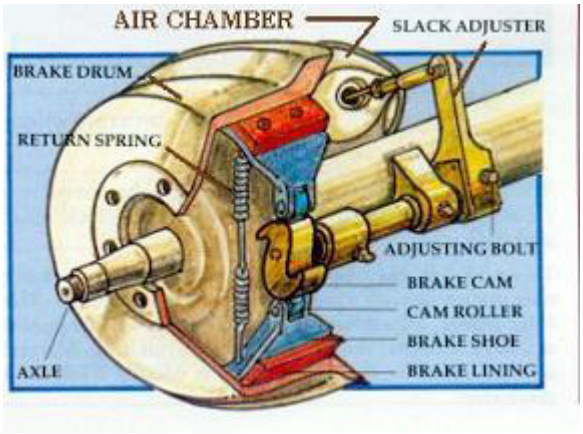
On-board Brake Stroke Monitoring Systems

Objective

On-board brake stroke monitoring systems enhance commercial motor vehicle safety by relaying critical information about air brake adjustment and operational status to drivers, inspectors, and maintenance personnel. These systems can detect major brake problems in real-time.

Description of Major Brake Problems

Brake Over-stroke. When the driver of an air-braked vehicle applies the brake pedal, air flows into the brake actuator (air chamber), which forces the actuator pushrod out against the end of the slack aduster, a lever with an internal adjustment mechanism. The slack adjuster is connected to a shaft with an S-shaped cam on the opposite end. (Although there are several types of air brakes, S-cam brakes are used most widely.) When the pushrod moves the slack adjuster, the shaft and S-cam turn, forcing the brake shoes and linings against the brake drum to create friction and braking force that decelerates the vehicle. As brake linings wear, the gap between the lining and drum increases, and the push rod, slack adjuster, and camshaft must move further. This is where the adjustment mechnism on the slack adjuster comes into play. The mechanism, which can be either a manual or self-adjusting type, rotates the camshaft inside the slack adjuster housing and advances the S-cam to reduce the clearance between the brakelining and drum.



Air Brake

If the gap between the brake drum and lining becomes too large, either due to the failure to properly adjust the brake with a manual type of slack adjuster or the inability of the self-aduster mechanism to make the proper adjustment, the actuator push rod will move outward or overstroke to the point where the actuator force is reduced. In the extreme case, the push rod will "bottom-out" inside the actuator housing before developing any force on the slack adjuster. At this point, the brake force will be zero.

Non-releasing Brakes. If the pushrod does not fully retract into the actuator when the driver releases

fire. This problem can occur if the brake is over-adjusted (too tight) or if brake components are improperly installed and interfere with each other or another vehicle part. A broken spring inside the parking brake portion of the actuator can also cause this problem if the broken spring parts block the pushrod's full return into the actuator.

Inoperative Brakes. If the driver applies the brake pedal, and a system defect, such as a defective valve or plugged airline, prevents air from reaching the brake actuator, then the push rod will not move at all. In this case, the brake is inoperative.

Description of On-Board Brake Stroke Monitoring Systems

On-board brake stroke monitoring systems utilize sensors located at each brake actuator to monitor pushrod travel and determine if a brake on an air-braked vehicle has any of the three problems described above (i.e., over-stroking, not releasing, or inoperative). These monitoring systems include driver interfaces that display the existence and location of these problems to drivers, technicians, and inspectors. The display units, which can be mounted anywhere on the vehicle, use different colored light emitting diodes (LEDs) to indicate the type of fault at a specific wheel location. They may also incorporate a separate warning light on the vehicle's dashboard. Some systems transmit brake fault information on the vehicle's SAE J1587 or J1939 electronic databus which makes it possible to display fault information on microprocessor-based "smart" dashboards or to transmit the information to off-board monitoring devices using wireless technology. Brake stroke monitoring systems also incorporate self diagnostics and provide an indication of sensor failures.

MGM Brake Stroke Monitoring System

Application

The performance of air brakes is particularly sensitive to and dependent on brake maintenance. The sensitivity to brake system adjustments is compounded by the lack of feedback to the driver, since a driver cannot easily detect brake degradation related to an adjustment condition until he or she needs to make an emergency stop. Since drivers are often unaware of existing brake defects and reduced braking capability, brake monitoring systems provide valuable information to let the driver know when brakes are out of adjustment or not working properly so that corrective measures can be taken to maintain the vehicle's safe operation. Proper brake adjustment is critical. If all of the brakes on a vehicle are not properly adjusted, then those in adjustment will take a disproportionate share of the load. In turn, this may cause them to fade prematurely and shift the load to other poorly adjusted brakes.

Brake stroke monitoring systems can aid carrier personnel in discovering air brake adjustment and operation problems in a timelier manner that may be due to the following defects:

- Worn, seized, or out of adjustment manual and automatic slack adjusters
- Slack adjusters that have not been installed properly

Pushrods that have been cut too short

Ruptured actuator diaphragms or leaking airlines

Plugged or crimped airlines

Frozen or stuck air valves

Cracked or broken brake drums

Brakes shoes that may be "hung-up" due to other faults in the foundation brake system or slack adjuster faults

Push rods that have not retracted due to components binding

Broken parking brake springs

Worn S-cams

Operations and Benefits

On-board brake stroke monitoring systems can provide important safety benefits for carrier personnel, since commercial motor vehicle braking system design and operation are directly related to stopping distance, handling, and overall vehicular safety. On-board brake stroke monitoring systems can provide warnings to drivers and/or maintenance personnel if braking ability is degraded to an unsafe level. The information provided by these systems can be a valuable aid in diagnosing braking problems for carriers in order to maintain the optimum safety and operation of the vehicle. In addition, braking information can be readily available to enforcement personnel during roadside inspections, possibly resulting in reduced numbers of brake inspections and reduced downtime associated with these inspections.

Operational safety can be increased by the driver's added awareness of the condition of the vehicle's brakes through the system's display of real-time operational data. By using these systems, the number of under-vehicle brake stroke inspections, requiring the driver or maintenance personnel to crawl under the power unit or trailer with a measuring tape to check each air-brake pushrod stoke, can be reduced. Also, pre-trip inspection times, which might last 30 minutes or more, can be substantially decreased. Although these systems can be a valuable aid to a driver in monitoring and maintaining proper brake adjustment, they are not intended to replace regular, comprehensive brake inspections.

Cost

The installed cost of an on-board brake adjustment monitoring system depends upon the type of system purchased and how it is purchased. Costs range from approximately $1,200 to $2,500. Costs may also vary depending upon the type of vehicle and its number of axles. In addition, some systems might require the replacement of the existing spring brake chambers with new sensor-equipped chambers, which could increase the cost. Most original equipment manufacturers will install the systems as part of a fleet specification; however, aftermarket kits are available through authorized product distributors or service centers.

Vendors

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