Shock Cooling: Time To Kill The Myth

There's no evidence that big power reductions damage horizontally opposed aircraft engines by "shock-cooling" them. It's time to trash the myth so pilots can focus on real risks to their airplanes and engines.

By Rick Durden (/db/fdc.collector?client_id=avweb&form_id=maileditform&link_id=308) , Features Editor | January 4, 2018

Need to make a big power reduction when ATC calls for a slam-dunk approach? It's OK, you aren't going to turn your engine into a boat anchor.

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By Paul Bertorelli | February 11, 2018

They're slow, they leak and they rust. But they make up for it. *More (/blogs/insider/Why-Seaplanes-Are-So-Boring-230296-1.html)*

FEATURED VIDEO

Some years ago, I had one of those “what in the world are they thinking?” conversations with a pilot who was towing gliders as a volunteer for the Civil Air Patrol. While he thought it was important to volunteer for a good group, he was ready to quit because of a screwy power reduction procedure imposed on the pilots by someone high up in the organization. The procedure was ostensibly to prevent cylinder cracking due to shock cooling during descent after the glider released. However, the procedure he described took so long that, even if the glider did several minutes of soaring during its flight, it was on the ground well before the tow plane. As a longtime tow pilot, this struck me as ludicrous.

The anti-shock-cooling exercise required a series of small reductions in manifold pressure, each followed by flying around for a period of time before making the next, while the airplane descended slowly, burning lots of fuel. If shock cooling actually existed and caused cylinder cracking, it would probably be cheaper for the operation to have bought a bevy of cylinders and kept them on hand for replacement than pay for the fuel they were going through to avoid a phantasm.

I used to be astonished at how aviation myths, particularly when it came to engine operation, have such incredible staying power. Now, when I hear one spouted, I just shake my head in admiration of the influence of ignorance and belief over data. With some folks, the laws of physics, aerodynamics, metallurgy and thermodynamics are trumped by unwavering faith in their particular superstitions.

Nevertheless, when aviation superstitions get in the way of safe, efficient engine operation and addressing real risks of damage to engines, they need to be exposed for the nonsense they are, particularly when they are adversely affecting others—such as the glider operation that could only get off a few flights an hour. Such practices, especially when they are taught as fact to new pilots, only perpetuate the foolishness.

The widely respected Daniel Patrick Moynihan put it eloquently: “Everyone is entitled to his own opinion, but not his own facts.”

Bob Hoover regularly shut down the engines on his Shrike while running at full power and never cracked a cylinder.

There is absolutely no hard evidence that making a large power reduction will cause cracking of the cylinders of a horizontally opposed piston aircraft engine. Because people like examples, we’ll start with a few: Bob Hoover regularly shut down and feathered the engines on his Aero Commander Shrike during airshows—going from max power to none—and never cracked a cylinder. That’s consistent with what skydiving and glider tow operators have known for decades—their engines hit TBO without much in the way of cylinder problems, even though they descend rapidly at low power settings. Flight schools, with their repeated touch and goes, don’t go through cylinders at a disproportionate rate.

Let’s look at the numbers involved in engine cooling, starting with the small role that the cylinder fins play. Only about 12 percent of the heat generated by combustion departs from the engine via the cooling fins. The biggest proportion, 44 percent, goes out the tailpipe. Eight percent, almost as much as is handled by the cooling fins, is dissipated through the oil. Much of the rest is dissipated via the big, metal prop bolted to the crankshaft.

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PILOT'S FLIGHTBAG

QUESTION OF THE WEEK

How Cool Was SpaceX's Launch of a Tesla Roadster Toward Mars?

- Cool as anything since the Apollo days.
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The engine manufacturer that has published data on the potential for shock-cooling damage—Lycoming (https://www.lycoming.com/content/how-avoid-sudden-cooling-your-engine)—said to avoid the risk of damage, pilots should limit CHT reduction in flight to 50 degrees F per minute. The good news is that, even assuming such a rate of cooling will damage an engine—Lycoming said that damage potential existed only if done "consistently"—it's nearly impossible to cool an engine that fast in flight even by shutting it down. In an article written by Kas Thomas more than 20 years ago and reprinted in *AVweb (https://www.avweb.com/news/maint/182883-1.html)*, he went through the published test data—which showed that cutting engine power by half only reduces CHT by 10 percent or so. That kind of CHT drop isn't capable of trashing cylinders—and isn't anywhere close to the CHT change that occurs in the opposite direction on takeoff—shock heating, so to speak. And there's never been any data to indicate that the massive shock heating during takeoff harms the cylinders.

Thomas also pointed out that flying through rain reduces CHTs by nearly as much as a 50 percent power reduction. There's no history of airplanes regularly flown through rain having to constantly replace cylinders.

In fact, the real shock cooling comes at the end of the flight when you pull the mixture to idle cutoff and the CHTs drop at more than 100 degrees per minute right away—yet every engine goes through that sort of shock cooling and manages to survive it.

In the last 20 years, graphic engine monitors have become common in general aviation—and the data they provide further support conclusions reached before they were around regarding the minor effect of big power changes. Many monitors are set to alarm if the CHTs show a drop at a rate of more than 60 degrees per minute. Pilots are discovering that it's nearly impossible to hit that rate without slamming the throttle shut and diving—which isn't comfortable for anyone in the airplane. Mike Busch, A&P and principal of Savvy Aircraft Maintenance Management, told me during a conversation at an AOPA Fly-In that he's tracked how fast CHTs will drop with various power reductions in his Cessna T310R. His observations were that it unusual to have CHTs drop at a rate of even 30 degrees per minute even with aggressive power reductions when ATC gives a slam-dunk approach.

In one of *AVweb* columnist John Deakin's excellent articles on engine operation

For decades the engines on glider tow airplanes have made TBO after a life of climbing at full power and descending quickly at minimal power.

(https://www.avweb.com/news/pelican/182544-1.html), he noted that when he waited 18 seconds to restart the engine of his Bonanza after running a tank dry, the CHTs only dropped 10 degrees.

In my opinion, It's time to put the shock cooling myth to bed, so that pilots can worry about things that really are a risk to their safety and wallets—such as runway loss of control accidents. After all, with more than 25 percent of accidents that cause damage to the airplane and engine arising from loss of control on landing rollout it seems to me that rather than designing complex power reduction strategies to avoid a mythical risk of damaging an engine, we should be practicing crosswind landings to protect a real risk that actually does damage engines—and the airframes wrapped around them.

Rick Durden holds a CFII and ATP with type ratings in the Douglas DC-3 and Cessna Citation and is the author of The Thinking Pilot's Flight Manual or, How to Survive Flying Little Airplanes and Have a Ball Doing it, Vols. 1 & 2. (http://www.rickdurden.com/book.html)

Kinda cool, but couldn't they have launched something useful?

- Totally a gimmick.
- Cool, but it distracted from the real technical achievement of the mission.
- OTHER. My opinion doesn't appear as a choice. I might send you an e-mail (http://www.avweb.com/avmail?kw=QOTW&subject_prefix=[QOTW]). (200 words or less, please. Remember we consider these e-mails for publication unless you specifically say otherwise.)

VOTE

PICTURE OF THE WEEK

(/gallery/Picture-of-the-Week-230299-1.html)

Picture of the Week (/gallery/Picture-of-the-Week-230299-1.html) »

Nice photos this week but we like pictures of airplanes in the air and Helen Lavigne's great shot of Andre Durocher's souped-up Beaver filled the bill. Nice shot, Helene.