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Revised 03-07



ZF-FreedomLine[®] Transmission

Operator Manual TP-20170

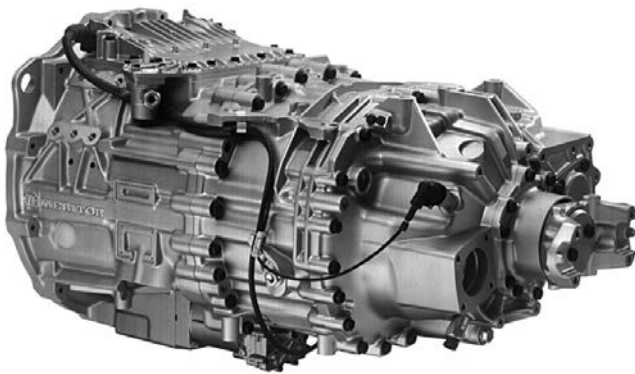


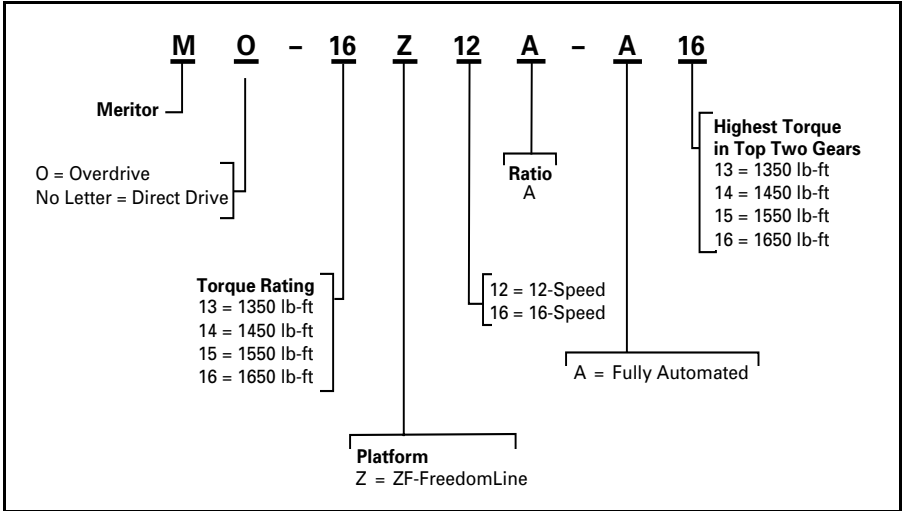


Table of Contents

Section 1: Nomenclature and Ratios	1
Section 2: Operating Guidelines	
How to Shift the Transmission	2
Automatic Mode	
Manual Mode	4
Parking a Vehicle	5
Drain Moisture from the Air Reservoir Every Day	
Remove Axle Shafts When You Tow a Vehicle with the Rear Wheels on the Ground	6
Optional OEM Transmission Temperature Gauge or Optional OEM Transmission Indicator Light	
Section 3: Shift Module	
Shift Module and Joystick	7
Shift Module	
NEUTRAL Button	
FUNCTION Button	
Shift-n-Cruise™ Speed Control Feature	8
Section 4: Displays	
Instrument Panel and Shift Module Displays	9
System Malfunction Warning	10
System Self-Check Status	11
System Air is Low	
Clutch Overload Status	12
Clutch Wear Warning	
Section 5: Fault Code Diagnostics	
Fault Codes	13
How to Retrieve Active and Inactive Fault Codes from the Instrument Panel Display	
How to Clear Inactive Fault Codes from TCU Memory	14
Before You Make a Warranty Repair on a ZF-FreedomLine® Transmission	15
Test and Repair Faults	
How to Retrieve Active and Inactive Fault Codes from the Instrument Panel Display Using a Steering Column-Mount Shift Lever	
How to Clear Inactive Fault Codes from the Instrument Panel Display Using a Steering Column-Mount Shift Lever	17
Section 6: Shift Labels	
Shift Labels	18



Section 1 Nomenclature and Ratios



12-Speed ZF-FreedomLine®

Transmission Description	Model Number	Torque Rating lb-ft	Overall Ratio		Rev. L	Rev. H	Ratio and Percent Step																							
			FWD.	REV.			1 %	2 %	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %	11 %	12 %												
12-Speed Direct Drive	M-13Z12A-A13	1,350	15.86	14.68	14.68	11.41	15.86	29	12.33	29	9.57	29	7.44	27	5.87	28	4.57	32	3.47	28	2.70	29	2.10	29	1.63	26	1.29	29	1.00	
	M-14Z12A-A14	1,450																												
12-Speed Overdrive	MO-13Z12A-A13	1,350																												
	MO-14Z12A-A14	1,450	15.81	14.62	11.41	8.88	12.33	29	9.59	29	7.44	29	5.78	26	4.57	29	3.55	31	2.70	29	2.10	29	1.63	28	1.27	27	1.00	28	.78	
	MO-15Z12A-A15	1,550																												
	MO-16Z12A-A16	1,650																												

16-Speed ZF-FreedomLine®

Transmission Description	Model Number	Torque Rating lb-ft	Overall Ratio		Rev. L	Rev. H	Ratio and Percent Step																														
			FWD.	REV.			1 %	2 %	3 %	4 %	5 %	6 %	7 %	8 %	9 %	10 %	11 %	12 %	13 %	14 %	15 %	16 %															
16-Speed Overdrive	MO-13Z16A-A13	1,350																																			
	MO-14Z16A-A14	1,450	17.01	15.75	13.07	10.81	14.12	21	11.68	22	9.54	21	7.89	21	6.52	21	5.39	18	4.57	21	3.78	22	3.09	21	2.56	22	2.09	21	1.73	21	1.43	21	1.18	18	1.00	20	0.83
	MO-15Z16A-A15	1,550																																			
	MO-16Z16A-A16	1,650																																			



WARNING

This vehicle is equipped with ZF-FreedomLine® fully-automated manual transmission. The vehicle can roll backward when stopped on a hill or grade, or when the vehicle is starting from a stop on a hill or grade. Serious personal injury and damage to components can result.

WHEN STOPPED ON A HILL OR GRADE: Press the brake pedal to keep the vehicle stationary.

WHEN STARTING FROM A STOP ON A HILL OR GRADE: Quickly move your foot from the brake pedal and firmly press the accelerator pedal.

How to Shift the Transmission

1. Start the engine.
2. Allow air pressure in the system to reach the specified range on the gauge.



WARNING

Do not drive the vehicle with "AL" on the display. Serious personal injury and damage to components can result.

NOTE: When you shift from a forward gear to a reverse gear, or from a reverse gear to a forward gear, you must first shift into Neutral with the vehicle stationary.

Automatic Mode

Switch Between Automatic and Manual Modes

Press and release the FUNCTION button without moving the joystick.

Shift Into Neutral at any Time

Press and release the NEUTRAL button.

To Prevent the Vehicle from Rolling Backward When Stopped on a Hill or Grade

Press the brake pedal to keep the vehicle stationary.



To Prevent the Vehicle from Rolling Backward When Starting from a Stop on a Hill or Grade

Quickly move your foot from the brake pedal and firmly press the accelerator pedal.

Shift Into a Forward Gear from Neutral at a Stop

1. Press and hold the brake pedal.
2. Move the joystick FORWARD.

Adjust the Starting Gear

1. Press and release the FUNCTION button as necessary to switch to manual mode.
2. Move the joystick FORWARD or BACKWARD.
3. Press and release the FUNCTION button to switch back to automatic mode.

Shift Into Low Reverse from Neutral at a Stop

1. Press and hold the brake pedal.
2. Press and hold the FUNCTION button. Move the joystick BACKWARD.
3. Release the FUNCTION button.

Shift Between Reverse Low and Reverse High While the Vehicle is Moving

1. Move the joystick FORWARD to shift from Reverse Low to Reverse High.
2. Move the joystick BACKWARD to shift from Reverse High to Reverse Low.

Upshift and Downshift

The transmission automatically shifts when in forward gears.

Section 2

Operating Guidelines



Manual Mode

Switch Between Manual and Automatic Modes

Press and release the FUNCTION button without moving the joystick.

Shift Into Neutral at any Time

Press and release the NEUTRAL button.

To Prevent the Vehicle from Rolling Backward When Stopped on a Hill or Grade

Press the brake pedal to keep the vehicle stationary.

To Prevent the Vehicle from Rolling Backward When Starting from a Stop on a Hill or Grade

Quickly move your foot from the brake pedal and firmly press the accelerator pedal.

Shift Into a Forward Gear from Neutral at a Stop

1. Press and hold the brake pedal.
2. Move the joystick FORWARD.

Adjust the Starting Gear

1. Press and release the FUNCTION button as necessary to switch to manual mode.
2. Move the joystick FORWARD or BACKWARD.
3. Press and release the FUNCTION button to switch back to automatic mode.

Shift Into Low Reverse from Neutral at a Stop

1. Press and hold the brake pedal.
2. Press and hold the FUNCTION button. Move the joystick BACKWARD.
3. Release the FUNCTION button.



Shift Between Reverse Low and Reverse High While the Vehicle is Moving

Move the joystick FORWARD to shift from Reverse Low to Reverse High.

Move the joystick BACKWARD to shift from Reverse High to Reverse Low.

Shift Between Forward Gears

Upshift One Gear

Move the joystick FORWARD.

Upshift Two Gears

Press and hold the FUNCTION button while you move the joystick FORWARD. Release the FUNCTION button.

Downshift One Gear

Move the joystick BACKWARD.

Downshift Two Gears

Press and hold the FUNCTION button while you move the joystick BACKWARD. Release the FUNCTION button.

Parking a Vehicle



WARNING

You must put the transmission into Neutral and follow the vehicle manufacturer's procedures when you park a vehicle. If the transmission is in gear when you start the vehicle, the vehicle can suddenly move forward. Serious personal injury and damage to components can result.

1. Bring the vehicle to a stop.
2. Apply the parking brake. Refer to the vehicle manufacturer's instructions for the correct procedures.

Drain Moisture from the Air Reservoir Every Day

When you drain moisture from the air reservoir, you help prevent moisture and contaminants from entering the system, which can affect operation and damage components.

Section 2 Operating Guidelines



Remove Axle Shafts When You Tow a Vehicle with the Rear Wheels on the Ground

Remove axle shafts when you tow a vehicle with the rear wheels on the ground. If you do not remove the axle shafts, the towing angle will not allow lubricants to reach the transmission main thrust washers and the axle pinion bearings. Damage to these components will result.

Refer to technical bulletin TP-9579 for complete procedures on how to correctly tow a vehicle. Call ArvinMeritor's Customer Service Center at 866-668-7221 to obtain this publication.

Optional OEM Transmission Temperature Gauge or Optional OEM Transmission Indicator Light



CAUTION

Do not operate the transmission when the optional temperature gauge is in the "WARNING" area, or the optional temperature indicator light comes ON. These are indications that the transmission is overheating. Stop the vehicle. Service the transmission as required to prevent damage to components.

Some vehicles use an optional OEM transmission temperature gauge or an optional OEM transmission indicator light to verify that the transmission is operating within normal temperatures. Refer to the vehicle's operating instructions for more information.

The gauge indicator will be in the "WARNING" area, or the temperature light will come ON when the transmission is overheating.

- **If the transmission is overheating:** Stop the vehicle. Service the transmission as required.

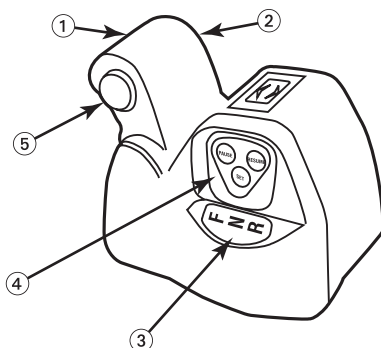


Shift Module and Joystick

The ZF-FreedomLine® transmission's shift module, designed with a joystick, is located next to the driver's seat. The shift module replaces the standard shift lever, shift tower and shift knob. Move the joystick FORWARD to upshift and BACKWARD to downshift (manual mode only).

Shift Module

- ① Joystick
- ② NEUTRAL Button
- ③ Shift Module Display
- ④ Shift-n-Cruise™ Speed Control Buttons
- ⑤ FUNCTION Button



NEUTRAL Button

Press and release the NEUTRAL button at any time to shift into Neutral.

Press and hold the NEUTRAL and FUNCTION buttons at the same time to list active fault codes on the instrument panel display.

Press and hold the NEUTRAL button, FUNCTION button and service brake at the same time to list inactive fault codes on the instrument panel display.

FUNCTION Button

Press and release the FUNCTION button to switch between automatic and manual mode, move into Reverse from a stop, and skip shift (manual mode only).

Press and hold the FUNCTION button and NEUTRAL button at the same time to list active fault codes on the instrument panel display.

Press and hold the FUNCTION button, NEUTRAL button and service brake at the same time to list inactive fault codes on the instrument panel display.



Shift-n-Cruise™ Speed Control Feature



WARNING

Only use the Shift-n-Cruise speed control feature when you operate a vehicle under normal operating conditions. Do not use this feature in heavy traffic or on winding, wet or slippery roads. These conditions can affect cruise control performance, which can result in loss of vehicle control, serious personal injury and damage to components.



CAUTION

Only use your finger to press the Shift-n-Cruise speed control PAUSE, RESUME or SET buttons located on the shift knob. If you use a screwdriver, ballpoint pen or any sharp item, a button can stick in the switch assembly and affect speed control operation. Damage to components can result.

Shift-n-Cruise buttons located on the shift module enable you to easily select speed control functions.

1. Press the SET button to select cruise speed.
2. Press the PAUSE button to temporarily deactivate speed control.
3. Press the RESUME button to return to the speed you selected at SET.



Instrument Panel and Shift Module Displays

NOTE: Refer to System Malfunction Warning in this section for additional information and instructions on how to operate the vehicle if a malfunction occurs in the system.

The instrument panel display illuminates to provide the following operating information:

- System and shift status
- Visual and audio alerts that a system malfunction occurred

Instrument Panel Display

Status	Display
The system is performing a self-check.	CH
The transmission is in Neutral.	N
= Automated mode (example shows 12th gear engaged)	12
No = Manual mode (example shows 12th gear engaged)	12
Reverse Low is engaged.	RL
Reverse High is engaged.	RH
System Malfunction	SM
System air is low.	AL
A clutch overload occurred.	CL
Clutch wear indicator (the clutch requires replacement)	CW
NO DATA (the SAE J1587 info is absent or loss of power to the transmission)	--
The display line between the main transmission control unit (main TCU) and the ZF-FreedomLine transmission electronic controller (ZMTEC) is faulty.	EE
PTO 1 is activated. The transmission is in Neutral.	PN
PTO 1 and 2 are activated. Third gear is engaged as a starting gear.	P3
Neutral Shift Timeout All truck OEMs except Freightliner LLC: The system was designed to react as follows when the vehicle idles for extended periods while in-gear: <ul style="list-style-type: none">• Between 0 and 14 minutes: no outward changes• Between 14 and 15 minutes: "NS" on the display, and you may have an audible alarm depending on vehicle configuration.• 15th minute: Transmission attempts an automated shift to neutral Any changes to service brake, accelerator pedal, gearshift position, etc., reset the timer. Timer was designed to not run during PTO operation or in the event of certain critical faults.	NS



System Malfunction Warning

Status	Instrument Panel Display	Shift Module Display
System Malfunction	SM	Emits a single beep



WARNING

If a system malfunction occurs, the instrument panel display illuminates "SM" for system malfunction, and the shift module emits a single beep. When this warning occurs, you may be unable to shift the transmission. Do not continue to operate the vehicle. Serious personal injury and damage to components can result. Safely move the vehicle to the side of the road and call for assistance.

If a system malfunction occurs, the instrument panel and shift module displays will alert you that the shift controls are not operable.

- The instrument panel display illuminates **SM** for system malfunction.
- The shift module emits a single beep.

What to do if a System Malfunction Occurs

Follow these procedures to move the vehicle to the side of the road and come to a safe stop.

1. Apply the brakes to slow the vehicle. Safely move the vehicle to the side of the road.
2. Stop the vehicle. Apply the parking brake.
3. Call for assistance.



System Self-Check Status

Status	Instrument Panel Display	Shift Module Display
System Self-Check	CH	F, N and R

“CH” will display on the instrument panel while the TCU performs a system self-check. A self-check is performed when the ignition is turned ON. Typically, the self-check continues until the engine is started, but can last longer if the TCU is being powered-up for the first time.

- **If the system self-check continues after the engine is started:**
Contact the ArvinMeritor Customer Service Center at 866-668-7221 and request a transmission specialist.

System Air is Low

Status	Instrument Panel Display	Shift Module Display
System Air is Low	AL	F, N or R



WARNING

If “AL” displays on the instrument panel, the transmission control unit (TCU) has determined that system air pressure is low. Apply the brakes and safely move to the shoulder of the road. Shift into Neutral and idle to allow air pressure to build-up. Do not drive the vehicle with “AL” on the display. Serious personal injury and damage to components can result.

“AL” will display on the instrument panel if the TCU determines that system air pressure is low. Apply the brakes and safely move to the shoulder of the road. Shift into Neutral and idle to allow air pressure to build-up. Do not drive the vehicle with “AL” on the display. Do not turn the ignition OFF with “AL” on the display. The vehicle may shut down in gear and not start until air pressure is built-up again.



Clutch Overload Status

Status	Instrument Panel Display	Shift Module Display
Clutch Overload	CL	F, N or R



WARNING

If “CL” displays on the instrument panel, the transmission control unit (TCU) has determined that the clutch is hot. Apply the brakes and safely move to the shoulder of the road. Shift into Neutral and idle to allow the clutch to cool. Do not drive the vehicle with “CL” on the display. Serious personal injury and damage to components can result.

“CL” will display on the instrument panel if the TCU determines that the clutch is hot. Apply the brakes and safely move to the shoulder of the road. Shift into Neutral and idle to allow the clutch to cool. Do not drive the vehicle with “CL” on the display.

Clutch Wear Warning

Status	Instrument Panel Display	Shift Module Display
Clutch Wear	CW	F, N or R



WARNING

If “CW” displays on the instrument panel, the transmission control unit (TCU) has determined that the clutch is worn. Replace the clutch. Do not drive the vehicle more than 1,000 miles (1610 km) with a worn clutch. Serious personal injury and damage to components can result.

“CW” will display on the instrument panel if the TCU determines that the clutch is worn. Replace the clutch. Do not drive the vehicle more than 1,000 miles (1610 km) with a worn clutch.



Fault Codes

ZF-FreedomLine® transmission control unit (TCU) uses a series of fault codes to identify system malfunctions that the TCU detects and stores into memory.

After you retrieve a fault code from the instrument panel display and identify the fault, use a volt-ohm meter to test the area where the fault code indicates that the malfunction has occurred. An authorized ZF-FreedomLine® distributor or dealer should repair the fault.

How to Retrieve Active and Inactive SAE and ISO Fault Codes from the Instrument Panel Display

NOTE: The vehicle must be stationary to retrieve active fault codes.

1. Park the vehicle and set the parking brake. Turn the engine OFF, but leave the ignition ON. Prepare to record the fault codes before you begin to retrieve them from the instrument panel display.
2. Use the following procedures to retrieve active and inactive SAE and ISO fault codes.

Active SAE and ISO Fault Codes

NOTE: All active fault codes will steadily display for approximately 1-1/2 seconds each. **Ignore fault codes that flash.** When the TCU has listed all active fault codes, the list will repeat.

Shifter	Active SAE Display Codes	Active ISO Display Codes
FreedomLine® Transmission Shifter	Neutral + Function	Neutral + Function + Downshift

1. The TCU will begin to list the active fault codes on the instrument panel display.
2. Record the fault codes.

NOTE: ISO display codes may not be available on vehicles built prior to January 2006.

3. When you're finished retrieving fault codes, release the NEUTRAL and FUNCTION buttons. Turn the ignition OFF.

Section 5

Fault Code Diagnostics



Inactive Fault Codes

NOTE: All inactive fault codes will steadily display for approximately 1-1/2 seconds each. **Ignore fault codes that flash.** When the TCU has listed all inactive fault codes, the list will repeat.

Shifter	Inactive SAE Display Codes	Inactive ISO Display Codes
FreedomLine [®] Transmission Shifter	"With brake pedal depressed" Neutral + Function	"With brake pedal depressed" Neutral + Function + Downshift

1. The TCU will begin to list the inactive fault codes on the instrument panel display.
2. Record the fault codes.

NOTE: ISO display codes may not be available on vehicles built prior to January 2006.

3. When you're finished retrieving fault codes, release the NEUTRAL and FUNCTION buttons, and the service brake. Turn the ignition OFF.

To View Active or Inactive Fault Codes Again

Repeat the previous steps.

How to Clear Inactive Fault Codes from TCU Memory

NOTE: Inactive faults are repaired active faults that have not been cleared from TCU memory.

1. The vehicle must be stationary to clear inactive fault codes. Park the vehicle and set the parking brake. Turn the engine OFF. Turn the ignition OFF.
2. Press and hold the NEUTRAL button and the FUNCTION button at the same time.
3. Turn the ignition ON. **Do not start the engine.** Count to three and release both buttons.
4. Count to three and press and hold the NEUTRAL button and the FUNCTION button at the same time.
5. Turn the ignition OFF. Count to three and release both buttons. The fault codes will be cleared from TCU memory.



Before You Make a Warranty Repair on a ZF-FreedomLine® Transmission

Call ArvinMeritor's Customer Service Center at 866-668-7221 for approval. You'll be asked to provide the transmission's model number, mileage, in-service date, serial number, VIN number and the reason for the repair.

Test and Repair Faults

1. Retrieve the fault codes.
2. Use a Volt-Ohm meter to test the areas where the fault codes indicate that malfunctions have occurred in the system.
 - **Active Faults:** Have a ZF-FreedomLine®-authorized technician repair the fault.
 - **Inactive Faults:** Have a ZF-FreedomLine®-authorized technician verify that the fault was previously repaired. Repair faults, if necessary.
3. Clear all fault codes from TCU memory.

How to Retrieve Active and Inactive SAE and ISO Fault Codes from the Instrument Panel Display Using a Steering Column-Mount Shift Lever

NOTE: The vehicle must be stationary.

1. Park the vehicle and set the parking brake. Turn the engine OFF, but leave the ignition ON. Prepare to record the fault codes before you begin to retrieve them from the instrument panel display.
2. Use the following procedures to retrieve active and inactive SAE and ISO fault codes.

Section 5

Fault Code Diagnostics



Active Fault Codes

NOTE: All active fault codes will steadily display for approximately 1-1/2 seconds each. **Ignore fault codes that flash.** When the TCU has listed all active fault codes, the list will repeat.

Shifter	Active SAE Display Codes	Active ISO Display Codes
Analog Shifter (Freightliner and Sterling Vehicles Only)	Neutral + Manual + Up	Neutral + Manual + Down

1. The TCU will begin to list the active fault codes on the instrument panel display.
2. Record the fault codes. When you're finished, turn the ignition OFF.

NOTE: ISO display codes may not be available on vehicles built prior to January 2006.

- **To view the fault codes again:** Repeat Step 1.

Inactive Fault Codes

NOTE: All inactive fault codes will steadily display for approximately 1-1/2 seconds each. **Ignore fault codes that flash.** When the TCU has listed all active fault codes, the list will repeat.

Shifter	Inactive SAE Display Codes	Inactive ISO Display Codes
Analog Shifter (Freightliner and Sterling Vehicles Only)	"With brake pedal depressed" Neutral + Manual + Up	"With brake pedal depressed" Neutral + Manual + Down

3. The TCU will begin to list the inactive fault codes on the instrument panel display.
4. Record the fault codes. When you're finished, turn the ignition OFF.
 - **To view the fault codes again:** Repeat Step 1.

NOTE: ISO display codes may not be available on vehicles built prior to January 2006.



How to Clear Inactive Fault Codes from the Instrument Panel Display Using a Steering Column-Mount Shift Lever


1. Turn the ignition OFF.
2. Select Neutral and manual mode on the shift lever. Pull and hold the shift lever in the UPSHIFT position.
3. Turn the ignition ON. Wait three seconds. Release the shift lever. Wait three seconds.
4. Pull and hold the lever in the UPSHIFT position.
5. Turn the ignition OFF. Wait three seconds. Release the shift lever.
6. Check that the inactive fault codes have been cleared from the instrument panel display.
 - **If the fault codes have not cleared:** Repeat this procedure.


Section 6 Shift Labels



Shift Labels

1. Refer to the shift label affixed to the sun visor or instrument panel for instructions on how to shift the transmission.
2. If the label is missing or unreadable, call ArvinMeritor Commercial Aftermarket at 888-725-9355 to order a new label. Install the new label in the vehicle.

 WARNING	
<p>This vehicle is equipped with ZF-FreedomLine fully-automated manual transmission. The vehicle can roll BACKWARDS when stopped on a hill or grade, or when starting from a stop on a hill or grade. Serious personal injury and damage to components can result.</p>	
<p>WHEN STOPPED ON A HILL OR GRADE: Press the brake pedal.</p>	
<p>WHEN STARTING FROM A STOP ON A HILL OR GRADE: Quickly move your foot from the brake pedal and firmly press the accelerator pedal.</p>	
<p>For more information, or to order ZF-FreedomLine Operator Manual TP-20170, call ArvinMeritor's Customer Service Center at 866-668-7221.</p>	
Meritor	2297-Z-8346 (03-01)

Operating ZF Meritor LLC's FreedomLine® Automated Transmission	
<p>To Prevent the Vehicle from Rolling BACKWARD on a Hill or Grade At a Stop: Press the brake pedal.</p>	
<p>When Starting from a Stop: Quickly move your foot from the brake pedal and firmly press the accelerator pedal.</p>	
<p>SHIFTING IN AUTOMATIC MODE</p> <p>Shift Into Neutral at any Time: Press and release the NEUTRAL button.</p> <p>Shift Into a Forward Gear from Neutral at a Stop: Press and hold the brake pedal. Move the joystick FORWARD.</p> <p>Shift Into Reverse from Neutral at a Stop: Press and hold the brake pedal. Press and hold the FUNCTION button. Move the joystick BACKWARD. Release the FUNCTION button.</p> 	<p>SHIFTING IN MANUAL MODE</p> <p>Shift Into Neutral at any Time: Press and release the NEUTRAL button.</p> <p>Shift Into a Forward Gear from Neutral at a Stop: Press and hold the brake pedal. Move the joystick FORWARD.</p> <p>Shift Into Reverse from Neutral at a Stop: Same as automatic mode.</p> <p>Upshift One Gear: Move the joystick FORWARD.</p> <p>Downshift One Gear: Move the joystick BACKWARD.</p> <p>Skip Shift: Press the FUNCTION button while moving the joystick.</p> <p><small>Also refer to FreedomLine Operator Manual TP-20170.</small></p>
	<small>2297-M-8463</small>



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Printed in the USA

Revised XX-07
16579/22882