Society of Automotive Engineers, Inc.
29 West 39th Street
New York City

AERONAUTICAL RECOMMENDED PRACTICE

ARP 85 B

AIR CONDITIONING EQUIPMENT, AIRPLANE GENERAL REQUIREMENTS FOR

Issued 1-1-43
Revised 8-1-48

1. PURPOSE:

1.1 "ARP - This identification is used for design and dimention standards or performance specifications based on sound engineering principals and intended as guides for future standard engineering practices for the aircraft industry."

1.2 This recommended practice is to be considered as being currently applicable and necessarily subject to revision from time to time, due to rapid development of the aircraft industry.

1.3 The following recommendations are based on practical engineering requirements for the design and testing of such types of heating and ventilating equipment as are now used on airplanes and for such as may be developed to meet the demand imposed in the field of service.

2. SCOPE:

2.1 Air Conditioning System - General - Dealing with design features.

2.2 Air Conditioning Equipment - Commercial Passenger - Dealing with features. Applicable only to commercial passenger carrying aircraft.

2.3 Desirable Design Features - General information for use of those concerned in meeting requirements contained herein.

3. AIR CONDITIONING SYSTEM - GENERAL:

3.1 Definition.

3.1.1 An aircraft air conditioning system should consist of the following:

a. A source of heat.
b. A source of fresh air. (If a cabin supercharger is used a second source of fresh air should be employed, second source to be completely independent of the supercharger.)
c. Distribution system.
d. Exhaust system.
e. Temperature control

and may include one or more of the following:

f. Cabin supercharger and driving mechanism.
g. Intercoolers or aftercoolers.
h. Cooling unit.
i. Filters.
   (1) Dust
   (2) Smoke
   (3) Odor (or counter agents)

j. Recirculating fans.
k. Dehumidifier.
l. Humidifier.
m. Germicidal lamps.
n. Germicidal Aerosols.
o. Automatic temperature control.
p. Automatic humidity control.
q. Cabin pressure regulating valves.
r. Cabin pressure altitude selector.
s. Cabin pressure rate of change selector.
t. Cabin emergency pressure relief valve.
u. Cabin vacuum relief valve.
v. Cabin pressure dump valve.
w. A means for controlling mass flow of supply air to pressurized cabins.
x. Cabin pressure indicator.
y. Cabin temperature indicator.
z. Cabin humidity indicator.
aa. Cabin low pressure warning device.

3.2 General Recommendations:

3.2.1 Component parts of the air conditioning equipment should be constructed of materials throughout which are considered acceptable for the particular use, and should be made and furnished with the degree, uniformity and grade of workmanship generally accepted in the aircraft industry.

3.2.2 The design of the air conditioning equipment shall be such as to preclude CO concentration in excess of 1 part in 20,000 or .005 of 1%.

3.2.3 The air conditioning system should provide adequate ventilation to avoid an objectionable odor level and smoke concentration for all normal flight conditions.

3.2.4 The duct distribution system including the air inlets to the occupied space should be such as to provide for a minimum of temperature variation and air movement in accordance with values hereinafter recommended, within the air conditioned space.

3.2.5 An adequate exhaust system should be provided for removal of vitiated air.

3.2.6 A temperature control system, either manual or automatic, should be provided which will provide a means for regulating the temperature within the air conditioned space independent of engine or airplane operation.

3.2.7 The airplane heating requirement should be met at all speeds and attitudes of the airplane.

3.2.8 The heating system and the airplane insulation should be so designed that a stable average temperature condition of 75 F can be achieved within 30 minutes with an ambient temperature of -40 F during all normal conditions of flight.

3.2.9 The airplane heating requirements should be met at all altitudes from sea level to the maximum design cruising altitude of the airplane.

4. AIR CONDITIONING EQUIPMENT:

4.1 Ambient design temperatures minus 65 F.

4.1.2 Cabin and crew station temperatures should be not less than 68 F at minus 65 F outside ambient temperature.

4.1.3 Maximum desirable warm air temperature entering occupied space 200 F.

4.1.4 Cargo compartment temperatures should be not less than 40 F.

4.1.5 The following equipment temperatures should be maintained during flight:

a. Air driven instruments should be maintained at minimum of 40 F.
b. Batteries should be maintained between 40 F and 120 F.

4.1.6 The distribution of heat within any crew station and all spaces normally occupied by passengers should be adequate to prevent air temperature variations in excess of 10 F from floor to ceiling and the forward and aft portion of the space.

4.2 Ventilating requirements:

4.2.1 Air Quantities:

4.2.1.1 Sources of outside air should be capable of supplying a minimum of 1.0 lbs per minute per occupant during all normal flight conditions. Depending on the effectiveness of the distribution system and on the amount of mechanical refrigeration available, it may be necessary to provide as much as 1.2 lbs per minute per occupant of additional air in order to obtain reasonable comfort during hot weather or heavy smoking. This additional ventilation may be provided either by the primary pressure source(s) or by re-circulation provided due allowance is made for efficiency of purification apparatus used in the re-circulation system.

4.2.1.2 A minimum quantity of fresh air during warm weather unpressurized (when no mechanical cooling is available) of 3.0 pounds per minute per occupant should be provided. (Equivalent to approximately 40 CFM per person at sea level.)

4.2.1.3 In addition to the minimum quantity of fresh air stipulated an additional quantity of cabin air may be recirculated in order to provide proper temperature distribution and lower air inlet temperatures during heating.

4.2.1.4 Toilets and galleys should be provided with adequate exhaust systems which will preclude the possibility of any air supplied to such spaces moving into any other occupied portion of the airplane, either through doors or recirculating systems.

4.2.1.5 Air velocity in occupied spaces.

4.2.1.5.1 During heating velocity over occupants should not exceed 75 feet per minute.

4.2.1.5.2 During cooling (when mechanical means of cooling the ventilating air are provided) velocity over occupant should not exceed 300 feet per minute, except for individual seat air outlets.

4.2.1.6 Air Inlets.

4.2.1.6.1 General air supply to occupied spaces should be through inlets which are adjustable only for purpose of balancing the system but are not to be controllable by occupants.

4.2.1.6.2 All crew stations or points of localized heating should have inlets controllable as to quantity or temperature. Such adjustment should not affect the overall balance of the distribution system.

4.2.1.6.3 Sleeper airplanes with enclosed berths should be provided with an inlet to each berth partially controllable by the occupant.

4.3 Pressurizing: See SAE Aeronautical Recommended Practice entitled "Airplane Cabin Pressurization."

4.4 Cooling:

4.4.1 Design Conditions:

4.4.1.1 Ambient Conditions - The average maximum temperature coincident with the average maximum humidity values for the four warmest months of the year in the territory where the airplane is to be operated should be used. For operation within the continental United States, values of 100 F dry bulb and 33% relative humidity at sea level are considered satisfactory.

4.4.1.2 Cabin conditions - A dry bulb and relative humidity (within the limits of 30% and 70%), the combination of which do not exceed an effective temperature of 80 F, should be used.

(Note: As defined in the American Society of Heating and Ventilating Engineers, Heating, Ventilating and Airconditioning Guide, "Effective temperature is an empirically determined index of the degree of warmth perceived on exposure to different combinations of temperature, humidity and air movement.")

4.4.1.3 The cooling load should, in addition to all normal existing loads, in the case of pressurized airplanes, include the heat of compression from the pressure source in order to permit use of the pressurizing system to control the rate of cabin pressure change from takeoff during warm weather operation.

4.4.1.4 When cooling is accomplished by some form of the air cycle system:

4.4.1.4.1 If the airplane is pressurized the source of pressure for pressurization of the cabin can usually be employed at lower altitudes as a source of pressure for an air cycle system.