

AIR CONDITIONING, HELICOPTERS, GENERAL REQUIREMENTS FOR

Issued 12-15-54  
Revised

1. PURPOSE:

- 1.1 This recommended practice is based on sound engineering principles and intended as guides for future standard engineering practices for the aircraft industry.
- 1.2 The detailed recommendations are based on practical engineering requirements for the design, installation, operation, and testing of such types of heating and ventilating equipment as are 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 subdivided as follows:

- 2.1 Air Conditioning System: Dealing with the general design aspects.
- 2.2 Air Conditioning Equipment: Design requirements for satisfactory system function and performance.
- 2.3 Desirable Design Features: General information for use of those concerned in meeting requirements contained herein.
- 2.4 Winterization and Pre-heating.

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. Exhaust system
- e. Temperature control

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. Humidifier
- f. Cabin temperature indicator
- g. Cabin humidity indicator

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### 3.2 General Recommendations:

- 3.2.1 The design of the air conditioning system should be such as to preclude CO concentration in excess of 1 part in 20,000 or .005 of 1% 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 An adequate means should be provided for removal of exhaust air. Emergency provisions should be made to remove smoke or other contaminants resulting from equipment malfunction or fire.
- 3.2.5 A temperature control system, either manual or automatic, should be included which will provide a means for regulating the temperature within the air conditioned space independent of engine or helicopter operation.
- 3.2.6 The helicopter heating and ventilating requirement should be met at all speeds, directions of flight, hovering, and altitudes of the helicopter.
- 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, 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.

### 4. AIR CONDITIONING EQUIPMENT:

- 4.1 Component parts of the air conditioning equipment should be constructed of materials 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.
- 4.2 Component equipment should be designed to start and operate satisfactorily at design temperatures of minus 65F to plus 160F, local environmental conditions and minus 65F to plus 120F ambient atmospheric temperatures. Special installations may require consideration of a broader temperature range for environmental conditions. If required, these would be stipulated in the detail specification.
  - 4.2.1 Cabin and crew station temperatures should not be less than 40F at minus 65F outside ambient temperature.

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4.2.2 The distribution of heat within any crew station and all spaces normally occupied by passengers should not cause undue discomfort to any occupants. Accordingly, present design practices have established a limitation of 250F for the warm air entering the occupied compartments.

4.2.3 The distribution of heat should be adequate to prevent air temperature variations in excess of 20F from foot to head level of personnel in a seated position in the forward and aft portion of the space.

#### 4.3 Ventilating Requirements:

##### 4.3.1 Air Quantities:

4.3.1.1 The ventilating system should be capable of supplying a minimum of 1.0 lb/min of fresh air per occupant during all normal flight conditions.

4.3.1.2 During warm weather the system should be capable of supplying at least 3.0 lb/min of fresh air per occupant (equivalent to approximately 40 cfm per person at sea level).

4.3.1.3 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.

##### 4.3.2 Air Velocity in Occupied Spaces:

4.3.2.1 During heating the maximum air velocity over occupants should not exceed 75 feet per minute.

4.3.2.2 During ventilating (no heating) the air velocity should not exceed 300 feet per minute over occupants.

##### 4.3.3 Air Inlets:

4.3.3.1 General air supply inlets to occupied spaces should be through openings which may be adjustable if desired, provided that such adjustment does not appreciably affect the overall balance of the distribution system.

##### 4.3.4 Cooling:

#### 4.4 Pressurization:

(Note: At the present time these general requirements 4.3.4 and 4.4 are noted for possible future consideration.)

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#### 4.5 Temperature Control:

- 4.5.1 A minimum of the following temperature controls should be provided:
- a. Overheat safety switch associated with the heat source in the air conditioning system.
  - b. Duct temperature limit switch to conform with the requirements of paragraph 4.2.2.
  - c. A control device to maintain the occupied space at the desired temperature level.
- 4.5.2 The controls of the entire system should be accessible only to the crew members (see paragraph 4.3.3).
- 4.5.3 The applicable portions of ARP 89A on temperature control equipment should be considered.
- 4.5.4 If an automatic temperature control is used, provision should be made for a simple means of manually over-riding such controls for emergency operation.

#### 4.6 Heater Installation:

- 4.6.1 In helicopter air conditioning systems where a combustion type heater is used as the source of heat, the installation requirements as presented in SAE ARP 266 are applicable. In addition, the pertinent sections of ARP 86A on exhaust gas heat exchangers are applicable.

#### 4.7 Defogging and Defrosting:

- 4.7.1 If the air conditioning system is used for defogging and defrosting cockpit transparencies then the system should be capable of maintaining adequate visibility for all conditions of helicopter operation.

### 5. DESIRABLE DESIGN FEATURES:

#### 5.1 Heating System:

- 5.1.1 Without the helicopter propulsion engines operating, the system should be capable of ground operation with only external electrical power provided.
- 5.1.2 Consideration should be given to maintaining all occupied compartment surface temperatures below that objectionable to touch.

#### 5.2 Ventilation:

- 5.2.1 Consideration should be given to the provision of individual air inlets in passenger type aircraft.
- 5.2.2 Outside fresh air intakes should be located so that the flow characteristics will not be materially affected by the altitude, direction of flight, and hovering of the helicopter.

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- 5.2.2.1 In addition, ventilating air intake locations should be such that they will preclude entrance of objectionable quantities of any toxic or combustible fluids from the aircraft, such as exhaust gases, de-icer fluids, gasoline, oil or the fumes therefrom, from entering the ventilating air system (or the combustion air system in installations utilizing combustion type heaters). In determining the location of air intakes a careful analysis should be made of engine exhaust gas distribution created by recirculation by the rotor (s). The CO concentration should not exceed that given in paragraph 3.2.1 under all flight conditions and ground maneuvering.
- 5.2.2.2 In addition, infiltration of engine exhaust gases through the fuselage should be precluded by means such as adequate sealing or providing a slight positive pressure within the occupied spaces, taking into consideration the pressure distribution around the fuselage.
- 5.2.2.3 Consideration should be given to location and design so that rain or objectionable foreign matter will not enter the opening. If such location is impractical, then a particle separator should be installed in the duct system immediately after the inlet.

### 5.3 Cooling for Transport Type Aircraft:

- 5.3.1 Consideration should be given for additional ventilating and cooling provisions for passenger carrying transport type helicopters.
- 5.3.1.1 Sufficient ventilating should be provided during warm weather operation in flight and on the ground to limit cabin temperatures to within 10F above ambient.
- 5.3.1.2 For long range transport type helicopters, consideration of the continued comfort of the passengers and crew should include the possible utilization of additional mechanical means of cooling.
- 5.3.1.3 Means should be provided for the connection of a ground air conditioning truck.

## 6. WINTERIZATION AND PRE-HEATING:

### 6.1 General Recommendations:

- 6.1.1 The recommendations presented herein are limited generally to pre-heating equipment associated with the air conditioning system heating equipment. However, this is consistent with the operational requirements of helicopters, particularly for military craft, which dictate the need for an integral pre-heating installation. These requirements are such that the helicopter power plant can be shut down at a remote location and restarted without the aid of external starting and pre-heating equipment. Kits may be provided for this purpose to be used only when conditions establish a requirement for pre-heat.