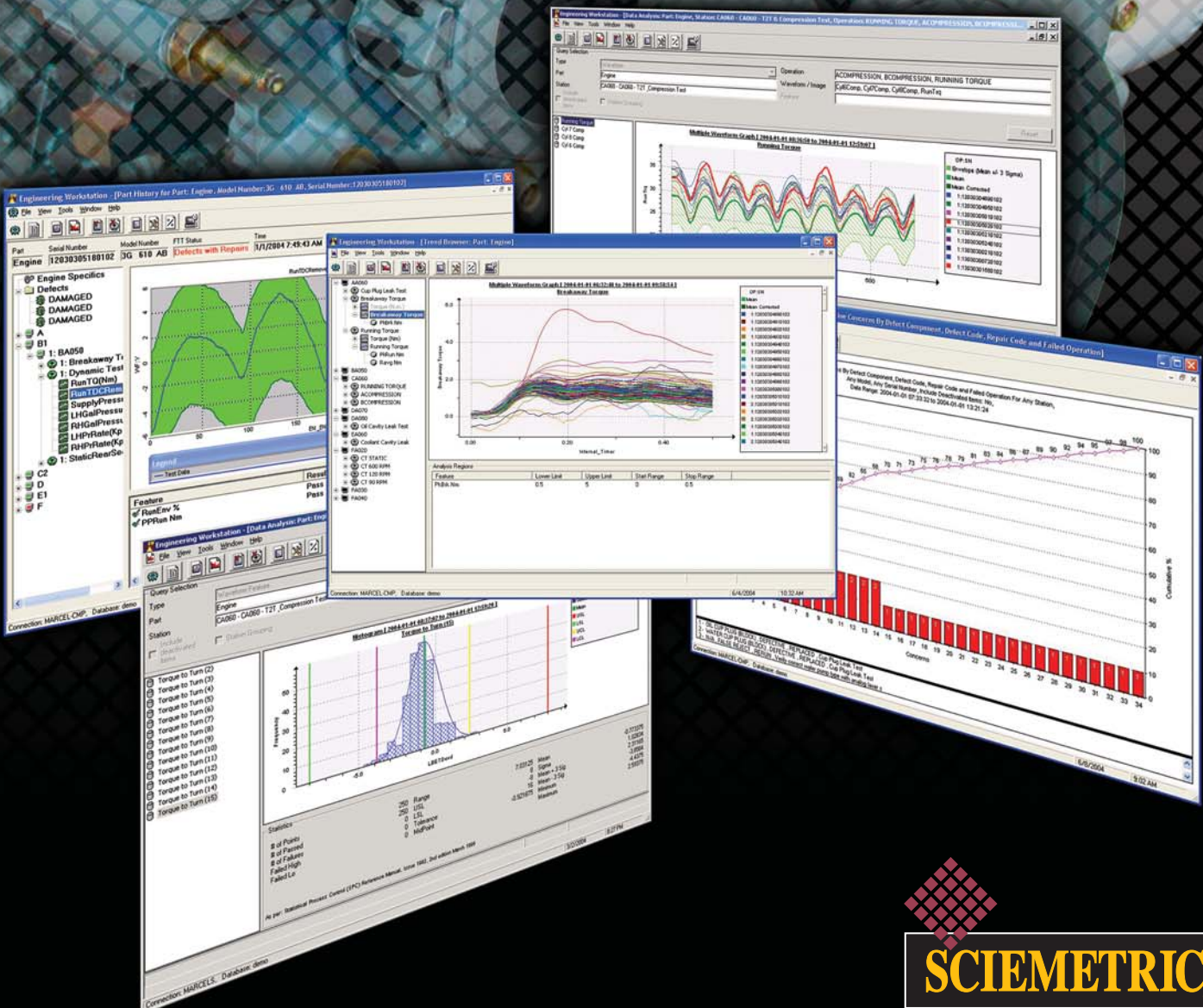


Engine
In-Process
Test Solutions

Exceptional Engine IPT Solutions



Engine IPT

Engine In-Process Test Solutions

ENGINE QUALITY CHALLENGES

Engine manufacturers must constantly balance their throughput and quality requirements. When an engine does not meet quality requirements, yield and efficiency are impacted. Engines with quality issues that make it to the field result in poor customer satisfaction and costly warranty claims.

An engine defect can be introduced at any machining or assembly station. It can be the result of a damaged sub-component or a problem with one of the assembly machines. Many engine manufacturers rely exclusively on end-of-line hot test to verify quality. If there is a quality issue detected at hot test, the manufacturer experiences an impact on throughput while engine defects are identified and repaired. When an engine is fully assembled it can be difficult to diagnose the root cause of a failure and requires greater time and effort to make the necessary repairs. The ability to catch a quality issue as soon as it is introduced makes it easier to detect and fix defects and improves overall yield.

Hot-test stations are a large expense for manufacturers and require a separate dedicated area of the facility. Hot test stations also require dedicated resources and maintenance. Due to the complexity of the station and the requirement to fully engage the engine, hot test cycle time is lengthy. Hot test costs are augmented when multiple test stations must be implemented to accommodate throughput.

Sciometric has leveraged decades of testing experience and knowledge to develop a suite of defect detection solutions for engine manufacturers. These powerful and comprehensive out-of-the-box solutions are designed for rapid implementation and immediate quality improvement.

ENGINE IN-PROCESS TEST SOLUTIONS

Sciometric's Engine In-Process Test (IPT) Solutions are specifically designed to catch defects as early as possible in the engine assembly process. Test stations are implemented at key points along the assembly process to verify or test the engine and process as it is built, or immediately after each value added step. This results in a dramatic decrease in costs.



\$	Design
\$\$	In-coming inspection
\$\$\$	In-process-test (IPT)
\$\$\$\$	End Of Line Test
\$\$\$\$\$	Warranty

LOWER COST - The earlier you find a defect, the less costly it is. Use Sciometric's Engine IPT to push defect detection upstream as far as possible.

The Engine IPT Solutions leverage Sciometric's advanced signature analysis technology to identify defects. This technology captures and converts test result data into graphical output as a full waveform. Advanced algorithms designed specifically for engine testing are used to identify defects by dissecting the waveform and comparing distinctive characteristics or features against specified limits.

Sciometric's signature analysis delivers more accurate and repeatable results than other test systems. Sciometric's application specific algorithms achieve better results while providing operators with a user friendly interface and a consistent look and feel.



APPLICATIONS

Some key Sciometric Engine IPT applications include the following:

Short Block Crank Torque to Turn Test:

The System finds defects introduced at the short block stage of the assembly process. The test examines breakaway torque, running torque and rear and front cup plug verification.

Defects Detected: contaminated main bearings, debris, incorrect fit, insufficient lubrication, nicked or bent cranks.

Short Block Verification System:

The System finds defects introduced at the short block stage of the assembly process. Tests include: breakaway torque peak threshold, running torque average and peak threshold, missing bearing detection and rear seal verification.

Defects Detected: missing con rod bearings, missing main bearings, incorrect fit, debris, reversed caps, blocked oil passages, bore lubrication.

Oil Cavity Leak Test System and Coolant Cavity Leak Test System:

The coolant cavity and oil cavity leak test is designed to find defects introduced at the long block stage of the assembly process.

Defects Detected: missing or leaking components, casting porosity, mis-assembled components, improper run-down torques.

Long Block Verification System:

The System finds defects introduced during the long block stage of the assembly process. Tests include: cylinder compression, and running torque average and peak threshold.

Defects Detected: low compression, mis-assembled timing chains, head installation problems, incorrect engine timing, and soft lash adjusters.

Cold Test System:

The System finds defects introduced during the final assembly stages. Tests include: high-speed tests, low speed tests and static tests with operator inspection.

Defects Detected: low vacuum, bad oil pump, EGR valve functionality, incorrect engine timing, leaking fuel rail, damaged fuel injectors, knock sensors, missing/damaged gaskets.



INTEGRATED SPC

Sciometric's Engine IPT Solutions come equipped with an integrated SPC (Statistical Process Control) module. The SPC module automatically calculates process control limits, graphically presents test data and provides trending on process variables. All data is reported in clear, easy-to-understand formats. By generating timely and critical information, the Engine IPT Solutions expose, analyse and resolve production problems, consistently keeping production processes in control and ensuring improved engine quality.

For manufacturers who need more advanced statistical analysis, the Engine IPT Solutions also have an optional interface to the Q-DAS® Statistical Server. This sophisticated analytical system enables the engine manufacturer to seamlessly validate the capability of its processes and to "drill down" into different process issues. The Q-DAS® Server is highly effective at identifying and resolving problems with system components, such as measuring equipment or machining systems.



DESIGNED FOR PRODUCTION ENVIRONMENTS

Sciometric's Engine IPT Solutions encompass a rugged and reliable hardware component that is designed specifically for harsh production environments. To ensure maximum reliability, all test data is protected by a comprehensive redundancy system, featuring dual hard drives and power supplies.



INTEGRATES SEAMLESSLY WITH EXISTING EQUIPMENT

Sciometric's Engine IPT Solutions support numerous communication and network options, including direct Ethernet connectivity and most fieldbus interfaces. The seamless integration with existing process machinery and controls maximizes the power of the solutions.

- OPC
- GE Genius
- Ethernet
- RS232
- Profibus-DP
- Interbus
- Devicenet
- CAN
- Modbus Plus
- Data Highway Plus

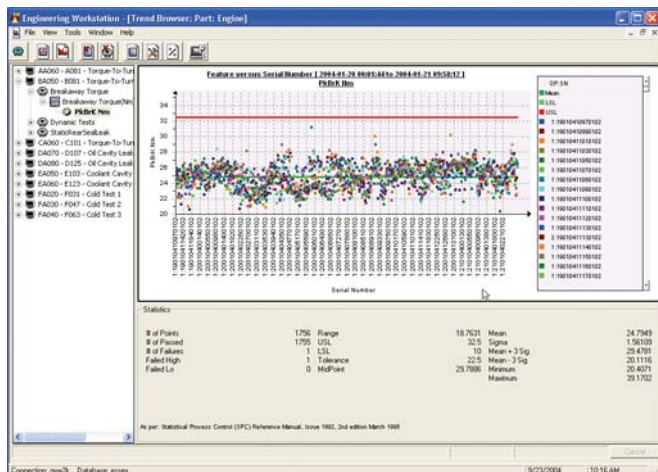


MANUFACTURING BIRTH HISTORY AND TRACEABILITY

Sciometric's optional QualityWorX® software provides rich birth history data and robust traceability to help engine manufacturers manage their process before, during and after production. Birth history enables engine manufacturers to improve their production process and quality, while traceability provides protection from the risk and cost associated with warranty claims.

Pre-production, the advanced analysis features of QualityWorX® can be used to scientifically set optimal test limits to minimize the occurrence of false accepts and false rejects. Using the advanced intelligence of the system, many engine manufacturers have substantially reduced new product launch times without sacrificing their quality objectives.

During production, QualityWorX® collects and archives comprehensive test result data across the assembly process. Using robust analysis features, engine manufacturers can evaluate the impact of a process change. QualityWorX® effectively ensures that your production process is under control and that productivity is maximized.



A QualityWorX screen showing some of the advanced trending abilities. Here a trend graph is shown for breakaway torque. This analysis can be used to identify the root cause of defects and take corrective actions.

Post production, QualityWorX® is a powerful tool for engine manufacturers to minimize the cost and risk involved with warranty claims. The comprehensive data available through QualityWorX® is what manufacturers need to address increasing customer expectations, longer warranty periods and growing government

legislation. Full traceability allows engine manufacturers to demonstrate adherence to specifications while providing the data mining capability required to locate engines with specific test result features. Leveraging this capability, engine manufacturers can proactively reduce the size of a recall and minimize their warranty costs.

BENEFITS OF USING SCIOMETRIC'S ENGINE IPT TEST SOLUTIONS

Finding defects as early as possible in the assembly process enables engine manufacturers to:

Improve Quality / Reduce Warranty Costs

Many defects that Sciometric solutions can find in early assembly stages can not be detected by hot test methods. Sciometric Engine IPT Solutions enable manufacturers to identify these defects during production where they are less expensive to fix. Shipping better quality engines translates into satisfied, repeat customers and fewer warranty claims.

Reduce Hot Test Costs

Implementing Sciometric solutions allow engine manufacturers to reduce and/or eliminate hot test stations. Sciometric Engine IPT Solutions identify problem engines and ensure that only engines that meet specifications get shipped.

Reduce Repair Costs

In process testing with Sciometric Engine IPT Solutions ensures that defects are identified at the point of introduction. This early detection enhances root cause understanding and minimizes repair time and effort.

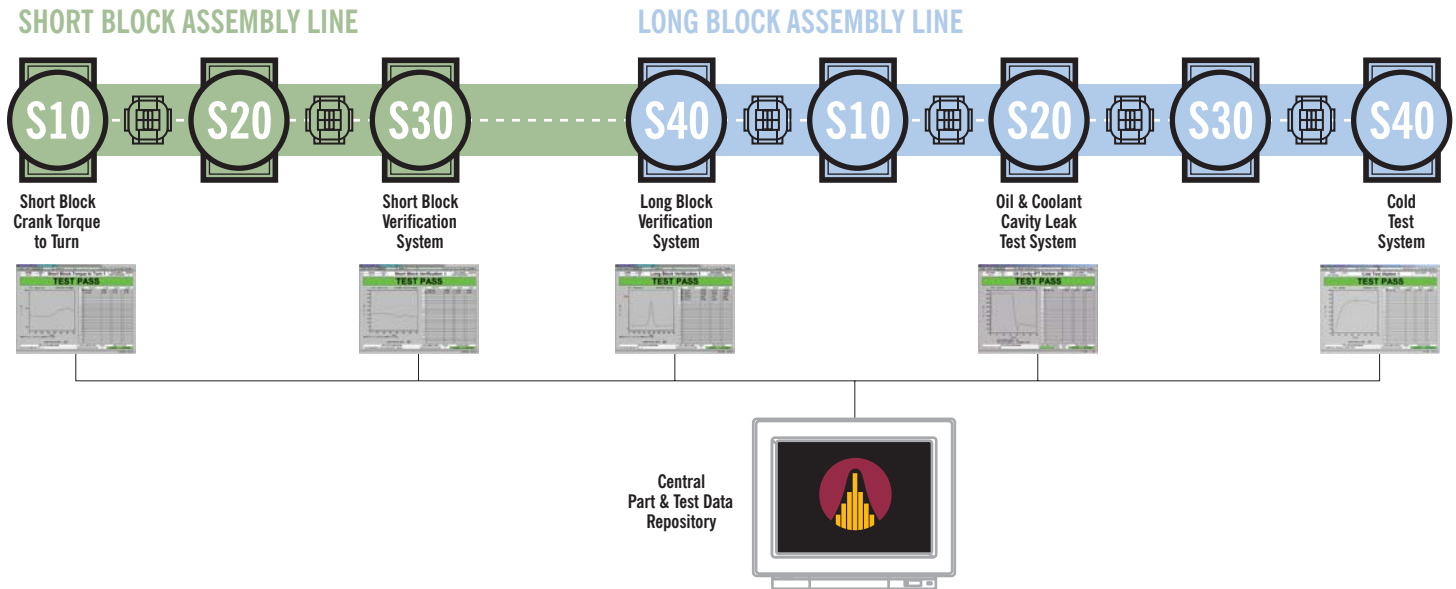
Reduce Wasted Cycle Time / Improve Yield

Engines with defects are stopped from proceeding through the manufacturing process to ultimately fail at hot test. The ability to remove defective engines as early as possible improves manufacturing efficiency.

Engine IPT

Engine In-Process Test Solutions

EXAMPLE DEPLOYMENT



Sciometric's Engine IPT Solutions can operate as a complete suite or each module can operate independently. For the ultimate solution, Sciometric's Engine IPT Solutions can be combined with the QualityWorX® Product Quality Management System. All product genealogy is captured and stored for each engine. This can include serial numbers, machines used to assemble each engine, sub-components used on each engine, test results and repair

data. Unique to QualityWorX®, complete test waveforms can be stored, empowering manufacturers to re-analyze stored waveforms without physically re-testing engines. This powerful feature allows engine manufacturers to prototype test recipes before implementing them into production. Specific engines can also be isolated in the event of a recall to avoid the cost of a mass recall.

ABOUT SCIOMETRIC

Sciometric is the premier provider of defect detection, analysis and traceability solutions for engine manufacturers. Our solutions deliver the insight engine manufacturers require to improve quality, increase productivity and decrease costs across the entire production lifecycle.

Sciometric has perfected the industrial application of electronic signature analysis technology - a powerful tool for detecting defects that were previously thought to be undetectable and for pinpointing the root causes of defects.

Customers who have implemented Sciometric solutions to help them achieve their quality and productivity objectives include Ford, General Motors, DaimlerChrysler, BMW, Toyota, Cummins, John Deere, Caterpillar, Mazda, Hyundai, Holden, International and Saturn.

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