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MILITARY SPECIFICATION

LIGHTING EQUIPMENT, AIRCRAFT, GENERAL SPECIFICATION FOR INSTALLATION OF

This specification is approved for use by all Departments
 and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers the requirements for the installation of exterior and interior aircraft lighting, except instrument lighting and aircrew station visual signals.

2. APPLICABLE DOCUMENTS

- * 2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

SPECIFICATIONS

Military

MIL-R-22	Resistors, Variable (Wirewound, Power Type), General Specification for
MIL-B-5087	Bonding, Electrical, and Lightning Protection, for Aerospace Systems
MIL-W-5088	Wiring, Aircraft Installation of
MIL-E-6051	Electromagnetic Compatibility Requirements, Systems
MIL-L-6484	Lights, Cockpit Utility, Aircraft, General Specification for
MIL-R-6749	Rheostats; Aircraft Power
MIL-E-7080	Electric Equipment, Aircraft, Selection and Installation of
MIL-L-7569	Light, Signal, Hand Held, Aircraft, Type MA-1
MIL-P-7788	Panels, Information, Integrally Illuminated
MIL-F-8180	Floodlight, Electric Incandescent, 28 Volts, 20 Watts, Type MB-1
MIL-S-9419	Switch, Toggle, Momentary, Four-Position On, Center Off
MIL-L-21652	Light, Beacon, Anticollision, Aircraft, General Specification for
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements for
MIL-E-25499	Electrical Systems, Aircraft, Design and Installation of, General Specification for

FSC 6220

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MIL-L-25866 Light, Emergency Exit, Aircraft LEU-1/A
 MIL-F-26301 Flashers, Position Light, Aircraft
 MIL-T-27493 Transformer, Variable, Single Phase, 400 Cycles, General
 Specification for
 MIL-L-81174 Lights, Landing, Aircraft, Retractable

STANDARDS

Military

MIL-STD-143 Standards and Specifications, Order of Precedence for the
 Selection of
 MIL-STD-411 Aircrew Station Signals
 MIL-STD-461 Electromagnetic Interference Characteristics, Requirements for
 Equipment
 MIL-STD-462 Electromagnetic Interference Characteristics, Measurement of
 MIL-STD-704 Electric Power, Aircraft, Characteristics and Utilization of
 MS15570 Lamp, Incandescent, G-6 Bulb, Single Contact, Bayonet Candelabra Base
 MS17245 Light, Cockpit, Utility
 MS23006 Cover, Light; Navigational and Warning, Aircraft
 MS24474 Light Assembly, Taxi (PAR 46 Bulb)
 MS24513 Lamp, Incandescent, Single Contact Bayonet Indexing Candelabra, GG-12B1 Bulb
 MS24517 Lamp - Incandescent, PAR-46 Bulb, Screw Terminal Base, Taxiing
 MS25010 Light, Panel - Plastic Plate Lighting
 MS25027 Light Assembly, Cockpit, Fixed
 MS25041 Light, Indicator, Press to Test, Small
 MS25069 Lamp, Incandescent, Single Contact, Miniature Bayonet Base, T-4-1/2 Bulb
 MS25215 Light Assembly, Upward Recognition
 MS25216 Cover, Top and Bottom Fuselage Lights
 MS25219 Light-Navigational and Warning, Aircraft
 MS25231 Lamps, Incandescent, Center Contact, Miniature Bayonet Base (T-3-1/4 Bulb)
 MS25235 Lamp, Incandescent, Single-Contact Bayonet Candelabra Base, S-11 Bulb
 MS25237 Lamp, Incandescent, Single Contact Midget Flanged Base (T-1-3/4 Bulb)
 MS25239 Lamp, Incandescent - PAR-36 Bulb, Screw Terminal Base, Signaling
 MS25241 Lamp, Incandescent, PAR-46 Bulb, Screw Terminal Base, Landing
 MS25242 Lamp, Incandescent, PAR-64 Bulb, Screw Terminal Base
 MS25309 Lamp, Incandescent Single Contact Bayonet Candelabra, GG-10 Bulb
 MS25331 Light Assembly, Press to Test Indicator
 MS25338 Lamp - Single Contact Bayonet Candelabra, GG-12A1 Bulb
 MS25358 Light, Dome, Cabin, Red and White
 MS28916 Light, Cabin Dome, Aircraft

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MS35478	Lamp, Incandescent, S-8 Bulb, Single Contact, Bayonet Candelabra Base
MS35480	Lamp, Incandescent: R-12 Bulb, Single Contact, Bayonet Candelabra Base

Air Force-Navy Aeronautical

AN887	Gasket - Circular Formation Light Cover
AN889	Gasket, Wing Position Light Cover
AN899	Gasket, Fuselage Light - Cover Screw
AN904	Gasket - Upward Recognition Light Cover
AN3030	Light Assembly - Circular Formation
AN3033	Light Assembly, Wing Position, Wing Tip
AN3037	Light Assembly, Cabin Dome
AN3040	Cover - Circular Formation Light
AN3042	Cover - Position Light
AN3047	Light, Desk, Aircraft
AN3119	Gasket - Common, Tail Position Light
AN3147	Light Assembly - Fixed Landing (PAR-46 Bulb, Flat)
AN3148	Light Assembly - Fixed Landing (PAR-64 Bulb, Flat)
AN3149	Light Assembly - Fixed Landing (PAR-64 Bulb, 10° Angle)
AN3177	Light Assembly, Top and Bottom Fuselage (Two Lamps)

DRAWINGSAir Force

44B18648	Gasket - Fixed Landing Light (PAR-64 Bulb)
44B19636	Gasket - Fixed Landing Light
57C6103	Wiring Diagram, Troop Jump and Equipment Drop Signal Circuit, Typical

(Copies of specifications, standards, publications, and drawings required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.2 Design and construction. Aircraft lighting equipment installations shall be in accordance with MIL-E-25499 or MIL-E-7080, as applicable. When lights are installed in areas subject to a differential in air pressure, a pressure barrier shall be provided between the pressurized section and the lights.

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Lighting fixtures shall not be used as part of the pressure barrier. All lights shall be prefocused, and all components shall be so indexed or designed that the lights are properly focused and aimed when reassembled after relamping.

3.2.1 Lamps. Lighting equipment shall be so designed that:

a. Lamp replacement can be accomplished without damaging or degrading the performance of the equipment when lamp replacement is necessary

b. Lamps used in the equipment will give satisfactory service under the environmental conditions encountered at installation locations and shall have a life under flight conditions which meets or exceeds the values specified in table I.

TABLE I. Lamp Life

Aircraft Lighting Fixtures	Minimum Required (Hours)	Minimum Design Goals (Hours)
Landing and taxi	50	100
Exterior other than landing and taxi	100	200
Interior other than instruments, indicators, etc which use subminiature long life lamps	200	500

3.2.2 Power circuits. Lights and equipment shall be designed to operate from the applicable power circuits as specified in MIL-STD-704.

3.2.3 Wiring cables. Wiring cables shall be in accordance with MIL-W-5088.

3.2.4 Electrical bonding. The system shall comply with the electrical bonding requirements of MIL-B-5087, Class R.

3.2.5 Auxiliary covers. If auxiliary covers are installed over the lighting fixtures, they shall be so designed that, when in place, the covers will not cause the light output of assemblies to fall outside of the limits specified. The covers shall not cause light to be reflected or directed into the cockpit or other areas where it would interfere with operating personnel. The covers shall not fail nor become distorted when the lamps over which they are installed are operated steady-burning with the aircraft on the ground or in flight.

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3.2.5.1 Fasteners. The auxiliary covers shall be provided with quick-disconnect-type fasteners to insure that the covers can be easily and quickly removed to permit lamp replacement.

3.2.6 Equipment. The most suitable equipment for the application shall be used to provide the best lighting system available. Primary consideration shall be given to meeting all applicable lighting performance requirements. Special or built-in fixtures may be used whenever the aircraft configuration is such that performance requirements cannot be met by the use of standard fixtures. However, in order to hold the number of different types of equipment to the minimum, the standard items specified in table II shall be used where applicable. Unless otherwise specified, the lamps listed in table II are for 28V service. Equivalent lamps presently available for 6V service are included in table III. The lower voltage lamps have a more rugged filament since it is heavier and shorter than the filament in an equivalent higher voltage lamp. Equipment other than specified in table II will be satisfactory provided:

- a. No similar standard item is available
- b. Items are capable of withstanding the environmental conditions under which they will be expected to operate
- c. The lamps required for use in the assemblies have been approved for use in military aircraft
- d. The specified light intensities are provided
- e. The equipment is approved by the procuring activity and at the mockup inspection
- f. Special equipment is necessary due to the high temperatures developed on very high-speed aircraft
- g. Shock-mounted assemblies are furnished for use in areas where excessive vibration is encountered.

3.2.6.1 Test model. The aircraft contractor shall prepare a test model of each exterior and interior lighting installation for light distribution tests and approval by the procuring activity prior to incorporating the installation in the aircraft mockup if one or more of the following are applicable:

- a. Nonstandard lighting equipment is used
- b. Equipment is installed in an unusual manner
- c. Equipment is so located that some components of the aircraft will interfere with the specified distribution
- d. Fixtures are installed under auxiliary covers.

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TABLE II. Lighting Fixtures and Lamps

Nomenclature	Fixture	Lamp (28V except where otherwise specified)			Cover		Gasket
		Number	Approx Ampere	CP or W	Part No.	Color	
Cabin light (Single-lamp)	AN3037-3	MS35478-307	0.65	21 cp	AN3037-9A	Aviation white (diffusing)	
		MS35478-307R	0.65				
		MS25235-311	1.28	50 cp			
		MS25235-R311	1.28				
Cabin light (Extra strength cover)	MS28916-3	(any one of the above lamps may be used)			MS28916-4	White (diffusing)	MS28916-6
		MS35478-307	0.65	21 cp			
		MS35478-307R	0.65				
		MS25235-311	1.28	50 cp			
Cabin light (Red - white) (Two-lamp)	MS25358-8	MS25235-R311	1.28		MS25358-4	White	MS25358-6
Cockpit light Fixed (Red)	MS25027-1	MS25069-1495	0.30	6 cp			
Cockpit light (Utility)	MS17245-5	MS25231-313	0.17	3 cp			
Formation light	AN3030-9A	MS25231-313	0.17	3 cp	AN3040-1B	Lunar white	AN887-1A
Fuselage light (Bottom) (Two-lamp)	AN3177-9	MS25235-311	1.28	50 cp	MS25216-1	Aviation white (clear) No Shield	AN904-1 AN899-1
		MS15570-303	0.30	6 cp			

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TABLE II. (CONT)

Nomenclature	Fixture	Lamp (28V except where otherwise specified)				Cover		Gasket Part No.
		Number	Approx Ampere	CP or W	Part No.	Color		
Fuselage light (Top) (Two-lamp)	AN3177-9	MS25235-311 MS15570-303	1.28 0.30	50 cp 6 cp	MS25216-2	Aviation white (clear) Shielded	AN904-1 AN899-1	
Fuselage light (Bottom) (Single-lamp)	MS25215-3	MS25235-311	1.28	50 cp	MS25216-1	Aviation white (clear) No shield	AN904-1 AN899-1	
Fuselage light (Top) (Single-lamp)	MS25215-3	MS25235-311	1.28	50 cp	MS25216-2	Aviation white (clear) Shielded	AN904-1 AN899-1	
Indicator light STD size Press-to-test	MS25331-5 MS25331-6 MS25331-7 MS25331-8	MS25231-313 MS25231-313 MS25231-313 MS25231-313	0.17 0.17 0.17 0.17	3 cp 3 cp 3 cp 3 cp		White (clear) Red Green Amber		
Indicator light small Press-to-test	MS25041-5 MS25041-6 MS25041-7 MS25041-8	MS25237-327 MS25237-327 MS25237-327 MS25237-327	0.04 0.04 0.04 0.04	0.34 cp 0.34 cp 0.34 cp 0.34 cp		White (clear) Red Green Amber		
Landing light (Controllable)	MIL-L-81174 Type MA-3	MS25241-4581	16.1	450w				
Landing light Fixed (PAR-46)	AN3147-1	MS25241-4581	16.1	450w			44B19636	

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TABLE II. (CONT)

Nomenclature	Fixture	Lamp (28V except where otherwise specified)			Cover		Gasket
		Number	Approx Ampere	CP or W	Part No.	Color	
Landing light Fixed (PAR-64)	AN3148-1	MS25242-4555 (115V)	8.7	1,000w			44B18648
		MS25242-4559	21.4	600w			
		MS25242-4556	35.8	1,000w			
		MS25242-Q4559	21.4	600w			
Landing light Fixed (PAR-64) (10° angle with mtg)	AN3149-1	MS25242-4555 (115V)	8.7	1,000w			44B18648
		MS25242-4559	21.4	600w			
		MS25242-4556	35.8	1,000w			
		MS25242-Q4559	21.4	600w			
Landing light retractable (PAR-64 lamp)	MIL-L-81174 Type MA-2	MS25242-4555 (115V)	8.7	1,000w			
		MS25242-4559	21.4	600w			
		MS25242-4556	35.8	1,000w			
		MS25242-Q4559	21.4	600w			
Landing light retractable (PAR-46 lamp)	MIL-L-81174 Type LTU-1/A	MS25241-4581	16.1	450w			
Light emergency exit	MIL-L-25866 Type LEU-1/A					Red White clear	
Plastic plate light semiflush- type	MS25010A11A MS25010A12A	MS25237-327	0.04	0.34 cp			
		MS25237-327	0.04	0.34 cp			

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TABLE II. (CONT)

Nomenclature	Fixture	Lamp (28V except where otherwise specified)			Cover		Gasket Part No.
		Number	Approx Ampere	CP or W	Part No.	Color	
Reading or thunderstorm light	MIL-F-8180 Type MB-1	MS35480-2	0.72	20w			
		MS35480-3 (6V)	3.33	20w			
Scanning or signal light	MIL-L-7569 Type MA-1	MS25239-4501	5.3	140w			
Taillight white (clear)	MS25219-11	MS35478-1683	1.02	32 cp	MS23006	Aviation white nondiffusing	AN3119-2
Taxi light	MS24474-1	MS24517-4551	8.9	250w			
Wing light (High intensity)		MS24513-4174	1.43	40w			
Wing light (Med intensity 180°)	AN3033-9	MS25309-7512	0.93	26w	AN3042-3 AN3042-4	Aviation red Aviation green	AN889-1 AN889-2
Worktable lights	AN3047-1B AN3047-2B AN3047-3B AN3047-4B AN3047-5B AN3047-6B	MS35478-307	0.65	21 cp			
		MS35478-307R	0.65				
		MS25235-311	1.28	50 cp			
		MS25235-R311 (any one of the above lamps may be used)	1.28				

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TABLE III. Equivalent Aircraft Lamps

Line No.	Trade No.	Military or ASA No.	Volts	Approx Amp	C? OR W	Bulb	Base	Approx Life (Hours)
1	327	MS25237-327	28	0.04	0.34 cp	T-1-3/4	S. C. Mid. Fl	1,000
2	328	MS25237-328	6	0.20	0.34 cp	T-1-3/4	S. C. Mid. Fl	1,000
3	313	MS25231-313	28	0.17	3 cp	T-3-1/4	S. C. Min. Bay.	500
4	316	MS25231-316	6	0.70	3 cp	T-3-1/4	S. C. Min. Bay.	500
5	303	MS15570-303	28	0.30	6 cp	G-6	S. C. Bay.	500
6	81	MS15570-81	6	1.02	6 cp	G-6	S. C. Bay.	500
7	307	MS35478-307	28	0.65	21 cp	S-8	S. C. Bay.	300
8	1129	MS35478-1129	6	2.04	21 cp	S-8	S. C. Bay.	200
9	1683	MS35478-1683	28	1.02	32 cp	S-8	S. C. Bay.	500
10	1680	MS35478-1680	6	4.10	32 cp	S-8	S. C. Bay.	300
11	311	MS25235-311	28	1.28	50 cp	S-11	S. C. Bay.	300
12	1725		6	6.18	50 cp	S-11	S. C. Bay.	100
13	7079	MS25338-7079	28	1.42	40w	GG-12	S. C. Index Base	150
14	1687	MS25338-1687	6	6.65	40w	GG-12	S. C. Index Base	150
15	4174	MS24513-4174	28	1.43	40w	GG-12	S. C. Index Base	300
16	1163	MS24513-1163	6	6.65	40w	GG-12	S. C. Index Base	300
17	7512	MS25309-7512	28	0.93	26w	GG-10	S. C. Index Base	300
18	600	MS25309-600	6	4.19	26w	GG-10	S. C. Index Base	300
19	1495	MS25069-1495	28	0.30	6 cp	T-4-1/2	Min. Bay.	500
20	1467	MS25069-1467	6	1.03	6 cp	T-4-1/2	Min. Bay.	1,000
21	1385	MS35480-2	28	0.72	20w	R-12	S. C. Bay.	300
22	1384	MS35480-3	6	3.33	20w	R-12	S. C. Bay.	300

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3.2.7 Mockup. A mockup of each lighting system shall be prepared by the contractor for inspection and approval by the procuring activity before aircraft are modified to include the installation or before the system is incorporated into production aircraft. Since representative articles will not satisfy the purpose of a light inspection, actual instruments, panels, paint, or uncoated structure shall be used. The mockup shall indicate the effectiveness of the proposed system involved.

3.2.8 Electromagnetic interference (EMI). The system shall comply with the emission and susceptibility requirements of MIL-STD-461.

3.2.9 Electromagnetic compatibility (EMC). The system shall comply with the compatibility requirements of MIL-E-6051.

3.3 Lighting requirements. The design and location of the lighting equipment shall be determined and provided for when the aircraft is being designed in order that the best lighting system obtainable is provided. If necessary, the lights shall be shielded to prevent direct or reflected glare from interfering with operating personnel. Chromaticity and transmission requirements shall conform to MIL-C-25050. The design and location of the lighting equipment shall provide:

a. Adequate lighting for safe night flying, takeoff, landing, taxiing, formation flying, refueling, identification, and other maneuvers

b. Adequate illumination so that the aircraft can be seen in ample time by other aircraft, under normal visual contact operating conditions, to avoid collision.

* 3.3.1 Anticollision lights. All aircraft shall be provided with an anticollision light system. The system shall consist of one or more approved anticollision lights so located that the emitted light will not be detrimental to the crew's vision and will not detract from the conspicuity of the position lights. Lights located on top of the fuselage shall be located as far back of the pilot as practicable in order to reduce to a minimum the possibility of causing vertigo to occupants of the cockpit. Anticollision lights shall meet the applicable environmental and material requirements of MIL-L-21652. The lights and coverage shall comply with the following provisions.

* 3.3.1.1 Field of coverage. The system shall consist of sufficient lights to cover all vital areas around the plane of flight of the aircraft considering the physical configuration and flight characteristics of the aircraft. The plane of flight for aircraft equipped with retractable anticollision lights shall be determined for the aircraft's attitude under conditions where the light will be extended and used. The field of coverage shall extend in all directions within not less than 30° above and 30° below the horizontal plane of flight of the aircraft, except that obstructed visibility totalling not more than 0.03 steradian is allowable within a solid angle equal to 0.15 steradian centered about the longitudinal axis in the rearward direction.

3.3.1.2 Shielding. The lights shall be positioned or shielded, or both, to prevent light beams from being directly or indirectly projected into the cockpit

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or other areas that would interfere with operating personnel. When the shielding or positioning is such that one light will not provide complete coverage around the aircraft, additional lights shall be installed to provide coverage in the deficient areas.

3.3.1.3 Flashing characteristics. The arrangement of the system, i.e., number of light sources, beam width, speed of rotation, et cetera, shall be such as to give an optimum effective flash frequency of 90 cycles per minute. The effective flash frequency shall be not less than 40 nor more than 100 cycles per minute except when the system includes overlaps created by more than one light source. In overlaps, effective flash frequencies shall not exceed 180 cycles per minute. The effective flash frequency is established as that frequency at which the aircraft's complete anticollision light system is observed from a reasonable distance.

* 3.3.1.4 Color. The color of all light emitted shall be aviation red or white, or both.

* 3.3.1.5 Light intensity. The minimum light intensity for each light in all vertical planes measured and expressed in terms of effective candlepower as determined by the formula below shall equal or exceed the values specified in table IV, column 3 entitled, Required. If the light is red, the measurement shall be made with the red color filter in place.

$$I_E = \frac{\int_{t_1}^{t_2} I(t) dt}{0.2 + (t_2 - t_1)}$$

Where I_E = Effective candlepower

$I(t)$ = Instantaneous candlepower as a function of time

$t_2 - t_1$ = Flash duration in seconds.

Note: Normally the maximum value of effective candlepower is obtained when t_2 and t_1 are so chosen that the effective candlepower is equal to the instantaneous candlepower at t_2 and t_1 .

3.3.1.6 Flash frequency vs effective intensity. The rise and decay characteristics of high-current lamps flashed by electrical means are such that the intensity may not decay during the (off) period to an acceptable level of less than 0.30 times the peak intensity. In such cases the flash frequency may be reduced to obtain an adequate decay provided that the effective light intensity (see table IV)

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is increased by twice the percentage of flash frequency reduction below 90 cycles per minute. As an example, if the flash frequency is 45 cycles per minute (a decrease from 90 cycles per minute of 50 percent), the effective intensity requirements of table IV shall be increased by 100 percent.

* TABLE IV. Light Intensities (With Red Color Filter if Light is Red)

Angle Above or Below Mounting Plane of Light in Degrees	Minimum Effective Intensities		
	I Min < 0.30 I Max		I Min > 0.30 I Max
	Design Goals	Required	
0 to 5	400	400	See 3.3.1.6
5 to 10	400	240	
10 to 20	240	80	
20 to 30	240	40	
30 to 40	240		
40 to 50	80		

3.3.2 Cabin and compartment lighting. Cabins and compartments shall be provided with suitable lighting for passengers and crew. The lights shall be so located and, if necessary, shielded to prevent them from being a source of direct or reflected glare to operating personnel. Lights used in areas where they may be broken by the loading of equipment or personnel shall be of rugged construction (heavy cover and fixture) or adequately protected to prevent breakage.

3.3.2.1 Controls. Rotary controls, with the off position located in the extreme counterclockwise position, shall be used. The brightness of the lights shall be varied uniformly over the full range of the control with full bright at the extreme clockwise position. The control shall dim the lights approximately 0.2 percent of the full bright value in the maximum counterclockwise position where the control supplies power to the lights. Variable autotransformers or rheostats may be used depending upon the type of power supplied. When rheostats are used, they shall be in accordance with MIL-R-6749 or MIL-R-22, as applicable. Autotransformers shall be in accordance with MIL-T-27493.

3.3.2.2 Levels of illumination. Levels of illumination required for the primary lighting systems of integrally lighted panels, instruments, and other equipment with self-contained illumination systems are generally specified in the specification for the items of equipment. The levels of illumination for the secondary lighting for these items and for areas which have no other lighting system are included in table V. The illumination shall be white unless red or some

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TABLE V. Levels of Illumination for Secondary Lighting

Location Dark Adaptation Not Required	Light Intensity (Footcandles)	
	Min	Max
Auxiliary powerplant compartments and engines where lighting is required (light values on work area)	5	10
Cabin area, passenger (light on reading area)	30	60
Cargo compartment (light on floor)	0.2	5.0
Crew station locations where map reading, course plotting, etc, are required (light on work areas)	30	60
Controls that are not lighted and require adjustment (light on controls)	5	10
Loading and ramp areas (light on the loading area)	2	10
Passageways (light on floor)	0.2	5
Tiedown locations with cargo in place (light on the tiedown area)	0.2	5
Cabin area general illumination <u>1/</u>	1	20
Emergency cabin and exit light measured 20 inches above the floor in area in front of the exit, and the routing to the exit when aircraft is in a normal parked, on ramp position	0.05	none
Emergency exterior lighting measured at the lower end of escape slide when aircraft is in such a position that the slide can be used	0.03	none
Emergency exterior lighting measured on the ground below normal and emergency exits without slides when aircraft is in a normal parked, on ramp position	0.02	none
Emergency exterior lighting on the wing in the path from the overwing exits.	0.05	none

1/ The 1 footcandle minimum shall be measured on the cabin aisle floor. The 20 footcandle maximum shall be measured 4 feet above the aisle floor level.

NOTE: Dimming as specified in 3.3.2.1 shall be provided for lights in areas where dark adaptation is required. The locations where dimming is to be provided shall be determined by the procuring activity.

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other color is specified. The same levels of illumination shall be provided irrespective of color. The levels of illumination for cabin area (passenger) shall apply to aircraft carrying troops, paratroops, litter patients, or some other classification of personnel considered a part of the intended mission. Unless otherwise specified, the values of illumination shall be the nominal working level.

3.3.3 Cockpit lighting. Cockpit lighting shall provide sufficient illumination to enable fast and accurate reading of dials, instruments, and information contained on panels for all night flying conditions, or set of conditions requiring artificial lighting. The lights shall have no deleterious effect on the pilot's or other operating personnel's night vision or scanning ability. Lights shall be located or shielded to prevent undesirable reflections in the cockpit enclosure from instruments, covers, or other highly reflective components.

3.3.3.1 Panel lighting. Control panels shall be sufficiently lighted to permit easy and accurate reading of the nomenclature on the panels. Plastic plate lighting conforming to MIL-P-7788 is approved for this application. If other methods are used, written approval of the proposed method shall be obtained from the procuring activity prior to the mockup inspection. The request for approval shall include complete details, drawings, and samples, with data to show that the proposed method is superior or more practicable for installation in the particular case under consideration.

3.3.3.1.1 Panel lighting controls. Controls for adjusting the intensity of the lighting shall be within easy reach of the operators who refer to the panels. Controls for panels used by more than one person shall be so positioned that they are convenient to personnel concerned. The controls shall be so designed that the dimmest position is reached just before the control is turned to the off position. The range of brightness shall vary from full bright to not more than 0.2 percent of the full-bright value distributed over the entire range of adjustment of the control.

3.3.4 Emergency lighting. Emergency lighting fixtures shall be provided in sufficient number and with adequate brightness to permit crew and passengers to orient themselves and subsequently escape from an aircraft in the event of a crash. Emergency lighting shall include interior lighting for personnel orientation, the location and identification of emergency exits, and exterior lighting at each exit illuminating the area around the exit. There shall be no self-luminous exit markers used for orientation, identification, locating, or escaping from any normal or emergency exit. Emergency exit signs in all cargo, cargo/transport, and passenger aircraft shall be so installed that they can be read directly by all occupants of the compartment in their normal seated positions.

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3.3.4.1 Interior emergency lighting. Sufficient interior emergency lighting shall be provided to allow crew and passengers to move to the normal and emergency exits within the critical escape time. This form of lighting is especially important in aircraft compartments where large numbers of passengers and troops are seated (high-density seating areas). These troops are usually unfamiliar with the aircraft exits, their location, and operation. Such lighting is also necessary in cockpits and special crew compartments. Interior emergency lighting fixtures should be mounted as aisle, dome, ceiling, or cornice lights.

3.3.4.2 Exit lighting for emergencies. Supplementary emergency lighting units shall be provided above or next to each normal and emergency exit with adequate brightness to permit untrained personnel to identify each exit, to read exit operating instructions, and to actuate the exit mechanism without difficulty. Emergency exit lighting fixtures include strobe lights, exit lights, exit location signs, overwing exit signs, exit path lights, and other lights used to provide emergency lighting. Lighting fixtures may serve more than one specific purpose such as exit location signs also serving as exit path lights. Emergency lights conforming to the requirements of MIL-L-25866 fall into this category.

3.3.4.3 Exterior emergency lighting. Exterior emergency lighting shall be provided at each exit to illuminate the ground near the exit and where escape and survival equipment is to be deployed when the aircraft is in a parked, on ramp position. Exterior emergency lighting includes ground floodlights, escape slide lights, and overwing exit floodlights.

3.3.4.4 Automatic and manual actuation. All emergency lighting units shall be designed to be actuated automatically and manually. Each unit shall be designed so that it can be reset manually or remotely in case of inadvertent actuation. A switch which can be used for actuating or resetting all of the emergency lighting units shall be located in the cockpit. Each unit that will be taken with the evacuees shall be equipped with a self-contained sensing device that will cause the lamp in the light to be energized when the unit is subjected to a shock impulse of 2g for 0.01 second duration acting at any angle between the longitudinal (-GX) axis and the vertical (+GZ) axis. Those units in the system that are to remain in the aircraft shall have self-contained power but may be actuated from one or more common sensing devices located remote from the lights. The common sensing devices shall operate under the same conditions as those included in the lights. The circuits for the lights shall be such that they will be energized in the event the circuits between the lights and the sensors are broken.

3.3.4.5 Structural considerations. All emergency units shall be self-contained, including the power source for the lamp, and shall be capable of operating independently of the main lighting system. The emergency lighting system, including batteries, wiring, relays, lamps, switches, mounting, and other components of the system necessary to provide the required illumination during a crash shall be capable of withstanding a 20g shock impulse for 0.10 second duration to insure

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structural integrity and continued operation after a crash situation. All components of the system shall be explosion-proof and readily accessible for periodic maintenance.

3.3.4.6 Power source. The power source for the emergency lights shall be independent of the main electrical power source for the aircraft and shall be self-contained in the lighting units. The source shall have sufficient capacity to provide effective illumination for a minimum of 15 minutes. The power source shall be such that it will be maintained in a fully charged condition by power obtained from the aircraft electrical system. Batteries shall be of the commercially available nickel-cadmium type, or equivalent.

3.3.5 Formation lights. Aircraft required to fly in formation at night shall be equipped with formation lighting systems that will provide visual unambiguous orientation information regarding the attitude and position of the lead aircraft to the pilot of the adjacent aircraft in the formation (see 6.3). The type of formation in which the aircraft is to be flown will determine the formation lighting system to be provided. Dimming controls shall be provided which are accessible to the aircrew. The system utilized shall be such that it will provide reliable service during all flight conditions under which the aircraft will be flown. No component of the system shall be such that it will be damaged while the aircraft on which it is installed is flown or parked in sunlight whether or not the system is energized. Helicopter formation lights shall be in accordance with 3.3.7.2.4.

3.3.5.1 Stepped-up formation. Aircraft required to fly in a stepped-up formation shall be provided with a formation lighting system that will permit pilots of wing aircraft to visually determine the attitude and position of the lead aircraft at night. Prior to installation, the contractor shall make a study to determine the optimum system of formation lights for the specific aircraft and submit the proposed system to the procuring activity for approval.

3.3.5.2 Side-by-side formation. Aircraft required to fly in formation at the same relative altitude, usually fighter types, shall be provided with a formation lighting system which will permit pilots of aircraft in the formation to determine and maintain their positions. Presently, aircraft flown in side-by-side formation over long distances are flown in what is known as a (loose formation). In this type of formation the aircraft are generally spaced approximately 500 feet apart. However, the distance of the spacing may vary anywhere from a few feet to 1,000 feet. Pilots of aircraft in the formation must be able to determine the pitch and roll angles of the adjacent aircraft in the formation. At night this information may be provided by floodlighting the sides and tail, or the sides or tail, of the adjacent aircraft or equipping it with linear lighting. Prior to installation, the contractor shall make a study to determine the optimum system of formation lighting for the specific aircraft and submit the proposed system to the procuring activity for approval.

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3.3.6 Fuselage lights. Unless otherwise specified by the procuring activity (see 6.2), aircraft equipped for night flying shall have white lights installed on the fuselage. Where practicable, the lights shall be installed approximately midway between the nose and the tail of the aircraft with the top light located approximately above the lower light. If necessary, additional lights may be installed around the fuselage to provide the specified distribution. However, the top lights shall be located aft of the cockpit and shielded, where necessary, to prevent direct light from being projected into the cockpit or other transparent enclosures through which operating personnel must make observations at night. The lights shall provide the distribution specified in table VI when rated voltage is applied except for areas where shielding is provided and at angles near the fuselage when nearly flush-type lights are used.

TABLE VI. Distribution of Fuselage Lights

Light Distribution	Minimum Intensity
In hemisphere above horizontal plane	25 candles
In hemisphere below horizontal plane	25 candles

3.3.7 Landing and taxi lights. All aircraft equipped for night flying shall be provided with lights for landing, taxiing, and hovering, as required by the particular type of aircraft. The installations shall be provided with sufficient lamps so that the aircraft will not be completely without light in the event of a filament burnout or a broken bulb. A system using a single bulb will not be acceptable. The installations shall be such that lamp replacements may be readily accomplished. The lights shall be so located or shielded that direct or indirect light is not projected or reflected into transparent enclosures housing operating personnel of the aircraft. If used, covers shall be such that they do not appreciably reduce or distort the light emitted. The lights shall be so oriented and positioned that the proper area in front of and beneath the aircraft is sufficiently illuminated to provide ground reference for the pilot in all phases of landing and taxiing. This requirement shall be given particular attention on aircraft that land at nonconventional attitudes.

3.3.7.1 Landing and taxi lights, fixed-wing aircraft. All fixed-wing aircraft equipped for night flying shall be provided with an installation that can be effectively used for landing and taxiing. The narrow-beam, high-intensity lamps and the wide-beam, lower-intensity lamps shall have separate control circuits. The lampholders shall be so positioned that, when a lamp is installed, the wide beam emitted by the lamp is horizontal. Lamps with filament shields, installed outboard of the pilot's compartment, shall have the shields on the pilot's side. Adequate illumination shall be provided to furnish wingtip clearance reference to pilots during ground operations. The required illumination may be provided by retractable-type taxi lights installed near the wingtips. Lights designed

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for crosswind landings shall be installed on the aircraft so that the beam is projected in the direction of the aircraft movement. The manufacturer's proposed installation shall be approved by the procuring activity before the system is installed in new or modified aircraft.

3.3.7.1.1 Landing illumination. The landing and taxi light system shall incorporate sufficient approved lamps to provide not less than 2 footcandles on the ground line referenced on figure 1 at point B when measurements are made in a vertical plane directly ahead of each narrow-beam, high-intensity lamp used in the system. The use of 1,000w lamps is recommended as first choice for this application.

3.3.7.1.1.1 The adjustment shown on figure 1 shall be used for aircraft where conventional landing procedures are followed and the aircraft structure does not obscure the illuminated area from the pilot during any phase of the landing operation. The lights shall be so positioned that the illuminated area is visible to the pilot during the landing operation in the event the landing procedures or the aircraft structure are such that point B cannot be seen by the pilot during any phase of the landing. The installation shall be approved by the procuring activity prior to incorporation in the aircraft.

3.3.7.1.2 Taxiing illumination. The landing and taxi light system shall incorporate sufficient approved lamps to provide not less than 0.5 footcandle measured in the vertical plane on the ground line referenced on figure 2 at point A. The minimum illumination shall be provided on each side of the centerline of the aircraft to 10 feet outboard from each wingtip. When retractable-type taxi lights are used, they shall be connected so the pilot may energize the lamp in any position from fully extended to fully retracted.

3.3.7.1.3 Terrestrial landing light. Aircraft designed to be handled by both a pilot and copilot during landing and takeoff procedures shall be provided with a retractable-type light to provide ground reference. The light shall be so connected that it can be extended or retracted, with lamp energized, from any position between its fully retracted position and its fully extended position. The angular coverage provided by the light shall be not less than 90° with the beam adjustable from directly downward beneath the aircraft to forward in the direction of flight of the aircraft. The light shall use a landing lamp of not less than 450w. The controls for the light shall be separate from those provided for the other landing and taxi lights in the system.

3.3.7.2 Landing lights, rotary-wing aircraft. Unless otherwise specified (see 6.2), each rotary-wing aircraft shall be equipped with a 1,000w or 600w, retractable-type landing light and a 450w, controllable searchlight. Both lights shall be located beneath the aircraft as far forward as practicable in order to hold interference with the light output to the minimum when the aircraft is in a nosedown attitude. Shielding shall be provided to prevent scattered

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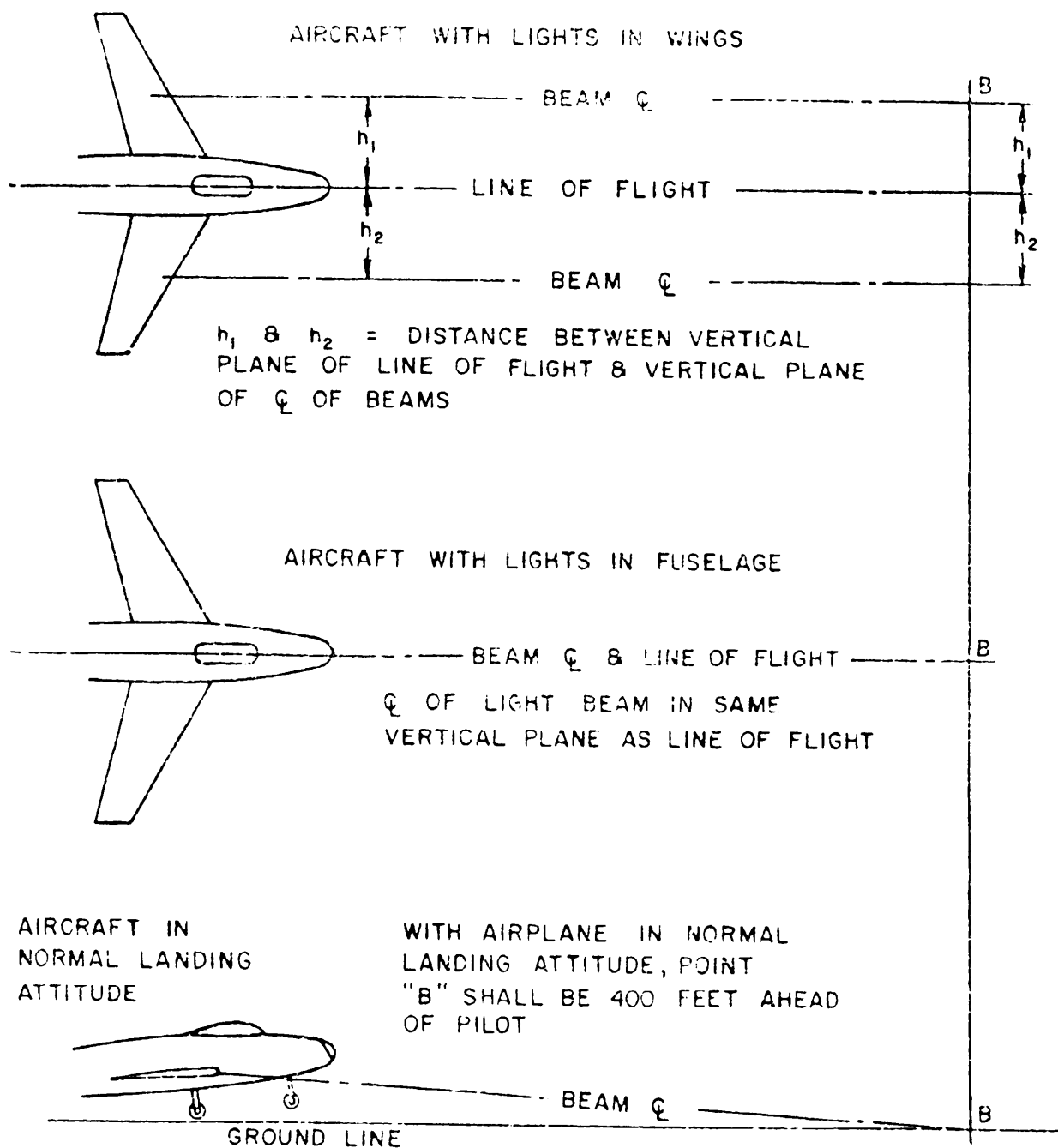


FIGURE 1. Landing Illumination

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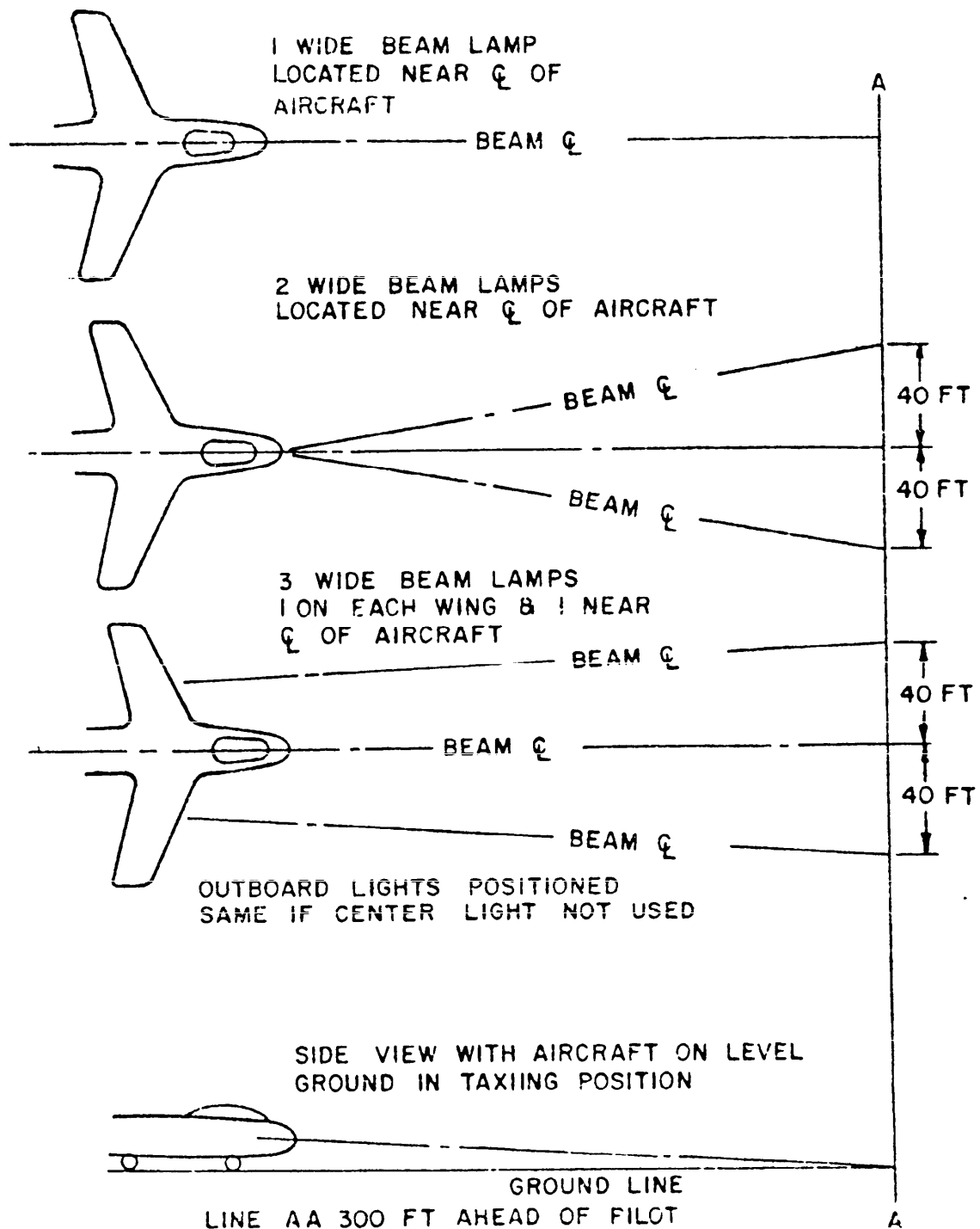


FIGURE 2. Taxi Illumination

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light from being projected into the transparent enclosures of the aircraft. If practicable, the retractable lights shall be installed on the nosewheel strut. Consideration shall be given to the light locations in order to hold interference with the light output to the minimum. Controls for the light shall be installed on the top of the collective control stick as shown on figure 3.

3.3.7.2.1 Retractable light. The 600w or 1,000w (1,000w preferred) retractable landing light shall be installed so that the beam from the lamp can be varied from 20° above to 60° below the normal level flight position of the aircraft. This light is required for illumination of obstructions that may be in the flight path of the aircraft during takeoff and landing. It is also required to provide illumination of the touchdown area during the landing procedure.

3.3.7.2.2 Controllable searchlight. The 450w, controllable searchlight shall be so installed that when the light is fully stowed, the plane of the lamp mounting ring will be horizontal when the aircraft is in normal, level flight. The searchlight shall be of a type that can be extended not less than 120° from its fully stowed position. The light covered by MIL-L-81174 shall be used for this application.

* 3.3.7.2.3 Rotor tip lights. Rotary-wing aircraft shall incorporate incandescent aviation white lamps on the rotor tips. These lamps shall have the intensity continuously variable from off to full bright. The size shall be such that the aerodynamic disturbance created is nil. The intensity at full bright shall be sufficient to be readily seen at the distances commonly flown in formation by the rotary wing aircraft. The light shall not be visible from directly above the aircraft, nor shall it be readily seen from below the rotor blade plane.

* 3.3.7.2.4 Formation fuselage lights. Rotary-wing aircraft shall incorporate electroluminescent panel lighting mounted on the fuselage so as to permit follower pilots to visually determine attitude and position of the lead aircraft at night. The illuminated area of the light shall be a minimum of 2.0 inches (5.08 cm) wide and 10.0 inches (25.40 cm) long. The brightness shall be continuously variable and at full bright shall not be less than 12 foot-lamberts (41.16 dc/m²). They shall be located, or shielded, such that they cannot be readily seen below the horizontal plane of the aircraft.

3.3.8 Refueling lights. Aircraft intended for inflight refueling operations at night shall incorporate adequate lighting for accomplishing the operation. The lights shall permit the receiver aircraft to visually locate and make contact with assigned tankers, and to permit the aircraft to fly in close proximity while fuel is being transferred. The manufacturer's proposed installation shall be coordinated with and approved by the procuring activity before it is installed. All lights used in the system shall be positioned and shielded to prevent any direct light from being projected into openings of the tanker or receiver aircraft through which observations must be made during final hookup or transfer of fuel. The light system shall be provided with variable dimming controls whereby the lights can be adjusted uniformly over the range of the control from the full bright to the off position.

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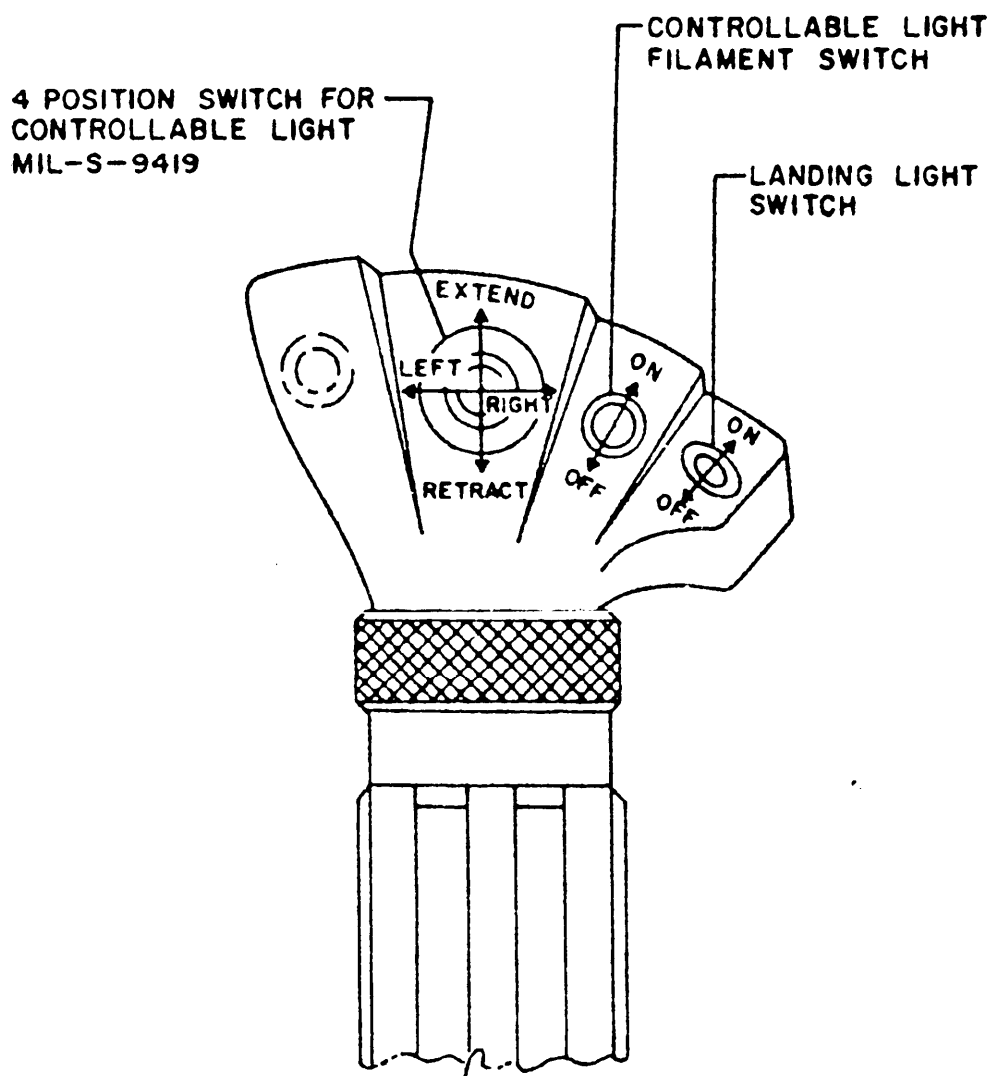


FIGURE 3. Collective Control Stick

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3.3.8.1 Tanker floodlighting. A system of illumination shall be provided in order that the pilot of the receiver aircraft can determine the position of the tanker in all positions of the receiver relative to the tanker during the refueling operation. In the case of the probe and drogue refueling operation this will require illumination of the top aft portion of both wings, the aft upper and lower portion of the fuselage, and the lower surface of the horizontal stabilizer.

3.3.8.2 Indicator lights. Amber and green indicator lights shall be installed on the tanker to inform the pilot of the receiver aircraft that the tanker is ready to transfer fuel, or that fuel is being transferred. The amber lights, controllable by the operator of the tanker, shall be used to indicate that the tanker is ready to transfer fuel. The green light shall come on while fuel is being transferred.

3.3.8.2.1 Positions of lights. The lights shall be so positioned that they are visible to the pilot of the receiver aircraft during final approach for contact with the tanker and while fuel is being transferred. Aircraft which have multiple means of transfer shall have indicator lights for each transfer position.

3.3.8.2.2 Size and intensity. The lights shall be of sufficient size and intensity and shall be suitably shielded so that they can be seen by the receiver pilot in bright daylight as well as at night. An intensity control shall be provided whereby the lights can be varied from full bright to off over the range of control.

3.3.8.3 Rendezvous lights. Unless otherwise specified (see 6.2), each tanker aircraft shall be provided with a coded rendezvous light system that will permit the receiver aircraft to visually locate and identify the tanker after being brought into visual range by electronic or other means. The rendezvous light shall meet the following provisions:

- a. It shall provide two rotating beams of white light 180° apart and two rotating beams of red light 180° apart. The red and white beams shall be spaced 90° apart.
- b. The circuitry for the light shall be such that either the red or the white beams can be turned on individually or both beams together.
- c. The light shall rotate between 20 and 30 rpm. This will provide flash rates of 40 to 60 flashes per minute with either the red or white beam on and 80 to 120 flashes per minute with both the red and white beams turned on.
- d. The light distribution for each beam (clear or red) emitted by the rendezvous light shall exceed that specified in 3.3.1.5.

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3.3.8.4 Probe light. Aircraft that use a probe for taking on fuel in flight shall be provided with a light so located that the side of the probe that is visible to the receiver pilot is floodlighted. The light shall have a variable dimming control whereby the brightness can be uniformly varied from full bright to off over the range of the control.

3.3.9 Scanning lights. Suitable fixed and portable scanning lights shall be provided on the types of aircraft referenced as follows.

- * 3.3.9.1 Fixed inspection lights. Unless otherwise specified (see 6.2), all aircraft except fighter, fighter trainer, and rotary-wing types shall have fixed inspection lights located in such positions that all areas of the wings and engines that are visible to personnel in the aircraft can be illuminated. The switch for energizing the lights shall be located in the cockpit in a position accessible to the pilot.

3.3.9.2 Portable inspection lights. A hand held scanning light with a bracket for mounting shall be installed in each helicopter and multiplace aircraft, except fighter types. The light covered by MIL-L-7569 is one type of light that has been approved for this application. Outlets shall be provided to permit the light to be used for projecting light through transparent openings to inspect flaps, wheels, wings, engines, et cetera, that may require inspection at night.

3.3.10 Position lights. All fixed- and rotary-wing aircraft shall be equipped with wing position and tail lights which will provide the minimum values of light distribution as outlined in 3.3.10.1.1 and 3.3.10.1.2 and the tables referenced therein. Every effort should be made to meet the design goals shown in table VII. Sufficient lights shall be installed to insure that the specified light distribution will be provided under all conditions of takeoff, flight, and landing; and also under all flight configurations on those aircraft designed to carry stores, tanks, or other items on the wingtips. Where practicable, the lights shall be installed on the wingtip and tail extremities. If inboard wingtip installations are required, the lights shall provide the same distribution as those installed on the wingtips, and small auxiliary red and green lights shall be installed on the wingtips. Lights installed within transparent fairings provided to match the aircraft contours shall meet the specified distribution with the fairings in place. The specified light distribution shall be provided under all flight conditions of all aircraft including those aircraft on which the wing positions are changed during takeoff, flight, or landing. Rotary-wing aircraft shall have the position lights installed on the sides of the fuselage. The color and distribution shall be the same as for lights installed on the wings of fixed-wing-type aircraft. Taillights on jet aircraft shall be so installed that they will not be damaged by heat or vibration from the jet exhaust.

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TABLE VII. Light Intensities

Dihedral Angle and Light Color	Angle from Right or Left of Longitudinal Axis Measured from Dead Ahead	Minimum Intensity Design Goals (Candelas)	Minimum Intensity Required (Candelas)	Maximum Intensity (Candelas)
L&R (forward red and green)	0° to 10°	60	40	
	10° to 20°	50	40	
	20° to 30°	30	30	
	30° to 40°	20	20	
	40° to 50°	15	15	
	50° to 70°	10	10	
	70° to 110°	6	6	
	110° to 120°			
	120° to 130°			5
A (rear white)	90° to 100°			5
	100° to 110°			
	110° to 180°	30	20	

3.3.10.1 Position light intensities. The intensities specified shall be provided by new equipment with covers in place. Light measurements shall be made with the lamps operating steady-burning at the rated voltage of the lamps used and with the temperature of the covers and fixtures stabilized.

3.3.10.1.1 Position light system dihedral angles. Each forward and rear position light must, as installed, show unbroken light within the dihedral angles described in this section.

- a. Dihedral angle L (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the aircraft, and the other 110° to the left of the first, as viewed when looking forward along the longitudinal axis.
- b. Dihedral angle R (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the aircraft, and the other at 110° to the right of the first, as viewed when looking forward along the longitudinal axis.
- c. Dihedral angle A (aft) is formed by two intersecting vertical planes making angles of 70° to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.

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3.3.10.1.2 Position light distribution and intensities. The light distribution and intensities of the forward and rear position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams, within dihedral angles L, R, and A, and must meet the following requirements:

- a. Intensities in the horizontal plane. Each intensity in the horizontal plane (the plane containing the longitudinal axis of the aircraft and perpendicular to the plane of symmetry of the aircraft) must equal or exceed the values in table VII.
- * b. Intensities in any vertical plane. Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) of the L and R dihedral angles (forward red and green) must equal or exceed the proper value included in the table below where I is the minimum intensity specified in table VII for the corresponding angles in the horizontal plane. The vertical distribution aft in the vertical plane passing through the white light source shall equal or exceed the minimum values specified for the A dihedral angle (rear white) in table VII. Vertical intensity equals multiplication factor x I.

<u>Angle Above or Below the Horizontal Plane</u>	<u>Multiplication Factor</u>
0°	1.00
0° to 5°	0.90
5° to 10°	0.80
10° to 15°	0.70
15° to 20°	0.50
20° to 30°	0.30
30° to 40°	0.10
40° to 90°	4.00 candelas minimum

c. Intensities in overlaps between adjacent signals. No intensity in any overlap between adjacent signals may exceed the values given in table VIII when the intensity directly forward is 40 candelas. Higher intensities in overlaps may be used when the main beam intensities are greater than the minimums specified in table VII and subparagraph b if the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity. When the peak intensity of the forward position lights is more than 40 candles, the maximum overlap intensities between them may exceed the values given in table VIII if the overlap intensity in Area A is not more than 25 percent of peak position light intensity and the overlap intensity in Area B out to 30° is not greater than 2.5 percent of peak position light intensity.

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d. Intensities emitted by the position lights in all areas around the lights outside of those areas designated in subparagraphs a, b, and c above shall not exceed 1 candela.

TABLE VIII. Light Intensities in Overlap Areas

Overlaps	Maximum Area A (Candles)	Intensity Area B (Candles)
Green in dihedral angle L	10	1
Red in dihedral angle R	10	1
Green in dihedral angle A	5	1
Red in dihedral angle A	5	1
Rear white in dihedral angle L	5	1
Rear white in dihedral angle R	5	1

Where:

a. Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10° but less than 20° .

b. Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20° .

3.3.11 Troop jump signal. When specified (see 6.2), a troop jump signal system conforming to Drawing 57C6103 shall be installed on cargo- and transport-type aircraft intended for airborne troop or cargo movements. When the system is installed in jet powered aircraft, a signal audible to the troops shall be used in lieu of the bell signal specified on Drawing 57C6103. The lights shall be located over the exit door in full view of the jump master's normal location. One or more auditory signals shall be installed in conjunction with the lights and so located that they will provide a satisfactory audible signal for the troops.

3.3.12 Utility light. One or more utility lights for use in illuminating maps, charts, or other work areas shall be provided for each of the operating personnel at his station. The light shall be such that it can be easily removed from its mounting base and used in any position within 4 feet of the base. It shall be so designed that the light output can be readily changed from red to white or white to red. The light shall be equipped with a self-contained intensity control whereby the light output can be uniformly varied from the full-bright to the off position over the range of the control. MIL-L-6484 covers one type of light that has been approved for this application.

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3.3.13 Worktable light. Lighting fixtures shall be installed to provide direct illumination of the navigator's, engineer's, et cetera, worktables. A rotary-type variable intensity control with an integral off position in the extreme counterclockwise position and the brightest position in the extreme clockwise position shall be provided to control the intensity at each station. Where practical, all labels, information plates, and other markings shall be illuminated by plastic-plate lighting or other means acceptable to the procuring activity. One type of worktable light suitable for this application is covered by AN3047.

3.3.14 Warning, caution, and advisory lights. The location, brightness, color, and dimming of warning, caution, and advisory lights shall be in accordance with MIL-STD-411.

3.4 Control circuits

3.4.1 General lighting controls. Controls for circuits where variable light output is required shall be of the rotary type with an off position in the extreme counterclockwise position. Rated voltage shall be applied to the lamps in the circuit when the control is turned to the extreme clockwise position. Maximum dimming shall be provided when the control is in the maximum counterclockwise position where power is applied to the circuits. The control shall be designed to vary the output of the lights from full bright to approximately 0.2 percent of the full-bright value when the control is in the maximum dimming position. Variable autotransformers may be used for controlling lights in alternating-current circuits, and rheostats in direct-current circuits. When used, rheostats shall conform to MIL-R-6749 or MIL-R-22, as applicable, and autotransformers shall conform to MIL-T-27493.

3.4.2 Landing- and taxi-light controls. The controls for the landing- and taxi-light system shall be such that the high-intensity, narrow-beam landing lamps and low-intensity, wide-beam taxi lamps used in the system may be operated simultaneously or separately.

3.4.2.1 Retractable light circuits. Circuits for retractable lights shall be such that the lamps are operated from a switch separate from the operating circuit for the light. This will permit the lamp to be turned on to melt ice in the event the light is frozen in the retracted position.

3.4.3 Navigation light controls. The control system for the exterior lights which includes the anticollision lights, navigation lights, and formation lights shall consist of the necessary switches and controls required to operate the various lights at the power brightness for each flight condition. The anticollision lights shall be operated by a switch separate from the other lights so that they may be turned on or off as required. The lights required for each flight condition are specified in table IX. Aircraft not provided with formation lights

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TABLE IX. Exterior Lights for Various Flight Conditions

	Anticol- lision Light	Wing Navigation Light	Top and Bottom Fuselage Section Lights	Tailights	Formation Fuselage Linear Lights	Wingtip Linear Formation Lights	Formation Lights on Top of Wing and Fuselage
Normal flight - good visibility conditions	On	On full bright steady burning	Off	On full bright steady burning	Off	Off	Off
Normal flight - Instrument conditions	Off	On full bright flashing 1/	On full bright steady burning	On full bright flashing 1/	Off	Off	Off
Join-up aircraft intended for formation flying at same relative altitude	Off	On full bright flashing 1/	On full bright steady burning	On full bright flashing 1/	On full bright steady burning	On full bright steady burning	
Join-up aircraft intended for step-up forma- tion flying	Off	On full bright flashing 1/	On full bright steady burning	On full bright flashing 1/			On full bright steady burning
Normal formation flying for air- craft intended for same relative altitude formation flying	Off	On with dimming provisions for opera- ting lights at approx 10% of rated value-steady burning	Off	Dimmed to approx 1% of normal	Dimmed to approx 2% of normal	Dimmed to approx 2% of rated light out- put	
Normal formation flying for air- craft step-up formation flying	Off	On with dimming provisions for opera- ting lights at approx 10% of rated value- steady burning	Off	Dimmed to approx 1% of normal			Dimmed to approx 25% of normal light output
Formation flying under maximum security con- ditions - aircraft intended for same altitude formation flying	Off	Off	Off	Off	Dimmed to approx 2% of rated light output	Dimmed to approx 2% of rated light output	
Formation flying under maximum security con- ditions aircraft intended for step-up forma- tion flying	Off	Off	Off	Off			Dimmed to approx 25% of normal light output

1/ Flashing is applicable only to those aircraft that are equipped with flashers in the navigation light circuits.

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shall have provisions for operating the wing, fuselage, and tail lights at either full bright or at approximately 1 percent of full bright as desired by the pilot. This shall be applicable to the steady-burning condition and to the flashing position of the wing and tail lights.

3.5 Flashing requirements for wing and tail lights. Unless otherwise specified by the procuring activity (see 6.2), the red and green wing lights and white tail lights shall be connected to flash simultaneously at the rate of 85 ± 15 flashes per minute with an on-to-off ratio of 2.4 to 1 ± 5 percent under those operating conditions where these lights are required to be flashed. Flashes required for 28V or 115V, 400-hertz circuits shall meet the applicable requirements of MIL-F-26301.

3.6 Lamp circuits. Circuits provided for furnishing power to lamps in the lighting fixtures shall be of sufficient capacity and connected to a power source that will not cause the lights to be deficient in light output due to low voltage being applied to the lamps. The circuits shall be provided with protective devices.

3.6.1 Voltage drop. The circuits and power source for the lamps shall be such that the voltage applied to the lamps will be within ± 7 percent of the rated voltage for the lamps under all normal takeoff, climb, cruise, combat, and landing conditions when the lamps are required to be operated. Incandescent lamps may be operated from alternating- or direct-current circuits that furnish power that is held to within the limits specified above. Where required, transformers or autotransformers may be used to provide rated voltage to the lamps. Normally, transformer rectifiers will not be suitable for furnishing power for operating the lamps.

3.6.2 Protective devices. Circuit breakers, fuses, or other protective devices shall be provided for automatically disconnecting the power from the light circuits in the event of a ground or short in the lighting fixtures, circuits, or controls. Careful consideration shall be given to the interrupting values for the protective devices in order to prevent the temperatures of the wires, controls, or fixtures from reaching such temperatures that will cause them to smoke or burn.

3.7 Spare lamps. Night-flying aircraft shall be provided with spare lamps as specified in table X. The lamps shall be for replacements that can normally be accomplished during flight. Storage space for the lamps shall be conveniently located so that the lamps are easily accessible to flight personnel during flight.

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TABLE X. Spare Lamps

Number of Same Type Lamps in Aircraft	Minimum Number of Spare Lamps, Per Type, to be Provided
1 to 5	1 ea
6 to 10	2 ea
11 to 20	3 ea
20 or over	5 ea

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection. Unless otherwise specified in the contract or order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Test conditions

4.2.1 Illumination evaluation systems. The illumination system shall be evaluated in a dark room, or in a viewing area at night, provided the area is free of artificial light. Government approval of each system is required.

4.2.2 Variations to illumination systems. No variations to the illuminated systems shall be made without prior Government approval. Affected systems shall be re-evaluated and resubmitted for Government approval.

4.3 Inspection. Each initial or revised installation shall be inspected to assure compliance with all applicable requirements of this specification. All deviations from applicable requirements shall be corrected and the affected system re-inspected.

4.4 Test data. When specified in the contract (see 6.2), the contractor shall provide photometric and test data showing that each installation furnishes the illumination and light distribution specified herein.

4.4.1 Electromagnetic interference (EMI) tests. Tests shall be performed in accordance with MIL-STD-462.

4.4.2 Electromagnetic compatibility (EMC) tests. Tests shall be performed in accordance with MIL-E-6051.

4.4.3 Electrical bonding tests. Tests shall be performed in accordance with MIL-E-6051.

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4.5 Inspection before delivery. All lenses and transparent covers shall be inspected after all work is completed on the aircraft and it is ready for delivery to the procuring activity. Any cover or lens on which the area through which the light is to be transmitted is scratched, damaged, or smeared with paint, sealing compound, or other foreign substance shall be cleaned or replaced before the aircraft is delivered.

5. PREPARATION FOR DELIVERY

5.1 This section is not applicable to this specification.

6. NOTES

6.1 Intended use. The lighting requirements specified herein are intended to cover exterior aircraft lights, interior illumination, and emergency lighting except instrument lighting and aircrew station visual signals.

* 6.2 Ordering data. Procurement documents should specify the following:

- a. That the contractor advise the procuring activity when the mockup has been completed and specify the tentative date for the mockup inspection (see 3.2.7)
- b. If fuselage lights as specified in 3.3.6 are not required
- c. If rotary-wing aircraft are not to be provided with a 1,000w or 600w, retractable-type landing light and a 450w, controllable searchlight (see 3.3.7.2)
- d. If rendezvous lights are not required (see 3.3.8.3)
- e. If fixed inspection lights are not required (see 3.3.9.1)
- f. If a troop jump signal system is required (see 3.3.11)
- g. If the aircraft navigation lights are not to be provided with flashing characteristics (see 3.5)
- h. Whether or not formation lights are to be provided and if so type to be furnished (see 3.3.5)

* i. When test data are required (see 4.2 and 4.4.4).

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6.3 Formation flying. The types of formations flown vary with the different types of aircraft and their missions. Some aircraft are flown at the same relative altitude with the wing aircraft being flown along side of or slightly aft of its lead aircraft. When the aircraft are flown close together it is called a (tight) formation; however, when aircraft are flown over long distances they are generally flown in a (loose) formation. The separation under these conditions is generally about 500 feet but may vary from a few feet between wingtips of adjacent aircraft up to 1,000 feet. Under some conditions a stepped-up formation is used. Under these conditions the trailing aircraft is flown so that it is above and aft of its lead aircraft.

6.4 Instrument lighting. Instrument lighting is covered by MIL-L-5667.

6.5 Formation lighting system. WADC Technical Report 55-124 may be used as a guide in providing a formation lighting system. The title of this document is Formation Lights for Fighter Aircraft, and it may be obtained from Defense Documentation Center (DDC), Cameron Station, Alexandria, Virginia 22314.

6.6 International standardization agreements. Certain provisions of tables II and III, 3.3.1, 3.3.3.1, 3.3.10, 3.3.11, and 3.3.14 of this specification are the subject of international standardization agreements ASCCAS 12/2 and ASCCAS 10/19 and STANAGS 3153, 3156, and 3224. When amendment, revision, or cancellation of this specification is proposed which will affect or violate the international agreement concerned, the preparing activity will take appropriate reconciliation action through international standardization channels including departmental standardization offices, if required.

6.7 Identification of changes. The margins of this specification are marked with an asterisk to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notation and relationship to the last previous issue.

Custodians:

Army - AV
Air Force - 11

Preparing activity:

Air Force - 11

Project No. 6220-0231

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Air Force - 82
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SPECIFICATION FOR INSTALLATION OF

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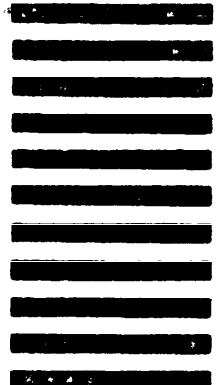
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