TAD 494.4

CHANGE

AC NO: AC 150/5340-24 CHG 1

DATE: November 25, 1977

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: CHANGE 1 TO ADVISORY CIRCULAR 150/5340-24, RUNWAY AND TAXIWAY EDGE LIGHTING SYSTEM

1. PURPOSE. This change transmits revised pages which are explained in paragraph 2.

2. CHANGES. References to the maximum installation height of 14 inches for edge lights have been changed to indicate this as a standard height with allowable increases for snow conditions. Runway "Entrance-Exit" lights, in lieu of guidance signs, are included. Changes to the text, except minor editorial corrections, are denoted by asterisks in the margins. Figures 13 and 16 have also been modified to reflect the maximum height change.

3. HOW TO OBTAIN THIS CHANGE. Obtain additional free copies of Change 1 to AC 150/5340-24, Runway and Taxiway Edge Lighting System, from the Department of Transportation, Publications Section, TAD-443.1, Washington, D.C. 20590.

PAGE CONTROL CHART

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William V. Vitale

WILLIAM V. VITALE
Acting Assistant Administrator
Office of Airports Programs

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1. INTRODUCTION. Edge lights are used to outline usable operational areas of airports during periods of darkness and low visibility weather conditions. This circular covers standards for the design and installation of the following systems:

Runways

LIRL - low intensity runway lights
MIRL - medium intensity runway lights
HIRL - high intensity runway lights

Taxiways

LITL - low intensity taxiway lights
MITL - medium intensity taxiway lights

2. SELECTION CONSIDERATIONS. The selection of a particular edge light should be based on the operational need in accordance with the following guidelines:

LIRL - for use on runways at visual flight rule (VFR) airports having no planned approach procedures
* MIRL - for use on VFR runways or runways having a nonprecision instrument flight rule (IFR) procedure for either circling or straight-in approaches *
HIRL - for use on runways having precision IFR approach procedures and for runways utilizing runway visual range (RVR)
LITL - for use on taxiways and aprons where LIRL is used on the runways
MITL - for use on taxiways and aprons on airports using either MIRL or HIRL on the runways

3. RUNWAY EDGE LIGHT CONFIGURATIONS. A runway edge lighting system is a configuration of lights which define the lateral and longitudinal limits of the usable landing area. Two straight lines of lights which are parallel to and equidistant from the runway centerline define the lateral limits. The longitudinal limits of the usable landing area are defined at each end of the area by straight lines of lights called threshold/runway end lights which are installed perpendicular to the lines of runway edge lights. Figure 1 depicts typical configurations.

a. Color of Lights. The runway edge lights emit white (clear) light except that yellow light is substituted for white light on the last 2,000 feet (610 m) of an instrument runway, or one-half the runway length, whichever is less, for indicating the caution zone. The yellow lights are intended for rollout information after landing and are installed on the runway end opposite the landing threshold. They are installed on both ends of a runway only when there is an

instrument approach to both ends. The lights in the caution zone emit yellow light in the direction facing the instrument approach threshold and white light in the opposite direction. The threshold lights emit green light toward the approach area while the runway end lights emit red light toward the runway. These lights are usually combined into one fixture and special lens or filters are used to give the desired light coverages.

b. Location and Spacing. The runway edge lights are located on a line not more than 10 feet (3 m) from the edge of the full strength pavement which is designated for runway use. For runways used by jet aircraft, it is usually advisable to install the lights at the maximum distance to avoid possible damage by jet blasts. For smaller airports a distance of approximately 2 feet (0.6 m) is recommended. The longitudinal spacing of the lights should not exceed 200 feet (61 m) and be located such that a line between light units on opposite sides of the runway is perpendicular to the runway centerline. The lights should be spaced as uniformly as possible with the threshold/runway end lights used as the starting reference points. Where a runway is intersected by other runways or taxiways, a semiflush light, type L-850C as described in AC 150/5345-46, should be installed to maintain the uniform spacing for HIRL's. For MIRL's and LIRL's a single elevated edge light should be installed on the runway side opposite the intersection to avoid gaps in excess of 400 feet (122 m) where the matching of lights on opposite sides of the runway cannot be maintained as illustrated in figure 1.

c. Threshold and Runway End Lights. The combination threshold and runway end lights are located on a line perpendicular to the extended runway centerline not less than 2 (0.6 m) nor more than 10 feet (3 m) outboard from the designated threshold of the runway. The designated threshold is the end of the pavement (surface) useful for aircraft operations. The lights are installed in two groups located symmetrically about the extended runway centerline. For instrument runways each group of lights contains not less than 4 lights; for other runways, not less than 3 lights. In either case, the outermost light in each group is located in line with the runway edge lights. The other lights in each group are located on 10 foot (3 m) centers toward the extended runway centerline.

d. Displaced Threshold. When the threshold is displaced from the * extremity of the runway, the threshold lights are located outboard * from the runway. The innermost light of each group is located in line with the line of runway edge lights, and the remaining lights are located outward, away from the runway, on 10-foot (3 m) centers on a line perpendicular to the runway centerline. As the displaced runway area is usable for specific operations (takeoff, rollout, taxiing), runway edge lights are installed to delineate the outline * of this area as shown in figure 2. For this case, the runway end lights are 360 degree red. *

e. Relocated Threshold. When the threshold is relocated from the extremity of the runway, the threshold and runway end lights may be installed as described in paragraph 3c or 3d. The method described in paragraph 3c is preferred and should be used except in those cases where access to the abandoned area is required or where excessive costs would be encountered.

4. TAXIWAY EDGE LIGHT CONFIGURATIONS. The basic configuration requirements for taxiway edge lighting are shown in figures 4 through 11. All taxiway edge lighting fixtures emit blue light. The light fixtures are located not more than 10 feet (3 m) from the edge of the full strength pavement on each side of the taxiway and spaced longitudinally not more than 200 feet (61 m) apart to define the lateral limits of the taxiing paths. On a straight section the lights on opposite sides of the taxiways are located on a line perpendicular to the taxiway centerline. The longitudinal spacing of the lights is influenced by the physical layout of the taxiways. Closer spacing of the lights should be provided on short taxiway sections, curves, and entrances to taxiways from runways or aprons. In lieu of shorter spacing of the lights, the lights may be supplemented by elevated L-853 reflectors. For low activity airports, elevated L-853 reflectors may be used in lieu of edge lights for outlining taxiing areas. Where used, the reflectors should be spaced the same as taxiway edge lights. When a taxiway extends along the edge of an apron, the lights are located as shown in figure 7. Use of taxiway lights on curved sections at * small general aviation airports may be reduced as shown in the typical layout of figure 10. Taxiway guidance signs are installed at runway-taxiway intersections to define the throat or entrance into the intersecting taxiing route. Where taxiway signs would interfere with aircraft operations, or at small general utility airports, two taxiway lights spaced as shown in figure 25 may be installed instead of the sign. *

5. SYSTEM DESIGN. Proper planning requires that the design of the lighting system be coordinated with the airport paving and drainage plans. The drainage design may influence the location of cable ducts and trenches. Also, adequate conduits and ducts should be provided prior to paving operations since they are very expensive to install under existing paved areas.

a. System Design Options. Several design options may be utilized as follows:

(1) Base mounted light units (see paragraph 5b) may be used on the HIRL, MIRL, or MITL.

(2) Stake mounted light units (see paragraph 5b) may be used on the HIRL, MIRL, LIRL, MITL, or LITL.

(3) Series power circuits (see paragraph 5c) may be used for the HIRL, MIRL, or MITL.

(4) Parallel power circuits (see paragraph 5c) may be used for the MIRL, LIRL, MITL, or LITL.

(5) Select the required type of threshold/runway end light for the MIRL (see paragraph 6a).

(6) Several control methods are available (see paragraph 5g).

(7) The use of a counterpoise wire is optional (see paragraph 6h(4).

b. Base Mounted or Stake Mounted Fixtures. The stake mounted method, in comparison to the base mounted method, costs less to install. Since the transformers, cables, and connectors are designed for direct earth burial, the underground system should provide years of fault-free service if properly installed. The base mounted installation is advantageous from a maintenance standpoint and provides added protection for the equipment. The stake mounted method can be used for either series on parallel circuits whereas the base mounted method is normally used only with series circuits.

c. Series or Parallel Circuits. The advantages of the series circuit are:

(1) Uniform lamp brightness - all lamps receive the same operating current.

(2) Lower costs for longer runways - generally those over 4,000 feet in length.

The advantage of the parallel circuit is lower costs for shorter runways - generally all those of 4,000 feet or less.

d. RVR Connections. Where runway visual range (RVR) equipment is to be installed, provide two No. 12 AWG wires for 120-volt control, or two No. 19 wires if 48-volt control is used, between the control tower and the vault. The ends of the wires are taped or sealed, until connections are made, to prevent the entrance of moisture. The wires in the vault connect to an interface unit provided with the RVR equipment. The wires in the tower connect to RVR equipment. All connections are made by personnel responsible for the RVR in accordance with instructions provided with the system.

e. Use of Reflectors. For low activity general aviation airports, taxiway lights can be augmented or replaced with L-853 elevated edge reflectors as described in AC 150/5345-39.

f. Brightness Steps.

(1) The HIRL has five brightness steps as follows:

k. Tape. Plastic electrical insulating tape is the type specified in item L-108 of AC 150/5370-10.

l. Vaults. Utilize design considerations for vaults contained in item L-109 of Advisory Circular 150/5370-10. Provide at least 2 square feet (0.2 sq. m.) net vent area per 100 KVA installed transformer capacity in the vault where the 24-hour average ambient temperature does not exceed 86°F. If the average ambient temperature exceeds 86°F., auxiliary means should be provided for removing excess heat. Install vault equipment, conduit, cables, grounds, and supports necessary to insure a complete and operable electrical distribution center for lighting systems. An up-to-date "as constructed" lighting plan should be kept available in the vault. When required, provide an emergency power supply and transfer switch, see Advisory Circular 150/5340-17. Install and mount the equipment to comply with the requirements of the National Electric Code and local code agencies having jurisdiction.

7. INSTALLATION. The system shall be installed in accordance with the National Electrical Code and/or local code requirements.

a. Light Base and Transformer Housing for Elevated Light Fixtures. The light base shall be installed on undisturbed soil as shown in figure 13. If the soil is unsuitable, then an adequate depth of soil should be removed and replaced with compacted acceptable material. The cable entrance hubs are oriented in the proper direction. Level the light base so that the mounting flange surface is approximately 1 inch above the finished grade. With the base properly oriented and held at the proper elevation, place approximately 4 inches (10 cm) of concrete backfill around the outside of the base. The top of the concrete is sloped away from the flange portion of the base so the sloped outer edges of the concrete are at surface grade. If concrete backfill is omitted, select earth backfill shall be compacted to maintain proper orientation and elevation of the base. In closed duct systems installed in soil conditions of good drainage, use light bases having a drain hole to prevent water accumulation.

b. Light Base and Transformer Housing for Semiflush Light Fixtures. The base is supported in the leaveout or excavated area in a position as shown in figure 23. Orient the base so that the cable entrance hubs on the base are properly aligned and so that the semiflush light fixture will be properly aligned, when installed, prior to placing the concrete backfill. When installed in bituminous pavement, leave the concrete backfill 3-4 inches (8-10 cm) low to allow completing the backfill with bituminous material after the concrete has cured.

c. Stake (Angle Iron) Mounting. Install the stake in a 6-inch (15 cm) diameter hole at a depth of 30 inches (76 cm) as shown in figure 13. Do not install stake by driving. Make electrical connections and backfill around the stake with thoroughly compacted earth passing a 1-inch (2.54 cm) sieve. Where required due to unstable soil conditions, backfill with concrete. Install the top of the stake even with, or not more than 1/2 inch (1.3 cm) above the finished grade and maintain within 1 degree of the vertical. In areas where frost may cause heaving, anchor the stake with concrete and use a permeable backfill material such as sand around the buried electrical components and then cover the top surface with an impervious material to reduce moisture penetration.

d. Light Fixtures - General. The light fixtures are supplied unassembled and consist of an optical system, lamp, connecting leads, and a mounting assembly. The installer will assemble, connect to mounting, level, and adjust the light fixture in accordance with the manufacturer's instructions. Care should be taken that the lamp specified by the manufacturer, for the particular use of the light fixture, is installed. The light fixtures are leveled and aligned, where appro- * priate, within 1 degree. The standard height of the top of the elevated light fixture is 14 inches (35 cm) above the finished grade. In areas where the mean annual total snowfall exceeds 2 feet (0.6 m), this standard elevation may be increased as illustrated in figure 24. In order to facilitate maintenance of light fixtures, it is recommended that identification numbers be assigned and installed by one of the following or similar methods. *

(1) Stencil numbers with black paint on the runway side of the base plate. The minimum height of the numbers is 2 inches (5 cm).

(2) Attach a noncorrosive disc with permanent numbers to the fixture. The minimum height of the numbers is 2 inches (5 cm).

(3) Impress numbers on a visible portion of the concrete backfill. The minimum height of the numbers is 3 inches (7.6 cm).

e. Base Mounted Light Fixtures. This type of installation is normally used only with series circuits to house the isolation transformer and accommodate a closed duct system. Prior to mounting the light fixture on the base, an L-823 connector kit is installed on the primary power cable ends and the appropriate L-830 isolation transformer is installed. These transformers serve as a means for isolating the light unit from the high voltage primary of the series circuit. Wrap the connector joints in the primary circuit with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (3.8 cm) on each side of the joint. Typical fixture and duct details are shown in figures 12 and 13. Plug the light disconnecting plug into the transformer secondary receptacle. Do not tape this connection.

f. Stake Mounted Light Fixtures. For series circuits, make connections and transformer installation as detailed in the previous paragraph. Bury the transformer primary cable connectors at least 10 inches (25 cm) deep and adjacent to the stake as shown in figure 13. By burying the components in like locations at each stake, maintenance of the underground system is facilitated. When installed in a location where the frost line depth exceeds the minimum cable installation depth, as specififed in AC 150/5370-10, item L-108, increase to a maximum of 2 feet (0.6 m) in depth the installation of the cable, transformers, and connectors. Do not attach cable connectors to the stakes. Install primary cable connectors, splices, and transformers at the same depth and in the same horizontal plane as the primary cable with adequate slack provided. The radius of cable bends should not be less than 10 inches (25 cm). Place the secondary leads from the transformer to the lamp socket in a loose spiral with excess slack at the bottom.

g. Shielding Taxiway Lights. In order to shield undesirable blue light to landing pilots or lessen the "sea-of-blue" effect, metal shields or hoods are available, as an option, from the lamp manufacturers. See figure 22 for suggested orientation. Orient fixtures with masked lamps by rotating the fixture on its mounting for proper light pattern before securing in place. Use of brightness control is desirable to adjust the blue light level to match visibility conditions. This feature also prolongs lamp life. Proper control circuiting will also help to eliminate the "sea-of-blue" effect by providing lighting only where it is needed.

h. Direct Burial Cable. Install all power or control cables by direct burial in trenches except where the routing is through paved or stabilized areas. Seal cable ends during construction to prevent the entrance of moisture. When using L-857 light bases in a system, provide at least 2 feet of slack cable to permit connections of the primary cable and the isolation transformer primary leads to be made above ground. Trenching, installation of cable, backfilling trenches, and the installation of cable markers is to conform to paragraph 108 of AC 150/5370-10. Cable plowing is allowed where suitable soil conditions exist.

i. Cable in Duct and/or Conduit. Install all power or control cables in ducts and conduits to conform to paragraph 108-3.2 of AC 150/5370-10. Provide slack cable for connections as stated in paragraph 7h. Install the duct and/or conduit conforming to the requirements of paragraph 110-3 of Advisory Circular 150/5370-10.

j. Installing Duct or Conduit Under Paved Surfaces. Provide a reasonable number of spare ducts or conduits in each bank for maintenance and future expansion of facilities. Avoid routing ducts or conduits through areas which may have to be excavated.

Where ducts are in tiers, use the lowest ducts to receive cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and interferences are avoided.

k. Counterpoise. If required, install counterpoise wire for lightning protection in the same trench 4 inches above the insulated cable it is to protect as specified in paragraph 108-3.9 of AC 150/5370-10.

l. Splices. Make splices on underground cables to conform to paragraph 108-3.8 of AC 150/5370-10. No splices are to be in ducts, conduits, or in circuits between light fixtures unless housed in an approved manhole, handhole,or light base and transformer housing. Where crimp connectors or field attached plug-in connectors conforming to AC 150/5345-26 are employed, use crimping tools of the type that must be fully closed before they can be released and designed for the specific type connector to assure crimps or detents meeting the necessary tensile strength.

8. INSPECTION.

a. Inspect each light fixture to determine that it is installed correctly, at the proper height, in line with the other fixtures, level,and properly oriented.

b. Check the light fixtures with asymmetrical lenses to determine that they are properly oriented with respect to the runway longitudinal sides and the threshold. Check all lights for alignment.

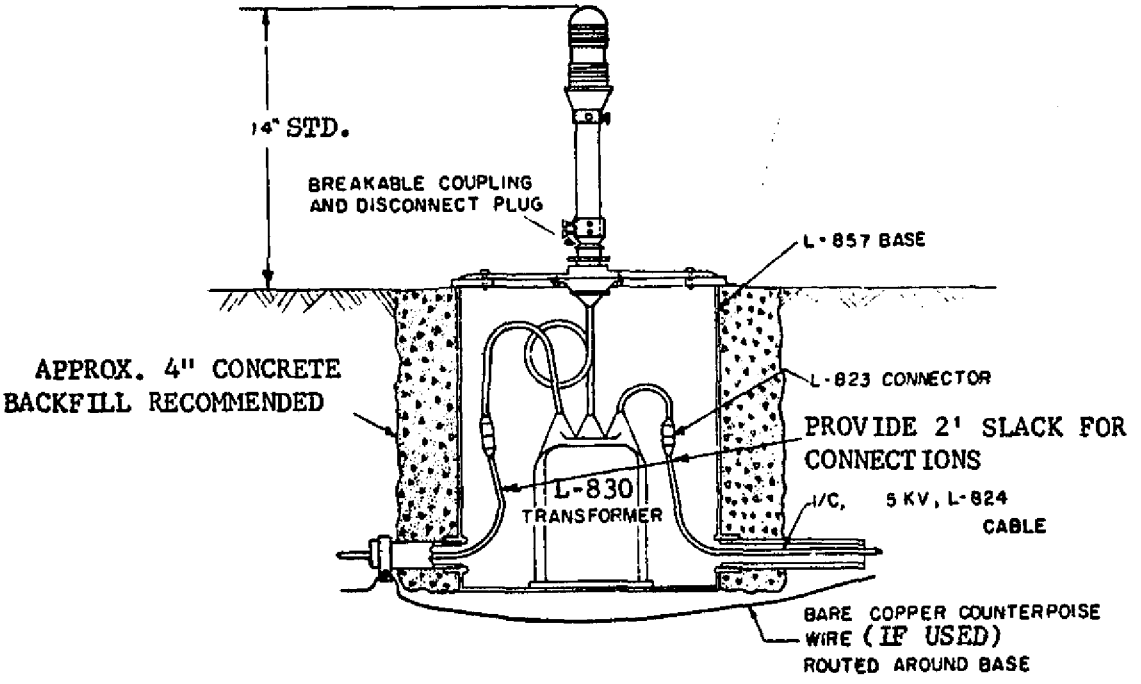
c. Check identification number for each light unit to determine that the number at the installation is as assigned in the plans.

d. Check equipment covered by Federal Aviation Administration specifications to determine if the manufacturers have supplied approved equipment. The equipment is also checked for general conformance with specification requirements.

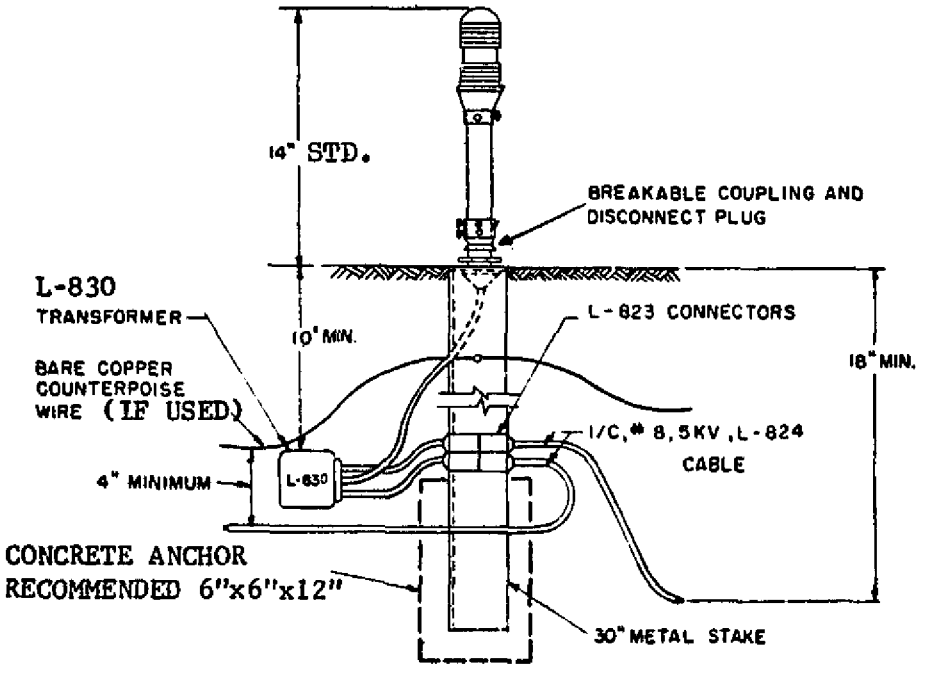
e. Inspect all cables, wiring, and splices to obtain assurance that the installation is in accordance with Advisory Circular 150/5370-10, National Electrical Code, and local codes. Inspect and test insulation resistance of underground cables before backfilling.

f. Check all ducts and duct markers to determine that the installation is in accordance with Advisory Circular 150/5370-10. Inspect underground ducts before backfill is made.

g. Check the input voltage at the power and control circuits to determine that the voltage is within limits required for proper equipment operation. Select the proper voltage tap on equipment where taps are provided.

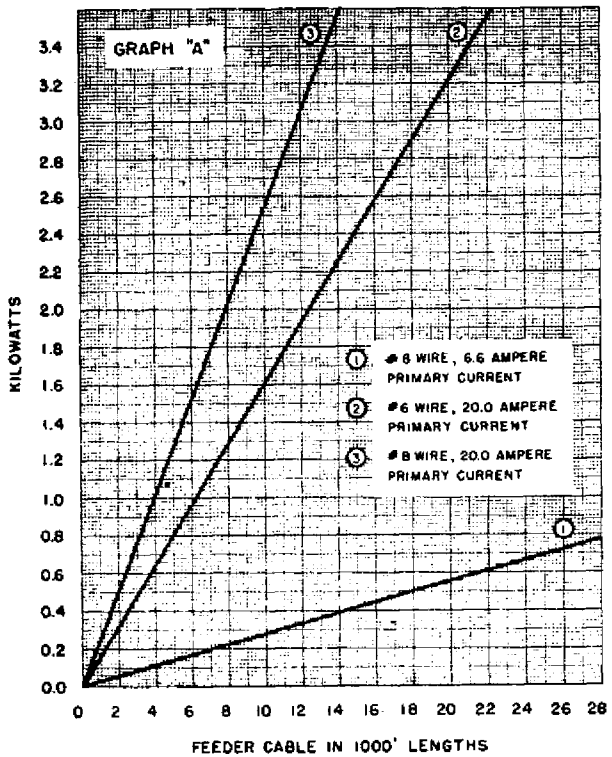


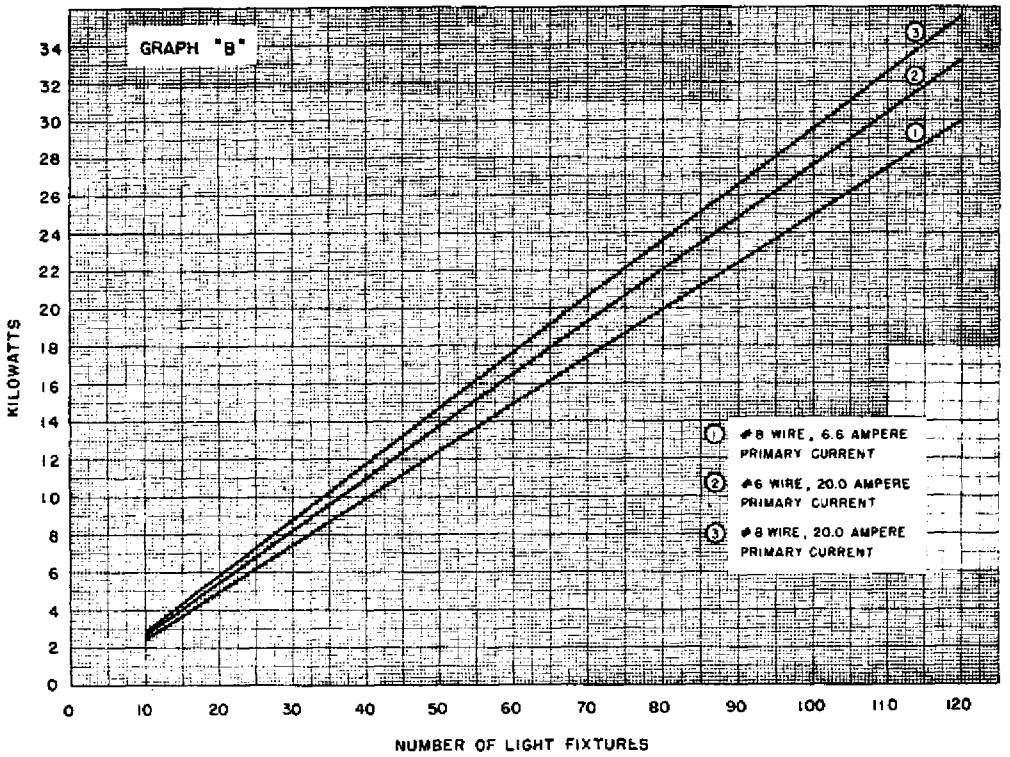
BASE MOUNTED, SERIES CIRCUIT



STAKE MOUNTED, SERIES CIRCUIT

FIGURE 13. SERIES CIRCUIT LIGHT FIXTURE WIRING



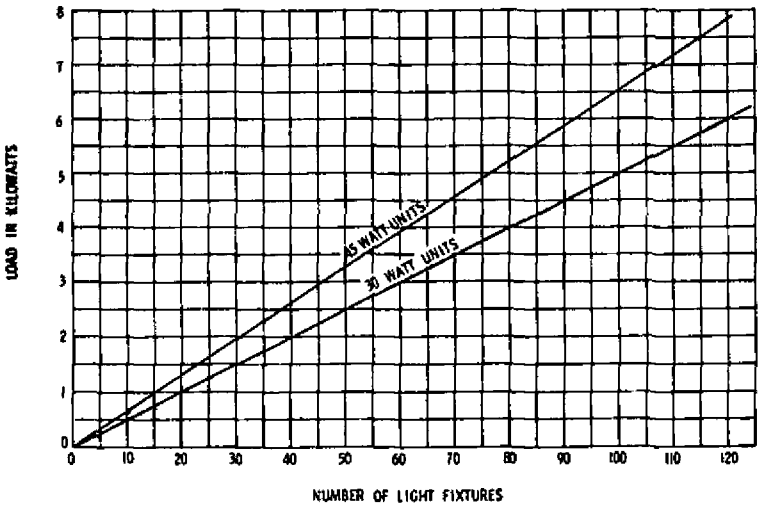


HOW TO DETERMINE TOTAL LOAD

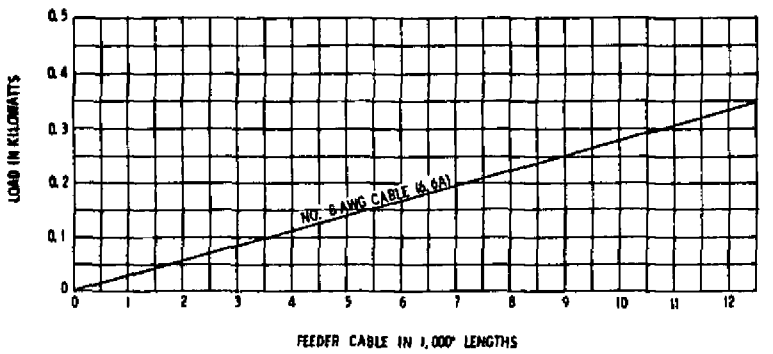
1. Multiply the distance between the vault and the runway by 2 to get the length of the feeder cable. Determine the KW power required for the feeder cable by getting the coordinate point on the applicable kilowatt-feeder cable line of GRAPH "A".
2. Determine KW power required for the number of fixtures to be installed by getting the coordinate point on the applicable kilowatt-number of light fixtures line of GRAPH "B" Curves based on use of 200W lamps.
3. Add kilowatts obtained from GRAPHS "A" and "B" to determine the total KW load required.

FIGURE 14. CURVES FOR ESTIMATING LOADS IN HIGH INTENSITY SERIES CIRCUITS

CURVE (a)



CURVE (b)



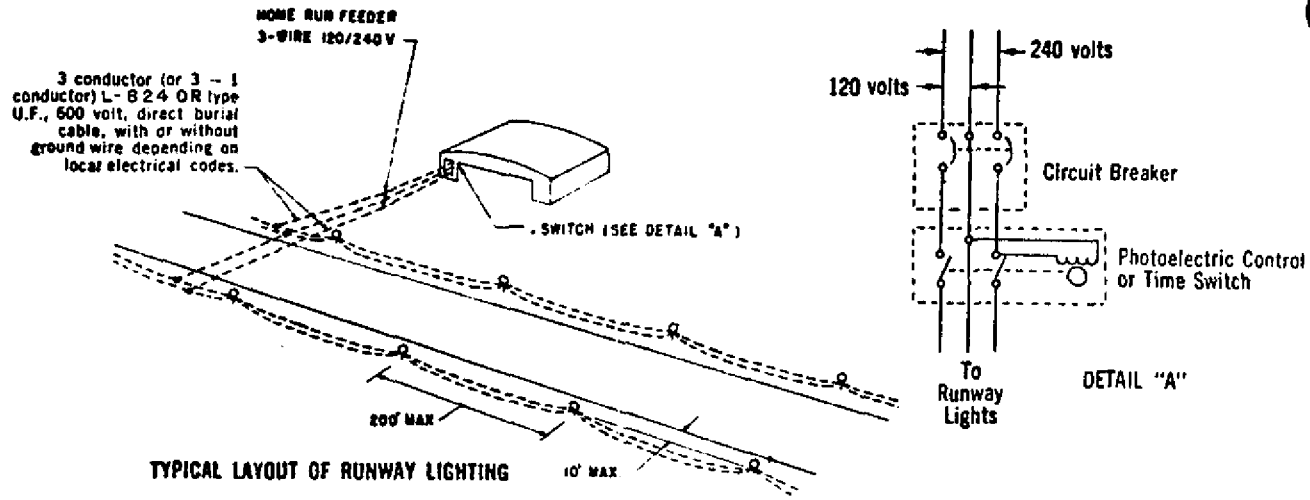
NOTES:

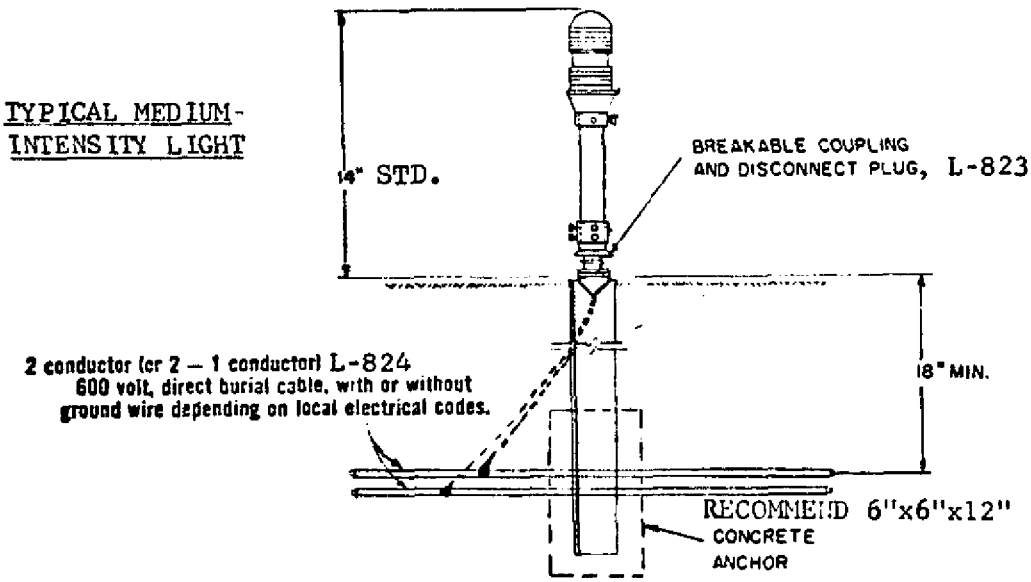
1. Computations based on actual circuit load tests.
2. In Curve (a) figure K. W. load using total number of 45 watt or 30 watt fixtures connected in circuit.
3. Basis for computing unit loads in Curve (a):

30/45 watt transformer with 45 watt lamp	54.7 watts
Cable loss, lamp tolerance, etc.	10.3 watts
Total estimated load per 45 watt unit	65.0 watts
30/45 watt transformer with 30 watt lamp	40.4 watts
Cable loss, lamp tolerance, etc.	9.6 watts
Total estimated load per 30 watt unit	50.0 watts

4. Basis for computing load per 1,000' of No. 8 AWG cable in Curve (b): $I^2R = (6.6A)^2 \times (0.6405 \text{ ohms/1,000'} = 27.9 \text{ watts/1,000'}$
5. Obtain total K. W. load per runway circuit by adding K. W. loads obtained from Curves (a) and (b).

FIGURE 15. CURVES FOR ESTIMATING KILOWATT LOADS FOR MEDIUM INTENSITY SERIES LIGHTING CIRCUITS





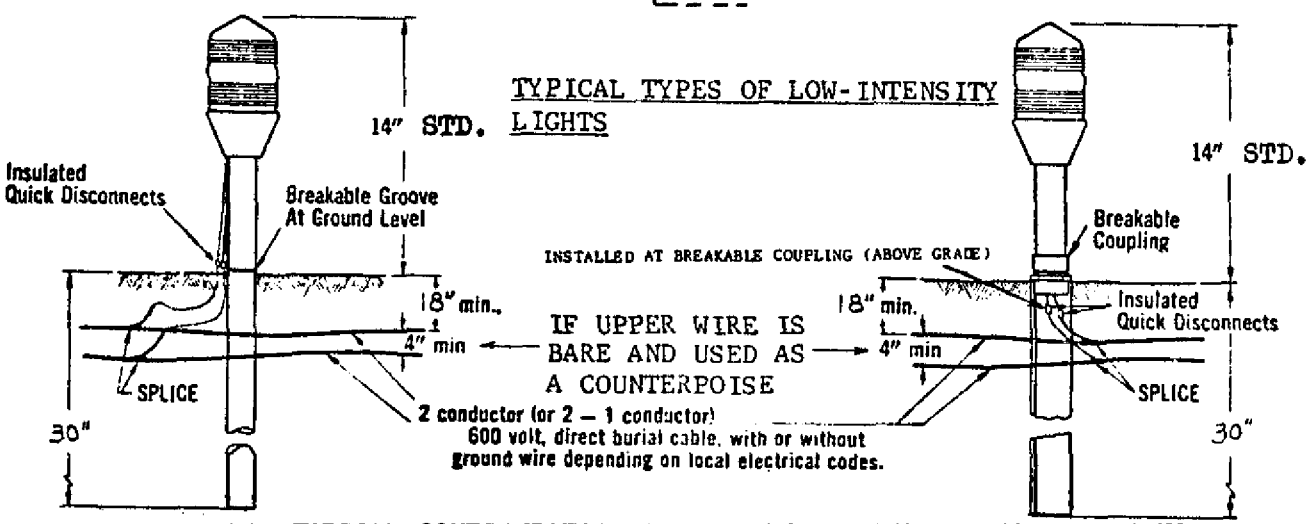
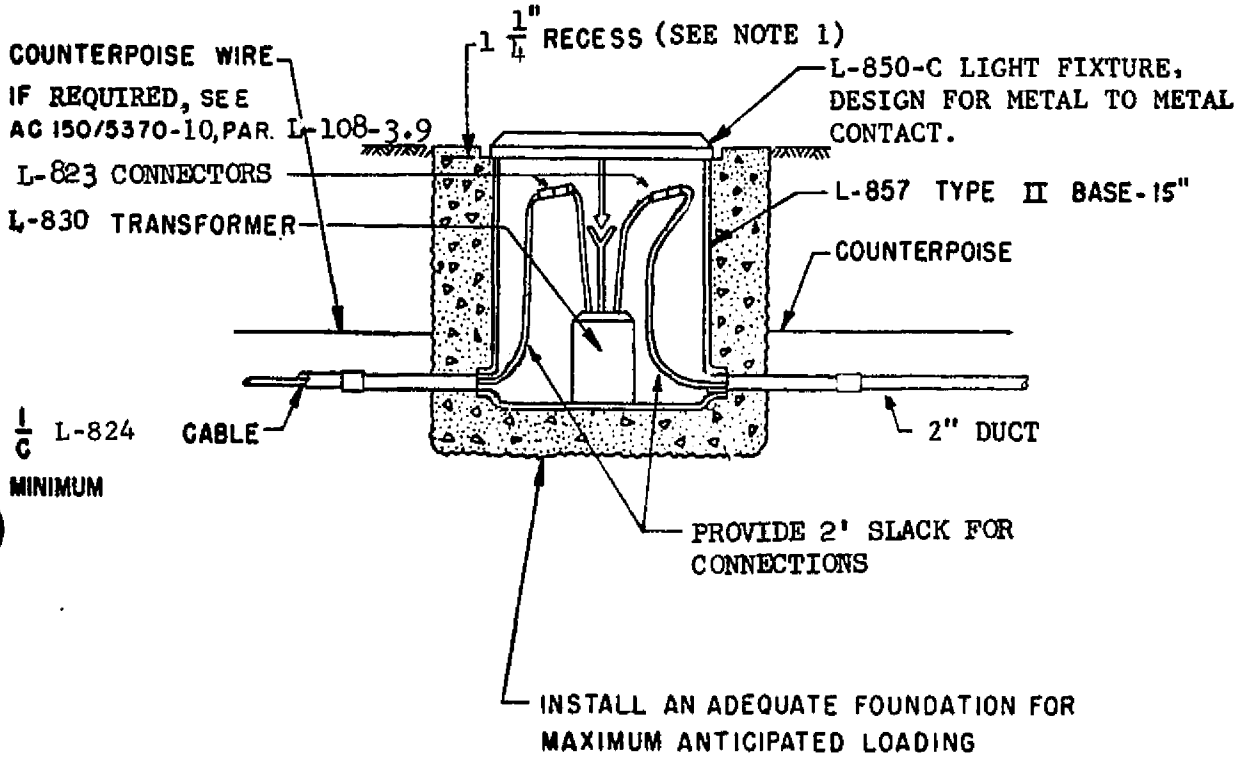
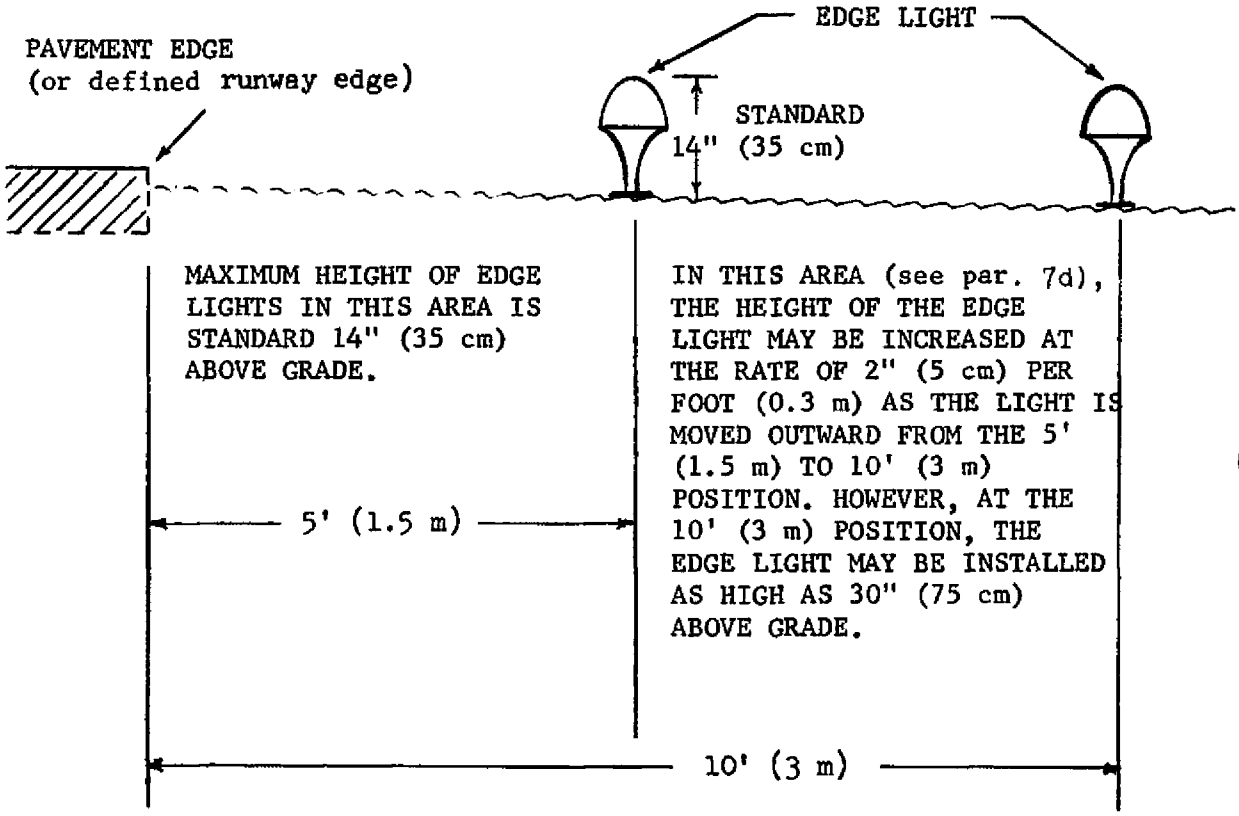


FIGURE 16. TYPICAL CONFIGURATION AND FIXTURE INSTALLATION OF LIGHTS USED IN PARALLEL CIRCUITS



NOTE 1. IF INSTALLATION IS IN BITUMINOUS PAVEMENT, LEAVE CONCRETE BACKFILL 3 - 4 INCHES LOW FOR BACKFILL WITH BITUMINOUS MATERIAL. ALTERNATELY USE A TWO SECTION BASE WITH THE SECOND SECTION INSTALLED AFTER THE FINISH BITUMINOUS SURFACE HAS BEEN CORED.

FIGURE 23. TYPICAL INSTALLATION OF L-850-C EDGE LIGHT



NOTE: WHEN LIGHTS ARE ELEVATED ABOVE STANDARD HEIGHT, A MINIMUM CLEARANCE OF 6" (15 cm) MUST BE MAINTAINED BETWEEN THE LIGHT AND ANY OVERHANGING PART OF AN AIRCRAFT EXPECTED TO USE THE RUNWAY OR TAXIWAY WHEN ITS MAIN LANDING GEAR IS LOCATED AT THE EDGE OF THE PAVEMENT.

FIGURE 24. ADJUSTMENT OF EDGE LIGHT ELEVATION DUE TO SNOW CONDITIONS

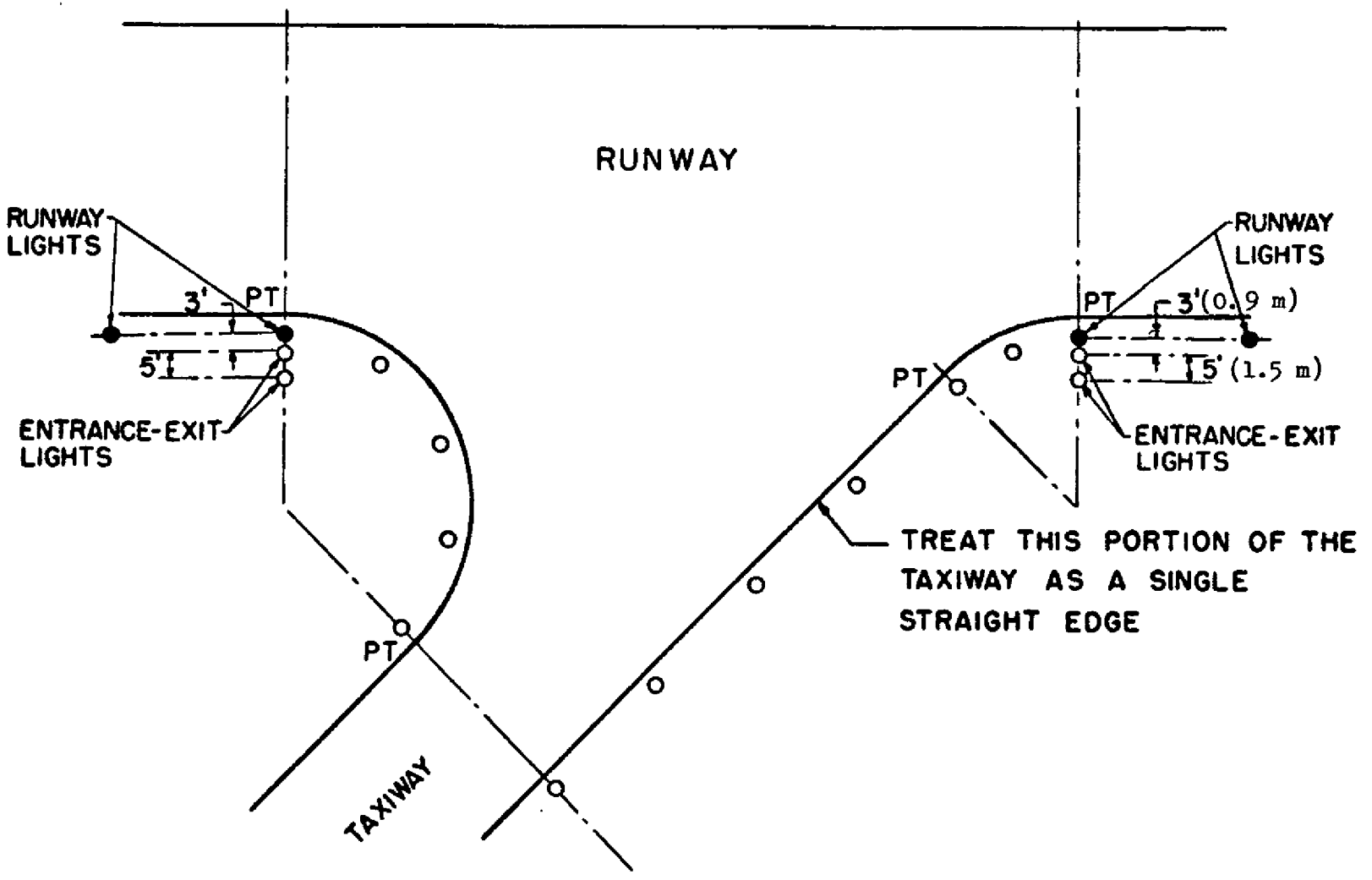


FIGURE 25. LOCATION OF ENTRANCE-EXIT LIGHTS (in lieu of guidance signs)

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Washington, D.C. 20591

Official Business

PENALTY FOR PRIVATE USE, $300

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