AIRCRAFT ENGINE MAINTENANCE

MAINTENANCE

- Maintenance covers the work that is required to maintain the engine and its systems in an airworthy condition while installed in an aircraft and the work required to return the engine to airworthy condition when removed from an aircraft.

Classified into:

- On-wing or line maintenance
- Overhaul or shape maintenance


COSTA CALIDA
cfm

TIME BETWEEN OVERHAUL(TBO)

- The maximum time an engine can remain installed in an aircraft is limited to a fixed period agreed between the engine manufacturer and airworthiness authority. This period is referred as TB0.
- For engines the time between overhaul is generally a function of complexity of the engine and how it is used.
- The engine basically consists of one or more assemblies and the TBO will be different.
- With the introduction of modular engines and mounting techniques available, TBO, method on limiting the engines life on- wing has been replaced by the on -condition method.

SCHEDULED MAINTENANCE

- This element concerns maintenance task performed at prescribed intervals.

- The scheduled tasks include replacement of life limited items, components requiring replacement for periodic overhaul, special inspections such as X-rays, checks or tests on condition items etc.

- With the progressive introduction of condition monitoring devices of increased efficiency and reliability, a number of scheduled checks may became unnecessary.

UNSCHEDULED MAINTENANCE

- Unscheduled maintenance covers work necessitated by occurrences that are not normally related to time limits, e.g. bird ingestion, a strike by lightening, a crash or heavy landing.

- Unscheduled work required may also result from malfunction, trouble shooting, scheduled maintenance and occasionally, manufacturers specific recommendations.

CONDITION MONITORING

- **Condition monitoring** is the process of monitoring a parameter of condition in machinery (vibration, temperature etc.), in order to identify a significant change which is indicative of a developing fault.

- Allows maintenance to be scheduled, or other actions to be taken to prevent consequential damages and avoid its consequences.

- Unique benefit in that conditions that would shorten normal lifespan can be addressed before they develop into a major failure.

- Normally used on rotating equipment, auxiliary systems and other machinery (compressors, pumps, electric motors, internal combustion engines, presses).

CONDITION MONITORING TECHNIQUES

* Vibration Analysis and diagnostics
* Lubricant analysis
* Acoustic emission (Airborne Ultrasound)
* Infrared thermography
* Ultrasound testing (Material Thickness/Flaw Testing)
* Motor Condition Monitoring and Motor current signature analysis (MCSA)
* Model-based voltage and current systems (MBVI systems)

FLIGHT DECK INDICATORS

- Flight deck indicators are used to monitor engine parameters such as thrust or power, r.p.m, turbine gas temperature, oil pressure and vibration.
- Other devices include:
- Accelerometers for more reliable and precise
- Vibration monitoring
- Turbine blade temperature
- Oil temperature indicators
- Engine surge or stall indicators
- Remote indicators for oil tank content

FLIGHT RECORDER

- A **flight recorder** is an electronic recording device placed in an aircraft for the purpose of facilitating the investigation of aviation accidents and incidents. Flight recorders are also known by the misnomer **black box**—they are actually bright orange to aid in their recovery after accidents.

- The **flight data recorder** (**FDR**) is a device that preserves the recent history of the flight through the recording of dozens of parameters collected several times per second.

- The **cockpit voice recorder** (**CVR**) preserves the recent history of the sounds in the cockpit, including the conversation of the pilots. The two recorders give an accurate testimony, narrating the aircraft's flight history, to assist in any later investigation**.**

GROUND INDICATORS

- The devices used or checked on the ground, as distinct from those used or checked in flight, may conveniently be referred to as ground indicators.

- Internal viewing instruments can be either flexible or rigid, designed either for end or angled viewing and, in some instances adaptable for still or video photography which may be linked to closed circuit television.

- The engine condition indicators include magnetic chip detectors, oil filters and certain fuel filters.

INDICATORS

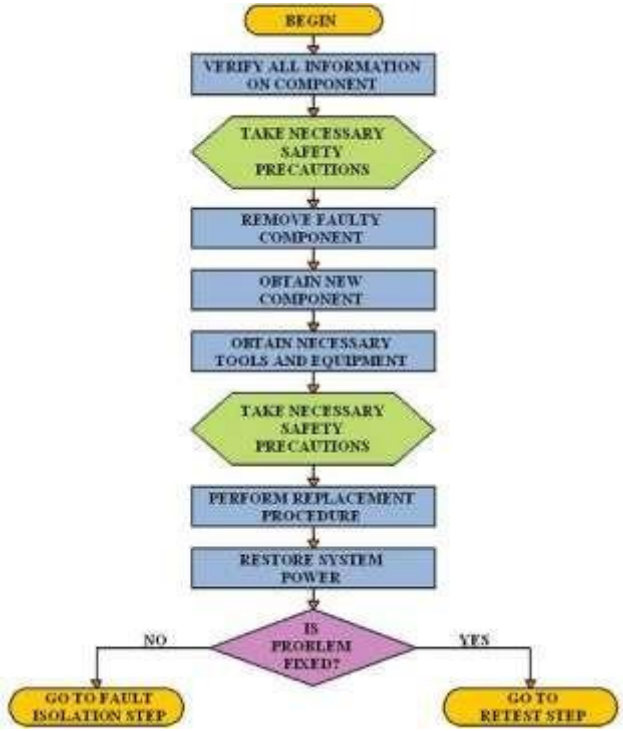
MAINTENANCE PRECAUTIONS

- During engine maintenance, it is necessary to observe some precautions.
- The supply from electrical system should be made safe before inspection.
- When oil system is being replenished, care must be taken that no oil is split.
- It should be ascertained that no possibility of the starter system being operated or ignition system being energized before an inspection of air intake or exhaust system.
- A final inspection should be made after any repair.

TROUBLESHOOTING

- Usually troubleshooting is applied to something that has suddenly stopped working.
- It is the procedure of locating a fault.
- Prevents unnecessary unit or engine removals.
- A logical and systematic method of diagnosis is followed.
- The manufacturers maintenance manual contains troubleshooting information, usually in chart form.

TROUBLESHOOTING



GROUND TESTING

- The basic purpose of engine ground testing is to confirm performance and mechanical integrity and to check a fault or prove a rectification during troubleshooting.
- Essential after engine installation.
- Certain precautions and procedures should be carried out during testing:
- Personnel engaged in testing should have detachable clothing and acoustic ear muffs.
- The aircraft should be prepared in an area free from loose material and loose objects, and clear of equipment.

GROUND TESTING

- The aircraft should be prepared in an area free from loose material and loose objects, and clear of equipment.
- The air intake and jet pipe must be inspected to ensure that they are free from debris or obstruction.
- Because of the mass of air that will be drawn into the intake and the resultant high velocity and temperature of exhaust gases during a ground test, danger zones will extend for a considerable distance.

MAINTENANCE CHECKS

* Aircraft maintenance checks are periodic inspections that have to be done on all commercial/civil aircraft after a certain amount of time or usage.

* Airlines and airworthiness authorities casually refer to the detailed inspections as "checks", commonly one of the following: A check, B check, C check, or D check.

* A and B checks are lighter checks, while C and D are considered heavier checks.

Inspections Required

Introduction:

- The owner or operator of an aircraft is primarily responsible for maintaining the aircraft in an airworthy condition
- All non-airworthy defects that occur between the inspections must be repaired before the airplane can be flown
- The types of inspections required on an aircraft are determined by the requirements of Federal Aviation Regulations and several variable factors such as the owners' or operators' type of aircraft, choice of inspection programs, or usage of the aircraft.
- the owner or operator has a choice of several different inspection programs to comply with the airworthiness requirements for their aircraft.

General Aviation Aircraft

- The requirements for the inspection of general aviation aircraft are specified in Part 91.409 of the Federal Aviation Regulations.
- This regulation covers all general aviation aircraft with the exception of large airplanes, turbojet or turbo-propeller-powered airplanes or aircraft inspected under some other
- type of FAA-approved inspection program.
- Part 91.409 states that no person may operate any aircraft unless, within the preceding or last Figure 1·1. The owner or operator of an aircraft Is responsible for the airworthiness of their aircraft 12 calendar months,

Large or Multi-Engine Turbine-Powered Aircraft

The requirements for the inspection of large general aviation aircraft or multi-engine turbine powered aircraft operated under Part 91 of the Federal Aviation Regulations are outlined in FAR Part 91 409.

1. A current inspection program recommended by the manufacturer of the airplane.
2. A continuous airworthiness inspection program that is currently in use by a certificated air carrier using the same type of aircraft.
3. An approved continuous inspection program currently in use by a certificated air travel club using the same type of aircraft.
4. An approved continuous inspection program currently in use by a certificated air charter operator using the same type of aircraft.
5. Any other inspection program established by the owner or operator of that airplane and approved by the FAA.

Piper PA46-310P and Cessna 152

- **Let's take a look at the above aircraft and see what the requirements would be for an inspection of the aircraft to determine that it meets it's type design and is in a condition for safe operation.**

REGISTRATION AND AIRWORTHINESS CERTIFICATES

AIRCRAFT REGISTRATION

UNITED SATES OF AMERICA

DEPARTMENT OF TRANSPORTATION-FEDERAL AVIATION ADMINISTRATION

STANDARD AIRWORTHINESS CERTIFICATE

1. NATIONALITY AND REGISTRATION MARKS	2. MANUFACTURER AND MODEL	**3. AIRCRAFT SERIAL NUMBER**	**4. CATEGORY**

5. AUTHORITY AND BASIS FOR ISSUANCE

This airworthiness certificate is issued pursuant to the Federal aviation Act of 1958 and certifies that, as of the date of issuance, the aircraft to which issued has been inspected and found to conform to the type certificate therefor, to be in a condition for safe operation, and had been shown to meet the requirements of the applicable comprehensive and detailed airworthiness code as provided in Annex 8 to the Convention on International Civil Aviation, except as noted herein.
Exceptions:

6. TERM AND CONDITIONS

Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator, this AIRWORTHINESS certificate is effective as long as the maintenance, preventive maintenance, and ALTERATIONS are performed in accordance with Parts 21, 43, and 91 of the Federal Aviation Regulations, as appropriate, and the aircraft is registered in the United States.

DATE OF ISSUANCE	FAA REPRESENTATIVE	DESIGNATION
NUMBER		

Any alteration, PRODUCTION, or misuse of this certificate may be punishable by a fine not exceeding $1,000 or imprisonment not exceeding 3 years or both. THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE FEDERAL AVIATION REGULATIONS.

91.203(a)(1)(2

The first thing we need to do in our research is to determine the aircraft had been registered and that is has an airworthiness certificate.

FAR 91.203 Civil Aircraft: Certification Requirements.

If these are not present, we must inform the owner/operator of their responsibility.

THE AMT and IA MUST RESEARCH:

MAINTENANCE RECORDS

SPECIFICATION OR DATA SHEET

AIRWORTHINESS DIRECTIVES

THE CURRENT MANUFACTURER'S MAINTENANCE MANUAL OR INSTRUCTIONS FOR CONTINUED AIRWORTHINESS.

FAR 43.13, 15, 16

Maintenance record research is a time consuming task but is a must. It is important to review the work that may have been accomplished since the last inspection. As part of the inspection you will be taking responsibility for the condition of the item being inspected and you want to make sure the work accomplished meets all the regulation and airworthiness requirements.

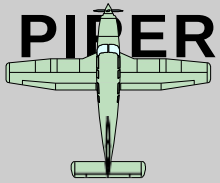
ARE THESE DOCUMENTS REQUIRED?

TYPE CERTIFICATE DATA SHEET

PA-46-310P MALIBU

PA-46-310P MALIBU

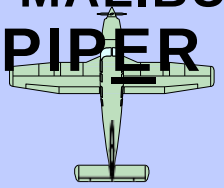
PIPER



FLIGHT MANUAL

PA-46-310P MALIBU

PIPER



APPROVED EQUIPMENT LIST

Let's take a look at each of these documents and see what the significance of the documents are to the inspection and how it will be used to determine the aircraft to meet it's type design.

The first document is the Aircraft Type Data Sheet.

This document provides a listing of all the equipment installed at the time of manufacturing and list optional equipment that could be installed on the aircraft.

Inspection of the aircraft to the type data sheet is a must.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATIC

A25S0
Revision 1 Piper PA-46-310P
December 30, 1983

TYPE CERTIFICATE DATA SHEET NO. A25SO

This data sheet , which is part of Type Certificate No. A25SO, prescribes conditions and limitations under which the product for, which the type certificate was issued meets the airworthiness requirements of the Federal Aviation Regulations.

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

Type Certificate Holder; Piper Aircraft Corporation
Vero Beach Division
Vero Beach, Florida 32960

Model PA-46-310P (Malibu), 6PCLM (Normal Category), Approved September 27, 1983)

Engine Teledyne Continental Model TSIO-520-BE

Fuel 100/100LL Minimum grade aviation gasoline

The type data indicates the following information:

Type Data Sheet Number and Revision

Aircraft Make and Model

Conditions and Limitations

Airworthiness Requirements Engines installed

Fuel Specification Engine Limits

Propeller and Propeller Limits

Airspeed Limits

Engine Limits For all operations:

2600 RPM and 38” Hg MAP (310 HP), sea level to 24,000 Ft.;
2600 RPM and 35” Hg MAP above 24,00 Ft.

2400 RPM and 31” Hg MAP maximum when leaned to 50 F lean of peak, any altitude.

Propeller and

Hartzell, Hub BHC-C2YF-1BF, Blade F8052 ( )

Propeller Limits

Pitch: High 38.0 plus/minus 1degree, low 16.0 plus/minus 0.2 at 30 station

Diameter: Not over 80”, not under 78”.
Spinner: Hartzell D-4810 or D-4810P
Governor: Hartzell Model E-5-2

Airspeed (KIAS) Limits

Vne (Never Exceed)	**203 KIAS**
Vno (Maximum Structural Cruise)	**173 KIAS**
Va (Maneuvering 4100 lbs.)	**135 KIAS**
Va (Maneuvering 2450 lbs.)	**103 KIAS**
Vfe (Maximum Flaps Extended)	**120 KIAS**

Page No. 1 2 3 4

Rev. No 1 1 1 -

Type Data Sheet: (Continued)

Airspeed Limits
Center of Gravity
Ranges Empty Weight
Maximum Weight

A25SO Revision 1

Airspeed Limits KIAS

Vlo (Maximum Landing Gear Operation)

Extension 170 KIAS

Retraction 130 KIAS

Vle (Maximum Landing Gear Extended) 200 KIAS

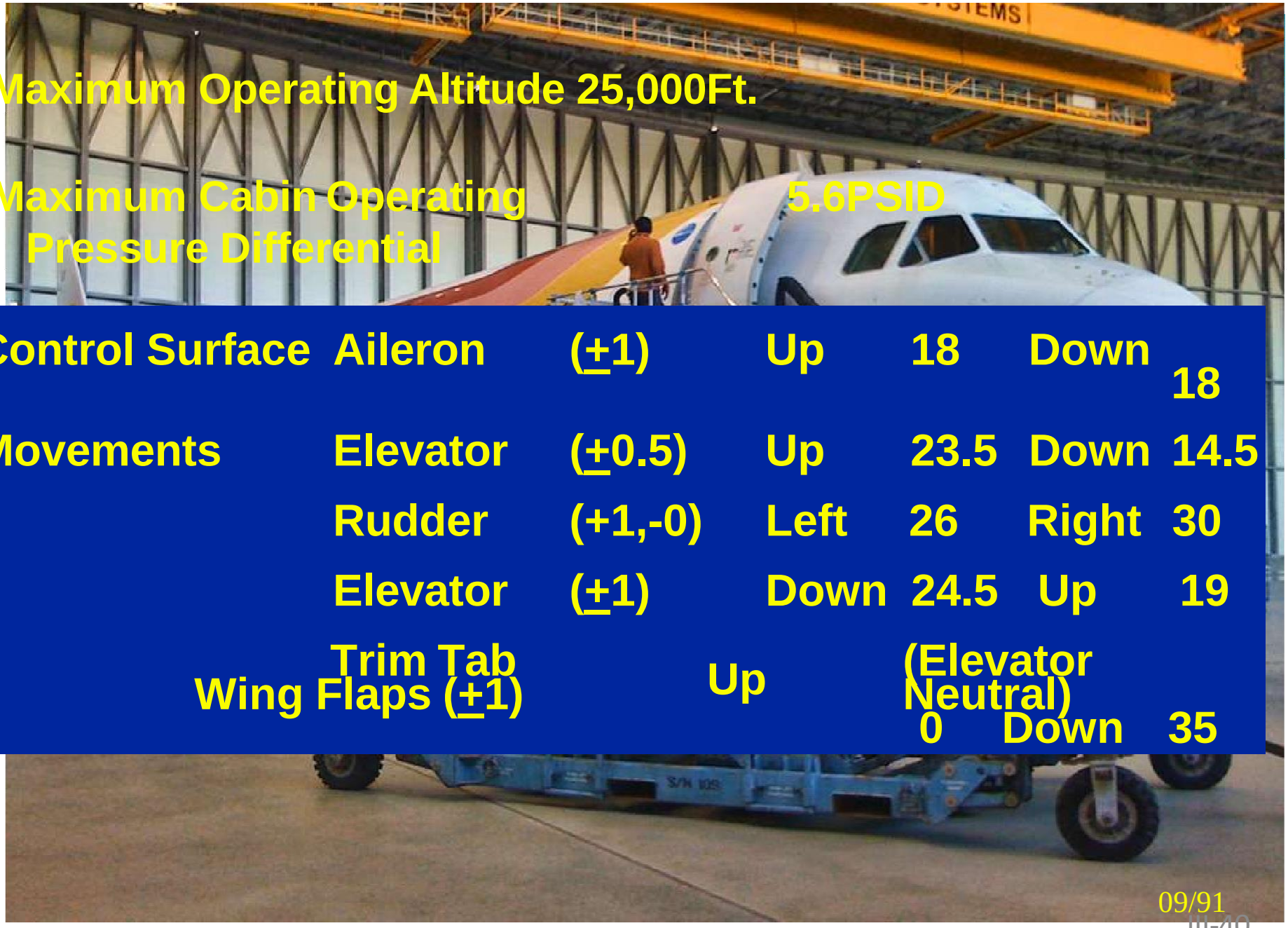
C.G. Range (Gear Extended) AFT OF DATUM)	WT. (LBS)	FWD Limit IN.'S AFT OF DATUM)	AFT Limit (IN.'S
4100		143.3 In.	147.1 In.
3680		136.1 In.	147.1 In.
2450 or less		130.7 In.	147.1 In.

Empty Weight	**None**	
C. G. Range		
Maximum Weight	**Ramp**	**4118 lbs.**
Takeoff	**Landing**	**4100 lbs.**
		3900 lbs.

Type Data Sheet: (Continued)

Number of Seats and their locations
Maximum baggage (Forward and Aft)
Fuel Capacity (number of Gallons and location) Oil Capacity (number of Quarts and location) Maximum Operating Altitude
Maximum Cabin Operating Altitude
Maximum Cabin Operating Pressure Differential Control surface movements

Number of Seats	**6**	**(2 at +135.5)** **(2 at +177.0)** **(2 at + 218.75)**
Maximum Baggage	**100 lbs at + 88.6 (Fwd.)** **100 lbs. at + 245.1 (Aft.)**	
Fuel Capacity	**122 gals. (2 wing tanks) at + 149.4** **See note 1 for data on fuel system.**	
Oil Capacity	**8 qts. at + 53.5** **See note 1 for data on oil system.**	



Maximum Operating Altitude 25,000Ft.

Maximum Cabin Operating Pressure Differential 5.6PSID

Control Surface Movements	Aileron	(±1)	Up	18	Down	18
	Elevator	(±0.5)	Up	23.5	Down	14.5
	Rudder	(+1,-0)	Left	26	Right	30
	Elevator	(±1)	Down	24.5	Up	19
	Trim Tab		Up	(Elevator Neutral) 0	Down	35
	Wing Flaps (±1)					

Type Data Sheet: (Continued)

- Manufacturer's Serial Numbers Datum
- Certification Basis Production Basis Equipment
- Noise Characteristics
- Current Weight and Balance Report
- Placards
- Life limit items

Manufacturer's 46-8408001 and up Serial Numbers
Datum 100 inches forward of pressure bulkhead.
Leveling Means Top or Bottom Fuselage at B.L.-0 (constant section)
Certification Basis FAR Part 23 effective February 1, 1965, thru amendment 23-25, effective Mar. 6, 1980; FAR 25.783(e), 25.831(c) and (d) of Amendment 12, effective

Aug. 1, 1981. No equivalent safety findings.

Production Basis: Production Certificate No. 206.

Production Limitation:

Record issued and the manufacturer authorized to issue airworthiness certificates under the delegation option provisions of FAR 21.

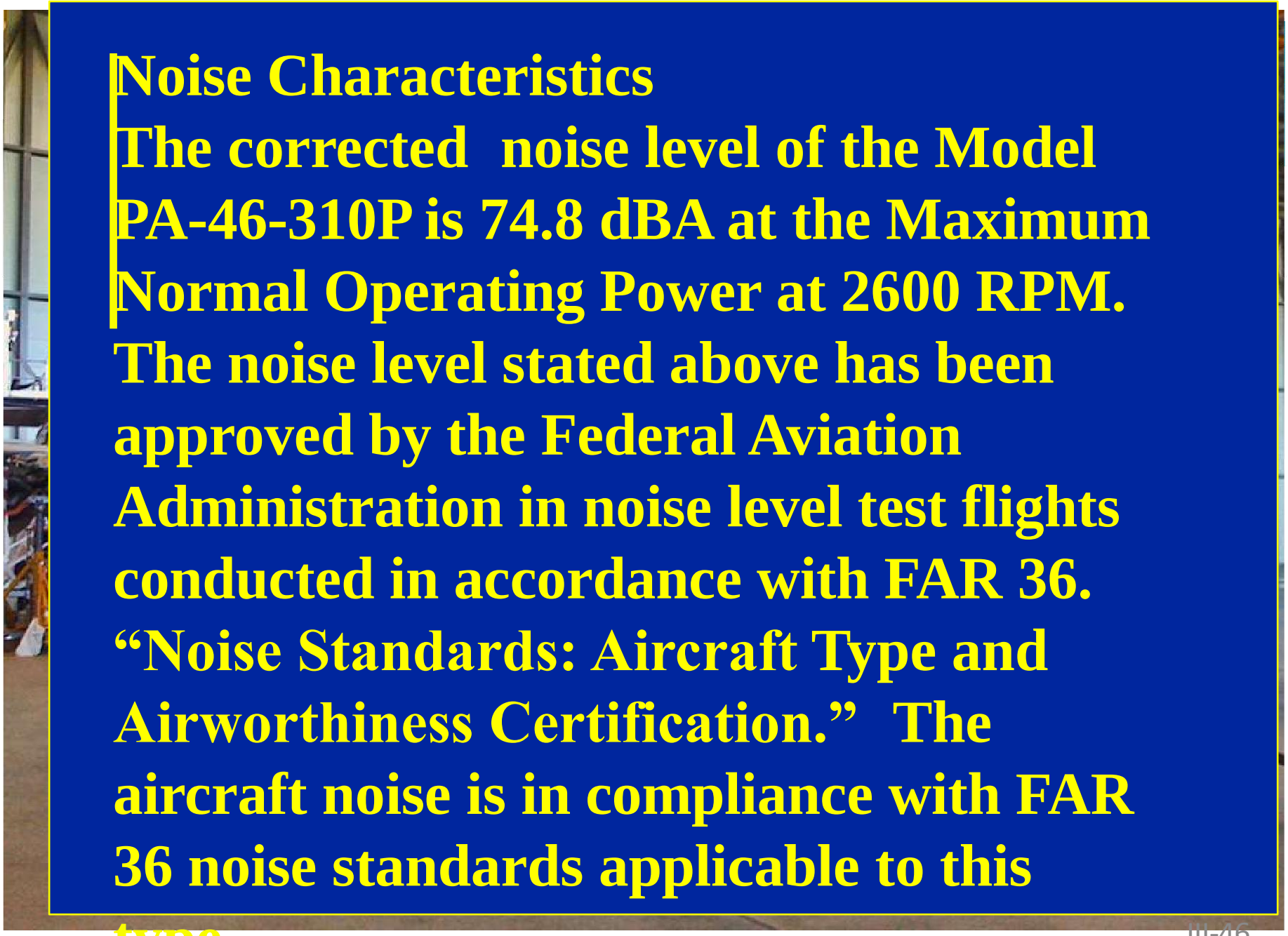
Equipment **The basic required equipment prescribed in the applicable airworthiness regulations (see Certification Basis) must**

be installed in the aircraft for certification. In addition, one of the following items of equipment are required for S/N 46-8408001 and up;

AFM Report FT-157, Appendix D approved September 26, 1983 or POH Report VB-1200

Did you notice that under equipment that the Aircraft Flight Manual (AFM) or Pilot Operating Handbook (POH) is required.

Therefore, when you are performing the inspection, you need to make sure these documents are available.



Noise Characteristics

The corrected noise level of the Model PA-46-310P is 74.8 dBA at the Maximum Normal Operating Power at 2600 RPM. The noise level stated above has been approved by the Federal Aviation Administration in noise level test flights conducted in accordance with FAR 36. "Noise Standards: Aircraft Type and Airworthiness Certification." The aircraft noise is in compliance with FAR 36 noise standards applicable to this type.

NOTE 1. Current Weight and Balance Report, including list of equipment included in certificated empty weight and loading instructions when necessary, must be provided for each aircraft at the time of original certification. The certified empty weight and corresponding center of gravity locations must include undrainable system oil (not included in oil capacity) and unusable fuel as noted below Fuel 12 lbs. at (+152.37) Oil 2.8 lbs. at (53.5)

-END-

NOTE 2. All placards required in the POH and AFM must be installed in the appropriate locations. The following placards must be displayed in clear view of the pilot: The markings and placards installed in this airplane contain operating limitations which must be complied with when operating this airplane in the normal category. Other operating limitations which must be complied with when operating this airplane in this category are contained in the airplane flight manual. No aerobatic maneuvers, including spins, approved.

NOTE 3. The life limit of the fuselage assembly, P/N is 82250 is 10,145 hours. The life limit of the wing assemble, P/N 831000 is 15,580 hours.

-END-

Equipment Lists are needed to determine what is installed on the aircraft that is not included on the Type Data Sheet.