



FORM NO. SENR7590-01

FOR USE IN SERVICE MANUALS:
VOLUME I SPECIFICATIONS, REG01312
D4 TRACTOR, REG00632
D4E TRACTOR, SENR7624
D4 SA TRACTOR, REG00784
D4E SA TRACTOR, SENR7636
NO. 112F MOTOR GRADER, REG00885
120G MOTOR GRADER, REG01654
130G & 140G MOTOR GRADERS,
REG01652
225 EXCAVATOR, REG01578
518 SKIDDER, REG00971
920 & 930 WHEEL LOADERS, REG00514
941 TRACK-TYPE LOADER, REG00527
950 WHEEL LOADER, REG00548
951 TRACK-TYPE LOADER, REG00783
955 TRACK-TYPE LOADER, REG00634
955L TRACK-TYPE LOADER, SENR7364
955L TRACK-TYPE LOADER, SENR7672

Specifications

3304 Vehicular Engine

NOTICE
This book also includes specifications for all 4.75" bore, four cylinder vehicle engines with vehicle serial numbers. The specifications in this book supersede the specifications in Form REG01350-01.

7Z1-UP
9Z1-UP
12Z1-UP
43V1-UP

46V1-UP
48V1-UP
78P1-UP

INTRODUCTION

The specifications given in this book are on the basis of information available at the time it was written. The specifications torques, pressures of operation, measurements, adjustments and other items can change at any time. These changes can effect the service given to the product. Get the complete and most current information before you start any job. Caterpillar Dealers have the most current information which is available. For a list of the most current modules and form numbers available for each Service Manual, see the SERVICE MANUAL CONTENTS MICROFICHE REG1139F.

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.

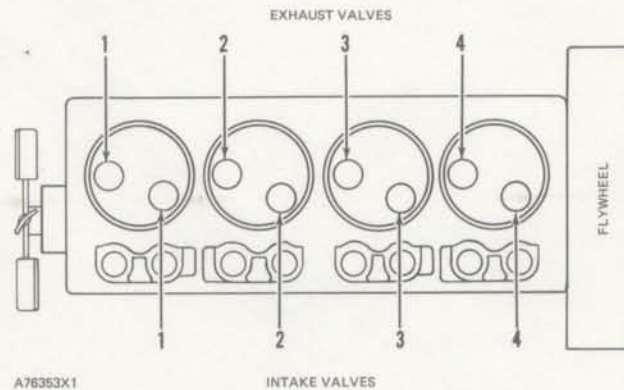
A comparison can be made between the measurements of a worn part, and the specifications of a new part to find the amount of wear. A part that is worn can be safe to use if an estimate of the remainder of its service life is good. If a short service life is expected, replace the part.

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NOTE: For Systems Operation and Testing and Adjusting, make reference to 3304 VEHICULAR ENGINES, Form No. SENR7591.

ENGINE DESIGN

Bore	4.75 in. (120.7 mm)
Stroke	6.0 in. (152.4 mm)
Number of Cylinders	4
Cylinder Arrangement	*in-line
Firing Order (Injection Sequence)	1, 3, 4, 2
Direction of Rotation (when seen from flywheel end)	Counterclockwise
*No. 1 Cylinder Is Opposite Flywheel End.	



CYLINDER AND VALVE IDENTIFICATION

NOTE: This book has been completely changed from the former issue.



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GENERAL TIGHTENING TORQUE FOR BOLTS, NUTS AND TAPERLOCK STUDS

The following charts give the standard torque values for bolts, nuts and taperlock studs of SAE Grade 5 or better quality. Exceptions are given in other sections of the Service Manual where needed.



THREAD DIAMETER		STANDARD TORQUE	
inches	millimeters	lb. ft.	N·m*
 Standard thread		Use these torques for bolts and nuts with standard threads (conversions are approximate).	
1/4	6.35	9 ± 3	12 ± 4
5/16	7.94	18 ± 5	25 ± 7
3/8	9.53	32 ± 5	45 ± 7
7/16	11.11	50 ± 10	70 ± 15
1/2	12.70	75 ± 10	100 ± 15
9/16	14.29	110 ± 15	150 ± 20
5/8	15.88	150 ± 20	200 ± 25
3/4	19.05	265 ± 35	360 ± 50
7/8	22.23	420 ± 60	570 ± 80
1	25.40	640 ± 80	875 ± 100
1 1/8	28.58	800 ± 100	1100 ± 150
1 1/4	31.75	1000 ± 120	1350 ± 175
1 3/8	34.93	1200 ± 150	1600 ± 200
1 1/2	38.10	1500 ± 200	2000 ± 275
Use these torques for bolts and nuts on hydraulic valve bodies.			
5/16	7.94	13 ± 2	20 ± 3
3/8	9.53	24 ± 2	35 ± 3
7/16	11.11	39 ± 2	50 ± 3
1/2	12.70	60 ± 3	80 ± 4
5/8	15.88	118 ± 4	160 ± 6
 Taperlock stud		Use these torques for studs with Taperlock threads.	
1/4	6.35	5 ± 2	7 ± 3
5/16	7.94	10 ± 3	15 ± 5
3/8	9.53	20 ± 3	30 ± 5
7/16	11.11	30 ± 5	40 ± 10
1/2	12.70	40 ± 5	55 ± 10
9/16	14.29	60 ± 10	80 ± 15
5/8	15.88	75 ± 10	100 ± 15
3/4	19.05	110 ± 15	150 ± 20
7/8	22.23	170 ± 20	230 ± 30
1	25.40	260 ± 30	350 ± 40
1 1/8	28.58	320 ± 30	400 ± 40
1 1/4	31.75	400 ± 40	550 ± 50
1 3/8	34.93	480 ± 40	650 ± 50
1 1/2	38.10	550 ± 50	750 ± 70

*1 newton meter (N·m) is approximately the same as 0.1 mkg.

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TORQUE FOR FLARED AND O-RING FITTINGS

The torques shown in the chart that follows are to be used on the part of 37° Flared, 45° Flared and Inverted Flared fittings (when used with steel tubing), O-ring plugs and O-ring fittings.

INVERTED 45° FLARED		37° FLARED					45° FLARED					O-RING FITTING - PLUG		SWIVEL NUTS		
TUBE SIZE (O.D.)	mm	3.18	4.78	6.35	7.92	9.52	TUBE SIZE (O.D.)	mm	12.70	15.88	19.05	22.22	25.40	31.75	38.10	50.80
	in.	.125	.188	.250	.312	.375		in.	.500	.625	.750	.875	1.000	1.250	1.500	2.000
THREAD SIZE (in.)		5/16	3/8	7/16	1/2	9/16 5/8	THREAD SIZE (in.)		3/4	7/8	1 1/16	1 3/16 1 1/4	1 5/16	1 5/8	1 7/8	2 1/2
TORQUE N-m		5 ±1	11 ±1	16 ±2	20 ±2	30 ±2	TORQUE N-m		50 ±5	55 ±7	75 ±7	90 ±7	110 ±7	135 ±15	160 ±15	310 ±30
TORQUE lb.in.		45 ±10	100 ±10	145 ±20	175 ±20	265 ±25	TORQUE lb.ft.		35 ±3	40 ±5	55 ±5	65 ±5	80 ±5	100 ±10	120 ±10	230 ±20

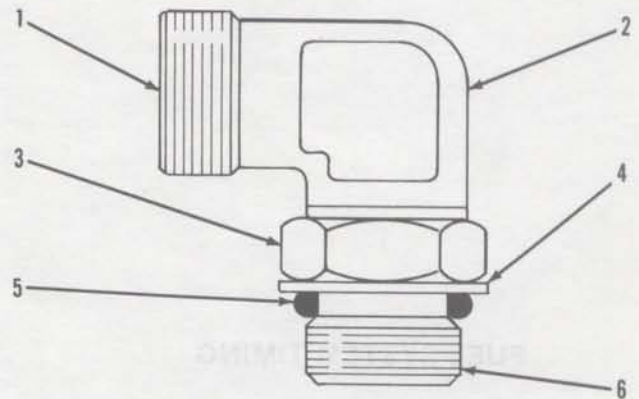
ASSEMBLY OF FITTINGS WITH STRAIGHT THREADS AND O-RING SEALS

- Put locknut (3), backup washer (4) and O-ring seal (5) as far back on fitting body (2) as possible. Hold these components in this position. Turn the fitting into the part it is used on, until backup washer (4) just makes contact with the face of the part it is used on.

NOTE: If the fitting is a connector (straight fitting) or plug, the hex on the body takes the place of the locknut. To install this type fitting tighten the hex against the face of the part it goes into.

- To put the fitting assembly in its correct position turn the fitting body (2) out (counterclockwise) a maximum of 359°. Tighten locknut (3) to the torque shown in the chart.

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ELBOW BODY ASSEMBLY

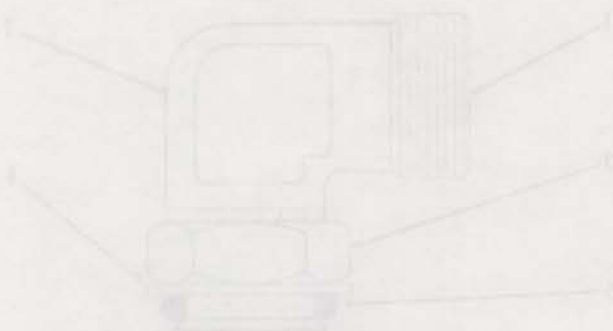
- End of fitting body (connects to tube).
- Fitting body.
- Locknut.
- Backup washer.
- O-ring seal.
- End of fitting that goes into other part.

TORQUE FOR FLARED AND O-RING FITTINGS

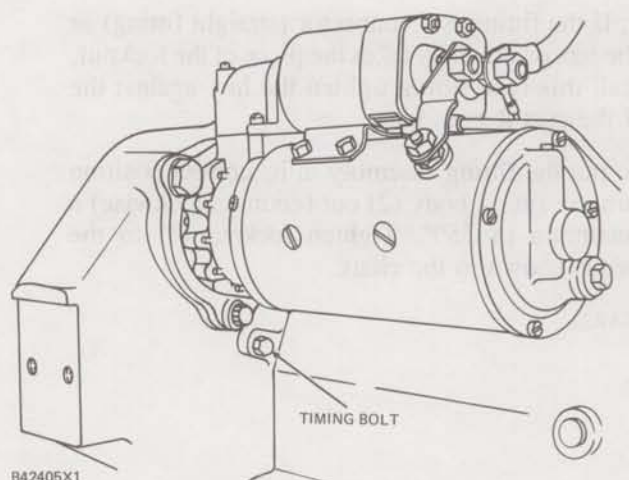
The torque shown in the chart below is to be used on the pin in the flared and O-ring fittings. (When the torque is applied to the pin in the flared and O-ring fittings, the torque is applied to the pin in the flared and O-ring fittings.)

FUEL SYSTEM USAGE CHART			
MODEL	*FUEL SYSTEM APPLICATIONS		
	Scroll (PC)	Sleeve Metering (PC)	Sleeve Metering (DI)
D4, D4 (SA)	Earlier	Later	—
D4E**, D4E (SA)	Japan	Earlier	Later
120G, 130G	—	Earlier	Later
112F	All	—	—
225	—	Earlier	Later
518	Earlier	Intermediate	Later
920, 930, 950	Earlier	Later	—
941, 951, 955	Earlier	Later	—
955L	—	All	—

*See the appropriate PARTS BOOK for effective Serial Numbers.
 **Later ENGINES built in Japan are (DI) with a scroll fuel system.



FUEL SYSTEM TIMING



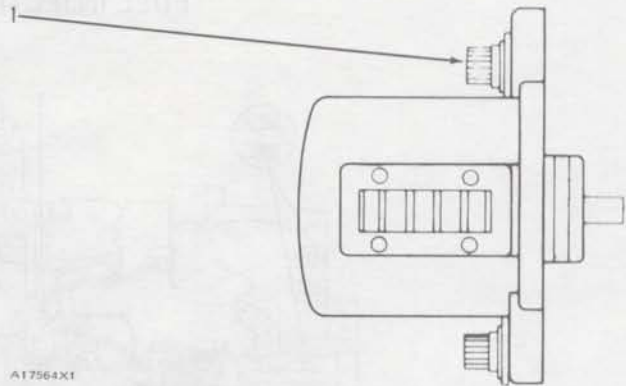
TYPICAL EXAMPLE

The timing bolt must go in the flywheel housing when the timing pin is installed in the notch in the fuel injection pump camshaft.

NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

**SERVICE METER
(EARLIER MODELS)**

- (1) Torque for bolts which hold service meter or adapter
for service meter drive 96 ± 24 lb. in. (10.9 ± 2.8 N·m)
- NOTE: Torque for cable nut 50 lb. in. (5.7 N·m)



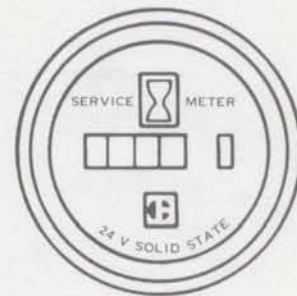
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**ELECTRIC SERVICE METER
(LATER MODELS)**

6N5906

Polarity is negative ground.

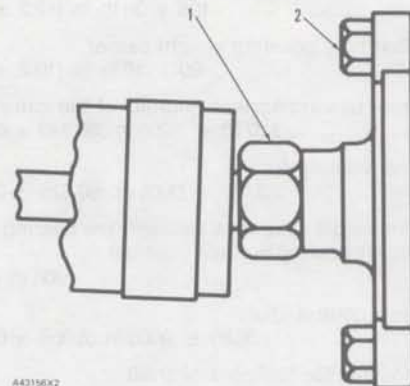
Operating voltage 24V DC only



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TACHOMETER DRIVE

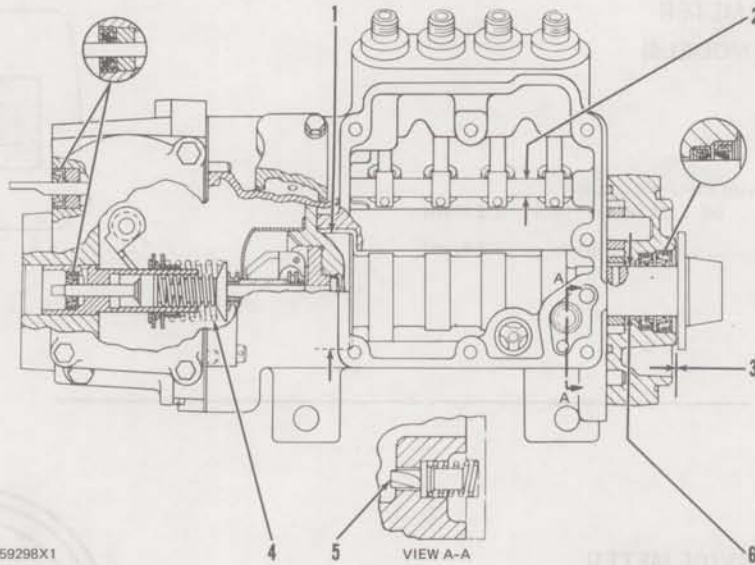
- (1) Torque for cable nut 100 ± 20 lb. in. (11.3 ± 2.3 N·m)
- (2) Tighten bolts which hold adapter for
tachometer drive to 96 ± 24 lb. in. (10.9 ± 2.8 N·m)



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(SLEEVE METERING FUEL SYSTEM — PC)

FUEL INJECTION EQUIPMENT



Firing order (injection sequence) 1, 3, 4, 2

Injection timing before TC (top center):

Fuel pump serial numbers to 044, 899 $12^{\circ} 30' \pm 1^{\circ}$

Fuel pump serial numbers, 044, 900 and up $13^{\circ} 30' \pm 1^{\circ}$

Torque for bolt in hole for timing pin 108 ± 36 lb. in. (12.2 ± 4.1 N·m)

Torque for bolts that hold governor weight carrier to camshaft 90 ± 10 lb. in. (10.2 ± 1.1 N·m)

(1) Diameter of rear bearing surface (journal) of the camshaft (new) $2.3720 \pm .0005$ in. (60.249 ± 0.013 mm)

Bore in the rear bearing for the camshaft (new) $2.3750 \pm .0005$ in. (60.325 ± 0.013 mm)

Maximum permissible clearance between the bearing and the camshaft bearing surface (journal) (worn) $.006$ in. (0.15 mm)

(2) Diameter of fuel control shaft (new) $.3530 \pm .0003$ in. (8.966 ± 0.008 mm)

Bore in the housing for fuel control shaft (new) $.3543 \pm .0005$ in. (8.999 ± 0.013 mm)

Maximum permissible clearance between the bore in the housing and the fuel control shaft (worn) $.003$ in. (0.08 mm)

(3) End play for camshaft with sleeve installed (new) $.023 \pm .018$ in. (0.58 ± 0.46 mm)

NOTE: When installing sleeve on end of camshaft, support the camshaft to prevent damage to parts inside of injection pump and governor housing.

(4) Governor spring:
Make reference to the chart "GOVERNOR SPRINGS."

(5) Bypass valve:
Make reference to the chart "BYPASS VALVE SPRINGS."

(6) Diameter of front bearing surface (journal) of the camshaft (new) $.9990 \pm .0005$ in. (25.375 ± 0.013 mm)

Bore in the front bearing for the camshaft (new) $1.0005 \pm .0005$ in. (25.413 ± 0.013 mm)

Maximum permissible clearance between the bearing and the camshaft bearing surface (journal) (worn) $.003$ in. (0.08 mm)

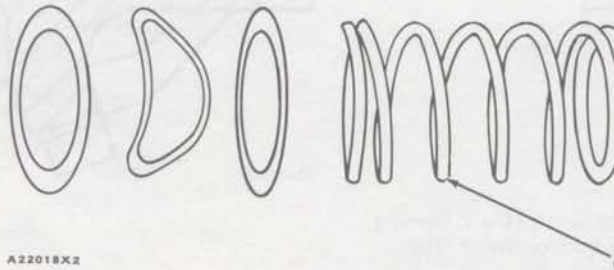
NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES

(SLEEVE METERING FUEL SYSTEM — PC)

Fuel Injection Equipment (Cont.)

GOVERNOR SPRINGS							
Part No.	Color Code (stripes)	Spring rate	Put a load on spring of	Then make spring shorter by	Total test force	Free length after test	Outside diameter
		lb./in. (N/mm)	lb. (N)	in. (mm)	lb. (N)	in. (mm)	in. (mm)
*4N4222	2 pink 1 yellow	10.0 (1.75)	2.9 (13.0)	.90 (22.8)	11.9 ± 0.5 (52.9 ± 2.0)	1.99 ± .03 (50.5 ± 0.7)	1.184 (30.07)
4N4224	2 yellow 1 white	12.0 (2.10)	4.0 (17.8)	.80 (20.3)	13.6 ± 0.4 (60.5 ± 1.8)	1.96 ± .03 (49.7 ± 0.7)	1.196 (30.37)
4N4225	2 yellow 1 pink	13.0 (2.28)	4.0 (17.8)	.80 (20.3)	14.4 ± 0.4 (64.1 ± 1.8)	1.95 ± .03 (49.4 ± 0.7)	1.200 (30.49)
4N4227	2 yellow 1 green	14.0 (2.45)	4.0 (17.8)	.80 (20.3)	15.2 ± 0.4 (67.6 ± 1.8)	1.94 ± .03 (49.2 ± 0.7)	1.200 (30.49)
4N4228	2 yellow 1 purple	15.0 (2.63)	4.0 (17.8)	.80 (20.3)	16.0 ± 0.4 (71.2 ± 1.8)	1.93 ± .03 (49.0 ± 0.7)	1.208 (30.69)
6N5169	1 pink 1 green	17.0 (2.98)	5.0 (22.2)	.80 (20.3)	18.6 ± 0.5 (82.7 ± 2.0)	1.92 ± .03 (48.8 ± 0.7)	1.214 (30.83)

*This spring gives close regulation.



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INSTALL SPRING AS SHOWN

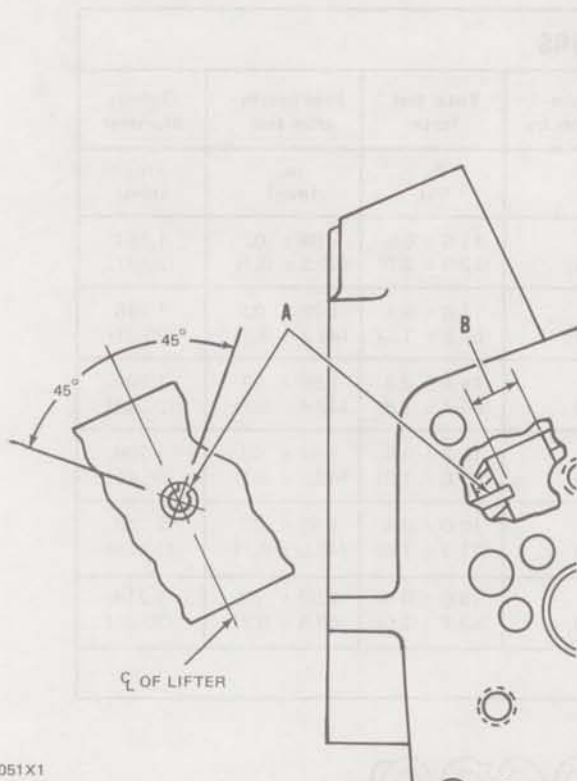
BYPASS VALVE SPRINGS		
Part No.	4N605	
	Later	Earlier
Direction of coil	either	right hand
Number of coils	13	12 1/2
Length under test force	.882 in. (22.40 mm)	1.23 in. (31.2 mm)
Test force	3.5 ± .2 lb. (15.5 ± 0.9 N)	1.4 ± .1 lb. (6.2 ± 0.4 N)
Free length after test	1.73 in. (43.9 mm)	1.50 in. (38.1 mm)
Outside diameter	.527 in. (13.39 mm)	.531 in. (13.49 mm)
Diameter of wire	.045 in. (1.14 mm)	.047 in. (1.19 mm)

NOTE: If the spring keeps the pressure in the fuel injection pump housing above 25 psi (170 kPa) with the engine operating under full load, the spring is good.

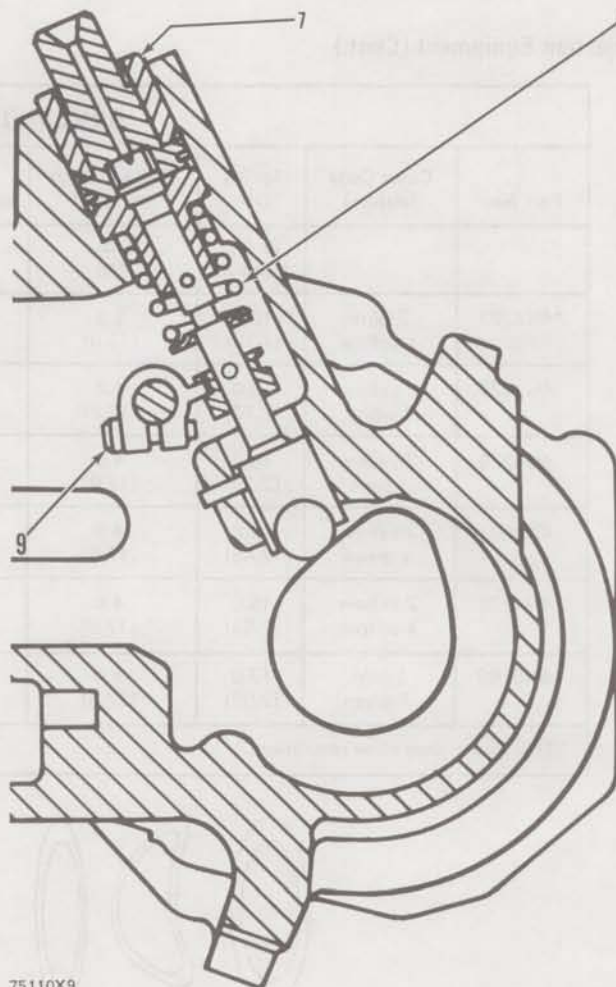
Pressure of fuel in housing for fuel injection pumps, (Full Load) 30 ± 5 psi (205 ± 35 kPa).

(SLEEVE METERING FUEL SYSTEM — PC)

Fuel Injection Equipment (Cont.)



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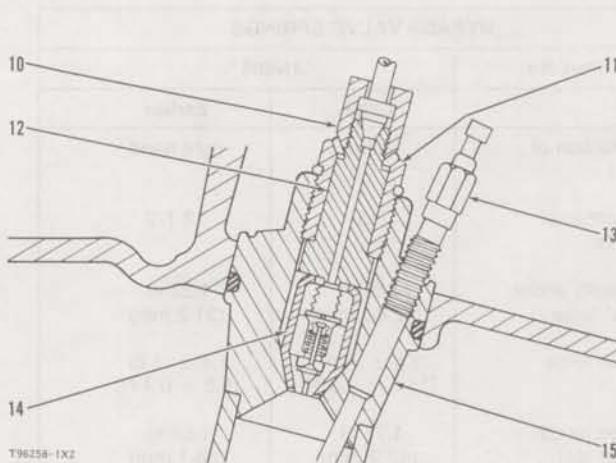


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Install guide pin (A) to depth (B) [.642 ± .003 in. (16.31 ± 0.08 mm)]. Slot in guide pin (A) must be in area shown from center of lifter.

- (7) Torque for bushing 70 ± 5 lb. ft. (95 ± 7 N·m)
- (8) 4N4318 Spring for injection pump:
 Length under test force 1.35 in. (34.3 mm)
 Test force 12.5 ± 1.3 lb. (55.5 ± 5.8 N)
 Free length after test 1.566 in. (39.78 mm)
 Outside diameter728 in. (18.49 mm)
- (9) Torque for bolt holding sleeve on control shaft 24 ± 2 lb. in. (2.8 ± 0.2 N·m)
- (10) Torque for the nuts that hold the fuel lines (Use 5P144 Fuel Line Socket) 30 ± 5 lb. ft. (40 ± 7 N·m)
- (11) Torque for the nuts that hold the nozzles 105 ± 5 lb. ft. (142 ± 7 N)
- (12) Body.
- (13) Put 5P3931 Anti-Seize Compound on threads of glow plug and tighten to 120 ± 24 lb. in. (13.6 ± 2.8 N·m)
- (14) Tighten nozzle finger tight on body.
- (15) Torque for precombustion chamber (put 5P3931 Anti-Seize Compound on threads) 150 ± 10 lb. ft. (205 ± 14 N·m)

NOTE: See Glow Plug Positioning.



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NOTE: FOR TORQUE VALUES NOT GIVEN, SEE THE FIRST PAGE OF SPECIFICATIONS FOR GENERAL TIGHTENING TORQUES