RELIABILITY, UP-TIME AND SAFETY

Mining operation involves a variety of heavy rotating machinery that is used for exploration and processing of precious metals, minerals and material extracted from the earth. This industrial machinery is subjected to moderate, and in some cases, extreme vibration levels while in use. It’s critical to trend these vibration levels to ensure equipment health reliability and to avoid unscheduled downtime.

IMI Sensors offers a full line of piezoelectric accelerometers, wireless solutions, transmitters, switches, enclosures, microphones, sound level meters, cable assemblies and accessories that are used within the mining industry to safely monitor and protect critical rotating assets.

RELIABILITY VIBRATION

- Underground (MSHA) Approved Sensors
- Hazardous Approved Sensors, Transmitters & Switches (Class I, Div. I & Class I, Div. II)
- Sensors for Harsh, Corrosive & High Temperature Environments
- Wireless Solutions for Dangerous and Hard to Reach Areas
- General Purpose Sensors, Transmitters & Switches

HAZARDOUS AREA APPROVALS

For use in hazardous areas, the “EX” prefix designates a vibration sensor compliant with the National Electric Code (North America) and the ATEX directive (Europe), when used with a properly installed, intrinsic safety barrier in environments shown on the table below.

INDUSTRIAL HYGIENE

- Worker Safety Products
- Environmental & Handheld Equipment
- Wireless Telemetry
- Acoustic Calibrators

NORTH AMERICAN HAZARDOUS CLASSIFICATIONS

- DIVISION 1 - Continuous or intermittent presence of ignitable substances under normal operating conditions
- DIVISION 2 - Unlikely presence of ignitable substances under normal operating conditions
- CLASS 1 - Gases, Vapors, and Liquids
  - Group A - Acetylene
  - Group B - Hydrogen
  - Group C - Ethylene
  - Group D - Propane
- CLASS 2 - Dusts
  - Group E - Metals
  - Group F - Coal
  - Group G - Grain
- CLASS 3 - Fibers

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UNDERGROUND MINING APPROVED SENSORS

Mining is inherently a dangerous industry where the health and safety is of the utmost importance to the miners and their organizations. Thus, the mining industry has invested a great deal of time and money to develop safety procedures and training to assure the health of their miners. Within the United States, The Mine Safety and Health Administration (MSHA) is dedicated to “Protecting Miners” by developing regulations that will assure the health and safety of the US miners. Organizations like MSHA are also found in other countries and like MSHA, have developed strict regulations and guidelines to assure the safety and well being of their miners. For underground mining where methane gas can present the possibility of an explosive atmosphere, IMI Sensors offers Mine Safety and Health Administration (MSHA) and ATEX Approved intrinsically safe accelerometers.

- Ideal for route-based PdM data collection
- High frequency response up to 15 kHz (±3dB)
- 2-pin MIL or integral cable options available

MSHA APPROVED PRECISION ICP® ACCELEROMETER
MODEL MS622A01 & MS622A11

- MSHA compliant limits for sensor power, temperature and seal
- Certified to MSHA Designation: Sensor Class K

ATEX MINING APPROVED PRECISION ICP® ACCELEROMETER
MODEL MX622B01 & MX622B11

- ATEX compliant limits for sensor power, temperature and seal
- Certified to ATEX Designation: I M1 Ex ia IIl Integral cable easily connects to boxes
SENSORS FOR HAZARDOUS AND EXTREME ENVIRONMENTS

Mining equipment reliability monitoring now requires instrumentation that is approved for hazardous environments. In addition to underground mining approved sensors (MSHA), IMI® has a full line of PdM sensors and related technologies, such as intrinsic safety barriers that, when used together, will meet CSA, ATEX, and IECEx approvals.

**PRECISION ACCELEROMETER**
MODEL EX622B01
- High frequency response
  15 kHz (+/- 3dB)
- Sensitivity (+/-5%) 100 mV/g

**PRECISION ACCELEROMETER**
MODEL EX625B01
- High frequency response
  10 kHz (+/- 3dB)
- Sensitivity (+/-5%) 100 mV/g

**TOP EXIT ACCELEROMETER**
MODEL EX628F01
- Quartz sensing element
- Thermo stability (sudden temperature change)

**COMPACT ACCELEROMETER**
MODEL EX603C01
- Small installation footprint
- IMI’s most popular top-exit low cost general purpose accelerometer

**SIDE EXIT ACCELEROMETER**
MODEL EX602D01
- Low profile thru bolt design
- IMI’s most popular side-exit low cost accelerometer

**FULLY-SUBMERSIBLE ACCELEROMETER**
MODEL EX608A11
- Submersible / extremely small installation footprint

**TRIAXIAL ACCELEROMETER**
MODEL EX604B31
- Triaxial design (horizontal, vertical & axial measurement directions)
- Low profile thru bolt design

**SWIVELER® ACCELEROMETER**
MODEL EX607A11
- Submersible / extremely low profile
- Patented swivel mount
SENSORS FOR CORROSIVE AND HIGH TEMPERATURE ENVIRONMENTS

In harsh, caustic, or high temperature areas, IMI Sensors offers a series of industrial ICP® sensors and cable assemblies that will withstand these rigorous environments. Cables and connectors made of material such as PTFE and FKM are available for higher temperature and/or caustic mining environments. Industry exclusive, ICP® sensors are available with temperature ratings up to 325 °F (162 °C). For temperatures greater than 325 °F (162 °C), IMI® has designed charge output sensors with inline electronics and appropriate cable assemblies that can hold up to temperatures up to 1200 °F (649 °C).

HIGH TEMPERATURE ICP® ACCELEROMETER
MODEL HT622B01
- Temperature response up to 325 °F (162 °C)
- High frequency response 15 kHz (+/- 3dB)

HIGH TEMPERATURE ICP® ACCELEROMETER
MODEL HT602D01
- 2-pin MIL connector
- Industry Exclusive temperature response up to 325 °F (162 °C)

HIGH TEMPERATURE ICP® ACCELEROMETER
MODEL HT628F01
- Temperature response up to 325 °F (162 °C)
- Quartz sensing element for better thermo stability

HIGH TEMPERATURE OR CORROSIVE RESISTANT CABLE ASSEMBLIES

MOLDED COMPOSITE 2-SOCKET MIL-STYLE TO BLUNT CUT
MODEL 055PAXXXBZ
- 2-conductor twisted pair, shielded
- 2-Pin MIL molded straight composite connector with blunt cut termination

MOLDED COMPOSITE RIGHT ANGLE 2-SOCKET MIL-STYLE TO BLUNT CUT
MODEL 055PXXXBZ
- 2-conductor twisted pair, shielded
- 2-Pin MIL molded right angle composite connector to blunt cut

FKM ENVIRONMENTAL PUSH-ON BOOT 2-SOCKET MIL-STYLE TO BLUNT CUT
MODEL 055M05/XXX
- 2-conductor twisted pair, shielded,
- Ideal for corrosive environments, and temperatures up to 250 °F (121 °C)
WIRELESS VIBRATION MONITORING FOR MINING APPLICATIONS

Why have people risk injury and venture into unsafe areas to collect vibration data on healthy machines? IMI Sensors offers the Echo® Wireless Vibration Monitoring System that can automatically collect machinery health data in dangerous areas without having a miner venture into those areas. Using this alarm based system, personal intervention is only required when the system identifies a problem.

- Easily integrates with legacy vibration and plant monitoring systems via Modbus®
- Eliminates expensive cable runs
- Transmits distances of 1/3 - 1/2 miles in typical industrial environments, through obstructions (Up to 5 mile radius in direct line-of-sight tests)
- Runs stand alone or with junction box
- Stores data in an ODBC compliant database
- Requires no repeaters, gateways, or mesh

WIRELESS MONITORING OF PUMPS IN TAILINGS PONDS

Barge pumps in tailings ponds are critical to the operation of a mine. These ponds can be very acidic and dangerous, as well as inaccessible, which is why most plants don’t monitor them. Because it takes a host of people, safety gear, and a lot of time to get a crew safely to the pump to take vibration readings, the Echo® Wireless Vibration Monitoring System can be used to safely collect machinery health data.
**ECHO WIRELESS MONITORING SOFTWARE:**

- **Vibration Alarm Panel:** See your machine health at-a-glance for all vibration sensors from a single receiver, as well as machine name and location details.
- **Vibration Trend Plot:** View and analyze the trend history and alarm levels of a single parameter for any sensor.
- **System Overview:** See your machine health and sensor status at-a-glance in a graphical presentation for all sensors and receivers.
- **Email Alerts:** Receive alerts about your machine’s health and vibration level wherever you are, so you can always be on top of the situation.

This data is also stored in a Microsoft SQL database and can also be input to a PLC or DCS using a Modbus® communication interface. Contact IMI® to discuss software feature details and additional data interface options.

**APPLICATIONS**

- Overhead cranes
- Pumps in tailings ponds
- Intermittent machines
- Machines in restricted areas
- Equipment in hard-to-reach areas
Continuous monitoring and protection of critical assets has become a common practice in today’s mining industry. IMI Sensors meet these continuous monitoring needs by offering a series of transmitters, switches and detectors that can be integrated within a facility’s control room to monitor critical machinery parameters 24-7.

### 4-20 mA TRANSMITTERS & VIBRATION SWITCHES

**4-20 mA TRANSMITTER**  
SERIES 640X
- 24V loop powered that interfaces directly with a PLC, DCS and SCADA systems
- Multiple ranges available
- Peak or RMS, acceleration or velocity output options
- Explosion proof versions available

**BEARING FAULT DETECTOR**  
MODEL 682C05
- Provides early warning of rolling element bearings (RFB) faults
- Outputs 4-20 mA signals for peak acceleration and overall unbalance vibration
- Requires ICP® accelerometer input

**4-20 mA TRANSMITTER**  
MODEL 682C03
- Outputs 4-20mA signal proportional to acceleration, velocity, or displacement
- Requires ICP® accelerometer input
- Analog vibration output via BNC allows point to be used in PdM route
- Not USB Programmable

### VIBRATION SWITCHES

**LINEAR ADJUST VIBRATION SWITCH**  
MODEL 685AX9
- Patented linear trip adjustment
- Provides better control over trip sensitivity than traditional mechanical vibration switches
- Manual and remote reset options available

**ELECTRONIC VIBRATION SWITCH**  
SERIES 685B
- Dual set points with individual alert and alarm relays
- On-board or external ICP® accelerometer options available
- Optional analog vibration output via BNC ideal for PdM routes

**USB PROGRAMMABLE SMART SWITCH**  
SERIES 686
- Programmable alarm thresholds, relay action (NO, NC) and 3 time delays
- Hermetically sealed to hold up to harsh environments
- Competitively priced compared to mechanical switches
PORTABLE CALIBRATORS

PORTABLE VIBRATION CALIBRATOR
MODEL 699B06
- Small and completely self-contained, ideal for field check of accelerometers, velocity transducers and proximity probes
- Ruggedized, weatherproof enclosure dramatically improves durability and portability
- Battery-powered unit offers extended life and enhanced protection against full discharge
- Precision quartz reference accelerometer and conditioning electronics for superior control and stability
- Provides NIST traceable transducer verification across a wide frequency and amplitude range

HANDHELD VIBRATION SHAKER
MODEL 699B02
- Can perform up to 1,600 operating cycles in field without loss of battery power
- Calibrates permanently mounted accelerometers at the machine
- Confirms operation of cables, switching devices, and monitoring systems
- Meets NIST traceability requirements
- Outputs 1g pk or rms; operates at 159.2 Hz
- Accepts sensors up to 250 gm (8.8 oz)
NOISE EXPOSURE & MONITORING

WORKER EXPOSURE - MSHA & OSHA COMPLIANCE

Mines can be a very noisy environment where employers have a responsibility to protect workers from noise induced hearing damage. To help assess the noise exposure risk and verify the effectiveness of a hearing protection program, Larson Davis offers a line of noise dosimeters, sound level meters, and software to measure noise exposure. Because exposure to vibration has also been shown to be a health risk, we offer the HVM100 with all the necessary sensors to measure human exposure to vibration.

MINING NOISE MONITORING - NOISE EMISSION IN RESIDENTIAL AREAS

Designed with the needs of the safety officer in mind, SoundTrack includes the features you need to ensure your hearing protection program is adequate for protecting workers and complying with regulations. Because SoundExpert is fully compliant with sound level meter standards and ships fully calibrated, you can trust the results.

HUMAN VIBRATION MONITOR

MODEL HVM100

- Whole body vibration monitoring
- Hand-arm vibration monitoring
- Complete line of sensors and software

INTRINSICALLY SAFE NOISE DOSIMETERS

MODEL 706RC, 705+, 703+X

- UL913 and MSHA approvals
- Proven, reliable technology
- Durable, strong metal housing (Model 705+)

NOISETUTOR NMS

MODEL NMS021

- Available in Class 1 or Class 2
- Dose and exposure computation & SLM Utility G3 software included
- USB interface to control data download

NOISETUTOR NMS

MODEL NMS021

- Class 1 sound level meter compliant with IEC 61672-1 and ANSI S1.4
- Demonstrate compliance with noise emission requirements
- WiFi or cellular network access for real time data
- Publish noise data to your website, and email and SMS alerts for noise events
- Data automatically sent to your server
- Options to record event sound and/or continuous sound
WIRELESS TELEMETRY FOR MINING APPLICATIONS -
ROTOR MEASUREMENTS OF DRIVESHAFT TORQUE & MOTOR TEMPERATURE

An RF power supply in the receiver provides power to the primary coil of an RF air gap transformer (the stationary pickup). The transmitter receives this power by secondary coils embedded inside the transmitter housing, and provides DC power to the strain gage sensor on the shaft and to the transmitter electronics. The strain gage converts shaft strain to mV output, which is amplified, anti-alias filtered, and digitized before transmitting the data to the receiver. The receiver outputs a +/- 10 V analog signal, thereby providing a direct measurement of the shaft strain (which is used to indicate the torque).

- Ideal for torque monitoring of large vehicle driveshafts (mill driveshaft & coupling)
- Continuously monitors stress levels in drivetrain components by wireless reporting of strain gage measurements-- maximizing production output
- Measurement feedback can be used to pinpoint causes of damage by understanding mean and transient torsional stresses.
- Aramid strap mounting allows easy application to varied shaft diameters.
- The use of induction power allows long term monitoring, regardless of whether the shaft or coupling is at standstill or high RPM.
- Contact us for continuous monitoring of large motor rotor temperatures (via single or multi-channel wireless telemetry) for thermocouple or RTD measurement. Maximize your production throughput, while providing valuable predictive maintenance for your machinery.

SOUNDEXPERT® LXT NMS (NOISE MONITORING SYSTEM) - NMS-SE-RI

The SoundExpert NMS is a great solution for unattended noise monitoring for up to two weeks using only eight D-cell batteries. When you need to make a site surveys or quick noise level check, the SoundExpert LxT is easily removed and used as a handheld sound level meter. Using the included SLM Utility G3 software, SoundExpert can be fully configured and data downloaded for analysis and reporting.

- Class 1 sound level meter compliant with IEC 61672-1 and ANSI S1.4
- Logging and community noise standard
- Lightweight, compact and affordable
- 2 weeks runtime using eight D-cell batteries
- 1/1 and 1/3 Octave filters standard
- SLM Utility G3 software included
- Designed for unattended, outdoor use in harsh environments
- Made to easily deploy, retrieve and download data
- Traceable calibration so you can trust your data
MTS Sensors, a division of MTS Systems Corporation (NASDAQ: MTSC), vastly expanded its range of products and solutions after MTS acquired PCB Piezotronics, Inc. in July, 2016. PCB Piezotronics, Inc. is a wholly owned subsidiary of MTS Systems Corporation. Additional information on MTS can be found at www.mts.com.

IMI Sensors, a division of PCB Piezotronics, Inc. manufactures industrial vibration monitoring instrumentation, such as accelerometers, vibration transmitters and switches that feature rugged stainless steel housings and survive in harsh environments like paper and steel mills, mines, gas turbines, water treatment facilities and power plants. Integrating with portable analyzers and PLC’s, IMI instrumentation helps maintenance departments reduce downtime and protect critical machinery. Visit IMI Sensors at www.pcb.com. PCB Piezotronics, Inc. is a wholly owned subsidiary of MTS Systems Corporation. Additional information on MTS can be found at www.mts.com.