Before beginning to tune any engine, ensure the engine has satisfactory compression. An engine with worn or broken piston rings, burned pistons, or scored cylinder walls, will not perform properly no matter how much time and expense is spent on the tune-up. Poor compression must be corrected or the tune-up will not give the desired results.

A regular maintenance program that is followed throughout the year, is one of the best methods of ensuring the engine will give satisfactory performance. As they say, you can spend a little time now or a lot of time and money later.

The extent of the engine tune-up is usually dependent on the time lapse since the last service. A complete tune-up of the entire engine would entail almost all of the work outlined in this manual. However, this is usually not necessary in most cases.

In this section, a logical sequence of tune-up steps will be presented in general terms. If additional information or detailed service work is required, refer to the section containing the appropriate instructions.

Tune-Up Sequence

During a tune-up, a definite sequence of procedures should be followed to return the engine to its maximum performance level. This type of work should not be confused with troubleshooting (attempting to locate a problem when the engine is not performing satisfactorily). In many cases, these two areas will overlap, because many times a minor or major tune-up will correct a malfunction and return the system to normal operation.

The following list is a suggested sequence of tasks to perform during a tune-up.

- Perform a compression check of each cylinder.
- Perform a valve adjustment
- Start the engine in a body of water and check the water flow through the engine.
- Check the injection pump for adequate performance and delivery.
- Test the starting and charging systems.
- Check the internal wiring.

Cylinder Compression

Cylinder compression test results are extremely valuable indicators of internal engine condition. The best marine mechanics automatically check an engine's compression as the first step in a comprehensive tune-up. A compression test will uncover many mechanical problems that can cause rough running or poor performance.

A compression gauge for diesel engines consists of a dummy injector connected to a gauge capable of reading 600 psi.

CHECKING COMPRESSION

1. Make sure that the proper amount and viscosity of engine oil is in the crankcase, then ensure the battery is fully charged.
2. Warm-up the engine to normal operating temperature, then shut the engine **OFF**.
3. Remove the injector lines and remove the injectors from each cylinder.
4. Install a diesel compression gauge into the No. 1 cylinder injector hole until the fitting is snug. When fitting the compression gauge adapter to the cylinder head, make sure the bleeder of the gauge (if equipped) is closed.
5. According to the tool manufacturer's instructions, connect a remote starting switch to the starting circuit.
6. With the ignition switch in the **OFF**position, use the remote starting switch to crank the engine through at least five compression strokes (approximately 5 seconds of cranking) and record the highest reading on the gauge.
7. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes and/or time as the first.
8. Compare the highest readings from each cylinder to that of the others. The indicated compression pressures are considered within specifications if the lowest reading cylinder is within 75 percent of the pressure recorded for the highest reading cylinder. For example, if your highest reading cylinder pressure was 150 psi (1034 kPa), then 75 percent of that would be 113 psi (779 kPa). So the lowest reading cylinder should be no less than 113 psi (779 kPa).
9. Compression readings that are generally low indicate worn, broken, or sticking piston rings, scored pistons or worn cylinders.
10. If a cylinder exhibits an unusually low compression reading, squirt a tablespoon of clean engine oil into the cylinder through the injector hole and repeat the compression test. If the compression rises after adding oil, it means that the cylinder's piston rings and/or cylinder bore are damaged or worn. If the pressure remains low, the valves may not be seating properly (a valve job is needed), or the head gasket may be blown near that cylinder.
11. If compression in any two adjacent cylinders is low (with normal compression in the other cylinders), and if the addition of oil doesn't help raise compression, there is leakage past the head gasket. Oil and coolant in the combustion chamber, combined with blue or constant white smoke from the tailpipe, are symptoms of this problem. However, don't be alarmed by the normal white smoke emitted from the tailpipe during engine warm-up during cold weather. There may be evidence of water droplets on the engine oil dipstick and/or oil droplets in the cooling system if a head gasket is blown.
12. When reinstalling the injector assemblies, install new washers and/or gaskets as appropriate.

Valve Adjustment

See Figures 102 thru 108

Four-stroke diesel engines use valves to admit the fuel/air mixture into the combustion chamber, to seal the combustion chamber for compression, and to allow the spent exhaust gases to escape. All of these functions occur using the valve train (camshaft, lifters/shims and rocker arms and pushrods.)

In order for the valves to operate properly, they must be adjusted to assure that the full benefit of the camshaft lobe lift is realized, but they also must be able to close fully once the lobe of the camshaft has gone by. Valves are adjusted by increasing or decreasing their lash, which is the amount of free-play in the valve train when the valve is closed (meaning the camshaft lobe is not actuating the pushrod or rocker arm). Valve lash therefore, is basically a gap that exists between components when the valve is fully closed.

Since valves open and close with every turn of the crankshaft, their movement becomes a blur at engine speeds, creating a pounding on the entire valve train. As the engine is operated, internal components slowly wear, affecting distances between the components in the valve train. Valve lash will tend to change (increase or decrease) depending on the model. On some engines, the valve seats and heads will wear slowly, causing the valve to come further