## REMOVAL AND INSTALLATION (Continued)

### INSTALLATION

(1) Remove the shop towels from the cylinder bores. Coat the bores with clean engine oil.

(2) Install cylinder head alignment studs (VM-1009).

(3) After determining the correct head gasket thickness, clean the block and head mating surfaces, place the engine cylinder head gasket over the dowels.

(4) Place the engine cylinder head over the dowels.

**CAUTION: New cylinder head bolts should be used.**

(5) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 24):

(a) The threads and underside heads of the bolts should be lubricated. Use the cylinder head alignment studs tool number VM-1009. Position the heads on the block and secure with the ten large center bolts and spacers (clamps), finger tight only. Be sure that the various clamps are installed correctly and the head gaskets remain in their proper position, completely covered. Then, lubricate and install the eight small bolts, also finger tight.

(6) Hand tighten oil feed line for rocker arm assemblies.

(7) Install the intake and exhaust manifolds with new gaskets, partially tightening the nuts to a maximum of 5 N·m (44 in. lbs.). This will align the heads (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(8) Then, tighten the 12mm bolts with special tool VM-1019 in the following manner:

1st Phase: Head Bolts Tightening -- (Fig. 24)

Central bolts (A-L): Tighten all bolts, starting with bolt A then B-C-D-E-F-G-H-I-L, to 30 N·m. Repeat the operation with the same torque. Following the same sequence rotate each bolt through an angle of 70 ° using angle torque tool. Then rotate the bolts an additional 70 ° following tightening sequence.

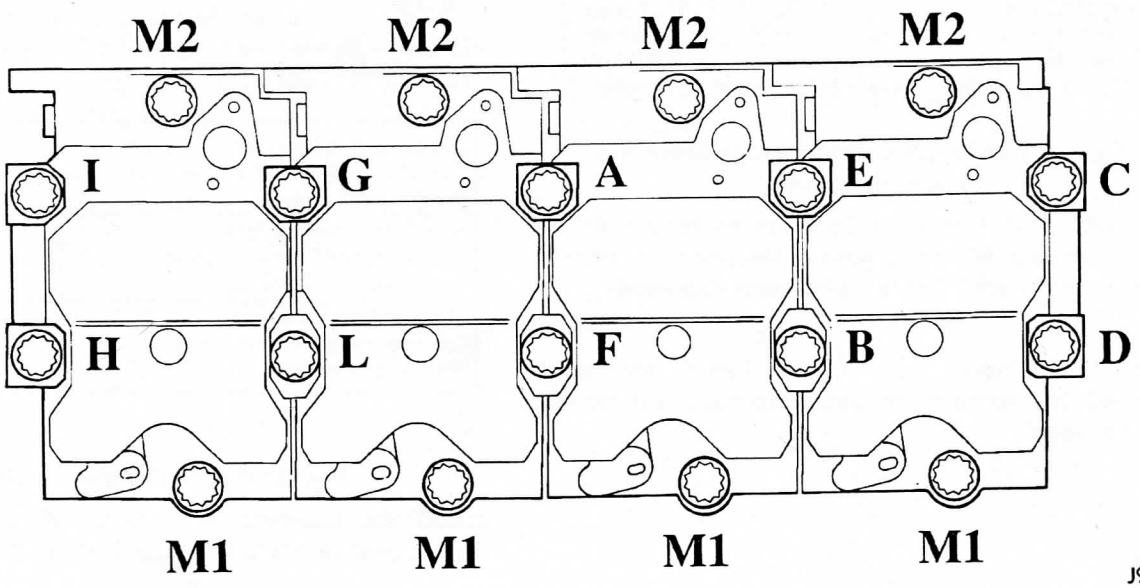



*Fig. 24 Engine Cylinder Head Bolt Tightening Sequence*

## REMOVAL AND INSTALLATION (Continued)

(9) Then, tighten the 14mm bolts with special tool VM-1018 in the following manner:

Side bolts (M1-M2): Tighten M1 bolts to 30 N·m, then rotate them 85 °(+/-5). Tighten M2 bolts to 30 N·m, then rotate them 85 °(+/-5).

**NOTE: If vehicle is equipped with A/C do not install A/C lines to compressor and charge A/C till Phase 2 is complete.**

(10) 2nd Phase: After 20 minutes of engine operation at operating temperature, allow engine to cool down completely. Then re-torque the head bolts as follows:

Central bolts A-L: Starting from bolt A, slacken and re-torque it immediately to 30 N·m + 65 °. Rotate the bolt an additional 65 °. Then proceed in the same way, bolt by bolt, following alphabetical order, as indicated.

Side bolts M1-M2: **Without slackening** , torque bolts M1 then bolts M2 to 90 N·m (66 ft. lbs.).

(11) Tighten intake nuts to 30 N·m (22 ft. lbs.) and exhaust manifolds nuts to 30 N·m (22 ft. lbs.) specified torque after completing Phase 2.

If the engine cylinder head is to be replaced and the original valves used, measure the valve stem diameter. Only standard size valves can be used with a service replacement engine cylinder head unless the replacement head valve stem guide bores are reamed to accommodate oversize valve stems. Remove all carbon buildup and reface the valves.

(12) Tighten oil feed lines for rocker arm assemblies to 13 N·m (112 in. lbs.).

(13) Install push rods and rocker arm assemblies, tighten nut to 35 N·m (26 ft. lbs.).

(14) Install valve cover, tighten nuts to 19 N·m (168 in. lbs.).

(15) Connect crankcase breather hose.

(16) Connect the injector sensor wire and the glow plug hot lead.

(17) Install turbocharger oil feed line, tighten banjo bolts to 27 N·m (20 ft. lbs), and install oil drain line to turbocharger.

(18) Install water manifold and tighten bolts to 12 N·m (106 in. lbs.).

(19) Install generator support bracket.

(20) Raise vehicle on hoist.

(21) Install transmission crossmember bolts.

(22) Install exhaust down pipe to turbocharger, tighten bolts to 22 N·m (16 ft. lbs.).

(23) Install exhaust down pipe heat shield.

(24) Install exhaust heat shield, Tighten bolts to 11 N·m (8 ft. lbs.).

(25) Install EGR valve to intake manifold, tighten bolts to 26 N·m (19 ft. lbs.).

(26) Install EGR tube to EGR valve, tighten bolts to 26 N·m (19 ft. lbs.).

(27) Install lower Charge air cooler hose to turbocharger.

(28) Install air cleaner assembly and hose.

(29) Install oil breather hose to air cleaner hose.

(30) Install upper charge cooler hose to turbocharger.

(31) Connect recover bottle hose to water manifold.

(32) Install fuel injectors use tool VM-1012 (refer to Group 14, Fuel System).

(33) Install fuel injector lines from the pump to injectors, tighten nuts to 23 N·m (17 ft. lbs.).

(34) Connect the A/C lines to compressor and install bracket on cylinder head cover, if equipped with air conditioning.

(35) Install fuel filter, Tighten bolts to 28 N·m (250 in. lbs.).

(36) Connect the fuel supply and return lines.

(37) Connect the upper radiator hose.

(38) Connect negative cable to battery.

(39) If equipped with A/C, evacuate and charge the air conditioning system (refer to Group 24, Heater and Air Conditioning).

(40) Fill the cooling system. Check for leaks.

**WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN DIRECT LINE WITH THE FAN. DO NOT PUT HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.**

(41) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the thermostat opens. Add coolant, if required.

**CAUTION: After rebuild or cylinder head gasket replacement, the cylinder head must be retorqued within the first 20,000km. If individual fiber type head gaskets were used.**

**NOTE: The one piece steel type head gasket does not require, the above mentioned, retorque procedure.**

### CYLINDER HEAD RE-TORQUE

Within the first 20,000 km after rebuild, retorque the head bolts as follows: (Fig. 24) Central bolts A-L: Without slackening the bolts, following alphabetical order tighten the bolts through an angle of 15 °. Side bolts M1-M2: Without slackening, tighten M1 then M2 bolts through an angle of 15 °.

## VIBRATION DAMPER

### *REMOVAL*

(1) Disconnect the battery cable.