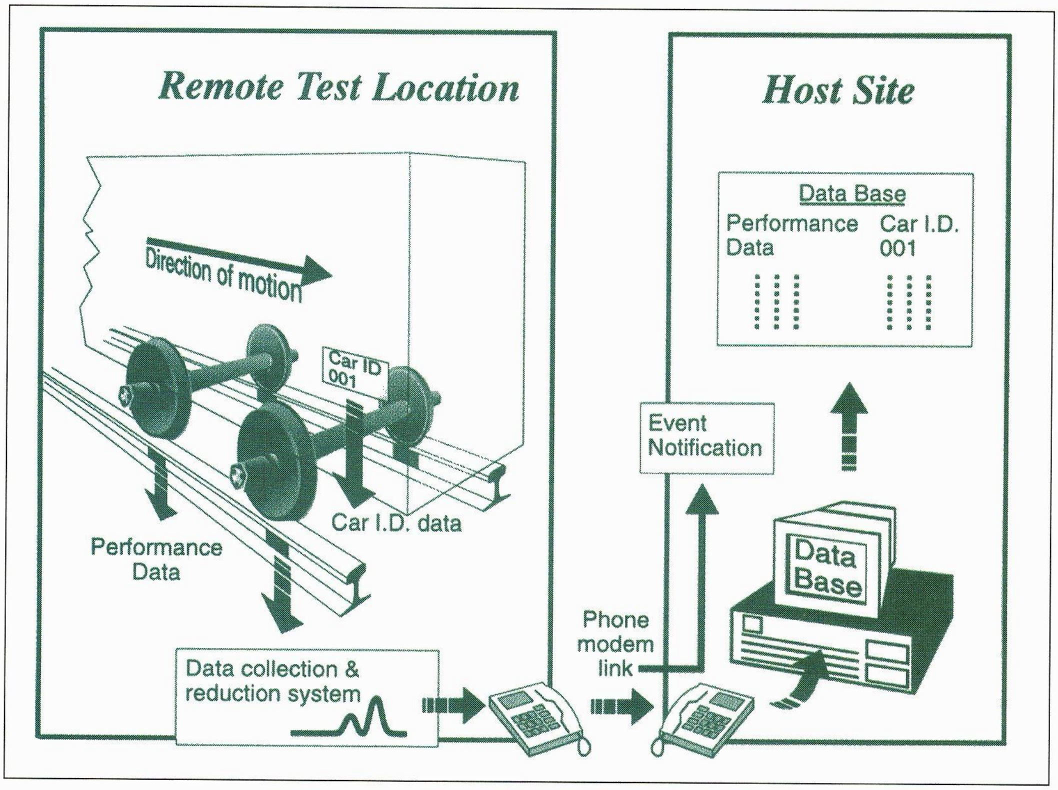
# Fault Detection Equipment




**AAR is developing what it calls a "Vehicle Defect" detector system aimed primarily at detecting poor performing trucks, which the Association says are "a safety and economic liability" to the industry. Poor performing trucks increase fuel consumption, increase track maintenance costs, and reduce the life of rail and track components. AAR's system looks at curve performance, wheel-on-rail forces, impact loads, and truck skewing and tracking. A railcar truck detector and a companion wayside detector have been developed, and during January 1996 a prototype system was installed on Norfolk Southern in unit coal train territory.**

The art of fault detection is experiencing a revolution in the methods and equipment used to detect faults in wheels, journal bearings, and in the train line. The current mainstay of wayside hot wheel and bearing detectors technology relies on infrared radiance; the detector scans passing wheels and axles on a moving train and compares their temperature to a pre-determined reference. Traditional wayside hotbox detectors have been using thermistor bolometer technology and, more recently, pyroelectric technology. The two methods have been shown to be roughly equal in reliability and performance.

Newer methods of wayside wheel and axle fault detection are based on acoustics. The detector analyzes the "sound signatures" of the wheel and bearing through a wayside microphone-like detector that sends signals through a processor with noise filtering capability. The theory is that a bearing's sound signature changes when defects such as overheating and spalling develop, usually long before the defect becomes visually or physically apparent. Acoustic fault detectors can be used as an early warning for bigger problems, and can be integrated into bearing maintenance programs.

Traditional wayside detectors send a radio alert signal to a locomotive cab when a defect is detected. This method has worked well for years but hasn't completely eliminated bearing and wheel related derailments on main lines, since a defective car can roll for miles or hours before a defective component passes a detector. Thus, the railway industry is now in the process of trying to develop practical, cost effective onboard defect detectors that can alert a locomotive engineer even before a defect becomes full-blown.

One such technology is the CYBERTRAX Wheelset Monitoring System from General Railway Signal, which continually monitors bearing temperature and can transmit an alarm to the locomotive cab. The CYBERTRAX sensor and transmitter are powered by a low-voltage battery, and are housed in a high-temperature-resistant molded plastic case mounted over a bearing's end-cap bolts. A spring loaded probe in the center of the bearing end-cap makes contact with the end of the axle and relays temperature information to the transmitter. The CYBERTRAX sensor unit also makes periodic transmissions to let the locomotive crew know that it's on line and functioning correctly.

Electronically controlled pneumatic (e-p) brakes are being exhaustively tested in unit trains around North America to establish a format and protocol for a standardized system. Burlington Northern Santa Fe is among those leading the way in testing, with several routes and trainsets already e-p equipped. With e-p brakes, which allow the locomotive engineer to apply brakes to each car of an entire train simultaneously (using either wired or wireless communications), fault detection in the train line is a potential add-on bonus.

Since either a wired or a wireless e-p system will require some type of onboard receiving/transmitting device, many in the industry believe that train line and wheel-and-axle fault detection equipment can be operated in conjunction. The Association of American Railroads' Research & Test Department has been working with railroads on developing equipment that can, above and beyond controlling and diagnosing air brake equipment, make use of the train line to:

—Control helper locomotives (including distributed power units).

—Provide continuous wheel and bearing fault detection.

—Monitor slack conditions.

—Compile data for rolling stock maintenance.

AAR has adopted the LonWorks system protocol, which is specifically designed for control network applications where frequent messages need to be transmitted. LonWorks system is accepted by the ISO (International Standards Organization), and its architecture is open so that third party vendors can build compatible equipment.

In addition, AAR is also developing what it calls a "Vehicle Defect" detector system aimed primarily at detecting poor performing trucks, which the Association says are "a safety and economic liability" to the industry. Poor performing trucks increase fuel consumption, increase track maintenance costs, and reduce the life of rail and track components.

AAR's system looks at curve performance, wheel-on-rail forces, impact loads, and truck skewing and tracking. A railcar truck detector and a companion wayside detector have been developed, and during January 1996 a prototype system was installed on Norfolk Southern in unit coal train territory to establish a database. Wayside data, says AAR, can be tailored for a railroad's specific needs. In tests involving 3,000 train passes, trucks with an undesirable low rail contact position and warped side frames were detected in significant numbers, says AAR. Another prototype installation of this system is planned on the Burlington Northern Santa Fe at a site that sees intermodal, doublestack, mixed freight, and passenger trains.

Locations for the defective truck detectors are selected based on track conditions sufficient enough to "exercise" railcar trucks. The Norfolk Southern site has detectors on both sides of a six-degree curve. The sensors and data collection equipment are located at the remote sites, and the data is transmitted via phone line to a central location. Urgent event information can be sent to any required facility.

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Researchers at the University of Illinois at Urbana-Champaign Affiliated Laboratory (UIUC) have been studying the prospect of using fiber optic cable as a means of detecting rail flaws such as heat kinks, buckled rail, and broken rail. The study team affixed a fiber optic cable to the web of the rail, noting that any bending or breaking of the cable affects the intensity of the output light. Strategically placed sensors detect changes in the signal light's intensity and also pinpoint the site of such a change. UIUC conducted an initial study in 1995; an ongoing follow-up study is examining practical designs to present to the industry.

UIUC's researchers say that they did find that the fiber optic cable and light sensors were able to measure and detect strain and buckling of their test rail, but they also noted that, in the field, the sensor would likely require a great deal of maintenance. Among other things, the current study is looking into the practicality of lower resolution sensors and the cost-versus-accuracy trade-off, and also the use of less expensive fiber optic cable. It is also looking into the durability and protection needed for the fiber optic cables.

UIUC hopes to develop a final plan that can be installed for testing at the AAR Rail Test Center in Pueblo, Colo.