6.4L Rebuild and Assembly Guide

Contents

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SPECIAL TORQUE CHART

Bedplate mounting bolts (crankcase bolts)	See page 12	See page 12
Camshaft follower guide bolt/washer	114 lbf/in	13 Nm
Camshaft position (CMP) sensor	114 lbf/in	13 Nm
Camshaft thrust plate mounting bolts	23 lbf/ft	31 Nm
Connecting rod bolt (Initial)	33 lbf/ft	45 Nm
Connecting rod bolt (Final)	50 lbf/ft	68 Nm
Coolant (block) heater	30 lbf/ft	41 Nm
Coolant pump mounting bolts	23 lbf/ft	31 Nm
Coolant pump pulley mounting bolts	23 lbf/ft	31 Nm
Crankcase breather to valve cover	114 lbf/in	13 Nm
Crankcase breather drain fitting to crankcase	18 lbf/ft	25 Nm
Crankcase breather tube clip bolt	23 lbf/ft	31 Nm
Crankcase coolant drain plug (M16)	180 lbf/in	20 Nm
Crankshaft position (CKP) sensor	114 lbf/in	13 Nm
Cylinder head bolts (only use new bolts, note 3)	See page 11	See page 11
EGR cooler inlet temperature sensor (EGRT Inlet)	32 lbf/ft	44 Nm
EGR coolant system hose clamps	31 lbf/in	3.5 Nm
EGR cooler outlet temperature sensor (EGRT Outlet)	28 lbf/ft	38 Nm
EGR DOC tube to RB up-tube bolts & nuts	23 lbf/ft	31 Nm

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EGR DOC tube to EGR cooler horizontal bolts	23 lbf/ft	31 Nm
EGR cooler vertical to EGR valve housing bolts	23 lbf/ft	31 Nm
EGR cooler vertical bracket mounting bolts	23 lbf/ft	31 Nm
EGR cooler horizontal to EGR cooler vertical flange	23 lbf/ft	31 Nm
EGR throttle body to EGR valve housing	88 lbf/in	10 Nm
EGR valve housing to intake manifold	88 lbf/in	10 Nm
EGR valve to EGR valve housing	88 lbf/in	10 Nm
Engine coolant temperature sensor (ECT)	159 lbf/in	18 Nm
Engine oil pressure switch (EOP)	124 lbf/in	14 Nm
Engine oil temperature sensor (EOT)	159 lbf/in	18 Nm
Exhaust backpressure (EP) connector to DOC tube	20 lbf/ft	27 Nm
Exhaust backpressure (EP) tube bracket nut	80 lbf/in	9 Nm
Exhaust backpressure (EP) tube nut to EP sensor	180 lbf/in	20 Nm
Exhaust backpressure (EP) tube nut to exhaust connector	180 lbf/in	20 Nm
Exhaust manifold flange studs	159 lbf/in	18 Nm
Exhaust manifold heat shield mounting bolts & nut	88 lbf/in	10 Nm
Exhaust manifold heat shield spacers to stud bolts	88 lbf/in	10 Nm
Exhaust manifold mounting bolts and stud bolts (note 4)	18 lbf/ft	25 Nm
Exhaust up-tube to exhaust manifold nuts	23 lbf/ft	31 Nm
Exhaust up-tube to turbo bolts	18 lbf/ft	24 Nm

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Flywheel/flexplate bolts (only use new bolts, note 3)	See page 12	See page 12
Front cover mounting bolts	23 lbf/ft	31 Nm
Fuel cooler reservoir mounting bolts	114 lbf/in	13 Nm
Fuel filter cap	20 lbf/ft	27 Nm
Fuel fitting banjo bolt with copper washer (M12)	28 lbf/ft	38 Nm
Fuel fitting banjo bolt with steel washer w/viton insert (M12)	18 lbf/ft	25 Nm
Fuel fitting banjo bolt (M14)	35 lbf/ft	47 Nm
Fuel injector hold down clamp bolts	28 lbf/ft	38 Nm
Fuel injector return tube nut to check valve	28 lbf/ft	38 Nm
Fuel return passage plug (rear of cylinder head)	20 lbf/ft	27 Nm
Fuel supply and return tube clamp to upper oil pan	23 lbf/ft	31 Nm

Glow plug	124 lbf/in	14 Nm
Glow plug control module bolts and nuts (GPCM)	114 lbf/in	13 Nm
High pressure common rail (HPCR) mounting bolts	23 lbf/ft	31 Nm
High pressure common rail (HPCR) to fuel injector tubes	See pages 7 & 8	See Pages 7 & 8
High pressure fuel injection pump & pump-to-rail tube installation	See pages 7 &8	See pages 7 & 8

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High pressure fuel injection pump cover mounting bolts	114 lbf/in	13 Nm
High pressure fuel injection pump drive gear bolt	57 lbf/ft	78 Nm
High pressure fuel injection pump mounting bolts	45 lbf/ft	62 Nm
High pressure fuel tube nuts (all)	144 lbf/in	30 Nm
Intake manifold pressure sensor (MAP)	106 lbf/in	12 Nm
Intake air temperature 2 (IAT2) sensor	124 lbf/in	14 Nm
Intake manifold bolts and stud bolts	See page 12	See page 12
Lifting eye bolts	45 lbf/ft	62 Nm
Oil cooler to crankcase mounting bolts (M8)	23 lbf/ft	31 Nm
Oil filter base to cooler cover screws (M6 thread forming)	89 lbf/in	10 Nm
Oil filter cap	18 lbf/ft	25 Nm
Oil filter housing to filter base bolts	16 lbf/ft	22 Nm
Oil filter stand pipe bolt (M5 thread forming) W/new oil cooler	61 lbf/in	7 Nm
Oil filter stand pipe bolt (M5 thread forming) reusing existing oil cooler	30 lbf/in	3 Nm
Oil pan bolt - lower pan	114 lbf/in	13 Nm
Oil pan bolt - upper pan	114 lbf/in	13 Nm
Oil pan drain plug (see note 1)	32 lbf/ft	44 Nm
Oil pickup tube bolts	114 lbf/in	13 Nm
Oil pump housing bolts	16 lbf/ft	22 Nm
Oil pressure regulator plug	26 lbf/ft	35 Nm
Piston cooling jet mounting bolts (see note 2)	114 lbf/in	13 Nm
Rocker arm assembly bolts	See Page 8 & 9	See Page 8&9
Rear cover M10 (manual only)	45 lbf/ft	62 Nm
Rear cover M8 (man & auto)	23 lbf/ft	31 Nm

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Thermostat housing hold down plate bolts	114 lbf/in	13 Nm
Turbocharger actuator mounting bolt	168 lbf/in	19 Nm
Turbocharger air inlet duct clamp	44 lbf/in	5 Nm
Turbocharger pedestal bolts	45 lbf/ft	62 Nm
Turbocharger to pedestal bolts	148 lbf/ft	201 Nm
Turbocharger crossover tube support mounting	79 lbf/in	9 Nm
Turbocharger heat shield bolts	96 lbf/in	11 Nm
Turbocharger oil supply banjo bolts (M12)	28 lbf/ft	38 Nm
Turbocharger oil supply standoff fittings to center housings	35 lbf/ft	47 Nm
Turbocharger oil supply tube retaining bolt to oil cooler	114 lbf/in	13 Nm
Valve cover base bolts	114 lbf/in	13 Nm
Valve cover bolts and studs	80 lbf/in	9 Nm

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Special Torgue Specs cont.

HPCR Fuel Components Assembly Procedure
IMPORTANT: Hand start and hand snug tube nuts.
Step 1: Install injectors, clamps, and bolts. Hand start the clamp bolts.
Step 2: Rundown injector clamp bolts to **1.5 lb/ft (2 Nm)**. Injectors will seat while torquing.
NOTE: Injectors must be fully seated and snugged, but still moveable for high pressure connector and HP tube alignment.
Step 3: Install HP rail and hand start two rail mounting bolts.
NOTE: Rail must be moveable, but not loose.
Step 4: Remove four plastic caps from rail high pressure connectors (HPC's) and four caps from injector HPC's.
Step 5: Obtain four **rail-to-injector jumper tubes** from packaging.
Step 6: Install jumper tubes (one at a time) between rail and injectors. Fully hand start and seat tube nuts onto mating rail and injector HPC's.
Snug rail and injector tube nuts using **inside-out step sequence** (two inside nuts, then two outside nuts) using a tube nut click wrench set to **1.5 lb/ft (2 Nm)**.
Step 7: Final torque injector clamp bolts to **28 lb/ft (38 Nm)**.
Step 8: Final torque two M8 rail bolts to **23 lb/ft (31 Nm)**.
Step 9: Torque rail and injector tube nuts to **106 lb/in (12 Nm +2 / -0)**.
Step 10: Mark tube nut and rail/injector threaded connection with a permanent marker. Turn tube nuts **one flat (60 degrees)**.

High Pressure Pump and Pump-to-Rail HP Tubes Installation Procedure
Step 1: Install and final torque high pressure fuel injection pump to **45 lb/ft (61 Nm)**.
Step 2: Install pump cover gasket and make electrical connections between pump and gasket. Install pump cover and fasten bolts.
Step 3: Remove four plastic caps covering supply, return, and high pressure rail connectors.
Step 4: Obtain left and right **pump-to-rail high pressure tubes** from packaging.
Step 5: Position tubes between pump and rails. Fully hand start and seat tube nuts onto mating pump and rail connections.
NOTE: Support tubes while hand snugging nuts to ensure proper joint assembly.
Step 6: Snug tube nuts to **1.5 lb/ft (2 Nm)**.

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Step 7: Torque pump and rail tube nuts to **106 lb/in (12 Nm +2 / -0)**.
Step 8: Mark tube nut and rail/pump threaded connection with a permanent marker. Turn tube nuts **one flat (60 degrees)**.

Injector-Pipe-Rail Sub-Assembly Process
Step 1: Place fuel injectors with clamps in head and snug bolts.
Step 2: Place and snug fuel rail (leave one thread loose).
Step 3: Place four fuel jumper tubes to injector/fuel rail and start 1–2 threads.
Step 4: Snug injector-side tube nuts to **1.5 lb/ft (2 Nm)** *(special torque sequence used)*.
Step 5: Snug fuel rail-side tube nuts to **1.5 lb/ft (2 Nm)** *(special torque sequence used)*.
Step 6: Final torque fuel rail mounting bolts.
Step 7: Final torque injector bolts *(special torque sequence used)*.
Step 8: Final torque injector-side tube nuts to **106 lb/in (12 Nm +2 / -0)** *(special torque sequence used)*.
Step 9: Final torque fuel rail-side tube nuts to **106 lb/in (12 Nm +2 / -0)** *(special torque sequence used)*.
Step 10: Mark tube nut and injector threaded connection. Turn tube nuts **one flat (60 degrees)** *(special torque sequence used)*.
Step 11: Mark tube nut and high pressure fuel rail threaded connection. Turn tube nuts **one flat (60 degrees)** *(special torque sequence used)*.
NOTE: Torque components in the **center two cylinders first**, then torque the **outer two cylinders last**.

Fulcrum Plate / Rocker Arm Support Assembly
Step 1: Position crankshaft at approximate **#1 and #4 cylinder TDC** by observing damper dowel pin and clocking it to the **10:30 position** (viewed from front of engine).
Step 2: Determine which cylinder is in firing position by installing pushrods and observing **#3 intake** and **#8 intake**.
Step 3:

- If **#3 intake pushrod shows cam lift**, this is **#1 firing position**. Torque fulcrum plates **#1, #2, #7, #8** only (Steps 4–6).
- If **#8 intake pushrod shows cam lift**, this is **#4 firing position**. Torque fulcrum plates **#3, #4, #5, #6** only (Steps 4–6).

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Step 4: Partially run down both M10 bolts until they just contact fulcrum plate.
Step 5: Fully run down and torque **inboard (upper) bolt** to **45 lb/ft (62 Nm)**.
Step 6: Fully run down and torque **outboard (lower) bolt** to **45 lb/ft (62 Nm)**.
Step 7: Rotate crankshaft **360 degrees** to alternate cylinder TDC (dowel pin at 10:30).
Step 8: Identify remaining fulcrum plates per Step 3 and torque per Steps 4–6.

EGR Cooler Mounting Clamps
Horizontal Cooler
Step 1: Pre-torque EGR clamps to **88 lb/in (10 Nm)**.
Step 2: Loosen clamp nuts **two full turns**.
Step 3: Final torque to **69 lb/in (8 Nm)**.

Vertical Cooler
Step 1: Pre-torque EGR clamps to **75 lb/in (8.5 Nm)**.
Step 2: Loosen clamp nuts **two full turns**.
Step 3: Final torque to **57 lb/in (6.5 Nm)**.

Fuel Rail Pressure Sensor (FRP)
Step 1: Snug sensor hand tight to **1.5 lb/ft (2 Nm)**.
Step 2: Mark sensor and high pressure fuel rail connection with permanent marker. Turn sensor **one flat (60 degrees)**.

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Hex Flange Head Bolts

Thread Diameter	Torque (lbf/ft)	Torque (Nm)	Wrench Size (mm)
Thread Diameter	Standard	Metric	Thread Diameter
M6 x 1	114 lbf/in	13 Nm	M6 x 1
M8 x 1.25	23 lbf/ft	31 Nm	M8 x 1.25
M10 x 1.5	45 lbf/ft	62 Nm	M10 x 1.5
M12 x 1.75	79 lbf/ft	107 Nm	M12 x 1.75

Hex Head Bolts

Thread Diameter	Torque (lbf/ft)	Torque (Nm)	Wrench Size (mm)
M6 x 1	6	8	10
M8 x 1.25	15	20	13
M10 x 1.5	30	40	16
M12 x 1.75	51	69	18
M16 x 2	128	173	24

Pipe Thread Bolts

Pipe Thread	Torque (lbf/ft)	Torque (Nm)
1/8" NPT	7.5	10.2
1/4" NPT	10	13.6
3/8" NPT	15	20.4
1/2" NPT	25	34.0
3/4" NPT	30	40.8

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Cylinder Head Bolts

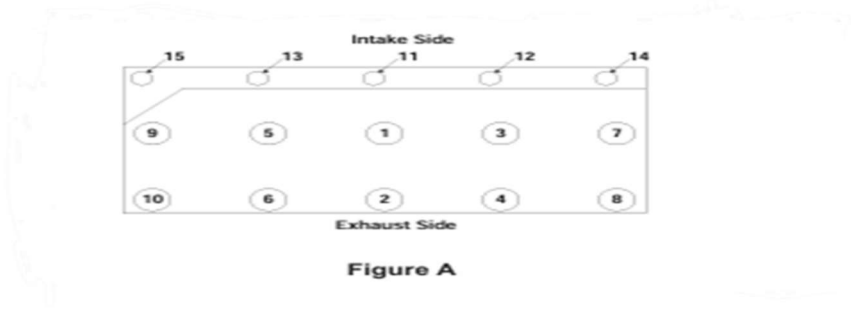

Figure A

Oem Head Bolts (M16-series torque-to-yield)

These MUST BE **NEW** on every rebuild.

OEM torque sequence (10 main bolts per head):

1. Lubricate threads & washers with clean engine oil.
2. Torque each to **70 lb·ft (95 Nm)** in sequence.
3. Back off and retorque to **115 lb·ft (156 Nm)**.
4. Angle tighten **90°** in sequence.
5. Angle tighten **additional 90°**.

Only use **angle torque steps** after proper initial torque to ensure correct clamp load.
Smaller M8 head cap fasteners (where applicable) are generally **23 lb·ft (31 Nm)**.

ARP STD Grade 425 Studs 250-4203 Torque Specs

1. **Stud Installation into Block**
   - Studs are **installed into the block by hand only** — *do not torque them down hard into the block threads*. This avoids damaging block threads.
2. **Head & Nut Torque Procedure (after head is seated)**
   - Use **ARP Ultra-Torque assembly lubricant** on stud threads, nuts, and washers for consistent clamping force.
   - Tighten the head stud nuts in **3 equal steps** to the final torque:
   - ➡️ **M16 head studs (numbers 1-10): ~275 ft-lb final torque.**
3. **Inner Row (OEM) Bolts- If any OEM-style inner row bolts are used (number 11-15), torque those to ~23-30 ft-lb.**

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Figure B

Flywheel Bolts

• Step 1: Torque the bolts to 1-5 lbf/ft (1.4-7 Nm) in the numerical sequence shown above.
• Final step: Torque the bolts to 69 lbf/ft (94 Nm) in the numerical sequence shown above.

Intake Manifold Bolts

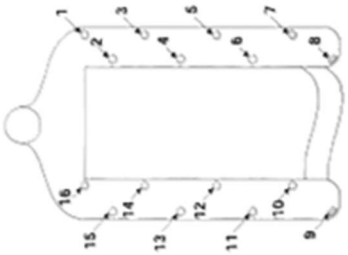

Figure D

• Step 1: Install bolts 1 through 8 finger-tight.
• Step 2: Torque bolts 9 through 16 to 8 lbf/ft (11 Nm).
• Final step: Torque all bolts to 8 lbf/ft (11 Nm) in the numerical sequence shown.

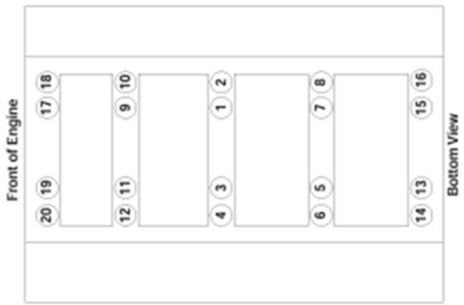

Figure E

Main Bearing Bolts

Bottom View
• Step 1: Torque the bolts to 110 lbf/ft (149 Nm) in the numerical sequence shown.
• Step 2: Torque the bolts to 130 lbf/ft (176 Nm) in the numerical sequence shown.
• Final step: Torque the bolts to 170 lbf/ft (231 Nm) in the numerical sequence shown.

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MAIN BEARINGS – CLEARANCE TARGETS

Build Type	Oil Clearance
Stock / Daily	0.0023" - 0.0028"
Heavy Tow	0.0027" - 0.0032"
Performance / Tuned	0.0030" - 0.0035"
Race / Extreme	0.0035" - 0.0040"

CONNECTING ROD BEARINGS – CLEARANCE TARGETS

Build Type	Oil Clearance
Stock / Daily	0.0018" - 0.0023"
Heavy Tow	0.0022" - 0.0027"
Performance / Tuned	0.0025" - 0.0030"
Race / Extreme	0.0030" - 0.0035"

THRUST & SIDE CLEARANCE

Component	Specification
Thrust Bearing (Race)	0.007" - 0.009"
Rod Side Clearance (Race)	0.014" - 0.018"
Crankshaft End Play (Standard)	0.005" - 0.007" (0.04 - 0.20 mm)
Crankshaft End Play (High HP)	0.0065" - 0.010"

MEASUREMENT & ASSEMBLY NOTES

- Measure at 90° to the parting line
- Dial bore gauge and micrometer required (0.0001" resolution)
- Torque caps to the final specification during measurement
- Log each journal individually

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- Verify oil pressure mechanically on first fire
- Measure crankshaft end play using a feeler gauge or dial indicator

PISTON RING END GAP SPECIFICATIONS

Application	Ring Type	End Gap Range	Typical Target / Notes
Standard / Performance	Top Compression Ring	0.012" – 0.020"	Typical target ~0.016"
Standard / Performance	Second Compression Ring	0.036" – 0.076"	Large gap to prevent pressure stacking
Standard / Performance	Oil Control Ring Rails	0.015" – 0.035"	Typical target 0.056" – 0.076"
High Horsepower (1000+ HP)	Top Compression Ring	0.020" – 0.024"	Increased gap for high boost and heat
High Horsepower (1000+ HP)	Second Compression Ring	0.036" – 0.076"	Large gap to prevent pressure stacking
High Horsepower (1000+ HP)	Oil Control Ring Rails	0.009" – 0.029"	Usually not filed unless out of spec

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6.4L POWERSTROKE – CYLINDER BORE SPECIFICATIONS

Section	Item	Specification
Standard Bore	Standard Bore Size	3.866" – 3.868" (MAX)
Oversize	.010" Over	3.876"
Oversize	.020" Over	3.886"
Oversize	.030" Over	3.896"
Oversize	.040" Over	3.906"
High Output Note	Additional Clearance	Add +0.001" clearance for applications exceeding 800 HP
Cylinder Finish	Crosshatch Angle	37°
Cylinder Finish	Final Hone	280-grit stone
Cylinder Finish	Final Finish	Plateau brush

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Engine Break-In Guidance – 6.4L Power Stroke

Oil Type Recommendations

Use standard engine oil only during the break-in period.

- 10W-40/15W-40 for bearing clearances under 0.0035"
- 20W-50 for bearing clearances 0.0040" and greater

(race or loose-clearance engines)

Special break-in oils or additives are not required. Modern diesel engine oils already contain sufficient anti-wear additives to protect bearings and piston rings during break-in.

Running Guidelines – First 1,000 Miles

- Do not allow the engine to idle for more than 10 minutes at a time
- Operate the engine at moderate RPM
- Avoid heavy load, towing, or sustained high RPM
- Change the engine oil at 1,000 miles to remove break-in debris and metal particles

Camshaft Note:

The 6.4L Power Stroke uses a hydraulic roller camshaft, which does not require a camshaft break-in procedure. No special cam break-in oil or process is necessary.

Oil Filter & Debris Inspection

Inspect the oil filter periodically during the first 1,000 miles.

- A small amount of fine metal particles in the filter is normal during break-in
- Excessive metal debris is a serious warning sign

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If excessive metal is found:

- Stop running the engine immediately

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