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Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE STANDARD

AS 264D

Instrument and Cockpit Lighting for Commercial Transport Aircraft

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1. OBJECTIVE: The desired system for aircraft instrument panel and cockpit lighting is one that will furnish light of adequate intensity and distribution under all conditions of external lighting so that the crew may read instrumentation, placards, check lists, manuals, maps, instrument color coding, distinguish controls, etc., without undue interference with their vision outside of the aircraft.

2. METHODS OF LIGHTING: Any method of providing red and white lighting separately controlled, which meets the requirements of this specification are considered satisfactory for air line transport use.

3. REQUIREMENTS:

3.1 To accomplish adequate lighting the following criteria are required and pertain to all:

3.2 Type of Light:

3.2.1 Both red and white lights separately controlled shall be incorporated.

3.2.2 The red light shall be above the wave length of 600 millimicrons (AN-C-56) and shall be obtained through either glass or plastic filters. Dipped bulbs as currently used are not considered satisfactory. However, bulbs with red glass envelopes that meet these requirements are considered satisfactory.

3.2.3 Lighting shall not interfere with legibility of white markings for daylight operation.

3.3 Arrangements:

3.3.1 The pilots' instrument panel shall be lighted in three sections consisting of the pilots' flight instruments, engine instruments, and copilots' flight instruments. The red light for each section shall be controlled by separate intensity controls. The white light for the entire panel shall be controlled by a single intensity control.

3.3.2 Side console lighting shall be only of the red type, each side controlled by a separate intensity control.

3.3.3 Red light shall be provided for overhead panels and controlled by a separate intensity control.

3.3.4 A 3 position override switch will be provided such that when in its neutral position all lights will operate on their respective intensity controls; when placed in up or forward position, white light at its highest intensity will be provided at all stations; and when placed in down or aft position all stations will provide only red light, through their respective intensity controls.

3.3.5 Aircraft containing large control cabins and multiple crew positions shall be provided with adequate light traps and curtains to isolate the pilots and flight engineer from strong light coming from other crew member positions.

3.3.6 Small adjustable position red lights of fixed intensity shall be provided at each pilot's station near the flight brief case position for lighting its interior.

3.3.7 Additional crew member stations including instrument panels and working areas shall be provided with both red and white lights controlled by separate intensity controls.

3.3.8 Each pilot shall be provided with a map-reading light controlled by an intensity control. This light must be capable of being quickly changed from red to white as required. (not connected to override circuit)

3.3.9 To provide an emergency lighting system a source of white light for the pilots and flight engineer panels shall be supplied.

3.4 Controls:

3.4.1 The intensity controls for operating the lights shall be of a rotary type. Full "off" in the extreme counter-clockwise position, proceeding clockwise from extinction to the approximate mid-point of its physical travel where the specified brightness values listed in Paragraph 3.5 will be met. Thereafter, proceeding to the full clockwise position of travel, at which point, approximately twice the specified values of brightness will be attained.

3.4.2 The knobs for white light intensity controls shall be of a shape corresponding to No. 1475, 1" in diameter, with white engraved arrow on top, as manufactured by Harry Davies Molding Co., 1428 North Wells Street, Chicago 10, Illinois. The knobs for red light shall be of a shape corresponding to No. 1450, 11/16" in diameter, with engraved white arrow on top, made by the same manufacturer.

3.4.3 Location:

3.4.3.1 Intensity controls shall be conveniently located for the crew member whose duty it is to control that particular facility. When a panel is lighted by both red and white light separately controlled, the red light control is to be mounted to the left of the white light control as viewed from the crew member's position, or concentrically with the small knob on top.

3.4.3.2 Switches for ceiling lights shall be either located at the light itself in small aircraft where they can be conveniently reached, or in large aircraft near the doorway into the compartment to be lighted, consistent with the locations as established in current architectural practice with the same functions. A master switch controlled by either pilot shall turn "on" or "off" the ceiling lights regardless of the position of the individual light controls.

3.4.3.3 General lighting and master control toggle switches controlled by the pilots shall be placed on one panel convenient to the reach of both the pilot and copilot while seated with belts fastened.

3.4.3.4 Map reading light intensity controls shall be convenient to the user.

3.4.3.5 The switches for the flight brief case lights shall be on or near the light itself.

3.5 Brightness Values:

3.5.1 The intensity of light supplied the pilots and flight engineer instrument panels shall be such as to produce a minimum brightness of dial markings as indicated below with the intensity control in the approximate physical mid-position.

Red Light	White Light
2.0 ± .2 millilamberts	55 ± 2 Millilamberts

reflectance = 75%

3.5.2 The intensity of map reading lights shall be such as to produce a minimum brightness measured at the pilots lap as indicated below, with the intensity control in the approximate physical mid-position.

Red Light	White Light
1.0 ± .2 millilamberts	5 ±1 millilamberts

reflectance = 30%

3.5.3 The intensity of instrument panel lights for crew members other that the pilots and flight engineer shall be such as to produce a minimum brightness as indicated below with the intensity control in the approximate physical mid-position.

Red Light	White Light
1.0 ± .2 millilamberts	15 ± 1.5 millilamberts

reflectance = 75%

3.5.4 All working areas of crew members such as the navigation table, flight engineers table, etc. shall have an intensity such as to provide a minimum brightness as indicated below, with the intensity control in the approximate physical mid-position.

Red Light	White Light
1.0 ± .2 millilamberts	6 ± 1 millilamberts

reflectance = 30%

3.5.5 Fixed intensity lights shall produce a brightness as specified below.

Red Light	White Light
1.0 ± .2 millilamberts	6 ± 1 millilamberts

reflectance = 30%

3.5.6 Side console lighting shall produce a brightness as specified below with the intensity control in the approximate physical mid-position.

Red Light

1.0 ± .2 millilamberts

reflectance = 30%

3.5.7 Intensity measurements shall be made with either a Macbeth Illuminometer or any standard illumination measuring instrument which takes into account the spectral sensitivity of the human eye.

3.5.8 Definitions:

3.5.8.1 Millilambert - A measure of the brightness of a surface which emits or reflects light. A perfectly reflecting surface illuminated by one foot-candle has a brightness of one footlambert (fl).

i.e. Footlamberts = footcandles x reflectance factor of surface.
Footlamberts (fl) x 1.076 = millilamberts (ml)
Millilamberts x 0.929 = (fl)

3.5.8.2 Footcandle - A measure of the intensiry of level of illumination. One footcandle (fc) is the intensity of illumination at a point on a surface one foot from a uniform point source of one standard candle.

3.5.8.3 The reflectance of common objects may be judged to vary from 20 to 80 percent. White paper has a reflectance of approximately 80% while an unfinished mahogany table top has a reflectance of approximately 20%.

3.6 Distribution:

3.6.1 Instrument Panels:

3.6.1.1 The distribution of light on each instrument shall be such that all markings can be read, without the presence of shadows or distinguishable light graduation and in no case greater than 3 to 1.

3.6.1.2 Where in a group of instruments on a panel, one or more of them appear to be better illuminated than others, because of differences in design or markings, an effort shall be made to equalize the apparent visibility.

3.6.2 Working Areas: Useable working areas such as navigation table, radio officers' tables, and flight engineers' tables, shall have illumination differences no greater than 5:1 and measurements will be taken to determine this difference. Light placement shall be such as to avoid working shadows.

3.6.3 Back Lit Panels: Back lighting through etched or marked panels shall have such distribution that any marking located in any position on the panel will appear to be of the same intensity. The maximum brightness difference shall be in the order of 3:1 from actual measurements and in no case shall the brightness be below one millilambert.

3.7 General Lighting:

3.7.1 Instrument Panels: To avoid visual illusions it is necessary to have a slight amount of light illuminating the instrument panel itself to avoid the effect of the instruments standing out by themselves. This brightness should be .03 ± .01 millilamberts.

3.7.2. A separate source of controlled red and white light shall be provided for the control pedestal, such that with the intensity control in its approximate, physical mid-position .2 ± .05 millilamberts will be obtained. A selector switch for red and white lights with a single intensity control for the light source selected meets this requirement.

3.7.3 Floor Illumination: Irregularities in cockpit floors shall be illuminated by step lights of fixed low intensity red light equal to .03 ± .01 millilamberts, actuated by the D.C. power master switch, or separate toggle switch.

3.8 Brightness Ratios:

3.8.1 Reading of an instrument dial necessitates close attention; therefore high contrast between the details and the work field is required as well as low contrast between the brightness of the work field and its surroundings. For a pilot the dial markings constitute the details, the whole instrument face is the work field, and everything else may be considered as the surroundings.

3.8.2 Considering the above, the following table of values is presented as adequate:

1. Brightness Ratios:	Desired	Permissible
Dial markings within a given instrument	1:1	1:1 - 3:1
Work field to surrounding	2:1	1:1 - 10:1
Various instruments within a given panel	1:1	1:1 - 3:1

3.8.2 Continued

2. Instrument Characteristics:

Brightness ratio of markings to work field	100:1	15:1 - 400:1
Reflectance of instrument markings (with external illumination)	100%	75% - 100%

3.8.3 The desired ratios of sky brightness to interior surface brightness in the cockpit is 100:1, however, 500:1 will be considered acceptable.

3.9 Instrument Markings: Instrument dials shall be so designed to give maximum readibility under the above specified red light. This is considered equal to a reflectance minimum of 80%.

4. COCKPIT FINISH:

4.1 To aid in accomplishment of the requirements under paragraph 3.8 above, consideration should be given to the use of light colored paints of various shades rather than black. These paints shall have a reflection characteristic no greater than 20%, and in no case shall their use compromise the night lighting requirements.

4.2 Reflections:

4.2.1 Reflections from instrument faces into the eyes of crew members shall be eliminated within the range of normal head movements.

4.2.2 Reflections from instruments into the cockpit windshield and thence into the eyes of crew members shall be eliminated within the range of normal head movements.

4.2.3 Reflection from interior portions of the aircraft onto the instruments and windshield that reflect into crew members' eyes shall be eliminated within the range of normal head movements.

4.2.4 Reflections from interior portions of the aircraft directly into crew members' eyes shall be eliminated within the range of normal head movements.

5. SIGNAL LIGHTS: (See ARP 450, Paragraph 2.4) Signal lights that are to be used in either a bright or dim position shall meet the following values:

Bright position 275 millilamberts
Dim position 25 millilamberts

5.1 Master Warning Lights: (See ARP 450, Paragraph 2.4) The intensity of the master light will be 275 millilamberts for the bright intensity and 140 millilamberts if dimming is used.

6. NOTE: The accomplishment of the above specification in detail should not be too difficult if begun in the initial stages of cockpit design and every effort should be made by the manufacturer to comply. However, in certain areas of the above specifications, compromises may be necessary. Such deviations shall be reconciled at the time of inspection.

7. REFERENCES: Below are listed the source references covering the subjects listed in this AS.

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