


Title:	Troubleshooting Diesel Exhaust Fluid (DEF) Headers on Cummins			
Number:	SB_406	Release Date:	12/6/2017	
Revision Number:	12	Revision Date:	07/18/2023	
Chassis Type:	All custom chassis with a 2016 and newer Cummins engine			
Component Description:	DEF Header			
Warranty:	Not Applicable			
Parts:	Not Applicable			
Tools:	Not Applicable			

**Supersedes: Bulletin 406 Supersedes bulletins, 425, 426, and 427.**

**Subject:**

This latest revision is to address production and service change from optical header 3539748 to ultrasonic header 3584091.

Identify options for dealing with multiple failure mode codes on various versions of DEF headers for 2016 and newer Cummins engines.

**Purpose/Background:**

Starting with 2016 engines, the EPA mandated that DEF quality needed to be monitored. Cummins utilizes a sensor on the DEF header for monitoring. Pierce has utilized two vendors (TE – Vendor A, KUS – Vendor B) for DEF headers since 2016. Both have had field failures/issues as detailed below. This bulletin's intent is to help sort through these failure modes if/when an issue occurs on a truck. Below are examples of codes pointing to the tank, header, or wiring connections to the header:

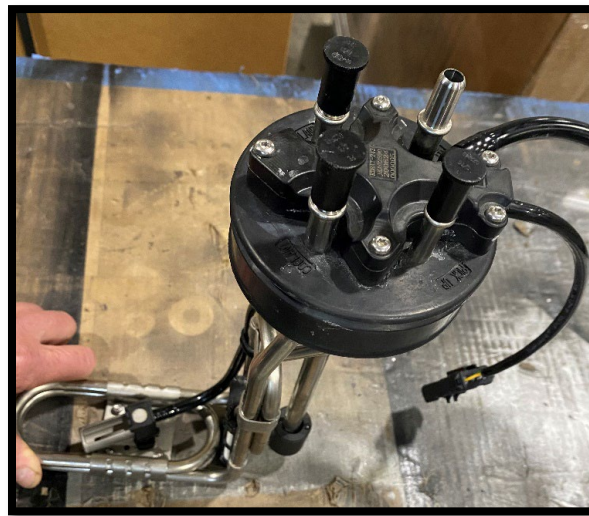
- **Both DEF header vendors**
  - There have been reports of debris in DEF tanks. This may affect the quality and level sensors.
  - There have been reports of loose connections causing engine codes.
- **PNs 2803471, 3044766, 3165156, 3249412 (TE) Used in production from May 2016 – Feb 2019**
  - DEF temperature sensor codes. May be due to control valve plumbing.
  - DEF level sensor codes. May be due to faulty operation of the float.
  - DEF quality sensor codes. May be due to large or small bubbles obstructing the sensor. Previous bulletins (prior to availability of 3280600 from Vendor B) implemented fixes including guards on the sensor and filters on the return line to mitigate bubble collection near the sensor.



*Figure 1 TE Header*

## SERVICE BULLETIN #406.12

- **PNs 3252987, 3264272, 3280600, 3438479, 3539748, 3584091 (KUS)** Used in production, and service, from July 2023 – date of writing.
  - Part number 3584091 (KUS Ultrasonic) is the most up-to-date header currently being used in production.
  - We have received reports of corrosion within the optical quality sensor on part number 3539748 (KUS Optical). This corrosion may contribute to quality sensor voltage and internal error faults (ie – Cummins Fault Codes 1685, 1686, 1715). Part number 3584091 (KUS Ultrasonic) is intended to reduce the frequency of these failures.
  - Micro-bubbles within the quality sensing area can cause inaccurate quality readings outside of the acceptable range required by the Cummins ECU. While ultrasonic quality sensors are considered by much of the industry to be more reliable than optical sensors in these conditions, we have received isolated reports of low concentration faults from pre-production versions of part number 3584091 (KUS Ultrasonic).



*Figure 2, KUS Ultrasonic Header*

## SERVICE BULLETIN #406.12

### Quality Sensor Logic:

The intent of the quality sensor is to identify if the DEF fluid has been diluted, and to ensure the correct concentration of urea is used to control NO<sub>x</sub> emissions.

There are several quality codes listed in this bulletin that could appear due to bubbles obstructing the quality sensor. Quality codes are currently the most frequently observed issue with DEF Header sensors. These codes must be monitored to check for recurrence. DEF quality is checked in the first 10 minutes of every key cycle. If the error code is still active after 5 key cycles over a 24hr period of time, further investigation is required. If the codes go inactive after continued use of the vehicle or by tapping on the DEF tank, they were likely caused by bubble interference. **As bubble interference is not related to a DEF header part failure, we will no longer be providing replacement DEF headers for quality code issues.**

### Cummins Logic:

It can be useful to understand how the Cummins ECU checks for DEF quality when dealing with DEF Header error codes.

At each engine start-up or when filling DEF tank, the engine ECU performs general checks of the DEF system (level, temperature, etc.). After these checks (roughly 5 minutes), a 5-minute check of DEF quality occurs, during which time the engine ECU monitors the quality sensor output.

If the DEF quality sensor reports a quality reading outside of the acceptable range during any 5-minute check, an engine code stating quality outside of the acceptable range will occur. The acceptable range in the Cummins ECU is different between 2016 EPA model year engines and 2017+ EPA model year engines and newer.

- For 2016 EPA model year engines, acceptable quality readings are 26% to 40% urea.
- For 2017+ EPA model year engines, acceptable quality readings are 22.5% to 60% urea.

2016 EPA engines are more susceptible to errant DEF quality readings.

Additionally, during the entire engine run time, the Cummins ECU checks if output exists from the quality sensor. If no quality output exists for more than 5 minutes (also possible due to extreme bubble interference), an engine code stating 'Quality Signal Not Valid' will occur.

If the engine continues to be used while codes are present, the checks above will continue to occur. If a check occurs that shows a good quality reading, the engine code(s) will go inactive and be stored.

### De-Rate and Limp Home not applicable:

It is important to note and make clear to customers and end users that Cummins engines used in Fire and Emergency applications will not initiate any emissions-related vehicle speed or engine torque derates. Under no condition should an emergency vehicle shut down due to an emissions fault. Cummins has confirmed that all statements in the Cummins Fire and Emergency Vehicles Emissions Derate Exemption Customer FAQ document apply to 2013 engines as well as every generation of Fire & Emergency engine produced since the original bulletin went out. Cummins Fire & Emergency ECM calibrations eliminate all emissions related vehicle speed or engine power (torque) derates. Despite codes for low DEF, incorrect DEF, DEF quality, DEF temperature, or DEF Level existing, the engine will not derate or go into limp-home mode.

## SERVICE BULLETIN #406.12

### **Expedited Troubleshooting Process for Specific Fault Codes:**

The following steps are *recommended* for trucks both in and out of the emission warranty period but are *required* for warranty consideration. If you have a code not specified in the next steps the full checklist on page 7 needs to be followed. For the 6 fault code categories outlined in this bulletin, only the sections of the Troubleshooting Checklist below are required to be completed, unless otherwise noted. Diagnostics screenshots showing all faults (active/inactive), date, and time must always be included in the warranty claim. A tech support incident is needed only when noted in the following instruction or if you are unsure if the Command Zone needs the DM1 update outlined in Service Bulletin 474.

The following must be included with the claim submission:

- All approved orders should be placed as an OOS order.
- Orders must include job number and the completed troubleshooting checklist applicable to your codes.
- The troubleshooting checklist and pictures will be required as an attachment for DEF header warranty claims within One Warranty. If the troubleshooting checklist is not completed, the claim will be denied.
- The troubleshooting checklist is also a method used to report to the EPA of changes made to the emissions system. Informing the EPA of changes is mandatory.
- All orders received will be reviewed by Customer service management to ensure the correct process has been followed and decide order shipment priority when inventory is available.

### **Troubleshooting Checklist**

Fill in all the blanks below and submit this list on the warranty claim as noted above. All blanks and Information must be filled in prior to sending in the form.

Date \_\_\_\_\_

Pierce Job # \_\_\_\_\_

Mileage \_\_\_\_\_

Engine EPA Year \_\_\_\_\_

Pierce Part Header # currently in Truck \_\_\_\_\_

(Reference table to right)

List Codes (Place "X" in Active or Inactive box)

\_\_\_\_\_ ☐ Active / ☐ Inactive

\_\_\_\_\_ ☐ Active / ☐ Inactive

\_\_\_\_\_ ☐ Active / ☐ Inactive

\_\_\_\_\_ ☐ Active / ☐ Inactive

\_\_\_\_\_ ☐ Active / ☐ Inactive

Control Module Software Version \_\_\_\_\_

Def Quality Percentage Measured with Refractometer \_\_\_\_\_ %

If DEF fluid quality is bad, or non-DEF fluid is found in the DEF tank, repair as necessary. Clear and recheck codes after repair.

Pierce Part #	Vendor Part #
2803471	FPP810B531
3044766	FPP810B531
3165156	No part #
3249412	No part #
3264272	JKA01499
3280600	JKA01499
3438479	JKA02396
3539748	JKA02520
3584091	JKA03076

List the codes that have returned active and submit warranty claim with a picture with date and time stamp of the diagnostic tool screen showing the codes.

### Active/Recently Inactive Fault Code 1713 - Aftertreatment 1 Diesel Exhaust Fluid Tank Heater - Data Valid but Above Normal Operating Range - Moderately Severe Level

This may be due to issues with DEF coolant system. Resolve FC1713 before addressing any other active DEF-related codes. This fault is unlikely to be caused by a failed header but may cause other header-related codes.

1. Ensure DEF Tank Heater Valve (DEFTHV) is installed on correct coolant line.
2. Ensure DEF Supply and Return lines are not crossed.
3. Ensure DEFTHV is facing the correct direction.
4. Determine if DEFTHV is stuck open or partially open. If stuck, replace valve.
5. If not stuck, replace header

### Simultaneous Fault Codes 1714, 4731, 4732

These fault codes are typically found as inactive and may occur when the header loses, then regains, power during operation. This may be inadvertently caused by the troubleshooting process (disconnecting/reconnecting the header pigtail while powered) or by loose wiring or connectors. These faults are unlikely to be caused by a failed header.

For high fault counts:

Inspect the def header connection. (Clean, tight, pin damage.)	Complete _____
Inspect the chassis engine harness aftertreatment connections (If you need a copy of the harness diagram for connection reference, contact the tech support team.)	Complete _____

In most cases:

Clear all codes and run the engine to operating temperature. Then operate the truck for 30 minutes or perform a forced regeneration.	Complete _____
Do any of the engine codes return	Yes or No
List the codes that have returned active and order a new header. Attach picture with a date and time stamp of the diagnostic tool screen showing the codes to the warranty claim.	
_____ Active	
_____ Active	
_____ Active	
_____ Active	

### Active Fault Code 1715 - Aftertreatment Diesel Exhaust Fluid Quality – Root Cause Not Known

This fault may set when the DEF header detects that its optical quality sensor has failed. The header should be replaced. Be sure to complete the above section of the troubleshooting checklist (Page 4) and include a diagnostic screenshot of the active codes on the warranty claim.

No tech ticket needed, after removed for replacement attach pictures to warranty claim.	Complete _____
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**Active Fault Code 1686 – Aftertreatment 1 Diesel Exhaust Fluid Quality Sensor Circuit - Voltage Above Normal or Shorted to High Source– Moderately Severe Level**

This fault may set when the DEF header internal circuitry has failed. The header should be replaced. Be sure to complete the above section of the troubleshooting checklist(Page 4) and include a diagnostic screenshot of the active codes on the warranty claim.

No tech ticket needed, after removed for replacement attach pictures to warranty claim	Complete_____
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**Simultaneous Fault Codes 3868, 4572, 4677**

These fault codes may occur when the truck has lost communication with the DEF header. This may be inadvertently caused by the troubleshooting process (disconnected header pigtail) or by wiring or connector issues. Intermittent wiring issues may be accompanied by inactive 1714, 4731, and 4732 codes.

For active faults and high counts of inactive faults:

Inspect the def header connection. (Clean, tight, pin damage.)	Complete_____
Inspect the chassis engine harness aftertreatment connections (If you need a copy of the harness diagram for connection reference, contact the tech support team.)	Complete_____
Clear all codes and run the engine to operating temperature. Then operate the truck for 30 minutes or perform a forced regeneration.	Complete_____
Do any of the engine codes return	Yes or No
List the codes that have returned active and order a new header. Attach picture with a date and time stamp of the diagnostic tool screen showing the codes to the warranty claim.	
_____ Active	
_____ Active	
_____ Active	
_____ Active	

**Other Common Fault Codes:**

**Active Fault Code 4277 (often with 6767) – Aftertreatment Diesel Exhaust Fluid Quality - Abnormal Rate of Change**

This fault may set when the quality sensor cannot determine a value for a period of time. Fault 6767 indicates multiple occurrences of 4277, so they are often seen/reported together. The full troubleshooting checklist should be followed for this fault. If all troubleshooting steps are completed and the codes still return as active, the header may be replaced at that time.

**Checklist (Page 7) and applicable pictures need to be attached to the warranty claim no tech incident needed.**

## SERVICE BULLETIN #406.12

Tech support incident needed when complete checklist is required **unless noted above** or **except when using for Code 4277 and 6767**

### Troubleshooting Checklist

Fill in all the blanks below and submit this list on the Technical Support Incident as noted above. **All** blanks and information must be filled in prior to sending in the form.

Date \_\_\_\_\_

Pierce Job # \_\_\_\_\_

Mileage \_\_\_\_\_

Incident # \_\_\_\_\_

Engine EPA Year \_\_\_\_\_

Pierce Part Header # currently in Truck \_\_\_\_\_

(Reference table to right)

List Codes (Place "X" in Active or Inactive box)

\_\_\_\_\_ ☐ Active / ☐ Inactive

\_\_\_\_\_ ☐ Active / ☐ Inactive

\_\_\_\_\_ ☐ Active / ☐ Inactive

\_\_\_\_\_ ☐ Active / ☐ Inactive

\_\_\_\_\_ ☐ Active / ☐ Inactive

Control Module Software Version \_\_\_\_\_

Def Quality Percentage Measured with Refractometer \_\_\_\_\_%

If DEF fluid quality is bad, or non-DEF fluid is found in the DEF tank, repair as necessary. Clear and recheck codes after repair.

Pierce Part #	Vendor Part #
2803471	FPP810B531
3044766	FPP810B531
3165156	No part #
3249412	No part #
3264272	JKA01499
3280600	JKA01499
3438479	JKA02396
3539748	JKA02520
3584091	JKA03076

### Initial all steps complete

Drain DEF tank and remove the DEF header.

Complete \_\_\_\_\_

Clean the def header quality sensor lens.

Complete \_\_\_\_\_

Does the DEF header quality sensor visually have any fluid trapped inside?

Yes or No

Inspect DEF tank for dirt or debris.

Complete \_\_\_\_\_

Take a picture of the removed def header with date and time stamp  
to attach to the tech support incident.

Complete \_\_\_\_\_

Inspect the def header connection. (Clean, tight, pin damage.)

Complete \_\_\_\_\_

Inspect the chassis engine harness aftertreatment connections

Complete \_\_\_\_\_

(If you need a copy of the harness diagram for connection reference,  
contact the tech support team.)

Reinstall header and fill the tank with fresh DEF fluid

Complete \_\_\_\_\_

Clear all codes and run the engine to operating temperature.

Complete \_\_\_\_\_

Then operate the truck for 30 minutes or perform a forced regeneration.

Do any of the engine codes return

Yes or No

List the codes that have returned active and create a technical support incident with a picture with a date and time stamp of the diagnostic tool screen showing the codes:

\_\_\_\_\_ Active

\_\_\_\_\_ Active

\_\_\_\_\_ Active

\_\_\_\_\_ Active

If any additional support is needed while following the troubleshooting checklist, please open a technical support incident on [Pierceparts.com](http://Pierceparts.com).