

■ **Combustion Chamber Volume Check: Verification of Cylinder Volume for Internal Combustion Engines**

Overview:

Exhaust emissions are becoming extremely critical for automobile engine manufacturers due to increasingly stringent environmental regulations. One of the many factors that can dramatically increase engine emissions is the volume of the combustion chambers.

Highlights:

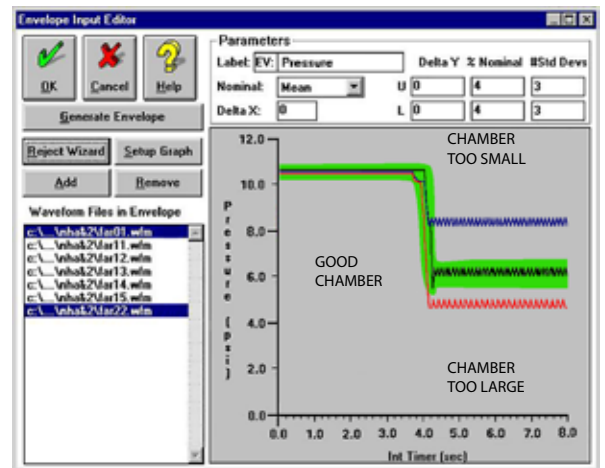
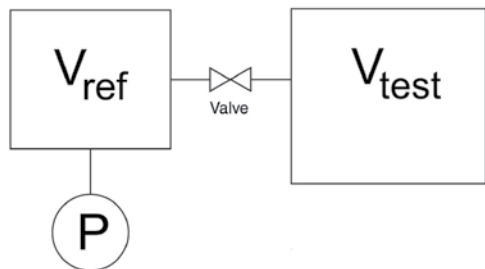
- Pressurized air test
- Defects detectable:
 - Casting differences
 - Valve problems
- Measures chamber volume
- Supports multiple recipes
- Fieldbus compatible
- PASS/FAIL output for host PLC
- Data logging and SPC

The newest regulations have become so difficult to meet that some automobile companies are adding in-process testing on the machining and assembly production lines to ensure all cylinders are within specification. If all engine combustion chambers are not within specification, compression rate changes due to the volumetric differences can cause increased emissions. In the past, this type of testing was reserved only for the laboratory. Recent developments in Signature Analysis technology have made this test practical for the production lines. High performance engines also can benefit from this testing to help increase engine power output.



The measurement is performed using compressed air and a unique pneumatic circuit with a reference volume chamber and a Sciometric® Signature Analysis system to control the test and evaluate the pressure signatures. The system can resolve volume to as little as 0.2 cc (cubic centimeters) on chambers of 35 cc, which is the average standard volume for a normal 2 liter L4 engine. This represents a measurement accuracy of 0.5% of the net volume. Test times will vary depending on the pneumatics and volumes, but a 35 cc chamber can be verified in approximately 10 seconds. Larger volumes will take proportionately more test time. Calibration is simplified by using a master reference chamber with an innovative pneumatic circuit design. This allows a calibration cycle to be performed automatically during production to increase the overall reliability of the system. Temperature compensation may be necessary in some manufacturing plants to ensure that variations in ambient and part temperature do not produce erroneous results. This normally requires the addition of one temperature sensor for the ambient air, and a second for the part under test, which is usually a non-contact infrared type sensor. The software then uses an algorithm to compensate the volume measurements for temperature changes.

The same system can be used to measure the volume of piston domes, and it can verify oil levels in assembled gear boxes and axles before shipment. Any volume chamber up to 5 liters (with appropriate reference chamber supplied with the unit) could be measured with this system. This is just one example of the many innovative in-process test solutions Sciometric® has developed to enhance quality in powertrain manufacturing operations.



SigMETER screen showing Pressure Signature Waveforms