

remove the piston pin, the connecting rod should be supported so that it does not have to take the shock of the blows. If this is not done, the rod may be damaged.

After the removal of a cylinder and piston, the connecting rod must be supported to prevent damage to the rod and crankcase. This can be done by supporting each connecting rod with the removed cylinder base oil seal ring looped around the rod and cylinder base studs.

Using a wire brush, clean the studs or cap-screws and examine them for cracks, damaged threads, or any other visible defects. If one cap-screw is found loose or broken at the time of cylinder removal, all the cap-screws for the cylinder should be discarded, since the remaining cap-screws may have been seriously weakened. A cylinder hold down stud failure places the adjacent studs under a greater operating pressure, and they are likely to be stretched beyond their elastic limit. The engine manufacturer's instruction must be followed for the number of studs that have to be replaced after a stud failure. When removing a broken stud, take proper precautions to prevent metal chips from entering the engine crankcase section. In all cases, both faces of the washers and the seating faces of stud nuts or cap-screws must be cleaned and any roughness or burrs removed.

## Cylinder Installation

See that all preservative oil accumulation on the cylinder and piston assembly is washed off with solvent and thoroughly dried with compressed air. Install the piston and ring assembly on the connecting rod. Be sure that the piston faces in the right direction. The piston number stamped on the bottom of the piston head should face toward the front of the engine. Lubricate the piston pin before inserting it. It should fit with a push fit. If a drift must be used, follow the same precaution that was taken during pin removal.

Oil the exterior of the piston assembly generously, forcing oil around the piston rings and in the space between the rings and grooves. Stagger the ring gaps around the piston and check to see that rings are in the correct grooves, and whether they are positioned correctly, as some are used as oil scrapers, others as pumper rings. The number, type, and arrangement of the compression and oil-control rings vary with the make and model of engine.

Perform any and all visual, structural, and dimensional inspection checks before installing the cylinder. Check the flange to see that the mating surface is smooth and clean. Coat the inside of the cylinder barrel generously with oil. Be sure that the cylinder oil-seal ring is in place and that only one seal ring is used.

Using a ring compressor, compress the rings to a diameter equal to that of the piston. With the piston at TDC, start the cylinder assembly down over the piston, making certain that the cylinder and piston plane remain the same. Ease the cylinder over the piston with a straight, even movement that moves the ring compressor as the cylinder slips on. Do not rock the cylinder while slipping it on the piston, since any rocking is apt to release a piston ring or a part of a ring from the ring compressor prior to the ring's entrance into the cylinder bore. A ring released in this manner expands and prevents the piston from entering the cylinder. Any attempt to force the cylinder onto the piston is apt to cause cracking or chipping of the ring or damage to the ring lands.

After the cylinder has slipped on the piston, so that all piston rings are in the cylinder bore, remove the ring compressor and the connecting rod guide. Then, slide the cylinder into place on the mounting pad. If cap-screws are used, rotate the cylinder to align the holes. While still supporting the cylinder, install two cap-screws or stud nuts 180° apart.

Install the remaining nuts or cap-screws and tighten them until they are snug. The hold down nuts, or cap-screws, must now be torqued to the value specified in the table of torque values in the engine manufacturer's service or overhaul manual. Apply the torque with a slow, steady motion until the prescribed value is reached. Hold the tension on the wrench for a sufficient length of time to ensure that the nut or cap-screw tightens no more at the prescribed torque value. In many cases, additional turning of the cap-screw, or nut, as much as one-quarter turn can be done by maintaining the prescribed torque on the nut for a short period of time. After the stud nuts, or cap-screws, have been torqued to the prescribed value, safety them in the manner recommended in the engine manufacturer's service manual.

Reinstall the push rods, push rod housings, rocker arms, barrel deflectors, intake pipes, ignition harness lead clamps and brackets, fuel injection line clamps and fuel injection nozzles (if removed), exhaust stack, cylinder head deflectors, and spark plugs. Remember that the push rods must be installed in their original locations and must not be turned end to end. Make sure that the push rod ball end seats properly in the tappet. If it rests on the edge or shoulder of the tappet during valve clearance adjustment and later drops into place, valve clearance is off.

Furthermore, rotating the crankshaft with the push rod resting on the edge of the tappet may bend the push rod. After installing the push rods and rocker arms, set the valve clearance. Before installing the rocker-box covers, lubricate the rocker arm bearings and valve stems. Check the rocker-