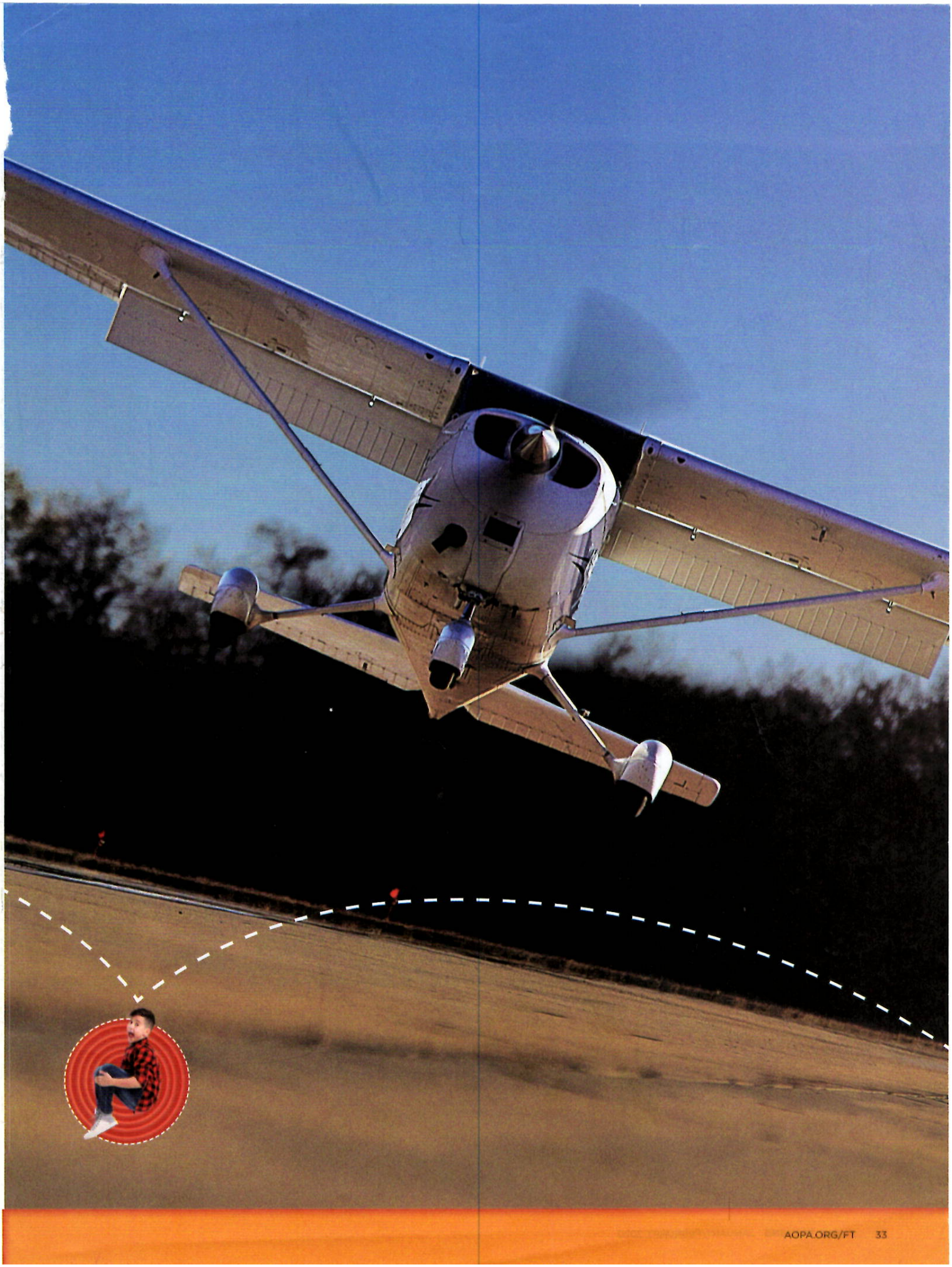


READY, AIM

Selecting an aiming point

When you're on final approach, do you train your attention on an aiming point? Early in flight training, you may count yourself lucky that the wheels touch down on pavement. But paying attention to the position of an aiming point in your windscreen can help you notice if you're too high or too low. If the aiming point is moving down in the windscreen, you're too high. If it's moving up, you're too low. Keep the aiming point stationary, and you'll descend toward that point until the flare. Your actual touchdown point will be about 300 feet beyond the aiming point in a typical trainer because of the distance traveled in the flare. *—Sarah Deener*
airsafetyinstitute.org/videos/aimingpoint

Don't wait until the situation becomes obvious and requires dramatic pilot intervention. Fix problems while they're still small, and minor adjustments in pitch and power will correct them.

unlikely to notice a slight drift in your ground track. You're less likely to see that you've climbed 100 feet from visual cues seen out the windshield, and subtle changes in groundspeed will be difficult, if not impossible, to notice. Landmarks will be less prominent and timing the rollout of your turn to final will be hard to nail.

Drop down to 800 to 1,000 feet above the ground, however, and all those variables become easy to notice. At the published traffic pattern altitude, you'll see right away whether you're climbing or descending, drifting toward the runway or away from it, and you can make smooth, timely, subtle corrections that put you where you want to be. The best part is that you'll see, sense, and feel these differences so you can keep your eyes outside where they belong, and you won't have to constantly shift your attention between inside and outside references. There's no mental transition from flying on the gauges to visual cues because you're visual the entire time. You'll only glance at the instrument panel momentarily.

Consistent, precise, stable approaches set up pilots for success because they have fewer variables to deal with as the airplane nears the ground. Configuration is set. Power is set. Airspeed and rate of descent are constant. Elevator trim is set. All the pilot needs to do is fly into ground effect and flare.

An unstable approach, by contrast, presents pilots with a slew of competing problems. Configuration and power changes lead to varying airspeeds, rates of descent, and control feel. Elevator trim is likely being altered late in the game, and a too-fast or too-slow airspeed can lead to excessive float in ground effect or not enough energy to flare. There are simply too many problems for a pilot to solve simultaneously.

If you're on final approach and you feel you have no choice but to make large changes in pitch, power, bank, speed, or configuration, realize that you really do have a choice. You don't have to land on this particular approach. The sooner you make a go-around decision, the less exciting the go-around itself is likely to be. Make the go-around decision during your base turn, for example, and flying the traffic pattern will be a nonevent. You may not even have to climb.

The longer you wait and the closer to the ground you get, however, the less likely you are to easily salvage the situation.

Airplanes are incredibly robust and durable in most situations—but they're terribly fragile in others. The main landing gear, for example, will tolerate all sorts of abuse from firm landings, and so will aircraft tires. But nosewheels, and the stainless steel firewalls they're attached to, have glass chins. They'll bend or break if they're allowed to hit the ground first, and they're not designed for side loads. Even worse, when a nose gear flexes or fails, the propeller is likely to contact the ground next—and that means extensive damage to the prop as well as an engine teardown.

The pilot's job—especially when things are going wrong on landing—is to protect the fragile and costly stuff first.

If and when you find yourself slow on short final with an excessive sink rate, add power and adjust the pitch so that the main landing gear absorbs the impact. If you're lucky, your last-minute reaction will convert what would have been a jump into a mere skip.

Or what would have been a skip becomes an insignificant hop.

Timing, as they say, is everything. **FT**

dave.hirschman@aopa.org

TEACH • MOTI

'You make the difference between dreaming and doing'

BY THOMAS A. HORNE

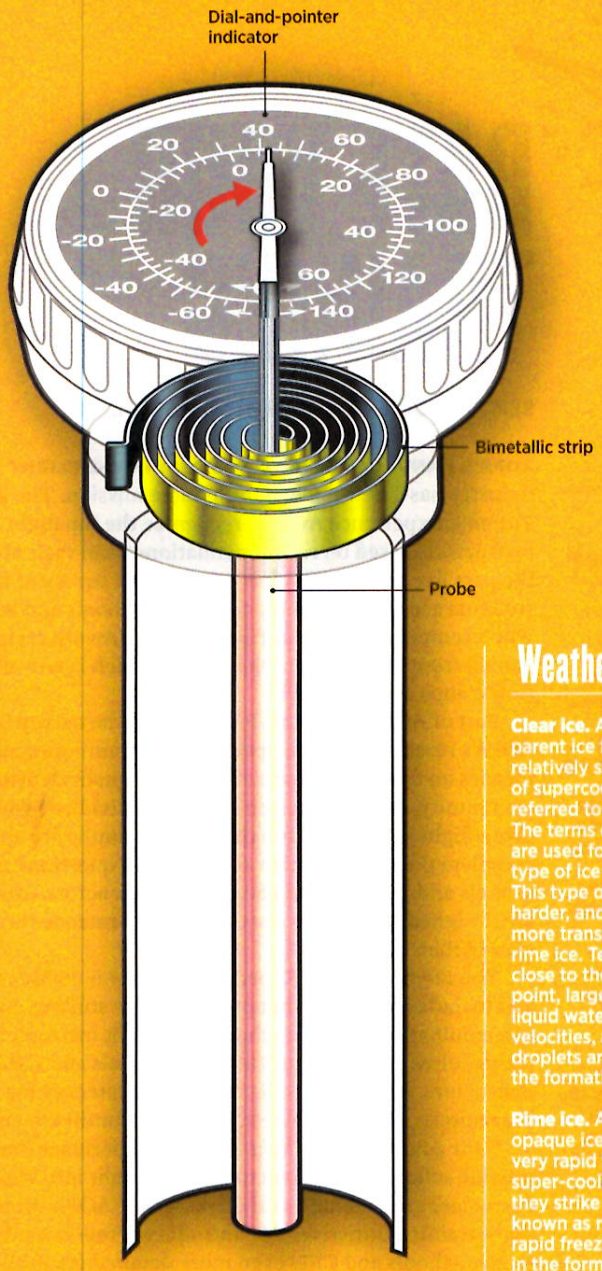
THE OAT GAUGE

SIMPLICITY IS ITS STRENGTH

MOST OF US DON'T GIVE MUCH THOUGHT TO THE outside air temperature (OAT) gauge, but it's there for some very good reasons. It provides the information necessary to make true airspeed, density altitude, and other calculations. It also serves as an early warning of potential icing conditions. Temperature between zero and minus 10 degrees Celsius? Expect clear icing if you happen to enter a cloud or precipitation. Between minus 10 and minus 12 Celsius? That's where rime icing tends to form.

The OAT gauge is stone-simple, and although it may appear crude, it's surprisingly accurate. It consists of three main components: a probe, a bimetallic strip, and a dial-and-pointer indicator. The probe picks up the air temperature, then sends it along to a thin strip of metal that's wound into a coil. The metal is really two different metals, usually steel and copper, fused one on top of the other. Each of these metals responds differently to heating or cooling. To use a term from physics class, they have different *coefficients* of thermal expansion. As the probe heats the coil, the outer band of copper expands, straightening the coil. With cooling, the inner band of steel contracts, causing the coil to tighten.

Meanwhile, the coil, which is mechanically connected to the OAT's pointer, moves so as to show the temperature on the dial's face. Older OATs use the Fahrenheit scale as the primary indication of temperature. Newer ones use the Celsius scale, which is rapidly becoming the coin of the realm in modern meteorology, pilot's operating handbooks, and aviation in general. Even so, both scales are usually represented, so that all pilots know the score—no matter their preference.



MARGINS OF ERROR

Some high-performance airplanes with glass cockpits measure OAT electronically. You might think this method is more accurate than the coiled-spring technique, but tests have confirmed that both can be equally accurate. True, frictional heating can cause false-high readings on coiled-spring OAT gauges, but this only occurs at airspeeds higher than 180 knots. And even then, the temperature rise is only a degree or two. To guard against friction, precipitation, and ice-accretion effects, some probes are enclosed in a metal sheath, perforated with holes to allow the free flow of air. *—TAH*

Weather words

Clear ice. A glossy, transparent ice formed by the relatively slow freezing of supercooled water is referred to as clear ice. The terms clear and glaze are used for the same type of ice accretion. This type of ice is denser, harder, and sometimes more transparent than rime ice. Temperatures close to the freezing point, large amounts of liquid water, high aircraft velocities, and large water droplets are conducive to the formation of clear ice.

Rime ice. A rough, milky, opaque ice formed by very rapid freezing of super-cooled droplets as they strike the aircraft is known as rime ice. The rapid freezing results in the formation of air pockets in the ice, giving it an opaque appearance and making it porous and brittle. Low temperatures, lesser amounts of liquid water, low velocities, and small droplets are conducive to the formation of rime ice.

Mixed ice. Mixed ice is a combination of clear and rime ice formed on the same surface. The shape and roughness of the ice is most important aerodynamically.

STEVE KARP

RATE YOUR TRAINING

SEND IN YOUR PICKS FOR BEST SCHOOL, CFI

AOPA'S ANNUAL SALUTE TO THE BEST IN THE FLIGHT TRAINING industry has a new name but the same mission. The 2017 *Flight Training* Experience Awards recognize the top flight schools and instructors, based on recommendations from their students. For the past five years, AOPA has conducted a survey of flight training students across the country to find the schools and instructors who exemplify the best in flight training. Award recipients are named from the results of the survey, which is now under way (www.aopa.org/ftsurvey).

Part of AOPA's You Can Fly program, the survey is based on AOPA's research into the optimal flight training experience and focuses on four key factors: educational quality, customer focus, community, and information sharing. Individuals who have taken flight training within the past 12 months are encouraged to complete the survey, which consists of 31 questions about flight schools and 25 questions about flight instructors. The questions are designed to measure the overall performance through the eyes of their customers.

The *Flight Training* Experience Survey is conducted online and includes measures that prevent ballot stuffing. Individuals can nominate both flight schools and flight instructors. In 2016, this resulted in reviews of 789 flight schools and 1,515 flight instructors. Awards are selected in each category for the following regions: West, Southwest, Midwest, Southeast, and Northeast.

"Our goal with the *Flight Training* Experience Survey is to provide schools and instructors with insight into what their customers are seeking," said Chris Moser, AOPA director of the flight training initiative. "We introduced 'report cards' last year to give schools and CFIs even more detailed feedback into their strengths and potential areas for growth. As we expected from the passionate and dedicated people in the flight training industry, we've heard from quite a few folks who are glad to know what they should keep doing and what they can focus on to serve their customers in even better ways."

Whether you're preparing for your first solo, brushing up on regulations, or taking a flight review, AOPA wants to hear from you. Think of this as a customer satisfaction survey; your constructive feedback helps AOPA identify the best flight training providers, and helps flight training providers identify their strengths and target areas for improvement. The *Flight Training* Experience Survey is available from May 22 through August 14, 2017 **(www.aopa.org/ftsurvey).**

THERE'S MORE

BONUS SWEEPSTAKES

Participants in the Flight Training Experience Survey are eligible to win sweepstakes prizes:

- **$150 gift card from Aircraft Spruce**
- **Pilot Workshops *Real World Coast to Coast* online course**
- **Online Sporty's *Learn to Fly* Private Pilot course**
- **Online Sporty's instrument rating course.**

Participation in the survey is not required to enter the sweepstakes. 2017 sweepstakes rules are available online (www.aopa.org/ftsurvey).

RECOGNIZE YOUR CFI
When filling out your survey, remember to ask your CFI for his or her certificate number. The survey will ask for the last four digits of your CFI's certificate number, ensuring the best instructors get the recognition they deserve.

ADDRESS CHANGE?
Send your new address and AOPA membership number to AOPA:

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Do you have questions or need information about an aviation topic? Access the team of aviation experts in our Pilot Information Center during our convenient weekday hours. Call 800-USA-AOPA (872-2672) Monday through Friday, 8:30 a.m. until 6 p.m. Eastern time, with your questions and our staff will be happy to assist you.

Visit the website (www.aopa.org/membership) to learn more about the benefits of AOPA membership.

BY IAN J. TWOMBLY

ATTITUDE INDICATOR

LET'S GO FOR A SPIN

GYROS ARE COOL. THESE PERFECTLY MACHINED LITTLE MARVELS ARE RESPONSIBLE FOR many of the inner workings of an airplane's instrument panel. The attitude indicator (AI) is one of the most important.

At the most basic level the attitude indicator is an easy instrument to understand. One quick glance and you can determine the airplane's position relative to the horizon. But get a little deeper and it's truly amazing what the AI can do and how it works.

A small cylinder of metal inside a casing spins rapidly to act as a gyroscope. High school physics taught us that a core principle of gyroscopes is rigidity in space, sort of like that 350-pound lineman who doesn't want to move. As the airplane banks and pitches, the gyroscope stays upright, spinning in place. So, believe it or not, the entire airplane turns around the gyroscope. The front of the instrument with the tick marks and the itty-bitty wings is fixed to the instrument panel, while the blue-and-brown horizon card is attached to the gyroscope. Those tick marks and the little wings pitch and bank with the airplane while the horizon card remains in place.

To spin the gyroscope, a pump attached to the engine (vacuum pump) sucks air out of back of the instrument case. As air flows across the gyro it spins and remains rigid. One of the dangers of vacuum instruments is that if the pump fails, it takes a long time for the vacuum to spin down and for the gyro to stop functioning. While that is happening, the attitude indicator will slowly fail and start listing, lulling many pilots into believing they are turning when they really aren't. If you aren't in the clouds, a quick look outside will help keep you upright.

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OPTIONS

TRIPLE ATTITUDE

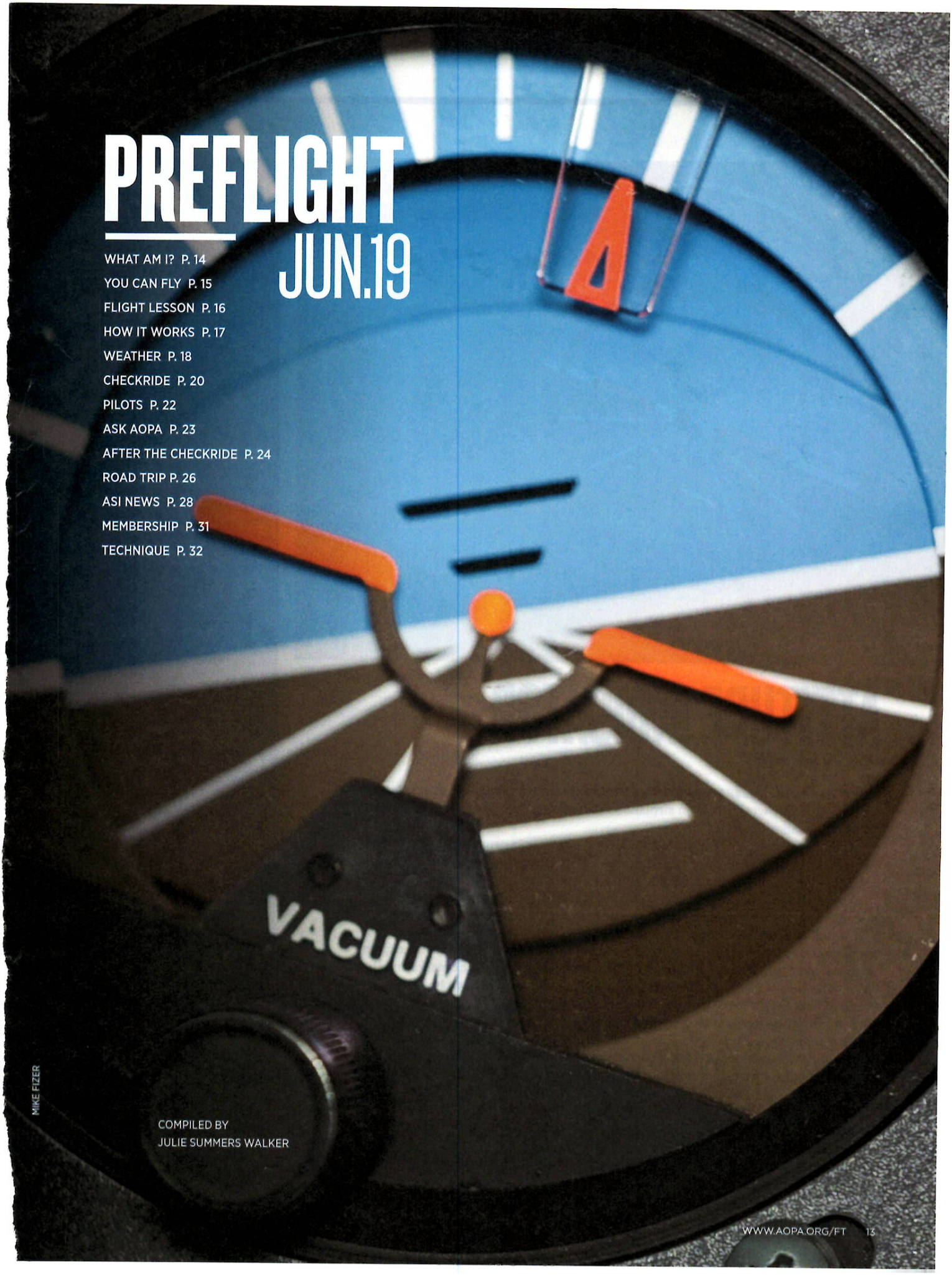
Three types of indicators

Traditional attitude indicator
A blue sky, a brown ground, measurements for pitch and bank, and a mechanical gyro in the back.

Digital attitude indicator
Run by a computer called an air data, attitude and heading reference system, new digital attitude indicators are much more reliable, weigh less, and take up less panel space.

Primary flight display
The primary flight display takes all the basic flight parameters, including speed, heading, yaw, altitude, and vertical speed and plasters them on a screen in which the attitude indicator takes center stage.

PREFLIGHT
JUN.19



MIKE FIZER

COMPILED BY
JULIE SUMMERS WALKER

BY DAVE HIRSCHMAN

ATTITUDE INDICATOR

KEEP THE BLUE SIDE UP

THE ATTITUDE INDICATOR (AI) IS THE CENTERPIECE OF THE INSTRUMENT PANEL for good reason: It shows the airplane's orientation relative to the horizon at a glance.

The AI (also known as the gyro horizon or artificial horizon) has been a staple of instrument flying for more than 75 years. Generations of pilots have placed the AI at the center of their scan, the constant cross-referencing that pilots must perform to control their aircraft without external visual references.

But AIs aren't infallible, and instrument pilots prepare for AI failures. The AI depends on a devilishly complex series of mechanical gimbals and a gyroscope that's traditionally powered by an air pump, called a vacuum pump. Internal parts can stop working without warning, and so can the air pump itself. When that happens, pilots must be prepared to fly "partial panel," relying on other instruments.

Also, AI gimbals usually have pitch and bank limits, and if an aircraft exceeds them, the AI can tumble, no longer showing the airplane's true attitude.

Newer, more reliable digital AIs made up of solid-state electronics are beginning to replace older, mechanical versions. The new models typically come with backup batteries that allow them to continue working if the aircraft electrical system fails, and they're not subject to pitch and bank limitations.

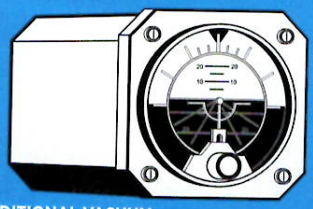
All AIs manufactured in Western countries have certain similarities in their displays. There's a horizon line with blue above and brown below; a miniature airplane; pitch lines that show whether the airplane's nose is pointing up or down; and a bank angle index with hashed lines at 10, 20, 30, and 60 degrees.

Keep the blue side up!

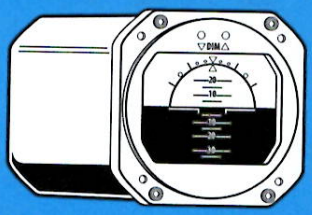
ON THE HORIZON

TYPES OF ATTITUDE INDICATORS

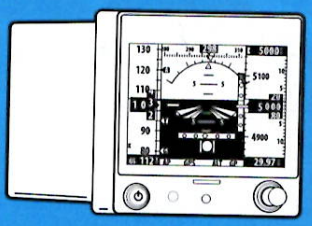
AIs come in many flavors.



TRADITIONAL VACUUM
A gyroscope powered by a vacuum pump drives a series of mechanical gimbals that display the airplane's pitch and bank attitudes within certain limits.



DIGITAL AI
Solid-state electronics with no moving parts increase reliability and do away with pitch and bank limitations.



ALL-IN-ONE AIS
Miniature glass panels such as the Garmin G5, Dynon D10A, L3 Trio, and Sandia Quatro use tiny air data computers to show aircraft heading, altitude, airspeed, and vertical speed.

PREFLIGHT
NOV.17

MIKE FIZER

COMPILED BY JULIE SUMMERS WALKER

BY MIKE COLLINS

MARKING TIME

UNDERSTANDING THE HOBBS METER

WHAT IS A STUDENT PILOT'S WORST NIGHTMARE—ENGINE FAILURE IN FLIGHT? AN encounter with unseen wake turbulence? An unexpected thunderstorm?

No, the joke goes, it's a runaway Hobbs meter. That small hour meter measures the amount of time that an aircraft is in operation, and aircraft rental charges usually are billed on the Hobbs reading.

Think of the Hobbs meter as a clock. Honeywell, which now owns the Hobbs brand, offers this definition: "An hour meter is a gauge or instrument that tracks and records elapsed time, normally displayed in hours and tenths of hours."

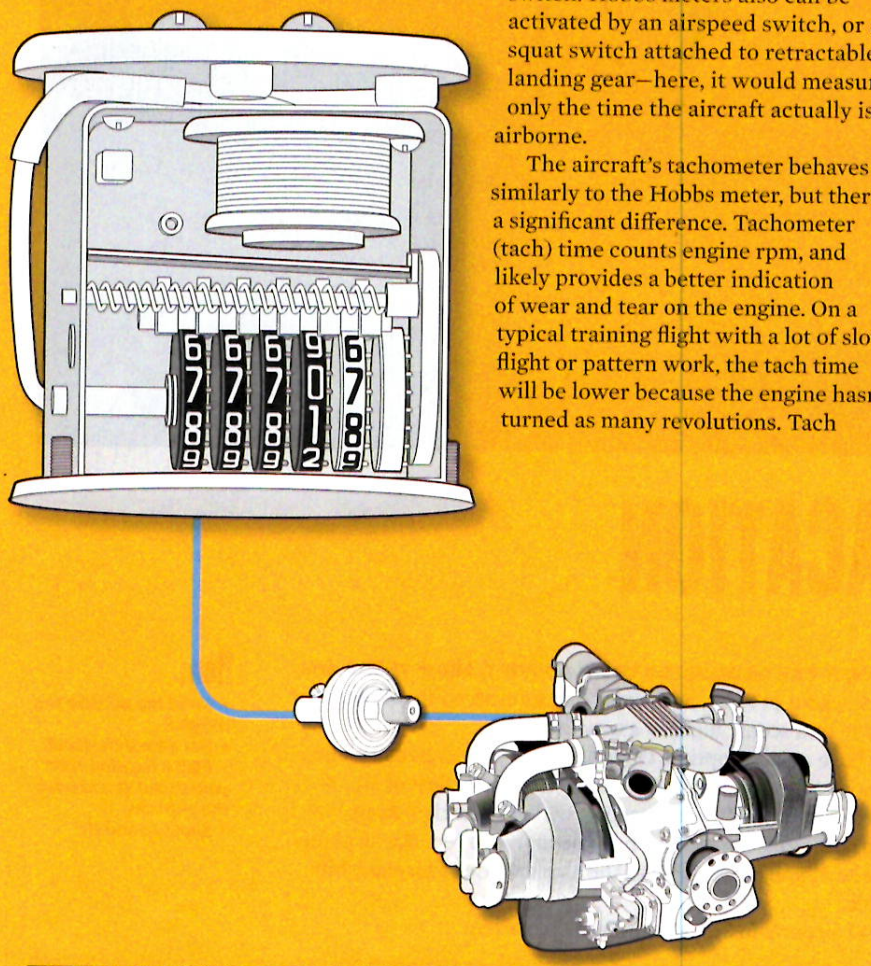
A Hobbs meter can measure different things. Most are activated by a pressure switch connected to the oil system, and the meter runs when the engine is operating. A meter can measure the time that the electrical system is on—think master switch. Hobbs meters also can be activated by an airspeed switch, or a squat switch attached to retractable landing gear—here, it would measure only the time the aircraft actually is airborne.

The aircraft's tachometer behaves similarly to the Hobbs meter, but there's a significant difference. Tachometer (tach) time counts engine rpm, and likely provides a better indication of wear and tear on the engine. On a typical training flight with a lot of slow flight or pattern work, the tach time will be lower because the engine hasn't turned as many revolutions. Tach time typically is 10 percent to 20 percent lower than Hobbs time, depending on the length of the flight and the power setting(s) used.

Most flight schools use the Hobbs meter to bill aircraft rental fees and the tachometer for engine service intervals, so don't be surprised if you're asked to log both at the end of a flight.

Why not just use tach time for everything? FAR 1.1 defines flight time as "Pilot time that commences when an aircraft moves under its own power for the purpose of flight and ends when the aircraft comes to rest after landing." An oil pressure switch-activated Hobbs meter most closely approximates this. (And if the rental cost was based on the tach instead of the Hobbs meter, you would find the hourly rate to be at least 10 percent higher.)

Hobbs meters are not just an aviation thing. Their use is common on off-road vehicles, as well as vehicles that experience high running or idling time, with comparatively lower actual mileage.



In this installation, an oil pressure switch (shown at center) senses when the engine is running, and sends an electrical impulse to the hour meter. Inside the meter, a solenoid (top) activates the mechanism that marks the time. The white dial on the right records each one-tenth of an hour; gearing automatically causes the hour, 10-hour, 100-hour, and 1,000-hour dials to advance at the proper intervals.

STEVE KARP

BY JILL W. TALLMAN

FLY ON YOUR VACATION

GET AN OPENAIRPLANE CHECKOUT

IF YOU WANT TO GO FLYING WHILE ON VACATION, IT CAN BE DONE. GO TO AN AIRPORT, SEE IF THERE ARE airplanes available to rent, and go through the checkout process. Keep your fingers crossed that time, your wallet, and the weather cooperate, so you can take that scenic flight in a new locale.

That's the way things used to be. Pilots now have another option. OpenAirplane (www.openairplane.com) lets you find, reserve, and pay online for an aircraft rental at participating locations. Best of all, provided that you get a Universal Pilot Checkout in advance of your vacation with any participating OpenAirplane provider, you don't have to get an additional checkout when you arrive to rent the airplane. You'll get a local procedure briefing, receive the keys, and be escorted to the airplane. OpenAirplane bills the flight to your credit card, which is kept on file.

OpenAirplane has operators at more than 100 airports in 31 states around the nation.

How:

- *Go to the website and register.*
- *Get a local checkout.*
- *Find a location near your vacation and book the airplane.*
- *Show up and fly!*