

# **Endurant™ 12-Speed Automated Transmission TRDR0950 EN-US**

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SUPPORT



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## Warnings and Cautions

The alert symbol, signal words (**DANGER**, **WARNING** and **CAUTION**) and statements throughout this manual indicate the potential severity of a situation. Ensure to read, understand and follow each statement to avoid vehicle damage, component damage, personal injury, severe injury and/or death.



**DANGER:** Indicates an immediate hazard. Failure to follow the indicated procedures will cause major vehicle component damage, severe injury or death.



**WARNING:** Indicates an immediate hazard. Failure to follow the indicated procedures may result in major vehicle component damage, severe injury or death.



**CAUTION:** Indicates a potential hazard. Failure to follow the indicated procedures could result in minor or moderate component damage and/or personal injury.

The **NOTICE** and **Note** statements through out this manual provide additional details required to avoid damaging a component or incorrectly completing a repair. Ensure to read, understand and follow each statement to properly complete a repair.

**NOTICE:** Indicates component or property damage could result if you do not follow the indicated procedure.

**Note:** Indicates additional detail that will aid in the repair of a component.



**WARNING:** Ensure to read, understand and follow each statement outlined below. Failure to read, understand and follow each statement outlined below may result in major vehicle component damage, property damage, severe injury or death.

- Read the entire driver instructions before operating this transmission system.
- If engine cranks in any gear lever position (shift mode) on the transmission driver interface device other than Neutral (N), service vehicle immediately.
- Before starting the engine, always be seated in the driver's seat, select Neutral (N) mode using the transmission driver interface device, confirm a solid "N" in the gear display, and set the vehicle parking brake.

## General Information

- Before working on a vehicle, parking the vehicle, or leaving the cab with the engine running, select Neutral (N) mode using the transmission driver interface device, confirm a solid “N” in the gear display, set the vehicle parking brake, and chock the wheels.
- Always depress and hold the vehicle service brake prior to selecting a gear lever position (shift mode) from Neutral (N) using the transmission driver interface device.
- Always ensure that fuel is at a sufficient operating level before operating vehicle. A loss of engine power could result in diminished transmission operation.
- Do not release the vehicle parking brake or attempt to select a gear lever position (shift mode) from Neutral (N) using the transmission driver interface device until the vehicle air system pressure is in the normal operating range.



**CAUTION:** Ensure to read, understand and follow each statement outlined below. Failure to read, understand and follow each statement outlined below could result in component damage.

- Before operating a Power Take-Off (PTO), refer to “Transmission Power Take Off Operation.”
- Prior to any type of welding on a vehicle equipped with this transmission system, disconnect the battery cables (+ and -).

**Railroad Grade Crossing Requirements:** It is a requirement that the driver of a commercial vehicle specified under paragraph A sections 1-6 of FMCSA regulation 392.10 need only cross railroad grade crossings in a gear that permits the vehicle to complete the crossing without a change of gears. Select MANUAL (M) mode using the transmission driver interface device to hold a transmission gear position while crossing a railroad grade, refer to “MANUAL Mode” on page 11.



**WARNING:** Failure to select MANUAL (M) mode to hold a transmission gear position while crossing a railroad grade could result in major vehicle component damage, property damage, severe injury or death.

## Transmission Driver Interface Device Modes

The transmission driver interface device is an OEM component. Refer to OEM for more information on operation, including engine brake operation.

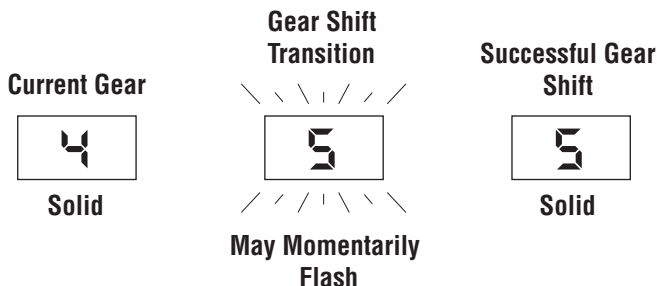
R	Selects Reverse mode	(see page 8 for details)
N	Selects Neutral mode, used for Start-Up and Power Down	(see page 9 for details)
D	Selects Drive mode	(see page 10 for details)
MANUAL	Selects MANUAL mode	(see page 11 for details)
LOW	Selects LOW mode	(see page 13 for details)
Upshift/ Downshift Function	Used to request Upshifts and Downshifts and to change start gears	

**Note:** The transmission system may automatically override or prevent the driver's Upshift or Downshift request on the transmission driver interface device or automatically initiate a gear change based on vehicle operating conditions. Refer to "Transmission MANUAL / LOW Mode Override" on page 14.

# Operation

## Gear Display

The gear display indicates the current gear position of the transmission. During an Upshift or Downshift the display may momentarily flash the target gear position.



A dash “-” appears in the gear display when the transmission system cannot achieve Neutral gear position.



“CA” appears in the gear display when a clutch abuse protection event is occurring.



“AN” appears in the gear display when the transmission system goes into Auto Neutral.



“CC” appears in the gear display when the transmission system is performing a clutch calibration.





## *Operation*

**Note:** Gear display indicators, messages, and tones will vary based on how the transmission system features and functions are configured in the Transmission Control Module (TCM) and how the OEM has implemented them. Refer to OEM for more information on the dashboard display.

**Low Transmission Air Message:** Allow the vehicle air system pressure to reach normal operating range prior to transmission system operation. Ensure the vehicle air system is operating and maintained per OEM guidelines.

**NOTICE:** If the low transmission air message is indicated, allow the engine to idle, shutting off the engine prolongs the condition. In most cases the transmission system will recover and towing the vehicle is not required.

**Clutch Temperature Message:** Safely and immediately discontinue the vehicle operation that is being performed which is causing increased clutch temperature. Depress and hold the vehicle service brake or apply the vehicle parking brake and idle the engine until the message is no longer indicated.

**NOTICE:** If the clutch temperature message is indicated, allow the engine to idle, shutting off the engine prolongs the condition. In most cases the transmission system will recover and towing the vehicle is not required.

**Note:** If the low transmission air and/or clutch temperature message is indicated, and the condition no longer exists, some vehicle displays may require a manual reset to clear the message. Refer to OEM guidelines regarding message reset procedure.

## Start-Up and Power Down

### Start-Up

1. Turn ignition key to On with the engine off to allow the transmission system to power-up.

**Note:** Engine cranking is delayed until the transmission system power-up is complete and the gear display shows a solid “N” indicating the transmission is in neutral gear position.

2. Once a solid "N" is indicated in the gear display, start the engine.
3. Allow vehicle air system pressure to build to normal operating range.
4. Depress and hold the vehicle service brake.

**Note:** If the vehicle service brake is not depressed prior to selecting a gear lever position (shift mode) using the transmission driver interface device, the request will be denied.

5. Select the desired gear lever position (shift mode) using the transmission driver interface device.

**Note:** If the initial gear lever position (shift mode) or start gear change request was denied, select Neutral (N) mode, depress and hold the vehicle service brake and re-select.

**Note:** The transmission system may automatically override or prevent the driver's Upshift or Downshift request on the transmission driver interface device or automatically initiate a gear change based on vehicle operating conditions. Refer to “Transmission MANUAL / LOW Mode Override” on page 14.

6. Release the vehicle parking brake.

## Power Down

1. Safely bring vehicle to a complete stop.
2. Continue to depress and hold the vehicle service brake.
3. Select Neutral (N) mode using the transmission driver interface device.

**Note:** A solid “N” in the gear display indicates the transmission is in neutral gear position.

**NOTICE:** Neutral gear position should always be achieved before initiating a power down, except in cases of an emergency.

4. Set the vehicle parking brake.



**WARNING:** Apply vehicle parking brake and follow OEM parking instructions. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

5. Key off.

# Operation

## Reverse Mode

- Selects Reverse (R) mode and a reverse gear position.

**Note:** If the vehicle service brake is not depressed prior to selecting Reverse (R) mode using the transmission driver interface device, the request will be denied. If the request was denied, select Neutral (N) mode, depress and hold the vehicle service brake and re-select.

- The driver may manually select a specific reverse start gear using the transmission driver interface device to Upshift or Downshift to the desired gear. Refer to OEM transmission driver interface device instructions.
- If vehicle speed is greater than 2 MPH, the transmission system will not allow engagement into a Reverse gear position.

**Note:** The transmission system may automatically override or prevent the driver's Upshift or Downshift request on the transmission driver interface device or automatically initiate a gear change based on vehicle operating conditions. Refer to "Transmission MANUAL / LOW Mode Override" on page 14.



**CAUTION:** Do not depress and hold the vehicle accelerator pedal and service brake pedal at the same time during a vehicle launch (two-footing). Two-footing during a vehicle launch may cause the vehicle and cab to rock and bounce resulting in component damage, property damage and/or personal injury.

## Neutral Mode

- Selects Neutral (N) mode and neutral gear position.
- Neutral is the initial gear position after Start-Up and the final gear position before Power Down.



**WARNING:** Apply vehicle parking brake and follow OEM parking instructions. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

**Note:** When attempting to start the engine and the engine does not crank, confirm Neutral (N) is selected on the transmission driver interface device, confirm a solid “N” in the gear display, vehicle parking brake is applied and vehicle service brake is depressed.

## Drive Mode (Auto Mode)

- Selects Drive (D) mode and a forward gear position.

**Note:** If the vehicle service brake is not depressed prior to selecting Drive (D) mode using the transmission driver interface device, the request will be denied. If the request was denied, select Neutral (N) mode, depress and hold the vehicle service brake and re-select.

- The transmission system automatically selects a forward start gear based on vehicle operating conditions such as: grade, load, and vehicle weight. Refer to “Smart Gear Selection” on page 20.
  - The driver may manually select a specific forward start gear using the transmission driver interface device to Upshift or Downshift to the desired gear. Refer to OEM transmission driver interface device instructions.
- The transmission system automatically selects and engages the appropriate gears based on vehicle operating conditions.
  - The driver may request a gear shift while driving using the transmission driver interface device to Upshift or Downshift to a desired gear when the transmission system is near a shift point. Multiple gear Upshifts and Downshifts may be allowed, each Upshift/Downshift request equals one gear change.

**Note:** The transmission system may automatically override or prevent the driver's Upshift or Downshift request on the transmission driver interface device or automatically initiate a gear change based on vehicle operating conditions. Refer to “Transmission MANUAL / LOW Mode Override” on page 14.

**Note:** Normal Drive mode is the recommended mode for optimal vehicle performance.



**CAUTION:** Do not depress and hold the vehicle accelerator pedal and service brake pedal at the same time during a vehicle launch (two-footing). Two-footing during a vehicle launch may cause the vehicle and cab to rock and bounce resulting in component damage, property damage and/or personal injury.

## **MANUAL Mode**

MANUAL mode allows the driver to manually shift gears instead of letting the transmission system select gears automatically.

- The driver requests gear shifts using the transmission driver interface device to Upshift or Downshift to the desired gears. Multiple gear Upshifts and Downshifts may be allowed, each Upshift/Downshift request equals one gear change.
- The transmission system holds the current gear position until the driver initiates another Upshift or Downshift.

**Note:** The transmission system may automatically override or prevent the driver's Upshift or Downshift request on the transmission driver interface device or automatically initiate a gear change based on vehicle operating conditions. Refer to "Transmission MANUAL / LOW Mode Override" on page 14.

**Note:** Normal Drive mode is the recommended mode for optimal vehicle performance.

## **MANUAL / Hold Mode Gear**

Hold Mode Gear is used to limit the use of MANUAL mode. When Hold Mode Gear is configured in the Transmission Control Module (TCM) to a specific gear, MANUAL mode becomes a hold gear function only. The default configuration for this function in the TCM is Disabled. The configuration can be changed using ServiceRanger.

- When MANUAL mode is selected and the transmission is in a gear equal to or greater than the configured Hold Mode Gear, the transmission will remain in the current gear; any Upshift or Downshift requests using the transmission driver interface device are not allowed and an audible tone may be emitted every 10 seconds.
- When MANUAL mode is selected and the transmission is in a gear less than the configured Hold Mode Gear, the transmission system allows normal MANUAL mode operation.

**Note:** The transmission system may automatically override or prevent the driver's Upshift or Downshift request on the transmission driver interface device or automatically initiate a gear change based on vehicle operating conditions. Refer to "Transmission MANUAL / LOW Mode Override" on page 14.



## LOW Mode

LOW mode allows the driver to maximize engine braking and minimize the use of the vehicle service brake when driving down long grades or coming to a stop.

- The driver may select LOW mode using the transmission driver interface device while the vehicle is moving to prevent the transmission system from Upshifting, and support Downshifting at the earliest opportunity to enable higher engine RPM to promote maximum engine braking based on vehicle operating conditions.
- If LOW mode is selected using the transmission driver interface device while the vehicle is stationary, the transmission system will shift into 1st gear and remain there; any Upshift or Downshift requests using the transmission driver interface device are not allowed.



**WARNING:** On low friction surfaces refrain from engine braking when in LOW mode. Excessive engine braking at high engine RPM may cause a loss of traction and vehicle control and may result in major vehicle component damage, severe injury or death.

**Note:** The transmission system may automatically override or prevent the driver's Upshift or Downshift request on the transmission driver interface device or automatically initiate a gear change based on vehicle operating conditions. Refer to "Transmission MANUAL / LOW Mode Override" on page 14.

## **Transmission MANUAL / LOW Mode Override**

The transmission system may automatically override or prevent the driver's Upshift or Downshift request on the transmission driver interface device or automatically initiate a gear change based on vehicle operating conditions. If the transmission system overrides or prevents a mode request, an audible tone may be emitted.

- If the transmission is being back-driven and the engine is approaching its high RPM level limit, the transmission system will override the MANUAL or LOW mode functions and perform an Upshift to prevent engine damage.

**NOTICE:** The transmission system initiates Upshifts for engine overspeed protection. Refer to “Engine Overspeed Protection” on page 20.

- If the driver manually selects a start gear using the transmission driver interface device that, when engaged, causes the engine to lug at a launch, the transmission system will override the MANUAL mode request and select an appropriate start gear to prevent engine lugging and possible damage.

## **Snow/Ice Operation**

This transmission system is designed to work in coordination with the vehicle's traction control system to ensure optimal operation.

- If the driver observes low friction road conditions (rain, ice, snow, etc.) and does not want the transmission system to make a gear shift, the driver may select MANUAL (M) mode using the transmission driver interface device. The transmission system will remain in the current gear position until the driver re-selects Drive (D) mode or chooses to Upshift or Downshift using the transmission driver interface device once road conditions improve.

## **Trailer Operation**

### **Trailer Connecting and Sliding Trailer Axle**

- Prior to backing the vehicle under the trailer, ensure proper trailer height.
- Select the lowest available start gear for Drive (1st) or Reverse (R1) using the Downshift function as needed on the transmission driver interface device.
- Refer to vehicle and trailer manufacturer guidelines for unlocking, sliding and locking trailer axles.

**Note:** If repeat attempts are made and the automated clutch starts to overheat, the display may indicate “CA” (Clutch Abuse) and/or a clutch temperature message and an audible tone may be emitted. Refer to “Clutch Abuse Protection” on page 19.

## Features

### Hill Start Aid

- Hill Start Aid (HSA) requests the vehicle foundation brake system to temporarily hold (3 seconds) the vehicle in place when stopped on a grade of 3% or greater to allow the driver to transition from the vehicle service brake pedal to the vehicle accelerator pedal to achieve a controlled launch.
- When HSA is configured on, or Enabled, in the Transmission Control Module (TCM) and the vehicle is stopped on a grade of 3% or greater the transmission system requests the vehicle electronic brake system keep the vehicle foundation brakes applied for 3 seconds after the driver releases the vehicle service brake.
- The feature may be disabled for one launch by selecting the vehicle's HSA switch. When the HSA switch is selected, the lamp on the switch flashes indicating the feature is disabled. The feature automatically enables after a successful launch. Refer to OEM for information on operation of the HSA switch.


**Note:** The default configuration for this feature in the TCM is Enabled and can be configured to activate on a 1%, 2% or 3% grade using ServiceRanger.

**NOTICE:** If the vehicle electronic brake system is faulted and not working, this feature will not function. Refer to OEM for more information on the vehicle electronic brake system.

# Operation


## Vehicle Facing Uphill – Forward Mode (HSA)

1. The transmission system must be in Drive (D) mode and on an incline greater than the Hill Start Aid Threshold configuration setting (1%, 2% or 3%) in the Transmission Control Module (TCM).
2. Bring the vehicle to a stop, depress the vehicle service brake then release the vehicle service brake to launch the vehicle.

 **WARNING:** The transmission system HSA feature requests the vehicle electronic brake system to apply the vehicle foundation brakes for approximately 3 seconds. After 3 seconds, once the vehicle foundation brakes release, the vehicle may begin to move backward if the vehicle accelerator pedal is not depressed or the vehicle service brake pedal is not re-applied by the driver. Failure to depress the vehicle accelerator pedal or re-apply the vehicle service brake after the vehicle foundation brakes are released may cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

## Vehicle Facing Downhill - Reverse Mode (HSA)

1. The transmission system must be in Reverse (R) mode and on an incline greater than the Hill Start Aid Threshold configuration setting (1%, 2% or 3%) in the Transmission Control Module (TCM).
2. Bring the vehicle to a stop, depress the vehicle service brake, then release the service brake to launch the vehicle.

 **WARNING:** The transmission system HSA feature requests the vehicle electronic brake system to apply the vehicle foundation brakes for approximately 3 seconds. After 3 seconds, once the vehicle foundation brakes release, the vehicle may begin to move forward if the vehicle accelerator pedal is not depressed or the vehicle service brake pedal is not re-applied by the driver. Failure to depress the vehicle accelerator pedal or re-apply the vehicle service brake after the vehicle foundation brakes are released may cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

## Clutch Abuse Protection

- Clutch Abuse Protection alerts the driver that the clutch is overheating due to improper use. When a Clutch Abuse Protection event occurs, a “CA” is indicated in the gear display and/or a clutch temperature message is shown on the dashboard display and an audible tone may be emitted. During a Clutch Abuse Protection event only 1st and R1 gear launches are allowed; Urge to Move and Creep Mode may be disabled.
- When a Clutch Abuse Protection event occurs, safely and immediately discontinue the vehicle operation that is being performed which is causing the increased clutch temperature. Depress and hold the vehicle service brake, or apply the vehicle parking brake, and idle the engine until the clutch temperature message is no longer indicated.

**Note:** Gear display indicators, messages, and tones will vary based on how the transmission system features and functions are configured in the Transmission Control Module (TCM) and how the OEM has implemented them. Refer to OEM for more information on the dashboard display.

**Note:** The default configuration for this feature in the TCM is Disabled. The configuration can be changed using ServiceRanger.

**NOTICE:** Allow the engine to idle, shutting off the engine prolongs the condition. In most cases, the transmission system will recover and towing the vehicle is not required.

Follow the recommendations below to avoid increased clutch temperature:

- Prior to low speed maneuvering select the lowest available start gear for Drive (1st) or Reverse (R1) using the transmission driver interface device.
- During operation on a grade:
  - Bring the vehicle to a stop, depress and hold the vehicle service brake until vehicle movement is required.

**Note:** Avoid using the vehicle accelerator pedal to hold the vehicle.
  - The transmission system Hill Start Aid (HSA) feature will request the vehicle electronic brake system to apply the vehicle foundation brakes for approximately 3 seconds when the driver is transitioning from the vehicle service brake pedal to the vehicle accelerator pedal.

## Engine Overspeed Protection

- The transmission system will automatically Upshift if necessary to prevent engine overspeed in Drive, MANUAL and LOW modes.

## Shuttle Shifting

- Shuttle shifting the transmission system between a forward or reverse mode is allowed if the vehicle speed is approximately 2 MPH or less.

## Smart Gear Selection

- Smart Gear Selection automatically selects the appropriate forward or reverse start gear based on vehicle operating conditions such as: grade, load, and vehicle weight.
- The driver can change the start gear by manually Upshifting or Downshifting to the desired gear using the transmission driver interface device. Refer to OEM transmission driver interface device instructions.

**Note:** If the transmission system determines the manually requested start gear is not appropriate based on vehicle operating conditions an audible tone is emitted and the gear selection is not allowed.

**Note:** Minimum and maximum manual start gear selections are configured in the Transmission Control Module (TCM) using ServiceRanger.

- The transmission system will automatically perform "Skip shifting" if the system determines vehicle operating conditions such as: grade, vehicle weight, engine torque and driver demand are within limits that allow for proper gear engagement and vehicle operation.



## Auto Neutral

- Auto Neutral automatically shifts the transmission system into a neutral state if the vehicle is left in a forward or reverse mode and the vehicle parking brake is set. When this occurs, an “AN” is indicated in the gear display and an audible tone is emitted. A notification message may also appear in the dashboard display depending upon specific OEM implementation.
- To continue normal operation the driver must perform the following using the transmission driver interface device:
  - If Pushbutton controlled, select the desired forward or reverse mode with the vehicle service brake applied.
  - If stalk shifter controlled, select Neutral (N) mode then select the desired forward or reverse mode with the vehicle service brake applied.

**Note:** Gear display indicators, messages, and tones will vary based on how the transmission system features and functions are configured in the Transmission Control Module (TCM) and how the OEM has implemented them. Refer to OEM for more information on the dashboard display.

## Load Based Shifting

- The transmission system constantly monitors the vehicle operating conditions and adapts the shift points to ensure the appropriate gear ratio is requested.

## **Coast Mode**

- Coast Mode prevents the transmission system from downshifting through each lower gear when the driver is bringing the vehicle to a stop. If the transmission system determines the vehicle is coasting and is in a gear below the Coast Down Gear configured in the Transmission Control Module (TCM), the transmission system will automatically shift into a neutral state, allowing the vehicle to roll uninterrupted as the driver brings it to a stop. Once stopped, the transmission system automatically shifts into an appropriate start gear.
- If the driver depresses the accelerator pedal during a Coast Mode event, the transmission system will shift into an appropriate gear position for the current vehicle operating conditions.

**Note:** The Coast Down Gear is configured in the Transmission Control Module (TCM) at the OEM. The configuration can be changed using ServiceRanger.

## Neutral Coast Mode

Neutral Coast Mode automatically shifts the transmission system into a neutral state on slight downhill grades when all of the following conditions are met:

- Vehicle Cruise Control is on
- Transmission is in Drive (D) mode
- Downhill grade identified by transmission system
- No engine power is being applied

When Neutral Coast Mode is active, the engine will drop to idle speed and the transmission system will automatically shift into a neutral state. During a Neutral Coast Mode event, the gear display may flash a gear number or “N”, or an OEM-specific character such as “SC”, depending upon the specific OEM implementation.

**Note:** Gear display indicators, messages, and tones will vary based on how the transmission system features and functions are configured in the Transmission Control Module (TCM) and how the OEM has implemented them. Refer to OEM for more information on the dashboard display.

- A flashing number in the gear display indicates the gear position that the transmission system will engage when necessary.
- The transmission system will inactivate Neutral Coast Mode and re-engage a gear if any of the following conditions occur:
  - Driver depresses vehicle service brake
  - Driver depresses vehicle accelerator
  - Vehicle Cruise Control is canceled or inactivated
  - Driver selects a shift mode other than Drive (D) on the transmission driver interface device
  - Driver performs an Upshift or Downshift request on the transmission driver interface device
  - Vehicle Cruise Control high or low set speeds are exceeded
  - Maximum vehicle grade is exceeded
  - A vehicle Adaptive Cruise Control system mode request is received

**Note:** Various brand names may be used for Neutral Coast systems. Contact the OEM for more information.

# *Operation*

## **Auto-Launch (Urge to Move)**

- Auto-Launch allows the vehicle to automatically start moving at engine idle speed when the transmission system is in a forward or reverse mode and the driver releases the vehicle service brake. After the vehicle has launched and begun moving, the transmission system will transition into Creep Mode.
- This feature is useful in low speed maneuvering situations where controlled movement is required without using the throttle. This includes but is not limited to stop and go traffic, dock backing and trailer coupling / uncoupling.

**Note:** The Auto-Launch feature is configured in the Transmission Control Module (TCM) at the OEM. The configuration can be changed using ServiceRanger.

## **Creep Mode**

- Creep Mode allows the vehicle to be driven at engine idle speed (no vehicle accelerator input). Upshifts and Downshifts can be requested by the driver using the transmission driver interface device to increase or decrease the vehicle speed for existing vehicle operating conditions. Creep Mode becomes inactive once the accelerator pedal is applied.
- This feature is useful for slow speed applications where slow and steady vehicle speed is required.

**Note:** The Creep Mode feature is configured in the Transmission Control Module (TCM) at the OEM. The configuration can be changed using ServiceRanger.

## **Blended Brake**

- Blended Brake enhances Auto-Launch and Creep mode for low-speed vehicle control and maneuvering.
- Light pressure on the service brake pedal will partially disengage the clutch, slowing the vehicle while keeping it moving. Increased pressure will fully disengage the clutch.

**Note:** The Blended Brake feature is configured in the Transmission Control Module (TCM). The configuration can be changed using ServiceRanger.

# *Operation*

## **Force Neutral / Hold Neutral Operation**

Force Neutral or Hold Neutral operation allow the use of a separate vehicle integrated switch “input” circuit to override the driver’s action and “force”, or hold, the transmission in a neutral state to prevent vehicle motion while a vehicle specific feature is performed or chassis mounted equipment is operated or deployed (e.g. PTO, Crane, Lift, etc.). When Force Neutral or Hold Neutral is active, an “HN” is displayed in the gear display.

**Note:** Gear display indicators, messages and tones will vary based on how the transmission system features and functions are configured in the Transmission Control Module (TCM) and how the OEM has implemented them. Refer to OEM for more information on the dashboard display.

**Note:** The Force Neutral and Hold Neutral features are configured in the Transmission Control Module (TCM) at the OEM or body builder. The configuration can be changed using ServiceRanger.

### **Force Neutral Operation**

When a vehicle integrated switch “input” circuit is activated, the transmission goes into a neutral state that is maintained until the switch “input” circuit is deactivated (off). The transmission system will deny any selection of a non-neutral mode (Drive/Reverse/Manual/Low) when the vehicle specific feature is on (switch “input” circuit is active).

### **Hold Neutral Operation**

This feature requires preselecting Neutral (N) mode using the transmission driver interface device. Neutral (N) mode is maintained until the vehicle integrated switch “input” circuit is deactivated. The transmission system will deny any selection of a non-neutral mode (Drive/Reverse/Manual/Low) when the vehicle specific feature is on (switch “input” circuit is active).

**Note:** The Force Neutral and Hold Neutral features are configured in the Transmission Control Module (TCM) at the OEM or body builder.

## Transmission Power Take Off Operation

Transmission Power Take Off (PTO) functionality is available for both stationary and mobile PTO applications. Each transmission has an 8-bolt, bottom-mounted PTO opening. Additionally, transmissions can be ordered with a 4-bolt, rear-mounted PTO as an option.

- Stationary PTO operation is performed with the transmission system in Neutral (N) mode with no vehicle movement.
- Mobile PTO operation is performed in Drive or Reverse. The transmission system automatically selects a start gear based on vehicle operating conditions such as: grade, load, and vehicle weight. Refer to “Smart Gear Selection” on page 20.
- Stop and Go Mobile PTO (Optional) allows PTO operation to continue when the service brake pedal is depressed and the vehicle is brought to a stop.

**Note:** Gear display indicators, messages, and tones will vary based on how the transmission system features and functions are configured in the Transmission Control Module (TCM) and how the OEM has implemented them. Refer to OEM for more information on the dashboard display.

**NOTICE:** The default configuration for these functions in the Transmission Control Module (TCM) is Disabled unless Enabled at the OEM or body builder. The configuration can be changed using ServiceRanger.



**WARNING:** Failure to properly install the PTO and configure the TCM for PTO operation may result in major vehicle component damage, severe injury or death.



**WARNING:** Apply vehicle parking brake and follow OEM parking instructions. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

# *Operation*

## **Stationary PTO Operation**

### **To engage a PTO for stationary operation:**

1. Ensure the vehicle is at a complete stop.
2. Depress and hold the vehicle service brake pedal.
3. Select Neutral (N) mode using the transmission driver interface device.
4. Apply the vehicle parking brake and release the vehicle service brake pedal.
5. Switch the PTO switch to On.

**Note:** The PTO is active when the PTO switch is On. An indicator lamp is illuminated and/or message is displayed when the PTO is active.

### **To disengage the PTO:**

1. Switch the PTO switch to Off.



## Mobile PTO Operation

### To engage a PTO for mobile operation (Drive and Reverse)

1. Ensure the vehicle is at a complete stop.
2. Depress and hold the vehicle service brake pedal.
3. Switch the PTO switch to On.

**Note:** For Mobile PTO operation the transmission system automatically selects a start gear based on vehicle operating conditions such as: grade, load, and vehicle weight. Refer to “Smart Gear Selection” on page 20.

4. Use the transmission driver interface device to Upshift or Downshift to change the current start gear.

**Note:** Shifting while vehicle is in motion is inhibited while the PTO is active.

5. Release the vehicle service brake pedal to allow for vehicle motion and to start PTO operation.

**Note:** If Stop and Go Mobile PTO is Enabled in the TCM, the PTO will continue to operate when the service brake pedal is pressed and the vehicle is brought to a stop. When the service brake pedal is released, the PTO will stop. Once the vehicle is again in motion PTO operation will resume.

**Note:** Mobile PTO operation will only allow Start Gears 2nd, 4th and R2. No shifts allowed, stays in start gear.

**Note:** The Stop and Go Mobile PTO feature is configured in the Transmission Control Module (TCM) at the OEM or body builder. The configuration can be changed using ServiceRanger.

### To disengage the PTO:

1. Switch the PTO switch to Off.

## Transmission Oil Display Message

The transmission contains a fluid pressure sensor that monitors the transmission oil lubrication system pressure. If the sensor indicates a low oil condition to the Transmission Control Module (TCM) a transmission low oil message is displayed and an audible tone may be emitted.

If the transmission low oil message is displayed, perform the following as soon as possible or transmission damage may occur:

1. Continue to drive the vehicle to the nearest safe location.
2. Select Neutral (N) mode using the transmission driver interface device.
3. Set the vehicle parking brake.

**Note:** Gear display indicators, messages, and tones will vary based on how the transmission system features and functions are configured in the Transmission Control Module (TCM) and how the OEM has implemented them. Refer to OEM for more information on the dashboard display.

**Note:** This feature is configured in the TCM with ServiceRanger.



**WARNING:** Apply vehicle parking brake and follow OEM parking instructions. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

4. Turn ignition key to Off and allow the engine to shut down.
5. Contact a service facility to have the transmission system evaluated.

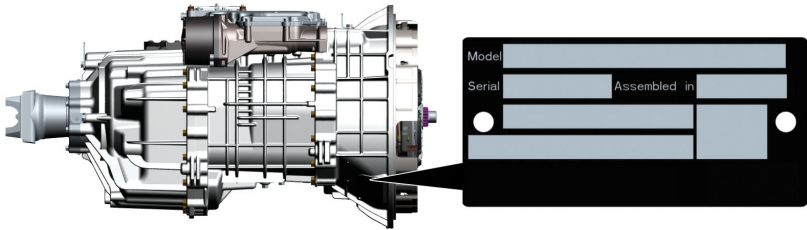
## General Model Information

### Serial Tag and Model Nomenclature

Transmission identification information is stamped on the serial tag located on the lower right side of the clutch housing.

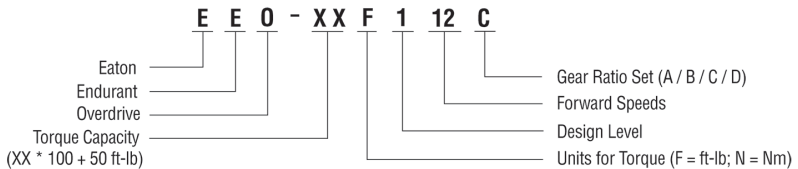
When calling for service assistance or parts, have the model and serial numbers handy.

**NOTICE:** Do not remove or destroy the transmission identification tag.



### Model Number

The model number gives basic information about the transmission and is explained below.



### Serial Number

The serial number is the sequential identification number of the transmission.

**Note:** Record the Transmission Model and Serial Numbers in the blank spaces provided below.

Transmission Model \_\_\_\_\_

Transmission Serial Number \_\_\_\_\_

## Troubleshooting

### Diagnostics

In the event there is a problem with the transmission system, there are three primary tasks the driver should perform:

1. Note the driving condition under which the problem occurred.
2. Note the condition of the transmission under which the problem occurred (i.e. operation mode (Drive, MANUAL, LOW), current gear, engine speed, etc.).
3. Transmission Reset Procedure.

### Transmission Reset Procedure

In some cases, proper transmission operation can be restored by “resetting” the Transmission Control Module (TCM). Use the following procedure to reset the TCM.

1. Continue to drive the vehicle to a safe location.
2. Select Neutral (N) mode using the transmission driver interface device.

**Note:** Once Neutral is selected, a gear engagement may not be allowed depending on the problem.

3. Set the vehicle parking brake.



**WARNING:** Apply vehicle parking brake and follow OEM parking instructions. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

4. Turn ignition key to Off and allow the engine to shut down.
5. Wait at least 2 minutes.
6. Restart the engine.
7. If the problem continues, contact a service facility to have the vehicle and transmission system evaluated.

## **Transmission Air Supply**

For optimal performance, the transmission requires a nominal air supply operating range between 90 psi (620 kPA) and 130 psi (896 kPA). Air supply outside this range can result in degraded or complete loss of transmission engagement and shift capabilities.



**CAUTION:** Vehicle air quality is important for transmission system operation. Failure to follow the vehicle air system maintenance requirements may result in transmission damage; this voids the transmission warranty. Refer to OEM guidelines for vehicle air and filter system maintenance.

## Proper Transmission Lubrication

Proper lubrication procedures are key to a good all-around maintenance program. If the lubricant is not doing its job or if the lubricant level is ignored, all the maintenance procedures in the world are not going to keep the transmission running or assure long transmission life.


Transmission internal parts are amply lubricated if these procedures are closely followed:

1. Maintain lubricant level and inspect regularly.
2. Follow maintenance interval chart.
3. Use the correct grade and type of lubricant.
4. Buy lubricant from an approved dealer.

## Lubrication Specifications

Use only Eaton approved lubricant. For information, see *Eaton Lubrication Product Specification Manual (TCMT0021)*.

 **CAUTION:** Failure to use the approved lubricant will affect the transmission performance and the warranty coverage.

 **CAUTION:** Additives and/or friction modifiers are not approved. Additives of any kind will affect the transmission performance and the warranty coverage.

For a list of Eaton approved lubricant suppliers, see *Eaton Approved Lubricant Suppliers Lubrication Guide (TCMT0020)*.

## Transmission Oil Level Inspection Procedure

1. Park vehicle in a safe area on level ground.
2. Key off.
3. Set vehicle parking brake and chock wheels.



**WARNING:** Apply vehicle parking brake and follow OEM parking instructions. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

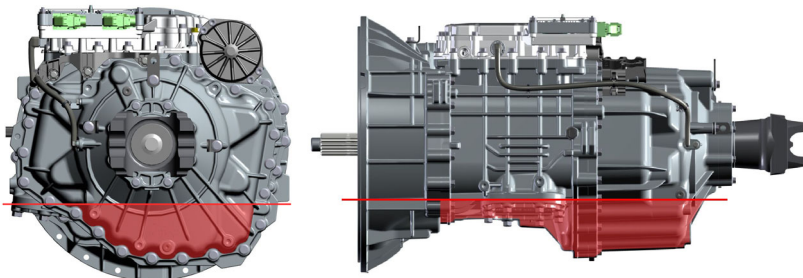
4. Locate the transmission check plug on the left side of the rear housing.
5. Place a suitable container under the Oil Check Plug and remove the check plug with a 6 mm hex key.
6. Oil level is correct when a small amount of oil runs out of the Oil Check Plug hole.

**Note:** If oil level is low, check for leaks (repair if necessary) and reference *Endurant HD Series Automated Transmission Service Manual (TRSM0950)*, Oil Service Procedure, Fill Oil.

7. Inspect the Oil Check Plug and O-ring for damage. If damaged, replace the Oil Check Plug; O-ring is serviced with plug.
8. Install the Oil Check Plug and torque to 24.5-29.5 Nm (18-22 lb-ft).

**NOTICE:** Do not over-torque the Oil Check Plug or transmission damage may occur.

# Service and Maintenance



**CAUTION:** Do not operate the transmission at an operating angle greater than 12° (approximately a 21% grade) or improper lubrication will occur causing damage to the transmission. The operating angle is the transmission mounting angle in the chassis plus the percent of upgrade (expressed in degrees).

## Transmission Lubrication Change Intervals

Lubricant changes should be based on the intervals shown in TCMT0021 *Eaton Lubrication Product Specification Manual*. Extending drain intervals beyond those indicated are not recommended and will affect the transmission performance and the warranty coverage.



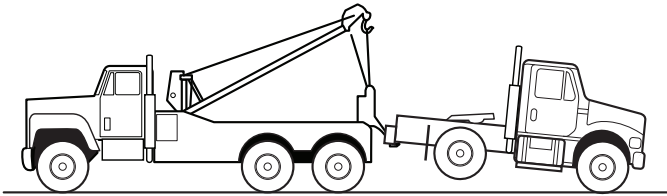
## Vehicle Towing

When towing the vehicle, do not allow the output shaft of the transmission to rotate. If the vehicle is towed with the drive wheels still in contact with the road surface, the vehicle axle shafts or driveline must be removed or disconnected prior to towing vehicle.



**CAUTION:** Failure to follow the Vehicle Towing procedure will result in transmission damage and voids the transmission warranty.

### Preferred




### Must remove vehicle axle shafts or driveline prior to towing



## **Limited Driveline-Connected Towing**

In an urgent situation and after specified vehicle and transmission system requirements are met, the vehicle may be towed a limited distance at a limited road speed and with the driveline connected and the drive wheels in contact with the road surface.

 **CAUTION:** Failure to follow the Limited Driveline-Connected Towing requirements listed below will result in transmission damage and voids the transmission warranty.

### **Vehicle and Transmission System Requirements:**

- Vehicle air pressure greater than 90 psi (620 kPa)
- Neutral (N) selected on the transmission driver interface device
- Solid Neutral (N) indicator on the vehicle's transmission driver interface device
- Solid “N” is indicated in the gear display
- Key off

### **Limited Towing Speed and Distance Requirements:**

- Road speed less than 25 mph (40 km/h)
- Distance less than 0.25 mile (0.40 km)

## Dynamometer Test Mode

In cases when vehicle dynamometer testing is required, the transmission system can be put into a dynamometer test mode.

**Note:** Transmission Control Module (TCM) software 5516062 or greater is required to support dynamometer test mode.

Use the following procedure to activate Dynamometer Test Mode in the TCM.



**WARNING:** Refer to dynamometer manufacturer's instructions regarding vehicle setup and testing. Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

### Vehicle and Transmission System Requirements:

- Key on with engine off.
- Ensure the vehicle is at a complete stop.
- Neutral (N) is selected on the transmission driver interface device.
- Solid "N" is indicated in the gear display.

### To Activate Dynamometer Test Mode:

1. Key on with engine off.
2. Depress and hold the vehicle service brake.
3. Perform the following sequence using the transmission driver interface device within 20 seconds.
  - a. Start in Neutral (N)
  - b. Select Drive (D)
  - c. Select Manual Mode (M)
  - d. Select Drive (D)
  - e. Select Reverse (R)
  - f. Select Drive (D)
  - g. Select Neutral (N)

## ***Service and Maintenance***

4. When complete, a 12 second audible tone indicates Dynamometer Test Mode is active in the TCM.
5. Perform required vehicle dynamometer testing.
6. When vehicle dynamometer testing is complete, key off to deactivate Dynamometer Test Mode.

**Note:** Gear display indicators, messages, and tones will vary based on how the transmission system features and functions are configured in the Transmission Control Module (TCM) and how the OEM has implemented them. Refer to OEM for more information on the dashboard display.



**WARNING:** Failure to follow these instructions could cause unintended vehicle movement and may result in major vehicle component damage, property damage, severe injury or death.

## **Overview**

The Endurant HD-N transmission and clutch system is designed specifically for the Cummins ISX12N Compressed Natural Gas (CNG) engine to match the unique operating characteristics of the CNG engine compared to a diesel engine.

Drivers will notice a significant difference in operation and performance with the HD-N and ISX12N combination when compared to the base Endurant HD transmission and diesel engine combination.

## **Launching and Low Speed Maneuvering**

Due to the operating characteristics of a CNG engine, drivers experienced a delayed input response from the accelerator pedal which affects how the transmission's clutch controls respond. When the driver depresses the accelerator pedal there is approximately a one half second delay until the engine responds and the transmission starts to close the clutch.

To move the vehicle slowly from a stop, the driver needs to slowly depress and hold the accelerator pedal, less than 50%, allowing the engine time to react to the input. As soon as the transmission sees the engine responding to the accelerator pedal, the clutch begins to close and provides vehicle movement. This delay in response is also present when releasing the accelerator pedal, as the engine needs approximately one half second to stop fueling the engine when the driver releases the accelerator pedal.

Once the clutch has started to close and the vehicle begins to move, if more power is needed the driver should slowly depress the accelerator pedal a little more and then hold the position, allowing time for the engine to react to the input.

The more accelerator pedal input that is provided results in more time required to bring the engine speed back down to idle and for the transmission to open the clutch when the accelerator pedal is released. The driver should avoid quick or rapid changes in accelerator pedal position when attempting to move the vehicle a short distance to provide smooth and steady operation.

# ***Endurant HD N***

## **Accelerating and Shifting**

The delayed response of the CNG engine also impacts how the vehicle accelerates and shifts through the gears. Drivers will notice that the engine does not build torque as fast as a diesel engine, so accelerating and shifting gears through an intersection from a stop or merging onto an expressway can take a little longer; drivers will need to take this into account.

## **Cruise Gears**

The Cummins ISX12 CNG engines operate at a higher RPM to develop the same power as a diesel engine, so with this in mind the Endurant HD-N transmission is programmed specifically for this engine to keep the engine at an optimal speed to provide the best performance and efficiency. Unlike diesel engines that operate in the 1000-1400 RPM range, the ISX12 engine operates in the 1250-1650 RPM range. Drivers can expect the engine to run a bit faster and possibly a gear lower than they are used to.



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