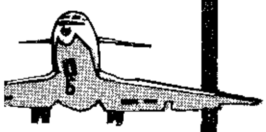
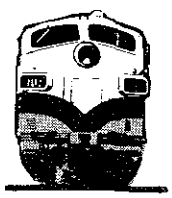
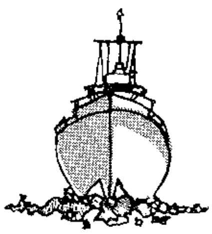


NATIONAL TRANSPORTATION SAFETY BOARD

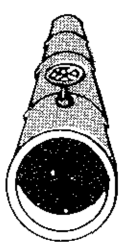


WASHINGTON, D.C. 20594



RAILROAD ACCIDENT REPORT

**DERAILMENT OF
UNION PACIFIC RAILROAD
FREIGHT TRAIN
GRANITE, WYOMING
JULY 31, 1979**



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UNITED STATES GOVERNMENT

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16. Abstract

On July 31, 1979, at 10:30 p.m., eastbound Union Pacific (UPRR) freight train No. GRX 31 derailed at Granite, Wyoming. The train was moving on main track No. 2 at 75 mph when the second and third locomotive units derailed and overturned in a 3°05.8' curve, separated from the lead unit, destroyed the track, and caused the following 81 freight cars to derail. Two locomotive units were heavily damaged, 80 freight cars were destroyed and 2 overpass bridges of Interstate 80 were damaged extensively. Total damage was estimated at $5 million.

The National Transportation Safety Board determines that the probable cause of this accident was the loss of braking capability because of a closed angle cock in the train line, which resulted in the engineer's inability to control the speed of the train, and the failure of the conductor in the caboose to apply the train brakes in emergency when the speed became excessive.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

DERAILMENT OF UNION PACIFIC RAILROAD FREIGHT TRAIN AT GRANITE, WYOMING JULY 31, 1979

Adopted: December 13, 1979

SYNOPSIS

On July 31, 1979, at 10:30 p.m., eastbound Union Pacific freight train No. GRX 31 derailed at Granite, Wyoming. The train was moving on main track No. 2 at a speed of 75 mph when the second and third locomotive units derailed and overturned in a 3°05.8' curve, separated from the lead unit, destroyed the track, and caused the following 81 freight cars to derail. Two locomotive units were damaged heavily, 80 freight cars were destroyed, and 2 overpass bridges of Interstate 80 were damaged extensively. Total damage was estimated at $5 million.

The National Transportation Safety Board determines that the probable cause of this accident was the loss of braking capability because of a closed angle cock in the trainline, which resulted in the engineer's inability to control the speed of the train, and the failure of the conductor in the caboose to apply the train brakes in emergency when the speed became excessive.

INVESTIGATION

The Accident

At 3:10 p.m., on July 31, 1979, eastbound Union Pacific Railroad Company (UPRR) freight train No. GRX 31 departed Rawlins, Wyoming, with 3 locomotive units, 81 cars, and a caboose. An inspection and test of the air brake system were conducted, and no exceptions were taken before departure from Rawlins. The engineer was informed from the caboose by radio that all cars and the caboose were moving as he left Rawlins Yard. The engineer stated that the reception of this communication was weak and that he had no other radio communication with the caboose. The train had advanced eastward 21.5 miles when the engineer stopped it at Walcott on an ascending grade to allow a westbound train to pass. The train continued eastward until the engineer stopped it on a 0.08 percent descending grade to check for a hot bearing on the 28th car. The head brakeman took no exception to the condition of the car, and the train continued eastward. The train then stopped at Laramie.

Each time the train stopped, the engineer used dynamic braking initially and made the stop with the automatic brakes. The conductor or flagman did not alight from the caboose at any of the train stops to perform the walking inspection of the cars in the train as required by the UPRR rules. (See appendix A.) At the first stop, the conductor attempted to contact the engineer, using the portable radio, but was unsuccessful. He made no further attempts to contact the engineer to determine why the train had stopped. After leaving Laramie, the train began to ascend a 0.82 percent grade for 18.7 miles. After cresting the grade, the train moved over a 0.80 percent descending grade for 2 miles until it crossed from main line track No. 1 to track No. 2 at Dale Junction. After crossing over, the train ascended a 0.82 percent grade for 4 miles to the top of Sherman Hill, milepost (MP) 540.44. Air brake retainers 1/ were not set on the cars before starting the descending 0.82 percent grade. After cresting Sherman Hill, the engineer used the dynamic brake to control the speed of the train. At East Buford, MP 536, the grade increased to 1.58 percent descending, and the engineer made a minimum brake application when the speed of the train reached 25 mph; however, instead of slowing, the speed continued to increase. When an additional application failed to slow the train, the engineer made a full service brake application, but the train continued to gain speed. When the train speed was about 35 mph, the engineer made an emergency brake application, but the train continued to accelerate. The head brakeman activated the emergency brake valve at his location on the left side of the cab, but there was no response since the engineer had already made the emergency application. The engineer realized that he could not control the train and called the train dispatcher to advise him that he had a runaway train and to clear the tracks through Cheyenne where he hoped to stop the train on Archer Hill. (See figure 1.)

Moments after, an engineer, working on a yard train at Granite, MP 529, overheard the transmission about the runaway train and saw the train as it passed him at an estimated speed of 65 mph. He noticed sparks flying only from the wheels of the first six cars and immediately radioed the engineer of the train and informed him that only the six lead cars had brakes set. He continued to watch the train but saw no evidence that the brakes on any other cars were applied. He attempted to radio the caboose to advise them to apply the train brakes in emergency. The conductor in the caboose of the freight train stated that he did not hear this radio communication but the engineer of GRX 31 heard it and replied that he had the train's brakes in emergency. The train continued to race downhill, gaining speed. When the train entered a 3°05.8' curve to the right it had reached a speed of 75 mph. As the train rounded the curve, the second and third locomotive units derailed and overturned to the left, separated from the lead unit, destroyed the track, and caused the following 81 cars to derail. The derailing equipment struck and destroyed the columns for the eastbound and westbound bridges for Interstate 80. (See figure 2.) The lead locomotive unit continued eastward for about 3 miles.

1/ Air brake retaining valves control the actual exhaust of brake cylinder air when the handle is moved to the required position. Heavy braking (HP position) retains 20 psi in the brake cylinder when brakes are released. The valves are used in certain grade braking situations to hold the train to a controlled speed during the time the brake valve handle is in the release position and car equipment is being recharged.

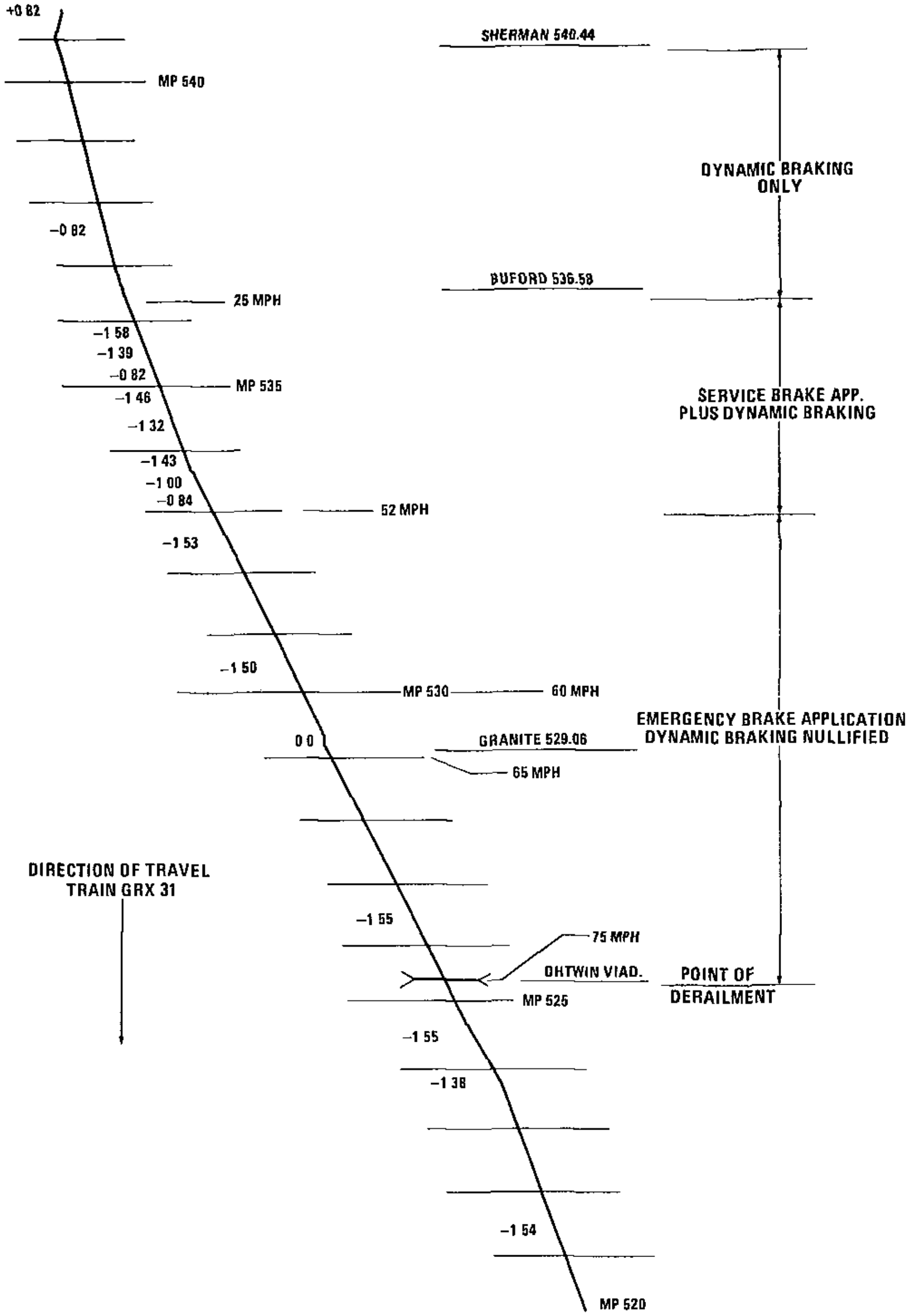

Figure 1. Profile of track between mileposts 540.44 and 520 showing speeds obtained and location of brake application.

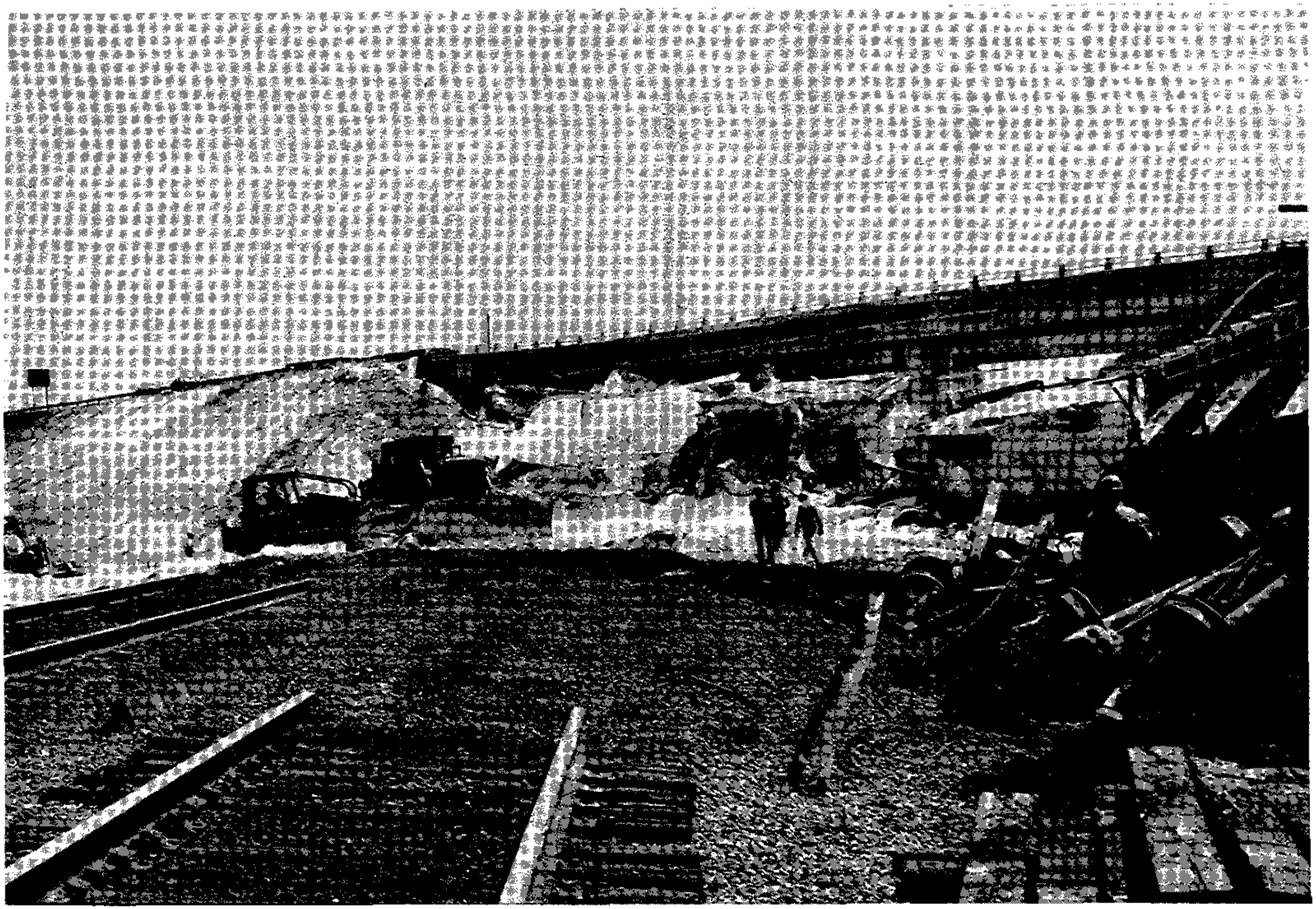

Figure 2. View to the east on track No. 2 of UPRR to the Interstate Highway overpass bridges of I-80.

Injuries to Persons

There were no reported injuries.

Damage

The second and third locomotive units were damaged heavily. Eighty cars were destroyed and one car was damaged extensively. Before the accident, the train was 4,906 feet long, but after the accident, the wreckage was confined to an area only 800 feet long. The lead pair of wheels on the caboose derailed. Six upright columns of the two overpass bridges of Interstate 80 were destroyed in addition to part of the roadway section. Two thousand feet of track and associated signal equipment were destroyed.

Damage was estimated as follows:

Train equipment	$2,340,000
Lading	480,000
Track and signal equipment	575,000
Cleanup	105,000
Bridge and roadway	1,500,000
Total	$5,000,000

Crewmember Information

The engineer, conductor, and two brakemen on the freight train were qualified without restrictions under UPRR operating rules. However, the conductor had taken his operating rules examination 4 years before the accident and the flagman 5 years before. Furthermore, the conductor had returned to duty only 20 days before the accident after being out of service for 6 months.

The crewmembers had been on duty 8 hours 5 minutes when the accident occurred. The engineer, conductor, and flagman were assigned regularly to the Cheyenne-Rawlins through freight pool, but this was the flagman's first trip. The head brakeman was filling a temporary vacancy, and it was his first day on this assignment. (See appendix B.)

The car inspector who tested the air brakes and inspected the train had been employed in the car department for 11 months. He received only on-the-job training. He had not been given an air brake instruction book nor had he been tested in the requirements for conducting brake tests. He was not on a regular assignment but was in a relief capability.

Train Information

Train No. GRX 31 originated in Green River, Wyoming, and was made up of cars that had been loaded at three chemical plants in Green River. The train consisted of 3 General Motors SD40-2, diesel-electric locomotive units, each having 3,000 hp, 81 freight cars, and a caboose for a total of 9,636 trailing tons. The lead locomotive unit had the short hood forward and was equipped with a functioning dual-sealed beam headlight, speed indicator and recorder, overspeed control, floor-mounted deadman pedal, and cab signals with acknowledging lever and warning whistle. At one time, each locomotive unit had been equipped with a brake pipe flow indicator, 2/ but it had been removed. A radio which was installed in the locomotive cab permitted the engineer to communicate with the caboose, other trains, and the train dispatcher. An emergency brake valve was installed on the left side of the cab near the head brakeman's position. Each locomotive unit had extended-range dynamic braking which retained a high retarding force down to about 6 mph. When the train's brakes were applied in emergency, the dynamic brake was nullified and the air brakes were allowed to apply fully. The PC switch 3/ when actuated could not be reset until 56 seconds after the emergency application.

The train consisted of 74 covered hopper cars, loaded with various dry chemicals, 6 loaded boxcars, and 1 empty covered hopper car. The covered hopper cars were new. The caboose was an all steel-cupola type. An A-1 emergency brake valve which permitted the crew to make brake applications was installed on the wall of the cupola section. (See figure 3.) The caboose was equipped also with a wheel/pulley/belt-driven generator which charged a 12-volt battery to provide electrical power for lighting and an FM radio. Neither the lights nor the radio was functional. Examination of the caboose after the accident indicated that one of the two drivebelts on the generator was excessively loose. The conductor reported that the lights and radio had been inoperative during the trip. A portable radio was also located in the caboose.

The train brakes were tested at Green River after the train was made up and crewmembers in the caboose were advised that the brakes applied and released on the rear of the train. The engineer stated that there was no detectable trainline leakage. At Rawlins, a running inspection was performed by a car inspector who was standing along the track as the inbound train moved by him at a speed of 30 to 40 mph. The train was stopped on the main line, the locomotives were fueled, and the train brakes were tested. A 500-mile brake test as required by Federal regulations was made at Rawlins. After noting a brake pipe pressure of 55 lbs on the caboose gage, the car inspector conducting the brake test mounted a four-wheel vehicle and proceeded along the train to check the brake application. He stopped at the seventh car because the road ended. He waited until the brakes were released and checked the release by riding the vehicle to the caboose. When he entered the caboose, he noted a brake pipe pressure of 75 lbs on the gage. He said he then advised the engineer that the brakes on the train were okay.

2/ The brake pipe flow indicator is an instrument which indicates the rate of flow of air through the automatic brake valves to the brake pipe. It is the only indicator which the engineer has to inform him of what is taking place in the brake pipe regarding air flow.

3/ The PC switch is an electrical device that will automatically reduce the locomotive throttle to idle when an emergency or penalty application of the brakes is made.

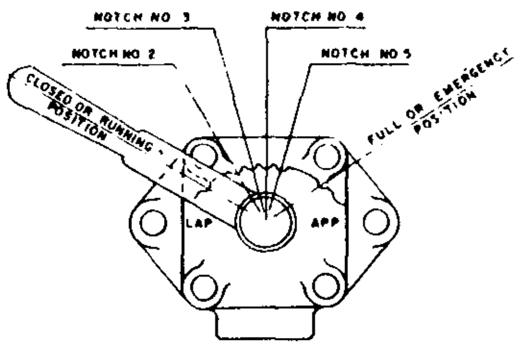

Figure 3. A-1 caboose valve.

Caboose Valve - An air valve connected to the brake pipe for the purpose of applying the brakes from the rear of a train should it become necessary for the crewmen at the rear to bring the train to a stop.

Track Structure

The track in the area of the accident was a double track main line. It was a series of curves from Sherman, MP 540.44, to the accident site at MP 525.38. At the derailment site, the track curved 3°05.8' to the right. The length of the spiral was 337.20 feet, and the curve was 337 feet long. The superelevation of the curve was 4 1/2 inches, and there was a descending 1.55 percent grade.

The track was constructed of 133-lb, continuous welded rail. The rail was box-anchored at each tie. The crossties were made of 7-inch by 9-inch by 9-foot oakwood. The rail was held by two 5/8-inch by 6-inch cut track spikes per tie plate. There were also two plate-holding spikes.

The equilibrium speed in the curve at the point of derailment was 48 mph because of the 4 1/2 inch superelevation. The track in the derailment site was maintained as class 4 or better in accordance with Federal track safety standards.

Method of Operation

Trains are operated over the two main tracks between Cheyenne and Rawlins according to automatic wayside signals of a centralized traffic control system which is supplemented by locomotive cab signals. Traincrews are directed in their duties over the radio by the dispatcher. The tracks are numbered 1 and 2 from north to south.

The top of Sherman Hill is 15 miles west and is 1,000 feet above the point of derailment. The UPRR timetable required that air brake retaining valves must be used from Sherman to Cheyenne and the speed must not exceed 20 mph when train tons per operative brake are over 100 and when the effective dynamic brake on units provides less than 1 hp per trailing ton. No air brake test is required on freight trains at Sherman. (See appendix A.) The UPRR timetable required that brake tests be made to determine that the air brakes were operative on all cars handled by Stauffer, Allied Chemical, and Texas Gulf Spurs in Green River.

UPRR rules state that, "The general direction and government of a train is vested in the conductor and all persons employed on the train must obey his instructions. . . .Conductor must know that train is being handled safely and speed restrictions are being observed. He must take immediate action to stop train when necessary. . . . At all stops, such walking and roll-by inspection as time will permit must be made, giving particular attention to running gear, brake and draft rigging, loose doors, shifted loads, overheated journals or any unsafe condition. Walking inspection must continue until entire train has been inspected or until movement starts." The conductor was instructed by the UPRR rules to require the use of retainers, even if the engineer did not want to use them, when the limits outlined in the timetable were reached.

The rules also provided that the conductor and engineer and anyone acting as pilot were equally responsible for the safety of the train and observation of the rules. Furthermore, other members of the crew must call to the attention of the conductor or engineer immediately any apparent failure to observe the requirements of rules, timetables, train orders, messages, or other instructions. When the train is to be stopped or speed reduced and the engineer and conductor fails to take proper action, other members of the crew must take immediate action to stop the train, using the emergency brake valve if necessary.

Meteorological Information

At the time of the accident, 10:30 p.m., the sky was clear, and the winds were light and variable. The temperature was 55° F. According to train crewmembers, the visibility was good.

Tests and Research

The portable radio in the caboose was used by an officer of the UPRR immediately after the accident. He stated that he could hear communications from the dispatcher at Cheyenne, Wyoming, 16 miles east of the derailment site.

The lead locomotive unit was inspected where it stopped. The brakeshoes had worn down completely and the brake cylinder pistons had excessive travel. The wheels had overheated and caused the tread to turn blue. When the locomotive air brakes were tested later, they were functioning properly. The other two locomotive units were inspected at the derailment site; the wheels showed evidence of excessive heating and the brakeshoes were worn out.

Twenty-one pairs of car wheels found near the east end of the derailment site indicated evidence of heavy braking by their discoloration. All other wheels examined showed no evidence of heavy braking.

The speed tape recovered from the lead locomotive unit indicated that the train was traveling at 58 mph when the train derailed; however, when the speed recorder device was calibrated, it registered 17 mph slow at 56 mph and 2 mph slow at 32 mph. The corrected speed of the train was 75 mph at the time of the derailment.

To reproduce the dynamics of the train as it descended the grade, 16 tests were conducted on a Train Dynamic Analyzer. (See appendix C.) Tests 1 through 12 failed to produce a profile similar to that described by the engineer. In test No. 13, the analyzer was programed for the brakes to be applied on only the three locomotive units and the first six cars of the train, as described by the yard train crew at Granite. The movement of the train was then programed as described by the engineer. This test produced a profile that most nearly duplicated the operation of the train as described by the engineer and indicated by the speed tape.

Tests No. 14, No. 15, and No. 16 were conducted to determine stopping distances if the brakes had been applied in emergency from the caboose. The speeds and locations used were determined from the speed tape removed from the lead locomotive unit. Test No. 14 allowed the speed of the train to reach 52 mph at MP 533 before the brakes were applied in emergency from the caboose;

the train stopped in 3,696 feet, 7 miles short of the the derailment site. Test No. 15 allowed the train to proceed to MP 530 and to reach a speed of 60 mph before the brakes were applied in emergency from the caboose; the train stopped in 4,752 feet, 3.8 miles short of the derailment site. Test No. 16 used the same speed and location as test No. 15 except the assumption was made that the brakeshoes on the locomotives and the first six cars were probably burned up and the braking effort was not effective; the train stopped in 7,920 feet, 3.2 miles short of the derailment site.

Observations made of car inspectors performing brake tests at Rawlins following the accident disclosed that they drove alongside the train in a four-wheel motorized vehicle at a speed too fast to check the angle cock handles and brake valve cutout cock handles. The inspectors were unable to observe the brake cylinders mounted in the brake beams or on the opposite side of the car. Also, no one was making inspections of the cars beyond the black-top road. The destruction of the cars in the train was so complete that it was impossible to reassemble the brake system to determine what caused the blockage. (See figure 4.)

Other Information

During the investigation, the conductor appeared to be confused on the proper allowable speed for the train. He stated that he thought the allowable speed was 30 mph instead of 20 mph. The flagman stated that he knew that the maximum speed requirement for the train was 20 mph on Sherman Hill and that he knew the train was exceeding the 20 mph speed limit when it descended Sherman Hill but he did not become concerned with the excessive speed and said nothing to the conductor.

ANALYSIS

The train stops made between Rawlins and Sherman Hill, Wyoming, required little braking effort. One was made on an ascending grade; one was made on level track; and the third was made on a slightly descending grade. These stops probably could have been made by shutting off the throttle or by using some dynamic braking. If the angle cock had been closed, the engineer's use of the automatic brake during these stops would have provided braking effort on the locomotive and first six cars similar to that which could be obtained by dynamic braking. Such braking would have been sufficient to control the train. Therefore, the operation of the train would not have provided any warning to the engineer of braking problems.

It is apparent from the yard crew's description of train GRX 31, as it passed them at Granite, and from the examination of the wheels after the accident that brakes had only been applied on the first six cars of the train. This could only have occurred in a properly charged train if an obstruction existed in the air brake train line between the sixth and seventh cars. A blockage may have resulted from a crimped air hose or a damaged brake pipe but this would not prevent all propagation of the brake application. This type of blockage would reduce the

Figure 4. Crushed covered hopper cars.

timing of the brake application, but after the train moved 7 miles, some brakes would have been applied on the rear cars. A complete blockage, such as the one on train GRX 31, could only have resulted from a closed angle cock.

The engineer controlled the speed of the train by using the dynamic brake as it crested Sherman Hill and began its descent. Because of the heavy trailing tons, the dynamic brakes of the three locomotive units did not have sufficient braking capability to control the speed of the train on the increasingly descending grade. When the speed increased and additional braking was required, the engineer applied the automatic air brakes. However, since sufficient braking power was not provided by the locomotive units and six cars, the speed continued to increase. Additional applications had little effect. Additionally, the emergency air brake application nullified the dynamic brake on the locomotive which eliminated most of the braking effort.

The statement of the car inspector that performed the test of the train brake system at Rawlins Yard indicated that the brakes responded properly to operation of the brake valve on the locomotive during the test of the brake system. This would indicate that all angle cocks were opened during the brake test. The angle cocks between the sixth and seventh cars must have been closed either following the brake test at Rawlins or during one of the stops made by the train between Rawlins and the accident.

The air brake test at Rawlins yard was performed by a car inspector riding in a four-wheel vehicle. The vehicle did not permit him to observe the brake cylinder pistons when mounted in the brake beam or mounted on the opposite side of the car. During the investigation, a car inspector was observed driving a similar vehicle alongside the standing train at a speed faster than a man could walk. The inspector was not able to observe angle cock handles and cutout valve handles. Additionally, the practice of turning around at the end of the road prevented the car inspector from checking the air brakes on about seven cars since the train had three locomotive units. During observation of an air test after the accident, no car inspector was observed inspecting the brakes on the head cars. After interviewing the car inspector who performed the air brake test on GRX 31 and his supervisor, it was obvious that the employees were not trained thoroughly in their duties nor did the supervisors require them to perform the air brake test in accordance with Federal Railroad Power Brake Law, CFR 49 Part 232.

Because of the tonnage and dynamic brake capability, the authorized speed of this train was 20 mph from Sherman to Cheyenne. The UPRR rules (see appendix A) hold the conductor and engineer equally responsible for the safety of the train and for compliance with the rules. The railroad also requires that other crewmembers take immediate action to stop the train, using the emergency brake valve, if necessary, if the speed of the train must be reduced and the engineer and conductor fail to do so. As it descended Sherman Hill, the train obtained a speed of 40 mph within 6 miles and 50 mph within 8 miles. The speed continued to increase to 60 mph and then to 75 mph, 15 miles below the top of Sherman Hill. Tests conducted after the derailment indicated that if the conductor or flagman had applied the train brakes in emergency from the caboose, even when the train was traveling at 60 mph - 40 mph over the authorized speed - the train would have stopped.

UPRR rules required the use of air brake retainers on the train from Sherman Hill to Cheyenne. The engineer stated that he mistakenly rated the locomotive units at 3,500 hp instead of 3,000. At 3,500 hp, the train would not have required retainers. The conductor stated that retainers were not set as required by the timetable because it was standard operating procedure not to use them. To set the retainers, the train had to be stopped and the crewmembers had to go to each car and set the handle in the proper position. If the train had stopped at Sherman Hill and had remained there for the retainers to be set, the train brakes would have been applied and would have been required to remain applied to hold the train. Had this been done, the Safety Board believes that the closed angle cock in the braking system probably would have been detected because of the failure of the brakes to apply behind the sixth car and the derailment would have been prevented.

The removal of the brake pipe flow indicators from UPRR locomotives eliminated the only tool the engineer had to inform him about the air flow in the brake pipe. With proper monitoring of the brake pipe flow indicator during the application and release of the automatic brake the engineer could have detected and corrected a blockage in the air brake system before descending Sherman Hill.

UPRR rules state that the general direction and government of a train is vested in the conductor. However, the conductor on the train failed to determine why stops were being made by his train en route. When those stops were made, no walking inspections were made as required. He failed to require the use of retainers even though the train was required by the timetable instructions to use them. He did not monitor the speed of the train. Although a speedometer was not available in the caboose, he should have used his watch to make time checks between mileposts since a chart was provided in the timetable for his use. (See appendix A.) When the speed of the train became excessive, he failed to take action to bring the train to a stop. He was confused about the proper speed restrictions for his train from Sherman to Cheyenne. The Safety Board believes that the conductor's failure to respond properly to the situations that developed during the trip indicates a lack of understanding and application of the operating rules and timetable instructions which may have been caused by UPRR's failure to test him on the operating rules within the last 4 years. Furthermore, the conductor had been out of service for 6 months and had returned to duty only 20 days before the derailment.

Although the flagman knew the speed limit requirements for the train, he took no action to stop the train. Furthermore, he did not question the conductor's apparent failure to enforce the requirements. The Safety Board believes that the failure of the crewmembers to understand and apply the rules indicates a lack of monitoring by UPRR supervision of crew compliance with the train operating rules.

CONCLUSIONS

Findings

1. The air brake trainline was blocked by a closed angle cock behind the sixth car.

2. The engineer could not slow the train because he could not apply the brakes behind the sixth car; the three locomotive units and first six cars did not have sufficient braking capability to control the speed of the train.

3. The conductor and flagman failed to monitor the speed of the train and did not take any action to stop the train when the speed became excessive.

4. The engineer and conductor failed to use the air brake retainers on the cars, as required by UPRR rules, before starting to descend to Sherman Hill.

5. With the removal of the brake pipe flow indicator, the engineer had no way of measuring the flow of air in his brake system.

6. Had the crewmembers in the caboose put the train brakes in emergency when the train speed became excessive, the train would have stopped and the derailment could have been avoided.

7. The air brake test at Rawlins was not conducted in accordance with requirements of the Federal Power Brake Law, CFR 49 Part 232.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the loss of braking capability because of a closed angle cock in the trainline, which resulted in the engineer's inability to control the speed of the train, and the failure of the conductor in the caboose to apply the train brakes in emergency when the speed became excessive.

RECOMMENDATIONS

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

— to the Union Pacific Railroad Company:

"Instruct employees who make train brake tests in the test requirements of the Federal Power Brake Regulations, CFR 49 Part 232, and establish monitoring procedures to insure that the tests are conducted properly. (Class II, Priority Action) (R-79-78)

"Review the operating rules examination and retesting procedures to insure that employees properly understand the requirements of the operating rules and timetable instructions. (Class II, Priority Action) (R-79-79)

"Establish a monitoring system for rule compliance of employees operating trains. (Class II, Priority Action) (R-79-80)

"Equip locomotives with brake pipe flow indicators to enable engineers to measure trainline air flow. (Class II, Priority Action) (R-79-81)"

to the Federal Railroad Administration:

"Enforce the requirements for testing train brakes in accordance with the Federal Power Brake Regulations, 49 CFR Part 232, on the Union Pacific Railroad. (Class II, Priority Action) (R-79-82)

"Issue regulations to require railroads to establish a system for regular instruction and testing of employee's knowledge of the operating rules. (Class II, Priority Action) (R-79-83)

"Review the monitoring system for rule compliance on the Union Pacific Railroad to insure that their supervision can adequately enforce the rules to provide a safe and efficient operation. (Class II, Priority Action) (R-79-84)

"Study the feasibility of requiring locomotives to be equipped with brake pipe flow indicators to enable engineers to measure trainline air flow. (Class II, Priority Action) (R-79-85)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PATRICIA A. GOLDMAN
Member

/s/ G. H. PATRICK BURSLEY
Member

December 13, 1979

APPENDIX A

EXCERPTS FROM UNION PACIFIC TIMETABLE NO. 2

DECEMBER 10, 1978

WYOMING DIVISION

WESTWARD			SECOND SUBDIVISION		EASTWARD		
STATION NUMBER	LENGTH OF SIDINGS FEET	FIRST CLASS 5 DAILY	Timetable No 2 STATIONS		MILE POST	FIRST CLASS 6 DAILY	RULE 6(B)
510		2 00PM 2.25PM	DN R CHEYENNE N	TRACKS 1,2	509 5	3 25PM 3.00PM	FPTXY
			1 3				
			WEST CHEYENNE		510 8		PX
			3 7				
515	900		WYCON (SPUR-E)		514 5		P
			4 6				
519	5164 1314		BORIE		519 1		PX
			9.5				
529	4173		GRANITE		528 6		PX
			8 0				
537	C 5852		BUFORD		536 6		P
			3 8				
540	1250		SHERMAN (SPUR-W)		540 4		PY
			2 6				
545	2171		DALE (SPUR-E)		543 0		P
			1.8				
			DALE JCT		544 8		PX
			3 1				
548			HERMOSA		547 9		PX
			6.1				
554	572		COLORES (SPUR-E)		554 0		P
			9.0				
563	519		FORELLE (SPUR-E)		563 0		P
			3 0				
566			DN R LARAMIE K		566 0		FPXY
548			HERMOSA	TRACK 3	B547 9		PX
			8 9				
557	5849		RED BUTTES		B556 8		P
			9 5				
566			DN R LARAMIE K		B566 3		FPXY
510			DN R CHEYENNE N	TRACKS 3,4	509 5		FPTXY
			9.5				
15 518	C 6489		SPEER		519 0		PXY
15 518	C 6489		SPEER	TRACK 3	519 0		PXY
			6 8				
15 526	6217		EMKAY		525 8		P
			8 4				
15 534	6408		LYNCH		534 2		P
			8 5				
15 543	6722		HARRIMAN		542 7		P
			6 8				
15-550	6134		PERKINS		549 5		P
			4 8				
			DALE JCT		554 3		PX
566		s3 50	DN-R LARAMIE K	TRACKS 1,2	566 0	s1 40PM	FPXY
			16.2				
			X582		582 2		PX
			3.1				
585	C 4301		BOSLER		585 3		P
			5 3				
590	753		COOPER LAKE (SPUR-E)		590 6		P
			3.3				
594	1585		LOOKOUT (SPUR-W)		593 9		PX
			11.4				
605	C 5944		ROCK RIVER		605 3		PY
			3 7				
609			WILCOX		609 0		PX
			13 9				
623	C 5985		D MEDICINE BOW MB		622 9		PY
			1.6				
			X624		624 5		PX
			13.9				
639			RAMSEY		639 4		PX
			3 7				
643	11772		DN-R HANNA HN		643 1		PXY
			7.1				
			DURRANT		650.2		PX
			6 4				
657	403		EDSON (SPUR-W)		656 6		P
			5.6				
662			WALCOTT		662 2		PXY
			9.9				
672			BENTON		672 1		PX
			4.2				
676			SINCLAIR		676 3		P
			6 5				
683	11602 19126	sA5 45PM	DN R RAWLINS RS		682 8	11 45AM	FP XY

CTC-ACS

WY DIVISION

Air Brake Rules

1029 (RW-2). Air brakes must be cut in and operative on all cars handled on Stauffer, Allied Chemical, and Texas Gulf Spurs

Before departure from Stauffer, Allied, Texas Gulf and FMC plant yards, termi nal test of air brakes must be made as prescribed by Air Brake Rule 1025

1029 (RW-3) On westward passenger trains, running air test as required by Air Brake Rule 1029 must be made at Wahsatch

1029 (RW-4) Air brakes must be cut in and operative on all cars handled on Park City and Ontario Branches

APPENDIX A

Eastward Sherman-Cheyenne			
Tons Per Operative Brake	**Effective Dynamic Brake On Units Providing**	**Retaining Valves**	**Speed Must Not Exceed**
Less than 60		Not required	Timetable speeds
60-80	1 HP Per Trailing Ton	Not required	Timetable speeds
	Less than 1 HP per Trailing Ton	Not required	30 MPH Sherman to Cheyenne Stop and remain standing 10 minutes at Granite and Borie to cool wheels
80 100	1 HP Per Trailing Ton	Not required	35 MPH Sherman to Cheyenne
	½ HP Per Trailing Ton	Not required	30 MPH Sherman to Cheyenne Stop and remain standing 10 minutes at Granite and Borie to cool wheels
	Less than ½ HP Per Trailing Ton	Retaining valves must be used Sherman to Cheyenne	20 MPH Sherman to Cheyenne
Over 100	1 HP Per Trailing Ton	Not required	30 MPH Sherman to Cheyenne
	Less than 1 HP Per Trailing Ton	Retaining valves must be used Sherman to Cheyenne	20 MPH Sherman to Cheyenne

TONNAGE RATINGS FOR ONE LOCOMOTIVE UNIT
FOR FREIGHT TRAINS AVERAGING 50 GROSS TONS PER CAR
RATINGS APPLY AT THE INDICATED MINIMUM CONTINUOUS SPEED

EASTERN DISTRICT		70-90B 5000 HP EMD DD35	100-129 1500 HP EMD GP7	131 349 1750 HP EMD GP9	300-344B 1) 470-499 2000 HP GP20	400-448 2400 HP EMD SD24	450-459 1500 HP EMD SD7	700-739B 800-875 2250 HP EMD GP30	740-763 2500 HP EMD GP35	1400-1409 2500 HP EMD SDP35	2000-2059 2000 HP GP38-2	2800-2809 2800 HP GE U28C	2810-2974 3000 HP GE U30C C30 7	3000 3399 3999 3000 HP SD40 SD40-2	3600-3649 3600 HP EMD SD45	6900-6946 6600 HP EMD DD40X	8000-8074 3000 HP EMD SD40-2	9000-9005 3500 HP EMD GP40X
		12 MPH	12 MPH	12 MPH	14 MPH	10 MPH	6 MPH	12 MPH	12 MPH	12 MPH	11 MPH	11 MPH	10 MPH	11 MPH	11 MPH	11 MPH	9 MPH	11 MPH
Co. Bluffs	To Valley	6000	2250	2650	2550	4050	2700	2950	3000	3650	3150	4500	5250	4900	4950	5800	4150	2900
Valley	To No. Platte	9700	3650	4250	4100	6550	4350	4750	4650	5900	5050	7250	8500	7850	7950	9350	6700	4700
No. Platte	To Sidney	6900	2600	3000	2950	4650	3100	3400	3450	4200	3600	5150	6050	5600	5650	6650	4750	3300
Sidney	To Cheyenne	5350	2000	2350	2250	3600	2350	2600	2650	3250	2800	4000	4650	4300	4350	5150	3650	2550
Valley	To Valparaiso	3350	1250	1450	1450	2250	1450	1650	1700	2050	1750	2500	2950	2750	2750	3200	2300	1600
Valparaiso	To Lincoln	9700	3650	4250	4100	6550	4350	4750	4850	5900	5050	7250	8500	7850	7950	9350	6700	4700
Lincoln	To Beatrice	3950	1500	1750	1700	2650	1750	1950	2000	2400	2050	2950	3450	3200	3250	3800	2700	1900
Beatrice	To Marysville	6000	2250	2650	2550	4050	2700	2950	3000	3650	3150	4500	5250	4900	4950	5800	4150	2900
Julesburg	To LaSalle	9700	3650	4250	4100	6550	4350	4750	4850	5900	5050	7250	8500	7850	7950	9350	6700	4700
Cheyenne	To Archer	5350	2000	2350	2250	3600	2350	2600	2850	3250	2800	4000	4650	4000	4350	5150	3650	2550
Valley	To Co. Bluffs	6900	2600	3000	2950	4850	3100	3400	3450	4200	3000	5150	6050	5600	5650	6650	4750	3300
Marysville	To Beatrice	8050	3050	3500	3400	5450	3600	3950	4050	4900	4200	6050	7050	6550	6600	7750	5600	3900
Beatrice	To Valparaiso	6900	2600	3000	2950	4650	3100	3400	3450	4200	3600	5150	6050	5600	5650	6650	4750	3300
Valparaiso	To Valley	3350	1250	1450	1450	2250	1450	1650	1700	2050	1750	2500	2950	2750	2750	3200	2300	1600
Cheyenne	To Buford	2700	1000	1200	1150	1800	1200	1350	1350	1650	1400	2050	2400	2200	2250	2600	1850	1300
Cheyenne	To Dale	4700	1750	2050	2000	3150	2050	2300	2350	2850	2450	3500	4100	3800	3850	4500	3200	2250

APPENDIX A

Time per Mile	Miles per Hour	Time per Mile	Miles per Hour	Time per Mile	Miles per Hour	Time per Mile	Miles per Hour	Time per Mile	Miles per Hour
40	90	50	72	1	60	1 10	51 4	2	30
41	87 8	51	70 6	1 1	59	1 11	50 7	2 15	26 6
42	85 7	52	69 2	1 2	58	1 12	50	2 30	24
43	83 7	53	67 9	1 3	57 1	1 15	48	2 45	21 8
44	81 8	54	65 6	1 4'	56 2	1 20	45	3	20
45	80	55	65 4	1 5	55 3	1 25	42 3	3 30	17 1
46	78 3	56	64 2	1 6	54 5	1 30	40	4	15
47	76 5	57	63 1	1 7	53 7	1 35	37 9	5	12
48	75	58	62	1 8	52 9	1 40	36	6	10
49	73 5	59	61	1 9	52 1	1 45	34 3	7	8 6
						1 50	32 7	8	7 5
						1 55	31 3	10	6

EXCERPTS FROM UNION PACIFIC OPERATING RULES

106. The conductor and engineer and anyone acting as pilot are equally responsible for safety of train and observance of rules, and under conditions not provided for by the rules, must take every precaution for protection

106 (A) Other members of the crew must call attention of conductor or engineer immediately to any apparent failure to observe the requirements of rules, time-table, train orders, messages or other instructions

When conditions or signals require that the train be stopped or speed of train be reduced and the engineer or conductor fails to take proper action to do so, or should the engineer become incapacitated, other members of the crew must take immediate action to stop the train, using emergency brake valve if necessary

800 The general direction and government of a train is vested in the conductor and all persons *employed on the train must obey his instructions* In the absence of the conductor, members of the crew on the engine must comply with the instructions of the engineer Should there be any doubt as to authority or safety of proceeding from any cause, the conductor must consult the engineer who shall be equally responsible with him for the safety and *proper handling of the train*

APPENDIX A

811 At all stops, such walking and roll-by inspection as time will permit must be made, giving particular attention to running gear, brake and draft rigging, loose doors, shifted loads, overheated journals or any unsafe condition Walking inspection must continue until entire train has been inspected or until movement starts

820 Conductor must know that train is being handled safely and speed restrictions are being observed He must take immediate action to stop train when necessary

APPENDIX B
CREWMEMBER INFORMATION

Conductor Thomas Delaine Larimore

Conductor Larimore, 36, was employed as a laborer by the UPRR and worked for 1 month in May 1960. He was re-employed as a switchman-brakeman on August 18, 1965. He worked as a switchman-brakeman until he was promoted to conductor on October 15, 1974. He took and successfully passed an operating rules examination and an air brake rules examination on July 1, 1975. Larimore passed a company physical examination on July 2, 1974, and was not restricted in any way. He was dismissed for his responsibility in a derailment on August 14, 1970, but he was reinstated to his position on December 23, 1970. He was dismissed again on January 26, 1979, for being on duty and on company property in a condition indicating the use of alcoholic beverages, but he was reinstated on July 10, 1979, 20 days before the accident.

Engineer Donnie Mix Smith

Engineer Smith, 35, was employed as a carman by the UPRR on September 25, 1969. On December 26, 1975, he transferred to the Transportation Department as a fireman. He completed an engineer's training program and was promoted to engineer on November 11, 1976. He took and successfully passed an air brake rules examination on March 19, 1976, and he passed a company physical examination on September 11, 1978. He was not restricted in any way. His service record was clear of citation or disciplinary action.

Head Brakeman John Trujillo

Brakeman Trujillo, 25, was employed as a laborer in the Maintenance of Way Department by the UPRR on August 17, 1973. On November 19, 1975, he transferred to the Transportation Department as a switchman-brakeman. He took and successfully passed the operating rules examination on February 10, 1979, and he passed a company physical examination on November 13, 1975. He was not restricted in any way. On June 14, 1979, he failed to report for trial operating rules examination for promotion to conductor. Therefore, he was not qualified for the position of conductor. His service record indicates that he has been assessed 30 demerits on two occasions -- for violation of safety rules on September 29, 1976, and for his responsibility in a derailment on December 21, 1977.

Rear Brakeman Mickey Vernon Cox

Brakeman Cox, 26, was employed as a clerk by the UPRR on June 17, 1972. He became a switchman-brakeman on July 6, 1972. He took and successfully passed an air brake rules examination on July 6, 1972, and an operating rules examination on November 14, 1974. He passed a company physical examination on November 1, 1977, and he was not restricted in any way. On January 15, 1976, he failed to pass the first trial air brake rules examination for promotion to conductor, and declined to take further air brake rules examinations on January 25, 1977, and March 20, 1978. Therefore, he was not qualified for the position of conductor.

His service record indicates that he was dismissed on May 22, 1974, for failing to take action to stop a train before passing a stop indication, but he was reinstated on November 12, 1974.

APPENDIX C

TESTS CONDUCTED USING TRAIN DYNAMIC ANALYZER

Test 1

Originated at MP 538, using dynamic and normal train handling procedures, setting minimum and further to 14-lb reduction and final emergency at MP 535, train stopped at MP 533.9.

Test 2

Originated at MP 537, using dynamic at 22 mph, set minimum reduction at MP 535.5 and later reduction to 16 lbs at MP 533.5; train stopped at MP 533.1.

Test 3

Originated at MP 536, using dynamic at 23 mph, set minimum reduction at MP 535.9, further set 10 lbs independent at MP 534.5, train stopped at 534.4.

Test 4

Originated at MP 537 at 22 mph, using dynamic only, speed increased to 50 mph at MP 533.5, and increased to 68 mph at MP 531.5.

Test 5

Originated at MP 540.5, in 8th notch power and 13.5 mph. This test was stretch braking to MP 536, and thereafter cycle braking with no time for recharge, final reductions of 40 lbs at MP 531.5 and release and 60-lb reduction at MP 530, train was controlled at 33 mph.

Test 6

Originated at MP 536 with 20 head-end cars only with brakes operative, plus units. Using dynamic, minimum reduction increased to 20 lbs at MP 533.5 and emergency at MP 532.5, speed reduced from 34 mph to 20 mph at MP 529.

Test 7

Originated at MP 535.5 with 20 head-end cars only and units with operative brakes using dynamic, minimum reduction increased to 18 lbs and full service at MP 532 into emergency at MP 531 and 50 mph speed reduced to 33 mph at MP 528. It was noted that draw bar forces exceeded 250,000 lbs in buff.

Test 8

Originated at MP 536 with 10 head-end cars only and units with operative brakes using dynamic plus minimum reduction, gradually increased to full service at MP 535.1 and 28 mph into emergency at MP 534.2; at 21 mph with independent brake applied, speed reduced to 4 mph at MP 532.5.

Test 9

Originated at MP 532.5 at 15 mph, applied emergency and 50-lb reduction of the independent brake speed increased to 25 mph at MP 531.

Test 10

Originated at MP 536 at 27 mph. No brakes applied and dynamic released. Independent brake applied at MP 535.9 and further increased to 72 lbs at MP 535.5. Speed increased to 62 mph at MP 530 where it was assumed brakeshoes completely deteriorated.

Test 11

Originated at MP 536 at 26 mph, with 10 head-end cars and units with operative brakes and cutoff valve in "out" position. Using dynamic, speed increased to 45 mph at MP 533. Dynamic cut out and independent brake fully applied. Speed increased to 72 mph at MP 525.

Test 12

Originated at MP 528 at 63 mph. Brakes operative on 10 head-end cars and units with brake valve cut out and 32-lb cylinder pressure on cars. Into emergency and speed increased to 65 mph at MP 525.

Test 13

Originated at MP 536 at 26 mph, with 6 head-end cars and units with operative brakes, using dynamic, minimum reduction, increased to full service at MP 533.9. Speed increased to 45 mph at MP 532.75 where applied emergency and full independent. Speed increased to 64 mph at MP 525.0.

Test 14

Originated at MP 533, speed 52 mph initiated emergency from rear end. At MP 532.5 at 28 mph deceleration rate - 47.5 mph/min. Train stopped MP 532.3. Total time 1 min 11 sec. Test included effective brakes on entire train.

Test 15

Originated at MP 530 at 60 mph. Initiated emergency from rear end at MP 529.5 at 50 mph, at MP 529.25 it was 37 mph. Train stopped at MP 529.1 total, time 1 min 31 sec. Test included effective brakes on entire train.

Test 16

Changed train configuration to 70 cars, 9,836 tons to simulate no effective brake on 6 head-end cars or locomotives. Started test at MP 530, speed 60 mph. Initiated emergency from rear end.

MP 529.75	Speed 60 mph
MP 529.5	Speed 55 mph
MP 529.25	Speed 47 mph
MP 529	Speed 38 mph (time: 1 min 10 sec)
MP 528.75	Speed 27 mph (Flat track at East Granite)

Train stopped just west of MP 528.5. Total time 2 min 26 sec.