

valve at the rear of the train within one second.

(b) The rear unit of the device shall send an acknowledgment message to the front unit immediately upon receipt of an emergency brake application command. The front unit shall listen for this acknowledgment and repeat the brake application command if the acknowledgment is not correctly received.

(c) The rear unit, on receipt of a properly coded command, shall open a valve in the brake line and hold it open for a minimum of 15 seconds. This opening of the valve shall cause the brake line to vent to the exterior.

(d) The valve opening shall have a minimum diameter of $\frac{3}{4}$ inch and the internal diameter of the hose shall be $\frac{5}{8}$ inch to effect an emergency brake application.

(e) The front unit shall have a manually operated switch which, when activated, shall initiate an emergency brake transmission command to the rear unit or the locomotive shall be equipped with a manually operated switch on the engineer control stand designed to perform the equivalent function. The switch shall be labeled "Emergency" and shall be protected so that there will exist no possibility of accidental activation.

(f) All locomotives ordered on or after August 1, 2001, or placed in service for the first time on or after August 1, 2003, shall be designed to automatically activate the two-way end-of-train device to effectuate an emergency brake application whenever it becomes necessary for the locomotive engineer to place the train air brakes in emergency.

(g) The availability of the front-to-rear communications link shall be checked automatically at least every 10 minutes.

(h) Means shall be provided to confirm the availability and proper functioning of the emergency valve.

(i) Means shall be provided to arm the front and rear units to ensure the rear unit responds to an emergency command only from a properly associated front unit.

§ 232.407 Operations requiring use of two-way end-of-train devices; prohibition on purchase of nonconforming devices.

(a) *Definitions.* The following definitions are intended solely for the purpose of identifying those operations subject to the requirements for the use of two-way end-of-train devices.

(1) *Heavy grade* means:

(i) For a train operating with 4,000 trailing tons or less, a section of track with an average grade of two percent or greater over a distance of two continuous miles; and

(ii) For a train operating with greater than 4,000 trailing tons, a section of track with an average grade of one percent or greater over a distance of three continuous miles.

(2) *Train* means one or more locomotives coupled with one or more rail cars, except during switching operations or where the operation is that of classifying cars within a railroad yard for the purpose of making or breaking up trains.

(3) *Local train* means a train assigned to perform switching en route which operates with 4,000 trailing tons or less and travels between a point of origin and a point of final destination, for a distance that is no greater than that which can normally be operated by a single crew in a single tour of duty.

(4) *Work train* means a non-revenue service train of 4,000 trailing tons or less used for the administration and upkeep service of the railroad.

(5) *Trailing tons* means the sum of the gross weights—expressed in tons—of the cars and the locomotives in a train that are not providing propelling power to the train.

(b) *General.* All trains not specifically excepted in paragraph (e) of this section shall be equipped with and shall use either a two-way end-of-train device meeting the design and performance requirements contained in § 232.405 or a device using an alternative technology to perform the same function.

(c) *New devices.* Each newly manufactured end-of-train device purchased by a railroad after January 2, 1998 shall be a two-way end-of-train device meeting the design and performance requirements contained in § 232.405 or a device

using an alternative technology to perform the same function.

(d) *Grandfathering.* Each two-way end-of-train device purchased by any person prior to July 1, 1997 shall be deemed to meet the design and performance requirements contained in § 232.405.

(e) *Exceptions.* The following types of trains are excepted from the requirement for the use of a two-way end-of-train device:

(1) Trains with a locomotive or locomotive consist located at the rear of the train that is capable of making an emergency brake application, through a command effected by telemetry or by a crew member in radio contact with the controlling locomotive;

(2) Trains operating in the push mode with the ability to effectuate an emergency brake application from the rear of the train;

(3) Trains with an operational caboose placed at the rear of the train, carrying one or more crew members in radio contact with the controlling locomotive, that is equipped with an emergency brake valve;

(4) Trains operating with a secondary, fully independent braking system capable of safely stopping the train in the event of failure of the primary system;

(5) Trains that do not operate over heavy grades and do not exceed 30 mph;

(6) Local trains, as defined in paragraph (a)(3) of this section, that do not operate over heavy grades;

(7) Work trains, as defined in paragraph (a)(4) of this section, that do not operate over heavy grades;

(8) Trains that operate exclusively on track that is not part of the general railroad system;

(9) Trains that must be divided into two sections in order to traverse a grade (e.g., doubling a hill). This exception applies only to the extent necessary to traverse the grade and only while the train is divided in two for such purpose;

(10) Passenger trains in which all of the cars in the train are equipped with an emergency brake valve readily accessible to a crew member;

(11) Passenger trains that have a car at the rear of the train, readily accessible to one or more crew members in

radio contact with the engineer, that is equipped with an emergency brake valve readily accessible to such a crew member; and

(12) Passenger trains that have twenty-four (24) or fewer cars (not including locomotives) in the consist and that are equipped and operated in accordance with the following train-configuration and operating requirements:

(i) If the total number of cars in a passenger train consist is twelve (12) or fewer, a car located no less than half-way through the consist (counting from the first car in the train) must be equipped with an emergency brake valve readily accessible to a crew member;

(ii) If the total number of cars in a passenger train consist is thirteen (13) to twenty-four (24), a car located no less than two-thirds (2/3) of the way through the consist (counting from the first car in the train) must be equipped with an emergency brake valve readily accessible to a crew member;

(iii) Prior to descending a section of track with an average grade of two percent or greater over a distance of two continuous miles, the engineer of the train shall communicate with the conductor, to ensure that a member of the crew with a working two-way radio is stationed in the car with the rearmost readily accessible emergency brake valve on the train when the train begins its descent; and

(iv) While the train is descending a section of track with an average grade of two percent or greater over a distance of two continuous miles, a member of the train crew shall occupy the car that contains the rearmost readily accessible emergency brake valve on the train and be in constant radio communication with the locomotive engineer. The crew member shall remain in this car until the train has completely traversed the heavy grade.

(f) *Specific requirements for use.* If a train is required to use a two-way end-of-train device:

(1) That device shall be armed and operable from the time the train departs from the point where the device is installed until the train reaches its destination. If a loss of communication occurs at the location where the device is installed, the train may depart the

location at restricted speed for a distance of no more than one mile in order to establish communication. When communication is established, the quantitative values of the head and rear unit shall be compared pursuant to § 232.409(b) and the device tested pursuant to § 232.409(c), unless the test was performed prior to installation.

(2) The rear unit batteries shall be sufficiently charged at the initial terminal or other point where the device is installed and throughout the train's trip to ensure that the end-of-train device will remain operative until the train reaches its destination.

(3) The device shall be activated to effectuate an emergency brake application either by using the manual toggle switch or through automatic activation, whenever it becomes necessary for the locomotive engineer to initiate an emergency application of the air brakes using either the automatic brake valve or the conductor's emergency brake valve.

(g) *En route failure of device on a freight or other non-passenger train.* Except on passenger trains required to be equipped with a two-way end-of-train device (which are provided for in paragraph (h) of this section), en route failures of a two-way end-of-train device shall be handled in accordance with this paragraph. If a two-way end-of-train device or equivalent device fails en route (*i.e.*, is unable to initiate an emergency brake application from the rear of the train due to certain losses of communication (front to rear) or due to other reasons, the speed of the train on which it is installed shall be limited to 30 mph until the ability of the device to initiate an emergency brake application from the rear of the train is restored. This limitation shall apply to a train using a device that uses an alternative technology to serve the purpose of a two-way end-of-train device. With regard to two-way end-of-train devices, a loss of communication between the front and rear units is an en route failure only if the loss of communication is for a period greater than 16 minutes and 30 seconds. Based on the existing design of the devices, the display to an engineer of a message that there is a communication failure indicates that communication has been

lost for 16 minutes and 30 seconds or more.

(1) If a two-way end-of-train device fails en route, the train on which it is installed, in addition to observing the 30-mph speed limitation, shall not operate over a section of track with an average grade of two percent or greater for a distance of two continuous miles, unless one of the following alternative measures is provided:

(i) Use of an occupied helper locomotive at the end of the train. This alternative may be used only if the following requirements are met:

(A) The helper locomotive engineer shall initiate and maintain two-way voice radio communication with the engineer on the head end of the train; this contact shall be verified just prior to passing the crest of the grade.

(B) If there is a loss of communication prior to passing the crest of the grade, the helper locomotive engineer and the head-end engineer shall act immediately to stop the train until voice communication is resumed, in accordance with the railroad's operating rules.

(C) If there is a loss of communication once the descent has begun, the helper locomotive engineer and the head-end engineer shall act to stop the train, in accordance with the railroad's operating rules, if the train has reached a predetermined rate of speed that indicates the need for emergency braking.

(D) The brake pipe of the helper locomotive shall be connected and cut into the train line and tested to ensure operation.

(ii) Use of an occupied caboose at the end of the train with a tested, functioning brake valve capable of initiating an emergency brake application from the caboose. This alternative may be used only if the train service employee in the caboose and the engineer on the head end of the train establish and maintain two-way voice radio communication and respond appropriately to the loss of such communication in the same manner as prescribed for helper locomotives in paragraph (g)(1)(i) of this section.

(iii) Use of a radio-controlled locomotive at the rear of the train under continuous control of the engineer in

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the head end by means of telemetry, but only if such radio-controlled locomotive is capable of initiating an emergency application on command from the lead (controlling) locomotive.

(2) If a two-way end-of-train device fails en route while the train on which it is installed is operating over a section of track with an average grade of two percent or greater for a distance of two continuous miles, the train shall be brought safely to a stop at the first available location in accordance with the railroad's operating rule, except the train may continue in operation if the railroad provides one of the alternative measures detailed in paragraph (g)(1) of this section.

(h) *En route failure of device on a passenger train.* (1) A passenger train required to be equipped with a two-way end-of-train device that develops an en route failure of the device (as explained in paragraph (g) of this section) shall not operate over a section of track with an average grade of two percent or greater over a distance of two continuous miles until an operable two-way end-of-train device is installed on the train or an alternative method of initiating an emergency brake application from the rear of the train is achieved.

(2) Except as provided in paragraph (h)(1) of this section, a passenger train required to be equipped with a two-way end-of-train device that develops an en route failure of the device (as explained in paragraph (g) of this section) shall be operated in accordance with the following:

(i) A member of the train crew shall be immediately positioned in the car which contains the rearmost readily accessible emergency brake valve on the train and shall be equipped with an operable two-way radio that communicates with the locomotive engineer; and

(ii) The locomotive engineer shall periodically make running tests of the train's air brakes until the failure is corrected; and

(3) Each en route failure shall be corrected at the next location where the necessary repairs can be conducted or at the next location where a required

brake test is to be performed, whichever is reached first.

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§ 232.409 Inspection and testing of end-of-train devices.

(a) After each installation of either the front or rear unit of an end-of-train device, or both, on a train and before the train departs, the railroad shall determine that the identification code entered into the front unit is identical to the unique identification code on the rear unit.

(b) After each installation of either the front or rear unit of an end-of-train device, or both, on a train and before the train departs, the functional capability of the device shall be determined, after charging the train, by comparing the quantitative value of the air pressure displayed on the front unit with the quantitative value of the air pressure displayed on the rear unit or on a properly calibrated air gauge. The end-of-train device shall not be used if the difference between the two readings exceeds three pounds per square inch.

(c) A two-way end-of-train device shall be tested at the initial terminal or other point of installation to determine that the device is capable of initiating an emergency power brake application from the rear of the train. If this test is conducted by a person other than a member of the train crew, the locomotive engineer shall be notified that a successful test was performed. The notification required by this paragraph may be provided to the locomotive engineer by any means determined appropriate by the railroad; however, a written or electronic record of the notification shall be maintained in the cab of the controlling locomotive and shall include the date and time of the test, the location where the test was performed, and the name of the person conducting the test.

(d) The telemetry equipment shall be tested for accuracy and calibrated if necessary according to the manufacturer's specifications and procedures at least every 368 days. The 368 days shall not include a shelf-life of up to 92 days prior to placing the unit in service. This test shall include testing radio