19.17 MEASURE SMOKE INTENSITY– TEST 16

FROM FORM 7SE416

MEASURE SMOKE INTENSITY**

16	MEASURE AT FULL LOAD AND RATED SPEED (RPM)			
	INSTRUMENT	GUIDELINE DATA†	1st CHECK	2nd CHECK
	WAGER SMOKE OPACITY METER 650A	OPACITY		
	SMOKE SAMPLING KIT	BOSCH NO.		

** Engine must be at normal operating temperature.

† Refer to "Performance Data Guidelines" in Section 20.

FIGURE 19–41 Smoke Intensity Check

The Wager portable smoke opacity meter **FIGURE 19–42** detects and measures the percent opacity of smoke at the exhaust stack.

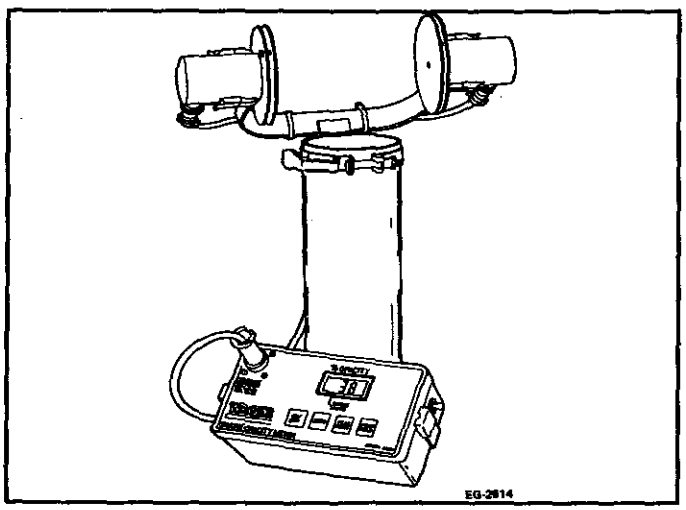


FIGURE 19–42 WAGNER PORTABLE SMOKE METER MODEL 650A

The opacity of smoke is measured by passing exhaust gas between a light source and a sensor which are mounted on special adapters which attach to the exhaust stack. Opacity is read directly in percent. The opacity reading on this meter represents the amount of light being blocked by the smoke as it passes through the sensor head.

The International Smoke Meter Table for Service **TABLE 19–1** correlates the Wager portable smoke opacity readings with the other types of smoke meters.

The Wager portable opacity meter enables smoke intensity to be measured while the vehicle is being driven on the road at actual road load conditions.

The Robert Bosch smoke sampling kit is used to measure smoke levels at the exhaust pipe at full load and rated speed.

The smoke sampling kit sampling pump draws off a precise amount of exhaust gas from the exhaust pipe of the respective engine and then sucks it through a filter paper disk.

The filter paper disk, in turn, darkens during this process and thus gives the measure of the soot content of the exhaust gases. The filter disk is then compared to the Bacharach Oil Burner Smoke Scale (Chart II). The Bosch smoke number is then determined and compared to the standards given in the Performance Data Guidelines, in Section 20.

NOTICE: **When using the smoke sampling kit follow the instrument manufacturers operating instructions to assure accurate readings. Do not deviate from those instructions.**

NOTICE: **Do not compare sampling discs with the smoke scale represented in Chart II. Use only the actual Bacharach Scale.**

MEASURE SMOKE INTENSITY

Chart II, **FIGURE 19–43**, compares darkness of filter paper to Robert Bosch Smoke Number.

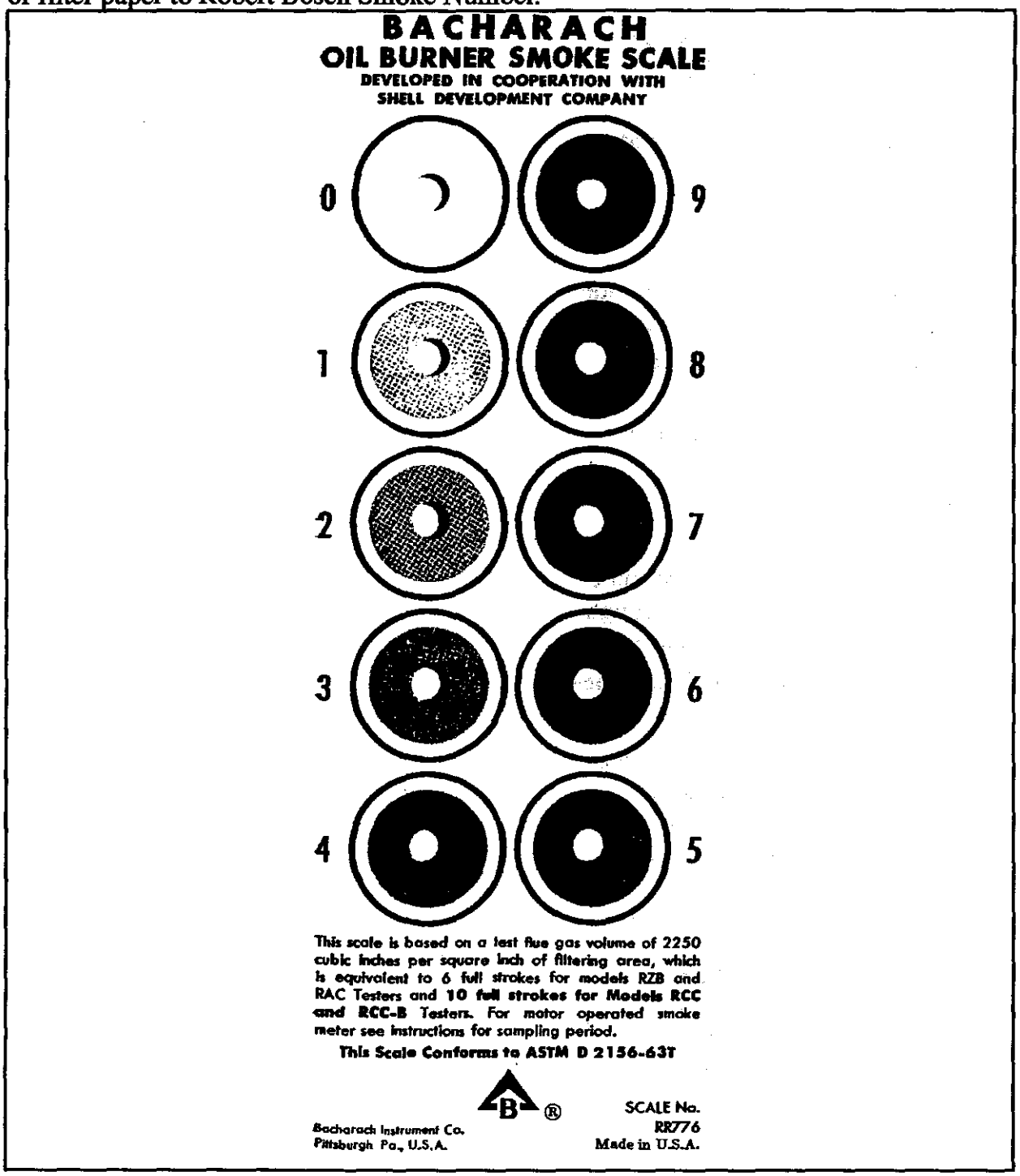


FIGURE 19–43 Chart II

MEASURE SMOKE INTENSITY

19.17.1 Smokemeter Table For Service

For those service technicians utilizing other smokemeter testing methods, the Smokemeter Table is used to convert the Robert Bosch number to other common smoke scales.

The other diesel smoke testing methods and scales are:

1. End of Line (E.O.L.) Opacimeter

   There are three acceptable E.O.L. opacimeters that can be expected to provide similar results on a given exhaust pipe size.

   a. USPHS (United States Public Health Service) meter.
   b. Telonic Berkely Model 200 Portable Opacity Meter.
   c. OTC Smoke Opacity Meter

   These instruments are installed at the end of the exhaust pipe. As smoke passes through these devices, percent opacity is measured.

2. The In-Line, Celesco Model 107 Smokemeter.

   This device is installed in the exhaust pipe line generally in a fixed installation such as on a chassis or engine dynamometer. The Model 107 is for a nominal six inch inside diameter exhaust pipe.

3. Hartridge Smoke Number:

   This number is determined by drawing a measured amount of smoke into a cylinder. A light passing through smoke measures opacity of sample. No adjustment is necessary for stack size.

MEASURE SMOKE INTENSITY

SMOKEMETER TABLE
[FOR DATA CORRELATION]

PERCENT OPACITY
E.O.L. * Smokemeter at exhaust pipe diameter.

Bosch Number	3"	4"	5"	In-line Celesco Model 107 6"	Hartridge Smokemeter H.S.U.**
0.4	0.	0.	0.	0.	3.
0.6	0.	1.	1.	1.	5.
0.8	1.	1.	1.	1.	7.
1.0	1.	1.	2.	1.	9.
1.2	1.	2.	2.	2.	11.
1.4	2.	2.	3.	3.	13.
1.6	2.	3.	4.	3.	15.
1.8	3.	4.	4.	4.	18.
2.0	3.	4.	5.	5.	20.
2.2	4.	5.	6.	6.	23.
2.4	5.	6.	7.	7.	26.
2.6	5.	7.	8.	8.	29.
2.8	6.	8.	10.	9.	32.
3.0	7.	9.	11.	10.	35.
3.2	8.	10.	12.	11.	38.
3.4	9.	11.	14.	13.	41.
3.6	10.	13.	15.	14.	45.
3.8	11.	14.	17.	16.	48.
4.0	12.	16.	19.	17.	52.
4.2	14.	17.	21.	19.	56.
4.4	15.	19.	23.	21.	59.
4.6	16.	21.	25.	23.	63.
4.8	18.	22.	27.	25.	67.
5.0	20.	24.	29.	27.	71.

TABLE 19–1 Smoke Table

*(E.O.L.) – End Of Line

**(H.S.U.) – Hartridge Smoke Unit

19.18 INTAKE AND EXHAUST VALVE CLEARANCE – TEST 17

FROM FORM 7SE416

INTAKE AND EXHAUST VALVE CLEARANCE

17 ENGINE OFF - HOT OR COLD.

INSTRUMENT	GUIDELINE DATA †	1st CHECK	2nd CHECK
FEELER GAUGE			

† Refer to "Performance Data Guidelines" in Section 20.

FIGURE 19–44 Intake and Exhaust Valve Clearance Check

Adjust valve lash as follows:

1. Remove the valve cover/intake manifold.

NOTE:
All valves are adjusted by rotating the engine only twice.

2. Rotate the crankshaft until the #1 piston is on the compression stroke and the timing mark on the damper pulley is aligned with the "TDC" mark on the timing indicator.

NOTE:
Confirm that the #1 piston is on the compression stroke by turning both push rods by hand to verify that both valves are closed. The valves are closed when the push rods are loose and can be turned easily.

3. Set valve lash by loosening the locknut and turning the valve adjustment screw with the appropriate size feeler gauge inserted between the rocker arm and valve stem tip. Tighten the valve adjustment screw until the valve lever can support the feeler gauge. Refer to **FIGURE 19–45.**

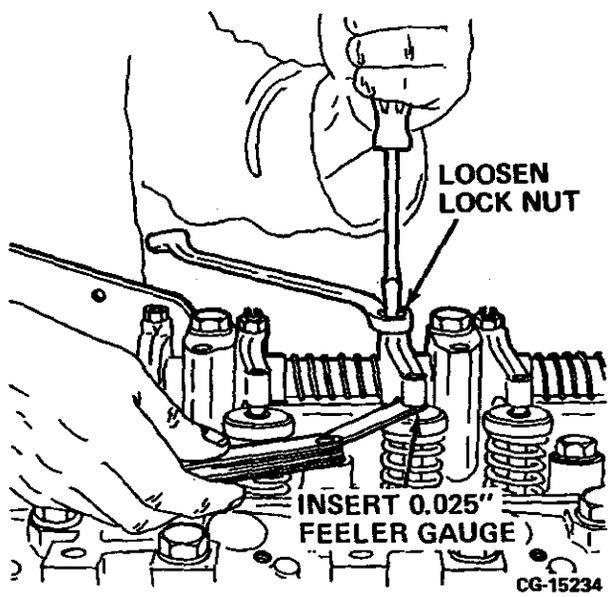


FIGURE 19–45 Adjust Valve Lash

INTAKE AND EXHAUST VALVE CLEARANCE

4. Tighten the locknut once the valve adjustment is set. Remove the feeler gauge. Refer to **FIGURE 19-46.**

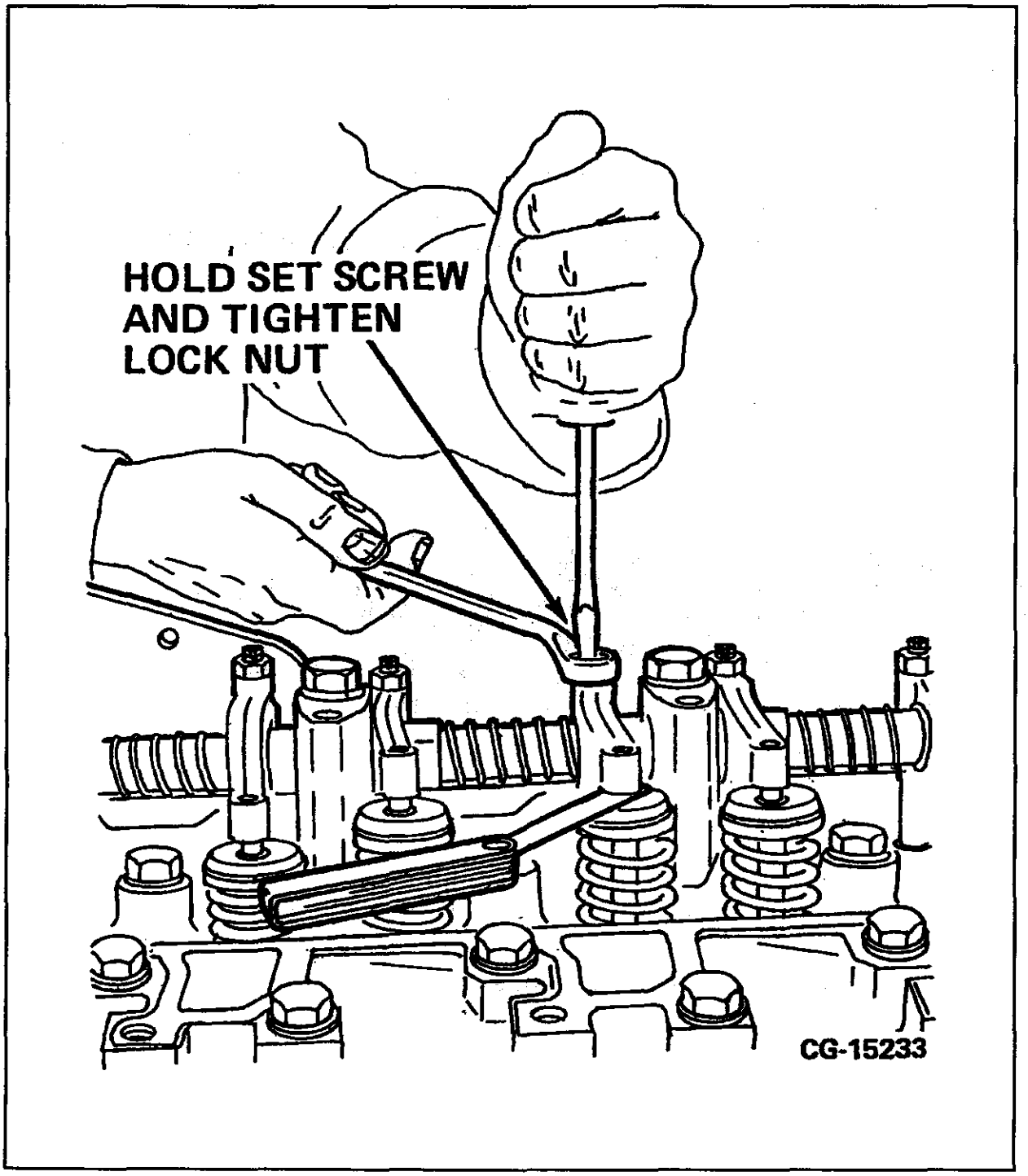


FIGURE 19-46 Tighten Valve Adjustment Screw Locknut

INTAKE AND EXHAUST VALVE CLEARANCE

Valve lash adjustment sequence:

WITH	ADJUST VALVES											
No. 1 Piston at T.D.C. [Compression]	INT 1	EXH 2	INT 3			EXH 6	INT 7			EXH 10		
No. 6 Piston at T.D.C. [Compression]				EXH 4	INT 6			EXH 8	INT 9		INT 11	EXH 12
← FRONT											REAR →	

Six valves are adjusted when the #1 piston is at "TDC" (compression) and the remaining six are adjusted when the #6 piston is at "TDC" (compression). **Refer to FIGURE 19-47.**

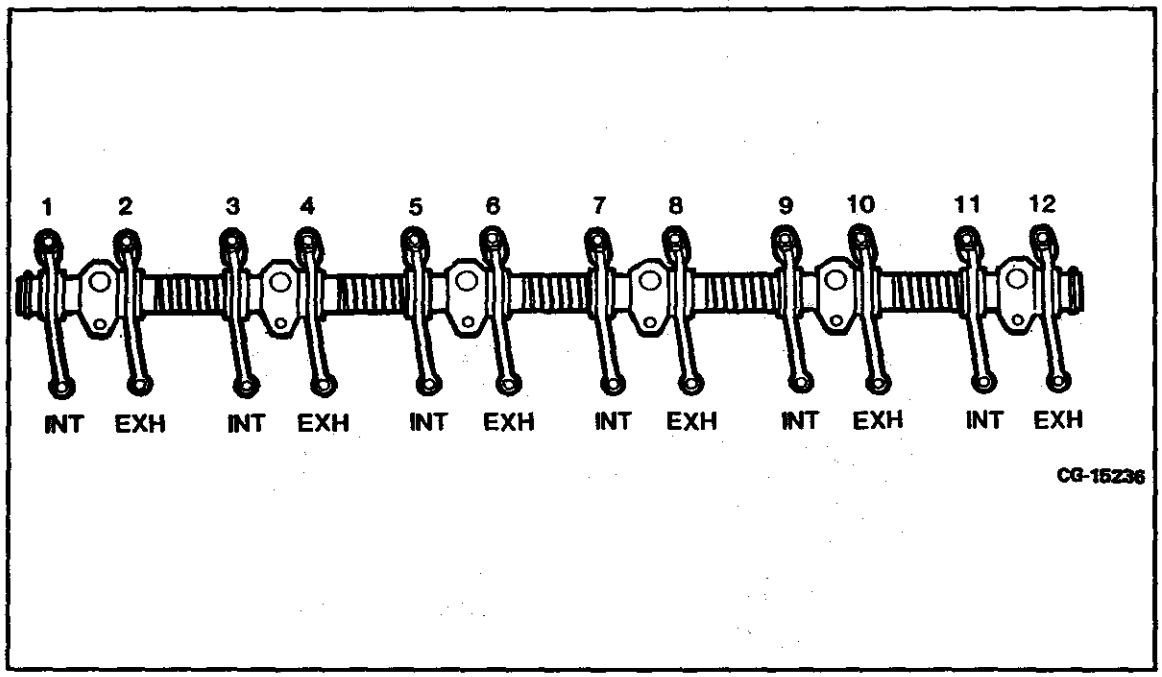


FIGURE 19-47 Valve Lash Adjustment Sequence

INTAKE AND EXHAUST VALVE CLEARANCE

5. Install the valve cover/intake manifold on the cylinder head. Tighten the mounting bolts to 13 lb·ft (17 N·m). Refer to **FIGURE 19–48**.

NOTE:

Be sure valve cover/intake manifold gasket is aligned before tightening.

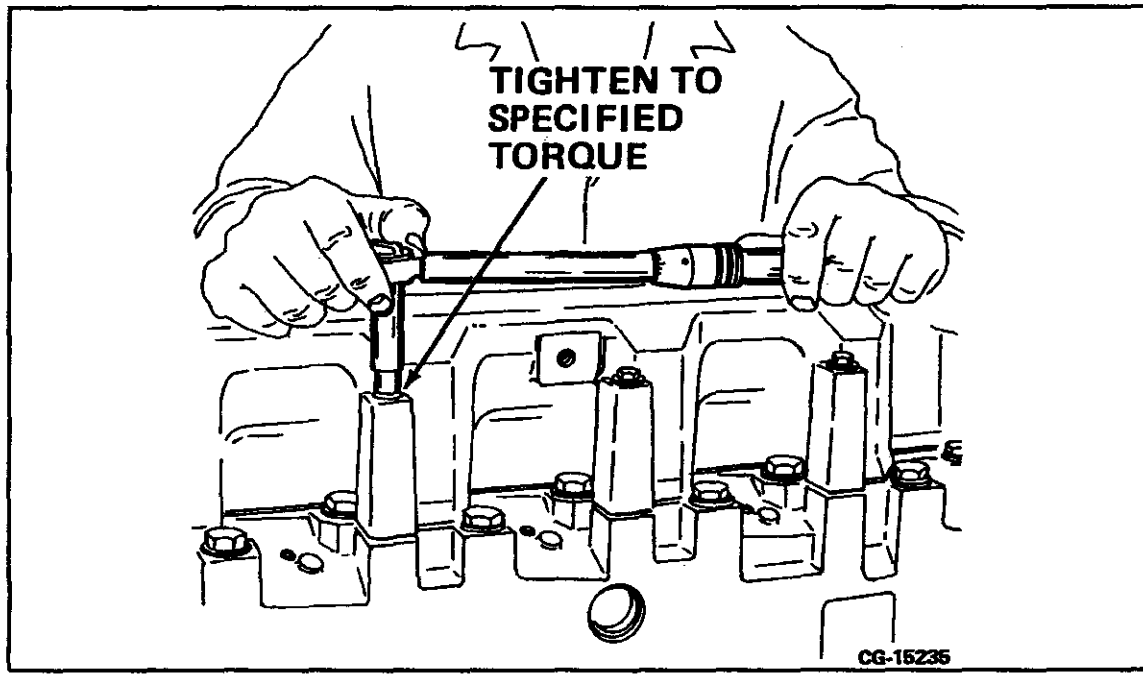


FIGURE 19–48 Install Valve Cover/Intake Manifold

VALVE LASH ADJUSTMENT CHART

ENGINES	INTAKE in. (mm)	EXHAUST in. (mm)
Series 40	0.025 (.635)	0.025 (.635)

20 PERFORMANCE DATA GUIDELINES

20.1 6.7LTA PERFORMANCE DATA GUIDELINES

6.7LTA/175 HP @ 2600 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 6.7LTA/A175

Engine rating ..... 175 BHP @ 2600 r/min

Injection Pump Part Number
Original Equipment 1 819 923 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number 1 820 943 C91
A/R Ratio ..... .85

Injection Nozzle Part Number
Original Equipment 1 822 349 C91

Nozzle Code ..... R

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (19,995 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 12°±1° BTDC (Static)

High Idle Speed – r/min ..... 2950± 75

Low Idle Speed – r/min ..... 650± 50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635 mm)
Exhaust ..... 0.025 in. (0.635 mm)

6.7LTA PERFORMANCE DATA GUIDELINES

6.7LTA/175 HP @ 2600 r/min w/Bowden Wire Shut-Off or Electric Shut-Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) - Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) - Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* ..... 8.0 in. H_2O** (2.0 kPa) (Requires Stabilized Operating Temperature)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 24.0 lb/in.^{2} ± 2.0 lb/in.^{2} (166 kPa ± 14 kPa) @ 2600
14.5 lb/in.^{2} ± 2.0 lb/in.^{2} (100 kPa ± 14 kPa) @ 1800

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* - Bosch Number ..... 1.5 Max. @ 2600 r/min
2.0 Max. @ 1800 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

6.7LTA PERFORMANCE DATA GUIDELINES

6.7LTA/190 HP @ 2600 r/min w/Bowden Wire Shut-Off or Electric Shut-Off [50 State 1993 Model Year]

1 of 2

Engine/Model 6.7LTA/A190

Engine rating ..... 190 BHP @ 2600 r/min

Injection Pump Part Number
Original Equipment 1 819 922 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number 1 820 944 C91
A/R Ratio ..... .95

Injection Nozzle Part Number
Original Equipment 1 820 836 C92

Nozzle Code C

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (20,000 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 12°±1° BTDC (Static)

High Idle Speed – r/min ..... 2970± 75

Low Idle Speed – r/min ..... 650± 50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635 mm)
Exhaust ..... 0.025 in. (0.635 mm)

6.7LTA PERFORMANCE DATA GUIDELINES

6.7LTA/190 HP @ 2600 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* ..... 8.0 in. H_2O** (2.0 kPa) (Requires Stabilized Operating Temperature)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 24.0 lb/in.^{2} ± 2.0 lb/in.^{2} (165 kPa ± 14 kPa) @ 2600
14.0 lb/in.^{2} ± 2.0 lb/in.^{2} (97 kPa ± 14 kPa) @ 1800

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.5 Max. @ 2600 r/min
2.0 Max. @ 1800 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

6.7LTA PERFORMANCE DATA GUIDELINES

6.7LTA/210 HP @ 2600 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 6.7LTA/A210

Engine rating ..... 210 BHP @ 2600 r/min

Injection Pump Part Number
Original Equipment 1 819 918 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number 1 822 233 C91*
A/R Ratio ..... W .76

Injection Nozzle Part Number
Original Equipment 1 822 351 C91

Nozzle Code ..... S

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (20,000 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 13°±1° BTDC (Static)

High Idle Speed – r/min ..... 2970± 75

Low Idle Speed – r/min ..... 650±50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635 mm)
Exhaust ..... 0.025 in. (0.635 mm)

* – Equipped with Wastegate.

6.7LTA PERFORMANCE DATA GUIDELINES

6.7LTA/210 HP @ 2600 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* (Requires Stabilized Operating Temperature) ..... 8.0 in. H_2O** (2.0 kPa)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 23.0 lb/in.^{2} ± 2.0 lb/in.^{2} (159 kPa ± 14 kPa) @ 2600
17.5 lb/in.^{2} ± 2.0 lb/in.^{2} (121 kPa ± 14 kPa) @ 1800

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.5 Max. @ 2600 r/min
2.0 Max. @ 1800 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

6.7LTA PERFORMANCE DATA GUIDELINES

6.7LTA/230 HP @ 2600 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 6.7LTA/A230

Engine rating ..... 230 BHP @ 2600 r/min

Injection Pump Part Number
Original Equipment 1 819 917 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number 1 822 233 C91*
A/R Ratio W.76

Injection Nozzle Part Number
Original Equipment 1 822 352 C91

Nozzle Code ..... T

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (20,000 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 13°±1° BTDC (Static)

High Idle Speed – r/min ..... 2990± 75

Low Idle Speed – r/min ..... 650± 50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635 mm)
Exhaust ..... 0.025 in. (0.635 mm)

* – Equipped with Wastegate.

6.7LTA PERFORMANCE DATA GUIDELINES

6.7LTA/230 HP @ 2600 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* (Requires Stabilized Operating Temperature) ..... 8.0 in. H_2O** (2.0 kPa)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 23.0 lb/in.^{2} ± 2.0 lb/in.^{2} (159 kPa ± 14 kPa) @ 2600
20.5 lb/in.^{2} ± 2.0 lb/in.^{2} (141 kPa ± 14 kPa) @ 1800

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.5 Max. @ 2600 r/min
2.0 Max. @ 1800 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

20.2 7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/195 HP @ 2400 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 7.6LTA/A195

Engine rating ..... 195 BHP @ 2400 r/min

Injection Pump Part Number
Original Equipment 1 819 920 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number 1 820 945 C91
A/R Ratio 1.06

Injection Nozzle Part Number
Original Equipment 1 820 834 C91

Nozzle Code ..... B

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (20,000 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 13°±1° BTDC (Static)

High Idle Speed – r/min ..... 2800± 75

Low Idle Speed – r/min ..... 650± 50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635 mm)
Exhaust ..... 0.025 in. (0.635 mm)

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/195 HP @ 2400 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* (Requires Stabilized Operating Temperature) ..... 8.0 in. H_2O** (2.0 kPa)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 23.0 lb/in.^{2} ± 2.0 lb/in.^{2} (159 kPa ± 14 kPa) @ 2400
11.0 lb/in.^{2} ± 2.0 lb/in.^{2} (76 kPa ± 14 kPa) @ 1600

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.3 Max. @ 2400 r/min
1.3 Max. @ 1600 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/210 HP @ 2400 r/min w/Bowden Wire Shut-Off or Electric Shut-Off [50 State 1993 Model Year]

1 of 2

Engine/Model 7.6LTA/A210

Engine rating ..... 210 BHP @ 2400 r/min

Injection Pump Part Number
Original Equipment 1 819 919 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number 1 820 946 C91
A/R Ratio 1.19

Injection Nozzle Part Number
Original Equipment 1 820 834 C91

Nozzle Code ..... B

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (20,000 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 13°±1° BTDC (Static)

High Idle Speed – r/min ..... 2800± 75

Low Idle Speed – r/min ..... 650± 50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635 mm)
Exhaust ..... 0.025 in. (0.635 mm)

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/210 HP @ 2400 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* ..... 8.0 in. H_2O** (2.0 kPa) (Requires Stabilized Operating Temperature)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 22.5 lb/in.^{2} ± 2.0 lb/in.^{2} (155 kPa ± 14 kPa) @ 2400
13.5 lb/in.^{2} ± 2.0 lb/in.^{2} (93 kPa ± 14 kPa) @ 1600

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.3 Max. @ 2400 r/min
1.3 Max. @ 1600 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/230 HP @ 2400 r/min w/Bowden Wire Shut-Off or Electric Shut-Off [50 State 1993 Model Year]

1 of 2

Engine/Model 7.6LTA/A230

Engine rating ..... 230 BHP @ 2400 r/min

Injection Pump Part Number
Original Equipment 1 819 914 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number ..... 1 822 253 C91 or 1 820 946 C91
A/R Ratio 1.19

Injection Nozzle Part Number
Original Equipment 1 820 838 C91

Nozzle Code ..... D

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (20,000 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 14°±1° BTDC (Static)

High Idle Speed – r/min ..... 2800±75

Low Idle Speed – r/min ..... 650±50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635mm)
Exhaust ..... 0.025 in. (0.635mm)

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/230 HP @ 2400 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* (Requires Stabilized Operating Temperature) ..... 8.0 in. H_2O** (2.0 kPa)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 24.5 lb/in.^{2} ± 2.0 lb/in.^{2} (169 kPa ± 14 kPa) @ 2400
15.0 lb/in.^{2} ± 2.0 lb/in.^{2} (103 kPa ± 14 kPa) @ 1600

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.5 Max. @ 2400 r/min
1.5 Max. @ 1600 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/250 HP @ 2400 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 7.6LTA/A250

Engine rating ..... 250 BHP @ 2400 r/min

Injection Pump Part Number
Original Equipment 1 819 913 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number ..... 1 820 941 C92 or 1 820 939 C92*
A/R Ratio W.95

Injection Nozzle Part Number
Original Equipment 1 820 842 C91

Nozzle Code ..... F

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,821–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (19,995 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 14°±1° BTDC (Static)

High Idle Speed – r/min ..... 2800±75

Low Idle Speed – r/min ..... 650±50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635mm)
Exhaust ..... 0.025 in. (0.635mm)

* – Equipped with wastegate.

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/250 HP @ 2400 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* (Requires Stabilized Operating Temperature) ..... 8.0 in. H_2O** (2.0 kPa)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 23.0 lb/in.^{2} ± 2.0 lb/in.^{2} (159 kPa ± 14 kPa) @ 2400
16.5 lb/in.^{2} ± 2.0 lb/in.^{2} (114 kPa ± 14 kPa) @ 1600

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.8 Max. @ 2400 r/min
1.5 Max. @ 1600 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/275 HP @ 2400 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 7.6LTA/A275

Engine rating ..... 275 BHP @ 2400 r/min

Injection Pump Part Number
Original Equipment 1 819 924 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number ..... 1 820 941 C92 or 1 820 939 C92*
A/R Ratio W.95

Injection Nozzle Part Number
Original Equipment 1 820 848 C91

Nozzle Code ..... J

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (19,995 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 14°±1° BTDC (Static)

High Idle Speed – r/min ..... 2800±75

Low Idle Speed – r/min ..... 650±50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635mm)
Exhaust ..... 0.025 in. (0.635mm)

* – Equipped with wastegate.

7.6LTA PERFORMANCE DATA GUIDELINES

7.6LTA/275 HP @ 2400 r/min w/Bowden Wire Shut-Off or Electric Shut-Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) - Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) - Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* (Requires Stabilized Operating Temperature) ..... 8.0 in. H_2O** (2.0 kPa)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 23.0 lb/in.^{2} ± 2.0 lb/in.^{2} (159 kPa ± 14 kPa) @ 2400
22.0 lb/in.^{2} ± 2.0 lb/in.^{2} (152 kPa ± 14 kPa) @ 1600

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* - Bosch Number ..... 1.5 Max. @ 2400 r/min
2.0 Max. @ 1600 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

20.3 8.7LTA PERFORMANCE DATA GUIDELINES

8.7LTA/250 HP @ 2200 r/min w/Bowden Wire Shut-Off or Electric Shut-Off [50 State 1993 Model Year]

1 of 2

Engine/Model 8.7LTA/A250

Engine rating ..... 250 BHP @ 2200 r/min

Injection Pump Part Number
Original Equipment 1 819 921 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number ..... 1 820 941 C92 or 1 820 939 C92*
A/R Ratio W.95

Injection Nozzle Part Number
Original Equipment 1 820 890 C91

Nozzle Code ..... K

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (19,995 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 12°±1° BTDC (Static)

High Idle Speed - r/min ..... 2550± 75

Low Idle Speed - r/min ..... 650±50

- Manual Transmission - Neutral
- Automatic Transmission - Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off - Hot or Cold)
Intake ..... 0.025 in. (0.635mm)
Exhaust ..... 0.025 in. (0.635mm)

* - Equipped with wastegate.

8.7LTA PERFORMANCE DATA GUIDELINES

8.7LTA/250 HP @ 2200 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* ..... 8.0 in. H_2O** (2.0 kPa) (Requires Stabilized Operating Temperature)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 22.5 lb/in.^{2} ± 2.0 lb/in.^{2} (155 kPa ± 14 kPa) @ 2200
16.5 lb/in.^{2} ± 2.0 lb/in.^{2} (114 kPa ± 14 kPa) @ 1300

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.0 Max. @ 2200 r/min
1.5 Max. @ 1300 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

8.7LTA PERFORMANCE DATA GUIDELINES

8.7LTA/275 HP @ 2000 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 8.7LTA/A275

Engine rating ..... 275 BHP @ 2000 r/min

Injection Pump Part Number
Original Equipment 1 819 916 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number ..... 1 820 941 C92 or 1 820 939 C92*
A/R Ratio W.95

Injection Nozzle Part Number
Original Equipment 1 820 846 C91

Nozzle Code ..... H

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (20,000 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 11°±1° BTDC (Static)

High Idle Speed – r/min ..... 2350±75

Low Idle Speed – r/min ..... 650±50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635mm)
Exhaust ..... 0.025 in. (0.635mm)

* – Equipped with wastegate.

8.7LTA PERFORMANCE DATA GUIDELINES

8.7LTA/275 HP @ 2000 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) - Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) - Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* ..... 8.0 in. H_2O** (2.0 kPa) (Requires Stabilized Operating Temperature)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 24.0 lb/in.^{2} ± 2.0 lb/in.^{2} (166 kPa ± 14 kPa) @ 2000
17.5 lb/in.^{2} ± 2.0 lb/in.^{2} (121 kPa ± 14 kPa) @ 1300

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.5 Max. @ 2000 r/min
2.0 Max. @ 1300 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

8.7LTA PERFORMANCE DATA GUIDELINES

8.7LTA/275 HP @ 2200 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 8.7LTA/AF275

Engine rating ..... 275 BHP @ 2200 r/min

Injection Pump Part Number
Original Equipment 1 820 266 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number ..... 1 820 941 C92 or 1 820 939 C92*
A/R Ratio W.95

Injection Nozzle Part Number
Original Equipment 1 820 892 C91

Nozzle Code L

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (19,995 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 12°±1° BTDC (Static)

High Idle Speed – r/min ..... 2550±75

Low Idle Speed – r/min ..... 650± 50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635mm)
Exhaust ..... 0.025 in. (0.635mm)

* – Equipped with wastegate.

8.7LTA PERFORMANCE DATA GUIDELINES

8.7LTA/275 HP @ 2200 r/min w/Bowden Wire Shut-Off or Electric Shut-Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) - Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) - Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* (Requires Stabilized Operating Temperature) ..... 8.0 in. H_2O** (2.0 kPa)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 23.5 lb/in.^{2} ± 2.0 lb/in.^{2} (162 kPa ± 14 kPa) @ 2200
18.0 lb/in.^{2} ± 2.0 lb/in.^{2} (124 kPa ± 14 kPa) @ 1300

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* - Bosch Number ..... 1.0 Max. @ 2200 r/min
2.5 Max. @ 1300 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

8.7LTA PERFORMANCE DATA GUIDELINES

8.7LTA/300 HP @ 2200 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

1 of 2

Engine/Model 8.7LTA/AF300

Engine rating ..... 300 BHP @ 2200 r/min

Injection Pump Part Number
Original Equipment 1 820 267 C91

Injection Pump Model ..... Robt. Bosch "PESP"

Turbocharger Part Number ..... 1 820 941 C92 or 1 820 939 C92*
A/R Ratio W.95

Injection Nozzle Part Number
Original Equipment 1 820 894 C91

Nozzle Code ..... M

Nozzle Valve Opening Pressure
New or Reconditioned ..... 3600–3750 lb/in.^{2} (24,820–25,855 kPa)

Nozzle Valve Minimum Opening Pressure
Before Replacement ..... 2900 lb/in.^{2} (19,995 kPa)

Injection Pump Initial Timing
(Engine Stopped) ..... 12°±1° BTDC (Static)

High Idle Speed – r/min ..... 2550± 75

Low Idle Speed – r/min ..... 650±50

- Manual Transmission – Neutral
- Automatic Transmission – Drive
- Engine PTO Engaged (if Equipped)

Intake and Exhaust Valve Clearance (Engine Off – Hot or Cold)
Intake ..... 0.025 in. (0.635mm)
Exhaust ..... 0.025 in. (0.635mm)

* – Equipped with wastegate.

8.7LTA PERFORMANCE DATA GUIDELINES

8.7LTA/300 HP @ 2200 r/min w/Bowden Wire Shut–Off or Electric Shut–Off [50 State 1993 Model Year]

2 of 2

The following data to be taken at high idle with [no load].

Air Cleaner Restriction* [Measured @ Air Cleaner Outlet]
(Check at High Idle [No Load]) – Max ..... 12.5 in. H_2O (3.13 kPa)
(Check at Full Load, Rated Speed) – Max ..... 25 in. H_2O (6.25 kPa)

Fuel Pressure [Minimum]* ..... 20 lb/in.^{2} (138 kPa)

Fuel Inlet Restriction Maximum* ..... 6 in. Hg Vacuum (20.261 kPa)

Crankcase Pressure [Maximum]* (Requires Stabilized Operating Temperature) ..... 8.0 in. H_2O** (2.0 kPa)

The following data to be taken at full load, full throttle rated engine speed on chassis dynamometer or on highway

Intake Manifold Pressure* ..... 23.5 lb/in.^{2} ± 2.0 lb/in.^{2} (162 kPa ± 14 kPa) @ 2200
21.0 lb/in.^{2} ± 2.0 lb/in.^{2} (145 kPa ± 14 kPa) @ 1300

Exhaust Back Pressure (After Turbocharger [Maximum])* ..... 0–27 in. H_2O (6.7 kPa)

Smoke Level* – Bosch Number ..... 1.5 Max. @ 2200 r/min
2.0 Max. @ 1300 r/min

Measure water temperature differential across the radiator with engine on a chassis dynamometer, at full load and ambient temperature of 80°F or above.

Water Temperature Differential Across Radiator ..... 6–12°F (3.3–6.6°C)

The following data to be taken after engine reaches stabilized operating temperature.

Lube Oil Temperature (Oil Gallery) ..... 230°F (110°C) Max.

Lube Oil Pressure at Operating Temperature
Low Idle (Min.) ..... 10 lb/in.^{2} (69 kPa)
Rated Speed (Min./Max.) ..... 42–70 lb/in.^{2} (290–483 kPa)

*Engine must be at normal operating temperature.

**Crankcase pressure [maximum] as measured with Orificed Restrictor Tool J39267.

APPENDIX A: GENERAL ENGINE SPECIFICATIONS

A.1 6.7L ENGINE SPECIFICATION

ENGINE SPECIFICATIONS

Number of Cylinders	6
Bore	4.301 in. (109.2 mm)
Stroke	4.680 in. (118.9 mm)
Displacement	408 cu. in. (6.7 Liter)
Brake Horsepower (Max.)*	See Engine Power Ratings Chart
Torque (ft–lbs) (Max.)	See Engine Power Rating Chart
Horsepower (A.M.A.)	See Engine Power Ratings Chart
Compression Ratio	16.3:1
Firing Order	1–5–3–6–2–4

Valve Tappet Clearance	Intake	Exhaust
(Cold)	0.025 in. (0.635 mm)	0.025 in. (0.635 mm)

Engine Lube Oil Pressure (Engine Lube Oil Pressure with SAE 15W–40 oil)

Low Idle (Minimum 650 r/min)	20–50 lb/in.^{2} (137–344 kPa)
High Idle	50 lb/in.^{2} (344 kPa)

Crankcase Capacity

Rear Sump (without filter)	22 quarts (20.8 liter)
Rear Sump (with filter)	26 quarts (26.4 liter)

GENERAL ENGINE SPECIFICATIONS

A.2 7.6L ENGINE SPECIFICATION

ENGINE SPECIFICATIONS

Number of Cylinders	6
Bore	4.301 in. (109.2 mm)
Stroke	5.350 in. (135.9 mm)
Displacement	466 cu in. (7.6 Liter)
Brake Horsepower (Max.)*	See Engine Power Ratings Chart
Torque (ft·lbs) (Max.)	See Engine Power Rating Chart
Horsepower (A.M.A.)	See Engine Power Ratings Chart
Compression Ratio	15.8:1
Firing Order	1–5–3–6–2–4

Valve Tappet Clearance	Intake	Exhaust
(Cold)	0.025 in. (0.635 mm)	0.025 in. (0.635 mm)

Engine Lube Oil Pressure (Engine Lube Oil Pressure with SAE 15W–40 oil)

Low Idle (Minimum 650 r/min)	20–50 lb/in.^{2} (137–344 kPa)
High Idle	50 lb/in.^{2} (344 kPa)

Crankcase Capacity

Rear Sump (without filter)	22 quarts (20.8 liter)
Rear Sump (with filter)	26 quarts (26.4 liter)

GENERAL ENGINE SPECIFICATIONS

A.3 8.7L ENGINE SPECIFICATION

ENGINE SPECIFICATIONS

Number of Cylinders	6
Bore	4.590 in. (114.3 mm)
Stroke	5.350 in. (135.9 mm)
Displacement	530 cu in. (8.7 Liter)
Brake Horsepower (Max.)*	See Engine Power Ratings Chart
Torque (ft–lbs) (Max.)	See Engine Power Rating Chart
Horsepower (A.M.A.)	See Engine Power Ratings Chart
Compression Ratio	15.8:1
Firing Order	1–5–3–6–2–4

	Intake	Exhaust
Valve Tappet Clearance (Cold)	0.025 in. (0.635 mm)	0.025 in. (0.635 mm)

Engine Lube Oil Pressure (Engine Lube Oil Pressure with SAE 15W–40 oil)

Low Idle (Minimum 650 r/min)	20–50 lb/in.^{2} (137–344 kPa)
High Idle	50 lb/in.^{2} (344 kPa)

Crankcase Capacity

Rear Sump (without filter)	22 quarts (20.8 liter)
Rear Sump (with filter)	26 quarts (26.4 liter)

GENERAL ENGINE SPECIFICATIONS

A.4 ENGINE POWER RATINGS CHART

Standard Power Rating – 6.7L
(1993 – 50 State Certification)

BHP @ RPM	Peak Torque @ RPM	Certification Code	Curve Number
175 @ 2600	430 @ 1800	A175	E4–N067–31–19
190 @ 2600	485 @ 1800	A190	E4–N067–31–18
210 @ 2600	520 @ 1800	A210	E4–N067–31–17
230 @ 2600	605 @ 1800	A230	E4–N067–31–16

Standard Power Rating – 7.6L
(1993 – 50 State Certification)

BHP @ RPM	Peak Torque @ RPM	Certification Code	Curve Number
195 @ 2400	520 @ 1600	A195	E4–N067–31–15
210 @ 2400	605 @ 1600	A210	E4–N067–31–14
230 @ 2400	660 @ 1600	A230	E4–N067–31–13
250 @ 2400	660 @ 1600	A250	E4–N067–31–12
275 @ 2400	800 @ 1600	A275	E4–N067–31–11

Standard Power Rating – 8.7L
(1993 – 50 State Certification)

BHP @ RPM	Peak Torque @ RPM	Certification Code	Curve Number
275 @ 2000	950 @ 1300	A275	E4–N067–31–8
300 @ 2000	1050 @ 1300	A300	E4–N067–31–6
250 @ 2200	800 @ 1300	A250	E4–N067–31–10
275 @ 2200	860 @ 1300	AF275	E4–N067–31–9
300 @ 2200	950 @ 1300	AF300	E4–N067–31–7

Note: All ratings certified with diesel fuel no. 2 unless otherwise specified.

GENERAL ENGINE SPECIFICATIONS

A.5 POWER RATINGS & SPEED SETTINGS

6.7L ENGINE

	175	190
Brake Horsepower @ RPM	2600	2600
High Idle RPM (No Load)	2875±50	2875±50
Low Idle RPM	650±50	650±50
Governed Speed Full Load RPM	2600±10	2600±10

	210	230
Brake Horsepower @ RPM	2600	2600
High Idle RPM (No Load)	2875±50	2875±50
Low Idle RPM	650±50	650±50
Governed Speed Full Load RPM	2600±10	2600±10

7.6L ENGINE

	195	210	230
Brake Horsepower @ RPM	2400	2400	2400
High Idle RPM (No Load)	2700±50	2700±50	2700±50
Low Idle RPM	650±50	650±50	650±50
Governed Speed Full Load RPM	2400±10	2400±10	2400±10

	250	275
Brake Horsepower @ RPM	2600	2600
High Idle RPM (No Load)	2700±50	2700±50
Low Idle RPM	650±50	650±50
Governed Speed Full Load RPM	2400±10	2400±10

8.7L ENGINE

	250	275	275
Brake Horsepower @ RPM	2200	2000	2200
High Idle RPM (No Load)	2475±50	2275±50	2475±50
Low Idle RPM	650±50	650±50	650±50
Governed Speed Full Load RPM	2200±10	2000±10	2200±10

	300
Brake Horsepower @ RPM	2200
High Idle RPM (No Load)	2475±50
Low Idle RPM	650±50
Governed Speed Full Load RPM	2200±10

APPENDIX B: COMPONENT SPECIFICATIONS

B.1 TURBOCHARGER

Turbine Shaft Axial End Play ..... 0.001–0.004 in. (0.02–0.10 mm)
Turbine Shaft Radial Shaft Movement (Play) ..... 0.003–0.006 in. (0.08–0.15 mm)
Wastegate Actuator Movement ..... .015 in. (0.369) at 28.5 lb/in.^{2} (196 kPa)

B.1.1 INTAKE MANIFOLD

Maximum Allowable Warpage ..... 0.010 in. (0.254 mm)

B.1.2 EXHAUST MANIFOLD

Maximum Allowable Warpage ..... 0.010 in. (0.254 mm)
Maximum Allowable Removal of Material ..... 0.025 in. (0.635 mm)
Flange Thickness (Minimum) ..... 0.725 in. (18.41 mm)

B.1.3 EXHAUST VALVES

	0.3110 in. (7.899 mm)
Stem Diameter	0.3117 in. (7.917 mm)
Stem to Guide Clearance (Max. Allowable Before Replacement)	0.006 in. (0.15 mm)
Face to Stem Run-Out (T.I.R. Max.)	0.0015 in. (0.038 mm)
Valve Face Angle	45° - 00' - 45° - 15'
Valve Face Margin (Min.)	0.045 in. (1.143 mm)
Valve Lash	0.025 in. (0.64 mm)

B.1.4 INTAKE VALVES

	0.3118 in. (7.920 mm)
Stem Diameter	0.3125 in. (7.938 mm)
Stem to Guide Clearance (Max. Allowable Before Replacement)	0.006 in. (0.15 mm)
Face to Stem Run-Out (T.I.R. Max.)	0.0015 in. (0.038 mm)
Valve Face Angle	30° - 00' - 30° - 15'
Valve Face Margin (Min.)	0.088 in. (2.24 mm)
Valve Lash	0.025 in. (0.64 mm)

COMPONENT SPECIFICATIONS

B.2 CYLINDER HEAD

Valve Guide Type	Replaceable
Valve Guide Length (overall)	2.391 in. (60.73 mm)
Valve Guide Bore Diameter in Cylinder Head for	0.5625 in. (14.288 mm)
Valve Guide Insert	0.5639 in. (14.323 mm)
	0.5646 in. (14.341 mm)
Service Valve Guide O.D	0.5654 in. (14.361 mm)
Service Valve Guide I.D.	0.3140 in. (7.976 mm)
(After Assembly)	0.3157 in. (8.019 mm)
	0.0007 in. (0.018 mm)
Service Valve Guide Interference Fit Dimension	0.0029 in. (0.074 mm)
Valve Guide Bore Out-of-Round (Max.)	0.002 in. (0.05 mm)
Valve Guide Bore Taper (Max.)	0.005 in. (0.13 mm)
Valve Guide Height from Cylinder Head Spring Pocket	0.868 in. (22.05 mm)
(Intake)	0.888 in. (22.56 mm)
Valve Seat Insert Angle (Intake)	30° - 00' - 30° - 15'
Valve Seat Insert Angle (Exhaust)	45° - 00' - 45° - 15'
	0.075 in. (1.91 mm)
Valve Seat Width (Intake & Exhaust)	0.085 in. (2.16 mm)
Valve Seat Run-Out (T.I.R. Max.)	0.002 in. (0.05 mm)
Valve Seat Insert O. D.	
(Intake)	
0.002" Oversize	2.0015 in. (50.838 mm)
0.015" Oversize	2.0145 in. (51.168 mm)
(Exhaust)	
0.002" Oversize	1.6285 in. (41.364 mm)
0.015" Oversize	1.6415 in. (41.694 mm)

COMPONENT SPECIFICATIONS

CYLINDER HEAD

Valve Seat Insert Cylinder Head Counterbore Diameter	1.996 in. (50.70 mm)
(Intake)	1.997 in. (50.72 mm)
	1.624 in. (41.25 mm)
(Exhaust)	1.625 in. (41.28 mm)
Valve Head Recession Relative to Deck	0.000 in. (0.00 mm)
Surface (Intake & Exhaust)	0.014 in. (0.36 mm)
Cylinder Head Surface Flatness	0.004 in. (0.10 mm) in 9 inches
	0.006 in. (0.15 mm) overall
Deck-to-Deck Dimension	4.190 in. (106.43 mm)
(Head Thickness) (New)	4.210 in. (106.93 mm)
Minimum Deck-to-Deck Dimension After Rework	4.180 in. (106.17 mm)

B.3 CYLINDER LINER

	0.00115 in. (0.029 mm)
Clearance in Piston	0.00065 in. (0.0165 mm)
Maximum Permissible Clearance in Piston, before replacing	0.0025 in. (0.064 mm)
	4.3015 in. (109.258 mm)
Inside Diameter (New) (6.7L and 7.6L)	4.3005 in. (109.233 mm)
	4.5905 in. (114.5 mm)
Inside Diameter (New) (8.7L)	4.5895 in. (116.6 mm)
Maximum Permisssible Diameter Liner Wear, at Top of Ring Travel before Replacement (Liner Taper)	0.004 in. (0.10mm)
	0.350 in (8.89 mm)
Counterbore Dimension in Crankcase	0.348 in. (8.84 mm)
Maximum Allowable Variation of Counterbore Depth (Between Four Points)	0.001 in. (0.025 mm)

COMPONENT SPECIFICATIONS

CYLINDER LINER

Maximum Cylinder Liner Counterbore Allowable Depth ..... 0.413 in. (10.49 mm)

0.353 in. (8.97 mm)

Flange Thickness ..... 0.0352 in. (8.94 mm)

0.005 in. (0.13 mm)

Protrusion above Crankcase ..... 0.002 in. (0.05 mm)

B.3.1 VALVE SPRINGS

Number of Springs per Valve 1

Intake:

- Identification Color Strip ..... Blue
- Valve Spring Free Length ..... 2.292 in. (58.22 mm)
- Test Length (Valve Closed) ..... 1.980 in. (50.29 mm)
- Test Load (Valve Closed) ..... 80–88 lbs. (356–391 N)
- Test Length (Valve Open) ..... 1.480 in. (37.59 mm)
- Test Load (Valve Open) ..... 214–224 lbs. (952–996 N)
- Wire Diameter ..... .207 in. (5.26 mm)

Number of Springs per Valve 1

Exhaust:

- Identification Color Strip ..... White
- Valve Spring Free Length ..... 2.448 in. (62.18 mm)
- Test Length (Valve Closed) ..... 1.980 in. (50.29 mm)

- Test Load (Valve Closed) ..... 121–129 lbs. (538–574 N)
- Test Length (Valve Open) ..... 1.530 in. (38.86 mm)
- Test Load (Valve Open) ..... 239–251 lbs. (1063–1117 N)
- Wire Diameter ..... .207 in. (5.26 mm)

B.4 CAMSHAFT

Cam Lobe Lift (Total):

- Intake ..... 0.3177 in. (8.070 mm)
- Exhaust ..... 0.2901 in. (7.369 mm)

Maximum Permissible Cam Lobe Wear ..... 0.020 in. (0.51 mm)

COMPONENT SPECIFICATIONS

CAMSHAFT

Camshaft Running Clearance	0.002 in. (0.05 mm) 0.007 in. (0.18 mm)
Maximum Permissible Camshaft Running Clearance	0.008 in. (0.20 mm)
Bushing I.D. (Installed in Crankcase)	2.2845 in. (58.026 mm) 2.2880 in. (58.115 mm)
Bushing Journal Diameter	2.2814 in. (57.948 mm) 2.2825 in. (57.976 mm)
Service Bushings Furnished to Size	Yes
Thrust Plate Thickness (New)	0.274 in. (6.96 mm) 0.276 in. (7.01 mm)
End Clearance	0.005 in. (0.13 mm) 0.013 in. (0.33 mm)

B.4.1 VALVE LEVER AND SHAFT ASSEMBLY

Valve Lever Shaft Diameter	0.8491 in. (21.567 mm) 0.8501 in. (21.593 mm)
Valve Lever Clearance on Shaft	0.0019 in. (0.048 mm) 0.0049 in. (0.124 mm)
Valve Lever Bushing (I.D.)	0.852 in. (21.64 mm) 0.854 in. (21.69 mm)
Bracket Orifice I.D.	0.042 in. (1.07 mm)

B.4.2 TAPPETS ROLLER

Diameter	1.1195 in. (28.435 mm) 1.1200 in. (28.448 mm)
Length	2.923 in. (74.24 mm) 2.953 in. (75.01 mm)

COMPONENT SPECIFICATIONS

TAPPETS ROLLER

	0.012 in. (0.30 mm)
Side Clearance (Roller to Tappet Body)	0.026 in. (0.66 mm)
	0.0025 in. (0.064 mm)
Tappet Clearance in Crankcase	0.0040 in. (0.102 mm)

B.4.3 PUSH ROD

	10.5898 in. (268.980 mm)
Length	10.6198 in. (269.743 mm)*
Maximum Run-Out (T.I.R.)	0.020 in. (0.51 mm)

B.4.4 VALVE LEVER SHAFT SPRINGS

Number of Springs	5
Free Length	4.06 in. (103.1 mm)
Test Length	2.07 in. (52.6 mm)
Test Load	7 lbs (31 N)
O.D	1.02 in. (25.9 mm)

* Length is measured over 0.3125 inch diameter gauge ball to theoretical end of ball.

B.5 CONNECTING RODS

Center-to-Center Distance between Connecting Rod	8.62 in. (218.9 mm)
Bearing Bore and Piston Pin Bushing	8.63 in. (219.2 mm)
	1.9255 in. (48.9 mm)
Bushing Bore Diameter (Pin End)	1.9235 in. (48.8 mm)
	1.8260 in. (46.3 mm)
Piston Pin Bushing I.D. (Installed)	1.8257 in. (46.3 mm)
	3.3526 in. (85.2 mm)
Bearing Bore Diameter (Crankshaft End)	3.3512 in. (85.1 mm)
Maximum Out-of-Round	0.002 in. (0.05 mm)
Maximum Taper/Inch	0.005 in. (0.127 mm)

COMPONENT SPECIFICATIONS

CONNECTING RODS

Measured over 0.1150 in. gauge pins (8.7L)	4.5015 in. (114 mm)
	3.1535 in. (80.098 mm)
Connecting Rod Bearing I.D. (Installed)	3.1533 in. (80.093 mm)
	0.0050 in. (0.130 mm)
Bearing Running Clearance	0.0018 in. (0.046 mm)
Maximum Permissible Bearing Running Clearance (Before Reconditioning)	0.007 in. (0.18 mm)
Connecting Rod Side Clearance on Crankshaft	0.012 in. (0.30 mm)
Maximum Permissible Side Clearance on Crankshaft	0.0165 in. (0.419 mm)
Connecting Rod Alignment	
Twist	0.002 in. (0.051 mm)
Bend	0.0015 in. (0.038 mm)

B.6 PISTONS

Running Clearance between Piston	0.0045 in. (0.114 mm)
and Cylinder Sleeve	0.0025 in. (0.064 mm)
(Measured 90° from pin bore and Skirt Diameter	4.298 in. (109.1 mm)
3.174 in. [80.6 mm] below bottom ring land) (6.7L)	4.297 in. (109. 1 mm)
(Measured 90° from pin bore and Skirt Diameter	4.298 in. (109.1 mm)
3.171 in. [83 mm] below bottom ring land) (7.6L)	4.297 in. (109. 1 mm)
Running Clearance between Piston	0.005 in. (0.127 mm)
and Cylinder sleeve (8.7L)	0.003 in. (0.07 mm)
(Measured 90° from pin bore and Skirt Diameter	4.5865 in. (116.49 mm)
2.358 in. [60 mm] below bottom ring land) (8.7.L)	4.5855 in. (116. 47 mm)
Number of Rings per Piston	3

COMPONENT SPECIFICATIONS

PISTONS

Piston Ring Groove Widths:

Top Compression Ring – .

Measured over 0.1150 in. gauge pins (6.7L & 7.6L) ..... 4.3118 in. (110 mm)

(Full Keystone) (6.7L & 7.6L) ..... 4.2844 in. (109 mm)

(Full Keystone) (8.7L) ..... 4.4676 in. (113 mm)

Intermediate Compression Ring –

Measured over 0.1150 in. gauge pins (6.7L & 7.6L) ..... 4.3168 in. (110 mm)

Measured over 0.1150 in. gauge pins (8.7L) ..... 4.6050 in. (117 mm)

(Full Keystone) (6.7L & 7.6L) ..... 4.2844 in. (109 mm)

(Full Keystone) (8.7L) ..... 4.5712 in. (116 mm)

Side Clearance: 0.0040 in. (0.102 mm)

Oil Control Ring ..... 0.0020 in. (0.050 mm)

B.6.1 PISTON RINGS – COMPRESSION

Number of rings per piston 2

Type (face and finish):

Top Ring ..... Full Keystone (offset crown) – Plasma Coated

Intermediate Ring ..... Full Keystone (offset crown) – Chromeless

Ring Gap with New Sleeve:

0.026 in. (0.66 mm)

Top Ring ..... 0.014 in. (0.36 mm)

0.075 in. (1.91 mm)

Intermediate Ring ..... 0.065 in. (1.65 mm)

B.6.2 PISTON RINGS – OIL CONTROL

Number of Rings Per Piston 1

Type ..... One Piece Slotted – Chrome

0.022 in. (0.056 mm)

Ring Gap (6.7L & 7.6L) ..... 0.012 in. (0.030 mm)

0.026 in. (0.66 mm)

Ring Gap (8.7L) ..... 0.014 in. (0.36 mm)

COMPONENT SPECIFICATIONS

B.6.3 PISTON PINS

Diameter	1.8251 in. (46.3 mm) 1.8249 in. (46.3 mm)
Length	3.490 in. (88.6 mm) 3.480 in. (88.3 mm)
Clearance in Rod	0.0011 in. (0.027 mm) 0.0006 in. (0.015 mm)
Maximum Permissible Clearance in Rod before replacing	0.003 in. (0.08 mm)
Clearance in Piston	0.00115 in. (0.029 mm) 0.00065 in. (0.016 mm)
Maximum Permissible Clearance in Piston before replacing	0.0025 in. (0.064 mm)

B.7 CRANKSHAFT

Type	Steel Forging, Induction Hardened, Grindable
Main Bearing Journal Diameter	
Standard Size	3.535 ± .0006 in. (89.7 ± .015 mm)
.010 in. Undersize	3.525 ± .0006 in. (89.5 ± .015 mm)
.020 in. Undersize	3.515 ± .0006 in. (89.2 ± .015 mm)
.030 in. Undersize	3.505 ± .0006 in. (89.0 ± .015 mm)
Main Bearing Width (Except Rear Thrust)	1.286 ± .010 in. (32.6 ± 0.25 mm)
Main Bearing Journal Max. Out-of-Round	0.002 in. (0.05 mm)
Main Bearing Thrust Face Runout (TIR Max.)	0.001 in. (0.025 mm)
Main Bearing Journal Taper (Max./In.)	0.0028 in. (0.071 mm)
Main Bearing Journal Fillet Radius	0.225/0.050 in. (5.7/1.27 mm)
Rod Journal Fillet Radius	0.225/0.050 in. (5.7/1.27 mm)
Rear Oil Seal Journal Runout (Max.)	0.003 in. (0.08 mm)
Damper Mounting Area Runout (Max.)	0.0005 in. (0.013 mm)
Flywheel Mounting Surface Runout (Max.)	0.002 in. (0.05 mm)
Number of Main Bearings	7
Thrust Taken By	Rear Main
Thrust Bearing Journal Length	
Standard Size to .020 in. Undersize	1.3545 ± .010 in. (34.4 ± 0.254 mm)
.030 in. Undersize	1.3545 ± .010 in. (34.4 ± 0.254 mm)

COMPONENT SPECIFICATIONS

CRANKSHAFT

Main Bearing to Crankshaft Clearance ..... 0.0047/0.0018 in. (0.120/0.046 mm)
Connecting Rod Journal Diameter
Standard Size ..... 3.1500 ± .0006 in. (80.0 ± .015 mm)
.010 in. Undersize ..... 3.1400 ± .0006 in. (79.7 ± .015 mm)
.020 in. Undersize ..... 3.1300 ± .0006 in. (79.5 ± .015 mm)
.030 in. Undersize ..... 3.1200 ± .0006 in. (79.2 ± .015 mm)
Connecting Rod Bearing Width ..... 1.385 in. (35.1 mm)
Connecting Rod Journal Max. Out-of-Round ..... 0.00025 in. (0.0064 mm)
Connecting Rod Journal Taper (Max./In.) ..... 0.00027 in. (0.0068 mm)
Connecting Rod Bearing to Crankshaft
Running Clearance ..... 0.005 - .0018 in. (0.130 - 0.305 mm)
Crankshaft Flange O.D. ..... 5.550 in. (140 mm)
Crankshaft End Play ..... 0.006 - .012 in. (0.152 - 0.30 mm)
Crankshaft End Play Max. Wear Limit ..... .020 in. (0.51 mm)
Rod to Crankshaft Side Clearance ..... 0.012 ± .0045 in. (0.30 ± .114)
Crankshaft Gear Backlash ..... 0.003 - .016 in. (0.08 - 0.41 mm)
Flywheel Runout ..... 7.0 in. (178 mm)
Flywheel Concentricity ..... 0.008 in. (.20 mm)
Flywheel Housing Bore Concentricity . SAE#1=0.12 in. (.030 mm), SAE#2=.011 in. (.028 mm)
Flywheel Housing Face Runout ..... SAE#1=0.12 in. (.030 mm), SAE#2=.011 in. (.028 mm)
Vibration Damper Max. Allowable Member Misalignment ..... 0.060 in. (1.5 mm)
Vibration Damper Wobble (Max.) ..... 0.060 in. (1.5 mm)

B.8 CRANKCASE

Crankcase Deck Flatness ..... 0.003 in. (0.08 mm)
Crankcase Deck Finish (Micro inches) ..... 125 AA
Centerline of Main Bearing Bore to Head Deck ..... 14.5 ± 0.0015 in. (368.35 ± 0.381 mm)
Crankcase Main Bearing Bore Diameter ..... 3.8491 ±0 .0005 in. (97.7 ±0 .013 mm)
Tappet Bore Diameter ..... 1.1225/1.1240 in. (28.511/28.550 mm)
Valve/Roller Tappet O.D. ..... 1.1195/1.1200 in. (28.435/28.448 mm)
Oil Jet Tube Bore Diameter (Spray Hole Dia.) ..... 0.048/0.049 in. (1.22/1.24 mm)
Counter Dimension in Crankcase .. .349 ± .001/at 5.1885 gage dia. (8.86 ± 0.02/at 132 mm)
Maximum Allowable Variation of Counterbore Depth (Between Four Points) 0.001 (0.02 mm)
Maximum Cylinder Sleeve Counterbore Allowable Depth ..... 0.364 in. (9.2 mm)
Protrusion Above Crankcase ..... 0.002 to .005 in. (0.05 to 0.127 mm)
Main Bearings
Type ..... Precision Replaceable
Material ..... Steel-Backed Copper/Lead

COMPONENT SPECIFICATIONS

CRANKCASE

Thrust Taken By ..... No. 7 Rear
Cap Attachment ..... 2 Bolts per Cap
Camshaft Bushing Bore Diameter in Crankcase
Front ..... 2.5005/2.5020 in. (63.512/63.550 mm)
Intermediate Front ..... 2.4805/2.4820 in. (63.005/63.043 mm)
Intermediate Rear ..... 2.4605/2.4620 in. (62.496/63.535 mm)
Rear ..... 2.4405/2.4420 in. (61.988/62.026 mm)
Crankshaft to Idler Backlash ..... TBD
Idler to Camshaft Backlash ..... TBD
Idler to Injection Pump Backlash ..... TBD
Idler to Idler Backlash ..... TBD

TBD: To Be Determined

B.9 OIL PUMP:

Type ..... "GEROTOR"
Drive ..... Crankshaft

End Clearance Inner and Outer

Radial Clearance between Outer Rotor Housing ..... TBD

Engine Oil Pressure* (Run engine until normal operating temperatures are reached)
At Low Idle Speed (650 RPM) (minimum) ..... 10 lb/in.^{2} (69 kPa)
Minimum At High Idle Speed ..... 40 to 70 lb/in.^{2} (276 to 488 kPa)

B.9.1 ENGINE OIL FILTER

Type ..... "SPIN-ON"
Number 1
Filter Bypass Location ..... TBD

B.9.2 COOLANT FILTER

Type ..... "SPIN-ON"
Number 1

COMPONENT SPECIFICATIONS

B.9.3 BYPASS VALVE SPRING

Location ..... In Filter

B.9.4 PRESSURE REGULATOR VALVE SPRING

Free Length ..... 2.589 in. (65.76 mm)
Test Length ..... 1.545 in. (39.24 mm)
Test Load ..... 24.1 lbs + 5% (107 N)
Outside Diameter ..... .600 in. (15.24 mm)

B.9.5 PRESSURE REGULATOR VALVE ASSEMBLY

Location ..... In Crankcase, Behind Filter Header
Setting ..... 48–52 lb/in.^{2} (331–359 kPa)

1.068 in. (27.13 mm)
Valve Assembly Diameter ..... 1.059 in. (26.89 mm)

0.0015 in. (0.381 mm)
Valve Clearance in Bore ..... 0.0035 in. (0.089 mm)

1.063 in. (27.00 mm)
Crankcase Bore I.D. ..... 1.065 in. (27.05 mm)

*Oil Pressure measurement should be made utilizing an oil gallery tap.

B.10 THERMOSTAT

Type ..... Poppet Valve, Pellet Operated
Operating Temperature Range
Start to Open Temperature ..... 180° – 185° F (82° – 85° C)
Full Open Temperature ..... 202°F (94°C)

COMPONENT SPECIFICATIONS

B.11 INJECTION PUMP

Model ..... Bosch 3000 or 7100
Drive ..... Gear -- Steel Forging

STATIC TIMING: (See Emission Label on Engine for Further Data)

RATED BHP	ENGINE	STATIC TIMING
175 HP@ 2600	6.7L	12 +/- 1 BTDC
190 HP@ 2600	6.7L	12 +/- 1 BTDC
210 HP@ 2600	6.7L	13 +/- 1 BTDC
230 HP@ 2600	6.7L	13 +/- 1 BTDC
195 HP@ 2400	7.6L	13 +/- 1 BTDC
210 HP@ 2400	7.6L	13 +/- 1 BTDC
230 HP@ 2400	7.6L	14 +/- 1 BTDC
250 HP@ 2400	7.6L	14 +/- 1 BTDC
275 HP@ 2400	7.6L	14 +/- 1 BTDC
250 HP@ 2200	8.7L	12 +/- 1 BTDC
275 HP@ 2000	8.7L	11 +/- 1 BTDC
275 HP@ 2200	8.7L	12 +/- 1 BTDC
300 HP@ 2000	8.7L	10 +/- 1 BTDC
300 HP@ 2200	8.7L	12 +/- 1 BTDC

B.11.1 FUEL FILTER

Type ..... Spin-on & Fuel Strainer

B.12 NOZZLES

Type ... Orifice
Actuation High Pressure Fuel from Injection Pump
Valve Opening Pressure (V.O.P.)
New or Reconditioned 3600–3750 lb/in.^{2} (24820–25855 kPa)
Minimum V.O.P. before Reconditioning ..... 2900 lb/in.^{2} (19995 kPa)

APPENDIX C: TORQUE DATA

Many conditions affect torque and the results of torque applications. The major purpose in tightening a fastener to a specified torque is to obtain tension in the fastener (i.e., bolt, nut, etc.), which in turn develops a clamping load which exceeds any possible loading imposed on parts due to engine RPM or vibration.

C.1 TENSION VALUES FOR STANDARD FASTENERS

The "Standard Nut and Bolt Torque Chart" provides tightening torque for general purpose applications using original equipment standard hardware as listed in the Parts Catalog for the application involved. **Do not substitute.** Original equipment standard hardware is defined as Type 8, coarse thread bolts and nuts and thru hardened flat washers (Rockwell "C" 38–45), all phosphate coated and assembled without supplemental lubrication (as received condition).

NOTE:

Phosphate coating is a dry lubricant.

C.2 FASTENER THREAD CONDITION

Threads that are dry, excessively rough, battered or filled with dirt require considerable effort just to rotate. Then when the clamping load is developed or the bolt tension is applied, the torque reading mounts rapidly (due to thread friction) to the specified torque value. However, the desired bolt tension and maximum clamping effect is not achieved. This condition can lead to failure of the fastener to maintain component integrity. The proper bolt tension and clamping effect can never be attained if the fastener is dry. The fastener threads must have a film of clean lubricant (engine oil) to be considered lubricated.

STANDARD NUT AND BOLT TORQUE CHART

Nominal Thread Diameter	Standard Torque ± 10% lb·ft	N·m
1/4	7	10
5/16	14	19
3/8	24	32
7/16	38	51
1/2	60	80
9/16	80	110
5/8	115	155
3/4	200	270
7/8	320	440
1	480	650
1-1/8	590	800
1-1/4	830	1100
1-3/8	1100	1500
1-1/2	1400	1900
1-3/4	2300	3100
2	3400	4600

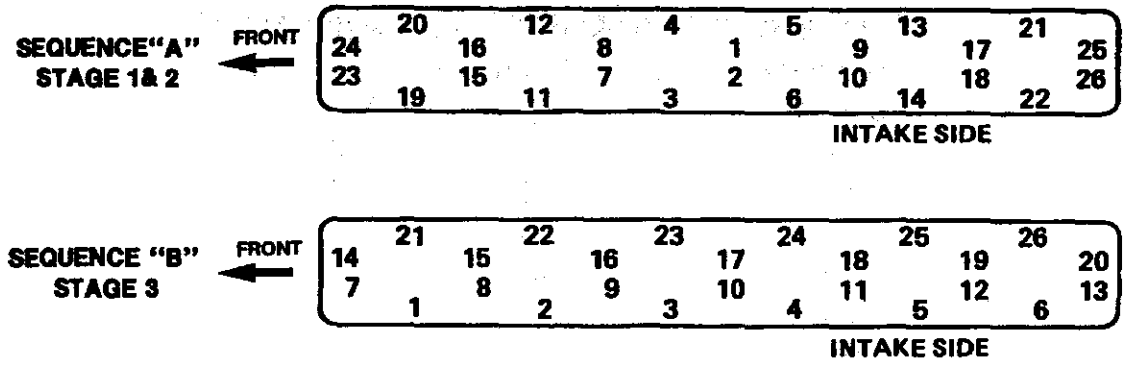
C.3 SPECIAL NUT AND BOLT TORQUE DATA

Back Plate-to-Center Housing Capscrews ..... 185–215 lb·in. (21–24 N·m)
Center Housing-to-Turbine Housing Capscrews ..... 115 lb·in. (13.0 N·m)
Center Housing-to-Compressor Housing Capscrews ..... 185–215 lb·in. (21–24 N·m)
Compressor Wheel ..... 100 lb·in. (11 N·m)
Impeller Shaft Locknut (Tighten finger-tight plus 90°)
(Use tee handle wrench only) ..... 19 lb·in. (2.15 N·m)
Turbocharger Mounting Nuts ..... 50 lb·ft (68 N·m)
Exhaust Manifold Bolts ..... 60 lb·ft (81 N·m)
Aneroid Hollow Screw ..... 24 lb·ft (32 N·m)
Valve Cover/Intake Manifold Bolts ..... 13 lb·ft or 156 lb·in. (18 N·m)

Valve Cover/Intake Manifold Capscrews ..... 13 lb·ft or 156 lb·in. (18 N·m)
Cylinder Head Bolts + ... 165 lb·ft (223.7 N·m)
Valve Adjusting Screw Nut ..... 20 lb·ft (27 N·m)

Tighten cylinder head bolts following the assembly steps listed:

1. Lubricate bolt threads, bolt head seating areas and washers with clean engine oil.
2. Tighten bolts in three (4) stages:



STAGE 1 - FOLLOWING SEQUENCE "A" TIGHTEN BOLTS TO 110 lbs-ft. (150 Nm)

STAGE 2 - FOLLOWING SEQUENCE "A" TIGHTEN BOLTS TO '155 lbs-ft. (210 Nm)

STAGE 3 - FOLLOWING SEQUENCE "B" TIGHTEN BOLTS, IN ROWS, TO 165 lbs-ft. (225 Nm)

Camshaft Thrust Plate Bolt ..... 19 lb·ft or 228 lb·in. (26 N·m)

TORQUE DATA

SPECIAL NUT AND BOLT TORQUE DATA

Connecting Rod Bolts	115 lb·ft (156 N·m)
Connecting Rod Bolt	115 lb·ft (156 N·m)
Crankshaft Main Bearing Cap Bolts	115 lb·ft (156 N·m)
Crankshaft Pulley Retainer Bolts	100 lb·ft (136 N·m)
Flywheel Bolts	100 lb·ft (136 N·m)
Flywheel Housing Mounting Bolts	80 lb·ft (108 N·m)
Oil Pan Bolts	13 lb·ft or 156 lb·in. (18 N·m)
Oil Pan Drain Plug 7/8 inch	50 lb·ft (68 N·m)
Oil Pick–up Tube Bolts	13 lb·ft or 156 lb·in. (18 N·m)
Oil Pick–up Tube Bracket Bolt	13 lb·ft or 156 lb·in. (18 N·m)
Oil Level Gauge Tube Clamp	30 lb·in. (14 N·m)
Idler Gear Retaining Bolt (Upper)	265 lb·ft (359 N·m)
Idler Gear Retaining Bolt (Lower)	470 lb·ft (637 N·m)
Camshaft Thrust Plate Bolt	19 lb·ft or 228 lb·in. (26 N·m)
Injection Pump Drive Gear Bolts	38 lb·ft (52 N·m)
Air Compressor Tail Bracket Mounting Bolts (Crankcase)	85 lb·ft (115 N·m)
Air Compressor Tail Bracket Mounting Bolt (Compressor)	49 lb·ft (66 N·m)
Air Compressor Drive Gear Nut	110 lb·ft (149 N·m)
Air Compressor Mounting Bolts	46 lb·ft (62 N·m)
Belt Tensioner (Front Cover)	37 lb·ft (50 N·m)
Belt Tensioner (Freon Compressor)	37 lb·ft (50 N·m)
Fuel Pump Gear Housing Cover	66 lb·in (7 N·m)
Water Pump Pulley	66 lb·in (7 N·m)
Fan Drive	13 lb·ft or 156 lb·in. (18 N·m)
Front Cover Bracket to Head (No Air Conditioner)	60 lb·ft (81 N·m)
Front Cover Bracket to Head (With Air Conditioner)	83 lb·ft (112 N·m)
Oil Pan Drain Plug	50 lb·ft (68 N·m)
Oil Pan Bolts	13 lb·ft or 156 lb·in. (18 N·m)
Oil Pickup Tube Mounting Bolts	13 lb·ft or 156 lb·in. (18 N·m)
Oil Level Gauge Tube Clamp	30 lb·ft (41 N·m)
Oil Temperature Pressure Valve	10 lb·ft or 120 lb·in. (13.5 N·m)

Water Pump Pulley (6 mm)	66 lb·in. (7 N·m)
Water Pump Mounting (6 mm)	66 lb·in. (7 N·m)
Belt Tensioner (Front Cover)	37 lb·ft (50 N·m)
Belt Tensioner (Freon Compressor)	37 lb·ft (50 N·m)
Fan Drive	13 lb·ft or 156 lb·in. (18 N·m)

TORQUE DATA

SPECIAL NUT AND BOLT TORQUE DATA

Injection Pump Drive Gear Bolts ..... 38 lb·ft (51 N·m)
Fuel Pump Gear Housing Cover Bolts ..... 66 lb·in. (7.5 N·m)
Fuel Injection Pump Access Cover ..... 66 lb·in. (7.5 N·m)
Nozzle Retainer Bolt (Crab Bolt) ..... 19 lb·ft (228 lb·in) (26 N·m)
Injection High Pressure Line Connector Nut* ..... 30 lb·ft (41 N·m)
Banjo Fuel Oil Connections ..... 26 lb·ft (35 N·m)
Banjo Lube Oil Connections ..... 24 lb·ft (32 N·m)
Aneroid Line Banjo Connection ..... 24 lb·ft (32 N·m)
Injection Pump Tail Bracket (To Injection Pump) ..... 85 lb·ft (115 N·m)
Injection Pump Tail Bracket (Cyl Block) ..... 85 lb·ft (115 N·m)
Injection Pump Tail Bracket (Pump) ..... 49 lb·ft (66 N·m)

Nozzle Cap Nut Torque (with nozzle installed) ..... 33 lb·ft (45 N·m)
Nozzle Retainer Bolt Torque (Crab) ..... 19 lb·ft (228 lb·in.) (26 N·m)
Injection High Pressure Line Connector Torque * ..... 30 lb·ft (41 N·m)

* Injection line fittings at the pump and nozzle are frequently overtightened due to the fitting size 3/4 inch (19 mm). This swedges the injection line, often partly closing the ends. This alters fuel delivery characteristics, raises injection line pressures and may cause performance problems or injection pump failure. Inspect the ends of the injection lines and discard any with swedged or damaged fittings or holes.

APPENDIX D: SPECIAL TOOLS

SPECIAL SERVICE TOOL LIST

MANUAL SECTION	TOOL DESCRIPTION	TOOL ORDER NO.
One (1)	No Special Tools Required	----
Two (2)	No Special Tools Required	----
Three (3)	No Special Tools Required	----
Four (4)	No Special Tools Required	----
Five (5)	No Special Tools Required	----
Six (6)	No Special Tools Required	----
Seven (7)	Nozzle Liner Installer	J39261
	Nozzle Liner Remover	J39262
	Universal Valve Seat Extractor	PT6390-45
	Valve Guide Installer	J39292
	Valve Guide Removal Tool	J41164
	Valve Seat Extractor Collet	PT6390-45
	Valve Seat Installer	J39535
	Valve and Clutch Spring Tester	J22738-02
Eight (8)	Camshaft Bushing Service Set	J39537
	Lower Idler Gear Socket (3/4 inch Drive 20mm 12 Point)	J41167
	Valve And Clutch Spring Tester	J22738-02
Nine (9)	Counter Bore Tool	PT2200-55
	Counter Bore Cutter Head	PT2250-A
	Cylinder Liner Puller	PT6410
	Piston Groove Wear Measuring Tool	J29511
	Piston Ring Compressor (8.7L)	J41166

SPECIAL TOOLS

SPECIAL SERVICE TOOL LIST

MANUAL SECTION	TOOL DESCRIPTION	TOOL ORDER NO.
Ten (10)	Counterbore Tool	PT2200–55
	Cutter Head	PT2250–A
	Crankshaft – Rear Oil Seal Installer	J41163
	Crankshaft – Front Oil Seal Wear Sleeve Installer	J39266
Eleven (11)	Vibration Damper Wear Liner Installing Tool	J39266
	Timing Pin (To Set Timing)	J41161
	Plunger Pin (To Check Timing)	J41162
	Lower Idler Gear Socket (3/4 in/20 mm 12 point)	J41167
Twelve (12)	Spring Load Tester	J22738–02
Thirteen (13)	No Special Tools Required	----
Fourteen (14)	Timing Pin (To Set Timing)	J41161
	Plunger Pin (To Check Timing)	J41162
Fifteen (15)	Nozzle Cleaning Kit	J39538
	Lapping Blocks	J22090–A
	Nozzle Liner Installer	J39261
	Nozzle Liner Remover	J39262
	Injection Nozzle Holding Fixture	J39263
	Holding Fixture Clamping Plate	J39264
	Nozzle Tester with Adapter	J29075–150
	Nozzle Puller	J41165

** Place order directly to:
Bacharach Instrument Company, 625 Alpha Drive, Pittsburgh, Pennsylvania 15238.

APPENDIX E: CONVERSION TABLES

The charts in the following sections convert English units into metric units.

E.1 METRIC CONVERSION FACTOR

METRIC CONVERSION FACTOR CHART

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
HEAT				
British therma unit (Btu)	1.055056	kilojoule (kJ)	0.947817	(Btu)
	1055.056	joule (J)	0.000947817	(Btu)
Btu per hour* (Btu/h)	0.2930711	watt (W)	3.412141	(Btu/h)
Btu per minute* (Btu/min)	17.58427	watt(W)	0.05686902	(Btu/min)
Btu per gallon (Btu/gal)	0.2787163	kilojoule per liter (kJ/l)	3.5878777	(Btu/gal)
***Heat flow rate. Also see POWER**				
LENGTH				
	25.4	millimetre (mm)	0.03937008	(in.)
inch (in.)	2.54	centimetre (cm)	0.3937008	
	0.0254	metre (m)	39.37008	
MASS WEIGHT				
ounce (oz)	28.34952	gram (g)	0.03527397	(0z)
	0.02834952	kilogram (kg)	35.27397	(0z)
grain	0.06479891	gram (g)	15.43236	grain
pound (lb)	0.4535924	kilogram (kg)	2.204622	(lb)
short ton (2000 lb)	907.1847	kilogram (kg)	0.001102311	short ton
	0.9071847	megagram (Mg)	1.102311	short ton
long ton (2240 lb)	1016.047	kilogram (kg)	0.000984206	long ton
	1.016047	megagram (Mg)	0.9842064	long ton
POWER				
horsepower (hp)	0.7456999	kilowatt (kW)	1.341022	(hp)
	745.6999	watt (W)	0.001341022	(hp)
Btu per hour* (Btu/h)	0.2930711	watt (W)	3.42141	(Btu/h)
Btu per minute* (Btu/min)	17.58427	watt (W)	0.05686902	(Btu/min)
*Also heat flow rate. See HEAT				
PRESSURE				
pound-force per square inch ($lb/in.^2$)	2.036	inch of mercury (in. Hg)	0.4912	($lb/in.^2$)
	27.68	inch of water (in. H_2O)	0.036125	($lb/in.^2$)
inch of mercury (in. Hg)	13.6	inch of water (in. H_2O)	0.0735	(in. Hg)
pound-force per swuare inch ($lb/in.^2$)	6.894757	kilopascal (kPa)	0.1450377	($lb/in.^2$)

METRIC CONVERSION FACTOR CHART

UNIT	MULTIPLY BY	TO GET	MULTIPLY BY	TO GET
	0.006894757	megapascal (MPa)	145.0377	($lb/in.^2$)
inch of mercury (in. Hg)	3.37685	kilopascal (kPa)	0.296134	(in. Hg)
PRESSURE				
	0.24884	kilopascal (kPa)	4.0186	(in. H_2O)
bar	100	kilopascal (kPa)	0.01	(bar)
TEMPERATURE				
degree Farenheit (F)	(F – 32) divided by 1.8	degree Celsuis (C)	(1.8 x C) + 32	(F)
TORQUE				
pound–force foot (lb·ft)	1.355818	newton metre (N·m)	0.7375621	(ft lb)
pound–force inch (lb·in)	0.1129848	newton metre (N·m)	8.850748	(in lb)
ounce–force inch (oz·in)	0.007061552	newton metre (N·m)	141.6119	(oz·in)

E.2 CONVERSION TO MILLIMETER EQUIVALENTS

CONVERSION TABLE – INCH FRACTIONS AND DECIMALS TO MILLIMETER EQUIVALENTS

Inch Fractions	Decimal	mm	Inch Fractions	Decimal	mm
	0.0004	0.01016		0.7874	19.99996
	0.001	0.0254	51/64	0.7969	20.24126
	0.0039	0.09906	13/16	0.8125	20.6375
	0.005	0.127		0.8268	21.00072
	0.0079	0.20066	53/64	0.8281	21.03374
	0.0098	0.24892	27/32	0.8438	21.43252
	0.01	0.254	55/64	0.8594	21.82876
	0.0118	0.29972		0.8662	22.00148
1/64	0.0156	0.39624	7/8	0.875	22.225
	0.0157	0.39878	57/64	0.8906	22.62124
	0.0197	0.50038		0.9	22.86
	0.0236	0.59944		0.9055	22.9997
	0.025	0.635	29/32	0.9063	23.02002
	0.0276	0.70104	59/64	0.9219	23.41626
	0.0295	0.7493	15/16	0.9375	23.8125
1/32	0.0313	0.79502		0.9449	24.00046
	0.0315	0.8001	61/64	0.9531	24.20874
	0.0354	0.89916	31/32	0.9688	24.60752
	0.0394	1.00076		0.9843	25.00122
3/64	0.0469	1.19126	1	1	25.4
	0.0472	1.19888		1.024	26.0096
	0.05	1.27	1 1/16	1.062	26.9748
	0.0551	1.39954		1.063	27.0002
	0.0591	1.50114		1.102	27.9908
1/16	0.0625	1.5875	1 1/8	1.125	28.575
	0.0669	1.69926		1.142	29.0068
	0.075	1.905		1.181	29.9974
5/64	0.0781	1.98374	1 3/16	1.188	30.1752
	0.0787	1.99898		1.221	31.0134
	0.0906	2.30124	1 1/4	1.25	31.75
3/32	0.0938	2.38252		1.26	32.004
	0.0984	2.49936		1.299	32.9946
	0.1	2.54	1 5/16	1.312	33.3248
	0.1024	2.60096		1.339	34.0106
7/64	0.1093	2.77622	1 3/8	1.375	34.925
	0.1181	2.99974		1.378	35.0012
1/8	0.125	3.175		1.417	35.9918
	0.1378	3.50012	1 7/16	1.438	36.5252
9/64	0.1406	3.57124		1.457	37.0078
5/32	0.1563	3.97002		1.496	37.9984
	0.1575	4.0005	1 1/2	1.5	38.1
11/64	0.1719	4.36626		1.535	38.989
	0.1772	4.50088	1 9/16	1.562	39.6748
3/16	0.1875	4.7625		1.575	40.005
	0.1969	5.00126		1.614	40.9956
	0.2	5.08	1 5/8	1.625	41.275
13/64	0.2031	5.15874		1.654	42.0116
	0.2165	5.4991	1 11/16	1.688	42.8752
7/32	0.2188	5.55752		1.693	43.0022
15/64	0.2344	5.95376		1.732	43.9928
	0.2362	5.99948	1 3/4	1.75	44.45
1/4	0.25	6.35		1.772	45.0088

CONVERSION TABLE – INCH FRACTIONS AND DECIMALS TO MILLIMETER EQUIVALENTS

Inch Fractions	Decimal	mm	Inch Fractions	Decimal	mm
	0.2559	6.49986		1.811	45.9994
17/64	0.2656	6.74624	1 13/16	1.813	46.0502
	0.2756	7.00024		1.85	46.99
9/32	0.2813	7.14502	1 7/8	1.875	47.625
	0.2953	7.50062		1.89	48.006
19/64	0.2969	7.54126		1.929	48.9966
	0.3	7.62		1.969	50.0126
5/16	0.3125	7.9375	2	2	50.8
	0.315	8.001	2 1/8	2.125	53.975
21/64	0.3281	8.33374		2.165	54.991
	0.3346	8.49884	2 1/4	2.25	57.15
11/32	0.3438	8.73252		2.362	59.9948
	0.3543	8.99922	2 3/8	2.375	60.325
23/64	0.3594	9.12876	2 1/2	2.5	63.5
	0.374	9.4996		2.559	64.9986
3/8	0.375	9.525	2 5/8	2.625	66.675
25/64	0.3906	9.92124	2 3/4	2.75	69.85
	0.3937	9.99998		2.756	70.0024
	0.4	10.16	2 7/8	2.875	73.025
13/32	0.4062	10.31748		2.953	75.0062
	0.4134	10.50036	3	3	76.2
27/64	0.4219	10.71626		3.15	80.01
	0.4331	11.00074	3 1/4	3.25	82.55
7/16	0.4375	11.1125		3.346	84.9884
29/64	0.4531	11.50874	3 1/2	3.5	88.9
5/32	0.4688	11.90752		3.543	89.9922
	0.4724	11.99896		3.74	94.996
31/64	0.4844	12.30376	3 3/4	0.75	19.05
	0.4921	12.49934		3.937	99.9998
1/2	0.5	12.7	4	4	101.6
	0.5118	12.99972		4.331	110.0074
33/64	0.5156	13.09624	4 1/2	4.5	114.3
17/32	0.5326	13.52804		4.724	119.9896
	0.5315	13.5001	5	5	127
35/64	0.5469	13.89126		5.118	129.9972
	0.5512	14.00048	5 1/2	5.5	139.7
9/16	0.5625	14.2875		5.512	140.0048
	0.571	14.5034		5.906	150.0124
37/64	0.5781	14.68374	6	6	152.4
	0.5906	15.00124		6.299	159.9946
19/32	0.5938	15.08252	6 1/2	6.5	165.1
	0.6	15.24	7	7	177.8
39/64	0.6094	15.47876		7.087	180.0098
	0.6103	15.50162	7 1/2	7.5	190.5
5/8	0.625	15.875		7.874	199.9996
	0.6299	15.99946	8	8	203.2
41/64	0.6406	16.27124	8 1/2	8.5	215.9
	0.6496	16.49984		8.661	219.9894
21/32	0.6563	16.67002	9	9	228.6
	0.6693	17.00022		9.449	240.0046
43/64	0.6719	17.06626	9 1/2	9.5	241.3
11/16	0.6875	17.4625		9.843	250.0122
	0.689	17.5006	10	10	254

CONVERSION TABLE – INCH FRACTIONS AND DECIMALS TO MILLIMETER EQUIVALENTS

Inch Fractions	Decimal	mm	Inch Fractions	Decimal	mm
	0.7	17.78		10.236	259.9944
45/64	0.7031	17.85874	11	11	279.4
	0.7087	18.00098		11.024	280.0096
23/32	0.7188	18.25752		11.811	299.9994
	0.7283	18.49882	12	12	304.8
47/64	0.7344	18.65376	13	13	330.2
	0.748	18.9992		13.78	350.012
3/4	0.75	19.05	14	14	355.6
49/64	0.7656	19.44624	15	15	381
	0.7677	19.49958		15.748	399.9992
25/32	0.7813	19.84502	16	16	406.4

APPENDIX F: STANDARD UNITS OF MEASUREMENT

Quantity	Application	English Units	Metric Units
Acceleration, angular		rad/s^2	rad/s^2
Acceleration, linear	Vehicle	(mile/hr)/s	(km/hr)/s
	General	ft/s^2	m/s^2
Angle, plane	Rotational calculations	r (revolution)	r (revolution)
		rad	rad
	Geometric and general	° (deg)	°
		' (min)	°(decimalized)
		" (sec)	°(decimalized)
Angle, solid	Illumination calculations	sr	sr
Area	Cargo platforms, frontal areas, fabrics general	$in.^2$	$m^2.m^2$
	Small areas, orifices	$in.^2$	mm^2
	Brake & clutch contact area, glass, radiators	$in.^2$	cm^2
	Land area	acre	ha
Bending Moment, *See Moment of Force*			
Capacitance, electric	Capacitors	µF	µF
Capacity, electric	Battery rating	A·hr	A·hr
Capacity, heat	General	Btu/°F	kJ/°C
Capacity, heat, specific	General	Btu/(lb·°F)	kJ/(kg·°C)
Capacity, volume, *See Volume*			
Coefficient of heat transfer	General	$Btu/(hr·ft^2·°F)$	$W/(m^2·°C)$
Coefficient of linear expansion	Shrink fit, general	$°F^{-1}$, (1/°F)	$°C^{-1}$, (1/°C)
Conductance, electric	General	mho	S
Conductance, thermal, *See Coeffient of heat transfer*			
Conductivity, electric	Material property	mho/ft	S/m
Conductivity, thermal	General	$Btu·ft/(hr·ft^2·°F)$	$W/(m·°C)$
Consumption, fuel, *See Efficiency, fuel*			
Consumption, specific, fuel, *See Efficiency, fuel*			
Consumption, oil	Vehicle performance testing	qt/1000 miles	L/1000 km

Quantity	Application	English Units	Metric Units
Consumption, specific, oil	Engine testing	lb/(hp·hr)	g/(kW·hr)
		lb/(hp·hr)	g/MJ
Current, electric	General	A	A
Density, current	General	A/in.^{2}	kA/m^2
		A/ft^2	A/m^2
Density, magnetic flux	General	kilogauss	T
Density, (mass)	Solid	lb/yd^3	kg/m^3
		lb/in.^{3}	kg/m^3
		lb/ft^3	kg/m^3
		ton (short)/yd^3	t/m^3
		ton (long)/yd^3	t/m^3
	Liquid	lb/gal	kg/L
	Gas	lb/ft^3	kg/m^3
Density of heat flow rate	Irradiance, general	Btu/(hr·ft^2)	W/m^2
Drag, See Force			
Economy, fuel, *See Efficiency, fuel*			
Efficiency, fuel	Highway vehicles		
	◆ economy	◆ mile/gal	◆ km/L
	◆ consumption	◆ ———	◆ l/100km
	◆ specific fuel consumption	◆ lb/(hp·hr)	◆ g/MJ
	Off-highway vehicles		
	◆ economy	◆ hp·hr/gal	◆ kW·hr/L
	◆ specific fuel consumption	◆ lb/(hp·hr)	◆ g/(kW·hr)
	◆ specific fuel consumption	◆ lb/(hp·hr)	◆ g/MJ
Energy, work , enthalpy, quantity of heat	Impact strength	ft·lb	J
	Heat	Btu	kJ
		kcal	kJ
	Electrical	kW·hr	kW·hr
		kW·hr	MJ
	Mechanical, general	ft·lb	J
		ft·pdl	J
		hp·hr	MJ
Energy, specific	General	cal/g Btu/lb	J/g kJ/kg
Enthalpy, *See Energy*			

Quantity	Application	English Units	Metric Units
Entropy, *See Capacity, heat*			
Entropy, specific, *See Capacity, heat specific,*			
Floor Loading, *See Mass per area*			
Flow, heat, rate, *See Power*			
Flow, mass rate	General	lb/min lb/s	kg/min kg/s
Flow, volume	Air, gas, general	ft^3/s	m^3/s
		ft^3/min	m^3/min
	Liquid flow, pump capacity	gal/s	L/s
		gal/s	m^3/s
		gal/min	L/min
	Seal and packing leakage	oz/s	mL/s
		oz/min	mL/min
Flux, luminous	Light bulbs	lm	lm
Flux, magnetic	Coil rating	maxwell	Wb
Force, thrust, drag	Pedal, spring belt, hand lever, general	lb,oz	N
	Drawbar, breakout, general	lb	kN
	General	pdl	N
		kg	
Frequency	System, sound and electrical	Mc/s	MHz
		kc/s	kHz
	Mechanical events, rotational	Hz, c/s	Hz
		r/s	s^{-1}, r/s
		r/min	min^{-1}, r/min
Heat flow rate, *See Power;* Heat flow–density of, *See Density of heat flow*			
Heat, specific *See Capacity, heat; Also see Capacity, heat, specific*	General	cal/g Btu/lb	kJ/kg
Heat transfer coefficient, *See Coefficient of heat transfer*			
Illuminance, illumination	General	fc	lx

Quantity	Application	English Units	Metric Units
Impact strength, *See Strength impact*			
Inductance, electric	Filters, chokes, permeance	H	H
Intensity, luminous	Light bulbs	candlepower	cd
Leakage, *See Flow, volume*			
Length	Land distances, maps, odometers	mile	km
	Field size, turning circle, braking distance, cargo platforms	rod yd ft	m m m
	Engineering drawings, engineering part specifications, motor vehicle dimensions	in.	mm
	Coating thickness, filter rating	mil µin. micron	µm µm µm
	Surface texture		
	◆ Roughness, average	◆ µin.	◆ µm
	◆ Roughness sampling length, waviness height and spacing	◆ in.	◆ mm
	Radiation wavelength, optical measurements, (interference)	µin	nm
Load, See Mass			
Luminance	Brightness	footlambert	cd/m^2
Magnetization	Coil field strength	A/in.	A/m
Mass	Vehicle mass (weight axle rating, rated load, tire load, lifting capacity, tipping load, load, general)	ton (long) ton (short) lb slug	Mg, t Mg, t kg kg
	Small mass	oz	g
Mass per area	General	lb/ft^2	kg/m^2
Mass per length	General	lb/ft	kg/m
Modulus of elasticity	General	$lb/in.^2$	MPa
Modulus, section	General	$in.^3$	mm^3
Modulus, section	General	$in.^3$	mm^3
Moment of area, second; Moment of section	General	$in.^4$	mm^4

Quantity	Application	English Units	Metric Units
Moment of force, torque, bending moment	General, engine torque, fasteners	lb·in. lb·ft	N·m N·m N·m
	Locks, light torque	oz·in.	mN·m
Moment of inertia	Flywheel, general	lb·ft²	kg·m²
Moment of mass	Unbalance	oz·in.	kg·mm
Momentum	General	lb·ft/s	kg·m/s
Momentum, angular; Moment of momentum	Torsional vibration	lb·ft²/s	kg·m²/s
Permeability	Magnetic core properties	H/ft	H/m
Potential/ electric	General	V	V
Power	General, light bulbs	W	W
	Air conditioning, heating	Btu/min	W
		Btu/hr	W
	Engine, alternator, drawbar, power take–off, general	hp(550 ft·lb/s)	kW
Pressure	All pressure except very small	lb/in.² in.Hg (60°F)	kPa
		in.H_2O (60°F)	kPa
		bar	kPa
	Very small pressures (high vacuum)	lb/in.²	Pa
Pressure, sound, level	Acoustical measurement	dB	dB
Quantity of electricity	General	C	C
Resistance, electric	General	W	W
Resistivity, electric	General	W·ft	W·m
		W·ft	W·cm
Spring rate, linear	General spring properties	lb/in.	N/mm
Spring rate, torsional	General	lb·ft/deg	N·m/deg
Strength, field, electric	General	V/ft	V/m
Strength, filed, magnetic	General	oersted	A/m
Strength, impact	Materials testing	ft·lb	J
Stress	General	lb·in.²	MPa
Temperature	General use	°F	°C
	Absolute temperature, thermodynamics, gas cycles	°R	°C
Temperature interval	General use	°F	°C

Quantity	Application	English Units	Metric Units
Tension, surface		dyne/cm	mN/m
Thrust, *See Force*			
Time	General	s	s
		hr	hr
		min	min
Torque, *See Moment of force*			
Toughness, fracture	Metal properties	ksi(in.)$^{1/2}$	MPa·m$^{1/2}$
Velocity, angular	General	rad/s	rad/s
		r/s	r/s
		r/min	r/min
Velocity, linear	Vehicle	mile/hr	km/hr
	General	ft/s	m/s
		ft/min	m/min
		in./s	mm/s
Velocity, rotational	General	rad/s	rad/s
		r/s	r/s
		r/min	r/min
Viscosity, dynamic	General liquids	centipoise	mPa·s
Viscosity, kinematic	General liquids	centistokes	mm^2/s
Volume	Truck body, shipping or freight, general	yd^3	m^3
		ft^3	m^3
		bushel	m^3
	Automobile luggage capacity	ft^3	L
	Gas pump displacement, air compressor, small gaseous, air reservoir	in.^{3}	cm^3
	Engine displacement	in.^{3}	L
	large engines small engines	in.^{3}	cm^3
	Liquid--fuel, lubricant, etc.	gal	L
		qt	L
		pt	L
	Small liquid	oz	mL
	Irrigation, reservoir	acre·ft	ha·m
Volume, air flow *See Flow*			

Quantity	Application	English Units	Metric Units
Weight, *See Force or Mass*			
Work, *See Energy*			
Young's Modulus, *See Modulus of Elasticity*			