



## Malibu-Mirage Owners & Pilots Association

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# Angle-of-Attack Indicator Simplified Major/Minor Alteration Determination and PA46-Specific Installation Guidance

### Criteria for Major Change In Type Design

A major change in type design is defined as one that has an appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product. If the AOA system meets the following criteria, it is not considered a major change in type design requiring a supplemental type certificate (STC):

#### Weight and Balance:

1. The installation of the AOA system does not result in a change the empty weight or empty balance which requires an increase in the maximum certificated weight or center of gravity limits of the aircraft.

#### Structural Strength:

2. The installation of the system is on an unpressurized aircraft:
  - a. The installation of the AOA probe is in a location that does not interfere with the pitot-static system or aircraft stall warning system, and:
    - i. On the wing:
      1. On an inspection panel, or is substituting for an inspection panel, on the underside of the wing provided that the probe is located where it does not interfere with the functioning of a primary flight control surface (aileron or spoiler).
    - ii. On the fuselage:
      1. On an inspection panel, or is substituting for an inspection panel.
      2. On an area of the fuselage that would accommodate a like installation of an antenna, and is installed in accordance with acceptable practices such as the aircraft maintenance manual, Advisory Circulars AC 43.13-1B and AC 43.13-2B.
  - b. The installation of the AOA probe pressure tubes, wiring, etc. do not require adding additional openings within the aircraft wing or fuselage primary structure.
  - c. The installation of the AOA indicator is:
    - i. In an existing opening in the instrument panel, or on the glareshield; or
    - ii. If an additional opening in the instrument panel is required to install the AOA indicator, the following requirements must be met:
      1. The instrument panel cannot be part of the aircraft primary structure;  
or

2. If the instrument panel is part of the aircraft primary structure, the aircraft manufacturer's instructions must contain provisions for providing an additional opening within the instrument panel.
- iii. In a manner in which the AOA indicator display does not interfere with the pilot's view of the primary flight instruments.
3. The AOA system may be installed on a pressurized aircraft, provided the installation meets the following criteria:
  - a. The installation of the AOA probe is in a location that does not interfere with the pitot-static system or aircraft stall warning system, and:
    - i. On the wing:
      1. On an inspection panel, or is substituting for an inspection panel, on the underside of the wing, provided that the probe is located where it does not interfere with the functioning of a primary flight control surface (aileron or spoiler).
    - ii. On the fuselage:
      1. On an area of the fuselage in the unpressurized section on an inspection panel, or is substituting for an inspection panel.
      2. On an area of the fuselage in the pressurized section that would accommodate a like installation of an antenna, provided the aircraft manufacturer's instructions must contain provisions for providing a mounting location.
  - b. The installation of the AOA probe pressure tubes, wiring, etc. do not require adding additional openings within the aircraft wing or fuselage primary structure and the manufacturer's instructions must contain provisions for providing a means to install them into the pressure vessel.
  - c. The installation of the AOA indicator is:
    - i. In an existing opening in the instrument panel, or on the glareshield; or
    - ii. If an additional opening in the instrument panel is required to install the AOA indicator, the following requirements must be met:
      1. The instrument panel cannot be part of the aircraft primary structure; or
      2. If the instrument panel is part of the aircraft primary structure, the aircraft manufacturer's instructions must contain provisions for providing an additional opening within the instrument panel.
    - iii. In a manner in which the AOA indicator display does not interfere with the pilot's view of the primary flight instruments.

**Reliability:**

4. The installation of the AOA system does not interface with the pitot-static system.
5. The AOA system cannot be used as an input source to any automation or system that controls the aircraft, such as an autopilot or stick pusher unless done by STC.
6. The electrical load requirements of the AOA system do not exceed 80 percent of the output load limits of the generator or alternator when operating in conjunction with the aircraft's required equipment.

**Operational Characteristics:**

7. The system is non-required and used in an advisory or supplementary manner:
  - a. There can be no changes to any aircraft operating limitations.

- b. There can be no changes to any aircraft operating procedures: Normal, Abnormal, and Emergency.
  - c. There can be no performance credit taken for the AOA installation, such as reduced stall speeds, reduced approach speeds, reduced takeoff or landing distances, etc.
8. Accuracy of indication of stall must coincide with the stall horn, or be conservative (indicate stall at a higher airspeed) as compared to existing stall warning devices.
  9. The AOA probe is installed on an inspection panel, or is substituting for an inspection panel, on the underside of the wing, provided that the probe is located where it does not interfere with the functioning of a primary flight control surface (aileron or spoiler).
  10. The AOA components located in the airstream do not exceed six square inches in frontal area.

**Other Characteristics Affecting Airworthiness**

11. If the AOA system provides an aural warning, it cannot be a source of nuisance warnings.
12. All electrical wiring is installed in accordance with acceptable practices such as the aircraft maintenance manual, Advisory Circulars AC 43.13-1B and AC 43.13-2B or ASTM standards F2639, F2696 and F2799.
13. The calibration procedure must be simple, and repeatable. Calibration procedures, if done in flight, can be safely accomplished by a pilot of average skill, and there are no required maneuvers that are not contained within the Private Pilot Practical Test Standard.
14. The operating instructions for the AOA system are provided by the manufacturer.

**Criteria for Major Alteration:**

A major alteration is 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.

**If the AOA system can be installed according to accepted practices and elementary operations, and it meets the following criteria, it is not considered a major alteration:**

**Weight and Balance:**

1. The installation of the AOA system does not result in a change to the empty weight or empty balance which requires an increase in the maximum certificated weight or center of gravity limits of the aircraft.

**Structural Strength:**

2. The installation of the system is on an unpressurized aircraft:
  - a. The installation of the AOA probe is in a location that does not interfere with the pitot-static system or aircraft stall warning system, and:
    - i. On the wing:
      1. On an inspection panel, or is substituting for an inspection panel, on the underside of the wing provided that the probe is located where it does not interfere with the functioning of a primary flight control surface (aileron or spoiler).
    - ii. On the fuselage:
      1. On an inspection panel, or is substituting for an inspection panel.
      2. On an area of the fuselage that would accommodate a like installation of an antenna, and is installed in accordance with acceptable practices such as the aircraft maintenance manual or Advisory Circulars AC 43.13-1B and AC 43.13-2B.
  - b. The installation of the AOA probe pressure tubes, wiring, etc. do not require adding additional openings within the aircraft wing or fuselage primary structure.
  - c. The installation of the AOA indicator is:
    - i. In an existing opening in the instrument panel, or on the glareshield; or
    - ii. If an additional opening in the instrument panel is required to install the AOA indicator, the following requirements must be met:
      1. The instrument panel cannot be part of the aircraft primary structure; or
      2. If the instrument panel is part of the aircraft primary structure, the aircraft manufacturer's instructions must contain provisions for providing an additional opening within the instrument panel.
    - iii. In a manner in which the AOA indicator display does not interfere with the pilot's view of the primary flight instruments.
3. The AOA system may be installed on a pressurized aircraft, provided the installation meets the following criteria:
  - a. The installation of the AOA probe is in a location that does not interfere with the pitot-static system or aircraft stall warning system, and:
    - i. On the wing:

1. On an inspection panel, or is substituting for an inspection panel, on the underside of the wing provided that the probe is located where it does not interfere with the functioning of a primary flight control surface (aileron or spoiler).
- ii. On the fuselage:
  3. On an area of the fuselage in the unpressurized section on an inspection panel, or is substituting for an inspection panel.
  4. On an area of the fuselage in the pressurized section that would accommodate a like installation of an antenna, provided the aircraft manufacturer's instructions must contain provisions for providing a mounting location..
- b. The installation of the AOA probe pressure tubes, wiring, etc. do not require adding additional openings within the aircraft wing or fuselage primary structure and the manufacturer's instructions must contain provisions for providing a means to install them into the pressure vessel.
- c. The installation of the AOA indicator is:
  - i. In an existing opening in the instrument panel, or on the glareshield; or
  - ii. If an additional opening in the instrument panel is required to install the AOA indicator, the following requirements must be met:
    1. The instrument panel cannot be part of the aircraft primary structure; or
    2. If the instrument panel is part of the aircraft primary structure, the aircraft manufacturer's instructions must contain provisions for providing an additional opening within the instrument panel.
  - iii. In a manner in which the AOA indicator display does not interfere with the pilot's view of the primary flight instruments.

#### **Performance:**

4. The AOA components located in the airstream do not exceed six square inches in frontal area.

#### **Powerplant Operation:**

5. The AOA system does not interface with the powerplant.

#### **Flight Characteristics**

7. The AOA probe is installed on an inspection panel, or is substituting for an inspection panel, on the underside of the wing, provided that the probe is located where it does not interfere with the functioning of a primary flight control surface (aileron or spoiler).
8. The AOA components located in the airstream do not exceed six square inches in frontal area.
9. The system is non-required and used in an advisory or supplementary manner:
  - a. There can be no changes to any aircraft operating limitations.
  - b. There can be no changes to any aircraft operating procedures: Normal, Abnormal, and Emergency.
  - c. There can be no performance credit taken for the AOA installation, such as reduced stall speeds, reduced approach speeds, reduced takeoff or landing distances, etc.
10. Accuracy of indication of stall must coincide with the stall horn, or be conservative (indicate stall at a higher airspeed) as compared to existing stall warning devices.

**Other Characteristics Affecting Airworthiness**

10. The installation of the AOA system does not interface with the pitot-static system.
11. The AOA system cannot be used as an input source to any automation or system that controls the aircraft, such as an autopilot or stick pusher unless done by STC.
12. If the AOA system provides an aural warning, it cannot be a source of nuisance warnings.
13. The electrical load requirements of the AOA system do not exceed 80 percent of the output load limits of the generator or alternator when operating in conjunction with the aircraft's required equipment.
14. All electrical wiring is installed in accordance with acceptable practices such as the aircraft maintenance manual, Advisory Circulars AC 43.13-1B and AC 43.13-2B or ASTM standards F2639, F2696 and F2799.
15. The calibration procedure must be simple, and repeatable. Calibration procedures, if done in flight, can be safely accomplished by a pilot of average skill, and there are no required maneuvers that are not contained within the Private Pilot Practical Test Standard.
16. The operating instructions for the AOA system are provided by the manufacturer.

NOTE: Final determination of the installation requirements (major alteration or minor alteration) is the responsibility of the installer and may be influenced by the aircraft's configuration.

## Installer Responsibilities

The installer must make the final determination of the AOA system installation requirements (major change in type design, a major alteration and a minor alteration). The installation determination may be influenced by the aircraft's configuration. If the installer determines that the AOA system installation meets the criteria in the Installation Determination section of this memorandum, the ACO approved installation data may be used to support the AOA system installation as a major alteration or a minor alteration. If the AOA system installation in a particular aircraft requires addition alterations data, outside of that contained within the manufacturers installation instructions, then the installer must make the final determination of the additional AOA system installation requirements (major change in type design, a major alteration and a minor alteration).

## Appendix 1

The basic requirements for maintenance, preventive maintenance, rebuilding, and alterations are contained in 14 CFR, part 43.

14 CFR, part 43, §43.13(b), amendment 43-37, states, in part:

*Performance rules (general).*

*(b) Each person maintaining or altering, or performing preventive maintenance, shall do that work in such a manner and use materials of such a quality, that the condition of the aircraft, airframe, aircraft engine, propeller, or appliance worked on will be at least equal to its original or properly altered condition (with regard to aerodynamic function, structural strength, resistance to vibration and deterioration, and other qualities affecting airworthiness).*

The person maintaining or altering an aircraft, airframe, aircraft engine, propeller, or appliance must determine the effect of a repair or alteration. There is substantial guidance regarding how to assess the effect of a repair or alteration. The following are excerpts from existing FAA guidance:

FAA Order 8900.1, Volume 4, Chapter 9, paragraph 4-1178 GENERAL, states:

*A. Factors to Consider. There are essentially three factors to consider in the performance of alterations or repairs. These definitions are provided in Title 14 of the Code of Federal Regulations (14 CFR) part 1, § 1.1.*

- 1) Is the alteration or repair major or minor, per 14 CFR part 43 appendix A? If determined to be a major repair or alteration, a field approval may be granted.*
- 2) If the alteration or repair is determined to be a major change to type design, a field approval will not be granted.*
- 3) Minor alterations or repairs do not require Federal Aviation Administration (FAA) approval.*

AC 43-210, paragraph 106, How will the alteration or repair affect the product, states:

- a. Repairs are intended to return the product to its original or properly altered condition. However, an alteration, by its very nature, alters the TC'd product. It is essential that you understand the scope of a proposed alteration and the effects that the alteration will have on the TC'd product. You must also ensure that the alteration or repair will result in a safe product.*
- b. The evaluation of the effect of the proposed alteration to the TC'd product requires a top-down approach.*

- (1) *If the proposed alteration changes the TC'd product so that a substantial reevaluation of the TC is required, then you must apply for a new TC (14 CFR part 21, section 21.19).*
- (2) *If the proposed alteration has an appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product, then you must apply for an STC or an amended TC.*
- (3) *All other alterations are approved provided that the provisions of sections 43.7 and 65.95 have been met.*
- c. *The degree of the effect of the alteration on the TC'd product will dictate the type of data needed for the alteration.*
  - (1) *If the proposed alteration is determined to be a minor alteration, then acceptable data is sufficient.*
  - (2) *All other alterations require the use of data that has been approved by the Administrator.*

For the purposes of this discussion, only alterations will be discussed, as the focus of this memo is to alter the airplane by adding equipment, rather than returning the airplane to its original or properly altered condition.

A major change in type design is a is one that has an appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of the product.

A major alteration is 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.

A minor alteration is an alteration other than a major alteration.



Figure 1-1 shows the overall decision path for the determination the person maintaining or altering an aircraft, airframe, aircraft engine, propeller, or appliance must perform:

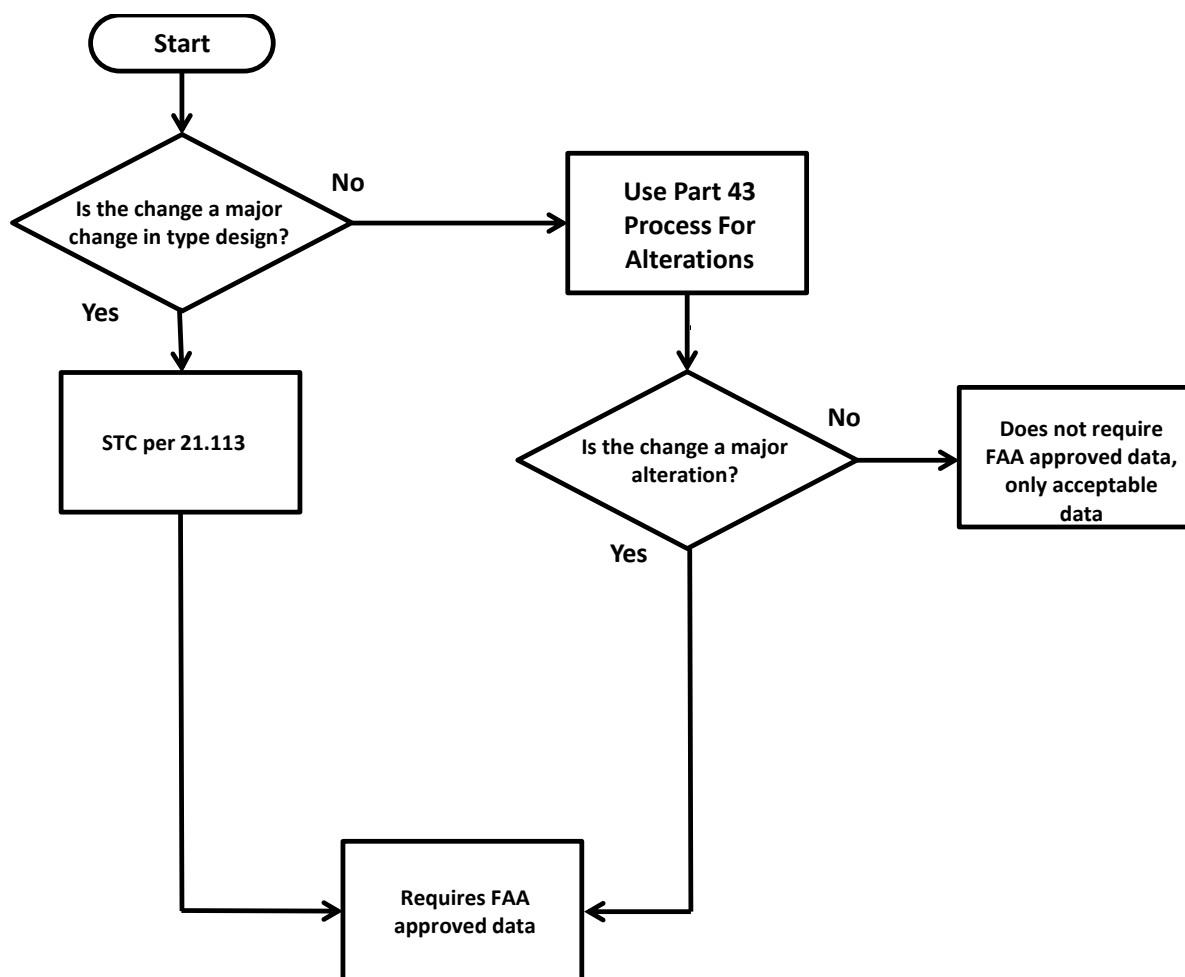
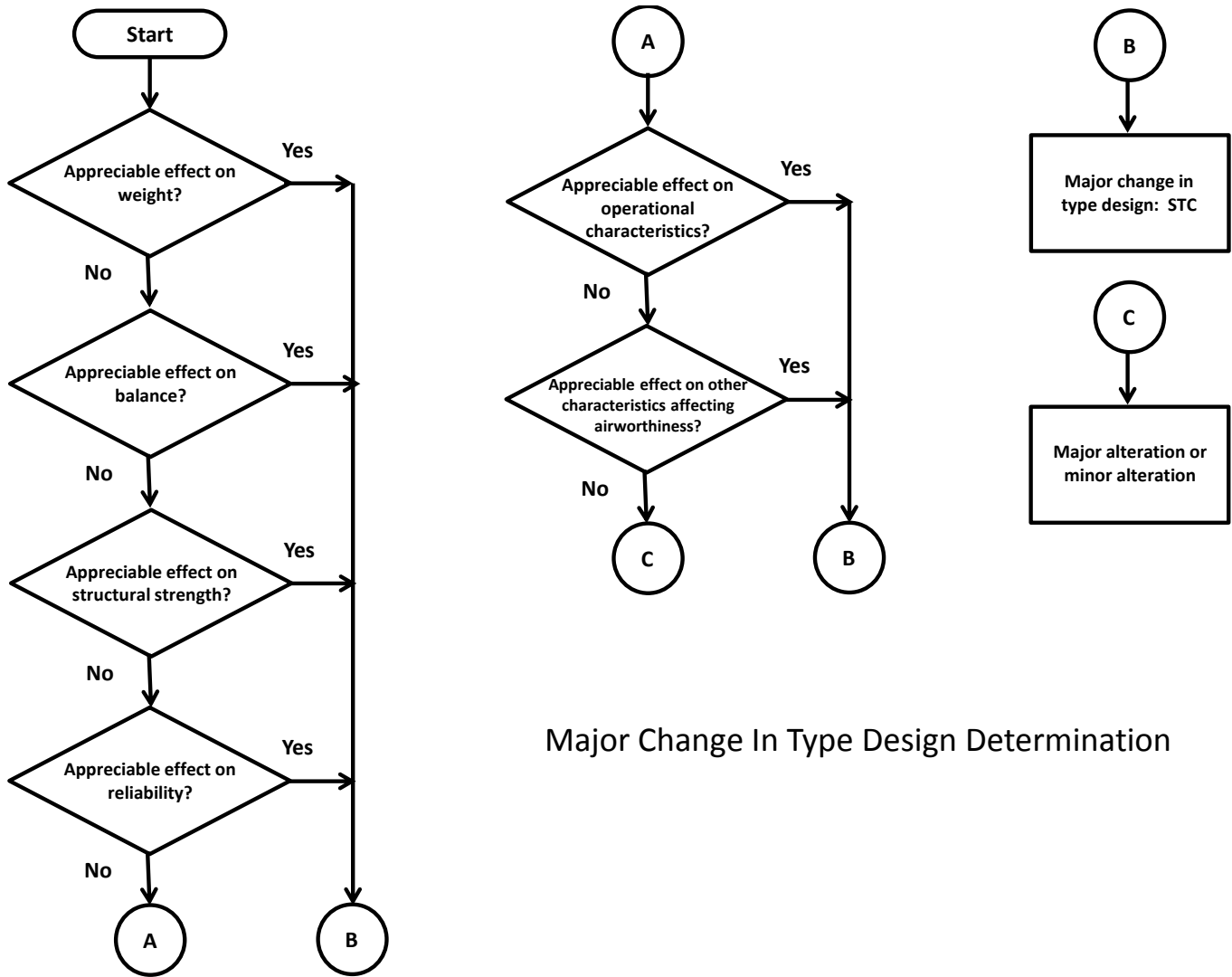


Figure 1-1

Figure 1-2 shows the details in determining if the alteration is a major change in type design:



Major Change In Type Design Determination

Figure 1-2

An example of an appreciable effect would be an alteration that requires the aircraft to have an increased gross weight, outside of the already certificated gross weight.

Figure 1-3 shows the details in determining if the alteration is a major alteration:

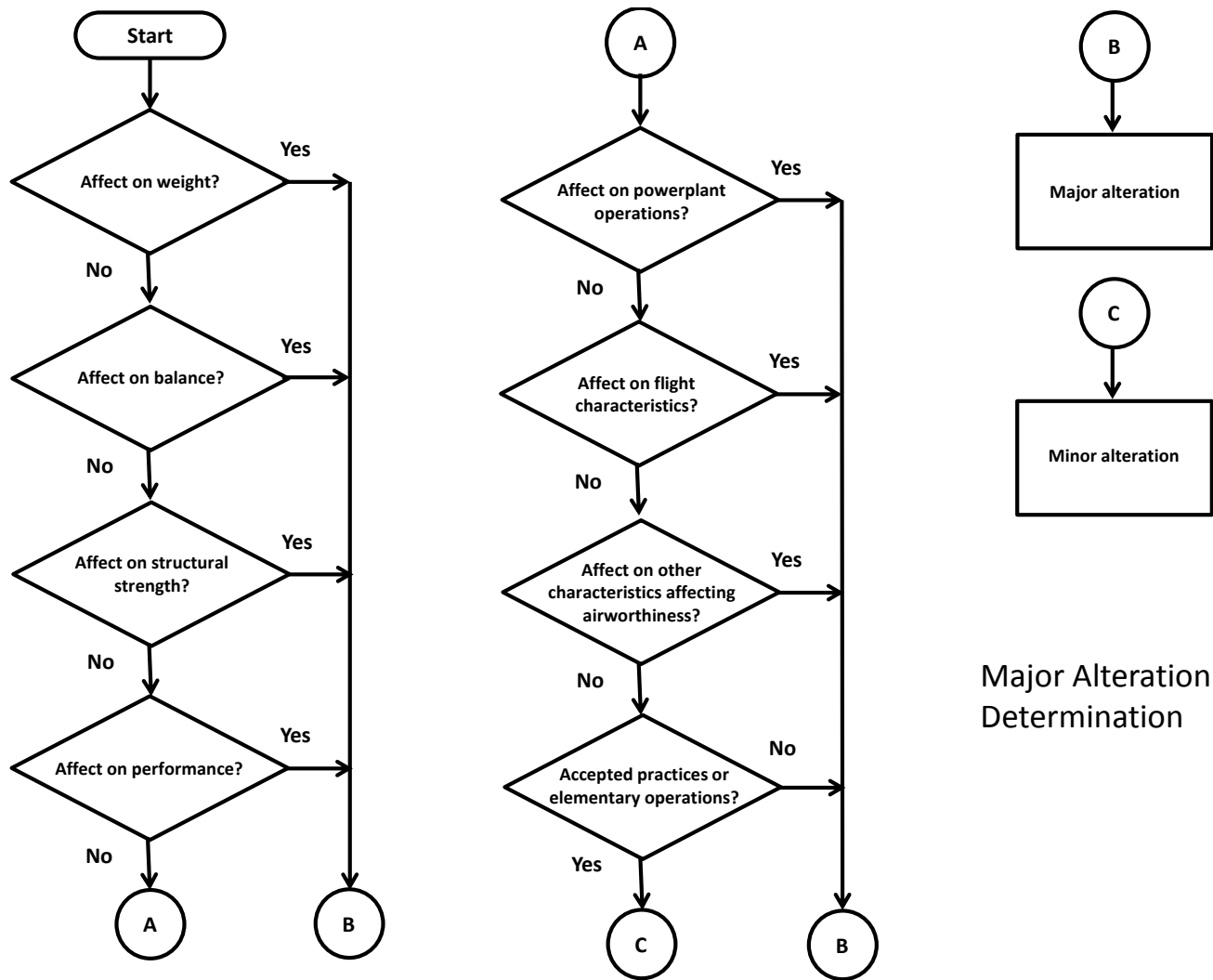


Figure 1-3

## Appendix 2

### PA46 Specific Installation Instructions.

1. See Piper Letter, dated July 9, 2014 in Figure 2-1.
2. Install the AOA probe on LH wing access panel just outboard of main landing gear door, P/N 83278-002, identified as item 67 in Figure 2-2, with the probe installed as shown in Figure 2-3.
3. Install the Sensor Interface Module LH wing access panel inboard of the AOA probe, as shown in Figure 2-4.
4. Remove left wing cover fairing, P/N 84665-004, identified as item 4 in Figure 2-5.
5. Access the male bulkhead connector, P/N 599-708 (MS3126F-22-41P), and the female harness connector, P/N 599-709 (MS3126F-22-41S), as shown in Figure 2-6 and Figure 2-7.
6. Utilize open pin connections in bulkhead connectors P/N 599-708 and P/N 599-709 for the required electrical inputs into the AOA system. See Amphenol PT/PT-SE MIL-DTL-26482 Series I data sheet (Appendix 3) for specific connector information regarding required pin types and tooling.
7. Install Display Interface Module to floor access panel forward of pilot seat rails as shown in Figure 2-8.

NOTE: All electrical wiring must be installed in accordance with acceptable practices such as the aircraft maintenance manual, Advisory Circulars AC 43.13-1B and AC 43.13-2B or ASTM standards F2639, F2696 and F2799.

Figure 2-1



July 9th, 2014

Re: Utilization of unused pins on existing wing to fuselage connectors of Piper Aircraft, Inc. PA-46 models in support of the installation of an Alpha Systems Angle of Attack system

To whom it may concern,

Piper Aircraft Inc. declares no technical objection to the proposal presented by the Malibu Mirage Owners and Pilots Association (MMOPA) with respect to the referenced subject.

In light of the fact that the left hand wing root located connectors (reference designators P101 [Left Wing harness] and P301 [Fuselage harness]) and are associated with existing systems, Piper recommends that the installer consider any potential interference (source or victim) associated with the following:

- Fuel Quantity Sensing Systems
- External Lighting
- Pitot heat
- Stall Warning/Stall Heat (Lift transducer/Lift transducer Heat)

If any questions should arise regarding this document, please contact this office.

Best regards,

PIPER AIRCRAFT, INC.

A handwritten signature in blue ink, appearing to read "Simon Atwill", is written over the printed name.

Simon Atwill  
Director – Core Engineering

Figure 2-2

PIPER AIRCRAFT, INC.  
PA-46-350P MALIBU MIRAGE  
AIRPLANE PARTS CATALOG

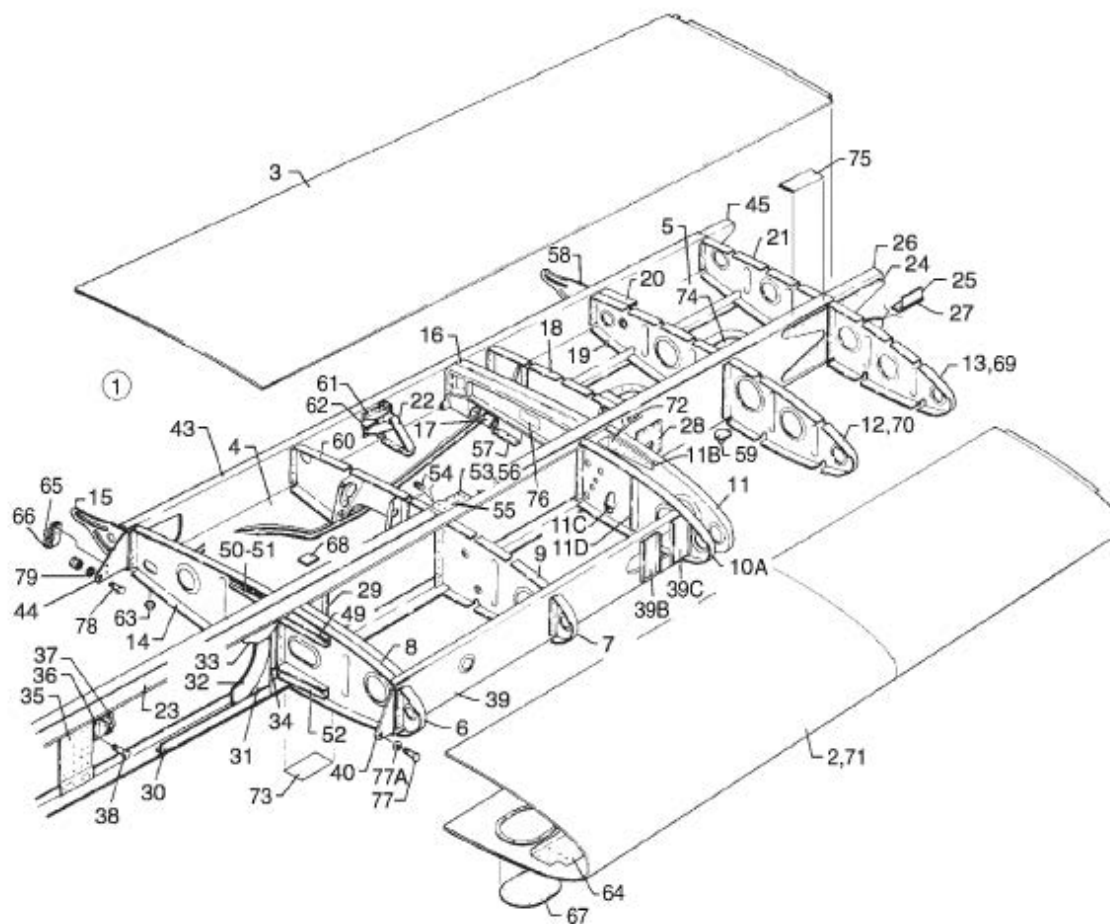


Figure 2. Wing Installation

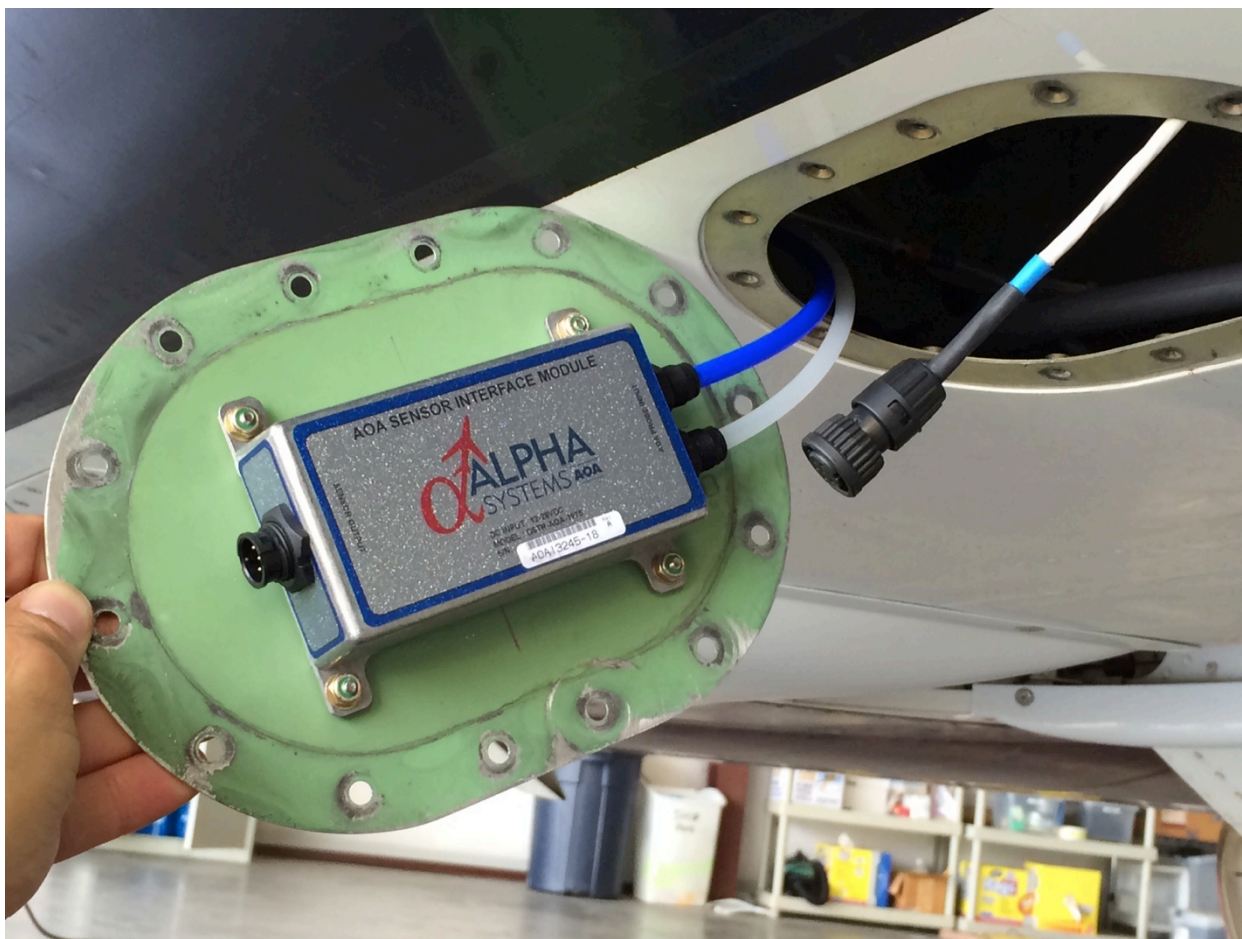
Reissued: December 10, 2006

1A18



AoA heated probe mounted to LH wing inspection panel outboard of MLG door.

**Figure 2-3**



AOA Sensor Interface Module mounted to LH wing inspection panel inboard of AOA Probe.

**Figure 2-4**



PIPER AIRCRAFT, INC.  
PA-46-350P MALIBU MIRAGE  
AIRPLANE PARTS CATALOG

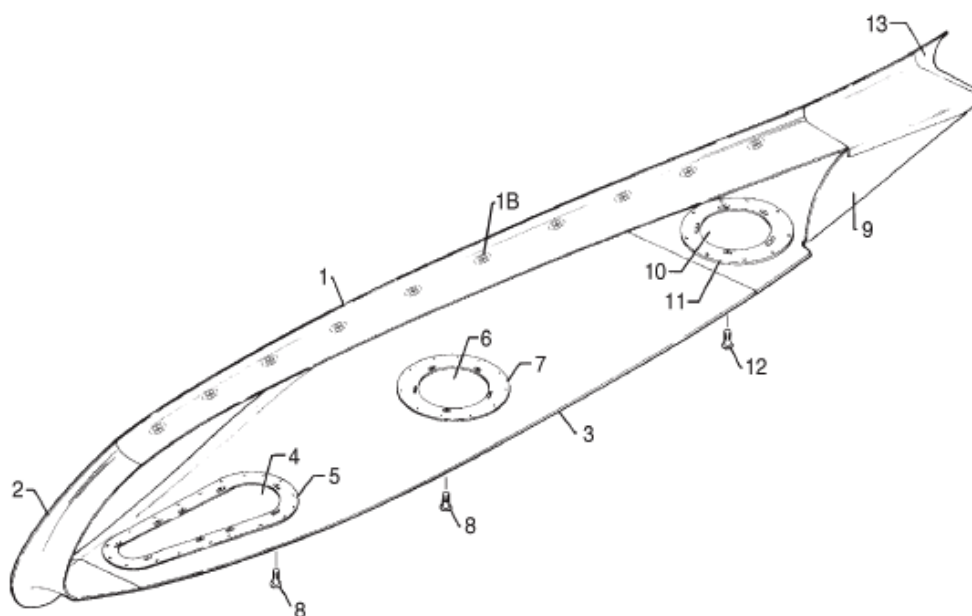
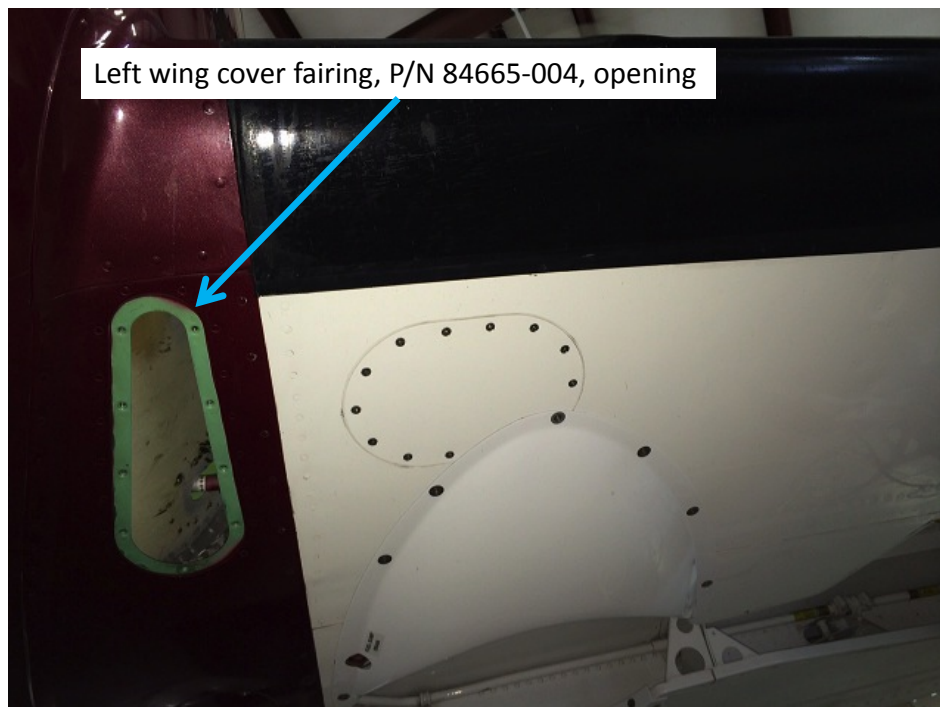


Figure 3. Wing to Fuselage Fairing Installation

Reissued: December 10, 2006

1A24

Figure 2-5



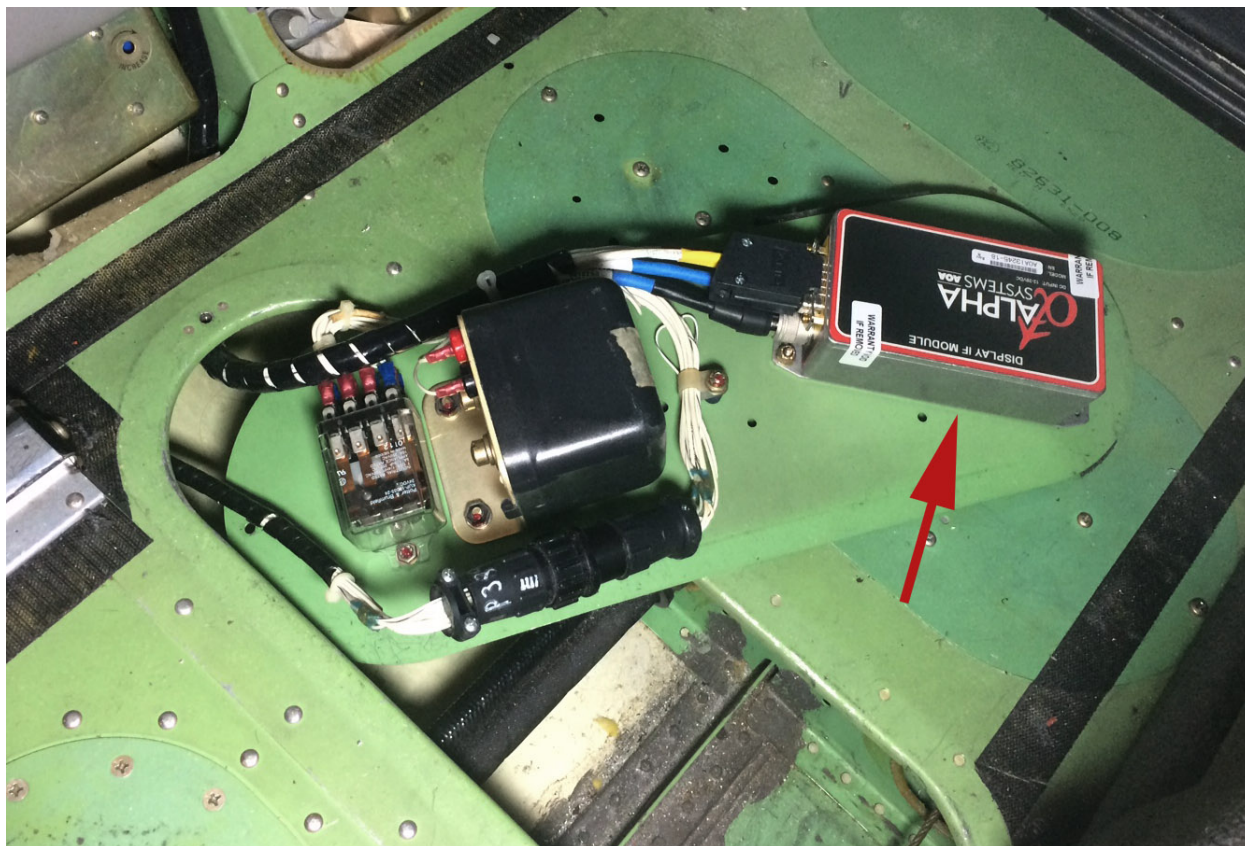
Left wing cover fairing, P/N 84665-004, opening

Figure 2-6



Bulkhead connector:  
Male, P/N 599-708 (MS3126F-22-41P)  
Female, P/N 599-709 (MS3126F-22-41S)

Figure 2-7



Display Interface Module mounted to floor inspection panel forward of pilot seat rails.

**Figure 2-8**

### Appendix 3

#### **Amphenol PT/PT-SE MIL-DTL-26482 Series I Data Sheet.**

Refer to separate PDF for acceptable manufacturer's data on procedures for using the Amphenol multi-pin bulkhead connector between the wing into the fuselage for passing angle-of-attack electrical power and data.

#### **Acknowledgements:**

MMOPA would like to thank the following people & companies who have supported this effort:

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