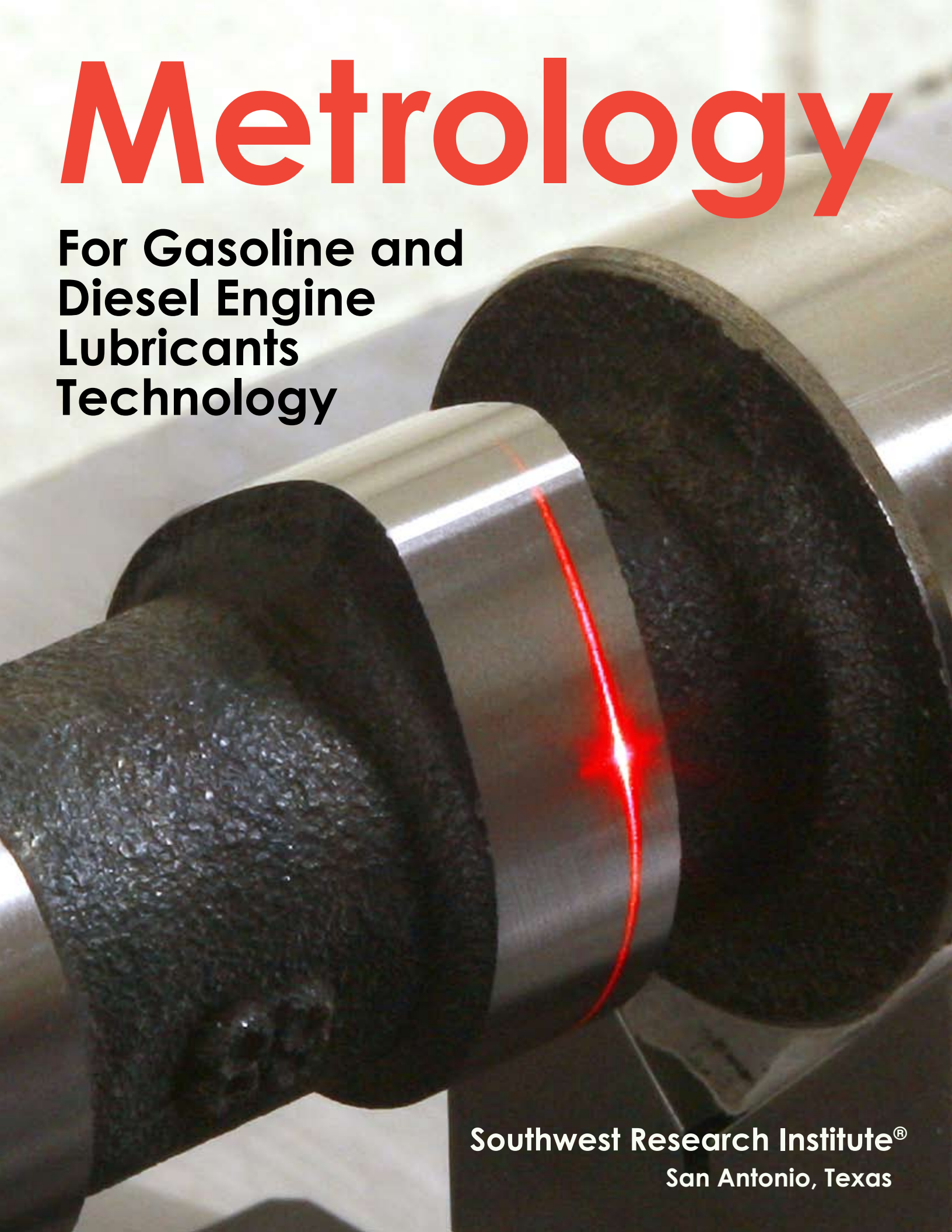
Metrology

For Gasoline and Diesel Engine Lubricants Technology



Southwest Research Institute®
San Antonio, Texas

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To help the automotive industry develop engine oils and lubricants that meet current and future requirements and challenges, Southwest Research Institute® (SwRI®) conducts detailed, precise studies of used and failed engine parts. The Institute uses state-of-the-art measurement equipment and skilled technicians to meet industry requirements for rapid, precise and reliable data.

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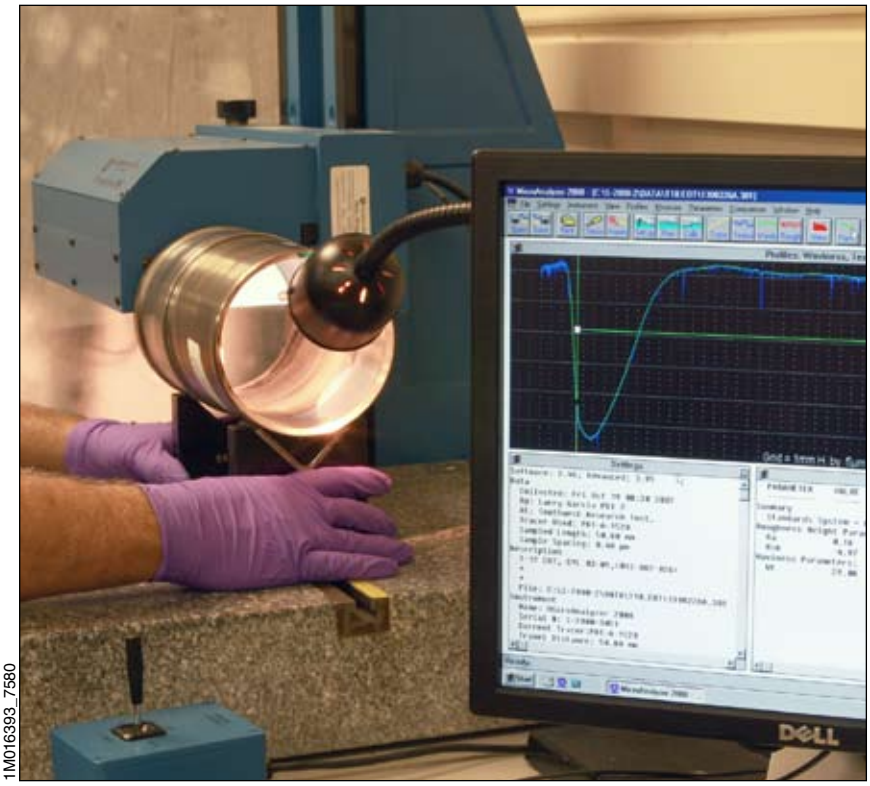
Surface Analyzer

The Fuels and Lubricants Research Division uses surface analyzer technology in a variety of computer programs. The Micro Analyzer 2000 Surface Analyzer is used to determine how varying component forms and surface textures affect fuel and lubricant performance in heavy-duty engines. Components studied include piston rings, pistons and cam lobe profiles. The analyzer measures wear and determines surface roughness on a variety of engine EOT and buildup parts. Surface texture and waviness variations can be measured on selected areas of components, including cylinder liners, piston rings from heavy-duty diesel engines, and cam profiles.



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Surface analyzer technology is used to determine how component forms and surface textures affect fuel and lubricant performance.

Dorsey Ring Tension Machine

The Dorsey Ring Tension Machine measures piston ring tension in pounds-force at a preselected piston ring end gap. The gage will accept rings with a cylinder bore size from 3 7/16 inches to 7 7/16 inches and a maximum thickness of 1/4". Ring tension determines the amount of wear and the amount of oil used in an engine during operation.

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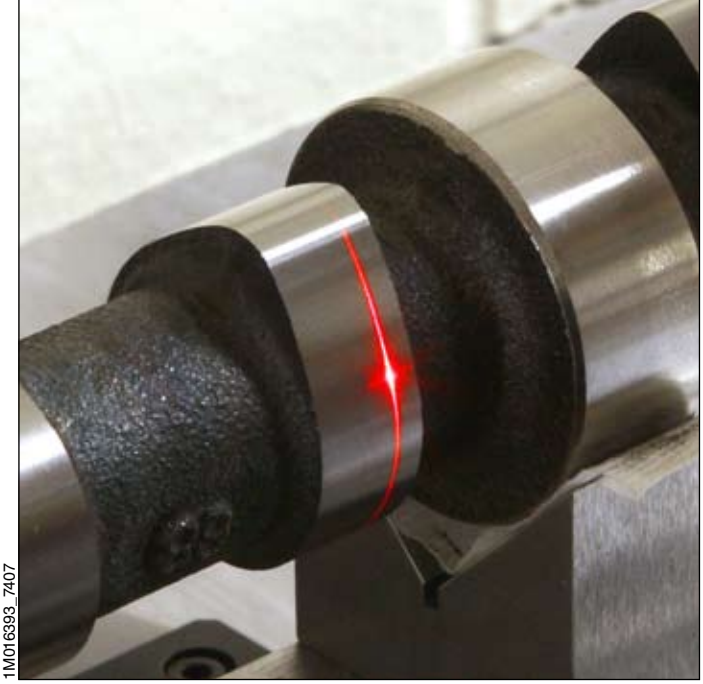
SwRI engineers use the Dorsey Ring Tension Machine to study heavy-duty diesel engine piston ring tension as it relates to engine wear and oil consumption.

Laser Scan Micrometer

The Mitutoyo Laser Scan Micrometer LSM-9506 is a non-contact system to measure object dimensions at a high speed using a highly directional scanning laser beam. The laser scan micrometer measures JASO M-354 diesel cam wear and Mitsubishi wear on cams, lobes and tappets. The micrometer moves a scanning laser beam over a component piece and determines its dimensions to ± 0.0001 mm by measuring the duration in which the beam is obstructed by the piece. Cam lobe wear indicates an oil additive's ability to protect the lobes under shear force.



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SwRI engineers utilize a laser scan micrometer – a non-contact, highly directional scanning laser beam – to measure object dimensions at high speed.

Portable Surface Analyzer

The Mitutoyo Portable Surface Analyzer Surftest SJ-400 is designed to measure surface roughness, surface waviness and steps. The SJ-400 has a 1.25 nm resolution and a stylus pressure of 0.75 mN. Maximum scanning distance is 50 mm and the analyzer is capable of measuring surface imperfections as large as 800 µm. The hand-held unit runs on a computer laptop, enabling portability in laboratory environments. The surface analyzer measures surface roughness of a part prior to its use at the beginning of a test. Wear measured by the apparatus may indicate ring reversal wear in the top of a liner.

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Using the Mitutoyo Portable Surface Analyzer, SwRI measures the roughness of the surface of a part before initiating a test to analyze wear rates.

Measuring Microscope

The Mitutoyo Measuring Microscope measures ring thickness, groove width, lands, chamfers and ring grooves of pistons. The

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The Mitutoyo Measuring Microscope allows SwRI researchers to analyze minute dimensions of ring thickness and groove width of a piston.

machine measures plus/minus one micron on the “X” and “Y” axes. The microscope uses cross hairs superimposed on a magnified image of a component set on a movable table with readout for both the X and Y axes.

Electronic Rod Indicator

The Sunnen R1-9000 Electronic Rod Indicator measures rods for bend, twist and center-to-center length within 0.0005 inch, and measures a variety of connecting rods.

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SwRI uses an electronic rod indicator to ensure connecting rods are properly aligned.

Improperly aligned rods will affect rod bearing wear and may cause metals to appear in the engine oil, affecting overall engine operation.

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SwRI uses the Wilson Rockwell Hardness Tester to characterize the hardness of materials determined through the depth of an indentation caused by specific load factors.

Hardness Tester

Surface hardness defines wear. SwRI engineers use the Wilson Rockwell Hardness Tester to check surface hardness on a variety of plastics (B scale, HRB 20 and under) and metals (C scale, HRC 20 to 60). It is used on cross heads, tractor clutch forks, roller bearing races and ball bearings. Digital readout reports hardness relative to C and B scale. There is a small variance on engine parts between being too hard or too soft for optimal engine performance.

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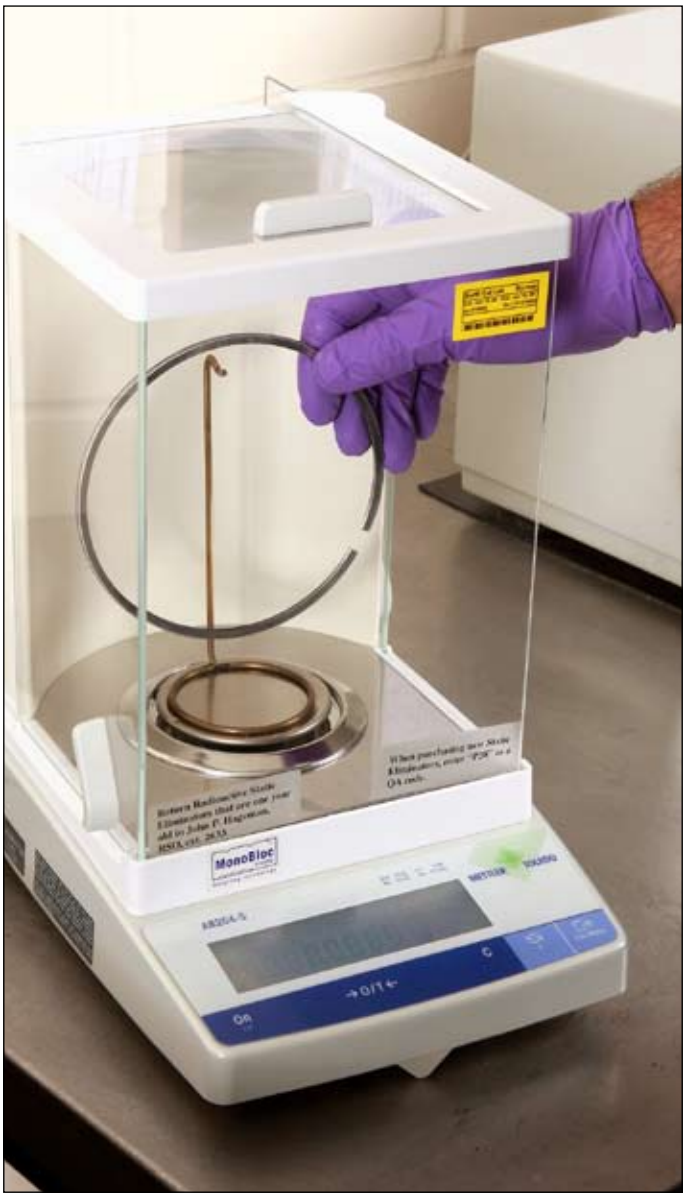
SwRI uses a Plating Surface Analyzer to ensure uniform plating thickness.

Plating Surface Analyzer

The Mitutoyo Digiderm 746 Plating Surface Analyzer measures plating thickness to .00000”/micron, .00005”/0.0001 mm. The Digiderm reads plating thickness up to 1.5 millimeters. Irregular surface plating can indicate abnormal flaking and/or abnormal wear of critical engine parts.

Electronic and Mechanical Scales

The electronic and mechanical scales measure weights of rings, main bearings, valve hats and valve followers in grams before and after a test. The scales are accurate to 1/10 milligram, 0.0001 gram, and the mechanical scale is accurate to 0.00001 gram. These scales are used to determine weight loss, which indicates wear on internal engine components.



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Researchers use electronic and mechanical scales to determine weight loss of rings, main bearings and other engine parts.

Snap Gage

The snap gage measures various components such as cam lobes, heel to toe, before and after a test. Results are reported in metric, plus/minus one micron, 0.001 millimeter. During normal engine operation, cam lobes are under intense and constant stress. Cam lobe wear indicates shear properties of an oil during engine operation. Cam lobe stress significantly changes overall engine operation.

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A snap gage measures stress factors of items such as cam lodes which can significantly change engine operation.

Olympus Microscope

The Olympus Microscope magnifies images to 0.001 millimeter. Magnified images detail micropits in predetermined templates in diesel coolant tests. Micropitting indicates poor protection by the coolant.

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SwRI uses the Olympus Microscope to analyze micropits in templates which can impact coolant properties.

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We welcome your inquiries.
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