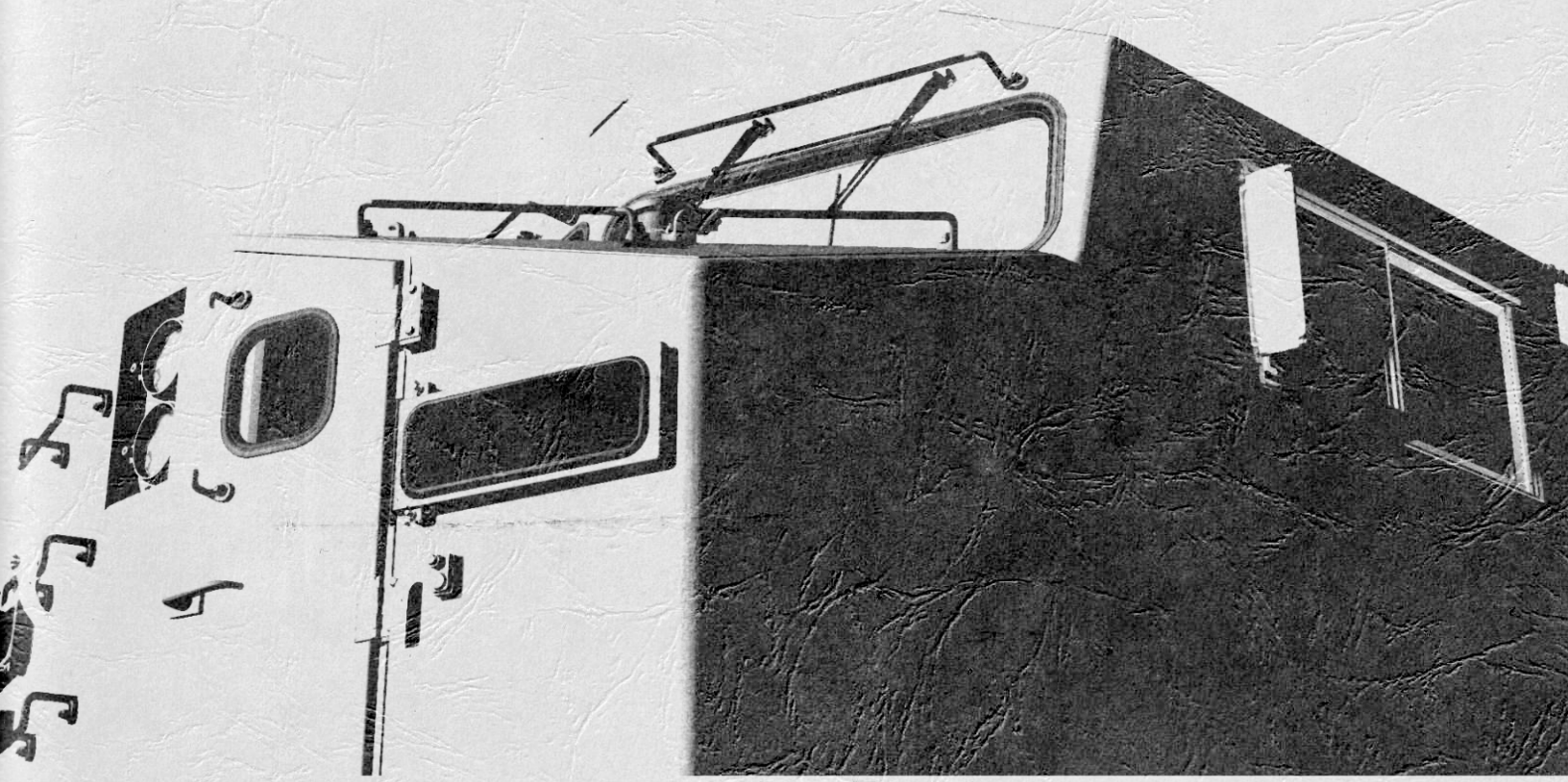
SEARCHLIGHT SIMULATIONS

AC4400CW
Locomotive



Operating Manual

OPERATING MANUAL

AC4400 DIESEL–ELECTRIC LOCOMOTIVES

WITH INTEGRATED FUNCTION CONTROL

FOR CPR ROAD NUMBERS: 8600 – 8655 and 9700 – 9740

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These instructions do not purport to cover all details or variations in equipment represented in-game nor to provide for every possible contingency to be met in connection with operation. Should further information be desired or should particular problems arise which are not covered sufficiently for the user's purposes, the matter should be referred to Searchlight Simulations LLC.

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THIS OPERATING MANUAL IS INTENDED FOR THE USE IN TRAIN SIMULATOR ONLY. SPECIFIC PORTIONS OF THE ORIGINAL MANUAL HAVE BEEN INTENTIONALLY LEFT OUT. DO NOT ATTEMPT TO USE FOR REAL-LIFE TRAINING.

Revisions are indicated by margin bars.

FOREWORD

NOTE: The purpose of this manual is to act as a guide in the operation of this locomotive.

Welcome to the Searchlight Simulations AC4400 in Canadian Pacific's “Golden Beaver” livery. We have spent the last five years committed to researching every nut and bolt of the AC4400, as well as ensuring the operational practices used by Canadian Pacific were well documented within reason. In those five years we went from just a programmer/3D artist/texture artist, audio engineer, and R&D man, to a team of eight. All people with goals aligned to recreate an immersive experience. This project is the accumulation of all of our dreams, and we hope that it shows. After ten thousands of hours of work, thousands of pictures taken and hundreds of sounds recorded from the prototype, months of scripting and trouble shooting and many stressful nights, we can finally deliver you the ultimate AC4400 experience.

This locomotive comes in a unprecedented level of accuracy never before seen in the North American market and includes ground-breaking features which will leave you speechless and fully immerse you the moment you step a foot inside the operating cab.

Carefully built upon direct feedback of actual engineers, conductors and mechanics, actual maintenance manuals and with the community in-mind, this AC4400 delivers everything you have ever wished for! We have not left out a single opportunity to recreate even the tiniest and seemingly most needless details of the prototype to ensure the closest driving experience in-game short of holding your own engineers license.

This Operating Manual is arranged in sections: INTRODUCTION, OPERATING CONTROLS, DIAGNOSTIC INFORMATION DISPLAY, OTHER EQUIPMENT, ALARMS/SAFEGUARDS, OPERATION, SCREEN CONTROLS and ADVANCED FEATURES.

The INTRODUCTION Section describes the first steps when entering a new scenario and gives a general overview of the Locomotive, including general locomotive data and required keybindings.

The OPERATING CONTROLS Section continues this overview by identifying the associated hardware located both in the operating cab and the start station. A brief description of the equipment is also included.

The DIAGNOSTIC INFORMATION DISPLAY Section gives an overview of the Diagnostic Information Display (DID) and it's use.

The OTHER EQUIPMENT Section explain the principal parts of the custom, road specific gross horsepower boost this locomotive comes equipped with and of which the operator should be aware.

The ALARMS Section lists, describes, and illustrates the various Alarms, Safeguards, Power Derations and Shutdown situations an operator may encounter.

The OPERATING PROCEDURES Section gives step–by–step instructions for locomotive operation as well as listing various functions available for use. The OPERATING PROCEDURES Section will guide the Operating Crew in operation of this locomotive.

While it may not be entirely necessary to know all of the locomotive's functions running in the background, reading about them in the manual might save you the hard climb if you know what signs to look out for. We STRONGLY advice to carefully read through this Operating Manual before attempting to use this product.

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RECOMMENDED SETTINGS AND WARNINGS

64 bit **THIS PRODUCT WILL ONLY RUN ON TRAIN SIMULATOR 64-BIT EDITION. TRAIN SIMULATOR 32-BIT EDITION IS NOT SUPPORTED.**

RECOMMENDED IN GAME SETTINGS

Below you'll find our recommended in game settings depending on your system. We have provided one for a low, mid and high-end system respectively.

PRESET:	LOW	MID	HIGH
Dynamic Lighting:	ENABLED	ENABLED	ENABLED
Dynamic Clouds:	DISABLED	OPTIONAL	OPTIONAL
Anti-Aliasing:	FXAA	FXAA	FXAA
Texture Filtering:	LINEAR	ANISOTROPIC X 2	ANISOTROPIC X 8
Scenery Quality (1-5):	5	5	5
Scenery Density (1-9):	5	7	9
View Distance (1-3):	1	2	3
Shadow Quality (1-4):	1	3	4
Water Quality (1-5):	1	2	4
Procedural Flora:	OFF	ON	ON
Adaptive Bloom:	OFF	OFF	OPTIONAL
Headlight Flares:	ON	ON	ON
Camera Motion Blur:	OFF	OFF	OFF
Ambient Occlusion:	OFF	OFF	OFF
Depth of Field:	OPTIONAL	OPTIONAL	OPTIONAL

NOTE: Make sure to leave the Ambient Occlusion setting OFF at all times.

WARNINGS

This product does not feature a full "Cold and Dark" startup procedure. A full "Cold and Dark" startup procedure would require a ten minute boot sequence for the operator screens to initialize. Hence we opted against it.

Save and resume scenarios are <u>NOT</u> supported. We keep our scenario length at about 45-60 minutes to ensure optimal running times in order to keep the player focused and engaged throughout the entire run.

Licensed branding has been removed from this build.

LIMITATIONS OF CORE SOFTWARE

AUDIO

Our AC4400 simulation requires a lot of game resources to deliver the all-around experience and in such it will consume most of the 256 available sound slots the game is capable to run simultaneously. This means that often you will "run" out of available sound slots and thus no longer hear certain sounds. This can occur when switching from the in-cab view to any of the external cameras. Since we require more external than internal sounds, you will run out of external sounds with too many locomotives running in your consist or with heavy AI traffic. Even though you won't always run out of sound slots in-game, it is a common occurrence from time to time.

In order to "reset" the sound slots, simply switch back into the cab view.

> ***NOTE: TRAIL, DP AND AI Engines run on a minimum number of sounds to help improve performance. If you notice a TRAIL, DP or AI Engine without sound, it is most likely due to all available sound slots already used up.***

OPERATOR SCREEN INTERACTION

Make sure to press and hold a soft key pressed until the desired operator screen function changes.

ANIMATION SPEED

Animations are unfortunately bound to in-game performance (fps). If you experience slow animations (wipers for instance), it's due to your in-game performance being low.

3rd PARTY DLC COMPATIBILITY

Unfortunately due to limitations we can not offer compatibility to 3rd party locomotive DLCs. Our locomotives are only compatible among each other, locomotives released in cooperation with Jointed Rail, our enhancement packs and default locomotives.

ENGINE START STATION AUDIO

Engine audio at the start station is only available for *startup* - *skip fire low idle* - *low idle*. Full throttle notches are not covered and the audio will fade away above low idle speed if you stay outside the operating cab when notching up.

GETTING STARTED

ENGINE INITIALIZATION

Upon scenario start you will notice a small alert message window come up in the top right hand corner of the screen. The message window display "INITIALIZATION IN PROGRESS..." and will stay visible for about five seconds. During the initialization time, the core locomotive systems are automatically set-up and the locomotive functions are inaccessible by the player.

***NOTE**: The player may select the locomotive at any given time during scenario run-time. The initialization process will run only once the locomotive has been actively selected by the player in-game, provided a "driver" has previously been attached to it.*

NOTE: During initialization, all available control surfaces within the operator cab will automatically be reset to their respective position. DO NOT ATTEMPT TO MOVE ANY CONTROL SURFACES DURING INITIALIZATION.

LOCOMOTIVE DESIGNATION WITHIN THE EDITOR

Within the editor, there's five specific locomotive types available to place within a player controlled or AI consist. They can be identified as followed:

1. *[Lead] – Place this engine as the leader of the player controlled consist.*

   [Trail] – Place this engine as the trailing unit of the player controlled consist. You can place as many trailing locomotives in your consist as you wish, however do NOT place these mid-train or at the rear.

2. *[DP1 & DP2] – Depending on the length and tonnage of your train, you may place up to two DPUs (Distributed Power Units) within your consist. If you require only one DPU, proceed to place "DP1" either mid-train or at the*
3. *rear of your consist. If you require two DPUs, proceed to place either "DP1" mid-train and "DP2" at the rear of your train, or place "DP1" at the rear and have "DP2" trail behind it as the last "car" of your train.*

   ***NOTE**: Both Trails and DPUs can be used in the same consist.*

   [AI Lead] – Place this engine as the leader of none player controlled consists ONLY. This engine can not be driven by the player.

   [AI Trail] – Place this engine as the trailing OR DPU unit of none player controlled consists ONLY. Position of placement of this engine within none player controlled consists does not matter. This engine can not be driven by the player.

***NOTE: Only the player controlled [Lead] unit has to be set-up for operation. Trailing locomotives and DPUs come pre-configured, ready to run.** See **Operating Procedures** Section of this manual.*

GETTING STARTED

AI CONTROLLED LOCOMOTIVES

None player controlled locomotives feature our in-house AIX simulation. In short this means that AI locomotives will dynamically throttle up and down, produce accurate sounds and light effects based on their acceleration. This was done to add more life to AI traffic and to ensure that AI controlled locomotives respond more natural to movement and speed. You will notice how headlights come on and off on AI controlled engines as they accelerate or come to a stop along with dynamic throttle changes which add to a better and overall more realistic running experience.

***NOTE**: Headlight light casting on AI locomotives will come on/off automatically based on the season and time.*

Winter: 0600 - 1800 = OFF
Spring: 0530 - 1830 = OFF
Summer: 0515 - 2030 = OFF
Autumn: 0530 - 1900 = OFF

MU (MULTIPLE UNIT) REQUIREMENTS

As noted before, you will find specific pre-configured DPU locomotives to place in the player controlled consist. DPUs will generally reduce brake pipe pressure charging times. This will however require rolling stock that's set up to forward consist messages. Since most default rolling stock does not come equipped with consist messaging, we highly suggest you only use rolling stock provided by either Searchlight Simulations or Jointed Rail.

***NOTE**: Rolling stock equipped with consist messaging can be downloaded for free on our store.*

RAILDRIVER® SUPPORT

We offer full RailDriver® support with the AC4400.

***NOTE**: For a detailed description and instructions, refer to AC4400 RailDriver® Support Manual.*

SIMPLE CONTROLS AND EXTERNAL 3rd PARTY CONTROLLERS

This locomotive will not properly work with simple controls, or other external controllers such as Xbox or Playstation. Nevertheless, external controllers can be used in conjunction with this locomotive, however note that optimal results are achieved with expert controls and mouse/keyboard input only.

LOCOMOTIVE IN-GAME NOISE LEVELS

We've scripted our audio in a way to automatically lower overall external engine noise levels based on the total locomotive count in your consist. That way we can maintain healthy and balanced audio levels for accessory audio such as horn/bell, radiator/dynamic brake fans etc.. Internal noise levels will remain the same, no matter the locomotive count in your consist.

EQUIPMENT DEFECT DETECTOR COMPATIBILITY

This locomotive comes equipped with our in-house Equipment Defect Detector capability.

***NOTE**: Our Equipment Defect Detectors can be downloaded for free on our store.*

GETTING STARTED

TRAIN SIMULATOR GRAPHICS SETTINGS

DYNAMIC LIGHTING

This product does not specifically require dynamic lighting to be enabled, however for the visual, aesthetic value of the product we highly suggest you running it only with dynamic lighting enabled.

HEADLIGHT FLARES

This product requires headlight flares to be enabled in your main Train Simulator settings tab.

> ***NOTE: Without headlight flares enabled in your Train Simulator settings tab, the headlights flares will not be visible and the headlights will not cast any light on the ground.***

LIGHT CONTROL

TRAILING UNITS AND DPUS

Lights on player controlled trailing units or DPUs have to be manually changed.

DAY VS NIGHT LIGHTING

Our AC4400 comes equipped with the ability to cycle between day and night gage lights provided the gage lights are turned on. See **Keybindings** Section of this manual.

> ***NOTE****: The short–hood number lights will cycle along with this feature.*

HEADLIGHT LIGHT CASTING

You can control the headlight light casting through a keybind. This is in place to avoid the headlights spilling light during daylight. Thanks to this feature you can disable the light casting during daylight but toggle it back on in tunnels for instance. See **Keybindings** Section of this manual.

SHADOW CASTING LIGHTS

All light sources located within the operator cab or start station and most of the external light sources can be toggled on or off to cast shadows. Shadow casting is extremely performance impacting and we do NOT suggest running with shadow casting enabled at all times. The ability to toggle shadow casting lights has been added so the user can take realistic night screenshots in-game. See **Keybindings** Section of this manual.

DISAPPEARING COMBINED POWER HANDLE

You might notice how the combined power handle sometimes disappears when you move the camera out of view. This is unfortunately due to an x-form issue with the animation and something that would require us to basically re-do all cab controls from scratch. At this point in time we will leave the issue as is and further address it once spare time becomes available.

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GENERAL LOCOMOTIVE DATA

Operating Cab and Controls . . . . . Wide Cab with Desktop Controller and IFC
Wheel Arrangement . . . . . C–C
Engine Data:
- Horsepower – Traction 4380
- Number of Cylinders 16
- Model . . . . . GE 7FDL16
- Bore and Stroke (in.) . . . . . 9 X 10–1/2
- RPM 1050
- Compression Ratio 12.7:1
- Cycle 4
- Turbocharged . . . . . Yes
- Electronic Fuel Injection . . . . . Yes
- Engine Cooling Fan 1
- Engine Cooling Fan Drive . . . . . AC Motor

Traction Equipment:
- Inverters 6
- Traction and Auxiliary Alternator . . . . . GMG 192
- Alternator Blower 1
- Traction Motors (6) GEB13
- Traction Motor Blower 1
- Blowers Drives . . . . . AC Motor

Major Dimensions (Approximate):
- Length . . . . . 73 ft. 2 in.
- Height . . . . . .15 ft. 5 in.
- Width . . . . . 10 ft. 3 in.
- Traction Pin Centers . . . . . 50 ft. 4 in.
- Truck Wheel Base . . . . . 13 ft. 2 in.

Minimum Track Curvature (radius and degrees):
- For Single Unit 273 ft./21
- For MU 273 ft./21

Driving Wheel Diameter (in.) 42
Weight (lbs, maximum) 420,000
Maximum Continuous Tractive Effort (lbf) / Speed (mph) 145,000/9.8
Maximum Starting Tractive Effort (lbf) 180,000
Peak Braking Effort (lbf/mph) . . . . . 98,000/20.0 down to 3.0
Gear Ratio 87/16
Maximum Speed (mph) – worn wheels 75
Supplies:
- Fuel Tank, High Impact (usable gallons) 4750
- Coolant (gallons) 380
- Lubricating Oil (gallons) 410
- Sand (cu. ft.) 40

Compressor, Air:
- Compressor Drive . . . . . AC Motor
- Maximum Displacement (cfm) 236
- Type of Cooling . . . . . Air
- Lubricating Oil (gallons) 16

Air Filtering Devices: Primary . . . . . Vortex, Self–Cleaning
- Secondary Engine Air Intake . . . . . AAF

KEYBINDINGS

Combined Throttle
Increase . . . . . **A**
Decrease . . . . . **D**
Reverser Insert (Toggle) . . . . . **Shift + R**
Reverser
Increase . . . . . **W**
Decrease . . . . . **S**
Automatic Brake
Increase . . . . . **'**
Decrease . . . . . **;**
Independent Brake
Increase . . . . . **]**
Decrease + Actuate . . . . . **[**
Horn . . . . . **Space**
Bell (Toggle) . . . . . **B**
Front Headlight
Increase . . . . . **H**
Decrease . . . . . **Shift + H**
Rear Headlight
Increase . . . . . **Ctrl + H**
Decrease . . . . . **Ctrl + Shift + H**
Ditch Light Selector
Increase . . . . . **Ctrl + D**
Decrease . . . . . **Ctrl + Shift + D**
Engine Control
Increase . . . . . **I**
Decrease . . . . . **Shift + I**
Alerter Reset . . . . . **Q**
Alerter Override (Toggle) . . . . . **Backspace**
Self-Test (Load Test) (Toggle) . . . . . (Numpad) **Enter**
Engine Prime/Start
Increase . . . . . **Shift + X**
Decrease . . . . . **Shift + Y**
Head + Rearlight Light Casting (Toggle) . . . . . **L**
Gage Lights Day/Night (Toggle) . . . . . **Ctrl + L**
Shadow Casting (Toggle) . . . . . **Return**
Train Data Request . . . . . **Ctrl + I**
Sand Button . . . . . **X**
Cab Dome Light Switch . . . . . **Shift + L**
Air Ride Simulation (Toggle) . . . . . **Shift + S**

OPERATING CONTROLS

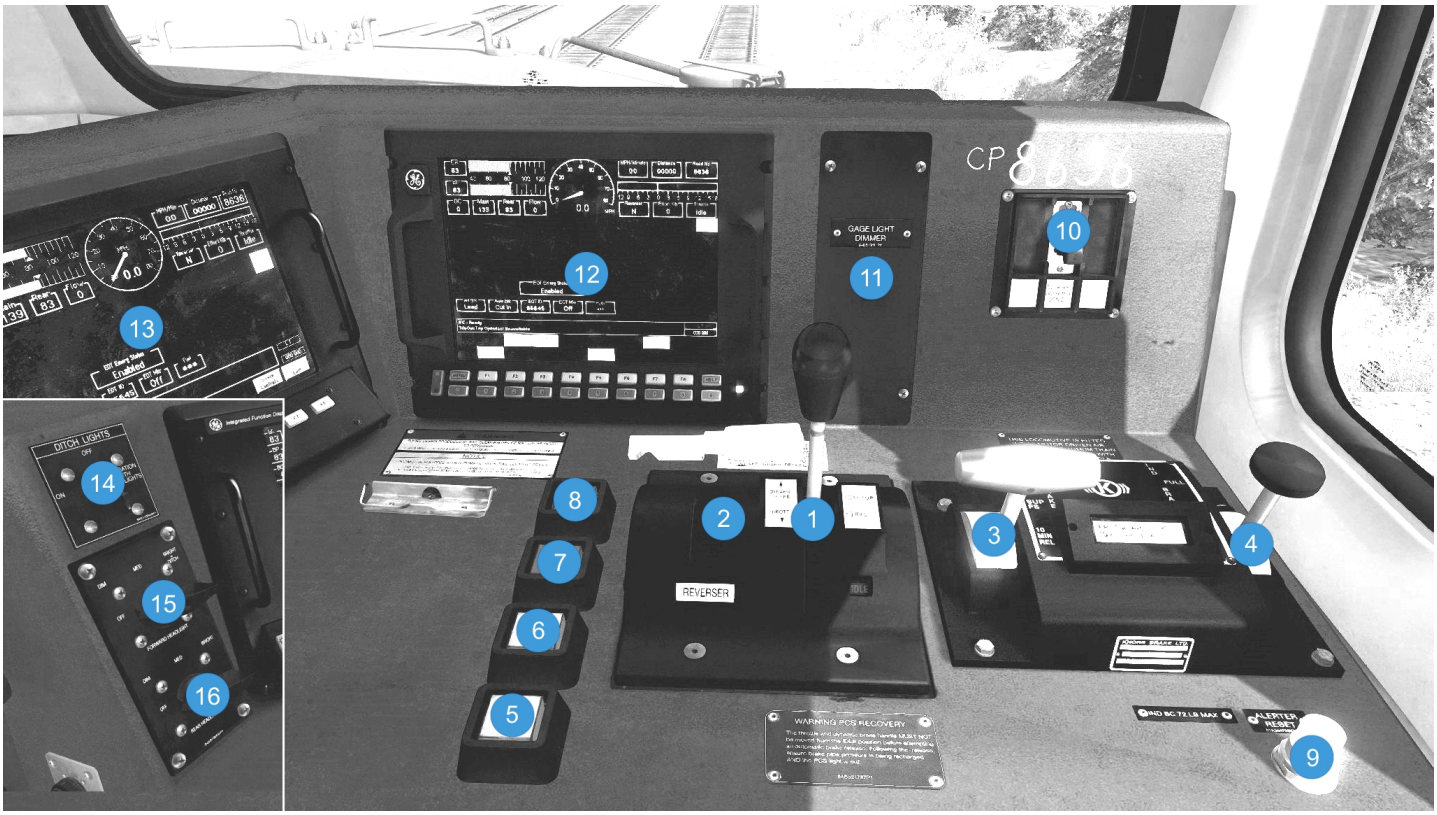

FIG. 1.

REF	DESCRIPTION
1.	COMBINED POWER HANDLE
2.	REVERSER HANDLE
3.	AUTOMATIC BRAKE HANDLE
4.	INDEPENDENT BRAKE HANDLE
5.	HORN PUSHBUTTON
6.	BELL PUSHBUTTON
7.	SAND PUSHBUTTON
8.	LEAD AXLE SAND PUSHBUTTON
9.	ALERTER RESET BUTTON
10.	EOT (REAR) EMERGENCY BRAKE TOGGLE SWITCH
11.	GAGE LIGHT DIMMER
12.	SDIS (SMART DISPLAY INTEGRATED SYSTEM)
13.	IFD (INTEGRATED FUNCTION DISPLAY)
14.	DITCH LIGHT SELECTOR SWITCH
15.	FRONT HEADLIGHT SWITCH
16.	REAR HEADLIGHT SWITCH

FIG. 2.

REF	DESCRIPTION
1.	ALERTER
2.	MU EMERGENCY SHUTDOWN TOGGLE SWITCH
3.	ATTENDANT CALL TOGGLE SWITCH
4.	WIPER CONTROL ENGINEER FRONT
5.	WIPER CONTROL ENGINEER REAR
6.	ENGINEER CAB LIGHT SWITCH
7.	RADIO EQUIPMENT
8.	ENGINEER'S DESK LIGHT SWITCH
9.	ENGINEER'S DESK LIGHT DIMMER

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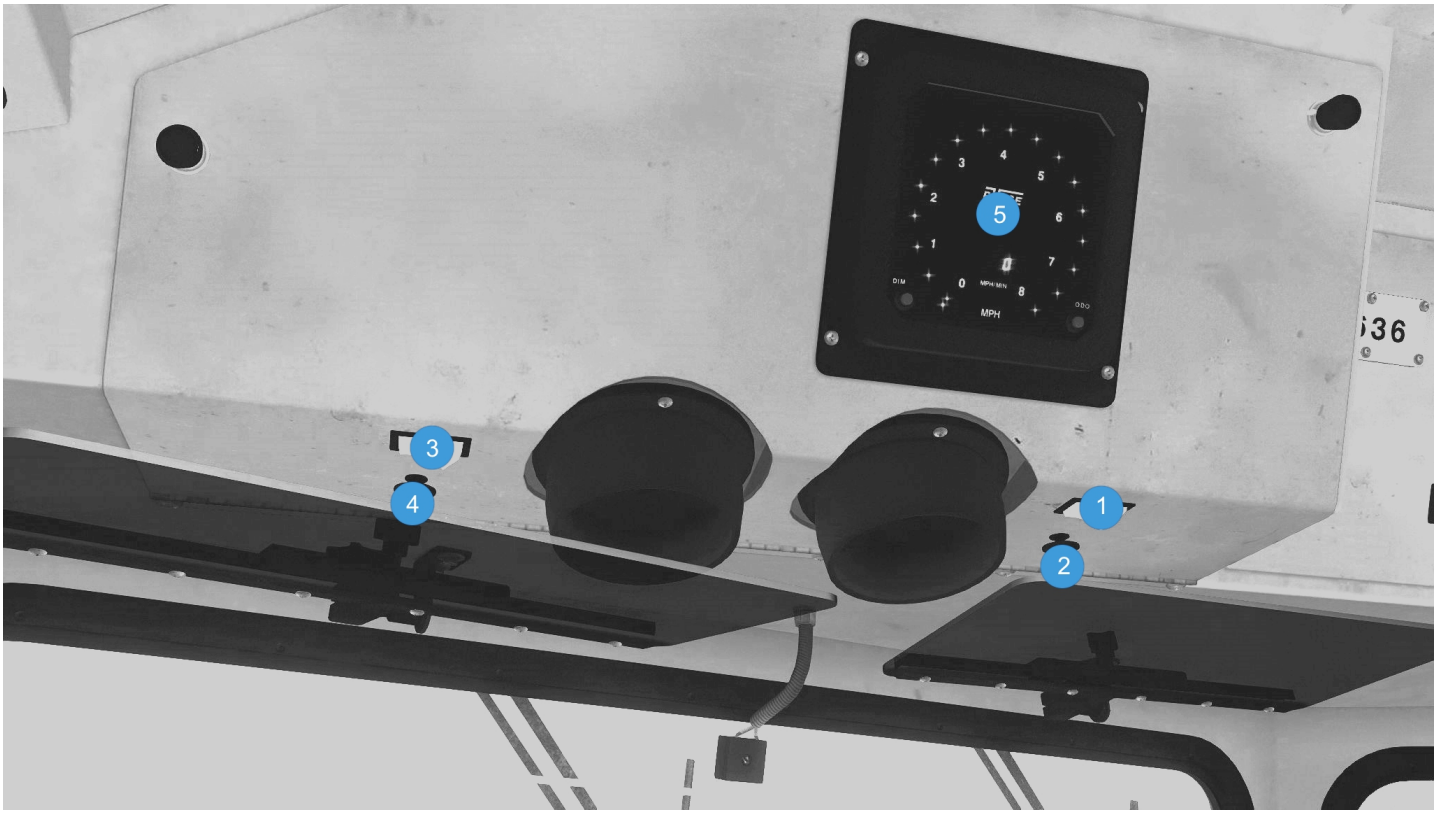

FIG. 3.

REF	DESCRIPTION
1.	CREW MEMBER’S RIGHT DESK LIGHT SWITCH
2.	CREW MEMBER’S RIGHT DESK LIGHT DIMMER
3.	CREW MEMBER’S LEFT DESK LIGHT SWITCH
4.	CREW MEMBER’S LEFT DESK LIGHT DIMMER
5.	CREW MEMBER'S SPEED INDICATOR

FIG. 4.

REF	DESCRIPTION
1.	EMERGENCY BRAKE VALVE
2.	HOT PLATE SWITCH
3.	WIPER CONTROL CONDUCTOR FRONT
4.	WIPER CONTROL CONDUCTOR REAR
5.	CONDUCTOR CAB LIGHT SWITCH
6.	CONDUCTOR CAB LIGHT SWITCH

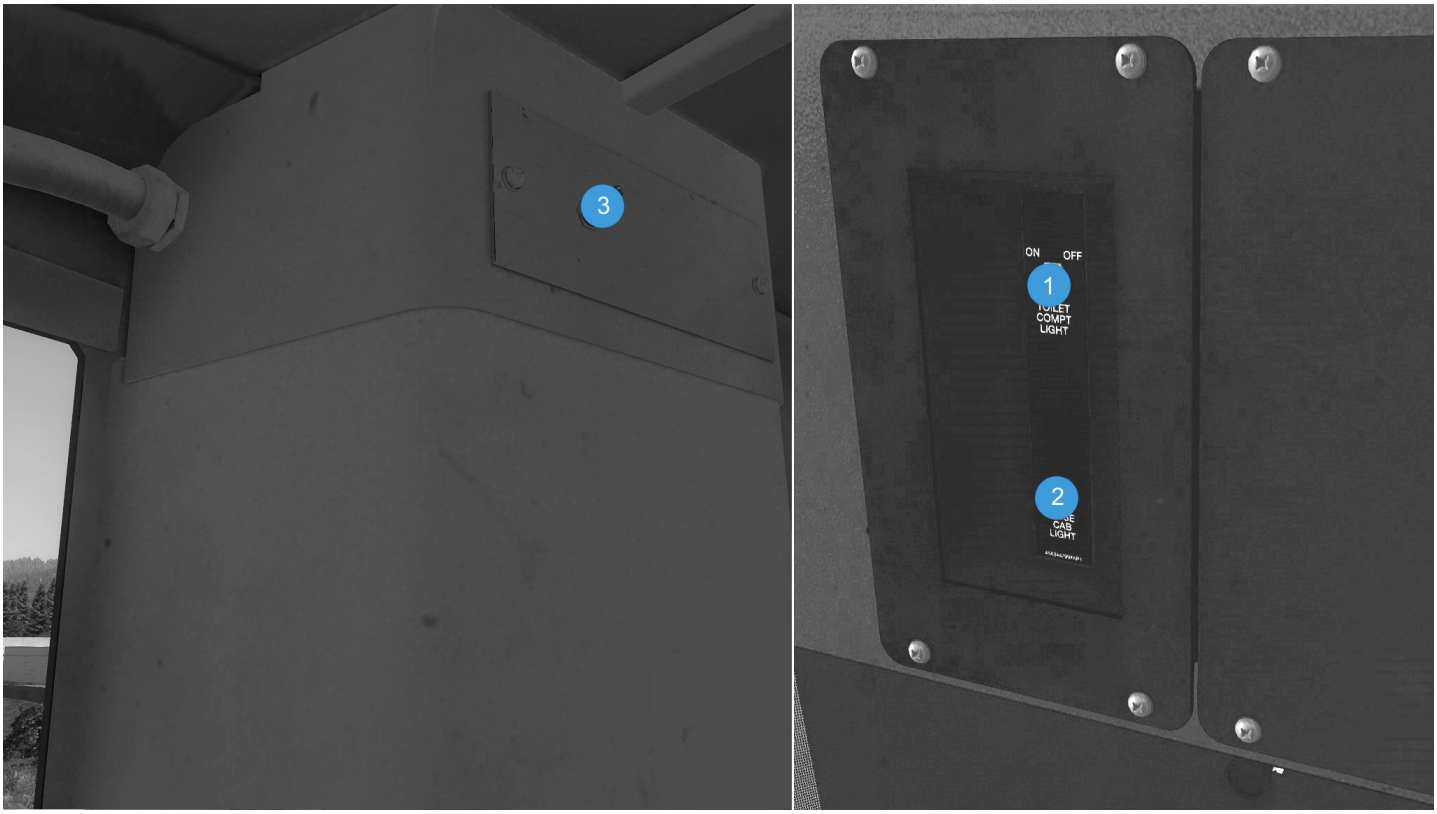

FIG. 5.

REF	DESCRIPTION
1.	TOIET COMPARTMENT LIGHT SWITCH
2.	NOSE CAB LIGHT SWITCH
3.	NOSE CAB LIGHT SWITCH

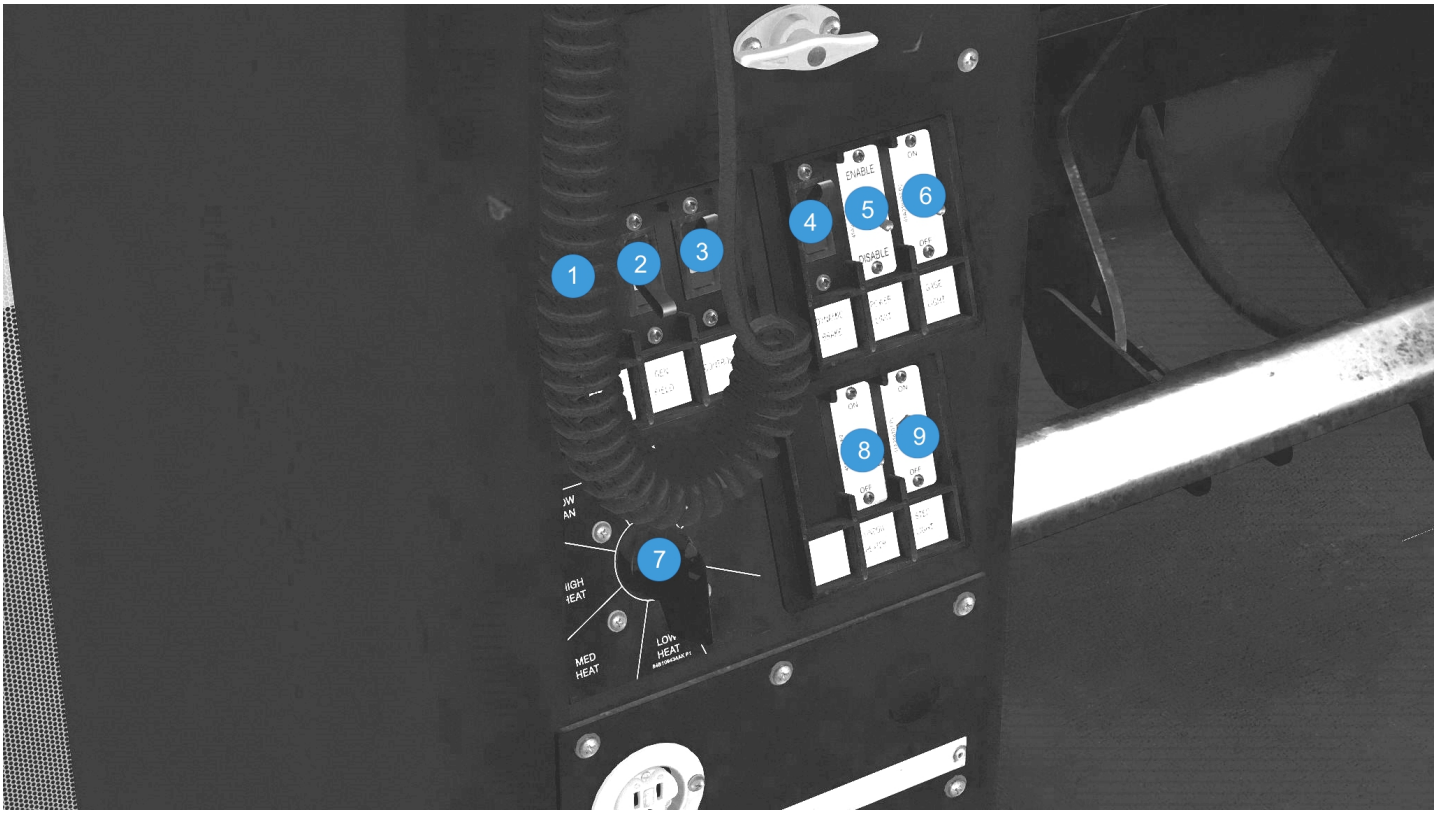

FIG. 6.

REF	DESCRIPTION
1.	ENGINE RUN CIRCUIT BREAKER
2.	GENERATOR FIELD CIRCUIT BREAKER
3.	CONTROL CIRCUIT BREAKER
4.	DYNAMIC BRAKE CIRCUIT BREAKER
5.	POWER LIMIT (N7) SWITCH
6.	GAGE LIGHTS SWITCH
7.	HEATER–A/C CONTROL SWITCH
8.	WINDOW HEATER SWITCH
9.	STEP LIGHT SWITCH

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FIG. 7.

REF	DESCRIPTION
1.	RAIL CLEANER SWITCH
2.	ENGINEER'S HEATER OUTPUT CONTROL
3.	CREW MEMBER'S HEATER OUTPUT CONTROL
4.	AUTO STOP (AESS) OVERRIDE PUSHBUTTON
5.	ENGINEER'S WALL HEATER CIRCUIT BREAKER (20 A)
6.	CREW MEMBER'S WALL HEATER CIRCUIT BREAKER (20 A)
7.	CAB HEATER/AIR CONDITIONER CIRCUIT BREAKER (200 A)

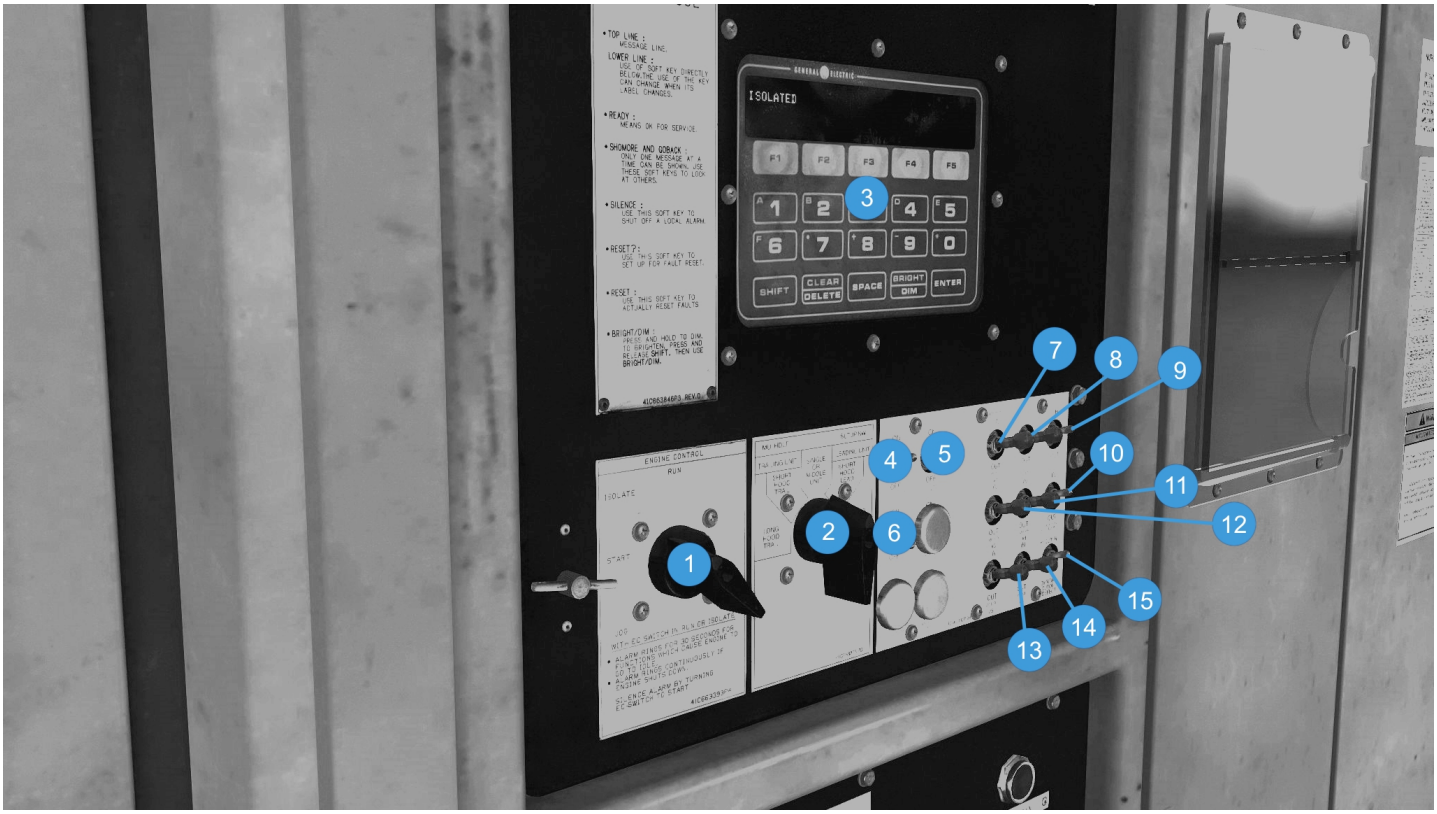

FIG. 8.

REF	DESCRIPTION
1.	ENGINE CONTROL SWITCH
2.	MU HEADLIGHT SET–UP SWITCH
3.	DID (DIAGNOSTIC INFORMATION DISPLAY)
4.	CROSSWALK LIGHTS SWITCH
5.	CONTROL COMPARTMENT LIGHT SWITCH
6.	SHORT–HOOD NUMBER LIGHTS SWITCH
7.	NO. 1 MOTOR CUT–OUT TOGGLE SWITCH
8.	NO. 2 MOTOR CUT–OUT TOGGLE SWITCH
9.	SPEED SENSOR CUT–OUT SWITCH
10.	LOCKED AXLE CUT–OUT SWITCH
11.	NO. 3 MOTOR CUT–OUT TOGGLE SWITCH
12.	NO. 4 MOTOR CUT–OUT TOGGLE SWITCH
13.	NO. 5 MOTOR CUT–OUT TOGGLE SWITCH
14.	NO. 6 MOTOR CUT–OUT TOGGLE SWITCH
15.	DYNAMIC BRAKE CUT–OUT SWITCH

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FIG. 9.

REF	DESCRIPTION
1.	DRAIN VALVES CIRCUIT BREAKER
2.	GLOBAL POSITIONING CIRCUIT BREAKER
3.	FUEL MONITOR CIRCUIT BREAKER
4.	WINDOW HEATER CIRCUIT BREAKER (15 A)
5.	ROAD CROSSING LIGHTS CIRCUIT BREAKER (15 A)
6.	SNOW PLOW CIRCUIT BREAKER
7.	RADIO CIRCUIT BREAKER (10A)
8.	REFRIGERATOR CIRCUIT BREAKER
9.	SHORT–HOOD HEADLIGHT CIRCUIT BREAKER (15 A)
10.	LONG–HOOD HEADLIGHT CIRCUIT BREAKER (15 A)
11.	ENGINE STOP PUSHBUTTON
12.	RUNNING LIGHTS CIRCUIT BREAKER (30 A)
13.	FUEL PUMP CIRCUIT BREAKER (20 A)
14.	LOCAL CONTROL CIRCUIT BREAKER (30 A)

FIG. 10.

REF	DESCRIPTION
1.	ENGINE PRIME/START SWITCH (START STATION)
2.	ENGINE STOP PUSHBUTTON (START STATION)

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INTEGRATED FUNCTION CONTROL SYSTEM

The Integrated Function Control system is divided into two major parts: the Integrated Function Computer (IFC) and the Integrated Function Displays (IFD).

In addition to IFC/IFD, this locomotive is equipped with an Electronic Air Brake system. The integrated control system is designed to:

1. *Provide the operator with more detailed functional information.*
2. *Reduce clutter in the operating cab through the elimination of bolt–on boxes and redundant displays.*
3. *Improve equipment reliability through reduction of parts and connections.*

IFC

IFC is the communications center for all on–board locomotive control functions. IFC's primary function is to distribute data among various systems:

1. *PSC controllers.*
2. *Auxiliary Speed Indicator.*
3. *IFDs on the Engineer's Control Console.*
4. *End of Train (EOT) information.*
5. *Electronic Air Brake Control and Distributed Power Systems.*
7. *Alerter Control.*

IFD

The Integrated Function Control System employs two IFDs which receive data from the IFC, display that information for the crew, and relay operator commands to the IFC. Each IFD is a ten–inch diagonal, backlighted, color graphics liquid crystal display (LCD) with up to eight menu soft keys arranged horizontally below the screen. Background color is black. Other screen colors have been chosen to attract the operator's attention: YELLOW for alarm or out–of–limit condition; RED for danger; BLUE, YELLOW and GREEN for bar graphs. Screen brightness may be adjusted manually through use of the IFD Screen Controls function.

***NOTE**: Each of the IFDs (Gage and Function Displays) has its own independent distance counter.*

***NOTE**: The forward facing IFD on our model has been replaced by a newer SDIS (Smart Display Integrated System). They remain virtually the same in terms of functionality with the addition of a new/more responsive UI (User-interface).*

INTRODUCTION

CONTROL CONSOL TOP AND BOTTOM DEVICES

EOT (Rear) Emergency Brake Toggle Switch

Pressing this spring–loaded toggle switch initiates an End Of Train Emergency Brake Application.

***NOTE**: Pressing the EOT Emergency Brake toggle switch (Item 10, Fig. 1) initiates an Emergency Brake application, causing the EOT device to vent the brake pipe at the end of the train. The EOT device will also vent the brake pipe in response to Emergency Brake applications triggered by the following conditions:*

a. Automatic Brake handle (Item 3, Fig. 1) moved to EMERGENCY
b. Emergency Brake Valve (Item 1, Fig. 4) on the crew member's console operated
c. Trainline Emergency (Occurs on separation of train at locomotive speed greater than 1MPH)

***NOTE**: An Emergency Brake application through the EOT device requires the EOT Emergency Status (Item 10, Fig. 1) to show Enabled on either IFD or SDIS. Provided an EOT device is attached to the rear of your train, on scenario start the locomotive will start off with the EOT communication test passed, meaning the IFC and the EOT device at the rear of the train are connected and the EOT device is actively transmitting telemetry data to the IFC.*

***WARNING**: The EOT device along with the rolling stock must be provided by Searchlight Simulations in order for this feature to operate properly due to custom consist messaging.*

Independent Brake Handle

To apply the locomotive Independent Brake using the Independent Brake Handle (Item 4, Fig. 1), move the handle away from the engineer. To release it, move the handle back toward the engineer.

To make an independent release of an Automatic Brake application (Actuate the Independent Brake), move the Independent Brake Handle to RELEASE and pull it to the right side. Spring action will return the handle to the original position when released.

***NOTE**: Use of independent air brake does not affect the braking effort from dynamic brake. Independent brake and dynamic brake can be applied at the same time with no reduction in either braking capability.*

Alerter Reset Pushbutton

This pushbutton (Item 9, Fig. 1) manually resets the Alerter safety device. This pushbutton, or other Alerter resets, must be operated at set time intervals or a penalty brake application will occur.

Automatic Brake Handle

The Automatic Brake Handle (Item 3, Fig. 1) operates through six detented control positions:

- RELEASE (REL)
- MINIMUM REDUCTION (MIN)
- FULL SERVICE (FS)
- SUPPRESSION (SUP)
- HANDLE OFF (HO)
- EMERGENCY (EM)

The service zone is between the minimum reduction and full service position (MIN and FS).

An indicator plate is provided indicating the six operating positions. A description of these six positions is as follows:

1. *RELEASE Position – When charging a train or releasing an Automatic Brake application, the Automatic Brake Handle should be placed in the REL position, which is the position closest to the engineer.*

2. *MINIMUM REDUCTION Position – When making a Service Brake application, move the Automatic Brake Handle away from the engineer to the minimum reduction position which will provide a 6.0 to 8.0 psi reduction. If necessary to increase the reduction, move the handle progressively away from the engineer, bearing in mind that the further the handle is moved into the service zone, the greater will be the reduction.*

3. *FULL SERVICE Position – A Full Service Brake application is obtained by moving the Automatic Brake Handle to this position. This position will reduce the Brake Pipe pressure by 26–28 psi and increase the Brake Cylinder pressure to 60–71 psi*

4. *SUPPRESSION Position – This position provides a Full Service Brake application.*

5. *HANDLE OFF (HO) Position – The Automatic Brake Handle should be moved to this position when the locomotive*
   is a trailing unit in a multiple–unit consist or is being towed DEAD.

6. *EMERGENCY Position – An Emergency Brake application is obtained by moving the Automatic Brake Handle to the EMER position (furthest away from the engineer). See **Alarms, Safeguards, Power Derations, and Shutdowns** Section of this manual.*

Combined Power Handle and Reverser Handle

***Reverser Handle** – Determines the direction of locomotive travel. There are three handle positions; Reverse, Off (N on IFD screen) and Forward.*

***NOTE**: Do not attempt to remove the Reverser Key with the Combined Power Handle in any notch other than IDLE.*

***Combined Power Handle** – Controls diesel engine speed and dynamic braking.*

a. The near position (handle pulled toward engineer) consists of nine handle positions: IDLE and eight power positions "notches". Indication of the throttle position is given in the window to the right of the handle.

b. The far position (handle pushed away from engineer) consists of two handle positions: SETUP and DYNAMIC BRAKE; a variable position ranging from 1 (minimum) to 8 (maximum) for selecting desired brake rate. (Level 8 is the farthest from the engineer.)

Mechanical Interlocking

1. **Reverser Handle:**

This handle serves as a key to unlock and lock the Reverser. With this handle removed, the controller is locked and the Combined Power handle can not be moved from the IDLE position.

The Reverser handle cannot be moved from FORWARD or REVERSE when the Combined Power handle is in:

a. *Notch 1 or higher of THROTTLE*
b. *SETUP*
c. *braking range of DYNAMIC BRAKE*

***NOTE**: The Reverser Key can only be inserted/removed with the Combined Power Handle in the IDLE position and the reverser in the CNTR position.*

2. **Combined Power Handle:**

This handle can be moved into throttle positions at any setting of the Reverser, but into dynamic braking positions only when the Reverser is in FORWARD or REVERSE positions (not OFF).

***NOTE**: The Combined Power Handle will stay locked in the IDLE position if the Reverser Key is removed.*

Horn Pushbutton

The locomotive horn (Item 5, Fig. 1) will sound as long as the Horn pushbutton is pressed. The locomotive Horn is interlocked with the Bell so that the Bell will sound when the Horn sounds.

Bell Pushbutton

Pressing the Bell pushbutton (Item 6, Fig. 1) starts the locomotive bell to sound. Pressing the Bell pushbutton again will silence the Bell.

Sand Pushbutton

Pressing this pushbutton (Item 7, Fig. 1) applies sand in front of the leading axle of both trucks when locomotive speed is less than 15 mph. Above 15 mph, manual sanding is not available. A trainline request for sand is also given.

Lead Axle Sand Pushbutton

Pressing this pushbutton (Item 8, Fig. 1) applies sand in front of the leading axle only, depending on locomotive direction, regardless of speed. No call for trainline sand is given.

Ditch Light Selector Switch

This switch (Item 16, Fig. 1) controls the operation of the Road Crossing Lights (Ditchlights) and has three positions; OFF, ON and OPERATION WITH DITCHLIGHTS. In the ON position, the Road Crossing Lights will come on independently from the short-hood headlights. In the OPERATION WITH DITCHLIGHT position, the Road Crossing Lights will come on when the **Front Headlight Switch** (Item 15, Fig. 1) is placed in the BRIGHT position.

Front Headlight Switch

This switch (Item 15, Fig. 1) controls the operation of the short–hood headlights and has four positions; OFF, DIM, MED and BRIGHT. The Road Crossing lights (Ditchlights) will automatically come ON with the BRIGHT position of the switch, provided the **Ditch Light Selecter Switch** (Item 14, Fig. 1) has been switched into the OPERATION WITH DITCHLIGHTS position.

Rear Headlight Switch

This switch (Item 16, Fig. 1) controls the operation of the long–hood headlights and has four positions; OFF, DIM, MED and BRIGHT.

Engine Run Circuit Breaker

This breaker (Item 1, Fig. 6) controls engine speed. Breaker must be ON on the lead unit to control engine speed through the throttle speed and engine run trainlines. When this breaker is tripped, the diesel engine will not run above Idle.

Generator Field Circuit Breaker

The Generator Field circuit breaker (Item 2, Fig. 6) is ON whenever the locomotive is powered and operating as a Lead unit. The breaker may be turned OFF to keep the main generator de–energized when it is necessary to run the engine at speeds higher than IDLE.

Control Circuit Breaker

The Control circuit breaker (Item 3, Fig. 6) provides power circuits such as the alarm bell. In MU operation, this breaker must be ON on the Lead unit.

Dynamic Braking Control Breaker

The Dynamic Braking Control breaker (Item 4, Fig. 6) is used to control the dynamic braking of the locomotive. In MU operation, this breaker must be ON on the Lead unit to control the dynamic braking of other units in the consist.

Power Limit Switch

This switch (Item 5, Fig. 6) has two positions, NORMAL and NOTCH 7. When the locomotive consist is in NOTCH 8 and the lead unit is slipping excessively, the Power Limit switch can be moved to NOTCH 7 to reduce power. This will reduce the tractive effort will usually improve the ability of the locomotive to hold the rail under bad rail conditions.

> ***NOTE**: Unless directed otherwise by Railroad Regulations, ensure Power Limit Switch is in NORMAL position on ALL units before operating the train.*

Gage Light Switch

This switch (Item 6, Fig. 6) turns on the engineer's console lens cover lights for the circuit breakers, switches, and Combined Power handle indicator.

Window Heater Switch

This switch (Item 8, Fig. 6) operates the Window heaters when the Window Heater circuit breaker, located on the EC Panel, is ON. An indicating light is supplied in the Overhead Console to alert the operator that the heater is ON.

Step Light Switch

This switch (Item 9, Fig. 6) turns on all step lights and all ground lights on the respective unit.

ENGINE CONTROL PANEL DEVICES

Top Row of Circuit Breakers

The top row of circuit breakers (Items 1-10, Fig. 9) on the EC panel are used for equipment that can be turned OFF when the unit is operating as a Trail unit.

Second Row of Circuit Breakers

The second row of circuit breakers (Items 12-14, Fig. 9) on the EC panel are used for equipment, ALL OF WHICH MUST BE LEFT **ON** whenever the unit is operating as a Lead or Trail unit.

Engine Stop Pushbutton

To shut down the engine, press the Engine Stop Pushbutton (Item 11, Fig. 9). *See **Operating Procedures** Section of this manual.*

Diagnostic Display Panel (DID)

See **DIAGNOSTIC INFORMATION DISPLAY (DID)** Section of this manual for description of this item (Item 3, Fig. 8).

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Engine Control Switch

The Engine Control (EC) switch (Item 1, Fig. 8) has four positions:

1. *START – The Engine Start switch, see Engine Start Station, is effective only when the EC switch is in START. When the engine is running and the EC switch is in START position, engine speed is held at IDLE and power cannot be applied to the locomotive.*

2. *ISOLATE – When the engine is running and the EC switch is in the ISOLATE position, the engine speed is held at IDLE and power cannot be applied to the locomotive. The message "ISOLATED" will appear on the DID.*

3. *RUN – When the engine is idling and the locomotive is to be operated, the Engine Control (EC) switch must be moved to the RUN position.*

4. *JOG – When the engine is shutdown and the locomotive is to be moved using battery power, the EC switch is moved to the JOG position. This feature is DISABLED on our model.*

   ***NOTE**: If the EC switch is left in the RUN, ISOLATE, or JOG position when the diesel engine is shut down manually, the Alarm Bell will sound continuously. Silence the Alarm Bell by turning the EC switch to START.*

MU Headlight Set–Up Switch

The MU Headlight Set–Up switch (Item 2, Fig. 8) has five positions. Positioning of this switch is determined by location of the locomotive unit in the consist and whether the short hood of the locomotive unit is leading or trailing. Switch positions are as follows:

1. *SINGLE OR MIDDLE UNIT – Place switch in this position on any locomotive unit operated singly or on all units, except the Leading or Trailing unit, when the locomotive consist is made up of more than one unit.*
2. *SHORT–HOOD LEAD – LEADING UNIT – Place switch in this position when the Leading unit is operated with the short hood forward.*
3. *LONG–HOOD LEAD – LEADING UNIT – Place switch in this position when the Leading unit is operated with the long hood forward.*
4. *SHORT–HOOD TRAIL – TRAILING UNIT – Place switch in this position when the final Trailing unit is connected so its short hood trails.*
5. *LONG–HOOD TRAIL – TRAILING UNIT – Place switch in this position when the final Trailing locomotive is connected so its long hood trails.*

Crosswalk Lights Switch

This switch (Item 4, Fig. 8) operates the crosswalk lights at the front and rear of the locomotive.

Control Compartment Light Switch

This switch (Item 5, Fig. 8) turns on the light located in the Engine Start Station.

Short–Hood Number Light Switch

This switch (Item 6, Fig. 8) operates short–hood number lights.

Traction Motor Cut–Out Switches – Pull to Throw

The Motor Cut–Out switches (Items 7-8 & 11-14, Fig. 8) can be used to cut–out one or more traction motors. At the same time, power output of the locomotive may be reduced. The IFD Operation Screen will visually show the cut–out traction motor(s). See **ALARMS, SAFEGUARDS, POWER DERATIONS, AND SHUTDOWNS** Section of this manual.

CAUTION: It is recommended that these switches be operated only with the Engine Control switch in the START or ISOLATE position so the unit is isolated and with the Combined Power handle in IDLE. Dynamic Brake operation could be affected.

NOTE: Dynamic Brake is automatically cut out when one or more traction motors are cut out.

Speed Sensor Cut–Out Switch

This switch (Item 9, Fig. 8) cuts out the Speed Sensor signal on all traction motors that are cut–out. This switch is only to be used to cut out faulty sensors; however, ensure that the sensor is at fault and not that it is indicating a locked axle or excessive wheel slip, etc. The sensor will only be cut out (even if the switch has been thrown) if the motor cut–out switch has been thrown. Wheelslip protection is lost only for the corresponding motor that is cut out.

***NOTE**: A minimum of two motor speed sensors must be operating for the unit to load.*

Locked Axle Cut–Out Switch

This switch (Item 10, Fig. 8) cuts out the Locked Axle Alarm. Before silencing the alarm using this switch, ensure the wheels are rolling.

***NOTE**: This feature is DISABLED on our model.*

Dynamic Brake Cut–Out Switch

This switch (Item 15, Fig. 8) cuts out Dynamic Brake and has three positions: CUT IN, CUT OUT – DEFECTIVE, and CUT OUT TO COMPLY WITH BRAKING EFFORT RESTRICTIONS. With this switch in either CUT OUT position, upon dynamic brake request, control will not permit unit to go into Dynamic Brake – unit will go to IDLE.

Rail Cleaner Switch

This switch (Item 1, Fig. 7) is used to clear the head of the rail of snow during winter using pressurized air from the main reservoir.

***NOTE**: The rail cleaner will automatically operate whenever the Lead Axle Sand pushbutton is on.*

Auto Stop (AESS) Override Switch

Press the Auto Stop Override switch (Item 4, Fig. 7) to prevent the diesel engine from automatically shutting down. Pressing this switch will prevent an automatic engine shut down for a period of two hours. See **Auto Engine Start/Stop (AESS) System** Section of this manual**.**

Strip Heater Circuit Breakers and Output Controls

These circuit breakers (Items 5-6, Fig. 7) will cut–out the Engineer's and Crew Member's wall heaters if tripped. The output control switches (Items 2-3, Fig. 7) have three positions: OFF, MEDIUM and HIGH.

Cab Heater/Air Conditioner Circuit Breaker

This circuit breaker (Item 7, Fig. 7) will cut out the cab heater/air conditioner unit.

CREW MEMBER'S AREA AND OVERHEAD CONSOLE DEVICES

Crew Member's Desk Light

On the bottom side of the Overhead Console are cab lights for illumination of the desk area. A switch (Items 1 & 3, Fig. 3) turns the cab light on, a dimmer (Items 2 & 4, Fig. 3) is provided to control the brightness of the light.

Indicator Lights

These lights located below the Audio Visual Alarm Box (AVB) are used to alert the crew that the AUX. LIGHTS (Left and Right), FRONT HEADLIGHTS (Top and Bottom), REAR HEADLIGHT and WINDSHIELD HEAT are operating. (AUX. refers to Road Crossing Lights [Ditchlights]).

Engineer's Console Light

On the bottom side of the Overhead Console is a cab light for illumination of the Control Console area. A Switch (Item 8, Fig. 2) turns the light on, a dimmer (Item 9, Fig. 2) controls the brightness of the light.

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MU Emergency Shutdown Toggle Switch

This toggle switch (Item 2, Fig. 2) is provided for Emergency Multiple–Unit Shutdown of all engines.

Attendant Call Toggle Switch

The Attendant Call toggle switch (Item 3, Fig. 2) is used to sound the Alarm Bell in all locomotive units. This toggle switch can be used to test the Alarm Bell when boarding the locomotive.

Alerter

This device (Item 1, Fig. 2) ensures operator vigilance at all times. The Alerter examines the engineer's control handling actions and will automatically bring the train to a stop should the engineer become incapacitated or unable to perform normal duties. The system requires a train handling control action to reset an internal timer that is speed dependent. When the timer period expires a visual and audible warning is given. If the operator fails to acknowledge the warning, a Penalty Brake application results. See **Alarms, Safeguards, Power Derations, and Shutdowns** Section of this manual.

Speed Indicator

A Pulse solid–state speed indicator (Item 5, Fig. 3) digitally indicates locomotive speed in miles–per–hour (from IFC system). Speed indicator is provided for viewing by crew members in short–hood operation.

Emergency Brake Valve

The handle of the emergency brake valve (Item 1, Fig. 4) is located at the back of the Crew Member's Desk (8). Lifting this handle causes an Emergency brake application. See **Alarms, Safeguards, Power Derations, and Shutdowns** Section of this manual.

Hot Plate Switch

This switch controls the power output of the hot plate and has three positions: OFF, MEDIUM AND HIGH.

Switches on the Aisle Side of the Control Console:

Toilet Compartment Light Switch

This switch (Item 1, Fig. 5) turns on a ceiling mounted light located in the toilet compartment.

Nose Cab Light Switch

This switch (Item 2, Fig. 5) turns on the light in the Nose Cab. It is a two–way switch that operates in conjunction with another switch (Item 3, Fig. 5) located near the Nose Cab door.

Cab Dome Light Switch

This switch will turn on the cab dome light and is located on the front side of the dome light housing.

ADDITIONAL DEVICES

ENGINE START STATION AND START SWITCH

The Engine Start Station is located behind the Engine Cab next to the main alternator. It consists of an engine PRIME/START switch (Item 1, Fig. 10), which is used to start the diesel engine, and an ENGINE STOP pushbutton (Item 2, Fig. 10). See **Operating Procedures** Section of this manual.

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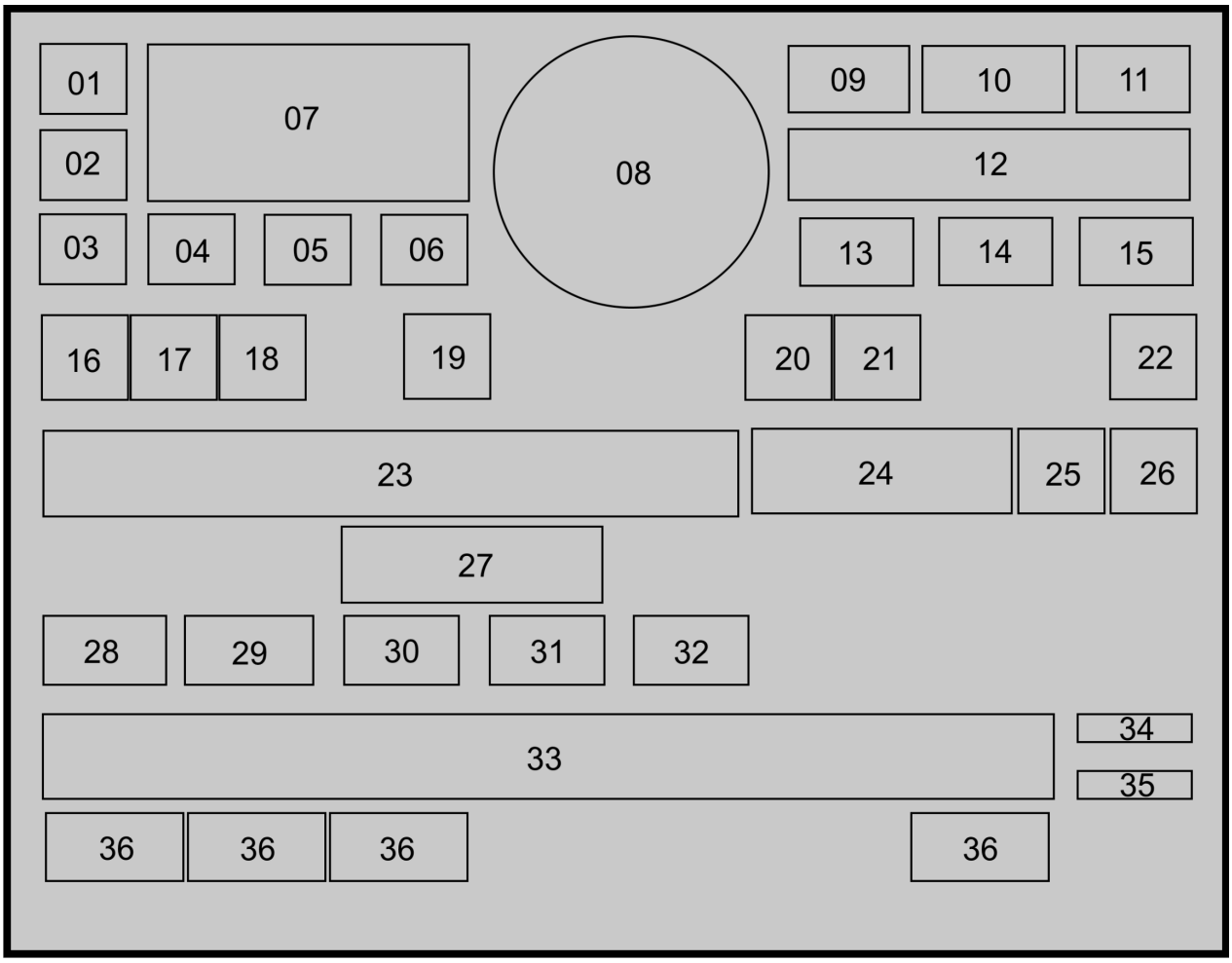
INTEGRATED FUNCTION DISPLAYS



REF.	DESCRIPTION
1.	EQUALIZING RESERVOIR PRESSURE (ER)
2.	BRAKE PIPE PRESSURE (BP)
3.	BRAKE CYLINDER PRESSURE (BC)
4.	MAIN RESERVOIR PRESSURE (MAIN)
5.	LAST CAR PRESSURE (REAR)
6.	AIR FLOW GAGE (FLOW)
7.	AIR PRESSURE (ER AND BP) BAR GRAPH
8.	LOCOMOTIVE SPEEDOMETER (GRAPHIC AND DIGITAL)
9.	ACCELERATION (MPH/MIN)
10.	DISTANCE COUNTER
11.	ROAD NUMBER
12.	LOAD METER BAR GRAPH (BRAKE AND MOTOR)
13.	REVERSER HANDLE POSITION
14.	TRACTIVE EFFORT/LOAD METER (KLBS)
15.	THROTTLE (COMBINED POWER) HANDLE POSITION
16.	WHEELSLIP ALARM (WHEEL SLIP)
17.	PCS OPEN ALARM (PCS OPEN)
18.	SAND ALARM (SAND)

REF.	DESCRIPTION
19.	PENALTY BRAKE ALARM (PENALTY BRAKE)
20.	DISTRIBUTED POWER ON (DP ON)
21.	EOT COMMUNICATION LOSS ALARM (EOT COMM)
22.	EOT MOTION MARKER (EOT MOVE)
23.	AIR BRAKE MESSAGE WINDOW
24.	TRACTION MOTOR CUT–OUT (MOTOR CUT OUT)
25.	BELL
26.	HORN
27.	EOT EMERGENCY STATUS
28.	INDEPENDENT BRAKE STATUS
29.	AUTOMATIC BRAKE STATUS
30.	EOT ID CODE
31.	EOT LANTERN MARKER STATUS
32.	FUEL QUANTITY
33.	OPERATOR MESSAGE WINDOW
34.	OPERATION SCREEN LEVEL INDICATOR
35.	OPERATION SCREEN NUMBER
36.	MENU SOFT KEYS**

**SEE APPROPRIATE SECTION OF THIS MANUAL FOR KEY DESIGNATIONS AND LABELS.

FIG. 11.

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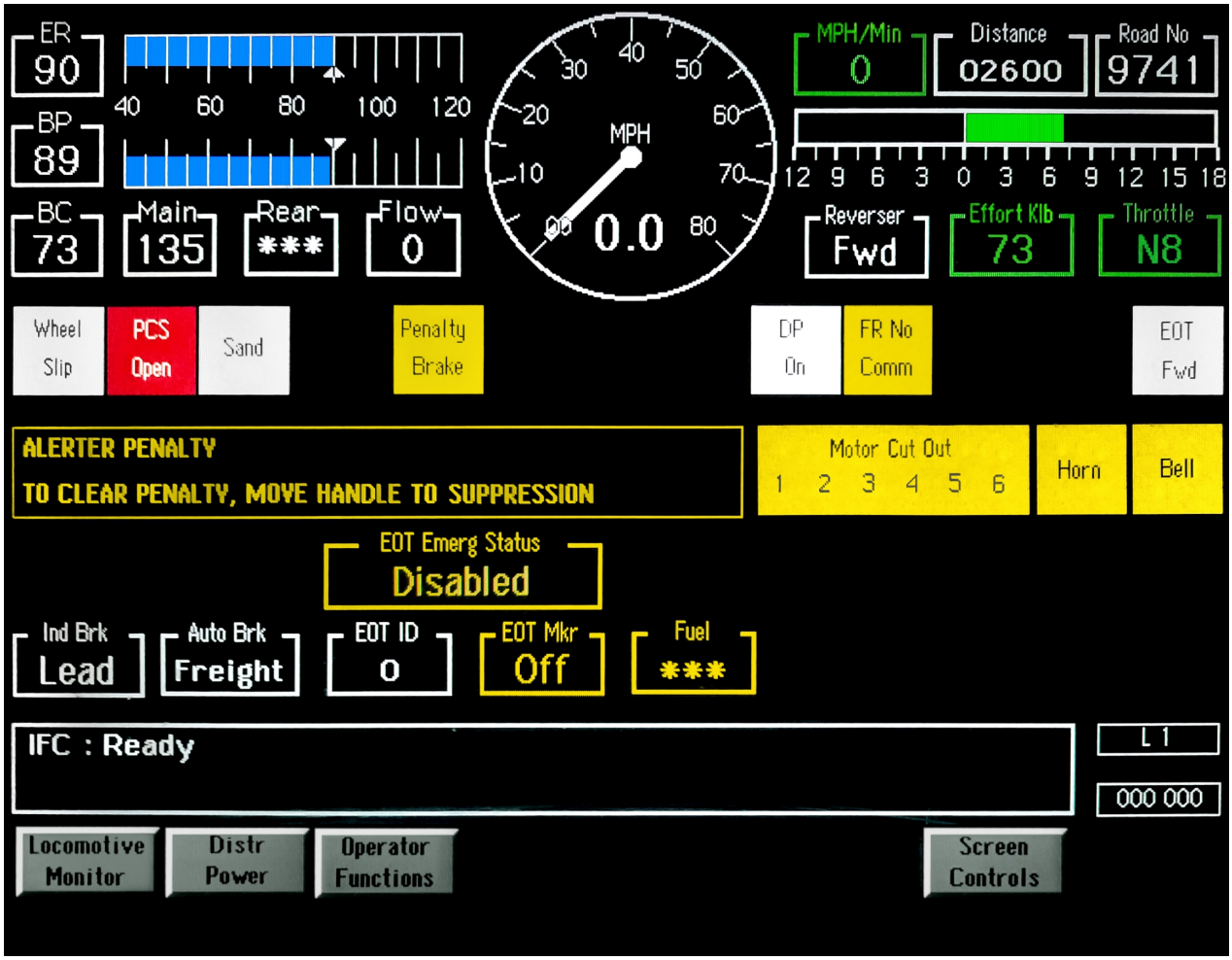

FIG. 12.

The Integrated Function Display (IFD) located on the control console (Item 13, Fig. 1) is a ten–inch diagonal, backlighted, liquid crystal display (LCD). On Power Up it will display the Operation Screen (Fig. 12). Refer to the following for screen components:

***NOTE**: The original IFD (Item 12, Fig. 1) on our model has been replaced by a SDIS.*

NOTE**: If any of the analog bars change color indicating an alarm or out–of–limit condition, the box surrounding the corresponding digital indication will turn yellow. When all fields contain "", the communications link has been lost.*

The following list of components corresponds with the numbered items presented on Figure 11, Sample Operation Screen Informational Areas:

1. **ER** – indicates Equalizing Reservoir pressure. The range for this digital marker is 0–200 psi. A digital reading of "**– – –**" indicates an invalid value from the corresponding transducer and "***" indicates Electronic Air Brake (EAB) is not communicating with IFC.

2. **BP –** indicates locomotive Brake–Pipe pressure. The range for this digital marker is 0–200 psi. A digital reading of "**– – –**" indicates an invalid value from the corresponding transducer and "***" indicates Electronic Air Brake (EAB) is not communicating with IFC.

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3. **BC –** indicates Brake Cylinder pressure. The range for this digital marker is 0–200 psi. A digital reading of "**– – –**" indicates an invalid value from the corresponding transducer and "*******" indicates Electronic Air Brake (EAB) is not communicating with IFC. The display and reading will flash yellow if Brake Cylinder pressure is greater than 0 and locomotive speed above 10 MPH.

4. **MAIN –** indicates Main Reservoir pressure. The border and the digital number turn red at pressures below the feed valve pressure + 15 psi. The range for this digital marker is 0–200 psi. A digital reading of "**– – –**" indicates an invalid value from the corresponding transducer and "*******" indicates Electronic Air Brake (EAB) is not communicating with IFC.

5. **REAR –** indicates trainline pressure for the last car if the End–Of–Train (EOT) device is installed. The border and digital number turn red at pressures below 45 psi. The range for this digital marker is 0–200 psi. Rear pressure is displayed as long as the EOT device is transmitting data from the rear of the train. In the case of total EOT communication loss, or if the EOT device is turned off, the display will show "*******".

6. **FLOW –** indicates air flow in the Brake Pipe. The range for this digital marker is 0–200 cfm. A digital reading of "**– – –**" indicates an invalid value from the corresponding transducer and "*******" indicates Electronic Air Brake (EAB) is not communicating with IFC.

7. **Air Gage Bar Graphs –** The ER and BP pressures are also shown in bar graph form. Range (full scale) is 40 120 psi for the bar graphs. Bar color is blue. The blue pointers indicate Regulating Valve Setting.

8. **Speedometer –** The digital portion of the speedometer registers locomotive speed in MPH with an alarm mode set above 70 MPH (independent of track maximum set speed) – graphic turns yellow in alarm mode. The digital portion is displayed in two scales – LO scale which reads from 0 to 9.9 mph in 0.1 mph segments and HI scale which reads from 10 – 99 mph in 1 mph segments. The analog portion of the speedometer registers as a graphic with a scale of 0–80 MPH. Numbers will turn yellow in alarm mode.

9. **MPH/MIN (Acceleration) –** The acceleration (deceleration) of the locomotive is computed by the control system (from Speed and Time) with a range of 0 to 99 mph/min in 1.0 mph/min segments. During acceleration the number, label and border will be green; in deceleration, yellow. The gage will disappear when the locomotive speed falls below 4.0 MPH and re–appear when speed rises above 6.0 MPH.

10. **DISTANCE –** The distance counter displays the distance traveled in feet (up to 99,999 feet) based on the input from the number two motor tachometer. The counting is bi–directional (counts up when moving forward; back when in reverse) except when passing through zero where it starts counting up again. Use the soft keys (COUNT UP, COUNT DOWN, ZERO COUNTER, PRESET COUNTER and RECALL PRESET) to control counter operation from Screen 310 000.

11. **ROAD NO –** The locomotive road number is displayed in this position. Number range is from 0 to 9999. If the road number is unknown or a loss of communication, a "*******" will be displayed.

12. **Effort Bar Graph –** This graph shows the average braking or tractive effort (Klb) from all cut–in traction motors. In Tractive Effort, the bar (from 0 to 180 Klb) is green. In Braking Effort, the bar (from 0 to 120 Klb) is yellow. This bar also turns yellow at Dynamic Brake setup.

    ***NOTE**: The Tractive Effort Bar Graph should show "0" during Self Load.*

13. **REVERSER –** This status marker indicates whether the Reverser Handle is in "Fwd", "N" or "Rev" position.

14. **EFFORT Klb –** This status marker indicates digitally what the Effort Bar Graph (12), located directly above, is displaying. The range is from 0 to 180 Klb with motoring in green and 0 to 120 Klb with braking in yellow.

15. **THROTTLE** – This status marker indicates the current position of the Combined Power handle (Throttle or Braking). In motoring the green indications can be: "Off", "Idle" or "N1" through "N8". In braking the yellow indications can be: "Off", "Set–Up" or "B1" through "B8".

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16. **WHEEL SLIP –** This white marker light indicates that the wheels on a locomotive in the consist are slipping or sliding. This is a trainlined indication.

17. **PCS OPEN –** This red marker light indicates a Penalty or Emergency air brake application has occurred. Power has been eliminated. Engine speed remains at IDLE. See **Alarms, Safeguards, Power Derations, and Shutdowns** Section of this manual.

18. **SAND –** This white marker light indicates that sanding is taking place either manually (lead axle pushbutton) or automatically. During a wheelslip, sanding and the SAND light will automatically turn on, then off. In Emergency Sanding, light will be on.

19. **PENALTY BRAKE –** This flashing yellow marker light indicates that the locomotive is in a penalty brake situation.

20. **DPS ON –** This white marker light indicates the Distributed Power System is active.

21. **EOT COMM –** This marker light indicates component problems with the End of Train (EOT) device. EOT COMM will light yellow when communication with EOT transmitter is broken. Value for REAR (5) will be ******* if EOT COMM alarm is active.

22. **EOT MOVE –** This status marker indicates movement status of the EOT Device. Possible indications are: “Fwd”, “Rev” and “Stop”.

23. **Air Brake Message Window** (occupies space for status markers 28–31) **–** The yellow worded messages (possible two lines) inform the operator of the Electronic Air Brake system status. See **AIR BRAKE OPERATION** Section of this manual.

24. **MOTOR CUT OUT –** This alarm indicator will alert the operator that a traction motor (or motors) has been cut-out. The alarm will show the number (1–6) of each Traction Motor that is cut–out.

25. **BELL –** This Crossing Bell alarm indicator will light when the bell has been activated.

26. **HORN –** This alarm indicator will light when the horn has been activated.

27. **EOT EMERGENCY STATUS –** This status marker indicates the Two–Way End of Train status. Possible indications are: “Enabled,” “Disabled” and “***”. The “***” indicates an unknown condition while “Disabled” indicates an alarm (or operator take note) condition.

28. **IND BRK –** This white status marker indicates whether the Independent Brake Handle is in “Lead” or “Trail” position. When in “Trail”, the marker is yellow.

29. **AUTO BRK –** This white status marker indicates whether the Automatic Brake Handle is in “Pass”, “Freight” or “Cut Out” position. When in “Cut Out”, the marker is yellow.

30. **EOT ID –** This white status marker lists the End Of Train Identification Code. The range is from 00000 to 99999. A “*******” will be displayed for an out–of–range or unknown value or loss of communication.

31. **EOT MKR –** This white status marker indicates the EOT Lantern Marker status. Possible indications are “ON” and “OFF”. When in “OFF”, the status marker is yellow. A “*******” will be displayed for an out–of–range or unknown value or loss of communication.

32. **FUEL –** This white marker displays the fuel quantity in gallons. A “*******” will be displayed for an out–of–range or unknown value and the marker willl turn yellow.

33. **Operator Message Window –** This area will display Summary Messages from the IFC system. Usually a white status indicator, this area will turn yellow whenever there is a new message or active alarm.

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34. **Operation Screen Level Indicator –** This white status marker indicates what level of operation the displayed screen permits. Possible levels are “L1”.

35. **Operator Screen Number –** This white status marker indicates what Operation Screen is being displayed. The number is used for operator assistance while operating the IFDs.

36. **Menu Soft Keys –** Below the Operator Message Window is a keypad with eight keys. Some keys on the key pad are restricted and used on specific occasions, primarily for L2 maintenance operations. Menu information only appears over active keys. See appropriate sections of this manual for key designations and labels.

DIAGNOSTIC INFORMATION DISPLAY (DID)

GENERAL INFORMATION

The DID panel is a fast and accurate means of communications between the locomotive operator and computers. The DID panel can be utilized in several ways:

1. If an abnormal operating condition (called a “FAULT”) is detected, the computers will initiate the ALARM mode. In the ALARM mode, the computer uses the DID panel to alert the operator to the FAULT by displaying a description of the FAULT and, in some cases, ringing the Alarm bell.

   ***NOTE**: All AC Locomotive FAULT messages are preceded by a four digit Fault Number beginning with a “7”.*

2. The FAULT detected may require that certain operating restrictions be imposed on the locomotive as a means of protecting the locomotive’s equipment. The locomotive computers impose the necessary restrictions and inform the operator of those restrictions through the DID panel in the form of SUMMARY messages.

3. A SUMMARY message on the display informs the operator of the general status of: the locomotive operating condition; the computers; any restriction placed on the locomotive from faults; and, in some cases, the status of the display itself.

   ***NOTE**: A SUMMARY message is not preceded by a number.*

4. The FAULT is recorded in a FAULT “Log” for later review by maintenance personnel.

5. The operator can use the DID panel to review active FAULTS and their related restrictions (SUMMARY messages). The DID panel also enables the operator to reset FAULTS, and attempt to return the locomotive to normal operation.

THE DISPLAY

Message Windows

The Diagnostic Display (DID) panel has a two–line display window as described in Figure 13.

Keys

Below the two–line display is a keypad with four rows of keys. Figure 13 describes the use of these keys in Level 1.

Using The Display

If a mistake is made while using the DID panel in Level 1, locomotive operation will not be interrupted or degraded and locomotive equipment will not be damaged. Use of this panel by all responsible persons is encouraged.

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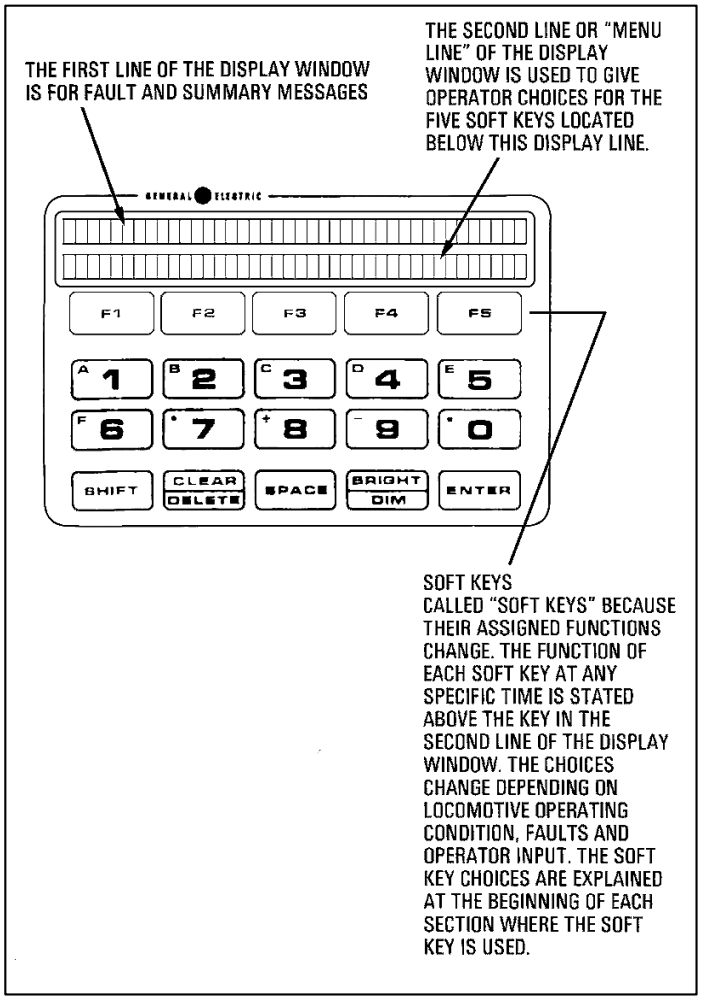


FIG. 13.

OPERATING MODES IN LEVEL 1

After the locomotive computers have been powered–up and are operating normally, three modes of operation are available in Level 1:

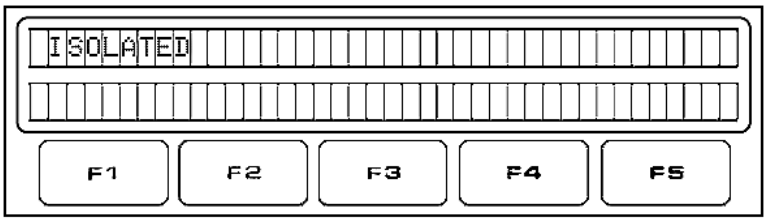
1. READY mode.
2. ALARM mode.
3. FAULT mode.

READY Mode

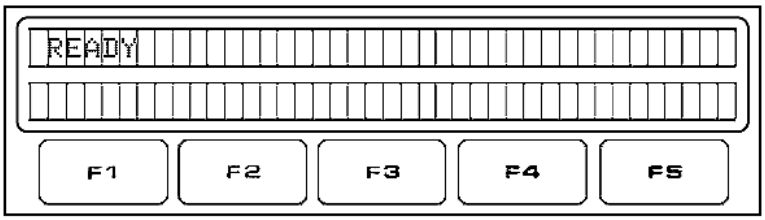
READY indicates that all of the locomotive systems are functioning properly, and the locomotive is "ready" to operate at full power. READY can be displayed in one of three ways:

1. "READY", appearing alone indicates that there have been no FAULTS detected, or reset.
2. "READY–Work Report Stored" indicates a FAULT has occurred, it has been reset, and all operating restrictions imposed by the FAULT have been removed.
3. Some FAULTS do not impose operating restrictions on the locomotive. When this type of FAULT occurs, "READY – Fault Message Stored" will be displayed.

This display indicates that the Engine Control (EC) switch is in the ISOLATED position.



This display indicates all systems are running and the locomotive is READY to function normally.



ALARM Mode

The computers check locomotive operation on a continuing basis. If an abnormal condition (FAULT) is detected, the ALARM mode may be initiated by the locomotive computers.

NOTE: If the computer initiates the ALARM mode, when the DID panel is operating in any other mode, it will interrupt that mode to display the ALARM. When the ALARM mode is completed, the display will return to its previous operating mode.

When the ALARM mode is initiated, a description of the problem will be given on the first line of the display in the form of a FAULT MESSAGE, the word “Silence” will appear on the second line of the display and, in most cases, an alarm bell will sound.

“Silence” Soft Key

“Silence” is the only soft key that appears in the ALARM mode. It does not appear in any other mode of operation.

When “Silence” is pressed OR if 30 seconds pass, the ALARM mode is terminated, the bell will stop ringing, the word “Silence” will disappear. The first line of the display will change from the FAULT message to show the operating restriction which has the greatest effect on the locomotive’s ability to operate normally (highest priority SUMMARY message).

NOTE: A few ALARMS are considered so serious that the bell cannot be silenced. In the cases of ENGINE SHUTDOWN, for example, no “Silence” soft key appears. The EC switch on the SHUTDOWN unit MUST be turned to the START position to silence the bell.

FAULT Mode

As mentioned before, as a result of abnormal conditions (FAULTS), it may be necessary to protect the locomotive’s equipment, by placing certain operating restrictions on the locomotive.

The FAULT mode of operation allows the operator to return the locomotive to the READY condition unless conditions exist that prohibit READY operation.

1. If a FAULT is reset, the operating restrictions imposed by it are removed and the related SUMMARY messages are no longer displayed.

2. Several FAULTS may impose the same operating restrictions and will therefore, result in the same SUMMARY message.

3. A FAULT may result in more than one operating restriction and therefore, more than one SUMMARY message.

4. Under normal operating conditions, the highest priority SUMMARY message will be displayed. Highest priority being those conditions which have the greatest effect on the locomotive's ability to operate normally.

FAULT Mode Soft Keys

The following soft keys can be used by the operator to view SUMMARY and FAULT messages and to begin and to complete the reset procedure.

Label	Explanation
Exit	Takes the DID panel out of the current operating mode.
Reset?	Reset? This soft key asks the operator, "Do you want to Reset?" (a FAULT). It can only appear when there are Active FAULTS that can be reset by the locomotive crew. Resetting a FAULT which has imposed operating restrictions is the only way to return the locomotive to the READY condition. Resetting a FAULT requires two steps: Pressing "Reset?" initiates the reset procedure. When "Reset?" is pressed, the most recent FAULT will be displayed with the choice of resetting that FAULT or looking at other FAULTS which have not been reset ("Active" FAULTS). ***NOTE**: "Reset" (without the question mark) must be pressed to complete the reset procedure.*
Reset	Pressing this key completes the reset procedure. Pressing "Reset" tells the computer this FAULT has been corrected, to remove all operating restrictions imposed by it and, if there are no other Active FAULTS, to return the locomotive to normal operation. When all Active FAULTS have been reset, the message "READY – Work Report Stored" will be displayed. If other Active FAULTS remain, the highest priority SUMMARY message will be displayed.
Older and Newer	FAULT messages are displayed in order and of most recent first. The "Older" and "Newer" soft keys allow the operator to view "Older" and "Newer" Active FAULT messages respectively.
ShoMore and GoBack	SUMMARY messages are displayed in order of **highest priority**. "ShoMore" and "GoBack" allow the operator to review ALL SUMMARY messages (operating restrictions). Each time "ShoMore" is pressed, the next lower priority SUMMARY message will be displayed. Pressing "GoBack" will display the next higher priority SUMMARY message. ***NOTE**: The choices "ShoMore" and "GoBack" are given only when there are lower or higher priority SUMMARY messages respectively.* ***NOTE**: If there is no key pad activity for 15 seconds, the display will change to show the highest priority SUMMARY message.*

Reset

Press "Reset" to clear the FAULT.

Several things happen when a FAULT is reset:

1. All operating restrictions imposed by the FAULT are removed.
2. If there are other Active FAULTS, the display will show the highest priority SUMMARY message of the remaining Active FAULTS.
3. If there are NO OTHER Active FAULTS, the display will change to show: “READY – Work Report Stored.”

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LIST OF SUMMARY MESSAGES

Highest Priority

BAD Summary Number
WAIT
Please Move EC To START For 20 Seconds
Auto Engine Start/Stop in Progress
WARNING! Axle Problem On Other Loco.
WARNING! Locked Axle Alarm is Disabled
WARNING! Hot Axle Bearing On This Loco.
WARNING! Hot Motor Pinion Bearing
WARNING! Air Compressor Does Not Pump
Won't Load: Locked Axle Detected
Auto Train Ctrl Speed Disabled – Bad SS2&5
WARNING! Spdmtr, Ovrspd Disabled – Bad TMSS2
Automatic Water Drain Disabled
SHUTDOWN: Low Water Flow
SHUTDOWN: Low Oil Pressure
SHUTDOWN: Low Water Pressure
SHUTDOWN: Crankcase Overpressure
SHUTDOWN: Engine Overspeed
SHUTDOWN: Electrical Control Problem
Won't Crank: Electrical Control Problem
Won't Crank: Cranking Inverters Disabled
Power Circuit Configuration In Progress
Automatic Diagnostic In Progress
Won't Crank: Cooling Delay
Won't Crank: Barrier Bar Open
Cranking Time Out
Possible Engine Or EFI Fueling Problem
Won't Crank: Cranking Inv 4,5 Cutout
Won't Crank: Low Battery Volts
Engine Not Running
Auto Engine Start Control NOT ACTIVE
Auto Engine Stop Control NOT ACTIVE
Please Move Throttle To IDLE
Can't Load Now: Too Much Cycling
Can't Charge Battery Now: BRP Cycling
No Battery Charge: Elect. Control Prob.
No Battery Charge
Won't Battery Jog: Elect. Control Prob.
Won't Battery Jog: Barrier Bar Open
Won't Self–Load: Elect Control Problem
Won't Self–Load HP: Elect Control Problem
Won't Load: Crankcase Overpressure
Won't Load: Low Water Pressure
Won't Load: Overspeed Governor Problem
Won't Load: Aux. Alternator Field C/O
Won't Load: Ground Isolation Switch Open
Won't Load: Barrier Bar Open
Won't Load: Electrical Control Problem
Won't Load: Too Many Speed Sensors C/O
Won't Load: Waiting for Aux. Alternator
Won't Load: Hot Engine
Won't Load: Power Circuit Ground
Won't Load: Power Circuit Problem
Won't Load: Battery Charge Problem
Won't Load: Hot Diodes
Won't Load: MU Error
Won't Load: Fault Message Stored
Won't Crank: Fault Message Stored
Won't Battery Jog: Fault Message Stored
ISOLATED
No Dynamic Brake: Man. Tract. Motor C/O
No Dynamic Brake: Power Circuit Ground
No Dynamic Brake: Elect. Control Prob.
No Dynamic Brake: Power Circuit Problem
No Dynamic Brake: Fault Message Stored
Reduced Dynamic Brake: Man. TM Cutout
Reduced Dynamic Brake: Auto TM Cutout
Reduced Dynamic Brake: Power Circuit Gnd
Reduced Dynamic Brake: Grid(s) Isolated
Reduced Dynamic Brake: Elec Control Problem
HP Limited: Man TM Cut Out
HP Limited: Auto TM Cut Out
Won't Self–Load: Fault Message Stored
Self–Load: LOAD CONDITIONS
Warning: Locked Axle Alarm Is Cutout
Load Limited: T/L 13 or T/L 16 Open
Load Limited: Low Oil Pressure
Load Limited: Low Water Pressure
Load Limited: Hot Diesel Engine Exhaust
Load Limited: Hot Engine
Load Limited: Cold Engine
Load Limited: Dirty Engine Air Filter
Load Limited: Traction Motors Cut Out
Load Limited: Trac. Motor Temp. Protection
Load Limited Due To Traction Alternator
Load Limited: Power Circuit Ground
Load Limited: Electrical Control Problem
Inverter Disabled: Fault Message Stored
May Reduce Load: Radiator Fan Cycling
May Reduce Load: Radiator Fan Problem
Please Initialize CAB Via Toolbox
Trainline Alarm
Fault Log is Almost Full
Wheel Diameter Calibration in Progress
Spare Summary Message 02
TE Limited: T/L 18 and T/L 19 Mismatch
TE Limited: TE Reduction Enabled
Spare Summary Message 06
Spare Summary Message 07
Spare Summary Message 08
Won't Crank: Bad TAP Panel
Spare Summary Message 0A
Spare Summary Message 0B
Optimal Number of Axles Powered
TE Limited: Man. TM Cut Out
TE Limited: Auto. TM Cut Out
READY – Fault Message Stored
READY – Engine Stop Control NOT ACTIVE
READY – Work Report Stored
READY

Lowest Priority

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HP BOOST AND CLEAN CAB RADIO

GROSS HP BOOST

Canadian Pacific's line of AC4400 locomotives are equipped with a gross horsepower boost. The gross horsepower boost will increase maximum available gross horsepower of the engine from around 4000 GHP to 4500 GHP when enabled. This will increase the locomotive's pulling ability on heavy trains and help the train accelerate quicker.

The horsepower boost is automatically regulated through the IFC and is enabled with the Combined Power Handle in NOTCH 8 up to 25 MPH. If the locomotive speed exceeds 25 MPH, the computer system automatically reduces the available gross horsepower down to 4000 GHP to lower wear and stress on the engine and it's components.

> ***NOTE: Should the locomotive speed fall below 25 MPH after the horsepower boost has previously been enabled, the Combined Power Handle must be moved to NOTCH 7 or lower for at least one second in order to reset the horsepower boost. Once reset, the operator may advance the Combined Power Handle back to NOTCH 8 in order to re-enable the horsepower boost.***

> ***NOTE: The gross horsepower boost is independent from the Power Limit Switch (Item 5, Fig. 6) and does not effect the tractive effort output of the locomotive.***

CLEAN CAB RADIO

Overview

To select a radio channel, press the TONE button. This will prompt you to enter a tone number. Select one of the DTMF numbers [0-9] to enter a tone number. Next up, press the CHAN button on the radio. This will blank out the transmitting (TX) and receiving (RX) channels and will prompt you to enter the first digit of the transmitting channel. Press the channel number to enter it and it will prompt you to enter the second channel number for the transmitting channel.

Repeat the same process for the receiving channel. To overwrite the active TX and RX channels, press the CHAN button again.

> ***NOTE****: The TX and RX channels can only be overwritten when both channels have previously been assigned a channel number. Overwriting just the TX or RX channel is invalid.*

Operation Guideline

Laggan and Mountain Subdivision

CHANNEL NUMBERS:

Main Channel: 91-91
RTC Tone up Channel: 21-91

TONE UP NUMBERS:

*Mount MacDonald Tunnel: *11#*
*Connaught Tunnel: *21#*
*Mountain Sub: *51#*
*Laggan Sub: *71#*

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ALARMS, SAFEGUARDS, POWER DERATIONS, AND SHUTDOWNS

ALERTER

The Alerter promotes safe train operation by monitoring various operator movements to ensure the alertness of the operating crew. If a proper control movement is not detected within a predetermined reset time period, an alarm sequence including audible and visual alarms is started requesting an acknowledgement. Lack of response to the system during this time will result in a penalty brake application by de–energizing the Alerter Magnet Valve. This action will command a full service brake application bringing the locomotive to a stop.

The Alerter starts counting down from sixty seconds. After sixty seconds and with no acknowledgement it will flash for about six seconds. If no response, an audible alarm will sound. The operator is then given another ten seconds to respond before a penalty brake application is automatically initiated.

***NOTE**: A penalty brake application will light up the BRAKE APPLIED window on the Alerter (Item 1, Fig. 2) for three seconds.*

***NOTE**: The Alerter Function is disabled when Brake Cylinder pressure is greater than 25 psi or the Alerter Override is enabled. Actuating the Alerter Override will light up the OVERRIDE window on the Alerter (Item 1, Fig. 2) for three seconds.*

The following control movements will reset the Alerter:

- Operating the Alerter reset pushbutton
- Operating the Bell switch, Horn switch, or movement of the Reverse handle or Throttle handle
- Movement of the Automatic Brake handle, Independent Brake handle, or Bail–off
- Change in Dynamic Brake

EMERGENCY SANDING

Emergency sanding is automatically applied in FORWARD and REVERSE directions during all Emergency Brake applications for a sufficient time to stop the train.

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MOTOR AND SPEED SENSOR CUT–OUT SWITCHES

CAUTION: Set the Engine Control Switch to the START or ISOLATE position and place the Throttle Handle in IDLE before operating any Motor Cut–Out switches.

Traction motors can be cut out manually or automatically. Manual cut out is done with individual Motor Cut–Out switches on the EC panel (Items 7-8 & 11-14, Fig. 8).

NOTE: Speed sensors do not need to be cut out on cut–out motors. When the Motor Speed Sensor switch is in the cut–out position, the speed signals from the speed sensors on motors that are cut out are ignored.

When a motor or motors are cut out, total power available for traction is adjusted as follows:

Motors Cut–Out	Horsepower Available for Input for Traction
All IN	Full HP
1 Out	Full HP
2 Out	Full HP
3 Out	3063 (See Note 1)
4 Out	2042 (See Note 1)
5 Out	1021 (See Notes 1 and 2)
6 Out	None
NOTE 1: Horsepower available for input for traction is limited to 1021 horsepower per each traction motor CUT IN.	
NOTE 2: Speed sensor inputs from at least two traction motors are required for locomotive to load.	
NOTE: Tractive Effort for Traction Motors is limited to 30 Klb starting and 24.1 Klb continuous.	

OIL AND WATER TEMPERATURE

Horsepower and/or engine speed will be altered if one of the following conditions exist:

Cold Engine

To protect a cold engine, restrictions are placed on engine load and speed until engine temperature has reached 140F (60 C) or higher for more than three minutes. Also, to keep engine operating temperatures within certain limits, engine speed will be altered when temperature drops below certain limits.

Hot Engine

Oil or Water Temperature Between 230 and 239 F (110 and 115 C)

Engine RPM goes to Notch 8 and power is derated from no deration at 230 F (110 C) to full deration (55% power) at 239F (115 C). Engine returns to requested Notch speed when the temperature drops to 230 F (110 C.)

NOTE: The engine will operate at 37% power between 236 and 239 F (113 and 115 C) for three minutes before the engine goes to IDLE.

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Oil or Water Temperature At 240 F (115.5 C) and Above

If the oil or water temperature exceeds 240 F (115.5 C), engine RPM goes to IDLE and Load goes to zero.

***NOTE**: Power Deration will be displayed on the Locomotive Data Monitor Screen 102 000 (Fig. 14.) as "Load Pot%".*

PCS FUNCTION OPERATION

The Pneumatic Control Switch (PCS) Function is controlled by the Electronic Air Brake system. During a safety control Penalty Brake or Emergency Brake application (power knockdown), this function activates. The Brake Control Computer signal (through the PCR relay) will affect engine speed (limited to IDLE), available locomotive power, and light the PCS OPEN warning light on the Operation screen (Item 17, Fig. 11).

To reset the PCS Function:

1. Move the Combined Power Handle to IDLE.

   ***NOTE**: If the PCS Function has been activated while in dynamic braking, the Braking handle must be returned to OFF to reset the circuit. Dynamic braking will be retained when PCS is open.*

2. Following the IFD display prompts, for **Penalties**, proceed to **Step a**. For **Emergencies**, proceed to **Step b**.

   a. Move the Automatic Brake Handle to SUPPRESSION and wait at least eight seconds for Power Up, Over-speed, or other Penalty applications.

   b. Move the Automatic Brake Handle to EMERGENCY and wait at least 60 seconds for Trainline, Operator, EOT, or Brake Valve Emergencies.

3. Move the Automatic Brake Handle, when instructed and ready, to RELEASE.

***NOTE**: Penalty applications can be reset "on the fly" meaning the locomotive does not need to come to a full stop before the penalty can be reset.*

WHEELSLIP

The locomotive computers continuously monitor axle speed. If a wheelslip or slide is detected by the Control System, the control decreases the torque command (motoring or dynamic brake) on the affected axle and orders sanding until the slip/slide is under control. Wheelslip is controlled per individual axle.

Sand can be applied either manually (using pushbuttons located on the control console) or automatically. Automatic sanding may take place as follows:

1. All locomotive axles are in a wheelslip/slide (synchronous slip) condition.

   ***NOTE**: Wheelslip Deration will be displayed on the Locomotive Data Monitor Screen 102 000 (Fig. 14.) as "W/S Derate" in percent of power output.*

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AUTO ENGINE START/STOP (AESS) SYSTEM

The AESS System enhances fuel savings by automatically shutting down the diesel engine during periods of inactivity. The system monitors certain locomotive parameters and restarts the engine as needed. When this system is active, the diesel engine may start and stop without operator intervention.

WARNING: This locomotive is equipped with Auto Engine Start/Stop (AESS). The diesel engine may start without operator action.

***NOTE**: Locomotives with AESS are identified by warning decals applied in the Operating Cab and at several locations on the exterior of the unit.*

The diesel engine will only shut down automatically during inactivity (parked idle) periods. Any powered operation or movement of the locomotive will prevent the AESS system from shutting down the diesel engine.

The maximum AESS shut down time is 90 – 210 minutes, depending on ambient temperature and oil temperature. There are a maximum of eight shut downs in a twenty–four hour period. If AESS begins the shutdown process (indicated by the ringing bell) and the process is aborted three consecutive times, AESS becomes inactive until the locomotive moves.

Conditions for Automatic Shut Down

These conditions must exist for 10 minutes prior to initial automatic engine shutdown and for subsequent shutdowns.

1. All AESS permissions (certain locomotive system parameters) are within limits.
3. The Reverser is in the CENTER position and the Reverser Key inserted.
4. The Throttle handle is in the IDLE position.
5. The Engine Control (EC) switch is in any position except JOG.
6. The independent brakes are fully applied.
7. Locomotive speed is zero.
8. Engine Warming is not in progress.
9. Engine is not in Self-Test mode.

***NOTE**: All AESS permissions can be found on the AUTO ENGINE START/STOP SYSTEM (AESS) warning label on the back wall located in the operator cab.*

Conditions for Automatic Start Up

***NOTE**: The DID must display "Auto Engine Start Control ACTIVE" for an Automatic Start–Up to take place. If "Engine Not Running" is displayed, a manual engine start is required.*

Any AESS trigger (certain locomotive system parameters) outside of its limits will initiate Automatic Start–Up as long as the following conditions are also met:

1. Engine stop was from an automatic shutdown.

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AESS Messages

The following messages appear on the DID.

Message	Meaning
Auto Engine Start/Stop In Process	Engine start or stop is happening now.
Auto Engine Start Control ACTIVE	The engine is stopped and the AESS System is activated (ready to start the engine) when a trigger occurs.
READY	The engine is running and the AESS System is activated.
AESS SUSPENDED for MMM:SS Minutes	The operator successfully suspended AESS shutdown activity.
Auto Stop May Occur: MMM:SS Minutes	All triggers for automatic engine stop are TRUE. (Time will count down until the automatic stop sequence begins or any trigger changes to FALSE.)

AESS Bell Warnings

The AESS System provides warnings to operating and maintenance personnel that an automatic engine start or stop is about to occur. The bell also sounds to signal error conditions.

***NOTE**: The AESS warning bell is located on the outside of the rear wall of the Auxiliary Cab, near the alternator, on the operator's (right) side of the locomotive. It is NOT the bell that rings in the Operating Cab.*

Bell	Condition Indicated
Continuous ringing until engine is stopped	Automatic shutdown is about to occur.
Continuous ringing until engine prime	Automatic start is about to happen.
Continuous ringing for 30 seconds	The AESS System cannot perform an Automatic Engine start even though ASDS is in the ON position.

Main Reservoir Drain Valves

The AESS System requires the use of electrically controlled, pneumatically activated Main Reservoir Drain Valves. The drain valves (splitters) allow moisture to be removed from the main reservoirs. During AESS engine shutdown, the drain valves are de–activated to maximize fuel savings however they will continue to run for about a minute after an engine shutdown occurred.

Engine Warming

During cold weather conditions, to protect a cold engine, restrictions are placed on engine load and speed until the engine, lubricating oil and water temperature have reached a predetermined level or higher for more than three minutes. Also, to keep engine operating temperatures within certain limits, engine speed will be altered and may differentiate from throttle indication when temperature drops below certain limits.

Engine warming will automatically be initiated if the following three conditions do not exist:

1. *Engine temperature above below 140 F (60 C).*
2. *Engine oil temperature above 105 F (40.5 C).*
3. *Engine water temperature above 105 F (40.5 C).*

***NOTE**: During Engine Warming, the message "Engine Warming In Progress" will be displayed on the DID.*

OPERATING PROCEDURES

OPERATION SCREENS

***NOTE**: When boarding the locomotive, the Main Operation Screen (000 000) will be displayed on both IFDs. (Item 12-13, Fig. 1).*

This screen is used to monitor locomotive performance. After the locomotive computers have been powered–up and are operating normally, the Main Operation Screen (000 000) will appear on the IFD and the message line will display any IFC Operator Messages. Two functions are available in Level 1:

1. *Locomotive Monitor (Key Position F1).*
2. *Operator Functions (Key Position F3).*

Locomotive Monitor

Pressing the Locomotive Monitor key will display screen 102 000.

Operator Functions

Pressing the Operator Functions key will display screen 300 000. Two keys are active on this screen:

1. Distance Counter

Pressing Key Position F1, Distance Counter, will display screen 310 000. Seven keys are active on this screen:

1. Count Up (Key Position F1)
2. Count Down (Key Position F2)
3. Stop Counter (Key Position F3)
4. Zero Counter (Key Position F4)
5. Preset Counter (Key Position F5).
6. Recall Preset (Key Position F7).
7. Exit (Key Position F8).

2. Exit

Pressing Key Position F8, Exit, will send the operator back to the Main Operation Screen (000 000).

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STARTING ENGINE

A manual engine shutdown will require a manual restart of the engine. See **Alarms, Safeguards, Power Derations, and Shutdowns** Section of this manual.

1. *Insert the Reverser Key and check that the Reverser Handle is in OFF and the Combined Power Handle in IDLE.*
2. *Turn ON all applicable circuit breakers (Items 1-10, Fig. 9) in the top row of breakers on the EC panel.*
3. *Turn ON **ALL** circuit breakers (Items 12-14, Fig. 9) in the second row of breakers on the EC panel.*
4. *Turn ON the Engine Run circuit breaker (Item 1, Fig. 6) and Engine Control circuit breaker (Item 3, Fig. 6) on the bottom control console.*
5. *Verify the Engine Control (EC) switch in the START position.*
6. *At the Start Station (Fig. 10), located near the engine, pull up both latches and open the hood doors to access the Start Switch.*
7. *Turn the Start Switch to the PRIME position. Hold the switch in the PRIME position for at least one second before turning it to the START position right after.*

   ***NOTE**: It is not required to hold the Start Switch in the START position to start the engine.*

   NOTE: On start–up, there will be a four to twelve second delay between the time the switch is placed in the START position and the diesel engine starts to rotate.

FASTER AIR PUMPING

To provide faster air pumping on locomotive, when reservoirs have been drained or after the locomotive has been coupled to a train, proceed as follows:

1. *Leave the Generator Field circuit breaker in the OFF position (Item 2, Fig. 6).*
2. *Insert the Reverser Key (place in center OFF position).*
3. *Move the Combined Power Handle to Notch 1. The air compressor speed is twice engine speed when the engine speed is below 525 RPM.*

BEFORE MOVING LOCOMOTIVE

1. *Place Rear and Forward Headlight switch (Item 15 & 16, Fig. 1) and the Ditchlight Selector switch (Item 14, Fig. 1) in the proper position for required operation.*
2. *Turn the Engine Control (EC) switch to the RUN position.*
3. *Make an Independent air brake application.*
4. *Check the IFDs for any fault messages. They should show Ready.*
5. *Release the hand brake and remove any blocking from the wheels. The train is now ready for operation. Refer to the OPERATION section of this manual.*

MOVING A TRAIN

1. *Close the Generator Field circuit breaker (Item 2, Fig. 6) on the bottom control console.*
2. *Move the Reverser Handle to the desired direction of movement.*
3. *Release the brakes completely.*
4. *Advance the Combined Power Handle. The Combined Power Handle has notches (IDLE up to Notch 8), with each successive notch representing an increase in power, or locomotive tractive effort.*

Starting a train depends on type, length, weight, grade, condition of rail, and amount of slack in the train. This locomotive is designed to have easily controlled tractive effort build–up characteristics, with the tractive effort in each notch limited to definite values as the Combined Power Handle is moved from the lowest to the highest notch. The engineer can easily control the amount of tractive effort required to start and accelerate a particular train. Speed can be controlled as desired by reducing or increasing the Combined Power Handle position.

STOPPING A TRAIN

Move the Combined Power Handle to IDLE, and apply the dynamic or air brakes according to Railroad Regulations. Also refer to Applying Dynamic Brakes paragraph located later in this section. If leaving the engineer's position after the train has stopped, move the Reverser Handle to OFF.

STOPPING ENGINE

1. *Move the Combined Power Handle to IDLE.*
2. *Open the Generator Field circuit breaker (Item 2, Fig. 6) on the bottom control console.*
3. *Move the Engine Control Switch into the START position.*
4. *Press the Engine Stop pushbutton (Item 11, Fig. 9) on the Engine Control Panel or at the Engine Start Station (Item 2, Fig. 10).*
5. *To shut down all engines when in multiple–unit operation, operate the MU Emergency Shutdown toggle switch (Item 2, Fig. 2) located on the Overhead Console.*

   ***NOTE**: The MU Emergency Shutdown toggle switch will only shut down all AC locomotives in the consist.*

CAUTION: The MU Emergency Shutdown toggle switch provides a single point capability to shut down all locomotives in a consist. In an emergency situation, pressing this switch on the lead controlling locomotive will shut down the diesel engines of all locomotives in the consist .

SAFETY CONTROLS

After a Penalty brake application has occurred, normal locomotive operation is restored in the following manner:

1. *Move the Combined Power Handle to IDLE.*
2. *Move the Automatic Brake Handle to SUPPRESSION.*
3. *Wait at least ten seconds, then move the Automatic Brake Handle to RELEASE when ready.*

DYNAMIC BRAKE OPERATION

Applying Dynamic Brakes

Applying dynamic braking is done in the following manner:

***NOTE**: Dynamic braking is dropped when locomotive speed falls below three MPH.*

1. *Move Combined Power Handle to IDLE.*
2. *Move the Combined Power Handle to SET–UP position; pause, then advance the handle into the BRAKING sector as desired.*
3. *After the slack is bunched, manipulate the Combined Power Handle until the desired braking effort is obtained. Observe and correct braking effort during the initial period of Dynamic Brake application.*

   The amount of braking effort obtainable varies with the position of the Combined Power Handle for various speeds. Maximum braking effort is obtained in the FULL BRAKING position at 20 MPH.

Use Of Air Brakes During Dynamic Braking

NOTE: Use of independent air brake does not affect the braking effort from dynamic brake. Independent brake and dynamic brake can be applied at the same time with no reduction in either braking capability.

When necessary, the automatic air brake may be used in conjunction with the dynamic brake.

DIAGNOSTIC SELF-TEST MODE (LOAD TEST)

Introduction

When in Self-Test, the diesel engine is run against the resistance grids of the dynamic brakes to “simulate” load on the engine. Because the electrical current generated by the main alternator is directed to the dynamic brake resistor grids instead of the traction motors, the dynamic brake resistor grid blowers will run up with increasing output on the main alternator. The following conditions must exist for Self-Test to be initiated:

1. *Reverser Key inserted and Reverser Handle placed in the OFF position.*
2. *The Engine Run circuit breaker, Engine Control circuit breaker and Generator Field circuit breaker (Items 1-3, Fig. 6) are in the UP position.*
3. *Engine Control (EC) switch in the RUN position.*
4. *Locomotive speed is ZERO MPH.*
5. *Engine is not in Engine Warming Mode. See **Alarms, Safeguards, Power Derations, and Shutdowns** Section of this manual.*
6. *Independent brake applied. (BC pressure must be greater than zero psi).*
7. *Self-Test switch is in the UP position. See **Keybindings** Section of this manual.*

   NOTE: The Self-Test switch is audible ONLY.

Performing a Self-Test

NOTE: Self-Test is only available in POWER MODE of THROTTLE, not in DYNAMIC BRAKING MODE.

With all previous preparations complete and with all Self-Test conditions existing, the operator may proceed by advancing the Combined Power Handle into a notch of THROTTLE. The Combined Power Handle should be increased every ten seconds by one notch until desired notch is reached.

During Self-Test, the “Throttle” mode window on the Locomotive Data Monitor (Fig. 14) will change from “Ready” to “SLoad LD”.

***NOTE**: Data for total Gross HP, Alternator Volts and Alternator Amps will also be displayed on the DID (Diagnostic Information Display) during Self-Load.*

Returning to normal mode

The locomotive can be returned to normal operation mode by the following actions:

1. *Move the Combined Power Handle to IDLE.*
2. *Flip the Self-Test switch into the DOWN position. See **Keybindings** Section of this manual.*

   NOTE: The Self-Test switch is audible ONLY.

***NOTE**: In normal locomotive operating mode, the DID panel should automatically resume normal operation and “Ready” be displayed in the “Throttle” mode window on the Locomotive Data Monitor (Fig. 14).*

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LOCOMOTIVE DATA MONITOR

The Locomotive Data Monitor (Fig. 14) function receives data from the control system to show various operating parameters of the locomotive. Pressing key position F8 (**Exit**) will return the operator to screen 000 000.

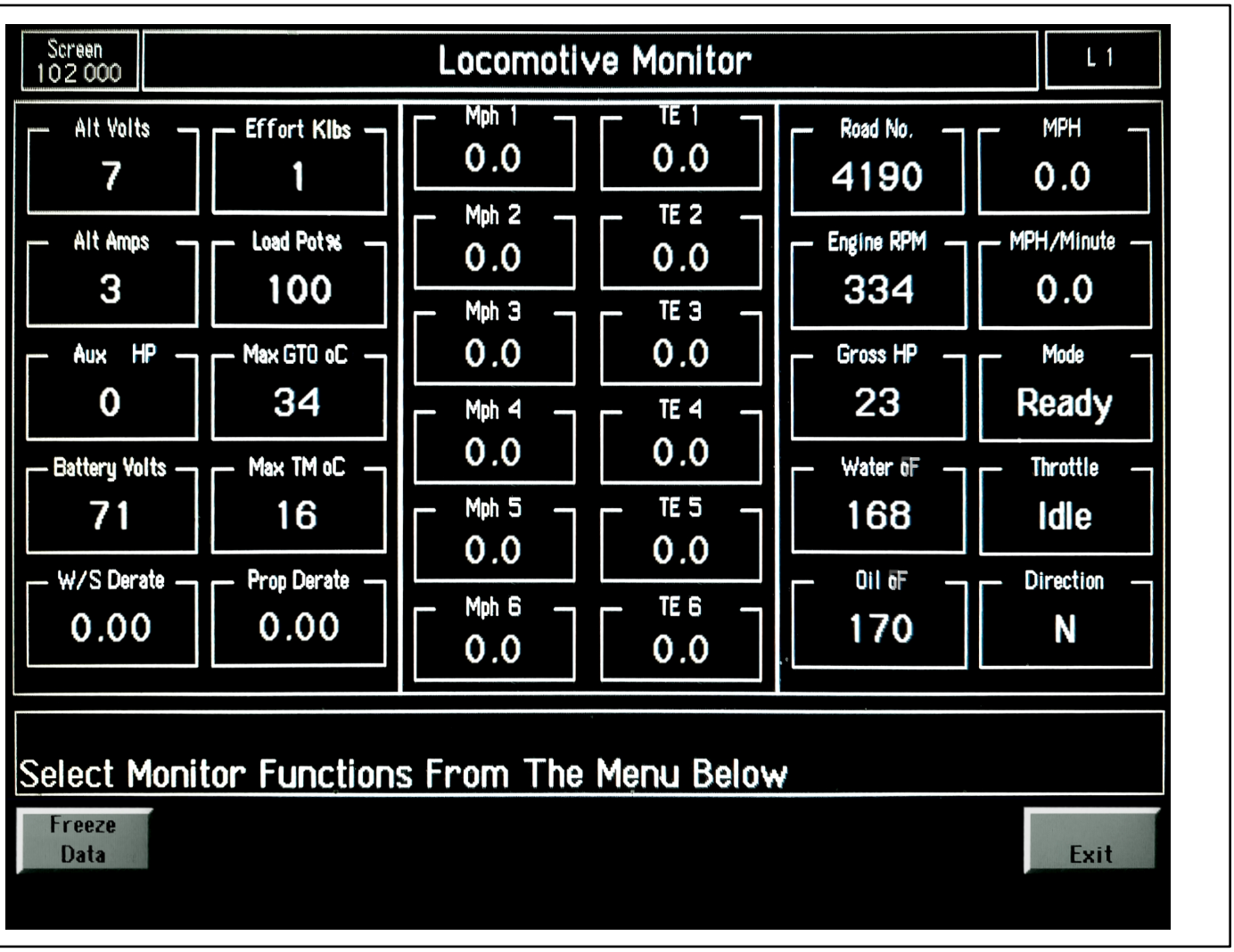

FIG. 14.

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DISTANCE COUNTER

INTRODUCTION

The Distance Counter function shows distance travelled in feet (Fig. 12). This function allows the crew to set, reset, or preset the counter for trip information. The counter operates independently from the counter on the other IFD/SDIS.

OPERATION

Press key position F1, Distance Counter, on the Operator Function Screen to display screen 310 000.

1. *Press key position F1 (Count Up) to start the counter from the current setting forward. The present locomotive direction will be considered forward.*
2. *Press key position F2 (Count Down) to start the counter from the current setting backward. The present locomotive direction will be considered forward.*
3. *Press key position F3 (Stop Counter) to stop the counter at the present reading. This key is not active until the counter is active.*
4. *Press key position F4 (Zero Counter) to set the counter to zero. If counter was operating, it will remain operating.*
5. *Press key position F5 (Preset Counter) to display screen 315 000.*

   a. Press key position F1 (UP Arrow) to increase the distance by 10,000 feet.

   b. Press key position F2 (UP Arrow) to increase the distance by 1,000 feet.

   c. Press key position F3 (UP Arrow) to increase the distance by 100 feet.

   d. Press key position F4 (UP Arrow) to increase the distance by 10 feet.

   e. Press key position F5 (UP Arrow) to increase the distance by 1 foot.

   f. Press key position F6 (Enter) to exit the operator to screen 310 000 with the new preset distance.

   g. Press key position F8 (Exit) to exit the operator to screen 310 000 with the old preset distance.
6. *Press key position F7 (Recall Preset) to recall the last saved preset value.*
7. *Press key position F8 (Exit) to return the operator to screen 300 000.*

TEMPERATURE SIMULATION

AMBIENT TEMPERATURE SIMULATION

The ambient air temperature plays a significant role in real-life railroad operation, it has however never been accounted for in-game. The ambient air temperature will have an effect on engine behavior over all four seasons of the year. During cold weather conditions and a low ambient air temperature, the IFC system may warrant Engine Warming to keep the engine, lubricating oil and water temperature at a predetermined level or higher for instance. With a high ambient air temperature, the engine might overheat during periods of high tractive effort demand over extended time.

The ambient air temperature also has an effect on air break performance. You will experience longer recharge times of the air brakes especially on long trains in cold weather conditions due to material shrinkage reducing the effective seals between rail cars and thus resulting in higher leakage of the brake pipe pressure. This in turn for instance will trigger the air compressor to come on more often to sustain a constant Main Reservoir pressure level.

Ambient air temperature will have an impact on many other engine conditions and parameters which however are not covered in this manual.

LUBRICATING OIL AND WATER TEMPERATURE SIMULATION

A dynamically changing oil and water temperature simulation based on engine parameters allows us to utilize real-life data gathered over years through actual engineers and conductors on our team and use that data to simulate all sorts of oil and water temperature related engine characteristics found on AC4400 series locomotives.

The lubricating oil and water temperature will have a direct effect on engine cooling and power deration. The radiator cooling fan will cycle on and off based on the water temperature and will run at different speeds depending on the engine speed. All temperature threshold values are the same as on the actual prototype to ensure the player experiences the closest behavior of the locomotive possible, short of seating in the real seat. Heat and cooling rates of both the lubricating oil and water are all dynamically changing based on season, engine load, engine operating time and other factors. This ensure that any input by the player will have an actual impact on engine performance.

If you creep your way up a mountainous grade at five miles an hour in Notch 8 for too long, your engine might likely derate power as either oil or water temperature exceed the maximum temperature threshold. This might result in your train stalling out on the hill. Just an example, it does however help to illustrate how your way of operating the locomotive will influence the outcome of every scenario. It will never just be a run from A to B. Every run will be unique and hopefully give you a run for your money.

RADIATOR COOLING FAN SIMULATION

As previously mentioned, the radiator cooling fan logic has been faithfully recreated in-game based on real-life data gathered from the prototype.

With rising water temperature, the cooling fan will cycle on and turn at ¼ speed at 192 F (89 C) , ½ speed at 196 F (91 C) and full speed at 200 F (93 C)

With falling water temperature, the cooling fan will drop to ½ speed at 190 F (87 C), ¼ speed at 186 F (85 C) and will cycle off at 182 F (83 C).

AIR RIDE SEATS

AIR RIDE SEATS SIMULATION

Comfort is everything! So who would voluntarily want to spend hours upon hours in the cab sitting on a fixed, slightly sprung cab seat, feeling every little bump of the rail? Not us. On a serious note, our air ride seat simulation delivers a very unique, yet extremely realistic immersion which we never really had a chance to experience in-game.

And what's the saying? Give credit where credit is due. This feature in particular was made possible by our friend Dan Holmes who stumbled upon a way to animate the cab camera in-game. This in turn made it possible for us to simulate the smooth, dynamic movement of the air ride seats under real-life conditions.

You will notice how the seats more and more begin to bounce as the locomotive speed increases and uneven spots on the rail begin to visually show at speed. Both seats in the operator cab visually move in sync with the bounce effect. This of course can also be viewed from the outside.

This is overall a really neat feature which we hope you enjoy as much as we do.

POWER OUTPUT AND PHYSICS

ADVANCED POWER OUTPUT SIMULATION AND PHYSICS

The AC4400 benefits from an advanced adhesion simulation that takes into account real world values that can affect your performance. With a base rail adhesion coefficient of 0.35, with the added wheel creep benefits, the locomotive on dry rail can achieve a coefficient of 0.5. What this all means is that on optimal dry rail, of the total potential 180,000 lbs of effort, you can get 100% of that to the rail (and then some). With average rail conditions, however, your coefficient is roughly 0.36, so of 180,000 lbs of potential starting tractive effort, you will hit 147,600 lbs of TE before wheel slip occurs and the locomotive will fight to correct it with sand and power reduction to the affected axles.

Rain, leaves on track, snow, and ambient temperature all greatly vary that traction coefficient, making every run you have dynamic and the amount of locomotives needed to keep it moving, varying. Power output will furthermore depend on the train tonnage and available horsepower. Heavy trains will feel heavy as they should and light trains will not accelerate like a rocket anymore. A lot of testing and fine tuning has been done to ensure the physics on our AC4400 are as close to the real deal as possible. We have spent many hours analyzing actual data collected on the prototype on different types of trains and under all possible external conditions to make sure we have accurate, solid data to base our simulation upon.

Despite being limited to the core game's physics engine, we were definitely able to produce a simulation that for the most part, entirely circumvents core physics, allowing us to simulate conditions which normally would fall out of range due to core game limitations.

NOTE: PROPER TRAIN PHYSICS CAN ONLY BE ACHIEVED USING ROLLING STOCK SOLELY PROVIDED BY SEARCHLIGHT SIMULATIONS OR OFFICIAL PARTNERS.

ADVANCED BRAKES

EBV AND ADVANCED AIR BRAKES SIMULATION

The AC4400 comes equipped with an advanced braking simulation that takes in account a number of critical variables that affect air brake performance. The effective ability for braking is impacted by things such as ambient temperature, train length, brake valve type, and brake pipe leakage. The colder the ambient temperature, the higher the leakage your train will experience due to material shrinkage reducing the effective seals between rail cars. The longer the train you have, the longer it will take to charge the brake pipe and auxiliary reservoirs, and depending on the age of the cars, they may be equipped with more efficient brake valves that propagate changes in brake pipe pressure faster and are more resilient to leaks. We have also implemented the charge time reduction when running with distributed power. Between one and two DP consists, the difference in time it takes to recharge a train is significantly reduced.

The operator controls the system through the Electronic Brake Valve. The EBV signals the handle positions for Automatic and Independent braking. An exception is the initiation of an Emergency Brake application which is propagated mechanically through a vent valve by placing the Automatic Brake Handle in the EMER (EMERGENCY) position.

Operating the brake, you will find that the EBV is selected in the Cut-In mode only. This means that the brake will only release when the handle is fully in the release position. When you, the operator, make a reduction to increase braking effort, you are controlling the Equalizing Reservoir's pressure, the reduction in pressure will make the control valve move to a position in which the brake pipe pressure is reduced at a service rate in order to reach equilibrium with the EQ Res. Every control valve on locomotive or freight cars will roughly equate 1 psi in BP pressure decrease to a 2.5 psi brake cylinder pressure increase. Example: 10 lb brake pipe reduction will equal 25 lbs increase in the brake cylinder at each local control valve. Equilibrium between the brake pipe volume and brake cylinder volume will occur at around 64 psi, thusly you will not experience any greater brake force reducing your brake pipe pressure past this point.

AIR COMPRESSOR SIMULATION

All AC4400 CW locomotives use an air compressor driven by an electric motor. Motor speed and compressor loading are controlled by the CAX Controller. It monitors main reservoir pressure and provides a pressure signal to the controller. The controller, in turn, energizes the compressor drive contactor to start the air compressor drive motor. The two-mode compressor will change poles based upon engine RPM to either run at double engine speed or in sync with engine speed to maximize CFM output.

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EXHAUST EFFECTS

EXHAUST EFFECTS

We have remastered our dynamic exhaust effects to deliver the classic “GE” style exhaust pattern. GE locomotives have different exhaust pattern compared to EMD engines due to them obviously being completely different in design. GEs will often have thicker, more spread out smoke compared to EMD engines. The velocity at which the particles exit the exhaust will also differ on GEs as the velocity changes depending on engine load. On EMDs, particle velocity is more proportional to engine rpm than load. The exhaust particle pattern furthermore varies based on the throttle notch. During notch ups you'll notice how the exhaust thickens as rpm and load increases. Once the rpm settle in, the exhaust will thin up slightly until the throttle is advanced another notch or reduced. The exhaust effects run in-sync with the rpm and every unit is assigned a random exhaust thickness on scenario start. Some units may smoke a lot more than others based on when they've been last maintained or what problems have occurred over time. It's such small details we pay attention to, trying to capture and replicate the exhaust characteristics as close as we can.

TRAIN DATA REQUEST

TRAIN DATA REQUEST MESSAGE

Pressing Ctrl + I will request current train data to be displayed. This new feature is extremely helpful for improving your train handling skills. The output data will dynamically change with your train. Isolating locomotives for instance will result in lower available gross/net horsepower, thus resulting in a lower HP/T (horsepower per ton) rating and lower calculated max speed.

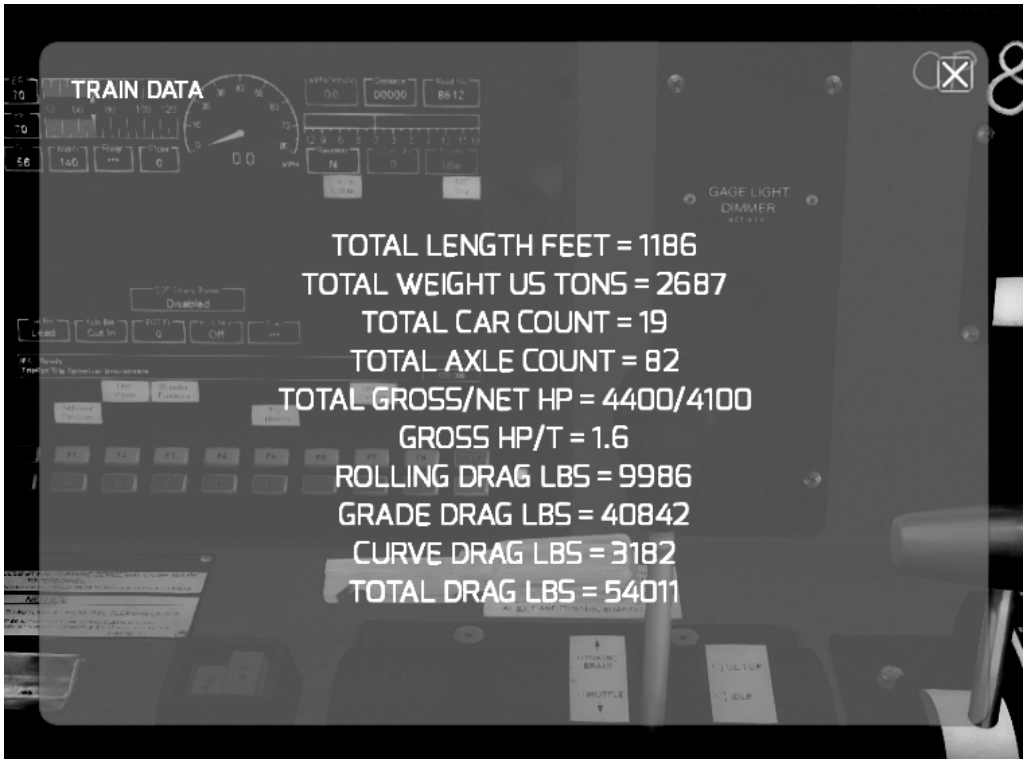

FIG. 15.

Train simulator uses the lead axle of your train as the only reference point to get the current grade, curvature and speed value from. This means that proper physics calculations for the entire length of your train are quite essentially impossible to run. The core game does not allow for proper calculations on a car-to-car or axle-to-axle basis. Hence the displayed drag values only properly account for constant grade and curvature track.

***NOTE**: Once displayed, the train data message window will pause your game. Close the window to return to your session.*

Only products marked with "Train Data Capability" are equipped with our train data request feature.

CREDITS

The AC4400 has been one hell of a ride for our team but we are proud of what we were able to accomplish over the course of a few years. We made a lot of new friends, both personal and in the community. The support, feedback and general interest in this project we have received over the years was absolutely amazing and we are glad to finally be able to provide a true piece of art which delivers everything the community has wished for.

We have many more great things planned for the future and can't wait to share them with the community!

Thank you to our entire team, all our beta testers, our scenario writer, our network engineer, JointedRail, all our friends for helping out wherever they could and those from the community who assisted us or offered other types of help during the creation of this model.

With special thanks to Matt Fleming from JointedRail for providing the Teoli “Bathtub” Gondolas and Walter Jaeschke for providing the audio samples for the aforementioned freight cars.

We would also like to express a special thank you to Canadian Pacific Railway for not only allowing us to proudly represent their beaver in our little, virtual world but also for genuinely showing support and interest in us as a company and this project. Their evaluation and guidance to ensure rivet counter accuracy on this model and exceptional and kind assistance during the licensing process for this product definitely put a smile of relief on our faces for which we are greatly thankful!

For proper support inquiries related to this product and or others, please use our support form on the our website or directly contact us at support@searchlight-simulations.com .

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