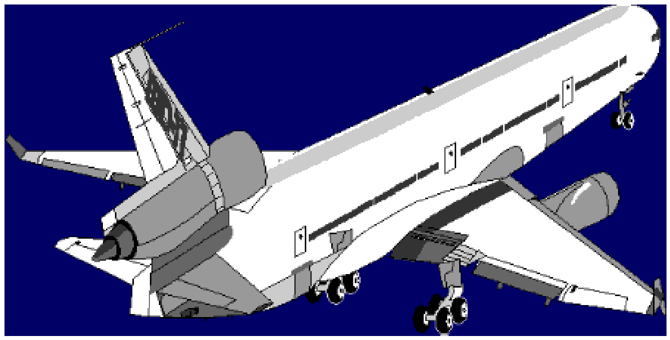
Interior Inspection Guidelines



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A. Airworthiness and Registration Certificate Examination

B. Flight Deck Inspection

C. Cabin Inspection

D. Cargo Compartment Inspection

Airworthiness and Registration Certificate Examination

Ensure the following:

1. Airworthiness and registration certificates are current and valid

2. Both certificates contain the same model, serial, and registration numbers

3. Temporary registration is current

4. Signatures are in permanent-type ink

Flight Deck Inspection

Inspect the following:

1. *Instrument security* and range markings

2. *Windows* (delamination, scratches, crazing, and general visibility)

3. Emergency equipment

4. Seal on medical kit (if located on flight deck)

5. *Seat belts and shoulder harnesses* (Technical Standard Order marking, metal to metal latching, and general condition)

6. Check the following if using cockpit jumpseat:

    a. Jump seat *oxygen system* - turn regulator on and select 100% oxygen

    b. Interphone system - select Comm 1 and Comm 2 to ensure systems are working

7. When the most forward jump seat is in the cabin, coordinate with the crew for connecting the headset and adapter cables.

8. Ensure that the jump seat is serviceable and that *seat belt* and shoulder harnesses are available

Cabin Inspection

Inspect the cabin to include the following:

1. Lavatory. Ensure the following:

    a. Fire extinguisher system is installed in sealed trash containers

    b. Smoke detection system is installed

    c. Trash containers are sealed according to applicable Airworthiness Directive(s)

    d. "No Smoking" placards are posted

    e. Ashtrays are available outside the lavatory

2. Flight attendant seats.

    a. Pull the jump seat down to ensure seat retracts (those in the path of exits)

    b. Inspect *seat belts* for Technical Standard Order marking, metal to metal latching and general condition

3. Cabin emergency equipment. All equipment requiring periodic inspections should have an inspection date marked on it. Inspect the following:

a. Flight attendant flashlight holder

b. Slide containers, to ensure containers are properly marked for content. Check pressure of slide inflation bottle if visible.

c. Medical kit (if not checked on flight deck)

d. First aid kit

e. *Emergency oxygen* (proper pressure and security)

f. Megaphone(s) (security and general condition)

g. Fire extinguishers (security, pressure, seal,)

h. *Liferaft* storage markings (if raft is required)

i. Emergency briefing cards (random sample)

j. General condition of emergency floor path lighting system

k. Placement of all "Emergency Exit" signs

l. Presence and legibility of *"Emergency Exit"* operation instructions

m. Placarding for location of all emergency equipment

n. *Life preservers* (vests)

4. Passenger seats. Ensure the following:

   a. Seats adjacent to emergency exits do not block exit path

   b. Seats are secure in seat rack (random sample)

   c. Seat breakover pressure is in accordance with operator's maintenance program (random sample)

   d. "Fasten Seat Belt During Flight" placards are in view from all seats

   e. *Seat belts* have metal to metal latches and are in good general condition (random sample)

5. Galleys/service centers. Inspect the following:

   a. Trash bin lids for fit

   b. Storage compartment restraints

   c. Stationary cart tiedowns

   d. Lower lobe equipment/restraints

   e. Lift operation

   f. Galley supply stowage

6. Overhead baggage compartments. Check for weight restriction placards and the doors for proper latching, when applicable

Cargo Compartment Inspection

1. Ensure the following:

    a. Cargo compartment fire protection is appropriate for its classification

    b. Cargo liner is free from tears and/or punctures. If these are noted, inspect structure behind liner for damage, e.g., stringers, circumferentials, etc. Ensure sealing tape is proper type and in good condition.

    c. Cargo door is free of fluid leaks and structural damage

    d. Fuselage door structure and sill are free of damage

    e. Smoke detectors are in satisfactory condition

    f. Lighting is operable and protective grills are installed

    g. Cargo flooring is free from structural or other damage

    h. Pallet positions/compartments are placarded for position identification and *weight limitations*

2. Inspect pallet system, if applicable. Ensure the following:

    a. Ball mats are serviceable, e.g., no broken or missing balls

    b. Forward, aft, and side restraints are serviceable

    c. Roller assemblies are secure and have no missing or broken rollers

3. Ensure the 9 g forward restraint net is serviceable, if applicable.

4. Ensure that cargo restraints for bulk loaded cargo are adequate, if applicable.

5. Inspect cabin mounted equipment.

6. Inspect fire extinguishers for inspection due dates and pressure.

7. Inspect load manifest for Hazardous Material. If present, determine crew knowledge of the following:

    a. Location and labeling of hazardous materials

    b. Special requirements, if required

    c. If proper paperwork is on board

8. Ensure captain is aware of the following responsibilities:

    a. Inspection of cargo to ensure proper *load distribution*

    b. Ensuring loads do not exceed compartment or position limits

    c. Ensuring loads are being properly restrained

LIFE PRESERVERS AND LIFERAFTS

344. GENERAL

Inflatable life preservers and liferafts are subject to general deterioration due to aging. Experience has indicated that such equipment may be in need of replacement at the end of 5 years due to porosity of the rubber coated material. Wear of such equipment is accelerated when stowed on board aircraft because of vibration which causes chaffing of the rubberized fabric. This ultimately results in localized leakage. Leakage is also likely to occur where the fabric is folded because sharp corners are formed. When these corners are in contact with the carrying cases, or with adjacent parts of the rubberized fabric, they tend to wear through due to vibration.

345. INSPECTION PROCEDURE FOR LIFE PRESERVERS

Life preservers should be inspected at 3 month intervals for cuts, tears, or other damage to the rubberized material. Check the mouth valves and tubing for leakage, corrosion, and deterioration. Remove the carbon dioxide cylinder and check the discharge mechanism by operating the lever to ascertain that the pin operates freely. Check the gaskets and valve cores of the cylinder container and the pull cord for deterioration. If no defects are found, inflate the preserver with air to a 2 pound pressure and allow to stand for 12 hours. If the preserver still has adequate rigidity at the end of that time, deflate and fit with CO2 cylinders having weights not less than that indicated on them by the manufacturer. All cylinders made in accordance with joint Army/Navy Specification MIL-C-00601D are so stamped and have a minimum permissible weight stamped on them. The use of such CO2 cylinders is recommended. These cylinders have the 5/32 inch end disc sealed by an electric welding process, which is intended to provide a superior seal compared to the older type, which have a similar disc surrounded by a thin rubber seal. Inasmuch as the rubber is subject to deterioration, its ability to maintain pressure will possibly be affected. Leaky electrically welded seals will probably be discovered upon final inspection at the manufacturer's plant. If such a cylinder is up to weight at the end of 3 months in all probability it will remain so until used; whereas, the old type with the rubber seal is apt to lose its pressure with age. Having fitted the preserver with an adequately charged cylinder, mark the preserver to indicate the date of inspection and pack into its container. It is recommended that the aforementioned procedure be repeated every 12 month period, utilizing the CO2 cartridge for inflation. Carbon dioxide permeates the rubberized fabric at a faster rate than air and will indicate if the porosity of the material is excessive.

346. REPAIR OF LIFE PRESERVERS

Leaks may be disclosed by immersion in soapy water. Repair leaks by the use of patches in accordance with the recommendations of the manufacturer. Clean corroded metal parts and replace missing or weakened lanyards. Life preservers which do not retain sufficient rigidity after the 12 hour period, because of general deterioration and porosity of the fabric, are beyond economical repair and should be replaced.

347. INSPECTION PROCEDURE FOR LIFERAFTS

Liferafts should be inspected at 3 month intervals for cuts, tears, or other damage to the rubberized material. If the raft is found to be in good condition, remove the CO2 bottle(s) and inflate the raft with air to a pressure of 2 pounds. The air should be introduced at the fitting normally connected to the CO2 bottle(s). After at least 1 hour to allow for the air within the raft to adjust itself to the ambient temperature, check pressure and adjust, if necessary, to 2 pounds and allow the raft to stand for 24 hours. If, after 24 hours, the pressure is less than 1 pound, examine the raft for leakage by using soapy water. In order to eliminate pressure variations due to temperature differences at the time the initial and final reading are taken, test the raft in a room where the temperature is fairly constant. If the pressure drop is satisfactory, the raft should be considered as being in an airworthy condition and returned to service after being fitted with correctly charged CO2 bottles as determined by weighing them. Rafts more than 5 years old are likely to be unairworthy due to deterioration. It is suggested that the rafts be marked to indicate the date of inspection and that soapstone be used when folding them preparatory to insertion into the carrying case. Take care to see that all of the raft's required equipment is on board and properly stowed. If the raft lanyard, used to prevent the raft from floating away from the airplane, is in need of replacement, use a lanyard not less than 20 feet long and having a breaking strength of about 75 pounds. It is recommended that the aforementioned procedure be repeated every 18 month period utilizing the CO2 bottle(s) for inflation. If a single bottle is used for inflating both compartments, it should be noted whether the inflation is proceeding equally to both compartments. Occasionally the formation of "carbon dioxide snow" may occur in one passage of the distribution manifold and divert a larger volume of gas to one compartment, which may burst if the mattress valve is not open to relieve the pressure. If the pressure is satisfactory, return the raft to service in accordance with the procedure outlined.

348. REPAIR OF LIFERAFTS

When leaks due to tears, abrasion, or punctures are found, make repairs in accordance with the recommendations of the manufacturer. Replace partially torn away supporting patches on the tube to restore the raft to its airworthy condition. Replace mildewed or weak lanyards, particularly those by which the CO2 bottle is operated. This applies also to the line used to attach the raft to the airplane. Check all metal parts for corrosion, and clean or repair if found to be defective. If leaky mattress valves have been found, they must be replaced.

SAFETY BELTS

The FARs require that when safety belts are to be replaced in aircraft manufactured after July 1, 1951, such belts must conform to standards established by the FAA. These standards are contained in Technical Standard Order TSO-C22. Safety belts eligible for installation in aircraft may be identified by the marking TSO-C22 on the belt or by a military designation number since military belts comply with the strength requirements of the TSO. Each safety belt must be equipped with an approved metal to metal latching device. Airworthy type-certificated safety belts currently in aircraft may be removed for cleaning and reinstalled. However, when a type certificated safety belt is found unairworthy, replacement with a TSO-C22 or a new belt is preferred.

a. The webbing of safety belts, even when mildew-proofed, is subject to deterioration due to constant use, cleaning, and the effects of aging. Fraying of belts is an indication of wear, and such belt are likely to be unairworthy because they can no longer hold the minimum required tensile load. Difference of opinion as to the airworthiness of a belt can be settled by testing a questionable belt to demonstrate that it will support the required load. Airworthy one person type-certificated belts should be able to withstand a tensile load of 525 pounds, and TSO belts withstand the rated tensile load indicated on the belt label. Most one person TSO belts are rated for 1,500 pounds. For two person belts, double the loads. Since type-certificated belts will not afford the crash protection provided by a TSO or military belt, such type-certificated belts are not to be repaired nor should their buckles or end fittings be reused on safety belts. If replacement of webbing or hardware of TSO or military belt is attempted, use parts of identical design and material. Make the stitch pattern identical to the original and the number of stitches per inch equal to the number used in the original belt. There is no objection to having a greater total length of stitching, provided one line of stitches is not placed over another line. Space lines of stitching at least 3/16 inch apart. Keep a record, preferably in the logbook, stating the extent to which the belt was repaired and the date. Retain the original identification marking on the belt, conforming either to that required by TSO-C22 to a deviation from this marking, or to the military designation. Operators of a fleet of airplanes should follow the above suggestions, but keeping a record of renovations in a logbook is impractical, since the belts are never associated with any one particular aircraft for any length of time. Therefore, in addition to retaining the original identification label and attaching it to the renovated belt, use some additional simple marking to indicate that the belt has been renovated and show the date of renovation. The use of letter "R" followed by the date would be acceptable. This marking could be in the form of an indelible ink stamping or cloth label stitched to the webbing.

OXYGEN SYSTEMS

a. General. The following instructions are to serve as a guide for the inspection and maintenance of aircraft oxygen systems. The information is applicable to both portable and permanently installed equipment.

(1) Aircraft Gaseous Oxygen Systems. The oxygen in gaseous systems is supplied from one or more high or low pressure oxygen cylinders. Since the oxygen is compressed within the cylinder, the amount of pressure indicated on the system gauge bears a direct relationship to the amount of oxygen contained in the cylinder. The pressure indicating line connection is normally located between the cylinder and a pressure reducing valve.
NOTE: Some of the gaseous oxygen systems do not use pressure reducing valves. The high pressure is reduced to a useable pressure by a regulator. This regulator is located between the high and low pressure system.

(2) Aircraft Liquid Oxygen Systems. Thus far it has not been a practice to use liquid oxygen in civil aircraft due to its complexity. This however, may change at any time as technological advances are made.

(3) Portable Oxygen Systems. The three basic types of portable oxygen systems are: demand, pressure demand, and continuous flow. The component parts of these systems are identical to those of a permanent installation with the exception that some parts are miniaturized as necessary. This is done in order that they may be contained in a case or strapped around a person's shoulder. It is for this portability reason that it is essential special attention be given to assuring that any storage or security provision for portable oxygen equipment in the aircraft is adequate, in good condition, and accessible to the user.
NOTE: Check portable equipment including its security provisions frequently, as it is more susceptible to personnel abuse than a permanently installed system.

b. Inspection. Hands, clothing, and tools must be free of oil, grease, and dirt when working with oxygen equipment. Traces of these organic materials near compressed oxygen may result in spontaneous combustion, explosions, and/or fire.

(1) Oxygen Tanks and Cylinders. Inspect the entire exterior surface of the cylinder for indication of abuse, dents, bulges, and strap chafing.
(a) Examine the neck of cylinder for cracks, distortion, or damaged threads.
(b) Check the cylinder to determine if the markings are legible.
(c) Check date of last hydrostatic test. If the periodic retest date is past, do not return the cylinder to service until the test has been accomplished.
NOTE: This test period is established by the Department of Transportation in the Code of Federal Regulations, Title 49, Chapter I, Paragraph 173.34.
(d) Inspect the cylinder mounting bracket, bracket hold-down bolts and cylinder holding straps for cracks and deformation, cleanliness, and security of attachment.

(e) In the immediate area where the cylinder is stored or secured, check for evidence of any types of interference, chafing, deformation, or deterioration.

(2) Lines and Fittings.
(a) Inspect oxygen lines for chafing, corrosion, flat spots and irregularities, that is, sharp bends, kinks, and inadequate security.
(b) Check fittings for corrosion around the threaded area where lines are joined together. Pressurize the system and check for leaks. (Reference c(2) (b) 4.)
CAUTION: In pressurizing the system, actuate the valve slowly to avoid surging which could rupture the line.

(3) Regulators, Valves, and Gauges.
(a) Examine all parts for cracks, nicks, damaged threads or other apparent damage.
(b) Actuate regulator controls and valve to check for ease of operation.
(c) Determine if the gauge is functioning properly by observing the pressure build-up and the return to zero when the system oxygen is bled off.

(4) Masks and Hoses.
(a) Check the oxygen mask for fabric cracks and rough face seals. If the mask is a full face model, inspect glass or plastic for cleanness and state of repair.
(b) When appropriate, with due regard to hygienic considerations, the sealing qualities of an oxygen mask may be tested by placing thumb over connection at end of mask tube and inhaling very lightly. Remove thumb from disconnect after each continuous inhalation. If there is no leakage, mask will adhere tightly to face during inhalation and definite resistance to inhalation will be noticeable.
(c) Flex the mask hose gently over its entirety and check for evidence of deterioration or dirt.
(d) Examine the mask and hose storage compartment of cleanliness and general condition.
(e) If the mask and hose storage compartment is provided with a cover or release mechanism, check its operation.

c. Maintenance.

(1) Oxygen Tanks, Cylinders, and Hold Down Brackets.
(a) Remove from service any cylinders that show signs of abuse, dents, bulges, cracks, distortion, damaged threads, or defects which might render the cylinder unsafe. Typical examples of oxygen cylinder damage are shown in figure 8.7.
(b) When replacing an oxygen cylinder, be certain that the replacement cylinder is of the same size and weight as the one removed.
NOTE: Cylinders having greater weight or size will require strengthened cylinder mounting brackets, and a reevaluation to determine that the larger or heavier cylinder will not interfere with adjacent systems, components, or structural members, and that the strength of attaching structure is adequate.

(c) Replace or repair any cylinder mounting brackets that show sign of wear. Visible cracks may be welded in accordance with Chapter 2, Section 2 of this Advisory Circular. Replace cylinder straps or clamps that show wear or abuse. For typical mounting bracket crack and failure, see figure 8.8.

(2) Lines and Fittings.
(a) Replace any oxygen line that is chafed, rusted, corroded, dented, cracked, or kinked.
(b) Clean oxygen system fittings showing signs of rusting or corrosion in the threaded area. To accomplish this, use a cleaner recommended by manufacturers of oxygen equipment. Replace lines and fittings that cannot be cleaned.

1. The high pressure lines which are located between the oxygen bottle, outside oxygen service filler, and the regulator are normally fabricated from stainless steel or thickwall, seamless copper alloy tubing. The fittings on high pressure lines are normally silver soldered.
NOTE: Use silver alloys free of cadmium when silver soldering. The use of silver solder which contains cadmium will emit a poisonous gas when heated to a molten state. This gas is extremely hazardous to health if inhaled.
2. The low pressure lines extend from the pressure regulator to each passenger and crew oxygen outlet. These lines are fabricated from seamless aluminum alloy, copper, or flexible hose. Normally, flare or flange-type connections are used. (Reference Chapter 10, Section 1, paragraph 393b of this Advisory Circular.)
CAUTION: Do not allow oil, grease, flammable solvent, or other combustibles such as lint or dust to come in contact with threads or any parts that will be exposed to pressurized oxygen.
3. It is advisable to purge the oxygen system any time work has been accomplished on any of the lines and fittings. Use dry nitrogen or dry air for purging the system. All open lines should be capped immediately after purging.
4. When oxygen is being lost from a system through leakage, a sequence of steps may be necessary to locate the opening. Leakage may often be detected by listening for the distinct hissing sound of escaping gas. If this check proves negative, it will be necessary to soap test all lines and connections with a castile soap and water solution or specially compounded leak test material. Make the solution thick enough to adhere to the contours of the fittings. At the completion of the leakage test, remove all traces of the soap and water.
CAUTION: Do not attempt to tighten any connections while the system is charged.

(3) Regulators, Valves, and Gauges. Line maintenance of oxygen regulators, valves, and gauges does not include major repair. These components are precision made and their repair usually requires the attention of a repair station or the manufacturer. Care must be taken when reinstalling these components to ascertain if the threaded area is free of nicks, burrs, and contaminants that would prevent the connections from sealing properly.

CAUTION: Do not use petroleum lubricants on these components.

(4) Masks and Hoses.

(a) Troubleshooting. If a mask assembly is defective (leaks, does not allow breathing, or contains a defective microphone), it is advisable to return the mask assembly to the manufacturer or a repair station.

(b) Maintenance Practice and Cleaning.

1. Clean and disinfect mask assemblies after use, as appropriate.

NOTE: Use care to avoid damaging microphone assembly while cleaning and sterilizing.

2. Wash mask with a mild soap solution and rinse it with clear water.

3. To sterilize, swab the mask thoroughly with a gauze or sponge soaked in a water merthiolate solution. This solution should contain 1/5 teaspoon of merthiolate per 1 quart of water. Wipe the mask with a clean cloth and air dry.

4. Replace the hose if it shows evidence of deterioration.

5. Hoses may be cleaned in the same manner as the mask.

6. Observe that each mask breathing tube end is free of nicks, and that the tube end will slip into the cabin oxygen receptacle with ease and not leak.

d. Functional Testing After Repair. Following repair, and before inspection plates, cover plates, or upholstering are replaced, test the entire system.

(1) Open cylinder valve slowly and observe the pressure gauge on a high pressure system. A pressure of approximately 1,800 psi (at 70° F.) should be indicated on the gauge. (Cylinder pressure will vary considerably with radical temperature changes.)

(a) Check system by installing one of the mask hose fittings (minus the mask) in each of the cabin wall outlets to determine whether there is a flow. If a demand mask is used, check by breathing through the mask (if appropriate, clean mask according to Paragraph c(4) (b)) to see whether there is a flow of oxygen.

(b) Check the complete system for leaks in accordance with the procedure outlined in c(2)(b)4.

(c) If leaks are found, close the cylinder valve; open an outlet to reduce the pressure in the system to zero.

(2) A pressure drop check of the system may be made as follows:
(a) Open the cylinder valve and pressurize the system. Observe the pressure gauge (a pressure of approximately 1,800 psi at 70° F. should be indicated). For the light weight ICC 3HT 1850 cylinders, pressurize the system to approximately 1,850 psi at 70° F.
(b) Close the cylinder valve and wait approximately 5 minutes for temperatures to stabilize.
(c) Record the pressure gauge reading and temperature and after 1 hour, record the pressure gauge reading and temperature again.
(d) A maximum pressure drop of 100 psi is permissible.
NOTE: Conduct the above tests in an area where changes of temperature will be less than 10° F. in the event that a change in temperature greater than approximately 10° F. occurs during the 1 hour period, suitable corrections would be required, or reconduct the test under conditions of unvarying temperatures.

e. Service Requirements - Oxygen Cylinders. Standard weight cylinders must be hydrostatic tested at the end of each 5 year period. This is a Department of Transportation requirement. These cylinders carry an ICC or DOT 3AA 1800 classification and are suitable for the use intended. The lightweight cylinders must be hydrostatic tested every 3 years, and must be retired from service after 15 years or 4,380 pressurizations, whichever occurs first. These cylinders carry an ICC or DOT 3HT 1850 classification.
CAUTION: Use only aviation breathing oxygen when having the oxygen bottle charged. MIL-O-27210C specifies that the moisture content of aviation breathing oxygen must not exceed 0.005 milligrams of water vapor per liter of gas at a temperature of 70° F and a pressure of 760 millimeters of mercury.

(1) Charging High Pressure Oxygen Cylinders. The following are recommended procedures for charging high pressure oxygen cylinders from a manifold system, either permanently installed or trailer mounted. Never attempt to charge a low pressure cylinder directly from a high pressure manifold system or cylinder.
(a) Inspection. Do not attempt to charge oxygen cylinders if any of the following discrepancies exist:

1. Contaminated fittings on the manifold, cylinder, or outside filler valve. If in doubt, wipe with stabilized trichloroethylene; however, do not permit solvent to enter any internal parts. Let air dry.
2. Cylinder out of hydrostatic test date. DOT regulations require ICC or DOT 3AA designation cylinders to be hydrostatic tested to 5/3 their working pressure, every 5 years. Cylinders bearing designation ICC or DOT 3HT must be hydrostatic tested to 5/3 their working pressure every 3 years, and retired from service 15 years or 4,380 filling cycles after date of manufacture, whichever occurs first.
3. Cylinder is completely empty. Do not charge, as the cylinder must be removed, inspected, and cleaned.

(b) Charging.

1. Connect cylinder valve outlet or outside filler valve to manifold.
2. Slowly open valve of cylinder to be charged and observe pressure on gauge of manifold system.
3. Slowly open valve of cylinder on manifold system having the lowest pressure and allow pressure to equalize.
4. Close cylinder valve on manifold system and slowly open valve of cylinder having next highest pressure. Continue this procedure until the cylinder has been charged in accordance with e(1)(d), Table of Filling Pressures.

(c) Top-off. After the cylinder has been filled in accordance with the filling table (shown under e(1)(d)):

1. Close all valves on manifold system.
2. Close valve on filled cylinder and remove the cylinder from the manifold.
3. Using leak detector, test for leakage around cylinder valve threaded connections. (If leakage is present, discharge oxygen and return cylinder to facility for repair.)
4. Let cylinder stabilize for period of at least 1 hour, and then recheck pressure.
5. Make any necessary adjustments in pressure.

(d) Table of Filling Pressures.

Initial Temp (°F)	Filling Pressure (psi)
0	1,650
10	1,700
20	1,725
30	1,775
40	1,825
50	1,875
60	1,925
70	1,975
80	2,000
90	2,050
100	2,100
110	2,150
120	2,200
130	2,250

Initial Temperature - Refers to ambient temperature in filling room.
Filling Pressure - Refers to the pressure to which aircraft cylinders should be filled. This table gives approximations only, and assumes a rise in temperature of approximately 25° F due to heat of compression. This table also assumes the aircraft cylinders will be filled as quickly as possible and that they will only be cooled by ambient air; no water bath or other means of cooling being used.
Example: If ambient temperature is 70° F, fill aircraft cylinders to approximately 1,975 psi - as close to this pressure as the gauge may be read. Upon cooling, cylinders should have approximately 1,850 psi pressure.

(2) Charging of Low Pressure Oxygen Systems and Portables. For recharging a low pressure aircraft oxygen system, or portable cylinders, it is essential that the oxygen trailer or cart have a pressure reducing regulator. Military types E-2 or C-1 reducing regulators are satisfactory. These types of regulators reduce the large cylinder pressure from 2,000 psi to a line pressure of 450 psig. (A welding pressure reducing regulator is not satisfactory.)
CAUTION: When refilling the low pressure system or portable cylinders, open the oxygen filler tank valve slowly to allow the system or portable cylinders to be filled at a slow rate. After the refilling operation is completed, check for leaks with a leak detector. If a leak is detected, paragraph c(2)(b)4 should be referred to for corrective action.

WINDSHIELDS, ENCLOSURES, AND EXITS

Section 1. PLASTIC WINDSHIELDS AND ENCLOSURES

375. GENERAL

These repairs are applicable to plastic windshields, enclosures, and windows in nonpressurized airplanes. For pressurized airplanes replace or repair plastic elements in accordance with the manufacturer's recommendation.

a. Types of Plastics. Two types of plastics are commonly used in transparent enclosures of aircraft. These materials are known as acrylic plastics and polyester plastics.

376. REPLACEMENT PANELS

Use material equivalent to that originally used by the manufacturer of the aircraft for replacement panels. There are many types of transparent plastics on the market. Their properties vary greatly, particularly in regard to expansion characteristics, brittleness under low temperatures, resistance to discoloration when exposed to sunlight, surface checking, etc. Information on these properties is in MIL-HDBK-17A, Plastics for Flight Vehicles, Part II - Transparent Glazing Materials, available from the Government Printing Office (GPO). These properties have been considered by aircraft manufacturers in selecting materials to be used in their designs and the use of substitutes having different characteristics may result in subsequent difficulties.

377. INSTALLATION PROCEDURES

When installing a replacement panel, use the same mounting method employed by the manufacturer of the airplane. While the actual installation will vary from one type of aircraft to another, consider the following major principles when installing any replacement panel:

a. Never force a plastic panel out of shape to make it fit a frame. If a replacement panel does not fit easily into the mounting, obtain a new replacement or heat the whole panel and reform. When possible, cut and fit a new panel at ordinary room temperature.

b. In clamping or bolting plastic panels into their mountings, do not place the plastic under excessive compressive stress. It is easy to develop more than 1,000 pounds per square inch on the plastic by overtorquing a nut and bolt. Tighten each nut to a firm fit, then back off one full turn.

c. In bolt installations, use spacers, collars, shoulders, or stopnuts to prevent tightening the bolt excessively. Whenever such devices are used by the airplane manufacturer, retain them in the replacement installation. It is important that the original number of bolts, complete with washers, spacers, etc., be used. When rivets are used, provide adequate spacers or other satisfactory means to prevent excessive tightening of the frame to the plastic.

d. Mount plastic panels between rubbed, cork, or other gasket material to make the installation waterproof, to reduce vibration, and to help to distribute compressive stresses on the plastic.

e. Plastics expand and contract considerably more than the metal channels in which they are mounted. Mount windshield panels to a sufficient depth in the channel to prevent it from falling out when the panel contracts at low temperatures or deforms under load. When the manufacturer's original design permits, mount panels to a minimum depth of 1-1/8 inch and with a clearance of 1/8 inch between the plastic and the bottom of the channel.

f. In installations involving bolts or rivets, make the holes through the plastic oversize 1/8 inch diameter and center so that the plastic will not bind or crack at the edge of the holes. The use of slotted holes is also recommended.

378. REPAIR OF PLASTICS

Replace extensively damaged transparent plastic rather than repair whenever possible since even a carefully patched part is not the equal of a new section either optically or structurally. At the first sign of crack development, drill a small hole at the extreme ends of the cracks as shown in figure 9.1. This serves to localize the cracks and to prevent further splitting by distributing the strain over a large area. If the cracks are small, stopping them with drilled holes will usually suffice until replacement or more permanent repair can be made. The following repairs are permissible; however, they are not to be located in the pilot's line of vision during landing or normal flight.

a. Surface Patch. If a surface patch is to be installed, trim away the damaged area and round all corners. Cut a piece of plastic of sufficient size to cover the damaged area and extend at least 3/4 inch on each side of the crack or hole. Bevel the edges as shown in figure 9.2. If the section to be repaired is curved, shape the patch to the same contour by heating it in an oil bath at a temperature of 248° to 302° F, or it may be heated on a hotplate until soft. Boiling water should not be used for heating. Coat the patch evenly with plastic solvent adhesive and place immediately over the hole. Maintain a uniform pressure of from 5 to 10 pounds per square inch on the patch for a minimum of 3 hours. Allow the patch to dry 24 to 36 hours before sanding or polishing is attempted.

b. Plug Patch. In using inserted patches to repair holes in plastic structures, trim the holes to a perfect circle or oval and bevel the edges slightly. Make the patch slightly thicker than the material being repaired and similarly bevel the edges. Install patches in accordance with figure 9.3. Heat the plug until soft and press into the hole without cement and allow to cool to make a perfect fit. Remove the plug, coat the edges with adhesive, and then reinsert in the hole. Maintain a firm light pressure until the cement has set, then sand or file the edges level with the surface; buff and polish.

379. CLEANING AND POLISHING TRANSPARENT PLASTIC

Plastics have many advantages over glass for aircraft use, but they lack the surface hardiness of glass, and care must be exercised while servicing the aircraft to avoid scratching or otherwise damaging the surface.

a. Cleaning. Clean the plastic by washing with plenty of water and mild soap, using a clean, soft, grit-free cloth, sponge, or bare hands. Do not use gasoline, alcohol, benzene, acetone, carbon tetrachloride, fire extinguisher or deicing fluids, lacquer thinners, or window cleaning sprays because they will soften the plastic and cause crazing.

b. Plastics should not be rubbed with a dry cloth since this is likely to cause scratches, and also build up an electrostatic charge which attracts dust particles to the surface. If after removing dirt and grease no great amount of scratching is visible, finish the plastic with a good grade of commercial wax. Apply the wax in a thin even coat and bring to a high polish by rubbing lightly with a soft cloth.

c. Polishing. Do not attempt hand polishing or buffing until the surface is clean. A soft, open-type cotton or flannel buffing wheel is suggested. Minor scratches may be removed by vigorously rubbing the affected area by hand, using a soft clean cloth dampened with a mixture of turpentine and chalk, or by applying automobile cleanser with a damp cloth. Remove the cleaner and polish with a soft, dry cloth. Acrylic and cellulose acetate plastics are thermoplastic. Friction created by buffing or polishing too long in one spot can generate sufficient heat to soften the surface. This will produce visual distortion and is to be guarded against.

EMERGENCY EXITS

The following material is intended as a guide for the inspection and maintenance of aircraft emergency exit provisions. Schedule inspections to coincide with all 100 hour/annual, progressive inspections or the maintenance procedures that have been approved by the Administrator. Before beginning inspection or maintenance activities of any type, consult the appropriate manufacturer's service manual for information specifying the type of exit release mechanism used.

a. Inspection. Examine the emergency exits and all associated hardware closely for deformation, excessive wear, security of attachment, lubrication, and cleanness.

(1) Doors.

(a) Inspect the door structure and skin for wrinkles, cracks, alignment with the fuselage, deep scratches, dents, loose rivets, corrosion, or any other indication of structural irregularity.

(b) Examine rubber seals for cuts, tears, excessive wear, proper contact with the entire door frame, and general deterioration.

(c) Inspect bearings, hinges, hinge fairings, latches, springs, pins, rods, handles, and related parts for wear and general condition.

(d) Examine the door jamb, frame, and supporting structure for cracks, loose fasteners, condition of stops, and corrosion or damage.

(e) Check the door for ease of operation and freedom of movement through its full range of travel.

(f) If a door warning light is provided, test it for proper operation and adjustment.

(g) Check the door locking mechanism for positive fit and at least the minimum lock pin engagement as specified in the applicable aircraft manual.

(2) Passenger Escape Hatches.

(a) Remove the escape batch. Check for ease of removal and correct functioning of the release mechanism through all angles of pull likely to be encountered during emergency conditions.

CAUTION: If applicable, position one man outside the aircraft to catch the hatch, thereby preventing it from failing and damaging the wing and/or hatch.

(b) Examine the escape hatch structure for cracks, dents, deep scratches, alignment, loose rivets and/or bolts, corrosion, or any other indication of structural irregularity.

(c) Inspect the rubber seals for excessive wear, deterioration, cuts, tears, and proper contact with the fuselage.

(d) Check the operating mechanisms for wear, cracks, and general condition; springs for proper tension, alignment, and security.

(e) If applicable, inspect external release mechanisms for wear, cracks, and proper operation. Check for presence and legibility of external placards and exit location markings.

(f) Examine the escape hatch opening jamb, frame, stops, and skin for cracks and other evidence of damage or failure.

(g) If an emergency escape rope is provided, check it for accessibility, attachment, freedom of operation, rot, broken strands, and general condition. Inspect the storage container or tube for sharp edges or moisture.

(3) Crew Compartment Sliding Windows.

(a) Inspect the window frame for cracks, dents, questionable scratches, loose rivets, corrosion, or any other indication of structural irregularity.

(b) Examine the extrusion seal for wear, general deterioration, and proper contact with the fuselage canopy.

(c) Check the window teleflex mechanism for loose bearings, wear, corrosion, and proper operation.

(d) Inspect the windows for cracks, scratches, nicks, crazing, fogging or moisture between panes, delaminations, hot spots or discoloration.

NOTE: Fogging or delaminations of windows other than windshields are generally not cause for replacement unless visibility is impaired. It is suggested the manufacturer be consulted on any question concerning windows installed in pressurized aircraft.

b. Maintenance.

(1) Lubrication. Lubricate all moving parts of the exit latching mechanisms. The following practices will generally apply when specific procedures are not available.

(a) Piano hinges and operating mechanism pivot points - oil lightly and wipe off excess. Use only oil that is compatible with the type of seal used on that specific aircraft. Do not allow the oil to contact fabrics or finished surfaces.

(b) Latch bolts and sliding surfaces - apply a light film from a graphite stick or latch lubricant (door ease).

(2) Seal Replacement. Information pertaining to special handling procedures for seals, gaskets, lubricants (dry or liquid), age limitations (shelf life), and types of adhesives may be found in the manufacturer's maintenance and overhaul manuals. Check the thickness of the seal or gasket for uniformity to prevent warping of the component, that is, hatch or door. Exercise care when using adhesives to cement seals to the hatch frame or exit door as spillage or excessive amounts could cause the exit to bind.

NOTE: Replace seals and gaskets with materials recommended by the manufacturer. Many times these materials have been changed due to service experience, therefore a check of manufacturers' service information should be made to ascertain that any replacement parts, materials, etc., are those currently recommended.

(3) Hatch/Window Replacement. Check replacement hatches or windows for proper size and fit to preclude opening problems. Improper loading of the aircraft or an accident may cause binding of the hatch/window if inadequate clearance exists.

(4) Emergency Exit Service Difficulties. Emergency exits that fail to open unless extreme force is exerted are usually caused by one of the following:

(a) Paint or primers on the mating surfaces of the exit which are not allowed to dry completely. As a result, the surfaces will stick to each other.

(b) Latches that bind or fail to work unless pulled straight out.

(c) Failure to lubricate mating or rubbing surfaces.

(d) Failure to operate exits after final assembly. The exits may perform satisfactorily before the airplane is painted, but the finishing process results in the application of solvents, cleaners, primers, and paint finishes that may tend to make the exit inoperable. Check the exit for ease of release after painting and finishing of an aircraft.

c. Operational Considerations.

(1) Placards. Check to assure that all required placards and markings are installed (FAR 23.1557(d) or 25.811). Make certain that curtains, drapes, clothes racks, etc. do not cover the placard or the exit operating handle. When the normal exit identification signs are obstructed by compartmentation, galleys or other similar furnishings, use signs which contain the word "EXIT" and appropriate arrows to direct the attention of occupants to the exit locations.

(2) Precautions. Following any cabin interior modifications or configuration changes, check the accessibility and operation of emergency exits by actual operation of the exit.

(a) Certain types of escape hatches have release handles which will not reinstall the lock pins into their locked position. If this type of release handle is pulled to any degree, either intentionally or inadvertently, it is necessary to ascertain that the locking pins are in position and safetied.

(b) Safety wire used to secure aircraft egress provisions should be of the type recommended by the manufacturer. Do not use stainless steel or other types of stiff wire. Acceptable substitutes would be either 0.011" copper or 0.020" aluminum soft safety wire.

(c) Some aircraft have inflatable door seals which assure a positive sealing capability during pressurization. Check these systems for proper operation in accordance with the manufacturer's maintenance instructions.

(d) Ascertain that seatbacks, tables, cabinets and other furnishings cannot interfere with the accessibility and opening of any exit either from inside or outside of the aircraft.

(3) Power Assist Devices. Some aircraft are presently equipped with powered systems to assist in door opening. It is imperative that the manufacturers' service instructions and manuals be reviewed before any maintenance is performed on such systems. These devices are usually hydraulically powered and, during an emergency condition, utilize a high pressure bottle system as an alternate source (pneumatic or CO_2). Future designs will quite possibly involve various combinations of hydraulic, electrical, or pneumatic units. Strict attention to all servicing procedures will be essential to assure proper functioning of the power assist device when needed in an emergency.

WEIGHT AND BALANCE

656. GENERAL

The removal or addition of equipment results in changes to the center of gravity and empty weight of the aircraft, and the permissible useful load is affected accordingly. Investigate the effects of these changes, otherwise the aircraft flight characteristics may be adversely affected. Information on which to base the record of weight and balance changes to the aircraft may be obtained from the pertinent aircraft specification, the prescribed aircraft operating limitations, airplane flight manual, and the aircraft weight and balance report. Removal or addition of minor items of equipment such as nuts, bolts, rivets, washers, and similar standard parts of negligible weight on fixed-wing aircraft do not require a weight and balance check. Since rotorcraft are in general more critical with respect to control with changes in CG positions, the procedures and instructions in the particular model maintenance or flight manual should be followed.

657. TERMINOLOGY

The following terminology is used in the practical application of weight and balance control.

a. Maximum Weight. The maximum weight is the maximum authorized weight of the aircraft and its contents as listed in the specifications.

b. Empty Weight. The empty weight of an aircraft includes all operating equipment that has a fixed location and is actually installed in the aircraft. It includes the weight of the airframe, powerplant, required equipment, optional and special equipment, fixed ballast, full engine coolant, hydraulic fluid, and the fuel and oil as explained in paragraph 658 f and g. Additional information regarding fluids which may be contained in the aircraft systems and which must be included in the empty weight will be indicated in the pertinent aircraft specifications whenever deemed necessary.

c. Useful Load. The useful load is the empty weight subtracted from the maximum weight of the aircraft. This load consists of the pilot, crew if applicable, maximum oil, fuel, passengers, and baggage, unless otherwise noted.

d. Weight Check. A weight check consists of checking the sum of the weights of all items of useful load against the authorized useful load (maximum weight less empty weight) of the aircraft.

e. Datum. The datum is an imaginary vertical plane from which all horizontal measurements are taken for balance purposes with the aircraft in level flight attitude. The datum is indicated on most FAA Aircraft Specifications. On some of the older aircraft, where the datum is not indicated, any convenient datum may be selected. However, once the datum is selected, all moment arms and the location of the permissible CG range must be taken with reference to it. Examples of typical locations of the datum are shown in figure 13.1.

f. Arm (or Moment Arm). The arm is the horizontal distance in inches from the datum to the center of gravity of an item. The algebraic sign is plus (+), if measured aft of the datum, and minus (-) if measured forward of the datum. Examples of plus and minus arms are shown in figure 13.2.

g. Moment. Moment is the product of a weight multiplied by its arm. The moment of an item about the datum is obtained by multiplying the weight of the item by its horizontal distance from the datum. A typical moment calculation is given in figure 13.3.

h. Center of Gravity. The center of gravity is a point about which the nose heavy and tail heavy moments are exactly equal in magnitude. If the aircraft were suspended from there, it would have no tendency to pitch in either direction (nose up or down). The weight of the aircraft (or any object) may be assumed to be concentrated at its center of gravity. (See figure 13.3.)

i. Empty Weight Center of Gravity. The empty weight CG is the center of gravity of an aircraft in its empty weight condition, and is an essential part of the weight-and-balance record. Formulas for determining the center of gravity for tail and nosewheel type aircraft are given in figure 13.4. Typical examples of computing the empty weight and empty weight CG for aircraft are shown in figures 13.5 and 13.6.

j. Empty Weight Center-of-Gravity Range. The empty weight center-of-gravity range is determined so that the empty weight CG limits will not be exceeded under standard specification loading arrangements. In cases where it is possible to load an aircraft in a manner not covered in the Aircraft Specification (that is, extra tanks, extra seats, etc.), complete calculations as outlined in paragraph 661. The empty weight CG range, when applicable, is listed on the Aircraft Specifications. Calculation of empty weight CG is shown in figures 13.5 and 13.6.

k. Operating Center-of-Gravity Range. The operating CG range is the distance between the forward and rearward center of gravity limits indicated on the pertinent aircraft specification. These limits were determined as to the most forward and most rearward loaded CG positions at which the aircraft meets the requirements of the Federal Aviation Regulations. The limits are indicated on the specification in either percent of mean aerodynamic chord or inches from the datum. The CG of the loaded aircraft must be within these limits at all times as illustrated in figure 13.7.

l. Mean Aerodynamic Chord (MAC). For weight and balance purposes it is used to locate the CG range of the aircraft. The location and dimensions of the MAC will be found in the Aircraft Specifications, Aircraft Flight Manual, or the Aircraft Weight and Balance Report.

m. Weighing Point. If the CG location is determined by weighing, it is necessary to obtain horizontal measurements between the points on the scale at which the aircraft's weight is concentrated. If weighed, using scales under the landing gear tires, a vertical line passing through the centerline of the axle will locate the point on the scale at which the weight is concentrated. This point is called the "weighing point." Other structural locations capable of supporting the aircraft, such as jack pads on the main spar, may also be used if the aircraft weight is resting on the jack pads. Indicate these points clearly in the weight and balance report when used in lieu of the landing gear. Typical locations of the weighing points are shown in figure 13.8.

n. Zero fuel weight. Zero fuel weight is the maximum permissible weight of a loaded aircraft (passengers, crew, cargo, etc.) less its fuel. All weights in excess of maximum zero fuel weight must consist of usable fuel.

o. Minimum fuel. Minimum fuel for balance purposes is 1/12 gallon per maximum-except-takeoff horsepower (METO), and is the maximum amount of fuel which could be used in weight and balance computations when low fuel might adversely affect the most critical balance conditions. To determine the weight of fuel in pounds divide the METO horsepower by two.

p. Full Oil. Full oil is the quantity of oil shown in the aircraft specifications as oil capacity. Use full oil as the quantity of oil when making the loaded weight and balance computations.

q. Tare. Tare is the weight of chocks, blocks, stands, etc., used when weighing aircraft, and is included in the scale readings. Tare is deducted from the scale reading at each respective weighing point where tare is involved to obtain the actual aircraft weight.

658. WEIGHING PROCEDURE

Weighing procedures may vary with the aircraft and the type of weighing equipment employed. The weighing procedures contained in the manufacturing manual should be followed for each particular aircraft.

Accepted procedures when weighing an aircraft are:

a. Remove excessive dirt, grease, moisture, etc., from the aircraft before weighing.

b. Weigh the aircraft inside a closed building to prevent error in scale reading due to wind.

c. To determine the CG, place the aircraft in a level flight attitude.

d. Have all items of equipment included in the certificated empty weight installed in the aircraft when weighing. These items of equipment are a part of the current weight and balance report. (See paragraph 662.)

e. Properly calibrate, zero, and use scales in accordance with the manufacturer's instructions. The scales and suitable support for the aircraft, if necessary, are usually placed under the wheels of a landplane, the keel of a seaplane float, or the skis of a skiplane. Other structural locations capable of supporting the aircraft, such as jack pads, may be used. Clearly indicate these points in the weight and balance report.

f. Unless otherwise noted in the aircraft specification, drain the fuel system until the quantity indicator reads "zero" or empty with the aircraft in level flight attitude. The amount of fuel remaining in the tank, lines, and engine is termed "residual fuel" and it is to be included in the empty weight. In special cases, the aircraft may be weighed with full fuel in tanks provided a definite means of determining the exact weight of the fuel is available.

g. Unless otherwise noted in the aircraft specification, the oil system should be completely drained with all draincocks open. Under these conditions, the amount of oil remaining in the oil tank, lines and engine is termed "residual oil," and it will be included in the empty weight. When weighed with full oil, actual empty weight equals the actual recorded weight less the weight of the oil in the oil tank (oil weight = oil capacity in gallons x 7.5 pounds). Indicate in all weight and balance reports whether weights include full oil or oil drained (see figure 13.9).

h. Do not set brakes while taking scale reading.

i. Note tare when the aircraft is removed from the scales.

659. WEIGHT AND BALANCE COMPUTATIONS

It is often necessary, after completing an extensive alteration, to establish by computation that the authorized weight or CG limits as shown on the Type Certificate Data Sheets and Specifications (TCDS) are not exceeded. Paragraph b. explains the significance of algebraic signs used in balance computations. The Aircraft Specifications contain the following information relating to the subject:

- Center of gravity range.
- Empty weight CG range when applicable.
- Leveling means.
- Datum.
- Maximum weights.
- Number of seats and arm.
- Maximum baggage and arm.
- Fuel capacity and arm.
- Oil capacity and arm.
- Equipment items and arm.

The FAA TCDS do not list the basic required equipment prescribed by the applicable airworthiness regulations for certification. Refer to the manufacturer's equipment list for such information.

a. Unit Weight for Weight and Balance Purposes.

Gasoline - 6 pounds per U.S. gallon.
Turbine Fuel - 6.7 pounds per U.S. gallon.
Lubricating oil - 7.5 pounds per U.S. gallon.
Crew and passengers - 170 pounds per person.

b. Algebraic signs. It is important to retain the proper algebraic sign (+ or -) through all balance computations. For the sake of uniformity in these computations, visualize the aircraft with the nose to the left. In this position any arm to the left (forward) of the datum is "minus" and any arm to the right (rearward) of the datum is "plus." Any item of weight added to the aircraft either side of the datum is plus weight. Any weight item removed is a minus weight. When multiplying weights by arms, the answer is plus if the signs are alike, and minus if the signs are unlike.

The following combinations are possible:
Items added forward of the datum -
(+) weight x (-) arm = (-) moment.
Items added to the rear of the datum -
(+) weight x (+) arm = (+) moment.
Items removed forward of the datum -
(-) weight x (-) arm = (+) moment.
Items removed rear of the datum -
(-) weight x (+) arm = (-) moment.
The total weight of the airplane is equal to the weight of the empty aircraft plus the weight of the items added, minus the weight of the items removed. The total moment of the aircraft is the algebraic sum of the empty weight moment of the aircraft and all of the individual moments of the items added and/or removed.

660. WEIGHT AND BALANCE EXTREME CONDITIONS

The weight and balance extreme conditions represent the maximum forward and rearward CG position for the aircraft. Include the weight and balance data information showing that the CG of the aircraft (usually in the fully loaded condition) falls between the extreme conditions.

a. Forward Weight and Balance Check. When a forward weight and balance check is made, establish that neither the maximum weight nor the forward CG limit listed in the Aircraft Specifications is exceeded. To make this check, the following information is needed:

(1) The weights, arms, and moment of the empty aircraft.

(2) The maximum weights, arms, and moments of the items of useful load which are located ahead of the forward CG limit; and

(3) The minimum weights, arms, and moments of the items of useful load which are located aft of the forward CG limit. A typical example of the computation necessary to make this check, using the above data, is shown in figure 13.10.

b. Rearward Weight and Balance Check. When a rearward weight and balance check is made, establish that neither the maximum weight nor the rearward CG limit listed in the aircraft specification is exceeded. To make this check, the following information is needed:

(1) The weight, arms, and moments of empty aircraft;

(2) The maximum weights, arms, and moments of the items of useful load which are located aft of the rearward CG limit; and

(3) The minimum weights, arms, and moments of the items of useful load which are located ahead of the rearward CG limit. A typical example of the computation necessary to make this check, using the above data, is shown in figure 13.11.

661. Loading Conditions and/or Placards

If the following items have not been covered in the weight and balance extreme condition checks, or are not covered by suitable placards in the aircraft, additional computations are necessary. These computations should indicate the permissible distribution of fuel, passengers, and baggage which may be carried in the aircraft at any one time without exceeding either the maximum weight or CG range.
The conditions to check are:

a. With full fuel, determine the number of passengers and baggage permissible.
b. With maximum passengers, determine the fuel and baggage permissible.

(1) Examples of the computations for the above items are given in figures 13.12, 13.13, and 13.14 respectively. The above cases are mainly applicable to the lighter type personal aircraft. In the case of the larger type transport aircraft, a variety of loading conditions is possible and it is necessary to have a loading schedule.

662. Equipment List

A list of the equipment included in the certificated empty weight may be found in either the approved Airplane Flight Manual or the weight and balance report. Enter in the weight and balance report all required, optional and special equipment installed in the aircraft at time of weighing and/or subsequent equipment changes.

a. Required equipment items are items go listed in the pertinent aircraft specification.
b. Optional equipment items are so listed in the pertinent aircraft specification and may be installed in the aircraft at the option of the owner.
c. Special equipment is any item not corresponding exactly to the descriptive information in the aircraft specification. This includes such items as flares, instruments, ashtrays, radios, navigation lights, carpets, etc.
d. Required and optional equipment may be shown on the equipment list making reference to the pertinent item number listed in the applicable specification only when they are identical to that number item with reference to description, weight, and arm given in the specification. Show all special equipment items by making reference to the item by name, make, model, weight, and arm. When the arm for such an item is not available, determine by actual measurement.

(1) Equipment Changes. The person making an equipment change is obligated to make an entry on the equipment list indicating items added, removed, or relocated with the date accomplished, and identify himself by name and certificate number in the aircraft records. Examples of items so affected are the installation of extra fuel tanks, seats, or baggage compartments. Figure 13.15 illustrates the effect on balance when equipment items are added within the acceptable CG limits and fore and aft of the established CG limits. Moment computations for typical equipment changes are given in figure 13.16 and are also included in the sample weight and balance sheet in figure 13.18.

663. SAMPLE WEIGHT AND BALANCE REPORT

Suggested methods of tabulating the various data and computations for determining the CG, both in the empty weight condition and fully loaded condition, are given in figures 13.17 and 13.18, respectively, and represent a suggested means of recording this information. The data presented in figure 13.17 have previously been computed in figures 13.10 and 3.11 for the extreme load conditions, and figure 13.16 for equipment change and represent suggested means of recording this information.

664. INSTALLATION OF BALLAST

Ballast is sometimes permanently installed for CG balance purposes as a result of installation or removal of equipment items and is not used to correct a nose up or nose down tendency of an aircraft. It is usually located as far aft or as far forward as possible in order to bring the CG position within acceptable limits with a minimum of weight increase. Permanent ballast is often in the form of lead plate wrapped around and/or bolted to the fuselage primary structure (tail-post, longerons, or bulkhead members). Permanent ballast invariably constitutes a concentrated load; therefore, the strength of the local structure and the attachment of the ballast thereto should be investigated for the design loading conditions pertinent to the particular aircraft. Placard permanent ballast "Permanent ballast –do not remove." It is not desirable to install permanent ballast by pouring melted lead into the tail-post or longerons, due to difficulties that may be encountered in subsequent welding repair operations. It should be noted that the installation of permanent ballast results in an increase of aircraft empty weight. See figure 13.19 for ballast computation. When disposable ballast is carried, the local strength of the compartment in which the ballast is carried and the effect of the ballast on aircraft balance and weight should be investigated.

665. LOADING SCHEDULE

The loading schedule should be kept with the aircraft and usually forms a part of the airplane flight manual. It includes instructions on the proper load distribution, such as filling of fuel and oil tanks, passenger seating, restrictions of passenger movement; distribution of cargo, etc.

a. Other means of determining safe loading conditions, such as the use of a graphical index, load adjuster, etc., are acceptable and may be used in lieu of the information in paragraph 661.

b. Compute a separate loading condition when the aircraft is to be loaded in other than the specified conditions shown in the loading schedule.

INSTRUMENTS

Section 1. MAINTENANCE OF INSTRUMENTS

864. GENERAL

The complexity of modern instruments, integrated flight systems, autopilots, air data computers, and inertial guidance systems necessitates complex maintenance procedures, sophisticated test equipment, and qualified personnel. The safety of aircraft operated in the National Airspace System is dependent in a large degree upon the satisfactory performance of airborne instrument systems. It is, therefore, important that maintenance be accomplished using the best techniques and practices to assure optimum performance. The term "system'" as used in this chapter means those units of power source, sensors, transmitters, indicator, and controllers which together perform a function of display, interpretation, or control of the functions of an aircraft, its systems, or the environment in which it operates.

865. DEFINITION

The definition of an instrument means a device using an internal mechanism to show visually or aurally the attitude, altitude, or operation of an aircraft or aircraft part. It includes electronic devices for automatically controlling an aircraft in flight.

866. MAINTENANCE OF INSTRUMENTS

Repairs and overhaul of aircraft instruments should be made only by a Federal Aviation Administration (FAA) approved facility having proper test equipment, adequate manufacturer's maintenance manuals and service bulletins, and qualified personnel. Details concerning the repair and overhaul of various instruments differ considerably. Test, repair, and adjust instruments and instrument systems in accordance with the manufacturer's maintenance instructions, manuals, and applicable Federal Aviation Regulations (FAR). Consult the airframe manufacturer for specific maintenance instructions involving instruments that are installed or supplied by them.

867. TEST/ADJUSTMENT OF INSTRUMENTS

Certain instruments, such as altimeters and vertical speed (rate of climb) indicators, are equipped with simple adjusting means. The barometric correlation adjustment should not be adjusted in the field; changing this adjustment may nullify the correspondence between the basic test equipment calibration standards and the altimeter. Additionally, correspondence between the encoding altimeter and its encoding digitizer or the associated blind encoder may be nullified. These adjustments should be accomplished by qualified personnel, using proper test equipment and adequate reference to the manufacturer's maintenance manuals.

867-1. LIQUID QUANTITY INDICATING SYSTEM

Any time a component is changed in a liquid quantity indication system, the system shall be calibrated. This applies to all aircraft liquid systems such as fuel, oil, alcohol, etc. Refer to applicable aircraft maintenance manual for procedures.

868. REPLACEMENT OF COMPONENTS

Replace damaged or defective instruments with identical serviceable components or components equivalent to the original in electrical and mechanical characteristics, operating tolerances, and the ability to function in the physical environmental conditions encountered in the operation of the aircraft. The replacement of instruments with other than identical or optional approved instruments may require FAA approval. Consult type certificate data sheet or parts manual. Be sure all shipping plugs and gyro caging devices that may have been installed for shipping purposes are removed before installing an instrument. Check new installations carefully prior to applying electrical power or connecting test equipment to avoid damaging sensitive mechanisms. Test the new instrument after installation for proper functioning (where applicable).

Section 2. INSPECTION AND CHECKS

880. GENERAL

Proper operation of aircraft instruments is important to safe flight. Inspection is an important part of instrument maintenance. Inspection of instruments and instrument systems should include at least the following items (where applicable):

a. Inspect external pitot-static equipment for poor condition, cleanliness and deformation.
b. Inspect instruments for poor condition, mounting, marking, broken or loose knobs, bent or missing pointers, and (where applicable) improper operation.
c. Check power-off indications of instrument pointers, tape scales, and warning flags for proper indications.
d. Apply power and chock for excessive mechanical noise, erratic or intermittent operation, failure to indicate, sluggishness or indication of excessive friction.
e. Check that erection or warmup time is not excessive, caging functions are normal, and warning flags and indicating lights and test circuits are operable.
f. Note the operation of instruments during engine runup (where applicable). Check for intermittent or improper operation of any instrument.
g. Inspect all systems for improper installation, poor general condition, apparent and obvious defects, and insecurity of attachment.

881. PERIODIC INSPECTION

Periodic inspections should be performed in accordance with applicable parts of the Federal Aviation Regulations.

882. ADDITIONAL INSPECTIONS

Periodic inspections may be supplemented by additional inspections based on the intended function of the aircraft and frequency of use. These additional inspections may be performed at any time to help maintain an airworthy aircraft. A suggested list of additional items is:

a. Check tubing connections and airframe mounts for security and condition.

b. Check pneumatic tubing for leaks, corrosion, erosion, cracks, bends and pinching, and evidence of chafing.

c. Check the instrument lighting system for range of illumination, burned out bulbs, and defective controls.

d. Check electrical connections, fuses, fuse clips and circuit breakers for proper size, security and condition.

e. Check wiring for excessive bends, chafing, excessive tension, improper support or broken lacing and ties.

f. Check for evidence of overheating or contamination of equipment by foreign matter or water. Dust, dirt, and lint contribute to overheating of equipment, poor ventilation, and malfunctioning. Special attention should be given that ventilation openings in equipment housings are open and free from obstructing lint and dust.

Section 3. INSTRUMENT POWER SOURCES

894. ELECTRICAL COMPATIBILITY

When replacing an instrument with one which provides additional functions or when adding new instruments, check the following electrical parameters (where applicable) for compatibility:

a. Voltage (AC/DC).

b. Voltage polarity (DC).

c. Voltage phase(s) (AC).

d. Frequency (AC).

e. Grounding (AC/DC).

f. System impedance matching.

g. Compatibility with system to which connected.

895. VACUUM SYSTEMS

The differential pressure to operate vacuum instruments is supplied by an engine driven vacuum pump or on a turbine engine by a pressure bleed operated venturi tube. Variation in pressure may be achieved by a pressure regulator valve according to the design requirements of the instruments; for example, 4-1/2 inches mercury differential pressure for horizon gyro and 2 inches mercury differential pressure for a turn-and-bank indicator.

a. Filters. Inspect the air filters in the vacuum system and clean or change them at any time that the vacuum system differential pressure reaches established limits. Clean or change all system filters at the same time and make any necessary pressure adjustment.

b. Tubing. A noncollapsible, flexible tubing should be used in vacuum systems when vibration isolation is required or desired.

Section 4. PITOT-STATIC SYSTEMS

907. SYSTEM COMPONENTS

Conventional design of the pitot-static system consists of pitot-static tubes or pitot tubes with static pressure ports or vents and their related heaters, if any, and includes lines, tubing, water drains and traps, and selector valves. Pressure actuated indicators such as the altimeter, airspeed, and rate-of-climb indicators, and control units such as air data transducers, and automatic pilots may be connected to the system.

908. PITOT-STATIC TUBES AND LINES

The pitot tube is installed with the axis parallel to the longitudinal axis of the aircraft unless otherwise specified by the manufacturer. When lines are attached or removed from a bulkhead feed through fitting or at a union, precautions must be taken to assure that the line attached to the opposite end is not loosened, twisted, or damaged by rotation of the fitting. Such fittings normally are provided with a hex flange for holding.

909. PRESSURE PORTS OR VENTS

Static pressure ports or vents should be mounted flush with the fuselage skin. Inspect for elevation or depression of the port or vent fitting. Such elevation or depression may cause airflow disturbances at high speeds and result in erroneous airspeed indications.

910. CLEANING OF SYSTEM

Inspect air passages in the systems for water, paint, dirt, or other foreign matter. Probe the drains in the pitot tube to remove dirt or other obstructions. Tubing diameter should be checked when a problem is experienced with drainage of the pitot-static system or freezing at altitude. If this diameter is less than 3/8 inch, it should be replaced with larger tubing. Water may not drain freely from smaller diameter lines. Water or obstructions may be removed from the lines by disconnecting them near the instrument and blowing clean, dry air through them. No instruments should be connected to the system during this process.

911. HEATER ELEMENTS

Some pitot-static tubes have replaced heater elements, while others do not have replaceable elements. Check replacement of the heater element or the entire tube for proper operation by noting either ammeter current or that the tube or port gets hot to the touch.

912. SYSTEM LEAK TESTING

Pitot-static leak tests should be made with all instruments connected to assure that no leaks occur at instrument connections. Such tests should be made whenever a connection has been loosened or an instrument replaced.

913. STATIC SYSTEM TEST

Advisory Circular AC 43-203B describes an acceptable means of complying with static system tests required by FAR Part 91, Section 91.171 and 91.172, for airplanes operated in controlled airspace under the instrument flight rule (IFR). (This circular also provides information concerning the test equipment used, and precautions to be taken when performing such tests.) Aircraft not operated in controlled airspace under IFR should be tested in accordance with the aircraft manufacturer's instructions. If the manufacturer has not issued instructions for testing static systems, the following may be used:

a. Connect the test equipment directly to the static ports, if practicable. Otherwise, connect to a static system drain or tee connection and seal off the static ports. If the test equipment is connected to the static system at any point other than the static port, it should be made at a point where the connection may be readily inspected for system integrity. Observe testing precautions given in paragraph 915.

b. Apply a vacuum equivalent to 1,000 feet altitude, (differential pressure of approximately 1.07 inches of mercury or 14.5 inches of water) and hold.

c. After one minute, check to see that the leakage has not exceeded the equivalent of 100 feet of altitude (decrease in differential pressure of approximately 0.105 inches of mercury or 1.43 inches of water).

914. PITOT SYSTEM TEST

Pitot systems should be tested in accordance with the aircraft manufacturer's instructions. If the manufacturer has not issued instructions for testing pitot systems, the following may be used:

a. Test the pitot system by sealing the drain holes and connecting the pitot pressure openings to a tee to which a source of pressure and a manometer or reliable airspeed indicator is connected.

b. Apply pressure to cause the airspeed indicator to indicate 150 knots (differential pressure 1.1 inches of mercury or 14.9 inches of water), hold at this point and clamp off source of pressure. After 1 minute, the leakage should not exceed 10 knots (decrease in differential pressure of approximately 0.15 inches of mercury or 2.04 inches of water). Warning: Do not apply suction to pitot lines.

915. PRECAUTIONS IN TESTING

Observe the following precautions in all pitot-static system leak testing:

a. Perform all other work and inspections before leak testing.

b. Use a system diagram. It will prevent applying reverse pressure to any instrument, and help determine the location of a leak while observing instrument indications.

c. Be certain that no leaks exist in the test equipment.

d. Run full range tests only if you are thoroughly familiar with the aircraft instrument system and the test equipment.

e. Pressure in the pitot system must always be equal to or greater than that in the static system. A negative differential pressure across an airspeed indicator can damage it.

f. The rate of change or the pressure applied should not exceed the design limits of any pitot or static instruments connected to the systems.

g. After the conclusion of the leak test, be certain that the system is returned to its normal flying configuration, such as removing tape from static ports and pitot tube drain holes and replacing the drain plugs, etc.

Section 5. MECHANICAL ADJUSTMENT OF MAGNETIC DIRECTION INDICATORS

927. CORRECTION FOR ERRORS

When a magnetic direction indicator does not provide satisfactory directional indications, it can be adjusted by the "ground swinging" technique to compensate for errors.

928. GROUND SWINGING

The ground swinging technique is as follows:

a. Move aircraft to a location free from influence of steel structures, underground pipes and cables, reinforced concrete, or other aircraft.

b. Place the aircraft in level flying position.

c. Check indicator for fluid level and cleanliness. If fluid is required, the compass is defective.

d. Remove compensating magnets from chambers or reset the fixed compensating magnets to neutral positions, whichever is applicable, before swinging.

e. Check the pivot friction of the indicator by deflecting the card with a small magnet. The card should rotate freely in a horizontal plane.

f. Align the aircraft with the North magnetic heading and compensate with compensating magnets. Repeat for the East magnetic heading. Then place on South and West magnetic headings and remove half of the indicated error by adjusting the compensators. Engine(s) should be running.

g. Turn the aircraft on successive 30° headings through 360°. Prepare a placard to show the correction to be applied at each of these headings. When significant errors are introduced by operation of electrical/ electronic equipment or systems, the placard should also be marked at each 30° heading showing the correction to be applied when such equipment or systems are turned on or energized.

929. REMOTE GYRO COMPASS SYSTEMS

Adjustment and compensation of remote indicating gyro compasses, polar path compasses, and other systems of this type may also be accomplished using the "ground swinging" technique. Reference should be made to the manufacturer's manual for special tools, instructions, and procedures.

Section 6. PRESERVATION AND PACKAGING

941. PRESERVATION

Preserve all instruments, serviceable or unserviceable, in accordance with the manufacturer's recommendations or other acceptable standards. Protect the unit against humidity, extreme temperatures, dust, rough handling or other damage until it is repaired or installed in an aircraft. The method used should be pickling, wrapping, sealing in plastic covering, rigid boxes with plastic or foam padding, or other methods appropriate to the instrument or subassembly.

942. STORAGE

Instruments should be stored in a location and a manner which provides maximum protection from physical damage. Serviceable instruments should remain packaged until installed in an aircraft. If a drying agent is used, the package should be dated so that the drying agent may be inspected for condition. Inspect units that remain in storage for extended periods of time for general condition and integrity of packaging and preserving materials.

943. SHIPPING

Protect the instrument from damage during shipment by sealing it in a moisture proof covering and protecting it with a drying agent. Use plastic foam, rubberized hair, or foam rubber molded to the configuration of the instrument case to support it inside a rigid shipping container. Large units may be shock mounted on fitted pallets or racks and protected with covers.