## **IN-PROCESS TESTING** Cup Plug & Dowel Press Monitoring **ENGINE MANUFACTURING** M50 Test Description: Measure cup plug and dowel pin insertion force. Signatures: Force vs. depth. Defects: Missing or damaged cup plugs and dowel pins, unseated plugs and pins, under or oversized hole. Signatures: Eddy current vs. thread depth. Solutions for Manufacturing. Defect Detection. Analysis. Traceability. HEAD MACHINING Head Leak Test insertion force as valve seats and/or guides are pressed into the cylinder head. Signatures: Force vs. distance. Test Description: Verify block/head casting integrity using pressurized leak test. Signatures: Air pressure decay vs. time, or mass flow. BLOCK MACHINING LINE CRANK MACHINING LINE HEAD SUB ASSEMBLY Crank Reluctor Wheel Valve Type Verification Test Description: Valve profile is scanned using a laser sensor and slide assembly. Signatures: Cross-sectional valve profile (distance vs. diameter). Test Description: Using a laser and encoder, verify reluctor notch symmetry and depth. Signatures: Depth vs. angle. Defects: Improper spacing, bad machining Defects: Incorrect valve type, damaged valves. M20 Cup Plug Press Test Description: Measure cup plug insertion force. Signatures: Force vs. depth. Defects: Missing or damaged cup plugs, unseated plugs, under or oversized hole Signatures: Valve stem profile vs. position. Defects: One or both keys missing or misaligned, cap missing, cap upside down, valve missing, wrong valve height, wrong valve stem diameter. SHORT BLOCK NVH Test Test Description: Objectively test for unacceptable level of engine NVH and defects that were not detected by other test methods. Walve Leak Test Test Description: Head is sealed and pressurized while measuring for air leakage Test Description: The crankshaft is rotated for the first time, usually at low speed (60-120rpm). Signatures: Breakaway torque and torque vs. angle over 360 degrees. ZONE DATA COLLECTOR nction: Upload all test and operation status sults from RF tag /PLC device to QualityWor. Hot Test Test Description: Monitor engine parameters in hot test for a 2-4 minute cycle time ar analyze various signatures to improve defect detection. Signatures: Ol pressure, vibration, PPM and oylinder drop out, vacuum, ignition, throttle position sensor, CAM position sensor, temperature, IAAP sensor, ECM modulant. Cold Test Cup Plug Leak Test 210 Test Description: Scan head profile using a laser to varify presence and orientation of roller finger follower. Test Description: General end of line functional cold test for the engine. Test Description: Verify sealing integrity of Cup Plug pressed into block. Signatures: Air mass flow or pressure decay vs. time. Signatures: Laser distance vs. position on head. Defects: Low vacuum, bad oil pump, EGR valve functionality, incorrect engine timing, eaking fuel rail, damaged fuel injectors, knock sensors, missing/damaged gaskets. Defects: Improper cup plug postion, missing or misaligned cup plug, deformed cup plug, undersized cup plug. Defects: Missing followers, off location followers 210b - Oil System Piston Ring Verification Test Description: Scan ring stack using a stopper motor and laser gage. Signatures: Ring edge profile vs. height. Defects: Upside down rings, damaged rings. 220a - Idle Stability 220b - Misfire Test 210d - Ignition 210e - EGR Valve 2200 - Mistire Test 220c - Bearing Test 220d - Sensor Tests 220e - I/O Test 220f - Vibration Crank Endplay Test Description: Crank is moved back and forth while measuring axial movement. 210 f - Sensor 6. Hey Signatures: Distance vs. time (using a Sony or LVDT probe) CAM Torque to Turn Defects: Tight or loose crank bearings, debris in bearing. Test Description: Camshaft rotated for 360 degrees while measuring torque to turn. Signatures: Torque vs. Angle and pressure vs. angle (1 per cylinder). ----SUB ASSEMBLY Incremental Torque (Piston Insertion) Test Description: Scan piston profile using a lase to verify ring integrity. Dual lasers account for gap. Signatures: Breakaway torque vs. time and torque vs. angle over 360 degrees. Signatures: Piston edge profile vs. position **Defects:** Piston defects, main and conrod bearing problems, abnormal drag friction. (Partnership Solution) LONG BLOCK ASSEMBLY LINE Coolant Cavity and Oil Cavity Leak Test Short Block Vibration Piston Type Verification Test Description: Crank is rotated for several and/or the oil cavity using a pressurized air test. Signatures: Pressure decay vs. time or mass flow. Defects: Missing or leaking or damaged components (frost plugs, gaskets, oil gallery plugs, drain plugs), casting porosity, mis-assembled components, imprope Signatures: Vibration vs. angle with frequency analysis (FFT with order tracking). Crank Seal and CAM Seal Leak Test Piston Protrusion Test Description: Rotate the crank shaft and measure dynamic piston movement. Calculate relative distance between fire face and maximum piston position. Test Description: Verify sealing integrity of Crankshaft Seal and CAM Seal. LEGEND NAME: ENGINE MANUFACTURING BLUEPRINT DATE: DEC 2004 REVISION: 04 ignatures: Air mass flow or pressure decay Signatures: Piston protrusion vs. time or engine position. Crank drag torque vs. Time or engine position. Air pressure or NVH. Defects: Incorrect head gasket grading, missing bearings, crank or bearing damage. = KEY IPT APPLICATION COMPANY SCIEMETRIC INSTRUMENTS INC. Signatures: Torque vs. angle and air back pressure vs. angle. SCIEMETRIC TEL: 613-254-7054 email: inquiries@sciemetric.com = PISTON SUB ASSEMBLY LINE = HEAD SUB ASSEMBLY LINE Refer to the Engine Manufacturing Line in-process testing matrix and specific Solution Sheets for more details on Sciemetric<sup>1</sup> in-process testing solutions. The applicability of each test and the defect detection success depends on many factors including the engine design and manufacturing process. Contact Sciemetric 10 obtain more information. = LONG BLOCK ASSEMBLY LINE = SAMPLE QualityWorX™ STATION(s)