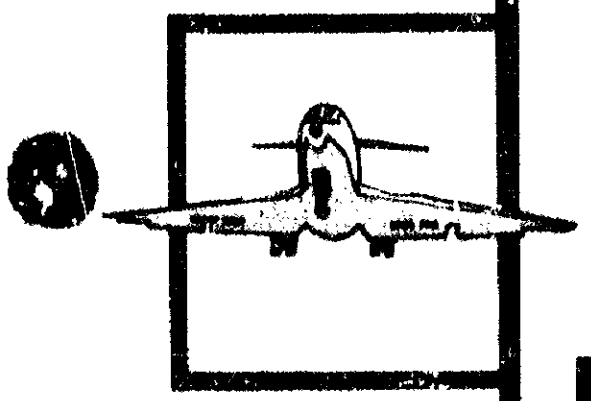
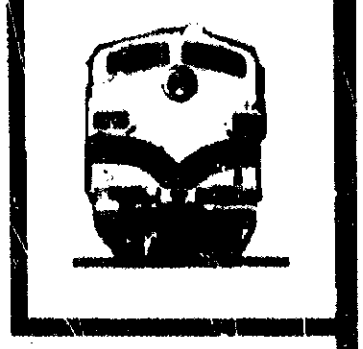
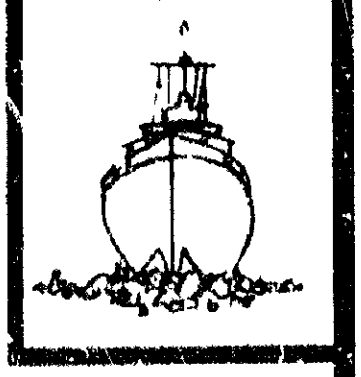
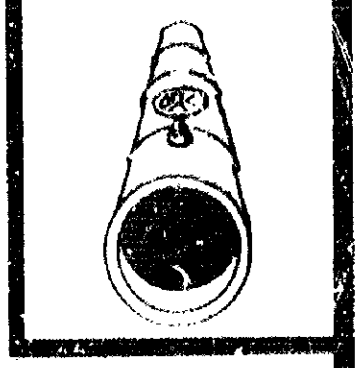








NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

DERAILMENT OF AMTRAK TRAIN ON LOUISVILLE AND NASHVILLE RAILROAD

NEW CASTLE, ALABAMA

JANUARY 16, 1977

REPORT NUMBER: NTSB-RAR-77-9

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB-RAR-77-9	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Railroad Accident Report - Derailment of Amtrak Train on Louisville and Nashville Railroad, New Castle, Alabama, January 16, 1977		5. Report Date October 20, 1977 6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 1984C 11. Contract or Grant No. 13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

About 4:15 a.m., on January 16, 1977, 1 locomotive unit and 12 cars of Amtrak train No. 315 derailed on the Louisville and Nashville Railroad Company's track near New Castle, Alabama. Seventy-six of the 129 persons on board the train were injured. Property and equipment damage was estimated to be $578,000.

The National Transportation Safety Board determines that the probable cause of this accident was the tipping of the east rail which caused the track gage to widen. The gage widened because the track structure was not able to withstand the lateral forces generated by oscillations of the locomotive trucks as the train moved around a 5° curve. The oscillations were generated by variations in track alignment and superelevation that complied with Federal Track Safety Standards for Class 3 track and by the ineffectiveness of a vertical snubbing device on the second locomotive unit.

As a result of the investigation of the accident, the National Transportation Safety Board submitted two recommendations to the Federal Railroad Administration regarding operation of SDP-40-F locomotives, and one recommendation to the National Railroad Passenger Corporation.

17. Key Words Amtrak; derailment; track alignment; track gage; superelevation; equilibrium speed; lateral/vertical ratio.		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 19	22. Price A02-A01

NTSB Form 1765.2 (Rev. 9/74)

CONTENTS

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

Adopted: October 20, 1977

DERAILMENT OF AMTRAK TRAIN ON LOUISVILLE AND NASHVILLE RAILROAD NEW CASTLE, ALABAMA JANUARY 16, 1977

SYNOPSIS

About 4:15 a.m., on January 16, 1977, 1 locomotive unit and 12 cars of Amtrak train No. 315 derailed on the Louisville and Nashville Railroad Company's track near New Castle, Alabama. Seventy-six of the 129 persons on board the train were injured. Property and equipment damage was estimated to be $578,000.

The National Transportation Safety Board determines that the probable cause of this accident was the tipping of the east rail which caused the track gage to widen. The gage widened because the track structure was not able to withstand the lateral forces generated by oscillations of the locomotive trucks as the train moved around a 5° curve. The oscillations were generated by variations in track alignment and superelevation that complied with Federal Track Safety Standards for Class 3 track and by the ineffectiveness of a vertical snubbing device on the second locomotive unit.

INVESTIGATION

The Accident

At 12:29 a.m., on January 16, 1977, southbound Amtrak train No. 315 departed Nashville, Tennessee, for Wildwood, Florida, with a consist of 2 SDP-40-F locomotive units, 11 Amtrak cars, and 9 auto-train cars. The train was operated daily between Chicago, Illinois, and Wildwood. Between Nashville and Birmingham, Alabama, the train was operated over the Louisville and Nashville Railroad (L&N) by an L&N crew.

The fireman, a qualified engineer, was operating the train as it approached New Castle, Alabama, 15.7 miles north of Birmingham. The train's speed had been reduced to 42 mph for about 1 mile before the train was to enter a 5° curve. The fireman again applied the brakes to slow the train to comply with a speed restriction. To maintain the prescribed 40 mph, the train brakes were released and the throttle placed in the No. 4 position. The throttle was then advanced to the No. 6 position because of a slightly ascending grade.

The fireman, who was viewing the train through the rearview mirror as it moved through the curve, saw sparks being generated under the rear truck of the second unit. He realized immediately that the train had derailed and made an emergency application of the brakes.

When the train stopped, the fireman went back to ascertain the severity of the derailment. The engineer remained in the cab of the lead locomotive unit, notified the train dispatcher of the derailment by radio, and requested that medical aid be dispatched to the scene.

The conductor, who was riding in car 11, the dining car, first became aware of the derailment by the emergency application of the brakes and the fire he saw toward the area of the locomotive. Immediately afterward, he felt the dining car derail. The flagman who was riding on the west side of the cupola of the caboose-type car at the rear end of the train saw fire in the vicinity of the locomotive.

No. 315 derailed as it moved around a 5° curve on an ascending grade of 0.4 percent at New Castle. The curve began 452 feet north of the derailment point and extended southward for 710 feet. The track was laid on a side-hill cut to the point of derailment and then southward on a fill which was 21 feet high at its midpoint. (See figure 1.)

The rear truck of the second locomotive unit, the following 12 cars and the lead truck of car 13 were derailed.

The track consisted of 132-lb RE, 39-foot rails connected by 6-hole, 36-inch joint bars. The rails rested on 7 7/8- by 14-inch, 1:40 canted double-shoulder, 8-hole tie plates and were supported by an average of 22, 9- by 7-inch by 8-foot 6-inch wooden crossties per 39-foot rail length. There was an average of two line-holding and one plate-holding spikes per tie plate; this exceeded the number of spikes required by the Federal Track Safety Standards for Class 3 track.

During July 1973, 1,225 timber ties were replaced in the mile leading to and around the curve. The curve was surfaced and superelevated 4 inches in December 1975. In July and August 1976, a maintenance crew raised low rail joints and performed other routine maintenance; no detailed records, however, were kept. On July 14, 1976, this section of track was inspected using an ultrasonic rail test car; no defects were detected. From January 1, 1976, through January 15, 1977, there were no reported rail failures. The track was last inspected on January 14, 1977. The L&N's track geometry bus charted the area of the derailment on July 21, 1976, and again on January 19, 1977. Results of these inspections indicated that the track conditions had not changed appreciably in the interim and that, except for the track disturbed during the derailment, it met the Federal Track Safety Standards for Class 3 track.

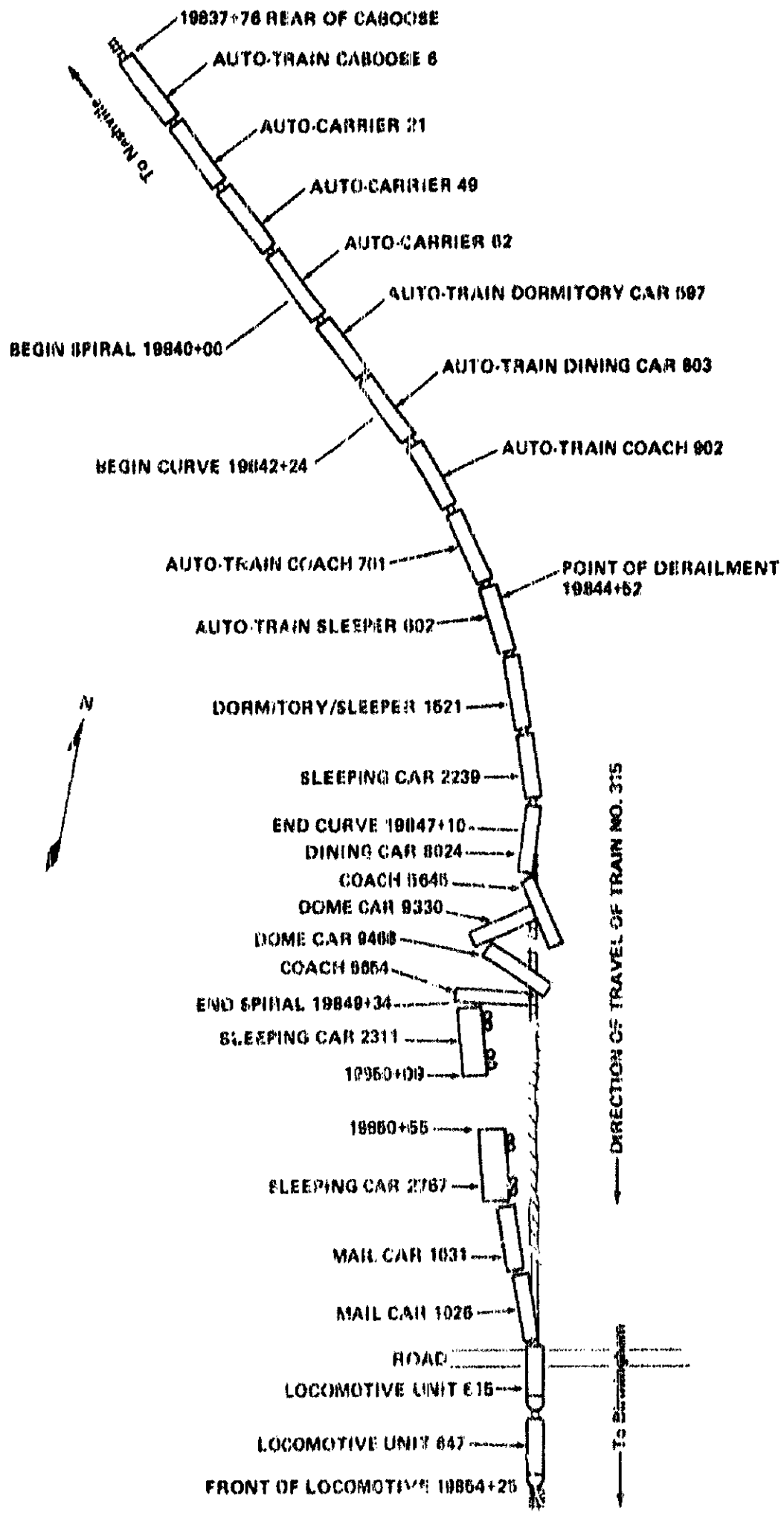


Figure 1. Plan of accident site.

Injuries to Persons

Injuries	Traincrew	Passengers	Service Personnel
Fatal	0	0	0
Nonfatal	0	68	8
None	5	43	5

Damage to Train and Track

The first locomotive unit was not damaged; the second unit sustained damage to its No. 2 truck. Three passenger cars were destroyed. Cost of damage to the other passenger cars varied between $3,000 and $60,000. The auto carriers were not damaged.

During the derailment, several cars separated and failed to remain in line because the shanks of their tightlock couplers fractured. The most serious of these separations resulted in the north end of the seventh car, a dome car, striking and destroying the windows and window posts on the west side of the eighth car, a coach. (See figure 2.)

The derailment destroyed about 850 feet of track. Several hundred feet of a carrier-owned telephone and communication lines adjacent to the track were damaged substantially.

Cost of damages were estimated as follows:

Cars	$564,900
Locomotive	1,500
Track	11,533
Clearing Wreckage	21,250
Total	$599,183

Method of Operation

Trains are operated in this area by signals of a traffic control system which is controlled by a dispatcher in Birmingham, Alabama. Maximum authorized speed was 70 mph, but was restricted to 40 mph on the curve on which the train derailed.

Train Information

The train consisted of two locomotive units coupled in multiple-unit control, two mail cars, five coaches, five sleeping cars, two dome cars, two dining cars, three autocarriers, and a caboose.

Figure 2. Damaged seventh and eighth cars (background) of train No. 315.

The locomotive units were Model SDP-40-F, manufactured by the ElectroMotive Division (EMD) of General Motors Corporation, and are rated at a maximum of 3,000 horsepower. They were equipped with two six-wheel trucks, each having three axle-hung, direct-current traction motors, the armatures of which are gear-connected to axles and 40-inch driving wheels. The units measured 72 feet 4 inches over coupler pulling faces and weighed 400,000 pounds. A 2,500-gallon fuel tank was hung under the frame. A 2,150-gallon water tank, also hung under the frame, and a 1,350-gallon deck-mounted water tank, supplied the steam generators.

Because of earlier derailments of trains with SDP-40-F locomotives units as they moved around curves of 2° or more, Amtrak had made several changes in the trucks; however, the second unit had not been modified. These modifications included: vertical snubbing units of increased capacity applied to each truck; secondary truck suspension changed to softer rubber springs; and, the clearance between the bolster and the truck frame increased.

All cars in the train were of standard steel construction. The autocarriers were enclosed triple-deck, flat cars. The entire consist was equipped with tightlock couplers.

Each locomotive unit was equipped with an electronic deadman control, a speed indicator, a speed recorder, and a radio. The conductor had a portable radio with which he could communicate with the enginecrew.

Meteorological Information

When the train derailed, lighting conditions were dark, the skies were cloudy, temperature was 29° F, and there were no reports of recent precipitation or any rapid change in the weather.

Survival Aspects

All of the injured were treated at the local hospitals. Two passengers were hospitalized immediately for treatment of heart conditions; one other was admitted later for a neck injury; all others were treated and released. Several persons were treated for window glass fragments in their eyes; however, the injuries of the other persons were confined to lacerations, bruises, and back and neck sprains which resulted from the passengers contact with the interior sides of the cars and the seats as the cars derailed. Most of the injured were in the dome car. The passengers who were in bed in the sleeping cars were not injured.

The inclination of the cars made evacuation difficult. However, there were no reports of injuries during rescue operations. Since several cars had run down the embankment and overturned, escape from these units was complicated by the need for removing people through windows or by the end doors. Movement through the interior of a passenger car that is laying on its side is hampered by seats and narrow aisleways. There was no fire.

Tests and Research

The lead locomotive unit stopped 973 feet beyond the derailment point. The east, or outside, rail of the curve was found to be tipped outward sufficiently at the derailment point to allow the west wheels of the trailing truck of the second locomotive unit to derail inside of the west rail. Marks on the rail indicated that the derailed wheels of the truck continued to spread the track until the train stopped. As the rails spread, the following cars derailed. Abrasive marks and gouges found on the wheels of the trailing truck of the second unit indicated that it was the first to derail. The tie plates had not moved laterally.

Inspection of the track north of the derailment area revealed irregularities in curvature, gage, and superelevation as follows:

1. Gage varied from standard 56 1/2 inches to 57 7/16 inches.

2. Curvature, when measured by using the midordinate measurement of a 62-foot chord, varied from a minimum of 4°15' to a maximum of 5°56'.

3. Superelevation varied from the designed 4 inches to between 4 and 5 inches.

All of the above deviations were within the requirements for Class 3 track. (See figure 3.) These measurements were taken with the track structure unloaded.

The two SDP-40-F locomotive units were moved to the L&N's shops in Louisville, Kentucky, where the units received detailed inspection and testing. A calibration test of the speed indicator and recorder indicated that a train speed of 42 mph resulted in an indicator speed of 40 mph and a recorder speed of 43 mph. The second unit was not supplied with a tape. The lead locomotive unit was thoroughly inspected and, except for being about 17 percent over horsepower, was found to be within design specification limits. Examination of the second unit revealed two defective components which were not considered to be the result of the accident. The wheel slip control module contained a loose wire which caused intermittant operation. The vertical snubbing device on the left side of the No. 2 truck was defective when it was operated in the compression mode.

ANALYSIS

Train No. 315 was being operated in compliance with L&N operating rules and instructions except that the speed limit on the curve was exceeded by 2 mph because of an error of the speed indicator in the locomotive. This overspeed by itself should not have contributed appreciably to the cause of the derailment.

A postaccident examination of the track indicated variations in line, gage, and elevation in the undisturbed track for 600 feet north of the point of derailment. Although the curve deviated from the planned 5° with 4 inches superelevation, these variations did not exceed those allowed by the Federal Track Safety Standards for Class 3 track. From 220 feet north to the point of derailment, track curvature varied from an approximate maximum of 5°45'; to a minimum of 4°15'; the greatest rate of change was within the last 100 feet before the point of derailment. Within this same area, superelevation varied from 4 1/4 inches to 4 3/4 inches, with the greatest rate of change 60 feet in approach to the point of derailment. In examining the relationship of the track's curvature to its elevation immediately prior to the point of derailment, as shown in figure 3, it is evident that the greatest variance occurred in the 200 feet before the derailment point. Many of these changes occurred in a short distance.

The L&N had prescribed an operating speed of 40 mph for passenger trains operating through the curve. Because of the error in the speed indicator, the train's speed was 42 mph as compared to the maximum speed of 43 mph allowed by 49 CFR 213.57b. The equilibrium speed for a train at the point of derailment should have been 34.6 mph. A 42-mph speed which exceeded equilibrium speed by 21 percent would result in an increased steady lateral loading on the outside rail. The SDP-40-F locomotive with three-axle truck normally exerts higher lateral forces on the outside rail of curves than other locomotives. The second unit had a defective vertical snubbing device on the trailing truck which decreased its vertical stability by an unknown value. The irregularities in the track geometry--surface, alignment, gage, and superelevation--would tend to generate additional lateral forces which are induced as impulses when the locomotive wheels strike the uneven points in the track geometry. If this results in an oscillatory harmonic effect, these impulses would be cumulative and add to those steady lateral forces already present. This could result in wide variations of the L/V ratio. (See appendix B.) The absence of lateral movement of the tie plates also suggests a diminishing of the vertical loading at the same time that a heavy lateral load was exerted on the head of the rail.

The facts indicate plainly that some force tilted outward the outside rail of the curve sufficiently to allow derailment. The sparks seen by the fireman through the rearview mirror were generated as the derailed wheels abraded the inside of the west rail.

The locomotive and the first, second, and third cars remained coupled. The severity of the derailment was probably increased by the terrain onto which the cars derailed. The cars trailed down the west side of the embankment producing stresses which broke the tightlock couplers of the fourth through eighth cars which permitted the cars to separate, overturn, and stop at various angles on, or near, the track structure.

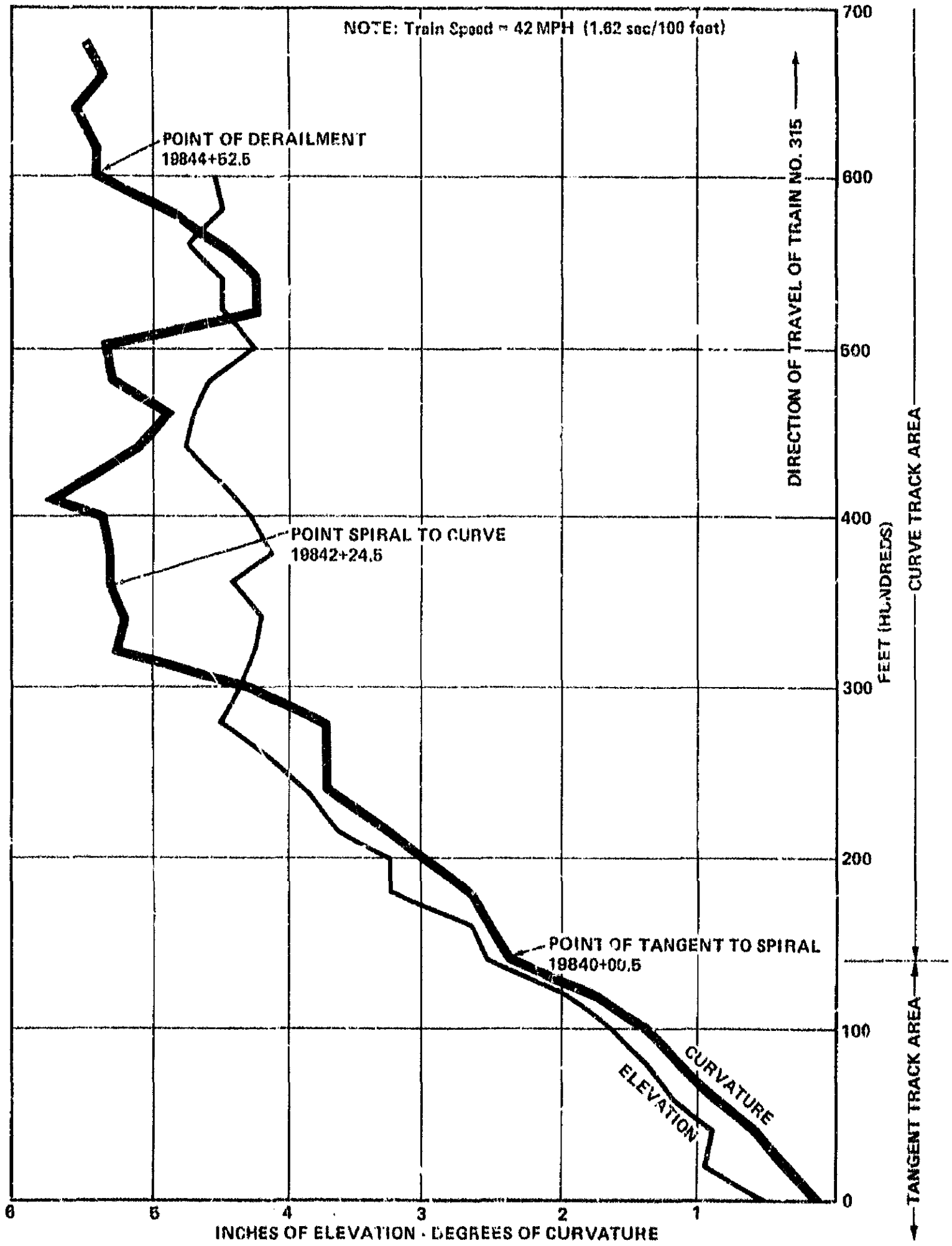


Figure 3. Deviations in curvature and superelevation.

Even though several of the passenger-carrying cars, after derailing, slid down the bank of the track structure and overturned, the passengers in these cars were not seriously injured. Most of their injuries were confined to lacerations and contusions which resulted from the passengers contacting the interior surfaces of the cars. This accident points out again that passengers who are not ejected from the cars in an accident tend to survive without critical injuries. Additional attention to the interiors of rail passenger cars will produce even better results.

CONCLUSIONS

Findings

1. The defective vertical snubbing device on the second locomotive unit decreased its trailing truck's vertical stability.

2. The track from 400 feet north to the derailment point contained variations in track alignment and superelevation which caused oscillations of the locomotive units which in turn developed a high L/V ratio.

3. The variations found in the track north of the derailment point were acceptable by the Federal Track Safety Standards.

4. The train exceeded the L&N speed restriction by 2 mph because of a speed indicator error as it entered the 5° curve on which it derailed.

5. The train's speed was calculated to be about 21 percent above the equilibrium speed for the 5° curve but was still within the maximum allowable speed by the Federal Track Safety Standards.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the tipping of the east rail which caused the track gage to widen. The gage widened because the track structure was not able to withstand the lateral forces generated by oscillations of the locomotive trucks as the train moved around a 5° curve. The oscillations were generated by variations in track alignment and superelevation that complied with Federal Track Safety Standards for Class 3 track and by the ineffectiveness of a vertical snubbing device on the second locomotive unit.

RECOMMENDATIONS

As a result of this investigation, and other investigations of derailments, the National Transportation Safety Board recommended on February 3, 1977, that the Federal Railroad Administration:

"Investigate immediately the interaction between SDP-40-F and P-30CH locomotives of passenger trains and track conditions to determine the causes for the widening of the track gage and act to correct the causes. (Class I, Urgent Followup) (R-77-1)

"Until such investigation and corrections are completed, restrict passenger trains with SDP-40-F locomotives to speeds that will permit safe operation around curves of 1°30' or more on Class 4 or less track. The speeds should not exceed the equilibrium speed on such curves. (Class I, Urgent Followup) (R-77-2)"

As a further result of this investigation, the Safety Board recommended on November 7, 1977, that the National Railroad Passenger Corporation:

"Establish inspection and repair procedures that will insure that locomotive units with defective truck components will not be dispatched. (Class II, Priority Followup) (R-77-36)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ KAY BAILEY
Acting Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

/s/ JAMES B. KING
Member

October 20, 1977

APPENDIX A

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: February 3, 1977

Forwarded to:

Honorable Asaph H. Hall
Administrator
Federal Railroad Administration
400 Seventh Street, S. W.
Washington, D.C. 20590

REVISED: April 18, 1977

SAFETY RECOMMENDATION(S)

R-77-1 and 2

On January 16, 1977, the second locomotive unit and 12 cars of Amtrak train No. 57 derailed on the Louisville and Nashville Railroad Company track about 15 miles north of Birmingham, Alabama. The train, with SDP-40F-type locomotive units, was moving at a speed of 43 mph around a 5° curve; the superelevation of the curve was 4 inches, and the maximum allowable speed was 40 mph.

Seventeen trains with either the SDP-40F-type locomotive or the P-30CH-type have derailed since January 14, 1974. (See attachment.) Preliminary investigations of these accidents indicate that on curves which exceed 1°30' and which have certain deviations in track geometry, passenger train locomotives of the SDP-40F and P-30CH-types with 6-wheel trucks and which travel at speeds above 48 mph cause the outside rail to either move laterally or to tip outward. This permits the wheels of the locomotive and following cars to derail.

The gage widens even though the 6-wheel truck locomotives do not deviate from design standards, and inspections of the track indicate that it generally complies with the Fedecal Track Standard for the authorized speeds of the trains.

R-77-1 and 2

Therefore, the National Transportation Safety Board recommends that the Federal Railroad Administration:

> Investigate immediately the interaction between SDP-40F and P-30CH locomotives of passenger trains and track conditions to determine the causes for the widening of the track gage and act to correct the causes. (Class I, Urgent Followup)(R-77-1)

> Until such investigation and corrections are completed, restrict passenger trains with SDP-40F locomotives to speeds that will permit safe operation around curves of 1°30' or more on Class 4 or less track. The speeds should not exceed the equilibrium speed on such curves. (Class I, Urgent Followup) (R-77-2)

TODD, Chairman, BAILEY, Vice Chairman, McADAMS, HOGUE, and HALEY, Members, concurred in the above recommendations.

Kay Bailey

for Webster T. Todd, Jr.
Chairman

APPENDIX A

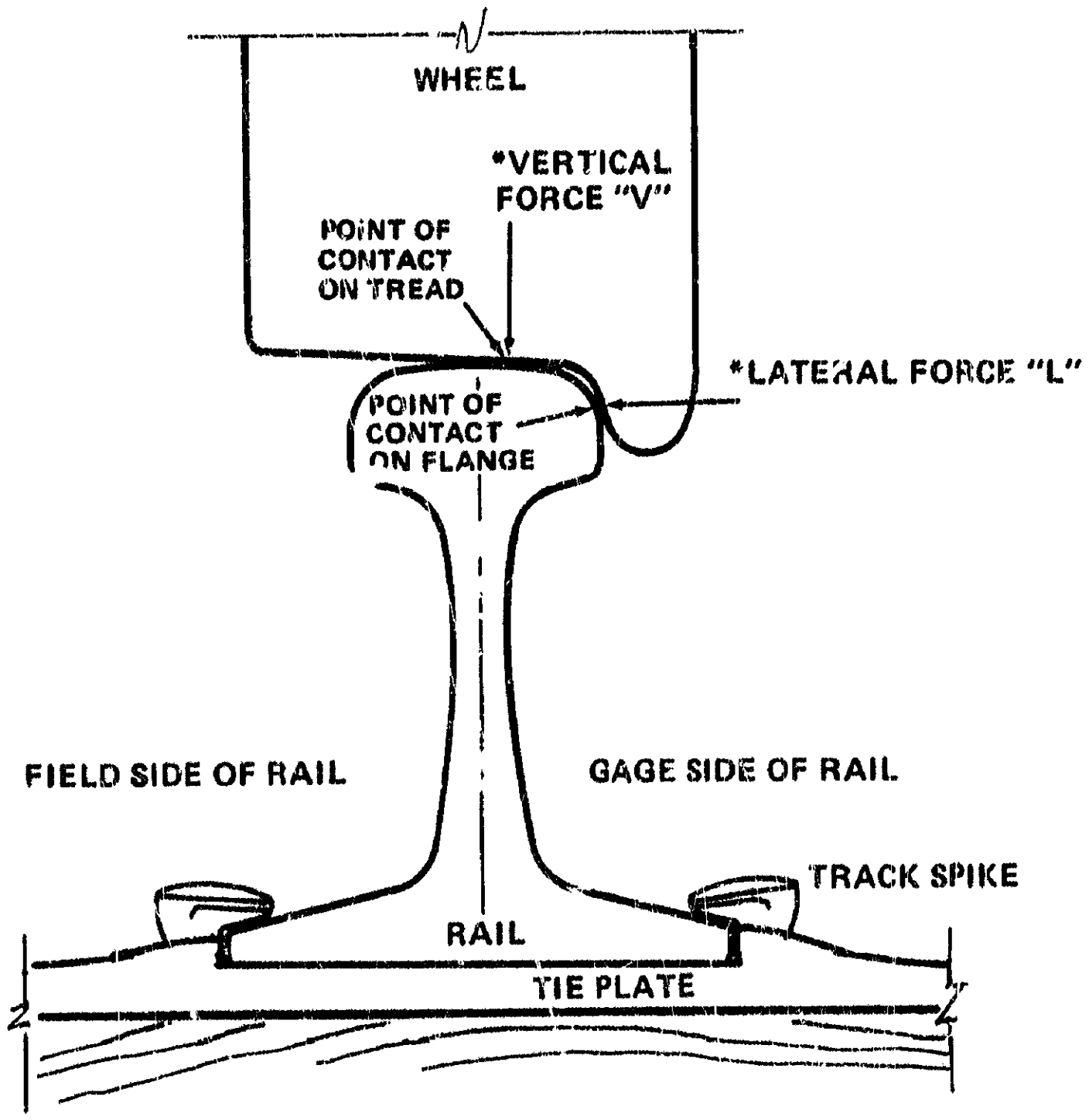
Attachment

R-77-1 and 2

Train derailments involving six-axle SDP-40F and P30CH locomotives:

	DATE	PLACE	RR	TRAIN	SPEED MPH	° CURVE OR TANGENT	TRACK CLASS
1.	12-26-76	Ralston, Neb.	BN	No. 6	53	2°30'	4
2.	11-29-76	Sewell, W.Va.	C & O	No. 51	52	2°	4
3.	9-29-76	E. Sewell, W.Va.	C & O	No. 50	52	2°3'	4
4.	9-9-76	Vaiden, Miss.	ICG	No. 59	79	0°10'	4
5.	6-30-76	Goodman, Miss.	ICG	No. 59	88	Tangent	4
6.	1-30-76	Shandon, Ohio	C & O	No. 51	50	4°	4
7.	1-24-76	Heath, Ohio	PC		70	Tangent	4
8.	1-5-76	Flynn, Mont.	BN	No. 10	60	3°22'	4
9.	10-1-75	Pulaski, Tenn.	L & N	Floridian	60	3°8'	4
10.	1-31-75	Huntington, W.Va.	C & O	No. 50	48	2°	4
11.	1-12-75	Castlerock, Wa.	BN	No. 11	59	2°32'	4
12.	12-28-74	Mifflin, Pa.	PC	No. 40	55	2°	4
13.	8-12-74	Wake Forest, N.C.	SCL	No. 81	58	3°15'	4
14.	7-16-74	Hartselle, Ala.	L & N	No. 316	60	2°4'	4
15.	7-5-74	New Florence, Pa.	PC	No. 30	52	2°	4
16.	4-30-74	Winamac, Ind.	PC	No. 53	47	1°	3
17.	1-14-74	Ardmore, Okla.	AT & SF	No. 15	56	3°10'	4

APPENDIX B



*The lateral to vertical ratio (L/V) is the lateral force pushing outward against the rail compared to the vertical force pushing downward on the top of the rail. The tendency for the rail to tip and/or move laterally, or for the wheel to climb the rail increases as the L/V ratio approaches unity.

Vertical forces due to the weight and movement of the train are transferred through the wheels of the locomotive and cars to the rail and tend to hold the rail in a vertical position on the tie plates, whereas whenever the wheel flanges come in contact with the side of the rail head as the train moves along the track they exert an overturning or tipping lateral force on the rail.