Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT
R04E0027

MAIN-TRACK DERAILMENT

CANADIAN PACIFIC RAILWAY
FREIGHT TRAIN 575-03
MILE 86.9, RED DEER SUBDIVISION
RED DEER, ALBERTA
04 MARCH 2004

Canada

Railway Investigation Report

Main-Track Derailment

Canadian Pacific Railway
Freight Train 575-03
Mile 86.9, Red Deer Subdivision
Red Deer, Alberta
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Report Number R04E0027

Summary

At 0420 mountain standard time on 04 March 2004, northward-bound Canadian Pacific Railway freight train 575-03, proceeding towards Red Deer, Alberta, from Calgary, Alberta, derailed 1 locomotive and 20 cars at Mile 86.9 of the Red Deer Subdivision, near Penhold, Alberta. The derailed cars included 5 cars loaded with steel, 4 residue dangerous goods tank cars and 11 non-dangerous goods empty cars. One anhydrous ammonia residue tank car was punctured, releasing a small amount of product to the atmosphere. As a result, 28 residents were temporarily evacuated from a nearby trailer park. While investigating the immediate cause of the derailment, the conductor was exposed to fumes. He was subsequently taken to hospital for observation.

Ce rapport est également disponible en français.

Other Factual Information

Freight train 575-03 (the train) departed Calgary[1] at 0051 mountain standard time[2] Thursday, 04 March 2004 with 3 locomotives, 51 loads, and 19 empties. The train weighed 4507 tons and was 4686 feet long. The crew consisted of a locomotive engineer, a conductor, and a trainee. All were qualified for their respective positions, and met fitness and regulatory requirements.

Movements over the Red Deer Subdivision, the southern half of the Canadian Pacific Railway (CPR) Calgary–Edmonton corridor, are governed by the Occupancy Control System as authorized by the *Canadian Rail Operating Rules*, and are supervised by a rail traffic controller located in Calgary. Traffic on the Red Deer Subdivision in 2003 was 26.4 million gross tons, which was composed mainly of grain and various petrochemicals, and intermodal traffic.

The weather was clear and calm with a temperature of –18°C.

After departing Calgary, the trip was uneventful until after the train stopped at Campaign, Mile 72.1 of the Red Deer Subdivision. At Campaign, locomotive CP 3064 was added as a fourth unit in the locomotive consist. It was isolated, that is, not generating power, and left in idle. From Campaign, the train continued northward towards Red Deer. Recorded information indicates that on departing Campaign the train was gradually accelerated up to about 40 mph using moderate throttle ranging from idle to throttle position four. At the time of the derailment, the train was in throttle position two, travelling about 39 mph. The posted subdivision speed at the point of derailment was 45 mph. However, due to excess cross-level variation[3] there was a temporary 40 mph slow order in effect.

At approximately 0411, the train experienced an undesired emergency brake application at Mile 86.9. It was later determined that the fourth locomotive (CP 3064) and the 20 cars immediately behind it had derailed. The derailed cars included one empty gondola, five gondolas loaded with steel, six empty covered hoppers, and eight residue tank cars. During the derailment, a broken rail punctured the side of tank car PLMX 135303, which contained anhydrous ammonia residue, causing a small amount of product to be released to the atmosphere.

This tank car was built in 2003 to Department of Transportation (DOT) specification 112J340W. Although the other tank cars remained intact, two of them (PROX 98738 and PROX 98755) had to be flared off by qualified personnel because they contained propylene residue.[4]

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1 All locations are in Alberta.

2 All times are mountain standard time (Coordinated Universal Time minus seven hours).

3 A cross-level variation is the difference in elevation between rails.

4 Propylene is a highly flammable gas used in the production of chemicals, rubber, gasoline, and plastic. Long-term exposure may damage the liver. Acute exposure causes dizziness, loss of consciousness, and death.

Anhydrous Ammonia

The manufacturer's Material Safety Data Sheet (MSDS) describes anhydrous ammonia as 99.8 per cent ammonia and 0.2 per cent water by weight. It stipulates that anhydrous ammonia gas or liquid is very corrosive to body tissues, reacting with body moisture on contact. Health hazards identified by the MSDS include, among others:

Eyes	May cause severe eye irritation with corneal injury and permanent vision impairment.
Skin	Contact may cause severe skin irritation, chemical burns, and blistering. Contact with vaporizing liquid may cause frostbite due to rapid evaporative cooling. Cooling effect may mask the extent of any corrosive injury received.
Inhalation	Contact is irritating to entire respiratory tract. Overexposure may cause severe irritation to the upper respiratory tract and potential lung damage.
Ingestion	Ingestion is not likely because of its physical state, which is a compressed, liquefied gas.

The TSB has investigated a number of derailments in recent years involving the release of anhydrous ammonia. On 23 September 1999, Canadian National freight train M304-41-21, destined for Toronto, Ontario, derailed 26 cars near Britt, Ontario (Report R99T0256). In that report, the Board concluded that first responders who have little experience with dangerous goods, such as fire-fighters and police in small communities, may incorrectly base their first danger estimates in part on the colour and shape of a placard, rather than on the specific characteristics of the product. As a result, the Board made the following recommendation:

> The Department of Transport review the classification and safety marks for anhydrous ammonia to ensure that it is in a class and division consistent with the risks it poses to the public.
>
> (R02-01, issued in 2002)

Transport Canada responded that the full information system, which includes "ANHYDROUS AMMONIA" and "Inhalation Hazard" stencilled on both sides of the car and the placard used, effectively provides information to responders.

At the time of the Britt derailment, anhydrous ammonia was classified in Canada as a "corrosive gas," Class 2.4 (9.2), UN 1005. Subsequently, Transport Canada proposed changing its classification to a Class 2.2, Compressed Gas, with a subsidiary classification of Class 8 (corrosive). This change was made. In section 2.14(b) of the *Transportation of Dangerous Goods Regulations*, Class 2.2 is described as "Non-flammable and Non-toxic Gases." Class 2.2 gases require a green placard, while classes 2.3, 6, and 8 require the white background used for toxic and corrosive products.

On 02 February 2001, CPR train 966-02 derailed five tank cars containing anhydrous ammonia at Mile 95.4 of the Red Deer Subdivision (Report R01E0009). Among the conclusions of the investigation were:

> Having anhydrous ammonia classified differently in different jurisdictions increases the risk of misunderstandings and errors of perception by the first responders and general public when identifying the dangers of an accidental release.
>
> The new Transport Canada Dangerous Goods classification system increases the risks of adverse consequences from anhydrous ammonia leaks as anhydrous ammonia is classified in a class and division that does not clearly identify the dangers posed by that product.

At the time of the derailment, anhydrous ammonia was classified as class 2.2 non-flammable compressed gas. Its presence was indicated by a green diamond-shaped placard showing a compressed gas cylinder. In addition, the cars carrying anhydrous ammonia had “Inhalation Hazard” stencilled on them.

After the derailment, the conductor encountered anhydrous ammonia fumes while walking back to inspect the train. He immediately returned to the lead locomotive, was taken to hospital, and later released with no injuries. The locomotive engineer and trainee were also taken to hospital, placed under observation, and subsequently released without injuries.

Twenty-eight residents from nearby Springbrook Trailer Park were evacuated as a precautionary measure. The evacuees were allowed to return to their homes approximately nine hours after the initial evacuation. There were no adverse affects or injuries to the residents as a result of the product release or the evacuation.

Particulars of the Track

The point of derailment (POD) was determined to be the south joint of a 36 foot, 115 pound closure or buffer rail[5] located in the east rail at Mile 86.9. Approximately 500 to 600 feet of track was damaged in the derailment. The track in the area of the derailment is tangent on a northward descending grade of –0.1 per cent. The track structure was 115-pound continuous welded rail (CWR) manufactured by Algoma in 1984. Rail was fully box-anchored on every tie for 200 feet from the joint, and box-anchored on every other tie beyond that point. The track subgrade was in good condition. The track shoulder was 18 to 24 inches wide and all cribs were full.

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[5] Closure rail is a piece of rail that connects the space between rail ends of long strings of rails such as continuous welded rails.

There was no record of when the closure rail was installed; however, the condition of the rail, i.e., the presence of battered rail ends at joints, indicated that it had been in place for some time. There were multiple rail fragments found at the POD. All of the rail breaks had occurred in the 115-pound closure rail. Two broken joint bars, as well as 29 pieces of the buffer rail, which had an approximate overall length of 94 inches, were recovered and sent to CP's Test Department in Winnipeg for failure analysis. The breaks were all catastrophic, and impact facets were observed on several sections of rail head, which were consistent with the train's direction of travel. Post-derailment inspection found three other broken rails on the east rail at Miles 70.4, 81.4, and 89.2. Each break was a clean, fresh, brittle fracture oriented along a transverse plane. Each originated from a pre-existing defect located on the bottom surface of the gauge side of the base.

The last rail flaw detector car inspection was conducted between Mile 67.3 and Mile 95.6 on 13 February 2004, with no defects found. The last Track Evaluation Car test was conducted on 04 November 2003, with two priority alignment defects identified at Mile 86.8 and at Mile 87.1 on either side of the POD. No defects were identified at the POD.

The last track inspection was conducted by the track maintenance supervisor on Wednesday 03 March 2004 with no anomalies noted. Post derailment examination led to a number of observations indicating that the POD joint and the adjacent rail had been unrestrained and moving freely under traffic before the derailment. That is,

- track spikes for approximately 30 to 35 feet in advance of the POD were standing high, and there was evidence of ice build-up between the rail seats of the tie plates and the base of the rail;
- in some spots, the rail base was sitting on top of spike heads that were not raised;
- some of the tie plates under the joint had been ejected to the field side of the track; and
- the field-side shoulder of the first tie plate south of the joint was broken off approximately ¾ inch east of the rail base.

A review of reports on track inspections conducted in the general vicinity of the POD over several months before the derailment, revealed poor rail and joint support. That is, there were

- a high number of broken, loose, and missing track bolts;
- broken tie plates; and
- cracked and broken joint bars.

Two joints were involved in the derailment: a compromise joint at the south end of the 36-foot buffer rail and a standard joint at the north end. Both rail ends in the north joint were battered and flattened. Maximum batter recorded was 5/32 inch near the middle of the joint, running out to zero approximately 11 inches in either direction. The north joint bars were manufactured by Algoma in the mid-seventies. Both bars failed at their approximate middles. The fracture surfaces of both bars showed pre-existing fatigue cracks extending from surface anomalies (corrosion pitting) on the joint bars' fishing surfaces[6]. The fatigue cracks were dark in colour. Those in the gauge bars measured 3/8 inch deep by ¾ inch wide. Those in the field bars measured ½ inch deep by 1 inch wide. In each case, when the fatigue cracks reached a critical size, they acted as macroscopic stress raisers that facilitated the nucleation of brittle fractures from the tip of the fatigue cracks and propagated downward through the remainder of the joint bars' cross-section.

The compromise bars on the south joint were used to compensate for the 3/16th inch difference in vertical head wear between the south end of the buffer rail and the adjoining rail. Both rail ends in the south joint were battered and flattened. Maximum batter was ¼ inch near the middle of the joint, running out to zero approximately 9½ inches in either direction. In addition, there was a ¾ inch gap between the rail ends. Both bars failed at their approximate middles. They had been manufactured by Portec in January 2003. The fracture surfaces of both bars showed fatigue cracks extending from the top fishing surfaces. The fatigue cracks were dark in colour. Those in the gauge bars measured ¾ inch deep by 1 inch wide and those in the field bars measured ¾ inch deep by 1½ inch wide. The remainder of the field-side bar cross-section failed downward in a brittle mode from the extremity of the fatigue cracks. The gauge side bar exhibited another fatigue crack extending upward from its bottom fishing surface. This fatigue crack measured ¾ inch deep by 1 inch wide and appeared to be more recent than the one extending from the top. The fatigue crack located at the bottom of the joint bar resulted in the nucleation of a secondary brittle fracture that propagated upward. This was the primary crack that caused the bar's failure. The dark colouring of the fatigue defects in the four joint bars indicated that they had been present for some time.

Chemical, hardness, macroscopic, and metallographic analyses conducted on the buffer rail and on the gauge-side joint bar revealed that both met specifications.

Even in CWR, rail joints are a common track feature and a necessary track discontinuity. Joints occur in switches, at track circuit limits, and where defective sections of rail have been cut out and replaced with pieces of matching rail called plugs. Joint bars, also known as angle bars, are fastenings designed to join the abutting ends of rails. A joint bar is fitted on each side of the rail ends to be joined. The assembly is fastened together, through the web of the rails to be joined, with four or six bolts, depending on the rail weight.

Joint bars are designed to provide strength and stiffness, and to keep both rail ends in line vertically and horizontally. As the moment of inertia[7] of a pair of joint bars is only about one-third the value for the corresponding rail, the stiffness in rail joints is well below that of the corresponding rail. Therefore, even when the joint bars are attached tightly to the rails, the resulting joint is still a weak spot in the track structure. As a result, joints require a high level of

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6 Fishing surfaces are the outside surfaces of a joint bar that come into contact with the underside of the head and top of the base of the rail.

7 Moment of inertia is a term used to describe the capacity of a cross-section to resist bending. It is a mathematical property of a section and concerns surface area and how that area is distributed about the reference axis, which is usually a centroidal, horizontal, or vertical axis.

maintenance. Due to their vulnerability and the cost of maintenance, railways constantly try to eliminate unnecessary joints with CWR and with thermite and flash butt welding.
Railway standard practice circulars dictate that maintenance personnel pay special attention to rail joints. Transport Canada Safety Inspectors also focus attention on joints. Ideally, joints must be firmly supported on sound ties on well-tamped, free-draining, clean ballast. In addition, they must be fully bolted (if timely thermite welding is not planned) and tightened to the recommended torque. If joints are not properly maintained, wheel impact forces will quickly lead to increased vertical rail deflections, causing loosening and deterioration of the joint assembly; rail head batter; and degradation of the ties, ballast, and subgrade under the joint.

When poorly maintained, joint bars and/or bolt holes drilled in the web of the rail are prone to developing fatigue cracks. Undetected and uncorrected, these cracks can eventually lead to failure and may cause a derailment. Although not specifically designed to do so, signal systems will provide limited protection from these types of defects. Track circuits may not show a problem until the rail or joint bars completely break apart and separate. If the rail breaks out within a joint and the joint bars remain intact, or if the rail break occurs on a tie plate, a track circuit continuity may not be disrupted. There is no protection from these types of defects on non-signalled track like the Red Deer Subdivision.

There was a derailment on 02 February 2001 (Occurrence R01E0009) on the Red Deer Subdivision at Mile 95.6 that involved the release of anhydrous ammonia, in which the condition of rail joints contributed to the accident. In addition, the United States National Transportation Safety Board (NTSB) investigated the 18 January 2002 CPR derailment near Minot, North Dakota, which resulted in the release of 240 000 gallons of anhydrous ammonia that caused an extensive evacuation, at least one death, and many serious injuries. In all three occurrences, inspection procedures before the accidents did not detect cracking in the joint bars and rails, allowing them to grow to a critical size that resulted in rail and/or joint bar failure.

The most common method of inspecting joint bars is visually from a moving hi-rail vehicle. While this type of inspection may find an obviously fractured, separated joint, small joint bar fatigue cracks are impossible to see. To adequately visually check joint bars, an inspector must conduct a visual, on-the-ground inspection.

A secondary benefit of an on-the-ground inspection is that the inspector can assess the rail joint gap and look for evidence of bent or loose bolts. Because of the time required to conduct a visual, on-the-ground inspection, they are considered impractical and are not routinely performed.

Although rail bound or hi-rail ultrasonic/induction testing is effective in testing rails, there is no known production method for field testing joint bars. Joint bars can be ultrasonically tested manually with a hand-held transducer. Although CPR had previously used this method, over time it was discontinued. Joint bars can also be tested using magnetic particle or dye penetration methods. However, railways consider both of these tests impractical because of the time, labour, and expense required.

A joint bar inspection system is currently under development and testing that will enable detection of cracked joint bars at speeds up to 50 mph. The system, a joint project with a railway engineering technology developer, the U.S. Federal Railroad Administration, and the Union Pacific and Canadian Pacific railways, is expected to be available in the near future.

Condition of Locomotive and Rolling Stock Wheels

Examination of the wheels on the first three units of the train was conducted at Red Deer. Impact damage was found on a number of the wheel treads on the east side of the locomotive consist. Wheels R1, R2, and R3 on the lead unit (CP8605), wheels L4 and L6 on the second unit (CP5927), and wheel L5 on the third unit (CP8621) all exhibited impact marks on the wheel treads indicating contact with a rail end. There were no corresponding marks on the wheels on the west side of the locomotive consist.

The train passed the last Hot Box and Dragging Equipment Detector at Mile 80.4 of the Red Deer Subdivision, 5.6 miles before the POD with no alarms or anomalies noted. Southward train 264-03 was the last train through the derailment area before the accident. Inspection of this train revealed a heavily shelled wheel on loaded tank car DOWX 70730. This wheel was on the east side of the train as it traversed the Red Deer Subdivision.

The wheel set was measured to determine if it was out of round and to determine the overall location and size of the damaged area. The wheel tread was determined to be 0.015 inch out of round over approximately 12 inches of wheel tread. TSB's gauging of the wheel tread defects (in CP's Winnipeg Test Department) determined two shelled areas measuring 1 inch and 1⅛ inches circumferentially, 1¼ inches and 1½ inches wide, respectively, 1 inch from the flange throat and 1½ inches from the outboard rim face over a length of about 5½ inches. The shells individually did not accommodate a 1-inch diameter template and were, therefore, not condemnable according to the AAR Field Manual of Interchange rules, Rule 41 A (1) (i), page 269. Two adjoining flat spots each measuring 1½ inch in length did make the wheel condemnable as a slid flat wheel under AAR Field Manual of Interchange Rule 41 Handling Line Responsibility 1 (b), page 280. Under Transport Canada's Freight Car Safety Rules the minimum safety standard for a shell is 1¼ inches wide and 1½ inches long, which is less restrictive than the AAR limit.

The TSB Engineering Branch has done a number of analyses of shelled wheels with damage similar to the heavily shelled wheel on loaded tank car DOWX 70730. For example, TSB performed an analysis of a failed locomotive wheel after an Ontario Northland Railway Passenger train derailed at Mile 4.0 of the CN Bala Subdivision in February 2001 (Report LP 010/01). One of the conclusions stated, in part: "The size limits of shells currently allowed by the various regulatory bodies may not be a reliable indicator of the large sub-surface cracks which can develop from shells on class 'C' wheels."

The last recorded Wheel Impact Load Detector data available for DOWX70730 on Canadian National (dated 23 January 2004), indicated a maximum of 84 kips.[8] The Association of American Railroads, Rule 41 of the A.A.R. Interchange Rules, established the condemnable limit at 90 kips.

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[8] A kip is a measure of impact.

Effective 01 July 2005, the AAR modified Rule 41 (Change No. 05-1) making it condemnable when a car is on a repair track for any reason and an impact has been detected by a wheel load impact detector between 80 kips and 90 kips for a single wheel.

Analysis

Introduction

There was no information to suggest that the cross-level variation, train handling, or train marshalling contributed to this derailment. The analysis will focus on track conditions, joint inspections, wheel impact, and the safety markings used in the transportation of anhydrous ammonia.

Track Conditions

The investigation determined that the derailment resulted from the failure of the compromise joint bars located in the east rail, at the south end of a 36 foot closure rail. The poorly supported and unrestrained joint and adjacent rails had been experiencing vertical deflection. This led to the development of micro-cracks from irregularities (i.e., corrosion pitting) on the fishing surfaces. Continued exposure to in-service cyclic loading led to the formation and growth of fatigue cracks that acted as macroscopic stress raisers. Brittle fractures initiated from the fatigue cracks when a single (impact) load exceeded the reduced strength of the bars' remaining cross-section.

Inspection of Joints

The history of broken and loose bolts, broken tie plates, and cracked and broken joint bars across the subdivision indicates that there is a risk of similar derailments. Although regular inspection by track forces in the months leading up to the derailment noted these conditions in the general vicinity of the POD, no corrective action was taken. Although rail joints are a well-known vulnerability within track structure, the joints involved in this derailment were inadequately inspected and maintained.

Inspections of rail joints using current rail defect detection equipment or geometry cars are unable to identify joint bar defects. Joint bars can be ultrasonically tested manually with a hand held transducer; however, the absence of a production method to test for internal defects increases the risk of latent internal defects growing to critical size, thus leading to joint bar failure and derailment.

Although new methods of testing joint bars are under development, the most effective way to avoid problems with joints is to eliminate them or to ensure that they are properly installed and continuously maintained.

Wheel Impact

Although the impacts recorded for tank car DOWX 70730 were below the AAR threshold, lower temperatures at the time of the derailment reduced the impact resistance of the rail steel. Given that the defective wheel was on the last train to have operated over the derailment location and given the reduced impact resistance of the rail, it is likely that impacts from this defective wheel contributed to the failure of the compromise joint bars and of three other broken rails that were found in the general vicinity of the POD.

The provisions of AAR Interchange Rule 41 A (1) (i) may be inadequate for defining a condemnable wheel due to shelled tread. Although individual shells less than one inch in diameter are not condemnable, adjoining shells of similar size act as one shell, increasing the risk of broken rails.

Safety Markings of Anhydrous Ammonia

When the conductor approached the derailed cars he was exposed to anhydrous ammonia and felt its effects before getting sufficiently close to observe the placards or the stencilling on the car. As referenced in this report, a recommendation and conclusions from previous TSB investigations involving the release of anhydrous ammonia remain relevant. Train accidents involving the release of anhydrous ammonia leading to serious injury and death continue to happen both in Canada and the United States (Minot, North Dakota, NTSB report RAR-04-01). The primary classification of this toxic and corrosive chemical as a compressed gas, with its commensurate green placard depicting a compressed gas cylinder, continue to be insufficient to represent the dangers posed by this product, particularly to first responders.

Findings as to Causes and Contributing Factors

1. The train derailed as it passed over a rail joint that had broken and separated.

2. The joint bars were weakened by fatigue defects due to the poorly supported and unsecured condition of the joint and adjacent rails.

3. Impact loading from a defective wheel with shells and flat spots on the previous train over the derailment site likely contributed to the failure of the joint bars at Mile 86.9 and of three additional rail breaks near the point of derailment.

4. Although regular inspection by track forces in the months leading up to the derailment noted a high number of broken and loose track bolts, broken tie plates, and cracked and broken joint bars in the general vicinity of the POD, action was not taken to correct these conditions.

Findings as to Risk

1. Although ultrasonic/induction testing is effective in testing rails, the absence of a similar production method to test for internal defects in joint bars increases the risk of latent internal defects growing to critical size, leading to joint bar failure and derailment.

2. The high number of broken and loose bolts, broken tie plates, and cracked and broken joint bars across the subdivision indicates that there is a risk of similar derailments.

3. The provisions of AAR Interchange Rule 41 A (1) (i) may be inadequate for defining a condemnable wheel due to shelled tread. Although individual shells less than one inch in diameter are not condemnable, adjoining shells of similar size act as one shell increasing the risk of broken rails.

4. The primary classification of this toxic and corrosive chemical (anhydrous ammonia) as a compressed gas, with its commensurate green placard depicting a compressed gas cylinder, continue to be insufficient to represent the dangers posed by this product, particularly to first responders.

Safety Action Taken

Subsequent to the derailment, Transport Canada visited the Red Deer Subdivision and found that the area in question had a number of joints in poor condition and poor ties that resulted in surface/cross-level deviations. Transport Canada indicates that CPR has since made changes to improve track conditions on this subdivision. In 2004, CPR increased track patrols on this section of track, significantly increased joint inspections (now conducted monthly), and performed joint elimination and surfacing. In 2005, CPR continued improvements with more joint elimination and surfacing and with the installation of joint ties in the area.

Planned revisions to the *Transportation of Dangerous Goods Regulations* contain the following items, with examples shown in Figure 1:

- The classification of anhydrous ammonia is to be changed to class 2.3.

- When UN1004, ANHYDROUS AMMONIA, is contained in a large means of containment, the large means of containment must have displayed on it one of the following placards:

    - until 15 August 2006 the placard to be displayed can be either the placard for class 2.2, for class 2.3, or for UN 1005;

    - after 15 August 2006 the placard to be displayed can be either the placard for class 2.3 or for UN1005.

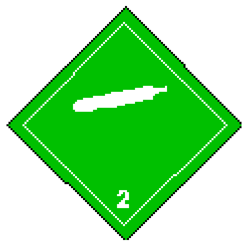
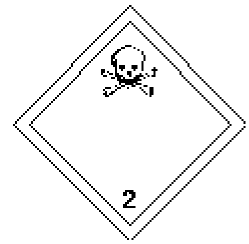
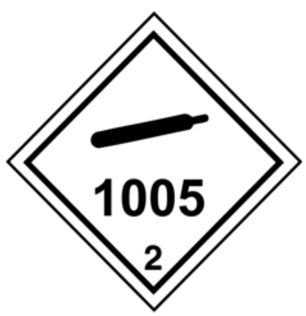
<table>
<tr><td>Class 2.2, Non-flammable and Non-toxic Gases

</td><td></td><td>Class 2.3, Toxic Gases

</td></tr>
<tr><td>Label and Placard
Black or White: Symbol, number and line 5 mm inside the edge for a label and 12.5 mm inside the edge for a placard
Green: Background
The symbol is a gas cylinder.</td><td></td><td>Label and Placard
Black: Symbol, number and line 5 mm inside the edge for a label and 12.5 mm inside the edge for a placard
White: Background
The symbol is a skull and crossbones.</td></tr>
<tr><td>Class 2.3, Toxic Gases

</td><td></td><td></td></tr>
<tr><td>Optional Label and Placard for UN1005, Anhydrous Ammonia
White background
The symbol is a gas cylinder.</td><td></td><td></td></tr>
</table>

Figure 1: Examples of labelling for the transportation of dangerous goods

CPR indicates that since this accident the following safety actions have been taken:

- All joint bars on this section of track were closely inspected on 27 February 2004 and replacement of all defective joint bars was completed on 05 March 2004.
- Track maintenance supervision was reorganized to ensure improved track inspection and timely corrective action.
- A new wheel impact detector was commissioned on 30 November 2004 at Mile 22.7 on the Red Deer Subdivision.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 25 October 2005.

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