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NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

DERAILMENT OF AMTRAK TRAIN NO. 7, THE EMPIRE BUILDER, ON BURLINGTON NORTHERN TRACK, GLACIER PARK, MONTANA MARCH 14, 1980

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16. Abstract

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The National Transportation Safety Board determines that the probable cause of this accident was the overturning of the outside rail of a 6°08' curve because the improperly maintained track could not sustain the lateral force generated by the acceleration of the locomotive in the curve. Contributing to the derailment was the failure of the railroad to issue a temporary slow order pending replacement of several defective rails.

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SYNOPSIS

About 4:00 p.m., on March 14, 1980, westbound Amtrak passenger train No. 7, the Empire Builder, derailed two locomotive units and eight cars while moving at 37 mph through a 6°08' curve on the Burlington Northern track at Glacier Park, Montana. Of the 170 passengers and 20 crewmembers, 115 persons were injured; 35 of the injured were hospitalized. Property damage was estimated to be $546,800.

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INVESTIGATION

The Accident

About 12:29 p.m., March 14, 1980, westbound Amtrak train No. 7, the Empire Builder, consisting of two locomotive units and eight cars, arrived at Havre, Montana, en route to Seattle, Washington, on Burlington Northern (BN) track. The arriving BN crewmembers did not report any problems with the train. The relieving crew and car department personnel performed the required airbrake tests and inspections, and no defective conditions were noted. The train departed on time at 1:00 p.m. After leaving Havre, the train passed six hot box detectors and no defects were indicated. Crewmembers also made frequent visual inspections of the train as it moved through curves; they did not take exception to its condition.

As train No. 7 entered a 0.8-percent descending grade about 4 miles east of Glacier Park, Montana, the engineer began to reduce the speed of the train from 60 mph to comply with a 35-mph speed restriction about 2 miles ahead. He reduced the throttle in increments from the No. 8 position to the No. 3 position while making several service brake applications. The train's speed was 35 mph as it entered the speed-restricted area. The brakes were released at the beginning of the area of restricted speed, and the speed of the train increased to about 40 mph as it continued down the descending grade. About 1/4 mile east of the Glacier Park station, which was not a scheduled stop, the engineer again made a minimum application of the automatic brakes. This brake application did not reduce the speed of the train, so he increased the brake application just before the train entered a 6°08' curve to the left, about 1,100 ft west of the station. The spiral of the curve began on a bridge, 107 ft before its west end. The bridge and curve were on a nearly level grade at the bottom of the descending grade.

The engineer released the brakes for an ascending grade when the train was about 300 ft into the curve and moving about 36 mph. The throttle was still in the No. 3 position. About 2 seconds after releasing the brakes, he felt the lead locomotive derail as the train began to accelerate to 37 mph. Immediately after derailing, he applied the automatic brakes in emergency. Neither the engineer nor fireman saw or felt anything unusual before the cars derailed.

The baggageman, who was riding in the front left seat of the first coach behind the baggage car, stated that he first felt the rear of the coach derail toward the outside of the curve, and then the front end derailed. The conductor and front brakeman, who were also riding in the first coach, and the rear brakeman, who was riding in the rear coach, first became aware of the accident when the cars in which they were riding derailed.

A BN maintenance of way employee, standing on the Glacier Park station platform, saw No. 7 derail. He had just inspected the north side of the train as it passed the station and had noted no defective conditions. He continued to watch the train as it moved past the station into the curve. He stated that when the lead locomotive unit came into view in the curve he saw it jump a little, then the second unit jumped, and then the baggage car jumped at about the same location. He said the rest of the cars were still riding smoothly as if they were still on the track. He then heard the noise of the emergency brake application. He stated that immediately after the noise, he saw what he thought was the second car after the baggage car separate from the lead cars. After the car uncoupled, which was near the middle of the curve, the car and the following cars continued forward down the bank to the outside of the curve.

After derailing, the locomotive continued over 800 ft around the remainder of the curve, stopping about 60 ft beyond the curve on tangent track. (See figure 1.) Both locomotive units, the baggage car, and the first two coaches remained coupled. The two coaches had tipped toward their right sides and were leaning at a 45° angle against the bank of a side hill cut. (See figure 2.) The fourth and fifth cars continued down a 15-ft-high embankment and tipped onto their sides near the bottom. The sixth car was leaning about 30° near the top of the bank. The seventh and eighth cars remained upright and derailed within the track structure. (See figure 3.)

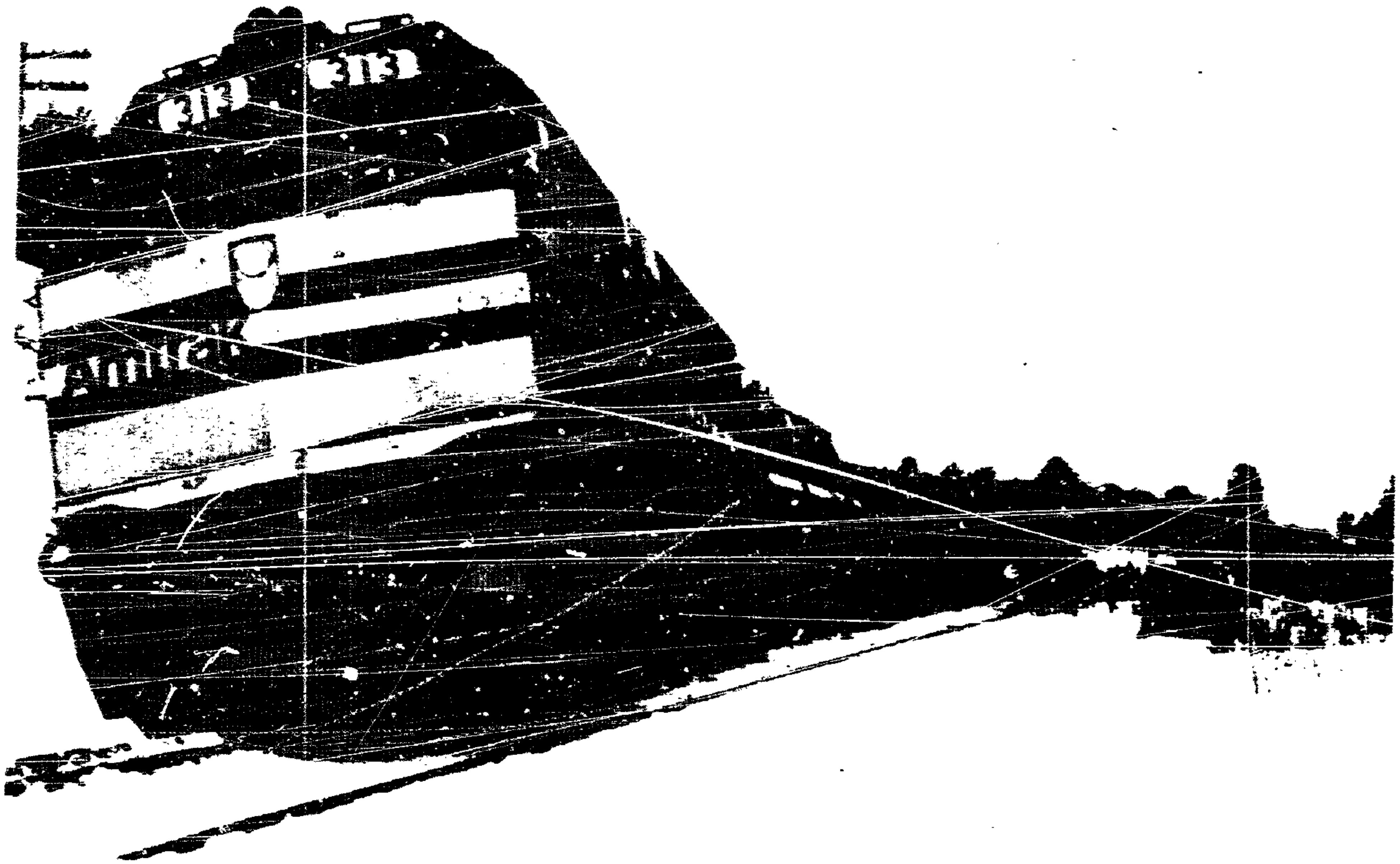


Figure 1.--Derailed locomotive.

Figure 2.--Track and first three derailed cars.

Figure 3.--Last three derailed cars.

When the train stopped, the engineer radioed the BN dispatcher at Havre to report the accident; the time was about 4:00 p.m. East Glacier residents also immediately began notifying area emergency rescue personnel. Emergency personnel responded from communities as far as 100 miles away because of the lack of hospital and emergency facilities at East Glacier.

Injuries to Persons

Injuries	Passengers	Crewmembers and Service Personnel	Total
Fatal	0	0	0
Nonfatal	107	8	115
None	63	12	75
Totals	170	20	190

Damage

The traction motors on the two locomotive units were damaged and the right front of the snowplow-type pilots were dented as they rode on the overturned north rail.

The baggage car's leading truck was damaged. Both equalizer bars were gouged on the rail side bottom corners just behind the wheels on the lead axles. The outside edge of the tread on the No. 1 wheel exhibited marks made by rubbing along the south rail. The tread on the No. 2 wheel had several indentations.

The trucks on the second and third cars had been damaged slightly and the exteriors of the cars were damaged on the right side. On the right sides of the cars, several windows were broken and the doors damaged as the cars came to rest against the embankment. Broken window glass was located inside the cars and baggage was scattered throughout. The coupler was broken at the back of the third car.

The trucks on the fourth and fifth cars had been damaged slightly. The right sides of the cars had been damaged, and windows had broken as the cars tipped onto their sides. The coupler on the leading end of the fourth car was broken off behind its head. The trucks on the sixth, seventh, and eighth cars were slightly damaged.

As a result of the derailment, about 1,000 ft of the north high rail in the curve was tipped over and damaged. The north rail was broken in several places during the derailment. Near the middle of the curve, the south rail was tipped slightly inward for seven rail lengths. (See figure 4.) The crossties were damaged slightly, mainly by wheel flange markings on the surface. The roadbed was not damaged. Costs of damage were estimated as follows:

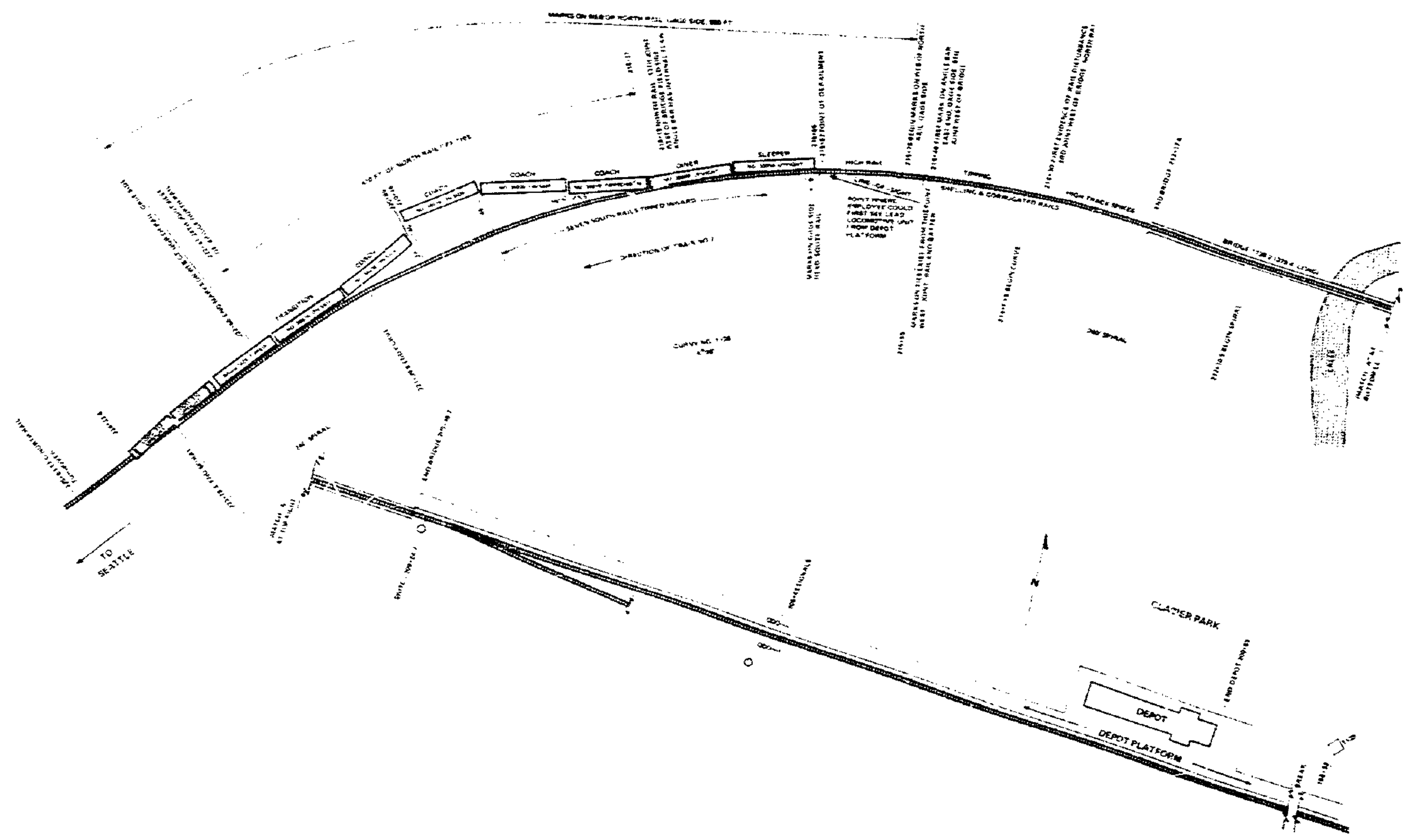


Figure 4.--Plan view of track and derailed train No. 7.

Locomotives	$ 25,000
Cars	495,000
Track	3,800
Removal of wreck	23,000
Total	$546,800

Crewmember Information

The engineer and fireman had been off duty about 24 hours before reporting for work on March 14, 1980. At the time of the accident, the engineer was regularly assigned to trains No. 7 and No. 8 between Havre and Whitefish, Montana. The fireman was making his first trip with this engineer. (See appendix B.)

Train Information

Train No. 7 was assembled on March 13, 1980, at Chicago, Illinois, and consisted of two locomotive units and eight cars. The train was inspected before leaving the Chicago Union Station. A 500-mile brake test and inspection were made at St. Paul, Minnesota; Grand Forks, and Minot, North Dakota; and Havre, Montana. No exceptions were taken during any of the inspections or tests.

The locomotive consisted of two F-40PH type, 4-wheel truck, 3,000-hp, diesel-electric units, manufactured by the Electro-Motive Division (EMD) of General Motors. They were delivered to Amtrak in July 1979. Each unit weighed about 259,000 lbs and was equipped with a speedometer, a speed recorder, a 26-L-type airbrake system, an overspeed control, and an electronic alerter control.

The train consisted of one baggage car, one transition coach, four bilevel coaches, one bilevel diner, and one bilevel sleeper. The four bilevel coaches, diner, and sleeper were constructed of stainless steel; each weighed 142,000 lbs to 156,000 lbs and was built in 1979 to Amtrak design specifications. The windows of each car were constructed of Lexan on the outside with a pane of safety glass on the inside. This was the first time that this equipment had been used on train No. 7. The baggage car and transition coach were also constructed of stainless steel. The baggage car which weighed 94,000 lbs was built in 1963; the transition coach weighed 159,000 lbs and was built in 1964.

The seven coaches were equipped with type-H tightlock couplers and four-wheel trucks with 26C brake valves and disc-type brakes. The baggage car was equipped with type-H tightlock couplers and four-wheel trucks with truck-mounted brake cylinders, D-22 brake valves, clasp-type brakes, and composition brakeshoes. The cars were equipped with electric heating and other electrical equipment, with current provided from the locomotive.

The two locomotive units received a 6-month airbrake inspection on January 23, 19[illegible]; their last monthly inspection was made on February 27, 1980.

Annual maintenance was last performed on the baggage car during May 1979, at the Amtrak Shops in Beech Grove, Indiana. The lead truck, which was at the

B-end of the car, had its wheels recontoured at the Amtrak Shops in Chicago, Illinois, on March 4, 1980. After March 4, 1980, the car had made one trip westbound to Seattle via another railroad. In Seattle the rear pedestal liners at the Nos. 1 and 2 wheel positions were renewed. One eastbound trip was made on March 10, on the BN via Glacier Park.

The seven coaches and baggage cars were inspected during February according to a programmed monthly maintenance schedule. The cars were also inspected at the end of their last in-service trip. No exceptions were taken to the condition of the cars during these inspections.

Postaccident Inspection of Train Equipment

The speedometer and recorder on the lead locomotive unit were calibrated and found to be accurate. The speed tape indicated that between Havre and Browning, Montana, train No. 7 was operated in accordance with all authorized speeds. After Browning, the speed tape indicated operation in accordance with a 45-mph and a 60-mph speed restriction. The 60-mph restriction was in force until 3 miles before the derailment site. The tape then indicated a slowing of the train to 32 mph for the 35 mph speed restriction at Glacier Park. An immediate gradual increase of speed to 40 mph was then shown in the next 1/2 mile within the 35-mph speed restriction. This 40-mph speed continued for about 1/2 mile. About 1/4 mile before the derailment, a reduction in speed to about 36 mph was indicated, then speed increased to 37 mph just before the accident. (See appendix C.)

Investigation of the baggage car disclosed that the lead truck had two of the four bolster centerplate bolts missing, the third bolt was broken through a progressive fracture, and the fourth bolt was loose. The rear of the slack adjuster was loose because of a missing bolt. Both of the lateral clearance shims were missing from the No. 2 bearing adapter. The weld of each shim was fractured, and there was evidence of rust and dirt on the fractured surfaces. The lateral clearance of the No. 1 axle was 15/16 in., and 9/16 in. for the No. 2 axle. The wheel adapter lugs on the lateral stops of the No. 2 pedestal were worn more than at the other wheel locations. The lead truck, No. 1 and 3 wheel positions, had only two sets of springs instead of the four sets required. The No. 2 and No. 4 wheel positions had only three of the four sets required. A considerable amount of dirt and rust was found in the missing spring locations. Diagonal measurements taken with a steel tape indicated that the lead truck was about 3/4 in. out of alignment; 1/8 in. is the maximum allowed by Amtrak. Inspection of the trailing truck of the baggage car did not disclose any defects. Inspection of the couplers of the baggage car disclosed that the lead coupler measured 32 1/4 ins. from the top of the rail to the centerline of the coupler; the trailing coupler measured 36 ins. The height of the lead coupler on the following transition car, which was coupled to the rear of the baggage car, was 31 ins. Amtrak standards list a minimum 34-ins. to a maximum 35-in. coupler height. There are no Federal regulations concerning any of the defective conditions found on the baggage car.

Track Information

At Glacier Park the 6°08' curve had a design superelevation of 3 1/4 ins. The track through the curve was built of 115-lb, jointed rail, laid with double-shoulder 8 1/2-in. by 12-in. tie plates, on 23, 7-in. by 9-in. by 8 1/2-ft treated hardwood or softwood crossties per 39-ft rail length. The crossties were last renewed and the track resurfaced in 1976. The outside high rail of the curve was renewed in 1974 and the inside low rail, in 1953. The 36-in., reinforced, 6-bolt-hole-joint bars, installed in the high rail in 19[illegible], were reused for the high-rail renewal in 1974 along with new 1-in. by 5 1/2-in. track bolts and spring washers. The rails were secured by two rail-holding spikes and one plate-holding 5/8-in. by 6-in. track spike per tie plate. The rail was anchored with an average of 16 anchors per 39-ft rail. The track was ballasted with crushed granite to a minimum depth of 8 ins. under the crossties and last surfaced during November 1979. The crosstie cribs were full and the shoulder ballast extended beyond the crosstie ends more than 10-ins. The permitted speeds of trains through the area of the derailment required the track to be maintained to the Federal track safety standards for class 3 track.

As the track approaches the Glacier Park station from the east, there is a 2°01', 0°58', 0°50' compound curve to the left, 3,500 ft long. West of the station the track is straight for about 1,600 ft. It then enters upon a 380-ft open timber deck girder bridge on a 0.4-percent descending grade as it approaches the 6°08' curve on which the train derailed. The 240-ft spiral for the curve begins on the bridge 107 ft before the west end abutment. The 1,062-ft curve is on a level grade.

The BN first calculated the superelevation of the curve for freight trains traveling at 30 mph to be 3 1/4 ins. It then determined that the 3 1/4 ins. of superelevation allows a speed of 35 mph for passenger trains. The 35-mph authorized speed is within the maximum allowable operating speed prescribed by the Federal track safety standard 49 CFR 213.57. The equilibrium speed for this 6°08' curve is about 27 mph.

Even though the Federal track safety standards require that a Class 3 main track over which passenger trains operate be inspected only twice weekly, the BN was inspecting the track daily because of the winter weather. In addition to the daily visual inspections, the track had also been inspected by the BN's track geometry car during July 1979. The rail was tested ultrasonically with a BN rail inspection vehicle during 1979, and no defects were found. However, the joint bars for the rails were only visually inspected by BN track inspectors.

Two of the south rails in the middle of the curve were replaced on February 23, 1980, because of a broken bolt hole. The maintenance crew returned on February 24, 1980, to fix one rail which was loose after passage of a train. The rails were shimmed and respiked to correct the condition.

The assistant superintendent, roadway maintenance for BN, made a walking inspection of the track in the curve on March 5, 1980. He stated that the largest deviation in gage was 3/4 in. greater than the standard 4 ft, 8 1/2 ins.; that the surface and alignment were good; and that the superelevation in the curve was a uniform 3 ins. He stated also that the high rail was curve worn moderately and that the low rail had a number of flat spots, creating a washboard effect.

The roadmaster, with the general foreman, made a walking inspection of the track from Glacier Park to Summit, Montana, on March 7. This inspection included the 6°08' curve at Glacier Park. He said the north rail was curve worn because of normal wear, and that there were approximately 12 to 14 rails in the south rail that were corrugated. He also said that he intended to repair this curve soon by replacing some of the corrugated rails on the south side, and replacing the north high rail in the coming summer.

The track inspector last inspected the track on a motor car about 9:30 a.m. on March 14, 1980. He took no exceptions to the track. Maintenance of Way Circular MW-17 instructs BN employees on how to make and report the results of their track inspections so that action can be taken when necessary to protect against and correct any deficiencies observed. (See appendix D.)

Between 11:30 a.m. and 2:40 p.m., March 14, 1980, the maintenance crew had distributed rail for replacement at various locations between Summit and Glacier Park. In performing this work, the foreman passed over the curve at the derailment site several times. He took no exception to the track. He stated, however, that the low side of the curve had several corrugated rails which were to be to replaced in the next several days.

About 30 minutes before the arrival of train No. 7, the track through the 6°08' curve at Glacier Park was plowed because of snow. The roadmaster was riding in the south side of the plow, and he took no exceptions to the track conditions in the curve.

Postaccident Inspection of Track and Equipment

Following the accident, the track approaching and leaving the accident site was checked for defective conditions which could have caused or contributed to the accident. Measurements of track gage varied from 1/4 in. to 7/8 in. more than the standard of 4 ft 8 1/2 ins. The superelevation through the curve varied in a few locations from 2 1/4 ins. to 3 3/8 ins. (See figure 4.) The crossties were frozen in the ballast and had not been disturbed by the derailing cars. Snow was covering the crossties, and it had to be brushed from the base of the rail and tie plates in order to inspect the spiking pattern and the tie plate condition. The crossties exhibited 1/4-in. average plate cutting on the field sides of the high rails. The base of rail at the field side of the high rail was higher than the shoulder of a number of the tie plates creating more than a 1/2-in. gap when the rail was not under load. At several suspended joint locations between the bridge and derailment area, there were no rail holding spikes on the field side of the joint bars. A number of gage side rail spikes for several of the high rails just beyond the bridge and approaching the derailment location were protruding from 1 in. to 3 ins. above the base of the rail. (See figure 5.) The high rail was curve worn from 1/4 in. to 1/2 in. The bottom surfaces of the rails indicated wear from contact with the tie plates on the gage side of the rail base. A number of low rails were corrugated and had crushed heads and were mushroomed and shelled to the extent that required the rails be replaced. (See figures 6 and 7.) At suspended joints, several low rails exhibited 1/2-in. end batter, crushed heads, and horizontal separation of the rail head surface metal. (See figure 8.)

Figure 5.--High track spikes in north rail.

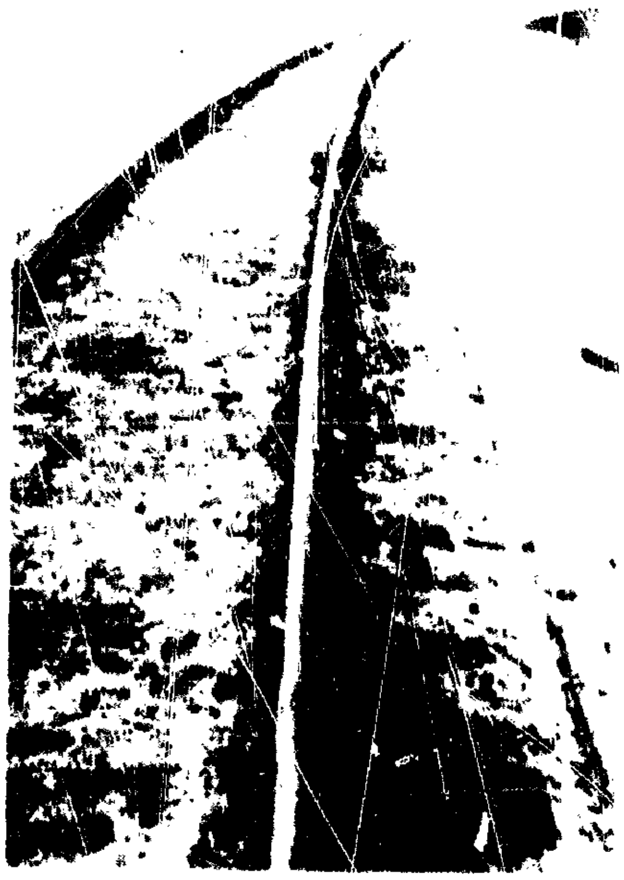


Figure 6.--Corrugations in south rail.

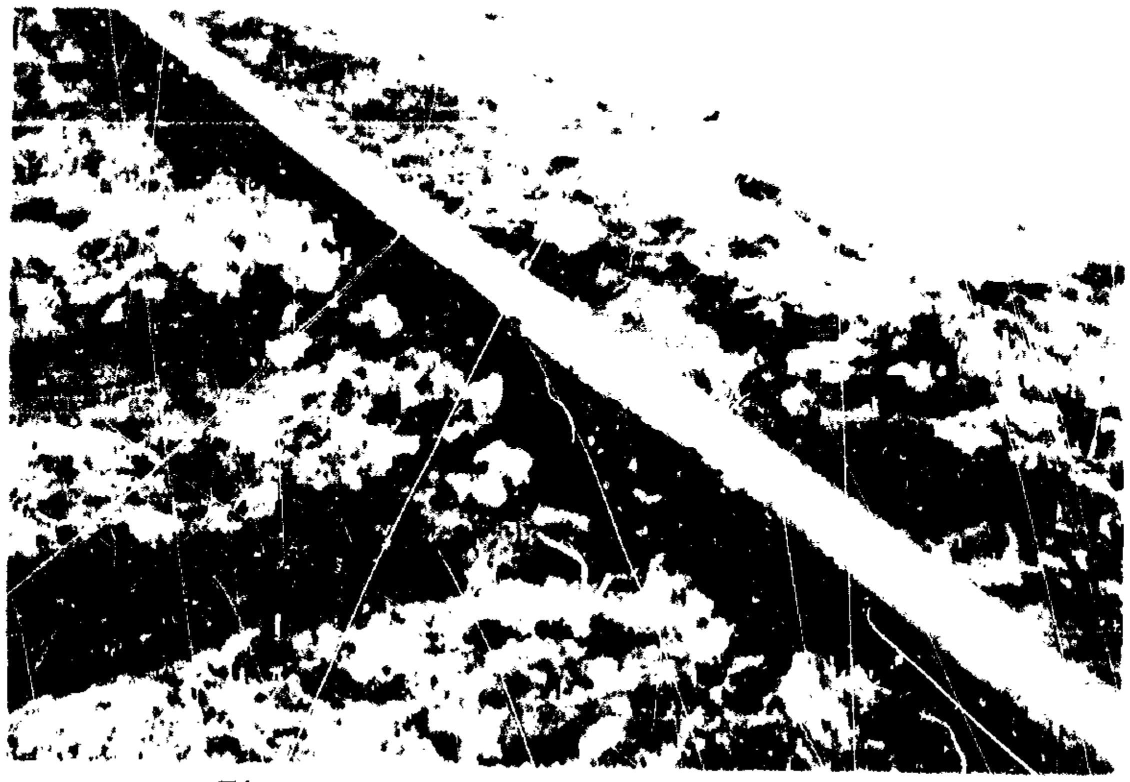


Figure 7.--Head crushing in south rail.

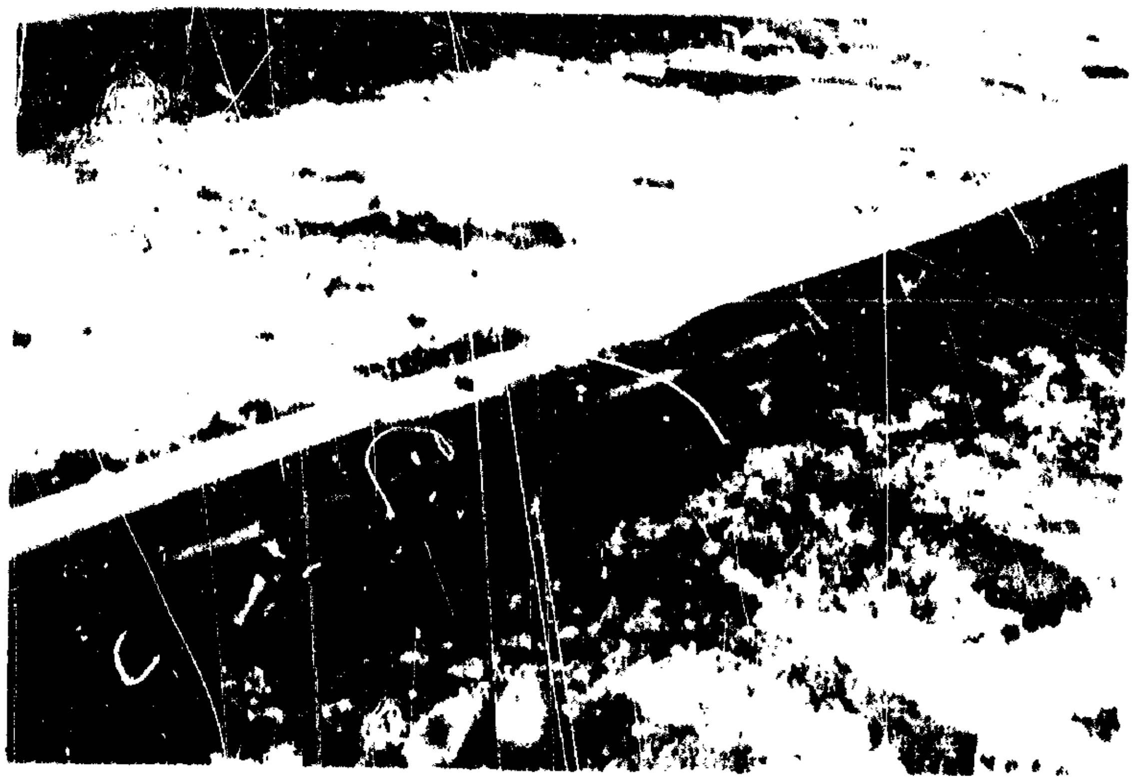


Figure 8.--Rail end batter in south rail.

The first marks of the derailment were found on the high rail in the curve, on the gage side joint bar, located at the sixth joint, 228 ft from the bridge. The east end of the bar and its bolts and nuts were nicked. The high rail was tipped outward beginning at this joint. There were wheel marks on the web of the high rail and gage side joint bars, from the sixth to the twenty-fourth joint. Several of the rails east of the sixth joint had to be reset after the derailment because the heads of a number of gage side-track spikes were under the base of the slightly tipped rail. (See figure 4.)

A broken joint bar on the field side of the high rail was found at the point where the cars began to derail down the embankment. The joint bar was broken near its center where the two rails meet. The three bolts in the west portion were sheared and had fallen from the bolt holes. The east portion was still attached to the rail with only one bolt intact. The other two bolts were in the bolt holes; one bolt head was sheared and a bolt nut was sheared on the gage side of the joint. Examination of the broken joint bar and the rail ends revealed evidence of a fissure near the top of the bar fracture. The fissure was about 1/2 in. in diameter and was blackened by oxidation. There was a similar fissure at the bottom of the fracture. The metal on the surface of the bar under the rail heads showed wear and a ridge where the rails had flexed at the joint. The surface of the break was crystalline and exhibited a pattern of tension breaking from the inside face outward to the field side of the bar.

Method of Operation

Trains are operated through Glacier Park by signal indications of a centralized traffic control system. Automatic train control or speed control is not provided. The maximum authorized speed for passenger trains is 79 mph, except in locations where speed restrictions are in effect. Trains are equipped with radios so that engineers can contact the train dispatcher, operators at stations, and crewmembers of other trains. The conductor and flagman are also furnished portable radios so that they can contact each other and the engineer.

Meteorological Information

During the afternoon of March 14, 1980, the weather at Glacier Park, Montana, was light blowing snow with a northwest wind of 10 to 20 mph and a temperature of 30° F. At 4 p.m., it was daylight but visibility was limited to about 1,000 ft because of the blowing snow. About 4 ins. of snow was on the ground at Glacier Park before the accident.

Medical and Pathological Information

Thirty-two passengers and three Amtrak service employees were hospitalized more than 24 hours with the following types of injuries: chest pains, fractured ribs, neck injuries, head injuries, hip injuries, back injuries, fractured legs, and skull fractures. The other injured passengers who were not hospitalized were treated for cuts, bruises, and sprains.

Survival Aspects

When the train derailed, the engineer notified the dispatcher at Havre who then summoned emergency help. In addition, residents of East Glacier near the scene of the accident began notifying the sheriff's office, State police, and emergency response personnel about 4:05 p.m. Immediately, calls for all available ambulances went out to communities within a 100-mile radius and emergency medical technicians responded.

In East Glacier, a triage area was established in a clinic. Several doctors classified the injured to determine who should be taken first to the two nearest hospitals at Browning and Cut Bank, 14 and 48 miles away.

The first problem encountered by emergency personnel was getting to the scene. The train had derailed on the side of an embankment, several hundred yards away from a highway that paralleled the track. Since the ground in the area was covered with deep snow, a bulldozer was used to clear a temporary road to the site. A local tow-truck was assigned to pull any ambulance that became stuck. The East Glacier school building was used to shelter the stranded passengers until buses arrived.

For several hours rescue workers continued to extricate passengers from the overturned cars, which was difficult because some of the pneumatically controlled sliding doors at the ends of the cars were inoperative or had to be forced upward because the cars were tipped on their sides. Ladders also had to be used to gain access to the side doors and emergency side windows. Some passengers in the overturned cars crawled through narrow passageways and stepped on seats to reach the emergency windows overhead; others were aided by other passengers. There were no roof hatches to facilitate escape or evacuation.

Passengers were injured when thrown from their seats against other seats, windows, and luggage racks as the cars derailed and overturned. Many of the seat locking mechanisms failed as the cars derailed, permitting the seats to rotate and injure the occupants. One of the most seriously injured passengers was an elderly woman who was pinned in a luggage rack for several hours before being extricated. Others were injured when thrown against the windows, which shattered as they struck the ground. The exterior Lexan bowed inward causing the interior safety glass to crack. Few injuries occurred in the newly designed dining car, which was equipped with all electric facilities, fixed shelving, and fixed seating.

There was no written emergency disaster plan in effect. The many agencies responding quickly adapted to the situation and cooperated with each other in an excellent manner. A number of the emergency personnel had never been on a passenger train and were not familiar with the various car floorplans and facilities; however, they quickly became familiar with the cars during the daylight hours. Also, the hospitals could not be alerted in advance about the injured passengers, so they never were sure how many injured were coming or what their injuries might be. Many off-duty hospital personnel voluntarily reported for work at the hospitals upon hearing of the accident.

Federal Regulations

Federal track safety standard 49 CFR 213.117 for class 3 track requires that rail end batter "may not be more than 3/8 in." Standard 49 CFR 213.127 requires that rails "must be spiked to the ties with at least one line holding spike on the field side," and that a tie that does not meet these spiking requirements is considered to be defective. Standard 49 CFR 213.113(b) requires that, when it is determined that a shelling or corrugated rail needs to be replaced, trains shall be limited to 20 mph until the rail is replaced. Standard 49 CFR 213.241 requires that the owner of the track keep a record of each track inspection and any deviation from the Federal track safety standards. (See appendix F.)

ANALYSIS

Train Defects

On March 13 and 14, the baggage car was being operated with two obvious defective conditions. Both the missing springs on the lead truck and the improper match in coupler heights between the baggage car and transition car are defects which car inspectors could have seen easily when the train was inspected at Chicago, St. Paul, Grand Forks, Minot, and Havre. In addition, bolts were missing from the center plate of the lead truck and the welds of the lateral clearance shims were broken. These defects may not have been evident to car inspectors between Chicago and the derailment site because the parts were hidden partially from view. However, since the baggage car was at Amtrak's Beech Grove shop for an annual inspection in May 1979, in the Chicago shop for contouring the lead truck wheels on March 4, 1980, and in the Seattle shop on March 10, 1980, for replacement of the rear pedestal liners at the Nos. 1 and 2 wheel positions, Amtrak and the BN had ample opportunity to recognize and correct the defective conditions. The Safety Board believes that the use of this baggage car in passenger service was unsafe. From the evidence, the Safety Board concludes that the car was receiving inadequate inspections and maintenance and that the car should not have been kept in service. Amtrak and the BN should have taken action to either repair the defects or remove the car from revenue service.

During its investigation of an accident at Lohman, Montana, on March 28, 1979, 2/ the Safety Board recommended that Amtrak and the Burlington Northern "Establish quality control standards for servicing of rolling stock maintained by contractual agreements or by Amtrak's own facilities . . . (R-79-59)." The Safety Board is still holding the recommendation, which was issued on August 2, 1979, in an open status, pending receipt of a reply from the BN and Amtrak.

Lack of springs and center plate bolts could contribute to a rough riding car, which when subjected to corrugated rails could cause excessive car bounce. Excessive bouncing and rocking may cause a wheel to lift over the high rail of a curve; however, they will not cause the wheel to overturn the high rails. In

2/ "Railroad Accident Report--Derailment of Amtrak Train No. 8, the Empire Builder, on Burlington Northern Track, Lohman, Montana, March 28, 1979, (NTSB-RAR-79-7).

addition, the baggageman did not notice any unusual riding condition while in the baggage car, and the visual inspection of the cars by maintenance-of-way employees at Glacier Park did not disclose any unusual bouncing or rocking about 1/4 mile before the derailment. If the lead truck of the baggage car had climbed over the high rail, the north side equalizer bar would not have been gouged in the manner exhibited. The excess lateral movement of the lead axle may also contribute to wheel climb. However, with wheel climb, a derailed baggage car would have stayed in line behind the locomotive and bounced along the track for some distance, instead of causing the two locomotive units to immediately derail. Between March 10 and 14, the baggage car had negotiated the same curves without derailing or causing a derailment. In view of the above, the Safety Board concludes that although the baggage car had a number of defects which could potentially have caused the derailment of a passenger car, none of these conditions caused or contributed to the derailment at Glacier Park.

<u>Track Conditions and Train Dynamics</u>

A number of track conditions found during the postaccident investigation indicated a developing problem that was not detected by railroad inspectors. The tie plate cutting on the field side of the crossties on the high rail side of the curve, the bearing of the base of the high rail on only the gage side of the tie plates, the track spikes that were missing on the field side of several high rail joints, the track spikes that were up 1- to 3-in. on the gage side of the undisturbed high rails near the bridge, and the general 1/2- to 7/8-in. wider-than-standard gage are all indicative of gage widening or tipping of the high rail. Therefore, the high rail's ability to withstand normal lateral forces from the passage of trains may have been substantially reduced. Tests 3/ have shown that these conditions can be particularly troublesome during the winter when the crossties are frozen in the ballast and when snow and ice get between the base of rail and tie plates. When snow was plowed from the track about 30 minutes before the arrival of No. 7, the track had already been inspected visually. The counteracting force of plowing on the rails could have increased rail tipping and gage widening by loosening track spikes, allowing snow and ice to get between the rail and tie plates. In addition, the plow could have struck the rail, causing it to tip.

When No. 7 entered the curve at Glacier Park, the brakes on the train were already applied to reduce its speed from 40 to 35 mph. However, since the throttle was in the No. 3 power position, the release of the brakes while in the curve would have caused the locomotive units to accelerate, as indicated on the speed tape. The force against the high rail in the curve created by the wheels of the two locomotive units when the brakes were released could have widened the gage and tipped the high rail even more. This would have been even more probable with the base of the rail higher than the outside shoulder of the tie plates and the rail base bearing against the field side track spikes. With the gage widened and the high rail tipped, the track spikes had to absorb the majority of lateral forces because the crossties were frozen in the ballast and were unable to help absorb and transfer the lateral forces to the ballast.

3/ A joint Federal Railroad Administration, Association of American Railroads and Railway Program Institute track train dynamics program test on the Union Pacific in 1974.

In addition to a deteriorating track condition, other evidence also indicates that the two locomotive units derailed before the baggage car and the rest of the train. First, the engineer stated that the lead locomotive unit derailed almost immediately after he released the brakes, and he did not believe that the cars behind had derailed first. Second, the section man had observed the two locomotive units jumping before the baggage car jumped and then saw the baggage car and several following coaches derailed. Third, the high rail was tipped over for more than 120 ft in front of the lead locomotive unit. Finally, both equalizer bars on the lead truck of the baggage car exhibited rail gouging marks as if its lead axle wheels dropped simultaneously inside of track gage. This would indicate that equipment ahead had already tipped the high rail and widened the track gage. Therefore, the Safety Board concludes that the two locomotive units were first to derail because of high rail tipping of an improperly maintained track that could not sustain the lateral forces of the locomotive.

After the locomotive derailed and its wheels dropped inside of the track gage, the field side joint bar broke and the rail separated. The separation allowed the fourth and following cars to go off the track structure and down the embankment. This derailing action progressively pulled the lead portion of the train, from the third car forward, farther from the track structure. This action explains why the baggageman felt the transition car derail and pull from the rear.

When Amtrak train No. 7 derailed in the 6°08' curve, it was operating over a portion of track which did not meet the Federal track safety standards for class 3 track. Since some time before the accident the roadmaster had determined the need to replace several rails and the section foreman had planned to replace several low rails in the curve which exhibited corrugations and shelling, there was the potentially dangerous possibility that a transverse separation or a detail fracture could cause a broken rail. A temporary slow order should have been issued to protect against the possibility of a rail breaking under a train. Maintenance procedures of the BN prescribe protective measures, and Federal regulations require that when a rail with corrugations and shelling needs to be replaced, the speed of trains shall be limited to 20 mph until the rail is replaced. In addition, several of the low rails also exhibited 1/2-in. rail end batter, which placed additional stresses on bolt holes and rail ends. These stresses can eventually cause bolt hole cracks and head and web separations, thereby becoming a serious derailment hazard. Even though such cracks and separations had not yet occurred, Federal regulations limit rail-end batter for class 3 track to not more than 3/8 in. If end batter is greater than 3/8 in., the railroad must reclassify the track to the appropriate lower class. Class I track allows 1/2-in. rail end batter, but the BN would have had to reduce the speed of passenger trains to 15 mph. The evidence indicates that several defective rail conditions existed in the curve both on and before March 14. Therefore, a 15-mph slow order should have been issued for the curve.

Had a 15-mph slow order been in effect until the defective rails were replaced, No. 7 would have been operating on March 14 at less than the equilibrium speed of 27 mph for the curve. At that speed, little, if any, lateral force would have been exerted on the high rail, and No. 7 may not have derailed.

FRA Regulations

Several of the track conditions which indicated a developing problem in this case are identified in the FRA enforcement manual. (See appendix F.) However, these conditions are not described for railroad inspectors in the Federal track safety standards. Moreover, because of the lack of field side track spikes in both crossties at several suspended rail joints, the track did not meet Federal regulation 213.109(d) requiring at least one nondefective crosstie at a joint in class 3 track. On the other hand, section C of the same regulation allows 70 ins. between nondefective crossties. Since the crossties at Glacier Park were spaced on 20-in. centers, there was only 60 ins. between nondefective crossties. Because of the conflict in the regulation, the lack of track spikes at the joint did not clearly constitute a deviation from Federal regulations. In its letter of January 10, 1980, to the Federal Railroad Administration concerning FRA's proposed revisions of the track safety standards, the Safety Board addressed the conflict in the regulation. The Board recommended that the permitted spacing between nondefective crossties be reduced to 48 ins. in curves. The FRA replied that it would consider this recommendation in the next revision of the track safety standards.

Survival Aspects

A major problem encountered during the evacuation was removing the injured passengers from the overturned cars. Some of the injured had to be lifted to overhead windows and down ladders; some of those injured were removed on stretcher boards. The Safety Board discussed this problem in its report of an Amtrak train accident near Salem, Illinois, on June 10, 1971 4/, in its report of an Amtrak train accident at Pulaski, Tennessee, on October 1, 1975 5/, and in its report of an Amtrak train accident at Lohman, Montana, on March 28, 1979 6/. After the accident at Salem, the Safety Board recommended to Amtrak that: "Purchase specifications for future passenger cars. . . should include provisions for the practical escape of nondisabled passengers from overturned cars when the exits at the ends of the cars are blocked." Following the investigation of the accident at Pulaski, the Safety Board recommended that the FRA: "Require that rail passenger equipment be fitted with roof hatches so that passengers can escape through the ceiling of a car which is lying on its side." The cars involved in this accident were manufactured after these recommendations were made and were not provided with roof hatches. The FRA has been collaborating in a program dealing with crashworthiness of rail passenger cars, which should also consider the use of roof hatches. In 1976 two passenger cars were made available to the FRA for roof hatch modification and emergency evacuation testing at the Pueblo Transportation Test Center. The FRA should expedite their research and testing of these obvious problems and should promulgate regulations to incorporate roof hatches in new and existing equipment.

4/ "Railroad Accident Report--Derailment of Amtrak Train No. 1 while operating on the Illinois Central Railroad Near Salem, Illinois, June 10, 1971" (NTSB-RAR-72-5).

5/ "Railroad Accident Report--Derailment of Amtrak Train on Louisville and Nashville Railroad, Pulaski, Tennessee, October 1, 1975" (NTSB-RAR-76-6).

6/ "Railroad Accident Report--Derailment of Amtrak Train No. 8, the Empire Builder on Burlington Northern Track, Lohman, Montana, March 28, 1979" (NTSB-RAR-79-7).

CONCLUSIONS

Findings

1. In travelling at 37 mph, train No. 7 was slightly exceeding the 35-mph speed restriction for the 6° 08' curve.

2. Several rails in the 6° 08' curve needed to be replaced because of defects caused by shelling, corrugations, and end batter.

3. Although it was known to responsible BN employees that the defective rails needed to be replaced, no temporary slow order was issued for movement of trains over these defective rails, as required by Federal regulations.

4. The frozen and snow-covered track in the curve contained irregularities in track spike placement, tie plate securement, and gage width. These irregularities could have reduced its ability to withstand the lateral forces induced by the locomotive units of No. 7.

5. Snow plowing could have created counteracting forces on the track in the curve and could have further reduced the track's ability to sustain lateral forces.

6. Train No. 7 accelerated in the 6° 08' curve when the automatic airbrakes were released with the throttle in the No. 3 position.

7. The outside rail in the curve was overturned by the trucks of the lead locomotive unit of train No. 7 because the track structure could not sustain the lateral forces generated by acceleration of train No. 7 upon release of its automatic brakes.

8. The joint bar and rails were broken during the derailment because of bending stresses.

9. Because the cars came to rest at a severe angle, escape was difficult and restricted because of the lack of escape hatches in the ceiling of the car.

10. The baggage car had a number of defective conditions which made the car unsafe for operating in passenger trains. These defects, however, did not cause or contribute to the derailment.

11. There are no Federal regulations covering the defective conditions found on the baggage car.

12. The BN and Amtrak had several opportunities to find and correct the defective conditions on the baggage car and should not have kept the car in service.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the overturning of the outside rail of a 6° 08' curve because the improperly maintained track could not sustain the lateral force generated by the acceleration of the locomotive in the curve. Contributing to the derailment was the failure of the railroad to issue a temporary slow order pending replacement of several defective rails.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations:

-- to the National Railroad Passenger Corporation (Amtrak):

> "Prohibit the use in revenue service trains of passenger train cars with defective conditions that may affect their safe operation. (Class II, Priority Action) (R-80-30)"

-- to the Federal Railroad Administration (FRA):

> "Promulgate regulations to establish minimum safety standards for the inspection and maintenance of railroad passenger cars. (Class II, Priority Action) (R-80-31)

> "Amend track safety standard 49 CFR 213.241, Inspection Records, to require railroad inspectors to list on their inspection records the location of rails which exhibit the external conditions listed in subpart (b) of 49 CFR 213.113, Defective Rails, and the remedial action they have taken. (Class II, Priority Action) (R-80-32)"

-- to the Burlington Northern:

> "Insure that track supervisors and inspectors take proper action to protect against conditions affecting safety of railway operations pending correction of defective track conditions as prescribed in Burlington Northern maintenance of way circulars and Federal regulations. (Class II, Priority Action) (R-80-33)"

The Safety Board reiterates and reemphasizes the importance of the following recommendation made to the Burlington Northern and Amtrak as the result of a previous accident on the Burlington Northern:

> "Establish quality control over standards for the servicing of rolling stock maintained by contractual agreements or by Amtrak's own facilities, and correct any existing discrepancies. (Class II, Priority Action) (R-79-59)"

In addition, the Safety Board reiterates the following recommendation to the Federal Railroad Administration:

> "Require that rail passenger equipment be fitted with roof hatches so that passengers can escape through the ceiling of a car which is lying on its side. (R-76-21)."

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ PATRICIA A. GOLDMAN
Member

/s/ G. H. PATRICK BURSLEY
Member

ELWOOD T. DRIVER, Vice Chairman, and FRANCIS H. McADAMS, Member, did not participate.

August 12, 1980

APPENDIXES

APPENDIX A

Investigation

The National Transportation Safety Board was notified of the accident about 7:30 p.m., on March 14, 1980. The Safety Board immediately dispatched an investigator from its Seattle field office and an investigator from Washington, D.C., to the scene. Investigation of operations, vehicle factors, track and structures, and human factors were conducted.

APPENDIX B

CREW INFORMATION

Engineer Thomas A. Reese

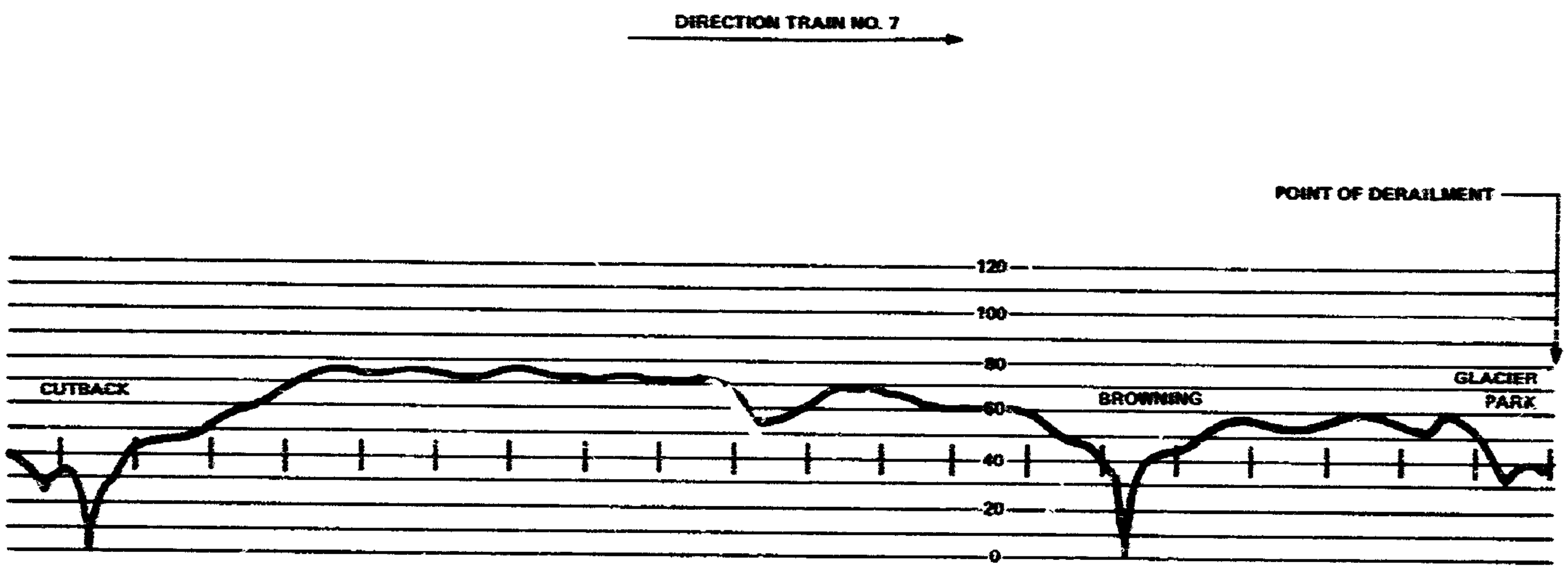
Mr. Reese, 59, was employed by the BN as a roundhouse laborer on February 1, 1942. He became a fireman on August 19, 1942, and was promoted to an engineer in October 1950. His last operating rules examination was in August 1978. His last airbrake and train handling rules examination was in July 1972. His last physical was in August 1979. He was required to wear eyeglasses with corrective lenses on the job.

Fireman Gary A. Reese

Mr. Reese, 24, was employed by the BN as a bridge and building helper on May 3, 1977. He became a brakeman on December 7, 1978, and became a fireman on April 20, 1979. He was not a promoted engineer and was not a current member of the BN training program for engineers. His last operating rules examination was April 19, 1979. He had not been examined on the BN's airbrake and train handling rules.

APPENDIX C

SPEED TAPE READOUT



APPENDIX D

EXCERPTS FROM BURLINGTON NORTHERN, INC., ENGINEERING CIRCULAR MW-17

BURLINGTON NORTHERN INC.
ENGINEERING DIVISION CIRCULAR MW-17

Inspections by Section Foremen, Maintenance Gang Foremen, Track Inspectors and Assistants to Roadmasters

GENERAL

The following rules set forth the minimum general requirements for inspection of Burlington Northern track and other facilities by Section Foremen, Maintenance Gang Foremen, Track Inspectors and Assistants to Roadmasters.

All inspections shall be carefully performed so that all conditions affecting railway facilities and safety of railway operation are observed and action taken to protect against and correct any deficiencies observed.

The types and frequency of inspection required for various classes of track and other facilities as set forth herein may be increased on authority of the Division Superintendent because of the many variables, local conditions or existing condition of the facility. All tracks are classified according to maximum allowable speed as follows, in accordance with FRA Track Safety Standards.

FRA Track Classification	Maximum Allowable Operating Speed	
	Freight Trains	Passenger Trains
Class 1	10 mph	15 mph
Class 2	25 mph	30 mph
Class 3	40 mph	60 mph
Class 4	60 mph	80 mph
Class 5	80 mph	90 mph

TRACK, ROADBED, AND RIGHT OF WAY

1. Section Foremen and Maintenance Gang Foremen shall inspect their territories either personally or by assignment of a qualified member of their gang as follows, except where Track Inspectors or Assistants to Supervisors Roadway Maintenance are assigned, their inspection shall replace the inspection by Track Foremen:

Any deviation from FRA Track Safety Standards must be noted as "FRA Defect".

a.

Class of Track	Type of Track	Rail Motor Car	Inspect Turnouts, Track & Highway Crossings
1, 2, 3	Main track and siding	Twice weekly, if the track carries passenger trains or more than 3 million gross tons of traffic during the preceding calendar year; Otherwise, weekly, or before use, if the track is used less than once a week.	Once a month
1, 2, 3	Other than main track and sidings	Monthly	Once a month
4, 5	Main track and sidings	4 days a week	Once a month

b. Their inspection shall be primarily concerned with the track structure and anything which may affect the safe operation of trains at authorized speed. They shall, however, in the course of their inspection, include bridges, tunnels, culverts, buildings, snowsheds, waterways, ditches, signal facil

APPENDIX D

ities, grade crossings, fences, signs, and all facilities on the right of way, reporting any unusual conditions or deficiencies.

c. The speed of the rail motor car should not be more than five miles per hour when passing over track crossings, highway crossings, or switches.

d. They shall throw all switches during turnout inspection. The motor car shall be stopped ahead of the switch points while inspection is being made and switch returned to normal position before proceeding.

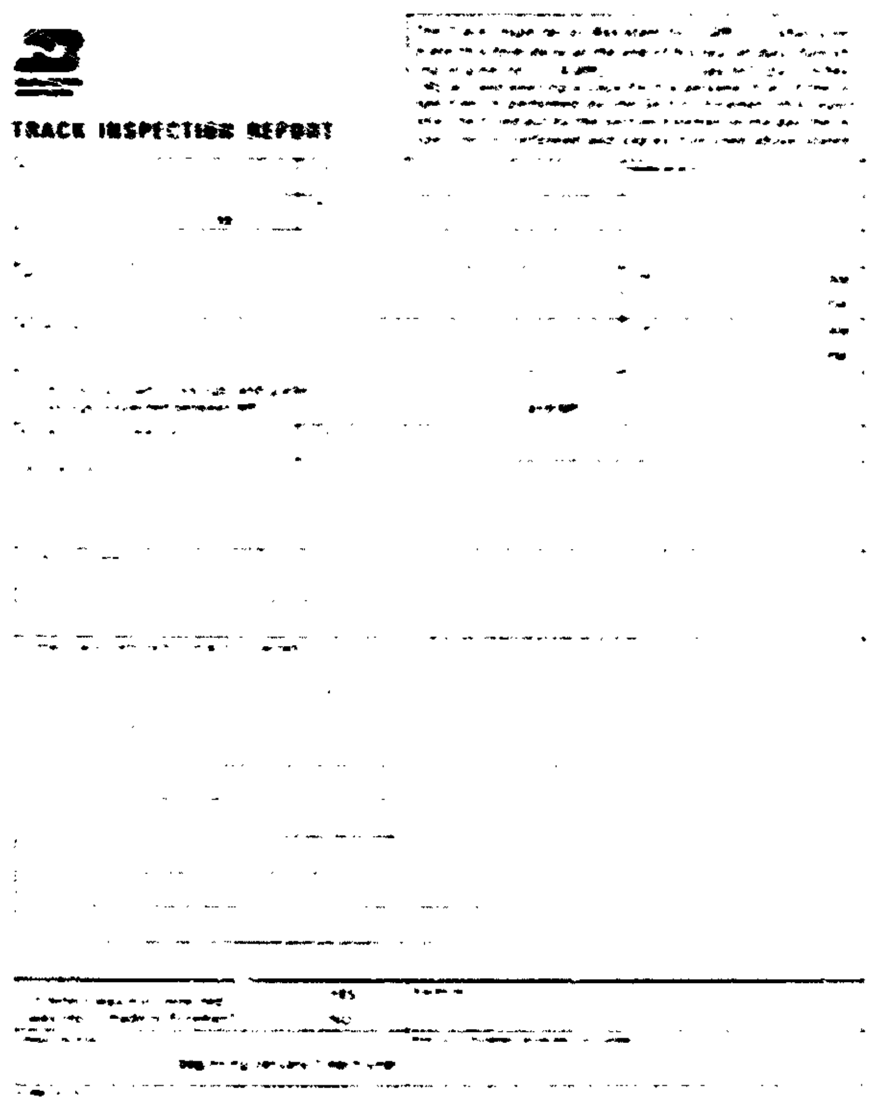
e. They shall prepare a written report on the date of each inspection on the attached form and submit to the Supervisor Roadway Maintenance.

f. They shall note on the daily report any deviations from FRA Track Safety Standards, and the defect shall be described as "FRA Defect".

RECOMMENDED BY:
B. G. Anderson
Assistant Vice President-Engineering

APPROVED:
[illegible]. C. E[illegible]ington
Vice President-Operations

Assistant Vice President-Engineering
St. Paul, Minnesota
September 13, 1971, Rev. 2/8/73


TRACK INSPECTION REPORT

-26-

APPENDIX E

EXCERPTS FROM FEDERAL TRACK SAFETY STANDARDS

Subpart D—Track Structure

§ 213.101 Scope.

This subpart prescribes minimum requirements for ballast, crossties, track assembly fittings, and the physical condition of rails.

§ 213.103 Ballast; general.

Unless it is otherwise structurally supported, all track must be supported by material which will—

(a) Transmit and distribute the load of the track and railroad rolling equipment to the subgrade;

(b) Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railroad rolling equipment and thermal stress exerted by the rails;

(c) Provide adequate drainage for the track; and

(d) Maintain proper track crosslevel, surface, and alinement.

§ 213.105 Ballast; disturbed track.

If track is disturbed, a person designated under § 213.7 shall examine the track to determine whether or not the ballast is sufficiently compacted to perform the functions described in § 213.103. If the person making the examination considers it to be necessary in the interest of safety, operating speed over the disturbed segment of track must be reduced to a speed that he considers safe.

§ 213.109 Crossties.

(a) Crossties may be made of any material to which rails can be securely fastened. The material must be capable of holding the rails to gage within the limits prescribed in § 213.53(b) and distributing the load from the rails to the ballast section.

(b) A timber crosstie is considered to be defective when it is—

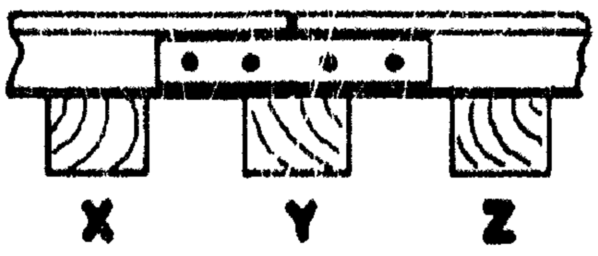
(1) Broken through;

(2) Split or otherwise impaired to the extent it will not hold spikes or will allow the ballast to work through;

(3) So deteriorated that the tie plate or base of rail can move laterally more than one-half inch relative to the crosstie;

(4) Cut by the tie plate through more than 40 percent of its thickness; or

SUPPORTED JOINT



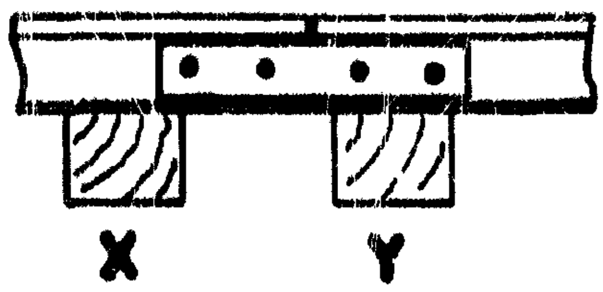
(5) Not spiked as required by § 213.127.

(c) If timber crossties are used, each 39 feet of track must be supported by nondefective ties as set forth in the following table:

Class of track	Minimum number of nondefective ties per 39 feet of track	Maximum distance between nondefective ties (center to center) (inches)
1	5	100
2, 3	8	70
4, 5	12	48
6	14	48

(d) If timber ties are used, the minimum number of nondefective ties under a rail joint and their relative positions under the joint are described in the following chart. The letters in the chart correspond to letters underneath the ties for each type of joint depicted.

SUSPENDED JOINT



APPENDIX E

Class of track	Minimum number of nondefective ties under a joint	Required position of nondefective ties	
		Supported joint	Suspended joint
1	1	X, Y, or Z.	X or Y
2, 3	1	Y	X or Y
4, 5, 6	2	X and Y, or Y and Z	X and Y

(e) Except in an emergency or for a temporary installation of not more then 6-months duration, crossties may not be interlaced to take the place of switch times.

(36 FR 20336, Oct. 20, 1971, as amended at 38 FR 875, Jan. 5, 1973)

§ 213.113 Defective rails.

(a) When an owner of track to which this part applies learns, through inspection or otherwise, that a rail in that track contains any of the defects listed in the following table, a person designated under § 213.7 shall determine whether or not the track may continue in use. If he determines that the track may continue in use, operation over the defective rail is not permitted until—

(1) The rail is replaced; or

(2) The remedial action prescribed in the table is initiated:

REMEDIAL ACTION

Defect	Length of defect (inch)		Percent of railhead cross-sectional area weakened by defect		If defective rail is not replaced, take the remedial action prescribed in note—
	More than	But not more than	Less than	But not less than	
Transverse fissure			20		B
			100	20	B
				100	A
Compound fissure			20		B
			100	20	B
				100	A
Detail fracture			20		C
Engine burn fracture			100	20	D
Defective weld				100	A, or E and H
Horizontal split head	0	2			H and F
	2	4			I and G
	4				B
Vertical split head	(Break out in railhead)				A
Split web	0	½			H and F
Piped rail	½	3			I and G
	3				B
Head web separation	(Break out in railhead)				A
	0	½			H and F
	½	1½			I and G
Bolt hole crack	1½				B
	(Break out in railhead)				A
Broken base	0	6			E and I
	6				(Replace rail)
Ordinary break					A or E
Damaged rail					C

NOTE

A—Assign person designated under § 213.7 to visually supervise each operation over defective rail.

B—Limit operating speed to 10 m.p.h. over defective rail.

C—Apply joint bars bolted only through the outermost holes to defect within 20 days after it is determined to continue the track in use. In the case of classes 3 through 6 track, limit operating speed over defective rail to 30 m.p.h. until angle bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.

D—Apply joint bars bolted only through the outermost holes to defect within 10 days after it is determined to continue the track in use. Limit operating speed over defective rail to 10 m.p.h. until angle bars are applied; thereafter, limit speed to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.

E—Apply joint bars to defect and bolt in accordance with § 213.121 (d) and (e).

F—Inspect rail 90 days after it is determined to continue the track in use.

G—Inspect rail 30 days after it is determined to continue the track in use.

H—Limit operating speed over defective rail to 50 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.

I—Limit operating speed over defective rail to 30 m.p.h. or the maximum allowable speed under § 213.9 for the class of track concerned, whichever is lower.

(b) If a rail in classes 3 through 6 track or class 2 track on which passenger trains operate evidences any of the conditions listed in the following table, the remedial action prescribed in the table must be taken:

Condition	Remedial action: If a person designated under § 213.7 determines that condition requires rail to be replaced	Remedial action: If a person designated under § 213.7 determines that condition does not require rail to be replaced
Shelly spots Head checks Engine burn (but not fracture)	Limit speed to 20 m.p.h. and schedule the rail for replacement	Inspect the rail for internal defects at intervals of not more than every 12 months
Mill defect Flaking Slivered Corrugated Corroded	do	Inspect the rail at intervals of not more than every 6 months

Class of track	Any mismatch of rails at joints may not be more than the following—: On the tread of the rail ends (inch)	On the gage side of the rail ends (inch)
1	1/4	1/4
2	1/4	3/16
3	3/16	3/16
4 5	1/8	1/8
6	1/8	1/8

§ 213.117 Rail end batter.

(a) Rail end batter is the depth of depression at one-half inch from the rail end. It is measured by placing an 18-inch straightedge on the tread on the rail end, without bridging the joint, and measuring the distance between the bottom of the straightedge and the top of the rail at one-half inch from the rail end.

(b) Rail end batter may not be more than that prescribed by the following table:

Class of track	Rail end batter may not be more than— (inch)
1	1/2
2	3/8
3	1/4
4	1/8
5	1/8
6	1/8

§ 213.119 Continuous welded rail.

(a) When continuous welded rail is being installed, it must be installed at, or adjusted for, a rail temperature range that should not result in compressive or tensile forces that will produce lateral displacement of the track or pulling apart of rail ends or welds.

(b) After continuous welded rail has been installed it should not be disturbed at rail temperatures higher than its installation or adjusted installation temperature.

§ 213.121 Rail joints.

(a) Each rail joint, insulated joint, and compromise joint must be of the proper design and dimensions for the rail on which it is applied.

(b) If a joint bar on classes 3 through 6 track is cracked, broken, or because of wear allows vertical movement of either rail when all bolts are tight, it must be replaced.

(c) If a joint bar is cracked or broken between the middle two bolt holes it must be replaced.

(d) In the case of conventional jointed track, each rail must be bolted with at least two bolts at each joint in classes 2 through 6 track, and with at least one bolt in class 1 track.

(e) In the case of continuous welded rail track, each rail must be bolted with at least two bolts at each joint.

(f) Each joint bar must be held in position by track bolts tightened to allow the joint bar to firmly support the abutting rail ends and to allow longitudinal movement of the rail in the joint to accommodate expansion and contraction due to temperature variations. When out-of-face, no-slip, joint-to-rail contact exists by design, the requirements of this paragraph do not apply. Those locations are considered to be continuous welded rail track and must meet all the requirements for continuous welded rail track prescribed in this part.

(g) No rail or angle bar having a torch cut or burned bolt hole may be used in classes 3 through 6 track.

APPENDIX E

§ 213.123 Tie plates.

(a) In classes 3 through 6 track where timber crossties are in use there must be tie plates under the running rails on at least eight of any 10 consecutive ties.

(b) Tie plates having shoulders must be placed so that no part of the shoulder is under the base of the rail.

§ 213.125 Rail anchoring.

Longitudinal rail movement must be effectively controlled. If rail anchors which bear on the sides of ties are used for this purpose, they must be on the same side of the tie on both rails.

§ 213.127 Track spikes.

(a) When conventional track is used with timber ties and cut track spikes, the rails must be spiked to the ties with at least one line-holding spike on the gage side and one line-holding spike on the field side. The total number of track spikes per rail per tie, including plateholding spikes, must be at least the number prescribed in the following table:

Subpart F—Inspection

§ 213.231 Scope.

This subpart prescribes requirements for the frequency and manner of inspecting track to detect deviations from the standards prescribed in this part.

§ 213.233 Track inspections.

(a) All track must be inspected in accordance with the schedule prescribed in paragraph (c) of this section by a person designated under § 213.7.

(b) Each inspection must be made on foot or by riding over the track in a vehicle at a speed that allows the person making the inspection to visually inspect the track structure for compliance with this part. However, mechanical, electrical and other track inspection devices may be used to supplement visual inspection. If a vehicle is used for visual inspection, the speed of the vehicle may not be more than 5 miles per hour when passing over track crossings, highway crossings, or switches.

(c) Each track inspection must be made in accordance with the following schedule:

Class of track	Type of track	Required frequency
1, 2, 3	Main track and sidings	*Weekly* with at least 3 calendar days interval between inspections, or *before use* if the track is used less than once a week, or *twice weekly* with at least 1 calendar day interval between inspections, if the track carries passenger trains or more than 10 million gross tons of traffic during the preceding calendar year
1, 2, 3	Other than main track and sidings	*Monthly* with at least 20 calendar days interval between inspections.
4, 5, 6		*Twice weekly* with at least 1 calendar day interval between inspections

(d) If the person making the inspection finds a deviation from the requirements of this part, he shall immediately initiate remedial action.

[36 FR 20336, Oct. 20, 1971, as amended at 40 FR 8558, Feb. 28, 1975]

§ 213.235 Switch and track crossing inspections.

(a) Except as provided in paragraph (b) of this section, each switch and track crossing must be inspected on foot at least monthly.

(b) In the case of track that is used less than once a month, each switch and track crossing must be inspected on foot before it is used.

§ 213.237 Inspection of rail.

(a) In addition to the track inspections required by § 213.233, at least once a year a continuous search for internal defects must be made of all jointed and welded rails in Classes 4 through 6 track, and Class 3 track over which passenger trains operate. However, in the case of a new rail, if before installation or within 6 months thereafter, it is inductively or ultrasonically inspected over its entire length and all defects are removed, the next continuous search for internal defects need not be made until 3 years after that inspection.

(b) Inspection equipment must be capable of detecting defects between joint bars, in the area enclosed by joint bars.

(c) Each defective rail must be marked with a highly visible marking on both sides of the web and base.

[36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973]

§ 213.239 Special inspections.

In the event of fire, flood, severe storm, or other occurrence which might have damaged track structure, a special inspection must be made of the track involved as soon as possible after the occurrence.

§ 213.241 Inspection records.

(a) Each owner of track to which this part applies shall keep a record of each inspection required to be performed on that track under this subpart.

(b) Each record of an inspection under §§ 213.233 and 213.235 shall be prepared on the day the inspection is made and signed by the person making the inspection. Records must specify the track inspected, date of inspection, location and nature of any deviation from the requirements of this part, and the remedial action taken by the person making the inspection. The owner shall retain each record at its division headquarters for at least 1 year after the inspection covered by the record.

(c) Rail inspection records must specify the date of inspection, the location, and nature of any internal rail defects found, and the remedial action taken and the date thereof. The owner shall retain a rail inspection record for at least 2 years after the inspection and for 1 year after remedial action is taken.

(d) Each owner required to keep inspection records under this section shall make those records available for inspection and copying by the Federal Railroad Administrator.

APPENDIX A—MAXIMUM ALLOWABLE OPERATING SPEEDS FOR CURVED TRACK

Elevation of outer rail (inches)

Degree of Curvature	0	½	1	1½	2	2½	3	3½	4	4½	5	5½	6
	Maximum allowable operating speed (mph)												
0 30	93	100	107										
0 40	80	87	93	98	103	109							
0 50	72	78	83	88	93	97	101	106	110				
1 00	66	71	76	80	85	89	93	96	100	104	107	110	
1 15	59	63	68	72	76	79	83	86	89	93	96	99	101
1 30	54	58	62	66	69	72	76	79	82	85	87	90	93
1 45	50	54	57	61	64	67	70	73	76	78	81	83	86
2 00	46	50	54	57	60	63	66	68	71	73	76	78	80
2 15	44	47	50	54	56	59	62	64	67	69	71	74	76
2 30	41	45	48	51	54	56	59	61	63	66	68	70	72
2 45	40	43	46	48	51	54	56	58	60	62	65	66	68
3 00	38	41	44	46	49	51	54	56	58	60	62	64	66
3 15	36	39	42	45	47	49	51	54	56	57	59	61	63
3 30	35	38	40	43	45	47	50	52	54	56	57	59	61
3 45	34	37	39	41	44	46	48	50	52	54	55	57	59
4 00	33	35	38	40	42	44	46	48	50	52	54	55	57
4 30	31	33	36	38	40	42	44	45	47	49	50	52	54
5 00	29	32	34	36	38	40	41	43	45	46	48	49	51
5 30	28	30	32	34	36	38	40	41	43	44	46	47	49
6 00	27	29	31	33	35	36	38	39	41	42	44	45	46
6 30	26	28	30	31	33	35	36	38	39	41	42	43	45
7 00	25	27	29	30	32	34	35	36	38	39	40	42	43
8 00	23	25	27	28	30	31	33	34	35	37	38	39	40
9 00	22	24	25	27	28	30	31	32	33	35	36	37	38
10 00	21	22	24	25	27	28	29	31	32	33	34	35	36
11 00	20	21	23	24	26	27	28	29	30	31	32	33	34
12 00	19	20	22	23	24	26	27	28	29	30	31	32	33

(36 FR 20336, Oct. 20, 1971, as amended at 38 FR 876, Jan. 5, 1973)

APPENDIX B—SCHEDULE OF CIVIL PENALTIES

Appendix B reflects a statement of policy by the Federal Railroad Administration in making applicable to Part 213 a specific civil penalty for a violation of particular sections of this part.

		Violation	Willful violation
Subpart A—General			
213.5	Responsibility of track owners	$1,000	$2,000
213.7	Designation of qualified persons to supervise certain renewals and inspect track	500	1,000
Subpart A—General—Continued			
213.9	Classes of track: operating speed limits	1,000	2,000
213.11	Restoration or renewal of track under traffic conditions	1,000	1,000
213.13	Measuring track not under load	500	1,000
Subpart B—Roadbed			
213.33	Drainage	500	1,000
213.37	Vegetation	500	1,000
Subpart C—Track geometry			
213.53	Gage	750	1,500
213.55	Alinement	750	1,500

APPENDIX F

EXCERPTS FROM FEDERAL RAILROAD ADMINISTRATION ENFORCEMENT MANUAL

213.127 -- Track Spikes

The table under 213.127 specifies the minimum number of track spikes per timber tie for each rail, including the plate holding or anchor spikes which, on curves, are a means of restraint against spread of gage.

Judgment is a prime factor in determining the holding ability of a track spike. High spikes, though common, are undesirable. Most owners provide for remedial action on a periodic basis. The section crew may redrive the spike, pull the spike with a claw bar, fill the hole with a treated tie plug and redrive or change out the tie completely. High spikes are often caused by:

a. Deterioration of tie wood fibers about the spike.

b. Vibration from passing trains.

c. Excessive rock or slag ballast atop the tie plate, allowing particles of ballast to work beneath the spike head, eventually causing the spike to rise.

d. Freezing of water beneath the rail or tie plate.

Spikes that have worked up 1 or 2 inches but still retain holding power should not necessarily be construed as deviations from the standards. A continuous pattern of this condition, however, may indicate a problem requiring remedy by the owner (i.e., inside rail gage spikes all high and rail tipping out). Spikes that can be pulled out by hand definitely constitute a deviation. The seriousness of a condition caused by a series of high, loose and/or missing spikes can be determined from the table under 213.109, crossties.