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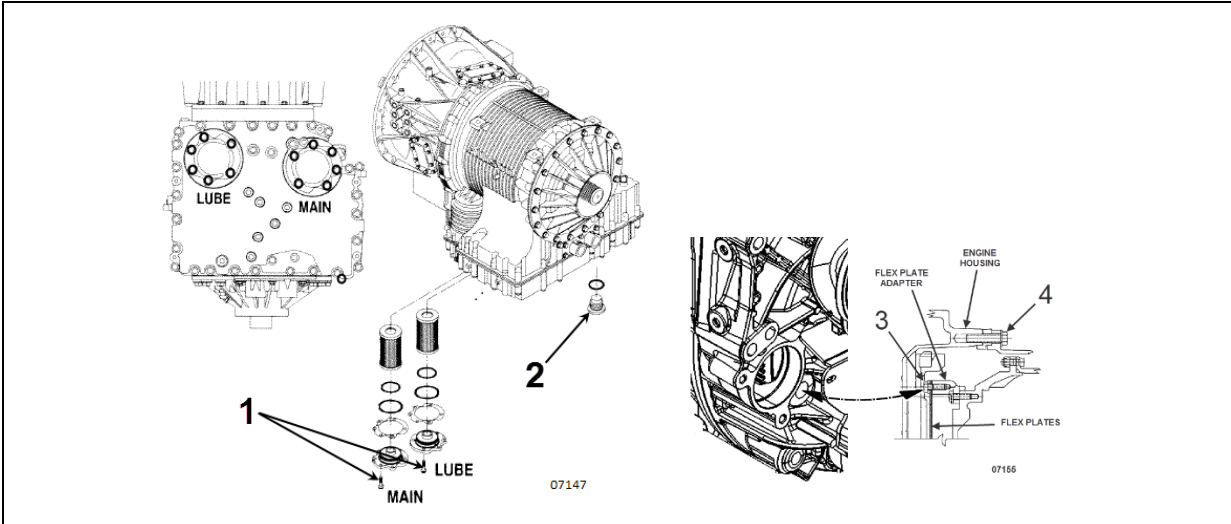
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**SECTION CHANGE LOG**

| DESCRIPTION |  | DATE |
|-------------|--|------|
| 1           |  |      |
| 2           |  |      |
| 3           |  |      |
| 4           |  |      |
| 5           |  |      |
| 6           |  |      |

**1. TORQUE TABLES**

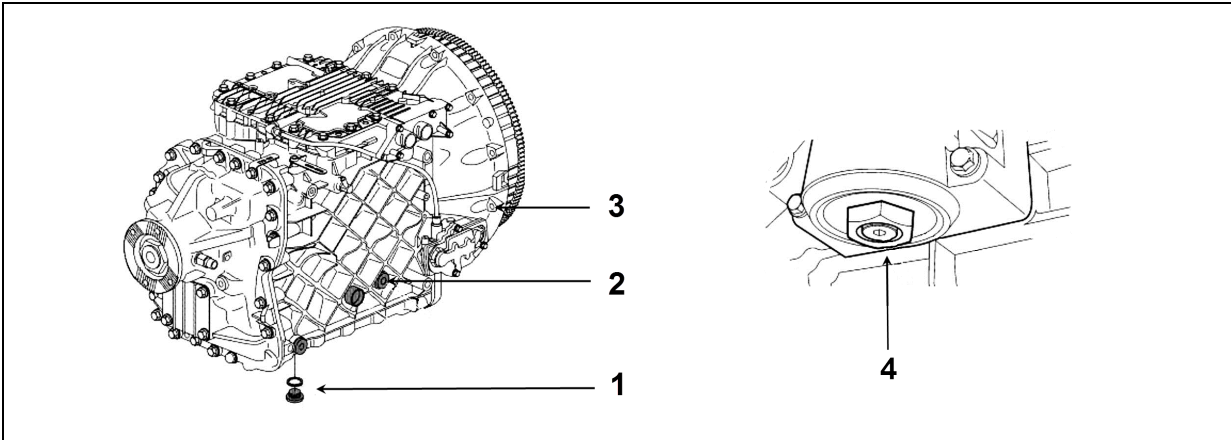
**1.1 ALLISON TRANSMISSION**



**ALLISON TRANSMISSION**

| No | DESCRIPTION                                   | TORQUE                 |
|----|---|------------------------|
| 1  | Lube and main filter cover bolts              | 38-45 lb-ft (52-61 Nm) |
| 2  | Drain Plug                                    | 18-24 lb-ft (24-33 Nm) |
| 3  | Flex plate screws                             | 24-30 lb-ft (33-41 Nm) |
| 4  | Transmission housing screws to engine housing | 46-50 lb-ft (62-68 Nm) |

1.2 VOLVO I-SHIFT TRANSMISSION



| <b>VOLVO I-SHIFT TRANSMISSION</b> |                              |                        |
|-----------------------------------|------------------------------|------------------------|
| <b>No</b>                         | <b>DESCRIPTION</b>           | <b>TORQUE</b>          |
| 1                                 | Oil drain plug               | 18-24 lb-ft (24-33 Nm) |
| 2                                 | Oil fill plug                | 22-30 lb-ft (30-41 Nm) |
| 3                                 | Transmission mounting screws | 66 lb-ft (89 Nm)       |
| 4                                 | Filter housing drain plug    | 11-13 lb-ft (15-18 Nm) |

## 2. DESCRIPTION

H3 and X3 Series vehicles may be provided with either an Allison automatic transmission or a Volvo I-Shift transmission.

### 2.1 ALLISON AUTOMATIC TRANSMISSION

The Series 4000 Allison Transmission has 6 speeds with two top range (fifth and sixth) overdrives.

Two variants are available: **B500** for commercially operated highway coaches and **4000MH** for private use motorhomes.

An electronic control allows the transmission to shift at exactly the right point on the engine's fuel consumption curve for best economy. Early lockup maintains the highest possible mechanical efficiency through the closely-spaced gear steps, culminating in two overdrive ratios. This combination allows progressive shifting techniques, where engine speeds are reduced for higher efficiency and lower fuel consumption.

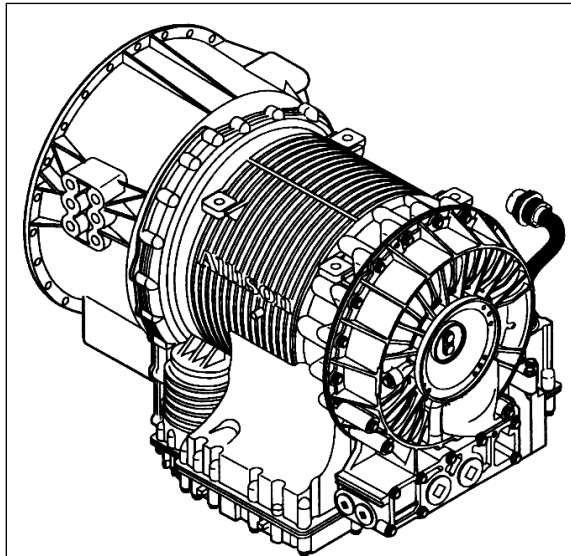


FIGURE 1: ALLISON TRANSMISSION (07075)

Gear selection and torque converter modes are controlled by a microcomputer-based electronic transmission management system. It is fed information regarding throttle position, operator range selection, engine speed, turbine speed, transmission output speed and various system pressures from special electronic sensors. With this information, it computes shift points and clutch pressures to meet immediate needs. Using closed loop adaptive logic, the electronic control looks at a number of parameters during the shift,

and makes minute adjustments to match the shift to desired profile stored in its memory. It then looks at these adjustments and resets the parameters, which allow the transmission to quickly compensate for variations in load, terrain or environment and to adjust for clutch wear and engine power changes. A Diagnostic Data Reader can be connected to the electronic control unit to provide a self-check of all systems in the transmission. Five-digit trouble codes greatly reduce the time it takes to pinpoint potential problems. (Refer to paragraph 6 "allison transmission TROUBLESHOOTING" in this section).

#### 2.1.1 Retarder

This optional auxiliary braking device for the automatic transmission is integrated into the basic envelope of the transmission and transmits its braking force directly to the propeller shaft. It requires no additional length and adds only 75 pounds (34 kg) of weight. Operation of the retarder is controlled electronically by the driver's use of the brake and/or by hand control lever.

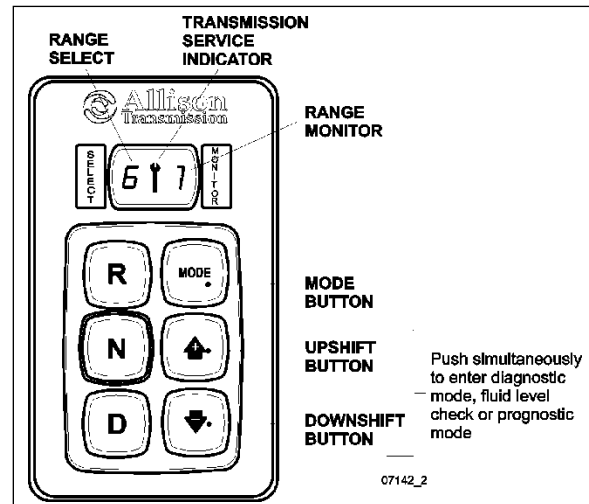


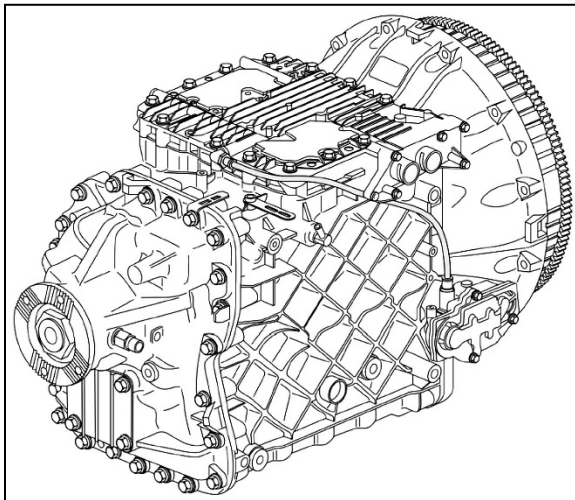
FIGURE 2: ALLISON PUSHBUTTON SHIFT SELECTOR

When activated, fluid enters a cavity and provides resistance to the turning of rotor blades revolving with the output shaft. This effectively slows the vehicle to the point where the service brakes are needed only for final stopping. The retarder is fully modulated and is compatible with ABS.

### 2.2 VOLVO I-SHIFT TRANSMISSION

The Volvo I-Shift transmission is a single countershaft transmission with 12 forward gears and two reverse gears. The I-Shift is an automated mechanical transmission.

If the I-Shift transmission system is to be used, the vehicle must have an electronic engine control unit as well as CAN communication. Since the clutch is automated (clutch pedal no longer fitted), the driver no longer has to activate the clutch.



**FIGURE 3: VOLVO I-SHIFT TRANSMISSION**

The transmitted torque (both engine and braking) will be interrupted during gear shifting, in both driving and coasting conditions. There is no clutch pedal and the gear shifting is controlled by the transmission or the driver through the pushbutton shift selector.

When in fully automatic mode, gears are selected and shifts made by the electronic control unit. The driver can still intervene if he wishes to. All system functions required are shown on the display, e.g. neutral, gear change, clutch overload and diagnosis information.

### 3. ALLISON TRANSMISSION MAINTENANCE

#### 3.1 MANUAL FLUID LEVEL CHECK

Take note that an oil level sensor (OLS) is standard in your transmission. With the OLS and Allison 6th generation shift selector, you can get a more accurate electronic fluid level check than with a dipstick.

To gain access to the dipstick, open the engine compartment rear door; dipstick is located on the radiator side of the engine (Figure 4).

Clean all dirt from around the end of the oil filler tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the oil

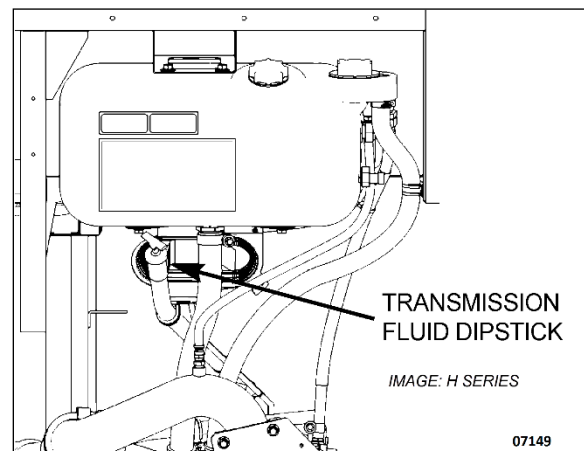
system since it will cause valves to stick, undue wear of transmission parts, and clogged passages. Check the oil level using the procedures in Cold Check and Hot Check. Record any abnormal level on your "Maintenance Records".



### WARNING

When checking the oil level, be sure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are chocked. Unexpected and possible sudden vehicle movement may occur if these precautions are not taken.

- Special care must be taken not to touch the engine coolant tubing and/or exhaust pipe, since this could cause severe burns.
- Do not wear loose clothing and, stay away from rotating parts during procedure; personal injury could occur.



**FIGURE 4: OIL LEVEL DIPSTICK (ALLISON)**

Always check the oil level reading at least twice when the engine is running. Consistency is important in maintaining the accuracy of the reading. If inconsistent readings persist, check the transmission breather to ensure it is clean and free of debris.

#### 3.1.1 Cold Check

The purpose of the **Cold Check** is to determine if the transmission has enough fluid to be operated safely until a **Hot Check** can be made.

**CAUTION**

The oil level rises as sump temperature increases. **DO NOT** fill above the Cold Run band if the transmission oil is below normal operating temperature. During operation, an overfull transmission can become overheated, leading to transmission damage.

1. Move the vehicle to a level surface, put transmission in «N» (Neutral), and set the parking brake.
2. With the engine idling (500 - 800 rpm), shift to «D» (Drive) and then shift to «R» (Reverse) to clear the hydraulic system of air.
3. Run the engine at idle in «N» (Neutral) for about one minute.
4. While the engine is running, remove the dipstick from the tube and wipe it clean (Figure 4). Insert the dipstick into the fill tube, pushing down until it stops.
5. Remove the dipstick and observe the fluid level. Repeat the check procedure to verify the reading. If the fluid on the dipstick is within the COLD CHECK band, the level is satisfactory for operating the transmission until the oil is hot enough to perform a **Hot Check**. If the fluid level **is not** within this band, add or drain fluid as necessary to bring the level within the COLD CHECK band.
6. Perform a **Hot Check** at the first opportunity after the normal operating temperature of 160°F to 200°F (71°C to 93°C) is attained.

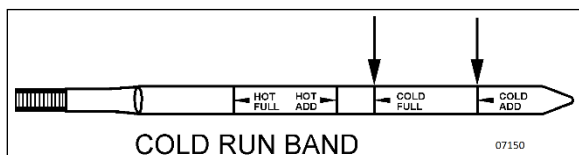


FIGURE 5: COLD CHECK

**CAUTION**

**DO NOT** operate the transmission for extended periods of time until a **Hot Check** has verified proper fluid level. Transmission damage can result from extended operation at improper fluid level conditions.

**CAUTION**

Obtain an accurate fluid level by imposing the following conditions:

- Engine is idling (500-800 rpm) in «N» (Neutral).
- Transmission fluid is at normal operating temperature.
- The vehicle is on a level surface.

## 3.1.2 Hot Check

To perform a **Hot Check**, do the following:

1. The **Hot Check** can be performed when the transmission oil reaches the normal operating temperature (160°F to 200°F / 71°C to 93°C). The transmission oil temperature can be checked with the Driver Information Display (DID) when selecting the Gauge menu (refer to the "Operator's Manual" for added information).

**CAUTION**

The oil **must be hot** to obtain an accurate check because the fluid level rises as temperature increases.

2. Park the vehicle on a level surface and shift to «N» (Neutral). Apply the parking brake and allow the engine to idle (500 - 800 rpm).
3. Remove the dipstick from the tube and wipe it clean. Insert the dipstick into the fill tube, pushing down until it stops.
4. Remove the dipstick and observe the fluid level. The safe operating level is anywhere within the HOT RUN band on the dipstick. Repeat the check procedure to verify the reading.
5. If the level **is not** within this band, add or drain fluid as necessary to bring the level within the HOT RUN band.
6. Be sure fluid level checks are consistent. Check level more than once and if readings are not consistent, check to be sure the transmission breather is clean and not clogged. If readings are still not consistent, contact your nearest Allison dealer or distributor.



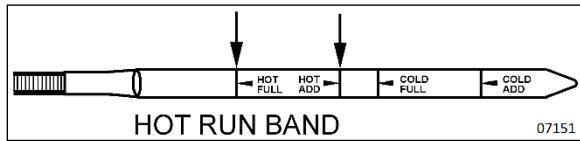


FIGURE 6: HOT CHECK

**NOTE**  
 The Cold Check is more appropriate for verifying the oil level after the first fill-up. In case of conflict, the Hot Check has priority over the Cold Check; the fluid level check using the pushbutton shift selector has priority over the Hot Check.

3.2 FLUID LEVEL CHECK USING THE PUSHBUTTON SHIFT SELECTOR

The oil level sensor (OLS) is standard in your transmission. With the OLS and Allison 6th generation shift selector, you can get a more accurate electronic fluid level check than with a dipstick.

Oil level codes are obtained as follows:

1. Park vehicle on a level surface, select «N» (neutral) on the pushbutton shift selector and apply parking brake.
2. Wait for at least 2 minutes to allow the oil to settle;
3. Press simultaneously the ▲ (Upshift) and ▼ (Downshift) arrow buttons once.
4. Oil level codes are displayed once the following parameters are met :
  - The vehicle has been stationary for approximately 2 minutes to allow the oil to settle;
  - Engine at idle;
  - Oil at normal operating temperature, between 104°F (40°C) and 220°F (104°C);
  - Transmission in «N» (Neutral);
  - Transmission output shaft stopped;
  - Oil level sensor present and working.

5. Correct fluid level is displayed as shown.



6. Low fluid level is displayed as shown. The number indicates the number of quarts of fluid the transmission requires.
7. High fluid level condition with the number of quarts in excess is displayed as shown.



**NOTE**  
 Confirm a low fluid level condition by making a manual fluid level check.

8. To exit the Oil Level Display Mode, press any range button «R», «N» or «D» at any time.

**NOTE**  
 Note that the quantities LO 4 and HI 3 are the largest values displayed and that the actual variation in oil level may exceed these numbers.

If the fluid level check cannot be completed, an invalid for Display fault is reported. Refer to table below to review the codes and conditions.

| CODE              | CAUSE OF FAULT CODE             |
|-------------------|---------------------------------|
| SETTLING OK       | Settling time too short         |
| ENG RPM TOO LOW   | Engine speed (rpm) too low      |
| ENG RPM TOO HIGH  | Engine speed (rpm) too high     |
| MUST BE IN NEU    | N (Neutral) must be selected    |
| OIL TEMP TOO LOW  | Sump fluid temperature too low  |
| OIL TEMP TOO HIGH | Sump fluid temperature too high |
| VEH SPD TOO HI    | Output shaft speed              |
| SENSOR FAILED     | Sensor failure                  |

3.3 RECOMMENDED AUTOMATIC TRANSMISSION FLUID

Only use fluids meeting Allison Transmission specification TES668, TES295 or TES389 in your transmission. Refer to TES668, TES295 or

TES389 Approved Fluids list, found under the Service/Parts heading on the home page of the Allison Transmission web site [www.allisontransmission.com](http://www.allisontransmission.com).


Allison Transmission recommends you take the following into consideration when selecting the appropriate fluid type for your transmission:

- Fluids meeting specification TES668, TES295 are preferred over TES389 fluids for use in all 4000 Product Families transmission applications.
- TES668, TES295 fluids are fully qualified for Severe Duty and Extended Drain intervals.
- A TES668, TES295 fluid allows you to operate at a lower ambient temperature than a TES389 type fluid.
- TES389 fluid is the minimum fluid requirement approved for use in 4000 Product Families transmissions.
- To extend the TES389 fluid drain intervals beyond the recommended mileage or hours change interval, use a fluid analysis program.

When choosing a fluid type to use, consider what the minimum fluid operating temperature of the fluid will be based on the ambient temperatures reached in the geographical location for the vehicle.

**Transmission Fluid Operating Temperature Requirements**

| Fluid type     | Minimum operating temperature |            |
|----------------|-------------------------------|------------|
|                | Celsius                       | Fahrenheit |
| TES668, TES295 | -35                           | -31        |
| TES389         | -25                           | -13        |



**CAUTION**

Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.

**NOTE**

*The use of an arctic preheat kit is recommended at temperatures below -25°F (-32°C). If a preheat kit is not available, the TCM*


*will restrict full operation until the sump temperature is increased.*

**3.3.1 Importance of Proper Fluid Level**

It is important that the proper fluid level be maintained at all times because the transmission fluid cools, lubricates, and transmits hydraulic power. If the fluid level is too low, the converter and clutches do not receive an adequate supply of fluid. If fluid level is too high, the fluid can aerate, causing the transmission to shift erratically or overheat.

**3.3.2 Keeping Fluid Clean**

Oil must be handled in clean containers, fillers, etc., to prevent foreign material from entering the transmission. Place the dipstick on a clean surface area while filling the transmission.



**CAUTION**

Containers or fillers that have been used to handle antifreeze or engine coolant must NEVER be used for handling transmission fluid. Antifreeze and coolant solutions contain ethylene glycol that, if introduced into the transmission, can cause the clutch plates to fail.

**3.3.3 Oil Contamination**

At each oil change, examine the drained oil for evidence of dirt or water. A nominal amount of condensation will emulsify during operation of the transmission. However, if there is evidence of water; check the cooler (heat exchanger) for other signs of leakage. This, however, may also indicate leakage from the engine oil system.

**3.3.4 Metal Particles**

Metal particles in the oil (except for minute particles normally trapped in the oil filter) indicate damage has occurred in the transmission. When these particles are found in the sump, the transmission must be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, coolers, and all other areas where the particles could lodge.



**CAUTION**

If excessive metal contamination has occurred, replacement of the oil cooler and replacement of all bearings within the transmission is recommended.

3.3.5 Coolant Leakage

If engine coolant leaks into the transmission oil system, immediate action must be taken to prevent malfunction and possible serious damage. The transmission must be completely disassembled, inspected, and cleaned. All traces of the coolant contamination must be removed. Friction clutch plates contaminated with ethylene glycol must be replaced.

3.4 CONTROL SYSTEM PROGNOSTICS

The transmission control system includes the provision for the user to monitor various transmission operating parameters. Transmission operating parameters monitored by the prognostics feature are:


- Oil Life Monitor
- Filter Life Monitor
- Transmission Health Monitor



**NOTE**

*The prognostics package requires the use of **TranSynd™** or an **Allison approved TES668, TES295 or TES389 licensed fluid** in the transmission and **Allison High Capacity filters**. If any other fluids or filters are used, Prognostic mode **must be disabled**. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.*




*Refer to TES668, TES295 or TES389 Approved Fluids list, found under the Service/Parts heading on the home page of the Allison Transmission web site.*

**[www.allisontransmission.com](http://www.allisontransmission.com)**

When a specified threshold is detected for any of the serviceable conditions, the TRANSMISSION SERVICE indicator  is illuminated to alert the operator. Failure to attend to the service condition and reset the TRANSMISSION SERVICE indicator within a defined operating period will result in illumination of the CHECK light with associated message in the DID, indicating the increased probability that the service condition will develop into a more serious condition.

To access the Prognostic Mode function, simultaneously press the  (Upshift) and  (Downshift) arrow buttons repeatedly.

3.4.1 Normal Prognostics Indication at Engine Start


- A system bulb check illuminates the TRANSMISSION SERVICE indicator  approximately 0.5 seconds.
- If Prognostics features are enabled, the TRANSMISSION SERVICE indicator  illuminates again for 3 seconds after the bulb check. If Prognostics features are disabled, the TRANSMISSION SERVICE indicator  does not illuminate again after the bulb check.

3.4.2 Oil Life Monitor

The display message denotes the calculated remaining life of the transmission fluid. This value is based on the established life for the required baseline fluid, and then is continuously adjusted for cumulative effects of such operating parameters as operating time, retarder operation, output shaft revolutions and shift frequency.

Display

The display is a two-digit number, denoting percentage of the fluid life which remains. New fluid is displayed as 99%.

The TRANSMISSION SERVICE indicator  will be illuminated, denoting a required change of transmission fluid, when the remaining fluid life reaches approximately 1 %. The indicator will be lit steadily upon each initialization of the TCM, and will remain on steady for approximately 2 minutes after the first selection of "D" (drive) range each time, until service is performed and the indicator is reset.

Failure to perform maintenance and reset the TRANSMISSION SERVICE indicator within a defined period will result in the illumination of the CHECK light with associated message in the DID and diagnostic code P0897 Transmission Fluid Deteriorated.

Reset

The TRANSMISSION SERVICE indicator can be reset by a message over the SAE J1939 communication interface, with the Allison DOC™

for PC diagnostic program, or by depressing and holding the MODE button for ten (10) seconds while the Oil Life Monitor function is displayed. It may also be reset by selecting N-D-N-D-N-R-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running. The TRANSMISSION SERVICE indicator illuminates briefly following a reset to acknowledge the reset was successful.

### Setting Fluid Type for Prognostics

The fluid type can be programmed if the specific calibration allows it. The operator can do the following:

With the engine off and the ignition on, perform the following sequence on the selector, N-R-N-D-N-R-N-D-N-R-N-D-N.

The TRANSMISSION SERVICE indicator flashes if TES389 is the current setting and illuminates solidly if TES668, TES295 is the current setting. To change the transmission fluid type, wait 5 seconds after entering transmission fluid type mode and perform the following sequences to select the proper transmission type:

N-R-N to select TES668, TES295

N-D-N to select TES389

The selector exits 30 seconds after entering transmission fluid type mode or the ignition may be turned off to exit earlier. Only one transmission fluid type selection may be made after entering transmission fluid type mode. All other attempt will be ignored. Transmission fluid type mode needs to be entered again if the wrong type of fluid is selected.



### CAUTION

*Verify prognostics fluid type setting matches transmission fluid type. Oil Life Monitor notifications will be inaccurate when mismatched. This could result in transmission damage from running a TES389 fluid too long or cause shortened TES668, TES295 fluid changes to occur.*



### CAUTION


Required calendar-based oil & filter change intervals (based on month) still apply because

Oil Life Monitor function cannot measure time while ignition power is OFF.


If the Oil Life Monitor function has not indicated the need for a fluid change before 60 months have passed when using TES668, TES295 fluid type or before 24 months have passed when using TES389 fluid type, it will be necessary to change the fluid and filters per calendar requirements and reset the system.


### 3.4.3 Filter Life Monitor

This feature provides an alert when the transmission's fluid filters need to be replaced. It helps extend filter change intervals to reduce routine maintenance downtime while providing maximum protection for the transmission.

The filter life indicator pressure switch signals the transmission control module when fluid exiting the main filter drops below a predetermined pressure. Both the main and lube filters **must be** changed when the TRANSMISSION SERVICE indicator  shows the main filter should be changed.

#### Filter Change Notification

The TRANSMISSION SERVICE indicator  will flash for 2 minutes after the first selection of "D" (drive) range. Once the Filter Monitor mode has been accessed via the shift selector, the "OIL FILTER OK" or "REPLACE FILTERS" message is displayed in the selector display window. An acceptable filter life status is displayed as "OIL FILTER OK". An unacceptable filter life status is displayed as "REPLACE FILTERS".

Once the programmed threshold for maximum filter pressure drop has been observed and verified, the diagnostic code P088A Transmission Filter Maintenance Alert will be recorded to indicate that the filter has reached the end of its designed life. At the next initialization of the TCM, the TRANSMISSION SERVICE indicator  will flash for 2 minutes after the first selection of "D" (drive) range. Thereafter, the indicator will illuminate and flash upon each TCM initialization, continuing to flash for 2 minutes after the first selection of a drive range each time, until service is performed and the indicator is reset.

Failure to perform maintenance and reset the monitor after a calibration-defined number of warnings will result in the illumination of the CHECK light with associated message in the DID

and diagnostic code P088B will be recorded to indicate a highly deteriorated filter.

Read and Reset Filter Life Monitor from Selector

**To enter** the filter life monitor, press simultaneously the ▲ (Upshift) and ▼ (Downshift) arrows three times. An acceptable filter life status is displayed as "OIL FILTER OK". An unacceptable filter life status is displayed as "REPLACE FILTERS".

The feature will **reset** automatically when the main fluid filter has been changed and the pressure drop across the filter no longer exceeds the threshold value. A manual reset can be performed by depressing and holding the MODE button for ten (10) seconds while the Filter Life Monitor function is displayed. It may also be reset by selecting N-R-N-R-N-D-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running. The TRANSMISSION SERVICE indicator ⚡ illuminates briefly following a reset to acknowledge the reset was successful.

#### 3.4.4 Transmission Health Monitor

This prognostic feature determines clutch life status of the transmission's clutches and alerts you when clutch maintenance is required. The clutch life status is determined by monitoring changes and the calculated running clearance of the transmission clutches.

##### Clutch Maintenance Notification

The transmission health monitor feature determines when clutch maintenance is needed. If any of the clutches (except lockup) reaches a remaining life of approximately 10% or if any of the clutch running clearances exceeds a maximum value, then the TRANSMISSION SERVICE indicator is steadily illuminated from just after ignition on until ignition is turned off. Thereafter, the indicator will be lit upon each initialization of the TCM, and will remain on steady during all vehicle operation until service is performed and the indicator is reset. If the transmission health monitor mode has been accessed via the shift selector, a "TRANS HEALTH OK" or "TRANS HEALTH LO" is displayed. An acceptable clutch life status is

displayed as "TRANS HEALTH OK". An unacceptable clutch life status is displayed as "TRANS HEALTH LO".

Read and Reset Transmission Health Monitor from Selector

**To enter** the transmission health monitor, press simultaneously the ▲ (Upshift) and ▼ (Downshift) arrows four times. An acceptable clutch life status is displayed as "TRANS HEALTH OK". An unacceptable filter life status is displayed as "TRANS HEALTH LO".

The feature will **reset** automatically upon elimination of the clutch clearance condition which initiated it. The indicator can also be manually reset using the Allison DOC™ for PC diagnostics program if necessary.

**The following table illustrates how to access Oil Level Check, Prognostics & Diagnostic Troubleshooting Codes functions on the Allison pushbutton shift selector.**

**SECTION 07: TRANSMISSION**

| ▲ (Upshift) & ▼<br>(Downshift) arrow<br>buttons pressed<br>simultaneously * | Description   | Message                 |                         |
|---|---|-------------------------|-------------------------|
| 1 <sup>st</sup> press   | Allison transmission oil level check  |                         |                         |
| 2 <sup>nd</sup> press   | <b>Oil Life Monitor</b>   | " O "                   | " M "                   |
|   | Oil life remaining will range from 99% down to 00%  | Some number from 9 to 0 | Some number from 9 to 0 |
| 3 <sup>rd</sup> press   | <b>Filter Life Monitor</b>  | " F "                   | " M "                   |
|   | Present life of filter is acceptable  | OIL FILTER OK           |                         |
|   | Present life of filter is unacceptable  | REPLACE FILTERS         |                         |
| 4 <sup>th</sup> press   | <b>Transmission Health Monitor</b>  | " T "                   | " M "                   |
|   | Shows " TRANS HEALTH OK " until remaining life of one or more of the clutch(es) wear enough so that the programming changes | TRANS HEALTH OK         |                         |
|   | One or more of the clutches have worn enough to change the program  | TRANS HEALTH LO         |                         |
| 5 <sup>th</sup> press   | Display of diagnostic codes   |                         |                         |

\* With the engine off and ignition on.

3.5 OIL AND FILTER CHANGE INTERVAL

TABLE 1

| Allison Transmission Recommended Fluid And Filter Change Intervals With Prognostics Mode <u>Disabled</u><br>Using TES389 or Mixture                                     |   |          |   |   |          |
|---|---|----------|---|---|----------|
| Severe vocation <sup>3</sup><br>Coaches or MTH equipped with retarder   |   |          | General vocation <sup>4</sup><br>Coaches or MTH without retarder  |   |          |
| Fluid   | Filters   |          | Fluid   | Filters   |          |
|   | Main & Lube   | Internal |   | Main & Lube   | Internal |
| Whichever is the first of the following:<br>12,000 Miles<br>20 000 km<br>6 Months/<br>500hrs<br><i>Note: always replace main and lube filters with the fluid change</i> | Whichever is the first of the following:<br>12,000 Miles<br>20 000 km<br>6 Months/<br>500hrs<br><i>Note: always replace main and lube filters with the fluid change</i> | Overhaul | Whichever is the first of the following:<br>25,000 Miles<br>40 000 km<br>12 Months/<br>1000hrs<br><i>Note: always replace main and lube filters with the fluid change</i> | Whichever is the first of the following:<br>25,000 Miles<br>40 000 km<br>12 Months/<br>1000hrs<br><i>Note: always replace main and lube filters with the fluid change</i> | Overhaul |

TABLE 2

| Allison Transmission Recommended Fluid And Filter Change Intervals <sup>1</sup> With Prognostics Mode <u>Disabled</u><br>Using 100% TranSynd or TES668/TES295 Approved Fluid <sup>2</sup> |  |          |  |   |          |
|---|--|----------|--|---|----------|
| Severe vocation <sup>3</sup><br>Coaches or MTH equipped with retarder   |  |          | General vocation <sup>4</sup><br>Coaches or MTH without retarder   |   |          |
| Fluid   | Filters  |          | Fluid  | Filters   |          |
|   | Main & Lube  | Internal |  | Main & Lube   | Internal |
| Whichever is the first of the following:<br>150,000 Miles<br>240 000 km<br>48 Months/<br>6000hrs<br><i>Note: always replace main and lube filters with the fluid change</i>               | Whichever is the first of the following:<br>75,000 Miles<br>120 000 km<br>36 Months/<br>3000hrs<br><i>Note: always replace main and lube filters with the fluid change</i> | Overhaul | Whichever is the first of the following:<br>300,000 Miles<br>480 000 km<br>48 Months<br>6000hrs<br><i>Note: always replace main and lube filters with the fluid change</i> | Whichever is the first of the following:<br>75,000 Miles<br>120 000 km<br>36 Months<br>3000hrs<br><i>Note: always replace main and lube filters with the fluid change</i> | Overhaul |

<sup>1</sup> Extended TranSynd, TES668/TES295 fluid and filter change intervals are only allowed with Allison High-Capacity filters.

<sup>2</sup> Less than 100% concentration of TranSynd or TES668/TES295 approved fluid is considered a mixture and should utilize TES389 change intervals. If the customer replaces non-TranSynd or non-tes295/non-tes668 fluid with TranSynd or TES295/tes668 equivalent, the change interval recommendations of TES389 or mixture must be followed. Upon the next oil change, if the customer reinstall TranSynd or TES295/tes668 equivalent, the fluid & filter change recommendation outlined in 100% TES295/tes668 approved fluids must be followed.

<sup>3</sup> Severe vocation= All retarder, On/Off highway, transit and intercity coach with duty cycle greater than one (1) stop per mile.

<sup>4</sup> General vocation= intercity coach with duty cycle less than or equal to one (1) stop per mile and all other vocations not listed in severe vocation.

TABLE 3

| Recommended Fluid And Filter Change Intervals With Prognostics Mode <u>Enabled</u>   |   |  |   |
|--|---|--|---|
|  | FLUID CHANGE INTERVALS  | HIGH CAPACITY MAIN & LUBE FILTERS CHANGE INTERVALS   | SUCTION FILTER ASSEMBLY CHANGE INTERVAL |
| TES668, TES295   | Whichever is the first of the following: <ul style="list-style-type: none"> <li>If the TRANS SERVICE indicator in the shift selector is illuminated steady for 2 minutes after D (drive) is selected</li> <li>60 calendar months</li> </ul> <i>Note: always replace main and lube filters with the fluid change</i> | Whichever is the first of the following: <ul style="list-style-type: none"> <li>If the TRANS SERVICE indicator in the shift selector is illuminated steady for 2 minutes after D (drive) is selected</li> <li>60 calendar months</li> <li>Any time fluid is changed</li> </ul> | At time of transmission overhaul        |
| TES389   | Whichever is the first of the following: <ul style="list-style-type: none"> <li>If the TRANS SERVICE indicator in the shift selector is illuminated steady for 2 minutes after D (drive) is selected</li> <li>24 calendar months</li> </ul> <i>Note: always replace main and lube filters with the fluid change</i> | Whichever is the first of the following: <ul style="list-style-type: none"> <li>If the TRANS SERVICE indicator in the shift selector is illuminated steady for 2 minutes after D (drive) is selected</li> <li>24 calendar months</li> <li>Any time fluid is changed</li> </ul> | At time of transmission overhaul        |
| Prognostics Mode requires the use an Allison approved TES668, TES295 or TES389 transmission fluid and Allison High Capacity filters.   |   |  |   |
| A mixture of TES668/TES295 and TES389 fluid must continue to use the TES389 fluid change intervals, until two fluid changes with only TES668/TES295 fluid have occurred, at which time the TES668/TES295 schedule may be used. |   |  |   |

3.5.1 Oil and Filter Change Interval with Prognostics Mode Disabled

Allison transmissions are factory fill with **Castrol TranSynd** fluid. Oil change must be performed with the vehicle on a flat and level surface and with parking brake applied. Oil and filter change frequency is determined by the severity of service and operating conditions of the transmission and by the filter equipment installed. See "TABLE 1 or TABLE 2" for oil and filter change intervals when PROGNOSTIC MODE is **disabled**. More frequent changes may be required when operations are subject to high levels of contamination or overheating. Filters must be changed at or before recommended intervals.

**IMPORTANT NOTE**

Your transmission is equipped with **High Capacity filters**. High Capacity filters allow for increased fluid and filter change intervals in transmissions utilizing TES668/TES295 approved fluid or TranSynd. High Capacity filters eliminate the requirement of the initial 5000 miles (8000km) main filter change.

**IMPORTANT NOTE**

Allison Transmission recommends that customers use fluid analysis as the primary method for determining fluid change intervals. Many customers have a systematical annual transmission fluid change while, in many cases, fluid analysis could demonstrate that the transmission fluid is still in good condition and a fluid change is not required. In the absence of a fluid analysis program, the fluid change interval listed in TABLE 1 & TABLE 2 should be used.

3.5.2 Oil and Filter Change Interval with Prognostics Mode Enabled

Oil Life Monitor and Filter Life Monitor of the Prognostics mode provide indicators of required maintenance actions. They are designed to maximize fluid and filter utilization. **Prognostics enabled require the use of an Allison approved TES668, TES295 or TES389 transmission fluid and Allison High Capacity filters.** If any other fluids or filters are used,



Prognostic mode **must be disabled**. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage. See "TABLE 3 for oil and filter change intervals with PROGNOSTIC MODE **enabled**.

#### **IMPORTANT NOTE**

*A mixture of TES668/TES295 and TES389 fluid must continue to use the TES389 fluid change intervals, until two fluid changes with only TES668/TES295 fluid have occurred, at which time the TES668/TES295 schedule may be used.*

Calendar-based change intervals of TABLE 3 must still be adhered to for both fluid and filter changes even if Prognostics has not indicated the need for either fluid or filter maintenance, unless fluid analysis is used.

### 3.6 FLUID AND FILTER CHANGE PROCEDURE

#### 3.6.1 Drain

1. The transmission should be at an operating temperature of 160°F (71°C) to 200°F (93°C) when the oil is drained. This will ensure quicker and more complete fluid drainage.
2. Remove the drain plug from under the transmission (Figure 7) and allow the oil to drain into a suitable container. Check the condition of the oil as described previously.
3. Remove twelve bolts (item 1), two filter covers (item 2), two gaskets (item 3), two O-rings (item 4), two O-rings (item 5) and the two filters (item 6) from the bottom of the control module (Figure 7).
4. When reinstalling parts, lubricate and install new O-rings (4) and (5) on each cover (2). Lubricate O-ring inside filter (6) and push filter onto cover (2). Install new gaskets (3) on cover (2) and align holes in gaskets with holes in cover.



#### **CAUTION**

Do not use bolts to draw the cover to sump. This can damage the cover, seal, or sump.

5. Install filter and cover assemblies into the filter compartment. Align each filter/cover assembly with the holes in the channel plate/sump. Push

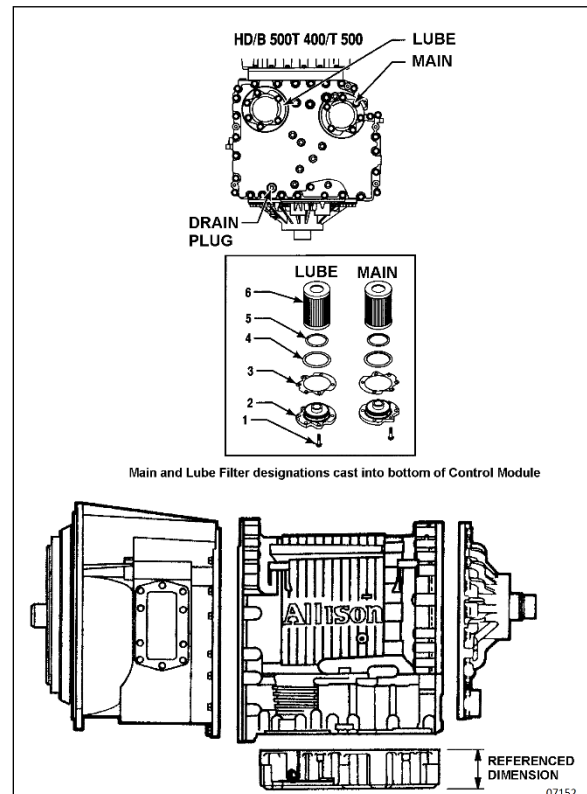
the cover assemblies in by hand to seat the seals.

6. Install twelve bolts and both covers.

**TORQUE:** 38-45 lb-ft (52-61 Nm)

7. Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug.

**TORQUE :** 18-24 lb-ft (24-33 Nm)



**FIGURE 7: DRAIN PLUG AND FILTERS**

#### **Fluid loss with filter change only**

When changing main and lube filters at recommended intervals, approximate fluid loss for each filter as follows:

Main filter = 2 quarts (1.9 liters)  
Lube filter = 8 quarts (7.6 liters)

#### 3.6.2 Refill transmission

The amount of refill fluid is less than the amount used for the initial fill. Fluid remains in the external circuits and transmission cavities after draining the transmission.

#### **NOTE**

*Quantities listed below are approximations and do not include external oil cooler lines.*

Using the oil level dipstick filler tube, refill with 24 US qts (23 liters), 28 US qts (26.5 liters) if equipped with retarder, and check the oil level using the **Fluid Level Check Using Pushbutton Shift Selector** procedure in this section. Add transmission fluid according to pushbutton shift selector fluid level check.

### 3.7 CLEANING AND INSPECTION OF ALLISON AUTOMATIC TRANSMISSION

The exterior of the transmission should be cleaned and inspected at regular intervals. The length of service and severity of operating conditions will determine the frequency of such inspections. Inspect the transmission for:

1. Loosen bolts (transmission and mounting components);
2. Oil leaks (correct immediately);
3. Loose, dirty, or improperly adjusted throttle sensor linkage;
4. Damaged or loose oil lines;
5. Worn or frayed electrical harnesses, improper routing;
6. Worn or out of phase drive line U-joint and slip fittings.



#### CAUTION

DO NOT pressure wash the transmission electrical connectors. Water and detergent will cause the contacts to corrode or become faulty.

#### 3.7.1 Breather

The breather is located on the engine, flywheel side near the valve cover. It serves to prevent pressure build-up within the transmission and must be cleaned to keep the passage opened. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Use care when cleaning the engine. Spraying steam, water or cleaning solution directly at the breather can force the water or solution into the transmission. Always use care when removing the hose connector from transmission to prevent the entry of foreign matter.

## 4. ALLISON TRANSMISSION OIL COOLER REMOVAL

### 4.1 TRANSMISSION WITHOUT RETARDER

Stop engine and allow engine to cool. Close both heater line shutoff valves (refer to Section 05 "Cooling").

To drain the cooling system, proceed as per Section 05 "Cooling", paragraph 5: Draining. If the cooling system is contaminated, flush system as per Section 05 "Cooling", paragraph 7: Flushing.

1. Remove the rear L.H. side tag axle wheel, then remove the rear L.H. side fender panel.
2. Disconnect the two transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination (Figure 8).



#### WARNING

A significant amount of oil may drain from oil lines when they are disconnected.

3. Unfasten the constant-torque hose clamps and remove the two hoses.
4. Unscrew the four holding nuts and remove the U-bolts, remove the oil cooler from engine compartment.
5. Reinstall transmission oil cooler by using reverse procedure.

### 4.2 TRANSMISSION WITH RETARDER

Stop engine and allow engine to cool. Close both heater line shutoff valves (refer to Section 05 "Cooling").

1. To drain the cooling system, proceed as per Section 05 "Cooling", paragraph 5: Draining. If the cooling system is contaminated, flush system as per Section 05 "Cooling", paragraph 7: Flushing.
2. Remove the rear L.H. side tag axle wheel, then remove the rear L.H. side fender panel.
3. Disconnect the transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination.

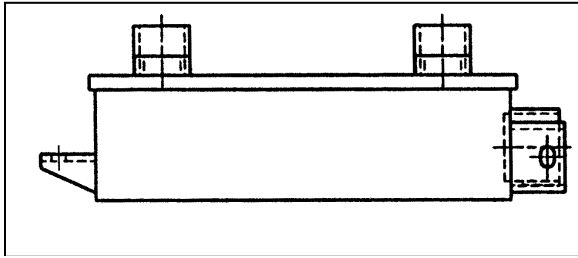


FIGURE 8: COOLER WITH RETARDER (07073)

**WARNING**

A significant amount of oil may drain from oil lines when they are disconnected.

4. Unfasten the constant-torque hose clamps and remove the two hoses.
5. Unscrew the holding bolts and nuts and remove the oil cooler from engine compartment.

**5. ALLISON TRANSMISSION INSTALLATION**

1. Place the transmission on a transmission jack.
2. Install a headless guide bolt into one of the 12 threaded holes in the flex plate adapter.

**NOTE**

For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up, or retracted (if applicable).

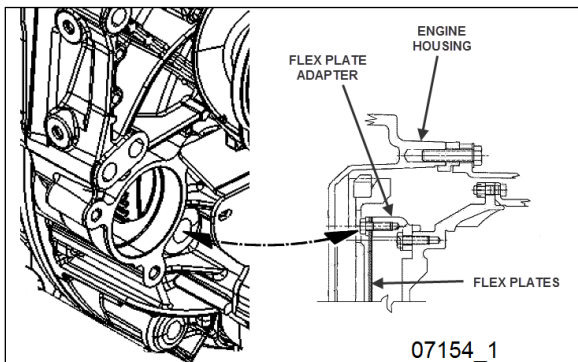


FIGURE 9: TRANSMISSION INSTALLATION

3. With the engine starter removed, use Volvo engine turning tool #88800014 (Figure 10) to align one of the 12 attaching screw holes in the flex plate with the engine starter access opening. If you do not have the Volvo tool, place a wrench on the crankshaft pulley

attaching screw to turn it and therefore turn the flex plate.



FIGURE 10: VOLVO ENGINE TURNING TOOL #88800014

4. Apply clear silicone (Prevost #680457 or equivalent) on the spacer and install it on the engine housing (Figure 11).



FIGURE 11: SPACER INSTALLATION

5. Lubricate the flywheel center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).
6. Raise transmission and position the flywheel pilot boss with the crankshaft hole.
7. Turn the flex plate adapter into the transmission to align the headless guide bolt with the flex plate hole facing the engine starter access opening.

**WARNING**

Severe damages and/or personal injury can occur if transmission is not adequately supported.

8. Apply clear silicone (Prevost #680457 or equivalent) around the edge of the

transmission housing (Figure 12: silicone application transmission housing).



**FIGURE 12: SILICONE APPLICATION TRANSMISSION HOUSING**

9. Seat the transmission against the engine housing (with the spacer in place). **NO FORCE IS REQUIRED.** If interference is encountered, move the transmission away from engine, then investigate the cause.

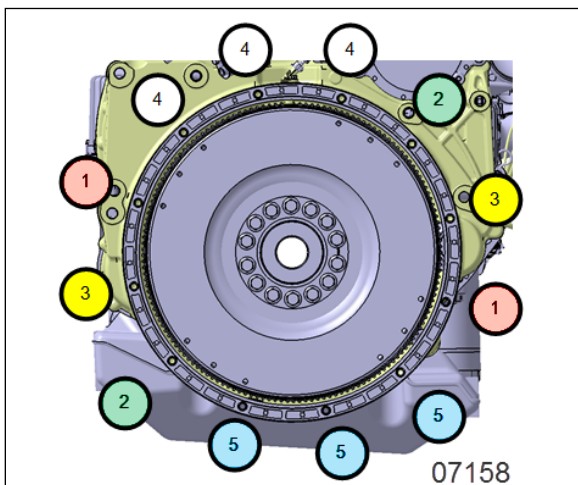


### CAUTION

The transmission housing must be seated against the engine housing (with the spacer in place) prior to tightening any screws. **DO NOT USE SCREWS TO SEAT THE HOUSING.**

10. Start all screws attaching the transmission housing to the engine housing.
11. Tighten them gradually in a criss-cross sequence as shown in Figure 13. Apply the following torque value:

**TORQUE:** 46-50 lb-ft (62-68 Nm)



**FIGURE 13: CRISS CROSS PATTERN**

12. Remove the headless guide bolt from the flex plate adapter through the engine starter access opening. Replace it with a self-locking screw, finger-tighten then start the remaining screws. Use Volvo engine turning tool #88800014 (Figure 10) to align holes. If you do not have the Volvo tool, place a wrench on the crankshaft pulley attaching screw to turn it and therefore turn the flex plate.

13. Tighten all screws to the following torque value:

**TORQUE:** 24-30 lb-ft (33-41 Nm)

### NOTE

*Reinstall engine starter and connect cables.*

*Reinstall access plug below starter motor.*

14. Remove jack from under transmission.
15. Connect all sensors.
16. Connect the main wiring harness.
17. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).
18. Connect the two transmission oil cooler hoses as they were previously.
19. Reinstall clamps and brackets, and replace locking ties previously removed during removal procedure.
20. Install propeller shaft and its safety guard. Refer to Section 09, "PROPELLER SHAFT".
21. Install transmission dipstick and filler tube.
22. Install cross member under transmission.
23. Install engine splash guards.
24. Adjust the retarder pressure to  $80 \pm 3$  psi with the air pressure regulator. For more information refer to Section 12, "BRAKE AND AIR SYSTEM", under heading "AIR PRESSURE REGULATOR". The air pressure regulator is located at back of engine compartment, on R.H. side (Figure 14) or in the R.H. side rear service compartment.
25. Make sure that the drain plug is in place, and then remove the transmission dipstick and pour approximately 24 US quarts (23 L) of automatic transmission fluid through the filler tube. Check and adjust oil level.

**CAUTION**  
 Do not overfill the transmission. Overfilling can cause oil aeration (milky appearance) and overheating. If overfilling occurs, drain oil as required to bring it to the proper level.

**CAUTION**  
 Place the battery master switch to the "OFF" position.

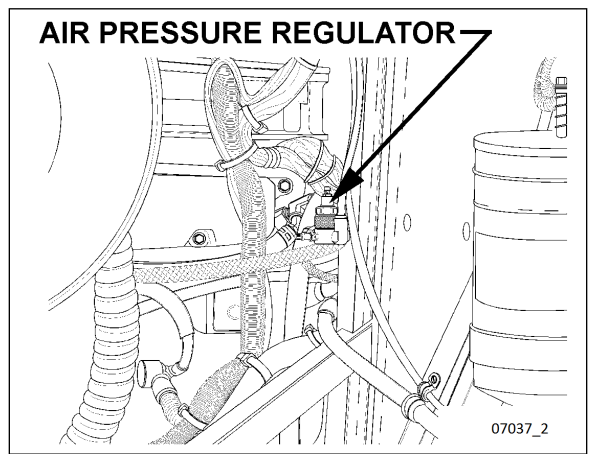


FIGURE 14: AIR PRESSURE REGULATOR (TYPICAL)

6.1 DIAGNOSTIC TROUBLESHOOTING CODES (DTC) — ALLISON 6TH GENERATION CONTROLS

Diagnostic features are provided with the transmission control system to assist in troubleshooting of malfunctions and/or the monitoring of specific operating parameters. When a control system malfunction is detected, a series of Diagnostic Trouble Codes (DTCs) are used to identify and clarify the nature of the malfunction. These DTCs are each named by a 5 character alphanumeric string that refers to a diagnostic algorithm running pass/fail tests to help identify a malfunction in the transmission or vehicle operation. Most DTCs have some kind of diagnostic response that the operator notices, such as an illuminated CHECK light, selector display change, lock in range, or inhibit shifts condition.

DTCs are logged in the Transmission Control Module (TCM) memory by severity and by their active/inactive status with the most severe and active codes listed first. A maximum of five DTCs (numbered d1- d5) from most recent to oldest may be read from the shift selector. As DTCs are added, the oldest inactive DTC (historic) is dropped from the list. If all DTCs are active, the DTC with the lowest priority is dropped from the list.

An active code is any code that is current in the TCM decision-making process and has failed the DTC test(s) associated with that specific diagnostic algorithm. Historical codes, which are by definition inactive, are codes that are no longer failing their algorithm but are retained in the TCM in order to help the technician analyze possible causes and provide them direction if the vehicle is brought in before they are cleared from the queue.

DTCs can be cleared manually by the operator or they clear automatically from last (d5) to first (d1) in the queue after a number of engine starts, without becoming active again.

6. ALLISON TRANSMISSION TROUBLESHOOTING

The Allison transmission has a new Transmission Control Module (TCM) which involves specific diagnostic incident codes. The TCM unit is located in the coach main power compartment.

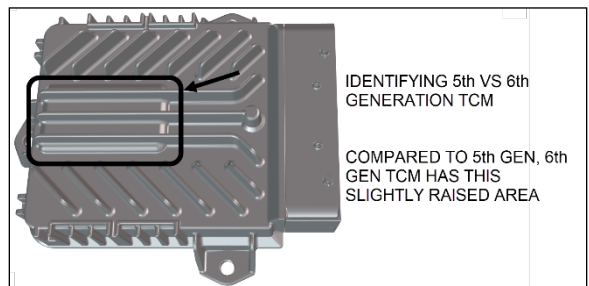


FIGURE 15: 6<sup>TH</sup> GENERATION TRANSMISSION CONTROL MODULE (07140)

TCM Replacement

The TCM is a non-serviceable electronic device. When it fails, it must be replaced using the following procedure:

- Open the coach main power compartment in order to get access to the TCM;
- Remove the electrical cable connectors;
- Unscrew the TCM unit;
- Replace by reversing the procedure.



### 6.1.1 Using Shift Selector for Accessing Diagnostics Information

DTCs can be displayed on the display portion of the shift selector. A DTC is either active or historic. An active DTC is a DTC that is current in the TCM decision-making process. Historic DTCs are retained in the TCM memory and do not necessarily affect the TCM decision-making process.

### 6.1.2 Display Sequence

Up to five DTCs may be displayed one at a time from the selector once the diagnostic display mode has been initiated by the operator. Each DTC is 5 characters in length. The DTC status active or inactive is shown below the DTC.



Shows active DTC P0730

The operator presses the MODE button to read the next DTC in the queue (if any) or requests to exit diagnostics mode. The diagnostics mode times out and returns the selector to normal operating mode after approximately 10 minutes of operator inactivity.

### 6.1.3 Diagnostic Code Display and Clearing Procedure

Diagnostic codes can be read and cleared by two methods:

- Using an Allison DOC™ diagnostic tool. For specific instructions on how to use an Allison DOC™ diagnostic tool, refer to the User Guide.
- Using the pushbutton shift selector.

To begin the diagnostic process:

1. Bring the vehicle to a stop at a safe location.
2. Apply the parking brake.

To display stored codes:

1. Simultaneously press the ▲ (Upshift) and ▼ (Downshift) arrow buttons five times (Prognostics enabled) to access the Diagnostic Display Mode. With Prognostics disabled, press the ▲ (Upshift) and ▼ (Downshift) arrow buttons twice.
2. Press the MODE button to read the next code in the queue, if any.

To clear all active stored codes:

While in Diagnostic Mode, clear all active codes by pressing and holding the MODE button for approximately three seconds until the MODE message flashes. Release the MODE button. The MODE message should not remain illuminated if the active DTC shown in the display has cleared. While in Diagnostic Mode, press and hold the MODE button for 10 seconds to clear both active codes and inactive codes. The MODE message flashes a second time indicating all codes are cleared from the queue.

### 6.1.4 Exiting Diagnostic Mode

Exit the diagnostic mode by one of the following methods:

1. Press simultaneously the ▲ (Upshift) and ▼ (Downshift) arrow buttons at the same time on the pushbutton shift selector.
2. Press any range button «D», «N» or «R» on the pushbutton shift selector.
3. After approximately 10 minutes of inactivity at the pushbutton shift selector, the diagnostic mode automatically exits and returns to normal operating mode.
4. Turn off power to the TCM (shut off the engine using the ignition key).

#### **NOTE**

*Be sure to record all codes displayed before they are cleared. This is essential for troubleshooting.*

#### **NOTE**

*If clearing a code while locked in a «D» (Drive) or «R» (Reverse) position (fail-to-range), the transmission will still be in «D» (Drive) or «R» (Reverse) when the clearing procedure is completed. «N» (Neutral) must be manually selected.*

### 6.1.5 Diagnostic Trouble Code Response

The electronic control system is programmed to inform the operator of a problem with the transmission system via the CHECK light and

shift selector display while it automatically takes action to protect the operator, vehicle, and transmission. When the Transmission Control Module (TCM) flags a Diagnostic Trouble Code

(DTC) as active, the TCM may take a combination of diagnostic responses as listed in the following table.

| CATEGORY OF RESPONSE           | ACTIONS TAKEN   |
|--------------------------------|---|
| DNS - Do Not Shift             | <p>Release lock up (LU) clutch and inhibit lock up operation.</p> <p>Inhibit shifts from the current attained range.</p> <p>Turn on the CHECK light.</p> <p>Display the current attained range in the MONITOR window of the shift selector.</p> <p>Blank the SELECT window of the shift selector.</p> <p>Ignore any range selection inputs from the shift selector.</p> |
| SOL OFF - SOLenoid OFF         | All solenoids are commanded off, resulting in hydraulic default operation of the transmission – PCS1 & PCS2 are on hydraulically when off electrically.   |
| RPR - Return to Previous Range | When the speed sensor ratio or PS1 tests do not pass, the TCM commands the same range as commanded before the shift.  |
| NNC - Neutral No Clutches      | When certain speed sensor ratio or PS1 tests do not pass, the TCM a neutral condition with no clutches applied.   |
| DNA - Do Not Adapt             | The TCM stops adaptive shift control while the code is active.  |

**6.2 DIAGNOSTIC TROUBLESHOOTING CODES (DTC) LIST - ALLISON 6TH GENERATION CONTROLS**

| <b>DTC</b> | <b>Description</b>                                       | <b>CHECK Light</b> | <b>Inhibited Operation Description</b>  |
|------------|--|--------------------|---|
| C1312      | Retarder Request Sensor Failed Low                       | No                 | May inhibit retarder operation if not using J1939 datalink  |
| C1313      | Retarder Request Sensor Failed High                      | No                 | May inhibit retarder operation if not using J1939 datalink  |
| P0122      | Pedal Position Sensor Circuit Low Voltage                | No                 | Use default throttle values. Freezes shift adapts.  |
| P0123      | Pedal Position Sensor Circuit High Voltage               | No                 | Use default throttle values. Freezes shift adapts.  |
| P0218      | Transmission Fluid Over Temperature                      | Yes                | Use default sump temp   |
| P0562      | System Voltage Low                                       | No                 | Inhibit TCC Operation, DNA  |
| P0602      | TCM Not Programmed                                       | Yes                | Lock in Neutral   |
| P0604      | Control module random access memory (RAM)                | Yes                | Lock in Neutral   |
| P0614      | Torque Control Data Mismatch - ECM/TCM                   | Yes                | Allows operation only in reverse and second range.  |
| P0634      | TCM Internal Temperature Too High                        | Yes                | SOL OFF (hydraulic default)   |
| P0642      | Sensor Reference Voltage "A" Circuit Low                 | Yes                | Default sensor data used  |
| P0643      | Sensor Reference Voltage "A" Circuit High                | Yes                | Default sensor data used  |
| P0657      | Actuator Supply Circuit Voltage 1 Open (HSD 1)           | Yes                | SOL OFF, DNA, Inhibit TCC operation, Inhibit main modulation  |
| P0658      | Actuator Supply Voltage 1 (HSD1) Low                     | Yes                | DNS, SOL OFF (hydraulic default)  |
| P0659      | Actuator Supply Voltage 1 (HSD1) High                    | Yes                | DNS, SOL OFF (hydraulic default)  |
| P0703      | Brake Switch Circuit Malfunction                         | No                 | No Neutral to Drive shifts for refuse packer. TCM inhibits retarder operation if a TPS code is also active. |
| P0708      | Transmission Range Sensor Circuit High Input             | Yes                | Ignore defective strip selector inputs  |
| P070C      | Transmission Fluid Level Sensor Circuit – Low Input      | No                 | None  |
| P070D      | Transmission Fluid Level Sensor Circuit – High Input     | No                 | None  |
| P0712      | Transmission Fluid Temperature Sensor Circuit Low Input  | Yes                | Use default sump temp   |
| P0713      | Transmission Fluid Temperature Sensor Circuit High Input | Yes                | Use default sump temp   |
| P0715      | Turbine Shaft Speed Sensor Circuit                       | Yes                | DNS, Lock in current range  |
| P0716      | Turbine Shaft Speed Sensor Circuit Performance           | Yes                | DNS, Lock in current range  |
| P0717      | Turbine Shaft Speed Sensor Circuit No Signal             | Yes                | DNS, Lock in current range  |
| P071A      | RELS Input Failed On                                     | Yes                | Inhibit RELS operation  |
| P071D      | General Purpose Input Fault                              | Yes                | None  |
| P0720      | Output Shaft Speed Sensor Circuit                        | Yes                | DNS, Lock in current range  |
| P0721      | Output Shaft Speed Sensor Circuit Performance            | Yes                | DNS, Lock in current range  |
| P0722      | Output Speed Sensor Circuit No Signal                    | Yes                | DNS, Lock in current range  |
| P0725      | Engine Speed Sensor Circuit                              | No                 | Default to turbine speed  |
| P0726      | Engine Speed Sensor Circuit Performance                  | No                 | Default to turbine speed  |
| P0727      | Engine Speed Sensor Circuit No Signal                    | No                 | Default to turbine speed  |
| P0729      | Incorrect 6 <sup>th</sup> Gear Ratio                     | Yes                | DNS, Attempt 5 <sup>th</sup> , then 3 <sup>rd</sup>   |
| P0731      | Incorrect 1 <sup>st</sup> Gear ratio                     | Yes                | DNS, Attempt 2 <sup>nd</sup> , then 5 <sup>th</sup>   |
| P0732      | Incorrect 2 <sup>nd</sup> Gear ratio                     | Yes                | DNS, Attempt 3 <sup>rd</sup> , then 5 <sup>th</sup>   |
| P0733      | Incorrect 3 <sup>rd</sup> Gear ratio                     | Yes                | DNS, Attempt 4 <sup>th</sup> , then 6 <sup>th</sup>   |
| P0734      | Incorrect 4 <sup>th</sup> Gear ratio                     | Yes                | DNS, Attempt 5 <sup>th</sup> , then 3 <sup>rd</sup>   |
| P0735      | Incorrect 5 <sup>th</sup> Gear ratio                     | Yes                | DNS, Attempt 6 <sup>th</sup> , then 3 <sup>rd</sup> , then 2 <sup>nd</sup>                                  |
| P0736      | Incorrect Reverse Gear ratio                             | Yes                | DNS, Lock in Neutral  |
| P0741      | Torque Converter Clutch System Stuck Off                 | Yes                | None  |
| P0752      | Shift Solenoid 1 Valve Performance-Stuck On              | Yes                | DNS   |
| P0776      | Pressure Control Solenoid (PCS) 2 Stuck Off              | Yes                | DNS, RPR  |
| P0777      | Pressure Control Solenoid 2 Stuck On                     | Yes                | DNS, RPR  |



| DTC   | Description   | CHECK Light | Inhibited Operation Description                                 |
|-------|---|-------------|---|
| P0796 | Pressure Control Solenoid 3 Stuck Off                   | Yes         | DNS, RPR  |
| P0797 | Pressure Control Solenoid 3 Stuck On                    | Yes         | DNS, RPR  |
| P0842 | Transmission Fluid Pressure Switch 1 Circuit Low        | Yes         | DNS, Lock in current range                                      |
| P0843 | Transmission Fluid Pressure Switch 1 Circuit High       | Yes         | DNS, Lock in current range                                      |
| P0847 | Transmission Fluid Pressure Switch 2 Circuit Low        | Yes         | None  |
| P0848 | Transmission Fluid Pressure Switch 2 Circuit High       | Yes         | None  |
| P088A | Transmission Fluid Filter Maintenance Alert             | No          | None  |
| P088B | Transmission Fluid Filter Maintenance Required          | No          | None  |
| P0880 | TCM Power Input Signal                                  | No          | None  |
| P0881 | TCM Power Input Signal Performance                      | No          | None  |
| P0882 | TCM Power Input Signal Low                              | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0883 | TCM Power Input Signal High                             | No          | None  |
| P0894 | Unexpected Mechanical Gear Disengagement                | Yes         | DNS, Lock in first  |
| P0897 | Transmission Fluid Deteriorated                         | No          | None  |
| P0960 | Main Pressure Modulator Solenoid Control Circuit Open   | Yes         | None  |
| P0962 | Main Pressure Modulator Solenoid Control Circuit Low    | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0963 | Main Pressure Modulator Solenoid Control Circuit High   | Yes         | None  |
| P0964 | Pressure Control Solenoid 2 (PCS2) Control Circuit Open | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0966 | Pressure Control Solenoid 2 (PCS2) Control Circuit Low  | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0967 | Pressure Control Solenoid 2 (PCS2) Control Circuit High | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0968 | Pressure Control Solenoid 3 (PCS3) Control Circuit Open | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0970 | Pressure Control Solenoid 3 (PCS3) Control Circuit Low  | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0971 | Pressure Control Solenoid 3 (PCS3) Control Circuit High | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0973 | Shift Solenoid 1 (SS1) Control Circuit Low              | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0974 | Shift Solenoid 1 (SS1) Control Circuit High             | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P0976 | Shift Solenoid 2 (SS2) Control Circuit Low              | Yes         | 7-speed: Allow 2 through 6, N, R<br>Inhibit TCC operation       |
| P0977 | Shift Solenoid 2 (SS2) Control Circuit High             | Yes         | 7-speed: Allow 2 through 6, N, R                                |
| P097A | Shift Solenoid 1 (SS1) Control Circuit Open             | Yes         | Lock in range   |
| P097B | Shift Solenoid 2 (SS2) Control Circuit Open             | Yes         | 7-speed: Allow 2 through 6, N, R                                |
| P0989 | Retarder Pressure Sensor Circuit Low                    | No          | None  |
| P0990 | Retarder Pressure Sensor Circuit High                   | No          | None  |
| P1739 | Incorrect Low Gear Ratio                                | Yes         | Command 2 <sup>nd</sup> and allow shifts 2 through 6, N, R      |
| P1790 | Gear Shift Module 1 Calibrated Invalid                  | Yes         | Shift selector language or units incorrect                      |
| P1791 | Gear Shift Module 2 Calibrated Invalid                  | Yes         | Shift selector language or units incorrect                      |
| P1891 | Throttle Position Sensor PWM Signal Low                 | No          | Use default throttle values                                     |
| P1892 | Throttle Position Sensor PWM Signal High                | No          | Use default throttle values                                     |
| P2184 | Engine Coolant Temperature Sensor 2 Circuit Low Input   | No          | Use default engine coolant values                               |
| P2185 | Engine Coolant Temperature Sensor 2 Circuit High Input  | No          | Use default engine coolant values                               |
| P2637 | Torque Management Feedback Signal (A)                   | Yes         | Inhibit SEM   |
| P2641 | Torque Management Feedback Signal (B)                   | Yes         | Inhibit LRTP  |
| P2669 | Actuator Supply Circuit Voltage 2 Open (HSD2)           | Yes         | SOL OFF, Inhibit TCC operation,<br>Inhibit Main modulation, ONA |
| P2670 | Actuator Supply Voltage 2 (HSD2) Low                    | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P2671 | Actuator Supply Voltage 2 (HSD2) High                   | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P2684 | Actuator Supply Circuit Voltage 3 Open (HSD3)           | Yes         | SOL OFF, Inhibit TCC operation,<br>Inhibit Main modulation, ONA |
| P2685 | Actuator Supply Voltage 3 (HSD3) Low                    | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P2686 | Actuator Supply Voltage 3 (HSD3) High                   | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P2714 | Pressure Control Solenoid 4 (PCS4) Stuck Off            | Yes         | DNS, RPR  |
| P2715 | Pressure Control Solenoid 4 (PCS4) Stuck On             | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P2718 | Pressure Control Solenoid 4 (PCS4) Control Circuit Open | Yes         | DNS, SOL OFF (hydraulic default)                                |
| P2720 | Pressure Control Solenoid 4 (PCS4) Control Circuit Low  | Yes         | DNS, SOL OFF (hydraulic default)                                |


**SECTION 07:  
TRANSMISSION**

| <b>DTC</b> | <b>Description</b>   | <b>CHECK Light</b> | <b>Inhibited Operation Description</b>                        |
|------------|--|--------------------|---|
| P2721      | Pressure Control Solenoid 4 (PCS4) Control Circuit High              | Yes                | DNS, SOL OFF (hydraulic default)                              |
| P2723      | Pressure Control Solenoid 1 (PCS1) Stuck Off                         | Yes                | DNS, RPR  |
| P2724      | Pressure Control Solenoid 1 (PCS1) Stuck On                          | Yes                | DNS, RPR  |
| P2727      | Pressure Control Solenoid 1 (PCS1) Control Circuit Open              | Yes                | DNS, SOL OFF (hydraulic default)                              |
| P2729      | Pressure Control Solenoid 1 (PCS1) Control Circuit Low               | Yes                | DNS, SOL OFF (hydraulic default)                              |
| P2730      | Pressure Control Solenoid 1 (PCS1) Control Circuit High              | Yes                | DNS, SOL OFF (hydraulic default)                              |
| P2736      | Pressure Control Solenoid 5 (PCS5) Control Circuit Open              | Yes                | Inhibit retarder operation                                    |
| P2738      | Pressure Control Solenoid 5 (PCS5) Control Circuit Low               | Yes                | Allow 2 through 6, N, R. Inhibit retarder and TCC operation   |
| P2739      | Pressure Control Solenoid 5 (PCS5) Control Circuit High              | Yes                | Inhibit retarder operation                                    |
| P273F      | Retarder Oil Temperature Sensor Over Temperature Condition           | No                 | None  |
| P2742      | Retarder Oil Temperature Sensor Circuit – Low                        | No                 | Use default retarder temp values                              |
| P2743      | Retarder Oil Temperature Sensor Circuit – High                       | No                 | Use default retarder temp values                              |
| P2761      | TCC PCS Control Circuit Open   | Yes                | Inhibit TCC operation   |
| P2763      | TCC PCS Control Circuit High   | Yes                | Inhibit TCC operation   |
| P2764      | TCC PCS Control Circuit Low  | Yes                | 7-speed: Allow 2 through 6, N, R. Inhibit TCC operation       |
| P2789      | Transmission Clutch Life Expired (Clutch Adaptive Learning at Limit) | No                 | None  |
| P2793      | Gear Shift Direction Circuit   | Yes                | Ignores PWM input from shift selector                         |
| P2808      | Pressure Control Solenoid 6 (PCS6) Stuck Off                         | Yes                | DNS, RPR  |
| P2809      | Pressure Control Solenoid 6 (PCS6) Stuck On                          | Yes                | DNS, RPR  |
| P2812      | Pressure Control Solenoid 6 (PCS6) Control Circuit Open              | Yes                | DNS, SOL OFF (hydraulic default)                              |
| P2814      | Pressure Control Solenoid 6 (PCS6) Control Circuit Low               | Yes                | DNS, SOL OFF (hydraulic default)                              |
| P2815      | Pressure Control Solenoid 6 (PCS6) Control Circuit High              | Yes                | DNS, SOL OFF (hydraulic default)                              |
| U0073      | CAN Communication Bus 1 Off  | No                 | Use default values  |
| U0074      | CAN Communication Bus 2 Off  | No                 | Use default values  |
| U0100      | Lost Communications with ECM A                                       | Yes                | Use default values  |
| U0103      | Lost Communication with Gear Shift Module (Shift Selector) 1         | Yes                | Maintain range selected, observe gear shift direction circuit |
| U0291      | Lost Communication with Gear Shift Module (Shift Selector) 2         | Yes                | Maintain range selected, observe gear shift direction circuit |
| U0304      | Incompatible Gear Shift Module 1 (Shift Selector)                    | Yes                | Ignore shift selector inputs                                  |
| U0333      | Incompatible Gear Shift Module 2 (Shift Selector)                    | Yes                | Ignore shift selector inputs                                  |
| U0404      | Invalid Data Received From Gear Shift Module (Shift Selector) 1      | Yes                | Maintain range selected, observe gear shift direction circuit |
| U0592      | Invalid Data Received From Gear Shift Module (Shift Selector) 2      | Yes                | Maintain range selected, observe gear shift direction circuit |

**7. ALLISON TRANSMISSION REMOVAL**

The following procedure deals with the removal of the Allison transmission without removing the power plant cradle from vehicle. The methods used to support the transmission and engine depend upon conditions and available equipment.

1. Select transmission's "NEUTRAL" positions, apply parking brake, and then set battery master switch to the "OFF" position.
2. Jack up vehicle, then place safety supports underneath body.

|   |                |
|---|----------------|
|  | <b>CAUTION</b> |
| Only the recommended jacking points must be used as outlined in Section 18, "BODY". |                |

|   |
|---|
| <i><b>NOTE</b></i>  |
| <i>For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up or retracted (if applicable).</i> |

3. Remove engine splash guards and protective panels surrounding transmission.
4. Remove cross member from under transmission.
5. Remove the transmission drain plug and allow oil to drain. Inspect the drain plug washer and replace it if necessary. Reinstall the drain plug (see "3.5 Oil and Filter Change" in this section).

**TORQUE:** 18-24 lb-ft (24-33 Nm)



### WARNING

It is better to drain oil when it is still warm. Avoid contact with oil since it can be very hot and cause personal injury.

6. Remove transmission dipstick and filler tube.
7. Disconnect propeller shaft from transmission and remove its safety guard. Refer to Section 09, "PROPELLER SHAFT".
8. Disconnect the two oil cooler hoses from transmission. Cover hose ends and fittings to prevent fluid contamination.



### WARNING

A significant amount of oil may drain from oil lines when they are disconnected.

9. Disconnect all sensors on L.H. side of the transmission.
10. Disconnect main wiring harness.
11. Disconnect the air supply line (steel-braided hose) from retarder control valve (if applicable).
12. Remove any locking tie, clamp and bracket that may interfere with the removal of transmission.
13. Support transmission using a suitable transmission jack.

### NOTE

Remove starter motor located on engine L.H. side. Removing the starter motor will allow access to unfasten the 12 converter-to-flexible plate attaching screws. Remove the plug located below starter motor and install cranking tool (88800014). Cranking the engine to gain access to the attaching screws may be done by turning the cranking tool using a suitable adapter (Figure 16).

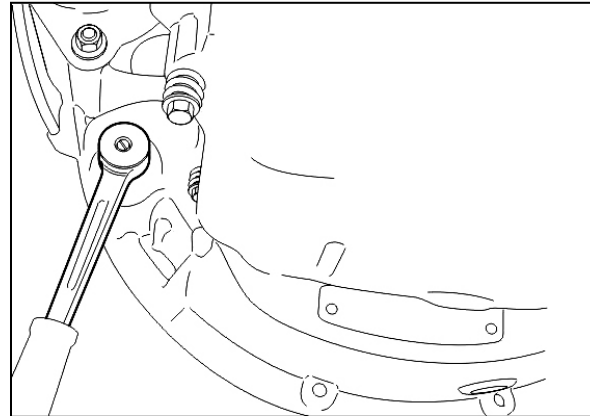


FIGURE 16: VOLVO ENGINE CRANKING POSITION



### CAUTION

Do not rotate alternator shaft clockwise to avoid removing tension on belt.

14. Remove the 12 screws retaining the torque converter housing to the flywheel housing.



### CAUTION

Make sure transmission-to-engine alignment is maintained when removing screws to avoid damaging torque converter housing.

15. Slowly pull transmission straight out to clear the engine.
16. Remove the transmission.

## 8. VOLVO I-SHIFT TRANSMISSION MAINTENANCE

### 8.1 TRANSMISSION OIL TYPE

Keep the transmission oil at the proper level and change it at the Volvo recommended intervals. Always replace the oil filter when the oil is changed. Always use the Volvo approved synthetic oil whenever adding or changing the transmission oil.

Consult "2.2 FLUIDS AND LUBRICANTS SPECIFICATION" in SECTION 24 for appropriate I-Shift transmission oils.

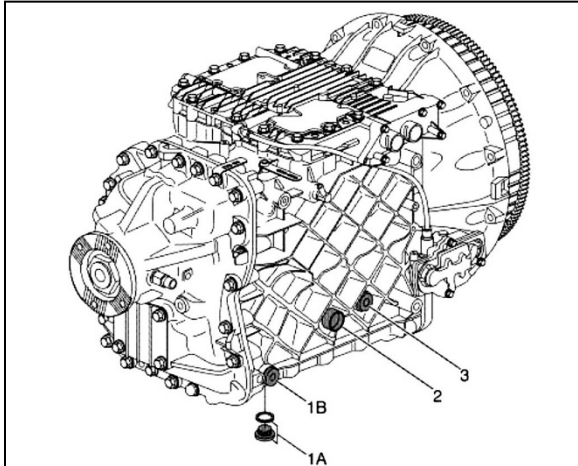


### CAUTION

Never reuse drained I-Shift oil. The oil must be replaced along with the oil filter. Reusing drained oil can result in damage to transmission components.

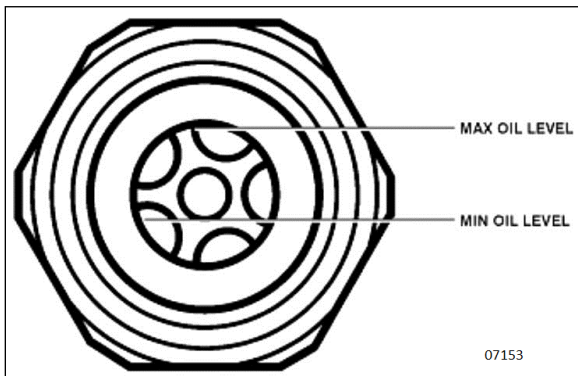
**8.2 CHECKING OIL LEVEL**

Check the transmission oil level at each service interval. Park the vehicle on a level surface. Check the oil level through the sight glass on the side of the transmission. Add oil as necessary. Always use the correct Volvo approved synthetic oil.



**FIGURE 17: I-SHIFT TRANSMISSION OIL CHANGE**

- Vehicle should be on horizontal ground when oil is changed;
- Do not check oil level straight after a journey (incorrect measurement). Undertake the check once the transmission oil has cooled down (lower than 104°F or 40 °C);
- Check oil level using transmission sight glass (2) ;




**FIGURE 18: SIGHT GLASS FOR CHECKING OIL LEVEL**

- Add oil through the oil filling point if necessary (3) ;
- Torque tighten fill plug.

**TORQUE:** 22-30 lb-ft (30-41 Nm)

**8.3 OIL DRAINS INTERVAL**

The length of time a transmission can operate before an oil change is required depends on the quality of the oil used and the vehicle application.



### MAINTENANCE

Always use Volvo approved synthetic oil whenever changing the transmission oil. Always replace the oil filter when the oil is changed.


Refer to “2.2 FLUIDS AND LUBRICANTS SPECIFICATION” in SECTION 24 for appropriate I-Shift transmission oils.

**Extended Drains**

For normal and heavy operating condition, change the transmission oil and filter at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING. This extended oil change interval requires using approved oil for extended drains.

**8.4 OIL CHANGE**

Approximately 15 liters (16 quarts) is needed for a complete oil change.




### WARNING

Hot oil can cause burns. DO NOT allow hot oil to contact the skin. When changing oil, wear protective gloves.

Remove the drain plug from under the transmission (1A or 1B, Figure 17) and allow the oil to drain into a suitable container.

Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug.

**TORQUE:** 18-24 lb-ft (24-33 Nm)



### CAUTION

Always dispose of all lubricants (engine oil, coolant, transmission oil, etc) and filters according to Federal or local regulations.

Change the oil filter (#20779040) at every oil change. Drain the oil filter housing before you remove the filter. Torque tighten oil filter housing drain plug.

**TORQUE:** 11-13 lb-ft (15-18 Nm)

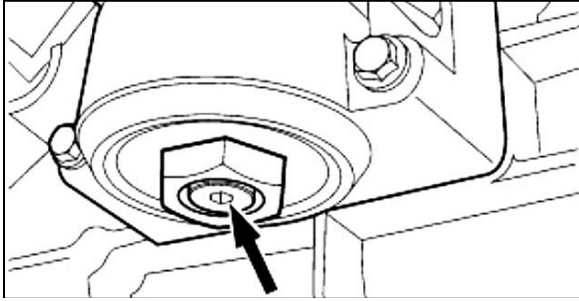


FIGURE 19: OIL FILTER HOUSING DRAIN PLUG

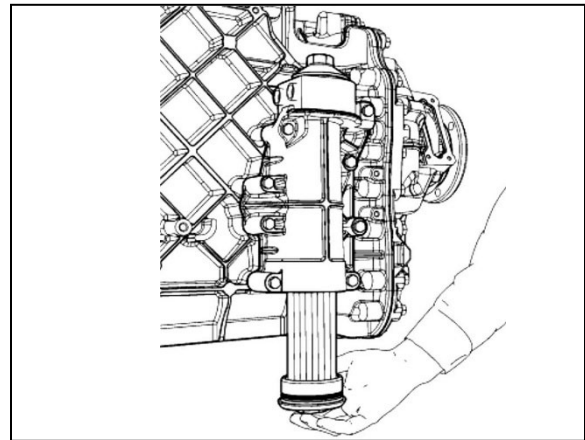


FIGURE 20: OIL FILTER

9. VOLVO I-SHIFT TRANSMISSION TECU FAULT CODES

| FUNCTION                            | PID/SID | FMI<br>J1587 | ERROR   | CONDITION   | SYMPTOM  | COMMENT  |
|-------------------------------------|---------|--------------|---|---|--|--|
| Brake switch                        | PID65   | FMI14        | Brake interlock active                          | <p><b>Activate:</b><br/>The gearlever is moved from neutral without prior application of the service brake</p> <p><b>Deactivate:</b><br/>The gearlever is returned to neutral or the vehicle speed is above 5km/h</p>   | <p>White lamp is sent together with a pop-up message</p> <p>The transmission will not engage the selected gear (stays in neutral)</p>                        | <p><b>Conditions for activation: (and)</b><br/>The brake interlock function is activated (VTNA vehicles only)</p> <p>The vehicle speed is below 5km/h</p> <p>The gear lever is moved from neutral or in folded position without prior activation of the service brake or parking brake</p> <p><b>Conditions for deactivation: (either)</b><br/>The vehicle speed is above 5km/h</p> <p>The gearlever is returned to neutral or folded position</p> |
| Calibration memory                  | SID253  | FMI13        | Out of range                                    | <p><b>Active:</b> Flash CS dataset error or program code missing</p> <p><b>Deactivate:</b> Flash CS OK</p>  | <p>Yellow lamp is sent</p> <p>Cranking is inhibited</p> <p>Engine cannot start</p>   |  |
| Clutch cylinder slip point position | PPID51  | FMI13        | Calibration value out of range                  | <p><b>Activate:</b> 1. The CS in NVRAM is not correct, or 2. The slip point has not been calibrated</p> <p><b>Deactivate:</b> Slip point has been successfully calibrated</p>   | <p>Yellow lamp is sent</p> <p>The vehicle cannot drive</p>   |  |
| Clutch load on plates               | PID50   | FMI0         | Data valid but above normal operational range   | <p><b>Activate:</b> The calculated stored energy is above 200kJ. The energy calculation is time-based for VTNA and physical for others.</p> <p><b>Deactivate:</b> 7.0s after activation and, energy below 180 kJ or neutral, or driving without clutch slip</p> | <p>Yellow lamp is sent</p> <p>Start gear changed to gear 1 in A/D, for RTC also in M</p> <p>The clutch is overheated</p> <p>The clutch is slowly engaged</p> | Clutch load on plates are set without any filtering  |
| Clutch load on plates               |         | FMI11        | Clutch protection active (unidentifiable error) | <p><b>Activate:</b> Only activated for VTNA. Clutch slip more than 8.0s with vehicle movement less than 0.8m (e.g. hill holding event)</p> <p><b>Deactivate:</b> 7.0s</p>   | <p>Yellow lamp is sent</p> <p>Start gear changed to gear 1 in A/D, for RTC also in M</p> <p>There has been unnecessary clutch slip</p>                       |  |

| FUNCTION                                | PID/SID | FMI<br>J1587 | ERROR   | CONDITION   | SYMPTOM  | COMMENT  |
|---|---------|--------------|---|---|--|--|
|   |         |              |   | after activation and, acc pedal released more than 6.0s or neutral, or driving without clutch slip  | The clutch is slowly engaged   |  |
| Clutch load on plates                   |         | FMI14        | Special instructions                          | <b>Activate:</b> If there is an attempt to start on a high range gear or above gear 4 in VTNA in manual mode<br><b>Deactivate:</b> The start gear is changed to an allowed gear   | White lamp is sent<br>Not possible to start  | This fault code is not saved   |
| Clutch plate wear condition             | PID36   | FMIO         | Data valid but above normal operational range | <b>Activate:</b> The clutch wear is more than or equal to "Service due position"<br><b>Deactivate:</b> The clutch disc is replaced and calibrated   | Yellow lamp is sent<br>If active during a long time the clutch may wear out and become damaged                                 |  |
| Clutch position sensor supply (SEPoC5V) | PPID54  | FMIO         | Data valid but above normal operational range | <b>Activate:</b> Voltage is above normal range<br><b>Deactivate:</b> Voltage is within normal range   | Yellow lamp is sent<br>Reduced clutch performance<br>Reduced gearbox comfort at start and marshalling<br>Gear changes are slow |  |
| Clutch position sensor supply (SEPoC5V) |         | FMI1         | Data valid but below operational range        | <b>Activate:</b> Voltage is below normal range<br><b>Deactivate:</b> Voltage is within normal range   | Yellow lamp is sent<br>Reduced clutch performance<br>Reduced gearbox comfort at start and marshalling<br>Gear changes are slow |  |
| Clutch system                           | PSID27  | FMIO         | Unintentional disengagement of the clutch     | <b>Activate:</b> 1. The clutch disengages when not commanded and,<br>2. There is no active fault code on the SEPoC and,<br>3. There is no active fault code for low air pressure and,<br>4. There is no active fault code on any of the clutch cylinder valves and, | Yellow lamp is sent<br>Slow gear changes<br>Low clutch performance   | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>- The clutch has been engaged for less than 10s with inactive engagement valves<br>- The clutch cylinder position has been at least 1mm below the engaged limit at some point during this time<br>- The clutch leaves the engaged state<br>- The clutch disengagement |

**SECTION 07:  
TRANSMISSION**

| FUNCTION      | PID/SID | FMI<br>J1587 | ERROR                                     | CONDITION  | SYMPTOM  | COMMENT  |
|---------------|---------|--------------|---|--|--|--|
|               |         |              |   | 5. The PCB temperature is above a specific limit<br><b>Deactivate:</b> The clutch response is OK   |  | valves are inactive<br>- There is no active fault code on any of the clutch cylinder position sensor (SEPoC) the clutch valves<br>- There is no active fault code for low air pressure<br>- The PCB temperature is above 10 dgC<br><i>The fault is deactivated if any of the following conditions are fulfilled:</i><br>- The clutch has been engaged for more than 20s with inactive engagement valves<br>- There is an active fault code for the clutch cylinder position sensor (SEPoC)   |
| Clutch system |         | FMI1         | Unintentional engagement of the clutch    | <b>Activate:</b> 1. The clutch engages when not commanded and,<br>2. There is no active fault code on the SEPoC and,<br>3. There is no active fault code for low air pressure and,<br>4. There is no active fault code on any of the clutch cylinder valves and,<br>5. The PCB temperature is above a specific limit<br><b>Deactivate:</b> The clutch response is OK | Yellow lamp is sent<br>Slow gear changes<br>Low clutch performance | <b>Algorithm for activation/deactivation</b><br>The following sequence must be passed three times (only once if the fault code-filter is switched OFF) in order to activate:<br>- The clutch is near the disengaged position<br>- All clutch valves are deactivated<br>- The initial average clutch position is calculated during 0.1s<br>- Wait for 3s<br>- The final average clutch position is calculated during 0.1s<br>- If the position has moved more than 1mm in the engagement direction, the FMI is set, else if the clutch has moved less than 0.2mm in the engagement direction the FMI is reset.<br><b>Additional conditions for activation:</b><br>- There is no active fault code on any of the clutch cylinder position sensor (SEPoC) the clutch valves<br>low air pressure<br>- The PCB temperature is above 10dgC |
| Clutch system |         | FMI7         | Mechanical system not responding properly | <b>Activate:</b> 1. The clutch does not disengage/engage properly when commanded<br>2. There is no active fault code on the SEPoC and,<br>3. There is no active fault code for low air   | Yellow lamp is sent<br>Slow gear changes<br>Low clutch performance | <b>Detailed conditions to activate/deactivate</b><br>One of the following conditions must be fulfilled three times in a row in order to activate the fault:<br>- The clutch position is more than 2mm from the disengaged position, after control of the clutch to the disengaged position during 1.0 s<br>- The clutch position is not in   |



| FUNCTION      | PID/SID | FMI<br>J1587 | ERROR                     | CONDITION   | SYMPTOM  | COMMENT  |
|---------------|---------|--------------|---------------------------|---|--|--|
|               |         |              |                           | pressure and,<br>4. There is no active fault code on any of the clutch cylinder valves and,<br>5. The PCB temperature is above 10 dgC<br><b>Deactivate:</b> The clutch response is OK |  | the interval [set point +3mm; set point -1mm] after control of the clutch to near the slip point position during 1.0s<br>- The clutch position is more than 2.5mm from the engaged position, after control of the clutch to the engaged position during 1.0s<br><i>The fault is deactivated after three successful occurrences, of control of the clutch to the requested position in 0.5s</i><br>The fault is also deactivated if<br>- There is an active fault on the clutch position sensor<br>- There is an active fault on any of the clutch valves<br>- There is an active fault code for low air pressure -<br>The PCB temperature is below 10 dgC          |
| Clutch system |         | FMI12        | Unintentional clutch slip | <b>Activate:</b> The clutch can not transfer a specific torque without slipping<br><b>Deactivate:</b> The clutch can transfer a specific torque without slipping                      | Yellow lamp is sent<br>The engine torque is reduced so that the clutch does not continue to slip | <b>Detailed conditions Activation:</b><br>- Clutch slip is detected when the engine torque is already reduced below the "Clutch slip warning torque level" in an attempt to prevent clutch slip. The clutch slip warning level is 2500Nm for MD16 (TMF) variants and 2000Nm for other variants (SMF)<br>- There is no active fault on any of: the sensor for the countershaft speed (SECS) the sensor for the clutch position (SEPoC) and the engine torque & engine speed is received from the engine ECU<br><b>Deactivation:</b><br>The clutch can transfer the maximum engine torque without slipping<br>the fault is also deactivated at startup of the system |
| Clutch system |         | FMI11        | Clutch drag               | <b>Activate:</b> The clutch transfers too much torque in disengaged position<br><b>Deactivate:</b> The clutch transfers no torque in disengaged position                              | Yellow lamp is sent<br>The clutch wear is high   | <b>Algorithm for activation/deactivation</b><br>- Start the check when the counter shaft has been stopped with the brake during slip point calibration when the gearlever is in neutral during normal operation.<br>- Release the brake and check the input shaft speed after 0.5s if input shaft speed > 300rpm, activate this fault code if input shaft speed < 300rpm, deactivate   |

**SECTION 07:  
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| FUNCTION  | PID/SID | FMI<br>J1587 | ERROR                                     | CONDITION  | SYMPTOM  | COMMENT   |
|---|---------|--------------|---|--|--|---|
|   |         |              |   |  |  | this fault code<br>- Continue with the slip point calibration   |
| Digital input flash NVRAM programming enable (DIEE) | PSID254 | FMI3         | Voltage above normal or shorted high      | <b>Activate:</b> The voltage level for DIEE-pin is high<br><b>Deactivate:</b> The voltage for the DIEE-pin is low  | Yellow lamp is sent<br>Cranking is inhibited<br>Engine can not start<br>All communication with the control unit is disabled except from programming of MSW | The boot-program does not save any fault codes  |
| Digital input flash NVRAM programming enable (DIEE) |         | FMI3         | Voltage above normal or shorted high      | <b>Active:</b> The voltage level for DIEE-pin is high<br><b>Deactivate:</b> The voltage for the DIEE-pin is low  | Yellow lamp is sent  | If the DIEE-pin is high during normal operation the fault code is saved.  |
| Fast clutch valves low side (VAF-)                  | PSID5   | FMI3         | Voltage above normal or shorted high      | <b>Activate:</b> The low-side drive is short circuit to Ubatt<br><b>Deactivate:</b> The low-side drive is OK   | Yellow lamp is sent<br>Fast engagement/disengagement disabled<br>Reduced clutch performance<br>Gear changes are slow                                       |   |
| Fast clutch valves low side (VAF-)                  |         | FMI6         | Current above normal or grounded circuit  | <b>Activate:</b> 1. The low-side drive is short circuit to Gnd and<br>2. There is no active fault code for short circuit to Gnd on VAFE or VAFD<br><b>Deactivate:</b> The low-side drive is OK | Yellow lamp is sent<br>Fast engagement/disengagement disabled<br>Reduced clutch performance<br>Gear changes are slow                                       |   |
| Gearbox brake                                       | PSID28  | FMI7         | Mechanical system not responding properly | <b>Activate:</b> The gearbox brake does not brake when the valve is activated  | Yellow lamp is sent<br>Slow gear changes at standstill   | <b>Detailed conditions</b><br>The following conditions must be fulfilled for five activations (only one with the fault code-filter switched OFF) of the gearbox brake in order to activate the fault code:<br>- The activation must last for at least 0.2s<br>- There is no active fault code on the sensor for the split cylinder position (SEPoS)<br>- The minimum valve of the derivative of the input shaft speed during activation is greater than -500 rpm/s<br>- There is no active fault on any of the gearbox brake valve (VAGB) |

| FUNCTION                    | PID/SID | FMI<br>J1587 | ERROR                                       | CONDITION  | SYMPTOM                                       | COMMENT   |
|-----------------------------|---------|--------------|---|--|---|---|
|                             |         |              |   |  |   | <p>the sensor for the countershaft speed (SECS) the sensor for the split cylinder position (SEPoS) low air pressure. The following conditions must be fulfilled for one activation of the gearbox brake <b>in order to deactivate</b>:</p> <ul style="list-style-type: none"> <li>- The minimum value of the derivative of the countershaft speed during the activation is greater than -1000rpm/s</li> </ul> <p>The fault is also deactivated if there is an active fault on the countershaft speed sensor (SESC), on the gearbox brake valve (VAGB), or the split position sensor (SEPoS)</p>   |
| Gears 1/R engagement system | PSID25  | FMI0         | Unintentional disengagement of 1:st gear    | <p><b>Conditions to set the fault code:</b></p> <ul style="list-style-type: none"> <li>-The 1/R cylinder leaves the 1:st position</li> <li>-The 1:st cylinder valves are inactive</li> </ul> | <p>Yellow lamp is sent<br/>Loss of torque</p> | <p><b>Detailed conditions to activate/deactivate</b></p> <p>The following conditions must be fulfilled three times (only one time if the fault code filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> <li>- The 1/R cylinder position indicates that the 1/R gear leaves the 1:st position</li> <li>- The 1:st cylinder valves are inactive</li> <li>- There is no active fault on any of the sensor for the position of the 1/R cylinder (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear</li> <li>- There is no active fault code for low air pressure</li> </ul> <p><i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information.</p> |
| Gears 1/R engagement system |         | FMI1         | Unintentional disengagement of reverse gear | <p><b>Conditions to set the fault code:</b></p> <ul style="list-style-type: none"> <li>-The 1/R gear leaves the reverse position</li> <li>-The 1/R cylinder valves are inactive</li> </ul>   | <p>Yellow lamp is sent<br/>Loss of torque</p> | <p><b>Detailed conditions to activate/deactivate</b></p> <p>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:</p> <p>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> <li>- The 1/R cylinder position indicates that the 1/R gear leaves the reverse position</li> <li>- The 1/R cylinder valves are inactive</li> <li>- There is no active fault on any of the sensor for the</li> </ul>  |

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TRANSMISSION**

| FUNCTION                    | PID/SID | FMI<br>J1587 | ERROR  | CONDITION  | SYMPTOM   | COMMENT  |
|-----------------------------|---------|--------------|--|--|---|--|
|                             |         |              |  |  |   | position of the 1/R cylinder (SEPo1R)<br>the valve for shift to 1:st gear the valve for shift to reverse gear<br>- There is no active fault code for low air pressure<br><i>Note:</i> The fault will always have the state inactive.<br>Check the fault count and last occurrence to get more information.   |
| Gears 1/R engagement system |         | FMI2         | Unintentional disengagement of neutral gear (1:st and reverse gear cylinder) | <b>Conditions to set the fault code:</b><br>-The 1/R gear leaves the neutral position<br>-The 1/R cylinder valves are inactive   | Yellow lamp is sent<br>Loss of torque   | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The 1/R cylinder position indicates that the 1/R gear leaves the neutral position<br>- The 1/R cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the 1/R cylinder (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear<br>- There is no active fault code for low air pressure<br><i>Note:</i> The fault will always have the state inactive.<br>Check the fault count and last occurrence to get more information. |
| Gears 1/R engagement system |         | FMI11        | Blocked engagement of 1:st gear  | <b>Conditions to set the fault code:</b><br>-The 1:st gear can not engage<br>-There is no active fault code on the SEPo1R<br>-There is no active fault code for low air pressure<br>-There is no active fault code on any of the 1:st and reverse gear cylinder valves | Yellow lamp is sent<br>Loss of torque<br>The 1:st gears will not be selected by the system for a short while. After five successful gear changes a new attempt to use 1:st gear may be made | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:(engagement of another gear will reset the count)<br>- The valve for reaching 1:st gear is activated for at least 0.8s<br>- The 1/R cylinder position sensor indicates that 1:st position is not engaged<br>- There is no active fault on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear<br>- There is no active fault code for low air pressure<br>The fault is deactivated if any of the following  |

| FUNCTION                    | PID/SID | FMI<br>J1587 | ERROR   | CONDITION   | SYMPTOM  | COMMENT  |
|-----------------------------|---------|--------------|---|---|--|--|
|                             |         |              |   |   |  | conditions are fulfilled:<br>- The 1/R position sensor indicates that 1:st position is engaged<br>- There is an active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear  |
| Gears 1/R engagement system |         | FMI12        | Blocked engagement of reverse gear                                  | <b>Conditions to set the fault code:</b><br>-The reverse gear can not engage                                  | Yellow lamp is sent<br>The R gear can not engage, but the system will try to engage it as long as the gearlever is in the reverse position | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only one time if the fault code filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The valve for reaching the reverse gear is activated for at least 0.8s<br>- The 1/R cylinder position sensor indicates that R position is not engaged<br>- There is no active fault on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear<br>- There is no active fault code for low air pressure. The fault is deactivated if any of the following conditions are fulfilled:<br>- The 1/R position sensor indicates that R position is engaged<br>- There is an active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear |
| Gears 1/R engagement system |         | FMI7         | Blocked engagement of neutral gear (1:st and reverse gear cylinder) | <b>Conditions to set the fault code:</b><br>-The neutral gear (1:st and reverse gear cylinder) can not engage | Yellow lamp is sent  | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The valve for reaching the reverse gear is activated for at least 0.8s<br>- The 1/R cylinder position sensor indicates that neutral position is not engaged<br>- There is no active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st  |

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| FUNCTION                    | PID/SID | FMI<br>J1587 | ERROR                                    | CONDITION  | SYMPTOM                               | COMMENT  |
|-----------------------------|---------|--------------|--|--|---------------------------------------|--|
|                             |         |              |  |  |                                       | gear the valve for shift to reverse gear<br>- There is no active fault code for low air pressure<br>The fault is deactivated if any of the following conditions are fulfilled:<br>- The 1/R position sensor indicates that neutral position is engaged<br>- There is an active fault code on any of the 1/R position sensor (SEPo1R) the valve for shift to 1:st gear the valve for shift to reverse gear  |
| Gears 2/3 engagement system | PSID26  | FMI0         | Unintentional disengagement of 2:nd gear | <b>Conditions to set the fault code:</b><br>-The 2/3 cylinder position indicates that the 2/3 gear leaves the 2:nd position<br>- The 2:nd cylinder valves are inactive | Yellow lamp is sent<br>Loss of torque | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only one time if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The 2/3 cylinder position indicates that the 2/3 gear leaves the 2:nd position<br>- The 2:nd cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear<br>- There is no active fault code for low air pressure<br><i>Note:</i> The fault will always have the state inactive. Check the fault count and last occurrence to get more information. |
| Gears 2/3 engagement system |         | FMI1         | Unintentional disengagement of 3:rd gear | <b>Conditions to set the fault code:</b><br>-The 2/3 cylinder leaves the 3:rd position<br>- The 3:rd cylinder valves are inactive                                      | Yellow lamp is sent<br>Loss of torque | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The 2/3 cylinder position indicates that the 2/3 gear leaves the 3:rd position<br>- The 3:rd cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear<br>- There is no active fault   |

| FUNCTION                    | PID/SID | FMI<br>J1587 | ERROR   | CONDITION   | SYMPTOM  | COMMENT   |
|-----------------------------|---------|--------------|---|---|--|---|
|                             |         |              |   |   |  | code for low air pressure<br><i>Note:</i> The fault will always have the state inactive.<br>Check the fault count and last occurrence to get more information.  |
| Gears 2/3 engagement system |         | FMI2         | Unintentional disengagement of neutral gear (2:nd and 3:rd gear cylinder) | <b>Conditions to set the fault code:</b><br>-The 2/3 cylinder leaves the neutral position<br>- The 2/3 cylinder valves are inactive | Yellow lamp is sent  | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The 2/3 cylinder position indicates that the 2/3 gear leaves the neutral position<br>- The 2/3 cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the 2/3 cylinder (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear<br>- There is no active fault code for low air pressure<br><i>Note:</i> The fault will always have the state inactive.<br>Check the fault count and last occurrence to get more information.   |
| Gears 2/3 engagement system |         | FMI11        | Blocked engagement of 2:nd gear   | <b>Conditions to set the fault code:</b><br>-The 2:nd gear can not engage   | Yellow lamp is sent<br>Loss of torque<br>The 2:nd gear will not be selected by the system for a short while. After five successful gearshifts a new attempt to use 2:nd gear may be made | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The valve for reaching 2:nd gear is activated for at least 0.8s<br>- The 2/3 cylinder position sensor indicates that 2:nd position is not engaged<br>- There is no active fault on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear<br>- There is no active fault code for low air pressure<br><i>The fault is deactivated if any of the following conditions are fulfilled:</i><br>- The 2/3 position sensor indicates that 2:nd 2:nd position is engaged<br>- There is an active fault code on any of the 2/3 position sensor (SEPo23) |

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| FUNCTION                    | PID/SID | FMI<br>J1587 | ERROR  | CONDITION  | SYMPTOM  | COMMENT  |
|-----------------------------|---------|--------------|--|--|--|--|
|                             |         |              |  |  |  | the valve for shift to 2:nd gear the valve for shift to 3:rd gear  |
| Gears 2/3 engagement system |         | FMI12        | Blocked engagement of 3:rd gear                                  | <b>Conditions to set the fault code:</b><br>-The 3:rd gear can not engage                              | Yellow lamp is sent<br>Loss of torque<br>The 3:rd gear will not be selected by the system for a short while. After five successful gearshifts a new attempt to use 3:rd gear may be made | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The valve for reaching 3:rd gear is activated for at least 0.8s<br>- The 2/3 cylinder position sensor indicates that 3:rd position is not engaged<br>- There is no active fault on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear<br>- There is no active fault code for low air pressure<br><i>The fault is deactivated if any of the following conditions are fulfilled:</i><br>- The 2/3 position sensor indicates that 3:rd position is engaged<br>- There is an active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear |
| Gears 2/3 engagement system |         | FMI7         | Blocked engagement of neutral gear (2:nd and 3:rd gear cylinder) | <b>Conditions to set the fault code:</b><br>-The neutral gear (2:nd 3:rd gear cylinder) can not engage | Yellow lamp is sent  | <b>Detailed conditions to activate/deactivate</b><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The valve for reaching gear (2:nd and 3:rd gear cylinder) is activated for at least 0.8s<br>- The 2/3 cylinder position sensor indicates that neutral position is not engaged<br>- There is no active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear<br>- There is no active fault code for low air pressure<br><i>The fault is deactivated if any of the following conditions are fulfilled:</i>   |



| FUNCTION                        | PID/SID | FMI<br>J1587 | ERROR                                     | CONDITION  | SYMPTOM   | COMMENT  |
|---------------------------------|---------|--------------|---|--|---|--|
|                                 |         |              |   |  |   | - The 2/3 position sensor indicates that neutral position is engaged<br>- There is an active fault code on any of the 2/3 position sensor (SEPo23) the valve for shift to 2:nd gear the valve for shift to 3:rd gear |
| J1708/J1587                     | SID250  | FMI9         | Abnormal update rate                      | <b>Activate:</b> The FMI shall be set if any of the messages* have not been received on the bus for 30s<br><b>Deactivate:</b> The FMI shall be cleared if all messages* are sent on the bus *PID190, PID85 and PPID212 | Yellow lamp is sent<br>Fault codes can not be read<br>On-vehicle tests can not be performed                 |  |
| J1939                           | SID231  | FMI2         | Data erratic, intermittent or incorrect   | <b>Active:</b> This FMI shall be set if the CAN transceiver signals "bus-off"<br><b>Deactivate:</b> FMI cleared if CAN-transceiver does not signal "bus-off"   | Yellow lamp is sent<br>Much reduced gear selection and gear change performance                              |  |
| Missing data on J1939 form BECU | PSID204 | FMI8         | Abnormal frequency, pulse width or period | <b>Activate:</b> The FMI shall be set if the wheel speeds from the BECU (MID136) are incorrect<br><b>Deactivate:</b> The FMI shall be cleared if the wheel speeds from the BECU (MID136) are correct                   | Yellow lamp<br>Automatic gear selection enters backup mode with gear changes only at certain vehicle speeds |  |
| Missing data on J1939 form BECU |         | FMI9         | Abnormal update rate                      | <b>Activate:</b> The FMI shall be set if message WSI from BECU (MID136) is not received within 1s<br><b>Deactivate:</b> The FMI shall be cleared if message WSI is received at normal rate                             | Yellow lamp<br>Automatic gear selection enters backup mode with gear changes only at certain vehicle speeds |  |
| Missing data on J1939 form GECU | PSID207 | FMI9         | Abnormal update rate                      | <b>Activate:</b> The FMI shall be set if message VP6 from GECU (MID223) is not received within 1s  | Yellow lamp<br>Slow response on manual gear changes and slow response when buttons                          |  |

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| <b>FUNCTION</b>   | <b>PID/SID</b> | <b>FMI<br/>J1587</b> | <b>ERROR</b>         | <b>CONDITION</b>  | <b>SYMPTOM</b>  | <b>COMMENT</b> |
|---|----------------|----------------------|----------------------|---|---|----------------|
|   |                |                      |                      | <b>Deactivate:</b> The FMI shall be cleared if message VP6 is received at normal rate   | are pressed on the gear lever.  |                |
| Missing data on J1939 from the adaptive cruise control    | <b>PSID211</b> | FMI9                 | Abnormal update rate | <b>Activate:</b> The FMI shall be set if message ACC1 from ACC (MID219) is not received within 1s, and ACC is installed<br><b>Deactivate:</b> The FMI shall be cleared if message ACC1 is received at normal rate | Yellow lamp<br>The retarder ACC function does not work  |                |
| Missing data on J1939 from the EMS                        | <b>PSID200</b> | FMI9                 | Abnormal update rate | <b>Activate:</b> The FMI shall be set if message EEC1 from EECU is not received within 200ms<br><b>Deactivate:</b> The FMI shall be cleared if message EEC1 is received at normal rate                            | Yellow lamp<br>If there is no POWERTRAIN_CAN, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds<br>If there is no Powertrain_CAN and the engine does not receive any messages from the TECU, the gear changes will be slow |                |
| Missing data on J1939 from the light control module (LCM) | <b>PSID210</b> | FMI9                 | Abnormal update rate | <b>Activate:</b> The FMI shall be set if message VP37 from LCM (MID216) is not received within 10s<br><b>Deactivate:</b> The FMI shall be cleared if message VP37 is received at normal rate                      | Yellow lamp<br>The start gear might be wrong<br>Automatic gear selection performance might be reduced a certain time after start<br>Automatic gear selection performance might be reduced a certain time after a trailer has been connected/disconnected              |                |
| Missing data on J1939 from the suspension ECU (ECS)       | <b>PSID208</b> | FMI9                 | Abnormal update rate | <b>Activate:</b> The FMI shall be set if message VW from ECS (MID150) is not received within 10s, and ECS is  | Yellow lamp<br>The start gear might be wrong after loading and unloading  |                |

| FUNCTION                        | PID/SID | FMI<br>J1587 | ERROR                                     | CONDITION  | SYMPTOM   | COMMENT  |
|---------------------------------|---------|--------------|---|--|---|--|
|                                 |         |              |   | installed<br><b>Deactivate:</b> The FMI shall be cleared if message VW is received at normal rate  |   |  |
| Missing data on J1939 from VECU | PSID201 | FMI8         | Abnormal frequency, pulse width or period | <b>Activate:</b> The FMI shall be set if the acc pedal pos or service brake-switch from the VECU (MID144) is incorrect<br><b>Deactivate:</b> The FMI shall be cleared if the acc pedal pos and service brake-switch from the VECU (MID144) are correct | Yellow lamp<br>If pedal pos is undefined, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds<br>If pedal pos is undefined, gearbox comfort at start and marshalling might be reduced<br>If service brake is undefined, automatic gear selection enters backup mode with gear changes only at certain vehicle speeds |  |
| Missing data on J1939 from VECU |         | FMI9         | Abnormal update rate                      | <b>Activate:</b> The FMI shall be set if message VP2 from VECU (MID144) is not received within 100ms<br><b>Deactivate:</b> The FMI shall be cleared if message VP2 is received at normal rate  | Yellow lamp<br>Automatic gear selection enters backup mode with gear changes only at certain vehicle speeds<br>Gearbox comfort at start and marshalling might be reduced  |  |
| Powertrain CAN                  | PSID232 | FMI2         | Data erratic, intermittent or incorrect   | <b>Activate:</b> The FMI shall be set if the CAN transceiver signals "busOFF"<br><b>Deactivate:</b> The FMI shall be cleared if the CAN-transceiver does not signal "busOFF"   | Yellow lamp is sent<br>Reduced automatic gear selection and gear change performance   | This fault code is only valid for vehicles where a Pwertrain_CAN link exist between the TECU and the engine. |
| Powertrain CAN                  |         | FMI9         | Abnormal update rate                      | <b>Activate:</b> The FMI shall be set if message VP24/MID128 is not received within 100ms<br><b>Deactivate:</b> The FMI shall be   | Yellow lamp is sent<br>Reduced automatic gear selection and gear change performance   |  |

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| FUNCTION                | PID/SID | FMI<br>J1587 | ERROR                                     | CONDITION   | SYMPTOM  | COMMENT   |
|-------------------------|---------|--------------|---|---|--|---|
|                         |         |              |   | cleared if message VP24/MID128 is received at normal rate   |  |   |
| Program memory          | SID240  | FMI2         | Data erratic, intermittent or incorrect   | <b>Activate:</b> Flash CS error or program code missing<br><b>Deactivate:</b> Flash CS OK   | Yellow lamp is sent<br>Cranking is inhibited<br>Engine can not start |   |
| Range engagement system | PSID24  | FMIO         | Unintentional disengagement of low range  | <b>Conditions to set the fault code:</b><br>-The range cylinder leaves the low range position<br>-The range cylinder valves are inactive  | Yellow lamp is sent<br>Loss of torque                                | <b>Detailed conditions to activate/deactivate:</b><br><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The range cylinder position indicates that range gear leaves the low range position<br>- The range cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the range cylinder (SEPoR) the valve for shift to high range the valve for shift to low range<br>- There is no active fault code for low air pressure<br>note: The fault will always have the state inactive.<br>Check fault-count and last occurrence to get more information |
| Range engagement system |         | FMI1         | Unintentional disengagement of high range | <b>Conditions to set the fault code:</b><br>-The range cylinder leaves the high range position<br>-The range cylinder valves are inactive | Yellow lamp is sent<br>Loss of torque                                | <b>Detailed conditions to activate/deactivate:</b><br><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The range cylinder position indicates that the range gear leaves the high range position<br>- The range cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the range cylinder (SEPoR) the valve for shift to high range the valve for shift to low range<br>- There is no active fault code for low air pressure   |

| FUNCTION                | PID/SID | FMI<br>J1587 | ERROR                            | CONDITION   | SYMPTOM                               | COMMENT  |
|-------------------------|---------|--------------|----------------------------------|---|---------------------------------------|--|
|                         |         |              |                                  |   |                                       | <p><i>note:</i> The fault will always have the state inactive. Check fault-count and last occurrence to get more information</p>   |
| Range engagement system |         | FMI11        | Blocked engagement of low range  | <p><b>Conditions to set the fault code:</b><br/>-The low range gear can not engage</p>  | Yellow lamp is sent<br>Loss of torque | <p><b>Detailed conditions to activate/deactivate:</b></p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br/>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> <li>- The low range can not engage within 3.8s</li> <li>- The gearbox oil temperature is above 10dgC</li> <li>- There is no active fault code on any of the sensor for the position of the range cylinder (SEPoR) low air pressure the range cylinder valves</li> </ul> <p><b>The fault is deactivated if any of the following conditions are fulfilled:</b></p> <ul style="list-style-type: none"> <li>- The range cylinder position sensor indicates that low range is engaged</li> <li>- The gearbox oil temperature is below 10dgC</li> <li>- There is an active fault on any of the sensor for the position of the range cylinder (SEPoR) low air pressure the range cylinder valves</li> </ul> |
| Range engagement system |         | FMI12        | Blocked engagement of high range | <p><b>Conditions to set the fault code:</b><br/>-The high range gear can not engage</p> | Yellow lamp is sent<br>Loss of torque | <p><b>Detailed conditions to activate/deactivate:</b></p> <p>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br/>(engagement of another gear will reset the count)</p> <ul style="list-style-type: none"> <li>- The high range gear can not engage within 3.8s</li> <li>- The gearbox oil temperature is above 10dgC</li> <li>- There is no active fault on any of the range position sensor (SEPoR) low air pressure the range cylinder valves</li> <li>- There is no active fault code for low air pressure</li> </ul> <p><b>The fault is deactivated if any of the following conditions are fulfilled:</b></p> <ul style="list-style-type: none"> <li>- The range cylinder position</li> </ul>  |

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| FUNCTION   | PID/SID | FMI<br>J1587 | ERROR                                    | CONDITION   | SYMPTOM  | COMMENT  |
|--|---------|--------------|--|---|--|--|
|  |         |              |  |   |  | sensor indicates that high range is engaged<br>- The gearbox oil temperature is below 10dgC<br>- There is an active fault code on any of the range position sensor (SEPoR)<br>low air pressure the range cylinder valves   |
| Sensor for the 1:st and reverse gear cylinder (SEPo1R) | PPID10  | FMI2         | Data erratic, intermittent or incorrect  | <b>Activate:</b> The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered.<br><b>Deactivate:</b> | Yellow lamp is sent<br>Slow gear changes                             | <b>Detailed conditions to activate / deactivate:</b><br><b>Activate:</b> The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set.<br><b>Deactivate:</b><br>Fault code stays until a clear DTC command is received |
| Sensor for the 1:st and reverse gear cylinder (SEPo1R) |         | FMI3         | Voltage above normal or shorted high     | <b>Activate:</b> Status from the ASIC is short circuit to Ubatt<br><b>Deactivate:</b><br>Status is OK   | Yellow lamp is sent<br>Slow gear changes                             |  |
| Sensor for the 1:st and reverse gear cylinder (SEPo1R) |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> Status from the ASIC is open circuit<br><b>Deactivate:</b><br>Status is OK   | Yellow lamp is sent<br>Slow gear changes                             |  |
| Sensor for the 1:st and reverse gear cylinder (SEPo1R) |         | FMI6         | Current above normal or grounded circuit | <b>Activate:</b> Status from the ASIC is short circuit to Gnd<br><b>Deactivate:</b><br>Status is OK   | Yellow lamp is sent<br>Slow gear changes                             |  |
| Sensor for the 1:st and reverse gear cylinder (SEPo1R) |         | FMI13        | Calibration value out of range           | <b>Activate:</b> The Checksum of the NVRAM is not correct, or the sensor has not been calibrated<br><b>Deactivate:</b><br>Sensor signal has been successfully calibrated                            | Yellow lamp is sent<br>Cranking is inhibited<br>Engine can not start |  |

| FUNCTION  | PID/SID | FMI<br>J1587 | ERROR   | CONDITION   | SYMPTOM   | COMMENT   |
|---|---------|--------------|---|---|---|---|
| Sensor for the inclination of the gearbox (SEIG)                    | PPID140 | FMI2         | Data erratic, intermittent or incorrect       | <b>Activate:</b> 1. The sensor signal is above or below normal range and 2. The vehicle has been standing still for a specific time<br><b>Deactivate:</b> The sensor signal is in the normal range  | Yellow lamp is sent<br>The start gear might be wrong<br>Gear selection performance might be reduced<br>Downhill and uphill gear change performance may be reduced |   |
| Sensor for the PCB temperature                                      | PPID55  | FMI0         | Data valid but above normal operational range | <b>Activate:</b> temp above 125dgC<br><b>Deactivate:</b> temp below 125dgC  | Yellow lamp is sent   |   |
| Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23) | PPID11  | FMI2         | Data erratic, intermittent or incorrect       | <b>Activate:</b> The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered.<br><b>Deactivate:</b> | Yellow lamp is sent<br>Slow gear changes  | <b>Detailed conditions to activate / deactivate:</b><br><b>Activate:</b> The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set.<br><b>Deactivate:</b> Fault code stays until a clear DTC command is received |
| Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23) |         | FMI3         | Voltage above normal or shorted high          | <b>Activate:</b> Status from the ASIC is short circuit to Ubatt<br><b>Deactivate:</b> Status is OK  | Yellow lamp is sent<br>Slow gear changes  |   |
| Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23) |         | FMI5         | Current below normal or open circuit          | <b>Activate:</b> Status from the ASIC is open circuit<br><b>Deactivate:</b> Status is OK  | Yellow lamp is sent<br>Slow gear changes  |   |
| Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23) |         | FMI6         | Current above normal or grounded circuit      | <b>Activate:</b> Status from the ASIC is short circuit to Gnd<br><b>Deactivate:</b> Status is OK  | Yellow lamp is sent<br>Slow gear changes  |   |

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| FUNCTION  | PID/SID | FMI<br>J1587 | ERROR                                    | CONDITION   | SYMPTOM  | COMMENT   |
|---|---------|--------------|--|---|--|---|
| Sensor for the position of the 2:nd and 3:rd gear cylinder (SEPo23) |         | FMI13        | Calibration value out of range           | <b>Activate:</b> The Checksum of the NVRAM is not correct, or the sensor has not been calibrated<br><b>Deactivate:</b> Sensor signal has been successfully calibrated                               | Yellow lamp is sent<br>Cranking is inhibited<br>Engine can not start |   |
| Sensor for the position of the range (SEPoR)                        | PID31   | FMI2         | Data erratic, intermittent or incorrect  | <b>Activate:</b> The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered.<br><b>Deactivate:</b> | Yellow lamp is sent<br>Slow gear changes                             | <b>Detailed conditions to activate / deactivate:</b><br><b>Activate:</b> The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set.<br><b>Deactivate:</b> Fault code stays until a clear DTC command is received |
| Sensor for the position of the range (SEPoR)                        |         | FMI3         | Voltage above normal or shorted high     | <b>Activate:</b> Status from the ASIC is short circuit to Ubatt<br><b>Deactivate:</b> Status is OK  | Yellow lamp is sent<br>Slow gear changes                             |   |
| Sensor for the position of the range (SEPoR)                        |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> Status from the ASIC is open circuit<br><b>Deactivate:</b> Status is OK  | Yellow lamp is sent<br>Slow gear changes                             |   |
| Sensor for the position of the range (SEPoR)                        |         | FMI6         | Current above normal or grounded circuit | <b>Activate:</b> Status from the ASIC is short circuit to Gnd<br><b>Deactivate:</b> Status is OK  | Yellow lamp is sent<br>Slow gear changes                             |   |
| Sensor for the position of the range (SEPoR)                        |         | FMI13        | Calibration value out of range           | <b>Activate:</b> The Checksum of the NVRAM is not correct, or the sensor has not been calibrated<br><b>Deactivate:</b> Sensor signal has been successfully calibrated                               | Yellow lamp is sent<br>Cranking is inhibited<br>Engine can not start |   |



| FUNCTION   | PID/SID | FMI<br>J1587 | ERROR   | CONDITION   | SYMPTOM  | COMMENT  |
|--|---------|--------------|---|---|--|--|
| Sensor for the position of the Split (SEPoS)       | PID32   | FMI2         | Data erratic, intermittent or incorrect       | <b>Activate:</b> The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered.<br><b>Deactivate:</b> | Yellow lamp is sent<br>Slow gear changes                             | <b>Detailed conditions to activate / deactivate:</b><br><b>Activate:</b> The position sensor is distributing a temperature-signal from the sensor ASIC, if the value from this sensor deviates too much this fault code is triggered, the diagnostics are based upon cross-reference between all four position-sensors. This means that if the value differs more than +/- 20dgC from the average-temp, if the temperature is out of boundary -60dgC to +160dgC or if the temperature changes at a rate higher than 10dgC during 15s, then this fault code is set.<br><b>Deactivate:</b><br>Fault code stays until a clear DTC command is received |
| Sensor for the position of the Split (SEPoS)       |         | FMI3         | Voltage above normal or shorted high          | <b>Activate:</b> Status from the ASIC is short circuit to Ubatt<br><b>Deactivate:</b><br>Status is OK   | Yellow lamp is sent<br>Slow gear changes                             |  |
| Sensor for the position of the Split (SEPoS)       |         | FMI5         | Current below normal or open circuit          | <b>Activate:</b> Status from the ASIC is open circuit<br><b>Deactivate:</b><br>Status is OK   | Yellow lamp is sent<br>Slow gear changes                             |  |
| Sensor for the position of the Split (SEPoS)       |         | FMI6         | Current above normal or grounded circuit      | <b>Activate:</b> Status from the ASIC is short circuit to Gnd<br><b>Deactivate:</b><br>Status is OK   | Yellow lamp is sent<br>Slow gear changes                             |  |
| Sensor for the position of the Split (SEPoS)       |         | FMI13        | Calibration value out of range                | <b>Activate:</b> The Checksum of the NVRAM is not correct, or the sensor has not been calibrated<br><b>Deactivate:</b><br>Sensor signal has been successfully calibrated                            | Yellow lamp is sent<br>Cranking is inhibited<br>Engine can not start |  |
| Sensor for the pressure of the supply air (SEPrSA) | PID37   | FMI0         | Data valid but above normal operational range | <b>Activate:</b> 1. Sensor signal is in normal range<br>2. Pressure is above 10.0 [bar]<br><b>Deactivate:</b> 1. Sensor signal is in normal range<br>2. Pressure is below 10.0 [bar]                | Yellow lamp is sent<br>reduced clutch performance                    |  |
| Sensor for the pressure                            |         | FMI1         | Data valid but below                          | <b>Activate:</b> 1. Sensor signal is in normal range  | Yellow lamp is sent<br>The symbol for                                |  |

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| FUNCTION   | PID/SID | FMI<br>J1587 | ERROR                                  | CONDITION  | SYMPTOM   | COMMENT   |
|--|---------|--------------|--|--|---|---|
| of the supply air (SEPrSA)                         |         |              | operational range                      | 2. Pressure is below 5.0 [bar]<br><b>Deactivate:</b> 1. Sensor signal is in normal range<br>2. Pressure is above 5.0 [bar]   | compressed air, gearbox is sent<br>Gear changes may be absent<br>Reduced clutch performance   |   |
| Sensor for the pressure of the supply air (SEPrSA) |         | FMI3         | Voltage above normal or shorted high   | <b>Activate:</b> The sensor signal is above normal range<br><b>Deactivate:</b> The sensor signal is in normal range  | Yellow lamp is sent   |   |
| Sensor for the pressure of the supply air (SEPrSA) |         | FMI5         | Current below normal or open circuit   | <b>Activate:</b> The sensor signal is below normal range<br><b>Deactivate:</b> The sensor signal is in normal range  | Yellow lamp is sent   |   |
| Sensor for the speed on the counter shaft (SESC)   | PID161  | FMI1         | Data valid but below operational range | <b>Activate:</b> 1. The sensor signal is within normal range and,<br>2. The counter shaft speed differs from both the main shaft speed (SESM) and the vehicle speed received from the vehicle ECU when the counter shaft is rotating<br><b>Deactivate:</b> 1. The sensor signal is within normal range<br>2. The counter shaft speed and the main shaft speed are equal when the counter shaft is rotating | Yellow lamp is sent<br>Reduced gear change performance<br>Gearbox brake up shifts can not be used<br>Slip point can not be updated which will give reduced performance at starts<br>Start gear engagement only possible at standstill and when the vehicle speed is high enough to synchronize the main box with the engine | Detailed condition to activate:<br>The following conditions must be fulfilled for a time of 2.0s in order to activate:<br>A gear (not neutral) is engaged in the gearbox<br>The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm<br>-The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the main shaft speed sensor (SESM) differ more than 50rpm<br>-The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the vehicle speed received from the vehicle ECU differ more than 30rpm<br>-The values of the input shaft speed calculated from the main shaft speed sensor (SESM) and the vehicle speed received from the vehicle ECU differ less than 30rpm<br>-There is no active fault on any of<br>-The sensor for the main shaft speed (SESM)<br>-The sensor for the position of the split cylinder (SEPoS)<br>-The sensor for the position of the shift cylinder1R |

**SECTION 07: TRANSMISSION**

| FUNCTION | PID/SID | FMI<br>J1587 | ERROR | CONDITION | SYMPTOM | COMMENT  |
|----------|---------|--------------|-------|-----------|---------|--|
|          |         |              |       |           |         | <p>(SEPo1R)<br/>                     -The sensor for the position of the shift cylinder 23 (SEPo23)<br/>                     -The sensor for the position of teh range cylinder (SEPoR)</p> <p>The fault is deactivated if the following conditions are fulfilled for a time of 2.0s:<br/>                     -A gear (not neutral) is engaged in the gearbox<br/>                     -The value of the input shaft speed calculated from the countershaft speed sensor (SESC) is more than 300rpm, or<br/>                     -the value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm<br/>                     -The values of the input shaft speed calculated from the countershaft speed sensor (SESC) and the main shaft speed sensor (SESM) differ less than 50rpm</p> <p>The fault is also deactivated if the following conditions are fulfilled for a time of 2.0s:<br/>                     -A neutral gear is engaged in the gearbox<br/>                     -The engine speed is above 400rpm<br/>                     -The clutch is engaged<br/>                     -Direct or indirect split is engaged<br/>                     -The values of the input shaft speed is calculated from the counter shaft speed sensor (SESC) and the engine speed received from the engine ECU differ less than 50 rpm</p> <p>The fault is also deactivated if the signal from the countershaft speed sensor (SESC) is not within normal range or if there is an active fault code on any of:<br/>                     -The clutch position sensor (SEPoC)<br/>                     -The sensor for the position of the split cylinder (SEPoS)<br/>                     -The sensor for the position of the shift cylinder1R (SEPo1R)<br/>                     -The sensor for the position of the shift cylinder 23 (SEPo23)<br/>                     -The sensor for the position of teh range cylinder (SEPoR)</p> |

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| <b>FUNCTION</b>                                  | <b>PID/SID</b> | <b>FMI<br/>J1587</b> | <b>ERROR</b>                           | <b>CONDITION</b>  | <b>SYMPTOM</b>  | <b>COMMENT</b>  |
|--|----------------|----------------------|--|---|---|---|
| Sensor for the speed on the counter shaft (SESC) |                | FMI4                 | Voltage below normal or shorted low    | <b>Activate:</b> The sensor signal is below normal range.<br><b>Deactivate:</b> The sensor signal is within normal range  | Yellow lamp is sent<br>Reduced gear change performance<br>Gearbox brake up shifts can not be used<br>Slip point cannot be updated which will give reduced performance at starts<br>Start gear engagement only possible at standstill and when the vehicle speeds is high enough to synchronize the main box with the engine |   |
| Sensor for the speed on the counter shaft (SESC) |                | FMI5                 | Current below normal or open circuit   | <b>Activate:</b> The sensor signal is above normal range<br><b>Deactivate:</b> The sensor signal is within normal range   | Yellow lamp is sent<br>Reduced gear change performance<br>Gearbox brake up shifts can not be used<br>Slip point cannot be updated which will give reduced performance at starts<br>Start gear engagement only possible at standstill and when the vehicle speed is high enough to synchronize the main box with the engine  |   |
| Sensor for the speed on the main shaft (SESM)    | <b>PID160</b>  | FMI1                 | Data valid but below operational range | <b>Activate:</b> 1. Sensor signal is within normal range and 2. The main shaft speed differs from both the value of the countershaft speed and the vehicle speed received from the vehicle ECU<br><b>Deactivate:</b> 1. Sensor signal is within normal range and, 2. The main | Yellow lamp is sent<br>Reduced gear change performance<br>Reduced gear change comfort   | Detailed condition to activate:<br>The following conditions must be fulfilled for a time of 2.0s in order to activate:<br>A gear (not neutral) is engaged in the gearbox<br>The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm<br>The values of the input shaft speed calculated from the |

**SECTION 07: TRANSMISSION**

| FUNCTION | PID/SID | FMI<br>J1587 | ERROR | CONDITION   | SYMPTOM | COMMENT  |
|----------|---------|--------------|-------|---|---------|--|
|          |         |              |       | <p><i>shaft speed and the counter shaft speed are equal when the main shaft is rotating</i></p> |         | <p>main shaft speed sensor (SESM) and the counter shaft speed sensor (SESC) differ more than 50rpm<br/>                     The values of the input shaft speed calculated from the main shaft speed sensor (SESM) and the vehicle speed received from the vehicle ECU differ more than 30rpm<br/>                     The values of the input shaft speed calculated from the counter shaft speed sensor (SESC) and the vehicle speed received from the vehicle ECU differ less than 30rpm<br/>                     There is no active fault on any of<br/>                     The sensor for the countershaft speed (SECS)<br/>                     The sensor for the position of the split cylinder (SEPoS)<br/>                     The sensor for the position of the shift cylinder1R (SEPo1R)<br/>                     The sensor for the position of the shift cylinder 23 (SEPo23)<br/>                     The sensor for the position of teh range cylinder (SEPoR)<br/>                     The following conditions must be fulfilled for a time of 2.0s in order to deactivate:<br/>                     A gear (not neutral) is engaged in the gearbox<br/>                     The value of the input shaft speed calculated from the main shaft speed sensor (SESM) is more than 300rpm, or the value of the input shaft speed calculated from the counter shaft speed sensor (SESC) is more than 300rpm<br/>                     The value of the input shaft speed calculated from the main shaft speed sensor (SESM) and the counter shaft speed sensor (SESC) differ less than 50rpm<br/>                     The fault is also deactivated if<br/>                     The sensor signal (SESM) is not within normal range<br/>                     There is an active fault on any of<br/>                     The sensor for the countershaft speed (SECS)<br/>                     The sensor for the position of the split cylinder (SEPoS)<br/>                     The sensor for the position of the shift cylinder1R (SEPo1R)<br/>                     The sensor for the position of the shift cylinder 23 (SEPo23)</p> |

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| FUNCTION                                     | PID/SID | FMI<br>J1587 | ERROR                                   | CONDITION   | SYMPTOM   | COMMENT  |
|--|---------|--------------|---|---|---|--|
|  |         |              |   |   |   | The sensor for the position of the range cylinder (SEPoR)  |
| Sensor for the speed on the mainshaft (SESM) |         | FMI2         | Data erratic, intermittent or incorrect | <p><b>Activate:</b> The sensor indicates wrong traveling direction</p> <p><b>Deactivate:</b> The sensor indicates correct traveling direction</p> | <p>Yellow lamp is sent</p> <p>Reduced gear change performance</p> | <p>Detailed conditions to activate</p> <p>The following conditions must be fulfilled for a time of 2.0s in order to activate:</p> <p>The input shaft speed calculated from the countershaft speed sensor (SESC) is above 300 rpm and the clutch is engaged or The input shaft speed calculated from the countershaft speed sensor (SECS) is above 600 rpm, the clutch position is more engaged than the slip point and the engine speed is received from the engine ECU and above 600rpm.</p> <p>A forward gear is engaged in the gearbox and the main shaft speed sensor (SESM) indicates reverse movement or a reverse gear is engaged and the main shaft speed sensor (SESM) indicates forward movement</p> <p>There is no other active fault on the sensor for the main shaft speed (SESM)</p> <p>There is no active fault on any of:</p> <ul style="list-style-type: none"> <li>-The sensor for the countershaft speed (SECS)</li> <li>-The sensor for the clutch position (SePoC)</li> <li>-The sensor for the position of the split cylinder (SePoS)</li> <li>-The sensor for the position of the shift cylinder (1R SEPo1R)</li> <li>-The sensor for the position of the shift cylinder (23 SEPo23)</li> <li>-The sensor for the range cylinder (SEPoR)</li> </ul> <p>The fault is deactivated if the following conditions are fulfilled for a time of 2,0s:</p> <p>The input shaft speed calculated from the counter shaft speed sensor (SECS) is above 300 rpm and the clutch is engaged or The input shaft speed calculated from the counter shaft speed sensor (SECS) is above 600 rpm, the clutch position is more engaged than the slip point and the engine speed is received from the engine ECU and</p> |

| FUNCTION   | PID/SID | FMI<br>J1587 | ERROR   | CONDITION  | SYMPTOM  | COMMENT   |
|--|---------|--------------|---|--|--|---|
|  |         |              |   |  |  | <p>above 600rpm<br/>A forward gear is engaged in the gearbox and the main shaft speed sensor (SESM) indicates forward movement or A reverse gear is engaged and the main shaft speed sensor (SESM) indicates reverse movement.<br/>The fault is also deactivated if the main shaft speed sensor (SESM) signal is not within normal range, or if there is an active fault on any of the sensors:<br/>-The sensor for the countershaft speed (SECS)<br/>-The sensor for the clutch position (SePoC)<br/>-The sensor for the position of the split cylinder (SePoS)<br/>-The sensor for the position of the shift cylinder (1R SEPo1R)<br/>-The sensor for the position of the shift cylinder (23 SEPo23)<br/>-The sensor for the range cylinder (SEPoR)</p> |
| Sensor for the speed on the main shaft (SESM)          |         | FMI3         | Voltage above normal or shorted high          | <b>Activate:</b> Signal or supply voltage is above normal range<br><b>Deactivate:</b> Signal and supply voltage is in normal range.  | Yellow lamp is sent<br>Reduced gear change performance<br>Reduced gear change comfort                  |   |
| Sensor for the speed on the main shaft (SESM)          |         | FMI4         | Voltage below normal or shorted low           | <b>Activate:</b> Signal and supply voltage is below normal range.<br><b>Deactivate:</b> Signal and supply voltage is within normal range   | Yellow lamp is sent<br>Reduced gear change performance<br>Reduced gear change comfort                  |   |
| Sensor for the speed on the main shaft (SESM)          |         | FMI5         | Current below normal or open circuit          | <b>Activate:</b><br>1.Signal voltage is below normal range and,<br>2. Supply voltage is in the normal range<br><b>Deactivate:</b> Signal and supply voltage is in the normal range | Yellow lamp is sent<br>Reduced gear change performance<br>Reduced gear change comfort                  |   |
| Sensor for the temperature of the gearbox oil (SETeGO) | PID177  | FMI0         | Data valid but above normal operational range | <b>Activate low:</b><br>1.The sensor signal is in normal range<br>2. Temperature is above 100dgC during 18000s   | <b>Low:</b><br>Yellow lamp is sent<br>Symbol for high gearbox oil temperature is lit<br><b>Medium:</b> | Gearbox oil temperature fault codes are only set if the vehicle has oil temperature sensor functionality installed  |

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| <b>FUNCTION</b>  | <b>PID/SID</b> | <b>FMI<br/>J1587</b> | <b>ERROR</b>                            | <b>CONDITION</b>  | <b>SYMPTOM</b>  | <b>COMMENT</b>   |
|--|----------------|----------------------|---|---|---|--|
|  |                |                      |   | <p><b>Deactivate low:</b><br/>1. The sensor signal is in normal range<br/>2. Temperature is below 100dgC</p> <p><b>Activate medium:</b> 1. The sensor signal is in normal range<br/>2. Temperature above 120dgC during 600s</p> <p><b>Deactivate medium:</b> 1. The sensor signal is in normal range<br/>2. Temperature is below 120dgC</p> <p><b>Activate high:</b><br/>1. The sensor signal is in normal range<br/>2. Temperature is above 140dgC during 30s</p> <p><b>Deactivate high:</b> 1. The sensor signal is in normal range<br/>Temperature is below 140dgC</p> | <p>Yellow lamp is sent<br/>Symbol for high gearbox oil temperature is lit</p> <p><b>High:</b><br/>Red lamp is sent<br/>Symbol for high gearbox oil temperature is lit</p> |  |
| Sensor for the temperature of the gearbox oil (SETeGO) |                | FMI4                 | Voltage below normal or shorted low     | <p><b>Activate:</b> The sensor signal is below normal range<br/><b>Deactivate:</b> The sensor signal is in normal range</p>   | Yellow lamp is sent   |  |
| Sensor for the temperature of the gearbox oil (SETeGO) |                | FMI5                 | Current below normal or open circuit    | <p><b>Activate:</b> The sensor signal is above normal range<br/><b>Deactivate:</b> The sensor signal is in normal range</p>   | Yellow lamp is sent   |  |
| Sensor position of the clutch (SEPoC and SEPoCINV)     | <b>PID33</b>   | FMI2                 | Data erratic, intermittent or incorrect | <p><b>Activate:</b> The difference between clutch positions indicated by the sensor signal (SEPoC) and the inverted sensor signal ( SEPoC INV) is to large and both signals is within normal range<br/><b>Deactivate:</b> The difference between clutch positions</p>   | <p>Yellow lamp is sent<br/>Reduced clutch performance<br/>Reduced gearbox comfort at start and marshalling<br/>Gear changes are slow</p>                                  | <p>The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)<br/>The clutch position sensor has four connectors: one supply, one ground and two connectors for the sensor signal. With correct input the input voltage of the sensor signal, the inverted sensor signal and the sensor supply, they will follow the nominal relation (Usepoc + Usepoc_inv) / Usepoc5V = 100%</p> |



| FUNCTION   | PID/SID | FMI<br>J1587 | ERROR                                | CONDITION  | SYMPTOM   | COMMENT   |
|--|---------|--------------|--------------------------------------|--|---|---|
|  |         |              |                                      | indicated by the sensor signal (SEPoC) and the inverted sensor signal (SEPoC INV) is normal  |   |   |
| Sensor position of the clutch (SEPoC and SEPoCINV) |         | FMI3         | Voltage above normal or shorted high | <p><b>Activate:</b> Sensor signal is short circuit to Ubatt or sensor supply, when at least one of the sensor signals is above normal range.</p> <p><b>Deactivate:</b> No sensor signal is above normal range</p>  | <p>Yellow lamp is sent</p> <p>Reduced clutch performance</p> <p>Reduced gearbox comfort at start and marshalling</p> <p>Gear changes are slow</p> | The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54) |
| Sensor position of the clutch (SEPoC and SEPoCINV) |         | FMI5         | Current below normal or open circuit | <p><b>Activate:</b> 1. Open circuit on any of the sensor signals is detected when: one of the sensor signals is within normal range and the other sensor signal is below normal range</p> <p>2. Open circuit on ground, detected when both the sensor signals are within the normal range and the sum of the sensor signals is above a specific value</p> <p><b>Deactivate:</b> No activation condition is no longer fulfilled</p> | <p>Yellow lamp is sent</p> <p>Reduced clutch performance</p> <p>Reduced gearbox comfort at start and marshalling</p> <p>gear changes are slow</p> | The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54) |
| Sensor position of the clutch (SEPoC and SEPoCINV) |         | FMI12        | Faulty device or component           | <p><b>Activate:</b> Both sensor signals are below normal when:</p> <ol style="list-style-type: none"> <li>Status of the sensor ASIC reports internal fault on the sensor, or</li> <li>Short circuit to Gnd on any of the sensor signals, or</li> <li>Open circuit on supply, or</li> <li>Short circuit between the two sensor signals</li> </ol> <p><b>Deactivate:</b> Both sensor</p>   | <p>Yellow lamp is sent</p> <p>Reduced clutch performance</p> <p>Reduced gearbox comfort at start and marshalling</p> <p>gear changes are slow</p> | The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54) |

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| FUNCTION   | PID/SID | FMI<br>J1587 | ERROR   | CONDITION  | SYMPTOM   | COMMENT  |
|--|---------|--------------|---|--|---|--|
|  |         |              |   | signals are not below normal level   |   |  |
| Sensor position of the clutch (SEPoC and SEPoCINV) |         | FMI13        | Calibration value out of range                | <b>Activate:</b> 1. The CS in NVRAM is not correct<br>2. The cylinder has not been calibrated<br><b>Deactivate:</b> Sensor signal has been successfully calibrated                             | Yellow lamp is sent<br>Cranking is inhibited<br>Engine can not start  | The PID 33 fault code should not be set if there is an active fault code on the clutch position sensor supply (PPID 54)  |
| Slow clutch valves low side (VAS-)                 | PSID6   | FMI3         | Voltage above normal or shorted high          | <b>Activate:</b> The low-side drive is short circuit to Ubatt<br><b>Deactivate:</b> The low-side drive is OK   | Yellow lamp is sent<br>Slow engagement/disengagement disabled<br>Reduced clutch performance, especially at start and marshalling  |  |
| Slow clutch valves low side (VAS-)                 |         | FMI6         | Current above normal or grounded circuit      | <b>Activate:</b> 1. The low-side drive is short circuit to Gnd and<br>2. There is no active fault code for short circuit to Gnd on VASE or VASD<br><b>Deactivate:</b> The low-side drive is OK | Yellow lamp is sent<br>Slow engagement /disengagement disabled<br>Reduced clutch performance, especially at start and marshalling |  |
| Split engagement system                            | PSID23  | FMI0         | Unintentional disengagement of indirect split | <b>Conditions to set the fault code:</b><br>-The split cylinder position leaves the indirect position<br>-The split cylinder valves are inactive   | Yellow lamp is sent<br>Loss of torque   | <b>Detailed conditions to activate/deactivate:</b><br><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The split cylinder position indicates that split gear leaves the indirect position<br>- The split cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split<br>- There is no active fault code for low air pressure<br><i>note:</i> The fault will always have the state inactive.<br>Check fault-count and last occurrence to get more information |

| FUNCTION                | PID/SID | FMI<br>J1587 | ERROR  | CONDITION   | SYMPTOM  | COMMENT   |
|-------------------------|---------|--------------|--|---|--|---|
| Split engagement system |         | FMI1         | Unintentional disengagement of direct split  | <b>Conditions to set the fault code:</b><br>-The split cylinder position leaves the direct position<br>-The split cylinder valves are inactive  | Yellow lamp is sent<br>Loss of torque  | <b>Detailed conditions to activate/deactivate:</b><br><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The split cylinder position indicates that split gear leaves the direct position<br>- The split cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split<br>- There is no active fault code for low air pressure<br><b>Note:</b> The fault will always have the state inactive.<br>Check fault-count and last occurrence to get more information  |
| Split engagement system |         | FMI2         | Unintentional disengagement of neutral split | <b>Conditions to set the fault code:</b><br>-The split cylinder position leaves the neutral position<br>-The split cylinder valves are inactive | Yellow lamp is sent  | <b>Detailed conditions to activate/deactivate:</b><br><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br>(engagement of another gear will reset the count)<br>- The split cylinder position indicates that split gear leaves the neutral position<br>- The split cylinder valves are inactive<br>- There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split<br>- There is no active fault code for low air pressure<br><b>Note:</b> The fault will always have the state inactive.<br>Check fault-count and last occurrence to get more information |
| Split engagement system |         | FMI11        | Blocked engagement of indirect split         | <b>Conditions to set the fault code:</b><br>-The indirect split gear can not engage   | Yellow lamp is sent<br>Loss of torque<br>Only direct split gears will be selected by the | <b>Detailed conditions to activate/deactivate:</b><br><br>The following conditions must be fulfilled three times (only once if the fault code-  |

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| FUNCTION                       | PID/SID | FMI<br>J1587 | ERROR                                     | CONDITION  | SYMPTOM  | COMMENT   |
|--------------------------------|---------|--------------|---|--|--|---|
|                                |         |              |   |  | <p>system for a short while. After five successful gearshifts a new attempt to use indirect split may be made</p>  | <p>filter is switched OFF) in a row, in order to set the fault code:<br/>                     - The split valve for reaching indirect split is activated for at least 0.8s<br/>                     - The split cylinder position sensor indicates that indirect position is not engaged<br/>                     - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split<br/>                     - There is no active fault code for low air pressure<br/> <b>The fault is deactivated if any of the following conditions are fulfilled:</b><br/>                     - The split cylinder position sensor indicates that indirect position is engaged<br/>                     - There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split</p>  |
| <p>Split engagement system</p> |         | <p>FMI12</p> | <p>Blocked engagement of direct split</p> | <p><b>Conditions to set the fault code:</b><br/>                     -The direct split gear can not engage</p> | <p>Yellow lamp is sent<br/>                     Loss of torque<br/>                     Only indirect split gears will be selected by the system for a short while. After five successful gearshifts a new attempt to use direct split may be made</p> | <p><b>Detailed conditions to activate/deactivate:</b><br/><br/>                     The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br/>                     - The split valve for reaching direct split is activated for at least 0.8s<br/>                     - The split cylinder position sensor indicates that direct position is not engaged<br/>                     - There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to indirect split<br/>                     - There is no active fault code for low air pressure<br/> <b>The fault is deactivated if any of the following conditions are fulfilled:</b><br/>                     - The split cylinder position sensor indicates that direct position is engaged<br/>                     - There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split</p> |

| FUNCTION                                     | PID/SID | FMI<br>J1587 | ERROR   | CONDITION  | SYMPTOM  | COMMENT  |
|--|---------|--------------|---|--|--|--|
| Split engagement system                      |         | FMI7         | Blocked engagement of neutral split           | <b>Conditions to set the fault code:</b><br>-The neutral split gear can not engage   | Yellow lamp is sent<br>Eco roll is not available   | <b>Detailed conditions to activate/deactivate:</b><br><br>The following conditions must be fulfilled three times (only once if the fault code-filter is switched OFF) in a row, in order to set the fault code:<br>- The split valve for reaching neutral split is activated for at least 0.8s<br>- The split cylinder position sensor indicates that neutral position is not engaged<br>- There is no active fault on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split<br>- There is no active fault code for low air pressure<br><b>The fault is deactivated if any of the following conditions are fulfilled:</b><br>- The split cylinder position sensor indicates that neutral position is engaged<br>- There is an active fault code on any of the sensor for the position of the split cylinder (SEPoS) the valve for shift to direct split the valve for shift to indirect split |
| TECU Power supply                            | PID158  | FMI0         | Data valid but above normal operational range | <b>Activate:</b> 24V system: above 36V<br>12V system: above 19V<br><b>Deactivate:</b> 24V system: below 36V<br>12V system: below 19V | Yellow lamp is sent  |  |
| TECU Power supply                            |         | FMI1         | Data valid but below normal operational range | <b>Activate:</b> 24V system: below 17V<br>12V system: below 9V<br><b>Deactivate:</b> 24V system: above 17V<br>12V system: above 9V   | Yellow lamp is sent<br>Reduced gearbox performance   |  |
| Valve for activating the PTO number 1 (VAP1) | PSID20  | FMI3         | Voltage above normal or shorted high          | <b>Activate:</b> The high side drive is short circuit to Ubatt<br><b>Deactivate:</b> The high side drive is OK                       | Yellow lamp is sent<br>The valve is activated<br>The PTO can not be deactivated<br>Reduced gear change comfort | PTO fault codes are only set if the PTO exists   |
| Valve for activating the                     |         | FMI5         | Current below normal or open circuit          | <b>Activate:</b> The high side drive is open circuit   | Yellow lamp is sent<br>The valve can   |  |

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| <b>FUNCTION</b>                                   | <b>PID/SID</b> | <b>FMI<br/>J1587</b> | <b>ERROR</b>                             | <b>CONDITION</b>  | <b>SYMPTOM</b>   | <b>COMMENT</b> |
|---|----------------|----------------------|--|---|--|----------------|
| PTO number 1 (VAP1)                               |                |                      |  | <b>Deactivate:</b> The high side drive is OK  | not be activated<br>The PTO does not work  |                |
| Valve for activating the PTO number 1 (VAP1)      |                | FMI6                 | Current above normal or grounded circuit | <b>Activate:</b> The high side drive is short circuit to Gnd<br><b>Deactivate:</b> The high side drive is OK  | Yellow lamp is sent<br>The valve can not be activated<br>The PTO does not work                                       |                |
| Valve for activating the PTO number 2 (VAP2)      | PSID21         | FMI3                 | Voltage above normal or shorted high     | <b>Activate:</b> The high side drive is short circuit to Ubatt<br><b>Deactivate:</b> The high side drive is OK  | Yellow lamp is sent<br>The valve is activated<br>The PTO can not be deactivated<br>Reduced gear change comfort       |                |
| Valve for activating the PTO number 2 (VAP2)      |                | FMI5                 | Current below normal or open circuit     | <b>Activate:</b> The high side drive is open circuit<br><b>Deactivate:</b> The high side drive is OK  | Yellow lamp is sent<br>The valve can not be activated<br>The PTO does not work                                       |                |
| Valve for activating the PTO number 2 (VAP2)      |                | FMI6                 | Current above normal or grounded circuit | <b>Activate:</b> The high side drive is short circuit to Gnd<br><b>Deactivate:</b> The high side drive is OK  | Yellow lamp is sent<br>The valve can not be activated<br>The PTO does not work                                       |                |
| Valve for fast disengagement of the clutch (VAFD) | PSID3          | FMI3                 | Voltage above normal or shorted high     | <b>Activate:</b> 1. The high-side drive is short circuited to Ubatt and 2. there is no active fault code for short circuit to Ubatt on VAF-<br><b>Deactivate:</b> The high-side drive is OK | Yellow lamp is sent<br>Fast engagement/disengagement disabled<br>Reduced clutch performance<br>Gear changes are slow |                |
| Valve for fast disengagement of the clutch (VAFD) |                | FMI5                 | Current below normal or open circuit     | <b>Activate:</b> The high-side drive is open circuit<br><b>Deactivate:</b> The high side drive is OK  | Yellow lamp is sent<br>Fast disengagement disabled<br>Reduced clutch performance<br>Gear changes are slow            |                |
| Valve for fast disengagement of the clutch (VAFD) |                | FMI6                 | Current above normal or grounded circuit | <b>Activate:</b> The high-side drive is short circuit to Gnd<br><b>Deactivate:</b> The high-side drive is OK  | Yellow lamp is sent<br>Fast disengagement disabled<br>Reduced clutch performance<br>Gear changes are slow            |                |
| Valve for fast engagement of the clutch (VAFE)    | PSID1          | FMI3                 | Voltage above normal or shorted high     | <b>Activate:</b> 1. The high-side drive is short circuited to Ubatt and, 2. there is no active fault code for   | Yellow lamp is sent<br>Fast engagement/disengagement disabled  |                |

| FUNCTION                                       | PID/SID | FMI<br>J1587 | ERROR                                    | CONDITION  | SYMPTOM   | COMMENT |
|--|---------|--------------|--|--|---|---------|
|  |         |              |  | short circuit to Ubatt on VAF-<br><b>Deactivate:</b> The high-side drive is OK                                 | Reduced clutch performance<br>Gear changes are slow   |         |
| Valve for fast engagement of the clutch (VAFE) |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> The high-side drive is open circuit<br><b>Deactivate:</b> The high side drive is OK           | Yellow lamp is sent<br>Fast engagement disabled<br>Reduced clutch performance<br>Gear changes are slow  |         |
| Valve for fast engagement of the clutch (VAFE) |         | FMI6         | Current above normal or grounded circuit | <b>Activate:</b> The high-side drive is short circuit to Gnd<br><b>Deactivate:</b> The high-side drive is OK   | Yellow lamp is sent<br>Fast engagement disabled<br>Reduced clutch performance<br>Gear changes are slow  |         |
| Valve for shifting to direct split (VADS)      | SID37   | FMI3         | Voltage above normal or shorted high     | <b>Activate:</b> The high side drive is short circuit to Ubatt<br><b>Deactivate:</b> The high side drive is OK | Yellow lamp is sent<br>The valve is activated<br>Indirect and neutral split gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds |         |
| Valve for shifting to direct split (VADS)      |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> The high side drive is open circuit<br><b>Deactivate:</b> The high side drive is OK           | Yellow lamp is sent<br>The valve can not be activated<br>Split gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds              |         |
| Valve for shifting to direct split (VADS)      |         | FMI6         | Current above normal or grounded circuit | <b>Activate:</b> The high side drive is short circuit to Gnd<br><b>Deactivate:</b> The high side drive is OK   | Yellow lamp is sent<br>The valve can not be activated<br>Split gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds              |         |
| Valve for shifting to                          | PSID12  | FMI3         | Voltage above normal                     | <b>Activate:</b> The high side drive is  | Yellow lamp is sent   |         |

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| FUNCTION                                     | PID/SID       | FMI<br>J1587 | ERROR   | CONDITION   | SYMPTOM   | COMMENT |
|--|---------------|--------------|---|---|---|---------|
| gear 1<br>(VAG1)                             |               |              | or shorted<br>high                                | short circuit to<br>Ubatt<br><b>Deactivate:</b> The<br>high side drive is<br>OK   | The valve is<br>activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds                                   |         |
| Valve for<br>shifting to<br>gear 1<br>(VAG1) |               | FMI5         | Current below<br>normal or<br>open circuit        | <b>Activate:</b> The<br>high side drive is<br>open circuit<br><b>Deactivate:</b> The<br>high side drive is<br>OK              | Yellow lamp is<br>sent<br>The valve can<br>not be activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds |         |
| Valve for<br>shifting to<br>gear 1<br>(VAG1) |               | FMI6         | Current above<br>normal or<br>grounded<br>circuit | <b>Activate:</b> The<br>high side drive is<br>short circuit to<br>Gnd<br><b>Deactivate:</b> The<br>high side drive is<br>OK   | Yellow lamp is<br>sent<br>The valve can<br>not be activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds |         |
| Valve for<br>shifting to<br>gear 2<br>(VAG2) | <b>PSID14</b> | FMI3         | Voltage<br>above normal<br>or shorted<br>high     | <b>Activate:</b> The<br>high side drive is<br>short circuit to<br>Ubatt<br><b>Deactivate:</b> The<br>high side drive is<br>OK | Yellow lamp is<br>sent<br>The valve can<br>not be activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds |         |
| Valve for<br>shifting to<br>gear 2<br>(VAG2) |               | FMI5         | Current below<br>normal or<br>open circuit        | <b>Activate:</b> The<br>high side drive is<br>open circuit<br><b>Deactivate:</b> The<br>high side drive is<br>OK              | Yellow lamp is<br>sent<br>The valve can<br>not be activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds |         |
| Valve for<br>shifting to                     |               | FMI6         | Current above<br>normal or                        | <b>Activate:</b> The<br>high side drive is<br>short circuit to  | Yellow lamp is<br>sent<br>The valve can   |         |



| FUNCTION   | PID/SID       | FMI<br>J1587 | ERROR   | CONDITION   | SYMPTOM   | COMMENT |
|--|---------------|--------------|---|---|---|---------|
| gear 2<br>(VAG2)                                   |               |              | grounded<br>circuit                               | Gnd<br><b>Deactivate:</b> The<br>high side drive is<br>OK   | not be activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds  |         |
| Valve for<br>shifting to<br>gear 3<br>(VAG3)       | <b>PSID15</b> | FMI3         | Voltage<br>above normal<br>or shorted<br>high     | <b>Activate:</b> The<br>high side drive is<br>short circuit to<br>Ubatt<br><b>Deactivate:</b> The<br>high side drive is<br>OK | Yellow lamp is<br>sent<br>The valve can<br>not be activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds |         |
| Valve for<br>shifting to<br>gear 3<br>(VAG3)       |               | FMI5         | Current below<br>normal or<br>open circuit        | <b>Activate:</b> The<br>high side drive is<br>open circuit<br><b>Deactivate:</b> The<br>high side drive is<br>OK              | Yellow lamp is<br>sent<br>The valve can<br>not be activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds |         |
| Valve for<br>shifting to<br>gear 3<br>(VAG3)       |               | FMI6         | Current above<br>normal or<br>grounded<br>circuit | <b>Activate:</b> The<br>high side drive is<br>short circuit to<br>Gnd<br><b>Deactivate:</b> The<br>high side drive is<br>OK   | Yellow lamp is<br>sent<br>The valve can<br>not be activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds |         |
| Valve for<br>shifting to<br>gear reverse<br>(VAGR) | <b>PSID13</b> | FMI3         | Voltage<br>above normal<br>or shorted<br>high     | <b>Activate:</b> The<br>high side drive is<br>short circuit to<br>Ubatt<br><b>Deactivate:</b> The<br>high side drive is<br>OK | Yellow lamp is<br>sent<br>The valve is<br>activated<br>Gears are<br>missing<br>Automatic gear<br>selection enters<br>faulty gearbox<br>mode with gear<br>changes only at<br>certain vehicle<br>speeds         |         |
| Valve for<br>shifting to                           |               | FMI5         | Current below<br>normal or<br>open circuit        | <b>Activate:</b> The<br>high side drive is<br>open circuit<br><b>Deactivate:</b> The  | Yellow lamp is<br>sent<br>The valve can<br>not be activated   |         |

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| <b>FUNCTION</b>                              | <b>PID/SID</b> | <b>FMI<br/>J1587</b> | <b>ERROR</b>                             | <b>CONDITION</b>   | <b>SYMPTOM</b>   | <b>COMMENT</b> |
|--|----------------|----------------------|--|--|--|----------------|
| gear reverse (VAGR)                          |                |                      |  | high side drive is OK  | Gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds  |                |
| Valve for shifting to gear reverse (VAGR)    |                | FMI6                 | Current above normal or grounded circuit | <b>Activate:</b> The high side drive is short circuit to Gnd<br><b>Deactivate:</b> The high side drive is OK   | Yellow lamp is sent<br>The valve can not be activated<br>Gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds       |                |
| Valve for shifting to high range (VAHR)      | SID35          | FMI3                 | Voltage above normal or shorted high     | <b>Activate:</b> The high side drive is short circuit to Ubatt<br><b>Deactivate:</b> The high side drive is OK | Yellow lamp is sent<br>The valve is activated<br>Low range gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds     |                |
| Valve for shifting to high range (VAHR)      |                | FMI5                 | Current below normal or open circuit     | <b>Activate:</b> The high side drive is Open circuit<br><b>Deactivate:</b> The high side drive is OK           | Yellow lamp is sent<br>The valve can not be activated<br>Range gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds |                |
| Valve for shifting to high range (VAHR)      |                | FMI6                 | Current above normal or grounded circuit | <b>Activate:</b> The high side drive is short circuit to Gnd<br><b>Deactivate:</b> The high side drive is OK   | Yellow lamp is sent<br>The valve can not be activated<br>Range gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds |                |
| Valve for shifting to indirect split (VAIDS) | SID38          | FMI3                 | Voltage above normal or shorted high     | <b>Activate:</b> The high side drive is short circuit to Ubatt<br><b>Deactivate:</b> The                       | Yellow lamp is sent<br>The valve is activated<br>Direct and  |                |

| FUNCTION                                     | PID/SID | FMI<br>J1587 | ERROR                                    | CONDITION  | SYMPTOM  | COMMENT |
|--|---------|--------------|--|--|--|---------|
|  |         |              |  | high side drive is OK  | neutral split gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds  |         |
| Valve for shifting to indirect split (VAIDS) |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> The high side drive is open circuit<br><b>Deactivate:</b> The high side drive is OK           | Yellow lamp is sent<br>The valve can not be activated<br>Split gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds |         |
| Valve for shifting to indirect split (VAIDS) |         | FMI6         | Current above normal or grounded circuit | <b>Activate:</b> The high side drive is short circuit to Gnd<br><b>Deactivate:</b> The high side drive is OK   | Yellow lamp is sent<br>The valve can not be activated<br>Split gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds |         |
| Valve for shifting to low range (VALR)       | SID36   | FMI3         | Voltage above normal or shorted high     | <b>Activate:</b> The high side drive is short circuit to Ubatt<br><b>Deactivate:</b> The high side drive is OK | Yellow lamp is sent<br>The valve is activated<br>High range gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds    |         |
| Valve for shifting to low range (VALR)       |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> The high side drive is open circuit<br><b>Deactivate:</b> The high side drive is OK           | Yellow lamp is sent<br>The valve can not be activated<br>Range gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds |         |
| Valve for shifting to                        |         | FMI6         | Current above normal or                  | <b>Activate:</b> The high side drive is short circuit to   | Yellow lamp is sent<br>The valve can   |         |

**SECTION 07:  
TRANSMISSION**


| FUNCTION  | PID/SID | FMI<br>J1587 | ERROR                                    | CONDITION  | SYMPTOM   | COMMENT |
|---|---------|--------------|--|--|---|---------|
| low range (VALR)                                  |         |              | grounded circuit                         | Gnd<br><b>Deactivate:</b> The high side drive is OK  | not be activated<br>Range gears are missing<br>Automatic gear selection enters faulty gearbox mode with gear changes only at certain vehicle speeds |         |
| Valve for slow disengagement of the clutch (VASD) | PSID4   | FMI3         | Voltage above normal or shorted high     | <b>Activate:</b> 1. The high-side drive is short circuit to Ubatt and<br>2. There is no active fault code for short circuit to Ubatt on VAS-<br><b>Deactivate:</b> The high-side drive is OK | Yellow lamp is sent Slow engagement/disengagement disabled<br>Reduced clutch performance, especially at start and marshalling                       |         |
| Valve for slow disengagement of the clutch (VASD) |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> The high-side drive is open circuit<br><b>Deactivate:</b> The high-side drive is OK   | Yellow lamp is sent Slow disengagement disabled<br>Reduced clutch performance   |         |
| Valve for slow disengagement of the clutch (VASD) |         | FMI6         | Current above normal or grounded circuit | <b>Activate:</b> The high-side drive is short circuit to Gnd<br><b>Deactivate:</b> The high-side drive is OK   | Yellow lamp is sent Slow disengagement disabled<br>Reduced clutch performance   |         |
| Valve for slow engagement of the clutch (VASE)    | PSID2   | FMI3         | Voltage above normal or shorted high     | <b>Activate:</b> 1. The high-side drive is short circuit to Ubatt and<br>2. There is no active fault code for short circuit to Ubatt on VAS-<br><b>Deactivate:</b> The high-side drive is OK | Yellow lamp is sent Slow engagement/disengagement disabled<br>Reduced clutch performance, especially at start and marshalling                       |         |
| Valve for slow engagement of the clutch (VASE)    |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> The high-side drive is open circuit<br><b>Deactivate:</b> The high-side drive is OK   | Yellow lamp is sent Slow engagement disabled<br>Reduced clutch performance, especially at start and marshalling                                     |         |
| Valve for slow engagement of the clutch (VASE)    |         | FMI6         | Current above normal or grounded circuit | <b>Activate:</b> The high-side drive is short circuit to Gnd<br><b>Deactivate:</b> The high-side drive is OK   | Yellow lamp is sent Slow engagement disabled<br>Reduced clutch performance, especially at   |         |

| FUNCTION                           | PID/SID | FMI<br>J1587 | ERROR                                    | CONDITION  | SYMPTOM  | COMMENT |
|------------------------------------|---------|--------------|--|--|--|---------|
|                                    |         |              |  |  | start and marshalling  |         |
| Valve for the gearbox brake (VAGB) | PSID22  | FMI3         | Voltage above normal or shorted high     | <b>Activate:</b> The high side drive is short circuit to Ubatt<br><b>Deactivate:</b> The high side drive is OK | Red lamp is sent<br>The valve and the brake are activated<br>The gearbox will be damaged if the vehicle drives<br>The prop shaft has to be removed to move the vehicle |         |
| Valve for the gearbox brake (VAGB) |         | FMI5         | Current below normal or open circuit     | <b>Activate:</b> The high side drive is open circuit<br><b>Deactivate:</b> The high side drive is OK           | Yellow lamp is sent<br>The valve can not be activated<br>Shifting to the start gear takes long time  |         |
| Valve for the gearbox brake (VAGB) |         | FMI6         | Current above normal or grounded circuit | <b>Activate:</b> The high side drive is short circuit to Gnd<br><b>Deactivate:</b> The high side drive is OK   | Yellow lamp is sent<br>The valve can not be activated<br>Shifting to the start gear takes long time  |         |

## 10. VOLVO I-SHIFT TRANSMISSION GSECU FAULT CODES

| PID/PPID<br>SID/PSID | FMI | LAMP  | CONTENT                     | TEXT                                    | COMMENT                   | CONSEQUENCES                       |
|----------------------|-----|-------|-----------------------------|---|---------------------------|------------------------------------|
| SID231               | 2   | None  | SAE J1939 Data Link         | -                                       | -                         | Redundancy on J1587                |
| SID237               | 3   | CHECK | Start enable device         | Check Gear Selector System at next stop | Only for EMS1.xx vehicles | Start relay not working            |
| SID240               | 2   | CHECK | Program memory              | Gear Selector System failure            | Boot                      | Not possible to engage gear        |
| SID250               | 9   | None  | SAE J1708 /J1587 data link  | -                                       | -                         | -                                  |
| SID253               | 2   | CHECK | Program memory              | Gear Selector System failure            | -                         | Not possible to engage gear        |
| SID254               | 12  | CHECK | Controller #1               | Gear Selector System failure            | -                         | Not possible to engage gear        |
| PSID9                | 12  | CHECK | Gear level position sensors | Check Gear Selector System at next stop | -                         | Not possible to engage/change gear |

**SECTION 07:  
TRANSMISSION**

| PID/PPID<br>SID/PSID | FMI | LAMP  | CONTENT                | TEXT                                    | COMMENT   | CONSEQUENCES   |
|----------------------|-----|---|------------------------|---|---|--|
| PSID36               | 7   |  | Output actuator (REPS) | Check Gear Selector System at next stop | -   | Fault displayed after ignition OFF. Risk of battery discharge if main circuit breaker is not opened when vehicle is not used |
| PSID36               | 12  |   | Output actuator (REPS) | Check Gear Selector System at next stop | -   | Gearbox not supplied   |
| PSID42               | 2   | None  | Ignition signals       | -                                       | -   | Power supply always on   |
| PSID200              | 9   | None  | Data Link, MID128      | Check Gear Selector System at next stop | Only for AMT-C, Boot                              | Affects RT only (can be sent for VT)   |
| PSID201              | 9   | None  | Data Link, MID144      | Check Gear Selector System at next stop | Only for AMT-C, Boot                              | Affects RT only (can be sent for VT)   |
| PSID205              | 9   | None  | Data Link, MID130      | Check Gear Selector System at next stop | Boot  | Affects RT only (can be sent for VT)   |
| PSID214              | 9   | None  | Data Link, MID249      | -                                       | Only when second gear selector is installed, Boot | Not possible to switch to/from secondary gear lever  |

**11. SPECIFICATIONS**

**ALLISON AUTOMATIC TRANSMISSION WITH OR WITHOUT RETARDER**

Coaches & Commercial use

**Allison B500**

Gross input power (maximum).....500 HP (335 kW)  
 Gross input torque (maximum) ..... 1525 Lbf-ft (2068 Nm)  
 Rated input speed (minimum-maximum) ..... 1600-2300 rpm

X3-45 VIP, H3-45 VIP motorhomes. Private use

**Allison MH4000**

Gross input power (maximum).....525 HP (392 kW)  
 Gross input torque (maximum) ..... 1650 Lbf-ft (2237 Nm)  
 Rated input speed (minimum-maximum) ..... 1600-2300 rpm

**Mounting:**

Engine.....SAE #1 flywheel housing, flex disk drive

**Torque converter:**

Type ..... One stage, three element, polyphase  
 Stall torque ratio ..... TC 551-1.8  
 Lockup clutch with torsional damper ..... Integral/standard

**Gearing:**

Type ..... Patented, constant mesh, helical, planetary

Ratio:

First .....3.51:1  
 Second..... 1.91:1  
 Third ..... 1.43:1  
 Fourth..... 1.00:1  
 Fifth .....0.74:1  
 Sixth .....0.64:1  
 Reverse .....4.80:1

**Total coverage<sup>3</sup>:**

6 speed .....5.48:1

- **Gear ratios do not include torque converter multiplication.**

**Oil System:**

Oil type..... TRANSYND, TES668, TES295, TES389  
 Capacity (excluding external circuits) ..... Initial fill 47 US qts (45 liters)  
 Oil change..... 24 US qts (23 liters)  
 Oil change (with retarder) ..... 27.6 US qts (26.5 liters)

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<sup>3</sup> Total coverage is determined by dividing the highest gear ratio by the lowest gear ratio. Total coverage expresses the transmission gear ratio versatility. Transmissions with a larger total coverage number have a wider variety of available ratios.

**Oil Filters:**

Make ..... Allison Transmission  
Type ..... Disposable cartridge

**VOLVO I-SHIFT TRANSMISSION**

**Oil System:**

Oil change..... 16 US qts (15 liters)

**Oil Filter:**

Make ..... Volvo  
Type ..... Disposable cartridge