



AEROSPACE RECOMMENDED PRACTICE

Society of Automotive Engineers, Inc.
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ARP 1411

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Revised

FLIGHT DECK ENVIRONMENT

1. INTRODUCTION

This Aerospace Recommended Practice (ARP) is intended to specify the environmental conditions necessary to permit the operating crew of large civil transport aircraft to perform their required duties and functions in comfort, with minimum fatigue and no distraction. Environmental conditions should cause no short or long-term effects deleterious to health or physical well being, nor significantly impair ability to perform normal flight deck crew functions.

2. SCOPE

Part I of this ARP applies to flight deck ventilation and considers such factors as air flow rates, temperature and humidity.

Part II of this ARP applies to noise and vibration in the flight deck working environment.

Part III of this ARP applies to radiation exposure in the flight deck working environment.

3. PART I RECOMMENDATIONS - VENTILATION

These recommendations apply to all operating regimes of the aircraft. However, it should be noted that some circumstances - for example, extended ground holding on congested taxiways - may impose conditions which are difficult to meet. Careful consideration should be given to such items as: Location of ventilating air inlets when other than engine bleeds are used; location of APU exhaust; placement of ground support equipment; and provision for alternate sources of breathing air for the flight deck crew.

- 3.1 Air Flow: A minimum flight deck air flow rate as specified in ARP 85, as amended, is recommended for all flight and ground operating regimes. Additional airflow may be required for instrument and electronic equipment located within the flight deck. Ventilating air inlets should be adjustable for volume flow and direction to permit the crew to control velocity and eliminate drafts.

3.2 Temperature Control:

- 3.2.1 Flight deck temperature control should be capable of maintaining a stable, comfortable, "shirt sleeve" temperature on the flight deck throughout the operational envelope of the aircraft. Night and day differences in temperature radiation effects through flight deck windows should be considered.

- 3.2.2 The flight deck temperature control capability shall be independent of the passenger or cargo cabin temperature control system.

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- 3.2.3 The ground air conditioning system - whether external or self contained - shall be capable of bringing the flight deck temperature to $21 \pm 4^{\circ}\text{C}$ ($70 \pm 7^{\circ}\text{F}$) within 30 min. after it is turned on, with the aircraft either heat or cold soaked in any ambient temperature from -18°C to $+38^{\circ}\text{C}$ (0°F to 100°F) in direct sunshine. For aircraft operated at airports where weather conditions are more severe than those considered in this recommendation supplemental techniques, systems and/or equipment should be utilized in order to permit flight crews to perform their on board operating functions normally and without special clothing.
- 3.2.4 The temperature control sensors should be in a location to sense the average flight station air and not be subject to temperature variation from sunlight or convection/radiation from conditioned supply air or instrument panels.
- 3.3 Humidity: Means should be provided to alleviate the problem of drying out of skin and mucous membranes during long, high altitude flights, where excessively high humidity may be encountered.

4. PART II RECOMMENDATIONS - NOISE AND VIBRATION

- 4.1 Noise: Two considerations must be included in the recommendations for permissible flight deck noise environment. First is the effect of noise on crew performance as it relates to the operational safety of flight, and second is the effect of noise on flight crew members' health, both long and short term. The operational safety consideration will usually impose the more restrictive guideline.

- 4.1.1 Operational Safety: Adequate intelligibility of vocal communications between flight crew members is requisite for operational safety. Flight deck soundproofing shall be provided to ensure that ambient noise levels during any phase of normal flight operations are sufficiently low as to permit reliable un-augmented voice communication. Communication equipment shall be provided for speech augmentation under conditions of excessive ambient noise.

(Note) Commonly used criteria relating ambient noise level to vocal effort and distance between communicators are considered not to be completely relevant when applied to aircraft flight deck environment and type of communication. Additional studies are required to determine criteria that are technically valid for application to flight deck communications.

- 4.1.2 Health Effects: In order to prevent undue fatigue and to minimize permanent noise induced hearing loss and temporary noise induced threshold shift the flight deck continuous, ambient noise level midway between the pilots' reference eye positions should not exceed 87dBA. Peak noise levels up to 93dBA may be tolerated for short periods of no more than 5 min. duration.

(Note) Currently accepted hearing conservation criteria are not directly applicable to flight crew environment since these criteria are based on a long-term continuous exposure, which constitutes a higher risk than does the more intermittent cycle to which flight crew are exposed. Development of a valid criterion for flight deck exposure is not deemed necessary since flight deck noise levels in civil jet transports are now well below limits specified in the commonly used criteria for long-term continuous exposure.

- 4.1.3 Annoyance: Attention should be given to window and hatch sealing, duct sound suppression, electronic and instrument sound suppression, in order to minimize annoying hisses, whistles, buzzes and similar subjectively unpleasant sounds.
- 4.2 Vibration: Seat, floor, control or equipment vibration which can be perceived subjectively either visually, aurally or tactilely should be minimized.