CHAPTER 17

ANTENNAS

This chapter provides information of wire, cable, and common hardware used in the installation of antennas and the supporting guys for the antenna towers or poles. Information is also provided on the required method of the lighting of structures as a warning to aircraft of an obstruction.

The high frequency (HF) antennas used at Naval Shore Communication Stations are usually procured by NAVELEX as complete antenna kits including towers. These antenna kits are procured under NAVELEX electronic specifications and NAVFAC structural specifications. Installation is usually accomplished by a commercial contractor under contract to NAVFAC or a NAVFAC Engineering Field Division (EFD). Supervision of the installation contractor is supplied by the NAVFAC EFD's for structural matters and by a NAVELEX Engineering Field Activity (EFA) for electronic matters. Checkout of a completed antenna installation is performed jointly by the EFD and EFA for structural and electronic acceptance respectively. NAVELEX Handbook 0101,104 provides technical information and criteria on the selection, design, and installation of HF antenna systems employed at shore communication stations.

17.1 ANTENNA HARDWARE

17.1.1 Wire

The most common materials used for antenna and guy wires are galvanized steel strand, copper, copper-clad steel, and aluminum-clad steel. The wire consists of either a single solid conductor or a number of identical-size wires may be twisted together to form a strand for greater strength and flexibility. Copper-clad or aluminum-clad steel wires are being used to a greater extent. They consist of a high grade steel core over which has been added a bonded coating of copper or aluminum. The wire consisting of copper or aluminum and steel offers the advantages of each metal and the desirable qualities of both. They offer the proper balance of strength, weight, and conductivity for most military communication applications. Copper-clad steel wire approaches the tensile strength of steel wire with a conductivity capability of 30 to 40 percent of that of solid copper and twice that of aluminum-clad steel. The principal advantages of aluminum-clad steel are: equal in tensile strength to high strength steel, lighter than copper or steel, much higher conductance than steel, and lasts longer than either.

17.1.2 Insulators

Insulators (see figure 17-1) used in antenna work are designed in various shapes and for many different purposes. They are used to isolate current-carrying conductors from other conductors or metallic surfaces. Insulators are made with smooth, rounded edges with a glazed surface to minimize the adherence of dirt, moisture, or other foreign substances to reduce the possibility of flashover or arcing. Materials used in the manufacture of insulators include porcelain, ceramics, and special glass.

Antenna insulators require period maintenance. The surface of the insulators should be examined at regular intervals to detect cracks, blisters, sharp edges, and poracity traces. Impurities such as salt spray, soot, dirt, and dust should be removed by clean water rinses. Paint, varnish, shellac, or grease should not be applied to the insulating material.

Among the types of insulators used are the strain, and spreader or spacer types. Such insulators are produced in a wide range of sizes and strengths.

a. Strain Insulator. The strain (suspension) insulator is used to support wire antennas and guy strands, as well as to isolate them from other conductors. They are made in rectangular or cylindrical shapes with holes at each end. Some strain insulators have eyebolts at the ends for tie points. Strain insulators should be installed with clevises and shackles to permit easy accessibility for maintenance or replacement.

b. Spreader Insulator. The spreader (spacer) insulator has holes at each end through which the transmission lines are inserted to maintain a specific spacing between transmission-line conductors.

17.1.3 Clamps

An antenna clamp is used to change the direction of an antenna wire. Clamps, made of cast bronze, are available in 45^{o}, 90^{o}, 135^{o}, 180^{o}, and tee configurations. Each configuration can be obtained for use with 1/8-inch diameter antenna wire and 5/16-inch diameter wire rope. Antenna clamps are attached to support hardware by means of shackles. The antenna wire is placed in the grooves of the clamp, and the two parts of the clamp are connected together with hexagonal-head bronze studs and split lockwashers.

17.1.4 Shackles

A shackle is usually used to secure a strain insulator to a padeye, staple, or antenna clamp. The two standard sizes of shackles in common use throughout communications stations are the 5/16 and 7/16-inch types. Figure 17-2 contains dimensioning data concerning typical shackles.

17.1.5 Padeyes and Staples

Padeyes and staples provide a means for attaching the antenna wire to a metallic structure, such as a tower. Padeyes and staples are welded to the structure and fabricated as shown in figure 17-3.

17.1.6 Dead Ends

Dead ends provide a simple, effective way of terminating guy strands and electrical conductors. They are made of the same basic material as the strand to which applied and come in standard size strands of galvanized steel, aluminum and copper clad steel, and stainless steel strands and wire ropes. They can be applied quickly and easily without special tools. Its major advantages are uniformity of all applications, safe installation, prevents strand slippage and premature fatigue failure, and maintains a powerful helical hold on the strand or rope under all climatic conditions. Figure 17-4 shows several standard applications for dead ends in the termination of guy strands.

17.1.7 Spacers

Communication spacers are used to provide an effective, quick, and inexpensive way of eliminating mid-span hits on open wire lines and to maintain critical spacing between cables of any size, on antenna arrays, transmission, and dissipation lines. They are made of materials compatible with the wires and cables to which attached. Spacers for open wire lines are made of high-impact polyvinyl chloride (PVC) and possess excellent chemical and strength characteristics. Figure 17-5 shows a complete spacer unit installation.

17.1.8 Assembling Antenna Hardware

The various items of antenna hardware may be assembled in several ways; the way chosen will depend upon the specific application of the assembly. Figure 17-6 illustrates several representative ways in which antenna hardware may be assembled.

17.2 POLE AND TOWER LIGHTING

Poles and towers which are a potential hazard to aircraft must be lighted at night by obstruction lights. The requirements and specifications for the lighting of potential hazards to air navigation have been established through the joint cooperation of the Federal Aviation Agency (FAA), the Federal Communications Commission (FCC), the Department of Defense (DOD), and the aviation industry. In foreign countries it is based on similar requirements of the International Civil Aviation Organization (ICAO).

Both the FAA and the FCC lighting specifications are set forth in terms of the heights of the antenna structures. Figure 17-7 and table 17-1 illustrate the requirements for placement of obstruction lights on towers up to 450 feet in height. The specification further stipulates that the placement of the lights on either square or rectangular towers shall be such that at least one top or side light be visible from any angle of approach. A typical system for structures up to 150 feet in height will consist of a double light fixture mounted so that it extends above the pole or tower to be lighted, a transfer relay to automatically switch the power to the spare light in the event the operating light fails, and a photoelectric control unit to turn the light on at dusk and off at dawn. The photoelectric control unit has an adjustment range to control the amount of light required to activate the unit. The normal operating setting would turn the lights on when the north skyline intensity is less than 35 foot-candles, and would disconnect the power when the north skyline light intensity is greater than about 58 foot-candles.

Towers and poles higher than 150 feet require lights of a greater brilliancy and a beacon flasher to cause the lights to flash on and off at periodic intervals, or a rotating red beacon. When a flashing beacon is required, it shall be equipped with a flashing mechanism capable of producing not more than 40 nor less than 12 flashes per minute, with a period of darkness equal to one-half the luminous period.

To insure proper operation of tower lights, the FCC specifies that the lights be inspected at least once every 24 hours; the inspection can be performed either by direct observation or by observation of an automatic, properly maintained, indicator designed to register failure of such lights. Where obstruction lighting is not readily accessible for periodic inspection, the rules permit the use of electric signaling devices to indicate lamp failure.

Table 17-1. Tower Lighting Requirements

Tower Height (Feet)	FAA-Approved System Nomenclature	FCC-Approved System Nomenclature	Typical System Detail Figure 17-7
21-150	A-1	17.24	A
151-300	A-2	17.25	B
301-450	A-3	17.26	C

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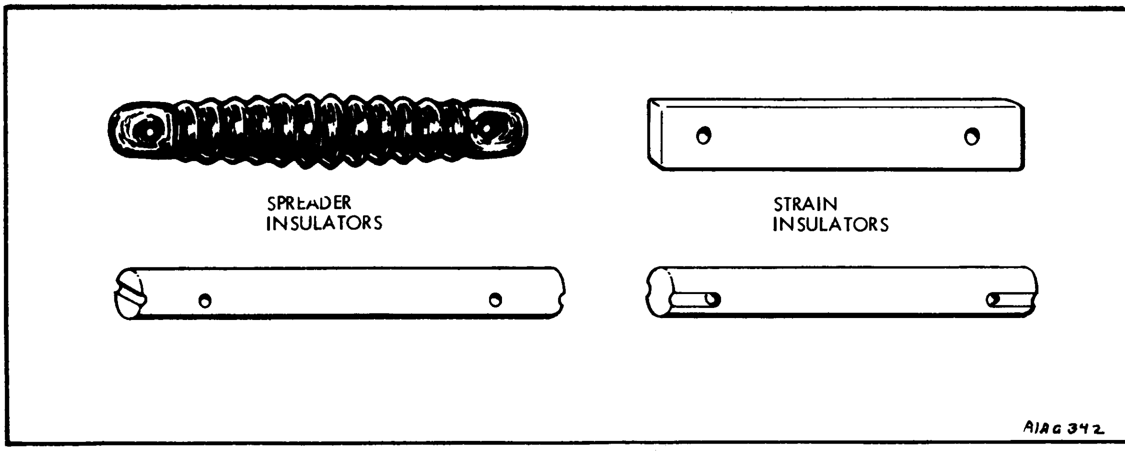
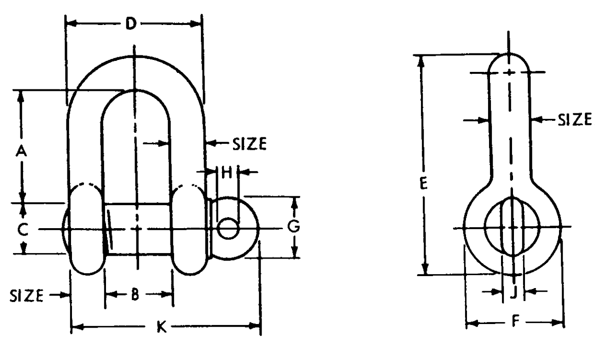


Figure 17-1. Antenna Insulators



SIZE	A	B	C	D	E	F	G	H	J	K	THREAD (NC-2)	WEIGHT (LB)
5/16	1	17/32	3/8	1-5/32	1-15/16	13/16	9/16	3/16	3/16	1-3/4	3/8-16	0.3
7/16	1-7/16	23/32	1/2	19/32	2-21/32	1-1/16	23/32	1/4	15/64	2-11/32	1/2-13	0.5

NOTE: ALL DIMENSIONS ARE IN INCHES.

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Figure 17-2. Typical Antenna Shackles

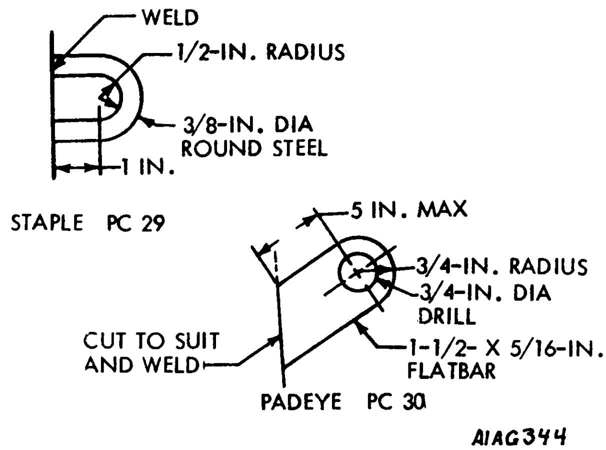


Figure 17-3. Antenna Padeyes and Staples

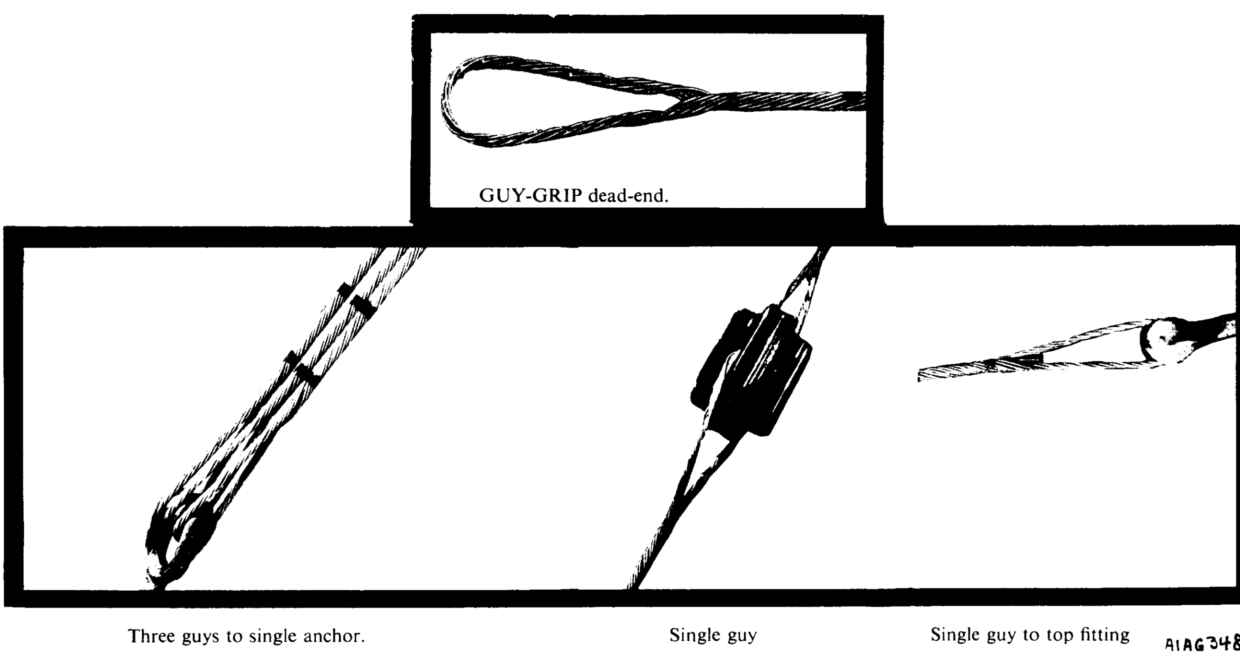
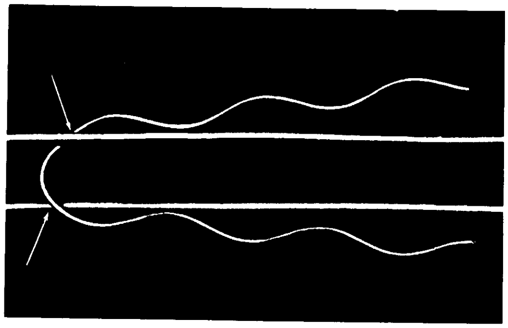
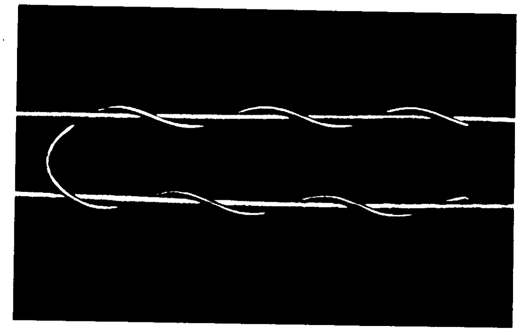


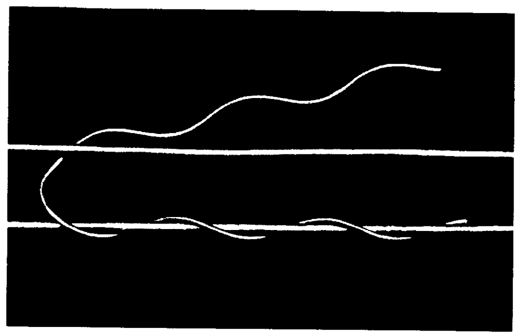
Figure 17-4. Use of Dead Ends in Terminating Guy Strands.



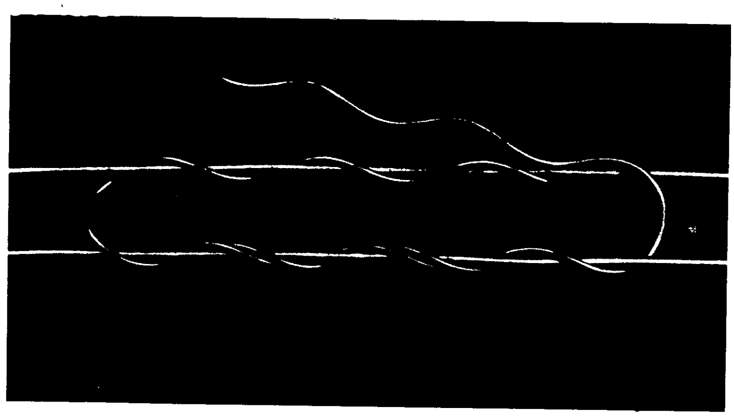
1. Position first spacer so that its loop is placed over one strand and under the other as shown (see arrows).



3. First spacer completely applied.

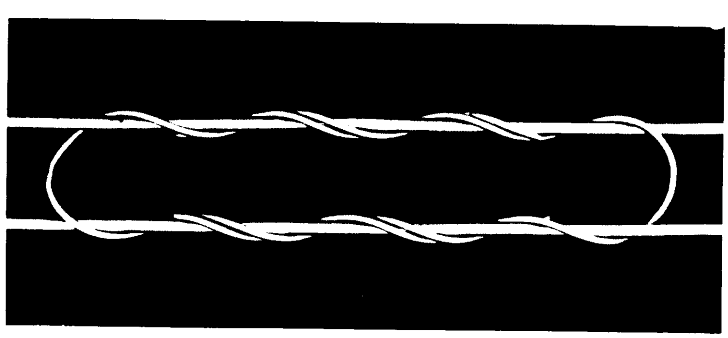


2. Apply first spacer by rotating each leg around its corresponding strand.



4. Position second spacer with its loop outside the ends of the first spacer as shown. Important - again notice that the loop extends over one strand and under the other but in reverse position to the loop of the first spacer.

Then apply by rotating each leg around the corresponding strand. Be sure that the legs nest in snugly with the legs of the first spacer.



5. Completed application of PREFORMED Spacer Unit.

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Figure 17-5. Completed Spacer Unit Installation

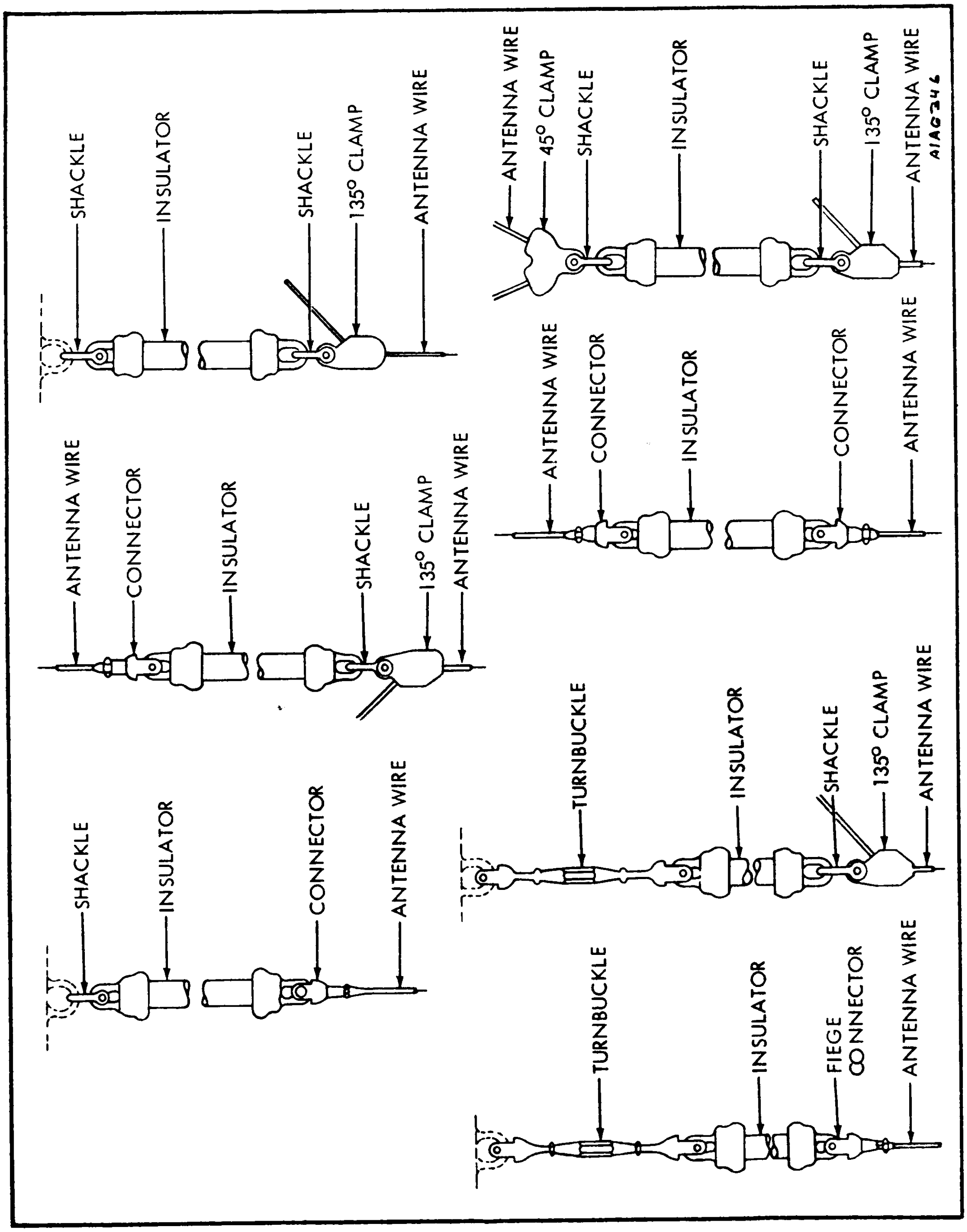

Figure 17-6. Typical Antenna Hardware Assemblies

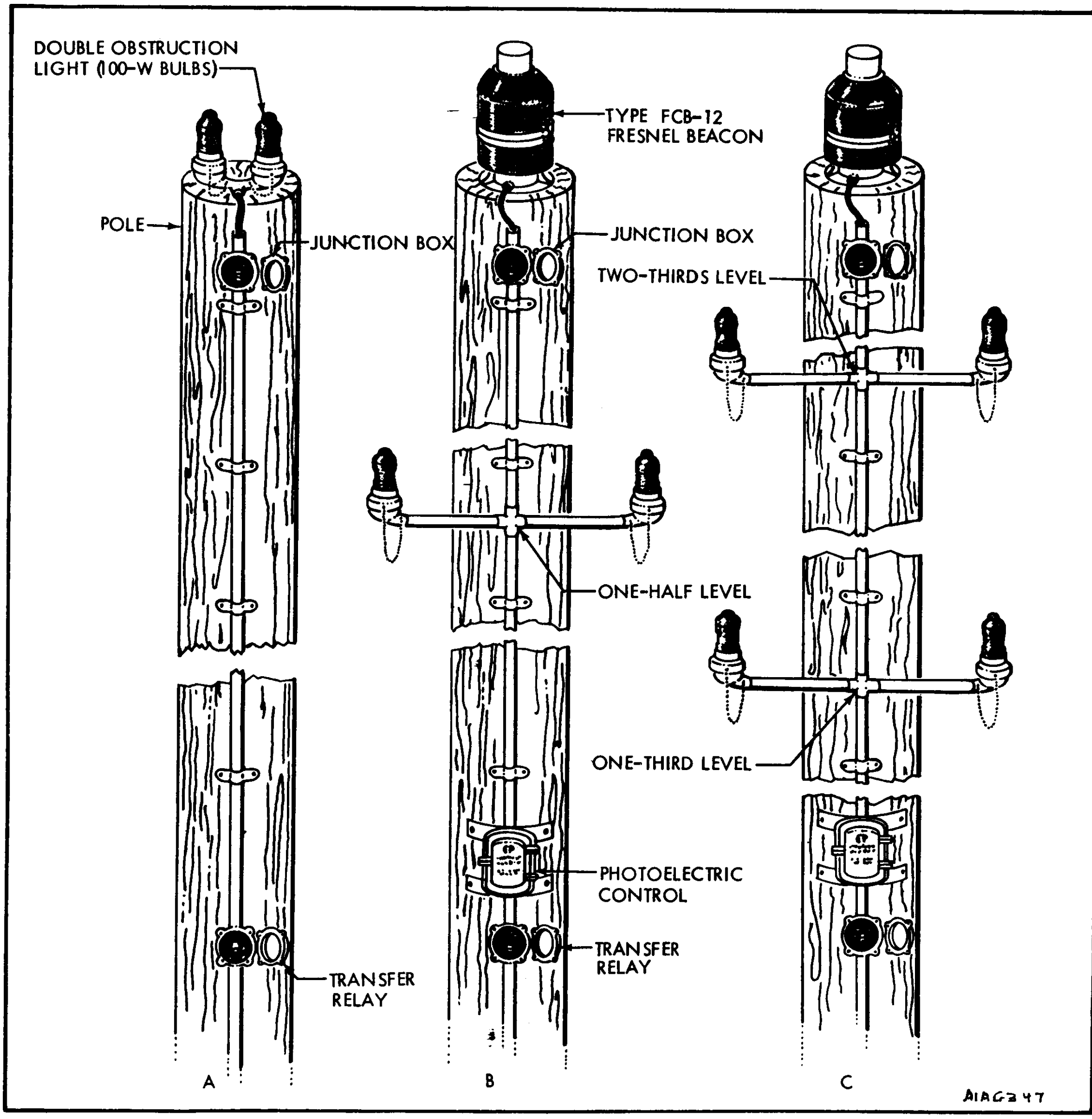

Figure 17-7. Typical FAA-and FCC - Approved Obstruction Lights.