

Troubleshooting

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed drive plate(or fly wheel).	Repair or replace the drive plate(or fly wheel) as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression . Repair or replace as required.
	Worn crankshaft thrust bearings.	Replace the crankshaft and bearings as required.
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem can cause the valve not to close properly.)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and HLA.
Engine misfire with coolant consumption.	•Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and engine block cooling system. •Coolant consumption may or may not cause the engine to overheat.	•Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. •Repair or replace as required.
Engine misfire with excessive oil consumption.	Worn valves, valve guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	Inspection the cylinder for a loss of compression. Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity.	Drain the oil. Install the correct viscosity oil.

	Worn crankshaft thrust bearing.	Inspect the thrust bearing and crankshaft. Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	Inspect the camshaft lobes. Replace the camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.)	Inspect the valves and valve guides, then repair as required.
Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace damaged components as required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil pump screen.	Inspect the oil pan. Inspect the oil pump screen. Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	Inspect the oil pump screen. Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	Inspect the piston and cylinder bore. Repair as required.

Excessive piston pin-to-bore clearance.	Inspect the piston, piston pin and the connecting rod. Repair or replace as required.
Excessive connecting rod bearing clearance.	Inspect the following components and repair as required. •The connecting rod bearings. •The connecting rods. •The crankshaft. •The crankshaft journal.
Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. •The crankshaft bearings. •The crankshaft journals.
Incorrect piston, piston pin and connecting rod installation.	Verify the piston pins and connecting rods are installed correctly. Repair as required.
Low oil pressure.	Repair or replace as required.
Excessive connecting rod bearing clearance.	Inspect the following components and repair as required. •The connecting rod bearings. •The connecting rods. •The crankshaft.
Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. •The crankshaft bearings. •The crankshaft journals. •The cylinder block crankshaft bearing bore.

Engine will not crank. (crankshaft will not rotate)	Hydraulically locked cylinder. •Coolant/antifreeze in cylinder. •Oil in cylinder. •Fuel in cylinder.	Remove spark plugs and check for fluid. Inspect for broken head gasket. Inspect for cracked engine block or cylinder head. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain gears.	Inspect timing chain and gears. Repair as required.
	Foreign material in cylinder. •Broken valve. •Piston material. •Foreign material.	Inspect cylinder for damaged components and/or foreign materials. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	Inspect crankshaft and connecting rod bearing. Repair or replace as required.
	Bent or broken connecting rod.	Inspect connecting rods. Repair or replace as required.
	Broken crankshaft.	Inspect crankshaft. Repair or replace as required.

Specifications

Description		Specifications	Limit
General			
Type		In-line, DOHC	
Number of cylinders		4	
Bore		75.60 mm (2.9764 in)	
Stroke		89.00 mm (3.5039 in.)	
Total displacement		1,598 cc (97.52 cu.in)	
Compression ratio		10.5 ± 0.2 : 1	
Firing order		1-3-4-2	
Valve timing			
Intake valve	Opens	BTDC 93° - ATDC 17.5°	
	Closes	ABDC 35.5° - ABDC 86°	
Exhaust valve	Opens	BBDC 43° - ABDC 7°	
	Closes	ATDC 0° - ATDC 50°	
Cylinder head			
Flatness of gasket surface		Less than 0.05 mm (0.0020 in) for total area Less than 0.02 mm (0.0008 in) for a section of 100 mm (3.9370 in) x 100 mm (3.9370 in)	
Camshaft			
Cam height	Intake	37.32 mm (1.4693 in)	
	Exhaust	37.44 mm (1.4740 in)	
Journal outer diameter (Intake, Exhaust)	No.1	36.451 - 36.467 mm (1.4351 - 1.4357 in)	
	No.2, 3, 4, 5	22.956 - 22.972 mm (0.9038 - 0.9044 in)	
Camshaft cap oil clearance	No.1	0.040 - 0.071 mm (0.0016 - 0.0028 in)	

	No.2, 3, 4, 5	0.035 - 0.066 mm (0.0014 - 0.0026 in)	
End play		0.10 - 0.19 mm (0.0039 - 0.0075 in)	
Valve			
Valve length	Intake	112.84 mm (4.4425 in)	
	Exhaust	122.83 mm (4.8358 in)	
Stem outer diameter	Intake	5.465 - 5.480 mm (0.2152 - 0.2157 in)	
	Exhaust	5.458 - 5.470 mm (0.2149 - 0.2154 in)	
Face angle		45.25° - 45.75°	
Thickness of valve head (margin)	Intake	0.7 mm (0.0276 in)	
	Exhaust	0.91 mm (0.0358 in)	
Valve stem to valve guide clearance	Intake	0.025 - 0.052 mm (0.0010 - 0.0020 in)	
	Exhaust	0.035 - 0.059 mm (0.0014 - 0.0023 in)	
Valve guide			
Inner diameter		5.505 - 5.517 mm (0.2167 - 0.2172 in)	
Valve spring			
Free length	Intake	52.55 mm (2.0689 in)	
	Exhaust	50.00 mm (1.9685 in.)	
Out of squareness		Less than 1.5°	
Cylinder block			
Cylinder bore		75.60 - 75.63 mm (2.9764 - 2.9776 in)	

Flatness of gasket surface		Less than 0.05 mm (0.0020 in) for total area Less than 0.02 mm (0.0008 in) for a section of 100 mm (3.9370 in) x 100 mm (3.9370 in)	
Piston			
Piston outer diameter		75.555 - 75.585 mm (2.9746 - 2.9758 in)	
Piston to cylinder clearance		0.035 - 0.055 mm (0.0014 - 0.0022 in)	
Ring groove width	No. 1 ring groove	1.230 - 1.250 mm (0.0484 - 0.0492 in)	
	No. 2 ring groove	1.030 - 1.050 mm (0.0406 - 0.0413 in)	
	Oil ring groove	2.030 - 2.045 mm (0.0799 - 2.0805 in.)	
Piston ring			
Piston ring width	No. 1 ring	1.170 - 1.190 mm (0.0461 - 0.0469 in)	
	No. 2 ring	0.970 - 0.990 mm (0.0382 - 0.0390 in)	
	Oil ring	1.920 - 1.960 mm (0.0756 - 0.0772 in)	
Side clearance of piston to piston ring	No.1 ring	0.040 - 0.080 mm (0.0016 - 0.0031 in)	
	No.2 ring	0.040 - 0.080 mm (0.0016 - 0.0031 in)	
	Oil ring	0.050 - 0.105 mm (0.0020 - 0.0041 in)	
End gap	No. 1 ring	0.14 - 0.19 mm (0.0055 - 0.0075 in)	
	No. 2 ring	0.20 - 0.30 mm (0.0079 - 0.0118 in.)	

	Oil ring	0.10 - 0.40 mm (0.0039 - 0.0157 in)	
Piston pin			
Piston pin outer diameter		18.997 - 19.000 mm (0.7479 - 0.7480 in)	
Piston pin hole inner diameter		19.004 - 19.009 mm (0.7482 - 0.7484 in)	
Piston pin hole clearance		0.004 - 0.012 mm (0.0002 - 0.0005 in)	
Connecting rod small end hole inner diameter		19.005 - 19.011 mm (0.7482 - 0.7485 in)	
Connecting rod small end hole clearance		0.005 - 0.014 mm (0.0002 - 0.0006 in)	
Connecting rod			
Connecting rod big end inner diameter		45.000 - 45.018 mm (1.7717 - 1.7724 in)	
Connecting rod bearing oil clearance		0.037 - 0.055 mm (0.0015 - 0.0022 in)	
Side clearance		0.1 - 0.25 mm (0.0039 - 0.0098 in)	
Crankshaft			
Main bearing oil clearance	No. 1, 2, 3, 4, 5	0.030 - 0.048 mm (0.0012 - 0.0019 in)	
End play		0.100 - 0.280 mm (0.0039 - 0.0110 in)	
Engine oil			
Oil quantity	Total	5.0 L (1.32 U.S.gal., 5.28 U.S.qt., 4.4 imp.qt.)	When replacing a short engine or a block assembly
	Oil pan	4.4 L (1.16 U.S.gal., 4.65 U.S.qt., 3.87 imp.qt.)	
	Drain and refill	4.8 L (1.27 U.S.gal., 5.07 U.S.qt., 4.22 imp.qt.)	Including oil filter

Oil grade	Specification	SAE 0W-20, API SN PLUS (or above grade) ☐ •Refer to the "Lubrication System" for recommended SAE viscosity number.	
Oil pressure (at 1000rpm)		98.07 kPa (1.0 kgf/cm ² , 14.22 psi) or above	Oil temperature in oil pan : 108 - 112 °C (226.4 - 233.6 °F)
Cooling system			
Cooling method		Forced circulation with water pump	
Coolant quantity		Approx. 6.8 L (1.79 US.gal., 7.19 US,qt., 5.98 Imp.qt.)	
Coolant Radiator cap	Main valve opening pressure	125.3 - 154.7 kPa (1.28 - 1.58 kgf/cm ² , 22.44 - 18.17 psi)	
	Vacuum valve opening pressure	MAX. 6.8 kPa(0.07 kgf/cm ² , 1.00 psi)	

Tightening Torques

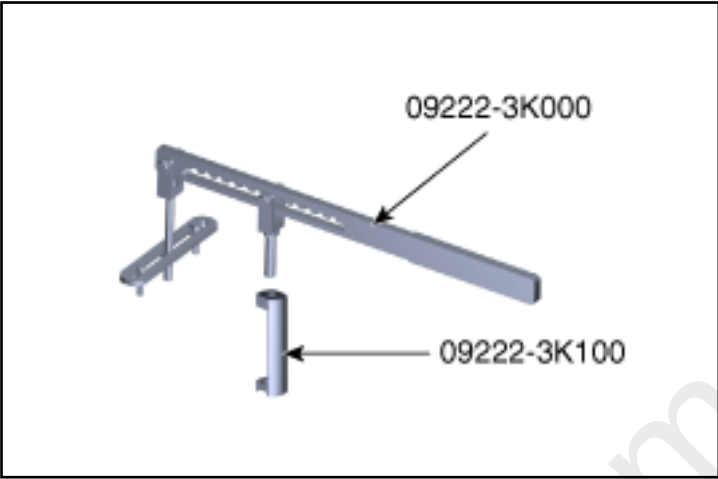
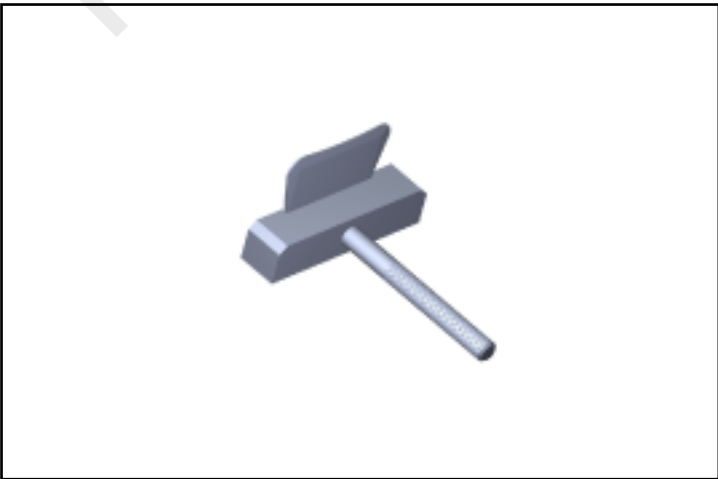
Item	N.m	kgf.m	lb-ft
Engine mounting			
Engine mounting bracket to body fixing bolt	63.7 - 83.4	6.5 - 8.5	47.0 - 61.5
Engine mounting support bracket to engine mounting insulator fixing nut	88.3 - 107.9	9.0 - 11.0	65.1 - 79.6
Engine mounting support bracket to engine fixing bolt	88.3 - 107.9	9.0 - 11.0	65.1 - 79.6
Engine mounting support bracket to engine fixing nut	88.3 - 107.9	9.0 - 11.0	65.1 - 79.6
Transaxle mounting bracket to body fixing bolt	63.7 - 83.4	6.5 - 8.5	47.0 - 61.5
Transaxle mounting bracket to transaxle mounting support bracket fixing bolt	107.9 - 127.5	11.0 - 13.0	79.6 - 94.0

Roll rod bracket to sub frame fixing bolt	49.0 - 63.7	5.0 - 6.5	36.2 - 47.0
Roll rod bracket to roll rod support bracket fixing nut	107.9 - 127.5	11.0 - 13.0	79.6 - 94.0
Drive belt system			
Drive belt tensioner bolt [M8]	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Drive belt tensioner bolt [M10]	34.3 - 41.2	3.5 - 4.2	25.3 - 30.4
Crankshaft damper pulley bolt	[66.7 - 70.6] + [98 - 102°]	[6.8 - 7.2] + [98 - 102°]	[49.2 - 52.1] + [98 - 102°]
Timing chain			
Timing chain cover bolt (A,B,C,D)	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Timing chain cover bolt (E,F)	39.2 - 44.1	4.0 - 4.5	28.9 - 32.5
Cam to cam guide	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain tensioner bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain tensioner arm bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain guide bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Oil pump chain tensioner bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Variable force solenoid valve(VFS) bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Cylinder head			
Cylinder head cover bolt	[3.9 - 5.9] + [7.8 - 9.8]	[0.4 - 0.6] + [0.8 - 1.0]	[2.9 - 4.3] + [5.8 - 7.2]
Cam carrier bolt	18.6 - 22.6	1.9 - 2.3	13.7 - 16.6
Camshaft bearing cap bolt (M6)	[4.9 - 6.9] + [11.8 - 13.7]	[0.5 - 0.7] + [1.2 - 1.4]	[3.6 - 5.1] + [8.7 - 10.1]
Camshaft bearing cap bolt (M8)	[4.9 - 6.9] + [9.8 - 11.8] + [18.6 - 22.6]	[0.5 - 0.7] + [1.0 - 1.2] + [1.9 - 2.3]	[3.6 - 5.1] + [7.2 - 8.7] + [13.7 - 16.6]
Camshaft front bearing cap bolt (M8)	[4.9 - 6.9] + [9.8 - 11.8] + [18.6 - 22.6]	[0.5 - 0.7] + [1.0 - 1.2] + [1.9 - 2.3]	[3.6 - 5.1] + [7.2 - 8.7] + [13.7 - 16.6]
Cylinder head bolt	[29.4] + [90°] + [90°]	[3.0] + [90°] + [90°]	[21.7] + [90°] + [90°]

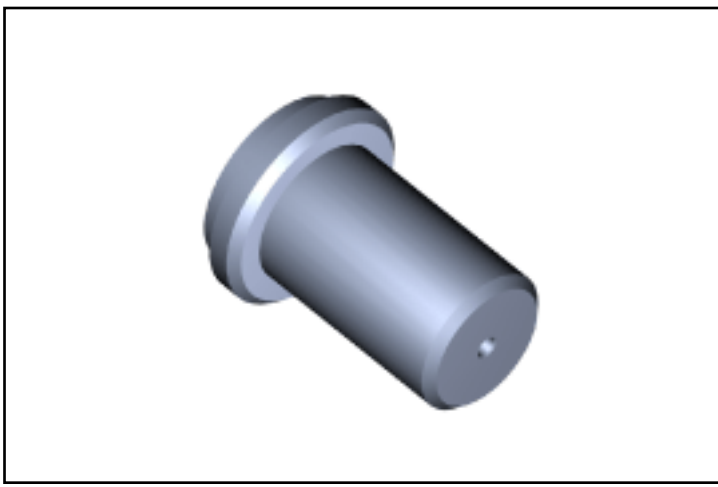
Intake OCV (Oil control valve) & center bolt	[22.6 - 26.5] + [32 - 36°]	[2.3 - 2.7] + [32 - 36°]	[16.6 - 19.5] + [32 - 36°]
Exhaust OCV (Oil control valve) & center bolt	[22.6 - 26.5] + [32 - 36°]	[2.3 - 2.7] + [32 - 36°]	[16.6 - 19.5] + [32 - 36°]
Cylinder block			
Drive plate bolt	71.6 - 75.5	7.3 - 7.7	52.8 - 55.7
Fly wheel bolt	71.6 - 75.5	7.3 - 7.7	52.8 - 55.7
Connecting rod bearing cap bolt	[17.7 - 21.6] + [68 - 72°]	[1.8 - 2.2] + [68 - 72°]	[13.0 - 15.9] + [68 - 72°]
Crankshaft position sensor (CPS) wheel bolt	12.7 - 13.7	1.3 - 1.4	9.4 - 10.1
Crankshaft bearing cap bolt	[27.5 - 31.4] + [118 - 122°]	[2.8 - 3.2] + [118 - 122°]	[20.3 - 23.1] + [118 - 122°]
Piston cooling jet bolt	8.8 - 12.7	0.9 - 1.3	6.5 - 9.4
Crank lower case	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Cooling system			
Water pump pulley bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Water pump bolt	11.8 - 13.7	1.2 - 1.4	8.7 - 10.1
Heater pipe (A) bolt & nut	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Heater pipe (B) M8 bolt	14.7 - 21.6	1.5 - 2.2	10.8 - 15.9
Water inlet fitting nut	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Integrated thermal management module (ITM) bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Lubrication system			
Oil filter	34.3	3.5	25.3
Oil pan bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Oil pan drain plug bolt	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5
Oil pump bolt	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Oil filter bolt	22.6 - 27.5	2.3 - 2.8	16.6 - 20.3
Oil cooler bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Intake and exhaust system			

Intake manifold bolt & nut	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Warmup catalytic converter upper stay bracket	39.2 - 44.1	4.0 - 4.5	28.9 - 32.5
Warmup catalytic converter lower stay bracket	49.0 - 53.9	5.0 - 5.5	36.2 - 39.8
Warmup catalytic converter stay nut	35.3 - 41.2	3.9 - 4.2	26.0 - 30.4
Intercooler inlet pipe bolt	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Turbo charger coolant outlet hose eyebolt	34.3 - 39.2	3.5 - 4.0	25.3 - 28.9
Turbo charger coolant inlet hose eyebolt	34.3 - 39.2	3.5 - 4.0	25.3 - 28.9
Oil feed pipe eyebolt	16.7 - 21.6	1.7 - 2.2	12.3 - 15.9
Oil drain pipe	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Exhaust manifold heat protector A bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Exhaust manifold heat protector B bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Turbocharger nut	49.0 - 53.9	5.0 - 5.5	36.2 - 39.8
Muffler nut	39.2 - 58.8	4.0 - 6.0	28.9 - 43.4

Special Service
Tools

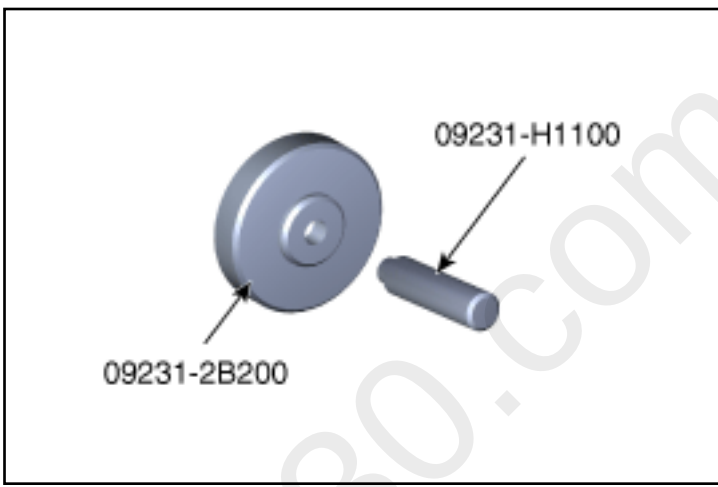
Tool (Number and name)	Illustration	Use
Valve spring compressor (09222-3K000) Valve spring compressor adapter (09222-3K100)	 The illustration shows a valve spring compressor tool, labeled 09222-3K000, which is a long, thin metal bar with a hook at one end and a threaded section at the other. A valve spring compressor adapter, labeled 09222-3K100, is shown separately. It is a short, thick metal rod with a flange at one end and a threaded section at the other. The tools are shown in a 3D perspective view.	Removal and installation of the intake / exhaust valve spring and retainer lock
Valve stem seal installer (09222-2B100)	 The illustration shows a valve stem seal installer tool, labeled 09222-2B100. It is a long, cylindrical metal rod with a textured, knurled section in the middle and a smooth, polished section at one end. The tool is shown in a 3D perspective view.	Installation of the valve stem seal
Oil pan remover (09215-3C000)	 The illustration shows an oil pan remover tool, labeled 09215-3C000. It is a T-shaped metal tool with a flat, rectangular head and a long, thin handle. The tool is shown in a 3D perspective view.	Removal of oil pan

Crankshaft front oil seal installer
(0K231-2C200)



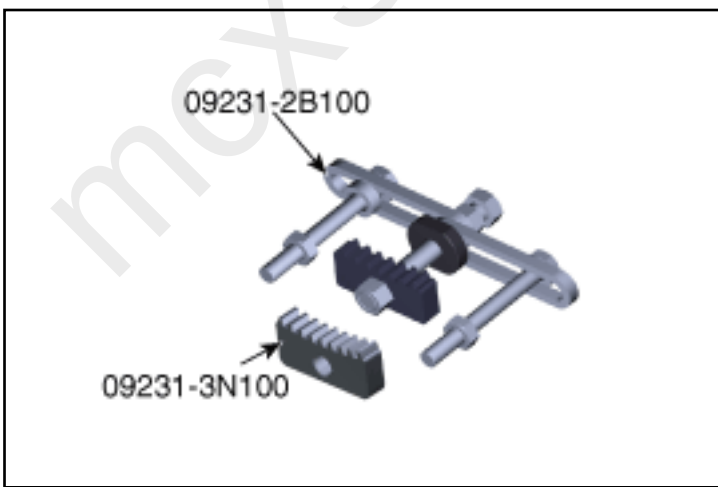
Installation of the crankshaft front oil seal

Crankshaft rear oil seal installer
(09231-2B200)
Handle
(09231-H1100)



Installation of the crankshaft rear oil seal

Ring gear stopper
(09231-3N100)
(09231-2B100)



Removal and installation of crankshaft damper pulley bolt