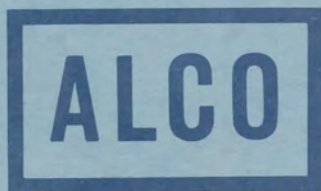


TP-429

OPERATING MANUAL



**2000 HP ROAD SWITCHERS
MODELS RS-32 AND RSD-33**

**ALCO PRODUCTS, INC.
Schenectady, N. Y.**

To
Lou
from
Frank

July 20th 1962

OPERATING MANUAL

TP-429 FOR MODELS RS-32 AND RSD-33 ROAD SWITCHER LOCOMOTIVES



This manual covers basic operating instructions to assist the engineman in the efficient handling of the 2000 HP road switching locomotives.

Specification DL-721

Model RS-32—Two Four Wheel Two-Motor Trucks

Specification DL-722

Model RSD-33—Two Six Wheel Three-Motor Trucks

Descriptive information pertaining to the most commonly used "specialties" is contained herein and defined with the phrase (if used). The manual is written so as to be complete for locomotives with or without the specialty equipment.

The information furnished is based on construction as of date material was compiled.



ALCO PRODUCTS, INC.
Schenectady, New York



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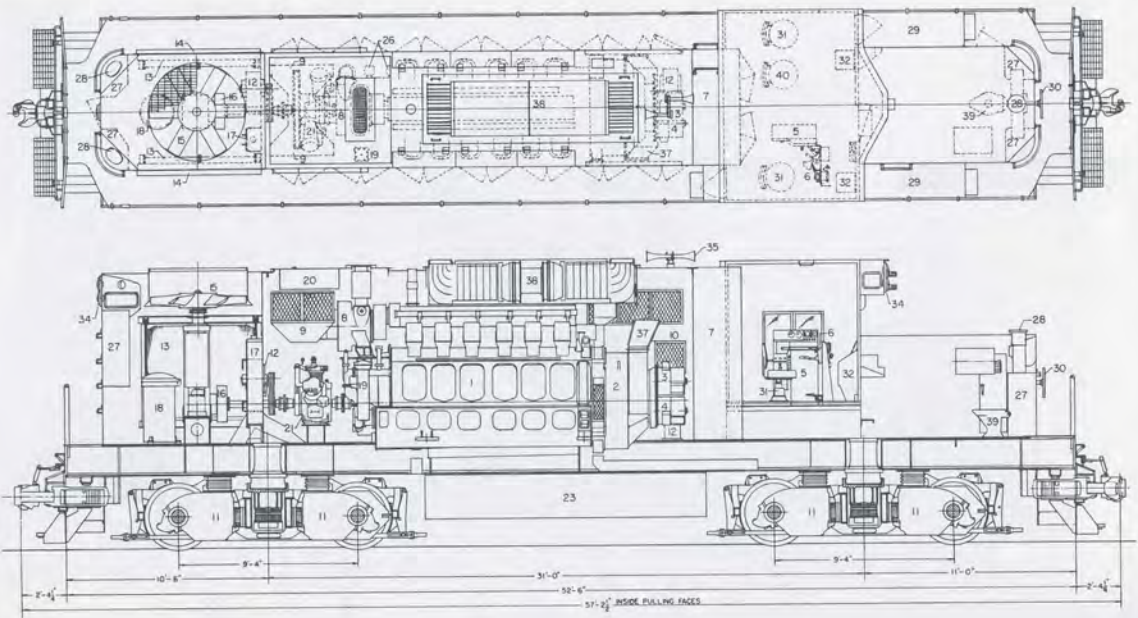
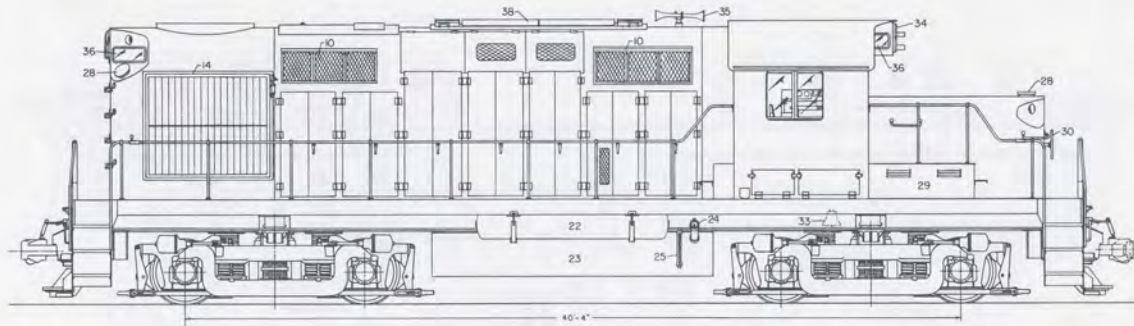


Fig. 1 — Part 1
 LOCATION OF APPARATUS
 OF RS-32 (4 MOTOR)

Fig. 1 — Part 2
 LOCATION OF APPARATUS
 OF RS-32 (4 MOTOR)



- 1 - ENGINE
- 2 - MAIN GENERATOR
- 3 - EXCITER
- 4 - AUXILIARY GENERATOR
- 5 - CONTROL STAND
- 6 - BRAKE VALVES
- 7 - CONTROL COMPARTMENT
- 8 - TURBOSUPERCHARGER
- 9 - TURBOSUPERCHARGER FILTERS
- 10 - AIR FILTERS
- 11 - TRACTION MOTOR
- 12 - TRACTION MOTOR BLOWER
- 13 - RADIATOR

- 14 - RADIATOR SHUTTER
- 15 - RADIATOR FAN
- 16 - RADIATOR FAN CLUTCH
- 17 - LUBRICATING OIL COOLER
- 18 - LUBRICATING OIL FILTERS
- 19 - LUBRICATING OIL STRAINER
- 20 - ENGINE WATER TANK
- 21 - AIR COMPRESSOR
- 22 - MAIN AIR RESERVOIR
- 23 - FUEL TANK
- 24 - FUEL TANK FILLING CONNECTION
- 25 - FUEL TANK GAUGE
- 26 - FUEL OIL FILTERS

- 27 - SAND BOX
- 28 - SAND BOX COVER
- 29 - BATTERIES
- 30 - HAND BRAKE
- 31 - CAB SEAT
- 32 - CAB HEATER
- 33 - BELL
- 34 - HEADLIGHT
- 35 - HORN
- 36 - NUMBER BOX
- 37 - GENERATOR AIR INTAKE DUCT
- 38 - DYNAMIC BRAKE BLOWER AND GRIDS
- 39 - TOILET
- 40 - CAB SEAT

} MODIFICATIONS

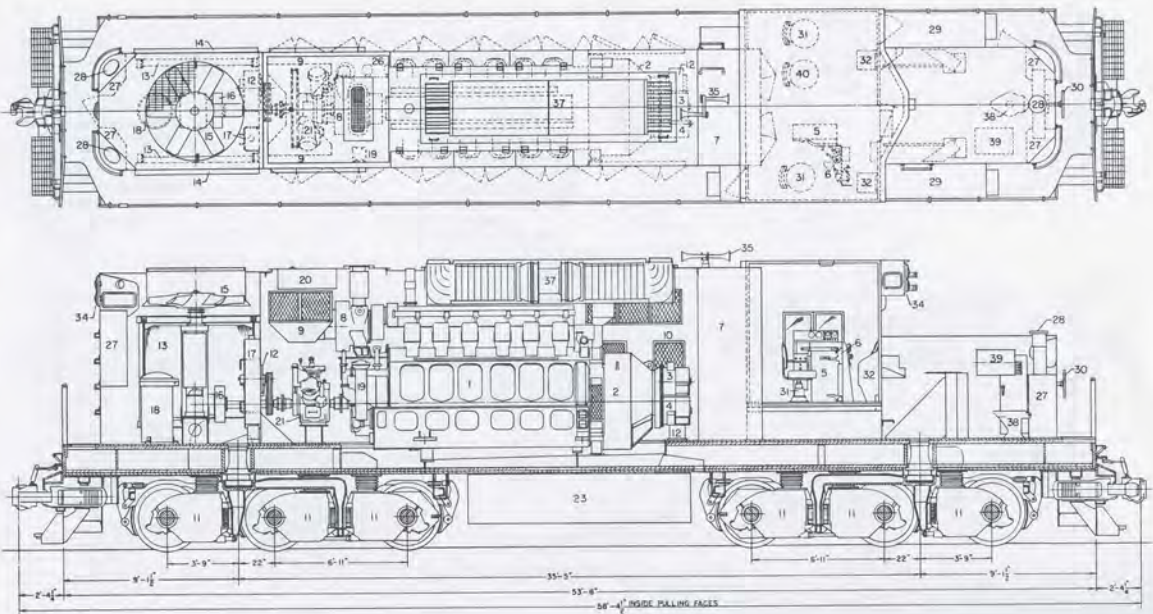
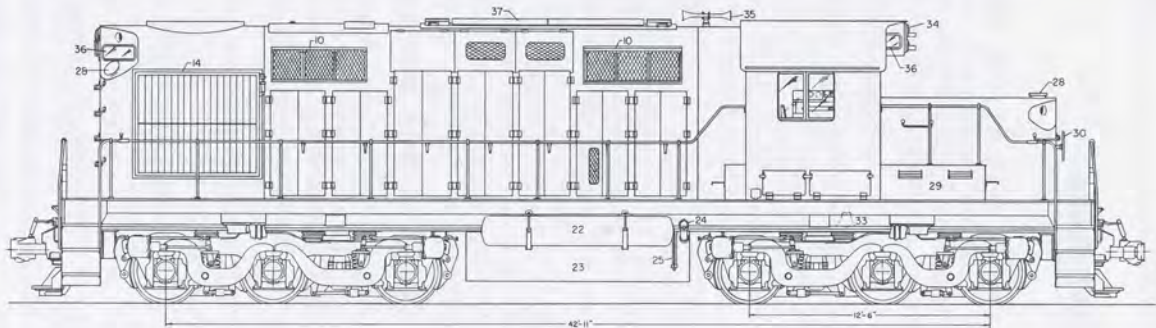


Fig. 2 — Part I
 LOCATION OF APPARATUS
 OF RSD-33 (6 MOTOR)

Fig. 2 — Part 2
 LOCATION OF APPARATUS
 OF RSD-33 (6 MOTOR)



- 1 - ENGINE
- 2 - MAIN GENERATOR
- 3 - EXCITER
- 4 - AUXILIARY GENERATOR
- 5 - CONTROL STAND
- 6 - BRAKE VALVES
- 7 - CONTROL COMPARTMENT
- 8 - TURBOSUPERCHARGER
- 9 - TURBOSUPERCHARGER FILTERS
- 10 - AIR FILTERS
- 11 - TRACTION MOTOR
- 12 - TRACTION MOTOR BLOWER
- 13 - RADIATOR

- 14 - RADIATOR SHUTTER
- 15 - RADIATOR FAN
- 16 - RADIATOR FAN CLUTCH
- 17 - LUBRICATING OIL COOLER
- 18 - LUBRICATING OIL FILTERS
- 19 - LUBRICATING OIL STRAINER
- 20 - ENGINE WATER TANK
- 21 - AIR COMPRESSOR
- 22 - MAIN AIR RESERVOIR
- 23 - FUEL TANK
- 24 - FUEL TANK FILLING CONNECTION
- 25 - FUEL TANK GAUGE
- 26 - FUEL OIL FILTERS

- 27 - SAND BOX
- 28 - SAND BOX COVER
- 29 - BATTERIES
- 30 - HAND BRAKE
- 31 - CAB SEAT
- 32 - CAB HEATER
- 33 - BELL
- 34 - HEADLIGHT
- 35 - HORN
- 36 - NUMBER BOX
- 37 - DYNAMIC BRAKE BLOWER AND GRIDS
- 38 - TOILET
- 39 - TOILET WATER TANK
- 40 - CAB SEAT

} MODIFICATIONS

GENERAL DATA

Model Number	RS-32, RSD-33
Class—AAR; RS-32	B-B
RSD-33	C-C
Rated Engine Speed	1025 RPM
Engine Horsepower	2000 HP
Bore	9 Inch
Stroke	10½ Inch
Fuel Oil Tank Capacity	1200 Gal.
Lubricating Oil Capacity	200 Gal.
Cooling Water Capacity	250 Gal.
Governor Oil System Capacity	4 Quarts
Sand Capacity	28 Cu. Ft.
Wheel Diameter	40 Inch
Journal Size	6½ Inch
Height (Maximum)	14'-6"
Width (Maximum)	10'-1 ⅝"
Length (Inside Knuckles) RS-32	57'-2½"
RSD-33	58'-4½"
Track Curvature (Max.) — M-U Operation	
RS-32	30°
RSD-33	25°
Single Unit Operation	
RS-32	39°
RSD-33	30°
Weight—On Drivers RS-32	240,000-260,000 Lbs.
RSD-33	285,000-390,000 Lbs.
Total Locomotive RS-32	240,000-260,000 Lbs.
RSD-33	285,000-390,000 Lbs.

INTRODUCTION

The 2000 HP Road Switching Locomotives are dual purpose locomotives designed for freight, passenger and switching service. Controls may be applied for multiple unit operation with units controlled from one cab.

DIESEL ENGINE

Each locomotive is powered by a 12 cylinder, V type 9" x 10½", single acting, turbosupercharged, 2000 HP, Model 251, diesel engine of four stroke cycle having an open combustion chamber with solid fuel injection. The engine speed is 400 RPM idle to 1025 RPM full speed and is governed by an electro-hydraulic governor.

The diesel engine has an all welded steel frame. Full pressure lubrication of all parts is provided. A closed cooling system is used; the cooling water flows successively through the engine, the radiators and the lubricating oil cooler and is circulated by an engine driven centrifugal pump. Lubricating oil is cooled by the water in the heat exchanger and the water by fan cooled radiators.

Thermostatically controlled radiator shutters and fan maintain desired engine temperature automatically.

TRACTION AND AUXILIARY GENERATORS

The traction generator is direct-connected to the diesel engine crankshaft while the auxiliary generator and exciter are gear driven from the generator shaft. The traction generator produces direct current for the operation of the traction motors and the exciter supplies power to the excitation system. The auxiliary generator furnishes current for battery charging, lighting and control circuits.

TRACTION MOTORS

Each motor is supported by axle suspension bearings and a spring nest mounted on the truck transoms.

Shrunk onto the motor armature shaft is a pinion which meshes with a drive gear pressed onto the wheel axle. The gear ratio between the pinion and drive gear is expressed by two figures such as "74/18". The first number indicates the number of teeth on the driven gear and the second number indicates the number of teeth on the pinion.

The traction motors are automatically connected in the following manner according to the locomotive speeds.

4 Motor—Model RS-32

1. Series-Parallel Full Field
2. Series-Parallel reduced field
3. Parallel Full Field
4. Parallel reduced field

6 Motor—Model RSD-33

1. Two Series-Three Parallel full field
2. Two Series-Three Parallel reduced field
3. Six Parallel Full field
4. Six Parallel reduced field

The motor connections take place in reverse order when locomotive is decelerating with power on.

"Transition" is the changing of traction motor connections and is controlled automatically.

The forward and reverse movement of the locomotive is controlled by the positioning of the reverser which, when moved from forward to reverse position, by the reverse handle at the Engineman's position, changes the direction of the current through the traction motor fields.

TRACTION MOTOR BLOWERS

The traction motor blowers supply ventilating air for the traction motors on both trucks. The blower next to the radiator compartment is belt driven from the fan drive shaft and supplies air to the motors in the truck directly below the radiator compartment. A second blower is gear driven from the main generator shaft and supplies air to the motors in the truck below the cab.

AUXILIARY EQUIPMENT

The diesel engine drives the radiator fan through an eddy current clutch. Connection between the air compressor and engine is through a flexible coupling.

DYNAMIC BRAKING (If Used)

The dynamic brake is a means by which the traction motors are used to produce braking instead of pulling effort. The motors are reconnected as generators and the power produced by them is dissipated as heat by fan blown resistors. This brake is used principally on grades, though it may be used to very good advantage for slow-

downs. The resistor assembly is mounted under the engine hood above the diesel engine.

CONTROLLER OPERATING HANDLES

THROTTLE HANDLE

Has an IDLE or "O" position and eight running notches. Its position is shown by an indicator above handle.

1. Advance throttle handle completely into each succeeding notch. Do not leave it halfway between notches. It is advisable to leave throttle handle in each notch for a few seconds before advancing.
2. The throttle handle can be returned to idle as rapidly as desired.

SELECTOR HANDLE

Has an OFF position with four MOTORING positions to the left and a BRAKING or "D" range to the right. Its position is shown by an indicator at top of controller.

1. Handle in OFF position disconnects traction motors, power and braking circuits.
2. Handle in MOTORING position No. 1 sets up motor-ing circuits. Transition will take place automatically both accelerating and decelerating.
3. When in M.U. with units equipped for non-supervisory* automatic transition, the selector handle in the lead unit should remain in the No. 1 Transition position.
4. When in M.U. with units equipped for supervisory** automatic transition, the selector handle on lead unit should be placed in Selector position No. 4.
5. When in M.U. with units equipped for Manual Transition, Selector Handle should be moved from Position No. 1 up through position No. 2, 3, and 4 according to operating instructions on the locomotive equipped with manual transition.

*No manual control of transition with selector handle.

**Manual control of transition with Selector Handle.

6. Handle in braking range provides control of dynamic braking. If locomotive is not equipped with dynamic braking, a stop on the controller prevents movement of the handle into the braking range.

REVERSE HANDLE

Has three positions, FORWARD, OFF and REVERSE for selecting the desired direction of locomotive movement. Move handle in same direction as desired for locomotive movement. Center position is OFF.

HUMP CONTROL HANDLE (If Used)

Has an OFF position and a Hump Control range when moved downward.

MECHANICAL INTERLOCKING BETWEEN HANDLES

THROTTLE HANDLE

Can be moved from IDLE position only with Selector Handle in 1, 2, 3, or 4 and Reverse Handle installed.

SELECTOR HANDLE

1. Can be moved from OFF to the No. 1 position regardless of Reverse Handle position.
2. Can be moved to position No. 2, 3 or 4 only when reverse handle is FORWARD or REVERSE.
3. On units equipped with dynamic braking the Selector Handle can be moved into the braking range only when Reverse Handle is FORWARD or REVERSE and Throttle Handle is in IDLE.

REVERSE HANDLE

1. Can be moved only when Throttle Handle is in IDLE, and with Selector Handle in OFF or No. 1 position.
2. Can be installed or removed only when in OFF position.

HUMP CONTROL HANDLE (If Used)

Can be moved regardless of position of the above handles.

PREPARING FOR OPERATION

BEFORE BOARDING

1. Check fuel supply.

2. Check steam generator water supply (if used).
3. Check proper positioning of angle cocks and shut-off valves, also for liquids leaking from external piping.
4. Check for loose or dragging parts.
5. Drain condensate from main reservoirs.
6. Check connection of air hoses and jumper cables. (If used in multiple unit operation—see Dynamic Brake Unit Selector Switch.)

IN ENGINE COMPARTMENT

1. Inspect to see that no rags, tools, lanterns, etc., are near shafts, belts, or other moving parts or electrical apparatus. Never use waste on the locomotive.
2. Lubricating oil drain valves must be closed.
3. Check the diesel engine lubricating oil level. Bayonet gauge should show oil between the high and low marks.
4. Cooling water drain valve must be closed.
5. Check the quantity of water in the cooling water system. The sight glass attached to the water expansion tank should show water at all times.
6. The engine governor operates under hydraulic oil pressure. The reservoir of oil in the governor base is equipped with two sight glasses. The oil level should not be below line on lower sightglass and not above line on top sightglass.
7. The Emergency Fuel Shutoff Valve must be open. If closed, reset by raising the valve stem and slipping the crutch under the raised stem.
8. Check to be sure Control Air, Air Compressor Governor and unloader Cutout Cocks are open.
9. The engine overspeed trip handle must be in the vertical position which indicates the overspeed trip is set. (See Diesel Engine Overspeed for reset instructions.)

10. Check the Air Compressor oil level. Maintain the oil level at the full mark on the bayonet gauge with the engine shut down.

STARTING DIESEL ENGINE

1. Close Battery Switch. This switch is located in the lower right hand corner of control compartment.
2. Close all Circuit Breakers on the Control Compartment Panel.
3. Toggle Switches on Engineman's Control Panel will operate lights.
4. Push the RUN button of Emergency Engine STOP-RUN switch on Engineman's Control Stand.
5. Move Throttle to IDLE.
6. Move Reverse and Selector Handles to OFF.
7. The Ground Relay Cutout Switch must be closed and the ground relay indicating pointer must not be over the red dot. If tripped, see Ground Relay Instructions.
8. The Traction Motor Cutout Switch (if used) should indicate ALL IN. If in any other position see TRACTION MOTOR CUTOUT SWITCH instructions.
9. Turn Engine Control Switch to IDLE.
10. Close the Control and Fuel Pump Breakers on Engineman's Control Panel. Allow pressure to build up to 35-50 psi on Fuel Oil Pressure Gauge. Starting Indicating Light located directly over Start Button will light until engine is started and oil pressure closes the pressure switch. The Engine Control Switch, Start Button and Starting Indicator Light are mounted on the front side of the Control Compartment. NOTE: If the engine control switch is in RUN position when the fuel pump breaker is closed, the alarm bell will ring and the low oil indicating light will light in addition to the starting indicator light.

11. Push Start Button to crank engine. Hold in while cranking the engine until the Starting Indicating Light goes out. **WARNING:** Releasing the Start Button before the light goes out will stop the engine.
12. Do not discharge battery by repeated attempts to crank. If the first two or three attempts are not successful, recheck complete starting preparation.
13. Check Lubricating Oil Pressure Gauge on Gauge Panel for 35 psi minimum pressure.
14. Open Crankcase Exhauster Circuit Breaker located on Control Compartment Panel.
15. Check Engine Lubricating Oil Level. Keep level between the HIGH and LOW marks on the bayonet gauge with the engine idling, crankcase exhauster shut off and the locomotive on a level track.
16. Close Crankcase Exhauster Circuit Breaker.
17. Make sure Crankcase Exhauster Light on Control Compartment Panel is ON.
18. Move Engine Control Switch to RUN position.

BEFORE MOVING A TRAIN

1. Install Brake Valve Handles and Reverse Lever.
2. Check Main Reservoir Air Pressure.
3. Check Control Air Pressure—Normal 70 psi.
4. Place the Brake Pipe Cutout Cock in OPEN position for 6 SL and 24 RL Equipment. On 26 L equipment, move the Brake Pipe Cutoff Valve to FRT or PASS position depending upon the intended use of the locomotive.
5. On 26 L equipment with MU control, place the MU-2 valve in LEAD position.
6. Make Brake application, release Hand Brake.
7. The Dead Engine Cock must be in LIVE position.
8. Test Sanders

9. Make Air Brake Test.
10. Have at least 120° F. water temperature, if possible, before notching up.

OPERATING PROCEDURE

MOVING A TRAIN

1. Close Generator Field Switch on Engineman's Control Panel.
2. Move Reverse Handle to FORWARD or REVERSE position depending on direction desired.
3. Move Selector Handle to Position 1. See SELECTOR HANDLE.
4. For positioning Hump Control Handle, see HUMP CONTROL.
5. Depress Safety Control Pedal (If Used).
6. Release Brakes.
7. Open Throttle.

STOPPING A TRAIN

Move Throttle Handle to IDLE and apply Air Brakes. If leaving Engineman's position, move Selector and Reverse Handles to OFF.

REVERSING LOCOMOTIVE

1. Bring Locomotive to Full Stop.
2. Move Selector Handle to No. 1 position.
3. Move Reverse Handle to opposite direction.
4. Release Brakes.
5. Open Throttle.

SHUTTING DOWN DIESEL ENGINE

1. Open Generator Field Switch located at Engineman's Control Panel.
2. Move Engine Control Switch to IDLE position.

3. Press and hold Stop Button located near Start Button on the Control Compartment until Starting Light lights.
4. Apply Hand Brake and release Air Brakes.
5. Open all other Switches and Circuit Breakers at Engineman's Control Panel.
6. Open Battery Switch.

NOTE: Engine Stop Button on Engineman's Control Panel to be used for Emergency Stop ONLY.

M. U. OPERATION

When operating units with different minimum continuous speeds, the engineman must not operate the units below the minimum continuous speed of any one unit in multiple.

COUPLING UNITS EQUIPPED WITH 6 SL BRAKE EQUIPMENT

ON LEADING UNIT

Position all Switches, Breakers, and Cutout Cocks the same as for single unit operation.

ON TRAILING UNITS

1. See that all Circuit Breakers on Control Compartment Panel are closed.
2. Make sure that the Control, Fuel Pump and Generator Field Circuit Breakers located on the Engineman's Control Panel are OFF.
3. Throttle Handle MUST be in IDLE.
4. Selector Handle MUST be in OFF.
5. Reverse Handle MUST be in OFF and REMOVED.
6. Move Independent Brake Valve Handle to RELEASE and Automatic Brake Valve Handle to LAP. The Handles can be removed in these positions.
7. Move Brake Pipe Cutout Cock to TRAIL position.

ON ALL UNITS

1. Engage Couplers.
2. Connect Air Hoses and Multiple-unit Jumpers between units.
3. Open air line Angle Cocks.

NOTE: When 6 SL and 26 L equipped Locomotives are operated in MU, the following hose connections must be made.

<u>6 SL</u>	<u>26 L</u>
Brake Pipe.....	Brake Pipe
MR Equalizing Pipe.....	MR Equalizing Pipe
BC Equalizing Pipe.....	BC Equalizing Pipe
	Actuating Pipe (closed)

COUPLING UNITS EQUIPPED WITH 24RL BRAKE EQUIPMENT

ON LEADING UNIT

1. Position all switches, breakers and cutout cocks the same as for single unit operation.
2. Place Rotair Valve in PASS for a short train (50-75 cars or less) and FRGT for a long train (50-75 cars or more).

ON TRAILING UNITS

1. See that all Circuit Breakers on Control Compartment Panel are closed.
2. Make sure that the Control, Fuel Pump and Generator Field Circuit Breakers located on the Engineman's Control Panel are OFF.
3. Throttle Handle MUST be in IDLE.
4. Selector Handle MUST be in OFF.
5. Reverse Handle MUST be in OFF and REMOVED.
6. The Rotair Valve Handle must be in FRGT LAP if the Rotair Valve on the Lead or Controlling Unit is in FRGT and in PASS LAP if the Rotair Valve on Lead Unit is in PASS.
7. Place Automatic Brake Valve Handle in Running Position and Independent Brake Valve Handle in Release Position and remove both handles.
8. Close Brake Pipe Cutout Cock.

9. On the D-24 Control Valve set the Charging Change-over Cock in the same position on all units as the Rotair Valve on the lead unit.

ON ALL UNITS

1. Engage Couplers.
2. Connect Air Hoses and Multiple-unit Jumpers between units.
3. Open air line Angle Cocks.

NOTE: When 24RL and 26L Equipped Locomotives are operated in MU, the following hose connections must be made.

<u>24RL</u>	<u>26L</u>
Brake Pipe.....	Brake Pipe
Actuating Pipe.....	Actuating Pipe
MR Equalizing Pipe.....	MR Equalizing Pipe
Ind. Application & Release Pipe.....	BC Equalizing Pipe

COUPLING UNITS EQUIPPED WITH 26L BRAKE EQUIPMENT

ON LEADING UNIT

1. Position all switches, breakers and cutout cocks the same as for single unit operation.
2. Place MU-2 valve in LEAD position.

ON TRAILING UNITS

1. See that all Circuit Breakers on Control Compartment Panel are closed.
2. Make sure that the Control, Fuel Pump and Generator Field Circuit Breakers located on the Engineman's Control Panel are OFF.
3. Throttle Handle MUST be in IDLE.
4. Selector Handle MUST be in OFF.
5. Reverse Handle MUST be in OFF and REMOVED.

6. Place the MU-2 valve in TRAIL-6 or 26 position if unit is trailing behind a locomotive using 6SL or 26L brake equipment and TRAIL-24 position if unit is trailing a 24RL equipped locomotive.
7. Place Automatic Brake Valve Handle in HANDLE-OFF position and Independent Brake Valve Handle in RELEASE position and remove both handles.
8. Position Brake Valve Cutoff Valve in CUT-OUT position.

ON ALL UNITS

1. Engage couplers.
2. Connect air hoses and multiple-unit jumpers between units.
3. Open air line angle cocks.

AUTOMATIC TRANSITION

Both Models RS-32 and RSD-33 road switchers are equipped with automatic transition and no supervisory control. Placing the Selector Handle in Position No. 1 permits automatic transition to take place at predetermined locomotive speeds during acceleration and deceleration.

THROTTLE HANDLING

An inherent feature of the locomotive provides throttle control of tractive effort. This offers two advantages. First, it affords the Engineman the ability to control, by throttle notch position, the amount of tractive effort to be developed. Second, it provides a positive protection against excessive load current on the traction motors and generator.

The proper use of this feature offers much in improved train handling as well as protection to the electrical equipment. It is important therefore that the Engineman thoroughly understands its proper use, since it does require slightly different throttle handling than for other types of locomotives not so equipped.

HOW IT WORKS

For each throttle position a definite maximum load current and corresponding tractive effort may be developed. The increase, as the throttle is advanced from one

position to the next, is made immediately but smoothly. Since, however, the total tractive effort of the locomotive is divided into eight steps available on the eight throttle notches, it is necessary to advance all the way into the 8th notch in order to develop full tractive effort. Further, since maximum current is controlled, it is perfectly safe so far as electrical or mechanical equipment is concerned to advance the throttle rapidly into the 8th notch; in fact this is not only desirable but necessary under certain starting conditions.

HOW IT IS USED

It is well understood that the worst treatment that can be given a traction motor is to allow it to stand at "Stall" condition for any appreciable length of time with load current applied to it. It is therefore most important, having given due care to insure that the brakes are released and that train slack is out to:

1. Start the locomotive to move as quickly as possible; and
2. Accelerate to a speed which will bring the loadmeter pointer down into the Green zone in a minimum time. Therefore, in making a start, it is good practice to advance the throttle promptly to a notch that will start locomotive movement. If after starting, acceleration is too fast or until it is certain that all slack is out, the throttle may be backed off as required to maintain desired locomotive speed. As soon as the slack is out, the throttle may be advanced as fast as desired to suit operating conditions. It is good practice to hesitate at each notch position to allow the engine to come up to the new notch speed which is indicated when the loadmeter pointer has come to rest at the new position.

STARTING PASSENGER OR LIGHT TRAINS

For normal starting of passenger and light trains, no appreciable difference in throttle handling will be noted from other types of equipment except the immediate response obtained for each throttle notch advance.

NORMAL STARTING OF HEAVY TRAINS

Normally it is not necessary to "bunch" the slack. If the train is known to be stretched, as soon as the brakes are fully released, throttle should be advanced immediately to whatever notch is required to start movement. Then adjust up or down to suit desired operating conditions bearing in mind desirability of accelerating the train to where the loadmeter registers in the Green zone in minimum time. For normal level grade starting, if no movement is obtained when the throttle has reached its 5th or 6th notch, shut off throttle and recheck to insure that the brakes are fully released.

STARTING HEAVY TRAINS ON SEVERE GRADES

It is occasionally necessary to take as much as the 7th or 8th notch to make a start. The Engineman must, of course, use due care in handling the train slack and to time his power application to insure that brakes are released. Having assured himself of slack and brake conditions, he should have no hesitancy in advancing the throttle quickly into even the 8th notch to get the train moving. While the load current will be high, the control limits it to value corresponding to approximately the maximum short time rating as shown on the Loadmeter. The important thing is to get the locomotive moving and thus keep to a minimum the length of time during which heavy load current is applied to the motors before they start to turn.

WHEEL SLIP

1. Wheel slip is indicated by a warning light and buzzer. The occasional wheel slip will be corrected by automatic power reduction and smooth reapplication.
2. Upon repeated slip indication, apply sand.
3. If this does not correct slipping, reduce throttle.
4. When a spinning slip develops, it cannot be arrested by sand application. Throttle must be reduced until spinning stops, then manually apply sand and reapply power.

5. The loadmeter is another means by which wheel slip may be detected. A sudden drop of the loadmeter pointer or an abnormally low reading may be an indication of wheel slip.
6. A continuous wheel slip warning may indicate a locked axle. Check should be made to insure free rotation of all wheels.
7. A wheel slip indication is provided when in dynamic braking (if used). If wheel slip light stays on for more than 5 seconds, reduce dynamic braking until slip is corrected.

OPERATING WITHOUT LOADMETER

If the loadmeter becomes inoperative, the following table gives the approximate minimum continuous speed at which the locomotive may be operated in the eighth notch.

APPROXIMATE MINIMUM CONTINUOUS SPEEDS 8TH NOTCH OPERATION

Max. Speed—MPH	Gear Ratio	Min. Speed—MPH	
		RS-32	RSD-33
65	74/18	11.5	7
75	65/18	13	8.5
80	64/19	14.5	9

AIR EQUIPMENT

6-SL AIR BRAKE EQUIPMENT

The 6 SL brake equipment when used on road switcher locomotives consists primarily of the automatic brake valve, independent brake valve, brake pipe cutout cock, feed valve, distributing valve, H-6 relayair valve (if used) and application valve (if used). Details of this equip-

ment vary on different railroads to meet specific operating requirements.

1. Automatic Brake Valve Handle has five positions, namely: "running", "holding", "lap", "service" and "emergency".
 - a. Running Position is used to charge the train brake system. It is also used when the brakes are charged and are ready for use, when the brakes are not being operated and to release the locomotive and train brakes. In this position the feed valve will charge the brake pipe as rapidly as possible at feed valve pressure.
 - b. Holding Position is used to hold the locomotive brake applied while the train brakes are being released and their auxiliary reservoirs recharged to feed valve pressure. This position is nullified when dynamic braking is used.
 - c. Lap Position is used while holding the brakes applied after a service application until it is desired either to make a further brake pipe reduction or a release of them.
 - d. Service Position gives a gradual reduction of brake pipe pressure to cause a service application.
 - e. Emergency Position is used for prompt and heavy application of brakes. A large and direct communication between the brake pipe and atmosphere is made causing a sudden and heavy discharge of brake pipe air.
2. Brake Pipe Cutout Cock is used to open or close the passage between the brake valve and brake pipe. When the handle is vertical, the brake valve is cut out or closed; when the handle is parallel with the floor, it is cut in or open.

3. Brake Pipe Cutout Cock on locomotives equipped for multiple-unit operation has three operating positions: "lead", "trail" and "dead". The handle should be correctly positioned in accordance with unit operation. A spring loaded latch provided in the handle locks it into position, preventing accidental movement.
4. Feed Valve attached to the brake valve body regulates pressure in the brake pipe with the automatic brake valve handle in "running" or "holding" position.
5. Independent Brake Valve Handle has two positions, Release and Application. It is of the self lapping type. No fanning of the brake valve handle is necessary as the valve automatically builds up the application pressure to the amount corresponding to the handle position and then laps. The release of the locomotive brakes may be made after an automatic brake application by depressing the independent brake valve handle in RELEASE position.
6. Distributing Valve is the automatic valve which controls the operation of the brakes on the locomotive in accordance with the movements of both brake valve handles.
7. Dead Engine Cock mounted near the distributing valve is to be open when a locomotive is to be hauled "dead" in a train and closed under all other conditions.
8. Safety Control Pedal (If Used) is located on the floor in front of the engineman's seat. The pedal must be depressed at all times except when the locomotive is stopped and 30 pounds or more brake cylinder pressure exists. If the pedal is released during operation, the safety control whistle will sound for two to four seconds during which time the pedal can be depressed preventing brake action. Otherwise a full service application of brakes will be made.
9. Dynamic Brake Interlock is furnished with dynamic brake equipment and is used to release or prevent

an automatic brake application on the locomotive if the dynamic brake is on. Independent application and release of the locomotive brake is available at all times irrespective of dynamic brake operation. If the automatic brake valve is placed in the emergency position, or for any penalty application, the dynamic brake is nullified allowing the automatic to operate.

10. Pneumatic Control Switch (If Used) is an air operated electric switch. Any penalty application of air brakes such as emergency application of brakes, safety control application of brakes (if used), train control application (if used) and locomotive over-speed (if used) will trip this switch returning the diesel engine to idle. The switch is reset automatically as soon as the Brake Pipe is recharged or Main Reservoir Air Pressure drops below 40 psi.

24-RL BRAKE EQUIPMENT

The 24-RL brake equipment on road switcher locomotives consist primarily of the automatic brake valve, independent brake valve, brake pipe cutout cock, feed valve and D-24 control valve. Details of this equipment vary on different railroads to meet specific operating requirements.

1. Automatic Brake Valve Handle has six positions, namely: "release", "running", "first service", "lap", "service" and "emergency".
 - a. In Release Position (extreme left position of brake valve handle) controlled full release (providing full release selector cock is in FV position) is obtained in which the large capacity feed valve provides a high rate of air flow to the brake pipe at feed valve pressure without the liability of over-charge.
 - b. In Running Position the air flow to the brake pipe is at a restricted rate. This position is used to release the brakes when the brakes are charged and ready for use and when the brakes are not being operated.

- c. First Service Position provides for an initial normal service rate of brake pipe reduction to initiate quick service on the train brakes, after which a slower rate is imposed, allowing the brake pipe pressure to readjust itself throughout the train thus avoiding a heavy reduction at the front end.
 - d. Lap Position is used while holding the brakes applied after a service application until it is desired either to make a further brake pipe reduction or to release the brakes.
 - e. Service Position causes the locomotive brakes and train brakes to apply uniformly on both a time and pressure basis by delaying the beginning of effective brake cylinder pressure development on the locomotive to coincide with that on the train.
 - f. Emergency Position applications are adjustable to provide for a slack control according to the services (Rotair Valve Position). This feature provides a rapid development of locomotive brake cylinder pressure for passenger and short freight trains, or a controlled build-up for long freight trains.
2. First Service Cock on the back side of the automatic brake valve is used for cutting-in or out the first service operation of the brake valve. When the handle is towards the Engineman, it is cut-in.
 3. Selector Cock on the rotary valve seat portion has two positions; "MR" main reservoir and "FV" feed valve. With the handle on "MR" and the automatic brake valve handle in release position, main reservoir air flows to the brake pipe unaffected by the regulating portion of the feed valve and overcharging is possible. When the handle is moved to "FV" position and the automatic brake valve in release or running position, the brake pipe is connected to the control pipe and feed valve pressure will be maintained in the brake pipe.
 4. Brake Pipe Cut-out Cock on the lower portion of the automatic brake valve is used for cutting the brake

valve in or out. When the handle is in the horizontal position, the brake valve is cut-in and in the vertical position it is cut-out.

5. Safety Control Cut-out Cock (if used) on the service application portion is used to cut in or out all safety devices: safety control, locomotive overspeed and train control. With the handle down, all safety devices are cut in.
6. Rotair Valve located near Engineman's position is a manually operated selector valve having four positions: freight, freight lap, passenger and passenger lap. The handle should be placed in "FRGT" position on long trains where controlled emergency (delayed emergency action of the locomotive brakes) is desired and "FRGT LAP" on trailing units. In lap position, the independent brake valve is cut out. The handle should be placed in "PASS" position on short trains where the controlled emergency feature is inoperative and "PASS LAP" on trailing units.
7. Control Valve located under the cab floor, when actuated by the brake valve, operates to charge, apply and release the brakes. The control valve includes the charging change-over cock, dead engine cock and graduated release cap. Charging Change-over Cock should be positioned at "F" or "P" to correspond with the position of the rotair valve. When in "F", charging of the auxiliary reservoir is at a slow rate while in "P", the rate is much faster. Dead Engine Cock should be in "LIVE" position for normal operation and "DEAD" when the locomotive is hauled dead in a train. Graduated Release Cap has two positions, graduated "Gra" and direct "Dir". This applies to automatic release of the locomotive brakes which will usually be graduated in passenger and light freight service and direct in heavy freight service.
8. Independent Brake Valve Handle has two positions, Release and Application. The brake valve is of the self lapping type. Leakage is automatically controlled which insures that the brake will not release

due to leakage. When the brake valve handle is set in any position of the application zone, the valve will automatically lap when the applied pressure reaches the value corresponding to the position of the handle. The locomotive brakes may be released after an automatic application by depressing the independent brake valve handle in release position.

9. Safety Control Pedal (If Used) is located on the floor in front of the engineman's seat. The pedal must be depressed at all times except when the locomotive is stopped and 30 pounds or more brake cylinder pressure exists. If the pedal is released during operation, the safety control whistle will sound for two to four seconds during which time the pedal can be depressed preventing brake action. Otherwise a full service application of brakes will be made.
10. Dynamic Brake Interlock is furnished with dynamic brake equipment and is used to release or prevent an automatic brake application on the locomotive if the dynamic brake is on. Independent application and release of the locomotive brake is available at all times irrespective of dynamic brake operation. If the automatic brake valve is placed in the emergency position, or for any penalty application, the dynamic brake is nullified allowing the automatic to operate.
11. Pneumatic Control Switch (If Used) is an air operated electric switch. Any penalty application of air brakes such as emergency application of brakes (if desired), safety control application of brakes (if used), train control application (if used) and locomotive overspeed (if used) will trip this switch returning the diesel engine to idle. The switch is reset automatically as soon as the Brake Pipe is recharged or Main Reservoir Air Pressure drops below 40 psi.

26-L BRAKE EQUIPMENT

The 26-L brake equipment when used on road switcher type locomotives consists primarily of the automatic brake valve, independent brake valve, brake valve cutoff valve,

controlair valve, control valve, and MU-2 valve (if used). Details of this equipment vary on different railroads to meet the specific operating requirements.

1. The Automatic Brake Valve is a self-lapping valve with six positions, namely: "release", "minimum reduction", "service", "suppression", "handle-off" and "emergency".
 - a. Release position (extreme left position of brake valve handle) conditions the brake valve to charge the brake pipe at controlair valve setting without the liability of overcharge.
 - b. Minimum Reduction position provides a reduction of approximately 6 to 8 psi pressure in the equalizing reservoir which in turn reduces the brake pipe pressure similarly.
 - c. Service position consists of that sector of the handle movement which regulates brake pipe pressure to a pressure lower than minimum reduction. Intensity of the service brake application is increased as the handle is moved to the right.
 - d. Suppression Position is used for the purpose of nullifying any safety control, overspeed or train control brake application within the allowable penalty time. If the brake valve handle is placed in suppression position just prior to a penalty application, a penalty brake application may be avoided. However, the brake valve is so designed that whenever the handle is placed in suppression position, a full service brake application will be obtained.
 - e. Handle Off Position is that sector of the handle movement which reduces the brake pipe pressure to zero and the various valves are positioned to make inoperative the normal operating functions of the brake valve. The brake valve handle can be removed in this position.
 - f. Emergency Position is the extreme right position of the brake valve handle in which the brake pipe is vented at the fastest possible rate to produce an emergency brake application.

2. The Independent Brake Valve is a self-lapping type with two positions, release and application. Leakage is automatically controlled which insures that the brake will not release due to leakage. When the brake valve handle is set in any position of the application zone, the valve will automatically lap when the applied pressure reaches the value corresponding to the position of the handle. Depression of the handle in release position will cause release of any automatic brake application existing on the locomotive.
3. The Brake Valve Cutoff Valve has three positions; "Cutout", "Pass." and "Frt." In the cutout position, the brake valve is cutout, interrupting the flow of air from the relay portion to the brake pipe. In this position, a positive measurement of brake pipe leakage can be made. Move the brake valve handle to an appropriate service brake application position and turn cutoff valve to cutout position when the brake pipe exhaust ceases. This will prevent the brake valve from maintaining leakage and a time measurement can be taken. For all normal operations of the locomotive, the cutoff valve must be placed in either Freight or Passenger position, depending upon the intended use of the locomotive.
4. The Controlair Valve is operated by a cam on the brake valve handle shaft which regulates development of pressure to the equalizing reservoir charging pipe. Movement of the brake valve handle from the release position to the service sector causes this valve to reduce equalizing reservoir pressure in proportion to handle movement. Adjustment of the equalizing reservoir pressure in release position is made by adjusting the knob on the rear of the regulating valve portion. This valve is self-lapping and will automatically maintain pressure developed by the valve against overcharge and leakage.
5. The Control Valve is an automatic valve capable of responding to the service rate of change of the brake pipe pressure and thus develop brake cylinder pressure from brake pipe reductions with reference to a

- control reservoir pressure. The 26-F (if used) contains the Graduated Release Cap with two positions, graduated, GRA, and direct, DIR. This applies to the automatic release of the locomotive brakes which will be graduated in passenger and light service and direct in heavy freight service.
6. The MU-2 Valve (if used) is a three position valve applied to a 26-L equipped locomotive permitting it to operate with 6, 24 and 26 equipped locomotives. The three positions are marked LEAD or DEAD, TRAIL 6 or 26, and TRAIL 24. When the locomotive is operating singly, as a "lead" unit or hauled "dead" in a train, the valve must be positioned at LEAD or DEAD. When operating as a trailing unit behind 6 or 26 equipment, the valve must be positioned at TRAIL 6 or 26. When behind 24 type equipment, the valve is positioned at 24.
 7. Safety Control Pedal (if used) is located on the floor in front of the engineman's seat. The pedal must be depressed at all times except when the locomotive is stopped and 30 pounds or more brake cylinder pressure exists. If the pedal is released during operation, the safety control whistle will sound for two to four seconds during which time the pedal can be depressed preventing brake action. Otherwise a full service application of brakes will be made.
 8. Reduction Selector Valve (if used) with associated devices, provides an automatic split reduction during a penalty application, from overspeed (if used), deadman safety control (if used), or train control (if used), when the Freight-Passenger cut-out cock is in Freight position.
 9. Dynamic Brake Interlock is furnished with dynamic brake equipment and is used to release or prevent an automatic brake application on the locomotive if the dynamic brake is on. Independent application and release of the locomotive brake is available at all times irrespective of dynamic brake operation. If the automatic brake valve is placed in the emergency position, or for any penalty application, the dynamic brake is nullified allowing the automatic to operate.

10. Pneumatic Control Switch (if used) is an air operated electric switch. Any penalty application of air brakes such as emergency application of brakes (if desired), safety control application of brakes (if used), train control application (if used), and locomotive overspeed (if used) will trip this switch returning the diesel engine to idle. The switch is reset automatically as soon as the Brake Pipe is recharged or Main Reservoir Air Pressure drops below 40 psi.

RECOVERY OF BRAKE AFTER PENALTY APPLICATION

1. Place brake valve in Lap Position. (Suppression for 26-L).
2. Close throttle to IDLE.
3. Depress safety control pedal. (if used).
4. Allow application pipe to build up to main reservoir pressure. (About 12-14 secs.)
5. Release brakes.

OPERATING 6-SL OR 14-EL WITH 24-RL OR 26-L EQUIPMENT IN M.U.

When operating locomotives in multiple, those units having 24-RL brake equipment must be ahead of those having 6-SL or 14-EL equipment and the brake piping of the 24-RL equipped unit must be appropriately modified. When operating any one of these brake systems in multiple with 26-L, provisions are available on the 26-L equipped unit so that it may Lead or Trail with the other mentioned brake systems.

AUXILIARY AIR EQUIPMENT

LOCOMOTIVE BELL VALVE

The Bell Ringer Operating Valve is located near the brake valves and controls the air from the main reservoir for operating the pneumatic bell ringer.

HORN VALVES

1. The control valves for both horns are located in the ceiling of the cab and control main reservoir air pressure to the horns. Pull ropes for both horns are conveniently located at the Engineman's position.

2. The shutoff cock for both horns is located under the cab floor and is accessible through the hinged door on the outside of the cab.

SANDER VALVE

1. The Sander Valves located at the Enginemans position provides Forward and Reverse sanding on both trucks.
2. The valves have "ON" and "OFF" positions for Forward and Reverse sanding.
3. If unit is equipped for M.U. operation, the sander valve will provide sand to all units for the direction of locomotive movement. This is accomplished electrically through the reverser.
4. A sander cutout cock for each truck is located under the frame over the leading wheels of front truck and trailing wheels of rear truck.

NOTE: On some units an electric switch, mounted at the Engineman's position with Forward, Neutral and Reverse positions, operates the sanders directly through the magnet valves.

NOTE: On some units a Toggle Switch located on the gauge panel in front of the engineman provides for operation of all sanders in case of an emergency such as a "plugging" operation.

WINDSHIELD WIPER VALVES

1. A needle valve located at each of the windshield wipers provides independent control of speed.
2. The shutoff globe valve for air supply to wipers is located under the cab floor directly under Engineman's position and is accessible through the hinged door on the outside of the cab.

CONTROL AIR REDUCING VALVE

Air from the No. 1 Main Reservoir is reduced to 70 psi through a reducing valve located with the control air pressure gauge on the side wall inside the short hood. This air is then piped to operate the reverser, series and parallel contactors, and dynamic braking switch (if used).

MISCELLANEOUS OPERATING INSTRUCTIONS

CHANGING OPERATING ENDS— 6-SL BRAKE EQUIPMENT

ON UNIT BEING CUT OUT

1. Make full service application with automatic brake valve and then move to Lap.
2. Place brake pipe three position cutout cock in Trail position.
3. With automatic brake valve in Lap and independent in Release, remove handles.
4. Place Reverse Handle in OFF position and remove. To do this, Selector Handle must be in OFF and Throttle in IDLE.
5. At the Engineman's Control Station, open the Control and Generator Field Breakers leaving the Fuel Pump Breaker closed. Note: On some units equipped to M.U. with units of other manufacture, the control breaker must be left closed until control and fuel pump breakers are closed on unit being cut in.

ON UNIT BEING CUT IN

1. Insert Reverse Handle in controller and leave in Off position.
2. Move independent brake valve to FULL Application position.
3. Place brake pipe three position cutout cock in Lead position.
4. Move automatic brake valve handle to Running position.
5. Close Control and Fuel Pump Breakers on Engineman's Control Stand.
6. Open the Fuel Pump Breaker on Engineman's Control Panel ON UNIT BEING CUT OUT. Note: Open control breaker - see note above.
7. Close Generator Field Breaker on Engineman's Control Panel.
8. Place foot on Safety Control Pedal (if used) and Release Independent Brake.

CHANGING OPERATING ENDS—**24-RL BRAKE EQUIPMENT****ON UNIT BEING CUT OUT**

1. Make a 20 pound brake pipe reduction with the Automatic Brake Valve, after which move the Brake Valve handle to Lap Position.
2. Move Independent Brake Valve handle to Release Position and observe that the brakes are still applied.
3. Close Brake Pipe Cutout Cock (vertical position).
4. Place the Rotair Valve in either FRGT LAP for a long train or PASS LAP for a short train.
5. Move Automatic Brake Valve handle to Running position and remove both handles.
6. Place Reverser Handle in OFF position and remove. To do this it is necessary that the Selector Handle be in OFF position and the throttle in IDLE.
7. At the Engineman's Control Station open Control and Generator Field Breakers leaving the Fuel Pump Breaker closed. Note: On some units equipped to M.U. with units of other manufacture, the control breaker must be left closed until control and fuel pump breakers are closed on unit being cut in.

ON UNIT BEING CUT IN

1. Insert Reverse Handle in Controller and leave in OFF position.
2. Insert Automatic and Independent Brake Valve handles.
3. Place Rotair Valve in PASS for a short train and FRGT for a long train.
4. Move Independent Brake Valve handle to FULL Application Position.
5. Open Brake Pipe Cutout Cock (Horizontal Position).
6. To avoid the possibility of overcharge due to the lowering of the Feed Valve setting and when the locomotive is not connected to a train, move the Automatic Brake Valve Handle to emergency position and then back to Lap. Depress the Independent Brake Valve Handle in Full Application position for about 15 seconds.

7. Move Automatic Brake Valve handle to Running or Release position.
8. Close Control and Fuel Pump Breakers on the Engineman's Control Panel.
9. Open Fuel Pump Breaker ON END BEING CUT OUT. Note: Open control breaker - see note above.
10. Close Generator Field Breaker on Engineman's Control Panel.
11. Place foot on Safety Control Pedal (if used) and release Independent Brake.

CHANGING OPERATING ENDS - 26-L BRAKE EQUIPMENT

ON UNIT BEING CUT OUT

1. Make a 20 lb. brake pipe reduction by moving the Automatic Brake Valve Handle to SERVICE position.
2. Move Independent Brake Valve Handle to RELEASE position and observe that the brakes are still applied.
3. Move Brake Valve Cut-Off Valve to CUT-OUT position.
4. Move the M.U. -2 valve to TRAIL 6 or 26 when trailing 6 or 26 equipment and to TRAIL 24 when trailing 24 equipment.
5. Move Automatic Brake Valve Handle to HANDLE-OFF position and remove both handles.
6. Place Reverser Handle in OFF position and remove. To do this it is necessary that the Selector Handle be in OFF position and the Throttle in IDLE.
7. At the Engineman's Control Station, open Control and Generator Field Breakers leaving the Fuel Pump Breaker closed. Note: On some units equipped to M.U. with units of other manufacture, the control breaker must be left closed until control and fuel pump breakers are closed on unit being cut in.

ON UNIT BEING CUT IN

1. Insert Reverse Handle in Controller and leave in OFF position.
2. Insert Automatic and Independent Brake Valve handles.
3. Move the M.U. -2 valve to LEAD OR DEAD position.

4. Move the Brake Valve Cut-Off Valve to FRGT or PASS position depending upon the service intended.
5. Move the Independent Brake Valve Handle to FULL application position.
6. Move Automatic Brake Valve Handle to RELEASE position.
7. Close Control and Fuel Pump Breakers on Engineman's Control Panel.
8. Open Fuel Pump Breaker ON END BEING CUT OUT. Note: Open control breaker - see note above.
9. Close the Generator Field Breaker on Engineman's Control Panel.
10. Place foot on Safety Control Pedal (if used) and release Independent Brake.

DYNAMIC BRAKING OPERATION (If Used)

DYNAMIC BRAKE UNIT SELECTOR SWITCH (If Used)

1. When operating all ALCO units in multiple:
 - a. Place unit selector switch on all units in No. 1 position.
 - b. Do not install field loop dynamic braking jumpers between units.
2. When operating ALCO units in multiple with units of other manufacture:
 - a. Place unit selector switch on all trailing units in No. 1 position.
 - b. Place unit selector switch on lead unit to correspond with number of units in consist.
 - c. Install field loop dynamic braking jumpers between all units.

WHEN ALL UNITS ARE EQUIPPED WITH AUTOMATICALLY CONTROLLED DYNAMIC BRAKE

The Engineman controls the application of the Dynamic Brake with the Selector Handle. After full handle position has been reached, the brake is automatically regulated to develop maximum available braking effort at any speed without manual attention. The selector handle must be advanced SLOWLY through the braking range. If braking current builds up too rapidly, hesi-

tate advance (do not back off) until current is steady. Any effort to manually reduce the braking current would probably cause a "hunting" condition. When advancing the selector handle into the braking range, the engine speed will increase to 4th throttle notch thereby providing additional cooling for the traction motors. The operation and effect of the Dynamic Brake on the train is similar to that of the locomotive independent air brake; braking effort is applied to the locomotive only. The same precautions for bunching the slack and preventing slack "run out" are required.

DYNAMIC BRAKING LIMITS

At high speeds maximum braking must be reduced manually to the yellow dot on the loadmeter. The following table lists the speeds for all gearings.

DYNAMIC BRAKING LIMITS

Gearing	Restrict to Yellow Marker Above
65 MPH	56 MPH
75 MPH	64 MPH
80 MPH	68 MPH

TO APPLY DYNAMIC BRAKING

1. Move Throttle to IDLE.
2. Have Reverse Handle in Forward or Reverse depending on direction of motion.
3. Move Selector Handle to OFF and then to "D" in the braking range. Loadmeter Pointer will show slight movement.
4. Bunch train slack by advancing Selector Handle cautiously into the braking range. Do not allow Loadmeter Pointer to exceed the first White line on the Green Scale until all slack is bunched.
5. After slack is bunched advance Selector Handle slowly into braking range until the desired braking effort is reached. If maximum braking effort is desired move handle to its full ON position. Make handle movements slowly.

6. The amount of braking effort obtainable varies with the train speed. To obtain maximum braking performance, the Selector Handle must be moved to its full ON position. With the Selector Handle in its full ON position, the braking effort will increase as the speed decreases until it reaches maximum value. It will maintain this maximum value for a few MPH after which it will gradually fall off to reach 0 at 0 MPH.

The speed range of maximum braking effort for all gearing is as follows:

	65 MPH	75 MPH	80 MPH
RS-32	25	28	30
RSD-33	21	24	26

7. It is permissible to start from a standstill on a down-grade with dynamic brake applied.
8. When braking a heavy train on a severe grade, the maximum dynamic braking may not be sufficient to hold the desired train speed. An application of the automatic air brake may be used in addition to the dynamic to maintain desired train speed. The Dynamic Braking Interlock will hold the locomotive brakes released for any position of the automatic brake valve other than emergency. See DYNAMIC BRAKE INTERLOCK AND PNEUMATIC CONTROL SWITCH.

RELEASE OF DYNAMIC BRAKES WHEN NOT USING AIR BRAKES

1. Reduce braking slowly; pause when the Loadmeter pointer indicates at the first White line on the Green Scale to prevent slack run out.
2. Handle can now be moved to OFF or into Motoring.

RELEASE OF DYNAMIC BRAKES DURING AUTOMATIC AIR BRAKE APPLICATION

To maintain desired speed on severe grades, an application of the automatic air brake may be used to supple-

ment the dynamic brake. However, no automatic air brake application except emergency is possible ON THE LOCOMOTIVE while using dynamic brakes. Flat wheels may result on the locomotive if independent air brakes are applied while using dynamic brakes. When releasing the dynamic brake after an automatic air brake application has been made, depress the independent brake valve handle in Release position and then move the Selector Handle to OFF position. The independent brake valve handle may now be released. After this operation, the independent brake on the locomotive may be applied if desired. CAUTION: On 6-SL and 24-RL Brake equipment, if the dynamic brake is released BEFORE depressing the independent brake valve handle, a rapid locomotive brake cylinder pressure may build-up resulting in locked axles and flat wheels.

RELEASE OF DYNAMIC BRAKES WITH AN EMERGENCY AIR BRAKE APPLICATION

In an emergency air brake application, whether initiated by the Brake Valve Handle or from the train, the dynamic brake will automatically be cut out and an emergency air brake application will be made on the locomotive as well as the train. Under these conditions the Engineman should return the Selector Handle to OFF position as promptly as is consistent with operating instructions.

CUT-OUT OF DYNAMIC BRAKES WITH ENGINE CONTROL SWITCH

1. If the Engine Control Switch is turned to Idle, dynamic braking on that unit will be inoperative.
2. Cut out dynamic brake only when Selector Handle is OFF; this avoids surges on the equipment or on the train. For the same reasons, dynamic brake must not be cut in except with Selector Handle in OFF.

DYNAMIC BRAKING WITH LEAD UNIT IDLING OR SHUT DOWN

The loadmeter will not operate. When lead unit is cut

out, keep engine idling if conditions permit. This maintains battery charging, air pressure, engine temperature, etc. On 6-SL brake equipment the Dynamic Braking should not be used. However, if conditions require, the dynamic brake may be applied; if applied the Independent Brake Valve Handle must be depressed in the RELEASE position to hold the air brakes off all locomotive units. If this is not done, it may result in locked axles, and consequently, flat wheels. For conditions in lead units see: OPERATING WITH LEAD UNIT IDLING OR SHUT DOWN.

OPERATING IN M.U. WITH LOCOMOTIVES HAVING MANUALLY CONTROLLED DYNAMIC BRAKING

Operate in usual manner. If brake warning light operates, it indicates that the braking limit has been exceeded on a trailing unit. The Engineman must reduce braking to a point where the light will not operate.

DUAL CONTROL (If Used)

When two operating control stations are applied in the same cab, the Fuel Pump Breaker, Control Breaker and Generator Field Switch are wired in series. Therefore, where these breakers and switches are referred to in the operating instructions, they must be operated at **both** control stations in order to obtain the desired function.

HUMP CONTROL (If Used)

This device is a means by which the Engineman can obtain precise control of tractive effort. Its use permits close control of low train speeds as in humping service. In general service its use will be very helpful in starting trains under difficult conditions.

A small controller mounted on the control stand is the means by which hump control is obtained. The handle of this controller can be moved from an OFF or maximum tractive effort position through a decreasing range to the FULL ON or minimum tractive effort position. By moving the handle down from the OFF position, the tractive effort will be reduced below the tractive effort setting of the throttle. The farther the handle is moved downward the greater the tractive effort reduction.

APPLICATION

1. For Humping Service

- a. Have handle of Hump Controller in OFF position.
- b. Start train in the normal manner.
- c. Advance throttle only to the notch required to move train at proper humping speed and leave in this position.
- d. As train becomes lighter, gradually move Hump Controller downward to hold proper speed.
- e. When Hump Controller reaches FULL ON position, reduce throttle one notch and move Hump Controller toward OFF to hold proper speed.
- f. Observe Loadmeter for short time overloads.

2. For Heavy Duty Service

Following are two methods of using Hump Control in heavy duty service. Because of the variations in this type of service, it is difficult to predict the best method to use. Therefore, it is suggested that the Engineman select the one best suited for his particular case.

a. First Method:

- (1) With throttle handle in notch 1, move the hump controller handle to FULL ON.
- (2) Advance throttle handle fairly rapidly until 8th notch is reached unless experience indicates that a lower notch is sufficient.
- (3) Move hump controller handle toward the OFF position until train begins to move. Train speed can be further increased or controlled by handle movements.
- (4) When train is started, the hump controller handle should be moved to OFF position unless control of tractive effort is necessary to get traction without wheel slip.

b. Second Method:

- (1) Start train by advancing throttle in normal manner.

- (2) If wheel slip occurs in any notch, leave throttle in that notch and reduce tractive effort by moving Hump Controller down from the OFF position.
- (3) After wheel slip stops, move Hump Controller toward OFF position to obtain the tractive effort that can be applied without slip.
- (4) As train picks up speed, move Hump Controller to OFF position and operate normally.

BRAKING WITH POWER

1. Gradually apply automatic brake for a light brake pipe reduction.
2. Release locomotive brakes by depressing independent valve handle in the Release position.
3. Reduce throttle to maintain Loadmeter Pointer in Green band of motoring scale as train speed decreases. Move throttle to IDLE before train comes to a dead stop.
4. On locomotive in M.U. with manual transition locomotives, move the Selector Handle into the position corresponding to the speed of the locomotive.

FASTER AIR PUMPING

1. Generator Field Switch located on Engineman's Control Panel must be OFF.
2. Reverse Handle must be in OFF position.
3. Selector Handle must be in position 1.
4. Open throttle as desired up to Notch 5. If the compressor governor cuts out after a short interval of pumping it is indicative that a higher engine RPM is being used than is necessary for the air being consumed.

EMERGENCY ENGINE SHUT DOWN

A Stop-Run Switch is located on the Engineman's Control Panel. When the Red "Stop" Button is pushed, it will

shut down the engine of the unit and simultaneously all other engines of a multiple unit locomotive. It is provided for "emergency" use only. Normal shut downs should be made with the Engine STOP BUTTON located on the Control Compartment near the Engine Control Switch.

To restart engines of a single or multiple unit locomotive after shut down by Emergency Stop-Run Switch:

1. Reset switch by pushing in Black RUN Button.
2. Start engine on any unit in the normal manner after first turning the Engine Control Switch to the IDLE position.
3. Hold start button until Starting Indicator Light goes out. The low lube oil pressure light and alarm bell will continue to operate until all units in M. U. have been started as long as the engine control switch is in the RUN position on any shut down unit. If the Engine Control Switch is returned to IDLE on all units the low oil light will not light and alarm bell will not ring.

OPERATING THROUGH WATER

Do not exceed 2 or 3 MPH if there is water above the railhead. Do not pass through water over 4 inches above railhead.

PASSING OVER RAILROAD CROSSINGS

The severe mechanical shocks received by traction motors when passing over railroad crossings at high speed may cause the brushes to bounce and flash-over the traction motors. At high speeds, reduce throttle to 5th notch or below while all units pass over the crossing. This is not necessary at low speeds. It is also desirable to reduce dynamic braking at high speeds over crossings for the same reason.

TAKING DIESEL ENGINE "OFF THE LINE" IN M.U. OPERATION

Turn the Engine Control Switch to IDLE position. If it becomes necessary to stop the engine, press Stop Button

on Control Compartment and open the Fuel Pump, and Exhauster Breakers on the Control Compartment Panel.

PUTTING DIESEL ENGINE "ON THE LINE" IN M.U. OPERATION

If the engine has been shut down, start in usual manner. Turn Engine Control Switch to RUN position. However, it is advisable to allow engine to warm up to at least 120° F. before putting the engine on-the-line.

TOWING DEAD LOCOMOTIVE

In freezing weather, drain engine and steam generator (if used) water systems. Brake equipment on one or more "dead" units which are in multiple with a "live" leading unit should be set up the same as "live" trailing units. It is recommended that brake equipment on each unit of a "dead" multiple unit locomotive which is not in multiple with a "live" unit should be set up as a single "dead" unit as follows:

1. Drain all air from main reservoirs and air brake system.
2. Close brake pipe cut-out cock on brake valve pedestal (DEAD position with 6-SL brake if unit is equipped for M.U. operation). On 26-L equipment, move brake pipe cutoff valve to CUTOUT position and MU-2 valve to DEAD position.
3. Place Automatic Brake Valve Handle in RUNNING (Handle-Off in 26-L) position and Independent Brake Valve Handle in RELEASE position.
4. Place throttle in IDLE, Selector and Reverse Handles in OFF position. Remove Reverse Handle.
5. Place Dead Engine Cock in DEAD (Open) position.
6. Set safety valve on distributing valve for 25 psi (6-SL brake).
7. Place Rotair Valve and Charging Changeover cock on D-24 Control Valve in PASS position (24-RL brake).
8. Release Cap (if used) on control valve should be in DIRECT RELEASE position (24 and 26 brakes).
9. Connect brake pipe hose only.

OPERATING WITH LEAD UNIT IDLING OR SHUT DOWN

To operate with lead unit idling, turn Engine Control Switch to IDLE. Operate in usual manner, however, loadmeter will be inoperative. See OPERATING WITHOUT LOADMETER. To operate with lead unit shut down:

1. Turn Engine Control Switch on lead unit to IDLE.
2. Close battery switch on lead unit.
3. Close Main Control Negative and Battery Breakers on the lead unit Control Compartment Panel and Lighting Breakers only as required.
4. Open all other circuit Breakers on lead unit Control Compartment Panel.
5. Close Control Breaker, Fuel Pump Breaker and Generator Field Switch on lead unit Engineman's Control Panel.
6. Dynamic braking will be inoperative on lead unit. See DYNAMIC BRAKING WITH LEAD UNIT DOWN.

NOTE: With engine dead, battery charging generator ceases to function. The battery voltage will weaken enough in a few hours to prevent further locomotive operation. In all cases above conditions in trailing units are the same as normal.

OPERATING WITH DEAD BATTERY ON LEAD UNIT (Without Headlight)

1. Turn Engine Control Switch on lead unit to IDLE.
2. Open Battery Switch on lead unit.
3. Open all circuit breakers on Control Compartment Panel and Electric Cab Heater Circuit Breaker (if used).
4. Open Fuel Pump and Control Breakers and Close Generator Field Switch on Engineman's Control Panel in lead unit.
5. On any ONE of the TRAILING UNITS, close Fuel Pump and Control Breakers on Engineman's Control Panel.
6. Dynamic Brake cannot be used.

OPERATING WITH DEAD BATTERY ON LEAD UNIT

(With Headlight)

ON LEAD UNIT

1. Turn Engine Control Switch to IDLE.
2. Open Battery Switch.
3. Open Electric Cab Heater Circuit Breaker (if used).
4. Open all circuit breakers on Control Compartment Panel except Headlight, Cab Light and Engine Room Light Breakers.
5. Open Fuel Pump Breaker and close Generator Field Switch and Control Breaker on Engineman's Control Panel.

ON ANY ONE TRAILING UNIT

1. Close Fuel Pump and Control Breakers on Engineman's Control Panel.
2. Make sure all circuit breakers on Control Compartment are closed.

CAUTION: DO NOT use more than one headlight—Control Breaker may trip.

ENGINE WATER TEMPERATURE CONTROL

The engine water temperature is controlled by a single radiator fan and a pair of radiator shutters located at the enginehood end of the locomotive on the right and left side.

The speed of the fan and the positioning of the shutters are automatically controlled by the temperature of the water leaving the Diesel engine.

In the event that the shutters fail to operate automatically, they can be operated manually by first closing the cutout cock to the shutter magnet valve. The air is automatically bled from the system allowing free positioning of the shutter vanes. They may be blocked in any desired position but under no condition should the fan be operated with the shutters closed.

REVERSER EMERGENCY OPERATION

If the reverser fails to operate, turn Engine Control Switch to Idle on the unit affected. Try throwing the reverser by pressing the magnet valve buttons. Left magnet valve for Forward—Right magnet valve for Reverse.

If this is not effective, remove manual operating handle from bracket on inside of Control Compartment. Insert handle in hole provided in operating lever on top of operating shaft and move left for Forward movement and right for Reverse movement.

TRACTION MOTOR CUTOFF SWITCH (If Used)

The traction motor cutoff switch is located in the Control Compartment. It is connected in the control circuits and provides for cutting out any one motor or a pair of motors in either truck on model RS-32 (4 Motor) locomotives. On RSD-33 (6 Motor) locomotives provision is made for cutting out all motors in either truck.

The throttle or the engine control switch must be in idle before operating the motor cutoff switch. Power of the unit is automatically restricted when motors are cut out. In the event the ground relay trips, the motor cutoff switch may be used to isolate a truck set of motors to determine location of trouble.

HAND BRAKE OPERATION

TO APPLY

Turn wheel clockwise until brake is fully applied.

TO RELEASE

Turn wheel counter clockwise until brake is fully released.

CAB HEATERS AND DEFROSTERS

1. Located on right and left side, forward end of cab.
2. Defroster damper and rheostat switch for controlling heater fan are located on the heater.

CIRCUIT BREAKERS

Circuit breakers are used in all control circuits and will trip and open whenever an overload occurs. Breakers, suitably identified, are located at the Engineman's Position and on the Control Compartment Panel.

If a circuit breaker should trip, the handle will be approximately midway between ON and OFF. To reset, move handle to OFF position and then to ON. In some cases it may be necessary to wait a few minutes before the breaker can be reset.

CLASSIFICATION LIGHTS

Classification lights are permanently installed in each of the four corners, front and rear, of the locomotive body. Because of the angle the lenses are visible both from the front and side of the locomotive. Two colored lenses, red and green, are arranged so that each in turn may be swung between the light and the clear glass lens to give the desired color indication. The colored lens is moved by pulling on the winged locking pin and moving the lens into position.

GAUGES AND INSTRUMENTS

LOADMETER

The loadmeter, Fig. 3, is a color band device to be used as a guide in correct locomotive operation.



FIG. 3
LOADMETER

MOTORING BAND

The pointer position on the Color Band indicates the relative amount of tractive effort being developed by the locomotive, also the load current on the traction motors.

The Green Zone represents normal operation. In this zone, operating time is unrestricted.

The Yellow Zone indicates short time capacity of the traction motors. The point at which the color band changes from Green to Yellow indicates the end of the continuous rating.

SHORT TIME LOAD OPERATION

The overload range has been graduated to show the time in minutes that various loads may be carried. The greater the load, the shorter the time allowed.

The maximum time allowed in the Yellow Zone is 50 minutes. The other marks in the Yellow Zone indicate the maximum time allowed when the pointer is at these points. If the pointer remains between any two numbers, the maximum time allowed must be estimated by the Engineman.

If the load changes, the Engineman must judge when he has used up the full allowable time in the Yellow Zone. For example: If only half the time were used at one load before it changed the allowable time at the new load would be $\frac{1}{2}$ of its indicated time.

When the short time load has been used for the full allowable time, the load should be reduced until the pointer will be AT OR BELOW THE YELLOW TRIANGLE which appears near the upper end of the Green band.

The load must be held below the Yellow triangle for at least 20 minutes before another overload in the Yellow Zone may be repeated. If this practice is not followed, the traction motors may be seriously damaged.

SPEEDMETER

Has a Speed Scale which indicates locomotive speed in miles per hour.

AUXILIARY GENERATOR AMMETER

Indicates auxiliary generator ampere output. It should show a reading whenever the Diesel Engine is running; however, the reading will vary widely depending upon the auxiliaries being operated.

If meter shows no reading, check to insure that the Auxiliary Generator Field Circuit Breaker on Control Compartment Panel is closed.

If still no reading is shown, minimize auxiliary load to conserve battery.

LUBRICATING OIL PRESSURE GAUGE

1. Located on gauge panel in front of Engineman's position.
2. Should indicate 55-60 psi.

ENGINE WATER TEMPERATURE GAUGE

1. Located in engine water outlet piping to radiator.
2. Normal operating temperature is 150° F. to 180° F.

BOOSTER AIR PRESSURE GAUGE

1. Located on gauge panel in front of Engineman's position.
2. Indicates turbosupercharger air pressure to diesel engine.
3. Should indicate 15-18 psi with throttle in eighth notch with engine fully loaded and lower pressures in lower throttle notches.
4. If pressure drops to 14 psi with throttle in eighth notch and engine fully loaded the cause of the low pressure should be corrected.

FUEL OIL PRESSURE GAUGE

1. Located on gauge panel in front of Engineman's position.
2. Should indicate 35-50 psi at all engine speeds.

AIR GAUGES

1. Located on gauge panel in front of Engineman's position.
2. One gauge indicates brake pipe and brake cylinder pressures.
3. Second gauge indicates main reservoir and equalizing reservoir pressures.

CONTROL AIR PRESSURE GAUGE

1. Mounted inside short hood on left side.
2. Should indicate 70 psi.
3. Loss of control air pressure prevents operation of the electro-pneumatic contactors and further locomotive movement.

AUTOMATIC ALARMS AND SAFEGUARDS

In Single or Multiple Unit operation, an alarm system is provided for the following:

1. Low lube oil pressure.
2. Hot engine or low water.
3. Ground relay tripped.
4. Boiler flame out (if used).
5. Wheel slip.
6. Dynamic brake (if used).

An alarm bell for items 1, 2, 3 and 4 will sound in all cabs and a warning light will operate on the affected unit.

A warning light and buzzer for item 5 will indicate in the lead cab as well as the unit affected.

A warning light and buzzer for item 6 will operate in the cab of the lead unit only when a trailing unit equipped with manually controlled braking has exceeded the braking limits. The light and buzzer will also operate in these trailing units.

LOW LUBRICATING OIL PRESSURE

If oil pressure drops to 30 psi or below the OPS will shut the engine down, sound the alarm bell, light the green Low Lubricating Oil Pressure Light on the Engineman's Control Panel and Starting Indicator Light on the Control Compartment.

HOT ENGINE OR LOW WATER

When engine cooling water temperature reaches 185° F.:

1. The Hot Engine (red) Indicating Light, located on the Control Compartment will light.
2. The Alarm Bell will sound.

When engine cooling water level reaches a predetermined low level in the expansion tank:

1. The Hot Engine (Red) Indicating Light located on the Control Compartment will light.
2. The Alarm Bell will sound and the engine will be shut down.

GROUND RELAY

1. A ground in the power circuit operates the Ground Relay to return the engine to idle, sound the Alarm bell and light the White Ground Indicating Light on the Engineman's Gauge Panel.
The indicator pointer on the Ground Relay will point to the Red Dot. The pointer can be seen through the window on the plate covering the relay and is located in the Control Compartment.

2. To Reset Ground Relay:
 - a. Turn Engine Control Switch to IDLE.
 - b. Push in Ground Relay Reset Button.
 - c. Turn Engine Control Switch to RUN.
 - d. If Ground Relay stays in, continue normal operation.

3. If Ground Relay continues to trip:
 - a. The Motor Cutout Switch (if used) may be used to isolate a faulty truck of motors. For example: reset Ground Relay as outlined in 2 above; turn Motor Cutout Switch to cut out a truck set of motors and start locomotive. Follow same procedure for motors on remaining truck.
 - b. Under extreme emergency conditions; reset Ground Relay as outlined in 2 above, open Ground Relay Cutout Switch in Control Compartment and move locomotive no farther than is necessary observing for smoke or overheating of electrical equipment. If in M.U. operation, the unit should be taken "Off the Line".
 - c. Repeated Ground Relay tripping may indicate a traction motor failure. This might result in a locked axle. A check should be made to be sure all wheels turn freely.

BOILER FLAME OUT (If Used)

If the steam generator stops, the boiler alarm relay closes and causes the White Flame-Out Light to light and the alarm to sound.

DYNAMIC BRAKE WARNING (If Used)

When the dynamic brake limit is exceeded on any trailing unit not equipped with automatically controlled braking, the Brake Warning Light and Buzzer will operate. The Selector Handle must be retarded to a point where the light will not operate.

WHEEL SLIP WARNING

When the Wheel Slip Relays operate, the Wheel Slip Light and Buzzer will operate, power will be automatically reduced and reapplied. For further information see WHEEL SLIP.

CRANKCASE EXHAUSTER

1. The Yellow Crankcase Exhauster Light, located on the Control Compartment Panel, should be ON continuously to indicate that the Exhauster is running.
2. If Light is Out, see that Crankcase Exhauster Breaker is closed. If Breaker is closed and lamp is not burned out, report condition.
3. If Exhauster is not running, the engine should be shut down and the trouble corrected.

JOURNAL BOX HEAT INDICATOR (If Used)

Heat indicators installed in the covers of roller bearing journal boxes emit a pungent odor when journal box temperature reaches 250° F.

DIESEL ENGINE OVERSPEED

If the diesel engine overspeeds, the overspeed mechanism located at the free end of the engine, right side will operate to shut down the engine. At 1135-1175 engine RPM, a trip lever releases a spring loaded shaft which in turn rotates the fuel pump control shaft to shut off the fuel supply.

To reset, turn the reset handle counter-clockwise as indicated by the arrow.

LOCOMOTIVE OVERSPEED (If Used)

Three types of locomotive overspeed devices may be used:

1. An overspeed signal from an axle generator will automatically initiate a service brake application if the speed limit setting is exceeded. An Engineman's warning light in the gauge board will light at 3 MPH below maximum locomotive speed.

2. An overspeed signal from a microswitch in the speed recorder will initiate a service brake application if the speed limit setting is exceeded. No warning is provided.
3. An overspeed signal from the speed governor in the train control system will initiate a service brake application if the locomotive exceeds the maximum speed for the block conditions.

All three systems operate through the PCS switch causing the Diesel Engine to return to idle.

To recover brake: See RECOVERY OF BRAKE AFTER PENALTY APPLICATION.

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