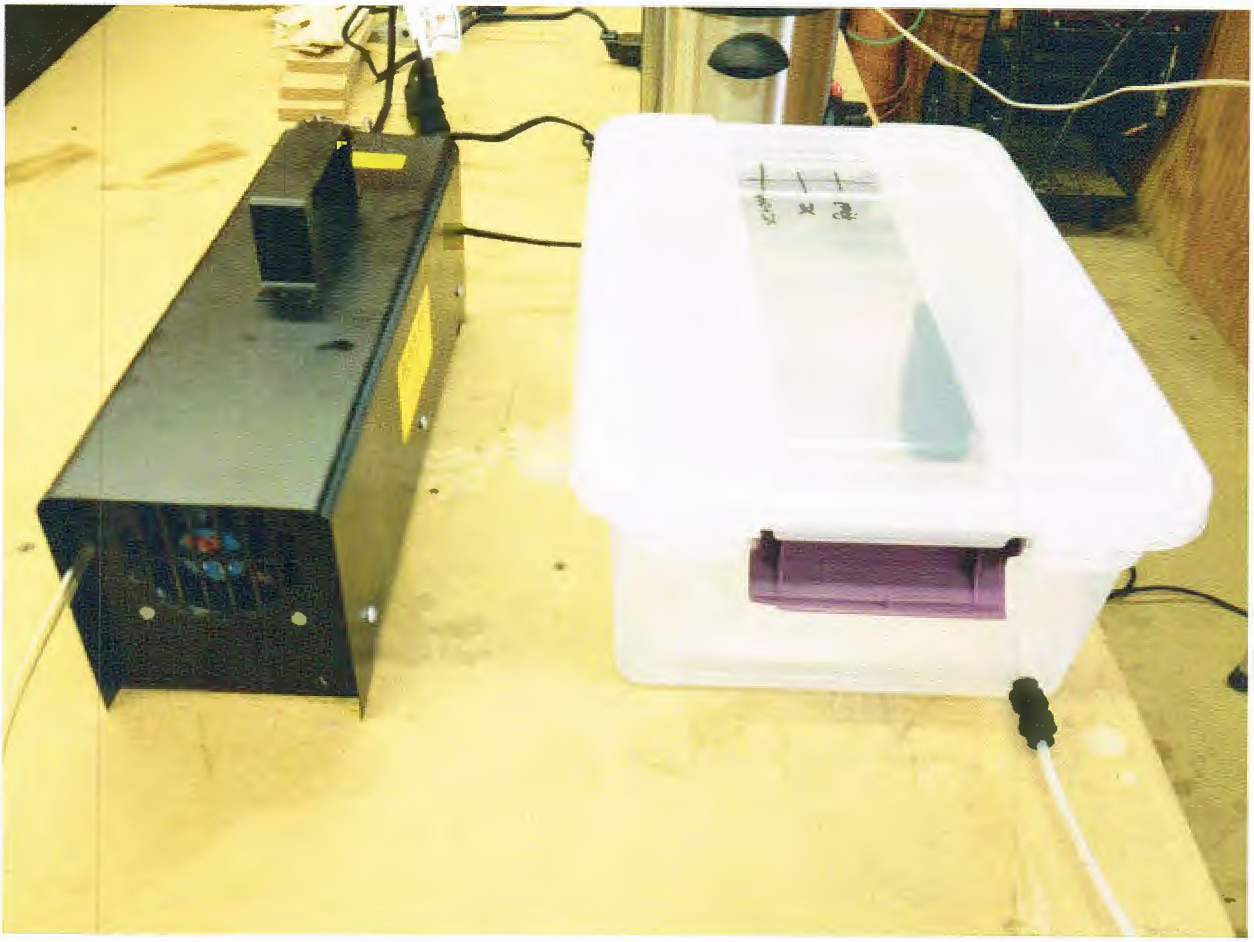
## In Search of Optimal Preheating (Part III)

Last month in Part II of this series, I attempted to quantify the value of engine dehydrators on preserving internal engine components between flights. While the temperature and humidity data I collected with the data loggers produced a compelling case for the use of engine dehydrators, one important variable still needed to be carefully considered. While I demonstrated that the use of engine dehydrators significantly reduced the relative humidity and dew point in my engines between flights, what about the oil that coats the engine after shutdown? Won't that oil protect my engine parts, making the dehydrators redundant? It's no stretch of the imagination to envision that once we shut down our engines, internal engine components remain coated in oil, providing a barrier to the high humidity conditions that exist after shutdown. But the significant unanswered question remains, how long will this coating of oil protect our engines before rust will begin to form on the vulnerable camshaft, lifters, starter adapter, and other critical components? If you are like me, the iron component of my oil analysis is directly proportional to the time my airplane has been idle between oil changes. There is no question but that rust begins to form on these critical engine components over time. The question I set out to answer in this, the final part of this series, is how long will our engines sit between flights (with, and without engine dehydrators) before rust and corrosion begins to form?

There have been a myriad of tests performed on engine oils, and additives, all designed to demonstrate the value of one product over another. In my testing here, I am primarily focused on quantifying the value of engine dehydrators. This is what separates my testing from other tests you may have read about in the past.

### The Test:

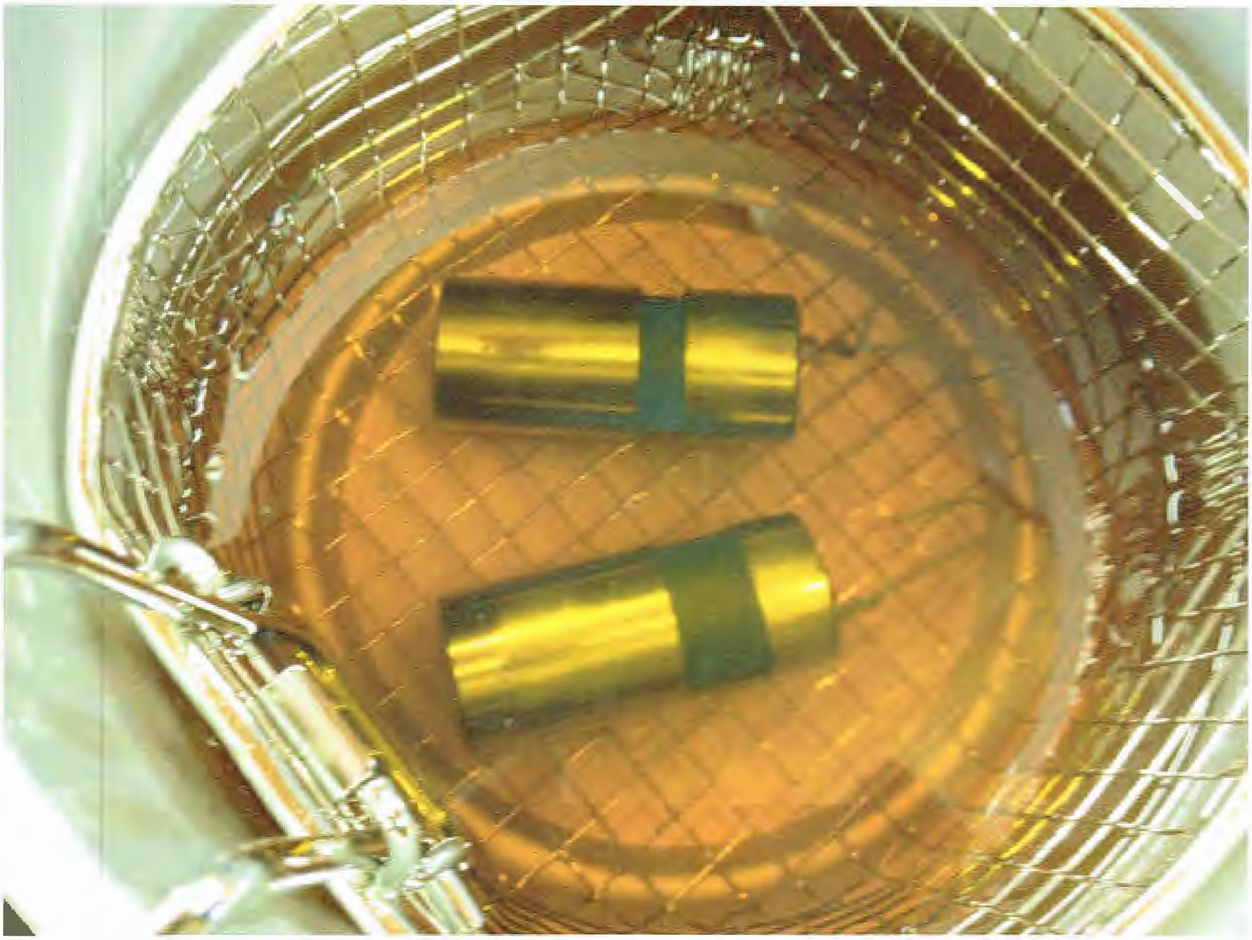
I began my testing by building two humidity chambers. The first humidity chamber was fed exclusively by one of my Aircraft Component Inc.'s Black Max engine dehydrators that I've been using on my C-310's engines for the past five years. The relative humidity in this chamber then becomes a function of the Black Max's dehydrating capability. Over the trial period, the relative humidity in this low humidity chamber was measured at between 18-28 percent.



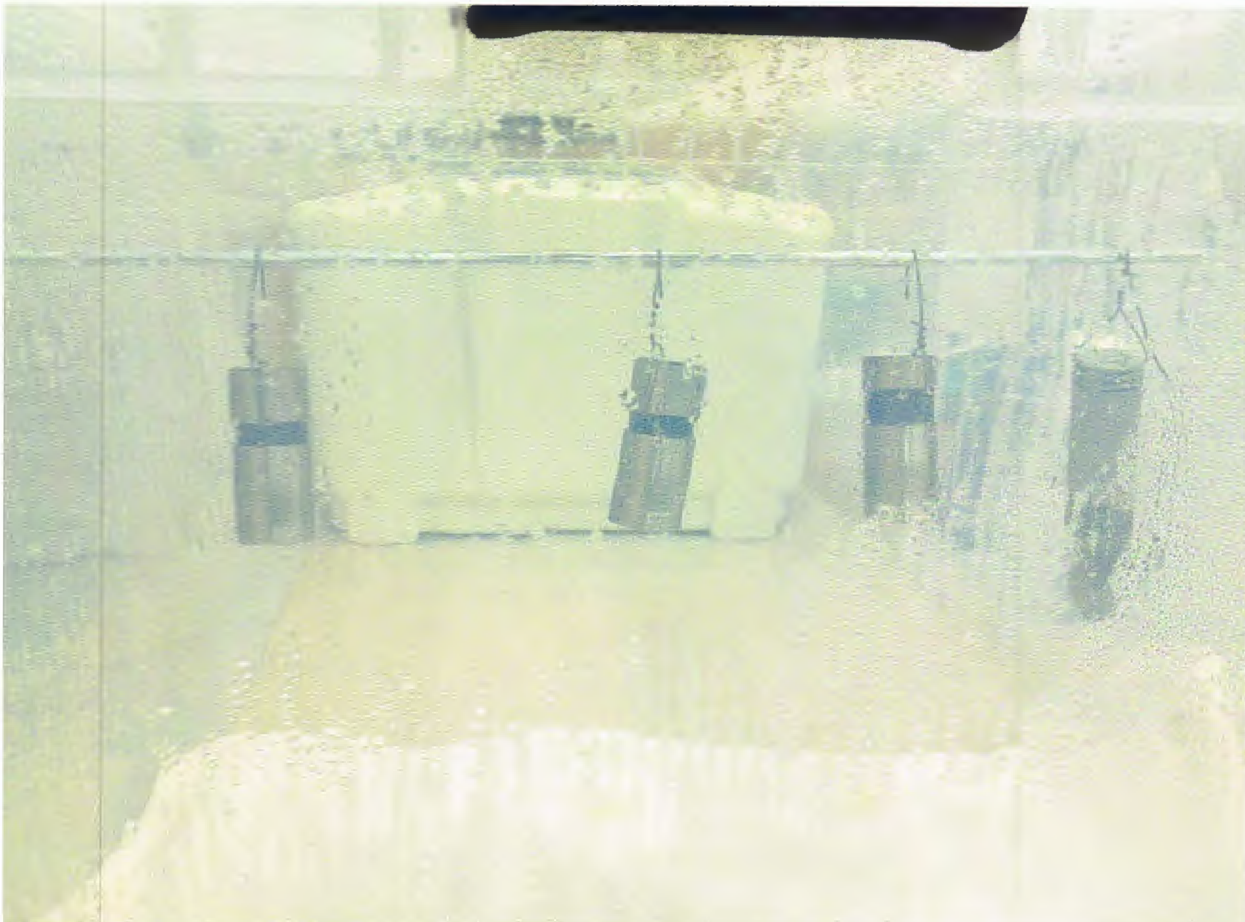
The second humidity chamber used a high-flow humidifier that produced a measured range of relative humidity from 85-93 percent.

The next step was to simulate a normal flight. After a discussion with my mechanic over the engine components most vulnerable to rust and corrosion, I decided to use actual valve lifters that I had replaced in my engine two years ago. These valve lifters were preserved in an airtight bag since they had been removed, and showed wear, but no signs of rust or corrosion. To simulate a normal flight, I procured three small deep fryers. In one fryer I used Phillips XC; in the second fryer I used Phillips XC plus the oil additive CamGuard, properly proportioned to one quart of engine oil; and in the third, I used Exxon Elite. I then turned on the fryers and raised the temperature of the oil to 190˚F. I then suspended two lifters in each fryer of oil and "cooked" them for exactly one hour. Simultaneously, I suspended a pair of dry lifters in an oven preheated to exactly 190˚F, and "baked" those lifters for exactly one hour. Once the baking and cooking time was complete, I placed one lifter from each mixture into each humidity chamber.


TAYLOR
X/C
AVIATION
SAE 20W-50



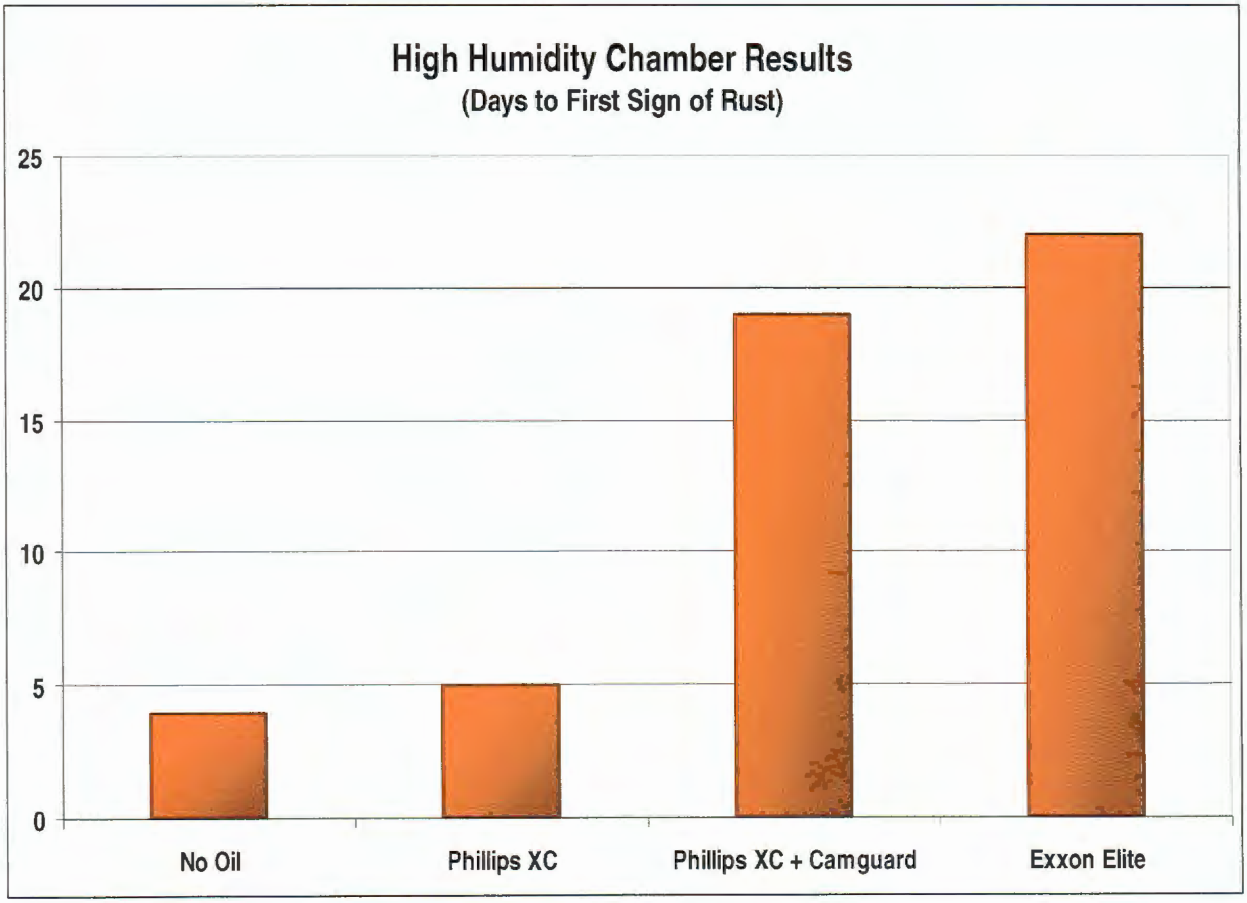
Thereafter, I monitored the lifters twice a day, and used the data loggers I used in Part II of this series to monitor conditions inside the chambers to insure they were providing a consistent environment for the test.



According to testing done by the makers of CamGuard, I expected the "dry" lifter in the high humidity chamber to begin rusting after five days. In addition, their test results using a similar methodology to my high humidity chamber suggested that the lifter cooked in oil with their additive would begin to rust in 21-days. I had no idea what to expect with the lifters in the low humidity chamber that was being controlled by the engine dehydrator.

**Results:**

After just four days in the high humidity chamber, the "dry" or "No Oil" lifter began to rust. C After five days in the high humidity chamber, the lifter cooked in Phillips XC began to rust. The lifter cooked in Phillips XC plus CamGuard made it to 19-days in the high humidity chamber before rest began to appear, and the lifter cooked in Exxon Elite made it 22-days in the high humidity chamber before rust began to appear.

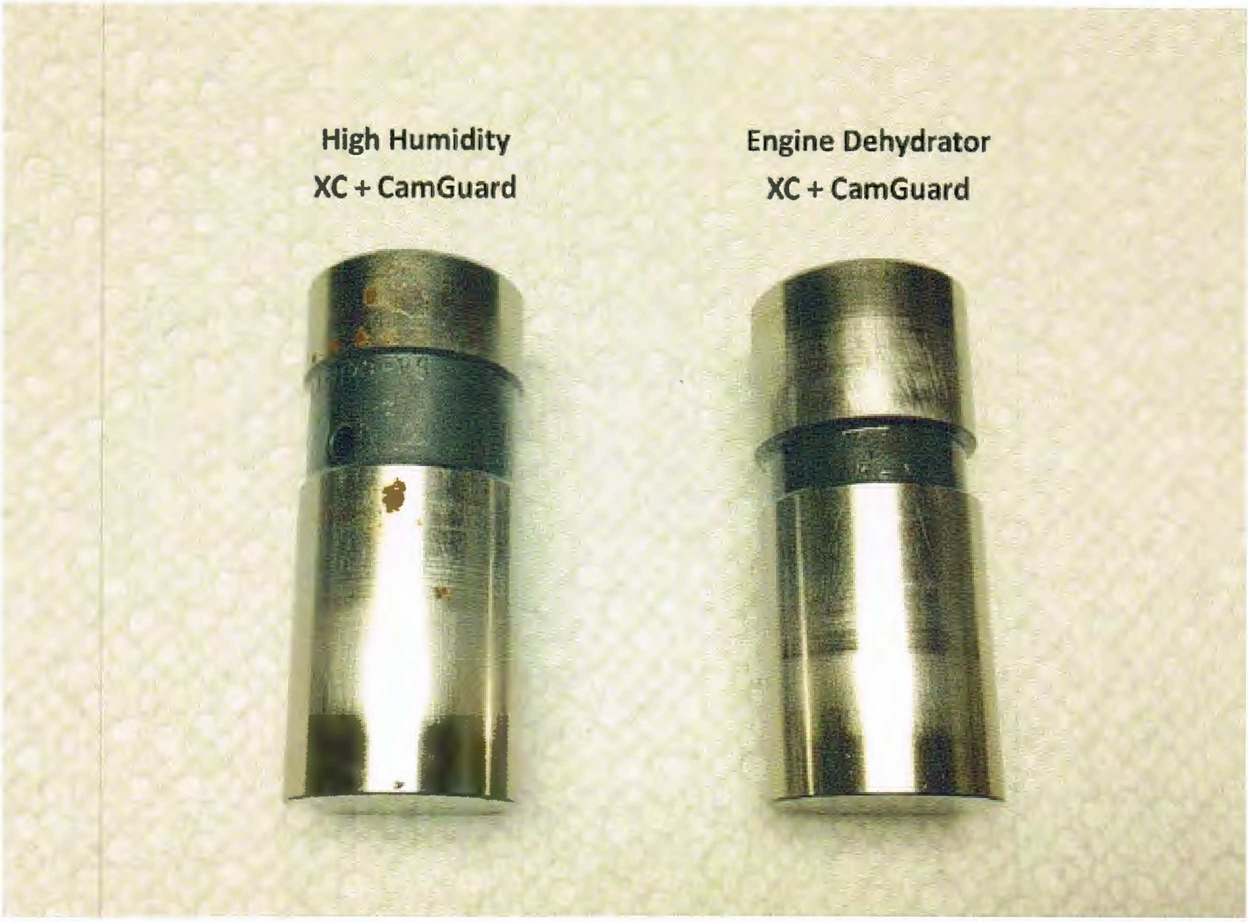



After 24-days, I terminated the high humidity chamber test. During these 24-days, I monitored the lifters in the low humidity chamber (the chamber controlled by the engine dehydrator), and rust never appeared on any of the lifters in the low humidity environment.

After 24-days, I documented the following results:


After 24-days, the lifter baked in the oven with no oil coating had heavy rust and pitting on all surfaces. The other lifter baked with no oil but alternatively placed in the low humidity chamber had no sign of rust.


After 24-days, the lifter cooked in Phillips XC engine oil had significant rust and pitting on most of its surfaces. The top quarter of the lifter was much worse than the bottom as clearly, the oil drains off the lifter from top to bottom over time. The other lifter cooked in Phillips XC, but alternatively placed in the low humidity chamber had no sign of rust.




After 24-days, the lifter cooked in Phillips XC engine oil plus CamGuard anti-corrosion additive had rust on the top third of the surface, and some minor signs of rust on the lower body. The other lifter cooked in Phillips XC + CamGuard, but alternatively placed in the low humidity chamber had no sign of rust.

After 24-days, the lifter cooked in Exxon Elite engine oil had small patches of rust to the top third of the lifter body, only. The other lifter cooked in Exxon Elite, but alternatively placed in the low humidity chamber shows no sign of rust.

After 24-days, none of the lifters in the low humidity chamber showed any sign of rust or corrosion. In fact, I let these lifters remain in the low humidity chamber controlled by the engine dehydrator, and ***after 31-days***, I terminated the test with ***absolutely no sign of rust or corrosion!*** It appears that it would take a very long time, if ever for rust to ever get started in this low humidity environment created by the engine dehydrator.

From these tests, I've concluded that it is certainly important to use an engine oil with an anti-corrosion additive like Exxon Elite (or add an anti-corrosion additive like CamGuard). However, the big takeaway from this testing for me was the fact that using the engine dehydrator protected the lifters from rust and corrosion well beyond the point where lifters exposed to a high humidity environment like inside our engines after shutdown, began rusting. Do the dehydrators work to completely eliminate rust and corrosion from inside our engines? Most likely, there are cavities and chambers inside our engines that the dehydrator cannot reach to push a steady flow of exceptionally dry air. Yet, by using them, I move closer to the optimum environment for protecting my engines from premature wear. Of course, another option would be to simply fly my airplane at least once every four to five days. However, if you're like me, no matter how much I might wish it so, this is simply not a viable option.

**Summary:**

So what have I learned from all of my effort? Let me summarize the five main points I've learned on how I can more effectively manage my C-310 based upon the results of the tests performed in this series:

1. Preheat the engines before ***every*** flight in an attempt to get their temperature as close to normal operating temperature, as possible. The GSM Auto cellular switch goes a long way to providing convenient and timely control to the engine preheating process.
2. Use engine dehydrators when preheating to reduce the relative humidity and lower the dew point inside the engines.
3. Use insulated engine cowl covers to increase effectiveness of preheating, and to more uniformly preheat all the engine components.
4. Within 30-minutes of engine shutdown, begin using engine dehydrators to rapidly reduce the relative humidity inside the engines. Continue to run the dehydrators on the engines until the next time the engines are ready to be started. This will maintain a very low relative humidity environment inside the engines, protecting them from rust and corrosion even after the oil coating those components has dripped back into the sump.
5. Use an engine oil that contains an anti-corrosion additive, or use an anti-corrosion additive in the engine oil.