TECHTALK

OH MY ... THERE’S OIL ON MY BELLY!

Few subjects provoke a more zealous response from Cirrus owners than oil on the belly. Methodical diagnosis may be helpful, but Band-Aid solutions aren’t.

by Mike Busch

I’ve never quite understood the obsession that many aircraft owners have with oil on the belly. Some oil discharge from the engine breather is absolutely normal, and an oil film on the belly certainly doesn’t hurt anything. When was the last time you heard someone complaining about an oil film on the underside of his pickup, tractor or lawnmower?

“Excessive” oil discharge (whatever that means) has a number of possible causes, most of them quite innocuous and unrelated to airworthiness. Nevertheless, it’s quite apparent that many Cirrus owners are concerned about minimizing the discharge of oil on the belly of their aircraft. So let’s examine the causes of this phenomenon, what we can do to minimize it, and what we should avoid doing.

Why Does It Happen?

Each certificated piston aircraft engine is required by regulation to incorporate a crankcase breather system to prevent build-up of excessive pressure in the engine’s crankcase. This is extremely important, because excessive crankcase pressure can result in engine failure.

There are numerous cases on record where an iced-up crankcase breather line resulted in blowout of the front crankshaft seal, followed quickly by oil exhaustion and lubrication failure. In other cases, a pressurized crankcase forced oil into the magnetos and caused ignition failure.

Where does crankcase pressure come from? Most of it comes from “blow-by,” which is simply hot, high-pressure combustion gases that leak past the compression rings and into the crankcase. Rings never seal perfectly, so some blow-by is inevitable. As cylinders and rings wear, blow-by tends to increase over time, and therefore so does the volume of gas expelled through the crankcase breather.

There are a few other possible causes of excessive crankcase pressure besides blow-by. A leaking seal on the oil filler cap can allow ram air to enter the crankcase and pressurize it. A leaking front crankshaft seal can do the same thing. In turbocharged engines, a worn turbocharger can pressurize the crankcase, although this is rare.

When the engine is running, the spinning crankshaft and camshaft both throw copious quantities of engine oil in every direction, filling the crankcase with a dense oil mist. So when excess crankcase pressure is vented through the crankcase breather, the discharge invariably contains a significant quantity of oil. That oil egresses through the breather line and winds up on ... you know where!

Anything that increases the amount of oil being flung about inside the crankcase will naturally increase the amount of oil carried out of the crankcase breather. Filling the oil sump to its maximum capacity will often do this, especially in TCM engines with their low-slung camshafts. Many TCM engines seem to be happiest when the sump is filled to between two-thirds and three-fourths of maximum. High oil pressure and/or low oil viscosity will also increase the quantity of oil that is extruded from engine bearings and splashed about inside the crankcase.

One more thing that can increase flow through the crankcase breather is when the end of the breather tube is located in a low-pressure area, creating a partial vacuum in the breather tube that causes oil-laden gas to be literally sucked out of the crankcase. This can occur with any engine installation if the breather tube is positioned incorrectly.

Pinpointing the Cause

Some oil discharge from the breather is normal. While there is no clear-cut guidance on what constitutes “excessive” oil discharge, TCM has a service bulletin that says that oil consumption in excess of a quart in three hours is cause for concern and warrants investigation to determine the cause. (A quart in three hours is a LOT of oil on the belly!)

The most frequent cause of excessive oil discharge is excessive blow-by of combustion gases past the compression rings of one or more cylinders. Perhaps the easiest way to determine whether your engine is suffering from excessive blow-by is to note how quickly the oil turns dark and opaque after an oil change. In a “tight” engine with minimal blow-by, it usually takes 15 to 25 hours of operation before the oil turns dark and opaque. If this happens in five or 10 hours, that’s a pretty good indication that the engine is suffering from excessive blow-by in one or more cylinders.

If this is the case, the next step in diagnosis is to determine which cylinders are the culprits. This can usually be accomplished by means of compression testing, borescope inspection, and spark plug inspection. Weak compression with air leaking past the rings suggests a worn cylinder barrel, but the test only detects wear in the top-of-stroke ring-reversal area, and may not reveal mid-stroke wear. A borescope inspection is probably the best available test; barrel wear will often show up under the borescope as shiny areas in the cylinder bore where the entire crosshatch hone pattern has been worn away. Corrosion damage and vertical scoring caused by broken rings or piston skirt scuffing will

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also be obvious under the borescope. Oily top spark plugs are also indicative of a seriously worn cylinder.

If one or more worn cylinders are found but the cylinders are not worn to the point of being technically unairworthy, you will need to decide whether or not to replace them. Replacing one cylinder typically costs about $2,000, and replacing six cylinders (“top overhaul”) can cost $9,000. How much is a clean belly worth to you?

If oil discharge from the breather seems excessive but the oil is not turning dark quickly, then you may want to look for a cause other than blow-by. TCM Service Bulletin M89-9 describes a method for detecting elevated crankcase pressure by installing a modified oil filler cap plumbed to an old airspeed indicator that is used as an ultra-sensitive pressure gauge to measure crankcase pressure. The service bulletin includes a table that defines maximum acceptable crank-case pressure for each model of TCM engine.

If crankcase pressure is excessive but the oil is not darkening quickly, suspect a leaky oil filler cap, leaky front crankshaft seal, or possibly a problematic turbocharger. If crankcase pressure is not excessive but oil discharge is excessive, suspect a mispositioned breather line.

**Band-Aid Solutions**

Some Cirrus owners have chosen to address the oil-on-the-belly “problem” by installing an aftermarket air-oil separator in the crankcase breather plumbing. The separator is essentially a swirl chamber that uses centrifugal force to separate liquid from gas, and returns the liquid to the crankcase while allowing gas to pass out the breather tube.

Several such aftermarket air-oil separators have STCs for installation on most TCM and Lycoming engines. The most common such devices are the M-20 Model 300 (manufactured by M-20 Oil Separators LLC) and the Walker AirSep (manufactured by Airwolf Filter Corp).

I call such devices “Band-Aid solutions” because their purpose is to conceal the symptom (oil on the belly) rather than to address the root cause (crankcase pressurization). I have long discouraged the installation of such devices, and many world-class engine experts have been quite outspoken in opposition to their use.

Installing an aftermarket air/oil separator in the engine breather is “like hooking a line up to your anus and piping it back into your mouth,” writes John Schwaner of Sacramento Sky Ranch (www.sacskyranch.com) and author of the marvelous Sky Ranch Engineering Manual.

Schwaner points out that the quantity of oil discharge from the engine breather is an important indicator of engine health, and installation of an air/oil separator deprives the owner and his mechanic from using this tool. He also points out that small air/oil separators can freeze up in cold weather, blocking the breather and possibly causing engine failure.

Bob Moseley of SkyTEK Inc. in Fulton, Mo. (www.skytekonline.com) has been building aircraft engines for more than 30 years and served as a regional field representative for TCM for five years. “Aftermarket air/oil separators can, and many times do, compromise the integrity of the crankcase
breather system, and that can cause you a LOT more problems than a lubricated belly,” says Mose. “If you take a look at the snotty, nasty, moisture-laden oil that is being returned to your engine by an aftermarket air/oil separator, you might well reconsider.”

In addition to relieving crankcase pressure, the crankcase breather allows the engine to purge moisture from the oil and vent it overboard. This is extremely important, because corrosion is the number-one reason that engines fail to make TBO, and internal moisture build-up is one of the two factors that cause internal engine corrosion. (The other factor is loss of protective oil film due to disuse.) To the extent that an aftermarket air/oil separator returns moisture-laden oil to the crankcase rather than allowing it to be discharged overboard, it can contribute to the corrosion problem and wind up costing you truly big bucks.

Therefore, if you have excessive oil discharge on the belly from the crank-case breather, I would suggest that you do some troubleshooting to identify and eliminate the problem at its source, or alternatively that you learn to live with a little oil on the belly.

About the Author

Mike Busch has been a pilot for more than 40 years and 7,000 hours, and an aircraft owner and CFI for more than 35 years. He became increasingly interested in the maintenance aspects of aircraft ownership about 20 years ago, and ultimately earned his A&P/IA. Mike is also a prolific aviation writer, with over hundreds of technical articles published in American Bonanza Society Magazine, Aviation Safety, AVweb, Cessna Pilots Association Magazine, IFR, Light Plane Maintenance, and The Aviation Consumer. He co-founded AVweb in 1995 and served as its editor-in-chief for more than seven years. Mike conducts weekend “Savvy Owner Seminars” at which aircraft owners learn how to obtain better aircraft maintenance while spending a lot less money (http://www.savvyaviator.com). Questions for Mike Busch may be emailed to mike.busch@savvyaviator.com.

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