



Title: Automatic Train Control (ATC) – Cab Signal System

Issued to: All Rail Operating Personnel

Approved by:


Chief Transit Officer

Supersedes: Automatic Train Control (ATC) – The Cab Signal System, 8196 (04-19-15)

INTRODUCTION

The Automatic Train Control (ATC) cab signal system is a technology that communicates to the Operator the maximum speed that a train is allowed to operate in whichever section of the rail system the train is currently located. The ATC cab signal system enforces these allowable speeds to prevent rear-end collisions between trains. Components of the ATC cab signal system are installed on all series of rail cars currently in service and everywhere in the rail system except for rail yards.

The system protects trains by:

- Indicating to the Operator allowable speeds (maximum speeds allowed by the ATC system) that are set based on:
 - The location of trains ahead in the signal block/track circuit.
 - Possible track conditions (for example, broken rail).
 - Signal and switch status ahead.
 - Actual train speed.
 - In some circumstances, conditions for Workers Ahead (WA) zones (see SOP 8111 *Workers Ahead Warning System*).
- Enforcing speed restrictions: bringing the train to a safe stop if the Operator fails to respond to speed reduction commands in a timely fashion.

The components of the ATC cab signal system include:

- At track level: signal bonds, wayside signs, signals and the running rails.
- On the train: the receiver coil and the Aspect Display Unit (ADU) in the motorcab.
- An audio frequency carrying the signal block's allowable speed.

Lengths of track between signal bonds are known as signal blocks or track circuits. Each signal block has a set allowable speed.

To communicate the set allowable speed, the signal bonds at the start of a signal block send an audio frequency through the running rails to the receiver coil on the train. The receiver coil then sends the allowable speed to the ADU in the head car motorcab for display through the relevant ADU signal aspects.

Title: Automatic Train Control (ATC) – Cab Signal System

This SOP describes the ATC cab signal system components with their functions and provides instructions on how to use this safety system when operating a train.

VISIBLE COMPONENTS OF THE ATC CAB SIGNAL SYSTEM

Signal Bonds

Signal bonds:

- Separate the signal blocks/track circuits.
- Are programmed with data about allowable speeds for their respective signal blocks/track circuits.
- Are frequently accompanied with wayside signs.



Figure 1: Signal Bond



Figure 2: Signal Bond (circled), Wayside Track Circuit Sign and Cab Signal Sign

Wayside Signs

Wayside signs (Figures 3 through 6):

- Mark the locations of signal bonds.
- Mark where the allowable speed may change.
- Show the Operators where ATC cab signal territories begin and end, for example, when leaving or entering a rail yard.

WAYSIDE SIGNS FOUND THROUGHOUT THE RAIL SYSTEM

Track Circuit Sign

These yellow signs:

- Identify each ATC signal bond with an alphanumeric identifier.
- Mark the approximate location where a change in ATC aspect is most likely to occur.



Figure 3: Track Circuit Sign

Cab Signal Sign

These yellow signs locate the approximate place where the allowable speed may change to the limit shown on the sign.

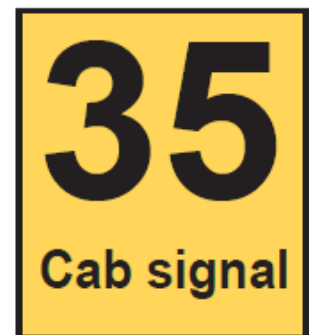


Figure 4: Cab Signal Sign

Title: Automatic Train Control (ATC) – Cab Signal System

WAYSIDE SIGNS LOCATED ONLY IN RAIL YARDS**Begin Cab Signal Sign**

This yellow sign marks the beginning of ATC territory.

Typically this sign is located where a train is leaving a yard and moving past the interlocking home signal.

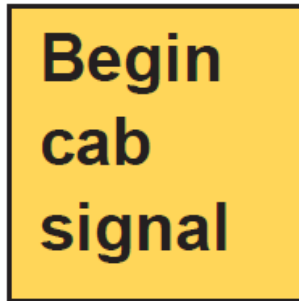


Figure 5:
Begin Cab Signal Sign

Begin Operation “On Sight” Sign

- This yellow sign marks the end of ATC territory and the beginning of track where operating on sight (R6.4) is required.

- R6.4 and R8.2 must be followed at all times in yards.

- See page 11 for details on activating Rule R6.4.



Figure 6:
Begin Operation “On Sight” Sign

Aspect Display Unit (ADU) in Motorcab Features

The ADU continuously displays the actual speed of the train and the speed allowed in the track circuit where the train is located. Features of the ADU include, approximately from top to bottom of the ADU and left to right:

- Illuminated green, yellow and red signal aspects to indicate the allowable speed. (See pages 7 through 9 for more details.)
- A white indicator aspect to illuminate and flash when the Operator has pressed the Activate Rule R6.4 button. (See page 9 for more details.)
- A Restricted Speed indicator (3200 and 7000 series rail cars only). (See page 8 for more details.)
- A gauge (allowable speed indicator) to indicate the allowable speed.

An allowable speed indicator located to the left of the speedometer illuminates at different levels, indicating the allowable speed at that moment.

- A gauge (speedometer) to indicate the actual train speed.

The gauge displaying actual train speed on the ADU has small lighted lamps (speed indicators) that move up and down a vertical speed scale with numerical values listed on the right.

- **2600 and 3200 series rail cars:** A cluster of two lamps indicates an even-numbered speed. A cluster of three lamps indicates an odd-numbered speed.
- **5000 and 7000 series rail cars:** A single lamp indicates the train speed.
- A Cab Signal Cut-Out Indicator. (This is located above the other cab signal aspects on the ADU, but is a notice of a defective ADU and should be extremely rare. Note that the 7000 series does not have a cab signal cut-out aspect. See page 10 for more details.)

Title: Automatic Train Control (ATC) – Cab Signal System

Aspect Display Unit (ADU) in Motorcab, by Series

ADU IN 2600 SERIES

Figure 7 illustrates the type of ADU found in the 2600 series rail cars.

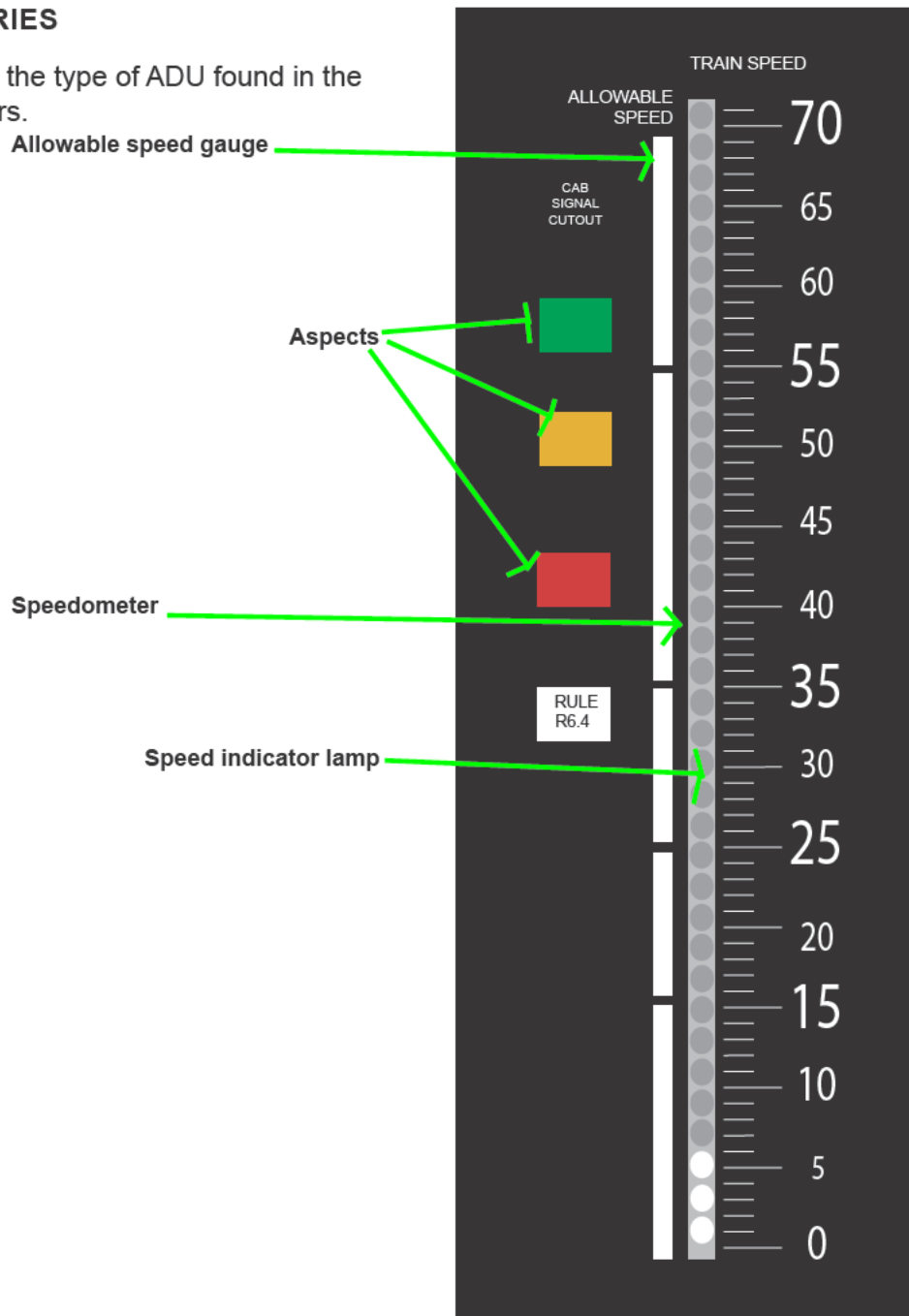


Figure 7: 2600 Series ADU

Title: Automatic Train Control (ATC) – Cab Signal System

ADU IN 3200 SERIES

Figure 8 illustrates the type of ADU found in the 3200 series rail cars.

ADU IN 5000 SERIES

Figure 9 illustrates the type of ADU found in the 5000 series rail cars. The circle below the Rule 6.4 indicator aspect is a photo cell to adjust the brightness of the indicator lights on the ADU.

ADU IN 7000 SERIES

Figure 10 illustrates the type of ADU found in the 7000 series rail cars.

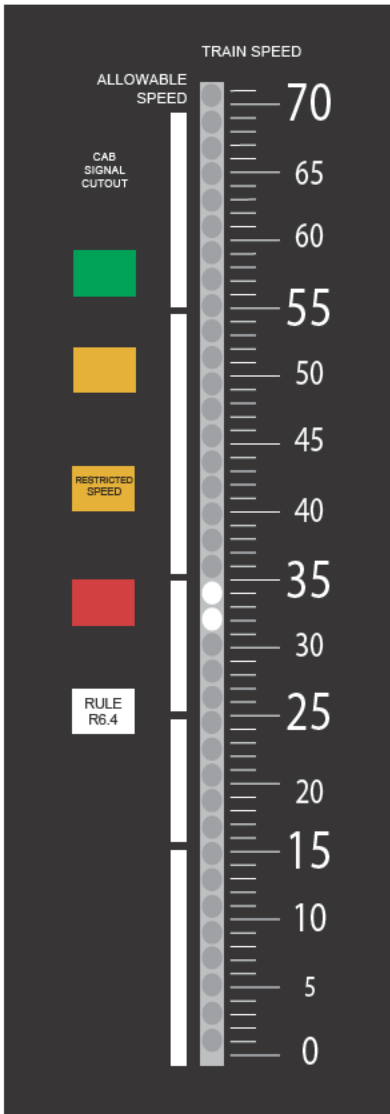


Figure 8: 3200 Series ADU

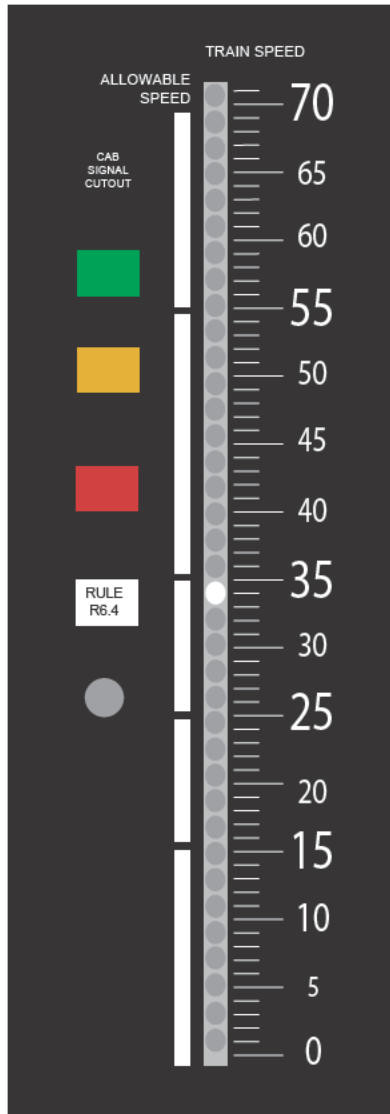


Figure 9: 5000 Series ADU

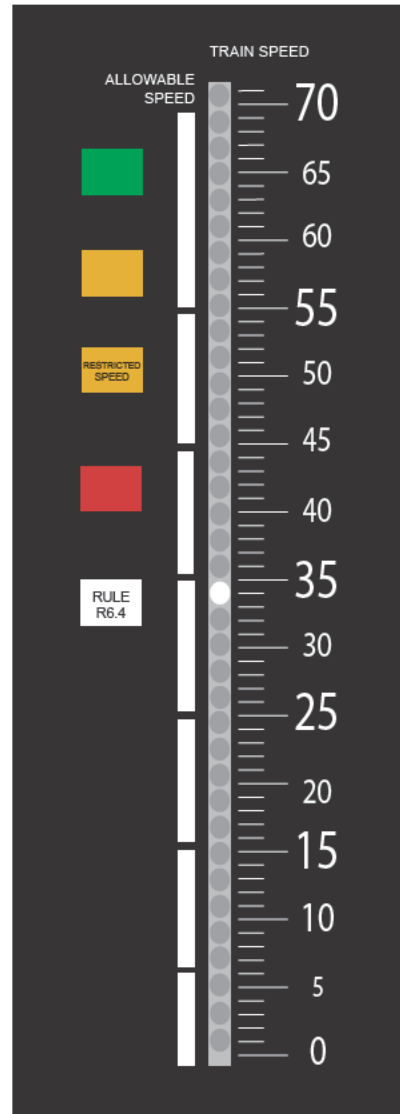


Figure 10: 7000 Series ADU

HOW TO USE THE ADU TO OPERATE THE TRAIN AT AN APPROPRIATE SAFE SPEED

When preparing a train for revenue service, check the cab signal for proper operation. (See SOP 8085 *Yard Testing of Rail Car Equipment*.) The ADU must illuminate. In yards, a red aspect and flashing Rule R6.4 aspect must be displayed. In 7000 series trains, activate Yard Mode (see p. 12). If preparing a train for service from a part of the system under signal protection,

Title: Automatic Train Control (ATC) – Cab Signal System

the illuminated aspect may be red or yellow. Observe the ADU every time you start a train, and frequently while operating the train.

Determining the Permitted Speed

An allowable speed is the maximum speed that the *ATC* allows. Permitted speed is the maximum speed at which the train may be operated per *Rail Operations rules*. Permitted speed may be the same as or lower than the allowable speed.

Never exceed the permitted speed. The permitted speed is the maximum speed at which a train may be safely operated and is the **most restricted speed of:**

- The allowable speed displayed by the cab signal on the ADU.
- The speed allowed by a wayside signal.
- The posted speed shown on a wayside sign.
- A hand, flag, verbal or written speed instruction given by an authorized person.

WHEN WAYSIDE SIGNS AND CAB SIGNAL ASPECTS AND INDICATIONS CHANGE

If the cab signal changes to a less restrictive aspect – for example, from **Yellow 35** to **Green 55** – train speed **may** be increased accordingly.

If the cab signal changes to a more restrictive aspect – for example, from **Yellow 35** to **Yellow 25** – train speed **must** be reduced accordingly.

From the time you see the “Begin operation ‘on sight’” sign until you pass the “Begin cab signal” sign, the train **must** be operated “on sight.” (Rail System Rule 6.4.2) The ATC does not function between these signs and will not check the location of trains nor check the condition of the track ahead. You must press the Activate R6.4 button to indicate that you are operating on sight.

WHEN THE ALLOWABLE SPEED DIFFERS FROM A POSTED SPEED

If the cab signal aspect on the ADU indicates an allowable speed that exceeds the speed posted on a wayside sign, **stop and call the Control Center**. A cab signal aspect on the ADU indicating an allowable speed that exceeds the speed on a wayside sign is an abnormal condition in most situations.

Note: Exception for posted speeds under 15 mph on 2600, 3200 and 5000 series rail cars:
The ADU on 2600, 3200 and 5000 series rail cars cannot show allowable speeds below 15 mph. When the posted speed is under 15 mph, the ADU will always display an allowable speed (15 mph) that exceeds the posted speed (under 15 mph).

For example, the posted and permitted speed in the Loop is 10 mph on the curves. Because the posted speed of 10 mph is less than the minimum allowable speed that the ADU can display, the difference is normal and calling the Control Center is not required.

Responding to Speedometer Information, Alarms and Penalty Stops

If the allowable speed is exceeded, an audible alarm will sound to alert the Operator to reduce speed. To reduce speed and to avoid an ATC penalty stop, within two and one-half seconds the Operator must place the Master Controller in:

Title: Automatic Train Control (ATC) – Cab Signal System

- B2 or B3 on 2600 and 3200 series rail cars.
- Maximum Service Brake on 5000 and 7000 series rail cars.

If the alarm sounds and the train is **not** in the brake position listed above within two and one-half seconds, the train will make a penalty stop. The audible alarm will emit a continuous tone until the train stops.

To proceed after the penalty stop, the Operator must reset the brakes.

- **2600 and 3200 series rail cars:** Place the Master Controller in the B3 brake position.
- **5000 and 7000 series rail cars:** Place the Master Controller in the Maximum Service Brake position.

After the brakes are reset, if it is safe to do so **and** the ADU displays a permissive cab signal, place the Master Controller in a power position to proceed.

Responding to Cab Signal Aspects and Indications

In this section, the aspect indication definitions per the Rail System Rule Book are surrounded by black outlines.

Note: The following descriptions of the green and yellow aspect indications differ slightly from the corresponding Rail System Rule Book rules. The Rail System Rule Book rules for the green and yellow aspects state specific speeds; here they are summarized as “the allowable speed.”

GREEN	YELLOW	Indication
<p>Green cab signal aspect possibilities are Green 70 mph and Green 55 mph.</p>	<p>Yellow cab signal aspect possibilities are Yellow 35 mph, Yellow 25 mph and Yellow 15 mph.</p>	<p>Proceed.</p> <p>The block is clear and the train may be operated at a speed not to exceed the allowable speed or the wayside indications, whichever is more restrictive.</p>
<p>Figure 11: 2600 / 3200 Series ADU with a Green Aspect Illuminated at 70 mph</p>	<p>Figure 12: 2600 / 3200 Series ADU with a Yellow Aspect Illuminated at 35 mph</p>	<p>Note: If while standing at a wayside interlocking signal displaying “red over red” signal aspects (which indicates STOP AND STAY), the yellow aspect on the ADU is lit (indicating to proceed), stop and wait for the signal to clear. If it does not change, contact the Controller.</p>
<p>The image shows a vertical speedometer with a scale from 0 to 70 mph. A green light is illuminated at the 70 mph mark. The needle is positioned at 70 mph.</p>	<p>The image shows a vertical speedometer with a scale from 0 to 70 mph. A yellow light is illuminated at the 35 mph mark. The needle is positioned at 35 mph.</p>	

YELLOW RESTRICTED SPEED

The restricted speed cab signal aspect is only present on ADUs in the 3200 and 7000 series rail cars. When the allowable speed is set to Restricted Speed (6 mph or less):

- A 3200 or 7000 series motorcab ADU will display the Restricted Speed aspect.
- The speed indicator lamps will be functional within the train speed gauge to indicate actual train speed.
- The allowable speed gauge will be dark on 3200 series motorcab ADUs and the allowable speed will be illuminated at 6 mph on 7000 series motorcab ADUs.

Figure 13: 3200 Series ADU with a Restricted Speed Aspect Illuminated

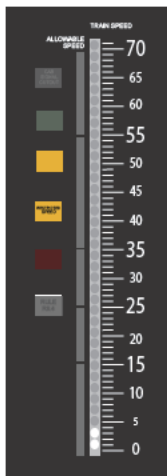
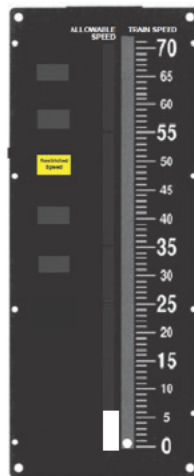


Figure 14: 7000 Series ADU with a Restricted Speed Aspect Illuminated



Indication

Proceed at Restricted Speed.

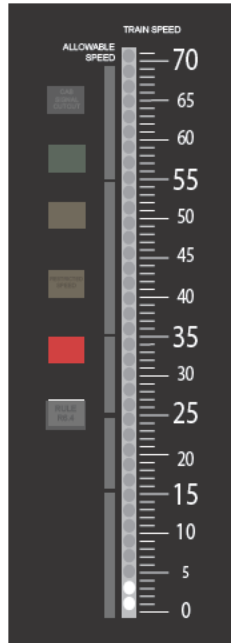
The block is clear and the train may proceed at restricted speed expecting to encounter a stop aspect at next signal or track conditions that require restricted speed.

Title: Automatic Train Control (ATC) – Cab Signal System

RED

A red cab signal aspect indicates **stop**.

Figure 15: 2600 / 3200 Series ADU with a Red Aspect Illuminated



Indication

Stop.

If the reason for the stop is a train ahead that is expected to proceed shortly, the Operator must wait for the signal aspect to change to a proceed indication (green, yellow or restricted speed aspect).

Note: When trains approach rigid switches being manually operated at track level, cab signals will always display a red signal aspect, indicating STOP.

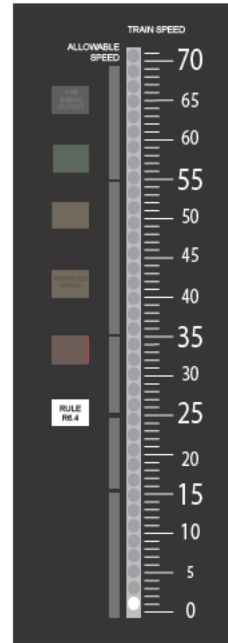
If the reason for the stop is not evident, or if the signal does not clear within 30 seconds, the Operator **must** call the Controller for instructions. If the Controller cannot be reached, the Operator must stand and wait until the Controller authorizes a move.

The Controller may authorize overriding the protections of the ATC system and instead proceeding to operate on sight (Rule R6.4). See Overriding the ATC System Protection on page 11.

RULE R6.4

The Rule R6.4 aspect illuminates **after** the Operator has pressed the Activate R6.4 button.

Figure 16: 5000 / 7000 Series ADU with a Rule R6.4 Aspect Illuminated



Indication

Operate according to R6.4. Contact the Controller. If the Controller cannot be reached, the Operator must stand and wait until authorization is given by the Controller to move. Expect to encounter a train ahead, a switch not properly lined or a broken rail, and call the Controller again for instructions.

Once authorized, proceed on sight to the next signal bond at a speed not to exceed 15 mph.

Title: Automatic Train Control (ATC) – Cab Signal System

CAB SIGNAL CUT-OUT

The cab signal cut-out aspect is only present in the 2600, 3200 and 5000 series rail cars. It illuminates when the train’s ATC protection system has been deactivated due to a problem with the train or the system. **An illuminated cab signal cut-out aspect is a warning of an abnormal condition and should be extremely rare.** Without cab signals, the ADU *does not display allowable speeds or restrictions of any kind and rear-end collision protection is lost.*

If the cab signal cut-out aspect is illuminated, **immediately stop the train and notify the Controller** per R5.16.8. Request authorization for manual block operation. (See SOP 8198 *Manual Block Operation.*) Supervisory personnel will intercept the train.

Figure 17:
2600 / 3200 Series ADU with a Cab Signal Cut-Out Aspect Illuminated

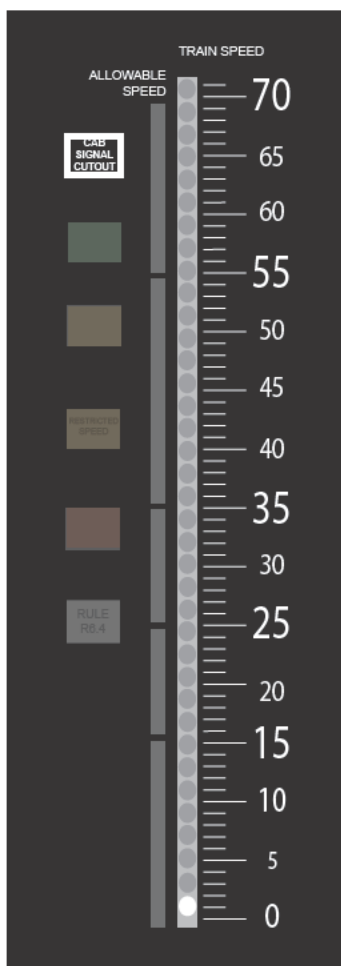
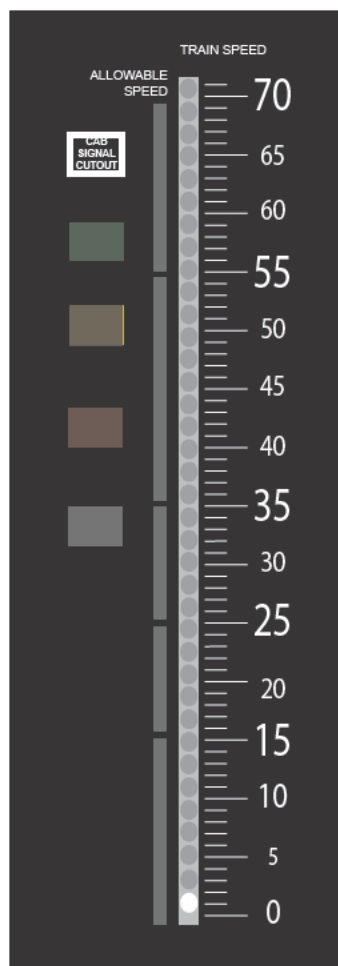


Figure 18:
5000 Series ADU with a Cab Signal Cut-Out Aspect Illuminated



Indication

Stop. Contact the Controller for instructions.

OVERRIDING THE ATC SYSTEM PROTECTION

Whenever there is a signal displaying a “stop” indication, stop and wait for the signal to clear. In some situations detailed in R6.4, contact the Controller for authorization to proceed. The Controller

Title: Automatic Train Control (ATC) – Cab Signal System

may authorize overriding the protections of the ATC system and instead proceeding to operate on sight following Rule R6.4. **Controller authorization is required.**

When the ATC protections are overridden and you are operating on sight under R6.4:

- The train will **not have front collision protection** or overspeed enforcement/speed restriction.
- The train will **not have rear-end collision protection.**
- The ATC cab signal system will **not bring the train to a safe stop (ATC penalty stop)** if the Operator fails to respond to speed reduction commands in a timely fashion.
- The ATC cab signal system will **not enforce speed restrictions** other than 15 mph.
- The ATC cab signal system will **not indicate allowable speeds** based on the location of trains ahead, possible track conditions (for example, broken rail), signal and switch status ahead (for example, a switch improperly lined) and actual train speed.

How to Override the ATC System Protections (Activating Rail System Rule R6.4)

To override the ATC system protections and begin operating on sight according to R6.4 (train operation at signals displaying “stop” indication), push the “Activate R6.4” pushbutton (Figures 19 and 20) located above the ADU. On 7000 series rail cars, press the button for four or more seconds to activate R6.4 mode.

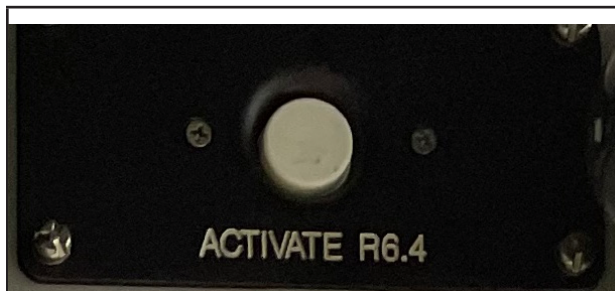


Figure 19:
Activate R6.4 Button in
2600, 3200 and 5000 Series Rail Cars



Figure 20:
Activate R6.4 and Yard Mode Button in
7000 Series Rail Cars

When the Activate R6.4 button is pushed:

- Inside the motorcab, the “Rule R6.4” aspect will flash on the ADU to signify to the Operator that they must operate on sight without signal protection, according to Rule R6.4. (See page 9 for more on the Rule R6.4 aspect.)
- Outside the train, the exterior train light turns red to indicate that R6.4 has been activated. This signifies to employees at track level that the Operator is operating on sight without signal protection, according to Rule R6.4.

7000 series rail cars: The Activate R6.4/Yard Mode button on the 7000 series rail cars has two modes. When either R6.4 mode or Yard Mode is activated:

- The red aspect illuminates continuously.
- The allowable speed bar stays dark.
- An intermittent audible alarm will sound whenever the train speed is greater than 0 mph.

Title: Automatic Train Control (ATC) – Cab Signal System

- **R6.4 mode:** Press the button for four or more seconds to activate R6.4 mode (speed limit 15 mph). The R6.4 (white with black letters) aspect will flash and the exterior red signal light (R6.4 indicator) on the run number box will illuminate continuously.
- **Yard mode:** Press the button for less than four seconds to activate Yard Mode (speed limit 6 mph). While Yard Mode is activated, the Restricted Speed aspect and the R6.4 (white with black letters) aspect both illuminate continuously. The exterior red signal light (R6.4 indicator) on the run number box will flash. (See page 8 for more on the Restricted Speed aspect.)

Overriding the ATC System

Pushing the Activate R6.4 button overrides the ATC system *protections* associated with a “stop” indication. It does not override the entire ATC system. When the Activate R6.4 button has been pushed, the ATC protections are overridden, but at the next signal block the train may again receive the audio frequency and display the relevant signal aspects on the ADU.

To override the *entire* ATC system to remove all signal protections, a Controller **must** authorize ATC system bypass. ATC system bypass is reserved for rare ATC system malfunctions. See SOP 7014 *Bypass Operation*.

SAFETY IS PART OF THE JOB

Follow all CTA established rules relating to safe operation, as well as those rules relating to use of tools, materials, equipment and personal safety in performance of these procedures.