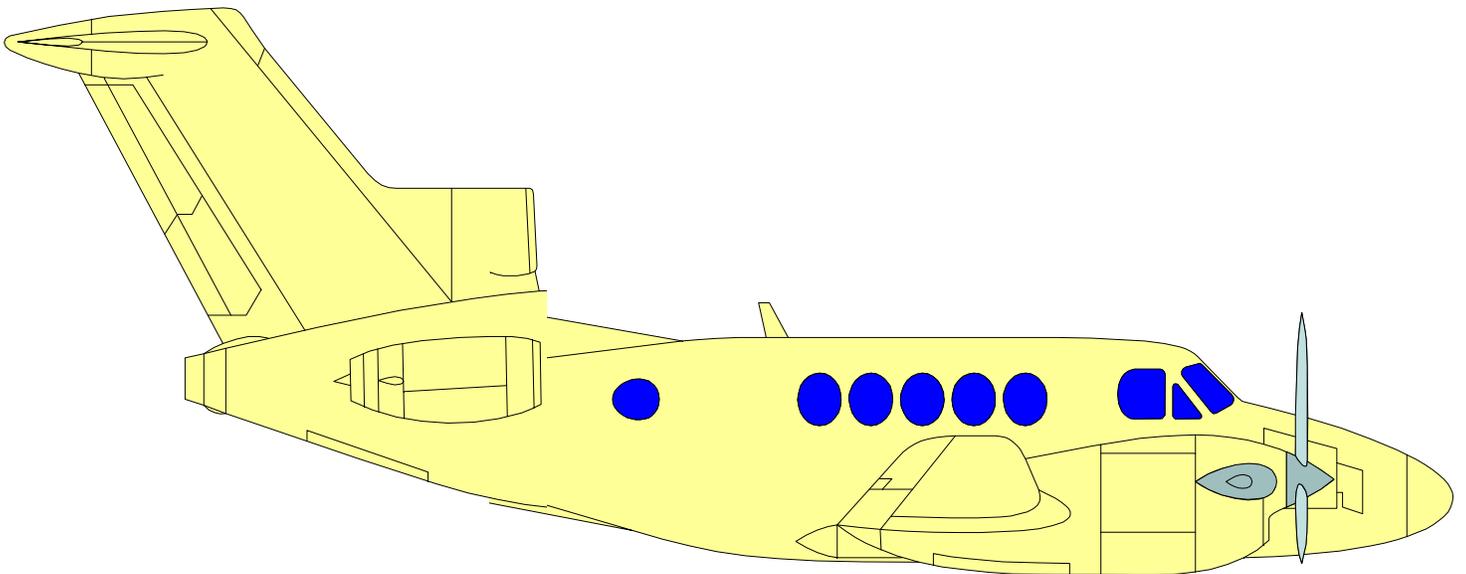


PLANE SENSE

AIRCRAFT ALTERATIONS



DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WESTERN REGION

PREFACE

How well acquainted are you with the aircraft alteration program? If you have been involved in altering aircraft, you have probably asked some of the following questions:

What is an aircraft alteration? How do you determine if an alteration is minor or major? Are the acceptable methods, techniques, and practices for aircraft alterations in AC 43.13-2 approved data? Are the items on a manufacturers equipment list considered major or minor alterations? What is approved data? Who is responsible for determining if an alteration is minor or major, or if the data is approved or unapproved? What kind of alteration requires a STC (Supplemental Type Certificate)? What kind of alteration can be "field approved" on a Form 337? Who can grant a "field approval?" How many kinds of field approval are there? Why will one district office give certain field approvals and another office refuse to approve similar alterations? Which regulations are applicable to aircraft alterations? What is the correct procedure for obtaining the various alteration approvals? What are the differences between a "one aircraft only alteration" approval, a "one aircraft only data" approval, and approval for "duplication by original modifier?"

The purpose of this publication is to answer those questions and in so doing accomplish the following objectives:

1. Improve communications between aircraft owners, repair stations, aviation mechanics, I.A.s, FAA maintenance inspectors, and FAA aerospace engineers, regarding aircraft alterations.
2. Expedite the aircraft alteration approval process.
3. Improve the judgmental process of evaluating aircraft alterations in accordance with the Federal Aviation Regulations.
4. Prevent aircraft accidents and incidents relating to aircraft alterations.

This information is a collective review of pertinent requirements and procedures relating to aircraft alterations for educational purposes only. The material should be useful to aviation mechanics, repair station personnel, FAA maintenance and avionics inspectors and engineering and manufacturing personnel. It is not regulation and does not constitute a legal interpretation of the regulations. If you have any questions regarding the rules and procedures mentioned herein, we suggest that you contact your local FAA Flight Standards aviation maintenance inspector for advice and counsel.

PLANE SENSE ABOUT AIRCRAFT ALTERATIONS

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SECTION I

WHY ALL THE CONFUSION?

Anyone who has ventured very far in altering modifying, or changing an aircraft, or any type certificated product or part, has been confronted with rules, procedures, and terminology that may have been very confusing. Even the mechanic who doesn't want to become involved in any alteration that has not been previously approved oftentimes becomes perplexed with whether an alteration is minor or major or whether certain data is approved or not approved. The aircraft alteration program is a much misunderstood one.

There are two primary reasons for the misunderstanding and resulting confusion:

1. The innumerable variety of alterations that may be performed on a wide variety of aircraft that range from the very simple to the most complex design.
2. The wide range of training, experience, ingenuity, fortitude, technical expertise and competence of the individual mechanics, inspectors and engineers who are involved in the design, approval, performance, and approval for return to service of major alterations.

For example, the installation of a small radio antenna on a Cessna 150 aircraft would be a very simple alteration that any airframe mechanic could easily accomplish. However, to install that same antenna on a pressurized, high performance jet aircraft would be a complex alteration requiring more technical knowledge.

Between the two extremes of the very simple and the most complex, (aircraft and/or alterations) there is a broad range of degree and nature of complexity. Making decisions on alterations that fall at each end of the complexity range is as easy as discerning black from white. However, there is a broad gray area in the center of the spectrum in which decision making is based strictly upon personal judgement ability. We hope to narrow that gray area by improving judgement ability with this presentation. The complexities of the alteration program make it impossible to give solutions in this presentation to all problems that may be encountered when altering aircraft. Don't hesitate to call on your FAA maintenance inspector for advice and counsel whenever you need help in the decision making process.

To better understand the current FAA alterations approval program, we need to know a little of the background on why and how it evolved. To begin with, we should all be aware of the fact that aircraft alterations are essentially an engineering and manufacturing function in which maintenance personnel have necessarily become involved. Before World War II, there were relatively few aircraft and correspondingly few alterations. After the war, many military surplus aircraft were bought by the aviation industry and converted or modified for use in civil aviation. In the 1950's civil aircraft became more complex and more sophisticated equipment became available for them. Since aircraft alterations are actually a change in the type design of a product, all applicants for original alteration approvals were required to either obtain a new type certificate or, depending on the nature of the change, a supplemental type certificate. This required submittal of sufficient data for engineering analysis of the project. The limited staff of FAA engineering quickly became swamped with applications for STC's that oftentimes contained inadequate data for proper analysis. Aviation mechanics who became involved in alterations jokingly remarked, "When the paper work equals the empty weight of the aircraft, you may have sufficient data to obtain a STC." By the mid 1950's the alteration approval program became so bogged down that numerous aircraft were grounded for weeks or months while waiting for appraisal, inspections, and tests. The larger the backlog of alteration projects became, the more the complaints mounted from irate airplane owners and operators.

Consequently, the CAA (FAA's predecessor) reevaluated the alteration policies and procedures in the mid 1950's. The Aircraft Engineering Division and Aircraft Maintenance Division coordinated their efforts to establish a new, more practical approach to aircraft alteration approval.

Simply stated, the new alteration approval procedure, which is the one currently being utilized by the FAA, is as follows:

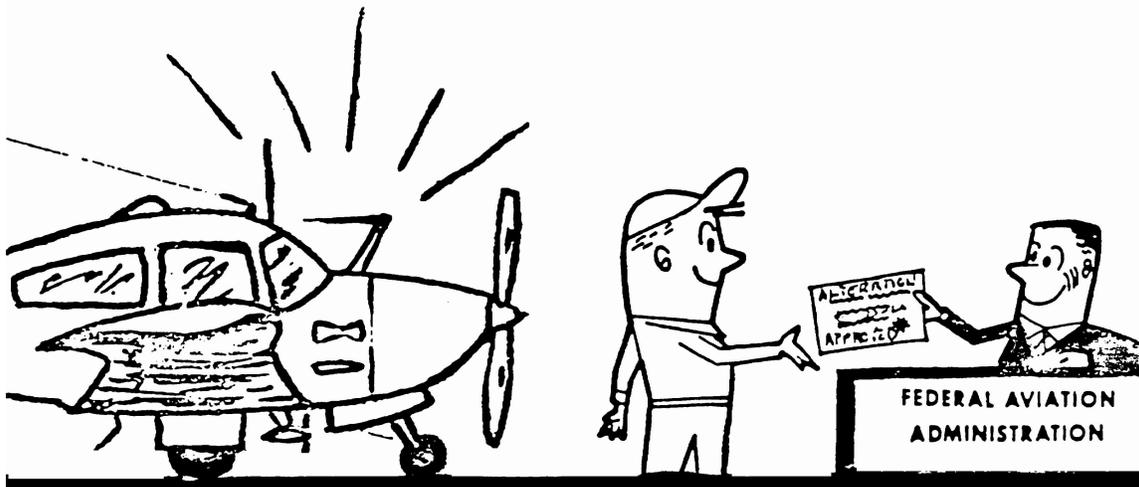
1. To avoid unnecessary rework and save time, the proposed alteration data should be presented to an FAA maintenance inspector for evaluation before any work is started.
2. The FAA maintenance inspector makes the determination of how the proposed alteration will be handled.

3. If the FAA inspector determines the proposed alteration is within the guidelines established for a field approval, it will be handled locally.
4. Where the alteration requires a STC, the applicant is furnished an application and guidelines for its use and is advised to submit his data to the appropriate FAA Regional Aircraft Engineering Branch.

In many cases the services of an FAA Designated Engineering Representative (DER) may be beneficial to the applicant. These self employed engineers have expertise in specific areas where their advice can save time and expense in obtaining FAA approval. Advisory Circular 183.29-IJ (or later supplement) includes the names, addresses, and designation areas of these consultants. A copy of this advisory circular may be obtained from the U. S. Dept. of Transportation, Publications Section, TAD 443.1, Washington, D. C. 20590, or examined at a General Aviation or Flight Standards District Office.

5. When FAA approved data for an alteration has been identified, an A&P mechanic with inspection authorization or appropriately rated FAA approved repair station may perform, inspect and approve the modification for return to service.

The certification procedures for altering aircraft will be covered in more detail in another section.



SECTION II

WHAT IS A MAJOR ALTERATION?

There tends to be an inherent, inclination to confuse the word major with the word approved when discussing aircraft alterations. This section is concerned primarily with the decision making process of major alteration vs. minor alteration, not whether an alteration is approved or not approved. The term "approved" will be discussed in Section III.

What is an alteration? The dictionary defines an "alteration" as: "The act, process, state or result of altering." "To make different without changing into something else."

To alter also means to modify or to change in some particular way. The FAA rules pertaining to airworthiness standards and certification of products refer to an alteration as a change in type design. But before we go further into rules with which most aviation mechanics may not be familiar, let's take a look at the rule with which mechanics should be most familiar.

FAR 43 MAINTENANCE, PREVENTIVE MAINTENANCE, REBUILDING, AND ALTERATION.



FAR 43.3, titled "Persons Authorized to Perform Maintenance, Preventive Maintenance, Rebuilding, and Alterations," contains the following statement. "Those items, the performance of which is a major alteration, a major repair, or preventive maintenance, are listed in Appendix A."

AIRFRAME MAJOR ALTERATIONS

Appendix A (a)(1) states: "Alterations of the following parts and alterations of the following types, when not listed in the aircraft specifications issued by the FAA are airframe major alterations."

This statement immediately eliminates certain items from being considered a major alteration. Any item that is listed on an aircraft specification, powerplant specification, or propeller specification, and is installed or performed in accordance with the data indicated on the specification, or other acceptable data, is considered to be a minor alteration. Regardless as to how major an alteration appears to be, if it is listed on one of those FAA specifications, it is still a minor alteration and requires only a maintenance record entry in accord with F.A.R 43.9(a) for approval for return to service.

Continuing with FAR 43, Appendix A (a)(1), "Alterations of the following parts and alterations of the following types, when not listed in the aircraft specification issued by the FAA, are airframe major alterations.

- (i) Wings.
- (ii) Tail surfaces.
- (iii) Fuselage
- (iv) Engine mounts.
- (v) Control system.
- (vi) Landing gear.
- (vii) Hull or floats."

If taken literally at face value, any alteration to an airframe not listed on an aircraft specification would be a major alteration. Surely there must be some minor alterations that can be performed on these components that are not listed on an aircraft specification.

- (viii) Elements of an airframe including spars, ribs, fittings, shock absorbers, bracing, cowlings, Fairings and balance weights.

What part of an airframe does this exempt? This definition of airframe major alterations is so broad as to appear to be all encompassing. However, some of the remaining items in Appendix A become more specific.

- (ix) Hydraulic and electrical actuating system of components.
- (x) Rotor blades.

Rotor blades are extremely critical components to an airframe and very complex in nature. Therefore, any alteration to a rotor blade would likely be considered major in nature to most aviation mechanics.

- (xi) Changes to the empty weight or empty balance which result in an increase in the maximum certificated weight or center of gravity limits of the aircraft.

This is the only alteration listed thus far that has not been, broad in scope and difficult to specifically identify. If approved maximum certificated weight or approved C.G. limits are exceeded, it is a major alteration. This will be discussed later in more detail.

(xii) Changes to the basic design of the fuel, oil, cooling, heating, cabin pressurization, electrical, hydraulic, de-icing, or exhaust systems."

Is even the smallest change to an aircraft system a major alteration? This implies that the rerouting of an electrical wire would be a major alteration. It should be obvious by now that more specific detail is needed than is provided here to determine if a particular change to an airframe is a major alteration.

(xiii) Changes to the wing, or to fixed or movable control surfaces which affect flutter and vibration characteristics.

If all the items preceding this one are considered in a broad sense as major alterations, there would be no need to include this one. Any changes to wings were implied in item (i) and control systems were mentioned in item (v). This item, however, is clarifying in nature and gives guidance that only the weight and balance item has provided thus far. Any alteration, which affects flutter and vibration characteristics, should be considered a major alteration.

POWERPLANT MAJOR ALTERATIONS



The items listed under powerplant major alterations and propeller major alterations in FAR 43, Appendix A are more specific in nature and leave little room for speculation about whether they should be considered major alterations.

(2) Powerplant major alterations. The following alterations of a powerplant when not listed in the engine specifications issued by the FAA, are powerplant major alterations:

(i) Conversion of an aircraft engine from one approved model to another, involving any changes in compression ratio, propeller reduction gear, impeller gear ratios or the substitution of major engine parts which requires extensive rework and testing of the engine.

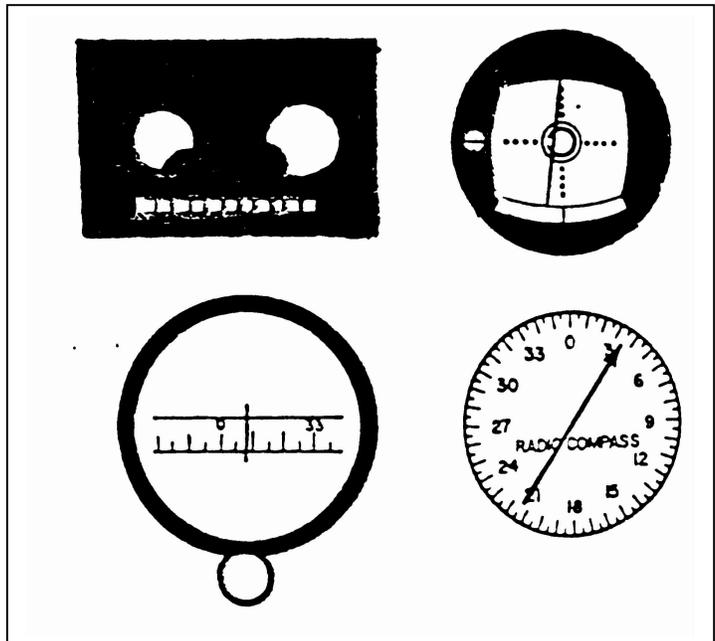
- (ii) Changes to the engine by replacing aircraft engine structural parts with parts not supplied by the original manufacturer or parts not specifically approved by the Administrator.
- (iii) Installation of an accessory which is not approved for the engine.
- (iv) Removal of accessories that are listed as required equipment on the aircraft or engine specification
- (v) Installation of structural parts other than the type of parts approved for the installation.
- (vi) Conversions of any sort for the purpose of using fuel of a rating or grade other than that listed in the engine specifications.

(3) Propeller major alterations. The following alterations of a propeller when not authorized in the propeller specifications issued by the, FAA are propeller major alterations!

- (i) Changes in blade design.
- (ii) Changes in hub design.
- (iii) Changes in the governor or control system.
- (iv) Installation of a propeller governor or feathering system.
- (v) Installation of propeller de-icing system.
- (vi) Installation of parts not approved for the propeller

APPLIANCE MAJOR ALTERATIONS

The following description of appliance major alterations differs somewhat from the description of airframe, powerplant, and propeller alterations. There are no FAA specifications on appliances. Changes to appliances that are made in accordance with the appliance manufacturer's recommendations or an airworthiness directive are minor alterations. This does not say that all airworthiness directives on airframes, etc. are minor alterations.



- (4) Appliance major alterations. Alterations of the basic design not made in accordance with recommendations of the appliance manufacturer or in accordance with a FAA Airworthiness Directive are appliance major alterations. In addition, changes in the basic design of radio communication and navigation equipment approved under type certification or a Technical Standard Order that have an effect on frequency stability, noise level, sensitivity, selectivity, distortion, spurious radiation, AVC characteristics, or ability to meet environmental test conditions and other changes that have an effect on the performance of the equipment are also major alterations.

To those who do not have training and experience in radio communication and navigation equipment any alteration to this equipment would be considered a major alteration. If, for no other reason, the fact that we don't know, and we know we don't know, the effect on the things mentioned above would make it a major alteration.

If a person doesn't understand the technique involved or the effects that an alteration may have on airworthiness characteristics, the fact that he doesn't understand could make it a major alteration. Conversely, if a person has infinite knowledge and understanding of the product and the techniques involved, and knows it is not contrary to the airworthiness requirements, he may consider that same alteration a minor one

As mentioned heretofore, some of these descriptions of major alterations in FAR 43, Appendix A are very broad in nature. When this information was recodified from old CAM 18, a few words were changed that broadened these areas more than they originally were.

The following words preceded the listing of airframe components in the interpretation of airframe major alterations in CAM 18. "Major changes to the basic design or external configuration of any structural component such as: wings, tail surfaces, fuselage, etc."

To be practical, the foregoing interpretation should be used in conjunction with FAR 43, Appendix A to determine if a change to one of the airframe components is minor or major. This will allow you to quickly make a determination if the alteration is very simple and minor in nature. However many alterations will continue to fall in the broad gray area where a judgement must still be made as to whether they actually are a major change or not. More help is needed to make the determination.

That help is available in FAR 1, "Definitions and Abbreviations" Here is a definition of "major alteration" that should be used to help you analyze any particular alteration to determine if it is minor or major.

Major alteration" means an alteration not listed in the aircraft, aircraft engine, or propeller specifications-

- (1) That might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness; **OR**
- (2) That is not done according to accepted practices or cannot be done by elementary operations.

An analysis of this definition will reveal that it can be very helpful in reducing that broad gray area in the spectrum of the minor-major decision making process. The description of a major alteration in FAR 43 has already made it very clear that an alteration listed in the aircraft, aircraft engine, or propeller specification is a minor alteration.

What if the aircraft has an aircraft data sheet instead of a specification There is practically no equipment listed on data sheets. Are those items of equipment on the manufacturer's equipment list that comes with the aircraft considered to be minor or major alterations? And while discussing the matter, are those alterations in Advisory Circular 43.13-2, "Acceptable Techniques, Methods, and Practices for Aircraft Alteration, minor, or are they major? How about an alteration performed in accordance with an existing, STC, are they all major?

The incorporation of a STC on an aircraft is generally considered a major alteration because a STC approval is not required unless the alteration is a major change type design. The answer to all the rest of those questions is IT ALL DEPENDS ON AN ANALYSIS OF THE PARTICULAR ALTERATION BASED ON THE DEFINITION OF A MAJOR ALTERATION. With the exception of the items listed on a FAA specification, any alteration that might appreciably affect weight, balance, structural strength, performance, etc., is a major alteration.

The person performing the alteration is primarily responsible for making the determination of whether the alteration is minor or major. Knowing what the word "appreciably" means as used in the foregoing definition of major alteration should help a person make this decision.

There is no definition for "appreciably" in FAR 1 , so the dictionary definition will have to suffice. "Appreciably" means: "Enough to be Perceived or estimated or noticed. For example, "An appreciable difference in pay, Let's philosophize that example.

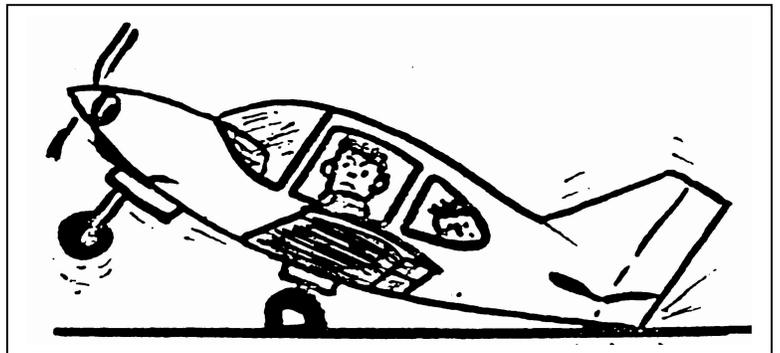
If an apprentice mechanic is paid \$50.00 per week and a doctor makes \$1000.00 per week, they, without doubt, have an appreciable difference in pay. Now, give both of them a 2% raise in pay. The mechanic is now making \$51.00 and the doctor is making \$1020.00. Is that an appreciable change in pay? In this inflated society, a 2% raise is not appreciable. However, with only \$50.00 per week salary, the mechanic might think that one dollar more is appreciable. That dollar may be more appreciable to him than the \$20.00 was to the doctor. Unless the doctor happened to be in financial straits because of the monthly payments he is making on that light twin airplane he bought a few months ago for transportation to and from Las Vegas. In that case, the \$20.00 may be appreciable to him. So, the word appreciable is a relative term that depends on the circumstances of the situation and individual involved. This same philosophy applies to aircraft alterations.

In other words, a paraphrased rendition of the major alteration definition might read as follows: A major. alteration is an alteration that, in your estimation, opinion, or judgement, based on your education, experience and expertise, might have a noticeable effect on, or produce a noticeable change in, the weight and balance, structural strength, performance, etc.

This should answer the question regarding the reason why certain alterations are handled as major alterations by some people while others may consider them minor. It would be nice to have a more standardized procedure; however, this is it until such time that the FAA distributes a precise listing of every conceivable major alteration for every aircraft flying. The possibilities of this happening is extremely remote because of the innumerable complexities involved.

APPRECIABLE EFFECT ON WEIGHT AND BALANCE

What kind of alteration would appreciably affect weight and balance? FAR 43, Appendix A gave us a clear, specific answer to this one. If the alteration results in a change of the empty weight or the empty weight C.G. that results in an increase in the maximum certificated weight or center of gravity limits of the aircraft it would be a major alteration.



Most modern aircraft have weight and balance loading charts or C.G. envelopes which show the allowable weight and C.G. limits under various loading conditions. If an alteration does not allow the weight or center of gravity to exceed the limits of the C.G. envelopes the alteration is a minor one as far as weight and balance is concerned.

When computing the weight and balance on a proposed alteration that will cause an increase in empty weight, care should be taken to assure that the maximum certificated weight is not exceeded when the aircraft is

loaded in accordance with the applicable airworthiness requirement (CAR 4(a), 4(b), FAR 23, 25, etc.). For your information, this requirement in FAR Part 23 "Airworthiness Standards for Normal, Utility, and Acrobatic Category Airplanes" is as follows:

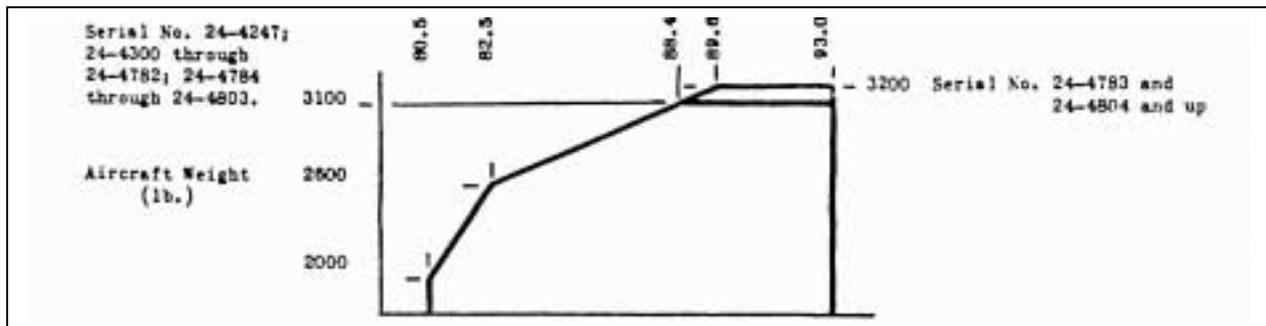
23.25 Weight limits.

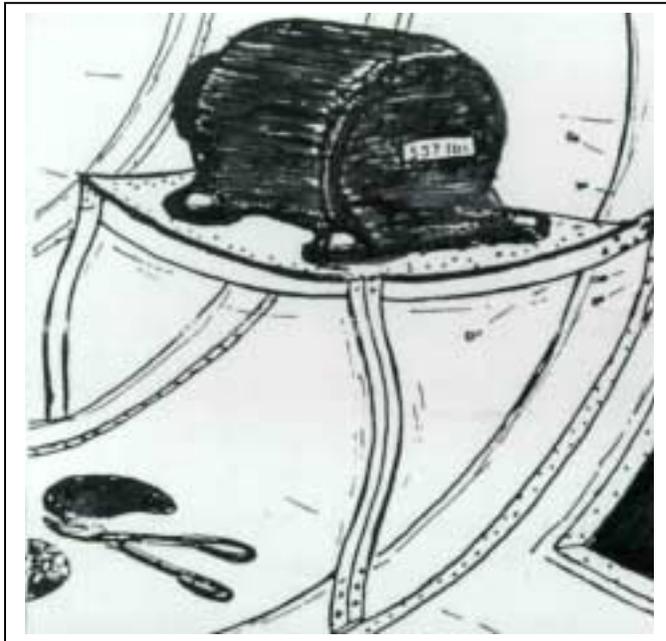
- (a) Maximum weight. The maximum weight is the highest weight at which compliance with each applicable requirement of this Part (other than those complied with at, the design landing weight) is shown. The maximum weight must be established so that it is assuming a weight of 170 pounds for each occupant of each seat for normal category airplanes and 190 pounds (unless otherwise placarded) for utility and acrobatic category airplanes not less than the weight with:
 - (i) Each seat occupied, oil at full tank capacity, and at least enough fuel for one-half hour of operation at-rated maximum -continuous power; or
 - (ii) The required minimum crew, and fuel and oil to full tank capacity.

If computations reveal that the weight limits or C.G. limits will be exceeded and the modifier wishes

to proceed with the alteration, it must be done in accordance with previously approved data or he must

apply for a Supplemental Type Certificate. Field approvals are not granted for extending weight or balance limits.





APPRECIABLE EFFECT ON STRUCTURAL STRENGTH

In determining whether a particular alteration will appreciably affect structural strength, there are some guidelines in FAR 43, Appendix A under Major Repairs, that can help in the decision making process. Alterations that involve any of the following may appreciably affect structural strength.

1. Alterations involving the strengthening, reinforcing, splicing, and manufacturing of primary structural members or their replacement, when replacement is by fabrication such as riveting or welding.

If the aircraft is being repaired because of damage to these structural members, these functions would be considered major repairs. It makes sense that if it becomes necessary to perform these functions during an alteration, the alteration would be a major alteration?

FAR 43, Appendix A contains a listing of primary structural members under "Major Repairs."

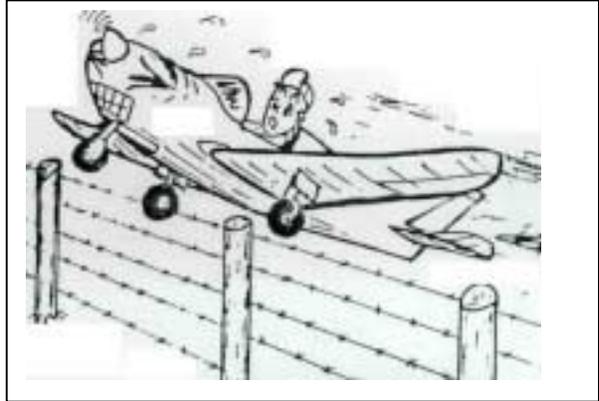
2. Alterations on non-pressurized aircraft that require cutting of metal or plywood stressed skin more than six inches in any direction.
3. Alterations that require drilling or cutting into any pressurized skin.
4. Alterations that require the making of additional seams or splicing of skin sheets.
5. Installation of equipment having an appreciable weight.
6. Replacement of fabric covering using other than the original types of materials and/ or fasteners.

Whatever your decision regarding major or minor alteration to aircraft structure, be sure to always put back as much structural strength as was removed. Advisory Circulars 43.13-1 and 43.13-2 contain acceptable methods, techniques, and practices that can be used to-strengthen or reinforce structure.

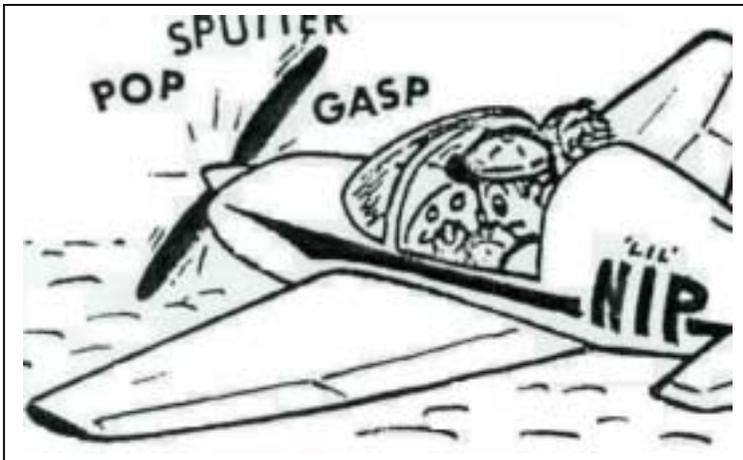
APPRECIABLE EFFECT ON PERFORMANCE

Any of the following might appreciably affect the performance of an aircraft.

1. Any change in the external configuration of the basic aircraft design.
2. Any change from the approved aircraft engine-propeller combination.
3. Any change that might appreciably affect the weight or balance.
4. Changes that may restrict or otherwise alter the operation of aircraft, powerplant or propeller controls.
5. Alteration to any system that may appreciably affect the operation of powerplant, propeller, landing gear, etc (exhaust system, fuel system, oil system, hydraulic system, environmental system, etc.).



Flight performance can be appreciably affected by changes that might appear to be very insignificant. For example, problems have been experienced with rib-stitch knots positioned along the top center of the rib instead of beside the rib as they were on the original type design of fabric covered wings. The substitution of braiser head rivets for flush rivets in wing skins might: appreciably affect flight characteristics and also the performance of a high performance aircraft.



APPRECIABLE EFFECT ON POWERPLANT OPERATION

The following powerplant alterations (in addition to those listed in Appendix A) might appreciably affect powerplant operation.

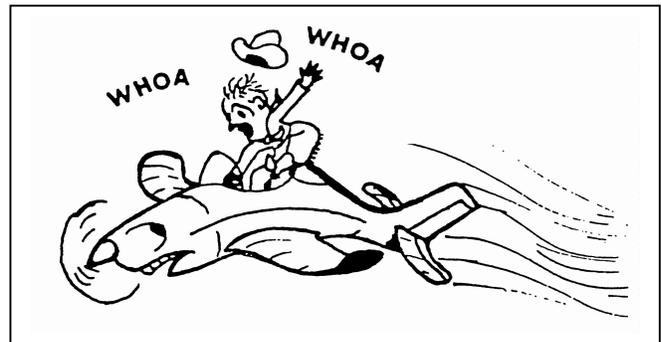
1. Change in cowling design.
2. Change in shape, size, position, or composition of engine air baffles.
3. Changes in exhaust system.

4. Major alterations to the propeller.
5. Fuel system changes that might affect fuel flow.
6. Changes in the engine oil system such as oil filter installations.
7. Changes that affect carburetor air induction.
8. Changes involving powerplant controls.

Any alteration that might cause the powerplant pressures, temperatures to exceed normal operating limits is a major alteration.

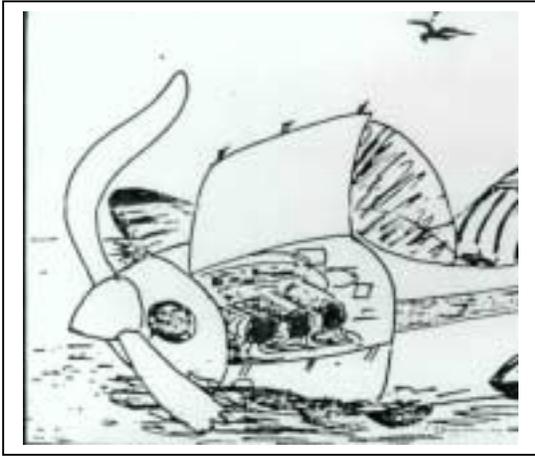
APPRECIABLE EFFECT ON FLIGHT CHARACTERISTICS

Any alteration that is apt to change the balance of a flight control might appreciably affect flight characteristics. Changes in the external configuration of fixed and movable control surface or of any surface forward of a flight control might affect the proper air flow around the control surface and cause flutter or vibration. A seemingly insignificant change in the location of, or type of, flight control surface drain has appreciably affected the flight characteristics of high performance aircraft.



Any one particular alteration might have appreciable affect on one or more of these airworthiness qualities. The affects on one may become a spin-off affect for others. For example, the weight and balance may have been affected in such a manner that fixed ballast was required in the very aft of the fuselage. The weight and installation of the fixed ballast may have appreciably affected the structural strength. The added weight in the extreme aft section of the fuselage might appreciably affect the flight characteristics during certain flight maneuvers. Analytical consideration should be given to all these qualities before determining that any specific alteration is minor or major.

OTHER QUALITIES AFFECTING AIRWORTHINESS



Other qualities that should be considered to determine if they might be appreciably affected are:

1. Ground or, water handling characteristics (wheels, brakes, struts, landing gears, floats, etc.).
2. Personnel and cargo accommodations (pilot's view, ventilation, crash worthiness, safety and emergency provisions, etc.)
3. Fire protection, aircraft and-powerplant.
4. Vibration and deterioration characteristics.
5. Functioning of required equipment.

Continuing the analysis of the major alteration definition Item #2 stated "That is not done according to accepted practices or cannot be done by elementary operations."

Whether or not an operation is elementary is another judgement-item that depends on the training, experience, and expertise of the individual making the judgement. What was elementary to Sherlock Holmes might have been rather complex to his sidekick Mr. Watson. A good "rule of to use in determining if a job is elementary or not is-if you have any problem making the decision-it isn't elementary and therefore is a major alteration.

An alteration that is not done in accordance with accepted practices is not only a major alteration but is an unapproved major alteration. If such an alteration is contemplated, the modifier should contact an FAA maintenance inspector and discuss it with him. FAR 43.13(a) states in part, "Each person maintaining or altering or performing preventive maintenance shall use methods, techniques, and practices acceptable to the Administrator."

Material from FAR 43, Appendix A, regarding major repairs has been discussed in this section as being helpful in determining if an alteration is major or minor. What is the difference between a major alteration and major repair? Here is the definition of "major repair" as given in FAR 1, "Definitions."

Major repair" means a repair-

- (1) That, if improperly done, might appreciably affect weight, balance, structural strength performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness

or

- (2) That is not done according to accepted practices or cannot be done by elementary operations.

The definitions are almost identical. The distinct differences are that an alteration changes the product and a repair restores it to a sound state. If the primary purpose of the work is to restore to a sound state, it is a major repair. If the primary purpose of the work is to alter the product, it is an alteration. Both, if they are major, are to be accomplished in accordance with approved data. When altering a product, the qualities and characteristics affecting airworthiness apply to the alteration. When performing major repairs, they are to be applied to the term "if improperly done." In other words, to properly analyze repairs that are not specifically identified in FAR 43, Appendix A, you would ask of those qualities affecting airworthiness: "If we goofed in doing the job, would it appreciably affect weight and balance, structural strength, etc.?"

This section would not be complete without assuring that the definitions of minor alterations and minor repairs are made perfectly clear. Here it is straight from FAR 1:

"Minor alteration" means an alteration other than a major alteration.

"Minor repair" means a repair other than a major repair.

A review of Section II may be in order if the above definitions are not perfectly clear!





The terms "acceptable" and "approved," as used in FAA publications have caused some stir. What do they mean and when is one or the other, or both, applicable to aircraft alterations? Is acceptable data approved data?

A word of caution before proceeding farther, do not get the words "major" and "minor" confused with the words "acceptable" and "approved." They are different breeds of words, even though one may relate to the other. The words should not be used interchangeably when discussing alterations. For example, major alterations must be done in accordance with approved data, but an alteration does not become a major alteration simply because the data is approved or unapproved.

"Approved," unless used with reference to another person, means approved by the Administrator. (FAR-1)

"Acceptable" means capable or worthy of being accepted: it can mean "barely adequate." (Webster's Dictionary).

With respect to aircraft alterations, the word "approved" refers to a FAA formal or official approval of a specific alteration for a specified certificated product.

"Acceptable methods, techniques, and practices" refers to generally accepted ways and means which may be used to accomplish the work involved.

Any person who does any work on a civil aircraft must use methods, techniques, and practices acceptable to the Administrator. (FAR 43.13(a))

A major alteration must be done in accordance with technical data approved by the Administrator before a mechanic with inspection authorization or FAA approved repair station may approve the aircraft or component for return to service. (FAR 65.95(a)(1); FAR 145.51)

ACCEPTABLE DATA

The following items are among those that are considered to be acceptable to the Administrator.

1. Advisory Circular 43.13-1, "Acceptable Methods, Techniques, and Practices-Aircraft Inspection and Repair."
2. Advisory Circular 43.13-2, "Acceptable Methods, Techniques, and Practices-Aircraft Alterations."
3. Aircraft, powerplant, propeller or equipment manufacturers overhaul manuals and service instructions.
4. AC 65-9, "A & P Mechanics General Handbook."
5. AC 65-12, "A & P Mechanics Powerplant Handbook."
6. AC 65-15, "A & P Mechanics Airframe Handbook."
7. Other methods, techniques, and practices that are generally accepted as aviation industry practice.
8. Data that is "approved" by the Administrator.
9. Applicable military tech orders and other service information.

APPROVED DATA

The following items are among those that are considered to be approved by the Administrator.

1. Type design data for type certificated products (manufacturer's drawings, specifications, and other required data).
2. Supplemental Type Certificate data.
3. Data specified on FAA Form 337 with FAA inspector's "field approval."
4. Delegation Option Authorization manufacturer's approved data.
5. Designated alteration station authorization approvals.
6. Airworthiness Directives.
7. Other specific approvals by authorized representatives of the Administrator (FAA aviation maintenance inspectors).

PRACTICAL EXAMPLES

1. Acceptable practices are not necessarily "approved." For example, AC 65-15, "A&P Mechanics Airframe Handbook" Chapter 3 on "Aircraft Fabric Covering" states: "A generally standard style and weight of dacron cloth has evolved for use as aircraft covering. It is a plain weave with a weight of about 3.7 oz./sq./ yd. This heavy-duty fabric has a tensile strength of approximately 148 lbs./in. and can be used, to replace Grade A cotton and linen fabrics." This does not say that dacron fabric has been approved for replacement of cotton fabric on all aircraft. It simply says that dacron has been found to be an acceptable replacement for cotton fabric. Many approvals have been granted for this type of major alteration, but this statement in AC 65-15 is not a general approval. Glass cloth covering and metal covering have also been found to be acceptable replacements for fabric covering, but that statement doesn't approve the replacement for all fabric covered aircraft. This type of approval will normally require the issuance of a STC.

2. The installation of an item of equipment, based on a previous approval must be performed in accordance with the methods, techniques, and practices used in the original approval or further approval may be required (with exception of minor deviations). A good example of this is quoted from the equipment list of a well known "Delegation Option Authorization" manufacturer: "A separate FAA approval must, be obtained if the following items are not installed per applicable Cessna drawings or accessory kit instructions."

3. Mechanics and other maintenance agencies may use AC 43.13-1 and 43.13-2 "Acceptable Methods, Techniques, and Practices" as approved data if the information therein is complete and compatible with the aircraft design, and results in work that complies with all applicable airworthiness requirements. For example:
 - (a) A mechanic is asked to install a simple radio and antenna on a BC-12-D Taylorcraft. He may review AC 43.13-2, Chapter 2, "Radio Installations" and Chapter 3, "Antenna Installations" ' and decide it Is a minor alteration. No FAA approval is required.

 - (b) A Beech Baron is brought to him for installation of a second VOR, DME, and transponder He decides it is a major alteration and believes the information in AC 43.13-2, Chapter 2 and Chapter 3 is sufficient to comply with the applicable airworthiness requirements for this aircraft. He should call his local FAA maintenance inspector and discuss the installation with him. The FAA inspector may advise him that he may use AC 43.13-2 as approved data for that particular installation. A mechanic with inspection authorization may approve it for return to service.

(c) A fan-jet Falcon comes into the shop for additional radio and antenna. A review of 43.13-2 reveals that this would not only be a major alteration, but the acceptable methods, techniques, and practices may not be sufficient to comply with all the applicable airworthiness requirements for this particular aircraft. Additional data may need to be presented to the local FAA inspector for FAA approval (STC or field approval). Approval should be obtained before work is accomplished.

Supplemental Type Certificates and FAA Forms 337 on which the FAA has granted "field approvals state the precise coverage of the, approval. For example:

(a) STC's may be issued for one aircraft only or for any number of makes, models, or serial numbers of aircraft, depending on the applicant's desires, the adequacy of the data submitted, and the nature of the change. If anyone wishes to incorporate the same change on an aircraft that is not covered by the STC, it may be necessary to apply for another STC (contact the local FAA maintenance inspector).

(b) "Field approvals" on FAA Form 337 may be granted for one aircraft only, or for duplication of the change on identical aircraft when accomplished by the original modifier. If anyone else wishes to make the same change on another aircraft not covered by the 337 field approval, it will be necessary for them to make application on another 337. Due to the practical nature of the "field approval" procedure for one aircraft only, the data contained on a Form 337 may not be sufficient for duplication on other aircraft. Contact the local FAA aviation maintenance inspector for advice and counsel.

Eliminate the communications gap between the FAA and the Aviation Industry! Talk it over before you alter! Use acceptable practices in all work. Use approved data for major repairs and major alterations.



SECTION IV
PROCEDURAL REQUIREMENTS FOR ORIGINAL ALTERATION APPROVALS

Part 21—Certification Procedures
Subpart A—General

§ 21.1 Applicability.

(a) This Part prescribes—

(1) Procedural requirements for the issue of type certificates and changes to those certificates; the issue of production certificates; the issue of airworthiness certificates; and the issue of export airworthiness approvals;

(2) Rules governing the holders of any certificate specified in subparagraph (1); and

(3) Procedural requirements for the approval of certain materials, parts, processes, and appliances.

For the purposes of this Part, the word "aircraft" means—

Federal Aviation Regulation Part 21, "Certification Procedures for Products and Parts" prescribes the procedural requirements for the issue of type certificates and changes to those certificates. An alteration to an aircraft, aircraft powerplant, or propeller is a change to the type certificate of that product. Any person who is interested in obtaining an original approval on a prototype alteration should be familiar with certain sections of Part 21.

Notice the similarity in the definition of a "major alteration," as discussed in Section II and a "change in type design" as specified in FAR Section 21.93.

21.93 Classification of changes in type design.

Changes in type design are classified as minor and major. A "minor change" is one that has no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product. All other changes are "major changes."

This clearly indicates that a major alteration is a major change in the type design of a product. What is the type design?

21.31 Type design.

The type design consists of:

- (a) The drawings and specifications necessary to show the configuration of the product concerned and the design features covered in the requirements of that part of this subchapter applicable to the product;
- (b) Information on dimensions, material, and processes necessary to define the structural strength of the product; and
- (c) Any other data necessary to allow, by comparison, the determination of the airworthiness [and noise characteristics where applicable] of later products of the same type.

In other words, any change in an aircraft that does not conform to the original drawings, specifications, structural information, or other data with which the manufacturer showed compliance with the applicable airworthiness requirements, is a change in type design, or an aircraft alteration.

What are the requirements for obtaining an approval of major changes in type design?

SUPPLEMENTAL TYPE CERTIFICATES AND "FIELD APPROVALS"

Although the following "quotes" from FAR 21 do not mention the term "field approval," the procedures for "field approvals" are primarily based on this section of the rules. The FAA Form 337 with a FAA "field approval" on it has been affectionately called a "poor man's STC." The "field approval" is essentially a substitute for a STC and is handled as such with a few practical exceptions in the approval procedure.

The reasons for the practical exceptions in the procedures are discussed in Section I, page 2 of this manual.

FEDERAL AVIATION AGENCY
MAJOR REPAIR AND ALTERATION
(Aircraft, Powerplant, Propeller, or Appliance)

INSTRUCTIONS: Print or type all entries. See FAR 41.417 FAR 41.419 Appendix B and AC 41.41-1 for instructions and disposition of this form.

1 AIRCRAFT MAKE CESSNA SERIAL NO 172-6980 MODEL 172
2 OWNER NAME (As shown on registration certificate) JOE I. FLY NATIONALITY AND ADDRESS (A) N2 ADDRESS (B) 290 W. PORDUN
3 FOR FAA USE ONLY

"FIELD APPROVAL"

4 UNIT IDENTIFICATION

Subpart E-SUPPLEMENTAL TYPE CERTIFICATES

21.111 Applicability

This subpart prescribes procedural requirements for the issue of supplemental type certificates.

For the practical purposes of this publication, you might add "and FAA field approvals," to FAR Section 21.111. The practical aspects of "FAA field approvals" will be discussed in relation to the STC requirements of Part 21 Subpart E.

21.113 Requirement of supplemental type certificate.

Any person who alters a product by introducing a major change in type design, not great enough to require a new application for a type certificate under Section 21.19, shall apply to the Administrator for a supplemental type certificate, except that the holder of a type certificate for the product may apply for amendment of the original type certificate. The application must be made in a form and manner prescribed by the Administrator.

Note that Section 21.113 refers to the altering of a product as a major change in type design, as previously discussed. Next, a person who is contemplating an alteration needs to know whether or not the alteration is great enough to require an application for a new type certificate.

21.19 Changes requiring a new type certificate.

Any person who proposes to change a product must make a new application for a type certificate if:

- (a) The Administrator finds that the proposed change in design, configuration, power, power limitations (engines), speed limitations (engines), or weight is so extensive that a substantially complete investigation of compliance with the applicable regulations is required;
- (b) In the case of a normal, utility, acrobatic, or transport category aircraft, the proposed change is:
 - (1) In the number of engines or rotors; or,
 - (2) To engines or rotors using different principals of operation.
- (c) In the case of an aircraft engine, the proposed change is in the principle of operation; or
- (d) In the case of propellers, the proposed change is in change is in the number of blades or principle of pitch change operation

If any of the foregoing changes are contemplated, the modifier must contact FAA Engineering in the Regional Office for further advice and counsel.

An application for a type certificate or STC must be made on FAA Form 8110-12 (formerly FAA Form 312).

Applications for "FA.A field approvals" are made on FAA Form 337, "Major Repairs and Major Alterations" FAA Advisory Circular AC 43.9 contains instructions for completion of FAA Form 337. The applicant should submit with the Form 337, all substantiating data and necessary descriptive data, including reference to the applicable rule sections and how each are to be complied with, stress analysis, test reports, sketches, or photographs as applicable. It would be wise for the applicant to submit the FAA Form 337 and substantiating data before the alteration is begun. This procedure may significantly reduce the time the aircraft will be out of service and prevent the possibility of having to perform any "rework" to comply with the FARs.

The applicant for a STC and the applicant that wishes to obtain "data approval" on a Form 337 "field approval" must submit the necessary data with the application, as mentioned above, to show compliance with applicable airworthiness requirements as described in FAR Section 21.115.

21.115 Applicable airworthiness requirements.

- (a) Each applicant for a supplemental type certificate must show that the altered product meets applicable airworthiness requirements as specified in paragraphs (a) and (b) of Section 21.101.
- (b) Each applicant for a supplemental type certificate must meet Section 21.33 and 21.53 with respect to each change in the type design.

The applicable airworthiness requirements are the airworthiness standards that a product must meet before a type certificate is issued. Some of the ones with which maintenance technicians should be familiar are:

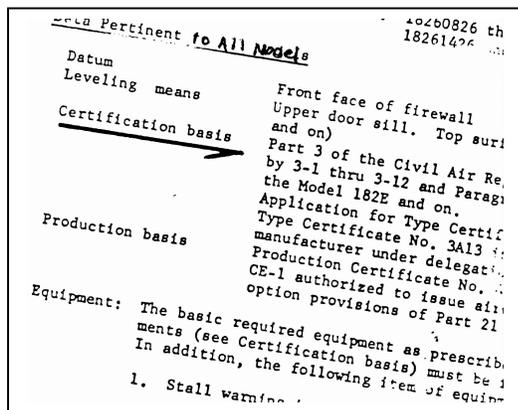
1. Civil Aeronautics Manual (CAM) 3 - "Airplane Airworthiness; Normal, Utility, and Acrobatic Categories."
2. CAM 4(a) - "Airplane Airworthiness."
3. CAM 4(b) - "Airplane Airworthiness Transport Category."
4. Federal Aviation Regulation (FAR) Part 23 - "Airworthiness Standards; Normal, Utility, and Acrobatic Category Airplanes."
5. FAR Part 25 - "Airworthiness Standards: Transport Category Airplanes."
6. Other CAMs and FARs cover the powerplant, propeller, helicopter, glider, and balloon airworthiness requirements.

Which requirement is applicable to which product?

21.101 Designation of applicable regulations.

- (a) Except as provided in [Sections 25.2 and 36.2,] of this chapter, an applicant for a change to type certificate must comply with either-
 - (1) The regulations incorporated by reference in the type certificate; or
 - (2) The applicable regulations in effect on the date of the application, plus any other amendments the Administrator finds to be directly related.

FAR 25.2 pertains to special retroactive requirements involving an increase in passenger loading capacity on transport category aircraft and FAR 36.2 pertains to special retroactive requirements for compliance with noise standards on certain aircraft.



The regulations incorporated by reference in the type certificate can be determined by referencing the "certification basis" on the aircraft, engine, or propeller specification or data sheet. If the aircraft is certificated under one of the Civil Air Regulations (CAM 3, 4(a), 4(b),) and those regulations are available sections may be used to provide the airworthiness standards for the alteration. If the old regulation is not available, or if the applicant chooses, he may refer to the new airworthiness standard that would apply to that aircraft if it were being type certificated today (FAR 23, 25, etc.). FAR 23 may be used for small aircraft originally certificated under Bulletin 7, CAM 3, or CAM 4(a). FAR 25 may be used for large aircraft originally certificated under CAM 4(a), 4(b), or old Bulletin 7. The only time the regulations referenced in the type certificate may not be used as a basis for compliance is when those regulations do not provide adequate standards with respect to the proposed change. FAR 21.101(b) covers this subject:

21.101(b) Designation of applicable airworthiness requirements.

- (b) If the Administrator finds that a proposed change consists of a new design or a substantially complete redesign of a component, equipment installation, or system installation, and that the regulations incorporated by reference in the type certificate for the product do not provide adequate standards with respect to the proposed change, the applicant must comply with:
- (1) The applicable provisions of this subchapter, in effect on the date of the application for the change, that the Administrator finds necessary to provide a level of safety equal to that established by the regulations incorporated by reference in the type certificate for the product; and
 - (2) Any special conditions, and amendments to those special conditions, prescribed by the Administrator to provide a level of safety equal to that established by the regulations incorporated in the type certificate for the product.

When alterations of the nature described in 21.101(b) are incorporated on older aircraft, it may be necessary to perform special or additional inspections and tests not provided in the newer regulations in order to determine that the aircraft still meets the same level of safety as provided in the original airworthiness requirement. This may sound incredible, but the advancements in aviation technology over the years have brought about new designs, exotic equipment and sophisticated systems that were not in existence at the time of original certification of some of the older aircraft. This type of alteration on older aircraft will generally require FAA engineering approval.

Advisory Circular AC 20-33, "Technical Information Regarding Civil Aeronautics Manuals 1,3, 4(b), 5, 6, 7, 8, 9, 10, 13, and 14," gives advice that can be very helpful. It advises us that the policy information contained in those Civil Aeronautics Manuals may be used in conjunction with specific sections of the FARs which correspond with the sections of the CARs to which the policies are applicable.

CAM policies provide detailed technical information on acceptable methods of complying with the regulations. These policies can be very helpful in substantiating compliance with the CARs and FARs in the alteration data.

Civil Aeronautics Manuals should not be discarded because the rules contained therein, and the accompanying policies, will continue to apply to products which have been certificated thereunder as long as those products are in existence.

FAR 21.115, "Applicable Airworthiness Requirements," also mentions that each applicant for a STC must meet 21.33 and 21.53 with respect to each change in the type design. FAR 21.33 prescribes inspection and test requirements and FAR 21.53 requires a statement of conformity. Let's take a look at 21.33:

21.33 Inspection and tests.

(a) Each applicant must allow the Administrator to make any inspection and, in the case of aircraft, any flight and ground tests necessary to determine compliance with the applicable requirements of the Federal Aviation Regulations. However unless otherwise authorized by the Administrator:

(1) No aircraft or part thereof may be presented to the Administrator for tests unless compliance with paragraphs (b)(2) through (b)(4) of this section has been shown for that aircraft or part thereof; and

(2) No change may be made to an aircraft or part thereof between the time that compliance with paragraph (b)(2) through (b)(4) of this section is shown for that aircraft or part thereof and the time that the aircraft or part thereof is presented to the Administrator for tests.

- (b) Each applicant must make all inspections and tests necessary to determine-
- (1) Compliance with the applicable airworthiness (and aircraft noise) requirements;
 - (2) That materials and products conform to the specifications in the type design;
 - (3) That parts of the products conform to the drawings in the type design; and
 - (4) That the manufacturing process, construction and assembly conform to those specified in the type design.

The applicant for a STC will be advised by FAA Engineering and Manufacturing personnel regarding the inspections and tests required after they have reviewed the proposed design changes. The extent of the inspection and tests for "field approvals" depend on the nature and complexity of the change, the applicable sections of the airworthiness requirements involved, the expertise of the modifier and the FAA maintenance inspector involved, and the adequacy of the data submitted with the FAA Form 337.

The procedural requirement in FAR 21.33 will not normally be followed for "field approvals" but the principles involved will be considered in every case. If the data submitted with the FAA Form 337 describes the alteration in sufficient detail, including the inspections and tests that will be performed by the modifier to substantiate compliance with the applicable FAR, a "field approval" for one aircraft only may be granted by the FAA maintenance inspector based entirely on the examination of the data only.

If the data submitted with the FAA Form 337 is not sufficient and the necessary inspections and tests are not specified, the FAA maintenance inspector may recommend changes and/or additions and suggest that reapplication be made; or, he may, at his own discretion, make arrangements with the applicant to perform the necessary inspections and witness the necessary tests to substantiate compliance with the applicable airworthiness requirements himself. If the inspections and tests are satisfactory, he may grant a "field approval" of the alteration, for that one airplane only, based on his own physical inspection and observation of demonstrations and tests.

If the data presented with the FAA Form 337 is in sufficient detail and the inspections and tests necessary to substantiate compliance with the applicable airworthiness requirements are adequately specified to allow the original modifier to duplicate the alteration on other identical aircraft make and model, a "field approval" may be granted to allow the original modifier to duplicate the alteration on other identical aircraft.

The "duplication on identical aircraft" type of field approval may entail a certain amount of inspection and test by the FAA maintenance inspector, depending on the nature and complexity of the particular alteration.

STATEMENT OF CONFORMITY

The applicant for a STC must submit a statement of conformity to FAA Engineering and Manufacturing for each aircraft or part presented for tests. Unless authorization has been given to the applicant to forego the tests required by 21.33(a), the conformity statement will certify that those tests have been conducted.

The statement of conformity on "field approvals" is included in Item #6 of the FAA Form 337. The mechanic, repair station, or manufacturer, accomplishing the alteration signs the conformity statement on the Form 337.

This statement certifies that the alteration was made in accordance with the Federal Aviation Regulations.

The approval for return to service on the Form 337 is a secondary statement of conformity by an authorized individual certifying that he has inspected the alteration and found that it complies with the approved data and the applicable FARs.

21.117 Issue of supplemental type certificates.

- (a) An applicant is entitled to a supplemental type certificate if he meets the requirements of Sections 21.113 and 21.115.
- (b) A supplemental type certificate consists of-
 - (1) The approval by the Administrator of a change in the type design of the product; and
 - (2) The type certificate previously issued for the product.

This rule does not give the holder of a STC any rights whatever to the original type certificate. It simply means that the approval of the change doesn't stand alone. The change, when incorporated on the product for which the type certificate was originally issued, becomes the STC. In other words, the type certificate plus approved change in type design equals a supplemental type certificate. It should be easy to discern from this regulation why a "field approval" alteration on a FAA Form 337 is sometimes referred to as a substitute STC.

The privileges granted to the holder of a STC differ somewhat from the privileges of the holder of a field approval:

21.119 Privileges.

The holder of a supplemental type certificate may-

- (a) In the case of aircraft, obtain airworthiness certificates;
- (b) In the case of other products, obtain approval for installation on certificated aircraft; and,
- (c) Obtain a production certificate for the change in the type design that was approved by that supplemental type certificate.

The holder of a "field approval", on a FAA Form 337 may:

- (a) In the case of a "one aircraft only" "Data Approval," have that alteration performed, inspected, and tested in accordance with that data by qualified persons and approved for return to service by an A & P mechanic with inspection authorization or appropriately certified and rated FAA approved repair station.
- (b) In the case of a "one aircraft only" "Alteration Approval", have that alteration performed, inspected, tested, and approved for return to service as authorized and directed by the FAA maintenance inspector who approves the alteration.
- (c) In the case of a "duplication on identical aircraft data approval," the original modifier may duplicate the alteration on identical aircraft make and model in accordance with the approved data and have the aircraft approved for return to service by an A & P mechanic with inspection authorization or an appropriately certificated and rated FAA approved repair station.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

MAJOR REPAIR AND ALTERATION
frame, Powerplant, Propeller, or Appliance)

See FAR 43.9, FAR 43 Appendix B, and A...

MODEL PA-50-100
NATIONALITY AND REGISTRATION N111JH
ADDRESS (As shown on registration certificate)
465 Meandering Road
Big Town, California

MAKE Piper
SERIAL NO. 50-101
NAME (As shown on registration certificate) John J. Jones

3. FOR FAA USE ONLY
The data identified herein complies with the applicable airworthiness requirements and is approved for duplication on identical aircraft make, model, and altered configuration when accomplished by the original modifier.

Signature of FAA Inspector *Ima M. Sactor*
Date FEB 1, 74
4. UNIT IDENTIFICATION WE-6ADD-1

MAKE SERIAL NO. ***** (As described in item 1 above) *****

SECTION V DETERMINING COMPLIANCE WITH APPLICABLE
AIRWORTHINESS REQUIRMENTS

When applying for an original alteration "data approval," the applicant should submit a Form 337 with sufficient data to substantiate compliance with all applicable airworthiness requirements. Each rule section applicable to the alteration should be cited and a description of how the applicable rules are complied with should be given. Any necessary test reports, stress analyses, sketches, or photographs to help substantiate compliance should also be with the file.

Section IV described how to determine the applicable airworthiness requirements for a particular aircraft, (CAM 4(a), 4(b), 3; FAR 23, 25). How do you determine which rule sections in the CAM or FAR are applicable to the particular alteration?

Each alteration must be carefully analyzed to determine what affect it might have on any of the airworthiness qualities covered in the applicable airworthiness requirement.

Most field approvals relate to equipment installations. With this in mind, let's look into the applicable airworthiness requirements of a Part 23 aircraft and determine what the applicable rule sections are concerning equipment installations.

The general requirements for equipment installations is a good place to start.

SUBPART F - Equipment

General

23.1301 Function and installation.

- (a) Each item of installed equipment essential for safe operation must-
 - (1) Be of a kind and design appropriate to its intended function;
 - (2) If appropriate, be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors;
 - (3) Be installed according to limitations prescribed for that equipment and in compliance with 23.1431; and
 - (4) Function properly when installed.
- (b) Whenever necessary, additional equipment that is installed as prescribed in the operating rules of this chapter, must meet the requirements of this section.

The items of equipment required by Part 23 and those items required by the operating rules (FAR 91, 135, etc.) are considered to be essential for safe operation. To show compliance with 23.1301, the alteration data should:

- (1) Describe the kind and design of the equipment.
- (2) Describe placards and markings that may be required as to identification, function, operating limitations, etc.
- (3) Describe any prescribed limitations for the equipment installation in a statement proclaiming compliance with those limitations.
- (4) If the equipment is electronic in nature, there should be a statement affirming compliance with 23.1431.

23.1431 Electronic equipment.

Radio equipment and installations must be free of hazards in themselves, in their method of operation, and in their effects on other components.

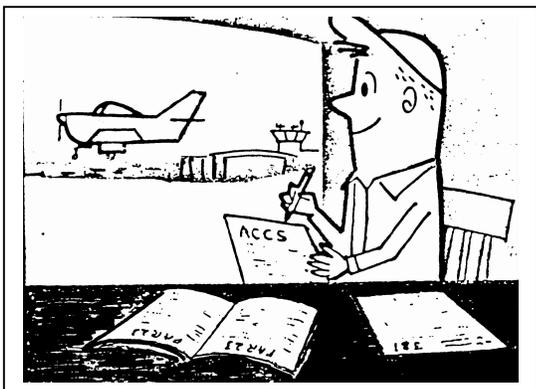
- (5) Describe how the equipment will be functionally tested or inspected after installation to determine that it functions properly.

The functional check may be based on the functional requirements for the equipment as prescribed in the operating rule (91.33, 135 Subpart E, etc.). FAR Part 23 requires only an airspeed indicator, an altimeter and a magnetic direction indicator, in regards to flight and navigation instruments; however, if other equipment is installed in a Part 23 aircraft, that equipment installation must also meet the requirements of the applicable sections of Part 23.

The general rules of section 23.1301 are only the beginning of the rules that should be considered when installing equipment in a Part 23 aircraft. The fact is, other rule sections must be referenced to comply with this general rule requirement.

Reviewing the rules to find all sections that are applicable to a particular alteration is no small task. If the rules are diligently searched out, as they should be, it could take many hours and much effort. To save time and effort in this regard, the FAA aviation maintenance inspectors have been issued "Airworthiness Compliance Check Sheets" to use as a guide to determine which rules are applicable to many of the alterations for which "field approval" may be granted.

AIRWORTHINESS COMPLIANCE CHECK SHEETS (ACCS)



The airworthiness compliance check sheets are not approved data. They are precisely what they are called—check sheets. They are to be used as a guide only and should not be referenced as approved data.

Appendix B of this manual contains a listing of the CCS that are available, and a copy of ACCS #30, "Instrument Installations- Adding Instruments, FAR 23 Aircraft," for your information. The ACCS are not available through normal G.P.O. distribution channels. If you are contemplating one of the alterations listed, you may contact, your local FAA aviation maintenance inspector who may make a copy of the particular ACCS available to you.

The ACCS are grouped into four broad chapter headings for powerplant, airframe, radio and electrical, and instruments.

The data in the ACCS reflects the requirements of FAR 23 and CAM 3 (whichever is applicable) in effect on the date of issuance of the ACCS. It may be applied to aircraft type certificated prior to this date with exception of transport (large) aircraft certificated in accordance with CAR 4(a)T.

Use these guidelines to insure that other sections of the regulations, not specific to the modification, are not affected. Caution should also be used to determine that the modification is compatible with previous modifications and the original type design.

The current regulations should also be reviewed for any applicable rule changes which may affect the alteration.

There are four main headings under which compliance with the applicable regulations should be checked:

- (1) Structural requirements.
- (2) Hazards to the aircraft or its occupants.
- (3) Operating aspects.
- (4) Detail design standards.

The ACCS first lists the rule sections that may be applicable to the particular alteration. A general statement of instruction regarding the subject usually follows the rules listing. Keep in mind that the ACCS was written for the FAA maintenance inspector's guidance and evaluate the instructions accordingly. ACCS #30 in Appendix B contains the following statement:

"Added instrument installations which are the same as those made by the airframe manufacturer or other installations which are already approved, may be accepted without further investigation. On other installations, the following points should be checked to determine that the installation is satisfactory."

The phrase, "may be accepted without further investigation," simply means that installations of that type may be approved by the FAA inspector without further substantiation. For example, if the inspector has given a previous "one aircraft only field approval" on an instrument installation in the same make and model aircraft and the data on another FAA Form 337 is essentially the same, he may approve it without further investigation.

In a similar manner, the maintenance technician may, in his evaluation of a particular alteration in accordance with Sections II and III of this manual, decide that an alteration is minor or major. If major and approved data is available, he may handle it as a major alteration without seeking additional approval. This is not to imply that a "one aircraft only data approval', contains sufficient data to be duplicated and called "approved data by a mechanic on any other aircraft. Remember that "approved" as used in the FARs means approved by the Administrator.

The checklist portion of the ACCS is presented in the form of questions. The questions, in most cases, simply ask if the particular rule has been complied with. The data that is submitted in answer to the questions should explain how the rule is being complied with on that particular installation. There may be many acceptable ways and means to comply with a rule. What the inspector wants to know is; How is it being done on this aircraft?

Some alterations may require the services of a stress analyst or other engineering talent. The modifier may find it advantageous to employ an appropriately rated Designated Engineering Representative (DER) to assist in substantiating compliance with the FARs.

We urge you again to contact your local FAA maintenance inspector before you start altering an aircraft. He may assist you by furnishing a copy of an ACCS or seeking the advice and counsel of FAA Engineering regarding technical problems that may be encountered.

SECTION VI

SUMMARY OF FAA ALTERATION APPROVAL PROCEDURE

1. When a major alteration is proposed for which there is not previously approved data available, the proposed alteration data should be presented to an aviation maintenance inspector at the nearest FAA Flight Standards, General Aviation, or Air Carrier district office.
2. The FAA maintenance inspector will make the determination that a supplemental type certificate is necessary, or that the alteration may be handled as a field approval. (See Appendix A for representative list of alterations which generally will require engineering approval.)
3. If the alteration requires a STC, the inspector will explain why, furnish the applicant an application for a STC, advise him to attach all supporting data and send it directly to the Regional Aircraft engineering office. The applicant should not proceed with the alteration prior to determining that the project is feasible.
4. If the maintenance inspector determines that the proposed alteration does not require a STC but he is not thoroughly familiar with all aspects of the alteration or has any doubt about its expected airworthiness, he will seek coordination and assistance from engineering, operations, or other technical personnel to the extent necessary to enable him to reach a clear decision before granting or denying approval. (Appendix A contains a list of alterations which may require engineering assistance due to the nature of the proposed change).
5. If the inspector determines that the proposed major alteration is airworthy, he will grant a field approval. The airworthiness determination is based on whether or not the proposed alteration may reasonably be expected to result in safe operation of the aircraft and conforms to the requirements of the applicable Federal Aviation Regulations.
6. The maintenance inspector may grant any one of three different types of "field approvals" depending on the completeness and quality of data submitted.
 - (a) Approval by examination of data for one aircraft only.
 - (b) Approval by physical inspection demonstration, testing, etc., for one aircraft only.
 - (c) Approval by examination of data and physical inspection, demonstration, testing, etc., for duplication on identical aircraft when accomplished by original modifier.
7. After FAA data/alteration approval, the alteration may be completed, with appropriate inspections and tests being conducted as specified, and an A & P mechanic with inspection authorization or an appropriately rated repair station may perform the conformity inspection and approve the work for return to service.

APPENDIX A

REPRESENTATIVE LIST OF ALTERATIONS WHICH GENERALLY WILL REQUIRE ENGINEERING APPROVAL (STC). The following are examples of typical changes which normally require engineering evaluation and approval:

- a. Increase in gross weight and/or changes in center of gravity. range;
- b. Installation or relocation of equipment and systems or changes which may adversely affect structural integrity, flight, or ground handling characteristics of the aircraft. For example, engines and/or controllable propellers of a different make or model; pressurization systems; alternate static air or pressure systems; initial or prototype installation of an automatic pilot or automatic approach system; modification of automatic pilot or automatic approach system which changes servo forces, servo rates, or any flight control or performance characteristics; and the relocation or change of throttle levers, flap controls, and similar items;
- c. Any change (alteration) of movable control surfaces which may adversely disturb the dynamic and static balance, alter the contour, or make any difference (plus or minus) in the weight distribution;
- d. Change in control surface travel outside approved limits, control system mechanical advantage, location of control system component parts, or direction of motion of controls;
- e. Changes in basic dimensions or external configuration of the aircraft, such as wing and tail plan-form or incidence angles, canopy, cowlings, contour or radii, or location of wing and tail fairings;
- f. Changes to landing gear, such as internal parts of shock struts, length, geometry of members, or brakes and brake systems;
- g. Any change to engine cowling and/or baffling which may adversely affect the flow of cooling air, and changes to manifolding;
- h. Changes to primary structure which may adversely affect strength or flutter and vibration characteristics;
- i. Changes to systems which may adversely affect aircraft airworthiness such as relocation of exterior fuel vents, use of hydraulic components, tube material and fittings not previously approved, or use of new type fusible hydraulic plugs;
- j. Changes to oil and fuel lines or systems which may adversely affect their operation, such as new type of hose and hose fittings changes in fuel dump valves, new fuel cell sealant, new fuel or oil line materials, and new fuel or oil system components;

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- k. Any change to the basic engine or propeller design controls or operating limitations, and unapproved changes to engine adjustments and settings having an effect on power output;
 - l. Changes in a fixed fire extinguisher or detector system which may adversely affect the system effectiveness or reliability, such as relocation of discharge nozzle or detector units; use of new or different detector components in new circuit arrangements; deletion of detector units or discharge nozzles; change extinguishing agent or decrease in amount of extinguishing agent;
 - m. Changes which do not conform to the minimum standards established in a Technical Standard Order under which a particular aircraft component or appliance is manufactured;
 - n. Modifications to approved type (TSO or CAATC) radio communications and navigational equipment which may adversely affect reliability or airworthiness, such as changes which deviate from the vacuum tube operating limitations prescribed by the manufacturer; major changes in IF frequency; extension of receiver frequency range above or below the manufacturer's extreme design limits; major changes to the basic design of low approach aids; and changes which deviate from the design environmental performance;
 - o. Changes to aircraft structure or cabin interior of aircraft which may adversely affect evacuation of occupants in any manner;
 - p. Changes in airplane flight manuals and/or manual information in the form of placards or markings. (Ref. Federal Aviation Regulations 23.1581, 25.1581.)
2. ALTERATIONS WHICH MAY REQUIRE ENGINEERING APPROVAL OR ASSISTANCE DUE TO THE NATURE OF THE CHANGE PROPOSED.
- a. Use of synthetic covering materials.
 - b. Substitution of materials, parts, or processes on which insufficient information is available.
 - c. New chrome plating applications.
 - d. New titanium applications.
 - e. Ceramic coatings.
 - f. Use of synthetic resin glues.
 - g. New stripping or plating coatings.

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- h. New welding or brazing techniques.
- i. Welding of certain types of propeller or engine parts.
- j. Application of TSOs to specific installations.
- k. Alternative means for complying with Airworthiness Directives or approved service bulletins.
- l. New magnesium applications.

APPENDIX B

AIRWORTHINESS COMPLIANCE CHECK SHEET LISTING

ACCS NO.

CHAPTER 1. POWERPLANT

1. Generator Installations - FAR 23 aircraft.
2. Generator Installations - FAR 25 aircraft.
- 3- Wind-Driven Generator Installations - FAR 23 aircraft.
- 4- Motor and Dynamotor Installations - FAR 25 aircraft.
5. Engine lubricating Oil Filter Installation - FAR 23 aircraft.
6. Modification of an Airplane to Replace the Engine Exhaust System with One of New Design - FAR 23 aircraft.
7. Modification of an Electric Starting System by Substitution of a Starter made by a Different Manufacturer, Assuming that the Size and Shape of the Engine Mounting Pad is Correct - FAR 23 aircraft.
8. Battery Installations -FAR 23 aircraft.
9. Battery Installations -FAR 25 aircraft.
10. Modification of an Airplane Involving Installation of a Fuel Flow Meter - FAR 23 aircraft.
11. Modification of a Fuel System by the Installation of a Fuel pump to Transfer Fuel from an Auxiliary to a Main Fuel Tank - FAR 23 aircraft.
12. Modification of an Airplane to Relocate an Auxiliary_Fuel Tank without Altering the Fuel System Arrangement FAR 23 aircraft.

CHAPTER 2. AIRFRAME

13. Modification and/or Installation of Seats - FAR 23 aircraft.
- 14- Modification and/or Installation of Seats - FAR 25 aircraft.

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AIRWORTHINESS COMPLIANCE CHECK SHEET
LISTING

ACCS NO.

CHAPTER 2. AIRFRAME

- | | | |
|-----|---|------------------|
| 15. | Landing Light Installations | FAR 23 aircraft. |
| 16. | Landing Light Installations | FAR 25 aircraft. |
| 17. | Interior Light Installations | FAR 23 aircraft. |
| 18. | Interior Light Installations | FAR 25 aircraft. |
| 19. | Anti-collision Light Installations | FAR 25 aircraft. |
| 20. | Buffet and Cabinet Installations | FAR 23 aircraft. |
| 21. | Buffet and Cabinet Installations | FAR 25 aircraft. |
| 22. | Installations or Modifications of Windshields With or Without Electrical Heating Provisions in Non-pressurized | FAR 23 aircraft. |
| 23. | Modification of an Exhaust Type Cabin Heater to Increase Heat Output without any Changes to the Existing Exhaust System | FAR 23 aircraft. |

CHAPTER 3. RADIO & ELECTRICAL

- | | | |
|-----|---|--------------------|
| 24. | Buffet Installation (Electrical Portion) | -FAR 23 aircraft. |
| 25. | Buffet Installation (Electrical Portion) | -FAR 25 aircraft. |
| 26. | Radio Racks and Radio Equipment Installations | - FAR 25 aircraft. |
| 27. | Radio Antenna Installation | - FAR 25 aircraft. |
| 28. | Appliance Outlet Installation | - FAR 25 aircraft. |

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AIRWORTHINESS COMPLIANCE CHECK SHEET
LISTING

ACCS NO.

CHAPTER 4. INSTRUMENTS

- | | | |
|-----|---|------------------|
| 29. | Instrument Installations - Relocating Instruments | FAR 23 aircraft. |
| 30. | Instrument Installations - Adding Instruments | FAR 23 aircraft. |
| 31. | Instrument Installations - Relocating Instruments | FAR 25 aircraft. |
| 32. | Instrument Installations - Adding Instruments | FAR 25 aircraft. |
| 33. | Gyroscopic Instruments | FAR 23 aircraft. |
| 34. | Gyroscopic Instruments | FAR 25 aircraft. |
| 35. | Installation of Liquid Nitrogen Air Conditioners | FAR 23 aircraft. |

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AIRWORTHINESS COMPLIANCE CHECK SHEET #30

1. SUBJECT: -Instrument Installations - Adding Instruments, FAR 23 Aircraft

APPLICABLE FEDERAL AVIATION REGULATIONS

23.301 Loads

Instruments and Markings

23.1301 Functional and Installation Requirements - Equipment

23.1321 Arrangement and Visibility of Instrument Installations

Instrument Panel Vibration Characteristics

23.1327 Magnetic Direction Indicator

23.1337 Instrument Lines

Fuel Quantity Indicator

Cylinder Head Temperature Indicating System for Air-cooled Engines

23.1543 Instrument Markings

23.1547 Magnetic Direction Indicator

23-1555 Accessory and Auxiliary Controls

Added instrument installations which are the same as those made by the airframe manufacturer or other installations which are already approved, may be accepted without further investigation. On other installations, the following points should be checked to determine that the installation is satisfactory.

3. Checklist

a. Structural Requirements:

- (1) If holes are added to instrument panel, is the structural integrity of the panel or its supporting structure impaired? (FAR 23.301).

NOTE: This may normally be determined by a visual check. If the panel or its supporting structure is an integral part of the airplane structure, caution should be used in the evaluation.

b. Hazards to the Aircraft or its Occupants:

- (1) If powerplant instruments are added, are their lines which carry inflammable fluids and gases under pressure

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provided with restricted orifices or other safety devices at the source of pressure to prevent excessive escape of fluid or gas in case of line failure? (FAR 23.1337).

c. Operating Aspects:

- (1) Are added flight, navigation and powerplant instruments installed in such a manner that they are easily visible for use by the pilot? (FAR 23.1321).
- (2) Are added identical powerplant instruments on multiengine aircraft so located as to prevent any confusion as to the engines to which they relate? (FAR 23.1321).
- (3) Is the added magnetic compass installed in the aircraft so that its accuracy is not affected excessively by vibration and transient magnetic fields? (FAR 23.1327).
- (4) Is the added magnetic compass compensated for deviation error not exceeding plus or minus 10 degrees on any heading in level flight? (FAR 23.1327).
- (5) If a magnetic compass is added, is a placard installed with the compass deviation error recorded? (FAR 23.1329 and FAR 23.1547).

d. Detail Design Standards:

- (1) Are the instrument panel vibration characteristics such as not to impair the accuracy of added instruments? (FAR 23.1321).
- (2) Are the applicable instrument connector tubing, flexible lines, electrical conductors, and cables to the added instruments, considered satisfactory to perform their intended function and are their installations satisfactory? (FARs 23.1301, 23.1321, and 23.1337).
- (3) Are instruments properly range marked or placarded? (FAR 23.1543, and FAR 23.1583).

APPENDIX C

1. ALTERATION APPROVAL - DOCUMENT DISPOSITION

<u>Applicant Presents</u>	<u>Applicant Receives</u>	<u>Applicant Sends</u>
<p>(a) FAA Form 337 or Air Carrier Engineering Orders (in duplicate).</p> <p>(b) Substantiating data: A clear description of work performed is required. Drawings or sketches that include sufficient detail for a determination of compliance with acceptable airworthiness standards may be satisfactory.</p> <p>(c) Photographs, if available, may be acceptable in lieu of drawings. Sufficient descriptive data must accompany them to identify material used but need not be so detailed as to support reproduction unless a "duplication by original modifier" type of approval is requested.</p>	<p>(If data and FAA Form 337 and/or Engineering Order are acceptable).</p> <p>(a) All copies of FAA Form 337 and/or Engineering Order with one of the 3 approval statements as appropriate and the signature of the approving inspector.</p> <p>(b) Inspection for conformity with this approved data will be in accordance with FAR 43.</p> <p>(If the data submitted is not acceptable).</p> <p>(a) The complete file will be returned to the applicant with specific instructions for correcting all discrepancies.</p>	<p>(To The FAA)</p> <p>(a) When inspection for conformity is completed, a duplicate of the FAA Form 337 will be forwarded through channels in accordance with regional office instructions. (Supporting data other than the description of work performed need not be forwarded).</p> <p>(To the owner).</p> <p>(b) The original of the FAA Form 337 with supporting data for the aircraft records.</p> <p>In addition, the mechanic should make a maintenance record entry in accordance with FAR 43.9(a)1-4.</p>

APPENDIX C

2. APPROVALS WHICH MAY BE GRANTED ON FA.A FORM 337

(a) Approval by Examination of Detailed Data Only - One aircraft.

"The data identified herein complies with the applicable airworthiness requirements and is approved for the above described aircraft, subject to conformity inspection by a person authorized in FAR 43, section 43.7."

Date

Signature of FAA Inspector

(b) Approval by Examination of Incomplete Data, Physical Inspection, Demonstration, Testing, etc. - One Aircraft.

"The alteration identified herein complies with the applicable airworthiness requirements and is approved for the above described aircraft, subject to conformity inspection by a person authorized in FAR 43, section 43.7."

Date

Signature of FA.A Inspector

(c) Approval by Examination of Detailed Data and Physical Inspection, Demonstration, Testing, etc., - Duplication on Identical Aircraft.

"The data identified herein complies with the applicable airworthiness requirements and is approved for duplication on identical aircraft make, model, and altered configuration when accomplished by the original modifier."

Date

Signature of FA.A Inspector

