

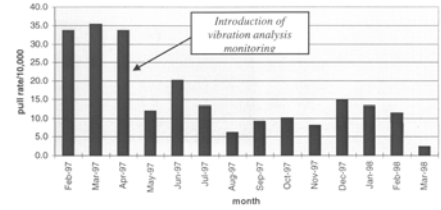
MAARS Application Note

Engine Test Stand Monitoring Application

Vibration analysis of reciprocating gasoline engines has proved to be very successful in solving vibration-related engine failures at an engine production facility. The "pull ratio" of engines returned to the factory has been reduced by 70% over the pre-vibration testing levels.

Problem Statement

At the end of the production line of 4-cylinder gasoline engines are six test cells where the completed engines are rigged up and started-up for the first time after manufacture. Historically, the engines were allowed to warm up for a few minutes and then inspected manually by the operator. The operator would listen for unusual noises and check for oil or water leaks using an ultraviolet lamp. The next step in the evolution of the test cells was to use a portable data collector to acquire vibration data from several points on the engine block while the engine was running. From 5 to 10 analysis parameters were defined to aid in diagnosis of internal problems in the engines. Alarm limits were assigned to the parameters to provide a pass-fail result for the test. After successful demonstration of the addition of vibration analysis to the engine test cell program, the manufacturer asked MAARS to design an automated system to replace the manual vibration data collection process.

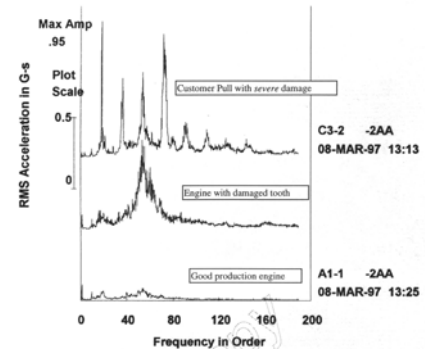
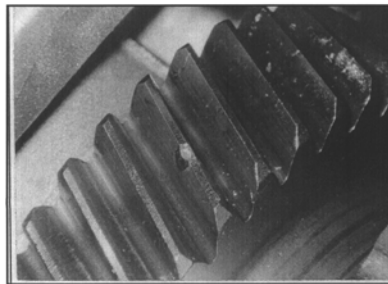


Vibration Analysis

Gear damage was one item that was easily identifiable for pulling engines prematurely. One can see from the photograph and data shown below that this defect is easily identifiable through spectral analysis. Gear damage and a close-up are shown below:

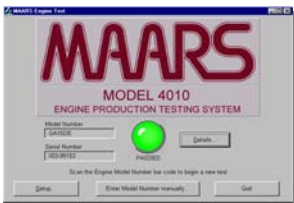
Other Detectable Engine Faults:

- Incorrect Intake Timing
- Incorrect Exhaust Timing
- Defective Primary Tensioner
- Camshaft Damaged Lobe
- Poor Cam Form
- Missing Tappets
- Incorrect Ladder Frame Timing
- Wrong Valve Springs
- Imbalanced Flywheel



Test Program Results

The use of vibration analysis has proven to be an invaluable tool in the production line testing of engines. The reduction in pull rate, coupled with the identification of specific engine faults, enables the facility to enjoy a significantly improved reputation for customer satisfaction. The MAARS Model 4010 Engine Test Stand Monitoring System provides a cost-effective solution for engine testing with a significant impact on engine production quality. In addition, production line speed was increased over the manual method of data collection using a portable data collector.



Engine Test Failure Report

Serial Number: 8786453
 Model Number: 97XFG6L084BA
 Test Type: Test01
 Test Cell: New M4010
 Date Start: 05/03/99 1:58:32 PM
 Date Stop: 05/03/99 1:58:35 PM

Channel	Parameter	Value	Alert Limit	Fault Limit
Chan01	Overall	1.738	1.500	1.500
Chan02	Overall	1.741	1.500	1.500
Chan03	Overall	1.750	1.500	1.500

Check the following possible causes (most likely cause first):
 1 Wrong Springs

Actual findings / Repair action taken:

Model Test Results

Test Setup: VX62 2.3 Aut (97XFG6L084BA)
 Date Start: 2/29/99 9:21:39 AM
 Date Stop: 5/3/99 9:21:39 AM

Total Passed: 9/13 (69%)
 Total Failed: 4/13 (30%)

Serial Number	Date Start	Duration	Result
ignore	3/23/99 12:59:53 PM	1.00 Sec	Passed
ign004	3/23/99 1:20:02 PM	1.00 Sec	Passed
X1066457	3/23/99 1:23:51 PM	1.00 Sec	Failed
junk	3/23/99 1:25:23 PM	0.00 Sec	Failed
X1066464	3/23/99 1:36:51 PM	0.00 Sec	Failed
X1066465	3/23/99 1:44:26 PM	1.00 Sec	Failed
X1066450	3/23/99 1:34:45 PM	0.00 Sec	Failed
ignore	3/23/99 1:57:56 PM	1.00 Sec	Passed
ignore	3/23/99 1:59:47 PM	0.00 Sec	Passed
ignore	3/23/99 2:14:08 PM	1.00 Sec	Passed
X1066471	3/23/99 1:49:46 PM	1.00 Sec	Passed
temp	3/23/99 3:34:07 PM	0.00 Sec	Passed

Test Result

Serial Number: 8786453
 Test Type: VX62 2.3 Aut
 Date Start: 3/23/99 1:36:51 PM
 Date Stop: 3/23/99 1:36:51 PM

Channel	Param	Warnings	Param Faults
Head-EX	0	0	0
Head-INT	0	0	0
Block-INT	1	2	2
Overall	1.437	Normal	
1X Crank	1.061	Normal	
1X Val	4.963	Fault	
1.5X Val	2.727	Warning	
0.2X Val	6.036	Fault	
2X Crank	0.008	Normal	

The Model 4010 main operator's screen (above) and Sample report screens.

Contact Information

If you have production line monitoring problems in your plant, please call MAARS, Inc. at (865) 927-6626 or email us at sales@maars.com.

MAARS would like to thank Andrew Daly for providing the pictures, spectral data and text for this application note. Most of the information contained herein was adapted from his paper, "Detection and Identification of Gear-Related Noise Concerns on DOHC Engines Using Spectral Analysis" developed for his B. Eng. (Honours) Degree in Manufacturing Systems Engineering at the University of East London.