How to Keep a Wet Compass Wet

With the coming of hot weather, it's not unusual for cockpit temperatures to soar into the high 100s (Fahrenheit)—and for so-called "wet" compasses to go dry. If your cockpit smells vaguely like jet fuel the next time you climb aboard, check the compass. Its fluid chamber is probably dry (at which point you're grounded, because FAR 91.33 requires every standard-category U.S. aircraft to have a functioning "magnetic direction indicator" for VFR flight).

Simply adding more fluid may not be the answer. The typical wet compass incorporates a *thermal relief* diaphragm at the back of the instrument, the purpose of which is to keep the compass from bursting in the event the kerosene-like fluid inside expands or starts to boil (or freeze, in cold weather). Under even mild-weather conditions, this diaphragm gets a pretty good workout; most compasses are painted black and sit atop a black glare shield in full view of the sun. Eventually, after numerous expansion/contraction cycles, as the diaphragm ages (and dries out in spots), it'll shrink, split, and start leaking fluid. Adding more fluid won't help, at this point; what you need is a new diaphragm.

Happily, replacing the diaphragm in a wet compass is a simple job, taking no more than 15 minutes (and perhaps $10 or $12) to accomplish. Technically, even A&P mechanics aren't allowed to work on compasses (instrument repairs are the domain of instrument repairmen), so you're on your own as far as approval goes. Ask your mechanic who he gets to sign off *his* work.

The Airpath C-2300 is serviced with compass fluid via the filler plug atop the case, which can be opened with a dime.

Diaphragm Shopping

New Airpath P/N C21-100 diaphragms are cheap (one of the last great bargains in aviation), typically $4.98 or so. You also need fluid, however—not alcohol (contrary to myth), but MIL-C-7020 compass fluid. You can order an Airpath Compass Repair Kit consisting of a thermal relief diaphragm and one-half pint of mil-spec compass fluid—enough for numerous compass refills—for $11.70 (shipping included) from Aircraft Spruce & Specialty Co., P.O. Box 424, Fullerton, CA 92632 (phone 714/870-7551). Check with your FBO or instrument shop, too, though. You might well be able to do better buying locally.

It's not a bad idea to invest in some fluid and a diaphragm now, even if you don't need them yet. You *will* need them sooner or later—it's not a question of whether, but when.

Rehydration

If your compass is already dehydrated, you don't want to let it stay that way for long. The fluid in a wet compass (a type of mineral spirit akin to kerosene) not only buoys the card—and lubricates the bearing pivots—but keeps corrosion from forming inside the instrument. More important, it also *dampens card oscillations*, keeping dipological errors within the average pilot's ability to chase.

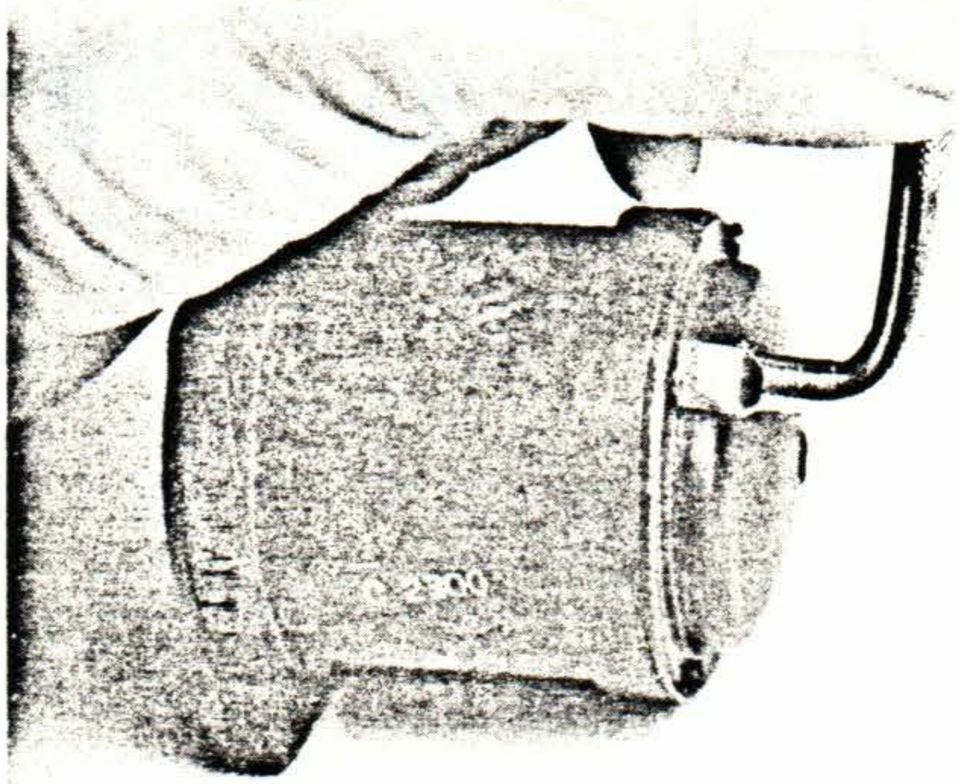
You shouldn't need to remove the compass from the plane if all you are doing is "topping off" the fluid chamber. (Do this whenever you can see air at the top of the card.) There's a giant, slotted filler cap at the top of the instrument barrel, easily opened with a dime (or screwdriver, if you have room, but you probably don't). To service the comapss with fluid, you simply unscrew the filler cap, add makeup fluid with an eyedropper or small vial (the plastic coffee scoops that come in Maxwell House cans work well), and replace the cap, torquing with a dime until "E pluribus unum" is imprinted in your thumb.

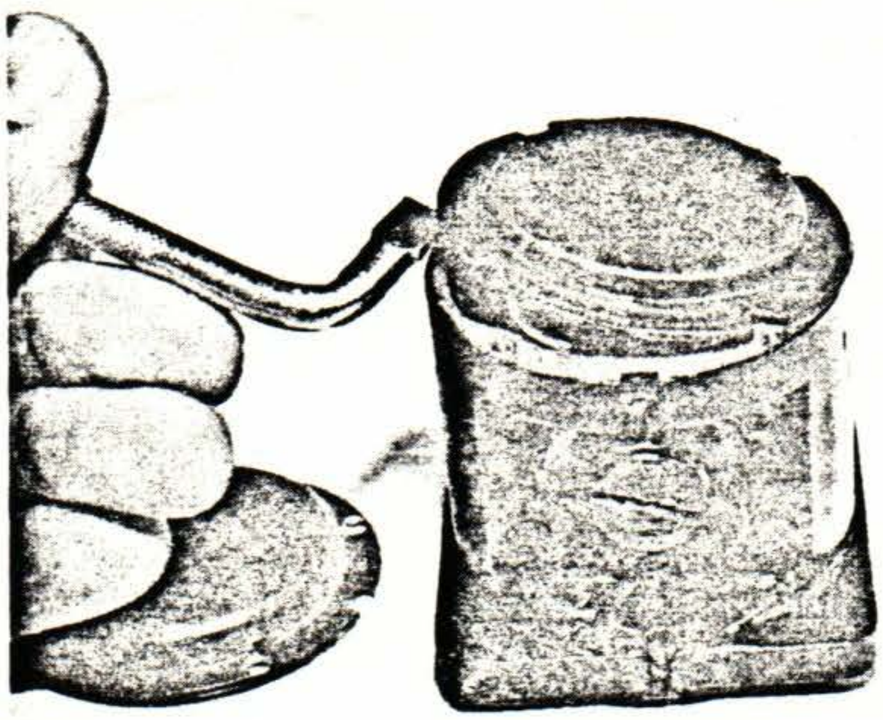
If you're not sure that you need a new diaphragm, try gaining access to the screws at the back of the instrument case, and alternately *retighten the four tiny slot-head screws* (being careful not to strip them) before servicing the instrument with fresh fluid. Sometimes mere cold-flowing ("setting") of the diaphragm rubber will result in a leak that can be fixed (for a while, anyway) by retorquing the cover screws.

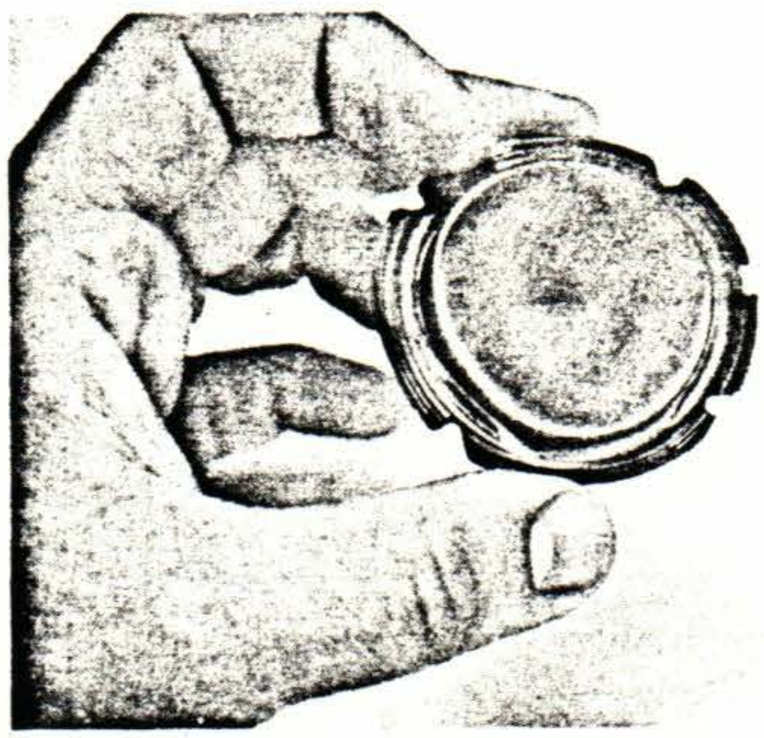
Re-Phragming

Of course, if you can *see* fluid running out of the instrument, you *know* that a new diaphragm is needed. Getting the old diaphragm out doesn't absolutely require that you remove the compass from the panel (although it helps); you *may* be able to replace the diaphragm *in situ* with the aid of a small right-angle (crook-neck) screwdriver like the one shown in the accompanying photos. (These little jewels are great for working in tight spaces—such as between a compass and a windshield. Pick one up at Sears.)

Your compass may be of the lighted (as in night flying) variety, in which case you'll notice a pair of wires exiting the instrument case. Slide off







Clockwise from top left: Expansion diaphragm is accessed via the metal cap at the rear of the instrument. Here, a crook-neck screwdriver (handy for use in tight spaces) is used to remove the four brass screws . . . The old diaphragm must be carefully pried loose with a knife or screwdriver blade . . . The compass diaphragm has recesses for screw clearance . . . Soak new diaphragm in compass fluid before laying it in place.

any protective covers that may be concealing the wires, unravel and/or unplug the wires, and dismount the compass, setting aside all mounting screws where they won't get lost. (Remember, these are *non-magnetic* screws that *must not* be replaced with steel counterparts.)

When the compass is free, tilt it up on its end (face plate down) to expose the back of the instrument, where the diaphragm is. (The standard Airpath compass is designed to read accurately at angles of attack up to 18 degrees, but you can't hurt it by tilting it more than that, so don't worry about knocking the card off its pivots. The non-tumbling card/float assembly is permanently mounted to the spring-loaded pivot and shaft.) The diaphragm is sandwiched between the instrument case and the black metal end cap at the back, held on by four tiny slot-head screws. Remove these screws (don't drop any behind the panel!), gently pry the end plate off with your screwdriver, and you've exposed the old dqaphragm.

After peeling the old diaphragm off, inspect the compass case for damage. (The new diaphragm must fit flush, like a gasket.) If the seating surface is gouged or defective, consult with your mechanic as to whether you should attempt to reface the surface, or buy a new instrument.

Soak the new diaphragm in MIL-C-7020 compass fluid for a minute or two before laying it in position where the old diaphragm was. Then replace the cover plate and reinstall the slot-head screws (which, remember, are non-magnetic and mustn't be replaced with steel screws) until tight. There is no set torque value for these; just don't strip the little dudes.

Now you can service the compass with fresh fluid, rocking it gently to dislodge air bubbles. Assuming you haven't touched the compensation magnets (a definite no-no), the instrument should read exactly as before, and no reswinging is necessary.

Wrap-Up

When you're finished, *do not* repaint the compass unless you're sure that the paint you intend to use is free of magnetic pigments. And once again, be sure you've used the same non-magnetic mounting screws that came with the instrument. (Take care not to overtorque them—brass threads strip easily.)

The expansion diaphragm isn't the *only* location where a compass can leak fluid; there's also a gasket at the *front* of the instrument (to hold the face glass, which is quite thick). The face gasket rarely gives trouble, however. More than likely, if your compass is going dry, it's because the thermal relief diaphragm is damaged, or the back-plate screws aren't tight, or the filler plug at the top of the instrument is loose.

The point is, you should check your compass often for fluid loss (especially in hot weather). And when a diaphragm job is called for, consider doing it yourself. Don't get soaked for a $30 repair to a $40 instrument. (New Airpath C-2300 compasses, like the one shown in the accompanying photos, can be bought for $38, shipping included, from—among others—Chief Aircraft Parts, 345 Whispering Pines, Grants Pass, OR 97527; phone 1-800-447-3408 or 503/474-2409).