It's Baffling

Your presenter…

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"I recently had my engine rebuilt and had a new baffle kit installed…"

Cessna T210

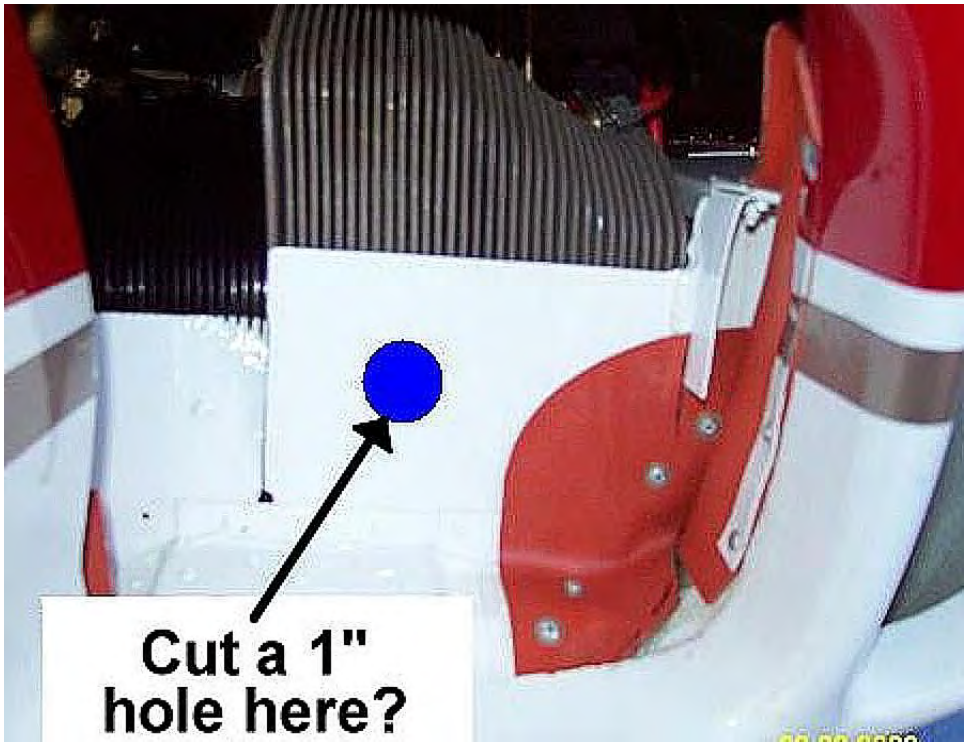
"The CHTs for cylinders #5 and #6 are always 20°F to 30°F hotter than the rest…"

"During climb the difference gets even bigger…"

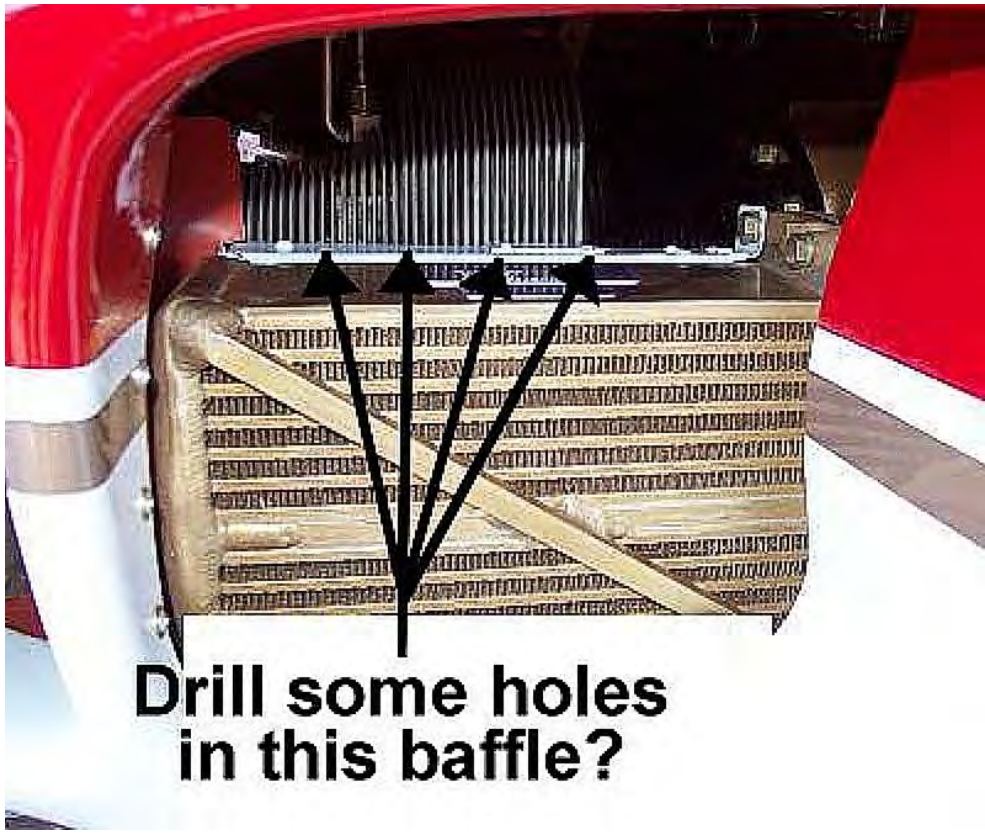
"Cylinder #5 and #6 CHTs are very difficult to keep below 400°F during a climb, even with the cowl flaps open and full-rich mixture…"

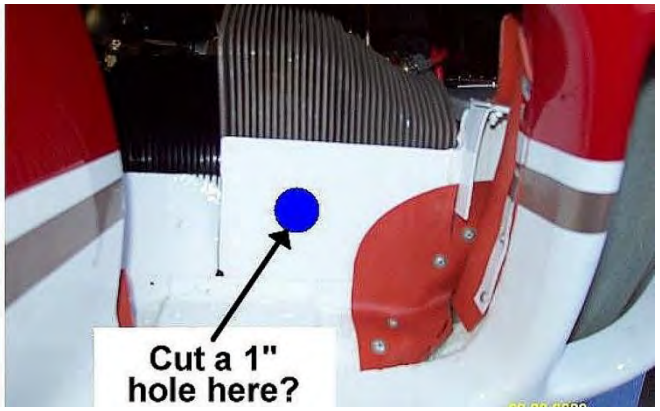
"Should I consider giving them some air?"

"On cylinder #6, why not cut one or more holes in the white aluminum baffle in front of the cylinder?"



"On cylinder #5, why not drill one or more holes in the horizontal aluminum plate located behind the oil cooler?"

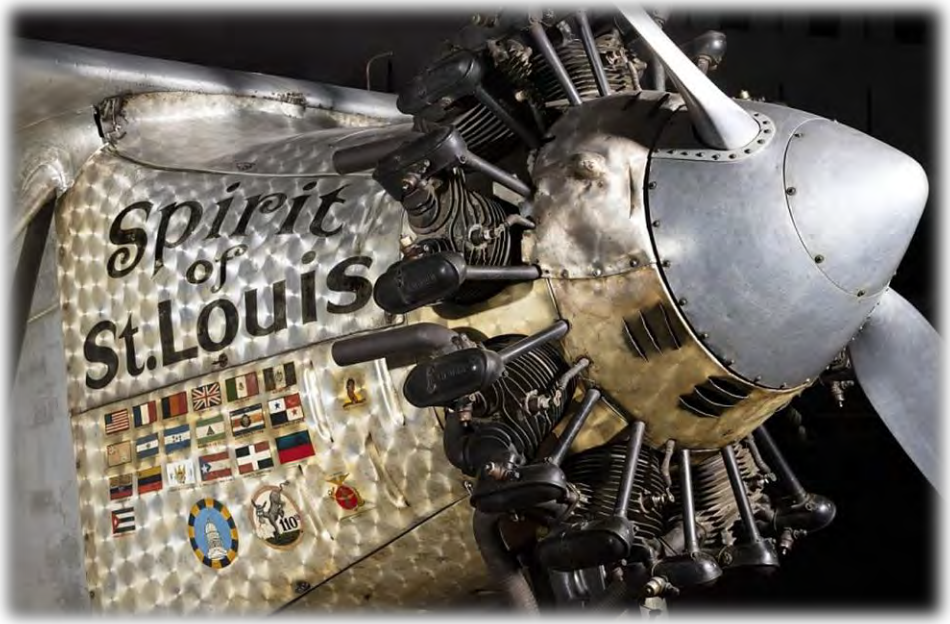




I told the T210 owner that cutting holes in the baffles was definitely NOT a good idea, and that doing so would make his cooling problems worse, not better

It was apparent that this owner didn't understand how the powerplant cooling system in his aircraft works and what the function of the baffles is…

(He's not alone—some A&P mechanics don't fully understand it, either!)



1920s

2010s

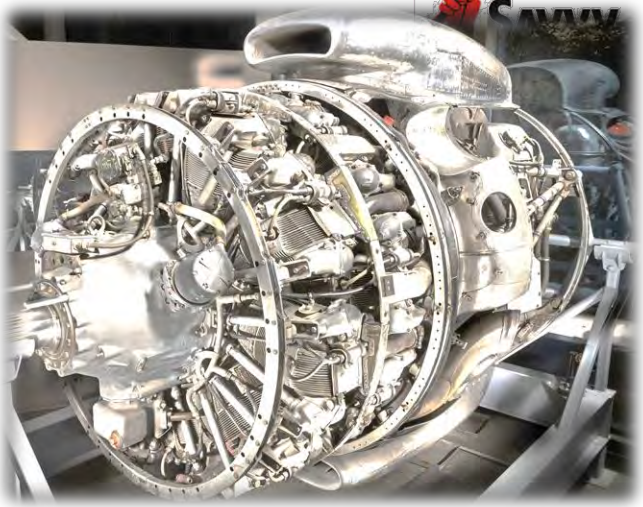
Engine Cooling: Then and Now…

In the early days, aircraft designers took a simple approach to the problem of cooling aircraft engines…

The engines were mounted with their finned cylinders out in the slipstream and cooled by the horizontal flow of ram air

This is known as "velocity cooling" and was adequate for cooling the single-row radial engines of the time

As engines grew more powerful and multi-row radials and horizontally opposed engines came into fashion, simple velocity cooling wasn't up to the job

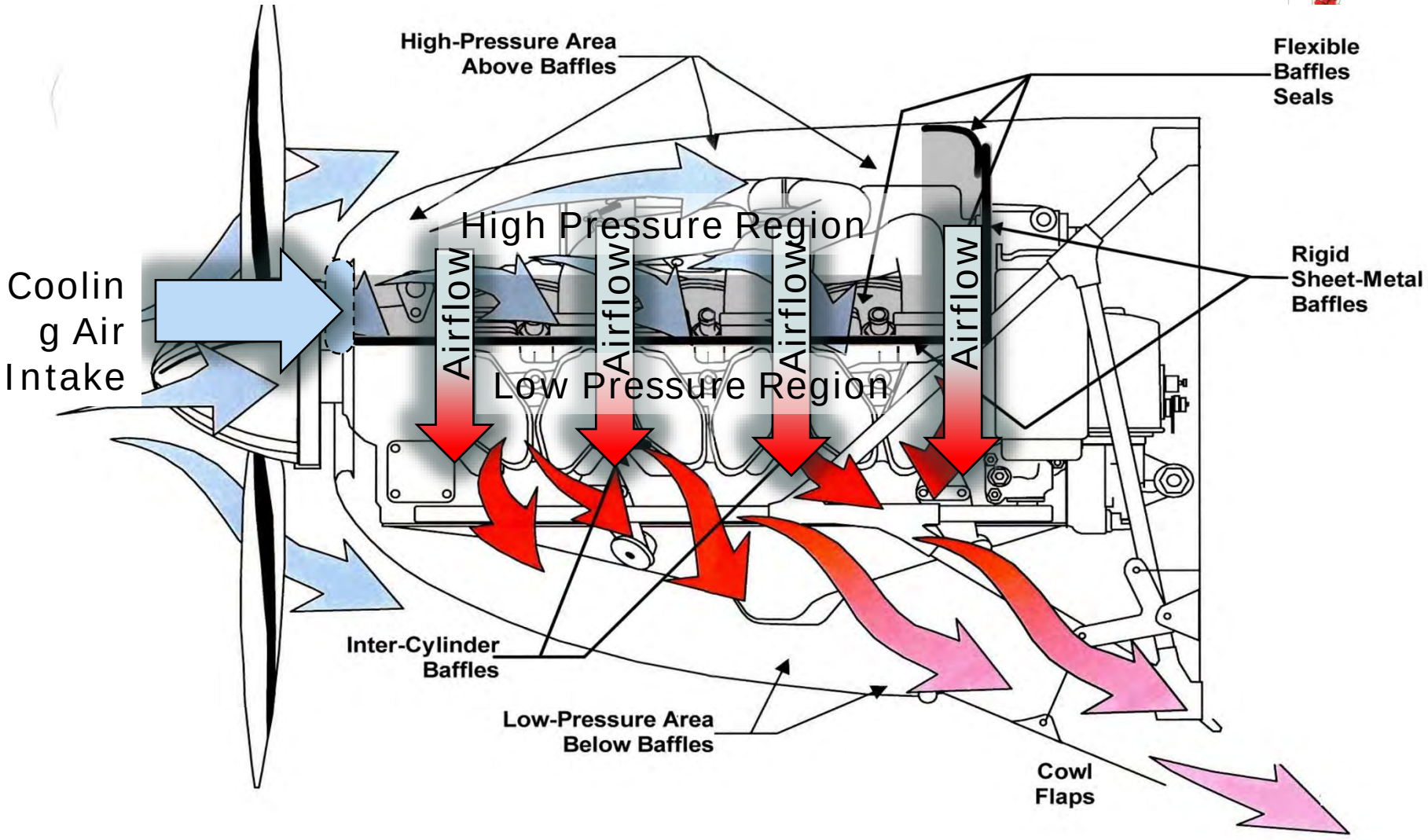


For one thing, cooling was uneven—front cylinders got a lot more cooling airflow than rear ones

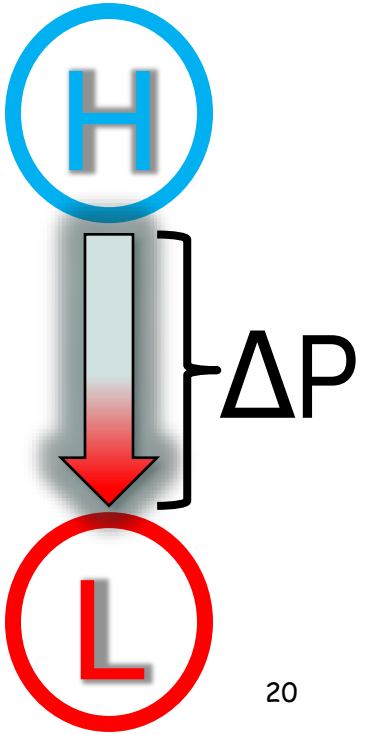
For another, sticking all those finned cylinders out in the breeze created horrendous cooling drag

That better system was known as "pressure cooling" and is the method used in all modern piston aircraft

Pressure cooling is accomplished by placing a cowling around the engine and using a system of rigid baffles and flexible baffle seals to produce the volume and pattern of cooling airflow necessary to achieve even cooling with minimum drag



The volume of cooling airflow that passes across the cylinders is a function of the pressure difference ("ΔP") between the high-pressure (upper) chamber and the low-pressure (lower) chamber

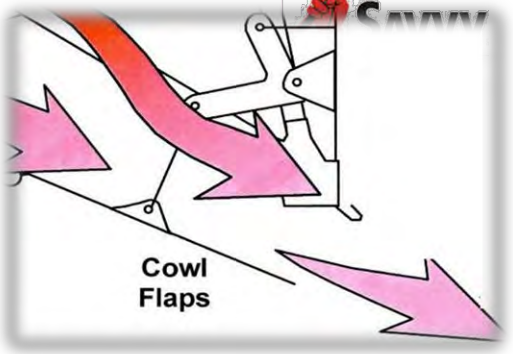


ΔP is remarkably small:

A typical high-performance piston aircraft generally relies on a ΔP of just 6-7 inches of water—about 1/4 PSI

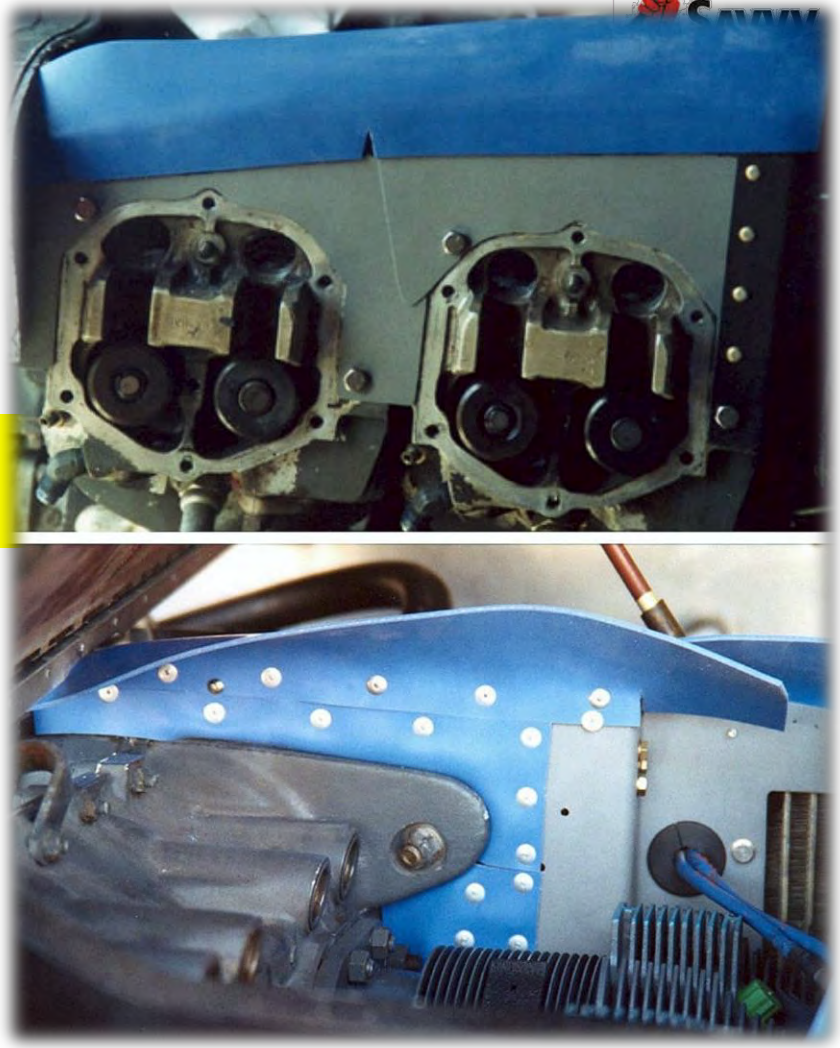
Aircraft designers try to keep this ΔP to an absolute minimum, because higher delta-P means higher cooling drag

Cowl flaps may be used to modulate the cooling airflow

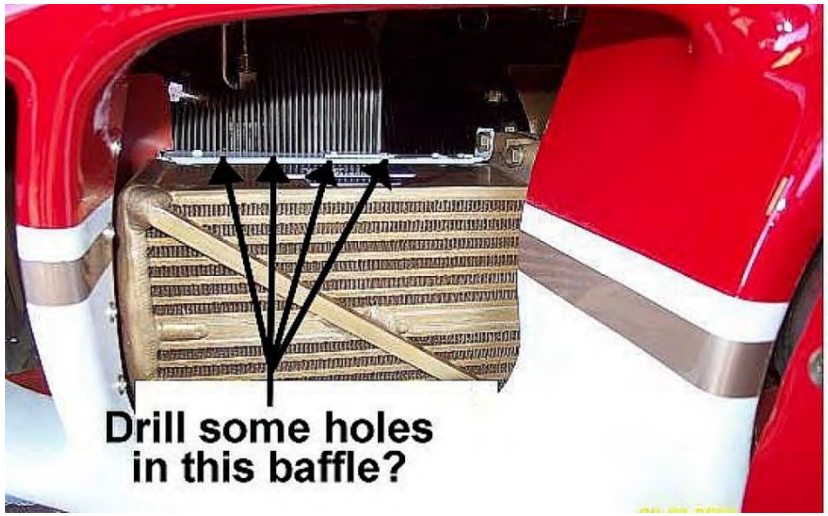


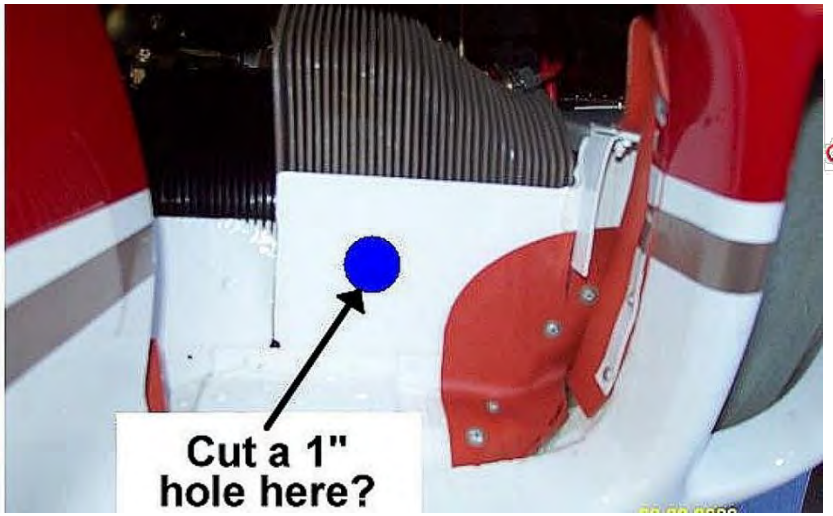
Opening the cowl flaps reduces the pressure in the lower chamber, and **increases ΔP and the volume of cooling air** that passes vertically across the cylinder fins

Because ΔP is so tiny, even small leaks in the system of baffles and seals can have a serious adverse impact on cylinder cooling



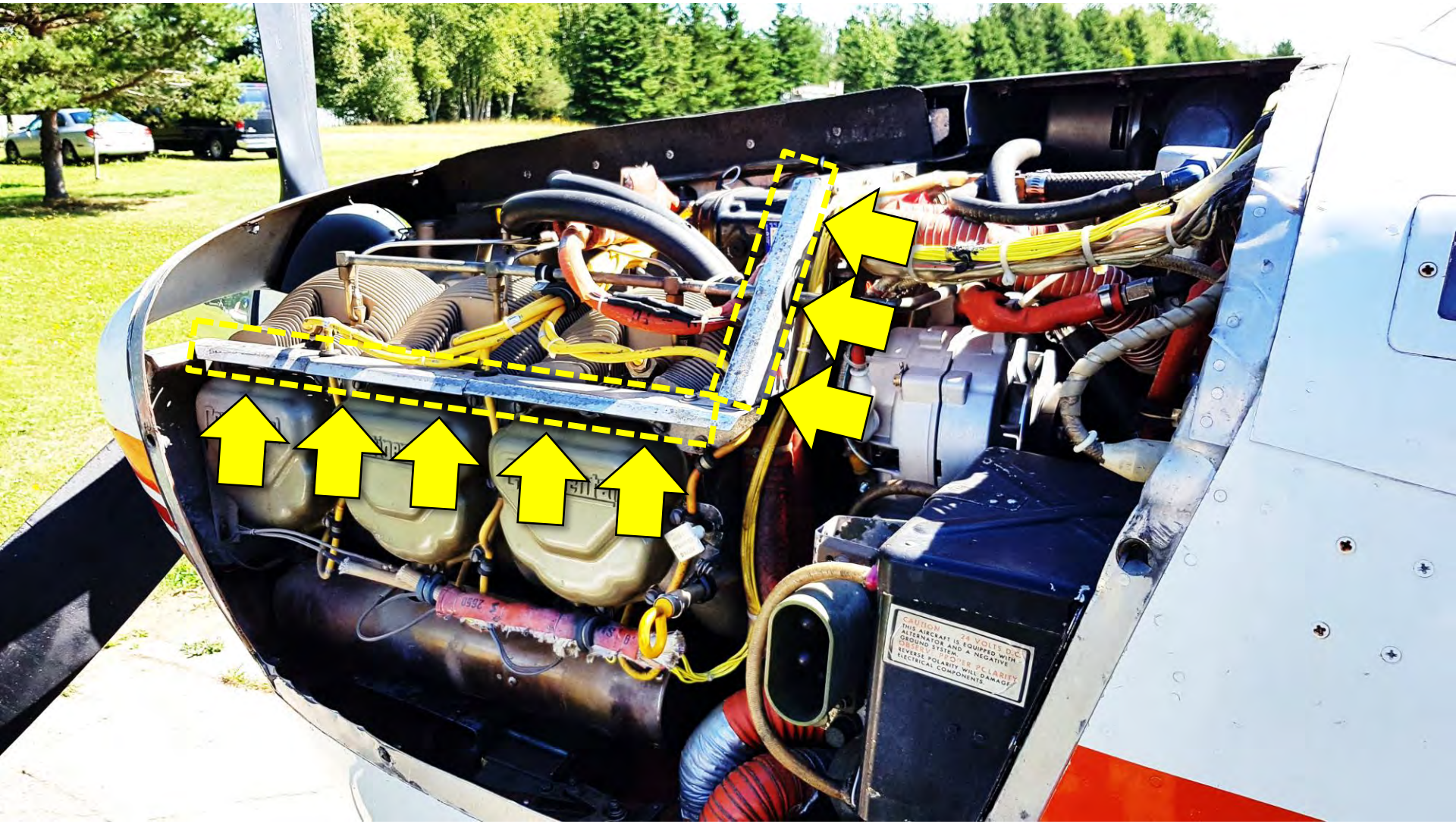
Any missing, broken, or improperly positioned baffles or seals will degrade engine cooling by providing an alternative path for air to pass from the upper chamber to the lower chamber without flowing across the cylinder cooling fins





That's why doing this would have made the cooling situation worse!

What's wrong with this picture?



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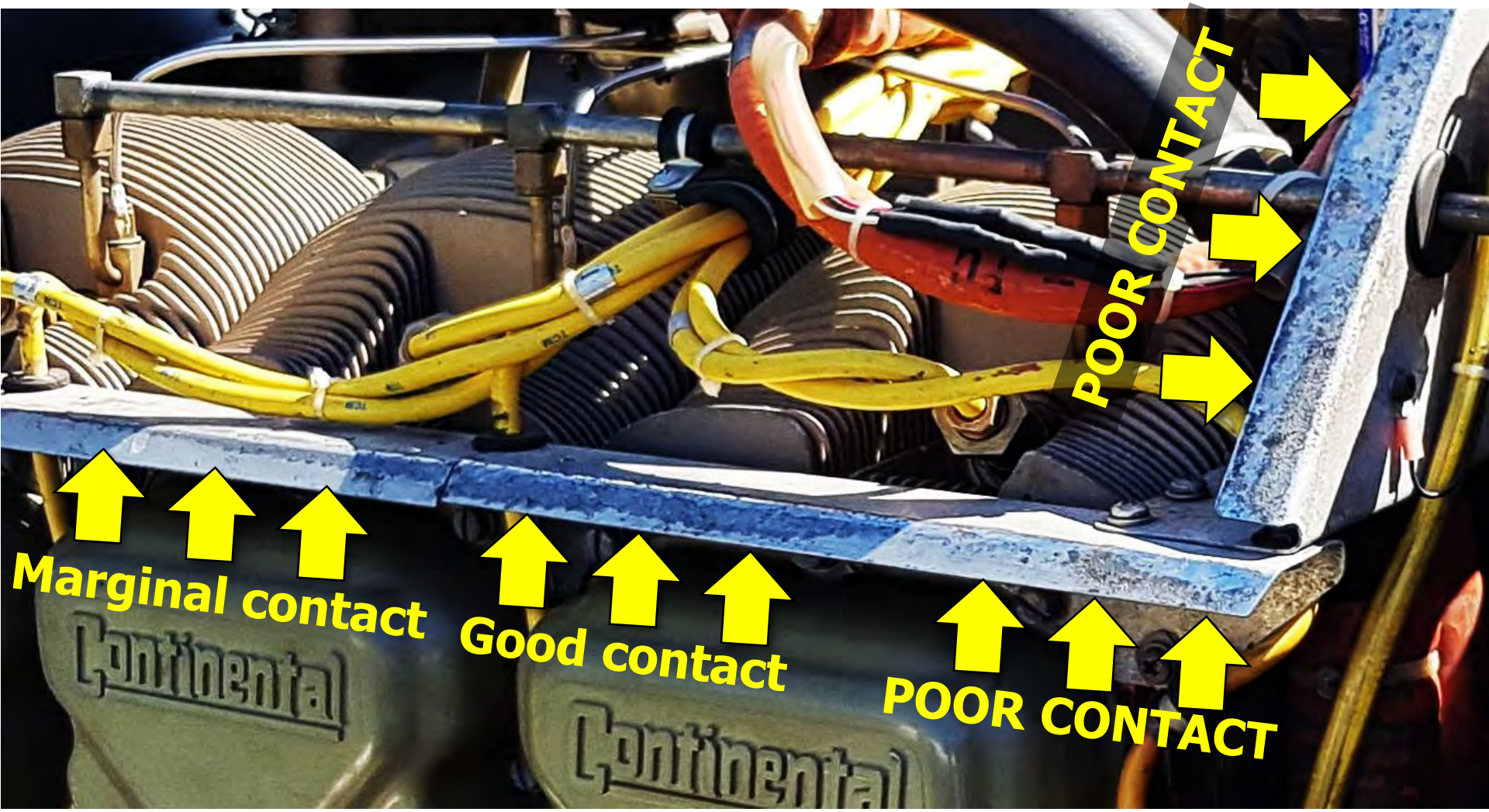

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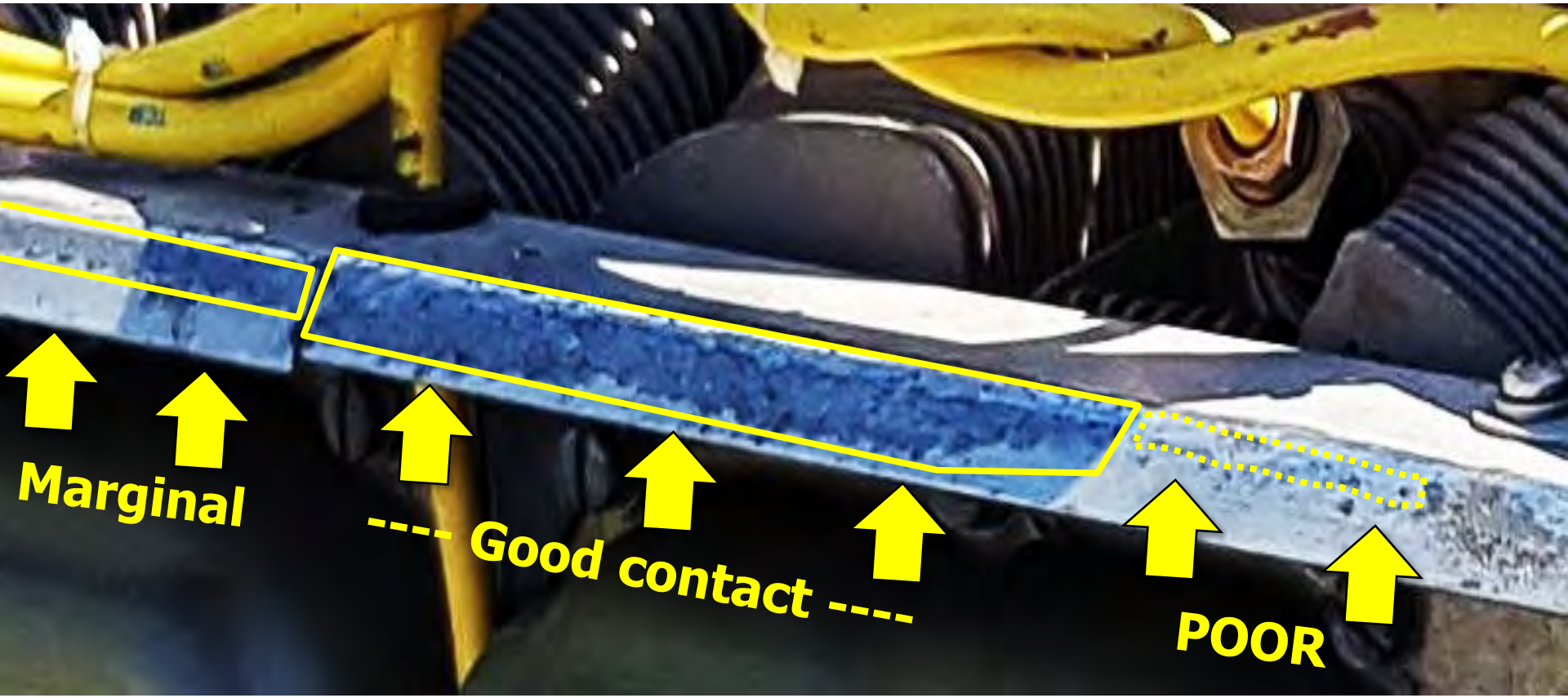

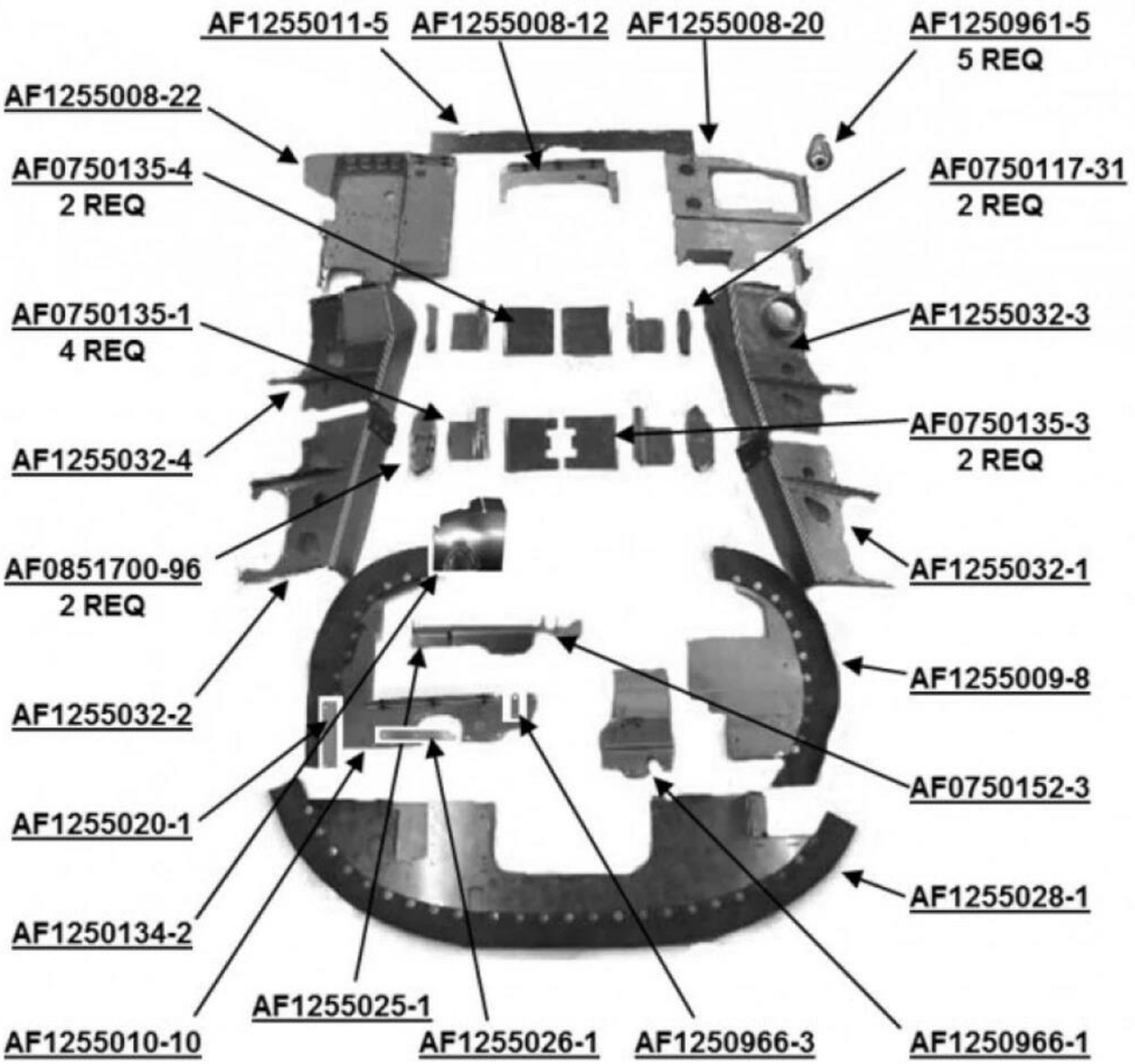
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2 REQ
AF0750135-1
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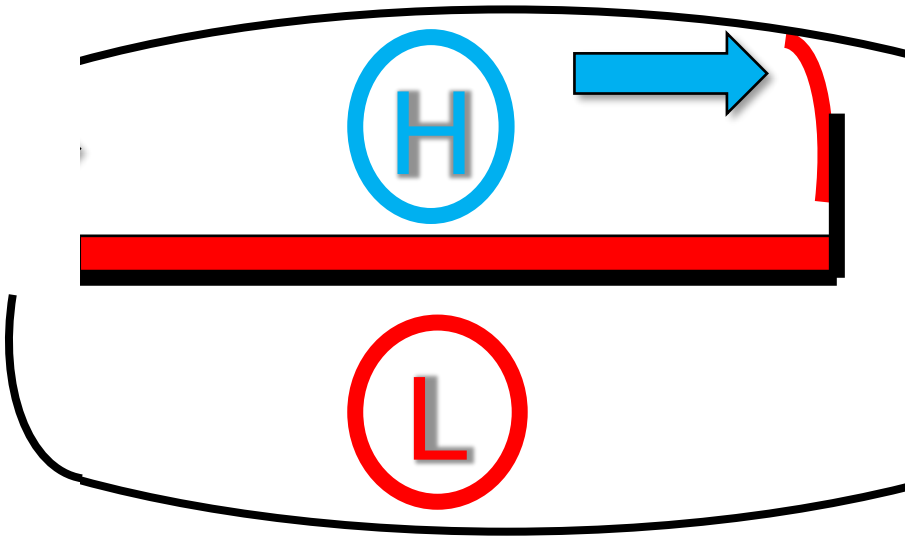
AF1255032-3
AF1255032-4
AF0750135-3
2 REQ
AF0851700-96
2 REQ
AF1255032-1
AF1255032-2
AF1255009-8
AF0750152-3
AF1255020-1
AF1250134-2
AF1255028-1
AF1255025-1
AF1255010-10
AF1255026-1
AF1250966-3
AF1250966-1

One of the most problematic parts of the cooling system is the flexible baffle seals

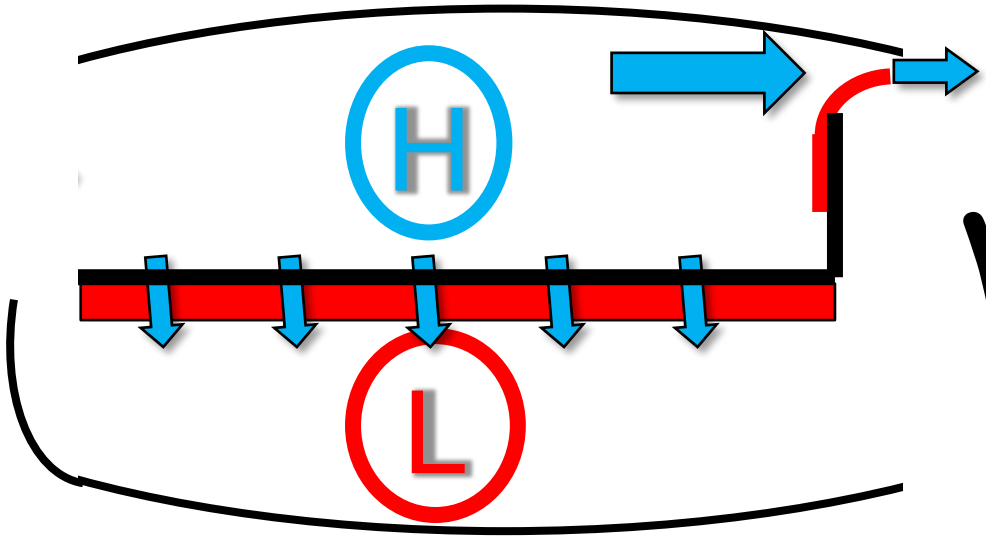
These silicone rubber strips are used to seal up the gaps between the rigid sheet metal baffles and the cowling

These flexible seals are necessary because the baffles move around inside the cowling as the engine rocks on its shock mounts

The flexible seals must curve up and forward so that ΔP presses the seals tightly against the cowling

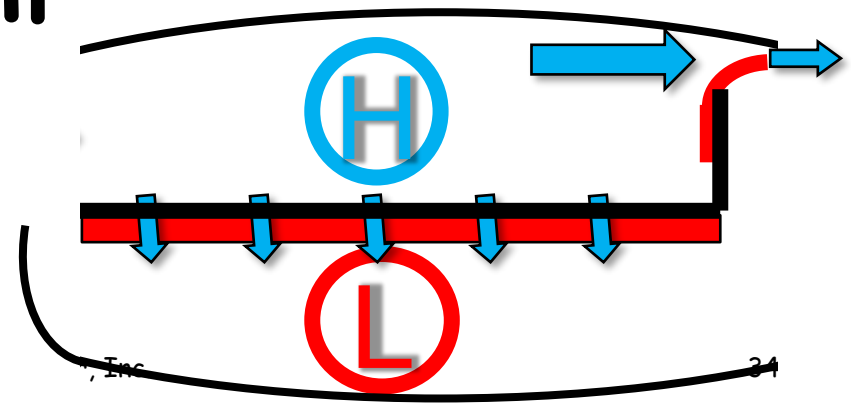


RIGHT



WRONG!!!

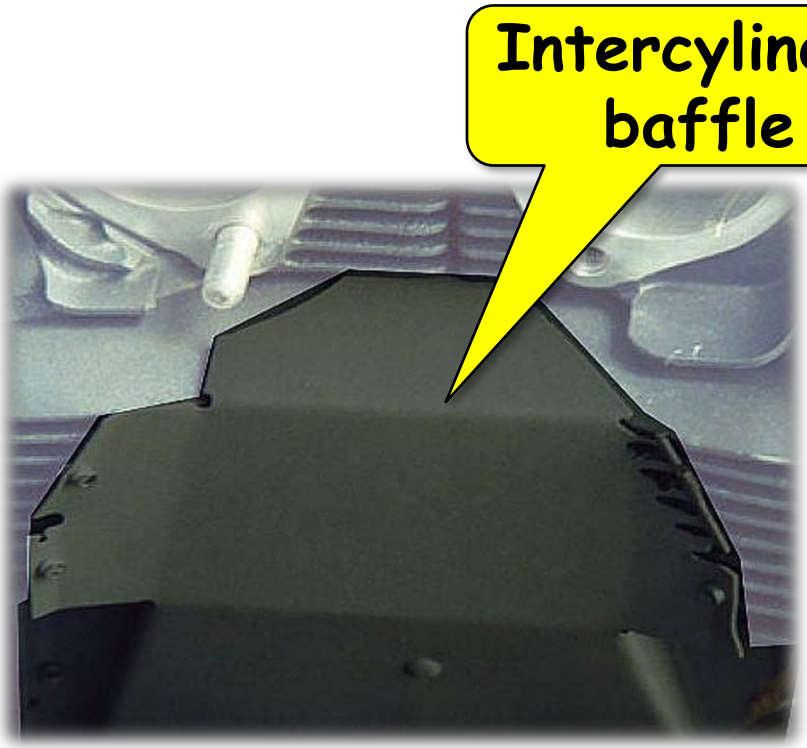
If the seals are permitted to curve away from the high-pressure area—not hard to do when reinstalling the cowling—they will blow away from the cowling in-flight and permit precious cooling air to escape



Another common problem is that seals may develop wrinkles or creases when the cowling is installed, preventing them from sealing airtight against the cowling

Inspect for such problems whenever the cowling is removed and replaced

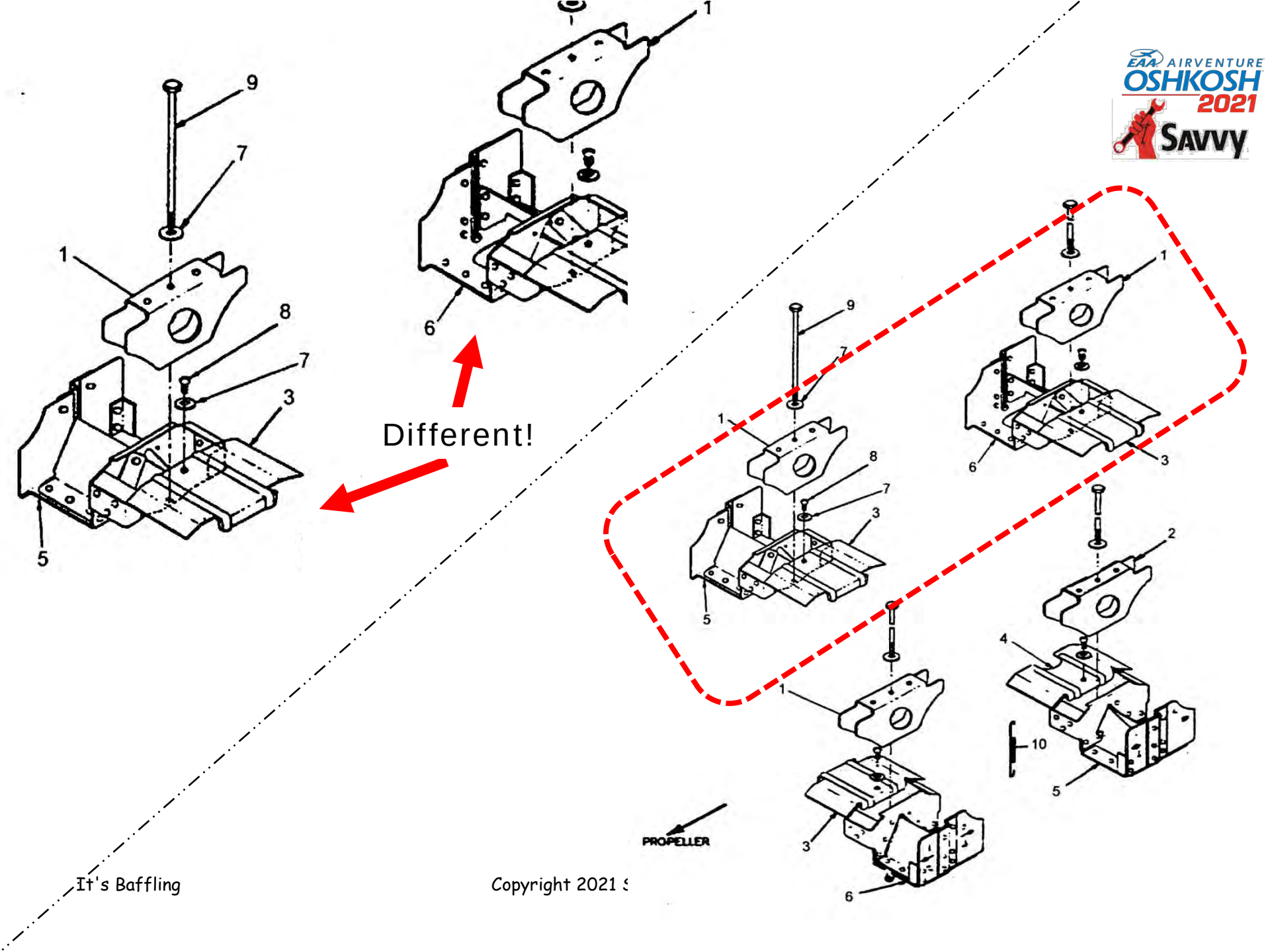
Yet another common cooling system problem involves the intercylinder baffles



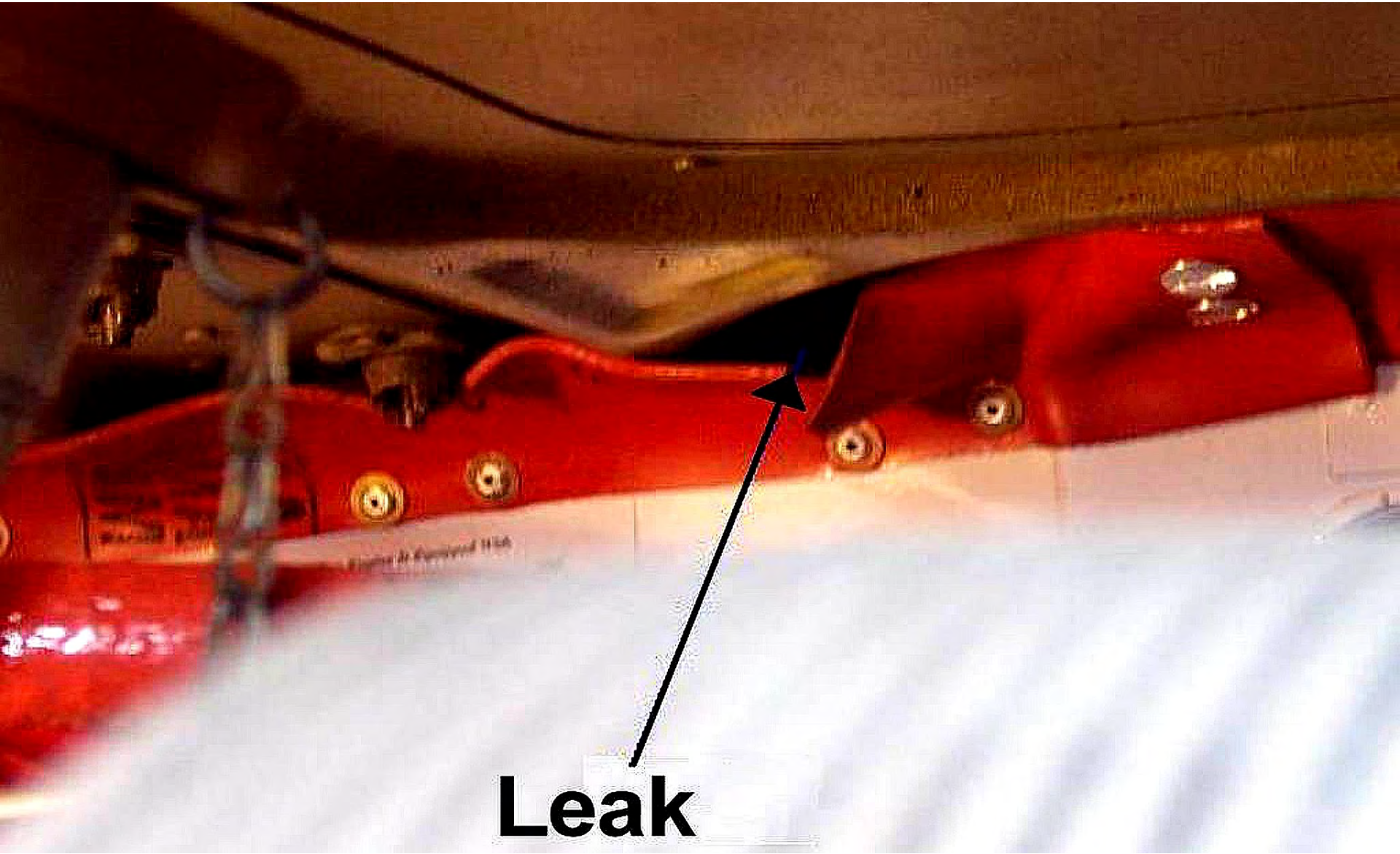
These small, oddly-shaped pieces of sheet metal are mounted below and between the cylinders


Intercylinder
Baffle

Their purpose is to prevent cooling air from passing through the spaces between adjacent cylinders, and to force the down-flowing cooling air to wrap around and cool the bottom of the cylinders, rather than just cooling the top and side



Why the T210 Cylinders Ran Hot…


Leak

Studying photos sent by the T210 owner, I was able to identify a dozen leaks in the T210's baffle system—some small, others more serious—that combined accounted for a significant loss of cooling efficiency

With a little trimming of the flexible seal strips plus a few well-placed dabs of high-temp RTV sealant, the owner succeeded in plugging the leaks in short order, and reported that his engine was running noticeably cooler

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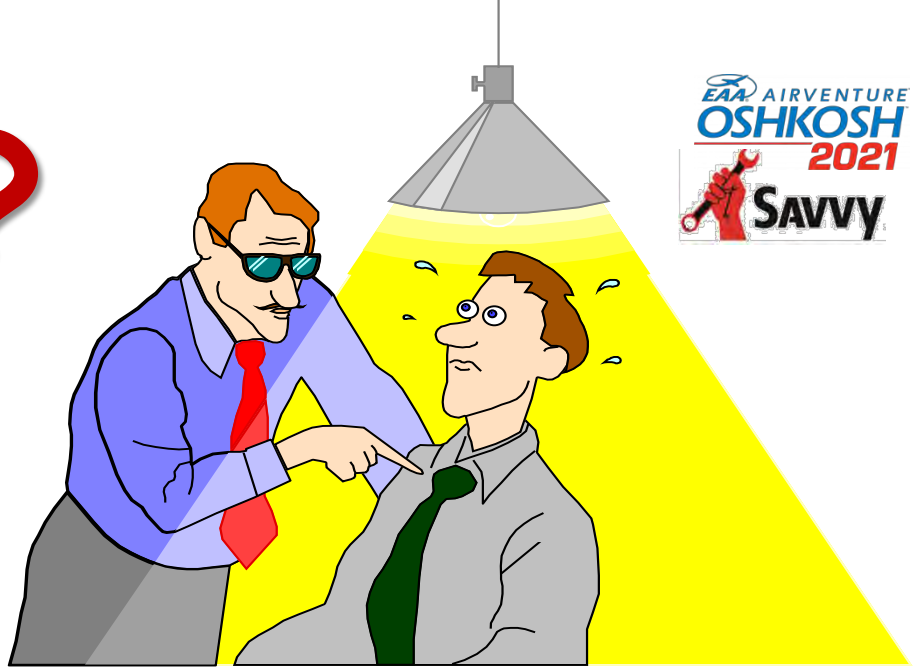

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