TECHNOLOGY DIGEST

Timely Technology Transfer

"ECP BRAKE REVENUE SERVICE TESTING UPDATE"

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Summary

The Association of American Railroads (AAR) has been conducting revenue service tests of electronically controlled pneumatic (ECP) brake systems since summer 1995. Preliminary results of the ongoing tests show that the cable-powered ECP system continues to operate reliably and the benefits of extended wheel life are becoming evident. Although over-th-road performance and stopping ability continue to be impressive, brake shoe usage has increased with the ECP brake system.

Draft specifications covering the performance of the brake system, connectors, cable, power supply, and brake communications will be delivered to working committees as ECP testing continues in 1997. In addition, the selection process of a standard AAR ECP connector will begin. In the coming year, AAR's research and testing efforts will focus on establishing implementation guidelines for the railroad industry and testing the interoperability of different manufacturers' ECP systems.

Currently, Burlington Northern Santa Fe operates three double stack trains, two unit coal trains, one taconite train, and one unit grain train equipped with the ECP brake system. In addition, Conrail is operating one ECP-equipped unit coal train and CP Rail has begun using ECP brakes on an intermodal train operating between Toronoto and Montreal. There are already indications that the number of ECP trains in service will increase in 1997.

Suggested Distribution:

- ❑ Equipment/Rolling Stock
- ❑ Train Handling
- ❑ Intermodal/Safety
- ❑ Car Department

Association of American Railroads
Railway Technology Department

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INTRODUCTION AND CONCLUSION

Preliminary tests of electronically controlled pneumatic (ECP) brakes show that the cable-powered system continues to operate reliably and the benefits of extended wheel life are beginning to become evident. Revenue service testing conducted by the Association of American Railroads (AAR) has been under way since summer 1995. The over-the-road performance and stopping ability of the ECP systems remain impressive; however, brake shoe usage has increased.

Draft specifications covering the performance of the performance of the brake system, connectors, cable, power supply, and brake communications will be delivered to AAR working committees as revenue service testing continues. In addition, the selection process will begin for a standard AAR ECP connector. AAR's research and testing efforts this year will focus on establishing implementation guidelines for the railroad industry and testing the interoperability of different manufacturers' ECP systems.

Currently, Burlington Northern Santa Fe (BNSF) operates three double stack trains, two unit coal trains, one taconite train, and one unit grain train equipped with the ECP brake system. Conrail operates one ECP unit coal train while CP Rail has begun using ECP brakes with an intermodal train operating between Toronto and Montreal. The following is a full list of trains using ECP and where they operate:

Train	Route	Specific Items Under Test
2 BNSF Double Stacks	Chicago-Los Angeles	Wheels, Brake Shoes
BNSF Double Stack	Chicago-Seattle	
2 BNSF Unit Coal Trains	Powder River-Becker, MN	ECP Connectors
BNSF Taconite Train	Superior, WI-E. St. Louis	ECP Connectors
BNSF Unit Grain Train	Kansas City-Galveston	
Conrail Unit Coal Train (and conventional train)	Pittsburgh-Philadelphia	Wheels, fuel consumption, brake shoes, train delays
CP Rail Intermodal	Toronto-Montreal	

STOPPING DISTANCES

Additional stop distance tests have been made on some of the BNSF trains. Exhibit 1 summarizes the tests.

Exhibit 1. BNSF Stop Distance Tests

	Conventional	ECP
Loaded taconite train; 20,000 tons, 6,000 feet, 165 cars, 38 mph	~4,500 ft.	1,830 ft.
Empty taconite train; 5,000 tons, 6,000 feet, 165 cars, 40 mph	~1,459 ft.	800 ft.
Unit coal: 15,428 tons, 6,181 feet, 113 cars, 50 mph	5,429 ft.	3,524 ft.

The stop distance numbers for the conventional taconite train are estimates by a BNSF road foreman. The empty taconite train was not stopped with a full-service application in conventional mode because the road foreman was reluctant to risk a derailment due to brake induced slack action. There were no concerns about slack action with the empty ECP train.

As dramatic as the stop distance improvements are, the most valuable train handling feature has proven to be graduated release. This allows for a control of train speed superior to that of the dynamic brake. Crews using the ECP brake instead of the dynamic as the variable speed-controlling brake were able to control train speed on difficult grades within 1 mph of track speed.

REDUCTION IN BRAKE-RELATED WHEEL DEFECTS

Wheel replacement savings have improved on BNSF and they have become noticeable on Conrail. Two of the BNSF double stack trains have been operating between Chicago and Los Angeles since December 1995. These trains are made up of 70 three-unit, drawbar-connected Gunderson cars constructed in late 1995. Data given in Exhibit 2 was taken after approximately 150,000 miles of service. The ECP cars have been compared with a like number of conventionally braked cars from the same production run.

Exhibit 2. Wheel Replacement Comparison—BNSF

	Conventional	ECP
Wheels replaced for slid flats —hand braked axles	7	0
Wheels replaced for slid flats—non-hand braked axles	1	0
Wheels replaced for shells or spalls	7	0

Admittedly, some flat spots on the conventional cars could have been caused by misapplied hand brakes, but the ECP cars also equipped with hand brakes. Even if some of the slid flats are attributes to hand brakes, the trend is positive and encouraging.

Initial performance of the Conrail ECP train is being compared with an identical conventionally braked unit coal train in the same service. Items such as wheel replacement due to brake-related defects, fuel consumption, brake shoe consumption, and brake-related train delays are being compared. With about 15,000 miles of service on each train, the wheel change due to brake-related defects are given in Exhibit 3.

Exhibit 3. Wheel Replacement Comparison—Conrail

	Conventional	ECP
Wheels replaced for slid flats	2	0
Wheels replaced for high impact (out of round)	1	0
Wheels replaced for shells or spalls	3	0

Wheel replacement rates for brake-related defects on the conventional BNSF double stacks and the Conrail unit coal trains were 1.43 and 3.86 wheels per million car miles, respectively. Actual mileage on the Conrail conventional train used in calculation was 13,500 miles. The ECP train had run 16,500 miles during the same period.

The higher wheel replacement rate on the Conrail conventional train is most likely a result of the ECP train having a much lower empty brake ratio. The better brake cylinder pressure control of ECP brakes may also be a factor. Note that the cars in the double stack trains are almost never operated empty or lightly loaded, while the unit coal train is empty 50 percent of the time. None of the unit coal cars are equipped with empty/load. The conventional coal train has a full-service brake cylinder pressure of 64 psi and a resulting empty brake ratio of 35 percent. However, the empty ECP-equipped coal train is limited to 35 psi full-service brake cylinder pressure, which results in an empty brake ratio of 20 percent. This limitation is made when the ECP brake system is set up at the initial terminal.

Note that the lower empty brake ratio of the ECP train is achieved entirely with software control and without troublesome car-mounted load sensing equipment. The lower brake ratio sharply reduces the likelihood of wheel slide on the empty ECP train. The stopping ability of the empty ECP train is still shorter than the conventional empty train due to the much faster response of the ECP brake.

REDUCED SLACK ACTION

A test car was used in both the Conrail ECP and conventional trains to measure the drawbar energy during a number of trips. The preliminary results show a marked reduction in buff and draft forces, but the data cannot be adequately quantified at this time. More runs are needed with the test car in the ECP train before statistically significant numbers can be published. Certainly the feature most noticed by first time ECP train riders is the lack of slack action. The improvement in longitudinal ride quality could have a significant benefit; especially for autorack service.

BRAKE SHOE USAGE

Brake shoe wear, to date, on the Conrail test and on the BNSF double stacks is shown in Exhibit 4.

The Conrail test started with new brake shoes on both the ECP and the conventional trains, but has not accumulated enough mileage to wear out the brake shoes. Those that have been replaced fell off in the rotary dumper.

Exhibit 4. Brake Shoe Usage—Conrail, BNSF

After 150,000 miles of service	Brake Shoes Replaced	
	ECP	Conventional
BNSF	585	84
Conrail	8	7

Brake shoe wear has been surprisingly high on the ECP-equipped BNSF double stacks. This may be attributed to the crews taking the opportunity to use the new system whenever possible. The high brake shoe wear could also indicate the ECP brake system is a superior train handling tool; thus, is used by engineers more frequently.

STATUS OF AAR SPECIFICATIONS

As stated earlier, draft specifications covering the performance of the brake system, connectors, cable power supply, and brake communications will be delivered to the AAR Mechanical Division working comm ittees in January 1997. The selection process of a standard AAR ECP connector will also begin at that time.

Work remains on the communications requirements for distributed power, sensor interface, and locomotive interface as part of the Locomotive Systems Integration project. Two manufacturers are developing radio as an alternative to cabled ECP systems; these will be evaluated as developed. The radio alternative would do away with cable connections but requires an on board power source for every car. The radio systems must demonstrate superior reliability and economics before the radio option can be implemented. The rpoposed wireless systems essentially follow the AAR draft specifications. However, if they are adopted as an industry standard, a new communications specification must be written. Finally, establishing implementation guidelines for the railroad industry will be a major focal point of AAR research and testing efforts in 1997.

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