



FORM NO. SENR2763-01

FOR USE IN SERVICE MANUALS:
225D, 229D & 231D EXCAVATORS,
SENR4265
613C WHEEL TRACTOR SCRAPER,
SENR2760
V700, V800, V900 CH, V925,
V925 LH & V1100 CTH LIFT TRUCKS,
SENB8260
VEHICULAR & TRUCK ENGINE
SPECIFICATIONS, SENR4192

Specifications

3208 Vehicular Engine

79V1-Up

Important Safety Information

Most accidents involving 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 should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "WARNING" as shown below.



The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning, explaining the hazard, can be either written or pictorially presented.

Operations that may cause product damage are identified by NOTICE labels on the product and in this publication.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.

The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job. Caterpillar dealers have the most current information available. For a list of the most current publication form numbers available, see the Service Manual Contents Microfiche, REG1139F.

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Introduction

When the words "use again" are in the description, the specification given can be used to determine if a part can be used again. If the part is equal to or within the specification given, use the part again.

When the word "permissible" is in the description, the specification given is the "maximum or minimum" tolerance permitted before adjustment, repair and/or new parts are needed.

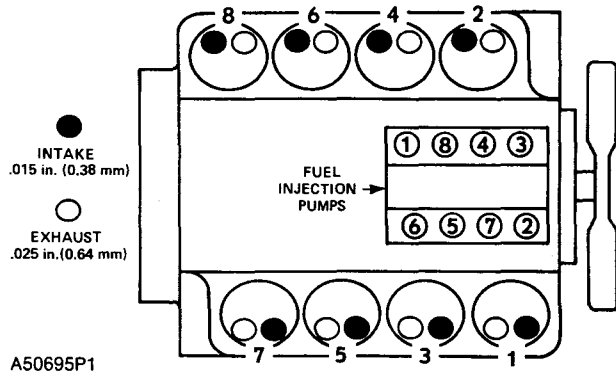
A comparison can be made between the measurements of a worn part and the specifications of a new part to find the amount of wear. A part that is worn can be safe to use if an estimate of the remainder of its service life is good. If a short service life is expected, replace the part.

REFERENCE: See 3208 Vehicular Engine, Form No. SENR2764, For Systems Operation, Testing And Adjusting.

A "C" in the left margin is an indication of a change from the former issue.

Specifications

Engine Design

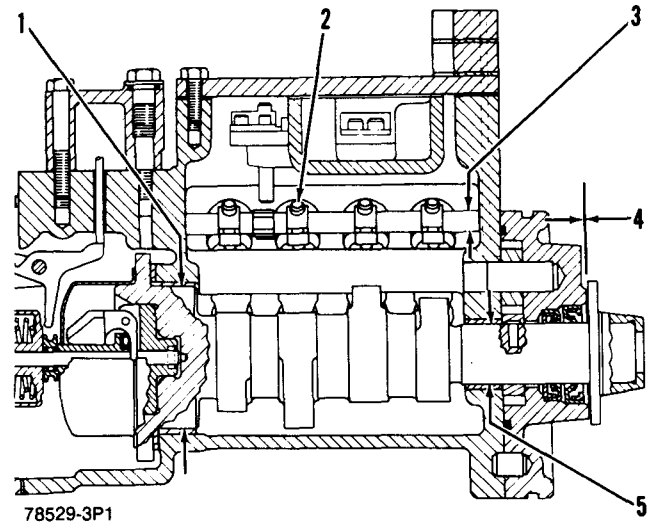


Cylinder, Valve And Injection Pump Location

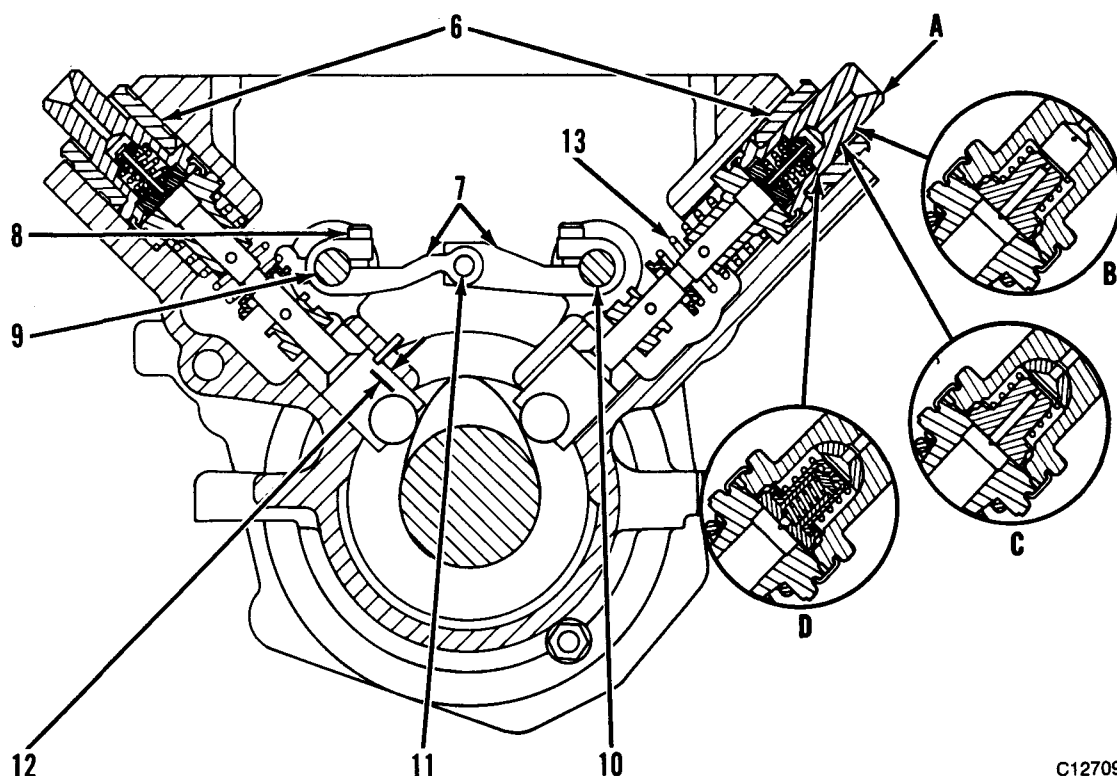
Bore	114.3 mm (4.5 in)
Stroke	127.0 mm (5.0 in)
Number Of Cylinders	8
Cylinder Arrangement	90°V
Firing Order (Injection Sequence)	1,2,7,3,4,5,6,8
Direction Of Rotation (As Seen From Flywheel End)	Counterclockwise

Fuel Injection Pump

Firing order (injection sequence)	1,2,7,3,4,5,6,8
Injection timing BTC (before top center)	15 ± 1°
Torque for the nuts that hold the fuel lines (Use 5P0144 Fuel Line Socket)	41 ± 7 N•m (30 ± 5 lb ft)



- (1) Bore in the rear bearing for the camshaft
(new) 60.325 ± 0.013 mm (2.3750 ± .0005 in)
Diameter of rear bearing surface (journal) of the camshaft (new) 60.249 ± 0.013 mm (2.3720 ± .0005 in)
Maximum permissible clearance between the bearing and the camshaft bearing surface (journal) (worn) 0.15 mm (.006 in)
- (2) Torque for screws that hold sleeve control levers 3.0 ± 0.5 N•m (27 ± 4 lb in)
- (3) Bore in the housing for the fuel control shaft (new) 8.999 ± 0.013 mm (.3543 ± .0005 in)
Diameter of sleeve control shaft (new) 8.966 ± 0.008 mm (.3530 ± .0003 in)
Maximum permissible clearance between the bore in the housing and the sleeve control shaft (worn) 0.08 mm (.003 in)
- (4) End play for camshaft with sleeve installed (new) 0.58 ± 0.46 mm (.023 ± .018 in)
NOTE: When installing sleeve on end of camshaft, support the camshaft to prevent damage to parts inside of injection pump and governor housing.
- (5) Bore in the front bearing for the camshaft (new) 25.413 ± 0.013 mm (1.0005 ± .0005 in)
Diameter of front bearing surface (journal) of the camshaft (new) 25.375 ± 0.013 mm (.9990 ± .0005 in)
Maximum permissible clearance between the bearing and the camshaft bearing surface (journal) (worn) 0.10 mm (.004 in)



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(6) Torque for bushing $80 \pm 7 \text{ N}\cdot\text{m}$ ($60 \pm 5 \text{ lb ft}$)

(7) Crossover levers.

NOTE: For adjustment of crossover levers, see the Testing And Adjusting Section.

(8) Torque for screws that hold crossover levers $2.70 \pm 0.25 \text{ N}\cdot\text{m}$ ($24 \pm 2 \text{ lb in}$)

(9 and 10) Fuel control shafts.

(11) Dowel pin (linkage between crossover levers).

(12) Distance guide pin extends into bore $1.20 \pm 0.10 \text{ mm}$ ($.047 \pm .004 \text{ in}$)

NOTE: Install guide pin with slot toward the top of the lifter bore.

(13) 4N4318 Spring for injection pump:

Length under test force 34.24 mm (1.348 in)

Test force $55.5 \pm 5.8 \text{ N}$ ($12.5 \pm 1.3 \text{ lb}$)

Free length after test 39.78 mm (1.566 in)

Outside diameter 18.49 mm ($.728 \text{ in}$)

(13) 9N5862 Spring for injection pump:

Length under test force 35.13 mm (1.383 in)

Test force $56.7 \pm 6.6 \text{ N}$ ($12.4 \pm 1.4 \text{ lb}$)

Free length after test 40.80 mm (1.606 in)

Outside diameter 18.49 mm ($.728 \text{ in}$)

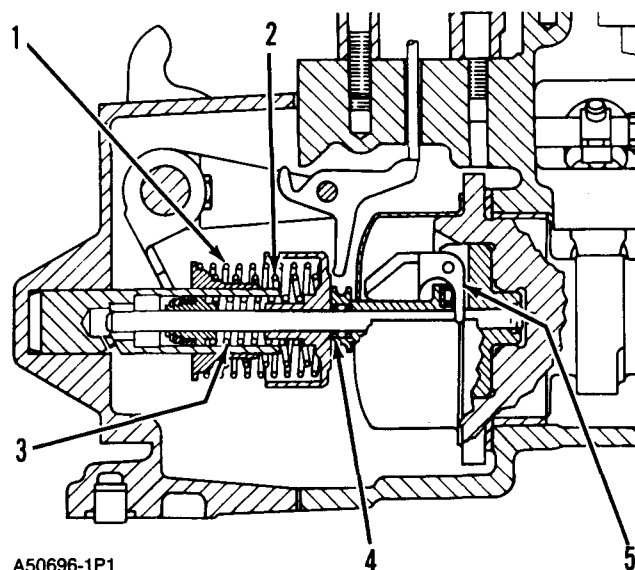
A. Reverse Flow Check Valve (RFC).

B. Orificed Delivery Valve (ODV).

C. Orificed Delivery Valve - Lo Volume (ODV).

D. Orificed Reverse Flow Check Valve (ORFC).

c Governor



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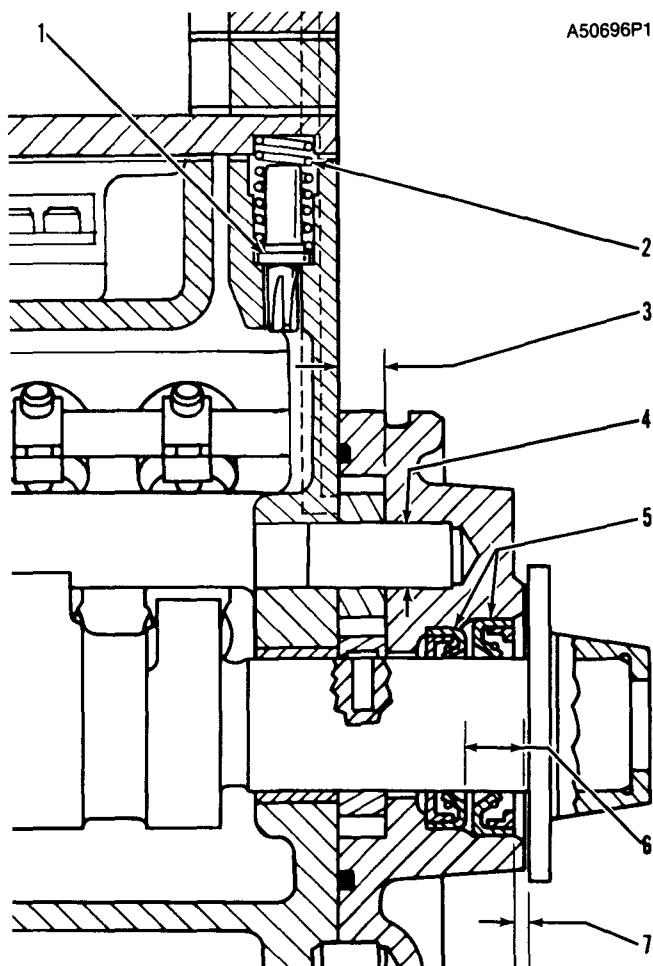
GOVERNOR SPRING CHART			
Part No.	(1) 9L6508	(1) 4N5661	(1) 4N6119
Color Code (Stripes)	One Yellow	Two White	Three Green
Put a force on spring of	22.24 N (5.0 lb)	13.34 N (3.0 lb)	13.34 N (3.0 lb)
Then add more force to make spring shorter by	17.78 mm (.700 in)	17.78 mm (.700 in)	17.78 mm (.700 in)
Total test force	87.63 ± 2.31 N (19.70 ± .52 lb)	56.94 ± 1.51 N (12.80 ± .34 lb)	50.71 ± 1.16 N (11.40 ± .26 lb)
Free length after test	44.20 ± 0.51 mm (1.740 ± .020 in)	44.20 ± 0.51 mm (1.740 ± .020 in)	42.14 ± 0.53 mm (1.659 ± .021 in)
Outside diameter	38.56 mm (1.518 in)	38.24 mm (1.506 in)	38.24 mm (1.506 in)

GOVERNOR SPRING CHART			
Part No.	(1) 7N3807	(2) 4N5663	(3) 6N2517
Color Code (Stripes)	Three Yellow	One Pink	None
Put a force on spring of	8.90 N (2.0 lb)	4.45 N (1.0 lb)	8.90 N (2.0 lb)
Then add more force to make spring shorter by	15.24 mm (.600 in)	17.78 mm (.700 in)	5.08 mm (.200 in)
Total test force	27.58 ± 0.53 N (6.20 ± .12 lb)	20.02 ± 0.53 N (4.50 ± .12 lb)	24.91 ± 0.80 N (5.60 ± .18 lb)
Free length after test	42.14 ± 0.53 mm (1.659 ± .021 in)	42.93 ± 0.51 mm (1.690 ± .020 in)	28.86 mm (1.136 in)
Outside diameter	37.84 mm (1.490 in)	29.06 mm (1.144 in)	14.99 mm (.590 in)

(4) OVER FUELING SPRINGS		
Part No.	4N0527	6N6662
Length under test force	8.71 mm (.343 in)	19.00 mm (.748 in)
Test force	0.85 ± 0.08 N (.19 ± .02 lb)	0.84 ± 0.08 N (.189 ± .02 lb)
Free length after test	18.29 mm (.720 in)	28.60 mm (1.126 in)
Outside diameter	9.14 mm (.360 in)	9.14 mm (.360 in)
Color code (Stripes)	None	One White

- (5) Torque for bolts that hold governor weight carrier to camshaft (earlier) 14 ± 3 N•m (10 ± 2 lb ft)
Torque for bolts that hold governor weight carrier to camshaft (later with thin bolt head) 10.2 ± 1.1 N•m
(90 ± 10 lb in)

Fuel Transfer Pump

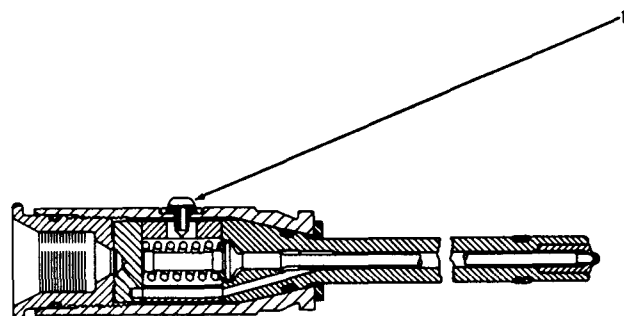


- (1) Bypass valve:
Fuel pressure at FULL LOAD .. 205 ± 35 kPa (30 ± 5 psi)
- (2) 4N0605 Spring for bypass valve:
Length under test force 22.35 mm (.880 in)
Test force 15.7 ± 0.80 N ($3.53 \pm .18$ lb)
Free length after test 43.92 mm (1.729 in)
Outside diameter 13.39 mm (.527 in)
- (3) Thickness of gears (new) 9.489 ± 0.008 mm
(.3736 \pm .0003 in)
Depth of counterbore (new) 9.525 ± 0.013 mm
(.3750 \pm .0005 in)
- (4) Diameter of shaft for idler gear 12.482 ± 0.008 mm
(.4914 \pm .0003 in)
Bore in idler gear 12.512 ± 0.008 mm
(.4926 \pm .0003 in)
- (5) Put a thin layer of 5S1454 Sealing Compound on the outside diameter of the seals before installation. Remove the extra sealing compound after assembly.

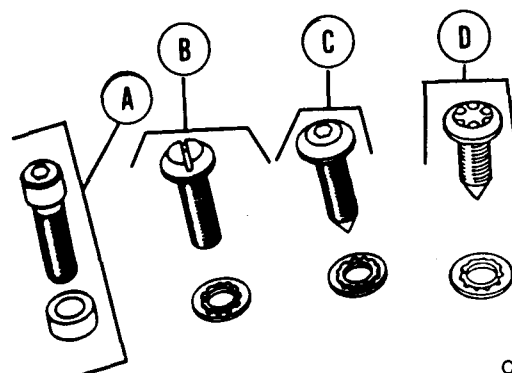
- (6) Install inner seal from outside edge of body assembly to a distance of 11.50 ± 0.25 mm (.453 \pm .010 in)
- (7) Install outside seal from outside edge of body assembly to a distance of 0.75 ± 0.25 mm (.030 \pm .010 in)

C Fuel Injection Nozzles

7000 Series Nozzle



- (1) Bleedscrew.



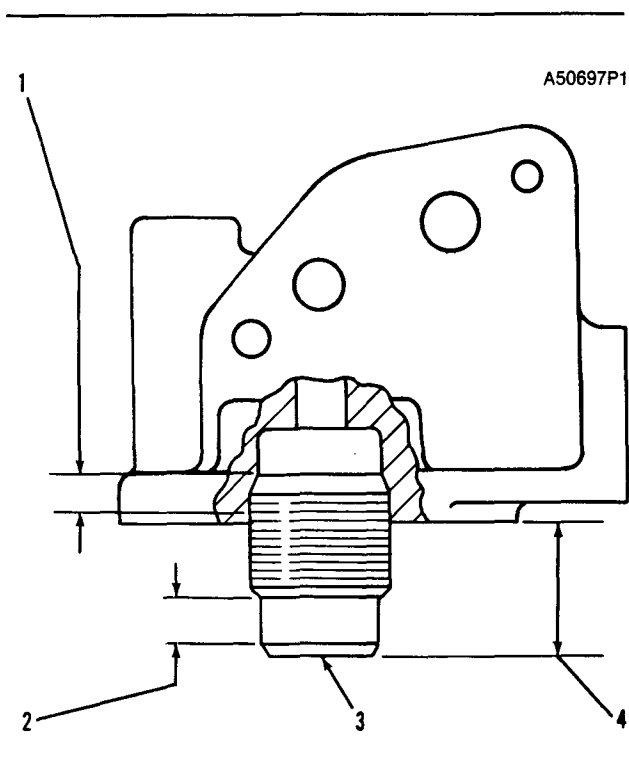
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BLEED SCREW CHART

Type	Torque
A	0.9 ± 0.1 N•m (8 ± 1 lb in)
B	1.8 ± 0.2 N•m (16 ± 2 lb in)
C	2.2 ± 0.8 N•m (20 ± 7 lb in)
D	2.2 ± 0.8 N•m (20 ± 7 lb in)

NOTE: All fuel injection line nuts are tightened to a torque of 41 ± 7 N•m (30 ± 5 lb ft)

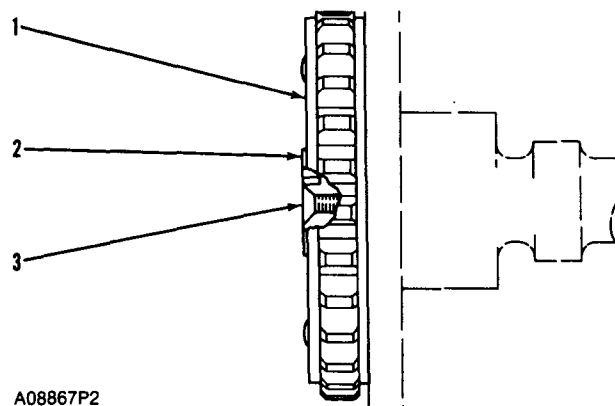
C Fuel Filter Base



- (1) Put 9S3263 Thread Lock Compound on the threads of the tapered end of the stud to a distance of 7.6 ± 1.5 mm (.30 \pm .06 in)
 - (2) Sealing surface of stud.
- NOTE:** Do not damage this surface.
- (3) Torque for stud 70 ± 7 N•m (50 \pm 5 lb ft)
 - (4) Distance from sealing surface of base to end of stud 24.6 ± 2.3 mm (.97 \pm .09 in)

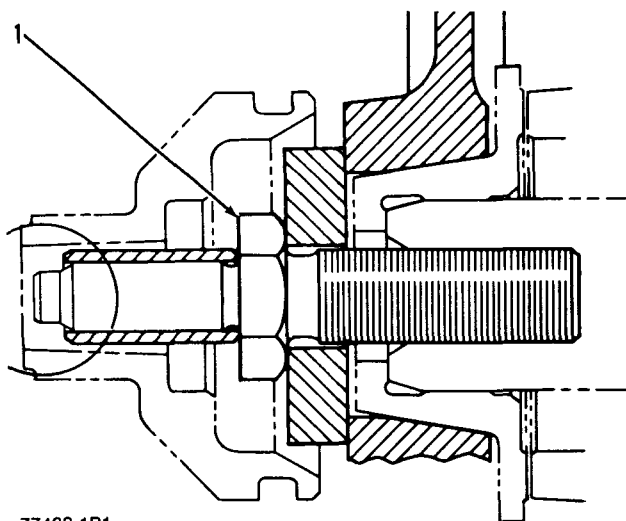
C Automatic Timing Advance Unit

3.5° and 5° unit

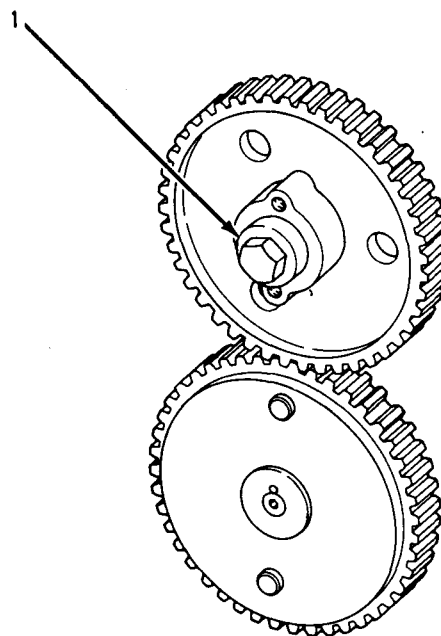


- End play between washer (2) and timing advance unit
- (1) 0.08 to 0.94 mm (.003 to .037 in)
 - (3) Torque for screw 7.9 ± 0.6 N•m (70 \pm 5 lb in)
- "Stake" (make a mark with a punch) screw (3) in two places.

c Drive Gear For The Injection Pump



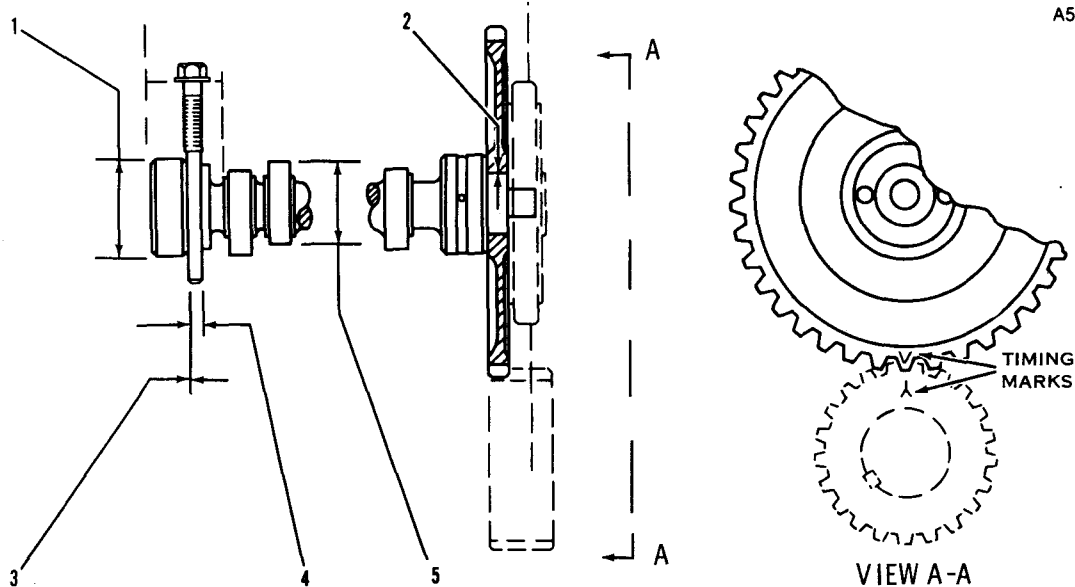
With tachometer drive



Without tachometer drive

- (1) Torque for the bolt that holds the drive gear to the camshaft of the injection pump $149 \pm 14 \text{ N}\cdot\text{m}$
($110 \pm 10 \text{ lb ft}$)

Camshaft



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- (1) Diameter of the surfaces (journals) for the camshaft bearings (new) .. 63.500 ± 0.013 mm ($2.5000 \pm .0005$ in)
Bore in the five bearings for the camshaft (new) 63.589 ± 0.038 mm ($2.5035 \pm .0015$ in)
Maximum permissible clearance between bearing and bearing surface (journal) (worn) 0.18 mm (.007 in)
- (2) Tight fit between the gear and camshaft 0.030 to 0.082 mm (.0012 to .0032 in)
Maximum permissible temperature of the gear for installation on the camshaft (do not use a torch) 315° C (600° F)
- (3) End play for the camshaft 0.18 ± 0.08 mm ($.007 \pm .003$ in)
Maximum permissible end play (worn) 0.51 mm (.020 in)
- (4) Width of thrust groove in camshaft (new) 9.14 ± 0.05 mm ($.360 \pm .002$ in)
Diameter of thrust pin (new) 8.97 ± 0.03 mm ($.353 \pm .001$ in)
Torque for thrust pin 48 ± 7 N•m (35 ± 5 lb ft)
- (5) Height of camshaft lobes.

To find lobe lift, use the procedure that follows:

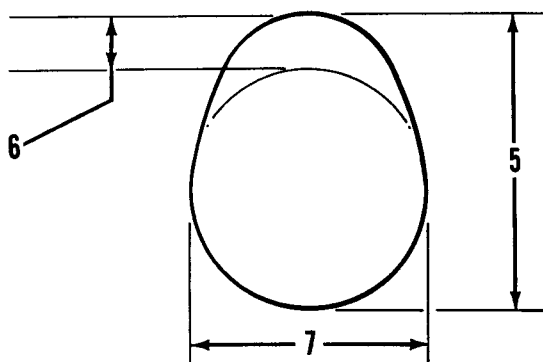
- A. Measure camshaft lobe height (5).
- B. Measure base circle (7).
- C. Subtract base circle (Step B) from lobe height (Step A).
The difference is actual lobe lift (6).
- D. Specified camshaft lobe lift (6) is:

9N5230 Camshaft used with roller lifters:

- a. Exhaust lobe 9.40 mm (.370 in)

- b. Intake lobe 9.33 mm (.367 in)
- 2W4238 Camshaft used with flat face lifters:
- a. Exhaust lobe 9.40 mm (.370 in)
 - b. Intake lobe 9.06 mm (.357 in)

Maximum permissible difference between actual lobe lift (Step C) and specified lobe lift (Step D) is 0.25 mm (.010 in).



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Camshaft Installation

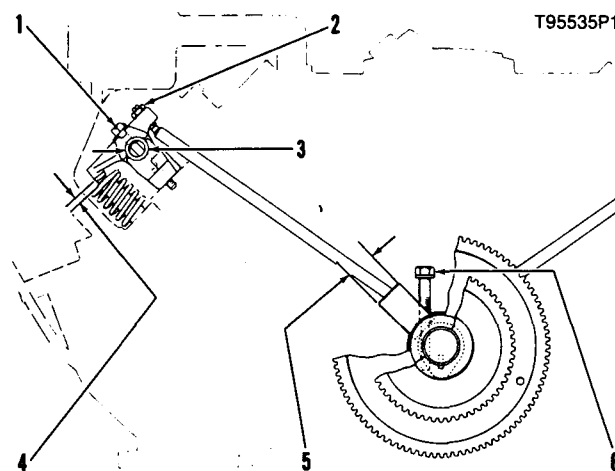
NOTE: For installation of camshaft, the timing mark on the camshaft gear tooth must be in alignment with the timing mark on the tooth space of the crankshaft gear.

Intake Valve Timing

1. Check the No. 1 intake valve clearance with the engine stopped. The valve clearance must be 0.30 to 0.46 mm (.012 to .018 in). If the valve clearance is not in this range, adjust the clearance to 0.38 mm (.015 in).
2. Mark Top Center Position of the crankshaft on the vibration damper or pulley.
3. Use a dial indicator to measure the intake valve movement.
4. Rotate the crankshaft in the direction of normal engine rotation. Stop when the intake valve is 1.91 mm (.075 in) off its seat in the opening sequence. At this point the crankshaft must be $10 \pm 2^\circ$ After Top Center.

Valve Rocker Arms And Lifters

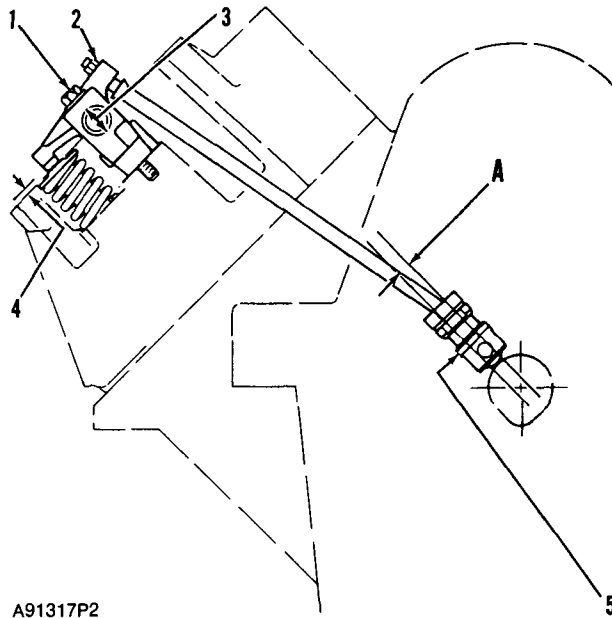
For Engines That Have Flat Face Lifters



- (1) Torque for bolts that hold rocker arms $24 \pm 7 \text{ N}\cdot\text{m}$
($18 \pm 5 \text{ lb ft}$)
- (2) Torque for locknut for valve adjustment screw $33 \pm 7 \text{ N}\cdot\text{m}$ ($24 \pm 5 \text{ lb ft}$)
- (3) Diameter of the shaft for the rocker arms $21.793 \text{ to } 21.814 \text{ mm}$ (.8580 to .8588 in)
Minimum permissible diameter (worn) 21.768 mm (.8570 in)

Bore in bearings for the rocker arms
(new) $21.852 \pm 0.020 \text{ mm}$ (.8603 \pm .0008 in)
Maximum permissible bore (worn) 21.920 mm (.8630 in)
Maximum permissible clearance between bore in bearing and shaft (worn) 0.13 mm (.005 in)
- (4) Clearance for valves (intake valve) 0.38 mm (.015 in)
Clearance for valves (exhaust valve) ... 0.64 mm (.025 in)
- (5) Diameter of cam follower $29.436 \pm 0.010 \text{ mm}$ ($1.1589 \pm .0004 \text{ in}$)
Minimum permissible diameter (worn) 29.401 mm (1.1575 in)
Bore in block for cam follower $29.525 \pm 0.025 \text{ mm}$ ($1.1624 \pm .0010 \text{ in}$)
Maximum permissible bore (worn) 29.591 mm (1.1650 in)
- (6) Torque for the thrust pin for the camshaft $45 \pm 7 \text{ N}\cdot\text{m}$
($35 \pm 5 \text{ lb ft}$)

For Engines That Have Roller Lifters

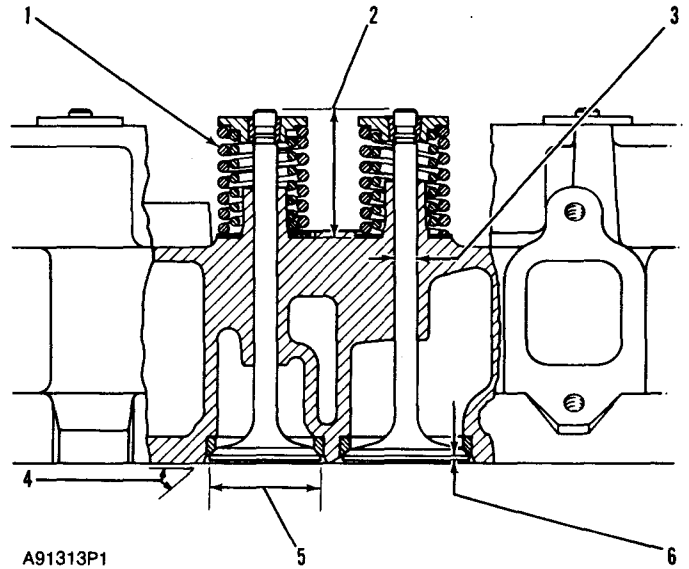


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1. Turn camshaft so cam lobe is opposite lifter bore.
2. Install guide spring on lifter.
3. Put lifter assembly in engine oil and install into lifter bore so that the tab on the guide spring is located within area (A).
4. Push lifter into bore until contact is made with camshaft.
 - (1) Torque for bolts that hold rocker arms $24 \pm 7 \text{ N}\cdot\text{m}$ ($18 \pm 5 \text{ lb ft}$)
 - (2) Torque for locknut for valve adjustment screw $33 \pm 7 \text{ N}\cdot\text{m}$ ($24 \pm 5 \text{ lb ft}$)
 - (3) Diameter of the shaft for the rocker arms 21.793 to 21.814 mm (.8580 to .8588 in)
Minimum permissible diameter (worn) 21.768 mm (.8570 in)
Bore in bearings for the rocker arms (new) $21.852 \pm 0.020 \text{ mm}$ (.8603 \pm .0008 in)
Maximum permissible bore (worn) 21.920 mm (.8630 in)
Maximum permissible clearance between bore in bearing and shaft (worn) 0.13 mm (.005 in)
 - (4) Clearance for valves (intake) 0.38 mm (.015 in)
Clearance for valves (exhaust) 0.64 mm (.025 in)
 - (5) Diameter of lifter $29.464 \pm 0.015 \text{ mm}$ (1.1600 \pm .0006 in)
Bore in block for lifter $29.525 \pm 0.025 \text{ mm}$ (1.1624 \pm .0010 in)

Valves

NOTE: GUIDELINE FOR REUSABLE PARTS; VALVES AND VALVE SPRINGS, Forms SEBF8002 and SEBF8034, have the procedure and specifications necessary for checking used valves and valve springs.



A91313P1

- (1) 9N5496 Spring for valves (outer):

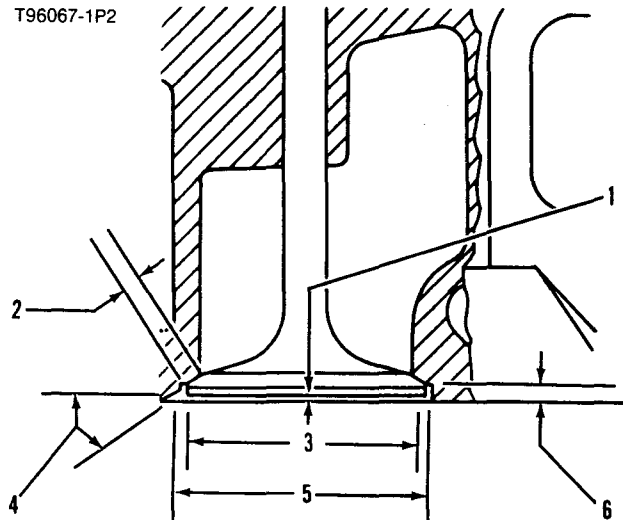
Length under test force	45.47 mm (1.790 in)
Test force	$185.0 \pm 18.0 \text{ N}$ ($41.6 \pm 4 \text{ lb}$)
Use again minimum load at length under test force	166 N (37.3 lb)
Length of spring at valve open position	30.23 mm (1.190 in)
Use again minimum load at valve open position	600 N (135 lb)
Free length after test	51.77 mm (2.038 in)
Outside diameter	39.62 mm (1.560 in)
Spring must not be bent more than	1.80 mm (.071 in)
- (1) 9N5495 Spring for valves (inner):

Length under test force	42.47 mm (1.672 in)
Test force	$91.2 \pm 9.0 \text{ N}$ ($20.5 \pm 2 \text{ lb}$)
Use again minimum load at length under test force	81.9 N (18.4 lb)
Length of spring at valve open position	27.33 mm (1.072 in)
Use again minimum load at valve open position	295 N (66.3 lb)
Free length after test	48.77 mm (1.920 in)
Outside diameter	26.67 mm (1.050 in)
Spring must not be bent more than	1.70 mm (.067 in)
- (2) Distance from the end of the valve to the valve spring spacer seat $52.40 \pm 0.38 \text{ mm}$ ($2.063 \pm .015 \text{ in}$)

-

Intake Valve (without valve seat insert)

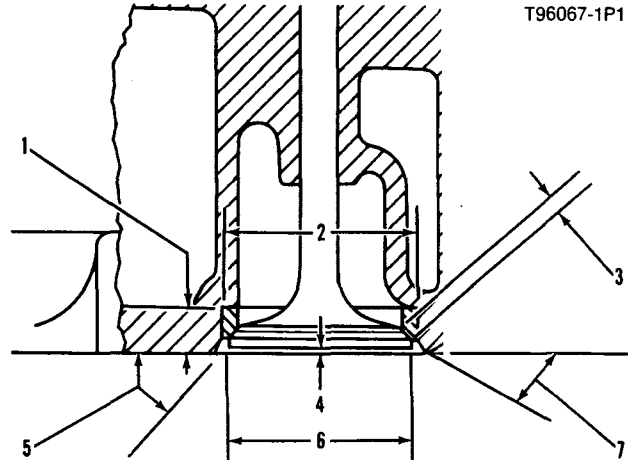
T96067-1P2



- (1) Distance from head of valve to cylinder head face:
Maximum permissible (valve closed) ... 1.73 mm (.068 in)
Minimum permissible (valve closed) 0.91 mm (.036 in)
- (2) Maximum permissible width of the face of the valve seat 3.05 mm (.120 in)
- (3) Outside diameter of the valve seat 52.23 ± 0.13 mm
($2.045 \pm .005$ in)
Maximum permissible 52.45 mm (2.065 in)
- (4) Angle of the face of the valve seat $30 \frac{1}{2} \pm \frac{1}{2}^\circ$
- (5) Diameter of the bore 54.61 mm (2.150 in)
- (6) Maximum permissible depth of the bore to make the face of the valve seat smaller 4.32 mm (.170 in)

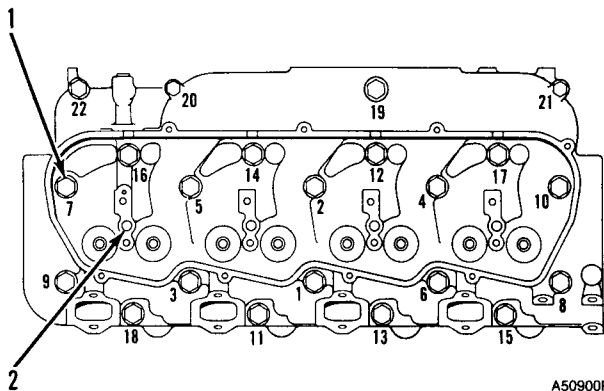
Exhaust Valve

T96067-1P1



- (1) Depth of bore in head for valve seat insert 11.23 ± 0.13 mm ($.442 \pm .005$ in)
- (2) Diameter of valve seat insert 48.565 ± 0.013 mm
($1.9120 \pm .0005$ in)
Bore in head for valve seat insert 48.489 ± 0.013 mm
($1.9090 \pm .0005$ in)
- (3) Maximum permissible width of the face of the valve seat insert 2.67 mm (.105 in)
- (4) Distance from head of valve to cylinder head face:
Maximum permissible (valve closed) ... 2.16 mm (.085 in)
Minimum permissible (valve closed) 1.27 mm (.050 in)
- (5) Angle of the face of the valve seat insert $45 \frac{1}{2} \pm \frac{1}{2}^\circ$
- (6) Outside diameter of the face of the valve seat insert 44.07 ± 0.13 mm ($1.735 \pm .005$ in)
Maximum permissible 44.70 mm (1.760 in)
- (7) Angle to grind face of seat insert (to get a reduction of maximum seat diameter) 15°

C Cylinder Head



- (1) Put 6V4876 Molykote Lubricant on bolt threads and tighten bolts according to the HEAD BOLT TORQUE CHART that follows:

HEAD BOLT TORQUE CHART		
Tightening Procedure	Earlier Bolts (With Six Dash Marks) ¹	Later Bolts (With Seven Dash Marks) ¹
Step 1. Tighten bolts 1 through 18 in number sequence to:	130 ± 7 N•m (95 ± 5 lb ft)	150 ± 7 N•m (110 ± 5 lb ft)
Step 2. Loosen bolts 1 through 18 until the washers can be turned freely.		
Step 3. Tighten bolts 1 through 18 in number sequence to:	80 ± 14 N•m (60 ± 10 lb ft)	80 ± 14 N•m (60 ± 10 lb ft)
Step 4. Tighten bolts 1 through 18 in number sequence to:	130 ± 7 N•m (95 ± 5 lb ft)	150 ± 7 N•m (110 ± 5 lb ft)
Step 5. Again tighten bolts 1 through 10 in number sequence to:	130 ± 7 N•m (95 ± 5 lb ft)	165 ± 7 N•m (120 ± 5 lb ft)
Step 6. Tighten bolts 19 through 22 in number sequence to:	43 ± 7 N•m (32 ± 5 lb ft)	43 ± 7 N•m (32 ± 5 lb ft)

¹ See Illustration 1 for identification of EARLIER and LATER bolts.

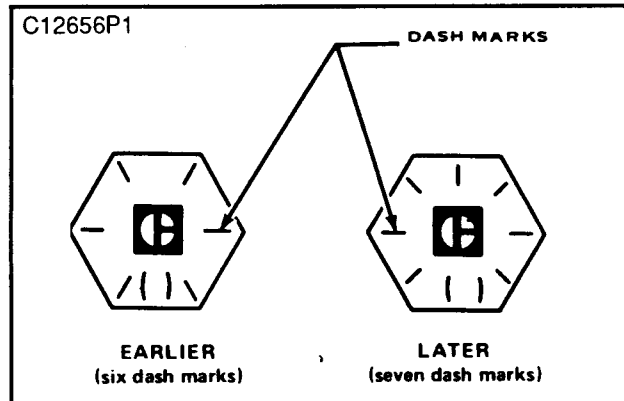
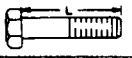
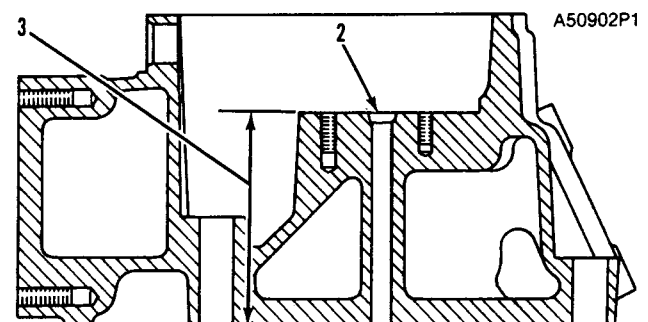


Illustration 1. Bolt head identification.

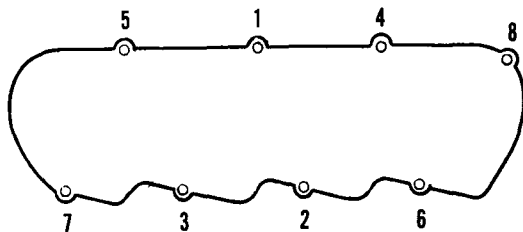
- (2) Holes for fuel injection nozzles.

HEAD BOLT LOCATION CHART 			
Dia.	Part No.	Location (Bolt No.)	Bolt Length "L"
1/2"	6F5282	5,2,4,10	133.4 mm (5.25 in)
	2B2006	7,9,3,1,6,8	120.6 mm (4.75 in)
	L1329	16,14,12,17	76.2 mm (3.00 in)
	2B0947	18,11,13,15	57.2 mm (2.25 in)
3/8"	5B9603	19,20,21	127.0 mm (5.00 in)
	S1571	22	44.5 mm (1.75 in)

- (3) Thickness of cylinder head (measure through the fuel injection nozzle holes at each end of the cylinder head).
 New 96.14 ± 0.15 mm (3.785 ± .006 in)
 Minimum permissible thickness 95.86 mm (3.774 in)
 Flatness of the cylinder head should be within 0.15 mm (.006 in) total, and a maximum of 0.08 mm (.003 in) for any 152.4 mm (6 in) span.



Valve Covers

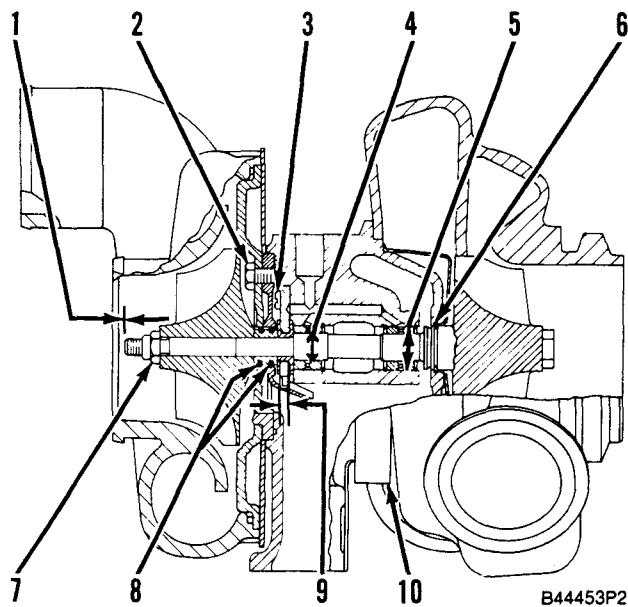


A50698P1

Tighten bolts in sequence shown to a torque of $14 \pm 3 \text{ N}\cdot\text{m}$ ($10 \pm 2 \text{ lb ft}$)

C Turbocharger

TF51 & TF54



B44453P2

- (1) End play for shaft (new) $0.051 \text{ to } 0.081 \text{ mm}$ ($.0020 \text{ to } .0032 \text{ in}$)
- (2) Tighten bolts that hold back plate to bearing housing to $9.5 \pm 1 \text{ N}\cdot\text{m}$ ($84 \pm 9 \text{ lb in}$)
- (3) Tighten screws that hold thrust bearing to $2.5 \pm 0.2 \text{ N}\cdot\text{m}$ ($22 \pm 2 \text{ lb in}$)

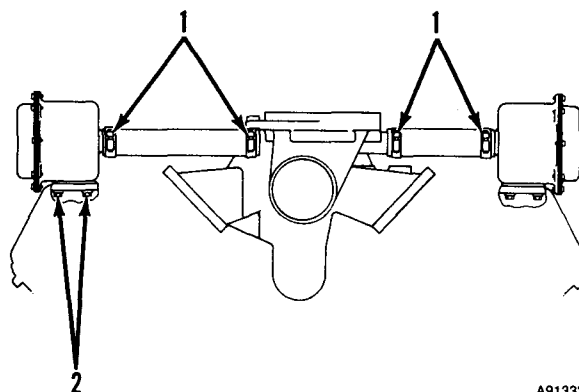
- (4) Diameter of surface on shaft (journal) for the bearing (new) $12.992 \text{ to } 13.000 \text{ mm}$ ($.5115 \text{ to } .5118 \text{ in}$)
Bore in the bearing (new) $13.028 \text{ to } 13.038 \text{ mm}$ ($.5129 \text{ to } .5133 \text{ in}$)
- (5) Bore in housing (new) $20.175 \text{ to } 20.188 \text{ mm}$ ($.7943 \text{ to } .7948 \text{ in}$)
Outside diameter of the bearing (new) $20.069 \text{ to } 20.081 \text{ mm}$ ($.7901 \text{ to } .7906 \text{ in}$)
- (6) Turbine end oil seal ring, end gap when installed in a bore of 20.90 mm ($.823 \text{ in}$) $0.10 \text{ to } 0.38 \text{ mm}$ ($.004 \text{ to } .015 \text{ in}$)
- (7) Put 2P2506 Thread Lubricant on the shaft threads and on the nut face and tighten nut to $4 \text{ N}\cdot\text{m}$ (35 lb in)
Tighten nut more 120°

NOTICE

Do not bend or add stress to the shaft when nut is loosened or tightened.

- (8) Impeller end oil seal ring, end gap when installed in a bore of 17.463 mm ($.6875 \text{ in}$) $0.08 \text{ to } 0.38 \text{ mm}$ ($.003 \text{ to } .015 \text{ in}$)
- (9) Thickness of thrust bearing $4.359 \text{ to } 4.369 \text{ mm}$ ($.1716 \text{ to } .1720 \text{ in}$)
- (10) Put 5P3931 Anti-Seize Compound on threads and tighten bolt holding band clamp to $14 \pm 1 \text{ N}\cdot\text{m}$ ($120 \pm 12 \text{ lb in}$)

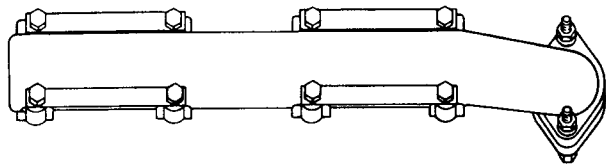
Crankcase Ventilation Valve



A91332P2

- (1) Torque for hose clamps $2.3 \pm 0.2 \text{ N}\cdot\text{m}$ ($20 \pm 2 \text{ lb in}$)
- (2) Torque for bolts $3.4 \pm 0.5 \text{ N}\cdot\text{m}$ ($30 \pm 4 \text{ lb in}$)

Exhaust Manifolds



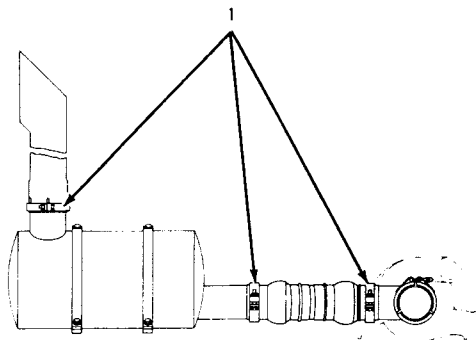
A91316P2

Put 5P3931 Anti-Seize Compound on threads of bolts.

Torque for bolts $45 \pm 7 \text{ N}\cdot\text{m}$ ($33 \pm 5 \text{ lb ft}$)

Locks must be bent on a flat side of the bolt head. Bolts must be turned no more than 30° (in the direction of increased torque only) for the alignment of locks with a flat side of the bolt head.

Exhaust System (613C)

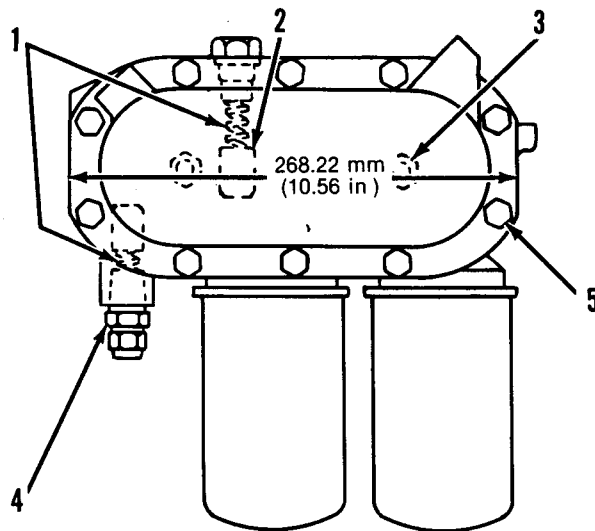


B75797P2

Put 5P3931 Anti-Seize Compound on threads of bolts.

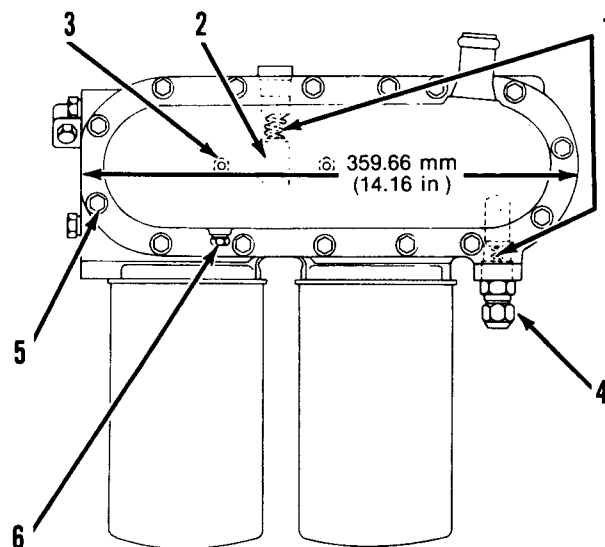
(1) Tighten clamp bolts to $20 \pm 7 \text{ N}\cdot\text{m}$ ($15 \pm 5 \text{ lb ft}$)

c Engine Oil Cooler And Filter



A92220P3

Earlier



B44475P2

Later

Oil pressure difference that makes the oil filter bypass valve open $140 \pm 30 \text{ kPa}$ ($20 \pm 4 \text{ psi}$)

Oil pressure difference that makes the oil cooler bypass valve open 125 ± 30 kPa (18 ± 4 psi)

- (1) 9L9188 Spring (oil cooler and oil filter bypass valve):
 Length under test force 43.2 mm (1.70 in)
 Test force 15.6 N (3.5 lb)
 Free length after test 57.9 mm (2.28 in)
 Outside diameter 11.18 mm (.440 in)

(2) Oil filter bypass valve.

- (3) Torque for nuts that hold oil cooler core to oil cooler base (hand torque only) 22 ± 3 N•m (16 ± 2 lb ft)

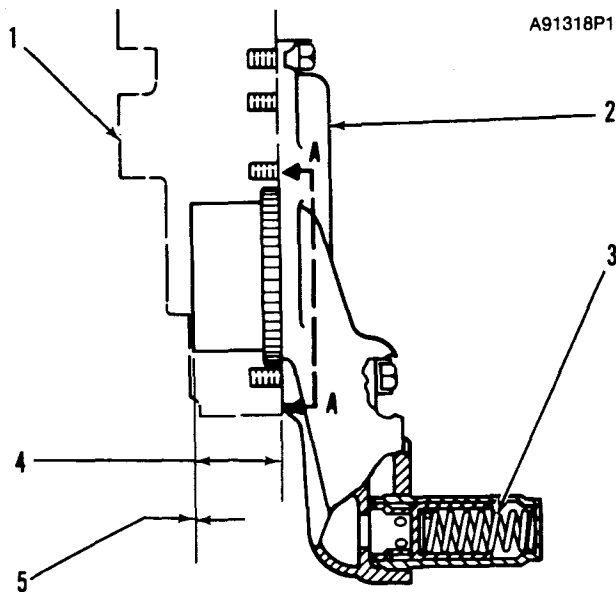
NOTE: If applicable, assemble gasket to oil cooler base with indexing point toward the front of the engine and in the up position.

(4) Oil cooler bypass valve.

- (5) Tighten bolts to a torque of 31 ± 4 N•m (23 ± 3 lb ft)

- (6) Tighten plug to a torque of 22 ± 3 N•m (16 ± 2 lb ft)

Oil Pump



NOTE: Tighten relief valve guide to 41 ± 7 N•m (30 ± 5 lb ft)

(1) Front housing assembly.

(2) Oil pump cover assembly.

- (3) 1W1788 Spring (pump pressure relief valve):
 Length under test force 59.94 mm (2.360 in)
 Test force 314 ± 14 N (71 ± 3 lb)
 Free length after test 78.23 mm (3.080 in)
 Outside diameter 22.23 mm (.875 in)

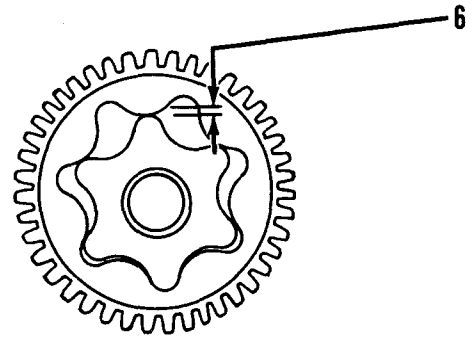
- (3) 1W2208 Spring (pump pressure relief valve):

Length under test force 59.94 mm (2.360 in)
 Test force 290 ± 14 N (65 ± 3 lb)
 Free length after test 85.85 mm (3.380 in)
 Outside diameter 22.23 mm (.875 in)

- (4) Width of oil pump rotors (new) 36.474 ± 0.008 mm (1.4360 ± .0003 in)

Depth of counterbore in front housing (new) 36.576 ± 0.025 mm (1.4400 ± .0010 in)

- (5) Maximum permissible end clearance of oil pump rotors when measured with oil pump installed to front cover 0.15 mm (.006 in)

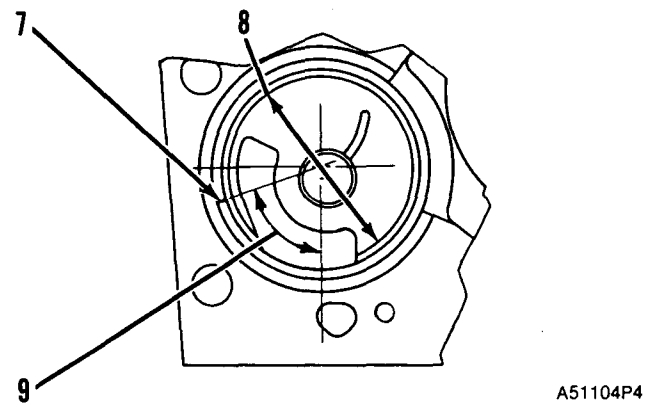


C5327P5

View A-A Of Oil Pump Rotor

- (6) Clearance of oil pump rotor tip when measured with oil pump installed to front cover 0.05 to 0.15 mm (.002 to .006 in)

Maximum permissible clearance of oil pump rotor tip 0.28 mm (.011 in)



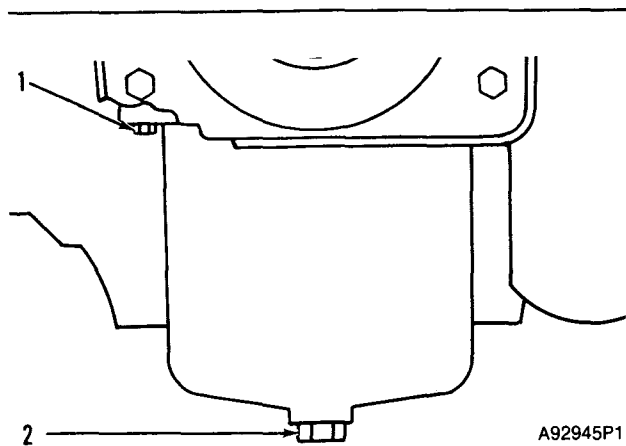
View A-A Of Front Housing

(7) Bearing junction.

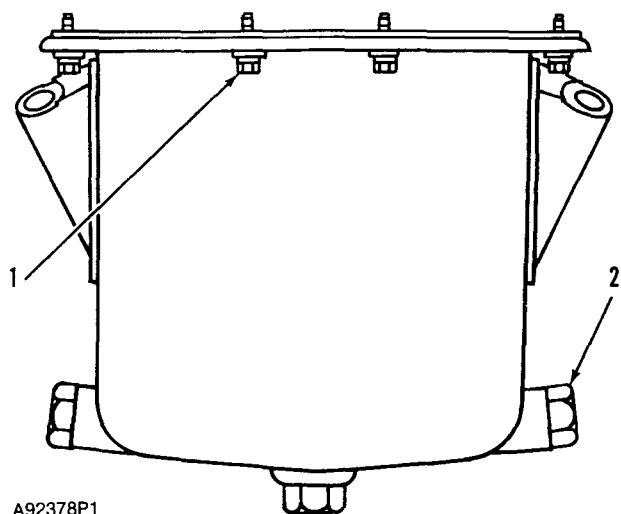
- (8) Diameter of bearing for rotor (new) ... 71.224 ± 0.056 mm (2.8041 ± .0022 in)

- (9) Position of main bearing junction from vertical centerline $75 \pm 30^\circ$

C Oil Pan

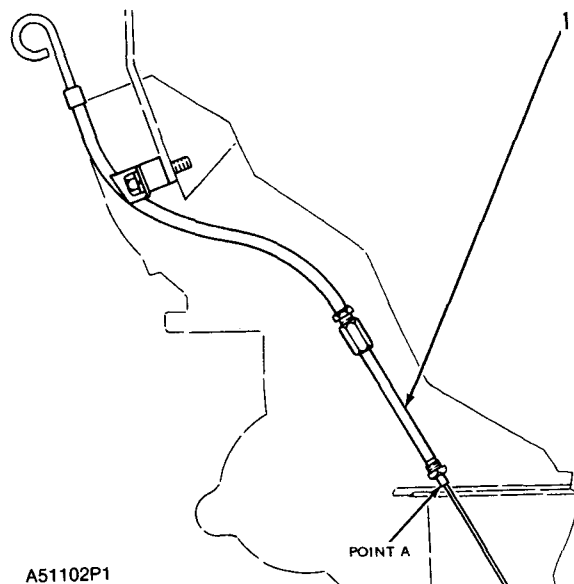


- (1) Torque for bolts that hold oil pan $23 \pm 4 \text{ N}\cdot\text{m}$
($17 \pm 3 \text{ lb ft}$)
- (2) Torque for oil pan drain plug $70 \pm 15 \text{ N}\cdot\text{m}$
($50 \pm 11 \text{ lb ft}$)



- (1) Torque for bolts that hold oil pan $23 \pm 4 \text{ N}\cdot\text{m}$
($17 \pm 3 \text{ lb ft}$)
- (2) Torque for oil pan drain plug $54 \pm 7 \text{ N}\cdot\text{m}$ ($40 \pm 5 \text{ lb ft}$)

Oil Level Gauge

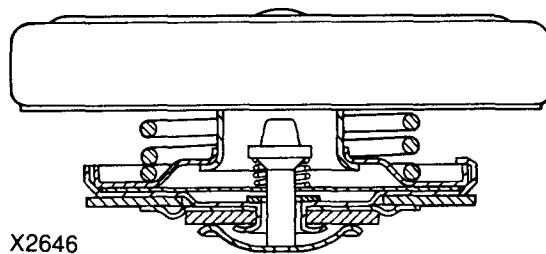


- (1) Guide assembly.

Assemble lower part of guide assembly (1) so that Point A is even with bottom surface of block within $\pm 0.8 \text{ mm}$ (.03 in).

Cooling System Pressure Cap

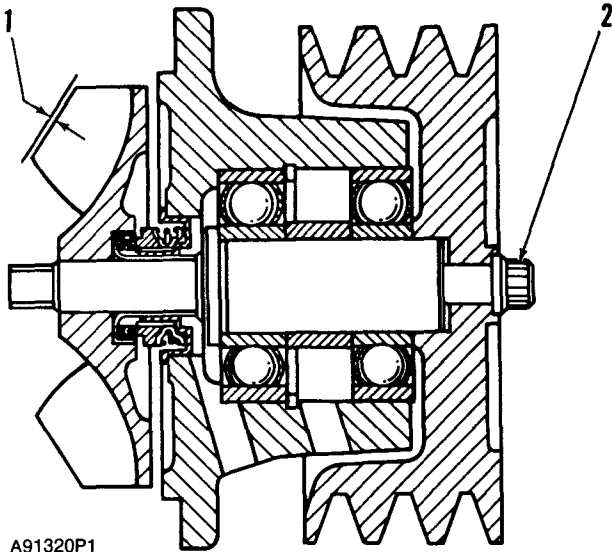
6L8617



Pressure that makes the relief valve open 45 to 55 kPa
(6.5 to 8.0 psi)

Vacuum valve must open at a maximum of 4 kPa (.6 psi)

Water Pump

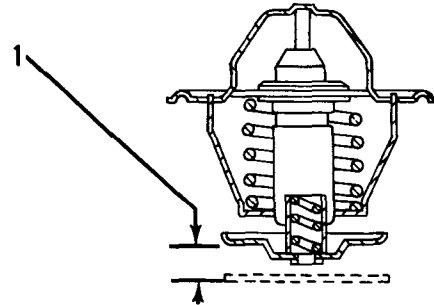


C NOTE: Put 9S3263 Thread Lock Compound on outer bearing OD and housing bore before assembly.

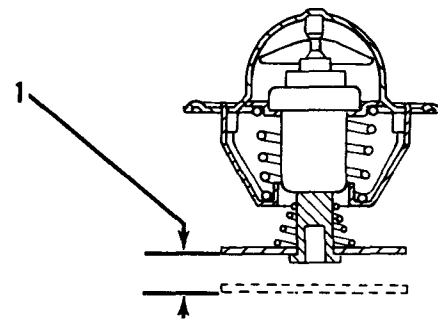
- (1) Clearance between the water pump impeller face and front cover 0.28 to 0.84 mm (.011 to .033 in)
- (2) Torque for pulley $75 \pm 7 \text{ N}\cdot\text{m}$ ($55 \pm 5 \text{ lb}\cdot\text{ft}$)

c Water Temperature Regulators

9N5121



Type A Temperature Regulator



Type B Temperature Regulator

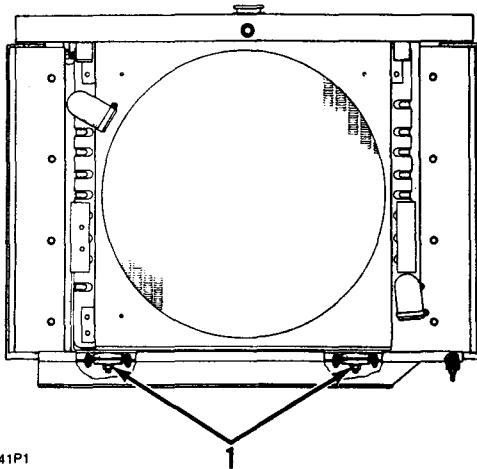
Temperature when completely open 94°C (201°F)

(1) Minimum stroke at fully open temperature:

Type A	7.50 mm (.300 in)
Type B	8.13 mm (.320 in)

Radiator

613C Wheel Tractor-Scraper



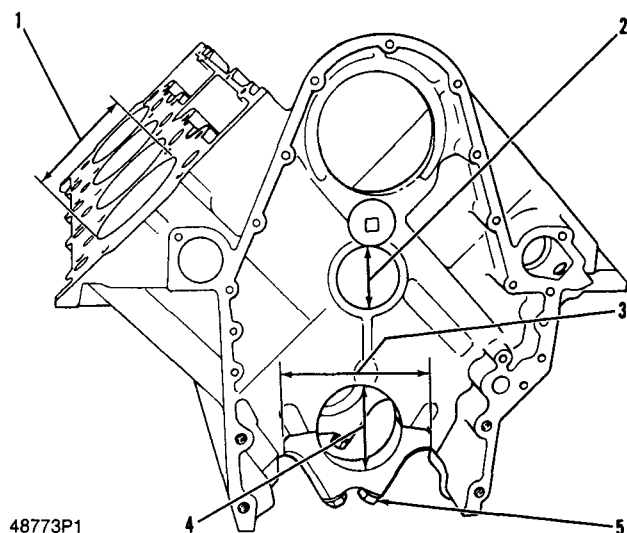
-
- (1) Torque for radiator mount bolts $65 \pm 4 \text{ N}\cdot\text{m}$
($48 \pm 3 \text{ lb ft}$)

c Belt Tension Chart

BELT TENSION CHART										
BELT SIZE	WIDTH BELT TOP		WIDTH TOP OF PULLEY GROOVE		BELT TENSION "INITIAL"		BELT TENSION "USED"		BORROUGHS GAUGE NUMBERS	
	GAUGE READING		GAUGE READING		GAUGE READING		GAUGE READING		OLD GAUGE NO.	NEW GAUGE NO.
	mm	in.	mm	in.	N	lb	N	lb		
3/8	10.72	.422	9.65	.380	445 ± 22	100 ± 5	400 ± 22	90 ± 5	BT-33-95	BT-33-97
1/2	13.89	.547	12.70	.500	534 ± 22	120 ± 5	400 ± 44	90 ± 10	BT-33-95	BT-33-97
5V	15.88	.625	15.24	.600	534 ± 22	120 ± 5	400 ± 44	90 ± 10	BT-33-72-4-15	BT-33-72C
11/16	17.48	.688	15.88	.625	534 ± 22	120 ± 5	400 ± 44	90 ± 10	BT-33-72-4-15	BT-33-72C
3/4	19.05	.750	17.53	.690	534 ± 22	120 ± 5	400 ± 44	90 ± 10	BT-33-72-4-15	BT-33-72C
15/16	23.83	.983	22.30	.878	534 ± 22	120 ± 5	400 ± 44	90 ± 10	BT-33-72-4-15	BT-33-72C
8K	27.92	1.099			800 ± 22	180 ± 5	489 ± 44	110 ± 10		BT-33-109
MEASURE TENSION OF BELT FARTEST FROM THE ENGINE										
"INITIAL" BELT TENSION is for a new belt. "USED" BELT TENSION is for a belt which has more than 30 minutes of operation at rated speed of engine.										
										A10232-4P1

Cylinder Block

Measure wear of the cylinder bore at the top and bottom of piston ring travel.



- (1) Cylinder bore [standard, original size] 114.300 to 114.338 mm (4.5000 to 4.5015 in)
 The recommendation is made to make the cylinder bore the next size larger when the size of the bore is 114.452 mm (4.5060 in)

Cylinder bore must be made the next size larger when the size of the bore is 114.529 mm (4.5090 in)
 Cylinder bore [0.51 mm (.020 in) larger than the original size] 114.821 ± 0.013 mm (4.5205 ± .0005 in)
 The recommendation is made to make the cylinder bore the next size larger when the size of the bore is 114.960 mm (4.5260 in)
 Cylinder bore must be made the next size larger when the size of the bore is 115.037 mm (4.5290 in)
 Cylinder bore [1.02 mm (.040 in) larger than the original size] 115.329 ± 0.013 mm (4.5405 ± .0005 in)
 Maximum permissible wear of cylinder bores (replacement of the cylinder block is necessary) 115.545 mm (4.5490 in)

- (2) Bore in block for camshaft bearing .. 67.374 ± 0.013 mm (2.6525 ± .0005 in)

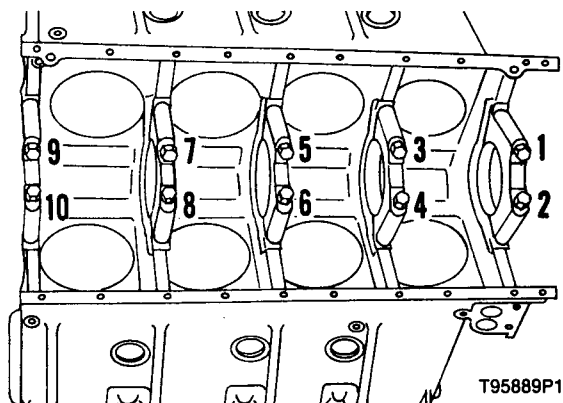
NOTE: Install camshaft bearings with the oil hole toward the top of the cylinder block.

- (3) Width of main bearing cap 166.624 ± 0.018 mm (6.5600 ± .0007 in)

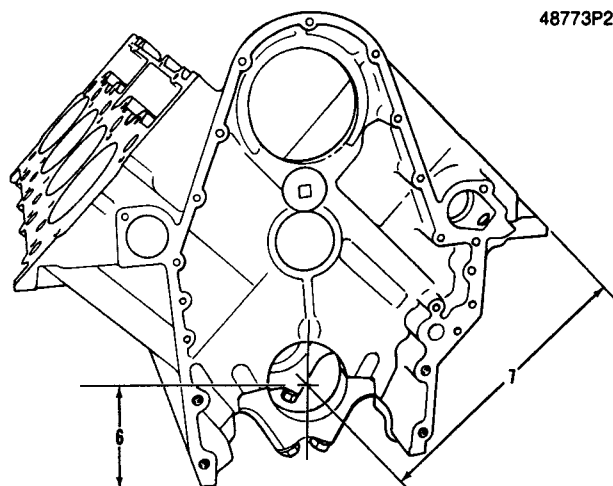
Minimum permissible width of main bearing cap 166.573 mm (6.5580 in)
 Width of main bearing cap guide (in cylinder block) 166.598 ± 0.013 mm (6.5590 ± .0005 in)

- (4) Bore in block for main bearing 94.170 ± 0.013 mm (3.7075 ± .0005 in)

Permissible amount of distortion in bore 94.13 to 94.21 mm (3.706 to 3.709 in)



- (5) Torque for bolts holding caps for main bearings:
- Put 2P2506 Thread Lubricant on bolt threads and washer face.
 - Tighten all bolts in number sequence to $41 \pm 4 \text{ N}\cdot\text{m}$ ($30 \pm 3 \text{ lb ft}$)
 - Put a mark on each bolt and cap.
 - Tighten all bolts in number sequence from mark $120 \pm 5^\circ$

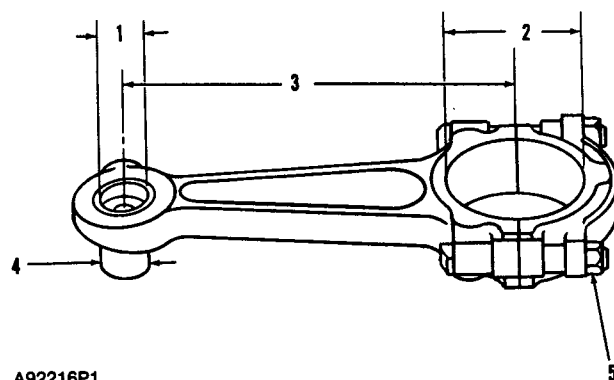


- (6) Dimension (new) from centerline of crankshaft bearing bore to bottom of block (pan rails) ... $95.250 \pm 0.038 \text{ mm}$ ($3.7500 \pm .0015 \text{ in}$)
- (7) Dimension (new) from centerline of crankshaft bearing bore to top of block (top deck) $322.656 \pm 0.127 \text{ mm}$ ($12.7030 \pm .0050 \text{ in}$)

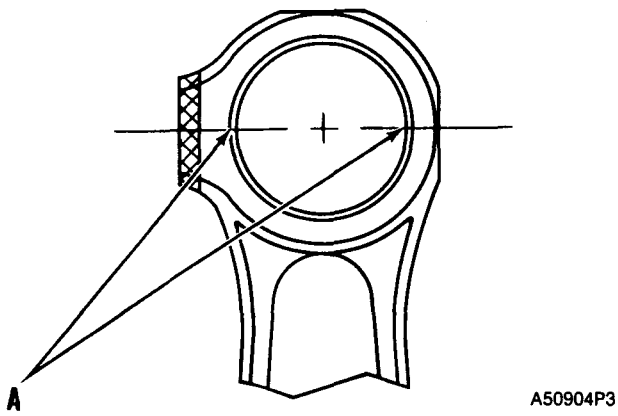
NOTICE

There are holes in the bores for the main bearings, between the cylinders for piston cooling orifices. These holes must have orifices or plugs installed or low oil pressure will be the result.

c Connecting Rod



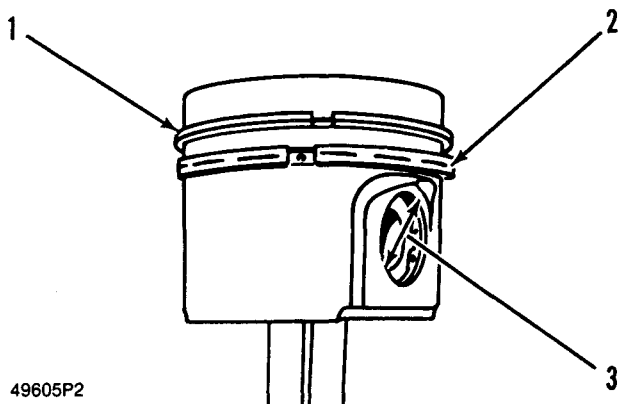
- (1) Bore in bearing for piston pin $38.125 \pm 0.008 \text{ mm}$ ($1.5010 \pm .0003 \text{ in}$)
- (2) Bore in connecting rod for bearing [when tightened according to procedure shown in (5)] $74.721 \pm 0.013 \text{ mm}$ ($2.9418 \pm .0005 \text{ in}$)
- (3) Distance between center of bearing for piston pin and center of bearing for crankshaft journal $200.66 \pm 0.03 \text{ mm}$ ($7.900 \pm .001 \text{ in}$)
- (4) Diameter of piston pin $38.097 \pm 0.005 \text{ mm}$ ($1.4999 \pm .0002 \text{ in}$)
- (5) Torque for nuts:
- Put 2P2506 Thread Lubricant on bolt threads and seating faces of cap and nut.
 - Tighten both nuts to $41 \pm 4 \text{ N}\cdot\text{m}$ ($30 \pm 3 \text{ lb ft}$)
 - Put a mark on each nut and cap.
 - Tighten each nut from mark $60 \pm 5^\circ$



NOTE: Piston pin bearing junction and locating notch must be assembled in the top half of rod eye. Location of bearing junction to be within $\pm 5^\circ$ of center line "A".

Pistons And Rings

Make reference to Guideline For Reusable Parts: Pistons, Form No. SEBF8049.



PISTONS AND PISTON RINGS		
	(1) Top Ring	(2) Oil Control Ring*
	9L6233	2W8045
Width of groove in piston for piston ring (new).	3.276 ± 0.013 mm (.1290 \pm .0005 in)	2.806 ± 0.013 mm (.1105 \pm .0005 in)
Thickness of piston ring (new).	$3.150 + 0.000 - 0.038$ mm (.1240 + .0000 - .0015 in)	2.756 ± 0.013 mm (.1085 \pm .0005 in)
Clearance between groove and piston ring (new).	0.076 to 0.140 mm (.0030 to .0055 in)	0.025 to 0.076 mm (.0010 to .0030 in)
Clearance between ends of piston ring when installed in a cylinder with a bore size of 114.300 mm (4.5000 in) (new).	0.572 ± 0.190 mm (.0225 \pm .0075 in)	0.508 ± 0.254 mm (.0200 \pm .0100 in)
Increase in clearance between ends of piston ring for each 0.03 mm (.001 in) increase in cylinder bore size.	0.08 mm (.003 in)	0.08 mm (.003 in)

NOTE: 9L6233 Top Ring (1) has the mark "UP-1".

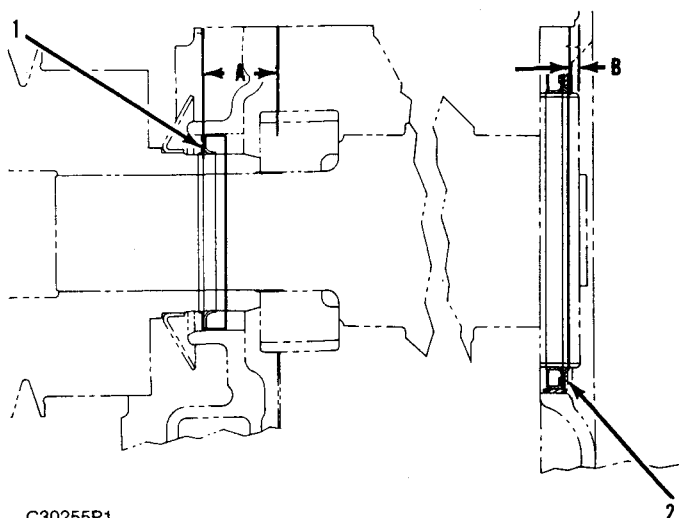
*Install 2W8045 Oil Control Ring (2) with the gap in the spring 180° away from the gap in the ring.

NOTE: Use 5P3519 Piston Ring Groove Gauge to check the top ring groove only. For instructions on the use of the gauge, see the Guideline For Reusable Parts; Pistons, Form No. SEBF8049.

(3) Bore in piston for pin 38.113 to 38.123 mm
(1.5005 to 1.5009 in)

Clearance between pin and bore in piston
(new) 0.011 to 0.031 mm (.0004 to .0012 in)
Maximum permissible clearance between piston pin and
bore in piston (worn) 0.08 mm (.003 in)

c Crankshaft Seals



C30255P1

9N542 Crankshaft Seal Group

(1) 7C6660 Hydrodynamic Seal Group. (2) 7W3200 Hydrodynamic Seal Group.

- (A) The distance from the edge of seal (1) to the gasket surface of the front housing is 38.10 ± 0.50 mm ($1.500 \pm .020$ in)
- (B) The distance from the edge of the hydrodynamic seal (3) to the edge of the wear sleeve is 4.30 ± 0.25 mm ($.169 \pm .010$ in)

Remove front and rear seal groups as follows:

- Use the 1P3075 Puller Group to remove the seals.
- Use the 5P7318 Distorter Group to remove the wear sleeves.

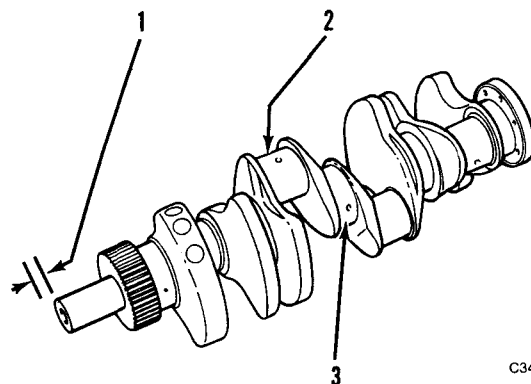
NOTE: Seals and wear sleeves can not be used again after the seals and wear sleeves are separated.

Install front and rear seal groups as follows:

- Clean the outer surface of the crankshaft with 6V1541 Quick Cure Primer.
- Crankshaft seals must be installed with the lip of the seal toward the inside of the engine as shown. The 7C6660 Hydrodynamic Seal Group is the front crankshaft seal. The 7W3200 Hydrodynamic Seal Group is the rear crankshaft seal.
- Do not separate the seals from wear sleeves. Install the seal groups as a unit on each end of the engine as shown with correct tooling.

NOTE: See Special Instruction Form No. SMHS8508 for the installation of the hydrodynamic seals.

c Crankshaft



C34404P4

Heat gear to install. Do not heat to a temperature of more than 260°C (500°F).

- (1) End play for the crankshaft 0.08 to 0.25 mm ($.003$ to $.010$ in)
- Maximum permissible end play for the crankshaft (worn) 0.36 mm ($.014$ in)

- (2) Make reference to Bearings For Connecting Rods And Mains.
- (3) Make reference to Bearings For Connecting Rods And Mains.

NOTE: See Reconditioning Procedures for the correct method to check for bent crankshafts.

c Bearings For Connecting Rods And Mains

Make reference to Guidelines For Reusable Parts: Main Bearings And Connecting Rod Bearings, Form No. SEBF8009.

CONNECTING ROD BEARINGS	
Original Size Journal	69.840 ± 0.015 mm ($2.7496 \pm .0006$ in)
Undersize Journal 0.25 mm (.010 in)	69.586 ± 0.015 mm ($2.7396 \pm .0006$ in)
Undersize Journal 0.51 mm (.020 in)	69.332 ± 0.015 mm ($2.7296 \pm .0006$ in)
Undersize Journal 1.27 mm (.050 in)	68.570 ± 0.015 mm ($2.6996 \pm .0006$ in)

Clearance between bearing and journal (new) 0.053 to 0.140 mm ($.0021$ to $.0055$ in)

Maximum permissible clearance between bearing and journal 0.15 mm ($.006$ in)

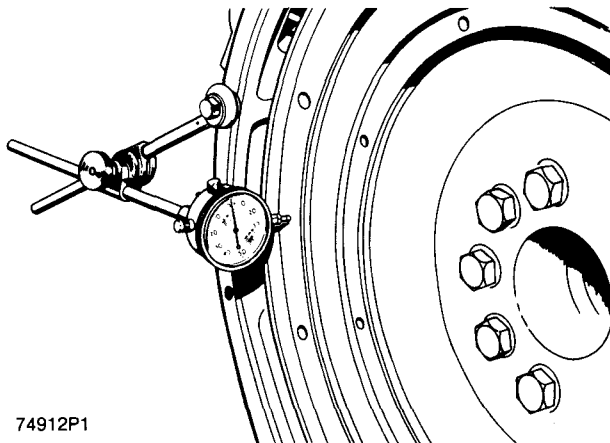
MAIN BEARINGS	
Original Size Journal	88.887 ± 0.015 mm (3.4995 ± .0006 in)
Undersize Journal 0.25 mm (.010 in)	88.633 ± 0.015 mm (3.4895 ± .0006 in)
Undersize Journal 0.51 mm (.020 in)	88.379 ± 0.015 mm (3.4795 ± .0006 in)
Undersize Journal 1.27 mm (.050 in)	87.617 ± 0.015 mm (3.4495 ± .0006 in)

Clearance between bearing and journal
(new) 0.076 to 0.168 mm (.0030 to .0066 in)

Maximum permissible clearance between bearing and journal 0.18 mm (.007 in)

Flywheel Runout

Face Runout (Axial Eccentricity) Of The Flywheel:

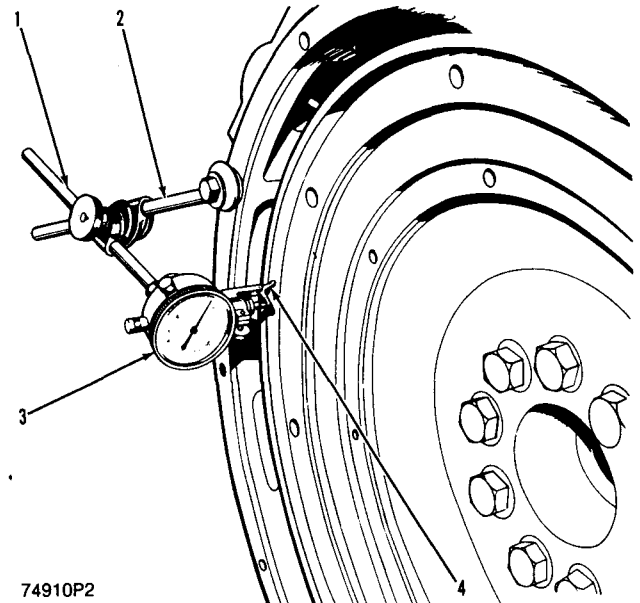


74912P1

Checking Face Runout Of The Flywheel

1. Install the dial indicator as shown. Put a force on the flywheel toward the rear.
2. Set the dial indicator to read 0.00 mm (.000 in).
3. Turn the flywheel and read the indicator every 90°. Put a force on the flywheel to the rear before each reading.
4. The difference between the lower and higher measurements taken at all four points must not be more than 0.15 mm (.006 in), which is the maximum permissible face runout (axial eccentricity) of the flywheel.

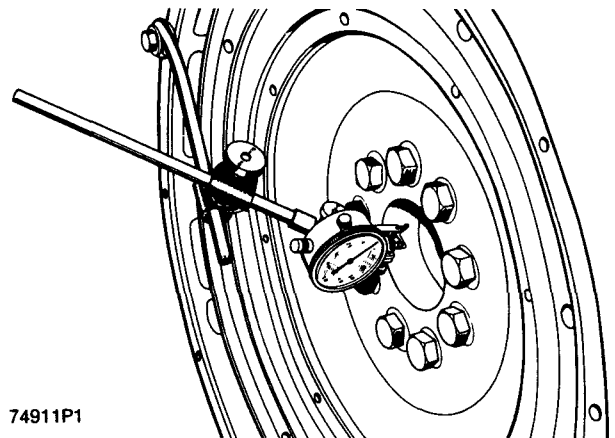
Bore Runout (Radial Eccentricity) Of The Flywheel:



74910P2

Checking Flywheel Bore

1. Install the dial indicator (3) and make an adjustment of the universal attachment (4) so it makes contact as shown.
2. Set the dial indicator to read 0.00 mm (.000 in).
3. Turn the flywheel and read the indicator every 90°.
4. The difference between the lower and higher measurements taken at all four points must not be more than 0.15 mm (.006 in), which is the maximum permissible bore runout (radial eccentricity) of the flywheel.

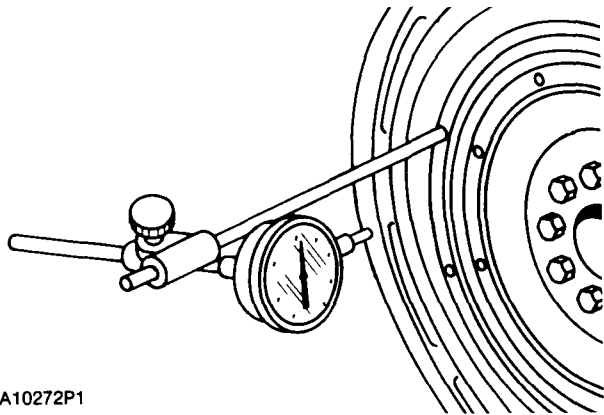


74911P1

5. Runout (eccentricity) of the bore for the pilot bearing for the flywheel clutch, must not exceed 0.13 mm (.005 in).

Flywheel Housing Runout

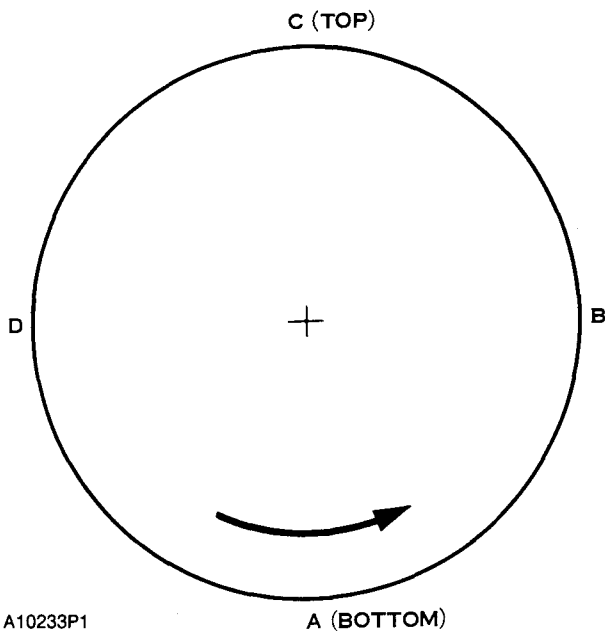
Face Runout (Axial Eccentricity) Of The Flywheel Housing:



A10272P1

8T5096 Dial Indicator Group Installed

1. Fasten a dial indicator to the crankshaft flange so the anvil of the indicator will touch the face of the flywheel housing.
2. Put a force on the crankshaft toward the rear before reading the indicator at each point.



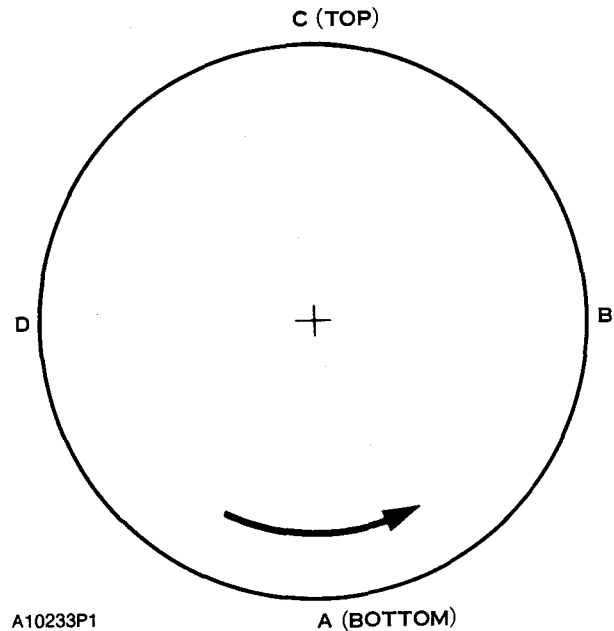
A10233P1

A (BOTTOM)

3. With dial indicator set at 0.00 mm (.000 in) at location (A), turn the crankshaft and read the indicator at locations (B), (C) and (D).

4. The difference between lower and higher measurements taken at all four points must not be more than 0.25 mm (.010 in), which is the maximum permissible face run out (axial eccentricity) of the flywheel housing.

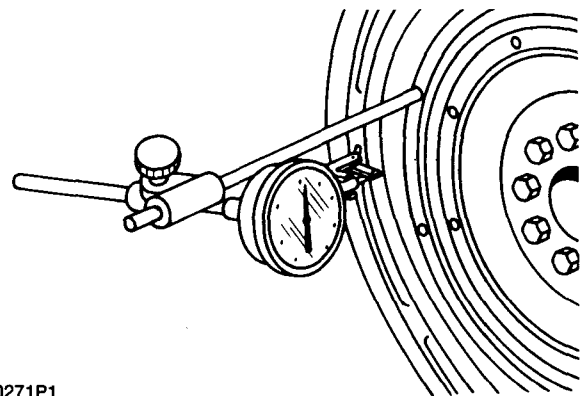
Flywheel Housing Bore



A10233P1

A (BOTTOM)

NOTE: Write the dial indicator measurements with their positive (+) and negative (-) notation (signs). This notation is necessary for making the calculations in the chart correctly.



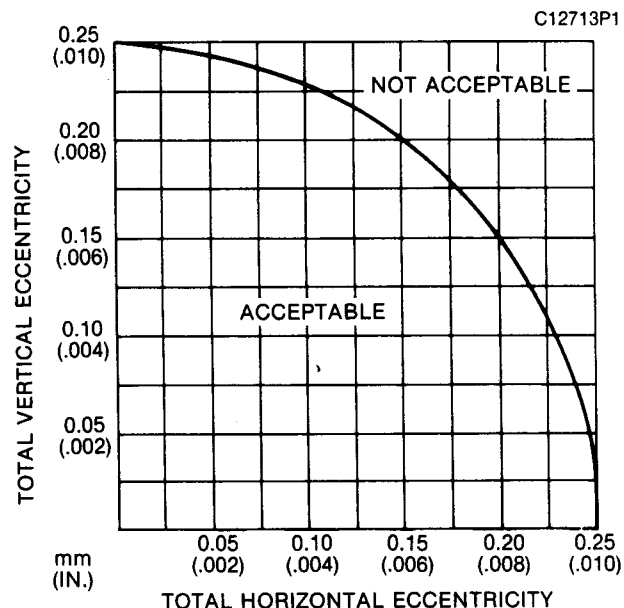
A10271P1

1. With the dial indicator in position at (C), adjust the dial indicator to "0" (zero). Push the crankshaft up against the top bearing. Write the measurement for bearing clearance on line 1 in column (C).

2. Divide the measurement from Step 1 by 2. Write this number on line 1 in columns (B) & (D).
3. Turn the crankshaft to put the dial indicator at (A). Adjust the dial indicator to "0" (zero).
4. Turn the crankshaft counterclockwise to put the dial indicator at (B). Write the measurement in the chart.
5. Turn the crankshaft counterclockwise to put the dial indicator at (C). Write the measurement in the chart.
6. Turn the crankshaft counterclockwise to put the dial indicator at (D). Write the measurement in the chart.
7. Add lines I and II by columns.
8. Subtract the smaller number from the larger number in line III in columns (B) & (D). The result is the horizontal "eccentricity" (out of round). Line III, column (C) is the vertical eccentricity.

CHART FOR DIAL INDICATOR MEASUREMENTS					
	Position of dial indicator				
	Line No.	A	B	C	D
Correction for bearing clearance	I	0			
Dial Indicator Reading	II	0			
Total of Line 1 & 2	III	0	**	*	**
<p>*Total Vertical eccentricity (out of round).</p> <p>**Subtract the smaller No. from the larger No. The difference is the total horizontal eccentricity.</p>					

A10234P1

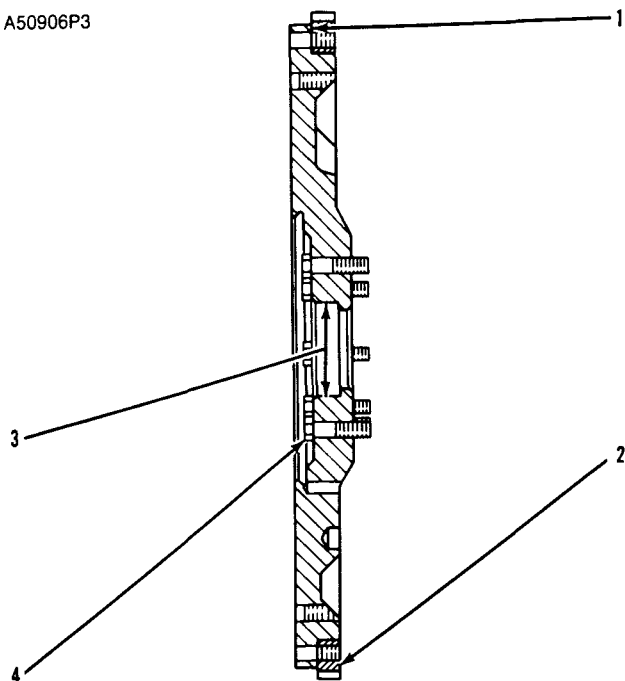


Total Horizontal Eccentricity

9. On the graph for total eccentricity find the point of intersection of the lines for vertical eccentricity and horizontal eccentricity.
10. If the point of intersection is in the range marked "Acceptable" the bore is in alignment. If the point of intersection is in the range marked "Not Acceptable", the flywheel housing must be changed.

Flywheel

A50906P3



Typical Illustration

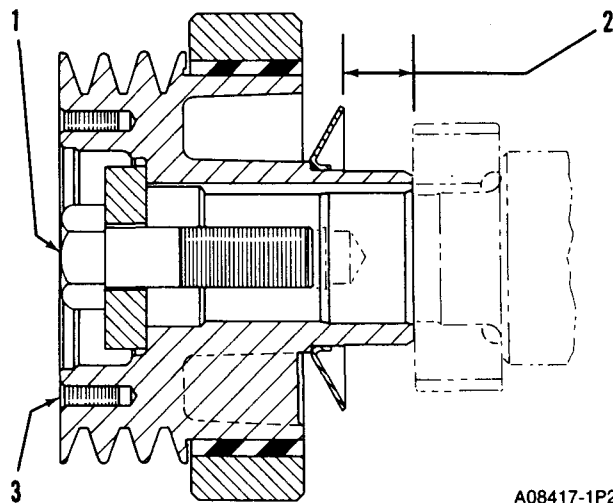
- (1) Flywheel shoulder.
- (2) Install ring gear so that Part No. is on this side. Ring gear must be assembled against shoulder of flywheel.

NOTE: Do not heat ring gear to more than 204°C (400°F) before installing on flywheel.

- (3) Pilot bore.
- (4) Torque for bolts holding flywheel to crankshaft $90 \pm 7 \text{ N}\cdot\text{m}$ ($66 \pm 5 \text{ lb ft}$)
Put 5P3413 Sealant on the bolt threads.

NOTE: Dash mark on flywheel must be in alignment with dash mark on crankshaft.

Pulley And Damper



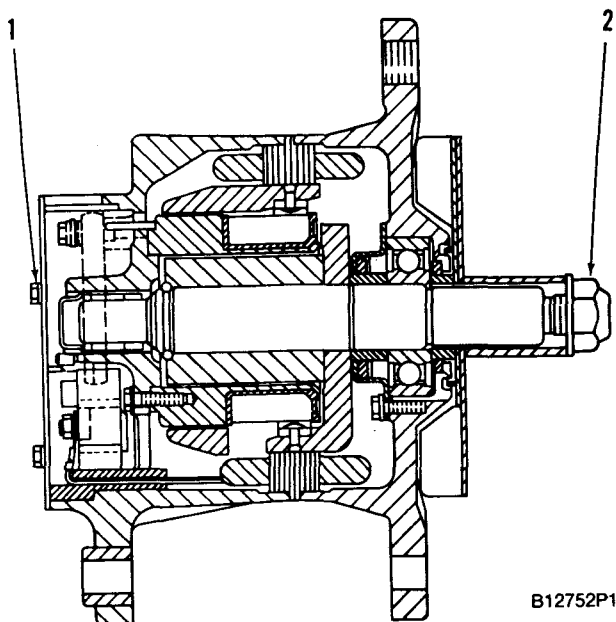
A08417-1P2

Install the damper assembly on the crankshaft until the hub of the damper assembly comes in contact with the gear on the crankshaft. DO NOT use the bolt and washer that holds the damper assembly on the crankshaft to install the damper assembly.

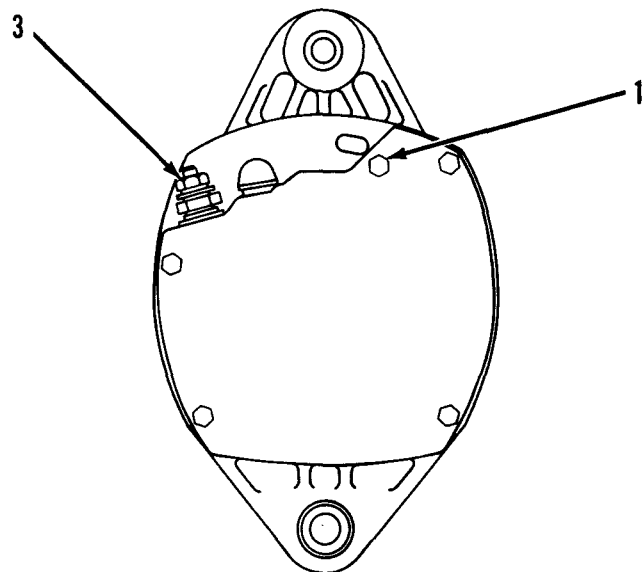
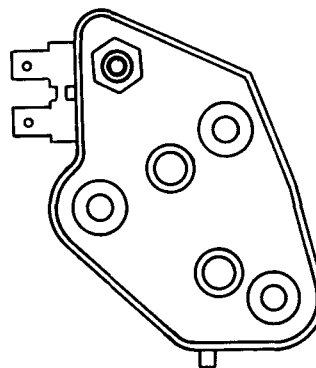
- (1) Torque for bolt that holds the pulley $624 \pm 80 \text{ N}\cdot\text{m}$ ($460 \pm 60 \text{ lb ft}$)
When a front power takeoff is used, increase torque for bolt to $950 \pm 50 \text{ N}\cdot\text{m}$ ($700 \pm 37 \text{ lb ft}$)
- (2) Distance from end of damper assembly to edge of dust shield $31.8 \pm 1.5 \text{ mm}$ ($1.25 \pm .06 \text{ in}$)
- (3) When front power takeoff is used, tighten bolts to $55 \pm 7 \text{ N}\cdot\text{m}$ ($40 \pm 5 \text{ lb ft}$)

C Alternators And Regulators

Delco-Remy (20SI)



Polarity	Negative Ground
Rotation	Either Direction
Speed for testing (rpm)	5000
Output voltage	$27.5 \pm 1.0V$
Output (hot)	35A
(1) Torque for the ground terminal nut	$2.3 \pm 0.6 \text{ N}\cdot\text{m}$ ($21 \pm 5 \text{ lb in}$)
(2) Torque for the pulley nut	$102 \pm 7 \text{ N}\cdot\text{m}$ ($76 \pm 5 \text{ lb ft}$)
(3) Torque for the output terminal nut	$7.1 \pm 0.9 \text{ N}\cdot\text{m}$ ($64 \pm 8 \text{ lb in}$)



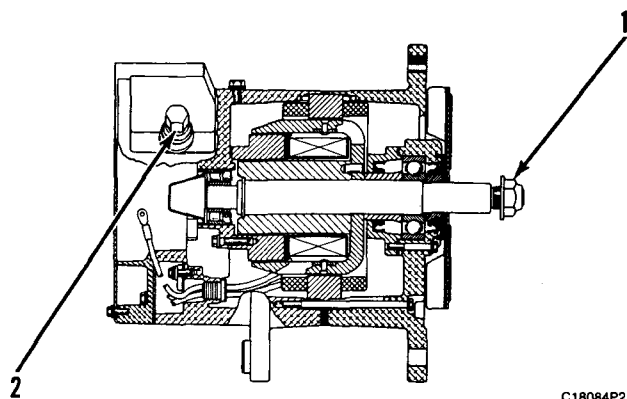
3T6354 Regulator Inside Alternator

Voltage setting	No adjustment
Permissible voltage range	26 to 30V

3T6352 24V 35A

NOTE: Load the battery with a carbon pile (6V4930 Battery Load Tester) to get the maximum alternator output.

Delco-Remy (25SI)



3T1888 24V 50A

NOTE: Load the battery with a carbon pile (6V4930 Battery Load Tester) to get the maximum alternator output.

Polarity	Negative Ground
Rotation	Either Direction
Speed for testing (rpm)	5000
Output voltage	$27.5 \pm 1.0V$
Output (hot)	50A
(1) Torque for the pulley nut	$102 \pm 7 \text{ N}\cdot\text{m}$ ($76 \pm 5 \text{ lb ft}$)
(2) Torque for the output terminal nut	$13.5 \pm 1.3 \text{ N}\cdot\text{m}$ ($10 \pm 1 \text{ lb in}$)

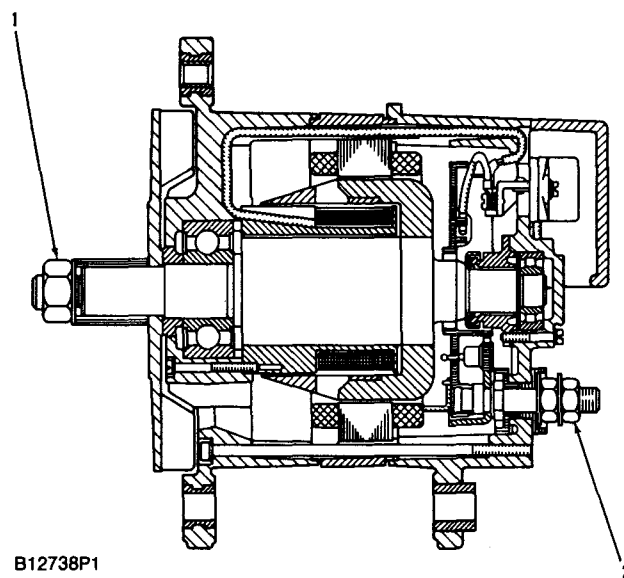
7N0129 Regulator Inside Alternator

Voltage setting range	$27.5 \pm 1.0V$
Adjust voltage setting to	28V

NOTE: There are two types of adjustment: One type of adjustment is made by removing a pipe plug and turning the adjusting screw one or two notches in a clockwise direction to increase the voltage setting or one or two notches in a counterclockwise direction to decrease the voltage setting. The second type of adjustment is similar except, remove the end cover to expose the potentiometer for adjustment.

Then increase speed to get a maximum output of 50A

Bosch



7N9720 24V 35A

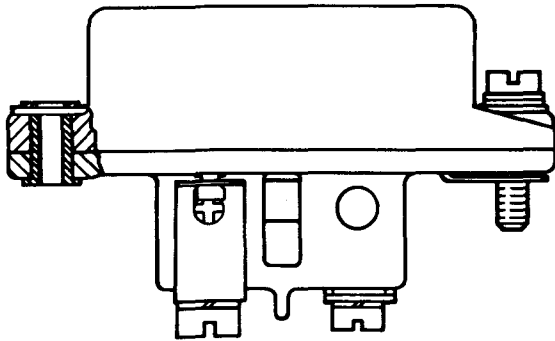
NOTE: Load the battery with a carbon pile (6V4930 Battery Load Tester) to get maximum alternator output.

Polarity	Negative Ground
Rotation (viewed from pulley end)	Clockwise
Speed for testing (rpm)	5000
Output voltage	$27.5 \pm 1.0V$
Output (hot)	35A
(1) Torque for the pulley nut	$102 \pm 7 \text{ N}\cdot\text{m}$ ($76 \pm 5 \text{ lb ft}$)
(2) Torque for the output terminal nut	$13.5 \pm 1.3 \text{ N}\cdot\text{m}$ ($10 \pm 1 \text{ lb ft}$)

9G9538 24V 50A

NOTE: Load the battery with a carbon pile (6V4930 Battery Load Tester) to get the maximum alternator output.

Polarity	Negative Ground
Rotation	Either Direction
Speed for testing (rpm)	5000
Output voltage	$27.5 \pm 1.0V$
Output (hot)	50A
(1) Torque for the pulley nut	$102 \pm 7 \text{ N}\cdot\text{m}$ ($76 \pm 5 \text{ lb ft}$)
(2) Torque for the output terminal nut	$13.5 \pm 1.5 \text{ N}\cdot\text{m}$ ($10 \pm 1 \text{ lb ft}$)



B12749P1

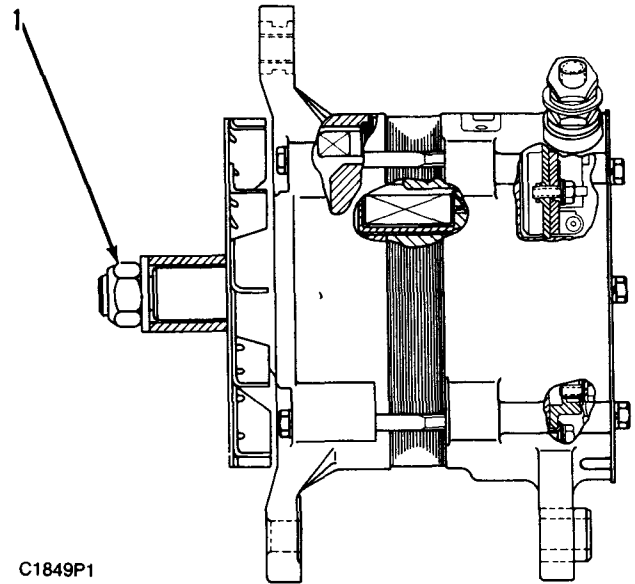
9G7567 Regulator Under alternator cover. For use with 9G9538 and 7N9720 alternators.

Voltage rating 28V

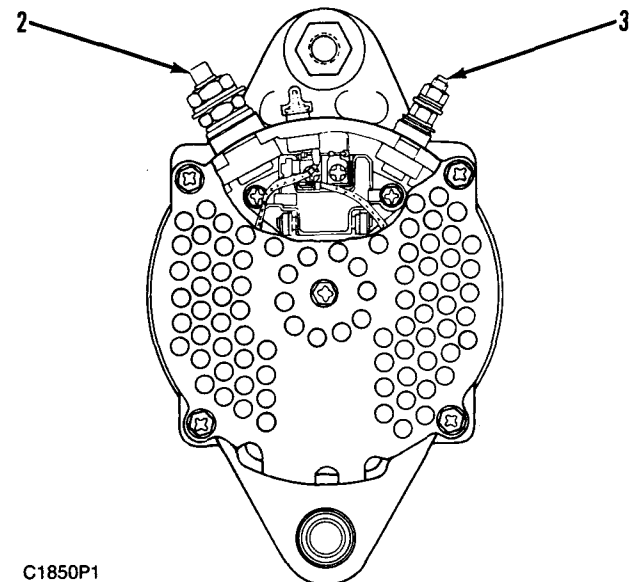
Polarity Negative Ground

Voltage setting range 26.7 to 28.3V

Nippondenso



C1849P1



C1850P1

9G4574 24V 35A

NOTE: Load the battery with a carbon pile (6V4930 Battery Load Tester) to get the maximum alternator output.

Polarity Negative Ground

Rotation Either Direction

Speed for testing (rpm) 5000

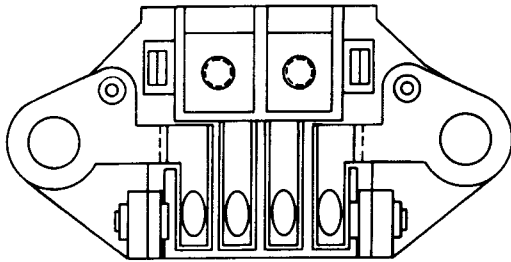
Output voltage $27.5 \pm 1.0V$

Output (hot)	35A
(1) Torque for the pulley nut	$102 \pm 7 \text{ N}\cdot\text{m}$ ($76 \pm 5 \text{ lb ft}$)
(2) Torque for the output terminal nut	$13.5 \pm 1.3 \text{ N}\cdot\text{m}$ ($10 \pm 1 \text{ lb ft}$)
(3) Torque for the ground terminal nut	$8 \pm 3 \text{ N}\cdot\text{m}$ ($6 \pm 2 \text{ lb ft}$)

6T7223 24V 50A

NOTE: Load the battery with a carbon pile (6V4930 Battery Load Tester) to get the maximum alternator output.

Polarity	Negative Ground
Rotation	Either Direction
Speed for testing (rpm)	5000
Output voltage	$27.5 \pm 1.0\text{V}$
Output (hot)	50A
(1) Torque for the pulley nut	$102 \pm 7 \text{ N}\cdot\text{m}$ ($76 \pm 5 \text{ lb ft}$)
(2) Torque for the output terminal nut	$13.5 \pm 1.3 \text{ N}\cdot\text{m}$ ($10 \pm 1 \text{ lb ft}$)
(3) Torque for the ground terminal nut	$8 \pm 3 \text{ N}\cdot\text{m}$ ($6 \pm 2 \text{ lb ft}$)



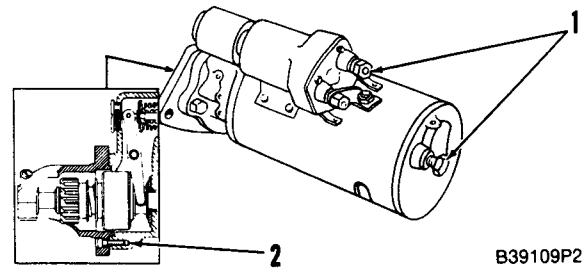
C10874P1

7T2798 Regulator Inside alternator. For use with 9G4574 and 6T7223 alternators.

Voltage setting	No Adjustment
Permissible voltage range	26.5 to 28.5V

C Electric Starter Motors

Delco-Remy Starter Motors



8C3651 24V

Rotation as seen from drive end	Clockwise
Minimum speed with no load	6300 rpm
Maximum speed with no load	8400 rpm
Current consumption (draw) at no load:	
Minimum with solenoid at 23V	60A
Maximum with solenoid at 23V	75A
Clearance between pinion and housing (pinion clearance)	8.3 to 9.9 mm (.33 to .39 in)
(1) Torque for terminal nuts	27 to 34 N·m (20 to 25 lb ft)
(2) Torque for screws holding nose housing to lever housing	18 to 30 N·m (13 to 22 lb ft)

9G4339 24V

Rotation as seen from drive end	Clockwise
Minimum speed with no load	6300 rpm
Maximum speed with no load	8400 rpm
Current consumption (draw) at no load:	
Minimum with solenoid at 23V	60A
Maximum with solenoid at 23V	75V
Clearance between pinion and housing (pinion clearance)	8.3 to 9.9 mm (.33 to .39 in)
(1) Torque for terminal nuts	27 to 34 N·m (20 to 25 lb ft)
(2) Torque for screws holding nose housing to lever housing	18 to 30 N·m (13 to 22 lb ft)

3T2647 24V

Rotation as seen from drive end	Clockwise
Minimum speed with no load	6000 rpm
Maximum speed with no load	10260 rpm

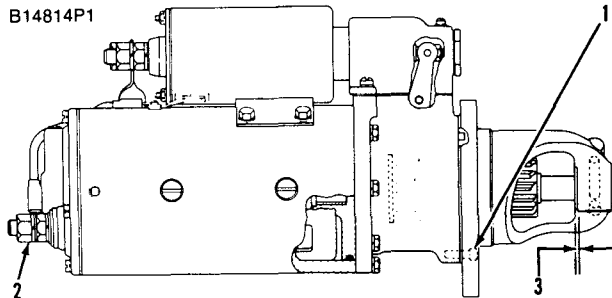
Current consumption (draw) at no load:

Minimum with solenoid at 23V	60A
Maximum with solenoid at 23V	118A

Clearance between pinion and housing (pinion clearance)

- (1) Torque for terminal nuts 27 to 34 N•m (20 to 25 lb ft)
- (2) Torque for screws holding nose housing to lever housing 18 to 23 N•m (13 to 17 lb ft)

Prestolite Starter Motors



9G4338 24V

Rotation as seen from drive end Clockwise

Minimum speed with no load 6500 rpm

Current consumption (draw) at no load:

Maximum with solenoid at 20V 77A

- (1) Torque for screws holding nose housing to lever housing 11 N•m (8 lb ft)
- (2) Torque for terminal nuts 27 to 34 N•m (20 to 25 lb ft)
- (3) Clearance between pinion and housing (pinion clearance) 0.51 to 1.27 mm (.020 to .050 in)

9G4339 24V

Rotation as seen from drive end Clockwise

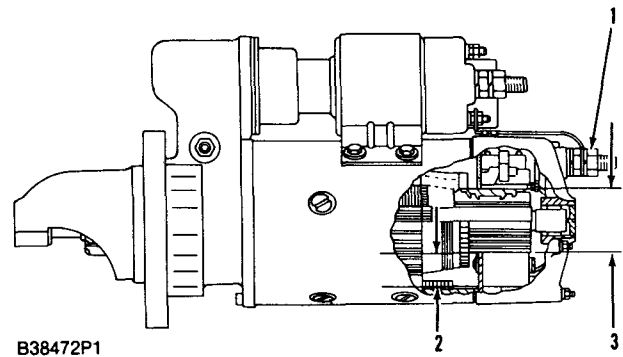
Minimum speed with no load 5000 rpm

Current consumption (draw) at no load:

With solenoid at 20V 65A

- (1) Torque for screws holding nose housing to lever housing 11 N•m (8 lb ft)
- (2) Torque for terminal nuts 27 to 34 N•m (20 to 25 lb ft)
- (3) Clearance between pinion and housing (pinion clearance) 0.51 to 1.27 mm (.020 to .050 in)

Bosch Starter Motors



3T6305 24V

Rotation as seen from drive end Clockwise

Minimum speed with no load 5500 rpm

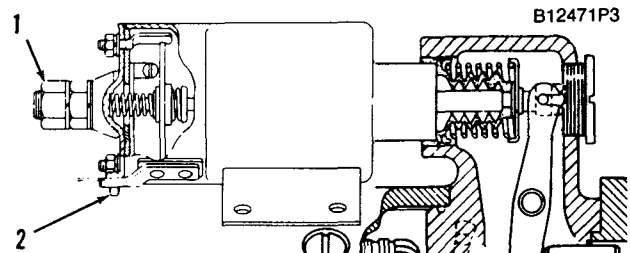
Current consumption (draw) at no load:

Maximum with solenoid at 24V 140A

- (1) Torque for large terminal nuts 27 to 33 N•m (20 to 24 lb ft)
- Torque for small terminal nuts 4 to 5 N•m (3 to 4 lb ft)
- (2) Service limit of brushes 17.5 mm (.69 in)
- (3) Service limit of commutator diameter 48 mm (1.9 in)
- Pinion to ring gear clearance 1.5 to 5.5 mm (.06 to .22 in)

Starter Solenoids

Delco-Remy Starter Solenoids



3T4704 24V 7T8854 24V

Current consumption (draw):

Pull-in windings at 5V 8.5 to 10A

Hold-in windings at 20V 6.8A max

- (1) Torque for terminal nuts 27 to 34 N•m (20 to 25 lb ft)

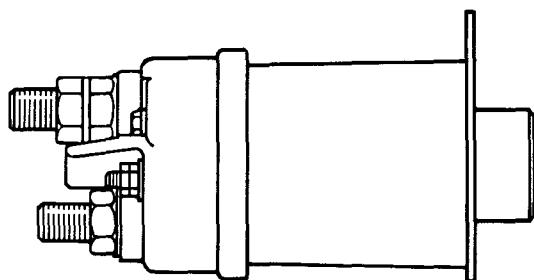
- (2) Torque for terminal screws 2.0 to 2.5 N•m
(18 to 22 lb in)

7T0258 24V

Current consumption (draw):

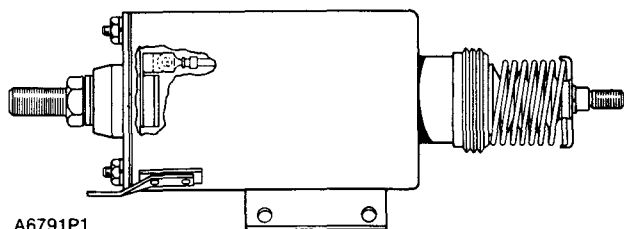
- Pull-in windings at 5V 8.5 to 10A
Hold-in windings at 20V 11 to 15A

- (1) Torque for terminal nuts 27 to 34 N•m (20 to 25 lb ft)
(2) Torque for terminal screws 2.0 to 2.5 N•m
(18 to 22 lb in)



C12727P1

Prestolite Starter Solenoids



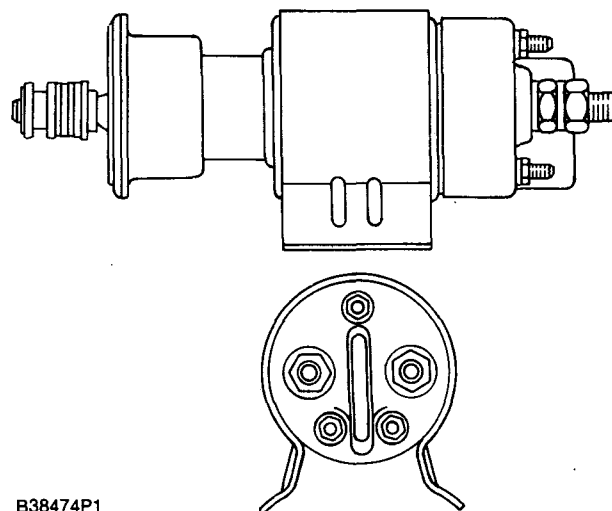
A6791P1

3T8635 24V

Current consumption (draw):

- Pull-in windings at 12V 23.2 to 26.6A
Pull-in windings at 24V 38.7 to 44.4A
Hold-in windings at 12V 4.1 to 4.8A
Hold-in windings at 24V 6.8 to 8.0A

Bosch Starter Solenoids



B38474P1

3T0868 24V

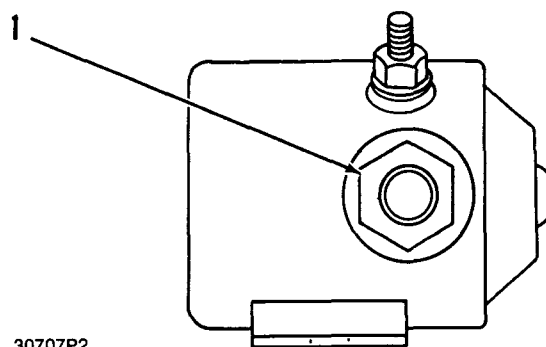
Resistance of pull-in windings513 to .567 ohm

Resistance of hold-in windings 3.28 to 3.62 ohm

Current consumption (draw):

- Pull-in windings at 20V 35.3 to 39.0A
Hold-in windings at 20V 5.5 to 6.1A

c Starter Magnetic Switches



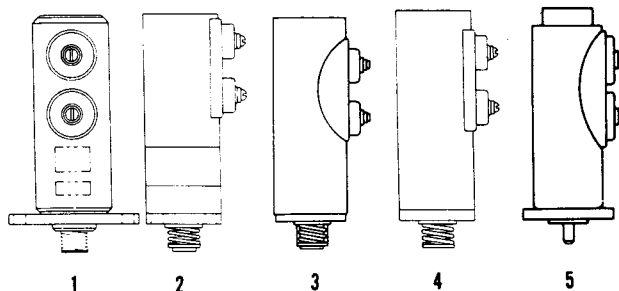
30707P2

9F3099 24V

- (1) Torque for large terminal nuts 3.6 ± 4 N•m
(32 \pm 4 lb in)
Torque for small coil nuts 1.70 ± 0.25 N•m
(15 \pm 2.3 lb in)

Coil voltage 24V
 Current consumption (draw) at 15V51 to .56A

C Shutoff Solenoids

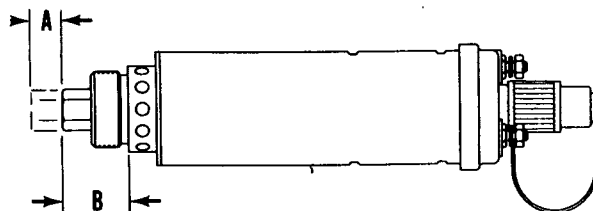


C12717P1

Caterpillar Number	Figure Number	Voltage Rating	Coil Resistance at 25°C (77°F)
8C5523	5	12	1.26 to 1.40 ohms
6N3749	1	12	4.23 to 5.17 ohms
6T4750	3	12	4.23 to 5.17 ohms
6T6121	2	12	4.23 to 5.17 ohms
8C5524	5	24	4.86 to 5.38 ohms
7N8884	1	24	15.30 to 18.70 ohms
6T4126	4	24	17.70 to 21.70 ohms
6T6122	2	24	17.70 to 21.70 ohms

C Latching Type (613C)

9X5524 (24VDC)



C21055P1

When installing to governor housing, tighten to a torque of $50 \pm 10 \text{ N}\cdot\text{m}$ ($37 \pm 7 \text{ lb ft}$)

Resistance at 25°C (77°F):

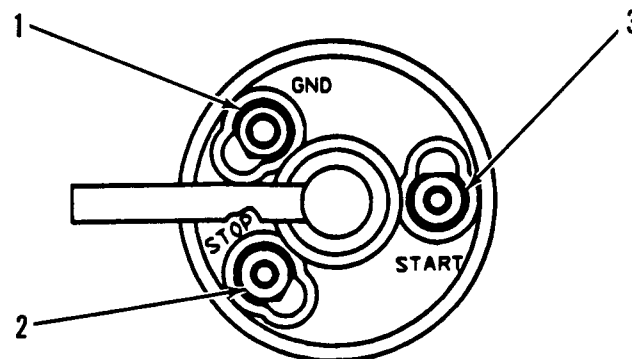
Start $.70 \pm .07 \text{ ohms}$

Stop $5.50 \pm .55 \text{ ohms}$

Hold-in force automatic mechanical latch

Plunger stroke (A) when unlatched (minimum) 16 mm (.63 in)

Latch position (B) when latched $27.20 \pm 0.71 \text{ mm}$ ($1.071 \pm .028 \text{ in}$)

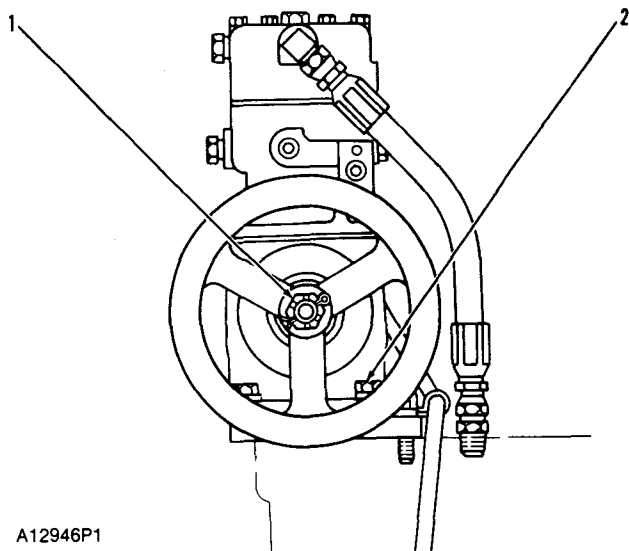


C21055P2

End View Of Shutoff Solenoid

- (1) Ground terminal. Use 10 gauge wire to ground.
- (2) Stop terminal. Use 16 gauge wire to OFF terminal of key switch.
- (3) Start terminal. Use 10 gauge wire to S (switch) terminal of starter motor.

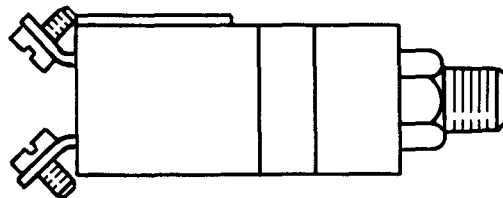
C Air Compressor



(1) Torque for nut that holds drive pulley 70 N•m (50 lb ft)

NOTE: Tighten nut more to get alignment of hole for cotter pin.

(2) Torque for studs that hold air compressor .. 70 ± 10 N•m
(50 ± 7 lb ft)



B99612P1

3T4418
3T6962
6T7663
9W3187

Test switch at a temperature of 25°C (77°F)

With an increase in pressure, switch opens at 93 ± 20 kPa
(14 ± 3 psi)

With a decrease in pressure, switch closes at 69 ± 20 kPa
(10 ± 3 psi)

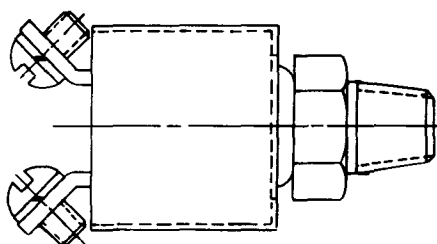
9W0263

Test switch at a temperature of 25°C (77°F)

With an increase in pressure, switch opens at 48 ± 14 kPa
(7 ± 2 psi)

With a decrease in pressure (minimum), switch closes
at 24 kPa (3.5 psi)

C Pressure Switches

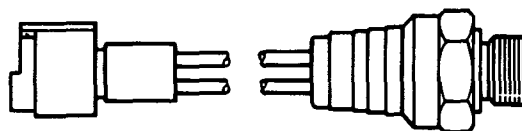


9G8010

Test switch at a temperature of 25°C (77°F)

With an increase in pressure, switch opens
at 110 ± 21 kPa (16 ± 3 psi)

With a decrease in pressure, switch closes at 62 ± 21 kPa
(9 ± 3 psi)

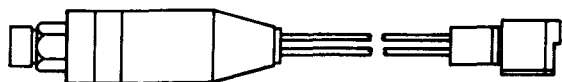


C21789P1

7X1080

With an increase in pressure, switch opens at ... 93 ± 20 kPa
(14 ± 3 psi)

With a decrease in pressure, switch closes at 69 ± 20 kPa
(10 ± 3 psi)



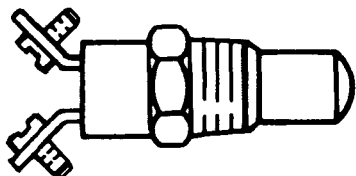
C5615P1

9X1344

With an increase in pressure, switch opens at ... 93 ± 20 kPa
(14 ± 3 psi)

With a decrease in pressure, switch closes at 69 ± 20 kPa
(10 ± 3 psi)

c Temperature Switches



A65332P2

7N9785 6T2665

Switch must open between ... 104 and 110°C (219 and 230°F)

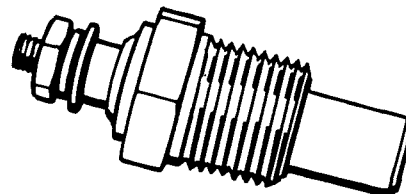
Switch must close at (minimum) 93°C (199°F)

8N1693

Switch must open between 35 and 41°C (95 and 106°F)

Switch must close at (minimum) 26°C (79°F)

c Temperature Sending Unit



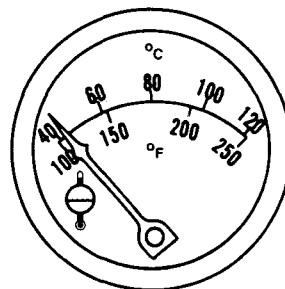
48736P1

6N5926 8N3844

INSPECTION TEST REQUIREMENT CHART				
Bath Temp $^{\circ}\text{C}/^{\circ}\text{F}$	Constant Voltage	Series Resistance	Current Limits (ma)	Resistance Limits (Ω)
54.4/130	27.2	312Ω	3.6–4.5	5806–7264
115.6/240	27.2	312Ω	30.3–32.5	524–586

Inspection procedure: The resistance of sender must fall within the limits shown in chart at indicated bath temperature with sender in a continuous flow bath with series resistance and applied voltage specified in chart. Bath medium shall be U con oil spec. 50-HB-280X with flow controlled to 228.6 to 254.0 mm per second. Power shall be applied for a minimum of seven minutes before inspection.

c Water Temperature Gauges



C10273P1

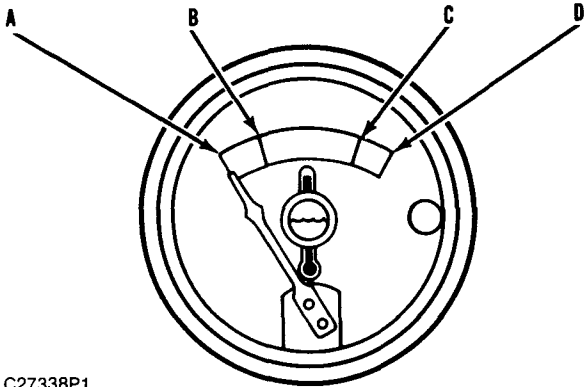
4W0483

Range 38 to 121°C (100 to 250°F)

Test voltage $27.2 \pm .3$ V

NOTE: Prior to inspection warm up indicator for a minimum of 5 minutes with 27.2 Volts applied. Check calibration with ascending pointer.

CALIBRATION CHART	
Test Resistance	Temperature
5200 to 14400Ω	50°C (122°F)
1950 to 2350Ω	80°C (176°F)
630 to 690Ω	110°C (230°F)

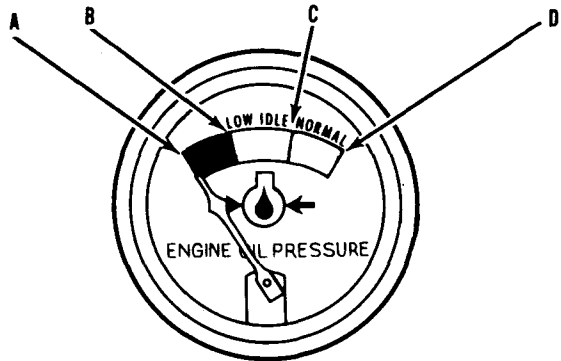


4N7562

CALIBRATION CHART	
Pointer Position	Test Reading Temperature
A*	38 to 40°C (100 to 104°F)
B	70 to 72°C (158 to 162°F)
C	108 to 111°C (227 to 231°F)
D*	121°C (250°F)

* Pointer must not move beyond end of indicator band.

c Oil Pressure Gauge



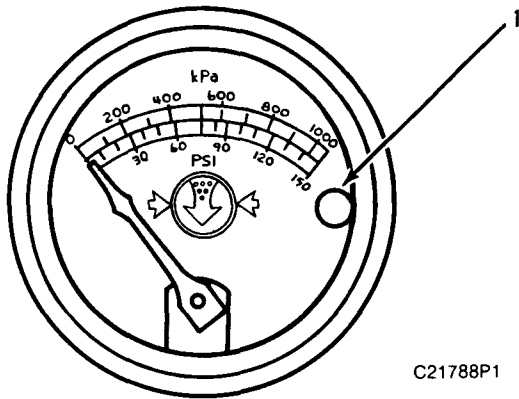
78685P4

6N9885

CALIBRATION CHART	
Pointer Position	Test Reading Pressure
A	0 to 28 kPa (0 to 4 psi)
B	96 to 110 kPa (14 to 16 psi)
C	201 to 215 kPa (29 to 31 psi)
D*	552 kPa (80 psi)

* Pointer must stop within 0 to 2.3 mm (0 to .09 in) from point D.

c Air Pressure Gauge



C21788P1

(1) Calibration hole.