General Equipment Safety Bulletin

Technical Support Department

Bulletin 006/2015

Subject	Fast fill fuel system leakage
Affected Product	797B Large Mining Truck*
Risk identified	Personal injury, property damage

Problem Overview

Hastings Deering has received three recent reports of fires on Caterpillar 797B Off Highway Trucks. The fires resulted from fuel exiting the fuel tank breather/filter during the fast fill refuelling process, and contacting engine exhaust components. The affected 797B's were fitted with the pressurized fuel tank shut off system – refer explanation below.

Discussion

Two fast fuel systems are available ex-factory on some Caterpillar products – Pressurized tank and Non-pressurized tank. Both systems, if operated correctly, will automatically shut off fuel flow from the filling nozzle, when the fuel tank has filled to the correct level. Fuel exiting from the breather can be an indication of one or more of the following:

1. A system malfunction
2. Excessive fill rate
3. Operator error
4. A system modification that does not accord with the Original Equipment Manufacturer's product or system design.

Some information in this bulletin will be applicable to several Caterpillar products. However, as there are slight variations in system design between different model lines, this discussion specifically applies to Caterpillar Large Mining Trucks

Pressurized fuel tank shut off system

These systems rely on pressure build up within the fuel tank to shut off the filling nozzle. Pressurized systems are supplied with one, bi-directional vent valve with an external line from the vent valve to a filter/breather mounted above the tank. This breather allows air to exit the fuel tank during the filling process, and filters air that enters the tank as fuel is consumed during normal truck operation. The nozzle used to fill Caterpillar pressurized tank systems should shut off at a pressure no higher than 69 kPa (10 psi).

Once the tank has filled to the design level, the vent valve shuts off and allows pressure to build up in the tank. This pressure build up is sensed at the nozzle, causing it to shut off. If the operator attempts to add more fuel, or the nozzle malfunctions, the vent valve relief system will open at approximately 83 kPa (12 psi), allowing excess fuel to vent via the tank breather. On this system, fuel will continue to flow if the filler nozzle handle is forced. The vent valve has a maximum capacity of 568 litres/minute (150 US gallons/minute). Refer to page 3 of this bulletin for further explanation of the operation of the pressurized fuel tank fast fill system.

*No incident reports received on other models, however content also applies to other Caterpillar Large Mining Trucks

Non-Pressurized fuel tank shut off system

Caterpillar non-pressurized fast fill tanks have two vent valves, the same bi-directional valve as fitted to the pressurized system, connected to an external breather, and an 'exhale only' vent valve that contains a float valve and a signal line connection. When the tank reaches its design fill level, the 'exhale only' vent float valve shuts, and transmits a signal via an internal line to the fuel inlet valve. This shuts off the fill valve and shuts off the filling nozzle in a similar manner to the pressurized system. Unlike the pressurized tank system, no more fuel can be added once the system shuts off. As the 'exhale only' vent valve does not allow the ingress of air, it does not need to be connected to a breather. Each vent valve on the Caterpillar non-pressurized fuel system has a capacity of 568 litres/minute (150 US gallons/minute). Refer to pages 4 and 5 of this bulletin for further explanation of Non-pressurized tank system.

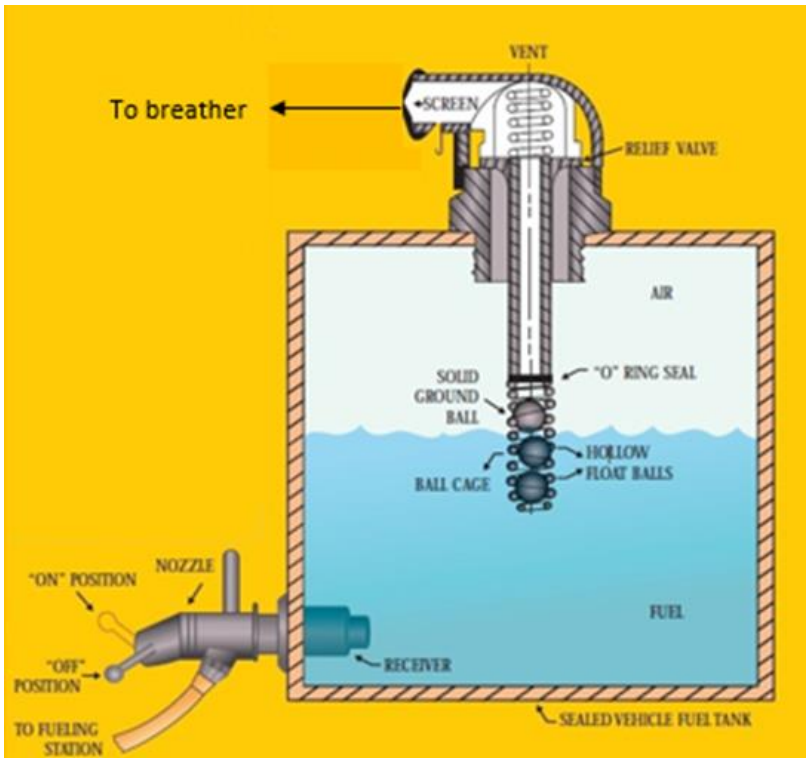
Recommended actions to prevent fuel exiting the fuel tank breather / filter

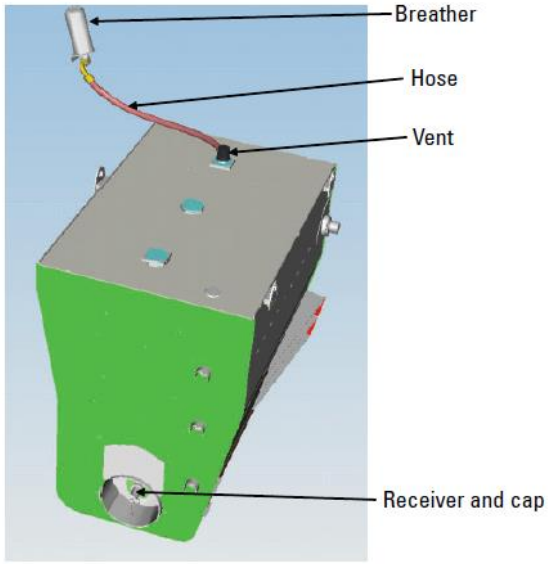
- Do not fill trucks at a higher rate than the standard vent valve allows – 568 litres/minute (150 US gallons/minute) for single vent pressurized tank systems. Excess fill rates can cause foaming of distillate, even if fuel enters below fuel level in tank.
- Do not 'top off' fuel tanks or manually hold nozzle operating handle in the on position, after automatic nozzle shut-off. A specified air gap must remain above the fuel level to allow for fuel expansion, foaming, and to facilitate correct nozzle shut-off on pressurized systems.
- Do not interfere with the operation of nozzle operating mechanism or operating handle.
- Ensure fuel nozzles for pressurized tank systems have a maximum shut-off pressure of 69 kPa (10 psi).
- Check the fast fill system for correct operation and ensure it is maintained on a regular basis. Ensure nozzles, fill valves and vents are in working order.
- Seek professional advice from a qualified person prior to modifying systems or 'mixing and matching' components.
  NB: Some aftermarket modifications can increase fuel level above the design limit, reducing air volume above fuel level. This can change nozzle shut-off characteristics – increase shutoff 'harshness' and encourage operator to 'top off' fuel tanks to unsafe levels.
- Keep fill receiver valves and nozzles clean. Refit protective caps after refilling is complete. Dirt entry can cause the malfunction of fast fill fuel system components. Dirt entry also causes a reduction in fuel system component life – even with high efficiency filter systems.
- Replace the fuel tank breather filter at the recommended interval.
- Ensure the fuel nozzle operator remains at the quick fill point during the refuelling process.
- Perform a risk assessment or hazard analysis; to identify where, in the event of a fuel fill shut off malfunction, operator error, or overfill, fuel flow will exit in relation to hot components.
- Attach an 'overflow' hose to the 'exhale only' vent to direct fuel to a safe location.

Future mitigation actions

Hastings Deering is developing a kit to allow the retrofit of a new fuel tank breather base that allows any leakage from overfills, to be directed to ground level via an 'overflow' hose.

Typical pressurized tank fast fill fuel system



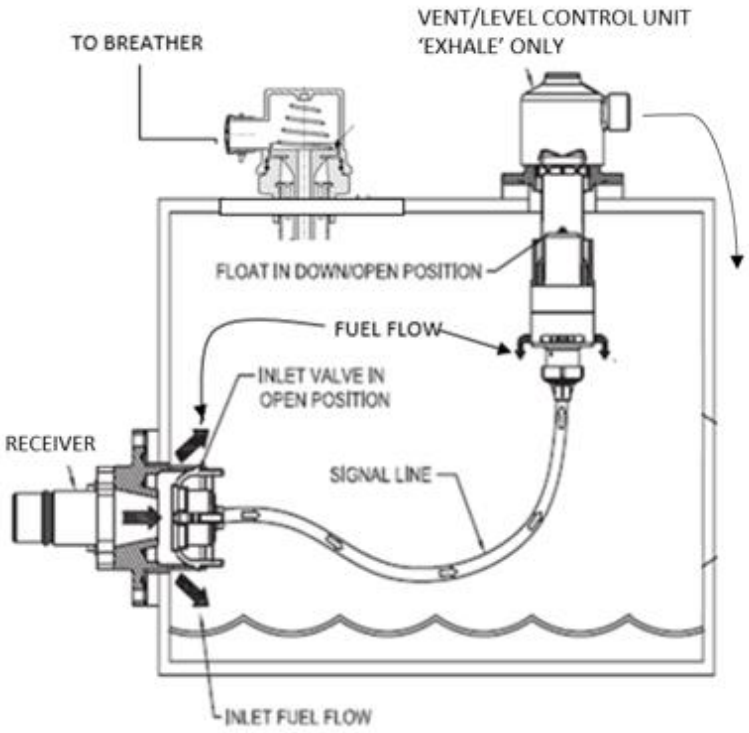


General layout – pressurized tank fast fill system.

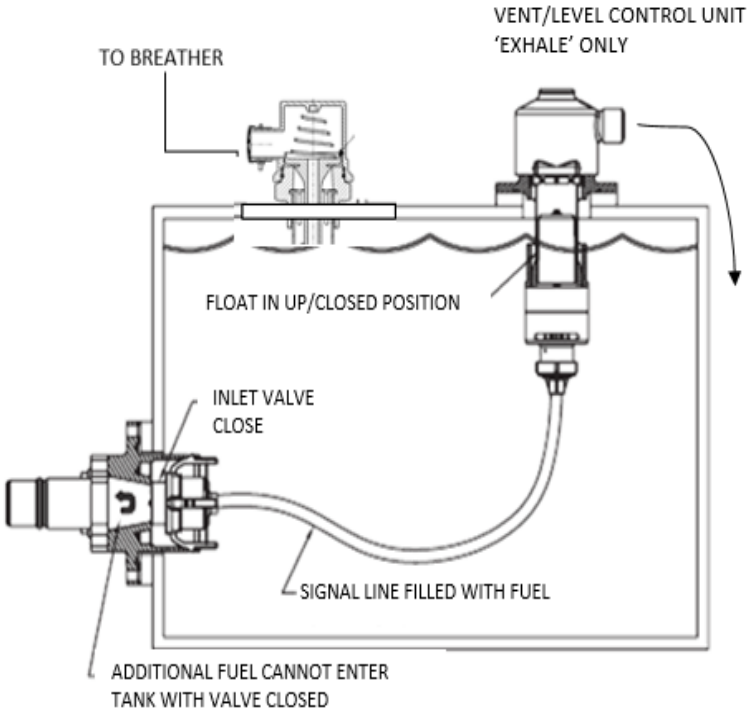
How It Works

- This system relies on the concept of using a sealed vehicle tank to allow a small amount of back pressure to build up and automatically shut off the nozzle.
- The nozzle is attached to the receiver, the handle is turned to the "ON" position, and fuel begins to fill the fuel tank at a rate up to 568 litres/minute (150 US gallons/minute).
- As fuel enters the tank, it forces the air inside the tank to exit through the vent. When the fuel level nears the top of the tank, the "hollow floating balls" force the third "solid ball" to seal against the vent "stem", sealing the tank and stopping the air flow out of the tank.
- As fuel continues to flow, pressure inside the tank builds until it reaches 55-69 kPa (8-10 psi). At 55-69 kPa (8-10 psi), the nozzle automatically shuts off.
- If the fuel flow does not shut off, (e.g. incorrect nozzle used or if operator forces filler nozzle handle) a relief valve in the vent opens at approximately 83 kPa (12 psi) and fuel exits via vent valve to breather.

Caterpillar non-pressurized tank fast fill fuel system



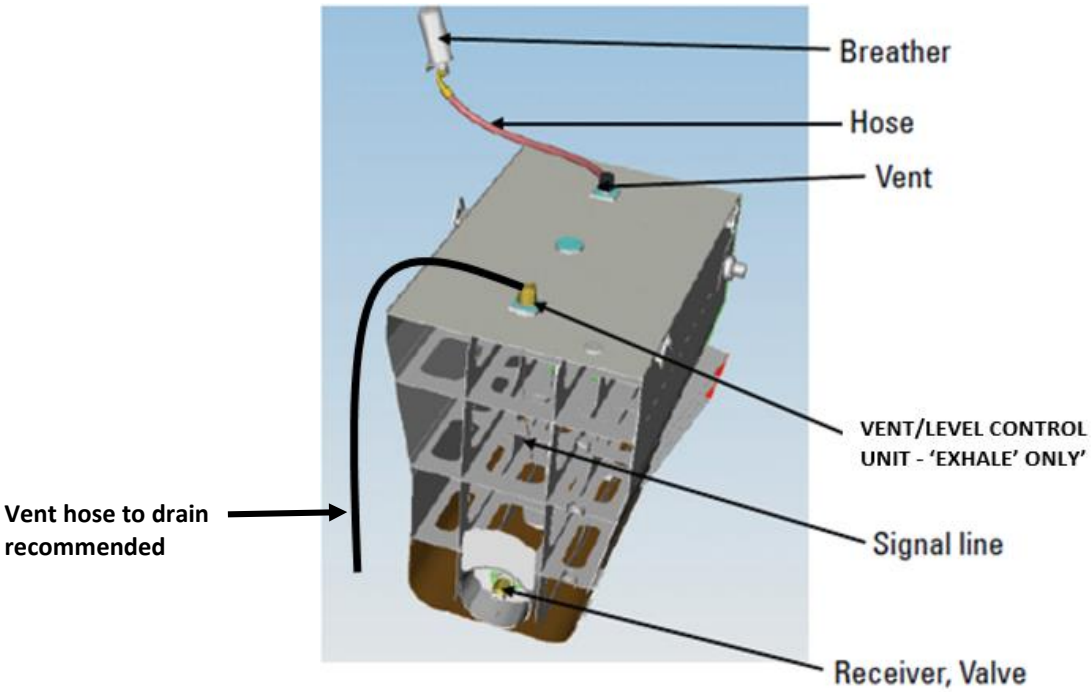
Commencement of fill process



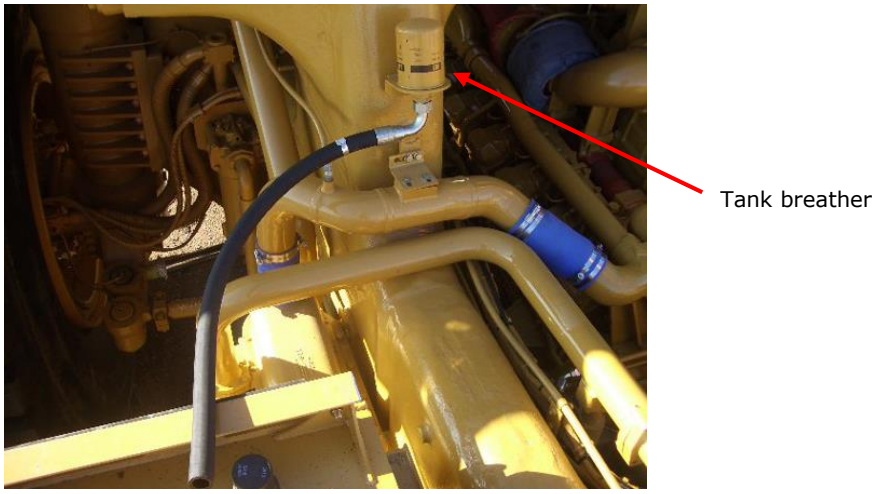
Fill process completed

How it works

- The nozzle is attached to the receiver, the handle is turned to the "ON" position. Fuel begins to fill the fuel tank at a rate up to 568 litres/minute (150 US gallons/minute).
- During filling, a small amount of fuel flows up a signal line and out into the tank.
- When the fuel level reaches the full tank level, the float shut shutoff valve closes and fuel flow through the signal line is stopped.
- Backpressure created by the closed signal line causes the inlet valve to close.
- The closed inlet valve causes backpressure to build between receiver and refueling nozzle, causing it to shutoff.
- With the float in the up position (signal line valve closed), fuel can no longer be forced into tank, preventing the operator 'topping off' fuel tank to unsafe levels.



General layout – non pressurized system



Typical location of fuel tank breather - 797B shown

Please direct any enquiries regarding this bulletin to your Hastings Deering Product or Mining Support Representative

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