The next sheet is actually sheet 13 of 24

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|  | Refer to Figure 39:   1. Install a new intake manifold gasket (OHT p/n OHTIVB-17177-1) on the intake manifold. |
| Figure 39 |  |
|  | Refer to Figure 40:   1. Install the intake manifold with three (3) bolts (black arrows) and two (2) nuts (white arrows). Using a 12 mm socket torque wrench, tighten the bolts and nuts to the target torque in the sequence indicated. The target torque is 21 Nm (15 ft-lbf). |
| Figure 40 |  |
|  | Refer to Figure 41:   1. Install two (2) studs (OHT p/n OHTIVB-08052-1) in the exhaust side of the cylinder head at the indicated positions. |
| Figure 41 |  |
|  | Refer to Figure 42:   1. Install a new exhaust manifold gasket (OHT p/n OHTIVB-17173-1) on the exhaust manifold in the indicated orientation. The black arrow indicates vertical direction, and the white arrow indicates the direction to the front of the engine. |
| Figure 42 |  |
|  | Refer to Figure 43:   1. Install the exhaust manifold with two (2) bolts (numbers) and two (2) nuts (numbers). Using a 12 mm socket torque wrench, tighten the bolts and nuts to the target torque in the sequence indicated. The target torque is 27 Nm (20 ft-lbf). |
| Figure 43 |  |
|  | Refer to Figure 44:   1. Install a new gasket (A) for the OHT engine coolant out hose barb adapter plate (B). 2. Install the OHT engine coolant out hose barb adapter plate with two (2) bolts. Using a 10 mm socket torque wrench, tighten the bolts to the target torque. The target torque is 10 Nm (7 ft-lbf). 3. Install the engine coolant out thermocouple. Using a 1/2 in box-end wrench, tighten the compression fitting nut that holds the engine coolant out thermocouple until snug. |
| Figure 44 |  |
|  | 1. Follow the instructions in Section 2, Camshaft and Lifter Installation Procedure to install a set of camshafts and lifters used for break-in purposes. Install a new set of intake and exhaust camshaft sprockets (OHT p/n OHTIVB-13523-1).   **Note: Some trial and error will be required to select the appropriate lifter grades.**  Refer to Figure 45:   1. Install the new timing chain guide (OHT p/n OHTIVB-13566-1) to the engine block with two (2) bolts (marked with arrows). Using a 10 mm socket torque wrench, tighten the two (2) bolts holding the timing chain guide to 10 Nm (7 ft-lbf). |
| Figure 45 |  |
|  | Refer to Figure 46:   1. Arrange the camshaft sprockets such that the rectangular timing marks are approximately vertical. Arrange the crankshaft sprocket such that the flat edges are vertical. 2. Wrap a new timing chain (OHT p/n OHTIVB-13506-1) around the camshaft and crankshaft sprockets. The colored links on the chain should line up with both camshaft sprocket timing marks.   **Note: With cylinder 1 in TDC on the compression stroke, the marked plate on the timing chain should be approximately in the position shown.** |
| Figure 46 |  |
|  | Refer to Figure 47:   1. Install a new timing chain tension arm (OHT p/n OHTIVB-13591-1) with a bolt (marked with arrow). Using a 10 mm socket torque wrench, torque the bolt holding the timing chain tension arm to 10 Nm (7 ft-lbf). |
| Figure 47 |  |
|  | Refer to Figure 48:   1. Install a new timing chain tensioner gasket (OHT p/n OHTIVB-13552-1) on the timing chain tensioner. |
| Figure 48 |  |
|  | Refer to Figure 49:   1. Install the timing chain tensioner with two (2) bolts. Using a 10 mm socket torque wrench, tighten the two (2) bolts holding the timing chain tensioner to the engine block to 10 Nm (7 ft-lbf). |
| Figure 49 |  |
|  | Refer to Figure 50:   1. Install a new O-ring (OHT p/n OHTIVB-003-2) in the O-ring groove on the OHT front cover (OHT p/n OHTIVB-003-1). A suitable adhesive, such as petroleum jelly, may be used to hold the O-ring in place. 2. Apply Toyota Three Bond Black 1282B, or equivalent RTV sealant, on the highlighted areas. |
| Figure 50 |  |
|  | Refer to Figure 51:   1. Install a gasket and O-rings in the locations indicated in Table 2, below.   Table 2: Locations to install gasket and O-rings at front of oil pan   |  |  |  | | --- | --- | --- | | Location | Description | OHT p/n | | A | O-ring | OHTIVB-09031-1 | | B | O-ring | OHTIVB-27014-1 | | C | Gasket | OHTIVB-19023-1 | |
| Figure 51 |  |
|  | Refer to Figure 52:   1. Ensure the spline in the oil pump gear is aligned, such that one is pointed left and the other is pointed right while the flat edges on the crankshaft sprocket are oriented vertically. |
| Figure 52 |  |
|  | Refer to Figure 53:   1. Install the front engine mount (OHT p/n OHTIVB-12305-1) with three (3) bolts. Hand-tighten only. |
| Figure 53 |  |
|  | Refer to Figure 54:   1. Install the OHT front cover on the engine with fifteen (15) bolts. The dimension of each bolt is shown in Table 3, below. Hand-tighten only.   Table 3: Dimensions of front cover bolts   |  |  |  | | --- | --- | --- | | Bolt | Length  [mm (in)] | Thread Diameter [mm (in)] | | A and E | 25 (0.984) | 8 (0.315) | | B | 40 (1.57) | 10 (0.394) | | C | 40 (1.57) | 8 (0.315) | | D | 70 (2.76) | 10 (0.394) |   **Note: Apply Toyota Three Bond 1324, or equivalent, adhesive to the threads of Bolt E.**  **Note: Stock front cover is displayed in Figure 54 for illustration purposes only. OHT modified front cover should be used.** |
| Figure 54 |  |
|  | Refer to Figure 55:   1. Using the appropriate socket drive adapted to a torque wrench, tighten the eighteen (18) bolts on the timing chain cover to the target torque in the sequence indicated. The target torque for each bolt is listed in Table 4.   Table 4: Target torques for each front cover bolt   |  |  | | --- | --- | | Bolt | Target Torque [Nm (ft-lbf)] | | A, C, E | 24 (18) | | B, D | 51 (38) |   **Note: Stock front cover is displayed in Figure 55 for illustration purposes only. OHT modified front cover should be used.** |
| Figure 55 |  |
|  | Refer to Figure 56:   1. Align the set key on the crankshaft pulley with the key groove in the crankshaft. Slide the crankshaft pulley onto the crankshaft. 2. Using a crankshaft pulley installation tool (OHT p/n OHTIVB-09960-1), hold the crankshaft pulley to prevent the engine from rotating. 3. Using a 19 mm socket torque wrench, install the crankshaft pulley bolt by tightening to 164 Nm (121 ft-lbf). |
| Figure 56 |  |
|  | Refer to Figure 57:   1. Mount the wiring harness ground (A) at the rear of the cylinder head. Using a 10 socket torque wrench, torque the mounting bolt to 14 Nm (10 lbf-ft). |
| Figure 57 |  |

This concludes the cylinder head installation procedure. The engine is now ready to undergo the break-in and silicone pacification procedure. Refer to Section D of the Sequence IVB Operations Procedure for instructions to conduct the break-in and silicone pacification.

**Test Intake Valve Spring Installation Procedure**

This procedure is to be conducted after a cylinder head has completed the engine break-in and silicone pacification procedure in Section D of the Sequence IVB Operations Procedure. The objective is to remove the intake valve springs used during the break-in procedure and to install stiffer test intake valve springs. The procedure detailed in this section can be conducted with the engine on the test stand or removed and placed on an engine build-up stand.

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| 1. After the break-in and silicone pacification procedure has been completed, follow instructions in Section 2 of the Toyota Engine Assembly Manual to remove the intake and exhaust camshafts.   **Note: Ensure plastic wedge is firmly in place within the timing chain access port to keep the timing chain tensioners from collapsing on the timing chain.**   1. Using visual cues ensure the piston in cylinder 1 is located at the top-dead-center (TDC) position on the compression stroke. The list of visual cues is detailed in Section 2 of the Toyota Engine Assembly Manual.   **Note: The mechanic can check for TDC by inserting a long plastic rod into the open spark plug port. Make sure that the rod is long enough to extend beyond the top of the spark plug tubes. Turn the crankshaft slowly, and watch the rising and falling of the tip of the rod. Stop turning when the tip reaches the apex of its travel. The top of the piston should be approximately 168mm (6.61in) from the top of the spark plug hole.**  **Warning: When rotating the crankshaft, ensure the timing chain is always in tension to keep the chain links engaged with the crankshaft sprocket. Pull upwards on the timing chain segment exposed at the cylinder head area while rotating the crankshaft to maintain tension in the chain. This is to prevent damage at an extrusion underneath the crankshaft sprocket on the OHT front cover.** | |
| http://buy1.snapon.com/catalog/objects_lg/17800/17717.JPG | Refer to Figure 58:  **Note: The following procedure details valve spring removal using the Snap-On YA8845 Valve Spring Compressor Tool. However, any equivalent portable valve spring compressor tool can be used for this procedure.** |
| Figure 58 |  |
|  | Refer to Figure 59:   1. Mount the fulcrum posts (A) at the front and rear ends of the cylinder head using the bolt holes circled in red. Use M6x1.0 bolts. |
| Figure 59 |  |
|  | Refer to Figure 60:   1. Place fulcrum rod (B) through the topmost holes in the fulcrum posts (A). |
| Figure 60 |  |
|  | Refer to Figure 61:   1. Obtain eight (8) Sequence IVB intake valve springs (OHT p/n OHTIVB-30034-1) (B). Note the difference between a stock valve spring (OHT p/n OHTIVB-25063-1) (A). |
| Figure 61 |  |
|  | Refer to Figure 62:   1. Hang the timing chain on the fulcrum rod. 2. Attach an air line with the correct adapter for the spark plug port (A) to the cylinder 1 spark plug port. 3. Pressurize cylinder 1 with dry, clean compressed air.   **Warning: If the piston is too far off the TDC position, the compressed air will suddenly push the piston downwards and rotate the crankshaft. Therefore, it is very important that step 2 is strictly followed.** |
| Figure 62 |  |
|  | Refer to Figure 63:   1. Connect valve compressor load arm (A) with the valve compressor lever (B) using the second bolt hole from the handle (C). |
| Figure 63 |  |
|  | Refer to Figure 64:   1. Mount the compressor load arm on the fulcrum rod. Use the notch on the lever arm that is furthest away from the handle, (D) in Figure 6. The lever arm from the fulcrum to the connection to the load arm should be approximately 100mm. Ensure the load bearing surface of the load arm is making even contact with the top surface of the valve spring retainer (inset) for intake position 1 (closest to the front of the engine). In this configuration, the load arm should be applying even force normal to the top surface of the retainer. |
| Figure 64 |  |
|  | Refer to Figure 65:   1. Pull down on the lever to compress the valve spring until the valve stem tip is above the top surface of the valve spring retainer. The retainer locks should fall off the valve tip. 2. Pick up the retainer locks with a magnetic tool. 3. Remove the valve spring and the retainer. 4. Place a Sequence IVB intake valve spring in place of the stock valve spring. |
| Figure 65 |  |
|  | Refer to Figure 66:   1. Place valve spring retainer locks into the recess of the valve spring retainer. Ensure that the larger ends of the taper on the retainer locks are oriented towards the top surface of the retainer. 2. Place the valve retainer with the retainer locks on top of the valve spring. |
| Figure 66 |  |
|  | Refer to Figure 67:   1. Place index finger on top of the valve spring retainer to keep the retainer locks from being pushed out by the valve stem tip. |
| Figure 67 |  |
|  | Refer to Figure 68:   1. Pull down on the valve compressor lever to compress the valve spring until the valve stem tip is above the top surface of the valve spring retainer. Allow the valve stem tip to slide upwards between the retainer locks until the extrusions in the retainer locks are roughly at the same vertical level as the receiving grooves in the valve stem tip. |
| Figure 68 |  |
| 1. Slowly and carefully decompress the valve spring. As the retainer moves upwards, it should receive the retainer locks and secure them within the tapered recess.   **Note: When the valve spring is in its installed state, the valve spring retainer should be holding the retainer locks in place at the valve stem tip.**   1. Move the valve compressor tool in position to the next intake valve position. Repeat steps 10-19 for the next valve position.   **Note: The intake valve spring positions are designated from 1 to 8, with position 1 being closest to the front of the engine. The test intake valve springs should be installed in the following sequence: 1, 2, 7, 8. When moving from position 2 to position 7, the compressed air line should be moved from the cylinder 1 to cylinder 4 spark plug port.**   1. Rotate the crankshaft 180°. 2. Using the technique detailed in step 2 to ensure that the piston in cylinder 2 is at the TDC position. 3. Move the compressed air line from cylinder 4 to cylinder 2. Repeat steps 10-20 to install the test valve springs for positions 3, 4, 5,6, in that order. | |

This concludes the test intake valve spring installation procedure. The cylinder head is now ready to be used for Sequence IVB testing. For installation of test camshafts, please refer to Section 2 of the Toyota Engine Assembly Manual.