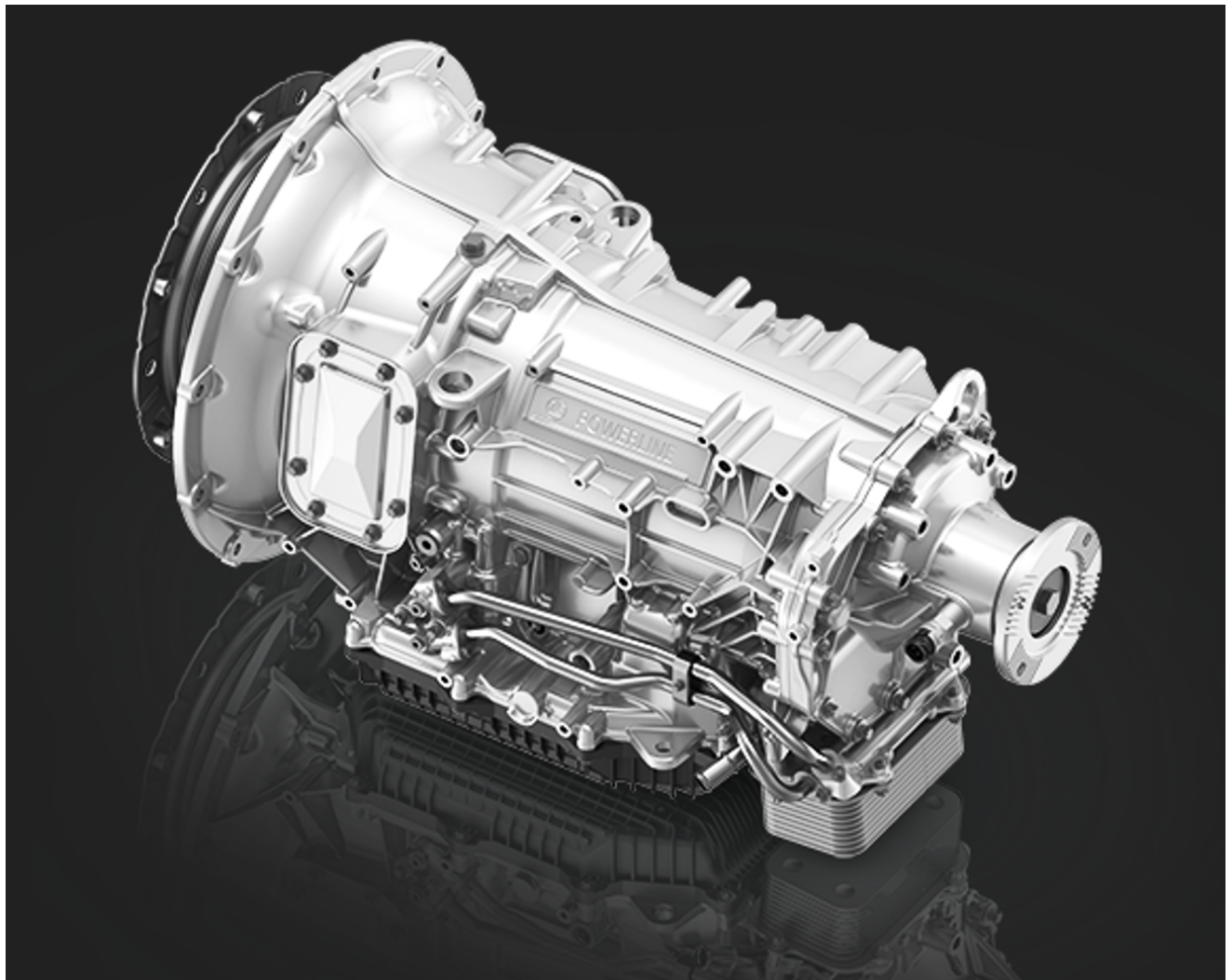


ZF PowerLine Automatic Transmission Operator Guide



13 Operation

13.1 Information on operation

This chapter uses an example describing operation with a ZF rotary range selector.

- Depending on the manufacturer and vehicle type, the control elements and operating processes may deviate from those in this manual.
- Please observe the operating instructions provided by the vehicle manufacturer.

Observe the following:

- The vehicle must not be left with the engine running and a gear selected.
- If there is no engine function, steering servo and engine brake do not function and gears cannot be selected.
- Apply the service brake until the vehicle is slowed down to a standstill. Engage the parking brake before leaving the vehicle.
- The control unit determines the shift points at which gear changes are performed.

WARNING

Risk of accident due to loss of the braking effect of the engine.

Death or serious injury possible.

⇒ Shift the range selector to neutral position [N] only when vehicle is in stationary position.

If Neutral [N] is selected at the range selector while driving, the power flow between engine and transmission will be interrupted. This will result in a loss of the braking effect of the engine.

WARNING


Risk of accident due to loss of the braking effect of the engine.

Death or serious injury possible.

⇒ Apply the service brake.

⇒ Bring the vehicle to a complete standstill.

In the event of a power failure or faults in the control unit, the transmission automatically shifts to Neutral.

-  • For optimal shift comfort, the transmission software needs to teach itself in. The teach-in process for the transmission software (adaption) is performed autonomously during normal vehicle operation in new vehicles. With new vehicles, it may be that the teach-in process for the transmission software has not yet been fully completed and optimal shifting comfort is only reached after a short period of use.
- The adaption will not be carried out if transmission-side power take-offs are mounted on the transmission. Instead, a standstill adaptation due to torque errors of the power take-offs must be carried out by the vehicle manufacturer, bodybuilder or retrofitter.

13.2 Starting the engine

Requirements:

- Observe ambient temperature (*refer to Section Starting the vehicle at low temperatures*).
- Vehicle in stationary position.

! WARNING

Risk of accident due to unintended motion of the vehicle.

Death or serious injury possible.

⇒ Engage the parking brake or service brake.

NOTICE

Possible material damage to transmission due to jump start with battery jumper cable.

⇒ Connect the battery jumper cable to the battery as specified.

⇒ Use buffered jump-start devices or connect a powerful battery in parallel.

1. Engage service brake and, as an option, parking brake.

2. Set the range selector to neutral position [N].



- Vehicle with starter inhibitor: If the range selector is not in neutral position [N], the engine does not start. For details, please consult the vehicle operating instructions.
- Vehicle without starter inhibitor: If the range selector is not in neutral position [N] when the engine is started, the display in the driver information system will start flashing and the transmission will remain in neutral. In order to launch the vehicle, set the range selector to neutral position [N], then select the desired direction of travel [D] or [R].

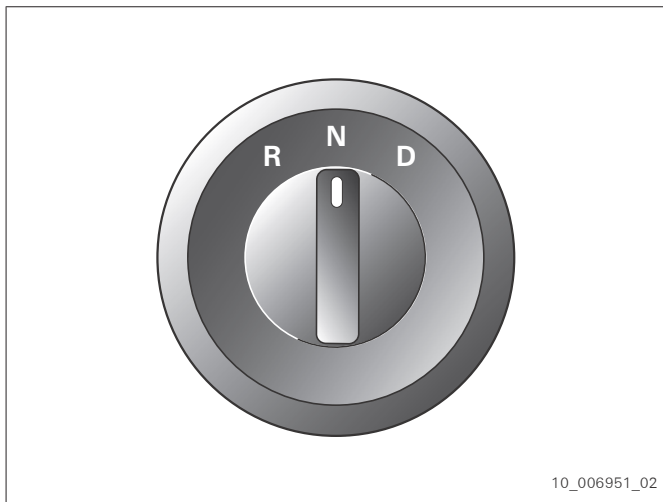


Fig. 86

3. Switch on ignition.

→ Shift system self-check.

→ The self-check of the shift system is completed when [N] is displayed in the driver-information system.

→ Transmission is in neutral position.



Shifting is not possible when engine is switched off.

4. Start engine.

13.3 Launching

Observe the vehicle manufacturer specifications.

Requirements:

- Oil temperature in transmission sump above -20°C .
- The vehicle is stationary.
- Engine is running.

CAUTION


Risk of accident due to unintended rolling of the vehicle.

Slight to moderate injury possible.

⇒ Only release brake when setting off.

1. Apply the service brake.
2. Move the range selector from neutral position [N] to position [D] or [R].
 - Automatic mode is activated.
 - The driver-information system displays the engaged starting gear. The shift system will select the starting gear.
3. Actuate the accelerator pedal and release the service brake and/or the parking brake at the same time.

Depending on the vehicle configuration and loading condition, the vehicle may start at a low speed on a level track or on a slight uphill gradient after the service brake and/or the parking brake are released. A lower driving speed is achieved through actuation of the service brake.

 Launching after long downtime:

 - Depending on the downtime and the ambient temperature, launching may be delayed by up to 30 seconds.

13.4 Hill starting

During hill starting, ensure that the vehicle does not roll forward or backward unintentionally.

Requirements:

- Parking brake is actuated.

WARNING

Risk of accident due to unintended motion of the vehicle.

Death or serious injury possible.

⇒ When you feel propulsion of the vehicle in the direction of travel, release the parking brake.

WARNING

Risk of accident due to unintended motion of the vehicle.

Death or serious injury possible.

⇒ Always start with utmost caution when setting off near persons or obstacles.

⇒ Carefully actuate the accelerator pedal.

NOTICE

Damage at transmission possible due to setting off with actuated parking brake and/or service brake.

⇒ When you feel propulsion of the vehicle in the direction of travel, release the parking brake and service brake.

⇒ Launch with an engaged parking brake and/or service brake for a maximum of 5 seconds.

1. Move the range selector to position [D] or [R].
2. Actuate accelerator pedal.
3. As soon as propulsion is available, release the parking brake.

13.5 Rolling off on downhill gradients

- If the preselected direction of travel and the running direction of the vehicle do not match, the engine may stall. Driver information can be output, e.g., via diagnosis, buzzer control or the driver information system.
- When the vehicle moves off without a selected direction of travel – with the range selector in [N] – no engine braking effect is available.

Requirements:

- Engine is running.
- Do not allow the vehicle to roll in the opposite direction to the selected direction of travel.

WARNING

Risk of accident due to unintended motion of the vehicle.

Death or serious injury possible.

⇒ Engage the parking brake or service brake.

1. Set the direction of travel [D] or [R] on the range selector in accordance with the running direction.

2. Release the parking brake or service brake.

→ The vehicle will start to move without the driver having to actuate the accelerator pedal, if the preselected direction of travel matches the running direction of the vehicle.



If the vehicle rolls forward (transmission in neutral position) once the brake has been released and the driver shifts from [N] to [D], the transmission system selects a gear appropriate for the driving speed. The driveline is thus closed.

13.6 Changing the direction of travel

Change the direction of travel by changing the range selector position only when the vehicle is stationary, otherwise the transmission will shift into Neutral.

1. Bring the vehicle to a complete stop.

- 2.

WARNING

Risk of accident due to unintended motion of the vehicle.

Death or serious injury possible.

⇒ Engage the parking brake or service brake.

Engage the parking brake or service brake in neutral position.

3. Set the direction of travel [D] or [R] on the range selector in accordance with the running direction.



The display is definitive for the direction of travel selected in the transmission.

13.7 Engine brake

WARNING

Risk of accident due to unintentional acceleration of the vehicle.

Death or serious injury possible.

⇒ Apply the service brake.

The vehicle may accelerate when traveling downhill.

If necessary, actuate the service brake.

By activating the engine brake, the transmission system shifts down until maximum braking torque is reached.

13.8 Shifting the transmission

Upshifts and downshifts are carried out automatically and depend on the following factors:

- Driving resistance
- Loading
- Position of accelerator pedal
- Speed
- Engine speed
- Engine brake

The engaged gear will show up in the driver-information system, depending on the manufacturer.

13.9 Stopping

The vehicle can be stopped at any time through activation of the service brake, irrespective of the position of the range selector.

Owing to the propulsion of the converter, the vehicle may respond as follows:

- The vehicle may come to a standstill on a slight uphill gradient even without brake actuation.
- After stopping, the vehicle may start moving unintentionally, even without actuation of the accelerator pedal, if the brake is not engaged.

WARNING

Risk of accident due to unintended motion of the vehicle.

Death or serious injury possible.

⇒ Engage the parking brake or service brake.

1. Engage the parking brake or service brake.

2. In case of prolonged stops, set the range selector to position [N].



The electronic control unit will automatically set the transmission to neutral if the following conditions prevail simultaneously:

- Vehicle approaching standstill
- Parking brake or service brake is engaged.
- Accelerator pedal is not actuated.

The last direction of travel selected at the range selector will remain active. As soon as one of the three conditions no longer prevails, the appropriate starting gear will be engaged.



Observe the following:

- Always engage the parking brake or service brake when vehicle is stationary.
- When the vehicle is stationary with the engine running and a direction of travel selected, all you have to do to launch the vehicle is press the accelerator pedal.

- Before leaving the vehicle with the engine running, the transmission must be shifted into neutral and the parking brake engaged. The range selector position [N] must match with the display in the driver information system.
- Engaging the parking brake during travel and on a smooth surface may bring the engine to a standstill. Steering assistance is then no longer available.

13.10 Parking

When the vehicle is stationary, there is no direct connection between the engine and axle (transmission in neutral position [N]). Always engage the parking brake before leaving the vehicle. This also applies to workshop operation (vehicle lift).

WARNING

Risk of accident due to unintended motion of the vehicle.


Death or serious injury possible.

⇒ Engage parking brake.

1. Engage parking brake.
2. Set the range selector to neutral position [N].

13.11 Parking lock

The transmission is optionally available with a parking lock. Requirements have to be agreed with ZF.

 The parking lock is engaged and the emergency release is vehicle-specific and can be found in the vehicle manufacturer's operating concept and operating instructions.

If a manually operated transfer case has been installed, observe the following:

- The parking lock is only effective in the high range mode of the transfer case.
- In order to prevent damage to the transmission, the parking lock must only be activated in the high range mode of the transfer case.

For emergency release of the parking lock, please observe the instructions of the vehicle manufacturer.

Driver warning

It is forbidden to deactivate the driver warning (e.g., by a specialist workshop).

Observe the following points:

- Driver warning, e.g., acoustic and optical signal must be installed in the vehicle by the vehicle manufacturer.
- Design of the acoustic and visual signals (text, symbol) in the on-board computer system depends on the vehicle manufacturer.


- The driver warning must be active if the driver opens the door and the parking brake or parking lock is not engaged.

13.12 Tow starting

The engine cannot be started by tow starting the vehicle.


13.13 Towing

13.13.1 Towing a vehicle with engine switched on


 When towing, observe the vehicle manufacturer's instructions.

The following conditions must be fulfilled when towing a vehicle with the engine switched on:

- Parking lock disengaged. For emergency release of the parking lock, please observe the instructions of the vehicle manufacturer.
- Engine runs at idling speed.
- Range selector is set to Neutral [N].
- Maximum towing time: no limit
- Maximum towing speed:
 - For ambient temperature above -15°C: no limit
 - For ambient temperature below -15°C: at most 5 km/h

 If transmission damage is suspected (e.g., parking lock cannot be disengaged), the driveline must be disconnected between the transmission and the wheels of the vehicle (*refer to Section Towing a vehicle in case of suspected transmission damage*).

13.13.2 Towing a vehicle with engine switched off

 When towing, observe the vehicle manufacturer's instructions.

Towing the vehicle with a flange-mounted universal shaft or axle half shaft is permitted under the following conditions:

- Parking lock disengaged. For emergency release of the parking lock, please observe the instructions of the vehicle manufacturer.
- Towing distance of at most 100 km
- Max. towing time: 2 hours
- The maximum permissible towing speed is to be determined depending on the rear-axle ratio and the tire size as per the diagram. In addition, the maximum permissible towing speeds determined by local legislation must also be observed.

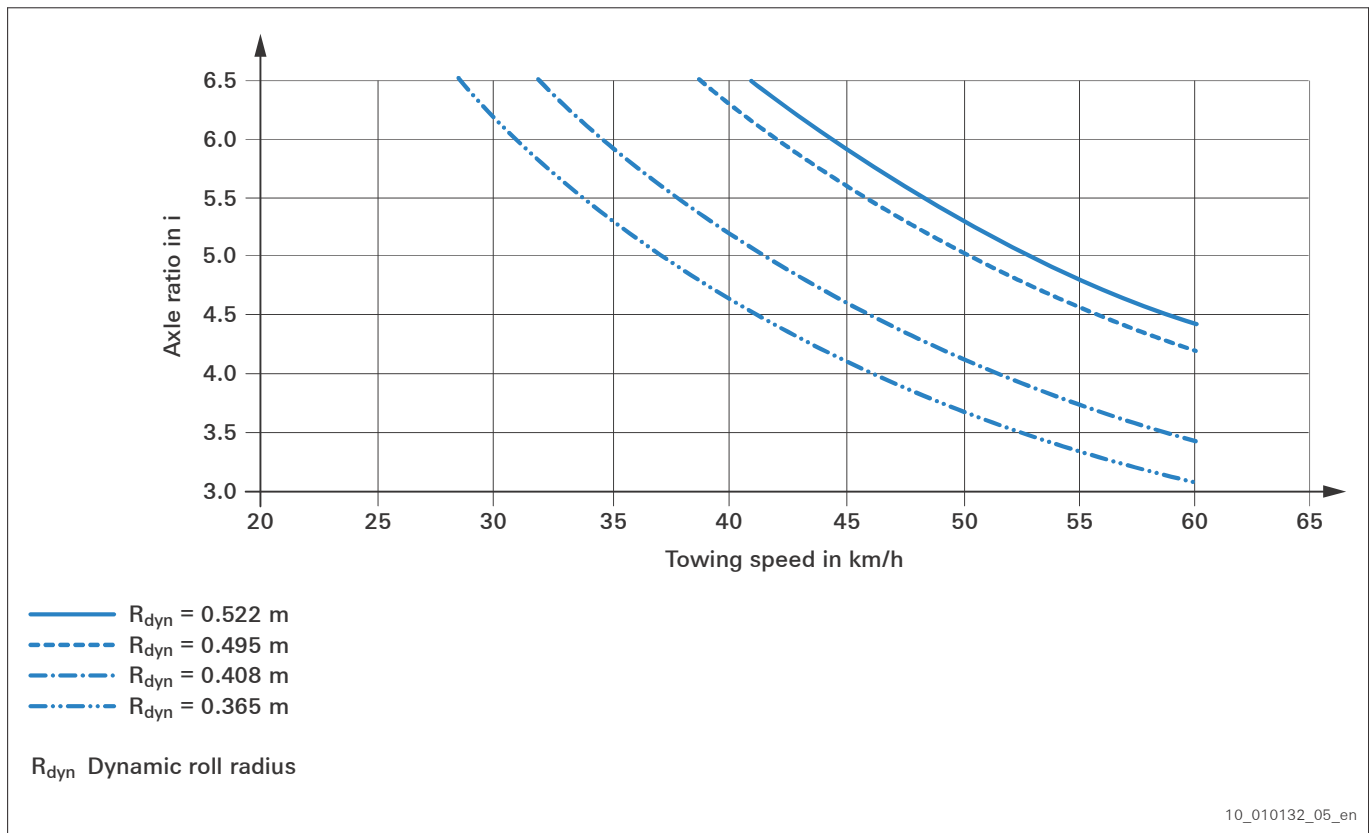


Fig. 87 Towing time

The operator is responsible for ensuring that the required conditions are met for towing with flange-mounted universal shafts or axle half shafts.

If the vehicle is towed with disconnected axle half shafts, environmental damage due to possible oil loss must be avoided.

i If transmission damage is suspected (e.g., parking lock cannot be disengaged), the driveline must be disconnected between the transmission and the wheels of the vehicle (*refer to Section Towing a vehicle in case of suspected transmission damage*).

13.13.3 Towing in case of suspected transmission damage

i When towing, observe the vehicle manufacturer's instructions.

i Transmission lubrication is not ensured if the engine is not running.

NOTICE

Towing a vehicle with the driveline connected may cause damage to the transmission.

- ⇒ Before towing the vehicle, please make sure that the drive wheels are not in contact with the road.
- ⇒ You can also remove the universal shaft or the floating axles as an alternative.

The following conditions must be fulfilled when towing a vehicle with suspected transmission damage (e.g., parking lock cannot be disengaged):

- Transmission is in neutral position [N].
- Remove the universal shafts or the axle half shafts of the driven axle or make sure the drive wheels are not in contact with the road.

If the vehicle is towed with disconnected axle half shafts, environmental damage due to possible oil loss must be avoided.

13.14 Operation with clutch-dependent PTO



Observe accountability (*refer to Section Retrofitting of the power take-off*).

- The PTO functionality must be coordinated between the vehicle manufacturer, bodybuilder or retrofitter and ZF (*refer to Section PTO*).
- Control element and operation depend upon vehicle manufacturer and vehicle type.
- The vehicle manufacturer is responsible for specifying the PTO operation in the vehicle operating instructions.

13.15 Temperature monitoring

Temperatures are monitored by the Mechatronic in the transmission and communicated to the vehicle's control unit via [CAN](#).

Automated functions when the monitored temperatures are approached or exceeded

- For display of warnings (vehicle-dependent), please consult the vehicle operating instructions.

Actions to be taken by the driver when a temperature warning is displayed

- Drive at partial load

If the temperature warning is still displayed once the actions have been performed, execute the following additional steps:

- Stop the vehicle.
- Shift the range selector to neutral position [N]
- Let engine run at increased speed.

If the temperature warning is still displayed, the following causes are possible:

- Oil level too low
- Oil level too high
- Heat exchanger of the vehicle dirty
- Cooling circuit of the vehicle defective
- Transmission damage

Inform ZF Aftermarket if required.

13.16 Roller test bench

WARNING

Risk of accident due to unintended motion of the vehicle.

Death or serious injury possible.

⇒ Engage the parking brake or service brake.

The vehicle may leave the rollers even if the accelerator is not depressed.

Observe the following points:

- Once you have driven the vehicle onto a roller test bench (brake test bench), shift the range selector into neutral position [N].
- When the rollers are running, the transmission system recognizes the [driving vehicle] function. If a gear is engaged, the torque converter will close.
- When the rollers are running, the reverse gear cannot be selected.
- The transmission requires information on the driving speed from the front wheels. If this information is missing, the transmission will remain in the same gear. All tests with vehicle speed information missing must therefore be carried out on an approved test track, for example.

13.17 Status monitoring and warning lamps

13.17.1 Warning lamp

Errors are indicated via the driver information system, for example by the following warning messages:

- Illuminated warning lamps (red or yellow)
- Warnings in the driver-information system

For details, please consult the vehicle operating instructions.

13.17.2 Status monitoring

The electronic control unit's diagnosis system monitors the transmission in the following situations:

- Whenever the vehicle system voltage is switched on
- During operation

13.18 System failures

13.18.1 Transmission system failure

System failures are indicated via the driver information system depending on their error classes.

Error class 1, unrestricted operation is possible:

- No error display
- Entry in fault memory
- Reduced driving comfort possible
- Rectify the error during the next workshop visit.

Error class 2, restricted operation is possible:

- Error display, e.g. yellow warning lamp or wrench icon
- Entry in fault memory
- Reduced driving comfort
- The launching and maneuvering performance may deteriorate
- Increased shift times possible
- Possible limitation of gears available
- Visit specialist workshop.

Error class 3, no further operation is possible:

- Error display, e.g. red warning lamp or stop icon
- Entry in fault memory
- The transmission response depends on the error. Very limited or no response to gear request. A condition may be reached in which shifting is no longer possible and the gear selected before is retained. The transmission control will attempt to enable selection of the starting gear and neutral so that the hazard area can be evacuated.
- Contact nearest specialist workshop.

13.19 Transmission response to a malfunction

WARNING

Risk of accident due to limited system monitoring in the event of transmission system malfunctions. Death or serious injury possible.

- ⇒ Pay attention to information from the driver-information system.
- ⇒ Contact ZF Aftermarket.

NOTICE

Possible material damage to the transmission due to transmission system malfunctions.

- ⇒ Pay attention to information from the driver-information system.
- ⇒ Contact ZF Aftermarket.

To protect the transmission in the event of a malfunction, the following transmission responses are provided:


- Shifting to neutral
In the event of serious malfunctions in the transmission's voltage supply, e.g., a short circuit.
- Switching to emergency operation mode


If there is an interruption of CAN communication or a loss of speed information.
Depending on the fault prevailing, limitations may occur during emergency operation.

13.20 Application at low temperatures

13.20.1 Starting the vehicle at low temperatures

Heating-up and warm-up phase of the transmission at low temperatures

 Depending on the downtime and the previous development of the ambient temperature, the oil temperature in the transmission sump may be higher or lower than the current ambient temperature.

 WARNING

**Risk of accident due to unintended rolling of the vehicle.
Death or serious injury possible.**

- ⇒ Engage parking brake.
- ⇒ Shift transmission to neutral (N).
- ⇒ Secure vehicle with chocks.

External temperature	Motor start	Observe when starting	Restrictions
warmer than -20°C	permitted	At temperatures down to -20°C, the transmission is operable and all functions are provided.	Longer shifting times are to be expected at temperatures around -20°C.
between -20°C and -30°C	permitted	Warm-up phase of at least 10 minutes, with an increased idle speed between 1,200 rpm and 1,500 rpm, transmission in neutral position.	During the warm-up phase, the control unit will activate several functional restrictions (maintaining neutral position despite selected speed range via range selector, limitation of speed and torque).
between -30°C and -40°C	Transmission must be preheated before the engine is started	Preheating can be done with hot air, for example, which must not exceed 130°C at the transmission. Do not apply heat directly to the transmission, around the Mechatronics, the cabling and the sensors.	

Tab. 35 Starting the vehicle at low temperatures

17 Initial Operation

- Initial operation of the ZF product
- Resuming operation of the ZF product after a prolonged downtime
- Resuming operation of the ZF product after repair

17.1 Before initial operation

For initial start-up, restart after repair

Perform before start-up of the vehicle:

- If the transmission is filled, check the oil level after starting the engine (*refer to Section Checking oil level after engine start*).
- If the transmission is unfilled, fill it up with oil (*refer to section Filling oil*).
- Start-up of the power take-off: The vehicle manufacturer, bodybuilder or retrofitter is accountable for the specifications regarding start-up of the power take-off.

After short-term storage for up to 6 months

Perform before start-up of the vehicle:

- Remove the preservative oil from any metallic bare surfaces.
- Check the oil level after starting the engine: (*refer to Section Checking oil level after engine start*).
- Start-up of the power take-off: The vehicle manufacturer, bodybuilder or retrofitter is accountable for the specifications regarding start-up of the power take-off.

After long-term storage for up to 24 months

Perform before start-up of the vehicle:

- Remove the preservative oil from any metallic bare surfaces.
- Remove screw plug from the bore for the plug-in coupling (breather). Screw in and tighten the plug-in coupling (breather).
Tightening torque: **10 Nm**
- Drain the oil for version with standard oil drain (*refer to Section Draining oil for version with standard oil drain*).
- Fill up with oil (*refer to Section Filling oil*).
- Completely fill the oil/coolant heat exchanger with coolant in accordance with the vehicle manufacturer's specifications. The composition of the coolant specified by the vehicle manufacturer must be adhered to. For details, please consult the vehicle operating instructions.
- Start-up of the power take-off: The vehicle manufacturer, bodybuilder or retrofitter is accountable for the specifications regarding start-up of the power take-off.

After long-term storage for up to 48 months

Perform before start-up of the vehicle:

- Remove the preservative oil from any metallic bare surfaces.
- Remove screw plug from the bore for the plug-in coupling (breather). Screw in and tighten the plug-in coupling (breather).
Tightening torque: **10 Nm**

- Drain the oil for version with standard oil drain (*refer to Section Draining oil for version with standard oil drain*).
- Fill up with oil (*refer to Section Filling oil*).
- Completely fill the oil/coolant heat exchanger with coolant in accordance with the vehicle manufacturer's specifications. The composition of the coolant specified by the vehicle manufacturer must be adhered to. For details, please consult the vehicle operating instructions.
- Start-up of the power take-off: The vehicle manufacturer, bodybuilder or retrofitter is accountable for the specifications regarding start-up of the power take-off.

After long-term storage for more than 48 months

- ZF recommends complete disassembly, remanufacturing and modernization of the transmission after consultation with ZF.
- Start-up of the power take-off: The vehicle manufacturer, bodybuilder or retrofitter is accountable for the specifications regarding start-up of the power take-off.