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When operating in cold weather, be aware that your altimeter will read higher than actual.
Mayo Clinic Photo

COLD HEARTED **LIES**

COLD WEATHER BRINGS WITH IT AN OFTEN-OVERLOOKED AND UNDERESTIMATED DANGER TO IFR AND VFR PILOTS ALIKE — THE INACCURATELY HIGH READINGS OF YOUR PRESSURE ALTIMETER.

by Matt Johnson

Baseball season is over and football and hockey seasons are in full swing. For many of us, this indicates the time of year when the heavy sweaters come out of hiding for yet another long, cold winter season.

While there is a beauty to winter (although some might disagree), with it comes a number of issues related to aviation, including the generally better performance associated with colder temperatures, the need to preheat our aircraft and the increased awareness of icing.

What many of us overlook, however, is the fact that our pressure altimeters can and *will* give us inaccurate indications on a blustery, cold day. Think this issue only concerns instrument-rated pilots and instrument flight rules (IFR) capable helicopters? Think again!

THE PROBLEM

The pressure altimeter in your helicopter is calibrated for a standard-day pressure condition. We correct for non-standard pressure every time we fly — we call on ol' man Kollsman (i.e., the Kollsman window) and adjust him according to the local setting. However, your pressure altimeter *cannot* be corrected for non-standard temperature.

Does this really matter to us as helicopter pilots? Yes!

Cold temperatures can have a dramatic effect on helicopter operations. Strolling along too low on a minimum descent altitude or breaking out a tad too far down on an instrument landing system approach could ruin your day — and both of these things can happen on a cold day. But there also can be reasons for concern even in visual flight rules (VFR) operations.

THE MECHANICS

Let's keep it simple. We know that cold air is denser than warmer air. While flying, our pressure altimeter setting is based on the column of air in which we are flying.

In colder, denser, heavier air, the helicopter is more or less pushed down below a datum. This datum would be found at a standard temperature of 15 degrees Celsius. Translation: when the air is colder than standard (datum) the helicopter is actually lower than the altimeter is indicating. Conversely, when the air is warmer than standard, the helicopter is at an altitude that is higher than indicated by the pressure altimeter.

Being closer to the ground than your altimeter is indicating should be of concern to you. Of how much concern, you ask? That depends on how cold it is, and on your current flight regime. In day VFR conditions, the impact of an erroneous altimeter reading may be negligible. But, if you find yourself having to perform an instrument approach after entering inadvertent instrument meteorological conditions (IMC) in air that is much colder than standard, then you'll be glad you know how to read and adjust for altimeter lies.

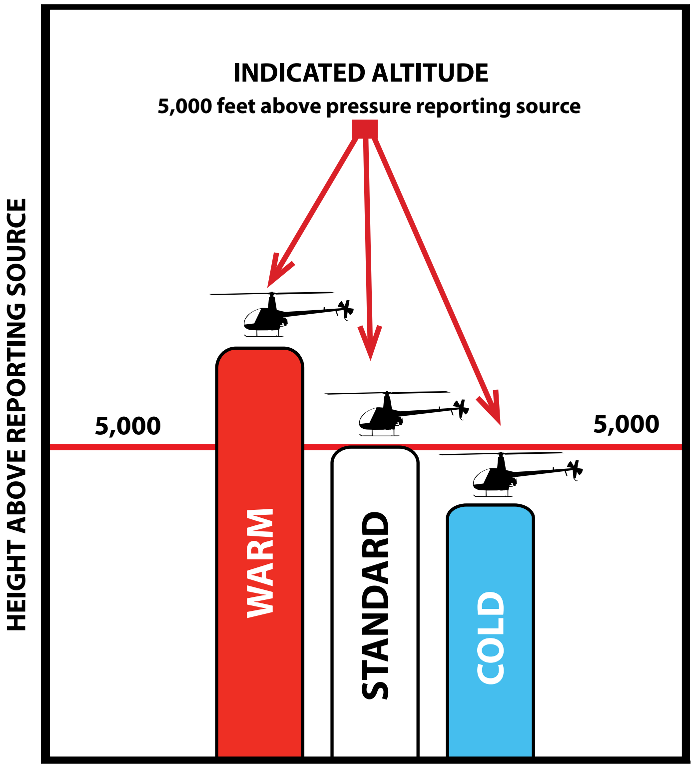
In this situation, don't count on air traffic control (ATC) to make adjustments for non-standard temperatures. If you are getting vectored — as you probably would be in an inadvertent IMC event or maybe even during the course of a "normal" IFR helicopter approach — ATC will not factor in temperature corrections. The actual Mode C transponder signal sent from your helicopter to ATC is always based on an altimeter setting of 29.92 inches of mercury. While the ATC computers make adjustments based on the local altimeter settings, they *do not* correct for non-standard temperature.

This is where a little mathematics — or in the practical case of helicopter flying, a quick-reference chart — comes into play to help us with cold-temperature corrections. When using the chart, it is paramount that the correction be made based on the helicopter's height above the reporting source, which is normally the airport's automatic terminal information service or automated weather observing system (AWOS). The correction can also be made based on the height above an important point in the approach, such as the procedure turn or final approach fix (FAF).

As an example, take a look at the correction chart *(see p.76)*, which is available in Chapter 7 of the United States Federal Aviation Administration's Aeronautical Information Manual (and Chapter 9 of the RAC section of Transport Canada's Aeronautical Information Manual). From this, we see that for a temperature of –20 C, while at a height of 800 feet above the airport reporting the altimeter setting, the correction factor is 120 feet. Under these conditions, you should be flying an additional 120 feet above what is required for that particular segment of the approach (1,440 feet in "standard" conditions).

So, if you have passed the FAF on a localizer-only approach to Runway 29, and have a minimum descent altitude of 1,440 feet (810 feet above the altimeter setting location, which is at a 630-foot elevation), you should maintain 1,560 feet until reaching the missed approach point.

Let's look at another practical example with a



3 HELICOPTERS WITH THE SAME ALTIMETER SETTING

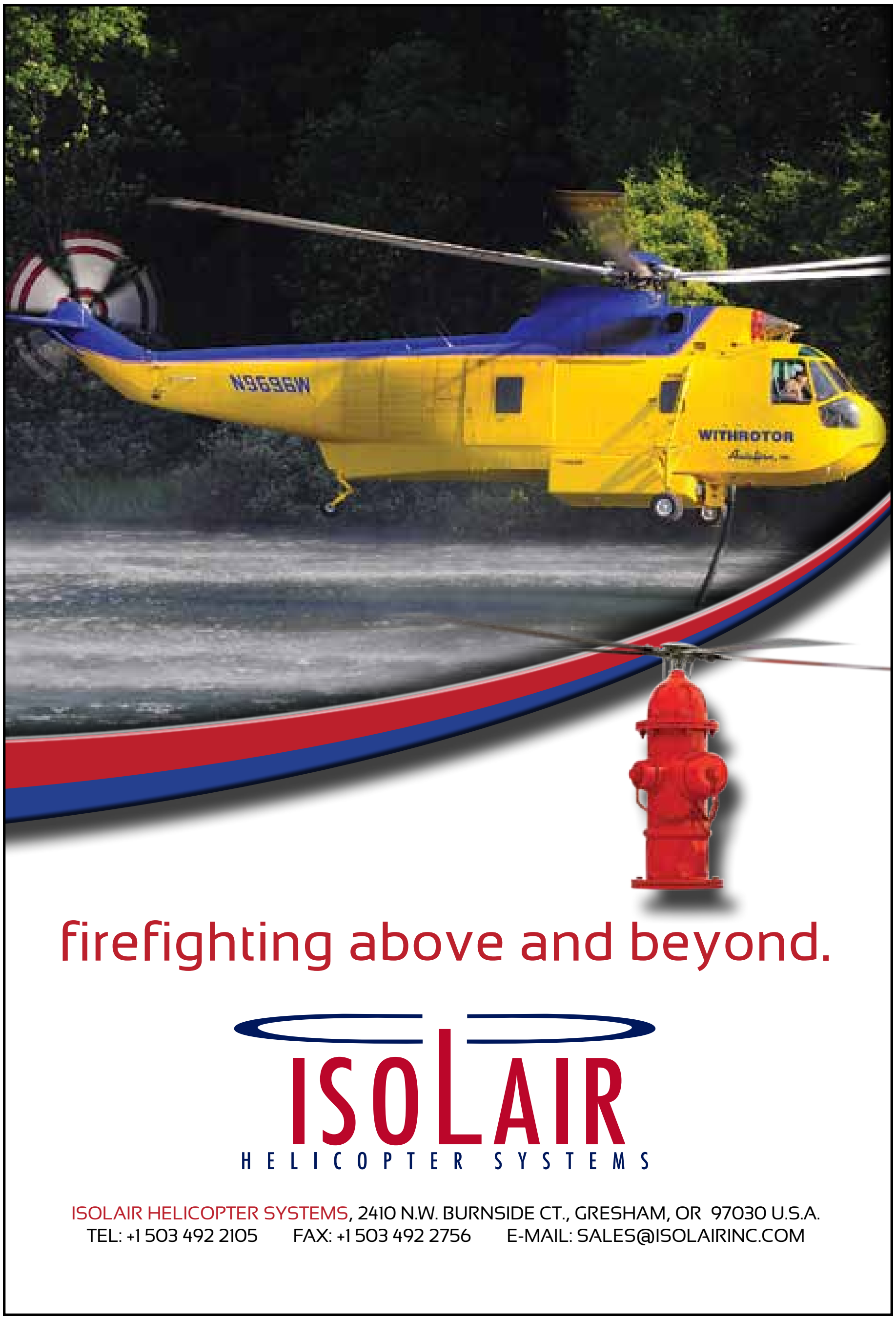
snapshot of an instrument landing system (ILS) approach *(see the diagram on p.77)*. Note the decision height of 819 feet, circled in red, and also the touchdown zone elevation of 619 feet, also circled in red. Simple math shows us that this is a 200-foot-minimum ILS approach (as circled in blue).

Now, consider that the AWOS is reporting a temperature of –10 C. Under this non-standard temperature condition,

HELICOPTER HEIGHT (IN FEET) ABOVE REPORTING SOURCE

REPORTED TEMPERATURE (IN CELSIUS)	200	300	400	500	600	700	800	900	1,000	1,500	2,000	3,000	4,000	5,000
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
–10	20	30	40	50	60	70	80	90	100	150	200	290	390	490
–20	30	50	60	70	90	100	120	130	140	210	280	420	570	710
–30	40	60	80	100	120	140	150	170	190	280	380	570	760	950
–40	50	80	100	120	150	170	190	220	240	360	480	720	970	1,210
–50	60	90	120	150	180	210	240	270	300	450	590	890	1,190	1,500

ALTIMETER CORRECTION FACTOR (IN FEET)



and based upon the correction chart on p.76, when your altimeter indicates you are at 819 feet above mean sea level (the decision height of 200 feet above ground), you are actually at 799 feet, 20 feet lower than expected. Therefore, you should fly the final approach segment down to an altitude of 839 feet, as opposed to the 819 feet indicated on the approach chart.

Let's expand on this same point to include other parts of the approach, again based on the approach snapshot on p.77. This time, however, the reported temperature at the airport is –20 C *(see the table above, and the one on p.77).*

For those math junkies out there — who can actually fly an instrument approach in a helicopter and do the calculations at the same time — Canadian aviators have long used a published formula that looks like this:

0.004 x degrees Celsius from ISA x height above reporting point = Correction (add if colder than standard, subtract if warmer)

This formula, when using our current example of –20 C reported at the airport, which is 35 C colder than the International Standard Atmosphere (ISA) model, looks like this:

0.004 x 35 (–20 C is 35 C from ISA) x 200 = 28 feet.

Do the math — it works!

BEYOND IFR

Think this information isn't for you? Well, think again!

The next time you come in to land on the runway numbers on a dark night with the temperature well below standard, take the information we've just discussed into account. You may see the runway numbers and think you are at a "safe altitude," but as you can see from our examples, you may be significantly lower than your pressure altimeter indicates. And, just because you see the runway numbers doesn't mean you see what is below you!

Even day VFR operations can be problematic. Add the factor of a cold-weather altimeter error to a fresh layer of snow that wreaks havoc on your depth perception, and you just might have enough links to complete an accident chain.

Flight instructors, especially instrument flight instructors, take note of this information and educate your students, even if you are doing instrument training in "simulated" conditions in your "faster than light" piston helicopter. You or your student could well find yourself in need of this information someday, whether in an inadvertent IMC situation or down the road when flying actual IFR helicopter operations.

FINAL THOUGHTS

This information shouldn't scare you, nor should it seem like another burden of "one more thing to remember" — it is just something to be aware of during these cold winter days. Do yourself a favor: make a copy of a temperature correction chart (such as the one shown here) and put it in your nifty little kneeboard to keep the information handy... unless, of course, you are one of those special "math junkie" kind of people.

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PART OF APPROACH	ALTITUDE (IN FEET MSL)	HEIGHT ABOVE TEMP REPORTING SOURCE*	CORRECTION TO BE ADDED	ALTITUDE TO FLY
PROCEDURE TURN	2,600	2,000	280	2,880
FINAL APPROACH FIX	2,600	2,000	280	2,880
MISSED APPROACH POINT (DH)	819	200	30	849

*Roughly