TSB Recommendation R22-01

Reducing the risk of uncontrolled movements through the implementation of periodic maintenance requirements for brake cylinders

The Transportation Safety Board of Canada recommends that the Department of Transport establish enhanced test standards and time-based maintenance requirements for brake cylinders on freight cars operating on steep descending grades in cold ambient temperatures.

Rail transportation safety investigation report	R19C0015
Date the recommendation was issued	31 March 2022
Date of the latest response	June 2022
Date of the latest assessment	August 2022
Rating of the latest response	Satisfactory Intent
File status	Active

Summary of the occurrence

On 04 February 2019, the Canadian Pacific Railway Company (CP) freight train 301-349 being operated by a relief crew derailed on Field Hill near Field, British Columbia, on a 13.5-mile section of track with a steep descending grade (average 2.2%) and several sharp curves. The 3 crew members—a locomotive engineer, a conductor, and a conductor trainee—were fatally injured in the derailment.

Rationale for the recommendation

In this occurrence, the brake cylinders on the freight cars were leaking compressed air, a situation exacerbated by their age and condition and the extreme cold temperature (the ambient temperature was in the range of –25 °C to –28 °C), reducing the braking capacity of the train's automatic air brake system. From post-occurrence testing, it was found that about 50% of the cars on the occurrence train had reduced air brake effectiveness during the initial descent of Field Hill and, as a result, an emergency brake application was necessary. Given the extreme cold temperature and the length of time the train's cars were stationary with the brakes applied at Partridge, the rate of brake cylinder pressure (BCP) loss on some cars was

likely excessive. Consequently, about 3 hours later, the brakes could no longer hold the train, which began to roll on its own.

The leakage of compressed air from air brake components is a fundamental problem in cold ambient temperatures. Air brake leakage typically increases with decreasing temperature, and can become quite pronounced in extreme cold (at or below −25 °C). Many of the seals and gaskets in the air brake system are made of rubber or a composite material. The effects of cold-weather conditions on rubber can vary, depending on its composition, age, and wear. Also, cold-weather conditions are generally known to decrease rebound resilience, making the rubber stiffer and less effective at preventing leakage. This is particularly the case for air brake components with extended time in service, such as car control valve (CCV) gaskets, brake cylinder packing cup gaskets, and brake pipe flange gaskets.

Air leakage from the brake cylinders on rail cars can be especially problematic when descending a long steep grade, because a sufficient amount of BCP is needed for an extended period of time to maintain train speed. Descending the 13.5-mile Field Hill grade at 15 mph requires air brakes to remain engaged and provide a constant amount of brake retarding force for over 52 minutes.

To mitigate the risk of freight cars developing excessive air leakage from the brake cylinder, it is crucial that brake cylinders undergo regular testing and maintenance. However, there are no specific industry or regulatory requirements for regular maintenance on freight car brake cylinders.

The repair history for the 112 cars on the occurrence train showed that 23 cars (20.5%) had received brake cylinder replacement or servicing in the previous 5 years due to a failed single car test.

Brake cylinder leakage remains the second highest failure rate during the single car test, after CCV failures.

The railway industry has considered the problem of brake cylinder leakage. In 2011, the Association of American Railroads (AAR) Brake Systems Committee proposed to reduce by half the maximum brake cylinder leakage acceptable during a periodic single car test (SCT), a test which verifies the intended operation of car brakes and ensures, among other things, that the brakes remain applied and do not exceed allowable leakage rates.

According to AAR Standard S-486,[1] the maximum acceptable limit of brake cylinder leakage during an SCT is 1 psi/minute. At this leakage rate, the occurrence train would have lost 52 psi of BCP on the descent of Field Hill, which represents an 81.3% loss in braking capacity and, nearing the bottom of the descent, the remaining BCP on the train would have been the equivalent of a minimum reduction brake application (7 psi), which is insufficient to maintain

[1] Association of American Railroads, Standard S-486, "Brakes and Brake Equipment Code of Air Brake System Tests for Freight Equipment – Single Car Test" (revised 2018).

train speed at 15 mph. In comparison, if the proposed maximum acceptable leakage rate of 1 psi/2 minutes were adopted, a train descending Field Hill would retain enough BCP to complete the descent at 15 mph with only one supplemental brake application to compensate for leakage.

The proposal from the AAR Brake Systems Committee was not accepted. The industry did not consider this revision to the standard to be needed for all of North America, primarily because of the regional nature of the problem: the more stringent maximum leakage rate is only needed for steep descending grade operations in cold winter temperatures.

Brake cylinders used to be subject to "clean, oil, test and stencil" (COT&S) reconditioning on a regular basis, but these requirements were eliminated by the AAR in 1992.[2] Since then, the industry's approach to brake cylinder maintenance has become one of voluntary preventative maintenance or run-to-failure. However, as this occurrence has shown, without periodic, scheduled maintenance, brake cylinder leakage can jeopardize safe train operations when sustained brake applications are required, especially in cold weather conditions.

The requirements for COT&S had also been removed for CCVs in 1992. However, following a 10 January 2018 occurrence at Luscar Industrial Spur in Leyland, Alberta, in which a freight train rolled uncontrolled while proceeding down a mountain grade,[3] and in response to a number of other occurrences in Canada and the U.S., the AAR reconsidered this position and made rule changes that have re-introduced a COT&S schedule for CCVs in certain circumstances.[4] The AAR has defined conditions under which CCVs should be replaced due to their age and exposure to service conditions in cold-weather environments. This new requirement applies to freight cars operating north of the 37th parallel during winter months that have CCVs older than 13 years since their last COT&S date.

Brake cylinders are also prone to declining performance after extended periods in service without maintenance, including lubrication and renewal of safety-critical rubber gaskets and seals. However, unlike the recent re-implementation of COT&S requirements for CCVs, there are no AAR requirements to service or replace brake cylinders on freight cars on a set time interval.

Excessive brake cylinder leakage of freight cars on steep descending grade territory in cold ambient temperatures increases the risks that loss of control events will occur due to degraded brake capacity. Uncontrolled movements of railway equipment, although low-frequency events, can create high-risk situations that may have catastrophic consequences.

For a train negotiating a long descending grade in cold weather conditions where a brake application will be held for an extended duration, such as Field Hill, with a brake cylinder leakage rate of 1 psi/minute—the maximum acceptable limit specified in AAR Standard S-

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2 S. Butler, "The Evolution of Freight Car Air Brake Testing on Repair Track", presented at the Air Brake Association Technical Conference, Chicago, Illinois (14 – 17 September 1997).

3 TSB Rail Transportation Safety Investigation Report R18E0007.

4 Association of American Railroads, *Field Manual of the AAR Interchange Rules* (July 2021), Rule 4.A.2-3.

486—there is a risk that brake cylinder leakage will render the air brake system ineffective. To prevent uncontrolled movements in these situations, brake cylinder leakage limits need to be regulated to a more stringent maximum acceptable level.

To mitigate the risk of freight cars developing excessive brake cylinder leakage, it is crucial that brake cylinders undergo regular, time-based, maintenance.

If Transport Canada and the railway industry do not take measures to prevent excessive brake cylinder leakage on freight cars, the risk of a loss of control due to insufficient braking capacity will persist, a risk that increases on steep descending grades, especially in cold ambient temperatures.

Therefore, the Board recommended that the Department of Transport establish enhanced test standards and time-based maintenance requirements for brake cylinders on freight cars operating on steep descending grades in cold ambient temperatures (TSB Recommendation R22-01).

Previous responses and assessments

N/A

Latest response and assessment

June 2022: Transport Canada's response

Transport Canada (TC) agrees with recommendation R22-01 and is taking immediate steps to address the identified gap in the railway safety regulatory regime:

- By July 2022, a Ministerial Order is expected to be issued to railways [sic] companies, requiring them to strengthen inspection, testing and maintenance requirements for air brake components to improve cold weather performance.
- Under this Ministerial Order, industry will be required to submit revisions to the *Railway Freight and Passenger Train Brake Inspection and Safety Rules* in two phases, with the first phase required in November 2022 (regular inspection) and the second by May 2023 (testing and periodic maintenance).

This approach will provide opportunities for further engagement and discussions, including the requirements under the *Railway Safety Act* for industry to consult with labour organizations when revising the *Railway Freight and Passenger Train Brake Inspection and Safety Rules*. Ultimately, the intent of these efforts is to mitigate the underlying risk of uncontrolled movements and provide nationally consistent standards to improve the performance of air brakes.

August 2022: TSB assessment of the response (Satisfactory Intent)

Transport Canada (TC) agrees with the recommendation. Since its initial response, TC issued Ministerial Order MO 22-04 to strengthen inspection, testing and maintenance requirements for

air brake components, including brake cylinders, to improve cold weather performance. TC requires industry to submit revisions to the *Railway Freight and Passenger Train Brake Inspection and Safety Rules* in a two-phased approach. Phase 1 submissions for the establishment of regular inspection requirements are required by 30 November 2022. Phase 2 submissions for testing and periodic maintenance are required by 31 May 2023.

The Board is encouraged that TC recognizes that there is a gap in the railway safety regulatory regime regarding the inspection and maintenance of critical air brake components. TC has set out a plan to address this gap and improve cold weather air brake performance, including possible amendments to the regulatory framework. However, the Board is concerned that a performance-based approach to maintenance, rather than a time-based approach, will not address in a timely manner the underlying safety deficiency that supports this recommendation. Subject to the details of any proposed regulatory amendments, the Board considers the response to Recommendation R22-01 to show **Satisfactory Intent**.

File status

The TSB will monitor TC's progress on its planned actions.

This deficiency file is **Active**.