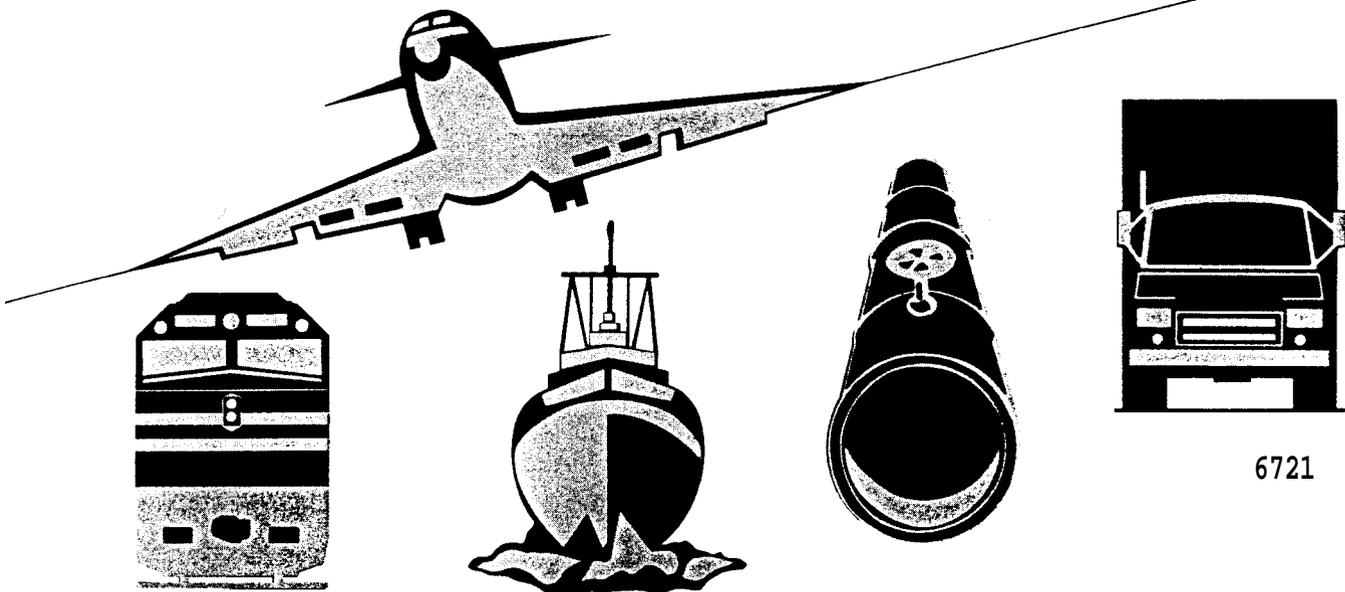


NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, DC 20594

RAILROAD ACCIDENT REPORT

DERAILMENT OF AMTRAK TRAIN 49
ON CONRAIL TRACKAGE
NEAR BATAVIA, NEW YORK, ON AUGUST 3, 1994



6721

Abstract: On August 3, 1994, westbound Amtrak (National Railroad Passenger Corporation) train 49 derailed on Conrail (Consolidated Rail Corporation) trackage at milepost 406.7 near Batavia, New York. Ten crewmembers and 108 passengers sustained injuries.

The major safety issues included in this report are the lack of Federal and industry guidelines for flattened rail head conditions and the integrity of passenger car seats. The report also discusses the timeliness and adequacy of emergency response services.

As a result of its investigation, the National Transportation Safety Board issued safety recommendations to the Federal Railroad Administration, the National Railroad Passenger Corporation, the Association of American Railroads, and the American Short Line Railroad Association.

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Adopted: July 11, 1996

Notation 6721

**NATIONAL
TRANSPORTATION
SAFETY BOARD**

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EXECUTIVE SUMMARY

About 3:44 a.m. on August 3, 1994, Amtrak (National Railroad Passenger Corporation) train 49, the Lake Shore Limited, en route from New York, New York, to Chicago, Illinois, was traveling westbound about 79 mph on Conrail (Consolidated Rail Corporation) trackage when it derailed at milepost 406.7 near Batavia, New York. No fatal injuries were sustained; 108 passengers and 10 crewmembers were injured.

The National Transportation Safety Board determines that the probable cause of the derailment was the fact that Federal and industry guidelines do not currently address flattened rail head conditions, due to an insufficient understanding of the risk that flattened rail poses to train operation.

The major safety issues discussed in this report are the lack of Federal and industry guidelines for flattened rail head conditions and the integrity of passenger car seats. The report also discusses the timeliness and adequacy of the emergency response services.

As a result of its investigation of this accident, the National Transportation Safety Board makes recommendations to the Federal Railroad Administration, the National Railroad Passenger Corporation, the Association of American Railroads, and the American Short Line Railroad Association.

INVESTIGATION

The Accident

Amtrak (National Railroad Passenger Corporation) passenger train 49, the Lake Shore Limited, was a regularly scheduled westbound train that traveled from New York, New York, to Chicago, Illinois. (See figure 1.) The train consisted of 2 locomotive units, 2 material handling cars (MHCs), 1 baggage car, 12 passenger cars, and 1 baggage/dormitory car. Before the train left Albany, New York, its operating crew received a list of speed restrictions for their trip. The crewmembers inspected the locomotive unit consist, reviewed the cab defect and inspection cards, and checked the radio. They also did a mandatory road air brake test, by applying and releasing the train air brakes. The crew found no problem with the locomotive consist or the air brakes.

Train 49 left Albany at 10:46 p.m. on August 2, 1994, and reached Rochester, New York, by early morning on August 3. It left Rochester about 3:13 a.m.; and at 3:27 a.m., it passed over a dragging equipment and train defect detector, which did not detect any defects. (See figure 2.) About 3:42 a.m., it reached milepost (MP) 403.7, the point where the initial derailment¹ occurred. The train

continued west and passed the head end of a Conrail (Consolidated Rail Corporation) freight train at MP 406.45. The freight train on the adjacent track, main line track 1, was also moving west. According to both the Conrail train engineer and conductor, sparks and gravel were coming from the underside of either the second or third car behind the locomotive units of train 49. The crew of the freight train attempted to alert the crew of train 49 by radio.

No response was received from the initial attempt. Train 49 responded to the second attempt, but the general derailment at MP 406.7 occurred almost simultaneously. At the time, train 49 had a clear (proceed) signal indication and was traveling, according to the event recorder, about 79 mph. The event recorder data strip also indicated that the emergency brakes were initiated by a train line separation after the general derailment had occurred.

Fourteen cars of the 18-car consist had derailed. The two locomotive units and the first seven cars remained on the right-of-way within the track structure after the derailment. The locomotive units and the second and third cars did not derail, and only the lead trucks of the first, fourth, and fifth cars derailed.

¹At the initial derailment, two wheels of the train left the track, but the train continued on. The general derailment happened 3 miles and 2 minutes 15 seconds later, when several more train cars derailed and the train could no longer proceed. The initial derailment as it occurred was not witnessed, nor was the train crew aware of it.

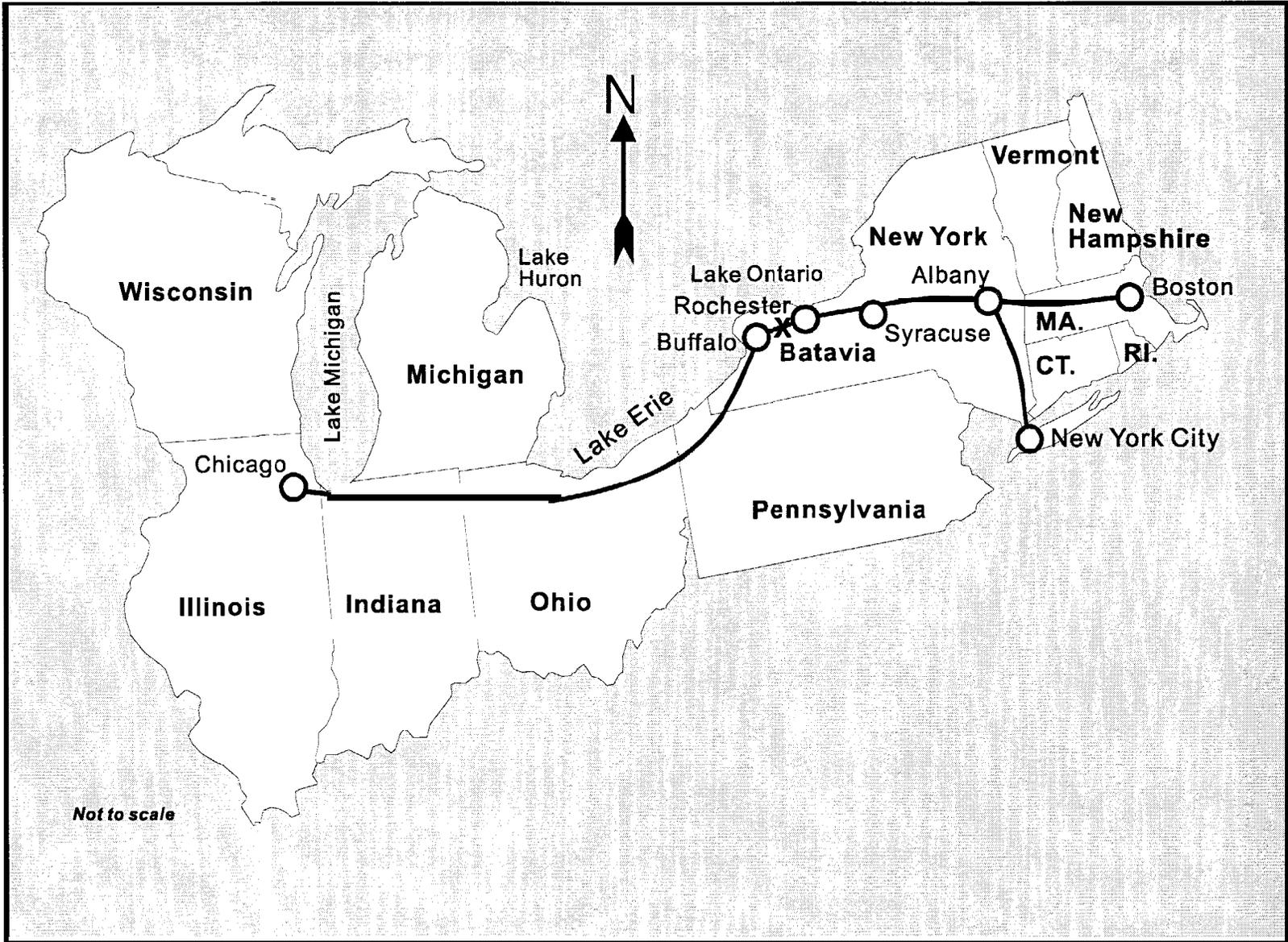


Figure 1 — Route of the Lake Shore Limited.

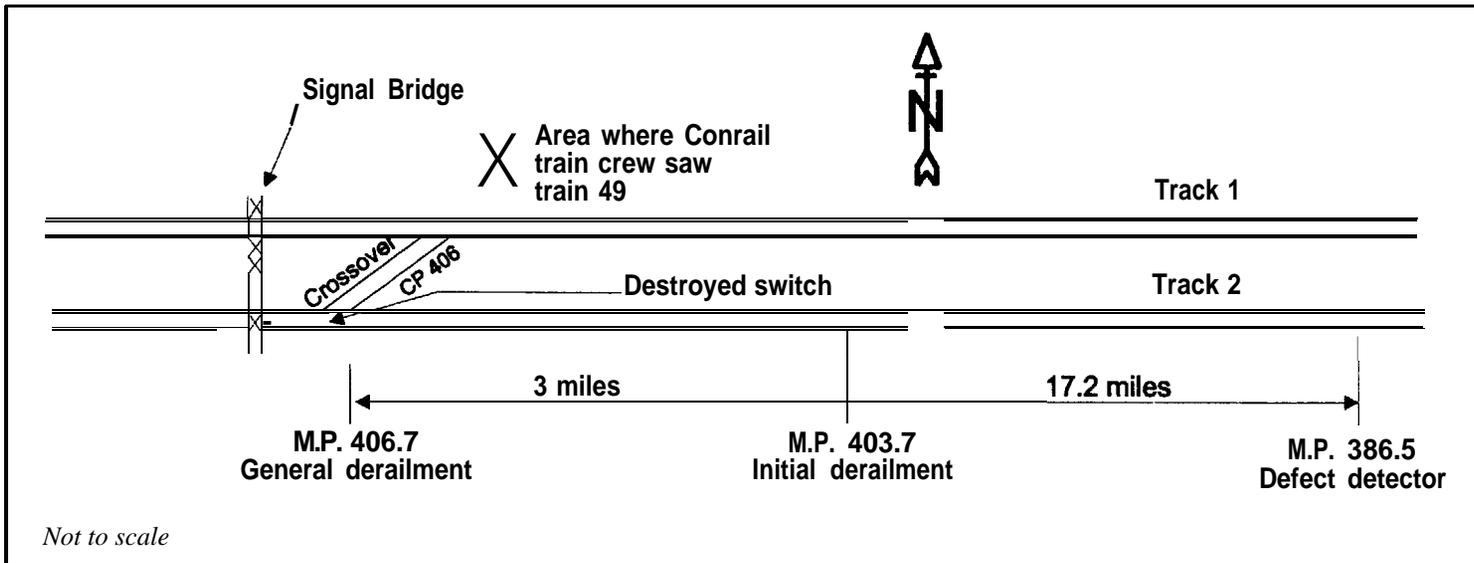


Figure 2 — Profile of defect detector and initial and general derailment sites.

The last nine cars descended the railroad embankment to the south of the tracks and separated into two groups. (See figures 3, 4, and 5.) The first group, the 8th through the 12th cars, went down the embankment and came to rest on their sides. The roof of the eighth car, dome coach 9411, faced the tracks, and the other four cars landed with their roofs pointed away from the tracks. The second group, with the last four cars of the train, remained upright but tilted with the contour of the embankment.

The signal bridge at control point 406 was struck in the derailment, and the bridge fell onto the 14th and 15th cars. (See figure 6.) According to the signal event recorder, the signal system was interrupted at 3:43:58 a.m.

The general derailment occurred near a Conrail police unit that was doing a routine check of Conrail construction equipment. The Conrail police officer

notified the Conrail dispatcher, who advised the Genesee County Emergency Communication Center (GCECC) of the derailment at 3:46 a.m. The GCECC dispatcher immediately sent a sheriff's deputy to the accident scene and at 3:55 a.m. informed the Batavia town and city fire departments as well as at least 11 other emergency services.

The fire chief arrived at the accident scene at 3:59 a.m., assumed command, and requested additional ambulances and helicopters at 4:01 a.m. The New York State (NYS) police were notified at 4:03 a.m. and responded. The Genesee County Emergency Management Coordinator (GCEMC) arrived on scene at 4:08 a.m. and called for every available ambulance, rescue unit, and extrication tool. Staging areas for ambulances and helicopters and for fire and rescue equipment were established at a nearby plant and on the south side of the tracks, respectively.



Figure 3 — Derailed cars.



Figure 4 — General derailment site (looking west).

An emergency shelter was established at 5 a.m. in the town of Batavia fire hall. The NYS police, who were in charge of transporting the train passengers by bus, listed the names of the injured passengers before taking them to the emergency shelter, where their need for hospitalization was evaluated. During

this evaluation, several more passengers asked to be taken to hospitals. Seriously injured passengers had been removed from the accident scene by 5 a.m., and the last passenger left the scene at 6:15 a.m. The derailment scene was secure and returned to Conrail at 10:30 a.m.

Injuries*

Type	Operating Crew	Service Crew	Passengers	Total
Serious	0	0	25	25
Minor	3	7	83	93
None	2	7	212	221
Total	5	14	320	339

*Based on the injury criteria (49 Code of Federal Regulations [CFR] 830.2) of the International Civil Aviation Organization, which the Safety Board uses in accident reports for all transportation modes.

No.	Unit	Unit No.	Condition	No.	Unit	Unit No.	Condition
1	Engine	374	Upright	10	Dome coach car	9411	On side, over bank
2	Engine	207	Upright	11	Diner car	8503	On side, over bank
3	Material handling car	1500	Upright, lead truck off	12	Coach car	4007	On side, over bank
4	Material handling car	1505	Upright	13	Coach car	4716	On side, over bank
5	Baggage car	1162	Upright	14	Coach car	4640	On side, over bank
6	Coach car	4705	Upright, lead truck off	15	Sleeper car	2430	Upright, over bank
7	Coach car	4602	Upright, lead truck off	16	Sleeper car	2433	Upright, over bank
8	Coach car	4728	Upright, both trucks off	17	Sleeper car	2056	Upright, over bank
9	Lounge car	28021	Upright, both trucks off	18	Dormitory car	BD1621	Upright

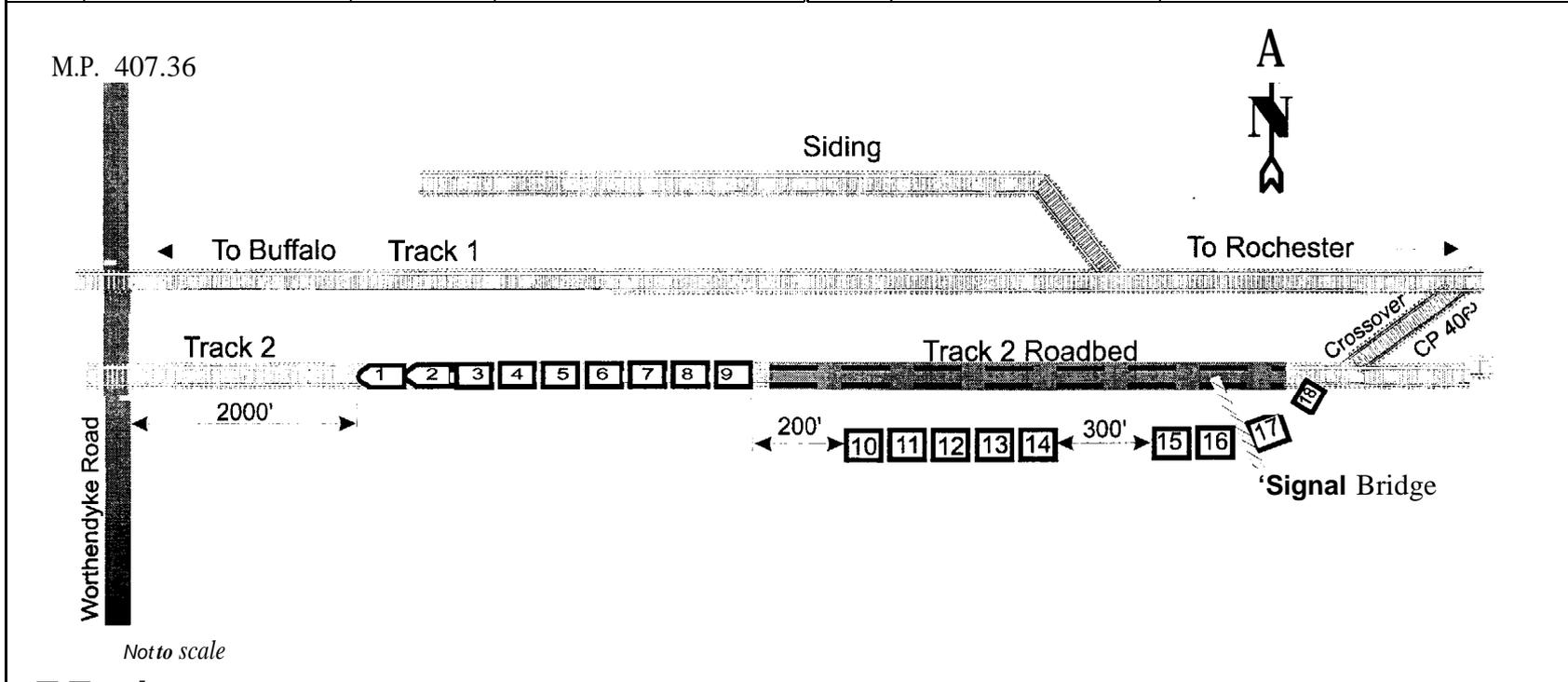


Figure 5 – Location of cars after accident.

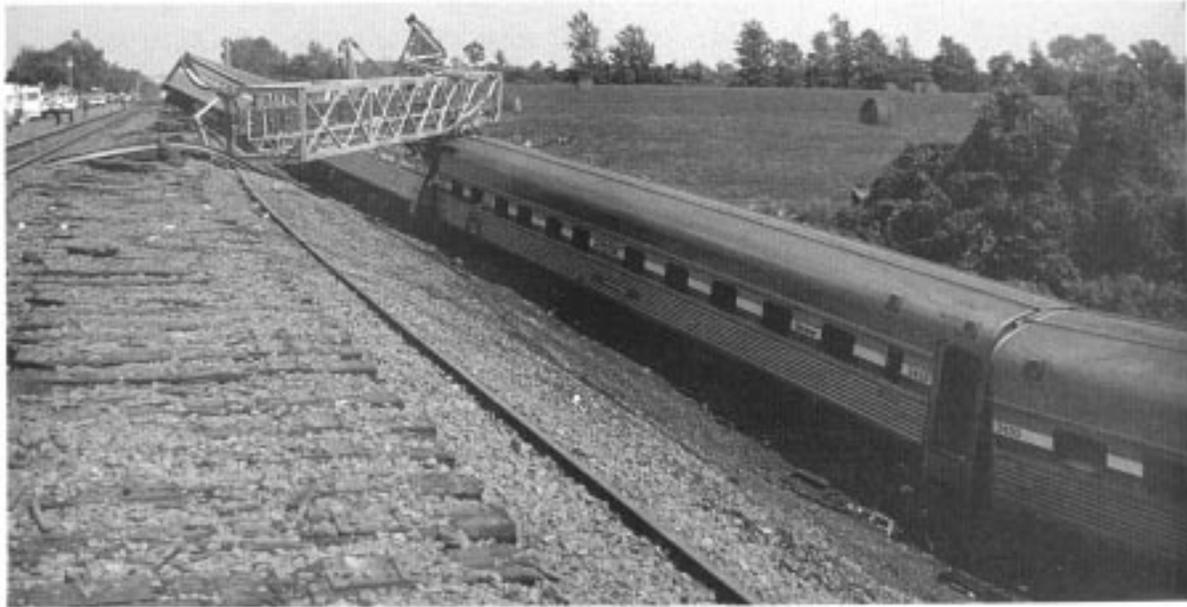


Figure 6 — Signal bridge.

Damages

Equipment	\$686,103
Track and Signals*	<u>130,169</u>
Total	\$816,272

*The south switch of the crossover and about 1,280 feet of main line track 2 were destroyed.

Personnel Information

The crew of train 49 consisted of an engineer, a conductor, 3 assistant conductors, and 14 on-board service crewmembers. The crew, except for the conductor, went on duty at Albany at 9:13 p.m. on August 2, 1994. The conductor went on duty at Schenectady, New York, at 9:30 p.m. the same day. A scheduled locomotive engineer change was made in Syracuse, New York, at 12:17 a.m. on August 3.

Each operating crewmember had been off duty for more than 8 hours

before boarding train 49 and, therefore, was in compliance with the Hours-of-Service Act. Each operating crewmember was qualified on the operating rules and the physical characteristics to operate trains over this territory. All crewmembers had been qualified by Amtrak. The engineer and conductor had attended operating rules and instruction classes on the Northeast Operating Rules Advisory Committee (NORAC) rules in 1993. The three assistant conductors had attended NORAC classes in 1994.

The track inspector, who was responsible for the inspection of the area that encompassed the derailment, had been qualified in accordance with 49 CFR 213.7 by Conrail. According to his statement, he had been a track foreman and had been inspecting track for almost 20 years. In the year he began inspecting track, he participated in a 4-week foreman training class. During the interim years, he had attended a 4-week

supervisory school, a 4-week foreman school, and a 1-week track inspection school.

Train Information

The Amtrak Lake Shore Limited was a consolidation of trains 449 and 49, which were combined at Albany for the trip to Chicago. Trains 449 and 49 had originated at the South Hampton Street Yard in Boston, Massachusetts, and at the Sunnyside Yard on Long Island, New York, respectively. Train 449 had consisted of the two locomotive units and the first seven cars of the Lake Shore Limited. These locomotives had their air brakes tested and inspected on the day before the derailment when still part of train 449. Train 49 had included the cars that became the last eight cars on the Lake Shore Limited. Mechanical personnel had tested and inspected the air brakes on August 2 at 5:50 a.m. When train 49 arrived at Albany, eight of its cars and dome car 9411 were added to the end of train 449 to form the consist of the Lake Shore Limited. After the two trains were combined, mechanical personnel, in accordance with 49 CFR 232.12(b), did a 1,000-mile inspection, and no defects were noted.

Operations

The accident track was a section of the Chicago line of the Albany division, which was governed by the signal indications of the traffic control signal system, supplemented by bulletins, timetable special instructions, NORAC operating rules, and radio communications. Conrail owned the track, and Amtrak had trackage rights to operate passenger trains over it. Over 45-million

gross tons of freight were transported on main line track 2 in 1993.

The train dispatcher for the Albany division was in Selkirk, New York, and operated the Chicago line territory remotely under a traffic control system. The trains were routed and controlled on the main tracks by automatic and control point signals. According to the timetable, train 49 was limited at Batavia to a speed of 79 mph. The engineer was operating the train under Amtrak *Air Brake and Train Handling Rules and Instructions* for passenger train operations.

Track and Signals

The accident track was designated as Federal Railroad Administration (FRA) class 5 track, and the maximum speed for a passenger train, under 49 CFR 213.9, was 90 mph. However, FRA regulations do not allow any train to operate at speeds greater than 80 mph unless the train is equipped with automatic cab signals or automatic train stop or train control systems. Since the Conrail Rochester to Buffalo main line was not equipped with either of the systems, the Conrail timetable limited passenger trains to a maximum speed of 79 mph. No other operational speed restrictions were in effect for main line track 2 on the day of the derailment.

The derailment areas had two main line tracks. Main line track 1 was north of main line track 2. The tracks, spaced 13 to 13.5 feet apart, ran from east to west. The numbering of the mileposts increased also from east to west. The track gradient between the initial point

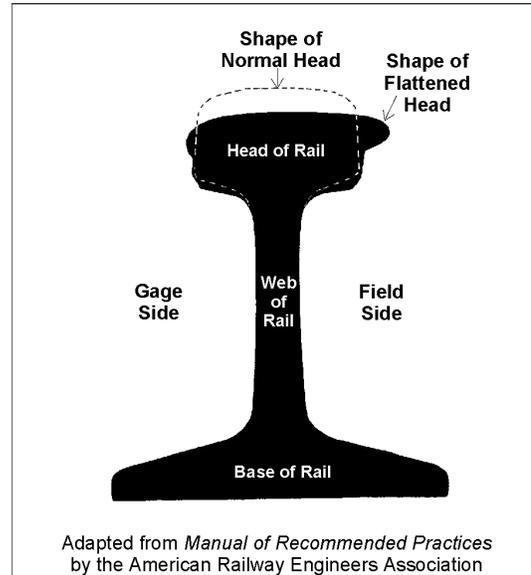
of derailment (POD), MP 403.7, and MP 405.1 was 0.25 percent ascending, followed by a 0.14-percent descending grade to the general POD at MP 406.7. The initial POD was in a 1° 0' curve to the right (westward) on main line track 2.

Main line track 2 was constructed of 140-pound RE (American Railroad Engineering Association), control cooled, continuous welded rail. Manufactured by United States Steel, it was classified as an “A” rail,² heat number CH D 27080A26, and installed new in 1977. The rail at the initial POD was fastened to wooden cross-ties with double shoulder tie plates (1:40 cant) with two plate-holding spikes and two rail-holding spikes per tie plate.

According to 49 CFR 213.233, class 5 track must be inspected twice a week. Between July 5 and the day before the accident, the Conrail track inspector had inspected the track between MPs 356 and 407 nine times from a high-rail vehicle. He had noted the following track defects: 24 bolt defects in joints, a missing frog bolt, a wide-gage location, and 2 cross level variations. Each defect was reported as being corrected the same

²“A” rails are rolled from the topmost portions of ingots cast from the open hearth steel-making process. During earlier times, railroads generally restricted the use of “A” rail to yard or side tracks because of a tendency for inclusions and impurities to congregate in the top of an ingot. Conrail had not restricted the placement of “A” rails because in 1977, when the subject rail was manufactured and installed, the clean steel-making processes were in use. During the last 5 years, newly manufactured “A” rails have disappeared entirely because rails are now manufactured using a continuous casting process.

day as noted, and not one of the noted defects was in the area of MP 403.7.



Adapted from *Manual of Recommended Practices* by the American Railway Engineers Association

Figure 7 — View of normal and flattened rail heads.

FRA track inspectors randomly accompany Conrail track inspectors to observe track inspections. An FRA track inspector had accompanied the Conrail track inspector, riding a high-rail vehicle, 9 days before the August 3 derailment. They found flattened rail head³ (see figure 7) at MP 403.7. The Conrail track inspector stated that they thought the flattened rail head might constitute a track geometry defect.⁴ After measuring the track for compliance with the track geometry requirements for class 5 track, the inspectors found that

³The head is the running surface of the rail; a flattened head is one that has acquired a depression.

⁴When an inspector finds a track defect, he must take, according to CFR 213.9, one of two immediate actions: either have the defect repaired or lower the track class number, thus lowering the maximum operating speed of a train.

the track met the standards, and no other exceptions were noted. They stopped at other areas without noting any defects.

Sperry Rail Service conducted an internal rail defect inspection for Conrail on June 27, 1994. No rail defects were noted in the initial POD area at MP 403.7.

Main line track 2 had its last track geometry test 2 months before the accident on June 6, 1994. One FRA reportable defect was noted between MPs 403 and 408. This defect at MP 405.72 consisted of a cross level variation (height level between two rails) of 1.37 inches on tangent track. The FRA allowable tolerance for class 5 track cross level variation is 1.0 inch. The defect was corrected on June 8, when a section of rail was replaced because of a flattened rail head.

The geometry test in the span between MPs 403 and 408 revealed five deviations from Conrail standards: four cross level variations (from 0.78 to 0.87 inch, with 0.75 inch as the threshold for class 5 variance) and one cross level variation in a spiral to the curve (0.68 inch, with 0.5 inch as the threshold for class 5 variance in a spiral). However, the deviations were not FRA defects. Conrail categorizes such deviations as level 1, which do not require immediate attention.

The most recent major maintenance projects were tie replacement from MPs 401.6 to 405.8, track surfacing between MPs 402.8 and 405.9, and rail grinding from MPs 382.0 to 435.8 on July 21 and 26 and September 13, 1993, respectively. No record of unscheduled maintenance

that was performed in the derailment area was reported.

Signal test records before the accident indicated no anomalies, and the system was functioning as intended. All required FRA signal tests were current and complete.

Rail Defects

Rail defects are addressed in the FRA track safety standards under 49 CFR 213.113. The standards identify such rail defects as transverse fissures, compound fissures, detail fractures, engine burns, damaged rails, defective welds, horizontal or vertical split heads, split web or web separations, and cracks or ordinary breaks. Inspectors find these defects by either visual or electronic inspection, and various remedial actions are prescribed to reduce the effect of a defect on the safety of train operations. The FRA track safety standards define damaged rail as rail that has sustained damage from one of three causes: a wreck; broken, flat, or unbalanced wheels; or slipping wheels. No definition addresses a flattened rail head.

Because a flattened rail is neither defined as nor considered a rail defect, no category was provided within the Conrail track inspector's form on which to record the findings of his inspection. The track inspector, according to his statement, had recorded observed flattened rail head conditions on the other side of his report forms as a reference for subsequent inspections. He said that he had first identified the flattened rail at MP 403.7 as engine burn since it did not fit any identified category.

The Sperry Rail Service Rail Defect Manual, used as a reference by railroad track departments, does not contain a definition of a flattened rail head. However, it states that a crushed rail head is a "flattening of several inches of the head usually accompanied by a crushing down of the metal, but with no cracking under the head." The origin is usually a soft spot in the steel of the head. The crushed rail head grows when heavy loads go over it, and the faster that the heavy load is traveling, the more the depth of the crushing increases. The manual goes on to state that a crushed head is not a serious defect, but is generally removed from high speed track because it can cause rough riding of equipment and concentrated load defects (rail fracture) may develop from impact.

Conrail has a program for replacing worn curve rail. The flattened rail near the initial POD was not considered to be worn rail and was not reported to the supervisor as part of this worn rail program.

Meteorological Information

At the time of the accident, the skies were cloudy, visibility was about 5 miles with some fog, winds were calm, temperature was about 69 °F, and dew point was 67 °F with 90 percent humidity.

Pathological, Medical, and Toxicological Information

No fatal injuries were sustained in the accident. The injured included 108 passengers and 10 crewmembers who were either treated at and released from or admitted to one of five local hospitals. The 93 people who were treated and

released from hospitals sustained bruises, abrasions, and small lacerations. The 25 passengers who were admitted sustained extremity and rib fractures, back injuries, internal injuries, and concussions.

FRA regulations required the operating crewmembers of train 49 to submit blood and urine specimens for toxicological testing; the test results were negative.

Survival Aspects

The Heritage class dome coach 9411 had seats that rotated and reclined (see figure 8), which differed from all the other seats in the train cars. Each back frame was attached to its pan frame by two 12-inch-long tapered metal braces. During the derailment, the pan frames remained attached to the pedestals, and the pedestals remained anchored to the floor tracks and sidewalls. However, 20 back frames, including the back cushions, separated from the pan frames, exposing the metal braces. (See figure 9.) No car occupants reported being injured by these braces.

Some passengers reported that they had no difficulty in evacuating the cars; others, however, said that the evacuation was difficult. Several passengers in the cars that had turned on their sides stated that they had trouble reaching the exposed side windows. Other passengers said that they could not open the heavy car-end doors. Darkness, the steep embankment, and the awkward position of the cars were other reasons attributed to a difficult evacuation.



Figure 8 — Interior view of dome coach 9411 after derailment.



Figure 9 — Exposed metal seat back braces.

Disaster Preparedness

The GCEMC initiated the Genesee County mass casualty incident plan for this accident. The plan was to provide guidelines for orderly and efficient response procedures to incidents that tax normal day-to-day response. The last disaster drill, according to the GCEMC, had been in September 1993 and simulated a hazardous material spill accident in which five fatalities and two injuries occurred at a rest stop on an interstate highway.

In October 1994 at the New York State Fire Academy, Amtrak presented to emergency response agencies its 3-hour training course, which includes how emergency responders should interact with Amtrak crewmembers, what emergency responders should know about Amtrak equipment, and how to evacuate Amtrak trains. Genesee County emergency response agencies participated in this training. In April and May 1995, Amtrak provided passenger cars for use in disaster drills in five communities near the site of the Batavia derailment.

Postaccident Tests

Rail Heads — The south rail was the high rail in the accident curve. The head of the south rail at the initial POD was flattened in several places (see figure 10), most significantly just to the east, where the head was flattened for a length of 38 inches for a maximum depth of 0.43 inch on the high side of the curve. (See figure 11.) At the same spot was a mark, which appeared to be a wheel flange (see figure 12) mark on top of the rail head, dropping off onto the crossties

and ballast and leading to the general POD. (See figure 13.)



Figure 10 — Flattened rail head at initial POD (looking east).

In the flattened rail head area, the top of the head had flowed outward (mushroomed) toward both the gage and field sides⁵ of the rail head, resulting in an increase in the width of the head and a low spot in the running surface. The head material spread a greater amount toward the field side of the rail (a maximum amount of more than 0.5 inch

⁵The gage side is between the running rails and is adjacent to the wheel flange. The field side is opposite the gage side.



Figure 11 — Flattened rail head after removal.

beyond the field side of the head) than toward the gage side (about 0.15 inch). The maximum width of the head in the flattened area, as measured in the Safety Board materials laboratory, was 3.695 inches. The typical maximum head width of the rail was about 2.815 inches. (The rail head width and height is 3.0 and 7.31 inches, respectively, for a new 140-pound RE rail section.) The following table lists the south rail field measurements from the initial POD to 15 feet 10 inches east of the POD:

Location	Rail Head Width (inches)	Rail Height (inches)
MP 403.7 (POD)	3.0	7.28
4 feet 6 inches east*	3.62	6.79
9 feet 0 inches east	3.0	7.13
11 feet 8 inches east	3.0	7.22
15 feet 10 inches east	3.0	7.26

Corresponds with center of flattened rail section.

The head of the south rail was also flattened in about 12 other locations east of the initial POD. One such location of flattened rail head was at MP 402.79, where the track alignment was in a 1028' curve. The flattened rail head was on the high side rail of the curve and appeared to be marked by a wheel flange. The following table lists the observed rail head measurements:

Location	Rail Head Width (inches)	Rail Height (inches)
mark on rail head	2.98	7.09
flattened head (maximum)	3.17	7.02

The Safety Board did track geometry measurements with the track in the loaded and static conditions. The cross level variation at the flattened rail head at the initial POD in the loaded condition was 1.125 inches. The maximum allowable deviation for class 5 track is 1 inch under 49 CFR 213.63.

Signals — Postaccident signal testing was completed on August 8, 1994, in accordance with FRA requirements. No exceptions were noted.

Material Handling Car 1500 — The first and second cars behind the locomotive consist were the empty MHC 1500 and the half-loaded MHC 1505, respectively. (The car weight light and with maximum cargo load is 76,700 and 177,000 pounds, respectively.) These cars were painted steel gray with Amtrak striping and logos.

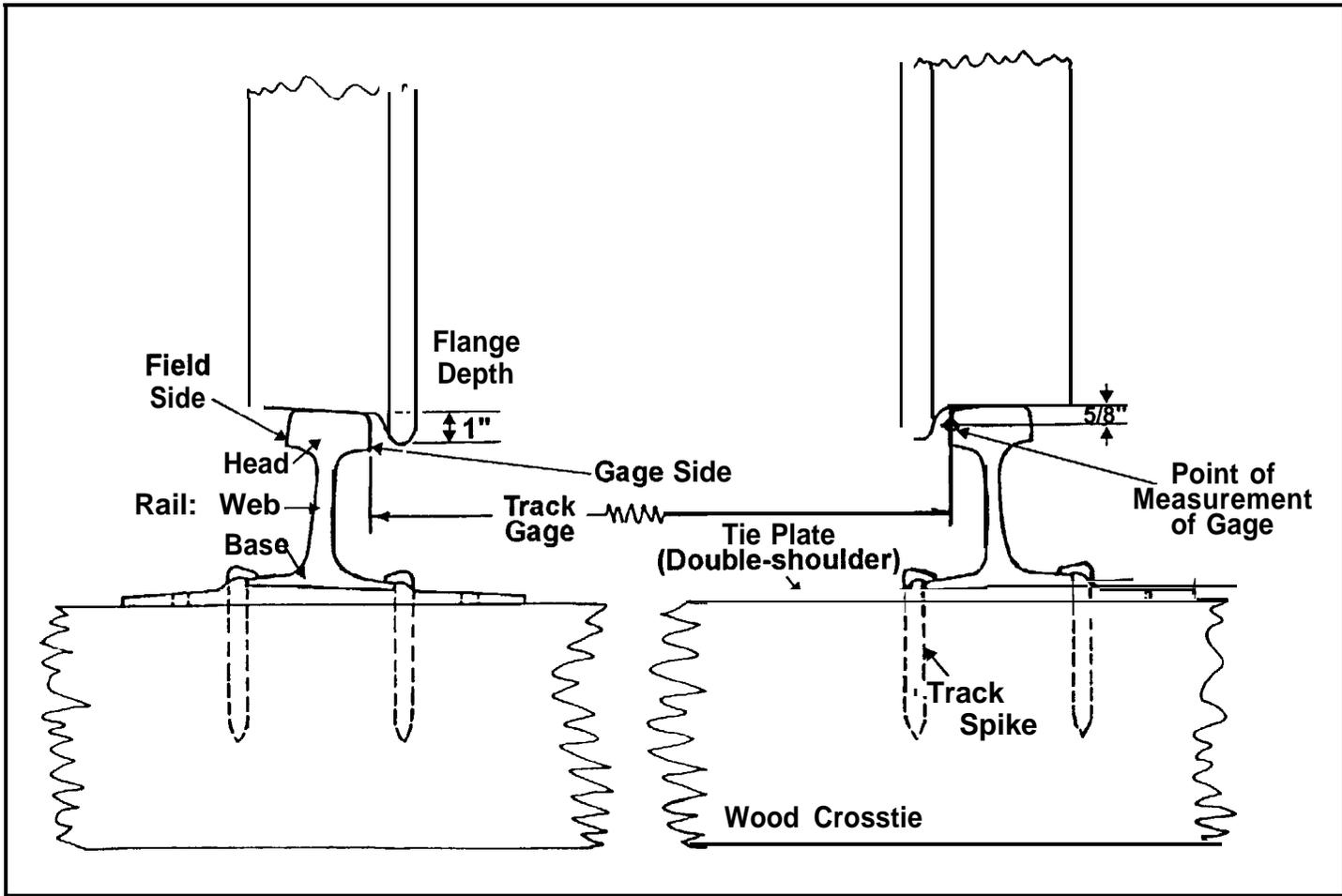


Figure 12 — Wheel/Rail interface.



Figure 13 — General derailment.

Amtrak had received 69 MHCs of the 1500-series, numbered 1500 to 1568, from Thrall Car Manufacturing Company in 1990. With a 50-ton capacity, the cars carry sealed mail and all manner of less-than-carload packages and printed material. (See appendix B for additional MHC characteristics.) MHCs have no end doors, batteries, or heating. They are designed to run with all Amtrak passenger equipment and are equipped with through cables for power and control to following passenger cars. The MHCs and their trucks are rated for a maximum operating speed of 110 mph. (See figures 14 and 15.)

Based on witness statements and the marks that led from the initial POD to the general POD, the Safety Board focused on the derailed MHC 1500, which had been the first car immediately behind the locomotive consist.

Both wheel sets of the B-end (lead)

truck of MHC 1500 derailed. The left outside equalizing beam between wheels 2 and 4 and the wheel 4 equalizer beam seat had come off, as well as the associated equalizer springs. The truck and associated loose parts were shipped from the derailment site to the Amtrak Rensselaer, New York, (near Albany) mechanical shop, where the Safety Board examined the truck on August 5, 1994. The B-end truck was later sent to the Amtrak Beach Grove facility in Indianapolis, Indiana, where the Safety Board continued the examination on October 13, 1994.

Back-to-back wheel measurements were taken on each wheel set at about equal distances around the circumference. The distance from the bottom of the brake disc to the top of the rail was measured. Each wheel was then removed, and its circumference was measured with a tape.

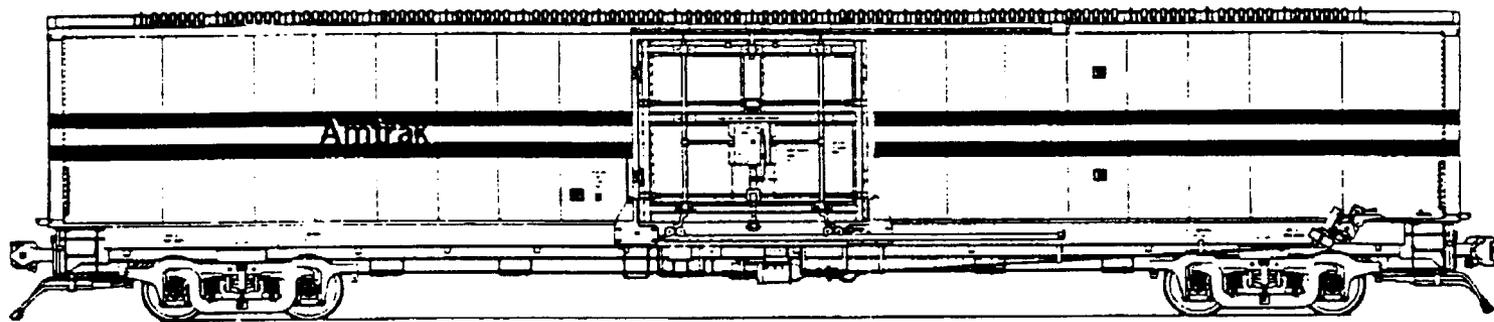
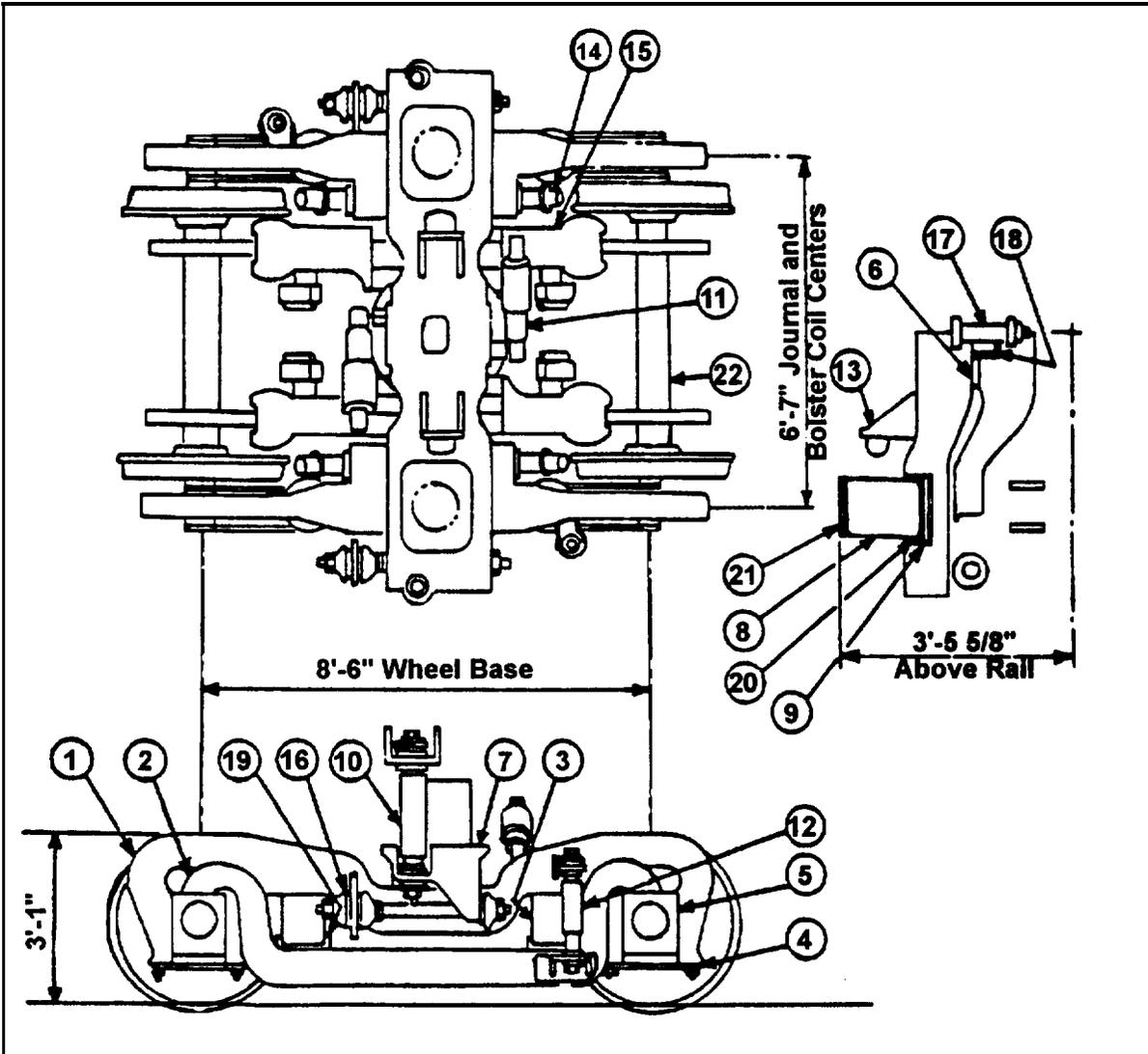


Figure 14 — Material handling car of 1500-series.



LEGEND

1	Truck Frame	12	Friction Snubber
2	Equalizer Beams	13	Lateral Bumper
3	Equalizer Springs	14	Package Tread Brake
4	Pedestal Tie Bar	15	Disc Brakes
5	Roller Bearing Adapter	16	Bolster Anchor Assembly
6	Central Bearing	17	Locking Center Pin
7	Truck Bolster	18	Vertical Wear Sleeve
8	Secondary Coil Springs	19	Equalizer Spring Seat
9	Rubber Sandwich	20	Bolster Spring Seat Assembly
10	Vertical Shock Absorber	21	Insulation Pad
11	Lateral Shock Absorber	22	Wheel and Axle Assembly

Figure 15 — Truck of material handling car 1500.

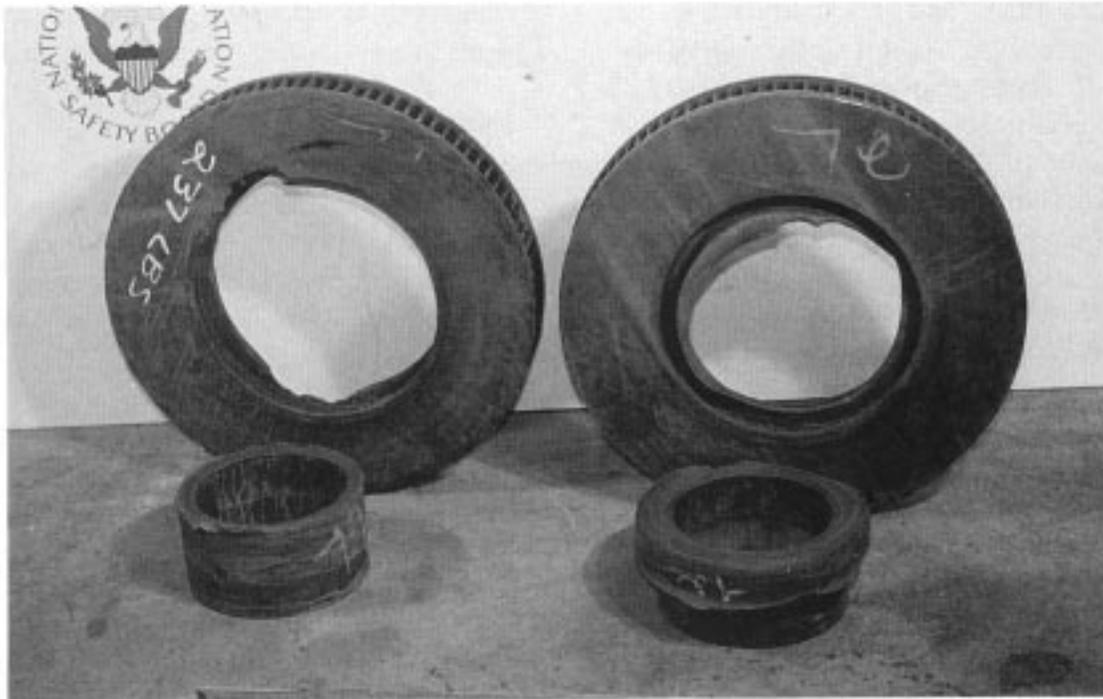


Figure 16 — Broken brake discs.

The truck frame was turned upside down for tram measurements.⁶ In all cases, the dimensions measured were within the manufacturers' allowable tolerances for the wheels and the trucks.

The brake disc rotors 1 and 3 were broken from their attachment housings. Some pieces of the rotor were unaccounted for. The broken discs were sent to the Safety Board materials laboratory for analysis. (See figure 16.)

The jaw spacing for the wheel axle and bearings was measured. The lateral spacing between pedestal jaw columns was also measured. All frame measurements of the truck met or were within the design tolerance specifications.

⁶Measuring diagonals to observe whether the frame is square.

Safety Board investigators noted no unusual wear or damage.

Dynamic Interaction between Material Handling Car 1500 and Rail Head — Three tests were conducted to emulate the interaction between MHC 1500 and the flattened rail head. For the first test, Amtrak contracted with an engineering consulting firm, which completed its last results on December 4, 1994. The firm used the computer modeling program "NUCARS," which was developed by the Association of American Railroads (AAR) to simulate the dynamics of newly designed rail cars. The second test was organized by the Safety Board and was conducted by the AAR. This computer simulation incorporated the used condition of MHC 1500 in the NUCARS computer modeling program and was completed in August 1995. The

final test was also organized by the Safety Board and was conducted by the Research and Test Department of the AAR Transportation Test Center (TTC) in Pueblo, Colorado, between November 7 and 10, 1995. This test physically replicated the dynamics of the flattened rail head being traversed by MHC 1500.⁷

According to the consulting firm, MHC 1500 lost vertical wheel load near the initial POD because of the flattened rail head. The narrowing of track gage due to flattened rail head resulted in an increase of lateral wheel forces. The firm concluded that these two factors in union would be sufficient to cause the derailment.

In addition, the consulting firm conducted simulations comparing the dynamic vehicle performance of an empty MHC 1500 at 70 mph with the following: an empty trailer-on-flat-car (TOFC) at 50 and 70 mph, a loaded TOFC at 50 and 70 mph, a loaded and an empty hopper at 50 mph, and an Amcoach car at 70 mph. The results were preliminary in nature; however, these results indicated that the empty MHC and the empty TOFC were more susceptible than the other cars to losing vertical wheel load when the flattened rail head was traversed.

In February 1995, a team of three TTC vehicle/track interaction dynamics engineers at the Amtrak Beech Grove shop facility inspected MHC 1500 to factor the condition of the car into the computer model. Amtrak and repre-

sentatives of the truck manufacturer were present while the team examined the car. MHC 1500 was not in the same condition as at the time of the derailment, and the trucks inspected were not the same trucks that were installed at the time of the derailment. The car had been released and returned for service. AAR in its initial report noted the following:

- The B-end left side bolster anchor rod was misadjusted, causing the bolster to rub on its keeper and to have a potential for vertical and lateral suspension binding.
- The car body leaned to the left.
- The bolster springs on both ends of the car had more shims on the right side of the car than on the left side.
- The B-end left side bearing gap was almost completely closed up and showed signs of frequent rubbing between the bolster and truck frame. Wear surfaces at the other three side bearings showed little signs of rubbing.
- Fatigue cracks were developing where some of the secondary vertical suspension friction dampers were mounted to the side sill. This condition might be a sign of binding in the dampers causing excess force transmission into the body.
- Several axle journal boxes were binding in the truck frame pedestal jaws.
- The B-end bolster was offset to the right so that the right side lateral stop was almost in contact and showed signs

⁷The second and third tests were conducted in partnership with Amtrak, Conrail, the AAR, and the FRA.

of frequent rubbing. The left side stop showed no sign of contact or rubbing.

- The wheel profile measurements from the derailed axles showed a ridge in the gage corner of both wheels of the second axle.

Amtrak and the truck manufacturer considered the conditions noted by the TTC team to be still within design tolerances. The car had been in service successfully for some months after the accident.

The AAR, in participation with the Safety Board and the parties to the investigation, oversaw additional computer modeling in August 1995. The TTC initial computer modeling verified to a great extent the Amtrak consulting firm's results; however, the TTC did not agree with all of the conclusions. The Amtrak consultant concluded that the lateral wheel force was sufficient to cause derailment, but the TTC believed that the lateral force predicted was not sufficient to cause flange climb. The TTC thought that an extreme component failure, such as the truck failing to rotate for the curve, would be necessary to cause a derailment. An actual field test was proposed to determine whether the AAR NUCARS model reasonably predicted the actual on-track performance of MHC 1500. Therefore, the TTC installed the accident rail in its own test tracks and secured MHC 1500 to replicate the dynamics of the accident. Then, the TTC conducted the following tests between November 7 and 10, 1995:

- Twist and Roll: The TTC measured the suspension dynamics of the test car over known track perturbations and

compared the results with the computer model parameters.

- Steady State Curving: The TTC measured truck rotations and other dynamic characteristics of MHC 1500 in a 7.5- and 5-degree curve.
- Flattened Rail Head: The TTC measured the response of MHC 1500 over the flattened rail from the accident site.
- Balloon Track: The TTC measured truck rotations and other dynamic characteristics of the car on the curved track.

These test results correlated relatively well with the NUCARS simulations.

During flattened rail head tests, minor wheel unloading occurred at 50 mph in the lead axle, and a more pronounced wheel unloading occurred at 55 mph. The trailing axle wheel seemed in the video to be unloaded, but the computer data indicated a positive vertical force in the downward direction. Further calculations revealed that the maximum unloading occurred approximately 4 to 4.5 feet from the flattened rail, corresponding with the Safety Board POD measurement in Batavia. At that point, the contact position sensor indicated that the wheel flange was forced away from the rail. The tests were terminated at 55 mph.

The AAR engineer suggested that the rail "fell away" from the wheel because of the inertia of the wheel and suspension, and when it came back in contact with the wheel, it caused a

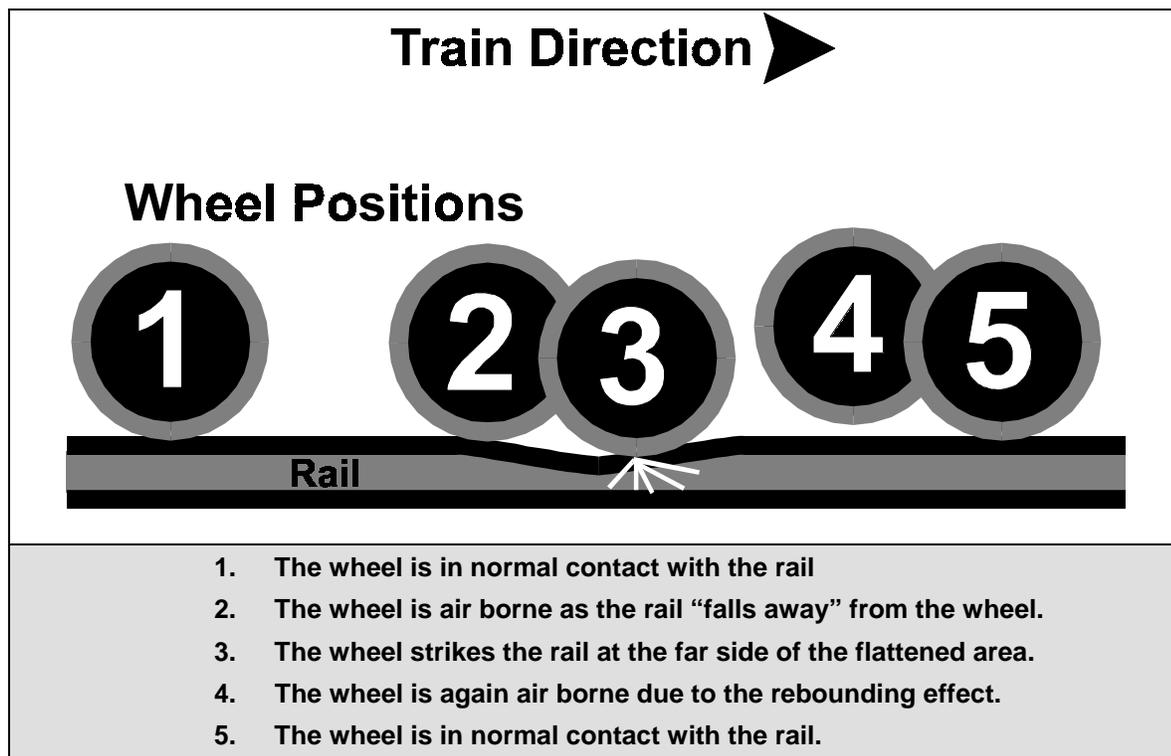


Figure 17 — Movement of wheel on flattened rail head.

relatively large vertical force that created a "bouncing" effect. Figure 17 illustrates the sequence.

The AAR engineer had noticed in his inspection of MHC 1500 that the car body leaned to the left. A leaning car body can decrease side bearing clearance and cause increased turning friction in the truck as it attempts to steer through a curve. To simulate this condition at the test track, a shim was welded onto the side bearing on the low-rail side. The resulting side bearing clearance⁸ on the modified truck was

⁸A side bearing is intended to control the roll dynamics of the car. Side bearing clearance allows the truck of a rail car to swivel freely to adjust to changes in the rail. Absence of side bearing clearance increases friction force in the

approximately zero, which creates more friction in the side bearing and makes it more difficult for the truck to turn.

The results of the tests with the trucks shimmed closely corresponded with the results of the test without the shims. The data from the second set of tests showed greater wheel unloading and a greater total moment around the center pin. The trucks, however, did not lock.

During the second set of tests, at 60 mph, the video image of the trailing axle showed the flange riding on the gage corner of the rail. The tests were terminated at this time because snow

side bearing and decreases the ability of the truck to swivel.

began falling, which changed the friction coefficients between rail and wheel.

Metallurgical — The Safety Board materials laboratory examined the flattened area and the adjacent section of the rail before the TTC tests were conducted. An ultrasonic test of the rail showed no identifiable internal defects.

After the TTC tests were performed, the materials laboratory examined two additional sections of the rail. One section was from the center of the flattened area, and the other, without flattening, was from an area near the first section. The shape of the base and web of the rail on both sections appeared to closely conform with the specified shape of a new 140-pound RE rail. However, the section without flattening contained wear to the gage side and to the top of the head, and the section from the center of the flattened area was shown to have substantial deformation, as previously documented. Figure 7 shows an approximate outline of the shape of a new 140-

pound RE rail superimposed on the head of the flattened rail section. Most of the lateral deformation of the rail, as indicated in this figure, was toward the field side. Also, more vertical (downward) deformation was on the field side of the head than on the gage side.

Approximately 60 hardness measurements were taken on a grid pattern throughout the head portion of each rail section. These measurements generally ranged from 60 to 64 HRA (about 223 to 262 Brinell). Within about 0.375 inch of the head surface of the section from the flattened area, the hardness was higher, up to a maximum measured value of 69.6 HRA (345 Brinell). A thinner layer of increased hardness was also noted adjacent to the head on the other section, up to a maximum hardness of 66.6 HRA (304 Brinell). Standard rail manufactured in the 1970s has a typical hardness of 250 Brinell.

ANALYSIS

General

The investigation by the Safety Board determined that the members of the operating crew of train 49 were qualified for their duties and were operating the train properly. The crewmembers were rested in accordance with applicable regulations, and the on-board service crewmembers performed their duties correctly.

The signal system had been recently inspected, and preaccident tests had not revealed any defects. The signal event recorder indicated that the signal system had been interrupted at 03:43:58 a.m., when the train derailed and struck the supporting structure of the signal bridge. The investigation by the Safety Board determined that the signal system had no deficiencies, had functioned as intended at the time of the derailment, and had been clearly visible to the train crew. Train 49 was operating on a clear signal indication as intended. In addition, the weather did not affect the visibility of the signal aspects and was not a factor in the derailment.

Therefore, the Safety Board concludes that the operation of train 49, the performance of the operating and on-board service crews, the signal system, and the weather were not factors in the derailment.

The 118 injured passengers and crewmembers were removed from the derailment site within 1 hour 16 minutes.

All severely injured people were given priority attention. Therefore, the Safety Board concludes that the local emergency response personnel reacted promptly and acted effectively at the derailment site.

Accident

The track structure between the initial and general PODs was marked by the flange of a wheel, indicating that at least one car was derailed. Other marks were also found near other flattened rail before the initial POD, indicating that wheel lift or some degree of dynamic instability between the track and a train car may have occurred. To correlate the marks with a particular car or with the Amtrak train as a whole, however, was not possible. The Safety Board also determined that neither the equipment nor the track deviated from the FRA and design specifications. The investigation, therefore, focused on the interaction between the flattened rail head at the initial POD, MP 403.7, and MHC 1500.

Rail Structure

The determination that the initial POD was at MP 403.7 was based on the two wheel flange marks on the gage side of the rail head that began about 22 feet east of the POD and continued westward on the rail head for about 34.8 feet before leading to the field side. The marks indicate that at this point, the

wheel dropped off the rail and struck the tie plates 42.4 feet later. The same marks continued for about 3 miles until they reached the general POD at MP 406.7.

The rail head was flattened for approximately 38 inches, starting about 4.6 feet east of the POD, and the depression was 0.43 inch at its deepest point. The Safety Board concentrated its investigation on this depression and the series of other flattened rail heads and wheel/flange marks east of the initial POD to determine what part, if any, the rail and track structure had in the accident.

Wheel and Rail Dynamics

The TTC of the AAR replicated the wheel/rail dynamics between MHC 1500 and a segment of the flattened rail removed from the accident track. These tests were electronically monitored for vertical/horizontal loads and real-time video recording of the wheel/rail interface at various speeds. The TTC installed the flattened rail in its high speed test track in a 0' 50" curve.

Safety Board investigators observed the video monitor showing the wheel/rail interface at various running speeds with MHC 1500 in a nominally modified condition, as well as in its increased side bearing friction condition. Investigators noted that when the car was traveling between 55 and 60 mph, a space was between the trailing wheel of the lead truck and the rail surface when the car went over the depression. The wheel then dropped to the rail surface and rebounded for a short time before returning to the running surface of the rail. The contact position sensors of the

instrumented wheels indicated that a flange had been in contact with the rail for between 2 and 2.5 feet at the flattened rail head. The sensors also showed that the flange had had two very brief periods of rail contact in the 10 feet past the flattened rail head. The sensors, thus, validated the importance of the marks that the Safety Board had noted on the gage face of the rail after the testing. What the investigators saw on the video monitor was generally consistent with what the Safety Board had found at the initial POD and with the results of the computer simulations performed by Amtrak and the AAR.

In addition, the Safety Board found an area further east of the initial POD where the rail head was flattened and the running surface was marked by a wheel flange. The rail head was not flattened as severely as it was at the POD; but it still evidenced wheel lift.

Safety Board investigators analyzed all of the evidence available in this derailment. The results of the various computer simulations and field tests do not conclusively predict that a flange climb derailment would take place at the POD that was identified at the accident scene. However, the test results do indicate that extreme wheel unloading and flange contact was at the flattened rail just before the POD, which are two conditions that must be present for a flange climb derailment to occur. Therefore, the Safety Board concludes that the simulations and field tests corroborate the location of the initial POD and confirm that the flattened rail head allowed the wheel to lose contact with the rail.

Track and Rail Inspection

Title 49 CFR 213.233 required that main line track 2 be inspected twice weekly. The Safety Board investigation determined that two inspections of the track in the Batavia area had been done by the Conrail track inspector within the 6 days before the derailment. On July 29, 1994, the Conrail track inspector performed his last inspection of the track before the August 3 derailment and noted no exceptions on his inspection report.

The FRA randomly assigned an inspector to observe the Conrail track inspector's practices during an inspection. On July 25, 1994, during a routine joint track inspection, an FRA track inspector and the Conrail track inspector rode together on a high-rail vehicle. The inspectors stopped at several locations, including the section of track near MP 403.7. They found the flattened rail condition at what was to become the initial POD. They examined the rails at that location and found the condition to be within track geometry specifications.

The Safety Board investigation determined that both the carrier and the FRA inspectors were experienced and had knowledge of the existing standards for track defects. The Safety Board, therefore, concludes that the track inspections were being performed as intended by the carrier and by the FRA and that the flattened rail condition at MP 403.7 had been detected before the derailment occurred.

Under FRA track safety standards a flattened rail head is neither defined as nor considered a rail defect. The Conrail

track inspector had recorded the observed flattened rail head on the other side of his report forms because no category was provided within the form to record these observations. He used this record as a reference for subsequent inspections. As he told Safety Board investigators, he had first identified the flattened rail at MP 403.7 as engine burn since it did not fit any identification category. Because flattened rail head was not defined as or considered an FRA rail defect and because the industry had no identification for flattened rail head, the FRA and Conrail track inspectors, when they noted the flattened rail condition during their joint inspection, had no guidance to follow for a potentially dangerous situation. The Safety Board concludes that the FRA has not provided the guidance on what size or type of flattened rail head is potentially hazardous to train operations that would allow track inspectors to take corrective action. Consequently, the inspectors could only examine the area of the flattened rail head for a track gage or cross level violation of the track geometry standards. The Safety Board, therefore, concludes that the flattened rail head at the initial POD was not considered a defect because it did not meet the definition of an existing rail defect and the track geometry did not meet defect specifications.

During the postaccident investigation, the cross level variation of the track at the center of the flattened rail head near the initial POD was 1.125 inches, which would have been considered a track geometry defect requiring repair or the reclassification of the track to FRA class 4. Had the track been repaired by leveling the geometry defect, the

flattened rail condition would have remained in the track. The flattened rail still being in the track would have caused the geometry to vary again from the wheel pounding over the rail irregularity and would have caused a potential for wheel lift. Had the track been reclassified, the maximum speed for a passenger train on the track would have been lowered to 80 mph. Nevertheless, the speed of train 49 would not have been affected because the train was governed by the Conrail maximum allowable timetable speed of 79 mph for passenger trains. Consequently, the Safety Board concludes that the track geometry defect found after the derailment at the initial POD was not a contributing factor in the derailment.

Flattened Rail Definition Standards

The Conrail division engineer who after the accident had accumulated data about flattened rail estimated that 30.72 miles of the 300 miles of rail between Selkirk (near Albany) and Bay View, New York, (near Buffalo, New York) is “A” rail, which is the type of rail that seems to be subject to flattening.

The flattened rail head found in this accident is not unique to Conrail. The AAR examined rail in 1994 from the Chicago & North Western (CNW) and from the Canadian National (CN) railroads that exhibited physical and chemical properties that were similar to the properties of the flattened rail head from the Batavia derailment. These rails were manufactured in the 1970s; the CNW rail was an “A” rail. (A CNW and CN review of other rails suggested “A”

rails were more likely to have this flattened head condition.) Rolling load tests on the CN rail, performed by the AAR, disclosed that after 2 million cycles of impact simulation, no internal fatigue defects developed. The AAR concluded that these flattened rail conditions tended not to be structurally destructive. As a remedy for the rail condition, the CNW placed a speed restriction on its track, and the CN attempted to weld and grind the affected areas. The industry, however, has not determined the best long-term remedial action.

The chief engineer of Conrail, who also was the president of the American Railway Engineering Association,¹ told the Safety Board that flattened rail heads had not been discussed to any extent with other railroads, other than being reported on at various committees, with the CNW experience being the predominant incident.

The Safety Board is concerned about the incidents of flattened rail on Conrail, CNW, and CN tracks because they indicate that this condition may occur elsewhere and, thus, threaten the safety of train operations. The Safety Board recognizes that some time would be required to collect and analyze data to ascertain the cause of flattened rail and the extent of the potential hazard. Safety-enhancing steps, however, could be

¹ The engineering body of the North American railroad industry, which presents a forum for discussion and development of standards of recommended practices for railroad maintenance and design. Its members are railroad engineers and other qualified individuals who serve on various organization committees.

taken in the interim. The FRA could issue technical bulletins for its inspectors that provide them with an interim aide in determining the hazard posed by flattened rail conditions. A bulletin could explain the circumstances of this accident and offer guidelines based on such information as the speed and type of a train and its operating area. Therefore, the Safety Board believes that the FRA should develop, not later than December 31, 1996, an interim technical bulletin authorizing track inspectors to take corrective action to prevent the potential hazard of flattened rail head conditions to train operations.

The Conrail division engineer accumulated data on removed flattened rail to determine whether he could establish any correlation between the likelihood of rail being flattened and its weight, curvature, or classification. He found that "A" rails had the highest percentage of flattening, with the highest number of occurrences in curves of 1 degree or less. (The flattened rail head in this accident was no exception to his findings; the "A" rail was in a 1-degree curve.)

The Safety Board materials laboratory did not find any metallurgical defects in the flattened rail head from the POD. Although the reason for the flattening cannot be conclusively determined, the rail seemed to have much in common with other rail that has developed flattened rail head: it was an "A" rail manufactured in the 1970s that had been heavily used in terms of tonnage and high axle loads. Additional research is

needed on flattened rail head to determine the type of rail that is likely to flatten, the conditions that will cause it to flatten, and the risk posed by the flattening. The Safety Board believes that the FRA should conduct appropriate research and develop a data base that can be used to assess the risk posed by flattened rail heads. In addition, the Safety Board believes that the AAR and the American Short Line Railroad Association, in conjunction, should assist the FRA in developing the data base.

As a result of the Safety Board's investigation, Conrail devised a working definition of flattened rail head when considering flattened rail replacement. Conrail defined it as rail head that has a depression that is at least 12 inches long and 0.25 inch deep. The chief engineer stated that this definition is arbitrary and had been chosen as a starting point. The definition would be more valuable if it were based on an understanding of the correlation between risk and degree of flattening. However, both the FRA and the industry lack the necessary data. The Safety Board concludes that the FRA track safety standards fail to address flattened rail head condition risks such as found in this accident. Therefore, the Safety Board believes that the FRA should develop guidelines, using the data compiled about the risk of flattened rail heads, for track inspectors to use to identify rail head that may be hazardous to train operations and also regulations to ensure that corrective action is taken when such flattened rail head conditions have been identified.

Rail and Material Handling Car 1500 Dynamics

The TTC as part of its on-track simulation tests of the dynamic interaction between the track and MHC 1500 noted several irregularities; however, none were serious enough to be considered defects. The irregularities indicated normal wear and tear, and they were used to devise a more accurate representation of the car for the computer simulation. MHC 1500 had been repaired and released back into service up to that time. However, these anomalous conditions had not been previously reported and might have been of some significance to the performance of the car in its dynamic interaction with the rail.

The detailed inspection of the car by the Safety Board, both at the site of the accident and at the Amtrak shop before the car was repaired, did not reveal any conditions that either caused or contributed to the accident. On October 13, 1994, the trucks were disassembled and measured at the Amtrak Beech Grove shop, and the car truck frames and parts were found to be within specification.

During testing at the TTC, a 0.025-inch shim was tack welded into the lead left side bearing gap, completely filling the gap. As a consequence, some of the weight of the car shifted from the center bowl to the side bearing, causing a friction increase when the trucks slewed. The attempt to modify the behavior of the car during the dynamic testing at the TTC had no significant effect on the performance of the car.

MHC 1500 had no history of performance, maintenance, or repair problems, either before or after the accident, and the car had accumulated about 200,000 miles annually without incident. Consequently, the Safety Board concludes that even though the rail in the flattened area met FRA requirements when inspected before the accident and MHC 1500 had no design deficiencies, the dynamic interaction of the car with the flattened rail head initiated the derailment sequence.

The analysis of the engineering consulting firm contracted by Amtrak indicated that lightly loaded or shorter wheel base cars, such as MHCs or empty TOFCs, have a greater tendency to initiate wheel lift as they transverse over flattened rail head than do longer wheel base or heavier cars. Flattened rail may be a hazard to all trains and could cause cars in both freight and passenger trains to derail.

The materials laboratory of the Safety Board examined both broken brake discs from MHC 1500. Not all of the fracture surface could be examined because some of the fracture surface was obliterated and other pieces of the fracture surface were missing. The remaining material on both discs exhibited typical features of overstress separations. No indications of preexisting cracks were in any of the pieces examined.

Investigators examined the truck, brake cylinders, and brake calipers for any indication of strike damage from a loose brake disc. No marks were found on these components that would be consistent with a loose brake disc. Thus, no evidence was found to support the

theory of a broken brake disc occurring before the accident. The Safety Board, therefore, concludes that the brake discs of MHC 1500 broke as a result of the forces of derailment and were not causal to the derailment.

Survival Aspects

No occupant of the Heritage dome car reported being injured by the 12-inch-long metal seat back braces that were

exposed when the frames of the car seats separated. The Safety Board concludes, however, that these exposed metal seat back braces in dome coach car 9411 were a potential hazard for passengers when that car overturned. Therefore, the Safety Board believes that Amtrak should install, in all Heritage coach dome cars in its possession, a positive locking feature that will prevent the separation of the car seat backs from the seat back braces.

CONCLUSIONS

1. The operation of train 49, the performance of the operating and on-board service crews, the signal system, and the weather were not factors in the derailment.
2. The local emergency response personnel reacted promptly and acted effectively at the derailment site.
3. The simulations and field tests corroborate the location of the initial point of derailment and confirm that the flattened rail head allowed the wheel to lose contact with the rail.
4. The track inspections were being performed as intended by the carrier and by the Federal Railroad Administration, and the flattened rail condition at milepost 403.7 had been detected before the derailment occurred.
5. The FRA has not provided the guidance on what size or type of flattened rail head is potentially hazardous to train operations that would allow track inspectors to take corrective action.
6. The flattened rail head at the initial point of derailment was not considered a defect because it did not meet the definition of an existing rail defect and the track geometry did not meet defect specifications.
7. The track geometry defect found after the derailment at the initial point of derailment was not a contributing factor in the derailment.
8. The Federal Railroad Administration track safety standards fail to address flattened rail head condition risks, such as found in this accident.
9. The rail in the flattened area met the Federal Railroad Administration requirements when inspected before the accident, and material handling car 1500 had no design deficiencies.
10. The derailment occurred because of the dynamic interaction of material handling car 1500 and the flattened rail head.

11. The brake discs of material handling car 1500 broke as a result of the forces of derailment and were not causal to the derailment.

12. The exposed metal seat back braces in dome coach car 9411 were a potential hazard for passengers when that car overturned.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the derailment was the fact that Federal and industry guidelines do not

currently address flattened rail head conditions, due to an insufficient understanding of the risk that flattened rail poses to train operations.

RECOMMENDATIONS

As a result of its investigation, the National Transportation Safety Board makes the following recommendations:

--to the Federal Railroad Administration:

Develop not later than December 31, 1996, an interim technical bulletin authorizing track inspectors to take corrective action to prevent the potential hazard of flattened rail head conditions to train operations. (Class II, Priority Action)(R-96-12)

Conduct appropriate research and develop a data base that can be used to assess the risk posed by flattened rail heads. (Class II, Priority Action)(R-96-13)

Develop guidelines, using the data compiled about the risk of flattened rail heads, for track inspectors to use in identifying rail head that may be hazardous to train operations and also regulations to ensure that corrective action is taken when such flattened rail head conditions have been identified. (Class II, Priority Action)(R-96-14)

--to the National Railroad Passenger Corporation:

Install, in all Heritage coach dome cars in its possession, a positive locking feature that will prevent the separation of the car seat backs from the seat back braces. (Class II, Priority Action)(R-96-15)

--to the Association of American Railroads:

Inform its membership of the circumstances of this accident. (Class II, Priority Action)(R-96-16)

Assist the Federal Railroad Administration, in conjunction with the American Short Line Railroad Association, in developing

a data base that can be used to assess the risk posed by flattened rail heads. (Class II, Priority Action)(R-96-17)

--to the American Short Line Railroad Association:

Inform its membership of the circumstances of this accident. (Class II, Priority Action)(R-96-18)

Assist the Federal Railroad Administration, in conjunction with the Association of American Railroads, in developing a data base that can be used to assess the risk posed by flattened rail heads. (Class II, Priority Action)(R-96-19)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES E. HALL
Chairman

ROBERT T. FRANCIS II
Vice Chairman

JOHN A. HAMMERSCHMIDT
Member

JOHN J. GOGLIA
Member

GEORGE W. BLACK, JR.
Member

July 11, 1996

APPENDIX A

Investigation and Hearing

The National Transportation Safety Board was notified at 5:21 a.m. on August 3, 1994, of the derailment of Amtrak (National Railroad Passenger Corporation) train 49, the Lake Shore Limited, on Conrail (Consolidated Rail Corporation) trackage near Batavia, New York. The investigator-in-charge and other members of the Safety Board investigative team were dispatched from the headquarters in Washington, DC. Investigative groups studied operations, track, signals, mechanical, survival factors, and human performance.

The Association of American Railroads, Brotherhood of Locomotive Engineers, Consolidated Rail Corporation, National Railroad Passenger Corporation, New York State Department of Transportation, and U.S. Department of Transportation Federal Railroad Administration assisted in the Safety Board investigation.

Safety Board staff conducted a deposition hearing as part of its investigation on December 14, 1995, at which six witnesses testified.

APPENDIX B

Material Handling Car Characteristics

The following are the general characteristics of an MHC:

Length between Pulling Face of Coupler	64 feet 03.50 inches
Maximum Width over Grab Irons	8 feet 10.25 inches
Maximum Height	13 feet 06.25 inches
Distance between Truck Centers	41 feet 03.00 inches
Truck Wheel base	8 feet 06.00 inches
Distance Centerline of Trucks to Coupler	11 feet 06.25 inches
Car Construction Material	carbon steel
Minimum Turning Radii	250 feet (22.7 degrees)
Coupler Type	H tightlock
Draft Gear	dresser type WM-6-DPB
Wheel Size and Type	36-inch diameter class B

APPENDIX C

Acronyms Used in this Publication

AAR	Association of American Railroads
Amtrak	National Railroad Passenger Corporation
Conrail	Consolidated Rail Corporation
CN	Canadian National Railroad
CNW	Chicago & North Western Railroad
FRA	Federal Railroad Administration
GCECC	Genessee Country Emergency Communication Center
GCEMC	Genessee County Emergency Management Coordinator
MHC	material handling car
MP	milepost
NORAC	Northeast Operating Rules Advisory Committee
NYS	New York State
POD	point of derailment
TOFC	trailer on flat car
TTC	Transportation Test Center