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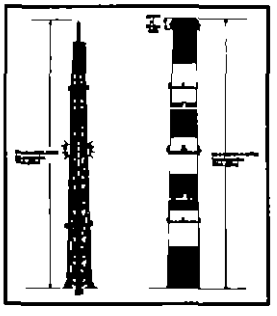
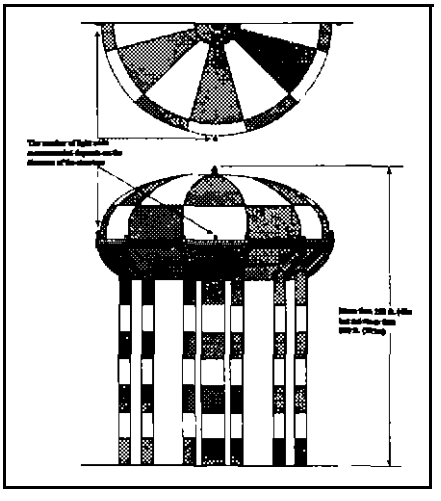
U S Department
of Transportation
Federal **Aviation**
Administration

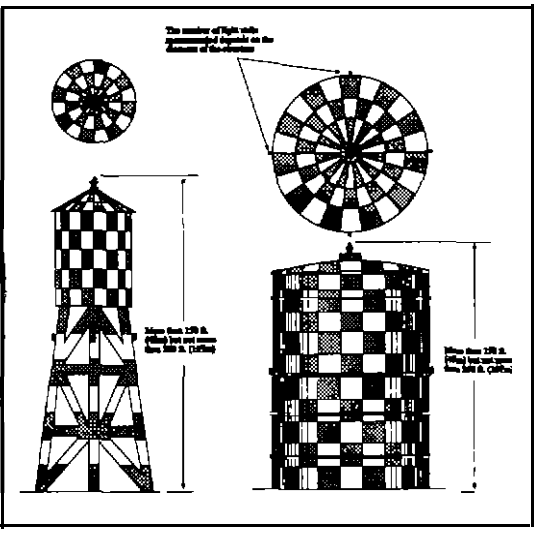
ADVISORY CIRCULAR

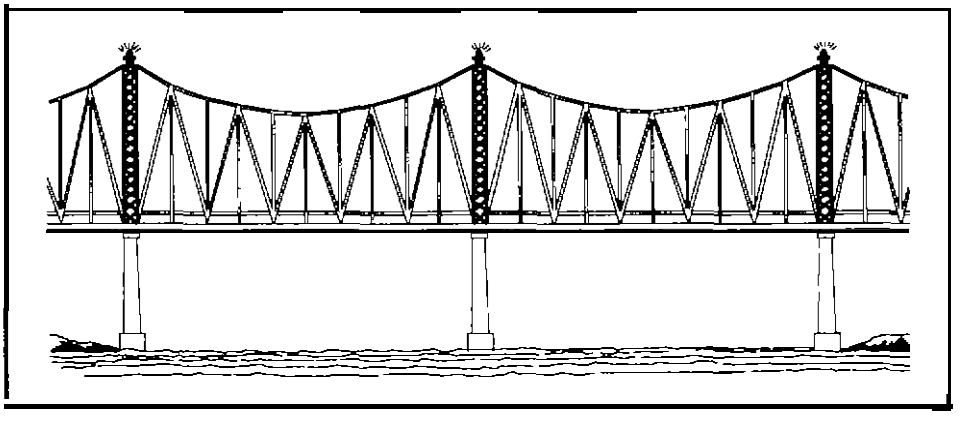
AC 70/7460–1 J



Obstruction Marking and Lighting







U.S. Department of Transportation
Federal Aviation Administration

ADVISORY CIRCULAR

Subject: Obstruction Marking and Lighting

Date: 11/29/95

Initiated by: ATP-240

AC No 70/7460-1J

1 PURPOSE This Advisory Circular (AC) describes the Federal Aviation Administration's (FAA) standards for marking and lighting structures to promote aviation safety

2 CANCELLATION AC 70/7460-1H, Obstruction Marking and Lighting, dated August 1991 is canceled by this revision

Note-
BACKGROUND Since there is a typographical similarity between the alphanumeric characters "I and "I" the "I" character has been skipped and the letter "J' has been used for this edition of the advisory circular

3 EFFECTIVE DATE This advisory circular becomes effective January **1, 1996.**

4 RELATED DOCUMENTS.

a. Federal Aviation Regulations Part 77 describes the standards used relative to objects in the navigable airspace and specifies the requirements for notice to the Administrator of certain proposed construction or alteration.

b. Federal Communications Commission (FCC) specifications contained in Part 17 of the FCC Rules and Regulations

5 HIGHLIGHTS. This circular contains numerous editorial changes Major changes are indicated below

a. Paragraph 5, Modifications and Deviations, states sponsor's responsibility to adhere to recommended chapters of AC Paragraph added concerning voluntary marking and/or bghtmg "Paragraph added advising proponents to become familiar with various bghtmg systems "

b. Paragraph 6, FCC Approval, adds notification requirement to National Oceanic and Atmospheric Administration (NOAA) of modifications/deviations to marking and/or lighting

c. Paragraph 33. Patterns. adds requirement to paint conduit and cable wires

d. Paragraph 36. Catenary Lighting, deleted

e. Paragraph 43, Catenary Lighting, added

f. Paragraph 51, Standards, adds requirement for lights to flash simultaneously

g Paragraph 53b(2)(b), Poles, Towers. and Similar Skeletal Structures, revised

h. Paragraph 105. Catenary Lighting, added

i Paragraph 115, Catenary Lighting, added

J. Paragraph 132. Availability of Specifications, changes General Service Administration's address and telephone number

k. Appendix 1. Figure 1 (Types of Red Obstruction Lights) and Figure 2 (Types of High and Medium Intensity White Obstruction Lights), deleted These figures are replaced with a listing of types of obstruction lights

L. LANE SPECK
Program Director for Air Traffic Rules and Procedures

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CHAPTER 1 ADMINISTRATIVE PROCEDURES

1 REPORTING REQUIREMENTS

Each person proposing any type of construction or alteration under the provisions of Federal Aviation Regulations (FAR) Part 77 is required to notify the Federal Aviation Administration (FAA) by completing FAA Form 7460-1, Notice of Proposed Construction or Alteration The completed form should be sent to the Air Traffic Division, FAA regional office having jurisdiction over the area where the construction or alteration would be located FAA Form 7460-1 may be obtained from the FAA headquarters, regional offices. and Airports District Offices

2 PRECONSTRUCTION NOTICE

This notice must be submitted

a. At least 30 days before the date the proposed construction or alteration is to begin

b. On or before the date, an application for a construction permit is filed with the Federal Communications Commission (FCC) (The FCC advises its applicants to file with the FAA well in advance of the 30 day period required in paragraph 2 a, in order to expedite FCC processing)

3 FAA ACKNOWLEDGMENT

The FAA will acknowledge, in writing, receipt of each notice (FAA Form 7460-1) received

4 SUPPLEMENTAL NOTICE

If required for submission, FAA Form 7460-2, Notice of Actual Construction or Alteration, will accompany the FAA determination This is the authorized form that sponsors must complete and mail to the FAA when reporting the start, completion, or abandonment of construction Letters are acceptable in cases where the construction/alteration is temporary or a proposal is abandoned This notification process is designed to permit the FAA the necessary time to change affected procedures and/or minimum flight altitudes and to otherwise alert airmen of the structure's presence

Caution-
NOTIFICATION AS REQUIRED IN THE DETERMINATION IS CRITICAL TO AVIATION SAFETY

5 MODIFICATIONS AND DEVIATIONS

Requests for modification or deviation from these standards must be submitted to the FAA regional office serving the area where the structure would be located Once approved, the sponsor is responsible to adhere to specific advisory circular chapter recommendatons and should notify the FAA & FCC prior to removal of marking and/or lighting A request received after a determination is issued may require a new study and could result in a new determination

The FAA strongly recommends that proponents become familiar with the different types of lighting systems and to request specifically the type of system desired when submitting FAA Form 7460-1 Information about these systems can be found in the Advisory Circulars listed in Chapter 13, Marking and Lighting Equipment and Information Information should also be obtained from the manufacturers Proponents can then determine which system best meets their needs based on purpose, installation, and maintenance costs The type of system desired should then be requested in item 2 D of FAA Form 7460-1 The FAA will make every effort to accommodate the request.

a. ***Modifications*** Modifications may be approved when they would not impair aviation safety Some examples of modifications are

*1. **Marking and/or Lighting Only a Portion of an Object.*** The object may be so located with respect to other objects or terrain that only a portion of it needs to be marked or lighted

*2 **No Marking and/or Lighting*** The object may be so located with respect to Other objects Or terra",, removed from the general flow of air traffic, or may be so conspicuous by its shape, size, or color that marking or lighting would serve no useful purpose

*3 **Voluntary Marking and/or Lighting*** The object may be so located with respect to other objects or terrain that the sponsor feels increased conspicuity would better serve aviation safety

*4 **Marking or Lighting an Object in Accordance with the Standards for an Object of Greater Height or Size*** The object may present such an extraordinary hazard potential that higher standards may be recommended for increased conspicuity to ensure the safety to air navigation

b. ***Deviations*** The FAA regional office conducts an aeronautical study of the proposed deviation(s) and forwards its recommendation to FAA headquarters in Washington, DC, for final approval Examples of deviations are changes in the

1 Colors of objects

2. Dimensions of color bands or rectangles

3 Colors/types of lights

4 Basic signals and intensity of lighting

5 Night/day lighting combinations

6 Flashrate

6 FCC APPROVAL

Any change to an original FAA determination including modification, deviation or optional upgrade to white lighting on structures which are regulated by the FCC must also be filed with the FCC for proper authorization and annotations of obstruction marking and lighting These structures will be subject to inspection and enforcement of marking and lighting requirements by the FCC Upon completion of the actual change, notify Aeronautical Charting at.

NOAA Aeronautical Charting Division
SSMC-4 N/CG3111
1305 Eat-west Highway
Silver Spring. MD 20910-3233

7. METRIC UNITS

To promote an orderly transition to metric units, specifications include both English and metric (SI units) dimensions The metric conversions may not be exact equivalents, and until there is an official changeover to the metric system, the English dimensions will govern

CHAPTER 2. GENERAL

20. OBJECTS TO BE MARKED AND LIGHTED

Any temporary or permanent object, including all appurtenances, that exceeds an overall height of 200 feet (61m) above ground level (AGL) or exceeds any obstruction standard contained in FAR Part 77, Subpart C, should normally be marked and/or lighted However, an FAA aeronautical study may reveal that the absence of marking and/or bgbtmg will not impair aviation safety Conversely, the object may present such an extraordinary hazard potential that higher standards may be recommended for increased conspicuity to ensure safety to air navigation Normally outside commercial lighting is not considered sufficient reason to omit recommended marking and/or lighting The FAA may also recommend marking and/or lighting a structure that does not exceed 200 feet AGL or Part 77, Subpart C standards because of its particular location

21 GUYED STRUCTURES

The guys of a 2,000 foot (610m) skeletal tower are anchored from 1,600 feet (488m) to 2,000 feet (610m) from the base of the structure This places a portion of the guys 1,500 feet (458m) from the tower at a height of between 125 feet (38m) to 500 feet (153m) AGL FAR Section 91 119 requires pilots, when operating over other than congested areas, to remain at least 500 feet (153m) from man-made structures Therefore. the tower must be cleared by 2,000 feet (610m) horizontally to avoid all guy wires Properly maintained marking and lighting are Important for increased conspicuity since the guys of a structure are difficult to see until aircraft are dangerously close

22 MARKING AND LIGHTING EQUIPMENT

It is strongly recommended that construction sponsors become familiar with the types of lighting systems available and request the desired lighting systems when submitting FAA Form 7460–1 If the marking and/or lighting is not specified on the form, the FAA regional office specialists will contact the sponsor by telephone and ascertain their preference. The FAA recommends use of only those marking and lighting systems which meet the technical standards established by the FAA Considerable effort and research have been expended in determining the minimum systems or quality of materials that will produce an acceptable level of safety in marking and lighting obstructions to air navigation While additional lights may be desirable to identify an obstruction to air navigation and may, on occasion be recommended, the FAA has specified the minimum level in these recommended standards in the interest of economy, safety and related concerns Therefore, to provide an adequate level of safety, obstruction lighting systems should be installed, operated and maintained as stated in these recommended standards (See CHAPTER 13)

23 LIGHT FAILURE NOTIFICATION

Conspicuity is achieved only when all recommended lights are working Partial equipment outages decrease the margin of safety Any outage should be corrected as soon as possible Failure of a steady burning side or intermediate hgbt should be corrected as soon as possible, but notification is not required Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light regardless of its position should be reported immediately to the nearest automated flight service station (AFSS) or flight service station (FSS) so a Notice to Airmen (NOTAM) can be issued Toll-free numbers are listed in most telephone books This report should contain the following information

a Persons or organizations reporting light failures should furnish their name, title, address, and telephone number

b The type of structure

c. Location of structure, including latitude and longitude, if known (prominent structures, landmarks, etc)

d. Height of structure above ground level (AGL)/above mean sea level (AMSL), if known

e. The date that normal operations are expected to resume

24 NOTIFICATION OF RESTORATION

As soon as normal operation is restored, notify the same AFSS/FSS that received the notification of failure When the outage occurs on an FCC-regulated structure, the FCC will be notified if notice of restoration is not received within 30 days FCC advises that noncompliance with notification procedures could subject its licensees to penalties or monetary forfeitures

25 FCC REQUIREMENT

FCC licensees are required to file an environmental assessment with the Commission when seeking authorization for the use of the high intensity flashing white bgbtmg system

CHAPTER 3. MARKING

30 PURPOSE

Marking makes a structure more conspicuous to pilots during daylight hours This may be accomplished by coloring the structure or by using smtable markers

31 PAINT COLORS

Alternate sections of aviation orange and aviation white paint provide maximum visibility of an obstruction by contrast in colors (See paragraph 131)

32 STANDARDS

To be effective, paint should meet specific color requirements when freshly applied to a structure However, all outdoor paints deteriorate with tune While it is not practical to give a maintenance schedule for all climates, surfaces should be repainted when the color changes noticeably or its effectiveness is reduced by scaling, oxidation, chipping, or layers of industrial contamination Tolerance charts are available for determining when repainting is required The color should be sampled on the upper half of the structure, since weathering is greater there Color tolerance charts may be purchased from a supplier (See paragraph 133)

a. ***Materials and Application*** Quality paint a n d materials should be selected to provide extra years of service The paint should be compatible with the surfaces to be painted, including any previous coatings, and suitable for the environmental conditions Surface preparation and paint application should be in accordance with manufacturer's recommendations

b. Surfaces Not ***Requiring Paint*** Ladders, decks, and walkways of steel towers and similar structures need not be painted if a smooth surface presents a potential hazard to maintenance personnel Paint may also be omitted from precision or critical surfaces if it would have an adverse effect on the transmission or radiation characteristics of a signal However, the overall marking effect on the structure should not be reduced

c. ***Skeletal Structures*** Complete all marking/painting prior to or immediately upon completion Of construction This applies to catenary support structures, radio and television towers, and similar skeletal structures To be effective, paint should be applied to all inner and outer surfaces of the framework

33 PATTERNS

Paint patterns of various types are used to mark structures The pattern to be used is determined by the size and shape of the structure

a. ***Solid Pattern*** *Obstacles* should be colored aviation orange if the structure has both horizontal and vertical dimensions not exceeding 10 5 feet (3 2m)

b. ***Checkerboard Pattern*** Alternating rectangles of aviation orange and white are normally displayed on structures as follows

1. ***Normal uses***

(a) Water, gas. and gram storage tanks

(b) Buildings, as required

(c)Large structures exceeding 105 feet (3 2m) across having a horizontal dimension that is equal to or greater than the vertical dimension

2. ***Size*** of ***Rectangles*** Sides of the checkerboard rectangles should measure not less than 5 feet (1 5m) nor more than 20 feet (6m) and should be as nearly square as possible However. if it is impractical because of the size or shape of a structure, the rectangle may have sides less than 5 feet (1 5m) When possible, comer surfaces should be colored orange

3. ***Exceptions*** Structural designs *not* conducive *to* standard markings may be marked as follows

(a) If it is not practical to color the roof of a structure in checkerboard pattern, it may be colored solid orange

(b) If a spherical structure is not smtable for an exact checkerboard pattern, the shape of the rectangles may be modified to fit the shape of the surface (See APPENDIX 1 , FIG 2)

(c)Storage tanks not smtable for a checkerboard pattern may be colored by alternating bands of aviation orange and white or a limited checkerboard pattern applied to the upper one-third of the structure

(d) The skeletal framework of certain water. gas, and gram storage tanks may be excluded from the checkerboard pattern

c. ***Alternate*** Bonds Alternate bands of aviation orange and white are normally displayed on the following structures

1. Normal Uses

(a) Communication towers and catenary support structures

(b) Poles

(c) Smokestacks

(d) Skeletal framework of storage tanks and similar structures

(e) Structures which appear narrow from a side view, that are 10 5 feet (3 2m) or more across, and the horizontal dimension is less than the vertical dimension

(f) Wmd turbine generator support structures including the nacelle or generator housing

(g) Coaxial cable, conduits and other cables attached to the face of a tower

2. *Color* ***Band Characteristics*** Bands for structures of any height should be

(a) Equal in width, provided each band is not less than $1^1/_2$ feet (0 5m) nor more than 100 feet (31m) wide

(b) Perpendicular to the vertical axis with tbe bands at the top and bottom ends colored orange

(c) An odd number of bands on the structure

(d) Approximately one-seventh the height if the structure is 700 feet (214m) AGL or less For each additional 200 feet (61m) or fraction thereof, add one (1) additional orange and one (1) additional white band

(e) Equal and in proportion to the structure's height AGL (See TBL 1) (See APPENDIX 1 , FIG 1)

Structure Height to Bandwidth Ratio

Example: If a Structure is:		
Greater Than	But Not More Than	Band Width
10 5 feet (3 2m)	700 feet (214m)	$^1/_7$ of height
701 feet (214m)	900 feet (275m)	$^1/_9$ of height
901 feet (275m)	1,100 feet (336m)	$^1/_{11}$ of height
1,100 feet (336m)	1,300 feet (397m)	$^1/_{13}$ of height

TBL I

3. *Structures With a* ***Cover or Roof*** *If the* structure has a cover or roof, the highest orange band should be continued to cover the entire top of the structure

4 ***Skeletal Structures Atop Buildings*** If a flagpole, skeletal structure, or similar object is erected on top of a building, the combined height of tbe object and building will determine whether marking is recommended, however, only the height of the object under study determines the width of the color bands

5. *Partial Marking* *If* marking is recommended for only a portion of a structure because of shielding by other objects or terrain, the width of the bands should be determined by the overall height of the structure A minimum of three bands should be displayed on the upper portion of tbe structure

6. ***Wind Turbine Rotor Blades*** Each rotor blade should be marked, front and beck, with three bands of orange and white paint beginning with an orange band at each tip The bands should be approximately the same width as those on the tower Tbe rem-g (inner) blade area may be any color (See APPENDIX 1 , FIG 10)

d. *Teardrop Pattern* Spherical water storage tanks with a single circular standpipe support may be marked in a teardrop striped pattern. (See APPENDIX 1 , FIG 4) The tank should show alternate stripes of aviation orange and white The stripes should extend from the top center of the tank to its supporting standpipe The width of the stripes should be equal, and the width of each stripe at the greatest girth of the tank should not be less than 5 feet (1 5m) nor more than 15 feet (4 6m)

e ***Community*** Names If it is desirable to paint the name of the community on the side of a tank, the stripe pattern may be broken to serve this purpose This open area should have a maximum height of 3 feet (0 9m) (See APPENDIX 1 , FIG4)

34 MARKERS.

Markers are used to highlight structures when it is impractical to make them conspicuous by painting Markers may also be used in addition to aviation orange and white paint when additional conspicuity is necessary for aviation safety They should be displayed in conspicuous positions on or adjacent to the structures so as to retain tie general definition of tbe structure They should be recognizable in clear air from a distance of at least 4,000 feet (1219m) and in all directions from which aircraft are likely to approach Markers should be distinctively shaped, i e spherical, cylindrical, so they are not mistaken for items that are used to convey other information They should be replaced when faded or otherwise deteriorated.

a. *Spherical Markers* Spherical markers are used to identify overhead wires Markers may be of another shape, i e , cylindrical, provided the projected area of such markers will not be less than that presented by a spherical marker

1. ***Size and*** color

(a) The diameter of the markers used on extensive catenary wires across canyons, lakes, rivers, etc , should be not less than 36 inches (91cm) Smaller 20–inch (51cm) spheres are permitted on less extensive power lines or on power lines below 50 feet (15m) above tbe ground and within 1,500 feet (458m) of an airport runway end Each marker should be a solid color such as aviation orange. white, or yellow (See paragraph 131 for color standards)

2 ***Installations***

(a) ***Spacing*** Markers should be spaced equally along the wire at intervals of approximately 200 feet (61m) or fraction thereof Intervals between markers should be less in critical areas near runway ends (i e , 30 to 50 feet) They

should be displayed on the highest wire or by another means at the same height as the highest we where there is mom than one wire at the highest point, the markers may be installed alternately along each wire if the distance between adjacent markers meets the spacing standard This method allows the weight and wind loading factors to be distributed

(b) *Pattern An* alternating color scheme provides the most conspicuity against all backgrounds Mark overhead wires by alternating solid colored markers of aviation orange, white, and yellow Normally, an orange sphere is placed at each end of a line and the spacmg is adjusted (not to exceed 200 feet) to accommodate the rest of the markers When less than four markers are used, they should all be aviation orange

b. *Flag Markers* Flags are used to mark certain structures or objects when it is technically impractical to use spherical markers or painting Some examples are temporary construction equipment, cranes, derricks, oil and other drilling rigs Catenaries should use sperical markers

1 *Minimum* Sue Each side of the flag marker should be at least 2 feet (0 6m) in length

2. *Color Patterns* Flags should be colored as follows

(a) *Solid.* Aviation orange

(b) *Orange* and *White* Arrange two triangular sections, one aviation orange and the other white to form a rectangle

(c) *Checkerboard.* Flags 3 feet or larger should be a checkerboard pattern of aviation orange and white squares, each 1 foot (0 3m) plus or minus 10 percent

3. *Shape* Flags should be rectangular in shape and have stiffeners to keep them from drooping in calm wmd

4. *Display* Flag markers should be displayed around, on top, or along the highest edge of the obstruction When flags are used to mark extensive or closely grouped obstructions, they should be displayed approximately 50 feet (15m) apart The flag stakes should be of such strength and height that they will support the flags above all surrounding ground, structures, and/or objects of natural growth

35 UNUSUAL COMPLEXITIES

The FAA may also recommend appropriate markmg in an area where obstructions are so grouped as to present a common obstruction to air navigation

36 OMISSION OR ALTERNATIVES TO MARKING

There ate two alternatives to markmg Either alternative requires FAA review and concurrence

Note- PROPONENTSMUSTENSURE THAT ALTERNATIVES TO *MARKING ARE COORDINATED WITH THE FCC FOR STRUCTURES UNDER ITS JURISDICTION*

a. High Intensity Flashing White Lighting Systems. The high intensity lighting systems are more effective than aviation orange and white paint and therefore can be recommended instead of markmg This is particularly true under certain ambient light conditions involving the position of the sun relative to the direction of flight. When high intensity hghtmg systems are operated during daytime and twilight, other methods of markmg may be omitted When operated 24 hours a day, other methods of markmg and lighting may be omitted (See paragraph 71. and CHAPTER11)

b *Medium Intensity Flashing White Lighting Systems* When medium intensity lighting systems are operated during daytime and twilight on structures 500 feet (153m) AGL or less, other methods of markmg may be omitted *When operated 24* hours a day on structures 500 feet (153m) AGL or less, other methods of marking and lighting may be omitted (See paragraph 61, and CHAPTER 10)

CHAPTER 4 LIGHTING

40 PURPOSE

This chapter describes the various obstruction lighting systems used to identify structures that an aeronautical study has determined will require added conspicuity The lighting standards in this circular are the minimum necessary for aviation safety

41 STANDARDS

The standards outlined in this AC are based on the use of lighting units that meet specified intensities, beam patterns, color, and flash rates as specified in AC 150/5345-43

These standards may be obtained from.

Department of Transportation

Property Use and Storage Section, Subsequent Distribution Office

M483 6

Ardmore East Business Center
3341 Q 75th Avenue

Landover, MD 20785

Note-
All flashing lights on a structure should flash simultaneously except for catenary support structures which have a distinct sequence flashing between levels

42 SYSTEM CONFIGURATIONS

Obstruction lighting may be displayed on structures as follows

a. *Aviation Red Obstruction Lights* Use flashing beacons and/or steady burning lights during nighttime

b. *Medium Intensity Flashing White Obstruction Lights* Medium intensity flashing white obstruction lights may be used during daytime and twilight with automatically selected reduced intensity for nighttime operation when this system is used on structures 500 feet (153m) AGL or less in height, other methods of marking and lighting the structure may be omitted Aviation orange and white paint is always required for daytime marking on structures exceeding 500 feet (153m) AGL This system is not normally recommended on structures less than 200 feet (61m) AGL

c. *High Intensity Flashing White Obstruction Lights* Use high intensity flashmg white obstruction lights during daytime with automatically selected reduced intensities for twilight and nighttime operations When this system is used, other methods of marking and lighting the structure may be omitted. This system should not be recommended on structures 500 feet (153m) AGL or less. unless an FAA aeronautical study shows otherwise

d. Dual Lighting This system consists of red lights for nighttime and high or medium intensity flashmg white lights for daytime and twilight. When a dual lighting system incorporates medium flashmg intensity hghts on structures 500 feet or less, or high intensity flashmg white lights on structures of any height, other methods of marking the structure may be omitted

e. *Obstruction Lights During Construction.* As the height of the structure exceeds each level at which permanent obstruction lights would be recommended, two or more hghts of the type specified in the determination should be installed at that level Temporary high or medium intensity flashmg white hghts. as recommended in the determination, should be operated 24 hours a day until all permanent lights are in operation In either case, two or more lights should be installed on the uppermost part of tbe structure any time it exceeds the height of the temporary construction equipment. They may be turned off for periods when they would interfere with construction personnel If practical, permanent obstruction hghts should be installed and operated at each level as construction progresses The hghts should be positioned to ensure that a pilot has an unobstructed view of at least one light at each level

f. *Temporary Construction Equipment Lighting* Smce there is such a variance in construction cranes, derricks, oil and other drilling rigs, each case should be considered individually Lights should be mstalled according to the standards given in CHAPTER 5 , CHAPTER 6 , CHAPTER 7 , or CHAPTER 8 as they would apply to permanent structures (See CHAPTER 3 for daytime marking)

43 CATENARY LIGHTING

Lighted markers should be used for increased night conspicuity of high-voltage (69KV or higher) transmission line catenary wires These markers should be used on transmission line catenary wires near airports, heliports, across rivers, canyons. lakes, etc The lighted markers should be manufacturer certified as recognizable from a minimum distance of 4,000 feet (1219m) under nighttime, minimum VFR conditions or having a minimum intensity of at least 32 5 candela The lighting unit should emit a steady burning red light. They should be used on the highest energized line If the markers are mstalled on a line other than the highest catenary, then spherical markers specified in paragraph 34 should be used in addition to the lighted markers (The maximum distance between the line energizing the lighted markers and the highest catenary above the lighted marker should be more than 20 feet) Markers should be distinctively shaped, i e , spherical, cylindrical, so they are not mistaken for items that are used to convey other information They should be visible in all directions from which au-craft are likely to approach

a. Sue ***and Color*** The diameter of the markers used on extensive catenary wires across canyons, lakes, rivers, etc , should be not less than 36 inches (91cm) Smaller 20–inch (51cm) markers are permitted on less extensive power lines or on power lines below 50 feet (1 5m) above tie ground and within 1,500 feet (458m) of an airport runway end Each marker should be a sobd color such as aviation orange, white, or yellow (See paragraph 131 for color standards)

b ***Installations***

1 ***Spacing*** Lighted markers should be spaced equally along the wire at intervals of approximately 200 feet (61m) or fraction thereof Intervals between markers should be less in critical areas near runway ends (1 e , 30 to 50 feet) If lighted markers are installed on a lme other than the highest catenary, then spherical makers specified in paragraph 34 should be used in addition to the lighted markers The maximum distance between the line energizing the lighted markers and the highest catenary above the lighted markers should be no more than 20 feet. The lighted markers may be installed alternately along each wire if the distance between adjacent markers meets the spacing Standard This method allows the weight and wmd loading factors to be distributed

2 ***Pattern*** An alternating color scheme provides the most conspicuity against all backgrounds Mark overhead wires by alternating solid colored markers of aviation orange. white, and yellow Normally, an orange marker is placed at each end of a line and the spacing is adjusted (not to exceed 200 feet) to accommodate the rest of the markers When less than four markers are used, they should all be aviation orange

44 RATED LAMP VOLTAGE

To ensure the proper lumen output, for fixtures with incandescent lamps, the voltage prowled to the lamp filament should not vary more than plus or minus 3 percent of the rated voltage of the lamp The input voltage should be measured at the lamp socket with the lamp operating during the hours of normal operation. Lamps should be replaced after being operated for not more than 75 percent of their rated life or immediately upon failure Flashtubes in a light unit should be replaced immediately upon failure, when the peak effective nighttime intensity falls below 2,000 effective candela, or when the fixture begins skipping flashes, or at the manufacturer's recommended intervals (See paragraph 23, for reporting requirements in case of failure)

45 NONSTANDARD LIGHTS

Moored balloons, chimneys, church steeples. and similar obstructions may be floodlighted by fixed search light projectors installed at three Or more equidistant points around the base of each obstruction The searchlight projectors should provide an average illumination of at least 15 footcandles over the top one-thud of the obstruction

46 PLACEMENT FACTORS

The height of the structure AGL determines the number of light levels The light levels may be adjusted slightly, but not to exceed 10 feet, when necessary to accommodate guy wires and personnel who replace or repair light fixtures Except for catenary support structures, the following factors should be considered when determining the placement of obstruction lights on a structure

a. Red Obstruction Lighting Systems The *overall* height of the structure mcludmg all appurtenances such as rods, antennas, obstruction lights, etc , determines the number of light levels (See APPENDIX 1 , PIG 11)

b. ***Medium Intensity Flashing White Obstruction Lighting*** Systems The overall height of the structure mcludmg all appurtenances such as rods. antennas, obstruction hghts. etc , determines the number of light levels (See APPENDIX 1 , FIG 12)

c. ***High Intensity Flashing White Obstruction Lighting Systems*** The overall height of the main structure excludmg all appurtenances such as rods, antennas, obstruction lights, etc , determines the number of light levels (See APPENDIX 1 , FIG 13)

d. Dual Obstruction Lighting Systems The overall height of the structure mcludmg all appurtenances such as rods. antennas, obstruction hghts, etc , is used to determine the number of light levels for a medium intensity white obstruction light/red obstruction dual lighting system The overall height of the structure excludmg all appurtenances is used to determine the number of light levels for a high intensity white obstruction light/red obstruction d u a l lighting system (See APPENDIX 1 , FIG 7)

e. ***Adjacent Structures*** The elevation of the tops of adjacent buildings in congested areas may be used as the equivalent of ground level to determine the proper number of light levels required

f. ***Shielded Lights. If any*** light is shielded by an adjacent object, horizontal placement of the lights should be adjusted or additional lights should be mounted on that object to retain or contribute to the definition of the obstruction

47 MONITORING OBSTRUCTION LIGHTS

Although some obstruction lighting systems have redundant features, they should be closely monitored by visual or automatic means It is extremely important to visually inspect obstruction lighting in each operating intensity at least once every 24 hours on systems without automatic monitoring In the event a structure is not readily accessible for visual observation, a properly maintained automatic monitor should be used. This monitor should be designed to register the malfunction of any light on the obstruction

regardless of its position or color The monitor (aural or visual) should be located in an area generally occupied by responsible personnel In some cases, this may require a remote monitor in an attended location. All obstruction lights should be visually inspected on a regular basis

48 ICE SHIELDS.

Where icing is likely to occur, metal grate.3 or similar protective ice shields should be installed directly over each light unit to prevent falling ice 01 accumulations from damaging the light units

49. DISTRACTION.

a. Where obstruction lights may distract operators of vessels in the proximity of a navigable waterway, the sponsor must coordinate with the Commandant, US Coast Guard, to avoid interference with marine navigation

b. The address for marine information and coordination is

Chief, Short Range Aids to Navigation
Division (G-NSR)
US Coast Guard Headquarters
2100 2nd street SW
Washington, DC 20593-0001
Telephone (202) 267-0980

CHAPTER 5. RED OBSTRUCTION LIGHTING STANDARDS

50 PURPOSE

Red obstruction lights are used to increase conspicuity during nighttime Daytime and twilight marking is required

51 STANDARDS

The red obstruction lighting system is composed of flashing omnidirectional beacons (L-864) and/or steady burning (L-810) lights when one or more levels is comprised of flashing beacon lighting, the lights should flash simultaneously (See APPENDIX 1 FIG 11)

a. *Single Obstruction Light.* A single (L-810) light may be used when more than one obstruction light is required either vertically or horizontally or where maintenance can be accomplished within a reasonable time

1 ***Top Level.*** A single light may be used to identify low structures such as airport ILS buildings and long horizontal structures such as perimeter fences and building roof outlines

2. ***Intermediate Level.*** Single lights may be used on skeletal and solid structures when more than one level of lights is installed and there are two or more single lights per level

b. *Double Obstruction Light.* A double (L-810) light should be installed when used as a top light, at each end of a row of single obstruction lights, and in areas or locations where the failure of a single unit could cause an obstruction to be totally unlighted

1. ***Top Level.*** Structures *150* feet (46m) AGL or less should have one or more double lights installed at the highest point and operating simultaneously

2. ***Intermediate Level.*** Double lights should be installed at intermediate levels when a malfunction of a single light could create an unsafe condition and in remote areas where maintenance cannot be performed within a reasonable time Both units may operate simultaneously, or a transfer relay may be used to switch to a spare unit should the active system fall

3 Lowest ***Level.*** The lowest level of light units may be installed at a higher elevation than normal on a structure if the surrounding terrain, trees, or adjacent building(s) would obscure the lights (See APPENDIX 1) In certain instances, as determined by an FAA aeronautical study, the lowest level of lights may be eliminated

52 CONTROL DEVICE

Red obstruction bghts should be operated by a satisfactory control device (e g , photo cell, tuner, etc) adjusted so the lights will be turned on when the northern sky illuminance reaching a vertical surface falls below a level of 60 footcandles (645 8 lux) but before reaching a level of 35 footcandles (367 7 lux) The control device should turn the lights off when the northern sky illuminance rises to a level of not more than 60 footcandles (645 8 lux) The lights may also remain on continuously The sensing device should, if practical, face the northern sky in the Northern Hemisphere (See AC 150/5345-43)

53 POLES, TOWERS, AND SIMILAR SKELETAL STRUCTURES

The following standards apply to radio and television towers, supporting structures for overhead transmission lines, and similar structures

a. Top Mounted Obstruction ***Light.***

1. ***Structures*** 150 ***Feet (46m)*** *AGL or* ***Less*** *Two* or more steady burning (L-810) lights should be installed in a manner to ensure an unobstructed view of one or more lights by a pilot

2. ***Structures Exceeding 150 Feet (46m) AGL.*** At least one red flashing (L-864) beacon should be installed in a manner to ensure an unobstructed view of one or more lights by a pilot.

3 ***Appurtenances*** *40 Feet (12m) or Less If a rod,* antenna, or other appurtenance 40 feet (12m) or less in height is incapable of supporting a red flashing beacon, then it may be placed at the base of the appurtenance If the mounting location does not allow unobstructed viewing of the beacon by a pilot, then additional beacons should be added

4. ***Appurtenances Exceeding*** *40 Feet (12m) If a* rod, antenna, or other appurtenance exceeding 40 feet (12m) in height is incapable of supporting a red flashing beacon, a supporting mast with one or more beacons should be installed adjacent to the appurtenance Adjacent installations should not exceed the height of the appurtenance and be within 40 feet (12m) of the tip to allow the pilot an unobstructed view of at least one beacon

b ***Mounting Intermediate*** Levels The number of light levels is determined by the height of the structure, including all appurtenances, and is detailed in APPENDIX 1 The number of lights on each level is determined by the shape and height of the structure These lights should be mounted so as to ensue an unobstructed view of at least one light by a pilot.

1 ***Steady Burning Lights*** *(L.-MO)*

(a) ***Structures*** *350 Feet (107m) AGL or Less Two* or more steady burning (L-810) lights should be installed on diagonally or diametrically opposite positions

(b) *Structures Exceeding 350 Feet (107m) AGL.* Install steady b-g (J-8 10) lights on each outside corner of each level

2. *Flashing Beacons (L–864)*

(a) Structures 350 Feet (107m) AGL or Less These structures do not require flasbmg (L-864) beacons at intermediate levels

(b) *Structure Exceeding 350 Peel (107m) AGL.* At intermediate levels, two beacons (L–864) should be mounted outside at diagonally opposite positions of intermediate levels

54 CHIMNEYS, FLARE STACKS, AND SIMILAR SOLID STRUCTURES.

a *Number of Light Units*

1. The number of units r-ended depends on the diameter of tbe structure at tbe top The number of bghts recommended below are the minimum

2. When the structure diameter is

(a) 20 Feet (6m) or Less Three light units per level.

(b) *Exceeding 20 Feet (6m) But Not More Than 100* Feet *(31m)* Four light units per level

(c) *Exceeding 100 Feet (31m) But* Not *More Than 200 Feet (61m)* Six light units per level

(d) *Exceeding 200 Feet (61m)* Eight light units per level

b *Top Mounted Obstruction Lights*

1. Structures 150 Feet (46m) AGL or Less L-810 lights should be mstalled horizontally at regular intervals at or near the top

2. Structures Exceeding 150 Feet (46m) AGL. At least three *L-864* beacons should be installed

3. *Chimneys, Cooling Towers, and Flare Stocks* Lights may be displayed as low as 20 feet (6m) below the top to avoid the obscuring effect of deposits and heat generally emitted by this type of structure It is important that these lights be readily accessible for cleaning and lamp replacement (See APPENDIX 1)

c. *Mounting Intermediate Levels* The number of bght levels is determined by the height of the structure including all appurtenances For cooling towers 600 feet or less, intermediate light levels are not necessary

d . *Structures Exceeding 600 Feet (183m) AGL.* Structures exceeding 600 feet (183m) AGL should have a second level of light units installed approximately at the midpoint of the structure and in a vertical line with the top level of lights

1. Steady Burning (L-810) Lights The recommended number of light levels may be obtained from APPENDIX 1 At least three lights should be installed on each level

2. *Flashing (L-864) Beacons* The recommended number of beacon levels may be obtained from APPENDIX 1 At least three lights should be installed on each level

(a) Structures 350 Feet (107m) AGL or Less These structures do not need intermediate levels of flashing beacons

(b) *Structures Exceeding 350 Feet (107m) AGL* At least three flashing (L-864) beacons should be mstalled on each level in a manner to allow an unobstructed view of at least one beacon

55. WIND TURBINE STRUCTURES

These structures should be lighted by mounting one flashing red beacon on the highest practical point. The recommended number of intermediate bght levels may be obtained from APPENDIX 1 At least three steady b-g red bghts should be mstalled An FAA aeronautical study may recommend fewer bghts at locations where several structures are closely grouped

56 GROUP OF OBSTRUCTIONS.

When individual objects within a group of obstructions are not tbe same height and are spaced a maximum of 150 feet (46m) apart, the prominent objects within the group should be lighted in accordance with tbe standards for individual obstructions of a corresponding height In addition, at least one flashing beacon should be installed at tbe top of a prominent center obstruction or on a special tower located near the center of the group

57 ALTERNATE METHOD OF DISPLAYING OBSTRUCTION LIGHTS

When recommended in an FAA aeronautical study, bghts may be placed on poles equal to the height of the obstruction and mstalled on or adjacent to the structure instead of installing lights on the obstruction

58. PROMINENT BUILDINGS AND SIMILAR EXTENSIVE OBSTRUCTIONS

When objects within a group of obstructions are approximately tbe same overall height above tbe surface and are located a maximum of 150 feet (46m) apart, the group of obstructions may be considered an extensive obstruction Install light units on tbe same horizontal plane at tbe highest portion or edge of prominent obstructions Light units should be placed to ensure that the light is visible to a pilot approaching from any direction Steady burning lights

should be &splayed to indicate the extent of the obstruction as follows

a. Structures 150 **Feet** *(46m) or Less in Any Horizontal Direction If* the structure/extensive obstruction is 150 feet (46m) or less horizontally, at least one steady burning light (L-810) should be displayed on the highest point at each end of the major axis of the obstruction. If this is impractical because of the overall shape, display a double obstruction light in the center of the highest pomt

b *Structures Exceeding* 150 *Feet (46m) in at Least One Horizontal Direction.* If the structure/extensive obstruction exceeds 150 feet (46m) horizontally, display at least one steady burning light for each 150 feet (46m), or fraction thereof, of the overall length of the major axis At least one of these lights should be displayed on the highest point at each end of the obstruction Additional lights should be displayed at approximately equal intervals not to exceed 150 feet (46m) on the highest points along the edge between the end lights If an obstruction is located near a landing area and two or more edges are the same height, the edge nearest the landing area should be lighted

c. *Structures Exceeding 150 Feet (46m) AGL. Steady* burning red obstruction lights should be installed on the highest point at each end At intermediate levels. steady burning red lights should be displayed for each 150 feet (46m) or fraction thereof The vertical position of these lights should be equidistant between the top lights and the ground level as the shape and type of obstruction will permit. One such light should be displayed at each outside comer on each level with the remaining hghts evenly spaced between the corner hghts

d *Exceptions* Flashing *red* beacons *(L-864)* may be used instead of steady burning obstruction hghts if early or special warning is necessary These beacons should be displayed on the highest points of an extensive obstruction at intervals not exceeding 3.000 feet (915m) At least three beacons should be displayed on one side of the extensive obstruction to indicate a line of hghts

e *Ice Shields Where* icing is likely to occur, metal grates or similar protective ice shields should be installed directly over each bght unit to prevent falling ice or accumulations from damaging tie light units The light should be mounted in a manner to ensure an unobstructed view of at least one light by a pilot approaching from any direction.

CHAPTER 6 MEDIUM INTENSITY FLASHING WHITE LIGHTING SYSTEM STANDARDS

60 PURPOSE

Medium intensity flashing white (L-865) obstruction lights may provide conspicuity both day and night.

61 STANDARDS

The medium intensity flashing white light system is normally composed of flashing omnidirectional lights This system is not normally recommended on structures less than 200 feet AGL

62 RADIO AND TELEVISION TOWERS AND SIMILAR SKELETAL STRUCTURES

a. ***Mounting Lights*** *The* number of levels recommended depends on the height of the structure, including antennas and similar appurtenances (See APPENDIX 1)

1 ***Top Levels*** One or more lights should be installed at the highest point to provide 360 degree coverage ensuring an unobstructed view

2 ***Appurtenances 40 feet (12m) or less*** If a rod, antenna, or other appurtenance 40 feet (12m) or less in height is incapable of supporting the medium intensity flashing white light, then it may be placed at the base of the appurtenance If the mounting location does not allow unobstructed viewing of the medium intensity flashing white light by a pilot, then additional lights should be added.

*3. **Appurtenances Exceeding 40 feet (12m) If a rod,*** antenna, or other appurtenance exceed.9 40 feet (12m) above the tip of the main structure, a medium intensity flashing white light should be placed within 40 feet (12m) from the top of the appurtenance If the appurtenance (such as a whip antenna) is incapable of supporting the light, one or more lights should be mounted on a pole adjacent to the appurtenance Adjacent installations should not exceed the height of the appurtenance and be within 40 feet (12m) of the tip to allow the pilot an unobstructed view of at least one light.

b ***Intermediate Levels*** At intermediate levels, two beacons (L-865) should be mounted outside at diagonally or diametrically opposite positions of intermediate levels The lowest light level should not be less than 200 feet (61m) AGL

c. Lowest ***Levels*** The lowest level of light units may be mstalled at a higher elevation than normal on a structure if the surrounding terrain, trees, or adjacent building(s) would obscure the lights (See APPENDIX 1) In certain instances, as determined by an FAA aeronautical study, the lowest level of lights may be eliminated

d ***Structures 500 Feet (153m) ACL or Less When*** white lights are used during nighttime and twilight only. marking is required for daytime When operated 24 hours a day, other methods of marking and lighting are not required

e. ***Structures Exceeding 500 Feet (153m) AGL The*** lights should be used during nighttime and twilight and may be used 24 hours a day Marking is always required for daytime (See CHAPTER 2 and CHAPTER 3)

f. Ice ***Shields*** Where icing is likely to occur, metal grates or similar protective ice shields should be installed directly over each light unit to prevent falling ice or accumulations from damaging the light units The light should be mounted in a manner to ensure an unobstructed view of at least one light by a pilot approaching from any direction

63 CONTROL DEVICE

The light intensity is controlled by a device that changes the intensity when the ambient light changes The system should automatically change intensity steps when the northern sky illumination in the Northern Hemisphere on a vertical surface is as follows

a. ***Twilight-to-Night*** This should not occur before the illumination drops below five footcandles (53 8 lux) but should occur before it drops below two footcandles (215 lux)

b. ***Night-to-Day*** The intensity changes listed in (a) above should be reversed when changing from the night to day mode

64 CHIMNEYS, FLARE STACKS, AND SIMILAR SOLID STRUCTURES

a. Number ***of Light Units The*** number of units recommended depends on the diameter of the structure at the top Normally, the top level is on the highest point of a structure However, the top level of chimney lights may be mstalled as low as 20 feet (6m) below the top to minimize deposit build-up due to emissions The number of lights recommended in the following table are the minimum When the structure diameter is

1.20 ***Feet (6m) or Less*** Three light units per level

2. ***Exceeding 20 Feet (6m) But Not More Than 100 Feet (31m)*** Four light units per level

3. ***Exceeding 100 Feet (31m) But Not More Than 200 Feet (61m)*** Six light units per level

*4 **Exceeding 200 Feet (61m) Eight light units per level.***

65 GROUP OF OBSTRUCTIONS

When individual objects within a group of obstructions are not the same height and are spaced a maximum of 1.50 feet (46m) apart, the prominent objects within the group should

be lighted in accordance with the standards for individual obstructions of a corresponding height. In addition, at least one medium intensity flashing white light should be installed at the top of a prominent center obstruction or on a special tower located near the center of the group

66 SPECIAL CASES

Where lighting systems are installed on structures located near highways, waterways. airport approach areas, etc , caution should be exercised to ensure that the lights do not distract or otherwise cause a hazard to motorists, vessel operators, or pilots on an approach to an airport In these cases, shielding may be necessary This shielding should not derogate the intended purpose of the lighting system (Also see paragraph 47)

67 PROMINENT BUILDINGS AND SIMILAR EXTENSIVE OBSTRUCTIONS

When objects within a group of obstructions are approximately the same overall height above the surface and are located a maximum of 150 feet (46m) apart, the group of obstructions may be considered an extensive obstruction Install light units on the same horizontal plane at the highest portion or edge of prominent obstructions Light units should be placed to ensure that the light is visible to a pilot approaching from any direction Lights should be displayed to indicate the extent of the obstruction as follows

a. *Structures 150 Feet (46m) or Less in Any Horizontal Direction. If* the structure/extensive obstruction is 150 feet (46m) or less horizontally, at least one light should be displayed on the highest point at each end of the major axis of the obstruction If this is impractical because of the overall shape. &splay a double obstruction light in the center of the highest point.

b *Structures Exceeding 150 Feet (46m) in at Least One Horizontal Direction If the* structure/extensive obstruction exceeds 150 feet (46m) horizontally, display at least one light for each 150 feet (46m) or fraction thereof, of the overall length of the major axis At least one of these lights should be displayed on the highest point at each end of the obstruction Additional lights should be displayed at approximately equal intervals not to exceed 150 feet (46m) on the highest points along the edge between the end lights If an obstruction is located near a landing area and two or more edges are the same height, the edge nearest the landing area should be lighted

c. *Structures Exceeding 150 Feet (46m) AGL* Lights should be installed on the highest point at each end At intermediate levels, lights should be displayed for each 150 feet (46m), or fraction thereof The vertical position of these lights should be equidistant between the top lights and the ground level as the shape and type of obstruction will permit One such light should be displayed at each outside corner on each level with the remaining lights evenly spaced between the comer lights

CHAPTER 7 HIGH INTENSITY FLASHING WHITE LIGHTING SYSTEMS STANDARDS

70 PURPOSE

Lighting with high intensity (L–856) flashing white obstruction hghts provides the highest degree of conspicuity both day and night

71 STANDARDS

When high intensity white lights are operated 24 hours a day, other methods of marking and lighting may be omitted This systems should not be recommended on structures 500 feet (153m) AGL or less unless a" FAA aeronautical study shows otherwise

72 CONTROL DEVICE

The light intensity is controlled by a device that changes the intensity when the ambient light changes The system should automatically change intensity steps when the northern sky illumination in the Northern Hemisphere on a vertical surface 1s as follows

a. *Day–to–Twilight* This should not occur before the illumination drops to 60 footcandles (645 8 lux), but should occur before it drops below 35 footcandles (376 7 lux) The illuminance sensing device should. if practical, face the northern sky in the Northern Hemisphere

b *Twilight–to–Night.* This should not occur before the illumination drops below five footcandles (53 8 lux), but should occur before it drops below two footcandles (21 5 lux)

c. *Night–to–Day* The intensity changes bated in (a) and (b) above should be reversed when changing from the night to day mode

73 UNITS PER LEVEL

One or more light units is needed to obtain the desired horizontal coverage The number of hght units recommended per level (except for the supporting structures of catenary wires and buildings) depends upon the average outside diameter of the specific structure, and the horizontal beam width of the light fixture The light units should be installed in a manner to ensure a" unobstructed view of the system by a pilot approaching from any direction The "umber of hghts recommended are the minimum (See APPENDIX 1) When the structure diameter is

a. 20 *Feet (6m) or Less* Three light units *per* level

b. *Exceeding 20 Feet (6m) But Not More Than 100 Feet (31m)* Four light units per level

c *Exceeding 100 Feet (31m)* SIX light units *per level*

74 INSTALLATION GUIDANCE

Manufacturing specifications provide for the effective peak intensity of the light beam to be adjustable from zero to 8 degrees above the horizon Normal installation should place the top light at zero degrees to the horizontal and all other light units installed in accordance with TBL 2

Light Unit Elevation Above the Horizontal

Height of Light Unit Above Terrain	Degrees of Elevation Above the Horizontal
Exceeding 500 feet AGL	0
401 feet to 500 feet AGL	1
301 feet to 400 feet AGL	2
300 feet AGL or less	3

TBL 2

a. *Vertical Aiming* Where terrain, nearby residential areas, or other situations dictate, the light beam may be further elevated above the horizontal The main beam of light at the lowest level should not strike the ground closer than 3 statute miles (5km) from the structure If additional adjustments are necessary. the hghts may be individually adjusted upward, in 1 degree increments, starting at the bottom Excessive elevation may reduce its conspicuity by raising the beam above a collision course flight path

b *Special Cases* Where lighting systems are installed on structures located near highways, waterways, airport approach areas, etc , caution should be exercised to ensure that the lights do not distract or otherwise cause a hazard to motorists, vessel operators, or pilots on an approach to an airport. In these cases, shielding or an adjustment to the vertical or horizontal light aiming may be necessary This adjustment should not derogate the intended purpose of the lighting system Such adjustments may require review action as described in CHAPTER 1 , paragraph 5 (Also see CHAPTER 4 , paragraph 49)

c. *Relocation or Omission of Light Units* Light units should not he installed in such a manner that the light pattern/output is disrupted by the structure

1 *Lowest Level.* The lowest level of light units may be installed at a higher elevation than normal on a structure if the surrounding terrain, bees. or adjacent building(s) would obscure tie lights (See APPENDIX 1) In certain instances, as determined by an FAA aeronautical study, the lowest level of hghts may be eliminated

2. *Two Adjacent Structures Where* two structures *are* situated within 500 feet (153m) of each other and the light units are installed at the same levels, the sides of the structures facing each other need not be lighted However, all hghts on both structures must flash simultaneously, except for adjacent catenary support structures Adjust

vertical placement of the bgbts to either or both structures' intermediate levels to place the bgbts on the same horizontal plane Where one structure is higher than the other, complete level(s) of lights should be mstalled on that part of the higher structure which extends above the top of the lower structure If the structures are of such heights that the levels of lights cannot be placed in identical horizontal planes. then the light units should be placed such that the center of the horizontal beam patterns do not face toward the adjacent structure For example, structures situated north and south of each other should have the light units on both structures mstalled on a northwest/southeast and northeast/southwest orientation (See APPENDIX 1)

3 Three or More A&cent Structures The treatment of a cluster of structures as an individual or a complex of structures will be determined by the FAA as the result of an aeronautical study, taking into consideration the location, heights, and spacing with other structures

75 ANTENNA OR SIMILAR APPURTENANCE LIGHT

When a structure lighted by a high intensity flashing light system 1s topped with an antenna or similar appurtenance exceeding 40 feet (12m) in height, a medium intensity flashing white light (L–865) should be placed within 40 feet (12m) from tbe tip of the appurtenance This light should *operate 24* hours a day and flash simultaneously with the rest of the lighting system

78 CHIMNEYS, FLARE STACKS, AND SIMILAR SOLID STRUCTURES

The number of light levels depends on the height of the structure excluding appurtenances Three or more bgbts should be mstalled cm each level in such a manner to ensure an unobstructed view by tbe pilot. Normally, the top level is on the highest point of a structure However, the top level of chimney bgbts may be installed as low as 20 feet (6m) below the top to minimize deposit build–up due to emissions

77. RADIO AND TELEVISION TOWERS AND SIMILAR SKELETAL STRUCTURES.

a. ***Mounting Lights*** The number of levels recommended depends on the height of the structure. excluding antennas and similar appurtenances At least three lights should be mstalled on each level and mounted to ensure that the effective intensity of the full horizontal beam coverage is not impaired by the structural members

b. *Top* ***Level.*** One level of lights should be installed at the highest pant of tbe structure If tbe highest point is a rod or antenna incapable of supporting a lighting system then the top level of ltgbts should be mstalled at the highest portion of the main skeletal structure When guy wires come together at the top, it may be necessary to install this level of bgbts as low as 10 feet (3m) below the top If the rod or antenna exceeds 40 feet (12m) above the main structure, a medium intensity flashing white light (L–865) should be mounted on the highest point If the appurtenance (such as a whip antenna) is incapable of supporting a medium intensity light, one or more lights should be mstalled on a pole adjacent to the appurtenance Adjacent installation should not exceed the height of tbe appurtenance and be within 40 feet (12m) of the tip to allow an unobstructed view of at least one light (See paragraph 75)

c. Ice ***Shields*** Where icing is likely to occur, metal grates or similar protective ice shields should be mstalled directly over each bgbt unit to prevent falling ice or accumulations from damaging the light units

78 HYPERBOLIC COOLING TOWERS

Light units should be installed in a manner to ensure all unobstructed view of at least two lights by a pilot approaching from any direction. (See APPENDIX I)

a. ***Number of Light Units*** **The number** of units recommended depends on the diameter of the structure at the top The number of lights recommended in the following table are the minimum When the structure diameter is

1 20 ***Feet (6m) or Less Three*** light units per level

2. Exceeding 20 Feet (6m) But Not More Than 100 Feet (31m) Four light units per level

3. Exceeding 100 Feet (31m) But Not More Than 200 Feet ***(61m)*** Six light units per level

4 ***Exceeding 200 Feet (61m)*** Eight light units per level

b. ***Structures Exceeding 600 Feet (183m) AGL*** Structures exceeding 600 feet (183m) AGL should have a second level of light units mstalled approximately at the midpoint of the structure and in a vertical lme with the top level of lights

79. PROMINENT BUILDINGS AND SIMILAR EXTENSIVE OBSTRUCTIONS

When objects within a group of obstructions are approximately the same overall height above the surface and are located not more than 150 feet (46m) apart, the group of obstructions may be considered an extensive obstruction. Install light units on tbe same horizontal plane at the highest portion or edge of prominent obstructions Light units should be placed to ensure that the light is visible to a pilot approaching from any direction These lights may require shielding, such as louvers. to ensure minimum adverse impact on local communities Extreme caution in the use of high intensity flashing white lights should be exercised

a. ***If*** *the Obstruction* ***is 200*** *feet* ***(61m)*** *or* ***Less in Either Horizontal Dimension,*** install three or more light units at the highest portion of the structure in a manner to ensure that

at least one light is visible to a pilot approaching from any direction Units may be mounted on a single pedestal at or near the center of the obstruction. If light units are placed more than 10 feet (3m) from the center point of the structure, use a minimum of four units

b. *If* the ***Obstruction Exceeds 200 Feet (61m) in One Horizontal Dimension,*** but is 200 feet (61m) or less in the other, two light units should be placed on each of the shorter sides These light units may either be installed adjacent to each other at the midpoint of the edge of the obstruction or at (war) each corner with tbe light unit aimed to provide 180 degrees of coverage at each edge One or more light units should be installed along the overall length of the major axis These lights should be installed at approximately equal intervals not to exceed a distance of 100 feet (31m) from the corners or from each other

c. *If the* ***Obstruction*** *Exceeds 200 Feet* ***(61m) in*** *Both* ***Horizontal Dimensions,*** light units should b e equally spaced along the overall perimeter of the obstruction at intervals of 100 feet (31m) or fraction thereof

CHAPTER 8. DUAL LIGHTING WITH RED/MEDIUM INTENSITY FLASHING WHITE SYSTEMS

80 PURPOSE

This dual lighting system includes red lights (L-864) for nighttime and medium intensity flashing white lights (L-865) for daytime and twilight use This lighting system may be used in heu of operating a medium intensity flashing white lighting system at night There may be some populated areas where the use of medium intensity at mght may cause significant environmental concerns The use of the dual lighting system should reduce/mitigate those concerns

81 INSTALLATION

The hght units should be installed as specified in tbe appropriate portions of CHAPTER 4 , CHAPTER 5 , and CHAPTER 6 The number of light levels needed may be obtained from APPENDIX 1

02. OPERATION

Lighting systems should be operated as specified in CHAPTER 4 , CHAPTER 5 , and CHAPTER 6 as appropriate Botb systems should not be operated at the same tune. however. there should be no more than a Z-second delay when changing from one system to tbe other Outage of one of two lamps in the uppermost red beacon (L-864 incandescent unit) or outage of any uppermost red strobe shall cause the white obstruction light system to operate in its specified "night" step intensity,

83 CONTROL DEVICE

The light system is controlled by a device that changes the system when tbe ambient light changes The system should automatically change steps when the northern sky illumination in the Northern Hemisphere on a vertical surface IS as follows

a. ***Twilight-to-Night.*** This should not occur before the illumination drops below 5 footcandles (53 8 lux) but should occur before it drops below 2 footcandles (215 lux)

b. ***Night-to-Day*** The intensity changes listed ma above should be reversed when changing from the night to day mode

84 ANTENNA OR SIMILAR APPURTENANCE LIGHT

When a structure utilizing this dual lighting system is topped with an antenna or similar appurtenance exceeding 40 feet (12m) in height, a medium intensity flashing white and a red flashing beacon should be placed within 40 feet (12m) from the tip of tbe appurtenance The white light should operate during daytime and twilight and the red light during nighttime These lights should flash simultaneously with the rest of the lighting system

85. OMISSION OF MARKING

When medium intensity white lights are operated on structures 500 feet (153m) AGL or less during daytime and twilight, other methods of marking may be omitted.

CHAPTER 9. DUAL LIGHTING WITH RED/HIGH INTENSITY FLASHING WHITE SYSTEMS

90 PURPOSE

This dual lighting system includes red lights (L-864) for nighttime and high intensity flashing white lights (L–856) for daytime and twilight use This lighting system may be used in lieu of operating a flashing white lighting system at night. There may be some populated areas where the use of high intensity at night may cause significant environmental concerns The use of the dual lighting *system* should reduce/mitigate those concerns

91 INSTALLATION

'The light units should be installed as specified in the appropriate portions of CHAPTER 4 , CHAPTER 5 , and CHAPTER 7 The number of light levels needed may be obtained from APPENDIX 1

92 OPERATION

Lighting systems should be operated as specified in CHAPTER 4 , CHAPTER 5 , and CHAPTER 7 a s appropriate Both systems should not be operated at the same time, however. there should be no more than a 2-second delay when changing from one system to the other Outage of one of two lamps in the uppermost red beacon (L-864 incandescent unit) or outage of any uppermost red strobe shall cause the white obstruction light system to operate in Its specified " night" step intensity

93 CONTROL DEVICE.

The light intensity is controlled by a device that changes the intensity when the ambient light changes The system should automatically change intensity steps when the northern sky illumination in the Northern Hemisphere on a vertical surface is as follows

a. Day–to–Twilight This should not occur before the illumination drops to 60 footcandles (645 8 lux) but should occur before it drops below 35 footcandles (376 7 lux) The illuminance sensing device should. if practical, face the northern sky in the Northern Hemisphere

b *Twilight–to–Night* This should not occur before the illumination drops below 5 footcandles (53 8 lux) but should occur before it drops below 2 footcandles (21 5 lux)

c *Night–to–Day* The intensity changes listed in a and b above should be reversed when changing from the night to day mode

94 ANTENNA OR SIMILAR APPURTENANCE LIGHT.

When a structure utilizing this dual lighting system is topped with an antenna or similar appurtenance exceeding 40 feet (12m) in height, a medium intensity flashing white light (I-865) and a red light should be placed within 40 feet (12m) from the tip of the appurtenance The white light should operate during dayhme and twilight and the red light during nighttime

95 OMISSION OF MARKING

When high intensity white lights are operated during daytime and twilight, other methods of marking may be omitted

CHAPTER 10 MARKING AND LIGHTING OF CATENARY AND CATENARY SUPPORT STRUCTURES - MEDIUM INTENSITY FLASHING WHITE LIGHTS

100 PURPOSE

Lighting catenary support structures with a medium intensity (L-866) omnidirectional flashing white lighting system provides conspicuity both day and night. In addition, the unique sequential/simultaneous flashing light system alerts pilots of the associated catenary wires In those instances where normally marking and red lighting of the structures would be deemed adequate for conspicuity, the medium intensity flashing white lighting system would be the preferred system The use of spherical markers shall be considered and is a separate issue involving additional factors

101 STANDARDS

a. ***Levels*** A system of three levels of sequentially flashing light units should be installed on each supporting structure or adjacent terrain Install one level at the top of the structure, one at the height of the lowest point in the catenary, and one level approximately midway between the other two light levels The middle level should normally be at least 50 feet (15m) from the other two levels The middle light unit may be deleted when the distance between the top and the bottom light levels is less than 100 feet (30m) If the installation presents a potential danger to maintenance personnel, or when necessary for lightning protection, the top level of lights may be mounted as low as 20 feet (6m) below the highest point of the structure

1. Top ***Levels*** One or more lights should be installed at tie top of the structure to provide 360-degree coverage ensuring an unobstructed view If the installation presents a potential danger to maintenance personnel, or when necessary for lightning protection, the top level of hghts may be mounted as low as 20 feet (6m) below the highest point of the structure

2. ***Horizontal Coverage*** The light units at the middle level and bottom level should be installed so as to provide a minimum of 180-degree coverage centered perpendicular to the flyway Where a catenary crossing is situated near a bend in a river, canyon. etc , or is not perpendicular to the flyway. the horizontal beam should be directed to provide the most effective light coverage to warn pilots approaching from either direction of the catenary wires

3. ***Variation.*** The vertical and horizontal arrangements of the lights may be subject to the structural limits of the towers and/or adjacent terrain A tolerance of 20 percent from uniform spacing of the bottom and middle light is allowed If the base of the supporting structure(s) is higher than the lowest point in the catenary, such as a canyon crossing, one or more lights should be mstalled on the adjacent terrain at the level of the lowest point in the span These lights should be installed on the structure or terrain at the height of the lowest point in the catenary

b. ***Structures*** 500 ***Feet (153m) AGL or Less When*** white lights are operated 24 hours a day, painting can be ommitted This system with its unique flash rate and sequence precludes a pilot from mistaking tie support structures for stand-alone towers When white lights are used during nighttime and twilight only, painting should be used for daytime marking Spherical markers may also be needed

c. ***Structures Exceeding 500 Feet (153m) AGL The*** white lights should be used during nighttime and twilight and are recommended for use 24 hours a day Painting should always be used for daytime marking

d ***Flash Sequence*** The flash sequence should be middle level, top level, and bottom level with all lights on the same level flashing simultaneously The time delay between flashes of levels is designed to present a unique system display

e ***Synchronization.*** Although desirable. the corresponding light levels on associated supporting towers of a catenary crossing need not flash simultaneously

102 CONTROL DEVICE

The light intensity is controlled by a device that changes the intensity when tbe ambient light changes The system should automatically change intensity steps when the northern sky illumination in the Northern Hemisphere on a vertical surface is as follows

a. ***Twilight-to-Night.*** This should not occur before tbe illumination drops below five footcandles (53 8 lux) but should occur before it drops below two footcandles (215 lux)

b. ***Night-to-Day*** The intensity changes listed in a above should be reversed when changing from the night to day mode

103 AREA SURROUNDING CATENARY SUPPORT STRUCTURES

The area in the immediate vicinity of the supporting structure's base should be clear of all items and/or objects of natural growth that could interfere with the line-of-sight between a pilot and the structure's lights

104 THREE OR MORE CATENARY SUPPORT STRUCTURES

Where a catenary wire crossing requires three or more supporting structures, the inner structures should be equipped with enough light units per level to provide a fall coverage

105 CATENARY LIGHTING

Lighted markers are available f o r increased night conspicuity of h&voltage (69KV or higher) transmission he catenary wires Lighted markers provide conspicuity both day and night, installation, size, color. and pattern should follow the guidelines of paragraphs 34 and 36 These markers should be used for increased night conspicuity of high-voltage (69KV or higher) transmission line catenary wires near airports, heliports, across rivers, canyons, lakes, etc The lighted markers should be manufacturer certified as recognizable from a minimum distance of 4,000 feet (1219m) under nighttime, minimum VFR conditions or having a minimum intensity of at least 32 5 candela The lighting unit should emit a steady burning red light They should be used on the highest energized line If the lighted markers are installed on a line other than the highest catenary, then markers specified in paragraph 34 should be used in addition to the lighted markers (The maximum distance between the line energizing the lighted markers and the highest catenary above the bghted marker should be no more than 20 feet.) Markers should be distinctively shaped, i e , spherical, cylindrical, so they are not mistaken for items that are used to convey other information They should be visible in all directions from which aircraft are likely to approach

a. ***Size and*** Color The diameter of the markers used on extensive catenary wires across canyons, lakes, rivers, etc , should be not less than 36 inches (91cm) Smaller 20-inch (51cm) markers are permitted on less extensive power lines or on power lines below 50 feet (15m) above the ground and within 1,500 feet (458m) of an airport runway end. Each marker should be a solid color such as aviation orange, white, or yellow (See paragraph 131 for color standards)

b ***Installations***

1. ***Spacing*** Lighted markers should be spaced equally along the wire at intervals of approximately 200 feet (61m) or fraction thereof Intervals between markers should be less in critical areas near runway ends (i e , 30 to 50 feet) If the markers are installed on a line other than the highest catenary, then markers markers specified in paragraph 34 should be used in addition to the lighted markers The maximum distance between the line energizing the lighted markers and the highest catenary above the markers can be no more than 20 feet The bghted markers may be installed alternately along each wire if the distance between adjacent markers meets the spacing standard. This method allows the weight and wind loading factors to be distributed

2. ***Pattern.*** An alternating color scheme provides the most conspicuity against all backgrounds Mark overhead wires by alternating solid colored markers of aviation orange. white, and yellow Normally. an orange marker is placed at each end of a line and the spacing is adjusted (not to exceed 200 feet) to accommodate the rest of the markers When less than four markers are used, they should all be aviation orange

CHAPTER 11 MARKING AND LIGHTING OF CATENARY AND CATENARY SUPPORT STRUCTURES - HIGH INTENSITY FLASHING WHITE LIGHTS

110 PURPOSE

Lighting catenary support structures with a high intensity *(L-857)* flashing white lighting system provides the highest degree of conspicuity both day and night In addition, the unique sequential/simultaneous flashing light system alerts pilots of the associated catenary wires

111 STANDARDS

When this system is operated 24 hours a day, marking of the support structure is not necessary

a. ***Levels*** A system of three levels of sequentially flashing light units should be installed on each supporting structure or adjacent terrain Install one level at the top Of the structure, one at the height of the lowest point in the catenary, and one level approximately midway between the other two light levels The nuddle level should normally be at least 50 feet (15m) from the other two levels The nuddle light unit may be deleted when the distance between the top and the bottom light levels is less than 100 feet (30m) If the installation presents a potential danger to maintenance personnel, or when necessary for lightning protection, the top level of lights may be mounted as low as 20 feet (6m) below the highest point of the structure

b. ***Top Levels*** One or more hghts should be installed at the top of the structure to provide 360-degree coverage

c. ***Flash Sequence*** The flash sequence should be nuddle. top level, and bottom level with all hghts on the same level flashing simultaneously The tune delay between flashes of levels is designed to present a unique system display

d ***Flash Rate*** Each series of flashes is repeated 60 times every minute

e. ***Synchronization*** Although desirable, the corresponding light levels on associated supporting towers of a catenary crossing need not flash simultaneously

f. ***Horizontal Coverage*** l-he light units at the middle level and bottom level should he installed so as to provide a minimum of 180-degree coverage centered perpendicular to the flyway Where a catenary crossing is situated near a bend in a river, canyon, etc , or is not perpendicular to the flyway, the horizontal beam should he directed to provide the most effective light coverage to warn pilots approaching from either direction of the catenary wires

g ***Variation.*** The vertical and horizontal arrangements of the lights may be subject to the structural limits of the towers and/or adjacent terrain A tolerance of 20 percent from uniform spacing of the bottom and nuddle light is allowed If the base of the supporting structure(s) is higher than the lowest point in the catenary, such as a canyon crossing, one or more hghts should be installed on the adjacent terrain at the level of the lowest point in the span These lights should be installed on the structure or terrain at the height of the lowest point in the catenary

h Structures ***Exceeding 500 Feet (115m) AGL. When*** high intensity white lights *are operated 24* hours a day, others methods of marking and lighting may be omitted. This system should not be recommended on structures 500 feet (153m) AGL or less unless and FAA aeronautical study shows otherwise

112 CONTROL DEVICE

The light intensity is controlled by a device that changes the intensity when the ambient light changes The system should automatically change intensity steps when the northern sky illumination in the Northern Hemisphere on a vertical surface is as follows

a. ***Day-to-Twilight*** This should not occur before the illumination drops to 60 footcandles (645 8 lux), but should occur before it drops below 35 footcandles (376 7 lux) The illuminance sensing device should. if practical. face the northern sky in the Northern Hemisphere

b ***Twilight-to-Night.*** This should not occur before the illumination drops below 5 footcandles (53 8 lux), but should occur before it drops below 2 footcandles (21 5 lux)

c ***Night-to-Day*** The intensity changes listed in (a) and (b) above should be reversed when changing from the night to day mode

113 AREA SURROUNDING CATENARY SUPPORT STRUCTURES

The area in the immediate vicinity of the supporting structure's base should be clear of all items and/or objects of natural growth that could interfere with the line-of-sight between a pilot and the structure's lights

114 THREE OR MORE CATENARY SUPPORT STRUCTURES

Where a catenary wire crossing requires three or more supporting structures, the inner structures should be equipped with enough light units per level to provide a full coverage

115 CATENARY LIGHTING

Lighted markers are available for increased night conspicuity of high-voltage (69KV or higher) transmission line catenary wires Lighted markers provide conspicuity both day and night, installation, size, color, and patter" should follow the guidelines of paragraphs 34 and 36 These markers should be used for increased night conspicuity of

high–voltage (69KV or higher) transmission line catenary wires near airports, heliports, across rivers, canyons, lakes, etc The lighted markers should be manufacturer certified as recognizable from a minimum distance of 4,000 feet (1219m) under nighttime, minimum VFR conditions or having a minimum intensity of at least 32 5 candela The lighting unit should emit a steady burning red light The marker should be used on the highest energized line If the lighted markers are installed on a line other than the highest catenary, then markers specified in paragraph 34 should be used in addition to the lighted makers (The maximum distance between the line energizing the lighted markers and the highest catenary above the lighted marker can be no more than 20 feet) Markers should be distinctively shaped, i e , spherical, cylindrical, so they are not mistaken for items that are used to convey other information They should be visible in all directions from which aircraft are likely to approach

a Sue and ***Color*** The diameter of the markers used on extensive catenary wires across canyons, lakes, rivers, etc , should be not less than 36 inches (91cm) Smaller 20–inch (51cm) markers are permitted on less extensive power lines or on power lines below 50 feet (15m) above the ground and within 1,500 feet (458m) of an airport runway end Each marker should be a solid color such as aviation orange, white, or yellow (See paragraph 131 for color standards)

b ***Installations***

1 ***Spacing*** Markers should be spaced equally along the wire at intervals of approximately 200 feet (61m) or fraction thereof Intervals between markers should be less in critical areas near runway ends (i e , 30 to 50 feet) If hghted markers are installed on a line other than the highest catenary, then markers specified in paragraph 34 should be used in addition to the light markers The maximum distance between the line energizing the lighted marker and the highest catenary above the lighted marker can be no more than 20 feet The markers may be installed alternately along each wire if the distance between adjacent markers meets the spacing standard This method allows the weight and wmd loading factors to be distributed

2 ***Pattern.*** An alternating color scheme provides the most conspicuity against all backgrounds Mark overhead wires by alternating solid colored makers of aviation orange, white, and yellow Normally, an orange marker is placed at each end of a line and the spacing is adjusted (not to exceed 200 feet) to accommodate the rest of the markers When less than four markers are used. they should all be aviation orange

CHAPTER 12 MARKING AND LIGHTING MOORED BALLOONS AND KITES

120. PURPOSE.

The purpose of marking and lighting moored balloons, lutes, and their cables or mooring lines is to indicate the presence and general definition of these objects to pilots when converging from any normal angle of approach

121. STANDARDS.

These marking and lighting standards pertain to all moored balloons and lutes which require marking and lighting under FAR Part 101

122. MARKING

Flag markers should be used on mooring lines to warn pilots of their presence during daylight hours

a. ***Display*** Markers should be displayed at no more than 50-foot (15m) intervals and should be visible for at least 1 statute mile

b. ***Shape*** Markers should be rectangular in shape and not less than 2 feet (0 6m) on a side Stiffeners should be used in the borders so as to expose a large area, prevent drooping in calm wind, or wrapping around the cable

c. color ***Patterns*** one of the following color patterns should be used.

1. ***Solid Color*** Aviation orange

2 orange ***and White*** Two triangular sections, one of aviation orange and the other white, combined to form a rectangle

123 LIGHTING

Flashing obstruction lights should be used on moored balloons or kites and their mooring lines to warn pdots of their presence during the hours between sunset and sunrise and during periods of reduced visibility These lights may be operated 24 hours a day

a. ***Systems*** Flashmg red (L-864) or white beacons (L-865) may be used to light moored balloons or kites High intensity lights (L-856) are not recommended

b ***Display*** Flashing lights should be displayed on the top, nose section, tail section, and on the tether cable approximately 15 feet (4 6m) below the craft so as to define the extremes of size and shape Additional lights should be equally spaced along the cable's overall length for each 350 feet (107m) or fraction thereof

c. ***Exceptions When the*** requirements of this paragraph cannot be met, floodlighting may be used (See paragraph 45)

124 OPERATIONAL CHARACTERISTICS

The light intensity is controlled by a device that changes the intensity when the ambient light changes The system should automatically turn the lights on and change intensities as ambient light conditions change The reverse order should apply in changing from nighttime to daytime operation The lights should flash simultaneously

CHAPTER 13 MARKING AND LIGHTING EQUIPMENT AND INFORMATION

130 PURPOSE.

This chapter lists all the documents relating to obstruction marking and lighting and where they may be obtained

131. PAINT STANDARD

Paint and aviation colors referred to in this publication should conform to Federal Standard FED-STD-595

Paint Standards Color Table

COLOR 1 2 3	NUMBER
Orange	12197
White	17875
Yellow	13538

TBL 3

NC&-

m FEDERAL SPECIFICATION T1-P-59, AVIATION SURFACE PAINT READY MIXED INTERNATIONAL ORANGE

❑ *FEDERAL SPECIFICATION T1-102, AVIATION SURFACE PAINT, OIL TITANIUM LEAD ZINC*

3 *FEDERAL SPECIFICATION T1-102, AVIATION SURFACE PAINT, OIL EXTERIOR READY-MIXED WHITE AND LIGHT TINTS*

132 AVAILABILITY OF SPECIFICATIONS

Federal specifications describing the technical characteristics of various paints and their application techniques are available There is a charge for these documents Please call for price The documents may be obtained from

GSA- Specification Section
470 L'Enfant Plaza
Suite 8100
Washington, DC 20407
Telephone (202) 755-0325

133 TOLERANCE CHART

In-Service Aviation Orange Color Tolerance Charts are used to determine when the paint has faded beyond acceptable limits and repainting is needed The tolerance charts may be purchased from a supplier

134 LIGHTS AND ASSOCIATED EQUIPMENT

The lighting equipment referred to in this publication should conform with the latest edition of one of the following specifications, as applicable

a. *Obstruction Lighting Equipment*

1 AC 150/5345-43, FAA Specification for Obstruction Lighting Equipment

2. Military Specifications MIL-L-6273, Light, Navigational, Beacon, Obstacle or Code, Type G-1

3. Military Specifications MIL-L-7830, Light Assembly, Markers, Aircraft Obstruction

b *Certified Equipment*

1 AC 150/5345-53, Airport Lighting Certification Program lists the manufacturers that have demonstrated compliance with the specification requirements of AC 15cv5345-43

2. Other manufacturers' equipment may be used provided that equipment meets the specification requirements of AC 150/5345-43.

c. *Airport Lighting Installation* and *Maintenance*

1. AC 150/5340-21, Airport Miscellaneous Lighting Visual Aids, provides guidance for the installation, maintenance, testing, and inspection of obstruction lighting for airport visual aids such as airport beacons, wind cones, etc

2 AC 150/5340-26, Maintenance of Airport Visual Aid Facilities, provides guidance on the maintenance of airport visual aid facilities

d. *Vehicles*

1. AC 150/5210-5, Painting, Marking, and Lighting of Vehicles Used on an Airport, contains provisions for marking vehicles principally used on airports

e. *FAA Facilities* Obstruction marking for FAA facilities shall conform to FAA Drawing Number D-5480, referenced in FAA Standard FAA-STD-003, Paint Systems for Structures

135. AVAILABILITY

The standards and specifications listed above may be obtained free of charge from the designated office

a. *Military Specifications*

Standardization Document Order Desk
700 Robbins Avenue
Building #4, Section D
Philadelphia, PA 19111-5094

b. *FAA Specifications*

Manager, ASD-1 10
Department of Transportation
Document Control Center
Martin Marietta/Air Traffic Systems
475 School St., SW
Washington, DC 20024
Telephone (202) 646-2047
FAA Contractors Only

c. *FAA Advisory Circulars*

Department of Transportation
Property Use and Storage Section
Subsequent Distribution Office. M483 6
Ardmore East Business Center
3341 Q 75th Avenue
Landover, MD 20785
Telephone (301) 322-4961

APPENDIX 1 Specifications for Obstruction Lighting Equipment Classification

Type	Description
L-810	Steady–burning Red Obstruction Light
L-856	High Intensity Flashing White Obstruction Light (40 FPM)
L-857	High Intensity Flashing White Obstruction Light (60 FPM)
L-864	Flashing Red Obstruction Light (20–40 FPM)
L–865	Medium Intensity Flashing White Obstruction Light (40–FPM)
L-866	Medium Intensity Flashing White Obstruction Light (60–FPM)
L–864/L–865	Dual Flashing Red Obstruction Light (20–40 FPM) and Medium Intensity Flashing White Obstruction Light (40 FPM)
L-885	Red Catenary 60 FPM
FPM = Flashes Per Minute	

TBL 4

PUNTING AND LIGHTING OF CHIMNEYS, POLES, TOWERS AND SIMILAR STRUCTURES

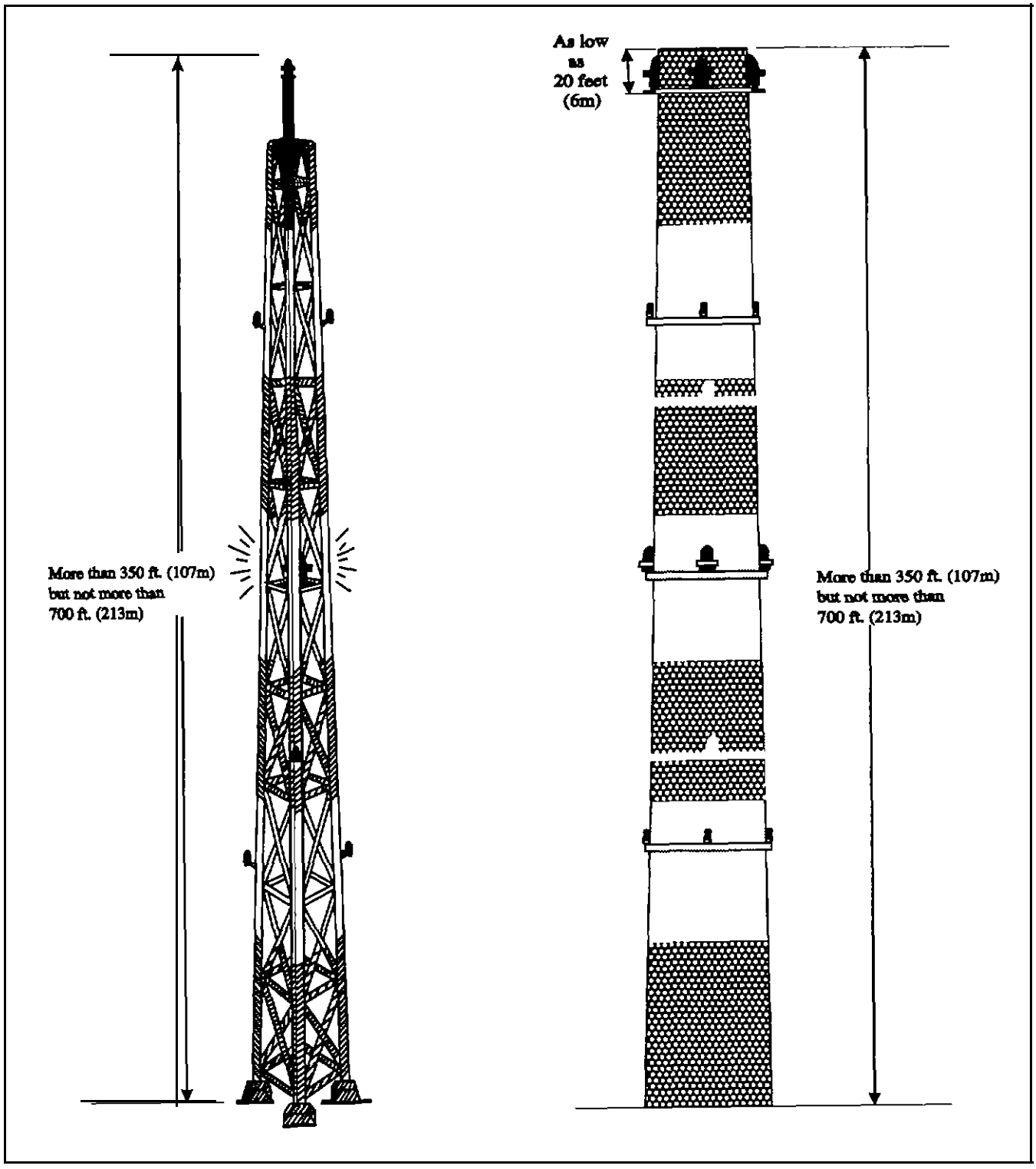


FIG 1

PAINTING AND LIGHTING OF WATER TOWERS, STORAGE TANKS AND SIMILAR OBSTRUCTIONS

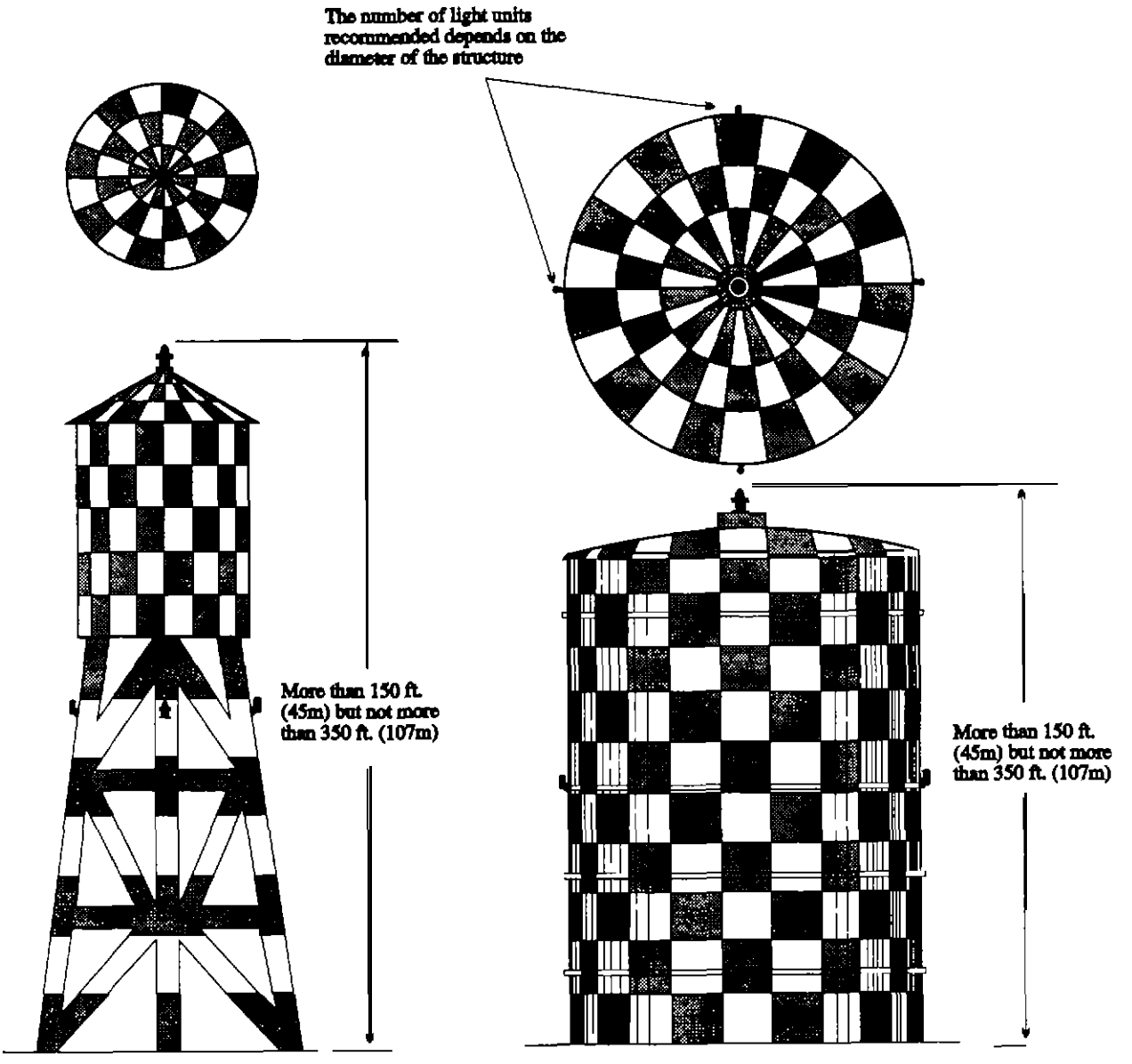


FIG 2

PAINTING AND LIGHTING OF WATER TOWERS AND SIMILAR OBSTRUCTIONS

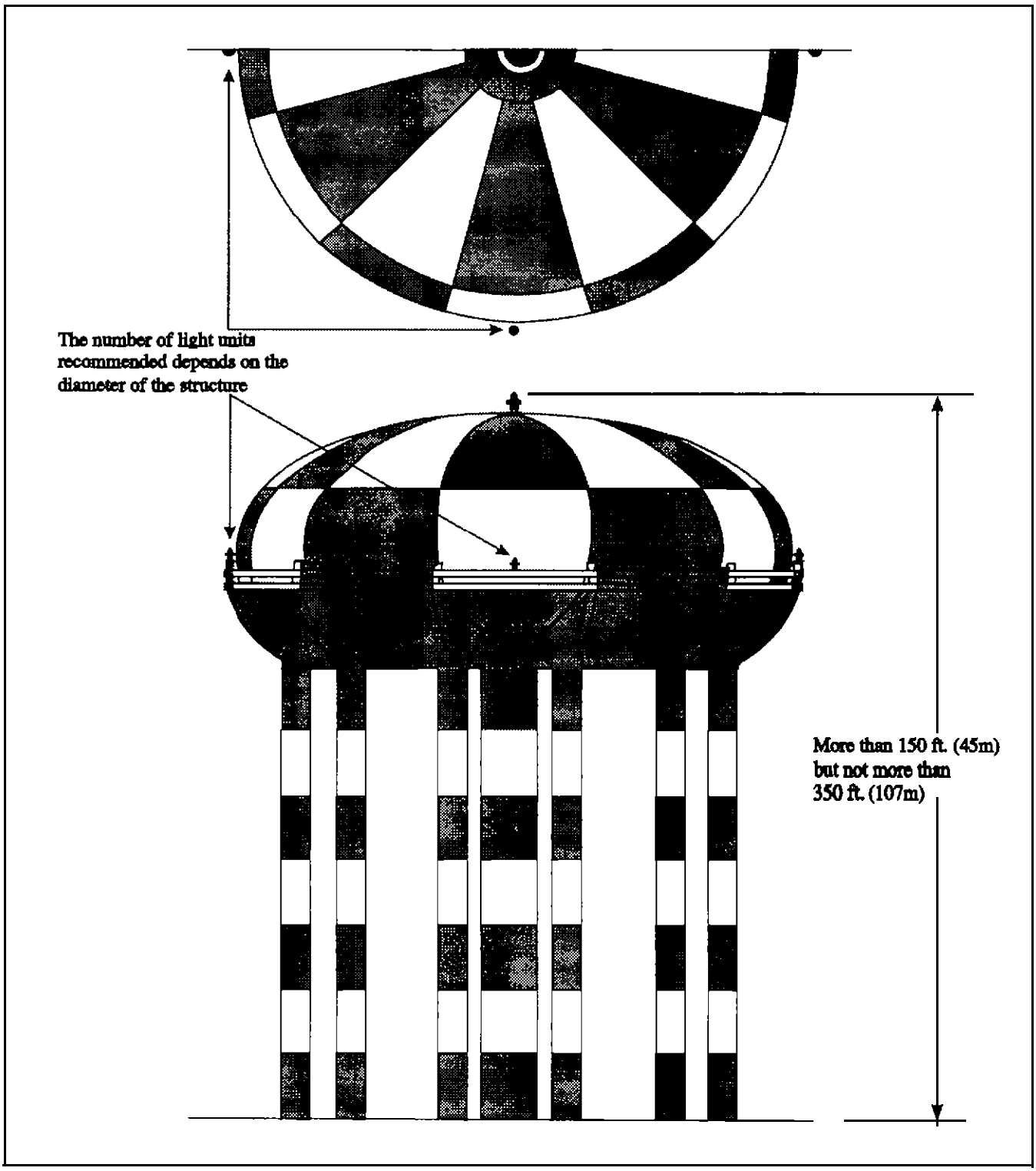


FIG 3

PAINTING OF SINGLE PEDESTAL WATER TOWER BY TEARDROP PATTERN

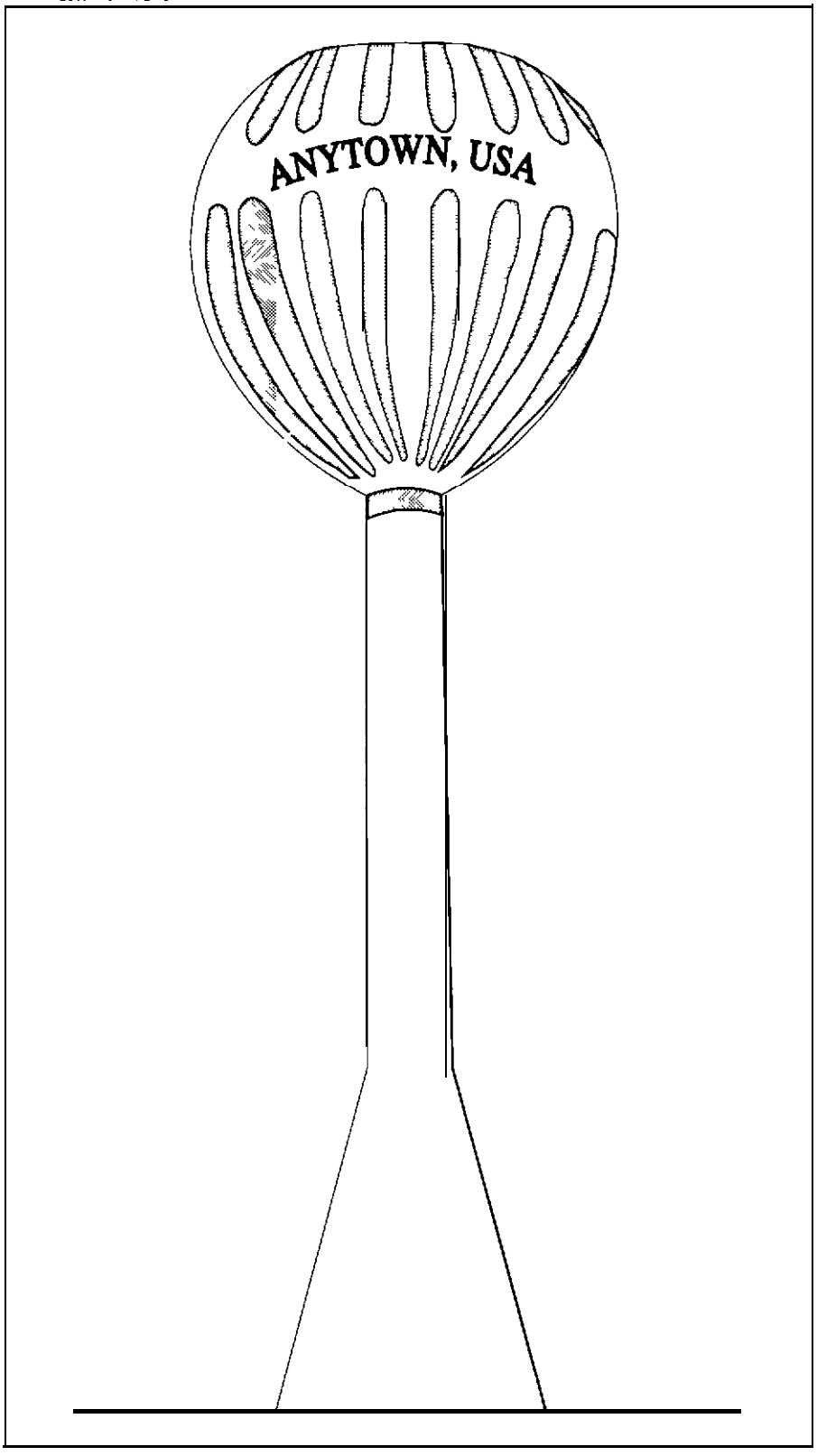


FIG 4

LIGHTING ADJACENT STRUCTURES

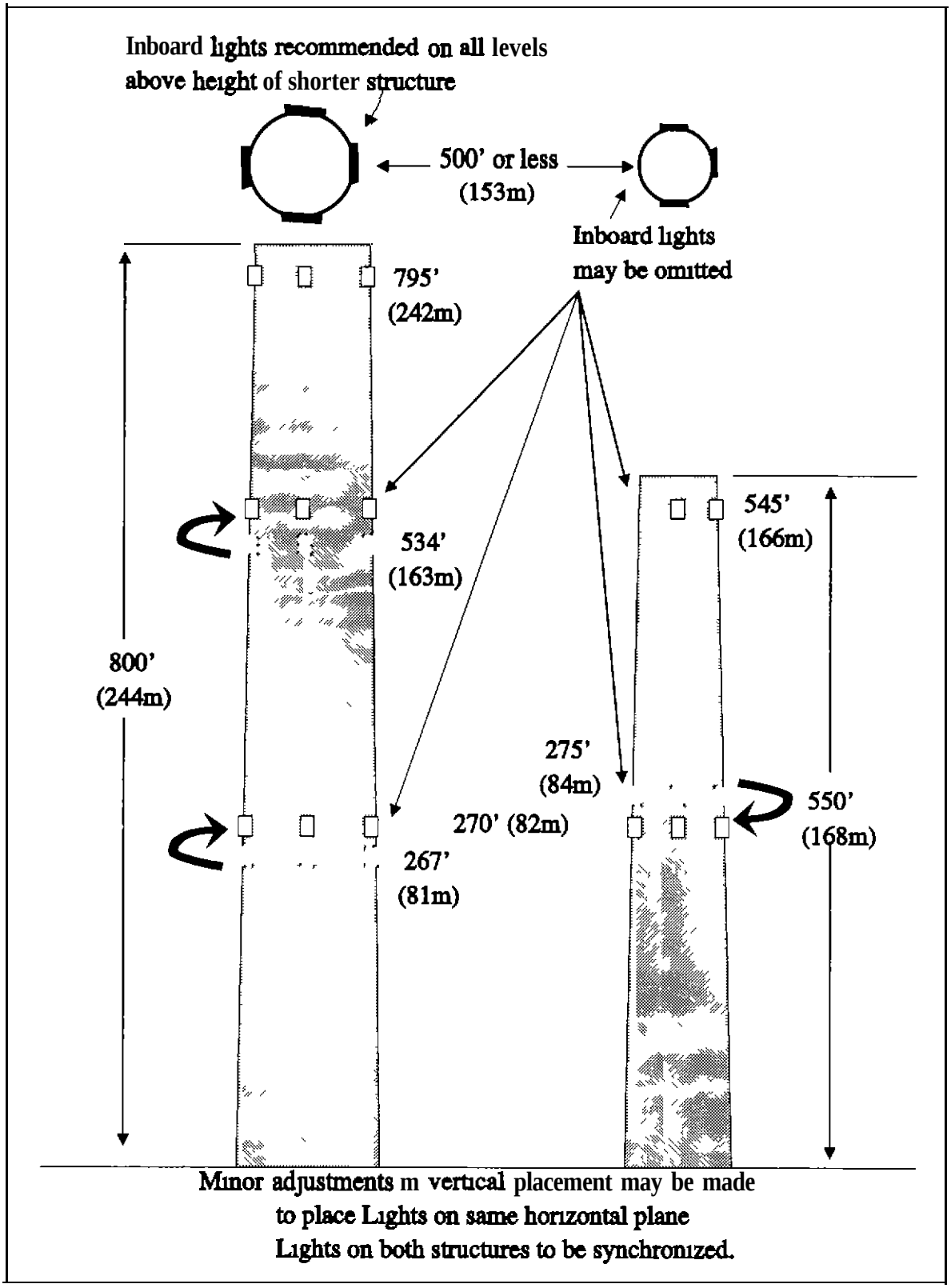


FIG 5

LIGHTING ADJACENT STRUCTURES

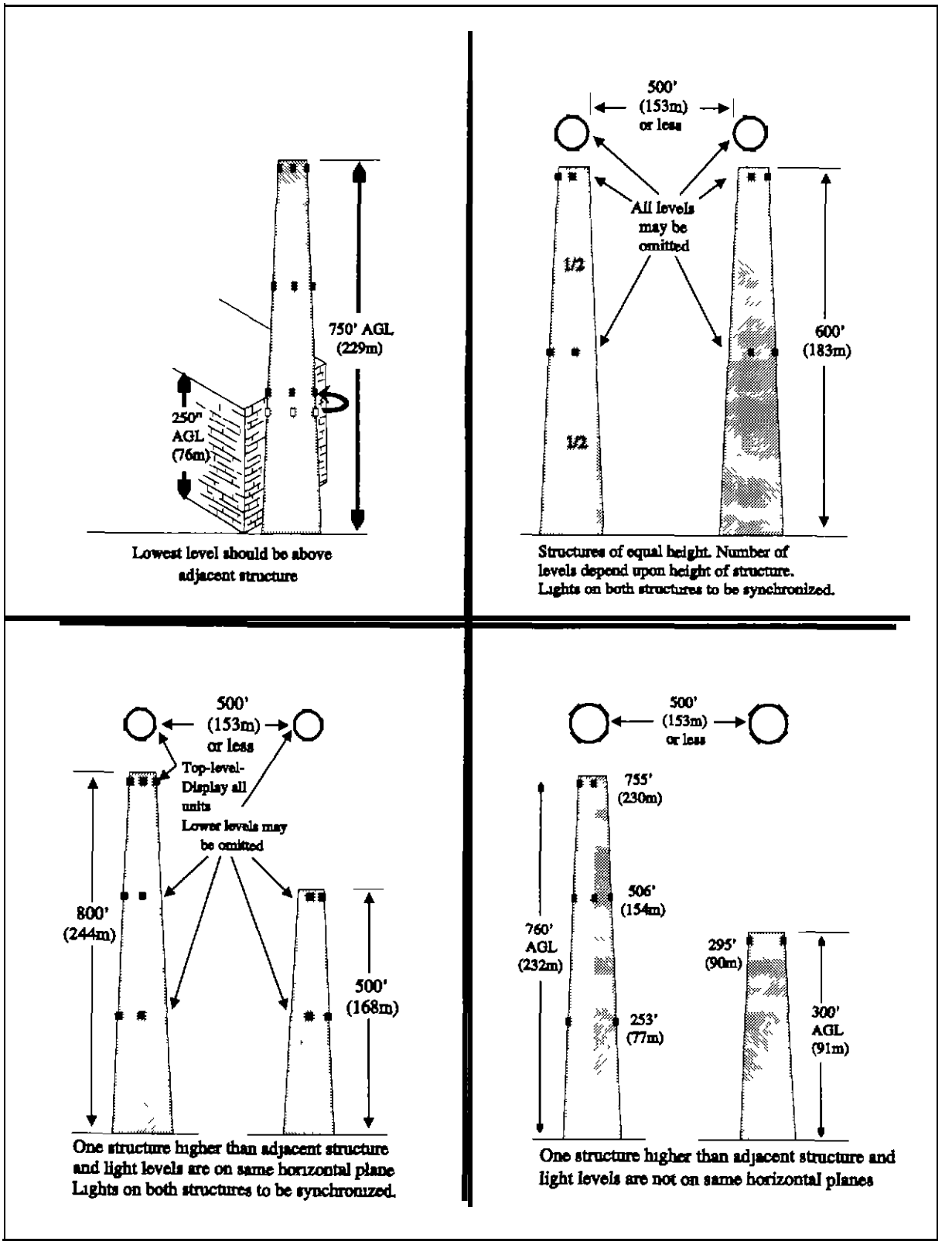
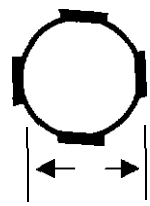


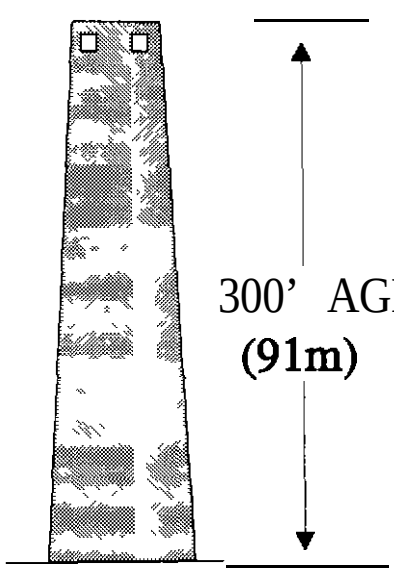
FIG 6

LIGHTING ADJACENT STRUCTURES

a - 20' (6m) or less



b - Exceeding 20' (6m) but not more than 100' (3 lm)



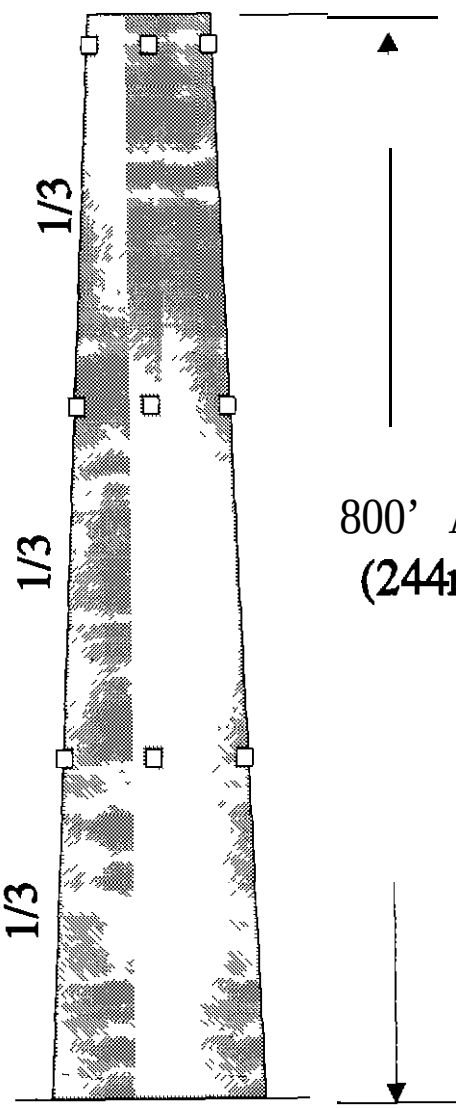
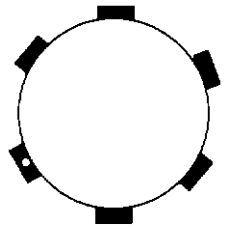


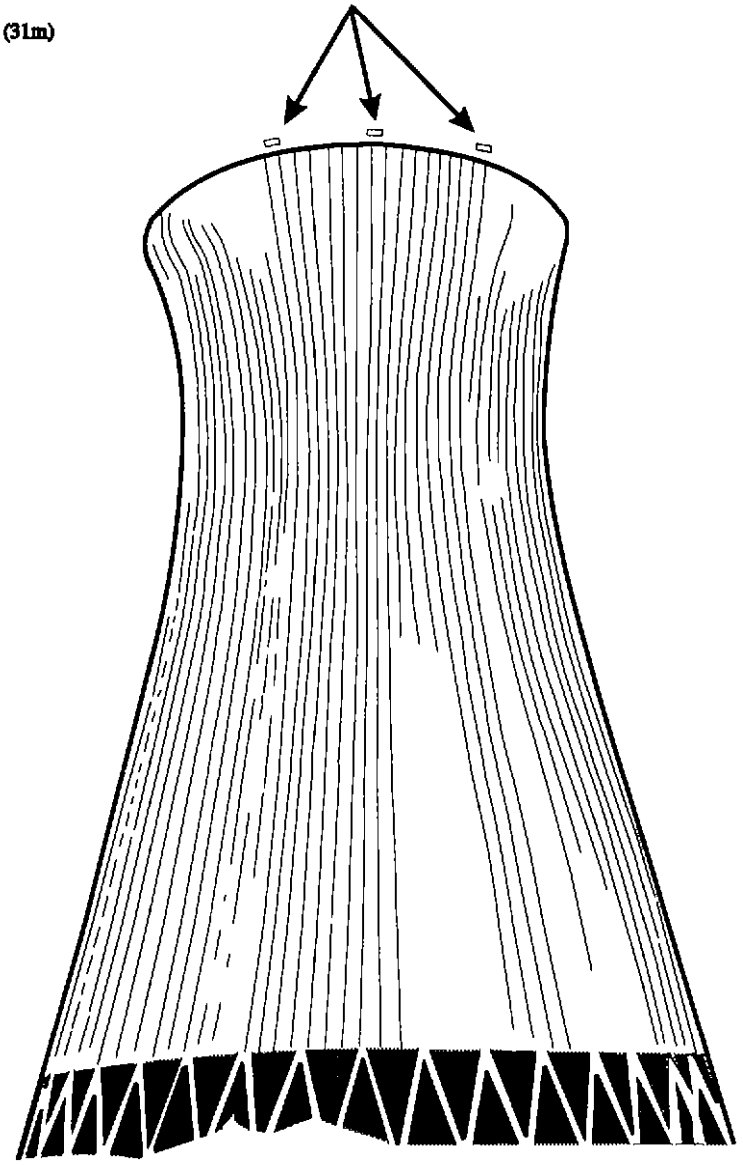
FIG 7

HYPERBOLIC COOLING TOWER



a - Exceeding 100' (31m)

The number of light units recommended depends on the diameter of the structure



HYPERBOLIC COOLING TOWER

FIG 8

BRIDGE LIGHTING

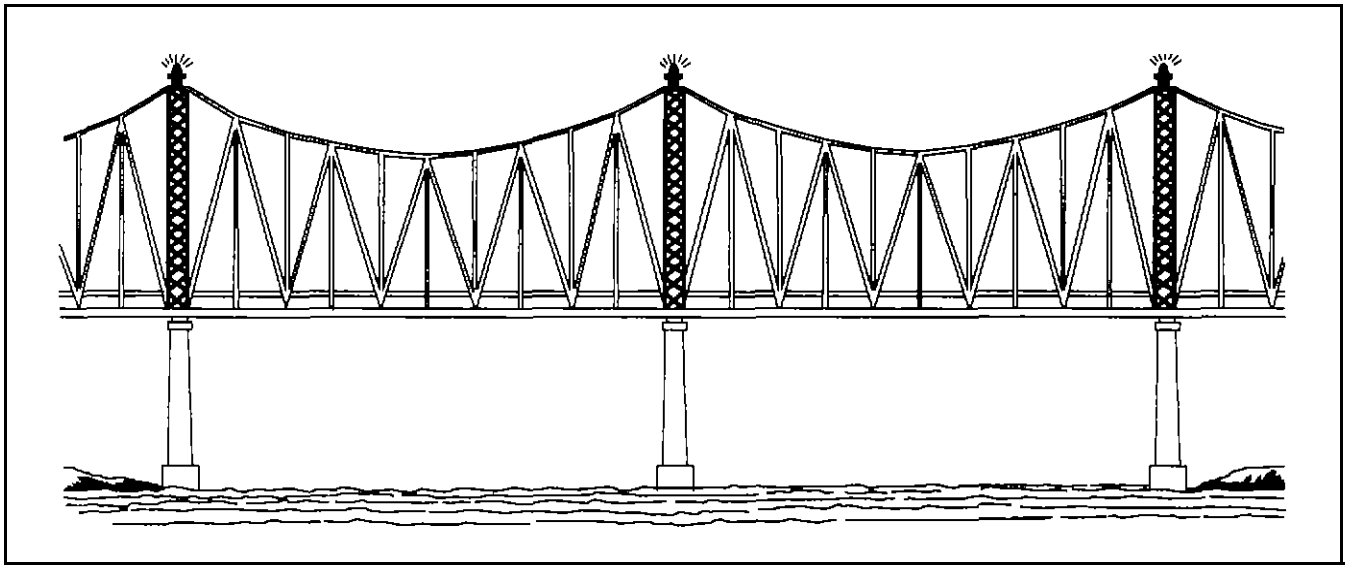


FIG 9

WIND TURBINE GENERATOR

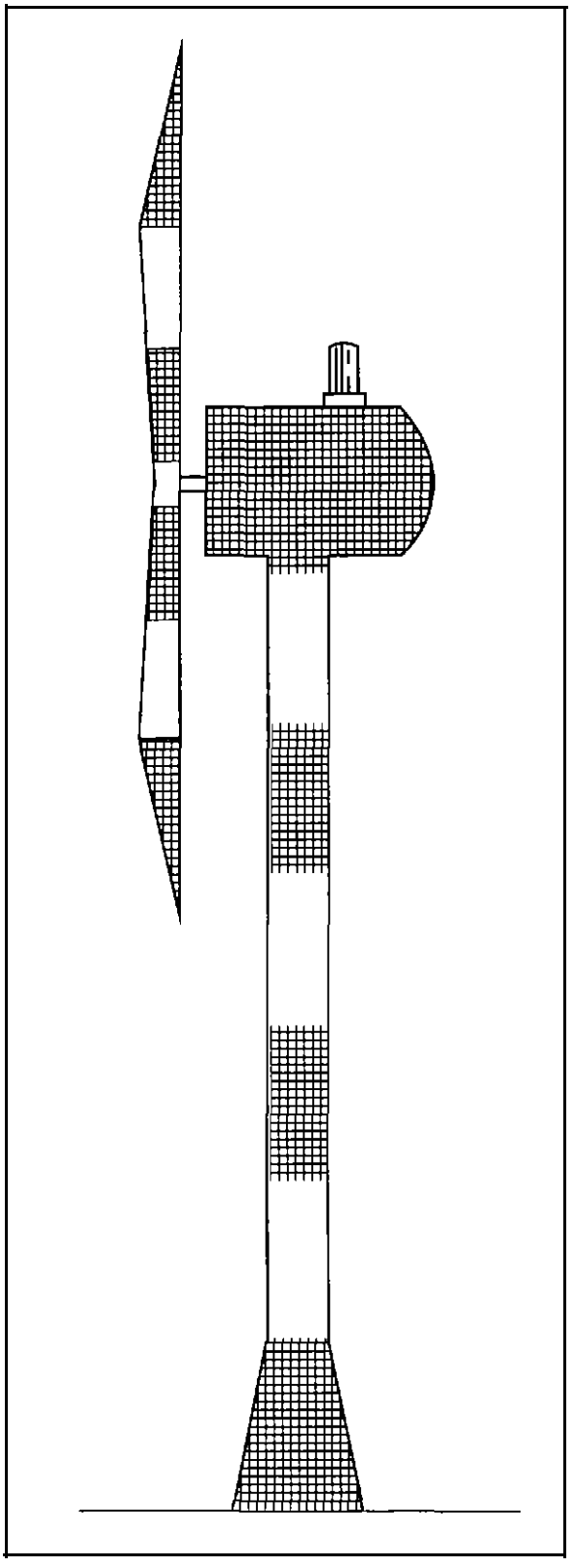


FIG 10

RED OBSTRUCTION LIGHT STANDARDS

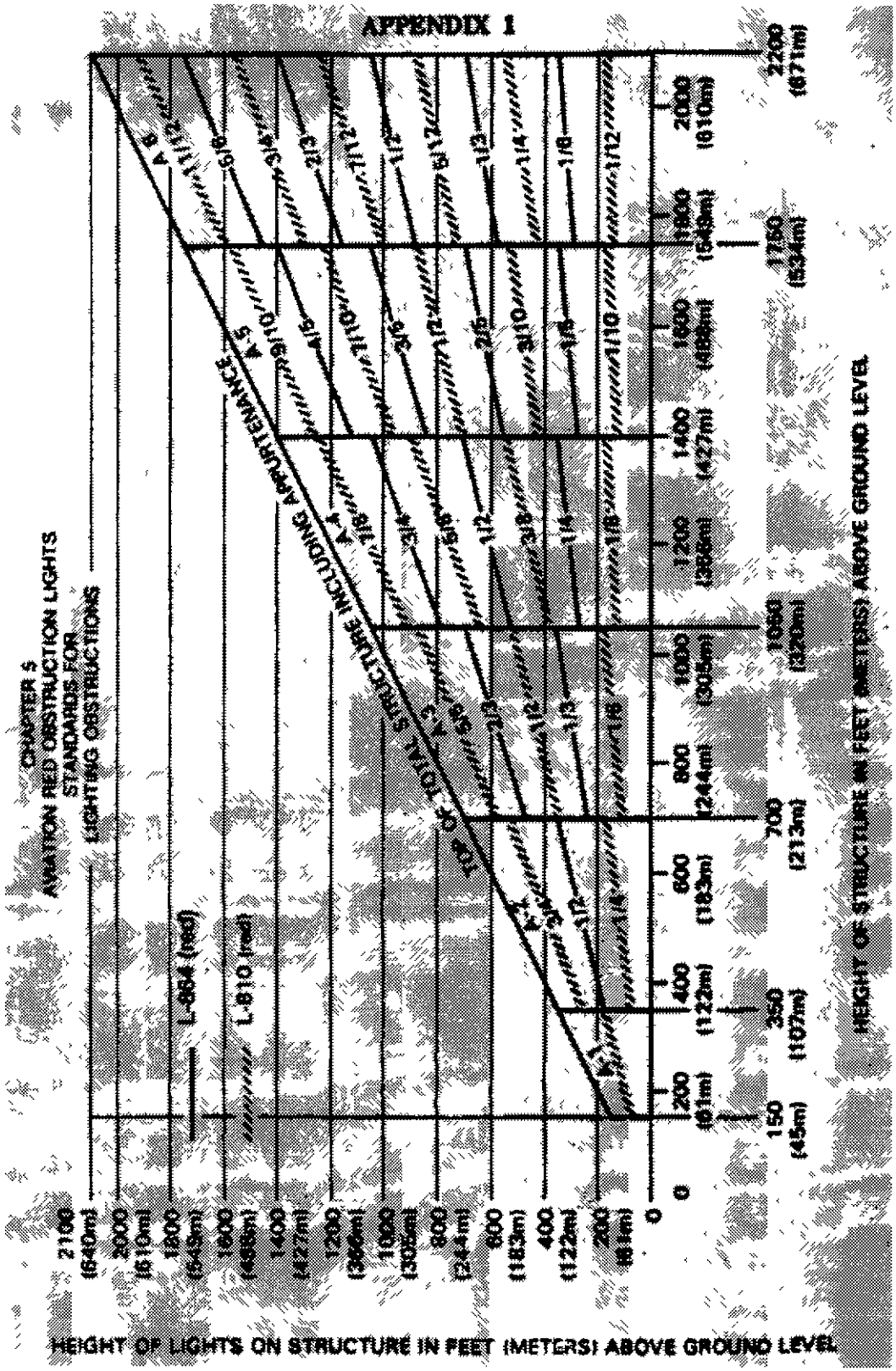


FIG 11

MEDIUM INTENSITY WHITE OBSTRUCTION LIGHT STANDARDS

APPENDIX 1

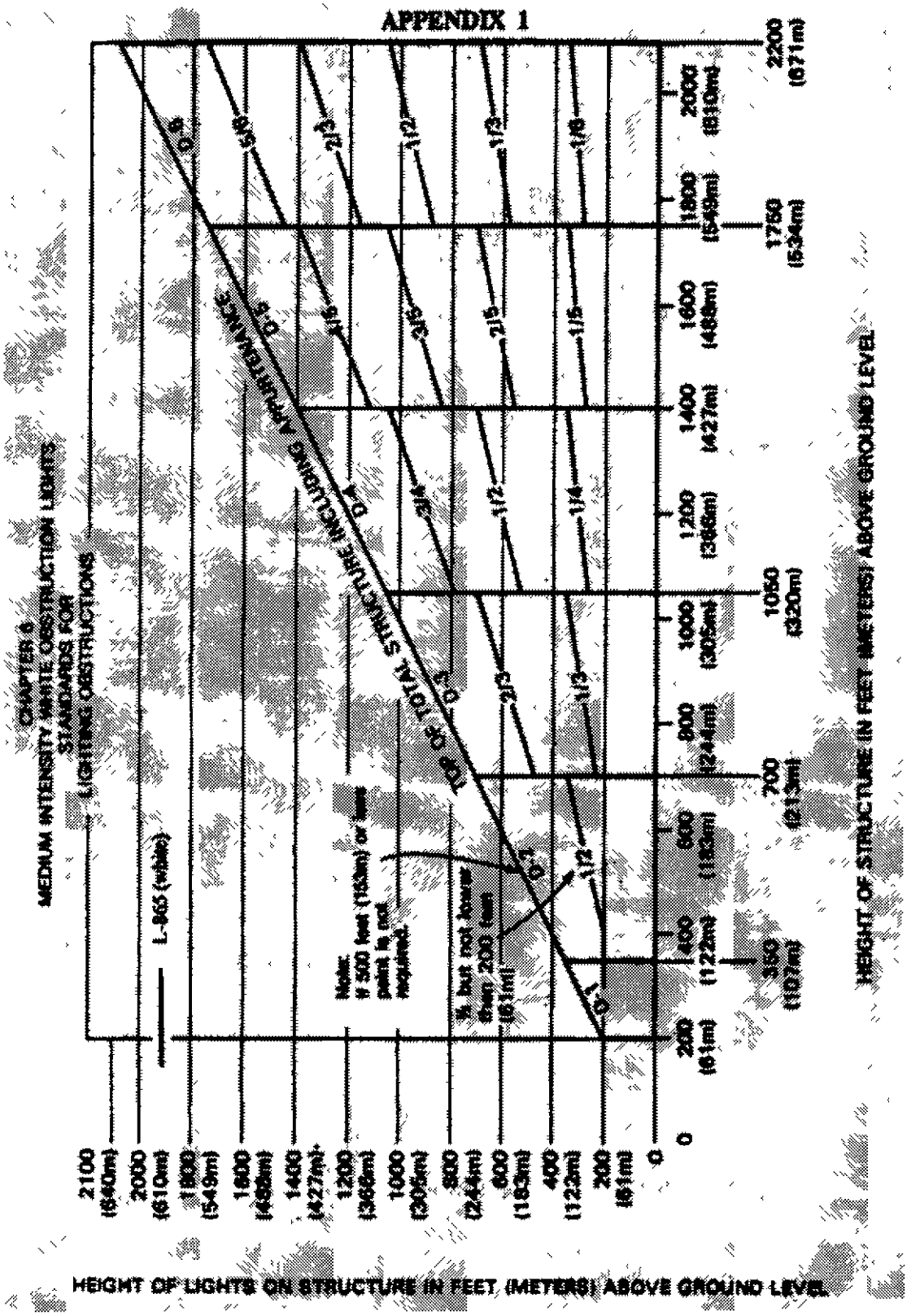


FIG 12

HIGH INTENSITY WHITE OBSTRUCTION **LIGHT** STANDARDS

APPENDIX 1

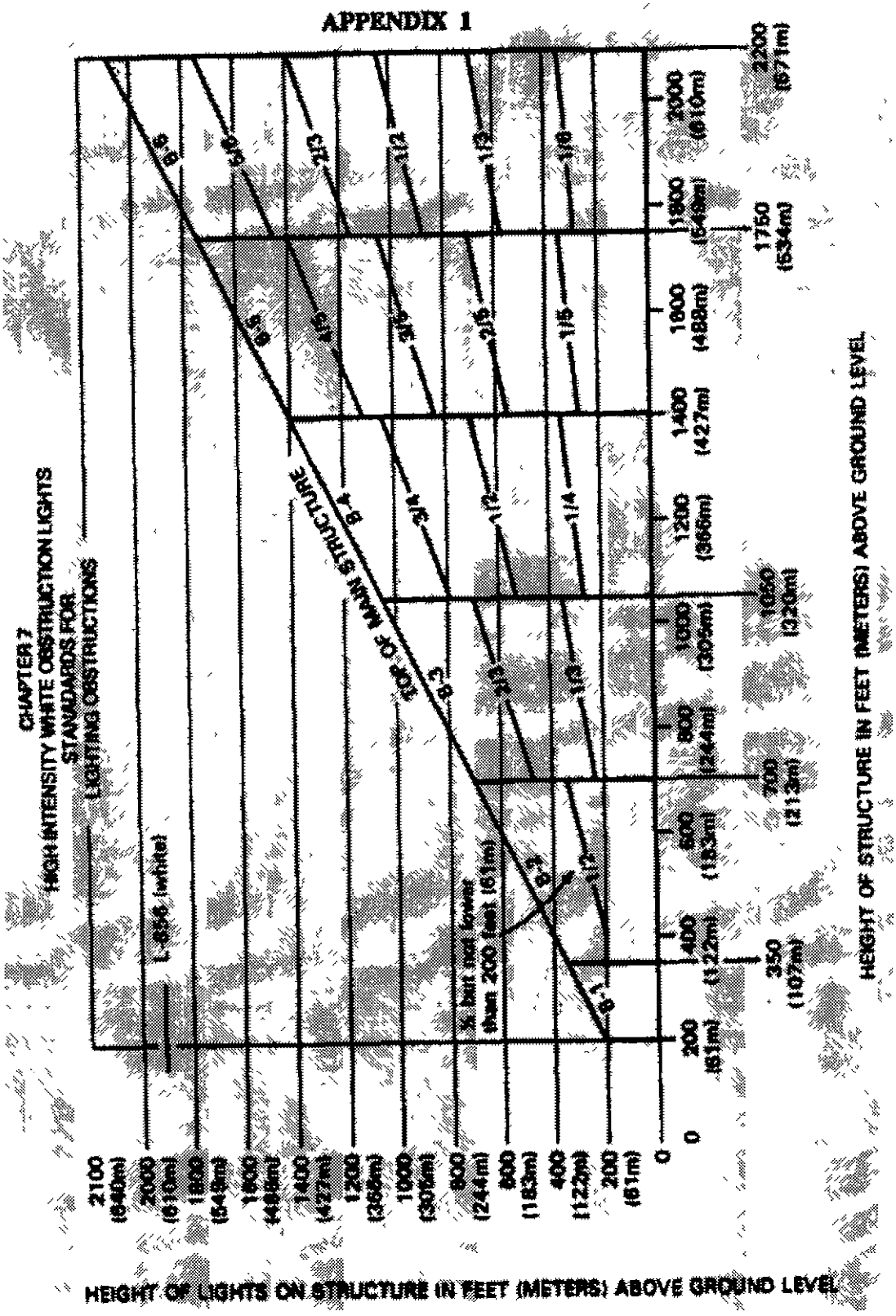


FIG *13*

HIGH AND MEDIUM INTENSITY WHITE OBSTRUCTION LIGHT STANDARDS

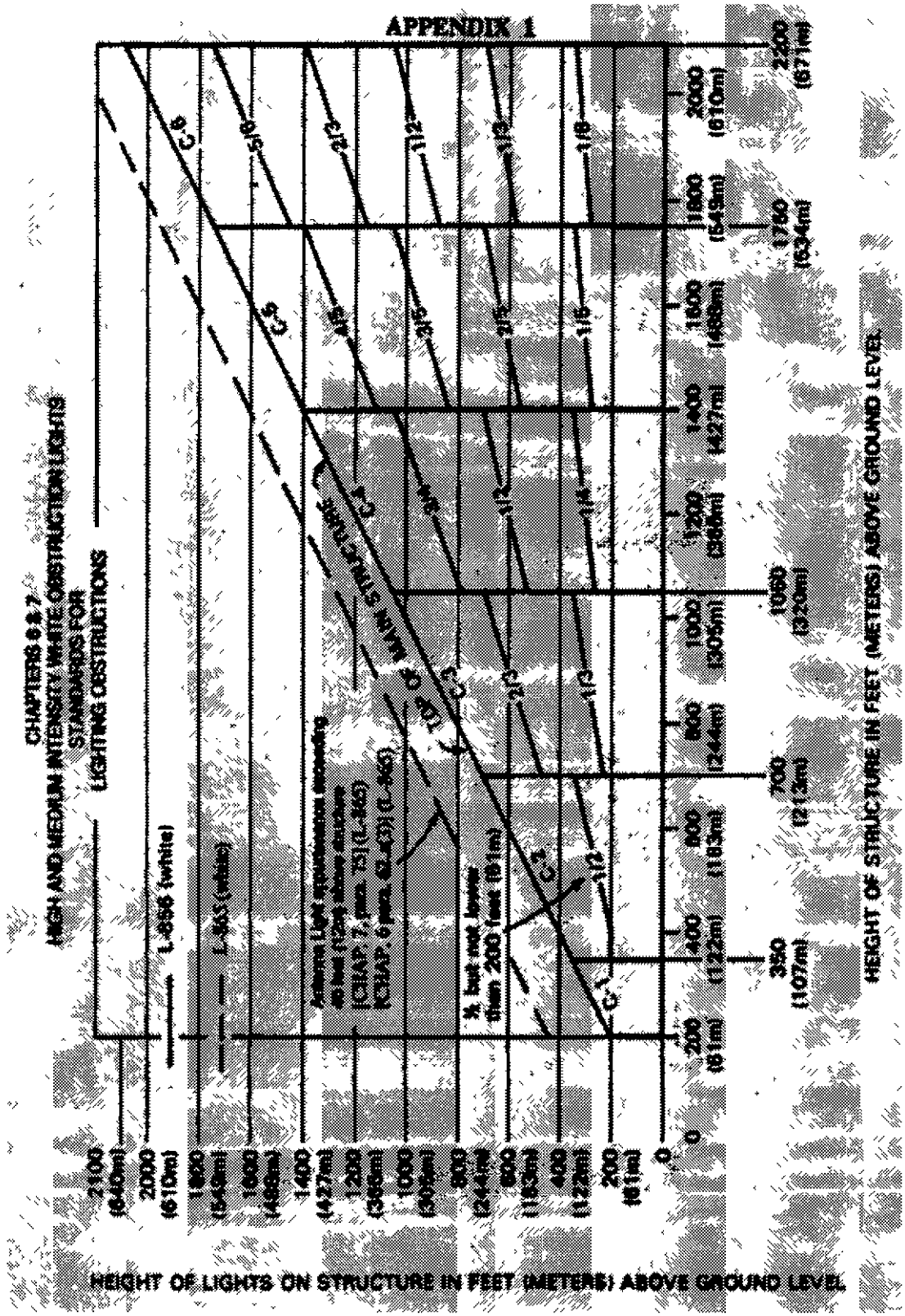


FIG 14

DUAL LIGHTING STANDARDS

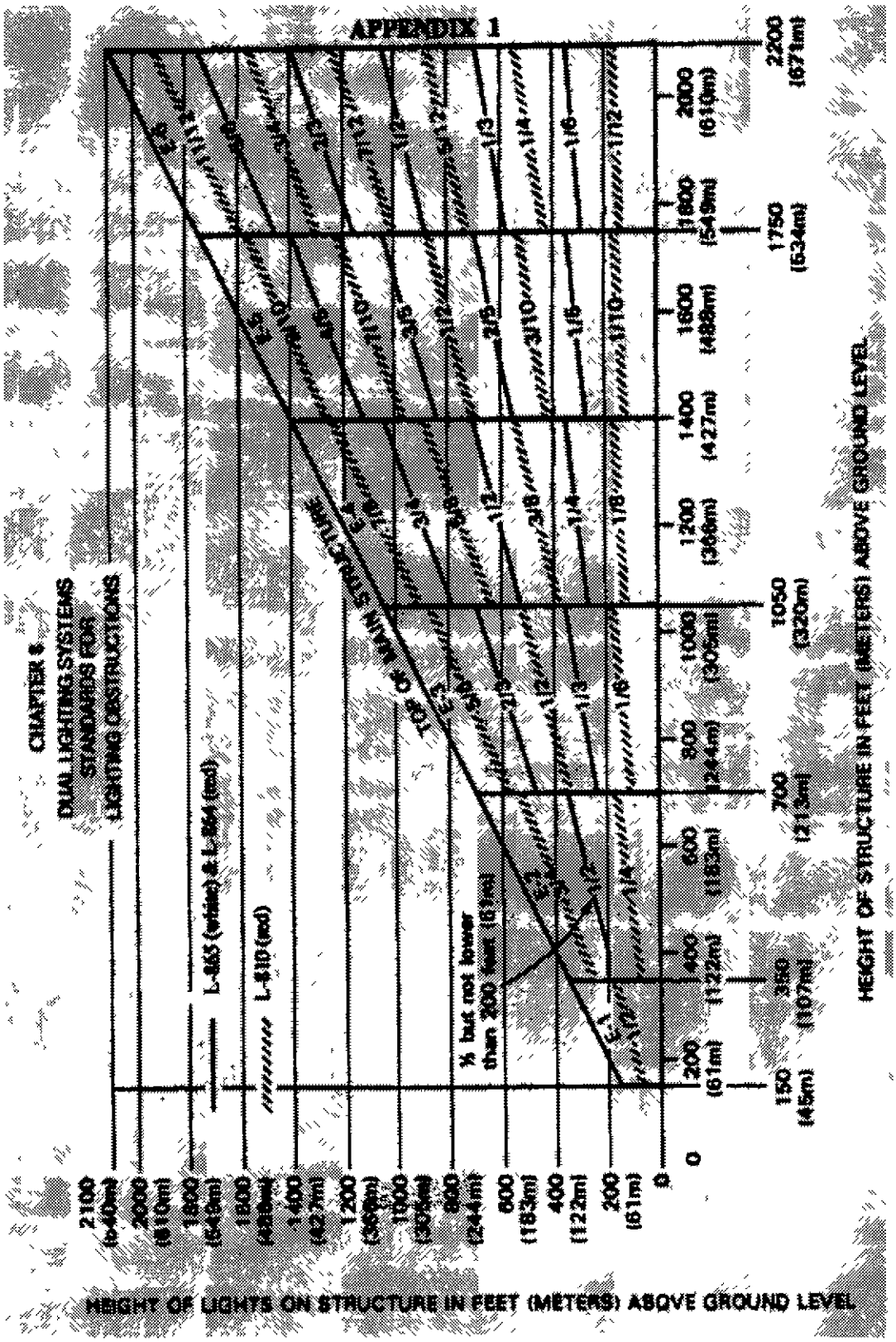


FIG 15

DUAL LIGHTING STANDARDS

APPENDIX 1

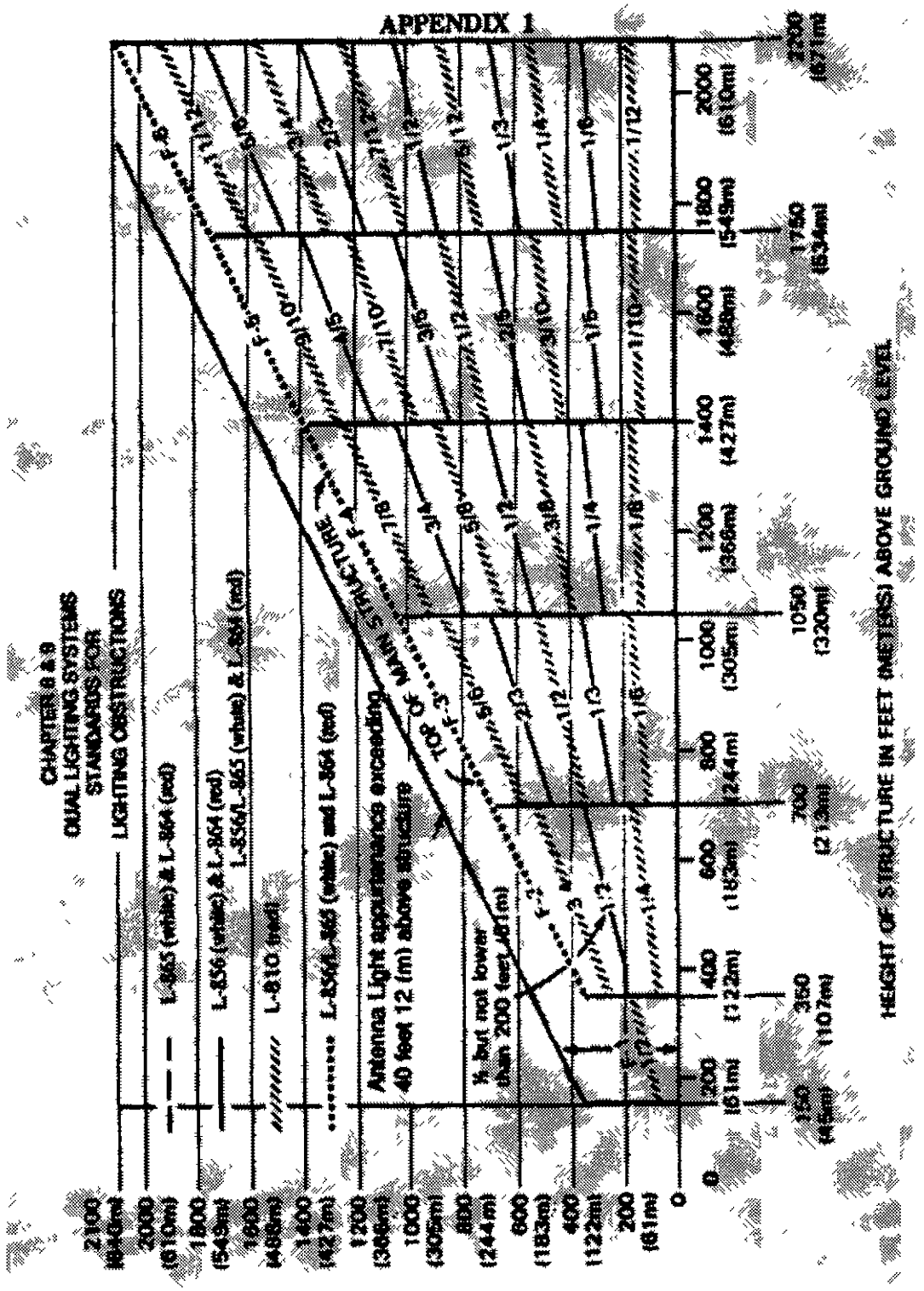


FIG 16

APPENDIX 2 Miscellaneous

1 RATIONALE FOR OBSTRUCTION LIGHT INTENSITIES

Sections 91 117. 91 119 and 91 155 of the FAR Part 91. General Operating and Flight Rules, prescribe aircraft speed restrictions, minimum safe altitudes, and basic visual fight rules (VFR) weather minimums for governing the operation of aircraft, including helicopters, within the United States

2 DISTANCE VERSUS INTENSITIES

TBL 5 depicts the distance the various intensities can be seen under 1 and 3 statute miles meteorological visibilities

Distance/Intensity Table

Time Period	Meteorological Visibility Statute Miles	Distance Statute Miles	Intensity Candelas
Night		2 9 (4 7km)	1,500 (+/- 25%)
	3 (4 8km)	3 1 (4 9km)	2,000 (+/– 2 5 %)
		1 4 (2 2km)	3 2
Day		15 (2 4km)	200,000
	1 (1 6km)	1 4 (2 2km)	100,000
		1 0 (1 6km)	20,000 (+/– 2 5 %)
Day		3 0 (4 8km)	200,000
	3 (48km)	2 7 (4 3km)	100,000
		1 8 (2 9km)	20,000 (+/- 2 5 %)
Twilight	1 (1 6km)	1 0 (1 6km) to 1 5 (2 4km)	20,000 (+/– 25%)[1]
Twilight	3 (4 8km)	18 (2 9km) to 4 2 (6 7km)	20,000 (+/– 25%)[1]

Note–
[1] *DISTANCE CALCULATED FOR NORTH SKY ILLUMINANCE*

TBL 5

3 CONCLUSION

Pilots of aircraft travelling at 165 knots (190 mph/306kph) or less should be able to see obstruction lights in sufficient time to avoid the structure by at least 2,000 feet (610m) horizontally under all conditions of operation, provided the pilot is operating in accordance with FAR Part 91 Pilots operating between 165 knots (190 mph/303 km/h) and 250 knots (288 mph/463 kph) should be able to see the obstruction lights unless the weather deteriorates to 3 statute miles visibility at night, during which tune period 2,000 candelas would be required to see the lights at 1 2 statute miles (1 9km) A higher intensity, with 3 statute miles visibility at night, could generate a residential annoyance factor In addition, aircraft in these speed ranges can normally be expected to operate under instrument flight rules (IFR) at night when the visibility is 1 statute mile

4 DEFINITIONS

a Flight Visibility The average forward horizontal distance, from tbe cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

Reference–
AIRMAN'S INFORMATION MANUAL
PILOT/CONTROLLER GLOSSARY

b. Meteorological Visibility A term that denotes the greatest distance, expressed in statute miles, that selected objects (visibility markers) or lights of moderate intensity (25 candelas) can be seen and identified under specified conditions of observation.

5 LIGHTING SYSTEM CONFIGURATION.

a. *Configuration* A Red lighting system

b. *Configuration B* High intensity flashing white lighting system

c. *Configuration* c High intensity flashing white lighting system with appurtenance exceeding 40 feet (12m) above the top of the structure

d *Configuration D* Medium intensity flashing white lighting system

e. *Configuration E* Dual hghtmg system (red/medium intensity white lights)

f. *Configuration* F Dual lighting system (red/high intensity white lights) with an appurtenance exceeding 40 feet (12m) above the top of the structure

Example-
CONFIGURATION B 3' DENOTES A HIGH INTENSITY LIGHTING SYSTEM WITH THREE LEVELS OF LIGHT

INDEX

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