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LOCOMOTIVE CAB DESIGN DEVELOPMENT
Volume II: Operator's Manual

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INTERIM REPORT

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16. Abstract Locomotive Cab 913 designed as a result of Contract DOT-TSC-913 has been built as a hard mock-up. This Operator's Manual is to familiarize the user with the mock-up. Normal and emergency procedures and cab facilities are described.					
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PREFACE

The purpose of contract DOT/TSC-913 is to develop a locomotive cab design based on the operator's functional requirements in train operation. A locomotive cab design has been developed through analysis of functional requirements based on human and other engineering disciplines. Based on this design, a full scale mock-up of the locomotive cab was constructed. This manual has been prepared to familiarize the user with the procedures to be employed when using the mock-up. The authors would like to acknowledge the assistance received from Dr. John P. Jankovich, the contract technical monitor, and Mr. Norman Macdonald of the Electromotive Division of General Motors Corporation.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures				Approximate Conversions from Metric Measures			
Symbol	When You Know	Multiply by	To Find	Symbol	When You Know	Multiply by	To Find
LENGTH							
in	inches	2.5	centimeters	cm	centimeters	0.04	inches
ft	feet	30	meters	m	meters	3.3	feet
yd	yards	0.9	kilometers	km	kilometers	1.1	yards
mi	miles	1.6				0.6	miles
AREA							
in ²	square inches	6.5	square centimeters	cm ²	square centimeters	0.16	square inches
ft ²	square feet	0.09	square meters	m ²	square meters	1.2	square yards
yd ²	square yards	0.8	square meters	m ²	square meters	0.4	square miles
mi ²	square miles	2.6	square kilometers	km ²	square kilometers	2.5	acres
	acres	0.4	hectares	ha	hectares (10,000 m ²)		
MASS (weight)							
oz	ounces	28	grams	g	grams	0.035	ounces
lb	pounds	0.45	kilograms	kg	kilograms	2.2	pounds
	short tons (2000 lb)	0.9	tonnes	t	tonnes (1000 kg)	1.1	short tons
VOLUME							
teaspoon	teaspoons	5	milliliters	ml	milliliters	0.03	fluid ounces
Tablespoon	tablespoons	15	milliliters	ml	liters	2.1	pints
fl oz	fluid ounces	30	milliliters	ml	liters	1.06	quarts
c	cup	0.24	liters	l	liters	0.26	gallons
pt	pint	0.47	liters	l	cubic meters	35	cubic feet
qt	quart	0.95	liters	l	cubic meters	1.3	cubic yards
gal	gallon	3.8	liters	l			
cu ft	cubic feet	0.03	cubic meters	m ³			
yd ³	cubic yards	0.76	cubic meters	m ³			
TEMPERATURE (exact)							
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature

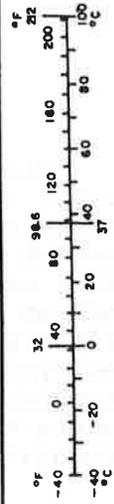
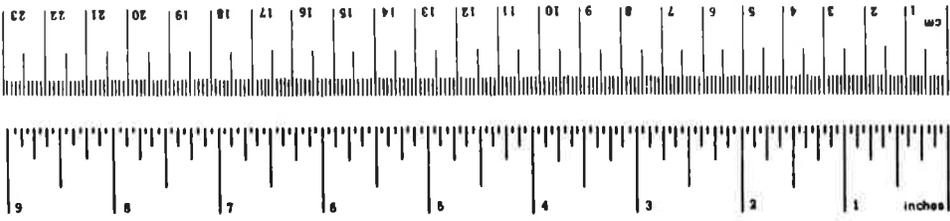


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1. INTRODUCTION

This manual has been compiled as an aid to understanding the operation of the features and equipment of the CAB 913 mock-up. The operating procedures contained herein are not to be construed as an exhaustive survey of train handling techniques or locomotive practices. Rather, they are intended to illustrate the procedures to be followed when using the new cab.

1.1 SIGNIFICANT DIFFERENCES

Since most engine crews using CAB 913 have had considerable experience in conventional locomotive cabs, the significant differences between these cabs are listed below.

1. Controls and displays are conveniently located in front of engineman's seated position on a semi-wrap-around console.
2. For operating the locomotive in reverse, a reverser control panel is located behind the engineman's seated position.
3. Auxiliary controls are located on an overhead control panel.
4. Engineer's emergency brake control is separate from the train brake.
5. Independent brake control has added functions to control brake cylinder pressure during train brake service applications.
6. Throttle and dynamic brake are combined into a recessed wheel-type control that is a continuous control rather than notched.
7. Equalizer reservoir and brake pipe pressure indicators are combined into a vertical tape instrument.
8. Loadmeter and power force indicator are combined into a single duplex meter.
9. A time, speed, distance calculator is provided to check speedometer error, to time short-time ratings on power pointer, and to time train brake tests.

10. Greatly expanded annunciator panel is provided for easier troubleshooting en route.
11. Train handling display is provided so that information on grade, curvature, drawbar forces, and brake pipe pressure gradient is available.

1.2 CAB CHARACTERISTICS

CAB 913 is a functionally designed cab meant to provide the engine crew with a high degree of comfort and efficiency. Cab structure will provide a greater degree of crashworthiness and external visibility than has been available in the past and cab interior will provide a more comfortable and less noisy working environment so that crews will be able to exercise their skill in train handling in a more professional manner. Cab facilities and arrangement can be seen in Figures 1 and 2.



FIGURE 1. CAB EXTERIOR FEATURES



FIGURE 2. CAB INTERIOR FEATURES

2. ENGINEMAN CONTROLS AND DISPLAYS

2.1 MAIN CONTROL PANEL

The main control panel is located directly in front of the engineman's seat on the cab's control desk. All the primary controls needed to operate the locomotive are located on this panel and described below. See Figure 3 for an illustration of this panel.

1. Manual Sand - Pushbutton used to manually apply sand to drive wheels. To activate sanding mechanism, push button in and release. Sander action is verified when pushbutton is lighted. To stop sanding action, push button again and release. Light in pushbutton will extinguish when sanding action stops.
2. Train Brake - T-handle lever used to control air brake action on entire train.

Reset - Spring loaded position used to recover from emergency brake application. Place handle in this position momentarily and then allow it to return to RELEASE position. This resets the electrical circuitry and the train can now be charged.

Release - Used for charging equipment and releasing train brakes. This is normal running position.

Minimum Reduction - Notched position is located by moving handle rearward from "RELEASE". Six- to eight-pound brake pipe reduction is obtained.

Service Range - Variable adjustment of train brake is available between "MIN REDUCTION" and "FULL SERVICE". Any brake pipe reduction up to 23 pounds may be made in this range by properly locating control handle in service range.

Full Service - Notched position denotes maximum available train brake application in service range.

Suppression - Used to suppress an automatic brake application caused by overspeed condition. Brake handle must be placed in this position for appropriate amount of time to recover control of the locomotive.

3. Independent Brake - T-handle lever to control air brakes on locomotive.

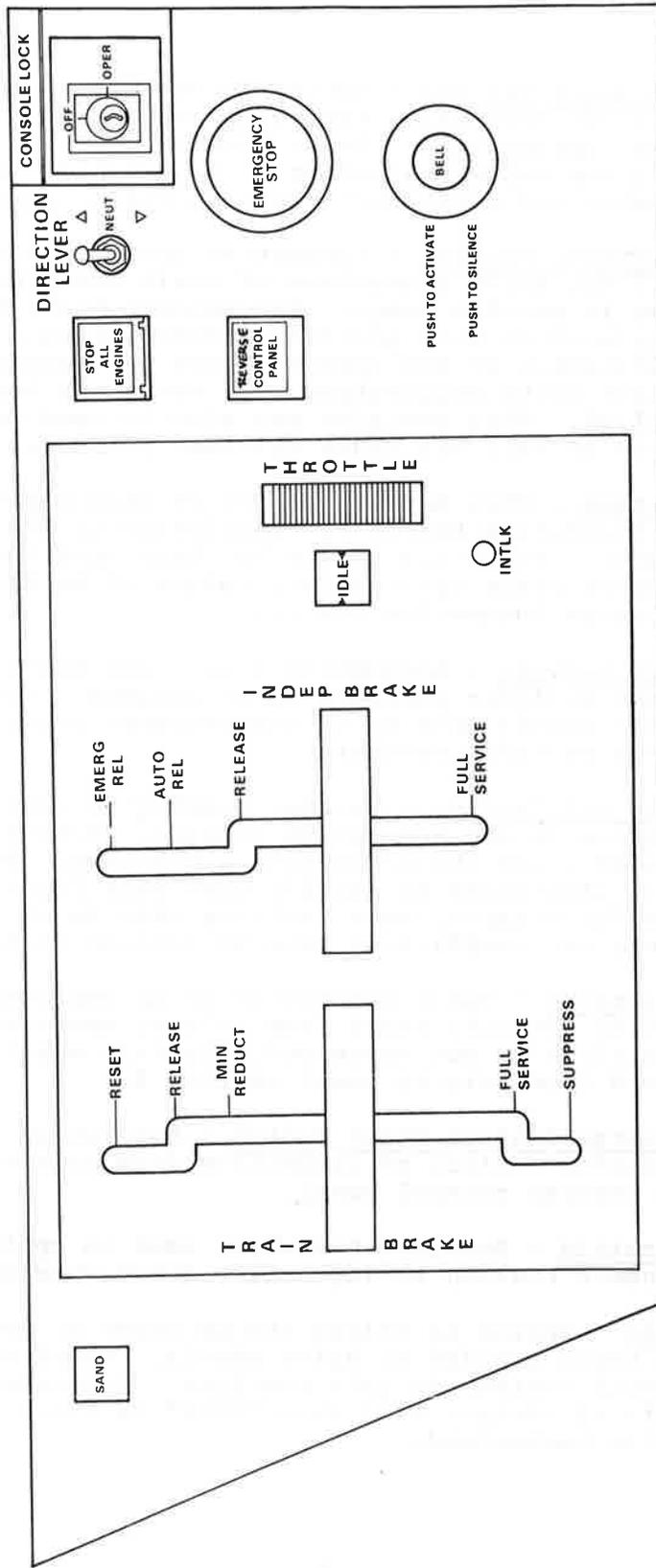


FIGURE 3. MAIN CONTROL PANEL

Emergency Release - Spring-loaded position used to bail off locomotive brakes in case of an emergency brake application. Brake handle must be held in this position while monitoring brake cylinder pressure indicator and draft/buff graph on train handling display.

Automatic Release - Locomotive brakes are released and will not apply regardless of train brake handle position in service range. Independent brake handle must be placed in this position before making a train brake application if the operator does not require a locomotive brake application when the train brakes are applied. This position may also be used on a momentary basis to bail off brake cylinder pressure.

Release - When handle is left in this position, control of locomotive brakes is transferred to the train brake handle. When this handle has been used for an independent brake application, return of handle to this releases locomotive brakes.

Full Service - Locomotive brakes are fully applied and brake cylinder pressure is at maximum. Independent brake handle must be in its rearmost position for full brake cylinder pressure.

4. Stop All Engines - Guarded pushbutton used to stop all engines in the locomotive consist. Activate by lifting hinged guard and depressing pushbutton. Pushbutton will illuminate to signify that this function is active. Use for example, when trailing unit is on fire and there is insufficient time to isolate engine.
5. Interlock - Small pushbutton to be depressed when moving throttle wheel from idle to dynamic braking. If interlock is not depressed, throttle wheel can only be moved from idle to power setting 8.
6. Reverse Control Panel Switch - Pushbutton switch to transfer control of locomotive from main control panel to reverse control panel.
7. Throttle - Recessed handwheel used to apply power or dynamic braking to locomotive drive wheels.

Idle - Engine is idling and no power or dynamic braking is being applied to drive wheels. Wheel control has a smooth surface in this position. Indicator window to left of control will show "IDLE" in black letters with white background.

Power Settings - Wheel control is moved forward to increase power and speed. Indicator window will show control settings 1 through 8 with black numbers on a green background. The control may be set at any point between 1 and 8 for fine setting of the throttle. Wheel surface is ribbed in this area with ribs closer together toward power setting 8.

8. Dynamic Brake - Wheel control is moved rearward after depressing interlock to decrease speed by increasing braking.

Set Up - Pause a minimum of 10 seconds or as otherwise specified. Time delay allows the voltage in the electrical system to decay before it is repositioned for dynamic braking and allows slack to gradually bunch behind locomotive.

Dynamic Brake Settings - Moving wheel control rearward from the SET UP position will increase dynamic braking. Indicator window will show settings from 1 through 8 with black numbers on an orange background. Control may be placed as desired in this operating range either on or between setting numbers. Wheel in this area is grooved with grooves closer together toward dynamic brake setting 8.

9. Direction Lever - Lever lock toggle switch used to set direction of locomotive.

Forward - Indicated by an arrow pointing in the forward direction. Control is set in this position by pulling the switch handle out from the panel and placing in its forward leaning position. Locomotive will move forward when power is applied.

Neutral - Indicated by legend "NEUT". Switch handle in this position is perpendicular to panel face. No power or dynamic braking can be applied to drive wheels regardless of throttle position.

Reverse - Indicated by arrow pointing to rear of locomotive. Control is placed in this position by pulling switch handle out from panel and placing in appropriate location. Locomotive will move in reverse when power is applied.

10. Emergency Stop - Large recessed button used to initiate emergency brake application. Depressing the button initiates a full exhaust at maximum of air from the brake pipe, cuts off the flow of air to the pipe, and initiates a full service application of the independent brake. An emergency stop, once initiated, cannot be overridden.

CAUTION

IMPROPER USE OF EMERGENCY BRAKE MAY RESULT
IN SEVERE SLACK ACTION LEADING TO EQUIPMENT
DAMAGE AND PERSONAL INJURY

11. Bell - Pushbutton control used to activate or silence locomotive bell. When bell is activated the button is illuminated.
12. Console Lock - Key operated pushbutton used to secure control panel against unauthorized use. Key is inserted and turned to "OPERATE" position to operate controls. To lock console, remove key and depress button. Vehicle will operate with key removed if lock is turned to "OPERATE".
13. Feed Valves - Knobs used to set nominal brake pressures. Controls are turned clockwise to decrease pressure and counterclockwise to increase pressure. Both knobs are located behind a panel to the engine-man's right, under the side window.

2.2 MAIN DISPLAY PANEL

The main display panel is located on the rear vertical face of the control console directly in front of the engineman's seated position. All primary displays needed for proper handling of the locomotive are located here. See Figure 4 for an illustration of this panel.

1. Brake Pipe Air Flow - Round dial instrument used to monitor flow of air in the brake pipe. Pointer will deflect to left of 0 when brake pipe is exhausting as in case of brake application or leakage. Pointer will deflect to right of 0 when brake pipe is being charged. Pointer will be stationary when brake pipe pressure is balanced. Adjustable pointer is provided to show leakage rate.
2. Main Reservoir Pressure - Round dial instrument showing main reservoir pressure. Center section of the dial is coded green to indicate operating zone. Red coded sections at each end of the safe zone indicate low and high reservoir pressure. Low pressure can be rectified before a run to more quickly charge the air brake system. Enroute, both a high and low pressure indication when the brake pipe pressure is static is indicative of

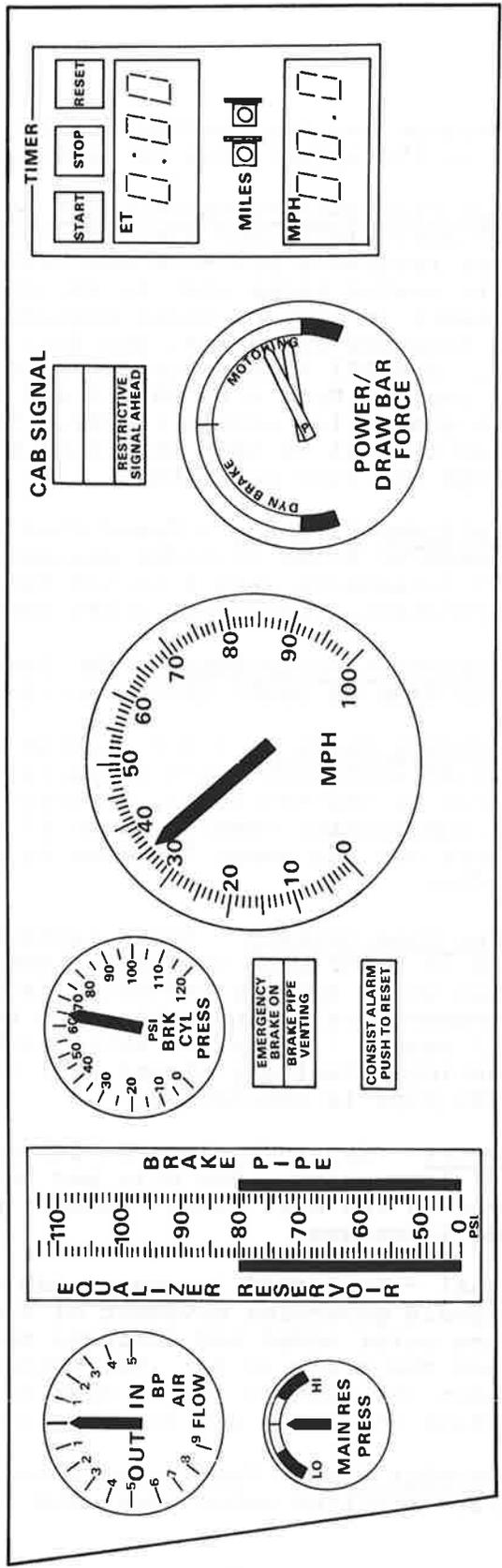


FIGURE 4. MAIN DISPLAY PANEL

a malfunction and may require stopping the train depending on the operational situation.

3. Equalizer Reservoir Pressure/Brake Pipe Pressure - Vertical scale indicator simultaneously displaying equalizer reservoir pressure and brake pipe pressure. The white moving tapes next to the numbered scale show the pressure in each of these systems. The tapes will rise as pressure increases, and fall as pressure decreases. One PSI increments are used in the 50 PSI to 110 PSI range. From 0 to 50 PSI and from 110 to 130 PSI each graduation equals 10 PSI. This indicator is placed so that it is near the train brake control and brake pipe air flow indicator.
4. Brake Cylinder Pressure - Round dial indicator displaying locomotive brake cylinder pressure. Calibration is in 5 PSI increments from 0 to 120 PSI. Pressure is set by manipulating independent brake control.
5. Brake Condition Annunciator - Two legend annunciator lights to display brake system special conditions.
 - a. Emergency Brake On - Red lighted annunciator to warn of emergency brake application, either intentional or unintentional, anywhere in the train. The annunciator remains on until reset by the engineer via the reset function on the train brake handle.
 - b. Brake Pipe Venting - Green lighted display to advise of brake pipe venting. Legend will be illuminated while service reduction is being made, or emergency brake application has been started, and will remain illuminated while brake pipe is exhausting. Auditory signal will also sound while brake pipe is exhausting.
6. Speedometer - Centrally located instrument indicating speed of locomotive. One mile per hour increments are displayed on the dial face. Pointer moves clockwise as speed increases.
7. Cab Signal - Projected images on cab signal faces indicate signals governing movement of train. The two top faces are color coded and indicate signals governing the block the train is in. The bottom face is illuminated when the signals in the next block are more restrictive and is an aid for planning train handling.
8. Power/Drawbar Force - Dual pointer round dial indicator displaying traction motor power and locomotive consist

drawbar force. Pointer labeled "POWER" is similar to loadmeter (ammeter) on earlier locomotives. Power pointer will rotate to right (from neutral mark at top of dial) when throttle is advanced. Green zone denotes safe operating range. Red zone denotes avoid region indicating excessive current being supplied to traction motors. Short time ratings for traction motor loadings in this red region are indicated. To return to safe operating range the throttle should be reduced.

Power pointer will rotate to left from neutral point when locomotive is in dynamic braking. Orange zone denotes safe operating range in dynamic braking. Red zone denotes overload of dynamic brake system to be avoided by reducing braking effort.

Drawbar force of the locomotive consist as a function of tractive effort or dynamic braking is indicated by pointer labeled "FORCE". Pointer will rotate to right from neutral when coupler on locomotive consist is in draft. Pointer will rotate to left when locomotive coupler is in buff. Green and blue bands show safe operating zones in draft and buff respectively. Red bands show danger areas denoting overloads in draft or buff.

9. Timer - Digital instrument for time, speed, and distance calculation. This timer may be used to check for speedometer error, to time brake pipe leakage tests and to keep track of short-time ratings on traction motor power.

Start - Pushbutton to start timing action of calculator.

Stop - Pushbutton to stop timing action of calculator.

Reset - Elapsed time and speed readouts are reset to zero.

ET - Elapsed time readout of timer.

Miles - Manual entry of distance traveled during elapsed time by use of start thumbwheels.

MPH - Average speed of locomotive during ET will be displayed when "STOP" button is pushed.

10. Consist Alarm - The consist alarm is an annunciator that flashes orange when any of the following malfunctions occur in any locomotive in the consist other than the lead locomotive.

- a. Traction Motor Hot
- b. Excitation Limit Exceeded
- c. Crank Case Pressure Low
- d. Hot Engine Condition
- e. No Charge Light

Depressing the annunciator stops the flashing and the light remains on in a steady state until the malfunction is corrected. If a second malfunction occurs while the annunciator light is in a steady state the light will resume flashing. Correct fault or isolate locomotive in consist.

2.3 SECONDARY DISPLAY PANEL

The secondary display panel is located on the section of the console to the engineman's left. This panel contains the CAUTION/WARNING/ADVISORY lights, train handling display, and radio as shown in Figure 5.

1. Radio - Used for communication within train, to dispatcher, other trains, wayside, etc.

Channel - Rotary selector to select operating channel for radio.

Volume - Rotary switch to set volume of radio.

Handset - Earpiece speaker and mouthpiece microphone with "PUSH TO TALK" switch on inside of handset handle.

2. Train Handling Display - Cathode ray tube (TV type) displaying real time train situation. The train is shown as a heavy black line with the track grade below it. The train is stationary, but the grade profile moves under it giving the impression that the train is moving from left to right. The train, grade profile and numbered mile posts are always present on the display. Train length and weight distribution information are inserted into a mini-computer that drives the CRT display. The thickness of the line representing the train indicates train make up. The heaviest part of the line indicates the heaviest part(s) of the train. In addition to the above features there are selectable optional real time displays.

Grade - Selecting track grade causes an alpha numeric readout showing grade directly under the train and two miles ahead in percent. The numerical grade is followed by a D or U to indicate an up or down grade.

Draft/Buf - Selecting draft/buff causes the drawbar forces along the train to be displayed in graphic form

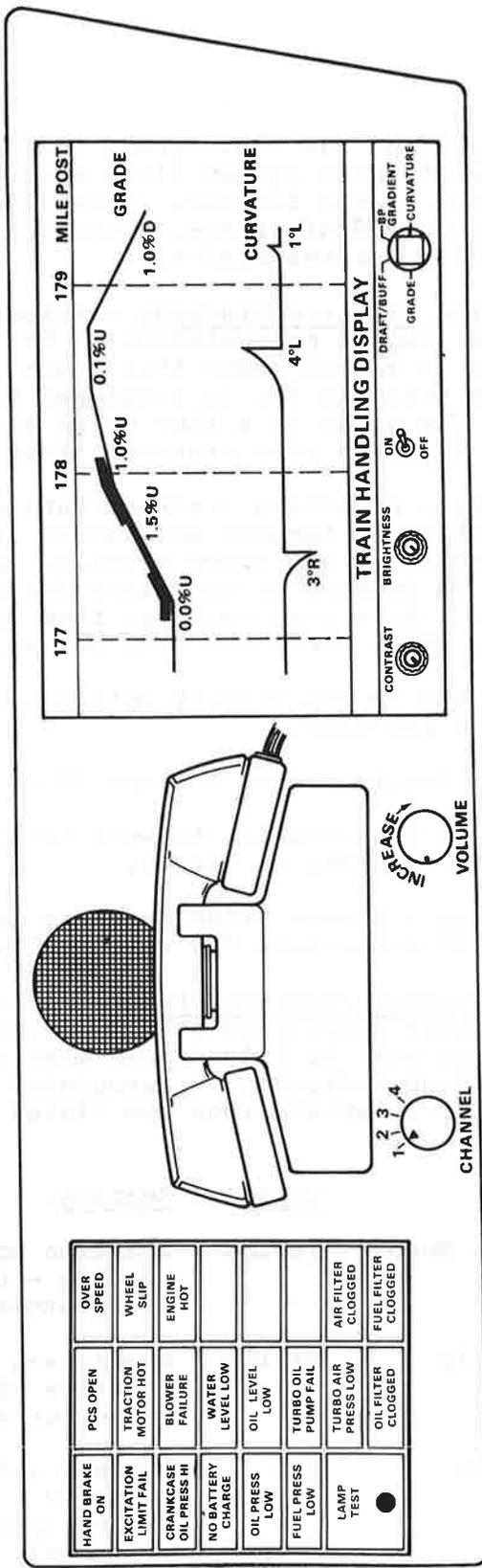


FIGURE 5. SECONDARY DISPLAY PANEL

directly under the train/grade indication. The graph consists of three dotted lines across the top, middle and bottom of the display. These lines indicate maximum allowable draft force, neutral and maximum allowable buff force respectively.

Brake Pipe Pressure Gradient - Selecting this option causes a graphic presentation of train lined brake pipe pressure to appear under this train and track profile. Pressure scale in PSI is displayed to the left of the graph. The graph is a line whose slope corresponds to changes in brake pipe pressure along the train.

Curvature - Selecting track curvature causes a graphic presentation of tangent and curved track to appear under the train and track profile. Curve severity is labeled in degrees of curvature for a 100 foot section of track. Mile post markings from grade display aid in locating curve start and stop points.

In addition to the display options, the following controls are provided.

ON-OFF - Toggle switch to turn TV on or off.

Contrast - The contrast between the display image and the background may be varied.

Brightness - Screen brightness may be varied from low to high to compensate for ambient light conditions.

3. Caution/Warning/Advisory Panel - A series of indicator lights displaying status of locomotive systems. Indicators will be illuminated when unusual conditions exist. Each indicator is associated with one particular fault. Explanations are listed below.

<u>Legend</u>	<u>Color</u>	<u>Meaning</u>
Traction Motor Hot	Yellow	Traction motor is overheating - damage will occur if throttle is not reduced
Wheel Slip	Yellow	Wheels are slipping - tractive effort must be reduced, or sanding initiated
Overspeed	Red	Maximum safe speed has been exceeded - take action to reduce speed or penalty brake will apply

<u>Legend</u>	<u>Color</u>	<u>Meaning</u>
Excitation Limit Fail	Yellow	Generator excitation protection system has failed - cut tractive effort
PCS Open	Yellow	Pneumatic control switch has opened - apply brake handle to "suppression" followed by "reset" on train brake control
Crankcase Oil Press Hi	Yellow	Oil pan pressure in engine is high
Engine Hot	Yellow	Engine has overheated
No Battery Charge	Yellow	Battery charging system has failed
Oil Level Low	Yellow	Lube oil system does not have sufficient oil
Blower Failure	Yellow	Equipment blower has failed
Air Filter Clogged	Yellow*	Engine air filter is no longer serviceable
Turbo Air Press Low	Yellow*	Turbo charger is not providing enough boost for proper power development
Fuel Press Low	Yellow	Engine fuel pressure insufficient
Oil Press Low	Yellow	Oil pressure insufficient for safe operation
Oil Filter Clogged	Yellow*	Lube oil filter is clogged and is being bypassed
Fuel Filter Clogged	Yellow*	Fuel filter is no longer serviceable
Turbo Oil Pump Fail	Yellow	Pump supplying oil to turbo-charger has failed
Water Level Low	Yellow	Engine coolant level is low
Hand Brake	Green	Hand brake is applied

*These annunciators will be behind a maintenance advisory cover for use by maintenance personnel and will not activate consist alarm.

Lamp Test - Momentary pushbutton to test lamps in Caution/Warning/Advisory panel; when button is pushed in all lights should illuminate. Indicators that do not illuminate have burned out bulbs or other malfunction. The lamps should be tested periodically.

2.4 OVERHEAD CONTROL PANEL

The overhead control panel is located directly in front of the engineman above the windshield. Controls located on this panel are functionally grouped as shown in Figure 6.

1. Dynamic Brake Cutout - The dynamic brake cutout is a two position slide switch. Moving the switch to the cutout position makes the dynamic brake inoperative in the controlling unit without affecting other locomotives in the consist.
2. Generator Field - The generator field switch is a two position slide switch that turns the generator field in the main generator on and off.
3. Engine Run - The engine run switch is a two position slide switch. In the on position the switch couples the engine to the throttle control.
4. Fuel Pump - The fuel pump control is a two position slide switch that turns the fuel pump on and off.
5. Ground Relay Reset - Push button control will light the word "RESET" when ground relay must be reset. When the light comes on, it indicates the generator has unloaded and engine has returned to idle because of a high voltage ground. If this occurs push button in and hold until light goes out signifying ground relay has been reset.
6. Cab Temperature Control - Slide type thermostat to set cab temperature.
7. Air Conditioner - Push button switch to activate air conditioning unit.
8. Heat - Push button switch to activate heating unit.
9. Class Lights - Rotary selector to turn on and select color of classification lights.
10. Traction Motor Cutout - This four position rotary switch is used for cutting out a defective traction

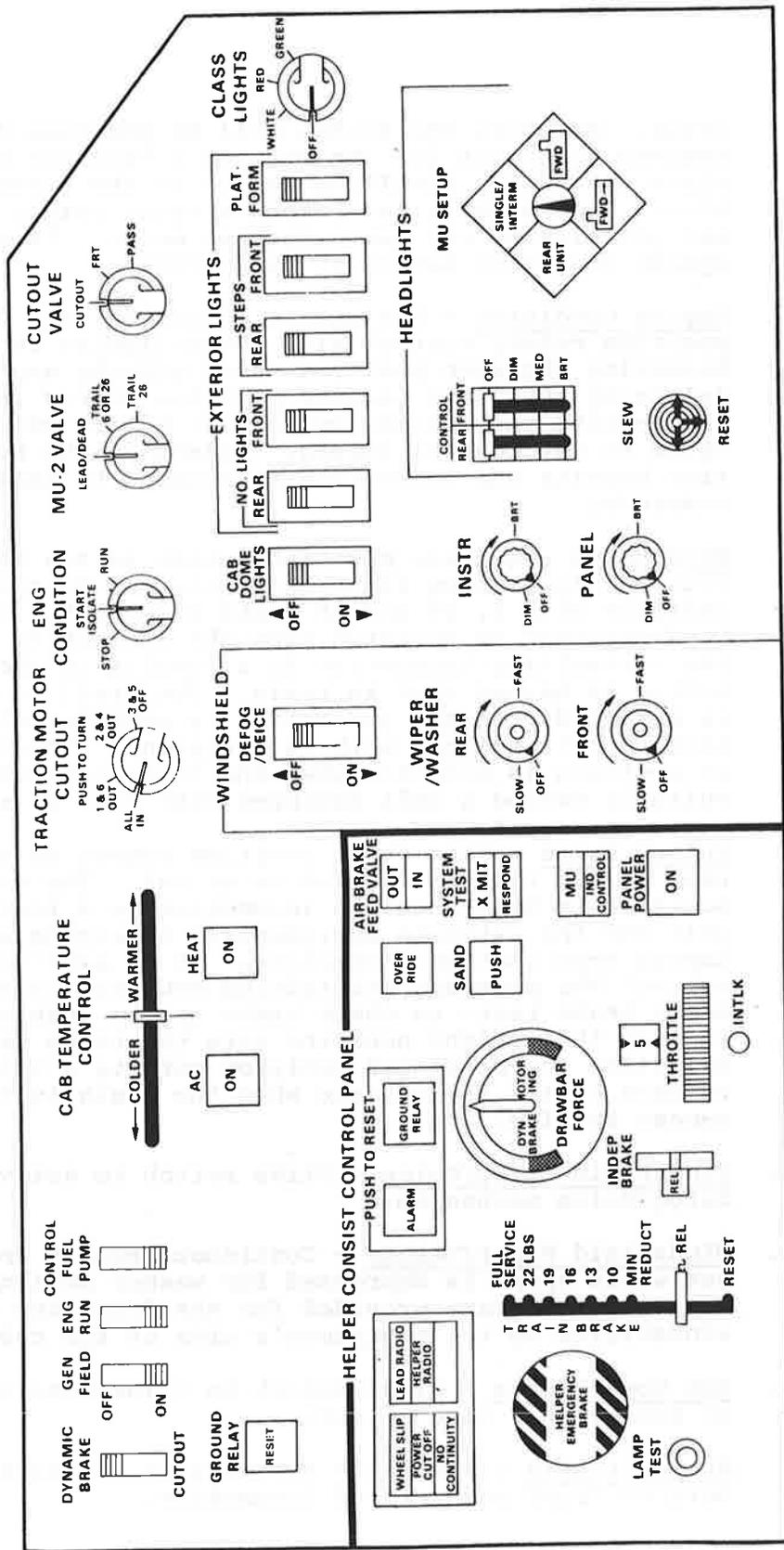


FIGURE 6. OVERHEAD AUXILIARY CONTROL PANEL

motor. Normally the switch will be positioned for all engines to be cut in. To cut out a traction motor place the ENGINE CONDITION switch in the start position. Then push in the traction motor cutout switch and position to cut out defective motor. Then place engine condition switch in run position.

11. Engine Condition - The engine condition is a three position rotary control with the following functions. Selecting the stop position shuts off the engine. Selecting the start isolate position starts the engine and permits the locomotive to idle but it will not respond to any control inputs. Selecting the run position permits the locomotive to respond to input commands.
12. MU-2 Valve - A three position rotary switch that permits the locomotive air brake equipment to operate in multiple with 6, 24 and 26 brake equipment. The Lead/Dead position is selected when the locomotive in either the controlling locomotive in a consist or when locomotive is hauled dead in train. The trail 24 position is selected when the locomotive is used in multiple behind a unit equipped with 24 equipment. The trail 6 or 26 position is selected when the locomotive is used in multiple behind a unit equipped with 6 or 26 equipment.
13. Cutout Valve - This three position rotary selector is used to cut the brake valve in or out. The cutout position is used when the locomotive is a trailing unit and the airbrake equipment is receiving command inputs from another locomotive. It is also used to cut out the pressure maintaining equipment when making train brake tests to check brake system leakage. Selecting the freight position cuts the brake valve in. Selecting the passenger position permits a graduated release of the train brake when the train is in passenger service.
14. Windshield Defog/Deice - Slide switch to activate defog/deice mechanism.
15. Windshield Wiper/Washer - Continuous rotary knob to set wiper speed is depressed for washer action. Separate knobs are provided for the front and rear windshields on the enginemen's side of the cab.
16. Cab Dome Lights - Slide switch to illuminate cab area on engineman's side of cab.
17. Number Lights - Two slide switches to illuminate numbers on front and rear of locomotive.

18. Step Lights - Two slide switches to illuminate steps on front and rear of platform.
19. Platform Lights - Slide switch to illuminate platforms on side of locomotive.
20. Spare - Slide switch available for future growth.
21. Instrument Lights - Continuous rotary knob to set light levels for instruments.
22. Panel Lights - Continuous rotary knob to set light levels for illuminated legends on control panels.
23. Headlight Control - Two notched lever switches to independently control front and rear headlights.
24. Headlight MU Set-Up - Four-position rotary selector to set up headlights for MU operation.
25. Headlight Slew - One headlight is steerable by using this momentary 3-way switch.

2.5 HELPER CONSIST CONTROL PANEL

This portion of the overhead control panel controls the operation of a helper consist remotely located in the train.

1. Wheelslip - Indicator light denoting helper consist is slipping wheels.
2. Power Cutoff - Indicator light denoting a power loss in the helper consist due to a locomotive malfunction.
3. No Continuity - Indicator light denoting interruption of radio communication between the two consists.
4. Lead Radio - Indicator light denoting a malfunction in lead radio; back-up radio is functioning.
5. Remote Radio - Indicator light denoting malfunction in radio on helper; back-up radio is functioning.
6. Helper Emergency Brake - Large recessed push button to initiate emergency braking at the helper consist.
7. Lamp Test - Push button to test lights on panel.

8. Train Brake - Notched lever to set brake pipe pressure at helper consist. Functional positions are same as on main control panel except test brake pipe reduction positions are notched at 3 PSI intervals.
9. Independent Brake - Star thumberwheel to set locomotive brakes. Thumberwheel is notched at 10 PSI intervals.
10. Alarm - Lighted pushbutton to indicate malfunction in helper consist. Button is pushed to reset and silence audible alarm.
11. Ground Relay - Lighted pushbutton to indicate that ground relay needs resetting. Button is pushed to reset.
12. Drawbar Force - Round dial instrument to display drawbar force at the rear of the helper consist. Display format is same as drawbar force on main display panel.
13. Interlock - Small push button that is depressed to allow throttle to go into dynamic braking.
14. Throttle - Recessed wheel control to set power and dynamic braking. From idle, the wheel is moved to the right to increase power. From idle, the wheel is moved to the left, after depressing the interlock, to engage dynamic braking. Position markings are the same as throttle wheel on main control panel.
15. Override - Push button illuminates when depressed to keep helper consist in power or dynamic braking. It is used whenever radio communications between lead and helper consist may be interrupted due to obstructions such as tunnels or cuts.
16. Sand - Push button illuminates when depressed. It is used to activate sanding mechanism on helper consist.
17. Air Brake Feed Valve - Push button to control action of feed valve in helper consist. Button is depressed to change modes. When feed valve is cut out, top portion will light. Bottom portion will light when feed valve is cut in.
18. System Test - Before starting runs and when radio system integrity is in doubt, depress button until "Xmit" portion illuminates. Release button and wait for "respond" portion to momentarily illuminate. If either portion of push button does not illuminate, radio system to remote unit has a malfunction.

19. MU/IND Control - Push button to put helper consist in MU or independent control. In MU the controlling and helper consists are synchronized with the helper consist responding to throttle and brake commands from the lead consist. IND, independent control allows the use of power on the helper consist when the lead consist is in idle or dynamic braking.
20. Panel Power - When push button is depressed and illuminated, power to panel is on. If button is again depressed and released, extinguishing the light, power is off.

2.6 REVERSE CONTROL PANEL

The reverse control panel is a swing-out control panel located on the right wall of the cab behind the engineman's seated position. This panel is to be used when the locomotive is operated in reverse and using the controls on the main control panel is inconvenient. Engineman's chair may be rotated 180° to take advantage of rearward vision through the windows in the rear doors. When not in use, panel is recessed into wall and held in place by a latch. Releasing latch will allow panel to swing out into position ready for use. Panel is activated by a pushbutton on the main control panel. Panel face is shown in Figure 7 and details are listed below.

1. Emergency Stop - Large pushbutton to initiate emergency braking.
2. Direction Lever - Lever locked toggle switch used to set direction of locomotive. The switch is activated by lifting the switch handle away from the panel and moving it forward into the reverse position or to the rear into the forward position.
3. Train Brake - Slide control to set brake pipe pressure. Positions provided are:

Release - Detent position releases train brakes and restores full brake pipe pressure.

Minimum Reduction - Notched position applies minimum train brakes by reducing brake pipe pressure 6-8 PSI.

Service Range - Service brake application is available between "MIN REDUCT" and "FULL SERVICE" similar to train brake control on main control panel.

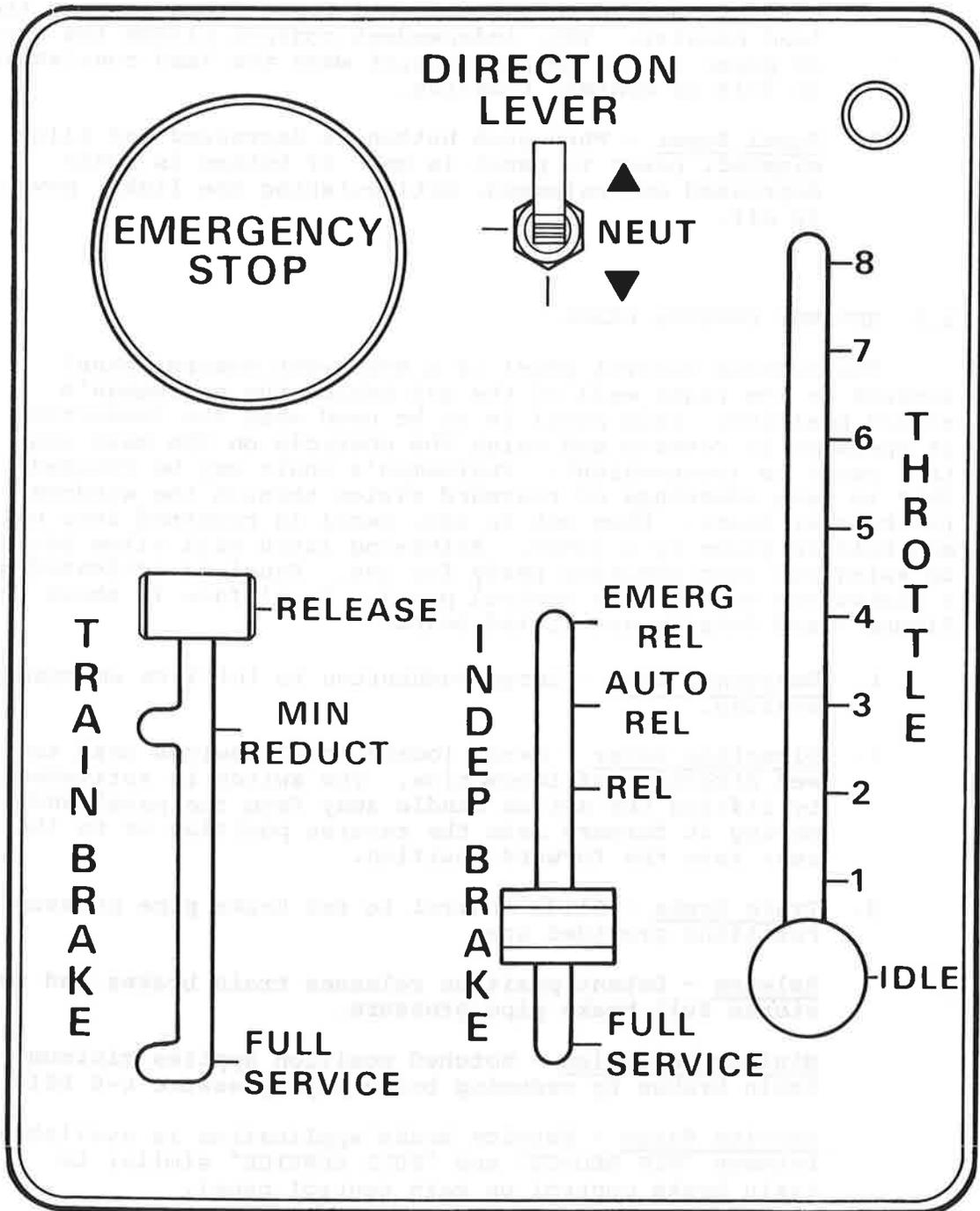


FIGURE 7. REVERSE CONTROL PANEL

Full Service - Full service braking is obtained in this position.

4. Independent Brake - Slide control to set locomotive brake cylinder pressure.

Emergency Release - Spring-loaded position to bail off locomotive brakes in case of an emergency brake application. Brake handle must be held in this position while monitoring brake cylinder pressure indicator on main instrument panel.

Automatic Release - Selection of this position releases the locomotive brakes. The locomotive brakes will not apply when a service application of the automatic brake is made. This position may also be used on a momentary basis to bail off brake cylinder pressure.

Release - Locomotive brakes are released and brake cylinder pressure will be reduced to zero.

Service Range - Service brake application on locomotive is available between "RELEASE" and "FULL SERVICE".

Full Service - Maximum brake cylinder pressure resulting in full service brake application on locomotive.

5. Panel Power Indicator Light - This light (located in upper right corner) is illuminated when remote control panel is active. Panel is activated by guarded push button on main control panel.
6. Throttle - Slide control to apply tractive effort. Positions are "IDLE" and eight throttle settings. Maximum tractive effort is obtained in position 8.

3. LEFT SEAT CONTROLS AND DISPLAYS

This crew station is located on the left side of the cab and contains the controls and displays necessary for the proper execution of brakeman or fireman duties. The controls and displays are listed below and console configuration may be seen in Figure 8.

3.1 CONSOLE

1. Speedometer - Indicates speed of locomotive. One mile per hour increments are displayed on the dial face. Pointer moves clockwise as speed increases.
2. Cab Signal - Projected images on cab signal faces indicate signals governing movement of train. The two top faces are color coded and indicate signals governing the block the train is in. The bottom face is illuminated when the signals in the next block are more restrictive and is an aid for planning train handling.
3. Lighting Switch - Continuous rotary knob to set light levels on instrument panel.
4. Heating/Air Conditioning Switch - Thermostat slide to set temperature on brakeman's side of cab.

3.2 EMERGENCY BRAKE VALVE

Lever type control for initiating emergency brake application. Lever is pulled out of recess for activation.

3.3 COMMUNICATION HANDSET

Handset and speaker for radio communication is available on the right side of the helper's console.

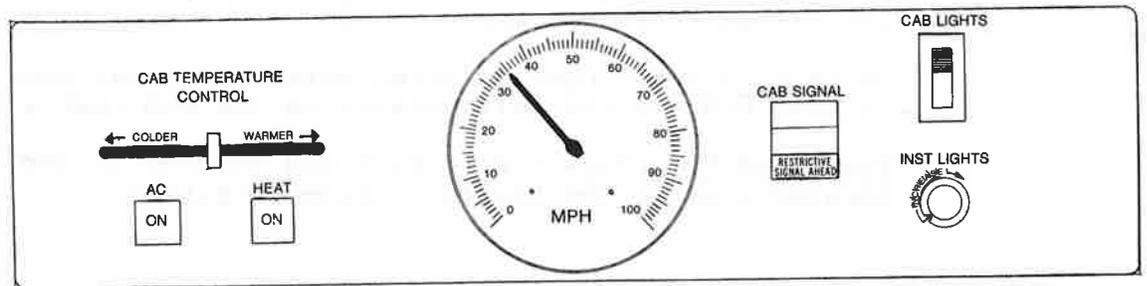


FIGURE 8. ENGINEER HELPER'S PANEL

4. CAB FACILITIES

General cab facilities not directly associated with a particular crew station are listed below. These facilities are shown in Figures 9 and 10.

1. Trash Container - Trash receptacles are provided at each crewman's station and in the lavatory.
2. Stowage - Provisions for stowage of crew personal gear carried on the locomotive are in the rear of the cab next to the left rear door.
3. Lavatory - Toilet and washroom facilities are located in the rear of the cab.
4. Food Storage - A refrigerator is mounted on the rear wall of the cab above the stowage closet. Food and authorized beverages may be cooled and stored here.
5. Drinking Water - Cool drinking water and paper cups are located next to the refrigerator on the cab rear wall.
6. Fuses and Torpedoes - Fuse rack and torpedo holder is located next to the helper's seated position.

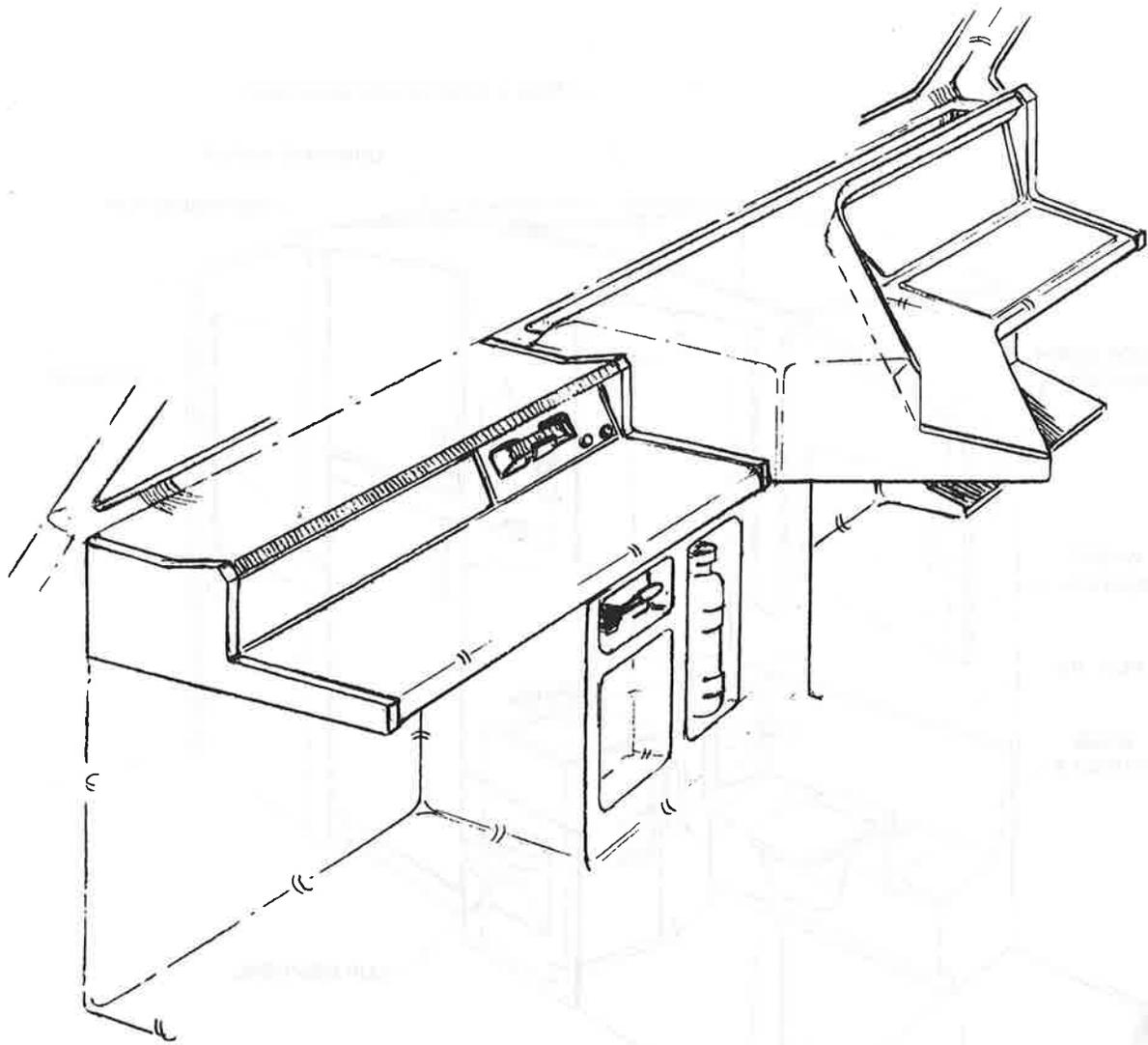


FIGURE 9. PICTORIAL OF HELPER'S CONSOLE

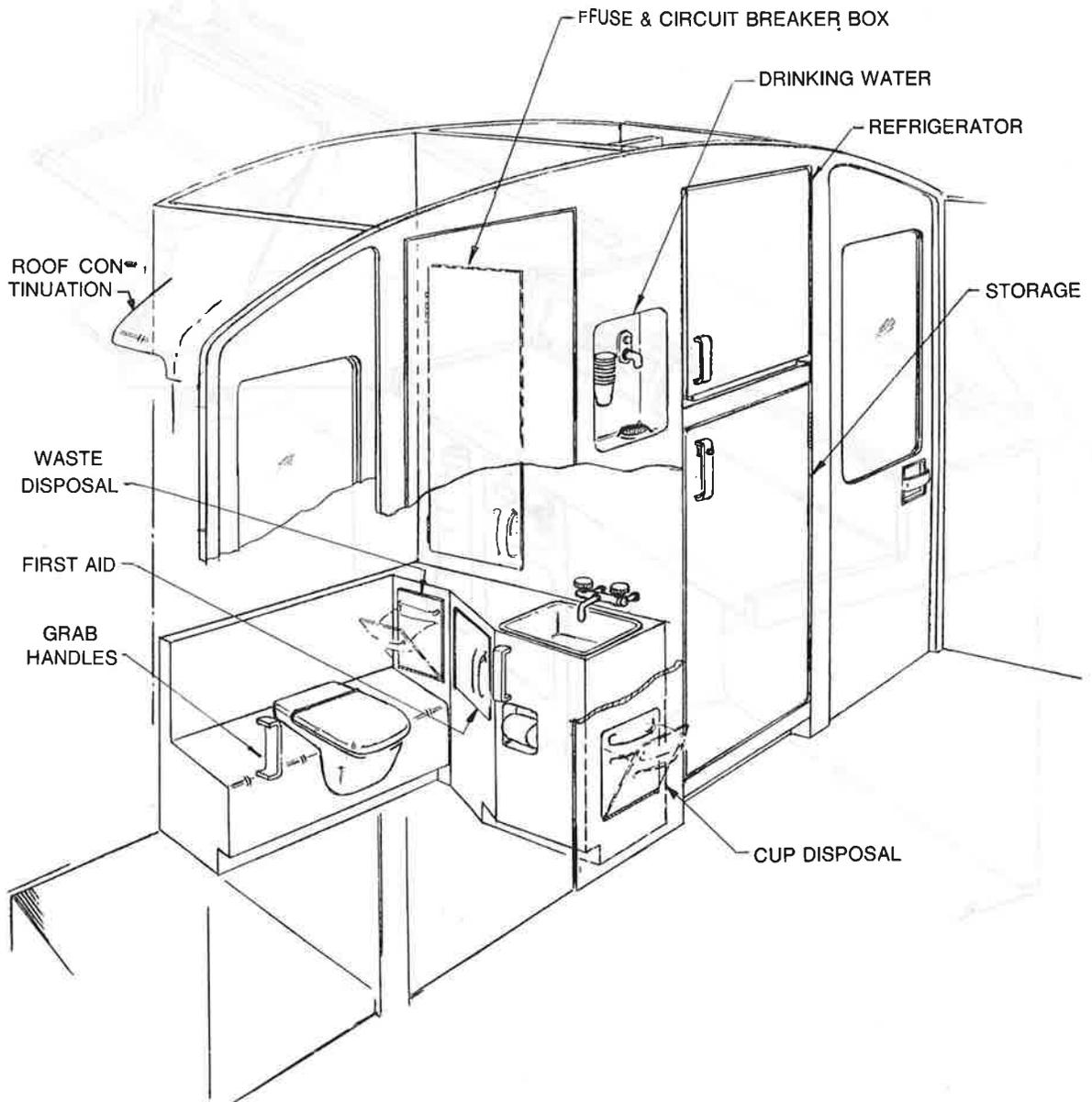


FIGURE 10. PICTORIAL OF CAB REAR WALL

5. EMERGENCY PROVISIONS

5.1 INGRESS/EGRESS

Normal and emergency escape/rescue is through the two doors in the rear of the cab. Additional emergency escape/rescue points are:

Side Windows - Windows slide open toward rear.

Front Windshields - Windshields may be removed by pulling a small handle located on the rubber stripping around the glass. When handle is pulled the rubber stripping is exposed and can be pulled away to remove the window. Instructions for use are printed on inside and outside of cab.

Roof Hatch - In case of roll-over, hatch will be accessible for escape/rescue. Hatch is opened by unlocking and rotating two securing levers and pulling hatch in.

NOTE

THE ENTIRE TRAIN AND ENGINE CREW SHOULD BE FAMILIAR WITH AND KNOW THE LOCATION OF FIRE EXTINGUISHERS, AND FIRST AID KITS. IF IN DOUBT AS TO PROCEDURES TO BE USED IN CASE OF FIRE ON LOCOMOTIVES CHECK WITH ROAD FOREMEN, SAFETY DEPARTMENT, SUPERVISOR OF LOCOMOTIVES, MASTER MECHANIC OR FIRE CHIEF.

5.2 FIRE

1. Fire extinguisher is provided in cab next to brakeman's seat.
2. Guarded push button on main control panel will stop all engines in locomotive consist in case of fire, smoke, or other emergency.
3. Engine condition switch on overhead panel will stop engine on locomotive in case of emergency
4. Fuel pump cutoff switch on overhead panel will stop fuel flow to engine in case of fire.

5.3 FIRST AID

First aid kit available in recessed cabinet in toilet compartment.

6. OPERATING PROCEDURES

6.1 PRE-RUN PREPARATION (Lead Unit or Trail Unit)

1. Fuse and switch panel (located in lavatory compartment). Place switches in positions as specified by governing authority.
2. Overhead control panel. Place switches in positions as specified by governing authority.
3. Check main control panel to see that:
 - a. Throttle is in IDLE.
 - b. Direction lever is in NEUTRAL.
 - c. Console lock is pushed in and key removed.
 - d. Train brake is in suppression.
 - e. Independent brake is in full application.
 - f. Stop all engines is not illuminated.
4. Energize powerplant by turning fuel pump ON and turning engine condition switch to START ISOLATE.
5. Check main reservoir pressure - pointer must be in green band before proceeding.
6. Locomotive brake test
 - a. Check main reservoir pressure - pointer in green band.
 - b. Unlock console by inserting key and turning to operate position.
 - c. Check hand brake indicator light - green "HAND BRAKE ON" light must be illuminated indicating hand brake is applied.
 - d. Train brake placed in release position.
 - e. Independent brake placed in release position.
 - f. Check brake cylinder pressure - must be 0.

- g. After placing independent brake in full application the brake cylinder pressure gage should show increase in pressure to maximum pressure as specified by operating authority.
 - h. Turn on step and platform lights
7. Train Brake Test
- Train brake test are performed as specified by governing authority. Use should be made of "Brake Pipe Venting" indicator, air flow gage, timer, and train handling display to take full advantage of these facilities.
8. Sanding Test
- a. Depress manual sand button - button should illuminate and latch in the down position.
 - b. Ground observer should check to see that sand is being properly applied.
 - c. Depress manual sand button - button should be popped out and not illuminated. Sanding action should stop.
9. Leave track and perform cab signal test.

6.2 RUNNING PROCEDURES

1. Pre-Start Checkout
- a. Throttle - move to idle
 - b. Direction lever - move to neutral
 - c. Brakes - set as required
 - d. Generator field place switch - in ON position
 - e. Engine run place switch - in ON position
 - f. Ground relay reset - assure button is not lighted
 - g. Cab temperature control - set it comfortable
 - h. Class lights - set to appropriate color
 - i. Traction motor cutout - set to appropriate position
 - j. Cutout valve - set to FRT or PASS

- k. Windshield defog/deice - set as needed
 - l. Windshield wiper/washer - set controls as needed
 - m. Cab dome lights - set as needed
 - n. Number lights (rear and front) - ON
 - o. Instrument and panel lights - set as needed
 - p. MU setup - set to "SINGLE/INTERMEDIATE" if locomotive is operated as single unit or is intermediate unit consist. Select "REAR UNIT" if operated as rear unit in consist, select bottom position if operated as lead unit with long hood forward, and right position if operated as lead unit with cab end forward.
 - q. Headlight control - set to position required by governing authority
 - r. Headlight slew - push switch to right to adjust movable headlight to right, push to left to adjust headlight to left, push toward "RESET" to center the movable headlight.
 - s. Check caution/warning/advisory panel - assure that all indicator lights are not lighted. If indicator is lighted, correct fault before proceeding, except lube pump which will stay on for 30 minutes.
 - t. Check train handling display to assure all display modes are operating.
 - u. Perform communications check on radio
 - v. Perform cab signal check
2. Starting Train
- a. Release train brakes allowing sufficient time for all brakes in train to release. Train handling display may be used to verify when brake pipe pressure has stabilized.
 - b. Check main reservoir pressure - pointer must be in green band
 - c. Move direction lever in desired direction

- d. Release independent brake
- e. Move throttle wheel forward to move train
- f. Read power/drawbar force meter
- g. Roll throttle forward to achieve desired acceleration without allowing either "FORCE" or "POWER" needles on power/drawbar force meter to cross into red zone. Throttle settings are numbered 1 through 8 on a green background.

3. Accelerating Train

- a. Throttle wheel is a variable control allowing operator to place throttle between numbered settings to achieve desired tractive effort. However, advancing the throttle more than one numbered setting at a time is not desirable to prevent wheel slipping.
- b. Desired acceleration can be achieved by noting rate that speed increases and holding "FORCE" pointer on power/drawbar force meter steady by gradually advancing throttle when force pointer moves back toward center of dial.
- c. "FORCE" pointer and "POWER" pointer on power/drawbar force meter must be carefully monitored to assure that neither pointer crosses into the red zone. If either pointer crosses into the red zone, throttle may be reduced to avoid this condition.
- d. Draft/buff indication on train handling display must be monitored to assure that drawbar force is not exceeded throughout length of train. If curve climbs too rapidly toward a maximum level, or exceeds the maximum level, corrective action must be taken to prevent excessive forces from building up.

4. Train braking - speed may be decreased by using any one, or combination, of the following methods:

- a. Roll throttle wheel back to sufficiently decrease tractive effort and reduce speed. Train handling display may be used to review grade and curvature characteristics. Rate of change of speed should be noted so that new target speed will be met without excessive throttle movements.
- b. Dynamic brakes are activated by assuring throttle is in idle, depressing interlock button and rolling throttle wheel back to "SET UP" position. After

pausing in "SET UP" for a period specified by the governing authority the throttle wheel may be rolled back into dynamic brake to slow the train. The dynamic brake positions are numbered 1 through 8 on a blue background. When throttle is placed in dynamic braking power/drawbar force pointers will move into blue dynamic brake band. Neither pointer should be allowed to move into the red zone. Train handling display may be used to monitor drawbar force throughout the length of train to assure that maximum forces are not exceeded. If graph of draft/buff force drops below neutral line too rapidly or exceeds maximum buff limit at bottom of display, throttle wheel may be rolled forward a sufficient amount to reduce danger of exceeding drawbar force limit.

- c. Train brakes operate in a manner similar to 26L brake equipment. Pulling the train brake handle back in the service range decreases equalizer reservoir and brake pipe pressure. Brake system values are indicated on the vertical tape instrument on the main display panel. Emergency brake function is on right side of panel.
- d. Independent brakes are operated in the same manner as 26L brakes in the service range except for bail-off. See Section 4 for explanation of release, auto release, and emergency release positions.
- e. Emergency brakes may be used in either of two ways. Push button labeled "EMERGENCY STOP" will activate emergency brakes when depressed. Red handle at brakeman's console will activate emergency brakes when pulled. Red "EMERGENCY BRAKE ON" indicator light will illuminate when emergency brakes are applied.

During emergency brake application (either intentional or unintentional) locomotive brake application may not be desired. To counteract locomotive brake application during emergency braking, place independent brake handle in "EMERGENCY RELEASE" position. This position is spring-loaded and handle must be held in this position until brake cylinder gauge displays "O". Locomotive brakes may be re-applied as specified by governing authority.

Emergency brakes may be released by placing the emergency brake control that was used into normal "OFF" position. When train has stopped, brake pipe has stopped venting, as indicated by the green "BRAKE PIPE VENTING" indicator light no longer being

lighted, and train handling display shows no pressure in brake handle in "RESET" position. When brake pipe pressure has been restored, place train brake handle in "RELEASE" and resume mission.

5. Operating Train in Reverse
 - a. Train must be at a complete stop
 - b. Throttle must be in "IDLE"
 - c. Pull direction lever toggle switch out from panel and place into appropriate position. Switch handle should point in direction locomotive must move.
 - d. Release brakes and apply tractive effort by rolling throttle wheel forward as required.
6. Changing control position from main control panel to reverse control panel
 - a. Main control panel setup
 - (1) Direction lever - "NEUTRAL"
 - (2) Throttle wheel - "IDLE"
 - (3) Train brake - "RELEASE" or specified by governing authority
 - (4) Independent brake - "Full application" or as specified by governing authority
 - (5) Bell - OFF
 - (6) Emergency stop - Off
 - (7) Sand - OFF
 - (8) Console lock - OPERATE
 - (9) Remote control panel switch - on
 - b. Reverse control position setup
 - (1) Throttle - "IDLE"
 - (2) Train brake - "RELEASE" or as specified by governing authority
 - (3) Independent brake - "Full Application" or as specified by governing authority

- (4) Emergency stop - OFF
- (5) Direction lever - "NEUTRAL"
- (6) Panel power - ON

c. Operation - controls on this panel operate in the same manner as controls on the main control panel with the exception of the throttle. This control is a slide that increases or decreases power. No dynamic braking is available.

6.3 POST-RUN PROCEDURES

- 1. Note all malfunctions, failures, performance parameters, on appropriate form.
- 2. Throttle - "IDLE"
- 3. Direction lever - "NEUTRAL"
- 4. Train brake - "SUPPRESSION"
- 5. Independent brake - full application
- 6. Generator field switch - OFF
- 7. Console lock-key removed and button depressed
- 8. If engine is to be shut down, move engine condition switch to STOP position. Engine will immediately shut down.

