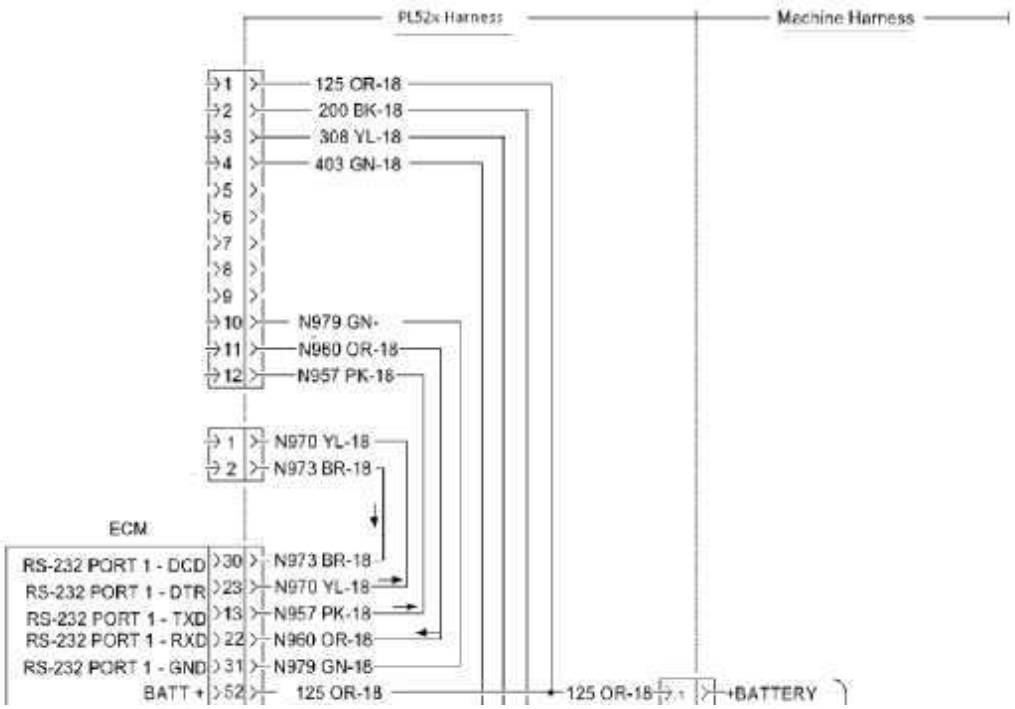
Illustration 6 g02173530

Example of PL522 or 523 digital input schematic

For a list of switches that may be used, refer to Special Instruction, REHS2365.

System Level Schematic

Ver imagen



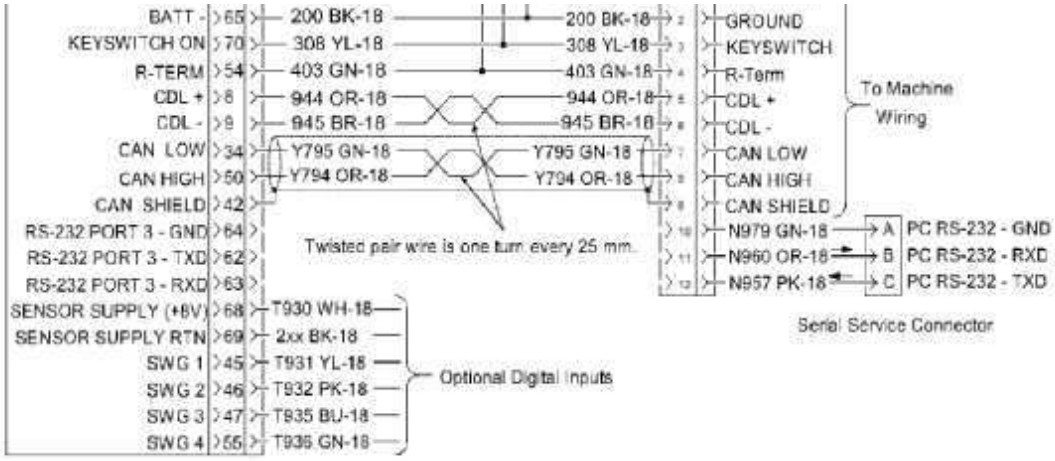


Illustration 7 g02173534

Sistema de carga - Probar

SMCS - 1406-081

El estado de carga de la batería en cada inspección regular indicará si el sistema de carga está funcionando correctamente. Es necesario un ajuste cuando la batería está constantemente en una condición de carga baja o se necesita una gran cantidad de agua. Una gran cantidad de agua sería más de una onza de agua por una celda por una semana o por cada 100 horas de servicio.

Cuando sea posible, efectúe una prueba de la unidad de carga y del regulador de voltaje en el motor, y utilice los cables y los componentes que forman parte permanente del sistema. Las pruebas de banco del motor darán una prueba de la unidad de carga y de la operación del regulador de voltaje. Estas pruebas darán una indicación de la reparación que será necesaria. Después de efectuar las reparaciones, efectúe una prueba para demostrar que las unidades han sido reparadas y puestas en las condiciones originales de operación.

Vea los procedimientos correctos que se deben seguir para probar el sistema de carga en la Instrucción Especial, REHS0354, "Localización y solución de problemas del sistema de carga". Esta publicación contiene también las especificaciones que debe utilizar cuando compruebe el sistema de carga.

Herramientas de prueba para el sistema de carga

Tabla 1

Herramientas necesarias		
Número de pieza	**Nombre de la pieza**	**Cantidad**
225-8266	Grupo de amperímetro	1
237-5130 o 146-4080	Grupo de multímetro digital o Grupo de multímetro digital	1

Grupo de Herramienta de Amperímetro 225-8266

Ver imagen

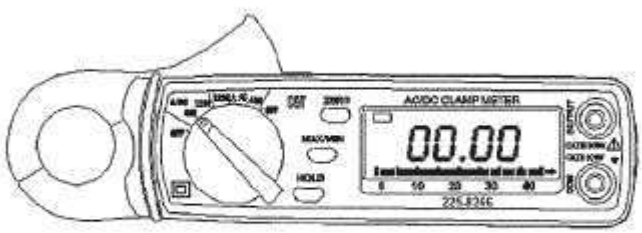


Ilustración 1 g01012117

Grupo de Herramienta de Amperímetro 225-8266

El Grupo de Herramienta de Amperímetro **225-8266** es completamente portátil. Este amperímetro es un instrumento autocontenido que mide las corrientes eléctricas sin interrumpir el circuito y sin alterar el material aislante del conductor.

El amperímetro contiene una pantalla digital que se utiliza para supervisar la corriente directamente en un intervalo comprendido entre 1 y 1200 amperios. Si se conecta un Cable **6V-6014** optativo entre el amperímetro y el multímetro digital, las lecturas actuales se pueden visualizar directamente en la pantalla del multímetro. Se debe utilizar el multímetro bajo una sola condición:

- Las lecturas son menores de 1 amperio.

Una palanca abre las mandíbulas del amperímetro sobre un conductor. El diámetro del conductor no puede ser mayor de 19 mm (0,75 pulg).

Las mordazas cargadas por resorte se cierran sobre el conductor para medir la corriente. El amperímetro es controlado por un interruptor de disparo. El interruptor de disparo se puede trabar en la posición de ENCENDIDO o de APAGADO.

Después de que el interruptor de disparo haya estado funcionando y se haya movido a la posición de APAGADO, la lectura aparece en la pantalla digital durante cinco segundos. Esto mide con precisión las corrientes en áreas de acceso limitado. Por ejemplo, estas áreas incluyen áreas que están más allá de la vista del operador. Para operar con corriente continua, el amperímetro contiene un control cero, y las baterías dentro de la palanca suministran la corriente de alimentación.

Multímetro digital 237-5130 o Multímetro digital 146-4080

Ver imagen

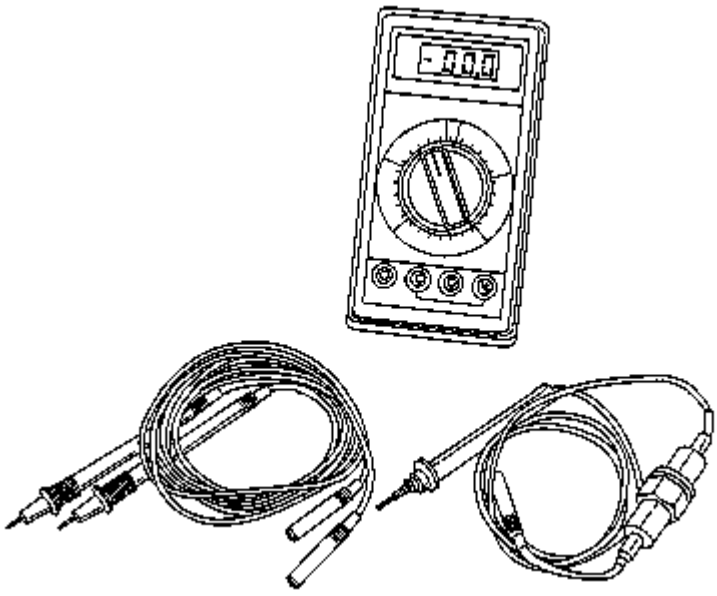


Ilustración 2 g00283566

Multímetro digital 237-5130 o Multímetro digital 146-4080

El Multímetro Digital **237-5130** y el Multímetro Digital **146-4080** son herramientas de servicio manuales portátiles con una pantalla digital. Estos multímetros se construyen con protección adicional contra daños en las aplicaciones de campo. Ambos multímetros están equipados con siete funciones y 29 gamas. El Multímetro digital **237-5130** y el Multímetro digital **146-4080** tienen un indicador instantáneo de ohmios. Este indicador permite comprobar la continuidad para efectuar una inspección rápida de los circuitos. Estos multímetros también se pueden utilizar para localizar y solucionar problemas en los capacitores que tienen valores pequeños.

Las válvulas de muestreo de fluido rediseñadas están disponibles para todos los productos Cat

SMCS - 7542

Productos Caterpillar:

- **Todos**

Las válvulas de muestreo de fluido recientemente diseñadas pueden soportar temperaturas de trabajo superiores, presiones superiores y pueden proporcionar una mayor vida útil.

Ver imagen

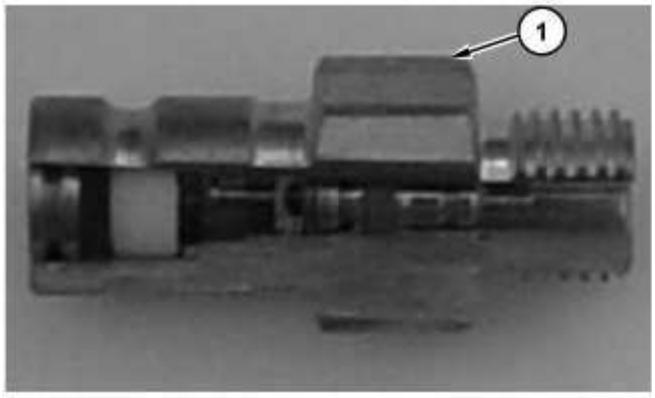


Ilustración 1 g02413897

(1) Válvula de muestreo de fluido actual sin corte de muesca

Las válvulas de muestreo de fluido actuales (números de piezas 8C-3446, 164-5590 (incluye números de piezas. 8C-3446 y 3J-7354), 7X-3387, 8C-3345, 159-8336) pueden tener fugas. Se ha introducido un diseño mejorado. Los números de piezas para estas válvulas de muestreo de fluido permanecen iguales, pero se han modificado los niveles de cambio.

Ver imagen

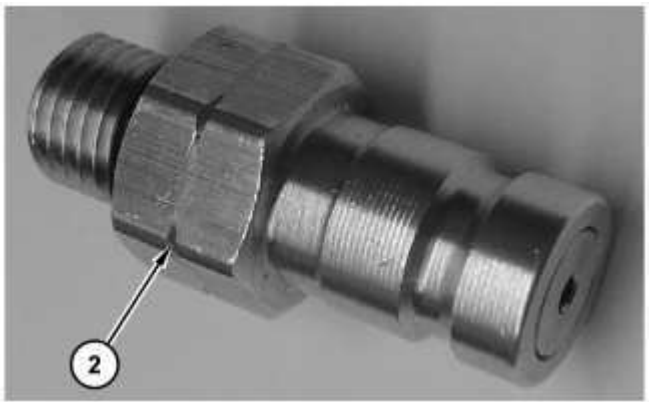


Ilustración 2 g02413896

(2) Nuevo diseño de válvula de muestreo de fluido con corte de muesca

La válvula de muestreo de fluido recientemente diseñada puede utilizarse para reemplazar la válvula de muestreo de fluido que tiene una fuga. La diferenciación se indica por una muesca en el lado hexagonal. Consulte la figura 1 para obtener el diseño actual y la figura 2 para obtener el diseño nuevo.

Cambios en el uso y la limpieza del grupo de monitor de contaminación

SMCS - 0645; 0680; 1280; 1348; 3080; 429F; 5095

Productos Caterpillar:
- **Todos**

ReferenciaInstrucción Especial, SEBF9180, "Análisis de limpieza del combustible diesel con recuento automático de partículas"

El Grupo de Monitor de Contaminación 293-8413 puede utilizarse para analizar la limpieza del aceite del motor, el aceite hidráulico y determinados combustibles diesel. Se deben utilizar las nuevas instrucciones de limpieza y de uso.

En las instrucciones ahora se especifica que el Grupo de Monitor de Contaminación 293-8413 se debe utilizar para analizar únicamente los líquidos con un punto de encendido igual o superior a 55 °C (131 °F). Existe una remota posibilidad de que los líquidos con un punto de encendido inferior a 55 °C (131 °F) se enciendan en el Grupo de Monitor de Contaminación 293-8413.

Al purgar o limpiar el Grupo de Monitor de Contaminación 293-8413, use únicamente un aceite mineral o un combustible diesel. El aceite mineral y el combustible diesel deben tener un punto de encendido igual o superior a 55 °C (131 °F). En Europa, el combustible diesel que cumple con esta especificación se denomina combustible diesel No. 5. El nombre de este combustible diesel varía en todo el mundo.

El uso de agentes de limpieza que no cumplan con las nuevas instrucciones puede dañar el grupo de monitor de contaminación. Existe una remota posibilidad de que el Grupo de Monitor de Contaminación 293-8413 se encienda si se usan líquidos incorrectos.

Prácticas para mangueras y acoplamientos Caterpillar

SMCS - 0618; 1000; 5057; 7000

Productos Caterpillar:

- **Todos**

Caterpillar ha embarcado algunas máquinas con conjuntos de mangueras hidráulicas que utilizan acoplamientos hidráulicos no-Caterpillar. Se utilizaron mangueras Caterpillar. Los conjuntos de manguera se fabricaron para cumplir con los requisitos de Caterpillar. Si hay daños de los conjuntos de manguera no-Caterpillar, se aplica lo siguiente. Reemplace los conjuntos de manguera con mangueras Caterpillar y acoplamientos Caterpillar. No vuelva a utilizar los acoplamientos de manguera no-Caterpillar.

Caterpillar no puede garantizar la seguridad o el rendimiento de ningunainterfaz de acoplamiento de manguera que utiliza otros acoplamientos en una manguera Caterpillar producida fuera de lainstalación de fabricación.

Noticiero IRM, PELJ0481 , "Expansión de la línea de productos Caterpillar para mangueras y acopladores de presión baja y media"

SMCS - 5057

Productos Caterpillar:

- **Todos**

En este Noticiero se anuncia la reciente introducción de la máquina rebordeadora variable y la capacidad que tienen ahora los distribuidores Caterpillar de dar servicio a las mangueras hidráulicas largas de presión baja y media y a los acoplamientos permanentes. Anteriormente los distribuidores sólo tenían capacidad para construir mangueras hidráulicas de 50,8 mm (2,0 pulg) y con diámetro interior muy pequeño. La máquina rebordeadora variable tiene capacidad para manipular mangueras hidráulicas de hasta 88,9 mm (3,5 pulg) de diámetro interior. Para obtener más información sobre el componente, la herramienta y las especificaciones técnicas, consulte el Noticiero HOS05-01, PELJ0481. Vea más información sobre los conjuntos de manguera afectados en la Tabla 1.

Este Noticiero IRM está disponible a través del sistema normal de distribución de publicaciones. La publicación se puede encontrar también en el Sistema de Información de Servicio Caterpillar (SIS).

Tabla 1

No. de pieza de la configuración	Descripción
108-3440	Conjunto de manguera
111-4515	Conjunto de manguera
111-4516	Conjunto de manguera
111-4524	Conjunto de manguera
111-4525	Conjunto de manguera
114-5241	Conjunto de manguera
115-4763	Conjunto de manguera
115-4834	Conjunto de manguera
115-4839	Conjunto de manguera
115-5324	Conjunto de manguera

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

This special instruction provides the necessary information in order to create SIS Web Feedback. All information provided in this document is necessary in order to provide the SIS Web Feedback analyst with the necessary information to expedite the resolution. SIS Web feedback is intended to provide feedback on any discrepancies within the Service/Parts literature. The feedback system is not intended to address any problems related to machine or component performance. Refer to the Dealer Solutions Network (DSN) for any problems associated with machine or component performance.

Note: Feedback is only available through SIS Web. Feedback is not available through SIS Network or SIS DVD.

Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

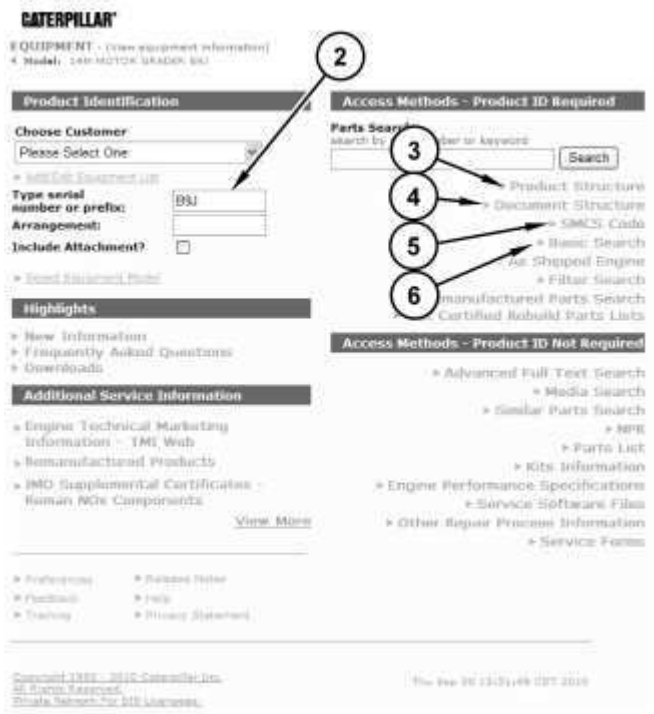


Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

   Note: Using any other method in searching for parts and service information will result in missing information in the discrepancy ticket. Any missing information may delay resolution of the discrepancy.

Ver imagen

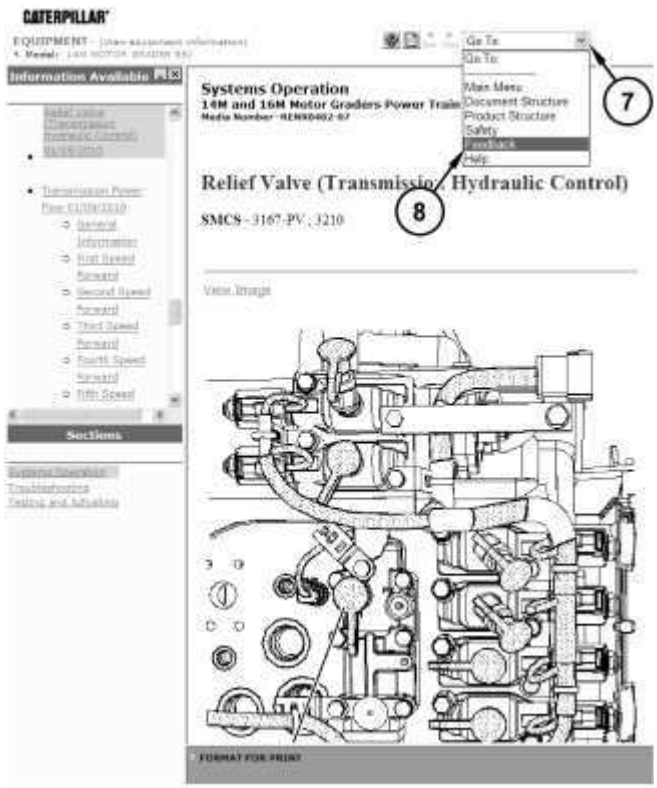


Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

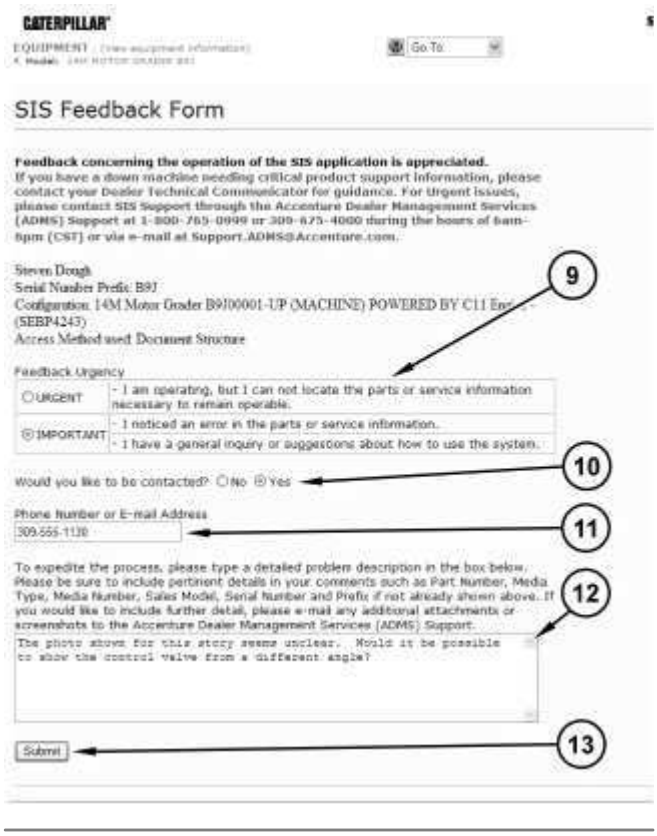


Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
7. Provide the contact information in box (11). The contact information can include an E-mail address and/or a telephone number.
8. Provide a detailed description of the discrepancy in box (12). Be sure to include pertinent details such as: part number, media type, media number, sales model, serial number and prefix. This information will expedite the resolution of the discrepancy.
9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

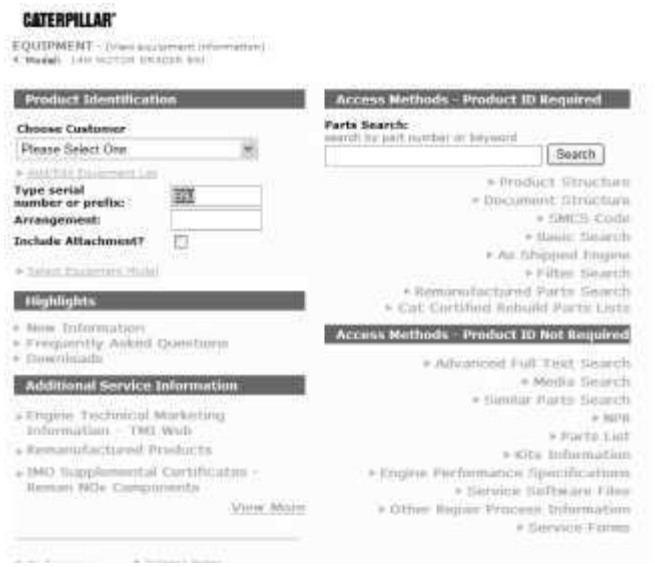
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



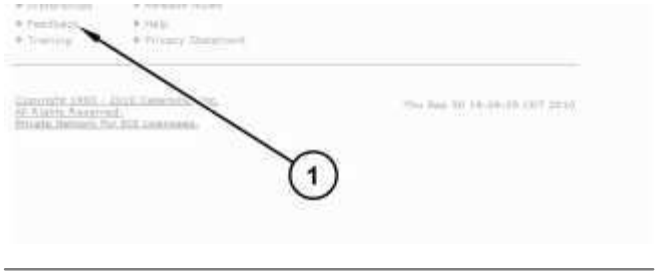


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Hose and Coupling Assembly and Repair Process Guide{0684, 3016, 3103, 3154, 4133, 4257, 4304, 5057, 7554}

SMCS - 0684; 3016; 3103; 3154; 4133; 4257; 4304; 5057; 7554

Caterpillar Products: All

Introduction

The following information explains the repair/assembly process for hydraulic hoses through the hose service shop. The steps follow the Caterpillar recommended best practices. Every service shop is different, but the basic workflow and process still applies to all. It is a management decision at the dealership as to what extent they follow the process. The dealer can use the Service Operation Development and Assessment (SODA), SERF8918 to access their level of compliance. The compact disc can be ordered through the media logistics system. After the assessment is completed, a plan can be developed based on the findings. Service Operation Development and Assessment (SODA), SERF8918 will help identify process and tooling gaps in operations. This document also references other supporting documents that cover the various stages of the hose repair in detail.

References

Table 1

References	
Title	Media Number
General Information for Hose Assembly	NEHS0768
Reusable Coupling Tool List	NEHS0750
Setup/Operation of **145-5161** Hose Machine	NEHS0695
Use of 9U-5792, 4C-5052, 4C-5054, 4C-3670, 4C-3680, Hose Machines	NEHS0744
Setup/Operation if **139-5439** Combine Machine	NEHS0686
Assembling Reusable Coupling in the 139-5439, 145-3381, and 152-3910 Combination Hose Machines	NEHS0746
Crimping Permanent Couplings Using the **136-3642** Crimp Tool Group in Combination and XT Hose Machines	NEHS0748
Assembling Reusable Coupling in the 4C-9900, 150-2568, and 173-9805 Hydraulic Hose Machines	NEHS0745
150-3622 Bench Model Hose Machine Operating Instruction	NEHS0715
Using the Variable Crimping Hose Machine to Crimp Permanent Coupling for All Hose Types Except 1543	NEHS0870
Setup and Operation of the 145-7042 and 146-5861 Crimputer Groups	NEHS0754

Crimping 1E1028 Thermoplastic and 1E1543 Air Conditioning Hose	NEHS0749
"Certified Clean" Sticker	NEEG2828
"Reusable Coupling" Sticker	PEEP7210
Service Operation Development and Assessment	SERF8918

Workflow

1. Customer brings in a hose to a clearly marked hose shop.
2. The work order is written.
3. Parts availability is verified.
4. New hose is cut to the correct length.
5. Clean the hose.
6. Skive the hose.
7. Reclaim the old couplings if needed for the new hose assembly.
8. Install first coupling on the new hose.
9. Crimp the first coupling onto the hose.
10. Install armor guarding if necessary.
11. Set the angle of orientation of the new couplings.
12. Crimp the second coupling onto the hose.
13. Deburr the couplings if necessary.
14. Clean the final assembly.
15. Recheck the assembly for the correct angle of orientation and overall assembly length.
16. Install caps or plus on the couplings.
17. Attach the bag containing seals to the hose assembly.
18. Apply the appropriate stickers to the finished assembly.
19. Apply the metal assembly part number band.
20. Present the final assembly to the customer or store the assembly on a shelf for the customer to pickup.

Parts Counter / Receiving Area

The first thing the customer should see is signage off of the frontage road. The sign should indicate hydraulic hose shop. Marketing literature for promoting Caterpillar hose and couplings should be on the parts counter for the customer to read. The customer should be greeted by the counterperson or hose assembler who will fill out the work order. Information required from the customer is the machine type, system pressure and temperature, and environmental conditions. This information is necessary for the identification of the proper hose components. The Caterpillar Hydraulic Information System needs to be available for cross referencing all hose product to available Caterpillar hose and coupling offering.

Work Bench

The following items should be located next to the parts counter:

- A layout bench equipped with a bench vise.
- A tape measure for checking total assembly length.
- A **7S-1125** protractor for measuring the angle of orientation of the old assembly.
- A calculator available to prevent errors when calculating the hose cut-off factor.
- An **8T-0450** thread identification kit for measurement and identification of the couplings.
- Caterpillar's Hydraulic Information System in order to identify the correct part numbers.
- A copy of Caterpillar's Product Guide, PECP5030, "Cat Hose Products & Tooling" as a back-up to Caterpillar's Hydraulic Information System is unavailable.

The parts availability must be physically verified including any seals that are required. All required seals must be kept in a clean shipping bag that will be attached to the finished assembly.

Coupling Storage Cabinets

All couplings should be stored in cabinets or drawers. The cabinets need to be labeled on the outside for easy identification of parts location. Store the low and medium pressure couplings separate from the high pressure couplings. This will ensure that the low and medium couplings aren't used on the high pressure hoses. The flow of the assembly process will be more efficient by keeping the low and medium pressure couplings near the machine that is used to crimp these couplings. Couplings are not interchangeable with different styles of high pressure hose. Reusable couplings need to be stored separately from the permanent couplings. All of the drawers or compartments need to be labeled with the correct part number of the coupling or with a bar code. This will make it easier for inventory control and ordering.

Hose Storage and Cut-off Area

The technician must cut the correct length of the proper hydraulic hose. The hose storage area should have all the hoses neatly rolled up and stored in slots or bulk hose can be stored on the shipping spools. All hoses may be run through a tubing storage/delivery system, as long as they are separated and easily accessible. Tubing takes the curl out of the bulk hose. The minimum length of the storage tubing is 3 m (10 ft.) in order to ensure the proper straightening of the hose. Utilize the **202-8559** cut-off support group in order to ensure a perpendicular hose cut. The saw needs to be equipped with a fume exhauster to draw the fumes and dust out of the area. This will cut down on the airborne contamination. Use a fine tipped gel pen to mark the cut

location on the hose. Utilize **174-8912** abrasive cut-off wheel . Proper safety equipment, such as a face shield is recommended when operating the saw. Measure the hose again to ensure the hose has been cut to the proper length.

Hose Cleaning

The inside of the hose must be cleaned after cutting to the correct length. Refer to Special Instruction, SEBF8485, "Cleaning Fluid-Carrying Hose and Tube Assemblies in Shop and Field Applications" for the complete cleaning instructions. This manual also lists the hose cleaning groups available through Caterpillar. The hose cleaning group consists of a gun, nozzles, projectiles and projectile catcher. Make sure the hose cleaning process is in sight of the customer. Cleaning the hose in front of the customer indicates a level of quality and attention to detail. A perceived contaminant free assembly establishes a differentiation between the dealer service shop and the competition. An air line will be necessary for the operation of the gun. It is also recommended that the air pressure is at least 620 kPa (90 psi) in order to ensure that the projectile will travel the entire length of the assembly without lodging the projectile in the hose. Storing the nozzles in a **156-0055** Rack-Nozzle Organizer will keep them separate and make it easier to locate the correct nozzle. Store the various sizes of projectiles in a modular drawer or other contamination free cabinet. The projectiles need to be located close to the cleaning station. Post the Projectile Selection Chart, NEEG2955 in the cleaning area for reference when locating the correct nozzle and projectile. A **130-6420** Catcher Bag needs to be utilized in order to capture the projectiles fired through the assembly. The used projectiles need to be shown to the customer in order to prove that using the hose cleaning group is providing them with a contaminate free hose. The projectile may be placed in a bag and sent with the assembly for later reference.

Skive Area

All high pressure hoses must be skived. The correct tooling must be utilized including a skive tool along with a **226-7150** hose gauge kit . A Skive Length Chart, NEEG2956 should be available for easy reference in order to identify the correct skive length. Use a fine tipped marking pen to mark the correct length on the black outer cover of the hose. A skive vise should be mounted on the workbench to help support the hose during skiving. The hose is ready to be skived after the hose is marked and the hose is clamped in the vise. Place a waste bin in the skiving area to capture the outer cover that has been removed during the skiving process to keep the areas as clean as possible. Collect the skived material. Housekeeping in this area must be managed especially if in view of the customer.

Tooling

All of the tooling required for the assembly and/or disassembly of the coupling needs to be kept on a shadow board or in labeled drawers. This will insure that all the tooling has been returned. Clean all the tooling before returning to storage. Cleaning the tooling will help prevent assembly contamination and prolong the life of the tooling.

Coupling Reclamation

Reusable couplings must be reclaimed if replacement couplings are not available. Refer to the Tool Operating Manual for the machine being used for reclaiming, Tool Operating Manual, NEHS0746, "Combination Hose Machine" or Tool Operating Manual, NEHS0745, "XT-Hose Machine" may be used. The Tool Operating Manuals provide a list of all the tooling required and a step by step process for reclaiming the couplings. The couplings need to be reclaimed, cleaned, and inspected before they can be reused. Use a filtered parts washer to maintain coupling cleanliness when required. Inspect the couplings

after cleaning. Refer to Guideline for Reusable Parts and Salvage Operations, SEBF8176 to determine the coupling reusability.

Assembly

The assembly process can be started once the hose has been cleaned and the couplings are obtained. Refer to the Tool Operating Manual of the machine being used for the tooling needed in the assembly process. Crimp one coupling. Check and record the crimp diameter to ensure the coupling is within crimp specifications. Refer to Chart of Proper Crimp Diameters and Tolerances, NEEG2746. Make any adjustments to the tooling prior to conducting the next crimp. If armor guard is needed, install the armor guard on the new hose before assembling the second coupling. The angle of orientation must be set before crimping the second coupling. Refer to the Reusable Coupling Tool List, NEHS0750 for the correct angle of orientation. Crimp the second coupling. Check the crimp diameter and record all of the values.

Final Inspection and Cleaning

Visually inspect the final assembly. Deburr any rough edges that may be on the couplings due to the crimping process. Check the final assembly for the correct assembly length and angle of orientation. The finished assembly then needs to be cleaned one last time. Obtain the correct projectile for the couplings being used. Fire the projectile through the assembly from the end with the smallest opening. After the hose is cleaned, the couplings need to be capped or plugged to keep out contaminates. A various assortment caps and plugs must be available at the cleaning station and installed immediately following the final hose cleaning. The assembly should be tagged indicating that the assembly is now contaminate free. Attach the "Certified Clean" sticker to the finished assembly. Attach the "Reuse this Coupling" sticker to any reusable couplings. Attach the identification tag to the finished assembly, if applicable. Place any saved projectiles in a bag and attach it to the assembly for customer inspection. Place the seals in a clean bag and attach the bag to the assembly. The finished assembly is now ready to be delivered to the customer. If the customer is not present at the time then store the assembly on a rack for easy retrieval when the customer arrives for pick-up.

Grupo de monitor de contaminación portátil que proporciona una alternativa económica al conteo de partículas

SMCS - 0781; 0784; 0786; 1300; 5050

Productos Caterpillar:
- **Todos**

Ver imagen

Illustración 1 g01087914

El Grupo de monitor de contaminación 243-3130 permite que el técnico vigile la limpieza del fluido hidráulico y aceite lubricante en sistemas con una presión máxima de 689 kPa (100 lb/pulg^2). El grupo de monitor de contaminación es ideal para usar con carritos de filtro. El grupo de monitor de contaminación puede bombear una muestra de aceite de los sistemas no presurizados o de botellas S·O·S para hacer verificaciones rápidas de la muestra.

Este grupo de monitor de contaminación proporciona códigos de limpieza ISO únicamente, pero cuesta menos que los equipos de conteo de partículas tradicionales. Los códigos de limpieza ISO se pueden indicar en tamaños de partícula de 6 micrones o de 14 micrones. Si el grupo de monitor de contaminación está conectado a un computador, se pueden mostrar también tamaños de partícula de 4 micrones.

El grupo de monitor de contaminación se debe usar con el Acoplador 6V-4144, el Acoplador rápido 243-3133 (para muestreo de fluido) o el Acoplador 210-5530.

El grupo de monitor de contaminación incluye el equipo siguiente: un conjunto monitor, una fuente de corriente CC, una fuente de corriente CA, un cable de comunicación, un disco de software, un manual para el usuario and un estuche para transporte.

Vea más información en el Manual de Operación de Herramientas, NEHS0908.

Tabla 1

Especificaciones para el Grupo de monitor de contaminación 243-3130	
Presión Máxima	689 kPa (100 lb/pulg^2)

	689 kPa (100 lb/pulg²)
Pantalla	3 dígitos, código de limpieza ISO (ejemplos: 18/15, 16/13)
Monitor	De 3 canales con bomba de pistones integrada para usar en sistemas de baja presión o en sistemas sin presión
Corriente	Requiere 12 a 30 voltios CC
Adaptador CA	110 a 250 voltios AC de entrada/24 voltios CC de salida, 80 vatios
Comunicaciones	Requiere un conector DB9
Calibración	ISO-11171
Tamaño total	299 X 203 X 172 mm (11,75 X 8,0 X 6,75 pulg)

Tabla 2

Piezas de repuesto para el Grupo de monitor de contaminación 243-3130	
Número de pieza	**Descripción**
243-3131	Cable eléctrico (con pinzas de conexión)
243-3132	Suministro de corriente (Adaptador CA)
243-3144	Cable de comunicación (RS232)
188-0639	Conjunto de manguera (baja presión)

Información sobre reparación

La unidad está garantizada por el fabricante durante un año después de la fecha de la compra. Si una unidad en América del Norte o en América del Sur requiere servicio, comuníquese con la instalación de reparación del fabricante:

PAMAS-USA

6721 E. 106th St.
Tulsa, OK 74133 U.S.A.
Teléfono: 918-299-4019Fax: 918-299-7410

Si una unidad en Europa o Asia requiere servicio, comuníquese con la instalación de reparación del fabricante:

PAMAS-GmBH

Dieselstrasse 10
D-71277 Rutesheim
Postfach 1162
Alemania

ó

Sintech Scientific (SEA) Pet Ltd

Siltech Scientific (SEA) Pvt Ltd.

No. 196 Pandan Loop #02-18
Pantech Industrial Complex
Singapur 128384

Las válvulas de muestreo de fluido rediseñadas están disponibles para todos los productos Cat

SMCS - 7542

Productos Caterpillar:

- **Todos**

Las válvulas de muestreo de fluido recientemente diseñadas pueden soportar temperaturas de trabajo superiores, presiones superiores y pueden proporcionar una mayor vida útil.

Ver imagen

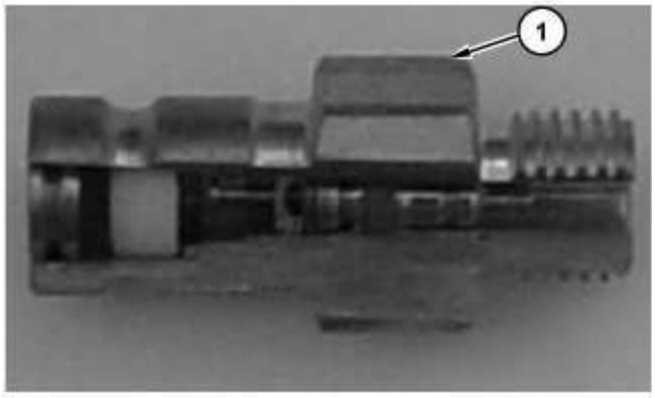


Ilustración 1 g02413897

(1) Válvula de muestreo de fluido actual sin corte de muesca

Las válvulas de muestreo de fluido actuales (números de piezas 8C-3446, 164-5590 (incluye números de piezas. 8C-3446 y 3J-7354), 7X-3387, 8C-3345, 159-8336) pueden tener fugas. Se ha introducido un diseño mejorado. Los números de piezas para estas válvulas de muestreo de fluido permanecen iguales, pero se han modificado los niveles de cambio.

Ver imagen

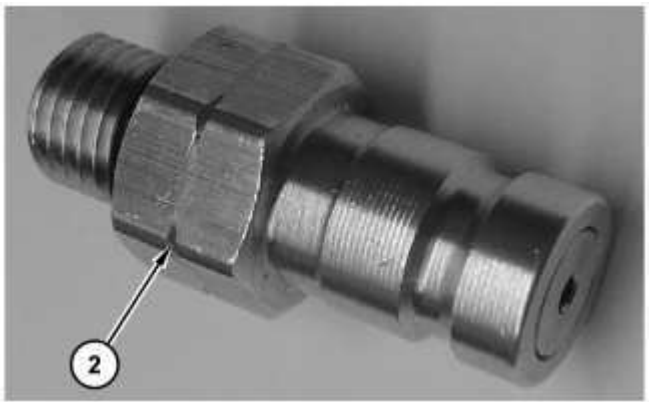


Ilustración 2 g02413896

(2) Nuevo diseño de válvula de muestreo de fluido con corte de muesca

La válvula de muestreo de fluido recientemente diseñada puede utilizarse para reemplazar la válvula de muestreo de fluido que tiene una fuga. La diferenciación se indica por una muesca en el lado hexagonal. Consulte la figura 1 para obtener el diseño actual y la figura 2 para obtener el diseño nuevo.

Cambios en el uso y la limpieza del grupo de monitor de contaminación

SMCS - 0645; 0680; 1280; 1348; 3080; 429F; 5095

Productos Caterpillar:
- **Todos**

ReferenciaInstrucción Especial, SEBF9180, "Análisis de limpieza del combustible diesel con recuento automático de partículas"

El Grupo de Monitor de Contaminación 293-8413 puede utilizarse para analizar la limpieza del aceite del motor, el aceite hidráulico y determinados combustibles diesel. Se deben utilizar las nuevas instrucciones de limpieza y de uso.

En las instrucciones ahora se especifica que el Grupo de Monitor de Contaminación 293-8413 se debe utilizar para analizar únicamente los líquidos con un punto de encendido igual o superior a 55 °C (131 °F). Existe una remota posibilidad de que los líquidos con un punto de encendido inferior a 55 °C (131 °F) se enciendan en el Grupo de Monitor de Contaminación 293-8413.

Al purgar o limpiar el Grupo de Monitor de Contaminación 293-8413, use únicamente un aceite mineral o un combustible diesel. El aceite mineral y el combustible diesel deben tener un punto de encendido igual o superior a 55 °C (131 °F). En Europa, el combustible diesel que cumple con esta especificación se denomina combustible diesel No. 5. El nombre de este combustible diesel varía en todo el mundo.

El uso de agentes de limpieza que no cumplan con las nuevas instrucciones puede dañar el grupo de monitor de contaminación. Existe una remota posibilidad de que el Grupo de Monitor de Contaminación 293-8413 se encienda si se usan líquidos incorrectos.

Prácticas para mangueras y acoplamientos Caterpillar

SMCS - 0618; 1000; 5057; 7000

Productos Caterpillar:

- **Todos**

Caterpillar ha embarcado algunas máquinas con conjuntos de mangueras hidráulicas que utilizan acoplamientos hidráulicos no-Caterpillar. Se utilizaron mangueras Caterpillar. Los conjuntos de manguera se fabricaron para cumplir con los requisitos de Caterpillar. Si hay daños de los conjuntos de manguera no-Caterpillar, se aplica lo siguiente. Reemplace los conjuntos de manguera con mangueras Caterpillar y acoplamientos Caterpillar. No vuelva a utilizar los acoplamientos de manguera no-Caterpillar.

Caterpillar no puede garantizar la seguridad o el rendimiento de ningunainterfaz de acoplamiento de manguera que utiliza otros acoplamientos en una manguera Caterpillar producida fuera de lainstalación de fabricación.

Grupo de monitor de contaminación portátil que proporciona una alternativa económica al conteo de partículas

SMCS - 0781; 0784; 0786; 1300; 5050

Productos Caterpillar:
- **Todos**

Ver imagen

Illustración 1 g01087914

El Grupo de monitor de contaminación 243-3130 permite que el técnico vigile la limpieza del fluido hidráulico y aceite lubricante en sistemas con una presión máxima de 689 kPa (100 lb/pulg^2). El grupo de monitor de contaminación es ideal para usar con carritos de filtro. El grupo de monitor de contaminación puede bombear una muestra de aceite de los sistemas no presurizados o de botellas S·O·S para hacer verificaciones rápidas de la muestra.

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PAMAS-GmBH

Dieselstrasse 10
D-71277 Rutesheim
Postfach 1162
Alemania

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Siltech Scientific (SEA) Pvt Ltd.

No. 196 Pandan Loop #02-18
Pantech Industrial Complex
Singapur 128384

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

This special instruction provides the necessary information in order to create SIS Web Feedback. All information provided in this document is necessary in order to provide the SIS Web Feedback analyst with the necessary information to expedite the resolution. SIS Web feedback is intended to provide feedback on any discrepancies within the Service/Parts literature. The feedback system is not intended to address any problems related to machine or component performance. Refer to the Dealer Solutions Network (DSN) for any problems associated with machine or component performance.

Note: Feedback is only available through SIS Web. Feedback is not available through SIS Network or SIS DVD.

Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

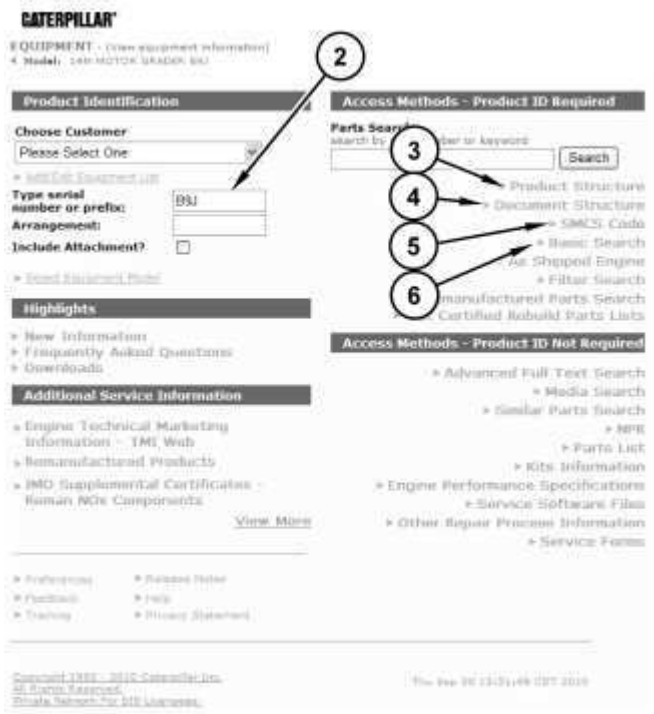


Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

   Note: Using any other method in searching for parts and service information will result in missing information in the discrepancy ticket. Any missing information may delay resolution of the discrepancy.

Ver imagen

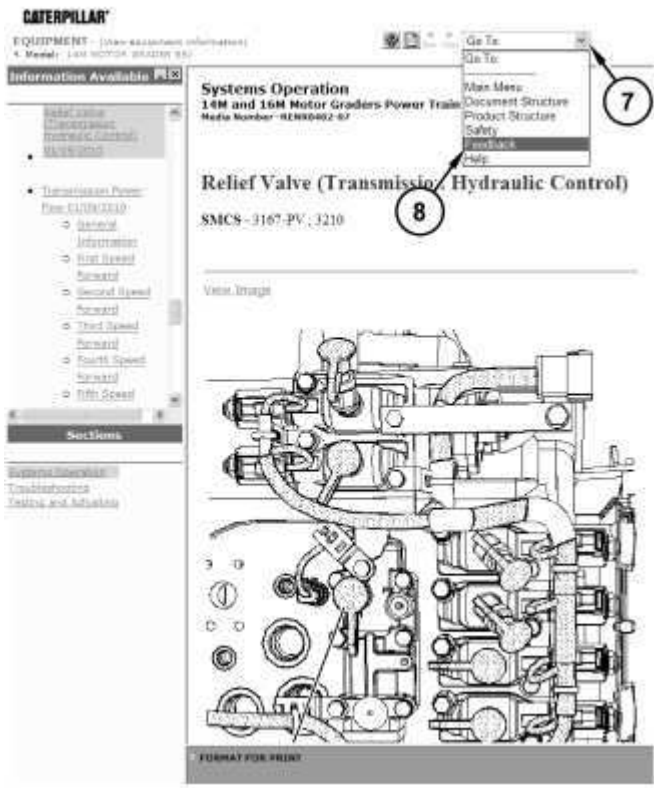


Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

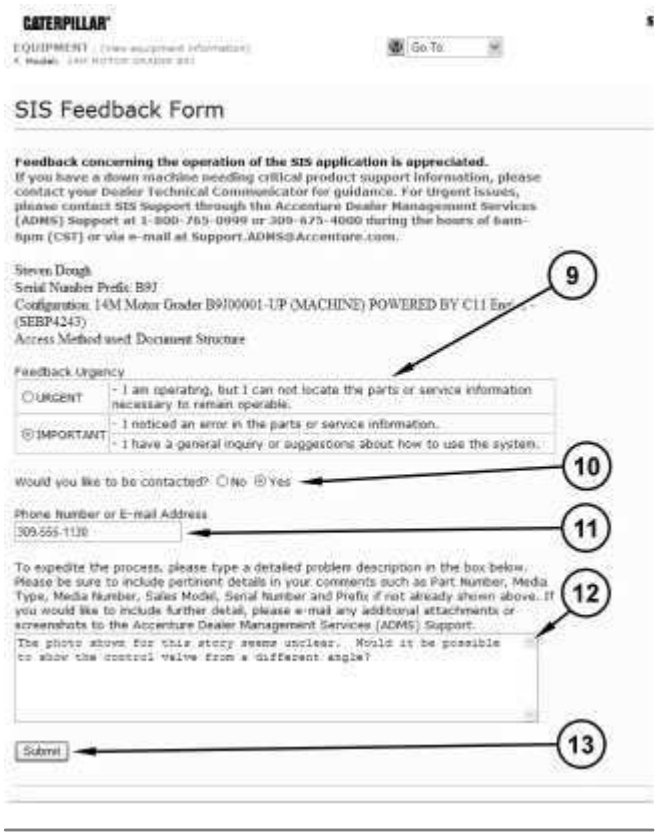


Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
7. Provide the contact information in box (11). The contact information can include an E-mail address and/or a telephone number.
8. Provide a detailed description of the discrepancy in box (12). Be sure to include pertinent details such as: part number, media type, media number, sales model, serial number and prefix. This information will expedite the resolution of the discrepancy.
9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

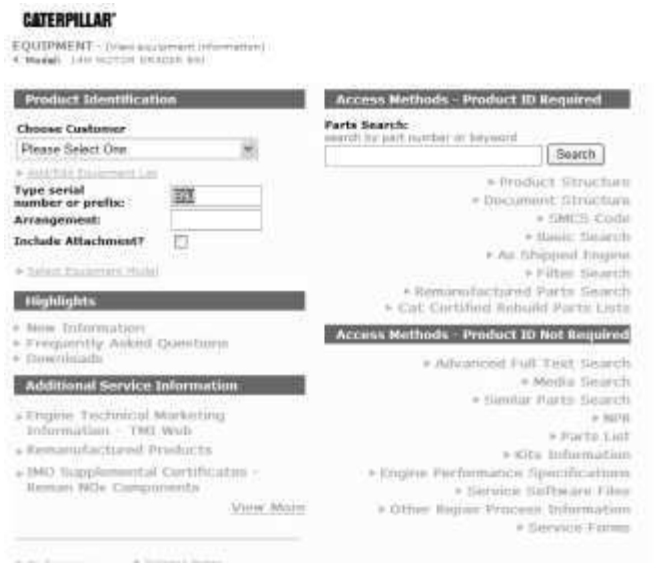
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



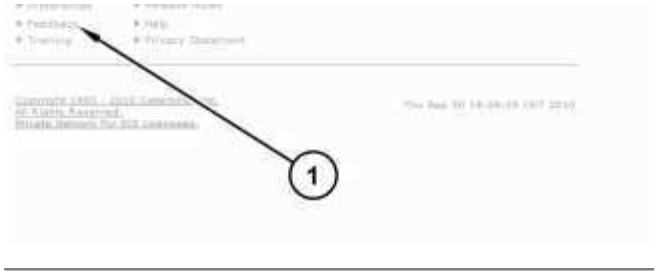


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Engine Oil Pressure - Test

SMCS - 1304-081

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Tools and Shop Products Guide" for tools and supplies suitable to collect and contain fluids on Caterpillar products.

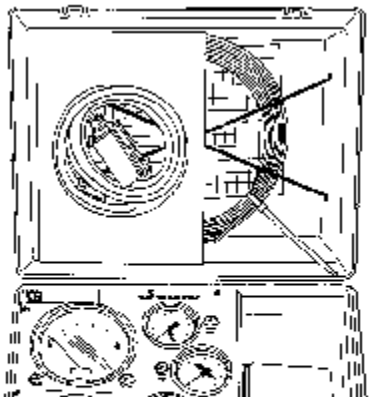
Dispose of all fluids according to local regulations and mandates.

Table 1

Tools Needed		
Part Number	**Part Name**	**Quantity**
1U-5470	Engine Pressure Test Group	1

An oil pressure gauge that has a defect can indicate low oil pressure or high oil pressure.

Ver imagen



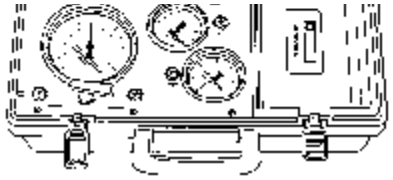


Illustration 1 g00296486

1U-5470 Engine Pressure Test Group

The **1U-5470** Engine Pressure Test Group measures the oil pressure in the system. This Engine Pressure Test Group has a gauge that monitors the oil pressure inside the oil manifold.

Note: Refer to Special Instruction, SEHS8907 for additional information on using the **1U-5470** Engine Pressure Test Group.

Ver imagen

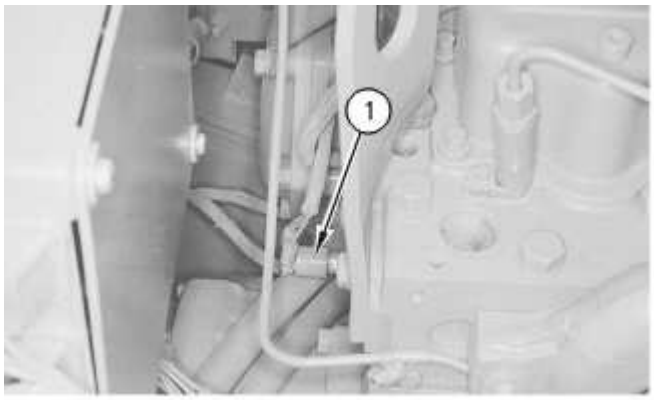


Illustration 2 g00323033

Location of Oil Pressure Switch

(1) Oil pressure switch.

WARNING

Work carefully around an engine that is running. Engine parts that are hot, or parts that are moving, can cause personal injury.

Oil pressure to the camshaft and main bearings should be checked on each side of the cylinder block at oil gallery plug (1). With the engine at operating temperature, the minimum oil pressure at full load rpm should be approximately 250 kPa (36 psi). Minimum oil pressure at low idle rpm should be approximately 100 kPa (14 psi).

Ver imagen

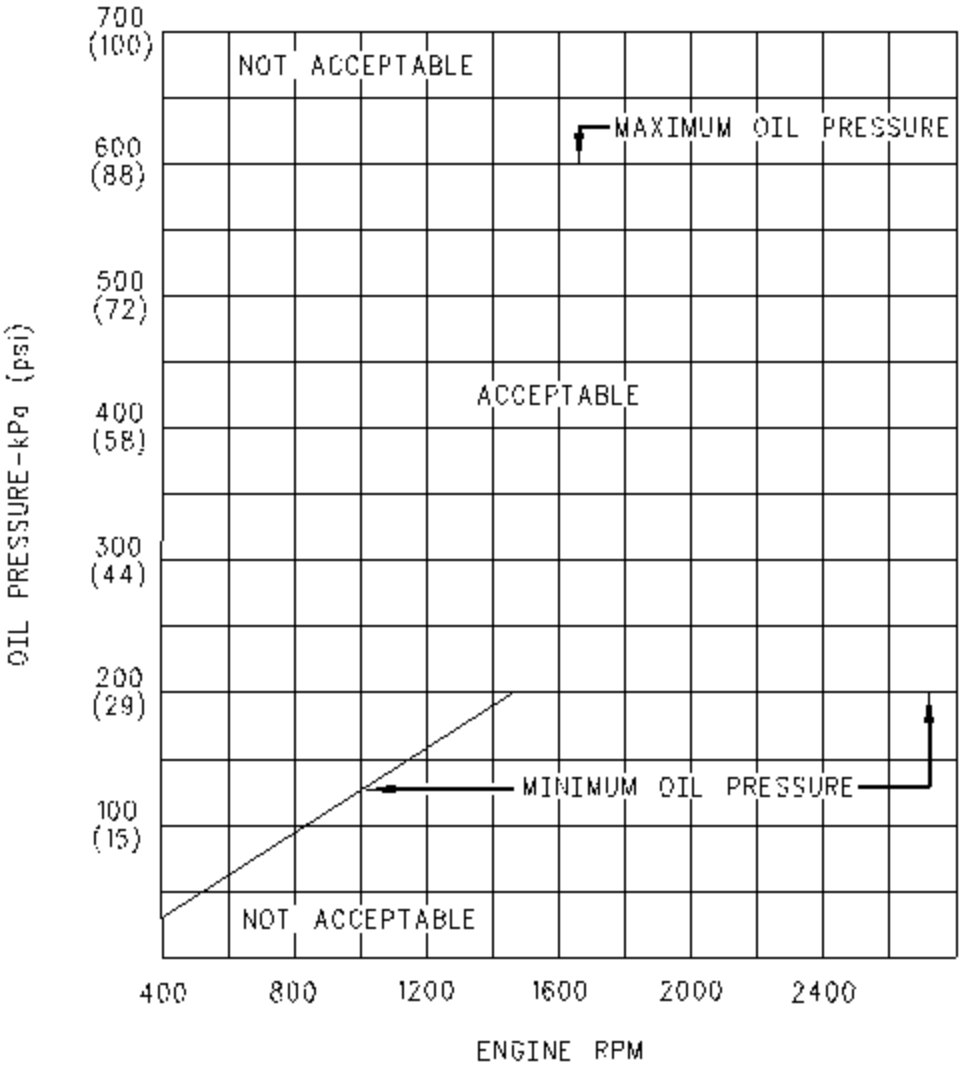


Illustration 3 g00296494

Engine Oil Pressure Graph

Low Oil Pressure

Crankcase Oil Level

Check the level of the oil in the crankcase. Add oil if oil is needed. The oil level can possibly be too far below the oil pump supply tube. This will cause the oil pump to NOT have the ability to supply enough lubrication to the engine components.

The Oil Pump Does Not Work Correctly

The inlet screen of the supply tube for the oil pump can have a restriction. This restriction will cause cavitation and a loss of oil pressure. Air leakage in the supply side of the oil pump will also cause cavitation and loss of oil pressure. If the bypass valve for the oil pump is held open, the lubrication system can not reach the maximum pressure. Oil pump gears with too much wear cause a reduction in oil pressure.

Oil Filter Bypass Valve

If the bypass valve for one or more of the oil filters is held open due to a restriction, a reduction in the oil pressure can be the result. Remove each bypass valve and clean each bypass valve. This allows you to correct the problem. You must also clean each bypass valve bore. Install new Caterpillar oil filters. New filters will prevent more debris from causing this problem.

NOTICE

Caterpillar oil filters are built to Caterpillar specifications. Use of an oil filter not recommended by Caterpillar could result in severe engine damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Caterpillar.

Excessive Clearance At Engine Bearings Or Open Lubrication System

Components that are worn and components that have too much bearing clearance can cause low oil pressure. Low oil pressure can also be caused by an oil line or by an oil passage that is open, broken, or disconnected.

Piston Cooling Jet

The piston cooling jet directs the oil flow to the bottom of the piston when you are operating the engine. This cools the piston. This also provides lubrication for the piston pin. A seizure of the piston will occur quickly if a jet experiences any of the following problems:

- Breakage
- Restriction
- Incorrect installation

Use the **5P-8709** Cooling Jet Alignment Tool to check the alignment of the piston cooling jets.

High Oil Pressure

Oil pressure will be high if the bypass valve for the oil pump can not be opened.

Oil pressure will also be high if the oil filter is plugged with a inoperable filter bypass valve. Foreign matter in the engine oil system could be the cause for the restriction of the oil flow and the movement of the engine oil bypass valves. If the engine oil bypass valves are stuck in the closed position, remove each bypass valve and clean each bypass valve in order to correct this problem. You must also clean each bypass valve bore. Install new engine oil filters. New engine oil filters will prevent more debris from causing this problem.

NOTICE

Caterpillar oil filters are built to Caterpillar specifications. Use of an oil filter not recommended by Caterpillar could result in severe engine damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Caterpillar.

Consumo excesivo de aceite de motor - Inspeccionar

SMCS - 1348-040

Fugas de aceite en el exterior del motor

Compruebe si hay fugas en los sellos en cada extremo del cigüeñal. Revise si hay fugas en la empaquetadura del colector de aceite del motor y en todas las conexiones del sistema de lubricación. Revise si hay fugas de aceite del motor procedentes del respiradero del cárter. Esto puede deberse a fugas de gas de combustión alrededor de los pistones. Un respiradero del cárter que esté sucio causará una alta presión en el cárter. Un respiradero del cárter sucio causará que las empaquetaduras y los sellos tengan fugas.

Hay fugas de aceite del motor en el área de combustión de los cilindros

El aceite de motor que se fuga por el área de combustión de los cilindros puede ser la causa de que salga humo azul. Hay varias formas posibles de que gotee aceite en el área de combustión de los cilindros:

- Fugas entre las guías de válvula desgastadas y los vástagos de las válvulas
- Componentes desgastados o dañados (pistones, anillos de pistón u orificios de retorno sucios para el aceite del motor)
- Instalación incorrecta del anillo de compresión y del anillo intermedio.
- Fugas en los anillos de sellado del eje del turbocompresor
- Llenado excesivo del cárter
- Indicador o tubo guía errado de nivel de aceite
- Operación sostenida en cargas ligeras

También se puede producir un consumo excesivo de aceite del motor si se utiliza un aceite con la viscosidad incorrecta. El aumento de temperatura del motor puede hacer que el aceite del motor tenga una viscosidad ligera.

Aumento de temperatura del aceite del motor - Inspeccionar

SMCS - 1348-040

Cuando el motor esté funcionando a la temperatura de operación y el motor esté usando aceite SAE 10W30 o SAE 15W40, la temperatura máxima del aceite debe ser de 110 °C (230 °F). Ésta es la temperatura del aceite después de pasar por el enfriador de aceite.

Si la temperatura del aceite es alta, vea si hay una restricción en los conductos de aceite del enfriador de aceite. Una restricción en el enfriador de aceite no causará una baja presión de aceite en el motor.

Determine si la válvula de derivación del enfriador de aceite se mantiene en la posición abierta. Este estado permitirá que el aceite pase por la válvula en vez del enfriador de aceite. La temperatura del aceite aumentará.

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

This special instruction provides the necessary information in order to create SIS Web Feedback. All information provided in this document is necessary in order to provide the SIS Web Feedback analyst with the necessary information to expedite the resolution. SIS Web feedback is intended to provide feedback on any discrepancies within the Service/Parts literature. The feedback system is not intended to address any problems related to machine or component performance. Refer to the Dealer Solutions Network (DSN) for any problems associated with machine or component performance.

Note: Feedback is only available through SIS Web. Feedback is not available through SIS Network or SIS DVD.

Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

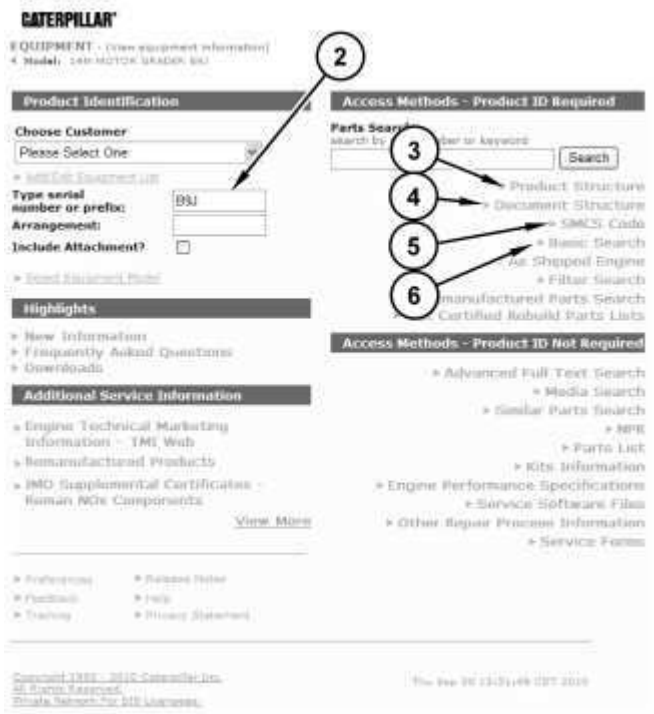


Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

   Note: Using any other method in searching for parts and service information will result in missing information in the discrepancy ticket. Any missing information may delay resolution of the discrepancy.

Ver imagen

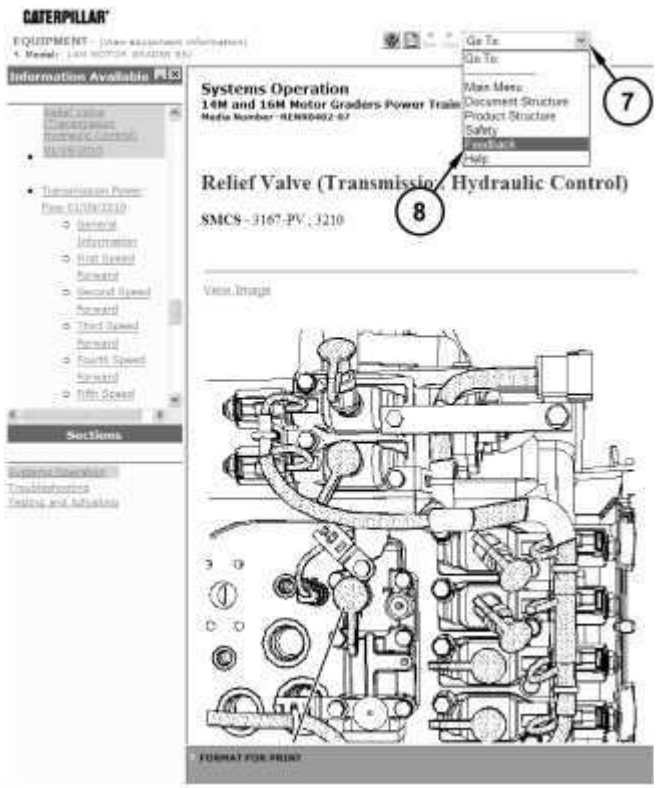


Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

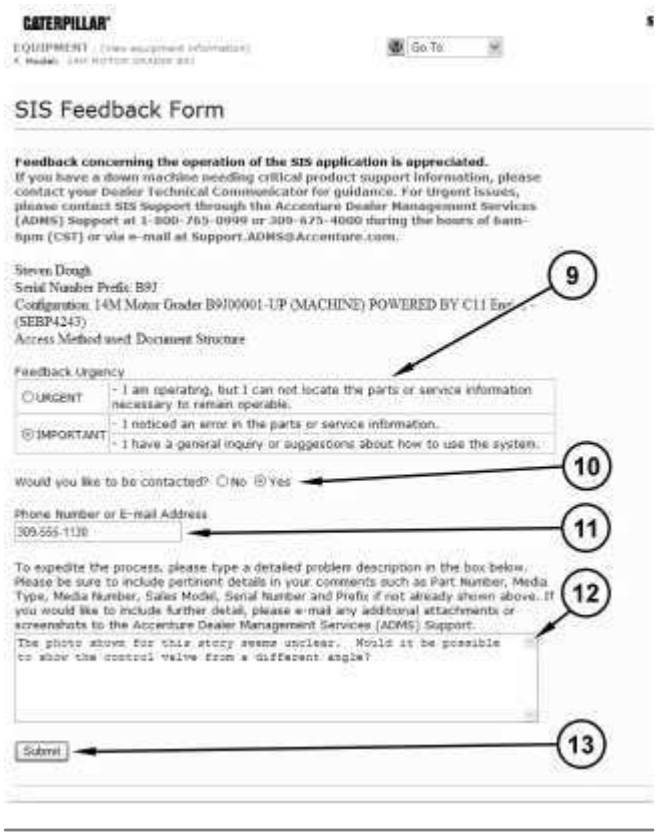


Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
7. Provide the contact information in box (11). The contact information can include an E-mail address and/or a telephone number.
8. Provide a detailed description of the discrepancy in box (12). Be sure to include pertinent details such as: part number, media type, media number, sales model, serial number and prefix. This information will expedite the resolution of the discrepancy.
9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

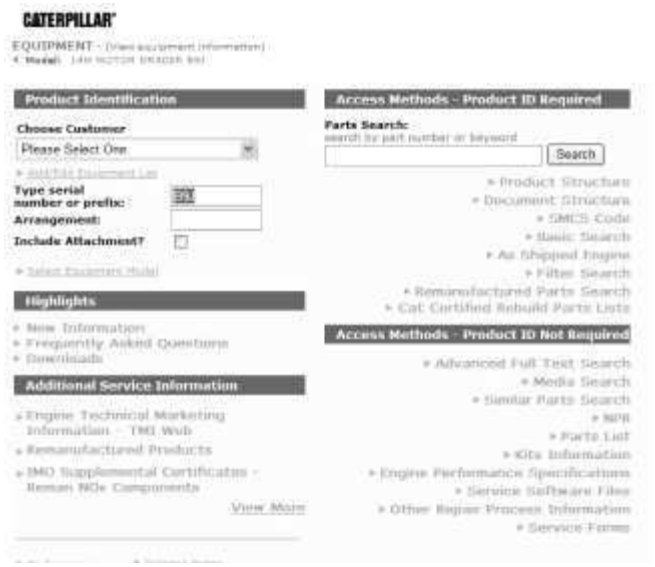
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



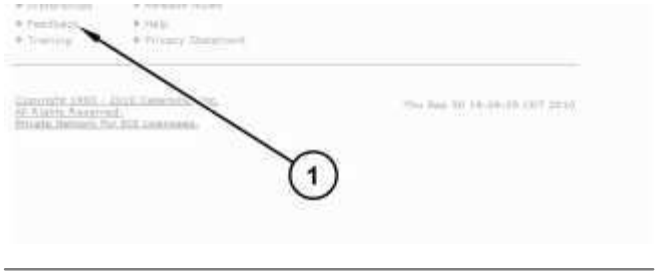


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Air Inlet and Exhaust System - Inspect

SMCS - 1050-040

A general visual inspection should be made to the air inlet and exhaust system. Make sure that there are no signs of leaks in the system.

Table 1

Tools Needed		
Part Number	**Part Name**	**Quantity**
1U-5470	Engine Pressure Group	1

Ver imagen

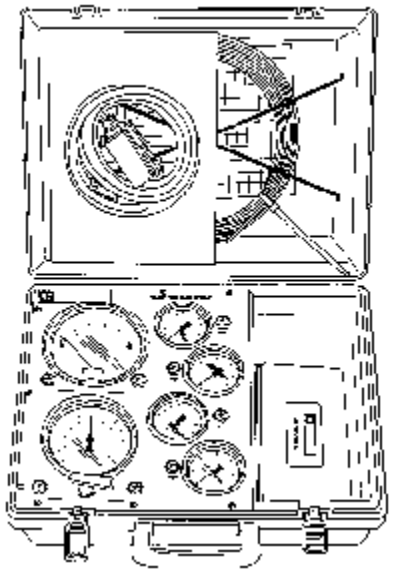


Illustration 1 g00295554

1U-5470 Engine Pressure Group

WARNING

Hot engine components can cause injury from burns. Before performing maintenance on the engine, allow the engine and the components to cool.

WARNING

Making contact with a running engine can cause burns from hot parts and can cause injury from rotating parts

and can cause injury from rotating parts.

When working on an engine that is running, avoid contact with hot parts and rotating parts.

Air Inlet Restriction

There will be a reduction in the performance of the engine if there is a restriction in the air inlet system.

1. Inspect the engine air cleaner inlet and ducting in order to ensure that the passageway is not blocked or collapsed.
2. Inspect the engine air cleaner element. Replace a dirty engine air cleaner element with a clean engine air cleaner element.
3. Check for dirt buildup on the clean air side of the engine air cleaner element. If dirt buildup is observed, contaminants are flowing past the engine air cleaner element and/or the seal for the engine air cleaner element.
4. Use the differential pressure gauge of the **1U-5470** Engine Pressure Group .

Ver imagen

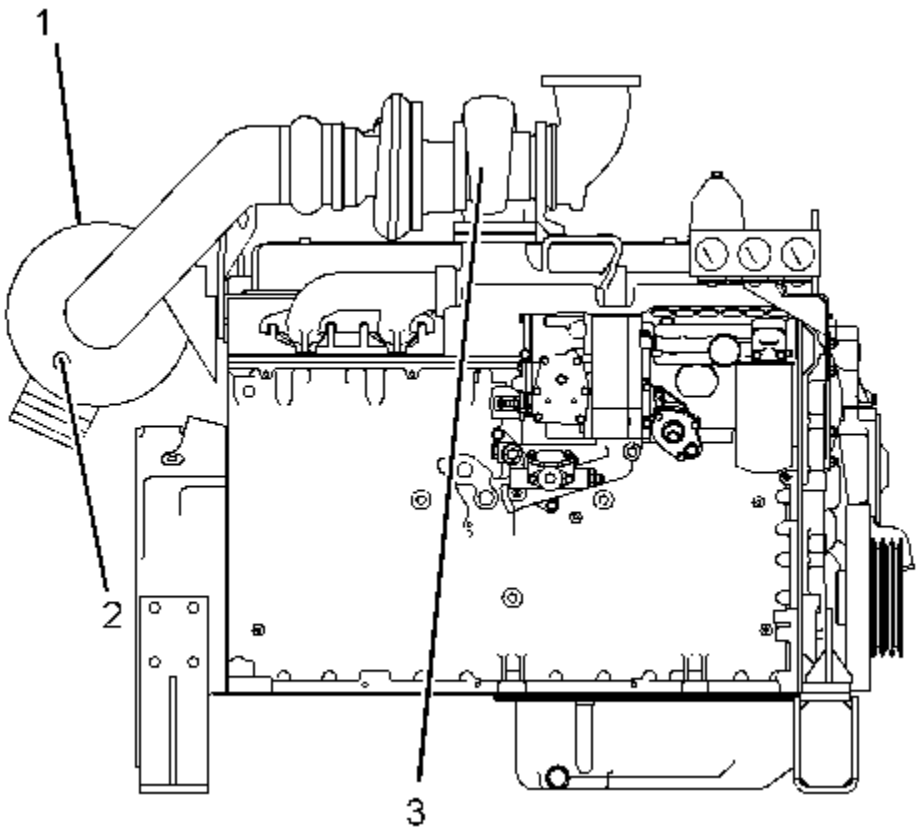


Illustration 2 g01110545

Air inlet piping

(1) Air cleaner

(2) Test location

(3) Turbocharger

a. Connect the vacuum port of the differential pressure gauge to test location (2). Test location (2) may be located anywhere along the air inlet piping after air cleaner (1) but before turbocharger (3) .

b. Leave the pressure port of the differential pressure gauge open to the atmosphere.

c. Start the engine. Run the engine in the no-load condition at high idle.

d. Record the value.

e. Multiply the value from Step 4.d by 1.8.

f. Compare the result from Step 4.e to the appropriate value that follows.

The air flow through a used air cleaner may have a restriction. The air flow through a plugged air cleaner will be restricted to some degree. In either case, the restriction must not be more than the following amount:

Maximum restriction ... 7.5 kPa (30 inch of H_2O)

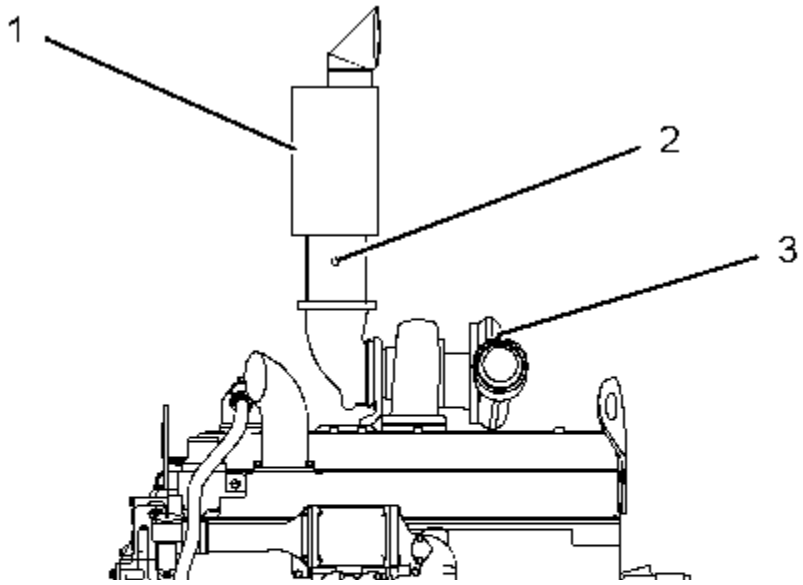
Exhaust Restriction

There will be a reduction in the performance of the engine if there is a restriction in the exhaust system.

Back pressure is the difference in the pressure between the exhaust at the outlet elbow and the atmospheric air.

Use the differential pressure gauge of the **1U-5470** Engine Pressure Group in order to measure back pressure from the exhaust. Use the following procedure in order to measure back pressure from the exhaust:

Ver imagen



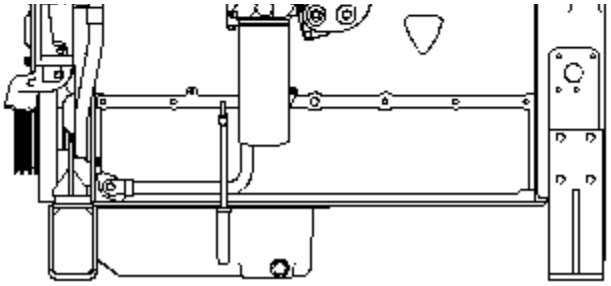


Illustration 3 g01110631

Exhaust piping

(1) Muffler

(2) Test location

(3) Turbocharger

1. Connect the pressure port of the differential pressure gauge to test location (2). Test location (2) can be located anywhere along the exhaust piping after turbocharger (3) and before muffler (1) .
2. Leave the vacuum port of the differential pressure gauge open to the atmosphere.
3. Start the engine. Run the engine in the no-load condition at high idle.
4. Record the value.
5. Multiply the value from Step 4 by 1.8.
6. Compare the result from Step 5 to the appropriate value that follows.

Back pressure from the exhaust must not be more than the following amount:

Maximum back pressure ... 686 kPa (27 inch of H_2O)

Grupo de probador de refrigerante/baterías que prueba rápidamente el refrigerante y el ácido de la batería

SMCS - 0773; 0785

Productos Caterpillar:

- **Todos**

Ver imagen

Illustración 1 g01080194

El Grupo de probador de refrigerante/baterías 245-5829 (Refractómetro) mide el punto de congelación del refrigerante de glicol etilénico y del refrigerante de glicol propilénico. El probador de refrigerante/baterías mide también la densidad específica del ácido de la batería para determinar el estado de carga de la batería.

El técnico sólo necesita aplicar dos o tres gotas de refrigerante o ácido al probador de refrigerante/baterías. El probador muestra los resultados en grados Celcius. El probador también puede mostrar los resultados en grados Fahrenheit. El diseño de prisma y lente, con ajuste de enfoque, facilita la operación. El diseño incluye características de compensación por temperatura automática para proporcionar resultados precisos.

El probador de refrigerante/baterías cumple con los reglamentos de la Unión Europea. Se incluyen con el probador un estuche de transporte, una botella de agua destilada, un cuentagotas medicinal y un destornillador de calibración.

Tabla 1

Especificaciones	
Gama	**Resolución**
Punto de congelación de glicol propilénico de -60° a 32°F	10°F
Punto de congelación de glicol etilénico de -50° a 0°C	5°C
Densidad específica del ácido de la batería de 1,15 a 1,30	0,01

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

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Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

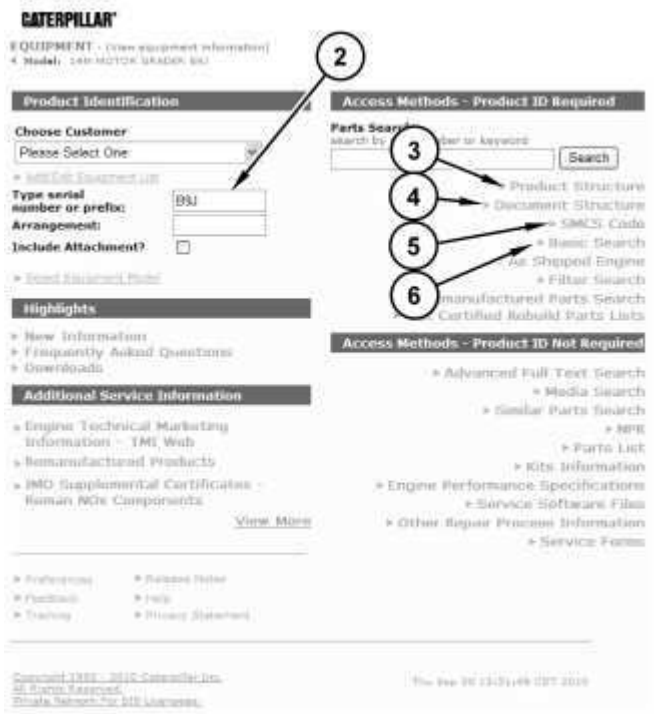

Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

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Ver imagen

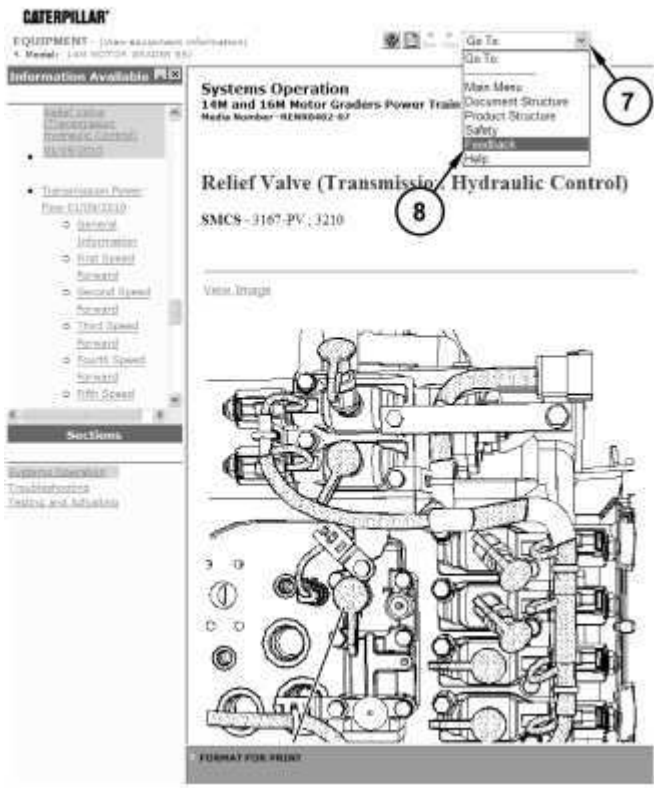

Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

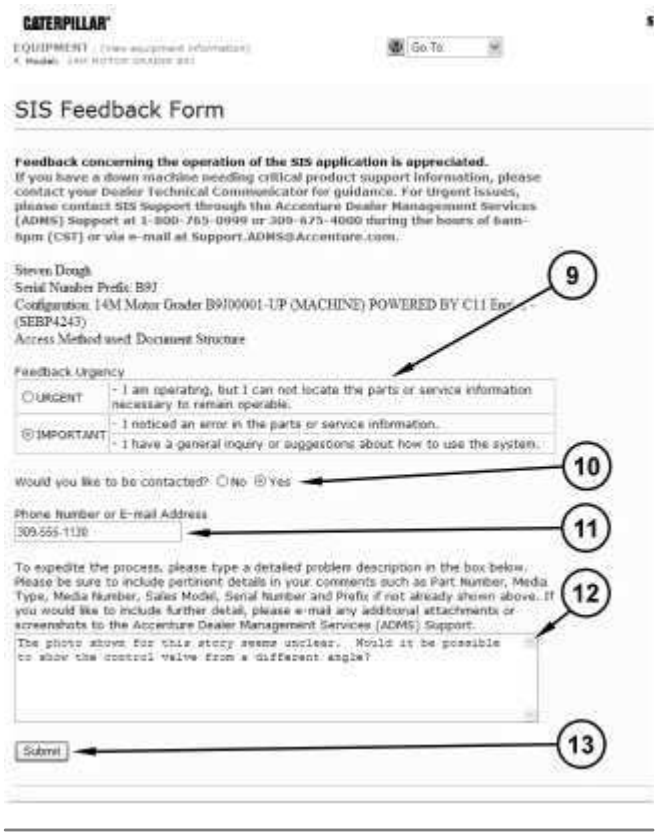

Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
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9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

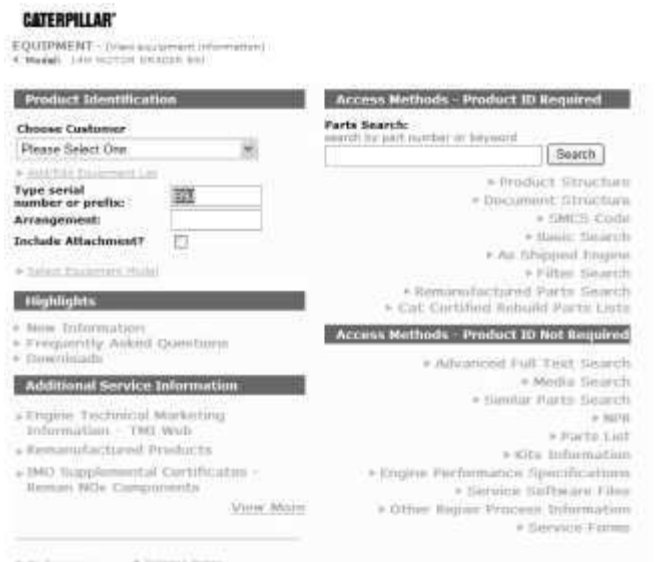
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



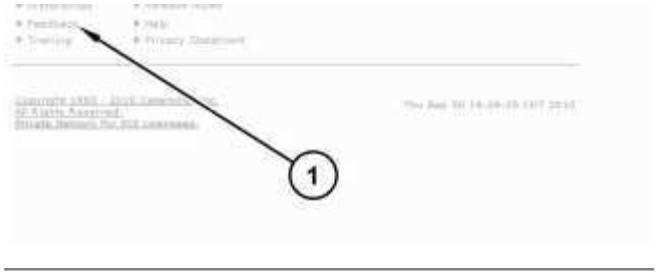


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Know Your Cooling System{0708, 1000, 7000}

SMCS - 0708; 1000; 7000

Caterpillar Products: All

Introduction

Diesel engine manufacturers have increased engine operating temperatures to improve engine efficiency. This increase in temperature means proper cooling system maintenance is especially important. Overheating, overcooling, pitting, cavitation-erosion, cracked heads, piston seizures, and plugged radiators are classic cooling system failures.

Proper coolant selection and maintenance are your choice, and coolant is vital to successful engine service life. In fact, coolant is as important as the quality of your fuel and lubricating oil.

This booklet tells the coolant story: its composition, contamination, and typical consequences. This booklet also offers preventive measures to help you avoid the costly effects of coolant related failures.

Note: Always check the latest Service Information for updates to ensure that the most current specifications and test procedures are used.

Understanding Cooling Systems

Proper cooling system design and maintenance is an important part of the satisfactory operation and service life of an engine. Understanding how the cooling system works can help reduce owning and operating costs.

Functions

The temperature of burning fuel in Caterpillar Engines can reach 1927° C (3,500° F). However, only about 33% of this total heat is converted into crankshaft horsepower. Approximately 30% is expelled through exhaust, while another 7% is radiated directly into the atmosphere from engine surfaces. The remaining 30% must be dissipated through a carefully designed cooling system.

The cooling system must remove heat in order to keep the engine at the correct operating temperature. The cooling system must not remove too much heat or the engine will run cold.

Ver imagen

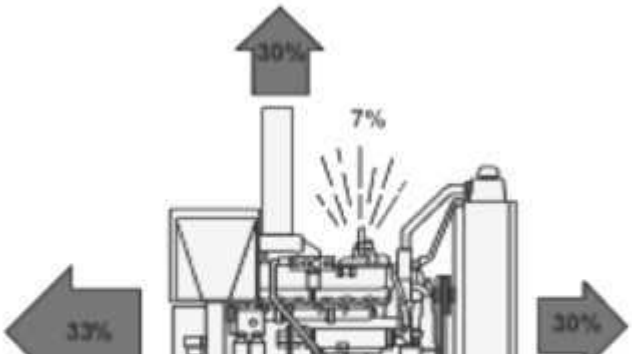


Illustration 1 g02143772

Proportional amount of heat dissapated from engine

In addition to removing heat generated from fuel combustion, in some applications, the cooling system must also remove heat from other sources.

Other components that transfer heat to the coolant include:

- transmission oil coolers
- hydraulic oil coolers
- aftercoolers
- water-cooled exhaust manifolds
- water-cooled turbocharger shields and housings
- marine gear oil coolers
- torque converter/retarder coolers

The cooling system has a direct effect on the operation and service life of the engine. Overheating or overcooling can result from the following conditions:

- The cooling system is not the correct size
- Poor maintenance of the cooling system
- Incorrect operation of the engine

Overheating or overcooling can shorten the engine service life. Overheating or overcooling can also cause poor engine performance. Find the cause of any problem in the cooling system and correct the problem immediately.

Thus, the function of the cooling system is to remove the proper amount of heat to keep the engine running at correct operating temperatures. This function is vital to the operation of an internal combustion engine.

Function of Components

There are many types of cooling systems. Most cooling systems use a radiator and a fan to remove the heat from the engine and other systems on a machine. Other types of cooling systems use a heat exchanger, keel coolers, or cooling towers to remove heat.

Figure 2 shows the basic components of most cooling systems. These basic components are: coolant, the water pump, the engine oil cooler, water temperature regulators in the thermostat housing, the fan, and the

radiator. In normal operation, the water pump pushes coolant through the engine oil cooler and into the cylinder block. The coolant then flows through the cylinder block and into the cylinder head or heads where it flows to the hot areas of the cylinder head. After flowing through the cylinder head or heads, the coolant goes into the thermostat housing.

When the engine is cold, the temperature regulators prevent the flow of coolant to the radiator and direct the coolant back to the water pump. As the temperature of the coolant becomes warmer, the temperature regulators begin to open and permit some flow of coolant to the radiator.

The regulator opens to maintain the correct engine temperature. The amount that the regulator opens and the percent of coolant flow to the radiator depends on the temperature of the coolant that in turn is determined by the load on the engine and the outside air temperature.

The fan pushes or pulls air through the radiator and around the tubes and fins that go from the top to the bottom of the radiator. (Some machines, such as lift trucks and highway trucks, can have cross flow radiator cores.) Other cooling systems have a separate pressure relief valve to limit the pressure in the cooling system.

When the hot coolant goes through the tubes in the radiator, the flow of air around the tubes and fins lowers the temperature of the coolant. The coolant then flows back through the water pump.

Ver imagen

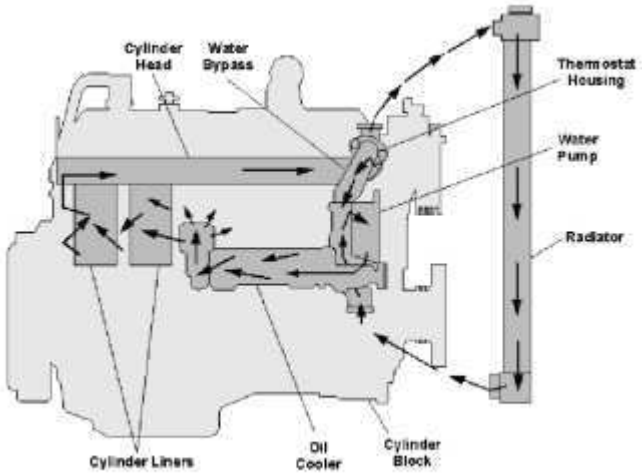


Illustration 2 g02143774

Typical Cooling System

In many applications, there are other components that transfer heat to the coolant. These components can be aftercoolers, water cooled exhaust manifolds, water cooled turbocharger shields and housings, transmission oil coolers, torque converters, and marine transmission oil coolers.

In some cooling systems, a shunt line is used to maintain a positive water pressure at the water pump inlet. The shunt line also provides a path for filling the cooling system.

Some cooling systems use a radiator cap that seals the opening in the top tank or overflow tank and limits

the pressure in the cooling system.

An orifice may be used between the thermostat and the radiator top tank for flow balance. If your cooling system is equipped with this system, it must not be changed or removed.

Most marine engines have an expansion tank and keel cooler or a heat exchanger instead of a radiator or fan. A second water pump is used to push sea water through the heat exchanger and, in some applications, through an aftercooler.

In heat exchanger cooling systems, an expansion tank and heat exchanger perform the same function as the radiator. However, instead of transferring heat into the air, a heat exchanger system transfers coolant heat to an external water supply. In marine applications, a keel or skin cooler is used as an outboard heat exchanger. This cooler is either attached to the submerged part of a vessel's hull or built as part of the hull.

Ver imagen

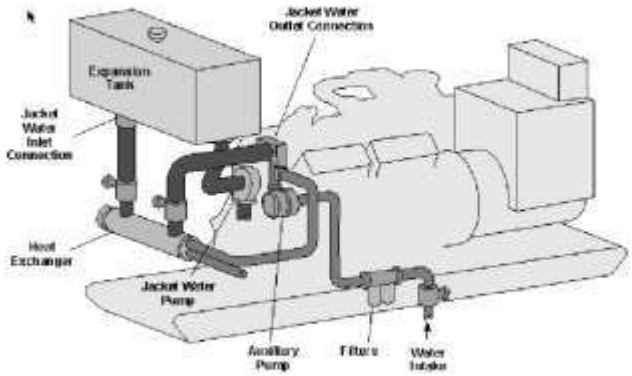


Illustration 3 g02143775

Schematic of typical heat exchanger cooling system

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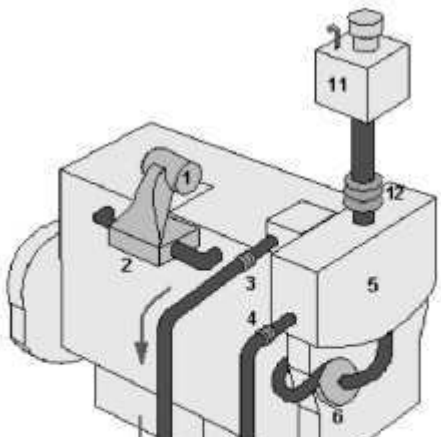

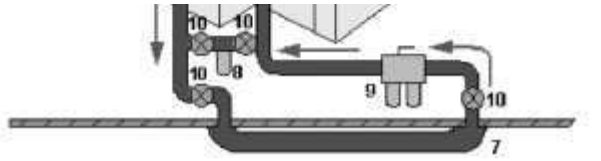

Illustration 4 g02143777

Schematic of typical keel cooler cooling system

(1) Turbocharger

(2) Aftercooler, jacket water cooled

(3) Jacket water outlet connection

(4) Jacket water inlet connection

(5) Expansion tank

(6) Jacket water pump

(7) Keel cooler

(8) Bypass filter

(9) Duplex full-flow strainer

(10) Shut-off valve

(11) Auxiliary expansion tank

(12) Flexible connection

Some machines use other cooler cores (radiators) to lower the temperature of transmission oil, hydraulic oil or air conditioning refrigerant. In most cases, the cores are upstream of the air flow to the radiator to get the coolest air. The additional cores increase the temperature of the air that passes through the radiator as well as increase the resistance to air flow. The additional cores also make it more difficult to thoroughly clean the radiator core. Recent design changes on some machines allow these additional cores to be easily swung to the side to allow better access to clean the radiator core.

Cooling System Temperature

Cooling System Temperature Cooling systems are designed to keep an engine operating within a desired temperature range. The temperature of the coolant must remain high to allow the engine to operate efficiently. However, the temperature must stay low enough to prevent the coolant from boiling.

A cooling system regulates temperature by transferring heat from the engine to the coolant and, eventually, into the air (or external water supply). How quickly the system transfers heat from the coolant into the air directly affects the system's temperature. This rate of heat transfer at the radiator depends on many different factors.

A major factor of heat transfer is the difference between the temperature of coolant inside the radiator and the temperature of surrounding air. When the difference between coolant temperature and ambient temperature increases, the rate of heat transfer increases. Alternatively, when this temperature differential decreases, the rate of heat transfer declines.

If the coolant starts to boil or steam, coolant is pushed out of the radiator's pressure relief valve. This action lowers the level of coolant and leads to engine overheating. Once overheating begins, continued operation only worsens the condition.

Three factors can change the boiling temperature of the coolant.

- The amount and type of coolant
- The pressure in the cooling system
- The altitude or barometric pressure

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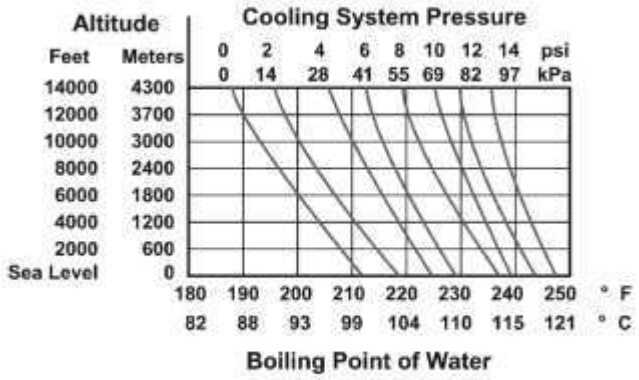

Illustration 5 g02143780

Pressure/Temperature chart

The boiling point is higher at higher pressure levels. Hence, most cooling systems are designed to operate under pressure. Maximum pressure of the system is controlled by a valve in the radiator cap or by the pressure relief valve.

Increasing the pressure of the cooling system raises the boiling point of the coolant. For this reason, most cooling systems are designed to operate under pressure. The amount of pressure is controlled by a valve in the radiator cap or the pressure relief valve.

A higher altitude causes a lower boiling point. Figure 5 shows the relationship of the altitude and the pressure in the cooling system with the boiling point. This chart is for water with no coolant.

For example, at 1800 meters (6,000 feet) above sea level, water boils at 93°C (200'F). But at 3700 meters (12,000 feet), water boils at only 88°C (190'F).

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Boiling Point of Coolant at Varying Glycol Concentrations	
% Concentration	Temperature at which Coolant with Ethylene Glycol Will Boil(1)
20	103° C (217° F)
30	104° C (219° F)
40	106° C (223° F)
50	108° C (226° F)
60*	111° C (232° F)

(1) At sea level
* Caterpillar Recommends not to exceed 60% concentration

Illustration 6 g02143785

Coolant boiling point concentration chart

Along with altitude and pressure, the type and the amount of coolant that is added to water also changes the boiling point. The boiling point is higher with higher concentrations of ethylene glycol in water when compared to propylene glycol based antifreeze in water. However, ethylene glycol is less effective than water at transferring heat. Use the correct concentration of ethylene glycol because of the effects on boiling point and heat transfer.

Factors That Affect the Cooling System

The rate of heat transfer from the radiator to the air is directly related to the difference between the coolant and air temperatures. High ambient air temperature causes the coolant temperature to be higher. Air density decreases as the altitude increases. Therefore, the rate of heat transfer to the air will decrease as the altitude increases. Because of this, higher altitudes cause higher coolant temperatures. However, ambient air temperatures normally decrease at higher altitudes, so the effects often counterbalance one another.

Sources of Heat

Operation of the machine in an overload condition can also cause overheating. The correct selection of gears is very important. If the machine is operated for a long period in a speed range that is near the stall speed of the torque converter, the cooling system can overheat. Under such conditions a large amount of heat is generated by the engine and/or torque converter while the speed of the fan and water pump are decreased.

Fuel combustion creates heat in all internal combustion engines. How much heat is determined by the API density and the amount of fuel used.

Cooling systems are generally designed to maintain proper operating temperature of the engine at full load conditions. If the load is increased with a drop in the rpm of the engine or if the rpm of the engine is decreased with no change in the load, the cooling system can overheat. In many applications, the cooling

system must absorb heat from several other sources. Among those sources are: Engine Oil Coolers, Aftercoolers, Transmission or Torque Converter Oil Coolers, Retarder Coolers, Water Cooled Exhaust Manifolds, Water Cooled Turbocharger Shields, and Hydraulic Oil Coolers.

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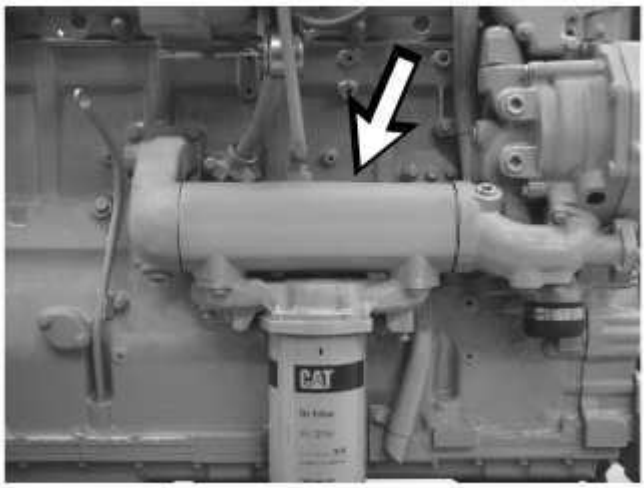

Illustration 7 g02143789

Typical engine oil cooler

Oil Coolers

Many engines, especially engines with turbochargers, have engine oil coolers. Most of the heat in the oil comes from oil that is sprayed on the bottom side of the pistons. The coolant must absorb enough heat in the oil cooler to prevent the oil from overheating. High temperature of pistons is caused by high inlet air temperatures, wrong injection timing, incorrect fuel settings, or low turbocharger boost, all of which increase the temperature of the oil.

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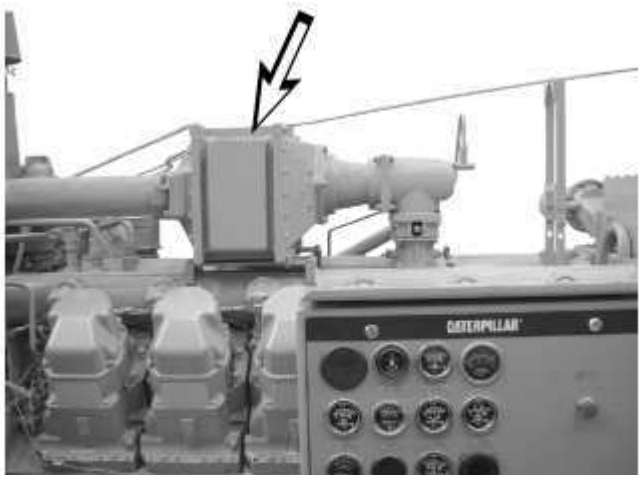

Illustration 8 g02143792

One type of aftercooler

Aftercoolers

The air at the outlet of the turbocharger is at a higher temperature than the air at the inlet of the turbocharger. Some engines have an aftercooler to lower the temperature of turbocharger outlet air. Coolant is used in many aftercoolers to absorb the heat from the turbocharged air. If the aftercooler core has dirt or oil in it, the coolant cannot absorb as much heat as it does normally. This can raise piston temperature and lower engine horsepower.

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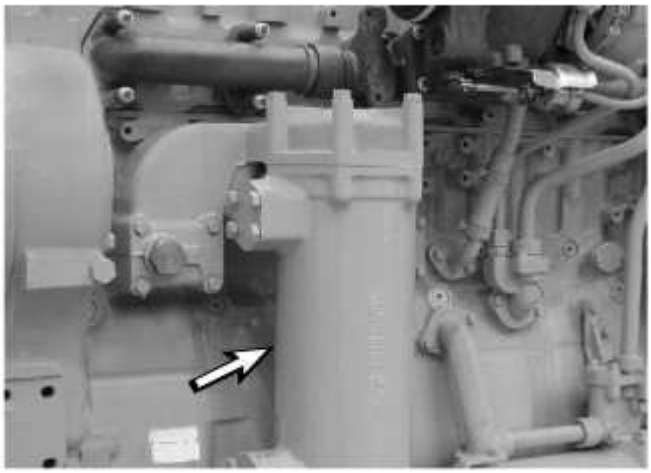

Illustration 9 g02143795

Typical transmission oil cooler

Transmission, Marine Transmission or Torque Converter Oil Coolers

The operation of transmissions, marine transmissions, and torque converters generates heat. Most of the heat in transmissions and marine transmissions is caused by the churning of oil. Normally, the amount of heat will increase with load, because some heat is generated by gears meshing. For torque converters, much of the heat is caused by shearing of oil between moving parts. The greatest amount of heat is generated when the torque converter operates near stall speed. A significant amount of heat is also generated in the torque converter when the machine runs at high speed with no load - usually downhill.

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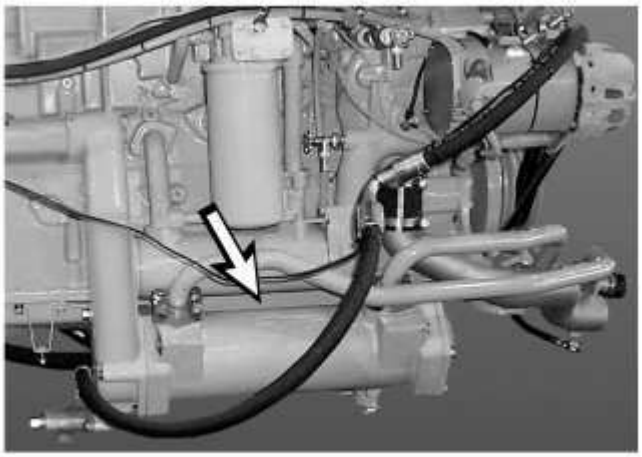

Illustration 10 g02143814

Combination retarder/transmission oil cooler.

Retarder Coolers

Some machines have a retarder that can be used to help slow the machine on a downslope. Use of this retarder causes heat in the retarder oil. It is important that proper engine speed and transmission speed range are used when using the retarder.

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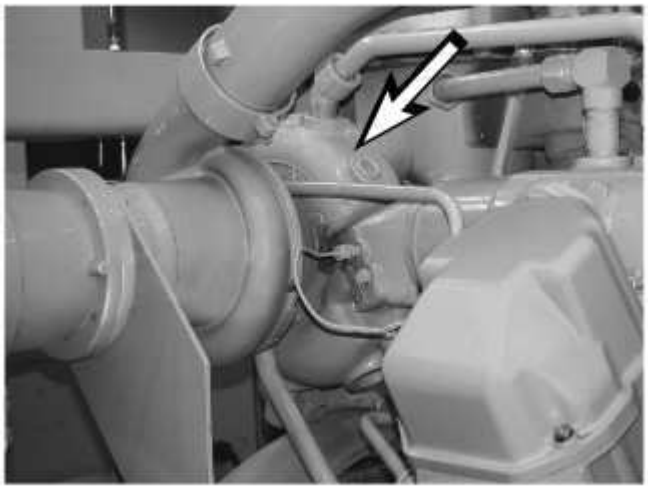

Illustration 11 g02143799

Water cooled turbocharger

Water Cooled Exhaust Manifolds and Water Cooled Turbocharger Shields

Some engines, especially marine engines, are equipped with water-cooled exhaust manifolds and/or watercooled turbocharger shields. Incorrect fuel settings or injection timing, excessive load on the engine, high inlet air temperature, or restrictions in the inlet or exhaust air flow can cause high exhaust temperatures and high coolant temperatures.

Hydraulic Oil Coolers

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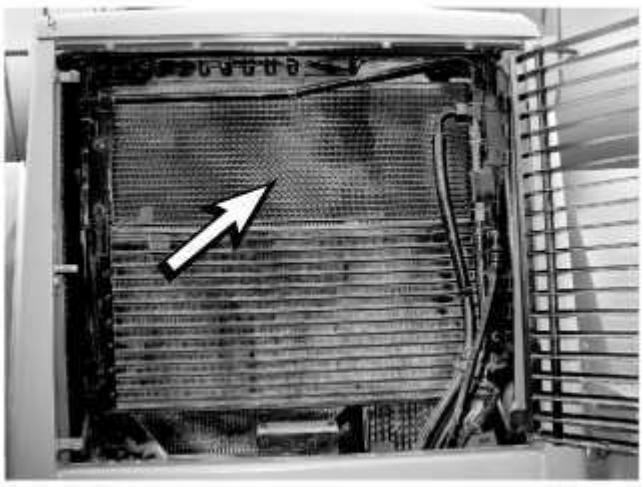

Illustration 12 g02141790

Hydraulic Oil Coolers

Some machines have hydraulic oil coolers. Generally, these are radiator-type coolers. On some machines, the cooler core is between the fan and the radiator. The air must pass through the cooler before it goes through the radiator. If the hydraulic oil overheats, so can the cooling system. Hot hydraulic oil is normally the result of a cycle time that is too rapid, the relief valve pressure set too low or exceeded, or the hydraulic system operated in an overload condition.

Safety Recommendations

Always wear eye protection when you perform any service work on a cooling system.

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Illustration 13 g02141793

Care must be taken during removal of the radiator cap

Release the pressure in the cooling system before performing any service work. If the pressure in the cooling system is not released or the temperature of the system is not permitted to cool, steam or hot water may be released when you remove the radiator cap. This may cause personal injury. To release the pressure in a cooling system, let the system cool, put a heavy cloth over the cap and loosen it SLOWLY.

- Do not allow undiluted corrosion inhibitors or diluted/undiluted radiator cleaners to come in contact with the skin or eyes.
- Do not use chromate corrosion inhibitors or any other cooling tower treatment chemistries in an engine cooling system. The use of these inhibitors in the cooling system can produce deposits that will lead to poor heat transfer.
- Always follow the manufacturer's instructions when handling corrosion inhibitors, radiator cleaners, or antifreeze. Be especially sure to follow the manufacturer's recommendations concerning toxicity.
- Glycol may catch fire when it is hot or exposed to an open flame. Do not weld, cut or use an open flame near leaking coolant that contains antifreeze.
- Do not use alcohol in place of antifreeze. Alcohol has a lower boiling temperature and flash point.
- Do not operate a machine or perform any service work around the area of the fan with the fan guards removed. Moving fan blades can cause personal injury. Moreover, anything that may fall into a moving fan can be thrown out with force.
- Do not work near fan belts with the engine running.
- Do not attempt to tighten any hose clamps while the cooling system is hot or under pressure. If there is a failure of the hose clamp when it is tightened, a sudden loss of hot coolant or steam could result.

Cooling System Maintenance

Coolant

Coolant generally consists of water combined with corrosion inhibitors or water combined with antifreeze and corrosion inhibitors. The correct selection of coolant has a direct effect on the efficiency and/or service life of both the cooling system and the engine. Coolant must be able to transfer heat from hot engine components to a radiator or heat exchanger where the heat is dissipated.

components to a radiator or heat exchanger where the heat is dissipated.

Heat Transfer

Heat transfer describes the tendency of heat to move from a hot area to a cooler area. Rate of heat transfer is measured by the specific heat properties of a given liquid. (Specific heat is the ratio of the quantity of heat required to raise the temperature of an amount of a specific liquid 1° compared to that required to raise the temperature of an equal mass of water 1°). In coolant, the rate of heat transfer also depends on the temperature difference between the outside air and the coolant itself, plus the conductive properties of the material that surrounds the coolant.

A coolant mixture of 50% ethylene glycol, which has a specific heat of .880, and 50% water, will increase the atmospheric boiling temperature of the mixture to approximately 107°C (225°F). The heat transfer of an ethylene glycol mixture is less than the heat transfer of water. The temperature at which the glycol mixture will boil is higher. This means some loss in cooling capability is recovered by obtaining a higher temperature in the radiator top tank without loss of coolant because of boiling.

Protection Against Freezing of the Coolant

The best protection against coolant freezing is the correct mixture/ratio of the coolant. Use the correct mixture/ratio of ethylene glycol and water or the correct mixture/ratio of propylene glycol and water as a coolant. The most common antifreezes that are available use ethylene glycol to provide freeze protection.

Note: Use a mixture of water, ethylene glycol (antifreeze), and cooling system conditioner. Pure, undiluted antifreeze will freeze at -23°C (-9°F).

Corrosion Resistance

The coolant must prevent the formation of rust and pits in the engine and other components. Since all water can cause corrosion, water should not be used alone. Any type of water is unacceptably corrosive when corrosion inhibitors or antifreeze are not added.

Always add Cat SCA (Supplemental Cooling Additive), or equivalent to the water antifreeze mixture at the time of the initial fill of the cooling system. [Adding Cat SCA is not necessary when using Cat ELC (Extended Life Coolant) or Cat DEAC (Diesel Engine Antifreeze/Coolant). The Caterpillar formula in these products includes all necessary inhibitors for initial fill.]

Note: NOTE: Do NOT use conventional SCA with Cat ELC. Use only Cat ELC Extender with Cat ELC.

Note: NOTE: Conventional Coolants DO require periodic additions of SCA to maintain cooling system protection.

Water alone is corrosive. If water alone is used (not recommended), it is extremely important that Cat SCA be added. Refer to this publication, "Water and Supplemental Coolant Additive" topic.

Scale and Deposits

The general characteristics of the water used as a coolant determine scale and deposit formations. It is impossible to inhibit "poor" water completely so as to make it usable as a coolant mixture. The water must be pretreated.

Compatibility

The coolant must not damage seals, hoses or any of the materials used in the construction of cooling systems such as copper, aluminum, and steel. Inhibitors in Cat ELC, Cat DEAC, and Cat SCA are designed to protect these materials.

Non foaming

The coolant used in a system must not foam or make sludge that can damage the cooling system.

Sediment

The coolant must be clear and not have mud or an oil residue in it.

Cylinder Wall Pitting

Proper cooling system maintenance helps to control cylinder wall pitting. Cylinder wall pitting is the result of the combined action of cavitation-erosion and corrosion. Essentially, during the normal course of engine operation, the cylinder wall flexes causing small air bubbles to form on the coolant side of the wall. Cavitation occurs when these bubbles break or implode and remove the cylinder wall's protective oxide film. Once this film is removed, corrosion is free to develop and eventually the cylinder wall surface deteriorates.

Erosion-corrosion is a combination of mechanical and chemical or electrochemical action that cause corrosion. Cavitation is a particular type of erosioncorrosion and a common cause of cylinder wall pitting.

Cylinder wall pitting can be controlled if the cooling system is regularly replenished with Cooling System Conditioner. If, however, conditioner is not added at the proper intervals (see page 24) and in the correct quantities, pitting will worsen, ultimately allowing coolant to penetrate the combustion chamber and cause major engine damage.

Coolant Properties

General Coolant Information

NOTICE

These recommendations are subject to change without prior notice. Contact your local Caterpillar Dealer for the most up to date recommendations.

NOTICE

Never add coolant to an overheated engine. Engine damage could result. Allow the engine to cool first.

NOTICE

If the engine is to be stored in, or shipped to an area with below freezing temperatures, the cooling system must be either protected to the lowest outside temperature or drained completely to prevent damage caused by freezing coolant.

Frequently check the specific gravity of the coolant for proper freeze protection or for anti-boil protection.

Clean the cooling system for the following reasons:

- Contamination of the cooling system
- Overheating of the engine
- Foaming of the coolant

Note: Air pockets can form in the cooling system if the cooling system is filled at a rate that is greater than 20 L (5 US gal) per minute.

After you drain the cooling system, and after you refill the cooling system, operate the engine. Operate the engine without the filler cap until the coolant level stabilizes. Ensure that the coolant is maintained to the proper level.

NOTICE

Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators. Removing the regulators allows some coolant to bypass the radiator, potentially causing overheating.

Many engine failures are related to the cooling system. The following problems are related to cooling system failures: overheating, leakage of the water pump, plugged radiators or heat exchangers, or pitting of the cylinder liners.

These failures can be avoided with proper cooling system maintenance. Cooling system maintenance is as important as maintenance of the fuel system and the lubrication system. Quality of the coolant is as important as the quality of the fuel and the lubricating oil.

Coolant is normally composed of three elements: water, additives, and glycol.

Water

NOTICE

All Caterpillar diesel engines equipped with air-to-air aftercooling (ATAAC) require a minimum of 30 percent glycol to prevent water pump cavitation.

NOTICE

Never use water alone without Supplemental Coolant Additives (SCA) or without inhibited coolant. Water alone is corrosive at engine operating temperatures. Water alone does not provide adequate protection against boiling or freezing.

Water is used in the cooling system in order to transfer heat.

Distilled water or deionized water is recommended for use in engine cooling system.

DO NOT use the following types of water in cooling systems: hard water, softened water that has been conditioned with salt, and seawater.

If distilled water or deionized water is not available, use water that meets or exceeds the minimum acceptable water requirements listed in Figure 14.

Table 1

Caterpillar Minimum Acceptable Water Requirements		
Property	**Maximum Limit**	**ASTM Test**
Chloride (CI)	40 mg/L ((2.4 grains/US gal))	"D512" "D4327"
Sulfate (SO_4)	100 mg/L ((5.9 grains/US gal))	"D516" "D4327"
Total Hardness	170 mg/L ((10 grains/US gal))	"D1126"
Total Solids	340 mg/L ((20 grains?US gal))	Federal Method (1) "2540B"
Acidity	pH of 5.5 to 9.0 ()	"D1293"

(1) Total dissolved solids dried at 103-105° C, "Standard Methard for the Elimination of Water and Wastewater", American Public Health Association,etal, 1015 15th Street, N.W. Washington, DC 20005

For a water analysis, consult one of the following sources:

- Caterpillar dealer
- Local water utility company

- Agricultural agent
- Independent laboratory

Additives

Additives help to protect the metal surfaces of the cooling system. A lack of coolant additives or insufficient amounts of additives enable the following conditions to occur:

- Corrosion
- Formation of mineral deposits
- Rust
- Scale
- Pitting and erosion from cavitation
- Foaming of the coolant

Many additives are depleted during engine operation. These additives must be replaced periodically. This can be done by adding SCA (Supplemental Coolant Additives) to Cat DEAC (Diesel Engine Antifreeze/Coolant) or by adding Cat ELC Extender to Cat ELC (Extended Life Coolant).

Additives must be added at the proper concentration. Over concentration of additives can cause the inhibitors to drop out-of-solution. The deposits can enable the following problems to occur:

- Formation of gel compounds
- Reduction of heat transfer
- Leakage of the water pump seal
- Plugging of radiators,coolers,and small passages

Glycol

Glycol in the coolant helps to provide protection against the following conditions:

- Boiling
- Freezing
- Water pump cavitation (ATAAC equipped engines)

For optimum performance, Caterpillar recommends a 1:1 mixture of a water/glycol solution.

Note: Use a mixture that will provide protection against the lowest ambient temperature.

Note: 100 percent pure glycol will freeze at a temperature of -23° C (-9° F).

Most conventional heavy-duty coolant/antifreezes use ethylene glycol. Propylene glycol may also be used. In a 1:1 mixture with water, ethylene and propylene glycol provide similar protection against freezing and

boiling. See Figures 15 and 16.

Table 2

Ethylene Glycol		
Concentration	**Freeze Protection**	**Boil Protectio (1)**
50 percent	−37° C (−34° F)	106° C (223° F)
60 percent	−52° C (−62° F)	111° C (232° F)

(1) Boiling protection is increased with the use of a pressurized radiator.

Fig. 15: Ethylene Glycol Concentration Chart.

NOTICE

Do not use propylene glycol in concentrations that exceed 50 percent glycol because of propylene glycol's reduced heat transfer capability. Use ethylene glycol in conditions that require additional protection against boiling or freezing. Do not use ethylene glycol in concentrations that exceed 60 percent glycol.

Table 3

Propylene Glycol		
Concentration	**Freeze Protection**	**Boil Protectio (1)**
50 percent	−32° C (−26° F)	106° C (223° F)

(1) Boiling protection is increased with the use of a pressurized radiator.

Fig. 16: Propylene Glycol Concentration Chart

Note: Propylene glycol coolant that is used in the cooling systems for Caterpillar diesel engines must meet "ASTM D6210-04," "Fully-Formulated Glycol-Based Engine Coolant for Heavy-Duty Engines." When propylene glycol coolant is used in heavy-duty diesel engines, a regular addition of SCA is required for protection against liner cavitation. Consult your Caterpillar dealer for additional information.

Testing Glycol Concentration

To check the concentration of glycol, use the **245-5829** Coolant/Battery Tester Gp . The tester gives readings that are immediate and accurate in both degrees Celsius and degrees Fahrenheit. The tester can be used with ethylene or propylene glycol.

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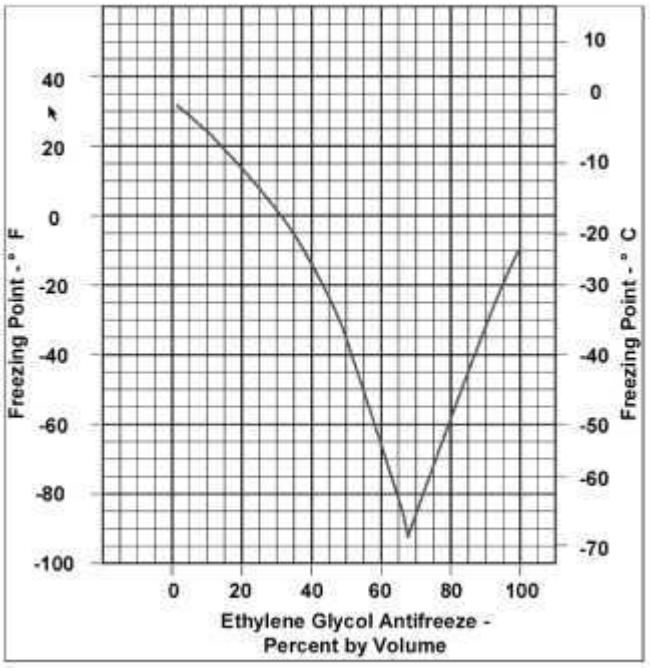

Illustration 14 g02141905

Freezing point curve for typical ethylene glycol solution

Table 4

Freeze Protection Temperatures for Antifreeze Concentrations (1)	
Protection to:	**Concentration**
−15° C (5° F)	30% glycol, 70% water
−24° C (−12° F)	40% glycol, 60% water
−37° C (−34° F)	50% glycol, 50% water
−52° C (−62° F)	60% glycol, 40% water

(1) Ethylene Glycol-based antifreeze

Fig. 18: Protection Temperatures for Antifreeze Concentrations.

Coolant Recommendations

The following two types of coolants may be used in Caterpillar diesel engines.

Preferred – Cat ELC (Extended Life Coolant) or a commercial extended life coolant that meets the

Caterpillar EC-1 specification

Acceptable – Cat DEAC (Diesel Engine Antifreeze/Coolant) or a commercial heavy-duty coolant/antifreeze that meets "ASTM D4985" or "ASTM D6210" specifications

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NOTICE

Do not use a commercial coolant/antifreeze that only meets the "ASTM D3306" specification. This type of coolant/antifreeze is made for light duty automotive applications.

Use only the coolant/antifreeze that is recommended.

Caterpillar recommends a 1:1 mixture of water and glycol. This mixture of water and glycol will provide optimum heavy-duty performance as a coolant/antifreeze.

Note: Cat DEAC does not require a treatment with an SCA at the initial fill. However, a commercial heavy-duty coolant/antifreeze that only meets the "ASTM D4985" specification WILL require a treatment with an SCA at the initial fill. A commercial heavy-duty coolant/antifreeze that meets the "ASTM D6210" specifications will NOT require a treatment with an SCA at the initial fill. Read the label or the instructions that are provided by the manufacturer of the commercial heavy-duty coolant/antifreeze.

Note: These coolants WILL require a treatment with a supplemental coolant additive on a maintenance basis.

In stationary engine applications and marine engine applications that do not require anti-boil protection or freeze protection, a mixture of supplemental coolant additive and water is acceptable. Caterpillar recommends a six percent to eight percent concentration of Cat SCA in those cooling systems. Distilled water or deionized water is preferred. If distilled water or deionized water is not available, use water that meets or exceeds the minimum acceptable water requirements listed in Figure 14.

NOTICE

All Caterpillar diesel engines equipped with air-to-air aftercooling (ATAAC) require a minimum of 30 percent glycol to prevent water pump cavitation.

Note: Caterpillar recommends a minimum of 30 percent glycol in diesel engine cooling systems. Refer to engine specific Operation and Maintenance Manuals for exceptions. Containers of several sizes are available.

Table 5

Coolant Service Life	
Coolant Type	**Service Life** (1) (2)
Cat ELC	12000 Service Hours or Six years (3)

Commercial coolant that meets the Caterpillar EC-1 Specification	6000 Service Hours or Six years (4)
Cat DEAC	3000 Service Hours or Three years
Commercial Heavy-Duty Coolant/Antifreeze that meets "ASTM D6210"	3000 Service Hours or Two years
Commercial Heavy-Duty Coolant/Antifreeze that meets "ASTM D4985"	3000 Service Hours or One years
Cat SCA (5) and Water (6)	3000 Service Hours or Two years
Commercial Supplement coolant additive (7) and Water (6)	3000 Service Hours or One years

(1) Use the interval that occurs first.

(2) Refer to the specific engine Operation and Maintance Manual and Maintenance Interval Schedule for the correct interval for replacement of the Cooling System Water Temperature Regulator

(3) Cat ELC Extender must be added at 6000 service hours or one half of the service life for the coolant.

(4) Requires the addition of an extender at 3000 hours or one half of the service life for the coolant.

(5) The CAT SCA concentration in a cooling sustem that uses "CAT SCA " and water should be 6 to 8 percent by volume.

(6) Refer to this publication General Coolant Information under the section that discusses water for requirements.

(7) Consult the supplier for the commerical SCA for instructuions on usage. Also, refer to this Special Publication, Water and Supplement Coolant Assitive topic for additional information.

Fig. 19: Coolant Service Life Chart

Note: These coolant change are only achievable with the annual "S·O·S" Services Level 2 coolant sampling and analysis.

Cat ELC can be recycled into conventional coolants.

Containers of several sizes are available.

Table 6

Coolant Part Numbers		
Description	**Size**	**Part Number (1)**
Cat DEAC "Concentrate"	Bulk	2P-9868 or 156-2649
	208.2 L (55 US gal)	8C-3686 238-8653 (2)
	3.8 L (1 US gal)	8C-3684 238-8651 (2)
Cat ELC	Bulk	156-2653
	208.2 L (55 US gal)	101-2845 238-8650 (2)

Cat ELC "50/50 Premix"	18.9 L (5 US gal)	129-2151 238-8649 (2)
	3.8 L (1 US gal)	101-2844 238-8648 (2)
Cat ELC "concentrate"	3.8 L (1 US gal)	119-5150 238-8647 (2)
Cat ELC Extender	0.946 L (1 qt) 3.8 L (1 US gal)	119-5152 210-0786

(1) The availability of part numbers will vary by region. Consult your Caterpillar dealer.

(2) With embitterment. Embitterment makes the coolant tast bad. This is done in order to deter accidental human or animal ingestion of the coolant antifreeze.

Recommended Coolant/ Antifreeze for Caterpillar Gas Engines

NOTICE

Do not use Extended Life Coolant (ELC) with Caterpillar Gas Engines.

ELC was not formulated for use in Caterpillar Gas Engines.

Use only the coolant/antifreeze that is recommended.

Preferred - Caterpillar Natuaral Gas Engine Coolant (NGEC). Alternatively, use Caterpillar Diesel Engine Antifreeze/Coolant (DEAC) or a commercail heavyduty coolant/antifreeze that meets "ASTM D6210" or "ASTM D4985" specifications. The preferred coolant antifreeze can contain either ethylene glycol or propylene glycol. The coolant/antifreeze must be low in silicates. The coolant/antifreeze must be mixed with water that meets the properties that are listed in the table in the "General Coolant Information" topic. The coolant/antifreeze must also have the correct concentration of Supplemental Coolant Additive (SCA).

NOTICE

Do not use a commercial coolant/antifreeze that only meets the STM "D3306" specification. This type of coolant/antifreeze is made for light duty automotive applications.

Use only the coolant/antifreeze that is recommended.

Cat ELC (Extended Life Coolant)

Caterpillar provides Cat ELC for use in the following applications:

- Heavy-duty diesel engines
- Automotive applications

When Cat ELC is compared to conventional coolants the Cat ELC anti-corrosion package is based on a totally different additive system. Cat ELC has been formulated with the correct amounts of additives in order to provide superior corrosion protection for all metals that are in engine cooling systems.

Cat ELC extends the service life of the coolant to 12000 service hours or six years. Cat ELC does not require a frequent addition of a SCA (Supplemental Coolant Additive). An Extender is the only additional maintenance that is needed at 6000 service hours or one half of the ELC service life.

Cat ELC is available in a 1:1 premixed cooling solution with distilled water. The Premixed ELC provides freeze protection to -37°C (-34°F). The Premixed ELC is recommended for the initial fill of the cooling system. The Premixed ELC is also recommended for topping off the cooling system.

ELC Concentrate is also available. ELC Concentrate can be used to lower the freezing point to -52°C (-62°F) for arctic conditions.

See Page 14 for available quantities and part numbers.

Note: Caterpillar developed the EC-1 specification. The EC-1 specification is an industry standard. The EC-1 specification defines all of the performance requirements that are needed for an engine coolant to be sold as an extended life coolant for Caterpillar engines. Cat ELC can be used in most OEM engines of the following types: diesel and gasoline. Cat ELC meets the performance requirements of "ASTM D4985" and "ASTM D6210" for heavy-duty low silicate antifreeze/coolants, but does not require treatment with conventional SCA. Cat ELC also meets the performance requirements of "ASTM D3306" for automotive applications.

Cat ELC Cooling System Maintenance

NOTICE

Use only Caterpillar products or commercial products that have passed Caterpillars EC-1 specification for pre-mixed or concentrated coolants.

Use only Cat ELC Extender with Cat ELC.

Do NOT use conventional SCA with Cat ELC. Mixing Cat ELC with conventional coolants and/or conventional SCA reduces the Cat ELC service life.

Do NOT mix brands or types of coolant. Do NOT mix brands or types of SCA. Different brands or types may use different additive packages to meet the cooling system requirements. Different brands or types may not be compatible.

Failure to follow the recommendations can reduce cooling system components life unless appropriate corrective action is performed.

In order to maintain the correct balance between the antifreeze and the additives, you must maintain the

In order to maintain the correct balance between the antifreeze and the additives, you must maintain the recommended concentration of ELC. Lowering the proportion of antifreeze lowers the proportion of additive. This will lower the ability of the coolant to protect the system from pitting, from cavitation, from erosion, and from deposits.

During daily maintenance, use the premixed Cat ELC as a cooling system top-off. This action will bring the coolant up to the proper level. Check the specific gravity of the coolant system with the 245-5829 Coolant/Battery Tester/Refractometer. This tester gives readings that are immediate and accurate in both degrees Celsius and degrees Fahrenheit. Use Cat ELC Concentrate to restore the proper glycol concentration in the coolant system. This action should be done before the engine is exposed to freezing temperatures.

NOTICE

Do not use a conventional coolant to top-off a cooling system that is filled with Cat ELC.

Do not use standard conventional SCA or an SCA maintenance element. Only use Cat ELC Extender in cooling systems that are filled with Cat ELC.

Cat ELC Extender

Cat ELC Extender is added to the cooling system halfway through the Cat ELC service life. Treat the cooling system with Cat ELC Extender at 6000 hours or one half of the coolant service life. A 119-5152 Container (0.946 L) (1 qt.) or a 210-0786 Container (3.79L) (1 gal) of Cat ELC Extender are available for convenient use. Containers are available in metric liter sizes. Consult your Caterpillar dealer for the part numbers.

Use the formula in Figure 21 to determine the proper amount of Cat ELC Extender for your cooling system. Refer to Operation and Maintenance Manual, "Refill Capacities and Recommendations" in order to determine the capacity of the cooling system.

Table 7

Formula for Adding Cat ELC Extender to Cat ELC
V ×0.02 = X **V is the capacity of the cooling system.** **X is the amount of Cat ELC Extender that is required**

Fig. 21: Formula for Adding Cat ELC Extender to Cat ELC

Figure 22 is an example for using the formula that is in Figure 21.

Table 8

Example of The Formula for Adding Cat ELC Extender to Cat ELC		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of Cat ELC Extender that is Required (X)**

946 L (250 US gal)	× 0.02	19 L (5 US gal)

FIG. 22: Example for using Formula for Adding Cat ELC Extender to Cat ELC.

NOTICE

When using Cat ELC, do not use conventional SCA's or SCA maintenance elements. To avoid SCA contamination of an ELC system, remove the SCA element base and plug off or by-pass the coolant lines.

Cat ELC Cooling System Cleaning

Note: If the cooling system is already using Cat ELC, cleaning agents are not required to be used at the specified coolant change interval. Cleaning agents are only required if the system has been contaminated by the addition of some other type of coolant or by cooling system damage.

Clean water is the only cleaning agent that is required when Cat ELC is drained from the cooling system.

Cat ELC can be recycled into conventional coolants. The drained coolant mixture can be distilled in order to remove the ethylene glycol and the water. The ethylene glycol and the water can be reused. This distilled material does not contain the additives that are required to be classified as either Cat ELC or Cat DEAC. Consult your Caterpillar dealer for more information.

After the cooling system is drained and after the cooling system is refilled, operate the engine while the cooling system filler cap is removed. Operate the engine until the coolant level reaches the normal operating temperature and until the coolant level stabilizes. As needed, add the coolant mixture in order to fill the system to the proper level.

Changing to Cat ELC

To change from heavy-duty coolant/antifreeze to the Cat ELC, perform the following steps:

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, NENG2500, "Caterpillar Dealer Service Tool Catalog" and to Special Publication, GECJ0001 "Cat Shop Supplies and Tools" guide for tools and supplies suitable to collect and contain fluids on Caterpillar products.

Dispose of all fluids according to local regulations and mandates.

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1. Drain the coolant into a suitable container.
2. Dispose of the coolant according to local regulations.
3. If equipped, remove the empty SCA maintenance element and remove the element base. Plug the coolant lines or bypass the coolant lines.

NOTICE

Do not leave an empty SCA maintenance element on a system that is filled with ELC.

The element housing may corrode and leak causing an engine failure.

Remove the SCA element base and plug off or by-pass the coolant lines.

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4. Flush the system with clean water in order to remove any debris.
5. Use Caterpillar cleaner for cooling systems in order to clean the system. Follow the instruction on the label.
6. Drain the cleaner into a suitable container. Flush the cooling system with clean water.

   Note: Deposits that remain in the system may be loosened and removed by the Cat ELC.
7. In systems with heavy deposits, it may be necessary to disconnect the hoses. Clean the deposits and debris from the hoses and the fittings. Install the hoses and tighten the hose fittings. Refer to Specifications, SENR3130, "Torque Specifications" for the proper torques. Pipe threads may also need to be cleaned and sealed. Seal the threads with 5P-3413 Pipe Sealant.
8. Fill the cooling system with clean water and operate the engine until the engine is warmed to 49°C to 66°C (120°F to 151°F).

NOTICE

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

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9. Drain the cooling system into a suitable container and flush the cooling system with clean water.

NOTICE

The cooling system cleaner must be thoroughly flushed from the cooling system. Cooling system cleaner that is left in the system will contaminate the coolant. The cleaner may also corrode the cooling system.

10. Repeat Steps 8 and 9 until the system is completely clean.
11. Fill the cooling system with Cat ELC
12. Operate the engine until the engine is warmed. While the engine is running, inspect the engine for leaks. Tighten hose clamps and connections in order to stop any leaks.
13. Attach the Special Publication, PEEP5027, "Label" to the cooling system filler for the engine in order to indicate the use of Cat ELC.

    Note: Clean water is the only flushing agent that is required when Cat ELC is drained from the cooling system.

Cat ELC Cooling System Contamination

NOTICE

Mixing ELC with other products reduces the effectiveness of the ELC and shortens the ELC service life. Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specification for premixed or concentrate coolants. Use only Cat ELC Extender with Cat ELC. Do NOT mix brands or types of coolants. Failure to follow these recommendations can result in shortened cooling system component life.

Cat ELC cooling systems can withstand contamination to a maximum of ten percent of conventional heavy-duty coolant/antifreeze and/or SCA before the advantages of Cat ELC are reduced. If the contamination exceeds ten percent of the total system capacity, perform ONE of the following procedures:

- If cooling system contamination is caused by cooling system damage, follow the procedures under the "Changing to Cat ELC" heading. Also follow the procedures under the "Changing to Cat ELC" heading if the engine has been operated since being contaminated with more than ten percent conventional heavy-duty coolant/antifreeze and/or SCA. Certain types of cooling system contamination may require cooling system tear-down and manual cleaning of system components.
- If the cooling system is contaminated with more than ten percent conventional heavy-duty coolant/antifreeze and/or SCA, but the engine hasn't been operated, drain the cooling system into a suitable container. Dispose of the coolant according to local regulations. Thoroughly flush the system with clean water. Fill the system with Cat ELC.
- Maintain the system as a conventional DEAC (Diesel Engine Antifreeze/Coolant) or other conventional coolant. If the SCA concentration is less than three percent, treat the system with an SCA. Maintain three to six percent SCA concentration in the coolant. Change the coolant at the

interval that is recommended for Cat DEAC or at the interval that is recommended for the conventional commercial coolants.

Commercial Extended Life Coolant

If Cat ELC is not used, then select a commercial extended life coolant that meets the Caterpillar specification of EC-1 and the "ASTM D6210" specification. Do not use an extended life coolant that does not meet the EC-1 specification. Follow the maintenance guide for the coolant from the supplier of the commercial extended life coolant. Follow the Caterpillar guidelines for the quality of water and the specified coolant change interval.

Diesel Engine Antifreeze/Coolant and Coolant Additives

Cat DEAC (Diesel Engine Antifreeze/Coolant)

Caterpillar recommends using Cat DEAC for cooling systems that require a high performance conventional heavy-duty coolant/antifreeze. Cat DEAC is an alkaline single-phase ethylene glycol type antifreeze that contains corrosion inhibitors and antifoam agents.

Cat DEAC is formulated with the correct amount of Cat SCA (Supplemental Coolant Additive). Do not use Cat SCA at the initial fill when Cat DEAC is used.

Containers of several sizes are available. See page 14 for available quantities and part numbers.

If concentrated Cat DEAC is used, Caterpillar recommends mixing the concentrate with distilled water or with deionized water. If distilled water or deionized water is not available, use water which has the required properties. For the water properties see this publication, "General Coolant Information."

Note: The concentrated Cat DEAC and the recommended water must be thoroughly mixed prior to filling the cooling system.

Supplemental Coolant Additive

The use of SCA (supplemental coolant additive) helps to prevent the following conditions from occurring:

- Corrosion
- Formation of mineral deposits
- Cavitation erosion of the cylinder liners
- Foaming of the coolant

Cat DEAC is formulated with the correct level of Cat SCA. When the cooling system is initially filled with Cat DEAC, adding more Cat SCA is not necessary until the concentration of Cat SCA has been depleted. To ensure that the correct amount of Cat SCA is in the cooling system, the concentration of Cat SCA must be tested on a scheduled basis. Refer to the specific engine's Operation and Maintenance Manual, "Maintenance Interval Schedule" (Maintenance Section).

Cat SCA maintenance elements and containers of Cat SCA are available in several sizes. See page 18 for available quantities and part numbers.

Note: Do not exceed six percent maximum concentration of SCA.

Conventional Coolant/Antifreeze Cooling System Maintenance

NOTICE

Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators.

Check the coolant/antifreeze (glycol concentration) in order to ensure adequate protection against boiling or freezing. Caterpillar recommends the use of a refractometer for checking the glycol concentration. Use the Coolant/Battery Tester/Refractometer (245-5829). The tester gives readings in both degrees Celsius and degrees Fahrenheit that are immediate and accurate. The tester can be used with ethylene or with propylene glycol.

Caterpillar engine cooling systems should be tested at 250 hour intervals or at the PM level 1 intervals for the concentration of Supplemental Coolant Additive (SCA). SCA test kits are available from your Caterpillar dealer. Test the concentration of SCA or submit a coolant sample to your Caterpillar dealer at 250 hour intervals or at the intervals for PM Level 1. Refer to this publication "S·O·S Services Coolant Analysis" for more information on this topic.

Additions of SCA are based on the results of the test or based on the results of the coolant analysis. An SCA that is liquid or a maintenance element for an SCA (if equipped) may be needed at 250 hour intervals or at the intervals for PM Level 1.

Figure 23 lists the amount of Cat SCA that is needed at the initial fill in order to treat coolant/antifreeze. These amounts of Cat SCA are for systems that use heavy-duty coolant/antifreeze.

Figure 23 also lists additions of supplemental coolant additive for liquid and for maintenance elements at 250 hour intervals or at the intervals for PM Level 1. The additions are required for Cat DEAC and for commercial coolant/antifreezes.

Note: Conventional heavy-duty coolant/antifreeze of all types REQUIRE periodic additions of SCA.

Table 9

Caterpillar SCA Requirements for Heavy-Duty Coolant			
Cooling System Capacity in L (US Gal)	**Caterpillar Liquid SCA**		**Spin-on Element at 250 Service Hour or Intervals for PM Level 1**
	Initail Fill (1)	**250 Service Hour or Intervals for PM Level 1 (2)**	
22 to 30 (6 or 8)	0.95 L (32 fl oz)	0.24 L (8 fl oz)	111-2370 (3)

31 to 38 L (9 to 10 US gal)	1.18 L (40 fl oz)	0.36 L (12 fl oz)	111-2369
39 or 49 L (11 to 13 US gal)	1.42 L (48 fl oz)	0.36 L (12 fl oz)	111-2369
50 to 64 L (14 to 17 US gal)	1.90 L (64 fl oz)	0.47 L (16 fl oz)	9N-3368
65 to 83 L (18 to 22 US gal)	2.37 L (80 fl oz)	0.60 L (20 fl oz)	111-2371
84 to 114 L (23 to 30 US gal)	3.32 L (112 fl oz)	0.95 L (32 fl oz)	9N-3718
115 to 163 L (31 to 43 US gal)	4.75 L (160 fl oz)	1.18 L (40 fl oz)	two units 111-2371
164 to 242 L (44 to 64 US gal)	7.20 L (256 fl oz)	1.90 L (64 fl oz)	two units 9N-3718

(1) When the coolant sysstem is first filled, the SCA is not required to be used with Cat DEAC or fully formulated coolants that meet the "ASTM D6210-04" specification.

(2) Do not exceed the six percent maximum concentration. Check the concentration of SCA with an SCA test kit, or check the concentration of SCA with Cat SOS Coolant Analysis.

(3) Do not use the maintenance element for the SCA and the liquid for the SCA at the time.

Fig: 23: Caterpillar SCA Requirements for Heavy-Duty Coolant.

Note: : Specific engine applications may require maintenance practices to be periodically evaluated in order to properly maintain the engine's cooling system. Refer to Figure 23 and Figure 24 for part numbers and for quantities of SCA maintenance elements and liquid SCA.

Table 10

Caterpillar Liquid SCA (1)	
Part Number	**Size of Container**
6V-3542	0.24 L (8 oz)
8T-1589	0.47 L (16 oz)
3P-2044	0.94 L (32 oz)
217-0616	1 L (34 oz)

237-7673	5 L (1.3 US gal)
8C-3680	19 L (5 US gal)
217-0617	20 L (5.3 US gal)
5P-2907	208 L (55 US gal)
217-0618	208 L (55 US gal)

(1) The availability of part numbers will vary from one region to another region.

Fig: 24: Caterpillar Liquid SCA container sizes.

Cooling Systems with Larger Capacities

Adding the Supplemental Coolant Additive to Conventional Coolant/Antifreeze at the Initial Fill

Note: When the coolant system is first filled, the SCA is not required to be used with Cat DEAC or with fully formulated coolants that meet the "ASTM D6210-04" specification.

Note: Do not exceed six percent maximum concentration. Check the concentration of SCA with an SCA test kit, or check the concentration of SCA with CAT S·O·S coolant analysis.

Commercial heavy-duty coolant/antifreeze that meets only the "ASTM D4985" specification WILL require adding supplemental coolant additive at the initial fill. Read the label or the instructions that are provided by the manufacturer of the commercial heavy-duty coolant/antifreeze.

Use the equation that is in Figure 25 to determine the amount of Cat SCA that is required when the cooling system is initially filled with fluids that meet the following specification: "ASTM D4985"

Table 11

Equation for Adding the Cat SCA to Conventional Coolant/Antifreeze at Initial Fill
V × 0.045 = X **V is the total volume of the cooling system** **X is the amount of Cat SCA that is required**

Fig. 25: Equation for Adding the Cat SCA at Initial Fill.

Table 12

Example of the Equation for Adding the Cat SCA to Conventional Coolant/Antifreeze at Initial Fill		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of Cat SCA that is Required (X)**
	× 0.045	

946 L (250 US gal)	× 0.045	43 L (11 US gal)

Fig. 26: Example of Equation for adding CAT SCA at Initial Fill

Adding the supplemental coolant additive to Conventional Coolant/Antifreeze for Maintenance

Heavy-duty coolant/antifreeze of all types REQUIRE periodic additions of a supplemental coolant additive.

Test the coolant/antifreeze periodically for the concentration of supplemental coolant additive. For the interval, see the Operation and Maintenance Manual, Maintenance Interval Schedule for your engine. Supplemental coolant additive test kits are available from your Caterpillar dealer. Test the concentration of supplemental coolant additive or submit a coolant sample to your Caterpillar dealer. Refer to, in this publication, "S·O·S Services Coolant Analysis" topic.

Additions of supplemental coolant additive are based on the results of the test or based on the results of the coolant analysis. The size of the cooling system determines the amount of supplemental coolant additive that is needed.

Use the equation that is in Figure 27 to determine the amount of Cat SCA that is required, if necessary.

Table 13

Equation for Adding the Cat SCA to Conventional Coolant/Antifreeze for Maintenance
V × 0.014 = X **V is the total volume of the cooling system** **X is the amount of Cat SCA that is required**

Fig. 27: Equation for Adding the Cat SCA for Maintenance

Figure 28 is an example for using the equation that is in Figure 27.

Note: Specific engine applications may require maintenance practices to be periodically evaluated in order to properly maintain the engine's cooling system.

Figure 24 lists part numbers and the sizes of containers for Cat SCA that is available from your Caterpillar dealer

Table 14

Example of the Equation for Adding the Cat SCA to Conventional Coolant/Antifreeze for Maintenance		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of Cat SCA that is Required (X)**
946 L (250 US gal)	× 0.014	13 L (4 US gal)

Fig. 28: Example of the Equation for Adding the Cat SCA for Maintenance.

Cleaning of Heavy-Duty Coolant/Antifreeze Systems

Before Caterpillars supplemental coolant additive can be effective, the cooling system must be free from rust, scale and other deposits. Preventive cleaning helps avoid downtime caused by expensive out-of-service cleaning required for extremely dirty and neglected cooling systems.

Caterpillar Cooling System Cleaner - Standard:

- Dissolves or depresses mineral scale, corrosion products, light oil contamination, and sludge.
- Cleans the cooling system after used coolant is drained or before the cooling system is filled with new coolant.
- Cleans the cooling system whenever the coolant is contaminated or whenever the coolant is foaming.
- Cleans engine while still in service.
- Reduces downtime and cleaning costs.
- Avoid costly repairs from pitting and other internal problems caused by improper cooling system maintenance.
- Can be used with glycol-based antifreeze.
- For the recommended service interval, refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" for your engine.

Caterpillar Cooling System Cleaner - Standard is designed to clean the system of harmful scale and corrosion without taking the engine out of service. The cleaners, both "Standard" and "Quick Flush," can be used in all Caterpillar Engine cooling systems. Contact your Caterpillar dealer for part numbers.

Note: These cleaners must not be used in systems that have been neglected or have heavy scale buildup. These systems require a stronger commercial solvent available from local distributors.

Follow label directions for proper usage.

Commercial Heavy-Duty Coolant/Antifreeze and Supplemental Coolant Additive

If Cat DEAC is not used, select a coolant/antifreeze with low silicate content for heavy-duty applications that meets "ASTM D6210" or "ASTM D4985" specifications.

When a heavy-duty coolant/antifreeze is used, treat the cooling system with three to six per cent Cat SCA by volume. Maintain a concentration level of SCA in the cooling system that is between three percent and six percent. For more information refer to, in this publication, "Conventional Coolant/Antifreeze Cooling System Maintenance" topic.

If Cat SCA is not used, select a commercial supplemental coolant additive. The commercial supplemental coolant additive must provide a minimum of 1400 mg/L or 1400 ppm (82 grains/US gal) of nitrites in the final coolant mixture.

Maintain a concentration level of nitrates in the cooling system that is between 1200 ppm (70 grains/US gal) and 2400 ppm (140 grains/US gal).

Coolant/antifreeze for heavy-duty applications that meet only the "ASTM D4985" specification WILL require treatment with supplemental coolant additive at the initial fill. These coolants WILL require treatment with supplemental coolant additive on a maintenance basis.

Coolant/antifreezes for heavy-duty applications that meet the "ASTM D6210" specification do not require treatment with supplemental coolant additive at the initial fill. Treatment with supplemental coolant additive WILL be required on a maintenance basis.

When concentrated coolant/antifreeze is mixed, Caterpillar recommends mixing the concentrate with distilled water or with deionized water. If distilled water or deionized water is not available, water which has the required properties may be used. For the water properties, see, in this publication, "General Coolant Information" topic.

Water and Supplemental Coolant Additive

NOTICE

All Caterpillar diesel engines equipped with air-to-air aftercooling (ATAAC) require a minimum of 30 percent glycol to prevent water pump cavitation.

Note: Caterpillar recommends a minimum of 30 percent glycol in diesel engine cooling systems. Refer to engine specific Operation and Maintenance Manuals for exceptions.

NOTICE

Never use water alone without Supplemental Coolant Additives (SCA). Water alone is corrosive at engine operating temperatures. Water alone does not provide adequate protection against boiling or freezing.

In engine cooling systems that use water alone, Caterpillar recommends the use of Cat SCA. Cat SCA helps to prevent the following conditions from occurring:

- Corrosion
- Formation of mineral deposits
- Cavitation erosion of the cylinder liner
- Foaming of the coolant

If Cat SCA is not used, select a commercial supplemental coolant additive. The commercial supplemental coolant additive must provide a minimum of 2400 mg/L or 2400 ppm (140 grains/US gal) of nitrites in the final coolant mixture.

The quality of the water is a very important factor in this type of cooling system. Distilled water or deionized water is recommended for use in cooling systems. If distilled water or deionized water is not available, use the recommended water properties in this publication, "General Coolant Information" topic for water that meets the minimum requirement.

A cooling system that uses a mixture of supplemental coolant additive and water only needs more supplemental coolant additive than a cooling system that uses a mixture of glycol and water. The supplemental coolant additive concentration in a cooling system that uses supplemental coolant additive and water should be six to eight percent by volume. Refer to Figure 29 for the amount of supplemental coolant additive that is required for various capacities of the cooling system.

Refer to Figure 30 for part numbers and for container sizes of SCA.

Table 15

Caterpillar SCA Requirements for Cat SCA and Water Cooling Systems		
Cooling System Capacity	**Cat SCA at Initial Fill**	**Cat SCA at 250 Hours (1)**
22 to 30 L (6 to 8 US gal)	1.75 L (64 fl oz)	0.44 L (15 fl oz)
31 to 38 L (9 to 10 US gal)	2.30 L (80 fl oz)	0.57 L (20 fl oz)
39 to 49 L (11 to 13 US gal)	3.00 L (100 fl oz)	0.75 L (25 fl oz)
50 to 64 L (14 to 17 US gal)	3.90 L (128 fl oz)	0.95 L (32 fl oz)
65 to 83 L (18 to 22 US ga)	5.00 L (168 fl oz)	1.25 L (42 fl oz)
84 to 110 L (23 to 29 US ga)	6.60 L (224 fl oz)	1.65 L (56 fl oz)
111 to 145 L (30 to 38 US ga)	8.75 L (296 fl oz)	2.19 L (296 fl oz)
146 to 190 L (39 to 50 US ga)	11.50 L (392 fl oz)	2.88 L (89 fl oz)
191 to 250 L (51 to 66 US ga)	15.00 L (512 fl oz)	3.75 L (128 fl oz)

(1) Do not exceed the eight percent maximum concentration. Check the concentration o Cat SCA with a test kit for supplemental coolant additive of perform an SOS Coolant Analysis.

Table 16

Caterpillar Liquid SCA (1)	
Part Number	**Size of Container**
6V-3542	0.24 L (8 oz)
8T-1589	0.47 L (16 oz)
3P-2044	

	0.94 L (32 oz)
217-0616	1 L (34 oz)
237-7673	5 L (1.3 US gal)
8C-3680	19 L (5 US gal)
217-0617	20 L (5.3 US gal)
5P-2907	208 L (55 US gal)
217-0618	208 L (55 US gal)

(1) The availability of part numbers will vary from one region to another region.

Fig. 30: Caterpillar Liquid SCA Container Sizes.

Maintain the Cat SCA in the same way as you would maintain a cooling system that uses heavy-duty coolant/antifreeze. Adjust the maintenance for the amount of Cat SCA additions. See Figure 29 for the amount of Cat SCA that is required.

Cooling Systems with Larger Capacities

Adding the Cat SCA to Water at the Initial Fill

Use the equation that is in Figure 31 to determine the amount of Cat SCA that is required at the initial fill. This equation is for a mixture of only Cat SCA and water.

Table 17

Equation for Adding the Cat SCA to Water at Initial Fill
V × 0.07 = X **V is the total volume of the cooling system.** **X is the amount of CAT SCA that is required**

Fig. 31: Equation for CAT SCA at the Initial Fill

Figure 32 is an example for using the equation that is in Figure 31.

Table 18

Example of the Equation for Adding Cat SCA to Water at the Initial Fill		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of Cat SCA that is Required (X)**
946 L (250 US gal)	× 0.07	66 L (18 US gal)

Adding the Cat SCA to Water for Maintenance

For the recommended service interval, refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" for your engine.

Submit a coolant sample to your Caterpillar dealer. See, in this publication, S·O·S Services Coolant Analysis.

Additions of Cat SCA are based on the results of the coolant analysis. The size of the cooling system determines the amount of Cat SCA that is required.

Use the equation that is in Figure 33 to determine the amount of Cat SCA that is required for maintenance, if necessary:

Table 19

Equation for Adding the Cat SCA to Water for Maintenance
V × 0.023 = X **V is the total volume of the cooling system.** **X is the amount of CAT SCA that is required**

Equation for adding Cat SCA to Water for Maintenance.

Figure 34 is an example for using the equation that is in Figure 33.

Table 20

Example of the Equation for Adding Cat SCA to Water at the Initial Fill		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of Cat SCA that is Required (X)**
946 L (250 US gal)	× 0.023	22 L (6 US gal)

Fig. 34: Example of the Equation for adding Cat SCA to Water for Maintenance.

Specific engine applications may require maintenance practices to be periodically evaluated in order to properly maintain the engine's cooling system.

Figure 30 lists part numbers and the sizes of containers for Cat SCA that are available from your Caterpillar dealer.

S·O·S Service Coolant Analysis

Testing the engine coolant is important to ensure that the engine is protected from internal cavitation and corrosion. The analysis also tests the ability of the coolant to protect the engine from boiling and freezing. S·O·S coolant analysis can be done at your Caterpillar dealer. Caterpillar S·O·S coolant analysis is the best way to monitor the condition of your coolant and your cooling system. S·O·S coolant analysis is a program based on periodic samples.

NOTICE

Do not use the same vacuum sampling pump for extracting oil samples that is used for extracting coolant samples.

A small residue of either type sample may remain in the pump and may cause a false positive analysis for the sample being taken.

Always use a designated pump for oil sampling and a designated pump for coolant sampling.

Failure to do so may cause a false analysis which could lead to customer and dealer concerns.

New, Refilled, and Converted Systems

Perform an S·O·S coolant analysis (Level 2) at the following maintenance intervals.

- Every Year
- Initial 500 service hours

Perform this analysis at the interval that occurs first for new systems, for refilled systems, or for converted systems that use Cat ELC or use Cat DEAC. This 500 hour check will also check for any residual cleaner that may have contaminated the system.

Recommended Interval for S·O·S Coolant Sampling

Table 21

Recommended Interval		
Type of Coolant	**Level 1**	**Level 2**
CAT DEAC	Every 250 hours (1)	Yearly (1) (2)
CAT ELC	Optional (2)	Yearly (2)

(1) This is the recommended coolant sampling interval for all conventional heavy duty coolant/antifreeze. This is also the recommended coolant sampling interval for commercial coolants that meet Cat EC-1 (EngineCoolant specifications - 1.

(2) The Level 2 Coolant Analysis should be performed sooner if a problem is suspected or identified.

Recommended Interval for S·O·S Coolant Sampling

Note: Check the SCA (Supplemental Coolant Additive) of the conventional coolant at every oil change or at every 250 hours. Perform this check at the interval that occurs first.

S·O·S Coolant Analysis (Level 1)

A coolant analysis (Level 1) is a test of the properties of the coolant.

The following properties of the coolant are tested:

- Glycol concentration for freeze protection and boil protection
- Ability to protect from erosion and corrosion
- pH
- Conductivity
- Visual analysis
- Odor analysis
- Water hardness

The results are reported, and appropriate recommendations are made.

S·O·S Coolant Analysis (Level 2)

A coolant analysis (Level 2) is a comprehensive chemical evaluation of the coolant. This analysis is also a check of the overall condition of the inside of the cooling system.

The S·O·S coolant analysis has the following features:

- Full coolant analysis (Level 1)
- Identification of the source of metal corrosion and of contaminants
- Identification of buildup of the impurities that cause corrosion
- Identification of buildup of the impurities that cause scaling
- Determination of the possibility of electrolysis within the cooling system of the engine

The results are reported, and appropriate recommendations are made.

For more information on S·O·S coolant analysis, consult your Caterpillar dealer.

Caterpillar Conditioner Elements

Note: Do NOT use SCA precharge or SCA maintenance elements with Cat ELC. Do NOT use liquid SCA with Cat ELC.

When using Cat DEAC, no precharge elements are required. Caterpillar DEAC contains the necessary amount of supplemental coolant additives at initial fill. However, maintenance elements are still available. Using the wrong size element can result in overconcentration of additives.

Supplemental coolant additive maintenance element assemblies are also available from Caterpillar for use instead of liquid coolant additives in some applications. Element assemblies are in a dried state. The contents of these element assemblies dissolve into the coolant when the coolant passes through the element. Use precharge elements at original fill, and use other elements as maintenance items at specific service intervals. Elements can be identified by part number or element length. In marine applications, Caterpillar recommends using a liquid supplemental coolant additive.

recommends using a liquid supplemental coolant additive.

Ver imagen

Illustration 15 g02142906

Supplemental Coolant Additive Element Assembly.

At original fill, precharge elements can be used with commercial coolants that meet only the "ASTM D4985" specifications for heavy-duty coolants that require a precharge with SCA. The precharge establishes a protection level between a minimum of 0.030 liter per 3.8 liters (1.0 ounce per gallon) and a maximum of 0.059 liter per 3.8 liters (2.0 ounces per gallon). Use precharge elements only at original fill or after the system has been drained and refilled.

Precharge elements are necessary at original fill and after the system has been drained and refilled because maintenance elements do not supply sufficient amounts of coolant additives. If the cooling system lacks the necessary concentration of coolant additives, some surfaces have protection against corrosion and pitting at the expense of other surfaces.

Table 22

Supplement Coolant Additive Elements By Capacity				
Cooling System Capacity liter (gal)	**Initial (1) Precharge Element**	**Qty**	**250 Hour Maintenance Elemant**	**Qty**
22-30 (6-8)	112-0926	1	111-2370	1
31-38 (9-10)	111-2373	1	111-2369	1
39-49 (11-13)	9N-6123	1	111-2369	1
	9N-3366	1	9N-3368	1

50-64 (14-17)	9N-3366	1	9N-3368	1
65-83 (18-22)	9N-3367	1	111-2371	1
84-114 (23-30)	9N-3367	1	9N-3718	1
117-163 (31-43) 117-163 (31-43)	9N-3367 1W-5518	2 1	111-2371 111-2371	2 2
166-242 (44-64)	9N-3367	2	9N-3718	2

(1) When using Caterpillar Antifreeze, no precharge elements are required

Fig. 37: Supplemental Coolant Additive Elements by Capacity.

Note: One 9N-3668 base assembly is required for all capacities listed, except for 117-163 liters (31- 43 gallons) and 166-242 liters (44-64 gallons), each of which require two base assemblies. Also, all capacities require two 9N-3666 Valve Assemblies.

A 3% to 6% concentration of liquid supplemental coolant additive is required during the original fill of the cooling system mixture. This initial concentration of supplemental additive is vital. If the concentration of additive is too high, insoluble salts form and can cause wear on water pump seal surfaces. Engine damage can also result when the concentration of supplemental coolant additive or antifreeze exceeds recommended levels,

Note: Higher aluminum content engines require silicates to protect aluminum surfaces. Supplemental coolant additive used on these engines must pass the following tests:

- ASTM D1384 - Glassware corrosion test
- ASTM D2809 - Cavitation Erosion Of Aluminum ASTM D4340 - Hot Surface Corrosion Of Aluminum
- ASTM D4340 - Hot Surface Corrosion Of Aluminum

In addition, the additives must control cast iron cylinder liner and block pitting, and cavitation erosion.

Ver imagen

Illustration 16 g02142925

Water Pump Seal Deterioration

Over a period of time, the concentration of coolant additives is depleted. This depletion occurs because additives deplete during the coating of metal surfaces, and from continuously neutralizing acids that form in the system. Therefore, to maintain constant protection, it is necessary to periodically replenish the additive concentration. Either replace the initial precharge element with the maintenance element or add 0.47 liter (1 pint) of additive for every 75.8 liters (20 U.S. gallons) of coolant at recommended intervals.

Normal recommended intervals are 16,000 to 19,000 kilometers (10,000 to 12,000 miles), or at 250 Service Meter Hours. Follow container instructions for the correct concentration

Table 23

Supplemental Coolant Additive Precharge Element Assemblies Available from Caterpillar			
Part No.	**Description**	**Amount of Additive**	**Length of Element**
9N-3366	Precharge Element	453 g (16 oz)	175 mm (6.9 inch)
9N-3367	Precharge Element	906 g (32 oz)	201 mm (7.9 inch)
9N-6123	Precharge Element	340 g (12 oz)	175 mm (6.9 inch)
1W-5518	Precharge Element	907 g (32 oz)	263 mm (10.4 inch)
111-2371	Precharge Element	141 g (5 0z)	133 mm (5.25 inch)
111-2373	Precharge Element	280 g (10 oz)	175 mm (6.9 inch)
112-0926	Precharge Element	227 g (8 oz)	175 mm (6.9 inch)

Table 24

Supplemental Coolant Additive Maintenance Element Assemblies Available from Caterpillar			
Part No.	Description	Amount of Additive	Length of Element
9N-3366	Maintenance Element	113 g (4 oz)	133 mm (5.25 inches)

9N-3718	Maintenance Element	226 g (8 oz)	175 mm (6.9 inches)
111-2369	Maintenance Element	85 g (3 oz)	133 mm (5.25 inches)
111-2370	Maintenance Element	57 g (2 oz)	133 mm (5.25 inches)

Coolant Additives and Element Assemblies Chart

Note: Soluble oil must not be used as a supplemental coolant additive in Caterpillar engines. Soluble oil damages the radiator hoses and certain engine seals. Also, soluble oil does not lubricate pump bearings or protect engine parts from damage caused by cavitation erosion.

Functional Effects

Without careful selection and maintenance of coolant, certain functional effects can cause problems in the cooling system. Coolant mixtures must be formulated to minimize the possibility of problems like:

- pitting and cavitation-erosion
- rust
- acidity
- alkalinity imbalance
- galvanic and electrolytic corrosion
- scale and deposit formation
- aeration

Using acceptable water and correct additives helps prevent these functional effects.

Ver imagen

Illustration 17 g02142933

Cylinder liner walls with heavy external scale may have areas that are free of scale and are experiencing cavitation-erosion induced pitting corrosion.

Ver imagen

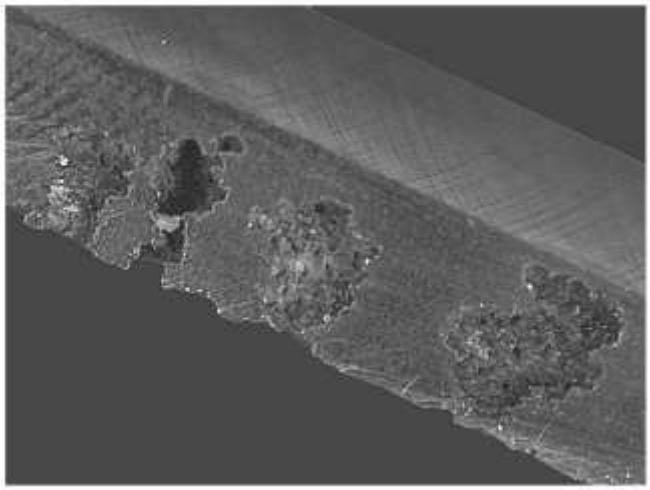


Illustration 18 g02142934

Careful examination of what appears to be small surface pits in Fig. 37 will reveal large underlying holes in the liner wall. This is called concentration cell pitting corrosion.

Ver imagen

Illustration 19 g02142935

Rust and scale deposits, due to the absence of supplemental coolant additive, caused temperature regulators to fail.

Ver imagen

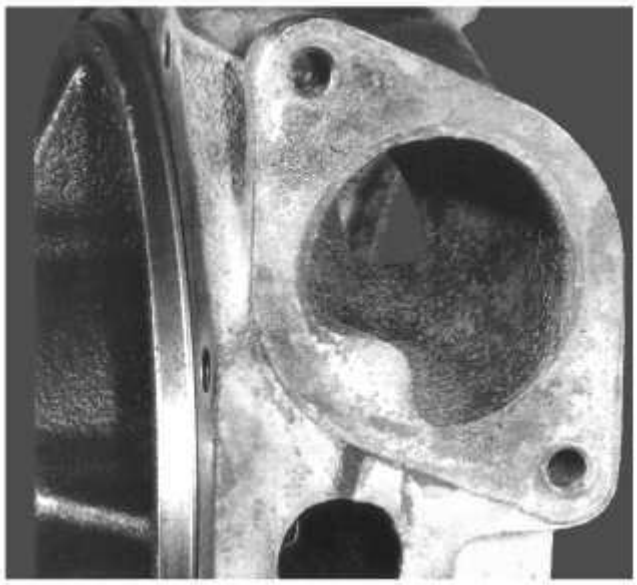


Illustration 20 g02142936

Corrosion on a water pump passage due to lack of supplemental coolant additive in the cooling system.

Note: CAT ELC does not require treatment with SCA in order to provide cooling system protection.

Conventional coolants DO require periodic additions of SCA to maintain cooling system protection

Corrosion is a chemical or electrochemical action that gradually wears away metal surfaces in the cooling system. In some instances, corrosion can eventually destroy an engine. All cooling system components need protection from corrosion. Supplemental coolant additives are used to protect metal surfaces. They coat these surfaces and prevent the formation of scale, rust, and cavitation erosion.

Types of cooling system corrosion are pitting and cavitation erosion, rust, acidity-alkalinity imbalance caused erosion, and galvanic and electrolytic corrosion. Other functional effects of coolants with no, or low, levels of supplemental coolant additives are aeration and the formation of scale and deposits.

Pitting and Cavitation-Erosion

Electrical current flow in a localized area is one of the causes of pitting corrosion. Pitting is the most damaging type of corrosion. After pitting has progressed for any appreciable length of time, there is no practical way to stop pitting before perforation takes place. Because one ampere of current flowing for thirty hours removes one ounce of iron, current flow concentrated on a small area is very destructive. Therefore, prevention is the best policy.

Erosion-corrosion is a combination of mechanical and chemical or electrochemical action that causes corrosion. Cavitation is a particular type of erosion-corrosion and a common cause of cylinder wall pitting.

Ver imagen

Illustration 21 g02142940

Example of cylinder wall cavitation-erosion

Ver imagen

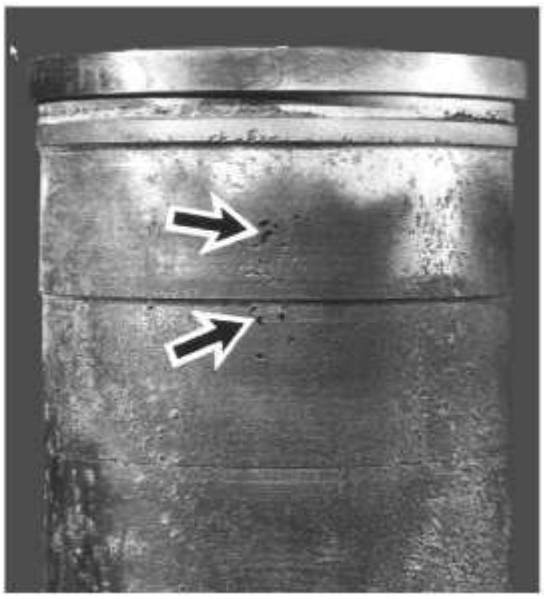


Illustration 22 g02142941

Example of cylinder wall cavitation-erosion.

Cavitation of the cylinder wall begins when air bubbles remove the wall's protective oxide film. Flexing of

the cylinder wall after the fuel mixture explodes in the combustion chamber causes cylinder wall vibration and creates air bubbles in the coolant. Concentration of air bubbles increases when cooling system pressure is low or when the system leaks. Also, increased vibration amplifies the quantity of air bubbles. Vibration multiplies when the engine is run cold, because of increased piston-to-cylinder clearance. Vibration also multiplies when the engine is lugged.

These air bubbles form on the outside of the cylinder wall (perpendicular to the wrist pin) and then explode inward (implode). When air bubbles continue to implode, sufficient energy is released to physically attack the cylinder wall and remove the oxide film.

Ver imagen

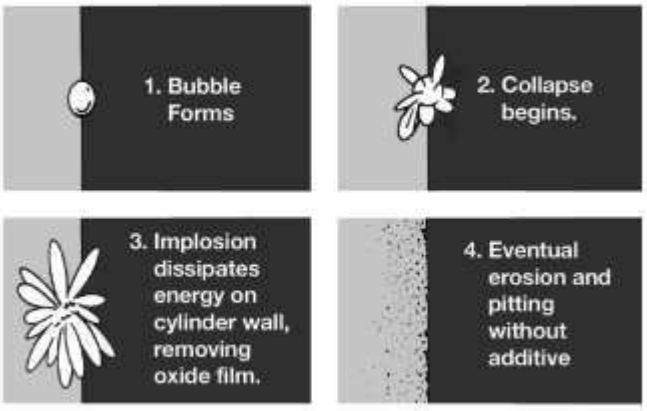


Illustration 23 g02143110

Progression of cavitation and pitting on cylinder wall.

Corrosion and pitting then take place at a high rate.

Eventually, a pit can become deep enough to break through the cylinder wall and allow coolant to leak into the cylinder. This coolant leak contaminates the lubricating oil.

Ver imagen

Illustration 24 g02143112

Eventually, a pit can penetrate the cylinder wall and allow coolant to leak into the cylinder.

Supplemental coolant additives coat metal surfaces and control cavitation-erosion and pitting. Unfortunately, small particles or ferrous scale often shield the surfaces underneath from the protective action of coolant additives. If this condition persists, pits can form. Keeping your cooling system clean, along with regularly replenishing your coolant additives, helps prevent pitting. However, if coolant additives are not added at the proper intervals and in correct quantities (see page 24), cavitation erosion and pitting intensifies. Eventually, coolant can penetrate the cylinder wall and cause major damage to the engine.

Cat SCA helps prevent pitting when the system is filled with either Cat DEAC or commercial heavy-duty coolant/antifreeze that contains a minimum of 1200 ppm Nitrite.

Cat ELC does not require the addition of Caterpillar supplemental coolant additives. Do not use supplemental coolant additives with Cat ELC.

Ver imagen

Illustration 25 g02143114

Effects of improperly treated cooling system.

Ver imagen

Illustration 26 g02143115

Corrosion/erosion of aluminum material.

3406 Water Pump Adapter

Ver imagen

Illustration 27 g02143117

Rust deposits on outside of cylinder wall surface.

Ver imagen

Illustration 28 g02143119

Rusting inside water pump.

Rust

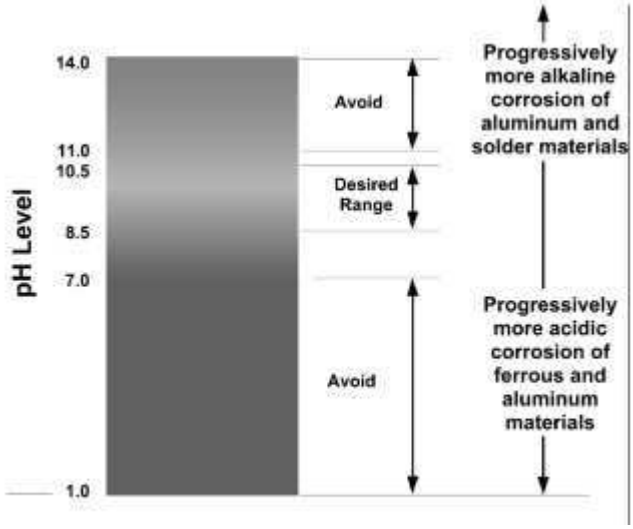
Rust is caused by oxidation within the cooling system. Heat and moist air accelerate this process. Rusting leaves residual scale deposits that can clog the cooling system. This causes accelerated wear and reduces the efficiency of heat transfer.

Cat SCA helps prevent rust in cooling system passages.

Acidity-Alkalinity Imbalance

A coolant mixture's acidity-alkalinity content is measured by its pH level. The pH level, ranging from 1 to 14, indicates the degree of acidity or alkalinity and the coolant's corrosiveness. For best results, the cooling system's pH level should be maintained between 8.5 and 10.5. When the pH level is above 11.0, the coolant attacks aluminum and copper, or non-ferrous materials. When the pH level is below 7.0, the coolant becomes acidic and attacks ferrous materials. When the pH level is below 7.0, or above 11.0, the coolant mixture is unsuitable.

Ver imagen



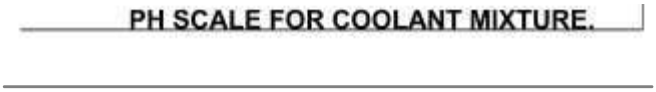


Illustration 29 g02143120

pH scale for coolant mixture.

Supplemental coolant additives used in the coolant mixture must contain buffering agents to properly maintain the pH level and to neutralize acids produced by blow-by gases.

Galvanic and Electrolytic Corrosion

Electrical current flowing through coolant between different metals causes galvanic corrosion. The coolant acts as an electrical conductor between metals that are coupled together. An electromotive force or a potential voltage that exists between the two dissimilar metals allows current to flow. Galvanic corrosion occurs on the least resistant metal.

In marine applications where sea water is highly conductive, sacrificial material (rods) are placed in seawater flow passages to absorb current flow. Typically, this wear material is either magnesium or zinc. Rods must be inspected regularly and replaced when necessary. Caterpillar recommends inspecting rods every 50 hours until a wear rate is established.

In truck, earthmoving, and other non-marine applications, if galvanic corrosion occurs, immediately drain, flush, and refill the coolant mixture. The source of voltage must be determined to prevent continued corrosion.

Corrosion can also occur when the source of current flow through the coolant is external. To help prevent this electrolytic corrosion, electrical systems must be designed so that no continuous electrical potential is imposed upon any cooling system components. Despite coolant mixture quality, the presence of an electrical potential can cause materials in the cooling system to be damaged by electrolytic corrosion.

Soundness of ground connections should be checked with a volt/ohm meter. Typically, measured resistance between an electrical component on the engine and battery negative should be less than 0.3 ohms. All grounds should be tight and free of corrosion.

Aluminum material parts are susceptible to electrolytic corrosion. Aluminum requires only about one-half the electrical potential as iron to produce the same damaging effect. With the aluminum components of newer engines, greater care is required to ensure proper grounding to prevent electrical potential differences.

Troubleshooting these types of corrosion is extremely complicated. The source of electrical current must be located. Common sources of stray current are improper grounding of electrical components or corroded ground strap connections.

Scale and Deposit Formation

The general characteristics of water - including pH level, calcium and magnesium hardness, total hardness, and temperature determine scale and deposit formation. Use of supplemental coolant additive is a major factor in preventing scale and deposit formation. Common scale deposits in a cooling system include:

- calcium carbonate
- calcium sulfate

- calcium sulfate
- iron
- copper
- silica
- lead

Ver imagen

Illustration 30 g02143201

Rust deposits on water pump impeller caused by lack of supplemental coolant additive.

Scale and deposit formations are detrimental to the cooling system because they act as insulators and barriers to heat transfer. Thus, scale and deposit formations reduce the cooling system's efficiency. Only 1.6MM (1/16") of scale has the same insulating potential as approximately 101 mm (4") of cast iron. This thin scale deposit can reduce heat transfer by 40%. In many cases, severe damage to the engine results.

It is impossible to completely eliminate poor water characteristics. However, water must be pretreated to meet the manufacturer's specifications for the cooling system. (See page 15).

Used in proper concentration, Cat SCA helps prevent the formation of scale and deposits.

Aeration

Air leakage into the cooling system often results in coolant foaming. Foaming promotes pitting, particularly around water pump impellers. Pitting and corrosion increase significantly when exhaust gases enter the cooling system, introducing bubbles, foam, and acid forming compounds.

To help prevent such problems, foam suppressant additives must be added to the coolant mixture. Cat SCA contains de-foaming agents and helps prevent the formation of air bubbles.

contains de-foaming agents and helps prevent the formation of air pockets.

Coolant-Related Failures

Because of the cooling system's vital function in regulating temperature, coolant-related problems, such as corrosion or aeration in the cooling system, can ultimately lead to failure of the engine. Temperatures that are excessively high or low lead to engine failure. Overheating typically causes cracking of cylinder heads and cylinder blocks and seizure of pistons. Excessively low operating temperatures lead to other types of problems such as sludge formation and carbon build-up.

Overheating can be traced to many different sources:

- slow hydraulically driven fan
- low coolant level
- plugged radiator core
- broken or leaking coolant hoses
- loose fan belts
- excessive engine load
- failure of water pump or water temperature regulator
- restriction of inlet or exhaust air flow
- engine operation with no temperature regulator
- cooling system (heat exchanger, cooler, or radiator) that is defective or too small

Many of these causes are related to coolant. Examples of coolant-related failure symptoms are cracked or warped cylinder heads, cylinder block damage, piston seizure, and cold operating temperatures.

Cracked or Warped Cylinder Heads

When an engine overheats, stress in the cylinder head increases. This can cause the cylinder head to become warped or cracked.

Ver imagen

Illustration 31 g02144414

Coolant-related overheating caused this crack in the cylinder head at the nozzle hole.

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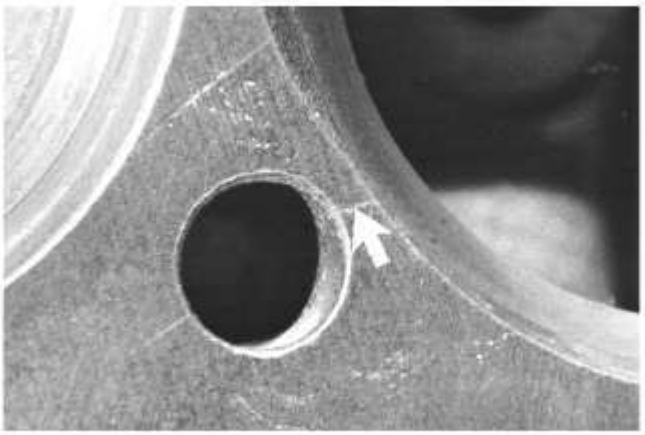

Illustration 32 g02144415

Further inspection of the crack shows extention into the valve seat area.

Cylinder Block

The cylinder block represents another potentially vulnerable area. Cavitation-erosion and excessive pitting in the water passage around the cylinder liner can cause holes in the cylinder wall. Pitting and cavitation-erosion often result from incorrect cooling system maintenance. These types of problems can be prevented by properly maintaining the cooling system, which includes regular additions of Cat SCA as required.

Piston Seizure

Piston damage, in varying amounts, is typical of overheating failure. Normally, several pistons have seizure damage (scuffing), while the skirts of the remaining pistons are polished or have normal appearance. Usually, more severe damage occurs on pistons in one or more of the rear cylinders.

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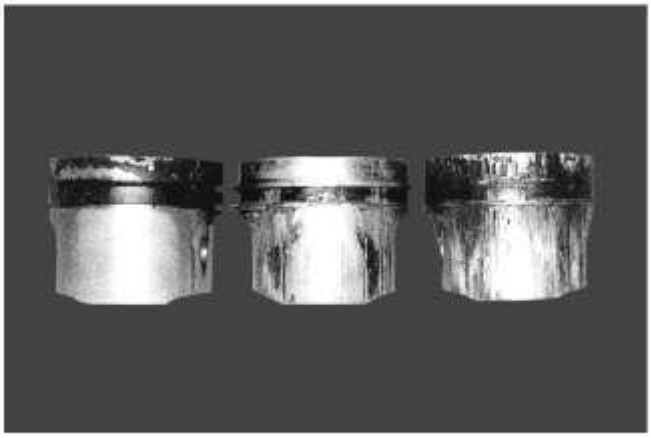

Illustration 33 g02143215

Piston damage on this direct-injection engine resulted from improper cylinder jacket cooling. As shown by the middle piston, seizure usually begins in the skirt area while the top land escapes damage. The piston on the right shows further progression after skirt seizure.

Seizure damage from improper cylinder jacket cooling usually begins in the piston's skirt area on direct injected fuel system engines. On precombustion fuel system engines, piston seizure often begins at the top land.

Cold Operating Temperatures

Overcooling can damage an engine, just as overheating can. Correct operating temperature is critical to engine performance. Engines must reach a specific operating temperature to run efficiently and prevent failures.

Continued engine operation at cold temperatures can result in sludge formation in the crankcase. Sludge can gum valve lifters, valve stems, pistons, and piston rings. Also, when using fuels with high sulfur content, sulfuric acid can form more readily and accelerate corrosion.

Cold operating temperatures can also lead to carbon buildup. Carbon buildup is a result of over-lubrication or cold engine operation. Correct temperatures help reduce carbon deposits from forming on valves.

Ver imagen

Illustration 34 g02143229

Excessive carbon buildup on an intake valve. Carbon buildup can be caused by engine operating at cold temperatures.

All Caterpillar Engines are equipped with temperature regulators (thermostats) for temperature control. Regulators can vary according to engine application. Make sure the recommended regulator has been installed and is operating correctly.

Service and Periodic Maintenance

Periodic Maintenance

Periodic maintenance is necessary for the cooling system to operate efficiently. The following maintenance practices extend both cooling system and engine service life.

Note: These are general recommendations. For specific requirements, consult the engine manufacturer's owner's guide.

WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove cooling system pressure cap slowly to relieve pressure only when engine is stopped and cooling system pressure cap is cool enough to touch with your bare hand.

Do not attempt to tighten hose connections when the coolant is hot, the hose can come off causing burns.

Cooling System Coolant Additive contains alkali. Avoid contact with skin and eyes.

INITIAL FILL

- 1. If Cat ELC or Cat DEAC will not be used, select proper water, supplemental coolant additive, and coolant.
- 2. Before the cooling system is filled, close all drain plugs.
- 3. Before adding to the cooling system, always premix water, supplemental coolant additive, and

3. Before adding to the cooling system, always premix water, supplemental coolant additive, and coolant concentrate, or use fully formulated premixed coolant. Premixed coolants that are not fully formulated may require a precharge of coolant additive. Consult manufacturers label.

- 4. Do not fill the cooling system faster than 20 liters (5 gallons) per minute. Air pockets can form in the cooling system if the cooling system is filled at a faster rate. Air pockets result in an incomplete fill and could possibly cause damaging steam.
- 5. After filling the cooling system, run the engine for several minutes with the radiator cap off. Next, install the radiator cap and run the engine at low idle until the coolant becomes warm.
- 6. Inspect coolant level in top tank. If necessary, add coolant. Examine all cooling system components for leaks. If none are found, the engine is ready for service.

10-HOUR OR DAILY CHECK

- 1. Inspect the coolant level in the top tank or the overflow tank.
- 2. Remove foreign material and dirt from outside the radiator core (and between the panels of folded core radiators).

50-HOUR INTERVAL

- 1. Perform all 10-hour maintenance.
- 2. Inspect zinc or magnesium rods if so equipped.

250-HOUR OR MONTHLY CHECK

- 1. Perform all 10 and 50-hour maintenance.
- 2. Inspect the condition and tension of all fan belts. If necessary, adjust or replace any belts.
- 3. Add supplemental coolant additive, or change element assemblies if so equipped.
- 4. Test the coolant for freeze protection.
- 5. Inspect the radiator or overflow tank cap gasket.
- 6. Inspect all hoses for leaks.
- 7. Inspect/check all engine grounds.

3000 HOURS OR 24 MONTHS (whichever occurs first)

- 1. Perform all 10, 50, and 250-hour maintenance.
- 2. Add Cat ELC Extender if filled with Commercial ELC.
- 3. Drain, clean, and refill the cooling system if filled with Cat DEAC, commercial heavy-duty coolant/antifreeze, or supplemental coolant additive and water. (See page 63, Caterpillar Cooling System Cleaners.)
- 4..Inspect the condition of fan blades and guards. Inspect the condition of hoses and clamps. Tighten all clamps.

- 5. Obtain a coolant analysis.

6000 HOURS OR 6 YEARS (whichever occurs first)

- 1. Perform all 10, 50, and 250-hour maintenance.
- 2. Add Cat ELC Extender if filled with Cat ELC. See page 20 for the amount of Cat ELC Extender to add.
- 3. Drain, clean, and refill the cooling system if filled with commercial coolant that meets the Caterpillar EC-1 specifications.
- 4. Inspect the condition of fan blades and guards. Inspect the condition of hoses and clamps. Tighten all clamps.
- 5. Obtain a coolant analysis.

12,000 HOURS OR 6 YEARS with CAT ELC Only. (whichever occurs first)

- 1. Perform all 10, 50, and 250-hour maintenance.
- 2. Drain, clean, and refill the cooling system if filled with Cat ELC only.
- 3. Inspect the condition of fan blades and guards. Inspect the condition of hoses and clamps. Tighten all clamps.

Troubleshooting Checklist

Three basic problems are typical of cooling systems:

- overheating
- overcooling
- loss of coolant

A cooling system problem should first be diagnosed by visual inspection. If the problem cannot be diagnosed, tools must be used to find the cause.

Caterpillar has published booklets that contains the following service information in extensive detail:

- Cooling system inspection, test and troubleshooting procedures
- Overheating and overcooling problems and causes
- Steps to clean and recondition cooling systems
- Components that affect cooling systems

Refer to the "Reference Material" section at the back of this publication.

Troubleshooting Overheating

Visual Inspections for Overheating

If an overheating problem is suspected, first check to see if an overheating problem actually exists.

Look for radiator clogging, low coolant level and low fan rpm.

Check for coolant leaks or steam coming out of the overflow on the radiator when the engine is stopped.

If no problem is found after these simple visual checks, more accurate ways to check cooling system components are necessary.

Ensure that the coolant temperature gauge is accurate. Use a 4C6500 Digital Thermometer Group or other temperature testing tools shown on pages 68 and 69 to check the temperature of the coolant. Most coolant temperature gauges for pressurized cooling systems are calibrated to show overheating at approximately 108°C (226°F).

Ver imagen

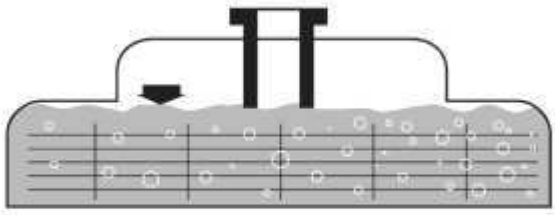

Illustration 35 g02143259

Correct coolant level in radiator

Check the level of the coolant in the radiator. Ensure that the coolant is cool first. A low coolant level can cause overheating. A low coolant level can also be the result of overheating. If the coolant begins to boil, the pressure relief valve in the radiator top tank or filler cap will open. The cooling system pressure remains constant, but coolant is lost. If the level of the coolant is low, add more coolant as needed. See the appropriate Operation and Maintenance Guide for the amount of coolant to add. If the engine overheats again, the low coolant level was not the cause of overheating.

Ver imagen

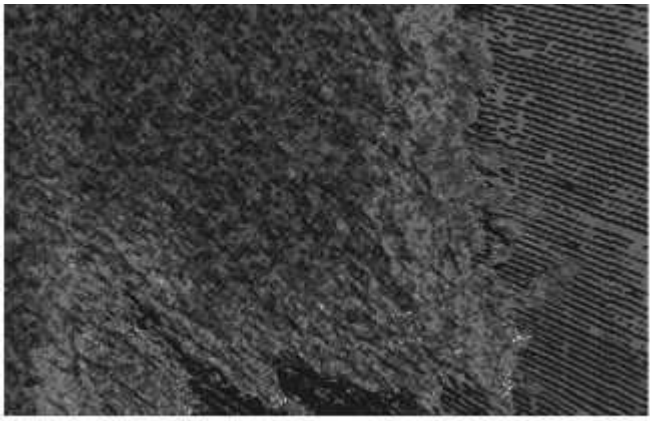

Illustration 36 g02143260

Dirt in the radiator core.

Check for restrictions that can stop the flow of air through the radiator. Look for dirt in the cores, especially outside of the fan blast area. Use a light to check for plugged areas in the core. Lower light on one side of the radiator and visually inspect the opposite side.

Ver imagen

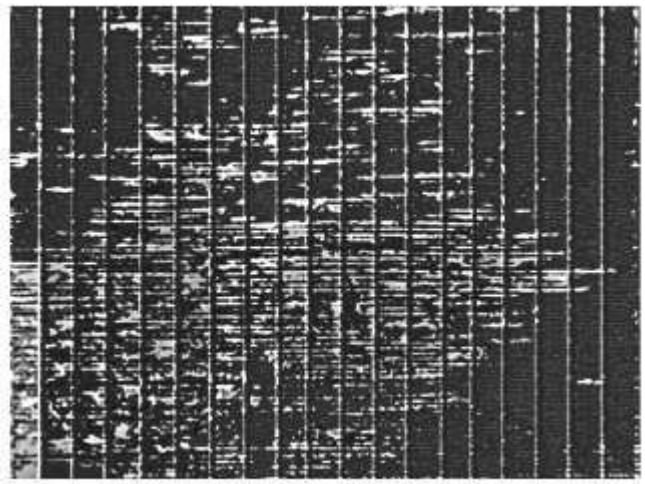

Illustration 37 g02143263

Radiator with bent cooling fins.

Check for radiator fins that are bent, damaged, or show signs of leakage from the radiator. On truck engines that have shutters on the radiator, check to see if the shutters are stuck in a closed position.

Check engine high idle speed. If necessary, adjust until the correct high idle speed is reached.

Check for correct shutter opening temperature. The relationship between the thermostat and shutter operating temperature must be defined

operating temperature must be defined.

Check fan belts and pulley grooves. Loose belts will wear at a faster rate and cause damage to pulleys. It is also possible for loose fan belts to slip and cause the fan to turn at a slower rate. This too can cause overheating.

Make sure there is no oil or grease on the fan belts or pulleys. Oil or grease will cause the belts to slip. The outside diameter of a new fan belt must extend beyond the edge of the pulley a small amount. If the fan belt is even with the outside diameter of the pulley, either the fan belt or pulley is worn. Check the inside surface of the fan belts for cracks. Cracks on the inside surface of the fan belt will cause the belt to break after a period of time. Replace fan belts in sets. A new fan belt will stretch a small amount after several days of operation. A new fan belt and a used fan belt used together will cause excessive stress on the new fan belt. When an adjustment is made to the belts, the new belt will tighten before the used belt and thus carry all of the load.

Check fan speed of hydraulically driven fans. Low relief valve pressure setting or low fan pump flow can cause slow fan speed.

Ver imagen

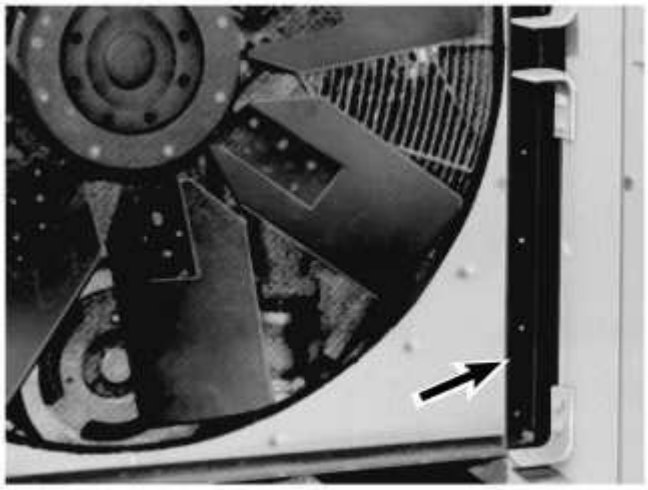

Illustration 38 g02143265

Radiator Baffle

Check the fan blades for damage. Look for missing or damaged radiator baffles. The baffles prevent recirculation of air around the sides of the radiator. A missing or damaged baffle raises the temperature of the air that goes through the radiator.

Ver imagen

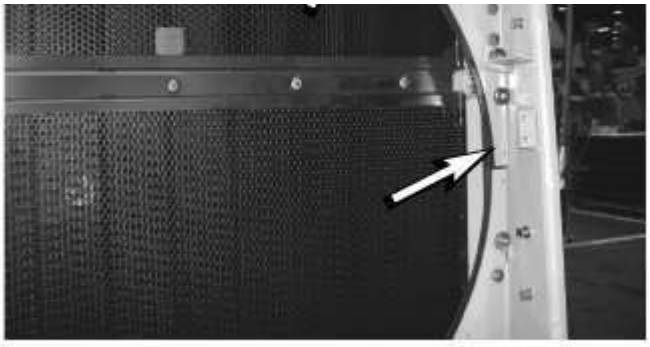

Illustration 39 g02143266

Fan shroud

Check the condition of the shrouds. Make sure they are installed correctly. Also, make sure the rubber strips are in good condition. Fan and radiator shrouds increase the efficiency of the fan by helping to move air through the radiator. The fan shroud must be near the outer edges of the fan blade to prevent recirculation of air around the ends of the fan.

Check the air inlet system, If an industrial or marine engine is in a closed room and has an air inlet pipe that provides a supply of outside air to the engine, make sure the inlet pipe does not leak and that it is properly connected to the engine. The temperature of the air in the room will rise because of engine heat. If the inlet pipe is not connected correctly, the inlet air will be hot. Make sure there are no restrictions in the air cleaner, air inlet and exhaust lines, or to the flow of air through the cooling system.

Check the condition of all hoses. A collapsed hose with the engine running, is an indication that the water pump cannot pump enough coolant because of a restriction in the radiator. If the hose is collapsed after shutoff and cool down, the system is not vented properly to allow pressures to equalize. Check the vented filler cap or the relief valve in older systems to assure the vacuum valve is functioning properly.

Avoid installation where the radiator is significantly higher than the engine. Excess head pressure can cause pump seal leaks while the engine is stopped. For instance, if the engine is in the basement and the cooling tower is on the roof, the height differential cannot exceed 17.4 meters (57feet). If the height differential exceeds 17.4 meters, an auxiliary expansion tank should be incorporated to ensure the water pump seals and hoses do not leak.

Check for leaks around the water pump. On all engines, there is a drain hole between the coolant seal and the bearing seal in the water pump. Without this drain hole, coolant can get into the oil if there is a failure of the seals in the water pump. Look for signs of coolant or oil leaks at the junction of the cylinder head and cylinder block. Leaks in this area are an indication of head gasket failure,

If no cause for overheating can be found, make these additional visual checks before cooling system tests are made:

Check the condition of the gasket in the radiator cap. If necessary, install a new gasket or radiator cap.

Check the radiator gasket sealing surface in the cap for gouges, nicks, or grooves. This surface must be smooth and even.

Ver imagen

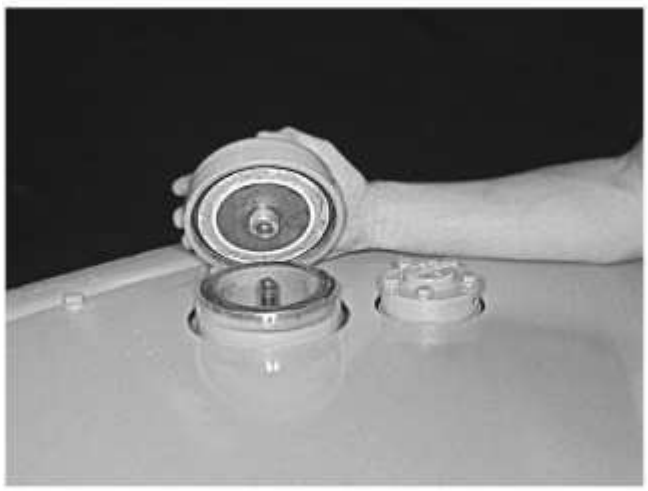

Illustration 40 g02144418

Type of radiator cap held by studs

If the radiator cap is held in position by a stud, tighten the cap and feel for contact between the gasket and the surface on the radiator top tank. If the stud is too long or damaged, the cap will not provide a complete seal.

NOTICE

Do not disassemble the relief valve in the cooling system until the radiator cap has been removed from the radiator and the pressure in the cooling system is released. If there is pressure in the cooling system when the relief valve is removed, steam can be released. This can cause personal injury.

... Remove the relief valve and check its condition and the condition of the gasket surface for the relief valve. If the parts are in good condition, remove any rust or scale deposits and install the relief valve back in the top tank.

... Make sure the fan is installed correctly. A fixedblade fan that is installed backwards can lose approximately 50% of its capacity.

... Check the governor seal to see if the fuel setting was changed. Make sure the machine is not used in an overload condition or is not operated near the stall speed of the torque converter.

... Check for transmission and steering clutch slippage.

... Make sure the brakes on the machine are not dragging.

... Check the retarder or BrakeSaver to see if it is fully disengaged.

... Check the [illegible]

... Check the glycol concentration of the coolant. The glycol should not exceed 50%.

Cooling System Tests

If the cause of overheating was not discovered during the visual inspections, cooling system tests must be made. Before any tests are made, let the engine temperature cool and install self sealing probe adapters in the following positions if not already installed:

- 1. Radiator top tank
- 2. Radiator bottom tank or water pump inlet
- 3. Water pump outlet or oil cooler inlet
- 4. Water temperature regulator housing
- 5. Torque converter oil outlet
- 6. Engine oil manifold or oil cooler outlet

NOTICE

Remove the radiator cap slowly to release the pressure in the cooling system. It is not necessary to drain the coolant if the engine is allowed to cool and probe adapters are already installed. If these steps are not taken, hot coolant can run out or spray out and cause personal injury.

Test Water Temperature Regulators

Increase the water temperature to the opening temperature of the regulator (this is stamped on the regulator). After several minutes at this temperature, quickly check the regulator to see if it has cracked open. Raise the water temperature approximately 15°C (25°F) above the opening temperature for approximately 10 minutes. Remove the regulator from the water and immediately measure the opening dimension. If the distance is less than the specified dimension in the Service Manual, replace the regulator.

Ver imagen

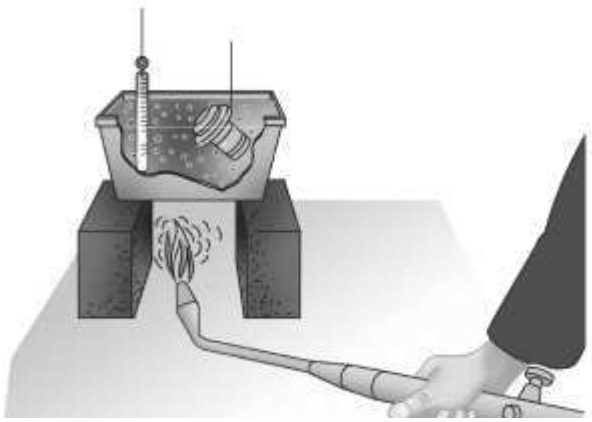

Illustration 41 g02143293

Testing water temperature regulators

Do not operate the engine without the water temperature regulators installed. Removing the regulator(s) opens the water pump bypass allowing most of the coolant to bypass the radiator, compounding any potential overheating. In some applications, removing the regulators can be a time consuming task. In these cases it may be easier to determine regulator opening in the engine. This can be done by measuring water temperatures and comparing differential temperatures.

Measure temperatures at the locations specified in "Cooling System Tests." The regulator is not fully open if the radiator temperature drop is considerably higher than the engine temperature rise. The regulator is fully open when both temperature differentials are the same. if the engine and the radiator temperature differentials are greatly different when the engine reaches maximum temperature, it is likely the regulator is not opening properly.

The source of the overheating problem can usually be identified by determining engine temperature rise and radiator temperature drop during the overheating condition. Engine heat rejection and jacket water pump flow can be obtained from the Technical Marketing Information Files (TMI).

This information can be used to calculate the proper temperature differentials at full load. If the measured temperature differentials are much higher than calculated, a water flow problem exists. The heat transfer capacity of the radiator (heat exchanger) is too low if the engine overheats when the temperature differentials are correct or less than the calculated value. Any number of problems can cause low cooling capacity. These problems could include: improper sizing (too small initial heat transfer capacity), airflow too low, excessive glycol concentration, over loaded engine, lug operation, etc.

Check Air Velocity

Before the air velocity is checked, put the transmission in the machine in neutral position. Put the parking brakes "ON" and lower all equipment. Make all checks at rated speed with the radiator grill swung out of the way.

NOTICE

Wear eye protection when working around a running engine.

Check the air velocity with a 8T2700 Blowby/Air Flow Indicator Group. Take several readings and average the results. Care must be taken when trying to pinpoint problem areas in the radiator core. On machines and trucks, it is normal for velocities at the center (fan hub area) and outside edges of the radiator to be as much as five times less than the velocity at the blade sweep area of the core. This meter not only measures air velocity but also helps pinpoint the location of any core clogging that can cause overheating. Use Special Instruction, Form SEHS8712, as a guide for using the 8T2700 Blowby/Air Flow Indicator Group.

Note: The air flow through commercial engine radiators is determined by the type of installation. Radiators,

with fans located remotely, may have equal air velocities across the radiator and will NOT have higher velocity at the blade sweep area.

If the radiator core has no restrictions, check the fan speed with the 9U7400 Multitach II Tool Group. The complete test procedure is given in Special Instruction, Form NEHS0605.

Check for Air, Gases and Steam in the Cooling System

A cooling system that is not filled to the correct level or that is not filled correctly can cause air in the cooling system. Also, leaks in some components, such as aftercoolers and hoses, permit air to get into the cooling system, especially on the inlet side of the water pump.

Air in the cooling system causes foaming or aeration and affects the performance of the water pump. The air bubbles in the system act as insulation and reduce pump flow. Coolant cannot come in contact with different parts of the engine that have air bubbles, so "hot spots" develop on these different parts. To keep air out of the system, fill the cooling system slowly at the original fill and make sure all suction hose clamps are tight. Start the engine. Check the coolant level to make sure the radiator is still full.

Combustion gas leakage into the cooling system also causes foaming or aeration. Combustion gases can get into the cooling system through cylinder head gaskets that have internal cracks or defects. Most of the causes can be found by a visual check but some need disassembly or a simple test.

Gas in the cooling system is one cause of overheating which can be found by a test known as the "bottle test." For the bottle test, fill the cooling system to the correct level with coolant. Fasten a hose to the outlet relief valve in the radiator top tank or expansion tank. Put the other end of the hose in a jar of water. See Figure 65. Install the radiator cap and tighten it. Start the machine and run it at torque converter stall for three to five minutes. Make sure the temperature of the cooling system is between 85°C (185°F) and 99°C (210°F). This temperature can be checked by installing a thermistor probe in the regulator housing ahead of the regulator. This is a test for gas in the system, not steam, which can produce similar conditions if the temperature is permitted to increase. Look at the amount of bubbles in the glass jar. If an occasional bubble is visible there is no air or combustion gases in the cooling system. However, a constant violent flow of bubbles indicates the presence of air or combustion gases.

Loose precombustion chambers, defective precombustion chamber seals, a loose cylinder head, a cracked liner, or a damaged head gasket will also cause combustion gases in the cooling system.

Ver imagen

Illustration 42 g02143297

Bottle test used to check for air or combustion gases in the cooling system.

Check the Cooling System Relief Valve

The cooling system relief valve must open at the pressure level indicated in the appropriate Engine Specification Module. To check the pressure, install a pressure gauge in the radiator top tank. Tighten the radiator cap. Use an air pressure regulating valve or a 9S8140 Pressurizing Pump to put pressure in the cooling system. Any additional pressure above must go past the relief valve. With the air supply turned off, the system must hold the minimum pressure indicated in the Engine Specification Module.

Test During Machine Operation

If the cause of overheating is not discovered by visual checks and simple cooling system tests, a temperature measurement must be taken. Temperatures are measured at different locations on the machine and compared to see if they are normal. The 4C6500 Thermistor Thermometer Group is used to measure temperatures at the following locations:

- Radiator top tank
- Water pump outlet
- Water temperature regulator housing
- Torque converter oil (inlet and outlet) measured across cooler
- Engine oil cooler

The temperature in the radiator top tank must be below coolant boiling point. The difference between the temperature in the radiator top tank and the ambient air must not be more than 61°C (110°F) with the regulator fully open, full coolant flow through the radiator, and the engine at full load. The water pump outlet temperature must be approximately 4.5° to 11°C (8° to 20°F) below the temperature in the radiator top tank.

NOTICE

The regulator in most machines is fully open when the water temperature is approximately 93°C (200°F - 205°F). The regulators in some earlier commercial engines and engines with reduced emissions will fully open at higher water temperatures.

The cooler inlet oil temperature must not be more than 132°C (270°F). The normal temperature range for cooler inlet oil temperature is 6° to 11°C (10° to 20°F) over the radiator top tank temperature when a machine is operated under full load. The cooler outlet oil temperature will be 8° to 22°C (15° to 40°F) lower than the cooler inlet oil temperature.

Measure Manifold and Aftercooler Temperatures

The temperature of the oil in the oil manifold is approximately 17°C (30°F) higher than the water temperature at the pump outlet. If the temperature of the oil in the oil manifold is 19° to 22°C (35° to 40°F) higher than the water pump outlet temperature, then scaling may be the cause.

A dirty aftercooler will result in high inlet air temperature. For every 1° (Fahrenheit or Centigrade) increase in inlet air temperature the exhaust temperature increases 3° (Fahrenheit or Centigrade). A dirty aftercooler, contaminated with oil mist or corrosion, will not permit normal heat transfer. Where raw or sea water aftercoolers leak into the engine, salt corrosion and wear of engine parts can result.

Table 25

SUMMARY OF OVERHEATING PROBLEMS AND CAUSES	
Problem	**Possible Causes**
1. Low coolant level	A. External leaks caused by loose connections, radiator cap or cooling system relief valve with defects. B. Internal leaks caused by cracked cyllinder head, cracked cylinder block, loose cylinder heads, damaged cooler core, damaged after cooler, damaged gaskets.
2. Reduced air flow through radiator	A. Plugged raditor core B. Damaged or bent radiator fins. C. Low fan speed because of low engine high idle speed. D. Fan is damaged or installed backwards. E. Loose or worn fan belts and F. Damaged fan shroud, wrong diameter fan or incorrect number of fan blades. G. Incorrect fan blade position. (Fan projection out of the shroud must be approximately 50%) H. Excessive fan tip to shroud clearance. Should be .38" maximum clearance. I. Closed shurrter (if equipped). J. Fluid coupling for fan not engaged.
3. Insufficient cooling system pressure	A. Defective pressure gauge. B. Defective radiator cap. C. Defective cooling system pressure relief valve. D. B. Defective radiator top tank neck or stud.
4. Coolant overflow	A. Air in cooling system because of incorrect coolingsystem fill. B. Combination gases in cooling system from loose cylinder head, cracked cylinder head, loose or defective precombustion chamber, defective cylinder head gasket, worn cylinder liner counterbore. C. Steam in cooling system because of engine torque converter over load or low coolant level.
5. Insufficient coolant flow	A. Stuck water temperature regulator. B. Absence of water temperature regulator. C. Low engine high idle speed. D. Loose water pump impeller. E. Radiator plugged on inside.

6. High inlet air temperature or restriction	A. Highambient air temperature. B. Plugged openings in screen for engine compartment with a blower fan. C. Disconneccted inlet air pipe in engine room. D. Dirty aftercooler core. F. Plugged air cleaner. G. Damaged of carbon packed turbocharger.
7. Low heat transfer	A. Insuffcient flow of raw water through heat exchanger. B. Crusted over keel cooler. C. Hot air for radiator caused by overheating hydraulic oil cooler. D. Scale on cylinder liners or cylinder head.
8. Exhaust restriction	A. Plugged air cleaner. B. Damaged turbocharger. C. Restriction in exhaust pipes. D. Water in muffler. E. Loose baffle in muffler. F. Excessively long exhaust pipe.

Overheating Troubleshooting Chart

Troubleshooting Overcooling

Engine Overcooling

Overcooling can damage an engine just as overheating can. Overcooling occurs when the normal temperature at which the engine operates cannot be reached. This condition is most severe with the use of high sulfur fuel. High sulfur fuel increases wear if the temperature is not over 80°C (175°F). Overcooling is the result of coolant bypassing the water temperature regulators and flowing directly to the radiator.

Causes of Overcooling

Low ambient air temperature and light load application conditions may exist when overcooling occurs. A defective temperature gauge can give an indication of overcooling. The gauge can be checked for accuracy by comparing the actual temperature of the coolant in the water temperature regulator housing with the temperature indication on the gauge. Use a 4C6500 Digital Thermometer to check the temperature of the coolant. If necessary, install a new gauge.

The most common cause of overcooling is water temperature regulators that do not close or allow excess coolant leakage because of a defect. It is possible for coolant to flow around a water temperature regulator that is in good condition. This too will give an indication of overcooling.

Check the water temperature regulator the same way you would for an overheating problem. Even if the. regulator opens and closes correctly, check it for other defects. On bonnet-type regulators that are used in the full-flow bypass system, check the bonnets for wear grooves and dents. These can prevent the regulator from sealing correctly.

Ver imagen

Illustration 43 g02143400

Fig. 67: Bonnet-type water temperature regulator.

After the water temperature regulators have been checked thoroughly, inspect the water temperature regulator housing. Check the counterbores that the regulators fit into. Make sure the surfaces of the counterbore are clean, smooth, and free of foreign material. Check the seal in the regulator housing and check for cocking which causes coolant to flow past the regulator and seal. Some housings have a bleed hole orifice to permit coolant flow to bleed air out of the cooling system when it is filled with coolant. Make sure this bleed hole is open. Do not enlarge this hole; it could cause overcooling. In some machinery, check valves are used to stop coolant flow through the bleed hole when the engine starts.

Ver imagen

Illustration 44 g02143619

Bleed hole in water temperature regulator housing.

Some engine installations use external vent lines to vent air. Excessive vent line flow can be controlled by

adding a vent/check valve (i.e. 8N9071).

NOTICE

Do not alter highway truck vent lines on shunt type cooling systems.

Reconditioning the Cooling System

In the course of time, certain components in the cooling system will need reconditioning. The most common reasons for reconditioning are machine operating environment, normal wear of parts, or accidents. The following procedures and tips will assist you during reconditioning and repair of the cooling system.

Cleaning the Outside of a Standard Radiator Core

WARNING

Wear eye protection at all times when cleaning the cooling system. Pressurized water could cause debris to be blown and result in personal injury.

Always clean the radiator fins with the engine stopped. Failure to do so, could result in personal injury caused by the moving fan blades.

If cleaning with air, use 205 kPa (30 psi) maximum pressure to prevent personal injury.

Remove the radiator grill from the machine. Find the direction of air flow from the fan. If the machine is equipped with a blower fan, the core must be cleaned from the side opposite the fan. If the machine is equipped with a suction fan, the core must be cleaned from the fan side of the radiator. The fan guards have to be removed to clean a radiator core that uses a suction fan. For normal debris such as dust, leaves, small twigs, nettles, cotton fluff, etc., use shop air or a compressor with a capacity of 1.4 to 1.7 cmm (50 to 60 cfm) at a pressure of 350 kPa (50 psi) to clean the core. Hold the air nozzle approximately 6 mm (1/4 ") from the fins. Slowly move the air nozzle from the top of the core to the bottom of the core in order to clean the debris from between the vertically positioned tubes in the radiator core.

Ver imagen

Illustration 45 g02143622

Cleaning the radiator core (equipped with blower fan).

The debris in a radiator core on machines equipped with a blower fan is thicker and packed more tightly than the debris in a radiator core on machines equipped with a suction fan. If necessary, use a light bulb behind the radiator core to see if it is completely clean. Use the air to check for thick areas of dirt.

Ver imagen

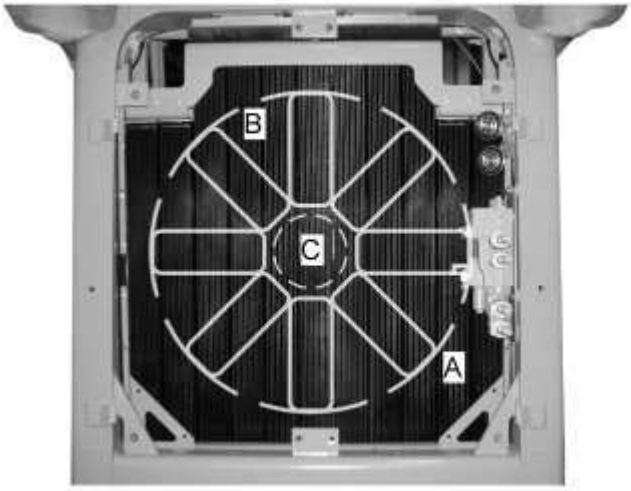

Illustration 46 g02143627

Critical locations of the radiator core.

On machines equipped with a blower fan, the thicker debris will be in area A (Figure 70) on the outside edge of the radiator core surrounding the fan. Area B of the radiator core, which is the approximate location of the fan, will have some debris, but it will not be as thick as the debris in area A. The air velocity in area B is high. This will cause most of the debris to be in the second and third rows of tubes in the radiator core. Area C of the radiator core is the approximate location of the fan hub. The air velocity is very low in this area and most of the time it remains quite clean.

High pressure water is an excellent means to clean the debris out of a radiator core.

If there is oil in the fins of the radiator core, use a steam cleaner and soap to remove it. Use shop air to remove any loose debris before using the steam cleaner. Some materials like red-wood bark or shredded paper (normally found in sanitary landfill operations) and very stringy type materials can be difficult to

remove. If necessary, remove the radiator core from the machine and use shop air and a steam cleaner. Make sure the core is thoroughly cleaned before it is installed in the machine.

Ver imagen

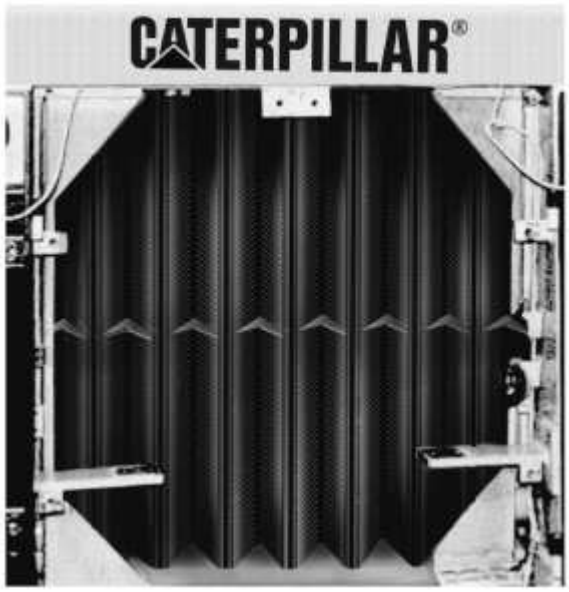

Illustration 47 g02143629

Folded core radiator.

Although the folded core radiator looks different from a standard core radiator, the principle of cooling and cleaning are the same. The same precautions taken with a standard radiator should be used with the folded core radiator. For example, in a wooded application, engine enclosures should be used and kept in good repair. For machines used in dusty applications, the radiator should be blown out at regular intervals. The radiator is susceptible to plugging in certain applications and maintenance actions should be adjusted for these conditions. As with the standard core, reasonable maintenance should still be practiced.

Compressed air, high pressure water and steam are three preferred cleaning mediums that can be used to clean these radiator cores. For dust, leaves, and general debris, any of these methods may be used. However, the use of compressed air is preferred. Acceptable results will be obtained by opening the front grill and directing the cleaning medium at right angles to the front of each core face. Move the nozzle from the middle to the upper end of each core working from the rear of the vee, and then back again to the front of the vee. Go across the entire face of each core and then do the lower half.

After the core is cleaned, start the engine and accelerate to high idle several times, or until loosened debris is no longer blown from the core. Stop the engine and go over the face again. Exposure time may be kept shorter on this second pass. Restart the engine and accelerate it to high idle several times.

A method to increase the air velocity is to place a piece of plywood over the lower third of the radiator. Put the plywood in between the grill and the radiator toward the bottom of the core. Start and accelerate the engine several times or until trash ceases to be expelled. Stop the engine and then reposition the plywood toward the top of the core. The plywood may have to be wired in place. Repeat the engine acceleration process. The increased air velocities will aid in the removal of debris from between the fins. If steam or water is used, continue running the engine until the core is hot and does not have water vapor coming off the fins. The machine is then ready for use.

If oil, sap, or mud is encountered, a different cleaning procedure is required. Oil and sap can be cleaned from a core by using a commercial degreaser. The degreaser must be applied to both sides of the core face, especially in the area of visible plugging. Let it soak for a minimum of 5 minutes and then wash the core. Use very hot water under high pressure and a small amount of laundry detergent. Concentrate the cleaning efforts on areas which were exposed to the oil or sap, working from both sides of the core. Be sure to wash the areas on each end of each core in the area around the seal. Excess oil in this area can be detrimental to the seals. After washing, rinse the core with hot water. Start the engine. Accelerate the engine several times and rinse the core again. Repeat this rinse process until detergent bubbles are no longer emitted from the fins. Continue to operate the engine until there are no water vapors coming off the fins. Do not put the machine back to work until all water has evaporated.

Plugging by mud may be of two types: mud splatter and mud impregnation. Mud splatter may be easily removed by shutting the engine off and spraying water on both sides of the core to soften the mud. If heat from,the radiator causes the water to evaporate, spray the core again. Once the mud has softened, direct the water nozzle from the fan side towards the front of the radiator. Try to keep the nozzle perpendicular to the face of each core. Then go to the front of the radiator and spray water at each core. Keep the nozzle pointed to the rear of the engine. This nozzle position will allow the mud to flake or peel off. After the mud has flaked off, reposition the nozzle as in general cleaning and go across the core assemblies. When the water from the core appears clear, the core has been cleaned. Be sure to dry the radiator as previously described. Small patches of mud splatter and other debris may be removed with a file cleaner card, such as a Colton's file cleaner #10.

Mud impregnation is very difficult to clean on any type of radiator. For best results, remove the fan guards, fan, and shroud. Thoroughly flush both sides with high pressure water until the water flowing from between the fins is clear. To check for cleanliness of the radiator core, a light behind the core can be used to check for dirt. If dirt is visible, additional cleaning is necessary. If this method of cleaning impregnated mud does not give good results, remove the radiator. Cap the inlet and outlet holes in the top and bottom tank and place it in a large tank of water and laundry detergent. After soaking and agitating the core in water, rinse with hot water and blow dry. The time required for soaking is dictated by your particular problem.

Do not place folded core radiators in solvent baths that can remove paint. Folder core radiators are painted with a special process to get full fin penetration. If the original paint is removed, the fins will corrode at an accelerated rate.

Cleaning the Outside of a Multiple Row Module or Advanced Modular Cooling System (AMOCS) Radiator

Ver imagen

Illustration 48 g02143633

AMOCS Radiator.

The Multiple Row Module and AMOCS radiator have evolved from the folded core radiator, which replaced the standard core radiator in most equipment. The Multiple Row Module and AMOCS radiators use individual core assemblies. However, use of these radiators greatly reduces many plugging problems previously experienced. Since they are similar to the other two types of radiators, please see "Cleaning the Outside of a Standard Radiator Core" and "Cleaning the Outside of a Folded Core Radiator" for cleaning assistance.

Cleaning Inside Parts of the Cooling System

There are several ways to determine if the cooling system needs more than a mild cleaning:

- 1. Flow restrictions - Remove the radiator cap and see if the cooling tubes are plugged. If so, simply using a mild cleaner will not be satisfactory.
- 2. Constant overheating - If the fan belt, thermostat, and water pump are functioning properly, but the engine continues to overheat, then the cooling system may be badly plugged.
- 3. Water pump failure - If the water pump fails and upon inspection, heavy water contamination damage is found in the bearing, seal, and shaft area, the cooling system probably needs a thorough cleaning with special chemicals.
- 4. Visible heavy rust and green slime - If green slime (chromium hydroxide) is evident in the bottom of the radiator cap and the coolant is so cloudy that an antifreeze tester cannot be read, the system will need a more thorough cleaning with special solvents.

When the inside parts of the cooling system become contaminated, normal heat transfer is not possible. Oil is a common form of contamination in cooling systems. If an oil cooler has a defect, oil can enter the cooling system when the engine runs because the oil pressure is higher than the water pressure. When the engine stops, water or antifreeze in the oil will settle into the oil sump because the circulation stops. Also, water or antifreeze will continue to leak into the oil system, since cooling system pressure drops very slowly. A pressure check of the oil cooler may reveal a defect. Alternatively, oil samples may determine the presence of antifreeze or water in the oil.

After the problem that caused contamination of the cooling system has been found, the cooling system can be cleaned as follows:

1. Drain all of the coolant from the cooling system.
2. Fill the cooling system with clean water.
3. Start the engine and run it until the thermostats open.

4. Add two cups of non foaming soap. Automatic dishwasher soap is best. Do not use plain laundry soap.

5. After the non foaming soap is added, run the engine for approximately twenty minutes. Check to see if the oil is breaking up or if the water has oil patches.

6. If oil patches.are still present, add two more cups of soap and.run the engine for ten minutes. Drain the mixture from the cooling system.

7. Fill the cooling system again with clean water. Check the surface of the water for oil. If oil is still present, repeat Steps 3 through 7. When the water is clear, drain and rinse the cooling system one more time. Add coolant and conditioner.

Scale or rust in a cooling system can affect heat transfer. The scale and rust can be cleaned out of the cooling system with a two step type heavy duty radiator cleaner. This cleaner consists of an oxalic acid, which cleans the scale and rust, and a neutralizer. Two step type heavy duty cleaners are available from industrial supply outlets or they can be mixed as follows:

Acid - Mix 900 g (2 lb) of sodium bisulfate ($NaHS0^4$) per 38 liters (10 gal) of water (25 grams per liter).

Neutralizer - Mix 225 g (1/2 lb) of sodium carbonate crystals Na^2CO^3 per 38 liters (10 gal) of water (6 grams per liter).

The cooling system may also be cleaned with Caterpillar Cooling System Cleaners. These are designed to clean the system of harmful scale and corrosion without taking the engine out of service. It can be used in all Caterpillar Engines' and other manufacturers' cooling systems in any application. This mild solvent must not be used in systems that have been neglected or have heavy scale buildup. These systems require a stronger commercial solvent available from local distributors.

Caterpillars Cooling System Cleaners are available in the following size containers:

- 4C4609: 0.236 L (1 pint)
- 4C4610: 1,980 L (1 quart)
- 4C4611: 3.780 L (1 gallon)
- 4C4612: 18.90 L (5 gallon)
- 4C4613: 208 L (55 gallon drum)
- 6V4511L 1.9 liters (1 1/2 gallon'

Drain the cooling system completely. Refill with clean water and a 6% to 10% concentration of cleaner. Run the engine for 1/2 hours. Then, drain the coolant and flush the system with clean water. Refill the system with the proper amount of Cat ELC, or Cat DEAC and water. If Caterpillar Coolant is not used, the appropriate amount of Supplemental Coolant Additive must be added too. -

Components that Affect the Cooling System

Battery Ground Connections

Improper ground connections at the engine can cause problems In the cooling system. Make sure all ground connections are clean and tight.

Ver imagen

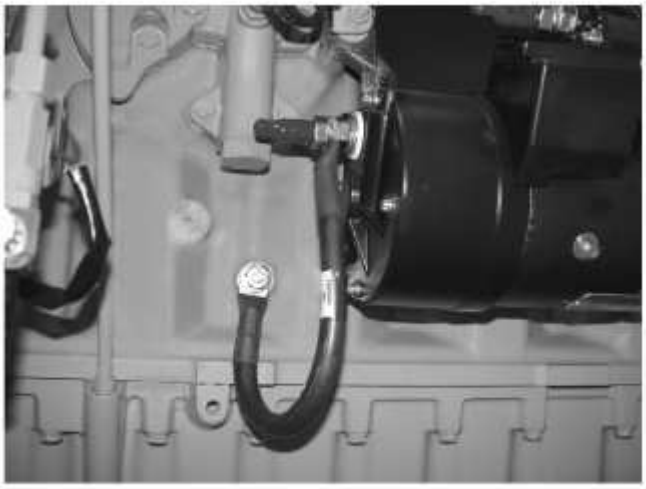

Illustration 49 g02143640

Battery Ground.

Sea Water Inlet Screen

Marine vessels and dredges use raw water coolers. Raw water coolers must be equipped with inlet screens to prevent debris entry. A clogged inlet screen or no inlet screen at all can result in overheating.

Oil Cooler Cores

A pressure check of the oil cooler cores can be made to detect leaks. The cooler must be removed for such a check. Depending on their size and location, some leaks can be repaired.

Oil flows around the tube bundles in an oil cooler core and the water flows through the tubes. If the tubes that the water flows through become plugged, they can be cleaned as shown in Figure 74. If the oil passages in the cooler core become plugged, they cannot be cleaned.

Ver imagen

Illustration 50 g02143643

Cleaning the tube bundles.

Cooler cores contaminated by a system failure should be replaced. Before installing the new core, inspect the oil filter. The oil filter will give an indication of the condition of the oil cooler core. Inspect the oil filter as follows:

1. Check the schematic of the lubrication system to determine if oil flows through the oil filter before it goes to the oil cooler core, or if oil flows through the oil cooler first and then goes to the oil filter. In most lubrication systems, oil flows through the cooler and then to the oil filter before it goes to the oil gallery.

2. Look for chips in the oil filter. If the oil flows from the oil cooler to the oil filter and the filter is full of chips, the oil cooler can also be full of chips. It is not possible to clean these chips out of the cooler core, so the core is not reusable. If the oil flows through the oil filter first, check the amount of chips in the oil filter and inspect the inlet of the oil cooler core to see if it contains any chips. If the oil filter is clean, the oil cooler will probably be clean.

3. Check the cause of a wear failure. If the failure was instant, only a few chips will be present. If the wear failure was gradual, the first few chips will be small, increasing in size as the failure progresses.

A failure that stops the flow of oil will not produce chips in the oil cooler even if there is a large amount of failure debris.

Refer to SEBF8077 Caterpillar Guideline For Reusable Parts and Salvage Operations "Engine Oil Coolers" and SEBF8085 Caterpillar Guideline, For Reusable Parts and Salvage Operations "Endsheet Inspection of Rubber Endsheet Oil Coolers".

Aftercooler Cores

See Technical Marking Information (TMI) for Marine Application Performance Specifications.

Usually, an aftercooler core used on a vehicle receives adequate air supply. However, adequate air supply is crucial if an aftercooler core is used on an engine that is in a room. If this is the case, make sure all blowby fumes are directed out of the room. If the fumes are piped into the air intake, they will decrease the efficiency of the aftercooler.

The water side of the core can be kept clean by the use of correct maintenance procedures. This is not true with raw water aftercoolers. Sea water and stream water can plug the water side of the core. A temperature check of the air, after it goes through the aftercooler, will determine whether or not the aftercooler core is plugged. Ideally, the inlet manifold air temperature will never be above 52°C (125°F), but the temperature on some arrangements can reach 93°C (200°F). If the aftercooler core is clean and the temperature of the sea water is 29°C (85°F), the air temperature on marine engines must not be more than 49° + 2.8°C (12° ±

5°F). The air temperature will decrease 1° (Fahrenheit or Centigrade) for each 1° (Fahrenheit or Centigrade) the water temperature is under 29°C (85°F). This means if the temperature of the sea water is 18°C (65°F) and the aftercooler core is clean, the air temperature must be 38° ± 2.8°C (100° ± 5°F). If the sea water is 18°C (65°F) or lower and the air temperature goes above 52°C (125°F) on marine engines, the aftercooler core needs to be investigated. If the jacket waterside temperature differential is low, suspect an aftercooler problem. If the jacket waterside temperature differential is high, check the pump as pump flow is most likely the problem.

Because of the construction of the aftercooler, it is impossible to clean the inside of the tube bundles with a rod. But it is possible, with special plumbing, to reverse the flow of raw water through the aftercooler to back flush it. This can be accomplished by running the engine for approximately one hour with a light load or no load. This will help clean the core. If this is not possible, remove all the pipes connected to the aftercooler and make adapters that can be used to flush the core with fresh water. If fresh water is used to clean the core, the water pressure must not be more than 170 to 205 kPa (25 to 30 psi). Do not stop the outlet flow of water out of the core and let the water pressure build up in the core. If the aftercooler core can be removed easily, it is best to clean it in a shop.

Radiator Cap

The radiator cap must prevent water and pressure loss in the cooling system. On large radiator caps, a worn gasket can be replaced. Smaller automotive type radiator caps cannot be serviced. A new cap must be installed.

Relief Valve

The cooling system relief valve cannot be serviced but it can be cleaned. If there is a loss of pressure in the cooling system, install a new relief valve and plate.

Fan Belts

Fan belts come in a set. If one of the fan belts is worn, all the fan belts must be replaced.

Pulleys

Some pulleys can be reconditioned under certain conditions. A pulley is reconditioned by remachining the grooves. For reconditioning procedures and specifications, see Guideline for Reusable Parts, Cast Iron And Steel Pulley Grooves, Form SEBF8046. Pulleys wear on the side faces of the groove. This wear is caused by abrasive material between belts and grooves. As the pulley wears, the belt will drop deeper into the groove. If the belt and pulley are in good condition, the belt will extend beyond the pulley edge as shown in Figure 75.

Ver imagen

Illustration 51 g02143645

When fan belts and pulleys are in good condition belts extend beyond the edge of the pulley.

Do not use belt dressing or other compounds that prevent belt slippage. Most of these compounds will make the side walls of the belt soft and weak and cause the belt to wear.

Fan Assembly

Do not repair a damaged fan assembly. When a fan is constructed, a balance point is established so the fan will run with a minimum amount of vibration. A repair would affect this balance point and can weaken the structure of the fan.

Fan Shroud and Baffles

The fan shroud and baffles cannot be reconditioned. Make sure these parts are installed when a radiator core is replaced. The fan shroud and baffles have an effect on fan efficiency and prevent recirculation of air. At times, wear or interference between the fan blade tips and the baffles will be noticed. This is normal. When a radiator guard flexes, it can cause the shroud to contact the tips of the fan blades.

Radiator Mounts

The flexible radiator mounts protect the radiator from damage normally caused by machine and/or engine vibration. When a radiator is removed for any repair, check the mounts, especially the condition of the rubber. If the rubber is deteriorated, install new mounts. Be sure the mounting bolts are tightened to the correct torque. See the appropriate Service Manual module.

Fan Guards

Vibration can damage fan guards. Make sure the bolts that hold the fan guards are tight at all times. If a guard wire is broken at an original weld joint, it can be tack welded into place. If a guard wire is broken, a new wire must be installed.

Water Temperature Regulators

There are no parts in the water temperature regulator that can be repaired. See the topic, "Test Water Temperature Regulators" on page 46.

Hoses and clamps

On machines where it is possible, turn the valves in the heater lines to the "OFF" position during summer

months so that there is no system pressure in the heater hoses. If one heater hose comes loose, all of the coolant can be lost if coolant flow is available to these hoses. Knowing the location of heater hoses is important because they must be checked often.

When you install hose clamps, do not tighten them too much. Tighten the clamp until it compresses the rubber coating on the hose. If the clamp tears the rubber coating, revealing the cords in the hose, it has been over tightened. Hoses are usually replaced when they have a leak or during a scheduled service interval. Remember, all hoses in the cooling system are made of similar material and operate in the same environment. So, if any one hose starts to leak, replace all of the hoses. If a scheduled service interval is used, change hoses every three years or 4000 hours.

It is difficult to check the condition of a hose because all hose coverings are painted and it is normal for paint to flake, check, and crack. As pressure in a cooling system increases, the hoses expand, causing the paint to check. The exterior appearance of the hose is not a good indication of wear. The "feel" of the hose is a good indication of wear. When the temperature of the cooling system is cold and the pressure in the system is released, the hose will need to be replaced if it feels soft. Softness of the hose may be due to a number of factors. If a radiator or cooling system has had oil in it, the inner liner of the hose will soften. The hose will also feel soft if it is very old and the inner liner has loosened from the fabric. A loose inner liner can fold down into a water passage on the suction side of the water pump and restrict the flow of coolant. An inner liner folded into a water passage is not only rare, but because there is no external leakage, it is also difficult to find. Finding a loose liner is especially difficult if you are troubleshooting an overheating problem.

Temperature Gauges

There are two types of temperature gauges, electrical and mechanical. If there is a problem with an electric gauge, the temperature sending unit and the gauge must be checked separately. With the mechanical gauge, the bulb and tube are fastened to the gauge and must be checked as a unit. If you install a new mechanical gauge, make sure the tube is long enough for correct installation.

There are different types of mechanical gauges and their red ranges are different. The red range is 108°C (227°F) for most gauges and 99°C (210°F) for highway trucks. The red range for most transmission temperature gauges is 132°C (270°F). The part number is different on each gauge because of the difference in the length of the tube to the bulb.

Later model machines have EMS panels. On these machines, the high coolant temperature light will come on at a temperature of 107°C (225°F).

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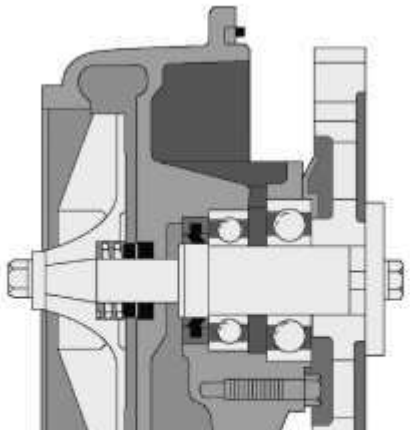

Illustration 52 g02143649

Water pump.

Water Pump

The need for water pump repair is generally the result of seal leakage. All water pumps have a drain cavity in the pump housing. The cavity will direct water leakage to the ground. If this cavity is closed, the water will be pushed past the oil seal on the shaft, allowing the water to get into the engine oil system. This will cause damage to the engine.

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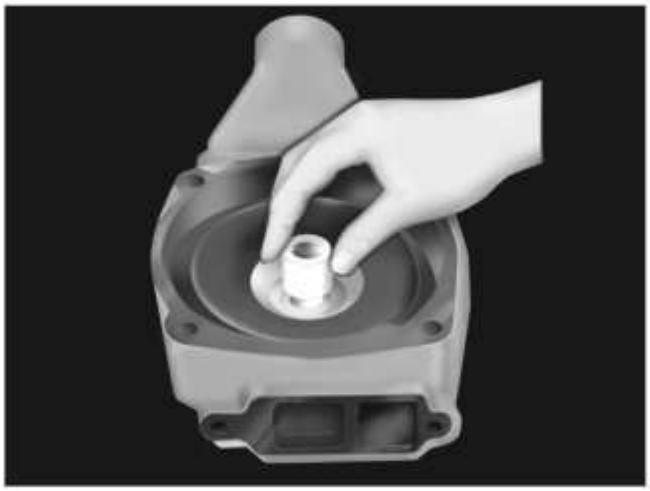

Illustration 53 g02143651

Use a special tool to install the seal assembly.

Seal assemblers are available for all water pumps. Some seal assemblers come with a small tool that is used to install the seal and ring correctly. Clean water, used as a lubricant, will make the installation of the seal easier. Never use oil as a lubricant. Oil can make the seal swell or soften or cause it to turn on the shaft.

The bearings in the water pump can be replaced when the pump is reconditioned. The impeller, shaft, and cover can be used again, unless there was a bearing failure and the pump has operated for some period of time. Most of the time the impeller wears into the cover when there is a bearing failure.

Note: When reconditioning a water pump, make sure the shaft is clean before any seals are installed. Rust or scale can tear the seal. Do not use a hammer to install the impeller. A hammer will crack the seal face. Use a press or a retaining bolt to pull the seal in position on the shaft.

Note: When installing a new water pump, put a small amount of oil on the bearings. Do not start or turn over an engine unless the cooling system is filled with coolant. If the water pump is operated in a dry condition, seal failure will result from overheating.

Note: If a cooling system has been flushed, check the condition of the water pump closely for approximately one week. Many times, a seal failure will result soon after the cooling system has been flushed. This is because the loose rust and scale, which is purged by the cleaning process, goes through the pump seal area.

Cylinder Heads

Normally, cylinder head repair is needed because of leaks or cracks. A defect in a core plug (freeze plug) in the top deck of the cylinder head can cause a leak. If there is a leak in this area, water spots will be visible in the plug recess. The old plug must be removed, the hole for the plug cleaned and a new plug installed. Make sure to put a sealant on the new plug before installation.

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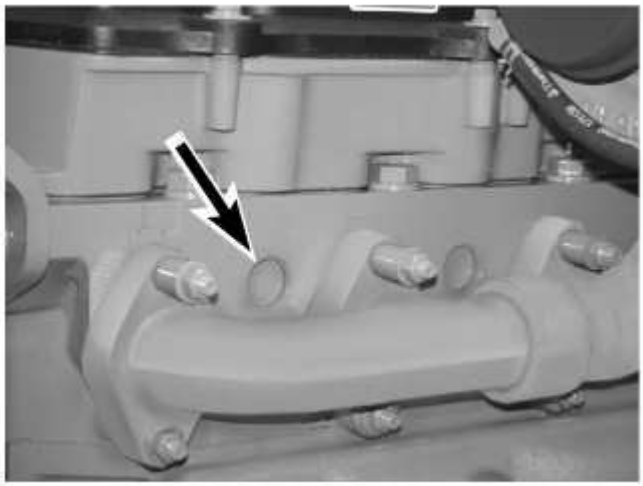

Illustration 54 g02143653

Freeze plug in cylinder head.

Cracks in a cylinder head are generally found between valve ports. Cracks can also be found at precombustion chamber or nozzle openings to a valve port. Cracks in a cylinder head can be repaired by a remanufacturing welding process. Remanufactured cylinder heads are available from the Caterpillar Parts Distribution System.

Before installing a new precombustion chamber in a cylinder head, check the precombustion chamber gasket surface in the head for pits or rust. If there are pits or rust, a new precombustion chamber will not seal correctly.

If you remove a precombustion chamber from a cylinder head, install a new O-ring seal on the precombustion chamber before it is used again in the head. O-ring seals can harden and break. If there is a leak in the area around the seal, overheating will result, especially if scale prevents heat transfer from the body of the precombustion chamber. Also, it is important that a new gasket is installed. This gasket helps

body of the precombustion chamber. Also, it is important that a new gasket is installed. This gasket helps make sure the hole for the glow plug is in the correct position. See the appropriate Service Manual module for the orientation of this hole.

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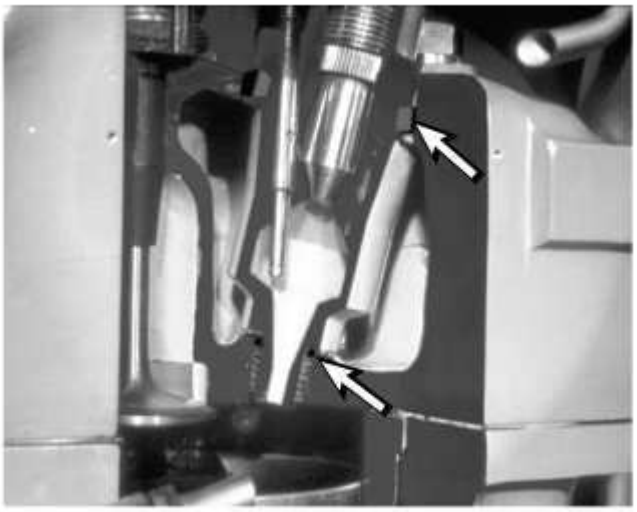

Illustration 55 g02143654

O-ring seals and gasket on precombustion chamber.

Cylinder Block

If an engine has been completely disassembled, check the condition of the cylinder block carefully.

Be sure to measure the depth of the counterbores for the cylinder liners. The thickness of the flange on the cylinder liner must be more than the depth of the. counterbore. See the appropriate Service Manual for the correct liner projection. If the liner projection is not correct, there will be insufficient compression on the cylinder head gasket. If the counterbore has been damaged by a loose cylinder head, a fretting pattern will be visible on the ledge of the counterbore. The block can be reconditioned with a counterboring tool and the use of inserts under the flange of the cylinder liner. These inserts are available from the Caterpillar Parts Distribution System.

If the deck surface of a cylinder block is damaged, consult the factory for information as to how much stock can be removed from the block. If the block is ground, the clearance will decrease between the valves and the top of the pistons at top dead center of crankshaft rotation for that cylinder.

Cylinder Liners

Check the condition of the cylinder liners. Look for fretting on the flange and any pits and scale on the water side of the liner. If there are pits in the liner, turn the liner 90° from its original position during reinstallation in the, cylinder block. Put liquid soap on the lower seals of the liner before installation. Do not use ethylene glycol on these seals because some of it may drain down to the oil pan and give a positive antifreeze reaction in an S·0·S Services oil analysis test. Put mineral oil or crankcase oil on the upper seal in the liner. Install the seal immediately. The mineral oil or crankcase oil will cause the seal to swell. Normal wear dimensions for the different types of cylinder liners can be found in the Service Manual

wear dimensions for the different types of cylinder liners can be found in the Service Manual.

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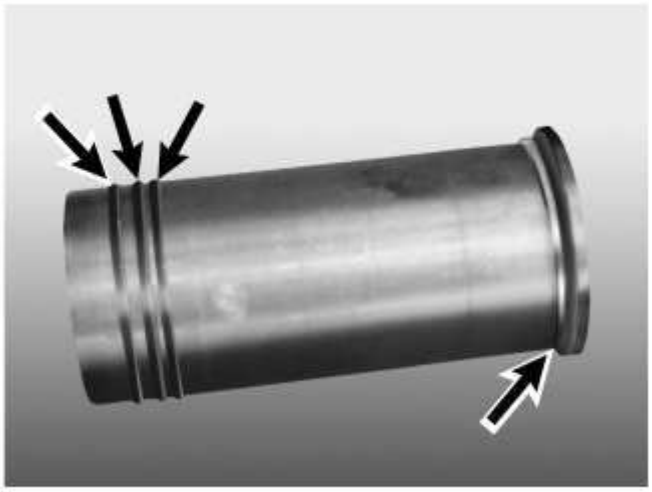

Illustration 56 g02143659

Filler band and O-ring seals on cylinder liner.

Test Equipment

Troubleshooting and analyzing cooling system conditions can be easier with the right test equipment.

See pages 62-69 for cooling system troubleshooting and analyzing tools available from the Caterpillar Parts Distribution System.

Cooling System Maintenance Products

Cat ELC (Extended Life Coolant)

Ver imagen

Illustration 57 g02143663

101-2844 Cat ELC (1 gal).

Developed, tested, and approved by Caterpillar, Cat ELC lasts up to six times as long as conventional coolant. Cat ELC requires no supplemental coolant additives (SCA's); instead, Cat ELC Extender is added once, at 6000 service hours or one half of the service life. Cat ELC is the coolant used as standard factory fill worldwide for all Caterpillar machines. Cat ELC can be used in all Cat and most OEM diesel and gasoline engines.

See page 18 for available quantities and part numbers.

Supplemental Coolant Additive

Ver imagen

Illustration 58 g02143666

Cat SCA (Supplemental Coolant Additive).

Cat SCA helps prevent rust, mineral and deposit formation in the cooling system. Cat SCA helps protect all metals, including aluminum. Cat SCA does not affect gaskets or hoses and is compatible with glycol-base antifreeze.

See page 24 for available quantities and part numbers.

Supplemental Coolant Additive Elements

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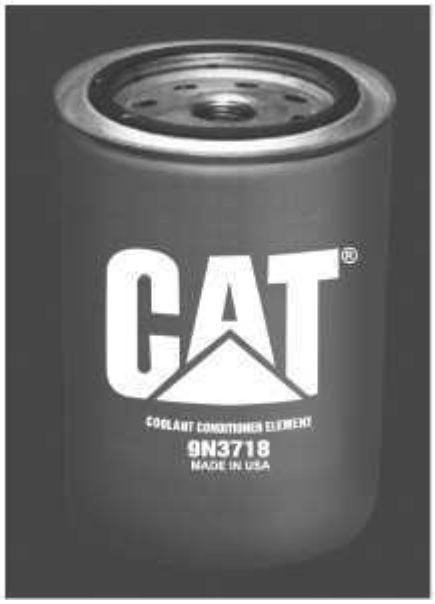

Illustration 59 g02143668

9N3718 Caterpillar Conditioner Element.

Spin-on supplemental coolant additive elements contain a pre-measured amount of chemical coolant additives that dissolve during engine operation. The elements can be used year-round to help prevent cavitation, corrosion, and erosion. Elements are available for most Cat diesel engines. To avoid over-concentration, never use supplemental coolant additive elements and liquid supplemental coolant additive simultaneously. Never use supplemental coolant additive elements with Cat ELC.

See page 24 for available quantities and part numbers.

Antifreeze

Ver imagen

Illustration 60 g02143669

8C-3684 Cat DEAC (Diesel Engine Antifreeze/Coolant) (1 gal).

Cat DEAC is specially formulated for use in diesel cooling systems. Cat DEAC helps protect against cylinder liner and block pitting and helps prevent corrosion. Cat DEAC does not require supplemental coolant additive at initial fill. See page 18 for available quantities and part numbers.

Cooling System Cleaners

Ver imagen

Illustration 61 g02143670

6V4511 Cooling System Cleaner - Standard (1/2 gal).

Caterpillar Cooling System Cleaner - Standard is designed to clean the system of harmful scale and corrosion without taking the engine out of service. Caterpillar Cooling System Cleaner - Standard can be used in all Caterpillar engines' and other manufacturers' cooling systems in any application.

Caterpillar Cooling System Cleaners, both "standard" and "Quick Flush," must not be used in systems that have been neglected or have heavy scale buildup. These systems require a stronger commercial solvent available from local distributors.

Caterpillars Cooling System Cleaner 1.9 liters (1/2 gallon) - Standard is available (Part No. 6V-4511) in

containers or, if an immediate cleaning is desired, the following Caterpillar Cooling System Cleaners can be used:

- 4C4609: 0.236 L (1 pint)
- 4C4610: 1,980 L (1 quart)
- 4C4611: 3.780 L (1 gallon)
- 4C4612: 18.90 L (5 gallon)
- 4C4613: 208 L (55 gallon drum)

Refer to label for cleaning instructions.

NOTICE

Use of commercially available cooling system cleaners may cause damage to the aluminum components in the cooling system. Use only cleaners that are approved for use with aluminum.

Coolant Sampling Tools

Fluid Sampling Bottle Kit (169-8373)

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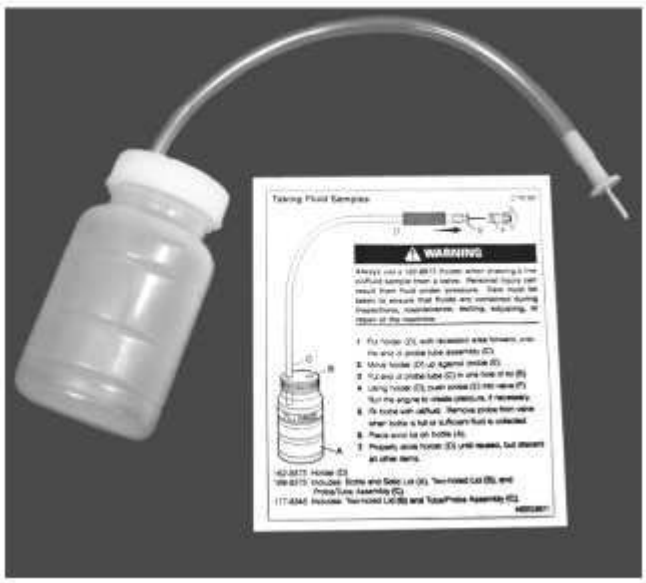

Illustration 62 g02143679

Sampling Bottle with Cap and Probe

Sampling Bottle with Cap and Probe.

The 169-8373 Fluid Sampling Bottle Kit provides a 118 ml (4 oz) sampling bottle attached to the 177-9343 Cap and Probe Group. There are 300 bottle kits to a box.

The 177-9343 Fluid Sampling Cap and Probe Group can be ordered without a bottle attached. There are 500 cap and probe groups in a box. Both the kit and the group have a metal tipped probe with a plastic housing and 317 mm (12.5 in) of tubing attached. The probe is for use with systems that have self-sealing probe adapters installed. This probe allows taking samples from the cooling system without first cooling down and opening the system. The probe and cap are a single use, disposable system.

There are two sizes of sampling bottles with caps available. The 169-7372 Fluid Sampling Bottle Assembly holds 118 ml (4 oz.). The 169-7373 Fluid Sampling Bottle Assembly holds 74 ml (2.5 oz.). Both bottle assemblies are packaged 200 to a box.

Vacuum Pump (1U-5718)

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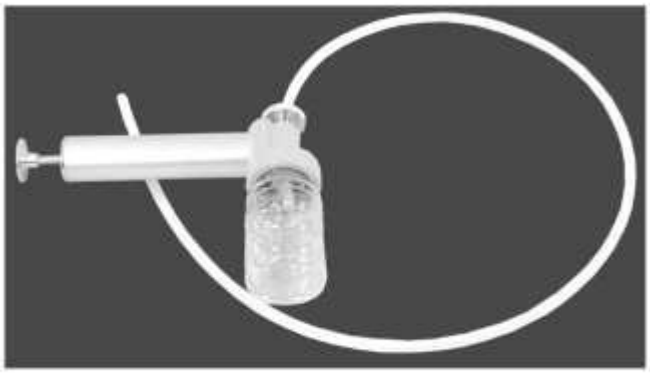


Illustration 63 g02143682

Vacuum Pump with Bottle Attached.

The 1U-5718 Vacuum Pumps is used for taking samples for analysis when live sampling under pressure with a probe is not available. The 30.5 m (100 ft) roll of 4C4056 Plastic Tubing is used with the vacuum pump after cutting to the required length for sampling. The plastic bottle assemblies from the previous article are used with this vacuum pump to contain and ship the samples.

Probe Adapter Groups (5P-2720, 5P-2725, and 5P- 3591)

Ver imagen

Illustration 64 g02143683

Self-sealing Probe Adapter Groups.

These self-sealing probe adapters allow one to use sampling probes, temperature probes, and pressure probes in the cooling system without first cooling down and opening the system. The adapters automatically seal when the probes are removed. Use the probe adapters to make a cooling test faster and easier. The probe adapters can be used in any cooling system with pressures up to 690 kPa (100 psi) and temperatures up to 120°C (250°F). The 5P-2720 Probe Adapter Gp has 1/8 inch pipe threads. The 5P-2725 Probe Seal Adapter has 1/4 inch pipe threads. The 5P-3591 Probe Adapter Gp has 9/16-18 threads.

Coolant Condition Test Tools

Cat ELC Dilution Test Kit (223-9116)

Ver imagen

Illustration 65 g02143686

Cat ELC Test Kit.

This simple pass/fail 223-9116 Cat ELC Dilution Test Kit indicates, by color, if the inhibitor level of the coolant is correct. All new Caterpillar machines are shipped with Cat ELC in the cooling system. This kit contains enough material for ten tests. Complete instructions for performing the test and interpreting the results are enclosed within the kit. This kit has been cancelled.

Note: When the inventory of these kits is exhausted, they will not be restocked.

Coolant Condition and Ethylene Glycol Test Kit (8T-5296)

Ver imagen

Illustration 66 g02143688

Cat SCA and Ethylene Glycol Test Kit.

This test kit accurately measures the concentration of Cat SCA and ethylene glycol in your coolant. The kit helps monitor Cat SCA and ethylene glycol concentrations to ensure proper protection of the cooling system. The test can be performed in only minutes. The kits contain material for approximately 30 tests.

Note: The Cat SCA and ethylene glycol test kit checks for the concentration of nitrites in the coolant. Some other brands of supplemental coolant additives are based on phosphate inhibitors and the test kit will yield readings that are inaccurate. If another supplemental coolant additive is used, refer to the manufacturer for an appropriate test kit.

Coolant Condition Test Kit (4C-9301)

Ver imagen

Illustration 67 g02143690

Nitrite Concentration Test Kit.

This kit gives quick results for systems that use nitrite. The kit can be used with Caterpillar liquid cooling system conditioners. The kit contains material for 100 tests.

Coolant/Battery Tester (245-5829)

Ver imagen

Illustration 68 g02143714

Portable Refractometer Freezing Point Tester.

The 245-5829 Refractometer measures the freezing points of both ethylene glycol coolant and propylene glycol coolant. The refractometer also measures the specific gravity of battery acid in order to determine the condition of a battery's charge.

The technician simply applies two or three drops of the coolant or the acid in the refractometer. The refractometer displays in degrees Celsius. The refractometer also displays in degrees Fahrenheit. The prism and lens design with a focus adjustment provides ease of operation for the technician. The design includes automatic temperature compensation features in order to deliver accurate results.

A carrying case and a calibration screwdriver are included with the refractometer.

Temperature Testing Tools

Infrared Thermometer (164-3310)

Ver imagen

Illustration 69 g02143716

High Temperature Scale Infrared Thermometer.

The 164-3310 Infrared Thermometer is rugged and easy to operate. This thermometer is ideal for determining the temperature of objects that are out of reach, too hot to touch, or continuously moving. The measure range is -30° to 900°C (-24° to 1600°F). This thermometer is powered by 2 AA cell batteries. 110 VAC and 220 VAC models are also available.

Infrared Thermometer (213-4310)

Ver imagen

Illustration 70 g02143717

Caterpillar Non-Contact Infrared Thermometer.

The 213-4310 Infrared Thermometer with a built-in laser pointer is convenient, reliable, and easy to use. Just point, shoot, and read the temperature instantly on the backlit display. The temperature measurement range is -20° to 260°C (-4° to 500°F) ±1°F/C.

Additional uses beyond testing engine cooling systems could include determining undercarriage component temperature, checking brake and bearing temperatures, verifying heating and air conditioning systems, and determining defrost grid temperatures.

Multimeter with Infrared Thermometer (237-5130)

Ver imagen

Illustration 71 g02143718

Caterpillar Digital Multimeter with Built-in Infrared Thermometer.

The 237-5130 Digital Multimeter Group has a built-in laser pointer and a type-K thermocouple included. The temperature range of the infrared thermometer is -20° to 270°C (-4° to 518°F). The temperature range of the thermocouple is -20° to 750°C (-4° to 1382°F). The multimeter group with included leads, also measures true root mean square (RMS) AC voltage, DC voltage, current, resistance, capacitance, frequency, duty cycles, and temperature for display on the backlit display.

Digital Thermometer Group (4C-6500)

Ver imagen

Illustration 72 g02143719

Five Channel Digital Thermometer Group.

The 4C-6500 Digital Thermometer Group is a portable tool with five channels for measuring temperatures. This tool will calculate the differential temperature between any 2 of the 5 channels. The range of temperature is from -50°C to 850°C (-58°F to 1582°F). The group includes 3 probes, ranging from 25.4 mm (1") to 63.5 mm (2.5 in.) in length. The probes are designed for use with included Probe Seal adapters and the 4 included 20 foot cable assemblies. One high temperature and one exhaust probe is also included in the foam insert in the carrying case. Additional probes are available for use with the digital thermometer.

Thermocouple Temperature Adapter (6V-9130)

Ver imagen

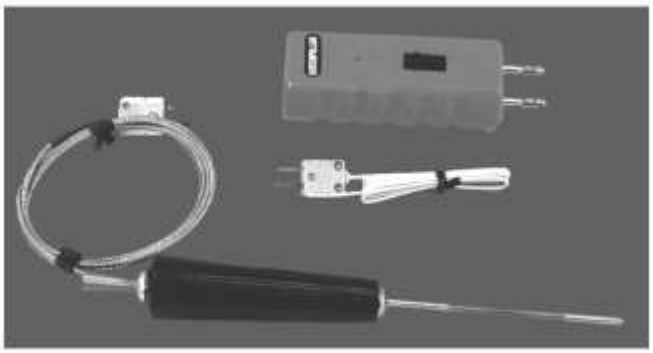


Illustration 73 g02143722

Temperature Adapter for Digital Multimeters.

The 6V-9130 Thermocouple Temperature Adapter is available for use with most digital multimeters. The ranges are from -46° to 900°C (-50° to 1,652°F). Probes available include a hand probe, wire, immersion, and exhaust probe.

Recorder Group (8T-2844)

Ver imagen

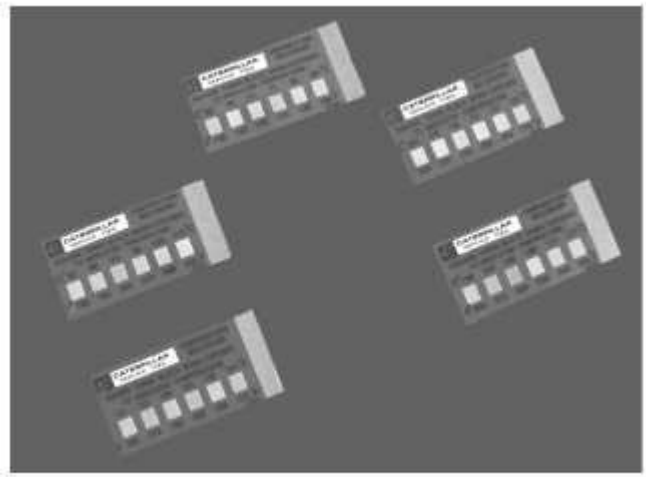


Illustration 74 g02143724

Adhesive cards for Varied Temperature Ranges.

The 8T-2844 Recorder Group group contains temperature recorders in order to check five different ranges of temperatures. Each card is used for a specific temperature range. The cards have adhesive backs. Attach a card to any clean dry surface. Remove the card and keep the card as a permanent record.

Thermometers (5N-4562, 9U-5325, 6H3050, and 2F-7112)

Ver imagen

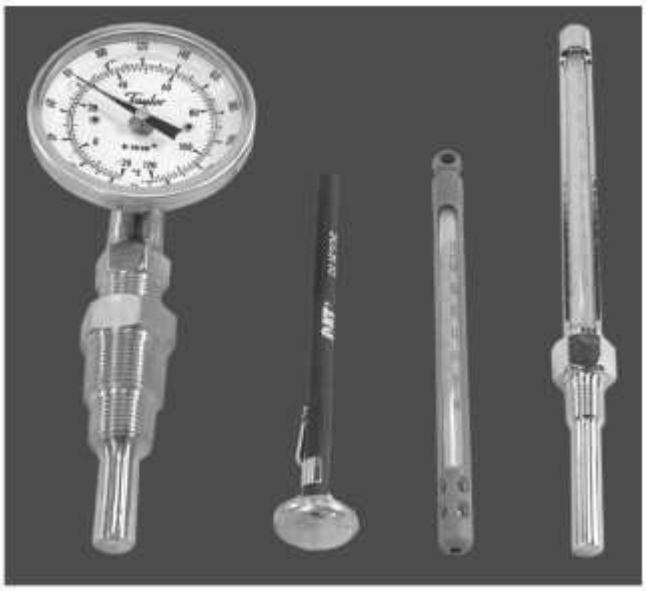


Illustration 75 g02143727

Selection of Thermometers Available.

These thermometers check coolant temperature and accuracy of the coolant temperature gauge. The 2F-7112 Thermometer can be installed in a hole with 1/4 inch pipe threads. The 5N-4562 Thermometer can be installed in a hole with 1/2-14 NPTFs threads or 3/4-14 NPTF threads.

Air Flow Test Tools

Multitach II Tool Group (9U-7400)

Ver imagen

Illustration 76 g02143728

Multitach to Check Fan and Engine Speed.

The 9U-7400 Multitach II Tool Group contains a LED Photo Pickup and several tachometer adapters for use with the included tachometer generator. A battery charger is included for the required AA batteries. A 9U-7402 Multitach II Tool Group that contains only the LED Photo Pickup is also available.

Blowby/Air Flow Indicator (8T-2700)

Ver imagen

Illustration 77 g02143729

Indicator for Checking for Plugged Radiator.

The 8T-2700 Blowby/Air Flow Indicator Group contains a hand-held digital indicator, a remote mounted pickup, 915 mm (36 inch) of cable, a blowby hose, and the necessary connectors. This indicator can measure the volume of the blowby gases that are coming out of the crankcase breather. Also, the indicator

can measure the air velocity through the radiator. The indicator will check if the air flow through the radiator is within specifications. Use the indicator to check the different areas of the core and determine if any of the areas in the core are plugged.

Pressure Test Tools

Pressurizing Pump (9S-8140)

Ver imagen

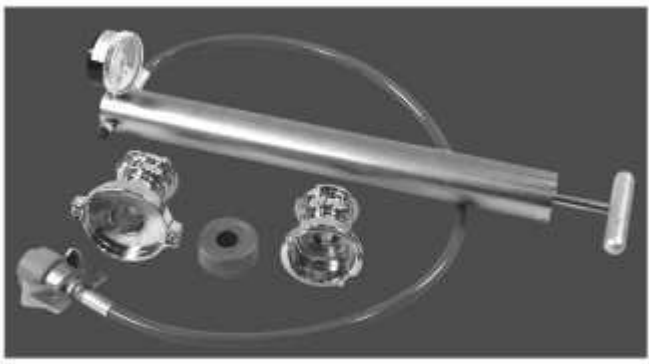


Illustration 78 g02143743

Pump for Pressurizing Cooling Systems.

The 9S-8140 Pressurizing Pump is designed to put pressure into the cooling system in order to test for leaks. The pressurizing pump can also be used to test the pressure relief valve and pressure gauges.

Pressure Probe (164-2192)

Ver imagen

Illustration 79 g02143745

Pressure Gauge Probe Adapter.

to check the coolant pressure at the water pump inlet or at the water pump outlet. The probe can be installed in a 1/8 inch pipe threaded hole or the probe can be installed in any of the probe adapters that were mentioned on page 65.

Pressure Gauge (6V-7830)

Ver imagen

Illustration 80 g02143747

Tetragauge Group.

The 6V-7830 Tetragauge Group is a general purpose pressure gauge. The gauge can be used to measure pressure from -100 kPa (-15 psi) to 40000 kPa (5800 psi).

Digital Pressure Indicator (198-4240)

Ver imagen

Illustration 81 g02143749

Digital Pressure Indicator for Remote Reading.

The 198-4240 Digital Pressure Indicator is a microprocessor based device that reads vacuum, pressure, differential pressure, and temperature. The indicator uses sensors and cables to remotely measure systems that are under pressure.

Engine Pressure Group (1U-5470)

Ver imagen

Illustration 82 g02143750

Illustration 82 g02143750

Digital Pressure Indicator for Remote Reading.

The 1U-5470 Engine Pressure Group is used to check the performance of turbocharged diesel and natural gas engines. With the optional 1U-5554 Panel and 8T-0840 Pressure Gauge, operating adjustments to naturally aspirated gas engines can be made.

Leak Detection Tool

Ultraviolet Lamp Group (1U-5566 [10 VAC] and 1U-6444 [220 VAC])

Ver imagen

Illustration 83 g02143752

Tooling for Leak Detection.

Use the 1U-5566 Ultraviolet Lamp Gp (110 Volt) and 1U-6444 Ultraviolet Lamp Gp (220 Volt) ultraviolet lights to detect leaks. The following additives help detect leaks in the cooling system: 1U-5576 Additive (1 oz) and 1U-5577 Additive (0.473 L [1 pint]).

Attachments

All machines and engines have some attachments for the cooling system. A few of the attachments described here are used exclusively on earthmoving machinery. Others can be used on all engines. Attachments for specific models are shown in the appropriate Parts Book.

Hood and Engine Enclosures

In certain applications, such as logging, land clearing, or sanitary landfilling, loose material in the engine

compartment can be a problem. Loose material can plug the radiator core, which make frequent cleaning of the radiator necessary. If the radiator is not cleaned, overheating will result. One way to reduce the problem is to use hood and side panels that are perforated. These perforated panels can extend the cleaning intervals and/or service life of the radiator by permitting air to flow to or from the radiator while preventing entry of loose material into the engine compartment.

Ver imagen

Illustration 84 g02143754

Perforated Hood and Engine Side Enclosures.

Abrasion Resistant Grid for Radiators and Ejectortype Fans

In applications where there is blowing sand or abrasive material kicked up by the machine, sandblasting can be a problem. Sandblasting is the erosion of radiator tubes and fins by fine particles. This normally only occurs with blower fans. After a period of time, sandblasting can cause coolant leaks.

The abrasion resistant grid deflects and slows the particles so they pass through the radiator without wearing the tubes or fins. This will give the radiator a longer service life.

An ejector-type blower fan will also lessen sandblasting problems. The ejector fan has the back edge of its blades bent around into a hook shape. This makes a channel along the back of each blade which takes most of the debris out of the air flow and discharges it radially.

In applications where sandblasting is not a problem, use of the abrasion resistant grid is not recommended. However, larger loose particles may yet lodge between the grid and radiator and make frequent cleaning of the radiator necessary.

Ver imagen

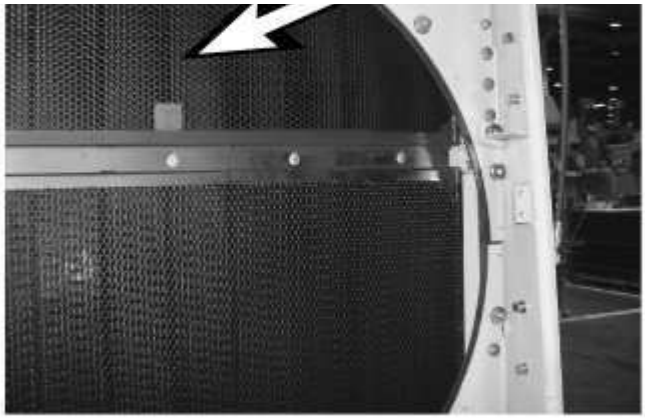


Illustration 85 g02143757

Abrasion Resistant Grid.

Crankcase Guards

Although crankcase guards are not a cooling system attachment, they can have a positive or negative effect on the cooling system. The crankcase guard will decrease the amount of loose material that enters the engine compartment. On machines with blower fans, this can decrease radiator core plugging or sandblasting. In logging, land clearing, or sanitary landfilling applications, the additions of screens over the openings in and around the crankcase guard will further decrease the entry of loose material into the engine compartment.

Normally, some of the heat in the engine transmission and torque converter is transferred directly to the air that flows around these components. Mud, dirt, or other material that becomes packed in and around the crankcase guard will act as an insulating material and prevent heat transfer to the air. This will cause the engine, transmission and torque converter oil temperatures to rise and, in some conditions, cause coolant overheating.

Ver imagen

Illustration 86 g02143759

Crankcase Guards.

Reversible Fan

A reversible fan makes it possible to change from a suction to a blower fan or vice-versa very easily. Some reversible fans automatically reverse every few minutes to blow or suck out debris that may get lodged in the radiator.

Ver imagen

Illustration 87 g02143760

Reversible Fan.

Hinged Radiator Guard

A hinged radiator guard permits easy access to the front of the radiator. This makes it easy to inspect and thoroughly clean the radiator without removing the heavy guards.

Ver imagen

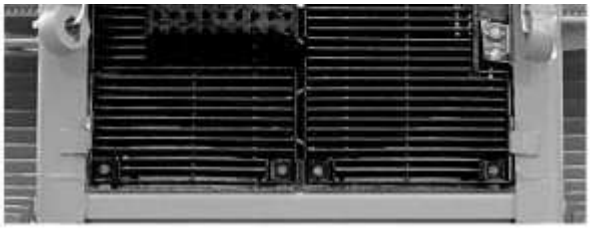


Illustration 88 g02143761

Hinged Radiator Guard.

Coolant Flow Indicators

Coolant flow indicators are found on some machines. When there is a loss of coolant, the coolant flow indicator, which will be a horn and a light, will signal the operator to let him know there is a problem. Loss of coolant flow can be caused by low coolant level, water pump failure, sudden loss of coolant, broken fan belts or severe water pump cavitation.

Ver imagen

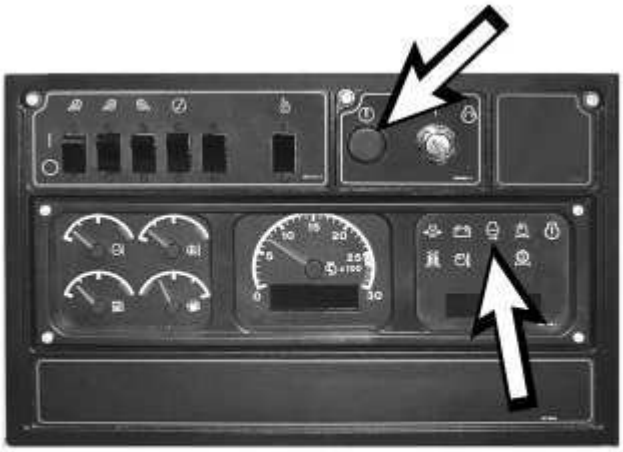


Illustration 89 g02143763

Coolant Flow Indicator.

Jacket Water Heater

Jacket water heaters have an electric heating element to keep the coolant warm in the engine. These heaters are required to start a cold engine in temperatures below -18°C (0°F). Jacket water heaters are also used on electric set engines that have automatic stop-start.

Summary

Cooling system maintenance is your responsibility. Extra time invested in caring for your cooling system

Cooling system maintenance is your responsibility. Extra time invested in caring for your cooling system can prolong engine life and lower operating costs.

The consequences of improper coolant selection and cooling system maintenance are evident. Coolant related failures and loss of efficiency directly affect your operation.

Selecting and maintaining the proper coolant helps your engine in the long run. Understanding coolant and its effects on your engine is crucial to an efficient operation.

Reference Material Available From Caterpillar

The following publications are available through your local Caterpillar dealer. Some publications may have a nominal charge.

Note: The information contained in the listed publications is subject to change without notice. Contact your local Caterpillar Dealer for the most up to date recommendations.

Note: Refer to this publication, the listed publications, the respective product data sheet, and to the appropriate Operation and Maintenance Manual for product application recommendations.

"Cold Weather Recommendations", SEBU5898

"Cooling System Fundamentals," LEKQ1475

"Oil And Your Engine," SEBD0640

"Diesel Fuels And Your Engine," SEBD0717

"Caterpillar Machine Fluids Recommendations," SEBU6250

"Know Your Track-type Tractor Cooling System," REHS1063

"Caterpillar Commercial Diesel Engine Fluids Recommendations," SEBU6251

"Caterpillar On-highway Diesel Truck Engine Fluids Recommendations," SEBU6385

"Data Sheet - Cat DEAC (Diesel Engine Antifreeze/Coolant)," PEHP9554

"Cat ELC (Extended Life Coolant) 222-9116 Dilution Test Kit," PELJ0176

"Label - ELC Radiator Label," PEEP5027

"Data Sheet - Cat ELC (Extended Life Coolant)," PEHJ0067

Standards Methods for the Examination of Water and Wastewater, 20th ed.

American Public Health Association, 800 I Street NW, Washington, D.C. 20001-3710 Phone - 201-777-2742

Annual Book of Standards for Section II, Volume 11.01

ASTM 100 Bar Harbor Drive Conshohocken, PA 19428 Phone - 610-832-9585

Cooling System - Check - Overheating

SMCS - 1350-535

Above normal coolant temperatures can be caused by many conditions. Use the following procedure to determine the cause of above normal coolant temperatures:

WARNING

Personal injury can result from escaping fluid under pressure.

If a pressure indication is shown on the indicator, push the release valve in order to relieve pressure before removing any hose from the radiator.

1. Check the coolant level in the cooling system. Refer to Operation and Maintenance Manual for more information on the coolant system. If the coolant level is too low, air will get into the cooling system. Air in the cooling system will cause a reduction in coolant flow and bubbles in the coolant. Air bubbles will keep coolant away from the engine parts, which will prevent the transfer of heat to the coolant. Low coolant level is caused by leaks or incorrectly filling the radiator.

2. Check the mixture of antifreeze and water. The mixture should be approximately 50 percent water and 50 percent antifreeze with 3 to 6 percent coolant conditioner. Refer to Operation and Maintenance Manual for more information on the correct coolant mixtures. If the coolant mixture is incorrect, drain the system. Put the correct mixture of water, antifreeze and coolant conditioner in the cooling system.

3. Check for air in the cooling system. Air can enter the cooling system in different ways. The most common causes of air in the cooling system are not filling the cooling system correctly and combustion gas leakage into the cooling system. Combustion gas can get into the system through inside cracks, a damaged cylinder head, or a damaged cylinder head gasket. Air in the cooling system causes a reduction in coolant flow and bubbles in the coolant. Air bubbles keep coolant away from the engine parts, which prevents the transfer of heat to the coolant.

4. Check the fan clutch, if equipped. A fan clutch or a hydraulic driven fan that is not turning at the correct speed can cause improper air speed across the radiator core. The lack of proper air flow across the radiator core can cause the coolant not to cool to the proper temperature differential.

5. Check the water temperature gauge. A water temperature gauge which does not work correctly will not show the correct temperature. Refer to Testing and Adjusting, "Cooling System - Inspect".

6. Check the sending unit. In some conditions, the temperature sensor in the engine sends signals to a sending unit. The sending unit converts these signals to an electrical impulse which is used by a mounted gauge. If the sending unit malfunctions, the gauge can show an incorrect reading. Also if the electric wire breaks or if the electric wire shorts out, the gauge can show an incorrect reading.

7. Check the radiator.

    a. Check the radiator for a restriction to coolant flow. Check the radiator for debris, dirt, or deposits on the inside of the radiator core. Debris, dirt, or deposits will restrict the flow of coolant through the radiator.

b. Check for debris or damage between the fins of the radiator core. Debris between the fins of the radiator core restricts air flow through the radiator core. Refer to Testing and Adjusting, "Cooling System - Inspect".

c. Ensure that the radiator size is adequate for the application. An undersized radiator does not have enough area for the effective release of heat. This may cause the engine to run at a temperature that is higher than normal. The normal temperature is dependent on the ambient temperature.

8. Check the filler cap. A pressure drop in the radiator can cause the boiling point to be lower. This can cause the cooling system to boil. Refer to Testing and Adjusting, "Cooling System - Test".

9. Check the fan and/or the fan shroud.

   a. The fan must be large enough to send air through most of the area of the radiator core. Ensure that the size of the fan and the position of the fan are adequate for the application.

   b. The fan shroud must be the proper size and the fan shroud must be positioned correctly. Ensure that the size of the fan shroud and the position of the fan shroud are adequate for the application.

10. If the fan is belt driven, check for loose drive belts. A loose fan drive belt will cause a reduction in the air flow across the radiator. Check the fan drive belt for proper belt tension. Adjust the tension of the fan drive belt, if necessary.

11. Check the cooling system hoses and clamps. Damaged hoses with leaks can normally be seen. Hoses that have no visual leaks can soften during operation. The soft areas of the hose can become kinked or crushed during operation. These areas of the hose can cause a restriction in the coolant flow. Hoses become soft and/or get cracks after a period of time. The inside of a hose can deteriorate, and the loose particles of the hose can cause a restriction of the coolant flow. Refer to Operation and Maintenance Manual for more information on inspection of hoses.

12. Check for a restriction in the air inlet system. A restriction of the air that is coming into the engine can cause high cylinder temperatures. High cylinder temperatures cause higher than normal temperatures in the cooling system. Refer to Testing and Adjusting, "Air Inlet and Exhaust System - Inspect".

    a. If the measured restriction is higher than the maximum permissible restriction, remove the foreign material from the engine air cleaner element or install a new engine air cleaner element. Refer to Operation and Maintenance Manual for more information on cleaning or replacing an engine air cleaner element.

    b. Check for a restriction in the air inlet system again.

    c. If the measured restriction is still higher than the maximum permissible restriction, check the air inlet piping for a restriction.

13. Check for a restriction in the exhaust system. A restriction of the air that is coming out of the engine can cause high cylinder temperatures.

    a. Make a visual inspection of the exhaust system. Check for damage to exhaust piping or for a damaged muffler. If no damage is found, check the exhaust system for a restriction. Refer to Testing and Adjusting, "Air Inlet and Exhaust System - Inspect".

Testing and Adjusting, "Air Inlet and Exhaust System - Inspect".

b. If the measured restriction is higher than the maximum permissible restriction, there is a restriction in the exhaust system. Repair the exhaust system, as required.

14. Check the shunt line, if the shunt system is used. The shunt line must be submerged in the expansion tank. A restriction of the shunt line from the radiator top tank to the engine water pump inlet will cause a reduction in water pump efficiency. A reduction in water pump efficiency will result in low coolant flow and overheating.

15. Check the water temperature regulator. A water temperature regulator that does not open, or a water temperature regulator that only opens part of the way can cause overheating. Refer to Testing and Adjusting, "Water Temperature Regulator - Test".

16. Check the water pump. A water pump with a damaged impeller does not pump enough coolant for correct engine cooling. Remove the water pump and check for damage to the impeller. Refer to Testing and Adjusting, "Water Pump - Test".

17. Check the air flow through the engine compartment. The air flow through the radiator comes out of the engine compartment. Ensure that the filters, air conditioner, and similar items are not installed in a way that prevents the free flow of air through the engine compartment.

18. Check the aftercooler (if equipped). Refer to Testing and Adjusting, "Aftercooler - Test".

19. Consider high outside temperatures. When outside temperatures are too high for the rating of the cooling system, there is not enough of a temperature difference between the outside air and coolant temperatures.

20. Consider high altitude operation. The cooling capacity of the cooling system goes down as the engine is operated at higher altitudes. A pressurized cooling system that is large enough to keep the coolant from boiling must be used.

21. The engine may be running in the lug condition. When the load that is applied to the engine is too large, the engine will run in the lug condition. When the engine is running in the lug condition, engine rpm does not increase with an increase of fuel. This lower engine rpm causes a reduction in air flow through the radiator. This lower engine rpm also causes a reduction in coolant flow through the system. This combination of less air and less coolant flow during high input of fuel will cause above normal heating.

Cooling System - Inspect

SMCS - 1350-040

Cooling systems that are not regularly inspected are the cause for increased engine temperatures. Make a visual inspection of the cooling system before any tests are performed.

WARNING

Personal injury can result from escaping fluid under pressure.

If a pressure indication is shown on the indicator, push the release valve in order to relieve pressure before removing any hose from the radiator.

1. Check the coolant level in the cooling system. Refer to Operation and Maintenance Manual for more information about the correct coolant levels for the engine.
2. Check the quality of the coolant. The coolant should have the following properties:
   - Color that is similar to new coolant
   - Odor that is similar to new coolant
   - Free from dirt and debris

   If the coolant does not have these properties, drain the system and flush the system. Refill the cooling system with the correct mixture of water, antifreeze, and coolant conditioner. Refer to Operation and Maintenance Manual for additional information on the correct coolant mixtures for the engine.
3. Look for leaks in the system.

   Note: A small amount of coolant leakage across the surface of the water pump seals is normal. This leakage is required in order to provide lubrication for this type of seal. A hole is provided in the water pump housing in order to allow this coolant/seal lubricant to drain from the pump housing. Intermittent leakage of small amounts of coolant from this hole is not an indication of water pump seal failure.
4. Ensure that the airflow through the radiator does not have a restriction. Look for bent core fins between the folded cores of the radiator. Also, look for debris between the folded cores of the radiator.
5. Inspect the drive belts for the fan.
6. Check for damage to the fan blades.
7. Look for air or combustion gas in the cooling system.
8. Inspect the filler cap, and check the surface that seals the filler cap. This surface must be clean.

Cooling System - Test

SMCS - 1350-040; 1350-081

This engine has a pressure type cooling system. A pressure type cooling system has two advantages. The cooling system can be operated in a safe manner at a temperature higher than the normal boiling point (steam) of water.

This type of system prevents cavitation in the water pump. Cavitation is the forming of low pressure bubbles in liquids that are caused by mechanical forces. A pressure type cooling system helps to prevent pockets of air from forming.

Ver imagen

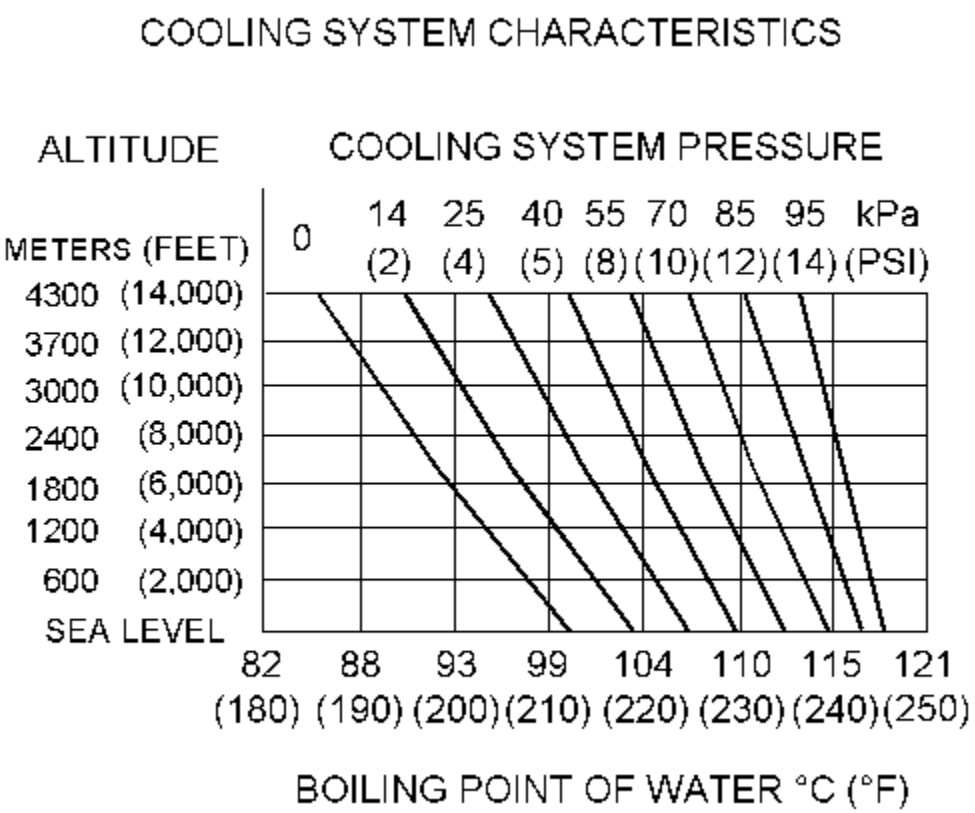


Illustration 1 g01106438

Effects of pressure on boiling point of a cooling system

Temperature and pressure work together. When a diagnosis is made of a cooling system problem, both temperature and pressure must be checked. Cooling system pressure will have an effect on the cooling system temperature. For an example, refer to Illustration 1. This will show the effect of pressure on the boiling point (steam) of water. This will also show the effect of height above sea level.

WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove filler cap slowly to relieve pressure only when engine is stopped and radiator cap is cool enough to touch with your bare hand.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes.

The coolant must be to the correct level in order to check the coolant system. The engine must be cold and the engine must not be running.

Slowly loosen the pressure cap in order to relieve the pressure out of the cooling system. Then remove the pressure cap.

The level of the coolant should not be more than 13 mm (0.5 inch) from the bottom of the filler pipe. If the cooling system is equipped with a sight glass, the coolant should be to the proper level in the sight glass.

Tools for Testing the Cooling System

Table 1

Tools Needed		
Part Number	**Part Name**	**Quantity**
4C-6500	Digital Thermometer	1
8T-2700	Blowby/Air Flow Indicator	1
9S-8140	Pressurizing Pump	1
9U-7400	Multitach Tool Group	1
245-5829	Coolant/Battery Tester Gp	1

WARNING

Making contact with a running engine can cause burns from hot parts and can cause injury from rotating parts.

When working on an engine that is running, avoid contact with hot parts and rotating parts.

Ver imagen

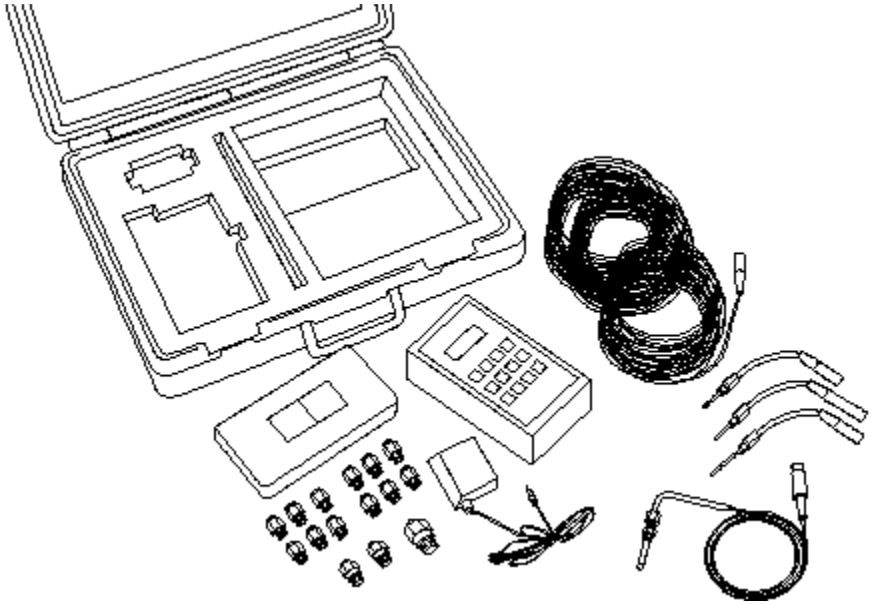


Illustration 2 g00876179

4C-6500 Digital Thermometer

The **4C-6500** Digital Thermometer is used for the diagnosis of overheating conditions and for the diagnosis of overcooling conditions. This group can be used to check temperatures in several different parts of the cooling system. Refer to the tool's Operating Manual for the testing procedures.

Ver imagen

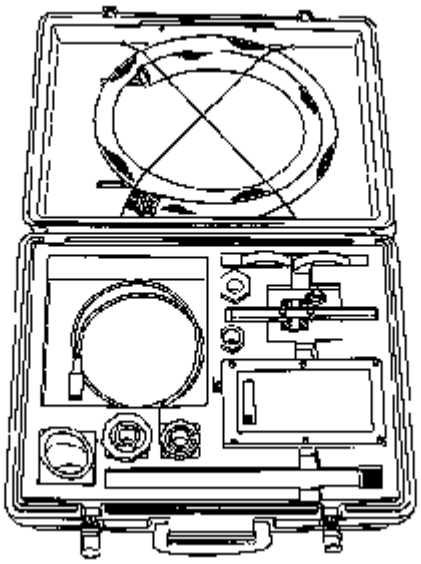


Illustration 3 g00286269

8T-2700 Blowby/Air Flow Indicator

The **8T-2700** Blowby/Air Flow Indicator is used to check the air flow through the radiator core. Refer to Special Instruction, SEHS8712, "Using the **8T-2700** Blowby/Air Flow Indicator " for the test procedure for checking the blowby of a cooling system's radiator.

Ver imagen

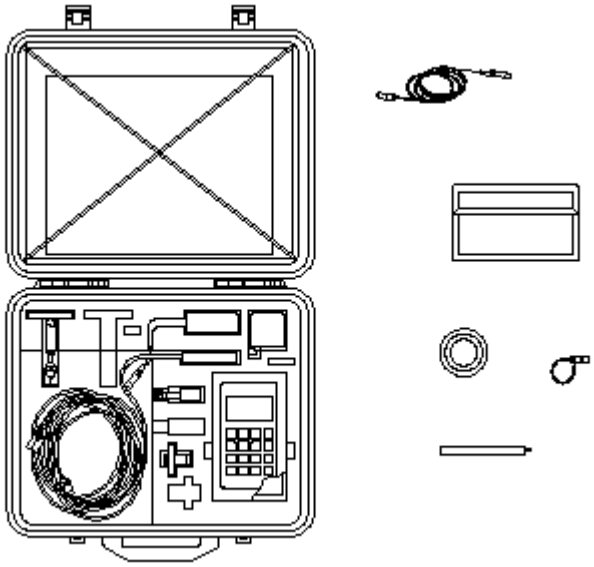


Illustration 4 g00286276

9U-7400 Multitach

The **9U-7400** Multitach Tool Group is used to check the fan speed for an engine. Refer to the tool's Operating Manual for the testing procedure.

Ver imagen

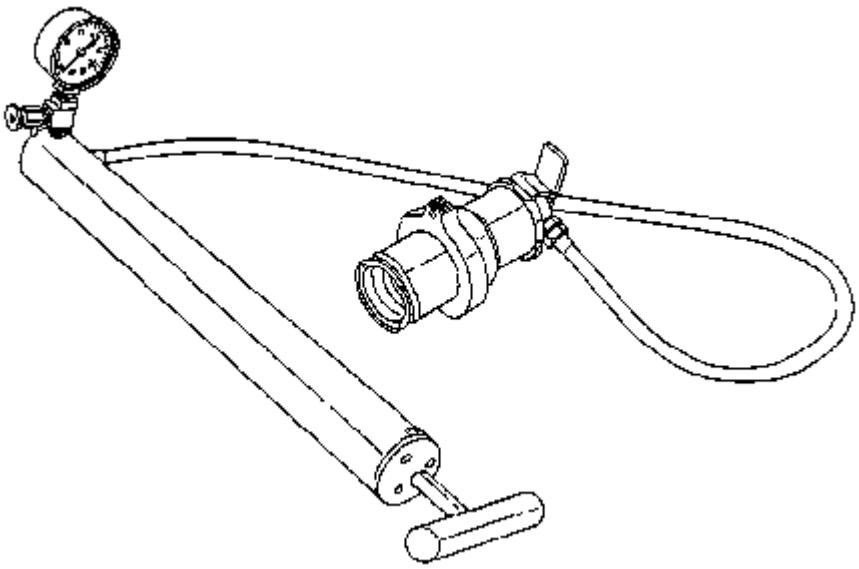


Illustration 5 g00286369

9S-8140 Pressurizing Pump

The **9S-8140** Pressurizing Pump is used to pressure test the radiator's filler cap. This pressurizing pump is

also used to pressure test the cooling system for leaks.

Check the coolant frequently in cold weather for the proper glycol concentration. Use the **245-5829** Coolant/Battery Tester Gp in order to ensure adequate freeze protection. The testers are identical except for the temperature scale. The testers give immediate, accurate readings. The testers can be used for antifreeze/coolants that contain ethylene or propylene glycol.

Test and Inspect the Filler Cap

Table 2

Tools Needed		
Part Number	**Part Name**	**Quantity**
9S-8140	Pressurizing Pump	1

One cause for a pressure loss in the cooling system can be a damaged seal on the radiator filler cap.

Ver imagen

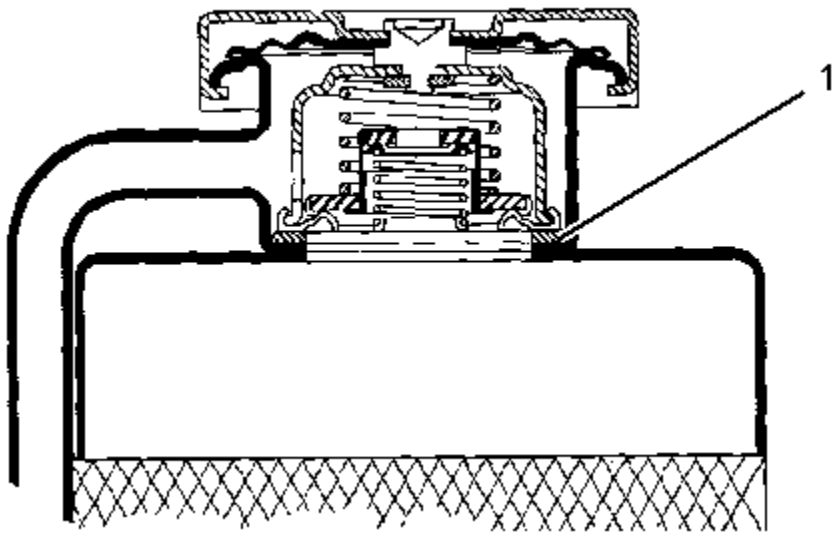


Illustration 6 g01096114

Cutaway view of a filler cap and radiator

(1) Sealing surface of both filler cap and radiator

WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns

steam. Any contact can cause severe burns.

Remove filler cap slowly to relieve pressure only when engine is stopped and radiator cap is cool enough to touch with your bare hand.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes.

To check for the amount of pressure that opens the filler cap, use the following procedure:

1. After the engine cools, carefully loosen the filler cap. Slowly release the pressure from the cooling system. Then, remove the filler cap.

   Carefully inspect the filler cap. Look for any damage to the seals and to the sealing surface. Inspect the following components for any foreign substances:

   - Filler cap
   - Seal
   - Surface for seal

   Remove any deposits that are found on these items, and remove any material that is found on these items.

2. Install the filler cap on the **9S-8140** Pressurizing Pump .
3. Look at the gauge for the exact pressure that opens the filler cap.
4. Compare the gauge reading with the opening pressure that is listed on the filler cap.
5. If the filler cap is damaged, replace the filler cap.

Test the Radiator and the Cooling System for Leaks

Table 3

Tools Needed		
Part Number	**Part Name**	**Quantity**
9S-8140	Pressurizing Pump	1

Use the following procedure in order to check the cooling system for leaks:

WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove filler cap slowly to relieve pressure only when engine is stopped and radiator cap is cool enough to touch with your bare hand.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes.

1. Ensure that the engine is cool. Loosen the filler cap slowly and allow pressure out of the cooling system. Then remove the filler cap from the radiator.
2. Ensure that the coolant level is above the top of the radiator core.
3. Install the **9S-8140** Pressurizing Pump onto the radiator.
4. Take the pressure reading on the gauge to 20 kPa (3 psi) more than the pressure on the filler cap.
5. Check the radiator for leakage on the outside.
6. Check all connection points for leakage, and check the hoses for leakage.

The following conditions exist if the cooling system does not have external leakage:

- You do not observe any outside leakage.
- The pressure reading on the cooling system remains steady after five minutes.

The following conditions exist if the cooling system has internal leakage:

- The pressure reading on the cooling system decreases in a five minute period.
- You do not observe any outside leakage.

Repair the cooling system, as required.

Test for the Water Temperature Gauge

Table 4

Tools Needed		
Part Number	**Part Name**	**Quantity**
4C-6500	Digital Thermometer	1

WARNING

Personal injury can result from escaping fluid under pressure.

If a pressure indication is shown on the indicator, push the release valve in order to relieve pressure before removing any hose from the radiator.

WARNING

Making contact with a running engine can cause burns from hot parts and can cause injury from rotating parts.

When working on an engine that is running, avoid contact with hot parts and rotating parts.

Check the accuracy of the water temperature indicator or water temperature sensor if you find either of the following conditions:

- The engine runs at a temperature that is too hot, but a normal temperature is indicated. A loss of coolant is found.
- The engine runs at a normal temperature, but a hot temperature is indicated. No loss of coolant is found.

Ver imagen

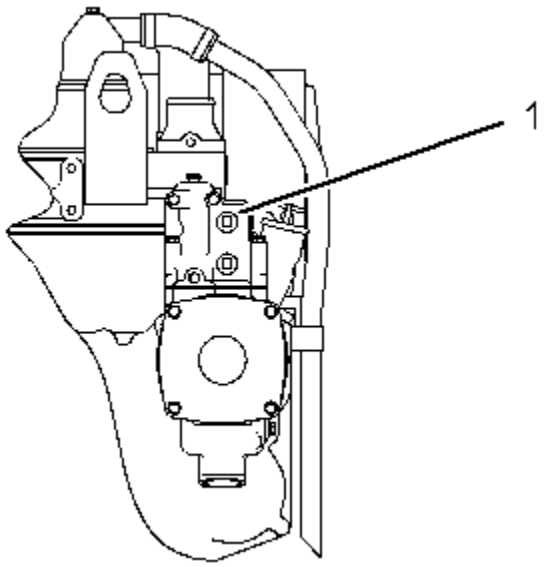


Illustration 7 g01110892

(1) Water manifold assembly

Remove a plug from water manifold assembly (1). Install the thermometer into the open port:

- The **4C-6500** Digital Thermometer

Any temperature indicator of known accuracy can also be used to make this check.

Start the engine. Run the engine until the temperature reaches the desired range according to the test thermometer. If necessary, place a cover over part of the radiator in order to cause a restriction of the air

flow. The reading on the temperature indicator should agree with the test thermometer within the tolerance range of the water temperature indicator.

Termostato - Probar

SMCS - 1355-081-ON ; 1355-081

ADVERTENCIA

El fluido que escapa a presión puede causar lesiones personales.

Si el medidor indica que hay presión, presione la válvula de alivio para aliviar la presión antes de quitar una manguera del radiador.

---

1. Quite el termostato del agua del motor.
2. Caliente el agua en un recipiente hasta que la temperatura del agua sea igual a la temperatura de apertura completa del termostato. Consulte la temperatura de apertura completa del termostato en Especificaciones, "Termostato de agua ". Agite el agua en el recipiente. De esta forma se conseguirá una temperatura uniforme en el mismo.
3. Suspenda el termostato en el recipiente de agua. El termostato tiene que estar por debajo de la superficie del agua. El termostato tiene que estar alejado de los lados y de la parte inferior del recipiente.
4. Mantenga el agua a la temperatura correcta durante diez minutos.
5. Después de diez minutos, saque el termostato. Mida inmediatamente la abertura del termostato. Consulte en Especificaciones, "Termostato de agua" la distancia mínima de apertura del termostato de agua a la temperatura de apertura completa.

Si la distancia es menor que la cantidad indicada en el manual, reemplace el termostato de agua.

Policy on Testing of Fuel Injectors and Fuel Nozzles {1251}

SMCS - 1251-081

Caterpillar Products:

- **All**

Do not use any off-engine diagnostic test on fuel injectors or fuel nozzles prior to installation of the injectors or nozzles. Caterpillar Fuel Systems Division does not recommend the use of any test equipment that is outside of the factory for field evaluation of injectors and nozzles prior to the installation of the injectors or nozzles.

The Marketing and Product Support Division supports the recommendation of the Fuel Systems Division.

Fuel Injectors

- The 6V-4022 Fuel Injector Tester was cancelled and replaced by components that were also cancelled or discontinued.
- The 1U-6661 Pop Tester Gp was discontinued.

The testers were rendered obsolete by increased injection pressures and by performance requirements for injectors. The inaccuracy of the testers' use with improved injectors resulted in replacement of good injectors. This caused warranty claims for injectors with no fault.

The service literature that was related to the testers has been removed from the Service Information System (SIS) and from Media Logistics. References to the testers and to the removed service literature have also been removed or the references are in the process of being removed.

The Marketing and Product Support Division will no longer accept any warranty claims on any injectors that are evaluated by the above testers or by any other commercial device that is used for the testing of injectors.

Fuel Nozzles

The 5P-4150 Nozzle Testing Group is used for the bench testing of fuel nozzles only after the nozzles have been tested in the engine and the performance of the nozzles are questionable.

The 5P-4150 Nozzle Testing Group is still serviceable.

Do not use the 5P-4150 Nozzle Testing Group with fuel injectors.

The Marketing and Product Support Division will no longer accept any warranty claims on any nozzles that are evaluated prior to being tested by engine operation.

The Pop (Injector) Tester Is not Available for Fuel Injectors {0782, 1251, 1254, 1290, 1713}

SMCS - 0782; 1251; 1254; 1290; 1713

Caterpillar Products:

- **All**

Engine News, SEBD9138, 01 August 1988, "New Pop (Injector) Tester Available for Fuel Injectors". Disregard the article. Refer to the information below.

The 1U-6661 Pop Tester Gp was cancelled and replaced by components that were also cancelled or discontinued. The tester was rendered obsolete by increased injection pressures and by performance requirements for injectors.

Do not use the 1U-6661 Pop Tester Gp to test unit fuel injectors.

Cambios en el uso y la limpieza del grupo de monitor de contaminación

SMCS - 0645; 0680; 1280; 1348; 3080; 429F; 5095

Productos Caterpillar:
- **Todos**

ReferenciaInstrucción Especial, SEBF9180, "Análisis de limpieza del combustible diesel con recuento automático de partículas"

El Grupo de Monitor de Contaminación 293-8413 puede utilizarse para analizar la limpieza del aceite del motor, el aceite hidráulico y determinados combustibles diesel. Se deben utilizar las nuevas instrucciones de limpieza y de uso.

En las instrucciones ahora se especifica que el Grupo de Monitor de Contaminación 293-8413 se debe utilizar para analizar únicamente los líquidos con un punto de encendido igual o superior a 55 °C (131 °F). Existe una remota posibilidad de que los líquidos con un punto de encendido inferior a 55 °C (131 °F) se enciendan en el Grupo de Monitor de Contaminación 293-8413.

Al purgar o limpiar el Grupo de Monitor de Contaminación 293-8413, use únicamente un aceite mineral o un combustible diesel. El aceite mineral y el combustible diesel deben tener un punto de encendido igual o superior a 55 °C (131 °F). En Europa, el combustible diesel que cumple con esta especificación se denomina combustible diesel No. 5. El nombre de este combustible diesel varía en todo el mundo.

El uso de agentes de limpieza que no cumplan con las nuevas instrucciones puede dañar el grupo de monitor de contaminación. Existe una remota posibilidad de que el Grupo de Monitor de Contaminación 293-8413 se encienda si se usan líquidos incorrectos.

No utilice el Probador de Inyectores de Combustible 6V-4022 para probar inyectores unitarios

SMCS - 0782; 1251; 1254; 1290; 1713

Tractores Agrícolas:
- **75 (N/S: 43Z1-Y SIG.)**

Retroexcavadoras Cargadoras:
- **446 (N/S: 2FG1-Y SIG.)**

Motor:
- **3116 (N/S: 7AG1-Y SIG.; 3RJ1-Y SIG.; 7HJ1-Y SIG.)**
- **3208 (N/S: 9WC1-Y SIG.; 5CD1-Y SIG.; 6SF1-Y SIG.; 99R1-Y SIG.; 90S1-Y SIG.; 62W1-Y SIG.; 93Z1-Y SIG.)**
- **3304 (N/S: 4XB1-Y SIG.)**
- **3304B (N/S: 2KK1-Y SIG.)**
- **3406B (N/S: 9PL1-Y SIG.)**
- **3412 (N/S: 7HG1-Y SIG.; 5RL1-Y SIG.)**
- **3508 (N/S: 8TL1-Y SIG.)**
- **3512 (N/S: 5EL1-Y SIG.; 6FL1-Y SIG.)**
- **3516 (N/S: 5MJ1-Y SIG.; 6CL1-Y SIG.; 7CL1-Y SIG.)**
- **3608 (N/S: 8LL1-Y SIG.)**

Excavadoras:
- **225 (N/S: 79V1-Y SIG.)**
- **5230 (N/S: 2PK1-Y SIG.)**
- **FB221 (N/S: 03Z1-Y SIG.)**
- **LL216 (N/S: 90N1-Y SIG.)**
- **996D (N/S: 2ZF1-Y SIG.; 90V1-Y SIG.; 4YD1-Y SIG.; 07Z1-Y SIG.; 09Z1-Y SIG.; 12Z1-Y SIG.; 1CK1-Y SIG.; 08Z1-Y SIG.; 10Z1-Y SIG.; 13Z1-Y SIG.)**

Portaherramientas Integrales:
- **IT18F (N/S: 97Z1-Y SIG.)**

Camiones de Obras/Tractores de Tiro:
- **784B (N/S: 4WJ1-Y SIG.)**
- **785 (N/S: 96Z1-Y SIG.)**

Cargadores de Cadenas:
- **931 (N/S: 45V1-Y SIG.)**
- **941B (N/S: 78P1-Y SIG.; 48V1-Y SIG.)**
- **943 (N/S: 10X1-Y SIG.)**
- **973C (N/S: 3LJ1-Y SIG.)**
- **983B (N/S: 70V1-Y SIG.)**

Tractores de Cadenas:
- **48 (N/S: 13E1-Y SIG.)**
- **D11N (N/S: 7YG1-Y SIG.; 4ZL1-Y SIG.; 99W1-Y SIG.)**
- **D4E (N/S: 59Z1-Y SIG.)**
- **D5 (N/S: 49V1-Y SIG.)**
- **D6D (N/S: 8TD1-Y SIG.)**
- **D7F (N/S: 03N1-Y SIG.)**
- **D7G (N/S: 91V1-Y SIG.; 92V1-Y SIG.; 62Z1-Y SIG.)**
- **D8K (N/S: 17S1-Y SIG.; 50V1-Y SIG.)**
- **D8L (N/S: 77M1-Y SIG.)**
- **D9H (N/S: 97V1-Y SIG.; 99V1-Y SIG.)**

Cargadores de Ruedas:
- **926E (N/S: 7YJ1-Y SIG.)**

928F (N/S: 4TF1-Y SIG.; 98Z1-Y SIG.)
930 (N/S: 9CB1-Y SIG.; 46V1-Y SIG.)
966C (N/S: 47V1-Y SIG.)
966R (N/S: 1AF1-Y SIG.; 60Z1-Y SIG.)
980C (N/S: 11N1-Y SIG.; 81Y1-Y SIG.)
988 (N/S: 52K1-Y SIG.)
988B (N/S: 48W1-Y SIG.)
992B (N/S: 98S1-Y SIG.)
992C (N/S: 73W1-Y SIG.)
994 (N/S: 54Z1-Y SIG.)

Arrastradores de Troncos de Ruedas:

528 (N/S: 67V1-Y SIG.)

Mototraíllas:

660 (N/S: 73X1-Y SIG.)

Service Magazine, SSBD1234, 13 septiembre 1982, "Están disponibles dos grupos de bomba de cebado eléctrica para ser utilizados con el Probador **6V-4022**". No tenga en cuenta este artículo. Vea la información a continuación.

El Probador de Inyectores de Combustible 6V-4022 fue cancelado y reemplazado por componentes que también fueron cancelados o descontinuados. El probador quedó obsoleto por el aumento de las presiones de inyección y por los requisitos de rendimiento de los inyectores.

No utilice el Probador de Inyectores de Combustible 6V-4022 para probar inyectores unitarios.

Política sobre las pruebas de los inyectores y las boquillas de combustible

SMCS - 1251-081

Productos Caterpillar:
- **Todos**

No utilice ninguna prueba de diagnóstico fuera de motor en los inyectores o las boquillas de combustible antes de instalar dichas piezas. La División de Sistemas de Combustible de Caterpillar no recomienda utilizar ningún equipo de pruebas fuera de la fábrica para la evaluación en el campo de los inyectores y las boquillas antes de instalarlos.

La División de Mercadotecnia y Respaldo al Producto respalda la recomendación de la División de Sistemas de Combustible.

Inyectores de combustible

- El Probador de Inyectores de Combustible 6V-4022 se ha cancelado y ha sido reemplazado por componentes que también se han cancelado o descontinuado.
- El Probador de Presión 1U-6661 se ha descontinuado.

Los probadores son obsoletos debido al aumento en las presiones de inyección y a los requisitos de rendimiento de los inyectores. Al usarlos con los inyectores mejorados, la falta de precisión de los probadores llevó al reemplazo de inyectores en buen estado. Por ello se recibieron reclamaciones de garantía por inyectores que no tenían problemas.

Las publicaciones de servicio relacionadas con estos probadores se han eliminado del Sistema de Información de Servicio (SIS) y de Media Logistics. Las referencias a los probadores y a las publicaciones de servicio eliminados también se han eliminado o están en proceso de eliminación.

La **División de Mercadeo y Soporte de Productos no aceptará reclamaciones de garantía para los inyectores evaluados con los probadores antes mencionados ni con ningún otro dispositivo comercial utilizado para someter los inyectores a prueba.**

Inyectores de combustible

El Grupo de Probador de Inyectores 5P-4150 se utiliza para la prueba de banco de los inyectores de combustible después de que se han probado en el motor y que el rendimiento de los inyectores es cuestionable.

El Grupo de Prueba de los Inyectores 5P-4150 todavía es reemplazable.

No utilice el Grupo Probador de Inyectores 5P-4150 con los inyectores de combustible.

La **División de Mercadeo y Respaldo al Producto no acepta reclamaciones de garantía por inyectores que se hayan evaluado antes de someterlos a prueba mediante la operación del motor.**

No utilice el Probador de Inyectores de Combustible 6V-4022 para medir el caudal de combustible

SMCS - 1251; 1254; 1290; 1713

Productos Caterpillar:

- **Todas**

Service Magazine, SSPD0144, 1 marzo 1993, "Asegúrese de que la polaridad del Suministro de potencia **1U-6665** es correcta cuando haga la Prueba de los Inyectores Unitarios Electrónicos". No tenga en cuenta este artículo. Vea la información a continuación.

El Probador de Inyectores de Combustible 6V-4022 fue cancelado y reemplazado por componentes que también han sido cancelados o descontinuados. El probador es obsoleto debido al aumento en la presión de inyección y a los requisitos de rendimiento de los inyectores.

No utilice el Probador de Inyectores de Combustible 6V-4022 para medir el caudal de combustible en el inyector unitario.

El probador de resorte (inyector) no está disponible

SMCS - 0782; 1251; 1254; 1290; 1713

Productos Caterpillar:
- **Todos**

Service Magazine, SSBD1874, 18 julio 1988, "Nuevo probador de resorte (inyector) disponible para inyectores de combustible". No tenga en cuenta este artículo. Vea la información a continuación.

El Grupo de probador de resorte 1U-6661 se ha cancelado y reemplazado por componentes que también han sido cancelados o descontinuados. El probador es obsoleto debido al aumento en la presión de inyección y a los requisitos de rendimiento de los inyectores.

No utilice el Grupo de probador de resorte 1U-6661 para probar los inyectores unitarios de combustible.

Prácticas para mangueras y acoplamientos Caterpillar

SMCS - 0618; 1000; 5057; 7000

Productos Caterpillar:

- **Todos**

Caterpillar ha embarcado algunas máquinas con conjuntos de mangueras hidráulicas que utilizan acoplamientos hidráulicos no-Caterpillar. Se utilizaron mangueras Caterpillar. Los conjuntos de manguera se fabricaron para cumplir con los requisitos de Caterpillar. Si hay daños de los conjuntos de manguera no-Caterpillar, se aplica lo siguiente. Reemplace los conjuntos de manguera con mangueras Caterpillar y acoplamientos Caterpillar. No vuelva a utilizar los acoplamientos de manguera no-Caterpillar.

Caterpillar no puede garantizar la seguridad o el rendimiento de ningunainterfaz de acoplamiento de manguera que utiliza otros acoplamientos en una manguera Caterpillar producida fuera de lainstalación de fabricación.

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

This special instruction provides the necessary information in order to create SIS Web Feedback. All information provided in this document is necessary in order to provide the SIS Web Feedback analyst with the necessary information to expedite the resolution. SIS Web feedback is intended to provide feedback on any discrepancies within the Service/Parts literature. The feedback system is not intended to address any problems related to machine or component performance. Refer to the Dealer Solutions Network (DSN) for any problems associated with machine or component performance.

Note: Feedback is only available through SIS Web. Feedback is not available through SIS Network or SIS DVD.

Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

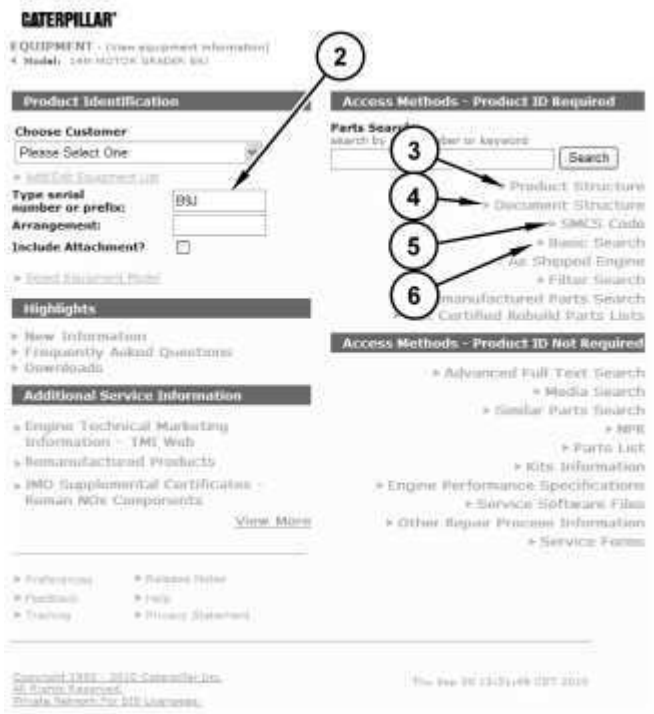


Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

   Note: Using any other method in searching for parts and service information will result in missing information in the discrepancy ticket. Any missing information may delay resolution of the discrepancy.

Ver imagen

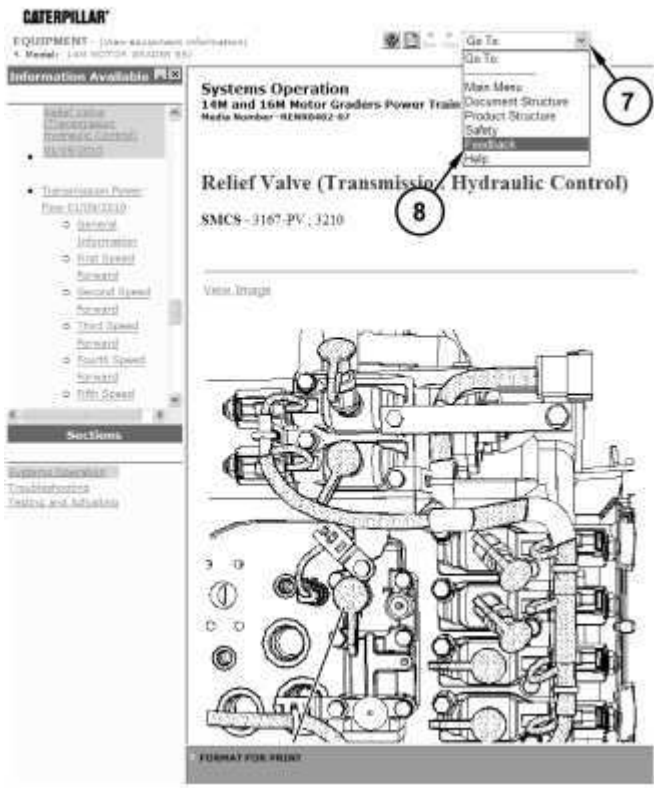


Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

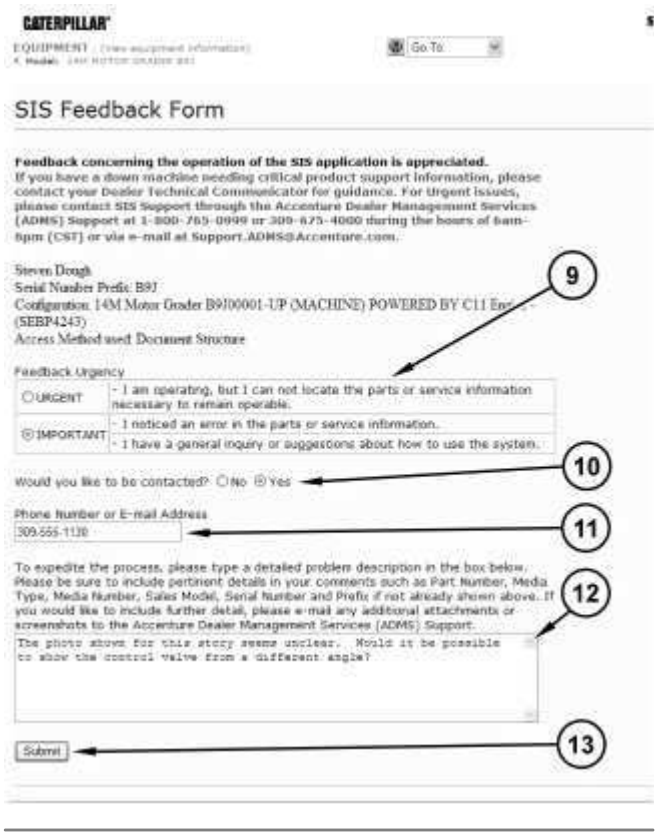


Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
7. Provide the contact information in box (11). The contact information can include an E-mail address and/or a telephone number.
8. Provide a detailed description of the discrepancy in box (12). Be sure to include pertinent details such as: part number, media type, media number, sales model, serial number and prefix. This information will expedite the resolution of the discrepancy.
9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

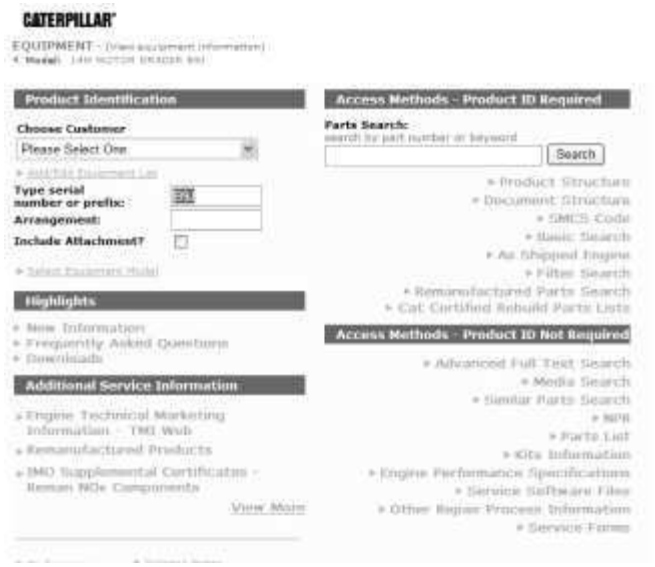
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



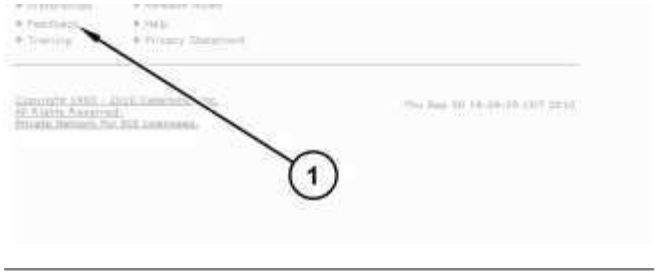


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Fuel System - Inspect

SMCS - 1250-040

Either too much fuel for combustion or not enough fuel for combustion can be the cause of a problem in the fuel system. It can be difficult to determine the source of a problem. Therefore, work is often done on the fuel system when the problem is really with some other part of the engine.

When noticeable smoke rises from the exhaust, this problem can be caused by a faulty fuel injection valve. However, this unusual smoke can also be caused by one or more of the following reasons:

- Not enough air for good combustion
- An overload at high altitude
- Oil leakage into combustion chamber
- Not enough compression
- Air inlet and exhaust leaks
- The timing is retarded.

Note: Refer to Testing and Adjusting, "Troubleshooting" for additional information on the fuel system.

Fuel System Inspection

Remove the 1/8 inch Pipe Plug from the fuel filter base in order to check for low fuel pressure. Use a pressure gauge. Install a **1U-5470** Engine Pressure Group .

Run the engine at high idle and check the fuel pressure. The fuel pressure must be at least 105 kPa (15 psi).

A problem with the components that send fuel to the engine can cause low fuel pressure. This can decrease engine performance. To inspect the fuel system, follow this procedure:

1. Check the fuel level in the fuel tank. Ensure that the vent in the fuel cap is not filled with dirt.
2. Check all fuel lines for fuel leakage. The fuel lines must be free from restrictions and faulty bends. Verify that the fuel return line is not collapsed.
3. Install a new fuel filter.
4. Cut the old filter open with the **175-7546** Oil Filter Cutter. Inspect the filter for excess contamination. Determine the source of the contamination. Make the necessary repairs.
5. Service the primary fuel filter (if equipped).
6. Operate the hand priming pump (if equipped). If excessive resistance is felt, inspect the fuel pressure regulating valve. If uneven resistance is felt, test for air in the fuel. Refer to Testing and Adjusting, "Air in Fuel - Test" for more information.
7. Remove any air that may be in the fuel system. Refer to Testing and Adjusting, "Fuel System - Prime".

Follow these steps when you drain air from the fuel injection lines:

NOTICE

The fuel injection nozzles can be permanently damaged by twisting if only one wrench is used to loosen or tighten the fuel line nuts.

Use one wrench to hold the nozzle and another to loosen the nut.

---

1. Loosen the fuel line nuts on the fuel injection nozzle by 1/2 turn.
2. Move the governor lever to the LOW IDLE position.
3. Crank the engine with the starting motor until fuel without air flows from the fuel line connections.
4. Tighten the fuel line nuts.

Note: The fuel priming pump will not provide enough pressure for pushing fuel through the reverse flow check valves in the fuel injection pumps.

Checking Engine Cylinders Separately

If any of the following conditions occur, check the individual engine cylinders:

- The engine runs rough.
- The engine misfires.
- The exhaust system blows out black smoke.

Use this procedure to check the engine cylinders separately:

1. Run the engine at a speed that gives the maximum misfiring or rough running.

NOTICE

The fuel injection nozzles can be permanently damaged by twisting if only one wrench is used to loosen or tighten the fuel line nuts.

Use one wrench to hold the nozzle and another to loosen the nut.

---

2. Then, loosen a fuel line nut on the fuel injector nozzle for each cylinder one at a time. This will stop the flow of fuel to that engine cylinder.

   When a fuel line nut is loosened, the misfiring or rough running should increase.

3. Tighten the fuel line nut

3. Tighten the fuel line nut.

4. Repeat 1 through Step 3 with each engine cylinder in sequence until you discover a loosened fuel line that does NOT affect the engine's performance.

5. When you find the engine cylinder that does NOT affect the engine's performance, perform the following operations:

    a. Test the fuel injection pump for that cylinder.

    b. Test the fuel injector nozzle.

When an engine runs at low idle speed, the temperature of an exhaust manifold can indicate the condition of a fuel injector nozzle. A low temperature indicates that no fuel is reaching the cylinder. This can possibly signify that the fuel injector nozzle has a defect.

When an engine runs at low idle rpm and the temperature of an exhaust manifold is at an extra high temperature, too much fuel is probably flowing into the engine cylinder. This can also signify that the fuel injector nozzle has a defect.

The most common defects on fuel injector nozzles include the following defects:

- Plugging or blocking by carbon at the orifice of a fuel injector nozzle
- Orifice wear due to abrasive particles in the fuel
- Wear from a wire brush on the fuel injector nozzle's tip

Refer to Special Instruction, SEHS8149 for the procedure for checking the temperatures in the exhaust manifold port.

Fuel Injection Lines

Fuel from the Fuel Injection Pumps to the Fuel Injector Nozzles

Fuel from the fuel injection pumps flows to the fuel injector nozzle through fuel injection lines.

When fuel injection lines are disconnected, always place caps on the end and plugs on the end. This will keep the dirt out of the fuel injection lines. When fuel injection lines are installed, ensure that all clamps and all dampers are returned to original positions.

The nuts that connect a fuel injection line to both the fuel injector nozzle and the fuel injection pump must be tightened to the correct torque.

If the nuts are not tightened to the proper torque, the following problems may occur:

- If the nut is loose, fuel will leak from the connection.
- If the nut is too tight, the inside diameter of the line will become smaller. This causes a restriction to the fuel flow in the fuel line.

Use a torque wrench and a **5P-0144** Fuel Line Socket to tighten the fuel injection line nut to a torque of 41 ± 7 N·m (30 ± 5 lb ft).

WARNING

Fuel injection lines that are bent, damaged, or rubbing against surfaces can leak and cause a fire. Replace any lines that are bent, or damaged when tightened to the correct torque. Correct or replace any lines that are rubbing when tightened to the correct torque.

Checking the Plunger and Lifter of an Injection Pump

Note: If the pump plunger is worn, good contact will not occur. A pump plunger must be replaced if the pump plunger is damaged. A lifter must also be replaced if the lifter is worn. There are no different sizes of spacers that are available so you can adjust the timing dimension of the fuel injection pumps. Since there is no possible adjustment to the timing dimension, no off-engine adjustment procedure for the engine lifter setting procedure is available.

If the pump plunger on the fuel injector is worn, the lifter may also be worn. If either of these conditions exists, good contact will not be possible. Replace the lifters soon after you see wear on the pump plunger. Also, replace lifters that show any signs of wear.

Ver imagen

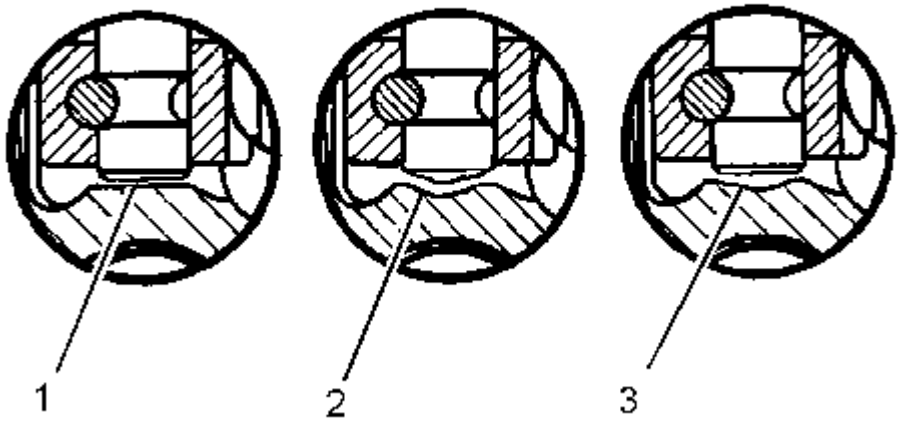


Illustration 1 g01109359

Wear Between the Lifter and the Pump Plunger

(1) The contact surface of a new pump plunger and surface of a new lifter

(2) The contact surface of a pump plunger with considerable wear and surface of lifter with considerable wear

(3) Fast wear due to the new end of a pump plunger with poor contact against worn lifter

A fuel injection pump can send a good fuel flow, yet this fuel injection pump may not be a good pump. Wear on the bottom end of the pump plunger causes slow timing. When you test a used fuel injection pump

Wear on the bottom end of the pump plunger causes slow timing. When you test a used fuel injection pump with a long life, use a micrometer to measure the length of the pump plunger.

If the length of the pump plunger is shorter than the minimum, specified length, replace the fuel injection pump. Any amount that is below the specified length indicates that the pump plunger is worn. See Table 1 for additional information on the Fuel Pump Plunger.

Table 1

Specifications for Fuel Pump Plunger	
Length for new fuel pump plunger	73.886 ± 0.013 mm (2.9089 ± .0005 inch)
Minimum length for worn fuel pump plunger	73.873 mm (2.9084 inch)

Also, look for wear at the top of the pump plunger. Check the operation according to the instructions in Testing and Adjusting, "Fuel Injection Test Bench".

Aire en el combustible - Probar

SMCS - 1280-081

Este procedimiento comprueba si hay aire en el combustible. Este procedimiento ayuda también a hallar la fuente del ingreso de aire.

1. Examine el sistema de combustible para determinar si hay fugas. Asegúrese de que las conexiones de la tubería de combustible estén correctamente apretadas. Compruebe el nivel del combustible en el tanque de combustible. El aire puede entrar en el sistema de combustible por el lado de succión, entre la bomba de transferencia de combustible y el tanque de combustible.

2. Instale un Conjunto de tubo **2P-8278** (MIRILLA) en la tubería de retorno de combustible. Cuando sea posible, instale la mirilla indicadora en una sección recta de la tubería de combustible que tenga una longitud de 304,8 mm (12 pulg) como mínimo. No instale la mirilla indicadora cerca de los siguientes dispositivos que producen turbulencia:

   - Codos
   - Válvulas de alivio
   - Válvulas de retención

   Observe el flujo de combustible durante el giro del motor. Vea si hay burbujas de aire en el combustible. Si no hay combustible en la mirilla indicadora, cebe el sistema de combustible. Para mayor información, refiérase a Pruebas y Ajustes, "Sistema de combustible - Cebar". Si el motor arranca, compruebe para determinar si hay aire en el combustible a diferentes velocidades del motor. Siempre que sea posible, opere el motor bajo las condiciones que se han sospechado como las responsables del ingreso de aire en el combustible.

Ver imagen

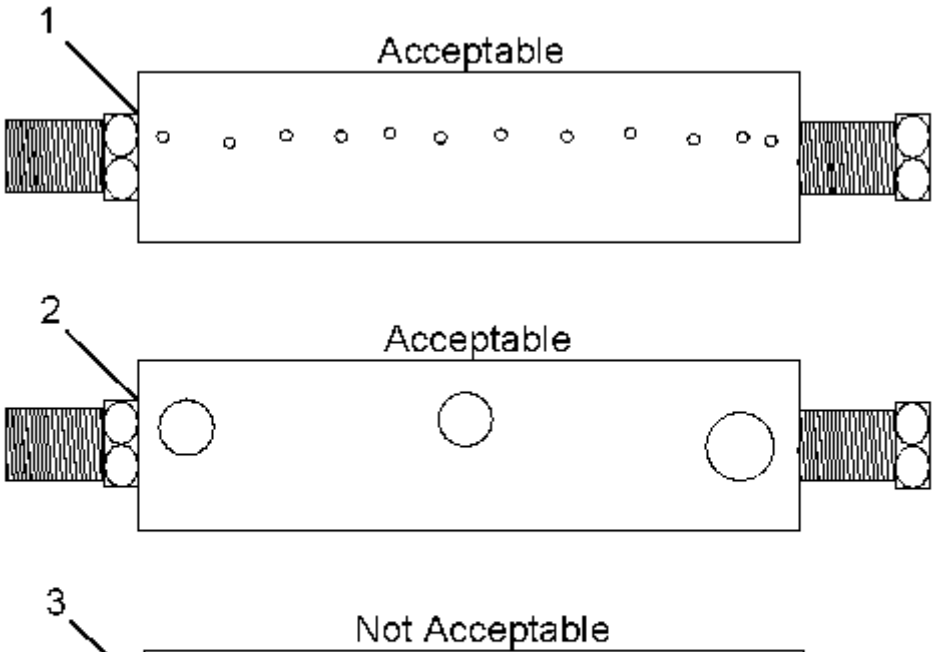


Ilustración 1 g01096678

Conjunto de tubo 2P-8278 (MIRILLA)

(1) Una corriente estable de burbujas pequeñas con un diámetro de aproximadamente 1,60 mm (0,063 pulg) representa una cantidad aceptable de aire en el combustible.

(2) Las burbujas con un diámetro de aproximadamente 6,35 mm (0,250 pulg) son también aceptables si hay intervalos de dos a tres segundos entre burbujas.

(3) Un exceso de aire en el combustible no son aceptables.

3. Si se observa un exceso de aire en la mirilla de la tubería de retorno de combustible, instale una mirilla a la entrada de la bomba de transferencia de combustible. Si no hay mirilla disponible, mueva la mirilla de la tubería de retorno de combustible e instálela a la entrada de la bomba de transferencia de combustible. Observe el flujo de combustible durante el giro del motor. Observe para determinar si hay burbujas de aire en el combustible. Si el motor arranca, compruebe para determinar si hay aire en el combustible a diferentes velocidades del motor.

   Si el exceso de aire no se observa a la entrada de la bomba de transferencia de combustible, el aire está ingresando en el sistema después de la bomba de transferencia de combustible. Siga con el Paso 6.

   Si el exceso de aire se observa a la entrada de la bomba de transferencia de combustible, el aire está ingresando por el lado de succión del sistema de combustible.

⚠ ADVERTENCIA

Para evitarse lesiones, póngase anteojos y máscara de protección siempre que tenga que usar aire comprimido.

ATENCION

Para evitar daños, no utilice más de 55 kPa (8 lb/pulg^2) para presurizar el tanque de combustible.

4. Presurice el tanque de combustible a 35 kPa (5 lb/pulg^2). No utilice más de 55 kPa (8 lb/pulg^2) para evitar los daños al tanque de combustible. Observe para determinar si hay fugas en las tuberías de combustible entre el tanque y la bomba de transferencia de combustible. Repare cualquier fuga que encuentre. Verifique la presión de combustible para asegurarse que la bomba de transferencia de

combustible esté operando correctamente. Para información sobre la forma de comprobar la presión de combustible, refiérase a Pruebas y Ajustes, "Presión del sistema de combustible - Probar".

5. Si no se halla la fuente del aire, desconecte el conjunto de tubería de suministro del tanque de combustible y conecte una toma externa de combustible a la entrada de la bomba de transferencia de combustible. Si esto resuelve el problema, repare el tanque de combustible o la tubería que está montada en el tanque de combustible.

6. Si el manguito del inyector esta desgastado o dañado, es posible que se puedan hallar fugas de los gases de combustión en el sistema de combustible. También pueden hallarse fugas de los gases de combustión en el sistema de combustible si los sellos anulares en los manguitos del inyector están desgastados, faltan o están dañados.

Calidad del combustible - Probar

SMCS - 1280-081

Esta prueba determina si hay problemas relacionados con la calidad del combustible. Para obtener detalles adicionales, consulte la publicación El combustibles diesel y su motor, SSBD0717.

Utilice el siguiente procedimiento para comprobar si hay problemas de calidad de combustible:

1. Determine si hay agua o contaminantes en el combustible. Inspeccione el separador de agua (si lo tiene). Si no hay un separador de agua presente, proceda al paso2. Drene el separador de agua, si es necesario. Un tanque de combustible lleno reduce la posibilidad de condensación durante la noche.

   Nota: Un separador de agua puede parecer que está lleno de combustible cuando en realidad está lleno de agua.

2. Determine si hay contaminantes en el combustible. Saque una muestra de combustible de la parte inferior del tanque de combustible. Inspeccione visualmente para ver si hay contaminantes en la muestra de combustible. El color del combustible no es necesariamente una indicación de la calidad del combustible. Sin embargo, el combustible de color negro o pardo, o de aspecto similar al lodo, puede ser una indicación de crecimiento de bacterias o contaminación de aceite. A temperaturas frías, el combustible turbio indica que puede ser inadecuado para las condiciones de operación. Se pueden usar los métodos siguientes para evitar que la cera obstruya el filtro de combustible:

   - Calentadores del combustible
   - Mezcla de combustible con aditivos
   - Uso de un combustible con una temperatura baja de enturbiamiento, como el queroseno.

   Para mayor información, refiérase al Manual de Operación y Mantenimiento, SEBU6251, "Recomendaciones sobre fluidos para motores comerciales diesel Caterpillar", "Recomendaciones sobre combustibles".

3. Verifique el combustible API con un Gp de calibración de fluido y combustible **9U-7840** para situaciones de baja potencia. La gama aceptable de combustible API es de 30 a 45 cuando el API se mide a 15°C (60°F), pero hay una diferencia significativa de energía dentro de esta gama. Para los factores de corrección del API, refiérase alManual de operación de la herramientaNEHS0607 cuando se presente un problema de baja potencia y el API esté alto.

   Nota: Un factor de corrección mayor que "1" puede ser la causa de baja potencia y/o consumo deficiente de combustible.

4. Si todavía se sospecha que la calidad del combustible es una posible causa de los problemas de rendimiento del motor, desconecte la tubería de entrada de combustible y haga funcionar temporalmente el motor con combustible obtenido de un proveedor distinto de combustible que esté reconocido como bueno. Esto determinará si la causa del problema es la calidad del combustible. Si se determina que la calidad del combustible es la causa del problema, drene el sistema de combustible y reemplace los filtros de combustible. El rendimiento del motor puede ser afectado por las siguientes características:

   - Número de cetano del combustible

- Presencia de aire en el combustible
- Otras características del combustible

Governor - Adjust

SMCS - 1264-025

Governor Adjustment for Fuel Ratio Control Linkage

Table 1

Required Tools		
Part Number	**Part Name**	**Quantity**
6V-4186	Fuel Pump Timing Pin	1
6V-2105	Rack Adjustment Tool	1
6V-2017	Governor Adjustment Tool	1
0S-1614	Bolt	1
9S-0229	Indicator Contact Point	1
5P-4814	Collet Clamp	1
6V-3075	Dial Indicator	1
6V-7941	Spring Compressor As	1
6V-2014	Bracket As	1

The governor adjustment for the fuel ratio control linkage can be completed with the fuel injection pump and the governor on the engine or with the fuel injection pump and the governor off the engine.

Ver imagen

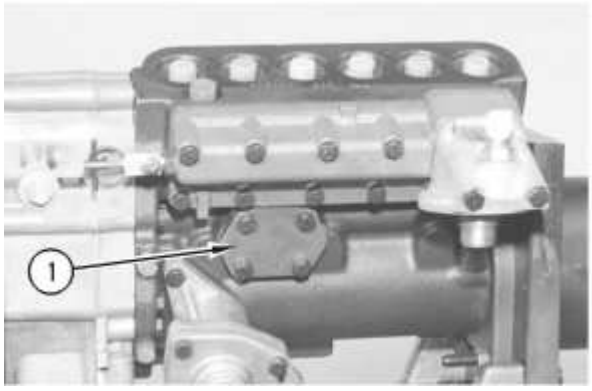


Illustration 1 g00319835

Fuel Injection Pump and Governor

(1) Cover

1. Remove cover (1) from the side of the fuel injection pump housing.

Ver imagen

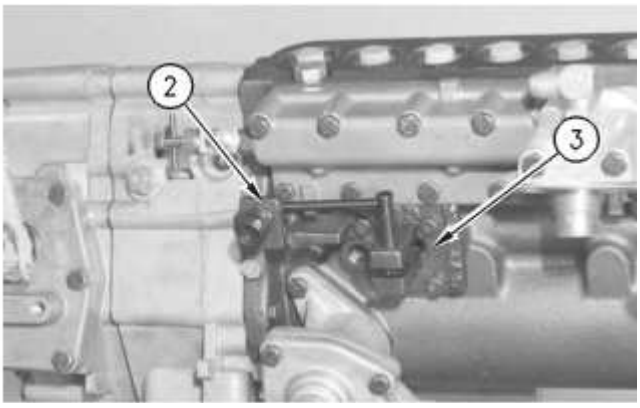


Illustration 2 g00319836

Installed Bracket Assembly

(2) 5P-4814 Collet Clamp

(3) 6V-2014 Bracket

2. Install **5P-4814** Collet Clamp (2) onto **6V-2014** Bracket (3).

Ver imagen

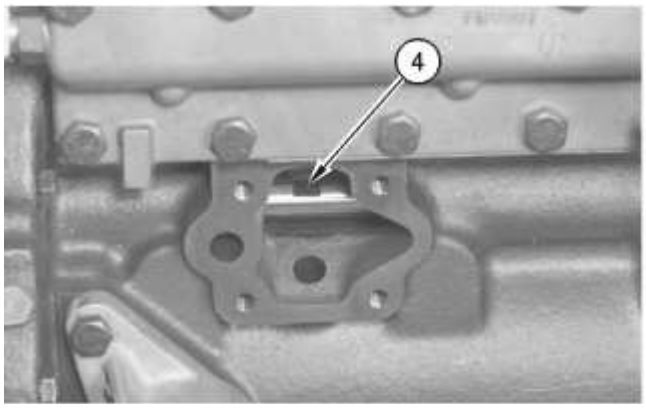


Illustration 3 g00319837

Fuel Injection Pump and Governor with Removed Cover

(4) Slot on fuel rack

Ver imagen

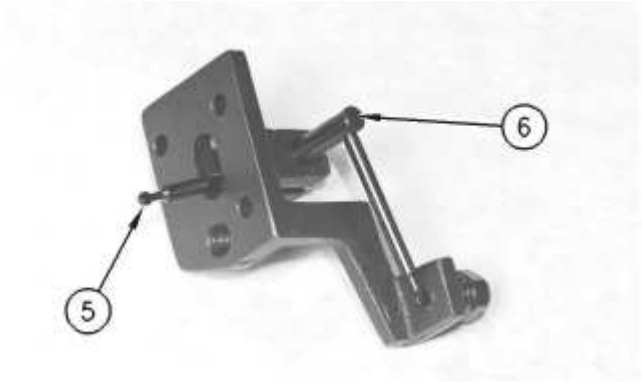


Illustration 4 g00319838

Bracket Assembly

(5) Lever

(6) Shaft

3. Install bracket assembly (3) onto the fuel pump housing.

   Lever (5) on bracket assembly (3) must be inserted into slot (4) on the fuel rack. Push up on the bracket assembly (3) while you tighten the bolts.

   After bracket assembly (3) is tightened to the fuel pump housing, shaft (6) must have an axial movement. Axial movement alternates between clockwise movement and counterclockwise movement. If there is no axial movement of the shaft, follow these steps:

   a. Ensure that lever (5) is securely inserted into the slot on the fuel rack.

   b. Ensure that lever (5) is not bent.

   c. Ensure that the bracket assembly is installed correctly.

   d. Ensure that lever (5) is at a right angle (perpendicular) to the mounting face of the bracket assembly.

Ver imagen

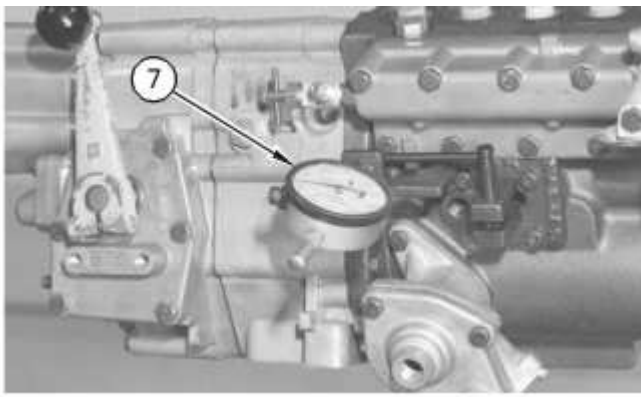


Illustration 5 g00319839

Installed Dial Indicator

(7) 6V-3075 Dial Indicator

4. Connect the **9S-0229** Indicator Contact Point to **6V-3075** Dial Indicator (7), and install the dial indicator into **5P-4814** Collet Clamp (2) .

Ver imagen

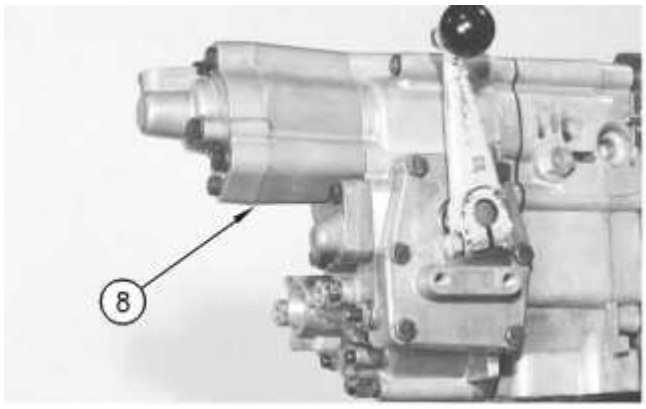


Illustration 6 g00319925

Governor

(8) Fuel air ratio control

5. Remove fuel air ratio control (8) from the rear of the governor housing.

Ver imagen

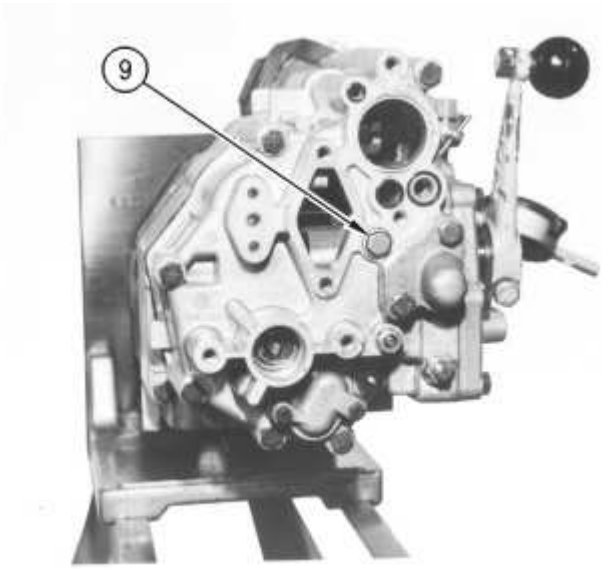


Illustration 7 g00321104

Rear of Governor Housing

(9) Plug

6. Remove plug (9) from the rear of the governor housing.
7. Move the governor control lever to the FUEL-OFF position.

   Note: Rotate the governor shaft clockwise.

Ver imagen

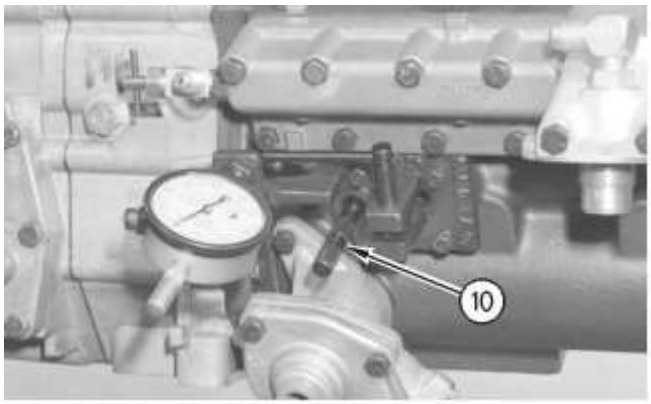


Illustration 8 g00319943

Installed Fuel Pump Timing Pin

(10) 6V-4186 Fuel Pump Timing Pin

8. Install **6V-4186** Fuel Pump Timing Pin (10) into the hole in the bracket assembly.

   Push in the fuel pump timing pin (10) until the timing pin contacts the fuel rack. Then, hold the fuel pump timing pin gently against the fuel rack for Steps 9 and 11.a.

   If too much force is used to hold the fuel pump timing pin, the fuel rack can stick. This causes an incorrect zero reading.

Ver imagen

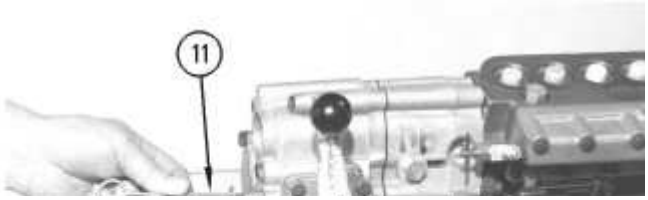


Illustration 9 g00319963

Using the 6V-7942 Hook

(11) 6V-7942 Hook

Ver imagen

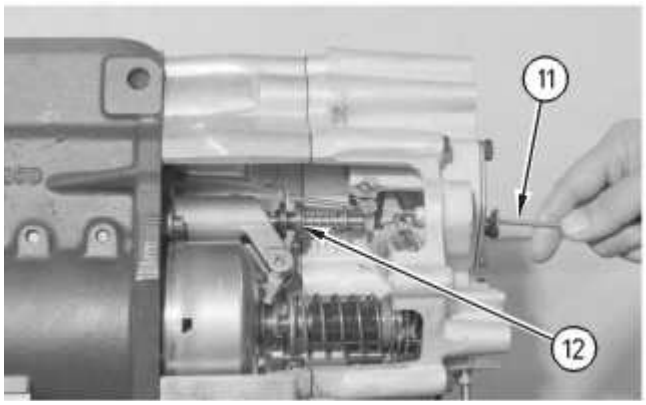


Illustration 10 g00320023

Cutaway View of Governor

(11) 6V-7942 Hook

(12) Collar

9. Hold the governor control lever in the HIGH IDLE position.

   Note: Rotate the governor shaft counterclockwise.

10. Place the fuel rack into zero position.

    a. Insert **6V-7942** Hook (11) into the hole that is left from the removal of plug (9) .

    b. Engage the end of **6V-7942** Hook (11) with collar (12) .

    c. Pull these two components toward the rear of the governor housing until the collar stops moving.

       This ensures that the fuel rack stops against fuel pump timing pin (10). The rack will then be in zero position.

11. Complete these final steps for removing the timing pin:

a. With hook (11) that is pulled toward the rear of the governor housing, loosen collet (2) .

b. Then, adjust the revolution counter on the dial indicator to zero.

c. Tighten collet clamp (2) enough to hold the indicator in this position.

d. Proceed to move the indicator's dial to zero.

12. Remove fuel pump timing pin (10) .

Ver imagen

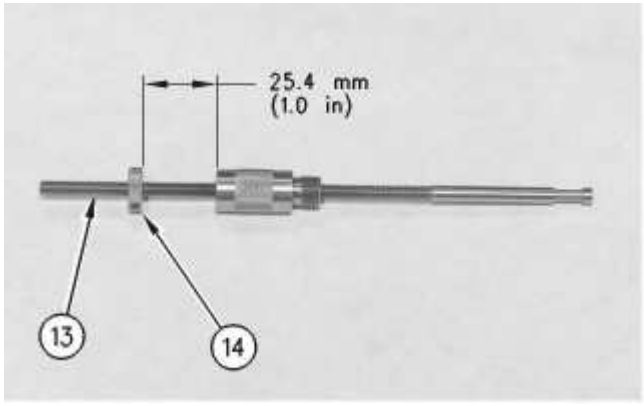


Illustration 11 g00320183

6V-7941 Spring Compressor

(13) Rod

(14) Knob

Ver imagen

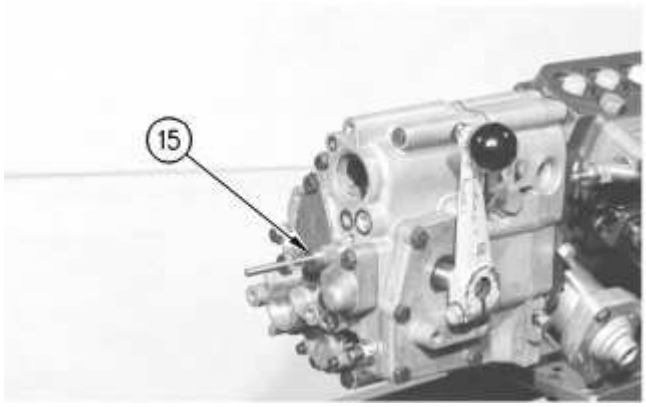


Illustration 12 g00320203

Installed Compressor Assembly

(15) 6V-7941 Spring Compressor

13. Turn rod (13) out of **6V-7941** Spring Compressor (15) until knob (14) is 25.4 mm (1.00 inch) from the compressor body. Install the **6V-7941** Spring Compressor (15) into the hole that is left from the removal of plug (9) .

Ver imagen

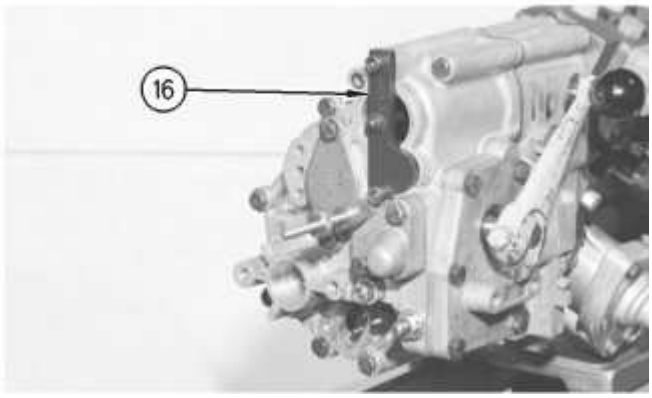


Illustration 13 g00320223

Installed Governor Adjusting Tool

(16) 6V-2017 Governor Adjustment Tool

14. Move the governor control lever to the FUEL-OFF position.

    a. Use two **OS-1614** Bolts to install **6V-2017** Governor Adjustment Tool (16) .

    b. Ensure that the end of the tool is behind the governor linkage.

    c. Also, ensure that the flange is completely against the governor housing. Remember that the filter screen may need to be removed.

       Note: If you expect to change the setting, install the outer part of **6V-2105** Rack Adjustment Tool. Install this tool along the left side of the **6V-2017** Governor Adjustment Tool (16) .

15. Move the governor control lever to the FULL LOAD position. Then, hold the governor control lever in this position.

16. Turn the spring clockwise until the indicator hand stops moving. This is the Static Fuel Ratio Control Lever Setting.

17. Now, slowly turn the rod counterclockwise until the indicator hands stop moving. This is the Static Fuel Ratio Control Lever Setting.

    Note: There will be a small, initial amount of movement by the indicator hands. Then, the indicator hands will stop moving while the rod is turned out for another 1 1/2 turns. Now, the indicator hands will begin to move again. The indicator hands will follow the turning of the rod until the setting is reached. Remember to turn the rod slowly so the rack can follow the governor components.

18. Compare the reading on the dial indicator to the correct fuel ratio lever setting in the Technical Marketing Information (TMI).

Ver imagen

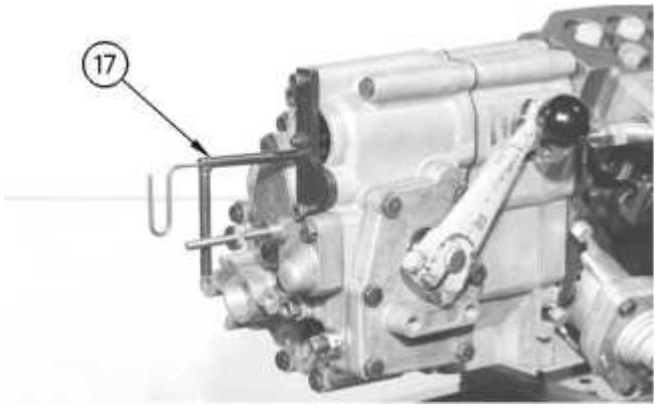


Illustration 14 g00320243

Governor Linkage Adjustment

(17) 6V-2105 Rack Adjustment Tool

a. If the fuel ratio control setting is not correct, use **6V-2105** Rack Adjustment Tool (17) to loosen the locknut (19) .

Ver imagen

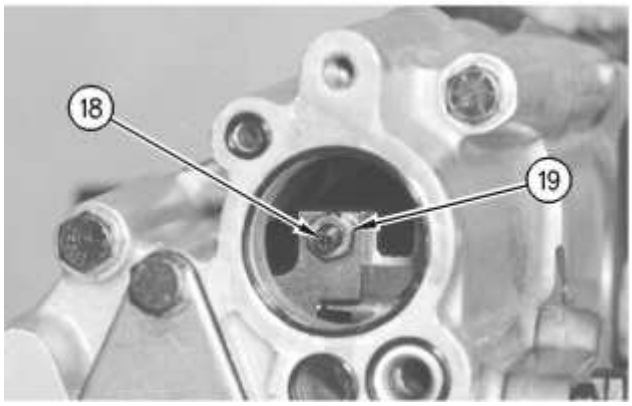


Illustration 15 g00320264

Adjustment Screw for Governor

(18) Adjustment screw

(19) Locknut

b. Turn adjustment screw (18) clockwise. This decreases the amount of fuel that is possible. This also allows less fuel rack travel at the limited rack position.

Note: One revolution of the adjustment screw will change the setting by approximately 0.79 mm (.031 inch). Also, remember that the dial indicator hands will not follow the movement of the adjustment screw. You need to repeat Steps 15 through 18 until the correct setting is obtained.

Variable Horsepower Solenoid

Remove the following components from the back end of the governor housing. These components should be removed before checking and adjusting the HIGH POWER specification.

- Fuel Air Ratio control or the smoke limiter
- Variable Horsepower solenoid

Ver imagen

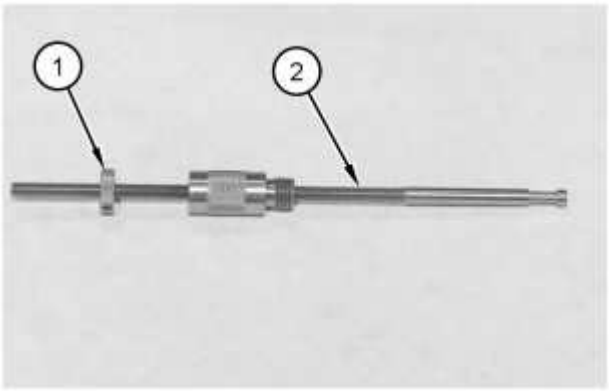


Illustration 16 g01110000

6V-7941 Spring Compressor

(1) Nut

(2) Rod

Use the **6V-7941** Spring Compressor to check and adjust the following settings:

- high power Full Load fuel setting
- Full Torque static value

Use the following procedure to check the LOW POWER FULL LOAD fuel setting.

1. Remove the fuel pump cover. Install the rack zero pin in the rack slot.
2. Clear all readings on the electronic rack position indicator.
3. Move the pointer to the actual field, and zero the indicator.

4. Hold the throttle in the fully open position.
5. Install the variable horsepower solenoid on the rear of the governor housing.
6. Remove the zero pin.
7. Apply pressure to the governor control shaft in the open direction. This will fully open the throttle.
8. Remove the variable horsepower solenoid. The reading on the indicator should be within ± 0.13 mm of the Full Torque fuel setting.
9. Rotate the variable horsepower solenoid to the low power Full Load fuel setting.

   Note: Do not exceed the Full Load setting. If the Full Load setting is exceeded, Steps 7 through 9 must be repeated in order to achieve the correct setting.
10. Lock the variable horsepower solenoid.
11. Recheck the setting by moving the throttle to shut off position, and then back to full open position.
12. Remove the indicator and install the cover on the pump.
13. Install the Fuel Air Ratio Control or the smoke limiter on the rear of the governor housing.

    Note: If the low power FULL LOAD fuel setting is positive, the electronic indicator should be reading positive numbers. The numbers will decrease until the desired setting is reached.

    Note: If the low power FULL LOAD fuel setting is negative, the electronic indicator should be reading positive numbers. If the FULL TORQUE fuel setting is positive, the numbers will decrease to zero. When the numbers have decreased to zero, the numbers will start to increase in a negative direction.

Fuel Air Ratio Control and Governor Check

Table 2

Required Tools		
Part Number	**Part Name**	**Quantity**
2W-9161	Manual Shutoff	1
6V-4186	Fuel Pump Timing Pin	1
6V-6070	Governor Adjusting Tool Gp	1
0S-1614	Bolt	1
9S-0229	Indicator Contact Point	1
9U-7400	Multitach Tool Gp	1
FT-1906	Air Test Kit	1
8T-1000	Electronic Position Indicator	1

4N-5656	Cover	1

Note: The governor seals do not need to be cut or removed for the procedures that follow. For additional information on the tooling, refer to Special Instruction, SEHS8463. This Special Instruction is available only on microfiche.

1. Install the rack position indicator in order to measure the fuel rack's movement. See Steps 1 through 5 in the "Fuel Setting Procedure" for the correct installation of the tooling.
2. Turn the ignition key to "ON". This activates the shutoff solenoid. **DO NOT START THE ENGINE AT THIS TIME.**
3. Move the governor control linkage to the full FUEL-ON position. Hold the governor control linkage in this position, or fasten the control linkage in this position.
4. Install the **6V-4186** Fuel Pump Timing Pin in the hole for the rack's zeroing pin.
5. With the governor control lever in the full FUEL-OFF position, use a **1N-9954** Lever to slowly move the manual shutoff shaft, if equipped. Move this manual shutoff shaft to the FUEL-OFF position. This moves in a counterclockwise direction.

   Ensure that the **6V-4186** Fuel Pump Timing Pin drops into the slot in the fuel rack. Also, ensure that the pin engages with the slot in the fuel rack.
6. Release the manual shutoff shaft and the **8T-1000** Electronic Position Indicator. Press the zero button.
7. Remove the **6V-4186** Fuel Pump Timing Pin, and watch the movement.

   The electronic position indicator should display a positive reading in the "FUEL ON" direction.

   Note: If no movement occurs, repeat Steps 4, 5, and 6.
8. Release the governor control shaft and the governor control linkage.
9. Remove the air line from the engine. Put plugs over the opening. This keeps dirt out of the system.
10. Start the engine, and allow the engine to run for a minimum of five minutes. This warm-up time is required for the following reasons:
    - The governor gets enough time to attain normal operating temperature.
    - The engine gets enough time to attain normal operating temperature.

WARNING

Personal injury can result from rotating and moving parts.

Moving fan blades and moving parts will throw or cut any object or tool that falls or is pushed into them.

Ensure that no one is working on, underneath or close to the machine

before starting the engine. Ensure the area is free of personnel.

Ver imagen

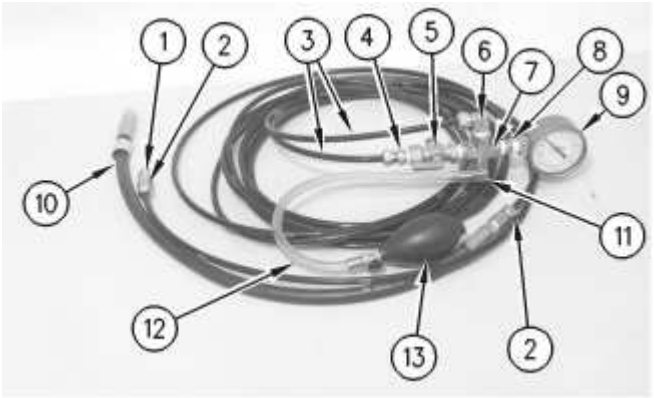


Illustration 17 g00320303

FT-1906 Air Test Kit

(1) 8L-6557 Flared Connector

(2) 5P-4405 Air Brake Connector (two are necessary)

(3) 5P-6011 Tube

(4) 5P-4476 Air Brake Connector

(5) 6K-5741 Drain Valve

(6) 5P-4459 Air Brake Elbow

(7) 7B-0192 Connector

(8) 3B-6768 Reducer Bushing

(9) 6V-7775 Air Pressure Gauge

(10) 6N-3169 Hose Assembly

(11) 6V-6757 Pipe Elbow

(12) 6.35 mm (.2500 inch) ID Flexibility Tubing that is 1.2 m (4 ft) long

(13) Air pressure bulb

11. Check the leakdown rate of the fuel air ratio control with the engine at low idle. Follow these steps:

    a. Connect the following items to the fitting that was left from the removal of the air line:

        - Pressure gauge
        - Shutoff valve
        - Pressure regulator

- Air supply

b. Apply 70 kPa (10 psi) of air pressure to the fuel air ratio control.

c. Turn off the shutoff valve, and check the leakdown rate.

Note: A leakdown rate of 20 kPa (3 psi) within 30 seconds is acceptable.

d. If leakage is more than 20 kPa (3 psi) within 30 seconds, the fuel air ratio control needs to be repaired before Steps 14 through 16 are completed.

e. Apply 70 kPa (10 psi) of air pressure on the fuel air ratio control for Step 12.

Note: Step 11 also activates the fuel air ratio control for Step 12.

12. While the engine is operating at low idle, rapidly move the governor control shaft to the FUEL-ON position. Then, read the measurement on the **8T-1000** Electronic Position Indicator .

13. Press the "MAX" on the position indicator and then read the dynamic fuel ratio control setting. Record the reading, and repeat this step several times.

Note: The fuel air ratio control is activated, and the maximum reading is the dynamic full torque setting of the engine. This setting is 0.5 mm (.02 inch) greater than the static full torque setting. The static full torque setting appears on the Engine Information Plate for later engines. This information can also be found in the TMI.

Note: The fuel air ratio control activates at start-up for engines with a fuel air ratio control that is out of adjustment. At this time, the reading of the **8T-1000** Electronic Position Indicator can be the dynamic full torque setting for Step 17.

14. Release all the air pressure from the fuel air ratio control.

15. While the engine is operating at 900 rpm, rapidly move the governor control shaft to the FUEL-ON position. Then, read the measurement on the **8T-1000** Electronic Position Indicator .

16. Press the "MAX" on the indicator, and then read the dynamic fuel ratio control setting. Record the reading, and repeat this step several times.

Note: An adjustment is not needed if the dynamic air/fuel setting is within 0.25 mm (.010 inch) of the specifications in either of the following references:

- The Engine Information Plate for later engines
- TMI

For the adjustment of the control, see the "Fuel Ratio Control Adjustment" topic.

17. Observe these steps to check the inlet air pressure for full torque rack travel:

a. Connect the following items to the fitting that was left from the removal of the air line:

- Pressure gauge
- Pressure regulator

- Pressure regulator
- Air supply

b. Apply 25 kPa (4 psi) of air pressure to the fuel air ratio control.

c. Run the engine at 900 rpm. Rapidly move the governor control shaft to the full FUEL-ON position. Record the maximum reading on the indicator.

d. Repeat this process several times. With each repetition, increase the air pressure by 5 kPa (.5 psi).

e. Record the first air pressure setting that registers the full torque rack travel.

Note: Remember that the full torque rack travel was calculated in Step 16.

f. This is the inlet air pressure that moves the fuel air ratio control out of the rack control position. This pressure provides the dynamic full torque rack travel.

Fuel Ratio Control Adjustment

Table 3

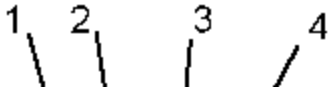
Required Tools		
Part Number	**Part Name**	**Quantity**
2W-9161	Manual Shutoff	1
6V-4186	Fuel Pump Timing Pin	1
6V-6070	Governor Adjusting Tool Gp	1

Note: Before the governor seals are removed or the governor seals are severed, check the "Fuel Ratio Control and Governor Check" in order to ensure that an adjustment is needed.

1. See either of the following references for the correct specification of the dynamic air/fuel setting before you make an adjustment:
   - The Engine Information Plate for later engines
   - TMI
2. Install the zero rack position indicator group, and zero the rack position indicator.

   Note: See the "Fuel Ratio Control and Governor Check" for additional information regarding this procedure.

Ver imagen



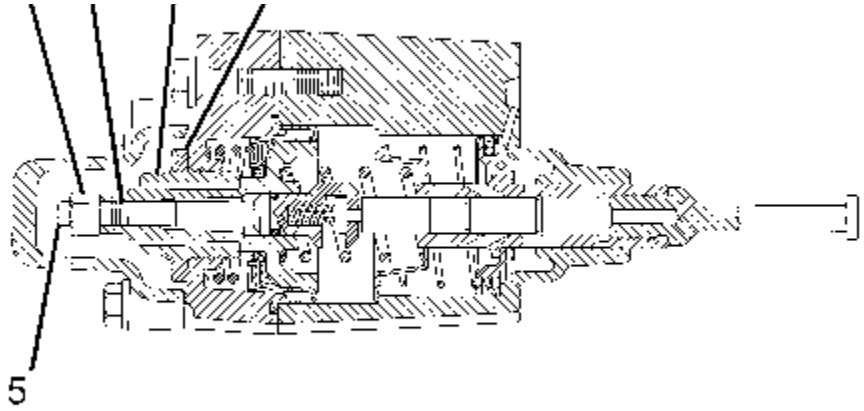


Illustration 18 g01110011

Earlier Fuel Air Ratio Control

(1) Nut (valve extension)

(2) Retainer

(3) Stop

(4) Nut

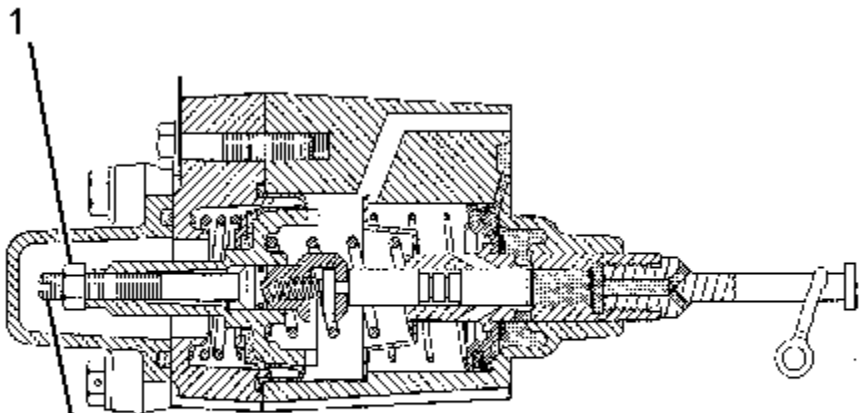
(5) Valve extension

3. Remove the cover from the fuel ratio control valve.

   Note: For earlier engines, the completion of Step 4 is necessary to ensure that stop (3) does not contact retainer (2). Later engines do not contain stop (3) and nut (4). **Do not add these parts when you repair the fuel air ratio control.**

4. Loosen nut (4), and turn stop (3) clockwise until stop (3) contacts the shoulder on retainer (2). Next, turn the stop (3) counterclockwise for two complete turns. Tighten nut (4) .

Ver imagen



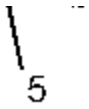


Illustration 19 g01110020

Later Fuel Air Ratio Control

(1) Nut (valve extension)

(5) Valve extension

WARNING

Personal injury can result from rotating and moving parts.

Moving fan blades and moving parts will throw or cut any object or tool that falls or is pushed into them.

Ensure that no one is working on, underneath or close to the machine before starting the engine. Ensure the area is free of personnel.

5. Start the engine, and allow the engine to run for a minimum of five minutes. This warm-up time is required for the following reasons:
   - The governor gets enough time to attain normal operating temperature.
   - The engine gets enough time to attain normal operating temperature.
6. Activate the fuel air ratio control by pushing in on valve extension (5) .
7. Hold retainer (2) in position, and loosen nut (1). This prevents the fuel ratio control diaphragm from turning when you loosen nut (1) .

   Note: Use the same procedure to tighten this nut.
8. Turn valve extension (5) in order to attain the correct setting. A clockwise movement provides a more positive setting.

   Note: A counterclockwise movement provides a more negative setting.

   Several adjustments of valve extension (5) may be needed to meet the specifications.
9. After each adjustment is made, check the dynamic fuel ratio control setting:
   a. Operate the engine at 900 rpm, and rapidly move the governor control shaft to the FUEL-ON position.
   b. Carefully read the dial indicator. This reading will be at the maximum for only a moment. Record the reading on the indicator.

Note: If the correct dynamic fuel ratio control setting can NOT be made with this adjustment, check the internal governor linkage for another possible adjustment. Check the fuel ratio control linkage for repair and for replacement.

10. After the correct adjustment has been made and while you are holding retainer (2) in position, tighten nut (1). Also, check the fuel ratio control setting again.

11. Install the gasket and the cover on the fuel ratio control. Then, install the cover to a torque of 9 ± 3 N·m (7 ± 2 lb ft).

12. Apply 70 kPa (10 psi) of air pressure to the fuel air ratio control at the fitting. This will fully extend the fuel air ratio control so the dynamic full torque can be attained.

13. Check the dynamic full torque setting:

    a. Operate the engine at 900 rpm.

    b. Rapidly move the governor control shaft to the full FUEL-ON position.

    c. Read the maximum measurement that is displayed on the dial indicator.

    Note: If the dynamic full torque setting can NOT be reached, the fuel air ratio control may need to be repaired or replaced.

14. Install the wire and the seal onto the fuel air ratio control.

15. Remove the tooling for the rack position indicator.

Fuel Setting Procedure

Table 4

Required Tools		
Part Number	**Part Name**	**Quantity**
6V-6070	Governor Adjusting Tool Gp	1
8T-0500	Continuity Test Light	1

The static fuel setting can be determined with the fuel injection pump on the engine or with the fuel injection pump off the engine. For additional information, see Special Instruction, SEHS8024.

Ver imagen

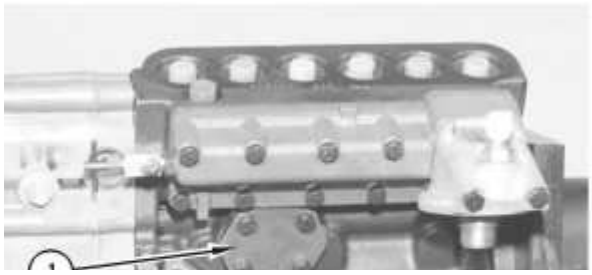


Illustration 20 g00319835

Fuel Injection Pump and Governor

(1) Cover

1. Remove cover (1) from the side of the fuel injection pump housing.

Ver imagen

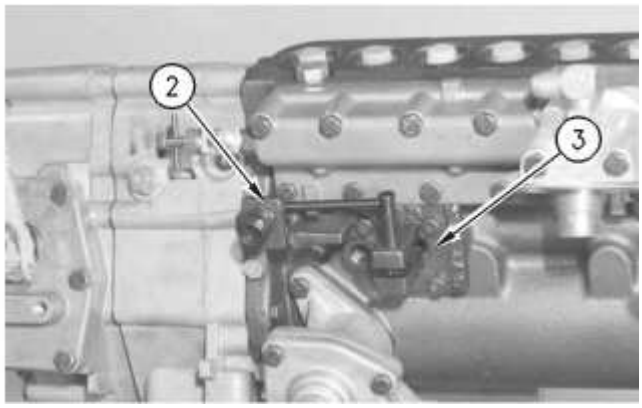


Illustration 21 g00319836

Installed Bracket Assembly

(2) 5P-4814 Collet Clamp

(3) 6V-2014 Bracket

2. Install **5P-4814** Collet Clamp (2) onto **6V-2014** Bracket (3) .

Ver imagen

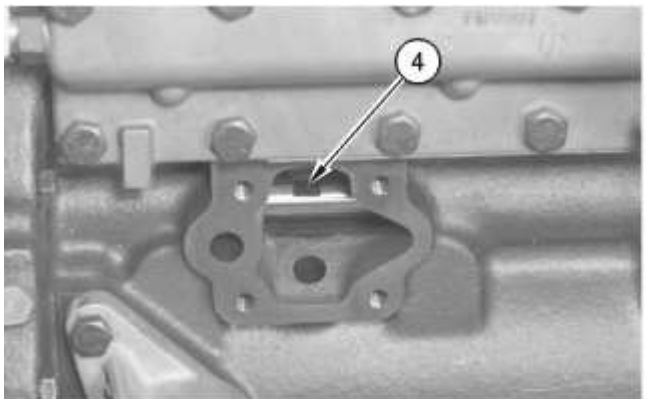


Illustration 22 g00319837

Removed Cover

(4) Slot on the fuel rack

Ver imagen

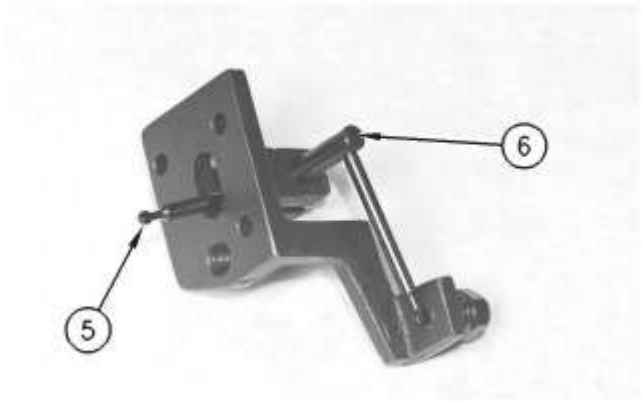


Illustration 23 g00319838

6V-2014 Bracket

(5) Lever

(6) Shaft

3. Install **6V-2014** Bracket (3) onto the fuel injection pump housing. Ensure that lever (5) on the bracket assembly fits slot (4) on the fuel rack.

   After the **6V-2014** Bracket (3) is tightened to the fuel injection pump housing, shaft (6) must have axial movement. Axial movement alternates between clockwise movement and counterclockwise movement.

   If there is no axial movement, ensure of these conditions:

   - Lever (5) fits correctly in the slot (4) on the fuel rack.
   - The bracket assembly is attached correctly.
   - Lever (5) is not bent.

   Remember that lever (5) must be at a right angle (perpendicular) to the mounting face of the bracket assembly.

Ver imagen

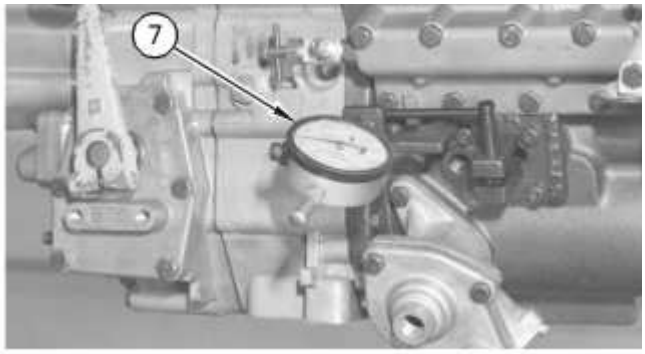


Illustration 24 g00319839

Installed Dial Indicator

(7) 6V-3075 Dial Indicator

4. **9S-0229** Indicator Contact Point measures 9.7 mm (.38 inch) long. Attach this contact point onto **6V-3075** Dial Indicator (7). Also install the dial indicator in **5P-4814** Collet Clamp (2) .

Ver imagen

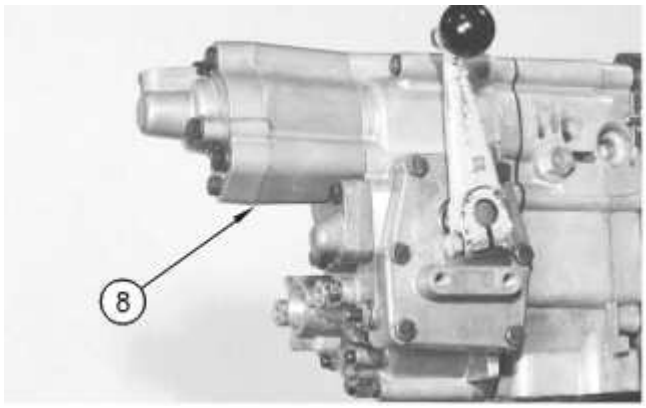


Illustration 25 g00319925

Governor

(8) Fuel air ratio control

5. Remove fuel air ratio control (8) from the rear of the governor housing.

Ver imagen

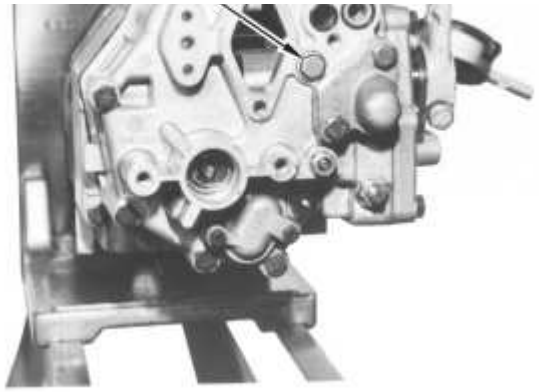


Illustration 26 g00321104

Rear of Governor Housing

(9) Plug

6. Remove plug (9) from the rear of the governor housing.
7. Move the governor control lever to the FUEL-OFF position. This can be done by rotating the governor shaft clockwise.

Ver imagen

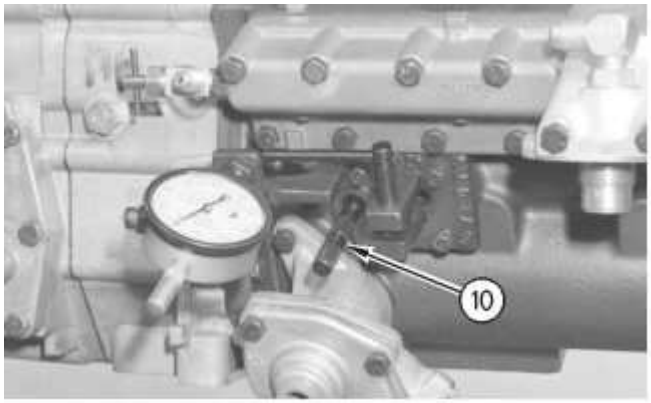


Illustration 27 g00319943

Installed Timing Pin

(10) 6V-4186 Fuel Pump Timing Pin

8. Install **6V-4186** Fuel Pump Timing Pin (10) into the hole in the bracket assembly.
   a. Push in fuel pump timing pin (10) until this timing pin contacts the fuel rack.
   b. Hold the fuel pump timing pin (10) gently against the fuel rack for Steps 9 and 11.

      If too much force is used to hold the fuel pump timing pin (10), the fuel rack can stick. This sticking can produce an incorrect zero reading.

sticking can produce an incorrect zero reading.

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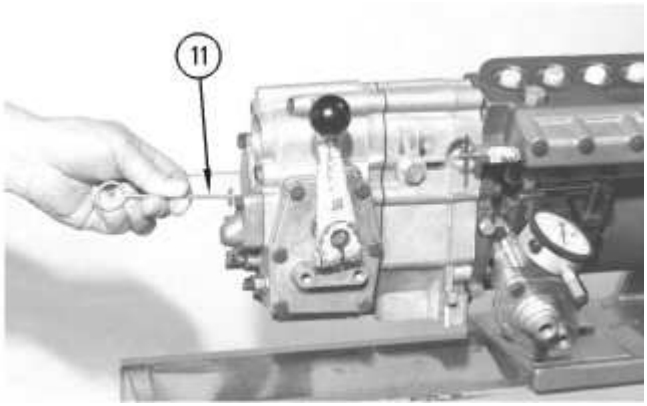


Illustration 28 g00319963

Using 6V-7942 Hook

(11) 6V-7942 Hook

Ver imagen

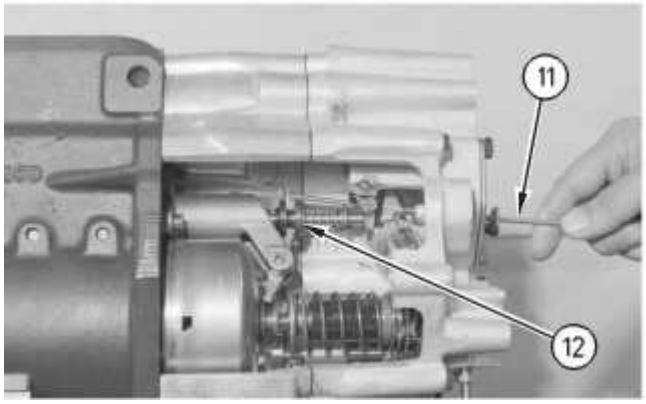


Illustration 29 g00320023

Cutaway View of Governor

(11) 6V-7942 Hook

(12) Collar

9. Hold the governor control lever in the HIGH IDLE position. Rotate the governor shaft counterclockwise.

10. Insert **6V-7942** Hook (11) into the hole that is left from the removal of plug (9) .

    a. Engage the end of **6V-7942** Hook (11) with collar (12) .

b. Pull these two components toward the rear of the governor housing until the collar stops moving.

   This ensures that the fuel rack stops against fuel pump timing pin (10). The rack will then be in zero rack position.

11. With hook (11) that is pulled toward the rear of the governor housing, loosen collet (2).

    a. Then, adjust the revolution counter on the dial indicator to zero.

    b. Tighten collet (2) enough to hold the indicator in this position.

    c. Move the indicator's dial to zero.

12. Remove **6V-4186** Fuel Pump Timing Pin (10) .

Ver imagen

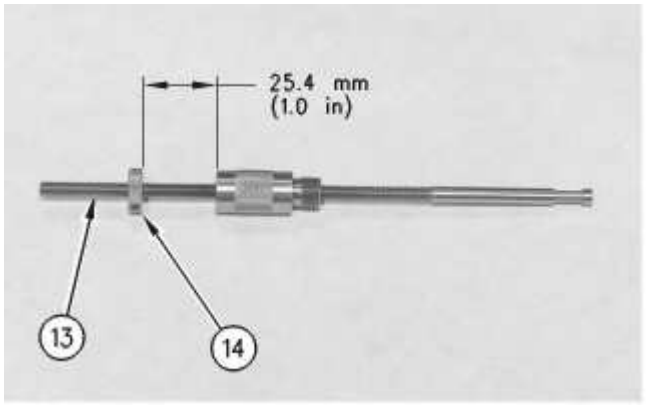


Illustration 30 g00320183

6V-7941 Spring Compressor

(13) Rod

(14) Knob

Ver imagen

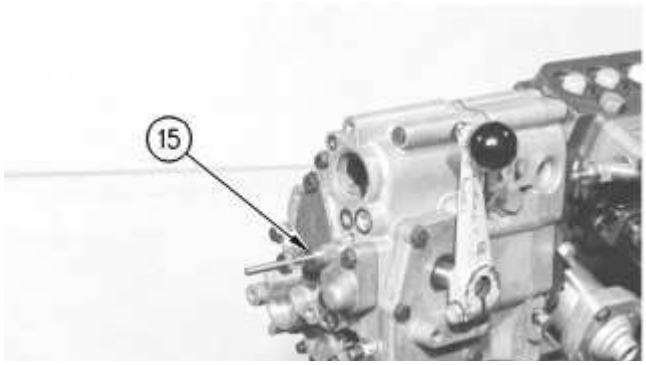


Illustration 31 g00320203

Installed Compressor Assembly

(15) 6V-7941 Spring Compressor

13. Turn rod (13) out of **6V-7941** Spring Compressor (15) until knob (14) is 25.4 mm (1.00 inch) from the compressor body. Install this assembly into the hole that is left from the removal of plug (9) .

Fuel System Without a Torque Spring

Note: The procedure for checking the fuel setting is different from the procedure for adjusting the fuel setting. Use Steps 1 through 4 to check the fuel setting. Use Steps 6 through 8 to adjust the fuel setting.

Ver imagen

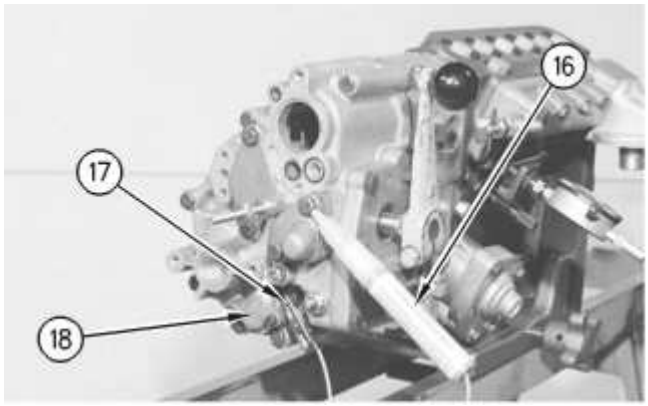


Illustration 32 g00320505

Checking the Static Fuel Setting

(16) 8T-0500 Continuity Tester

(17) Rack contact screw

(18) Adjustment screw cover

1. Fasten the clip end of **8T-0500** Continuity Tester (16) to rack contact screw (17). Connect the other end to an electrical ground.

2. Hold the governor control lever in the FUEL-ON position. Fully rotate the governor control lever in a counterclockwise direction.

3. Turn rod (13) on **6V-7941** Compressor Assembly (15) clockwise until the light in the continuity tester (16) goes out.

   After the light goes out, the hands on the dial indicator will move for an additional 2 mm in the negative direction.

NOTICE

Do not turn the rod any further inward if the rod begins to tighten. Damage to the governor can occur if the rod is turned further inward.

4. Slowly turn rod (13) counterclockwise until the circuit tester light just turns on. This is the static fuel setting.

   Note: See the TMI for more information on the correct static fuel setting.

   Note: There will be a small, initial amount of movement by the indicator hands. Then, the indicator hands will stop moving while the rod is turned out for another 1 1/2 turns. Now, the indicator hands will begin to move again. The indicator hands will follow the turning of the rod until the setting is reached. Remember to turn the rod slowly so the rack can follow the governor components.

5. If the static fuel setting is not correct, remove adjustment screw cover (18) from the rear of the governor housing.

Ver imagen

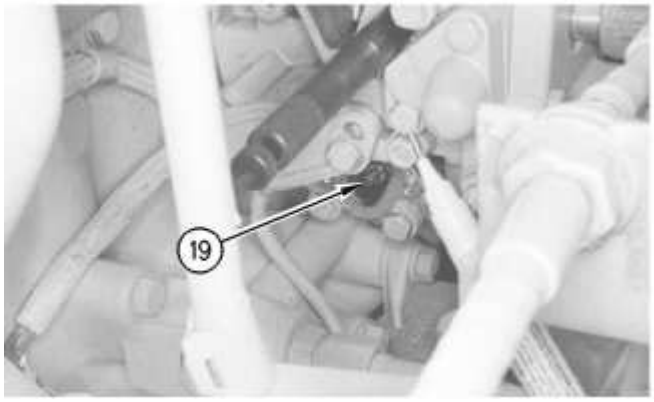


Illustration 33 g00320507

Adjustment Screw Cover after Removal

(19) Fuel setting screw

6. Determine the amount that the static fuel setting must change. Use Table 5 for turning measurements. Also, review the following examples carefully.

Table 5

Adjustment Screw Chart	
Amount of Change	**Turns of Adjustment Screw**
3.0 mm (.118 inch)	3 3/4

2.8 mm (.110 inch)	3 1/2
2.6 mm (.102 inch)	3 1/4
2.4 mm (.094 inch)	3
2.2 mm (.087 inch)	2 3/4
2.0 mm (.079 inch)	2 1/2
1.8 mm (.071 inch)	2 1/4
1.6 mm (.063 inch)	2
1.4 mm (.055 inch)	1 3/4
1.2 mm (.047 inch)	1 1/2
1.0 mm (.039 inch)	1 1/4
.08 mm (.031 inch)	1
.06 mm (.024 inch)	3/4
.04 mm (.016 inch)	1/2
.02 mm (.008 inch)	1/4

Table 6

Example #1

Actual Reading	(1.05 mm)
Desired Reading	(1.25 mm)
Difference	(0.20 mm)

Since the desired setting is higher than the actual reading, turn the adjustment screw counterclockwise by approximately 1/4 of a turn. Recheck the new setting, and readjust the setting, if necessary.

Please, review the remaining examples:

Table 7

Example #2

Actual Reading	(2.77 mm)
Desired Reading	(1.85 mm)
Difference	(0.92 mm)

Since the desired setting is lower than the actual reading, turn the adjustment screw clockwise by approximately 1 1/8 of a turn. Recheck the new setting, and readjust the setting, if necessary.

Table 8

Example #3

Actual Reading	(-1.05 mm)
Desired Reading	(-1.25 mm)
Difference	(0.20 mm)

Negative numbers work differently than positive numbers. If one number (-1.25) has a larger value than the other number (-1.05), the first number is actually less than the other number. Therefore, the desired setting is lower than the actual reading. Turn the adjustment screw clockwise by approximately 1/4 of a turn. Recheck the new setting, and readjust the setting, if necessary.

Table 9

Example #4

Actual Reading	(-2.77 mm)
Desired Reading	(-1.85 mm)
Difference	(0.92 mm)

Since the desired setting is higher than the actual reading, turn the adjustment screw counterclockwise by approximately 1 1/8 of a turn. Recheck the new setting, and readjust the setting, if necessary.

Table 10

Example #5

Actual Reading	(+1.05mm)
Desired Reading	(-1.25 mm)
Difference	(2.30 mm)

The desired setting is lower than the actual reading. Therefore, turn the adjustment screw clockwise by approximately 2 7/8 of a turn. Recheck the new setting, and readjust the setting, if necessary.

Table 11

Example #6

Actual Reading	(-1.05mm)
Desired Reading	(+1.25 mm)
Difference	(2.30 mm)

The desired setting is higher than the actual reading. Turn the adjustment screw counterclockwise by approximately 2 7/8 of a turn. Recheck the new setting, and readjust the setting, if necessary.

Ver imagen

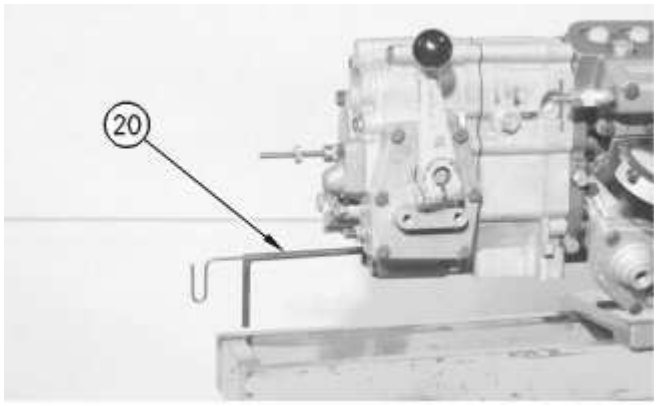


Illustration 34 g00320508

Adjusting the Fuel Setting

(20) 6V-2105 Rack Adjustment Tool

7. Use **6V-2105** Rack Adjustment Tool (20) to loosen the locknut for the adjustment screw. Also, use this tool in order to turn the locknut.

8. Adjust the fuel setting screw by the number of turns that were determined in Step 6. Always recheck the fuel setting after you adjust the setting. Adjust the setting again, if necessary.

Fuel System With a Torque Spring

Ver imagen

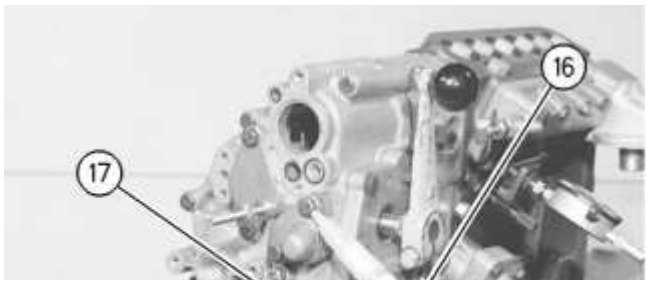


Illustration 35 g00320505

Checking the Static Fuel Setting

(16) 8T-0500 Continuity Test Light

(17) Rack contact screw

(18) Adjustment screw cover

1. Fasten the clip end of **8T-0500** Continuity Tester (16) to rack contact screw (17). Connect the other end to an electrical ground.
2. Hold the governor control lever in the FUEL-ON position. Fully rotate the governor control lever in a counterclockwise direction.
3. Turn rod (13) on **6V-7941** Compressor Assembly (15) clockwise until the light in the continuity tester (16) goes out.

   After the light goes out, the hands on the dial indicator will move for an additional 2 mm in the negative direction.

NOTICE

Do not turn the rod any further inward if the rod begins to tighten. Damage to the governor can occur if the rod is turned further inward.

4. Slowly turn rod (13) counterclockwise until the circuit tester light just turns on. This is the static fuel setting.

   Note: See the TMI for more information on the correct static fuel setting.

   Note: There will be a small, initial amount of movement by the indicator hands. Then, the indicator hands will stop moving while the rod is turned out for another 1 1/2 turns. Now, the indicator hands will begin to move again. The indicator hands will follow the turning of the rod until the setting is reached. Remember to turn the rod slowly so the rack can follow the governor components.
5. Slowly turn rod (13) outward until the indicator hands stop moving. Then, turn the rod outward for an additional 1 to 2 turns.
6. Push in on the rack stop collar. The new reading on the dial indicator is the Full Torque Setting. Refer to the TMI for additional information.

   Note: On later engines, the dimension for the Full Torque Setting is given on the Engine Information Plate. The Full Torque Setting is a direct reading on the dial indicator.

Table 12

Example #1

Static Fuel Setting	(2.18 mm)
Static Full Torque Setting	(3.18 mm)
Torque Rise Differential	(1.00 mm)

7. If the fuel setting or the full torque setting is not correct, remove adjustment screw cover (18) from the rear of the governor housing.

8. Refer to Table 12. Determine the changes of the settings. Refer to Table 5 in order to determine the number of turns for the adjustment screws.

9. Use the **6V-2105** Rack Adjusting Tool to loosen the locknut for the adjustment screw. Also use this tool in order to turn the locknut.

10. If both settings need to be increased turn the torque adjustment screw counterclockwise for the same number of turns as the fuel setting adjustment screw. If the static fuel setting must be decreased, it is not necessary to change the torque rise setting at this time.

11. Adjust the fuel setting screw by the number of turns that were determined in Step 8. Always recheck the fuel setting after you adjust the setting. Adjust the setting again, if necessary.

12. After the static fuel setting is correct, adjust the torque rise adjustment screw by the number of turns that were determined in Step 8. Always recheck the fuel setting after you adjust the setting. Adjust the setting again, if necessary.

Engine Speed Measurement

Table 13

Required Tools		
Part Number	**Part Name**	**Quantity**
9U-7400 6V-4950	Multitach Tool Gp or Speed Pickup	1

Ver imagen

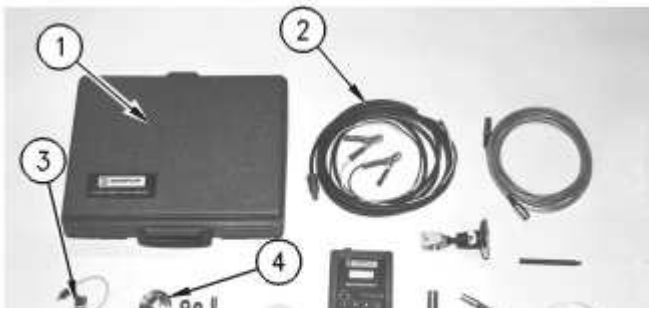


Illustration 36 g00320509

9U-7400 Multitach Tool Gp

(1) Carrying case

(2) Power cable

(3) Tachometer generator

(4) Tachometer drive group

(5) Multitach

The **9U-7400** Multitach Tool Gp can measure engine speed from a tachometer drive on the engine. This multitach can also measure engine speed from the tracking of tape on a rotating engine part.

Note: See Special Instruction, NEHS0605. This information is provided with the **9U-7400** Multitach Tool Gp. This information also provides instructions for the test procedure.

The **6V-4950** Speed Pickup can be used as a diagnostic tool accessory with a **9U-7400** Multitach Tool Gp.

Ver imagen

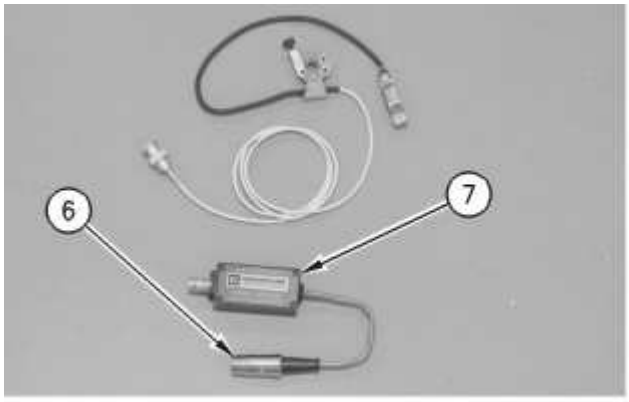


Illustration 37 g00320510

6V-4950 Speed Pickup

(6) 1U-9139 Fuel Line Pickup

(7) 6V-6113 Pickup Amplifier

The **6V-4950** Speed Pickup can be used on all Caterpillar Diesel Engines that are equipped with 6 mm (.25 inch) single wall fuel injection lines. This speed pickup can measure engine rpm automatically. This speed pickup can also measure engine rpm with an accuracy of ±1 rpm.

Note: See Special Instruction, SEHS8029 that is with this tooling. This publication provides instructions for using the **6V-4950** Speed Pickup .

Governor Adjustments

NOTICE

A service technician with training in governor adjustments is the only one to make the adjustment to the set point rpm.

Check engine rpm with an accurate tachometer. See "Engine Speed Measurement".

Low Idle Adjustment

Note: You can find the correct low idle rpm in the TMI.

WARNING

Personal injury can result from rotating and moving parts.

Moving fan blades and moving parts will throw or cut any object or tool that falls or is pushed into them.

Ensure that no one is working on, underneath or close to the machine before starting the engine. Ensure the area is free of personnel.

Start the engine, and operate the engine until the engine reaches the normal operating temperature. Check the low idle rpm without a load on the engine. If you need to make an adjustment, use the following procedure:

1. To adjust the low idle rpm, operate the engine with the governor in the LOW IDLE position:

Ver imagen

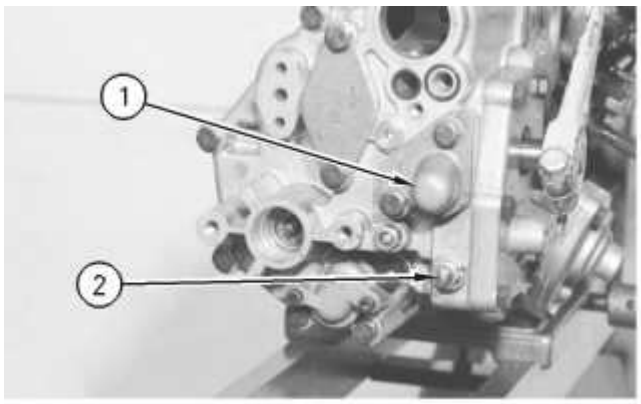


Illustration 38 g00320512

Low Idle Adjustment

(1) Cover

(2) Low idle screw

a. Loosen the locknut for low idle screw (2) .

b. Find the correct low idle rpm by turning low idle screw (2) .

c. Then, increase engine rpm, and return to low idle rpm.

d. Recheck the low idle rpm.

e. Tighten the locknut.

Checking the Set Point (Balance Point)

Table 14

Required Tools		
Part Number	**Part Name**	**Quantity**
9U-7400	Multitach Tool Gp	1

Refer to Illustration 36.

An engine relies on the set point (balance point) for the correct operation of the engine. An engine's set point is an adjusted specification. High idle rpm is NOT an adjusted specification.

The set point (balance point) equals full load rpm plus an additional 20 rpm. The set point is a measuring point that can be measured. At the set point, the fuel setting adjustment screw and the first torque spring just begin to make contact.

At this rpm, the fuel setting adjustment screw and the first torque spring still have movement between the two components. When an additional load is put on the engine, the fuel setting screw with the stop, or the first torque spring will become stable. These components stabilize after the initial contact with pressure.

Ultimately, the fuel setting adjustment screw and the first torque spring control the set point.

There is a new, more accurate method for checking the set point of the engine. Review the required tools for the new method. If these tools are not available, you can use an alternative method for checking the set point.

Note: See Special Instruction, NEHS0605 for instructions on the installation and usage of the Multitach Tool Gp .

Alternative Method for Checking Set Point

Table 15

Required Tools		
Part Number	**Part Name**	**Quantity**

8T-0500	Circuit Test Light	1
9U-7400	Multitach Tool Gp	1

If the set point is correct and the high idle rpm is within specifications, the fuel system operation of the engine is correct.

- The set point for the engine is 20 rpm greater than full load rpm.
- The set point for the engine is at the rpm when the fuel setting screw first contacts the stop, or the first torque spring.

Use the following procedure to check the set point:

Ver imagen

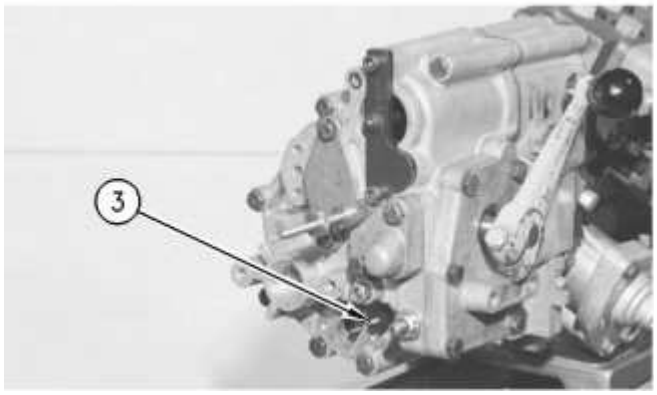


Illustration 39 g00320609

Terminal Location

(3) Brass terminal screw

Note: See Special Instruction, SEHS7050 for additional information on loading an engine.

1. Connect an accurate tachometer to the tachometer drive.
2. Connect the clip end of the **8T-0500** Continuity Test Light to brass terminal screw (3) on the governor housing.
3. Then, connect the other end of the tester to a place on the fuel system with a good ground connection.

WARNING

Personal injury can result from rotating and moving parts.

Moving fan blades and moving parts will throw or cut any object or tool that falls or is pushed into them.

Ensure that no one is working on, underneath or close to the machine before starting the engine. Ensure the area is free of personnel.

4. Start the engine.
5. With the engine at normal operating conditions, operate the engine at high idle.
6. Record the rpm of the engine at high idle.
7. Slowly add load to the engine until the circuit tester light just comes on.

   This is the set point.
8. Record the engine rpm at the set point.
9. To ensure that the correct reading is found, repeat Step 7 several times.
10. Stop the engine.
11. Compare the records from both Steps 6 and 8 with the information on the Engine Information Plate.

    If the Engine Information Plate is not available, see the TMI.

    The tolerance for the set point is ± 10 rpm. The tolerance for high idle rpm is ± 30 rpm. If the readings from both Steps 6 and 8 are within tolerance, no adjustment is needed.

Note: In some applications, high idle rpm will be less than the lower limit. This can be caused by high parasitic loads. Loads with hydraulic pumps and loads with compressors are good examples of high parasitic loads.

Adjusting the Set Point (Balance Point)

If the set point and the high idle rpm are within tolerance, no adjustment is needed.

If the set point is not correct, follow these instructions:

1. Remove cover (1), and loosen the locknut.

Ver imagen

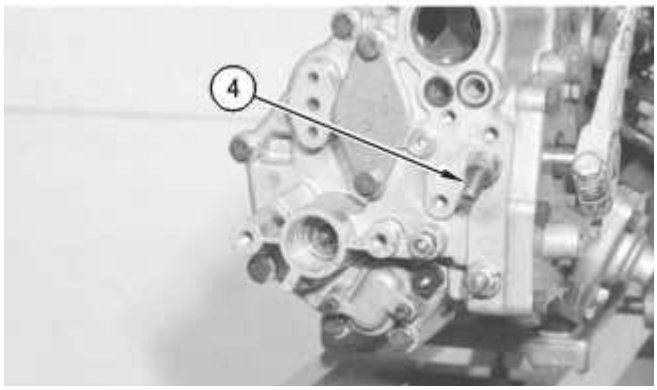


Illustration 40 g00320610

Adjustment for Set Point

(4) Adjustment screw

2. Turn adjustment screw (4) in order to adjust the set point to the midpoint of the tolerance.
3. When the set point is correct, check the high idle rpm. The high idle rpm must not be more than the high limit of the tolerance.
   a. If the high idle rpm is more than the high limit of tolerance, check the governor spring and the flyweights.
   b. If the high idle rpm is less than the low limit of tolerance, check the governor for excess parasitic loads. Then, check the governor spring and the flyweights.

Dashpot Screw Adjustment

The dashpot adjustment screw does not need an adjustment normally from the factory setting. If the engine is slow in changing rpm with a change in load, the dashpot adjustment screw may possibly need an adjustment.

Ver imagen

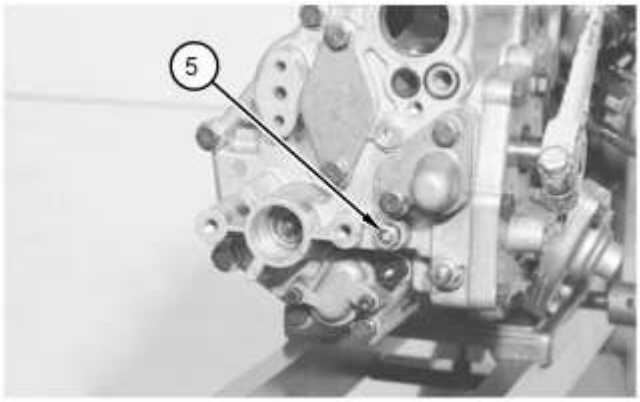


Illustration 41 g01110036

Dashpot Screw Adjustment

(5) Dashpot adjustment screw

Ver imagen

Illustration 42 g00390372

1. Turn dashpot adjustment screw (5) clockwise until the dashpot adjustment screw stops.
2. Turn dashpot adjustment screw (5) counterclockwise by 1/2 ± 1/4 turn.

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

This special instruction provides the necessary information in order to create SIS Web Feedback. All information provided in this document is necessary in order to provide the SIS Web Feedback analyst with the necessary information to expedite the resolution. SIS Web feedback is intended to provide feedback on any discrepancies within the Service/Parts literature. The feedback system is not intended to address any problems related to machine or component performance. Refer to the Dealer Solutions Network (DSN) for any problems associated with machine or component performance.

Note: Feedback is only available through SIS Web. Feedback is not available through SIS Network or SIS DVD.

Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

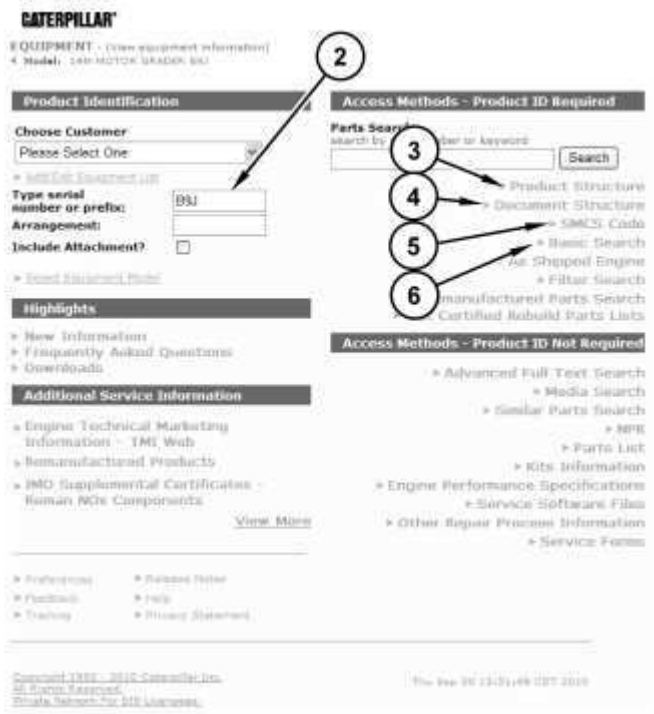


Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

   Note: Using any other method in searching for parts and service information will result in missing information in the discrepancy ticket. Any missing information may delay resolution of the discrepancy.

Ver imagen

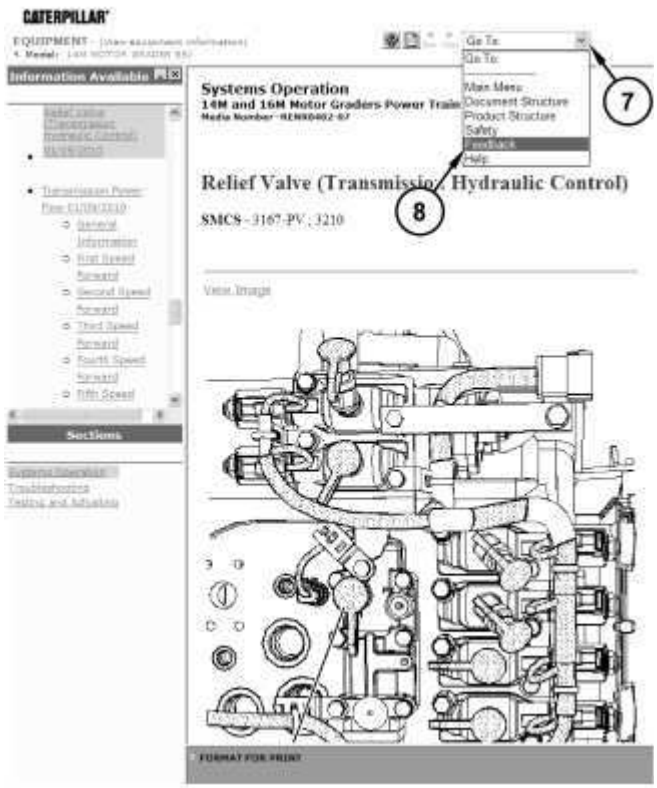


Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

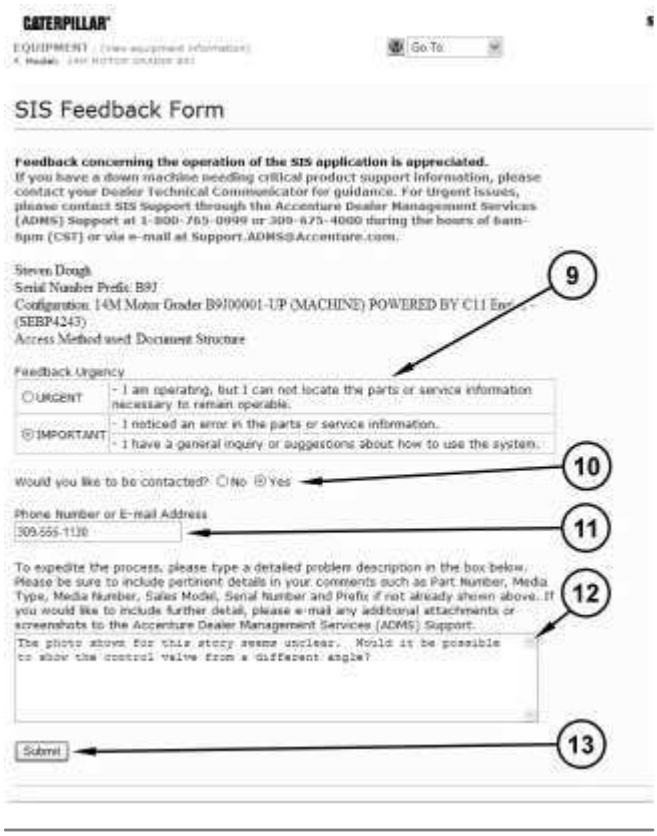


Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
7. Provide the contact information in box (11). The contact information can include an E-mail address and/or a telephone number.
8. Provide a detailed description of the discrepancy in box (12). Be sure to include pertinent details such as: part number, media type, media number, sales model, serial number and prefix. This information will expedite the resolution of the discrepancy.
9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

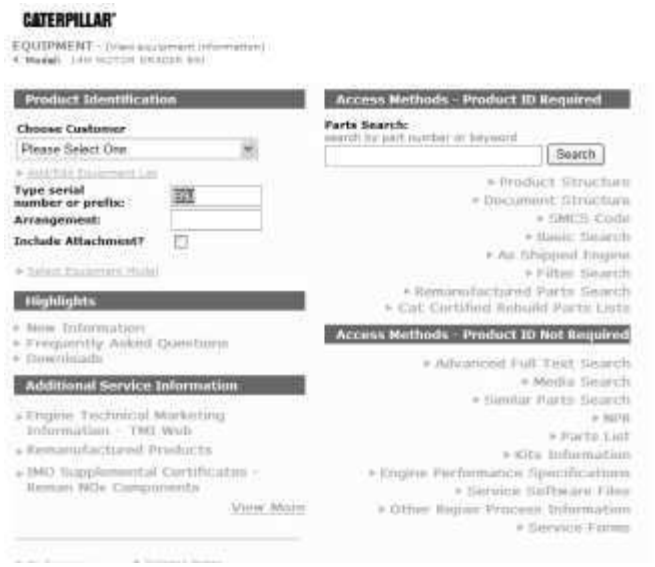
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



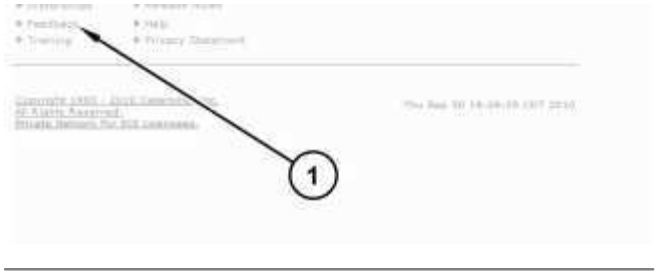


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Index of Wall Charts for Drive Train, Hydraulics, Engine and Undercarriage{1000, 4000, 4150, 5050}

SMCS - 1000; 4000; 4150; 5050

Caterpillar Products: All
Engine:Commercial All Diesel
Engine:Truck All

Introduction

This guideline enables dealers and customers to benefit by providing an index for the current wall charts. The index will provide an easy way to locate the media numbers and the titles of the wall charts. This guideline must be used with the latest information that is available from Caterpillar Inc. in order to be sure that improvements are incorporated.

Wall charts are publications that generally contain the following items:

- Disassembly procedures
- Assembly procedures
- Special torques
- Torque sequences

The wall charts are printed on paper that is resistant to stains and tears. Wall charts cover selected models of the following items:

- Drive train
- Undercarriage
- Engines
- Hydraulics

Wall charts cannot be viewed in SIS. Caterpillar dealers can view wall charts from the Web site for your regional marketing profit center. Caterpillar customers should contact a Caterpillar dealer in order to view wall charts. You will not be able to print these wall charts. You will not be able to change these wall charts.

To view the wide range of Caterpillar wall charts, perform the following steps:

1. Go to the Web site for your regional marketing profit center.
2. Scroll down the left side and select "SERVICE OPERATIONS". A new page will be displayed.
3. Select "REPAIR PROCEDURES". A new page will be displayed.
4. Click on the link under the tab for "WALL CHARTS". A new page will be displayed.
5. Select the link that corresponds to the wall chart that suits your needs. The wall chart will be

displayed.

Wall Charts

Table 1

Drive Train		
Form Number	**Title**	**Web Address (1)**
RENR1978	"785B Final Drive Group Tapered Bearing Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349300/7/sebf1978-00.pdf
RENR5396	"797 & 797B Final Drive Group Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349301/7/senr5396-01.pdf
SENR5669	"789B Final Drive Group Straight Bearing Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349302/7/senr5669-01.pdf
SENR6235	"785 & 789 Transmission Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349303/7/senr6235-00%20assembly.pdf
SENR6235	"785 & 789 Transmission Sepcifications"	https://productsupportglobalcontent.cat.com/cda/files/349304/7/senr6235-00%20specifications.pdf
SENR6389	"785B Final Drive Group Straight Bearing Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349305/7/senr6389-01.pdf
SENR6834	"793 Transmission Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349306/7/senr6834-00%20assembly.pdf
SENR6834	"793 Transmission Specifications"	https://productsupportglobalcontent.cat.com/cda/files/349307/7/senr6834-00%20specifications.pdf
SENR8602	"793 Final Drive Group Assembly"	https://productsupportglobalcontent.cat.com/cda/files/349308/7/senr8602-01.pdf
SENR9014	" **8W-9545** Differential and Bevel Gear Group used in 785 Trucks"	https://productsupportglobalcontent.cat.com/cda/files/349309/7/senr9014-00.pdf
SENR9015	"Assembly for **8W-9550** Differential and Bevel Gear Group Used in 793 Trucks"	https://productsupportglobalcontent.cat.com/cda/files/349315/7/senr9015-00.pdf
SENR9016	"Assembly for **8X-0243** Differential and Bevel Gear Group Used in 793 Trucks"	https://productsupportglobalcontent.cat.com/cda/files/349316/7/senr9016-00.pdf

(1) All web addresses were current at the time of publication.

Table 2

Undercarriage

Undercarriage		
Form Number	**Title**	**Web Address** (1)
RENR2052	"Disassembly and Assembly Procedures for Idlers with Inverted Duo-Cone Seals"	https://productsupportglobalcontent.cat.com/cda/files/347335/7/renr2052.pdf
RENR2059	"Disassembly and Assembly Procedures for Rollers with Inverted Duo-Cone Seals"	https://productsupportglobalcontent.cat.com/cda/files/348235/7/renr2059.pdf
RENR3960	"Disassembly and Assembly Procedures for Idlers with Conventional Duo-Cone Seals"	https://productsupportglobalcontent.cat.com/cda/files/347338/7/renr3960.pdf
RENR3961	"Disassembly and Assembly Procedures for Rollers with Conventional Duo-Cone Seals"	https://productsupportglobalcontent.cat.com/cda/files/347339/7/renr3961.pdf
RENR3962	"Disassembly and Assembly Procedures for Snap Ring and Oval Track Rollers"	https://productsupportglobalcontent.cat.com/cda/files/347340/7/renr3962.pdf
RENR3963	"Disassembly and Assembly Procedures for Hydraulic Excavator "	https://productsupportglobalcontent.cat.com/cda/files/347341/7/renr3963.pdf
RENR3964	"Disassembly and Assembly Procedures for Hydraulic Excavator Idlers"	https://productsupportglobalcontent.cat.com/cda/files/347342/7/renr3964.pdf
RENR3965	"Adjustment, Setup, and Operation Procedures for the Caterpillar Track Torque Wrench"	https://productsupportglobalcontent.cat.com/cda/files/348941/7/renr3965-00-01-all.pdf
SENR1788	"Non-PPR Sealed and Lubricated Track Reconditioning"	https://productsupportglobalcontent.cat.com/cda/files/347369/7/senr1788-03.pdf
SENR1838	"Positive Pin Retention Sealed and Lubricated Track Reconditioning"	https://productsupportglobalcontent.cat.com/cda/files/347370/7/senr1838-03.pdf

(1) All web addresses were current at the time of publication.

Table 3

Engine		
Form		

Form Number	Title	Web Address [1]
RENR1230	"In-Frame Overhaul Procedure 3116 & 3126 HEUI Diesel Truck"	https://productsupportglobalcontent.cat.com /cda/files/347333/7/renr1230-02.pdf
RENR1935	"3516 & 3516B Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347334/7/renr1935-02.pdf
RENR3731	"3512 & 3516B Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347337/7/renr3731-02.pdf
RENR3968	"C7 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347345/7/renr3968.pdf
RENR3969	"C13 On-Highway Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347346/7/renr3969.pdf
RENR3974	"In-Frame Overhaul Procedure C9 On-Highway Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347347/7/renr3974.pdf
RENR3976	"C9 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/348236/7/renr3976.pdf
RENR3977	"C15 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347349/7/renr3977.pdf
RENR3978	"C7 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347350/7/renr3978.pdf
RENR9683	"C11 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347352/7/renr9683.pdf
RENR9684	"C13 On-Highway Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347353/7/renr9684.pdf
RENR9686	"Major Overhaul Procedure Chart (Use Remanufactured Components) C18 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347354/7/renr9686-01-01-all.pdf
RENR9689	"Major Overhaul Procedure Chart (Use Remanufactured Components) C11 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347356/7/renr9689.pdf
RENR9690	"Major Overhaul Procedure Chart (Use Remanufactured Components) C13 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347357/7/renr9690.pdf
RENR9693	"Major Overhaul Procedure Chart (Use Remanufactured	https://productsupportglobalcontent.cat.com /cda/files/347358/7/renr9693.pdf

	Components) C15 Engine"	
RENR9696	"In-Frame Overhaul Procedure C11"	https://productsupportglobalcontent.cat.com /cda/files/347359/7/renr9696.pdf
RENR9697	"Major Overhaul Procedure Chart (Use Remanufactured Components) C27 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347360/7/renr9697-01-01-all.pdf
RENR9698	"In-Frame Overhaul Procedure C13 Truck Engines"	https://productsupportglobalcontent.cat.com /cda/files/347361/7/renr9698.pdf
RENR9699	"C18 Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/348934/7/renr9699.pdf
RENR9700	"C18 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/348935/7/renr9700.pdf
SENR1177	"In-Frame Overhaul Procedure 3306C Diesel Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347362/7/senr1177-02.pdf
SENR1182	"In-Frame Overhaul Procedure 3406C Diesel Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347363/7/senr1182-02.pdf
SENR1183	"In-Frame Overhaul Procedure 3406E & C-15 Diesel Truck Engines"	https://productsupportglobalcontent.cat.com /cda/files/347364/7/senr1183-02.pdf
SENR1198	"In-Frame Overhaul Procedure for the C-10, C-12 Truck Engines and the 3176C Engine and the 3196Engine"	https://productsupportglobalcontent.cat.com /cda/files/347365/7/senr1198-02.pdf
SENR2002	"3204 Engine Assembly Procedure (Engines with Precombustion Chambers)"	https://productsupportglobalcontent.cat.com /cda/files/347371/7/senr2002-02.pdf
SENR2027	"3304 Engine Assembly Procedure (Spacer Plate Engines)"	https://productsupportglobalcontent.cat.com /cda/files/347372/7/senr2027-02.pdf
SENR2028	"3306 Engine Assembly Procedure (Spacer Plate Engines)"	https://productsupportglobalcontent.cat.com /cda/files/347373/7/senr2028-02.pdf
SENR2030	"3204 Engine Assembly Procedure (With DI)"	https://productsupportglobalcontent.cat.com /cda/files/347374/7/senr2030-02.pdf
SENR2059	"3208 Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347375/7/senr2059-03.pdf
SENR2060	"In-Frame Overhaul Procedure 3208 Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347376/7/senr2060-02.pdf
SENR2061	"In-Frame Lower End Overhaul Procedure 3208 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347377/7/senr2061-02.pdf
SENR2181	"3406 Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347378/7/senr2181-02.pdf

	Determination Procedure	/cda/files/347378/7/senr2181-02.pdf
SENR2182	"In-Frame "Lower End" Overhaul Procedure 3406 Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347380/7/senr2182-02.pdf
SENR2183	"In-Frame Overhaul Procedure 3406 Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347381/7/senr2183-02.pdf
SENR2589	"3208 Mobile Ag Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347382/7/senr2589-02.pdf
SENR2590	"In-Frame Overhaul Procedure 3208 Mobile Ag Engine"	https://productsupportglobalcontent.cat.com /cda/files/347383/7/senr2590.pdf
SENR2591	"In-Frame "Lower End" Overhaul Procedure 3208 Mobile Ag Engine"	https://productsupportglobalcontent.cat.com /cda/files/347384/7/senr2591.pdf
SENR2743	"3306 PC/DI Truck Engine Repair Determination Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347385/7/senr2743-02.pdf
SENR2744	"In-Frame Overhaul Procedure 3306 PC/DI Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347386/7/senr2744-02.pdf
SENR2745	"In-Frame "Lower End" Overhaul Procedure 3306 PC/DI Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347387/7/senr2745-02.pdf
SENR3009	"One Day In-Frame Overhaul Procedure 3406 Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347388/7/senr3009-02.pdf
SENR3293	"Major Overhaul Procedure Chart (Use Remanufactured Components) 3208 Engine"	https://productsupportglobalcontent.cat.com /cda/files/347389/7/senr3293.pdf
SENR3460	"In-Frame Overhaul Procedure 3406 & 3406B Truck Engines"	https://productsupportglobalcontent.cat.com /cda/files/347395/7/senr3460-02.pdf
SENR3917	"In-Frame Overhaul Procedure 3306 & 3306B Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347396/7/senr3917-02.pdf
SENR3918	"In-Frame Overhaul Procedure 3208NA & 3208T Truck Engines"	https://productsupportglobalcontent.cat.com /cda/files/347397/7/senr3918.pdf
SENR5128	"3512 & 3516 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347398/7/senr5128-03.pdf
SENR5156	"3508 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347399/7/senr5156-02.pdf
SENR6598	"3116 In-Frame Overhaul Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347400/7/senr6598-02.pdf
SENR6599	"In-Frame Overhaul Procedure 3176 Diesel Truck Engine"	https://productsupportglobalcontent.cat.com /cda/files/347401/7/senr6599-02.pdf

SENR7362	"3306 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347406/7/senr7362-05.pdf
SENR7397	"D348 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347407/7/senr7397-03.pdf
SENR7412	"3406 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347408/7/senr7412-03.pdf
SENR7461	"D342 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347409/7/senr7461-04.pdf
SENR7471	"D346 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347410/7/senr7471-03.pdf
SENR7472	"D343 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347411/7/senr7472-03.pdf
SENR7473	"D353 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347412/7/senr7473-03.pdf
SENR7595	"D353 Engine Assembly Procedure (Spacer Plate Engines)"	https://productsupportglobalcontent.cat.com /cda/files/347413/7/senr7595-03.pdf
SENR7781	"D342 Engine Assembly Procedure (Spacer Plate Engines)"	https://productsupportglobalcontent.cat.com /cda/files/347414/7/senr7781-04.pdf
SENR7884	"3408 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/348936/7/senr7884-03.pdf
SENR7885	"3412 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347415/7/senr7885-02.pdf
SENR7897	"3304 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347830/7/senr7897-02.pdf
SENR7898	"3208 Engine Assembly Procedure"	https://productsupportglobalcontent.cat.com /cda/files/347831/7/senr7898-02.pdf

(1) All web addresses were current at the time of publication.

Table 4

Hydraulics		
Form Number	**Title**	**Web Address** (1)
SENR4939	"Swing & Track Motor Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files /348334/7/senr4939-00-01-all.pdf
SENR4940	"Track Motor Assembly Procedure for 973 Track Type Loader"	https://productsupportglobalcontent.cat.com/cda/files /348335/7/senr4940-00-01-all.pdf

SENR5206	"Hydrostatic Transmission Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files/348336/7/senr5206-00-01-all.pdf
SENR5207	"Piston Pump Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files/350132/7/senr5207-00-01-all.pdf
SENR5418	"Hydraulic Cylinder Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files/350131/7/senr5418-00-01-all.pdf
SENR6084	"300 Family Excavator Hydraulic Cylinder Assembly Procedures"	https://productsupportglobalcontent.cat.com/cda/files/348337/7/senr6084-00-01-all.pdf

(1) All web addresses were current at the time of publication.

Encontrará piezas Cat originales,

SMCS - 1000; 7000

Productos Caterpillar:
- **Todos**

ReferenciaInstrucción Especial, REHS5326, "Procedimiento para hacer pedidos de Vintage Parts"

Nota: Vintage Parts, Inc. no está asociado con Caterpillar Classic Parts.

Tradicionalmente, Caterpillar desechaba las piezas de repuesto obsoletas, inactivas y con movimiento lento cuando llegaban al fin de su vida útil. A través de un acuerdo entre Caterpillar y Vintage Parts, Inc., las piezas que se descontinúan por parte de Cat se transferirán a Vintage Parts, y estarán disponibles para la venta sólo a través de distribuidores de Caterpillar autorizados.

Las piezas tendrán el costo del último precio de venta neto publicado por un distribuidor Cat. Con el tiempo Vintage Parts puede ajustar el precio según lo considerenecesario. Vintage Parts le facturará a los distribuidores Cat directamente por los pedidos de las piezas más el envío. Todas las piezas son originales de Caterpillar, no son usadas ni universales. Las compras a través de este programa no otorgan derechos, garantías implícitas ni devoluciones por parte de Caterpillar.

Al encontrarse con una pieza cancelada o discontinuada, los distribuidores deben consultar la Columna 3 del Registro numérico de piezas (NPR), para averiguar si la pieza puede estar disponible en Vintage Parts. Dirija las preguntas de disponibilidad al equipo de Servicio de asistencia al cliente de Vintage Parts al(877) 846-8243 (EE. UU. y Canadá) o, (920) 356-0653 (Internacional). También puede comunicarse con el Servicio de asistencia al cliente de Vintage Parts a través del sitio web de Vintage Parts en la siguiente dirección:

http://www.vpartsinc.com

El horario de atención al cliente es de lunes a viernes de 7:00 a.m. a 7:00 p.m. y sábados de 7:30 a.m. a 1:30 p.m. Zona horaria central de EE. UU. Las piezas se enviarán en el mismo día si se realiza el pedido antes de las 4:00 p.m. del horario central o el próximo día laboral. Vintage Parts permite realizar cambios de las piezas durante 30 días sin cargo o realizar devoluciones de piezas sin fallas al distribuidor. Este programa está disponible en todo el mundo, para todos los distribuidores Caterpillar.

Nuevo método de entrega para las Informaciones Técnicas y las Crónicas de motor

SMCS - 1000; 7000

Productos Caterpillar:

- **Todos**

Service Magazine SSPD1011, 28 septiembre 2009, "Nuevo método de entrega para las Informaciones Técnicas y las Crónicas de motor". Haga caso omiso de este artículo. Consulte el artículo siguiente.

Después de revisar los resultados de la encuesta que se publicó en las Informaciones Técnicas y las Crónicas de motor anteriores, se ha determinado que se descontinuará el envío por correo de estas publicaciones. Las últimas copias en papel de estas publicaciones se imprimirán el 28 de septiembre de 2009. Si actualmente recibe una copia impresa de estas publicaciones y no tiene acceso al SIS Web de Caterpillar, contacte a su distribuidor local para obtener acceso al SIS Web de Caterpillar. Estos artículos están disponibles diariamente en SIS Web de Caterpillar a partir del 1 de octubre de 2009. Para los distribuidores Caterpillar, un archivo .pdf de la Información Técnica y de la Crónica de motor completas estará disponible para ver, descargar e imprimir a través del sitio web de Global Dealer Extranet: https://dealer.cat.com/periodicals

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Ver imagen

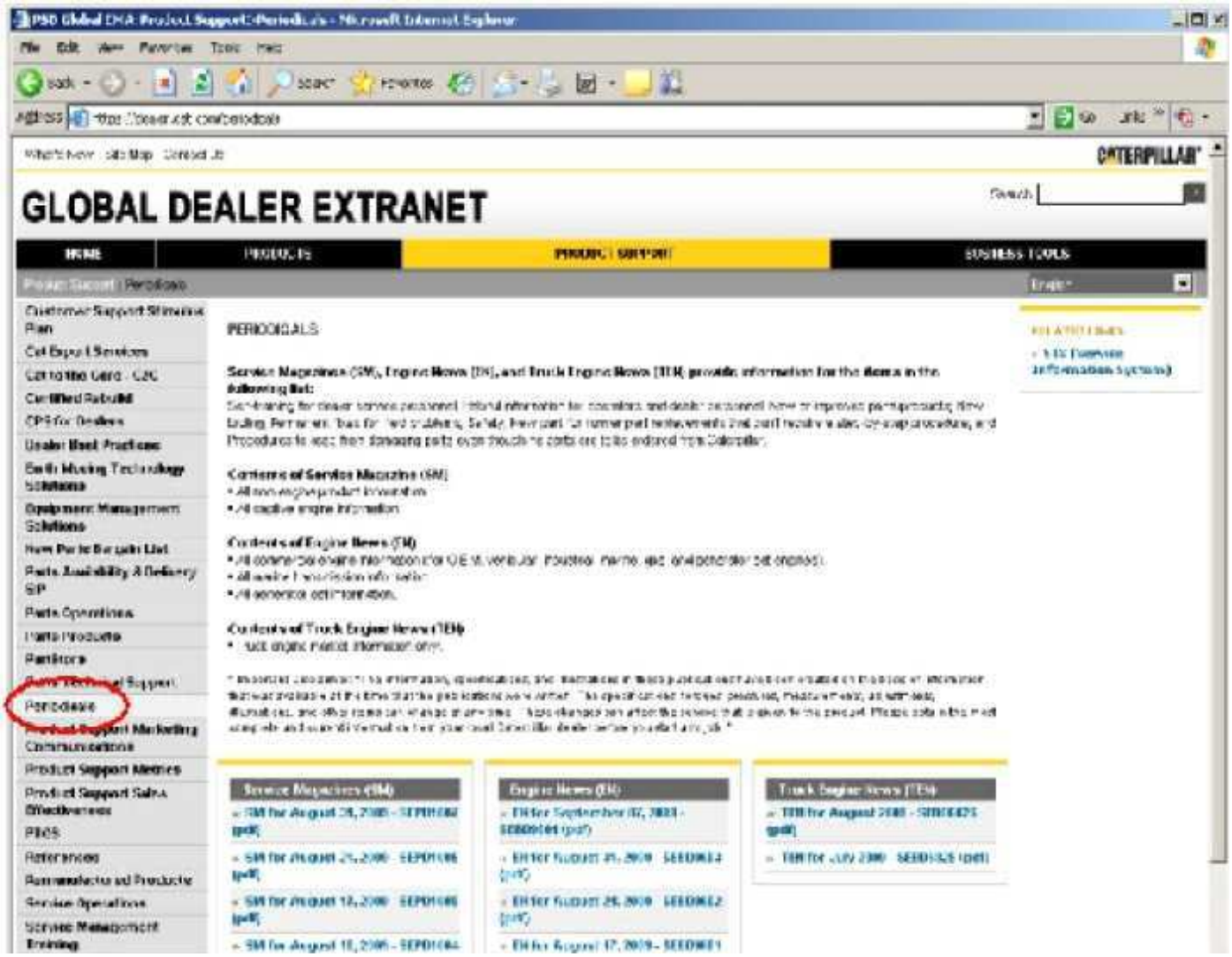


Ilustración 1 g01976237

Retiro de la versión impresa de Información Técnica y Crónica de Motores

SMCS - 1000; 7000

Productos Caterpillar:

- **Todos**

Service Magazine SSPD1005, 17 agosto 2009, "Retiro de la versión impresa de las publicaciones Información Técnica y Crónica de Motores". Haga caso omiso de este artículo. Consulte el artículo siguiente.

Después de revisar los resultados de la encuesta que se publicó en las Informaciones Técnicas y las Crónicas de motor anteriores, se ha determinado que se descontinuará el envío por correo de estas publicaciones. Ya no se imprimirán ni se enviarán por correo copias en papel de estas publicaciones al final del tercer trimestre de 2009. Estos artículos están disponibles diariamente en SIS Web de Caterpillar. Si recibe una copia impresa de estas publicaciones y no tiene acceso al SIS Web de Caterpillar, contacte a su distribuidor local para obtener acceso al SIS Web de Caterpillar.

Cómo consultar y utilizar la información de servicio

SMCS - 0374; 1000; 7000

Productos Caterpillar:
- **Todos**

Queremos escuchar sus opiniones. Se ha implementado una encuesta para recibir sus opiniones. Se ha conformado un grupo para investigar la forma en que la información de servicio (por ejemplo: los artículos de las publicaciones Información Técnica y Crónica de Motores, los Manuales de Servicio y los Manuales de Piezas) es utilizada por los Distribuidores Caterpillar y los clientes de Caterpillar. En particular, el uso de las versiones impresas de los artículos que se envían semanalmente de Información Técnicay mensualmente de Crónica de Motores. Si esta información se publicara diariamente en el sitio web del SIS de Caterpillar y posiblemente en Internet en una versión que se pueda consultar e imprimir, ¿sería ésta una opción viable comparada con la que se envía en papel por correo actualmente? También estamos evaluando la opción de proporcionar archivos que se puedan consultar e imprimir en Internet con artículos de Información Técnica y de los Manuales de Piezas. Utilice el enlace a continuación y complete esta pequeña encuesta que estará disponible hasta el 15 de mayo de 2009.

Para acceder a la encuesta, abra su programa explorador de Internet e introduzca el siguiente URL:

- https://www.caterpillarsurveys.com/se.ashx?s=4F5AA3C86BF5EC53

Si no tiene acceso a Internet, comuníquese con su distribuidor Caterpillar y hágale saber que usted desea contestar la encuesta pero no tiene acceso a Internet.

Sistemas automáticos de apagado de motores para equipos

SMCS - 1000; 7000

Productos Caterpillar:
- **Todos**

Service Magazine, SSPD0780, 18 abril 2005, "No se recomienda utilizar sistemas automáticos de apagado de motores para equipos móviles de movimiento de tierra". No tenga en cuenta este artículo. Consulte la siguiente información.

En algunas instalaciones permanentes de motores se utiliza un sistema de apagado automático. Algunos propietarios de equipo de movimiento de tierra a veces piden la instalación de un sistema de apagado automático en las máquinas móviles de movimiento de tierra.

Aunque Caterpillar no respalda el uso de sistemas específicos de apagado en velocidad en vacío comerciales, Caterpillar comprende sus posibles beneficios, incluidos la reducción del consumo de combustible al limitar el tiempo de baja en vacío y ayudar a los dueños de las flotas a cumplir con las normativas regionales. Usar ciertos sistemas de apagado en velocidad baja en vacío comerciales es decisión exclusiva del cliente.

En caso de que el cliente decida instalar un sistema de apagado en velocidad baja en vacío comercial, Caterpillar recomienda encarecidamente que se consideren los siguientes criterios mínimos:

- Procurar un estado de seguridad para la máquina
- Avisar al operador
- Dar al operario un medio para cancelar la operación
- Incluir un manual de instrucciones

Procurar un estado de seguridad para la máquina - Si se utiliza un sistema de apagado por inactividad comercial, el cliente debe asegurar que el mecanismo se active únicamente cuando la máquina se encuentre en estado seguro. El estado seguro incluye (entre otros pasos) verificar que el freno de estacionamiento de la máquina esté conectado y que la transmisión se encuentre en neutro antes de activar el dispositivo. El cliente debe capacitar a los operadores para que sigan las instrucciones de estacionamiento y abandono de la máquina que se incluyen en el Manual de Operación y Mantenimiento de la máquina (por ejemplo, los implementos de conexión a tierra, neutralización del sistema hidráulico de los implementos, bajada de la caja del camión, etc).

Aviso al operador - El dispositivo debe proveer una forma de notificar al operador que el dispositivo está activo (por ejemplo, una lámpara indicadora) con suficiente tiempo de antelación para que el operador pueda reaccionar si es necesario.

Dar al operador un medio para cancelar la operación - El dispositivo debe proveer un medio para que el operador cancele la operación del sistema si no se desea el apagado.

Incluir un manual de instrucciones - Si se instala un sistema de apagado en velocidad en vacío comercial, el cliente debe incluir un manual de instrucciones en la máquina que explique la operación del sistema.

Los sistemas de apagado en velocidad en vacío comerciales no deben usarse para apagar la máquina durante la operación normal o cuando la máquina no esté en estado seguro.

Caterpillar está evaluando actualmente otras ofertas de sistemas de apagado en velocidad en vacío instalados de fábrica y modificados.

Caterpillar no respalda ningún sistema de apagado en velocidad en vacío modificado ni comerciales. Caterpillar no se responsabiliza por la instalación, uso o mantenimiento de sistemas de apagado en velocidad en vacío comerciales, ni por ninguna pérdida ni daño causado por dichos sistemas.

Se recomienda el uso de sistemas como EMS, que advierten al operador de condiciones de alta temperatura, baja presión de aceite u otras condiciones. Sin embargo, tales sistemas no deben incluir un circuito de apagado automático.

Index of Repair Process Engineering Publications{0374, 1000, 7000}

SMCS - 0374; 1000; 7000

Agricultural Tractor: All
Articulated Truck: All
Asphalt Paver: All
Backhoe Loader: All
Caterpillar Products: Machines with Grease Lubricated Track with Swage Machines with Greased Lubricated Track (GLT) Machines with Positive Pin Retention (PPR) Track Machines with Positive Pin Retention 2 (PPR2) Track Machines with Rotating Bushing Track Machines with Sealed Positive Pin Retention (PPR) Track Machines with Sealed Track Machines with Sleeve Bearing Track Machines with SystemOne Undercarriage Machines with non-PPR Sealed and Lubricated Track
Challenger: All
Cold Planer: All
Combine: All
Compact Track Loader: All
Compact Wheel Loader: ALL
Earthmoving Compactor: All
Engine: 3300 3400 3400 All, 3300 All, 3200 All, 3100 All, 3000 All, and D-series All All 3500 Engines All 3600 Engines All C280 Engines C-10 All C-9 and C9 All C11 All C12 and C-12 All C13 and C-13 All C15 and C-15 All C16 and C-16 All C175 Engines C18 and C-18 All C27 All C32 All C7 All
Excavator: All
Felling Head: Caterpillar Branded
Forest Products: All
Integrated Toolcarrier: All
Landfill Compactor: All
Load Haul Dump: All
Mini Hydraulic Excavator: All
Motor Grader: All
Multi Terrain Loader: All
Off-Highway Truck/Tractor: All
Paving Compactor: All
Pipelayer: All
Road Reclaimer/Soil Stabilizer: All
Skid Steer Loader: All
Soil Compactor: All
Telehandler: All
Track Feller Buncher: Caterpillar
Track-Type Loader: All
Track-Type Skidder: All
Track-Type Tractor: All
Underground Articulated Truck: All
Wheel Dozer: All
Wheel Feller Buncher: All
Wheel Loader: All
Wheel Skidder: All
Wheel Tractor-Scraper: All

Introduction

Table 1

Revision	Summary of Changes in SEBF8029
33	Updated title listings
32	Revised format

This Reuse and Salvage Guideline contains the necessary information in order to allow a dealer to establish a parts reusability program. Reuse and salvage information enables Caterpillar dealers and customers to benefit from cost reductions. Every effort has been made in order to provide the most current information that is known to Caterpillar. Continuing improvement and advancement of product design might have caused changes to your product which are not included in this publication. This Reuse and Salvage Guideline must be used with the latest technical information that is available from Caterpillar.

For questions or additional information concerning this guideline, submit a form for feedback in the Service Information System. In order to address an urgent issue, please use the following resources in order to communicate your request to Caterpillar Repair Process Engineering:

- Caterpillar Dealer Technical Communicator
- Dealer Solution Network
- Caterpillar Technical Representative
- Knowledge Network

Summary

This bulletin is an index of the service literature that has the information on the reusability and/or repair of used parts and the tools needed to make the repairs.

Engine Reuse and Salvage media

Table 2

SEBF8002	Visual Inspection of Valves, Valve Springs, and Valve Bridges
SEBF8009	Visual Inspection of Main and Connecting Rod Bearings
SEBF8018	Visual Inspection of Turbochargers
SEBF8019	Specifications for Reusable Turbocharger Components
SEBF8034	

	Valve and Valve Spring Specifications
SEBF8039	Inspection of Crankshafts for Cracks
SEBF8041	Specifications for Crankshafts in Caterpillar Engines
SEBF8042	Procedure to Grind and Polish Crankshafts
SEBF8043	Visual Inspection of Crankshafts
SEBF8045	Timing Gears for All Engines
SEBF8046	Cast Iron and Steel Pulleys
SEBF8049	Visual Inspection of the Piston
SEBF8050	Specifications To Machine Reaction Faces for Flywheel Assemblies on 3208 Engines
SEBF8051	Inspection and Measuring Procedures for Piston Pins
SEBF8054	Procedure to Measure and Straighten Bent Crankshafts
SEBF8057	3208 Engine Sleeve Metering Fuel Systems (SMFS)
SEBF8058	3208 Engine Water Pumps
SEBF8059	Procedures and Specifications for Pistons
SEBF8061	Engine Precombustion Chamber and 3400 Series Engine Direct Injection Nozzle Adapters
SEBF8063	Visual Inspection of Connecting Rods
SEBF8064	Specifications for Connecting Rods
SEBF8066	Visual Inspection of 6N-6872/7N-4782 Lifter Guide Springs in 3400/3500 Series Engines
SEBF8067	Slipper Followers and Camshaft Roller Lifters
SEBF8068	

	Visual Inspection of Liners
SEBF8069	Procedure to Repair Lifter Bores for Engine
SEBF8071	Procedures to Salvage Turbocharger Components
SEBF8075	Salvage of Serrated Connecting Rods
SEBF8076	Specifications to Salvage Cylinder Block Contact Surfaces
SEBF8077	Engine Oil Coolers
SEBF8085	Inspection and Cleaning of Rubber Endsheet Oil Coolers
SEBF8092	Specifications For Reusable Turbocharger Components on 3600 Family Of Engines
SEBF8097	Measurement of the Camshaft
SEBF8101	Specifications for Cylinder Blocks in 3600 Family of Engines
SEBF8102	Specifications for Crankshaft Measurement (3600)
SEBF8103	Procedures for Grinding Crankshafts 3600 Family of Engines
SEBF8104	Specifications for Camshafts
SEBF8105	Injector and Valve Lifter Group 3600 Family of Engines
SEBF8106	Specifications for Cylinder Head Assemblies 3600 Engines
SEBF8107	Specifications for Pistons and Rings for the 3600 and C280 Family of Engines
SEBF8108	Specifications for Connecting Rods and Bearings Used in 3600 and C280 Engines
SEBF8109	Specifications for Measurement and Cleaning Cylinder Liners 3600 Family of Diesel Engines
SEBF8129	Procedure to Salvage Cylinder Head Assemblies for 3600 and G3600 Engines
SEBF8146	

	Visual Inspection of Camshafts
SEBF8148	General Salvage and Reconditioning Techniques
SEBF8149	Specifications for Connecting Rods in 3500 Family of Engines
SEBF8150	Procedure to Inspect, Clean and Flush Pistons - 3600 Family of Engines
SEBF8151	Procedure to Salvage Cylinder Blocks with Damaged Cylinder Head Stud Threads 3600 Family of Engines
SEBF8152	Procedures to Rebuild Vibration Dampers for 3600 Family of Engines
SEBF8155	Specifications for Cylinder Head Assemblies for 3500 Series Engines
SEBF8156	Procedure to Inspect Crankshafts in 3500 Family of Engines
SEBF8157	Specifications for Cylinder Blocks in 3500 Series Engines
SEBF8160	Procedures To Salvage Oil Pan Assemblies 3600 Series Engines
SEBF8162	Measure Procedures and Salvage Procedures for Cylinder Head Assemblies and Related Components
SEBF8164	Specifications for Liner Measurements and Salvage of 3500 Series Engines
SEBF8167	Reconditioning Procedures 3114 and 3116 Engines
SEBF8170	Specifications for Engine Oil Pump Measurement and Salvage 3500 Family of Engines
SEBF8171	Recommendations for Cleaning and Inspecting 3600 Family of Engine Components
SEBF8174	Rocker Arm, Rocker Arm Shafts, and Bridge Assemblies for 3500 Engines
SEBF8175	Specifications for Damper Inspection on the 3500 Family of Engines
SEBF8186	Specifications for Trunnion Inspection 3500 Family of Engines
SEBF8187	Standardized Parts Marking Procedures
SEBF8188	

SEBF8188	Specifications and Salvage Procedures for Rear Gear Train 3500 Family of Engines
SEBF8191	Camshaft Roller Followers 3500 Family of Engines
SEBF8192	Specifications and Salvage for Cylinder Blocks on 3114, 3116, 3126 and 3126B Engines
SEBF8196	Inspection, Measurement, and Salvage of Spacer Block for 3176 Engines
SEBF8197	Specifications to Machine Reaction Faces of Flywheel Assemblies on 3176/C10 and 3196/C12 Engines
SEBF8198	Procedure to Install Top Deck Inserts
SEBF8201	Specifications for Top Deck Cracks in Cylinder Blocks on 3208 Engine
SEBF8202	Inspection of Rear Engine Mounts on 3500 Family of Engines
SEBF8203	Reuse and Salvage Guidelines for 3500 Series Engines Volume 1
SEBF8206	Specifications for Connecting Rods on 3116 Engines
SEBF8207	Flywheel Specifications for 3114/3116/3126 and C7 Engines
SEBF8209	Reuse and Salvage Guidelines for 3116 and 3126 Engines
SEBF8213	Overhaul Check List 3500 Family of Engines
SEBF8215	3176 Series Reuse and Salvage Manual Contents
SEBF8218	Cylinder Head Assembly Specifications for 3114, 3116, and 3126 Engines
SEBF8219	Salvage of Cylinder Block Lower Liner Bores for 3500 Family of Engines
SEBF8224	Specifications to Measure and Salvage Crankshafts for 3054 and 3056 Engines
SEBF8226	Specifications and Salvage for Spacer Plates on 3500 Engines
SEBF8228	Procedure to Clean and Inspect One and Two-Piece Pistons in 3114/3116 Engines
SEBF8229	

SEBF8229	Specifications for Cylinder Head Assemblies on 3176 and 3196 Engines
SEBF8231	3200 Series Reuse and Salvage Manual Contents
SEBF8239	3400 Series Reuse and Salvage Manual Contents
SEBF8242	Procedure to Replace the Connecting Rod Eye Bearing or Test the Bearing Retention
SEBF8244	Specifications for Connecting Rods on 3176 Engines
SEBF8246	Salvage of Weld on Water Cooled Exhaust Manifold for 3500 Engines
SEBF8247	Specifications for Cylinder Liner Measurement and Salvage in 3176 Family of Engines
SEBF8250	Truck Engine Reuse and Salvage Manual Contents
SEBF8255	Procedure to Install Liner Seat Inserts into the Top Deck of Cylinder Blocks of 3500 Engines
SEBF8256	Visual Inspection of Camshafts and Rocker Arm Rollers in 3406E, C-15, and C-16 Engines
SEBF8260	Camshaft Roller Followers Used in 3114, 3116, & 3176 Engines
SEBF8261	Installing a 7C-6208 Cylinder Sleeve in 3114 and 3116 Engines and a 107-7604 Cylinder Sleeve in 3126 Engines
SEBF8263	Procedure to Repair Top Deck Pitting on Cylinder Blocks of 3500 Engines
SEBF8264	Camshaft Roller Follower Used in 3114 and 3116 Engines
SEBF8266	Valve Train Assembly for 3176, 3196, C-10, and C-12 Engines
SEBF8267	Rocker Arms and Rocker Arm Shafts for 3114 and 3116 Engines
SEBF8269	Procedure to Inspect and Salvage the Gear on 1W-5009 (D9N) and 6I-3746 (988F) Crankshaft Assemblies Used in 3408 Engines
SEBF8270	Specifications for Cylinder Head Assemblies on 3406E and 3456 Engines
SEBF8277	Specifications and Salvage for Cylinder Blocks on 3126 Engines
SEBF8281	

SEBF8281	Installation of Oversize Water Directors
SEBF8282	Specifications and Salvage for Cylinder Blocks on 3176 Engines
SEBF8290	Visual Inspection of Two-Piece Pistons
SEBF8291	Top Deck Threaded Hole Repair In 3400 and 3500 Series Engines
SEBF8293	Visual Inspection and General Information for Plunger and Barrel Assembly Used in New Scroll Fuel Systems (NSFS) of 3204, 3300, and 3400 Engines
SEBF8294	Visual Inspection and General Information for Lifter Assembly Used in New Scroll Fuel Systems (NSFS) of 3300 and 3400 Engines
SEBF8295	Visual Inspection and General Information for Camshaft Used in 3300 & 3400 Engines & New Scroll Fuel Systems (NSFS)
SEBF8296	Visual Inspection and General Information for the Rack Bar Used in 3300 and 3400 Engines with New Scroll Fuel Systems (NSFS)
SEBF8297	Visual Inspection and General Information for Housing Assembly Used in New Scroll Fuel Systems (NSFS) of 3300 and 3400 Engines
SEBF8298	Visual Inspection and General Information for Governor Assembly Used in New Scroll Fuel Systems (NSFS) of 3204, 3300, and 3400 Engines
SEBF8299	Visual Inspection of Fuel Transfer Pump Used in New Scroll Fuel Systems (NSFS) of 3204, 3300, and 3400 Engines
SEBF8300	Visual Inspection of Timing Advance Used in New Scroll Fuel Systems (NSFS) of 3300 and 3400 Engines
SEBF8301	Inspection and Reuse of Critical Fasteners Used in All Engines
SEBF8302	Reuse Specifications for 3600 Combustion Gaskets
SEBF8304	Salvaging Oil Pan Assemblies Used on 3500 Engines
SEBF8324	Contents for Fuel Systems Reuse and Salvage Manual for 3000, 3100, 3200, 3400, and D Series Engines
SEBF8326	Testing and Reuse of Fuel Injection Pump Housing
SEBF8327	Test Procedures for Low Pressure Fuel Supply System on 3204, 3300, 3406B and 3406C Engines with NSFS
SEBF8330	Procedure to Repair Cylinder Block Pump Mounting Pad on 3406B, 3406C, 3406E, C15, and C-15 Engines

SEBF8340	Fuel Systems Troubleshooting Guide for 3204, 3300, and 3400 Engines with New Scroll Fuel Systems (NSFS)
SEBF8343	Fuel System Tooling List for 3000 Family of Engines
SEBF8344	Tamper Resistant PLugs and Bolts Used to Prevent Changes to Air Fuel Ratio Control (FRC) Settings
SEBF8346	Fuel Ratio Control for New Scroll Fuel Systems (NSFS)
SEBF8348	Improved Nozzles and Lines forNew Scroll Fuel Systems (NSFS)
SEBF8353	3208 Marine Engine Fuel Systems Information for Sleeve Metering Fuel Systems (SMFS)
SEBF8357	General Cleaning Methods
SEBF8363	Examples of Parts Cleaning Racks and Baskets
SEBF8373	Specifications for Cylinder Head Assemblies on 3400 Engines
SEBF8374	Specifications for Cylinder Head Assemblies 3200 Engines
SEBF8375	Specifications for Cylinder Head Assemblies 3300 Engines
SEBF8376	Specifications for Cylinder Head Assemblies 1404 and D Model Engines
SEBF8377	Specifications and Salvage Procedures for Front Gear Train on 3500 Engines
SEBF8382	Process for Rebuilding the Cylinder Head
SEBF8387	Main Bearing Bolt Hole Repair in 3400 Series Engines
SEBF8389	Cylinder Head Racks
SEBF8403	Reuse Specifications for ABB Housings on 3500 Engines
SEBF8409	Reuse and Salvage Guidelines for 3600 Series Engines
SEBF8418	Salvage of Water Pumps in 3500 Engines

SEBF8422	Aftercoolers in 3500 Engines
SEBF8434	3100 Governor Inspection and General Information for Mechanical Governor Groups Used in 3114, 3116, and 3126 Engines Equipped with Mechanical Unit Injectors (MUI)
SEBF8437	Repairing the Hole for the Main Bearing Bolt in 3500 Series Engines
SEBF8479	Reuse and Salvage Guidelines for 3500 Series Engines Volume 2
SEBF8737	Reuse of Cylinder Heads on C-9 Engines with Injector Tip Damage
SEBF8740	Salvage of Water Pumps Used in C-9 Engines
SEBF8744	Camshaft Roller Followers Used in C-9 Engines
SEBF8745	Valve Train Assembly for C-9 Engines
SEBF8747	Inspection Preocedures for Welded Viscous Dampers and Rubber Isolation Dampers
SEBF8793	Repairing a Cylinder Block with an Oil Porosity Complaint
SEBF8804	Cleaning Components With Carbon Dioxide (CO2)
SEBF8814	Specifications for Measurements of Camshafts in 3056 and 3054 Engines
SEBF8818	Specifications and Salvage for Cylinder Blocks on 3054/3054B/3054C/3054E and 3056/3056E Engines
SEBF8819	Specifications for Cylinder Head Assemblies 3054 and 3056 Engines
SEBF8820	Reuse of Cylinder Heads on 3054 and 3056 Engines with Injector Tip Damage
SEBF8821	Procedure to Clean and Inspect Two-Piece Pistons in 3054 and 3056 Engines
SEBF8822	Valve Train Assembly for 3054 and 3056 Engines
SEBF8823	Camshaft Slipper (solid type) Followers Used in 3054 and 3056 Engines
SEBF8824	Specifications to Machine Reaction Faces of Flywheel Assemblies on 3054 and 3056 Engines

SEBF8827	Camshaft Slipper Followers Used in 3054 and 3056 Engines
SEBF8831	3054 and 3056 Engine Reuse and Salvage Manual Contents
SEBF8875	Main Bearing Bolt Hole Repair In C-15, C-16, and C-18 Engines
SEBF8882	Using Lock-N-Stitch Procedures for Casting Repair
SEBF8888	Specifications to Machine Reaction Faces of Flywheel Assemblies on C15/C18 Engines
SEBF8960	3116 Block Head Bolt Hole Salvage Guide
SEBF8966	Reuse Guidelines for Divided Turbine Housings
SEBF9006	Specifications for Cylinder Head Assemblies on C-Series Engines
SEBF9007	Specifications for Cylinder Block Assemblies on C-Series Engines
SEBF9008	Procedure for Reconditioning Cylinder Blocks on C-Series Engines
SEBF9011	Dynamometer Testing of Caterpillar Engines
SEBF9040	Specifications for Testing Fuel Injection Nozzles on 3044, 3046, 3064, and 3066 Engines
SEBF9041	Reference Literature for Fuel Injection Pumps on 3044, 3046, 3064, and 3066 Engines
SEBF9043	Cleaning, Testing, and Inspecting Oil Coolers for the 3044, 3046, 3064, and 3066 Engines
SEBF9044	Specifications for Oil Pumps and Front Housings on 3044, 3046, 3064 and 3066 Engines
SEBF9045	Specifications for the Cylinder Head Assemblies for the 3044, 3046, 3064, and 3066 Engines
SEBF9048	Specifications for Flywheel Assemblies on 3044, 3046, 3064, and 3066 Engines
SEBF9049	Specifications for Short Block Assemblies for 3044, 3046, 3064, and 3066 Engines
SEBF9052	Reuse and Salvage Guidelines for 3044, 3046, 3064, and 3066 Engines

SEBF9068	Inspection Procedures for 3064 and 3066 MHI Engines for Caterpillar Built Machines
SEBF9069	Specifications and Salvage for Cylinder Blocks for 3044, 3046, 3064, and 3066 Engines
SEBF9070	Specifications for the Salvage of the Cylinder Block Contact Surfaces for 3044, 3046, 3046, and 3066 Engines
SEBF9071	Specifications for the Cylinder Liner Measurement and Salvage for 3044, 3046, 3064, and 3066 Engines
SEBF9074	Salvage Procedures for Connecting Rods
SEBF9085	Failure Modes of Turbochargers
SEBF9088	Disassembly, Assembly, Testing and Salvage of Starting Motor for 3066, 3064 and 3046 Engines
SEBF9092	Valve Train Assembly for 3066, 3064, 3046, and 3044 Engines
SEBF9095	Specifications for Measurements of Camshafts in 3066, 3064, 3046 and 3044 Engines
SEBF9096	Reuse Criteria for the In-Line Fuel Injection Pumps on the 3064 and the 3066 Engines
SEBF9101	Visual Inspection of Camshafts for 3066, 3064, 3046 and 3044 Engines
SEBF9104	Specifications for Connecting Rods for 3044, 3046, 3064, and 3066 Engines
SEBF9106	Cleaning, Inspecting, and Measuring of Pistons for 3066, 3064, 3046 and 3044 Engines
SEBF9109	Cleaning and Handling Procedures for the Common Rail Fuel System Components
SEBF9110	Specifications and Procedures to Rebuild Turbochargers on 3066 and 3064 Engines
SEBF9112	Reuse Criteria for the Components on the Common Rail Fuel System
SEBF9121	Reuse and Salvage Guideline for Cylinder Head Bolt Holes in the Cylinder Block for 3208 Engines
SEBF9122	Specifications for Cylinder Liner Measurements and Salvage for C-Series Engines
SEBF9126	Installing a Cylinder Sleeve in C7 Engines

SEBF9132	Spacer Plates for the 3400, C15, C18, C27, and C32 Engines
SEBF9133	Reusability Guideline for the Connecting Rods on the 3618 Engine
SEBF9134	Procedure to Shot Peen 3512 and 3516 High Displacement Crankshafts
SEBF9137	Installation and Removal of the Valve Guides and Valve Seat Inserts for the G3500 Series of Engines
SEBF9162	Inspection and Reconditioning Procedures of Main Bearing Bores in Cylinder Blocks
SEBF9167	Inspection of Diesel Particulate Filters
SEBF9169	Repair Procedure for Cavitation Erosion in the Cylinder Block Bore
SEBF9172	Procedure to Install a Cylinder Sleeve in 3024 Engines
SEBF9177	Specifications for Reusability of the 251-7646 Fan Drive Bracket Assembly on 3500 Machine Engines
SEBF9182	Inspection and Repair Procedure for the Saddle of the Rocker Arm Shaft in C15, C16, C18, 3406E, C27, C32 and 3456 Engines
SEBF9185	Specifications for Cylinder Blocks in C175 Engines
SEBF9187	Specifications for Measurement of Camshafts in C175 Engines
SEBF9193	Specifications for Cylinder Head Assemblies for C175 Engines
SEBF9194	Specifications for Liner Measurements and Salvage of C175 Engines
SEBF9197	Specifcations for Connecting Rods in C175 Engines
SEBF9192	Specifications and Salvage Procedures for Rear Gear Train of C175 Engines
SEBF9191	Specifications and Salvage Procedures for Front Gear Train of C175 Engines
SEBF9198	Specifications for the Measurement and Salvage of the Engine Oil Pump for the C175
SEBF9179	Inspection and Specifications for Pistons and Rings for C175 Engines

SEBF9107	Procedure for Back Flushing the C175 Common Rail Fuel System
SEBF9202	Procedure for Repairing and Rebuilding 3400 and 3500 Series Turbochargers
SEBF9203	Procedure to Chamfer Liner Bores on Cylinder Blocks of 3500 Engines
SEBF9207	Specifications and Rebuilding Procedure for G3520 TPS-57 Type ABB Turbochargers

Hydraulic Reuse and Salvage Media

Table 3

SELD0475	**Hydraulic Repair Procedures Reference Manual**
SELD0471	Contents for Hydraulic Repair Procedures Reference Manual
SELD0473	Service and Repair Checklist
SENR5206	HPCU Transmission Assembly Procedure
SEBF8032	Piston Pumps and Motors
SEBF8033	Specifications for Piston Pumps and Motor Components
SEBV0563	Hydraulic Pump and Motor Failure Analysis
SEBF8133	Reusability of Hydraulic Piston Pumps
SEBF8136	Reusability of Hydraulic Piston Pumps and Motors (For Paving Products)
SEBF8144	Hydraulic Piston Motors and Pumps (L-Series)
SEBF8113	Specifications for L-Series Reusable Pump and Motor Components
SENR5207	Piston Pump Assembly Procedures (Vickers)
SEBF8179	Hydraulic Piston Pumps Used in E180, E200B, and E240 Excavators

SEBF8189	Interchangeability of Parts for Various Designs of SP10K Hydraulic Pumps
SEBF8180	Hydraulic Piston Pumps Used in E300, E450, and E650 Excavators
SEBF8253	Hydraulic Piston Pump (Mannesmann-Rexroth)
REHS1607	Rotating Group Adjustment Instructions for Bosch Rexroth Pumps and Motors
SENR4939	Swing and Track Motor Assembly Procedure (Excavators and Track-Type Tractors)
SENR4940	Track Motor Assembly Procedures (973)
SEBF8153	Universal Joint Assemblies for Hydraulic Link Motors
SEBF8165	Hydraulic Piston Motors
REHS2677	Hydraulic Cylinder Repair Process
SEBF8072	Inspection and Salvage of Hydraulic Cylinder Components
REHS2099	Reuse and Salvage Guideline for Front Suspension Cylinder Housings and Heads on Off-Highway Trucks
REHS1769	Reuse and Salvage Guideline for Off-Highway Truck Hoist Cylinder Rods
SEBF8194	Reuse and Salvage Guidelines Specifications for Rear Suspension Cylinder Components Used in Off-Highway Trucks
REHS2553	Reusability Guideline for Hydraulic Cylinder Position Sensor
REHS2689	Hydraulic Cylinder Honing
REHS2811	Hydraulic Cylinder Seal Failure Analysis
SENR5418	Hydraulic Cylinder Assembly Procedures Chart
SENR6084	Hydraulic Cylinder Assembly Procedures Chart - 300 Family of Excavators
REHS1765	Procedure for Testing Hydraulic Cylinders Using 188-3926 Caterpillar Cylinder Tester

PEKP1020	Hydraulic Cylinder and Seal Handbook
SEHS8630	Measuring Bores and Installing Seals
SEBF8208	Measuring the O-Ring Groove into the Face of Oversized Bolted Head Hydraulic Cylinders
SEBF9091	Repair Process for Gear Pumps
SEBF8073	Hydraulic Gear Pumps and Motors
SEBF8161	Hydraulic Gear Pumps Used in Transmissions
SEBF8080	Vane Type Hydraulic Pumps
SEHS9353	Vane Type Hydraulic Pump Identification Guidelines

Hydraulic Pump Bench Test Procedures

Table 4

SEBF8810	**Hydraulic Pump, Motor and Cylinder Bench Test Procedure Reference Manual**
SEBF8811	Contents for Hydraulic Pump, Motor and Cylinder Bench Test Procedure Reference Manual
SEBF1761	Required Tooling for Bench Testing Hydraulic Components
SEBF1765	Testing Hydraulic Cylinders Using the 9U-6803 Caterpillar Cylinder Tester
REHS1832	Bench Test Procedure for Gear Pumps
REHS1833	Bench Test Procedure for Vane Pumps
REHS1375	Bench Test Procedure for Hydraulic Piston Pumps
REHS1376	Bench Test Procedure for Hydraulic Piston Pumps
REHS1377	Bench Test Procedure for Hydraulic Piston Pumps
REHS1447	Bench Test Procedure for Hydraulic Piston Pumps
REHS1448	Bench Test Procedure for Hydraulic Piston Pumps
REHS1477	Bench Test Procedure for Hydraulic Piston Pumps
REHS1478	Bench Test Procedure for Hydraulic Piston Pumps
REHS1479	Bench Test Procedure for Hydraulic Piston Pumps

REHS1515	Bench Test Procedure for Hydraulic Piston Pumps
REHS1517	Bench Test Procedure for Hydraulic Piston Pumps
REHS1526	Bench Test Procedure for Hydraulic Piston Pumps
REHS1527	Bench Test Procedure for Hydraulic Piston Pumps
REHS1606	Bench Test Procedure for Hydraulic Piston Pumps
REHS1641	Bench Test Procedure for Hydraulic Piston Pumps
REHS1680	Bench Test Procedure for Hydraulic Piston Pumps
REHS1681	Bench Test Procedure for Hydraulic Piston Pumps
REHS1682	Bench Test Procedure for Hydraulic Piston Pumps
REHS1723	Bench Test Procedure for Hydraulic Piston Pumps
REHS1747	Bench Test Procedure for Hydraulic Piston Pumps
REHS1792	Bench Test Procedure for Hydraulic Piston Pumps
REHS1792	Bench Test Procedure for Hydraulic Piston Pumps
REHS1792	Bench Test Procedure for Hydraulic Piston Pumps
REHS1792	Bench Test Procedure for Hydraulic Piston Pumps
REHS1792	Bench Test Procedure for Hydraulic Piston Pumps
REHS1793	Bench Test Procedure for Hydraulic Piston Pumps
REHS1837	Bench Test Procedure for Hydraulic Piston Pumps
REHS2078	Bench Test Procedure for Hydraulic Piston Pumps
REHS2092	Bench Test Procedure for Hydraulic Piston Pumps
REHS2093	Bench Test Procedure for Hydraulic Piston Pumps
REHS2094	Bench Test Procedure for Hydraulic Piston Pumps
REHS2095	Bench Test Procedure for Hydraulic Piston Pumps
REHS2096	Bench Test Procedure for Hydraulic Piston Pumps
REHS2097	Bench Test Procedure for Hydraulic Piston Pumps
REHS2098	Bench Test Procedure for Hydraulic Piston Pumps
REHS2215	Bench Test Procedure for Hydraulic Piston Pumps
REHS2216	Bench Test Procedure for Hydraulic Piston Pumps
REHS2217	Bench Test Procedure for Hydraulic Piston Pumps
REHS2218	Bench Test Procedure for Hydraulic Piston Pumps

REHS2219	Bench Test Procedure for Hydraulic Piston Pumps
REHS2266	Bench Test Procedure for Hydraulic Piston Pumps
REHS2267	Bench Test Procedure for Hydraulic Piston Pumps
REHS2321	Bench Test Procedure for Hydraulic Piston Pumps
REHS2322	Bench Test Procedure for Hydraulic Piston Pumps
REHS2323	Bench Test Procedure for Hydraulic Piston Pumps
REHS2339	Bench Test Procedure for Hydraulic Piston Pumps
REHS2340	Bench Test Procedure for Hydraulic Piston Pumps
REHS2341	Bench Test Procedure for Hydraulic Piston Pumps
REHS2342	Bench Test Procedure for Hydraulic Piston Pumps
REHS2343	Bench Test Procedure for Hydraulic Piston Pumps
REHS2387	Bench Test Procedure for Hydraulic Piston Pumps
REHS2440	Bench Test Procedure for Hydraulic Piston Pumps
REHS2465	Bench Test Procedure for Hydraulic Piston Pumps
REHS2535	Bench Test Procedure for Hydraulic Piston Pumps
REHS2572	Bench Test Procedure for Hydraulic Piston Pumps
REHS2576	Bench Test Procedure for Hydraulic Piston Pumps
REHS2602	Bench Test Procedure for Hydraulic Piston Pumps
REHS2603	Bench Test Procedure for Hydraulic Piston Pumps
REHS2604	Bench Test Procedure for Hydraulic Piston Pumps
REHS2605	Bench Test Procedure for Hydraulic Piston Pumps
REHS2641	Bench Test Procedure for Hydraulic Piston Pumps
REHS2642	Bench Test Procedure for Hydraulic Piston Pumps
REHS2647	Bench Test Procedure for Hydraulic Piston Pumps
REHS2661	Bench Test Procedure for Hydraulic Piston Pumps
REHS2669	Bench Test Procedure for Hydraulic Piston Pumps
REHS2693	Bench Test Procedure for Hydraulic Piston Pumps
REHS2804	Bench Test Procedure for Hydraulic Piston Pumps
REHS2805	Bench Test Procedure for Hydraulic Piston Pumps
REHS2829	Bench Test Procedure for Hydraulic Piston Pumps

REHS2889	Bench Test Procedure for Hydraulic Piston Pumps
REHS3121	Bench Test Procedure for Hydraulic Piston Pumps
REHS3200	Bench Test Procedure for Hydraulic Piston Pumps
REHS3201	Bench Test Procedure for Hydraulic Piston Pumps
REHS3432	Bench Test Procedure for Hydraulic Piston Pumps
REHS3447	Bench Test Procedure for Hydraulic Piston Pumps
REHS3451	Bench Test Procedure for Hydraulic Piston Pumps
REHS3454	Bench Test Procedure for Hydraulic Piston Pumps
REHS3457	Bench Test Procedure for Hydraulic Piston Pumps
REHS3601	Bench Test Procedure for Hydraulic Piston Pumps
REHS3603	Bench Test Procedure for Hydraulic Piston Pumps
REHS3604	Bench Test Procedure for Hydraulic Piston Pumps
REHHS3606	Bench Test Procedure for Hydraulic Piston Pumps

Hose and Coupling Media

Table 5

PEKP0625	Hose and Coupling Assembler Training Manual
SEBF8727	Hose and Coupling Assembly Training Manual Contents
PEGT6025	Hose and Coupling Assembler Training Workbook

Contamination Control Guidelines

Table 6

SEBF9205	Contamination Control Guideline Reference Manual
SEBF9204	Contents for Contamination Control Reference Manual
SEBF9199	Filtration Times for Caterpillar Machine Fluid Compartments
SEBF9087	Caterpillar Bulk Oil Filtration Procedure
SEBF9086	Solvent Pretreatment Method for Determining Additive Interference in New Bulk Oils

SEBF8840	Basic Principles of Kidney Loop Filtering Hydraulic Fluid Systems
SEBF8470	Proper Oil Changing Procedures
SEBF8482	Obtaining Oil Samples for Analysis
SEBF8279	Procedures for Operating Caterpillar Filter Carts
SEBF8448	Procedure for Adding Filtration Capability to Solvent Stands
SEBF8485	Cleaning Fluid-Carrying Hose and Tube Assemblies In Shop and Field Applications
SEBF8797	Procedure for Filtering Final Drives, Rear Axles and Differentials on Caterpillar Machines
SEBF8920	Procedure for Filtering 9U-5000 Hydraulic Test Bench Hydraulic Oil
SEBF8484	Filtration Procedure for Implement/Transmission Oil on Challenger MT700 Series Tractors
SEBF8786	Procedure for Filtering Feller Buncher Hydraulic Oil
SEBF8489	Procedure for Filtering D20D-D550B and 725-730 Articulated Truck Hydraulic Oil
SEBF8486	Procedure for Filtering Articulated Truck Transmission Oil
SEBF8806	Procedure for Filtering 735 & 740 Articulated Truck Steering Tank Oil
SEBF8798	Procedure for Filtering 735 & 740 Articulated Truck Hydraulic Oil
SEBF8333	Backhoe Loader S·O·S Sampling Valve and Filter Cart Installation Procedure
SEBF8780	Procedure for Filtering D and E Series Backhoe Loader Hydraulic Oil
SEBF8800	Procedure for "Off-Board" Filtering Backhoe Loader and Integrated Toolcarrier Hydraulic Oil Equipped with Auxiliary Lines
SEBF8726	Procedure for Filtering Compact Equipment Hydraulic Oil
SEBF8405	Procedure for Filtering Oil in Rebuilt Engines

SEBF8442	Contamination Control of Rebuilt Engines by Using a Particle Counting Process Patent Pending
SEBF8703	Procedure for Filtering 5000 Series Front Shovels and Mass Excavator Hydraulic Oil
SEBF8706	Procedure for Filtering Wheeled Excavator Hydraulic Oil
SEBF8447	Procedure for Filtering Excavator Hydraulic Oil
SEBF8757	Procedure for "Off-board" Filtering 307-385B Excavator Hydraulic Oil Equipped with Auxiliary Hydraulic Lines
SEBF8788	Procedure for Filtering Forwarder Power Train Oil and Hydraulic Oil
SEBF8779	Procedure for Filtering Wheel-Type Skidder Hydraulic Oil
SEBF8404	Procedure for Filtering Track Feller Buncher Hydraulic Oil
SEBF8786	Procedure for Filtering Feller Buncher Hydraulic Oil
SEBF8787	Procedure for Filtering Wheel Harvester Hydraulic Oil
SEBF8828	Procedure for Filtering Knuckleboom Loader Hydraulic Oil
SEBF8453	Procedure for Filtering Motor Grader Hydraulic Oil
SEBF9175	Procedure for Filtering Motor Grader & Paving Compactor Hydraulic Oil
SEBF9127	Procedure for Filtration of Oil in the Motor Grader Tandem Drive
SEBF8461	Procedure for Filtering Transmission Oil on Motor Graders Without Ecology Drain
SEBF8462	Procedure for Filtering Transmission Oil on 24H & 24M Motor Graders Equipped with Ecology Drain Valve
SEBF8446	Procedure for Filtering Off-Highway Truck Hydraulic Oil
SEBF9195	Procedure for Filtering 797F Off-Highway Truck Hydraulic Oil
SEBF9196	Procedure for Filtering 797F Off Highway Truck Steering Oil

SEBF8445	Procedure for Filtering Off-Highway Truck (769-793) Transmission Oil
SEBF8460	Procedure for Filtering Off-Highway Truck Transmission and Torque Converter Oil
SEBF8438	Procedure for Filtering Off-Highway Truck Rear Axle Oil
SEBF8366	Cleaning Rear Axle Housings of 785 and 789 Off-Highway Trucks
SEBF8454	Procedure for Filtering Off-Highway Truck (769-777) Rear Axle Oil
SEBF8370	Cleaning Rear Axle Housing Assemblies of 793 Off-Highway Trucks
SEBF8490	Cleaning Front Wheel Groups of 793 and 797 Off-Highway Trucks
SEBF8483	Procedure for Filtering Front Wheel Groups of 793 and 797 Off-Highway Trucks
SEBF8724	Procedure for Filtering Off-Highway Truck Steering Oil
SEBF8440	Cleaning Asphalt Pavers
SEBF8781	Procedure for Filtering Hydraulic Oil in the Vibratory Compactor
SEBF8792	Procedure for Filtering Pneumatic Compactor Hydraulic Oil
SEBF9181	Procedure for Filtering Cold Planer Hydraulic Oil
SEBF9120	Procedure for Filtering E Series Vibratory Compactors
SEBF8785	Procedure for Filtering Telescopic Handlers Hydraulic Oil
SEBF8802	Procedure for Filtering 210-215 Telescopic Handler Hydraulic Oil
SEBF8803	Procedure for Filtering B Series Telescopic Handler Hydraulic Oil
SEBF8455	Procedure for Filtering Track-Type Tractor (D3-D6) & Pipelayer (561-587) Hydraulic Oil
SEBF8456	Procedure for Filtering (D7-D11) Track-Type Tractor & 589 Pipelayer Hydraulic Oil

SEBF9176	Procedure for Filtering Pipelayer Hydraulic Oil Equipped with Ecology Drain Valve
SEBF8465	Procedure for Filtering D6-D11T Track-Type Tractor Transmission Oil
SEBF8758	Procedure for Filtering Track-Type Loader Hydraulic Oil
SEBF9093	Procedure for Filtering Caterpillar Underground Mining Truck Rear Axle Oil
SEBF8791	Procedure for Filtering Load, Haul, Dump Hydraulic Oil
SEBF8790	Procedure for Filtering Underground Articulated Truck Hydraulic Oil
SEBF8789	Procedure for Filtering Underground Mining Truck Hydraulic Oil
SEBF8493	Procedure for Filtering Wheel Loader, Landfill Compactor, Soil Compactor, and Integrated Toolcarrier Hydraulic Oil
SEBF8494	Procedure for Filtering Large Wheel Loader and Landfill Compactor Hydraulic Oil
SEBF9178	Procedure for Filtering 924H Wheel Loader Hydraulic Oil
SEBF8725	Procedure for Filtering Large Wheel Loader Steering Oil
SEBF9053	Permanent Filtration Adapter Installation and Filtration Procedure for 992G Wheel Loaders Front and Rear Axles
SEBF8452	Procedure for Filtering Wheel Loader Transmission Oil (Equipped with an Ecology Drain)
SEBF8458	Procedure for Filtering Wheel Loader, Track-Type Tractor, Wheel Dozer, Earthmoving Compactor and Integrated Toolcarrier Transmission Without Ecology Drain
SEBF8459	Procedure for Filtering Transmission Oil on 994D Wheel Loader
SEBF8464	Procedure for Filtering Wheel Loader (988-992G) Front and Rear Axle Oil
SEBF8457	Procedure for Filtering Wheel Tractor-Scraper Hydraulic Oil
SEBF8463	Procedure for Filtering Wheel Tractor Scraper Transmission Oil for 611, 613C II, and 615C II
SEBF8481	Procedure for Filtering 621-651 G & E Series Front Engine Wheel Tractor-Scrapers

SEBF8750	Procedure for Filtering 627, 637, and 657 G & E Series Wheel Tractor Scraper Transmission Oil

Undercarriage Reconditioning Bulletins

Table 7

SEBF8599	Undercarriage Recondition Bulletic Manual
SEBF8501	"Undercarriage Reconditioning Bulletin Contents"
SEBF8502	"Foreward"
SEBF8504	"Introduction"
SEBF8351	"Mobil-Track Systems (MTS)"
SEBF8546	"Shop Repair Procedure for Positive Pin Retention Track"
SEBF8553	"Reusability Guidelines and Installation Procedures for Split Master Links"
SEBF8554	"Track Press Assembly Specifications"
SEBF8557	"Shop Repair Procedure for Non-PPR Sealed and Lubricated Track"
SEBF8558	"Guideline for Reusable Track Parts"
SEBF8562	"Procedure and Guidelines for Cleaning Phosphate Coated Track Pins for Series N and Series L Track-Type Tractors"
SEBF8565	"Track Service Evaluation Checklist"
SEBF8566	"Track Data Charts"
SEHS8881	"Repair Procedure for Quad Track"
SEHS8957	"Field Servicing Procedure for Non-PPR Sealed and Lubricated Track"
SEHS9371	"Track Seal Installers and Track Bushing Groove Gauges for Rigid Track Seals"
SEHS9542	"Field Repair of Rotating Bushing Track (RBT)"
SENR1788	"Non-PPR Sealed and Lubricated Track Reconditioning" Wall Chart
SENR1838	"Positive Pin Retention Sealed and Lubricated Track Reconditioning" Wall Chart
SEBF8591	"Track Servicing Equipment, Tooling, Literature, and Training Review"
SEBF8598	"Shop Repair Procedure for Grease Lubricated Track"
SEBF8609	"Shop Repair Procedure for Sleeve Bearing Track"
SEBF8612	"Field Service for Positive Pin Retention Track"

SEBF8613	"Field Service for Sleeve Bearing Track"
SEBF8614	"Field Repair of Swaged Grease Lubricated Track"
SEBF8619	"SystemOne Tool Reference"
SEBF9100	"Field Repair of SystemOne Track with the Multi-Pitch Track Press"
REHS1110	"Installation and Removal of SystemOne Track on Machines with an Elevated Sprocket"
REHS2220	"Installation and Removal of SystemOne Clamp Masters"
REHS2221	"Installation and Removal of SystemOne Track on Machines with an Oval Track"
REHS2403	"Installation and Removal of SystemOne Track with the Multi-Pitch Track Press"
REHS2412	"Removing SystemOne Track Links"
REHS2496	"Field Repair of SystemOne Track with the SystemOne Portable Track Press"
REHS2533	"Field Repair of SystemOne Track"
REHS2586	"Field Service for Positive Pin Retention 2 (PPR2)"
SEBF8506	"Conventional (Dry) Welding Procedure for Rollers and Idlers"
SEBF8507	"Procedure for Water-Cooled Welding of Track Rollers"
SEBF8511	"Reusability Recommendations for Duo-Cone Seals"
SEBF8552	"Idler Weld Rebuild Procedure"
SEBF8555	"Duo-Cone Seal Assembly and Installation Procedure for the 963 and 973 Track-Type Loaders"
SEBF8495	"Hydraulic Excavator Idler Disassembly and Assembly"
SEBF8568	"Hydraulic Excavator Roller Disasembly and Assembly Procedures"
SEBF8587	"Large Mining Products Roller Disassembly and Assembly"
SEBF8579	"Snap Ring Roller Disassembly and Assembly Procedures"
SEBF8580	"Carrier Roller Disassembly and Assembly Procedures"
SEBF8581	"Disassembly and Assembly Procedures for Track Rollers with Inverted Duo-Cone Seals"
RENR2059	"Disassembly and Assembly Procedures for Rollers with Inverted Duo-Cone Seals" Wall Chart

SEBF8582	"Disassembly and Assembly Procedures for Idlers with Inverted Duo-Cone Seals"
RENR2052	"Disassembly and Assembly Procedures for Idlers with Inverted Duo-Cone Seals" Wall Chart
SEBF8584	"Disassembly and Assembly Procedures for Track Rollers with Conventional Duo-Cone Seals"
RENR3961	"Disassembly and Assembly Procedures for Rollers with Conventional Duo-Cone Seals" Wall Chart
RENR7601	"Set-Up and Use of the Cat Test and Fill Machine" Wall Chart
SEBF8585	"Disassembly and Assembly Procedures for Idlers with Conventional Duo-Cone Seals"
RENR3960	"Disassembly and Assembly Procedures for Idlers with Conventional Duo-Cone Seals" Wall Chart
SEHS8364	"Assembly and Installation of Conventional Duo-Cone Seals"
SEHS8483	"Assembly and Installation of Inverted Duo-Cone Seals"
SEHS8484	"Tool and Specification Chart for Conventional Duo-Cone Seal Groups"
SEHS8515	"Repair Procedure for Retainer Assemblies on Track Idlers and Rollers"
SEHS8974	"Tool and Specification Chart for Inverted Duo-Cone Seals"
SEHS9990	"Installation of 3-Bolt Idler Caps"
REHS0062	"Installation of the 3-Bolt Idler Caps"
SEBF8586	"Removal, Installation, and Conditioning of Idler Bearings and Track Roller Bearings"
SEBF8588	"Oval Track Roller Disassembly and Assembly Procedures"
RENR3962	"Disassembly and Assembly Procedures for Snap Ring and Oval Track Rollers" Wall Chart
SEBF8589	"Roller Servicing Equipment, Tooling, Literature, and Training Review"
SEBF8590	"Idler Servicing Equipment, Tooling, Literature, and Training Review"
SEBF8595	"Track, Track Roller, and Track Idler Cycle Times"
SEBF8592	"Idler Service Evaluation Checklist"
SEBF8593	"Roller Service Evaluation Checklist"
SEBF8596	"Guideline fro Roller and Idler Component Reuse"
SEBF8597	"Reconditioning Procedure for Seal Ramps on Inverted Style Idler and Roller Shafts"
SEBF8616	"Disassembly and Assembly Procedures for Landfill Idlers"
SEBF8617	"Disassembly and Assembly Procedures for Sound Suppressed Idlers"

RENR3963	"Disassembly and Assembly Procedures for Hydraulic Excavator Rollers" Wall Chart
RENR3964	"Disassembly and Assembly Procedures for Hydraulic Excavator Idlers" Wall Chart
SEBF8956	"Disassembly and Assembly Procedures for Idlers of Track-Type Loaders"
SEBF8505	"Automatic Welding"
SEBF8509	"Welding Wire and Flux"
SEBF8548	"Field Inspection of Bogie Cartridge Pins on Suspended Undercarriage"
SEBF8556	"Procedure for Replacement Grouser Bars"
SEBF8569	"Reconditioning Dimensions for Track Rollers"
SEBF8570	"Reconditioning Dimensions for Carrier Rollers"
SEBF8571	"Reconditioning Dimensions for Idlers"
SEBF8574	"Track Roller Oil Fill Volume"
SEBF8575	"Carrier Roller Oil Fill Volume"
SEBF8576	"Idler Oil Fill Volume"
SEBF8577	"Oil Fill Volumes for Track Link Assemblies"
SEHS7751	"Installation of Sprocket Segment Adapter Groups or Salvaging Segmented Sprocket Hubs"
REHS1757	"Rebuild Guidelines for the Suspended Undercarriage"
SEHS8971	"Rebuild Guidelines for the Suspended Track Roller Frames"
RENR3965	"Adjustment, Setup, and Operation Procedures for the Caterpillar Track Torque Wrench"
SEBF8516	"Equipment and Tools for Undercarriage Rebuilding and Reconditioning Stations"
SEBF8594	"Nitrogen Pressure Test Unit"
SEBF8519	"Facility and Equipment Layouts"
SEBF8520	"Suggested Equipment Layouts"
SEBF8530	"Training Materials"

Transmission Bench Test Procedures

Table 8

SEBF8760	"Transmission, Torque Converter, and Relief Valve Bench Test Procedures Reference Manual"

	Manual
SEBF8761	Reference Manual Contents
REHS1668	"Bench Test Procedure for a 416C, 420D, 426C, 428C, 428D, 430D, 432D, 436C, 438C, 438D, and 442D Backhoe Loader Powershift Transmission"
REHS1669	"Bench Test Procedure for a 416C, 416 D, 420D, 424 D, 426C, 428C, 428D, 430D, 432D, 436C, 438D, and 442D Backhoe Loader Standard Shift Transmission"
REHS3499	"Bench Test Procedure for a 420D, 420D IT AWS, 420E, 428D NF ST, 428D PARA LIFT, 430D, 430D AWS, 430D IT, 430D IT AWS, 430E, 432D, 432E, 434E, 438D, 442D AWS, 442E, 444E, and 450E Backhoe Loader Transmission (Power Shift)"
REHS3580	"Bench Test Procedure For A 414E, 416E, 420E, 422E, 428E, 430E, 432E, 434E, 442Eand 444E Backhoe Loader Transmission (Standard Shift)"
REHS1326	"Bench Test Procedure for a D5M, D5N, D6M, and D6N Track-Type Tractor Transmission"
REHS1488	"Bench Test Procedure for a D6N Track-Type Tractor Transmission with Differential Steering"
REHS1327	"Bench Test Procedure for a D5M, D6M, and 561M Track-Type Tractor Transmission"
REHS1303	"Bench Test Procedure for a D6R, D6R Series II, D7R, D7R Series II, and 572R Track-Type Tractor Transmission"
REHS1607	"Bench Test Procedure D6R Track-Type Tractor"
REHS1389	"Bench Test Procedure for a D8R Series II Track-Type Tractor Transmission"
REHS2501	"Bench Test Procedure For A 583T Pipelayer And D8T Track-Type Tractor Transmission"
REHS1631	"Bench Test Procedure for a D9R Track-Type Tractor Transmission"
REHS1632	"Bench Test Procedure for a D9R Track-Type Tractor Transmission with Differential Steering"
REHS2246	"Bench Test Procedure for a D9T Track-Type Tractor Transmission with Differential Steering"
REHS1325	"Bench Test Procedure for a D10R Track-Type Tractor Transmission"
REHS3183	"Bench Test Procedure for a D10T Track-Type Tractor Transmission"
REHS2290	"Bench Test Procedure for a D10 and D11N Track-Type Tractor Transmission"
REHS3276	

REHS3276	"Bench Test Procedure for a D5 and D5B Track-Type Tractor Transmission"
REHS3277	"Bench Test Procedure for a D6C, D6D, D6E, D6G, and D6G Series II Track-Type Tractor Transmission"
REHS3278	"Bench Test Procedure for a D7F, D7G Track-Type Tractor, 571G, and 572G Pipelayer Transmission"
REHS3279	"Bench Test Procedure for a 589 Pipelayer and D8L Track-Type Tractor Transmission"
REHS3280	"Bench Test Procedure For a D8L, D9L, D9N, and D10N Track-Type Tractor Transmission"
REHS3496	"Bench Test Procedure for a D11R and D11T Track-Type Tractor Transmission"
REHS2274	"Bench Test Procedure for a 814B Wheel Dozer, 815B Soil Compactor, and 816B Landfill Compactor Transmission"
REHS1673	"Bench Test Procedure for a 814F Wheel Dozer, 815F Soil Compactor, and 816F Landfill Compactor Transmission"
REHS2836	"Bench Test Procedure for a 824C Wheel Dozer, 825C Soil Compactor, and 826C Landfill Compactor Transmission"
REHS2050	"Bench Test Procedure for a 824G Wheel Dozer, 824G Series II Wheel Dozer, 825G Soil Compactor, 825G Series II Soil Compactor, 826G Landfill Compactor, and 826G Series II Landfill Compactor Transmission"
REHS1671	"Bench Test Procedure for a 834G Wheel Dozer and 836G Landfill Compactor Transmission"
REHS2394	"Bench Test Procedure for an 844 Wheel Dozer Transmission"
REHS1783	"Bench Test Procedure for a 854G Wheel Dozer Transmission"
REHS2282	"Bench Test Procedure For a 834B Wheel Dozer And an 836 Landfill Compactor Transmission"
REHS2841	"Bench Test Procedure for a 910B Wheel Loader Transmission"
REHS2842	"Bench Test Procedure for a 910B Wheel Loader Transmission"
REHS2303	"Bench Test Procedure for a 918F, 924F Wheel Loader, and IT18F, IT24F Integrated Toolcarrier Transmission"
REHS2843	"Bench Test Procedure for a 920 and 930 Wheel Loader Transmission"
REHS2211	"Bench Test Procedure for a 924G and 924GZ Wheel Loader Transmission"

REHS2139	"Bench Test Procedure for a 924G, 924GZ, 924 HZ, 928G Wheel Loader and IT28G Integrated Toolcarrier Transmission (ECPC)"
REHS1628	"Bench Test Procedure for a 928G Wheel Loader and IT28G Integrated Toolcarrier Transmission with a Splined Coupling Drive"
REHS1629	"Bench Test Procedure for a 928G Wheel Loader and IT28G Integrated Toolcarrier Transmission with a Flexible Coupling Drive"
REHS1636	"Bench Test Procedure for a 938F and 938G Wheel Loader and IT38F and IT38G Integrated Toolcarrier Transmission"
REHS2844	"Bench Test Procedure for a 950B Wheel Loader Transmission"
REHS1468	"Bench Test Procedure for a 950G, 950G Series II, 962G, and 962G Series II Wheel Loader Transmission IT62G and IT62G Series II Integrated Toolcarrier Transmission"
REHS2845	"Bench Test Procedure for a 966D Wheel Loader Transmission"
REHS1630	"Bench Test Procedure for a 950H, 962H, 966G, 966G Series II, 966H, 972G, 972G Series II, and 972H Wheel Loader Transmission"
REHS2298	"Bench Test Procedure for a 980C Wheel Loader Transmission"
REHS2846	"Bench Test Procedure for a 980C Wheel Loader Transmission"
REHS1328	"Bench Test Procedure for a 980G and 980G Series II Wheel Loader Transmission"
REHS1721	"Bench Test Procedure for a 980G and 980G Series II Wheel Loader Transmission (Heavy Duty)"
REHS2751	"Bench Test Procedure for a 980H Wheel Loader Transmission"
REHS2071	"Bench Test Procedure for a 988F and 988F Series II Wheel Loader Transmission"
REHS2847	"Bench Test Procedure for a 988B Wheel Loader Transmission"
REHS1670	"Bench Test Procedure for a 988G and 988H Wheel Loader Transmission"
REHS2393	"Bench Test Procedure for a 990 and 990 Series II Wheel Loader Transmission"
REHS2848	"Bench Test Procedure for a 992C Wheel Loader Transmission"
REHS1782	"Bench Test Procedure for a 992D, 992G, and 992K Wheel Loader Transmission"

REHS2304	"Bench Test Procedure for a 928F Wheel Loader and IT28F Integrated Toolcarrier Transmission"
REHS3123	"Bench Test Procedure for a 910E, 910F, and 918F Wheel Loader Transmission IT12E, IT12F, IT14B, IT14F Integrated Toolcarrier Transmission"
REHS2230	"Bench Test Procedure for a 938H and 938G Series II Wheel Loader and IT38H and IT38G Series II Integrated Toolcarrier Transmission"
REHS3582	"Bench Test Procedure for a 993K Wheel LoaderTransmission"
REHS2293	"Bench Test Procedure for a 508 Wheel Skidder Transmission"
REHS1844	"Bench Test Procedure for a 515 and 525 Wheel Skidder Transmission"
REHS1845	"Bench Test Procedure for a 525B, 535B, and 545 Wheel Skidder Transmission"
REHS3131	"Bench Test Procedure For a 518 Wheel Skidder Transmission"
REHS3609	"Bench Test Procedure for a 527 Track-Type Skidder Transmission"
REHS3151	"Bench Test Procedure For a 528 Wheel Skidder Transmission"
REHS2310	"Bench Test Procedure for a D400E Series II and D400E Series II EJECTOR Articulated Truck Transmission"
REHS1313	"Bench Test Procedure for a 725 and 730 Articulated Truck Transmission"
REHS1409	"Bench Test Procedure for a 735 Articulated Truck Transmission"
REHS1410	"Bench Test Procedure for a 740 and 740 EJECTOR Articulated Truck Transmission"
REHS2270	"Bench Test Procedure for a 120G, 130G, 140G, 160G, 12G, 14G, and 16G Motor Grader Transmission"
REHS2124	"Bench Test Procedure for a 14H and 16H Motor Grader Transmission"
REHS3458	"Bench Test Procedure for a 120M, 12M, 140M, 140M Series II, 160M and 160M Series II Motor Grader Transmission"
REHS1427	"Bench Test Procedure for a 120H, 12H, 12K, 135H, 140H, 140K, 143H, 160H, 160K, and 163H Motor Grader Transmission"
REHS3458	"Bench Test Procedure for a 120M, 12M, 140M, and 160M Motor Grader Transmission"

REHS2369	"Bench Test Procedure for a 24H Motor Grader Transmission"
REHS3446	"Bench Test Procedure For A 14M and 16M Motor Grader Transmission"
REHS1749	"Bench Test Procedure for a 773D, 773E, 775D, and 775E Off-Highway Truck Transmission"
REHS3440	"Bench Test Procedure for a 773F and 775F Off-Highway Truck Transmission"
REHS2280	"Bench Test Procedure for a 776 and 777 Off-Highway Truck Transmission"
REHS1672	"Bench Test Procedure for a 776B, 776C, 776D, 777B, 777C, and 777D Off-Highway Truck Transmission"
REHS3436	"Bench Test Procedure for a 777F Off-Highway Truck Transmission"
REHS1426	"Bench Test Procedure for a 784B, 784C, 785, 785B, 785C,785D, 789, and 789B Off-Highway Truck Transmission"
REHS1388	"Bench Test Procedure for a 793, 793B, and 789C Off-Highway Truck Transmission"
REHS1344	"Bench Test Procedure for a 793C Off-Highway Truck Transmission"
REHS3434	"Bench Test Procedure for a 793D Off-Highway Truck Transmission"
REHS1346	"Bench Test Procedure for a 797 and 797B Off-Highway Truck Transmission"
REHS3494	"Bench Test Procedure for a 793F Off-Highway Truck Transmission"
REHS3497	"Bench Test Procedure for a 770 and 772 Off-Highway Truck Transmission"
REHS3602	"Bench Test Procedure for a 797F Off-Highway Truck Transmission"
REHS3186	"Bench Test Procedure for a 615 and 615C Wheel Tractor Scraper Transmission"
REHS3187	"Bench Test Procedure for a 621B, 623B, and 627B Wheel Tractor Scraper Transmission"
REHS1748	"Bench Test Procedure for a 627E, 627F, and 627G Wheel Scraper Transmission"
REHS3185	"Bench Test Procedure for a 613 and 613B Wheel Tractor Scraper Transmission"

REHS2438	"Bench Test Procedure for a 631E, 631E Series II, 631G, 633E Series II, 637E and 637G Wheel Tractor Transmission"
REHS2229	"Bench Test Procedure for a 637E and 637G Wheel Scraper Transmission"
REHS2292	"Bench Test Procedure for a 657E, 657G Wheel Scraper Transmission"
REHS3498	"Bench Test Procedure for a 613G Scraper Transmission"
REHS3495	"Bench Test Procedure for a 651E, 657E, and 657G Tractor Transmissions"
REHS3485	"Bench Test Prodcedure For a CX28 On-Highway Transmission"
REHS3184	"Bench Test Procedure For A CX31 and CX31-P600 Petroleum Transmission"
REHS3283	"Bench Test Procedure For A TA22 Transmission"
REHS3442	"Bench Test Procedure for a TH31-E61 Oil/Gas Transmission with Dropbox"
REHS3444	"Bench Test Procedure for a TH35-E81 Oil/Gas Transmission with Dropbox"
REHS2828	"Bench Test Procedure for a TH48FT – E80 Oil Field Transmission"
REHS3488	"Bench Test Procedure for TH55FT - E70 Oil Field Transmission"
REHS2305	"Bench Test Procedure For A 35, 45, and 55 Challenger Transmission"
REHS2644	"Bench Test Procedure for an MT735, MTC735, MT745, MTC745, MT755, MTC755, MT765, and MTC765 Agricultural Tractor Transmission"
REHS3025	"Bench Test Procedure For A MT835, MT845, MT855, MT865, MTC835, MTC845, MTC855, and MTC865 Agricultural Tractor Transmission"
REHS3448	"Bench Test Procedure for a 24H and 24M Motor Grader Torque Converter"
REHS3439	"Bench Test Procedure for a 768C, 769C, 769D, 771C, 771D, Off-Highway Truck, and D35-HP, D400 Articulated Truck Torque Converter"
REHS3126	"Bench Test Procedure for a 768C, 769C, 772B, 773B Off-Highway Truck Torque Converter"
REHS3445	"Bench Test Procedure for a 773F and 775F Off-Highway Truck Torque Converter"

REHS3466	"Bench Test Procedure for a 776B, 776C, 776D, 777B, 777C, and 777D Off-Highway Truck Torque Converter"
REHS3438	"Bench Test Procedure for a 777F Off-Highway Truck Torque Converter"
REHS3463	"Bench Test Procedure for a 784B, 784C, 785B, 785C, and 785D Off-Highway Truck Torque Converter"
REHS2360	"Bench Test Procedure for a 793C Off-Highway Truck Torque Converter"
REHS1347	"Bench Test Procedure for the 797 and 797B Off-Highway Truck Torque Converter Inlet Relief Valve, Torque Converter Outlet Relief Valve, and Transmission Main Relief Valve"
REHS1345	"Bench Test Procedure for a 797 and 797B Off-Highway Truck Torque Converter"
REHS3248	"Bench Test Procedure For A 589 Pipelayer, D8L, D9L, D9N, And D10N Track-Type Tractor Torque Converter"
REHS3450	"Bench Test Procedure for a D8R Track-Type Tractor Torque Converter"
REHS3460	"Bench Test Procedure for a 583R Pipelayer and a D8R Track-Type Tractor Torque Converter"
REHS3437	"Bench Test Procedure for a D11R and D11T Track-Type Tractor Torque Converter"
REHS3486	"Bench Test Procedure For a 583T Pipelayer and a D8T Track-Type Torque Converter"
REHS3459	"Bench Test Procedure for a 854G Wheel Dozer and 992G Wheel Loader Torque Converter"
REHS3465	"Bench Test Procedure for a 992G Wheel LoaderTorque Converter (No Lockup)"
REHS3453	"Bench Test Procedure for a 994D and 994F Wheel Loader Torque Converter"
REHS3489	"Bench Test Procedure for a D6R Series III and D6T Track-Type Tractor Transmission"
REHS3490	"Bench Test Procedure for a 994D, and 994F Wheel Loader Transmission"

Drive Train Reuse and Salvage Guidelines

Table 9

SEBF8287	

	"785, 789, and 793 Off-Highway Trucks Reuse and Salvage Manual Contents"
SEBF8289	"785, 789, 793 Off-Highway Trucks Reuse and Salvage Index"
SEBF8420	"Rebuilding Front Axles, Spindle Housings, Leaning Arms, and Lean Bars"
SEBF8761	"Transmission, Torque Converter, and Relief Valve Bench Test Procedure Reference Manual Contents Page"
SEBF8891	"797 and 797B Off-Highway Truck Reuse and Salvage Index"
SEBF8959	"797 OHT Differential Thrust Washer Mounting Hole Repair"
SEBF9168	"Universal Joints and Drive Shafts"
SEBF8187	"Standard Parts Marking Procedure"
REHS1806	"Welding Repair Of Motor Grader Frame"
REHS2099	"Reuse And Salvage Guideline For Front Suspension Cylinder Housings And Heads On Off-Highway Trucks"
REHS2110	"Center Steering Arm Straight Bore Inspection And Salvage Procedure For 785, 785B, And 785C Off-Highway Trucks"
REHS2346	"Weld Repair Procedure For The Rear Axle A-Frame And Rear Axle Housing On 785, 789, And 793 Off-Highway Trucks"
SEBF8004	"Output Flange For Torque Converters On D6, D7, D8, And D9 Track-Type Tractors"
SEBF8005	"Pump Drive Torque Converter"
SEBF8007	"Salvage Procedure for Torque Converters - 1T630 on D7 Tractors, 1T611 and 1T670 on D8 and D9 Tractors"
SEBF8008	"Turbine Wheel for Torque Converters Used with Power Shift Transmissions"
SEBF8011	"Freeswheel Side Plates and Thrust Races for Torque Converters"
SEBF8016	"1T149 Clutch Race"
SEBF8037	"Brake Drums Off-Highway Trucks, Tractors, and Scrapers"
SEBF8038	"Reconditioning of Worn 6D-7995 Circle Reverse Housing on 12E and 14E Motor

SEBF8038	"Reconditioning of Worn 6D-7993 Circle Reverse Housing on 12F and 14E Motor Graders"
SEBF8044	"Repair Of Torque Converter Stator Wheels"
SEBF8048	"Procedure to Machine Damaged Transmission & Differential Yokes"
SEBF8056	"Track-Type Tractor Brake Drums"
SEBF8060	"Repair Of Transmission, Torque Converter And Torque Divider Shafts"
SEBF8078	"Conventional (Non-Planetary) Final Drive Gears for Track-Type Tractors and Track-Type Loaders"
SEBF8079	"Planetary Final Drives For Track-Type Tractors"
SEBF8082	"Procedure to Repair Worn Torque Converter Housing Seal Area on 992C and Later 988B Wheel Loaders"
SEBF8083	"Inspection and Salvage of Wheel Spindles for all Off-Highway Trucks"
SEBF8084	"Procedure to Repair Damaged Sprocket Hubs for D8L, D8N, D9L, D9N, D10N, and D11N Track-Type Tractors"
SEBF8086	"Variable Capacity Torque Converter Impeller Salvage"
SEBF8087	"Cast Aluminum Stator Wheels for Torque Converters"
SEBF8088	"Pump Drive Group Salvage For 992B And 992C Wheel Loaders"
SEBF8090	"Wheel Loader Power Train Specifications"
SEBF8093	"Planet Final Drives for Wheel Loaders, Wheel Tractors, and Compactors"
SEBF8095	"Service Brakes for Off-Highway Trucks and Tractors"
SEBF8117	"Procedure to Repair Worn Blade Circles for 12G, 14G, 16G, 130G, 140G, and 160G Motor Graders"
SEBF8118	"Salvage of Center Bearing in Torque Converter Input Housing"
SEBF8119	"Differential Housing Components for Wheel Loaders, Off-Highway Trucks and Tractors, Articulated Trucks, Wheel Tractors, Compactors, and Integrated Toolcarriers"
SEBF8120	

SEBF8120	"992C Wheel Stud Hole Repair"
SEBF8121	"Wheel Loader Differential Carrier Salvage"
SEBF8122	"Off-Highway Truck Wheel Rim Repair Procedure"
SEBF8123	"Track-Type Tractor Sprocket Shaft Bore Repair"
SEBF8126	"U-Joints & Drive Shafts"
SEBF8127	"Yoke Bear Journals on Bulldozer Lift Cylinders for Track-Type Tractors and Wheel Dozers"
SEBF8132	"Salvage Of Final Drive Sprocket Hubs For Pipelayers, Track Loaders, And Track-Type Tractors"
SEBF8135	"Repair of Web Cracks in Final Drive Planetary Carriers"
SEBF8143	"Front Suspension Cylinder Housing on Off-Highway Trucks"
SEBF8158	"Steering Clutch, Brake Disc & Plates for Scrapers, Pipelayers, Track-Type Tractors, and Loaders"
SEBF8159	"Front Suspension Cylinder Rods for 789 Trucks"
SEBF8168	"Salvage of Final Drive Carrier Plate for 963 and 973 Track-Type Loaders"
SEBF8182	"Salvage and Reuse of Final Drive Axle Bearing Used in 769-797 Off-Highway Trucks and Tractors; 990; 992, and 994 Wheel Loaders"
SEBF8183	"Salvage of Final Drive and Differential Thrust Washer Used in Off-Highway Trucks, Tractors, and Wheel Loaders"
SEBF8185	"Salvage Procedure for Final Drive Planet Gear Used in Off-Highway Trucks"
SEBF8190	"Reusability of Tapered Bearings"
SEBF8193	"Reusability of Drive Train Gears"
SEBF8194	"Specifications For Rear Suspension Cylinder Components Used In Off-Highway Trucks"
SEBF8195	"Transmission Case Salvage Procedure"
SEBF8199	

SEBF8199	"Salvage of Brake Housings Used on Off-Highway Trucks"
SEBF8200	"Salvage of Differential Bearing Cage on Off-Highway Trucks"
SEBF8221	"Salvage of Planetary Carrier (Outer Pin Bore) Using Pressed In Sleeves for 785 and 789 Trucks"
SEBF8222	"Salvage of Planetary Pin Bores Using Tapered Roller Bearings for 785 and 789 Trucks"
SEBF8223	"Salvage of Inner Planetary Carrier Pin Bores Using Tapered Roller Bearings for 785, 789, and 793 Trucks"
SEBF8225	"Reusability of Final Drives on 785, 789, 793, and 797 Off-Highway Trucks"
SEBF8227	"Salvage of Differential Housing Assemblies Used on 785, 789, and 793 Trucks"
SEBF8252	"Salvage of Differential Housing Assembly Used on 785, 789, and 793 Trucks"
SEBF8254	"Stator Carriers For Off-Highway Trucks"
SEBF8271	"Salvage of Tapered Steering Bores"
SEBF8272	"Tool List For Powertrain Components Used In 785, 789, And 793 Off-Highway Trucks"
SEBF8275	"Off-Highway Truck Major Part Inspection Report"
SEBF8285	"Salvage of Outer Planetary Carrier Pin Bores, Using Metal Spray and Machining Operations"
SEBF8305	"Procedure to Install The Sleeve Bearings"
SEBF8312	"Transmission Reuse and Salvage Index"
SEBF8316	"Torque Converter, Drive Line, and Drive Axle Reuse and Salvage Index"
SEBF8317	"Torque Converter, Divider, Drive Line, and Drive Axle Salvage and Reuse Manual Contents"
SEBF8320	"Final Drive/Steering Reference Manual Index"
SEBF8321	"Final Drive/Steering Reference Manual Contents Page"
[illegible]	[illegible]

SEBF8334	"Installing New Tapered Roller Bearings in 8X-1019, 102-0313, 125-5937 and 132-4515 Wheel Assemblies on 793 Off-Highway Trucks"
SEBF8342	"Transmission, Torque Converter, and Final Drive Updates for 768C - 793B Off-Highway Trucks"
SEBF8366	"Cleaning Of Rear Axle Housing In Final Drives"
SEBF8370	"Cleaning Rear Axle Housings In 793 Off-Highway Trucks"
SEBF8401	"Dimensions Of Articulated Joints & Steering Cylinder Bores For Motorgraders"
SEBF8419	"Salvage Of Axle Housing - 24H"
SEBF8421	"Centershaft Bracket Assembly For 16G And 16H Motor Graders"
SEBF8439	"Procedure to Salvage Reaction Hubs, Retainers, and Seal Retainers Used in Wheel Groups of Off-Highway Trucks"
SEBF8443	"Procedure To Inspect & Repair Wheels On Off-Highway Trucks"
SEBF8487	"Rebuilding Wheel Tractor - Scraper Hitches, Brackets & Scraper Kingbolt Housings"
SEBF8490	"Cleaning Front Wheel Housing Assemblies Of 793 & 797 Off-Highway Trucks"
SEBF8728	"Specification for Inspection of Driveline Fasteners"
SEBF8752	"Off-Highway Truck Final Drive Planetary Carrier"
SEBF8759	"Small Off-Highway Truck Splines"
SEBF8772	"Reusability Of 797 Rear Links"
SEBF8783	"Salvage Of At Differential Carrier Assembly By Installation Of Service Repair Cage"
SEBF8805	"Motor Grader Circle Drive Pinion Reuse Guide"
SEBF8834	"Transmission Clutch Plates & Disc Assemblies W/ N6553 Carbon Friction Material"
SEBF8841	"Planetary Final Drives For Small And Medium Wheel Loaders And Small Integrated Tool Carriers"

SEBF8879	"Body Pivot Bore Repair For 785 To 797 Off-Highway Trucks"
SEBF8880	"797 Off-Highway Truck Front Axle Steering Arm Bolt Hole Repair"
SEBF8882	"Using Lock N Stitch Procedure For Casting Repair"
SEBF8958	"Inspection And Repair Procedure For Wheels That Are Used On 992 And 994 Wheel Loaders"
SEBF8988	"797 Off-Highway Truck Differential Repair Procedure"
SEBF9054	"Reusability Of Tapered Steering Bores"
SEBF9118	"Removal And Installation Of Large Diameter Wheel Bearings"
SEBF9135	"Off-Highway Truck Rim Assembly Inspections"
SEBF9138	"797 Rear Wheel Bearing Full Second Life Reusability Guidelines"
SEBF9161	"Manual Length Measurement For M - Series Motorgrader Steering Cylinders"
SEBF9166	"Front Strut Support For The 793, 793B, And 793C Off-Highway Truck"
RENR1978	"785B Final Drive Group Tapered Bearing Assembly"
RENR5396	"797 and 797B Final Drive Group Assembly"
SENR5669	"789B Final Drive Group Straight Bearing Assembly"
SENR6235	"785 and 789 Transmission Assembly"
SENR6389	"785B Final Drive Group Straight Bearing Assembly"
SENR6834	"793 Transmission Assembly"
SENR8602	"793 Final Drive Group Assembly"
SENR9014	"8W-9545 Differential and Bevel Gear Group used in 785 Trucks"

SENR9015	"Assembly for 8W-9550 Differential and Bevel Gear Group Used in 793 Trucks"
SENR9016	"Assembly for 8X-0243 Differential and Bevel Gear Group Used in 793 Trucks"

Transmission Reuse and Salvage Procedures

Table 10

SEBF8313	"Transmission Reuse and Salvage Manual Contents"
SEBF8091	"Transmission Components"
SEBF8147	"Replacing Tubes in Housings that are Installed with Mechanical Joints (Expanded and Welded)"
SEBF8014	"Identification and Applications of Transmission Clutch Plates and Specifications to machine Reaction Faces for Power Shift Transmissions"
SEBF8017	"Clutch Ring Gears for All Power Shift Transmissions"
SEBF8028	"Salvage Case Assembly and Idler Shaft in Transmission Transfer Gear Groups for 621B, 623B, 627B, 641B, 650B, 651B, 651E, 657B, 657E, 660B and 666B"
SEBF8036	"Transmission Parts Damaged by Cast Iron and Vespel Seal Rings"
SEBF8178	"Procedure to Salvage Tang Slots on Transmission and Brake Pistons"
SEBF8021	"Transmission Bevel Pinion And Transfer Gear For D5, D6, D8 and D9 Tractors with Oval Tracks"
SEBF8257	"Procedure to Salvage the Slots for the Pin and Holes for the Reaction Dowel in Transmission Clutch Plates, Pistons, and Housings"
SEBF8096	"Transmission Governor Salvage for Seven and Eight Speed Powershift Transmissions"
SEBF8134	"Individual Clutch Modulation Control Valves"
SEBF8098	"Transmission Clutch Plates and Disc Assemblies with Rayflex Friction Material"
SEBF8114	"Identification of Non-Metallic Discs used in Power Shift Transmissions"
SEBF8013	"Transmission Clutch Plates and Disc Assemblies with Sintered Bronze Friction Material"

Procedure to Report Parts and Service Information Discrepancies{1000, 7000}

SMCS - 1000; 7000

Caterpillar Products: All

Introduction

This special instruction provides the necessary information in order to create SIS Web Feedback. All information provided in this document is necessary in order to provide the SIS Web Feedback analyst with the necessary information to expedite the resolution. SIS Web feedback is intended to provide feedback on any discrepancies within the Service/Parts literature. The feedback system is not intended to address any problems related to machine or component performance. Refer to the Dealer Solutions Network (DSN) for any problems associated with machine or component performance.

Note: Feedback is only available through SIS Web. Feedback is not available through SIS Network or SIS DVD.

Procedure

Preferred Method for Reporting Discrepancies

Ver imagen

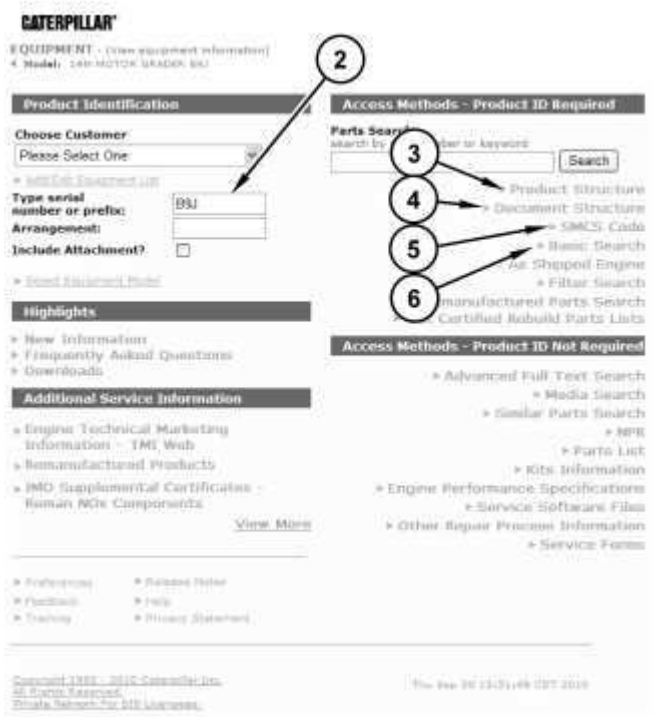


Illustration 1 g02283834

(2) Type serial number or prefix

(3) Product structure search

(4) Document structure search

(5) SMCS code search

(6) Basic search

1. It is imperative to use serial number prefix (2) in order to locate the discrepancy within the parts and service literature. This will provide the analyst with the correct machine model number and serial number involved in the discrepancy.

2. Use one of the four search methods in order to locate the discrepancy. The following search methods will provide the analyst with a direct link to the discrepancy: Product structure search (3), Document structure search (4), SMCS code search (5) and Basic search (6) .

   Note: Using any other method in searching for parts and service information will result in missing information in the discrepancy ticket. Any missing information may delay resolution of the discrepancy.

Ver imagen

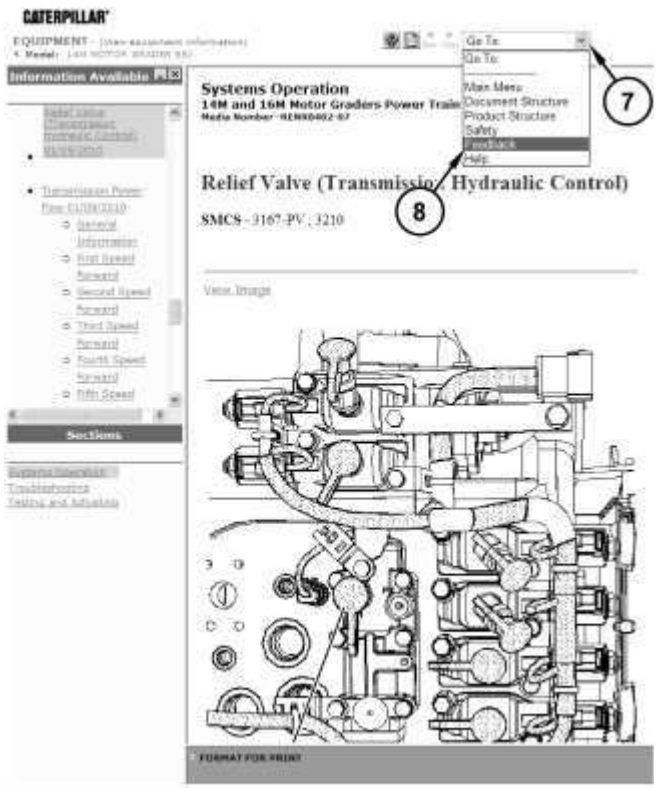


Illustration 2 g02283860

3. Select the pull down menu using radio button (7) .
4. Select Feedback selection (8) .

Ver imagen

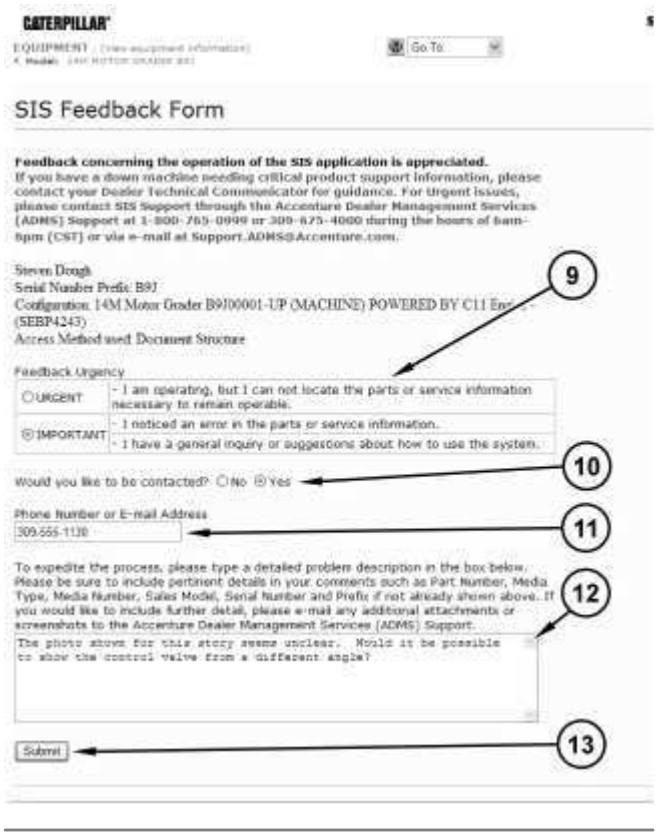


Illustration 3 g02283893

Typical example

5. In Feedback Urgency box (9), choose from one of the following selections that are provided:
   - Urgent
   - Important
6. Select yes or no for question (10) in order to identify whether you would like to be contacted regarding your feedback ticket. If the answer is yes to question (10), then proceed to the next step. If the answer is no to question (10), then proceed to Step 8.
7. Provide the contact information in box (11). The contact information can include an E-mail address and/or a telephone number.
8. Provide a detailed description of the discrepancy in box (12). Be sure to include pertinent details such as: part number, media type, media number, sales model, serial number and prefix. This information will expedite the resolution of the discrepancy.
9. Once the information has been provided for Step 5 through Step 8, complete the ticket by clicking

submit button (13) .

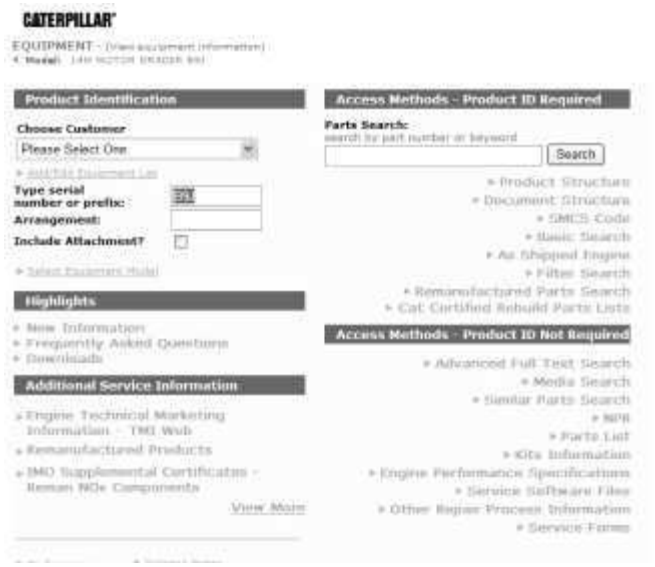
Ver imagen

Illustration 4 g02283914

10. Illustration 4 provides an example of a completed discrepancy ticket. This ticket has all of the pertinent information of the discrepancy, and provides a direct link to the page of the discrepancy. Click on return button (14) in order to return to the page that you were viewing prior to submitting the ticket.

Non-Preferred Method for Reporting Discrepancies

Ver imagen



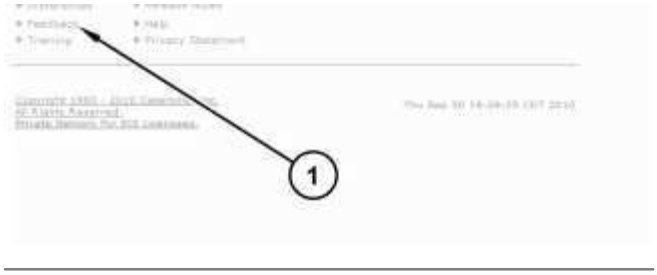


Illustration 5 g02283935

(1) Feedback

1. From the main page the feedback button allows you to submit a discrepancy ticket.

   Note: This method is not preferred because this method does not provide the analyst with a direct link to the problem. Refer to Step 1 through Step 10 in order to submit a discrepancy ticket. This procedure will provide the analyst with a direct link to the issue. This method will also provide the analyst with proper serial number and media number identification.

Instrucción Especial
Capturing Photo, Video, or Audio Evidence of Machine Issues{0336, 1000, 7000}
Número de medio -TIBU5940-01 **Fecha de publicación -02/08/2010** **Fecha de actualización -02/08/2010**

i04001573

Capturing Photo, Video, or Audio Evidence of Machine Issues{0336, 1000, 7000}

SMCS - 0336; 1000; 7000

Caterpillar Products: All

Introduction

The problem that is identified below has a known permanent solution. Follow the solution that is identified below.

Problem

Visual or audio evidence of issues with a part or machine are submitted to the Dealer Solution Network (DSN). In some cases, the photo or video does not clearly indicate the problem or issue experienced in the field. Unclear visual or audio evidence decreases the timeliness of the resolution process.

Solution

Capturing visual or audio evidence of machine issues is a helpful method of providing information to the Dealer Solution Network (DSN) analysts. Being able to diagnose a problem without being able to see the part or the machine is difficult. Use this document as a guideline when taking and submitting audio or visual evidence of problems. Following this guideline will improve the timeliness of the response from the DSN analysts.

Tips and Tricks for Taking and Submitting Technical Photos

Listed below are some pointers that will help produce quality photos that will convey the information you are trying to share.

- When providing photos of failed components, provide a photo of the machine ID plate showing the serial number, and the service hours on the machine. Also, where applicable, the component ID plate showing part number, serial number, and or date code.
- Digital cameras require an abundant amount of light in order to ensure that a clear photo is produced. Allowing for ample lighting will reduce the number of photos that will be discarded due to blurry images. Good lighting will also reduce or prevent shadows from developing on the parts you are photographing.
- Using a tripod or firm foundation to hold the camera when taking pictures will also reduce any opportunity for producing blurry and unusable images.

- Be sure that the photo is in focus. Review the photos before sending the photos off to ensure that the photos show the problem clearly. Remove photos that are blurry or out of focus.
- Some "post processing" may be necessary. Crop out unnecessary portions of pictures. Brighten the image if the image is a little dark. Add arrows and descriptions to draw attention to smaller details in large photos.
- When providing detailed close up photos, always include a complete zoomed out photo of the entire machine or component. For example on a cracked push arm of a tractor, supply a photo of the entire tractor. Then, provide a zoomed in view of the front of the tractor including the entire push arm. Next, provide a zoomed in view of only the push arm. The next photo should be a zoomed in view of the entire crack. Also, include a zoomed in view of the crack to indicate severity. Be sure to indicate where the crack is located by using arrows during post processing of the photo.
- When indicating problems such as cracks in welds, in structures, or scratches or scoring, the zoomed in view of the entire defect should indicate size. Indicate size by taking a photo with a tape measure or ruler to provide clear indication of the size of the defect.
- Take photos of components against a white background where possible to help improve the photo. This procedure will increase the clarity of the photo especially when taking photos of components with a high reflectivity such as chrome rods.
- If the flash on the camera is covering the defect on the component, increase the ambient light, and turn off the flash.
- When using photos for comparison, try to take side by side photos to indicate the comparison clearly. Use arrows to indicate the features you are comparing.
- When submitting photos with a DSN service request or in an E-mail, use WinZip or Win RAR to compress the files into one file. This process allows the recipient to open the file at once rather than downloading multiple photos one at a time.
- When taking photos of components, unless the photo is to indicate a leaking issue, wipe oil and debris away from the area. Removing oil and debris will help to provide a clear photo of the problem area.
- When the file is too large to send through the DSN system or in an E-mail, use the Caterpillar Secure Internet File Transfer (SIFT). SIFT is located at sift.cws.cat.com.
- Always refer to the operation manual for the camera for advise on to achieving quality photos and video.

Ver imagen

Illustration 1 g02175042

Use arrows to draw attention to the item in the photo.

Ver imagen

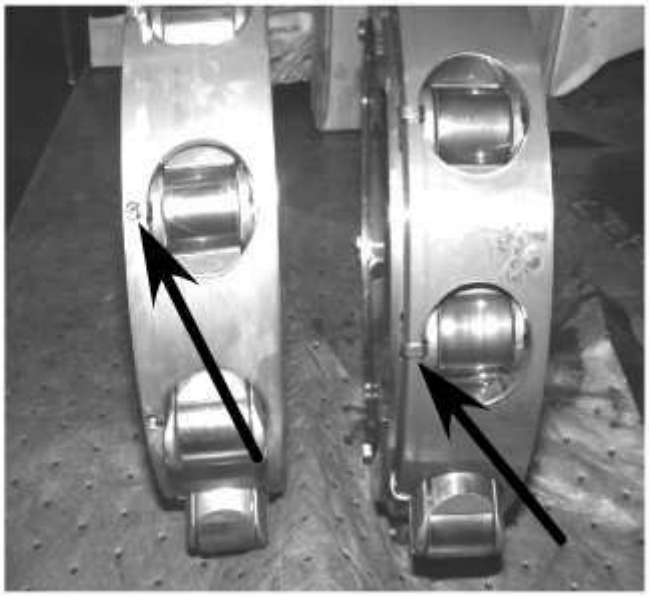


Illustration 2 g02175044

A side by side comparison shot will help the analyst or technician understand where the problem is on your component. Arrows indicate the problem area.

Ver imagen

Illustration 3 g02175045

Taking an overall photo will help indicate where your issue is on a large part. The overall photo will help indicate where the zoomed in photo is located.

Ver imagen

Illustration 4 g02175046

Zoomed in photo example.

Ver imagen

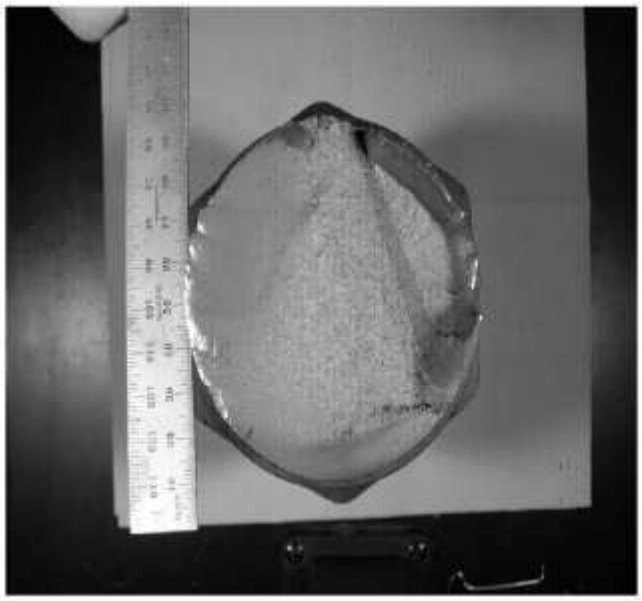


Illustration 5 g02175047

This photo shows the importance of proper lighting.

Ver imagen

Illustration 6 g02175049

This photo is an example of how poor lighting can hide important features.

Ver imagen

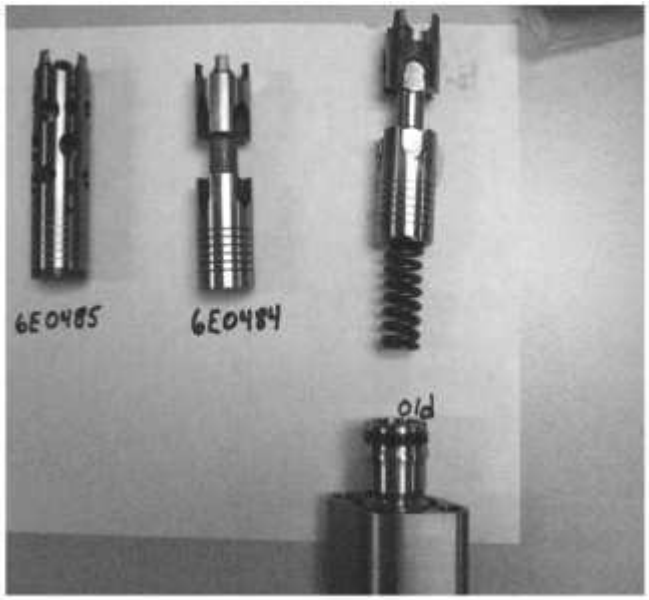


Illustration 7 g02175053

This photo is an example of good labeling.

Ver imagen

Illustration 8 g02175054

This photo is an example of a bad picture. The photo is out of focus and blurry. You are unable to determine what is shown in the photo.

Tips and Tricks for Recording Technical Video

Listed below are some pointers that will help produce quality videos that will convey the information you are trying to share.

- When providing video evidence of a machine issue, provide a shot of the machine ID plate showing serial number, and the service hours on the machine.
- If providing a zoomed in video, take an overall shot. Show what function the machine is performing before zooming down to the evidence of the problem.
- When recording video, use a tripod or firm foundation where applicable. A steady video will help the analysts understand the issue.
- Be sure that the video is in focus.
- When capturing a noise issue, try to get the machine in an area where there is little to no ambient noise.
- Highlight points in the video via narration to direct attention to key portions of the video.
- Review the video prior to sending to ensure that the problem is accurately recorded. Verify that any concerns of noise issues are audible in the video.
- Save the video file as a .wmv or .mov file.
- Due to the large file size of most videos, use Caterpillar's Secure Internet File Transfer (SIFT) to submit the video. SIFT is found at sift.cws.cat.com.

Wed Mar 23 2011 15:06:57 GMT-0300