

# HOME BUILTS FLYING

# IFR

**WHAT IT TAKES TO FLY YOUR E-AB IN THE SYSTEM, AND IN THE CLOUDS**

BY STEIN BRUCH

Light IFR and heavy IFR—those two terms are frequently used when people ask me the most common question I hear, “What equipment do I need in my homebuilt aircraft to fly ‘heavy’ or ‘light’ IFR?”

First, I think most can agree that the FAA generally doesn’t separate IFR into various or distinct levels of gravity. You are either in the system and filed, or you are not. Either way, the equipment required should be similar, if not the same. Separately, how you use your aircraft and the equipment will probably drive your decisions beyond the basics, but it won’t change the practical requirements.



# HOMEBUILTS FLYING IFR

**THIS TOPIC USUALLY RESULTS** in strong emotions, opinions, and long-winded debates at air shows and in online forums. While technically it can be a complex topic, it's actually very simple. We do know one thing for sure: If you ask the FAA a question, it will answer. The problem is, if you ask 50 different agency employees, you're likely to get 50 different answers, and many times those answers are just opinions disguised as facts.

So, big picture, what should you have? What really makes sense, both legally and functionally, if you intend to use your homebuilt for IFR flight, or even night VFR?

In its simplest form, the IFR requirements for our homebuilt aircraft are spelled out in the Federal Aviation Regulations (FARs) and, by proxy, in your aircraft's operating limitations. It can be easy to get caught up in a bunch of circular arguments relating to additional publications (like Part 43, advisory circulars, the *Aeronautical Information Manual*, service bulletins, etc.), but reality is often different than theory. There is a difference between what you must have and what you should have.

Instead of reprinting the entirety of 91.205 that details the list of items, let's just agree that you need all the instrumentation installed for day and night VFR, along with additional items to make your plane practical and legal for IFR use.

With that in mind let's break this down into the various sections of functionality. Please remember I'm referencing mainly operation in the United States. There are a myriad of various different laws and policies in other countries regarding IFR operation as it relates to instrumentation.

## FLIGHT INSTRUMENTS

Obviously you want and need a way to keep the shiny side of the aircraft facing up, which means you need an attitude indicator of some

sort. For many decades, this has been a spinning mass of metal enclosed in an instrument with the sky and ground displayed on it, powered by vacuum or electricity. The other five instruments that make up the standard six-pack are also needed and required (altimeter, airspeed indicator, magnetic compass, heading indicator, vertical speed indicator).

While still available in their familiar form, it's currently cheaper to purchase a number of fully solid-state digital indicators or EFISs (electronic flight instrument system) than it is to buy a set of traditional round instruments of decent quality. There are a number of options in the market, ranging from about \$1,700 to \$100,000. These units don't necessarily need to meet a technical standard order (TSO) or be certified, but they do need to meet the specs and pass a 24-month inspection/certification, just as they would in a standard certified aircraft.

While some folks still maintain that "round is better" (I won't argue that here), I will submit that a plethora of modern additions to the EFIS are extremely useful at reducing pilot workload and increasing situational awareness.

Since the majority of builders will be going with EFIS, you may notice that many companies offer a dual AHRS (attitude and heading reference system)—which in plain speak is a box of electronic gyros, to drive the displays. That is an excellent option for simple redundancy, but our take is that sometimes two identical AHRS boxes in the same system can be dangerous without proper thought or failure analysis during installation. If they are identical units, it is more likely that a software bug or problem will develop, which, unlike a simple hardware failure, could affect an entire system.

That means for practical purposes you should have an independent instrument of a different manufacture, technology, or model. This is the approach taken by the large transport category and many military aircraft with the set of standby instruments along with the main displays. These instruments are both for redundancy and safety. There are a number of options on the market for these devices, priced in the \$1,700 to \$3,500 range, that are nicely sized and often contain their own backup battery sources.





If you are worried that you've never flown behind any of the new gadgets and you won't be able to learn them, don't worry! Though some of the early systems did have somewhat complicated menu structures and could be cluttered, the manufacturers have spent a lot of time making the new systems quite easy to use and very intuitive. Another huge benefit of the modern EFIS is its ability to interface with many other systems in your plane. When connected, the EFIS will talk to your engine instruments, autopilot, radio, GPS, ELT, even things like a carbon monoxide detector or pitot tube. I point this out not because of the cool factor, but to make the argument that it does reduce pilot workload and increase situational awareness.

I'm also of the opinion that for practical IFR usage the new "smartphone or tablet" quasi-EFISs, which use separate wireless AHRS, are not a good option. For VFR use, backup use, or novelty, they are neat, but not something I'd yet be able to recommend in an IFR environment. Practically speaking, you should have at least one good quality EFIS (or collection of traditional flight instruments of good quality), along with a good standby or backup instrument of some sort. If you choose dual AHRS, I'd still strongly recommend a backup attitude source of some sort.

It's also important to ensure that whatever you choose has been installed in such a way that a simple electrical failure will not torpedo the entire system. This means having something like a backup battery, standby alternator, or other source of energy to power the main device in the event of a simple alternator or battery failure.

#### NAVIGATION

The simplest paraphrasing of the rules state that you must have installed equipment appropriate to the navigation and flight that you will be performing. For the very basic, a VHF nav/comm would suffice if your IFR flight was limited to VOR or ILS navigation or approaches.

The reality is that, while this will suffice at the most basic level, IFR GPS navigation is becoming standard, which the FAA is striving to implement as part of its NextGen air transportation system. In the past, the primary means of precision approaches was the ILS, but WAAS GPS approaches now outnumber those by a good margin, and

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continue to be implemented at a fast pace. Due to this, many folks are choosing to include a WAAS GPS in their homebuilts.

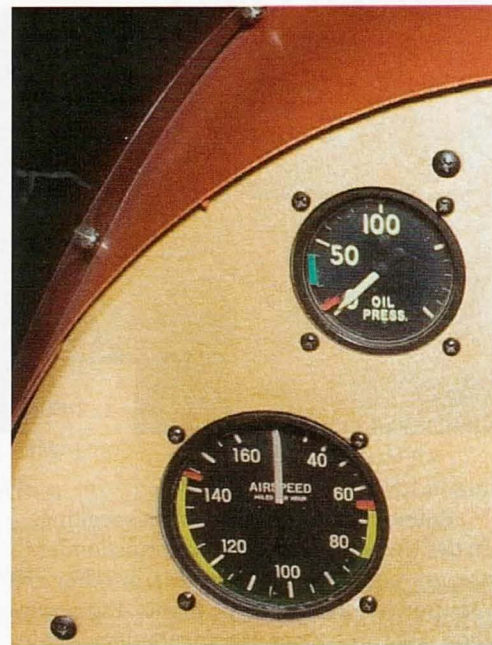
There is a whole series of details relating to the TSOs of such devices, and it is my opinion that a WAAS GPS used for precision IFR work must be certified. Without getting into too much detail, it's important to briefly look at TSO-C145a and TSO-C146a. Older non-WAAS units are certified to TSO-C129 and are typically for en route and nonprecision work. The 145/146 units are primarily used for WAAS GPS navigation.

There is an important distinction between 145 and 146. TSO 145 is basically the GPS unit, and when combined with a certified (or equivalent) FMS type system, it can be a fully functional and legal solution. Aside from that combination, the 146 units (such as the Garmin GTN or GNS, or the Avidyne IFD) are recommended, and about the only solutions readily available to homebuilders. These boxes are fully certified as stand-alone navigators, and the 145 boxes are not. Simply installing a 145-certified GPS with a noncertified EFIS (without extensive documentation, testing, or certification) will not suffice as an IFR legal replacement for the 146 boxes, no matter what the EFIS vendor states on a website or in an advertisement.

A good, certified WAAS GPS is not technically required, but functionally will make your IFR flights much easier and give you many more options. To fully take advantage of these magic boxes, they still must have appropriate indicators to display course deviation, HSI, etc. This can be accomplished through most EFISs, certified or not (except for certain countries that require the indicators to be certified or separate).

#### TRANSPONDERS AND RADIOS

At the core of flying are the terms *aviate*, *navigate*, and *communicate*. In regards to rules for homebuilts, the first two are



open to more debate than the last one. Communication is simple. You need an appropriate comm radio in the airplane to be IFR legal. In fact, two radios make life much easier, so I always recommend a second comm radio as an excellent addition to your IFR equipment list.

There are minute details that can be discussed and countries with other requirements, but most radios made here in the past 10-15 years are perfectly legal from a frequency spacing perspective, while many radios made more than 20 years ago are not. If you find a deal on a "360-channel VHF comm" from a buddy or online, it's nothing more than a boat anchor. Good radios are more than nice to have, and they are required.





Communicating is more than speaking. In the United States, airspace transponders are not required in all instances, but they are required in most IFR-type flights. Currently there are three types of transponders: Mode A (transponder code reporting only), Mode A/C (Mode A with pressure altitude reporting), and Mode S (similar to Mode C, but includes additional information about your aircraft in its reporting). Some countries do require Mode S, but currently the United States does not, and Mode C will suffice in most locations. Transponders are another area where I recommend using certified equipment that carries a TSO.

Regardless of whether it's remotely installed or mounted in the radio stack panel, aircraft transponders still must pass the same biennial transponder check and certification as everything else. Along with this, there is often some argument (from shops doing the test and agency folks as well) about whether the altimeter or encoder needs to be certified. At this time in the United States, if your altimeter and encoder meet the specifications and pass the pitot/static or transponder checks, they are fine, whether they are TSO'd or not. This has been the case for decades.

## OTHER EQUIPMENT

In addition to the items previously discussed, there are a few ancillary items of which some are legal "must-haves," but others are safety and functional "should-haves."

The "must-have" category includes an ELT if your airplane has more than one seat. In the United States you can still legally use a newer 406 MHz ELT, though, contrary to

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some information, it is not required at this time. You can also use the cheaper non-406 ELTs, but it should be noted that only the newer ELT will trigger the satellites and notify someone. The newer 406s also have the advantage of being many times more accurate than the older units. An alternative is to use a 243 unit plus a personal locator beacon (PLB), which would give you the accuracy benefits of the 406 ELTs.

Compasses are technically required, though in some installations, in some regions, with some inspectors, you will be credited for a compass through use of a secondary compass in an EFIS. This is still one of those areas in which policy interpretation is exactly that, and is not universal between various agency personnel or locations.

An autopilot isn't identified as a legal "must-have," but is one I include in a list for comfortable IFR flight. Prices range from \$1,700 to \$6,500 when purchased in conjunction with a good EFIS, making them so reasonable now for homebuilders that there is no reason not to at least install a basic two-axis autopilot. There are many options for autopilots, but well-integrated units will fly coupled approaches, holds, climbs, descents, and almost every other function that you'd use in a typical IFR flight.

The new electronic flight bag applications for smartphones or tablets can be reserved for their own article. They are of tremendous value and offer tons of useful additions to the cockpit of any aircraft, VFR or IFR. For the cost of just a few paper charts, you can have all of the charts (IFR, sectional, world aeronautical charts, etc.) on your tablet, all current, and within arm's reach. Certainly these aren't any sort of requirement, but they are an incredible use of money.

Last but not least is ADS-B and other situational awareness products. Having XM or ADS-B weather data certainly isn't required, but will give you things like cloud data, temperatures, winds aloft, freezing levels, radar data, METARs, terminal area forecasts, NOTAMs, temporary flight restrictions, SIGMETs, AIRMETs, and other data at near real-time intervals, making for a much more comfortable and safe flight.

## THE LIST

To recap, the items I feel you should have in your homebuilt for IFR flight are:

- Primary gyro-based attitude indicator or instrument (EFIS or equivalent)
- Primary flight instruments, likely an EFIS
- Secondary attitude indicator or instrument
- Backup power source if using an EFIS or other electrically powered units
- Certified WAAS GPS
- Certified transponder
- Autopilot, two-axis preferred
- ELT, new 406 MHz or old 243 MHz plus PLB
- Compass
- Weather and traffic system
- Backup or portable comm
- GPS

Obviously the aforementioned list is open to interpretation and opinion. Some of it is just a gray area, and several different opinions and answers will be correct. As I said from the start, "must-haves" and "should-haves" are two entirely different things. As a builder or owner of a homebuilt, you have access to a ton of equipment that is not only available at a good price point, but oftentimes offers superior functionality to what is available in the certified world. *EAA*

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