Repl. by 4C

AC 150/5340-4B

INSTALLATION DETAILS FOR RUNWAY CENTERLINE AND TOUCHDOWN ZONE LIGHTING SYSTEMS

May 6, 1969

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

AC NO: 150/5340-4B

DATE: 5/6/69

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: INSTALLATION DETAILS FOR RUNWAY CENTERLINE AND TOUCHDOWN ZONE LIGHTING SYSTEMS

1. PURPOSE. This advisory circular describes standards for the design, installation, and maintenance of runway centerline and touchdown zone lighting systems.

2. CANCELLATION. AC 150/5340-4A, Installation Details for Centerline and Touchdown Zone Lighting Systems, dated August 4, 1966, is cancelled.

3. REFERENCES. The publications listed under Appendix 1, Bibliography, are applicable to this advisory circular.

4. EXPLANATION OF REVISIONS. In addition to minor changes in the text and figures, the following changes have been made:

   a. Runway remaining color coding added to the runway centerline lights.

   b. Installation details added for touchdown zone and centerline fixture lights designed to fit the same types of bases.

   c. Installation details added to permit the use of a duct system with centerline and touchdown zone fixtures installed in new rigid and flexible pavements or existing flexible pavements.

   d. The type of sealer material used for wireway in flexible pavements.

   e. Details added for junction boxes that can be used to facilitate overlays in flexible pavements.

   f. Recommendations added for group replacement of centerline and touchdown zone lamps.

Initiated by: AS-580

5. HOW TO OBTAIN THIS CIRCULAR. Obtain additional copies of this circular, AC 150/5340-4B, Installation Details for Runway Centerline and Touchdown Zone Lighting Systems, from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

Chester G. Bowers
Director, Airports Service

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1. INTRODUCTION. The runway centerline and touchdown zone (narrow gauge) lighting systems are designed to facilitate landings, rollouts, and takeoffs under adverse day and night visibility conditions. The touchdown zone lights are primarily a landing aid. The centerline lights are most effective for rollout and takeoff.

2. BACKGROUND. In the interest of safety, regularity, and efficiency of aircraft operations, these lighting systems were developed to be used in conjunction with electronic precision approach aids and the standard approach lighting systems under limited visibility conditions. The centerline and touchdown zone lights are designed and installed to provide adequate visual guidance on rollout and takeoff under all visibilities down to and including 700-foot Runway Visual Range (RVR).

3. CONFIGURATION.

   a. Runway Centerline Lighting.

      (1) Spacing. Install the single lights along the runway centerline in a straight line. Space the light fixtures at 50-foot intervals. Locate the first centerline light 75 feet from the landing threshold. Extend these lights to a similar point at the opposite end of the runway. Offset the line of lights two feet maximum from the designed centerline when the centerline is viewed from the landing threshold. If the major taxiway turnoffs are to the right of the runway centerline, offset the runway centerline lights to the left. Conversely, if these turnoffs are to the left of the runway centerline, apply the reverse. Use this offset to avoid the paint stripe on the runway centerline.

      (2) Runway Remaining. Use color coding on the final 3,000-foot portion of the runway centerline lights as viewed from the approach or takeoff position. Provide alternate red and white lights as seen from the 3,000-foot to the 1,000-foot points, and all red lights for the last 1,000-foot portion of the runway centerline lighting system.

   b. Touchdown Zone Lighting.

      (1) Longitudinal Spacing. Provide the runway touchdown zone lighting system with two rows of transverse light bars located symmetrically about the runway centerline. Extend the system for a distance of 3,000 feet along the runway. Reduce this basic length to one-half the runway length for those runways less

than 6,000 feet. Locate the first pair of light bars 100 feet from the landing threshold, followed by each succeeding pair at 100-foot intervals to the end of the system.

(2) Lateral Spacing. Space the rows of transverse light bars equidistant from the runway centerline. Make the spacing or gauge between the innermost light fixtures 60 feet. Use transverse light bars of three unidirectional lights at intervals of five feet measured center to center.

(3) Tolerances. See Figure 2 for the longitudinal and lateral installation tolerances for these lights.

c. Displaced Thresholds.

(1) Centerline Lights. In the direction of landings, blank out the centerline lights in the displaced area. See Figure 1 for color coding of these lights in the takeoff direction.

(2) Touchdown Zone Lights. Blank out or remove the touchdown zone lights in the displaced area and extend the configuration, if required, to the length shown in Figure 2.

d. Long Radius Exit Taxiways. See AC 150/5340-19, Taxiway Centerline Lighting System, for lighting configurations.

4. DESIGN.

a. Layout. Provide a design drawing showing the dimensional layout of the centerline and touchdown zone lighting systems prior to construction. Compare this drawing with the up-to-date airport drawings to assure proper location of the wireways, ducts, and placement of the equipment.

b. Runway Centerline and Touchdown Zone.

(1) Light Fixtures and Wires. Design these systems for one of the conditions listed below:

(a) In new rigid pavements and new or existing flexible pavements, provide access to cables and transformers through the use of conduits and transformer bases. This type of installation can reduce maintenance downtime if the underground circuits require replacement.

(b) In existing rigid pavements, provide recesses or holes for the light fixtures and shallow sawed wireways for electrical conductors. This method eliminates the costly procedures required to remove existing rigid pavement for the installation of bases and conduits.

(c) The installation in Paragraph 4b(1)(b) may be used for new rigid and flexible pavements; however, if overlays are anticipated in flexible pavements, provide junction boxes as shown in Figure 13.

(2) Electrical Power. Design each system for a 20-ampere series primary circuit using a constant current regulator having an adequate kilowatt capacity. Provide each fixture with a 20/6.6-ampere, 200-watt insulating transformer. See Figure 14 for data to estimate total power requirement and primary cable size.

(3) Electrical Control. Make the centerline lighting system's controls independent of the touchdown zone lighting system and the high intensity runway edge lights. See Figures 3 and 4 for typical wiring details for AC and DC controlled systems. Use reduced size potentiometer, referenced in AC 150/5345-3A, if space is limited on the L-821 control panel. Provide spare wires in the control cable. These spares can be used to reduce downtime in circuits if faults develop in control wires.

c. Special Considerations. The load on the secondary of the 200-watt insulating transformer should not exceed the lamp load plus 0.40 ohm. If it is not practical to stay within this limit, use a 300-watt insulating transformer.

5. EQUIPMENT AND MATERIAL.

a. Specifications and Standards.

(1) Equipment and material covered by specifications are referred to by advisory circular numbers.

(2) Use distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other commercial items of electrical equipment not covered by Federal Aviation Administration specifications that conform to the applicable rulings and standards of the electrical industry.

b. Light Fixtures.

(1) Provide runway centerline light fixtures that conform to AC 150/5345-37B, Class A.

(2) Provide touchdown zone light fixtures that conform to one of the following specifications:

(a) AC 150/5345-16, Type A or Type B Unit.

(b) AC 150/5345-37B, Class B.

c. Insulating Transformers. Provide 200-watt insulating transformers that conform to the requirements of AC 150/5345-33 and 300-watt insulating transformers that conform to the requirements of MIL-T-27535. The transformers serve as a means for insulating the light unit from the high voltage characteristics of the series circuit. If in the event a lamp filament circuit opens, the continuity of the primary series circuit is maintained by the insulating transformer.

d. Light Base and Transformer Housings. Provide L-837 bases that conform to the requirements of AC 150/5345-32 and modified L-809 bases that conform to AC 150/5345-6. See Figures 7, 10, and 11 for the applications of these bases. The bases consist essentially of a cylindrical body with top flange and cable entrance hubs. Requirements for an internal grounding lug, which may be optionally specified by the user, are included. This internal grounding lug is used where bases are interconnected with the duct and the ground wire is installed through the duct system. Certain applications may require additional entrance hubs. Provide a 1/2-inch steel cover and a suitable gasket for off-runway installation. The cover should be adequately protected against corrosion.

e. Regulators. Provide L-828 constant current regulators that conform to the requirements of AC 150/5345-10B. The regulator is designed for stepless brightness control without interrupting load current. The assembly has lightning arresters, open circuit and overcurrent protective devices, and a local control switch. All parts are suitably enclosed for indoor or outdoor service. The equipment is wired at the factory as a complete assembly. Obtain various sizes, ratings, and options in accordance with AC 150/5345-10B. Provide porcelain-housed, absolute disconnect devices of 5KV or 7.5KV ratings on all outgoing series circuits.

f. Control Panel. Provide an L-821 remote control panel that conforms to the requirements of AC 150/5345-3A. 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 for each installation.

g. Auxiliary Relay Cabinet. If required, provide an L-841 auxiliary relay cabinet assembly that conforms to the requirements of AC 150/5345-13 for use in 48-volt DC control circuits. The assembly consists of an enclosure containing a DC power supply, control circuit protection, and 20 pilot relays.

h. Wire. Provide L-846 single conductor No. 10 AWG wires that conform to the requirements of AC 150/5345-30A for use in wireways.

i. Cables.

(1) Primary Cable. Provide L-824 primary cables that conform to the requirements of AC 150/5345-7, Type B. Select the AWG sizes shown in the plans.

(2) Control Cable. Provide L-824 control cables containing No. 12 AWG wires that conform to the requirements of AC 150/5345-7. If a low voltage DC control system is required, select control cable containing No. 19 AWG wires that is in accordance with Rural Electrification Administration Bulletin 345-14.

j. Connectors. Provide L-823 connectors to splice the L-824 primary cables. These connectors conform to the requirements of AC 150/5345-26. Use preinsulated connectors suitable for installation in wireways for splices from the L-846 wire to the centerline and touchdown zone inset fixture leads.

k. Tape. Provide plastic and electrical insulating tapes of the types specified in AC 150/5370-1A, Item L-108.

l. Conduit and Duct. Provide conduit for connecting the base-mounted units. Unless otherwise specified, select 2-inch galvanized steel flexible conduit of standard manufacture with a suitable protective covering. Provide all other conduits and ducts that conform to the requirements of AC 150/5370-1A, Item L-110.

m. Junction Box. If required, provide junction boxes for installation in flexible pavements. See Figure 13 for details.

n. Concrete. Provide concrete and reinforcing steel that conform to the applicable provisions of AC 150/5370-1A, Item P-501.

o. Sealer Materials. Select materials that conform to the requirements of AC 150/5370-1A, Item P-605, P-606, or FAA-E-2373, as required. Provide other types of materials with satisfactory adhesive and waterproofing qualities if approved by the engineer in charge.

(1) Wireways. Seal wireways (saw kerfs) with a liquid type sealer. Use Item P-606 material in rigid pavements and Item P-605, Type III, or FAA-E-2373 material in flexible pavements. If other types of material are used, select a sealer that has a certification that it is compatible with the pavement. The pouring temperature of hot-poured materials should not exceed 205 degrees Centigrade.

(2) Inset Fixtures. Seal the fixtures in place with a paste and liquid material as shown in Figure 12.

(3) Joints. Use joint sealing material conforming to Item P-605 across rigid pavement joints.

6. INSTALLATION.

a. Runway Centerline and Touchdown Zone - Existing Pavements.

(1) Rigid Pavements. Provide holes or recesses drilled in the pavements to accommodate the light fixtures. Saw wireways to accommodate electrical circuits. See typical installation details in Figures 6, 7, and 12.

(a) Pavement Drilling and Sawing. Drill the fixture recesses and saw the wireways at the locations shown in the plans. Standard sawing and coring equipment normally used on pavements may not be adaptable. Use the type coring or sawing equipment adequate for this type of work. Provide an approximate 1/4-inch clearance for sealer material between the sides and bottom of the receptacle and the drilled recess. Align the drilled holes in a longitudinal direction so they will not vary from an established line by more than 1/4 of an inch. Provide extra depth and special treatment where wireways cross rigid pavement joints. See Figure 6 for a typical detail. Make the extra depth and special treatment in accordance with the appropriate plans.

(b) Light Fixtures. Install centerline lights to follow the pavement contour. Place touchdown zone lights level in a horizontal plane. Unless otherwise specified, the tolerance for being level is ±1/2 degree.

1 Prior to placing the receptacle in the drilled hole, clean all external surfaces of the receptacle (sandblasting may be necessary) to assure an adequate bond between fixture, sealer, and pavement. Avoid handling the fixtures by the lead wires.

2 In lieu of the top fitting, use the plywood cover furnished with each L-850 base receptacle to protect the surface of the machine flange of the base during installation. Replace this cover with the L-850 top fitting after the base is in its final position. No plywood cover is furnished with the L-843 fixture; therefore, exercise care when installing the L-843 base.

3 Orientate the base and arrange the fixtures' lead wires properly with respect to their splicing position in the wireway. Use temporary plugs, if required, for blocking the wireway entrance into the drilled hole. The plugs will retain the sealer during the setting of the receptacle. The orientation tolerance for the base is one degree from a line parallel with the runway centerline.

4 Cover the bottom of the base receptacle with a paste type sealer material. Place a sufficient quantity of paste material in the drilled hole to assure a bond between the bottom of the base receptacle and the drilled hole. Place the base in the drilled hole to force sealer material up the sides of the base at least 1/8 of an inch. Use a liquid sealer (Paragraph 5o) to fill the remainder of the space between the sides of the base and the drilled hole. See Figure 12 for typical details on placement of sealers.

5 Use a jig to hold and position the receptacle. Install the L-850 receptacle at the position shown in Figure 12. Install the L-843 receptacle to permit the top fitting to be at the proper elevation with respect to the finished pavement. Leave the jig in place until the sealer reaches its initial set. If any voids are present around the receptacle after the initial set, fill them and remove all excess sealer from the cover of the base receptacle and pavement.

6 The recess for the L-850 Type II base requires special treatment. Drill a hole in the pavement not less than 12-1/2 inches in diameter. Where runway base and/or subbase is encountered below the drilled portion of the pavement, excavate the hole to a minimum of 3 inches below the level where the bottom of the installed light base will be located. Use high, early strength cement conforming to AC 150/5370-1A, Item P-501, to backfill to a level not less than 1/4 of an inch below the bottom of the light base. The clearance for sealer material between the sides of the receptacle and drilled recess should be at least 1/4 of an inch.

7 Remove the plywood cover, clean and dry the base receptacle after the sealer has cured, and install the top fitting in accordance with the manufacturer's instructions. Exercise care to properly seal all gaskets. Tighten all screws, bolts, or other securing hardware with a torque screwdriver or wrench to the manufacturer's recommended torque.

(c) Wireways. Prior to the installation of the wires in the pavement, chamfer or round to 2-inch radius vertical edges of the wireways at intersections, as required. Sandblast and clean wireways to ensure proper bond between pavement material and the sealer. If wireways have been wet-sawed, flush these wireways with a high velocity stream of water immediately after sawing. Prior to installation of the sealer, blow out the wireways with high velocity air jet or wipe dry.

(d) Wires. Place the L-846 wires in the wireways from the transformers near the runway edge to the light fixture leads. Use an adequate number of wedges, clips, or similar devices to hold the wires in place at least 1/2 of an inch below the pavement surface. Wood wedges and plugs are not acceptable. Install the top of the wedges below the pavement surface. Splice the light fixture leads to the L-846 wires. Use suitable preinsulated connectors. Make the crimped splice with a tool that requires a complete crimp before releasing. Stagger the location of the splices. Permit no splices in the single conductor wires except at each light. If the installation is made in stages, tape or seal the ends of exposed wires to prevent the entrance of moisture.

(e) Sealing. Seal the wires in rigid pavement with Item P-606 material. Apply this material as specified in AC 150/5370-1A. Seal the wires in rigid pavement in consecutive steps listed below. Follow the manufacturer's instructions for other sealing materials.

1 Pour Item P-606 liquid sealer in wireway until the surface of the wires is covered.

2 If recommended by the manufacturer, pour clean sand into the liquid sealer until a slight amount of sand shows on the surface. Use clean sand that can pass through a Number 40 sieve.

3 Fill the remainder of the wireway to pavement level with liquid sealer, but in no case above pavement level.

4 Remove any excess sealer material from pavement surface.

(2) Flexible Pavements. Install base-mounted fixtures with a duct system or inset fixtures with wireways. See Paragraph 6b for details concerning the installation of base-mounted fixtures. Follow the requirements in Paragraph 6a(1) for inset fixtures, except as modified below.

(a) Wireways - Paragraph 6a(1)(c). Unless otherwise specified, do not flush wireways in flexible pavement. Sandblast and clean (blown forced air is acceptable) wireways before sealing wires.

(b) Sealings - Paragraph 6a(1)(e). Use materials specified in Paragraph 5 o that are compatible with flexible pavements.

(c) Junction Boxes. On runways where future overlays are anticipated, install junction boxes as shown in Figure 13. When additional pavement is required, place the overlay directly over the junction box. Expose this junction box cover by coring out the overlay. Remove the cover on the junction box and retrieve the wires. Replace the cover on the junction box and add pavement to fill the cored hole. Make a new junction box installation at a different location to facilitate future overlays.

b. Runway Centerline and Touchdown Zone - New Rigid and Flexible Pavements and Existing Flexible Pavements. Install base-mounted fixtures with a duct system. As an alternate, use an inset fixture installation. See details listed below for the base-mounted fixtures. See Paragraphs 6a(1) and 6a(2), respectively, for the alternate inset installations in rigid and flexible pavements.

(1) Base-Mounted Light Fixtures.

(a) Concrete Encasement Areas. Install the base-mounted fixtures in encasement areas to obtain proper alignment.

1 In rigid pavements, make the encasement areas' leave-outs in the paving operation. See Figure 10 for a typical touchdown zone leave-out. Make centerline leave-outs 3 feet by 2-1/2 feet. Place centerline leave-outs at the location shown in the plans.

2 In flexible pavements, provide excavations for the encasement areas after the runway has been paved. Make the touchdown zone excavated area a minimum of 14 feet by 3 feet. Make the centerline excavated area 3 feet by 3 feet minimum. Provide this size to accommodate the base plus concrete. Exercise care to remove all material disturbed by excavation.

3 Provide the excavated openings and/or leave-outs for the installation of light bases, flexible conduit, and light fixtures. Make the top of the concrete encasement in the excavated opening or leave-out flush with the pavement. Extend the concrete approximately 4-1/2 inches below the light base.

4 Use concrete that conforms to AC 150/5370-1A, Item P-501, to fill the encasement areas.

(b) Base and Transformer Housing.

1 Excavate fill material within the pavement encasement area to a depth of approximately 4-1/2 inches greater than the depth of the base. Support the base in the leave-out or excavated area in a position where the top of the base flange is at the proper distance below the finished pavement at the lowest point. Connect the bases together with a 2-inch flexible conduit. In addition, install a 2-inch flexible conduit from the

outermost base to the edge of the concrete encasement. Make this flexible conduit slope downward to permit system drainage. Connect the flexible conduit to the rigid conduit installed under the pavement as shown in Figure 10.

2 Exercise care to support the bases when placing the concrete around them to assure that the proper alignment and elevation of the equipment will be maintained. Accomplish this with an anchorage system or jig.

3 Install all bases so that the top fitting of the light fixture will be at the proper elevation with respect to the finished pavement.

(c) Light Fixtures. Use light fixtures that meet the requirements of Paragraph 5b.

(d) Alignment. Align and orient adjustable fixtures in accordance with the manufacturer's instructions. Make final adjustments at night and to the satisfaction of the engineer in charge.

(2) Primary Cables. Install primary cables in accordance with AC 150/5370-1A, Item L-108.

c. Vault.

(1) Install the airport vault and equipment in accordance with AC 150/5370-1A, Item L-109.

(2) Exercise care during installations in the vault to prevent drill deposits, iron filings, insulation stripping, or other foreign matter deposits from collecting on relays, switches, and other operating components. Collect and remove all residue as the installation progresses. Use covers or shields during installation and wiring to protect components from foreign matter.

7. Inspection and Test.

a. Systems. The inspection and testing of runway centerline and touchdown zone lighting systems during construction are important. Many components of certain systems may not be accessible for corrective action after the final installation.

(1) Inspect the installed light unit to determine if the equipment has been installed in accordance with the manufacturer's instructions and at the proper elevation.

(2) Check the alignment of all units to determine if all lighting fixtures have been installed in accordance with design and installation requirements.

(3) Check the fixtures and bases to determine if the securing hardware has been tightened in accordance with the manufacturer's instructions.

(4) Visually inspect the lighting fixtures to determine if the lenses and channels in front of the lenses are clean.

(5) Test vault equipment and primary circuits as specified in AC 150/5370-1A, Item L-109 and L-108, respectively.

b. Inset Lights. Perform the inspection and test for these lights concurrently with the installation because of subsequent inaccessibility of some components. Before filling wireways, identify and test the secondary series circuit for each subsector of runway for continuity and insulation resistance to ground. Check the insulation resistance with a 500-volt (minimum) megohm meter (megger). An acceptable circuit has a resistance of at least 50 megohms. After fixtures and wires are installed, perform a visual inspection of the sealer in the wireways and around the fixtures to determine if all voids are filled and that the sealer is at the proper level with respect to the runway surface. After these tests have been performed and the lighting circuits are completed, test the system by continuous operation for a period of not less than one-half hour prior to acceptance. The tests include the operation of each control not less than 10 times.

c. Base-Mounted Lights. Perform inspections and tests for this installation in accordance with Paragraph 7a. Operate the system not less than one-half hour prior to acceptance. The tests include the operating of each control not less than 10 times.

8. MAINTENANCE.

a. General. Establish a maintenance program at airports where centerline and touchdown zone lights are installed 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.

(1) Perform a daily operational check of all lighting fixtures. Energize the runway centerline and touchdown zone lights and visually inspect the light output. If any lamps are out or fixtures are obscured with rubber deposits, record the location of the fixtures and replace the lamps or top fittings containing optical lenses. Replace lamps when the circuit is deactivated.

(2) Clean the lighting fixtures regularly so that the system can meet performance requirements for low visibility conditions. Clean the lens and channel in front of the lens periodically in accordance with manufacturer's recommendations. The regularity and type of cleaning will be dictated by the weather conditions and the location of the fixtures.

(3) Exercise extra care not to strike lighting fixtures with snowplow blades. After snow removal operations, inspect all lighting fixtures to locate and replace, if necessary, any damaged light assemblies. Make passes over the lights with a power broom only if practical. Whenever snowplows must traverse in-pavement light fixtures, they should be either traveling at less than 5 miles per hour or have the blades lifted clear of the fixtures. See recommended snow removal techniques in AC 150/5380-2A.

b. Lamps.

(1) Group Replacement. Keep a record of the number of hours the lamps are burned at top brightness. Replace the lamps when the operation hours equal the rated life of the lamp (500 hours unless otherwise specified).

(2) Relamping. Turn off the electrical energy to the primary circuit supplying the fixture containing the burned-out lamp and remove the top assembly. Replace the gaskets if they appear to be worn or damaged. Before the top assembly is replaced, clean and dry the unit. Exercise care to properly place all gaskets. In addition, tighten all screws, bolts, or other securing hardware with a torque wrench or screwdriver in accordance with manufacturer's recommended torque. (If fixtures are not properly secured, they might be damaged by normal aircraft operations.)

c. Removal of Water. The runway centerline and touchdown zone lights are designed to exclude both ground and surface water from entering. For varying reasons, water sometimes enters and becomes a serious problem, particularly where temperatures below freezing are encountered. If the bases or receptacles are allowed to fill with water, freezing may cause damage to the fixture by shearing the top assembly holddown hardware or rupturing the base or receptacle. To prevent this from occurring, establish a regular maintenance schedule to inspect each fixture for the presence of water, especially during the fall and winter months. Establish a regular schedule for tightening cover holddown bolts. If any of the fixtures contain water, remove this water and clean and dry the receptacle, lamp, and electrical contacts. Properly place all gaskets and tighten the hardware, securing the top assembly with a torque wrench or screwdriver in accordance with the manufacturer's recommended torque.

d. Cable. Check homeruns of cables with a 500-volt (minimum) megohm meter (megger) after the installation has been accepted. Make records of the megohm resistance values obtained. In order to check the condition of the system, compare monthly megger readings with the initial values. In an acceptable system, the initial megohm resistance values are not less than 50 megohms and usually as high as 200 megohms. If the monthly megger checks reveal progressive deterioration or faults, take corrective steps promptly. The most common faults in series underground cables are open circuits or grounded circuits.

(1) Make monthly megger checks by first de-energizing the regulator. Disconnect the series cable leads at the regulator. Connect one lead of the megger to either end of the series cable and the other lead of the megger to a proven ground. Operate the test equipment in accordance with instrument instructions.

(2) In view of the fact that high open-circuit voltages may be obtained by opening the primary of a series lighting circuit, only authorized personnel should be allowed to troubleshoot. A series circuit connected across a 50KW, 20.0 ampere regulator may have an open-circuit voltage as high as 3,500 volts. A regulator with a higher KW capacity will have a greater open-circuit voltage. Troubleshooting centerline and touchdown zone lighting circuits is complicated by the fact that in some instances the interconnecting wires are sealed in the runway pavements and the fixtures are located in an active part of the runway. For this reason, it is important to check the system during the installation and to establish an effective preventive maintenance program.

e. Spare Parts. Stock spare lamps, top fittings, and other replaceable components of the fixtures and replaceable components of the regulators, and other items that can be used for maintenance purposes.

f. Vault. Keep the vault (AC 150/5370-1A, Item L-109) uncluttered to prevent dirt from accumulating in control compartments and to allow equipment to be accessible at all times. Mount legible warning signs in conspicuous locations.

APPENDIX 1. BIBLIOGRAPHY

1. Obtain copies of the following publications from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

   a. AC 150/5340-19, Taxiway Centerline Lighting System.

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

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

   d. AC 150/5345-10B, Specification for L-828 Constant Current Regulator With Stepless Brightness Control.

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

   f. AC 150/5345-16, Specification for L-843 Airport In-Runway Touchdown Zone Light.

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

   h. AC 150/5345-30A, Specification for L-846 Electrical Wire for Lighting Circuits to be Installed in Airport Pavements.

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

   j. 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.

   k. AC 150/5345-37B, FAA Specification L-850, Light Assembly, Airport Runway Centerline and Touchdown Zone.

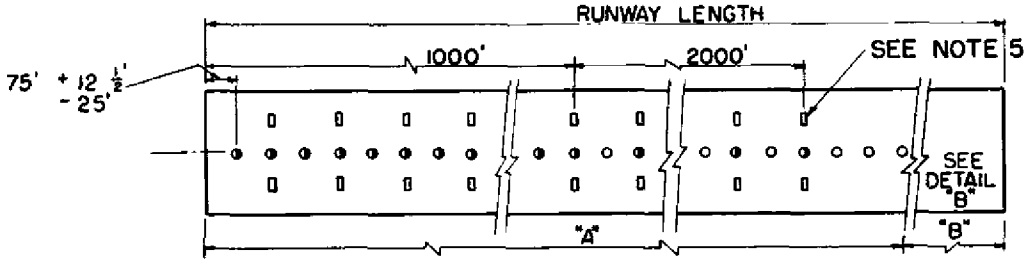
   l. AC 150/5380-2A, Snow Removal Techniques Where In-Pavement Lighting Systems are Installed.

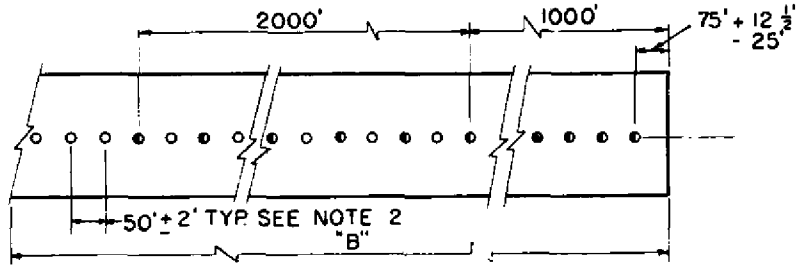
2. Obtain copies of AC 150/5370-1A, Standard Specifications for Construction of Airports, from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Send check or money order with your request made payable to the Superintendent of Documents in the amount of $3.50 for 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 U.S. Department of Agriculture, Rural Electrification Administration, Information Services Division, Washington, D.C. 20250.

4. Obtain copies of Military Specification MIL-T-27535 (ASG), Transformer, Power, Isolation: Series Circuit, Airport Lighting General Specification For, from Commanding Officer, Naval Supply Depot, 5901 Tabor Avenue, Philadelphia, Pennsylvania 19120, Attention: Code CDS.

5. Obtain copies of Specification FAA-E-2373, Adhesive Compound, Two-Components for Sealing Wires in Flexible Pavements, from Federal Aviation Administration, Systems Standards Branch, RD-420, 800 Independence Avenue, S.W., Washington, D.C. 20590.





DETAIL "B"

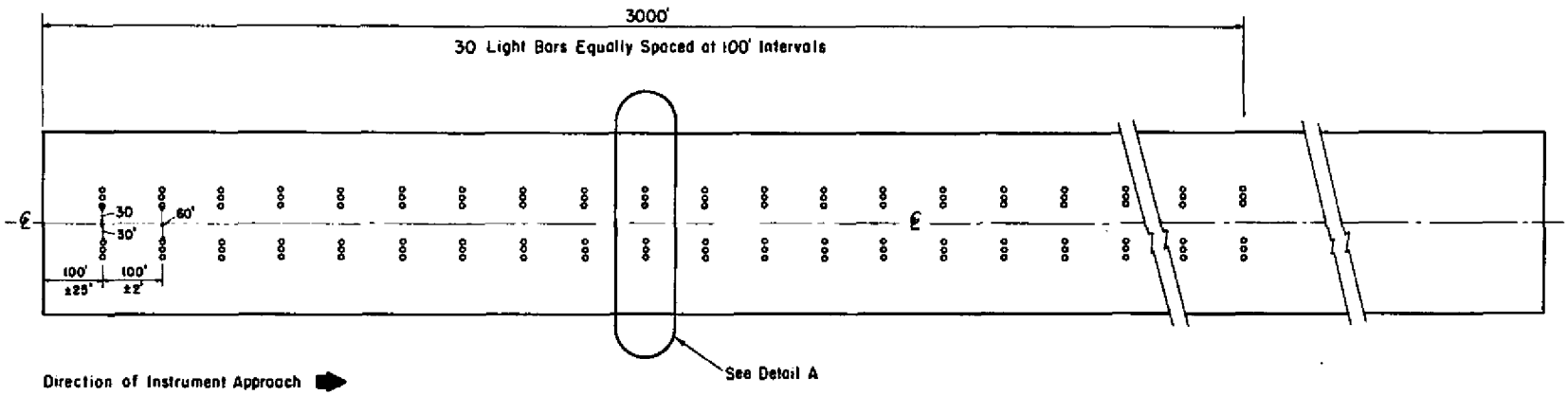
SYMBOLS

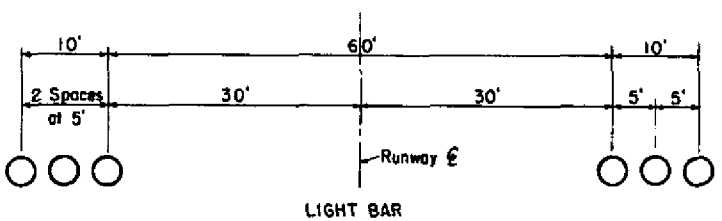
- □ — Unidirectional touchdown zone light
- ○ — Bidirectional runway centerline light white both directions
- r ◐ w — Centerline lights white (w) one direction and red (r) opposite direction.
- w ◑ r

NOTES

1. In rigid or flexible pavement all centerline lights may be offset 2' to the right or left of the runway centerline to avoid the centerline paint markings.
2. The centerline lights may have only a longitudinal tolerance of ± 2'.
3. The last 3000 - foot to 1000 - foot section of the runway centerline displays an alternate red and white light signal.
4. The last 1000 - foot section of the runway centerline displays an all red signal.
5. The touchdown zone light bar are not required to be in line with centerline lights. See figure 2 for configuration.

FIGURE 1. RUNWAY CENTERLINE LIGHTING LAYOUT





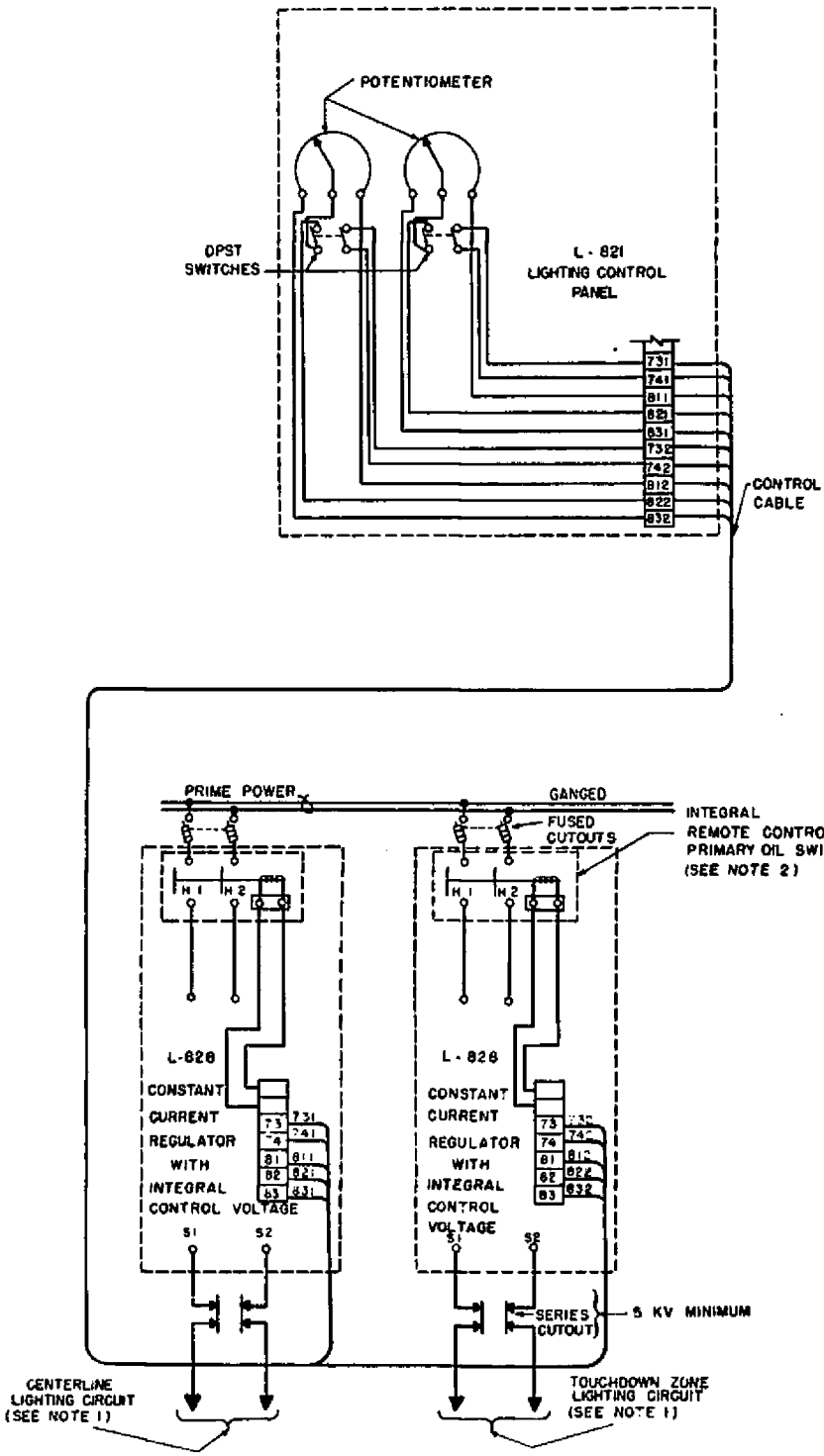
DETAIL A

NOTES:

1. THE LONGITUDINAL INSTALLATION TOLERANCE IN LOCATING THE PAIRS OF TRANSVERSE LIGHT BARS SHOULD NOT EXCEED 2 FEET.

2. THE SPACING BETWEEN THE INNERMOST TOUCHDOWN ZONE LIGHT FIXTURES SHOULD BE UNIFORM THROUGHOUT THE LENGTH OF THE SYSTEM. THIS SPACING IS 60 FEET EXCEPT WHERE CONSTRUCTION PROBLEMS PREVENT THIS SEPARATION. IN THIS CASE, THE UNIFORM SPACING IS REDUCED TO NOT LESS THAN 55 FEET.

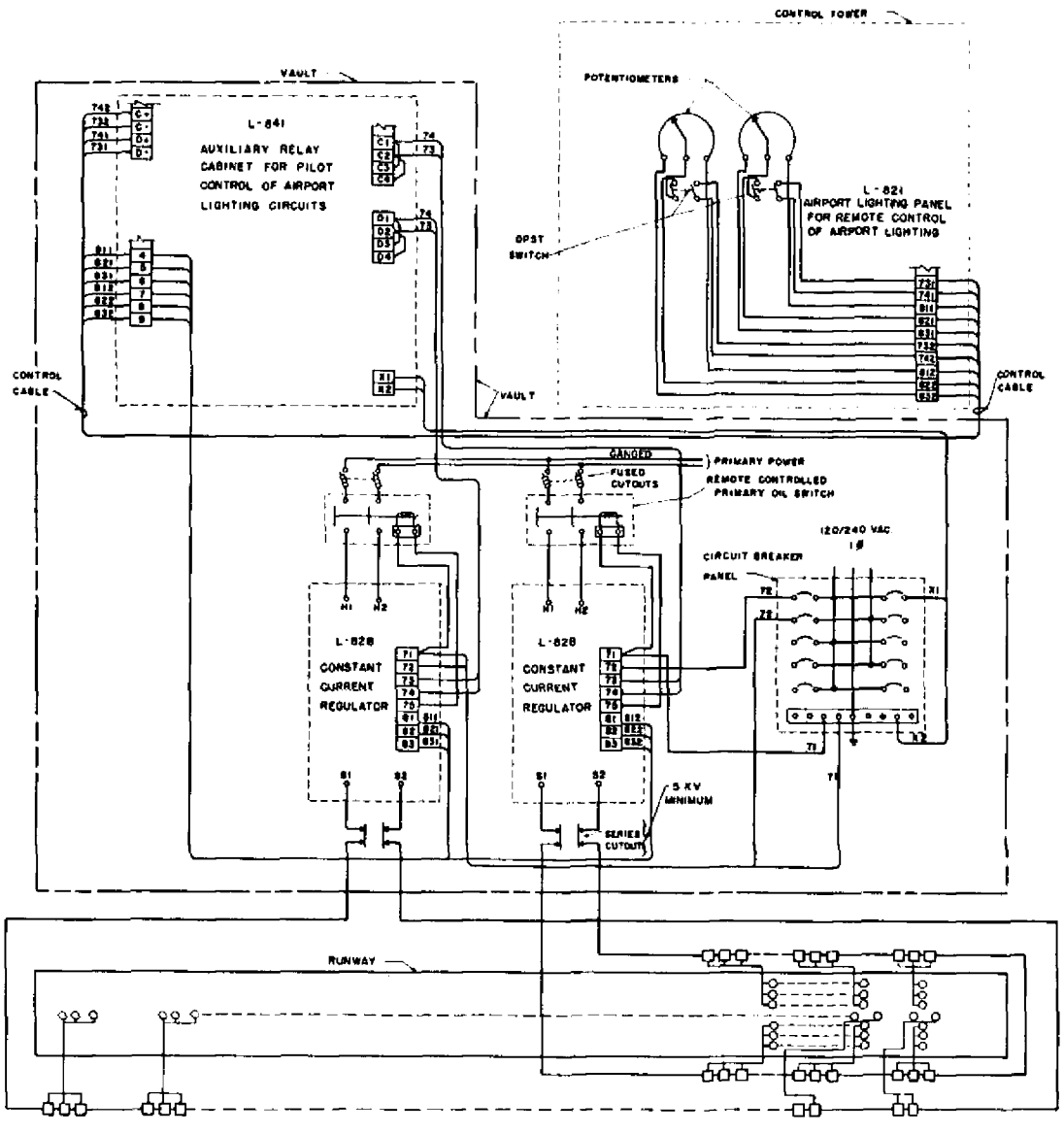
FIGURE 2. TOUCHDOWN ZONE LIGHTING LAYOUT



NOTES

1. See Figures 1 and 2 for layout and Figure 4 for applicable notes.
2. Regulators with an external remote controlled primary oil switch and control voltage are acceptable. See Figure 5.
3. This system is adequate for separations between the control panel and regulator of up to 7900 feet.

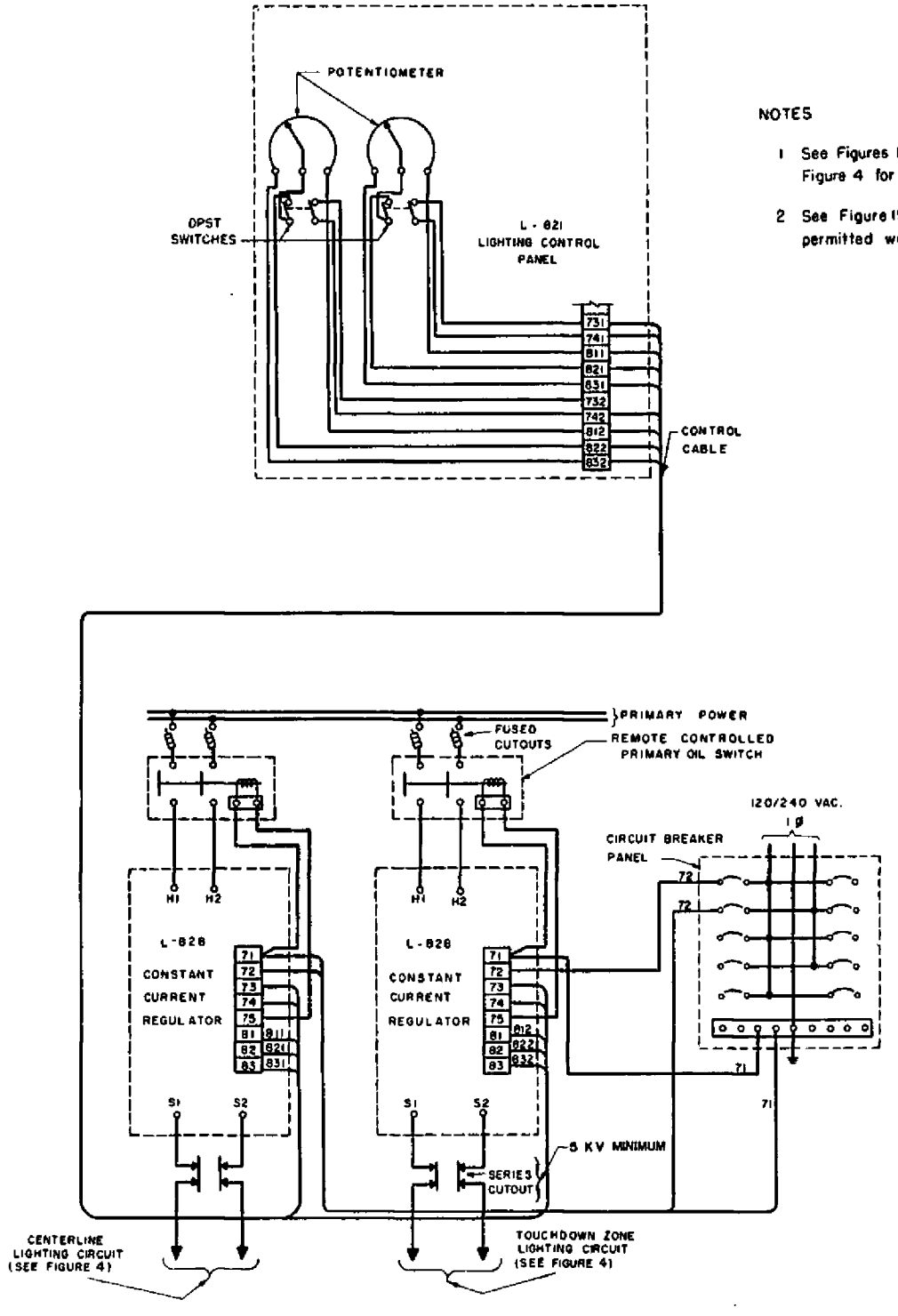
FIGURE 3. TYPICAL WIRING DIAGRAM WITH INTEGRAL CONTROL VOLTAGE



NOTES

1. The installation should conform to applicable sections of National Electrical Code and Local Codes.
2. Lightning arresters for Power and Control Lines should be installed as required.
3. Additional isolating devices should be installed as required.
4. Fuses, Circuit Breakers and Cutouts should be in accordance with equipment ratings.
5. Use solid link in fused cutout in ground circuit when wye connected.
6. The size regulators required for the runway centerline and touchdown lights can be determined from Figure 14.
7. The 48 volt DC controlled system is adequate for separations between the control panel and auxiliary relay cabinet of up to 7900 feet.

FIGURE 4. TYPICAL WIRING DIAGRAM WITH DC CONTROL VOLTAGE



NOTES

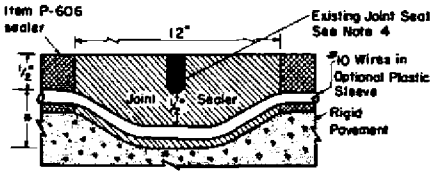
1. See Figures 1 and 2 for layout and Figure 4 for applicable notes.
2. See Figure 15 for maximum separation permitted with A C controls.

FIGURE 5. TYPICAL WIRING DIAGRAM WITH EXTERNAL AC CONTROL VOLTAGE

NOTES

Wires are not less than 1/2" below existing joint seal compound

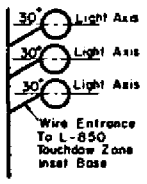
* Variable. See Sections A-A, B-B and C-C for dimensions.



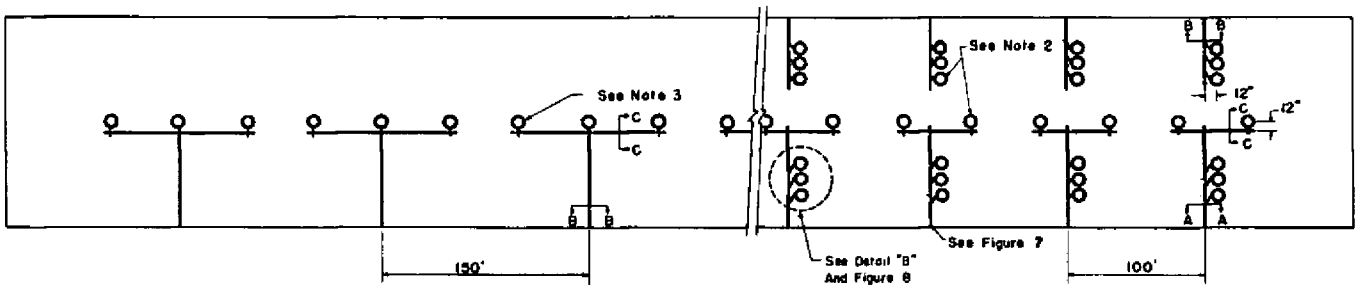
SAWING DETAIL AT
JOINT INTERSECTION
DETAIL "A"

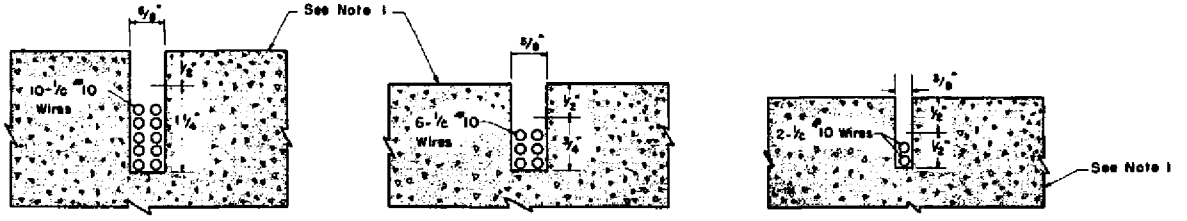
GENERAL NOTES

1. The installation details shown are for rigid or flexible pavement unless otherwise specified.
2. The diameters and depths of holes for the inset lighting fixtures are in accordance with Figures 9 and 12.
3. The alignment of drilled holes for centerline fixtures should not vary more than 1/4 inch.
4. Where saw kerfs cross joints in rigid pavement, their depth is increased as shown on plans. See Detail "A" for a typical detail at a joint intersection.



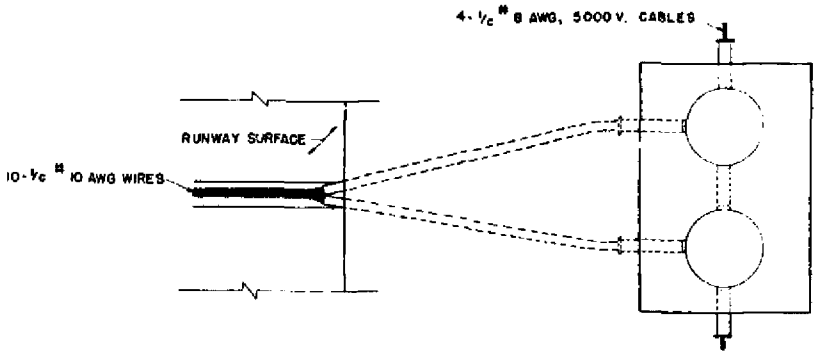
DETAIL "B"



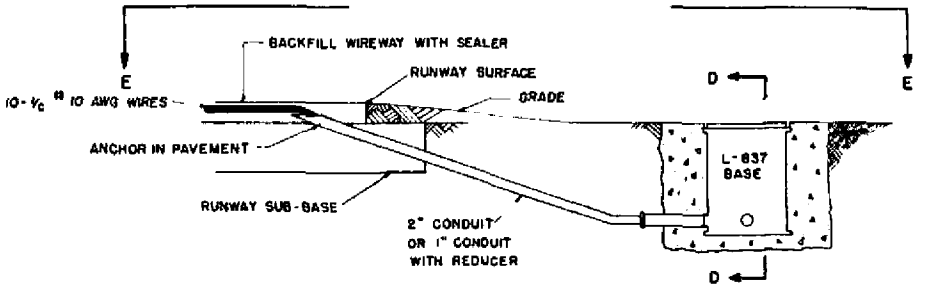


SECTION A-A
SECTION B-B
SECTION C-C

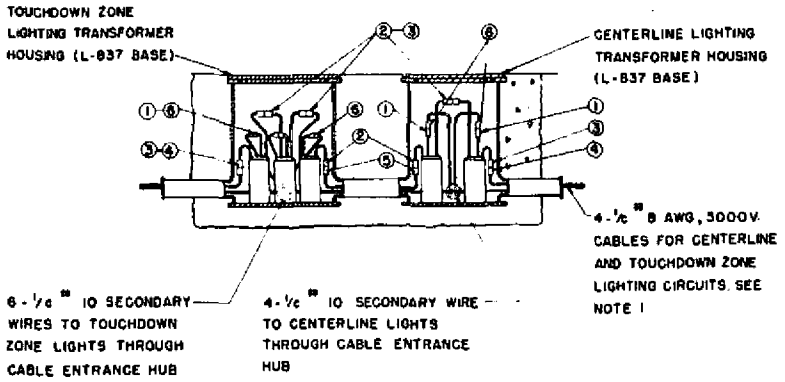
FIGURE 6. TYPICAL WIREWAY INSTALLATION DETAILS FOR TOUCHDOWN ZONE AND CENTERLINE LIGHTS



VIEW E-E



TYPICAL TRANSFORMER HOUSING INSTALLATION DETAILS



CONNECTOR	SPECIFICATION L-823 FIGURE NUMBER
1	1c
2	6a
3	6b
4	14a
5	14b
6	15

SECTION D - D

NOTE:
The primary cables are installed in accordance with Item L-108 of Standard Specifications for Construction of Airports.

FIGURE 7. TYPICAL TRANSFORMER HOUSING INSTALLATION DETAILS FOR TOUCHDOWN ZONE AND CENTERLINE LIGHTS

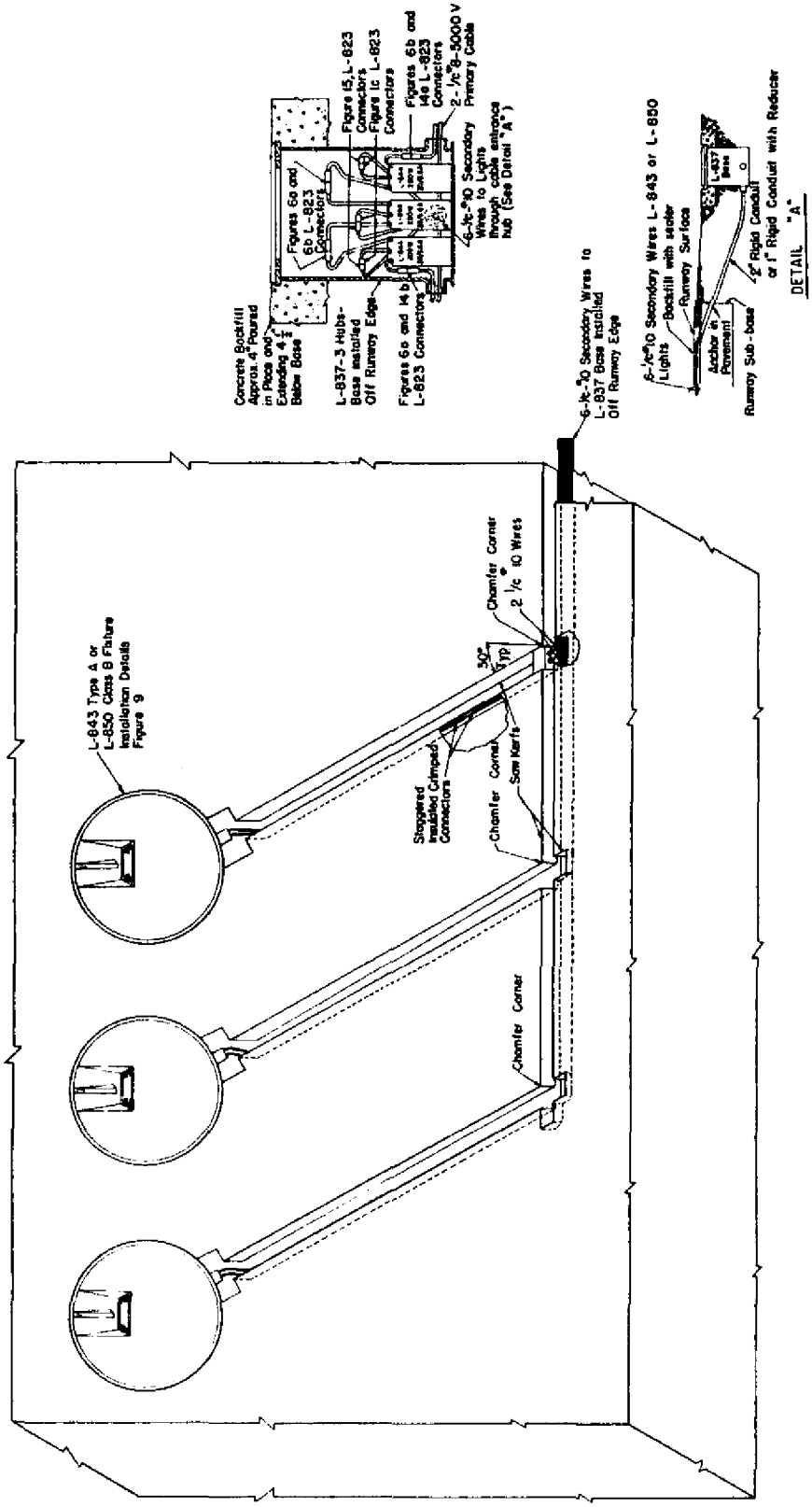
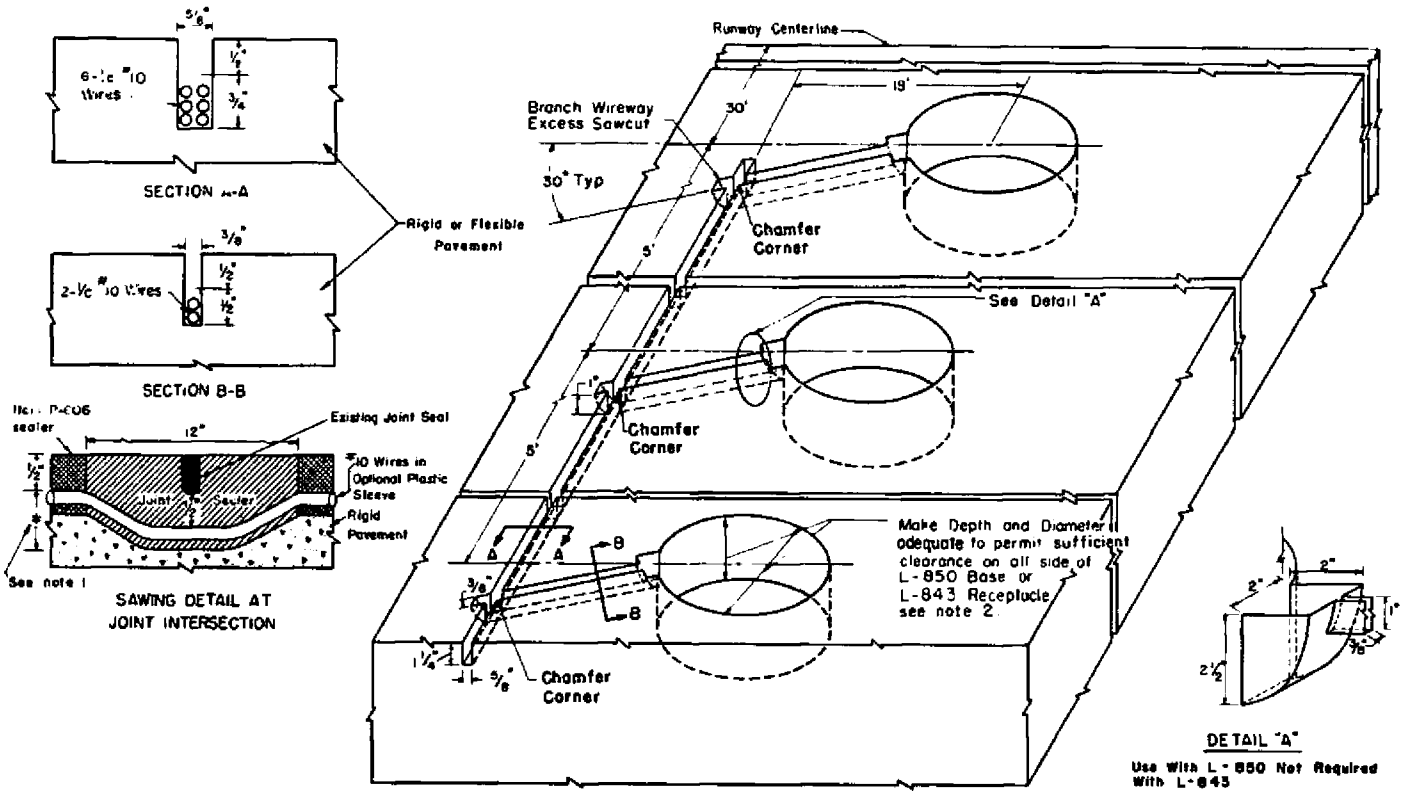


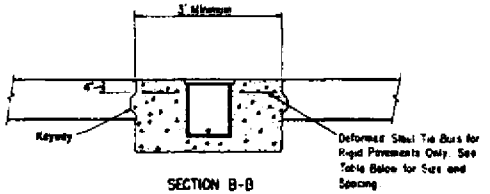
FIGURE 8. TYPICAL INSET TOUCHDOWN ZONE LIGHT EQUIPMENT LAYOUT

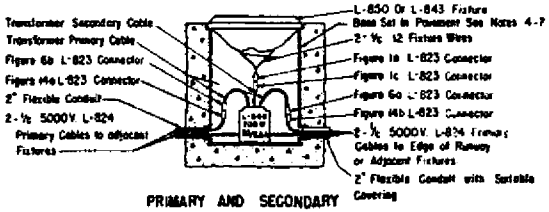


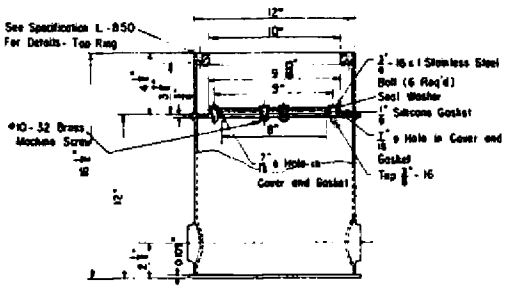
NOTES

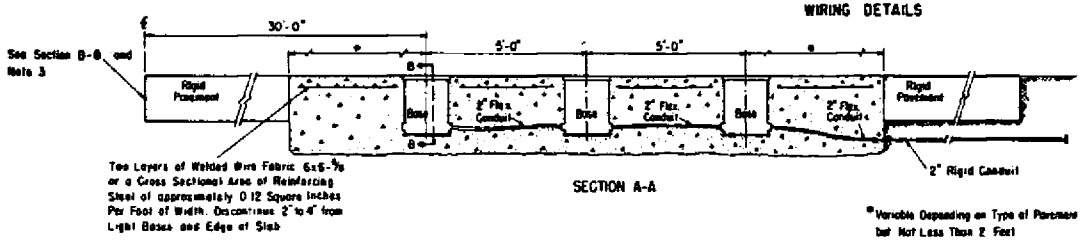
1. * Place wires not less than $\frac{1}{2}$" below existing joint seal compound, variable, see Sections A-A and B-B for dimensions.
2. The dimensions of cored hole for the L-850 fixture are: TYPE I - Depth - 4"
   - Diameter - 12 $\frac{1}{2}$"
   TYPE II - Depth - 9 $\frac{1}{4}$"
   - Diameter - 12 $\frac{1}{2}$"
3. The minimum dimensions of the cored hole for the L-843 fixture are: Depth - 3 $\frac{1}{4}$"
   Diameter - 12 $\frac{1}{2}$"

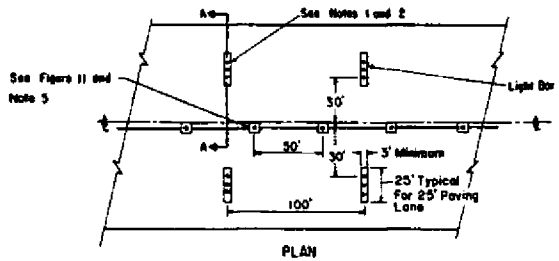
FIGURE 9. TYPICAL INSET TOUCHDOWN ZONE LIGHT INSTALLATION DETAILS









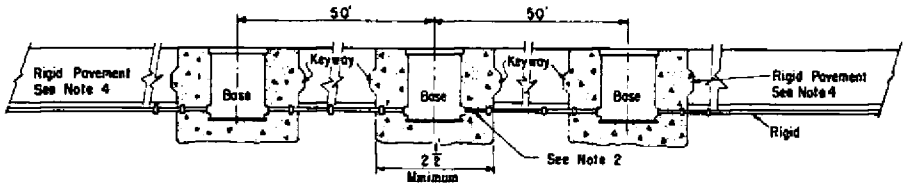


SIZE AND SPACING OF DEFORMED STEEL TIE BARS			
THICKNESS OF SLAB (INCHES)	TIE BARS		
	Bar No.	Length (in.)	Spacing (in.)
6-7	6	18	12
8-10	8	16	12
11-15	10	20	15

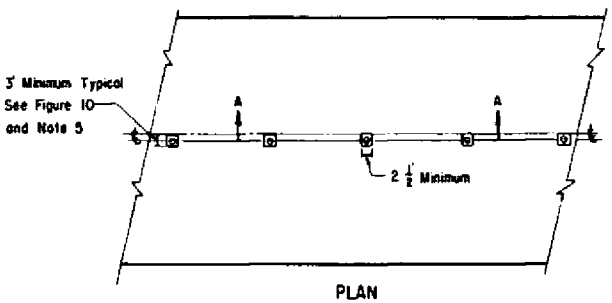
Notes

1. Make touchdown zone leave-outs for rigid pavements a minimum width of 3 feet.
2. In flexible pavements, provide encasement areas that are excavated after the runway has been paved. The excavated area for touchdown zone lights is a minimum 14 feet by 3 feet. The excavated area for centerlights is a minimum 3 feet by 2 1/2 feet.
3. Use a L-837 Base and an adapter plate with L-843, Type B Fixtures.
4. Use the base shown in Detail A for L-850 installations.
5. See Figures 1 and 2 for configurations.
6. Make leave outs in rigid pavement centerline 3 feet by 2 1/2 feet minimum.

FIGURE 10. TYPICAL DETAILS - TOUCHDOWN ZONE LIGHTING - BASE-MOUNTED - RIGID AND FLEXIBLE PAVEMENTS



SECTION A-A

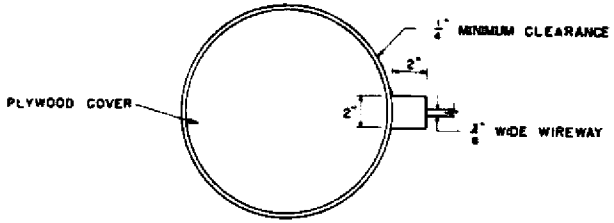


PLAN

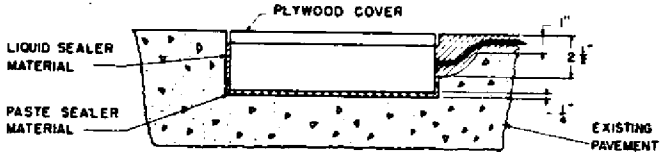
NOTES

1. See Figure 10 for notes concerning leave outs in rigid pavements and excavations in flexible pavements.
2. Use flexible conduit to facilitate the installation and orientation of the light bases.
3. Install electrical ducts in accordance with AC 150/5370-1A Item L-110.
4. In flexible pavements, eliminate keyway and make concrete encasement area a minimum 3 feet by 2½ feet.
5. Offset center of concrete encasement area a maximum of 2 feet.

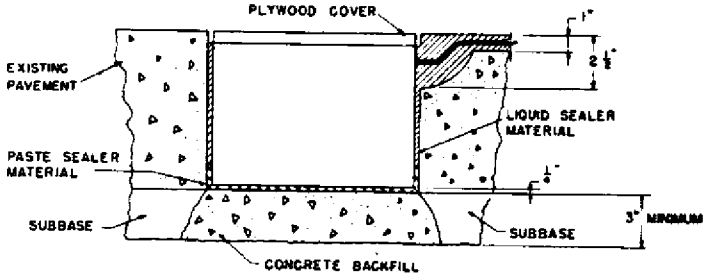
FIGURE 11. TYPICAL DUCT SYSTEM FOR BASE-MOUNTED CENTERLINE LIGHTS



TOP VIEW OF L-850 BASE
INSTALLATION TYPE I OR TYPE II



L-850 TYPE I BASE

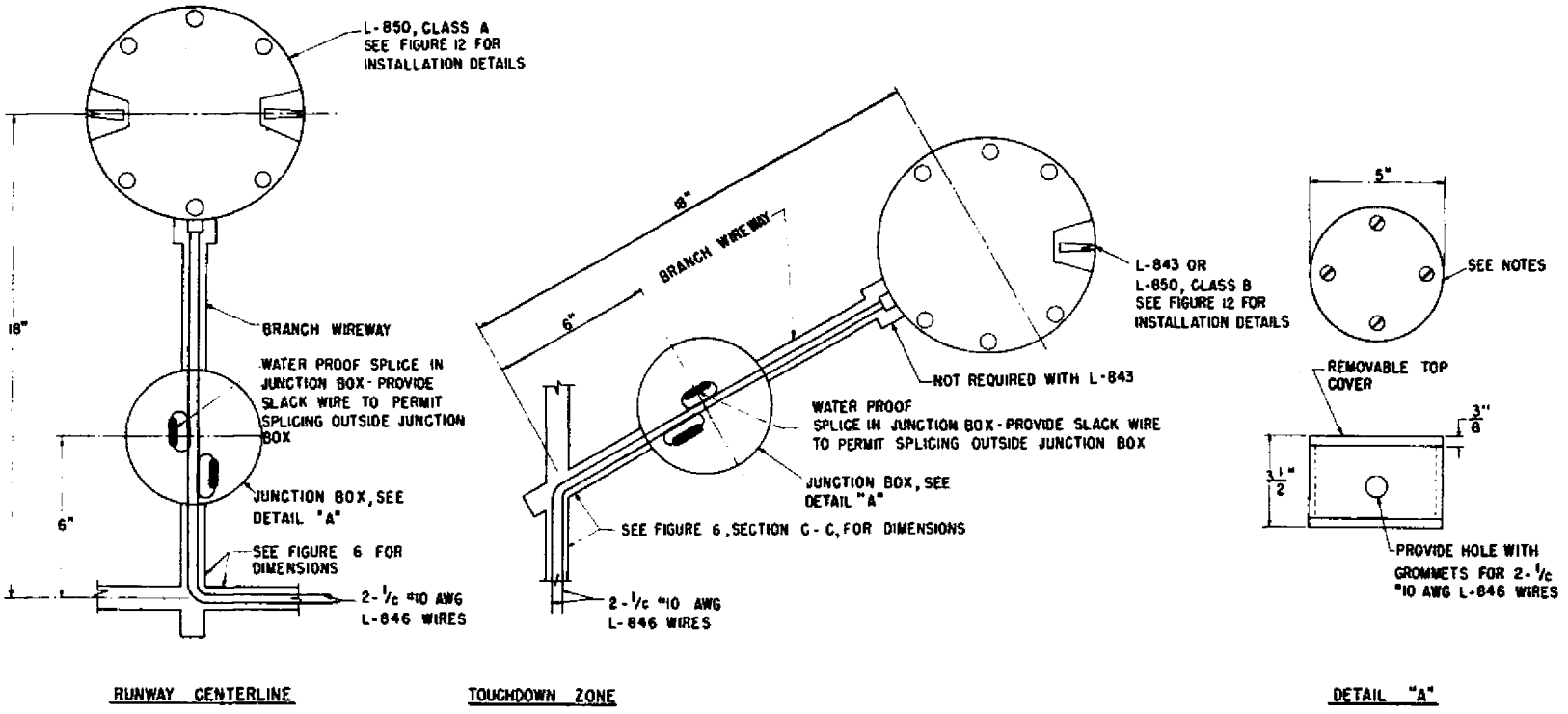


L-850 TYPE II BASE

NOTES

1. All dimensions are a minimum unless otherwise specified.
2. Sealer materials are in accordance with Item P-606.

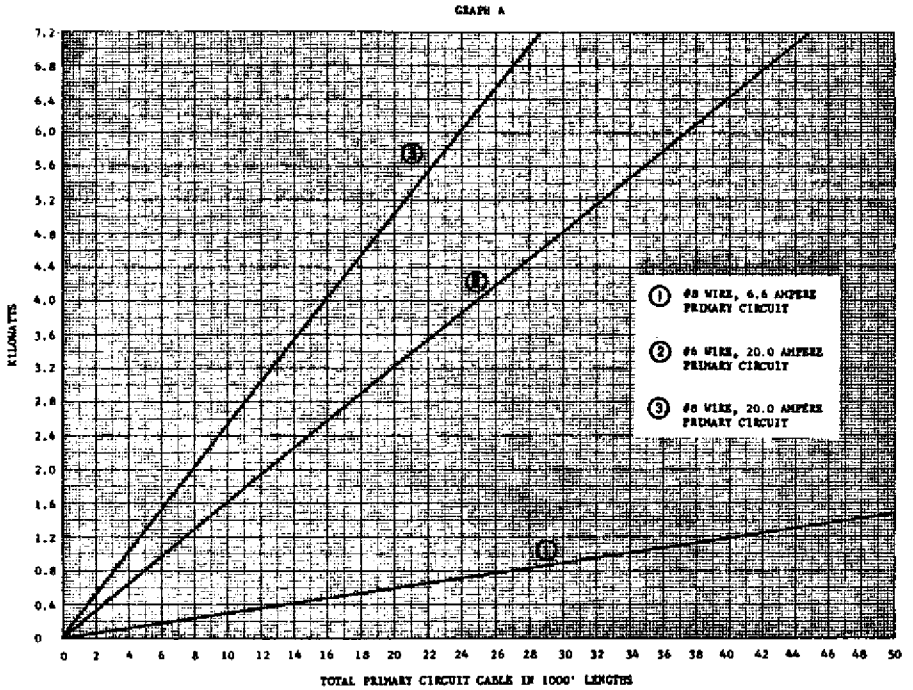
FIGURE 12. TYPICAL INSTALLATION DETAILS FOR L-850 BASE RECEPTACLE

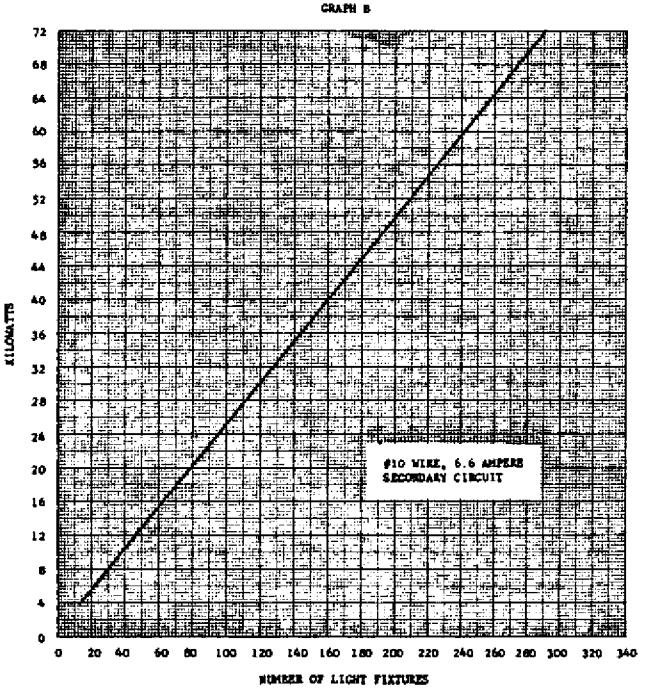


NOTES

1. Provide metal to metal contact between the top cover and the base of the junction box.
2. Fill junction box with a commercial non-setting material. This material is used to prevent water from collecting in the junction box.
3. Provide a suitable gasket and grommets to contain non-setting material in junction box.
4. Design and fabricate the junction box to meet the load requirements in specification L-850.
5. Install the junction box level with the surrounding pavements.
6. Zinc plate the box and cover to permit installation and service in pavements.

FIGURE 13. JUNCTION BOX FOR INSET FIXTURE INSTALLATIONS





HOW TO ESTIMATE TOTAL LOAD (DESIGN FOR 200-WATT LIGHT FIXTURE INSTALLATION)

1. Determine the total length of the series primary circuit. The circuit may consist of No. 6 AWG wire for feeder cables and No. 8 AWG Cable for the remainder of the circuit.
2. Determine the KW power required for the series primary cable by getting the coordinate point on the applicable "kilowatts--total primary circuit cable" line of graph A.
3. Determine the KW power required for the number of fixtures to be installed by getting the coordinate point on the "kilowatts-number of light fixtures" line of graph B.
4. Add Kilowatts Obtained from graphs A and B to determine total KW load.

FIGURE 14. LOAD CURVES FOR CENTERLINE OR TOUCHDOWN ZONE INSTALLATIONS

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.

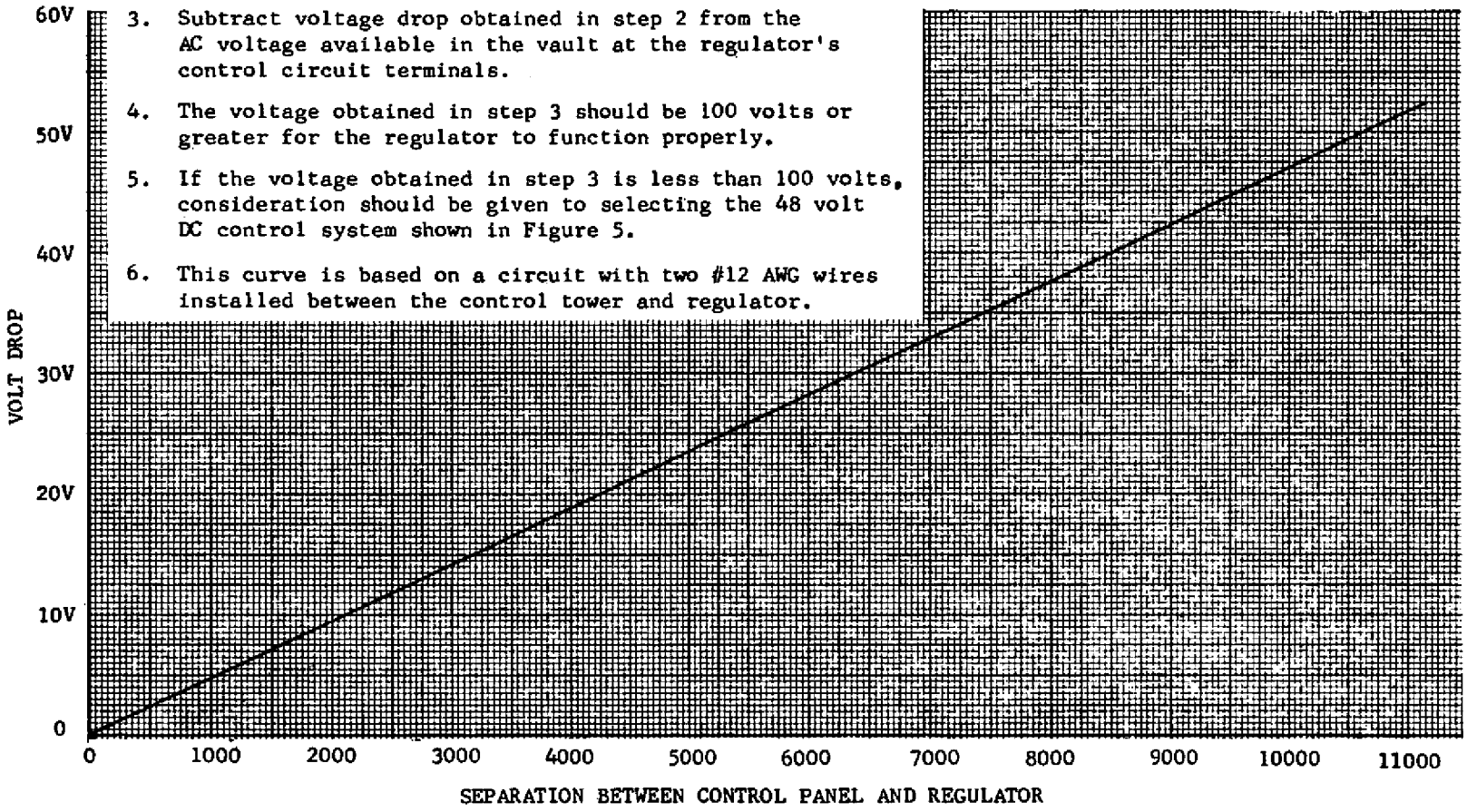


FIGURE 15. CURVES FOR ESTIMATING PHYSICAL SEPARATION BETWEEN CONTROL PANEL AND REGULATOR

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