**New Cylinder Head Assembly Procedure**

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|  | Refer to Figure 1:   1. Obtain a new Toyota 2NR-FE cylinder head (OHT p/n OHTIVB-11101-1). 2. Wash the cylinder head in a jet-washer for 20-30 minutes. Air-dry with clean, compressed air. 3. Spray cylinder head with a 50/50 mixture of EF-411 assembly fluid and degreasing solvent. Air-dry with clean, dry compressed air. |
| Figure 1 |  |
|  | Refer to Figure 2:   1. Obtain the set of new parts specified in Table 1. 2. Apply a light coat of EF-411 assembly fluid on all valve stems. |
| Figure 2 |  |

Table 1: New parts required to complete cylinder head assembly

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| Item no. | Description | OHT p/n | Qty |
| 1 | Intake valve | OHTIVB-13711-1 | 8 |
| 2 | Exhaust valve | OHTIVB-13715-1 | 8 |
| 3 | Valve spring seat | OHTIVB-13734-1 | 16 |
| 4 | Valve spring | OHTIVB-25063-1 | 16 |
| 5 | Valve spring retainer | OHTIVB-13741-1 | 16 |
| 6 | Valve spring retainer lock | OHTIVB-03028-1 | 32 |
| 7 | Intake valve stem oil seal | OHTIVB-02101-1 | 8 |
| 8 | Exhaust valve stem oil seal | OHTIVB-02112-1 | 8 |
| 9 | Spark plug tubes (not shown in Figure 2) | OHTIVB-11191-1 | 4 |

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|  | 1. Flip the cylinder head over, such that the top of the combustion chamber is the topside.   Refer to Figure 3:   1. Place the valves in their appropriate ports. Slide the valve stems into each valve guide. The exhaust valves are denoted as (A), and the intake valves are denoted as (B). 2. Flip cylinder head over, such that the combustion chamber is lying flat on the bench top. Ensure that the valves stay installed in the cylinder head. |
| Figure 3 |  |
|  | **Installing valve stem oil seals:**  Refer to Figure 4:   1. Place all valve stem oil seals in a plastic container. Fill the container with EF-411 assembly fluid until the valve seals are submerged. 2. Apply a small amount of EF-411 assembly fluid on the tip of the valve stem. |
| Figure 4 |  |
|  | Refer to Figure 5:   1. Insert valve spring seat (A) onto the valve spring recess. |
| Figure 5 |  |
|  | Refer to Figure 6:   1. Slide a 7 mm (0.276 in) OD valve stem protector (A) onto the valve stem. |
| Figure 6 |  |
|  | Refer to Figure 7:   1. Install the appropriate valve seal (bronze color for intakes, silver color for exhaust) over the valve stem protector.   **Warning: Do not try to force to valve seal to seat onto the top of the valve guide by hand.** |
| Figure 7 |  |
|  | Refer to Figure 8:   1. Using a pair of needle nose pliers, clamp onto the tip of the valve stem protector without damaging the valve stem tip. Pull the valve stem protector out while leaving the valve seal in place. |
| Figure 8 |  |
|  | Refer to Figure 9:   1. Place the appropriate valve seal installation tool (A) onto the top of the valve seal. |
| Figure 9 |  |
|  | Refer to Figure 10:   1. Apply force evenly on the tool to push the valve seal down.   **Note: Apply force by hand; no hammering should be required for valve seal installation. The technician in Figure 10 is applying force by pushing down on the tool with the end of a hammer.**   1. Repeat steps 9-15 for the other fifteen (15) valve positions. |
| Figure 10 |  |
|  | **Installing valve springs:**  Refer to Figure 11:   1. Using a 10mm socket driver adapted to a speed handle, remove all bolts securing the bearing end caps. Be sure to preserve the positions of the bearing end caps with respect to each other as they are being removed for ease of installation later. |
| Figure 11 |  |
|  | Refer to Figure 12:   1. Place a valve spring (A) and retainer (B) into the valve spring recess. |
| Figure 12 |  |
|  | Refer to Figure 13:   1. Place the cylinder head with the combustion chamber down onto a pneumatic valve spring press. If a valve spring press is unavailable, use the proper valve spring installation tool. |
| Figure 13 |  |
|  | Refer to Figure 14:   1. Compress the valve spring until the valve spring retainer is below the tip of the valve stem. Apply load normal to the valve spring, which is 20° off normal along the longitudinal axis of the cylinder head. |
| Figure 14 |  |
|  | Refer to Figure 15:   1. Install two valve spring retainer locks (C) in the valve retainer lock installation tool (A) (Bosch p/n J-43059, or equivalent). Ensure that the wider end of the taper on the retainer lock is oriented upwards with respect to the valve stem tip (B). |
| Figure 15 |  |
|  | Refer to Figure 16:   1. With the valve retainer lock installation tool holding onto the two halves of the retainer locks, slide the retainer locks onto the valve stem tip.   **Warning: Do not release the retainer locks yet.** |
| Figure 16 |  |
|  | Refer to Figure 17:   1. Decompress the valve spring. As the retainer moves upwards and receives the retainer locks, release the valve retainer lock installation tool.   **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. Repeat steps 18-23 for remaining fifteen (15) valve springs. 2. Reinstall the bearing end caps in their appropriate positions. Hand-tighten the bearing end cap bolts. |
| Figure 17 |  |
|  | **Installing spark plug tubes:**   1. Apply a light coat of EF-411 assembly fluid at one end of the spark plug tube. 2. Hold the lubricated end of the spark plug tube in contact with the corresponding recess in the cylinder head.   Refer to Figure 18:   1. Place the appropriate installation tool (A) onto the open end of the spark plug tube. |
| Figure 18 |  |
|  | Refer to Figure 19:   1. Hit the tool with a hammer to drive the spark plug tube into the recess. Stop hammering when the spark plug tube reaches the bottom f other recess. |
| Figure 19 |  |

**Cylinder Head Removal Procedure**

This procedure is to be conducted in the event that the installed cylinder head needs to be replaced with a new cylinder head. This procedure proceeds with the assumption that the camshaft and valve lifters have been removed. If this has not been completed, please refer to Section 2 of the Toyota Engine Assembly Manual for instructions on removing the camshaft and lifters.

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|  | Refer to Figure 20:   1. Using a crankshaft pulley installation tool (OHT p/n OHTIVB-09960-1), hold the crankshaft pulley to prevent the engine from rotating. 2. Using a 19 mm socket wrench, remove the crankshaft pulley bolt. 3. Remove crankshaft pulley. |
| Figure 20 |  |
|  | Refer to Figure 21:   1. Using a 14 mm socket wrench, remove the wiring harness ground (A) at the rear of the cylinder head. |
| Figure 21 |  |
|  | Refer to Figure 22:   1. Using a 14 mm socket wrench, remove the three (3) bolts that hold the engine mounting bracket to the OHT modified front cover (OHT p/n OHTIVB-003-1). |
| Figure 22 |  |
|  | Refer to Figure 23:   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.   **Note: Stock front cover is displayed in Figure 23 for illustration purposes only. OHT modified front cover should be used.**   1. Remove the OHT front cover and O-ring. |
| Figure 23 |  |
|  | Refer to Figure 24:   1. Remove the plastic wedge that is forcing the timing chain tensioners apart. 2. Push the plunger (marked with an arrow) into the timing chain tensioner. 3. Insert a 1.2mm (0.0472in) diameter pin into the hole (marked with a “1”) to lock the plunger. |
| Figure 24 |  |
|  | Refer to Figure 25:   1. Using a 10 mm socket wrench, remove the two (2) bolts holding the timing chain tensioner to the engine block. 2. Remove the timing chain tensioner. 3. Remove and discard the underlying timing chain tensioner gasket. |
| Figure 25 |  |
|  | Refer to Figure 26:   1. Using a 10 mm socket wrench, remove the bolt holding the timing chain tension arm to the engine block (marked with an arrow). 2. Remove the timing chain tension arm. |
| Figure 26 |  |
|  | Refer to Figure 27:   1. Using a 10 mm socket wrench, remove the two (2) bolts holding the timing chain guide to the engine block (marked with two arrows). 2. Remove the timing chain tensioner. 3. Remove the timing chain. |
| Figure 27 |  |
|  | Refer to Figure 28:   1. Using a 12 mm socket wrench, remove the three bolts (black arrows) and two nuts (white arrows) that hold the intake manifold to the cylinder head. 2. Remove the intake manifold, and place it securely on the engine stand. 3. Remove and discard the intake manifold gasket. |
| Figure 28 |  |
|  | Refer to Figure 29:   1. Using a 12 mm socket wrench, remove the two bolts (numbers) and two nuts (numbers) that hold the exhaust pipe assembly to the cylinder head. 2. Remove the exhaust pipe assembly, and place it securely on the engine stand. 3. Remove and discard the exhaust manifold gasket. |
| Figure 29 |  |
|  | Refer to Figure 30:   1. Using a 10 mm box-end wrench, loosen the compression fitting nut that holds the engine coolant out thermocouple (A). 2. Remove the engine coolant out thermocouple. 3. Remove the OHT engine coolant out hose barb adapter plate (OHT p/n OHTIVB-005-1) (B). |
| Figure 30 |  |
|  | Refer to Figure 31:   1. Using a 10mm bi-hexagonal drive wrench, loosen the ten (10) head bolts in the sequence shown. Loosen in at least three (3) quarter-turn steps. 2. Remove head bolts and plate washers. |
| Figure 31 |  |
|  | Refer to Figure 32:   1. Using a vernier caliper, measure the length of the head bolt, as indicated. The bolt length is not to exceed 128.2mm (5.01in). Discard the head bolt if it exceeds the maximum limit. Replace with a new head bolt (Toyota p/n 90910-02174). |
| Figure 32 |  |
|  | Refer to Figure 33:   1. Remove cylinder head (A). 2. Remove and discard cylinder head gasket (B). |
| Figure 33 |  |
|  | Refer to Figure 34:   1. Using a metal pick, carefully scrape carbon deposits off the piston tops. |
| Figure 34 |  |
|  | Refer to Figure 35:   1. Using a plastic scraper, scrape off any residual gasket material, silicone, and/or carbon deposits from the cylinder head deck surface and front cover surface. |
| Figure 35 |  |
|  | Refer to Figure 36:   1. Using a M10x1.5 tap bit, clean the head bolt hole threads in the engine block. 2. Spray degreasing solvent into each bolt hole. Air-dry each bolt hole with clean, dry compressed air. Ensure that no debris remains within each hole. |
| Figure 36 |  |

**Cylinder Head Installation Procedure**

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|  | Refer to Figure 36:   1. Install a new cylinder head gasket (OHT p/n OHTIVB-11115-1) in the orientation shown. Ensure that all cylinder head bolt holes on the gasket are aligned with those on the cylinder head deck surface. |
| Figure 36 |  |
|  | 1. Place the new cylinder head on top of the head gasket. 2. Apply a light coat of EF-411 assembly fluid to the threads of the ten (10) cylinder head bolts.   Refer to Figure 37:   1. Install the ten (10) cylinder head bolts and ten (10) plate washers into the cylinder head. Using a 10mm bi-hexagonal drive torque wrench, tighten the cylinder head bolts uniformly in several steps in the sequence shown. The target torque is 32 Nm (24 ft-lbf). 2. Using a 10mm bi-hexagonal drive wrench, further tighten each cylinder head bolt by one quarter turn in the sequence shown. 3. Repeat step 6 to turn each bolt one more quarter turn. |
| Figure 37 |  |
|  | Refer to Figure 38:   1. Install two (2) studs (OHT p/n OHTIVB-08060-1) in the intake side of the cylinder head at the indicated positions. |
| Figure 38 |  |