TECHNICAL BULLETIN

TB NO.1005
REV. 0

SUBJECT: Superior Diesel & Dual Fuel Engine Adjustment and Balance

I. INTRODUCTION

The basic operating principle of a Superior Diesel Engine is, four (4) cycle with fuel injected under a controlled pressurized condition and ignited by heat of compression. The intake valve is open and as the piston moves down-ward, air is drawn into the cylinder. As the piston moves upward with both valves closed, the air is compressed and generates sufficient heat to ignite the fuel. It is important to note the governor controls the pump rack setting and fuel is injected into the cylinder through a spray nozzle at a specific timing degree and the amount of fuel is dependent on load or horsepower requirements.

The basic operating principle of a Superior Dual Fuel Engine is the same as diesel. The primary differences are governing pilot fuel control and air/gas admission. The intake valve is open, and as the piston moves down-ward, a controlled mixture of air and gas is drawn into the cylinder. As the piston moves upward with both valves closed, the air and gas is compressed and generates sufficient heat to ignite the pilot fuel to burn the mixture of air and gas. The primary fuel being consumed under dual fuel operation is gas. The pilot fuel or small amount of diesel being consumed is for ignition only. It is important to note the timing of pilot fuel injection is critical and of equal importance as timing for spark ignited engines.

Under the diesel mode on dual fuel turbocharged engines the air inlet butterfly linkage is blocked open and the governor controls the pump rack setting. Under the dual fuel mode the linkage blocks the pump rack at the pilot fuel oil setting and the governor controls the air inlet butterfly and gas metering valve. On naturally aspirated dual fuel engines the governor controls the carburetor.

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II. DIESEL ENGINE ADJUSTMENT & BALANCE

The example being used and specified in this section are for training purposes only. Always refer to the instruction manuals for detailed specifications.

Periodic inspections and adjustments are required to maintain engine performance and reliability. Programs should be established on conservative time or operating hours and based on operating conditions, load and actual experience.

The fuel system is normally divided into two parts for discussion purposes. The Supply System consists of storage tanks, day tanks, transfer pumps, fuel filters, engine driven service pumps and distribution manifolds. The Injection System includes the fuel injection pumps, spray nozzle assemblies and the connecting high pressure tubing lines. It is important to note the fuel system is commonly referred to as the heart of a diesel engine.

The fuel injection pumps and spray nozzles contain highly precision machined barrel and plunger assemblies and spray tips. The parts are lap fitted and very sensitive to foreign particles and water in the fuel system. Periodic inspection and cleaning of the storage tank and day tank is required. The fuel filters should be re-placed at regular intervals (1000 hours) to assure cleanliness at all times.

The fuel injection pumps are to be removed, tested and cali-brated at regular intervals (4000 hours). A complete set of exchanged pumps is recommended to reduce downtime. The amount of fuel to each cylinder is controlled by mechanical linkage from the governor to the millimeter rack on each pump. The differential of rack readings under a loaded condition is an indication of an improperly calibrated or defective pump assembly. The rack readings should be within 2 to 3 millimeters between cylinders. A typical rack setting for idle is 6 MM and full load @ 900 RPM is 22 MM.

The spray nozzles are to be removed and tested at regular intervals (2000 hours). They should be disassembled, cleaned and tested in accordance with manufacturers' instructions in the manual. The opening pressures (approximately 3000 PSI) and spray patterns should be recorded for reference and the differentials should not exceed 50 PSI. Again, it is important to maintain cleanliness at all times and the manufacturers' instructions should be followed carefully.

Balance of load between cylinders must be maintained. Unbalance can create overload on an individual cylinder basis. Indications are excessive wear of bearings, piston rings, liners, power valves and seats. You can also experience piston and liner scuffing. Cylinder temperatures are an indication of load and should be recorded on a daily basis. 100% load @ 900 RPM will result in exhaust temperatures of between 700 and 800 °F.

In order for each of us to have a complete understanding of the importance of balance and adjustments, we have established the following 2000 hour inspection program for your review.

II. DIESEL ENGINE ADJUSTMENT & BALANCE - CONT'D.

2000 HOUR INSPECTION

1. Adjust intake and exhaust valves (hot).

2. Change lube oil and filters. Note: Inspect engine crankcase and filters for babbit and other foreign material.

3. Adjust drive chains and belt tensions.

4. Clean crankcase breather screen.

5. Inspect camshaft timing. Note: Remove #1 fuel pump and dial indicate travel of the fuel pump push rod. Refer to your instruction manual for specifications. An example is .138 lift @ 14° BTC. Adjust as required.

6. Inspect port closing on all fuel injection pumps (14° BTC). Refer to your instruction manuals for specifications.

7. Inspect, test or exchange all injection spray nozzles.

8. Inspect and lubricate all linkages.

9. Change governor oil.

10. Record compression of end cylinder. Note: At operating temperature and at a fixed RPM, disconnect the linkage from the pump, close the pump millimeter rack, and record compression pressure. Check one cylinder at a time. An example of a normal compression pressure would be 450 and 500 PSI.

11. Balance and record firing pressures on each cylinder. Note: At a fixed RPM and under a stable loaded condition (minimum of 50%), balance cylinder exhaust temperatures by adjusting the millimeter rack of the respective fuel pumps. All cylinders should be within 50°F. Check firing pressures on each cylinder. Adjust to within 50 PSI by removing shims below each pump to increase firing pressures or add shims to decrease. After completion, re-check exhaust temperatures. An example of a normal firing pressure would be 800 to 1100 PSI depending on BHP.

The 2000 Hour Inspection is a combination service and tune-up. We realize it requires extra time and efforts, but is necessary for performance and reliability.

III. DUAL FUEL ENGINE ADJUSTMENT AND BALANCE

The Superior Dual Fuel Engines are equipped with the same basic components as the diesel engine. The major difference is the control system and gas supply.

Superior Dual Fuel Engines are always started and shut-down in the diesel mode. After startup, the units are switched to dual fuel manually or automatically, depending on the system. At shutdown, the units automatically switch to diesel.

When we discuss adjustment and balance of dual fuel engines, it is very important to point out first that you must have a well-tuned and balanced diesel engine. All the inspections and steps outlined in the diesel section must be completed prior to balancing on dual fuel.

The primary fuel being consumed during the dual fuel mode is gas, but it is being ignited by diesel in the pilot oil position. Timing or port closing is important for proper ignition.

The pilot oil set point is dependent on the quality of the diesel fuel and condition of the injection components. Your objective is to use a minimum of diesel fuel for stable ignition. Normally, 4 millimeters is sufficient. Note: The pilot oil set point is always lower than diesel idle position.

In the dual fuel mode load is measured by air inlet manifold pressure. 100% load @ 900 RPM, turbocharged engines will have an air inlet manifold pressure of approximately 12" HG, positive and naturally aspirated of approximately 4" HG, negative.

Balance of loading in the dual fuel mode is monitored by exhaust temperatures and controlled by metering the amount of gas to each cylinder. 100% load @ 900 RPM will result in exhaust temperatures of between 900 and 1000 °F on turbocharged engines and 1000 to 1100 °F on naturally aspirated engines. Exhaust temperatures should be within 50 °F. Increase gas to the low cylinder as well as decreasing gas to the high cylinder. This will enable you to maintain proper governor travel. Balancing in the dual fuel mode does not require a change in the pilot oil set point.

The intent of this information is to point out normal over-sights. Your instruction manual lists the details and specifications of your particular engines.

For more information concerning the Superior Diesel or Dual Fuel engine's injection system balancing, please contact **EnDyn's** Technical Service Department direct or your local authorized **Power**Parts® Distributor.

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