

■ Automobile Air Conditioning Compressor: Torque to Turn Signature Analysis

Highlights:

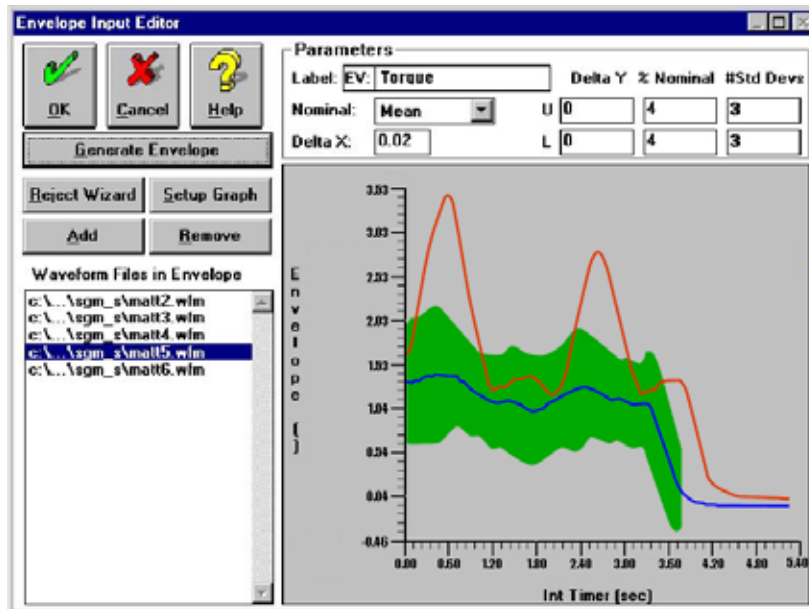
- Piston “slap” (loose) detection
- Hi torque (tight) detection
- Statistically learned limits
- Go-no-go outputs to PLC
- Ethernet link to plant server
- Integral “on line” SPC
 - Histogram
 - Trend charts
 - Capability
 - Control limits

Historically, compressors have utilized a rotating crankshaft directly acting upon pistons via connecting rods. Automotive underhood constraints dictate a smaller size, lighter weight and higher capacity compressor capable of being produced at a reasonable cost.

One solution is a “wobble plate” compressor, which engages several pistons through a disk, mounted at an angle on the rotating crankshaft. The result is a linear reciprocating motion of each piston as the crankshaft is rotated. Molecules of oil in the freon act as the bearing surface and it is extremely critical that a precise clearance be maintained in the manufacturing process. Excess clearance between the piston follower and the plate results in an audible and objectionable “slap” at operational speeds (even though the compressor fully performs to system specifications).



In the graph (shown below) the normal torque level is within the green envelope, while a compressor with one defective piston produces the red waveform. Very easy to spot when Signature Analysis is used. Also note that the bump is within the allowable torque limits.



SigMETER® Screen showing Acceptable and Unacceptable (Noisy) Compressors

By installing a Sciometric® Torque to Turn Signature Analysis system upstream in the assembly process, our customer was able to statistically learn the characteristic waveform of “quiet” compressors. This establishes production stable limit criteria for go-no-go evaluations. Advanced InspeXion® analysis tools in the Sciometric Test and Analysis System then look for subtle deviations from this established norm to accept or reject the sub-assembly before any additional cost burdens (such as after sale warranty) are realized.