



MsS Guided Wave System

The MsS system incorporates magnetostrictive sensor (MsS) technology, which generates and detects ultrasonic guided waves electromagnetically through the magnetostrictive sensor. This effect involves a physical dimension change in ferromagnetic materials under a magnetic field, enabling the generation of ultrasonic waves, while the inverse effect allows for wave detection. The system comprises several key components:

- **Equipment:** Models such as MsSR3030R and MsSRv5R, which are ruggedized for field use, offer a frequency range from 5 to 350 kHz with system band pass filters at 16, 32, 45, 64, 90, 128, 180, and 250 kHz. These units support operation modes like pulse-echo and pitch-catch, enhancing flexibility. They are powered by 120 V or 240 V AC, 50/60 Hz, or battery, with battery operation lasting up to 2 days under normal conditions.
- **Probes:** Available in encircling and sector types, MsS probes are critical for wave generation and detection. The encircling probe covers the full 360° circumference of a pipe, suitable for long-range inspections up to 500 feet in each direction under ideal conditions, with a defect detection sensitivity of approximately 2-3% of the pipe wall cross-section. Sector probes, ranging from 4 to 12 inches in length, are used for medium-range (5 to 20 feet) high-resolution inspections, particularly at pipe supports, wall penetrations, and soil-air interfaces. Probe construction includes a 0.15 mm thick ferromagnetic strip and a ribbon cable less than 4 mm thick, with attachment methods like dry coupling, shear couplant, or epoxy bonding. A minimum clearance of 25 mm is required between pipes for thin probes.
- **Software:** The MsS GIM software, running on a laptop computer, controls equipment parameters via a USB port, acquires data, and performs multi-frequency analysis up to 8 different center frequencies. It includes features like amplitude, velocity, and attenuation calibration, threshold level setting, indication finding, reduction of false calls, ultrasonic image generation, and remaining wall loss calculation. The system supports inspection ranges typically up to 150 feet on either side for pipelines, with potential extensions up to 300 feet under ideal conditions, and can handle pipe diameters from 1.50 to 32.00 inches. Its lightweight design, with the MsS probe for a 24-inch pipe weighing less than 1 kg and the instrument at 4.5 kg, enhances portability.



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Operational Mechanisms

The MsS equipment generates tone-burst electric pulses delivered to the MsS probes, which then detect induced voltage when ultrasonic guided waves pass through. The signals, received from both directions of the structure, are analyzed using the laptop software, which controls operating parameters and generates comprehensive reports. This setup is particularly effective for detecting anomalies like corrosion, cracks, and wall loss, reflecting off changes in the structure and recorded for analysis.

Applications and Use Cases

The MsS system's versatility is evident in its wide range of applications, including:

- **Pipeline Inspection:** Suitable for aboveground painted pipes in good condition, non-piggable pipelines, and high-temperature pipelines up to 500°C, with capabilities for corrosion under insulation (CUI) and pipeline integrity management system (PIMS) monitoring.
- **Structural Health Monitoring:** Used for bridge cables, anchor rods, heat exchanger tubing, boiler tubes, and tank walls, providing a cost-effective means to assess structural integrity over long distances.
- **Special Applications:** Includes inspection at pipe supports, wall penetrations, soil-air interfaces, and concrete-air interfaces, with sector probes enhancing sensitivity for challenging areas.

The system's ability to operate in high-temperature environments, supported by a FeCo strip with a Curie temperature of 938°C, makes it ideal for industrial settings where thermal conditions are extreme. Additionally, the permanently installed monitoring sensor (PIMS) offers a low-profile, high-sensitivity solution for continuous monitoring, with features like pure torsional and shear-horizontal modes for cylindrical and plate structures, respectively.

Industry Relevance and Adoption

The MsS Guided Wave System Equipment stands out as a robust, versatile tool for non-destructive testing, offering detailed inspection capabilities across a broad spectrum of structures and conditions. Its advanced features, such as multi-frequency analysis, high-temperature operation, and enhanced defect detection sensitivity, position it as a critical asset for ensuring safety and efficiency in industrial operations.