Solution K25756018
Friday, October 4, 2019 6:05:25 PM CEST

** SOLUTION **

Title	Vehicles With An Automated Manual Transmission (AMT) - Power Take-Off Diagnosis And Repair; PTO Air Leaks, Oil Leaks, Engagement, Noise

Mack Models

Mack Model	AN - Anthem , CHU - Pinnacle, Axle back , CXU - Pinnacle, Axle front , GR - Granite , GU - Granite , PI - Pinnacle , TD - Titan

Volvo Models

Volvo Model	VNL , VNM , VNR , VNX , VAH , VHD

Emission Standard

Emission Standard	US07 , US10 , US10+OBD13 , US14+OBD13 , US14+OBD15 , US14+OBD16 , US17+OBD16 , US17+OBD18 , US17+OBD19

Engine family

Engine family	11L Engine , 13L Engine , 16L Engine , MP7 , MP8 , MP10

Transmission

Transmission	AMT-F , AMT-F With Crawler Gears , AMT-F Without Crawler Gears , AMT-C , AMT-D , AMT-F , AMT-C , AMT-D , AMT-F , AMT-F With Crawler Gears , AMT-F Without Crawler Gears

** SOLUTION **

Cause

The service instructions for the gearbox mounted AMT PTO have not been readily available to the NA market when the PTO was made available for the AMT in NA. Although many of the parts have been available for the PTO in the NA parts system, not all parts are available because major components like gears and housing can quickly drive the cost of repair higher than the replacement cost. The parts that are available in NA parts system represent a reasonable repair option when internal inspection of the PTO and the failure mode show that a simple repair in the field is possible. See the failure mode and repair option information below for more information.

Solution

Where to find repair instructions

⚠ WARNING

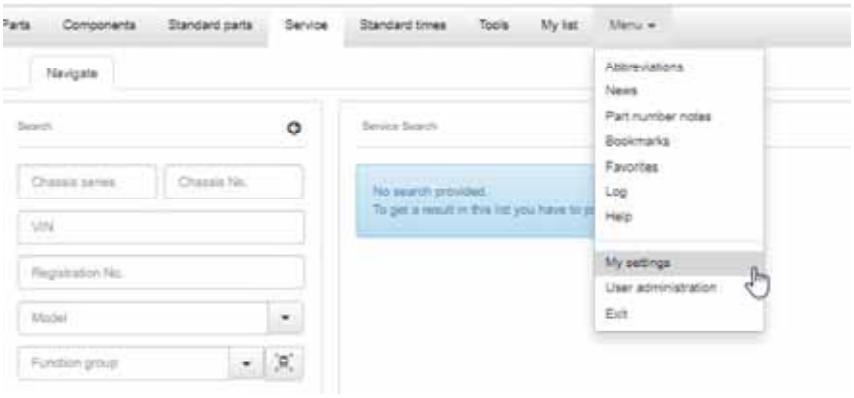
Language settings **must be returned** to English (United States) after following the instructions below. CBR will not function correctly if the language is improperly set.

Note: Not all dealers or users are set up to be able to do this.

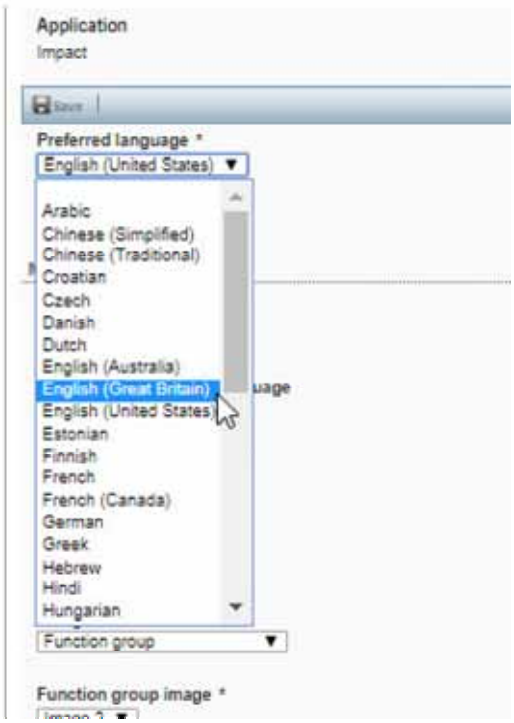
Service instructions are available in Europe for all of the PTOs currently available in NA. Changes

are ongoing to make this information available in the NA market. Until that happens please use the steps below to find the service instructions needed.

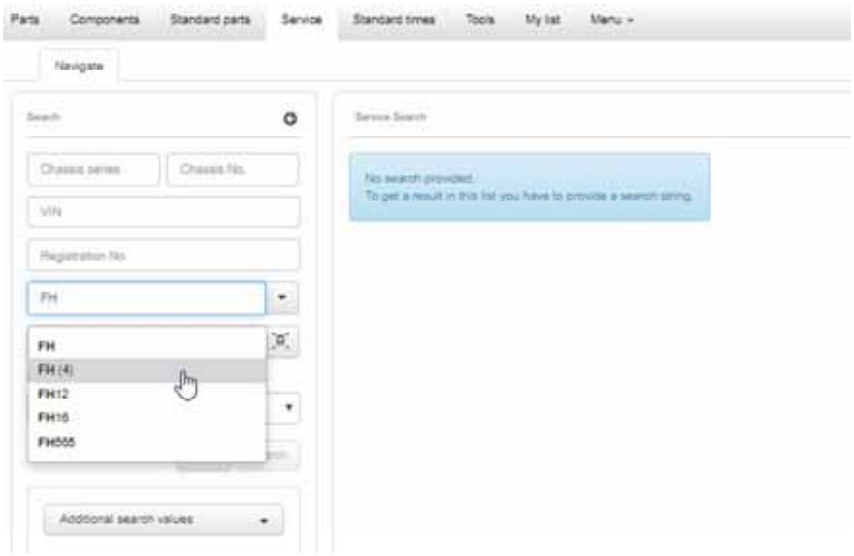
1. When looking for information in IMPACT click on the 'Menu' tab and select 'My Settings'.



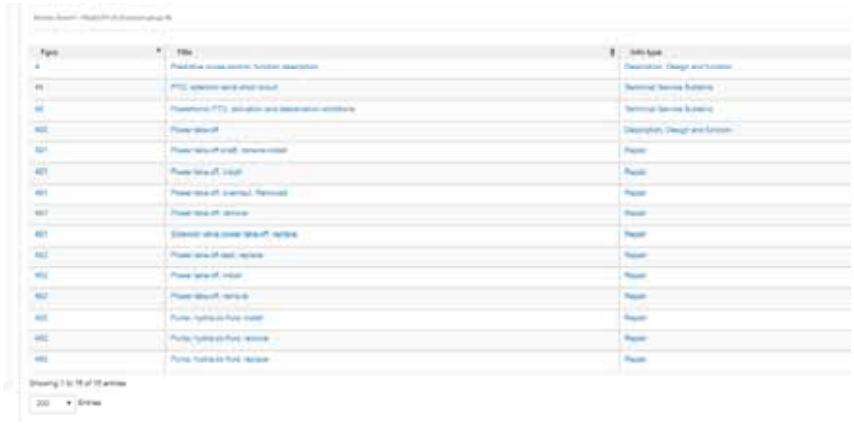
2. Change your preferred language to English (Great Britain) and hit 'Save'



3. Under the service tab search for Model 'FH (4)' -- Select Function Group 48. Power Take-Off-All service information and hit search.

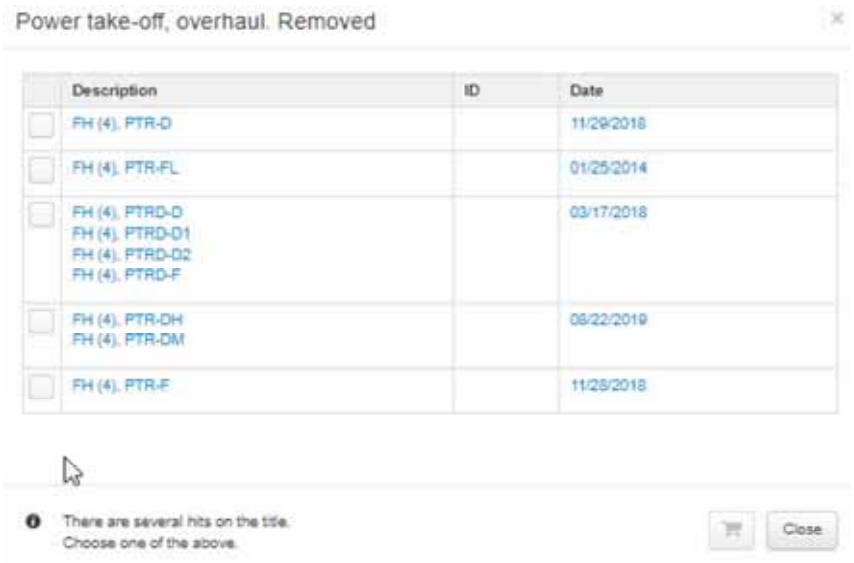


3.1. Here you will find Design and Function and service documentation.



4. Select the PTO model you have from the list and then you can download or print the document for reference.

Note: The PTO model is stamped in the case of the PTO.



Note: DO NOT forget to change language settings back when finished!

Fail modes

Note: This list assumes the PTO was previously working as designed and has stopped working properly and is not limited to these descriptions.

- **Air leaking from gearbox vents when the PTO is engaged.**

Air leaking from the vents with PTO engaged is an air seal issue. The seals are available, as are the gaskets for the repair. The limiting factor is if the bore in the case that the piston is riding in is scored or worn.

1. Inspect the air piston for wear. Look for evidence of the piston making contact with the bore as shown in the picture below.

- **If wear is found,** the bore needs to be inspected.

2. Inspect the piston bore. Check for any wear or damage as shown in the example below.

- **If the bore is serviceable**, the unit should be repaired. Replace the air piston and seals.

- **If the bore is worn**, replace the PTO. The piston bore is not repairable.

3. Check the piston and bore for rust.

- **If Rust if found on the piston face**, then there has been water intrusion to the piston. An example is shown below.

Check the vehicle air system for moisture and correct the root cause of the water intrusion.

- **If rust damage is found in the bottom of the piston bore,** clean the bore and inspect the sealing surface for damage. Rust in the bottom of the bore will not affect operation.

- **If the vehicle air system is dry and properly serviced**, the solenoid should be checked for a good rubber cap on the top.

If the cap seal is damaged then replace the solenoid.

- **PTO solenoid electrical checks**

- The PTO solenoid contains two fly-back/clamping diodes to prevent high voltage reverse voltage spikes from damaging the controlling ECU. Because of the orientation of these diodes, the unit will give unexpected readings for resistance with a multi-meter.

<<<<< insert picture-PTO solenoid electrical pins labled>>>>>>>

Resistance readings through the solenoid will show resistance in the Mega OHM range measured through one direction (Positive/Pin 1 and Negative /Pin 4) and an OL or open circuit when measure with reverse polarity (Positive/Pin 4 and Negative/Pin 1)

<<<<< insert picture-Resistance check PTO sol-pos to pos and neg to neg>>>>>>>
<<<<< insert picture-REsistance check PTO solenoid reverse polarity>>>>>>>

When using the Diode check function the readings will be OL with reverse polarity (Positive/Pin 4 and Negative/Pin 1) and test voltage value when measured with correct polarity (Positive/Pin 1 and Negative /Pin 4)

<<<<< insert picture-Diode Check PTO solenoid reverse polarity on meter>>>>>>>
<<<<< insert picture-Diode check PTO solenoid>>>>>>>

Beyond this, the solenoid can have power and ground applied to the pins (12V pin 1 and ground Pin 4) to check for functionality. Hooking up the voltage and ground with reverse polarity will damage the solenoid.

- **Oil Leaks**

All seals and gaskets are available in the parts system. Repair as needed.

- **Leaking output flange seals or loose output flanges** can be repaired on the truck without removing the PTO from the gearbox if the unit does not need to be disassembled.

- **Oil leaking from top of PTO solenoid** will usually include air leaking from the gearbox vents when the PTO is engaged. The air leaks section above should be reviewed.

> **NOTE:** The customer may not notice the air leak if the PTO is working properly unless the leak is large or they see an oil mist or 'smoke' coming from the vents.

- **PTO Will Not Engage or Disengage, or Grinds During or After Engagement**

If the PTO was functioning properly prior to the customer reporting this symptom, check to see that the PTO 'tries' to engage when the switch is turned on.

1. With the switch turned on manipulate the wiring. See if the PTO engages or disengages due to an electrical issue at the solenoids.

- **AMT-C and AMT-D (2007-2016) PTO solenoids** are controlled by wiring from the Transmission Electronic Control Unit (TECU) and will log electrical faults when the wiring to the solenoids is compromised.

- **AMT-F (2017-Present) PTO solenoids** are controlled by wiring from the Vehicle Electronic Control Unit (VECU) and/or the Body Builder Module (BBM) and will not log electrical faults when the wiring to the solenoids is compromised.

2. If the wiring is verified to be intact, the next likely item is a broken snap ring.

- The PTO drive shaft in the rear of the gearbox has a snap ring that contains the bearing to the shaft. If this snap ring breaks the pieces may end up in the PTO and get lodged under the shift fork and bind the fork.

- Depending on where the piece gets stuck will depend on how the failure is described.

- **If it is confirmed that the snap ring is the cause:**

  Repair as needed.

  Disassemble and inspect the PTO for repair or replacement.

Examples of snap ring failure can be found below:

Pieces of ring get into the PTO and cause operational issues.

Spline and sliding clutch: Damaged components should be replaced

PTO case damage from snap ring or other debris can be cleaned up and inspected. If the damage does not affect the operation of the PTO shifter and piston seals the PTO can be repaired.

- **Gearbox Low Lube, Mechanical or Contamination Failures**

A gearbox that fails for a low lube condition does not necessarily mean that the PTO is failed also. Contaminated oil may pass through the PTO, but may not necessarily cause damage. In several cases, PTOs replaced with a gearbox failure that have been inspected have been deemed acceptable for reuse. The PTO does not spin when not in use and so does not necessarily damage the internal parts due to low lube or contamination seen in the oil. The smaller single PTOs get lube all the time but the larger double PTOs do not. They only get oil from the gearbox when they are being used.

In cases of a gearbox failure of this nature, the PTO should be opened and inspected, cleaned, resealed and reused if the PTO is not failed.

Except for the dark oil in the housing, this PTO was perfect even though the gearbox failed for low lube.

Acceptable repairs and available parts

For all the fail modes listed above the repairs are typically straight-forward.

- Seals and gaskets for all PTOs are available in the parts system.

- The available parts include but may not be limited to common fasteners (nuts, bolts, washers and brackets), seals, gaskets, output flanges, sliding clutches and shift forks.

- Check parts availability for the repair.

- **When the repair starts to involve the replacement of the PTO case, gears or bearings the cost of parts and labor required to repair quickly exceeds the cost of replacement.**

Standard Repair Times

Operation	Description		SRT
4811-03-02-02	PTO Replacement (Transmission), All Models		0.8 hr
4811-04-04-01	Power Take-Off, Overhaul. Removed (Refer to appropriate PTO model to the right)	PTR-D	0.4 hr
		PTR-DH	1.8 hr
		PTR-DM	1.8 hr
		PTR-F	0.8 hr
		PTR-FH	1.6 hr
		PTR-FL	1.8 hr
		PTRD-D	1.4 hr
		PTRD-D1	1.4 hr
		PTRD-D2	1.4 hr
		PTRD-F	1.4 hr
4814-19-03-01	Power Take-off Shaft, Remove-Install, All Models		0.4 hr

Solution visibility Dealer distribution

Function(s)/component(s) affected

Function affected Air System , Air Dryer , PTO

Function Group

Function Group 481 power-take off (gearbox) , 483 control power take-off

Customer effect

Main customer effect fluid , diagnostics/methodology

Noise	grinding , whine , hissing noise , blowing noise
Fluid problem	leak
Fluid implicated	Transmission Oil
Visual appearance	leaking

Conditions

Vehicle operating mode	with a PTO
Frequency of occurrence of problem	random
Location of problem	underneath cab

Administration

Author	UT9268H
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NA_Reviewer	UT9268H
NA_Author_Group	GTT

Variantes Kola

5XX - PTO TRANSMISSION MOUNTED ADM.	PTOTRA-S - SINGLE PTO TRANSMISSION , PTOTRA-D - DOUBLE PTO TRANSMISSION
T4X - PTO TRANSM. MOUNTED	PTR-F - REAR PTO TRANS. FLANGE, 100% SPEDD , PTR-FL - PTO TRANS. MOUNTED REAR, FLANGE, LOW SPEED , PTRD-D1D - REAR PTO TRANS, DOUBLE,1 DIN-CONN.PUMP+1 FLANGE DIN 120 , PTR-D - REAR PTO TRANS., DIN-CONN.PUMP , PTR-DH - REAR PTO TRANS., DIN-CONN.PUMP, HIGH SPEED , PTR-DM - REAR PTO TRANS., DIN-CONN.PUMP,MEDIUM SPEED , PT RD-F - REAR PTO TRANS., DOUBLE, 1 SAE FLANGE , PTRD-D - REAR PTO TRANS., DOUBLE, 2 DIN-CONN.PUMP , PTRD-D2 - REAR PTO TRANS., DOUBLE, 1 DIN-CONN.PUMP + 2 FLANGES
RTX - AUTOMATIC GEARBOX	TRA-AMT