

## ■ Manual Torque to Turn and Missing Bearing Test: Verification of Engine Torque and the Presence of Bearings

### Overview:

A marine engine manufacturer buys engines from a major auto manufacturer, tears them down, changes components, and rebuilds them as 'marine ready'.

### Highlights:

- Waveforms collected:
  - Torque vs. Time
  - Torque vs. Position
  - Supply Pressure
  - Back Pressure vs. Encoder
- Analysis overview:
  - Breakaway torque
  - Running torque
  - Back pressure
  - Supply pressure
- Defects detectable:
  - Tight pistons
  - Missing main crankshaft bearing(s)
  - Missing connecting rod bearings
  - Debris in the crank journals
- Potential defects:
  - Con rod defects (e.g. not torqued down properly)
  - Bent cranks

A Sciometric Test and Analysis System with InspecXion® operating software was configured on a small engine assembly line to perform a short block test and check for defects in a high performance version of what was previously a normal 350 cubic inch block engine.

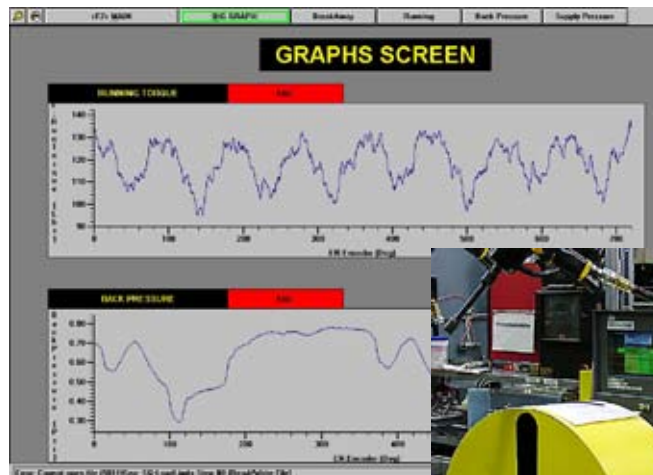
A handheld Atlas-Copco® Nut Runner torque wrench tool was manually attached to the crank and used to turn the crankshaft for brief periods at a constant velocity. A separate encoder and torque sensor were used to measure breakaway and running torque against angle while air back pressure is also measured in the oil gallery as pressurized air is forced into the block. The supply line (with the supply pressure sensor inline) and back pressure sensors were attached to the engine with quick disconnect couplings, and a hole in the engine oil gallery was plugged to prevent leakage. The software button "Run Test" is pressed, and the operator is prompted to enter a serial number. Once the serial number has been entered, the Sciometric Test and Analysis System remotely starts the Atlas-Copco® tool using a solid state relay (SSR) output.

Breakaway torque, running torque and air pressure are measured and evaluated and a PASS or a FAIL is indicated on the Sciometric® Test and Analysis System screen. Waveform data is saved for each engine as a PASS or FAIL with a filename that is 9 digits of the serial number entered by the user. A text log file is then updated with information from the test. The operator then disconnects the test apparatus from the engine and is ready for a new test. Additional plans to develop algorithms to identify which bearing is missing from the pressure waveforms are also scheduled.

Sciometric® worked with the engineers to provide a cost effective workable short block torque to turn test station with missing bearing air test capable of detecting all major failure modes they had identified.



V8 Engine Block Test Station with metal test fixture mounted on front



InspecXion Screen showing Running Torque and Back Pressure Waveforms.



Side View of station showing Engine Block in foreground and Sciometric Test and Analysis System in background.