**New Engine Disassembly Procedure**

The new Toyota 2NR-FE engine is delivered as a long block assembly. If the engine is equipped with a flywheel assembly, remove the flywheel. Install the engine on a suitable engine stand in the engine build area.

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|  | Refer to Figure 1:   1. Drain engine oil by removing the oil drain plug (A) with a 14 mm socket wrench. 2. Remove oil filter (B). 3. Disconnect the positive crankcase valve (PCV) hose (C) from the valve cover and intake manifold connections, and remove. 4. Using a 10 mm socket wrench, remove three (3) bolts on the stock throttle body (D), and remove. 5. Using an adjustable wrench, remove the oil pressure sensor (E). 6. Using a 10 mm socket wrench, remove the bolt to remove the crankshaft position sensor (F). |
| Figure 1 |  |
|  | Refer to Figure 2:   1. Unplug all connections on the engine wiring harness (A), and remove. 2. Using a 10 mm socket wrench, remove the bolt at the coolant inlet pipe bracket (B), and remove and remove the coolant inlet pipe and O-ring. 3. Using a 10 mm socket wrench, remove two (2) bolts on the coolant outlet assembly (C), and remove the coolant outlet assembly and gasket. 4. Using an adjustable wrench, remove the coolant temperature sensor unit (D). 5. Using a 10 mm socket wrench, remove the four (4) bolts on the ignition coil packs (E), and remove the ignition coil packs. 6. Using a 16 mm spark plug socket wrench, remove the four (4) spark plugs. |
| Figure 2 |  |
|  | Refer to Figure 3:   1. Using a 10 mm socket wrench, remove the ten (10) bolts from the valve cover. 2. Remove the valve cover and the valve cover gasket. If the gasket is stuck to the cylinder head, carefully use a plastic scraper to cut through the RTV sealant at the front cover to release the gasket. |
| Figure 3 |  |
|  | Refer to Figure 4:   1. Insert the prongs of the crankshaft pulley installation tool (OHT p/n OHTIVB-09960-1) into the holes of the crankshaft pulley. Hold onto the handle to prevent the crankshaft from rotating. 2. Using a 19 mm socket wrench, remove the crankshaft pulley bolt, and remove the crankshaft pulley. |
| Figure 4 |  |
|  | Refer to Figure 5:   1. Using a 14 mm socket wrench, remove the three (3) bolts on the engine mounting bracket. |
| Figure 5 |  |
|  | Refer to Figure 6:   1. Using the appropriate socket wrench, remove the thirteen (13) bolts on the engine front cover. The four (4) circled bolts must be removed with a 14 mm socket wrench. The remaining nine (9) bolts must be removed with a 10 mm socket wrench. |
| Figure 6 |  |
|  | Refer to Figure 7:   1. Using a flat-head screwdriver, remove the front cover by prying at the four indicated positions shown.   **NOTE: Tape the tip of the screwdriver to prevent damaging the contact surfaces between the engine front cover, engine block, oil pan, and cylinder head.** |
| Figure 7 |  |
|  | Refer to Figure 8:   1. Remove the front cover gasket and two O-rings, as indicated. |
| Figure 8 |  |
|  | 1. Rotate the engine crankshaft clockwise until the cylinder #1 piston is at top-dead-center (TDC) of the compression stroke, which can be confirmed with the following visual cues. The directions noted in the following description are valid when viewing the engine from the front.    1. Cylinder 1 intake cam lobes are pointed towards the left (see Figure 9).    2. Cylinder 1 exhaust cam lobes are pointed towards the right (see Figure 9).    3. Rectangular marks on the camshaft sprockets are positioned vertically (see Figure 9).    4. TDC mark on the crankshaft pulley is aligned with the TDC mark inscribed on the front cover (see Figure 10) |
| Figure 9 |
|  |
| Figure 10 |
|  | Refer to Figure 11:   1. Using a plastic scraper, clean all residual RTV sealant from the surfaces of the engine oil pan, engine block, and cylinder that were contact the engine front cover. |
| Figure 11 |  |

This concludes the new engine disassembly procedure. Please ship the unmodified Toyota front cover to the central parts distributor, OHT, for modification into a test part.

**OHT Front Cover (OHT p/n OHTIVB-003-1) Assembly Procedure**

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|  | Refer to Figure 12:   1. Install the oil pump gears into the OHT front cover with the triangular marks matched with the markings on the housing. 2. Apply a light coat of EF-411 assembly fluid on the gears and mating surfaces. |
| Figure 12 |  |
|  | Refer to Figure 13:   1. Install the pressure relief valve (A) into the oil pump cover. |
| Figure 13 |  |
|  | Refer to Figure 14:   1. Install the oil pump cover. Tighten indicated screws to 10 Nm (7 lbf-ft) using a Phillips-head driver adapted to a torque wrench. |
| Figure 14 |  |
|  | Refer to Figure 15:   1. Clean and degrease the front cover mating surfaces, shaded in gray. A light-duty cleaning pad, such as Scotch-BriteTM aluminum silicate white light cleansing pad, may be used to remove residual RTV sealant from the mating surface. |
| Figure 15 |  |
|  | Refer to Figure 16:   1. Install OHT O-ring seal (OHT p/n OHTIVB-003-2) into the O-ring groove. Use a suitable adhesive, such as petroleum jelly to hold the O-ring in place. 2. Apply Toyota Three Bond Black 1292B, or equivalent RTV sealant, to the highlighted areas.   **Note: Keep RTV sealant on the outside of the O-ring to prevent contamination with engine oil.** |
| Figure 16 |  |

**New Engine Reassembly Procedure**

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|  | Refer to Figure 17:   1. Apply a light coat of EF-411 assembly fluid to a new gasket (OHT p/n OHTIVB-19023-1) and two (2) new O-rings (OHT p/n OHTIVB-27014-1 and p/n OHTIVB-09031-1). 2. Install the gasket to position A. Install O-ring p/n 90301-27014 to position B. Install O-ring p/n 90301-09301 to position C.   **Note: Be careful not to drop any oil on the contact surfaces for the front cover, cylinder head, engine block, and oil pan.** |
| Figure 17 |  |
|  | Refer to Figure 18:   1. Ensure that flats on the crankshaft are oriented in the vertical direction on the left and right sides of the crankshaft. 2. Rotate by hand the oil pump rotor until the spline notches on the inner diameter of the rotor are oriented on the left and right sides of the rotor. |
| Figure 18 |  |
|  | Refer to Figure 19:   1. Install the OHT front cover onto the engine. Ensure that the oil pump rotor spline properly fits onto the crankshaft. 2. Install the front engine mounting bracket (highlighted). 3. Install the eighteen (18) bolts as indicated. The length of each bolt is designated in Table 1, below. Hand-tighten only.   **Note: Stock front cover is displayed in Figure 19 for illustration purposes only. OHT modified front cover should be used.**  Table 1: Bolt dimensions and target torques in Figure 19   |  |  |  |  | | --- | --- | --- | --- | | Item | Length | Thread Diameter | Target Torque | | Bolts A, E | 25 mm  (0.984 in) | 8 mm  (0.315 in) | 24 N-m  (18 ft-lbf) | | Bolt B | 40 mm  (1.57 in) | 10 mm  (0.394 in) | 51 N-m  (38 ft-lbf) | | Bolt C | 40 mm  (1.57 in) | 8 mm  (0.315 in) | 24 N-m  (18 ft-lbf) | | Bolt D | 70 mm  (2.76 in) | 10 mm  (0.394) | 51 N-m  (38 ft-lbf) |  1. Apply Toyota Genuine Adhesive 1324, Three Bond 1324, or equivalent, to Bolt E before installing. |
| Figure 19 |  |
|  | Refer to Figure 20:   1. Tighten the eighteen (18) bolts to the target torque in the sequence shown.   **Note: Stock front cover is displayed in Figure 20 for illustration purposes only. OHT modified front cover should be used.** |
| Figure 20 |  |
|  | Refer to Figure 21:   1. Apply MP grease to the lip of a new crankshaft oil seal (OHT p/n OHTIVB-90311-1). Make sure that the lip is clean of foreign matter. 2. Position the crankshaft oil seal on its recess on the front cover. Place the seal insert tool (OHT p/n IVB002-11) on top of the crankshaft oil seal. 3. Using a hammer, tap the SST to push the crankshaft oil seal into its recess. The top surface of the crankshaft oil seal should not be above the top surface of the recess by more than 0.5 mm (0.0197 in), and it should not be below it by more than 1.0 mm (0.0394 in).   **Note: Ensure that the SST is perpendicular to the crankshaft oil seal as it is tapped to prevent crankshaft oil seal from cocking within the recess.** |
| Figure 21 |  |
|  | Refer to Figure 22:   1. Align the pulley set key on the crankshaft with the key groove of the crankshaft pulley. Slide the crankshaft pulley onto the crankshaft. 2. Insert the prongs of the crankshaft pulley installation tool (OHTp/n OHTIVB-09960-1) into the holes of the crankshaft pulley. Hold onto the handle to prevent the crankshaft from rotating. 3. Using a 19 mm socket wrench, torque the crankshaft pulley bolt to 164 Nm (121 lbf-ft). |
| Figure 22 |  |
|  | Refer to Figure 23:   1. Apply a small amount of Toyota Three Bond Black 1207B, or equivalent to the indicated areas at the mating interface between the OHT front cover and the cylinder head.   **Note: The applied sealant should take up no larger than an area of 2.0 x 5.0mm (0.079 x 0.197in).** |
| Figure 23 |  |
|  | Refer to Figure 24:   1. Install a new valve cover gasket (OHT p/n OHTIVB-11213-1) (B) on the stock valve cover (A). |
| Figure 24 |  |
|  | Refer to Figure 25:   1. Install the valve cover onto the cylinder head. Install the ten (10) bolts. Hand-tighten only. 2. Using a 10mm socket drive torque wrench, torque the bolts in the sequence shown to 10 Nm (7 lbf-ft). |
| Figure 25 |  |
|  | Refer to Figure 26:   1. Install the front cover tensioner access plate (A) (OHT p/n OHTIVB-003-3) and gasket (OHT p/n OHTIVB-003-4). Install the seven (7) bolts. Hand-tighten only. 2. Using a 8 mm socket torque wrench, torque the bolts to 11 Nm (8 lbf-ft). 3. Install the water pump block off plate (B) (OHT p/n OHTIVB-004-1) and gasket (OHT p/n OHTIVB-004-2). Install the five (5) bolts. Hand-tighten only. 4. Using a 13 mm socket torque wrench, torque the bolts to 24 Nm (18 lbf-ft). |
| Figure 26 |  |
|  | Refer to Figure 27:   1. Install OHT modified coolant inlet pipe (A) (OHT p/n) with O-ring (B) (OHT p/n OHTIVB-90301-1) at the coolant pump housing inlet. 2. Install the bolt at the OHT modified coolant inlet pump bracket (C). Hand-tighten only. 3. Using a 12 mm socket torque wrench, torque the bolt to 24 Nm (18 lbf-ft). |
| Figure 27 |  |
|  | Refer to Figure 28:   1. Install the OHT coolant water pump adaptor plate (A) (OHT p/n OHTIVB-007-1) and gasket (OHT p/n IVB007-1) at the end of the OHT modified coolant inlet pipe with two (2) bolts. Using a 10 mm socket torque wrench, torque the bolts to 14 Nm (YY lbf-ft). 2. Install a 1/8 in x 4 in E-type thermocouple (TEI p/n X27622-652-00) into the compression fitting at the indication position (B) on the OHT modified coolant inlet pipe. Position the thermocouple such that the distance from the end to the compression fitting is approximately 12 mm (0.472 in). Using an adjustable wrench, tighten the compression fitting until snug. |
| Figure 28 |  |
|  | Refer to Figure 29:   1. Install a new exhaust manifold gasket (A) and catalytic with pipe converter assembly (B) with two bolts and two nuts. Hand-tighten only. 2. Install the heated oxygen sensor (OHT p/n OHTIVB-89465-1) at position (C). Using a 7/8 in crow’s foot adapted to a torque wrench with a 30cm (11.8in) long handle, tighten heated oxygen sensor to 40 Nm (30 lbf-ft). |
| Figure 29 |  |
|  | Refer to Figure 30:   1. Using a 12 mm socket torque wrench, torque the bolts and nuts to 27 Nm (20 lbf-ft) in the sequence shown. |
| Figure 30 |  |
|  | Refer to Figure 31:   1. Install the exhaust manifold stay (Toyota p/n ) with the nut (A) and the bolt (B). Using a 12 mm socket torque wrench, torque the nut and bolt to 27 Nm (20 lbf-ft). |
| Figure 31 |  |
|  | Refer to Figure 32:   1. Install a new intake manifold gasket (B) (OHT p/n OHTIVB-17177-1) onto the intake manifold (A). |
| Figure 32 |  |
|  | Refer to Figure 33:   1. Install the intake manifold and gasket onto the cylinder head using the three (3) bolts, indicated with black arrows, and two (2) nuts, indicated with white arrows. Hand-tighten only. 2. Using a 12 mm socket torque wrench, torque the bolts and nuts to 21 Nm (15 lbf-ft) in the sequence shown.   **Note: The throttle body and intake air box should still be attached to the intake manifold.** |
| Figure 33 |  |
|  | Refer to Figure 34:   1. Install the intake manifold pressure transducer line adapter (A) (TEI p/n), blowby ventilation hose adapter (B) (TEI p/n), and intake manifold pressure sensor plug (C) (TEI p/n) on their respective ports on the intake manifold. 2. Tighten the compression fittings on each component with an adjustable wrench until snug. |
| Figure 34 |  |
|  | Refer to Figure 35:   1. Connect the intake air box ventilation port with the valve cover ventilation port with the fresh air ventilation hose (A) (TEI p/n). Secure with 16 mm (0.625 in) hose clamps. 2. Connect the positive crankcase ventilation (PCV) port with the blowby ventilation hose adapter with the blowby ventilation hose (B). Secure with spring clamps (Toyota p/n 90460-70003). 3. Install the intake air pressure transducer line adapter (C) on the intake air box. Using an adjustable wrench, tighten the nut until snug. |
| Figure 35 |  |
|  | Refer to Figure 36:   1. Install a 1/8 in x 4” E-type thermocouple (TEI p/n X27622-652-00) into the compression fitting at the indication position (A) on the intake air box. Position the thermocouple such that the distance from the end to the compression fitting is approximately 34 mm (1.339 in). Using an adjustable wrench, tighten the compression fitting until snug. |
| Figure 36 |  |
|  | Refer to Figure 37:   1. Install the injector vibration insulator (B) (OHT p/n OHTIVB-23291-1) and injector O-ring (A) (OHT p/n OHTIVB-07033-1) on each of the four (4) fuel injectors (C) (Toyota p/n ). 2. Install the fuel injectors onto the fuel rail (D). |
| Figure 37 |  |
|  | Refer to Figure 38:   1. Install the fuel rail onto the cylinder head with two (2) bolts (A). Hand-tighten only. 2. Using a 12 mm socket torque wrench, torque the bolts to 24 Nm (18 lbf-ft). 3. Install the fuel supply line adapter (B) (TEI p/n) on the fuel supply port on the fuel rail. Using an adjustable wrench, tighten the compression fitting until snug. |
| Figure 38 |  |
|  | Refer to Figure 39:   1. Install the engine hangers (Toyota p/n 12281-47031) with two (2) bolts at the indicated positions. Hand-tighten only. 2. Using a 12 mm socket torque wrench, torque the bolts to 32 Nm (24 lbf-ft). |
| Figure 39 |  |
|  | Refer to Figure 40:   1. Install the oil gallery tee (A) (TEI p/n) in the indicated position. Wrap the threads of the male adapter of the tee with Teflon tape. Using an adjustable wrench, tighten the tee against the engine block until snug. 2. Install a 1/8 in x 4 in E-type thermocouple (TEI p/n X27622-652-00) into the compression fitting. Make sure the tip of the thermocouple is in the middle of the flow stream, which is approximately 6 mm (0.236 in) from its end to the compression fitting. Using an adjustable wrench, tighten the compression fitting until snug. 3. Install the crankshaft position sensor (B) with a bolt. Using a 10mm socket torque wrench, torque to the bolts to 7.5 Nm (5.5 lbf-ft). |
| Figure 40 |  |
|  | Refer to Figure 41:   1. Install OHT coolant outlet adapter (B) (OHT p/n OHTIVB-005-1) and gasket (OHT p/n IVB005-1) with two (2) bolts. Using a 10mm socket torque wrench, torque the bolts to 14 Nm (10 lbf-ft). 2. Install coolant outlet thermocouple adapter (A) (TEI p/n) at the indicated position. Apply Teflon tape at the male end of the adapter. Using an adjustable wrench, tighten the adapter against the cylinder head until snug. 3. Install a 1/8 in x 3 in E-type thermocouple (TEI p/n X27621-652-00) into the compression fitting. Make sure the tip of the thermocouple is in the middle of the flow stream, which is approximately 6 mm (0.236 in) from its end to the compression fitting. Using an adjustable wrench, tighten the compression fitting until snug. |
| Figure 41 |  |
|  | Refer to Figure 42:   1. Assemble the oil filter adapter as shown. The components are listed in Table 2, below.   Table 2: Oil filter adapter components   |  |  |  | | --- | --- | --- | | ID | TEI p/n | Description | | A |  | 4 mm x 62 mm OD O-ring | | B | SEQIVB-02-10-01 | Oil filter adapter ring | | C |  | 4 mm x 72 mm OD O-ring | | D | MOROSO 23682 | Remote oil filter adapter | | E | SEQIVB-02-10-02 | Oil filter adapter sleeve nut |  1. Using a 1-1/2 in socket torque wrench, torque the oil filter adapter sleeve nut to 54 Nm (40 lbf-ft). |
| Figure 42 |  |
|  | Refer to Figure 43:   1. Install oil sump thermocouple adapter (A) (TEI p/n) at the oil pan drain plug. 2. Install a 1/8 in x 4 in E-type thermocouple (TEI p/n X27622-652-00) into the compression fitting at the indication position (A) on the intake air box. Position the thermocouple such that the distance from the end to the compression fitting is approximately 36 mm (1.417 in). Using an adjustable wrench, tighten the compression fitting until snug. |
| Figure 43 |  |
|  | Refer to Figure 44:   1. Install the TEI modified oil fill cap (A) (TEI p/n). |
| Figure 44 |  |
|  | Refer to Figure 45:   1. Insert the prongs of the crankshaft pulley installation tool (OHT p/n OHTIVB-09960-1) into the holes of the crankshaft pulley. Hold onto the handle to prevent the crankshaft from rotating. 2. Apply adhesive to two or three threads at the end of each flywheel bolt. Use Toyota Three Bond 1324, or equivalent. 3. Install the flywheel with six (6) flywheel bolts. Using a 14 mm socket torque wrench, torque each bolt to 78 Nm (58 lbf-ft) in the sequence shown. |
| Figure 45 |  |

This concludes the new engine reassembly procedure.

**Clutch Assembly Procedure**

This procedure details the steps required to install the clutch assembly on an engine. This procedure is to be conducted on all new test engines, engines that have undergone cylinder head swap (see Toyota Engine Assembly Manual, Section 3), or if the previously-installed clutch assembly is found to be damaged and require replacement. The engine should be lifted on a hoist and hung from the two engine hangers.

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|  | Refer to Figure 46:   1. Install pilot shaft bearing (A) (OHT p/n IVB001-11) into the pilot hole in the rear of the crankshaft. Use a universal bearing installation kit to ensure that the bearing is set in the recess without cocking.   **Note: The pilot shaft bearing is only needed to be installed once in a new engine. It does not need to be removed.** |
| Figure 46 |  |
|  | Refer to Figure 47:   1. Place clutch disc assembly (A) (OHT p/n OHTIVB-31250-1) onto the flywheel (B). |
| Figure 47 |  |
|  | Refer to Figure 48:   1. Install the clutch cover assembly (A) (OHT p/n OHTIVB-31210-1) onto the flywheel. Align the flywheel dowel pins with the holes on the clutch cover, as indicated. 2. Secure the clutch cover assembly to the flywheel with six (6) bolts around the perimeter of the flywheel. Hand-tighten only such that the pressure plate can still be moved within the clutch cover assembly. |
| Figure 48 |  |
|  | Refer to Figure 49:   1. Insert the pilot output shaft (A) (OHT p/n IVB001-3) to center pressure plate spline with the flywheel pilot shaft bearing. 2. Using a 13 mm socket torque wrench, torque the bolts to 24 Nm (18 lbf-ft) in a criss-cross pattern.   **Note: Do not use an impact wrench to tighten the bolts.**   1. Remove the pilot shaft after the bolts have been tightened. |
| Figure 49 |  |
|  | Refer to Figures 50 and 51:   1. Install the OHT modified bell housing (OHT p/n OHTIVB-001-1) on the rear of the engine. Align the bell housing with the two dowel pins on the engine (A).   **Note: The flywheel with clutch assembly is not shown in Figure 50.**   1. Secure the bell housing with nine (9) bolts. Five (5) bolts must be installed using a 17 socket torque wrench at position (B). Four bolts must be installed using a 14 mm socket torque wrench at position (C). Torque all bolts to 81 Nm (60 lbf-ft).   **Note: Do not use an impact wrench to tighten the bolts.** |
| Figure 50 |
|  |
| Figure 51 |  |
|  | Refer to Figure 52:   1. Install starter assembly (A) (Toyota p/n 28100-0Y080) with the top bolt only. Ensure that the starter gear meshes with the flywheel gear teeth before tightening bolts.   **Note: Do not install the bolt at the bottom of the starter assembly.**   1. Using a 14mm socket torque wrench, torque the bolts to 54 Nm (40 lbf-ft).   **Note: Do not use an impact wrench to tighten the bolts.** |
| Figure 52 |  |
|  | Refer to Figure 53:   1. Install pilot output shaft (OHT p/n IVB001-3) onto the OHT modified bell housing. Ensure that the pilot shaft spline align with the clutch pressure plate spline. 2. Secure pilot output shaft with four (4) screws. Using a 3/8” Allen drive torque wrench, torque the bolts to 81 Nm (60 lbf-ft).   **Note: Do not use an impact wrench to tighten the bolts.** |
| Figure 53 |  |

This concludes the clutch assembly procedure. The engine is currently read to be installed on the test stand. Please refer to the engine installation procedure. In order to remove the clutch, perform the clutch assembly procedure in reverse. An impact wrench may be used to loosen bolts during the clutch removal procedure.

**Engine Installation Procedure**

This procedure details the steps required to install the assembled test engine on the test stand. This procedure is to be conducted if a used engine has been removed for maintenance or if a new engine is to be installed. At this stage, the clutch assembly and the OHT modified bell housing should also be installed on the engine. The engine should be lifted on a hoist and hung from the two engine hangers.

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|  | Refer to Figure 54:   1. Using an engine hoist, allow the engine to hang over the engine frame. Align the engine such that the bell housing mounts are over indicated area (A), and the front engine mount is over indicated area (B).   **Note: The front engine mount bracket is not secured to the engine frame to allow for engine installation from the front of the test stand.** |
| Figure 54 |  |
|  | Refer to Figure 55:   1. Install the front engine mount insulator (A) (OHT p/n OHTIVB-12305-1) on the front engine mount (B) on the engine. Secure with a flanged nut (C) (OHT p/n OHTIVB-21041-1) on the stud on the engine mount (D) and flanged bolt (E) (OHT p/n OHTIVB-10469-1). 2. Using a 14 mm socket torque wrench, torque the nut and bolt to 52 Nm (38 lbf-ft). |
| Figure 55 |  |
|  | Refer to Figure 56:   1. Secure the front engine mount insulator (A) to the front engine mount bracket (B) with two (2) bolts (TEI p/n) and two (2) nuts (TEI p/n). Using a 16 mm box end wrench, hold the nut on the underside of the front engine mount bracket. Using a 16 mm socket torque wrench, torque the bolts to 52 Nm (38 lbf-ft). |
| Figure 56 |  |
|  | Refer to Figure 57:   1. Install intake-side bell housing mount insulator (OHT p/n OHTIVB-12361-1) on the intake-side bell housing mount. Secure with flanged bolt (OHT p/n OHTIVB-81020-1) and flanged nut (OHT p/n OHTIVB-10016-1). Hand-tighten only. 2. Install the exhaust-side bell housing mount insulator (A) (OHT p/n OHTIVB-12371-1) on the exhaust-side bell housing mount. Secure with flanged bolt (B) (OHT p/n OHTIVB-81025-1) and flanged nut (not shown) (Toyota p/n). Hand-tighten only. |
| Figure 57 |  |
|  | Refer to Figure 58:   1. Adjust the vertical position of the intake-side bell housing mount until the roll of the engine with respect to the crankshaft axis of rotation is approximately 4.5° upwards on the intake side. |
| Figure 58 |  |
|  | Refer to Figure 59:   1. Confirm that the pitch of the engine with respect to the crankshaft axis of rotation is approximately 0°.   **Note: If the orientation of the engine cannot be achieved, check to make sure that the engine frame is level on all four sides, and adjust the elephant’s feet height as necessary. If orientation is still not achieved, consider replacing the engine mount insulators.**   1. Using a 14 mm socket torque wrench, secure the position of the engine by torquing the flanged bolts and nuts on the bell housing mounts on both intake and exhaust sides to 24 Nm (18 lbf-ft). Hold the flanged nut in place with a 14 mm box end wrench while tightening the bolts. |
| Figure 59 |  |

|  |  |
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|  | Refer to Figure 60:   1. Attach the exhaust pipe to the catalytic with pipe converter. Secure the junction with the exhaust bolted clamp (A) (TEI p/n 329920HPIW). Using a 3/4 in box end wrench, hold the bolt head on the clamp in place. Using a 3/4 in socket torque wrench, torque the nut on the clamp to 54 Nm (40 lbf-ft). |
| Figure 60 |  |
|  | Refer to Figure 61:   1. Install the driveshaft (A) on the adapter of the pilot output shaft (B) with four (4) bolts. Apply Loctite Blue 242, or equivalent, to the threads of each bolt. Install each bolt with a lock washer. Using a 5/8 in socket wrench, torque each bolt to 54 Nm (40 lbf-ft).   **Note: Do not use an impact wrench to tighten the bolts.** |
| Figure 61 |  |
|  | Refer to Figure 62:   1. Inject XX U-joint grease, or equivalent, into the front and rear U-joint of the driveshaft until excess grease starts to overflow from within the joint. |
| Figure 62 |  |
|  | Refer to Figure 63:   1. Install the inner guards (TEI p/n SEQIVB-06-03 (A) and SEQIVB-06-04 (B)) at the designated locations with eight (8) bolts. Install a flat washer with each bolt. Using a 1/2 in socket torque wrench, torque each bolt to 27 Nm (20 lbf-ft). |
| Figure 63 |  |
|  | Refer to Figure 64:   1. Install the upper driveshaft guard (TEI p/n SEQIVB-06-02) with six (6) bolts. Install a flat washer with each bolt. Using a 3/4 in socket torque wrench, torque each bolt to 81 Nm (60 lbf-ft). |
| Figure 64 |  |
|  | Refer to Figure 65:   1. Install the exhaust cooling fan (TEI p/n 1TDT2) and with two (2) bolts at the engine frame. Using a 9/16 in socket wrench, torque each bolt to 47 Nm (35 lbf-ft). |
| Figure 65 |  |
|  | Refer to Figure 66:   1. Install the coolant inlet hose (A) and coolant outlet hose (B) with hose clamps on each hose. Using a flat-head screwdriver, tighten the hose clamps until snug. |
| Figure 66 |  |
|  | Refer to Figure 67:   1. Connect the fuel supply line (A) and manifold pressure transducer line (B) to the designated ports. Using an adjustable wrench, tighten each compression fitting until snug. |
| Figure 67 |  |
|  | Refer to Figure 68:   1. Connect the knock sensor (A) and crankshaft position sensor (C) with their respective connectors on the engine wiring harness. 2. Connect the oil gallery pressure transducer line (B) to the designated port. Using an adjustable wrench, tighten the compression fitting until snug. |
| Figure 68 |  |
|  | Refer to Figure 69:   1. Install the ignition coil packs (A) in their respective positions.   **Note: The positions of each ignition coil pack should have been labeled prior to removal.**   1. Connect the fuel injectors (B) with their respective connectors on the engine wiring harness.   **Note: The connector colors should alternate between brown and gray from front to rear of the engine.** |
| Figure 69 |  |
|  | Refer to Figure 70:   1. Connect the camshaft position sensor (A) with its respective connector. 2. Attach the wiring harness engine ground (B) at its designated location with a bolt. Using a 12 mm socket torque wrench, torque the bolt to 14 Nm (10 lbf-ft). |
| Figure 70 |  |
|  | Refer to Figure 71:   1. Attach the wiring harness engine ground (A) at is designated location with a bolt. Using a 12 mm socket torque wrench, torque the bolt to 14 Nm (10 lbf-ft). |
| Figure 71 |  |
|  | Refer to Figure 72:   1. Connect the starter solenoid switch signal wire (A) to the designated connector on the starter. 2. Connect the battery ground cable (B) to the designated position on the starter with a bolt. Using a 17mm socket torque wrench, torque the bolt to 54 Nm (40 lbf-ft). 3. Connect the battery hot wire (C) to the designated position on the starter with a nut. Using a XX mm socket torque wrench, torque the nut to XX Nm (YY lbf-ft). |
| Figure 72 |  |
|  | Refer to Figure 72:   1. Secure the intake air box to the top of the intake air and fuel regulator assembly with bolt at the designated position (A). Using a 5/16 in Allen drive torque wrench, torque the bolt to 20 Nm (15 lbf-ft). |
| Figure 72 |  |

This concludes the test engine installation procedure. The engine is ready to undergo break-in, which is detailed in the Section D of the Sequence IVB Lab Operations Manual. To remove the engine from the test stand, conduct the steps detailed in this procedure in reverse. An impact wrench may be used to loosen bolts.