National Transportation Safety Board

Office of Railroad, Pipeline, and Hazardous Materials Investigations
Washington, D.C. 20594

Railroad Operations
Factual Report of Investigation

RRD19FR001
Union Pacific Railroad
Collision
Granite Canyon, Wyoming
October 4, 2018

Railroad Operations Factual

A. Accident

Location:	Granite Canyon, Wyoming
Train #1:	MGRCY04 (UP 5412)
Train #2:	MPCNP03 (UP 7113)
Railroad:	Union Pacific Railroad
Date:	October 4, 2018
Time:	7:40 p.m.[1]
Fatalities:	2
NTSB #:	RRD19FR001

B. Accident Summary

For a summary of the accident, refer to the *Accident Summary* report, within this docket.

C. Railroad Operation Group

Ted T. Turpin NTSB – Operations Group Chairman	Carl Smith SMART
Brian Fransen Safety Task Force – BLE&T	Donald Mai FRA
John Allberry UPRR	

Parties to the Operations Group include: Union Pacific Railroad, Federal Railroad Administration, Brotherhood of Locomotive Engineers and Trainmen, and Sheet Metal, Air, Rail, Transportation Union.

[1] All times in this report will be mountain daylight time (MDT) unless otherwise noted.

Narrative

On October 4, 2018, at 7:40 p.m., an eastbound Union Pacific (UP) freight train collided with the rear of a stationary UP freight train in Granite Canyon, Wyoming at about milepost (MP) 527. The crew of UP freight train, MGRCY04 (UP 5412), reported problems with the train air brake system; the train crew radioed the UP Harriman Dispatch Center to tell them they had accelerated to 50 mph and were unable to stop their train. The train was traveling on a descending grade leading up to the collision. The crew of the stationary train had de-boarded and cleared the area before the collision. Three locomotives and 57 cars of the striking train derailed as well as 8 cars of the stationary train. No hazardous materials were released. The accident occurred near MP 527 on the Laramie Subdivision, approximately 17 miles west of Cheyenne, Wyoming.

The MGRCY04 originated in Green River, Wyoming. The engineer and conductor went on duty at 12:01 a.m. (this was not the accident crew). When they took charge of their train it was on two tracks. The car department tested the emergency function of the EOT device.[2] The two sections of the train were connected by an air hose (without the train being on the same track) and the car department together with the engineer performed the initial terminal air brake test.

At about 3:09 a.m., the crew departed Green River with 76 loads and 10 empties. The train weighed 9,935 tons and was 5,627 feet long. There were three locomotives on the head end of the train: UP 5412, UP 5842, and UP 5003. The engineer stated that the trip from Green River to Rawlins, Wyoming was unremarkable but added that the air flow registered about 17 cubic feet per minute (CFM) during the trip. When they reached Rawlins at 6:38 a.m., the outbound crew was not on duty, so they secured the train at 6:49 a.m. and went off duty.

Rawlins to Accident

The accident crew went on duty at 8:45 a.m. The crew released the hand brakes and performed the required air test before departing Rawlins at 9:45 a.m. and proceeding to Laramie, Wyoming. At Laramie the crew added 19 cars to the head end of the train. A local UP supervisor observed the crew adding the cars to the train and performing an air test. He noted that the conductor used an air gauge at the rear of the 19 cars and performed an air test on these cars before adding them to the train. The conductor inspected the brake application and release on each car. They then added the cars to the train and performed an application and release test on the entire train. While waiting for the train dispatcher's authority to depart, the engineer applied the train brakes and performed a second train line continuity tested before leaving Laramie. They departed with 95 loads, 10 empties, with a total of 12,417 tons, and with a total length of 6,581 feet, at 4:56 p.m. The locomotives were unchanged with UP 5412, UP 5842, and UP 5003. After departing Laramie, the train did not stop before the accident.

Summary of Event Recorder Data (Green River to Rawlins)[3]

[22] The Granite Canyon Mechanical Factual describes this test in detail.

[3] [3] This data was from the event recorder of the lead locomotive UP 5412 starting at 3:00 a.m. when the train was departing Green River, Wyoming.

The MGRCY04 (UP 5412), train departed Green River, Wyoming (MP 813) on October 4, 2018, at about 3:09 a.m. with the PTC engaged. The air flow data showed an air flow of 20 CFM for 5.5 miles with the locomotive in power mode. For the next 75.4 miles the locomotive was in power and there was no indication of air flow. Between MP 739 and MP 733.74 the engineer used dynamic braking and applied and released the train brakes. The train brakes were released at about MP 734.87. The end of train device (EOT) recorded the application and release. The air flow stayed at 20 CFM until MP 729.62. At MP 729.62 the engineer used dynamic braking and the recorded air flow reduced to 0 CFM.[4] At about MP 727.2 the engineer changed from dynamic braking to power and the recorded air flow remained at 0 CFM.

The engineer maintained the locomotive in power until MP 711.14 and then changed to dynamic braking. The air flow remained at 0 CFM. Between MP 711 to MP 682, the engineer changed the locomotive from power to dynamic braking multiple times. Between MP 711 to MP 682, when the locomotive was in power there was an indication of air flow and when the locomotive was in dynamic braking there was no air flow.

Summary of Preliminary Event Recorder Data (Laramie to Accident)

Departing Laramie, the air brake system was still being charged following the air brake tests. The event recorder showed the air flow meter near 50 CFM's. This dropped to 30 CFM's after about 15 minutes of charging. From this time until the accident, when the air flow registered it was between 27 and 30 CFM's. However, when the engineer applied the dynamic braking and bunched the train, the air flow meter dropped to 0 CFM's. This happened twice. The first time was when the grade changed from ascending to descending and then returned to ascending at Dale Junction near MP 555. The second time the air flow meter went to 0 CFM's was after the train had crested the top of Sherman Hill near MP 540. The air flow meter remained at 0 CFM's until the collision.

As just mentioned, when the train crested the grade at MP 540, the engineer applied dynamic braking to control the train speed. Because of the tons per operative brake (TPOB) and the number of available dynamic braking, the train was restricted to 25 mph. The engineer applied a minimum brake application (5-7 psi reduction) at approximately MP 535.35 while traveling 19 mph. At MP 531.80 the engineer increased the brake pipe reduction to a total of 10 psi and still traveling at 19 mph. At MP 529.9 the speed had increased to 25 mph and the engineer increased the total brake pipe reduction to 17 psi. At MP 529.78 the engineer increased the brake pipe reduction to 26 psi (full-service application) and the train had increased to 26 mph. At MP 529.95 the train was still accelerating reaching 28 mph when the engineer applied an emergency application. The event recorder had been showing COMM OK with the rear end device for the previous 45 minutes until 15 seconds after the emergency application, at which time the status changed to FR NC - meaning no communication. Five minutes after the engineer applied the emergency braking, the train collided with the standing train at about 55 mph at MP 525.95.[5]

[4] The air flow gauge may have shown continuous readings below 20 CFM to the engineer, however, the event recorder often records 0 CFM when the air flow drops below 20 CFM.
[5] This data was from the event recorder of the lead locomotive UP 5412.

Train Dispatcher Communication and Actions

According to the radio recordings, one of the crew members of MGRCY04 (UP 5412) called the train dispatcher at 8:36:10 (CDT) and reported that their train was" not stopping" and "picking up speed."[6] The train dispatcher (P14) asked the crew to confirm their status.[7] The crew responded that the train was still gaining speed and they were currently at 37 mph. They also said they were unable to stop at any upcoming restrictive signals. The train dispatcher made a general broadcast, "Emergency, emergency, emergency uncontrolled movement headed east at CPW [MP] 530 main track 1." The train dispatcher repeated this message three more times.

During the postaccident interview, the train dispatcher said, "I grabbed my emergency book" when I got the initial notification from the crew so she could follow the appropriate steps. Train dispatcher P-14's immediate supervisor, the corridor manager, also noticed the emergency call light at P-14's workstation. (Several other supervisors noticed the issue and came to the workstation to aid.) Realizing the circumstances (and following the UP instructions), the corridor manager initiated the call for the local emergency response.

At 8:38:21 (CDT), the train dispatcher asked the crew of 5412 for a status report. The crew responded that the train was still picking up speed and had reached 51 mph, they had no brakes, and asked the train dispatcher to clear a path in front of them.

Meanwhile the adjacent train dispatcher (P-15) responded to the emergency and initiated communication with the trains ahead of the runaway train that were on his district. This train dispatcher also used the protocol – "emergency, emergency, emergency, uncontrolled movement" adding the location. All the trains east of the uncontrolled movement were stopped and the crew members had gotten off and clear of the trains. When the collision occurred, one of the nearby crewmembers, (a train length away), said they could hear "banging and clanging" and saw a large cloud in the air.

Train Information

Striking Train -MGRCY04 (UP 5412)

The striking train had three locomotives on the head end, UP 5412, UP 5842, and UP 5003. The train had 95 loads and 10 empties for a total of 12, 417 tons and was 6,581 feet long. According to the train consist the Tons Per Operative [Air] Brake was 119 tons and the Tons per Dynamic Brake Axle was 441 tons.

Standing Train -MPCNP03 (UP 7113)

[6] Both the engineer and conductor were using their individual radios to talk with the train dispatcher. Different voices can be heard during the broadcast, but investigators did not identify which individual had said which comment.

[7] The train dispatcher districts changed near the accident site. The uncontrolled movement started on train dispatcher P-14's district. The stopped trains east of the uncontrolled movement were on train dispatcher P-15's district.

The standing train had two locomotives on the head end, UP 7113 and UP 7620, and one mid train DPU, UP 9008. The train had 90 loads and 67 empties for a total of 13,474 tons and was 10,103 feet long. According to the train consist the Tons Per Operative [Air] Brake was 86 tons and the Tons per Dynamic Brake Axle was 448 tons.

Operating Documents

The crews were governed by the following operating rules:

- General Code of Operating Rules, Seventh Edition, Effective April 1, 2015, Updated as of October 1, 2018
- Union Pacific Special Instructions, Effective December 11, 2017
- Union Pacific Railroad, North Platte Timetable No. 5, Laramie Subdivision, Effective December 11, 2017 (Specific instructions for the grade at the accident location were in the Timetable – See Appendix A)
- Union Pacific Railroad, Air Brake and Train Handling Rules, effective May 2, 2016 (with updates September 19, 2018) (Specific instructions for handling trains in grade territory were in the Air Brake and Train Handling Rules – See Appendix A)
- Union Pacific Railroad, Safety Rules, Effective June 17, 2017 (with updates September 19, 2018)
- Track Warrants and Track Bulletins for UP 5412.

Method of Operations

The trains were authorized and governed by signal indication. The territory was Centralized Traffic Control with the train dispatcher controlling the signals located in Omaha, Nebraska at the Harriman Dispatch Center. The employees were governed by the General Code of Operating Rules and the modifications provided by the Special Instructions, General Orders, and Track Bulletins specific to the train.

There were two main tracks running primarily compass east and west. Both tracks had wayside signals to enable trains to operate in both directions on each track. Positive Train Control was active at the time of the accident.

The north track was main track 1 and the south track was main track 2. The accident train was eastbound on main track 1 at the time of the accident.

From MP 540 to MP 527 the train was operating on a descending grade close to 1.5 percent. The UPRR glossary to the Air Brake and Train Handling Rules stated "…Heavy Grade: At least 1.0% for a distance of 3 miles or more." This area exceeded both the distance and the percent of grade and was designated as Heavy Grade. All rules specific to heavy grades applied to the train operations and were found in either the rule books, timetable, special instructions, or daily track bulletins.

Heavy grade instructions required this train to operate at 25 mph on the grade based on the assumed available braking effort provided by a combination of dynamic braking and the air brake system. Heavy grade instructions also required the engineer to crest the grade at 5 mph less (20

mph) than the allowed speed of 25 mph. When the air brake reduction was greater than 18 psi to control the speed of the train, the rules required the engineer to apply an emergency application. Further, once the train reached 5 mph (30 mph) over the required 25 mph the engineer was required to use an emergency application of the train brakes. (See Appendix A for the applicable rules.)

Crew Information

Post-Accident Toxicological Testing – Both employees were killed, and toxicological specimens were sent to Civil Aerospace Medical Institute (CAMI) in Oklahoma City, Oklahoma for analysis. CAMI's results will be reviewed by the NTSB medical officer.

Hours of Service and Rest Cycle - Title 49 CFR Part 228 – **Hours of Service of Railroad Employees,** requires that railroad operating employees not work over 12 hours in a given shift and must have a minimum of 8 hours or 10 hours off duty between shifts.[8] The crew's duty hours were within the requirements of the regulation.

Operational Testing - Title 49 CFR 217.9 contains specific requirements for the testing and observations of operating employees while they perform their duties. UPRR maintains an operational testing program to monitor the performance and rules compliance of employees operating trains. The purpose of the operational testing program is to observe operating crew activities when they are unaware that a supervisor is present.

A. Engineer

The 40-year-old engineer was hired as a brakeman by the Union Pacific Railroad on August 7, 2006. He passed his promotion to conductor. Later he entered the engineer training program and was certified as a locomotive engineer November 20, 2014.

The engineer had a current 49 CFR 240 certification due to expire on June 28, 2021.[9] He was qualified to operate trains throughout the UP system. The accident train route was his regular job assignment.

Operational Testing - The engineer had been observed by supervisors 47 times in the last 12 months. He had been incompliance with the rules and procedures the supervisors had observed.

Two discipline incidents were on his record. When he was working as a switchman, he had failed to line a switch properly on October 1, 2012 and when he was an engineer, he had positioned the engine to close to an adjacent track before the switch was lined for his movement on December 21, 2016. Both events were handled by a conference with his supervisor.

Work/Rest Cycle – The following table shows the on/off duty times for the engineer for the previous three days before the accident. The duty times were within the Hours of Service regulations specified in Title 49 CFR 228.

[8] If an employee works for the full 12 hours, then the regulation requires 10 hours off duty before the next on duty period.

[9] 49 CFR 240 requires that engineers be certified every 3 years. The engineer must pass a written knowledge examination and performance skills examination.

Date	Rest Time	On Duty	Off Duty	Total Time
Monday 10/01/18		5:00 a.m.	11: a.m.	6 hours
Tuesday 10/02/18		Off		
Wednesday 10/03/18	49 hrs. 15 mins	12:15 p.m.	9:15 p.m.	9 Hours
Thursday 10/04/18 Accident Day	11 hrs. 30 mins	8:45 a.m.	7:40 p.m. Accident	

Training Record - The engineer was current with all the required training programs. He had passed his most recent operating rules examination with 100% on November 8, 2017, an Air Brake Test examination with 97% on November 8, 2017 and a Hazardous Materials Awareness examination with 93% on November 7, 2017.

Fit for Duty - The engineer had passed a medical, hearing, and vision examination in order to obtain his engineer certification in June 2018.[10]

B. ***Conductor***

The 39-year-old conductor was hired by the UP on March 9, 1998 as a track laborer. He moved through multiple positions in the engineering department. He transferred to the operating department on March 2, 2015 as a brakeman. He was first certified as a conductor September 17, 2015. According to the UPRR records, his last conductor certification was December 13, 2017 which would have expired on January 11, 2021.

Operational Testing - The conductor had been observed by supervisors 144 times in the last 12 months. He had complied with the railroad's rules and procedures properly for 139 of the observations. He had been coached by a supervisor twice for the proper way to step off equipment, once on the proper way to wear a "hoody" to allow peripheral vision, once concerning properly facing the locomotive door when closing, and finally the importance of standing clear of a switch lever during its operation.

The conductor had no formal disciplinary entries in his record. However, he was conferenced for taking photographs with his cell phone while on duty on February 19, 2018.

Work/Rest Cycle – The following table shows the on/off duty times for the conductor for the previous three days before the accident. The duty times were within the Hours of Service regulations specified in Title 49 CFR 228.

Date	Rest Time	On Duty	Off Duty	Total Time
Monday 10/01/18		7:00 a.m.	4:46 p.m.	9 hrs. 56 mins
Tuesday 10/02/18	OFF			
Wednesday 10/03/18	38 hrs. 43 mins	10:00 a.m.	8:49 p.m.	10 hrs. 49 mins
Thursday 10/4/18	11 hrs. 30 mins	8:45 a.m.	7:40 p.m. Accident	

[10] See Title 49 Part 240 *Qualification and Certification of Locomotive Engineers.*

Training Record - The conductor was current with all the required training programs. He had passed his most recent operating rules (GCOR) examination on March 10, 2017 with a 98 percent. He passed an Air Brake rules examination on March 10, 2017 with a 90 percent. And on March 9, 107, he passed the Hazardous Materials examination with an 87 percent.

Fit for Duty - The conductor had passed a medical, hearing, and vision examination in order to obtain his conductor certification in December 2017.[11]

- END –

[11] See Title 49 Part 242 *Qualification and Certification of Conductors.*

Appendix A
UPRR - Air Brake and Train Handling Rules, effective May 2, 2016 (with updates September 19, 2018)

32.9.1: Emergency Application Capability from Rear of Train

32.9.1 *49 CFR 232.407* Reference Rule 31.8.3	**Emergency Application Capability from Rear of Train** **A. Requirements** Trains must be operated with the ability to place the train in emergency from the rear. The following trains are exempt from the requirement of this rule:

Glossary Grade	• Passenger and Commuter Trains. • Light engine consist with 8 or fewer units. • Locals, road switchers, and work trains that do not operate on mountain grades. • Trains that do not exceed 30 MPH and do not operate in heavy grade or mountain grade territory. Application: Locals, road switchers, and work trains must: • Not exceed 4,000 trailing tons • Travel over a distance that can normally be operated by a single crew in a single tour of duty. **B. Providing Emergency Application Capability from Rear of Train** Any one of the following methods fulfills the requirement to provide emergency application capability from the rear of the train: • An operable, two-way, end-of-train telemetry system (HEU/EOT), which must be armed and tested at point of installation. • Distributed power placed on rear of train. • Trains with a manned helper, caboose/shoving platform, or passenger equipment at the rear of train equipped with an emergency brake valve and manned by an employee equipped with two-way radio communication with the engineer at head end of train.

Rule Updated Date

May 2, 2016

32.9.2: Installation

32.9.2 *49 CFR 232.409*	**Installation** End-of-train device must have been calibrated within the last 368 days. Check the affixed stickers prior to installation. **Exception:** Calibration is not required when an affixed sticker states the unit is: • Equipped with a Wabtec synthesized or Ritron FRA-compliant radio. or • Exempt from FRA mandatory periodic testing requirements. After entering the EOT number on the HEU of the locomotive, push the COMM TEST button to establish one-way communication with the EOT.

	After charging the train, the EOT pressure reading displayed in the locomotive HEU must be compared with that on the EOT. The EOT device must not be used if the difference between the two readings exceeds three pounds.

Rule Updated Date

March 24, 2017

System Special Instructions

Effective Date: June 1, 2017

32.9.3: Arming HEU/EOT

32.9.3 *49 CFR 232.409*	**Arming HEU/EOT** To arm the HEU: 1. Press the TEST button on the EOT, which will display the ARM NOW message on the HEU. 2. Immediately press the COMMUNICATIONS TEST/ARM button on the HEU, which will display the ARMD message and light the EMERG ENABLED status LED at the same time. If NOT ARMD appears on the HEU, the system did not accept the arming sequence. Repeat steps above. Some foreign HEU/EOT systems are self-arming when telemetry is established and may be so indicated by a "*" displayed on the HEU.

Rule Updated Date

January 20, 2012

32.9.4: Testing HEU/EOT

32.9.4 *49 CFR 232.407 232.409*	**Testing HEU/EOT** To test the emergency application capability from the rear of the train, do the following: 1. Close the angle cock ahead of the last car. 2. Initiate an EOT emergency from the lead locomotive HEU. The brake pipe pressure on the EOT must reduce to 0-psi. 3. Open the angle cock and determine that brake pipe pressure is restored before proceeding.

	A. Establishing Communications If the End of Train Telemetry System is unable to establish communications at the installation point, train may be moved a maximum of one mile at Restricted Speed in an attempt to establish communications. **B. Engineer Notification** When the test of the emergency application capability from the rear is conducted, the engineer must be notified verbally or in writing that the test was successfully performed. If verbal notification is made, the train crew must record this notification on Air Brake Test form. The written notification must include the following: • Date and Time of test. • Location of test. • Name of employee conducting test. Written notification must be maintained in the cab of the controlling locomotive.

Rule Updated Date

January 20, 2012

32.9.5: Emergency Switch

32.9.5 *49 CFR 232.409*	**Emergency Switch** Once a system is properly armed, an emergency brake application can be made at any time. To initiate an emergency brake application at the end of the train: 1. Lift the red cover of the EMERGENCY SWITCH. 2. Push the toggle switch up. 3. Verify that: a. The EMERGENCY message briefly appears in the message display window. b. The brake pipe pressure reading quickly drops to 0-psi. c. The LOW PRES message is displayed while the last car pressure is below 45-psi.

Rule Updated Date

January 20, 2012

32.9.6
 	
49 CFR 232.407
 	
Reference Rule Glossary
	Loss of Emergency Application Capability from Rear of Train
	Trains required to be equipped with rear-of-train emergency capability are considered to have an en route failure when any one of the following conditions occurs:
	
	• EOT/HEU indicates:
	  • Loss of front to rear communication. Message = FR NOCOM or NOCOM.
	  • Emergency valve not enabled. Message = NOT ARMD and/or "Emergency Enabled" indicator NOT illuminated.
	  • Emergency valve failure or EOT valve failure. Message = VALVFAIL.
	• Loss of communication exceeding 16 minutes 30 seconds as indicated by control console for distributed power locomotive on lead controlling locomotive at head end of train.
	• A loss of voice radio communication between a manned helper, caboose, or passenger equipment at the rear of the train and the lead controlling locomotive.
	
	When an en route failure occurs:
	
	• On other than mountain grades:
	  • Train must not exceed 30 MPH.
	  • Notify dispatcher.
	• On mountain grades, train must not proceed until:
	  • Failure is corrected.
	
	  or
	
	  • Another method of compliance is used.
	
	When communication is lost on mountain grade, a train may:
	
	• Move a train length to attempt to reestablish communication or sufficient distance to clear obstruction.
	• Move train in sections due to en route failure.
	• Continue during a loss of radio communication between the employee at rear of train, provided train does not exceed 5 MPH above maximum authorized speed.
	
	In the event of an emergency, use the emergency toggle switch to initiate emergency application, even if NO COM condition exists.

Rule Updated Date

May 2, 2016

34.2.6: Cresting Grade

34.2.6	**Cresting Grade** When approaching and cresting a grade: 1. Reduce the throttle as the lead locomotive crests the grade. 2. On the lead consist, continue to reduce the throttle and/or apply dynamic brake when necessary to keep the speed from increasing or make slack adjustments. 3. When cresting grade with cut-in help and or rear helper(s), reduce helper throttle consistent with good train handling to minimize in train forces, utilizing independent mode as needed. When operating in heavy or mountain grades, refer to System Special Instructions and/or site specific train handling instructions for additional requirements.

Rule Updated Date

May 2, 2016

34.3: Grade Operations

34.3	**Grade Operations** The following must be considered when operating in grade territory: • Tons per operative brake. • Tons per dynamic brake axle. • Percent of grade. • Track curvature. • Rail and weather conditions. • Train speed, ensuring that maximum speed is consistent with grade limitations required by area timetables. • Train Make-Up. • Distributed Power Placement.

Rule Updated Date

May 2, 2016

34.3.1: Balance Braking

34.3.1	**Balance Braking**
	When a constant speed on a grade is required for long distances, use a combination of train air brakes and dynamic brake as follows: 1. Make a minimum brake pipe reduction when dynamic brake is not sufficient to maintain speed. 2. Use additional reductions until the desired speed is maintained. 3. If a greater than 18-psi brake pipe reduction is required to control train speed, stop the train using emergency application and inspect to determine reason before proceeding. **Exception:** If an 18-psi reduction is due to Equalizing Reservoir leakage, apply Item 4 below. 4. If equalizing reservoir leakage is discovered and speed is decreasing, stop and secure the train, if necessary. After placing the automatic brake handle in release, place the brake valve cutoff valve in PASSENGER, if equipped. While operating in PASSENGER, movement of the automatic brake valve handle toward RELEASE will release the brakes throughout the train. When practicable, use a combination of train air brakes and dynamic brake to control speed when operating on descending grades exceeding 1.75%.

Rule Updated Date

UPRR - Air Brake and Train Handling Rules, effective May 2, 2016 (with updates September 19, 2018)

Glossary

Balanced Braking
The combined use of train air brakes and dynamic brake to stabilize, increase, or decrease train speed on a descending grade.

Grade (of Track)
Grade is other than level track and is usually expressed as a percentage. The percentage is the number of feet the track rises or falls in a distance of 100 feet. For example, a 1% ascending grade means that the track rises 1 foot in elevation for every 100 feet the equipment travels on the track. Unsecured rail equipment may roll on a grade.

- Grade designations include the following:
  - Light Grade: Less than 1.0%.
  - Heavy Grade: At least 1.0% for a distance of 3 miles or more.
  - Mountain Grade: 2.0% or greater for a distance of 2 miles or more.

Tons per Dynamic Brake Axle (TPDBA)
The total gross trailing tonnage of the train divided by the total number of dynamic brake axles, including helper locomotives, operating in dynamic brake.

When making this calculation, include in the gross trailing tonnage the weight of any locomotive, including a helper locomotive, not operating in dynamic brake or with dynamic brake cut-out.

Tons per Operative Brake (TPOB)
The gross trailing tonnage of the train divided by the total number of cars having operative brakes in the train. There is 1 brake per conventional car (See SSI Item 2-F, Table C for other car types).

UPRR - North Platte Area Timetable No. 5 - Laramie Subdivision, Effective: 12/11/2017

SI-12 TONNAGE RESTRICTIONS/TPOB

Maximum Gross Weight Restrictions:
158 Tons, Restrictions A and N.
Tonnage/Speed Restrictions – Freight Trains
Eastward Buford CP W536 to Cheyenne CPW511
On MT 1 and MT 2. Maximum allowable speed applies until lead engine reaches CP W511

Tons Per Operative Brake:	Tons Per Dynamic Brake Axle:	Maximum Speed
59 or less	No Dynamic Required	No restrictions
60-79	500 or less	No restrictions
	Over 500	25 MPH
80-99	500 or less	35 MPH
	Over 500	25 MPH
100-132	250 or less	35 MPH
	251 to 350	30 MPH
	351 to 750	25 MPH
	Over 750	20 MPH

UPRR - System Special Instructions

Effective June 1, 2018
Includes Updates as of October 3, 2018

Item 8: Heavy and Mountain Grade Operations

1. Descending Grade Requirements

Cresting the Summit "CG"

When freight trains (leading locomotive) and light locomotive consists crest the summit of grades listed below as "CG", speed must be at least 5 MPH below the maximum authorized speed.

Descending Grades

When operating freight trains or light locomotive consists on descending grades between locations listed below as 1% or 2%, if train speed reaches 5 MPH above maximum authorized speed:,

- Stop movement immediately, using an emergency brake application.
- When operating light locomotives consists, actuate and fully apply independent brake.
- After stopping, apply hand brakes as required to prevent movement.
- Do not move the train until authorized by a Designated Supervisor of Locomotive Engineers.

Refer to Rule 34.2.10 Emergency Brake Applications.