Intelligent Engine Analyzer

Training

Anatomy of the Compression Waveform

by Bernie Thompson - ATS

The compression waveform produced from the internal combustion engine holds the key to determine if the mechanical condition of the cylinder is in good working order or if there is a deficiency within the mechanical condition of the cylinder.

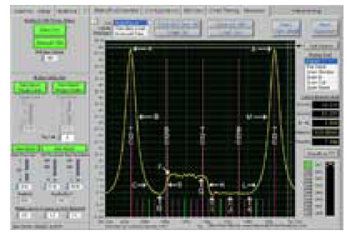


Fig. 1

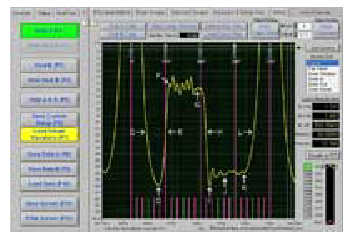
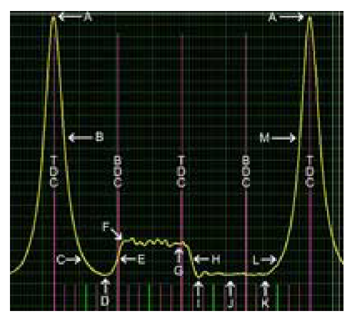


Fig. 2



Letter points

It is necessary to break the waveform down into several divisions in order to make a determination of the cylinder condition. In figure 1 (taken with a 300psi transducer) and in figure 2 (taken with a -30hg transducer to increase the resolution of the exhaust plateau) a compression waveform is shown from a good spark ignition engine at idle and has key points of the waveform marked. Note that the compression waveforms, figure 1 and figure 2, were taken from the same spark ignition engine. At the top of the waveform point A marks the peak pressure that occurred. This point will correspond to the point at which the piston position came within the closest distance to the cylinder head. This pressure is the sum of compression from point K to point A. The amount of pressure built will depend on the volume between the cylinder head and the piston, when the distance from the piston to the head is at its closest point. This peak pressure point will represent the top dead center (TDC 0º) position of the piston's movement. This is the point at which the piston has come to rest and is no longer in movement. This occurs when the crankshaft has reached the end of its stroke. This pressure will change due to the operating condition the engine is running under.

When the engine is in a cranking condition the compression on a spark ignition engine should be about 130lbs/square inch (psi). When this cranking pressure drops below 90psi it is an indication that the pressure within the cylinder is no longer adequate to support combustion of the hydrocarbon chains. When the engine is in a running condition the compression at idle should be about 70psi. When this running pressure drops below 40psi a misfire will occur. This is an indication that the pressure within the cylinder is no longer adequate to support the combustion of the hydrocarbon chains.

During a snap throttle compression test the idle compression pressure should increase by about 3 times. As the crankshaft rotates past the top dead center position the piston starts to move away from the cylinder head. This allows the volume between the cylinder head and the piston to increase. Under this condition the peak pressure that has been produced will start to decrease.

If the compression tower is measured from its lowest point, D, to its highest point, A, and this pressure is divided in half; then this point should occur at 30º after top dead center. This point is indicated by point B, halfway down the compression tower. The piston will then continue to move away from the cylinder head increasing the volume between the head and piston. The piston velocity will continue to increase until the crankshaft has reached the 90º position. The piston was at rest at top dead center and, as the crankshaft rotation continues, the piston speed increased until it obtained its