



Title: Propulsion and Braking System (Rail Cars): Series 5000 and 7000

Issued to: Rail Operating Employees

Approved by:

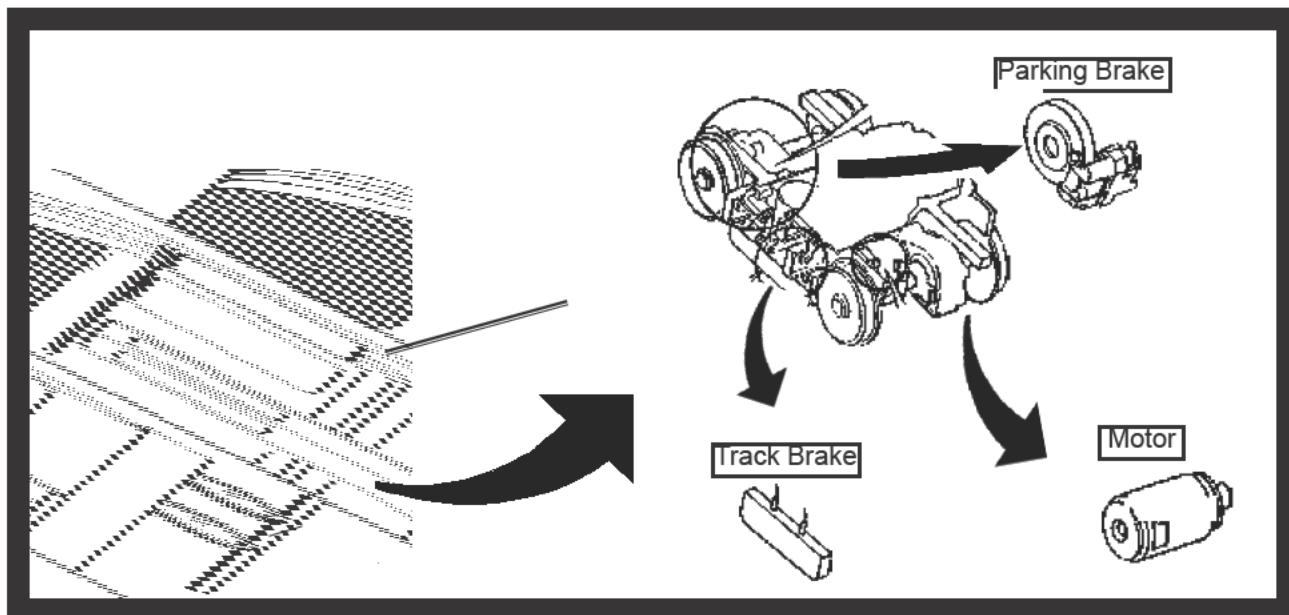


Chief Transit Officer

Supersedes: Propulsion and Braking System (Rail Cars): Series 5000 (09-01-19)

INTRODUCTION

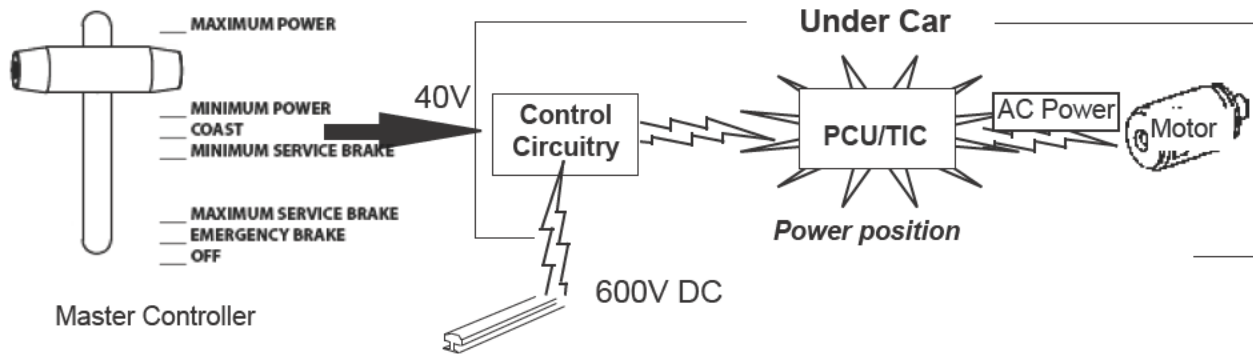
The propulsion and braking system controls the flow of electric current to the motors to provide the motoring and main (dynamic) braking action of the train. Parking and track brakes provide additional braking. The train is started and stopped at selected rates by using the Master Controller. This SOP describes the operation of Series 5000 and 7000 rail cars.



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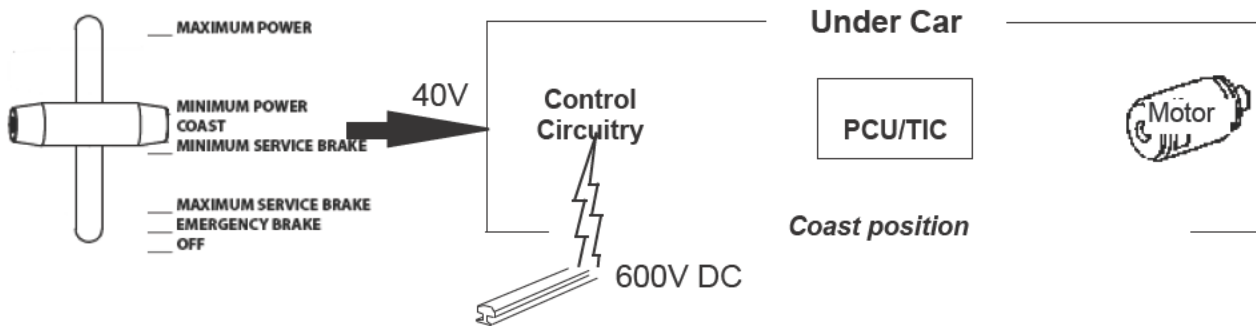
PROPULSION / ACCELERATION

Only when the Master Controller is placed in a power position can the motors be connected to the power supply. Depending on the position of the Master Controller, electric current reaches the motors to provide the selected rate of acceleration. The Propulsion Control Unit (PCU) [5000 series]/Traction Inverter Container (TIC) [7000 series] converts the 600V DC power to AC power for the motors. The PCU/TIC regulates the speed of the motors by varying the AC power to them. Speed is controlled by the Master Controller.



COAST

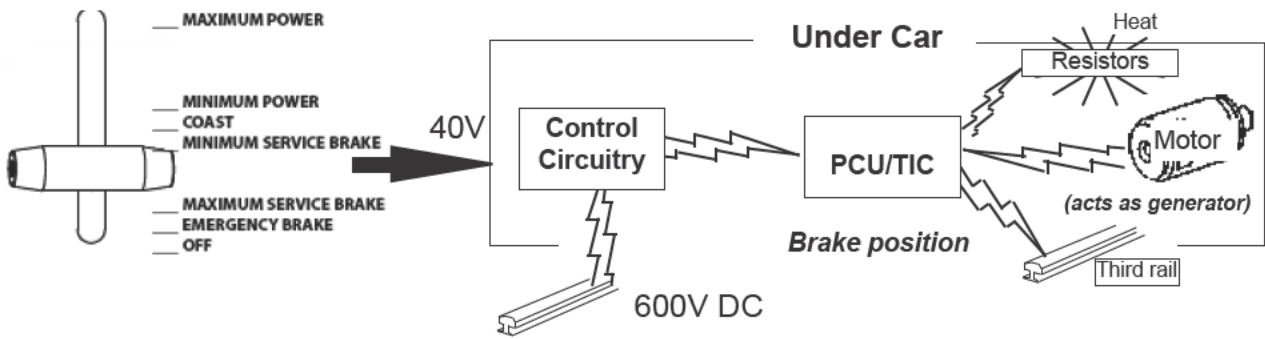
When the Master Controller is in COAST, the motors are disconnected from the power supply.



DYNAMIC AND REGENERATIVE BRAKING

When the Master Controller is placed in a service brake position while the train is moving, the motors are used to slow the train (dynamic braking) and to *generate* electricity. The PCU/TIC will return this energy back to the third rail (regeneration) or will send it to the resistors to be dissipated as heat. The position of the Master Controller determines the rate of braking. Dynamic braking slows the train to under 5 mph. At that point, dynamic braking fades and parking brakes apply to complete the stop.

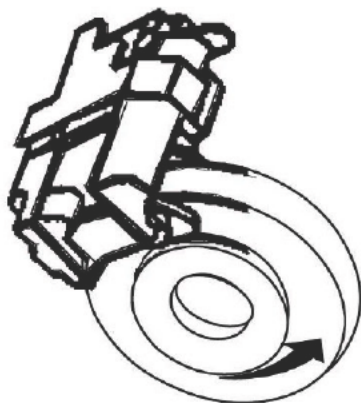
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PARKING BRAKES

Parking (friction) brakes are applied by spring pressure. They depend on battery current to release. The parking brakes are disc-and-caliper type.

The disc-and-caliper parking brake, as shown below, uses a caliper to push friction pads against the sides of a rotating disc that is attached to the gear box.



Disc-and-caliper parking brake

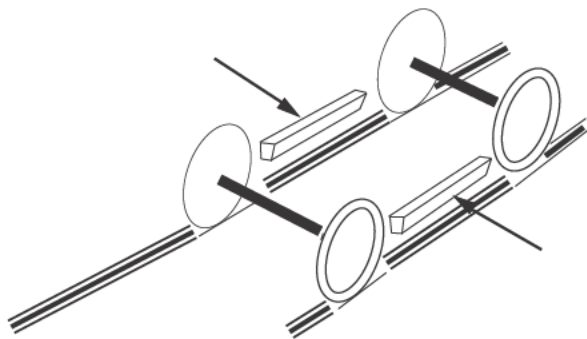
Parking brakes apply:

- Under 5 mph during service braking to provide final braking action and to stop the train.
 - To keep the train stationary when standing.
 - Immediately during service braking in the absence of dynamic braking (Troubleshooting Code: Dynamic).
 - Immediately when an emergency switch (“red ball”) is pulled.
- Immediately when a side trip underneath a rail car is activated.
 - Immediately during an emergency brake application.

TRACK BRAKES

Track brakes are blocks of steel suspended over the running rail between the wheels of a truck, as shown below. They are held off the rail by springs. When battery current is applied, the track brake becomes a magnet and is attracted to the running rail. Heavy friction between the track brake and the running rail causes aggressive and possibly rough braking.

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Track brakes

Track brakes apply:

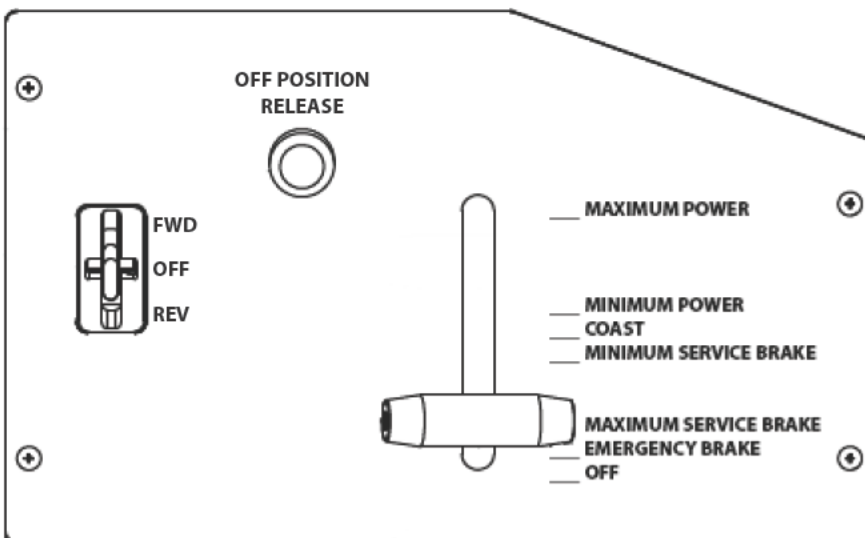
- When the track brake button is pressed.
- During an emergency brake application.

HOW TO START A TRAIN

The operating motorcab is prepared for service as follows:

1. Turn on the air comfort and interior and exterior lights (if not on already).
2. 5000 series: Insert the reverser key into the reverser and rotate it to the FORWARD position.
7000 series: Insert the MC-1 key into the MC reverser and rotate it to the FORWARD position.
3. Place the Master Controller in the MAXIMUM SERVICE BRAKE position.
4. 5000 series: Touch the Smart Card to the reader. Wait until the Train Operator's Touch Screen (TOTS) log-on screen appears (from 5 seconds to 2 minutes) and the red suspension power-up light is off.

7000 series: Log on to the TOTS with badge number and PIN. (See SOP 8255 *Check-In Procedure to Obtain a Secure Bus Access (SBA) PIN for Buses and 7000 Series Trains.*)



5. Insert an MUDC key (5000 series) or DC-1 key (7000 series) in the door control box and open the side doors on the platform side of the train.
6. Select NORMAL on the sign selector switch.

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7. Enter the appropriate one-digit departure or destination prefix followed by the three-digit run number. Press ENTR.
8. Select ORIGIN. Then press ENTR.
9. 5000 series: A confirmation screen will appear. Press ENTR.
7000 series: A confirmation dialog box will appear. Press Accept Route.
10. 5000 series: After confirmation of log-on information, the Operator Control Interface (OCI) will be in manual mode. Scroll down until the class of train message ("This is a Blue Line train to...") is in the ACT (action) position. Press ACT to play the message.
7000 series: After confirmation of log-on information, the OCI will be in auto mode.
11. 5000 series: Press the AUTO MODE button.
12. Wait until the pre-recorded message is completed before making any other announcement.
13. Close the side doors.

When ready to start:

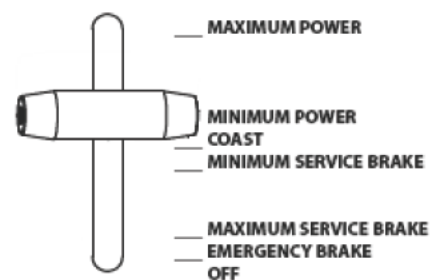
14. 5000 series: Turn the Master Controller handle 1/4 turn so it is horizontal. This enables the dead man relay.
7000 series: With the Master Controller in MAXIMUM SERVICE BRAKE, press EMERGENCY BRAKE RESET.

Note: If the Master Controller is released, the dead man relay opens causing full dynamic braking to apply. Before propulsion power can again be applied to the motors, move the Master Controller to maximum service brake and bring the train to a complete stop to reset the dead man relay.

Note: The following starting procedures apply to line-of-road operation. For starts made in yards, slow zones or other areas of restricted speed, apply minimum power so as to not exceed restricted speed.

Starting on Dry Rail

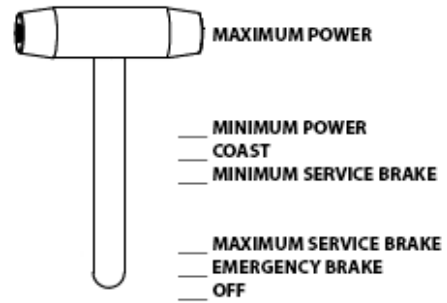
1. Place the Master Controller in MINIMUM POWER.



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As soon as the train moves:

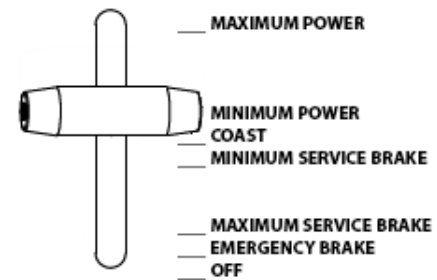
2. Move the Master Controller gradually to MAXIMUM POWER and hold until the permitted speed is attained or until it is desired to coast or to brake the train.



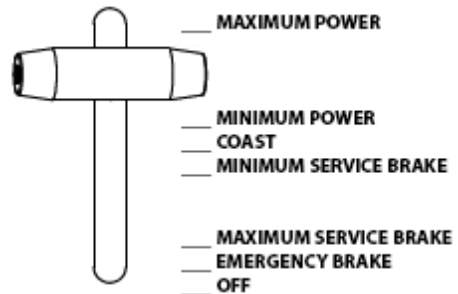
Starting on Slippery Rail

To ensure smooth operation in slippery conditions and to prevent mechanical and electrical problems, follow these steps to start the train:

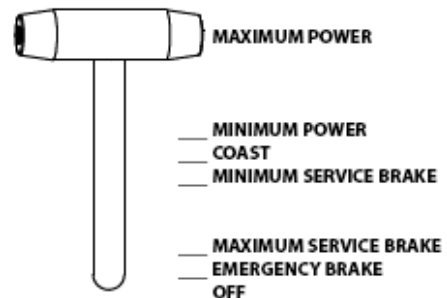
1. Place the Master Controller in MINIMUM POWER and hold for about 5 seconds.



2. Gradually move the Master Controller to a higher power position and hold for a few more seconds.

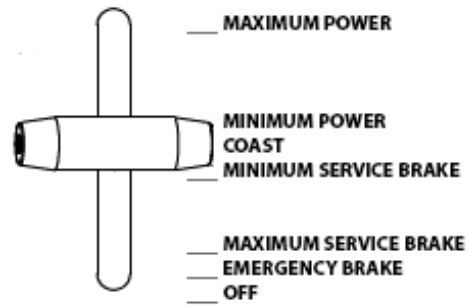


3. Gradually move the Master Controller to MAXIMUM POWER and hold until the permitted speed is attained or until it is desired to coast or to brake the train.



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4. If wheel spinning occurs, move the Master Controller to COAST immediately. When wheels stop spinning, repeat steps 2 and 3.

**Starting on Uphill Grades (Inclines)**

- Keep brakes applied until ready to start.
- When ready to move forward, press and hold the track brake button down while moving the Master Controller from a brake position to just above MINIMUM POWER. This will prevent momentary rollback. When power applies and you feel the train respond, release the track brake button and increase power as necessary.

Maintaining Smooth Operation

The 5000 and 7000 Series cars have a “Coast Contactor” feature that assists with maintaining an accurate speed. The Automatic Train Control (ATC) system compares the allowable speed to the speed of the train and will automatically put the propulsion system into coast to help **reduce the likelihood** of an over-speed penalty brake application.

- Hold the Master Controller at any **power** position to allow the coast contactor function to work.
- The Coast Contactor function will not regulate over-speed if:
 - The Master Controller is in coast or brake positions.
 - Operating the train on a decline.

If the Coast Contactor function is not regulating the speed correctly, proceed with the following steps to manually alternate between power and coast positions to maintain speed.

- Move the Master Controller to a power position between minimum and maximum power and hold until the desired speed is reached.
- When the desired speed is reached, move the Master Controller to COAST and hold until the speed decreases by 2-3 mph.
- Return to a power position to accelerate back to the desired speed.
- Repeat as necessary.

Avoid starting in MAXIMUM POWER for permitted speeds below 35 mph. This rate of acceleration can cause the train to exceed ATC speed limits, resulting in the need to brake rather than coast. This can produce a rough ride.

For operating speeds between 35 and 45 mph, accelerate to the desired speed using maximum power. Then move the Master Controller handle to a lower power position. Maintain speed by holding the Master Controller in this lower position or by moving the Master Controller up or down within the power range.

Title: Propulsion and Braking System (Rail Cars): Series 5000 and 7000**HOW TO STOP A TRAIN**

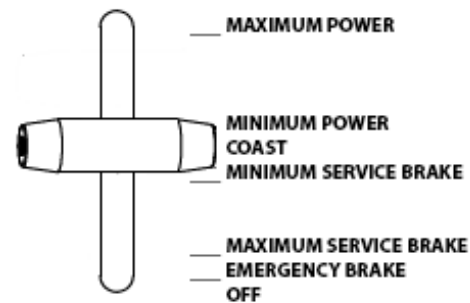
When approaching a station stop, the point to begin braking will vary based on load, grade, weather conditions and other factors. Remember, the distance to the stopping point will be greater when the train is heavily loaded, when a car is cut out, when stopping on a downgrade, and when stopping on slippery rail.

- At low speeds, lower braking rates produce the smoothest stop.
- At high speeds, higher braking rates provide quicker deceleration and save time.
- To make the smoothest, most accurate stop, reduce the braking rate as train speed decreases approaching the stop.

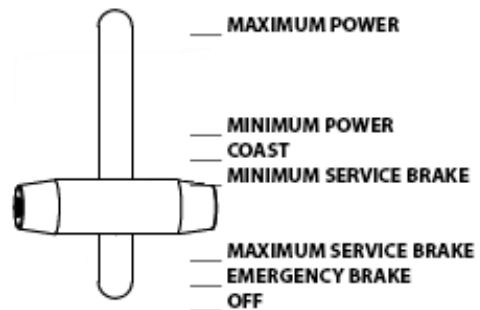
Stopping on Dry Rail

When approaching a station stop:

1. Move the Master Controller handle to COAST before reaching the braking point.



2. At the braking point, move the Master Controller up or down between minimum and maximum braking rates for a smooth stop. Braking characteristics will vary depending on the train speed, passenger load and the distance to the stopping point.

**Stopping on Slippery Rail**

Rail may be slippery when covered with dew, frost, wet leaves or when the track has not been used for some time. It may also be slippery during rain, especially when rain is just beginning or ending or when light rain is falling. When wheels slide, the train will seem unusually quiet and the brake light may illuminate on the panel.

- Anticipate the problem when approaching a stop. Begin braking sooner, using a lower braking rate and the track brake as necessary to avoid a slide.
- If wheels do slide, place the Master Controller in COAST while using the track brake. If the distance to the stop permits, apply power to get the wheels turning, then resume normal service braking using a lower braking rate (and track brake if needed) to avoid sliding.

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Proper Use of the Track Brake

Be prepared to use the track brake to assist in stopping when:

- Regaining control of the train when it appears it will overshoot the berthing mark.
- Braking on slippery rail or when you feel the train going into a slide.
- Operating a train with one or more cars cut out.
- Starting on an uphill grade (incline).
- Closing in on a train ahead or a bumping post.
- Moving at very low speeds as in yards, shops or when coupling/uncoupling.

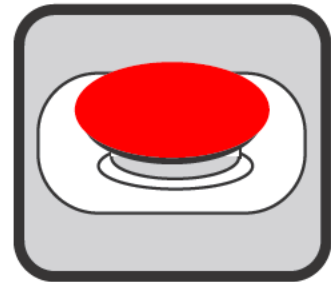
Use the track brake to avoid overrunning the desired stopping point and to prevent a wheel slide.

- **Do not use an emergency brake application** to prevent a wheel slide. Placing the Master Controller in EMERGENCY BRAKE (even for a brief moment) applies the parking brakes, which do not release until the train comes to a complete stop. This causes wheel slides and abuse to rails, trucks, brakes and wheels, requiring excessive and costly repairs.
- Do not use the track brake for normal service stops.

To use the track brake:

- Press and hold the track brake button until the train has reached the desired speed. Then release the button to avoid a rough stop.
- Do not “pump” the track brake button.

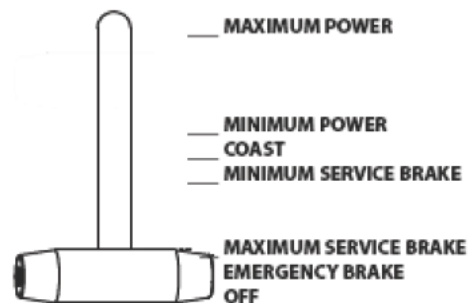
Note: When operating in areas with no 600V DC power, a white panel light indication on a two- or four-car train may indicate that the track brakes may not function properly due to low battery power.



CAUTION: Avoid applying track brakes while the train is passing wayside signals, especially at interlockings, to reduce the possibility of causing slivers that interfere with track circuits at insulated joints.

Stopping in an Emergency

When it is necessary to stop the train in the shortest possible distance, the Master Controller handle **must** be placed in EMERGENCY BRAKE. This will apply full dynamic, parking and track brakes until the train stops.



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Note: If the emergency switch (“red ball”) is pulled or if the side trip is activated, only full dynamic and parking brakes apply to stop the train. Track brakes **do not** apply.

Note: During any emergency brake application, the brakes will remain applied until the train comes to a complete stop.

Once the train stops, the brakes can be reset/released.

To reset emergency brake in the 7000 series, press **EMERGENCY BRAKE RESET**.

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.