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AEROSPACE RECOMMENDED PRACTICE

ARP 292B

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AIR CONDITIONING, HELICOPTER, GENERAL REQUIREMENTS FOR

1. PURPOSE

1.1 The purpose of this recommended practice is to provide the aerospace industry with a standard to which helicopter air conditioning systems may be designed for the civil aircraft industry.

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

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

2. SCOPE

These recommendations are written to cover the general requirements of helicopter air conditioning and are sub-divided as follows:

(1) Air Conditioning System - Dealing with the general design aspects.

(2) Air Conditioning Equipment - Design requirements for satisfactory system function and performance.

(3) Air Conditioning System Design Requirements - General information for use of those concerned in meeting requirements contained herein.

3. AIR CONDITIONING SYSTEM

3.1 Definition

3.1.1 A helicopter air conditioning system should consist of at least the following:

a. A source of heat
b. A source of ventilating air
c. Distribution system
d. Temperature control system
e. Exhaust system

3.1.2 The system may also include one or more of the following:

a. Cooling unit
b. Filters
   1) Dust
   2) Smoke
   3) Odor (or counter-agents)
c. Recirculating fan
d. Dehumidifier
e. Gabin temperature indicator
f. Individual passenger fresh air outlet system
g. Equipment cooling provisions
h. Defog and/or defrost system

3.2 General Recommendations

3.2.1 The design of the air conditioning system should be such as to preclude the possibility of introduction of harmful concentrations of any toxic, combustible, or objectionable fluids or gases from the helicopter or engine such as exhaust gases, de-icer fluids, fuel or the fumes therefrom. Carbon monoxide should not exceed concentration in fifty parts per million (0.005 percent) by volume under all operating conditions.

3.2.2 The air conditioning system should provide adequate ventilation for all flight and ground conditions.

3.2.3 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 should provide air movement in accordance with values hereinafter recommended within the air conditioned space.

3.2.4 A means should be provided to remove smoke or other contaminants resulting from equipment malfunction or fire. Windows or doors may be used for this purpose.

3.2.5 A temperature control system, either manual or automatic, should be included and should provide a means of regulating the temperature within the air conditioned space.

3.2.6 Air conditioning requirements should be met at all speeds, directions of flight, hovering, and altitudes.

3.2.7 Consideration should be given to materials utilized and to the location of components and connections to assure a minimum fire hazard from the heating system (i.e., insulation, location of the fuel drains, hydraulic and oil lines, tank vents, etc.). See applicable portions of ARP 266.

3.2.8 The consideration of minimum weight is of extreme importance in the design of the air conditioning system and component equipment for helicopters because weight control is more critical in helicopters than fixed wing aircraft.

3.2.9 Consideration should be given to keeping the air conditioning system's noise below an objectionable level. (Reference MIL-A-8806)

3.2.10 It is considered acceptable operation to turn the air conditioning system off during take-off and landing because of power requirements or dirt/dust contamination.

4. AIR CONDITIONING EQUIPMENT

4.1 Component Equipment Design

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

4.1.2 Component equipment should be designed to start and operate satisfactorily at design temperatures of -65 F to +160 F local environmental (compartment) conditions and -65 F to +120 F ambient temperatures. Specific installations may require consideration of a broader range of temperatures. This range should be stipulated in the detail specification.

4.1.3 Equipment should be designed fail-safe as may be required by the function of the component or system.

4.1.4 High energy equipment must be capable of self-containment in the event of catastrophic failure. The housing or scroll of all rotating machinery should contain the fragments from rotating blades and wheel bursts (tri-hub failure) at the maximum speed that can result from any failure inducing condition or 135% of the maximum normal speed, whichever is the greater, at the pressure and temperature associated with these speeds. Containment means that fragments may penetrate the containing housing but will not pass all the way through the housing. Fragments which pass through the inlet or outlet ports of the assembly should be contained by the adjoining ducting. Protection from rotating machinery, such as fans and compressors, should be provided for personnel during ground maintenance and operating checks. Resulting leakage should not create a hazard due to excessive temperature or pressure.

4.1.5 All equipment should be designed to withstand the vibration envelope shown in Fig. 1. Particular attention should be paid to resonances which may be excited in the blade passage frequency range of 3 to 15 cps.

5. AIR CONDITIONING SYSTEM DESIGN REQUIREMENTS

5.1 Ventilating Requirements

5.1.1 Air Quantities

5.1.1.1 Ventilation requirements for odor control varies upward from 12 cfm of fresh air per person, depending on the volume of cabin per occupant and degree of recirculated air used if no smoking is permitted, and 20 cfm if smoking is considered in the design goal.

NOTE: These ventilation requirements have been found satisfactory with volumes of cabins per occupant between 40 and 60 cubic feet.

5.1.1.2 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 to allow cooling or heating load reduction.

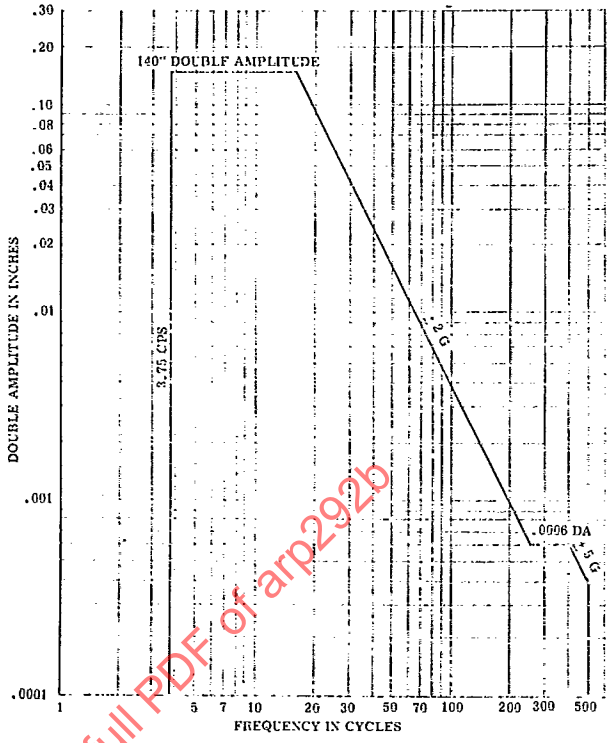


Figure 1
Ambient Vibration Envelope
Rotary Wing Aircraft

5.1.1.3 When the design does not include mechanical cooling, a minimum of 40 cfm of fresh air should be provided for each occupant during warm weather operation.

5.1.1.4 Sources of fresh air should be capable of supplying a minimum of 30 cfm of fresh air per occupant in the crew compartment. The air should not be recirculated from other compartments but, when exhausted, can be used for windshield heat, equipment cooling, etc.

5.1.1.5 If the air conditioning system is used for defogging and defrosting cockpit transparent areas, then the system should be capable of maintaining adequate visibility for all conditions of aircraft operation. For detail requirements, see MIL-T-5842.

5.1.1.6 Toilets and galleys should be provided with an exhaust system, the capacity of which will exceed the air supply in order to preclude the possibility of any air supplied to such spaces moving into any other occupied portion of the helicopter, either through doors or recirculation systems.

5.1.1.7 Air Velocity in Occupied Spaces

5.1.1.7.1 During heating or mechanical cooling, velocity over occupant should not exceed 40 fpm, except for individual seat air inlets.

5.1.1.7.2 Air velocity during ground cooling "pull-down" through the use of bypass duct systems should not exceed 200 fpm over the occupant and 600 fpm elsewhere.

5.1.1.8 Emergency Ventilation - An emergency ventilation source should be provided for use in the event of failure of the normal system.

5.1.2 Air Inlets - Main air supply to occupied spaces should be through inlets which are adjustable only for the purpose of balancing the system but are not to be controllable by the occupant.

5.2 Design Requirements for Heating, Cooling and Temperature Control

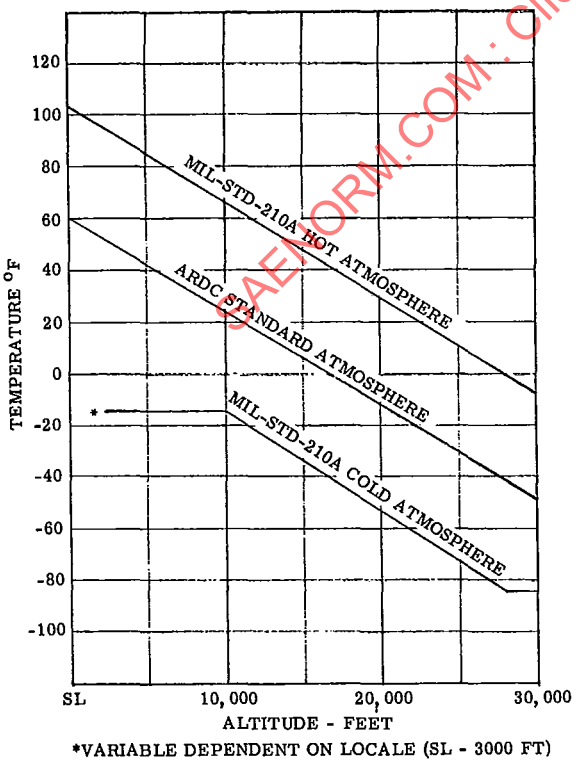
5.2.1 General:

5.2.1.1 Ambient Conditions - For particularly localized operations, the average maximum humidity and temperature values for the warmest month of the year, averaged over the last 10 years, in that area should be used for design cooling conditions. The average maximum humidity and minimum temperature values for the coldest month of the year, averaged over the last 10 years, in that area should be used for design heating conditions.

Operation within the continental United States and similar international areas, humidity and temperature conditions for design hot and cold days should be as shown on Figs. 2 and 3.

System design consideration should also be taken of the environmental factors of solar intensity, surface emissivity and helicopter airspeed.

5.2.1.2 Heating System - At normal cruise altitude, except for full cooling conditions, cabin temperature



*VARIABLE DEPENDENT ON LOCALE (SL - 3000 FT)

Figure 2

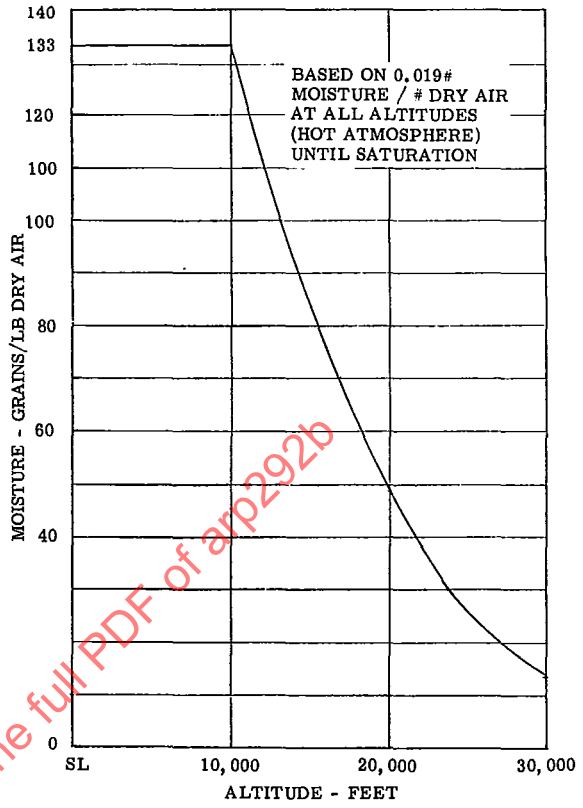


Figure 3

gradients for uniform passenger loading steady state conditions should not exceed 5 F measured in a vertical plane from 2 in. above floor level to seated head height; centerline temperature gradients should not exceed 5 F fore and aft passenger seats.

5.2.2 Cooling Load - The cold air discharge temperature should not be less than 35 F in order to prevent icing in the discharge duct, except when auxiliary means are provided to preclude the possibility of such ice formation.

The system should have the capability of maintaining a nominal cabin temperature of 75 F.

Suspended water vapor should not appear in the passenger compartments as a result of cooling system operation.

Ground "pull-down" time to reach 85% of design temperature differential on a design hot day, should not exceed 20 minutes for aircraft equipped with self-sustaining equipment or using an external power cart, aircraft closed, and no passengers aboard.

All cold air ducting should be insulated to prevent "sweating" wherever moisture collecting from condensation would have a deteriorating effect on other components or helicopter structure.

5.2.3 Heating Requirements - The heating requirements should be met at all associated helicopter speeds from sea level to the maximum design cruise altitude with a 20% passenger load.