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AERONAUTICAL RECOMMENDED PRACTICE

ARP 85A

HEATING AND VENTILATING EQUIPMENT, AIRPLANE- GENERAL REQUIREMENTS FOR

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I. INTRODUCTION

These specifications are to be considered as being currently applicable and necessarily subject to revision from time to time, due to rapid development of the aircraft industry. The National Aircraft Standards Committee is developing a more complete standard covering design criteria for airplane heating and ventilating systems and installations. This NASC standard will supersede ARP-85 when available.

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.

The SAE does not recommend, approve or endorse any specific type of heating or ventilating equipment and does not intend to limit the manufacturer's right to choose any design and type of construction so long as the equipment conforms to the general requirements herein set forth.

II. SCOPE

This specification is written to cover heating and ventilating equipment under four main classifications, namely;

A. HEATING AND VENTILATING EQUIPMENT - GENERAL - Dealing with features applicable to all makes and uses.

B. HEATING AND VENTILATING EQUIPMENT - MILITARY - Dealing with features applicable only to military aircraft.

C. HEATING AND VENTILATING EQUIPMENT - COMMERCIAL - Dealing with features applicable only to commercial aircraft.

D. DESIRABLE DESIGN FEATURES - General information for use of those concerned in meeting requirements contained herein.

III. HEATING AND VENTILATING EQUIPMENT - GENERAL

A. DEFINITION.

1. The heating and ventilating equipment of an airplane comprises:

   a. A source of heat.

   b. Air induction system.

   c. Distribution system.

   d. Exhaust system.

   e. Temperature control.

2. Nomenclature used in this specification and which are not defined elsewhere are listed with definitions below:

   a. Cabin, Pressurized - An airplane cabin which is sealed and so constructed as to permit the maintaining of a comfortable altitude pressure inside when operating at high altitudes.

   b. Cabin, Unpressurized - An airplane cabin constructed in the conventional way and not designed for pressurization.

   c. Distribution System - That combination of ducts, cabin inlet air openings and individual air inlet vents which distributes the air conditioning supply to the cabin.

   d. Exhaust System - That combination of air discharge vents and outlet grilles that permits the discharge of air from the cabin to the outside in the cycle of heating or ventilating of the airplane.

   e. Induction System - That combination of scoops and ducts which introduces outside air to the air distribution equipment of the airplane.

   f. Temperature, Ambient - The temperature surrounding the unit under consideration.

B. GENERAL REQUIREMENTS.

1. Component parts of the heating and ventilating equipment shall be so constructed as to permit compliance with existing Government specifications or others which may apply. Equipment shall be constructed of materials throughout which are considered acceptable for the particular use, and shall be made and furnished with the degree, uniformity and grade of workmanship generally accepted in the aircraft industry, and satisfactory to the user.

2. The design of the heating and ventilating equipment shall be such as to preclude the possibility of CO concentration in excess of 1 part in 20,000 or .005 of 1%.

For methods of determination of CO concentration, refer to U.S. Army Airplane Designers Hand Book, Section II, Part III - "Flight Test."

C. RATING AND TEST REQUIREMENT.

1. Flight speed

a. The airplane heating requirement shall be met both at the speed of best rate of climb at 2000 feet, and at the speed and power for maximum range.

2. Minimum Altitude

a. The minimum altitude for the airplane heating requirement shall be at or above the critical altitude of the engine.

3. Temperature Distribution Measurement

a. Measurements of cabin air temperature shall be taken to show that when heating during flight the temperature variation shall not exceed the limits specified in IV A-6 (Military)and V A-6(Commercial).

b. Measurements of equipment temperature shall be taken at all critical points on or within the equipment.

c. Method of Measurement -

(1) For actual air temperature; it is recommended that standard accepted type thermo couples, properly shielded against radiation, in combination with standard temperature recording equipment be used.

(2) For apparent temperature as will be experienced by personnel or equipment due to combination of radiation and air temperature, thermo couples should be bare or preferably embedded in a block of blackened metal.

4. Velocity Measurements

a. Measurements shall be made to show that flow velocities in all occupied zones are within the limits specified in parts IV, (Military) and V, (Commercial) of this specification.

b. Method of Measurement -

(1) It is recommended that a velocity meter of the instantaneous direct reading type be used for all air velocity measurements.

5. Cabin Air Flow Quantity Measurements

a. Measurements shall be made at a suitable point in the duct equipment where maximum possible airflow is available.

b. Method of Measurement of total flow. (Refer to Section VI-F)

D. EQUIPMENT CONTROL.

The heating system shall be capable of control within the limits herein specified without necessitating the shutting off of the heater when ambient outside air temperature reaches a maximum of 60° Fahrenheit.

E. TEST REPORT.

The responsible manufacturer shall furnish the user with a complete test report to show that requirements as outlined herein have been met. Where climatic conditions do not permit tests under design conditions, the manufacturer may supplement the test report with reasonable calculated data.

IV. HEATING & VENTILATING EQUIPMENT - MILITARY REQUIREMENTS

A. TEMPERATURES RECOMMENDED.

1. Outside Ambient Temperature for design calculations at sea level pressure of 29.92 inches Hg.

a. Unpressurized cabin - Minus 65° F)

b. Pressurized cabin - Minus 65° F)

2. Design cabin and crew station temperatures:

a. Minimum temperature - Plus 50° F at Minus 65° F Outside Air Temperature.

b. Desirable average temperature range - Plus 50° F to 60° F during heating conditions.

3. Design inlet temperatures:

a. Maximum desirable entering warm air temperature - Plus 250° F.

4. Cargo Compartments:

a. Minimum temperature - Plus 40° F.

5. Equipment Temperatures:

a. The following equipment shall be maintained during flight at the temperatures shown:

(1) Batteries - No requirement
(2) Ammunition - No requirement
(3) Gun Breeches - Plus 35° F Min with muzzle open
(4) Bomb Sights - Plus 5° F Min
(5) Gunners Turret Mechanism - Plus 35° F Min
(6) Air Driven Instruments
Gyro Instruments - Minus 30° F Min
All other Instruments - Minus 50° F Min
(7) Photographic Equipment - Plus 40° F Min
(8) Oxygen Pressure Reduction Regulators-Plus 70°F to Plus 160°F

b. All equipment having optical systems shall be furnished with defrosting and defogging means.

6. The maximum temperature variation shall be ± 10° Fahrenheit in any crew station and in all spaces normally occupied by passengers.

B. AIR VELOCITIES.

1. Drafts - Crew Station:

a. Maximum permissible velocity in any direction - 300 ft. per minute during heating.

C. AIR QUANTITIES

1. Fresh Air:

a. Minimum quantity of fresh air passing through the heater ducts during extreme cold weather - 15 cubic feet per minute per occupant at sea level.

b. Quantity of fresh air during hot weather unpressurized operation shall not be less than 1.75 lbs. per minute per occupant (23 CFM of standard sea level air per occupant).

2. Recirculated Air:

a. In addition to the stipulated minimum fresh air supply, it is permissible to recirculate an additional quantity of cabin air in order to meet the heating requirements.

V. HEATING AND VENTILATING EQUIPMENT - COMMERCIAL REQUIREMENTS

A. TEMPERATURES RECOMMENDED.

1. Design outside ambient temperature:

a. Unpressurized cabin - Minus 65° F

b. Pressurized cabin - Minus 65° F

2. Design Cabin and Cockpit Temperature:

a. Minimum temperature - Plus 68° F at design ambient temperature.

b. Desirable average temperature range - Plus 68° F to Plus 76° F during heating conditions.

3. Design inlet temperatures

a. Maximum desirable entering warm air temperatures - Plus 160° F

b. Average desirable entering warm air temperature - Plus 125° F

4. Cargo Compartments:

a. Minimum temperature - Plus 40° F

5. Equipment Temperatures:

a. Air driven instruments shall be maintained at a minimum of Plus 40° F

b. Batteries shall be maintained between Plus 40° F and Plus 110° F during flight.

6. The maximum temperature variation shall be ± 4° F in any crew station and in all spaces normally occupied by passengers.

B. AIR VELOCITIES

1. Drafts - Crew or Passenger Station:

a. Maximum velocity in any direction - 100 feet per minute during heating.

C. AIR QUANTITIES

1. Fresh Air:

a. Minimum quantity of fresh air passing in heater ducts during extreme cold weather - 1.92 lbs. per minute per occupant. (25 CFM of standard sea level air per occupant)

b. Quantity of fresh air during hot weather operation shall not be less than 3.06 lbs. per minute per occupant. (42 CFM of standard sea level air per occupant)

2. Recirculated Air:

a. In addition to the stipulated minimum fresh air supply, it is permissible to recirculate an additional quantity of cabin air in order to meet the heating requirements.

D. HUMIDITY

Means shall be provided, or the system shall be so designed to insure a minimum of fog or condensation on the interior of the airplane.

VI. DESIRABLE DESIGN FEATURES

A. HEATING SYSTEM

1. Should be capable of limited ground operation with no outside source of power (Military)

2. Should be capable of satisfactory operation during power off of any one engine on multi-engined aircraft.