TRACK TRAIN DYNAMICS

AAR
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GUIDELINES FOR:

TRAIN HANDLING
TRAIN MAKEUP
TRACK & STRUCTURE
ENGINEER EDUCATION

Government – Industry Research Program on Track Train Dynamics

TRACK TRAIN DYNAMICS

TO IMPROVE FREIGHT TRAIN PERFORMANCE

Government – Industry Research Program on Track Train Dynamics

1. DEFINITIONS AND FUNCTIONS OF EQUIPMENT

1.1 GENERAL

"A" Unit - A locomotive unit equipped with a cab and operating controls.

AB Control Valve (Including related schedules such as ABD, etc.) - The operating device used on freight cars which directs air from the brake pipe to replenish the auxiliary and emergency reservoirs, accomplishes the release of air in the reservoir to the brake cylinder for the various types of brake applications, and also directs the release of the car brake by releasing the pressure in the brake cylinder. It performs each of these operations by sensing a difference in pressure between the brake pipe and the auxiliary reservoir.

ABD Control Valve - Incorporates the same basic features and function as the AB valve, plus an accelerated service release feature, and a modified means of bleeding cars.

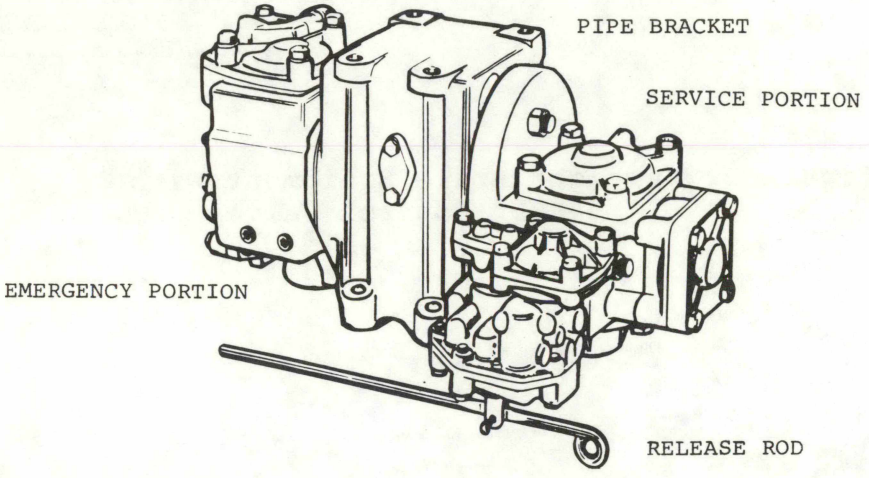


Figure 1. ABD Control Valve

Accelerated Emergency Release - A brake release feature of AB brake equipment (including ABD) whereby the brake system of each car assists in recharging the brake pipe after an emergency brake application by permitting air under pressure from the brake cylinder and auxiliary reservoir at each car to flow into the brake pipe, adding to the initial surge of the brake pipe recharge.

Accelerated Service Release - A brake release feature designed into ABD freight brake equipment which functions to assist brake pipe recharging after a service application by permitting air under pressure from the emergency reservoir at each car, to flow into the brake pipe, increasing brake pipe pressure, which in turn serially transmits release rapidly through the train. Brake release on a train equipped with ABD brakes is much faster, because of this feature.

Adhesion - The coefficient of friction between the wheel and the rail in the longitudinal direction, for acceleration and retardation. It is a direct indicator of the amount of turning force the wheel can impart on the rail before wheel slip occurs.

Example: high adhesion (dry, sanded rail) would mean a higher tractive effort can be achieved before wheel slip occurs.

low adhesion (wet rails) would mean less tractive effort can be achieved before wheel slip occurs.

A locomotive, with good rail conditions, can normally transfer between 20% and 25% of its weight into tractive effort.

Adverse Dynamic Behavior - Motion which is unfavorable to the movement of trains or individual cars, and will, in extreme cases, cause the derailment of a train, or damage the track structure. Examples of adverse dynamic behavior include rock-and-roll, truck hunting and vertical bounce.

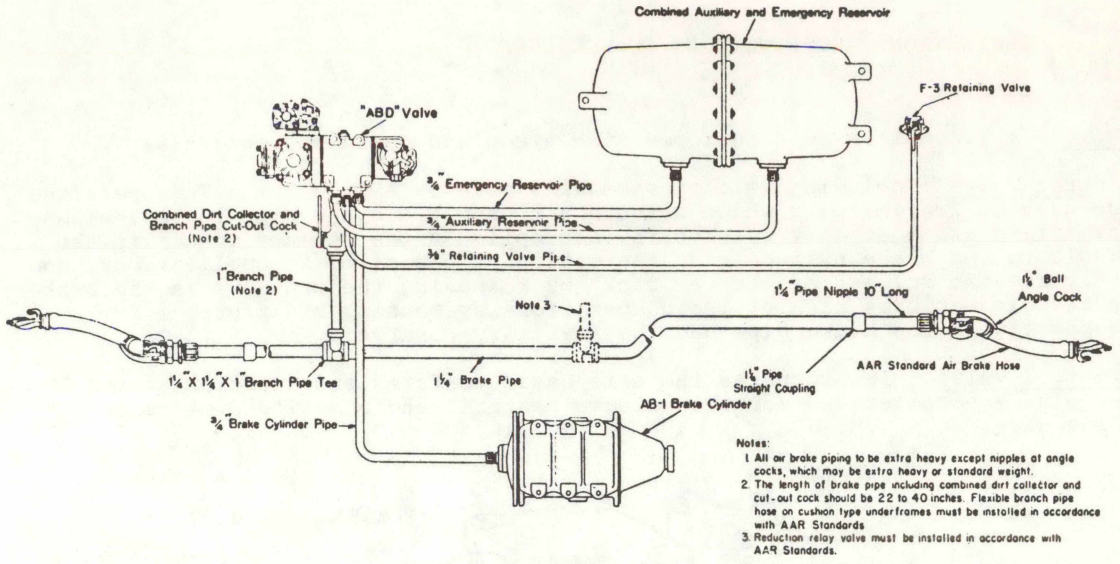


Figure 2. Freight Brake Equipment With "ABD" Control Valve

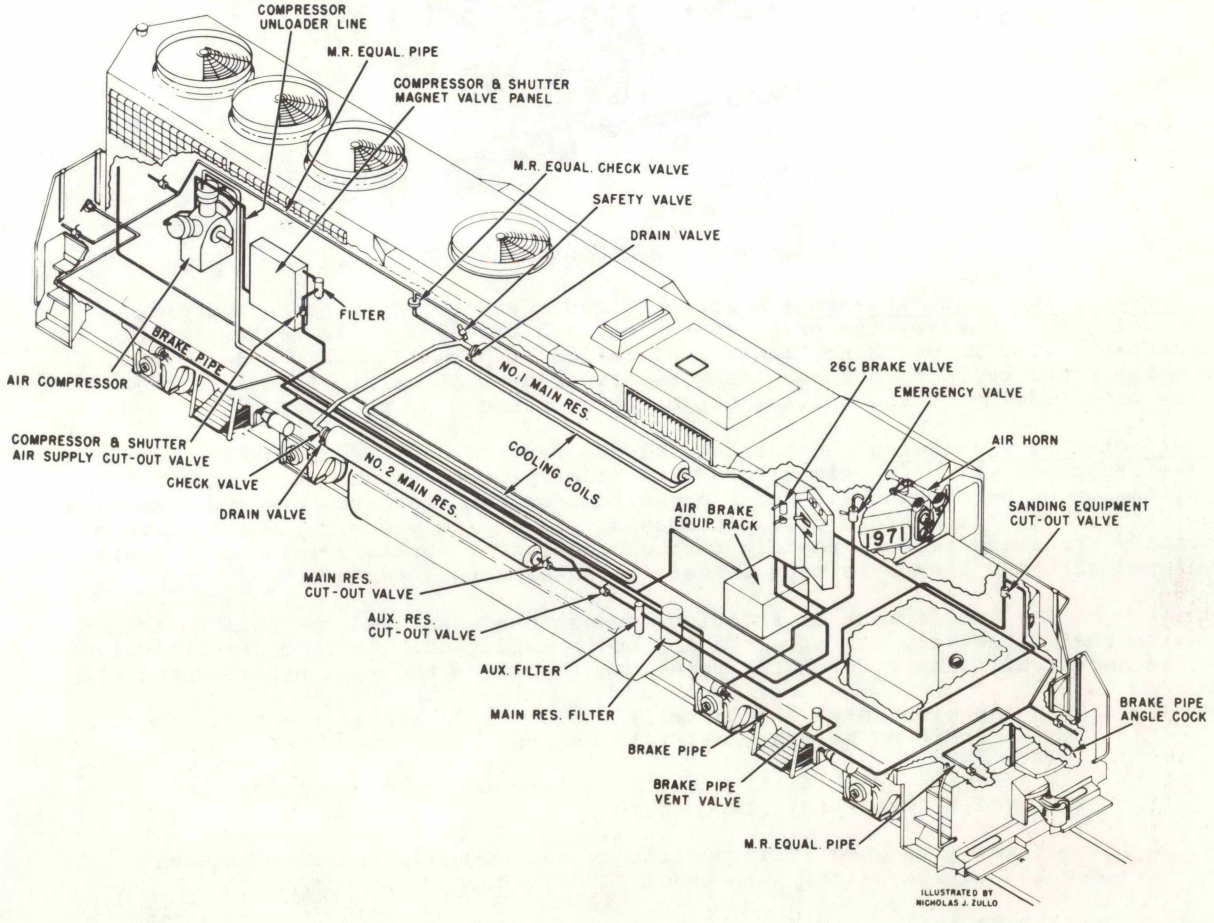


Figure 3. Typical Arrangement Of Locomotive Air Brake Components

Air Brake Hose - A reinforced tubing attached to a nipple that screws into the angle cock at the end of the brake pipe of each car or locomotive. The other end of the hose is fitted with a coupling (gladhand) which engages with an identical coupling on the adjoining car. The complete arrangement forms a flexible air connection between the brake pipes of the cars and locomotives throughout the train.

Air Brake System - All of the mechanisms and components necessary to formulate a pneumatic brake for retarding or stopping a locomotive and the individual cars of a train. Air compressors, control valves, piping, brake cylinders, and brake rigging are the major components of such a system. (See Figures 2 & 3)

Air Compressor - A device, usually of the piston and cylinder form, used to compress air. A compressor can be found on all locomotives, for the purpose of supplying compressed air to the brake system and other air operated devices, such as pneumatic relays, air horns, windshield wipers, bell, etc.

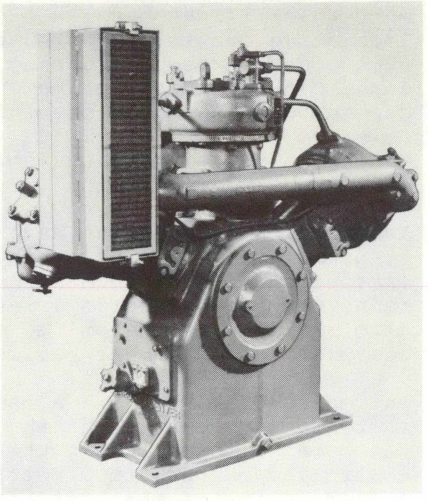


Figure 4. Air Compressor

Air Gauge - An instrument installed on all motive power and cabooses, for indicating air pressures of the locomotive and train air brake pipe. The ability of air gauges to indicate air pressures in the brake pipe and associated components is of significant importance to overall train operation.

Measurement of the train brake pipe pressure, main reservoir pressure, pressure in the locomotive brake cylinders, and the pressure in the equalizing reservoir, are all observed on air gauges in the locomotive.

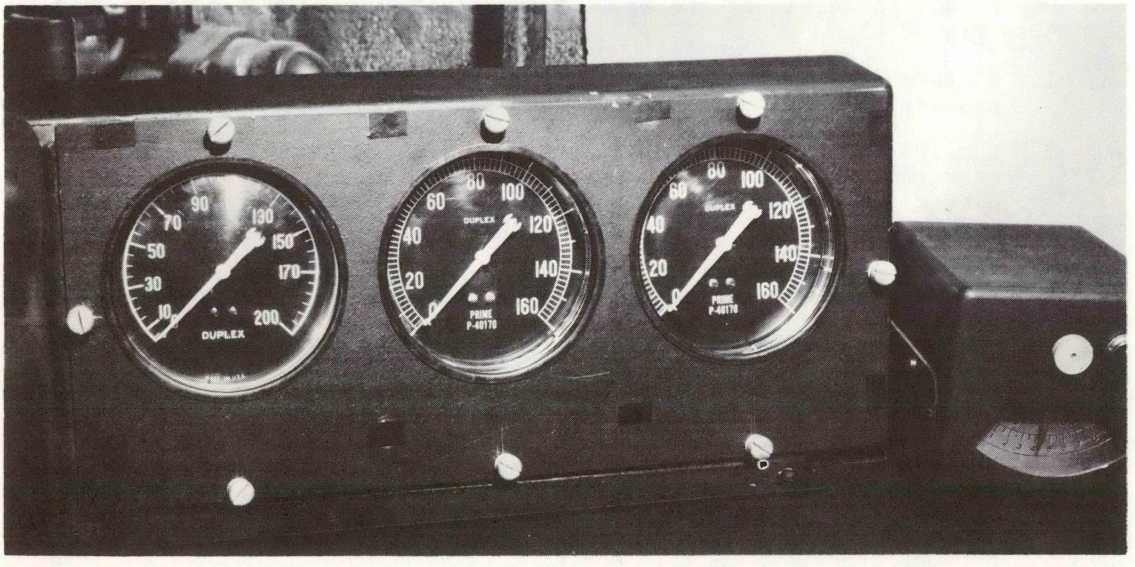


Figure 5. Locomotive Air Gauges

Alignment Control Couplers - Specially equipped couplers installed on some locomotives that will allow only limited lateral movement when in buff. This reduces lateral forces on the track, when in buff, and therefore reduces the possibility of rail turnover and jackknifing of the locomotive consist.

Ampere (Amperage, Amps) - The standard unit for measuring the flow of electric charge. The electrical term "ampere" is analogous to water flow in piping measured in gallons per minute.

Angle Cock - A valve located at each end of locomotives and cars used to open or close the brake pipe. The handle is hinged so as to lock in either the open or closed position.

Anti-Wheel Slip Control - A system to detect a sliding or slipping wheel of a locomotive consist. The Anti-Wheel Slip Control will attempt to correct some such occurrences by reducing the power supplied to the traction motors, adding sand, causing an air brake application, or a combination of the three, depending on the type of equipment installed.

Ascending Grade - See the definitions of "Light Ascending Grade" and "Heavy Ascending Grade."

Association of American Railroads - The AAR, formed in 1934, is the organization of principal railroads of the United States, Canada and Mexico, which deals with matters of common concern in the whole field of railroading: operations, maintenance, engineering, research and others. Standardization of equipment is also a major responsibility of the AAR, to allow for common interchange of equipment among member railroads.

Automatic Brake Valve - A manually operated pneumatic valve on the locomotive that provides control of the train brakes. The automatic brake valve provides this control by enabling the engineman to draw air from the brake pipe in a controlled manner, thus setting the brakes throughout the train. Following is a description of the basic groups of automatic brake valves currently in use by North American Railroads. They are the No. 6, 24 RL, and 26 L brake equipment.

No. 6 BRAKE EQUIPMENT:

Modifications have been made to the basic No. 6 type brake equipment as new developments and techniques were applicable to provide an upgrading of the equipment. Thus use of new style distributing valves, brake application valves, and multiple-uniting features have made this equipment far advanced in relation to the features available at the time it was first introduced.

The handle positions of the No. 6 Automatic Brake Valve are as follows: (See Figure 6)

1. RELEASE position* - A position that provides a large and direct passage from the main reservoir to the brake pipe.

2. RUNNING position - This is the proper position of the handle for charging and releasing the train brakes. In this position, a large direct passage connects the feed valve to brake pipe, thereby providing control of the charging pressure.

3. HOLDING position* - A position that provides for keeping locomotive brakes applied while releasing the train brakes.

4. LAP position - This position is used when it is desired to hold the train brakes applied after a service application. All ports in the locomotive brake valve are closed and no charging or further reduction of the brake pipe can occur.

5. SERVICE position - In service position, the equalizing reservoir pressure is reduced, which in turn reduces the brake pipe pressure at a service rate, thereby causing the brakes to apply.

6. EMERGENCY position - This position is used when the most rapid and heavy application of the brakes is desired or required. Large and

*These positions are usually blocked out.

direct openings are made through the rotary valve to vent the equalizing reservoir and brake pipe pressure to atmosphere at an emergency rate, thereby causing the brakes to rapidly apply and give maximum braking force in the shortest possible time.

24 RL BRAKE EQUIPMENT:

This brake equipment is a refinement of that used originally in high speed passenger service. 24 RL brake equipment can be converted for any type of freight or passenger service by adding the necessary portions that produce any of the desired features. For this reason, there are many different versions in use, and four different categories of this type brake equipment can be found in use throughout the railroad industry.

The handle positions of the automatic brake valve are indicated below: (See Figure 7)

Groups II and III are equipped with brake pipe pressure maintaining features, but of different types. Basically, Group II brake equipment maintains the brake pipe pressure in FIRST SERVICE position and Group III maintains it in the LAP position. Group III equipment poses no problem, since the brake valve handle is normally returned to LAP position after a service reduction. With Group II equipment, after the service equalizing reservoir reduction is made, the brake valve handle is returned to the FIRST SERVICE position with no pause at the LAP position while air is still exhausting from the service exhaust port. The handle must not be moved from FIRST SERVICE position to RUNNING or LAP positions, then returned to FIRST SERVICE position.

Split service reductions can be made by moving the handle from FIRST SERVICE to SERVICE and returning immediately to FIRST SERVICE position.

It is important that the brake pipe pressure-maintaining feature be cut out during the conduct of train air brake tests. This feature is cut out on Group II brake equipment by using LAP position after service reductions instead of moving the handle to the FIRST SERVICE position. The pressure-maintaining feature on Group III brake equipment may be cut out by means of a valve located at the base of the automatic brake valve stand. The two available positions are marked OUT and IN.

26 L BRAKE EQUIPMENT with the 26 C BRAKE VALVE:

The 26 L Brake Equipment is the most modern brake equipment available and utilizes new design characteristics, which include a simplified structure of internal parts. The use of diaphragm-operated pistons and spool valves with rubber "0" rings eliminate the ring-fitted pistons and slide valves found in older brake equipment.

26 C AUTOMATIC BRAKE VALVE:

The 26 C automatic brake valve is a self-lapping brake valve, and consists of two main portions: the automatic portion, designed for regulating the brake pipe pressure that controls both locomotive and train brakes, and the independent portion arranged to apply and release the locomotive brakes independently of the train brakes and to control the release of a locomotive automatic brake application independent of the train brakes.

The automatic brake valve also provides a brake pipe pressure-maintaining feature which maintains brake pipe pressure against leakage, as related to the equalizing reservoir pressure, unless the brake cutoff valve is placed in the OUT position.

The regulating valve takes the place of the feed valve that is common on other types of brake equipment. This valve regulates the supply and exhaust of air pressure to the equalizing reservoir, which in turn regulates the brake pipe pressure.

The automatic brake valve handle has six handle positions arranged from left to right as follows: (See Figure 8)

1. RELEASE (RUNNING) position - This position is for charging the equipment and releasing the locomotive and train brakes. It is located with

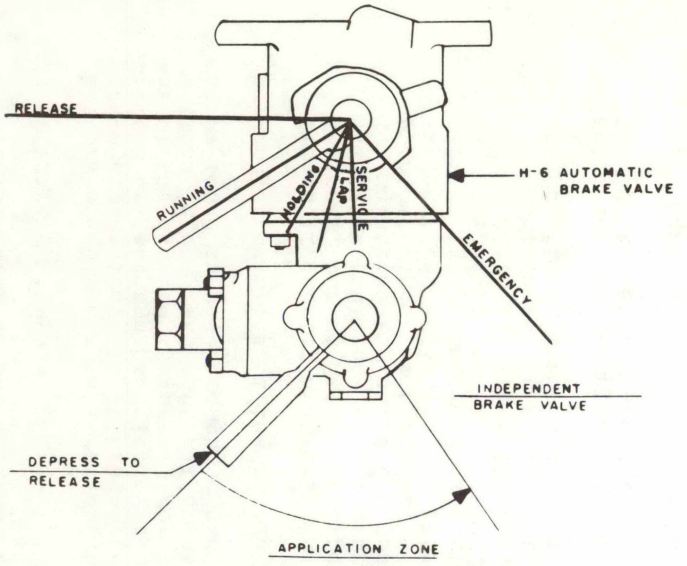


Figure 6. No. 6-BL Brake Equipment:
Brake Valve Handle Positions

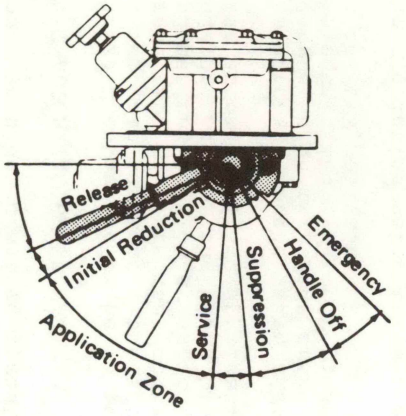
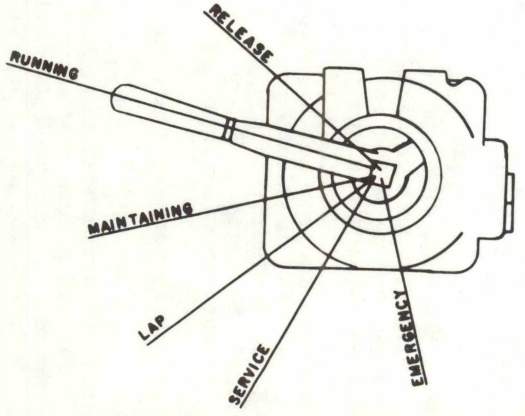
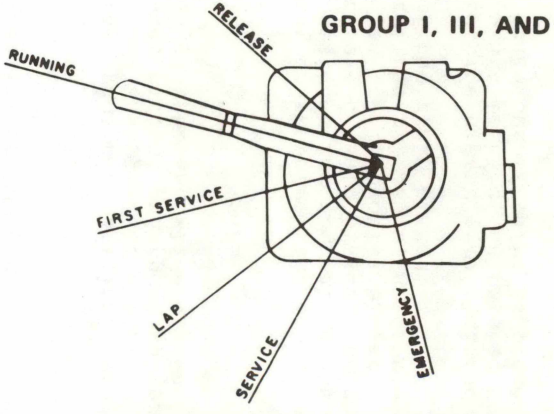


Figure 8. No. 26-L Brake Equipment:
Automatic Brake
Valve Handle Positions



GROUP II – MAINTAIN IN FIRST SERVICE



GROUP III MAINTAIN IN LAP POSITION

Figure 7. No. 24-RL Brake Equipment:
Automatic Brake
Valve Handle Positions

the brake valve handle at the extreme left of the quadrant and is the normal running position.

2. MINIMUM REDUCTION position - This position is located with the brake valve handle against the first raised portion of the quadrant to the right of RELEASE position. With the brake valve handle moved to this position, a 6 to 8 pound brake pipe reduction is obtained. On some locomotives, movement of the handle to this position will nullify a penalty application caused by overspeed or safety control.

3. SERVICE position - This position consists of a sector of brake valve handle movement to the right of the MINIMUM REDUCTION position. Movement of the brake valve handle from left to right through this sector will cause the degree of brake application to be increased and automatically lapped-off until a 23 pound brake pipe reduction is obtained. Additional brake pipe reductions may be made, and a full service brake application obtained, by moving the brake valve handle further to the right on the second raised portion of the quadrant toward the HANDLE-OFF position until the desired reduction of equalizing reservoir pressure has been made. A continuous service brake pipe reduction is obtained in the HANDLE-OFF position.

4. SUPPRESSION position - This position is located with the brake valve handle against the second raised portion of the quadrant to the right of RELEASE position. Although this point on the quadrant is called the SUPPRESSION position, on some locomotives, suppression of an overspeed brake application may be made in the MINIMUM REDUCTION position, or at any point on the quadrant up to and including the HANDLE-OFF position. The brake valve handle must be placed in this position for 30 seconds to recover control of the locomotive after a safety control brake application has occurred.

5. HANDLE-OFF position - This position is located by the first quadrant notch to the right of SUPPRESSION position. The brake handle may be removed in this position. This is the position in which the handle must be placed and removed on trailing units of a multiple-unit locomotive or on locomotives being towed Dead-In Train.

   As stated under SERVICE position, a continuous service brake pipe reduction is obtained in this position.

6. EMERGENCY position - This position is located to the extreme right of the brake valve quadrant. It is used to make brake valve emergency brake applications. When an emergency brake application is initiated from other than the automatic brake valve, the handle must be moved to EMERGENCY position and left in this position for approximately 90 seconds to properly reset the A-1 Charging Cutoff Pilot Valve. The handle may then be moved to RELEASE position and the brake system will recharge.

Automatic Train Control System (ATC) - A track side system working in conjunction with equipment installed on the locomotive, so arranged that its operation will automatically result in the application of the air brakes to stop or control a train's speed at designated restrictions, should the engineer not respond. ATC usually works in conjunction with cab signals.

Automatic Train Stop System (ATS) - A track side system working in conjunction with equipment installed on the locomotive, so arranged that its operation will automatically result in the application of the air brakes at designated restrictions, to bring the train to a stop, should the engineer not respond.

Auxiliary Reservoir - A storage volume for compressed air, charged from the brake pipe, which provides air pressure for use in service and emergency brake applications. An auxiliary reservoir is located on every car, contained in the same structure as the emergency reservoir. (See Figure 9, page 1-8)

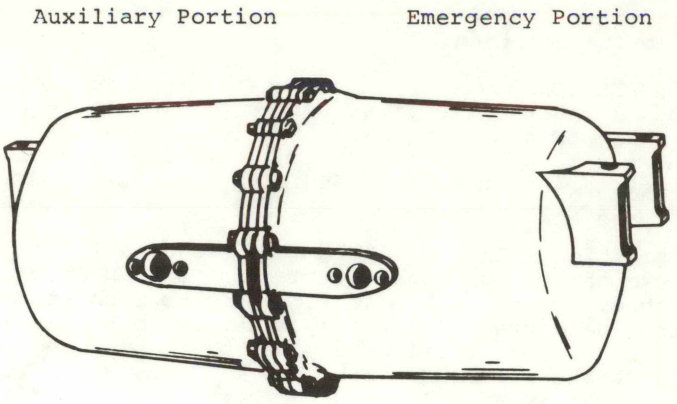


Figure 9. Freight Car Two Compartment Reservoir

"B" End of Car - The end on which the hand brake is located.

"B" Unit - A diesel unit without a cab and complete operation controls. It may be equipped with hostler controls for independent operating although they are usually used only at terminals, or places where the unit must be moved under its own power.

Back Up Hose (Tail Hose) - A portable back up valve. See "Back-Up Valve".

Back Up Valve - An air valve, either portable, as in the case of a tail hose, or permanently connected to the brake pipe (as found on the platforms of cabooses), for the purpose of applying the brakes from the rear of a train when it is necessary to make a backup movement. In the case of the portable backup valve (tail hose), it is connected, by a hose and coupling, to the brake pipe hose.

Balance Speed - The equilibrium speed at which the drawbar force exerted by the locomotive is equal to the train resistance, resulting in a constant speed. A change in drawbar force (i.e. raising or lowering the throttle or dynamic brake position) or a change in train resistance (i.e. variation in grade) will cause a corresponding change in speed until a new balance speed is reached.

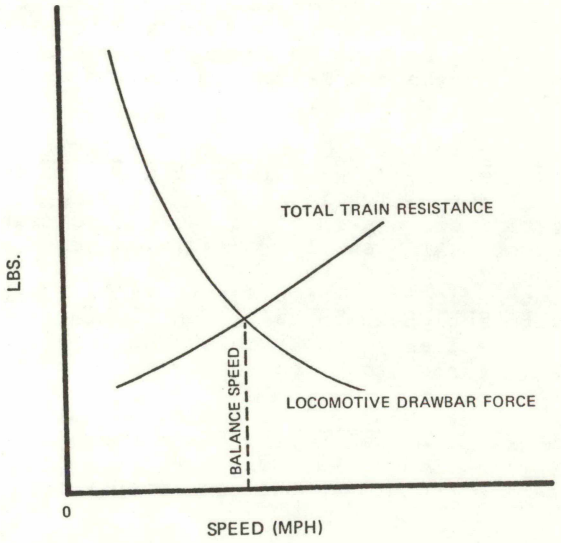


Figure 10. Balance Speed

Bleed or "Bleed Off" - A term commonly used for the venting of air pressure to the atmosphere, as in the venting of the air pressure from the brake cylinder of individual cars by manual manipulation of a release valve. This is done at yards, terminals, and other desired times to release the air application from the brake equipment on the cars to be switched. The operation of the release valve depends on the type of brake equipment.

Bleeding of AB equipment - A release valve of large capacity (which can be operated from any angle) is provided for bleeding the auxiliary and emergency reservoirs. The construction is such that both reservoirs can be discharged at the same time, or just the auxiliary reservoir alone. During either operation, brake cylinder air is also being released.

On some cars, a second rod may be found next to the regular release valve rod, which is connected to a brake cylinder release valve. In this case the brake cylinder release valve may be activated by pulling or pushing the rod connected to it, thus venting the air from the brake cylinder, but leaving both reservoir air pressures intact.

Bleeding of ABD equipment - Incorporates the same features of the AB equipment, however the second release rod is not needed because its function is also performed by the first release rod. A momentary pull on this one release rod will release only the brake cylinder air pressure. (See Figure 1)

Blocking of Couplers - A means of greatly limiting lateral coupler movement by the insertion of metal blocks next to the drawbar in the coupler pocket.

Bolster (Body) - The transverse members of the underframe of cars over the trucks which transmit the load carried by the longitudinal sills to the trucks through the center plates.

Bolster (Truck) - A beam placed across the frame of a truck to receive, through the center plate, the weight of the carbody and transfer it to the truck frame and wheels through the springs on which it is carried. (See Figure 29)

Bolster Blocks (Bolster Stops) - Metal blocks affixed to the locomotive bolster to restrict its movement relative to the truck side frame and thereby reduce the jackknifing tendencies of the locomotive car body during high buff situations.

Brake Cylinder - A cylinder with a piston and rod, located on each car and locomotive, that is operated by directing compressed air from the vehicle's own reservoir, to the piston, forcing it outward. This outward force is transmitted through the brake rigging to the brake shoes, and applies them to the locomotive or car wheels. When the compressed air is exhausted from the cylinder, the piston is returned to its normal position by a release spring, coiled around the piston rod within the cylinder.

Brake Cylinder Release Valve - A valve, located on the control valve structure under a car, for quickly releasing air from a brake cylinder without draining the auxiliary or emergency reservoirs. It is activated by either pushing or pulling a particular rod on either side of the car, which is linked mechanically to this valve. See "Bleed" for further information. (See Figure 1)

Brake Pipe (Train Line) - That section of the air brake piping of a car or locomotive which acts as a supply pipe for the reservoirs and, in the case of full pneumatic brakes, is also the sole connecting means by which the car brakes are controlled by the locomotive engineer. The pipe is usually 1¼ in. (inside diameter), and extends from one end of the car to the other. At the ends flexible hoses provide connections between the cars. When a train is made up and all brake pipes on the cars are joined together, the entire pipe line comprises what is commonly called the brake pipe. (See Figure 2)

Brake Pipe Gradient - Due to air leakages, and the intrinsic properties of air flowing through a pipe, the air pressure of the brake pipe will vary from a high at the head end of a train to a lower value at the rear. This relative difference in brake pipe pressure, head to rear, is called the brake pipe gradient.

Federal law states that this brake pipe gradient cannot be more than 15 psi. See Brake Pipe Pressure.

Brake Pipe Pressure - The amount of air pressure supplied to the brake pipe from the locomotive air compressor, expressed in pounds per square inch.

There is a gauge showing this value on both the locomotive and caboose of a train. Usual brake pipe pressure ranges from 70 to 90 lb per square inch, but may be found up to 110 psi. When the brake pipe is initially charged with a higher air pressure, more potential "stopping power" is sorted in each car. This is because air is actually being stored at a higher pressure in each of the individual car's reservoirs. (When a train is fully charged, the brake pipe, auxiliary reservoir, and emergency reservoir pressures are all equalized).

Because of these brake system characteristics, 90 psi is generally used on mountainous roads and high speed freight trains (in the 70 mph range) to provide increased stopping power. On the more level routes, 80 psi is more common.

Another reason for a higher initial brake pipe pressure is to maintain the pressure in the auxiliary reservoir after repeated air brake applications. For instance, if 20 psi is lost from the auxiliary reservoir due to brake applications, 70 psi would be left assuming the pipe was initially charged at 90 psi, 60 psi if the brake pipe was initially charged at 80 psi, etc. Therefore, heavier and more frequent brake applications can be safely made with a higher initial brake pipe pressure.

The major drawback with high brake pipe pressure is the air leakage associated with the higher pressure and wear on equipment. Federal law regulates acceptable brake pipe pressures during brake tests as follows:

1. The pressure gradient in the brake pipe from locomotive to caboose cannot be more than 15 psi.

2. The brake pipe pressure in the caboose should never be less than 60 psi.

3. The rate of air leakage in the brake pipe cannot be greater than 5 psi per minute.

Brake Pipe Vent Valve - A valve attached to the brake system of a car or locomotive which responds to an emergency rate of reduction of the brake pipe pressure, by locally venting the brake pipe at each vehicle to the atmosphere, thereby serially propagating the emergency application throughout the train. On freight cars, the brake pipe vent valve is held open on each car by the air from the quick action chamber, and will seat only after the quick action chamber is exhausted, usually 60 to 70 seconds, thus making immediate recovery from an emergency application impossible. Until such time as the brake pipe vent valve seats, the brake pipe has a direct connection to the atmosphere and the pressure in the brake pipe will remain at zero.

Braking Power - A term used to describe the ability of a train to stop. It is usually based on a tons per brake ratio, with the effect of increasing braking power when the tons per brake ratio is reduced.

Bridge or Hump Braking - A means of braking the train with the automatic brake valve, whereby the handle is not placed in service to make a reduction but instead is placed on the bridge (raised portion of the quadrant) between the positions in an attempt to attain a limited reduction and pressure maintaining.

Buff - A term used to describe compressive coupler forces.

"Bunch Braking" - A term used to describe the deceleration of a train by allowing the train to slowly run in against the locomotive, and then braking the train in this configuration. This has the effect of stopping the train with all of the slack between the cars available to aid in starting the train.

Caboose (way car, cabin car, van) - A car usually placed at the rear of a train, which provides an office and quarters for the conductor and/or trainmen while in transit, and for carrying the various supplies, tools, etc., used in freight train operations. From the caboose the crew is also able to observe the condition of the train and initiate measures to stop the train if unfavorable conditions arise.

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. Examples of caboose valves are back-up valves, conductor's valves, the A-1 and the A-2 valves.

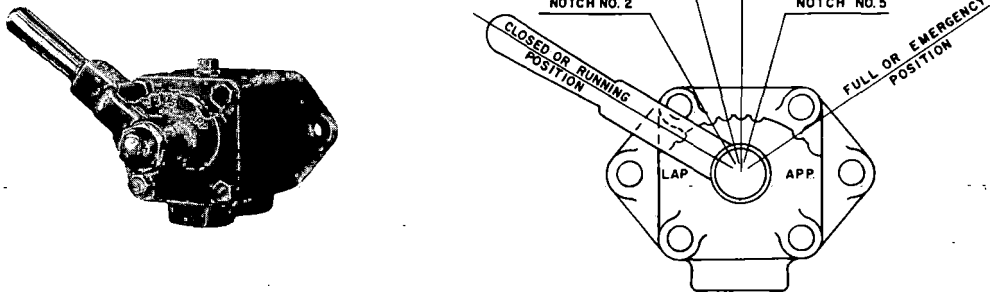


Figure 11. A-1 Caboose Valve

The A-1 and A-2 caboose valves have definite service positions as can be seen in Figure 11. Braking is increased as the handle is moved to the higher positions. The difference between the two valves is that the A-2 valve has a self latching mechanism that makes it impossible to return the handle to the running position until the handle is first moved to the FULL or EMERGENCY POSITION. The A-1 valve can be returned to the running position at any time.

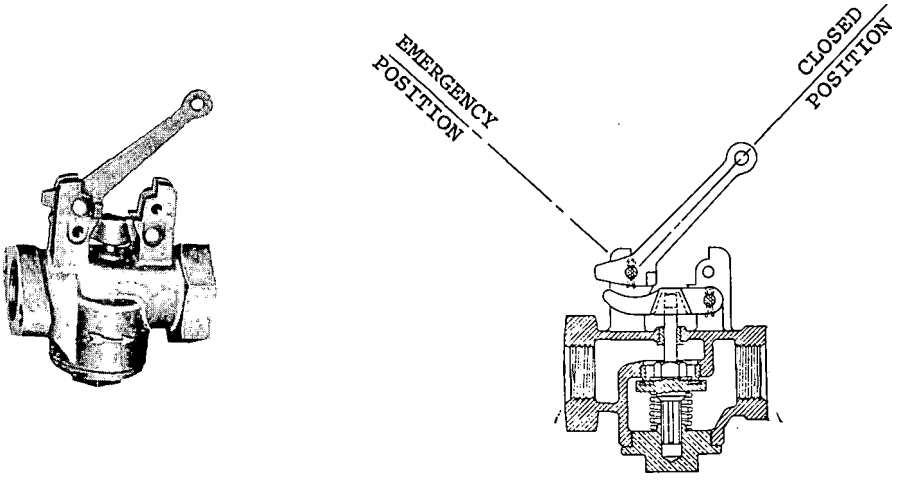


Figure 12. Conductor's Valve

The conductor's valve (emergency brake valve) may be permanently installed in a locomotive or caboose and can be used to make an emergency air brake application to the train. Unlike the A-1, A-2 valves, the conductor's valve has only two positions, closed (running) and emergency.

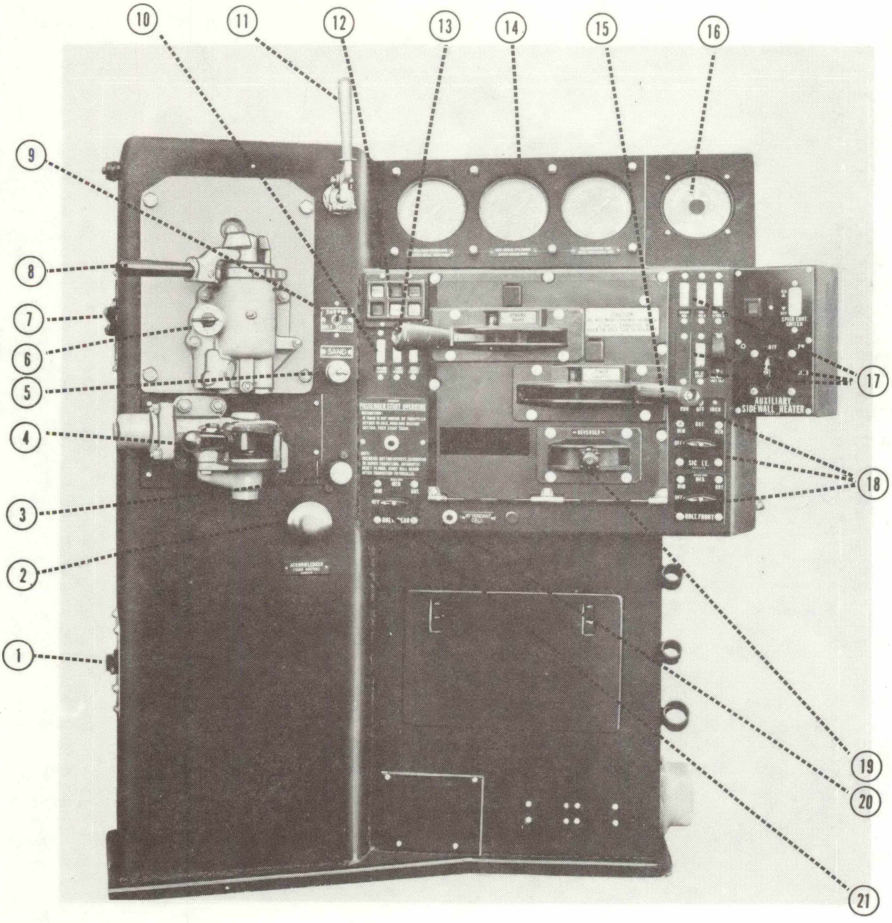


Figure 13. Locomotive

1. Dual Ported Cutout Cock (For MU)
2. Train Control Acknowledger
3. Bell Ringer Valve
4. Independent Brake Valve Handle
5. Sanding Wobble Stick
6. Cutoff Valve
7. Air Pressure Adjusting Knob
8. Automatic Brake Valve Handle
9. Sanding No. 1 Truck Switch
10. Ground, Gauge, & Step Light Switches
11. Air Horn Valve
12. Indicating Lights (Wheel Slip, PCS Open, Brake Warning, Oscillating Headlight, Sand, Speed Control Not Operating)
13. Dynamic Brake Handle
14. Air Gauge Panel
15. Throttle Handle
16. Load Current Indicator
17. Operating Switches (Control & Fuel Pump, Engine Run, Gen. Field, Dynamic Brake Circuit Breaker, & Signal Light Reset Switch)
18. Headlight Controls - Front
19. Reverser Handle
20. Attendant Call Button
21. Headlight Controls - Rear

Control Stand (AAR approved)

Cab Signal - A device or devices whereby the indication of signals on the track ahead whether clear or occupied is indicated in the cab of the locomotive by a display of colored lights or other signals.

Center Plate - One of a pair of plates which fit one into the other and which support the car body on the trucks, allowing them to turn freely under the car. The center pin or king bolt passes through both, but does not really serve as a pivot. The body center plate or male center plate is attached to the under side of the body bolster or in cast steel bolsters is made an integral part of the casting. The female or truck center plate is attached to the top side of, or cast integral with, the truck bolster. When the car is tilted, as on a curve, part of the weight is carried on the side bearings. (See Figure 29)

Center Sill - The central longitudinal member of the underframe of a car, which forms the backbone of the underframe and transmits most of the buffing shocks, from one end of the car to the other. In the AAR standard boxcar, the center sill is one of the units for which a required standard has been established. In freight cars with cushioned underframes, a special type of floating center sill construction is followed. (See Figure 25)

Clearance Diagram - An outline representing the limits to which the projecting parts on a car or locomotive extend.

Compensated Grade - A grade, the curved portion of which has been reduced by an amount sufficient to compensate for the resistance due to the curvature.

Compression of a Train - A term used to describe the application of two opposite longitudinal inward (buff) forces along a single axis of a train. Compression and bunching of a train may be thought of as the same.

Conductor's Valve - See Caboose Valve

Control Stand - The upright column upon which the throttle control, reverser handle, transistion lever, and dynamic braking control are mounted within convenient reach of the locomotive engineer on a locomotive. The air gauges and some control switches are also included on the control stand. (See Figure 13)

Control Unit - The locomotive unit from which the engineer operates the locomotive consist or consists under his control.

Control Valve - A three-way valve on locomotives and cars which charges the reservoirs and controls the application and release of air pressure to or from the brake cylinder, in response to the reduction or increase of brake pipe pressure.

On freight cars, the common control valves are the AB, ABD, and ABC-1. Common control valves on locomotives are the D-24 and 26F. A distributing valve is a term synonymous with control valve, except that it is an older term. An example of such a distributing valve is the 6-N, again found on some older locomotives.

Couplers - An appliance for connecting cars and/or locomotives together. Government regulations require that these must couple automatically by impact and must be capable of being uncoupled without going between the cars on all equipment engaged in interstate commerce. The coupler which is now standard on American railroads for freight service is called the AAR Stand Type "E" Coupler, and represents the combined work of the railroads and a group of coupler manufacturers.

Recent tank car studies have shown that some tank cars have been punctured in derailments because of car couplers coming apart, due to the lack of vertical restraint (sliding vertically through each other). Vertical restraint in all tank car couplings has been considered important enough to initiate the development of a type E coupler with a "top"and "bottom shelf". This coupler will be applied to certain cars to control vertical movement to the point that vertical separation of the couplers is virtually eliminated, regardless of the coupler type to which it is mated. (See Figure 14)

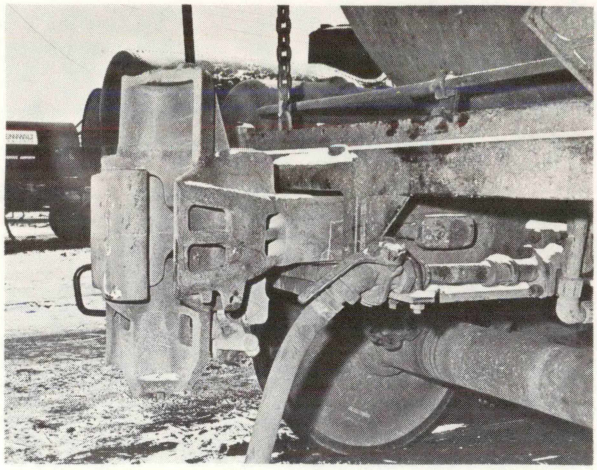


Figure 14. Top and Bottom Shelf Coupler

Cresting Grade - A long ascending grade which rapidly changes to a long descending grade, both of significant magnitude (usually Heavy Grade), to require a change in the train handling procedures when the grade is topped.

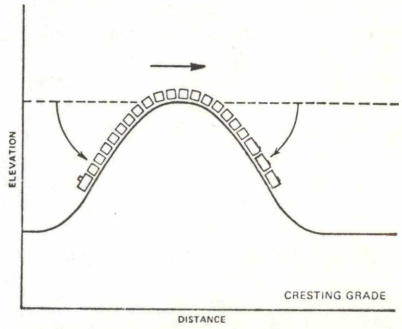


Figure 15. Cresting Grade

Department of Transportation - The United States Department of Transportation (DOT) was created on October 15, 1966, and started operation in April of 1967. The Secretary of the DOT is a member of the President's cabinet. Generally, DOT has the executive function formerly invested in several federal agencies. It has five major units -- the Federal Railroad Administration, Federal Aviation Administration, Federal Highway Administration, Coast Guard and St. Lawrence Seaway Administration. It also operates the Alaska Railroad. Regulatory functions remain with the Interstate Commerce Commission, but the ICC's safety function was also transferred to DOT.

Descending Grade - See "Light Descending Grade" and "Heavy Descending Grade".

Destination Block - A group of cars in a train that are all being sent to the same destination (city, terminal, yard, railroad connection, or consignee).

Diesel Electric Locomotive - A locomotive in which power developed by one or more diesel engines is delivered through a generator or alternator to the traction motors.

Draft - A term used to describe tensile coupler forces.

Draft Gear - The name of that unit which forms the connection between the coupler rigging and the center sill. The purpose of this unit is to receive the shocks associated with train movements and the coupling of cars, and to cushion the force of impact so that the maximum unit stress is brought within the capacity of the car structure for freight service. The types of draft gear now in use

are known as friction, spring, rubber and hydraulic. Refer to Figure 16 - "End of the Car Cushioning Devices".

Drag Rating - The amount of drawbar pull available from a particular locomotive consist calculated at the minimum continuous speed.

> For mixed locomotive consists, the highest minimum continuous speed of any locomotive unit in the consist is used for the whole consist in calculating the drag rating.

Drag Train - A term normally used to identify a long heavy train which is powered with a low horsepower per tonnage rating.

Drawbar Forces - Longitudinal forces at the couplers between cars and/or locomotives that may be either tensile (draft) or compressive (buff), depending on the operation of the train at the time.

Drawbar Pull - Tensile drawbar force. See "Drawbar Forces".

Dynamic Brake Interlock (D.B.I.) - A device installed on a locomotive that will automatically keep the locomotive brakes from applying, when an automatic brake application is made during dynamic braking operation.

Dynamic Braking - An electrical means used to convert some of the power developed by the momentum of a moving locomotive into an effective retarding force.

> The traction motors, being geared to the axles, are rotating whenever the train is moving. When using the dynamic brake, electrical circuits are set up which change the traction motors into generators when the locomotive is running and "on the line". Since it takes power to rotate a generator, this action retards the speed of the train. The power generated by the traction motors, is fed to the resistor grids and dissipated as heat in the case of diesel-electric locomotives, or fed back into the overhead wire system in the operation of a straight electric locomotive (regenerative braking). The dynamic brake produces a braking effect similar to an independent brake and the load indicating meter serves to show how much amperage each traction motor is developing. The higher the amperage, the more retarding force is being generated.

Dynamically Stable Train - A train where all the dynamic forces are in equilibrium in such a way that critical conditions are not exceeded and therefore there will be little tendency towards derailment.

"Dynamiter" or "Kicker" - A slang term for a car with a defective control valve which will create an emergency brake application and serially propagate the emergency application throughout the train, even though such action was not desired by the crew. Common causes are stuck valves in the car's control valve, or the opening of these valves due to the vibration and/or slack action of the car.

Electric Locomotive - A locomotive which receives electric power from an overhead contact wire or third rail shoe and employs the power to drive electric motors connected by gears or other mechanical means to the driving axles.

Electronic Alertness Control - A type of safety control system involving a low-powered radio frequency circuit that senses the movements of an alert engineman. The locomotive engineer's seat is equipped with a built-in antenna (essentially a copper screen which is suitably protected against physical damage by a ventilated, elastromeric coating), located directly beneath the seat upholstery. As the locomotive engineer goes about his normal activity, such as adjusting the throttle position or applying the brakes, sanding, blowing the horn, etc,, these motions produce a detectable change in the energy output of the seat antenna. Any such changes will reset the control and start a timing circuit. If, during the timing period (normally 20 seconds), no additional motion is detected, an audible and/or visual signal is provided to call his attention to this fact. If motion is still not present for an additional period, nominally 10 seconds, a relay contact is opened; and this signal is used to apply the brakes and reduce the engine speed to idle.

To release the brakes and regain power with this system, the automatic brake valve handle must be placed in suppression or lap, (depending upon the type of brake equipment on the locomotive) or the emergency position until the brake application valve resets and the throttle is manually returned to idle.

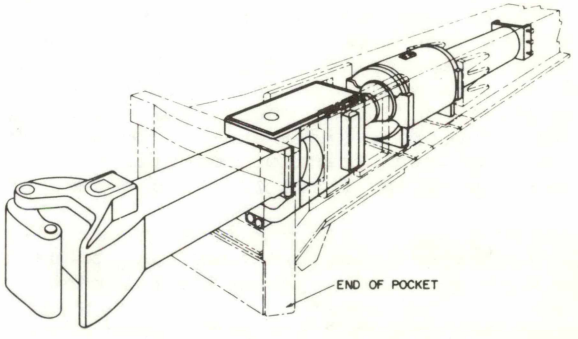
Other types of alertness control are also available.

Emergency Application - A rapid, heavy exhausting of air pressure from the brake pipe which exceeds the service rate of reduction and trips the brake pipe vent valves at each car. This insures the propagation of the emergency application throughout the train. This rapid loss of air pressure can be caused intentionally by opening any valve connected to the brake pipe (which is capable of quickly lowering the pressure of the brake pipe), or unintentionally by the train parting, a burst air hose, or other sources. To initiate an emergency application, a minimum of approximately 30 psi is needed in the brake pipe.

It is of interest to know the air pressure in each brake cylinder after an emergency air brake application, since this will determine the stopping force of each car. The brake cylinder pressure of each car following an emergency application, is approximately 6/7 that of the pressure at which the brake pipe was initially charged.

Emergency Reservoir - A storage volume for compressed air, recharged by the brake pipe, to provide air pressure for use in emergency brake applications and certain recharge features (accelerated service release feature of ABD valve for example). An emergency reservoir is located on every car, contained in the same structure as the auxiliary reservoir. (See Figure 9)

Figure 16. End-of-Car Cushioning Device



End-of-Car Cushioning Device - A unit installed at the ends of a car that develops energy-absorbing capacity through a hydraulic piston arrangement supplemented by springs to assure positive repositioning of the unit, in order that the maximum designed longitudinal cushioning for that device can be realized in both directions.

Equalizing Reservoir - A small reservoir which is connected to an equalizing piston or diaphram chamber for use in automatic air brake applications. The reservoir-piston chamber or diaphram arrangement can be found on all locomotives, although it is only cut-in on the controlling unit of a multiple unit consist. The reservoir's main purpose is to add volume to one side of the piston chamber.

When a brake pipe reduction is made, air is drawn from this equalizing reservoir which then automatically draws the proper amount of air from the brake pipe. For this reason the brake pipe pressure and the pressure in the equalizing reservoir are always the same except when they are equalizing after a brake pipe reduction, or a brake pipe charging operation. The idea behind the equalizing reservoir is to lend stability and to draw air at a controlled rate from the brake pipe.

"Fanning" the Brake - A term used to describe the movement of the automatic brake valve handle between the running and service position during a braking cycle. The intent is a release of brakes near the head-end on the train, and an application of the brakes on the rear portion. This method should not be used.

Feed Valve (Regulating Valve) - The valve that reduces air pressure from the main reservoir of the locomotive to the pressure desired in the brake pipe. The feed valve will automatically maintain that pressure when the automatic brake valve is in running position.

> The minimum value of air pressure in the brake pipe at the locomotive is 60 psi for switching and 70 psi for road service, as stated in the Federal Power Brake Law. The valve is manually set to the proper value.

"Feed Valve" Braking - The process of raising the brake pipe pressure above the standard for that train by adjusting the feed valve, and then reducing the feed valve. This creates a brake pipe reduction due to leakage. This form of braking was often used before the introduction of the maintaining feature.

Field Loop Control - A type of dynamic brake control which requires a special jumper cable in addition to the main jumper cable between locomotive units that are coupled together.

Flange Lubricator - A track mounted device, which is used to apply grease or oil to the flanges of a wheel for the purpose of reducing track and flange wear. Flange lubricators are used in territories where the track curvature is high, usually 10 degrees or more.

Flat Spot - Loss of roundness of the tread of a railroad wheel, caused by wheel-sliding.

Flow Meter - An instrument which indicates the rate of flow of air through the automatic brake valve to the brake pipe.

Foundation Brake Gear - The levers, rods, brake beams, etc., by which the piston rod of the brake cylinder is connected to the brake shoes in such a manner that when air pressure forces the piston out the brake shoes are forced against the wheels.

Full Service Application - A term used to define the application of the automatic air brake to the point that the auxiliary and brake cylinder pressures are equalized. Any further reduction in the brake pipe pressure, with the exception of an emergency application, will have absolutely no effect on the amount of pressure in the brake cylinder, and in effect, air is being wasted from the brake pipe (over reduction).

Initial Brake Pipe Pressure	Service Equalization Pressure	Brake Pipe Reduction to Obtain Equalization
70 psi	50 psi	20 psi
80 psi	57 psi	23 psi
90 psi	64 psi	26 psi
100 psi	71 psi	29 psi
110 psi	78 psi	32 psi

The above chart shows the amount of reduction needed to attain a full service application for various initial brake pipe pressures. Also listed is the brake cylinder pressure at full service, for various initial brake pipe pressures.

Gage (of the track) - The distance between the rails measured from the inside head of each rail at a right angle 5/8" below the top of the rail. The standard for this dimension on North American Railways is 4 ft. 8½ in.

Gear Ratio - The relation between the number of teeth on a gear wheel to those of a pinion with which it meshes. Thus a gear wheel with 55 teeth, driven by a

pinion having 11 teeth, would have a gear ratio of 55 to 11, or 5 to 1. Stated in another way, the motor armature would have to make 5 revolutions to 1 turn of the axle.

In railroading, the gear ratio that we are primarily concerned with, is that between the pinion gear of a traction motor and its geared driving wheel. E.M.D.'s more common gear ratios are 62:15, 60:17 and 59:18, while the most common gear ratio for Alco and General Electric locomotives is 74:18.

Gear ratios play an extremely important part in the minimum continuous speed and the top speed of a locomotive. The top speed of a locomotive, as determined by the gear ratio is based on the maximum R.P.M. that a traction motor can safely withstand before being damaged by centrifugal forces. Increasing the gear ratio (e.g. going from 60:17 to 62:15) will lower the minimum continuous speed that the locomotive can safely maintain while decreasing the gear ratio will raise the top speed that the locomotive can achieve. See "Minimum Continuous Speed".

Generator - A rotating electrical machine which changes mechanical energy into electrical energy. The main generator on a Diesel-electric locomotive receives power from the engine and delivers electrical energy to the traction motors.

Gross Weight - The total weight of a car, including the lading.

Ground Relay - A device that will unload a locomotive (not allowing it to develop power) in the event of a short circuit or ground in the electrical equipment. This is done to insure the safety of the crew on the locomotive, and to prevent damaging the locomotive itself.

Hand Brake - An arrangement of levers, rods, gears and fulcrum, actuated manually by a wheel or ratchet lever, used on cars or locomotives, to force the brake shoes against the braking surfaces (wheel tread or disc) to hold a car or locomotive in a state of rest when in the applied position.

Hazardous Materials - Materials with chemical and/or physical properties that are dangerous to life.

Examples are: Explosives, poisons, flammable liquids and solids, corrosive liquids, compressed gasses, oxidizing materials and radioactive materials.

Heavy Ascending Grade - An ascending grade greater than 1.5%. Train handling procedures relating to a train running on heavy ascending grades assume the grades to be long enough that the retarding influence of the grade will be balanced by the power of the locomotive. (See Figure 17)

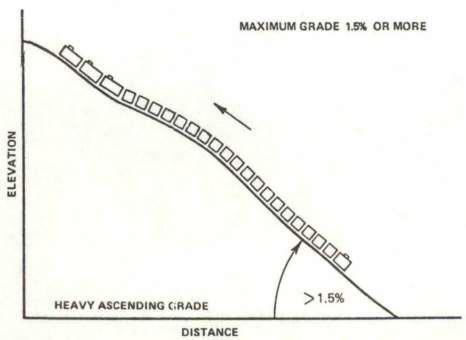


Figure 17. Heavy Ascending Grade

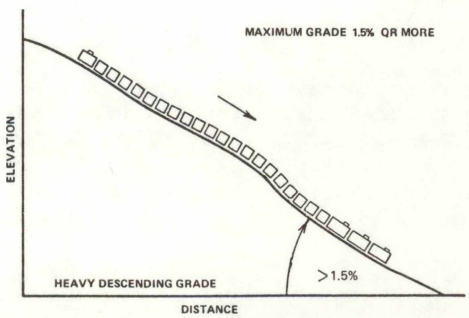


Figure 18. Heavy Descending Grade

Heavy Descending Grade - A descending grade greater than 1.5%. Train handling procedures for trains running on heavy descending grades assume that the grade is long enough that forces due to the grade, that tend to increase the speed of

the train, will be balanced by natural train resistance, automatic brakes, and dynamic brakes as required. (See Figure 18)

Helper - A manned locomotive, usually placed towards the rear of a train, to assist in the movement of the train. For instance, a helper may be used on a heavy ascending grade.

High Horsepower Locomotive - Generally refers to a modern locomotive of approximately 2250 horsepower or more.

H.P./Ton Ratio (Horsepower per Ton Ratio) - The ratio of the total amount of horsepower moving a train divided by the total weight of the train in tons. This ratio will then yield the amount of horsepower being used to move one ton of the train. For instance, if three engines of 3,000 H.P. each are M.U.'d together and are coupled to a train which weighs 6,000 tons (including the weight of engines), the horsepower per ton ratio is 3 x 3,000 H.P. divided by 6,000 tons which is 1.5 H.P./Ton. More horsepower per ton of train (higher ratio), is used on heavy grade territory and for fast moving trains. The normal range of this ratio is roughly between 1 and 3 H.P./Ton.

Hot Box Detector - A track mounted device that monitors the axle bearing temperatures of a passing train. If an axle bearing exceeds the temperature limit, the crew of the train is notified by either special track side signals, or by the dispatcher. Should a "hot box" be detected, the train must be stopped and inspected to determine whether or not it is safe to proceed. Many hot box detectors will not only discover a hot box, but will also indicate the position of the faulty bearing in the train.

Hump (Crest) - The act of switching and classifying train with gravity being used as the prime mover usually accomplished with the use of a small hill.

Hump Braking - See Bridge Braking

Hump Knoll or Hogback - A rapid increase in grade followed by a decrease in grade sufficient to result in abnormal slack adjustment.

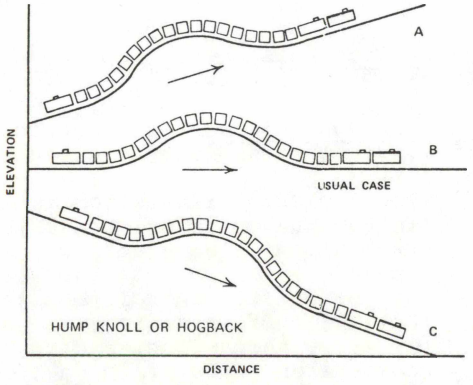


Figure 19. Hump Knoll or Hogback

Independent Brake Valve - A brake valve that provides control of the locomotive brakes regardless of the automatic brake valve handle position. The majority of the independent brake valves are self-lapping, and are mounted on the front of the automatic brake valve pipe bracket.

The brake valve handle (self-lapping) has two positions: Release Position at the extreme left end of the quadrant and Full Application Position at the extreme right end of the quadrant. Between the Release and Full Application Positions is an application zone, and the further the handle is moved to the right within this zone, the greater the application will be. A full application is obtained at the extreme right end of handle movement.

Depression of the independent brake valve handle while in the Release position will release any automatic brake application on the locomotive. Depression of the independent brake valve handle while it is anywhere in the application zone will release an automatic application only to the value corresponding to the position of the handle within the application zone.

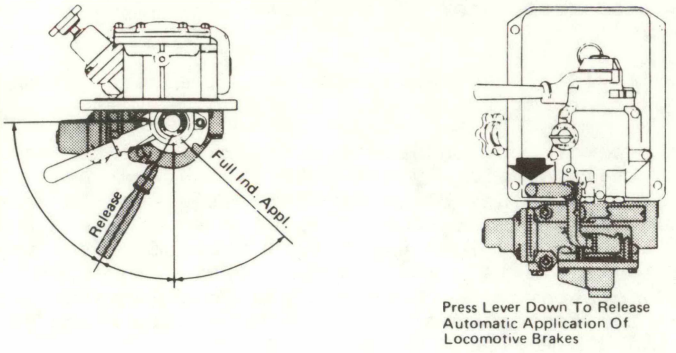


Figure 20. Independent Brake Valve

When applying the locomotive brake with the independent brake valve, move the handle to the right (full independent application--extreme right), and when releasing, move the handle to the left. The brake valve, being self-lapping, will lap off automatically at any point in the application zone when the handle movement has been stopped.

Independent Pressure Switch (I.P.S.) - A device installed on a locomotive that will automatically cut-out the extended range dynamic braking when an independent brake application of sufficient magnitude is made, usually 15 psi. This is to prevent the wheels of the locomotive from sliding, due to excessive braking forces.

Intermediate Horsepower Locomotive - Generally refers to a modern locomotive of 1800 to 2250 horsepower.

Isolation-Run Switch - An electrical device which disconnects the controls of one engine from the cab control circuits.

The isolation-run switch on a diesel-electric locomotive has two positions. In the Run position, the unit is placed "on the line", will respond to control and will develop power in operation. In the Isolation (or start-stop) position, the unit is isolated from the consist and will not develop power or respond to control, but will remain in an engine "idle" condition. The Isolation position is also used for setting up controls to normally stop or start the engine; and in the event of an engine alarm signal, it will also silence the alarm bell.

Jackknifing - A condition involving two coupled rail vehicles in which there is excessive center sill misalignment and coupler angularity. Jackknifing is caused by high buff forces in the train.

Kicker - See Dynamiter

Kinetic Friction - Friction of motion, such as that between the brake shoe and wheel (when the wheel is turning) or as between a wheel and rail (during sliding or slipping). Kinetic friction is always less than static friction.

L/V Ratio - Defined as the ratio of the lateral force to the vertical force of a car or locomotive wheel on a rail. It is an important indicator of wheel climb, rail turnover and/or derailments.

Research indicates that when the L/V Ratio reaches certain critical limits, there is the danger of an impending derailment. These theoretical values are:

0.64 (unrestrained rail may overturn)
0.75 (flange may climb worn rail)
0.82 (wheel may lift disengaging flange)
1.29 (flange may climb new rail)

Note: All the above values are time dependent occurrences. The normally accepted value for significant events, such as impending derailment situations, is 0.3 of a second. However, these time dependent occurrences will be further substantiated by other research in the Track-Train Dynamics Program.

Light Ascending Grade - An ascending grade less than 1.5%. Train handling procedures relating to a train running on light ascending grades assume the grade to be long enough that the retarding influence of the grade will be balanced by the power of the locomotive. (See Figure 21)

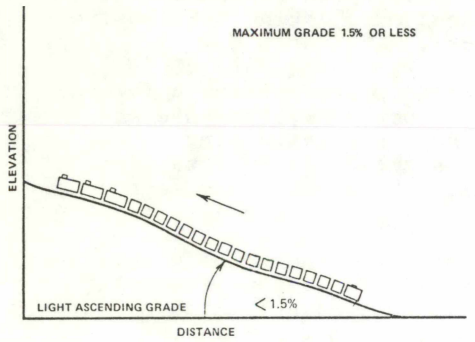


Figure 21. Light Ascending Grade

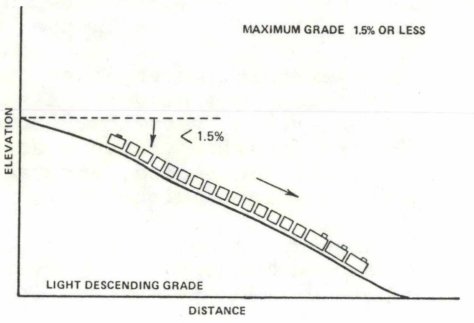


Figure 22. Light Descending Grade

Light Descending Grade - A descending grade less than 1.5%. Train handling procedures for trains running on light descending grades assume that the grade is long enough that forces due to the grade, that tend to increase the speed of the train, will be balanced by natural train resistance, automatic brakes, and dynamic brakes as required. (See Figure 22)

Load Indicating Meter (Ammeter, Loadmeter) - This meter monitors the amperage of a locomotive traction motor, usually the #2 motor. Since the amperage should be the same for all traction motors of a locomotive unit, the amperage in all the motors is effectively known. (It will, however, not monitor the amperage of M.U.'d units).

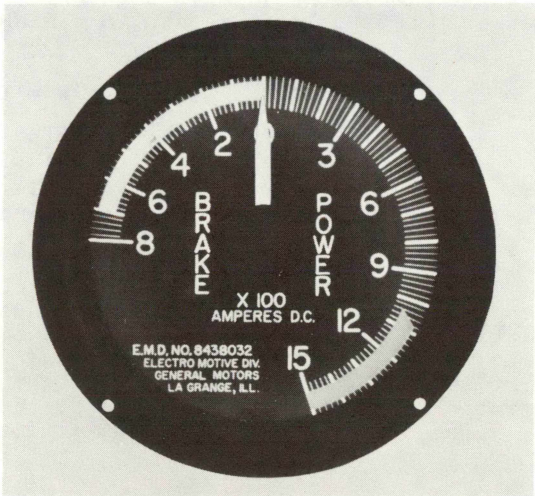


Figure 23. Load Indicating Meter

Excessively high amperage within a traction motor, for too long a duration, will damage or even destroy the traction motor. For this reason it is important for the engineer to monitor this meter and to be aware of the short time ratings (usually listed on the control stand), for the unit or units being operated.

Since the amperage through the motor, (for a given step of field shunt or transition) is proportional to the torque or force developed at the motor shaft, the meter can also be used as a "Pull Meter" to indicate the tractive effort of a locomotive. In general, the greatest need for increased "torque or force" is in starting heavy trains, running on ascending grades,

or accelerating the train. It is during these operations that amperage will rise, indicating that more "torque or force" is being produced.

Locomotive Consist - Designation for one or more locomotive units operated from a single control stand.

Low Horsepower Locomotive - Generally refers to a locomotive of less than 1800 horsepower.

Main Reservoir - An air reservoir on the locomotive for storing and cooling compressed air.

Minimum Continuous Speed - The minimum speed at which a locomotive can operate continuously under heavy load conditions, without damaging the traction motors by the application of high current (amperage). This speed is based on the maximum amperage the traction motor can accept without overheating. Excessive amperage will literally burn up the traction motors.

As an example, an engineer controlling a locomotive pulling a few cars at less than the minimum continuous speed need not worry, because the amperage rating will be very low. However, if an engineer is running in the higher throttle positions with a drag train and is only able to attain the minimum continuous speed, amperage will be high in the traction motors and must be watched closely.

If an engineer monitors the load-indicating meter and operates his train in such a manner as to prevent the application of destructively high amperage, the minimum continuous speed will not reach a critical value.

The minimum continuous speed will vary from unit to unit, depending upon gear ratio, number of powered axles, type of performance control or power reduction, etc.

See "Gear Ratio" and "Load Indicating Meter".

Mixed Consist - Operation of other than identical locomotive units in a single locomotive consist.

Multiple Unit (M.U.) - Two or more locomotive units operated together from a single control stand. When assembling such units, it is necessary to use those that are compatible in regard to train lined electrical and pneumatic functions.

Node - The point of zero longitudinal stress (or coupler force) in a train using RCE-1 or helper service. The node tends to fluctuate in any one train, due to changes in the terrain or in the control settings of the locomotive consists in the train.

Normal Operation (As used in this manual) - Operating procedures and techniques relative to train handling in territories which approach tangent, level conditions. Normal Operations also assume that there are no extreme or unforeseen circumstances, which might necessitate radical changes in the train handling operation such as sudden failure of the dynamic brake, washouts, pedestrians on the right-of-way, or sudden restrictive changes in the signal aspect.

Overcharge - Describes a situation in which the brake equipment of cars and/or locomotives is charged to a higher pressure than the maximum brake pipe pressure that can normally be achieved in that part of the train.

Overspeed Control (of a locomotive) - A safety device that will cause a penalty brake application to occur when the speed (mph) of the locomotive exceeds that of the overspeed setting.

Performance Control System (Power Matching) - A system which automatically controls the horsepower output of a locomotive during low speed operation to provide maximum tractive effort within the adhesion capabilities of the locomotive. This system also allows compatible operation with lower horsepower locomotives.

Pneumatic Foot Valve - A type of safety control system, commonly called a "dead man" feature. This arrangement requires that a foot valve be continuously depressed while operating the locomotive. If the engineman releases the foot pedal, a warning whistle in the cab begins to sound and continues to sound for the interval provided in the time delay feature, generally 4 to 6 seconds. If the warning whistle is ignored, a safety control brake application will automatically be initiated and engine speed will be reduced to idle. To prevent a penalty brake application within the time delay allowed, the foot pedal must be depressed or a manual brake application of approximately 25 psi brake cylinder pressure must be made.

A cycling device can be incorporated into the foot pedal system which requires that the engineman depress and release the foot valve at specific intervals rather than hold the foot pedal continuously depressed. After the engineman has held the foot pedal depressed for a specific time, the safety control whistle will begin to sound. If the engineman fails to depress or release the foot pedal within the specified time after the whistle begins to blow, a service rate brake application will automatically be initiated and the engine speed will be reduced to idle.

To release the brakes and regain power with this system, the automatic brake valve handle must be placed in suppression or lap, (depending upon the type of brake equipment on the locomotive) or emergency position until the brake application valve resets and the throttle is manually returned to idle.

Power Cut Off (Power Control) - An electrical device that will automatically reduce the locomotive throttle to idle. Depending on the function desired by each individual railroad, Power Cut Off can be initiated by an emergency, penalty or overspeed brake application. Automatic sanding may also occur during a Power Cut Off situation, again depending on the particular equipment installed.

Pragmatic Factor - A mathematical quantity to reduce the maximum allowable trailing tonnage. This factor provides a margin of safety which compensates for adverse operating conditions.

Pressure Maintaining Feature - A system designed to overcome normal brake pipe leakage and maintain the brake pipe pressure at the desired level during a service reduction initiated with the automatic brake valve. In this way, a brake application of a uniform desired amount can be held unchanged for long periods of time.

It is important to mention that a train with excessive brake pipe leakage, in the absence of a Pressure Maintaining Feature will decelerate more rapidly (because the leakage adds to the initial brake pipe reduction) than a train with the Pressure Maintaining Feature. It is particularly important that the desired amount of brake pipe reduction, which should never be less than 6 psi, be measured from the reading of the equalizing reservoir commencing at the time that the service exhaust opens. Otherwise, the Pressure Maintaining Feature may attempt to supply air to the brake pipe if it is at a lower pressure than the equalizing reservoir, and an unintentional release of the train brakes could result. The very nature of a Pressure Maintaining Feature requires that it must be cut out during brake pipe leakage tests.

Reduction (of the brake pipe) - A decrease in brake pipe pressure at a rate and of an amount sufficient to cause a train brake application to be initiated or increased.

Release Rod - A small rod situated at the side sill of a car, for the purpose of releasing the air brakes at terminals to allow switching. See "Bleed".

Retainers - In order to maintain retarding force on cars during release of train brakes on a grade, it is sometimes necessary to retain some brake-cylinder pressure even though control valves are in release position. Hence, the need for the brake-cylinder pressure retaining valve. Functionally, the retaining valve is simply a spring-loaded check valve or a restricting exhaust choke in series with the brake-cylinder exhaust. The ideal situation is for the average retained pressure on the train to be slightly less than that required to balance the grade.

Retainers are required because American freight train brakes are of the direct-release type. The two types of retainers currently being utilized on North American Railways are the four and three position retainers:

Four-position retainer - In the past, weights of cars and braking ratio characteristics called for the four-position retainers: (a) 20 psi retained in brake cylinder (high-pressure position), (b) 10 psi retained in brake cylinder (low pressure position), (c) slow blowdown--120 sec. 50 down to 5 psi (very slow exhaust), and (d) direct (normal) exhaust-- 25 sec. 50 down to 5 psi.

Three-position retainer - The new or present standard retainer is a three-position valve having one fixed pressure position, 20 psi, which may be increased by special springs to between 30 and 40 psi if needed for any specific unit-train operation. This retainer also has a slow blowdown position as well as direct (unrestricted) exhaust.

Rock and Roll - A slang term for the excessive lateral rocking of cars and locomotives, usually at low speeds and associated with jointed rail. The speed range at which this cyclic phenomenon occurs is between 10 and 25 mph, with the exact speed determined by such factors as the wheel base, height of the center of gravity of each individual car or engine, the spring dampening associated with each vehicle's suspension system, and the relative difference in elevation between successive joints in jointed rail territory. In extreme cases, actual wheel lift can occur which can result in derailments.

Ruling Grade - That section of track which will offer the most resistance to train movement between two specific points.

Run-In - Describes the relative movement of the cars in the train to a state of compression.

Run-Out - Describes the relative movement of the cars in the train to a state of tension.

Running Release - Release of an automatic (brake) service application while the train is in motion.

Sag or Dip - A rapid decrease in grade followed by an increase in grade sufficient to result in abnormal slack adjustment.

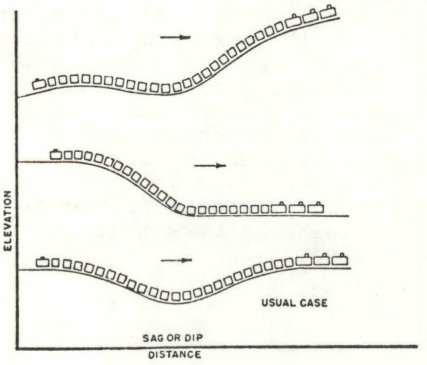


Figure 24. Sag or Dip

Safety Control Systems - A system which functions to assure the proper control of a moving train should physical impairment or inattention of the engineman actuate the system. It does this by requiring the proper attention or an intermittent action by the engineman to the system. Should distraction or physical incapacitation disrupt the normal functioning of the engineman, the system is designed to apply the brakes.

The most common types of systems in use are the pneumatic foot valve, and the electronic alertness control, although other types of safety control systems do exist in the industry. See "Electronic Alertness Control" and "Pneumatic Foot Valve".

Sanders - A pneumatic or electric device which applies sand to the rails in front of the driving wheels in order to improve adhesion. Sanding can be manually initiated on all units, whereas automatic sanding is accomplished only on those units so equipped. The purpose of sanding is to increase the adhesion between the driving wheel and the rail in order to prevent wheel slip, or wheel slide.

Schnabel Car - A special car designed to transport extremely heavy loads, such as large electrical transformers. The load being carried becomes an integral part of the car structure. See Figures 13 & 14 in the Train Make-up Section (page 3-32).

Service Application - Occurs when brake pipe is exhausted at a service rate to apply the train brakes. This may be one ("straightaway" reduction), or a series of brake pipe reductions (split service reduction) controlled by the engineer through positional changes of the automatic brake valve handle on the locomotive.

The amount of pressure at each individual brake cylinder of a car is directly proportional to the amount of air reduction from the brake pipe. A good rule of thumb to use in calculating the brake cylinder pressure is to multiply the amount of reduction in the brake pipe by 2½, to get the pressure in the brake cylinder of each car. For instance, a 10 psi brake pipe reduction would initiate a 25 psi (approximately) pressure in the brake cylinder.

Service Rate - The rate, slower than emergency, at which the brake pipe pressure is reduced by the engineer using the automatic brake valve during a service reduction, to cause the control valve at each car to assume its service position and vent air from the auxiliary reservoir to the brake cylinder on each car.

Shearing Stress - The action or force causing two contacting parts or layers to slide upon each other, moving apart in opposite directions parallel to the plane of their contact.

Sliding Center Sill Cushioning Devices - Equipment installed between a fixed center sill and an auxiliary sliding sill that absorbs shock to the car. The sliding sill travels longitudinally through the fixed sill and acts as a single unit throughout the car.

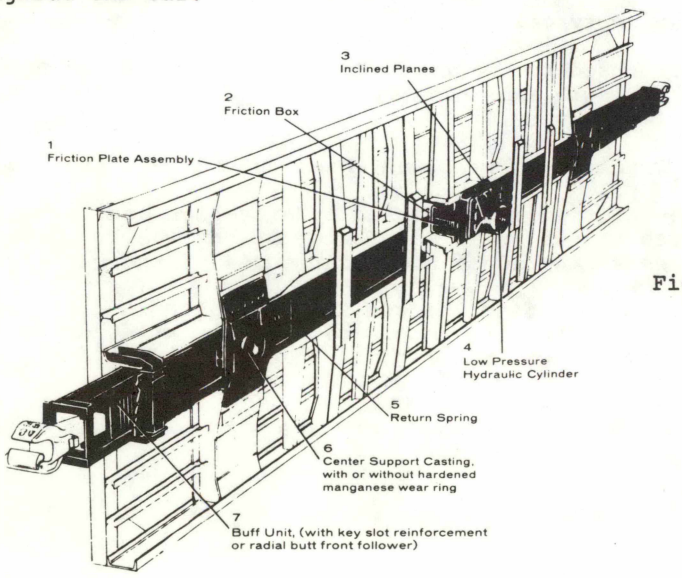


Figure 25. Sliding Center Sill Cushioning Device

Slug - A cableless locomotive which has traction motors, but no means of supplying power to them by itself. Power is provided by power cables from an adjacent unit. Slugs are used where low speeds and high tractive effort are needed, such as in hump yards.

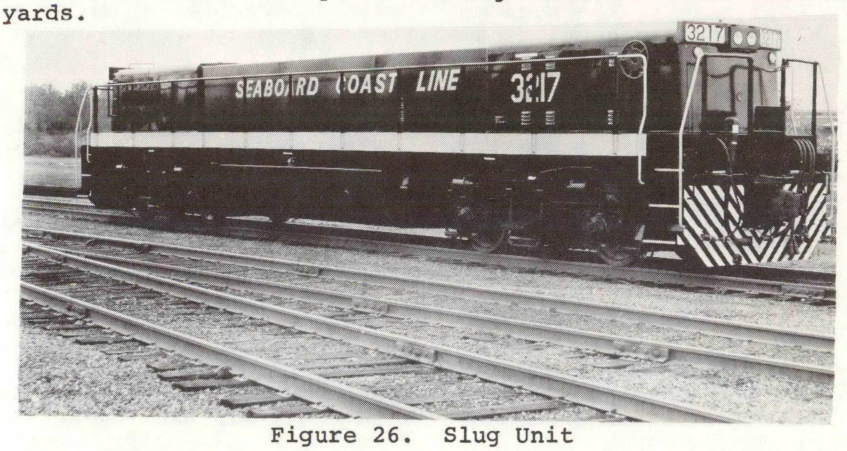


Figure 26. Slug Unit

Snubbers - Damping devices which are used to reduce the harmonic roll (rock and roll) of a car. Snubbers are very similar to shock absorbers.

Split Reduction - A term used to describe the process of making an initial brake pipe reduction to a lesser degree than the fully desired reduction, followed by further reductions until the desired total amount is reached. A smoother slow-down or stop is the principal advantage of this method.

> For the purposes of this book, a split reduction is accomplished by making an initial 6-8 psi reduction, waiting 20 seconds, and then making the remaining reduction to that value desired. The total reduction over the operations should not exceed 15 psi for normal operating conditions.

"Stretch" Braking - A term used to describe the decelerating of a train by application of the automatic brake while the locomotive is still working in power. This tends to keep the slack of the train stretched out or in tension, thus the reason for the term "stretch" braking.

Stringlining - A term used to describe the tendency of cars to pull off the inside of curves, trying to approach a straight line when the train is in draft.

Tare Weight - The weight of an empty car.

"Tension" (of a Train) - A term used to describe the application of two opposite outward forces (draft) along a single axis of a body. The terms tension and "stretching" (of a train) are synonymous.

Thermal Cracking of Wheels - Cracks in a railroad wheel due to excessive heat.

> Thermal cracking of wheels is normally caused by excessive heat generated by extreme braking forces on the tread and flange of the wheel. Heat treated and tempered wheels can reduce the occurrences of thermal cracks.

Track-Train Dynamics - A term used to describe the dynamic motion and the resulting dynamic forces that result from the interaction of the vehicles coupled into a train interacting with the track, under given climatic conditions, train handling, train makeup, grades, curvature and operating policies.

Track-Train Dynamics Blocking - The organization of cars within a train which minimizes the dynamic instability of the train.

Track-Train Environment - All the conditions which effect the track and/or the train, such as grades, curvature, locomotive and car characteristics, train handling, etc.

Traction Motor - A device that converts electrical energy into mechanical energy which turns the locomotive wheels. It is mounted directly on each driving axle, between the wheels of a locomotive truck.

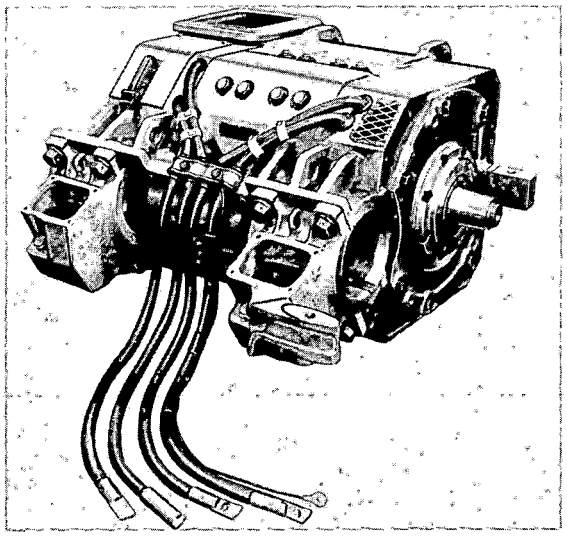


Figure 27. Traction Motor

Tractive Effort - The force exerted by a locomotive on the track for the movement of a train, measured in pounds.

Truck Hunting - An instability at high speed of a wheel set (truck), causing it to weave down the track, usually with the flanges striking the rail.

Undesired Emergency - That situation of the train going into emergency (air brake application) from unknown causes. (See Dynamiter)

Undulating Grade - A track profile with grade changes so often that an average train passing over the track has some cars on three or more alternating ascending and descending grades. The train slack is always tending to adjust as cars on descending grades tend to roll faster than those on ascending grades.

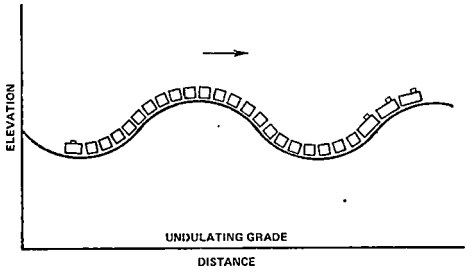


Figure 28. Undulating Grade

Unrestrained Rail - Rail that is without fasteners at either end or at the base.

Vertical Bounce - An instability at high speed where the vehicle oscillates vertically on the suspension system.

Wheel Sliding - The situation where the wheel is rotating slower than longitudinal movement would dictate.

Wheel Slipping - The situation where the wheel rotates faster than longitudinal movement would dictate.

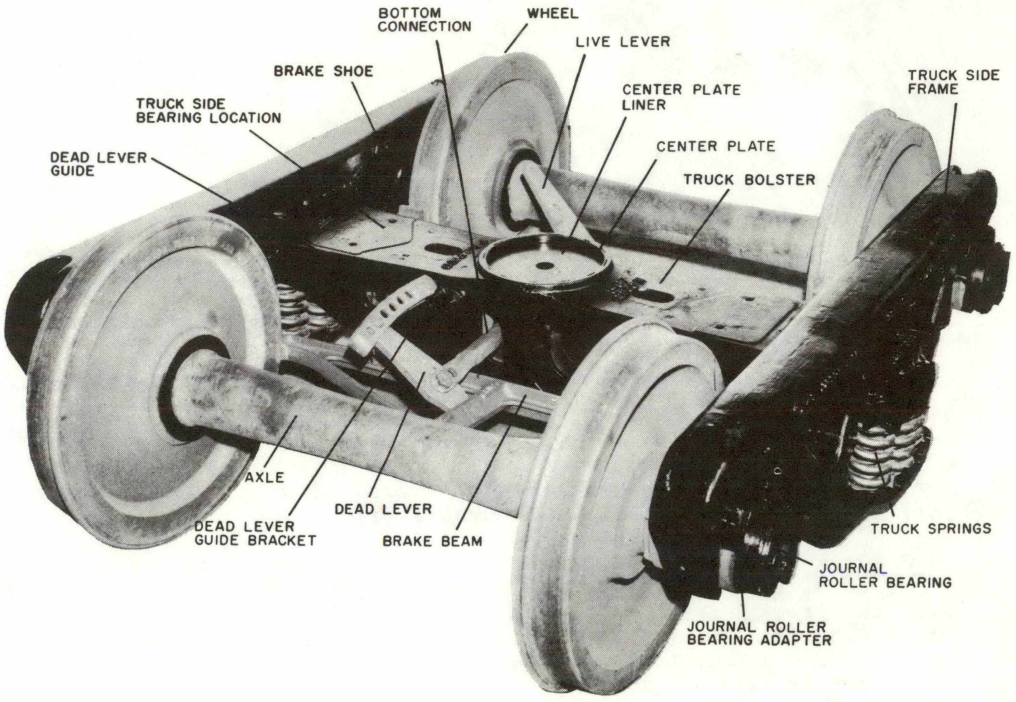


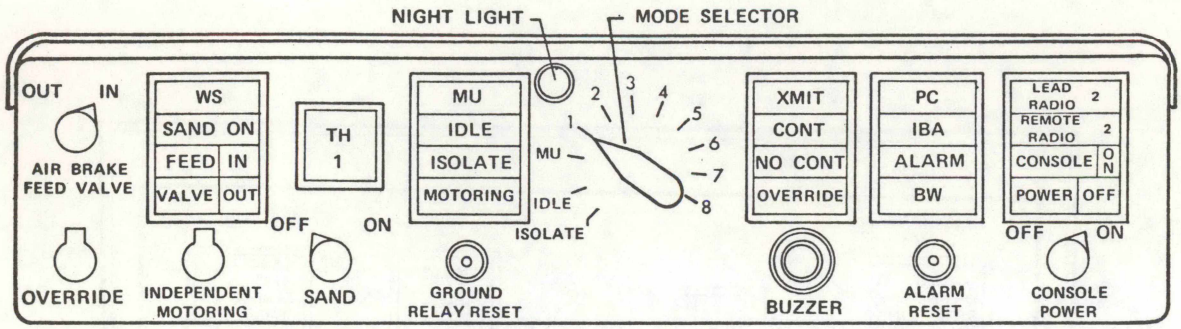
Figure 29. Freight Car Truck Nomenclature

1.2 RCE-1

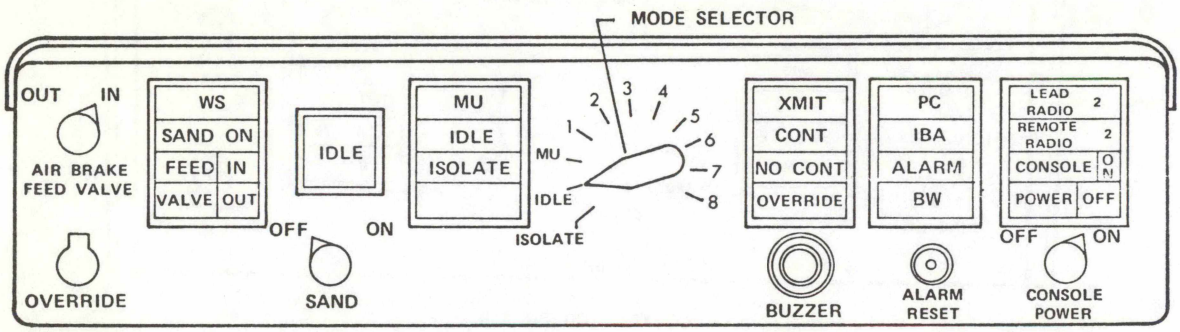
1.2.1 Definitions and Functions

1.2.2 Operating Modes

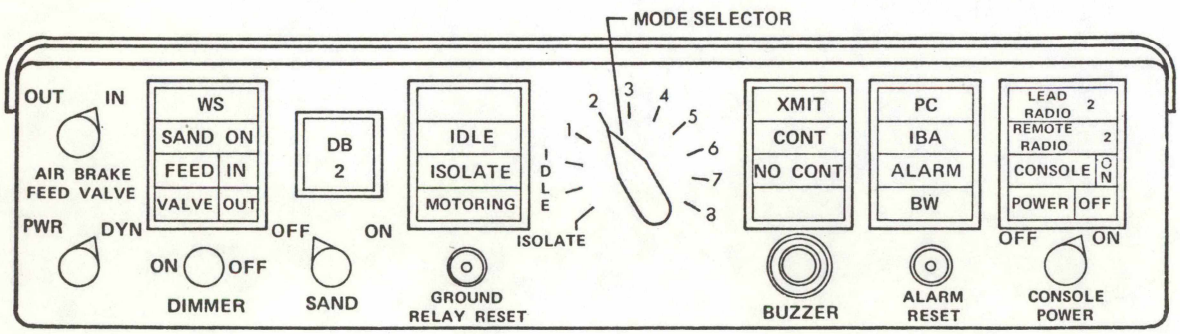
1.2.1 DEFINITIONS AND FUNCTIONS



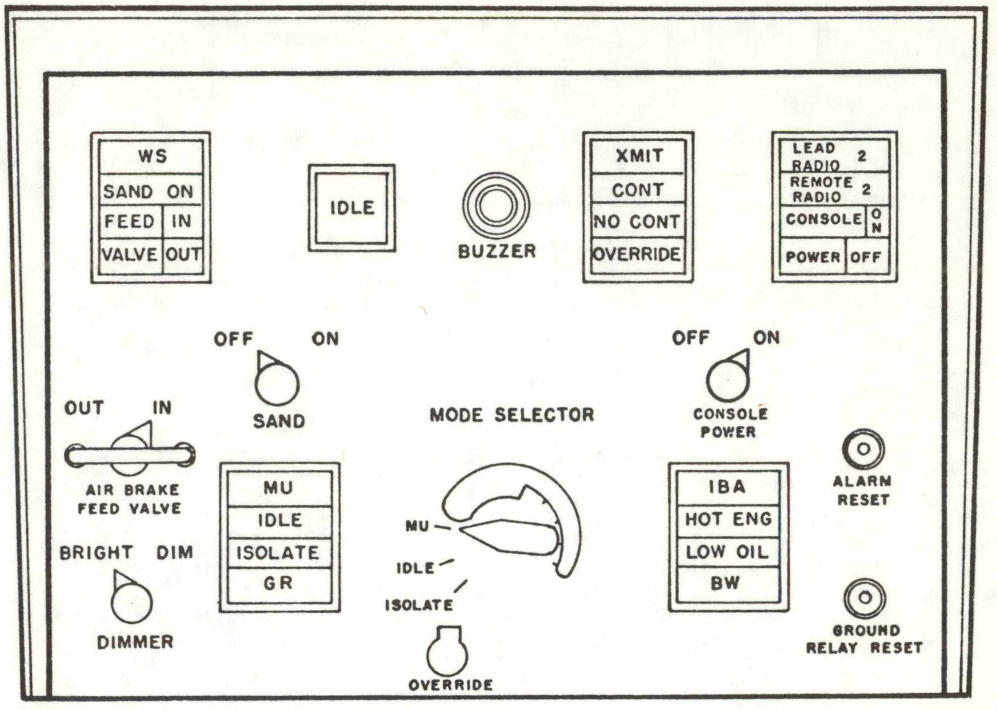
CONTROL CONSOLE A



CONTROL CONSOLE B



CONTROL CONSOLE C



CONTROL CONSOLE D

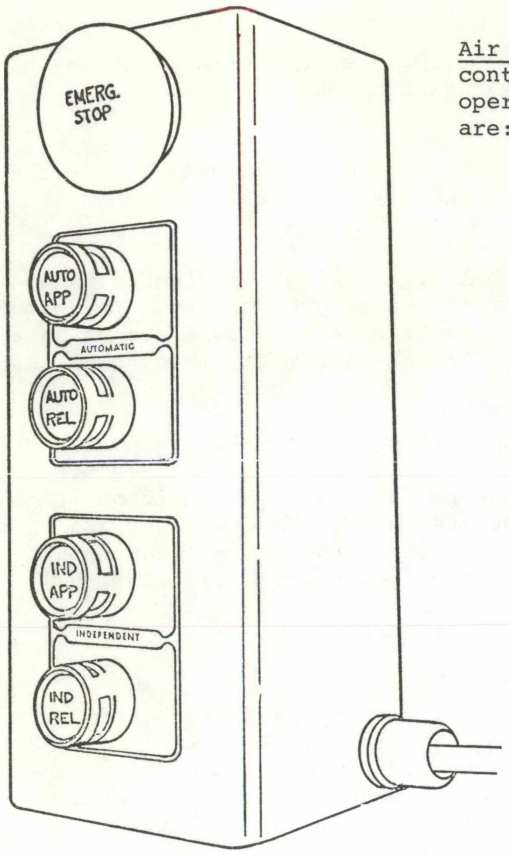


Figure 30. Air Brake Push Button Console

Air Brake Push Button Console - A group of controls which operate the air brakes in RCE operation. The controls and their functions are:

"EMERG. STOP" (EMERGENCY BRAKE BUTTON) - Activating this button causes an emergency brake application throughout the train, regardless of whether the RCE-1 equipment is turned on or off.

"AUTO APP" (AUTOMATIC BRAKE APPLICATION BUTTON) - To cause a minimum service reduction, depress this button for no more than 2 seconds. When held in for more than 2 seconds, a further service reduction will occur. The longer the button is held in, the greater the reduction will be. When the button is released, the brakes are automatically lapped.

CAUTION: The automatic brake valve handle must be latched in the release position and not used, except to recover from a penalty brake application. Use of the automatic brake valve handle will result in a penalty brake application.

"AUTO REL" (AUTOMATIC BRAKE RELEASE BUTTON) - Pushing this button momentarily will cause an automatic brake release.

"IND APP" (INDEPENDENT BRAKE APPLICATION BUTTON) - Pushing this button will apply at least 5 psi to the independent brakes on both controlling and remote consists. The application continues in specified increments as long as the button is held in, until the brake cylinder pressure reaches the maximum setting.

"IND REL" (INDEPENDENT BRAKE RELEASE BUTTON) - Pushing this button will fully release the locomotive brakes on both the controlling and remote consists. However pushing the independent release button will not release the controlling consist brakes if they were applied by using the independent brake valve.

NOTE: The independent brake valve may be used separately of the RCE-1 equipment to apply locomotive brakes on the controlling consist

Control Console - A group of controls, used in conjunction with the Air Brake Console and the normal stand, to communicate various operating functions to a remote locomotive consist. The controls and their operation are the following (however, no one console will have all the indicator lights or controls listed and since the indicators are updated by radio from the remote consist, the indications may not be valid in a no continuity situation): See Console A,B,C and D

"Air Brake Feed Valve Switch" - A switch having two positions - OUT and IN - which controls the RCE unit's feed valve. With the switch cut "IN", the RCE unit's feed valve is cut in, and will assist in charging the brake system.

"Alarm Light and Bell" - When the RCE-1 alarm bell sounds and the red Alarm indicator is lit on the control console, an alarm condition is occurring.

Control Console (Continued)

on the remote consist, due to no power, tripped ground relay, hot engine, low oil pressure, low water, or low crankcase pressure.

"Alarm Reset Button" - By pushing the Alarm Reset Button, the alarm bell will stop ringing (unless the condition is in the lead consist), but the indicator will continue to be lit until the alarm condition is corrected, or the affected unit isolated.

"BW Light (Brake Warning Light)" - When lit, this light indicates that a dynamic brake overload exists on a unit in the Remote Consist. To correct the dynamic brake overload, the dynamic braking lever should not be advanced further until the "BW" Light goes out. If this light fails to go out after a few seconds, the dynamic braking effort must be reduced.

"Console Power Switch" - This switch has two positions--"Off" and "On". It must be turned "On" at all times during RCE-1 operation. In the "Off" position, there is no radio control of the Remote Unit. In addition, the Air Brake Push Button Console and the associated air brake equipment are turned off and will not operate. The only exception is the Emergency Stop Button, which is always capable of initiating an emergency brake application.

"Console Power On-Off Light" - This light indicates the position of the Control Console Power Switch.

"Cont" and "No Cont" lights - When continuity is established between the Lead and Remote units, the green "Cont" light is on. A loss of continuity for a predetermined time will normally result in the "No Cont" light being displayed on the control console, the remote consist throttling back to "Idle", and the RCE unit's feed valve dropping out. See "Override"

"Dimmer Switch" - A two position switch - Bright and Dim - which controls the intensity of the lights on the Control Console and the air brake console.

"Feed Valve In/Out Light" - Indicates the position of the Remote Unit's feed valve (in or out).

"GR (Ground Relay Light)" - When this light is on, it indicates that the ground relay has tripped in the remote consist.

"Ground Relay Reset" - Button used to reset the ground relay on the remote consist. However, it will only be effective if the locomotives in the remote consist are equipped with a remote ground relay reset feature.

"Hot Eng (Hot Engine)" - When this light is on it indicates that a locomotive unit in the remote consist has developed a hot engine.

"IBA Light (Independent Brake Application)" - This red light indicates the presence of any brake cylinder pressure in excess of 5 psi on the locomotives in the Remote Consist.

"Independent Motoring Button" - This feature permits the use of power on the Remote Consist when the Lead Consist is in idle or dynamic braking.

"Lead Radio 2 and Remote Radio 2 Lights" - These lights, or absence of lights, indicate which lead and/or RCE unit radios are operating. If no lights, RCE is on Radio 1; if light is displayed, RCE is on Radio 2. During a no continuity condition, the lead Radio 2 light will come on and off at twelve second intervals as the radios switch back and forth attempting to re-establish continuity. The radios operating at the time continuity is re-established will be the ones to remain on.

"Mode Selector Switch" - This switch is used to position the throttle or dynamic brake setting on the remote consist. The Mode Selector Switch has the following 11 positions: (See next page)

Control Console (Continued)

MU - In this position the controlling and remote consists are synchronized, with the Remote consist responding to both throttle and brake commands from the Controlling Consist. The MU indication will be lit on the Indicator Light Panel.

IDLE - In this position the Remote Unit will not respond to throttle commands for either motoring or dynamic braking, but will respond to air brake commands. The IDLE indication will be lit on the Indicator Light Panel.

ISOLATE - This position isolates the throttle and brake systems of the Remote Consist from those of the Controlling Consist. Alarm conditions occurring on the remote consist will still be received at the Controlling Consist. In addition, an emergency brake application initiated on the Controlling Consist will be transmitted to the remote consist. The ISOLATE indication will be lit on the Indicator Light Panel.

Nos. "1-8" - These positions allow the Remote Consist throttle or dynamic brake to be regulated independently of the Master Consist.

"Motoring Light" - This light will be on when the RCE equipment is operated in the "INDEPENDENT MOTORING" Mode.

"Override Push Buttons" - This push button is used to keep the Remote consist in Power or Dynamic Braking whenever radio communications between the Lead and Remote Consist may be interrupted ("No Continuity") due to obstructions such as tunnels or cuts. The "Override" pushbutton must be pushed before the Lead unit enters the area where communications may be lost, and "Override" will remain in effect for a pre-set interval (usually 10 to 15 minutes). Several control consoles are designed with an automatic override, making manual manipulation of an override pushbutton unnecessary.

"PC Light (Power Cut-Off)" - When this light is on, it indicates that the remote consist is in a power cut off situation.

"PWR-DYN Switch" - This switch has two positions and must not be moved unless the Mode Selector Switch is in "IDLE".

PWR - In this position, when the Mode Selector Switch is moved from "IDLE" to the numbered zone "1" through "8", the "Motoring" aspect appears and the Remote Consist will motor to the throttle setting of the Mode Selector Switch, even though the Master Consist is in "IDLE" or "Dynamic Braking" or "Motoring".

DYN - In this position, the Remote Consist dynamic braking effort will be controlled by the position of the Mode Selector Switch in the numbered zone "1" through "8" - provided that the Master Consist is in a dynamic brake mode of operation.

"Sand Switch" - This switch has two positions - "OFF" and "ON" - and when "ON", sand will be applied to the Remote Consist in the direction in which it is moving. The "ON" position is also indicated by a flashing "SAND ON" indicator at the upper left of the Control Console. In the "OFF" position, only automatic sanding will occur on the Remote Consist.

"Throttle/Dynamic Brake Lights" - Indicates the degree of throttle (TH) or dynamic braking (DB) at the Remote Consist. It also indicates "IDLE" when the Remote Consist is in "IDLE".

"Xmit Light (Transmit)" - Indicates transmission of a radio message to the RCE unit. Normally during continuity this light will automatically flash on and off every 20 seconds and whenever a change in operation occurs. This light is on continuously whenever buttons are depressed for independent and/or automatic brake applications, or whenever a penalty air brake appli-

Control Console (Continued)
cation occurs. The "Xmit" light comes on at 4 second intervals shortly preceding and during a "NO CONT" condition.

"WS Light (Wheel Slip)" - Whenever this indicator is lit, an alarm buzzer will sound, indicating wheelslip or wheel slide is occurring in the remote consist. When the Sand Switch is turned ON, the buzzer will stop, but the light persists until the wheel slip or wheel slide stops.

Continuity - The condition when RCE-1 radio communication is established and maintained between the control unit and remote consist. During continuity, operating commands can be communicated to the remote consist, and the status of the remote consist operation is communicated to the control unit. When operating in a continuity condition, the "CONT" light on the control console will be lit. See no continuity.

Independent Control - This term describes the ability of the locomotive engineer to vary the mode selector settings of the control console (RCE-1) independently of the settings of the controlling unit, when both consists (Controlling and Remote) are in motoring or dynamic braking. Operation can not be mixed. See Independent Monitoring.

Independent Motoring - A feature of certain RCE equipment, which allows the use of power on the remote consist when the lead consist is in idle or dynamic braking.

No Continuity - The condition when RCE-1 radio communication is broken up by such intervening obstacles as mountains, deep cuts or tunnels. When in a No Continuity condition, operating commands cannot be radioed back to the remote consist, nor can the remote consist radio its status to the control unit. The only control the engineman has over the remote consist in a No Continuity condition, is through the brake pipe. When operating in a No Continuity mode of operation, the "NO CONT" light will be lit on the control console. See Continuity.

RCE-1 Unit - Any locomotive unit of the remote or control consist when operated in a RCE-1 train.

Remote Control Car (RCC) - A vehicle usually a locomotive shell or box car into which the remote RCE-1 equipment is installed. The RCC is then M.U.'d to the motive power of the remote consist to control their operation. Both the RCC (if one is used) and the remote motive power make up the remote consist.

Remote Consist - Designation for a locomotive consist and RCE-1 radio equipment that is placed in the body of a train and is controlled with the use of a radio by a locomotive engineer in the lead (or control) consist.

Remote RCE-1 Radio Equipment - Electrical equipment used to translate radio commands into control operations and to radio the status of the remote consist to the control unit. This equipment is permanently installed in either a remote control car, or one of the remote locomotive units.

System Address Code - A means of controlling a RCE-1 train in territory where more than one RCE-1 system may be operated. This is accomplished by assigning each lead RCE-1 system its own fixed address code. Remote RCE units have a changeable address code, making it possible for them to work with different lead RCE units on the Railroad. Great care must be taken to insure that the address code of the remote unit matches that of the lead unit for a specified train. Once established, the remote control unit will accept commands only with the established code. Two ways currently in use for matching the system address codes are:

(1) dial the code into the RCC or remote unit (not unlike a telephone dial)
(2) use of an electronic address card from the control unit.

1.2.2. RCE-1 OPERATING MODES

For the purpose of clarification, the discussion and guidelines included in this manual are specifically intended to cover the operation of "LOCOTROL" manufactured by Radiation Incorporated and New York Air Brake Company and the operation of "RMU" manufactured by Westinghouse Air Brake Company commonly referred to as RCE-1. Many of the guidelines, however, can apply to the operation of any remotely controlled locomotive consists. Refer to the Nomenclature Section 1.2.1 for clarification of the terms used.

This Section (1.2.2) is intended to give a general background on the RCE-1 modes of operation and how these modes are accomplished.

The application of those modes which apply during the braking of freight trains with RCE-1 is included in Section 2.1.2.5.

Section 2.1.3.3 covers the application of power and starting procedures when using RCE-1.

The specific operating procedures, as they relate to operating RCE-1 controlled trains over light, heavy or undulating grade territories or on territory with humps, sags or grade crests, are included in Section 2.2.

A. Advantages and Disadvantages

From a train handling aspect, the use of RCE-1 can provide improved operation especially when used in trains of high gross tonnage. The specific advantages are:

1. Faster initial charging times - about one-fourth the time of a regular train.

2. Shorter stopping distances due to faster brake responses throughout a train.

3. Increased stored energy for brake response in trains due to higher charge in reservoir pressure.

4. Reduced train shocks due to faster and more uniform brake responses. Release time is approximately 4 times faster.

5. Reduced drawbar stresses allowing heavier trains on heavy grade territory.

6. Increased energy available for brake control in stopping and in grade braking due to faster recharge.

Along with these advantages, however, there are some definite disadvantages if the controls are not manipulated correctly. Improper operation with RCE-1 can result in more severe consequences than would occur with the same operation on a regular train.

B. Control Console Variations

As with conventionally controlled trains, (head end power only) the method of handling a RCE-1 controlled train is governed by the track gradient, curvature, train make-up, weight and length of train, type of locomotive units, rated horsepower of consist, speed and various other conditions. Often, however, these factors must be evaluated several times when operating the RCE-1 train. Depending on the severity or degree of each operating parameter and the inter-relationship between them, consideration may have to be given to treating each locomotive consist as a separate entity to be operated more or less independent of the other. At the same time this independent operation must be coordinated properly to avoid large in-train forces, severe changes in slack and possible damage to lading, equipment or track structure.

Opposite to this there are also times when there is no need to consider each consist separately and successful operation can be obtained by operating the RCE-1 train as a conventionally powered train. This very fact has brought about some difference of opinion within the railroad industry as to how the operating modes of each consist should be coordinated.

On some railroads the philosophy is to operate both the control and remote consists much the same as any other multiple unit consist (i.e. control and remote units synchronized in both power or dynamic braking - MU). The opposite philosophy is to operate each consist as a separate entity dependent on the variables affecting that portion of the train ("Independent Motoring"). This difference in philosophy is reflected in the variations of Control Consoles used by the various railroads. Refer to the Control Console Diagrams included in Section 1.2.1.

> Control CONSOLE "A" is the basic console which is used to operate RCE-1 trains. All functions as originally designed are incorporated in this console. The remote units can be operated the same as the control units (MU), partially independent of the control units by varying the Mode Selector, or completely independent by using the Independent Motoring button and varying the Mode Selector.

1. THE INDEPENDENT MOTORING MODE ON CONSOLE "A" IS TO BE USED IN THE FOLLOWING MANNERS:

a. STARTING A TRAIN WITH INDEPENDENT MOTORING (1-1)

(1) "GENERATOR FIELD" AND "ENGINE RUN" SWITCHES ON THE LEAD LOCOMOTIVE MUST BE IN "ON" POSITIONS.

(2) MOVE MODE SELECTOR SWITCH TO "IDLE".

(3) PLACE REVERSE LEVER TO DIRECTION OF MOVEMENT.

(4) MOVE MODE SELECTOR SWITCH TO POSITION "1".

(5) MOVE LOCOMOTIVE SELECTOR HANDLE TO POSITION "1".

(6) LIFT COVER AND PUSH THE "INDEPENDENT MOTORING" PUSHBUTTON AND THE "MOTORING" LIGHT WILL APPEAR TO THE LEFT OF THE MODE SELECTOR SWITCH. THE REMOTE CONSIST IS NOW IN THROTTLE "NO. 1". POWER IS BEING APPLIED TO THE TRACTION MOTORS: TRAIN SHOULD BE STARTED AS OUTLINED UNDER SECTION 2.1.3.3 "RCE-1 POWER PROCEDURES" PG. 2-85.

THE THROTTLE POSITION OF THE REMOTE CONSIST WILL APPEAR IN THE THROTTLE WINDOW AND CAN BE REGULATED BY MOVING THE MODE SELECTOR SWITCH FROM POSITIONS 1-8. WHEN IN THIS CONFIGURATION THE REMOTE LOCOMOTIVE'S THROTTLE WILL ONLY RESPOND TO THE MODE SELECTOR SWITCH, THUS ALLOWING THE LEAD LOCOMOTIVE TO BE OPERATED INDEPENDENTLY IN IDLE, DYNAMIC BRAKING OR POWER.

b. TRAIN MOVING UNDER POWER IN "MU" TO CHANGE THE MODE OF OPERATION TO "INDEPENDENT MOTORING". (1-2)

(1) QUICKLY MOVE THE MODE SELECTOR SWITCH FROM "MU" TO THE CORRESPONDING THROTTLE SETTING OF THE LEAD LOCOMOTIVE. THE REMOTE LOCOMOTIVE THROTTLE IS NOW CONTROLLED BY THE MODE SELECTOR SWITCH.

(2) LIFT COVER AND PUSH THE "INDEPENDENT MOTORING" PUSHBUTTON AND THE "MOTORING" LIGHT WILL APPEAR TO THE LEFT OF THE MODE SELECTOR SWITCH. THE LEAD LOCOMOTIVE MAY NOW BE OPERATED INDEPENDENTLY IN IDLE, DYNAMIC BRAKING OR POWER.

NOTE: "INDEPENDENT MOTORING" WILL BE NULLIFIED BY MOVING THE MODE SELECTOR SWITCH FROM THE NUMBERED POSITION (1-8) TO "MU", "IDLE" OR "ISOLATE".

1-3

c. TRAIN MOVING WITH BOTH LEAD AND REMOTE CONSISTS ("MU") IN DYNAMIC BRAKING. TO CHANGE FROM DYNAMIC BRAKING TO POWER ON REMOTE CONSIST ONLY ("INDEPENDENT MOTORING").

(1) MOVE MODE SELECTOR SWITCH ONE POSITION AT A TIME TO POSITION 1. "DB-1" SHOULD INDICATE IN THE THROTTLE/DYNAMIC WINDOW.

NOTE: THIS MOVE SHOULD BE MADE SLOWLY AS DYNAMIC BRAKE FORCE IS BEING REDUCED WITH EACH MOVE.

(2) MOVE MODE SELECTOR SWITCH QUICKLY FROM POSITION 1 THROUGH "MU" TO "IDLE". "IDLE" SHOULD INDICATE IN THE THROTTLE/DYNAMIC BRAKE WINDOW.

(3) REMAIN IN "IDLE" POSITION FOR AT LEAST 10 SECONDS.

(4) LIFT COVER AND PUSH THE "INDEPENDENT MOTORING" PUSHBUTTON AND WHILE HOLDING DEPRESSED, MOVE MODE SELECTOR SWITCH QUICKLY FROM "IDLE" THROUGH "MU" TO POSITION 1. THE "MOTORING" LIGHT WILL APPEAR TO THE LEFT OF THE MODE SELECTOR SWITCH. "TH-1" SHOULD INDICATE IN THE THROTTLE/DYNAMIC BRAKE WINDOW. THE LEAD LOCOMOTIVE MAY NOW BE OPERATED INDEPENDENTLY.

NOTE: WHILE OPERATING IN THIS CONFIGURATION, THE MODE SELECTOR MUST NOT BE RETURNED TO MU WITHOUT FIRST MOVING TO "IDLE" OR BY REDUCING THE CONTROLLING UNIT TO "IDLE". TO DO SO WOULD CAUSE THE REMOTE CONSIST TO REVERT TO DYNAMIC BRAKE IMMEDIATELY CAUSING A SERIOUS CHANGE IN TRAIN SLACK.

1-4

d. TO CHANGE FROM THE "INDEPENDENT MOTORING" MODE TO POWER IN "MU" WITH THE TRAIN MOVING.

(1) MOVE MODE SELECTOR SWITCH SLOWLY TOWARD THE CORRESPONDING POSITION OF THE LEAD UNIT THROTTLE, AS INDICATED IN THE THROTTLE/DYNAMIC BRAKE WINDOW.

(2) MOVE MODE SELECTOR SWITCH QUICKLY TO "MU" POSITION. THE INDEPENDENT MOTORING LIGHT WILL GO OUT AND "MU" LIGHT WILL ILLUMINATE.

e. *TRAIN MOVING WITH THE LEAD CONSIST IN DYNAMIC BRAKING. TO CHANGE FROM "INDEPENDENT MOTORING" MODE TO DYNAMIC BRAKING (MU).*

1-5

(1) *MOVE MODE SELECTOR SWITCH ONE POSITION AT A TIME UNTIL POSITION 1 IS REACHED. "TH-1" SHOULD INDICATE IN THE THROTTLE/DYNAMIC BRAKE WINDOW.*

(2) *MOVE MODE SELECTOR SWITCH THROUGH "MU" TO "IDLE". THE "MOTORING" LIGHT SHOULD GO OUT AND "IDLE" WILL INDICATE IN THE THROTTLE/ DYNAMIC BRAKE WINDOW.*

NOTE: DO NOT LEAVE THE SELECTOR SWITCH IN "MU" WHEN MOVING TO "IDLE" SINCE THIS WILL CAUSE THE REMOTE UNITS TO IMMEDIATELY ASSUME THE DYNAMIC BRAKING MODE USED ON THE CONTROL UNIT.

(3) *WAIT AT LEAST 10 SECONDS.*

(4) *MOVE MODE SELECTOR SWITCH THROUGH "MU" TO POSITION 1. "DB-1" SHOULD INDICATE IN THE THROTTLE/DYNAMIC BRAKE WINDOW. THE DEGREE OF DYNAMIC BRAKE ON THE REMOTE CONSIST CAN NOW BE REGULATED WITH THE MODE SELECTOR SWITCH IN POSITIONS 1 THROUGH 8.*

NOTE: IF BRAKE WARNING (BW) ILLUMINATES ON THE CONTROL CONSOLE, QUICKLY REDUCE THE SETTING OF THE MODE SELECTOR SWITCH ONE POSITION AT A TIME UNTIL "BW" LIGHT GOES OUT.

2. MU Mode and Other Variations:

CONSOLES "B" and "D" do not provide for Independ- Motoring as noted by the absence of the motoring light and the button required for this function. Therefore, it is not possible to operate RCE-1 trains equipped with this console in the modes previously described. CONTROL CONSOLE "B" will only permit a limited amount of independent operation (Independent Control) if the control unit is in some throttle or dynamic brake position. Under these conditions the remote consist can be varied from Selector Position 1-8 which will provide the corresponding throttle or dynamic brake position depending on whether the control consist is being used in power or dynamic brake. If the control unit is reduced to Idle the remote units will immediately drop to Idle regardless of the setting of the mode selector switch. This type of operation can also be accomplished with CONSOLE "A" if the Independent Motoring button is not used.

The Independent Motoring button has also been removed from CONTROL CONSOLE "C". This does not, however, mean that independent motoring is not possible with this equipment since this button has been replaced by a two position switch labeled PWR-DYN. This arrangement permits the same independent operation of the remote consist as described earlier on page 1-39, using CONSOLE "A" with the Independent Motoring button.

Both CONSOLE "A" and CONSOLE "B" will permit automatic MU (Multiple Unit) operation of the control consist and the remote consist. CONSOLE "D" can only be operated in MU or IDLE since the other Mode Selector positions are blanked out and cannot be used. This is done by placing the Mode Selector Switch at MU and proceeding with normal operation of the control unit. The remote consist will then respond to the settings of the control unit as any other multiple unit consist would function if it was directly connected to the control unit. This assumes that radio communication between the control and remote consists is not interrupted.

A further revision to CONSOLE "C" is the elimination of the MU position on the Mode Selector and the corresponding MU indicator light. Therefore, when using CONTROL CONSOLE "C" the remote consist must be regulated independently of the operation of the control consist at all times.

The arrangements of CONSOLE "C" and CONSOLE "D" show the extent of the contrasting philosophies of remote unit operation between the various railroads. CONSOLE "C" has been modified to require independent operation of the two consists while CONSOLE "D" has been modified to require synchronization of the operation (MU).

3. Override:

A second major variation in control consoles is the Override function, although some railroads may not be equipped with override capabilities. CONSOLES "A", "B" and "D" provide a button for this operation (unless modified) while Override is accomplished automatically with CONSOLE "C".

When radio communication is interrupted (No Continuity) RCE-1 is designed to discontinue the present operating mode and drop out the air feed valve on the remote consist. However, since

there are occasions when it is undesirable to lose the use of the remote power, most systems also have the capability of continuing the last mode of operation by means of the Override function. As noted previously, some railroads prefer that Override be accomplished manually (CONSOLES "A", "B" and "D") while others prefer an automatic Override (CONSOLE "C").

When operating in Override, during No Continuity conditions, the remote consist will remain in the power or dynamic brake position which was last received by the remote consist before radio transmission was interrupted. The Override condition will exist until one or more of the following occurs:

a. The Override times out after predetermined period usually 12 to 15 minutes. Remote Units will then return to Idle position and the feed valve will drop out.

   NOTE: Some railroads prefer a longer Override period with a few using a continuous Override. Continuous Override can only be nullified by the conditions of Items "b" and "c" listed below.

b. A service or an emergency air brake application is initiated during this period.

c. Continuity is regained and normal operation is resumed.

   NOTE: When communications are re-established after a No Continuity condition the remote consist will immediately assume the mode of operation indicated on the CONTROL CONSOLE. *WHEN OPERATING IN OVERRIDE AND DURING NO CONTINUITY THE MODE SELECTOR SHOULD NOT BE CHANGED SIGNIFICANTLY FROM THE POSITION LAST COMMUNICATED TO THE REMOTE CONSIST BEFORE CONTINUITY WAS LOST.* A rapid change of throttle or dynamic braking effort could cause severe adjustments of slack.

1-6

*For further information on radio controlled locomotive operation, see Section F of the AAR-Mechanical Division, Manual of Standards and Recommended Practices.

DEFINITIONS AND FUNCTIONS OF EQUIPMENT

SECTION - 1

DEFINITIONS AND FUNCTIONS OF EQUIPMENT

SUMMARIZATION OF GUIDELINES

1.2.2 RCE-1 OPERATING MODES

1. THE INDEPENDENT MOTORING MODE ON CONSOLE "A" IS TO BE USED IN THE FOLLOWING MANNERS:

a. STARTING A TRAIN WITH INDEPENDENT MOTORING

(1) "GENERATOR FIELD" AND "ENGINE RUN" SWITCHES ON THE LEAD LOCOMOTIVE MUST BE IN "ON" POSITIONS.
(2) MOVE MODE SELECTOR SWITCH TO "IDLE".
(3) PLACE REVERSE LEVER TO DIRECTION OF MOVEMENT.
(4) MOVE MODE SELECTOR SWITCH TO POSITION "1".
(5) MOVE LOCOMOTIVE SELECTOR HANDLE TO POSITION "1". (1-1)
(6) LIFT COVER AND PUSH THE "INDEPENDENT MOTORING" PUSHBUTTON AND THE "MOTORING" LIGHT WILL APPEAR TO THE LEFT OF THE MODE SELECTOR SWITCH. THE REMOTE CONSIST IS NOW IN THROTTLE "NO. 1". POWER IS BEING APPLIED TO THE TRACTION MOTORS: TRAIN SHOULD BE STARTED AS OUTLINED UNDER SECTION 2.1.3.3 "RCE-1 POWER PROCEDURES" PG. 2-85.

THE THROTTLE POSITION OF THE REMOTE CONSIST WILL APPEAR IN THE THROTTLE WINDOW AND CAN BE REGULATED BY MOVING THE MODE SELECTOR SWITCH FROM POSITIONS 1-8. WHEN IN THIS CONFIGURATION THE REMOTE LOCOMOTIVE'S THROTTLE WILL ONLY RESPOND TO THE MODE SELECTOR SWITCH, THUS ALLOWING THE LEAD LOCOMOTIVE TO BE OPERATED INDEPENDENTLY IN IDLE, DYNAMIC BRAKING OR POWER.

b. TRAIN MOVING UNDER POWER IN "MU" TO CHANGE THE MODE OF OPERATION TO "INDEPENDENT MOTORING".

(1) QUICKLY MOVE THE MODE SELECTOR SWITCH FROM "MU" TO THE CORRESPONDING THROTTLE SETTING OF THE LEAD LOCOMOTIVE. THE REMOTE LOCOMOTIVE THROTTLE IS NOW CONTROLLED BY THE MODE SELECTOR SWITCH. (1-2)

(2) LIFT COVER AND PUSH THE "INDEPENDENT MOTORING" PUSHBUTTON AND THE "MOTORING" LIGHT WILL APPEAR TO THE LEFT OF THE MODE SELECTOR SWITCH. THE LEAD LOCOMOTIVE MAY NOW BE OPERATED INDEPENDENTLY IN IDLE, DYNAMIC BRAKING OR POWER.
NOTE: "INDEPENDENT MOTORING" WILL BE NULLIFIED BY MOVING THE MODE SELECTOR SWITCH FROM THE NUMBERED POSITION (1-8) TO "MU", "IDLE" OR "ISOLATE".

c. TRAIN MOVING WITH BOTH LEAD AND REMOTE CONSISTS ("MU") IN DYNAMIC BRAKING. TO CHANGE FROM DYNAMIC BRAKING TO POWER ON REMOTE CONSIST ONLY ("INDEPENDENT MOTORING").

(1) MOVE MODE SELECTOR SWITCH ONE POSITION AT A TIME TO POSITION 1. "DB-1" SHOULD INDICATE IN THE THROTTLE/DYNAMIC WINDOW.
NOTE: THIS MOVE SHOULD BE MADE SLOWLY AS DYNAMIC BRAKE FORCE IS BEING REDUCED WITH EACH MOVE.
(2) MOVE MODE SELECTOR SWITCH QUICKLY FROM POSITION 1 THROUGH "MU" TO "IDLE". "IDLE" SHOULD INDICATE IN THE THROTTLE/DYNAMIC BRAKE WINDOW.
(3) REMAIN IN "IDLE" POSITION FOR AT LEAST TEN (10) SECONDS.
(4) LIFT COVER AND PUSH THE "INDEPENDENT MOTORING" PUSHBUTTON AND WHILE HOLDING DEPRESSED, MOVE MODE SELECTOR SWITCH QUICKLY FROM "IDLE" THROUGH "MU" TO POSITION 1. THE "MOTORING" LIGHT WILL APPEAR TO THE LEFT OF THE MODE SELECTOR SWITCH. "TH-1" SHOULD INDICATE IN THE THROTTLE/DYNAMIC BRAKE WINDOW. THE LEAD LOCOMOTIVE MAY NOW BE OPERATED INDEPENDENTLY.
NOTE: WHILE OPERATING IN THIS CONFIGURATION, THE MODE SELECTOR MUST NOT BE RETURNED TO "MU" WITHOUT FIRST MOVING TO "IDLE" OR BY REDUCING THE CONTROLLING UNIT TO "IDLE". TO DO SO WOULD CAUSE THE REMOTE CONSIST TO REVERT TO DYNAMIC BRAKE IMMEDIATELY CAUSING A SERIOUS CHANGE IN TRAIN SLACK.

1-3

d. TO CHANGE FROM THE "INDEPENDENT MOTORING" MODE TO POWER IN "MU" WITH THE TRAIN MOVING.

(1) MOVE MODE SELECTOR SWITCH SLOWLY TOWARD THE CORRESPONDING POSITION OF THE LEAD UNIT THROTTLE, AS INDICATED IN THE THROTTLE/DYNAMIC BRAKE WINDOW.

1-4

(2) MOVE MODE SELECTOR SWITCH QUICKLY TO "MU" POSITION. THE "INDEPENDENT MOTORING LIGHT" WILL GO OUT AND "MU" LIGHT WILL ILLUMINATE.

e. TRAIN MOVING WITH THE LEAD CONSIST IN DYNAMIC BRAKING. TO CHANGE FROM "INDEPENDENT MOTORING" MODE TO DYNAMIC BRAKING ("MU").

(1) MOVE MODE SELECTOR SWITCH ONE POSITION AT A TIME UNTIL POSITION 1 IS REACHED. "TH-1" SHOULD INDICATE IN THE THROTTLE/ DYNAMIC BRAKE WINDOW.

(2) MOVE MODE SELECTOR SWITCH THROUGH "MU" TO "IDLE". THE "MOTORING" LIGHT SHOULD GO OUT AND "IDLE" WILL INDICATE IN THE THROTTLE/DYNAMIC BRAKE WINDOW.
NOTE: DO NOT LEAVE THE SELECTOR SWITCH IN "MU" WHEN MOVING TO "IDLE" SINCE THIS WILL CAUSE THE REMOTE UNITS TO IMMEDIATELY ASSUME THE DYNAMIC BRAKING MODE USED ON THE CONTROL UNIT.

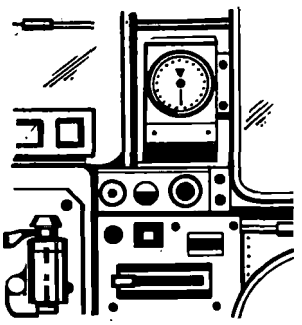
1-5

(3) WAIT AT LEAST TEN (10) SECONDS.

(4) MOVE MODE SELECTOR SWITCH THROUGH "MU" TO POSITION 1. "DB-1" SHOULD INDICATE IN THE THROTTLE/DYNAMIC BRAKE WINDOW. THE DEGREE OF DYNAMIC BRAKE ON THE REMOTE CONSIST CAN NOW BE REGULATED WITH THE MODE SELECTOR SWITCH IN POSITIONS 1 THROUGH 8.
NOTE: IF BRAKE WARNING (BW) ILLUMINATES ON THE CONTROL CONSOLE, QUICKLY REDUCE THE SETTING OF THE MODE SELECTOR SWITCH ONE POSITION AT A TIME UNTIL "BW" LIGHT GOES OUT.

NOTE: WHEN OPERATING IN OVERRIDE AND DURING NO CONTINUITY THE MODE SELECTOR SHOULD NOT BE CHANGED SIGNIFICANTLY FROM THE POSITION LAST COMMUNICATED TO THE REMOTE CONSIST BEFORE CONTINUITY WAS LOST.

1-6



TRAIN HANDLING

SECTION - 2

TRAIN HANDLING

SUMMARIZATION OF GUIDELINES

2.1.1.1. LOCOMOTIVE BRAKE TESTS

IN ADDITION TO STATUTE REQUIREMENTS, THE AIR BRAKES MUST BE TESTED AS FOLLOWS PRIOR TO BEING PLACED IN SERVICE OR IF THE LEAD UNIT OF A LOCOMOTIVE CONSIST IS CHANGED EN ROUTE:

ADDITIONAL CHECK OF THE FOLLOWING LOCOMOTIVE ITEMS SHOULD BE MADE BEFORE COMMENCING BRAKE TESTS:

1. WHEELS ARE PROPERLY BLOCKED OR HANDBRAKE IS APPLIED.
2. THE GENERATOR FIELD SWITCH IS OFF.
3. BRAKE VALVE CUTOUT COCKS ARE IN "CUTOUT" POSITION ON ALL UNITS EXCEPT THE CONTROLLING UNIT.
4. ANGLE COCKS ARE IN PROPER POSITION BETWEEN LOCOMOTIVE UNITS.
5. MU HOSES ARE PROPERLY COUPLED BETWEEN UNITS.

(2-1)

6. EQUIPMENT IS FULLY CHARGED.
7. AIR PRESSURE GAUGES FOR PROPER PRESSURE ADJUSTMENTS:

    a. MAIN RESERVOIR 130-140 (OR AS SPECIFIED)
    b. BRAKE PIPE PRESSURE
       FREIGHT 80 (OR AS SPECIFIED)
    c. INDEPENDENT BRAKE (AS SPECIFIED)

8. INDEPENDENT BRAKE IS IN RELEASE POSITION.
9. ASCERTAIN SANDERS ARE OPERATIVE.

LOCOMOTIVE BRAKES APPLICATION AND LEAKAGE TEST:

1. MAKE A 10 PSI BRAKE PIPE REDUCTION OR AS PRESCRIBED WITH THE AUTOMATIC BRAKE VALVE, CUT OUT MAINTAINING FEATURE IF EQUIPPED AND ASCERTAIN:

    a. BRAKES APPLY.

(2-2)

    b. BRAKE PIPE LEAKAGE DOES NOT EXCEED 5 PSI PER MINUTE.
    c. BRAKE CYLINDER PRESSURE IS OBTAINED AND DOES NOT DECREASE.

2. DEPRESS THE INDEPENDENT BRAKE VALVE HANDLE FOR FOUR (4) SECONDS PER UNIT FOR EACH UNIT IN THE CONSIST, AND NOTE BRAKES RELEASE ON ALL UNITS.

3. MOVE THE BRAKE VALVE CUTOFF VALVE TO IN POSITION. MAKE AN ADDITIONAL 15 PSI BRAKE PIPE REDUCTION AND NOTE: BRAKES REAPPLY.
4. MOVE THE THROTTLE TO NO. 3 POSITION. MOVE THE AUTOMATIC BRAKE VALVE HANDLE TO EMERGENCY POSITION AND NOTE:

   a. BRAKE PIPE PRESSURE REDUCED TO ZERO.
   b. BRAKE CYLINDER PRESSURE BUILDS UP AT A RAPID RATE AND PRESSURE OBTAINED.
   c. POWER CUTOFF SWITCH HAS OPERATED AND ENGINE RPM'S REDUCED TO IDLE, IF EQUIPPED.

2-2 cont.

5. DEPRESS THE INDEPENDENT BRAKE VALVE HANDLE AND NOTE, BRAKES RELEASE OR BRAKE CYLINDER PRESSURE DECREASES.
6. MOVE THE THROTTLE TO "IDLE". AFTER RECOVERING BRAKE CONTROL, APPROXIMATELY ONE (1) MINUTE, MOVE THE AUTOMATIC BRAKE VALVE HANDLE TO RUNNING OR RELEASE POSITION AND NOTE:

   a. BRAKE PIPE PRESSURE RESTORED TO NORMAL.
   b. POWER CUTOFF SWITCH HAS RESET.

TESTING DYNAMIC BRAKE INTERLOCK AND DYNAMIC BRAKE (IF LOCOMOTIVE IS EQUIPPED).

1. MAKE A 15 PSI BRAKE PIPE REDUCTION WITH THE AUTOMATIC BRAKE VALVE HANDLE, AND NOTE AIR BRAKES APPLY.
2. MOVE THE SELECTOR LEVER TO B POSITION, ADVANCE THE DYNAMIC BRAKING LEVER, AND NOTE, AIR BRAKES RELEASE ON THE LOCOMOTIVE.
3. MOVE THE INDEPENDENT BRAKE VALVE HANDLE TO FULL APPLICATION POSITION AND THEN TO RELEASE POSITION.
4. IF EQUIPPED WITH POWER CUTOFF (P.C.) SWITCH, PLACE THE AUTOMATIC BRAKE VALVE HANDLE IN EMERGENCY POSITION AND NOTE, AIR BRAKES APPLY AND ENGINE RPM IS REDUCED TO IDLE. AFTER RECOVERING BRAKE CONTROL (APPROXIMATELY ONE (1) MINUTE), RETURN BRAKE VALVE HANDLE TO RUNNING OR RELEASE POSITION AND CONDITION LOCOMOTIVE FOR POWER OPERATION.

(2-3)

   a. ATTAIN A SPEED OF 15-20 MPH AND REDUCE THE THROTTLE TO IDLE.
   b. SET THE LOCOMOTIVE CONSIST FOR DYNAMIC BRAKING IN ACCORDANCE WITH SECTION 2.1.2.4.C. PG. 2-49.
   c. ASCERTAIN THAT DYNAMIC BRAKING FORCE IS BEING GENERATED AND OBSERVE THE AMMETER GAUGE FOR READINGS.
   d. CLOSE THE TEST BY RETURNING THE LOCOMOTIVE CONSIST TO POWER OPERATION IN ACCORDANCE WITH SECTION 2.1.2.4.C. PG. 2-49.

WHEN OTHER THAN THE LEAD UNIT OF A LOCOMOTIVE CONSIST IS CHANGED, AN APPLICATION AND RELEASE TEST OF THE LOCOMOTIVE AIR BRAKES MUST BE MADE AS FOLLOWS: (IF THE LEAD UNIT IS CHANGED REFER TO PG. 2-3.)

1. HANDBRAKE SHOULD BE APPLIED OR WHEELS PROPERLY BLOCKED AND INDEPENDENT BRAKE RELEASED.
2. ASCERTAIN SANDERS ARE OPERATIVE.
3. WITH EQUIPMENT FULLY CHARGED, MAKE A 15 PSI BRAKE PIPE REDUCTION WITH AUTOMATIC BRAKE VALVE AND OBSERVE THAT BRAKES APPLY ON EACH UNIT. RELEASE AUTOMATIC BRAKE AND OBSERVE BRAKES RELEASE ON EACH UNIT.

(2-4)

4. APPLY INDEPENDENT BRAKE AND OBSERVE BRAKES APPLY ON EACH UNIT. RELEASE INDEPENDENT BRAKE AND OBSERVE BRAKES RELEASE ON EACH UNIT.
5. MAKE A 15 PSI BRAKE PIPE REDUCTION WITH AUTOMATIC BRAKE VALVE AND OBSERVE THAT BRAKES APPLY ON EACH UNIT. DEPRESS THE INDEPENDENT BRAKE VALVE HANDLE AND OBSERVE BRAKES RELEASE ON EACH UNIT.

IF RADIO CONTROLLED LOCOMOTIVE EQUIPMENT (RCE-1) IS TO BE USED, THE FOLLOWING TESTS MUST BE MADE IN ADDITION TO THOSE OUTLINED A. THROUGH C. PRIOR TO LEAVING SERVICE OR PARKING TRACK:

1. LEAD CONSIST MUST BE COUPLED TO THE REMOTE CONSIST AND WHEELS PROPERLY BLOCKED OR HANDBRAKES APPLIED. NO MU HOSES OR CABLE SHOULD BE COUPLED BETWEEN LEAD AND REMOTE CONSISTS.

(2-5)

2. LEAD UNIT PREPARATION:
   a. ALL SWITCHES ON THE CONTROL CONSOLE MUST BE IN THEIR OFF OR OUT POSITION.
   b. THE MODE SELECTOR MUST BE IN ISOLATE.
   c. PLACE ALL RCE-1 POWER SWITCHES AND CIRCUIT BREAKERS IN THE ON POSITION.

(2-6)

   d. PUT LOCKING DEVICE ON HANDLE OF AUTOMATIC BRAKE VALVE.
   e. PLACE THE CONSOLE POWER SWITCH TO ON POSITION.

3. REMOTE CONSIST PREPARATION WITH REMOTE CONTROL CAR (RCC):

(2-7)

   a. OPEN MAIN RESERVOIR CUTOUT COCKS IN RCC.
   b. OPEN BRAKE PIPE CUTOUT COCK.
   c. OPEN CUTOUT COCK TO AIR MANIFOLD.
   d. PLACE MU-2A VALVE IN LEAD POSITION.

e. CUTOUT DEAD ENGINE FEATURE.
f. CHANGE ADDRESS CODE SELECTOR TO CORRESPOND WITH ADDRESS CODE OF LEAD UNIT.
g. PLACE ALL RCE-1 POWER SWITCHES AND CIRCUIT BREAKERS IN ON POSITION.

2-7 cont.

h. PLACE SAME AND OPPOSITE SWITCH IN PROPER POSITION.
i. CONDITION ALL UNITS CONNECTED TO THE RCC AS CONVENTIONAL TRAILING UNITS.

4. REMOTE CONSIST PREPARATION WITH REMOTE UNIT:

a. PLACE THE SELECTOR LEVER IN OFF.
b. REMOVE THE REVERSER HANDLE.
c. OPEN THE AIR MANIFOLD CUTOUT COCK.
d. PLACE ALL RCE-1 POWER SWITCHES AND CIRCUIT BREAKERS IN ON POSITION.
e. PLACE THE INDEPENDENT BRAKE DOUBLE CUTOUT COCK IN OPEN (LEAD) POSITION.
f. PLACE THE INDEPENDENT BRAKE VALVE HANDLE IN THE RELEASE POSITION.

(2-8)

g. PLACE 26-C AUTOMATIC BRAKE VALVE HANDLE IN RELEASE POSITION.
h. PLACE 26-C AUTOMATIC BRAKE VALVE CUTOFF VALVE IN FRT POSITION.
i. SET PROPER ADDRESS CODE OR PLACE ADDRESS CARD FROM LEAD UNIT IN PROPER POSITION IN LOGIC CABINET NO. 2.
j. CLOSE FUEL PUMP AND CONTROL SWITCHES AND DYNAMIC BRAKE CIRCUIT BREAKER ON CONTROL STAND. ALL OTHER SWITCHES MUST BE IN OFF.
k. CONDITION ALL OTHER UNITS CONNECTED TO THE REMOTE UNIT AS CONVENTIONAL TRAILING UNITS.

5. LOCOMOTIVE (RCE-1) APPLICATION AND LEAKAGE TEST:

a. LOCOTROL CONSOLE SHOULD INDICATE CONT AND FEED VALVE OUT.
b. MOVE THE FEED VALVE SWITCH TO IN.
c. MOVE THE MODE SELECTOR TO IDLE.
d. PUSH THE ABR BUTTON AND OBSERVE BRAKES RELEASE ON ALL UNITS.
e. MOVE THE INDEPENDENT BRAKE VALVE HANDLE TO RELEASE AND OBSERVE BRAKES RELEASE ON ALL UNITS.

(2-9)

f. PUSH THE ABA BUTTON TO MAKE A 20 PSI EQUALIZING RESERVOIR REDUCTION AND NOTE, BRAKES APPLY ON ALL UNITS.
g. DEPRESS THE IND REL BUTTON FOR AT LEAST FIVE (5) SECONDS AND OBSERVE BRAKES RELEASE ON ALL UNITS.
h. PUSH THE EMERGENCY BUTTON ON AIR CONSOLE AND NOTE THAT BRAKE PIPE PRESSURE REDUCES TO ZERO AND BRAKES ON ALL UNITS APPLY.

THE PC SHOULD LIGHT ON CONTROL CONSOLE AND THE FEED VALVE ASPECT SHOULD SHOW FEED VALVE OUT.

i. WAIT TWO MINUTES AND PUSH THE ABR PUSHBUTTON FOR AT LEAST FIVE (5) SECONDS. THE FEED VALVE ASPECT SHOULD SHOW FEED VALVE IN AND THE PC LIGHT SHOULD GO OUT ON THE LOCOTROL CONSOLE.

2-9 cont. THE BRAKE PIPE SHOULD BE RESTORED TO STANDARD PRESSURE AND BRAKES SHOULD RELEASE ON ALL UNITS.

j. PUSH THE IND APP PUSHBUTTON AND NOTE BRAKE CYLINDER GAUGE RISES TO MAXIMUM PRESSURE. BRAKES SHOULD APPLY ON ALL UNITS.

k. PUSH THE IND REL PUSHBUTTON AND BRAKES SHOULD RELEASE ON ALL UNITS.

6. <u>FOLLOWING THE APPLICATION AND LEAKAGE TEST UNITS MUST BE CONDITIONED AS FOLLOWS</u>:

a. ALL SWITCHES ON THE CONTROL CONSOLE MUST BE IN OFF OR OUT POSITION.
b. THE MODE SELECTOR SWITCH MUST BE IN ISOLATE POSITION.
c. ALL RCE-1 POWER SWITCHES MUST BE IN OFF POSITION.
d. THE MAIN CIRCUIT BREAKER IN THE LOW VOLTAGE CABINET MUST BE IN OFF POSITION. (THIS CIRCUIT BREAKER SHOULD BE OFF WHEN ATTEMPTING TO START THE LOCOMOTIVE.)

(2-10)

e. THE LOCKING DEVICE FOR THE AUTOMATIC BRAKE VALVE HANDLE MUST BE IN THE UNLOCKED POSITION.
f. ALL OF THE ABOVE SWITCHES AND CONTROLS MUST REMAIN IN OFF OR OUT POSITION UNTIL TRAIN MAKE-UP IS COMPLETE AND THE CONTROL CONSIST IS ATTACHED TO THE TRAIN.
g. PROCEED WITH CONVENTIONAL OPERATION OF THE LOCOMOTIVE.

2.1.1.2 FREIGHT TRAIN AIR BRAKE TESTS

<u>THE STANDARD TRAIN BRAKE TEST SHOULD BE ACCOMPLISHED AS FOLLOWS</u>:

1. CHARGE THE TRAIN TO REQUIRED PRESSURE.
2. AFTER RECEIVING PROPER SIGNAL, MAKE A CONTINUOUS <u>15 POUND</u> EQUALIZING RESERVOIR PRESSURE REDUCTION.
3. <u>AFTER BRAKE PIPE DISCHARGE CEASES, CUT OUT THE PRESSURE MAINTAINING FEATURE (IF SO EQUIPPED), WAIT AT LEAST 40 SECONDS</u>, AND TIME THE BRAKE PIPE LEAKAGE WHICH <u>MUST NOT EXCEED 5 PSI PER MINUTE</u>.

(IF A SATISFACTORY LEAKAGE TEST CANNOT BE OBTAINED SEE SEC. C.1., PG. 2-33.)

4. FOLLOWING THE LEAKAGE TEST REDUCE BRAKE PIPE PRESSURE TO THE EQUIVALENT OF A FULL SERVICE APPLICATION, IF NOT ALREADY ACCOMPLISHED DUE TO LEAKAGE, THEN COMPLETE THE TRAIN BRAKE TEST WITH PRESSURE MAINTAINING FEATURE CUT OUT.
   NOTE: WHEN MAKING THIS REDUCTION WITH EQUIPMENT FURNISHED WITH PRESSURE MAINTAINING FEATURE, IT IS ADVANTAGEOUS TO REDUCE THE EQUALIZING RESERVOIR PRESSURE BELOW THE BRAKE PIPE PRESSURE BUT NOT TO EXCEED APPROXIMATELY 3 PSI BELOW. THIS SHOULD ELIMINATE ANY POSSIBILITY OF UNINTENTIONAL RELEASE OF TRAIN BRAKES. THIS PROCEDURE SHOULD BE ACCOMPLISHED JUST PRIOR TO RETURNING PRESSURE MAINTAINING FEATURE TO OPERATIVE POSITION. THE APPROXIMATE 3 PSI LIMIT IS RECOMMENDED IN ORDER TO REDUCE ANY POSSIBILITY OF AN UNDESIRED EMERGENCY BEING INITIATED WHEN THE PRESSURE MAINTAINING FEATURE IS RETURNED TO OPERATIVE POSITION.

(2-11)

5. WHEN PROPER SIGNAL FOR RELEASE IS RECEIVED, PLACE THE AUTOMATIC BRAKE VALVE HANDLE IN THE "RELEASE" OR "RUNNING" POSITION AND THE PRESSURE MAINTAINING FEATURE (IF SO EQUIPPED) SHOULD THEN BE "CUT IN".

TRAIN BRAKE TEST WITH RADIO CONTROLLED LOCOMOTIVES (RCE-1):

1. PLACE THE MODE SELECTOR SWITCH ON THE CONTROL CONSOLE TO IDLE POSITION.
2. DEPRESS THE AUTO REL PUSHBUTTON ON THE AIR BRAKE CONSOLE. TRAINMEN OR CAR INSPECTOR MUST ADVISE THE ENGINEMAN WHEN THE BRAKE PIPE PRESSURE BEGINS TO INCREASE ON THE CABOOSE TO INSURE A CONTINUOUS BRAKE PIPE.
   NOTE: THE LEAD BRAKE PIPE CUTOFF VALVE MUST BE CUT IN, AND THE RCE UNIT FEED VALVE MUST BE CUT OUT.

(2-12)

3. AFTER BEING ADVISED THAT BRAKE PIPE PRESSURE IS RISING ON THE CABOOSE, PLACE THE FEED VALVE SWITCH TO IN POSITION AND AGAIN DEPRESS AUTO REL PUSHBUTTON ON THE AIR BRAKE CONTROL CONSOLE.
4. AFTER TRAIN IS CHARGED TO REQUIRED PRESSURE (SUFFICIENT TIME MUST BE ALLOWED TO CHARGE THE BRAKE SYSTEM) AND UPON RECEIVING SIGNAL TO APPLY THE BRAKES, THE ENGINEER WILL DEPRESS THE ABA PUSHBUTTON TO MAKE A 15 PSI EQUALIZING RESERVOIR REDUCTION.

5. WHEN THE 15 PSI BRAKE PIPE REDUCTION IS COMPLETED AND THE SERVICE EXHAUST CLOSES:

   a. TURN THE FEED VALVE SWITCH TO OUT POSITION.
   b. TURN THE MODE SELECTOR SWITCH TO ISOLATE POSITION.
   c. TURN THE AUTOMATIC BRAKE VALVE CUTOFF VALVE TO OUT POSITION.

6. WAIT AT LEAST 40 SECONDS FOR THE BRAKE PIPE PRESSURE TO EQUALIZE.
7. OBSERVE THE BRAKE PIPE GAUGE AND TIME THE BRAKE PIPE LEAKAGE FOR ONE MINUTE. BRAKE PIPE LEAKAGE MUST NOT EXCEED 5 PSI/MINUTE (IF TEST IS NOT SATISFACTORY, REFER TO SEC. C.1. PG. 2-33.)
8. AFTER LEAKAGE TEST, IF BRAKE PIPE PRESSURE HAS NOT REDUCED TO A FULL SERVICE BRAKE APPLICATION.

   a. DEPRESS THE ABA PUSHBUTTON AND REDUCE THE EQUALIZING RESERVOIR PRESSURE BELOW THE BRAKE PIPE PRESSURE, BUT NOT TO EXCEED 3 PSI. (SEE NOTE, SEC. A.4. PG. 2-9.)
   b. TURN THE AUTOMATIC BRAKE VALVE CUTOFF VALVE TO IN POSITION.
2-12 cont.
   c. DEPRESS THE ABA PUSHBUTTON UNTIL THE DESIRED FULL SERVICE BRAKE PIPE REDUCTION IS OBTAINED.
   d. TURN THE AUTOMATIC BRAKE VALVE CUTOFF VALVE TO OUT POSITION UNTIL THE AIR BRAKE TEST IS COMPLETE AND A RELEASE SIGNAL IS GIVEN.

9. WHEN NOTICE IS GIVEN TO RELEASE TRAIN BRAKES, START THE AIR BRAKE RELEASE BY CUTTING IN ONLY ONE FEED VALVE AS OUTLINED BELOW, EITHER ON THE CONTROL LOCOMOTIVE OR ON THE REMOTE CONSIST. THE METHOD OUTLINED IN 9.a. IS RECOMMENDED AS THE MORE RELIABLE TEST FOR A "CONTINUOUS BRAKE PIPE" BETWEEN CONTROL AND REMOTE UNITS.

   a. IF THE FEED VALVE ON THE REMOTE UNIT IS CUT IN FIRST FOR THE RELEASE:
      (1) TURN THE MODE SELECTOR TO IDLE POSITION.
      (2) TURN THE FEED VALVE SWITCH TO IN.
      (3) DEPRESS THE ABR PUSHBUTTON.
      (4) WHEN THE BRAKE PIPE PRESSURE ON THE LOCOMOTIVE SHOWS A SIGNIFICANT INCREASE TURN THE AUTOMATIC BRAKE VALVE CUTOFF VALVE TO IN POSITION.
      (5) ASCERTAIN BRAKE PIPE PRESSURE IS RISING ON REAR OF TRAIN.

b. IF THE CONTROL LOCOMOTIVE FEED VALVE IS CUT IN FIRST FOR THE RELEASE:
   (1) TURN THE AUTOMATIC BRAKE VALVE CUTOFF VALVE TO IN POSITION.
   (2) DEPRESS THE ABR PUSHBUTTON.
   (3) WHEN NOTICE IS RECEIVED FROM THE REAR OF TRAIN THAT THE BRAKE PIPE PRESSURE IS RISING:
      (a) TURN THE MODE SELECTOR TO IDLE POSITION.
      (b) TURN THE FEED VALVE SWITCH TO IN POSITION.
      (c) DEPRESS THE ABR PUSHBUTTON.
      (d) OBSERVE ON THE CONTROL CONSOLE THAT THE FEED VALVE IN LIGHT IS LIT.

2-12 cont.

10. AFTER BRAKES RELEASE, THE TRAIN IS READY FOR DEPARTURE.
11. THE RELEASE INSPECTION MAY BE ACCOMPLISHED BY MEANS OF A "ROLL BY" INSPECTION.

THE INTERMEDIATE TERMINAL AIR BRAKE INSPECTION AND TEST, WHERE REQUIRED, WITH RCE-1 OPERATION WILL BE CONDUCTED AS FOLLOWS:

1. CENTER THE REVERSE LEVER.
2. PLACE THE MODE SELECTOR IN IDLE POSITION.
3. RELEASE THE INDEPENDENT BRAKES ON THE RCE UNIT AND REMOTE CONSIST BY DEPRESSING THE IND REL PUSHBUTTON.
4. MAKE A 20 POUND AUTOMATIC BRAKE APPLICATION WITH AUTO APP PUSHBUTTON. (2-13)
5. PLACE THE FEED VALVE SWITCH ON THE CONTROL CONSOLE IN THE OUT POSITION.
6. PLACE THE MODE SELECTOR SWITCH ON THE CONTROL CONSOLE IN THE ISOLATE POSITION.
7. TURN THE AUTOMATIC BRAKE VALVE CUTOFF VALVE TO OUT POSITION.
8. HANDLE AS OUTLINED UNDER "TRAIN BRAKE TEST WITH RADIO CONTROLLED LOCOMOTIVES (RCE-1)", SEC. B., STEPS 5-11., PGS. 2-10 THRU 2-12.

2.1.2.1. STOPPING ABILITIES OF FREIGHT TRAINS

(2-14) WHEN OPERATING LONG TRAINS, EXCESSIVE LEAKAGE AND EXCESSIVE GRADIENT MAY RESULT IN UNPREDICTABLE BRAKING OPERATIONS.

2.1.2.2 USE OF THE AUTOMATIC AIR BRAKE

(2-15) UNDER NORMAL OPERATION CONDITIONS, A BRAKE APPLICATION SHOULD BEGIN AT A SUFFICIENT DISTANCE SO THAT DESIRED RETARDATION MAY BE OBTAINED BY USING AN INITIAL MINIMUM SERVICE REDUCTION. NORMALLY, SLOWDOWNS OR STOPS SHOULD BE COMPLETED WITH NOT MORE THAN A 15 PSI TOTAL BRAKE PIPE REDUCTION.

(2-16) THE CONTROL OF SLACK IS ESSENTIAL TO PROPER TRAIN OPERATION AND ANY CHANGES IN SPEED WITHIN THE TRAIN MUST BE MADE SLOWLY TO ALLOW SUFFICIENT TIME TO LET THE TRAIN SLACK ADJUST TO BRAKE APPLICATIONS AND RELEASES UNLESS AN EMERGENCY ARISES.

A. SERVICE BRAKE APPLICATIONS

(2-17) "SUPER LIGHT" MINIMUM REDUCTIONS SHOULD DEFINITELY BE AVOIDED TO PREVENT "KICK OFF" OF BRAKES. INITIAL BRAKE PIPE REDUCTION SHOULD BE BETWEEN 6 and 8 PSI.

(2-18) UNDER NORMAL CONDITIONS, THE USE OF A SPLIT SERVICE REDUCTION OR GRADUATED APPLICATION IS THE DESIRABLE METHOD TO BE USED FOR APPLYING TRAIN BRAKES. THIS TYPE OF APPLICATION IS MADE BY MAKING A 6 TO 8 PSI INITIAL REDUCTION, WAITING FOR AT LEAST 20 SECONDS FOLLOWING WHICH FURTHER REDUCTIONS MAY BE MADE AS REQUIRED TO THE POINT OF EQUALIZATION, BEARING IN MIND, HOWEVER, THAT A TOTAL REDUCTION TO EQUALIZATION IF MADE TOO RAPIDLY CAN RESULT IN A HEAVY UNDESIRABLE SLACK SURGE DEPENDENT ON TRAIN MAKE-UP AND GRADE.

(2-19) WHILE BRAKING, NO FURTHER REDUCTIONS BEYOND FULL SERVICE SHOULD BE ATTEMPTED, EXCEPT EMERGENCY APPLICATION, SINCE THIS WOULD ONLY SERVE TO WASTE AIR AND DEPLETE THE BRAKE PIPE.

1. THE FOLLOWING PROCEDURES ARE RECOMMENDED FOR <u>STOPPING</u> FREIGHT TRAINS UNDER NORMAL CONDITIONS ON LEVEL TERRAIN:

(2-20) a. <u>STOPPING FROM SPEED BELOW 15 MPH WITH "SLACK BUNCHED" METHOD.</u> TO STOP A FREIGHT TRAIN WITH THE AUTOMATIC BRAKE VALVE AT SUCH SPEEDS:

(1) GRADUALLY REDUCE THE THROTTLE TO IDLE POSITION EARLY ENOUGH TO GENTLY BUNCH THE SLACK INTO THE LOCOMOTIVE, USING THE INDEPENDENT BRAKE TO ACCOMPLISH THIS, IF NECESSARY.

2-20 cont.

(2) COMPLETE THE STOP BY MAKING A LIGHT TRAIN BRAKE APPLICATION OF 6 OR 8 POUNDS HAVING THE LOCOMOTIVE BRAKES APPLIED WHEN THE TRAIN STOPS.

(3) USE SAND AS NECESSARY FOR THE LAST 8 OR 10 CAR LENGTHS.

* FOR GRADE STOPPING SEE SPECIFIC PROCEDURES SEC. 2.2.1 THRU 2.2.6

b. STOPPING FREIGHT TRAINS OF ALL MAKE-UP EXCEPT THOSE HAVING HEAVY LOADS BEHIND EMPTIES FROM A SPEED ABOVE 15 MPH USING THE "SLACK STRETCHED" METHOD. TO STOP WITH THE AUTOMATIC BRAKE VALVE WHILE WORKING POWER FROM A SPEED OF 15 MPH OR HIGHER, AND BEGINNING AT A POINT FAR ENOUGH IN ADVANCE TO ASSURE THAT THE LOCOMOTIVE WILL NOT PASS THE OBJECTIVE POINT, USE THE FOLLOWING PROCEDURE:

(1) INCREASE THE THROTTLE ONE OR TWO NOTCHES UNLESS ALREADY WORKING FULL POWER.

(2) MAKE AN INITIAL BRAKE PIPE REDUCTION OF 6-8 PSI WITH THE AUTOMATIC BRAKE VALVE.

(3) KEEP THE LOCOMOTIVE BRAKE FROM APPLYING DURING THE INITIAL REDUCTION BY DEPRESSING THE INDEPENDENT BRAKE VALVE HANDLE IN RELEASE POSITION.

2-21

(4) AS THE SPEED BEGINS TO DECREASE, GRADUALLY REDUCE THE THROTTLE ONE NOTCH AT A TIME TO PREVENT THE AMPERAGE FROM INCREASING. IT IS VERY IMPORTANT THAT THE LOAD METER BE OBSERVED AS THE STOP IS BEING MADE TO INDICATE THE CURRENT OR AMPERAGE TO THE TRACTION MOTORS IS NOT EXCESSIVE. THE THROTTLE SHOULD BE IN IDLE POSITION PRIOR TO STOP.

(5) FOLLOWING PLACEMENT OF THE THROTTLE IN IDLE, BEGIN LIGHT APPLICATION OF THE INDEPENDENT BRAKE. THE LOCOMOTIVE BRAKES SHOULD BE APPLIED DURING FINAL STAGES OF THE STOP.

(6) SAND SHOULD BE USED AS NECESSARY FOR THE LAST 8 OR 10 CAR LENGTHS.

* FOR GRADE STOPPING SEE PROCEDURES SEC. 2.2.1 THRU 2.2.6.

c. STOPPING FREIGHT TRAINS FROM A SPEED ABOVE 15 MPH USING THE "SLACK BUNCHED" METHOD, ESPECIALLY FOR TRAINS CONSISTING OF LOADS BEHIND EMPTIES OR TRAINS WITH ALL LOADS WHERE THE HEAVIER LOADS ARE CONCENTRATED TOWARD THE REAR. TO STOP A FREIGHT TRAIN WITH THE AUTOMATIC BRAKE VALVE UNDER NORMAL CONDITIONS AND ON LEVEL TERRAIN, WHILE WORKING POWER FROM SUCH SPEEDS:

(1) GRADUALLY REDUCE THE THROTTLE TO IDLE POSITION TO ALLOW THE SLACK OF THE TRAIN TO GENTLY BUNCH AGAINST THE LOCOMOTIVE. (ALLOW A REASONABLE TIME FOR THE SLACK TO ADJUST.)

(2) MAKE AN INITIAL REDUCTION OF 6-8 PSI AT A POINT FAR ENOUGH IN ADVANCE TO PREVENT PASSING THE OBJECTIVE POINT.

(3) IF SPEED PERMITS, ALLOW THE LOCOMOTIVE BRAKES TO APPLY WITH THE TRAIN BRAKES.

(4) LEAVE THE AUTOMATIC BRAKE VALVE IN THIS POSITION UNTIL WITHIN 200 FEET OF STOPPING AND THEN MAKE A FINAL 6 to 8 PSI BRAKE PIPE REDUCTION, HAVING THE BRAKE PIPE EXHAUST DISCHARGING WHEN THE TRAIN STOPS.

(2-22)

(5) USE SAND AS NECESSARY FOR THE LAST 8 to 10 CAR LENGTHS.

* FOR GRADE STOPPING SEE SPECIFIC PROCEDURES SEC. 2.2.1 THRU 2.2.6.

CAUTION: IF THERE ARE INDICATIONS THAT A PARTICULAR TRAIN HAS POTENTIAL FOR AN EMERGENCY APPLICATION WHEN SLOWING OR STOPPING (DYNAMITER HAS PREVIOUSLY GONE TO EMERGENCY, BRAKE VALVE PROBLEMS, ETC.), THE ABOVE LISTED PROCEDURE "SLACK BUNCHED" METHOD WOULD NOT BE DESIRABLE FOR STOPPING BUT WOULD ADD TO THE PROBABILITY OF TRAIN SEPARATION IF AN EMERGENCY DID OCCUR.

(2-23) NORMAL FREIGHT TRAIN STOPS SHOULD ALWAYS BE MADE WITH AS LIGHT A BRAKE APPLICATION AS IS CONSISTENT WITH CONDITIONS.

(2-24) EITHER METHOD OF "STRETCH" OR "BUNCH" BRAKING IS FULLY ACCEPTABLE FOR STOPPING UNDER NORMAL CONDITIONS ON LEVEL TERRAIN AT SPEEDS ABOVE 15 MPH: HOWEVER, JUDGMENT AS TO WHICH METHOD SHOULD BE UTILIZED SHOULD BE BASED UPON THE STATE OF THE SLACK PRIOR TO INITIATING STOP PROCEDURES.

(2-25) IF HEAVY LOADS ARE LOCATED AT THE REAR OF A TRAIN WITH LIGHT CARS ON THE HEAD END, "BUNCH" BRAKING, UNDER NORMAL CONDITIONS ON LEVEL TERRAIN, APPEARS TO BE THE MOST DESIRABLE METHOD FOR STOPPING.

2. THE FOLLOWING PROCEDURES ARE RECOMMENDED FOR SLOWING FREIGHT TRAINS WITH THE AUTOMATIC BRAKE VALVE UNDER NORMAL CONDITIONS ON LEVEL TERRAIN:

a. SLOWING USING THE "SLACK STRETCHED" METHOD FOR FREIGHT TRAINS OF ALL MAKE-UPS EXCEPT THOSE HAVING LOADS BEHIND EMPTIES OR TRAINS WITH ALL LOADS WHERE THE HEAVIER LOADS ARE CONCENTRATED TOWARD THE REAR.

(1) WHILE WORKING POWER, MAKE AN INITIAL REDUCTION OF 6-8 PSI. IF THE INITIAL BRAKE PIPE REDUCTION DOES NOT PROPERLY CONTROL THE SPEED, THEN ADDITIONAL LIGHT REDUCTIONS MAY BE MADE WITH THE AUTOMATIC BRAKE VALVE.

(2) KEEP THE LOCOMOTIVE BRAKE FROM APPLYING.

(3) WHILE THE BRAKE PIPE SERVICE EXHAUST IS DISCHARGING FROM THE INITIAL REDUCTION, LEAVE THROTTLE WHERE IT IS WHILE THE

(2-26) REDUCTION IS BEING MADE. AS THE SPEED REDUCES, GRADUALLY REDUCE THE THROTTLE ONE NOTCH AT A TIME.

(4) AFTER THE DESIRED BRAKING HAS BEEN ACCOMPLISHED, RELEASE THE TRAIN BRAKES IN ACCORDANCE WITH SEC. B.2. PGS. 2-27 AND 2-28 AND REDUCE THE THROTTLE UNTIL SLACK BECOMES ADJUSTED. REDUCE THE THROTTLE ONE STEP AT A TIME TO PREVENT AMPERAGE FROM INCREASING.

(5) AFTER THE BRAKES HAVE HAD TIME TO RELEASE, THE SLACK TO BECOME ADJUSTED, AND THE TRAIN HAS PASSED THROUGH THE ENTIRE RESTRICTED ZONE, CAREFULLY ADVANCE THE THROTTLE AND INCREASE SPEED.

b. SLOWING FREIGHT TRAINS OF ALL MAKE-UPS WITH AUTOMATIC BRAKE VALVE; ESPECIALLY THOSE CONSISTING OF LOADS BEHIND EMPTIES OR TRAINS HAVING ALL LOADS WITH HEAVIER LOADS CONCENTRATED AT THE REAR USING THE "SLACK BUNCHED" METHOD.

(1) GRADUALLY REDUCE THE THROTTLE TO IDLE

(2-27) POSITION TO ALLOW THE SLACK OF THE TRAIN TO GENTLY BUNCH AGAINST THE LOCOMOTIVE.

2-27 cont.

(2) MAKE AN INITIAL REDUCTION OF 6-8 PSI WITH THE AUTOMATIC BRAKE VALVE ALLOWING THE INDEPENDENT BRAKE TO APPLY. IF THIS BRAKE PIPE REDUCTION DOES NOT PROPERLY CONTROL THE SPEED THEN ADDITIONAL LIGHT REDUCTIONS MAY BE MADE WITH THE AUTOMATIC BRAKE VALVE.

(3) AFTER THE DESIRED BRAKING HAS BEEN ACCOMPLISHED, RELEASE THE TRAIN BRAKES IN ACCORDANCE WITH SEC. B.2 PGS. 2-27 AND 2-28.

(4) AFTER THE BRAKES HAVE HAD TIME TO RELEASE, THE SLACK TO BECOME ADJUSTED, AND THE TRAIN HAS PASSED THROUGH THE ENTIRE RESTRICTED ZONE, CAREFULLY ADVANCE THE THROTTLE AND INCREASE SPEED.

EITHER METHOD OF "STRETCH" OR "BUNCH" BRAKING IS FULLY ACCEPTABLE FOR SLOWING UNDER NORMAL CONDITIONS AND LEVEL TERRAIN. HOWEVER,

2-28

JUDGMENT AS TO WHICH METHOD SHOULD BE UTILIZED SHOULD BE BASED UPON THE STATE OF THE SLACK PRIOR TO INITIATING SLOWDOWN PROCEDURES. ANY UNNECESSARY CHANGING OF SLACK CONDITIONS TO CONFORM TO EITHER "STRETCH" OR "BUNCH" BRAKING WOULD ONLY SERVE TO INCREASE SLACK ACTION AND COUPLER FORCES.

IF HEAVY LOADS ARE LOCATED AT THE REAR OF A TRAIN WITH LIGHTER CARS ON THE HEAD END, "BUNCH" BRAKING, UNDER NORMAL CONDITIONS ON LEVEL TERRAIN APPEARS TO BE THE MOST DESIRABLE METHOD OF SLOWING SINCE THE NATURAL TENDENCY OF A BLOCK OF HEAVY LOADS

2-29

WHEN SLOWING WOULD BE TO RUN-IN OR TO BUNCH INTO THE LIGHTER LOADS OR EMPTIES.

A DISTINCT ADVANTAGE OF "STRETCH" BRAKING IS THE FACT THAT, IF EXECUTED CORRECTLY, IT WILL ALLOW AN ENGINEER TO NEGOTIATE MUCH MORE RAPIDLY THE ENTERING AND EXITING OF A PARTICULAR SLOWDOWN OPERATION.

ADDITIONAL TIME MUST BE ALLOWED TO OBTAIN A RELEASE OF TRAIN BRAKES AND RECHARGING OF THE

2-30

TRAIN BRAKE SYSTEM IF AN OVERREDUCTION HAS BEEN MADE. THIS IS PARTICULARLY EVIDENT WITH LONG TRAINS.

a. WHEN DESIRING TO MAKE RUNNING RELEASE OF TRAIN BRAKES THE RELEASE OPERATION SHOULD NOT BE STARTED UNTIL THE LAST REDUCTION OF A BRAKE APPLICATION HAS BECOME EFFECTIVE ON THE REAR CAR OF THE TRAIN. A RUNNING RELEASE SHOULD NOT BE ATTEMPTED UNLESS THE BRAKES ON ALL CARS CAN BE FULLY RELEASED

2-31

BEFORE THE SPEED HAS REDUCED TO NOT LESS THAN 15 MILES PER HOUR FOR TRAINS OF 40-60 CARS, 20 MPH ON TRAINS OF 60-100 CARS, AND 25 MPH ON TRAINS OVER 100 CARS IN LENGTH. HOWEVER, IF THE SPEED OF THE TRAIN CONTINUES TO REDUCE AND IT IS EVIDENT THE TRAIN IS GOING TO COME TO A STOP, A SERVICE BRAKE APPLICATION MUST BE MADE. THE INDEPENDENT BRAKE MAY ALSO BE APPLIED.

b. UNDER NO CONDITION, AFTER A SLOWDOWN HAS BEEN MADE, SHOULD A RUNNING RELEASE OF BRAKES BE

2-32

ATTEMPTED UNLESS A TOTAL REDUCTION OF NOT LESS THAN 10 POUNDS HAS BEEN MADE.

c. A RUNNING RELEASE SHOULD NOT BE MADE IF THE

2-33

BRAKE PIPE REDUCTION INDICATES EXCESSIVE LEAKAGE AND SLACK ACTION IS SEVERE.

d. A RUNNING RELEASE MUST NOT BE MADE ON TRAINS

2-34

AFTER AN EMERGENCY APPLICATION, NO MATTER HOW HIGH THE SPEED MAY BE.

WHEN MAKING RUNNING RELEASES OF SERVICE

2-35

APPLICATIONS, IT IS IMPORTANT TO ALLOW SUFFICIENT TIME FOR THE RELEASE OF THE BRAKES THROUGH THE TRAIN BEFORE INCREASING POWER.

3. Unintentional Releases

SOME PROCEDURES TO AVOID UNINTENTIONAL RELEASES OF TRAIN BRAKES ARE AS FOLLOWS:

a. <u>WHEN DETACHING MOTIVE POWER WITH OR WITHOUT CARS</u>

(1) REDUCE THE BRAKE PIPE PRESSURE TO <u>30 PSI OR LESS</u> AT A SERVICE RATE WITH THE AUTOMATIC BRAKE VALVE.

2-36

(2) WHEN BRAKE PIPE SERVICE EXHAUST CEASES, CLOSE THE ANGLE COCK ON REAR OF THE HEAD CUT.

(3) THE ANGLE COCK MUST BE LEFT <u>OPEN</u> ON CARS TO BE LEFT STANDING.

b. AFTER COUPLING ONTO THE REAR PORTION OF A TRAIN LEFT IN EMERGENCY (I.E. FOLLOWING A BREAK-IN-TWO)

IMMEDIATELY AFTER A COUPLING IS MADE, A BRAKE PIPE REDUCTION OF AT LEAST 30 POUNDS MUST BE MADE ON THE HEAD CUT (BY MOVING TO THE HANDLE "OFF" POSITION WITH A 26L BRAKE EQUIPMENT AND HELD BY MOVING THE BRAKE HANDLE TO SUPPRESSION POSITION), BEFORE THE AIR HOSES ARE COUPLED AFTER WHICH THE ANGLE COCK ON THE FRONT PORTION OF A TRAIN MAY BE OPENED SLOWLY AND THE TRAIN CHARGED.

c. DURING SERVICE REDUCTION WHEN THE BRAKE SYSTEM IS NOT FULLY CHARGED (CYCLE BRAKING).

IF A SERVICE REDUCTION IS NECESSARY WHEN THE BRAKE SYSTEM IS NOT FULLY CHARGED, THE EQUALIZING RESERVOIR SHOULD BE FURTHER REDUCED BY THE AMOUNT OF THE DESIRED REDUCTION FROM ITS READING AT THE MOMENT THE SERVICE EXHAUST OPENED, THIS PROCEDURE WILL PROVIDE EFFECTIVE BRAKING FOR AT LEAST TWO REDUCTIONS WHEN THE BRAKE SYSTEM IS NOT FULLY CHARGED.

d. USE OF GRADUATED RELEASE

2-36 cont. IN NO CIRCUMSTANCES SHOULD A PARTIAL OR "GRADUATED RELEASE" OR "PINGING OFF" OF THE FREIGHT TRAIN BRAKES BE ATTEMPTED.

e. BRAKE PIPE CUTOUT VALVE ON 26L BRAKE EQUIPMENT POSITIONED IN PASSENGER POSITION WHEN HANDLING FREIGHT EQUIPMENT.

NORMALLY THE BRAKE PIPE CUTOUT VALVE MUST BE IN FREIGHT POSITION WHEN HANDLING FREIGHT EQUIPMENT. HOWEVER, IF THE SERVICE EXHAUST FAILS TO CLOSE WITH THE AUTOMATIC IN SERVICE POSITION BECAUSE OF A DEFECT, THE BRAKE PIPE CUTOUT VALVE MAY BE PLACED IN PASSENGER POSITION WITH THE AUTOMATIC IN RELEASE POSITION TO CONTINUE THE TRIP UNTIL THE DEFECT IS REPAIRED OR ANOTHER UNIT IS INTRODUCED AS THE CONTROLLING LEAD UNIT.

IF THE BRAKE PIPE CUTOUT VALVE IS MOVED TO PASSENGER POSITION WITH THE AUTOMATIC IN OTHER THAN RELEASE POSITION AN UNINTENTIONAL RELEASE OF THE TRAIN BRAKES CAN RESULT.

IN ADDITION WITH THE CUTOUT VALVE IN PASSENGER POSITION ANY PARTIAL MOVEMENT OF THE AUTOMATIC TOWARDS RELEASE FROM SERVICE POSITION CAN RESULT IN AN UNINTENTIONAL RELEASE OF THE TRAIN BRAKES.

f. 24 RL BRAKE VALVE EQUIPPED WITH A PRESSURE MAINTAINING FEATURE.

FOLLOWING A SERVICE REDUCTION WITH THE AUTOMATIC BRAKE IN PRESSURE MAINTAINING, IF A RISE IN EQUALIZING RESERVOIR IS NOTED, AN ADDITIONAL SLIGHT REDUCTION SHOULD BE MADE (SHAVING) TO OFFSET THIS EQUALIZING RESERVOIR PRESSURE INCREASE AND PREVENT A POSSIBLE UNINTENTIONAL TRAIN BRAKE RELEASE.

g. REDUCTION OF BRAKE PIPE PRESSURE MANUALLY WITH ANY VALVE AT REAR OF TRAIN.

2-36 cont.

WHEN REDUCING THE BRAKE PIPE AT A RATE LESS THAN THAT WHICH PRODUCES AN EMERGENCY ACTION OF TRAIN BRAKES, IT IS IMPORTANT THAT THE DISCHARGE OF AIR IS NOT SUDDENLY STOPPED. TO DO SO WILL CAUSE A SUDDEN CHANGE IN BRAKE PIPE AIR FLOW DIRECTION AND PRESSURE WHICH CAN RESULT IN A RELEASE OF TRAIN BRAKES.

h. MISCELLANEOUS PROCEDURES TO BE AVOIDED.

IMPROPER BRAKING PROCEDURES SUCH AS THOSE LISTED BELOW MUST BE AVOIDED AS THEY CAN LEAD TO STICKING BRAKES, OR, MORE SERIOUSLY, TO UNINTENTIONAL RELEASES.

(1) "FANNING" THE BRAKE VALVE.
(2) "BRIDGE" OR "HUMP" BRAKING.
(3) "FEED VALVE" BRAKING.

C. MISCELLANEOUS CONSIDERATIONS

SUFFICIENT TIME SHOULD BE ALLOWED FOR CHARGING THE AIR BRAKE SYSTEM OF A TRAIN.
THE FOLLOWING TABLE CAN BE USED AS A GUIDE TO INDICATE THE MINIMUM TIME REQUIRED TO CHARGE THE BRAKE SYSTEM ON TRAINS HAVING ALLOWABLE BRAKE PIPE LEAKAGE:

2-37

25 CARS OR LESS	15 MINUTES
50 CARS OR LESS	20 MINUTES
75 CARS OR LESS	25 MINUTES
80 CARS OR LESS	30 MINUTES
90 CARS OR LESS	34 MINUTES
90 CARS OR GREATER -	DETERMINED BY THE GAUGE AT THE REAR OF THE TRAIN

NOTE: THE ABOVE IS BASED ON STARTING THE CHARGE WITH THE BRAKE SYSTEM DEPLETED. THESE CHARGING TIMES ALSO DO NOT APPLY TO RCE-1 OR AIR REPEATER CAR EQUIPPED CONSISTS.

IN ORDER TO INSURE PROPER CHARGING AND TO EXPEDITE THE MOVEMENT OF TRAINS THROUGH AND OUT OF YARDS THE FOLLOWING PROCEDURES SHOULD BE ADHERED TO:

a. WHEN COUPLING AIR HOSES, ALL SNOW, ICE AND DIRT, ETC., SHOULD BE REMOVED BEFORE MAKING THE COUPLING.

b. WHEN YARD AIR IS AVAILABLE, IT SHOULD BE USED TO CHARGE THE TRAIN BEFORE THE LOCOMOTIVE IS ATTACHED. TIME SHOULD BE ALLOWED TO CHARGE, INSPECT AND WORK A TRAIN IN ADVANCE OF THE TIME ROAD CREWS ARE TO GO ON DUTY. WORKMEN MUST HAVE WITH THEM TOOLS AND MATERIAL NECESSARY FOR CHANGING DEFECTIVE AIR HOSES, HOSE GASKETS, AND TIGHTENING LEAKS THAT MAY BE FOUND.

c. IN COLD WEATHER WHEN THE REQUIRED OPERATING PRESSURE CANNOT BE OBTAINED ON THE REAR END, AND AFTER A REASONABLE CHARGING TIME HAS BEEN ALLOWED, AN EMPLOYEE SHOULD USE A TEST GAUGE AND STARTING AT THE REAR OF THE TRAIN, WALK FORWARD FIVE (5) CARS AND CLOSE BOTH ANGLE COCKS BETWEEN THE 5TH AND 6TH CARS. THEN COUPLE THE TEST GAUGE TO THE BRAKE PIPE HOSE OF THE 6TH CAR AND SLOWLY OPEN THE ANGLE COCK. IF THE REQUIRED AIR PRESSURE IS SHOWN ON THE TEST GAUGE AT THIS POINT, THE EMPLOYEE SHOULD CONTACT THE SUPERVISOR IN CHARGE AND ADVISE HIM THAT THE TRAIN SHOULD BE REDUCED 5 CARS. IF REQUIRED AIR PRESSURE IS NOT UP TO THIS POINT, PROCEED FORWARD FIVE (5) CARS AT A TIME UNTIL A POINT WHERE A SATISFACTORY CHARGE IS SHOWN ON THE TEST GAUGE. THE TRAIN SHOULD BE REDUCED FROM THIS POINT AND FROM THE REAR OF THE TRAIN, IF POSSIBLE.

(2-38)

d. TO REDUCE CHARGING TIME, TRAINS PASSING THROUGH TERMINALS SHOULD NOT HAVE CARS BLED OFF OR BRAKES APPLIED IN EMERGENCY IF POSSIBLE TO PREVENT IT.

e. THE CHART ON PG. 34 (FIGURE 6.) CAN PROVIDE A GUIDE TO DETERMINE THE APPROXIMATE LENGTH OF TRAIN WHICH CAN BE OPERATED UNDER VARYING TEMPERATURE CONDITIONS BETWEEN 30°F and -50°F.

TO REDUCE THE EXCESS PRESSURE OF AN OVERCHARGED AIR SYSTEM, SHOULD ONE DEVELOP, PROCEED AS FOLLOWS:

a. LOCOMOTIVE OVERCHARGE

(1) MOVE THE INDEPENDENT BRAKE VALVE HANDLE TO RELEASE POSITION (HANDLE DEPRESSED IF SELF-LAPPING TYPE).

(2-39)

(2) WAIT APPROXIMATELY 4 SECONDS PER UNIT TO FULLY CHARGE THE ACTUATING LINE, THEN MAKE A SERVICE REDUCTION WITH THE AUTOMATIC BRAKE VALVE HANDLE AND REDUCE THE BRAKE PIPE PRESSURE NOT LESS THAN 20 POUNDS BELOW THE DESIRED FEED VALVE SETTING. USING THIS METHOD WILL REDUCE THE PRESSURE IN THE AUXILIARY RESERVOIRS (CONTROL RESERVOIR ON 26L EQUIPMENT AND APPLICATION CHAMBER ON #6 EQUIPMENT) AT THE SAME TIME THE BRAKE PIPE PRESSURE IS BEING REDUCED. WITH 24RL BRAKE EQUIPMENT PLACE THE AUTOMATIC BRAKE VALVE IN EMERGENCY POSITION INSTEAD OF SERVICE TO REDUCE THE OVERCHARGE IN THE EMERGENCY RESERVOIR WHICH IS USED WITH THIS EQUIPMENT. IF CIRCUMSTANCES DO NOT PERMIT AN EMERGENCY APPLICATION, A NUMBER OF SERVICE APPLICATIONS WITH THE INDEPENDENT BRAKE VALVE HANDLE DEPRESSED IN RELEASE POSITION WILL GRADUALLY REDUCE THE OVERCHARGED EMERGENCY RESERVOIR.

2-39 cont.

b. ROAD TRAIN OVERCHARGE (UTILIZE TO AVOID DELAYS FROM STICKING BRAKES CAUSED BY OVERCHARGE.)

(1) THE PRESSURE IN THE RESERVOIRS SHOULD BE REDUCED TO STANDARD PRESSURE. PROCEED BY MAKING TWO OR MORE FULL SERVICE APPLICATIONS, BACKING OFF ON THE FEED VALVE OR REGULATING VALVE 5 PSI AFTER EACH APPLICATION HAS BEEN MADE, AND BEFORE RELEASING THAT APPLICATION.

(2) AN ALTERNATIVE METHOD TO THE ABOVE IS TO RAISE THE BRAKE PIPE PRESSURE 5 PSI BY ADJUSTING THE TRAINLINE FEED VALVE OR REGULATING VALVE TO THIS HIGHER PRESSURE. (NEVER USE LESS THAN 5 PSI TO RELEASE STUCK BRAKES AND AVOID RAISING TRAINLINE PRESSURE ABOVE 100 PSI.)

(3) IN THE EVENT THE LOCOMOTIVE ENGINEER CANNOT REDUCE AN OVERCHARGE, TRAINMEN MAY ASSIST BY OPERATING THE RELEASE RODS AT EACH CAR BY HAND, BLEEDING THE RESERVOIRS.

NOTE: DO NOT USE AIR AT MAIN RESERVOIR PRESSURE TO MAKE RELEASES IN ORDER TO REDUCE OVERCHARGE.

2. EMERGENCY APPLICATION AND RELEASE

(2-40) EMERGENCY BRAKING INITIATED BY A MEMBER OF THE CREW WHILE A TRAIN IS IN MOTION SHOULD ONLY BE USED IN A SITUATION WHERE A STOP MUST BE MADE AS QUICKLY AS POSSIBLE

WHEN AN EMERGENCY APPLICATION IS TO BE INITIATED BY THE ENGINEER, OR IS INITIATED BY ACTION OTHER THAN THE AUTOMATIC BRAKE VALVE:

a. IMMEDIATELY PLACE THE AUTOMATIC BRAKE VALVE IN "EMERGENCY" POSITION.
b. MOVE THE THROTTLE TO "IDLE".
c. REGULATE THE LOCOMOTIVE BRAKE CYLINDER PRESSURE TO MAINTAIN THE MAXIMUM PRESSURE WITHOUT SLIDING THE WHEELS.
   NOTE: IF TRAIN IS IN A SLACK STRETCHED CONDITION, PARTICULARLY WITH LONG OVERHANG CARS AT THE HEAD END OF THE TRAIN, WHEN AN UNDESIRED EMERGENCY OCCURS, SOME RAILROADS PREFER TO PREVENT THE LOCOMOTIVE BRAKES FROM APPLYING TO REDUCE RUN-IN FORCES AT THE HEAD END.
d. WHEN A TRAIN IS STOPPED WITH AN EMERGENCY APPLICATION OF THE BRAKES, WHETHER FROM LOCOMOTIVE OR TRAIN, OR AT A SERVICE RATE OF REDUCTION FROM THE TRAIN, THE ENGINEER WILL NOT MOVE THE LOCOMOTIVE UNTIL HE HAS BEEN INFORMED BY A MEMBER OF THE CREW THAT INSPECTION HAS BEEN COMPLETED AND THAT IT IS SAFE TO DO SO. THE TRAIN WILL NOT PROCEED WITHOUT A PROCEED SIGNAL FROM THE REAR IN EVENT OTHER MEANS OF COMMUNICATION ARE LOST.

(2-41)

e. NO ATTEMPT SHOULD BE MADE TO RELEASE AN EMERGENCY APPLICATION FROM ANY CAUSE OR REGARDLESS OF TRAIN SPEED UNTIL THE TRAIN HAS COME TO A COMPLETE STOP.
f. WAIT AT LEAST ONE MINUTE AFTER TRAIN STOP IS COMPLETED FOR VENT VALVES TO CLOSE ON CARS, THEN THE ENGINEER SHOULD MOVE THE AUTOMATIC BRAKE VALVE TO RELEASE POSITION TO ALLOW AIR TO FLOW TO THE BRAKE PIPE TO AID CREWMEN IN LOCATING THE TROUBLE.
g. THE TRAIN CREW, AS CONDITIONS PERMIT, SHOULD VISUALLY INSPECT THE TRACK STRUCTURE TO ASCERTAIN IF THE EMERGENCY APPLICATION CREATED REPORTABLE TRACK DAMAGE (SHIFTING OF TRACK, KINKING OF RAIL, ETC.)

(2-42)

WHEN A TRAIN CONSISTING OF 90 OR MORE CARS IS REQUIRED TO PICK UP 20 OR MORE CARS ON THE HEAD END, THE BRAKES ON THE TRAIN ARRIVING AT THE PICK-UP POINT WILL BE HANDLED AS FOLLOWS:

(1) MAKE STOP IN THE USUAL MANNER.
(2) AFTER STOPPED, MAKE AN ADDITIONAL BRAKE PIPE REDUCTION TO EQUALIZATION.

(3) WHEN BRAKE PIPE SERVICE CLOSES, PLACE THE BRAKE HANDLE IN "RELEASE" OR "RUNNING" POSITION AND LEAVE IT THERE UNTIL BRAKES ARE RELEASED AT THE REAR OF THE TRAIN. THIS MAY BE DETERMINED BY ADVICE FROM THE CONDUCTOR OR BY WAITING AN AMOUNT OF TIME EQUAL TO APPROXIMATELY 1 SECOND FOR EACH CAR IN TRAIN.

(4) AS SOON AS THE BRAKES ARE FULLY RELEASED, REDUCE THE BRAKE PIPE PRESSURE TO 30 PSI OR LESS AT A SERVICE RATE WITH THE AUTOMATIC BRAKE VALVE.

2-42 cont.

(5) WHEN THE BRAKE PIPE SERVICE EXHAUST CEASES, CLOSE THE ANGLE COCK ON REAR OF THE HEAD CUT AND CUT OFF TO MAKE THE PICKUP.

(6) THE ANGLE COCK MUST BE LEFT OPEN ON FRONT END OF CARS TO BE LEFT STANDING.

(7) AFTER THE PICKUP IS MADE AND THE TRAIN IS RECOUPLED, CARE MUST BE EXERCISED IN OPENING ANGLE COCK AT POINT OF COUPLING TO AVOID PLACING THE BRAKES IN EMERGENCY.

b. PROCEDURES FOR HANDLING CARS WITH INOPERATIVE BRAKES DISCOVERED EN ROUTE ARE AS FOLLOWS:

(2-43)

IF NECESSARY TO CUT OUT BRAKES ON CARS WITH DEFECTIVE BRAKES DISCOVERED WHILE EN ROUTE, IT WILL BE PERMISSIBLE TO HAVE NOT MORE THAN TWO CONSECUTIVE CARS TOGETHER WITH INOPERATIVE BRAKES. BRAKES ON THE CAR NEXT TO THE LOCOMOTIVE AND THE REAR CAR MUST ALWAYS BE CUT IN AND EFFECTIVE.

CARS WITH DEFECTIVE BRAKES DISCOVERED EN ROUTE MAY BE HANDLED TO THE NEAREST AVAILABLE POINT WHERE REPAIRS CAN BE MADE, PROVIDING THE NUMBER OF OPERATIVE BRAKES IN THE TRAIN IS NOT LESS THAN EIGHTY-FIVE (85) PERCENT.

THE FOLLOWING TABLE IS FOR CONVENIENCE IN QUICKLY DETERMINING THE MAXIMUM NUMBER OF INOPERATIVE BRAKES WITH WHICH A TRAIN MAY BE PERMITTED TO PROCEED TO A POINT WHERE REPAIRS CAN BE MADE. (EACH TRAILING POWER UNIT WILL BE COUNTED AS ONE CAR.)

NO. OF CARS	INOPERATIVE BRAKES
6 CARS OR LESS	0 CARS
7 CARS TO 13 CARS, INCLUSIVE	1 CAR
14 CARS TO 19 CARS, INCLUSIVE	2 CARS
20 CARS TO 26 CARS, INCLUSIVE	3 CARS
27 CARS TO 33 CARS, INCLUSIVE	4 CARS
34 CARS TO 39 CARS, INCLUSIVE	5 CARS
40 CARS TO 46 CARS, INCLUSIVE	6 CARS
47 CARS TO 53 CARS, INCLUSIVE	7 CARS
54 CARS TO 59 CARS, INCLUSIVE	8 CARS
60 CARS TO 66 CARS, INCLUSIVE	9 CARS
67 CARS TO 73 CARS, INCLUSIVE	10 CARS
74 CARS TO 79 CARS, INCLUSIVE	11 CARS
80 CARS TO 86 CARS, INCLUSIVE	12 CARS
87 CARS TO 93 CARS, INCLUSIVE	13 CARS
94 CARS TO 99 CARS, INCLUSIVE	14 CARS
100 CARS TO 106 CARS, INCLUSIVE	15 CARS
107 CARS TO 113 CARS, INCLUSIVE	16 CARS
114 CARS TO 119 CARS, INCLUSIVE	17 CARS
120 CARS TO 126 CARS, INCLUSIVE	18 CARS
127 CARS TO 133 CARS, INCLUSIVE	19 CARS
134 CARS TO 139 CARS, INCLUSIVE	20 CARS
140 CARS TO 146 CARS, INCLUSIVE	21 CARS
147 CARS TO 153 CARS, INCLUSIVE	22 CARS
154 CARS TO 159 CARS, INCLUSIVE	23 CARS
160 CARS TO 166 CARS, INCLUSIVE	24 CARS
167 CARS TO 173 CARS, INCLUSIVE	25 CARS
174 CARS TO 179 CARS, INCLUSIVE	26 CARS
180 CARS TO 186 CARS, INCLUSIVE	27 CARS
187 CARS TO 193 CARS, INCLUSIVE	28 CARS
194 CARS TO 199 CARS, INCLUSIVE	29 CARS
200 CARS TO 206 CARS, INCLUSIVE	30 CARS

2-43 cont.

2.1.2.3 USE OF THE INDEPENDENT AIR BRAKE

(2-44) THE LOCOMOTIVE INDEPENDENT BRAKE SHOULD NOT BE USED BY ITSELF TO CONTROL A TRAIN AT ROAD SPEEDS.

(2-45) UNNECESSARY USE OF THE INDEPENDENT AIR BRAKE WHEN THE SAME RESULTS CAN BE OBTAINED WITH THE DYNAMIC BRAKE SHOULD BE AVOIDED.

(2-46) 1. THE INDEPENDENT BRAKE VALVE OF THE CONTROLLING UNIT MUST BE CUT IN AT ALL TIMES AND THE HANDLE MUST NOT BE BLOCKED OR WEDGED.

(2-47) 2. UNDER NORMAL CONDITIONS, THE INDEPENDENT BRAKE MUST NOT BE APPLIED WHILE THE THROTTLE IS IN ANY WORKING POWER POSITION OR WHILE THE DYNAMIC BRAKE IS APPLIED, EXCEPT DURING CERTAIN STOPPING OR STARTING PROCEDURES AS OUTLINED IN SEC. 2.1.2.4.F. PG. 2-51 "STOPPING USING DYNAMIC BRAKING", SEC. 2.2.3.C. PG. 2-130 "DESCENDING HEAVY GRADE TERRITORY WITH DYNAMIC BRAKING", AND SEC. 2.1.3.2.A. PG. 2-82 "STARTING PROCEDURES".

(2-48) 3. TO AVOID THE POSSIBILITY OF THE LOCOMOTIVE BRAKES NOT BEING RELEASED ON MULTIPLE UNIT CONSIST IN WHICH UNITS ARE NOT EQUIPPED WITH DYNAMIC BRAKING OR THE DBI, THE INDEPENDENT BRAKE SHOULD BE DEPRESSED IN THE RELEASE POSITION FOR 4 SECONDS PER UNIT WHEN UTILIZING DYNAMIC BRAKING.

(2-49) 4. WHEN A LOCOMOTIVE CONSIST EXCEEDS ANY COMBINATION OF 24 AXLES, USE OF THE INDEPENDENT BRAKE VALVE BELOW SPEEDS OF 10 MPH MUST BE DONE WITH EXTREME CARE TO PREVENT BUILD UP OF EXCESSIVE BRAKE CYLINDER PRESSURE WHICH COULD RESULT IN HIGH HEAD END FORCES AND JACKKNIFING.

(2-50) 5. WHEN OPERATING A MULTIPLE UNIT LOCOMOTIVE CONSIST AND IT IS DESIRED TO PREVENT THE LOCOMOTIVE BRAKES FROM APPLYING DURING AN AUTOMATIC BRAKE APPLICATION, THE INDEPENDENT BRAKE VALVE HANDLE MUST BE DEPRESSED IN RELEASE POSITION FOR 4 SECONDS PER UNIT FOR EACH UNIT IN THE CONSIST.

(2-51) 6. THE INDEPENDENT BRAKE SHOULD BE FULLY APPLIED AND LEFT IN THAT POSITION TO PREVENT THE LOCOMOTIVE FROM MOVING WHILE TAKING WATER, REFUELING, WORKING ON LOCOMOTIVE, OR ANY TIME WHEN TEMPORARILY LEFT STANDING.

2.1.2.4 USE OF DYNAMIC BRAKE

2-52 KNOWLEDGE OF THE TYPES OF DYNAMIC BRAKES IN A CONSIST IS ESSENTIAL IN MAINTAINING PROPER CONTROL OF THE DYNAMIC BRAKING FORCES.

2-53 THE FLAT SYSTEM GIVES THE ENGINEER MUCH BETTER CONTROL IN DETERMINING THE AMOUNT OF DYNAMIC BRAKING EFFORT HE DESIRES.

2-54 THE LOCOMOTIVE ENGINEER SHOULD KNOW THAT IF A UNIT EQUIPPED WITH TAPER SYSTEM OF BRAKING IS LEADING A UNIT(S) EQUIPPED WITH FLAT SYSTEM OF BRAKING, THE BRAKING LEVER MUST BE ADVANCED TO OBTAIN AN INCREASE IN DYNAMIC BRAKING ON THE TRAILING UNIT(S), EVEN THOUGH THE LEAD UNIT WITH THE TAPER BRAKING MAY BE IN MAXIMUM BRAKING IN THE LOWER BRAKING LEVER POSITIONS.

2-55 IT IS IMPORTANT THAT THE ENGINEER BE AWARE THAT THE EXTENDED RANGE FEATURE MAKES THE DYNAMIC BRAKE EFFECTIVE DOWN TO A MUCH LOWER SPEED ON UNITS SO EQUIPPED AND THAT HE BE ADVISED WHICH UNITS HAVE THIS FEATURE.

2-56 IF THE INDEPENDENT AIR BRAKE IS APPLIED IN THE 6 TO 23 MPH SPEED RANGE TO OVERCOME THE LOSS OF DYNAMIC BRAKING FORCE, THE LOCOMOTIVE ENGINEER SHOULD BE MADE AWARE THAT ON ENGINES SO EQUIPPED, THE EXTENDED RANGE POSITION OF THE DYNAMIC BRAKE WILL BE RELEASED BY THE INDEPENDENT PRESSURE SWITCH (IPS).

2-57 ALL UNITS HAVING EXTENDED RANGE DYNAMIC BRAKE SHOULD BE EQUIPPED WITH AN OPERABLE IPS CUTOUT SO REDUCE THE POSSIBILITY OF SLIDING THE WHEELS.

2-58 LOCOMOTIVE CONSISTS SHOULD BE RESTRICTED TO SIX 4-AXLE UNITS OR FOUR 6-AXLE UNITS OR ANY OTHER COMBINATION NOT EXCEEDING 24 AXLES USED IN DYNAMIC BRAKING.

2-59 IF IT IS FOUND NECESSARY TO RUN A LOCOMOTIVE CONSIST WITH MORE THAN 24 AXLES OF DYNAMIC BRAKES, THE DYNAMIC BRAKE ON THE ADDITIONAL UNITS SHOULD BE NULLIFIED OR CUT OUT BY SWITCHES PROVIDED FOR THIS PURPOSE OR BY ISOLATING THE UNIT. WHEN CUTTING OUT UNITS, START WITH THE SECOND UNIT AND CONTINUE CONSECUTIVELY TOWARD THE REAR OF THE LOCOMOTIVE CONSIST UNTIL THE PROPER NUMBER OF UNITS HAVE BEEN CUT OUT. THE LEAD UNIT SHOULD BE LEFT ON LINE IN ORDER TO PROVIDE LOADMETER READINGS.

2-60 THE DYNAMIC BRAKE SHOULD BE REDUCED (PROPORTIONATELY TO CURVATURE AND NUMBER OF POWERED AXLES IN CONSIST) BEFORE ENTERING AND UNTIL ONE HALF OF THE TRAIN HAS NEGOTIATED A SHARP TURNOUT, CORSSOVER OR CURVE.

2-61 WHEN TRAIN SPEED IS REDUCED TO COMPLY WITH A SPEED RESTRICTION, THIS MUST BE DONE PRIOR TO REACHING THE RESTRICTION.

2-62 WHEN POSSIBLE, SPEED SHOULD BE REDUCED SLIGHTLY BELOW MAXIMUM PERMISSIBLE SPEED PRIOR TO THE SPEED RESTRICTION.

2-63 WHEN CHANGING FROM POWER TO DYNAMIC BRAKE REDUCE THROTTLE ONE STEP AT A TIME, PAUSING A FEW SECONDS BETWEEN STEPS.

2-64 THE PROCEDURE WHEN TRANSFERRING FROM POWER OPERATION TO DYNAMIC BRAKING WHEN USING THE LATER MODEL CONTROL STANDS IS AS FOLLOWS:

1. ASSURE THAT THE THROTTLE IS IN "IDLE" POSITION.
2. MOVE SELECTOR LEVER TO "OFF" POSITION IF CONTROLS ARE SO EQUIPPED.
3. PAUSE A MINIMUM OF 10 SECONDS OR AS OTHERWISE SPECIFIED BY THE MANUFACTURER OR RAILROAD.
4. MOVE SELECTOR LEVER TO "B" OR MOVE DYNAMIC BRAKE LEVER TO "SETUP" DEPENDING ON TYPE OF CONTROLS.
5. USE THROTTLE LEVER OR DYNAMIC BRAKE LEVER TO CONTROL THE AMOUNT OF DYNAMIC BRAKING.

2-65 TO PREVENT RAPID RUN-IN OF SLACK WHEN BUNCHING THE TRAIN WITH THE DYNAMIC BRAKE, APPLY THE BRAKE SLOWLY AND OBSERVE THE LOAD METER, MAKING SURE THE AMPERAGE IS INCREASED SLOWLY.

2-66 ADEQUATE TIME MUST BE TAKEN WHEN RELEASING THE DYNAMIC BRAKE AND WHEN RETURNING TO POWER TO PERMIT SLACK TO ADJUST.

2-67 IF THE BRAKE WARNING LIGHT FLASHES ON, DO NOT CONTINUE TO INCREASE THE DYNAMIC BRAKING FORCE UNTIL THE LIGHT GOES OUT. IF THE LIGHT FAILS TO GO OUT AFTER SEVERAL SECONDS, SLOWLY REDUCE THE BRAKING FORCE UNTIL THE LIGHT GOES OUT. AFTER THE LIGHT GOES OUT, THE BRAKING LEVER MAY AGAIN BE ADVANCED TO INCREASE BRAKING EFFORT.

2-68 IF THE WHEELSLIP LIGHT BLINKS "ON AND OFF" SLOWLY AND PERSISTENTLY DURING OPERATION OF THE DYNAMIC BRAKE, THE DYNAMIC BRAKING FORCE SHOULD BE REDUCED. IF THE CONDITION CONTINUES, THE TRAIN SHOULD BE STOPPED IMMEDIATELY AND AN INVESTIGATION MADE TO DETERMINE WHETHER ALL WHEELS ON THE LOCOMOTIVE ARE ROTATING FREELY.

2-69 THE DYNAMIC BRAKE AND THE INDEPENDENT AIR BRAKE MUST NOT BE USED AT THE SAME TIME EXCEPT AT VERY LOW SPEEDS AND WHEN CHANGING FROM DYNAMIC TO INDEPENDENT AIR BRAKE DURING CERTAIN STARTING AND STOPPING PROCEDURES.

2-70 WHEN APPLYING THE DYNAMIC BRAKE, DEPRESS INDEPENDENT BRAKE HANDLE FREQUENTLY ENOUGH TO INSURE THAT BRAKE CYLINDER PRESSURE DOES NOT DEVELOP.

2-71 WHERE THE AVAILABLE DYNAMIC BRAKE FORCE WILL NOT PROPERLY CONTROL THE SPEED OF THE TRAIN, THE TRAIN AIR BRAKE SYSTEM SHOULD BE USED TO AN EXTENT WHICH WILL ALLOW THE DYNAMIC BRAKE TO BE REDUCED TO A VALUE WHERE IT WILL BE FLEXIBLE ENOUGH (1/2 TO 3/4 OF MAXIMUM) TO CONTROL THE CHANGES MADE IN SPEED DUE TO PHYSICAL CHARACTERISTICS OF THE ROAD. ALSO, AUTOMATIC AIR BRAKES CAN BE USED IN CONJUNCTION WITH DYNAMIC BRAKES AT LOCATIONS WHERE IT IS DESIRABLE TO REDUCE HEAD END BUFF FORCES.

NORMALLY THE COMBINED AUTOMATIC AIR AND DYNAMIC BRAKES SHOULD BE RELEASED AS FOLLOWS:

2-72 WITH THE DYNAMIC BRAKE FULLY APPLIED, RELEASE THE BRAKES ON THE TRAIN. AFTER TRAIN BRAKES HAVE RELEASED, CONTINUE TO USE THE DYNAMIC BRAKE AS NEEDED. IF NOT NEEDED, SLOWLY RELEASE DYNAMIC BRAKE AND RETURN CONTROL TO A PRE-POWER POSITION.

WHEN IT IS KNOWN THAT A FREIGHT TRAIN IS TO BE BROUGHT TO A STOP (THE "PLANNED STOP") FROM A FAIRLY HIGH RATE OF SPEED THE FOLLOWING PROCEDURE SHOULD NORMALLY BE USED:

1. GRADUALLY REDUCE THE THROTTLE TO IDLE.
2. SLOWLY BUNCH THE SLACK WITH THE DYNAMIC BRAKE OBSERVING THE GUIDELINES SET OUT IN SECTION C, PG. 2-49. AFTER SLACK ADJUSTS, DYNAMIC BRAKING EFFORT MAY BE INCREASED SLOWLY UNTIL THE DESIRED RATE OF RETARDATION IS ATTAINED.
3. CONDITIONS PREMITTING, THE AUTOMATIC AIR BRAKE APPLICATION SHOULD BE STARTED WITH A "MINIMUM REDUCTION" AND FURTHER REDUCTIONS SPACED AT TIME INTERVALS OF AT LEAST 20 SECONDS.

2-73 CAUTION: IF THERE ARE LONG OVERHANG CARS AT THE HEAD END OF A TRAIN, SOME RAILROADS PREFER TO REDUCE THE DYNAMIC BRAKING FORCE AT THIS POINT TO LOWER THE HEAD END BUFF FORCES.

4. WHEN THE SPEED HAS REDUCED SUFFICIENTLY AND THE DYNAMIC BRAKING EFFORT FADES, THE INDEPENDENT AIR BRAKE MAY BE APPLIED TO PREVENT FORWARD SURGE OF THE LOCOMOTIVE.
5. THE AUTOMATIC BRAKE APPLICATION SHOULD BE INCREASED WITH THE BRAKE PIPE EXHAUST BLOWING AS THE TRAIN STOPS.

6. IF NOT PREVIOUSLY RELEASED, THE DYNAMIC BRAKING LEVER MAY BE PLACED IN THE OFF POSITION.
NOTE: WHEN CONDITIONS ARISE MAKING IT NECESSARY TO INITIATE AN "UNANTICIPATED STOP", THE AUTOMATIC AIR BRAKES MAY BE APPLIED BEFORE MAKING A THROTTLE CHANGE: HOWEVER, AFTER THE INITIAL REDUCTION IS ESTABLISHED AND TRAIN SLACK ADJUSTED, THE THROTTLE MUST BE GRADUALLY REDUCED TO IDLE POSITION. THE LOCOMOTIVE BRAKE SHOULD NOT BE ALLOWED TO APPLY WHILE USING POWER. CONDITIONS PERMITTING, FURTHER REDUCTIONS SHOULD BE SPACED AT INTERVALS OF APPROXIMATELY 20 SECONDS. AFTER THE SLACK HAS ADJUSTED THE DYNAMIC BRAKE MAY BE USED TO ADD TO THE STOPPING FORCE AND THE REMAINDER OF THE STOP MADE AS NOTED IN THE PROCEDURES LISTED ABOVE.

2-73 cont.

IF AN EMERGENCY APPLICATION OF THE TRAIN AIR BRAKES OCCURS WHILE IN DYNAMIC BRAKE THE FOLLOWING PROCEDURE SHOULD BE USED:

1. ON LOCOMOTIVES WHERE THE DYNAMIC BRAKE IS NULLIFIED BY AN EMERGENCY AIR BRAKE APPLICATION, PLACE AUTOMATIC BRAKE HANDLE IN EMERGENCY POSITION AND REGULATE INDEPENDENT BRAKE TO ALLOW GREATEST BRAKE CYLINDER PRESSURE POSSIBLE WITHOUT SLIDING THE WHEELS.
2. IF THE LOCOMOTIVE IS NOT EQUIPPED FOR AUTOMATIC SANDING, THE HAND SANDING VALVE SHOULD BE OPENED AND LEFT OPEN UNTIL TRAIN IS STOPPED.

2-74

3. JUST BEFORE POINT OF STOP MOVE INDEPENDENT BRAKE VALVE HANDLE TO FULL APPLICATION ALLOWING BRAKE CYLINDER PRESSURE TO BUILD UP TO MAXIMUM AT INSTANT OF STOP. AGAIN, CARE MUST BE TAKEN TO PREVENT WHEELS FROM SLIDING.
NOTE: IF DYNAMIC BRAKE IS NOT NULLIFIED BY AN EMERGENCY AIR BRAKE APPLICATION, INDIVIDUAL RAILROAD INSTRUCTIONS WILL GOVERN.

IF THE DYNAMIC BRAKE FAILS OR SUDDENLY BECOMES INOPERATIVE WHILE IN USE, THE LOCOMOTIVE ENGINEER SHOULD BE AWARE THAT A RAPID RUN-OUT OF SLACK MAY OCCUR. THIS IS ESPECIALLY TRUE IF THE DYNAMIC BRAKE IS BEING USED AS THE PRIMARY FORCE TO RETARD THE MOVEMENT OF THE TRAIN. THE FOLLOWING ACTIONS CAN BE TAKEN TO EITHER CORRECT OR SUPPLANT THIS CONDITION:

2-75

1. ATTEMPT TO REGAIN DYNAMIC BRAKING BY OPERATING THE DYNAMIC BRAKE CONTROL SWITCH IN CASE FAILURE IS DUE TO A TEMPORARY CIRCUIT PROBLEM.

2. IMMEDIATELY MAKE AN AUTOMATIC AIR BRAKE APPLICATION OF SUFFICIENT MAGNITUDE TO PROVIDE THE DESIRED AMOUNT OF BRAKING FORCE ALLOWING THE INDEPENDENT BRAKE TO APPLY.
3. IMMEDIATELY APPLY THE INDEPENDENT BRAKE ONLY TO SUBSTITUTE FOR LOST BRAKING EFFORT. EXTREME CARE MUST BE TAKEN, HOWEVER, TO AVOID SEVERE CHANGES IN SLACK AS A RESULT OF HIGH INDEPENDENT BRAKING FORCES AND TO AVOID SLIDING THE WHEELS.

2-75 cont.

1. THE ALIGNMENT CONTROL FEATURE SHOULD BE CHECKED FREQUENTLY AND MAINTAINED WITHIN THE TOLERANCES RECOMMENDED BY THE MANUFACTURER.

(2-76)

LOCOMOTIVES NOT EQUIPPED WITH ALIGNMENT CONTROL OR SOME OTHER DEVICE TO LIMIT THE AMOUNT OF LOCOMOTIVE JACKKNIFING SHOULD NOT BE OPERATED BEHIND ENGINES HAVING OPERATIVE DYNAMIC BRAKES.

(2-77)

2. NEITHER THE DYNAMIC BRAKE NOR THE DIESEL ENGINE SHOULD INTENTIONALLY BE MADE INOPERATIVE OR CUT OUT WHILE THE DYNAMIC BRAKE IS IN OPERATION. SIMILARLY WHEN AN ENGINE IN ANY CONSIST IS ISOLATED, IT SHOULD NOT BE PLACED "ON LINE" OR MADE OPERATIVE WHILE THE DYNAMIC BRAKE IS IN OPERATION.

(2-78)

THE TRANSITION-BRAKING LEVER SHOULD BE REDUCED TO "OFF" POSITION BEFORE AN ISOLATED ENGINE IS PLACED "ON THE LINE".

(2-79)

2.1.2.5 RCE-1 BRAKING PROCEDURES

A. Automatic Air Brake

CAUTION: WHEN OPERATING RCE-1 TRAINS AND A CONDITION EXISTS WHERE BRAKE PIPE CONTINUITY MAY HAVE BEEN IMPAIRED, A CHECK SHOULD BE MADE TO CONFIRM THAT THERE IS A CONTINUOUS OPEN BRAKE PIPE BETWEEN THE CONTROL UNIT AND THE REAR OF THE TRAIN. THIS CHECK CAN BE EASILY ACCOMPLISHED WITH THE FOLLOWING PROCEDURE:

(2-80)

1. IF THE REMOTE CONSIST IS LOCATED WITHIN THE TRAIN NOTIFY PERSONNEL AT THE REAR OF THE TRAIN THAT A BRAKE PIPE CONTINUITY TEST IS BEING INITIATED.
2. MAKE A FULL SERVICE BRAKE PIPE REDUCTION WITH THE "AUTO APP" BUTTON.
3. CLOSE THE BRAKE PIPE CUTOFF VALVE ON THE CONTROL LOCOMOTIVE.

4. DEPRESS THE "AUTO REL" BUTTON AND OBSERVE THE LOCOMOTIVE BRAKE PIPE GAGE.
   NOTE: A SIGNIFICANT INCREASE IN PRESSURE (5 PSI OR MORE) WILL CONFIRM THAT A CONTINUOUS BRAKE PIPE EXISTS BETWEEN THE CONTROL UNIT AND THE REMOTE CONSIST. IF THE REMOTE CONSIST IS AT THE REAR OF THE TRAIN IT WILL ALSO CONFIRM A CONTINUOUS BRAKE PIPE FOR THE ENTIRE TRAIN.

2-80 cont.

5. IF THE REMOTE CONSIST IS NOT AT THE REAR OF THE TRAIN, WAIT FOR NOTICE FROM THE REAR THAT BRAKE PIPE PRESSURE IS RISING (5 PSI OR MORE INCREASE).
6. REOPEN THE BRAKE PIPE CUTOFF VALVE AND PROCEED WITH NORMAL OPERATION.

2-81 TIME AND DISTANCE PERMITTING, THE SPLIT SERVICE REDUCTION SHOULD BE USED WHEN MAKING AUTOMATIC AIR BRAKE APPLICATIONS.

2-82 THE "SLACK STRETCHED" BRAKING METHOD SHOULD NOT NORMALLY BE ATTEMPTED ON MOST REMOTELY POWERED TRAINS.

2-83 WHEN USING THE AUTOMATIC AIR BRAKES TO SLOW A RCE-1 TRAIN TO A PARTICULAR SPEED, THE BRAKES SHOULD NOT BE RELEASED BEFORE THE SPECIFIED AMOUNT OF SPEED REDUCTION HAS BEEN OBTAINED.

2-84 GENERALLY THE SAME PRECAUTIONS AND PROCEDURES LISTED UNDER SECTION 2.1.2.3 "USE OF INDEPENDENT AIR BRAKE" PAGE 2-41, SHOULD BE FOLLOWED ON RCE-1 TRAINS.

1. WHEN USING CONTROL CONSOLE "A", "B", OR "D" TO MAKE EITHER A "PLANNED" SLOWDOWN OR STOP ON COMPARATIVELY LEVEL TERRAIN AND THERE ARE NO UNITS WITH EXTENDED RANGE DYNAMIC BRAKE IN THE REMOTE CONSIST, THE FOLLOWING PROCEDURE MAY BE USED:
   a. WITH THE MODE SELECTOR IN MU, GRADUALLY REDUCE THE CONTROL UNIT THROTTLE TO IDLE AND APPLY THE DYNAMIC BRAKE AS OUTLINED IN SECTION 2.1.2.4., PAGE 2-49, TAKING PARTICULAR CARE TO OBSERVE ALL RECOMMENDED TIME DELAYS.
   b. AFTER SLACK ADJUSTS, IF ADDITIONAL RETARDING FORCE IS DESIRED TO SLOW DOWN OR TO COMPLETE A STOP, MAKE A MINIMUM BRAKE PIPE REDUCTION WITH THE "AUTO APP" BUTTON ON THE AIR BRAKE CONSOLE.

2-85

   c. IF STOP IS BEING MADE, WHEN THE SPEED HAS REDUCED TO APPROXIMATELY 10 MPH, LEAVE THE DYNAMIC BRAKE APPLIED AND GRADUALLY APPLY THE INDEPENDENT AIR BRAKE VALVE ON THE CONTROL UNIT TO PREVENT RUN OUT OF TRAIN SLACK ON HEAD END AND TO BUNCH ANY SLACK REMAINING BETWEEN CONTROL AND REMOTE CONSIST.

d. JUST PRIOR TO STOPPING, MAKE AN AUTOMATIC BRAKE APPLICATION ALLOWING THE LOCOMOTIVE BRAKE TO APPLY ON BOTH THE CONTROL AND REMOTE CONSIST.

2-85 cont.

2. AN ALTERNATIVE SLOWDOWN OR STOP PROCEDURE TO BE ESPECIALLY USED IF EXTENDED RANGE DYNAMIC BRAKE UNITS ARE PRESENT IN THE REMOTE CONSIST IS AS FOLLOWS:
NOTE: CONSOLE "A" OR "B" REQUIRED OR "C" MAY BE USED IF THE MU MODE IS SUBSTITUTED BY MANUAL COORDINATION OF THE CONTROLS.
   a. WITH THE MODE SELECTOR AT MU GRADUALLY REDUCE THE CONTROL UNIT THROTTLE TO IDLE AND APPLY THE DYNAMIC BRAKE AS OUTLINED IN SECTION 2.1.2.4., PAGE 2-49, TAKING PARTICULAR CARE TO OBSERVE ALL RECOMMENDED TIME DELAYS.
   b. AFTER SLACK ADJUSTS, IF ADDITIONAL RETARDING FORCE IS DESIRED TO SLOW DOWN OR TO COMPLETE A STOP, MAKE A MINIMUM BRAKE PIPE REDUCTION WITH THE "AUTO APP" BUTTON ON THE AIR BRAKE CONSOLE.
   c. WHEN THE SPEED HAS BEEN ADEQUATELY REDUCED THE DYNAMIC BRAKE ON THE REMOTE CONSIST MAY BE RELEASED IF SO DESIRED AND CONDITIONS PERMIT. THIS IS ACCOMPLISHED BY QUICKLY MOVING THE MODE SELECTOR FROM MU TO THE CORRESPONDING NUMBER BRAKING POSITION OF THE CONTROL UNIT BRAKING LEVER AND THEN SLOWLY TURNING THE MODE SELECTOR BACK TO POSITION 1 AND THEN QUICKLY TO IDLE.

2-86

NOTE: IF THE DYNAMIC BRAKE IS NOT SO RELEASED ON THE REMOTE CONSIST PRIOR TO THE STOP, IT MAY BE NECESSARY TO APPLY THE INDEPENDENT BRAKES ON THE REMOTE CONSIST WHEN THE DYNAMIC BRAKE FADES TO PREVENT A HEAVY RUN-IN OF SLACK. HOWEVER, THIS MAY BE DIFFICULT TO ACCOMPLISH, PARTICULARLY IF SOME UNITS HAVE EXTENDED RANGE DYNAMIC BRAKE AND SOME DO NOT. THERE IS NO SURE WAY OF KNOWING WHEN THE DYNAMIC BRAKING EFFORT FADES. FURTHER, THE INDEPENDENT BRAKE APPLICATION ON THE REMOTE UNITS CANNOT BE FULLY MONITORED DUE TO THE ABSENCE OF A BRAKE CYLINDER PRESSURE READING FROM THE REMOTE CONSIST.

   d. THE AUTOMATIC BRAKE APPLICATION MAY NOW BE INCREASED AS NEEDED WITH THE AIR BRAKE CONSOLE TO COMPLETE THE STOP.
   e. WHEN THE SPEED HAS REDUCED SUFFICIENTLY AND THE DYNAMIC BRAKING EFFORT FADES, THE INDEPENDENT AIR BRAKE MAY BE APPLIED TO PREVENT A FORWARD SURGE OF THE LOCOMOTIVE.

2-86 cont.

NOTE: FOR A SLOWDOWN THESE PROCEDURES MAY BE DISCONTINUED AFTER THE DESIRED AMOUNT OF SLOWING HAS BEEN ACCOMPLISHED. CONSOLE "C" MAY ALSO BE USED IN THIS MANNER; HOWEVER, WHERE MU IS SPECIFIED IT MUST BE SUBSTITUTED BY MANUAL COORDINATION OF THE CONTROLS.

3. AS A MODIFICATION TO THE PRECEDING METHOD OF BRAKING, IF A MORE CONTROLLED STOP IS DESIRED AND ADEQUATE TIME AND SPACE ARE AVAILABLE (E.G., STOPPING TO TAKE FUEL ON REMOTE UNITS), OR IF A BUNCHING OF TRAIN SLACK IS DESIRED, THE FOLLOWING CAN BE USED:
NOTE: CONSOLE "A" OR "C" IS REQUIRED.
a. WITH THE CONTROL CONSIST IN DYNAMIC BRAKE, THE REMOTE CONSIST REDUCED TO IDLE (STEPS 2-a THROUGH 2-c) AND AFTER OBSERVING PRESCRIBED TIME DELAYS, SET UP INDEPENDENT MOTORING MODE ON THE REMOTE CONSIST AS DESCRIBED IN SECTION 1.2.2., PART B.
NOTE: EXTREME CARE MUST BE TAKEN WHEN EMPLOYING THIS METHOD SINCE AN OVER APPLICATION OF EITHER THE THROTTLE ON THE REMOTE CONSIST OR THE DYNAMIC BRAKE ON THE LEAD CONSIST COULD SQUEEZE OR FORCE CARS OUT OF THE TRAIN. THIS WOULD BE ESPECIALLY TRUE IN CURVES OR WHEN OPERATING THROUGH TURNOUTS OR CROSSOVERS. AS A GENERAL RULE OF THUMB, THE NUMERICAL ADDITION OF THE LEAD DYNAMIC BRAKE POSITION AND REMOTE THROTTLE POSITION SHOULD NOT EXCEED 10 OR 11.

2-87

E. G. FULL DYNAMIC BRAKE - LEAD 8
ALLOWABLE THROTTLE - REMOTE 3
TOTAL 11

b. THE AUTOMATIC BRAKE APPLICATION MAY BE INCREASED AS NEEDED WITH THE AIR BRAKE CONSOLE TO COMPLETE THE STOP.
c. WHEN SPEED HAS BEEN REDUCED SUFFICIENTLY AND THE DYNAMIC BRAKING EFFORT FADES, THE INDEPENDENT BRAKE MAY BE APPLIED ON THE LEAD CONSIST ONLY TO PREVENT A FORWARD SURGE OF THE LOCOMOTIVE.
d. AT APPROXIMATELY 100 FEET BEFORE THE POINT OF STOP THE REMOTE CONSIST (MODE SELECTOR) MUST BE REDUCED TO IDLE.

E. PENALTY AIR BRAKE APPLICATION

2-88

WHEN OPERATING RCE-1 CONTROLLED TRAINS ALL AUTOMATIC AIR BRAKE APPLICATIONS AND RELEASES MUST BE MADE WITH THE AIR BRAKE CONSOLE LEAVING THE AUTOMATIC AIR BRAKE HANDLE LATCHED OR LOCKED IN THE RELEASE POSITION.

IF A PENALTY AIR BRAKE APPLICATION DOES OCCUR ON RCE-1 EQUIPPED TRAINS, THE FOLLOWING PROCEDURE SHOULD BE USED:

1. DURING STOPPING, PLACE THE CONTROLS OF BOTH THE LEAD AND REMOTE CONSISTS IN "IDLE" POSITION.
2. AFTER TRAIN HAS STOPPED UNLATCH THE AUTOMATIC BRAKE VALVE HANDLE AND MOVE HANDLE FROM "RELEASE" TO "SUPPRESSION" POSITION.
3. AS AN EXTRA SAFETY PRECAUTION THE REMOTE FEED VALVE SWITCH CAN BE PLACED IN "OUT" POSITION. ADDITIONALLY THE MODE SELECTOR CAN BE TURNED TO "ISOLATE" OBSERVING THAT THE "FEED VALVE OUT" INDICATOR LIGHTS.

(2-89)

4. AFTER SUFFICIENT TIME HAS BEEN ALLOWED FOR PC TO RESET RETURN AUTOMATIC BRAKE VALVE HANDLE TO "RELEASE" OR RUNNING POSITION AND REPLACE LATCH.
5. IF THE MODE SELECTOR WAS TURNED TO "ISOLATE", UNDER STEP 3 ABOVE, IT SHOULD NOW BE TURNED TO "IDLE" OR "MU". THE REMOTE "FEED VALVE" SHOULD ALSO BE RETURNED TO "IN" POSITION WHEN IT IS DESIRED TO RELEASE THE TRAIN BRAKES.
6. DEPRESS "AUTO REL" BUTTON ON AIR BRAKE CONSOLE NOTING "FEED VALVE IN" INDICATOR LIGHTS AND PROCEED WITH NORMAL TRAIN OPERATION.

IF A TRAIN SEPARATION HAS OCCURRED BETWEEN THE CONTROL CONSIST AND THE REMOTE CONSIST OR IF THERE IS A BRAKE PIPE SEPARATION, IT IS ABSOLUTELY ESSENTIAL THAT, AFTER THE STOP IS MADE, THE REMOTE CONSIST AIR BRAKE FEED VALVE BE CUT OUT, THE MODE SELECTOR PLACED AT "ISOLATE" AND THE ANGLE COCK LEFT IN FULL OPEN POSITION ON THE REAR SECTION OF THE TRAIN UNTIL THE TRAIN IS RECOUPLED.

(2-90)

THE FOLLOWING PROCEDURE SHOULD BE USED BEFORE CUTTING OFF FROM TRAIN:

1. DEPRESS "AUTO APP" PUSHBUTTON UNTIL BRAKE PIPE PRESSURE IS REDUCED TO 30 PSI OR LESS.
2. TURN THE REMOTE FEED VALVE SWITCH TO "OUT".
3. TURN MODE SELECTOR TO "ISOLATE" POSITION AND NOTE "ISOLATE" INDICATOR LIGHTS AND NOTE "FEED VALVE OUT" INDICATOR LIGHTS.

(2-91)

   NOTE: IN THE EVENT THAT "FEED VALVE OUT" LIGHT FAILS TO DISPLAY, INDICATING FEED VALVE IS NOT CUT OUT, THE REMOTE FEED VALVE MUST BE CUT OUT MANUALLY.
4. ANGLE COCK ON CARS TO BE LEFT STANDING MUST BE LEFT OPEN AS SPECIFIED IN THE UNINTENTIONAL RELEASE PORTION OF SECTION 2.1.2.2., PAGE 2-29. IMPORTANT - AT NO TIME DURING ANY CONDITION OF TRAIN SEPARATION BETWEEN THE CONTROL CONSIST AND THE REMOTE CONSIST SHOULD THE REMOTE CONSIST BE OPERATED FROM THE CONTROL UNIT.

IN THE EVENT OF AN EMERGENCY AIR BRAKE APPLICATION FROM ANY CAUSE WHEN USING RCE-1 EQUIPMENT PROCEED AS FOLLOWS:

1. PLACE BOTH THE CONTROL UNIT THROTTLE AND THE MODE SELECTOR AT "IDLE" POSITION.
2. REGULATE LOCOMOTIVE BRAKE CYLINDER PRESSURE ON LEAD CONSIST WITH INDEPENDENT BRAKE VALVE HANDLE TO MAINTAIN MAXIMUM PRESSURE WITHOUT SLIDING WHEELS.
3. AFTER TRAIN HAS STOPPED TURN REMOTE FEED VALVE SWITCH TO "OUT" AND NOTE "FEED VALVE OUT" INDICATOR LIGHTS.
4. MOVE MODE SELECTOR TO "ISOLATE", NOTE INDICATOR AND WAIT APPROXIMATELY TWO (2) MINUTES OR AS OTHERWISE SPECIFIED.
5. DEPRESS THE "AUTO REL" PUSHBUTTON FOR A MINIMUM OF 5 SECONDS.

(2-92)

NOTE: "PCS OPEN" LIGHT ON CONTROL UNIT SHOULD GO OUT.

6. TURN MODE SELECTOR TO "IDLE".
7. PUSH "AUTO REL"BUTTON AND NOTE "PC" INDICATOR ON CONTROL CONSOLE GOES OUT.
8. RETURN MODE SELECTOR TO "ISOLATE".
9. MAKE PROPER INSPECTION OF TRAIN AND EQUIPMENT AND DETERMINE THAT IT IS SAFE TO PROCEED.
10. WHEN BRAKE PIPE PRESSURE IS BEING RESTORED ON REAR OF TRAIN AS INDICATED BY GAGE ON REAR:
    a. TURN REMOTE FEED VALVE TO "IN".
    b. MOVE MODE SELECTOR TO "IDLE".
    c. PUSH "AUTO REL" PUSHBUTTON AND NOTE FEED VALVE "IN" INDICATOR LIGHTS.
11. MAKE NECESSARY TESTS AND PROCEED WITH NORMAL OPERATION.

2.1.2.6 USE OF THE CABOOSE VALVE

THERE ARE ONLY THREE INSTANCES THAT WARRANT USE OF A CABOOSE VALVE:

1. IMMEDIATE DANGER TO LIFE OR PROPERTY, IN WHICH CASE AN EMERGENCY BRAKE APPLICATION SHOULD BE MADE TO OBTAIN THE SHORTEST POSSIBLE STOP.
2. WHEN UNABLE TO INFORM THE ENGINEER BY RADIO OR VISUAL SIGNALS THAT TRAIN SPEED MUST BE REDUCED OR TRAIN STOPPED DUE TO OPERATING CONDITIONS. IN THIS INSTANCE A SERVICE BRAKE APPLICATION SHOULD BE MADE AND TRAIN BROUGHT TO A STOP.

(2-93)

3. DURING CERTAIN BACKUP PROCEDURES AS SPECIFIED IN SECTION 2.1.4., PAGE 2-90.

2-94 CAUTION: WHEN REMOTE CONTROLLED POWER OR AIR REPEATER RELAY CARS ARE EMPLOYED IN THE TRAIN, EMERGENCY APPLICATION SHOULD BE USED TO STOP THE TRAIN FROM THE REAR, REGARDLESS OF THE REASON FOR STOPPING.

1. SERVICE APPLICATION USING THE A-1 OR A-2 CABOOSE VALVES:
MOVE THE BRAKE VALVE HANDLE TO THE NOTCH MARKED #2 POSITION. LEAVE THE HANDLE IN THIS POSITION UNTIL THE BRAKE PIPE GAUGE HAND STOPS FALLING APPROXIMATELY 20 SEC. IF THIS REDUCTION IS NOT SUFFICIENT TO STOP THE TRAIN MOVE THE HANDLE TO THE RIGHT TO NOTCH #3 AND LEAVE IT THERE UNTIL THE TRAIN STOPS. IF SPEED OF THE TRAIN IS NOT SATISFACTORILY REDUCED WITH HANDLE IN POSITION #3 AFTER APPROXIMATELY ONE MINUTE, MOVE THE HANDLE QUICKLY TO THE EXTREME APPLICATION AND LEAVE IT THERE UNTIL THE TRAIN HAS STOPPED.
CAUTION: NEVER ADVANCE THE CABOOSE VALVE HANDLE MORE THAN ONE NOTCH WHILE THE BRAKE PIPE PRESSURE IS STILL FALLING, EXCEPT TO MAKE AN EMERGENCY APPLICATION. NEVER RETURN THE HANDLE TO "LAP" (CLOSED) POSITION UNTIL AFTER THE TRAIN STOPS.

2-95 SERVICE APPLICATION WITH OTHER THAN TYPE "A" VALVES:
WHEN MAKING SERVICE BRAKE APPLICATION WITH CABOOSE VALVES, USING OTHER THAN TYPES A-1 AND A-2, THEY SHOULD BE OPENED GRADUALLY IN SIMULATION TO THE PROCEDURE OUTLINED FOR THE TYPE "A" VALVES. WHERE CABOOSE GAUGES ARE AVAILABLE, THE BRAKE PIPE PRESSURE HAND SHOULD BE MONITORED TO MEASURE THE REDUCTIONS. WHEN CABOOSE GAUGES ARE NOT AVAILABLE AND IT BECOMES NECESSARY TO MEASURE BRAKE PIPE REDUCTION BY LISTENING TO AIR EXHAUST, CONSIDERATION SHOULD BE GIVEN TO THE FOLLOWING:

A. HIGHER BRAKE PIPE PRESSURE PRODUCES THE LOUDER SOUND.
B. SHORT TRAINS PRODUCE A LOUD EXHAUST SOUND VERSUS LONG TRAINS.
C. THE LATER BUILT CARS ARE EQUIPPED WITH CONTINUOUS QUICK SERVICE VALVES WHICH VENT A PROPORTIONED AMOUNT OF BRAKE PIPE AIR, THUS THE SOUND WILL BE WEAKER AT THE BRAKE VALVE.

NOTE: AFTER HANDLE HAS ONCE BEEN MOVED TO ANY APPLICATION POSITION, IT MUST NOT BE RETURNED TO THE CLOSED OR RELEASE POSITION UNTIL AFTER TRAIN HAS STOPPED. THE HANDLE MUST BE MOVED TO THE EXTREME APPLICATION POSITION BEFORE MOVING IT TO CLOSED OR RELEASE POSITION.

2-95 cont.

2. EMERGENCY APPLICATION:

TO STOP A TRAIN IN THE SHORTEST POSSIBLE DISTANCE, MOVE THE TYPE "A" BRAKE VALVE HANDLE QUICKLY TO THE POSITION MARKED "APP." AND LEAVE IT THERE UNTIL THE TRAIN STOPS.

2-96

IF THE CABOOSE IS EQUIPPED WITH A BRAKE VALVE OTHER THAN TYPES A-1 AND A-2 IT SHALL BE OPERATED BY OPENING THE VALVE QUICKLY AND FULLY, AND LEAVING IT IN THE OPEN POSITION UNTIL THE TRAIN COMES TO A COMPLETE STOP.

SOME BASIC DESIGN CONSIDERATIONS OF THE AIR REPEATER CAR SHOULD BE AS FOLLOWS:

1. ABILITY TO CHARGE AND MAINTAIN REAR BRAKE PIPE PRESSURE AT ANY CONTROLLED PRESSURE USING THE FRONT BRAKE PIPE PRESSURE AS A REFERENCE.
2. ABILITY TO TRANSMIT BRAKE PIPE REDUCTIONS FROM THE LOCOMOTIVE TO THE REAR PORTION OF THE TRAIN.
3. ABILITY TO TRANSMIT EMERGENCY APPLICATIONS FROM ANY LOCATION WITHIN THE TRAIN.
4. ABILITY TO DETECT A COMPRESSOR FAILURE OF THE AIR REPEATER CAR.

2-97

PRECAUTIONS WHICH SHOULD BE TAKEN WITH AIR REPEATER CARS INCLUDE:

1. IF YARD AIR IS USED TO CHARGE THE TRAIN, IT MUST BE CUT IN AHEAD OF THE AIR REPEATER CAR.
2. THE AIR REPEATER CAR SHOULD NOT BE DROPPED, KICKED OR HUMPED.
3. DURING A PICK UP OR SET OUT, OR AT ANY TIME THE LOCOMOTIVE UNITS ARE SEPARATED FROM THE TRAIN AND THE AIR REPEATER CAR IS IN OPERATION IN THE TRAIN, IT IS ABSOLUTELY ESSENTIAL THAT THE A.R.C. IS ISOLATED AND THE TRAINLINE ANGLE COCK BE LEFT OPEN ON THE TRAIN.

2-98

2.1.3.1 MULTIPLE UNIT (MU) OPERATIONS

2-99 BEFORE ATTEMPTING TO OPERATE A LOCOMOTIVE CONSIST THE LOCOMOTIVE ENGINEER SHOULD BE AWARE OF THE INDIVIDUAL OPERATING CAPABILITIES AND CHARACTERISTICS OF EACH TYPE OF UNIT AS WELL AS HOW THESE UNITS INTERACT (MULTIPLE UNIT) WITH ONE ANOTHER IN WHAT IS COMMONLY CALLED THE "MIXED CONSIST".

2-100 ALL LOCOMOTIVE CONSISTS MUST PROPERLY MU TOGETHER (I.E., COMPATIBLE AIR BRAKE EQUIPMENT, SANDERS, ETC.) AND ALL REQUIRED LOCOMOTIVE INTERCONNECTIONS, INSPECTIONS AND TESTS SHOULD BE MADE.

2-101 SECONDLY, THE RELATIONSHIP OF HORSEPOWER, TRACTIVE EFFORT, POWER REDUCTION, NUMBER OF POWERED AXLES, AND GEAR RATIOS SHOULD BE ANALYZED BY THE MOTIVE POWER SUPERVISOR TO DETERMINE IF IT IS SUITABLE FOR THE PARTICULAR OPERATION.

2-102 THE LOCOMOTIVE ENGINEER SHOULD ALSO BE AWARE OF THE VARIATIONS IN THROTTLE RESPONSE AND WHEELSLIP SYSTEMS WHEN OPERATING A MIXED CONSIST.

2-103 WHEN OPERATING A MIXED CONSIST, AND ALL LOCOMOTIVE UNITS DO NOT HAVE THE SAME "MINIMUM CONTINUOUS SPEED" RATING, THE CONSIST SHOULD NOT BE OPERATED WITH HIGH AMPERAGE READINGS FOR EXTENDED TIME PERIODS AT SPEEDS WHICH ARE SLOWER THAN THE HIGHEST "MINIMUM CONTINUOUS SPEED" RATING OF ANY UNIT IN THE CONSIST.

2-104 IF ALL LOCOMOTIVE UNITS IN A CONSIST DO NOT HAVE THE SAME GEAR RATIO, THE LOCOMOTIVE SHOULD NOT BE OPERATED WITH HIGH AMPERAGE READINGS FOR EXTENDED TIME PERIODS AT SPEEDS SLOWER THAN THE HIGHEST "MINIMUM CONTINUOUS SPEED" RATING OF ANY UNIT IN THE CONSIST.

2-105 WHEN OPERATING A LOCOMOTIVE CONSIST WITH UNITS HAVING MIXED GEAR RATIOS, THE LOCOMOTIVE SHOULD NOT BE OPERATED FASTER THAN THE UNIT(S) HAVING THE LOWEST MAXIMUM SPEED RATING.

2-106 WHEN STARTING TRAINS WITH MIXED LOCOMOTIVE CONSISTS OF OLDER AND NEWER LOCOMOTIVES HAVING DIFFERENT TYPES OF THROTTLE RESPONSE, THE LOAD METER SHOULD NOT BE USED AS THE PRIMARY FACTOR FOR DETERMINING WHEN TO ADVANCE THE THROTTLE.

2-107 THROTTLE CHANGES SHOULD BE MADE ONE STEP AT A TIME, PAUSING A FEW SECONDS BETWEEN STEPS.

2-108 IF WHEEL SLIP CONTINUES TO OCCUR WHEN OPERATING A MIXED LOCOMOTIVE CONSIST, THE THROTTLE SHOULD BE REDUCED UNTIL ADHESION CONDITIONS IMPROVE.

2-109 SUFFICIENT TIME MUST BE ALLOWED AFTER THE BRAKE RELEASE IS INITIATED FOR ALL TRAIN BRAKES TO RELEASE. COMMUNICATIONS, IF AVAILABLE, CAN BE USEFUL TO ADVISE WHEN THE BRAKES ARE RELEASED ON THE REAR OF THE TRAIN.

IN THE ABSENCE OF COMMUNICATIONS, THE APPROXIMATE AMOUNT OF TIME WHICH SHOULD BE ALLOWED FOR BRAKES TO RELEASE AFTER A FULL SERVICE APPLICATION ON A TRAIN WITH NOMINAL LEAKAGE IS AS FOLLOWS:

NO. OF CARS	BRAKE RELEASE TIME (MINUTES)
60 to 80	2
81 to 100	3
101 to 120	4
121 to 150	5
151 AND MORE	6

NOTE: AN ADDITIONAL 2 MINUTES SHOULD BE ALLOWED IF BRAKES WERE APPLIED IN EMERGENCY. MORE TIME MAY BE REQUIRED IF AIR LEAKAGE IS GREATER.

2-110 A TRAIN SHOULD BE STARTED WITH AS LOW A THROTTLE POSITION AS POSSIBLE.

NORMALLY IT SHOULD NOT BE NECESSARY TO TAKE SLACK TO START A TRAIN AND THE FOLLOWING GENERAL PROCEDURE CAN BE USED:

1. AFTER THE REQUIRED TESTS HAVE BEEN COMPLETED, PLACE ALL CONTROL HANDLES AND SWITCHES IN THEIR PROPER POSITIONS.
2. FULLY RELEASE ALL TRAIN AND LOCOMOTIVE BRAKES.
3. OPEN THE THROTTLE TO RUN 1 AND NOTE AMPERAGE INCREASE ON LOAD METER. 2-111
4. AFTER A FEW SECONDS PAUSE, ADVANCE THE THROTTLE TO RUN 2.

NOTE: THE TRAIN MAY START IN EITHER ONE OF THESE THROTTLE SETTINGS. ON SOME LOCOMOTIVES IT MAY BE NECESSARY TO REGULATE STARTING SPEED WITH THE INDEPENDENT AIR BRAKE. EXTREME CARE MUST BE USED, HOWEVER, WHEN RELEASING THIS BRAKE TO AVOID SLACK ACTION.

5. IF REQUIRED, ADVANCE THE THROTTLE TO RUN 3 OR 4 TO START THE TRAIN. DO NOT, HOWEVER, ADVANCE THE THROTTLE WHILE AMPERAGE IS INCREASING AS INDICATED BY THE LOAD METER. NOTE: IF THE TRAIN HAS NOT YET STARTED, RETURN THE THROTTLE TO IDLE. IT MAY BE NECESSARY TO TAKE SLACK TO START THE TRAIN OR THERE MAY BE TRAIN BRAKES STICKING. FURTHER ADVANCEMENT OF THE THROTTLE MAY CAUSE TRAIN SEPARATION OR DAMAGE TO THE LOCOMOTIVE.

2-111 cont.

6. REDUCE THROTTLE ONE OR MORE NOTCHES IF ACCELERATION IS TOO RAPID.
7. AFTER THE TRAIN IS STRETCHED AND ALL CARS ARE ROLLING, ADVANCE THE THROTTLE AS NEEDED.

2-112 WHEN NECESSARY TO TAKE SLACK, ONLY A FEW CARS SHOULD BE TAKEN OR THE WHOLE TRAIN SHOULD BE BUNCHED.

IF A TRAIN WILL NOT START BY TAKING SLACK ON ONLY A FEW CARS, THE FOLLOWING PROCEDURE MAY BE USED TO TAKE SLACK ON THE ENTIRE TRAIN. (SEE SECTION 2.1.4 BACK-UP PROCEDURES FOR FURTHER INFORMATION.)

1. MAKE AN AUTOMATIC BRAKE APPLICATION OF SUFFICIENT MAGNITUDE TO HOLD THE TRAIN WITH RESPECT TO GRADIENT.

2-113

2. SLOWLY BACK IN TO THE TRAIN UNTIL THE REAR CAR MOVES. CONTINUE SERVICE REDUCTION UNTIL TRAIN STALLS.
3. APPLY INDEPENDENT BRAKE FULLY AND CLOSE THE THROTTLE.
4. REPOSITION THE CONTROLS FOR FORWARD MOVEMENT AND PROCEED AS COVERED IN THE GENERAL STARTING PROCEDURE PREVIOUSLY SPECIFIED.

2-114 FOR MAXIMUM ACCELERATION WITHOUT SLIPPING, THE THROTTLE SHOULD BE ADVANCED ONE NOTCH EACH TIME THE LOAD METER POINTER BEINGS MOVING TOWARD THE LEFT (I.E. REDUCED AMPERAGE).

2-115 AS THE DESIRED SPEED IS APPROACHED, GRADUALLY REDUCE THE THROTTLE UNTIL A "BALANCED SPEED" CONDITION IS OBTAINED. IF THE "BALANCED SPEED" CANNOT BE MAINTAINED WITH ONE THROTTLE SETTING THE THROTTLE MAY BE VARIED SOMEWHAT, MAKING ALL CHANGES SLOWLY. HOWEVER, AVOID CONTINUAL DRIFTING AND REAPPLYING POWER TO MAINTAIN A CONSTANT SPEED. A CONSTANT, LOWER THROTTLE SETTING WILL GIVE BETTER TRAIN HANDLING.

(2-116) WHEN OPERATING OVER RAIL CROSSINGS AT SPEEDS EXCEEDING 25 MPH, REDUCE THE THROTTLE TO RUN 4 POSITION EIGHT TO TEN SECONDS BEFORE THE LOCOMOTIVE REACHES A RAIL CROSSING. IF THE LOCOMOTIVE IS OPERATING IN RUN 4 POSITION OR LOWER, OR RUNNING LESS THAN 25 MPH, ALLOW THE SAME TIME INTERVAL AND PLACE THE THROTTLE IN THE NEXT LOWER POSITION. ADVANCE THE THROTTLE AFTER ALL UNITS OF THE CONSIST HAVE PASSED OVER THE CROSSING.

2.1.4.1 CONSIDERATIONS DUE TO HIGH BUFF FORCES

(2-117) WITH GOOD CONDITIONS OF TRACK AND TRAIN NO MORE THAN 20 POWERED AXLES SHOULD BE USED TO START A BACK-UP MOVEMENT.

(2-118) WHEN ISOLATING UNITS TO LIMIT STARTING FORCE, ISOLATE UNITS AT THE HEAD END OF THE CONSIST. THE WORKING UNITS SHOULD BE AGAINST THE TRAIN.

(2-119) WITH MORE THAN 50 CARS, IF TRACK AND TRAIN CONDITIONS INDICATE A HIGH RISK OF JACKKNIFING, TURNING A RAIL OVER OR PUSHING CARS OFF THE OUTSIDE OF SHARP CURVES, NO MORE THAN 12 POWERED AXLES SHOULD BE USED TO START A BACK-UP MOVEMENT.

(2-120) IF A UNIT AT THE REAR OF A LOCOMOTIVE CONSIST DOES NOT HAVE AN ALIGNMENT CONTROL FEATURE, THE TOTAL BUFF FORCE APPLIED BY THE LOCOMOTIVE MUST BE REDUCED BY USING NO MORE THAN 12 POWERED AXLES.

2.1.4.2 STARTING A BACK-UP MOVEMENT

(2-121) MOST TRAINS SHOULD BE STARTED IN THE FOLLOWING MANNER:

1. ALLOW SUFFICIENT TIME FOR TRAIN BRAKES TO RELEASE BEFORE APPLYING POWER.
2. USE ONLY ENOUGH POWER TO START THE LOCOMOTIVE AND KEEP IT MOVING VERY SLOWLY UNTIL THE ENTIRE TRAIN HAS STARTED.
3. OBSERVE THE LOADMETER AND NOTE SLIGHT VARIATIONS IN CURRENT AS SLACK CLOSES AND ALL OF THE TRAIN IS STARTED. WATCH FOR ANY UNUSUAL CHANGES IN AMPERAGE WHICH MAY BE THE RESULT OF TRAIN BUCKLING. IF THIS OCCURS PROMPTLY APPLY THE INDEPENDENT BRAKE AND CLOSE THE THROTTLE.

A BACK-UP MOVE DOWN A DESCENDING GRADE MAY BE STARTED WITH A DIFFERENT PROCEDURE:

2-121 cont.

1. MAKE A LIGHT BRAKE PIPE REDUCTION TO APPLY THE TRAIN BRAKES WITH JUST ENOUGH FORCE TO HOLD THE TRAIN ON THE GRADE.
2. RELEASE THE LOCOMOTIVE BRAKES, LEAVING TRAIN BRAKES APPLIED.
3. USE JUST ENOUGH POWER TO MOVE THE LOCOMOTIVE VERY SLOWLY UNTIL THE ENTIRE TRAIN HAS STARTED AND RELEASE TRAIN BRAKES AS NECESSARY.

2.1.4.3 STOPPING A BACK-UP MOVEMENT

WHEN STOPPING A TRAIN FROM A BACK-UP MOVEMENT ON LEVEL OR ASCENDING GRADE WITH LOADS AT THE REAR END AND IF THE SPEED OF THE TRAIN IS SUFFICIENT TO ALLOW THE TRAIN BRAKES TO BECOME EFFECTIVE ON THE ENTIRE TRAIN BEFORE THE TRAIN COMES TO A STOP, THE TRAIN SHOULD BE STOPPED WITH "SLACK BUNCHED" AS FOLLOWS:

1. MAKE A MINIMUM BRAKE PIPE SERVICE REDUCTION WHILE WORKING POWER.
2. USE THE INDEPENDENT BRAKE VALVE TO KEEP THE LOCOMOTIVE BRAKES RELEASED.

(2-122)

3. AFTER TRAIN SLACK HAS BECOME ADJUSTED, MAKE FURTHER LIGHT REDUCTIONS OF 2 TO 3 POUNDS AS CONDITIONS REQUIRE, AVOIDING HEAVY BRAKE PIPE REDUCTIONS.
4. OBSERVE THE LOADMETER AND HANDLE THE THROTTLE TO GRADUALLY INCREASE BUFF FORCE TO PREVENT TRAIN SLACK FROM RUNNING OUT AS THE TRAIN SLOWS DOWN.
5. AS THE TRAIN COMES TO A STOP, CLOSE THE THROTTLE AND APPLY THE INDEPENDENT BRAKE.

WHEN STOPPING FROM A BACK-UP MOVEMENT WITH TRAIN MADE UP WITH A MAJORITY OF THE LOADS ON THE REAR ON LEVEL OR DESCENDING GRADE, THE STOP SHOULD BE MADE WITH THE "SLACK STRETCHED" AS FOLLOWS:

1. CLOSE THE THROTTLE GRADUALLY TO IDLE POSITION AND ALLOW SUFFICIENT TIME FOR TRAIN SLACK TO RUN OUT.

(2-123)

2. MAKE A MINIMUM BRAKE PIPE SERVICE REDUCTION PERMITTING THE LOCOMOTIVE BRAKES TO APPLY WITH TRAIN BRAKES.
3. AFTER SUFFICIENT TIME IS ALLOWED FOR THE BRAKE APPLICATION TO BECOME EFFECTIVE ON THE ENTIRE TRAIN ADDITIONAL LIGHT BRAKE PIPE REDUCTIONS MAY BE MADE AS REQUIRED TO STOP THE TRAIN. AVOID HEAVY BRAKE APPLICATIONS WHEN BACKING THE TRAIN.

THE LOCOMOTIVE BRAKE MAY BE USED TO STOP A BACK-UP MOVEMENT FROM SLOW SPEEDS ON LEVEL OR DESCENDING GRADE AS FOLLOWS, BUT EXTREME CAUTION MUST BE EXERCISED TO CONTROL THE SLACK:

1. ALLOW SUFFICIENT TIME TO SLOWLY CLOSE THE THROTTLE TO IDLE AND ALLOW THE SLACK TO RUN OUT.
2. APPLY LOCOMOTIVE BRAKES OR DYNAMIC BRAKE VERY GRADUALLY TO FURTHER STRETCH THE SLACK.

(2-124)

3. USE SAND TO AVOID SLIDING LOCOMOTIVE WHEELS AS LOCOMOTIVE BRAKE CYLINDER PRESSURE IS INCREASED TO COMPLETE THE STOP.

NOTE: AFTER THE SLACK HAS BEEN ADJUSTED AS OUTLINED IN 1. and 2., IF MORE BRAKING FORCE IS REQUIRED, A LIGHT APPLICATION OF TRAIN BRAKES MAY BE MADE WITH THE AUTOMATIC BRAKE VALVE. THE INDEPENDENT BRAKE VALVE MUST BE USED TO KEEP TRAIN SLACK STRETCHED AND TO AVOID SLIDING LOCOMOTIVE WHEELS AS THE TRAIN COMES TO A STOP.

A BACK-UP STOP MAY BE MADE AS FOLLOWS BY USING THE AIR VALVE ON THE REAR OF THE TRAIN IF THE DESIGN OF THE VALVE PERMITS A SERVICE APPLICATION OF TRAIN BRAKES (SEE SECTION 2.1.2.6 PAGE 2-63 "USE OF CABOOSE VALVES"):

1. THE VALVE SHOULD BE OPENED TO MAKE A LIGHT APPLICATION OF TRAIN BRAKES.
2. AFTER SUFFICIENT TIME IS ALLOWED FOR TRAIN SLACK TO ADJUST AND ADDITIONAL BRAKING FORCE IS REQUIRED

(2-125)

THE VALVE MAY BE OPENED FURTHER TO COMPLETE THE STOP.

3. KEEP LOCOMOTIVE BRAKE RELEASED AND WORK POWER LIGHTLY TO KEEP SLACK BUNCHED UNTIL TRAIN HAS STOPPED.
4. AFTER THE TRAIN HAS STOPPED THE VALVE MUST BE MOVED TO EMERGENCY POSITION AND LEFT THERE FOR TEN (10) SECONDS.
5. RETURN VALVE TO RUNNING POSITION.

(2-126) WHEN USING HELPERS THE BACK-UP MOVEMENT MUST BE CONTROLLED BY THE ENGINEER ON THE REAR HELPER LOCOMOTIVE.

(2-127) CUSHION UNITS SHOULD BE DESIGNED FOR OPTIMUM TRAIN HANDLING CHARACTERISTICS AS WELL AS FOR THEIR ENERGY ABSORPTION CAPABILITIES UPON IMPACT.

DUE TO DIFFERENT CHARACTERISTICS OF TRAIN ACTION, OPERATING PROCEDURES SHOULD BE REVIEWED RELATIVE TO END-OF-CAR CUSHIONING DEVICES TO ASSURE THAT LOCOMOTIVE BRAKING DOES NOT WORK TO ESCALATE (2-128) RESULTING LONGITUDINAL FORCES. IN ADDITION, CONSIDERATION SHOULD BE GIVEN TO THE HIGH IMPACT WHICH CAN RESULT WHEN LONG BLOCKS OF CARS WITH CUSHIONING DEVICES RELEASE THEIR ABSORPTION ENERGY AT A POINT IN A TRAIN INVOLVING CARS WITH STANDARD DRAFT GEAR.

2.1.5.3 COMMUNICATIONS (OVER THE ROAD)

WHERE CONDITIONS PERMIT, CREW MEMBERS SHOULD COMMUNICATE, WHETHER BY VOICE OR SIGNAL, TO THE LOCOMOTIVE ENGINEER ANY OF THE FOLLOWING OCCURRENCES:

1. EXCESSIVE SLACK ACTION FELT IN THE CABOOSE.
2. CONDITION OF TRAIN SLACK WHILE MOVING THROUGH CRITICAL AREAS.
3. THE END OF RESTRICTED SPEED ZONES.
4. (2-129) LOCATION OF THE END OF THE TRAIN RELATIVE TO TERRAIN FEATURES (E.G. UNDULATING TERRITORY, CRESTING GRADE, ETC.).
5. ABNORMAL CHANGE IN CABOOSE AIR GAUGE PRESSURE.
6. HOT BOX INDICATION, STICKING BRAKES, DRAGGING EQUIPMENT OR ANY DETECTION OF DEFECTIVE EQUIPMENT WHICH WOULD AFFECT THE ABILITY OF THE ENGINEER TO CONTROL HIS TRAIN.
7. NOTIFICATION FROM REAR END CREW WHEN REAR OF TRAIN IS ROLLING DURING STARTING.

(2-130) IN OPERATIONAL CIRCUMSTANCES UNDER WHICH HIGH L/V FORCE RATIOS ARE GENERATED, SUCH AS WHEN HEAVY DYNAMIC BRAKING FORCES ARE EMPLOYED IN CURVE TERRITORY, THE USE OF SANDING SHOULD BE HELD TO AN ABSOLUTE MINIMUM.

(2-131) TO LIMIT THE INSTANCES OF "OVERSPEEDS" HAPPENING ON AN INDIVIDUAL CARRIER, A SYSTEMATIC DETECTION, RECORDING, AND ANALYSIS OF OVERSPEED CONDITIONS SHOULD BE ACCOMPLISHED EITHER THROUGH THE UTILIZATION OF SUPERVISORY PRESONNEL, OR MULTI-EVENT RECORDERS, OR SPEED RECORDING OR INDICATING DEVICES, OR A COMBINATION OF THESE. THE ENTIRE TRAIN CREW AS WELL AS THE SUPERVISORY PERSONNEL SHOULD BE MADE AWARE OF THE POTENTIALLY SERIOUS CONSEQUENCES OF OVERSPEEDS.

2.2.1. UNDULATING GRADE TERRITORY

TO PROPERLY NEGOTIATE UNDULATING TERRITORY IT IS ESSENTIAL THAT THE LOCOMOTIVE ENGINEER BE KNOWLEGEABLE OF THE OPERATING CHARACTERISTICS OF THE FOLLOWING ITEMS PRIOR TO ENTERING THE TERRITORY:

A. THE GENERAL MAKE-UP OF THE TRAIN (DISTRIBUTION OF LOADS AND EMPTIES).
B. TOTAL NUMBER OF CARS IN THE TRAIN.
C. TOTAL LENGTH OF THE TRAIN.
D. TONNAGE OF THE TRAIN.
(2-132) E. THE HORSEPOWER OUTPUT OF THE LOCOMOTIVE CONSIST.
F. THE POWER LOADING CHARACTERISTICS OF EACH TYPE OF UNIT OF THE CONSIST.
G. THE DYNAMIC BRAKING CHARACTERISTICS OF EACH TYPE OF UNIT OF THE CONSIST.
H. LOCATION OF TERRAIN FEATURES, SIDINGS, AND SPEED RESTRICTIONS BY MILE POST NUMBER. A PROGRAMMED MECHANICAL DEVICE THAT IS AVAILABLE SHOWING THE TRACK PROFILE ON WHICH THE TRAIN IS LOCATED AT ALL TIMES CAN BE USED AS AN EFFECTIVE TOOL FOR AID IN NEGOTIATING UNDULATING TERRITORY.

OF PARTICULAR IMPORTANCE IN OPERATION OVER UNDULATING TERRITORY IS THE ABILITY OF THE ENGINEER TO KNOW THE EXACT LOCATION OF THE REAR PORTION OF THE TRAIN AT ALL TIMES, IN RELATION TO ASCENDING AND DESCENDING GRADES.

THE PROPER EXECUTION OF THE MOST DIFFICULT TRAIN HANDLING PROCEDURES ASSOCIATED WITH UNDULATING GRADE OPERATION ARE OUTLINED AS FOLLOWS:

THE STARTING OF A TRAIN WHERE THE REAR PORTION IS ON AN ASCENDING GRADE AND CONTAINS A LARGE BLOCK OF LOADED CARS, WHILE THE REMAINDER OF THE TRAIN IS LOCATED ON DESCENDING GRADE OR POSSIBLY ON ANOTHER ASCENDING GRADE PORTION OF THE UNDULATION (SEE
(2-133) FIGURE 24) SHOULD BE ACCOMPLISHED AS FOLLOWS:

CONSIDERATION MUST BE GIVEN FOR HOW THE TRAIN WAS STOPPED, THE CONDITION OF THE SLACK, THE MAKE-UP OF THE TRAIN, THE LOCATION OF THE REAR END AS WELL AS THE NUMBER OF UNDULATIONS UPON WHICH THE TRAIN IS POSITIONED. A LOCOMOTIVE ENGINEER MUST KEEP IN MIND THE FACT THAT THE SLACK IN A TRAIN, STANDING IN UNDULATING TERRITORY WITH THE BRAKE RELEASED, IS STRETCHED IN SOME PORTIONS AND BUNCHED IN OTHER PORTIONS.

1. IF IN DOUBT AS TO THE EXACT LOCATION OF THE REAR OF THE TRAIN AND WITH MIXED SLACK CONDITIONS ATTEMPT TO START THE TRAIN WITHOUT TAKING SLACK.
2. MAKE A FULL SERVICE BRAKE PIPE REDUCTION TO INSURE A COMPLETE RELEASE OF CAR BRAKES AS THE TRAIN IS STARTED.
3. AFTER THE BRAKE PIPE EXHAUST CLOSES, PLACE THE BRAKE VALVE IN RUNNING OR RELEASE POSITION, RELEASE THE LOCOMOTIVE BRAKE, AND APPLY LIGHT POWER (THROTTLE NO. 1 OR NO. 2) SO AS TO MOVE THE TRAIN WITH THE LEAST AMOUNT OF DRAWBAR FORCE. CAREFULLY OBSERVE AMPERAGE READING ON THE LOAD METER DURING STARTING: BEARING IN MIND THAT THE HIGHER THE READING THE HIGHER THE TRACTIVE EFFORT.
4. IF IT IS NECESSARY THAT THE THROTTLE BE ADVANCED ABOVE NO. 1 POSITION TO START THE HEAD END OF THE TRAIN, IT SHOULD BE REDUCED ONE NOTCH AS SOON AS THE START COMMENCES. IF ABLE TO MAINTAIN MOVEMENT IN THE NO. 1 THROTTLE POSITION, ALLOW THE ENTIRE TRAIN TO START BEFORE ADVANCING TO A HIGHER THROTTLE POSITION.

2-133 cont.

CAUTION: IF THE TRAIN SHOULD STALL, SHUT OFF POWER AND TAKE SLACK USING THE AUTOMATIC BRAKE. TWO METHODS MAY BE UTILIZED. THE FIRST METHOD (GENERALLY PREFERABLE IF THE TRAIN CAN BE STARTED THROUGH ITS USE) IS TO TAKE ONLY A FOOT OR TWO OF SLACK TO AVOID ANY POSSIBLE RUN OUT ON THE REAR OF THE TRAIN. THE SECOND METHOD IS TO TAKE THE SLACK IN THE ENTIRE TRAIN BY A LIGHT APPLICATION OF AUTOMATIC BRAKES AS THE LOCOMOTIVE IS BACKED INTO THE TRAIN, INCREASING THE THROTTLE UNTIL ALL SLACK IS BUNCHED. DO NOT ALLOW THE LOCOMOTIVE BRAKE TO APPLY UNTIL STOP IS COMPLETED. AFTER SLACK IS TAKEN BY EITHER METHOD, PROCEED AS IN ABOVE STEPS 2 THRU 4.

IF A PREPONDERANCE OF THE TRAIN IS ON A DESCENDING GRADE, LITTLE POWER WILL BE NEEDED TO KEEP THE TRAIN MOVING. HOWEVER, IT IS IMPORTANT TO KEEP STRETCHING OUT THE SLACK AS BRAKES SERIALLY RELEASE ON THE TRAIN. THE ABOVE DESCRIBED PROCEDURE, WHICH TAKES SKILL ON THE PART OF THE LODOMOTIVE ENGINEER, WHEN PROPERLY EXECUTED, WILL ENABLE EACH CAR ON THE REAR OF THE TRAIN TO START BEFORE THE SLACK CAN RUN OUT (BACKWARDS) FOR THAT PART OF THE TRAIN ON THE ASCENDING GRADE.

CONTROLLING SLACK THROUGH UNDULATING TERRITORY:

THROTTLE MODULATION METHOD:

THE MOST RELIABLE MANNER TO HANDLE A TRAIN OF ANY MAKEUP, EVEN IF ONLY ONE UNDULATION IS INVOLVED, IS TO REDUCE THE SPEED OF THE TRAIN PRIOR TO ENTERING THE SERIES OF UNDULATING GRADES AND OPERATE AT A CONSTANT SPEED THROUGHOUT THE UNDULATING AREA BY THROTTLE MANIPULATION. POSITIVE CONCENTRATION ON THE TASK IS DEMANDED FOR SUCCESSFUL NEGOTIATION.

1. KNOWING THE TRAIN LENGTH AT DEPARTURE FROM THE INITIAL TERMINAL, THE LOCOMOTIVE ENGINEER'S CONCENTRATION UPON ENTERING UNDULATING TERRITORY SHOULD BE FOCUSED ON THE LOCATION OF THE TRAIN ON THE GRADES, REAR OF THE TRAIN LOCATION, CHARACTERISTICS OF THE SLACK, OBSERVATION OF THE TRACTION AMPERAGE, SPEED AND PULL OF THE TRAIN.
2. THROUGHOUT THE AREA OF UNDULATION AS THE LOCOMOTIVE CONSIST APPROACHES AN ASCENDING GRADE (FIGURE 25) SLOWLY INCREASE THE THROTTLE JUST ENOUGH TO TOP THE GRADE, MAINTAINING A UNIFORM SPEED. AS THE LOCOMOTIVE CONSIST BEGINS TO DESCEND (FIGURE 26), GRADUALLY REDUCE THE THROTTLE, TAKING ADVANTAGE OF THE LOCOMOTIVE CONSIST WEIGHT AND LOW TRACTION AMPERAGE TO KEEP THE SLACK STRETCHED AT A UNIFORM SPEED.
3. ALERTNESS AND BEING RESPONSIVE TO REDUCE THE THROTTLE JUST BEFORE SLACK IS STRETCHED IS MOST ESSENTIAL. THIS IS DETERMINED BY OBSERVING A SLIGHT REDUCTION OF THE SPEED, LOAD METER, PULL OF THE TRAIN, RADIO COMMUNICATION FROM THE REAR OF THE TRAIN, AND JUDGMENT IN THE LENGTH OF THE TRAIN.
4. WHEN THE SLACK IS STRETCHED, GRADUALLY INCREASE THE THROTTLE TO MAINTAIN CONSTANT SPEED AND SLACK STRETCHED TO THE MAXIMUM CAPABILITY UNTIL THE UNDULATING TERRITORY HAS BEEN NEGOTIATED.

2-134

THE ABOVE LISTED METHOD IS ESPECIALLY DESIRABLE IN HANDLING TRAINS WHERE THE CONSIST EITHER INDICATES HEAVY LOADS ON THE EXTREME REAR AND EMPTIES ON THE HEAD END OF THE TRAIN OR HEAVY LOADS ON THE HEAD END AND LIGHT LOADS ON THE REAR.

SLOWING OR STOPPING IN UNDULATING TERRITORY

SLOWING A TRAIN BY AIR BRAKE APPLICATION:

A BRAKE APPLICATION IN THIS TYPE OF TERRITORY FOR THE PURPOSE OF CONTROLLING OR REDUCING TRAIN SPEED SHOULD BE MADE AT A SUITABLE DISTANCE IN ADVANCE TO MAINTAIN CONTROL. SOME UNDULATING GRADE OPERATIONS DO NOT LEND THEMSELVES TO DYNAMIC BRAKING. THIS IS BECAUSE THERE IS NOT ADEQUATE TIME TO SET UP, APPLY AND RELEASE THE DYNAMIC BRAKE BETWEEN CHANGES IN GRADE. SUCH AN OPERATION COULD RESULT IN EXCESSIVE SLACK ADJUSTMENTS IN THE TRAIN.

1. WHILE WORKING POWER, A MINIMUM SERVICE BRAKE PIPE REDUCTION (6-8 PSI) SHOULD BE MADE AT A TIME WHEN THE TRAIN SLACK IS STRETCHED AND THE HEAD END DUE TO TRACK PROFILE IS TENDING TO RUN AWAY FROM THE TRAIN, AND THE LOCOMOTIVE BRAKE SHOULD BE KEPT FULLY RELEASED.

(2-135)

2. AS THE TRAIN SPEED DECREASES AND THE LOCOMOTIVE ENGINEER IS ASSURED THAT THE BRAKE PIPE REDUCTION HAS APPLIED THROUGHOUT THE TRAIN, THE THROTTLE MAY BE REDUCED SLIGHTLY DEPENDING ON THE TRAIN LENGTH, BRAKE PIPE REDUCTION, AND DESIRED SPEED. ADDITIONAL LIGHT BRAKE PIPE REDUCTIONS MAY BE MADE AS CONDITIONS REQUIRE.
3. IT IS DESIRABLE THAT THE TRAIN BRAKES NOT BE RELEASED UNTIL THE SLACK ON THE HEAD END, DUE TO TRACK PROFILE, IS TENDING TO RUN IN. REFER TO SECTION B.2., PAGE 2-27 FOR PROPER PROCEDURES FOR RELEASE OF TRAIN BRAKES.
4. IF NECESSARY, THE THROTTLE MAY BE LOWERED GRADUALLY AS THE BRAKES BEGIN RELEASING THROUGHOUT THE TRAIN.

STOPPING A FREIGHT TRAIN BY AIR BRAKES APPLICATION:

TO ACCOMPLISH A DESIRED STOP IN UNDULATING TERRAIN:

1. WHILE WORKING POWER, START THE INITIAL BRAKE PIPE REDUCTION (6-8 PSI) AT A POINT THAT SHOULD, WITH NO ADDITIONAL REDUCTIONS, PREVENT THE LOCOMOTIVE FROM PASSING THE OBJECTIVE POINT. ALL ERROR OF JUDGMENT SHOULD BE ON THE SIDE OF STOPPING TOO SOON.

(2-136)

2. AFTER THE TRAIN BRAKES ARE APPLIED THROUGH THE TRAIN, GRADUALLY LOWER THE THROTTLE AND IF REQUIRED, CONTINUE THE BRAKE PIPE REDUCTION WITH LIGHT APPLICATIONS ATTEMPTING TO MAINTAIN A "SLACK STRETCHED" CONDITION UNTIL THE TRAIN STOPS.

THE THROTTLE SHOULD BE CLOSED TO IDLE POSITION JUST PRIOR TO STOPPING AND THE ENGINE BRAKE FULLY APPLIED AS THE STOP IS COMPLETED. WHERE POSSIBLE, THE TOTAL BRAKE PIPE REDUCTION FOR STOPPING SHOULD BE OF A LIGHT NATURE (10 POUNDS)

2-136 cont. TO PREVENT UNDUE STRAIN ON THE COUPLERS AT THE CREST OF THE GRADES OF AN UNDULATING PROFILE.

3. FOLLOWING THE STOP CONTINUE THE BRAKE PIPE REDUCTION UNTIL A FULL SERVICE APPLICATION HAS BEEN MADE, THIS BEING NECESSARY TO INSURE A COMPLETE RELEASE OF THE BRAKES THROUGHOUT THE TRAIN WHEN ATTEMPTING TO RESTART THE TRAIN.

2.2.2 NEGOTIATING LIGHT GRADE TERRITORY

LIGHT ASCENDING GRADES:

1. STARTING LIGHT ASCENDING GRADE
   a. ADVANCE THE THROTTLE TO RUN 1 AND RELEASE THE INDEPENDENT BRAKE.
   b. PLACE AUTOMATIC BRAKE VALVE IN RELEASE POSITION AND ADVANCE THE THROTTLE TO RUN 2 OR SUCCESSIVELY HIGHER POWER POSITIONS ATTEMPTING TO START EACH CAR MOVING AS THE BRAKES RELEASE PROGRESSIVELY TOWARD THE REAR.
   c. SHOULD SLIPPAGE OCCUR AS INDICATED BY THE WHEEL SLIP INDICATOR, REDUCE THE THROTTLE AND, IF NECESSARY, CLOSE THE THROTTLE TO IDLE, AND ATTEMPT TO START AGAIN, SANDING AS REQUIRED.

(2-137)

   d. IF THE TRAIN DOES NOT START WHEN RUN 4 (OR HIGHER POSITION DEPENDING ON LOCAL CONDITIONS) IS REACHED, REDUCE THE THROTTLE TO IDLE AND DETERMINE THE CAUSE OF THE TRAIN NOT MOVING. DO NOT ADVANCE THE THROTTLE WHILE AMPERAGE IS INCREASING AS NOTED ON THE AMMETER.
   e. IF THE ENTIRE TRAIN IS ON AN ASCENDING GRADE AND IT IS NECESSARY TO TAKE SLACK:
      (1) MAKE A BRAKE PIPE REDUCTION SUFFICIENT TO HOLD THE TRAIN ON THE GRADE, REVERSE THE LOCOMOTIVE, AND GRADUALLY OPEN THE THROTTLE TO BUNCH THE SLACK WHILE MAKING A FURTHER LIGHT BRAKE PIPE REDUCTION. RETURN THE THROTTLE TO IDLE AFTER TAKING THE DESIRED AMOUNT OF SLACK OR THE TRAIN HAS STALLED.

(2) PLACE THE AUTOMATIC BRAKE VALVE IN RELEASE POSITION AND LET THE LOCOMOTIVE AND HEAD PORTION OF THE TRAIN ROLL BACK TO FURTHER BUNCH THE SLACK.

(3) PLACE THE REVERSER IN FORWARD AND MOVE THE THROTTLE TO A POSITION THAT WILL ALLOW THE TRAIN TO START SLOWLY WHILE THE BRAKES AT THE REAR ARE RELEASING. (THE THROTTLE SHOULD NOT BE ADVANCED WHILE AMPERAGE IS INCREASING AND SHOULD BE ADVANCED SLOWLY TO AVOID A BREAK-IN-TWO.)

NOTE: IT MAY BE NECESSARY WHEN TAKING SLACK, FOR A TRAINMAN TO SET A SUFFICIENT NUMBER OF HAND BRAKES OR RETAINERS TO PREVENT A ROLL BACK OF THE REAR PORTION OF THE TRAIN, AND THE LOCOMOTIVE ENGINEER WILL HANDLE AS PREVIOUSLY DESCRIBED ABOVE a-e. (FOR PROCEDURES FOR THE SETTING OF HANDBRAKES OR RETAINERS SEE SEC. 2.2.3.C.4. PG. 2-137.) WHEN PROCEED SIGNAL IS SOUNDED, TRAINMAN WILL BEGIN RELEASING HANDBRAKES OR RETAINERS. IF RADIO COMMUNICATION IS AVAILABLE THE LOCOMOTIVE ENGINEER CAN ALSO TAKE SLACK IN ACCORDANCE WITH THE PROCEDURE OUTLINED IN SEC. 2.1.2.6. "USE OF CABOOSE VALVE".

2-137 cont.

f. IF THE LOCOMOTIVE CONSIST IS NOT EQUIPPED WITH VARIABLE THROTTLE RESPONSE (AMPERAGE RELATED TO THROTTLE POSITION) IT MAY BE NECESSARY TO CONTROL STARTING SPEED BY MEANS OF LIGHT INDEPENDENT BRAKE APPLICATIONS.
CAUTION: EXTREME CARE MUST BE USED WHEN THE INDEPENDENT BRAKE IS RELEASED TO AVOID SLACK ACTION.

g. AFTER THE TRAIN IS MOVING, THE SPEED SHOULD BE KEPT SLOW AND UNIFORM TO ALLOW PROPER TRAIN INSPECTION AND TO PERMIT TRAINMEN TO BOARD TRAIN OR CABOOSE SAFELY.

2. SLOW DOWN LIGHT ASCENDING GRADE:

a. NORMALLY POWER WILL ALREADY BE APPLIED AND A SLOWDOWN MAY BE ACCOMPLISHED WITH THROTTLE REDUCTION: HOWEVER, IF THIS IS NOT ADEQUATE TO PROPERLY RETARD THE TRAIN, AN INITIAL BRAKE PIPE REDUCTION OF 6-8 PSI SHOULD BE MADE KEEPING THE LOCOMOTIVE BRAKE RELEASED.

2-138

b. AS THE SPEED DECREASES, THE THROTTLE SHOULD BE REDUCED GRADUALLY TO PREVENT AMPERAGE FROM INCREASING AS INDICATED ON THE LOAD METER.

c. IF AN ADDITIONAL BRAKE PIPE REDUCTION IS REQUIRED, THE THROTTLE SHOULD BE REDUCED TO IDLE.

2-138 cont.

d. WHEN THE DESIRED SPEED REDUCTION HAS BEEN ATTAINED THE BRAKES SHOULD BE RELEASED AND THE THROTTLE MAY BE GRADUALLY INCREASED TO MAINTAIN OR INCREASE SPEED AS DESIRED.

3. STOPPING LIGHT ASCENDING GRADE

a. FROM SPEEDS ABOVE 15 MPH:

(1) GRADUALLY REDUCE THE THROTTLE TO IDLE ALLOWING THE TRAIN TO BUNCH.

(2) AS THE SPEED REDUCES AND UPON NEARING THE POINT OF STOP, APPLY THE TRAIN BRAKES WITH AN INITIAL BRAKE PIPE REDUCTION OF 6-8 PSI ALLOWING THE LOCOMOTIVE BRAKES TO APPLY.

(3) AN ADDITIONAL BRAKE PIPE REDUCTION MAY THEN BE MADE A SHORT DISTANCE FROM THE DESIRED STOPPING POINT WITH BRAKE PIPE EXHAUSTING AS THE STOP IS MADE.

(4) THE LOCOMOTIVE BRAKES SHOULD THEN BE ALLOWED TO FURTHER APPLY FOLLOWING THE LAST BRAKE PIPE REDUCTION TO KEEP THE TRAIN SLACK BUNCHED. WHERE RAIL ADHESION CONDITIONS ARE NOT FAVORABLE, SANDING SHOULD BE UTILIZED.

2-139

b. FROM SPEEDS BELOW 15 MPH:

(1) THE THROTTLE SHOULD BE GRADUALLY REDUCED TO IDLE AND THE TRAIN ALLOWED TO SLOW DUE TO NATURAL RESISTANCE

(2) WHEN NEARING THE POINT OF STOP, SAND SHOULD BE APPLIED TO THE RAIL AND THE INDEPENDENT BRAKE USED TO GRADUALLY BUNCH THE SLACK.

(3) A MINIMUM BRAKE PIPE REDUCTION OF 6 TO 8 PSI SHOULD BE MADE TO COMPLETE THE STOP AND PREVENT SLACK FROM RUNNING OUT.

1. STARTING LIGHT DESCENDING GRADE

CAUTION: WHEN STARTING A TRAIN ON A DESCENDING GRADE WHERE THE TRAIN WILL ROLL WITHOUT THE USE OF POWER, THE INDEPENDENT BRAKE SHOULD BE USED TO CONTROL THE SPEED OF THE HEAD PORTION OF THE TRAIN. IT SHOULD BE REMEMBERED THAT THE SLACK IS BUNCHED AND THE LOCOMOTIVE WILL MOVE SOME

2-140

DISTANCE BEFORE THE REAR CAR MOVES. IF EXCEPTIONAL CARE IS NOT TAKEN, THE SPEED OF THE FORWARD PORTION OF THE TRAIN WILL INCREASE RAPIDLY AND THE TRAIN MAY BE PARTED.

a. TO START THE TRAIN, RELEASE THE INDEPENDENT BRAKE A SUFFICIENT AMOUNT TO ALLOW THE LOCOMOTIVE TO GRADUALLY MOVE FORWARD UNTIL THE ENTIRE TRAIN IS MOVING.

b. AT CARRIER'S OPTION THE DYNAMIC BRAKE MAY BE PLACED IN OPERATION AND THE SELECTOR LEVER OR THROTTLE MOVED TO MAXIMUM BRAKING POSITION PRIOR TO STARTING, IF THE GRADE IS SUCH THAT CONTINUED BRAKING WILL BE NECESSARY.

2-140 cont.

c. HOLD THE TRAIN SLACK BUNCHED UNTIL ENTIRE TRAIN IS MOVING AT WHICH TIME THE INDEPENDENT BRAKE MAY BE GRADUALLY RELEASED AND THE AUTOMATIC OR DYNAMIC BRAKE APPLIED, AS CIRCUMSTANCES MAY REQUIRE.

2. SLOWDOWN LIGHT DESCENDING GRADE

a. DYNAMIC BRAKE AVAILABLE

NORMAL SLOWDOWNS CAN BE ACCOMPLISHED WITH THE DYNAMIC BRAKE AS THE PRIMARY BRAKE; HOWEVER, IF DYNAMIC BRAKE CAPACITY, AS COVERED IN SECTION 2.1.2.4, PG. 2-51, IS NOT SUFFICIENT FOR SLOWDOWN, PROCEED AS FOLLOWS:

(1) WITH THE DYNAMIC BRAKE APPLIED, A MINIMUM BRAKE PIPE REDUCTION OF 6 TO 8 PSI SHOULD BE MADE TO AUGMENT THE DYNAMIC BRAKE IF NECESSARY. FURTHER AUTOMATIC BRAKE REDUCTIONS MAY BE MADE TO PROVIDE THE DESIRED RETARDATION.

2-141

(2) WHEN THE DESIRED SPEED REDUCTION HAS BEEN ACHIEVED THE TRAIN BRAKES SHOULD BE RELEASED, BUT THE DYNAMIC BRAKE LEFT APPLIED KEEPING THE SLACK BUNCHED WHILE THE AIR BRAKES RELEASE THROUGHOUT THE TRAIN.

(3) AFTER THE TRAIN BRAKES HAVE RELEASED, THE DYNAMIC BRAKE CAN THEN BE USED TO MAINTAIN DESIRED SPEED.

b. DYNAMIC BRAKE NOT AVAILABLE (SLACK BUNCHED METHOD)

(1) A MINIMUM BRAKE REDUCTION SHOULD BE MADE OF 6 TO 8 PSI WITH THE THROTTLE IN IDLE POSITION PERMITTING ENGINE BRAKES TO APPLY BY THE USE OF THE AUTOMATIC BRAKE VALVE.

(2) SHOULD AN ADDITIONAL BRAKE PIPE REDUCTION BE REQUIRED THE LOCOMOTIVE BRAKE CYLINDER PRESSURE SHOULD BE REDUCED TO A LEVEL THAT WILL NOT PERMIT EXCESSIVE PRESSURE WHICH MAY CAUSE JACKKNIFING OR DERAILMENT OF CARS.

(3) WHEN THE DESIRED SPEED REDUCTION HAS BEEN ACHIEVED THE TRAIN BRAKES SHOULD BE RELEASED AND THE INDEPENDENT BRAKE ALLOWED TO REMAIN APPLIED UNTIL THE BRAKES HAVE RELEASED THROUGHOUT THE TRAIN IF THE CARRIER APPROVES OF USAGE OF THE INDEPENDENT BRAKE. WHERE CARRIERS DO NOT PERMIT USE OF THE INDEPENDENT BRAKE FOR CONTROLLING THE TRAIN SPEED, THE TRAIN SHOULD BE BROUGHT TO A STOP BEFORE RELEASING THE AUTOMATIC BRAKE.

2-141 cont.

c. DYNAMIC BRAKE NOT AVAILABLE (SLACK STRETCHED METHOD)

(1) WHILE WORKING LIGHT POWER, A BRAKE PIPE REDUCTION SHOULD BE MADE OF 6 TO 8 PSI AND KEEP THE LOCOMOTIVE BRAKES FULLY RELEASED.

(2) WHEN THE DESIRED SPEED REDUCTION HAS BEEN ACHIEVED BY ONE OR MORE BRAKE PIPE REDUCTIONS WITH ENGINE BRAKE FULLY RELEASED, THE TRAIN BRAKES SHOULD BE RELEASED.

(3) LOWER THE THROTTLE SETTING TO A VERY LOW SETTING AND PERMIT THE WEIGHT OF THE LOCOMOTIVES TO ASSIST IN KEEPING THE SLACK STRETCHED WHILE THE BRAKES ARE RELEASING.

(4) WHEN THE BRAKES ARE FULLY RELEASED THROUGHOUT THE TRAIN APPLY POWER AS NECESSARY.

3. <u>STOPPING LIGHT DESCENDING GRADES</u>

a. DYNAMIC BRAKE AVAILABLE

(1) WITH THE DYNAMIC BRAKE APPLIED MAKE A MINIMUM BRAKE PIPE REDUCTION OF 6-8 PSI AT A SUFFICIENT DISTANCE TO ENSURE STOPPING AT THE DESIRED POINT. FURTHER BRAKE PIPE REDUCTIONS OR INCREASED DYNAMIC MAY BE ACCOMPLISHED AS REQUIRED TO ATTAIN THE DESIRED RETARDATION.

2-142

(2) WHEN THE SPEED HAS REDUCED TO 5-10 MPH, THE INDEPENDENT BRAKE MAY BE APPLIED TO PREVENT THE ENGINE FROM RUNNING OUT. <u>CAUTION</u>: IF THERE ARE LONG OVERHANG CARS AT THE HEAD END OF A TRAIN, SOME RAILROADS

PREFER TO REDUCE THE DYNAMIC BRAKING FORCE AT THIS POINT TO LOWER THE HEAD END BUFF FORCES.

(3) AN ADDITIONAL BRAKE PIPE REDUCTION MAY THEN BE MADE A SHORT DISTANCE FROM THE DESIRED STOPPING POINT WITH THE BRAKE PIPE EXHAUSTING AS THE STOP IS MADE AND INDEPENDENT BRAKE FURTHER APPLIED.

(4) SAND MAY BE USED AS REQUIRED.

b. DYNAMIC BRAKE NOT AVAILABLE (SLACK BUNCHED)

(1) WHEN THE DYNAMIC BRAKE IS NOT AVAILABLE, THE THROTTLE SHOULD BE GRADUALLY REDUCED TO IDLE, PERMITTING THE SLACK TO BUNCH SLOWLY. A MINIMUM BRAKE PIPE REDUCTION OF 6 TO 8 PSI SHOULD THEN BE MADE AT A SUFFICIENT DISTANCE TO ENSURE STOPPING AT THE DESIRED LOCATION.

(2) THE LOCOMOTIVE BRAKE SHOULD BE PERMITTED TO APPLY WITH THE AUTOMATIC BRAKE BUT MAINTAINED AT A LOW LEVEL. THIS SHOULD PREVENT UNDESIRABLE HEAD END BUFF FORCES THAT COULD CAUSE JACKKNIFING OR DERAILMENT.

2-142 cont.

(3) AN ADDITIONAL BRAKE PIPE REDUCTION SHOULD THEN BE MADE JUST PRIOR TO STOP AND STOP COMPLETED WITH THE BRAKE PIPE EXHAUSTING.

c. DYNAMIC BRAKE NOT AVAILABLE (SLACK STRETCHED)

(1) WHILE WORKING LIGHT POWER, A BRAKE PIPE REDUCTION SHOULD BE MADE OF 6 TO 8 PSI KEEPING THE LOCOMOTIVE BRAKES FULLY RELEASED.

(2) AS THE TRAIN SPEED DECREASES, GRADUALLY LOWER THE THROTTLE PERMITTING THE WEIGHT OF THE LOCOMOTIVES TO ASSIST IN KEEPING THE SLACK STRETCHED. WITH ONE OR MORE BRAKE PIPE REDUCTIONS, CLOSE THE THROTTLE TO IDLE, KEEP THE ENGINE BRAKES RELEASED AND CONTINUE THE REDUCTION UNTIL THE TRAIN STOPS.

(3) THE LOCOMOTIVE BRAKES SHOULD BE APPLIED DURING FINAL STAGES OF THE STOP.

2.2.3. NEGOTIATING HEAVY GRADE TERRITORY

2-143 SPEED SHOULD BE KEPT LOW ON HEAVY GRADES.

2-144 IF THE DYNAMIC IS SUDDENTLY LOST OR BECOMES OVER-WORKED AND INEFFECTIVE FOR ANY REASON ON A HEAVY GRADE, SAFE PRACTICE IS TO GET THE TRAIN STOPPED QUICKLY USING EMERGENCY APPLICATION, IF REQUIRED.

2-145 THE AMOUNT OF BRAKE PIPE REDUCTION REQUIRED TO BALANCE THE GRADE SHOULD NORMALLY NOT EXCEED APPROXIMATELY 3/4 OF THE NORMAL FULL SERVICE TRAIN BRAKE, WITH EITHER THE DYNAMIC BRAKE OR PRESSURE MAINTAINING AVAILABLE.

2-146 WHEN NEITHER DYNAMIC BRAKE NOR THE PRESSURE MAINTAINING FEATURE IS AVAILABLE, THE CYCLE METHOD OF BRAKING SHOULD BE USED.

2-147 WHEN CYCLE BRAKING, THE AMOUNT OF BRAKE PIPE REDUCTION SHOULD NORMALLY NOT EXCEED ONE-HALF (½) OF THE NORMAL FULL SERVICE TRAIN BRAKE AVAILABLE.

2-148 INDEPENDENT BRAKE MUST BE FULLY APPLIED AND, UNLESS IT IS KNOWN THAT THE INDEPENDENT BRAKE WILL HOLD THE TRAIN, TRAIN BRAKES MUST BE LEFT APPLIED UNTIL READY TO PROCEED. IF NECESSARY TO RESTORE AIR BRAKE PRESSURE TO THE SYSTEM, SUFFICIENT RETAINERS AND/OR HAND BRAKES MUST BE SET TO HOLD THE TRAIN. AFTER CHARGING IS COMPLETED A BRAKE PIPE REDUCTION MUST BE MADE SUFFICIENT TO HOLD THE TRAIN WHILE HAND BRAKES ARE RELEASED. HAND BRAKES MUST BE SET ON REAR OF TRAIN WHEN ON ASCENDING GRADE AND ON HEAD END WHEN ON DESCENDING GRADE.

1. STARTING HEAVY ASCENDING GRADE
   REFER TO SECTION 2.2.2., PG. 2-116 "STARTING LIGHT ASCENDING GRADE".
   CAUTION: IF CONDITIONS ARE UNFAVORABLE, CONSIDERATION FOR A POSSIBLE DOUBLE OF THE TRAIN SHOULD BE GIVEN RATHER THAN EXPERIENCE A POSSIBLE TRAIN SEPARATION. SHOULD SLIPPAGE OCCUR, SURGES IN TRACTIVE FORCE MAY RESULT IN MOMENTARY EXCESSIVE STRAINS IN COUPLERS AND DRAFT GEARS. ALSO, THE TRAIN MUST BE STARTED SOON AFTER POWER IS APPLIED TO AVOID STALL BURNS TO TRACTION MOTOR COMMUTATORS OR RAIL BURNS FROM EXCESSIVE SLIPPING.

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2. SLOWDOWN HEAVY ASCENDING GRADE

A SLOWDOWN MAY NORMALLY BE ACCOMPLISHED BY GRADUALLY LOWERING THE THROTTLE AND ALLOWING THE SPEED TO DECREASE TO THAT DESIRED, KEEPING THE SLACK STRETCHED, AT WHICH TIME POWER MAY BE REAPPLIED ON SOME GRADES WITH SOME TRAINS.

2-150

CARE SHOULD BE EXERCISED WHEN REAPPLYING POWER FOLLOWING SLOWDOWN ON HEAVY GRADE TO AVOID SLIPPING AND INCREASED DRAWBAR FORCES THAT MAY CAUSE TRAIN SEPARATION. THE THROTTLE SHOULD ONLY BE ADVANCED ONE NOTCH AT A TIME, PAUSING A FEW SECONDS BETWEEN ADVANCEMENTS.

3. STOPPING HEAVY ASCENDING GRADE

STOPPING ON THIS TYPE OF TERRAIN, DEPENDING UPON LOCAL CONDITIONS, CAN BE ACCOMPLISHED BY USING THE "SLACK STRETCHED" OR "SLACK BUNCHED" METHODS:

a. "SLACK STRETCHED" METHOD

(1) WHILE WORKING POWER APPLY A MINIMUM BRAKE PIPE REDUCTION OF 6 TO 8 PSI KEEPING THE SLACK STRETCHED AND THE INDEPENDENT BRAKE RELEASED.

(2) WHEN THIS REDUCTION HAS APPLIED THROUGHOUT THE TRAIN MAKE ANOTHER REDUCTION. LOWER THE THROTTLE GRADUALLY, KEEPING THE SLACK STRETCHED.

(3) REDUCE THE THROTTLE IN COMPARISON TO THE SPEED, KEEPING TRACTION AMPERAGE AT A LOW LEVEL.

(4) UNTIL THE STOP IS COMPLETED, MAINTAIN THE THROTTLE IN NUMBER ONE OR TWO

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POSITION WITH JUST ENOUGH AMPERAGE TO KEEP THE SLACK STRETCHED. APPLY SAND AN ADEQUATE DISTANCE PRIOR TO STOP TO PROVIDE SAND ON THE RAIL UNDER THE LOCOMOTIVE.

(5) APPLY THE INDEPENDENT BRAKE FULLY AS THE STOP IS COMPLETED AND CLOSE THE THROTTLE.

(6) A FULL SERVICE BRAKE PIPE REDUCTION IS NOW DESIRABLE. FOLLOWING THIS REDUCTION SLACK WILL BE STRETCHED AND THE TRAIN SECURE.

CAUTION: JUDGMENT IN RELEASING THE LOCOMOTIVE BRAKE MUST BE EXERCISED. WITH THE TRAIN STOPPED IN THE ABOVE LISTED MANNER, THE SLACK SHOULD STAY STRETCHED AND THE ENGINE WILL NOT ROLL BACK AGAINST THE TRAIN CREATING A POTENTIAL HARSH SLACK ACTION WHEN AGAIN STARTING THE TRAIN.

b. PARTIAL "SLACK BUNCHED" METHOD
NOTE: THE FOLLOWING PROCEDURE MAY BE USED TO FACILITATE STARTING; HOWEVER, EXTREME CARE MUST BE EXERCISED IN STARTING AND ADVANCING THE THROTTLE SINCE THERE IS A HIGH PROBABILITY OF TRAIN SEPARATION AS THE SLACK IS PULLED OUT AHEAD OF THE REAR PORTION OF THE TRAIN WHICH MIGHT BE BUNCHED.

(1) REDUCE THE THROTTLE GRADUALLY UNTIL TRAIN SPEED HAS BEEN SLOWED TO APPROXIMATELY 5 MPH.

(2) MOVE THE THROTTLE TO IDLE POSITION.

(3) WHEN SPEED IS APPROXIMATELY 3 MPH, MAKE A 15 PSI BRAKE PIPE REDUCTION KEEPING THE LOCOMOTIVE BRAKES RELEASED. APPLY SAND AN ADEQUATE DISTANCE PRIOR TO STOP TO PROVIDE SAND ON THE RAIL UNDER THE LOCOMOTIVE.

2-151 cont.

(4) WHEN THE TRAIN STOPS, CLOSE SANDERS AND APPLY THE INDEPENDENT BRAKE IN FULL APPLICATION POSITION.
CAUTION: JUDGMENT IN RELEASING THE TRAIN BRAKES MUST BE EXERCISED. THE ABOVE LISTED METHOD OF STOPPING WILL NOT COMPRESS THE COUPLER SPRINGS, BUT WILL BUNCH SLACK ON A PORTION OF THE TRAIN TO ALLOW FOR STARTING THE TRAIN. IF BRAKE PIPE REDUCTION IS MADE OVER 3 MPH, THE COUPLER SPRINGS WILL BE COMPRESSED AS THE SLACK BUNCHES. WITH THE COUPLER SPRINGS COMPRESSED A "ROLL-OUT" OF SLACK MAY OCCUR WHEN THE TRAIN BRAKES ARE RELEASED.

1. STARTING HEAVY DESCENDING GRADE
THE BRAKE SYSTEM MUST BE CHARGED TO THE REQUIRED PRESSURE BEFORE A TRAIN IS ALLOWED TO START FROM THE SUMMIT OR AFTER A STOP ON A DESCENDING GRADE. THE OBSERVANCE OF THE AIR GAUGE ON THE LOCOMOTIVE PLUS THE AIR PRESSURE GAUGE INDICATION ON THE REAR CAR OF THE TRAIN SHOULD BE USED TO DETERMINE WHEN THE BRAKE SYSTEM IS CHARGED TO THE REQUIRED PRESSURE. REFER TO PAGE 2-31, "CHARGING" FOR PROPER CHARGING OF THE TRAIN.

2-152

THE BRAKES SHOULD BE APPLIED SOON AFTER STARTING TO MAINTAIN A SLOW TRAIN SPEED AND TO FREE THE BRAKE SHOES OF SNOW OR ICE IN AREAS OF WINTER OPERATION.

A TRAIN STANDING ON A HEAVY DESCENDING GRADE WILL NORMALLY HAVE THE SLACK BUNCHED AND THEREFORE THE INDEPENDENT BRAKE SHOULD BE UTILIZED. AS THE INDEPENDENT BRAKE IS GRADUALLY RELEASED THE LOCOMOTIVE WILL MOVE SOME DISTANCE BEFORE THE REAR CAR MOVES AND EXTREME CARE MUST BE USED TO CONTROL THE SPEED OF THE HEAD PORTION OF THE TRAIN, OR A BREAK-IN-TWO WILL RESULT.

a. DYNAMIC BRAKE AVAILABLE

(1) WITH INDEPENDENT BRAKE APPLIED, THE DYNAMIC BRAKE MAY BE SET UP AND THE BRAKING LEVER OR THROTTLE MOVED TO MAXIMUM BRAKING POSITION PRIOR TO STARTING. REFER TO SECTION 2.1.2.4., PAGE 2-49 FOR "APPLICATION OF DYNAMIC BRAKE".

(2) RELEASE THE TRAIN BRAKES BY PLACING THE AUTOMATIC BRAKE VALVE IN "RUNNING" OR "RELEASE" POSITION WAITING AN ADEQUATE TIME INTERVAL TO INSURE RELEASE OF BRAKES AT THE REAR OF THE TRAIN AND PROPER CHARGE.

2-152 cont.

CAUTION: IF THERE IS DOUBT AS TO THE ABILITY OF THE LOCOMOTIVE BRAKES OF A PARTICULAR TRAIN CONSIST TO BALANCE AND HOLD THE TRAILING TONNAGE WHEN STOPPED ON A HEAVY GRADE, SUFFICIENT NUMBER OF RETAINERS AND/OR HANDBRAKES SHOULD BE "SET" PRIOR TO RELEASE AS OUTLINED IN SECTION C.4., PAGE 2-137, TO KEEP THE TRAIN FROM MOVING PRIOR TO RELEASE OF BRAKES THROUGHOUT THE TRAIN AND PROPER CHARGING OF THE BRAKE SYSTEM.

(3) GRADUALLY RELEASE THE INDEPENDENT BRAKE A SUFFICIENT AMOUNT TO ALLOW THE LOCOMOTIVE TO SLOWLY MOVE FORWARD UNTIL THE ENTIRE TRAIN IS MOVING. IF HANDBRAKES WERE SET IT MIGHT BE NECESSARY TO APPLY LIGHT POWER TO START THE TRAIN. IF DYNAMIC BRAKE WAS NOT PREVIOUSLY SET UP, IT SHOULD BE DONE SO IN ACCORDANCE WITH THE PROCEDURE OUTLINED IN SECTION 2.1.2.4., PAGE 2-49 "APPLICATION OF DYNAMIC BRAKE".

CAUTION: PARTICULAR CARE SHOULD BE TAKEN SO THAT THE LOCOMOTIVE BRAKES ARE GRADUATED OFF AS DYNAMIC BRAKE BECOMES EFFECTIVE TO AVOID THE POSSIBILITY OF WHEEL SLIDE.

(4) MOVE THE BRAKING LEVER TO MAXIMUM BRAKING POSITION, IF NOT ALREADY ACCOMPLISHED, KEEPING THE SLACK BUNCHED AND CONTROL THE SPEED WITH THE DYNAMIC AND TRAIN BRAKES AS REQUIRED.

b. DYNAMIC BRAKE NOT AVAILABLE

2-152 cont.

USE THE APPLICABLE INDEPENDENT AND AUTOMATIC BRAKE MANIPULATIONS AS OUTLINED IN PROCEDURE a. ABOVE.

2. SLOWDOWN AND MAINTAINING SPEED ON HEAVY DESCENDING GRADE

THERE ARE BASICALLY THREE APPROACHES TO HEAVY GRADE BRAKING: "DYNAMIC BRAKE METHOD", "PRESSURE MAINTAINING METHOD", AND "CYCLE BRAKING METHOD". IF THE DYNAMIC BRAKE IS EFFECTIVE AND SUFFICIENT BRAKING IS AVAILABLE TO CONTROL A SLOWDOWN THE DYNAMIC BRAKE METHOD SHOULD BE UTILIZED.

2-153

a. DYNAMIC BRAKE METHOD

PRESSURE MAINTAINING AVAILABLE:

(1) THE DYNAMIC BRAKE SHOULD BE SET UP IN ACCORDANCE WITH SECTION 2.1.2.4., PAGE 2-49, TO CONTROL TRAIN SPEED ON THE DESCENDING GRADE.

(2) A MINIMUM BRAKE PIPE REDUCTION OF 6 TO 8 PSI SHOULD BE MADE SOON ENOUGH SO THAT ½ - 3/4 OF THE MAXIMUM DYNAMIC BRAKE FORCE COUPLED WITH THE BRAKE APPLICATION WILL CONTROL SPEED OF THE TRAIN.

(3) MAXIMUM DYNAMIC BRAKE WILL USUALLY BE REQUIRED FOR A SHORT TIME UNTIL THE TRAIN BRAKE APPLICATION BECOMES EFFECTIVE. THE DYNAMIC BRAKE MAY THEN BE VARIED AS TRAIN SPEED VARIES DUE TO CURVES AND CHANGES IN GRADE.

2-154

(4) TRAIN BRAKE APPLICATIONS MAY BE INCREASED IN 2 PSI INCREMENTS OR MORE AS REQUIRED IF ½ - 3/4 OF MAXIMUM DYNAMIC WILL NOT CONTROL SPEED OF THE TRAIN. THE BRAKE PIPE PRESSURE MAINTAINING FEATURE WILL ACT TO KEEP THE BRAKE PIPE REDUCTION AND RESULTANT BRAKE CYLINDER PRESSURE CONSTANT, THEREBY ALLOWING A BALANCED CONDITION TO BE ATTAINED.

PRESSURE MAINTAINING NOT AVAILABLE:

2-155

WHEN ONLY THE DYNAMIC BRAKE IS PRESENT, THE CYCLE METHOD DESCRIBED IN SECTION C., PAGE 2-134, MAY BE USED. GOOD JUDGMENT MUST BE EXERCISED

ALONG WITH KNOWLEDGE OF ABD BRAKING CHARACTERISTICS. THE FREQUENCY AND AMOUNT OF BRAKE PIPE REDUCTIONS REQUIRED WILL DEPEND UPON THE AMOUNT OF DYNAMIC BRAKE AVAILABLE, AND TRAIN WEIGHT, SINCE RETAINING VALVES MAY NOT BE REQUIRED. THE DYNAMIC BRAKE IS DEPENDED UPON TO CONTROL TRAIN SPEED DURING RELEASE AND RECHARGE.

2-155 cont.

CAUTION: ON HEAVY GRADES SPEED CAN GET OUT OF CONTROL IN A VERY SHORT TIME. ON GRADES WHERE A LARGE PORTION OF THE RETARDING FORCE IS BEING PROVIDED BY THE DYNAMIC BRAKE AND ALL OR PART OF THE DYNAMIC SUDDENLY BECOMES INOPERATIVE AS EVIDENCED BY A SEVERE SLACK RUN-OUT, LOSS OF DYNAMIC BRAKE AMPERAGE OR RAPID SPEED INCREASE, AN "EMERGENCY" AIR BRAKE APPLICATION SHOULD BE INITIATED WITHOUT HESITATION. SERVICE APPLICATIONS USUALLY REACT TOO SLOWLY AND ALLOW TOO MUCH SPEED INCREASE WHILE THEY ARE BECOMING EFFECTIVE.

b. PRESSURE MAINTAINING METHOD

(1) WHEN DYNAMIC BRAKE IS NOT AVAILABLE, AN INITIAL BRAKE PIPE REDUCTION SHOULD BEGIN AT A POINT THAT WILL PREVENT SPEED FROM BECOMING EXCESSIVE BEFORE THE APPLICATION BECOMES EFFECTIVE ON THE ENTIRE TRAIN. THE REDUCTION MUST BE AT LEAST 6 TO 8 PSI TO PREVENT QUICK SERVICE ACTIVITY OF THE CAR BRAKES FROM REDUCING THE BRAKE PIPE PRESSURE BELOW THAT OF EQUALIZING RESERVOIR PRESSURE, THEREBY CAUSING THE PRESSURE MAINTAINING FEATURE TO INCREASE BRAKE PIPE PRESSURE RESULTING IN RELEASE OF TRAIN BRAKES.

(2-156)

(2) THE LOCOMOTIVE BRAKES SHOULD NOT BE ALLOWED TO APPLY BY DEPRESSING THE INDEPENDENT BRAKE VALVE IN RELEASE POSITION.

(3) THE BRAKE PIPE REDUCTION MAY BE INCREASED TO MAINTAIN TRAIN SPEED TO THAT DESIRED. CAUTION: THE EQUALIZING RESERVOIR PRESSURE MUST BE OBSERVED (PARTICULARLY WITH 24RL EQUIPMENT WITH PRESSURE MAINTAINING) TO DETECT ANY RISE DUE TO THE SIZE OF THE EQUALIZING RESERVOIR AND TEMPERATURE EFFECT FOLLOWING A REDUCTION, WHICH WILL CAUSE UNDESIRED RELEASE OF THE BRAKES. ADDITIONAL LIGHT REDUCTIONS (SHAVING) MAY BE MADE UNTIL THE TRAIN SPEED IS CONTROLLED AT THE DESIRED LEVEL.

(4) IF OPERATING AND GRADE CONDITIONS PERMIT, BRAKES MAY BE RELEASED AND REAPPLIED. OTHERWISE, A STOP MUST BE MADE AND BRAKE PIPE PRESSURE RESTORED. PARTIAL RELEASE OF TRAIN BRAKES BY MOVING THE AUTOMATIC BRAKE VALVE FROM "MAINTAINING" POSITION TO "RUNNING" OR "RELEASE" POSITION MOMENTARILY AND BACK TO "MAINTAINING" POSITION MUST NOT BE ATTEMPTED TO AVOID AN UNINTENTIONAL RELEASE OF TRAIN BRAKES. SEE SECTION C. (4) PAGE 2-135 CONCERNING BRAKE SYSTEM RECHARGE.

2-156 cont.

c. CYCLE BRAKING METHOD

CAUTION: KNOWLEDGE OF BRAKING EQUIPMENT FUNCTIONING IS REQUIRED PRIOR TO USING THE FOLLOWING PROCEDURE TO PREVENT UNDESIRED RELEASES AND TO INSURE CYCLE LIMITATIONS ARE NOT EXCEEDED. REFER TO SECTION 3.c., PAGE 2-29.

(1) WHEN NEITHER THE DYNAMIC BRAKE NOR THE PRESSURE MAINTAINING FEATURE IS AVAILABLE, THE "CYCLE METHOD" OF BRAKING MUST BE USED AND RETAINERS "SET" WHERE REQUIRED. RETAINERS SHOULD BE SET UP IN ACCORDANCE WITH SEC. C.4 PAGE 2-137. IF RETAINERS ARE NOT USED, IT MAY BE NECESSARY TO STOP PERIODICALLY TO ALLOW THE BRAKE SYSTEM TO RECHARGE.

(2) AN INITIAL BRAKE PIPE REDUCTION OF 6-8 PSI SHOULD BE MADE WITH ADDITIONAL REDUCTIONS AS REQUIRED AND HELD UNTIL THE SPEED REDUCES BELOW THE DESIRED SPEED TO BE MAINTAINED, AT WHICH TIME THE BRAKES MAY BE RELEASED.

2-157

(3) THE RETAINERS, IF USED, SHOULD NOW ACT TO HOLD THE SPEED TO A SLOW INCREASE RATE AND ALLOW TIME FOR THE BRAKE SYSTEM TO RECHARGE.

(4) THE NEXT BRAKE APPLICATION AND EACH SUCCESSIVE APPLICATION SHOULD BE MADE AT A TIME THAT WILL ALLOW THE BRAKES TO EFFECTIVELY CONTROL THE DESIRED SPEED. THE AMOUNT OF EACH BRAKE PIPE REDUCTION WILL DEPEND ON THE PERIOD OF TIME THE TRAIN HAS BEEN ALLOWED TO RECHARGE AND MAY REQUIRE THAT EACH SUCCEEDING REDUCTION BE GREATER THAN THE PREVIOUS. THEREFORE, THE AMOUNT OF THE PREVIOUS BRAKE PIPE REDUCTION MUST BE KNOWN WHEN MAKING THE NEXT BRAKE APPLICATION. THIS SHOULD BE MADE BY OBSERVING THE EQUALIZING RESERVOIR GAUGE.

(5) THE APPLICATION AND RELEASE CYCLE MAY BE CONTINUED WHILE DESCENDING THE GRADE, KEEPING THE SPEED LOW AND PERMITTING SUFFICIENT RECHARGE OF THE BRAKE SYSTEM.
CAUTION: DURING ALL PHASES OF CYCLE BRAKING, THE TRAIN SHOULD BE OBSERVED FREQUENTLY BY ENGINEER AND TRAINMEN FOR ANY INDICATIONS OF OVERHEATED WHEELS. UNLESS OTHERWISE SPECIFIED BY CARRIER INSTRUCTIONS, A STOP TO COOL WHEELS NEED NOT BE MADE IF THERE IS NO INDICATION OF WHEELS OVERHEATING AND IN THE JUDGMENT OF THE TRAIN CREW IT IS SAFE TO PROCEED. INDIVIDUAL CARRIERS SHOULD DESIGNATE SPECIFIC LOCATIONS WHERE A STOP MUST BE MADE TO ALLOW WHEELS TO COOL DEPENDING ON SEVERITY OF GRADE, DURATION OF TRAIN BRAKING AND DEGREE OF TRAIN BRAKE APPLICATION. TRAINS SHOULD REMAIN AT SUCH STOP AT LEAST 10 MINUTES.

2-157 cont.

3. STOPPING HEAVY DESCENDING GRADE

a. DYNAMIC BRAKE AVAILABLE

(1) WHILE THE DYNAMIC BRAKE IS BEING USED TO CONTROL THE SPEED OF THE TRAIN A MINIMUM BRAKE PIPE REDUCTION OF 6 TO 8 PSI SHOULD BE MADE AT A SUFFICIENT DISTANCE TO INSURE STOPPING AT THE DESIRED POINT.

(2) WHEN THE AIR BRAKE APPLICATION BECOMES EFFECTIVE THE DYNAMIC BRAKE SHOULD BE FULLY APPLIED IF NOT ALREADY ACCOMPLISHED. IF REQUIRED, SUBSEQUENT BRAKE PIPE REDUCTIONS SHOULD BE MADE TO PROVIDE THE DESIRED RETARDATION, LEAVING THE DYNAMIC BRAKE FULLY APPLIED AND KEEPING THE LOCOMOTIVE BRAKES FROM APPLYING.

2-158

(3) WHEN SPEED HAS BEEN REDUCED TO 5 TO 10 MPH, THE INDEPENDENT BRAKE MAY BE APPLIED TO PREVENT THE LOCOMOTIVE FROM RUNNING OUT.

(4) AN ADDITIONAL BRAKE PIPE REDUCTION SHOULD THEN BE MADE JUST PRIOR TO STOP WITH THE BRAKE PIPE EXHAUSTING AS THE STOP IS MADE AND APPLY THE INDEPENDENT BRAKE. SAND SHOULD BE USED AS REQUIRED.

b. DYNAMIC BRAKE NOT AVAILABLE

USE THE AUTOMATIC AND INDEPENDENT BRAKE AS OUTLINED IN THE ABOVE SECTION a.

2-158 cont.

CAUTION: IF "CYCLE BRAKING METHOD" HAS BEEN USED PRIOR TO STOP, A BRAKE PIPE REDUCTION OF SUFFICIENT AMOUNT MUST BE MADE TO OVERCOME ANY FALSE TAPER CONDITION IN EFFECT AS A RESULT OF A PREVIOUS BRAKE APPLICATION. REFER TO SECTION c. (4), PAGE 2-135.

4. USE OF RETAINERS

UNDER NORMAL OPERATION, THE USE OF RETAINERS IS NOT REQUIRED IF THE TRAIN SPEED CAN BE CONTROLLED WITH OR WITHOUT DYNAMIC BRAKE AND/OR PRESSURE MAINTAINING FEATURES. RETAINERS WILL BE USED WHEN SPECIFIED BY CARRIER INSTRUCTIONS. THIS WILL GENERALLY BE WHEN THE AMOUNT OF TOTAL BRAKE PIPE REDUCTION EXCEEDS THOSE VALUES OUTLINED IN GUIDELINES 2-145 AND 2-147.

WHEN IT IS NECESSARY TO SET RETAINERS, A STOP SHOULD BE MADE IMMEDIATELY AND THE REQUIRED NUMBER OF RETAINERS AND/OR HAND BRAKES SET. SEE FIGURES 31 AND 32, PAGES 2-138 AND 2-139. THE BRAKE SYSTEM MUST BE RECHARGED BEFORE PROCEEDING.

2-159

WHEN RETAINERS ARE USED THEY WILL BE APPLIED TO CARS BEGINNING AT THE HEAD END AND IN A BLOCK OF NOT LESS THAN TEN CARS. ON CARS EQUIPPED WITH DOUBLE PRESSURE RETAINING VALVES, THE HANDLES MUST BE TURNED TO HIGH PRESSURE (HP) POSITION ON LOADED CARS, AND LOW PRESSURE (LP) OR SLOW DIRECT EXHAUST (SD) POSITION ON EMPTY CARS OR LIGHT LOADS.

SHOULD WHEELS SHOW A TENDENCY TO OVERHEAT RETAINERS SHOULD BE ALTERNATED.

RETAINERS MUST BE "TURNED DOWN" TO AN EXHAUST POSITION AT THE BOTTOM OF A GRADE OR WHEEL DAMAGE MAY RESULT. IT IS THE TRAINMAN'S RESPONSIBILITY TO SEE THAT RETAINING VALVES ARE PROPERLY POSITIONED ON CARS ADDED TO A TRAIN EN ROUTE.

THE GRAPH ON PG. 2-138 (FIGURE 31) IS SUGGESTED AS A GUIDE TO THE SETTING OF THE REQUIRED MINIMUM NUMBER OF RETAINERS FOR NEGOTIATION OF VARIOUS GRADES, WHEN DYNAMIC BRAKE IS NOT AVAILABLE IN A LOCOMOTIVE CONSIST.

NOTE: THE ACTUAL NUMBER OF RETAINERS REQUIRED TO BE SET MAY BE IN EXCESS OF THE AMOUNT SHOWN ON THE CURVE, DEPENDENT ON LOCAL CONDITIONS AND AT THE DISCRETION OF THE INDIVIDUAL CARRIER.

2-159 cont.

SEVERAL AAR MEMBER RAILROADS UTILIZE THE TONNAGE VS. PERCENT OF GRADE VALUES LISTED IN THE GRAPH ON PG. 2-139 (FIGURE 32) AS A GUIDE TO ASCERTAIN WHETHER THE SETTING OF RETAINERS IS REQUIRED WHEN DYNAMIC BRAKING IS AVAILABLE.

IF IT HAS BEEN DETERMINED FROM FIGURE 32 THAT RETAINERS ARE REQUIRED, A VARIETY OF APPROACHES ARE USED BY MEMBER RAILROADS WHEN DYNAMIC BRAKE IS AVAILABLE TO DETERMINE THE REQUIRED NUMBER OF RETAINERS TO BE SET, TWO TYPICAL EXAMPLES ARE:

1. BEGINNING AT THE HEAD END OF A TRAIN SET TEN RETAINERS PLUS ONE RETAINER FOR EACH ADDITIONAL 50 TONS PER UNIT IN EXCESS OF THAT ILLUSTRATED ON FIGURE 32. IF DYNAMIC BRAKE IS INOPERATIVE, RETAINERS WILL BE USED ON ALL CARS OR AS OUTLINED IN FIGURE 31.
2. BEGINNING AT THE HEAD END OF A TRAIN RETAINERS WILL BE TURNED UP SOLID ON ALL CARS FOR TONNAGE IN EXCESS OF THAT WHICH FALLS ABOVE THE CURVES.

THE FOLLOWING PRECAUTIONS SHOULD BE ADHERED TO WHEN OPERATING TRAINS WITH MANNED HELPER LOCOMOTIVES:

1. WHEN MORE THAN ONE LOCOMOTIVE IS USED TO HANDLE A TRAIN, THE AIR BRAKES MUST BE OPERATED FROM THE LEADING LOCOMOTIVE IN THE DIRECTION OF MOVEMENT. ALL OTHER MOTIVE POWER UNITS IN THE TRAIN MUST HAVE THE BRAKE PIPE CUTOUT COCK CLOSED AND THE BRAKE VALVE HANDLES KEPT IN THE PRESCRIBED POSITION.
2. WITH A HELPER LOCOMOTIVE ENTRAINED TOWARDS THE REAR, THE HELPER ENGINEER SHOULD WATCH THE LOAD METER CLOSELY AND BE READY TO REDUCE THROTTLE IF AMPERAGE INCREASES AS THE TRAIN SLOWS DOWN, ESPECIALLY WHEN A STOP IS BEING MADE. THE INDEPENDENT BRAKE ON THE HELPER SHOULD BE APPLIED IMMEDIATELY UPON STOPPING TO PREVENT THE REAR OF THE TRAIN FROM ROLLING BACK WHEN TRAIN BRAKES ARE RELEASED.

(2-160)

3. LOCOMOTIVE ENGINEERS ON THE LEAD AND HELPER LOCOMOTIVES SHOULD COMPARE SPEEDOMETER READINGS AT THE FIRST OPPORTUNITY.
4. WHEN DYNAMIC BRAKE IS USED ON BOTH THE LEAD AND HELPER LOCOMOTIVES, THE HELPER ENGINEER SHOULD MAINTAIN A CONSTANT DYNAMIC BRAKING FORCE WITH THE LEAD ENGINEER CONTROLLING THE SPEED BY VARYING THE DYNAMIC BRAKE AND BY MAKING A SUFFICIENT AUTOMATIC BRAKE APPLICATION TO ALLOW THE LEAD DYNAMIC BRAKE TO BE VARIED BETWEEN ½ and 3/4 MAXIMUM DYNAMIC TO BALANCE THE GRADE.

2.2.4 CRESTING GRADE TERRITORY

STARTING

THERE ARE NO SPECIAL CONSIDERATIONS WHICH MUST BE EMPHASIZED FOR STARTING ON CRESTING GRADES EXCEPT FOR THOSE WHICH APPLY TO ASCENDING AND DESCENDING GRADE AS OUTLINED IN SECTIONS 2.2.2. AND 2.2.3. PAGES 2-115 AND 2-125. HOWEVER, EXTREME CARE SHOULD BE EXERCISED WHILE ADVANCING THE THROTTLE FOR STARTING TO AVOID EXCESSIVE STRESS IN THE COUPLERS AT THE SUMMIT OF CRESTING GRADES. THE LOAD METER SHOULD BE MONITORED CONSTANTLY AND THE THROTTLE ADVANCED ONLY AS THE AMPERAGE FALLS TO A MODERATE LEVEL.

(2-161)

NEGOTIATING

IN ORDER TO PROPERLY CONTROL A TRAIN OVER EACH CRESTING GRADE LOCATION, PRIOR TO ENTERING THIS TYPE OF TERRITORY THE LOCOMOTIVE ENGINEER MUST BE AWARE OF THE CHARACTERISTICS OF THE TERRAIN FOLLOWING THE SUMMIT.

(2-162)

1. AS THE LOCOMOTIVE REACHES THE SUMMIT THE LOCOMOTIVE ENGINEER SHOULD ATTEMPT TO MAINTAIN SPEED BY REDUCING THE THROTTLE ONE OR TWO NOTCHES AS FEASIBLE TO RELIEVE STRESS ON THE COUPLERS OF THE CARS AT THE CREST OF THE GRADE.
2. AFTER STARTING THE DESCENT, BUT WHILE STILL PULLING THE TRAIN OVER THE CREST, THE LOCOMOTIVE ENGINEER MUST DECIDE (BASED ON THE TERRAIN CHARACTERISTICS OF THE DESCENDING GRADE WHICH WERE PREVIOUSLY SUPPLIED, FEEL AND MAKEUP OF THE TRAIN, AND PAST EXPERIENCE) WHAT SUBSEQUENT PROCEDURES WILL BE UTILIZED:
   a. IF THE GRADE FOLLOWING THE SUMMIT IS HEAVY GRADE TERRITORY (GREATER THAN APPROXIMATELY 1.5%), AFTER APPROXIMATELY ONE-HALF OF THE TRAIN HAS CRESTED OVER THE SUMMIT, THE DYNAMIC BRAKE, IF AVAILABLE AND CONDITIONS PERMIT, SHOULD BE SET UP AND USED AS DESCRIBED IN THE "DYNAMIC BRAKE METHOD" SECTION 2.2.3.C., PAGE 2-132, OR THE "PRESSURE MAINTAINING METHOD" OR "CYCLE BRAKING METHOD" AS OUTLINED IN SECTION 2.2.3.C., PAGES 2-133 and 2-134, SHOULD BE INITIATED TO SUPPLEMENT THE DYNAMIC BRAKE APPLICATION AS REQUIRED.

2-162 cont.

   b. IF THE GRADE FOLLOWING THE SUMMIT IS LESS THAN 1.5% THROTTLE MODULATION SHOULD BE ADEQUATE TO CONTROL THE TRAIN. HOWEVER, IF SPEED DOES BECOME EXCESSIVE AND ADDITIONAL RETARDATION IS REQUIRED A SLOWDOWN SHOULD BE ACCOMPLISHED IN ACCORDANCE WITH SECTION 2.2.2., PAGES 2-121 AND 2-122.

STOPPING

IF FEASIBLE TO DO SO, AVOID STOPPING ON CRESTING GRADES. TO ACCOMPLISH THIS, PRE-KNOWLEDGE OF THE LOCATION OF ALL CRESTING GRADES IS REQUIRED OF THE LOCOMOTIVE ENGINEER. A STOP ON A CRESTING GRADE CAN LEAD TO EXCESSIVE DRAWBAR FORCES WHILE ATTEMPTING TO RESTART THE TRAIN, ESPECIALLY WHEN NEGOTIATING THIS TERRITORY WITH A TRAIN OF SUCH TRAILING TONNAGE THAT IT IS BEING OPERATED AT THE DRAWBAR LIMIT.

2-163

HOWEVER, IF A STOP MUST BE ACCOMPLISHED, DO SO IN ACCORDANCE WITH THE STOPPING PROCEDURES AS OUTLINED IN SECTION 2.2.2., PAGES 2-122 AND 2-123, AND SECTION 2.2.3., PAGES 2-135 AND 2-136, FOR LIGHT AND HEAVY GRADE TERRITORIES.

RCE-1 AND MANNED HELPER CONSIDERATIONS

THE FOLLOWING CONSIDERATIONS SHOULD BE OBSERVED WHEN OPERATING TRAINS WITH RCE-1 OR HELPERS AT THE REAR OF A TRAIN ON CRESTING GRADE:

STARTING - ONLY THE REMOTE OR HELPER POWER SHOULD BE USED TO START A TRAIN ON THE CREST OF A GRADE, IF AT ALL POSSIBLE. HEAD END RUN-OUT OF SLACK SHOULD BE AVOIDED BY USE OF INDEPENDENT AIR BRAKE WITH THE DYNAMIC BRAKE IN OPERATING POSITION.

NEGOTIATING - GENERALLY BOTH THE LEAD AND REAR LOCOMOTIVE CONSISTS WILL BE OPERATING IN POWER APPROACHING A CREST OF GRADE. IF DYNAMIC BRAKE IS AVAILABLE AND THE RCE-1 TRAIN IS EQUIPPED WITH INDEPENDENT MOTORING, THE FOLLOWING PROCEDURE CAN BE USED TO NEGOTIATE THE CREST:

1. REDUCE POWER ON THE LEAD CONSIST AS IT TOPS THE SUMMIT LEAVING THE REAR CONSIST IN POWER AND GRADUALLY SET UP THE DYNAMIC BRAKE ON THE LEAD CONSIST AS SPECIFIED IN SECTION 2.1.2.4, PAGE 2-49. THE DYNAMIC BRAKE SHOULD BE INCREASED TO MAXIMUM AS NEEDED TO CONTROL SPEED.
   NOTE: IF LONG OVERHANG CARS ARE LOCATED AT THE HEAD END OF THE TRAIN, CONSIDERATION SHOULD BE GIVEN TO LIMITING THE AMOUNT OF DYNAMIC BRAKING TO BE USED.

(2-164)

2. MAKE A MINIMUM BRAKE PIPE REDUCTION WHEN APPROXIMATELY ONE-HALF OF THE TRAIN HAS NEGOTIATED THE CREST IF IT IS ANTICIPATED TRAIN BRAKES WILL BE REQUIRED ON THE DESCENDING GRADE OR IF REQUIRED TO FURTHER CONTROL THE SPEED OF THE TRAIN.
   NOTE: FURTHER REDUCTIONS CAN BE MADE IF NECESSARY TO FURTHER CONTROL SPEED. HOWEVER, CONSIDERATION SHOULD BE GIVEN TO THE ANTICIPATED AMOUNT OF TRAIN AIR BRAKING WHICH, WHEN COMBINED WITH 1/2 TO 3/4 DYNAMIC BRAKE ON THE LEAD CONSIST AND FULL DYNAMIC BRAKE ON THE REAR CONSIST, WILL BALANCE THE DESCENDING GRADE.
3. REDUCE POWER ON THE REAR CONSIST (REMOTE OR HELPER) AS IT TOPS THE SUMMIT AND GRADUALLY SET-UP THE DYNAMIC BRAKE AS SPECIFIED IN SECTION 1.2.2., PAGE 1-41.
4. GRADUALLY INCREASE THE DYNAMIC BRAKING FORCE TO MAXIMUM ON THE REAR CONSIST AND VARY DYNAMIC BRAKING FORCE ON THE LEAD CONSIST TO MAINTAIN BALANCED SPEED.

CAUTION: THE CONSIDERATIONS FOR HEAVY GRADE TERRITORY AS OUTLINED IN SECTION 2.2.3. MAY ALSO BE APPLICABLE TO "CRESTING" GRADE.

2.2.5. NEGOTIATING HUMP, KNOLL, OR "HOGBACK" TERRITORY

STARTING

THERE ARE NO SPECIAL CONSIDERATIONS TO BE GIVEN FOR STARTING IN HUMP OR KNOLL TERRITORY (CASE A,B,C) EXCEPT THOSE WHICH APPLY TO GRADE CONDITIONS (CASE A,C REFER TO SECTIONS 2.2.1., 2.2.2., 2.2.3.).

NEGOTIATING

WHEN NEGOTIATING HUMP, KNOLL OR "HOGBACK" TERRITORY, SLACK ACTION AND RUN-IN FORCES CAN OFTEN BE REDUCED BY THE FOLLOWING THROTTLE MODULATION:

1. AS THE LOCOMOTIVE STARTS UP THE HUMP, INCREASE THE THROTTLE SETTING, IF POSSIBLE, TO AVOID BUNCHING THE SLACK AT THE HEAD END, AND MAINTAIN THIS STRETCHED CONDITION UNTIL THE LOCOMOTIVE REACHES THE CREST OF THE HUMP. USUALLY SOME BUNCHING WILL TAKE PLACE.
2. AS THE LOCOMOTIVE PASSES THE HUMP AND STARTS TO PICK UP SPEED THE SLACK WILL TEND TO STRETCH OUT. KEEP THE SLACK ACTION TO A MINIMUM BY REDUCING THE THROTTLE TO KEEP THE SPEED CONSTANT.

(2-165)

3. KEEP THE SLACK ACTION TO A MINIMUM BY PROPER THROTTLE MANIPULATION. THIS CAN BE ACCOMPLISHED BY EITHER REDUCING THE THROTTLE WHEN HEAVY CARS ARE LOCATED AT THE REAR OR BY ADVANCING THE THROTTLE WITH LIGHTER CARS AT THE REAR OR TRAINS CONSISTING OF UNIFORM WEIGHT AT THE REAR. THIS SHOULD BE ACCOMPLISHED AS THE REAR OF THE TRAIN PASSES THE SUMMIT.

STOPPING

IF A STOP IS TO BE MADE ON A HUMP OR KNOLL, CONSIDERATION SHOULD BE GIVEN FOR THE DECELERATION (OR SLACK CLOSING) CREATED AS THE TRAIN ASCENDS THE HUMP WHICH WILL INCREASE THE "SLACK-CLOSING" EFFECT OF THE BRAKE APPLICATION. THE "SLACK STRETCHED" METHOD OF BRAKING AS DESCRIBED IN SECTION 2.1.2.2., PAGE 2-22 SHOULD BE USED FOR STOPPING TO AVOID THE HARSH BUNCHING OF SLACK ON HUMP OR KNOLL TERRITORY.

2.2.6. NEGOTIATING SAG OR DIP TERRITORY

NEGOTIATING

IN ORDER TO CONTROL SLACK WHEN MOVING THROUGH SAGS, THE TRAIN SPEED MUST BE ALLOWED TO REDUCE BEFORE THE TRAIN MOVES INTO THE SAG AND "THROTTLE MODULATION" USED TO NEGOTIATE THE TERRITORY. THIS IS ACCOMPLISHED BY REDUCING THE THROTTLE BEFORE APPROACHING SUCH AREAS. THE AMOUNT OF SPEED REDUCTION DEPENDS PRIMARILY ON THE LENGTH AND GRADIENTS OF THE SAG. IN CASES OF LONG SAGS AND HEAVY GRADES, THIS SPEED REDUCTION MAY BE AS GREAT AS 15 TO 20 MPH.

(2-166)

NORMALLY, SAG OR DIP TERRITORY DOES NOT PERMIT UTILIZATION OF THE DYNAMIC BRAKE.

"THROTTLE MODULATION" METHOD: (USUAL CASE)

1. REDUCE THE TRAIN SPEED WHEN APPROACHING THE SAG BY REDUCING THE THROTTLE. PAST EXPERIENCE SHOULD INDICATE THE AMOUNT THAT SPEED SHOULD BE ALLOWED TO REDUCE TO OPERATE THROUGH A GIVEN SAG WITHOUT EXCEEDING THE MAXIMUM AUTHORIZED SPEED.
2. CONTINUE TO REDUCE THE THROTTLE TO PREVENT SPEED INCREASE AS THE HEAD PORTION OF THE TRAIN BEGINS DESCENDING ONTO THE SAG.

2-166 cont.

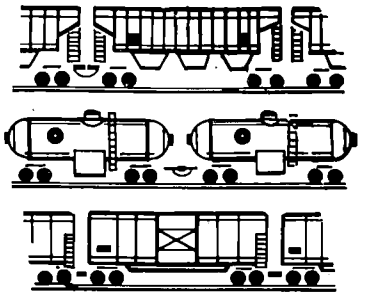
3. JUST BEFORE THE HEAD PORTION OF THE TRAIN REACHES THE ASCENDING GRADE, BEGIN TO ADVANCE THE THROTTLE GRADUALLY.
4. CONTINUE TO ADVANCE THE THROTTLE ONE NOTCH AT A TIME UNTIL THE REAR PORTION APPROACHES THE BASE OF THE SAG. THIS SHOULD RESULT IN THE TRAIN ACCELERATING AND THEREBY PREVENT A HEAVY SLACK RUN-IN FROM THE REAR OF THE TRAIN.
5. REDUCE POWER AS THE REAR PORTION STARTS ON THE ASCENDING GRADE OUT OF THE SAG THEREBY PERMITTING SLACK TO ADJUST GRADUALLY.

2.2.7. CURVATURE CONSIDERATIONS

(2-167) IF CONDITIONS PERMIT, SPEED CHANGES AS A RESULT OF THROTTLE MANIPULATION OR DYNAMIC OR AIR BRAKE APPLICATION SHOULD NOT BE MADE WITHIN, NEAR THE BEGINNING OR END OF ANY CURVE IN EXCESS OF 2 DEGREES. THE SPEED MUST BE REDUCED TO THE AUTHORIZED SPEED OR LOWER BEFORE THE LOCOMOTIVE ENTERS THE RESTRICTED SPEED ZONE.

(2-168) WHERE PRACTICAL, TRAIN SPEED AND BRAKE OPERATION SHOULD BE PLANNED SO THAT MAXIMUM OR HEAVY DYNAMIC BRAKING IS NOT USED WHEN NEGOTIATING CURVES GREATER THAN 2 DEGREES.

(2-169) TO REDUCE THE PROBABILITY OF "STRINGLINING" OF CARS WHEN OPERATING LONG TRAINS WITH 18 POWERED AXLES OR MORE OVER CURVATURE GREATER THAN 4 DEGREES AT SPEEDS OF LESS THAN 25 MPH, NO MORE THROTTLE SHOULD BE USED THAN IS ABSOLUTELY NECESSARY TO ADVANCE THE TRAIN AROUND THE CURVE.



TRAIN MAKEUP

SECTION - 3

SPECIAL NOTE

Decisions to put into practice many of the technically desirable guidelines on train makeup will be governed by cost/benefit considerations. However, the economic benefits to be derived from these guidelines have not yet been established. They are difficult to assess, since they encompass savings from reductions in derailments and damage to equipment, track and lading. All of these reductions can be affected by many factors other than train makeup.

Furthermore, the added costs of extra switching and of changes in operations necessary to achieve dynamically idealized train makeup are not known. These costs could be high, especially in periods of peak traffic demand.

In the absence of these economic facts, railroads can be expected to use these guidelines sparingly.

The most unstable consists are already being avoided by many companies as a result of their own earlier dynamic studies. In addition, train handling practices have been instituted by various railroads to avoid unstable train action when practical operating requirements necessitate handling suspected problem consists.

As these guidelines become more generally understood throughout the industry and their economic consequences more completely established, a gradual approach toward more stable consists can be expected. Furthermore, research in other areas of the Track-Train Dynamics Program will increase understanding and develop methods of improving train stability. With the guidelines presented in this report, problem consists will soon be identified by all railroads and their train handling practices modified to improve the effectiveness of their movement.

TRAIN MAKE-UP

SUMMARIZATION OF GUIDELINES

3. INTRODUCTION

3-1 BECAUSE MORE CARS THAT ARE PRONE TO ADVERSE DYNAMIC BEHAVIOR ARE BEING OPERATED IN TRAINS, CONSIDERATION MUST BE GIVEN TO TRACK-TRAIN DYNAMICS PROBLEMS. THE SOLUTION TO THESE PROBLEMS MAY IN SOME CASES BE INCONSISTENT WITH DESTINATION BLOCKING.

3.2.1 GROSS WEIGHT (HEAVY CAR VERSUS LIGHT CAR)

3-2 THE IDEAL TRAIN MAKE-UP TO REDUCE THE PROBABILITY OF UNDESIRABLE TRACK-TRAIN DYNAMIC PROBLEMS IS THE PLACEMENT OF THE HEAVY CARS CLOSEST TO THE MOTIVE POWER (REGARDLESS OF LOCATION) AND THE LIGHTER CARS FARTHEST FROM THE MOTIVE POWER.

3.2.1.1 DRAWBAR FORCES IN TRAINS

3-3 A GOOD PRACTICE IS TO LIMIT THE DRAWBAR FORCES IN A TRAIN TO 250,000 LBS. IN EITHER DRAFT OR BUFF.

3.2.2 LATERAL FORCES

3-4 IT IS HIGHLY DESIRABLE TO PLACE THE HEAVIEST CARS NEAREST THE MOTIVE POWER SO THAT THE L/V RATIOS ARE MAINTAINED WITHIN ACCEPTABLE LIMITS.

3.2.3 CAR WEIGHT BLOCKS

3-5 TRAINS USING THE 'CAR-WEIGHT BLOCK' METHOD, OPERATING WITH SAME OR MODERATELY HEAVIER TONNAGE, ARE LESS LIKELY TO EXCEED THE DYNAMIC LIMITATIONS OF EQUIPMENT AND TRACK.

3-6 ANOTHER METHOD OF TRAIN MAKE-UP FOR SEVERAL DESTINATION BLOCKS INVOLVES THE CALCULATION OF THE AVERAGE WEIGHT OF THE CARS IN EACH BLOCK (BLOCK TONNAGE DIVIDED BY THE NUMBER OF CARS). BLOCKS WOULD THEN BE MADE UP SO THAT THE HEAVIER DESTINATION BLOCKS (AVERAGE WEIGHT/CAR) ARE CLOSEST TO THE MOTIVE POWER AND THE LIGHTEST DESTINATION BLOCKS (AVERAGE WEIGHT/CAR) ARE FARTHEST FROM THE MOTIVE POWER. CAUTION: IT MUST BE REMEMBERED THAT THE LIGHT CAR AND THE LONG-SHORT CAR COMBINATION IN THE HEAVIER (AVERAGE WEIGHT/CAR) BLOCK MUST BE CONSIDERED INDIVIDUALLY WHEN HIGH DRAWBAR FORCES OCCUR IN THE TRAIN.

3.2.4 LONG CAR - SHORT CAR COMBINATIONS

(3-7) THOSE WHO ARE RESPONSIBLE FOR THE MAKE-UP OF TRAINS SHOULD BE AWARE THAT HIGH L/V RATIOS CAN BE DEVELOPED WHEN CARS OF 85 FEET OR LONGER ARE COUPLED WITH CARS OF LESS THAN 50 FEET IN LENGTH.

3.2.5 DYNAMICALLY UNSTABLE CARS

(3-8) TO AVOID ROCK-AND-ROLL, OPERATE TRAINS AT SPEEDS OUTSIDE THE 10 MPH - 25 MPH RANGE. WHEN PASSING THROUGH THIS SPEED RANGE, DO SO IN THE SHORTEST POSSIBLE TIME. ESPECIALLY AVOID THIS CRITICAL SPEED RANGE WHILE NEGOTIATING CURVES. CARS NEED NOT BE RESTRICTED TO ANY PARTICULAR IN-TRAIN LOCATION BECAUSE OF THESE TENDENCIES.

(3-9) IN-TRAIN PLACEMENT OF CARS WITH VERTICAL BOUNCE TENDENCIES IS NOT RESTRICTIVE. VERTICAL BOUNCE CAN BE DIMINISHED BY OPERATING TRAINS AT SPEEDS THAT DO NOT ENCOURAGE VERTICAL BOUNCE, OR BY HANDLING CARS WITH VERTICAL BOUNCE TENDENCIES IN TRAINS AT SLOWER SPEEDS.

(3-10) IN-TRAIN PLACEMENT OF CARS WITH TRUCK HUNTING TENDENCIES IS NOT RESTRICTIVE. TRUCK HUNTING CAN BE DIMINISHED BY OPERATING TRAINS AT SPEEDS THAT DO NOT ENCOURAGE TRUCK HUNTING, OR BY HANDLING CARS WITH TRUCK HUNTING TENDENCIES IN TRAINS AT SLOWER SPEEDS.

3.2.6 SPECIAL TYPE EQUIPMENT

(3-11) INFORMATION AND DIMENSIONS PERTAINING TO HIGH-WIDE AND HEAVY LOADS MUST BE FURNISHED TO THOSE WHO ARE RESPONSIBLE FOR MOVING THOSE LOADS.

(3-12) WHEN LOADED SCHNABEL CARS SHOULD BE PLACED AS CLOSE TO THE LOCOMOTIVE UNITS AS PRACTICAL, AND WHEN EMPTY THEY SHOULD BE PLACED AS CLOSE AS POSSIBLE TO THE CABOOSE. WHETHER LOADED OR EMPTY, SCHNABEL CARS MUST NOT BE SWITCHED IF DETACHED FROM THE MOTIVE POWER. OTHER CARS MUST NOT BE SWITCHED AGAINST THIS EQUIPMENT OR A LOAD OF CARS CONTAINING THIS EQUIPMENT. WHEN LOADED, SCHNABEL CARS MUST BE ACCOMPANIED BY ENOUGH ADDITIONAL CARS TO PROVIDE SUFFICIENT BRAKING POWER. BRAKING CARS SHOULD BE PLACED AT EACH END OF THE SCHNABEL CAR.

(3-13) WHEN EMPTY, A SCHNABEL CAR MUST BE PROPERLY LOCKED TOGETHER AND SECURED.

3-14 CONTINUOUS RAIL EQUIPMENT (BOTH LOADED AND EMPTY) MUST BE HANDLED AS A UNIT WITH THE AIR BRAKES CUT IN AND OPERATIVE, MUST NOT BE HUMPED OR CUT OFF WHILE IN MOTION, MUST NOT BE SWITCHED WITH OTHER CARS AND OTHER CARS MUST NOT BE KICKED OR DROPPED AGAINST THESE CARS OR INTO A GROUP OF CARS CONTAINING THESE CARS.

3-15 CRANES AND OTHER EQUIPMENT WITH BOOMS OR WINGS MUST BE HANDLED WITH BOOMS OR WINGS TRAILING DURING TRANSIT.

3-16 FOUR-WHEELED SCALE TEST CARS SHOULD BE MOVED ON THE REAR END OF THE TRAIN AHEAD OF THE CABOOSE.

3.3.2 BRAKE PIPE LEAKAGE AS AFFECTED BY TEMPERATURE

3-17 THE ALLOWABLE BRAKE PIPE LEAKAGE MUST NOT EXCEED 5 PSI PER MINUTE.

3-18 IN SUB-FREEZING WEATHER, THE TRAIN LENGTH SHOULD BE REDUCED TO COMPENSATE FOR THE INCREASED LEAKAGE RATE, AS SHOWN IN FIGURE 16, ILLUSTRATING THE EFFECTS OF TEMPERATURE ON THE MAXIMUM TRAIN LENGTH (IN NUMBER OF CARS) FOR:

1. A STANDARD FREIGHT TRAIN
2. A FREIGHT TRAIN HAVING AN AIR REPEATER CAR
3. A FREIGHT TRAIN HAVING RCE-1 UNITS

3.3.3 DETERMINATION OF TRAIN LENGTH

3-19 APPROXIMATE TRAIN LENGTH SHOULD BE KNOWN BY THE CREW UPON LEAVING THE TERMINAL.

MOTIVE POWER

3-20 AMONG THE FACTORS THAT SHOULD BE CONSIDERED IN THE ASSIGNMENT OF LOCOMOTIVES TO A TRAIN ARE (1) TONNAGE, (2) THE PHYSICAL CHARACTERISTICS OF THE TERRITORY OVER WHICH THE TRAIN IS TO OPERATE, (3) THE SCHEDULE OF THE TRAIN, (4) THE TYPES OF CARS IN THE TRAIN, AND (5) THE OPERATING PHILOSOPHY OF THE INDIVIDUAL RAILROAD.

3.4.2 MULTIPLE UNIT COMPATIBILITY

3-21 THE IDEAL LOCOMOTIVE CONSIST WOULD INVOLVE THE UTILIZATION OF THE SAME MODEL OF LOCOMOTIVES OR LOCOMOTIVES EQUIPPED WITH COMPATIBLE AIR BRAKE EQUIPMENT, COMPATIBLE POWER RESPONSE, AND THE SAME GEAR RATIOS.

SPEED RATINGS OF INDIVIDUAL UNITS OF THE CONSIST MUST BE CHECKED TO BE SURE THAT THE TRAIN IS NOT OPERATED SO AS TO EXCEED THEIR LIMITING RATINGS, AS FOLLOWS: TRAIN SPEED MUST NOT BE LESS THAN THE

3-22

HIGHEST CONTINUOUS SPEED RATING TO PREVENT TRACTION MOTOR OVERHEATING NOR AT ANY TIME SHOULD IT EVER EXCEED THE LOWEST MAXIMUM SPEED RATING TO PREVENT CENTRIFUGAL DAMAGE TO THE TRACTION MOTOR ARMATURES.

TO REDUCE POTENTIAL JACKKNIFING TENDENCIES, UNITS WITHOUT EITHER ALIGNMENT CONTROL COUPLERS OR OTHER ANTI-JACKKNIFING DEVICES, OPERATED IN MULTIPLE,

3-23

SHOULD BE PLACED AT LEAST FOUR UNITS FROM THE CLOSEST CAR. TO REDUCE POTENTIAL JACKKNIFING TENDENCIES, SWITCHER-TYPE UNITS, GENERALLY EQUIPPED WITH SHORT WHEEL BASES, RIGID TRUCKS AND WIDE SWING COUPLERS SHOULD BE PLACED AT LEAST FOUR UNITS FROM THE CLOSEST CAR.

3.4.3 PLACEMENT

LOCOMOTIVES, EITHER LEAD OR HELPER, WITH OPERATIVE

3-24

DYNAMIC BRAKES SHOULD BE ASSIGNED TO TRAINS OPERATING OVER TERRITORIES WITH HEAVY DESCENDING GRADES TO AVOID STOPPING THE TRAIN TO SET THE RETAINERS.

IN MANNED HELPER TERRITORY ALL LOCOMOTIVE UNITS

3-25

SHOULD BE EQUIPPED WITH OPERABLE RADIOS TO PERMIT IN-TRAIN COMMUNICATIONS, AND EACH ENGINEER MUST ANTICIPATE WHAT ACTIONS ARE NECESSARY TO PROPERLY HANDLE THE TRAIN.

3-26

NORMALLY HELPERS PLACED AT THE REAR OF THE TRAIN SHOULD NOT HAVE MORE THAN 20 POWERED AXLES.

HELPER LOCOMOTIVES CUT INTO THE TRAIN SHOULD BE PROPER-

3-27

LY POSITIONED IN THE TRAIN SO THAT THE TRACTIVE EFFORT IS BEING UTILIZED TO PUSH ONE-THIRD AND TO PULL TWO-THIRDS OF THEIR RATED LOAD. LOCOMOTIVES SHOULD BE SEPARATED BY AT LEAST 20 CARS.

THE HELPER UNITS SHOULD BE PLACED IN THE TRAIN SO THAT

3-28

THE "NODE" WILL BE LOCATED WELL IN FRONT OF THE HELPER UNITS. THE SAME RESULT CAN BE ACCOMPLISHED BY REDUCING THE NUMBER OF UNITS ON THE HEAD-END AND INCREASING THE NUMBER OF HELPER UNITS.

GENERAL GUIDELINE FOR THE ASSIGNMENT OF RCE UNITS:

RCE LOCOMOTIVES ARE NORMALLY PLACED IN-TRAIN PRIOR TO DEPARTURE FROM ITS ORIGINATING TERMINAL AND ARE UTILIZED OVER ONE OR MORE SUBDIVISIONS. THIS TYPE (3-29) OF LOCOMOTIVE IS SO PLACED IN THE TRAIN TO REDUCE DRAWBAR FORCES, IMPROVE BRAKING AND THUS IMPROVE TRAIN HANDLING. IT IS IMPORTANT THAT RCE UNITS NOT BE PLACED SO FAR BEHIND THE LEAD LOCOMOTIVE THAT RADIO CONTINUITY IS IMPAIRED.

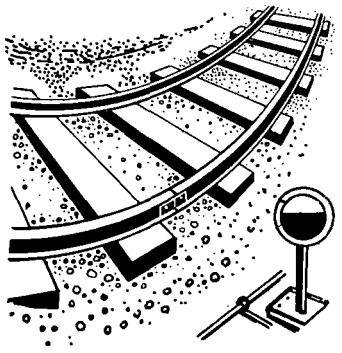
3.5.1 PRE-TRIP INFORMATION

SUGGESTED PRE-TRIP INFORMATION TO BE KNOWN BY THE CREW IS LISTED BELOW:

1. NUMBER OF LOADS
2. NUMBER OF EMPTIES
3. TRAILING GROSS TONNAGE
4. AVERAGE TONS PER CAR
5. LENGTH OF TRAIN
6. LOCATION OF LARGE BLOCKS OF LOADS
7. LOCATION OF LARGE BLOCKS OF EMPTIES (3-30)
8. LOCATION OF HAZARDOUS MATERIALS
9. LOCATION OF HIGH/WIDE OR HEAVY LOADS
10. PRESENCE OF RESTRICTED CARS
11. LOCATION OF REMOTE-CONTROL UNITS OR HELPERS
12. LOCATION OF 80 FOOT (OR LONGER) LIGHT CARS
13. LOCATION OF LONG CAR/SHORT CAR COMBINATIONS
14. LOCATION OF WORK EQUIPMENT

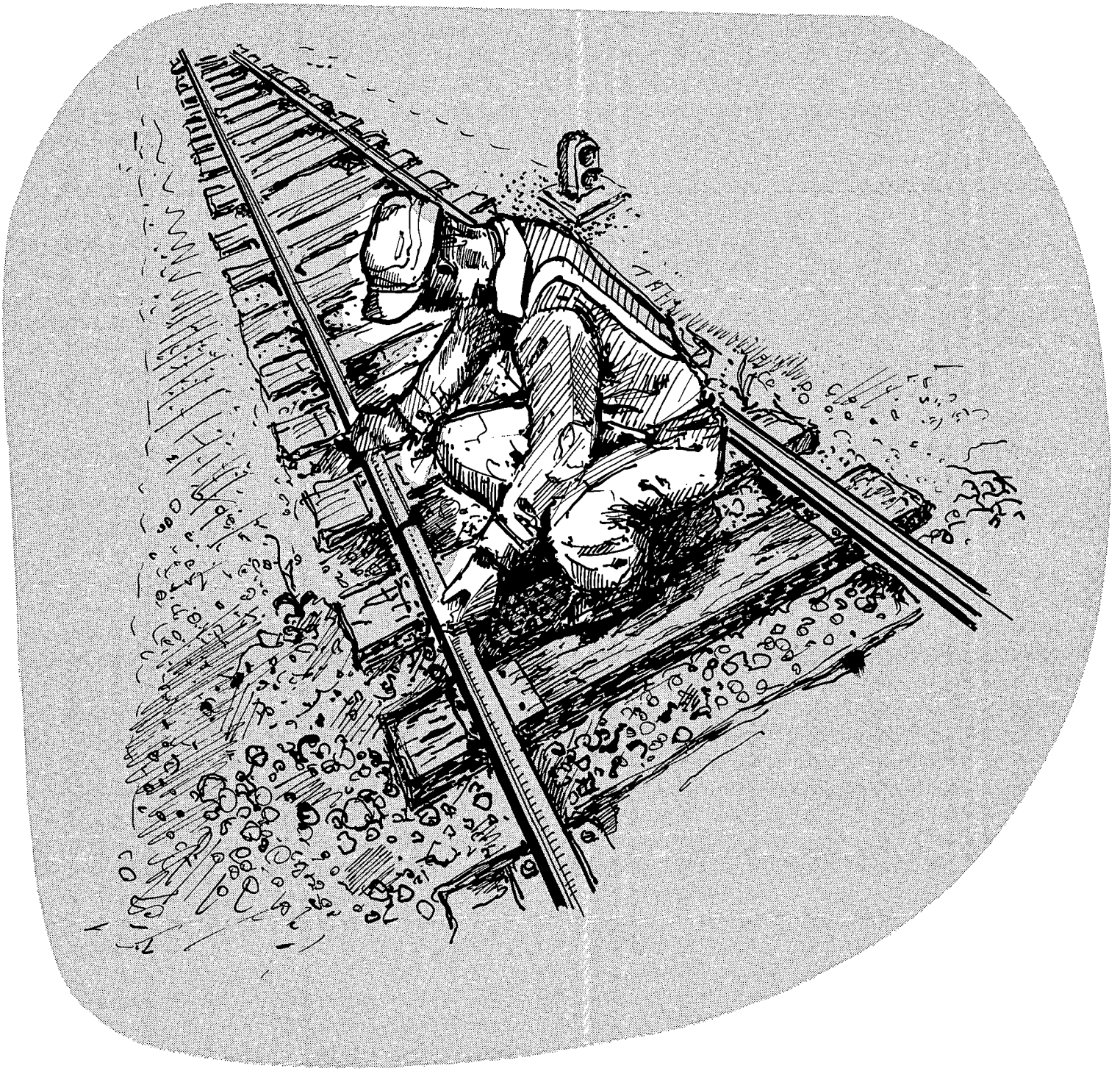
3.6 HAZARDOUS MATERIALS

IN LOCATING HAZARDOUS MATERIALS CARS IN A TRAIN, THEY MUST BE PLACED WHERE REGULATIONS GOVERNING HAZARDOUS MATERIALS PERMIT. IT IS IMPORTANT THAT (3-31) ALL OPERATING EMPLOYEES MUST BE AWARE OF THE REQUIREMENTS OF TRAIN MAKE-UP CONCERNING HAZARDOUS MATERIALS.



TRACK & STRUCTURE

SECTION - 4



TRACK AND STRUCTURES CONSIDERATIONS

SUMMARIZATION OF GUIDELINES

4.1 DYNAMIC FORCES ON RAIL

(4-1) SPECIAL LINES OF COMMUNICATION WITHIN THE COMPANY SHOULD BE ESTABLISHED SO THE PROBLEMS RELATING TO THE TRACK, THE EQUIPMENT, AND THE TRAIN HANDLING CAN BE MUTUALLY STUDIED AND EFFECTIVE SOLUTIONS IMPLEMENTED.

(4-2) THE LIMITS OF SPEED RESTRICTIONS MUST BE CAREFULLY SELECTED, CONSIDERING NOT ONLY THE SPECIFIC STRUCTURE OR SECTION OF TRACK TO BE PROTECTED BUT ALSO THE DIFFICULTY EXPERIENCED BY LOCOMOTIVE ENGINEERS IN CONTROLLING THE TRAIN AS IT APPROACHES THE RESTRICTION. IN ORDER TO ADEQUATELY PROTECT CURVES AND STRUCTURES PRIOR TO THE RESTRICTED AREA, IT MAY BE ADVISABLE TO EXTEND THE LIMITS OF THE RESTRICTION. SINCE ALL CARS IN THE TRAIN MUST BE BROUGHT THROUGH THE RESTRICTION SAFELY, THE CREW HAS THE RESPONSIBILITY TO OBSERVE THE SPEED RESTRICTION FOR THE ENTIRE LENGTH OF THEIR TRAIN UNLESS OTHERWISE SPECIFIED.

4.1.1.1 CURVES

(4-3) EQUIPMENT MUST NOT BE PERMITTED TO OPERATE ON CURVATURE GREATER THAN THAT FOR WHICH THE EQUIPMENT IS DESIGNED UNLESS INCREASES ARE MADE IN THE LATERAL FREEDOM OF AXLES OR GAGE OF THE TRACK. WHERE GAGE IS WIDENED APPROPRIATE RESTRAINTS ON OPERATING SPEED MUST BE IMPOSED.

(4-4) LIMITING CONDITIONS FOR VARIOUS 3-AXLE TRUCK LENGTHS ARE AS FOLLOWS:

Length of Truck Wheel Base	Standard Gage (4'-8½"), Standard Lateral Freedom Per Axle (3/8")	Standard Gage, With 1/2" Lateral Freedom Per Axle	4'-9" Gage, Standard Lateral Freedom Per Axle
11' - 6"	22°	25°	36°
13' - 6"	16°	18°	26°
15' - 6"	12°	14°	20°

(4-5) AVOID HEAVY FORCES TO START, DRAG OR ABRUPTLY INCREASE THE SPEED OF A TRAIN IN A CURVE, SINCE THE RESULTING "STRING LINE" EFFECT COULD SHIFT TRACK, TURN RAIL OVER OR OTHERWISE RESULT IN DERAILMENT.

(4-6) AVOID HEAVY BRAKING FORCES WHEN TRAINS ARE BEING SLOWED OR STOPPED ON CURVES SINCE THE TRACK MUST ABSORB ALL FORCES CREATED BY THE BRAKING ACTION.

4.1.1.1.A SUPERELEVATION

(4-7) WHERE PRACTICAL SUPERELEVATION SHALL BE PROVIDED FOR EQUILIBRIUM SPEED. OTHERWISE, IT IS RECOMMENDED THAT THE MAXIMUM SPEED OF THE 98" HIGH CENTER OF GRAVITY CARS (MAXIMUM HEIGHT CENTER OF GRAVITY ALLOWED IN FREE INTERCHANGE) BE RESTRICTED TO PROVIDE NO MORE THAN 2" UNBALANCE ELEVATION. A CURVE MUST NOT BE ELEVATED SO MUCH THAT UNLOADING OF THE HIGH RAIL MIGHT OCCUR AT VERY LOW SPEEDS OR WHEN STARTING. UNDER NO CIRCUMSTANCES SHALL SUPERELEVATION EXCEED 6", BUT IN MANY INSTANCES THE MAXIMUM ALLOWED MUST BE LESS THAN 6" DUE TO CURVATURE, ALLOWABLE CENTER OF GRAVITY OR OTHER FACTORS.

4.1.1.1.C REVERSE CURVES WITH INTERVENING TANGENT

(4-8) AN ADEQUATE LENGTH, AT LEAST THE MAXIMUM LENGTH OF ANY SINGLE CAR PERMITTED ON THE TRACK, OF TANGENT TRACK BETWEEN REVERSE CURVES SHOULD BE PROVIDED, OR SPEED REDUCED, TO ALLOW THE WHEELS AND TRUCKS OF A CAR TO RECOVER FROM THE ANGLE OF ATTACK ASSUMED IN NEGOTIATING THE FIRST CURVE AND RETURN TO A NORMAL POSITION PRIOR TO ENTERING THE SECOND CURVE.

4.1.1.2 TURNOUTS AND CROSSOVERS

(4-9) SAFE OPERATION THROUGH A TURNOUT REQUIRES ADHERENCE TO THE ALLOWABLE SPEED FOR WHICH THE TURNOUT WAS DESIGNED IF THE TRACK IS TO WITHSTAND THE HIGH LATERAL FORCES OF THE CAR AND AVOID WHEEL CLIMB OR WHEEL LIFT.

(4-10) PARTICULAR CARE MUST BE EXERCISED TO AVOID HIGH BUFF OR DRAFT FORCES WHILE NEGOTIATING A TURNOUT, AS THE HIGH LATERAL FORCES DEVELOPED BY THIS ACTION COULD EASILY CAUSE RAIL TURNOVER OR WHEEL CLIMB.

4-11 WHERE HIGH LATERAL FORCES ARE BEING EXERTED ON THE TRACK THROUGH TURNOUTS, HIGHER GUARD RAILS MAY BE EFFECTIVE IN PREVENTING WHEEL CLIMB.

4-12 THE LOCOMOTIVE ENGINEER SHOULD PLAN AHEAD WHEN APPROACHING TURNOUTS, ETC., SO THAT DURING THE TIME HIS ENTIRE TRAIN IS TRAVERSING THESE TRACK CONFIGURATIONS, HE CAN MINIMIZE SLACK ACTION.

4.1.1.3 GRADES

4-13 SPEED RESTRICTIONS ASSOCIATED WITH TRACK PROFILE SHOULD BE RE-EVALUATED AND UPDATED AS NECESSARY WHEN NEW EQUIPMENT IS INTRODUCED INTO SERVICE OR OPERATING PRACTICES CHANGED.

4.1.2 CONSIDERATIONS REGARDING PLACEMENT OF SPEED RESTRICTIONS

4-14 THE SIGNS USED TO ESTABLISH SPEED RESTRICTIONS MUST BE PLACED SO THEY CAN BE CLEARLY SEEN BY THE CREW AND THE TRAIN BROUGHT INTO CONFORMITY WITH THE RESTRICTION BEFORE ENTERING THE RESTRICTION.

4-15 WHERE PRACTICAL, SPEED RESTRICTIONS SHOULD BE PLACED SO THAT HEAVY BRAKING WILL NOT BEGIN IN A CURVE AND CREATE HIGH LATERAL FORCES IN THE EQUIPMENT AND ON THE TRACK.

4-16 THE LIMITS OF SLOW ORDERS MUST BE CAREFULLY ANALYZED TO ASSURE THAT THE LOCOMOTIVE ENGINEER CAN SAFELY CONTROL HIS TRAIN WITHOUT ADVERSELY AFFECTING TRACK AND STRUCTURES IN ADVANCE OF THE SPEED RESTRICTION.

4.1.2.1 ZONING OF SPEEDS

4-17 WHEN A SERIES OF RESTRICTIONS ARE CLOSE TOGETHER, IT IS ADVISABLE TO ESTABLISH A UNIFORM SPEED THROUGH THE ZONE RATHER THAN ATTEMPTING TO FLUCTUATE TRAIN SPEEDS UNNECESSARILY.

4.1.2.2 GRADUATED SPEEDS

4-18 IT MAY BE DESIRABLE TO ESTABLISH GRADUATED SPEED ZONES WHEN APPROACHING A SPEED RESTRICTION TO REDUCE EXCESSIVE LONGITUDINAL AND/OR LATERAL FORCES RATHER THAN RELYING SOLELY ON LOCOMOTIVE ENGINEERS' JUDGMENT TO INITIATE BRAKING AT THE PROPER LOCATIONS.

4.1.2.3 BRIDGES

4-19 SPEED RESTRICTIONS AND TRAIN HANDLING MUST BE CAREFULLY CONTROLLED OVER BRIDGES AND STRUCTURES.

4.1.2.4 SIGNAL SPACING

4-20 STOPPING DISTANCE USED IN CALCULATING SIGNAL SPACING AND LOCATION MUST RECOGNIZE THE MAXIMUM PERMISSIBLE TRAIN SPEED AND ALLOW ADEQUATE STOPPING DISTANCE BEFORE REACHING THE NEXT SIGNAL USING FULL SERVICE BRAKE APPLICATION.

4.2 SANDING

4-21 UNNECESSARY SANDING IS TO BE AVOIDED AS SAND PRESENTS MANY PROBLEMS TO MAINTENANCE FORCES.

4.3 TROUBLESOME EQUIPMENT

4-22 THE DESIGN OF NEW EQUIPMENT MUST BE CAREFULLY CHECKED FOR TRACK-TRAIN DYNAMICS PRIOR TO BEING PLACED IN SERVICE. IT IS FURTHER RECOMMENDED THAT MAINTENANCE OFFICERS BE CONSULTED PRIOR TO DEVELOPING PERFORMANCE SPECIFICATIONS FOR NEW EQUIPMENT TO AVOID THE POSSIBILITY OF GENERATING ELECTRICAL INTERFERENCE WITH EXISTING SIGNAL AND COMMUNICATIONS FACILITIES.

4.3.1 LOADS ON CARS

4-23 LOADS CARRIED ON A CAR SHOULD, WHEREVER POSSIBLE, BE EVENLY DISTRIBUTED OVER BOTH THE LENGTH AND THE WIDTH OF THE CAR. CARE MUST BE TAKEN TO SEE THAT LOADS ARE DISTRIBUTED EVENLY ON THE CAR AND THAT SHIFTING OF LOADS WHILE IN MOTION DOES NOT OCCUR.

4-24 AFTER PARTIAL UNLOADING CARS MOVED IN REGULAR FREIGHT SERVICE TO ANOTHER POINT FOR FURTHER UNLOADING MUST BE CAREFULLY INSPECTED TO AVOID POSSIBILITY OF AN ECCENTRIC LOAD CREATED BY THE PARTIAL UNLOADING.

4.3.2 HARMONIC ROLL

4-25 A GENERAL SOLUTION TO THE HARMONIC ROLL PROBLEM INVOLVES AN EXTENSIVE STUDY OF THE ENTIRE SYSTEM CONSISTING OF TRACK, SUSPENSION AND CAR BODY. BECAUSE THE PROBLEM IS OF IMMEDIATE CONCERN, CORRECTIVE MEASURES HAVE ALREADY BEEN INITIATED AS AN INTERIM SOLUTION FOR CONTROLLING HARMONIC ROLL. THESE ARE:

1. AVOIDING CRITICAL SPEED RANGE
2. INSTALLATION OF SUPPLEMENTAL SNUBBING DEVICES
3. UPGRADING OF JOINTED TRACK

ENGINEER EDUCATION

SECTION - 5

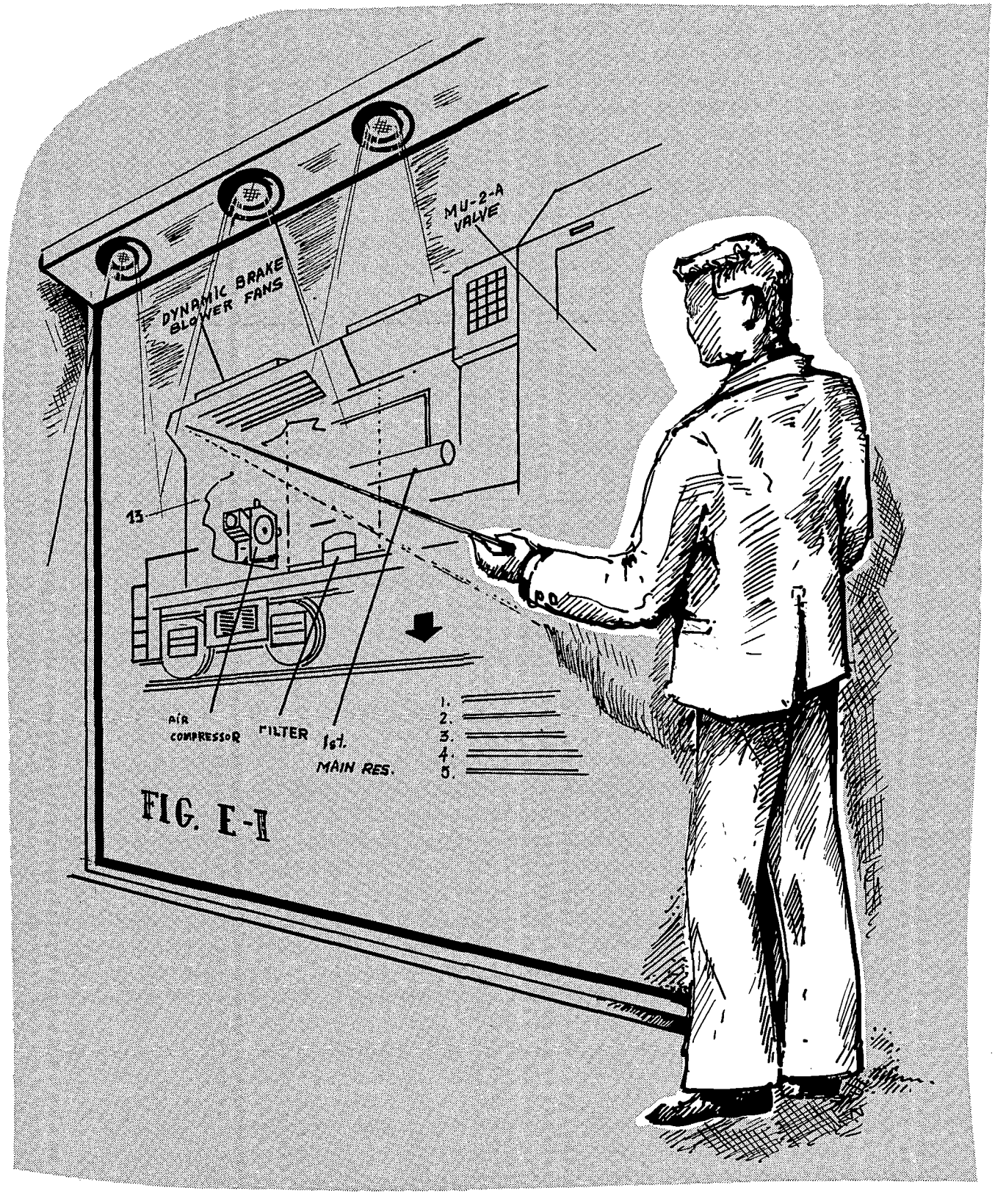


FIG. E-II

EDUCATION OF LOCOMOTIVE ENGINEERS

SUMMARIZATION OF GUIDELINES

5.2.1 GENERAL DISCUSSION

5-1 WHATEVER THE PROCESS BY WHICH LOCOMOTIVE ENGINEERS ON A PROPERTY ARE EDUCATED, THE MANY INDICATORS OF THEIR GENERAL COMPETENCE LEVEL SHOULD BE KEPT UNDER CONSTANT SCRUTINY.

5.2.2 OCCURRENCES OF WIDE GAUGE AND RAIL WEAR

5-2 THE COMPETENT TRACK SUPERVISOR WILL RECOGNIZE THAT THE CAUSE OF ABNORMAL OCCURRENCES OF WIDE GAUGE OR OF HEAVY RAIL WEAR OR DAMAGE MAY BE RELATED TO IMPROPER TRAIN SPEED OR EXCESSIVE SLACK ACTION. IF HE BELIEVES THIS TO BE THE CASE, HE SHOULD TAKE THE NECESSARY ACTION SO THAT THE MATTER IS BROUGHT TO THE ATTENTION OF THE APPROPRIATE TRANSPORTATION SUPERVISOR. IF AFTER SUITABLE INVESTIGATION THAT SUPERVISOR FINDS THAT IMPROPER SPEED OR EXCESSIVE TRAIN ACTION IS INDEED OCCURRING, HE WILL TAKE THE NECESSARY STEPS TO ELIMINATE IT.

5.2.3 INCREASE IN TRAIN LENGTH AND WEIGHT

5-3 THE NECESSARY LEVEL OF SKILL AND KNOWLEDGE TO ACHIEVE GOOD TRAIN HANDLING MAY INCREASE WITH A GROWTH IN LENGTH AND WEIGHT OF TRAIN. CARE IS NECESSARY TO ENSURE THAT SATISFACTORY AND WELL UNDERSTOOD PROCEDURES ARE BEING USED TO HANDLE TODAY'S FREIGHT TRAINS. THIS PROCESS MUST START WITH KNOWLEDGEABLE MONITORING OF PRESENT PRACTICES AND PROCEDURES, AND ADEQUATE EDUCATION OF THE LOCOMOTIVE ENGINEER.

5.2.4 DAMAGE TO LOCOMOTIVE AND CAR EQUIPMENT

5-4 CERTAIN TYPES OF DAMAGE TO LOCOMOTIVE AND CAR EQUIPMENT MAY BE INDICATORS OF INADEQUATE PERFORMANCE BY LOCOMOTIVE ENGINEERS AND OF A NEED FOR THE UPGRADING OF THEIR KNOWLEDGE AND SKILLS. TO TAKE ADVANTAGE OF THESE INDICATORS

IN ORDER TO REDUCE EQUIPMENT MAINTENANCE COSTS AND PERHAPS ALSO PERVENT OTHER OCCURRENCES SUCH AS TRACK DAMAGE OR DERAILMENT, PRUDENT RAILWAY MANAGEMENT WILL ENSURE:

1. THAT EQUIPMENT MAINTENANCE PERSONNEL CAN IDENTIFY THE PERTINENT TYPES OF DAMAGE AND THAT THEY ARE AWARE OF THE IMPORTANCE OF REPORTING THE OCCURRENCE OF SUCH DAMAGE.

(5-4)

2. THAT THERE EXISTS A WELL UNDERSTOOD AND EFFECTIVE SYSTEM FOR REPORTING SUCH DAMAGE.

3. THAT APPROPRIATE ENGINE SERVICE SUPERVISORY PERSONNEL BE ASSIGNED TO INVESTIGATE SUCH REPORTS WITH A VIEW TO ASCERTAINING IF THE DAMAGE WAS INDEED THE RESULT OF UNSATISFACTORY PERFORMANCE BY ENGINE SERVICE PERSONNEL, AND IF SO, TO TAKE STEPS TO PREVENT RECURRENCES.

5.2.5 THE INTRODUCTION OF NEW TYPES OF MOTIVE POWER

IT IS ESSENTIAL THAT THE LOCOMOTIVE ENGINEERS BE PROPERLY EDUCATED IN THE USE OF NEW UNITS. ADDITIONALLY, SUPERVISORS AND OTHER APPROPRIATE PERSONNEL FROM ENGINE SERVICE SHOULD BE CONSULTED AT AN EARLY STAGE OF THE PLANNING IN ORDER TO OBTAIN THE BENEFIT OF THEIR JUDGMENT REGARDING FEATURES BEING CONSIDERED FOR THE NEW UNITS, AND TO ENABLE PREPARATION OF ADEQUATE LOCOMOTIVE ENGINEER EDUCATIONAL PROGRAMS BEFORE THE NEW UNITS ARE SCHEDULED TO ENTER SERVICE.

(5-5)

5.2.6 INTRODUCTION OF DIFFERENT BRAKING SYSTEMS

PROPER EDUCATION OF THE LOCOMOTIVE ENGINEER IN THE PURPOSE AND OPERATION OF THE TRAIN BRAKING SYSTEM IS ESSENTIAL TO PROPER TRAIN HANDLING. IN ORDER TO MAINTAIN A SATISFACTORY QUALITY LEVEL OF TRAIN HANDLING, IT IS EQUALLY IMPORTANT THAT HE RECEIVES THE NECESSARY INSTRUCTION REGARDING ANY NEW BRAKING EQUIPMENT INTRODUCED ON LOCOMOTIVES OR CARS WHICH HE WILL BE REQUIRED TO HANDLE.

(5-6)

5.2.7 INVESTIGATIONS OF TRAIN ACCIDENTS, VIOLATIONS OF RULES, VIOLATIONS OF AUTHORIZED SPEEDS OR VIOLATIONS OF RESTRICTIONS REQUIRING A STOP

(5-7) INADEQUATE EDUCATION OF THE LOCOMOTIVE ENGINEER MAY BE THE CAUSE OF SOME PORTION OF THOSE TRAIN ACCIDENTS AND OTHER OCCURRENCES SUCH AS VIOLATION OF RULES, OR OF RESTRICTIONS REQUIRING A STOP.

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