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Making Modifications

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Parts installation guidelines

There's no logic to it! Why weren't the original variable-resistance-type fuel quantity gauges replaced during the installation of the new instrument panel and avionics suite?

Today it only takes the installation of a couple of boxes packed with digital technology to transform a 30- or 40-year-old general aviation airplane. This type of change is taking place hundreds of times a week in this country so the question lingers. Why keep that old technology? Well, the rules that apply to the installation of fuel gauges are the same rules that govern the installation of new parts for every certified airplane. So when you swap out the new for the old, you need to follow the rules.

The parts production and the installation approval for new parts on certified products are spelled out in the regulations. These codified rules are surprisingly flexible. Let's take a few minutes and boil the rules down. They're really not that difficult to understand.

The starting point

In the beginning of every certified airplane's life span someone — the manufacturer's representative if the manufacturer has been granted a production certificate or an FAA representative if the production certificate is pending — signs off on the airplane. This signature warrants that the airplane is airworthy in accordance with the type certificate.

Compliance with the type certificate is only one part of an airplane's airworthiness. The definition of airworthiness is in every certified airplane on the standard airworthiness certificate and in FAA advisory circulars AC 43.13-1B, and AC 120-77. An airplane is airworthy when it conforms to the type design, and is in condition for safe operation. Notice the two parts — one part is as objective as the black-and-white text that defines it, and the other part is subjective. It's purely in the eye of the manufacturer's representative, or the pilot, or the mechanic, the repair station owner, or the FAA maintenance or operations inspector. This objective provision contributes to a lot of rhetoric and confusion, but since it's impossible to write down exactly how to apply every rule in every conceivable circumstance, the final judges of airworthiness are the FAA administrator's representatives in the field and the airplane user. This objective standard is the reason one group of inspectors or their supervisor at one flight standards district office (FSDO) interprets a particular rule one way while the neighboring FSDO sees the same rule in a different way. It's also the reason some mechanics, and even some FAA maintenance inspectors, are confused about the difference between a major and a minor repair or alteration.

The objective standard carries weight every day in aviation. By issuing a pilot certificate, a mechanic certificate, or a repair station certificate, the FAA is saying that the responsibility for making the objective part of every airworthiness decision belongs squarely in the hands of the certificate holder.

That's where the responsibility should reside, but in order to arrive at informed airworthiness decisions maintenance technicians, repair stations, and pilots must know the regulations that govern their area of control.

The rules on products and parts

The rule governing replacement parts for installation on a type-certificated airplane is FAR 21.303. This rule says that all parts for installation on certified products such as an airplane or engine must be produced by a company that holds a parts manufacturer approval (PMA). There are four additions to this rule.

Parts built by a type certificate holder such as Cessna, Piper, Mooney, Cirrus, Lancair, Teledyne Continental, Textron Lycoming, Hartzell, or McCauley do not have to be PMA parts because these companies hold type certificates and/or production certificates. These certificates permit the production of parts for their airframes, engines, and propellers, as appropriate.

Companies seeking approval to manufacture and sell parts for installation on type-certificated products usually get this approval by applying for a PMA. Engine parts such as ring sets, valves, cylinders, and pistons sold by Engine Components Inc. and Superior Air Parts are examples of PMA approved parts.

The PMA approves the production and quality-control processes of the part — installation of the part is approved by being listed on the PMA holder's parts

eligibility list. An exhaust valve may be FAA PMA approved, but it's not legal to install that valve on an owner's engine unless the valve is listed with the appropriate engine make and model in the parts eligibility list.

Another addition to the PMA rule is standard parts. Parts such as bolts, nuts, washers, and safety wire that are built to a published specification such as National Aerospace Standards (NAS), Air Force-Navy Aeronautical Standards (AN), Society of Automotive Engineers (SAE), or Military Standards (MS) are defined as standard parts. This definition has recently been expanded to include discrete electrical and electronic component parts such as resistors, capacitors, diodes, and transistors. A paper trail certifying that standard parts comply with the appropriate specifications is supplied by the seller in the form of a certificate of compliance.

Standard parts may be installed in place of identical standard parts. If the standard part — the stainless-steel screws that many owners install in place of carbon-steel screws to improve the appearance of their airplane — does not come with a certificate of compliance listing the published specification standard, then the legality of the installation is open for debate.

There's one clarifying condition. If a part has a specified life limit in operating time or cycles, then by definition it is no longer a standard part.

TSOs

The next application is parts built to a technical standard order, or TSO. TSOs are minimum standards for the design and production of common parts and accessories. Altimeters, compasses, instruments, tires, seat belt assemblies, autopilots, aircraft-covering fabric, wheels, and many avionics are examples of TSO-approved items.

In some cases equipment built to a TSO may be used to replace like equipment such as replacing one altimeter with a similar altimeter. This is an approved installation provided that all the airplane-specific markings in the type certificate and owner's manual or pilot's operating handbook, such as airspeed range markings on airspeed meters and caution range and redline markings on tachometers and manifold pressure gauges, for example, are in place and correct.

But a TSO approval for a part is not an across-the-board approval to install all TSOed parts in all airplanes. Often, using TSO-approved parts requires an additional approval for the installation of the part, especially if the part was not part of an aircraft's original type-certificated design. For example, the TSOed fuel quantity gauges built by Rochester that were part of the original design of many Beechcraft airplanes would not be legal to install in a Cesna airplane in place of the Stewart Warner engine instruments on the Cessna TC without an installation approval.

The fact that most avionics are approved to replace like equipment under the TSO rule can be misleading. While this rule is easy to understand as it applies to compasses, seat belts, and instruments, all except the simplest avionics installations usually qualify as major alterations. So this article will be restricted to parts other than avionics.

All TSO-approved equipment must have an identification plate with the name and address of the manufacturer, the name, type, part number, or model designation of the article, and the serial number or date of manufacture, or both.

STCs

When a product alters an airplane enough for the change to be considered a major change in the type design, but not enough to require a new type certificate, the change is accomplished under the provisions of a supplemental type certificate, or STC. STCs include both parts and equipment approvals and installation approvals. There are a number of steps for STCed installations — ensure that the STC is approved for the airplane or engine make and model, complete the installation or modification in accordance with the step-by-step instructions, put the flight manual supplement and the instructions for continued airworthiness (ICA) that are supplied by the STC holder in the permanent aircraft records, amend the aircraft weight and balance record to account for the STC installation, enter the modification or installation on an FAA Form 337, get an airframe and powerplant technician with inspection authorization to sign off the 337, give one copy of the 337 to the owner, and send a copy to the local FSDO — but they're cut-and-dried.

Most popular modifications fall under the STC category. Vortex generators, engine and propeller upgrades, STOL (short takeoff and landing) kits, strobe lighting kits, engine analyzers, and wheel and brake upgrades are examples of typical modifications that are approved by the STC process.

Owner-produced parts

This sounds a little strange but it's true — owner-produced parts are acceptable replacement parts — provided they conform to FAA-approved data and are installed only on the owner's airplane. These parts may not be manufactured to sell.

According to a rules interpretation, the owner must control or participate in at least one of the following functions for the part to be considered owner-made. He must a) provide the manufacturer with the design or performance data to make the part; b) provide the manufacturer with the materials to make the part; c) provide the manufacturer with fabrication processes or assembly methods to make the part; d) provide the quality-control procedures to make the part; or e) personally supervise the manufacture of the part. The owner can hire someone, even his mechanic, to manufacture the part if he fulfills the conditions mentioned in the previous paragraph.

In order to get the appropriate data for the part the owner may petition the appropriate aircraft certification office under the Freedom of Information Act to release data related to the design of the part, or the owner may reverse engineer the part and have that data approved through the field approval process. Fabrication of really complicated parts may need data generated by an FAA-designated engineering representative (DER) and may need to be approved by an FAA representative.

The maintenance technician who is signing off the installation of an owner-made part is responsible for determining the airworthiness of that part. This determination is based, again, on the approving mechanic's objective opinion of how the appropriate regulations apply.

PMA and STC

Denver-based Forced Aeromotive Technologies (FAT) has developed a belt-driven supercharger installation that is now approved for installation on 1962 through 1976 Cessna 182-model airplanes by the STC process (see "Airframe & Powerplant: Getting FAT," October *Pilot*). The STC approves the installation of the FAT supercharger system for the make and model of airplanes that are listed in the STC holder's master eligibility list.

As this went to press, Forced Aeromotive had not yet been granted a PMA to build the parts that make up its supercharger system. Since the PMA has not yet been granted, the parts of each kit must be inspected and released by an FAA inspector. Needless to say, this method of selling modifications has severe drawbacks for the producer, the consumer, and the FAA.

Fuel gauges

Now that the most common equipment installation approval methods are known, can you guess why those old-fashioned fuel quantity gauges are still in the panel?

Part of the reason is because until very recently no one produced STC-approved, or TSO-approved, replacement fuel quantity gauges.

The first step in installing any modification is to determine the installation approval basis. Ideally, the modification is STCed and your make and model of airplane is listed on the STC holder's master eligibility list. For instance, the STCed replacement fuel gauges mentioned above were introduced at EAA AirVenture 2003 and are produced by Aerospace Logic Inc., of Ontario, Canada. They are STCed for 372 different airplane models.

If the part was produced by a manufacturer for installation on its product, no further approval is needed.

If the part was produced under a PMA, it's approved for installation if it's on the PMA holder's parts eligibility list for the make and model of airplane or engine.

If the part is generic, meaning common to general aviation airplanes, and has a TSO tag with the appropriate information affixed to it, it can be installed in place of a like piece of equipment if the unit it's replacing was part of the original aircraft certification and provided that all type-specific markings specified in the type certificate data sheet and the owner's manual or pilot's operating handbook are applied. If the TSOed part is not a direct replacement for a like part, installation approval will be needed.

If none of these methods work, or if the part needed is no longer available, an owner can manufacture a part for use on his own airplane provided he has the data required to produce the part correctly.

See, it wasn't that hard, was it?

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