ASSOCIATION OF AMERICAN RAILROADS

FREIGHT RAIL WAYSIDE DETECTORS: TYPES, TECHNOLOGY, AND SAFETY APPLICATIONS

Since the 1940s, freight railroads have voluntarily used a variety of inspection detectors to enhance safety and efficiency. These detectors have evolved over time, incorporating technological advancements including a variety of acoustic, infrared and optical sensors alongside tracks (wayside) or embedded directly into tracks to monitor trains as they move at speed across the nearly 140,000-mile network. Here are a few examples:

WHEEL MONITORING SYSTEMS AND BEARING DETECTION TECHNOLOGIES

- **Hot Bearing Detectors (aka Hot Box Detectors):** Infrared sensors measure the temperature of wheel bearings as trains pass by.
- **Hot Wheel Detectors:** Targets specific wheels that may be experiencing overheating due to sticking brakes.
- **Wheel Impact Load Detectors (WILD):** Track-embedded sensors measure defects of wheels through their impact on the rail.
- **Wheel Profile Detectors:** Lasers and optical sensors capture detailed images of a wheel's surface, measuring their wear and profile.
- **Wheel Temperature Detectors:** Infrared sensors provide a more comprehensive view of temperature conditions across all wheels to find braking issues or other mechanical problems that could arise in the future.
- **Acoustic Bearing Detectors:** Microphones and sound analysis algorithms are used to detect bearing defects.

RAILCAR INSPECTION AND MECHANICAL PERFORMANCE DETECTION SYSTEMS

- **Dragging Equipment Detectors:** Mechanical arms, laser beams or infrared sensors find objects hanging or dragging beneath a train.
- **Truck Performance Detectors:** A combination of sensors measure the performance and stability of railcar trucks to identify issues like misalignment or worn components. Trucks are the framework under a railcar that wheels connect to through axles and bearings.

- **Brake Shoe Detectors:** Optical or laser sensors inspect brake shoe conditions.

- **Load Measurement Systems:** Strain gauges or load cells monitor the distribution and weight of cargo in railcars to prevent overloading and ensure even load distribution. Strain gauges are devices that measure strain on an object and load cells are sensors that convert a force acting on it into an electrical signal.

- **Laser Scanning Systems**: High-precision laser scanners create 3D models of railcar parts, such as the undercarriage, for maintenance and safety checks.

TRACK MONITORING AND RAIL INFRASTRUCTURE DETECTION TECHNOLOGIES

- **Clearance Detectors**: Laser or optical sensors measure the space around passing trains to ensure they have sufficient clearance from trackside structures.

- **Broken Rail Detectors**: Various technologies, including ultrasonic sensors, identify fractures or breaks in the rails.

- **Rail Profile Detectors:** Laser scanning and other measurement tools measure the wear and profile of the rails themselves to ensure they are within safe operating limits.