

COPPER-WIRE, AMERICAN WIRE GAUGE B&S

B&S GAUGE NO.	OHMS PER 1 000 FEET 25 °C., 77 °F.	AREA CIRCULAR MILS	DIAMETER IN MILS AT 20 °C.	APPROXIMATE POUNDS PER 1,000 FEET (305 m)
2	0.1593	66,370	257.6	201
4	0.2523	41,740	204.3	126
6	0.4028	26,250	162.0	79
8	0.6405	16,510	128.5	50
10	1.018	10,380	101.9	31
12	1.619	6,530	80.81	20

Calculations

1. To determine the AWG size wire necessary for a specific connected load to maintain the proper voltage

for each miscellaneous lighting visual aid, use the above table and Ohms Law $I = \frac{E}{R}$ as follows:

- a. Example. What size wire will be necessary in a circuit of 120 volts AC to maintain a 2 percent voltage drop with the following connected load which is separated 500 feet from the power supply?

(1) Lighted Wind Tee Load - 30 lamps, 25 watts each = 750 watts.

(2) The total operating current for the wind tee is $I = \frac{\text{watts}}{\text{volts}} = \frac{750}{120} = 6.25 \text{ amperes}$.

(3) Permissible voltage drop for homerun wire is 120 volts x 2% = 2.4 volts.

(4) Maximum resistance of homerun wires with a separation of 500 feet (1,000 feet (305 m) of wire used) to maintain not more than 2.4 volts drop is $R = \frac{E}{I} = \frac{2.4 \text{ volts}}{6.25 \text{ amperes}} = 0.384 \text{ ohms}$ per 1,000 feet (305 m) of wire.

(5) From the above table, obtain the wire size having a resistance per 1,000 feet (305 m) of wire that does not exceed 0.384 ohms per 1,000 feet (305 m) of wire. The wire size that meets this requirement is No. 4 AWG wire with a resistance of 0.2523 ohms per 1,000 feet (305 m) of wire.

(6) By using No. 4 AWG wire in this circuit, the voltage drop is $E=IR=6.25\text{-amperes} \times 0.2523 \text{ ohms}=1.58 \text{ volts}$ which is less than the permissible voltage drop of 2.4 volts.

2. Where it has been determined that it will require an extra large size wire for homeruns to compensate for voltage drop in a 120-volt power supply, one of the following methods should be considered.

a. A 120/240-volt power supply.

b. A booster transformer, in either a 120-volt or 120/240-volt power supply, if it has been determined its use will be more economical.

Figure 68. Calculations for Determining Wire Size.

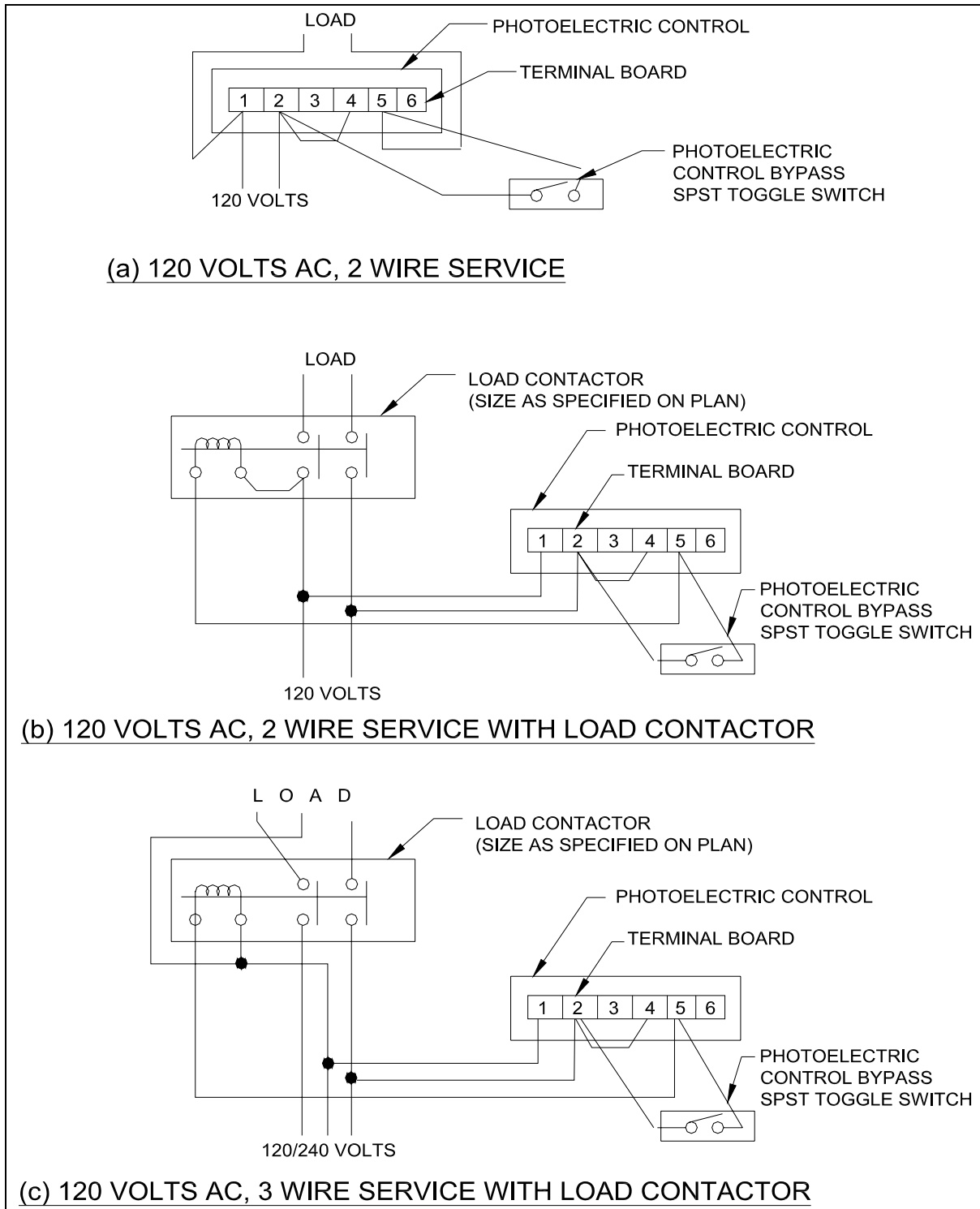


Figure 69. Typical Automatic Control.

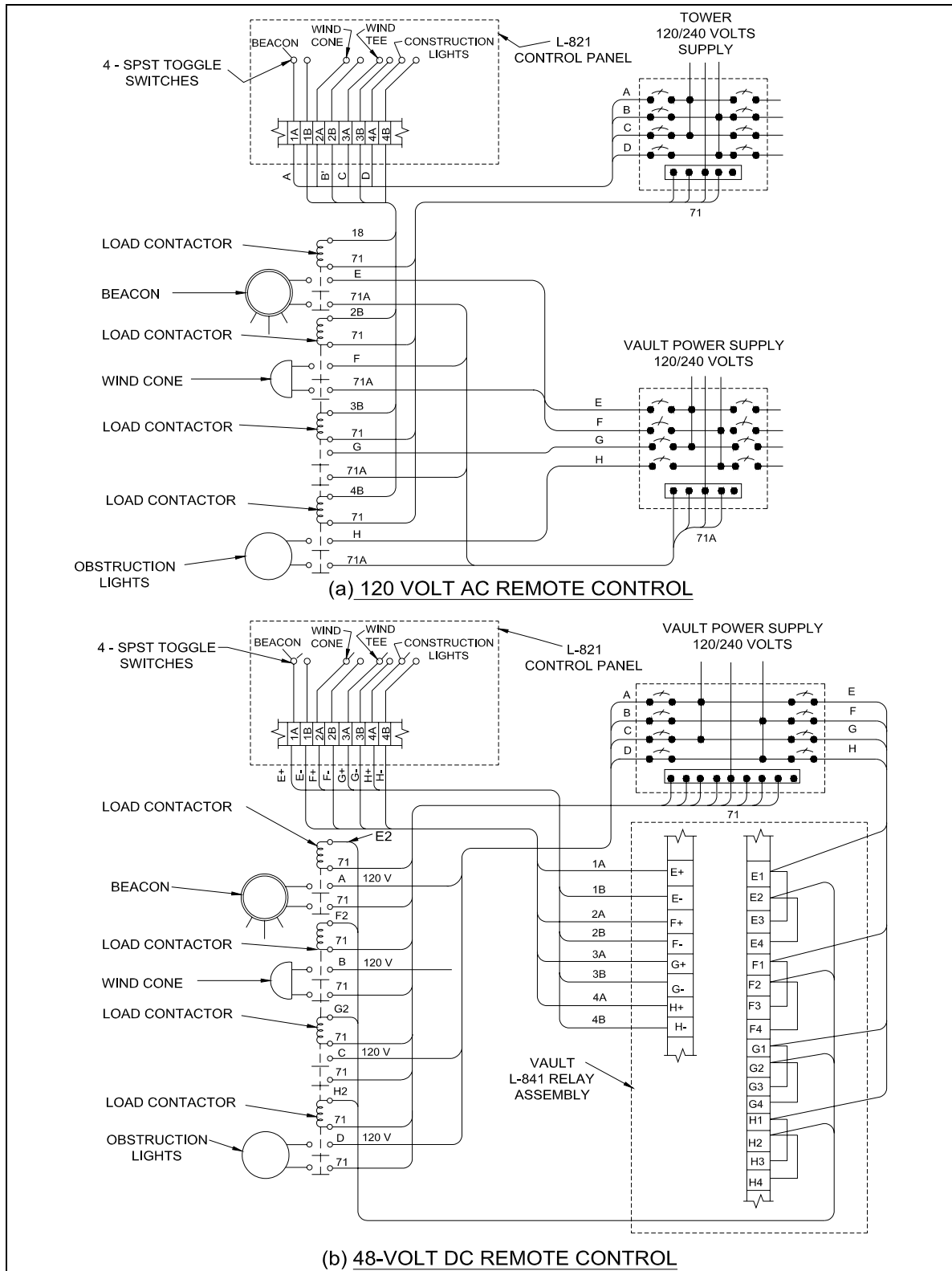


Figure 70. 120-Volt AC and 48-Volt DC Remote Control.

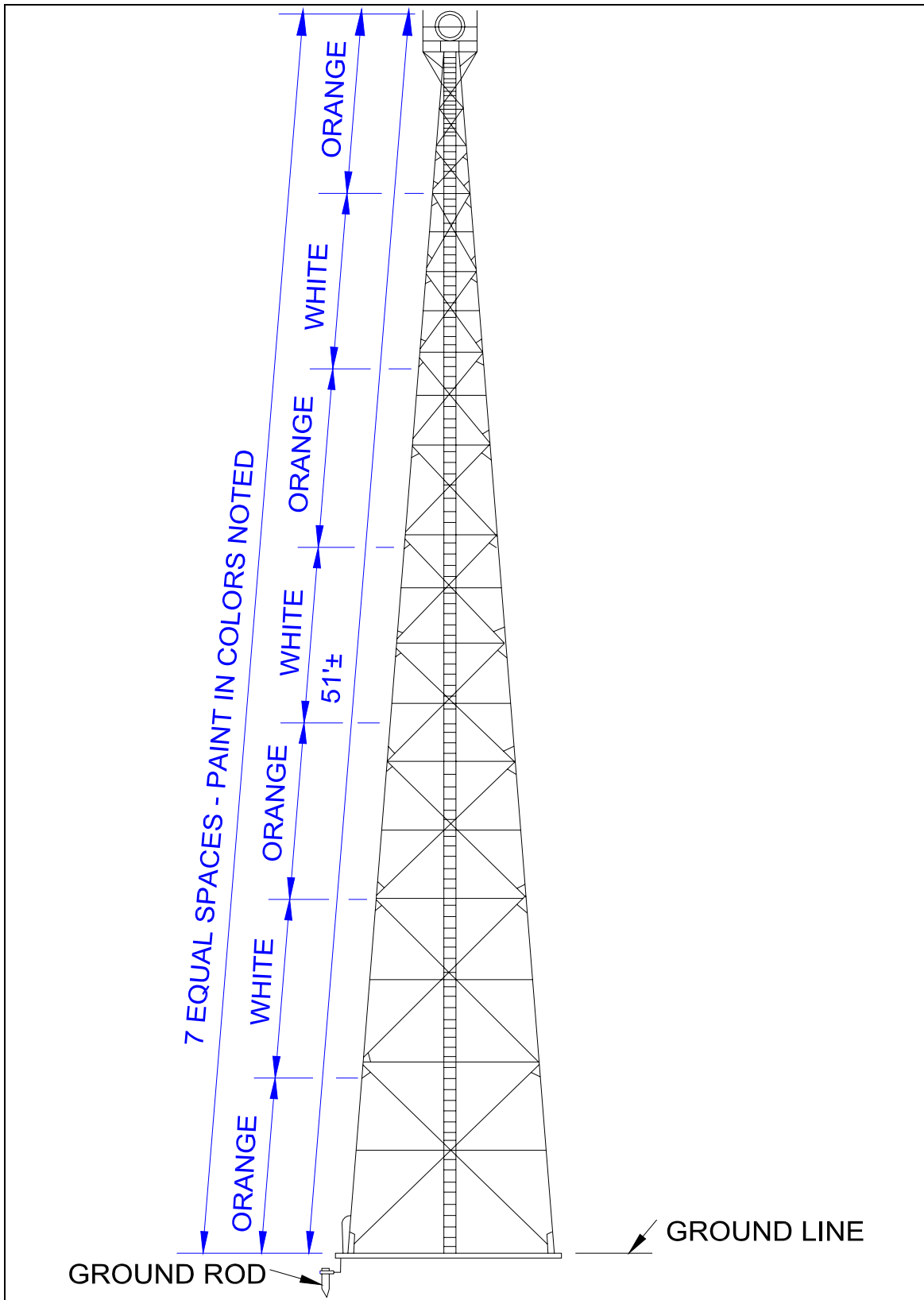


Figure 71. Typical Structural Beacon Tower.

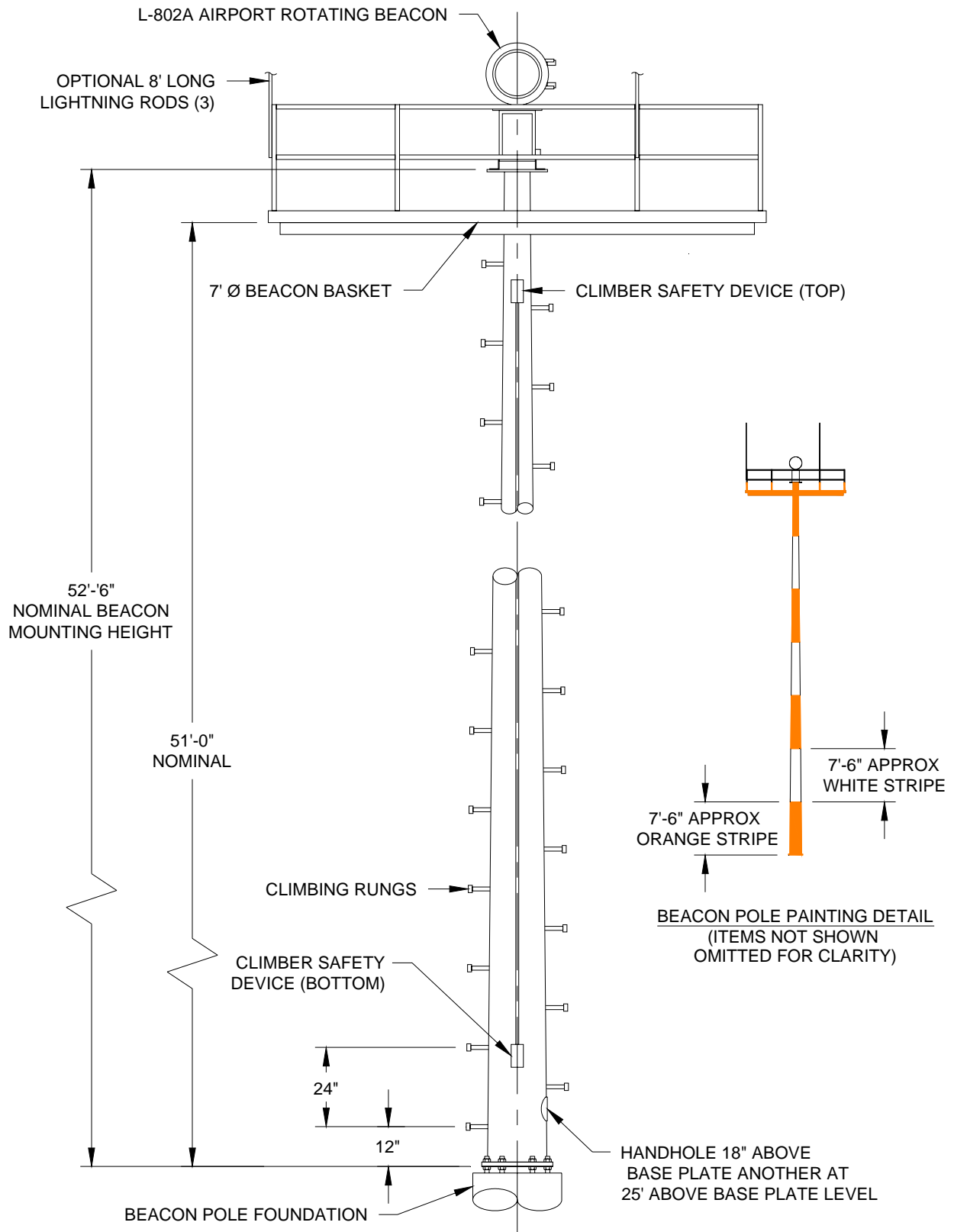


Figure 72. Typical Tubular Steel Beacon Tower.

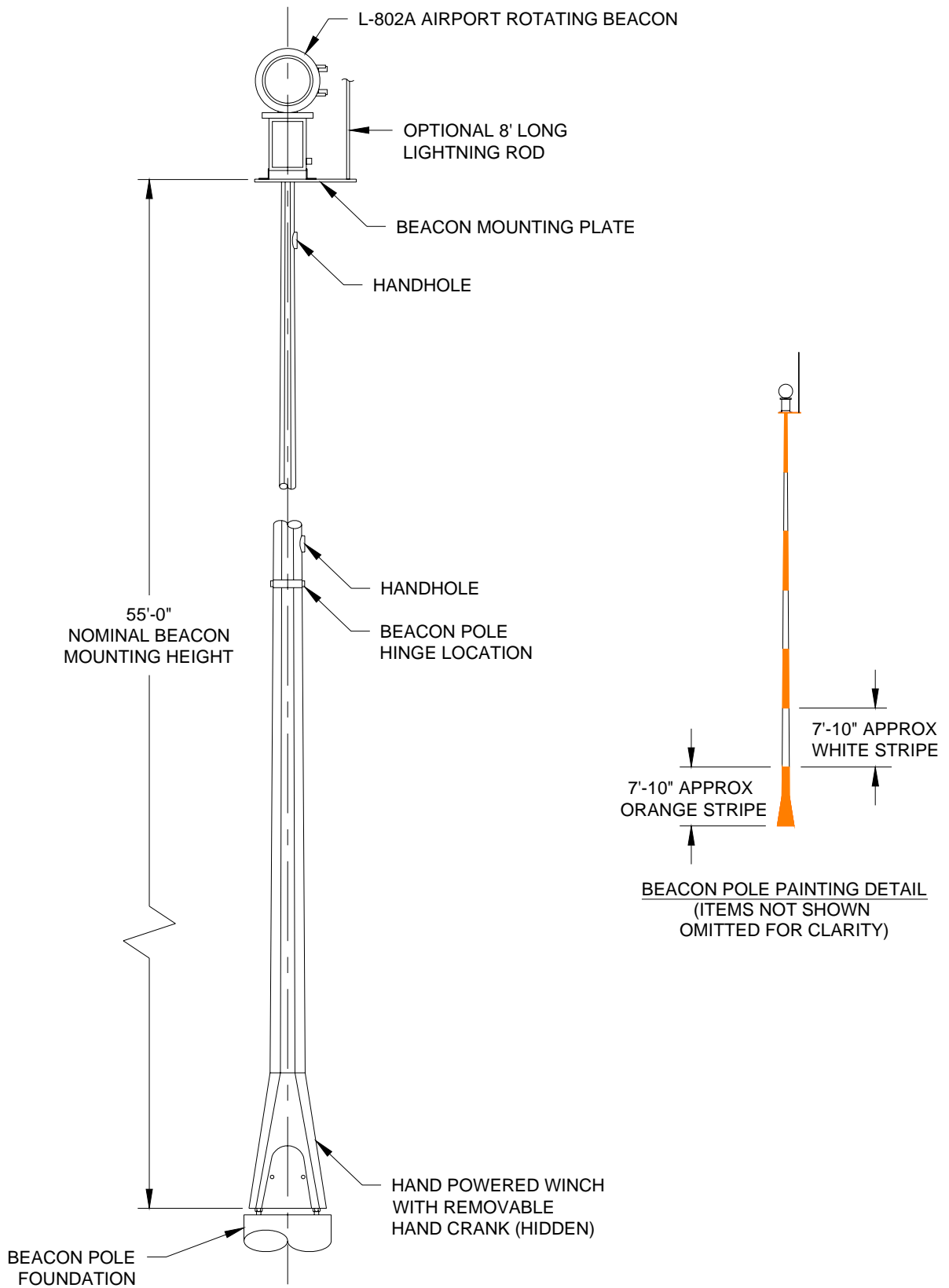


Figure 72a. Typical Airport Beacon Tip-Down Pole

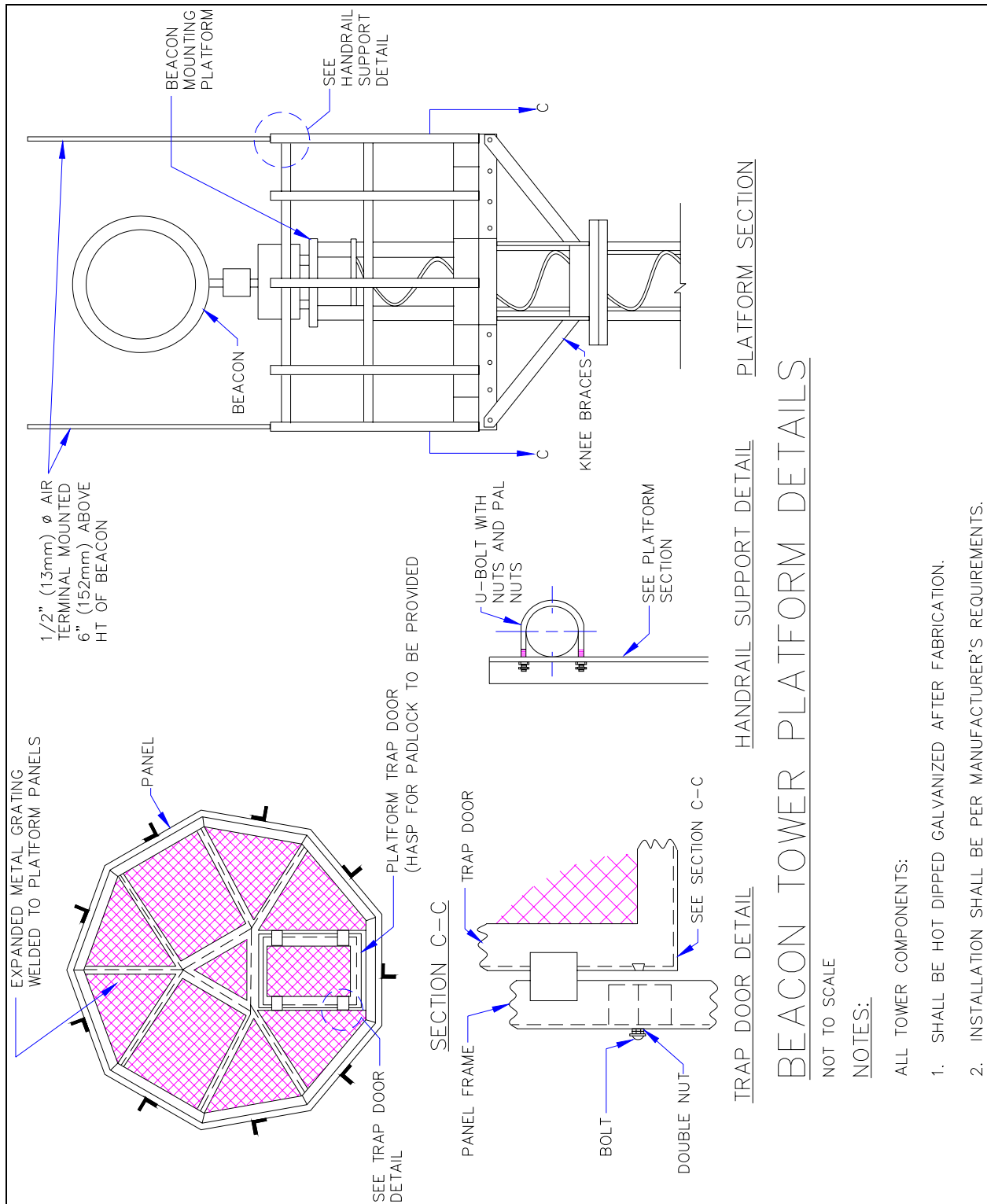
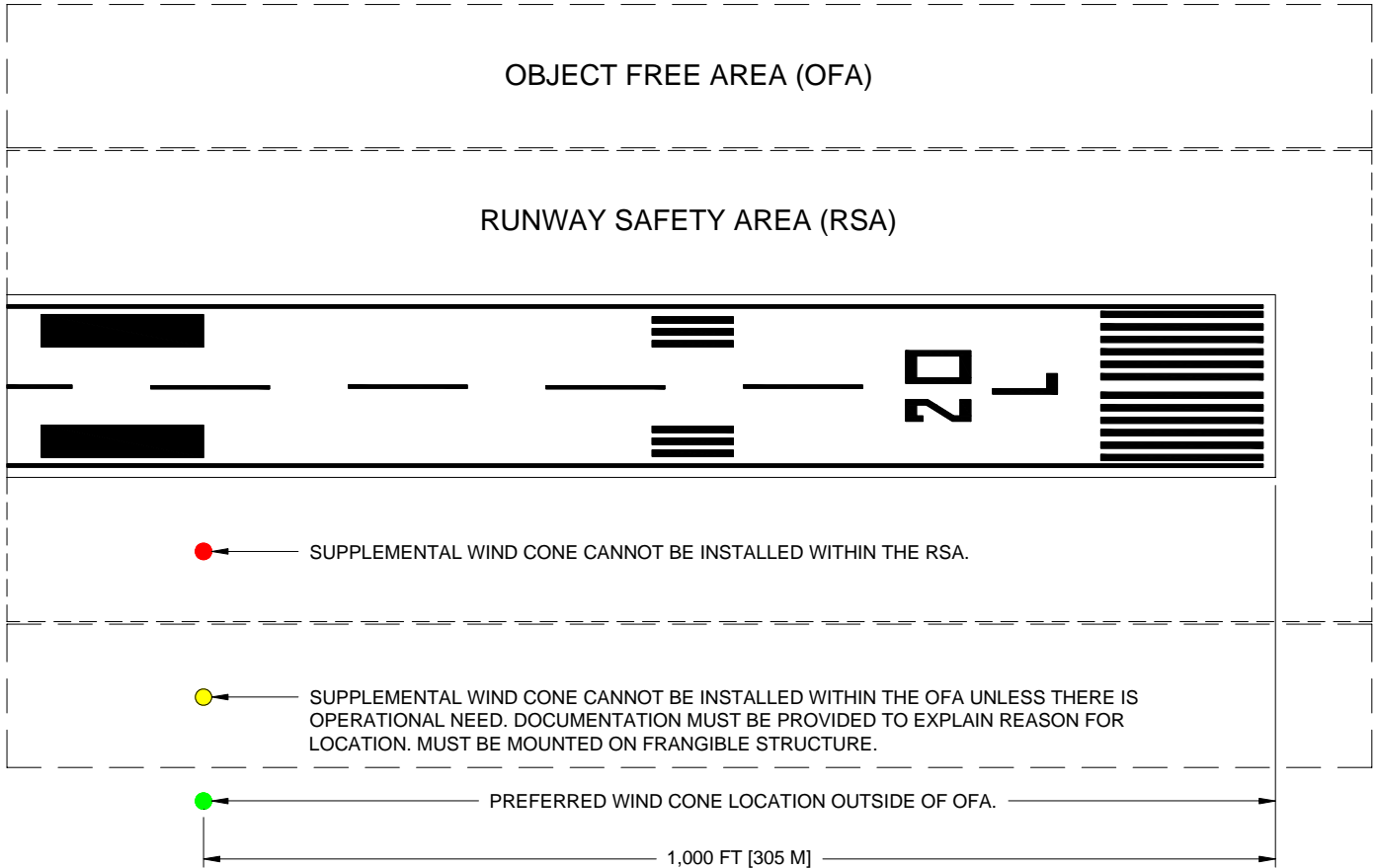


Figure 73. Typical Pre-fabricated Beacon Tower Structure.



NOTES:

1. THE PREFERRED LOCATION FOR THE SUPPLEMENTAL WIND CONE LOCATION IS BETWEEN 0 AND 1,000 FT FROM THE RUNWAY END.
2. SEE AC 150/5300-13 FOR DETAILED INFORMATION ABOUT THE LENGTH AND WIDTH OF THE RSA AND OFA - DIMENSIONS OF BOTH AREAS ARE DEPENDENT UPON THE AIRPLANE DESIGN GROUP AND AIRCRAFT APPROACH CATEGORY.
3. THE OBSTACLE FREE ZONE (OFZ) IS NOT SHOWN. SEE AC 150/5300-13 FOR DETAILED INFORMATION. THE SUPPLEMENTAL WIND CONE MUST NOT PENETRATE THE OFZ.

Figure 74. Typical Location of Supplemental Wind Cone.

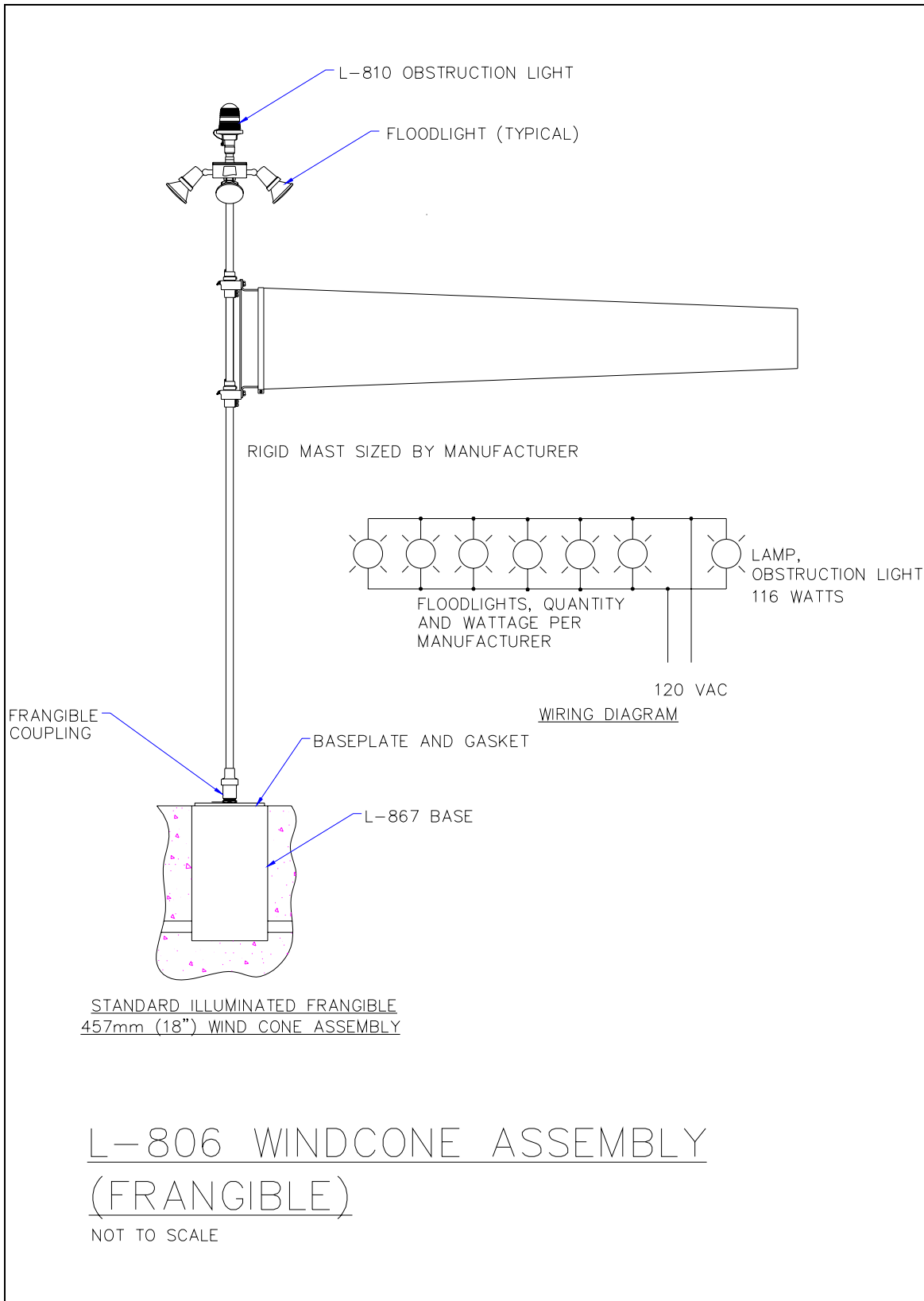


Figure 75. Externally Lighted Wind Cone Assembly (Frangible).

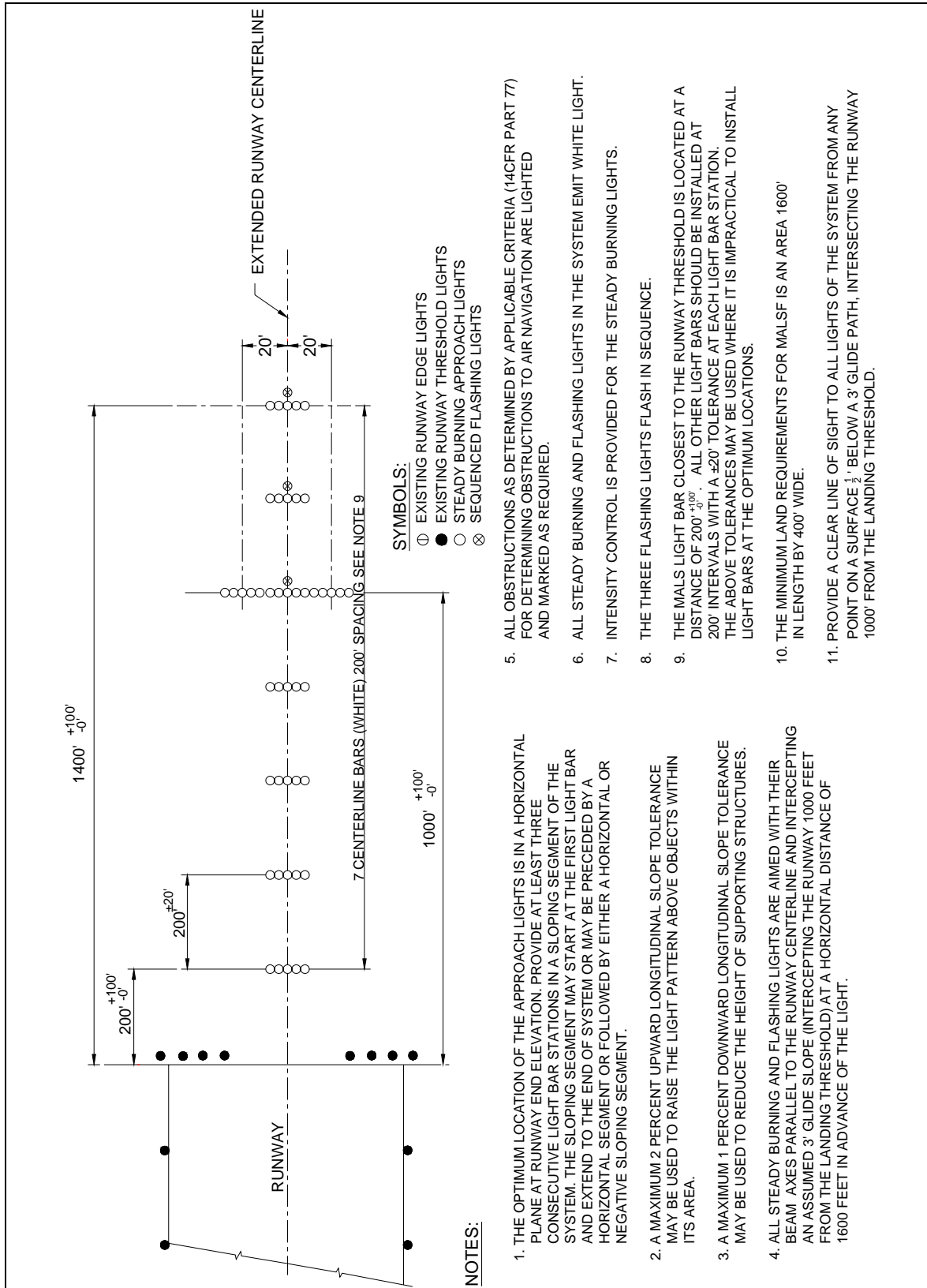
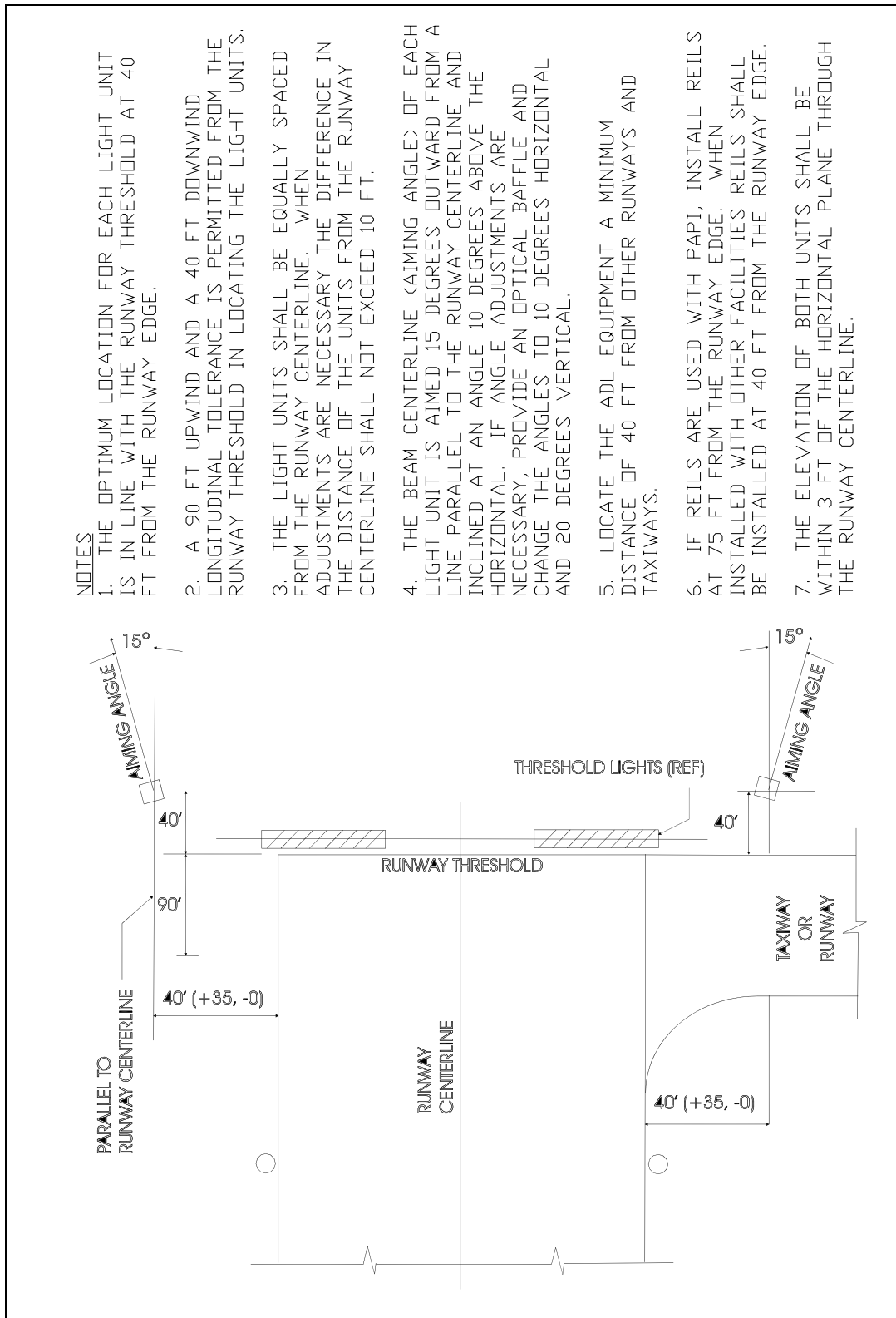


Figure 76. Typical Layout for MALS.



- NOTES**
1. THE OPTIMUM LOCATION FOR EACH LIGHT UNIT IS IN LINE WITH THE RUNWAY THRESHOLD AT 40 FT FROM THE RUNWAY EDGE.
 2. A 90 FT UPWIND AND A 40 FT DOWNWIND LONGITUDINAL TOLERANCE IS PERMITTED FROM THE RUNWAY THRESHOLD IN LOCATING THE LIGHT UNITS.
 3. THE LIGHT UNITS SHALL BE EQUALLY SPACED FROM THE RUNWAY CENTERLINE. WHEN ADJUSTMENTS ARE NECESSARY THE DIFFERENCE IN THE DISTANCE OF THE UNITS FROM THE RUNWAY CENTERLINE SHALL NOT EXCEED 10 FT.
 4. THE BEAM CENTERLINE (AIMING ANGLE) OF EACH LIGHT UNIT IS AIMED 15 DEGREES OUTWARD FROM A LINE PARALLEL TO THE RUNWAY CENTERLINE AND INCLINED AT AN ANGLE 10 DEGREES ABOVE THE HORIZONTAL. IF ANGLE ADJUSTMENTS ARE NECESSARY, PROVIDE AN OPTICAL BAFFLE AND CHANGE THE ANGLES TO 10 DEGREES HORIZONTAL AND 20 DEGREES VERTICAL.
 5. LOCATE THE ADL EQUIPMENT A MINIMUM DISTANCE OF 40 FT FROM OTHER RUNWAYS AND TAXIWAYS.
 6. IF REILS ARE USED WITH PAPI, INSTALL REILS AT 75 FT FROM THE RUNWAY EDGE. WHEN INSTALLED WITH OTHER FACILITIES REILS SHALL BE INSTALLED AT 40 FT FROM THE RUNWAY EDGE.
 7. THE ELEVATION OF BOTH UNITS SHALL BE WITHIN 3 FT OF THE HORIZONTAL PLANE THROUGH THE RUNWAY CENTERLINE.

Figure 77. Typical Layout for Runway End Identifier Lights (REILs).

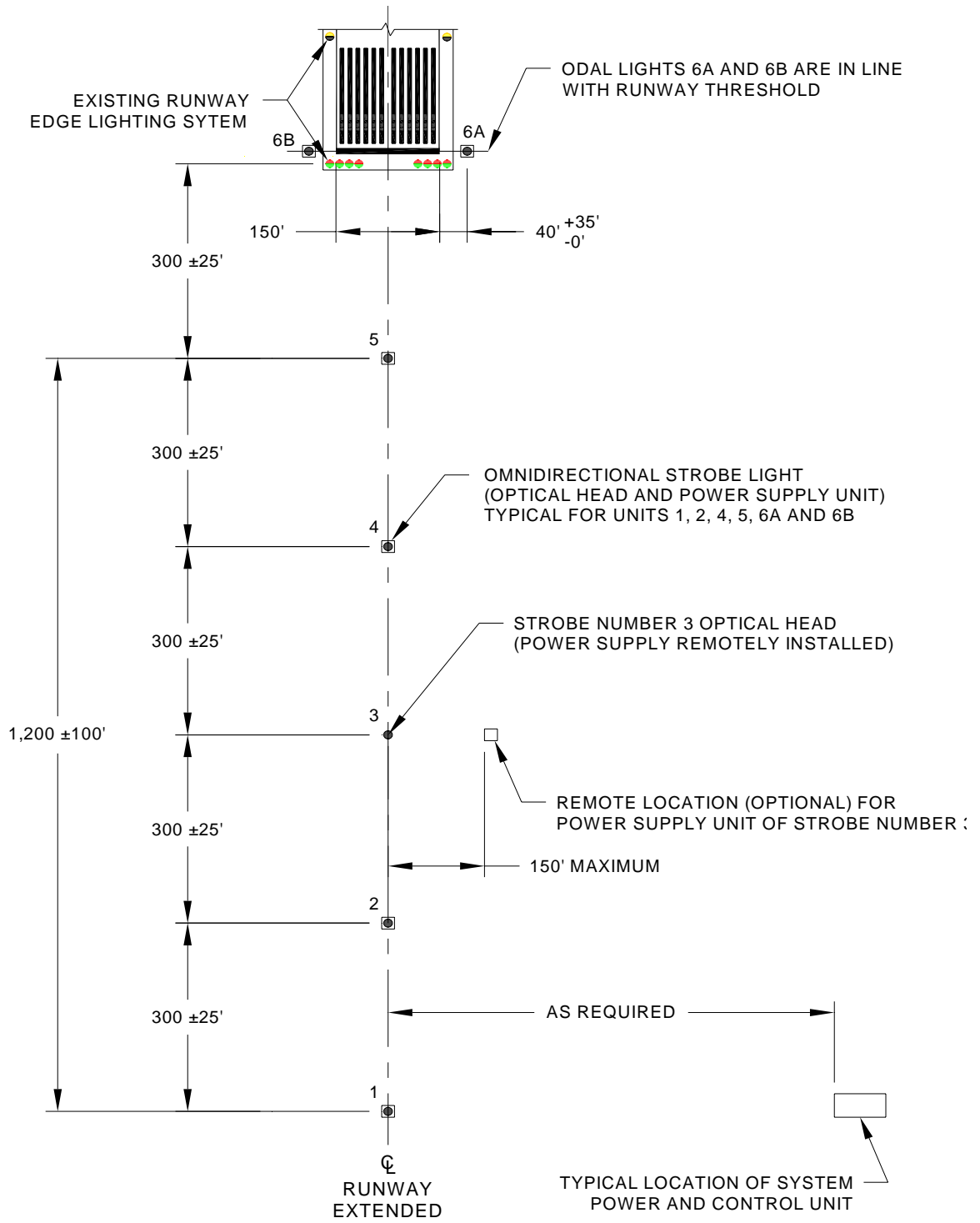
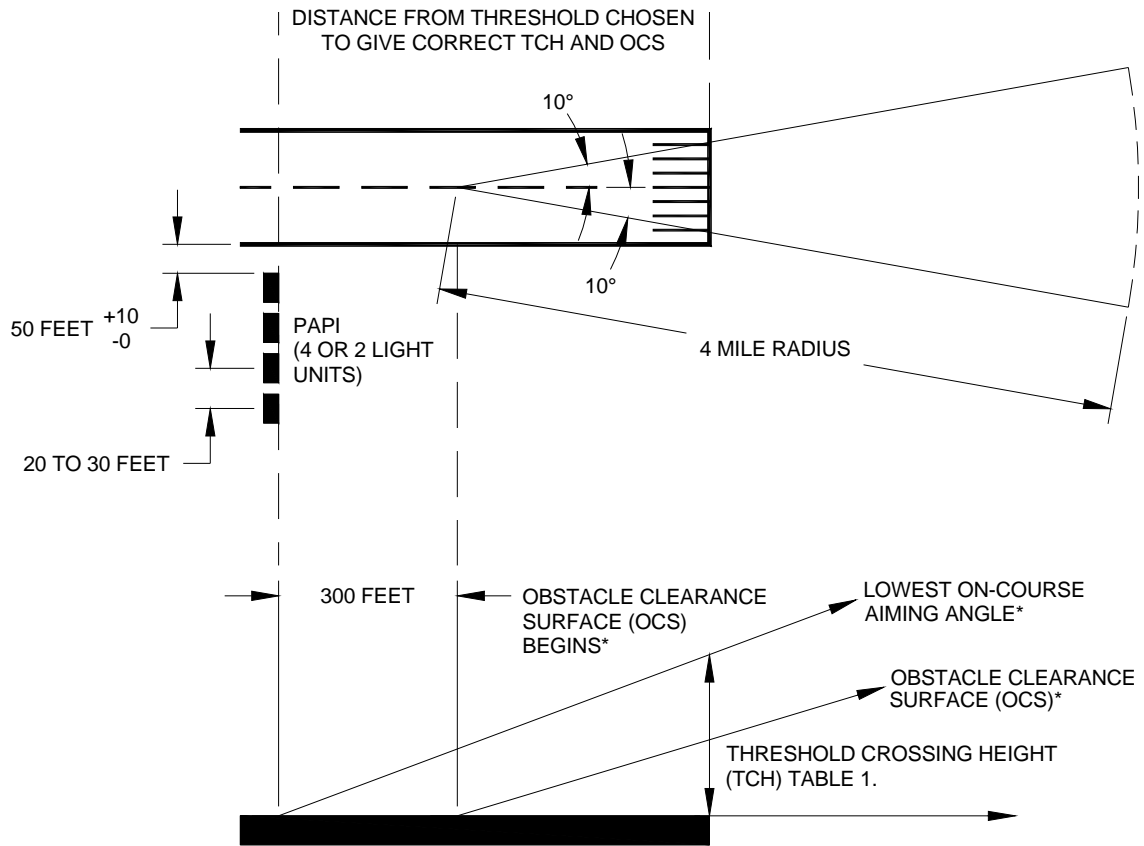


Figure 78. Typical ODALS Layout



PAPI OCS ANGLE = LOWEST ON-COURSE AIMING ANGLE - 1 DEGREE

NOTES:

1. THE VISUAL GLIDE PATH ANGLE IS THE CENTER OF THE ON-COURSE ZONE, AND IS A NOMINAL 3 DEGREES WHEN MEASURED FROM THE HORIZONTAL SURFACE OF THE RUNWAY.
 - A. FOR NON-JET RUNWAYS, THE GLIDE PATH MAY BE RAISED TO 4 DEGREES MAXIMUM TO PROVIDE OBSTACLE CLEARANCE.
 - B. IF THE PAPI GLIDE PATH IS CHANGED TO A HIGHER ANGLE FROM THE NOMINAL 3 DEGREES, IT MUST BE COMMUNICATED IN A NOTICE TO AIRMAN (NOTAM) AND PUBLISHED IN THE AIRPORT FACILITY DIRECTORY.

2. PAPI OBSTACLE CLEARANCE SURFACE (OCS).
 - A. THE PAPI OCS PROVIDES THE PILOT WITH A MINIMUM APPROACH CLEARANCE.
 - B. THE PAPI MUST BE POSITIONED AND AIMED SO NO OBSTACLES PENETRATE ITS SURFACE.
 - (1) THE OCS BEGINS 300 FEET [90M] IN FRONT OF THE PAPI SYSTEM.
 - (2) THE OCS IS PROJECTED INTO THE APPROACH ZONE ONE DEGREE LESS THEN AIMING ANGLE OF THE THIRD LIGHT UNIT FROM THE RUNWAY FOR AN L-880 SYSTEM, OR THE OUTSIDE LIGHT UNIT FOR AN L-881 SYSTEM.

Figure 79. PAPI Obstacle Clearance Surface.

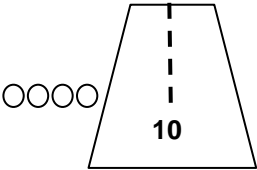
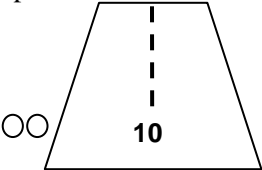
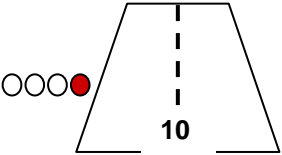
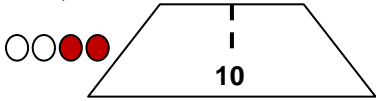
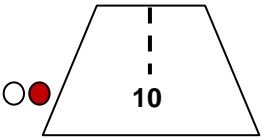
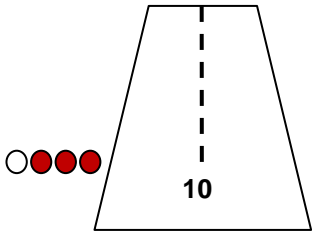
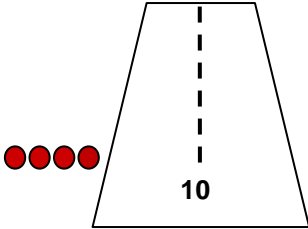
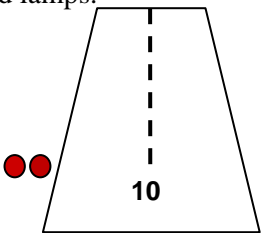
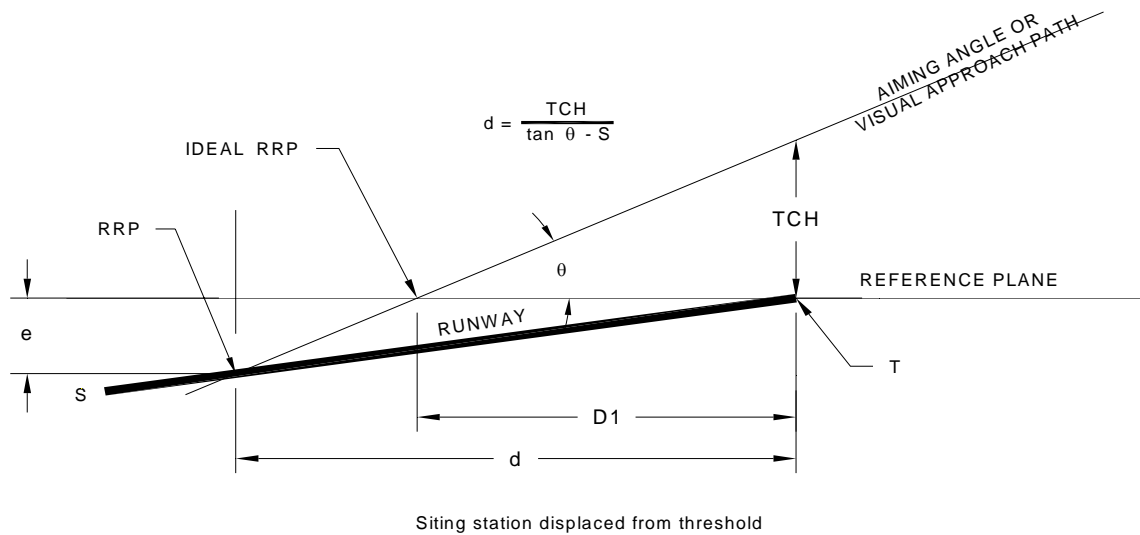
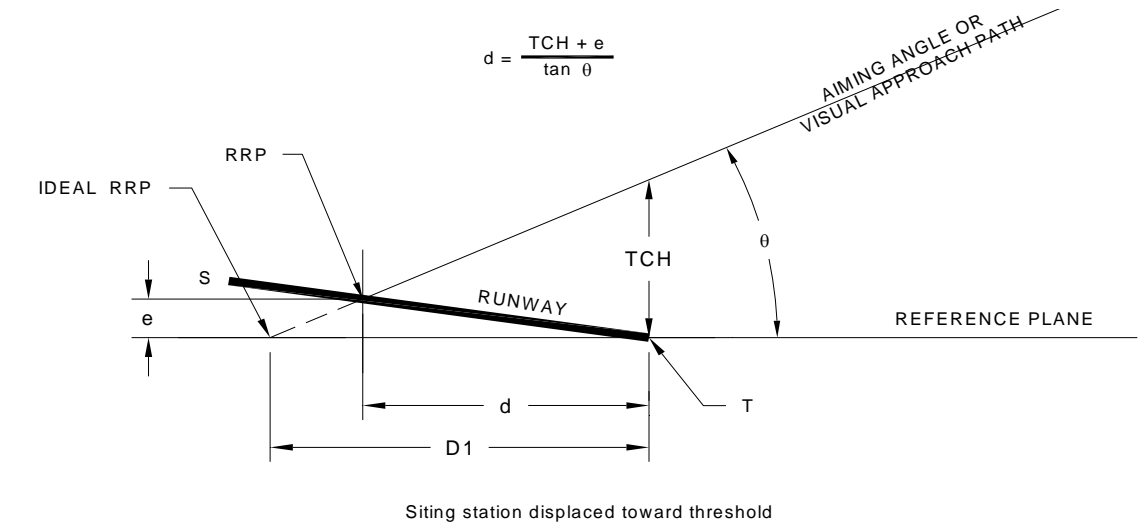
<p>(1) Above correct glide path All lamps white.</p> 	<p>(1) Above the correct glide path: 2 white lamps.</p> 
<p>(2) Slightly above correct glide path. 3 white, 1 red.</p> 	
<p>(3) On the correct glide path. Two white, two red.</p> 	<p>(2) On the correct glide path: 1 white, 1 red.</p> 
<p>(4) Slightly below the correct glide path. 1 white, 3 red.</p> 	
<p>(5) Below the correct glide path: All red.</p> 	<p>(3) Below the correct glide path: Two red lamps.</p> 
<p style="text-align: center;">Type L-880</p>	<p style="text-align: center;">Type L-881</p>
<p>NOTE: <i>The PAPI is a system of either four or two identical light units placed on the left of the runway in a line perpendicular to the centerline. The boxes are positioned and aimed to produce the visual signal shown above.</i></p>	

Figure 80. PAPI Signal Presentation.



SYMBOLS:

- D1 = ideal (zero gradient) distance from threshold
- RWY = runway longitudinal gradient
- TCH = threshold crossing height
- T = threshold
- e = elevation difference between threshold and RRP
- RRP = runway reference point (where aiming angle or visual approach path intersects runway profile)
- d = adjusted distance from threshold
- θ = aiming angle
- S = percent slope of runway = e/d
(S is used in decimal form in the equations)

Figure 81. Correction for Runway Longitudinal Gradient.

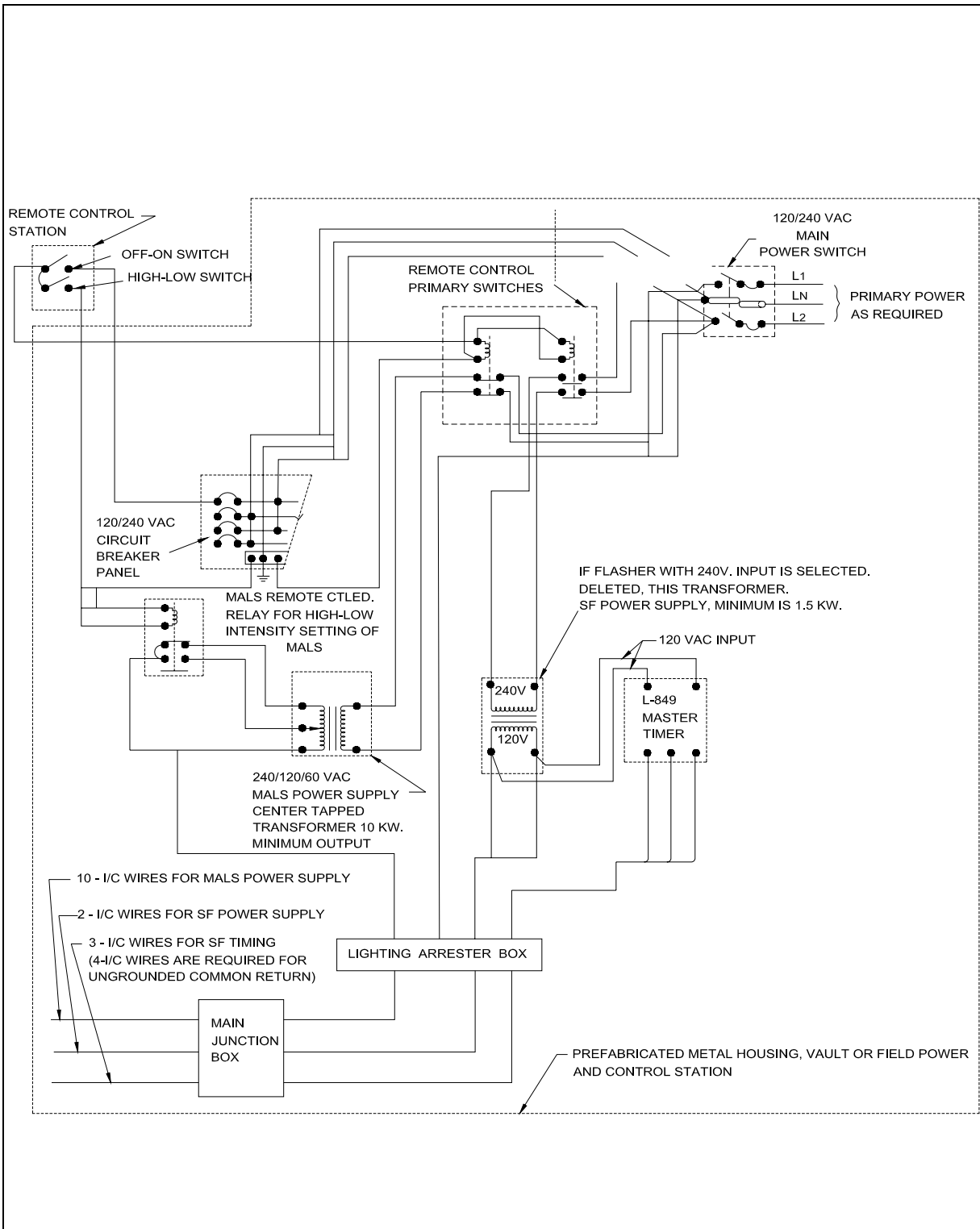


Figure 82. General Wiring Diagram for MALS with 120-Volt, AC Remote Control.

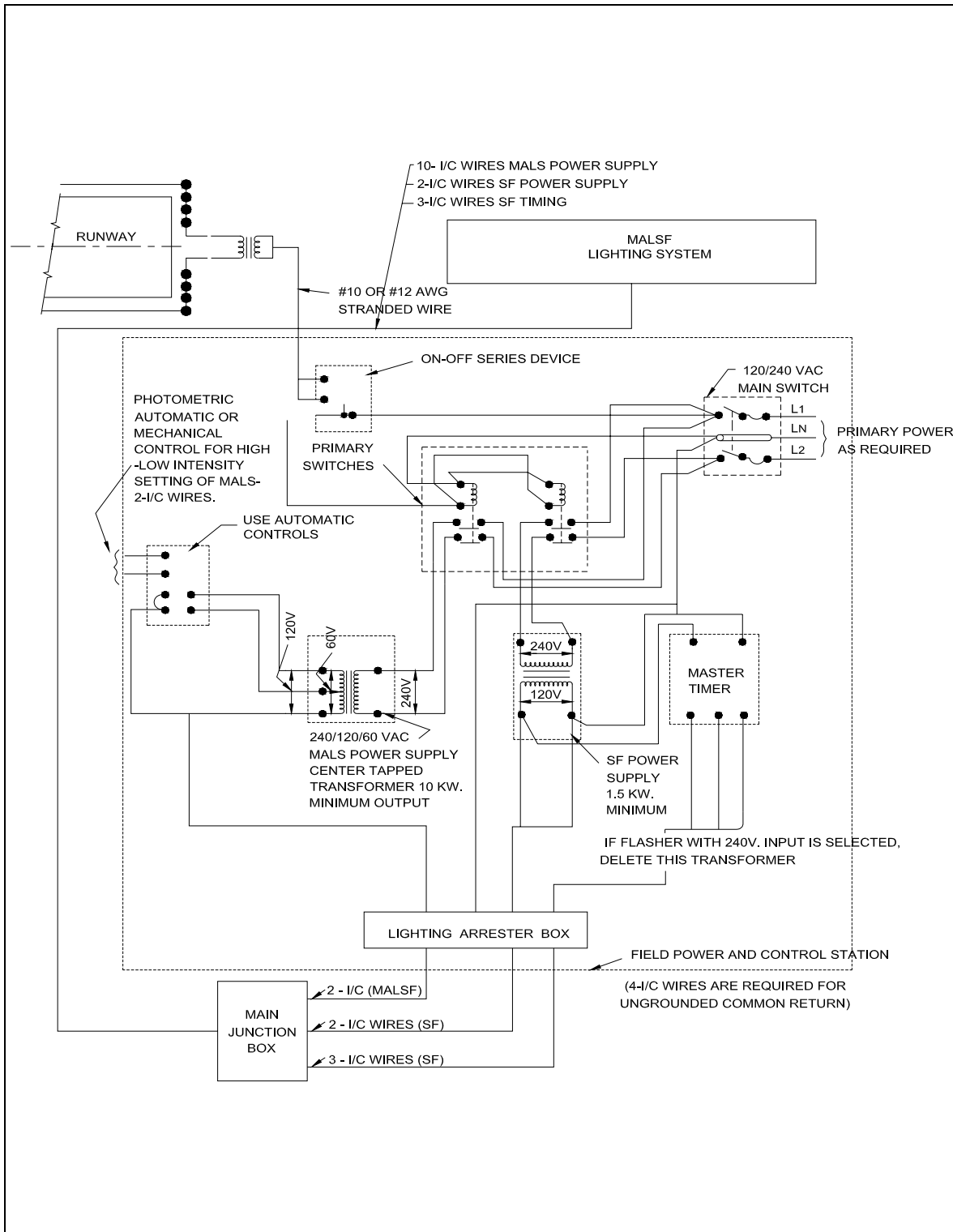


Figure 83. Typical Wiring Diagram for MALSF Controlled from Runway Lighting Circuit.

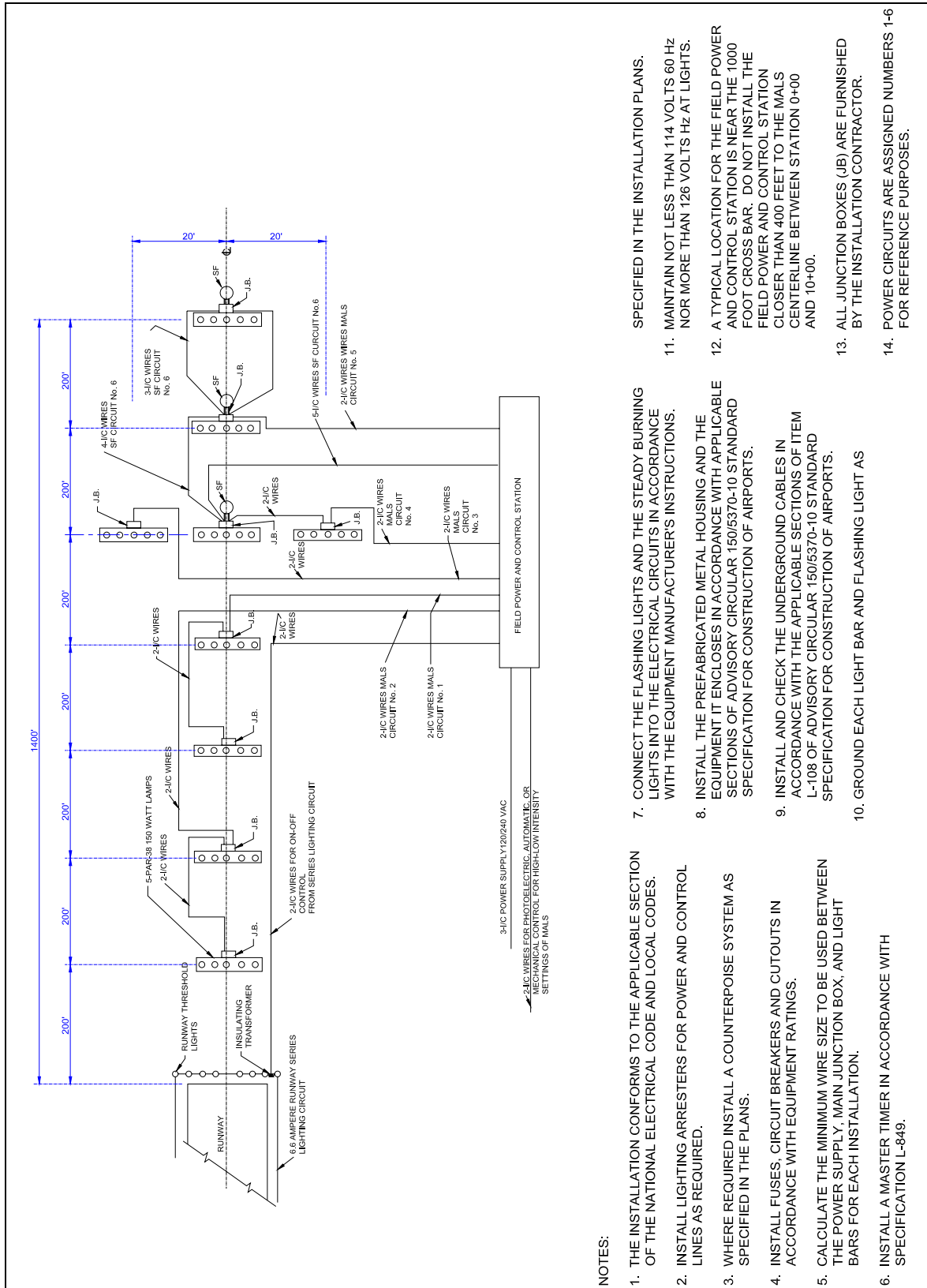


Figure 84. Typical Field Wiring Circuits for MALS.

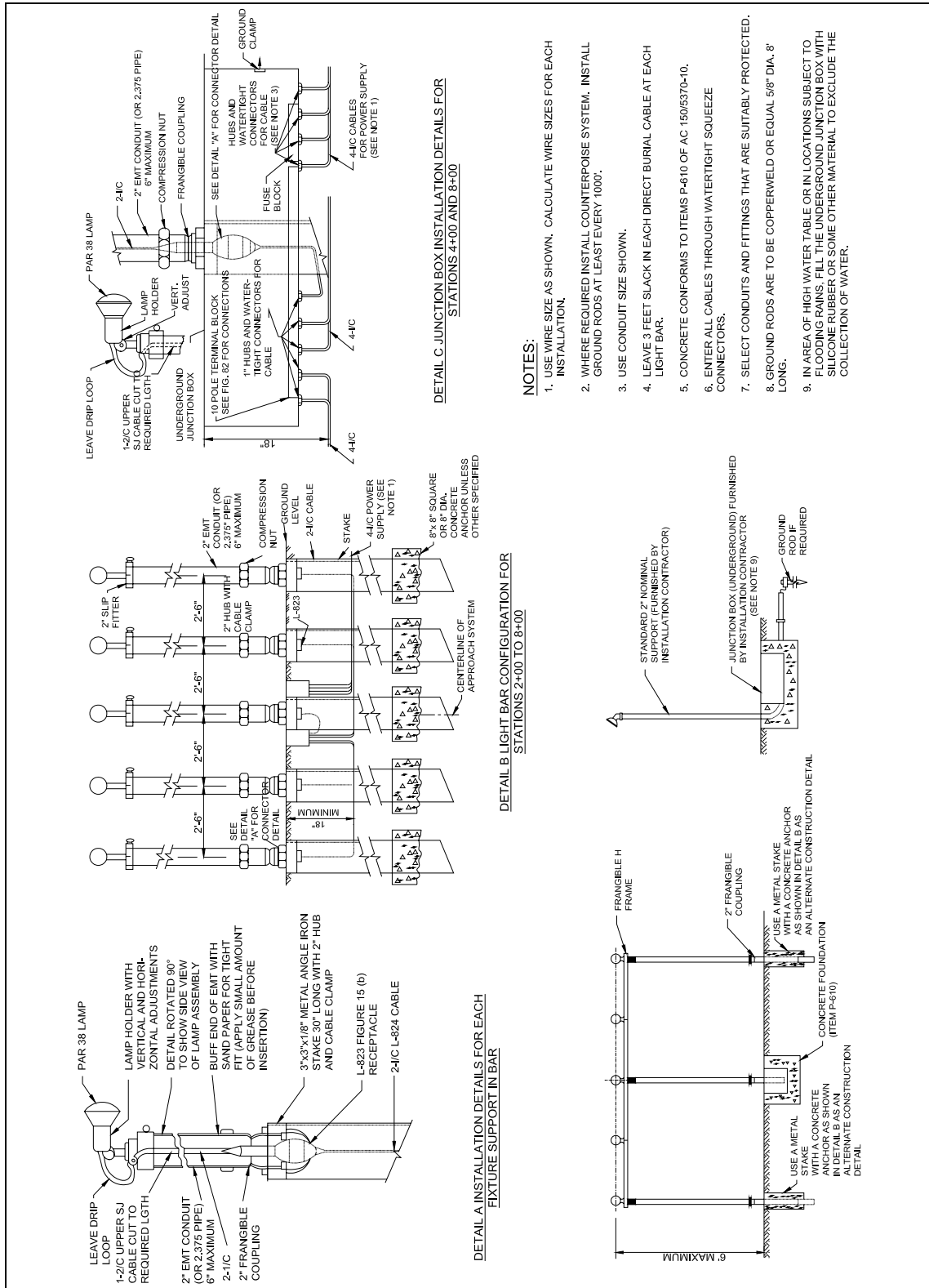


Figure 85. Typical Installation Details for Frangible MALS Structures – 6 foot (1.8 m) Maximum.

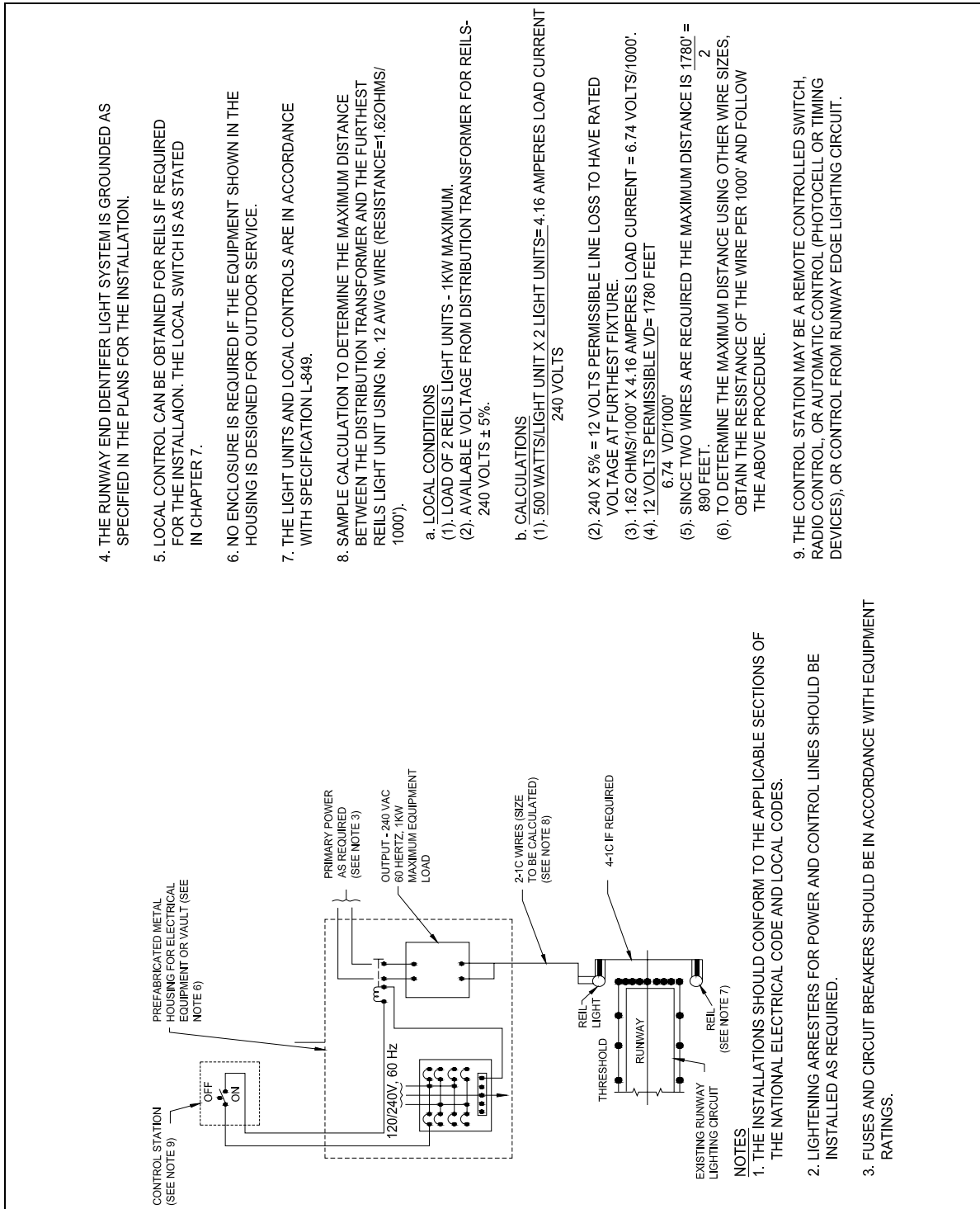
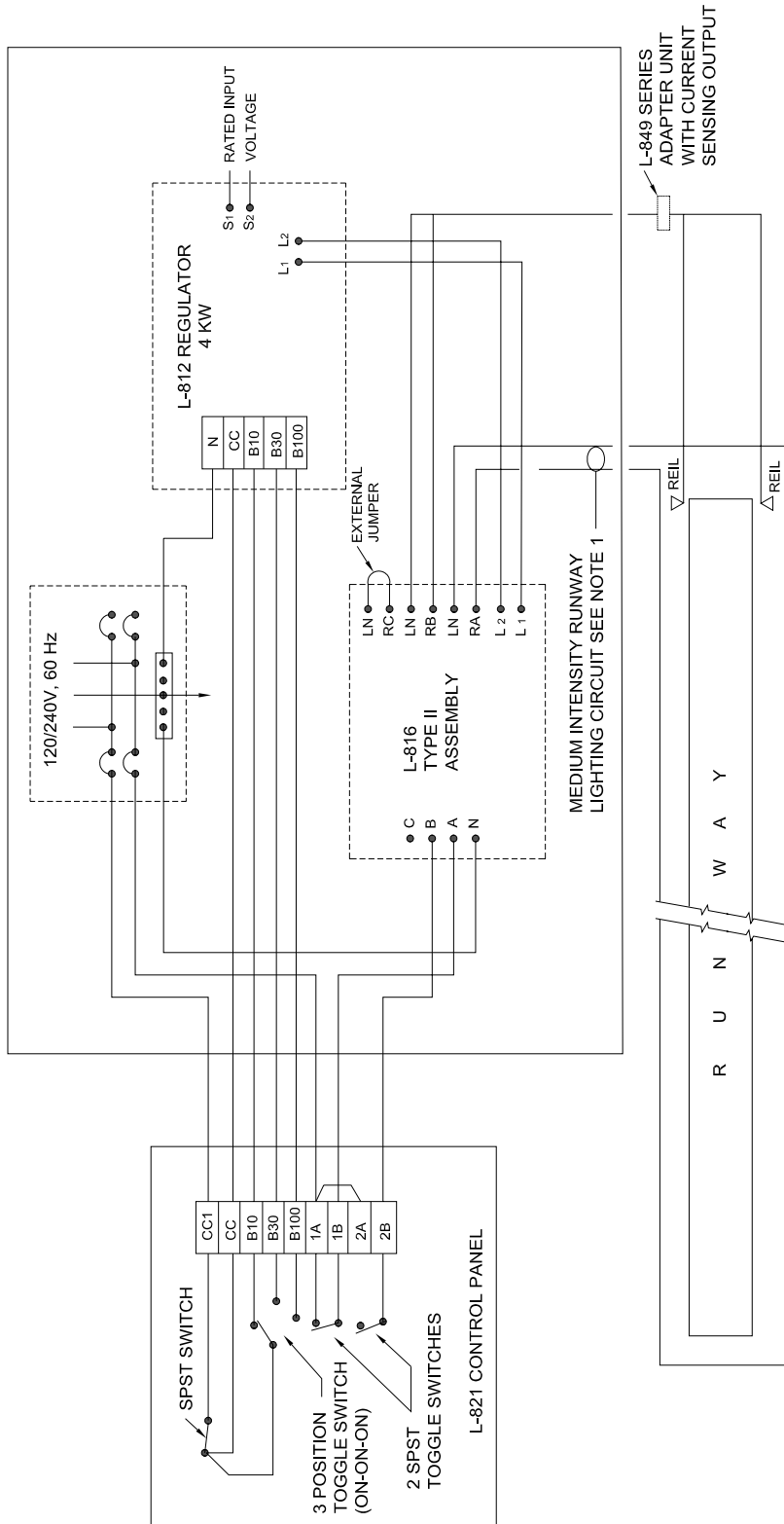


Figure 86. Typical Wiring for REILs Multiple Operation



NOTES

1. INSTALL MEDIUM INTENSITY FEEDER CABLES IN COMMON TRENCH WITH REIL FEEDER CABLES.
2. AN ADDITIONAL LOAD OF UP TO 3KW MAY BE ADDED TO THE REGULATOR IF THE REILS UNITS ARE CONNECTED INTO THE RUNWAY LIGHTING CIRCUIT.
3. THE REILS UNITS ARE CONNECTED INTO THE ELECTRICAL CIRCUITS IN ACCORDANCE WITH THE EQUIPMENT MANUFACTURER'S RECOMMENDATIONS.

Figure 87. Typical Wiring for REIL Series Operation

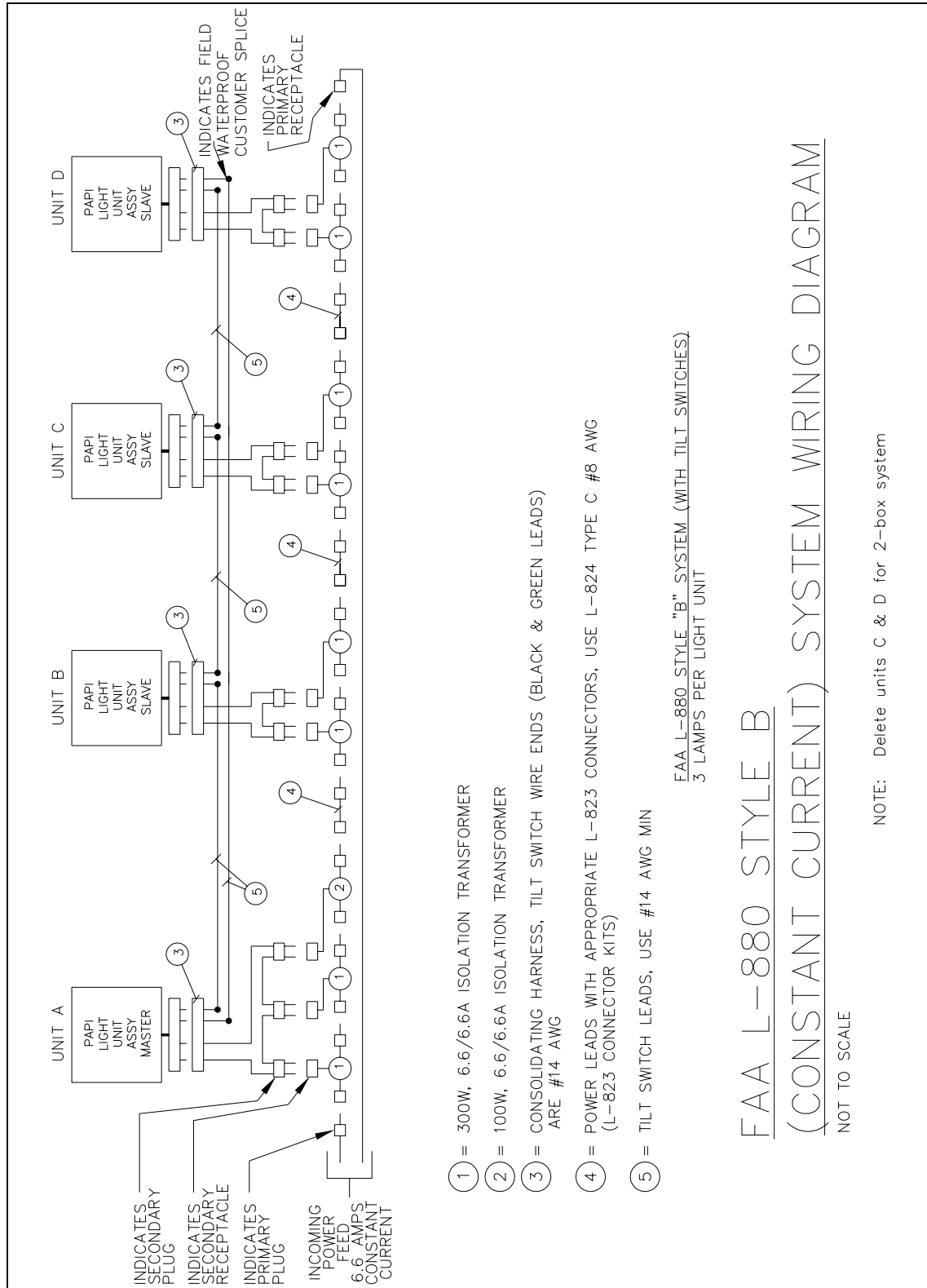


Figure 88. FAA L-880 Style B (Constant Current) System Wiring Diagram.