

SECTION 303-01C Engine — 6.4L Diesel

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SPECIFICATIONS

Material

Item	Specification	Fill Capacity
Gasket Maker TA-16	WSK-M2G348-A5	—
Motorcraft® Heavy Truck PAG Refrigerant Compressor Oil YN-24	WST-M1C231-B2	—
MERCON® SP Automatic Transmission Fluid XT-6-QSP (US); CXT-6-LSP12 (Canada)	MERCON® SP	—
MERCON® V Automatic Transmission Fluid XT-5-QM (or XT-5-QMC) (US); CXT-5-LM12 (Canada)	MERCON® V	—
Metal Brake Parts Cleaner PM-4-A or PM-4-B (US); CPM-4 (Canada)	—	—
Motorcraft® Premium Gold Engine Coolant VC-7-B (US); CVC-7-B (Canada)	WSS-M97B51-A1	29L (30.6 qt)
Motorcraft® SAE 0W-30 Super All Season Motor Oil XO-0W30-LAS	WSS-M2C171-E	14.1L (15 qt) with filter
Motorcraft® SAE 5W-40 Full Synthetic Diesel Motor Oil XO-5W40-5QSD	WSS-M2C171-E	—
Motorcraft® SAE 10W-30 Super Duty Diesel Motor Oil XO-10W30-QSD	WSS-M2C171-E	14.1L (15 qt) with filter
Motorcraft® SAE 15W-40 Super Duty Diesel Motor Oil XO-15W40-QSD (US); CXO-15W40-LSD12 (Canada)	WSS-M2C171-E	14.1L (15 qt) with filter
Penetrating and Lock Lubricant (US); Penetrating Fluid (Canada) XL-1 (US); CXC-51-A (Canada)	—	—
Motorcraft® R-134a Refrigerant YN-19 (US); CYN-16-R (Canada)	WSH-M17B19-A	—
RTV Silicone Sealant TA-31	—	—
Threadlock 262 TA-26	WSK-M2G351-A6	—

General Specifications

Item	Specification
General Specifications — Engine	
Displacement	6.4L (390 cu in)
Number of cylinders	8
Bore	98.2 mm (3.87 in)
Stroke	105 mm (4.134 in)
Firing order	1-2-7-3-4-5-6-8
Oil pressure — minimum	82.7 kPa (12 psi) at 700 rpm, 165.5 kPa (24 psi) at 1,200 rpm and 310.3 kPa (45 psi) at 1,800 rpm with engine at operating temperature
Oil capacity	14.1L (15 qt) with filter
Compression ratio	17.2:1
Engine weight (automatic transmission) (without accessory drive components)	513.5 kg (1,132 lb)
Engine weight (manual transmission) (without accessory drive components)	528.0 kg (1,164 lb)

SPECIFICATIONS (Continued)**General Specifications (Continued)**

Item	Specification
Cylinder head and valve train	
Cylinder head gasket surface flatness ^a	0.1 mm (0.004 in)
Cylinder head thickness — minimum	95 mm (3.74 in)
Combustion chamber volume	—
Valve arrangement (front to rear)	—
Valve guide bore diameter	7.003-7.029 mm (0.276-0.277 in)
Valve stem diameter	6.947-6.965 mm (0.2735-0.2742 in)
Valve stem-to-guide clearance	0.102 mm (0.004 in) max
Valve head diameter — intake	34.0 mm (1.33 in)
Valve head diameter — exhaust	29.5 mm (1.161 in)
Valve face runout (TIR max)	0.038 mm (0.0015 in)
Valve face angle	Exhaust — 39.5 degrees
Valve face angle	Intake — 37.0 degrees
Valve seat width	Intake — 1.80-2.56 mm (0.071-0.101 in)
Valve seat width	Exhaust — 1.48-2.24 mm (0.058-0.088 in)
Valve seat runout	0.035 mm (0.0014 in)
Valve seat angle	Exhaust — 40 degrees
Valve seat angle	Intake — 37.5 degrees
Valve spring free length	51.96 mm (2.045 in)
Valve spring solid height	36.1 mm (1.42 in)
Valve spring compression pressure — installed	46.5 mm (1.83 in) @ 340 ± 17 N (76.4 ± 3.8 lbf)
Valve spring compression pressure — valve open	38.3 mm (1.5 in) @ 850 ± 43 N (191.1 ± 9.71 lbf)
Valve spring installed height	—
Valve spring installed pressure	—
Roller follower ratio	1.40
Hydraulic lash adjuster	
Diameter	23.401 mm (0.92 in)
Clearance to bore	0.029 mm (0.0011 in)
Service limit	—
Hydraulic leakdown rate	18-90 seconds for 3.2 mm (0.12 in) — travel using 222 N (49.9 lbf)
Collapsed lash adjuster gap	—
Camshaft	
Gear backlash	0.17-0.30 mm (0.006-0.011 in)
Lobe lift	Intake — 5.82 mm (0.229 in)
Lobe lift	Exhaust — 5.91 mm (0.2326 in)
Allowable lobe lift loss	0.051 mm (0.002 in)
Journal diameter	61.987-62.013 mm (2.440-2.441 in)
Camshaft journal bearing inside diameter	62.05-62.14 mm (2.443-2.446 in)
Camshaft journal-to-bearing clearance	0.037-0.153 mm (0.0015-0.0060 in)
Runout	0.051 mm (0.002 in)
End play	0.051-0.211 mm (0.002-0.008 in)
Cylinder block	
Cylinder bore diameter	98.191 - 98.209 mm (3.866-3.867 in)

SPECIFICATIONS (Continued)**General Specifications (Continued)**

Item	Specification
Cylinder bore maximum taper	0.076 mm (0.003 in)
Cylinder bore maximum out-of-round	0.05 mm (0.002 in)
Main bearing bore inside diameter	85.99-86.01 mm (3.3854-3.3862 in)
Camshaft bearing bore inside diameter	65.98-66.02 mm (2.5976-2.5992 in)
Head gasket surface flatness	0.13 mm (0.005 in) across the total area 0.030 mm (0.0011 in) around fire rings and oil drain holes at 25 mm (0.98 in) length 0.35 mm (0.0014 in) around water jacket holes at 25 mm (0.98 in) length 0.060 mm (0.0024 in) around push rod opening at 25 mm (0.98 in) length
Crankshaft	
Main bearing journal diameter — Standard size	80.9873-81.0127 mm (3.188-3.189 in)
Main bearing journal diameter — 0.254 mm (0.010 in) undersize	80.7333-80.7587 mm (3.178-3.179 in)
Main bearing journal diameter — 0.508 mm (0.020 in) undersize	80.4793-80.5047 mm (3.168-3.169 in)
Main bearing journal diameter — 0.762 mm (0.030 in) undersize	80.2253-80.2507 mm (3.158-3.159 in)
Main bearing journal maximum taper	0.009 mm (0.0003 in)
Main bearing journal maximum out-of-round	0.006 mm (0.0002 in)
Main bearing journal-to-cylinder block clearance	0.014-0.090 mm (0.0006-0.0035 in)
Connecting rod journal diameter	
Standard size	71.9873 to 72.0127 mm (2.834 to 2.835 in)
0.253 mm (0.010 in) undersize	71.7333 to 71.7587 mm (2.824 to 2.825 in)
0.508 mm (0.020 in) undersize	71.4793 to 71.5047 mm (2.814 to 2.815 in)
0.762 mm (0.030 in) undersize	71.2253 to 71.2507 mm (2.804 to 2.805 in)
Connecting rod journal maximum taper	0.017 mm (0.007 in)
Connecting rod journal maximum out-of-round	0.006 mm (0.0002 in)
Crankshaft maximum end play	0.508 mm (0.020 in)
Piston and connecting rod	
Piston diameter — standard size	98.114-98.146 mm (3.8630-3.8640 in)
Piston diameter — 0.254 mm (0.010 in) oversize	98.368-98.400 mm (3.8730-3.8740 in)
Piston diameter — 0.508 mm (0.020 in) oversize	98.622-98.654 mm (3.8830-3.8840 in)
Piston diameter — 0.762 mm (0.030 in) oversize	98.876-98.908 mm (3.8930-3.8940 in)
Piston-to-cylinder bore clearance	0.045-0.095 mm (0.0018-0.0037 in)
Piston ring end gap — top compression	0.29-0.79 mm (0.011-0.031 in)
Piston ring end gap — intermediate compression	1.42-1.930 mm (0.056-0.076 in)
Piston ring end gap — oil control	0.24-0.737 mm (0.009-0.029 in)
Piston ring groove width (measured over 2.10 mm (0.082 in) gauge pins)	Upper limit — 96.606 mm (3.8034 in)
Piston ring groove width (measured over 2.10 mm (0.082 in) gauge pins)	Replacement limit — 96.406 mm (3.7955 in)
Piston ring width	1.990-1.969 mm (0.078-0.077 in)
Piston ring-to-groove clearance — intermediate	0.050-0.096 mm (0.0020-0.0038 in)
Piston ring-to-groove clearance — oil control ring	0.040-0.095 mm (0.0015-0.0037 in)
Piston pin bore diameter	38.511-38.512 mm (1.5162-1.5165 in)
Piston pin diameter	38.491-38.501 mm (1.5154-1.5158 in)
Piston pin length	74.6-75 mm (2.937-2.953 in)
Piston pin-to-piston fit	0.011-0.027 mm (0.0004-0.0011 in)
Connecting rod-to-pin clearance	0.058-0.041 mm (0.0023-0.0016 in)
Connecting rod pin bore diameter	38.542-38.550 mm (1.517-1.577 in)
Connecting rod length (center-to-center)	176 mm (6.929 in)

SPECIFICATIONS (Continued)**General Specifications (Continued)**

Item	Specification
Connecting rod maximum allowed bend	0.025 mm (0.001 in)
Connecting rod maximum allowed twist	0.05 mm (0.002 in)
Connecting rod bearing bore diameter	75.987-76.013 mm (2.9916-2.9926 in)
Connecting rod bearing-to-crankshaft clearance	0.0152-0.089 mm (0.0006-0.0035 in)
Connecting rod side clearance	0.230-1.067 mm (0.009-0.042 in)
Miscellaneous	
Exhaust manifold warpage — maximum allowable clearance (cold)	0.075 mm (0.030 in)
Intake manifold warpage — between ports	0.10 mm (0.004 in)
Intake manifold warpage — total	0.60 mm (0.024 in)
Oil pump end clearance (inner and outer rotor to housing)	0.060-0.105 mm (0.002-0.004 in)
Oil pump radial clearance (peak to peak)	0.50-0.180 mm (0.002-0.007 in)
Vibration damper face runout (max)	0.635 mm (0.025 in)
Vibration damper rubber bulging (max)	1.5 mm (0.059 in)
Push rod runout (max)	0.50 mm (0.02 in)
Piston height above crankcase deck (protrusion)	0.6096-0.8636 mm (0.024-0.034 in)
Oil pump flow rate	13 GPM @ 3,000 rpm
Camshaft position (CMP) sensor and crankshaft position (CKP) sensor air gap — Minimum	0.25 mm (0.01 in)
CMP sensor and CKP sensor air gap — Nominal	0.89 mm (0.035 in)
CMP sensor and CKP sensor air gap — Maximum	1.53 mm (0.060 in)
Trigger wheel runout (max)	0.35 mm (0.0137 in)
Fuel injection pump drive gear backlash	0.13-0.33 mm (0.005-0.013 in)
Maximum wear step at ring turn around (ring ridge)	0.152 mm (0.005 in)
Lower crankcase groove depth and width	4.242 mm (0.167 in) maximum

a Refer to the Cylinder Head Distortion procedure in this section.

Torque Specifications

Description	Nm	lb-ft	lb-in
Accessory drive belt idler pulley bolt	47	35	—
Accessory drive belt tensioner bolt	47	35	—
A/C compressor bolts	25	18	—
A/C condenser bolts	8	—	71
A/C drive belt tensioner bolt	47	35	—
A/C hose nut	15	—	133
Air cleaner outlet pipe clamps	5	—	44
Automatic transmission fluid indicator tube nut	8	—	71
Battery cable bracket nut	25	18	—
Battery cable nut	10	—	89
Battery ground cable-to-engine block bolt	47	35	—
Block heater	41	30	—
Body bolts	90	66	—
Body ground strap bolt	25	18	—
Camshaft position (CMP) sensor	13	—	115
Camshaft thrust plate-mounting bolts	31	23	—

SPECIFICATIONS (Continued)**Torque Specifications (Continued)**

Description	Nm	lb-ft	lb-in
Charge air cooler (CAC) bolts	22	16	—
CAC duct clamps (metal duct side)	8	—	71
CAC duct clamps (engine and CAC side)	12	—	106
Connecting rod bearing cap bolts ^a	—	—	—
Coolant pump bolts	31	23	—
Coolant pump pulley bolts	31	23	—
Cooling fan stator nuts and bolts	25	18	—
Cooling fan stator stand offs	47	35	—
Crankcase vent oil separator bolts	13	—	115
Crankcase vent oil separator tube clip bolts	25	18	—
Crankcase vent oil separator tube retaining nut	13	—	115
Crankshaft position (CKP) sensor	13	—	115
Crankshaft pulley bolts ^a	—	—	—
Cylinder block coolant drain plug ^b	20	—	177
Cylinder head bolts ^a	—	—	—
Degas bottle tray bolts	19	—	168
Engine front cover bolts	31	23	—
Engine mount center bolt	350	258	—
Engine mount nuts — LH	200	148	—
Engine mount nuts — RH	115	85	—
Engine mount-to-engine bracket bolts ^a	—	—	—
Engine rear cover bolts (M8)	31	23	—
Engine rear cover bolts (M10)	62	46	—
Engine wire harness bolt	8	—	71
EGR coolant adapter bolt	13	—	115
EGR coolant hose constant tension worm gear clamps	4	—	35
EGR cooler clamps ^a	—	—	—
EGR cooler coolant tube bolts	13	—	115
EGR cooler hose clamp	4	—	35
EGR cooler outlet studs	17	—	150
EGR-oxidation catalytic converter (OC) bracket bolt-to-cylinder block	62	46	—
EGR-OC bracket bolts	31	23	—
EGR-OC bracket nut and bolt	31	23	—
EGR-OC tube-to-horizontal EGR cooler bolts	31	23	—
EGR-OC tube-to-right inlet pipe bolts	31	23	—
Exhaust Gas Recirculation Temperature (EGRT) sensor, inlet (EGRT-1)	44	32	—
Exhaust downpipe bolts	40	30	—
Exhaust manifold bolts and stud bolts ^a	—	—	—
Exhaust manifold flange studs	18	—	159
Exhaust manifold heat shield mounting nuts and bolts	19	—	168
Exhaust manifold heat shield spacers	19	—	168
Exhaust pressure (EP) sensor connector-to-EGR OC tube fitting	27	20	—

SPECIFICATIONS (Continued)**Torque Specifications (Continued)**

Description	Nm	lb-ft	lb-in
EP sensor mounting nut	9	—	80
EP sensor tube nut	20	—	177
Fan clutch hub-to-coolant pump	150	111	—
Flywheel/flexplate mounting bolts ^a	—	—	—
Front bumper mounting bolts	47	35	—
Front end accessory drive nuts and bolts	47	35	—
Front end accessory drive studs (with pre-applied sealant)	9	—	80
Front impact severity sensor bolt	12	—	106
Fuel cooler bolts ^a	—	—	—
Fuel cooler nuts ^a	—	—	—
Fuel cooler radiator bolt	12	—	106
Fuel cooler stud bolts ^a	—	—	—
Fuel cooling pump bolts	3	—	27
Fuel filter cap	27	20	—
Fuel filter module bolts	13	—	115
Fuel injection pump supply tube retainer nuts	11	—	97
Fuel injector hold-down bolt ^a	—	—	—
Fuel injector return tube nut-to-check valve	38	28	—
Fuel injector return tube retainer bolts	13	—	115
Fuel injector return tube retainer nut	11	—	97
Fuel pump heat shield fuel line bracket	7	—	62
Fuel pump heat shield nuts and bolts	13	—	115
Fuel rail supply tube ^a	—	—	—
Fuel rail supply tube retainer bolts	13	—	115
Fuel return plug (back of head)	27	20	—
Fuel supply and return tube clamp bolt	31	23	—
Generator B+ wire nut	8	—	71
Glow plug	14	—	124
Glow plug module mounting bracket bolts	13	—	115
Ground wire nut	13	—	115
Heater hose tube nut and bolts (supply and return)	13	—	115
High-pressure fuel pump cover bolts	13	—	115
High-pressure fuel pump gear bolt	78	58	—
High-pressure fuel pump mounting bolts	62	46	—
High-pressure fuel pump tube nut	38	28	—
High-pressure fuel tube fittings ^a	—	—	—
High pressure pump adapter (303-765)	12	—	106
High-pressure rail mounting bolts ^a	—	—	—
Hood bolts	13	—	115
Horizontal EGR cooler outlet nuts	31	23	—
Intake manifold bolts ^a	—	—	—

SPECIFICATIONS (Continued)**Torque Specifications (Continued)**

Description	Nm	lb-ft	lb-in
Intake throttle adapter bolts	10	—	89
LH valve cover bracket assembly nuts	31	23	—
LH valve cover bracket nuts	9	—	80
Lower crankcase main bearing bolts ^a	—	—	—
Lower fan shroud bolts	7	—	62
M12 banjo bolts with copper sealing washer	38	28	—
M12 banjo bolts with Viton® sealing washers	25	18	—
M14 banjo bolts with copper sealing washer	47	35	—
M14 banjo bolts with Viton® sealing washers	28	21	—
Master cylinder nuts	30	22	—
Oil cooler bolts	31	23	—
Oil cooler cover screws — new cover	10	—	89
Oil cooler cover screws — used cover	7	—	62
Oil filter cap	25	18	—
Oil filter housing bolts	22	16	—
Oil filter return tube screw — new	7	—	62
Oil filter return tube screw — used	5	—	44
Oil level indicator tube bolt	13	—	115
Oil level indicator tube nut	31	23	—
Oil pan bolt — lower	13	—	115
Oil pan bolts — upper	13	—	115
Oil pan drain plug	44	32	—
Oil pickup tube flange bolts	13	—	115
Oil pressure regulator plug	35	26	—
Oil pump housing bolts — long bolts	31	23	—
Oil pump housing bolts — short bolts	22	16	—
Piston cooling tube bolt ^c	13	—	115
Power steering pump bolts	25	18	—
Power steering tube nut	25	18	—
Radiator strap bolts	10	—	89
RH engine mount studs	80	59	—
Rocker arm assembly bolts ^a	—	—	—
Running board bolts	13	—	115
Starter control wire nut	6	—	53
Starter mounting bolts	25	18	—
Starter positive cable nut	12	—	106
Steering damper nut	35	26	—
Steering shaft bolt	48	35	—
Thermostat housing retaining bolts	13	—	115
Torque converter nuts	35	26	—
Transmission cooler bolts	11	—	97
Transmission cooler tubes nut	9	—	80
Transmission external filter tube nuts (early build)	40	30	—

SPECIFICATIONS (Continued)**Torque Specifications (Continued)**

Description	Nm	lb-ft	lb-in
Transmission mount nuts	115	85	—
Transmission-to-engine bolts	47	35	—
Turbocharger bolts (M14, socket head, class 12.9)	201	148	—
Turbocharger crossover tube bolts	31	23	—
Turbocharger downpipe clamp nut	15	—	133
Turbocharger heat shield bolts	11	—	97
Turbocharger inlet pipe-to-exhaust manifold nuts	31	23	—
Turbocharger inlet pipe-to-turbocharger bolts	25	18	—
Turbocharger lifting bracket bolts (303-1266)	20	—	177
Turbocharger oil supply banjo bolts with copper sealing washer	38	28	—
Turbocharger oil supply banjo bolts with Viton® sealing washers	25	18	—
Turbocharger oil supply standoff fittings	47	35	—
Turbocharger oil supply tube bolt	13	—	115
Turbocharger pedestal bolts	62	46	—
Valve cover base bolts	13	—	115
Valve cover bolts	9	—	80
Valve tappet guide bolts	13	—	115
Vertical EGR cooler bracket bolt (M10)	62	46	—
Vertical EGR cooler bracket bolts (M8)	31	23	—
Vertical EGR cooler-to-EGR valve housing nut and bolt	31	23	—
Vertical EGR cooler-to-EGR valve housing stud	17	—	150
Vertical EGR cooler retaining clip nut	12	—	106

a Refer to the procedure in this section.

b Apply clean engine oil before installing.

c Apply Threadlock 262 to the bolt threads prior to installing.

Standard Torques — Class 10.9 Metric Bolts and Studs

Thread Diameter	Thread Pitch (mm/thread)	Torque ^a
6 mm	1	13 Nm (115 lb-in)
8 mm	1.25	31 Nm (23 lb-ft)
10 mm	1.5	62 Nm (46 lb-ft)
12 mm	1.75	107 Nm (79 lb-ft)
14 mm	2	172 Nm (127 lb-ft)
15 mm	2	216 Nm (159 lb-ft)
16 mm	2	266 Nm (196 lb-ft)
18 mm	2.5	368 Nm (271 lb-ft)
20 mm	2.5	520 Nm (384 lb-ft)

a Tolerances are ± 10% of nominal value.

Standard Torques — Class 12.9 Metric Bolts and Studs

Thread Diameter	Thread Pitch (mm/thread)	Torque ^a
6 mm	1	15 Nm (133 lb-in)
8 mm	1.25	36 Nm (27 lb-ft)
10 mm	1.5	72 Nm (53 lb-ft)

SPECIFICATIONS (Continued)**Standard Torques — Class 12.9 Metric Bolts and Studs (Continued)**

Thread Diameter	Thread Pitch (mm/thread)	Torque ^a
12 mm	1.75	126 Nm (93 lb-ft)
14 mm	2	201 Nm (148 lb-ft)
15 mm	2	252 Nm (186 lb-ft)
16 mm	2	311 Nm (229 lb-ft)
18 mm	2.5	430 Nm (317 lb-ft)
20 mm	2.5	608 Nm (449 lb-ft)

^a Tolerances are $\pm 10\%$ of nominal value.