

APPLICATION NOTE

INSTALLATION OF OPTICAL FIBER THERMOMETERS FOR IN-CYLINDER MEASUREMENTS

Optical Fiber Thermometer's (OFT's) have been installed in the cylinder heads of General Motors, Chrysler and Toyota production engines for dynamometer, chassis dynamometer and road testing. Cylinder head modifications are straightforward and can be completed within a day. The cylinder head is removed, sensor locations are determined and the cylinder head is drilled and tapped to accept a 10/32 English thread or M6x0.75 metric thread. Stainless steel inserts are installed and ground to conform to the engine cylinder contour (Figures 1 and 2). The hole in the engine insert through which the sensor is inserted into the cylinder is then polished with diamond paste and a 0.050" diameter wire to eliminate rough edges which can cause fracture of the sensor at the engine wall. Engine inserts can penetrate water passages using standard automotive engine sealants. Once the engine insert is installed and cylinder head dimensions are recorded the engine is reassembled. Sensors are then installed and located using the insert adjusting nut. (Detail 5 in Figure 1.)

In general the lengths of the engine insert components are designed to provide the range of sensor locations specified by the customer. Sensors have been located up to 0.08" from the cylinder wall.

Properly installed, the sensors exhibit unusual durability in the cylinder environment. For example, no sensor failures occurred during three days of dynamometer testing with the four OFT sensors array shown in Figure 2. during six months of road testing around two with engine speeds to 4500 rpm, the average lifetime of the sensors has been over one thousand miles. It has been found that sensors are damaged during road testing due to the ingestion of particles from the roadway. Additional data is necessary to determine the actual sensor lifetime for all engine operating conditions in the test stand or on the road.

Two example engine installations are presented in Figures 3 through 5. A four-sensor array installed in a 1984 Toyota SU-2 engine for chassis dynamometer testing is shown in Figure3. Figures 4 and 5 show the installation of two sensors in a 1984 Oldsmobile 3.78 liter, V6 engine for chassis dynamometer and road testing. The locations of the sensors in the GM engine were dictated by the limited engine access in the engine compartment. Notice the protective asbestos sleeve where the optical fiber cables cross the exhaust manifold. In general, the location of the sensors in cylinders of production engines is limited only by the engine access and the location of the intake and exhaust

valves in the space between the piston and cylinder head.

The installations shown in Figures 3 through 5 represent only an initial approach to in-cylinder measurements. Optical Fiber Thermometer measurements in automotive engines are quite new and many alternate installation techniques are now being developed by Accufiber and by our customers. Please contact the Accufiber factory to discuss your specific engine installation requirements.

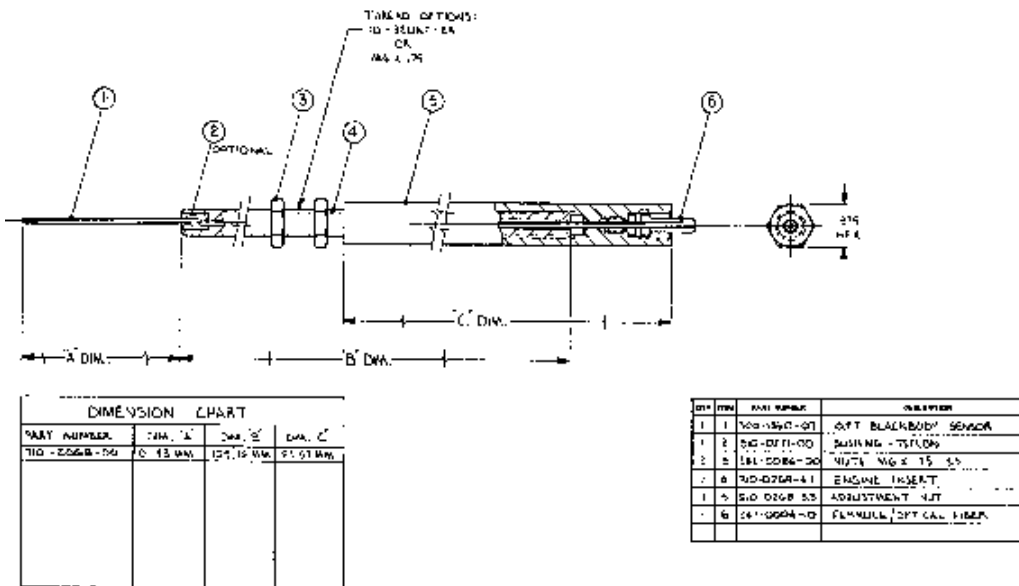


Figure 1: Standard OFT Engine Insert and Sensor



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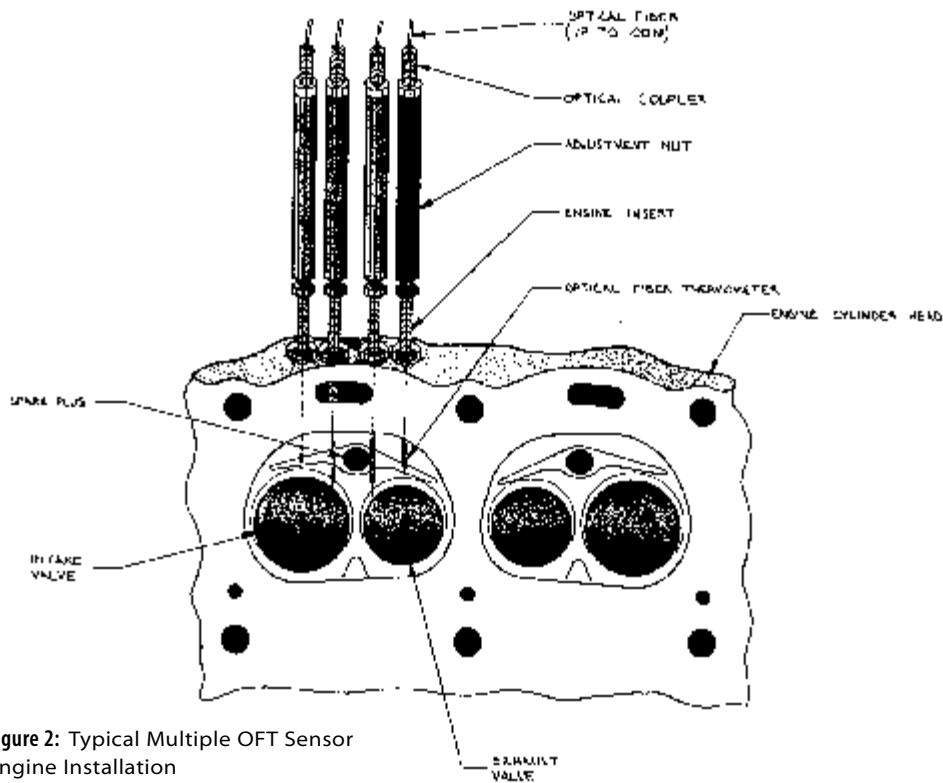


Figure 2: Typical Multiple OFT Sensor Engine Installation



Figure 3: Multiple OFT Sensor Installation in the Cylinder Head of a 1984 Toyota, Si-2 Engine

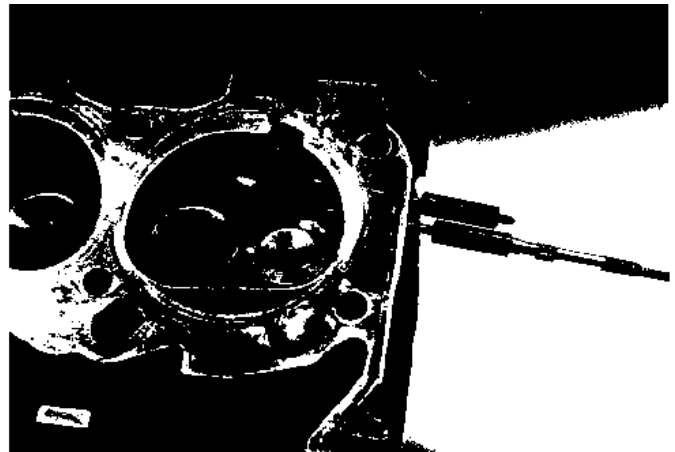


Figure 4: OFT Sensor Installation in the Cylinder Head of a 1984 Oldsmobile 3.78 Liter, V6 Engine



Figure 5: OFT Engine Insert and Optical Fiber Cable in 1984 Oldsmobile Engine Compartment.