To increase equipment availability, decrease ownership costs and improve safety, it is imperative to monitor the condition of machinery. An early indication of potential failure is necessary to achieve full benefits.

A new, innovative diagnostic tool with the capability to analyze large metallic particles and oil-borne wear debris in a single instrument has been developed to allow non-subjective decisions concerning machinery operating condition. Utilizing Laser Induced Breakdown Spectroscopy (LIBS), this new tool empowers informed maintenance decisions based on the quantity, alloy type, size and shape of debris particles and concentration (PPM) of oil-borne particulate wear. Digital image capture in combination with an innovative spectroscopy system is used to automatically and rapidly analyze collected debris. The intent is to minimize equipment downtime and unnecessary repairs, allow for more efficient planning of maintenance actions, reduce false positives and provide confidence to equipment operators with respect to safe and reliable operation of their machinery. Embedded diagnostic rules provide immediate GO/NO-GO maintenance decision assessments. Automated analysis and ease of use design allows for simple training to operate the instrument and assess results. The small, portable unit allows for field, plant or laboratory settings.

LIBS technology is utilized in multiple applications, including Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) defense, the Mars Rover and by Hazardous Materials (HAZMAT) personnel and First Responders.

The new instrument is designed for safe operation and is as safe to operate as an office laser printer.

This LIBS technology can replace larger laboratory atomic emission spectrometers for detailed elemental composition in the field or at the plant. In addition, large particulates can be individually sized and analyzed by specific alloy type – not just element composition. Particles can be from filters, around filter housings, in oil samples, from ferrograms, etc.
Field trials are currently being conducted in cooperation with the United States Air Force (USAF) to prove the benefits of the technology in an operational environment and to potentially replace the older atomic emission analysis technologies currently in use for oil analysis. Over the course of this trial, USAF personnel are utilizing the tool in its oil analysis configuration to support the monitoring efforts for USAF tactical aircraft. Collaborative projects are also on-going with the United States Army (USA) through the Army Oil Analysis Program (AOAP) and the RIMFIRE (Reliability Improvement Through Failure Identification and Reporting) program to demonstrate the benefits of the new technology to USA rotorcraft. Large particle debris collected during maintenance and overhaul activities are being analyzed. This new technology is also currently in use by gas turbine Original Equipment Manufacturers (OEM) as well as a major airline.

**KEYWORDS:** Maintenance, Oil Condition Monitoring, Spectroscopy, Wear, Wear Particle Analysis