Federal Aviation Agency

ADVISORY CIRCULAR CHANGE

AC NO:	150/5340-13 CH 1
	AIRPORTS
EFFECTIVE:	7/22/65

SUBJECT: CH 1 TO ADVISORY CIRCULAR NO. 150/5340-13, SUBJ: HIGH INTENSITY LIGHTING SYSTEM

1. PURPOSE. This advisory circular transmits a page change to the subject advisory circular to provide corrected curves for estimating loads in high intensity series circuits.

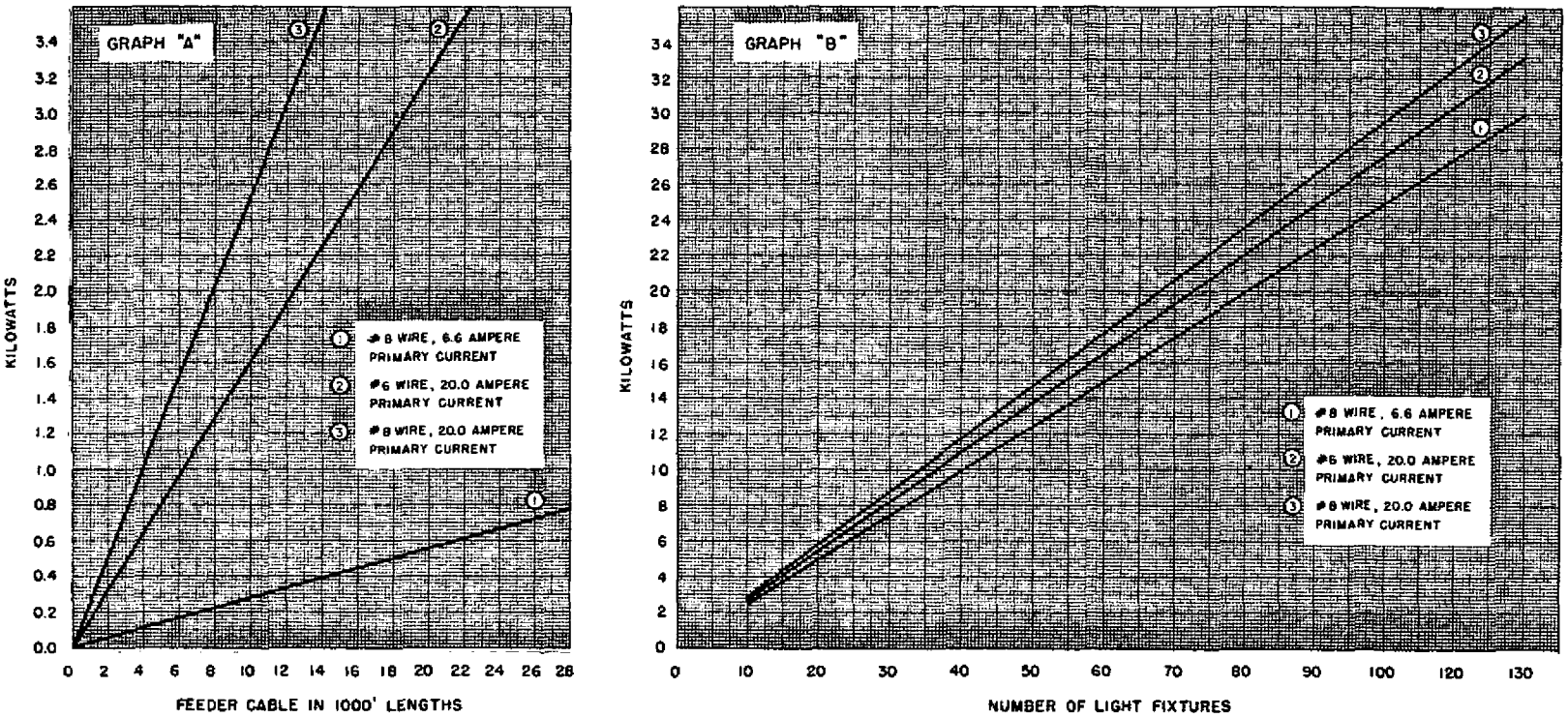
2. EXPLANATION OF CHANGE. To add corrected Figure 3, Curves For Estimating Loads in High Intensity Series Circuits, on Page 3 of Appendix 1.

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
Appendix 1 3	3/30/65	Appendix 1 3	7/22/65

Clarence A. Bowers

Cole Morrow, Director
Airports Service



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 kilowatts-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".
3. Add kilowatts obtained from GRAPHS "A" and "B" to determine the total KW load required.

FIGURE 3. CURVES FOR ESTIMATING LOADS IN HIGH INTENSITY SERIES CIRCUITS

(2) When the threshold is displaced from the extremity of the runway, the threshold lighting should consist of a line of lights outboarded on each side of the runway. These lights extend at least 40 feet outward from and at right angles to the line of runway lights. If the area created by the displaced threshold is useable for specific operations (take-off only, taxiing) and denied for others, it should be lighted to indicate the correct signal to the pilot for the operation. Denied and unuseable areas may be lighted by adding split colored filters and/or blank shields to the light fixtures. The fixtures indicate a green signal at the threshold area, a red signal for denied areas, a white signal for useable runway areas, and a blue signal for useable taxiing areas. Typical examples of relocated threshold lighting are shown in Figures 1, 2, and 3 of Appendix 2.

4. DESIGN.

a. General. The lighting system design should be coordinated with the airport paving and drainage. The drainage design may influence the lighting ducts and cable installations. If the lighting system design is coordinated with the paving design, the required conduits and duct can be provided under the paved areas. The number and size of ducts should be adequate for both present and future systems. It is extremely expensive to increase the number of ducts under an existing paved area.

b. Electrical Power. The high intensity lighting system may be designed for a 6.6-ampere or a 20.0-ampere series primary circuit depending on the KW load involved and the length of the homerun cables. The 6.6-ampere primary circuit is preferred due to the excessive line loss inherent with a 20.0-ampere circuit. A light fixture installed in an intersection, paragraph 3b(3)(a), requires a 300-watt insulating transformer with a 20.0-ampere output. All other lamp loads in the series circuit are supplied through either 6.6/6.6-ampere or 20.0/6.6-ampere, 200-watt insulating transformers. Figure 4, Appendix 2, may be used to estimate the total power requirements for a series circuit and the size cables required.

c. Electrical Control.

(1) Typical wiring details are shown in Figure 5, Appendix 2, for AC and DC controlled systems. The DC controlled system is adequate for separations between the control panel and auxiliary relay cabinet of up to 7900 feet. The maximum separation permissible with AC control can be estimated as shown in Figure 6, Appendix 2.

(2) Adequate spare wires should be provided in the control cables to permit the addition of new circuits after the initial installation. Spare wires are also useful for maintenance purposes. If trouble is experienced in the control wires between the control tower and vault, the components in the circuit can be connected to the spare wires.

d. Ducts. Design considerations for duct systems are in Item L-110 of AC 150/5370-1, Standard Specifications for Construction of Airports, and Supplement No. 2. Duct routes should be checked prior to construction to obtain assurance that the shortest routes are selected and interferences are avoided.

e. Vaults. Design considerations for vaults and transformer housings are in Item L-109 of AC 150/5370-1 and Supplement No. 2. At least two square feet net vent area per 100 KVA installed transformer capacity are provided in the vault where the 24-hour average ambient temperature does not exceed 30 degrees centigrade. If the average ambient temperature exceeds 30 degrees centigrade, auxiliary means should be provided for removing heat.

f. Code. The installation should conform with local code requirements.

g. RVR. At installations where runway visual range equipment is to be installed, two #19 AWG wires should be installed between the control tower and vault. The ends of the wires are taped until connections are to be made. This tape prevents 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 in accordance with instructions provided with the RVR system.

5. EQUIPMENT AND MATERIAL.

a. General.

(1) Equipment and material covered by Federal Aviation Administration specifications are specified by Advisory Circular numbers.

(2) Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA specifications conform to the applicable standards of the electrical industry.

b. Light Fixtures. The fixtures are furnished complete and ready for installation on a base.

(1) The elevated edge lights and threshold lights conform to the requirement of AC 150/5345-9A. The light consists essentially of an optical system, lamp, lampholder mounted in a suitable housing, and a mounting assembly.

(2) The semiflush light fixtures used in intersections conform to the requirements of AC 150/5345-19, Type I unit. The unit consists of an optical system, housing, lampholder, connecting leads, and connectors.

c. Insulating Transformers.

(1) These transformers serve as a means for isolating the light unit from the high voltage characteristics of the series circuit. In the event a lamp filament circuit becomes open, the continuity of the primary series circuit is maintained by the insulating transformer.

(2) The transformer used with AC 150/5345-19 light units conforms to the requirements of AC 150/5345-34. All other insulating transformers conform to the requirements of AC 150/5345-22, Type II units for 6.6-ampere series circuits and AC 150/5345-33 for 20.0-ampere circuits.

d. Bases. The bases conform to the requirements of AC 150/5345-6 or AC 150/5345-32, as required. The light fixtures are mounted on the bases. The bases also serve as an insulating transformer housing. The light base and transformer housing consist of a cylindrical body with top flange and cable entrance hubs. Requirements for an internal grounding lug are included which may be optionally specified by the user. This internal grounding lug is used where bases are interconnected with the duct and the ground wire is installed through the duct system.

e. Regulator. The constant current regulator conforms to the requirements of AC 150/5345-10A. The regulator is designed for stepless brightness control without interrupting load current. The assembly has lightning arresters, open circuit and overcurrent protecting devices, and a local control switch included as part of the equipment. All parts are suitably enclosed for indoor or outdoor service. The equipment is wired at the factory as a complete assembly. Various sizes and ratings may be obtained in accordance with the specification requirements.

f. Control Panel. The remote control panel conforms to the requirements of AC 150/5345-3. The panel consists of a top panel plate and a housing. In addition, it has toggle switches, terminal boards, and brightness control, as required. The number of components to be mounted on the panel are specified when the equipment is ordered.

g. Auxiliary Relay Cabinet. The auxiliary relay cabinet assembly for 48-volt, DC control conforms to the requirements of AC 150/5345-13. The assembly consists of an enclosure containing a DC power supply, control circuit protection, and 20 pilot relays.

h. Cables.

(1) Primary Cable. The primary cable conforms to the requirements of AC 150/5345-7.

(2) Control Cable. Control cable containing No. 12 AWG wires conforms to the requirements of AC 150/5345-7. The control cable containing No. 19 AWG wires conforms to the requirements of Rural Electrification Administration Bulletin 345-14.

i. Connectors. Connectors attached to the transformer primary and secondary leads for splices conform to the requirements of AC 150/5345-26.

j. Tapes. Plastic electrical insulating tape is the type specified in Item L-108 of AC 150/5370-1 and Supplement No. 2. Rubber and synthetic rubber tapes conform to industry standards.

k. Conduit and Duct. Conduit and duct conform to those specified in Item L-110 of AC 150/5370-1 and Supplement No. 2.

l. Concrete. Concrete and reinforcing steel conform to the applicable provisions of Item P-610 of AC 150/5370-1 and Supplement No. 2.

6. INSTALLATION.

a. General. The installation of cables, vault and vault equipment, and underground electrical duct is as specified in Items L-108, L-109, and L-110, respectively, of AC 150/5370-1 and Supplement No. 2.

b. Light Base and Transformer Housing.

(1) The base for the elevated light unit is installed on undisturbed soil at the specified location. The cable entrance hubs are oriented in the proper direction. Approximately 4 inches of concrete backfill is placed around the outside of the base. The concrete is poured in place. The top of the concrete is sloped away from the flange portion of the base so that a minimum amount of concrete is exposed above the leveled soil.

(2) The base for the semiflush fixture is supported in the leave-out or excavated area in a position so that the top of the base flange, at its lowest point, is 1-3/8 inches below the finished pavement. The 1-3/8 inch space is provided for the installation of the gasket, adapter plate, and top fitting specified in AC 150/5345-19. The concrete backfill around the outside of the base is approximately 4 inches. The cable entrance hubs on the base are properly oriented prior to placing the concrete backfill.

(3) The base is held in place so that the machined upper surface of the base flange is within ± 2 degrees of the position shown in the plans.

c. Light Fixtures.

(1) The light fixtures are assembled, leveled, and adjusted in accordance with the manufacturer's instructions. The fixtures are leveled within 1 degree. The maximum height of the top of the fixture is 14 inches from the finished grade.

(2) An identification number is assigned to each light unit. The numbers are installed by one of the following methods:

(a) Numbers are stenciled with black paint on the runway side of the base plate. The minimum height of the numbers is 2 inches.

(b) A noncorrosive disc with permanent numbers is attached to the fixture. The minimum height of the numbers is 2 inches.

(c) Numbers are impressed on a visible portion of the concrete backfill. The minimum height of the numbers is 3 inches.

d. Cable.

(1) The cables between the regulator and control panel and the regulator and field circuits are installed in accordance with the requirements of Item L-108 of AC 150/5370-1 and Supplement No. 2.

(2) The primary cable enters the light base and transformer housing as shown in the plans. If specified, the cable entrance is sealed with squeeze connectors. Squeeze connectors are provided with a rubber bushing of the correct size to fit the outside diameter of the cable. The connectors are tightened to provide a watertight seal without deforming the insulation and sheath of the cable.

(3) Slack cable is provided inside the light base and transformer housing to permit connections of the primary cable and the insulating transformer primary leads to be made above ground. The transformer secondary leads are connected to the lamp leads with a disconnecting plug and receptacle. The secondary connection is not taped; the cable connections to the insulating transformer's leads are made as specified in Item L-108 of AC 150/5370-1 and Supplement No. 2. The connector joints in the primary circuit are wrapped 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 on each side of the joint.

(4) Ends of cables should be taped until the splice is made to prevent the entrance of moisture.

d. System. Typical fixture, vault, and duct details are shown in Figure 7, Appendix 2.

7. INSPECTION.

a. Each light fixture is inspected to determine that it is installed erect, at the proper height, and in line with the other fixtures.

b. The light fixtures' lenses are checked to determine that the glassware is properly oriented with respect to the runway sides.

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

d. Equipment covered by FAA specifications should be checked to determine if the manufacturers are approved suppliers. The equipment is also checked for conformance with specification requirements.

e. All cables, wiring, and splices are inspected to obtain assurance that the installation is in accordance with AC 150-5370-1 and Supplement No. 2 and local codes. Underground cables should be inspected before the installation is completed.

f. All ducts and duct markers are checked to determine that the installation is in accordance with AC 150/5370-1 and Supplement No. 2. Underground ducts should be inspected before the installation is completed.

g. The input voltage at the regulator's power and control circuits should be checked to determine that the voltage is within specified limits.

h. Fuses and circuit breakers are checked to determine if they are of the proper rating.

8. TESTS.

a. The installation is tested by operating the system continuously for at least 1/2-hour. In addition, each control is operated not less than 10 times.

b. The completed circuits are tested in accordance with the requirements of Item L-108 of AC 150/5370-1 and Supplement No. 2. This test includes checking the megohm resistance of system circuits. The minimum acceptable resistance is 10 megohms.

c. The vault equipment is tested as specified in Item L-109 of AC 150/5370-1 and Supplement No. 2. This test includes a check to determine that the resistance to ground of any part of the grounding system will not exceed 10 ohms.

d. The regulators and other applicable equipment are subjected to performance tests specified in the manufacturer's instructions.

9. MAINTENANCE.

a. General. A maintenance program is necessary at airports with high intensity runway edge lights to insure proper operation and dependable service from the equipment. Although the system may be of the highest order of reliability, its effectiveness will soon depreciate unless it is properly maintained.

b. Operational Check. A daily operational check should be made of all lighting fixtures. If any lamps are out, the locations of the fixtures are recorded and the lamps replaced. The lamp socket and electrical contacts should be checked before replacing the lamp.

c. Lens. The light fixture lens is periodically checked to determine if the glassware has been cracked or pitted beyond use by debris. The lens is also cleaned periodically to permit the units to operate at maximum efficiency. The regularity and type of cleaning will be dictated by local conditions.

d. Snow Removal. Snow removal from around the lighting fixtures should be accomplished as soon as possible after a snowfall to prevent obscuring the light fixtures. Maintenance personnel should familiarize themselves with local agreements regarding snow removal and govern themselves accordingly.

e. Bases. The high intensity fixture and base installation are designed to exclude both ground and surface water from entering the base. For varying reasons, small amounts of water sometimes enter and can become a serious problem, particularly where temperatures below freezing are encountered. If the bases are allowed to fill with water, freezing may result that can cause damage. To prevent this damage, it is recommended that a regular maintenance schedule be established to inspect each base for the presence of water especially during the fall and winter months. A regular schedule for tightening cover holddown bolts is recommended. If any of the bases contain water, the water is removed and the gasket replaced if necessary.

f. Grass. A regular schedule should be established for removing grass or other vegetation near the lighting fixtures.

g. Cable. Homerun cables are meggered with a 500-volt megger. Records of the initial megohm resistance values obtained are kept. The condition of the system can be checked by comparing monthly megger readings with the initial values. In an acceptable system, the initial megohm resistance values are not less than 10 megohms. If the monthly megger checks reveal progressive deterioration or faults, corrective steps should be taken promptly. The most common faults in series underground cables are opened or grounded circuits.

(1) Monthly megger checks can be accomplished by de-energizing the regulator, disconnecting the series cable leads at the regulator, and connecting one lead of the megger to the series cable and the other lead to a proven ground. Operate the equipment in accordance with the instrument instructions.

(2) In view of the fact that high open-circuit voltages may be obtained by opening the primary of an energized series lighting circuit, only authorized personnel should be allowed to troubleshoot.

h. Spare Parts. Stock adequate spare parts for maintenance purposes.

i. Vault. The vault (AC 150/5370-1, Item L-109) should be kept clean and uncluttered to prevent dirt from accumulating in control compartments and to allow equipment to be accessible at all times. Warning signs should be legible and mounted in conspicuous locations.

APPENDIX 1. BIBLIOGRAPHY

1. Obtain copies of the following Federal Aviation Agency publications from the Federal Aviation Administration, Distribution Unit, HQ-438, Washington, D.C. 20590.

   a. AC 150/5345-1A, Approved Airport Lighting Equipment.

   b. AC 150/5345-3, Specification for L-821 Airport Lighting Panel for Remote Control of Airport Lighting.

   c. AC 150/5345-6, Specification for L-809 Airport Light Base and Transformer Housing.

   d. AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits

   e. AC 150/5345-9A, Specification for L-819 Fixed Focus Bidirectional High Intensity Runway Light.

   f. AC 150/5345-10A, Specification for L-828 Constant Current Regulator with Stepless Brightness Control.

   g. AC 150/5345-13, Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.

   h. AC 150/5345-19, Specification for L-838 Semiflush Prismatic Airport Light.

   i. AC 150/5345-22, Specification for L-834 Individual Lamp Series-To-Series Type Insulating Transformer for 5000 Volt Series Circuit.

   j. AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors.

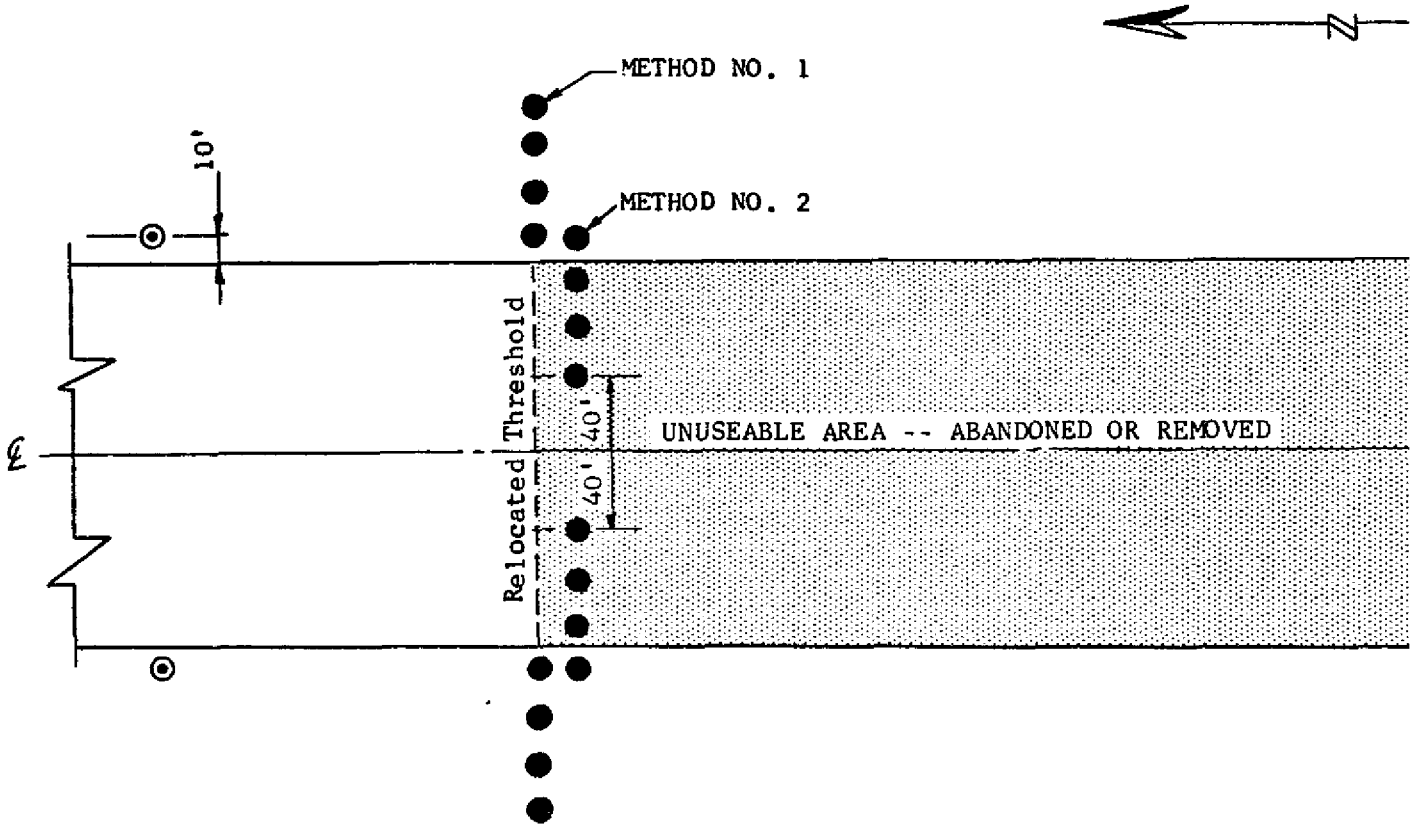
   k. AC 150/5345-32, Specification for L-837 Large-Size Light Base and Transformer Housing.

   l. AC 150/5345-33, Specification for L-844 Individual Lamp Series-To-Series Type Insulating Transformer for 5000 Volt Series Circuit 20/6.6 Amperes 200 Watt.

   m. AC 150/5345-34, Specification for L-839 Individual Lamp Series-To-Series Type Insulating Transformer for 5000 Volt Series Circuit 6.6/20 Amperes 300 Watt.

2. Obtain copies of AC 150/5370-1, Standard Specifications for Construction of Airports and Change 1, Supplement No. 2, from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Send check or money order with your request made payable to the Superintendent of Documents in the amount of $3.10 for each copy. No c.o.d. orders are accepted.

3. Obtain copies of Rural Electrification Administration (REA) Bulletin 345-14, REA Specification for Fully Color-Coded, Polyethylene Insulated, Double Polyethylene-Jacketed Telephone Cables for Direct Burial, from the U.S. Department of Agriculture, Rural Electrification Administration, Information Services Division, Washington, D.C. 20250.



LEGEND

⊙----360°White

●----360°Green

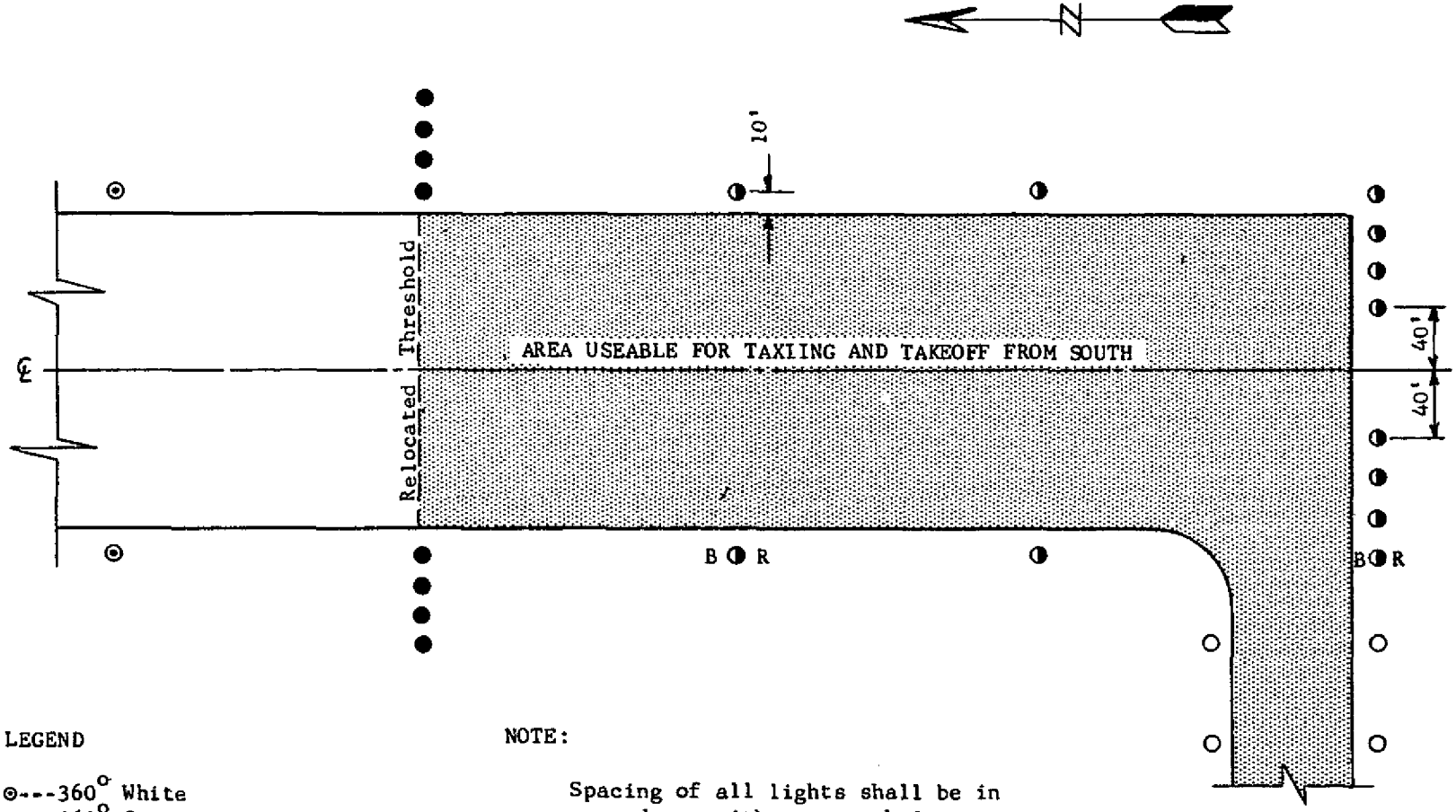
NOTE:

(1) Use Method No. 1 Threshold Installation Procedur
Area where paved surface is left in place.

(2) Use Method No. 2 Threshold Installation Procedur
Area where paved surface has been removed.

(3) Spacing of all lights shall be in accordance wit

FIGURE 1. RELOCATED THRESHOLD - UNUSEABLE AREA ABANDONED OR REMOVED



LEGEND

⊙---360° White
●---360° Green
B R--180° Blue and 180° Red
○---360° Blue

NOTE:

Spacing of all lights shall be in accordance with paragraph 3.

FIGURE 2. RELOCATED THRESHOLD - AREA USEABLE FOR TAXIING AND TAKEOFF FROM SOUTH

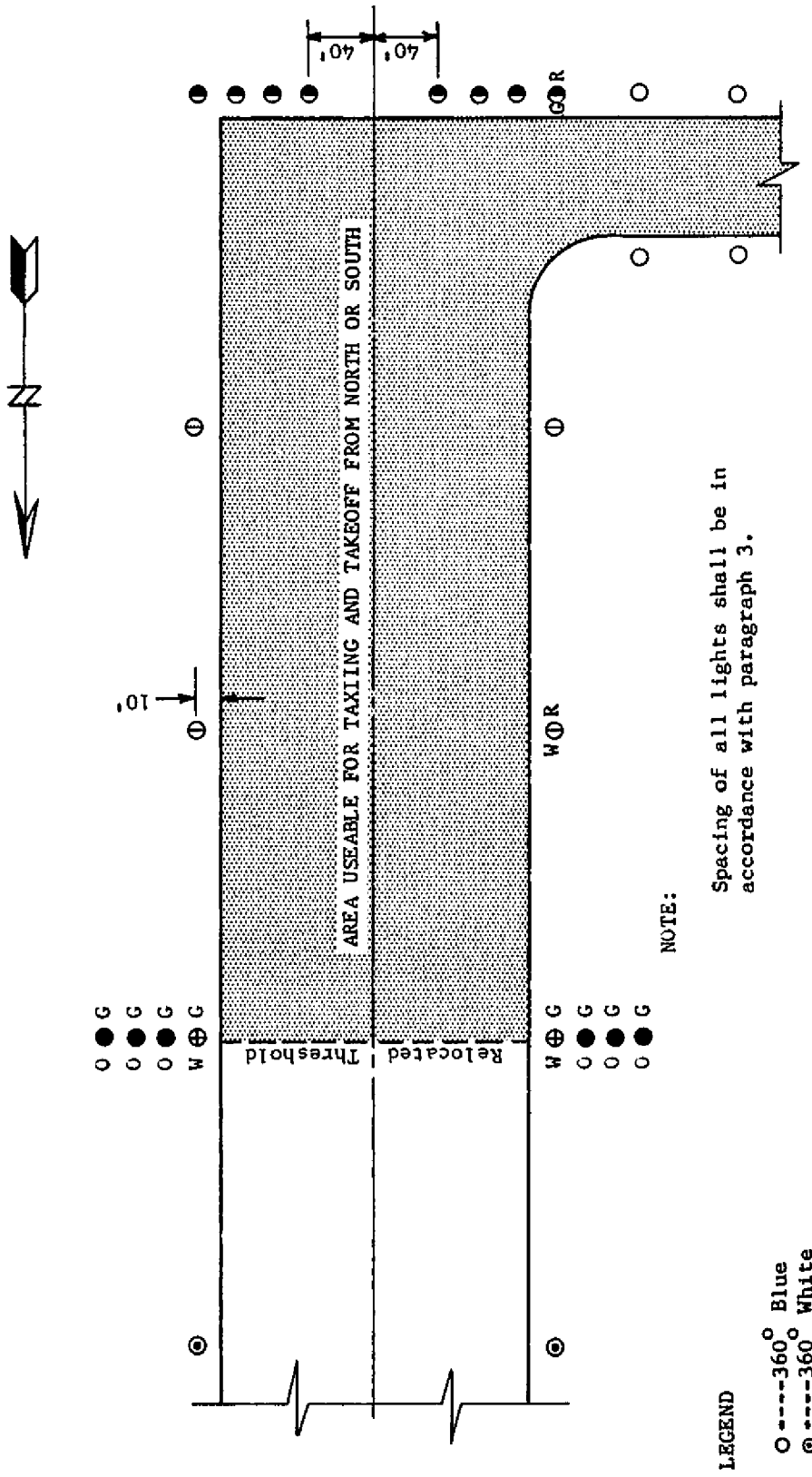
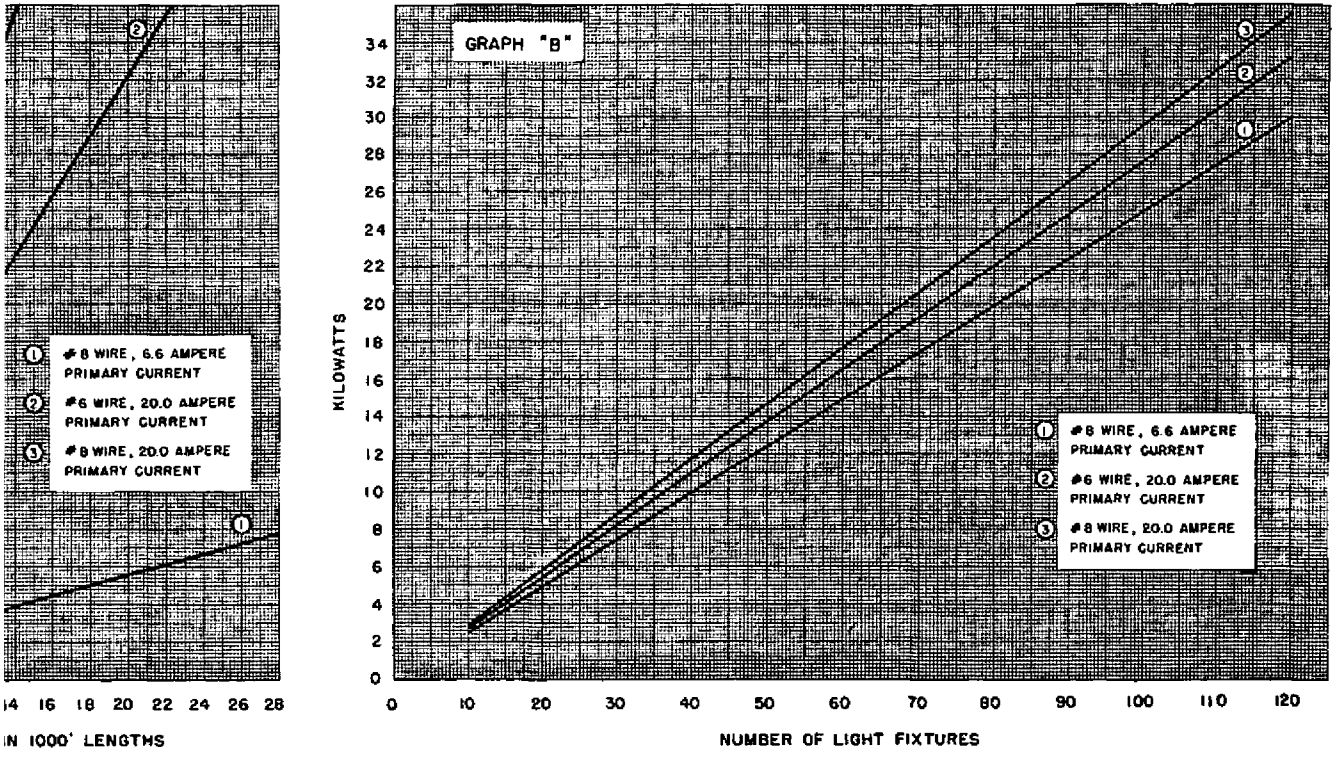


FIGURE 3. RELOCATED THRESHOLD - AREA USEABLE FOR TAXIING AND TAKEOFF FROM NORTH OR SOUTH



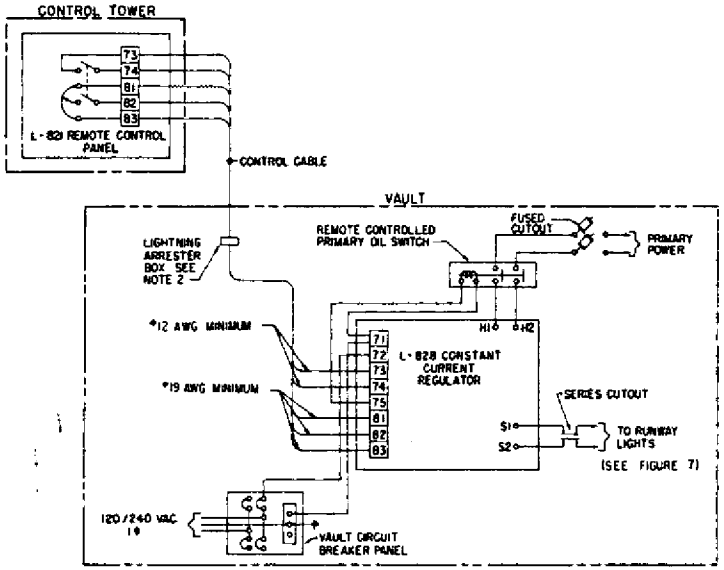
HOW TO DETERMINE TOTAL LOAD

he vault and the runway feeder cable. Determine feeder cable by getting plicable kilowatt-feeder

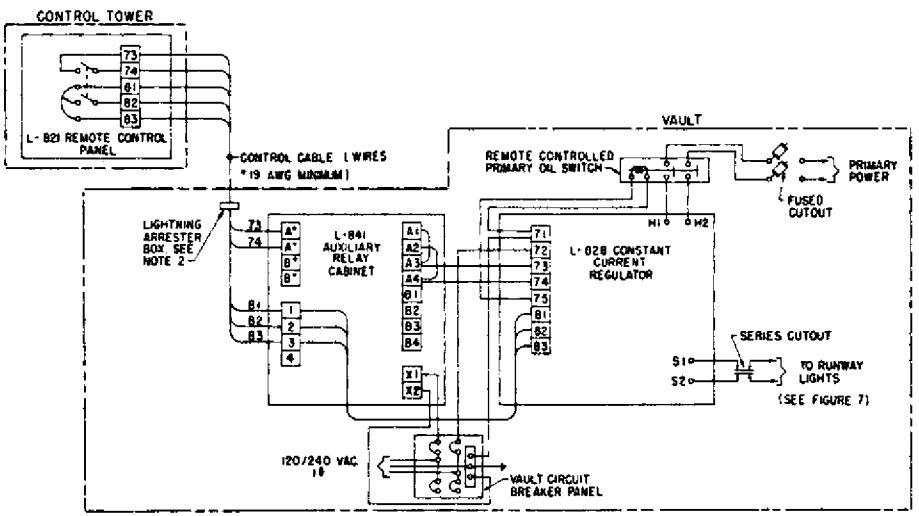
2. Determine KW power required for the number of fixtures to be installed by getting the coordinate point on the applicable kilowatt-number of light fixtures line of GRAPH "B".

3. Add kilowatts obtained from GRAPHS "A" and "B" to determine the total KW load required.

URE 4. CURVES FOR ESTIMATING LOADS IN HIGH INTENSITY SERIES CIRCUITS



120 VOLT A.C CONTROL



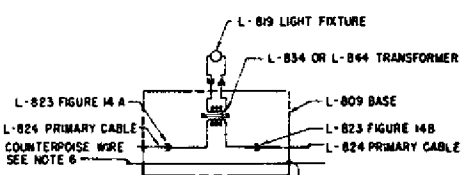
48 VOLT D.C. CONTROL

NOTES

1. The installations should conform to applicable sections of the National Electrical Code and local codes.
2. Additional isolating devices should be installed as required.
3. Fuses, circuit breakers, and cutouts should be in accordance with equipment ratings.
4. Use solid link in fused cutout in ground circuit when wye connected.
5. If the distance between the control tower and the vault is less than 7900 feet, 48 volt DC control may be used. The maximum separation allowable with AC control should be calculated. See Figure 6.
6. When a counterpoise wire installation is required, it is installed as specified in the plans and Item L-108 of Standard Specifications For Construction Of Airports.
7. Lightning arresters are furnished across the output terminals of the L-828 regulators as part of the equipment.

REGULATOR CAPACITY	LIGHTNING ARRESTER RATING	FUSE LINK RATING, TYPE "T"
10 KW	3 KV	15 AMP
20 KW	6 KV	25 AMP
30 KW	6 KV	40 AMP

SELECTION CHART FOR CIRCUIT COMPONENTS



FIXTURE AND TRANSFORMER WIRING DIAGRAM

FIGURE 5. TYPICAL WIRING DIAGRAMS FOR HIGH INTENSITY RUNWAY LIGHTING SYSTEMS

HOW TO DETERMINE MAXIMUM PHYSICAL SEPARATION
BETWEEN CONTROL PANEL AND REGULATOR

1. Determine physical separation between control panel and regulator.
2. Find the coordinate on graph of volt drop and separation between control panel and regulator.
3. Subtract voltage drop obtained in step 2 from the AC voltage available in the vault at the regulator's control circuit terminals.
4. The voltage obtained in step 3 should be 100 volts or greater for the regulator to function properly.
5. If the voltage obtained in step 3 is less than 100 volts, consideration should be given to selecting the 48 volt DC control system shown in Figure 5.
6. This curve is based on a circuit with two #12 AWG wires installed between the control tower and regulator.

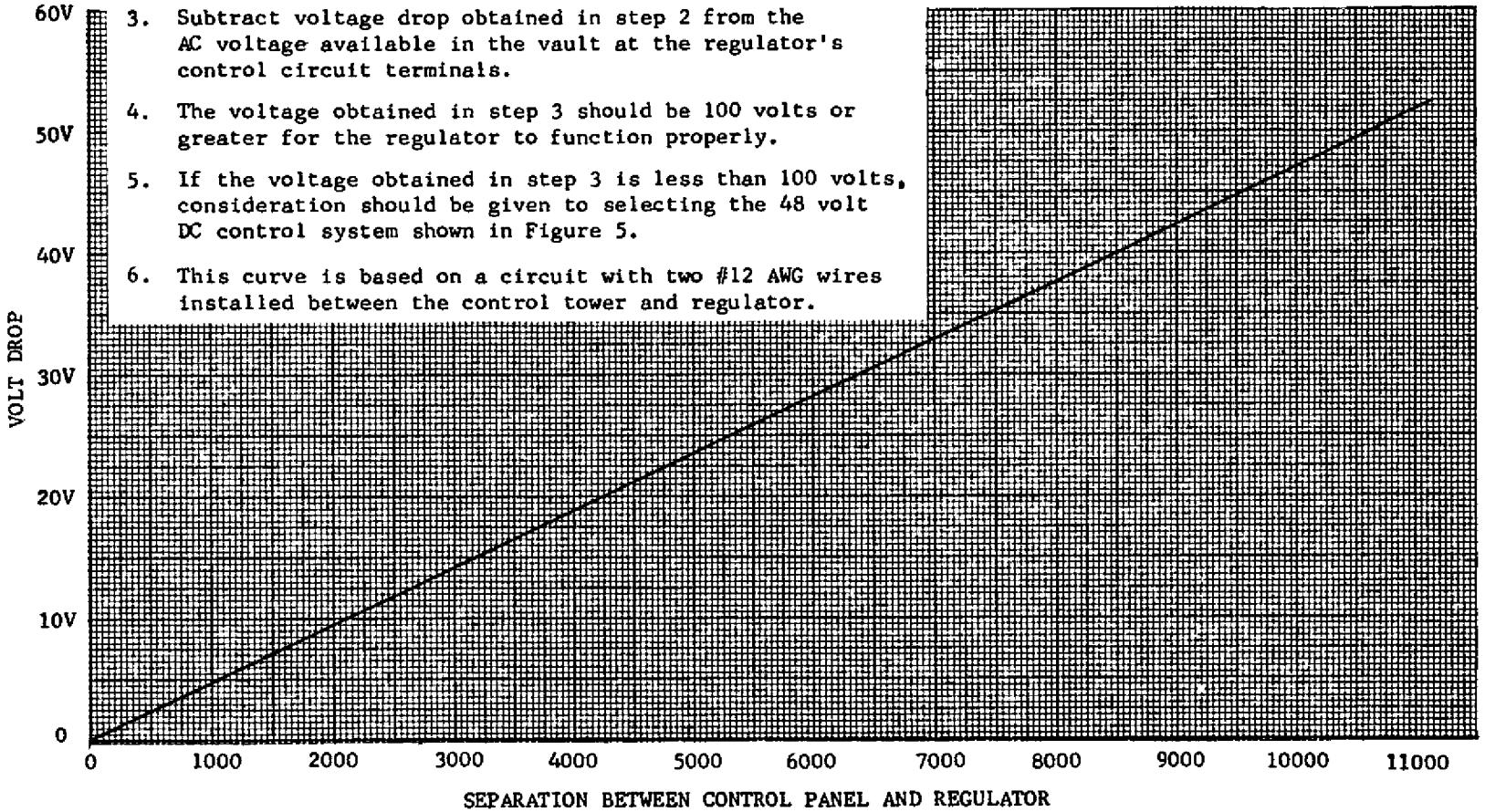
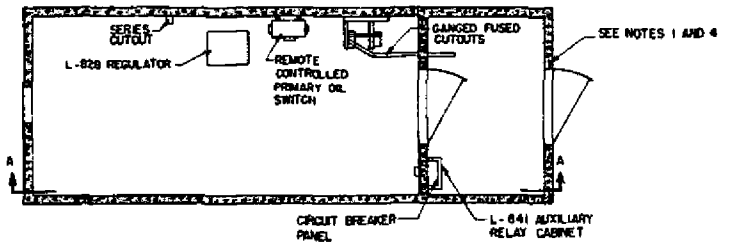
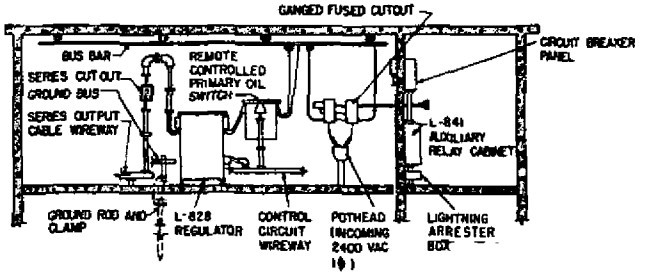


FIGURE 6. CURVES FOR ESTIMATING PHYSICAL SEPARATION BETWEEN CONTROL PANEL AND REGULATOR

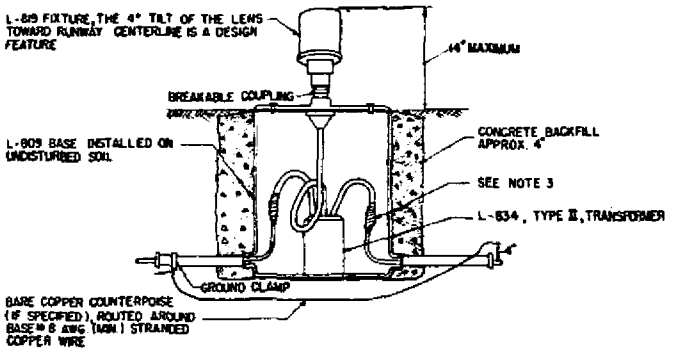


PLAN VIEW



ELEVATION A-A

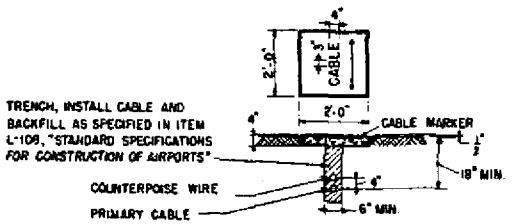
TYPICAL VAULT LAYOUT FOR HIGH INTENSITY LIGHTING EQUIPMENT



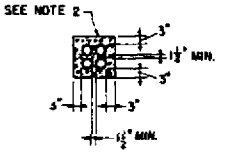
TYPICAL FIXTURE AND BASE INSTALLTION

NOTES

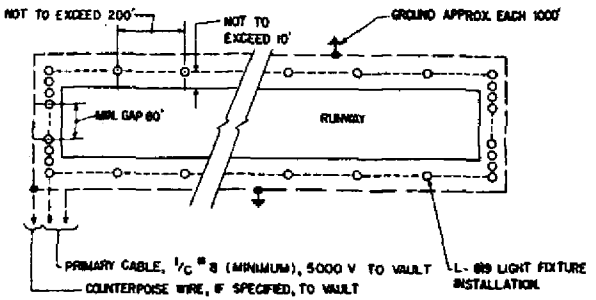
1. Vault construction and equipment installation are in accordance with the National Electrical Code, local codes, and item L-109 of FAA Standard Specifications for Construction of Airports.
2. The underground electrical ducts and duct markers are specified in the plans. The installations of ducts and markers are in accordance with item L-110 of FAA Standard Specifications for Construction of Airports.
3. Primary cable connector joints are wrapped with one layer of rubber tape and one layer of plastic tape, one-half lapped, extending at least 1½ inches each side of the joint.
4. An adequate number of lighting fixtures and electrical outlets are provided in the vault.



TYPICAL CABLE MARKER DETAILS



TYPICAL 4-WAY DUCT



TYPICAL LIGHTING CONFIGURATION

FIGURE 7. TYPICAL FIXTURE, VAULT, AND DUCT DETAILS

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