

# Technology in the Toolbox

Boscopes for the modern age

BY BRIAN AND CAROL CARPENTER

**IN THE LAST COUPLE** of articles, we talked about the ability to use a borescope in identifying detonation or pre-ignition problems within a cylinder. A pilot who stopped by the office while we were working on the detonation article had several questions about detonation. This, in turn, led to a completely different discussion about using a borescope to identify problems. We showed him some pictures we had collected using our newest borescope. This snowballed into a trip out to the hangar for show and tell, where we opened one of the bottom drawers labeled “Inspection Tools” that houses a plethora of boscopes from our last 40 years in the aviation business. Some of these boscopes appeared to be estranged from some aviation historical museum, while others look like they may have been dropped off by a NASA inspection team. By the time we had concluded our discussion, we were all in agreement that an article talking about the use of modern day boscopes would be unavoidable.

Although many aviators believe the “bore” in borescope refers to the bore of an engine cylinder, the origin of the term actually goes back to World War II when weapons manufacturers used them to inspect the interior “bore” of large gun barrels. The original boscopes were relatively primitive, consisting of a rigid tube and optical lenses that allow the observer to get a close-up view of an internal passageway from a substantial distance, much like a telescope. Since those early days of the borescope, there have been thousands of different types, morphing from the original rigid, fixed-distance designs into more usable instruments incorporating a variety of different capabilities including camera and video capability.

Early on, the borescope was considered a luxury. They were relatively expensive and could only be afforded in the most important of circumstances. The endoscope was the medical industry’s equivalent of the borescope. This device revolutionized the medical industry by allowing doctors to get a first-hand look inside of the human body without invasive surgery. Even though we had several rigid boscopes for inspecting cylinders, it really changed our perspective on the capability of these instruments the day that our local doctor brought his very expensive, high-quality endoscope from his office for us to use in inspecting the wing closeout on his Lancair IV-P. While there was much laughter and joking about the efficacy of this particular instrument transitioning its usefulness in both the human body and the workshop, it was our first exposure to an instrument that could turn corners, adjust lighting and focus, and



Digital borescope with camera and video capability



Smartphone borescope with wireless capability

extend far into the “bowels” of the aircraft wing. It provided an additional level of capability not possible before. Unfortunately, the cost of these tools at the time was something the average shop could not afford. We will admit, there were a few other “emergency” occasions when we asked to use the tool again. It wasn’t until many years later that the cost and capability of the borescope was really changed by the advent of digital technology.

Once the borescope hit the mass market, the product cost started dropping dramatically. Large tool manufacturers started offering digital boscopes with camera and video capability for use around the home and by contractors for inspecting all manner of things from interior walls and sewer





Borescope with fully articulating head

lines to HVAC systems. Many of these tools, now renamed inspection cameras, became very useful for aircraft inspection. Many of them had extensions that made it possible to access even the most remote parts of an aircraft. Initially, the cost was in the \$100 to \$200 price range. However, the cost of these units continues to decline even as their capabilities increase.

In the last five years or so, we have seen a completely new entry into the field: the borescope camera that adapts to a smartphone. There are dozens of manufacturers making these smartphone-enabled borescope cameras. By using the computing power of the smartphone, they are able to manufacture just the camera end of the borescope by placing the micro CMOS sensor (the device used to collect the digital picture) directly at the end of the borescope and transmitting that signal back through a conventional USB connector into the phone. Because of the proliferation of these camera components and millions being used around the world, the cost has plummeted, making the average cost between \$20 and \$40. Many of the smartphone borescopes have wireless capability, making them easy to manipulate in close quarters inside the aircraft while watching the video screen on your phone from a more comfortable location. Most of these types of borescopes working through your cell phone allow for capturing pictures as well as video of your inspection. Even if you can't easily watch your phone and manipulate the inspection camera at the same time, you can come back later, transfer the video to your computer, and conduct your inspection with a large screen and the capability of pausing and reviewing your subject matter.



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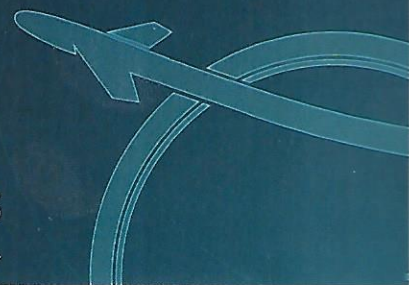
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As if all of this new tech wasn't enough, last year at EAA AirVenture Oshkosh 2017 we became intrigued by one of the vendors selling the latest adaptation to all of these innovations. Vividia Technologies has taken this basic concept to an entirely new level by providing a fully articulating head. When we saw this, we had to have one. And after researching all the different models Vividia has available, we elected to purchase the VA-980. This borescope appeared to have the most versatile application for aircraft.

The biggest problem associated with all the consumer borescopes has always been the limited amount of flexibility when trying to position the camera in such a fashion as to view or take a picture of a very particular spot when in a confined space. Of course, one of our most common usages is for inspecting cylinders. When using the traditional borescope, or many of the new consumer borescopes, there is a limited ability to be able to adjust the angle of viewing, usually less than 30 degrees. Even the adapters that can be fit to the end of the borescope to change the angle of viewing can be limiting because of their fixed location once inserted into a spark plug hole, for example. We may be able to see one side of the valve, or valve seat, but getting around to the opposite side still remained nearly impossible.

When working with our VA-980 articulating borescope, our ability to "take a walk" around the entire inside of the cylinder becomes possible. The ability to insert the camera through a spark plug hole and then reverse the lens 180 degrees really makes a huge difference and is just what the doctor ordered when it comes to inspecting a cylinder. We were recently conducting a borescope inspection on a Rotax 503. With the borescope inserted through the spark plug hole, to demonstrate its capability we took a selfie from inside the engine looking out through the exhaust port.

In our shop, we use a completely digital record-keeping system and now incorporate the pictures and video from borescope inspections directly into the aircraft records. Having the ability to send pictures and video directly to a customer can help in the



Brian's borescope selfie

communication process when dealing with a problem on an aircraft. We have really become dependent on these tools during an annual inspection. The days of standing on your head with your feet sticking out of the cockpit using a flashlight in a mirror under the instrument panel are over. We can sit in the cockpit with our laptop and borescope and explore even the most inaccessible areas. With these new tools at our fingertips, we have significantly increased our troubleshooting and inspection capability.

If you are an aviation maintenance technician, you may want to spend a little extra for the more professional articulating type of borescope. And although limited in its resolution (640-by-480), just being able to place the camera where you want it is invaluable. For the budget minded, the \$25 smartphone borescope adapter, even with its viewing limitations, makes it an addition to your toolbox that we think you will find surprisingly useful. *EAA*

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