



Tempest Tech-Tip 1113

Oil Filter ADB Valves

Background

Many aircraft engine oil filters incorporate anti-drain-back valves (ADB valves). Most mechanics know about them, but there's lots of misunderstanding about what they do and why. This Tempest Tech Tip takes the mystery out of the ADB valve.

ADB valves help prevent engines from running without sufficient oil pressure immediately after a 'hot start'. A hot start is when you land, shut down immediately, kick out a passenger or some freight and, within a minute or so, re-start the engine.

During a hot start, the hot thin engine oil can flow backwards from the filter through the oil pump and to the sump. That leaves the oil pump full of air.

While oil pumps pump oil efficiently, they don't handle air nearly as well. So, ultimately, the object of the ADB valve is to keep the oil pump full of oil instead of air!

In the worse case, it may take a minute or more before the pump expels the air and builds full oil pressure up again after an extreme hot start. During that time the engine would be running with low oil pressure.

How Does the ADB Valve Work?

The ADB valve's job is to trap oil in the passages leading from the sump, through the pump, and to the filter. As long as the pump stays full of oil, even hot thin oil, it will re-establish oil pressure almost instantly after the engine is started.

Figure 1 shows an illustrative engine oil system. The pump (1) sucks oil up from the sump through a tube (2) and pushes it through another oil passage (3) to the filter (4). After passing through the filter the oil goes to the oil cooler (5) and the pressure relief valve (6). The pressure relief dumps excess pump discharge (7) back in the sump. The remaining oil goes through the engine's lubricating system (8). After use, it returns (9) to the sump and the cycle starts again.

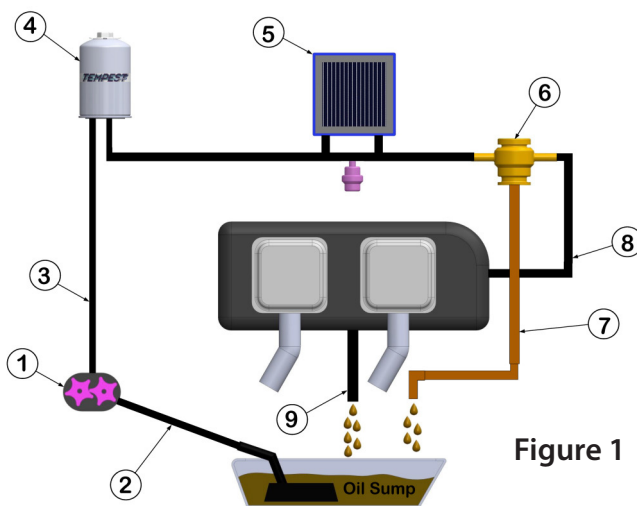


Figure 1





Think of the sump as a deep glass with tea in the bottom. Think of the oil passages leading from the sump, through the pump, and to the filter as a straw. If you suck tea up through the straw and, when the straw is full, put your tongue over the straw's upper end, the tea will stay trapped in the straw. Try it. Beer or bourbon works better. The point is: if a liquid is lifted into a tube by suction and then the top of the tube is sealed off, the liquid will stay up in the tube. This is particularly true if the bottom end of the tube remains covered in the liquid reservoir, as it does in the engine oil sump.

Assuming no air leaks into the 'straw', the fluid would stay suspended in the tube indefinitely. On the other hand, if air can get into the top end of the tube (your tongue leaks in our example) the liquid will run back down from whence it came. Try the experiment again but when you have the tea trapped in the straw take your tongue off the top. The tea will fall back into the glass.

To demonstrate the effect of a leak into the trapped liquid system, suck some tea into the straw and hold it captive with your tongue. Now, take a straight pin and punch a hole in the side of the straw up near your lips. When you pull the pin out of the straw you'll see the tea drain back into the glass.

When oil enters the filter, see **Figure 2**, it encounters the ADB valve. The oil pushes the valve aside and flows into the filter. During normal engine operations the oil flows into the filter and through it to the engine constantly. But, when the engine stops the 'forward oil flow' ceases. Then the ADB valve closes, see **Figure 3**. Once closed it won't permit flow backwards toward the sump. And, since the oil pump is in the oil flow path leading back to the sump, oil is also trapped inside the oil pump.

Figure 2

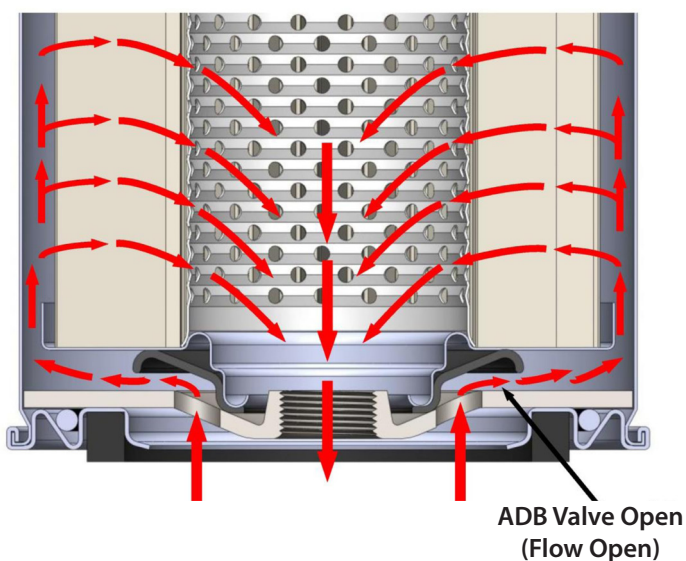
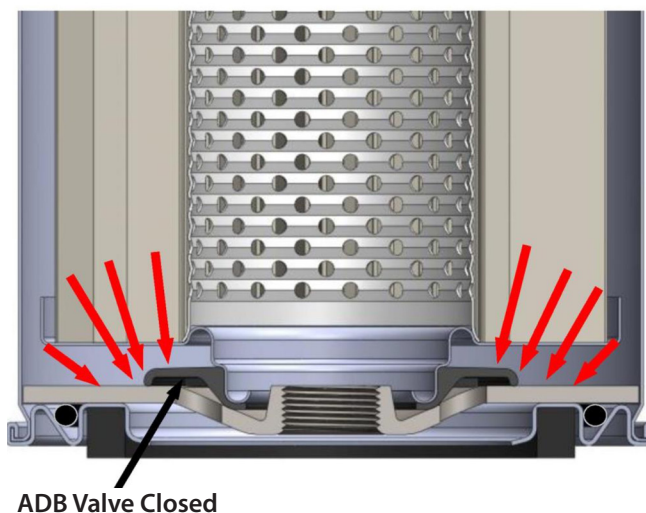


Figure 3





The ADB Seal System

Figure 4 shows an ADB seal system. The base plate and the seal retainer are shown slightly apart to illustrate a possible leak path around the ADB valve. This leak path acts like the pin hole in the straw. If this leak path exists, the oil will flow via the leak path back to the sump until it's all drained from the filter. Air will follow and fill the oil pump as the oil in the passages returns to back to the sump. With extremely hot oil, the 'hot start' scenario that the ADB valve is designed to address, this may occur in a minute or two.

Figure 5 shows the base plate and seal retainer in their actual positions as they are welded together in the filter. Note the O-ring that TEMPEST uses between the parts. It provides a "100 percent" positive seal. No oil (or air) can get past it. Thus, when the ADB valve closes, there's no leak path, not even a minute one, around the ADB valve to compromise the system.

Figure 4

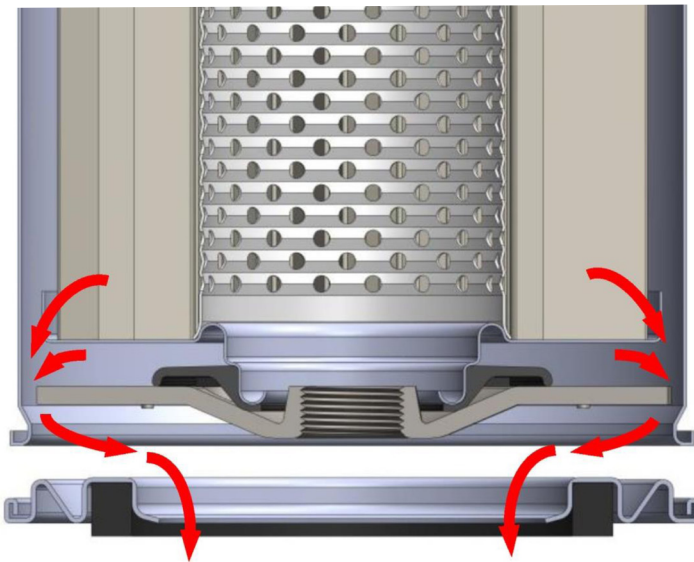
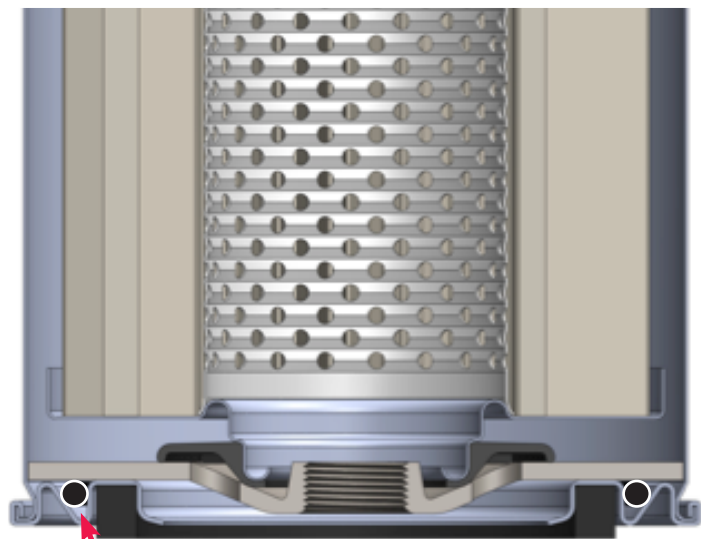


Figure 5



Tempest Filter with
O-Ring Seal





Other filters use caulk between the seal retainer and base plate, see **Figure 6**. The caulk is placed right where the two parts are spot welded together. The intense heat from welding often blows out some of the sealant. That can leave leak paths similar to the example shown between the two parts. Such internal leaks defeat the ADB system. TEMPEST tested caulked filters and found that all those tested leaked. That's why we designed the O-ring into TEMPEST filters.

ADB Misconception

A misconception about ADB valves is that they're supposed to keep the filter full after engine shutdown. That's not true. The ADB valve's job is to keep oil from draining back to the sump through the oil pump. It's irrelevant how much oil stays in the filter, as long as it leaks out of the filter some other way than back down through the pump to the sump!

How much oil remains in a filter is mostly determined by where and how the filter is

mounted on the engine. Oil will leak out of the filter through the central outlet hole and drip back into the sump from the engine's oil galleries if the filter's orientation and the engine's configuration permit it. The ADB valve has nothing to do with that.

Filters mounted baseplate up will stay mostly full of oil, ADB valve or not. Mounted horizontally, they typically drain to a level even with the bottom of the central outlet hole if they have an ADB. If not, they'll drain as far as the ring of inlet holes allows. Mounted baseplate down, they typically drain almost empty, assuming they are mounted high enough up on the engine to permit drainage. Regardless of how much oil stays in the filter or doesn't, as long as the oil can't flow from the ADB valve backwards to the sump through the pump it makes no difference. If the oil pump is full when the engine is started it will almost instantly refill the filter and pressurize the engine lubrication system (see, note 1).

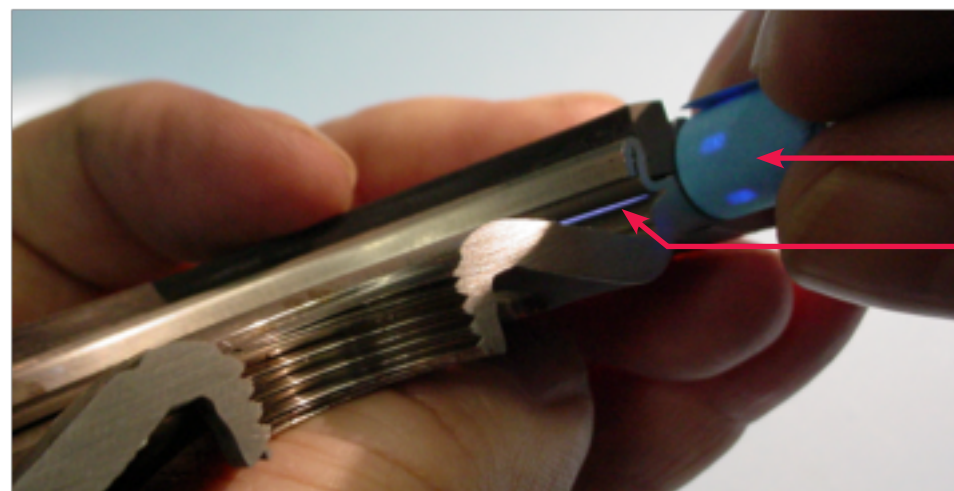


Figure 6
Competitive Filter
with Caulk Sealant

Light source
Light Is Shown
In The Leak Path





Once an engine has cooled a bit, say 30 minutes or an hour, even if the oil has leaked back down to the sump and the pump has air in it, that's not too much of a problem. Even in a half hour or an hour the oil has cooled enough for its viscosity (thickness) to increase. The thicker oil forms a better seal between the pump's gears and housing and can quickly re-establish oil pressure after the engine starts. Similarly, the thicker oil throughout the engine provides a bit more cushion and lubricity immediately after start up, thus protecting the engine parts until full oil pressure is established.

On What Engines Are ADB Valves Applicable?

As most mechanics know, some filter models have ADB valves and some don't. ADB valves are mostly used on Continental engines. That's a choice the engine manufacturer makes related to the physical design of the engine, oil pump, etc. Tempest oil filters, part numbers AA48108, AA48108-2 and AA48109 contain ADB valves.

The ADB valve doesn't require any attention from

the mechanic. There's nothing you can do or not do to make it work or not work. Nevertheless, understanding what it does and how it does it helps you understand the engine's lubrication system in its entirety and that makes you a more knowledgeable mechanic.

ADB Valves and Remote Filter Mounts

There is one thing regarding ADB valves you do need to keep in mind; if they're used with remote filter mounts it is absolutely imperative that the oil lines to the remote mount not be crossed. If they are, the oil will try to flow through the filter "backwards". The ADB valve will be forced shut and pressure in the filter will build to the point that either the filter's case will burst or filter element will be crushed. In addition, the rubber ADB valve can also be extruded backwards through the filter's inlet holes. When this happens, bits of the valve may be blown into the engine oil passages and clog oil passages. See **Figures 7, 8 & 9**.

Always pay special attention to the oil line connections on remote mounted filter.





Figure 7
Oil Lines Shown
Connected Correctly To
Remote Oil Filter Mount

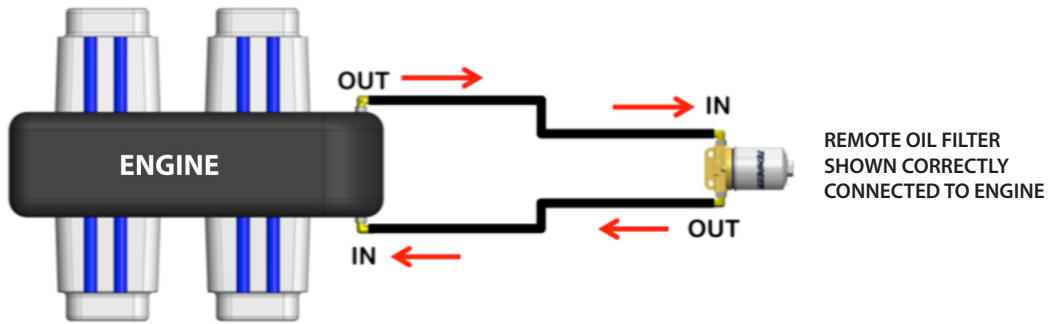


Figure 8
Oil Lines Shown
Connected Incorrectly
To Remote Oil Filter Mount

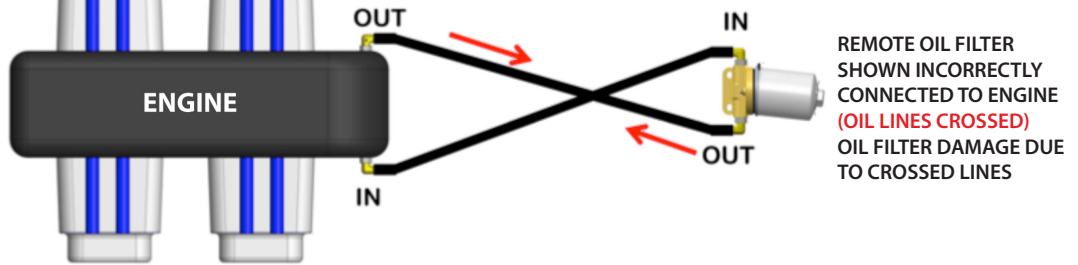


Figure 9

Over Pressurized Filter (DOMED CASE & BURST SEAL)



New Filter

For additional information on this Tempest Tech Tip and Tempest products, please go to www.tempestplus.com or call (800) 822-3200. We are happy to help!

Note 1. Typically, engine oil pumps in general aviation engines pump three to four gallons of oil per minute, even at near idle. Since the filter holds less than a quart of oil, it only takes a few seconds to fill an empty filter, even less to refill and partially full filter.

