

NAVSHIPS 900121(A)

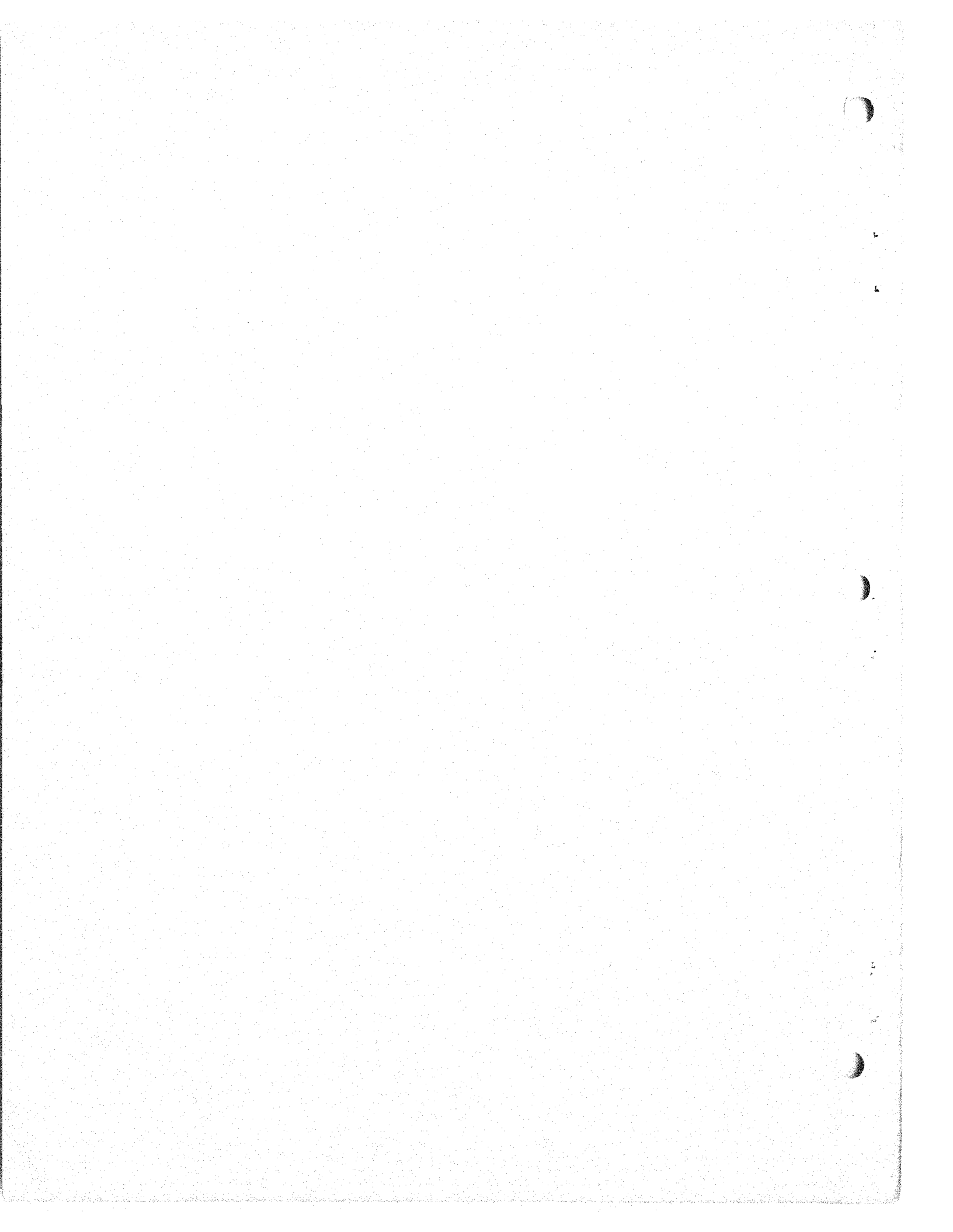
SHIPBOARD ANTENNA DETAILS

CHAPTER 2

INSTALLATION METHODS

BUREAU OF SHIPS

NAVY DEPARTMENT



Page Numbers	Change in Effect	Page Numbers	Change in Effect
Title Page	Original	2-1 to 2-97	Original
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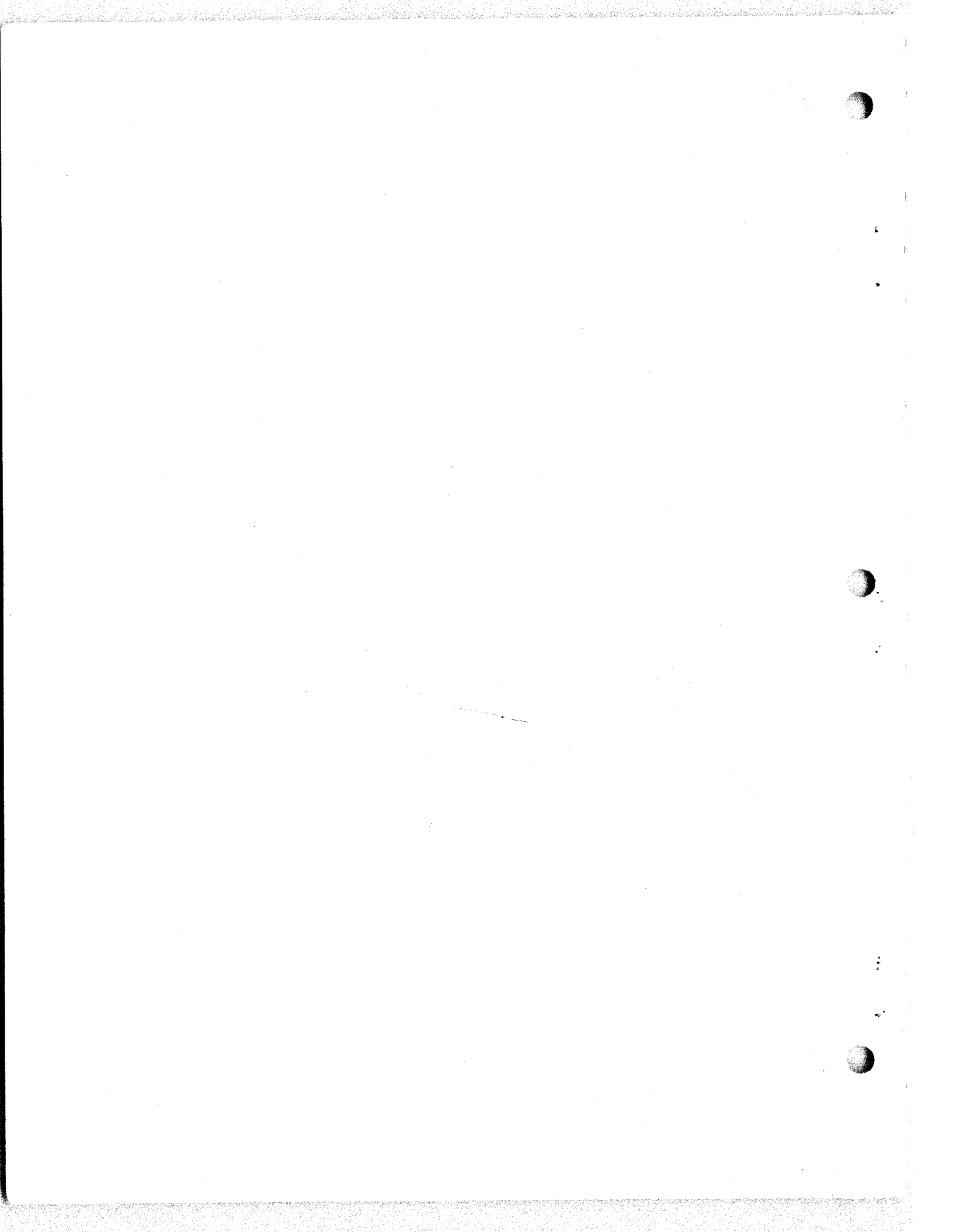


TABLE OF CONTENTS

SECTION 2-1. INTRODUCTION		SECTION 2-5. TRANSMITTING ANTENNAS	
Paragraph	Page	Paragraph	Page
1. General	2-1	1. General	2-55
SECTION 2-2. WIRE ANTENNAS		2. Installation	2-55
1. General	2-1	a. Separation of Antennas	2-55
2. Wire Rope	2-1	b. Length of Transmission Lines	2-55
3. Wire Rope Connectors	2-2	c. Installation of ground straps	2-56
a. Instructions for Installing Antenna Connector MX-1177/U on 7-#18 Antenna Wire	2-4	d. Special 3-Inch Line	2-56
b. Instructions for Installing Antenna Connector MX-1178/U on 5/16" (6 x 19) Wire Rope	2-5	e. Safety Precautions	2-58
4. Antenna Clamps	2-8	3. Antenna Trunks	2-58
5. Antenna Turnbuckles	2-8	a. Transmitters with Rated Output of 125 watts and Less	2-58
6. Shackles	2-8	b. Transmitters with Rated Output of over 125 watts	2-58
7. Staples and Padeyes	2-8	4. Antenna Disconnect Switches..	2-61
8. Safety Links	2-14	a. General	2-61
9. Wire Antenna Details	2-14	b. Types	2-61
SECTION 2-3. WHIP ANTENNAS		(1) Navy Type 24270	2-62
1. General	2-31	(2) Navy Type 24206	2-63
2. Types of Whip Antennas	2-31	(3) Navy Type 24223	2-63
3. Mounting Whip Antenna	2-31	c. Installation	2-63
a. General	2-31	SECTION 2-6. UHF ANTENNA INSTALLATIONS	
b. Preferred Method	2-31	1. General	2-66
c. Alternate Methods	2-32	2. Installation	2-66
d. Tilting Mount	2-32	a. Types of Antennas	2-66
SECTION 2-4. RECEIVING ANTENNAS		b. Locating the antenna	2-66
1. General	2-39	c. Transmission Line	2-67
2. Installation	2-39	d. Installation Rules	2-67
3. Receiving Antenna Distribution System	2-40	SECTION 2-7. ANTENNA INSULATORS	
4. Receiving Antenna Transfer Panels	2-43	1. General	2-72
5. Submarine Receiving Antenna Transfer Panel	2-52	2. Type of Antenna Insulators	2-72
6. Identification of Receiving Antennas	2-53	a. Strain Insulators	2-72
		b. Standoff Insulators	2-73
		c. Entrance Insulators	2-73
		d. Feedthru Insulators	2-73
		e. End Seals	2-73
		3. Maintenance of Antenna Insulators	2-73
		a. Visual Inspection	2-73
		b. Cleaning Insulators	2-74
		4. Insulator Drawings	2-74

SECTION 2-8. ANTENNA
MAINTENANCE

Paragraph	Page
1. General	2-93
2. Antenna Leakage Resistance..	2-94
3. Painting Antennas	2-94
a. General.....	2-94
b. Painting Radar Antenna Hoods	2-95

SECTION 2-8. ANTENNA
MAINTENANCE (Cont'd)

Paragraph	Page
4. Safety Precautions	2-95
a. Work on Transmitting Antennas	2-95
b. Stack Gas Warning.....	2-96
c. Warning Signs.....	2-96
d. Safety Precautions for Mast Workers.....	2-96
5. Antenna Rigging Photographs.....	2-97

LIST OF ILLUSTRATIONS

SECTION 2-2. WIRE ANTENNAS

Figure	Page
2-1 Wire Rope Connectors for Shipboard Antenna Systems.....	2-3
2-2 Step 1 - MX-1177/U	2-4
2-3 Step 2 - MX-1177/U	2-4
2-4 Step 3 - MX-1177/U	2-4
2-5 Step 4 - MX-1177/U	2-5
2-6 Step 5 - MX-1177/U	2-5
2-7 Step 6 - MX-1177/U	2-5
2-8 Step 1 - MX-1178/U	2-5
2-9 Step 2 - MX-1178/U	2-6
2-10 Step 3 - MX-1178/U	2-6
2-11 Step 4 - MX-1178/U	2-6
2-12 Step 5 and 6 - MX-1178/U	2-6
2-13 Step 7 - MX-1178/U	2-7
2-14 Step 8 - MX-1178/U	2-7
2-15 Step 9 - MX-1178/U	2-7
2-16 Step 10 - MX-1178/U	2-8
2-17 Antenna Clamps for 7-#18 Antenna Wire.....	2-9
2-18 Antenna Clamps for 5/16" (6 x 19) Wire Rope	2-10
2-19 Turnbuckles for use with 5/16" (6 x 19) Wire Rope..	2-11
2-20 Turnbuckles for use with 7-#18 Antenna Wire	2-12
2-21 Screw-Pin Shackles for Radio Antenna Systems ...	2-13
2-22 Antenna Safety Link	2-15
2-23 Wire Antenna Details - (Details A and B).....	2-16
2-24 Wire Antenna Details - (Details C and D).....	2-17

SECTION 2-2. WIRE ANTENNAS
(Cont'd)

Figure	Page
2-25 Wire Antenna Details - (Details E and F)	2-18
2-26 Wire Antenna Details - (Details G and H)	2-19
2-27 Wire Antenna Details - (Details I and J)	2-20
2-28 Wire Antenna Details - (Details K and L)	2-21
2-29 Wire Antenna Details - (Details M and N).....	2-22
2-30 Wire Antenna Details - (Details O and P)	2-23
2-31 Wire Antenna Details - (Details Q and R)	2-24
2-32 Wire Antenna Details - (Details S and T)	2-25
2-33 Wire Antenna Details - (Details U and V)	2-26
2-34 Wire Antenna Details - (Details W and X).....	2-27
2-35 Wire Antenna Details - (Details Y and Z)	2-28
2-36 Typical Wire Antenna Installation	2-30

SECTION 2-3. WHIP ANTENNAS

2-37 Recommended Method for Mounting a Whip Antenna.....	2-32
2-38 Details of Whip Antenna Termination Box	2-33

**SECTION 2-3. WHIP ANTENNAS
(Cont'd)**

Figure		Page
2-39	Mounting Whip Antennas - Methods A and B (Not Preferred)	2-34
2-40	Mounting Whip Antennas - Methods C, D and E (Not Preferred).....	2-35
2-41	Mounting Hardware for Whip Antennas.....	2-36
2-42	Tilting Mount for a Vertical Whip Antenna	2-37
2-43	Typical Receiving Antenna Installation	2-38

SECTION 2-4. RECEIVING ANTENNAS

2-44	Receiving Antenna Distribution System (Using Terminal Boxes).....	2-41
2-45	Receiving Antenna Distribution System (Using Antenna Transfer Panel) ...	2-42
2-46	Receiving Antenna Distribution System (Using AN/SRA-9 Antenna Filter Assembly)	2-42
2-47	Antenna Entrance Assemblies.....	2-44
2-48	Terminal Boxes for Receiving Antenna System..	2-45
2-49	Front View of Antenna Transfer Panel, Navy Type 23406.....	2-47
2-50	Cutaway Side View of Antenna Transfer Panel, Navy Type 23406.....	2-48
2-51	Antenna Transfer Panels.	2-49
2-52	Submarine Receiving Antenna Transfer Panel..	2-51
2-53	Typical Transmitting Antenna Installation	2-54

SECTION 2-5. TRANSMITTING ANTENNAS

2-54	Typical Antenna Trunk Installation.....	2-57
2-55	Clearances for Antenna Trunks	2-59
2-56	Navy Type 24270 Antenna Switch.....	2-62
2-57	Navy Type 24206 Antenna Switch.....	2-64

SECTION 2-5. TRANSMITTING ANTENNAS (Cont'd)

Figure		Page
2-58	Navy Type 24223 Antenna Switch	2-65

SECTION 2-6. UHF ANTENNA INSTALLATIONS

2-59	UHF Antenna Arrangements	2-68
2-60	Recommended Clearances Around Radio and IFF Antennas	2-69
2-61	Recommended Clearances Around Radar and ECM Antennas	2-70
2-62	Typical UHF Installation..	2-71

SECTION 2-7. ANTENNA INSULATORS

2-63	Strain Insulators Types 61479 and 61481	2-75
2-64	Strain Insulators Types 61493 and 61494	2-76
2-65	Entrance Insulator Type 61471.....	2-77
2-66	Entrance Insulator Type 61019C	2-78
2-67	Entrance Insulator Type 61276A	2-79
2-68	Entrance Insulator Type 61475.....	2-80
2-69	Entrance Insulator Type 61303.....	2-81
2-70	Standoff Insulator Type 61174B	2-82
2-71	Standoff Insulators Types 61175A and 61176A	2-83
2-72	Standoff Insulator Type 61339	2-84
2-73	Feedthru Insulator Type 61428	2-85
2-74	Feedthru Insulator Type 61350	2-86
2-75	Feedthru Insulator Type 61335	2-87
2-76	Standoff Insulator Type 61664C	2-88
2-77	End Seal MX-1203/U.....	2-89
2-78	End Seal MX-1460/U.....	2-90
2-79	End Seal MX-1461/U.....	2-91
2-80	End Seal MX-1465/U.....	2-92

LIST OF TABLES

SECTION 2-2. WIRE ANTENNAS

Table	Page
2-1	Characteristics of Type C (6 x 19) Phosphor Bronze Wire Rope 2-2
2-2	Characteristics of Radio Antenna Wire..... 2-2
2-3	Antenna Clamps 2-8
2-4	List of Standard Antenna Wire and Fittings 2-29

SECTION 2-4. RECEIVING
ANTENNAS

2-5	List of Parts for Receiving Antenna Distribution System 2-46
2-6	Receiving Antenna Trans- fer Panels 2-50

SECTION 2-4. RECEIVING
ANTENNAS (cont'd)

Table	Page
2-7	Fittings Supplied with Antenna Transfer Panels 2-52

SECTION 2-5. TRANSMITTING
ANTENNAS

2-8	Typical Shipboard Radio Transmitting Antenna Systems 2-60
-----	---

SECTION 2-7. ANTENNA
INSULATORS

2-9	List of Standard Shipboard Radio Insulators 2-74
2-10	Replacement Bowls 2-75

SECTION 2-1

INTRODUCTION

1. GENERAL.

It has been said that communications are the heart of modern warfare. The antenna system is an extremely important part of the communications system. This has been demonstrated by the number of communications failures and operational difficulties in the fleet which were caused by the antenna system. Its importance warrants the best methods and procedures for initial installation and subsequent maintenance.

In recognition of the need for increased efficiency and reliability of shipboard antenna systems, the Bureau of Ships

instituted the antenna program. The major responsibility for formulating an efficient antenna system rests with the Bureau, where various engineering recommendations and equipment developments are coordinated into plans. The installing activities are responsible for converting these plans into actual installations. This phase is very important, as the effectiveness of an antenna system can be no better than the installation practices observed.

The purpose of this chapter is to present the recommended installation practices for shipboard antenna systems.

SECTION 2-2

WIRE ANTENNAS

1. GENERAL.

In comparison with past practice, wire antennas are not used as commonly today in shipboard radio antenna installations. This is evidenced by the increasing use of whip and dipole antenna assemblies. In some installations, wire antennas are used solely as emergency antenna systems.

A wire antenna consists of a wire rope suspended either vertically or horizontally from a yardarm or the mast itself to outriggers, another mast, or to the superstructure.

The following paragraphs discuss the fittings commonly used in wire antenna installations.

2. WIRE ROPE.

Antenna wire is usually a twisted, stranded, non-insulated, phosphor or silicon-bronze wire. Phosphor-bronze wire is used because of its corrosion-

resisting and non-magnetic properties. It has less strength than steel wire rope and, therefore, working loads should be less.

For transmitting wire antennas a 5/16" diameter, type C (6x19), phosphor-bronze wire rope is usually employed. (A 6x19 wire rope has six strands with nineteen wires per strand.)

For receiving wire antennas a 1/8" diameter, 7-#18, phosphor or silicon-bronze wire is used. (Consists of 7 strands of #18 wire.) In some cases, the phosphor-bronze wire is supplied with a vinylite insulating jacket.

The "General Installation Specifications for Shipboard Radio Transmitting Antenna Systems", RE 66A 430, sets up the following requirements for antenna wire:

a. 6x19 wire rope shall be in accordance with Navy Department Specification 22 R3.

TABLE 2-1. CHARACTERISTICS OF TYPE C (6x19) PHOSPHOR BRONZE WIRE ROPE

Nominal Diameter (Inches)	Maximum Allowable Diameter (Inches)	Approx. Circum. (Inches)	Approx. Weight Per Foot (Pounds)	Nominal Breaking Strength (Pounds)	Minimum Breaking Strength (Pounds)	Maximum Pitch (Inches)
5/16	11/32	1	0.16	3680	3310	2.11
3/8	13/32	1-1/8	0.23	5240	4720	2.53
7/16	15/32	1-1/4	0.32	7080	6370	2.96
1/2	17/32	1-1/2	0.41	9220	8300	3.38

b. 7-#18 wire shall be in accordance with Specification MIL-W-17211 (Ships).

c. Sizes may be varied slightly from those specified in order to suit special physical or electrical requirements or to correspond with sizes specified for an associated or adjacent antenna which may be used interchangeably.

d. Shall be one of continuous length from entrance insulator to the extreme end.

e. Shall be free from kinks, sharp bends, deformed spots and broken strands.

Table 2-1 shows some of the characteristics of a few of the more common sizes of Type C (6x19) phosphor-bronze wire rope.

Table 2-2 gives some characteristics for various sizes of radio antenna wire (uninsulated).

Before installation, the phosphor-bronze wire rope and the bare antenna wire should be coated with heavy petrolatum.

3. WIRE ROPE CONNECTORS.

A connector is used to terminate the antenna wire. These connectors (Fiege connectors) are supplied in two sizes: MX-1177/U for 1/8" diameter, 7-#18 antenna wire and MX-1178/U for 5/16" diameter, 6x19 wire rope (Figure 2-1). They are made of manganese bronze in accordance with Military Specification MIL-B-994 (Ships).

TABLE 2-2. CHARACTERISTICS OF RADIO ANTENNA WIRE

Wire Size	No. of Strands	Individual Strands		Pounds Per 1000 ft. (nominal)	Minimum Breaking Strength (lbs)	Elongation for a 60" length (percent)
		AWG Size	Nominal Diameter (inches)			
7-12	7	12	0.08081	139	3675	85
7-14	7	14	0.06408	87	2200	85
7-16	7	16	0.05082	55	1600	85
7-18	7	18	0.04030	35	1050	85
7-20	7	20	0.03196	22	650	85
7-22	7	22	0.02535	13.5	420	85

INSTALLATION
METHODS

NAVSHIPS 900.121(A)

Section 2-2

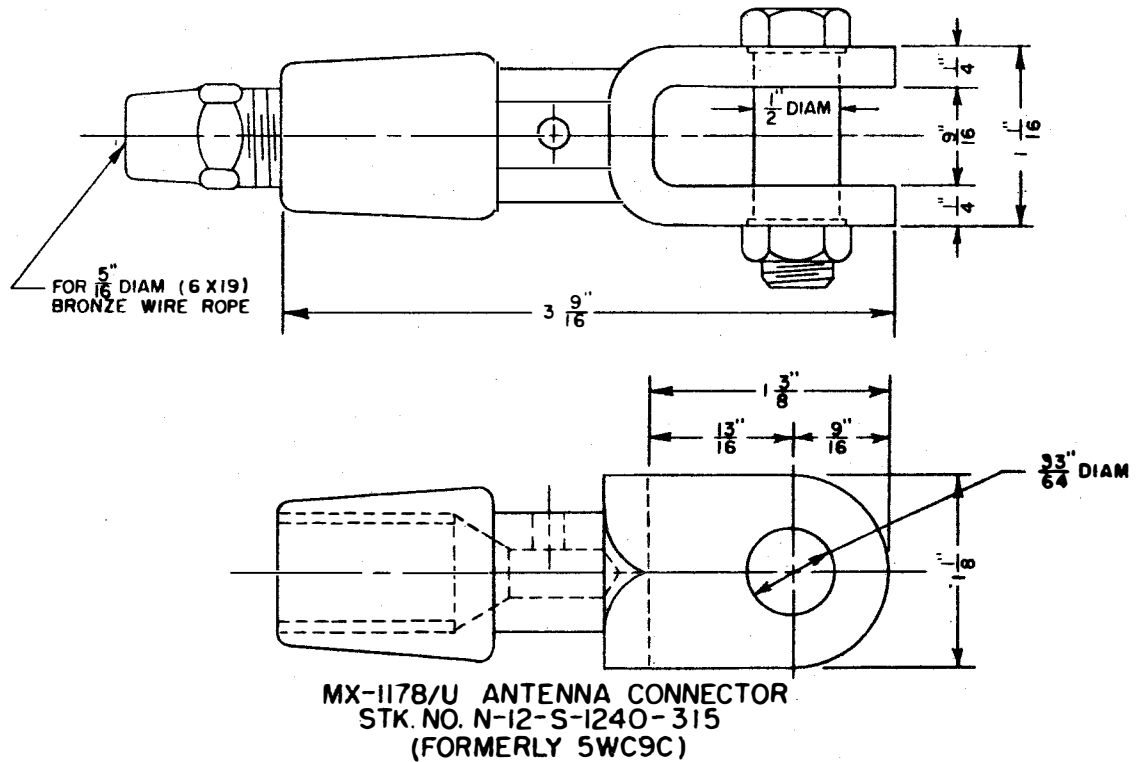
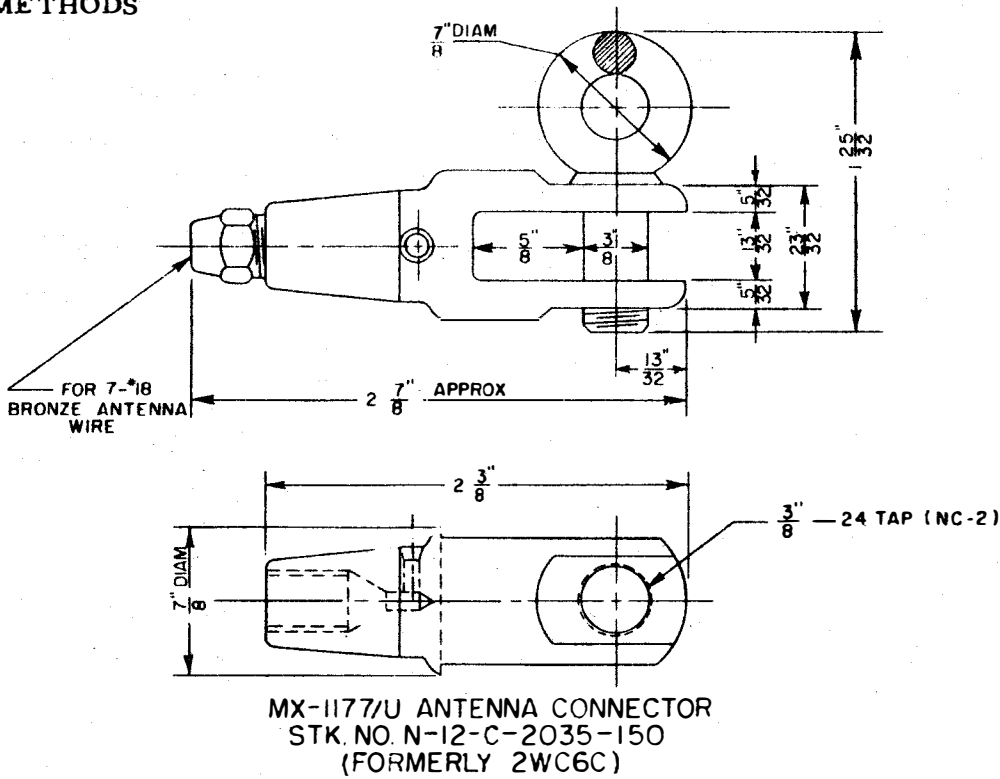


Figure 2-1. Wire Rope Connectors for Shipboard Antenna Systems

a. INSTRUCTIONS FOR INSTALLING ANTENNA CONNECTOR MX-1177/U ON 7-#18 BRONZE ANTENNA WIRE. (Figures 2-2 through 2-7.)

(1) Remove insulation, if any, and grip the strand vertically in a vise with copper-lined jaws. If there is only one seizing in use, apply a second seizing as shown.

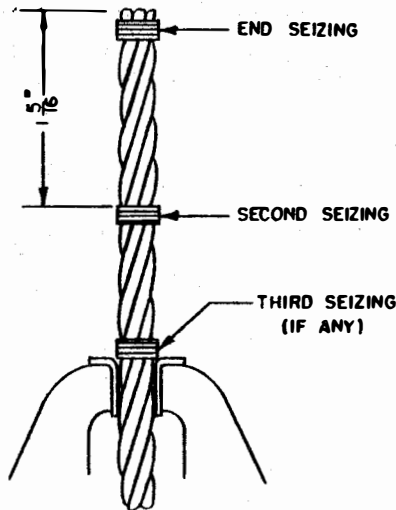


Figure 2-2. Step 1, MX-1177/U

(2) Before applying the sleeve, drive the end of the seizing close enough to the end of the strand so the sleeve can be

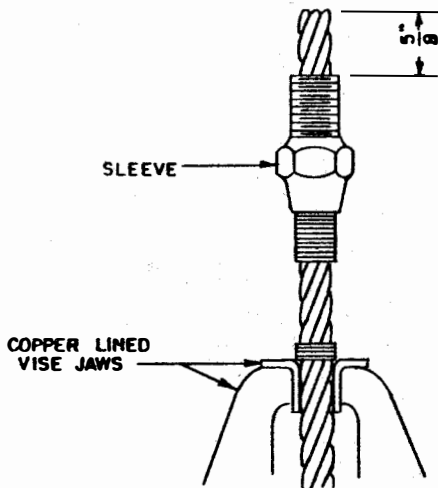


Figure 2-3. Step 2, MX-1177/U

easily started over it. Using a bar of copper or a piece of hardwood to protect the edge of the sleeve, drive the sleeve and seizing down along the strand until it projects to the dimension shown. With the socket screwed on a few turns, most of the required distance can be obtained by hammering the end of the fitting.

(3) Grip the strand in the vise over the seizing so the end of the sleeve bears solidly against the vise jaws. Fan out the wires so they are untwisted and project straight from the sleeve. Untwist

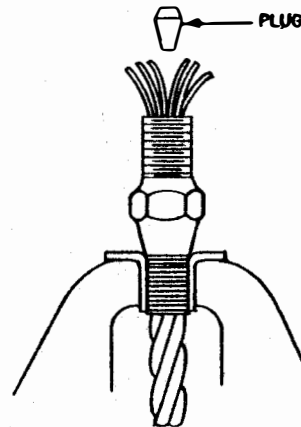


Figure 2-4. Step 3, MX-1177/U

the wires with pliers so they open out as far as possible to form a symmetrical rosette and apply the plug.

(4) Provide a round bar of steel with the end faced off square. Apply this punch and drive the plug down to a moderate seat sufficient to hold the strand, sleeve and plug safely together, then grip the sleeve securely in the vise by the hex. Drive the plug in solidly, making sure that it goes down as far as possible.

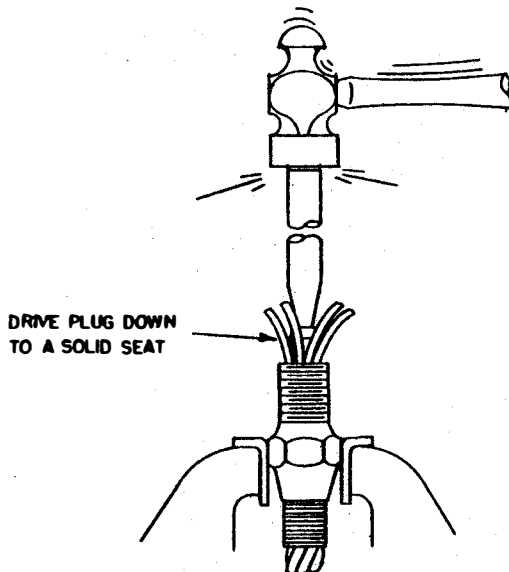


Figure 2-5. Step 4, MX-1177/U

(5) With the fingers, bend all wires together behind the plug; or if necessary again apply a temporary one-turn seizing wire and tighten with pliers to get all wires entered in the open end of the socket. After the wires have entered the socket, remove the temporary seizing. Then push and twist the socket down to the sleeve until the threads are engaged. Screw the socket down firmly.

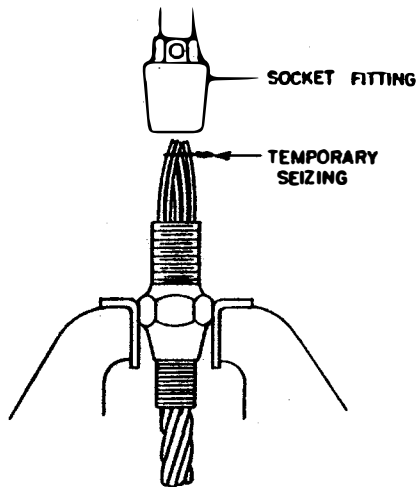


Figure 2-6. Step 5, MX-1177/U

If properly installed, there will be only one or two threads visible on the sleeve. Remove all seizings.

(6) View the Fiege twist at the inspection hole. If the installation has been properly made, the wires will be fully visible and twisted across the inspection hole at an angle to the axis of the rope and the fittings.

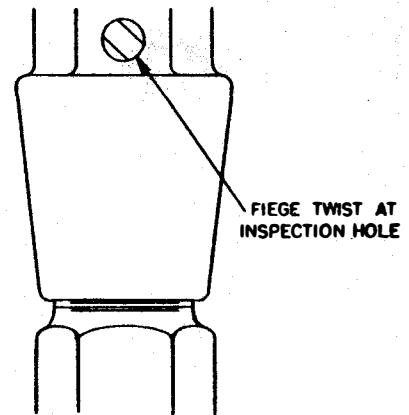


Figure 2-7. Step 6, MX-1177/U

b. INSTRUCTIONS FOR INSTALLING ANTENNA CONNECTOR MX-1178/U ON 5/16" DIAMETER (6x19) BRONZE WIRE ROPE. (Figures 2-8 through 2-16.)

(1) Grip the rope vertically in a vise with copper-lined jaws. If there is only one seizing in use, apply a second seizing as shown.

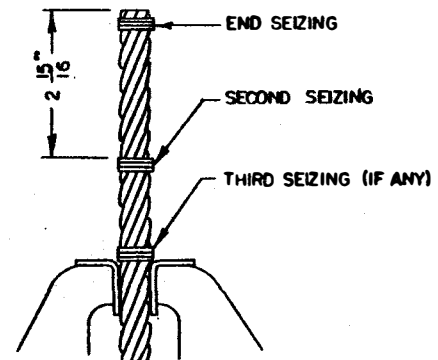


Figure 2-8. Step 1, MX-1178/U

(2) Before applying the sleeve, drive the end seizing close enough to the end of the rope so the sleeve can be easily started over it. Using a bar of copper or a piece of hardwood to protect the edge of the sleeve, drive the sleeve and the seizings down along the rope until it projects to the dimension shown. With the socket screwed on a few turns, most of the required distance can be obtained by hammering the end of the fitting.

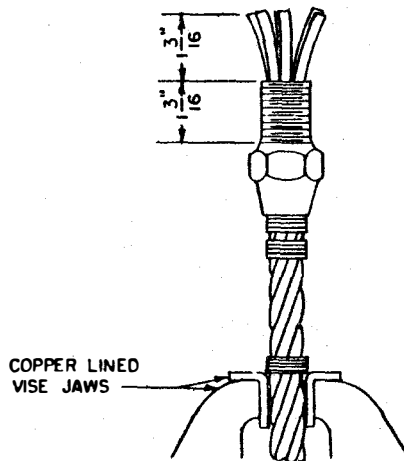


Figure 2-9. Step 2, MX-1178/U

(3) After the seizings have been driven to the correct location, grip the rope in the vise just below the seizings and remove the sleeve temporarily. Pull the hemp center out to one side between strands far enough so that it can be cut off to the dimension shown. Then push the hemp stub back into the center of the rope.

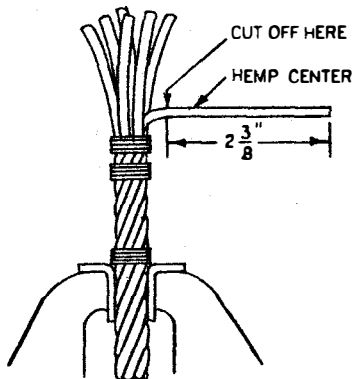


Figure 2-10. Step 3, MX-1178/U

(4) Apply the sleeve as follows: with the fingers or with a temporary one-turn seizing wire tightened with pliers, compress the strands together at the top until the sleeve can be twisted and pushed over the rope. Remove the temporary seizing and force the sleeve down to the original seizing.

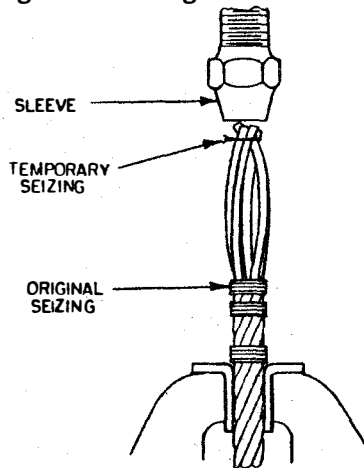


Figure 2-11. Step 4, MX-1178/U

(5) Grip the rope in the vise over the seizing so the end of the sleeve bears solidly against the vise jaws. Before beginning to broom out the wires, sharpen a length of stiff steel or copper wire and anchor the point in the top of the hemp stub. Its length should be a few inches longer than the projecting rope end. The purpose of this pilot wire is to facilitate finding the center of the rope after the strands have been broomed out, as will be apparent in paragraph (7).

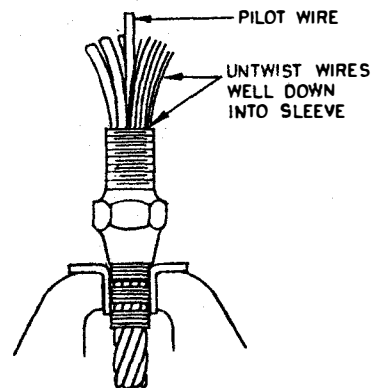


Figure 2-12. Step 5 & 6, MX-1178/U

(6) Broom out all strands by untwisting them with pliers. It may be convenient to use two short pieces of stiff wire inserted behind a strand to isolate it from the others while it is being worked on. Be sure the strand is untwisted well down into the sleeve. Remove the rope from the vise. It is best to thoroughly wash out all grease in gasoline. Use a bottle brush with which to penetrate well down into the sleeve between all wires as far as possible.

(7) The plug can be more easily installed and will be better-centered, if the following procedure is used. Provide a round bar of steel with a hole lengthwise through the axis and with a point somewhat more blunt than the center plug and slightly rounded. Drive this centering punch down over the pilot wire into the center of the broomed-out strands to a solid seat. This will give the wires enough set to insure the plug finding the center position for final assembly.

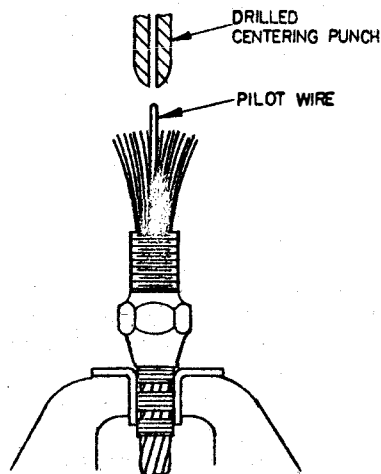


Figure 2-13. Step 7, MX-1178/U

(8) Remove first the pilot wire, then the centering punch, taking care to disturb the set of wires behind it as little as possible. Insert the solid plug and with a hammer and ordinary punch drive the plug down to a moderate seat sufficient to hold the rope, sleeve and plug safely together. Then grip the sleeve securely in the vise by the hex. Drive the plug in solidly, making sure that it goes down as far as possible.

ORIGINAL

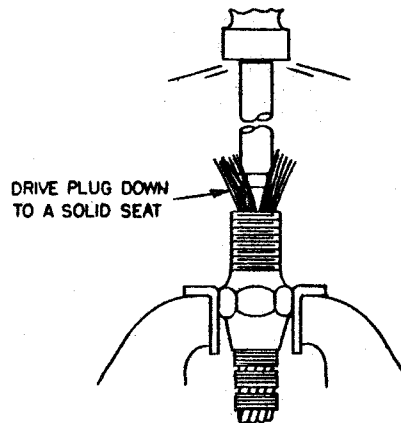


Figure 2-14. Step 8, MX-1178/U

(9) With the fingers, bend all wires together behind the plug; or, if necessary, again apply a temporary one turn seizing wire and tighten with pliers to get all wires entered in the open end of the socket. After the wires have entered the socket, remove the temporary seizing. Push and twist the socket down to the sleeve until the threads are engaged. Screw the socket down firmly. If properly installed, there will be only one or two threads visible on the sleeve. Remove all seizings..

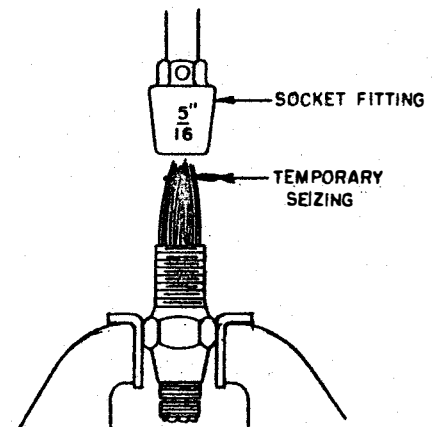


Figure 2-15. Step 9, MX-1178/U

(10) View the Fiege twist at the inspection hole. If the installation has been properly made, the wires will be fully visible and twisted across the inspection hole at an angle to the axis of the rope and fittings.

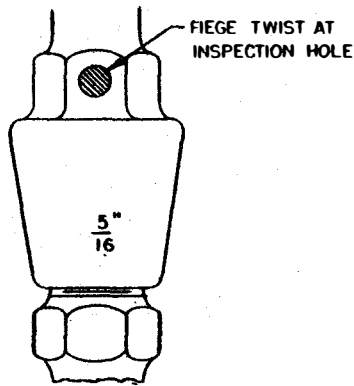


Figure 2-16. Step 10, MX-1178/U

4. ANTENNA CLAMPS.

Antenna clamps of appropriate types and size are utilized in the fabrication of all wire antennas to insure continuity of the conducting wire or cable. A clamp is used when necessary to change the direction of the wire. These antenna clamps are made of cast bronze in accordance with Military Specification MIL-B-16443. The required size and quantity of hexagon head bronze studs and split lockwashers are furnished with each clamp.

TABLE 2-3. ANTENNA CLAMPS

Type of Clamp	Navy Type Number (For 1/8" wire)	Navy Type Number (For 5/16" wire)
135°	10678*(A-2)	10684*(A-5)
90°	10679 (B-2)	10685 (B-5)
45°	10680 (C-2)	10686 (C-5)
180°	10681 (D-2)	10687 (D-5)
180°	10682 (E-2)	10688 (E-5)
TEE	10683 (F-2)	10689 (F-5)

* The figures in parentheses are the designations formerly used for these clamps.

Each type of clamp is supplied in two sizes: for 1/8" diameter antenna wire (Figure 2-17) and for 5/16" diameter wire rope (Figure 2-18). The Navy Type Numbers for the various types of antenna clamps used with these two sizes of antenna wire are given in Table 2-3.

5. ANTENNA TURNBUCKLES.

Turnbuckles are used in wire antenna installations to take up any excessive slack which develops in the wire after the antenna has been installed. There are four standard turnbuckles that are used in wire antenna installations. MX-1184/U and MX-1176/U are used with 5/16" diameter wire rope (Figure 2-19); MX-1179/U and MX-1180/U are used with 1/8" diameter wire (Figure 2-20).

The MX-1184/U and MX-1179/U turnbuckles have a clevis on one end and a Fiege connector on the other end. The MX-1176/U and MX-1180/U have a clevis on each end.

These turnbuckles are made of manganese bronze.

6. SHACKLES.

There are two standard sizes of shackles used in wire antenna installations: 5/16" and 7/16". These shackles are made of cast bronze. A shackle is used to secure a strain insulator to a padeye, staple or antenna clamp. A 5/16" shackle is used with 5" and 10" strain insulators; a 7/16" shackle is used with 15" and 20" strain insulators (Figure 2-21).

7. STAPLES AND PADEYES.

Staples and padeyes are used in wire antenna systems to provide a means of attaching the wire antenna to the mast or other point of support. They are usually fabricated from steel by the installing activity.

ORIGINAL

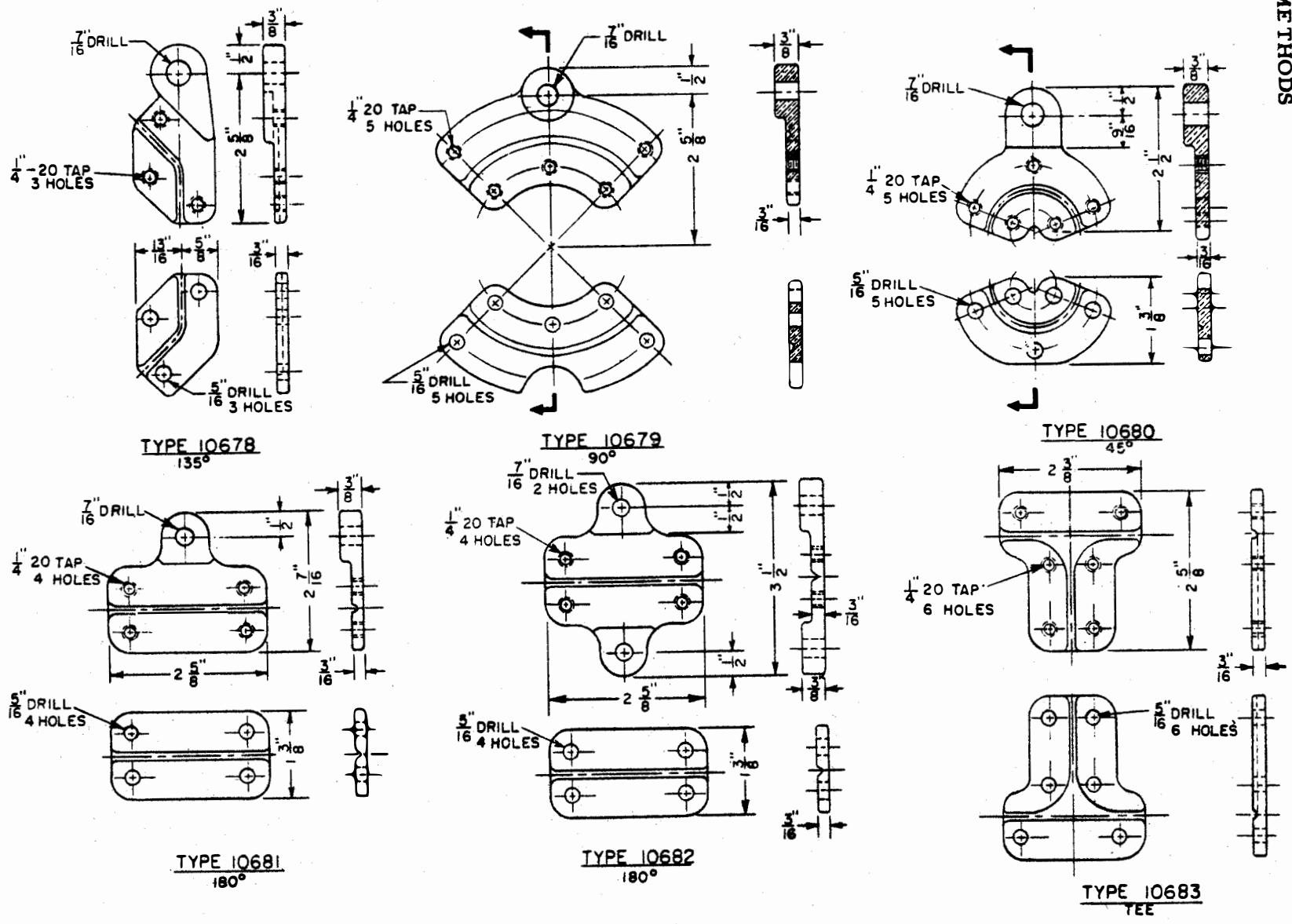


Figure 2-17. Antenna Clamps for 7-#18 Antenna Wire

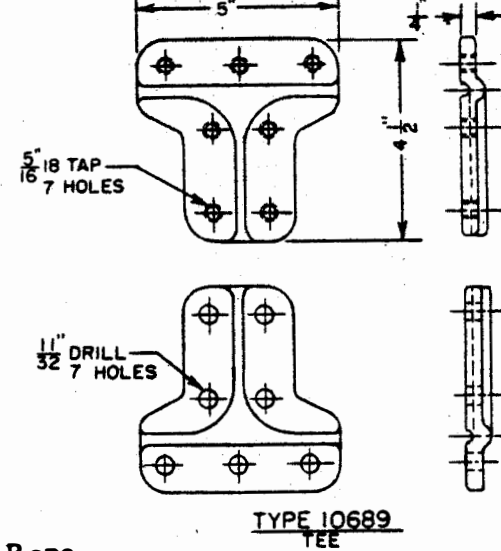
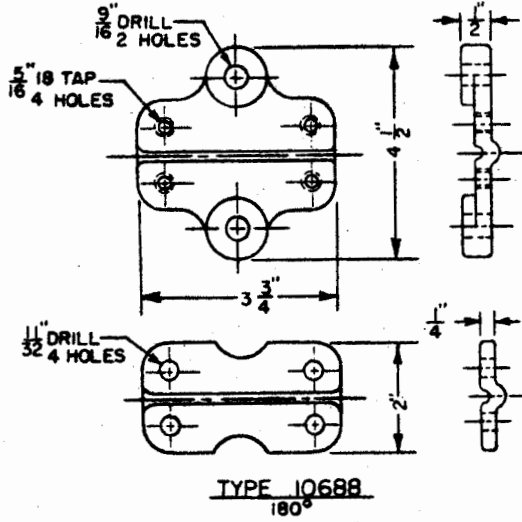
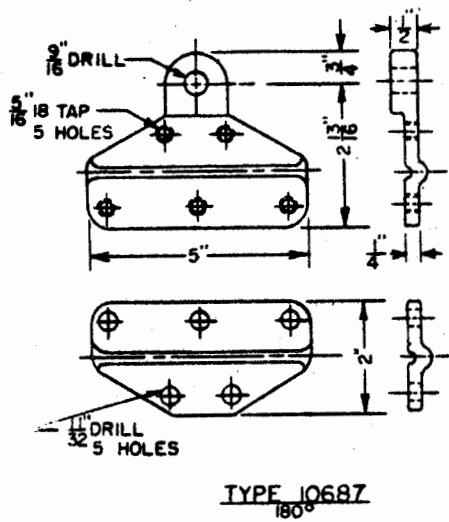
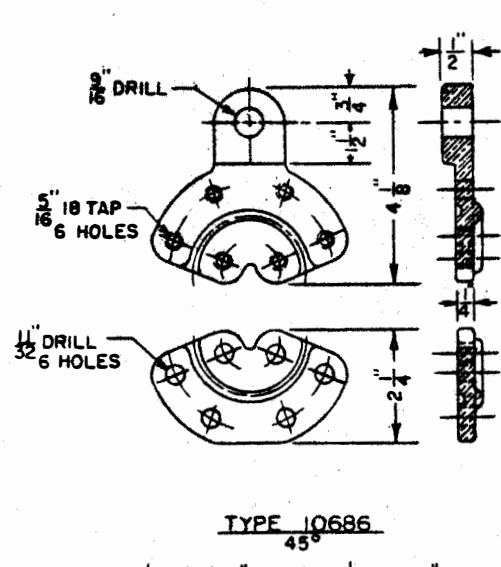
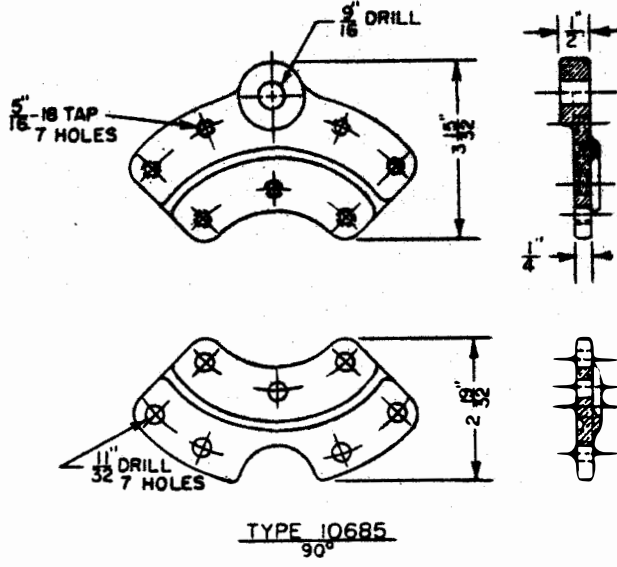
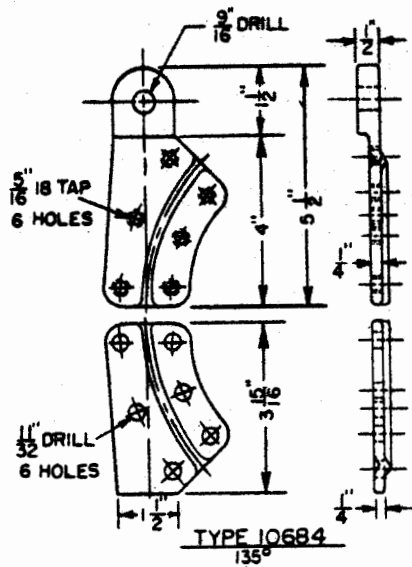
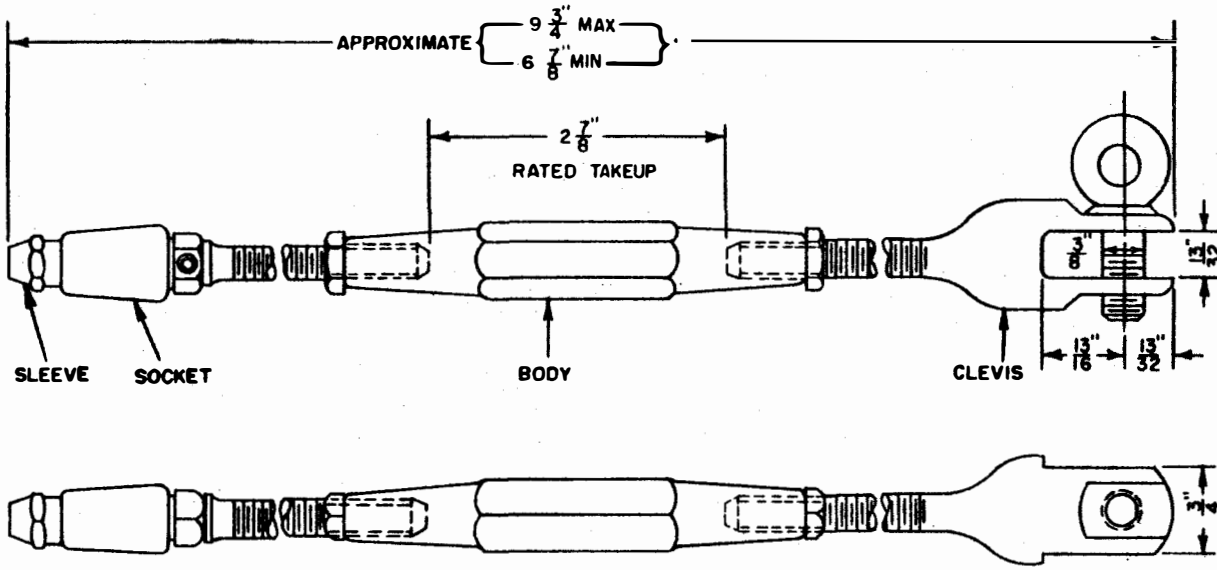
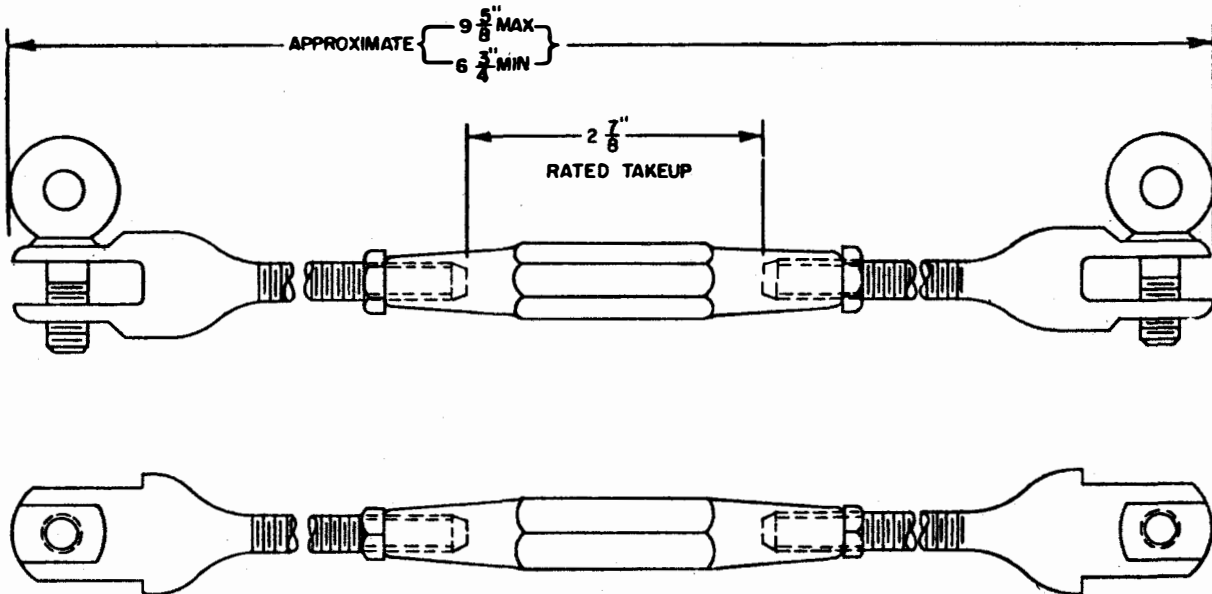


Figure 2-18. Antenna Clamps for 5/16" (6x19) Wire Rope

ORIGINAL

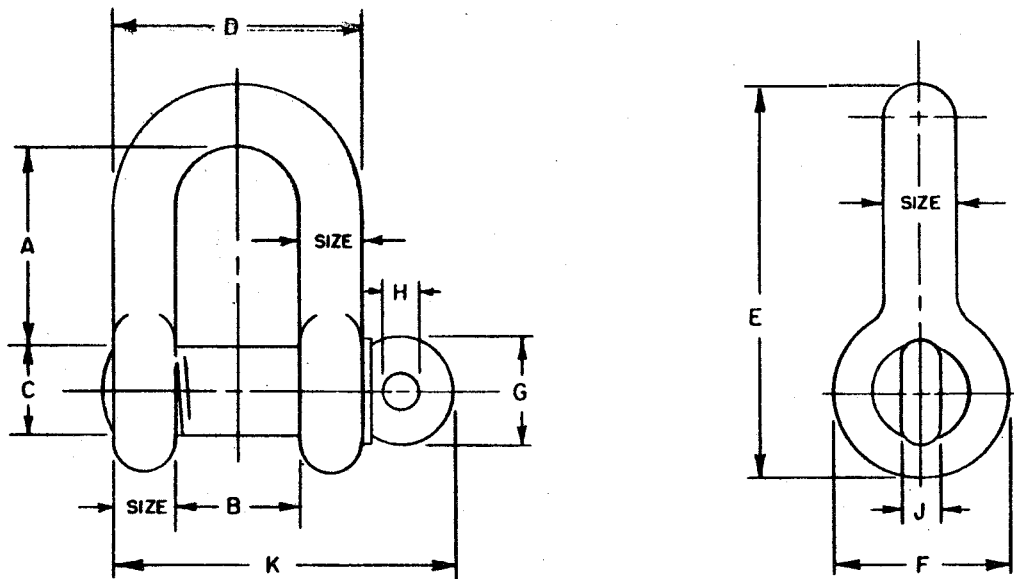


MX-1179/U ANTENNA TURNBUCKLE
(FORMERLY 2WT6C)



MX-1180/U ANTENNA TURNBUCKLE
(FORMERLY 6CT6C)

Figure 2-20. Turnbuckles for Use With 7-#18 Antenna Wire



Size	A ±1/16	B ±1/32	C	D	E	F	G	H		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 in inches.

Figure 2-21. Screw-Pin Shackles for Radio Antenna Systems

8. SAFETY LINKS.

Safety links in accordance with BuShips drawing RE 10C 2112 shall be installed in all horizontal wire-rope transmitting antennas which are rigged to stayed masts or structures. The safety link is usually at the highest point of connection of the wire antenna.

Often times dangerous voltages and currents exist on transmitting antennas. If the wire rope used for the transmitting antennas should break and fall to the deck, it would present a hazard to personnel. Additional stresses are introduced into a wire antenna by heavy winds, ice accumulation on the wire, and whipping of the wire. This additional load on the wire may produce a dangerous load condition on the mast or supporting structure. For this reason, a safety link is inserted into the wire antenna. The link is usually designed so that it has a breaking strength of about 1/4 the breaking strength of the wire rope used for the antenna. A safety pendant is provided in the safety link; so that when the link breaks the pendant will carry the load of the antenna and prevent the antenna from falling to the deck. The length of the safety pendant should be such that when fully extended the antenna will not foul adjacent rigging or structures. (See Figure 2-22.)

The safety pendant is held with a light seizing to permit free run of the wire rope when safety link breaks.

The safety link is fabricated by the installing activity according to BuShips drawing RE 10C 2112. The 7 strands of #18 phosphor-bronze antenna wire shown for the safety link is the minimum size. It has a breaking strength of 1050 pounds (approx). Larger wire of suitable breaking strength may be used according to requirements.

9. WIRE ANTENNA DETAILS.

The following paragraphs describe a nomenclature system which was set up in order to simplify drawings, specifications and any written material pertaining to the rigging of wire antennas.

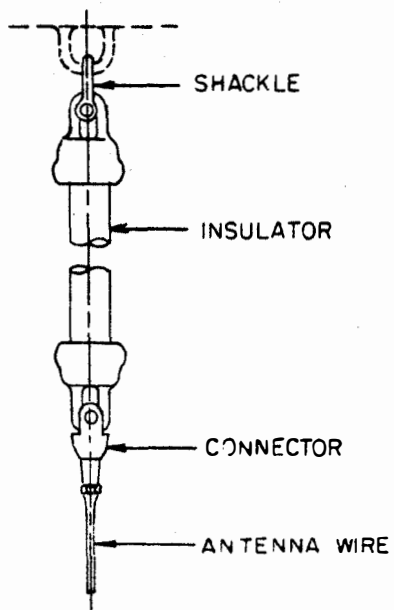
Each detail or drawing in this system is identified by a letter and a number. This letter represents the arrangement of parts in the detail, and the number indicates the size of the components. For example, details D1 and D4 have the same arrangement of parts, but the size of the wire, insulator and fittings vary.

In general, there are two sizes of fittings and four sizes of insulators. Details numbered 1 and 2 use 1/8" wire and fittings with 5" and 10" insulators. Numbers 3, 4 and 5 indicate 5/16" wire and fittings with 10", 15" and 20" insulators. The number 6 is used for details having both sizes of fittings.

Letters A to W inclusive apply to details with strain insulators. The letter X is used for conductor terminations, Y for junctions, and Z for miscellaneous items such as the padeye. These details are shown in Figures 2-23 through 2-35.

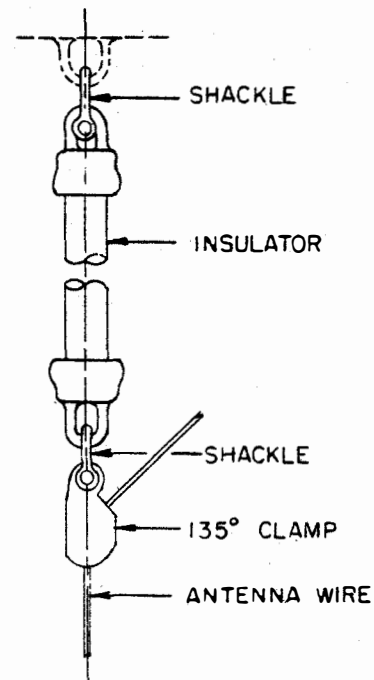
The piece numbers given in the table on each detail refer to more detailed information given in the List of Materials. Table 2-4.

An example of this nomenclature system applied to a typical antenna installation drawing is shown in Figure 2-36.



A

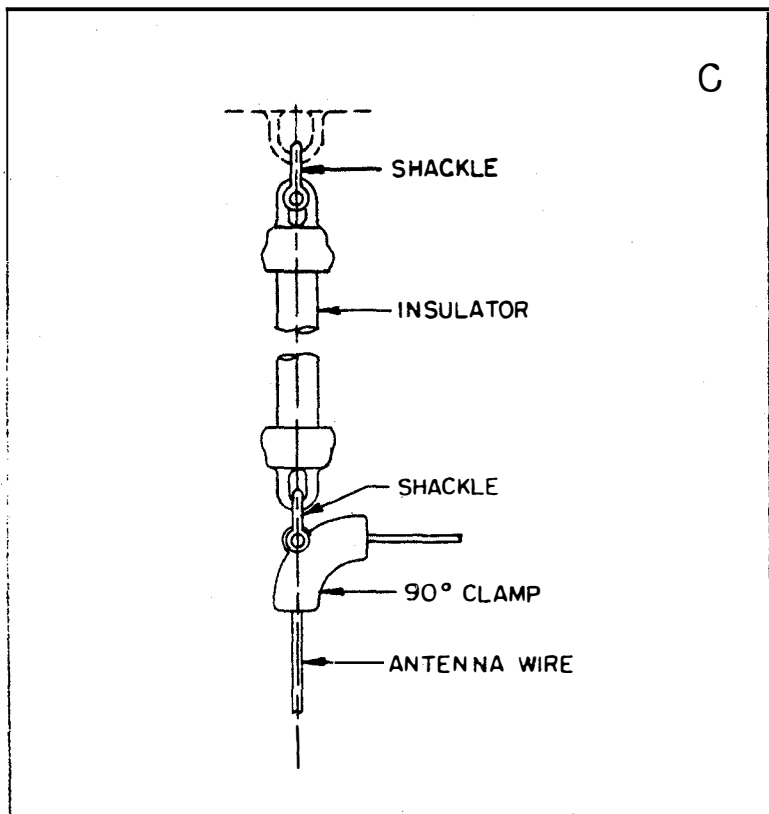
DETAIL	A1		A2		A3		A4		A5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
	Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6
Conn'r.	1/8	7	1/8	7	5/16	8	5/16	8	5/16	8
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2



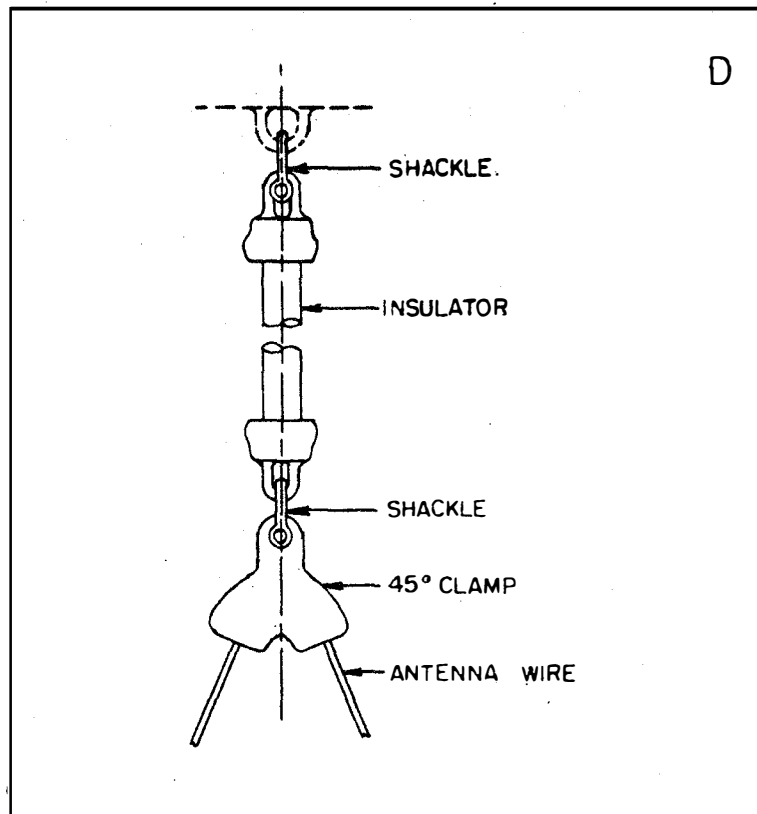
B

DETAIL	B1		B2		B3		B4		B5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
	Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6
Clamp	1/8	13	1/8	13	5/16	19	5/16	19	5/16	19
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2

Figure 2-23. Wire Antenna Details - (Details A and B)

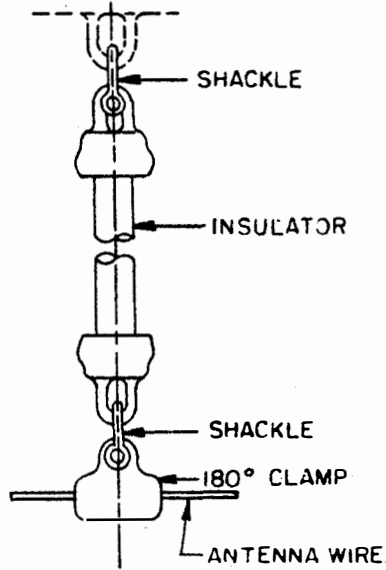


DETAIL	C1		C2		C3		C4		C5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6
Clamp	1/8	14	1/8	14	5/16	20	5/16	20	5/16	20
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2



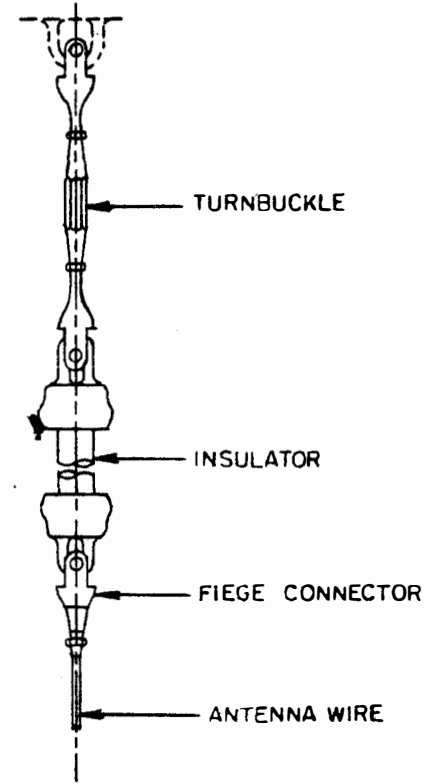
DETAIL	D1		D2		D3		D4		D5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6
Clamp	1/8	15	1/8	15	5/16	21	5/16	21	5/16	21
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2

Figure 2-24. Wire Antenna Details - (Details C and D)



E

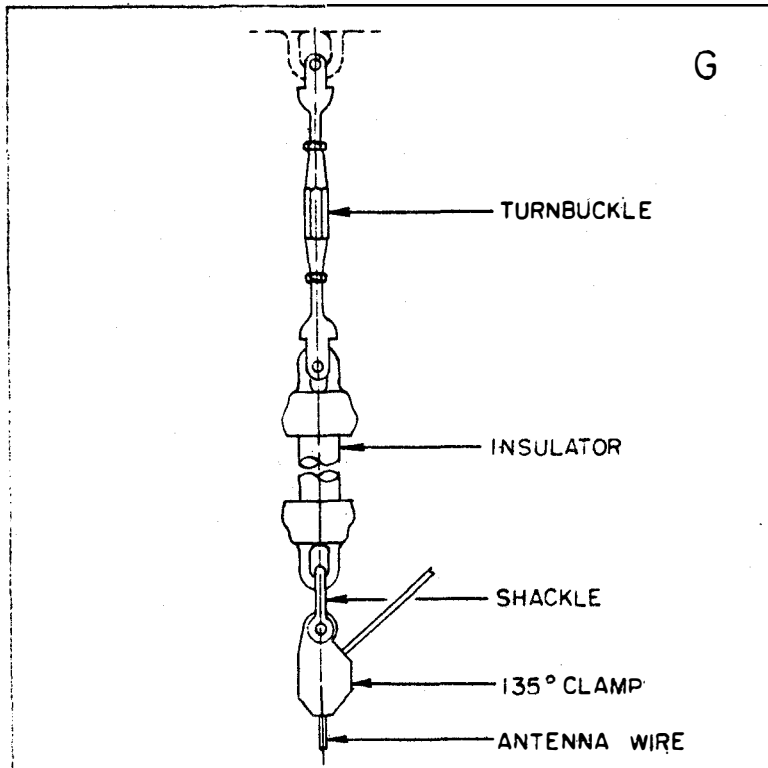
DETAIL	E1		E2		E3		E4		E5	
	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6
Clamp	1/8	16	1/8	16	5/16	22	5/16	22	5/16	22
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2



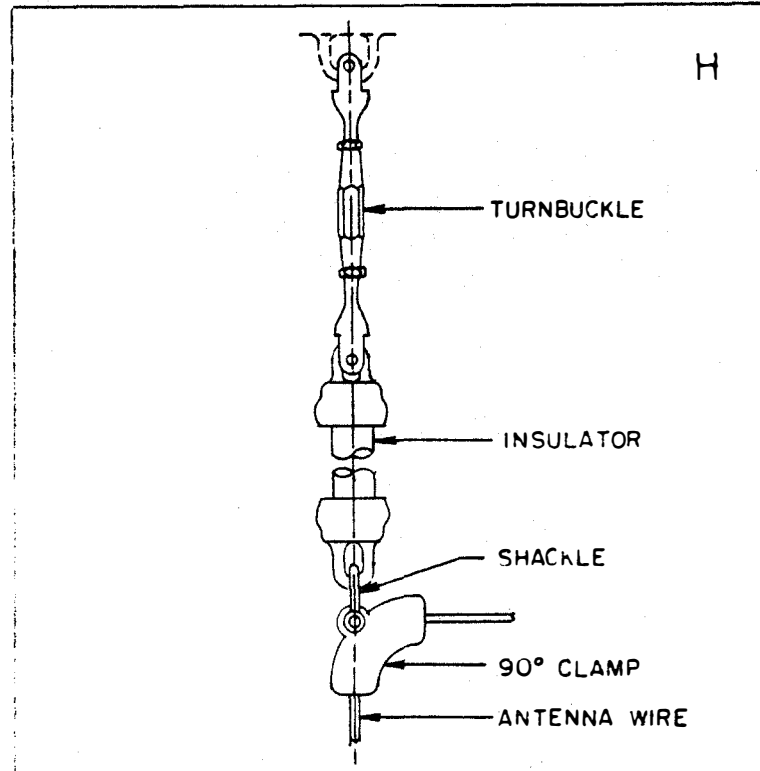
F

DETAIL	F1		F2		F3		F4		F5	
	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Turnb.	1/8	11	1/8	11	5/16	12	5/16	12	5/16	12
Insul'r.	5	3	10	4	10	4	15	5	20	6
Conn'r.	1/8	7	1/8	7	5/16	8	5/16	8	5/16	8
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2

Figure 2-25. Wire Antenna Details - (Details E and F)

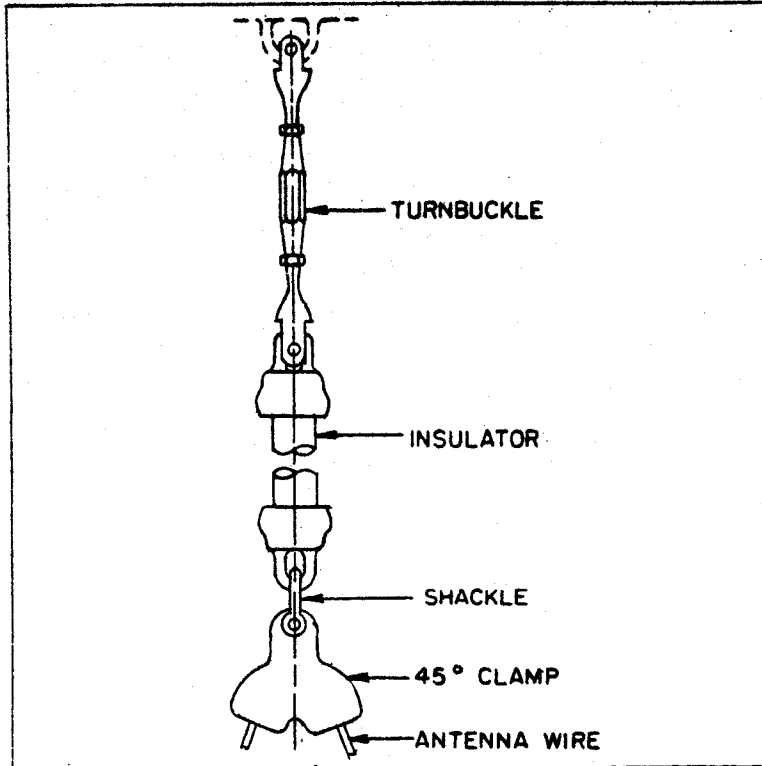


DETAIL	G1		G2		G3		G4		G5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Turnb.	1/8	11	1/8	11	5/16	12	5/16	12	5/16	12
Insul'r.	5	3	10	4	10	4	15	5	20	6
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Clamp	1/8	13	1/8	13	5/16	19	5/16	19	5/16	19
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2

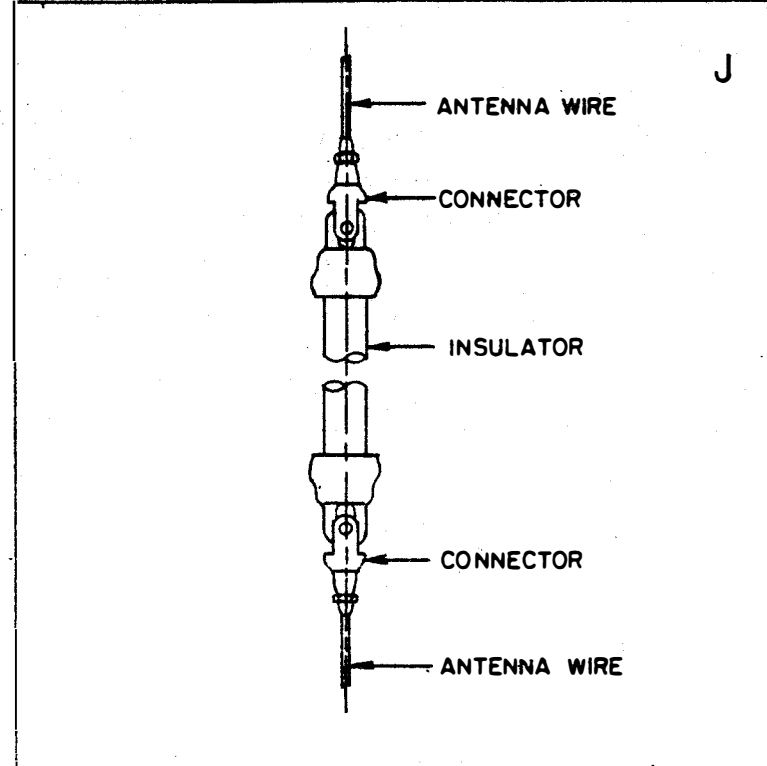


DETAIL	H1		H2		H3		H4		H5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Turnb.	1/8	11	1/8	11	5/16	12	5/16	12	5/16	12
Insul'r.	5	3	10	4	10	4	15	5	20	6
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Clamp	1/8	14	1/8	14	5/16	20	5/16	20	5/16	20
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2

Figure 2-26. Wire Antenna Details - (Details G and H)

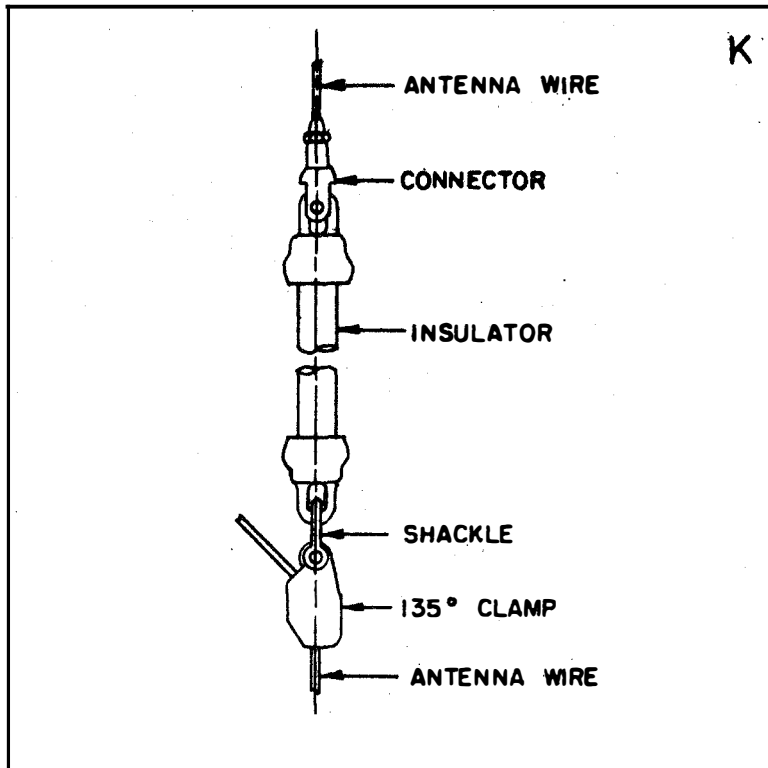


DETAIL	I1		I2		I3		I4		I5	
Sizes Nom'l. (inches)	Size	Pc. No.	Size	Pc. No.	Size	Pc. No.	Size	Pc. No.	Size	Pc. No.
Turnb.	1/8	11	1/8	11	5/16	12	5/16	12	5/16	12
Insul'r.	5	3	10	4	10	4	15	5	20	6
Shack.	5/16	25	5/16	25	3/16	25	7/16	26	7/16	26
Clamp.	1/8	15	1/8	15	5/16	21	5/16	21	5/16	21
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2

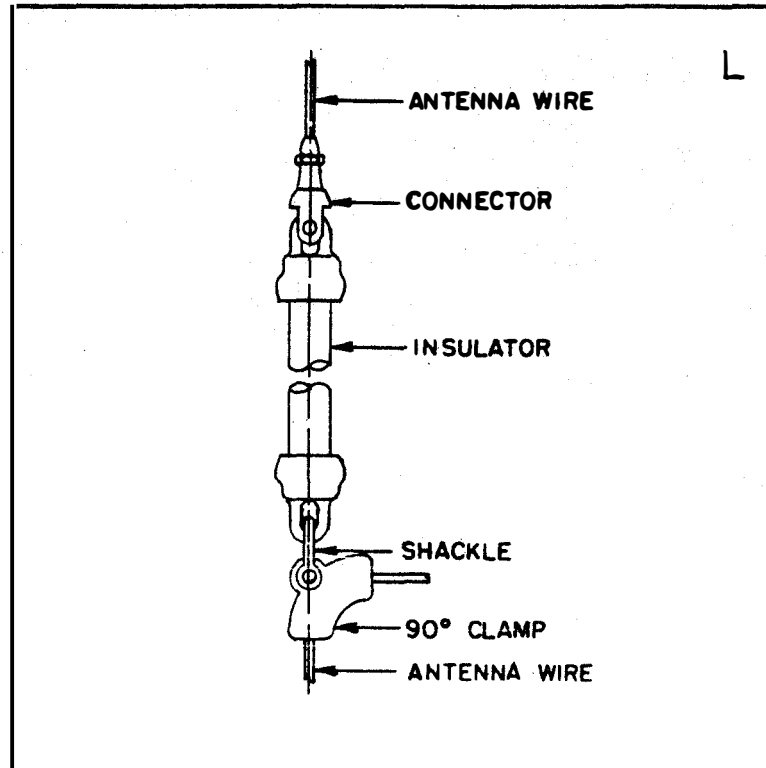


DETAIL	J1		J2		J3		J4		J5	
Sizes Nom'l. (inches)	Size	Pc. No.	Size	Pc. No.	Size	Pc. No.	Size	Pc. No.	Size	Pc. No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2
Conn'r.	1/8	7	1/8	7	5/16	8	5/16	8	5/16	8
Insul'r.	5	3	10	4	10	4	15	5	20	6

Figure 2-27. Wire Antenna Details - (Details I and J)

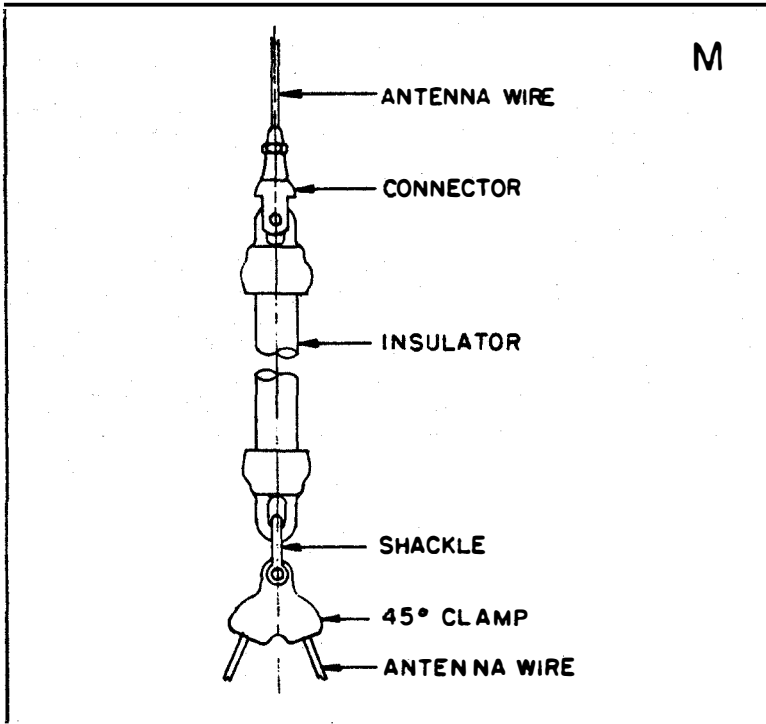


DETAIL	K1		K2		K3		K4		K5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2
Conn'r.	1/8	7	1/8	7	5/16	8	5/16	8	5/16	8
Insul'r.	5	3	10	4	10	4	15	5	20	6
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Clamp	1/8	13	1/8	13	5/16	19	5/16	19	5/16	19

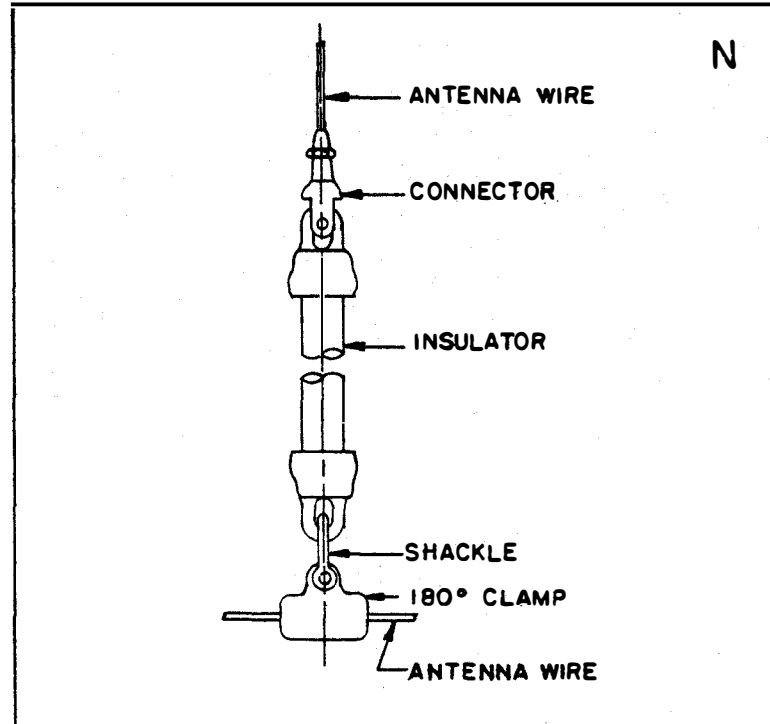


DETAIL	L1		L2		L3		L4		L5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2
Conn'r.	1/8	7	1/8	7	5/16	8	5/16	8	5/16	8
Insul'r.	5	3	10	4	10	4	15	5	20	6
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Clamp	1/8	14	1/8	14	5/16	25	5/16	20	5/16	20

Figure 2-28. Wire Antenna Details - (Details K and L)

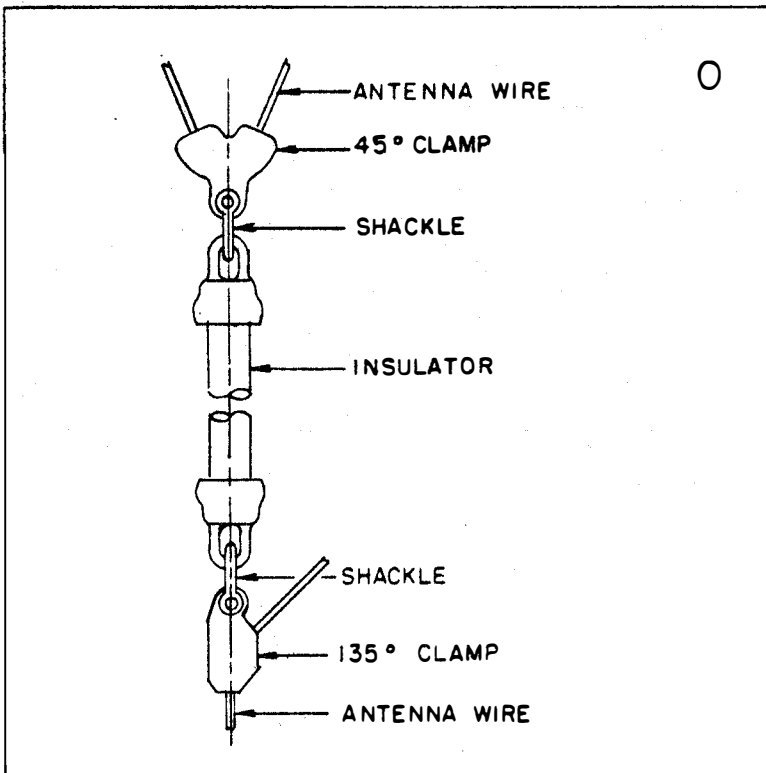


DETAIL	M1		M2		M3		M4		M5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2
Conn'r.	1/8	7	1/8	7	5/16	8	5/16	8	5/16	8
Insul'r.	5	3	10	4	10	4	15	5	20	6
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Clamp	1/8	15	1/8	15	5/16	21	5/16	21	5/16	21

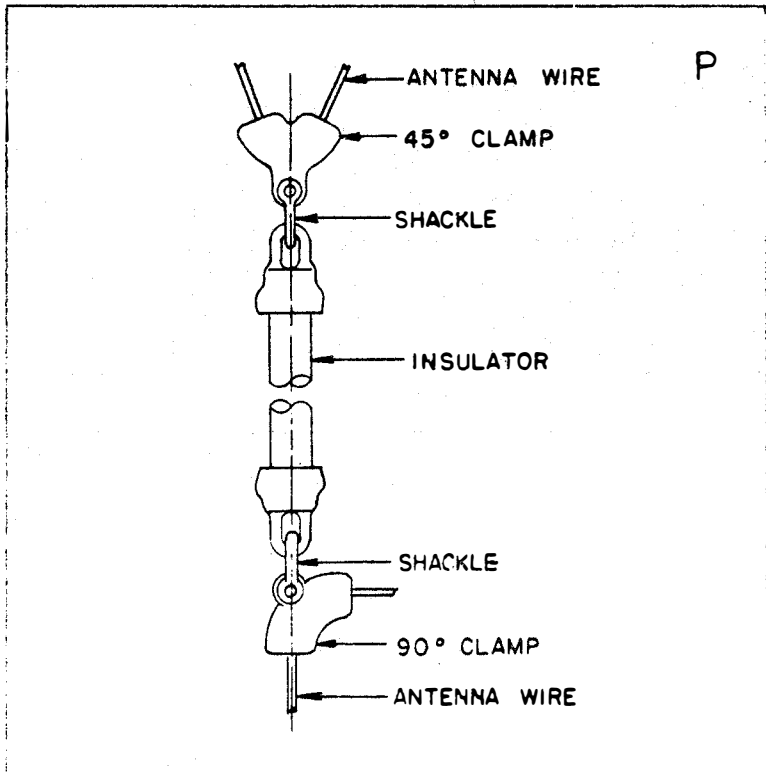


DETAIL	N1		N2		N3		N4		N5		N6	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2	1/8	1
Conn'r.	1/8	7	1/8	7	5/16	8	5/16	8	5/16	8	1/8	7
Insul'r.	5	3	10	4	10	4	15	5	20	6	20	6
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26	7/16	26
Clamp	1/8	16	1/8	16	5/16	22	5/16	22	5/16	22	5/16	22
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2	5/16	2

Figure 2-29. Wire Antenna Details - (Details M and N)

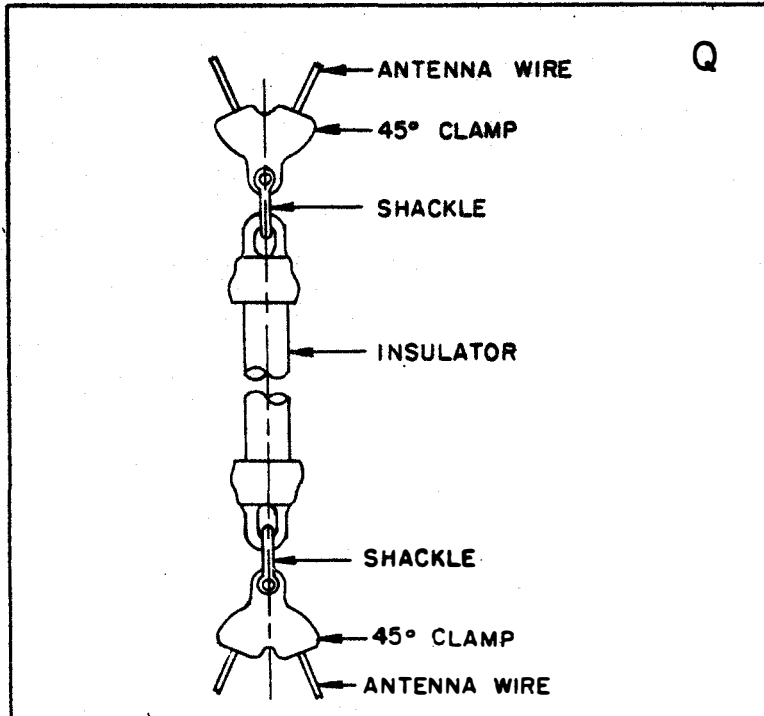


DETAIL	O1		O2		O3		O4		O5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2
Clamp	1/8	15	1/8	15	5/16	21	5/16	21	5/16	21
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6
Clamp	1/8	13	1/8	13	5/16	19	5/16	19	5/16	19

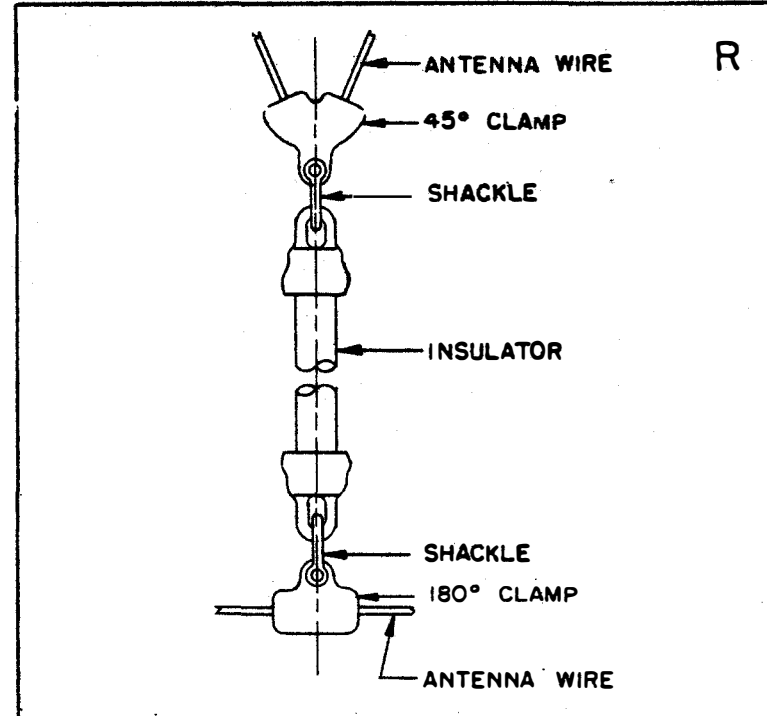


DETAIL	P1		P2		P3		P4		P5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2
Clamp	1/8	15	1/8	15	5/16	21	5/16	21	5/16	21
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6
Clamp	1/8	14	1/8	14	5/16	20	5/16	20	5/16	20

Figure 2-30. Wire Antenna Details - (Details O and P)

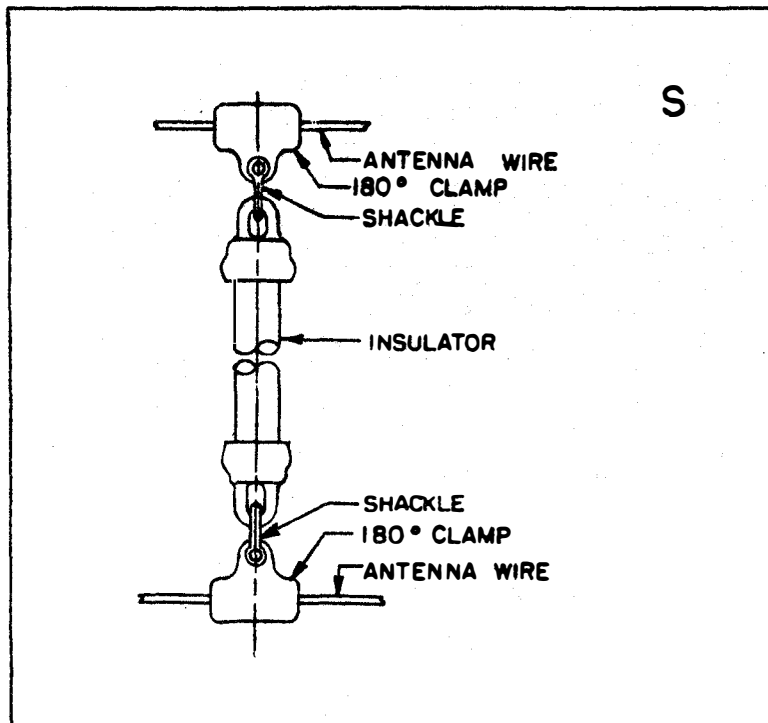


DETAIL	Q1		Q2		Q3		Q4		Q5	
	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2
Clamp	1/8	15	1/8	15	5/16	21	5/16	21	5/16	21
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6

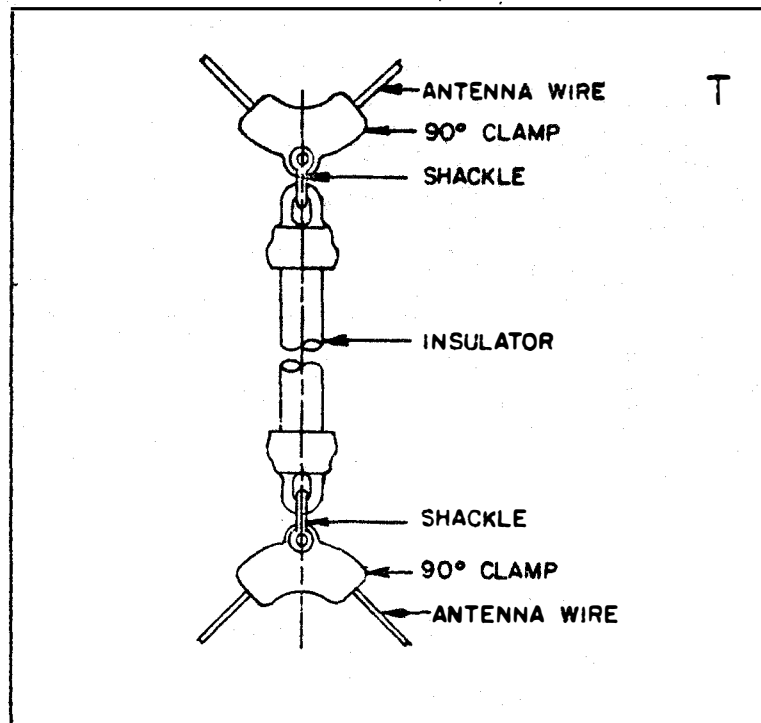


DETAIL	R1		R2		R3		R4		R5		R6	
	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2	1/8	1
Clamp	1/8	15	1/8	15	5/16	21	5/16	21	5/16	21	1/8	15
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6	20	6
Clamp	1/8	16	1/8	16	5/16	22	5/16	22	5/16	22	5/16	22
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2	5/16	2

Figure 2-31. Wire Antenna Details - (Details Q and R)

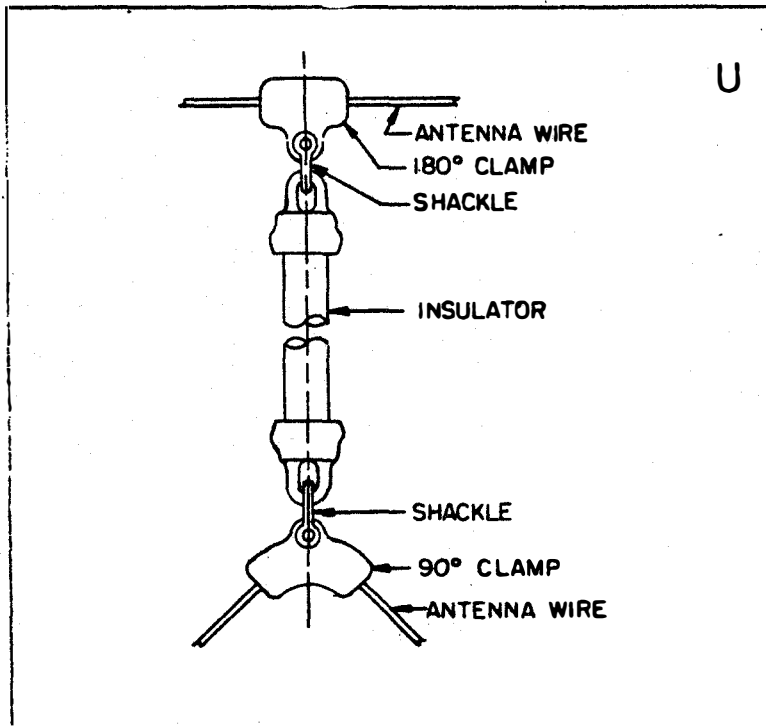


DETAIL	S1		S2		S3		S4		S5		S6	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2	1/8	1
Clamp	1/8	16	1/8	16	5/16	22	5/16	22	5/16	22	1/8	16
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6	20	6
Clamp	1/8	16	1/8	16	5/16	22	5/16	22	5/16	22	5/16	22
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2	5/16	2

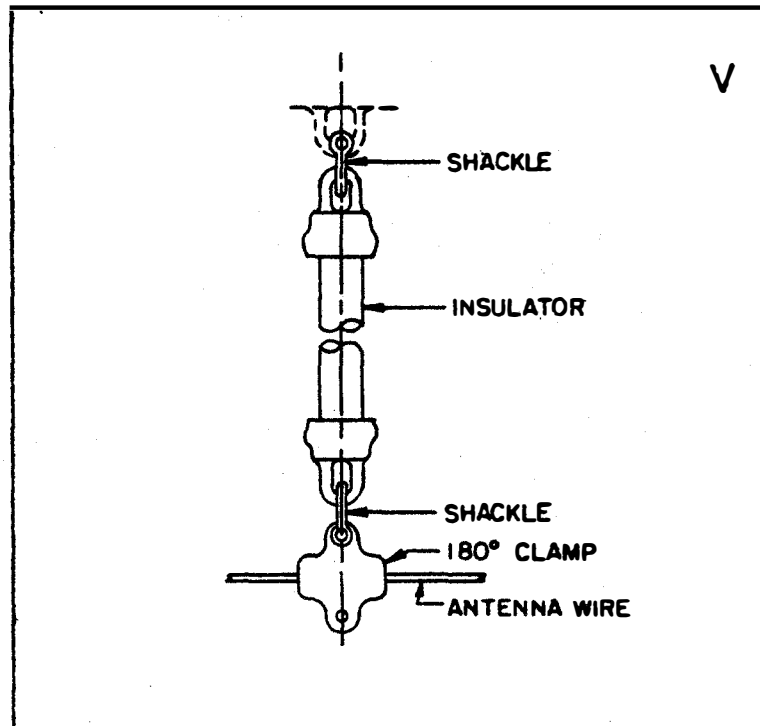


DETAIL	T1		T2		T3		T4		T5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	3/16	2
Clamp	1/8	14	1/8	14	5/16	20	5/16	20	5/16	20
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6

Figure 2-32. Wire Antenna Details - (Details S and T)



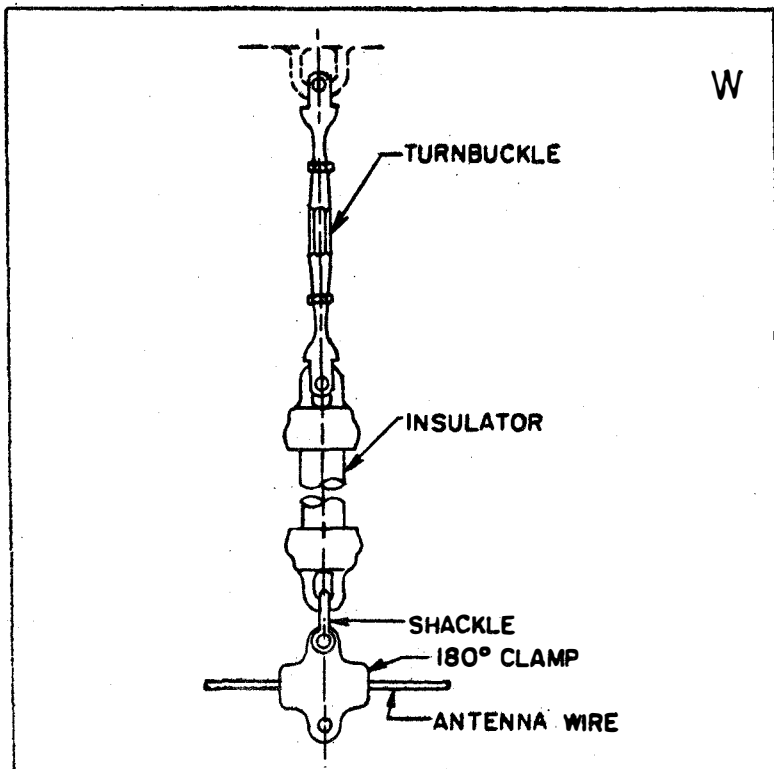
DETAIL	U1		U2		U3		U4		U5		U6	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2	5/16	2
Clamp	1/8	16	1/8	16	5/16	22	5/16	22	5/16	22	5/16	22
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6	20	6
Clamp	1/8	14	1/8	14	5/16	20	5/16	20	5/16	20	1/8	14
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2	1/8	1



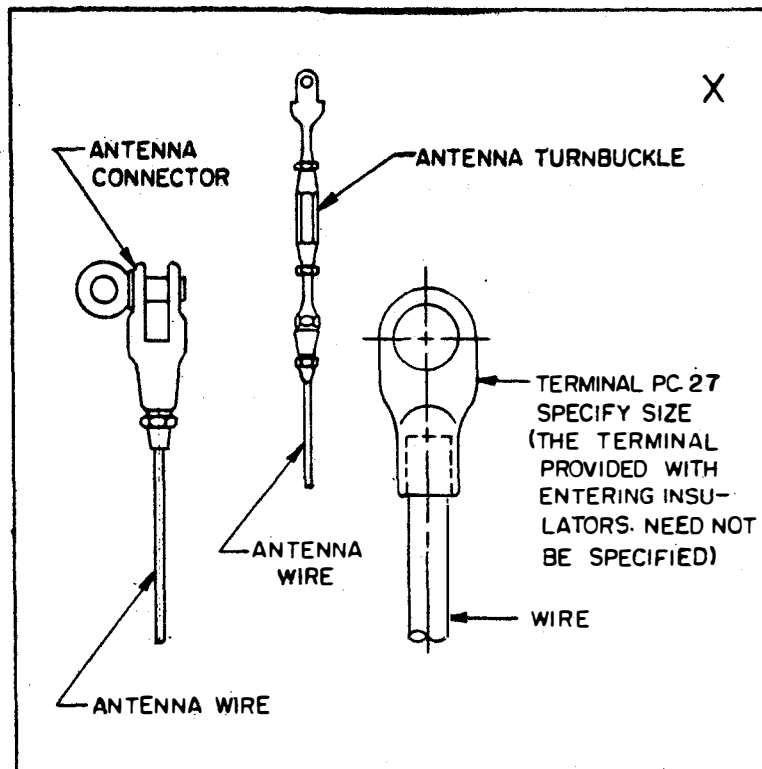
DETAIL	V1		V2		V3		V4		V5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Insul'r.	5	3	10	4	10	4	15	5	20	6
Clamp	1/8	17	1/8	17	5/16	23	5/16	23	5/16	23
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2

Figure 2-33. Wire Antenna Details - (Details U and V)

ORIGINAL



DETAIL	W1		W2		W3		W4		W5	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Turnb.	1/8	11	1/8	11	5/16	12	5/16	12	5/16	12
Insul'r.	5	3	10	4	10	4	15	5	20	6
Shack.	5/16	25	5/16	25	5/16	25	7/16	26	7/16	26
Clamp	1/8	17	1/8	17	5/16	23	5/16	23	5/16	23
Wire	1/8	1	1/8	1	5/16	2	5/16	2	5/16	2



DETAIL	X1		X2		X3		X4		X5		X6	
Sizes Nom'l. (inches)	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.	Size	Pc.No.
Wire	1/8	1	5/16	2	1/8	1	5/16	2	1/8	1	5/16	2
Conn'r.	1/8	7	5/16	8								
Turnb.					1/8	9	5/16	10				
Term'l.										27		27

Figure 2-34. Wire Antenna Details - (Details W and X)

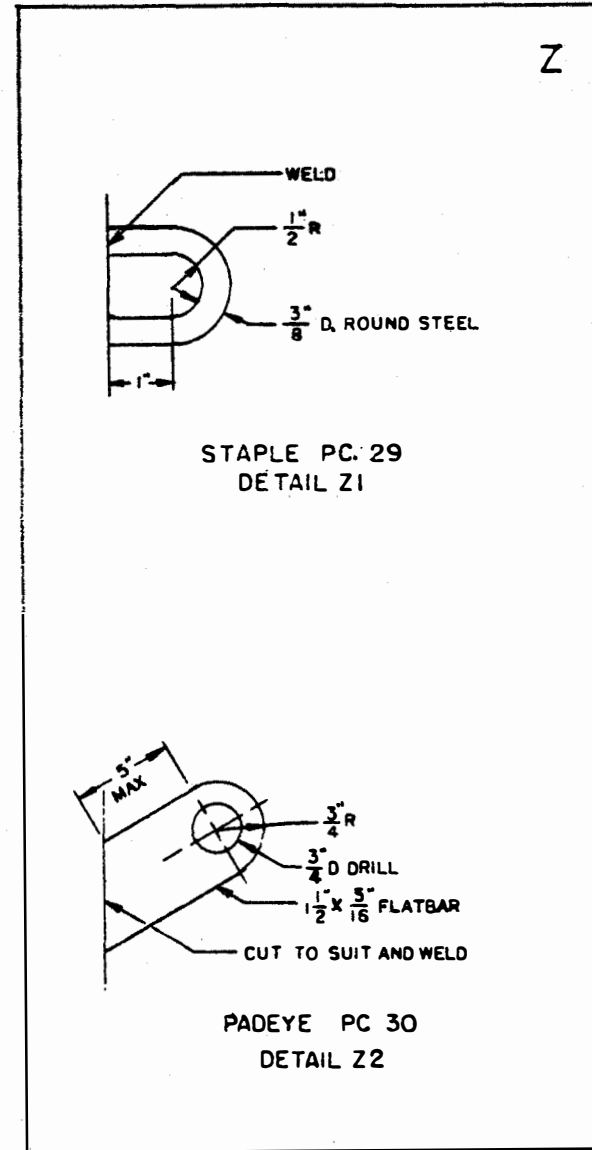
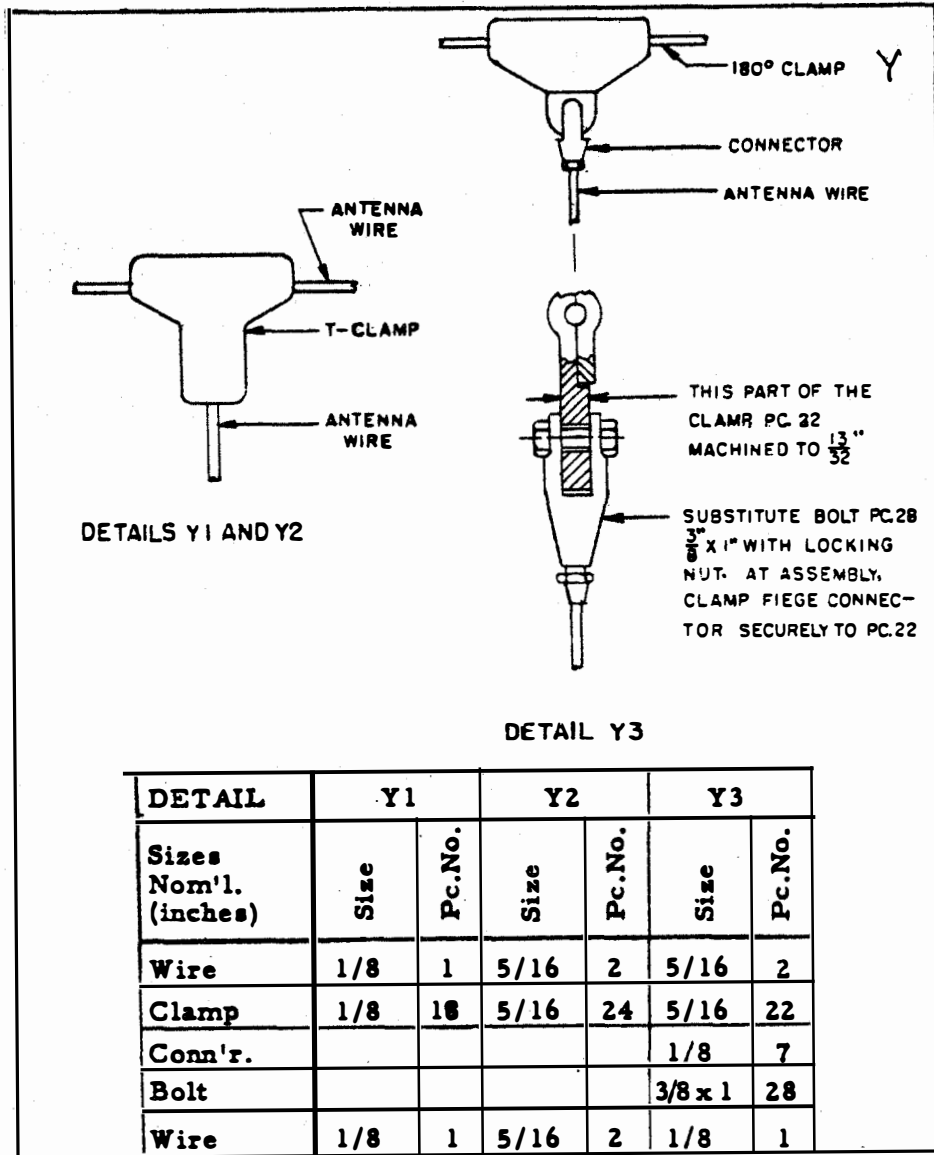


Figure 2-35. Wire Antenna Details - (Details Y and Z)

ORIGINAL

TABLE 2-4. LIST OF STANDARD ANTENNA WIRE AND FITTINGS

Pc. No.	Name	Material	Type Number	Drawing or Specification	Standard Navy Stock Number
1	Antenna Wire (7-#18) 1/8" D	Phos. Brz. (Vinyl covd) Silicone Bronze (Bare)		MIL-W-17211 MIL-W-17211	N16-W-3740-1 N22-W-1606-1550
2	Wire Rope (6x19) 5/16" D	Phosphor Bronze		22R3	G22-R-200
3	Suspension Insulator 5"		61479	RE 61AA 299	N17-I-72505-3001
4	Suspension Insulator 10"		61481	"	N17-I-72520-3001
5	Suspension Insulator 15"		61494	RE 61AA 301	N17-I-72547-3001
6	Suspension Insulator 20"		61493	"	N17-I-72565-3001
7	Antenna Connector 1/8"	Manganese Bronze	MX-1177/U	RE 66F 562	N12-C-2035-150
8	Antenna Connector 5/16"	" "	MX-1178/U	"	N12-S-1240-315
9	Antenna Turnbuckle 1/8"	" "	MX-1179/U	"	N12-T-3390-3975
10	Antenna Turnbuckle 5/16"	" "	MX-1184/U	"	N12-T-3390-4040
11	Antenna Turnbuckle 1/8"	" "	MX-1180/U	"	N12-T-3390-3875
12	Antenna Turnbuckle 5/16"	" "	MX-1176/U	"	N12-T-3390-3890
13	Antenna Clamp 135° 1/8"	Bronze Cast	10678	RE 66F 559B	N17-C-784452-336
14	Antenna Clamp 90° 1/8"	" "	10679	"	N17-C-785589-783
15	Antenna Clamp 45° 1/8"	" "	10680	"	N17-C-783955-196
16	Antenna Clamp 180° 1/8"	" "	10681	"	N17-C-783765-615
17	Antenna Clamp 180° 1/8"	" "	10682	"	N17-C-784957-595
18	Antenna Clamp Tee 1/8"	" "	10683	"	N17-C-783764-608
19	Antenna Clamp 135° 5/16"	" "	10684	"	N17-C-787349-315
20	Antenna Clamp 90° 5/16"	" "	10685	"	N17-C-787144-875
21	Antenna Clamp 45° 5/16"	" "	10686	"	N17-C-785917-404
22	Antenna Clamp 180° 5/16"	" "	10687	"	N17-C-786796-635
23	Antenna Clamp 180° 5/16"	" "	10688	"	N17-C-786211-596
24	Antenna Clamp Tee 5/16"	" "	10689	"	N17-C-786804-426
25	Antenna Shackle 5/16"	"		RE 66A 557	
26	Antenna Shackle 7/16"	"		"	
27	Terminal	Brass			
28	Bolt 3/8" x 1" (With Nut)	Brass			
29	Staple	Steel			
30	Padeye	Steel			

INSTALLATION
METHODS

NAVSHIPS 900, 121(A)

Section 2-2

ORIGINAL

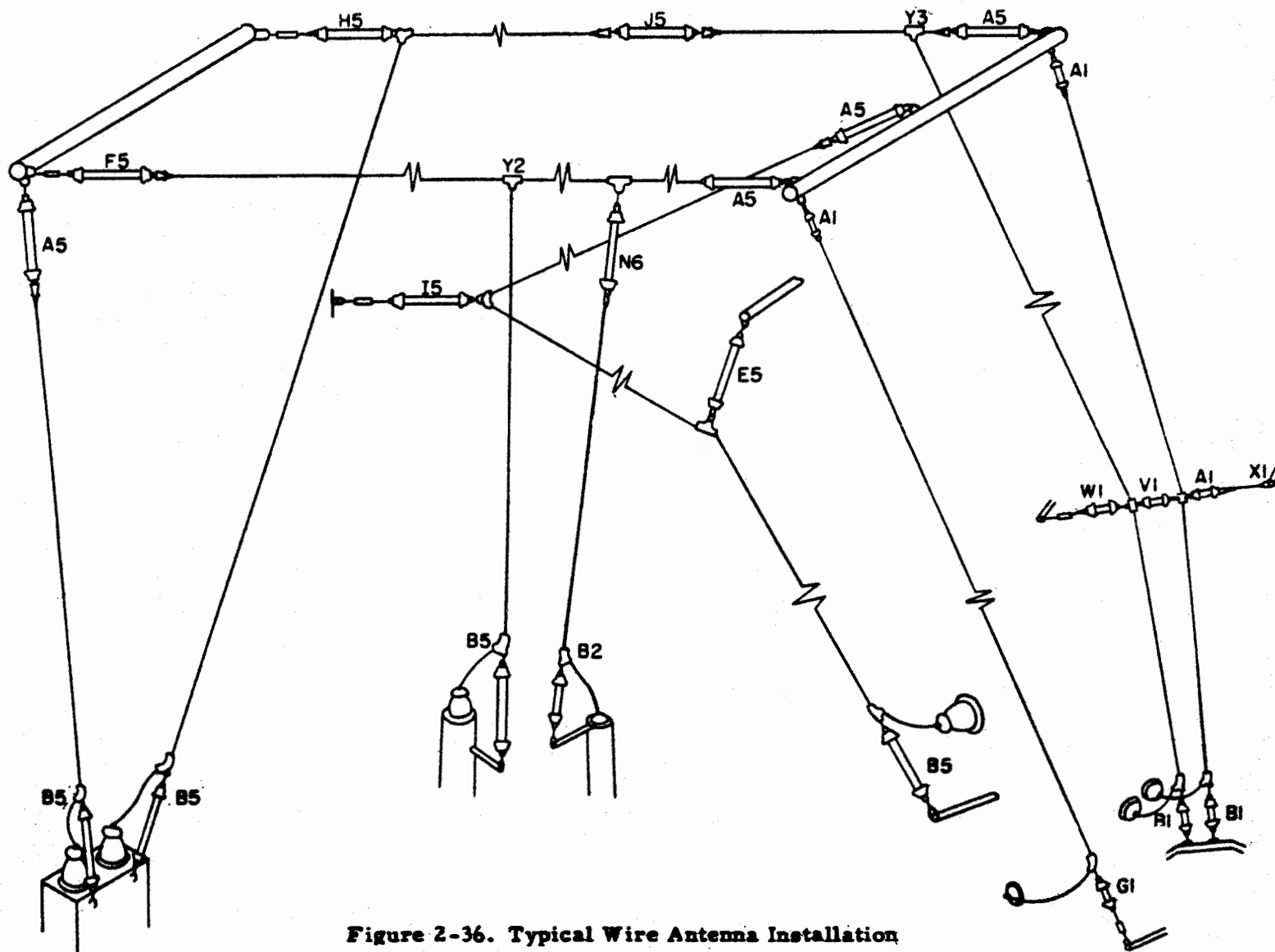


Figure 2-36. Typical Wire Antenna Installation

SECTION 2-3

WHIP ANTENNAS

1. GENERAL.

In shipboard radio antenna installations whip type antennas are replacing many of the wire antenna installations. The use of the whip type antennas give a cleaner rigging and a neater topside appearance to naval vessels.

2. TYPES OF WHIP ANTENNAS.

Several of the types of whip antennas that are commonly used in shipboard radio antenna installations are listed below:

- a. Navy Type-66044, 6 feet, one piece.
- b. AT-252/SR, 125 inches, one piece (part of Antenna Group AN/SRA-3).
- c. Navy Type-66053, 25 feet, 3 sections, non-telescoping.
- d. Navy Type-66046, 28 feet, 4 sections, non-telescoping.
- e. Navy Type-66047, 35 feet, 5 sections, non-telescoping.

Further details on these whip antennas may be found elsewhere in this manual under Chapter 5, "Antenna Data Sheets".

3. MOUNTING WHIP ANTENNAS.

a. GENERAL. - Since whip antennas are essentially self-supporting, they may be installed in many locations aboardship. They may be deck mounted or mounted on brackets on the stacks, superstructure, etc. If the stack is used, the outer casing will usually have to be reinforced to support the added weight and stress. When a whip antenna is installed on a stack, it should be mounted near the top and approximately 24 inches away from the stack. In all installations of whip antennas allowance must be made for swaying of the whip. The whip should be mounted in a clear space where it cannot strike other objects.

It should also be remembered that whip antennas that are to be used for receiving only should be mounted away from the transmitting antennas so that a minimum of energy from the transmitter will be picked up.

b. PREFERRED METHOD. - The preferred method for mounting whip antennas on shipboard is shown in Figure 2-37. The antenna is mounted on an antenna supporting insulator such as Navy Types 61428, 61335 and 61350. The Navy Types 66046 and 66047 whip antennas are self-supporting; when they are mounted in the above manner, they require no other brackets or clamps to support them. However, the Type 66053 whip antenna does require additional bracing.

The recommended method for terminating RG-10/U or similar types of solid-dielectric cable at whip antennas is also shown in Figure 2-37. A suitable termination box must be fabricated by the installing activity to enclose the base of the supporting insulator. The size of the box is determined by the size and type of supporting insulator used. Details of this termination box will be found in Figure 2-38. To prevent moisture condensation inside the box, it is recommended that the walls of the box be made with louvers in them. A hole one inch in diameter must be drilled in the side of the termination box for mounting the MX-1461/U End Seal. A short flexible lead connects the inner-conductor stud of the end seal to the stud of the supporting insulator. The necessary lugs are supplied with the end seal and insulator. This flexible connection is satisfactory for permanently mounted whips; however, for demountable whips which must be secured, a suitable quick-disconnect arrangement should be used.

c. ALTERNATE METHODS. - Several alternate methods for mounting whip antennas are shown in Figures 2-39 and 2-40. Many whip antennas presently installed on shipboard will be found mounted according to one of these methods; however, the Bureau of Ships has recommended that in the future all whip antennas be installed as shown in Figure 2-37. In all cases, a termination box with end seal should be used to enclose and protect the connection of the transmission line to the whip antenna.

Mounting hardware for ship antennas, such as the whip clamp and deck bracket, are shown in Figure 2-41. The Type 66053 whip antenna requires a clamp and bracket for additional support as shown in Method "A" of Figure 2-39.

d. TILTING MOUNT. - One method for providing a tilting mount for a whip antenna may be found in Figure 2-42.

This particular type of installation has been used on aircraft carriers to provide a means of lowering whip antennas that are installed along the edges of the flight deck. This tilting whip is pivoted on a trunnion and has a handle for raising or lowering the antenna. The antenna may be locked in either a vertical or horizontal position. The locking pin should be attached to a length of plumber's chain which is in turn fastened to the supporting framework. The counterweight at the base of the mount should be heavy enough to nearly balance the antenna in any position.

As can be seen from Figure 2-42, a trussed whip antenna is used in this installation. The bracing wires should be made of 7/16" diameter 6 x 19 wire rope or the equivalent. The antenna shown is a Type 66047 standard 35-foot whip antenna. It is insulated for connection to a radio transmitting equip-

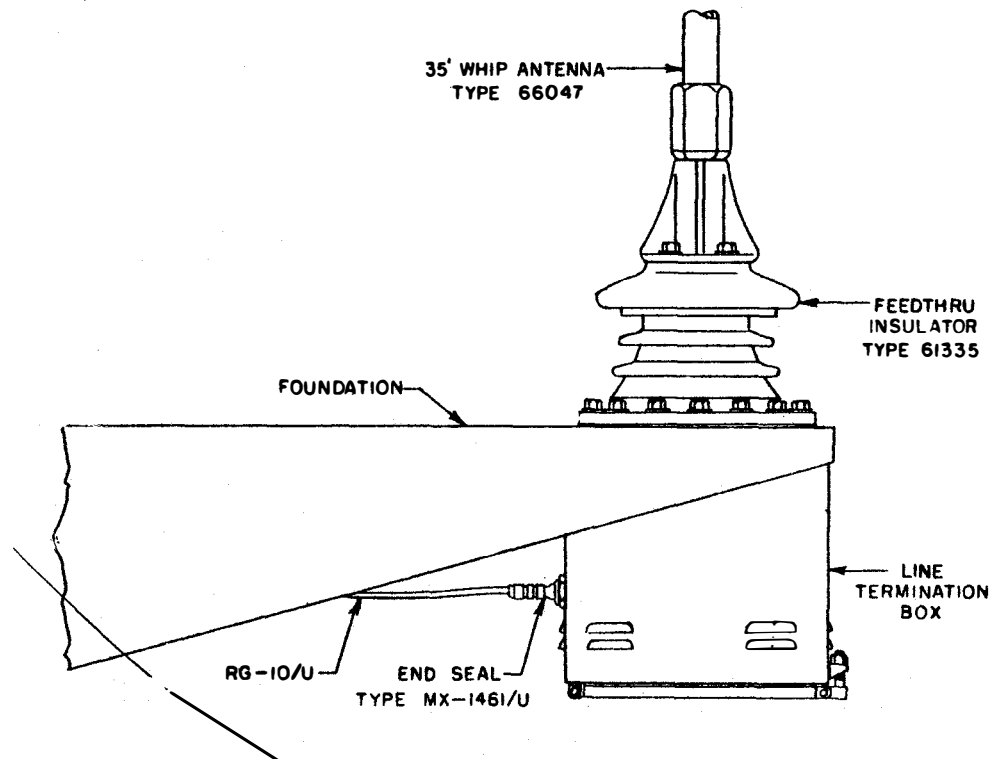


Figure 2-37. Recommended Method for Mounting a Whip Antenna

Type of Whip Antenna	Type of Base Insulator	Box Dimensions (inches)			Foundation Dimensions (inches)				
		A	B	C	D	E	F	G	H
66053	61428	10	10	10	2	10	2-1/2	5	6 holes 9/16" diam.
66046 or 66047	61350	15	15	15	2	15	9-1/2	10-3/4	8 holes 11/16" diam.
66046 or 66047	61335	18	18	18	2	18	13-1/8	14-5/8	12 holes 11/16" diam.

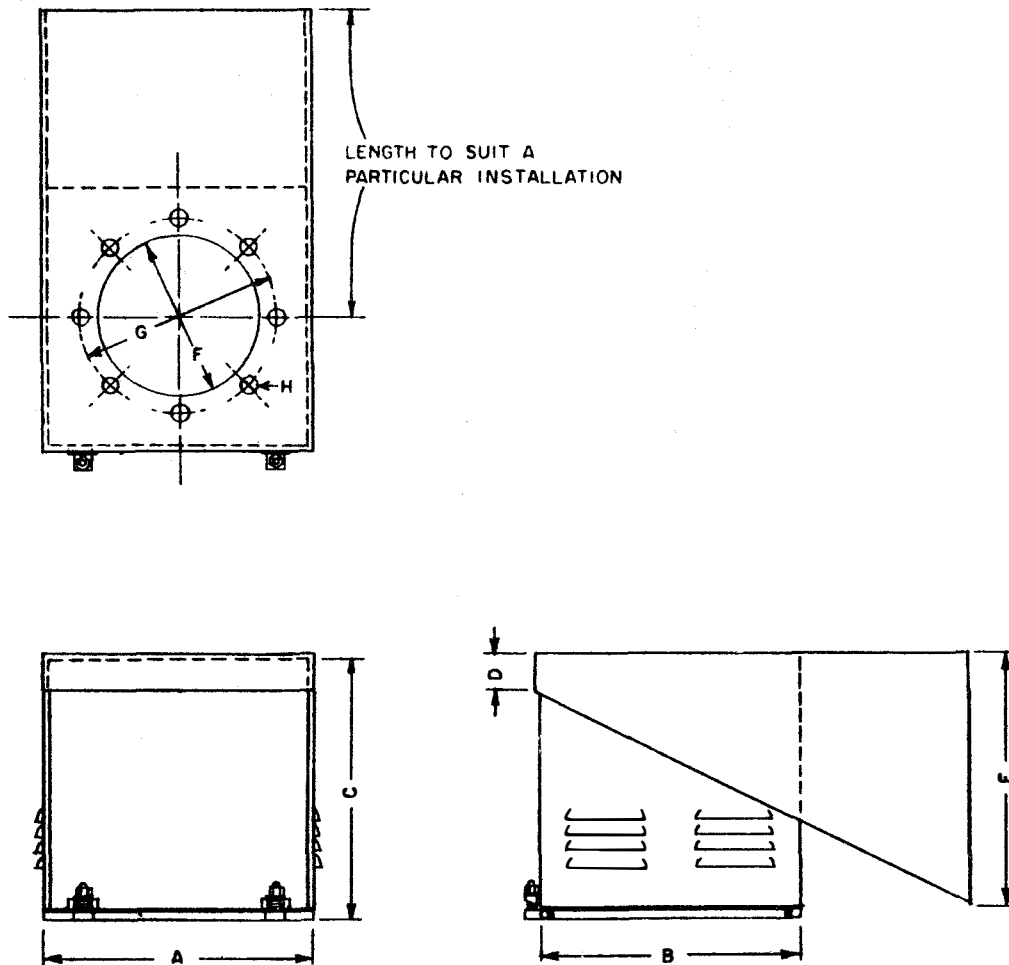


Figure 2-38. Details of Whip Antenna Termination Box

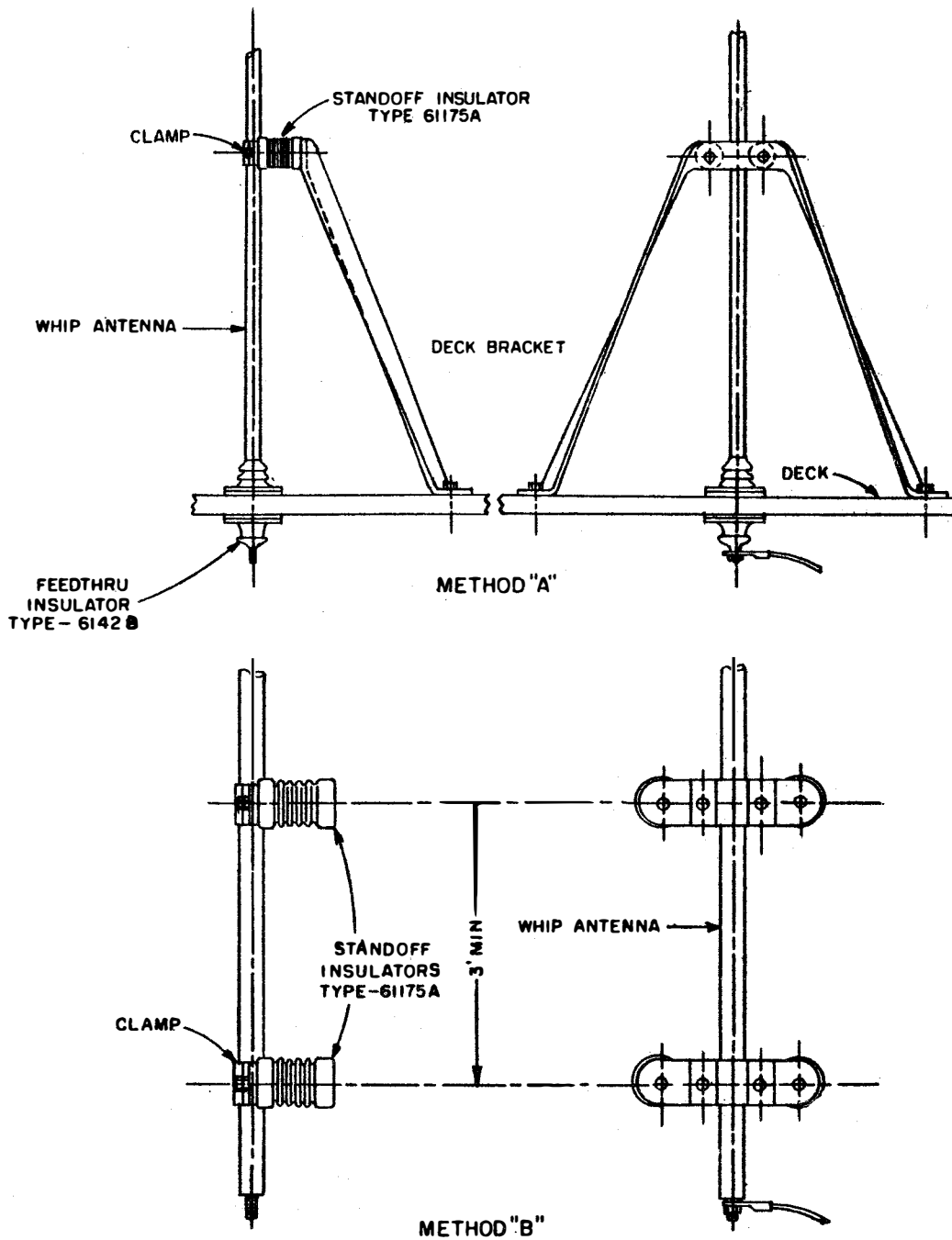


Figure 2-39. Mounting Whip Antennas - Methods A and B (Not Preferred)

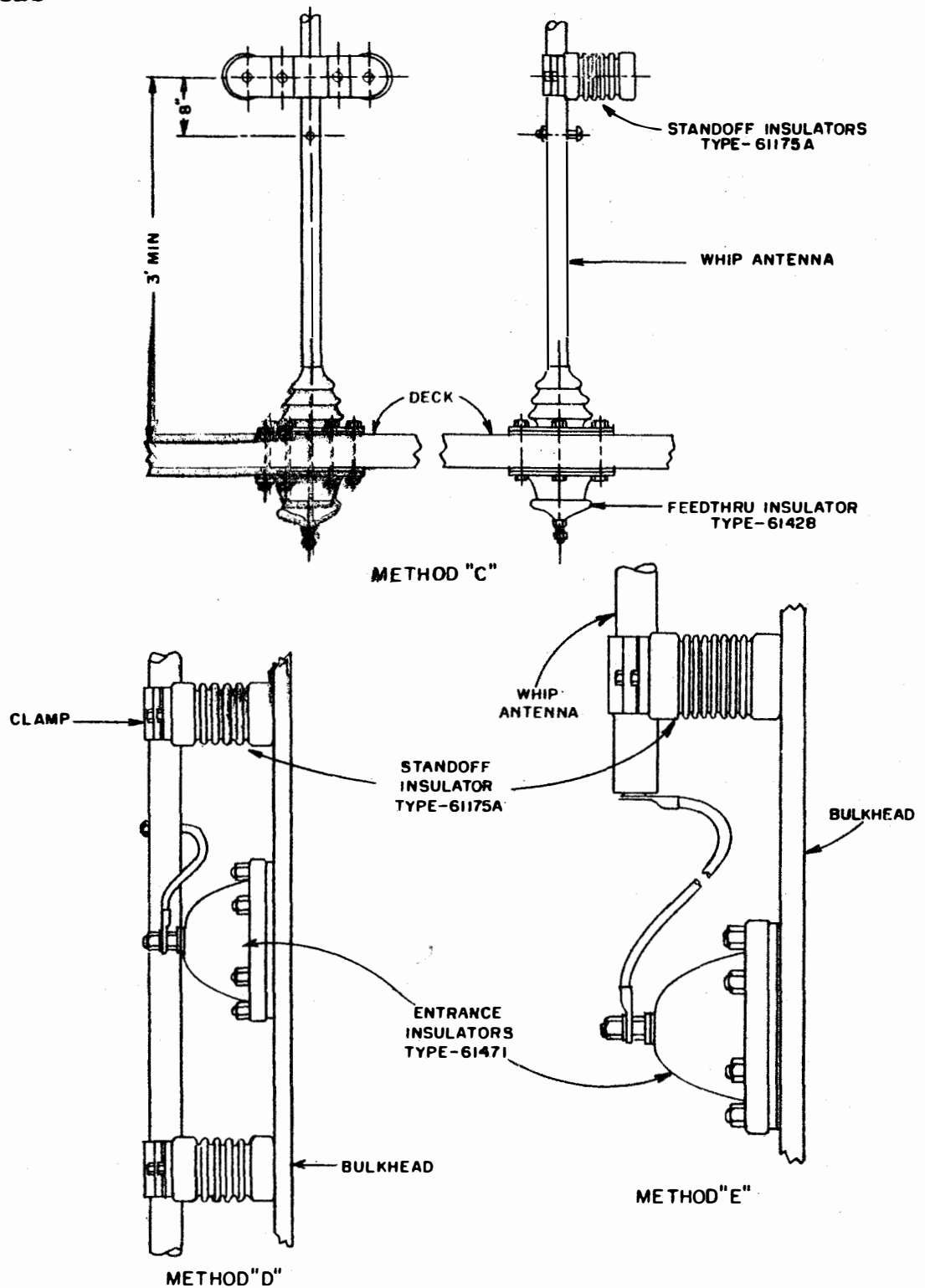
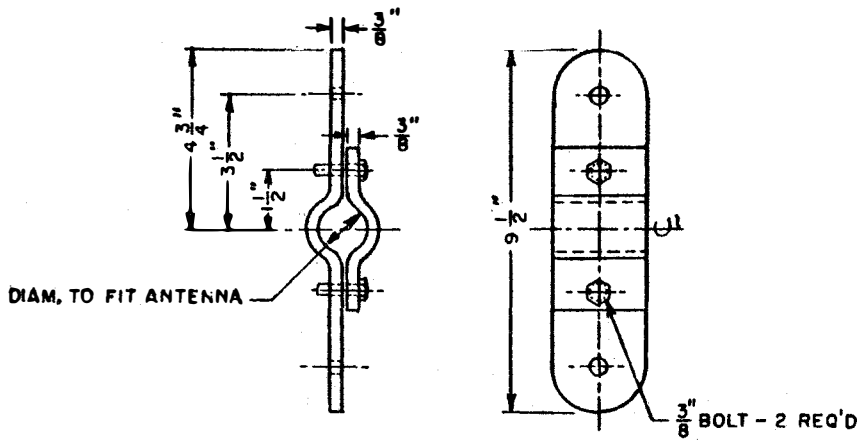
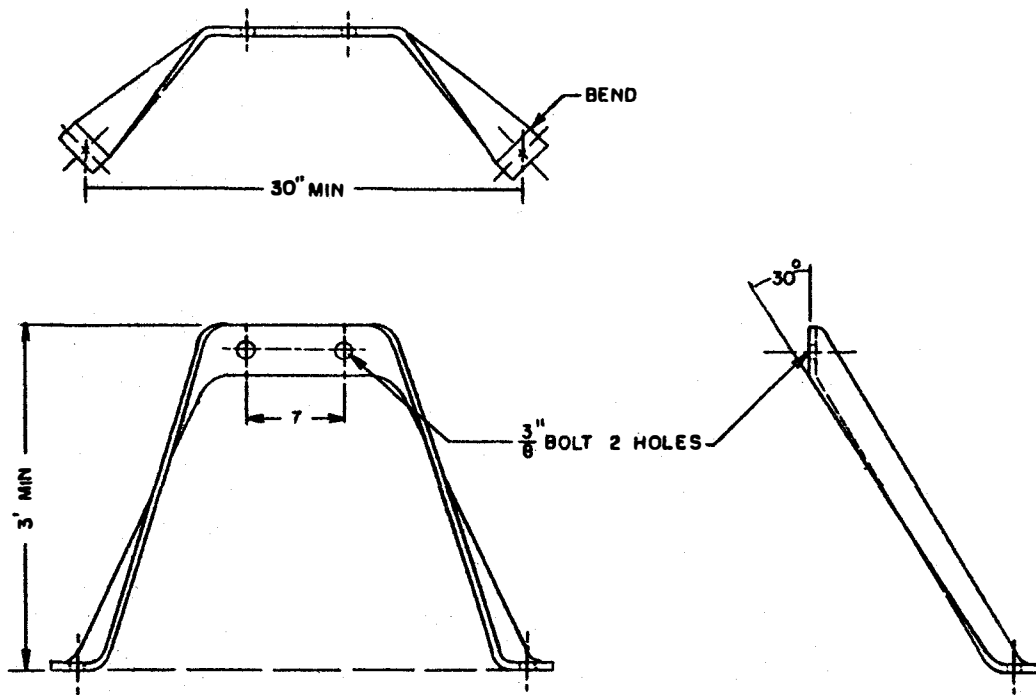


Figure 2-40. Mounting Whip Antennas - Methods C, D and E (Not Preferred)



WHIP CLAMP - BRONZE



DECK BRACKET - STEEL

Figure 2-41. Mounting Hardware for Whip Antennas

ment. If this antenna is to be used for receiving purposes only, a Type 61479 insulator may be used instead of Type 61493.

Several special types of tilting mounts for whip antennas are used aboard submarines. They are called "Erecting Mechanisms" and in many cases may be operated from within the submarines. They may be operated by a spring mechanism or be hydraulically operated. In most cases, as the submarine dives,

the force of the water causes the whip to fold back from a vertical to a horizontal position. The antenna is held by a catch in this position. When the submarine surfaces, the catch is released and the spring mechanism causes the antenna to snap back to its vertical position.

In newer submarine installations, the whip antennas may be mounted on retractable masts so that the antenna may be raised or lowered from within the submarine in much the same manner as the periscopes.

In the past, the Type 66053 whip antenna has been used in submarine installations, but many times this antenna was bent or damaged from the stresses encountered when the submarine was diving or surfacing. To remedy this situation a streamlined mid-fed whip antenna (AT-350/BRC) has been developed to replace the Type 66053 whip antenna. This mid-fed whip may be used for short range communications at periscope depth at low speeds; whereas, in the past, whip antennas had to be lowered to prevent damage to them as the submarine moved through the water while it was submerged.

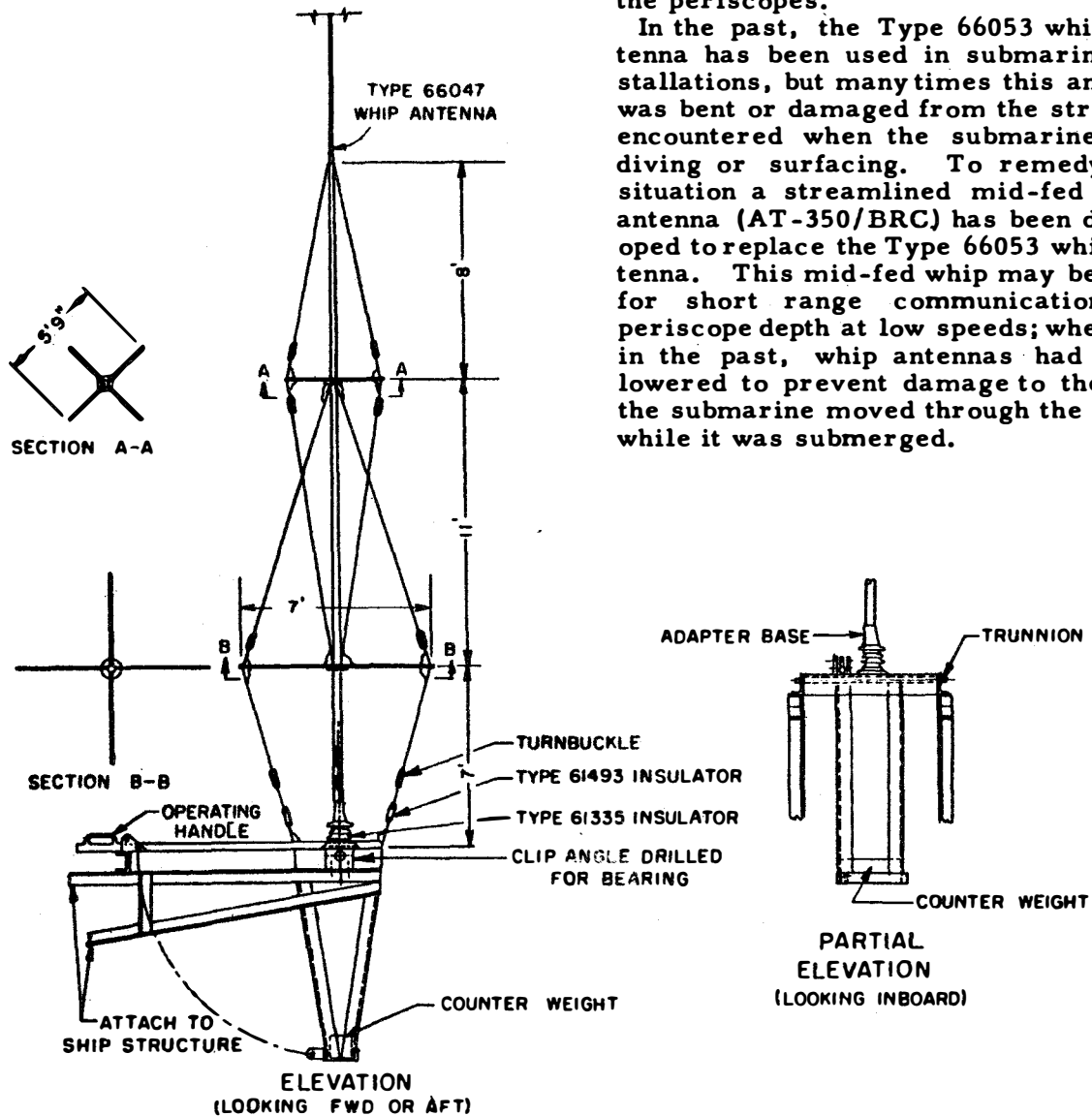


Figure 2-42. Tilting Mount for a Vertical Whip Antenna

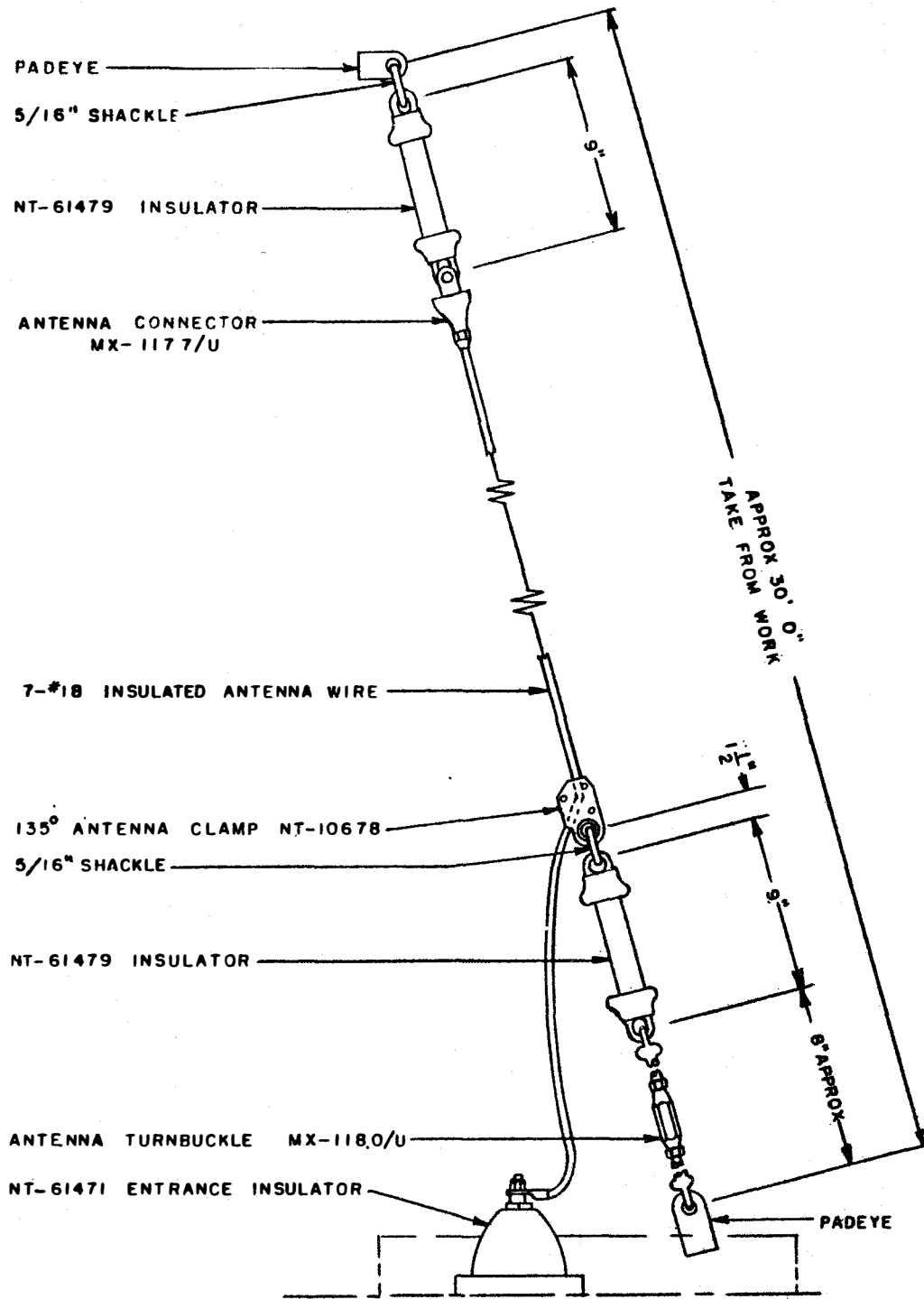


Figure 2-43. Typical Receiving Antenna Installation

SECTION 2-4

RECEIVING ANTENNAS

1. GENERAL.

In the past, shipboard receiving antennas have received much criticism. The poor performance of these antennas is the result of a number of factors:

- a. The lack of sufficient space on shipboard to install a suitable antenna for use in the low frequency band.
- b. The close coupling between transmitting and receiving antennas.
- c. The noise generated by a ship may override the received signal.

Many solutions have been offered, but none are capable of being applied to all classes of vessels. One group of engineers insist that an antenna which is long enough to receive signals above or overriding atmospheric noise and the inherent noise in the receiving equipment, will perform satisfactorily as a receiving antenna. In fact, it is probably more suitable than an antenna of greater length; since, as the effective height of an antenna is increased, the atmospheric noise becomes greater as compared with the inherent noise in the receiver.

Actually, it is better to try to design an antenna which will be resonant for the band of frequencies to be received. If such an antenna can be installed at the greatest possible distance from transmitting antennas and if the plane of this receiving antenna is as near to 90 degrees as possible to the plane of the transmitting antennas, then this antenna should be much superior to any compromise design. Unfortunately, because of the space limitations on most Naval vessels, it is usually impossible to install an antenna long enough to be resonant at the low frequencies. Therefore, it is necessary that the first line of thought be followed for antennas that are to be used at frequencies below 8 megacycles.

2. INSTALLATION.

Wire antennas are generally used on shipboard for receiving antennas; however, in many instances, whip antennas are being used in place of wire antennas. Figure 2-43 illustrates a typical receiving wire antenna installation. Receiving wire antennas are usually placed forward, rising nearly vertically from the pilot house top to brackets on the mast or yardarm. These positions are selected well forward so that a minimum of energy from the transmitting antennas will be picked up.

The wire antennas should never be pulled extremely taut because in that condition they are more susceptible to breakage under wind pressure. The amount of tension applied should never exceed the minimum required to keep the wire in a vertical position, neither should the tension be small enough to permit slackness.

All connections should be made with care, as the strength of the entire wire will depend upon the strength of each joint. All connections at clamps, connectors, turnbuckles, etc., should be examined periodically for signs of wear or loosening. The tension should be tested regularly and compensation made with turnbuckle, if necessary.

Aboard ship, each antenna is generally terminated in a patch panel where it can serve a maximum of four radio receivers; one connected directly and up to three connected in parallel through decoupling resistors. This practice not only limits severely the number of receivers supplied by the antenna, but also introduces significant losses (usually 6 to 10 db) in the decoupled circuits. As a result of this, ships which require a large number of communications circuits have become loaded down with antennas.

The use of multicouplers should help to alleviate this condition by reducing

The number of antennas required for a given number of receivers. The AN/SRA-9 receiver antenna filter assembly (multicoupler) provides for the simultaneous operation of a maximum of 28 receivers from a single antenna. However, except in extreme cases, the number of receivers operating from a single AN/SRA-9 shall be limited to seven or less. Further details on the AN/SRA-9 may be found elsewhere in this manual under Chapter 3 "Antenna Multicouplers".

In planning a receiving installation, the circuit requirements of a given ship as well as the number and type of available antennas should be taken into account. Antennas which are relatively short are most effective at high frequencies while long antennas such as long wires and "flattops" should be used at the lower frequencies.

Presently most shipboard receiving antennas are installed forward. In some cases it is necessary to route transmitting antenna down-leads from near the yardarm on the foremast. This practice sometimes produces a highly undesirable coupling between the transmitting and receiving antennas. In certain vessels presently under construction the receiving antennas are being erected in the vicinity of the main mast. This location requires from 60 to 100 feet of coaxial feed line; however, it is believed that the much smaller degree of coupling between receiving and transmitting antennas will permit the receivers to operate in a more efficient and reliable manner. "Burnouts" of receiver antenna coils caused by local transmitters should be eliminated.

3. RECEIVING ANTENNA DISTRIBUTION SYSTEM.

Typical receiving antenna distribution systems are shown in Figures 2-44, 2-45 and 2-46. In the past, RG-12/U, 70-ohm cable, was used in the receiving antenna distribution systems. However, the Bureau of Ships is presently attempting to standardize and thereby reduce the number of different types of RF cables installed in any particular ship. It was decided to use only 50-ohm lines where-

ever possible. The preferred lines are types RG-10/U and RG-18/U, 50-ohm cables. This standardization should not be carried to the point of diminishing returns. That is, presently installed RG-12/U cable in good condition shall not be replaced with type RG-10/U cable for the sole purpose of standardization. Furthermore, when the low-frequency receiving equipment is a considerable distance from the receiving antenna, it is preferable to install RG-79/U, 125-ohm cable, or 3-inch, 180-ohm air-filled coaxial line rather than RG-10/U or RG-18/U. In other words, every attempt should be made to provide each vessel with the best engineered system of transmission lines possible. The following factors should be considered

- a. Standardize as much as possible.
- b. Hold line losses below 1 db.
- c. Maintain shielding.
- d. Do not incur expenditures which are not justified.

The receiving antenna distribution system shown in Figure 2-44 is for small vessels and special applications only. The use of standard antenna transfer panels (Figure 2-45) is the preferred type of installation. In future installations AN/SRA-9 receiving antenna filter assemblies in conjunction with suitable line termination panels (Figure 2-46) may be used in lieu of present antenna transfer panels. These line termination panels must be manufactured by the installing activity. The coaxial receptacles used shall be of the same type as those used on the AN/SRA-9. When only one AN/SRA-9 filter assembly is installed, as in Figure 2-46, it is recommended that two receiving antennas be terminated at the Antenna Selector Patch Panel.

All terminal boxes comprising the antenna transfer assembly (Figure 2-44) shall be mounted within a 30-inch diameter circle to permit the use of standard 36-inch patchcords. The assembly should be mounted on a vertical bulkhead and in a position to facilitate convenient operation by supervising personnel.

Formerly, the lines running from the antenna transfer assembly to the indi-

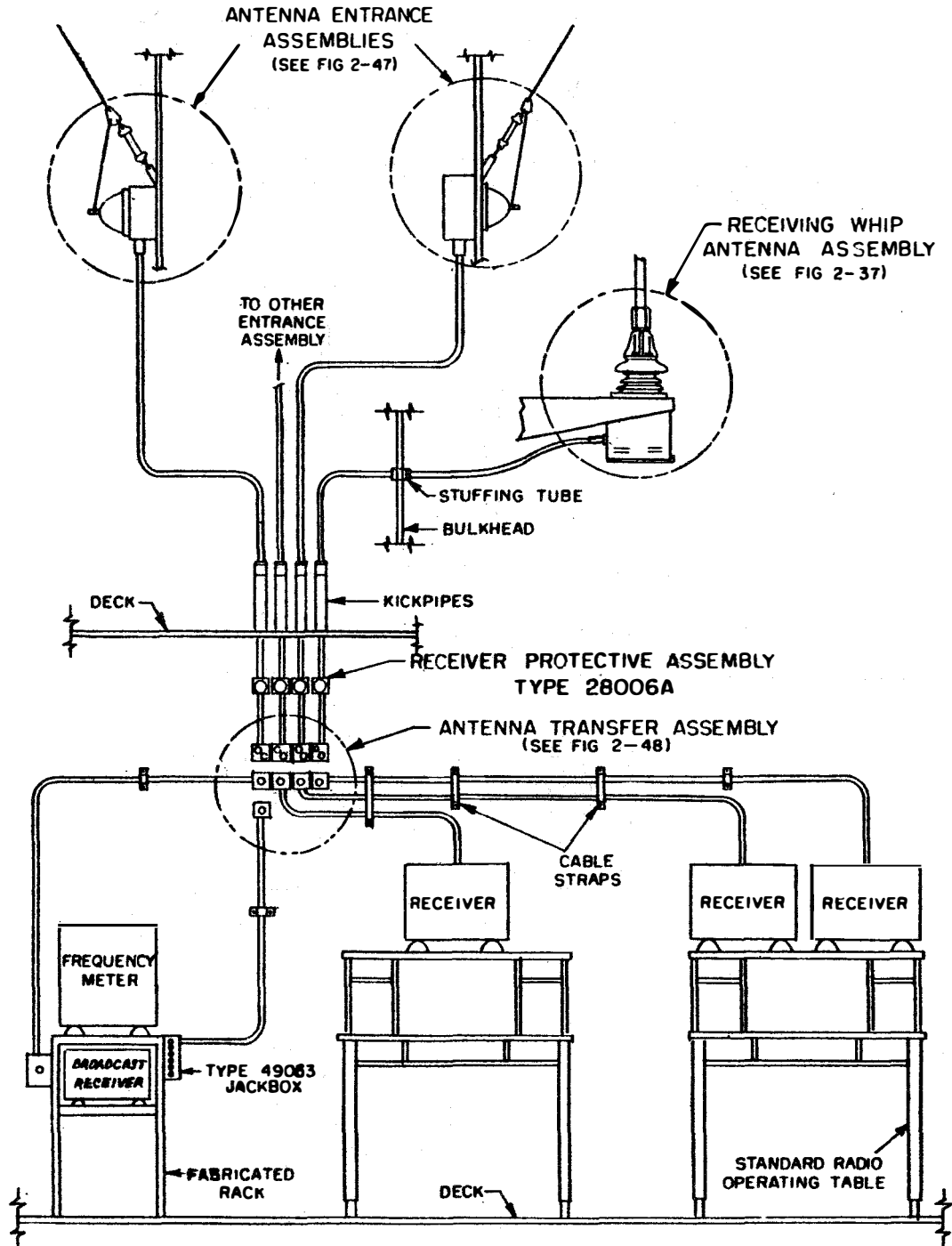


Figure 2-44. Receiving Antenna Distribution System (Using Terminal Boxes)

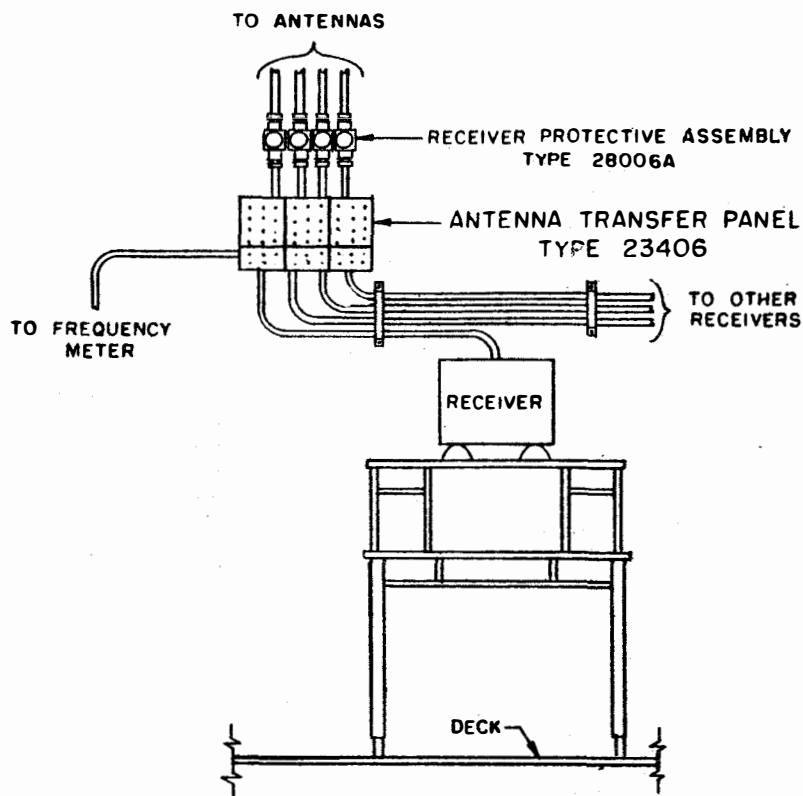


Figure 2-45. Receiving Antenna Distribution System
(Using Antenna Transfer Panel)

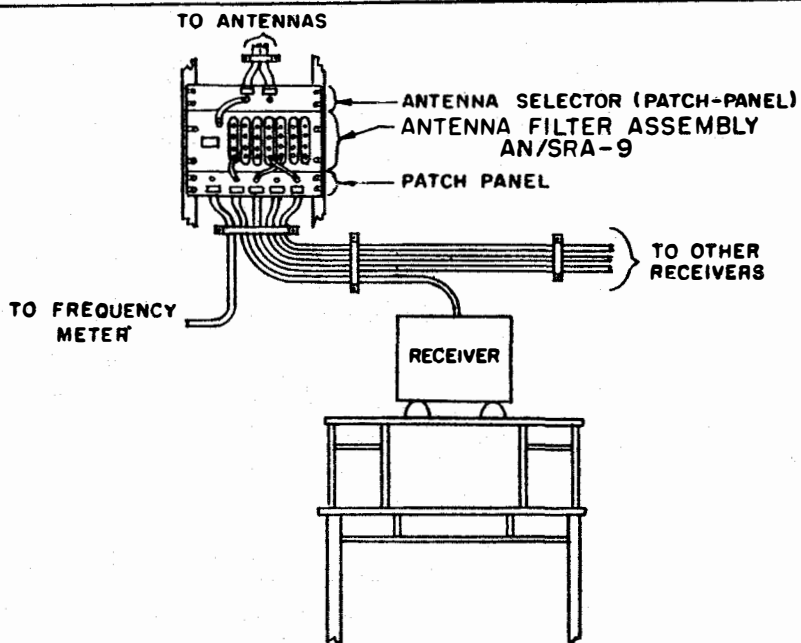


Figure 2-46. Receiving Antenna Distribution System
(Using AN/SRA-9 Antenna Filter Assembly)

vidual receivers terminated in jack boxes behind each receiver. A patchcord was used to connect the receiver to the jack box. In the future, the transmission line from the antenna transfer assembly shall be connected directly to the input connector on the receiver. The bulkhead patch boxes shall not be used.

Receiver Protective Assemblies Type 28006A (Standard Navy Stock Number N17-L-51275-7682) shall be installed in the Radio Room in a location that will provide accessibility. Preferably, they shall be mounted near the antenna transfer panel. Details of these protective assemblies may be found in BuShips drawing RE 28J 119A. Each assembly consists of a lamp socket mounted on a porcelain base and enclosed in a cylindrical aluminum can; it uses a 50 or 100-watt bulb. The purpose of this assembly is to protect the receiver antenna coil from excessive currents. The assembly will have to be modified for use with RG-10/U coaxial cable. It may be mounted on a 4-inch terminal box such as the one shown in Figure 2-48.

The Navy Type -49063 jackbox is mounted within 36 inches of the frequency meter input connection. It should be mounted on the frequency meter supporting structure or on an adjacent bulkhead.

Whenever a Type RG-10/U or RG-12/U cable is to be passed through an airtight, fumetight, or watertight deck or bulkhead, standard size "B" stuffing tubes shall be used. See BuShips drawings 9-S-4681-L, 9-S-4903-L and 9-S-5166-L. These stuffing tubes should be mounted on bulkheads and kickpipes as shown on BuShips drawing 9-S-3980-L. Stuffing-tube packing shall be in accordance with NRL drawing RA 62AA 314.

All cables shall be strapped at intervals of not greater than 16 inches. The straps used shall be in accordance with BuShips drawing 9-S-4441-L-4 for watertight decks and bulkheads, and BuShips drawing 9-S-4442-L-4 for non-watertight decks and bulkheads.

Stuffing tubes and cable straps for RG-10/U cable must be installed in a manner which will cause no deformation of the cable dielectric. The slightest deformation will change the electrical

characteristics of the cable.

Bends in RG-10/U cable should have a minimum radius of 10 times the diameter of the cable.

All cable runs comprising this system shall be designated "R-RA" and marked "Vital" (RED) in accordance with subsection S62-2 of the General Specification for Machinery.

Each transmission line from the antenna transfer assembly to an antenna will terminate in antenna entrance assembly. If a wire antenna is to be used, an entrance assembly of the type shown in Figure 2-47 will be used. There are two types of entrance assemblies: one has a weatherproof terminal box for outside cable runs and the other has a non-weatherproof terminal box for inside cable runs. If a whip antenna is to be used, a termination box of the type shown in Figure 2-37 will be used.

Figure 2-48 illustrates details of the terminal boxes used in the receiving antenna transfer assembly.

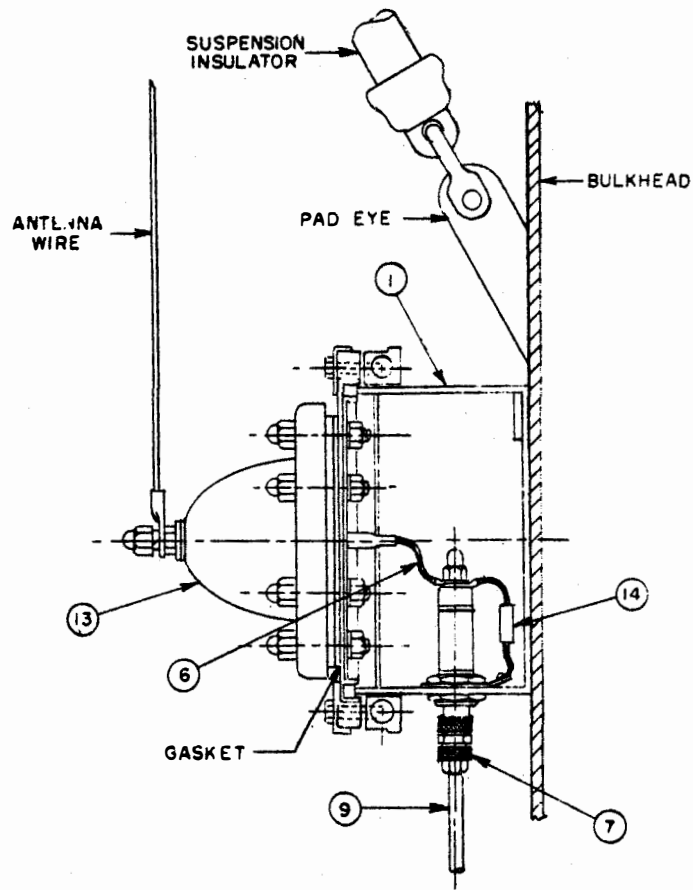
A list of the parts used in these receiving antenna distribution systems will be found in Table 2-5.

4. RECEIVING ANTENNA TRANSFER PANELS.

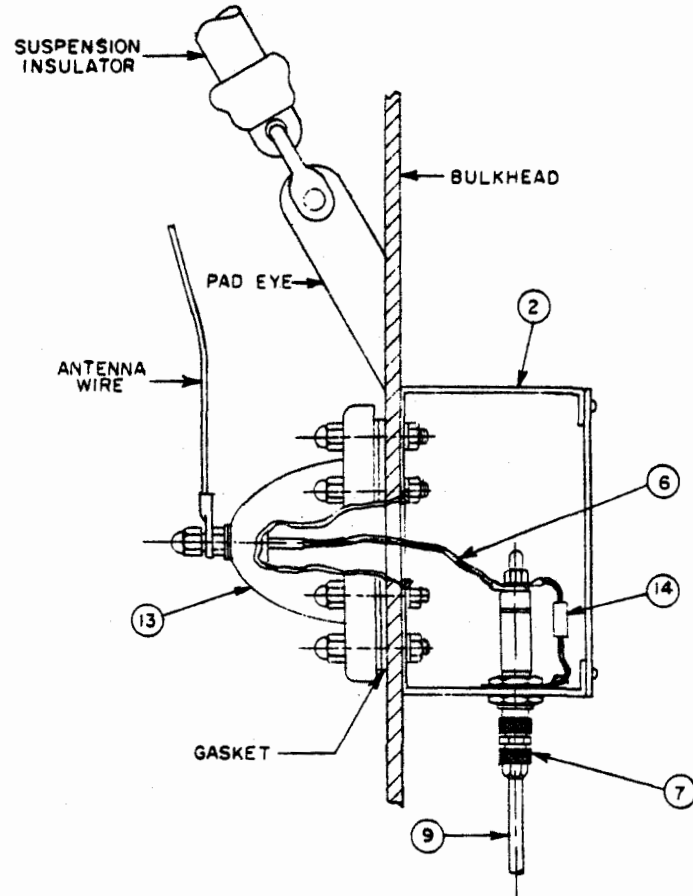
Receiving antenna transmission lines aboard ship usually are terminated in antenna transfer panels in the respective radiospaces. These transfer panels are interconnected so that a receiver in any radio space may be connected to any receiving antenna, regardless of its topside location.

There are four standard Receiving Antenna Transfer Panels that the Navy uses in shipboard installations: Navy Types 23404, 23405, 23406 and 23407. These transfer panels are the same structurally; their differences lie in the number of antennas and receivers that they can accommodate. Two views of Antenna Transfer Panel Type 23406 are shown in Figures 2-49 and 2-50. Drawings of the other three transfer panels are shown in Figure 2-51.

These transfer panels provide means for operating as many as four radio receivers simultaneously into one antenna. At the transfer panel each antenna is con-



(a) For Outside Cable Entrance



(b) For Inside Cable Entrance

Figure 2-47. Antenna Entrance Assemblies

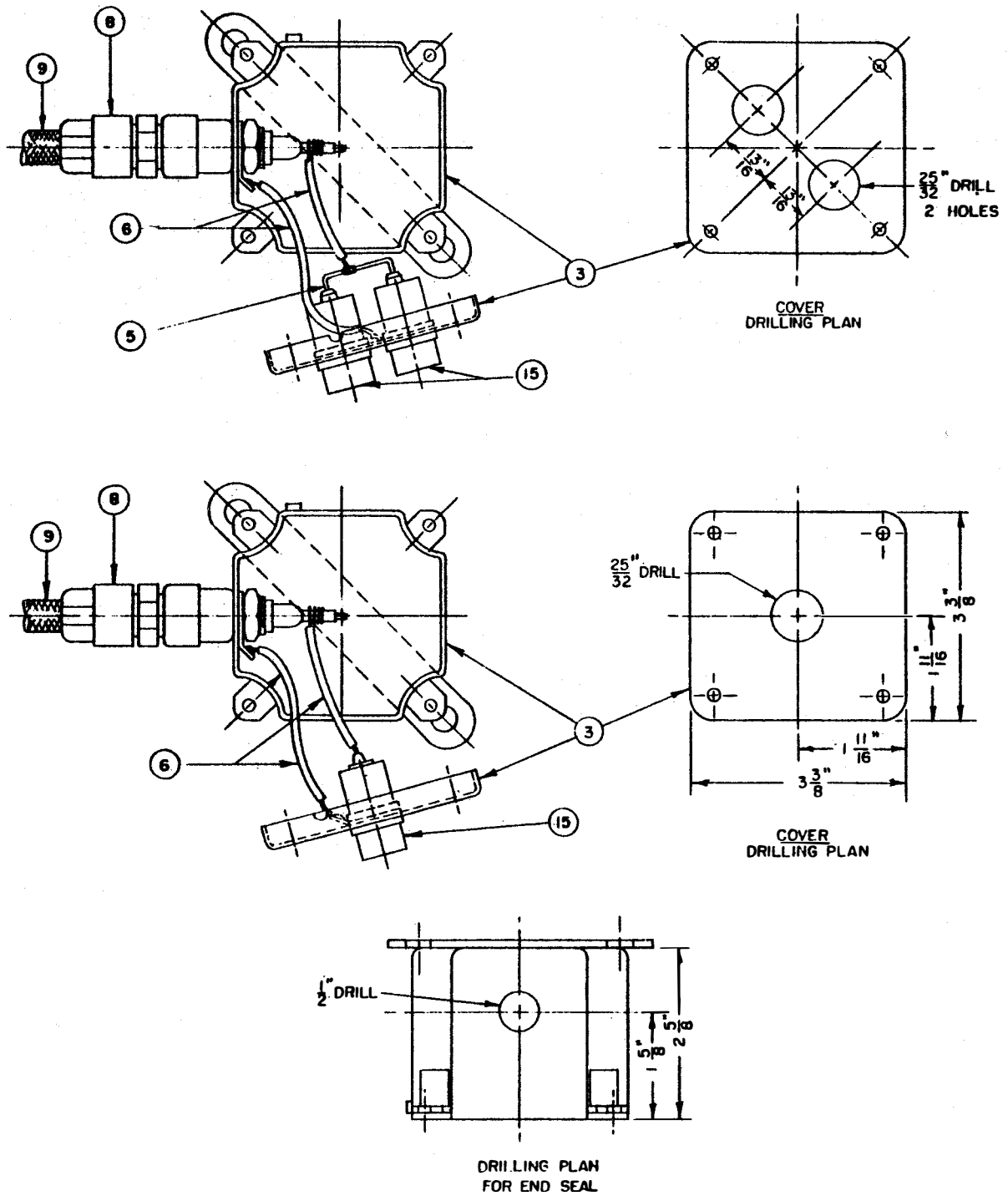


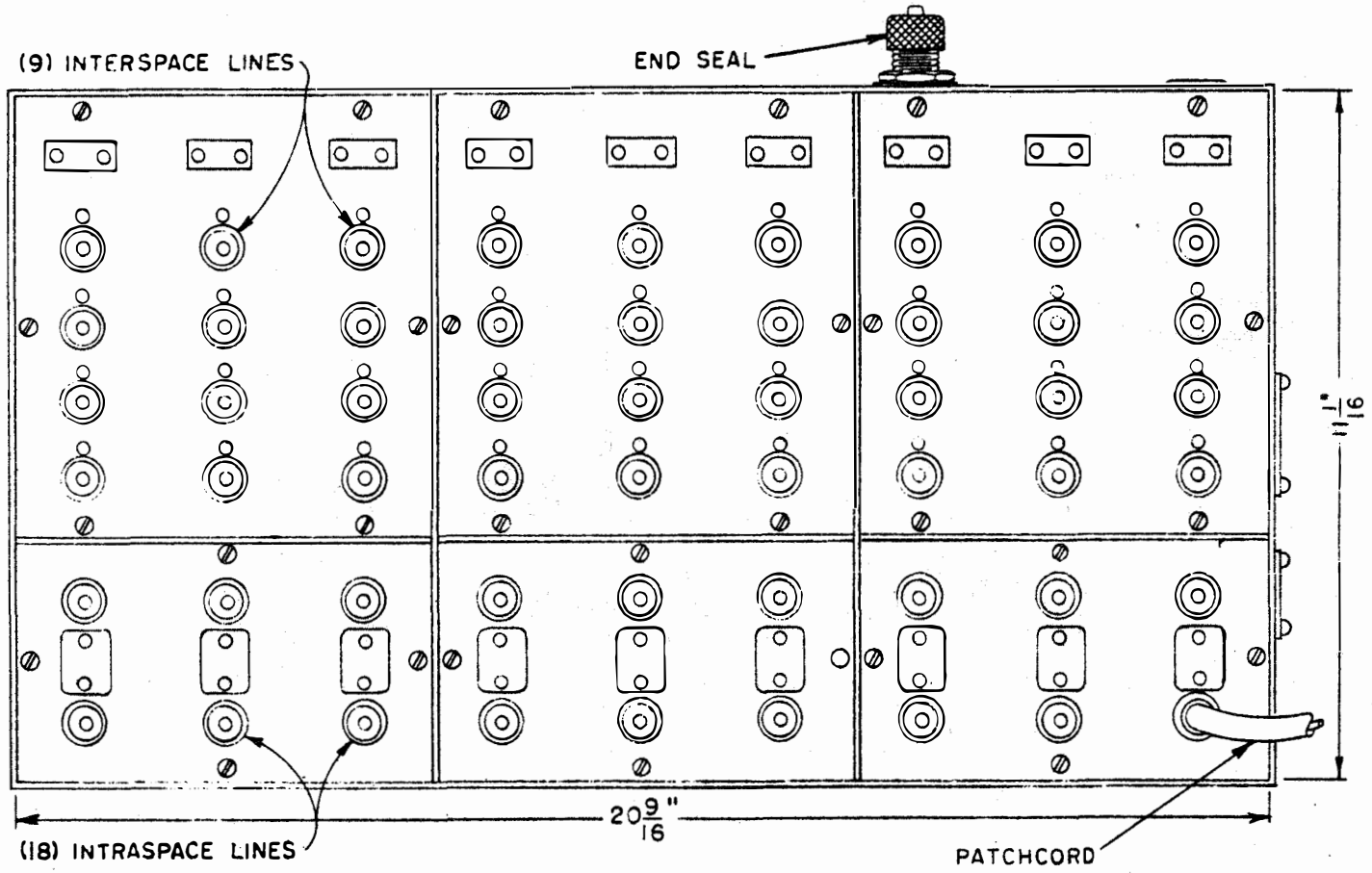
Figure 2-48. Terminal Boxes for Receiving Antenna System

nected to a row of four jacks. One jack is connected directly to the antenna; the other three jacks are connected in parallel through 600-ohm decoupling resistors. The receivers connected to the three decoupled jacks will operate at a reduced efficiency.

The cases of these transfer panels are made of brass with a black wrinkle finish. The front panels are made of aluminum. The Type 23406 transfer panel shown in Figure 2-49 will accommodate 9 interspace lines and 18 intraspace lines. The interspace lines which terminate in

TABLE 2-5. LIST OF PARTS FOR RECEIVING ANTENNA DISTRIBUTION SYSTEM

Part No.	Description	Material	Size	Navy or AN Type Number	Drawing or Specification
1	Entrance Box (Outside)	Steel		V-S-125	9-S-4302-L
2	Entrance Box (Inside)	Steel			
3	Terminal Box Assembly		2-5/8 Deep	Type G (NWT)	9-S-5333-L
4	Soldering Lug	Copper	For No. 8 Stud		Commercial
5	Bus Wire, Bare	Copper	No. 10 B&S		Commercial
6	Connector (Length to suit)	R. C. Stranded Copper Wire	No. 18 B&S		Commercial
7	End Seal			MX-1461/U	RE49F237
8	End Seal			MX-1465/U	RE49D371B
9	Solid Dielectric Cable			RG-10/U	JAN-C-17A
10	Cable Strap		No. 4		9-S-4441-L-4 9-S-4442-L-4
11	Stuffing Tube		B		9-S-5166-L
12	Stuffing Tube Packing		B		RA62AA314
13	Entrance Insulator			61471	RE61F293
14	Resistor, Static Leak		1 watt 1/2 meg.	63288	RE13A340
15	Concentric Jack			49120	RA49F215
16	Receiver Protective Assembly			28006A	RE28J119A



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2-47

Figure 2-49. Front View of Antenna Transfer Panel, Navy Type-23406

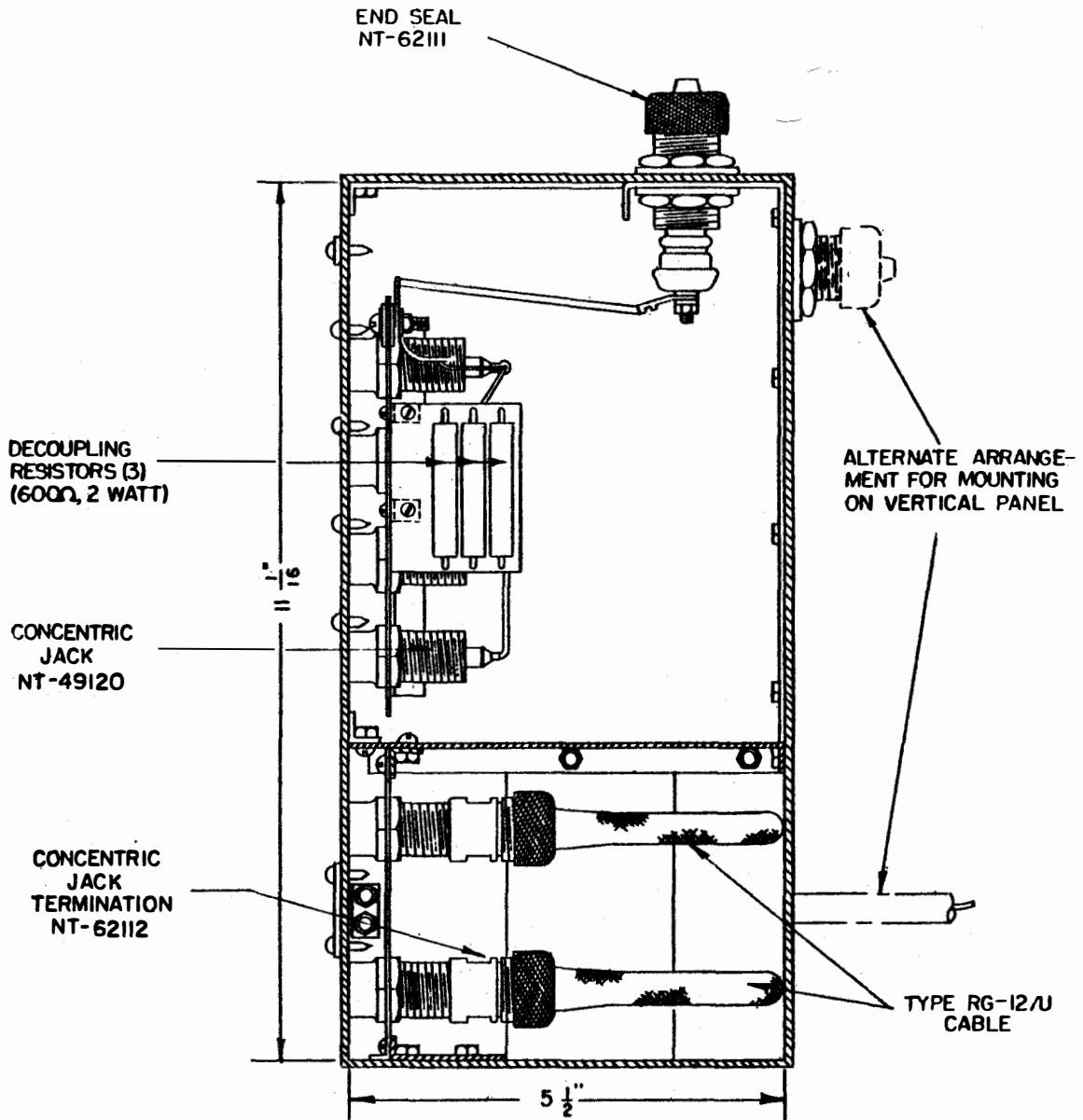


Figure 2-50. Cutaway Side View of Antenna Transfer Panel, Navy Type-23406

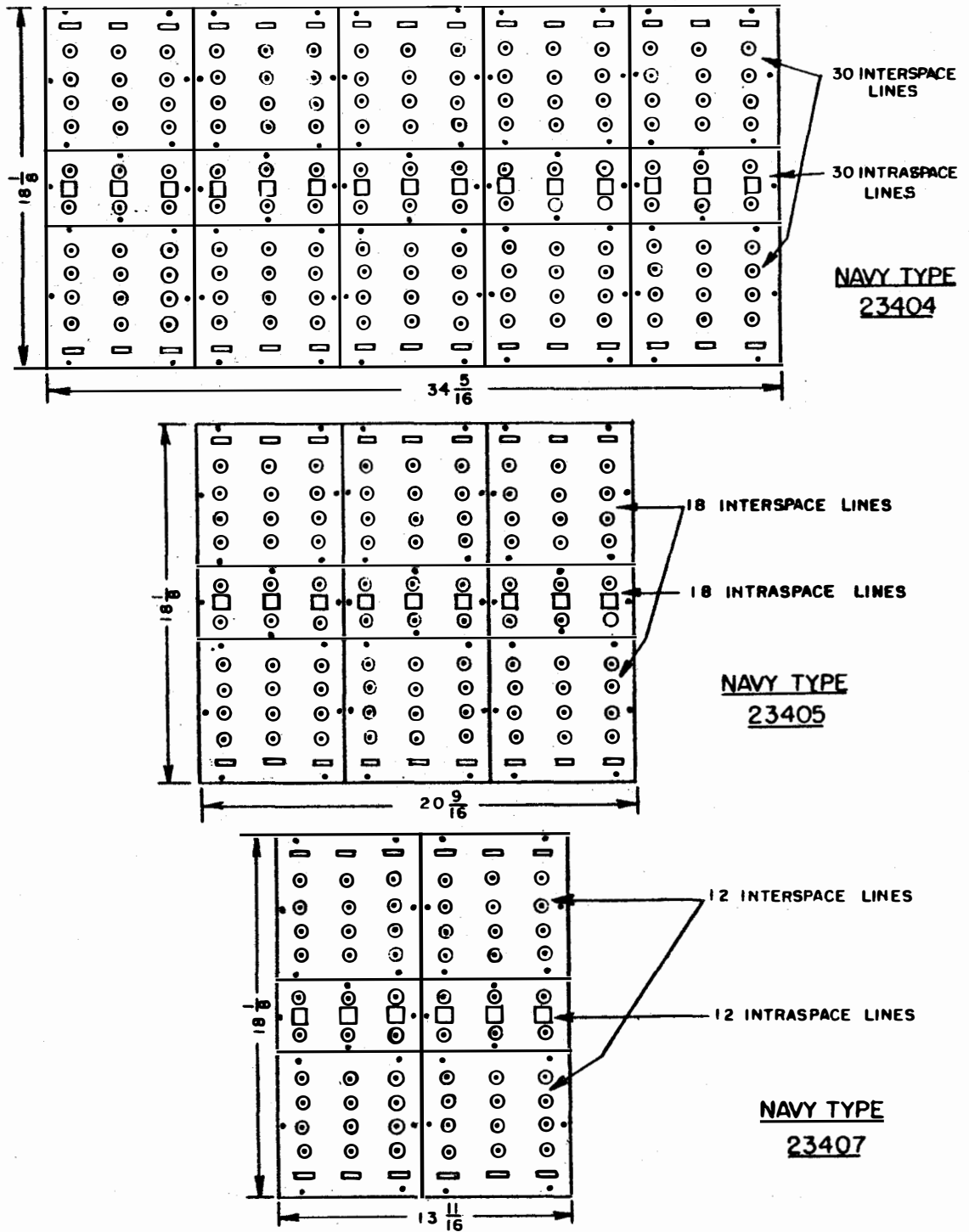


Figure 2-51. Antenna Transfer Panels

Type 62111 End Seals, connect to the various antennas and to other radio spaces. Each interspace line connects to a vertical row of four jacks. The escutcheon plate associated with each line should be marked to indicate the remote termination of that line.

A double row of jacks, each fitted with a Type 62112 Concentric Jack Termination, is provided on each panel for terminating the intraspace lines. These lines connect to terminal boxes located at the various receiver, frequency meter or other equipment positions. White escutcheon plates are mounted between each pair of jacks to enable the operator to mark the respective communications channels, frequencies or schedules thereon. These markings may be made

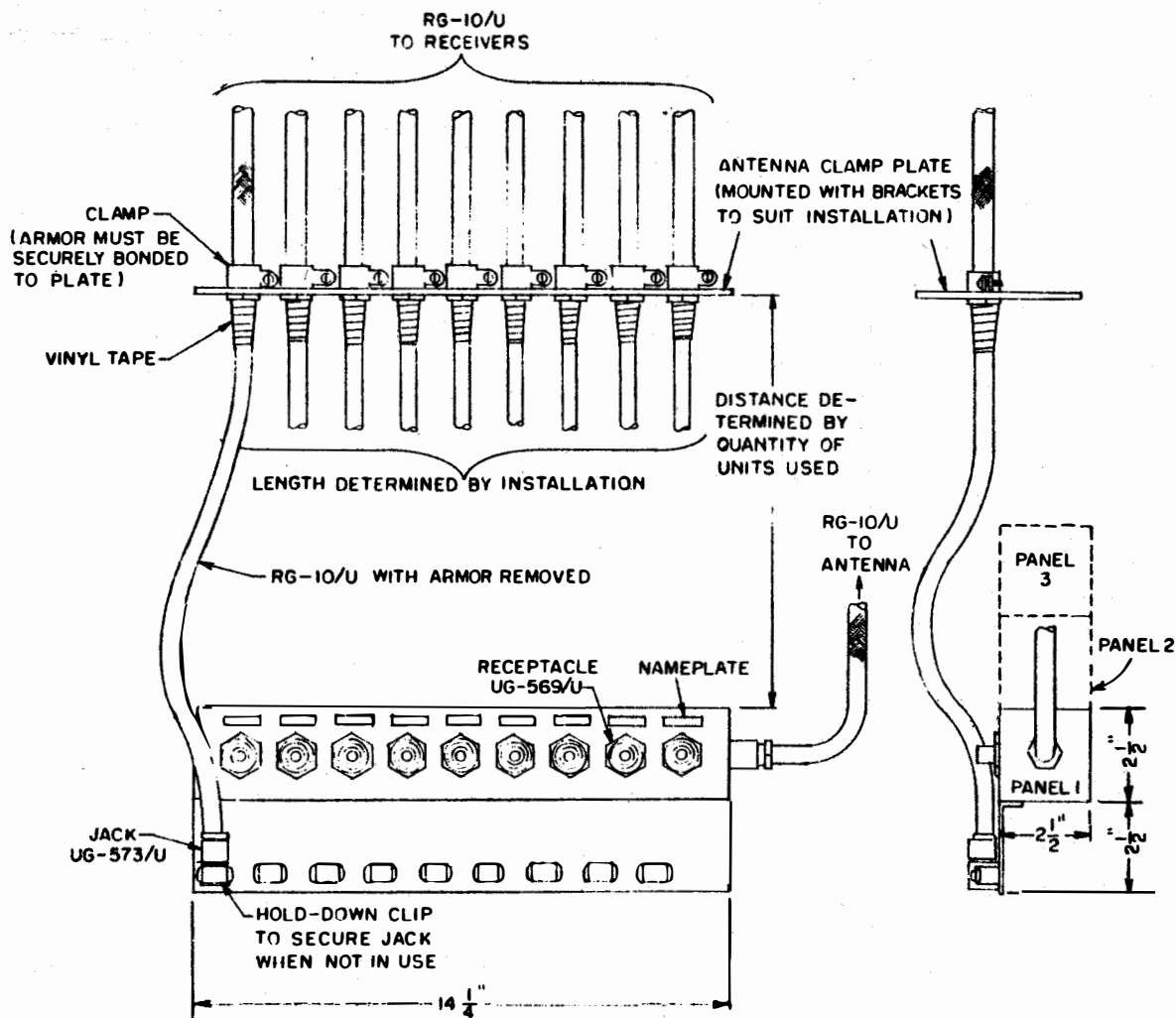
with pencil or ink and may be erased or washed off at will.

The transfer panels are intended to be mounted on a bulkhead with the cables entering the top and sides of the case. However, they may be mounted on a panel or on brackets. Figure 2-50 indicates this alternate arrangement with the cables entering the back of the case. Such a procedure is possible when there is sufficient space behind the panel to permit bending the cable. This distance should be more than six inches.

The dimensions and stock numbers for these four transfer panels are given in Table 2-6. The fittings supplied with each of these panels are listed in Table 2-7.

TABLE 2-6. RECEIVING ANTENNA TRANSFER PANELS

Navy Type Number	Overall Dimensions (Inches)			Standard Navy Stock Number	ESO Stock Number	Reference Drawing
	Height	Width	Depth			
23404	18-1/8	34-5/16	5-1/2	17-S-93142-7931	N16-P-2375	RA 49F 241B
23405	18-1/8	20-9/16	5-1/2	17-S-93129-7189	N16-P-2376	RA 49F 242
23406	11-1/16	20-9/16	5-1/2		N16-P-2377	RA 49F 243
23407	18-1/8	13-11/16	5-1/2	17-S-93121-5501	N16-P-2378	RA 49F 244



NOTES

- I. A COMPLETE SHIP INSTALLATION WILL CONSIST OF STACKED RECEPTACLE PANELS (ONE FOR EACH PERMANENT ANTENNA INSTALLED), ONE CLIP PANEL AND ONE ANTENNA CLAMP PLATE STACKED AS SHOWN.

Figure 2-52. Submarine Receiving Antenna Transfer Panel

TABLE 2-7. FITTINGS SUPPLIED WITH ANTENNA TRANSFER PANELS

Fitting	Transfer Panel Type 23404	Transfer Panel Type 23405	Transfer Panel Type 23406	Transfer Panel Type 23407
Concentric Jack Type 49120	150	90	54	60
Concentric Jack Termination Type 62112	30	18	18	12
18" Patch Cord Type 49122B	10	8	8	6
36" Patch Cord Type 49123B	18	16	10	10
48" Patch Cord Type 49150B	12			

The patchcords should be taken apart and inspected periodically to see that connections are secure, and that no frayed shield conductors can short the antenna circuits to ground.

The transfer panels are made with 70-ohm fittings and designed for use with 70-ohm cables such as RG-11/U and RG-12/U. However, RG-10/U 50-ohm cable may be used with these fittings by slightly enlarging the holes for the inner conductor.

The Bureau is currently investigating an antenna transfer panel employing quick-disconnect connectors and 50-ohm fittings and lines (see BuShips drawing RE 49F 680).

5. SUBMARINE RECEIVING ANTENNA TRANSFER PANEL.

A special receiving antenna transfer panel for use on submarines is shown in Figure 2-52. Because of space limitations on submarines, it is not practical to use the standard transfer panels such as Navy Type 23406. A separate receptacle panel is used for each permanently installed antenna; this provides nine receptacles connected to each antenna. Like receivers should not be used on the same antenna unless necessary. Clips are provided on a plate at the bottom of the panel to secure the receiver jacks when they are not in use. Since the armor is removed from that

portion of the receiver lines from the clamp plate to the transfer panel, it is important that the cable armor is securely bonded to the clamp plate through the armor clamp. The armor on the coaxial cables from the antennas should also be securely bonded to the receptacle panels through the armor clamps.

6. IDENTIFICATION OF RECEIVING ANTENNAS.

The Bureau has received a beneficial suggestion recommending posting a nameplate on antenna transfer panels whereby the useful frequency range of any receiving antenna installed in a ship will be readily apparent to the personnel of the vessel.

In accomplishing this suggestion it is recommended that each antenna terminal on an antenna transfer panel receive a nameplate approximately one-half inch by one and one-half inches. This nameplate shall contain the antenna designation and the length of the antenna in feet (i. e., RA-61 over 52 feet). A second nameplate of the same size shall be fastened adjacent to each antenna so that the useful frequency range of the antenna may be known. This information shall be engraved on the second plate (i. e., 2-7 mc). If this is not possible, then the second plate shall be of a material suitable for the personnel of the ship to record the useful range of each antenna as it becomes known from actual use.

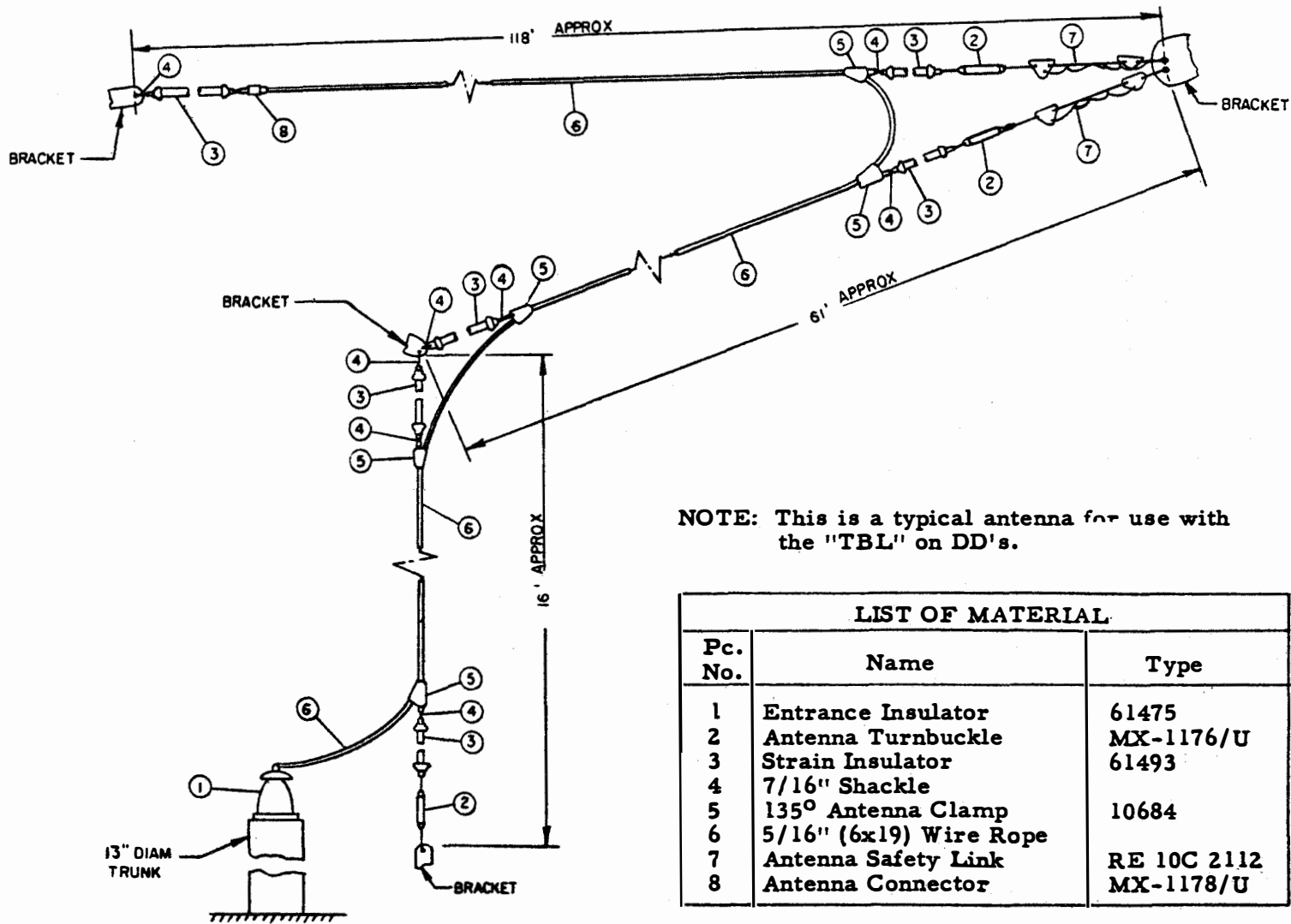


Figure 2-53. Typical Transmitting Antenna Installation

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SECTION 2-5

TRANSMITTING ANTENNAS

1. GENERAL.

In general, radio transmitting and receiving antennas are similar except that in the case of transmitting antennas much larger amounts of RF power are handled. Since transmitting antennas do present a hazard to personnel, the transmitting antenna installation should be planned so that personnel cannot accidentally come into contact with exposed portions of the antenna system.

In shipboard radio transmitting systems both open wire and whip antennas are used. Figure 2-53 shows a typical wire transmitting antenna installation. The transmission line for the antenna consists of a copper bus enclosed in an antenna trunk. Trunks are used with high-power transmitters. Coaxial cable may be used for the transmission line between the transmitter and antenna in low-power (10-125 watts) installations.

It is necessary to minimize the power losses in the transmission line, if most of the power from the transmitter is to be radiated from the antenna. Matched impedances should be maintained as closely as is practicable in the antenna system. The antenna impedance should be matched to the transmission system in a manner that will avoid high voltage standing wave ratios. Until the time that shipboard antennas become available which match the impedance of the interconnecting lines or trunks, it is desirable to keep the transmission lines as short as possible. For this reason it is recommended that transmitter rooms be located as close as possible to the antennas.

2. INSTALLATION.

a. SEPARATION OF ANTENNAS. — Antennas should be well dispersed to reduce interaction and directivity. If the

receiving antennas are installed forward and the transmitting antennas aft, less of the power from the transmitting antennas will be absorbed by the receiving antennas. Intercoupling between these antennas at high-frequencies and below necessitates the use of receiver protective devices.

To avoid operational interaction between transmitters connected to different antennas, the transmitting antennas should be separated a distance approximately equal to the height of the shorter antenna. This means that, ideally, a minimum separation of 35 feet should be maintained between two 35-foot whips, or between a 35-foot whip and any larger antenna. Unfortunately, space limitations aboard ship seldom permit antenna separations quite this large, but the rule is helpful in planning antenna installations.

b. LENGTH OF TRANSMISSION LINES. — In general, all transmission lines should be as short as possible. From considerations such as reduction in weight, space and cost, this is obvious. However, taking into account the characteristics of typical shipboard antennas and transmitters, the effectiveness of a given installation is dependent more upon favorable impedance matching than upon line losses. It is for this reason that extremely short, high impedance (180-ohm) line is recommended for use with "electrically short" antennas (i. e. all available shipboard antennas for use at the lower frequencies, below 600 kc). The impedance of a 9"x11" antenna trunk is roughly 180 ohms. Where antenna base tuning units are employed, as in the case of the AN/URT-3 transmitter, the line is reasonably well matched and its losses are considerably less.

It is recommended that antenna trunks be replaced by RG-18/U or some similar low-loss coaxial cable when the following types of antenna installations are used:

- (1) Broad-band antennas.
- (2) High efficiency, automatically tunable matching networks at the base of the antenna.
- (3) Fixed matching networks at the base of the antenna with switching arrangements to cover the band.
- (4) A fixed matching network at the base of the antenna to cover the low-frequency region.

c. **INSTALLATION OF GROUND STRAPS.** - The installation of RF ground connections should be performed with the same care as used in making "hot" or "live" connections. If a ground strap performs its proper function, it carries current substantially equal to that carried by the center conductor of the transmission line. With shipboard transmitters, copper strap is recommended for RF grounding. The Bureau has found that a piece of solid strap is superior to copper braid when conducting RF currents. Where flexibility is needed, a slightly longer strap in the form of a half-loop can be used.

BuShips Instruction 9670.16, dated 2 January 1953, provides the following minimum requirements for the grounding of electronic equipment installed on ships.

"All electronic equipment whose DC resistance from case to ground exceeds 0.01 ohm, shall be grounded by the use of straps as follows:

- (1) On units requiring sound isolation, the straps shall be copper braid, not less than 1/2 inch wide.
- (2) On other units, the strap shall not be less than 0.020 inch thick by 1/2 inch wide, sheet copper or brass.
- (3) The surface at the points of attachment of the straps shall be thoroughly cleaned to insure a metal-to-metal contact.
- (4) The straps shall be as short as possible with only enough loop allowed

to permit satisfactory deflection of shock or sound isolation mounts.

(5) The strap connections shall be locked to prevent loosening from vibration.

(6) Only one strap will be required for each unit unless tests indicate more are needed."

Static or DC ground straps are necessary when the transmitting equipment is shock mounted. This is primarily a measure of protection for personnel against injury from stray voltages, static charges, or high DC potentials. As in the case of RF grounds, a solid copper strap should be used and all connection points should be scraped clean and tightly secured. The equipment should be grounded to the deck or bulkhead.

Aboard ship where transmitters and antennas are unbalanced to ground coaxial line or a trunk should be used from the antenna lead-in to within a few inches of the transmitters' output terminals. A good RF ground connection should be made from the outer conductor or shell to the transmitter case. The transmitter case should also be bonded to the deck or bulkhead with a ground strap.

d. **SPECIAL 3-INCH LINE.** - In recognition of the problems of shipyards in making "coaxial installations" from rectangular trunks, a program has been initiated for improving and simplifying transmitting installations aboard ship. As a start, a special 3-inch, 180-ohm line with a series of fittings has been developed.

At present, 45 and 90-degree elbows are available which, with their swivel flanges and silicone rubber "O" ring seals, afford considerable flexibility of installation. Special end seals and solderless beryllium copper expansion type connectors for the inner conductor are also available.

Plans are under consideration for extending the use of this line to a number of small transmitters.

Characteristics of this special 3-inch line are as follows:

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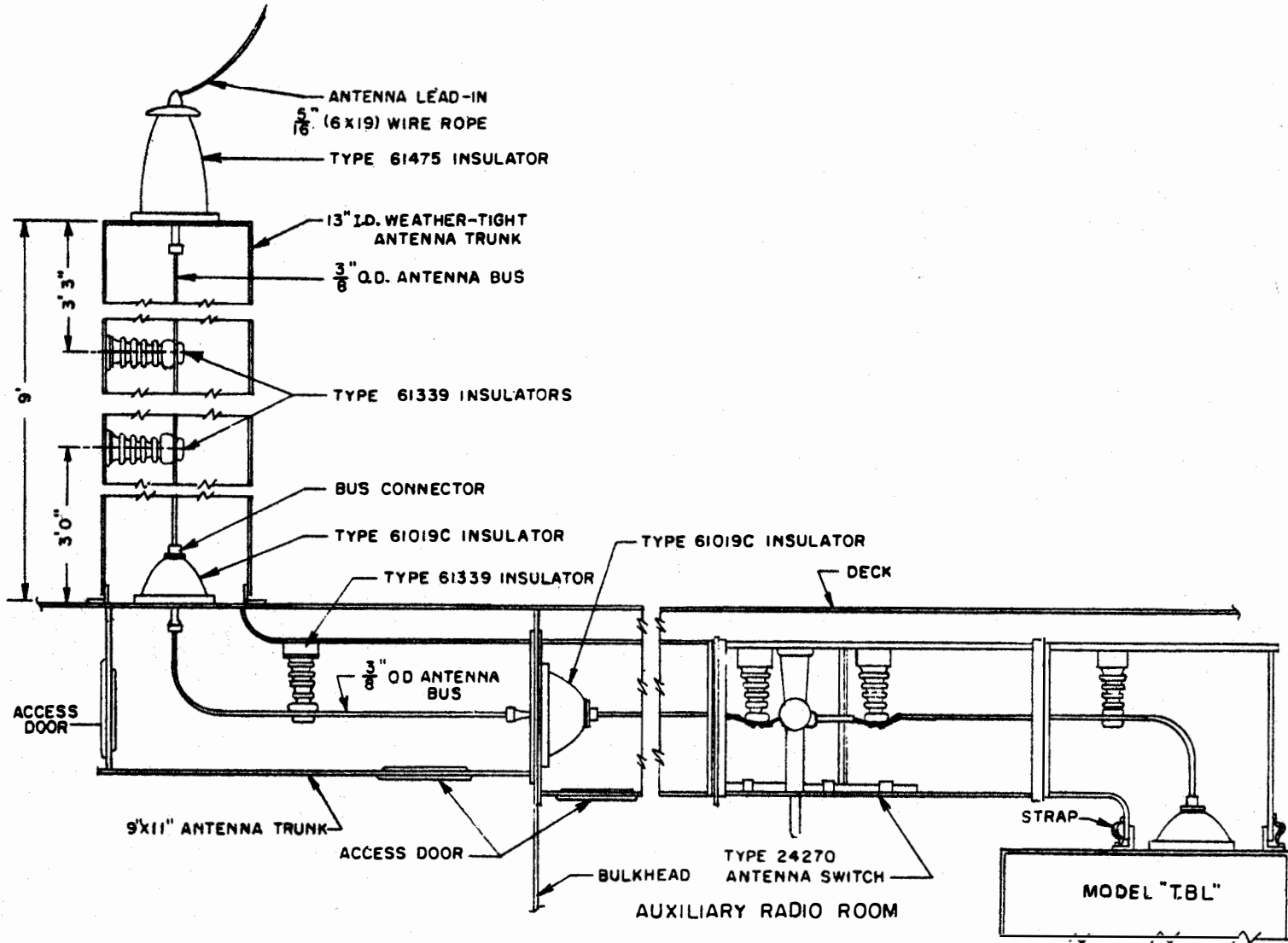


Figure 2-54. Typical Antenna Trunk Installation

2-57

- (1) Characteristic Impedance.....180 ohms
- (2) Outside Diameter.. 3.125 inches
- (3) Inside Diameter.....3.0 inches
- (4) Inner Conductor.....0.144 inch
- (5) Spacing, Teflon Beads.....12.0 inches
- (6) Line losses in db per 100 feet:
 - (a) at 1 mc.....0.179 db
 - (b) at 10 mc.....0.0566 db
 - (c) at 30 mc.....0.098 db
- (7) DC or peak 60-cycle rating.....10,500 volts

e. **SAFETY PRECAUTIONS.** - Antennas for transmitting shall be installed so as not to be readily accessible to unauthorized persons. A minimum clearance of 10 feet for low-power antennas and 12 feet for medium and high-power antennas shall be allowed above spaces normally accessible to personnel. (See Bureau of Standards Handbook H30, National Electrical Safety Code.)

Antenna lead-in conductors shall be installed and protected to prevent personnel from readily coming into accidental contact with them. Lead-in conductors shall be securely fastened to suitable insulators which provide a clearance of at least 2 inches from the nearest surface. If the lead-in has an effectively grounded metal sheath, such as coaxial cable, it may be attached directly to any surface.

The antenna lead-in should be provided with a grounding switch for lightning protection. If no conducting path between the antenna and ground is provided in the connected equipment, means shall be provided for draining static charges from the antenna system.

In wire antenna installations the connectors, clamps, shackles, etc., shall be strong enough to withstand a load which will break the antenna wire itself. A safety link which will release the wire before it breaks shall be used in all wire transmitting antenna installations.

3. ANTENNA TRUNKS.

An antenna trunk is used on shipboard to enclose and support the copper bus which serves as a transmission line between a radio transmitter and its an-

tenna. The trunk is used for shielding purposes, for mechanical protection of the antenna bus and also to prevent personnel from accidentally coming in contact with the antenna bus.

A trunk is basically a coaxial line. A copper bus is supported by stand-off insulators inside the grounded metallic trunk. A typical antenna trunk installation is shown in Figure 2-54.

In exposed locations the trunk should extend high enough so that personnel cannot accidentally come in contact with the antenna lead-in. Figure 2-55 illustrates these clearances.

The antenna trunk may be rectangular or circular in shape. The 9"x11" rectangular trunk is commonly used in shipboard radio transmitting antenna systems. A list of the trunk sizes and fittings used with some of the shipboard transmitters is given in Table 2-8.

The "General Installation Specifications for Shipboard Radio Transmitting Antenna Systems", RE 66A 430, sets up the following general requirements for antenna trunks:

a. TRANSMITTERS WITH RATED OUTPUT OF 125 WATTS AND LESS. -

(1) An antenna trunk is required when antenna bus is located in weather and where mechanical or personnel protection is necessary.

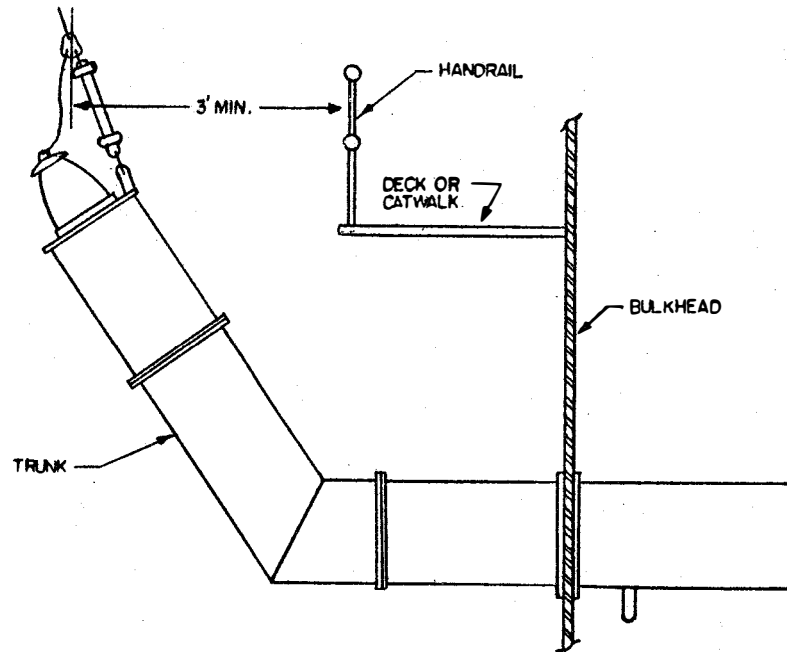
(2) An antenna trunk is required between antenna disconnect device and bulkhead when the transmitter is located in the same space with one or more transmitters having a rated output of over 125 watts.

b. TRANSMITTERS WITH RATED OUTPUT OF OVER 125 WATTS. -

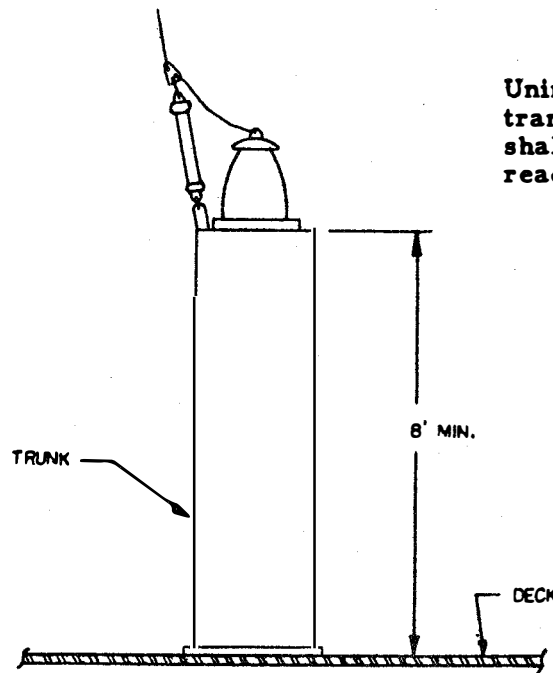
(1) Antenna trunk required between antenna disconnect device and entrance insulator in all types of vessels.

(2) Antenna trunk required between transmitter unit and disconnect device only in vessels having non-metallic (unshielded) radio spaces or where mechanical or personnel protection is necessary.

c. Whenever practicable, entrance insulators and antenna down-leads shall



(a) HORIZONTAL CLEARANCE



(b) VERTICAL CLEARANCE

NOTE

Uninsulated portion of transmitting antennas shall be out of normal reach of personnel.

Figure 2-55. Clearances For Antenna Trunks

TABLE 2-8. TYPICAL SHIPBOARD RADIO TRANSMITTING ANTENNA SYSTEMS

Transmitting Equipment (Model)	Antenna Bus (OD)	Standoff Insulators		Trunk Size (Inches)	Disconnect Device	Bulkhead & Deck Insul. (Inside)	Entrance Insulator (Outside)	Antenna Wire (OD)	Strain Insulators (Type)
		Type	Approx. Spacing						
TAD	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TAJ	3/8"	61339	48"	9 x 11	24270	61019C	61475	7/16"	61493
TAQ	3/4"	61338	60"	18 x 20	RE 66F 312	61475	61475	7/16"	61493
TBA	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TBK	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TBL	3/8"	61339	48"	9 x 11	24270	61019C	61475	5/16"	61493
TBM	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TBN	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TBU	3/4"	61338	60"	18 x 11	RE 66F 312	61475	61475	7/16"	61493
TCE	3/8"	61175A	48"	6 x 8	24206	61019C	61475	5/16"	61481
TCH	3/8"	61175A	48"	6 x 8	24206	61471	61019C	5/16"	61481
TCJ	3/8"	61339	48"	9 x 11	24270	61019C	61475	7/16"	61493
TCK	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TCO	3/8"	61175A	48"	6 x 8	24206	61471	61471	7-#18	61481
TCP	3/8"	61175A	48"	6 x 8	24206	61471	61019C	7-#18	61481
TCQ	3/8"	61175A	48"	6 x 8	24206	61471	61471	7-#18	61481
TCS	3/8"	61175A	48"	6 x 8	24206	61471	61471	7-#18	61481
TCU	3/8"	61175A	48"	6 x 8	24206	61019C	61475	5/16"	61481
TCX	3/8"	61175A	48"	6 x 8	24206	61471	61471	7-#18	61481
TCZ	3/8"	61175A	48"	6 x 8	24206	61019C	61475	5/16"	61481
TDA	3/8"	61339	48"	9 x 11	24270	61019C	61475	7/16"	61493
TDB	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TDE	3/8"	61175A	48"	6 x 8	24206	61019C	61475	5/16"	61481
TDJ	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493

be so located to eliminate the necessity for topside (weather) antenna trunks.

d. The antenna trunk shall be as short and as free from bends as practicable.

e. The trunk shall be fabricated from suitable solid sheet metal having a minimum thickness of 0.094". Wire-mesh or expanded metal trunks are not acceptable regardless of location.

f. Access doors or removable sections shall be provided to permit replacement of all pedestal, bulkhead and deck insulators enclosed therein.

g. Inside corner of all trunk bends shall have a minimum radius of 3". Screws, bolts, burrs or sharp edges shall not protrude from the inside surfaces of trunks.

h. All exposed steel surfaces resulting from cutting, drilling, welding, riveting, etc., shall be coated with an approved rust preventative.

i. The inside of all trunks shall be cleaned of loose material, burrs and projections prior to being placed in operation.

j. MATERIAL.

(1) PREFERRED MATERIAL. - Antenna trunks shall be constructed of one of the following materials, listed in order of preference:

(a) Copper-nickel clad steel. Clad 0.008" (min) thick, two sides.

(b) Copper-nickel clad steel. Clad 0.008" (min) thick, one side. (Cladding inside.)

(c) Copper-clad steel. Clad 0.008" (min) thick, two sides.

(d) Copper-clad steel. Clad 0.008" (min) thick, one side. (Cladding inside.)

(2) SUBSTITUTE MATERIAL. - When the above copper-clad steel is not available, it is permissible to substitute aluminum for use in fabricating radio transmitter antenna trunks. The aluminum should be 61 ST 6 in accordance with Navy Specification 47 A 12, condition

T, with a minimum thickness of 0.125 inch. The inside and outside of fabricated trunks shall be treated with a zinc chromate primer, the outside to be painted as required.

Each seam, with the exception of bolted access covers, and joints in which continuity of shielding or electrical conductivity must be maintained shall be welded.

It is recommended that the new inert-gas, shielded arc-welding equipment which is suitable for welding the 61 ST 6 aluminum alloy to be used. Type AL-43 welding rods (Navy Spec 46 R7, Class B) and argon or high-test "welding grade" helium gas should be used for this work as directed by the welding engineer.

4. ANTENNA DISCONNECT SWITCHES.

a. GENERAL. - Antenna disconnect switches are used in shipboard installations of radio transmitters to disconnect the antenna from the transmitter. The switch is usually installed overhead adjacent to the radio transmitter. A disconnect switch serves two purposes: it grounds the antenna as well as breaking the circuit between the transmitter and antenna.

The "General Installation Specifications for Shipboard Radio Transmitting Antenna Systems", RE 66A 430, sets up the following requirements for antenna disconnect switches:

(1) They shall be of the type specified or fabricated in accordance with the Bu-Ships type plan, or RE 66A 430 if the Bureau does not provide a type plan.

(2) They shall be of the shielded (blank-off) type when installed in a space containing one or more transmitters having a rated output of over 125 watts.

(3) In non-metallic (unshielded) radio spaces, they shall be installed in a manner that the transmitter end of the trunk will be blanked-off in lieu of the antenna end.

b. TYPES. - Antenna disconnect switches are usually large knife switches. The types most commonly used in shipboard installations are as follows:

(1) NAVY TYPE-24270 ANTENNA DISCONNECT SWITCH (Figure 2-56). - This disconnect switch is essentially a section of 9"x11" transmitting antenna trunk containing a single-pole, three-position knife switch. The three positions are marked on the cover: "GROUND", "CLOSED" and "OPEN". This switch has a shield, or blanking-off plate, which is inserted into the trunk section of the switch between the switch mechanism and the bus leading to the

transmitter. An interlock prevents the shield from being inserted into the slide except when the switch is in the grounded position. After the shield has been inserted into the slide, it locks the operating handle in the grounded position. This prevents closing the switch again before the shield has been removed. The trunk section of the switch is fabricated of copper-clad steel (cladding 0.008" thick, inside only).

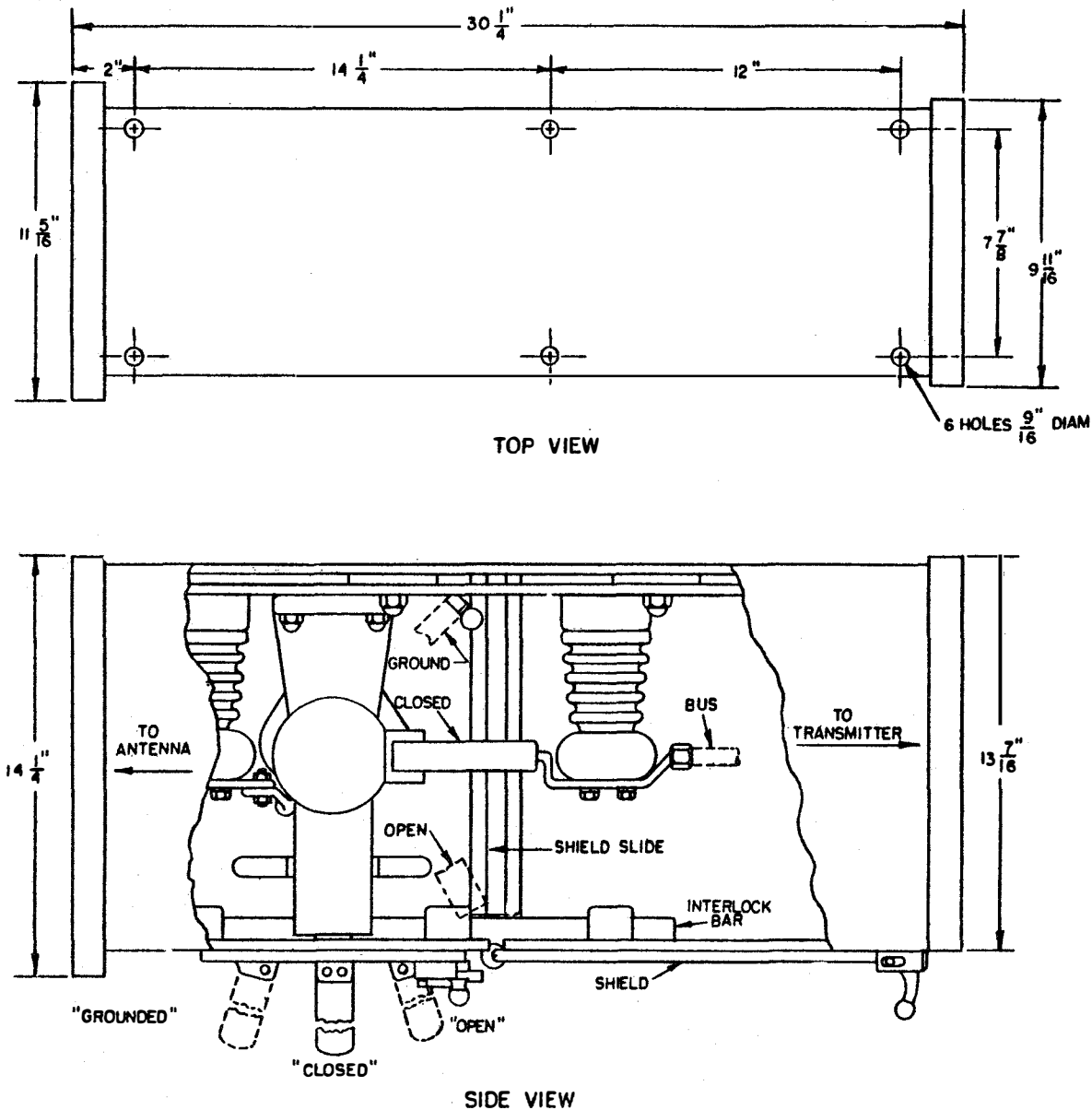


Figure 2-56. Navy Type-24270 Antenna Switch

**INSTALLATION
METHODS**

NAVSHIPS 900, 121(A)

**Section 2-5
Paragraph 4b(1)(a)**

(a) Capacity: 200 amperes at 15000 volts.

(b) Standard Navy Stock Number: 17-S-534-8777.

(c) ESO Stock Number: N16S-12100.

(d) Reference Drawing: RE 24J 161A

(2) NAVY TYPE-24206 ANTENNA DISCONNECT SWITCH (Figure 2-57). - Is a single-pole, double-throw knife switch. It has two positions: "CLOSED" and "GROUNDED". The switch contains two NT-61175A Insulators as supports. It has two compression type terminals for clamping on a 3/8" OD copper antenna bus.

(a) Capacity: 200 amperes at 7500 volts.

(b) Standard Navy Stock Number: 17-S-53636-1073.

(c) ESO Stock Number: N16S-12075.

(d) Reference Drawing: RE 24F 146.

(3) NAVY TYPE-24223 ANTENNA DISCONNECT SWITCH (Figure 2-58). - This switch is a single-pole, double-throw knife switch with a "CLOSED" and a "GROUNDED" position. It has a bus bar clamp type terminal on either end for connecting to a 3/8" OD antenna bus. The switch is supported by two NT-61174B Insulators.

(a) Capacity: 100 amperes at 2500 volts.

(b) Standard Navy Stock Number: 17-S-53632-2513.

(c) ESO Stock Number: N16S-12060.

(d) Reference Drawing: RE 24F 147.

c. INSTALLATION. - It is suggested that when any bar type antenna disconnect switch (drawing RE 66F 311) presently installed in many 9"x11" radio transmitting antenna trunks in Navy vessels is in need of repair, it be replaced by the installation of a Navy Type-24270 antenna disconnect switch as an alteration equivalent to repair.

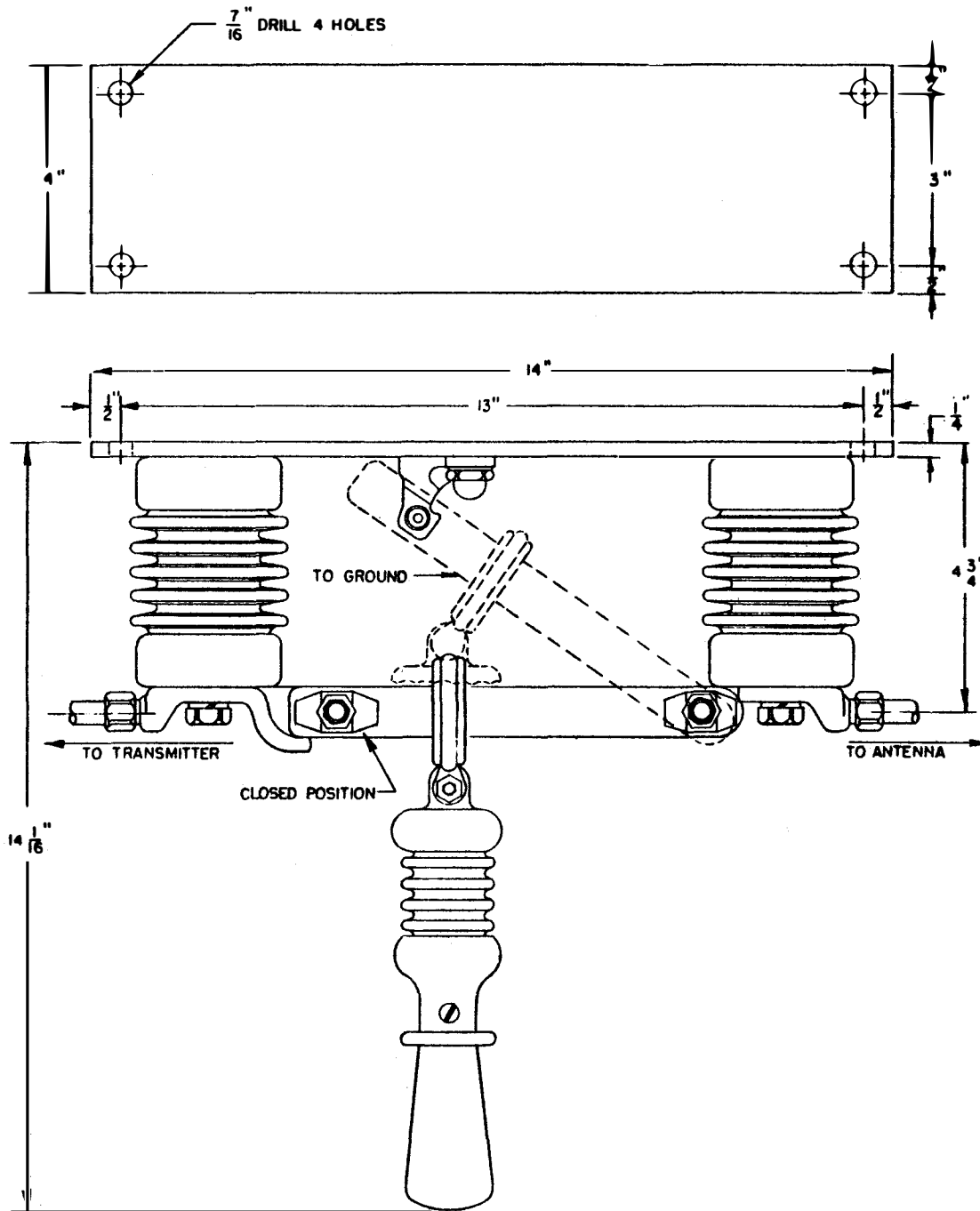


Figure 2-57. Navy Type-24206 Antenna Switch

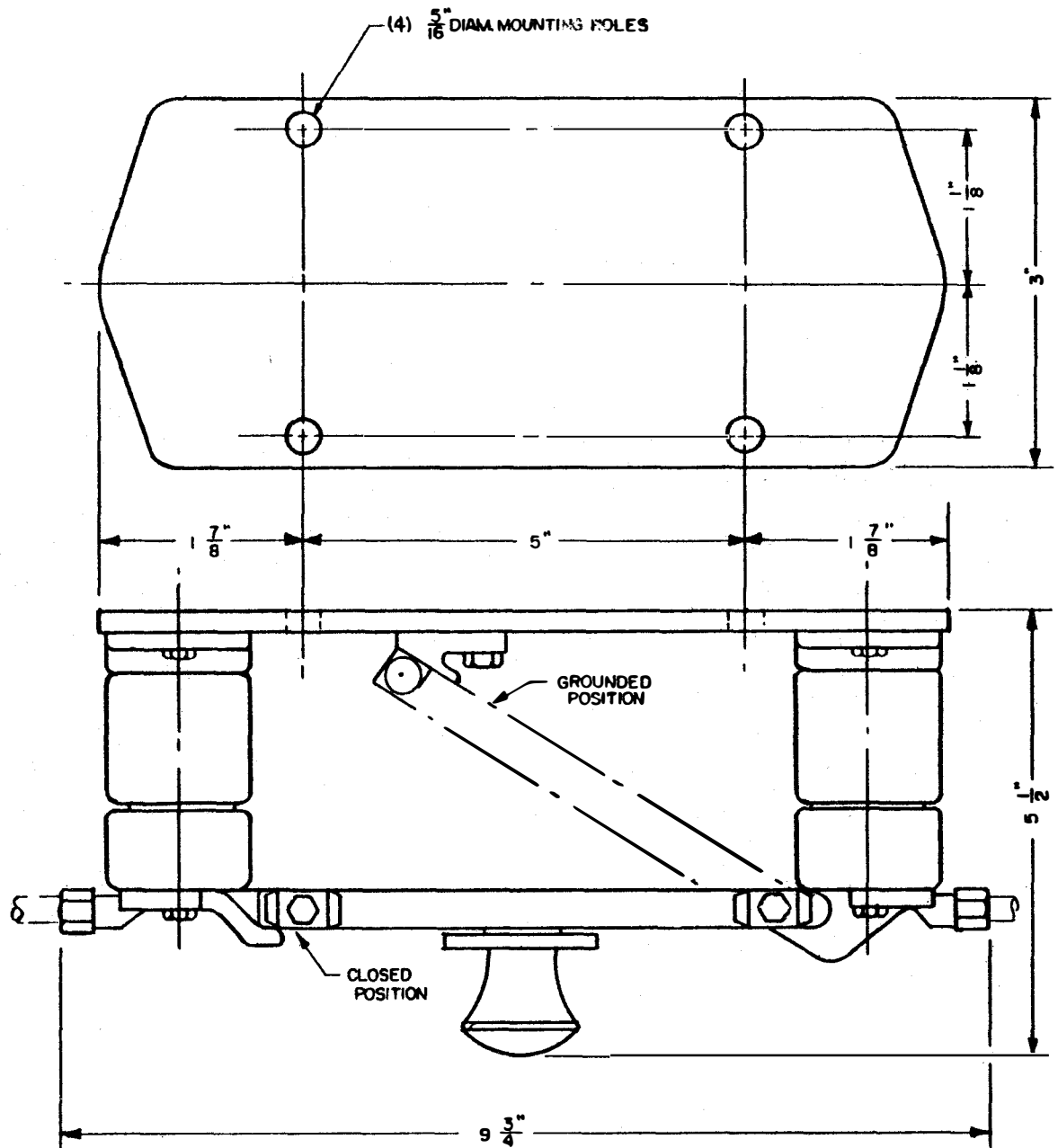


Figure 2-58. Navy Type-24223 Antenna Switch

SECTION 2-6

UHF ANTENNA INSTALLATIONS

1. GENERAL.

With the increasing use of ultra-high frequency radio equipment in Naval vessels, the antenna location problem has become very difficult. Experience has shown that extreme care must be taken in selecting UHF antenna locations. Of great importance is the fact that the antenna must be "in the clear". This is because mast structures, stanchions, other antennas, railings, stacks, and other metallic structures affect the antenna pattern.

In shipboard installations, it is very desirable to cover 360° in azimuth with both transmitting and receiving antennas. If this can be accomplished, transmitted signals will be received with the same strength at a given distance regardless of the respective headings of the ships. It is also very important to obtain sufficient signal strength at the receiving antenna. Sufficient signal strength is dependent upon the amount of noise present on the frequency of the received signal and upon the signal-to-noise ratio.

In order to obtain what approaches full coverage in azimuth and also give usable signals at ranges from 15 to 20 miles, the necessity of having UHF antennas as high as possible cannot be over-emphasized.

As a result of having to vie for favorable or the more-favorable positions with beacons and radar equipments, it has become necessary in some instances to accept compromise locations for the UHF antennas. However, at least one of the UHF antennas should be mounted in a high, clear position. Physical limitations and electronic requirements prevent installing all the UHF antennas in a similar position. When the UHF multi-

couplers become available, they should help to alleviate this condition. With multicouplers, it is possible to operate several equipments simultaneously into the same antenna.

2. INSTALLATION.

a. TYPES OF ANTENNAS.—Many UHF failures can be traced to the antenna. If the antenna is full of water or if its insulator is painted, it will not work. It is important that the antenna be installed vertically as all Navy UHF communication equipments use vertical polarization. Two new UHF antennas, the AT-150/SRC and the AS-390/SRC, have been developed and are available for replacement of the Type 66147 antenna. The AS-390/SRC is designed for mounting on top of a mast, whereas the AT-150/SRC should be mounted at the end of a yardarm or bracket. These new antennas offer a much better impedance match to the transmission line throughout the band, and they also produce a more uniform radiation pattern. It is recommended that these two antennas be used wherever possible for installations or for replacement of Type 66147 antennas.

b. LOCATING THE ANTENNA.—Having a good antenna is not sufficient; it must be installed in a location that permits it to radiate uniformly. Directivity is probably one of the major faults in the UHF system. A general rule for insuring good UHF antenna coverage is to locate the antenna in the clear. This is not too difficult for a single antenna, but unfortunately an installation will usually consist of several antennas.

The mast and objects on the mast such as ladders, brackets and stays cause variations in the antenna pattern. It has been found that little improvement can be effected by increasing the antenna spacing from the mast after 9 feet separation has been obtained. Best results are obtained when mast extensions are installed to elevate the UHF antennas to a high, clear position. Every ship should be provided with at least one UHF antenna that projects in the clear above the radar on the mast.

The bracket or stub mast used to support the antenna can cause severe pattern distortion. Best patterns are obtained with stub masts when AS-390/SRC antennas are installed atop the masts. When it is necessary to use AT-150/SRC antennas, they should be at least 4 feet from the nearest vertical section of the support mast or mounting bracket (see Figure 2-59). Horizontal members of the support brackets will not interfere with the vertically polarized radiation.

Another consideration in the installation of UHF antennas is the interference caused by spurious radiations from transmitters. Tests have shown that a horizontal spacing of at least 21 feet or a vertical spacing of at least 4 feet should be maintained between receiving and transmitting antennas (see Figure 2-59).

To prevent directivity effects on the patterns of nearby UHF antennas, a spacing of 6 to 8 feet should be maintained between antennas (see Figure 2-59).

Figures 2-60 and 2-61 indicate the regions surrounding other antennas in which it is not recommended to install UHF antennas. As a rule the larger the object, the greater is the separation required.

c. TRANSMISSION LINES. - The transmission lines used in UHF installations are 50-ohm solid-dielectric coaxial cables. Since maximum power efficiency is required in UHF communications, it is recommended that RG-18/U be used. This applies to receivers as

well as transmitters. Transmission lines should be checked to insure that no sharp bends or clamp pinches are present. Open and short-circuited tests should be performed frequently to determine the condition of the line. A typical UHF installation is shown in Figure 2-62.

d. INSTALLATION RULES. - The following general rules can be applied to all UHF antenna installations:

(1) Keep vertical UHF antennas at least one wavelength away from any vertical conductors.

(2) If possible, detune any vertical conductors within two wavelengths of the antenna.

(3) Mount antennas as far out from supporting structures as practicable. Wider antenna supporting structures and associated gear requires a greater outrigger distance between the antenna and mast than narrow supporting structures, for the same distortion in the resulting antenna pattern.

(4) Keep all conductors as close to the supporting structure as possible, to reduce the shadow angle through the structure.

(5) Make the supporting structure electrically narrow by breaking up with insulators all closed loops, especially those smaller than one wavelength.

(6) Pay attention to angles moderately above the horizon from the antenna, if aircraft communication is involved.

(7) Check the resulting antenna patterns, preferably at several frequencies within the range of the equipment. Do this both for surface and for elevated targets if the equipment may be used for communication with aircraft.

(8) It is desirable when planning a UHF antenna system to install at least one AS-390/SRC antenna atop a staff or mast. This antenna can usually be completely "in the clear". Type AT-150/SRC antennas are designed for mounting at the end of a horizontal support such as a yardarm or bracket.

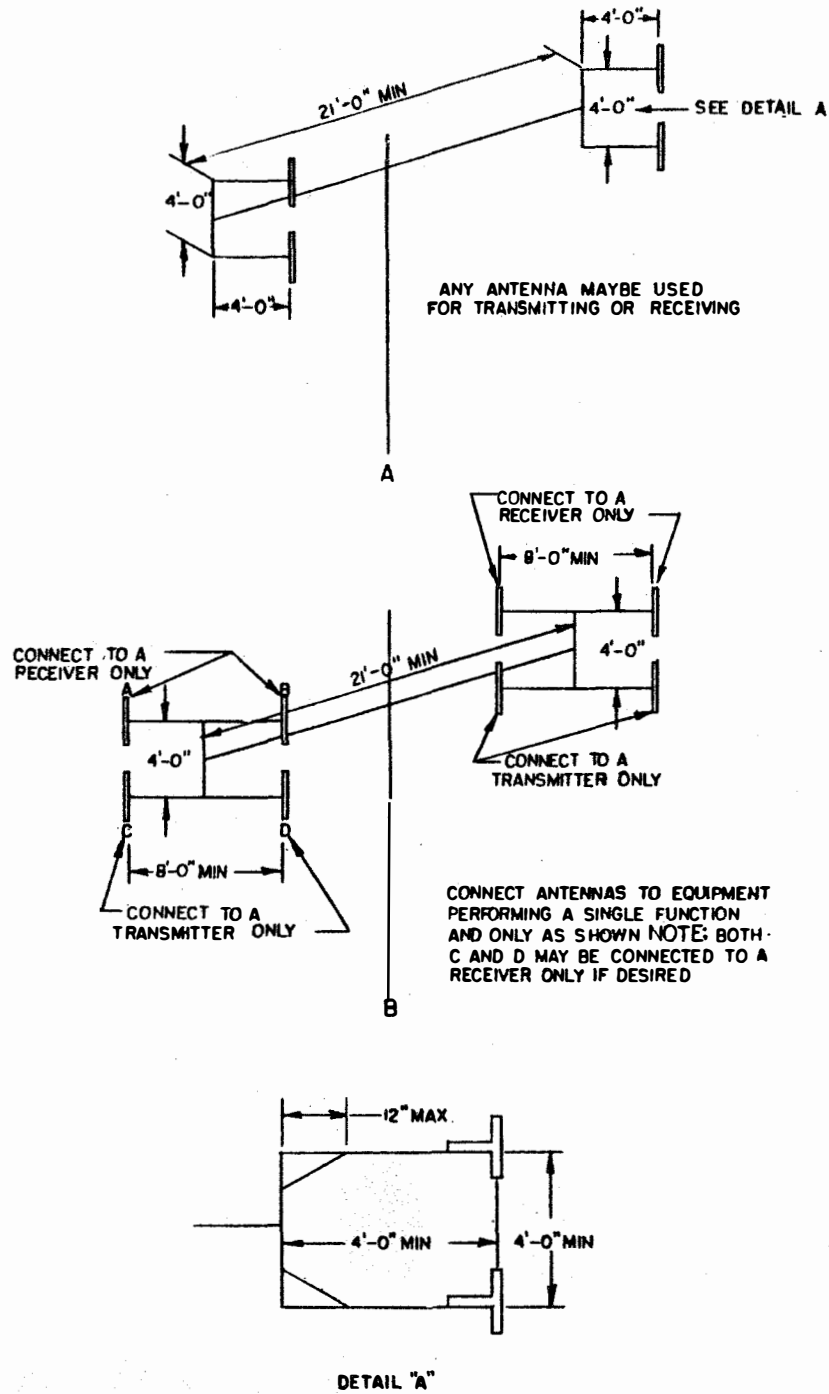


Figure 2-59. UHF Antenna Arrangements

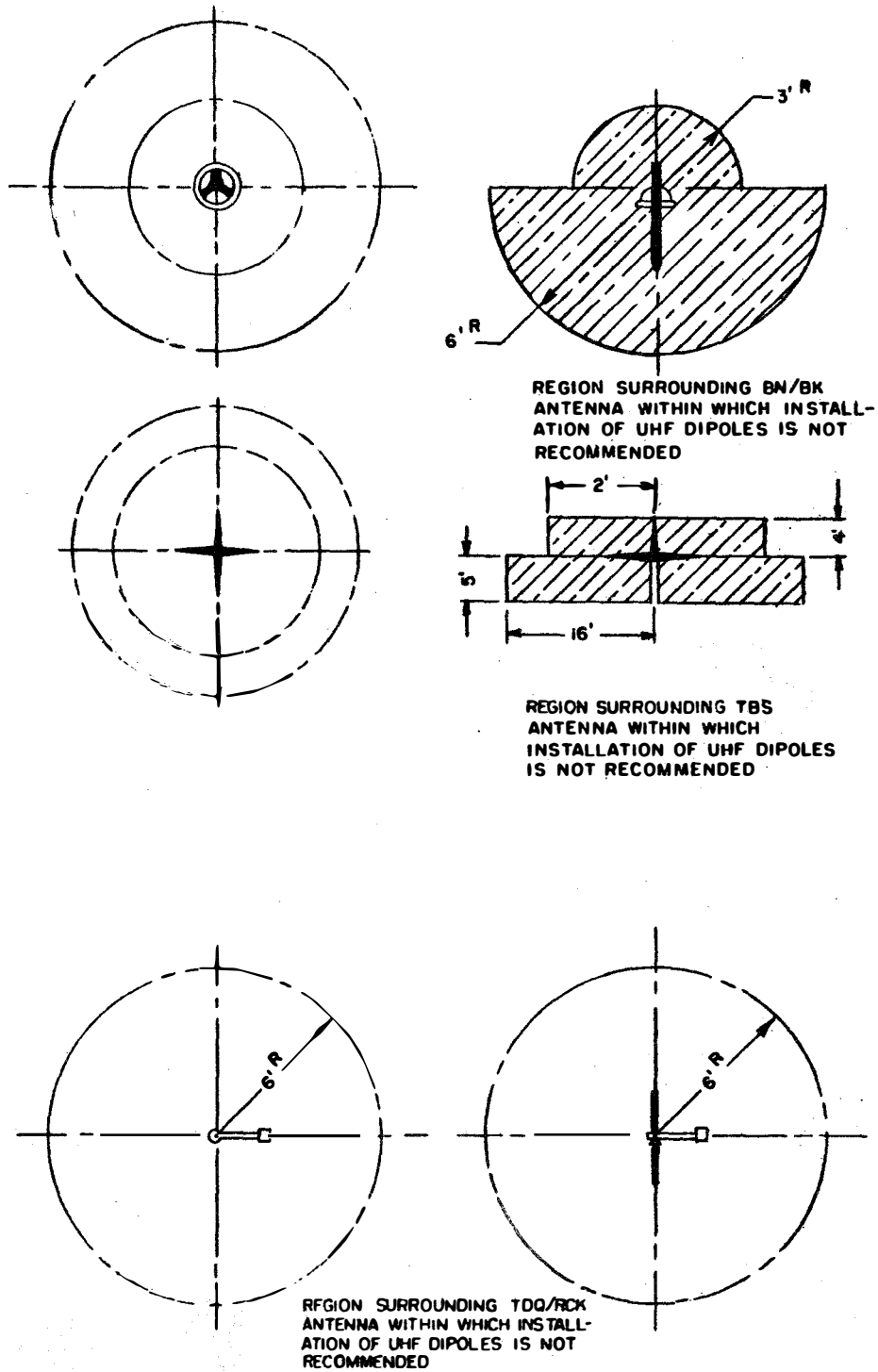
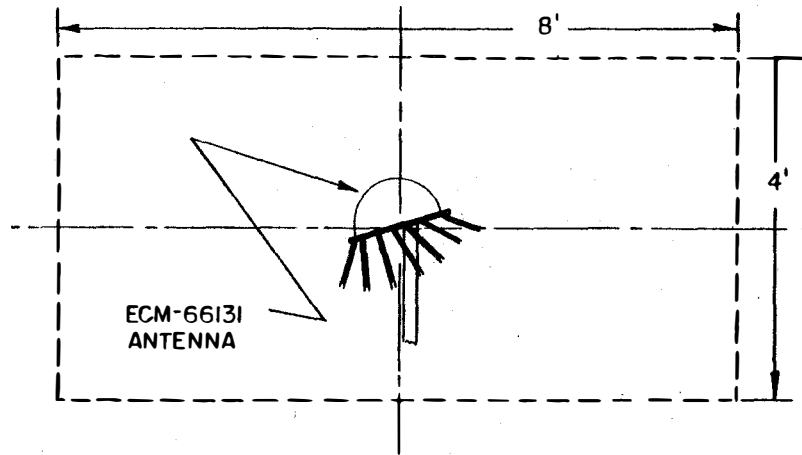
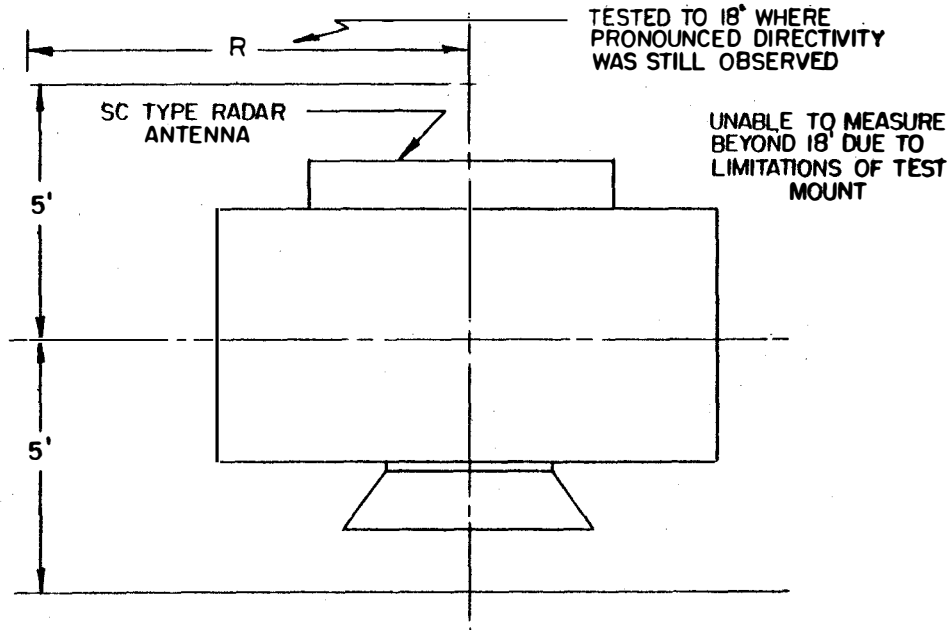


Figure 2-60. Recommended Clearances Around Radio and IFF Antennas

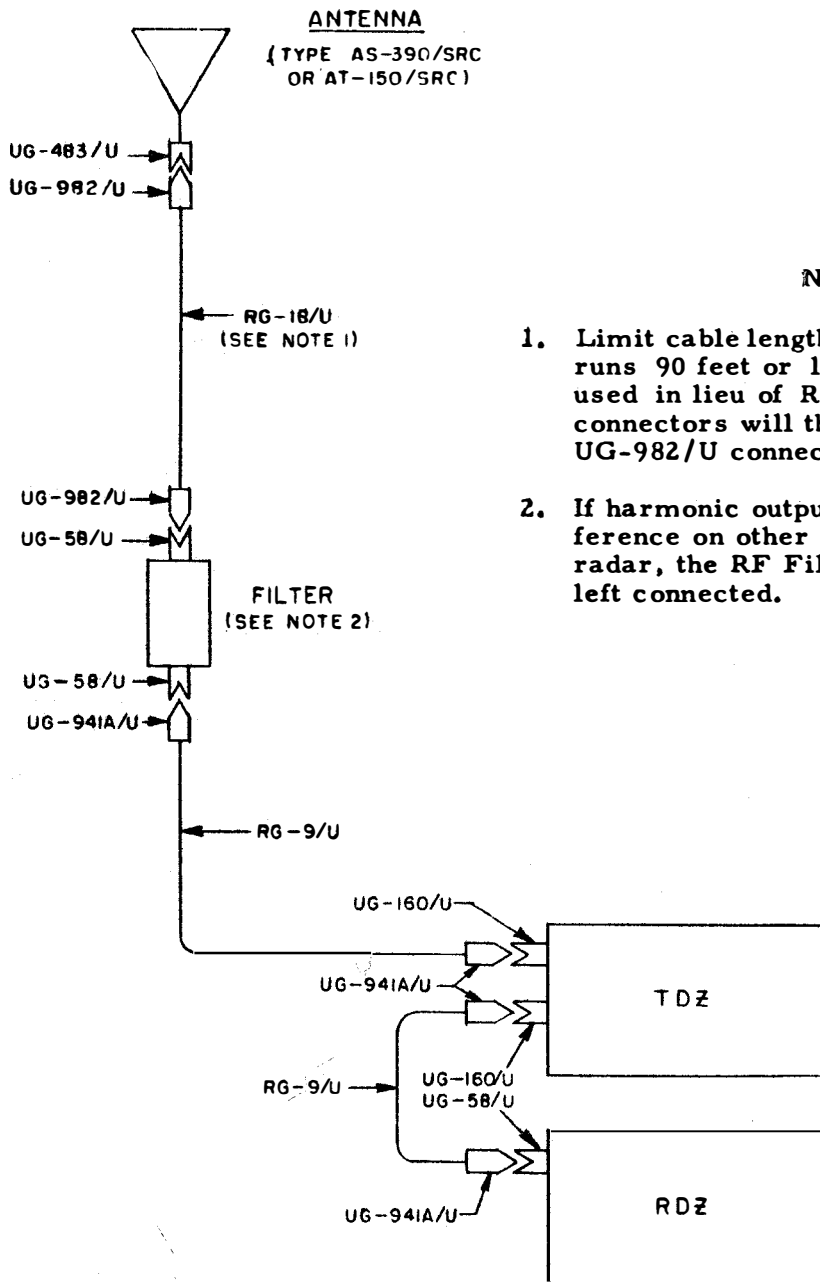


REGION SURROUNDING ECM-66131
ANTENNA WITHIN WHICH INSTALLATION
OF UHF DIPOLES IS NOT RECOMMENDED



REGION SURROUNDING SC TYPE RADAR
ANTENNA WITHIN WHICH INSTALLATION OF
UHF DIPOLE IS NOT RECOMMENDED

Figure 2-61. Recommended Clearances Around Radar and ECM Antennas



NOTES

1. Limit cable length to 200 feet. For cable runs 90 feet or less, RG-10/U may be used in lieu of RG-18/U. UG-941A/U connectors will then be used instead of UG-982/U connectors.
2. If harmonic output of TDZ causes interference on other transmitters, such as radar, the RF Filter Type 53349 may be left connected.

Figure 2-62. Typical UHF Installation

SECTION 2-7

ANTENNA INSULATORS

1. GENERAL.

An insulator is used to isolate current-carrying conductors from the ship's structure and from other conductors.

When we consider the current flow through an insulator, we must consider the current path over the surface as well as the path through the insulator itself. The flow of current or leakage current over the surface of an insulator may often exceed the flow of current through the material. The leakage path is usually due to moisture and impurities on the surface such as salt spray, soot, smoke or dust.

This reduction in insulation resistance because of leakage paths may be overcome by increasing the length of the surface leakage path. Some insulators are constructed in the shape of a bell with an additional inner fluted skirt. This type of construction permits a very long surface path in comparison to the direct path through the dielectric. The bell-like shape also tends to keep the inner path as dry as possible.

Since high temperatures and moisture lower the resistance and dielectric strength of an insulator, surges of high power pulses are capable of generating enough heat to cause insulators to blister, crack or flashover.

Another phenomenon associated with insulators is corona. Corona is a high voltage ionization of air between two points of different potential and is identified by a bluish glow and a sizzling sound. It often starts at 5000 volts and its effect increases with voltage and frequency. It has two effects:

(1) It constitutes a power loss in the line.

(2) It provides a path of high conductivity which in effect reduces the arc-over or creepage distance between a high-voltage point and ground.

To prevent arc-over, insulators are manufactured with smooth, rounded surfaces and without sharp edges. In general, antenna insulators possess a high strength-to-weight ratio. They usually have a glazed surface to which foreign material does not adhere readily and which tends to wash clean during rainstorms. The glaze also tends to resist moisture absorption.

2. TYPES OF ANTENNA INSULATORS.

Insulators for antenna systems and transmission lines are designed in various shapes and for many different uses. Antenna insulators may be classified according to their location in the antenna system.

1. STRAIN INSULATOR. -The strain or suspension type insulator is used in wire antenna assemblies, or similar applications. It is used to support the wire antenna as well as isolate it from the ship's structure. This type of insulator is designed for high tensile strength. The following installation instructions apply to strain insulators:

(1) Shall be rigged in a manner, using appropriate clevises and shackles, to permit replacement of the insulator without disturbing served joints.

(2) Antenna down-leads shall be rigged to strain insulators in such a manner as to prevent any strain on the conductor studs of entrance insulators.

b. **STANDOFF INSULATOR.** - The standoff or pedestal type of insulator is used to support an antenna or open-wire transmission line away from the ship's structure. They have found general application as an antenna bus insulator in trunk lines between the transmitter and the antenna. The following rules apply to standoff insulators:

- (1) Shall be mounted on soft rubber pads. The pad diameter shall be the same as the insulator base and 1/4" thick.
- (2) Shall be mounted with bolts, studs or screws. Brazing or welding to the structure is not acceptable.
- (3) Shall not be installed in locations exposed to the weather when used for antenna bus or wire supports.

c. **ENTRANCE INSULATOR.** - The entrance type is a bowl-like insulator which finds general application in isolating the antenna feed line as it passes through a structural part of the ship.

(1) Entrance Insulators (exposed to the weather):

- (a) Installations shall include corona shields.
- (b) Shall be so located to preclude accidental contact by personnel in normal positions.
- (c) Shall be secured with bolts, studs or screws. Brazing and welding is not acceptable.
- (d) Shall be installed with an approved type of waterproof gasket.

(2) Entrance Insulators (enclosed and protected from weather):

- (a) Installations shall not include corona shields.
- (b) Shall be secured with bolts, studs or screws. Brazing or welding is not acceptable.

d. **FEEDTHRU INSULATOR.** - The feedthru type insulator serves the purpose of providing a good insulating surface for feeding a transmission line through a bulkhead or deck. In shipboard

installations, they are generally used to support whip antennas.

- (1) Shall be secured with bolts, studs or screws. Brazing or welding is not acceptable.
- (2) Shall be installed with approved type waterproof gaskets.

e. **END SEAL.** - This type of insulator is used to terminate coaxial transmission lines.

- (1) The smaller end seals, such as MX-1461/U and MX-1465/U should be mounted in watertight boxes.
- (2) The larger type end seals, such as MX-1460/U and MX-1203/U, may be exposed to the weather.

3. MAINTENANCE OF ANTENNA INSULATORS.

Insulators are of great importance because they serve to protect equipment and personnel. For this reason, it is important to inspect and clean the antenna insulators frequently.

Chapter 67 of the Bureau of Ships Manual calls for periodic inspection and cleaning of antenna insulators. The recommended intervals between inspections and cleanings are the maximum permissible under ideal conditions.

Antenna insulators should be cleaned more frequently than recommended when conditions are such that dirt deposits accumulate rapidly. Failure to comply with this will result in inefficient operation, as proven by reports from the fleet. Frequent visual inspections should be made to detect damage, fouling and other readily detectable conditions which effect antenna efficiency. Frequent resistance checks should be made with a megger to determine resistance-to-ground conditions.

a. **VISUAL INSPECTION.** - A good visual inspection should be made when checking any insulator. Any damage or defect in the surface of the material such as blisters, cracks, sharp edges, porosity traces, etc., should be noted and carefully investigated to determine if

they indicate the presence of a cavity under the surface. Other parts of the insulator to check are:

(1) Surfaces around mounting holes which may not withstand the stress of mounting.

(2) Bearing surfaces which will not withstand bearing pressure or friction of associated parts.

b. **CLEANING INSULATORS.** -Leakage current over the surface of an insulator is usually due to moisture and impurities on the surface such as salt spray, soot, or dust.

All standoff insulators, end seals of transmission lines, and waveguide windows should be cleaned at least once a month, and more often if conditions warrant. Aboard submarines, this maintenance should be carried out as soon after surfacing as possible after every

dive lasting an hour or more. If the submarine does not submerge for extended periods, this procedure should be practiced at least once a week.

The smaller the insulator, end seal or waveguide window, the more important is this maintenance procedure.

Several rinsings should be used to remove accumulated dirt and salt water deposits. The cleaning must be thorough with nothing left to chance.

Paint, varnish, shellac or grease shall not be applied to any portion of ceramic or phenolic insulating materials forming a part of the antenna system.

4. **INSULATOR DRAWINGS.**

A list of standard radio insulators for use in shipboard antenna installations is given in Table 2-9. A list of replacement bowls for the entrance insulators is given in Table 2-10.

TABLE 2-9. LIST OF STANDARD SHIPBOARD RADIO INSULATORS

Style	Current Type	Size*	Standard Navy Stock Number N17-I-	Drawing Number	Latest Preceding Type
Strain	61479	5"	72505-3001	RE 61AA 299F	61014A
	61481	10"	72520-3001	RE 61AA 299F	61013A
	61494	15"	72547-3001	RE 61AA 301D	61249
	61493	20"	72565-3001	RE 61AA 301D	61012B
Entrance	61471	4"	59665-6401	RE 61F 293G	61447
	61019C	5"	59677-8201	RE 61F 203W	61019B
	61276A#	5"	59674-7751	RE 61F 259H	61276
	61475	10"	59697-7001	RE 61F 298	61022C
	61303#	16"	47460-5501	RE 61F 260D	None
Standoff	61174B	1-1/2"	70071-7651	RE 61A 247L	61056
	61175A	4"	70701-1481	RE 61AA 249G	61175
	61339	6"	70616-1101	RE 61F 262D	61176A
	61664C#	2"	81188-5441	RE 61F 345C	61664B
Feedthru	61428	3"	59692-6501	RE 61F 288F	61432
	61350	6"	59701-1001	RE 61F 291E	None
	61335	16"	59709-8876	RE 61F 290F	None

* Approximate surface leakage path

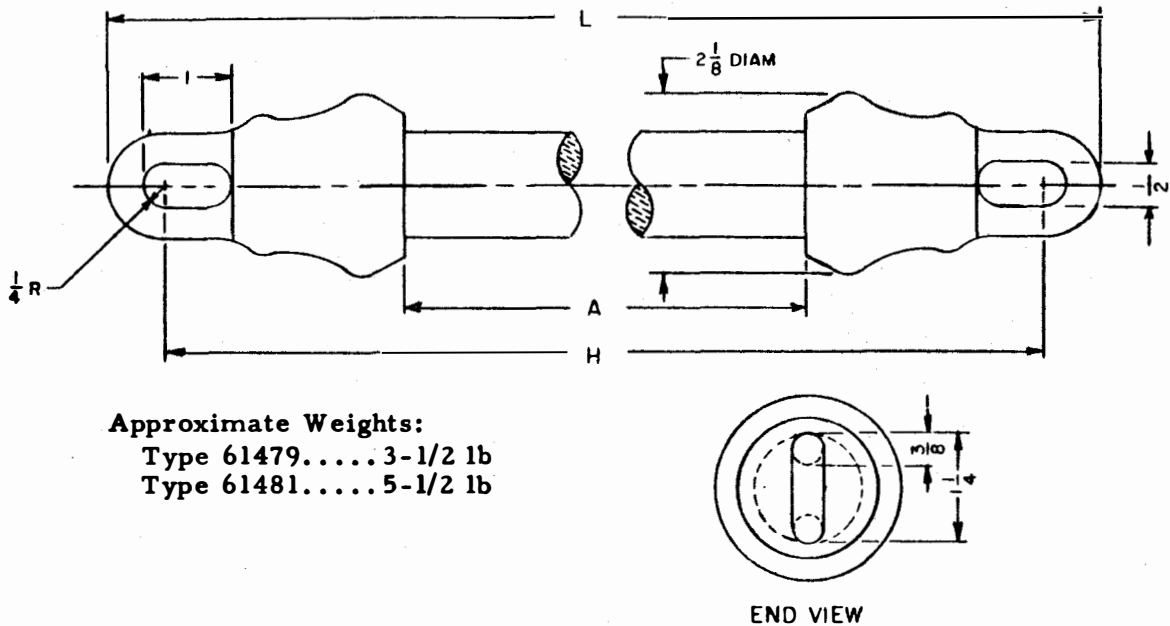
For submarine installations

TABLE 2-10. REPLACEMENT BOWLS.

Assembly Type No.	Bowl Type Number	Standard Navy Stock Number
61019C	61234A	N17-I-47445-5701
61276A	61277	N17-I-47437-5689
61471	61470	N17-I-47433-4501
61475	61476	N17-I-47447-5701

In Figures 2-63 through 2-76 will be found a drawing for each of these standard insulators. In addition, stock numbers, reference drawings, and a brief description for these insulators are included.

Drawings and data on the End Seals commonly used in shipboard antenna installations will be found in Figures 2-77 through 2-80.



Approximate Weights:
Type 61479..... 3-1/2 lb
Type 61481..... 5-1/2 lb

Figure 2-63. Strain Insulators Types 61479 and 61481

DESCRIPTION.

Strain Insulators, Navy Types -61479 and -61481, are similar except for the length of the ceramic body.

Material:
Body.....Ceramic, Grade L-2
End Caps.....Brass

Color.....Brown, glazed

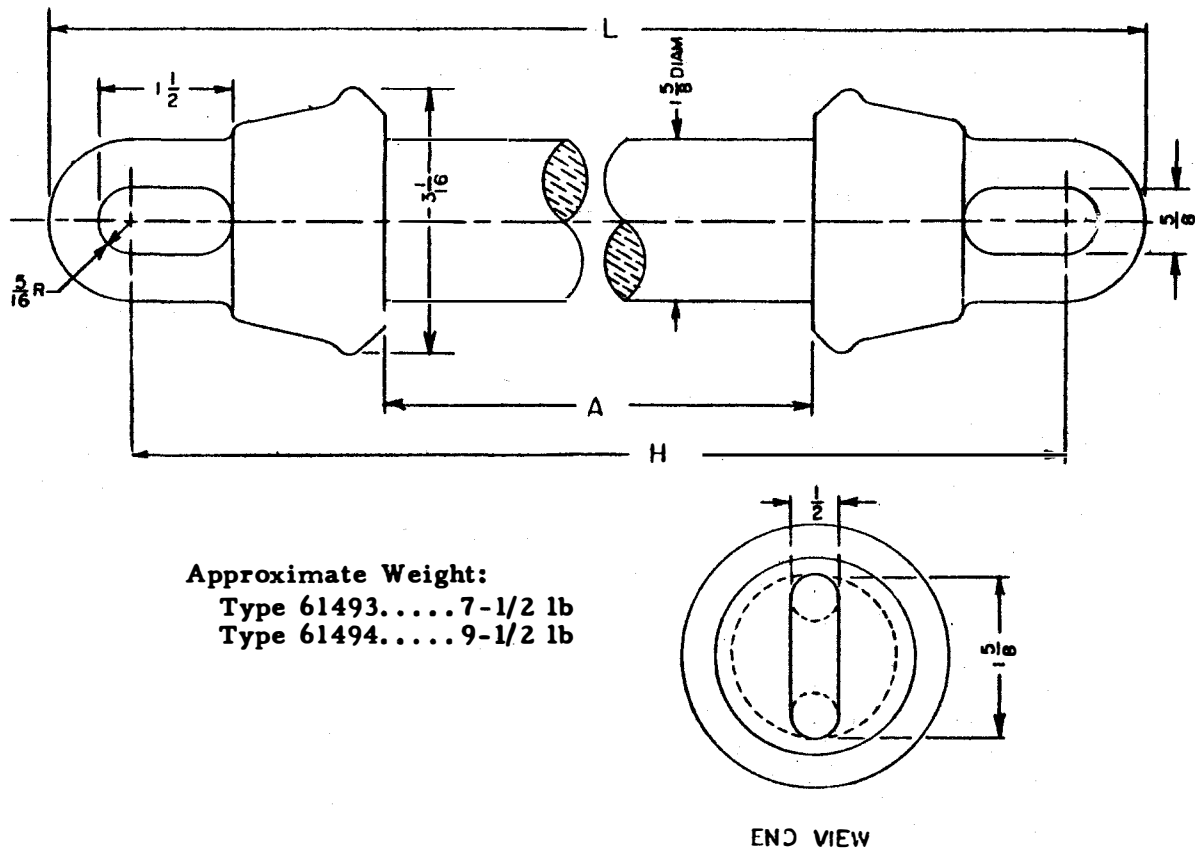
Working Load.....2000 lb

Ultimate Tensile Strength....4000 lb

REFERENCES.

BuShips Drawing: RE 61AA 299

Navy Type Number	Standard Navy Stock Number	Dimensions (inches)		
		L	H	A
61479	N17-I-72505-3001	10-1/4	9	5
61481	N17-I-72520-3001	15-1/4	14	10



Approximate Weight:
 Type 61493.....7-1/2 lb
 Type 61494.....9-1/2 lb

Figure 2-64. Strain Insulators Types 61493 and 61494

DESCRIPTION.

Strain Insulators, Navy Types-61493 and -61494, are similar except for the length of the ceramic body

Material:

Body.....Ceramic, Grade L-2
 End Caps.....Brass

Color.....Brown, glazed

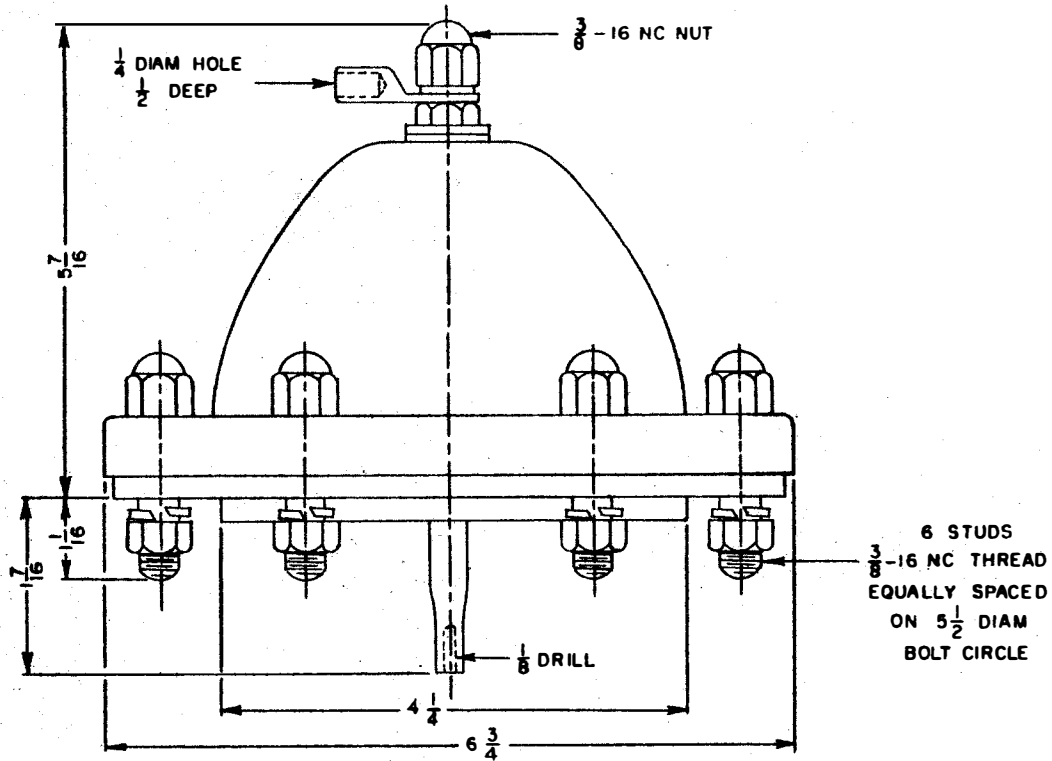
Working Load..... 3500 lb

Ultimate Tensile Strength.....7000 lb

REFERENCES.

BuShips Drawing: RE 61AA 301

Navy Type Number	Standard Navy Stock Number	Dimensions (inches)		
		L	H	A
61493	N17-I-72565-3001	27-1/2	25-7/8	20
61494	N17-I-72547-3001	22-1/2	20-7/8	15



(Standard Navy Stock Number: N17-I-59665-6401)

Approximate Weight: 6-1/2 lb

Figure 2-65. Entrance Insulator Type 61471

DESCRIPTION.

Entrance Insulator, Navy Type-61471, consists of bowl, Navy Type-61470, conductor rod, flange ring, clamping ring, and necessary gaskets, washers, studs, nuts and terminal lug. When insulator bowl NT-61470 is ordered separately it shall include 4 neoprene gaskets.

Material:

Bowl.....Brown, glazed ceramic,
Grade L-2

Conductor.....**Bronze**

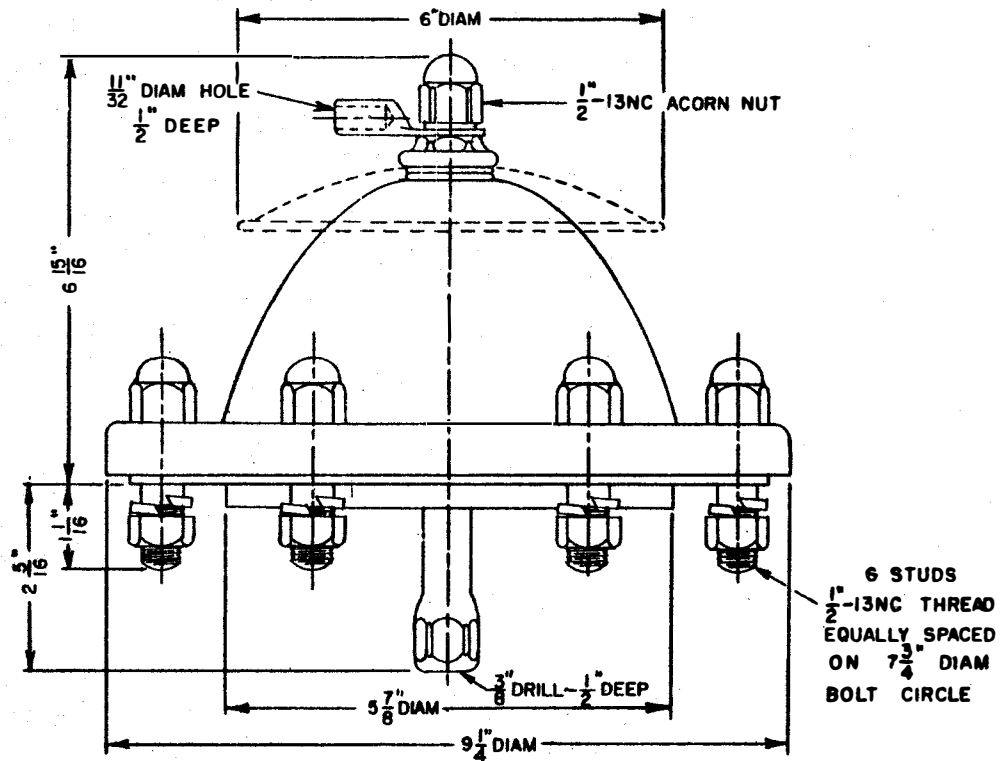
Clamping Ring.....**Brass**

Flange Ring.....**Brass or bronze**

Dry Flashover Test.....**20 kv Peak
Voltage**

REFERENCES.

BuShips Drawing: RE 61F 293



(STANDARD NAVY STOCK NO.: N17-I-59677-8201)

Approximate Weight: 16-1/2 lb

Figure 2-66. Entrance Insulator Type 61019C

DESCRIPTION.

Entrance Insulator, Navy Type-61019C, consists of a bell shaped bowl JAN Type NP2B4701 (was Navy Type-61234-A), conductor rod, flange ring, clamping ring, corona shield, and necessary gaskets, washers, spacers, studs, nuts, pins and a terminal lug. When bowl is ordered separately, 4 neoprene gaskets are shipped with it.

Material:

Bowl..... Brown, glazed ceramic, Grade L-2
 Conductor Rod..... Bronze
 Flange Ring..... Brass or bronze
 Clamping Ring..... Brass or bronze
 Corona Shield..... Brass

REFERENCES.

BuShips Drawing: RE 61F 203

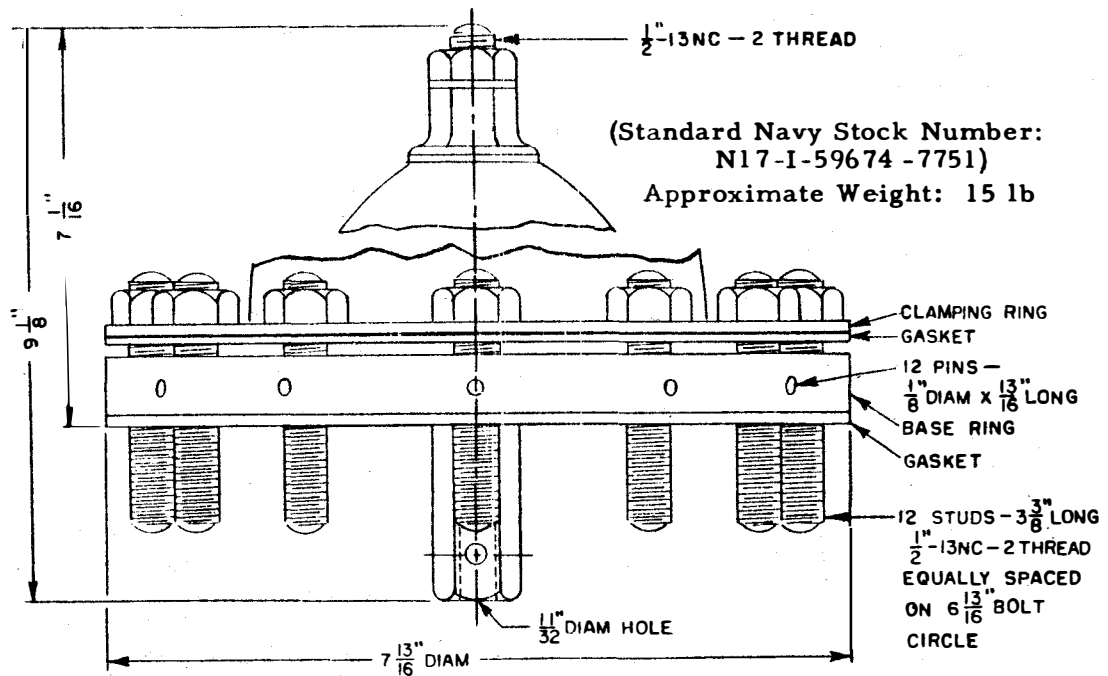


Figure 2-67. Entrance Insulator Type 61276A

Insulators will withstand a hydrostatic pressure of 300 psi. When insulator bowl Type 61277 is ordered separately, 3 neoprene washers and one neoprene gasket are included with each bowl.

The following procedure must be followed to insure watertight integrity of the assembly:

- (1) Install studs in mounting surface.
- (2) Coat gasket with approved sealing compound and place in position.
- (3) Place base ring in position on gasket.
- (4) Place nuts on all studs and tighten evenly to insure a permanent pressure-tight joint between the base ring and mounting surface.
- (5) Drill pin holes (#31 drill) through studs, using holes in base ring as guides.
- (6) Install drive pins to lock studs and base ring. (Pins furnished with insulator assembly.)
- (7) Remove nuts.
- (8) Complete remainder of the assembly in the usual manner.

DESCRIPTION.

Entrance Insulator, Navy Type-61276A, consists of a bell shaped bowl Navy Type-61277, conductor rod, base ring, clamping ring, and necessary gaskets, washers, studs, nuts and pins.

This insulator has been used in submarine installations as part of Antenna Assemblies AS-125/APR and AT-365/BL.

Entrance Insulator, Navy Type-61276A, is similar to Navy Type-61276 except that it has twelve mounting holes and revised brass fittings on top.

Material:

Bowl.....Brown, glazed porcelain, Grade L-2

Conductor Rod.....Brass

Clamping Ring.....Brass

Base Ring.....Bronze

REFERENCES.

BuShips Drawing: RE 61F 259
RE 61F 341

DO NOT ATTEMPT TO ASSEMBLE BASE RING AND BOWL SIMULTANEOUSLY!

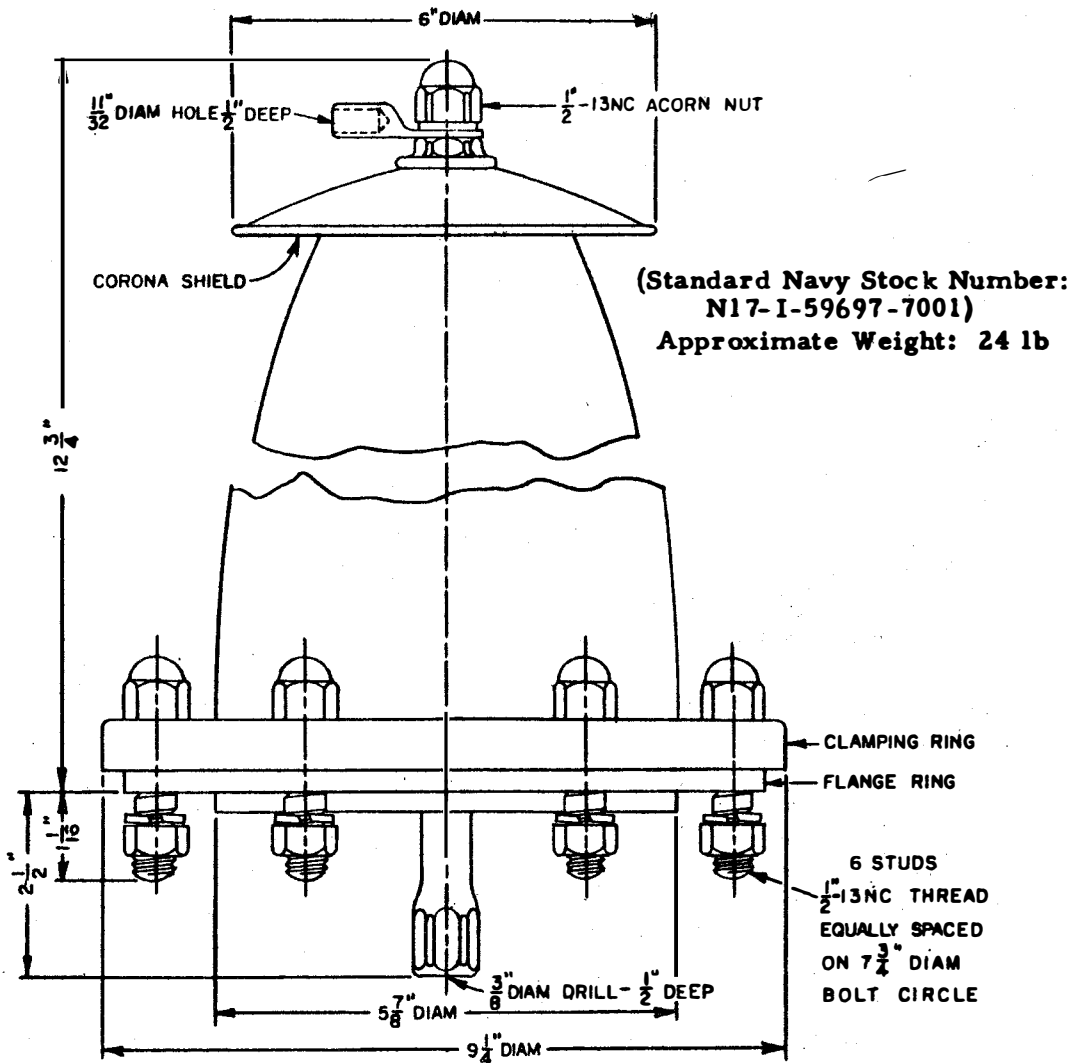


Figure 2-68. Entrance Insulator Type 61475

DESCRIPTION.

Entrance Insulator, Navy Type-61475, consists of a dome shaped bowl Navy Type -61476, a bronze conductor rod, clamping ring, flange ring, and necessary washers, gaskets, bolts, nuts and terminal lugs.

Material:

Bowl.....Brown, glazed porcelain,
Grade L-2

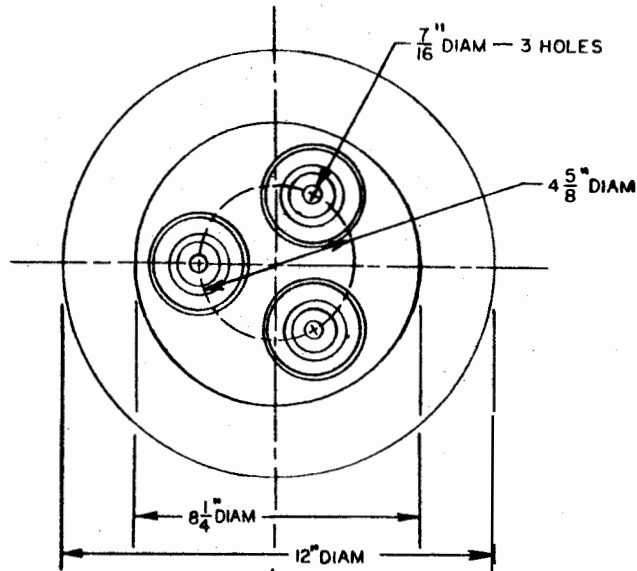
Conductor Rod..... Bronze
Clamping Ring and
Flange Ring..... Brass or bronze
Corona Shield..... Brass

Dry Flashover Test:

Peak Voltage..... 50 kv

REFERENCES.

BuShips Drawing: RE 61F 298



(Standard Navy Stock Number:
N17-I-47460-5501)
Approximate Weight: 38 lb

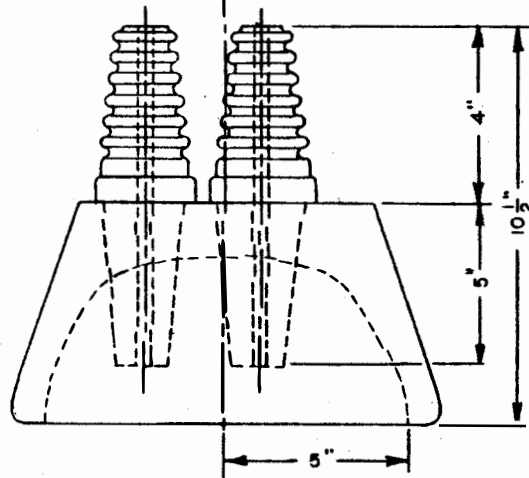


Figure 2-69. Entrance Insulator Type 61303

DESCRIPTION.

Bowl Insulator, Navy Type-61303, consists of a ceramic bowl with three ceramic bushings extending from the top.

Material:
Bowl. Brown, glazed porcelain,
Grade L-2

Bushings. Brown, glazed
porcelain, Grade L-2

REFERENCES.

BuShips Drawing: RE 61F 260D

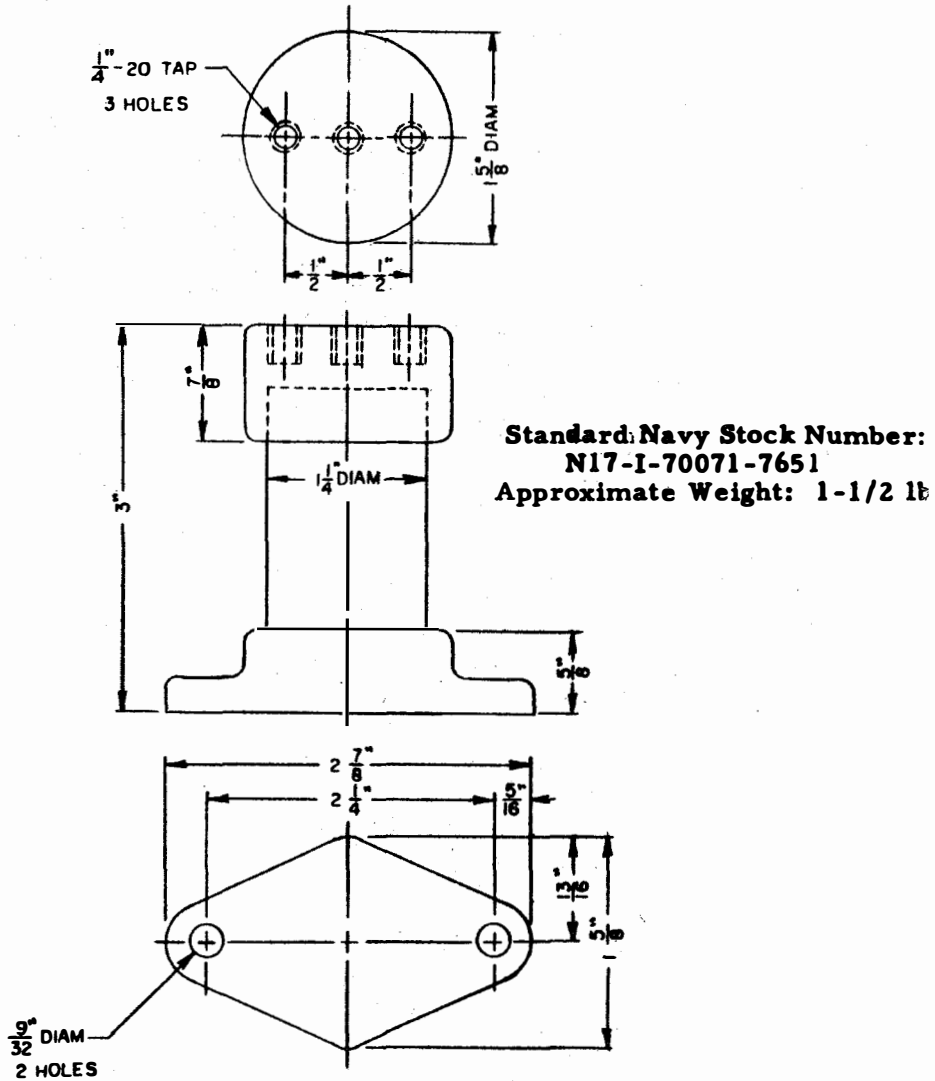


Figure 2-70. Standoff Insulator Type 61174B

DESCRIPTION.

Standoff Insulator, Navy Type-61174-B, consists of a cylindrical ceramic body with a metal base and cap.

Material:

Body..... Ceramic, brown glazed

Base..... Brass

Cap..... Brass

Cantilever Strength:

Minimum..... 170 lb
Average Ultimate..... 240 lb
Continuous Working..... 120 lb

Tensile Strength:

Minimum..... 650 lb
Average Ultimate..... 900 lb

REFERENCES.

BuShips Drawing: RE 61A 247

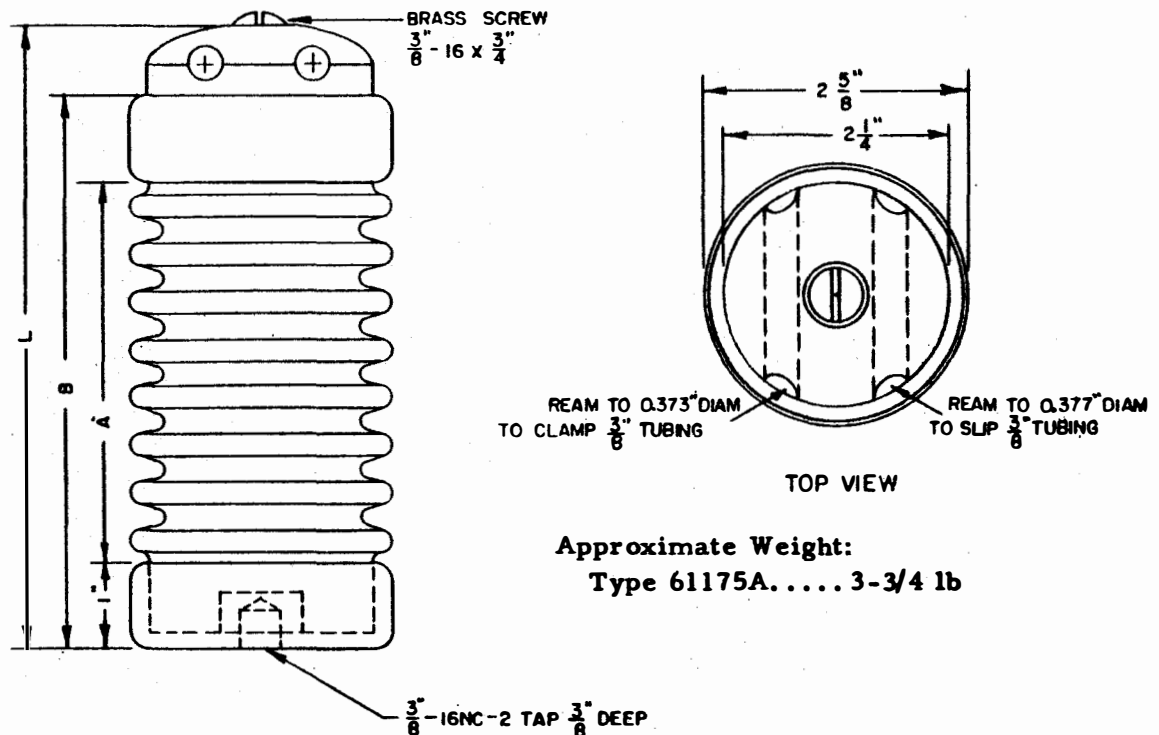


Figure 2-71. Standoff Insulators Types 61175A and 61176A

DESCRIPTION.

Standoff Insulators, Navy Types -61175A and -61176A, are similar except for the length of the ceramic body.

Material:

Body.....Porcelain, Grade L-2
Base and Cap..... Brass
Color.....Brown, glazed

Tensile Strength:

Minimum..... 1000 lb
Ultimate.....2000 lb

Cantilever Strength:

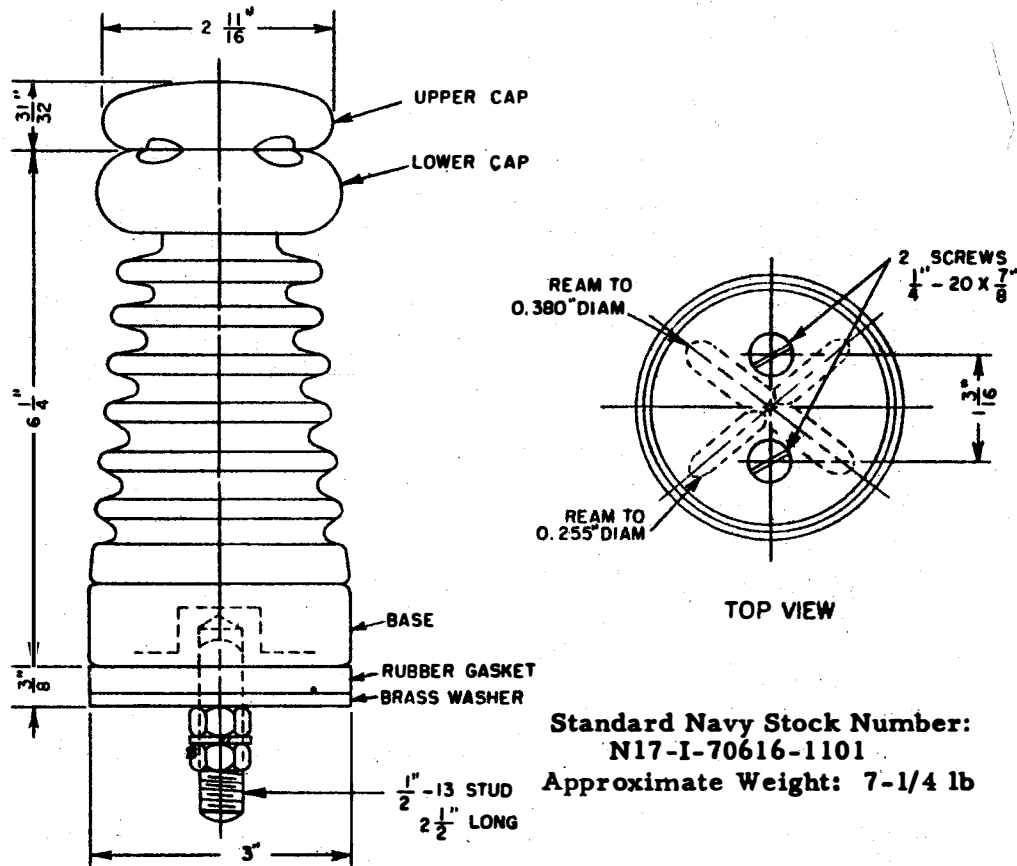
(Type 61175A)
Minimum..... 525 lb
Ultimate..... 750 lb
(Type 61176A)
Minimum..... 320 lb
Ultimate..... 450 lb

NOTE: Type 61176A has been replaced by Type 61339.

REFERENCES.

BuShips Drawing: RE 61AA 249

Navy Type Number	JAN Number	Standard Navy Stock Number	Dimensions (Inches)		
			L	B	A
61175A	NP2B3932	N17-I-70701-1481	4-25/32	4	2
61176A	NP2B3948	N17-I-70701-2181	6-25/32	6	4



Standard Navy Stock Number:
N17-I-70616-1101
Approximate Weight: 7-1/4 lb

Figure 2-72. Standoff Insulator Type 61339

DESCRIPTION.

Standoff Insulator, Navy Type-61339, may be used to support a 1/4-inch or a 3/8-inch conductor.

Material:

Body....Brown, glazed porcelain,
Grade L-2
Base and Caps....Brass or bronze

Dry Voltage Breakdown..... 40 kv

Ultimate Tensile Strength....1800 lb

Ultimate Compression

Load.....12, 500 lb

Cantilever Strength:

Minimum..... 200 lb
Ultimate..... 400 lb

NOTE: This insulator has been designated JAN Type #NP2B3902.

REFERENCES.

BuShips Drawing: RE 61F 262

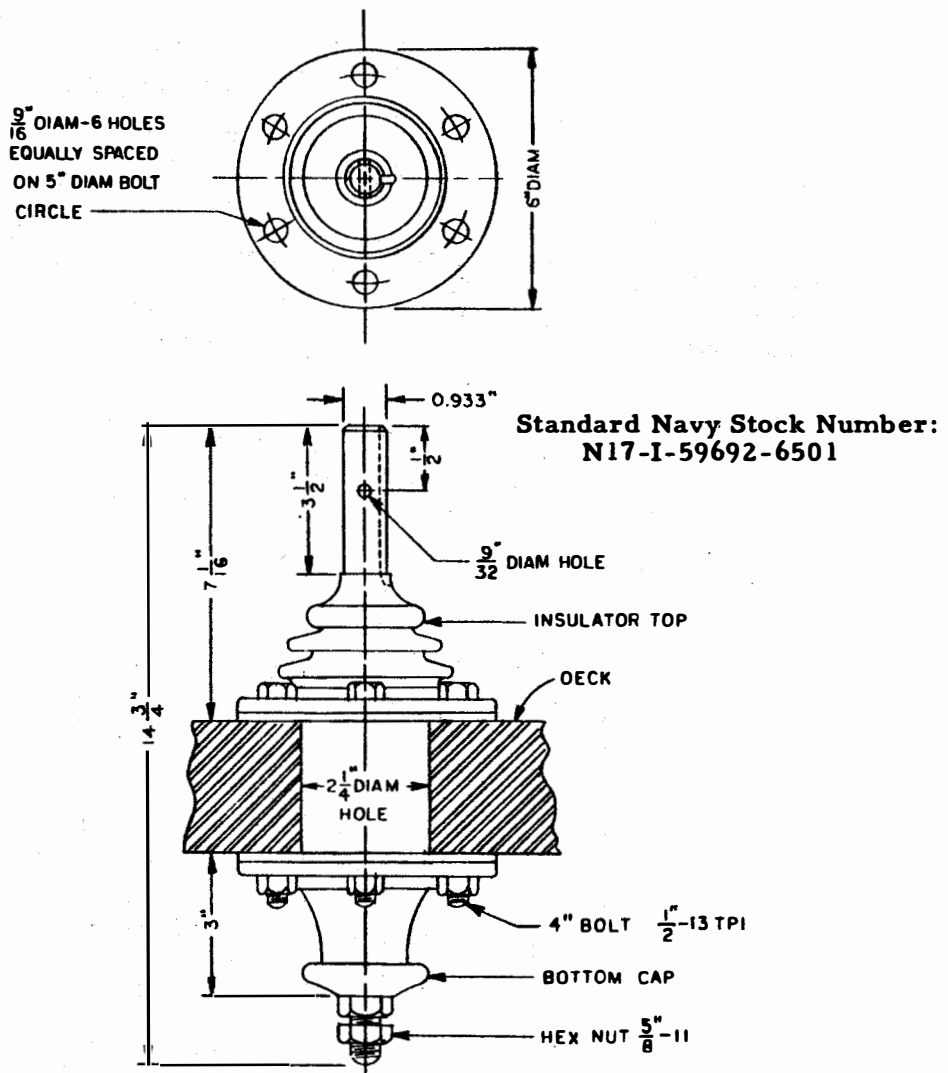


Figure 2-73. Feedthru Insulator Type 61428

DESCRIPTION.

Feedthru Insulator, Navy Type-61428, consists of two conical insulators which are mounted on opposite sides of the deck. The assembly includes mounting bolts, gaskets and washers. This insulator is used with Navy Types-66028 and -66040 Whip Antennas. Also used with -66053 Whip Antenna.

Material:

Insulator Cones..... Brown, glazed
porcelain, Grade L-2
Insulator Top..... Brass
Bottom Cap..... Brass
Stud..... Brass

REFERENCES.

BuShips Drawing: RE 61F 288

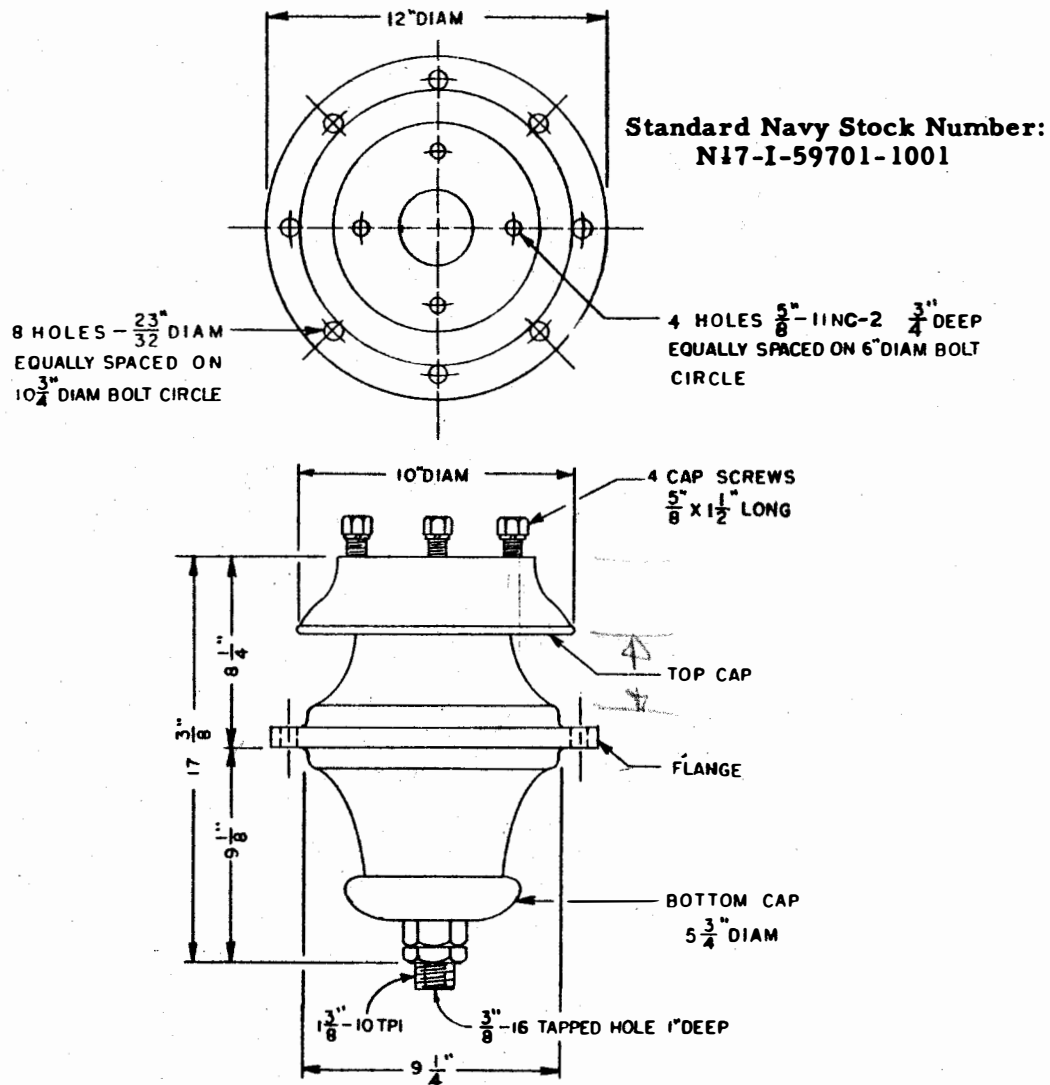


Figure 2-74. Feedthru Insulator Type 61350

DESCRIPTION.

Feedthru Insulator, Navy Type-61350, consists of two bowl insulators, Navy Type-61351, mounted on either side of a brass flange. When bowls are ordered separately, one neoprene gasket and one soft copper-washer are shipped with each bowl.

This insulator may be used with Navy Types-66046 and -66047 Whip Antennas.

Material:

Bowls.....Brown, glazed ceramic
Grade L-2

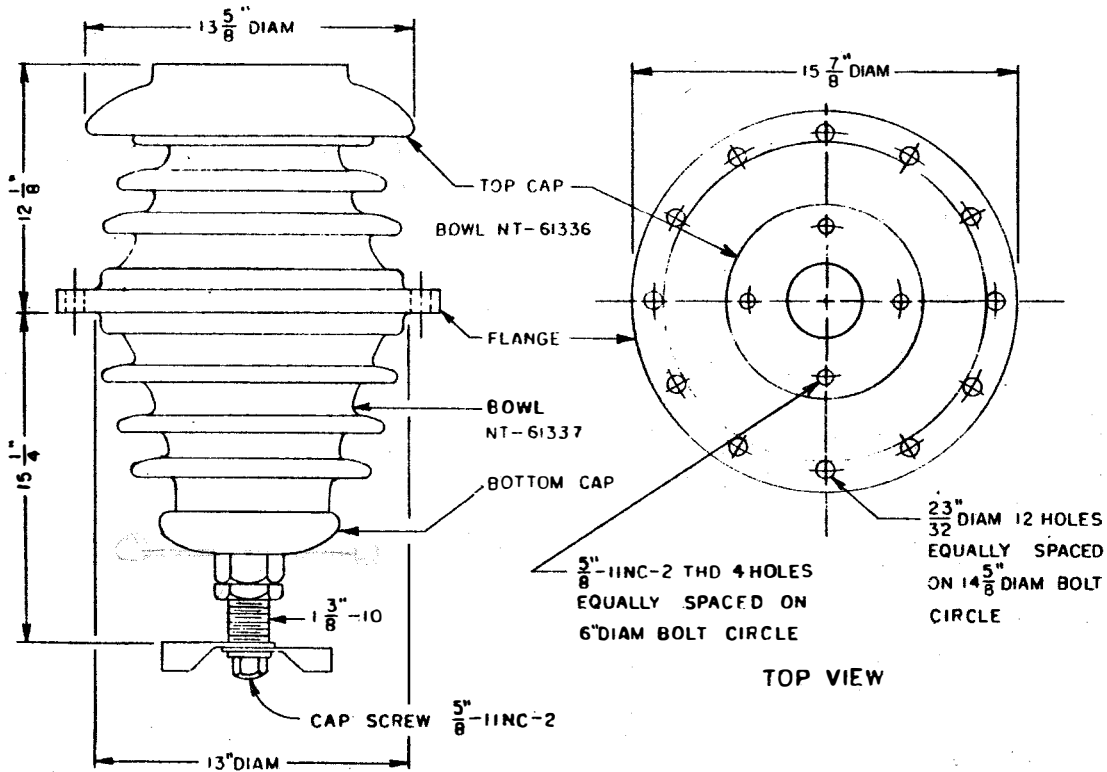
Flange.....Brass
Top and Bottom Caps.....Brass

Cantilever Load:

Minimum.....45,000 inch-lb
Ultimate.....90,000 inch-lb

REFERENCES.

BuShips Drawing: RE 61F 291



Standard Navy Stock Number:
N17-1-59709-8876
Approximate Weight: 150 lb

Figure 2-75. Feedthru Insulator Type 61335

DESCRIPTION.

Feedthru Insulator, Navy Type-61335, consists of two fluted bowls, Navy Types -61336 and -61337, end caps, anchor rod, mounting flange, and necessary bolts, washers, gaskets, and terminal lugs. When insulator bowls are ordered separately, one neoprene gasket and one soft copper washer are included with each bowl.

This insulator may be used with Navy Types-66046 and -66047 Whip Antennas.

Material:

- Bowls.....Brown, glazed ceramic, Grade L-2
- Caps.....Bronze
- Anchor Rod.....Galvanized Steel
- Flange.....Galvanized Steel

Cantilever Load:

- Minimum..... 50,000 inch-lb
- Ultimate..... 100,000 inch-lb

REFERENCES.

BuShips Drawing: RE 61F 290

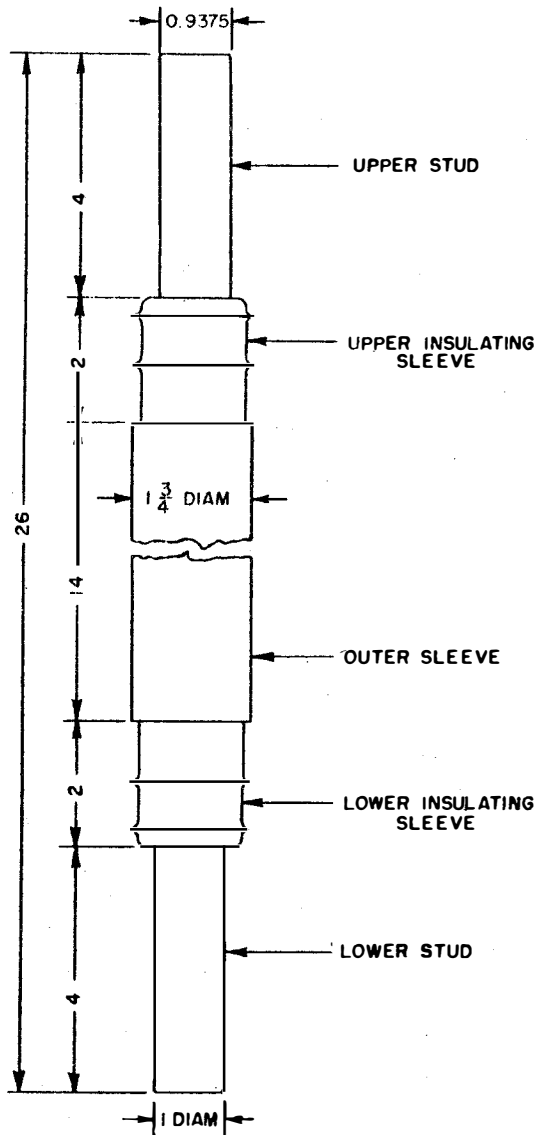


Figure 2-76. Standoff Insulator Type 61664C

DESCRIPTION.

Standoff Insulator, Navy Type-61664C consists of two cylindrical Teflon insulators mounted end to end and encased in tubing. There is a stud inserted in each end of the insulator. The top stud fits Whip Antenna Navy Type-66053 and the bottom stud mounts in a 1-inch diameter socket.

This insulator is used aboard submarines to support the Navy Type-66053 Whip Antenna.

Material:

Insulators.....Teflon
Studs..... Stainless Steel
Outer Sleeve..... Stainless Steel

Working Voltage..... 8000

Standard Navy Stock Number:
N17-I-81188-5441

REFERENCES.

BuShips Drawing: RE 61F 345C

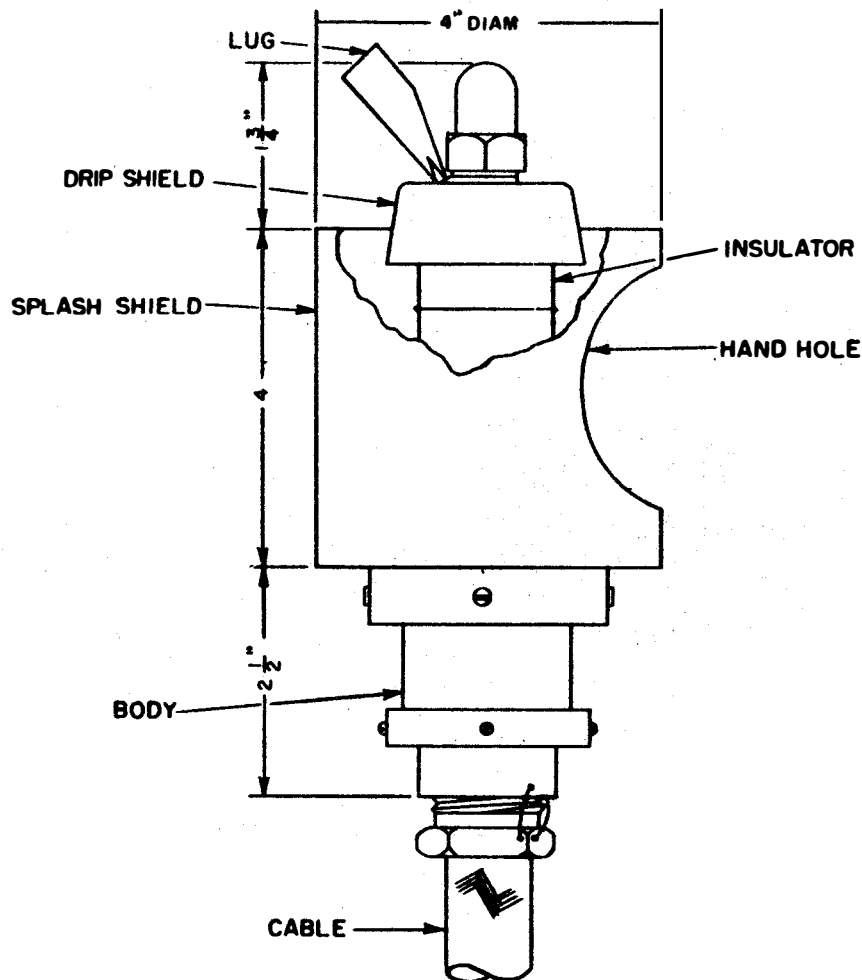


Figure 2-77. End Seal MX-1203/U

DESCRIPTION.

End Seal MX-1203/U is a pressure-proof weatherproof end seal for use on submarines. It is used with RG-17/U and RG-18/U cables. A drip shield is supplied for use when the end seal is mounted in a vertical position. A splash shield is supplied for use where wave splash spray is likely to occur. The

splash shield has a hand hole to permit cleaning the insulator and, if the end seal is mounted in a horizontal position, it also serves as a drain hole.

REFERENCES.

BuShips Drawings: RE 49F 602
RE 49D 619

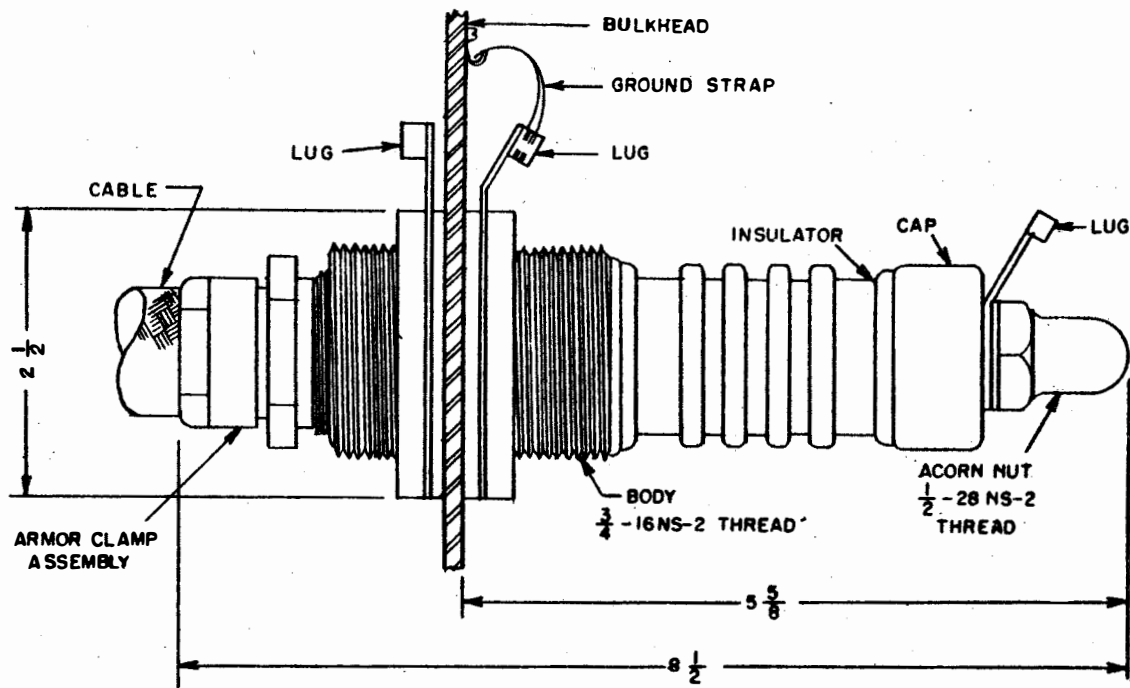


Figure 2-78. End Seal MX-1460/U

DESCRIPTION.

End Seal MX-1460/U is a weatherproof end seal for high-voltage applications. This end seal consists of an MX-407/U end seal which has been modified and has had an armor clamp added to it. It replaces the MX-407/U end seal.

This end seal is used with RG-17/U and RG-18/U cable and may be terminated exposed to the weather. It pro-

vides lugs for grounding the shield and armor of the cable.

Material:

Insulator Ceramic
Body Brass

REFERENCES.

BuShips Drawing: RE 49D 341

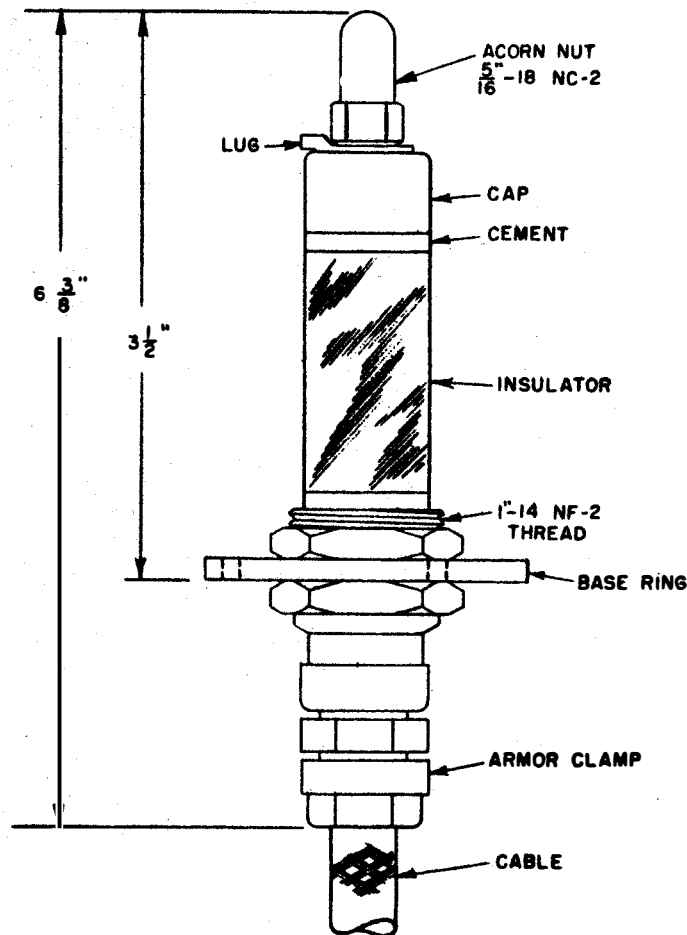


Figure 2-79. End Seal MX-1461/U

DESCRIPTION.

End Seal MX-1461/U is a weatherproof end seal for use with RG-10/U cable. It supersedes Navy Type-49530B end seal.

Basically, the MX-1461/U end seal consists of a modified Type 49530B end seal with an armor clamp. It has a lug for connecting to the inner conductor of the cable and a base ring for connecting the shield and armor of the cable to

ground. If the end seal is mounted on a panel or chassis, it is not necessary to use this base ring.

Material:

Insulator....Chocolate glazed ceramic
Body.....Brass

REFERENCES.

BuShips Drawing: RE 49D 237F

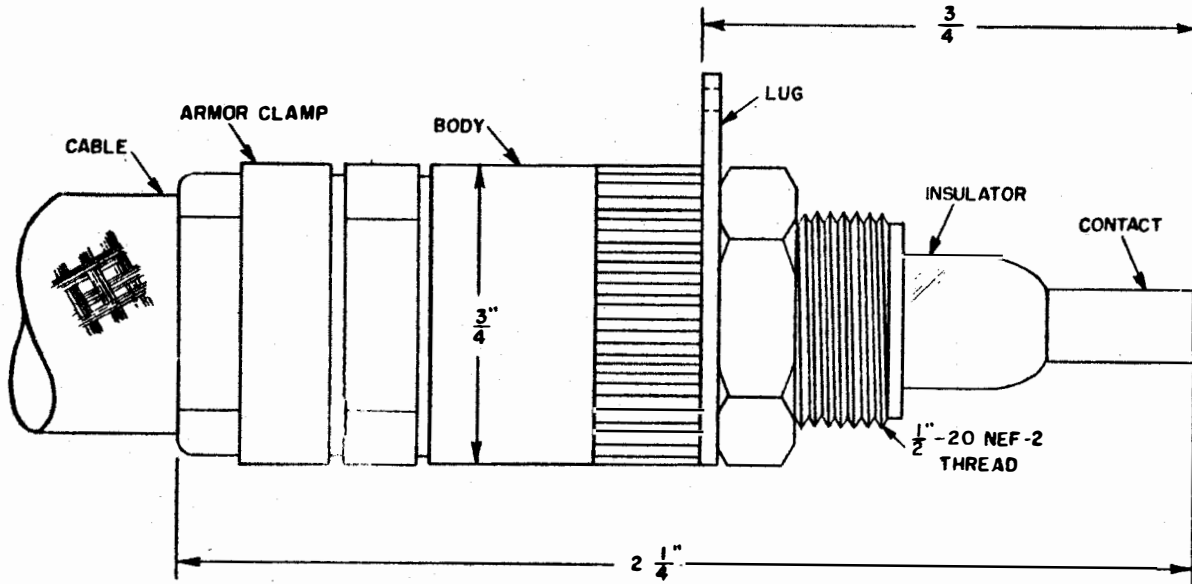


Figure 2-80. End Seal MX-1465/U

DESCRIPTION.

End Seal MX-1465/U is used for low-voltage applications and may not be installed exposed to the weather. For cable runs in the weather the end seal must be terminated in a watertight enclosure. This end seal may be used with the following cables: RG-8/U, RG-9/U, RG-10/U, RG-11/U, RG-12/U, RG-13/U, RG-63/U and RG-116/U. It has a solder terminal for connecting to the inner conductor of the cable and a lug for connecting the shield and armor of the cable to ground.

End Seal MX-1465/U supersedes the MX-498/U end seal. Basically, it consists of a modified MX-498/U end seal with an armor clamp. This end seal may be used without the armor clamp on unarmored cables, in which case the end seal is designated the MX-498A/U.

Material:

Body.....Brass
Insulator.....Bakelite

REFERENCES.

BuShips Drawing: RE 49D 371B

SECTION 2-8

ANTENNA MAINTENANCE

1. GENERAL.

Of necessity, antennas are located in the most exposed locations possible aboard ship. This makes for radiation or reception efficiency, but it complicates proper maintenance. Because of a natural reluctance to climb masts or stacks, the antenna system is occasionally neglected until a major casualty develops.

The major enemies of the antenna system are corrosion caused by salt spray or stack gases and paint on insulators.

Constant whipping of all types of antennas caused by the wind or ship motion contributes much towards broken strands, parted couplings and broken mounting brackets.

Aside from collecting moisture, enclosed trunk transmission lines give little trouble, requiring little more than periodic cleaning for proper maintenance.

Wire antennas should be lowered at frequent intervals and inspected for signs of deterioration, particularly at clamps and where they connect to trunks or transmission lines. Nicks and kinks should be avoided as the wire will be weakened at these points. It is a good policy to wire brush antennas while they are down as this removes soot and salt deposits as well as revealing any signs of weak or broken strands. Insulated-type receiving antennas should be wiped rather than wire-brushed. Whip-type antennas are usually hollow and have a tendency to collect moisture inside. A small hole should be drilled near the base of these antennas to permit moisture to drain out. Whips should be inspected while down for rust spots or loose sections. Mounting straps and stand-off insulators should be carefully checked for cracks, breaking or deterioration as well as cleanliness.

Dipole antennas usually have one pole grounded, while the other is connected to the inner conductor of the coaxial transmission line. Any insulators on the dipole should be carefully cleaned of any paint, salt or soot deposits. Care should be taken not to damage glazed surfaces of the insulators. The mechanical condition of dipoles should also be checked for loose mountings, rust spots, etc.

The lower section of the TBS antenna support contains a grounded concentric section of the radiator. Inside this section are one or two circular ceramic insulators which have a tendency to collect moisture over a period of time. Any moisture at this point will tend to nullify the effect of the insulator, which will in turn upset the inductive reactance of the antenna. This will result in a mismatch between the antenna and transmission line with consequent poor performance of the system. Many complaints of poor TBS performance can be traced to this insulator; therefore, the TBS antenna should be periodically disassembled and the insulators checked and cleaned.

It is strongly recommended that all antenna fittings such as insulator ring bolts, shackles, turnbuckles and any other topside antenna fittings be coated with a corrosion preventive compound after each cleaning. Satisfactory corrosion preventive compounds are available such as Hard-Film Corrosion Preventive (Standard Navy Stock Number G52-C-3094-50) and Gun Slushing Compound, Grade B (Standard Navy Stock Number W14-C-113).

Shipboard antenna systems, including transmission lines and associated wiring, as well as inter-unit wiring and connecting cables, form an important weak-link in the electronic installation, one which many personnel tend to neglect in their preventive maintenance schedules.

Many complaints of poor sensitivity on the part of a radio receiver or lack of range from a radar have frequently been traced to some minor defect in the antenna or transmission line. Instability and noise are often caused by loose cable couplings or poor equipment bonding.

2. ANTENNA LEAKAGE RESISTANCE.

Aside from actual physical damage, the most common fault in the antenna system is low resistance to ground. Moisture in trunks or coax, dirty insulators and coax dielectric breakdown all cause varying degrees of shunting resistance and must be guarded against if maximum system efficiency is to be expected.

The most convenient test of an antenna system is by means of high-voltage, high-resistance ohmmeter or "megger". The megger uses a high voltage (roughly 500 volts) which is sufficient in many cases to breakdown and thus reveal any weak spots in the insulation. Before proceeding with the test, the antenna should be inspected for any intentional DC shorts such as in the TBS antenna or receiver protective devices. The latter are found in most general-purpose receiving antennas and usually consist of a fixed resistor of about 1/2 megohm connected from line to ground. This resistor serves to protect the receiver and to drain off any accumulated static charges on the antenna. It is obvious that the resistor should be disconnected before testing the antenna and transmission line, as a constant and misleading resistance reading will be obtained.

After protective devices, intentional shorts, and equipment have been disconnected from the antenna, proceed as follows:

- a. Connect ground lead of megger to the hull.
- b. Connect high side or line connection of the megger to the inner conductor of the transmission line. It may be convenient to fabricate a suitable plug to match coaxial fittings for test purposes.
- c. Take and record the indicated resistance.

Theoretically, any antenna transmission line system should read infinity on the megger, but this is not always possible to obtain. Abrupt changes in the weather, high humidity or other natural causes often result in low readings. It is safe to say that any antenna reading under 100 megohms to ground for several successive daily readings should be investigated. In many cases, insulation resistance may be raised by cleaning the insulators or couplings. The coaxial cables and other cables and fittings used to connect the equipment together should also be tested. A check of continuity of the antenna system should also be made periodically. For insulation resistance the following values are suggested:

- (1) A resistance of 200 megohms to ground or more indicates an antenna in good condition.
- (2) A resistance from 5 to 100 megohms to ground indicates the need of cleaning the insulators.
- (3) A resistance of less than 5 megohms to ground indicates an immediate and urgent need for locating the leak in the antenna and taking the steps necessary to restore the system to its original condition.

3. PAINTING ANTENNAS.

a. GENERAL. -All transmitting and receiving antenna hardware and accessories, antenna framework, and dipoles should be inspected quarterly and those installed directly aft of the stack should be inspected monthly. The gases and high temperature in the vicinity of the stacks tend to dry out and crack the paint which accelerates corrosion.

When the extent of the damage only warrants a touch up job and there is an indication of corrosion, the surrounding area should be entirely cleaned of old paint, soot, rust, etc. One coat of wash primer pre-treatment (Spec. MIL-P-15328, Stock Number G52-P-20649-150) should then be applied to improve adherence of the primer and paint. One coat of zinc-chromate primer (Spec. JAN-P-735, Stock Number G52-P-20630-2 for 1 gallon or G52-P-20635-2 for 5

gallons) and not less than two coats of outside haze-grey No. 27 (Spec. MIL-P-15130, Stock Number G52-P-961) should follow the wash primer pre-treatment.

Brass dipoles need not be coated with zinc-chromate primer. Under no circumstances should metallic paints be used.

The above procedure applies also when the extent of damage warrants complete repainting. When just the finish coat is damaged and there is no indication of corrosion, one or two coats of the outside haze-grey paint number 27 should be applied after the proper cleaning.

Where it meets the approval of the local command, all or part of the metal rings, antenna transfer switches (outside only), other hardware and accessories associated with transmitting antennas should be painted with red enamel, (Spec. 52P31, Stock Number G52-P-7890) as a finish coat. Hardware and accessories used with receiving antennas should be painted with blue enamel (Spec. MIL-P-2852, Stock Number G52-P-7826) as a finish coat.

CAUTION: Paint, varnish, shellac or grease shall not be applied to any portion of insulating materials forming a part of the antenna system.

Paint, varnish, shellac or grease shall not be applied to the antenna bus nor the metallic portion of any insulator in contact with the antenna bus.

b. PAINTING RADAR ANTENNA HOODS. -The antenna hoods for radar equipment such as the SF, SL, SO, and SU series are made from fiberglass which requires no paint for preservation. However, if it is desired to paint the hood to match the ship's color, any non-metallic paint may be used providing that not more than two thin layers are applied to the surface.

(1) A non-metallic paint is one that has no metallic flakes suspended in the body of the paint. Navy haze-grey paint (Spec. 52-P-45) falls in this category and is approved for painting Navy radar antenna hoods.

(2) Metallic paints (aluminum, gold, etc.) contain metallic flakes which atten-

uate electromagnetic energy. These paints should never be used where that is a consideration.

(3) Preparation of the surface. Although the kind of paint used is of primary consideration, the procedure for preparing the surface and applying the paint is also quite important. The first step in the procedure is an inspection of the hood. If more than one coat of paint has been previously applied, the surface should be cleaned either by sandblasting or by use of a liquid paint remover.

(4) Painting the new surface. Navy haze-grey paint (Spec. 52-P-45) must be sprayed on as thin as possible and still color the surface. A brush must not be used. After the painted surface has dried, the following words should be stencilled on two opposite sides about 4 inches above the bottom edge of the hood: "DO NOT PAINT".

Radar antenna hoods on Coast Guard vessels require a spar-colored paint. A suitable paint usually may be obtained from the vessel being worked on. If the vessel can not supply the paint, it may be made up by mixing together the following ingredients:

1 gallon outside white (Navy Spec. 52-P-48).

1-3/4 pounds yellow ochre in oil (Fed. Spec. TT-P-381).

2-1/2 ounces avoirdupois vermilion red in oil (Fed. Spec. TT-P-381).

4. SAFETY PRECAUTIONS.

a. WORK ON TRANSMITTING ANTENNAS. -Chapter 67 of the Bureau of Ships Manual calls for the following precautions to be observed when working on transmitting antennas:

(1) Personnel shall not be permitted to go aloft while antennas are energized by electronic equipment except by means of ladders and landings rendered safe by grounded hand rails or similar structures unless it is definitely determined in advance by suitable tests that no danger exists. This will prevent casualty due to involuntary relaxation of the hands which might occur if a small spark is drawn from a charged piece of metal or

section of rigging. The spark itself might be quite harmless. The voltages, or resonant circuits, set up in a ship's structure or section of rigging will cause shock to personnel or produce open sparks when contact is broken, or when momentarily in contact with a metallic object. Personnel of the deck force or others working on rigging shall be warned regarding the hazards which may exist and the precautions to be observed. Safety belts shall be employed when working aloft to guard against falls.

(2) The above precautions should be observed when other antennas in the immediate vicinity are energized by electronic transmitters unless it is definitely known that no danger exists. Other antennas may be interpreted to mean any antennas on board another ship moored alongside or across the pier or at a nearby shore station.

(3) There is serious danger to men aloft from falls caused by radar or other antennas which rotate or swing through horizontal or vertical arcs. Motor switches controlling the motion of radar antennas should be tagged and locked open before men are allowed aloft within dangerous proximity to such antennas.

b. **STACK GAS WARNING.** - Personnel are further cautioned to guard against the poisonous effects of smoke pipe gases while servicing equipment aloft. Besides smoke particles and obnoxious fumes, stack gases also contain carbon monoxide. While the possibility of this gas building up to high concentrations in the open is remote, the results of prolonged exposure to even small concentrations can be lethal. Stack gases sometimes give no warning and can cause illness, loss of consciousness, or even death as a result of a fall from the mast. To prevent personnel from being overcome by these gases, the following precautions should be observed:

(1) Warning signs (BuShips drawing RE 10AA 529A) should be posted and located so that they will be in full view of personnel required to service equipment. It is recommended that one sign be located below near the access ladder,

and another aloft at the servicing platform.

(2) Oxygen breathing apparatus should be used. The Type-B oxygen breathing apparatus, BuShips #S-23-B-69855, due to its small size and weight is best suited for this work. Personnel who are required to service equipment aloft in the vicinity of stack gases and who are not familiar with oxygen breathing equipment should be instructed in its use by trained personnel.

(3) As a further precaution, a telephone chest or throat microphone set should be worn for communication with others in the working party. The working party should always include at least one man stationed below who is required to wear his phones and stand watch on the sound-powered telephone circuit as long as there is a man working aloft.

(4) Make sure to obtain all the necessary equipment before going aloft.

c. **WARNING SIGNS.** - Warning signs should be posted adjacent to transmitters and transmitting antenna leads where there is even a slight possibility that personnel might come in contact with high voltages which may be injurious or fatal.

Chapter 67 of the Bureau of Ships Manual requires that "DANGER" signs and suitable guards shall be provided to prevent personnel from coming in accidental contact with high voltages and for warning personnel to guard against the possible presence of explosive vapors in certain locations and against poisonous effects of smoke pipe gases while servicing electronic equipment aloft. The following BuShips drawings have been prepared for suitable warning signs:

(1) Drawing RE 10AA 608A-Warning regarding high voltage.

(2) Drawing RE 10AA 529A-Warning regarding stack gases.

(3) Drawing RE 10A 589A-Warning regarding explosive vapors.

d. **SAFETY PRECAUTIONS FOR MAST WORKERS.** - A safety belt should be worn at all times by mast workers. The safety belt should be of the approved type and periodically tested for its rated

load. These belts should be attached to a strong permanent support preferably the mast itself. A tool belt should be worn and care taken to prevent tools from falling. It is recommended that all hand tools be tied to the belt with a length of wire or string of sufficient length to permit ease in working. Whenever possible, work should be done from a scaffold or working platform. If a small job is to be done on the mast, it may be found that the use of a "bosun's chair" is a safer and more economical method than the construction of a scaffold.

5. ANTENNA RIGGING PHOTOGRAPHS.

The following information is taken from Chapter 67 of the Bureau of Ships Manual:

a. After any installation or alteration to a ship which changes or effects the antenna rigging or antenna system, photographs shall be taken by the installing or altering activity which shall contain the following views:

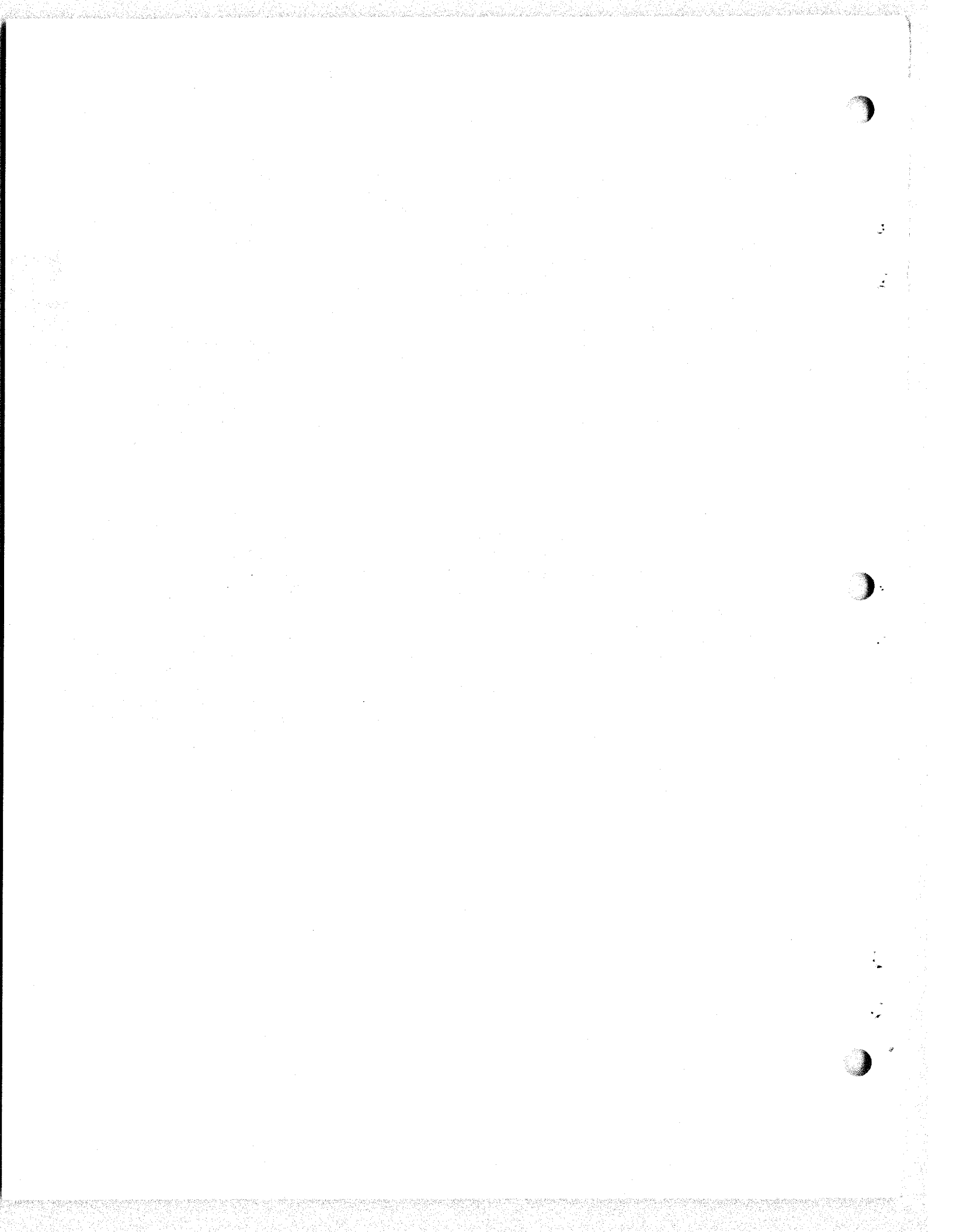
- (1) Broadside view.
- (2) Bow view about 45 degrees relative.
- (3) Stern view about 225 degrees relative.
- (4) Head on view.
- (5) View from directly astern.

b. Before a photograph is taken, that space or portion of the vessel to be photographed shall be entirely completed as regards structure, and all stagings, tools, extraneous wires, piping, hose, rubbish, etc., shall be removed.

c. The camera position should be so selected as to include as large a field as is practicable without the object within the field becoming indistinct and without objectionable foreshortening effects. The camera used for these photographs shall have sufficient depth of focus so that objects in the background will not be out of focus. All antennas on each print shall be labeled as to equipment for which they are installed.

d. The antenna rigging photographs should normally have a security classification of "RESTRICTED". Special or experimented installations should have higher classifications depending upon the subject of the photographs.

e. The negative and three 8x10 inch prints of each of the above views shall be forwarded for record and study to: Chief, Bureau of Ships, Attention Code 249. An information copy of the letter of transmittal should be forwarded to the U. S. Naval Photographic Center.



INDEX

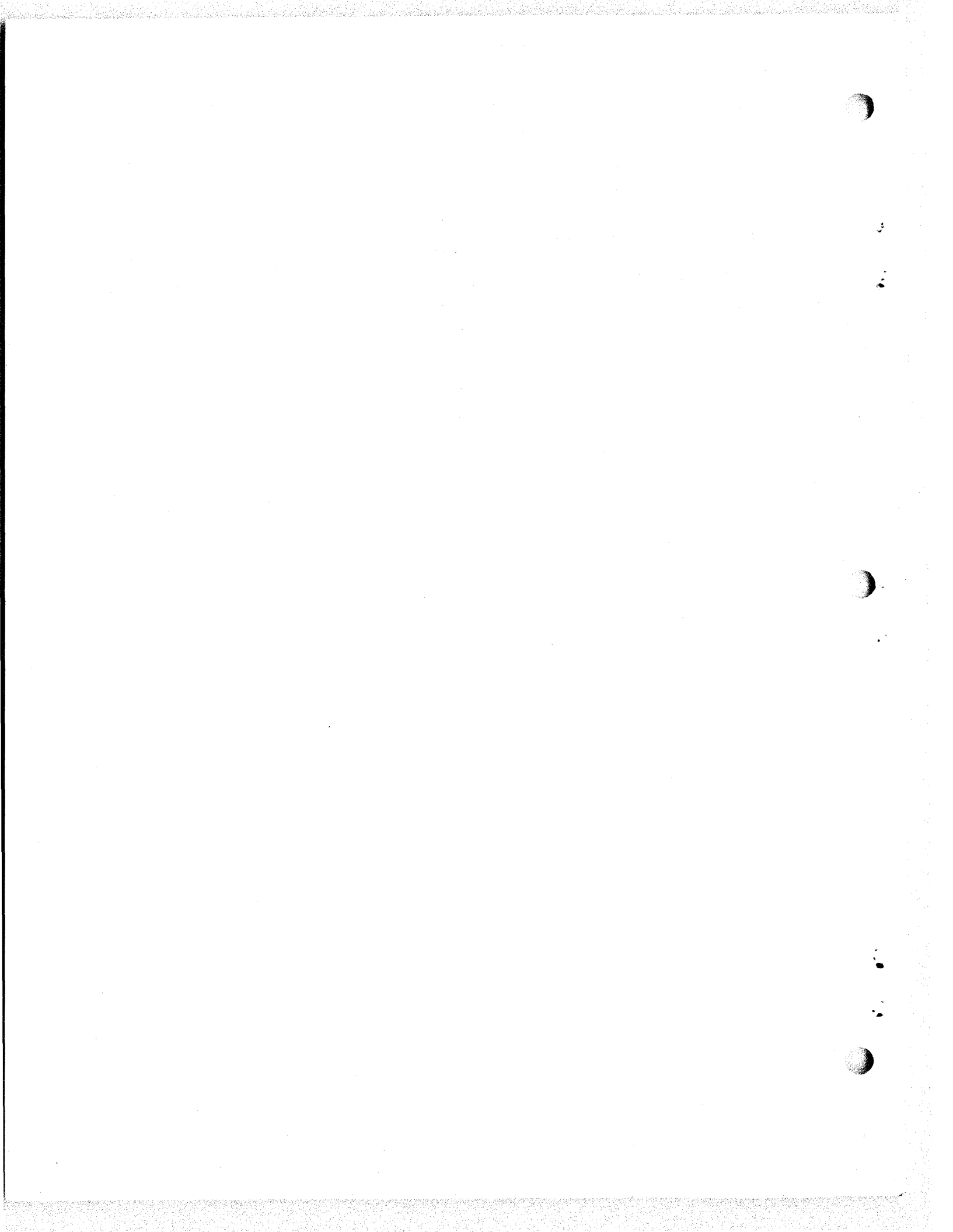
Subject	Figure or Table No.	Page
A		
Alternate methods of mounting whip antennas .....	.....	2-32
Antenna clamps .....	.....	2-8
Antenna clamps for 5/16" (6 x 19) wire rope	2-18	2-10
Antenna clamps for 7-#18 antenna wire	2-17	2-9
Antenna clamps, Table of	2-3	2-8
Antenna disconnect switches .....	.....	2-61
General .....	.....	2-61
Types .....	.....	2-61
Installation .....	.....	2-63
Antenna entrance assemblies	2-47	2-44
Antenna insulators, types of .....	.....	2-72
Strain insulator .....	.....	2-72
Standoff insulator .....	.....	2-73
Entrance insulator .....	.....	2-73
Feedthru insulator .....	.....	2-73
End Seal .....	.....	2-73
Antenna leakage resistance .....	.....	2-94
Antenna maintenance .....	.....	2-93
Antenna rigging photographs .....	.....	2-97
Antenna safety link	2-22	2-15
Antenna switch, Navy Type-24206	2-57	2-64
Antenna switch, Navy Type-24223	2-58	2-65
Antenna switch, Navy Type-24270	2-56	2-62
Antenna transfer panels	2-51	2-49
Antenna transfer panel, Navy Type-23406, cutaway side view of	2-50	2-48
Antenna transfer panel, Navy Type-23406, front view of	2-49	2-47
Antenna transfer panels, Table of fittings supplied with	2-7	2-52
Antenna trunks .....	.....	2-58
Antenna trunks, clearances for	2-55	2-59
Antenna turnbuckles .....	.....	2-8
Antenna wire and fittings, standard, list of	2-4	2-29
C		
Characteristics of Type C (6 x 19) phosphor bronze wire rope, Table of	2-1	2-2
Characteristics of radio antenna wire, Table of	2-2	2-2
Cleaning insulators .....	.....	2-74
D		
Details of whip antenna termination box	2-38	2-33

Subject	Figure or Table No.	Page
E		
End Seal .....	.....	2-73
End Seal, MX-1203/U	2-77	2-89
End Seal, MX-1460/U	2-78	2-90
End Seal, MX-1461/U	2-79	2-91
End Seal, MX-1465/U	2-80	2-92
Entrance Insulator .....	.....	2-73
Entrance Insulator, type 61471	2-65	2-77
Entrance Insulator, type 61019C	2-66	2-78
Entrance Insulator, type 61276A	2-67	2-79
Entrance Insulator, type 61475	2-68	2-80
Entrance Insulator, type 61303	2-69	2-81
F		
Feedthru Insulator .....	.....	2-73
Feedthru Insulator, type 61335	2-75	2-87
Feedthru Insulator, type 61350	2-74	2-86
Feedthru Insulator, type 61428	2-73	2-85
I		
Identification of receiving antennas .....	.....	2-53
Installation of antenna disconnect switches .....	.....	2-63
Installation methods - introduction .....	.....	2-1
Installation of ground straps .....	.....	2-56
Installation - receiving antennas .....	.....	2-39
Installation rules - UHF antennas .....	.....	2-67
Instructions for installing Antenna Connector MX-1177/U on 7-#18 antenna wire .....	.....	2-4
Instructions for installing Antenna Connector MX-1178/U on 5/16" (6 x 19) wire rope .....	.....	2-5
Insulators .....	.....	2-72
Insulator drawings .....	.....	2-74
L		
Length of transmission lines - transmitting antennas .....	.....	2-55
Locating the antenna - UHF antennas .....	.....	2-66
M		
Maintenance of antenna insulators .....	.....	2-73
Visual inspection .....	.....	2-73
Cleaning insulators .....	.....	2-74
Material for antenna trunks .....	.....	2-61
Preferred material .....	.....	2-61
Substitute material .....	.....	2-61
Mounting hardware for whip-type antennas	2-41	2-36

Subject	Figure or Table No.	Page
M		
Mounting whip antennas .....	.....	2-31
General .....	.....	2-31
Preferred method .....	.....	2-31
Alternate methods .....	.....	2-32
Tilting mount .....	.....	2-32
Mounting whip antennas, Methods A and B (Not preferred)	2-39	2-34
Mounting whip antennas, Methods C, D and E (Not preferred)	2-40	2-35
P		
Painting antennas.....	.....	2-94
General .....	.....	2-94
Painting radar antenna hoods .....	.....	2-95
Photographs - antenna rigging.....	.....	2-97
Preferred material - antenna trunks .....	.....	2-61
Preferred method of mounting whip antennas .....	.....	2-31
R		
Receiving antennas .....	.....	2-39
Receiving antenna distribution system .....	.....	2-40
Receiving antenna distribution system	2-44	2-41
Receiving antenna distribution system, List of parts for	2-5	2-46
Receiving antenna transfer panels.....	.....	2-43
Receiving antenna transfer panels, Table of.....	2-6	2-50
Recommended clearances around radio and IFF antennas.....	2-60	2-69
Recommended clearances around radar and ECM antennas.....	2-61	2-70
Recommended methods for mounting a whip antenna ..	2-37	2-32
Replacement bowls, Table of	2-10	2-75
S		
Safety links .....	.....	2-14
Safety precautions .....	.....	2-95
Work on transmitting antennas .....	.....	2-95
Stack gas warning.....	.....	2-96
Warning signs .....	.....	2-96
Safety precautions for mast workers .....	.....	2-96
Safety precautions - transmitting antennas .....	.....	2-58
Screw-pin shackles for radio antenna systems	2-21	2-13
Separation of antennas - transmitting antennas .....	.....	2-55
Shackles .....	.....	2-8
Special 3-inch line.....	.....	2-56
Stack gas warning .....	.....	2-96
Standard shipboard radio insulators, List of	2-9	2-74
Standoff insulator.....	.....	2-73
Standoff insulator, type 61174B	2-70	2-82
Standoff insulators, type 61175A and 61176A	2-71	2-83

Subject	Figure or Table No.	Page
S		
Standoff insulator, type 61339	2-72	2-84
Standoff insulator, type 61664C	2-76	2-88
Staples and padeyes .....	.....	2-8
Strain insulator .....	.....	2-72
Strain insulators, type 61479 and 61481	2-63	2-75
Strain insulators, type 61493 and 61494	2-64	2-76
Submarine receiving antenna transfer panel	2-52	2-52
Substitute material - antenna trunks .....	.....	2-61
T		
Terminal boxes for receiving antenna system	2-48	2-45
Three-inch coaxial line .....	.....	2-56
Transmission lines - UHF antennas .....	.....	2-67
Transmitting antennas - installation of .....	.....	2-55
Length of transmission lines .....	.....	2-55
Installation of ground straps .....	.....	2-56
Special 3-inch line .....	.....	2-56
Safety precautions .....	.....	2-58
Turnbuckles for use with 5/16" (6 x 19) wire rope ...	2-19	2-11
Turnbuckles for use with 7-#18 antenna wire	2-20	2-12
Types of antennas - UHF antennas .....	.....	2-66
Types of antenna disconnect switches .....	.....	2-61
Typical antenna trunk installation	2-54	2-57
Typical receiving antenna installation	2-43	2-38
Typical shipboard radio transmitting antenna systems, Table of	2-8	2-60
Typical transmitting antenna installation	2-53	2-54
Typical UHF installation	2-62	2-71
Typical wire antenna installation	2-36	2-30
Types of whip antennas .....	.....	2-31
Tilting mount for a vertical whip antenna	2-42	2-37
Tilting mount method of mounting whip antenna .....	.....	2-32
U		
UHF antenna arrangements	2-59	2-68
UHF antennas - installation .....	.....	2-66
Type of antennas .....	.....	2-66
Locating the antenna .....	.....	2-66
Transmission lines .....	.....	2-67
Installation rules .....	.....	2-67
W		
Warning signs .....	.....	2-96
Whip antennas .....	.....	2-31
Wire antennas .....	.....	2-1
Wire antenna details .....	.....	2-14
Wire rope .....	.....	2-1
Wire rope connectors .....	.....	2-2
Instructions for installing Antenna Connector MX-1177/U on 7-#18 antenna wire .....	.....	2-4

Subject	Figure or Table No.	Page
W		
Instructions for installing Antenna Connector MX-1178/U on 5/16" (6 x 19) wire rope .....	.....	2-5
Wire rope connectors for shipboard antenna systems	2-1	2-3
Work on transmitting antennas - safety precautions .....	.....	2-95



NAVSHIPS 900,121(A)

SHIPBOARD ANTENNA DETAILS

CHAPTER 2

INSTALLATION METHODS

BUREAU OF SHIPS

NAVY DEPARTMENT

Change 1: 1 Nov. 1954

LIST OF EFFECTIVE PAGES

Page Numbers	Change in Effect	Page Numbers	Change in Effect
Title Page	Change 1	2-49 to 2-53	Change 1
A Page	Change 1	2-54 to 2-55	Original
i to iv	Change 1	2-56 to 2-63	Change 1
2-1 to 2-37	Original	2-64 to 2-65	Original
2-38	Change 1	2-66 to 2-67	Change 1
2-39	Original	2-68 to 2-69	Original
2-40 to 2-43	Change 1	2-70 to 2-71	Change 1
2-44 to 2-45	Original	2-72 to 2-97	Original
2-46	Change 1	i-1 to i-4	Change 1
2-47 to 2-48	Original		

TABLE OF CONTENTS

SECTION 2-1. INTRODUCTION		SECTION 2-4. RECEIVING ANTENNAS (Cont'd)	
Paragraph	Page	Paragraph	Page
1. General.....	2-1	7. Submarine Receiving Antenna Transfer Panel.....	2-53
SECTION 2-2. WIRE ANTENNAS		8. Identification of Receiving Antennas.....	2-53
1. General.....	2-1	SECTION 2-5. TRANSMITTING ANTENNAS	
2. Wire Rope.....	2-1	.. General.....	2-55
3. Wire Rope Connectors.....	2-2	2. Installation.....	2-55
a. Instructions for Installing Antenna Connector MX- 1177/U on 7-#18 Antenna Wire.....	2-4	a. Separation of Antennas.....	2-55
b. Instructions for Installing Antenna Connector MX- 1178/U on 5/16" (6 x 19) Wire Rope.....	2-5	. Length of Transmission Line.....	2-55
4. Antenna Clamps.....	2-8	c. Installation of Ground Straps.....	2-55
5. Antenna Turnbuckles.....	2-8	d. Safety Precautions.....	2-56
6. Shackles.....	2-8	3. Antenna Trunks.....	2-57
7. Staples and Padeyes.....	2-8	a. General.....	2-57
8. Safety Links.....	2-14	b. Trunk Sizes.....	2-57
9. Wire Antenna Details.....	2-14	c. Material.....	2-57
SECTION 2-3. WHIP ANTENNAS		(1) Preferred Material.....	2-57
1. General.....	2-31	(2) Substitute Material.....	2-57
2. Types of Whip Antennas.....	2-31	d. Inner Conductor.....	2-57
3. Mounting Whip Antenna.....	2-31	e. Insulators.....	2-61
a. General.....	2-31	f. Installation.....	2-61
b. Preferred Method.....	2-31	4. Three-Inch Coaxial Line (RG-162/U).....	2-61
c. Alternate Methods.....	2-32	5. Antenna Disconnect Switches.....	2-63
d. Tilting Mount.....	2-32	a. General.....	7-63
SECTION 2-4. RECEIVING ANTENNAS		b. Types.....	2-63
1. General.....	2-39	(1) Navy Type 24270.....	2-63
2. Installation.....	2-39	(2) Navy Type 24206.....	2-63
3. Transmission Lines.....	2-40	(3) Navy Type 24223.....	2-63
4. Receiving Antenna Distri- bution Systems.....	2-40	c. Installation.....	2-63
a. Terminal Boxes.....	2-40	SECTION 2-6. UHF ANTENNA IN- STALLATIONS	
b. Protective Devices.....	2-43	i. General.....	2-66
c. Stuffing Tubes.....	2-43	2. Installation.....	2-66
d. Cable Straps .. Marking Cables.....	2-43	a. Types of Antennas	2-66
5. Receiving Antenna Transfer Panels.....	2-43	b. Locating the Antenna.....	2-66
6. Antenna Transfer Panel SB-346/SB.....	2-50	c. Transmission Line.....	2-67
		d. Installation Rules.....	2-67

SECTION 2-7.
ANTENNA INSULATORS

Paragraph	Page
1. General.....	2-72
2. Type of Antenna Insulators.....	2-72
a. Strain Insulators.....	2-72
b. Standoff Insulators.....	2-73
c. Entrance Insulators.....	2-73
d. Feedthru Insulators.....	2-73
e. End Seals.....	2-73
3. Maintenance of Antenna Insulators.....	2-73
a. Visual Inspection.....	2-73
b. Cleaning Insulators.....	2-74
4. Insulator Drawings.....	2-74

SECTION 2-8. ANTENNA
MAINTENANCE

Paragraph	Page
1. General.....	2-93
2. Antenna Leakage Resistance...	2-94
3. Painting Antennas.....	2-94
a. General.....	2-94
b. Painting Radar Antenna Hoods.	2-95
4. Safety Precautions.....	2-95
a. Work on Transmitting Antennas.....	2-95
b. Stack Gas Warning..	2-96
c. Warning Signs.....	2-96
d. Safety Precautions for Mast Workers..	2-96
5. Antenna Rigging Photographs.....	2-97

LIST OF ILLUSTRATIONS

SECTION 2-2. WIRE ANTENNAS

Figure	Page
2-1	Wire Rope Connectors for Shipboard Antenna Systems.....2-3
2-2	Step 1 - MX-1177/U.....2-4
2-3	Step 2 - MX-1177/U.....2-4
2-4	Step 3 - MX-1177/U.....2-4
2-5	Step 4 - MX-1177/U.....2-5
2-6	Step 5 - MX-1177/U.....2-5
2-7	Step 6 - MX-1177/U.....2-5
2-8	Step 1 - MX-1178/U.....2-5
2-9	Step 2 - MX-1178/U.....2-6
2-10	Step 3 - MX-1178/U.....2-6
2-11	Step 4 - MX-1178/U.....2-6
2-12	Step 5 and 6 - MX-1178/U.....2-6
2-13	Step 7 - MX-1178/U.....2-7
2-14	Step 8 - MX-1178/U.....2-7
2-15	Step 9 - MX-1178/U.....2-7
2-16	Step 10 - MX-1178/U.....2-8
2-17	Antenna Clamps for 7-#18 Antenna Wire.....2-9
2-18	Antenna Clamps for 5/16" (6 x 19) Wire Rope... 2-10
2-19	Turnbuckles for use with 5/16" (6 x 19) Wire Rope... 2-11
2-20	Turnbuckles for use with 7-#18 Antenna Wire.....2-12
2-21	Screw-Pin Shackles for Radio Antenna Systems.. 2-13

SECTION 2-2. WIRE ANTENNAS
(Cont'd)

Figure	Page
2-22	Antenna Safety Link..... 2-15
2-23	Wire-Antenna Details - (Details A and B).....2-16
2-24	Wire Antenna Details - (Details C and D).....2-17
2-25	Wire Antenna Details - (Details E and E').....2-18
2-26	Wire Antenna Details - (Details G and H)..... 2-19
2-27	Wire Antenna Details - (Details I and J).....2-20
2-28	Wire Antenna Details - (Details K and L).....2-21
2-29	Wire Antenna Details - (Details M and N)..... 2-22
2-30	Wire Antenna Details - (Details O and P)..... 2-23
2-31	Wire Antenna Details - (Details Q and R)..... 2-24
2-32	Wire Antenna Details - (Details S and T).....2-25
2-33	Wire Antenna Details - (Details U and V)..... 2-26
2-34	Wire Antenna Details - (Details W and X)..... 2-27
2-35	Wire Antenna Details - (Details Y and Z)..... 2-28
2-36	Typical Wire Antenna Installation.....2-30

SECTION 2-3.
WHIP ANTENNAS

Figure	Page
2-37	Recommended Method for Mounting a Whip Antenna.....2-32
2-38	Details of Whip Antenna Termination Box.....2-33
2-39	Mounting Whip Antennas - Methods A and B (Not Preferred).....2-34
2-40	Mounting Whip Antennas - Methods C, D and E (Not Preferred).....2-35
2-41	Mounting Hardware for Whip Antennas.....2-36
2-42	Tilting Mount for a Vertical Whip Antenna.....2-37

SECTION 2-4.
RECEIVING ANTENNAS

2-43	Typical Receiving Antenna Installation..... 2-38
2-44	Receiving Antenna Distribution System (Using Terminal Boxes).....2-41
2-45	Receiving Antenna Distribution System (Using Antenna Transfer Panel).....2-42
2-46	Receiving Antenna Distribution System (Using AN/SRA-9 Antenna Filter Assembly)..... 2-42
2-47	Antenna Entrance Assemblies..... 2-44
2-48	Terminal Boxes for Receiving Antenna System... 2-45
2-49	Front View of Antenna Transfer Panel. Navy Type 23406..... 2-47
2-50	Cutaway Side View of Antenna Transfer Panel, Navy Type 23406..... 2-48
2-51	Antenna Transfer Panel, SB-346/S..... 2-51
2-52	Submarine Receiving Antenna Transfer Panel... 2-52

SECTION 2-5. TRANSMITTING
ANTENNAS

Figure	Page
2-53	Typical Transmitting Antenna Installation. 2-54
2-54	Typical Antenna Trunk Installation..... 2-58
2-55	Clearances for Antenna Trunks..... 2-59
2-56	Navy Type 24270 Antenna Switch. 2-62
2-57	Navy Type 24206 Antenna Switch. 2-64
2-58	Navy Type 24223 Antenna Switch.. 2-65

SECTION 2-6. UHF ANTENNA
INSTALLATIONS

2-59	UHF Antenna Arrangements..... 2-68
2-60	Recommended Clearances Around Radio and IFF Antennas.. 2-69
2-61	Recommended Clearances Around Radar and ECM Antennas.....2-70
2-62	Typical UHF Installation.. 2-71

SECTION 2-7. ANTENNA INSULATORS

2-63	Strain Insulators Types 61479 and 61481.. 2-75
2-64	Strain Insulators Types 61493 and 61494..... 2-76
2-65	Entrance Insulator Type 61471..... 2-77
2-66	Entrance Insulator Type 61019C..... 2-78
2-67	Entrance Insulator Type 61276A..... 2-79
2-68	Entrance Insulator Type 61475.. ....2-80
2-69	Entrance Insulator Type 61303.....2-81
2-70	Standoff Insulator Type 61174B..... 2-82

SECTION 2-7. ANTENNA
INSULATORS (Cont'd)

SECTION 2-7. ANTENNA INSULA-
TORS (Cont'd)

Figure	Page	Figure	Page
2-71	Standoff Insulators Types 61175A and 61176A..... 2-83	2-75	Feedthru Insulator Type 61335.. .....2-87
2-72	Standoff Insulator Type 61339.. .....2-84	2-76	Standoff Insulator Type 61664C..... 2-88
2-73	Feedthru Insulator Type 61428.. .....2-85	2-77	End Seal MX-1203/U..... 2-89
2-74	Feedthru Insulator Type 61350.. .....2-86	2-78	End Seal MX-1460/U..... 2-90
		2-79	End Seal MX-1461/U..... 2-91
		2-80	End Seal MX-1465/U..... 2-92

LIST OF TABLES

SECTION 2-2. WIRE ANTENNAS

SECTION 2-4. RECEIVING
ANTENNAS (Cont'd)

Table	Page	Table	Page
2-1	Characteristics of Type C (6 x 19) Phosphor Bronze Wire Rope.....2-2	2-7	Fittings Supplied with Antenna Transfer Panels..... 2-50
2-2	Characteristics of Radio Antenna Wire..... 2-2		SECTION 2-5. TRANSMITTING ANTENNAS
2-3	Antenna Clamps.. .....2-8	2-8	Typical Shipboard Radio Transmitting Antenna Systems..... 2-60
2-4	List of Standard Antenna Wire and Fittings..... 2-29		SECTION 2-7. ANTENNA INSULATORS
	SECTION 2-4. RECEIVING ANTENNAS	2-9	List of Standard Shipboard Radio Insulators.....2-74
2-5	List of Parts for Receiving Antenna Distribution System.....2-46	2-10	Replacement Bowls.....2-75
2-6	Receiving Antenna Trans- fer Panels..... 2-49		

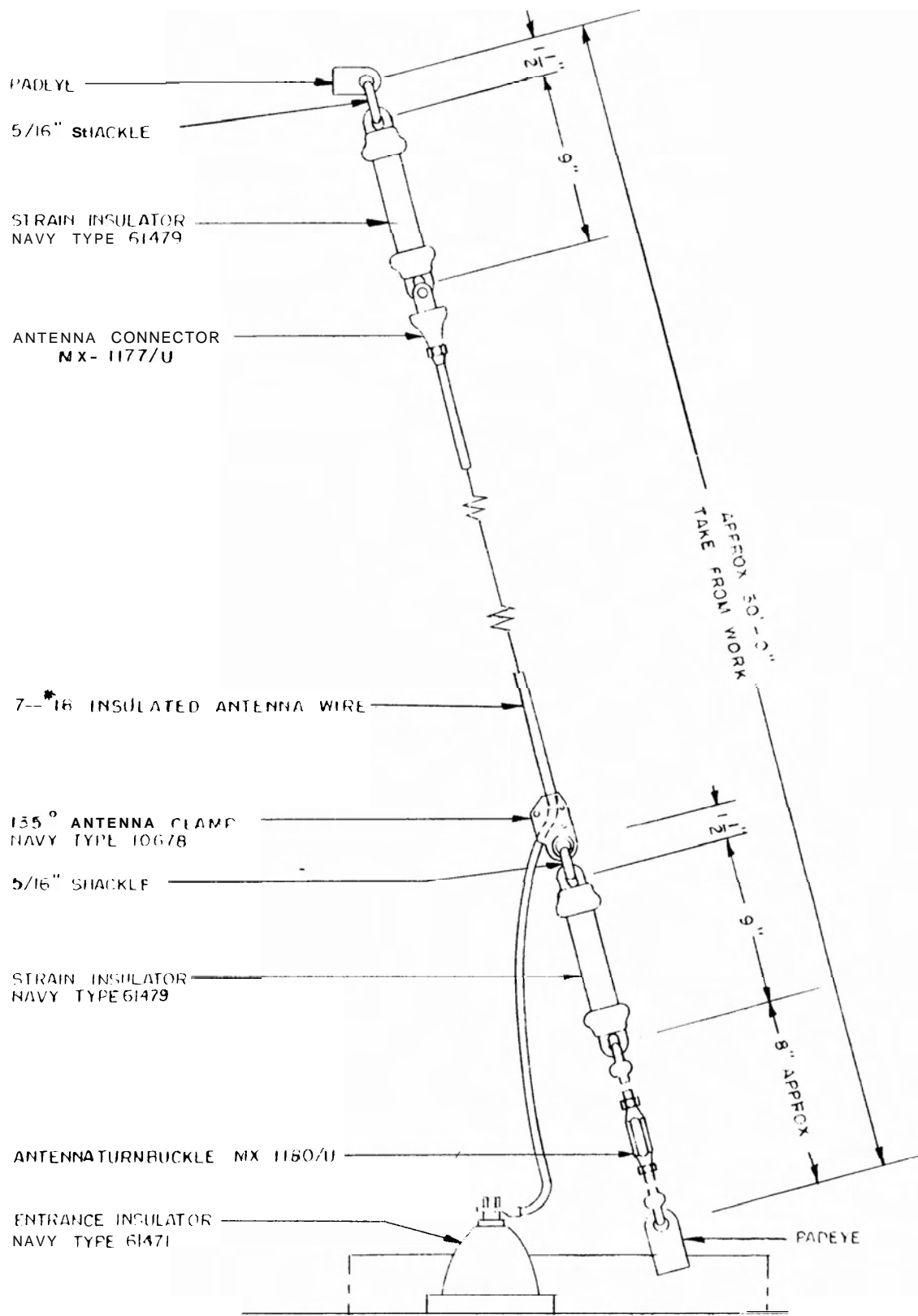


Figure 2-43. Typical Receiving Antenna Installation

the number of antennas required for a given number of receivers. For example, the AN/SRA-9A Filter Assembly (multicoupler) provides for the simultaneous operation of a maximum of 28 receivers from a single antenna. However, except in extreme cases, the number of receivers operating from a single AN/SRA-9A shall be limited to seven or less. Further details on the AN/SRA-9A may be found in another chapter of this manual - Chapter 3, "Antenna Multicouplers".

In planning a receiving installation, the circuit requirements of a given ship as well as the number and type of available antennas should be taken into account.

Presently, most shipboard receiving antennas are installed forward. In some cases it is necessary to route transmitting antenna down-leads from near the yardarm on the foremast. This practice sometimes produces a highly undesirable coupling between the transmitting and receiving antennas. In certain vessels presently under construction the receiving antennas are being erected in the vicinity of the main mast. This location requires from 60 to 100 feet of coaxial feed line; however, it is believed that the much smaller degree of coupling between receiving and transmitting antennas will permit the receivers to operate in a more efficient and reliable manner. "Burnouts" of receiver antenna coils caused by local transmitters should be eliminated.

3. TRANSMISSION LINES

In the past, RG-12/U, 70-ohm cable, was used in receiving antenna distribution systems. However, the Bureau of Ships is presently attempting to standardize and thereby reduce the number of different types of RF cables installed in any particular ship. It was decided to use only 50-ohm lines wherever possible; the preferred lines are types RG-10/U and RG-18/U. This standardization should not be carried to the point of diminishing returns. That is, presently installed RG-12/U cable in good condition shall not be replaced with type RG-10/U cable for the sole purpose of standardization. Furthermore, when

the low-frequency receiving equipment is a considerable distance from the receiving antenna, it is preferable to install RG-79/U, 125-ohm cable, or 3-inch, 180-ohm, air-filled coaxial line rather than RG-10/U or RG-18/U. In other words, every attempt should be made to provide each vessel with the best-engineered system of transmission lines possible. The following factors should be considered:

- a. Standardize as much as possible.
- b. Hold line losses below 1 db.
- c. Maintain shielding.
- d. Do not incur expenditures which are not justified.

4. RECEIVING ANTENNA DISTRIBUTION SYSTEMS

Typical receiving antenna distribution systems are shown in Figures 2-44, 2-45 and 2-46. They differ in the method used for connecting the receivers to the receiving antennas.

The distribution system using terminal boxes (Figure 2-44) is for small vessels and special applications only. The use of standard antenna transfer panels (Figure 2-45) is the preferred type of installation. In future installations filter assemblies such as the AN/SRA-9A or AN/SRA-12 may be used in place of present transfer panels (Figure 2-46). Line termination panels must be fabricated by the installing activity for use in conjunction with filter assemblies. The coaxial receptacles used shall be of the same type as those used on the filter assembly. The AN/SRA-12 is the same as the AN/SRA-9A except that it uses "quick-disconnect" type connectors. When only one filter assembly is installed as in Figure 2-46, it is recommended that two receiving antennas be terminated at the Antenna Selector Patch Panel.

a. **TERMINAL BOXES.** - All terminal boxes comprising the antenna transfer assembly (Figure 2-44) shall be mounted within a 30-inch diameter circle to permit the use of standard 36-inch patch-cords. The assembly should be mounted on a vertical bulkhead and in a position

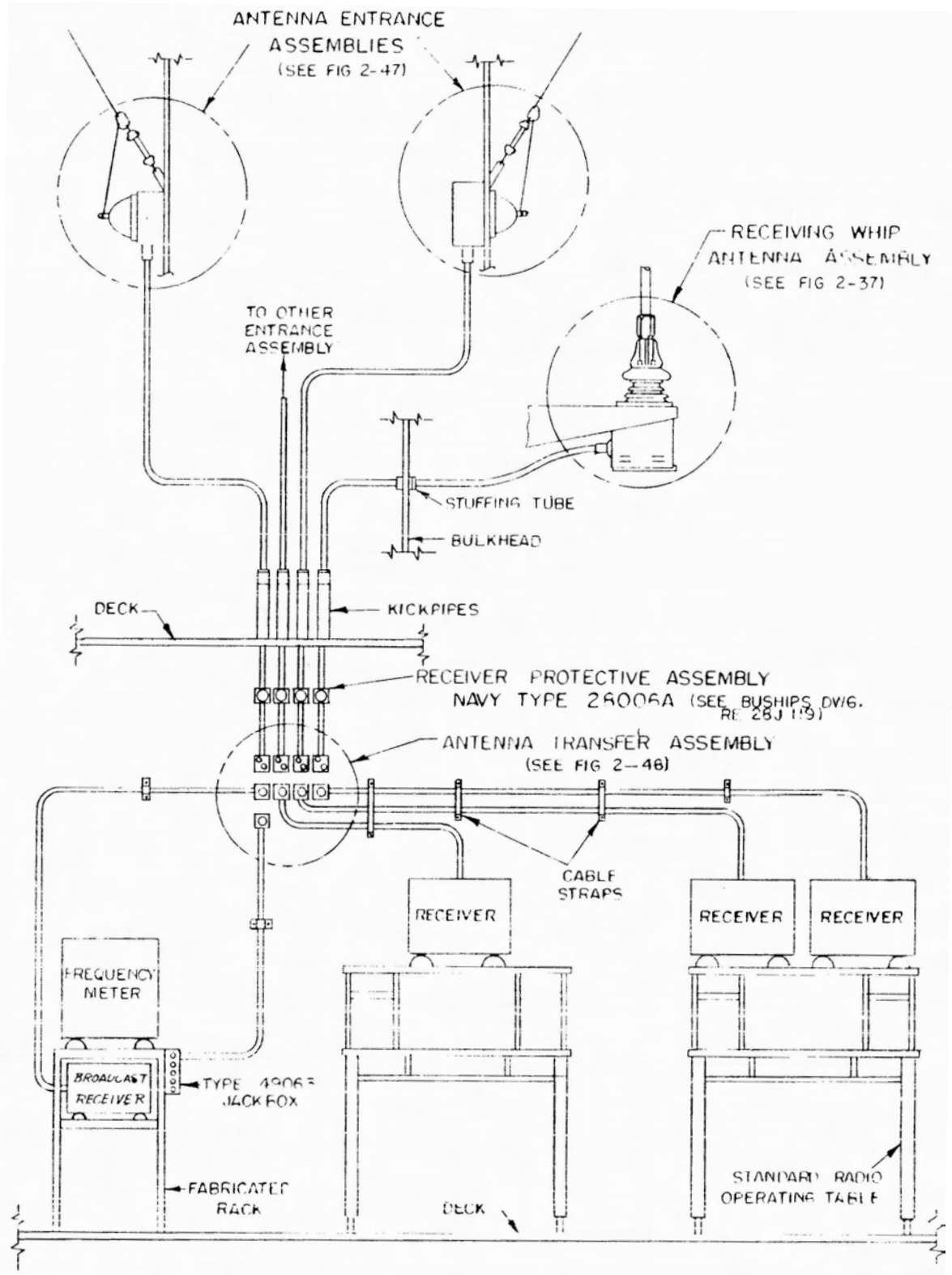


Figure 2-44. Receiving Antenna Distribution System (Using Terminal Boxes)

TABLE 2-5. LIST OF PARTS FOR RECEIVING ANTENNA DISTRIBUTION SYSTEM

Part No.	Description	Material	Size	Navy or AN Type Number	Drawing or Specification
1	Entrance Box (Outside)	Steel		V-S-125	9-S-4302-L
2	Entrance Box (Inside)	Steel			
3	Terminal Box Assembly		2-5/8" Deep	Type G (NWT)	9-S-5333-L
4	Soldering Lug	Copper	For No.8 Stud		Commercial
5	Bus Wire, Bare	Copper	No. 10 B&S		Commercial
6	Connector (Length to suit)	R. C. Stranded Copper Wire	No. 18 B&S		Commercial
7	End Seal			MX-1461/U	RE49F237
8	End Seal			MX-1465/U	RE49D371B
9	Solid Dielectric Cable			RG-10/U	JAN-C-17A
10	Cable Strap		No. 4		9-S-4441-L-4 9-S-4442-L-4
11	Stuffing Tube		B		9-S-5166-L
12	Stuffing Tube Packing		B		RA62AA314
13	Entrance Insulator			61471	RE61F293
14	Resistor, Static Leak		1 watt 1/2 meg.	63288	RE13A340
15	Concentric Jack			49120	RA49F215
16	Receiver Protective Assembly			28006A	RE28J119A

structurally; their differences lie in the number of antennas and receivers that they can accommodate. Two views of Antenna Transfer Panel NT-23406 are shown in Figures 2-46 and 2-47.

These transfer panels provide means for operating a many as four radio receivers simultaneously into one antenna. At the transfer panel each antenna is connected to a row of four jacks. One jack is connected directly to the antenna; the other three jacks are connected in parallel through 600-ohm decoupling resistors. The receivers connected to the three decoupled jacks will operate at a reduced efficiency.

The cases of these transfer panels are made of brass with a black wrinkle finish. The front panels are made of aluminum. The Type 23406 Transfer Panel shown in Figure 2-46 will accommodate 9 interspace lines and 18 intraspaces lines. The interspace lines which terminate in Type 62111 End Seals, connect to the various antennas and to other radio spaces. Each interspace line connects to a vertical row of four jacks. The escutcheon plate associated with each line should be marked to indicate the remote termination of that line.

A double row of jacks, each fitted with a Type 62112 Concentric Jack Termination, is provided on each panel for terminating the intraspaces lines. These lines connect to the various receiver, frequency meter or other equipment positions. White escutcheon plates are mounted between each pair of jacks to enable the operator to mark the respective communications channels, frequencies or schedules there-on. These markings may be made with pencil or ink and may be erased or washed off at will.

The transfer panels are intended to be mounted on a bulkhead with the cables entering the top and sides of the case. However, they may be mounted on a panel or on brackets. Figure 2-50 indicates this alternate arrangement with the cables entering the back of the case. Such a procedure is possible when there is sufficient space behind the panel to permit bending the cable. This distance should be more than six inches.

The dimensions and stock numbers for these four transfer panels are given in Table 2-6. The fittings supplied with each of these panels are listed in Table 2-7.

TABLE 2-6. RECEIVING ANTENNA TRANSFER PANELS

Navy Type Number	Overall Dimensions (Inches)			Standard Navy Stock Number	ESO Stock Number	Reference Drawing
	Height	Width	Depth			
23404	18-1/8	34-5/16	5-1/2	17-S-93142-7931	N16-P-2375	RA 49F 241B
23405	18-1/8	10-9/16	5-1/2	17-S-93129-7189	N16-P-2376	RA 49F 242
23406	11-1/16	20-9/16	5-1/2		N16-P-2377	RA 49F 243
23407	18-1/8	13-11/16	5-1/2	17-S-93121-5501	N16-P-2378	RA 49F 244

TABLE 2-7. FITTINGS SUPPLIED WITH ANTENNA TRANSFER PANELS

Fitting	Transfer Panel NT-23404	Transfer Panel NT-23405	Transfer Panel NT-23406	Transfer Panel NT-23407
Concentric Jack NT-49120	150	90	54	60
Concentric Jack Termination NT-62112	30	18	18	12
18" Patch Cord NT-49122B	10	8	8	6
36" Patch Cord NT-49123B	18	16	10	10
48" Patch Cord NT-49150B	12			

The transfer panels are made with 70-ohm fittings and designed for use with 70-ohm cables such as RG-11/U and RG-12/U. However, RG-10/U, 50-ohm cable may be used with these fittings by slightly enlarging the holes for the inner conductor.

The patchcords should be taken apart and inspected periodically to see that connections are secure, and that no frayed shield conductors can short the antenna circuits to ground.

6. ANTENNA TRANSFER PANEL SB-346/S

Antenna Transfer Panel SB-346/S is similar to the standard antenna transfer panels except that it uses "quick-disconnect" type connectors. It permits the operation of a maximum of twelve receivers from three antennas.

The SB-346/S consists of an aluminum case on which are mounted the upper

and lower halves of an aluminum front panel (Figure 2-51). Twelve jacks are mounted on the upper half of this front panel and arranged in three vertical rows of four jacks each. Aluminum partitions in the case shield the vertical rows of jacks from one another.

Three antenna input jacks are mounted on top of the case, one for each vertical row of four jacks. The top jack in the row is connected directly to the corresponding antenna jack; the remaining three jacks in the row are connected through 62-ohm decoupling resistors.

On the lower half of the front panel are mounted twelve jacks which are connected to corresponding jacks on the rear of the case. Twelve UG-941A/U plugs are supplied with the unit to connect the lines from the receivers to the jacks on the rear of the case. Also supplied are twelve patch cables for connecting the jacks on the lower front panel with those on the upper front panel.

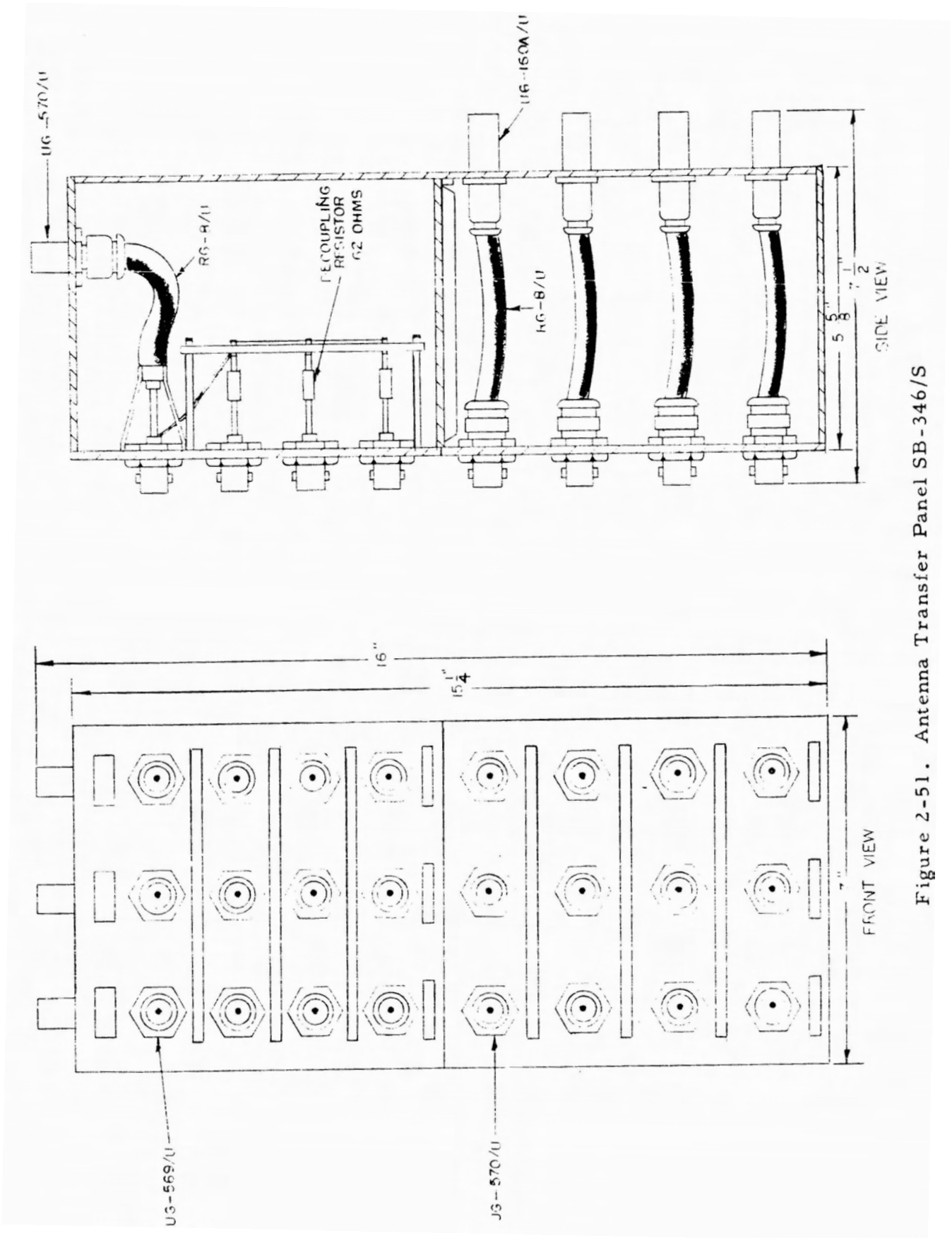
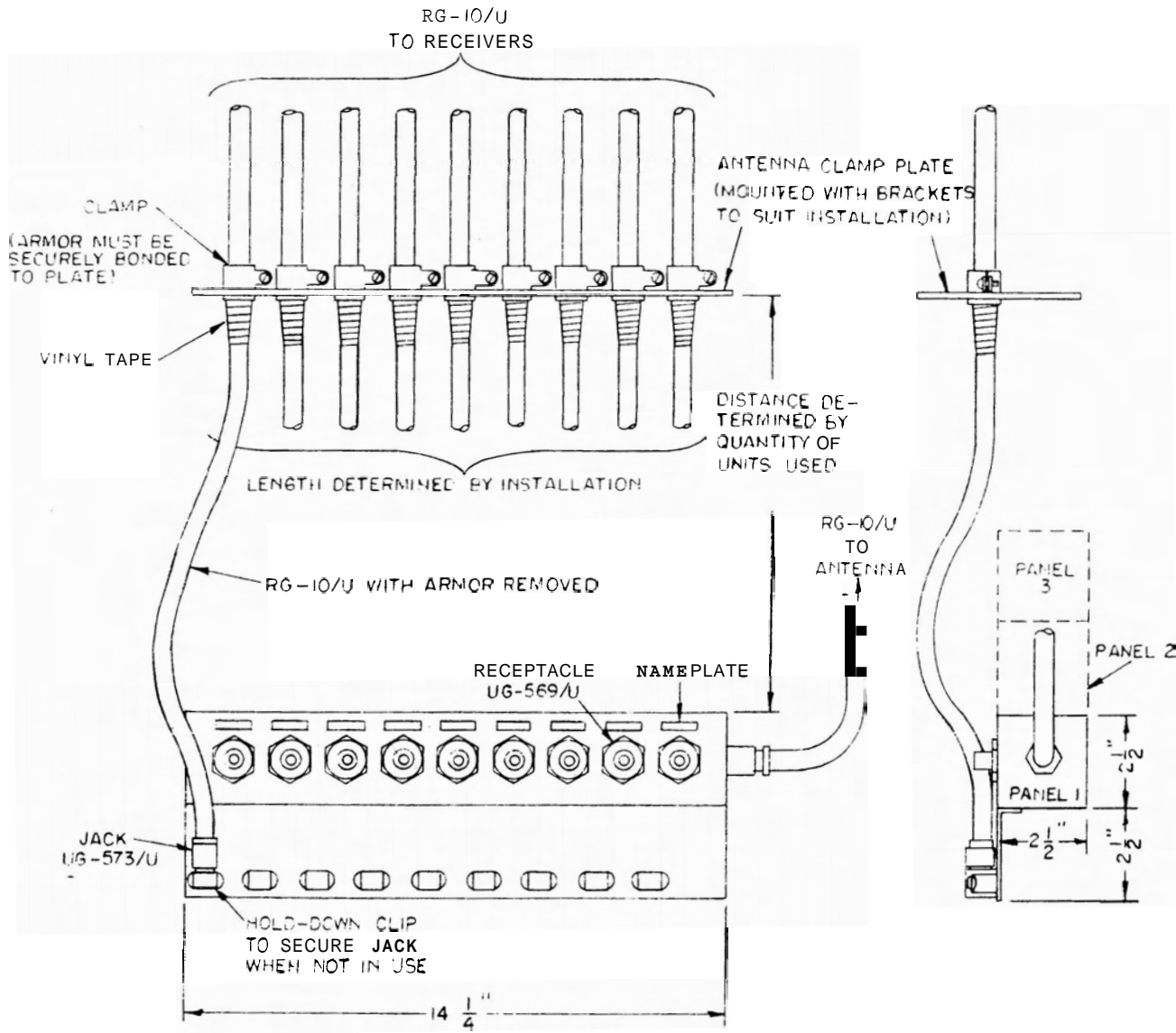


Figure 2-51. Antenna Transfer Panel SB-346/S



NOTE

1. A complete ship installation will consist of stacked receptacle panels (one for each permanent antenna installed), one clip panel and one antenna clamp plate stacked as shown.

Figure 2-52. Submarine Receiving Antenna Transfer Panel

7. SUBMARINE RECEIVING ANTENNA
TRANSFER PANEL

A special receiving antenna transfer panel for use on submarines is shown in Figure 2-52. Because of space limitations on submarines, it is not practical to use the standard antenna transfer panels such as Navy Type 23406. A separate receptacle panel is used for each permanently installed antenna; this provides nine receptacles connected to each antenna. Like receivers should not be used on the same antenna unless necessary. Clips are provided on a plate at the bottom of the panel to secure the receiver jacks when they are not in use. Since the armor is removed from that portion of the receiver lines from the clamp plate to the transfer panel, it is important that the cable armor is securely bonded to the clamp plate through the armor clamp. The armor on the coaxial cables from the antennas should also be securely bonded to the receptacle panels through the armor clamps.

8. IDENTIFICATION OF RECEIVING
ANTENNAS

The Bureau has received a beneficial suggestion recommending posting a nameplate on antenna transfer panels whereby the useful frequency range of any receiving antenna installed in a ship will be readily apparent.

In accomplishing this suggestion it is recommended that each antenna terminal on an antenna transfer panel receive a nameplate approximately one-half inch by one and one-half inches. This nameplate shall contain the antenna designation and the length of the antenna in feet (i.e., RA-61 over 52 feet). A second nameplate of the same size shall be fastened adjacent to each antenna so that the useful frequency range of the antenna may be known. This information shall be engraved on the second **plate** (i.e., 2-7 mc). If this is not possible, then the second plate shall be of a material suitable for the personnel of the ship to record the useful range of each antenna as it becomes known from actual use.

It is recommended that antenna trunks be replaced by RG-18/U or some similar low-loss coaxial cable when the following types of antenna installations are used:

- (1) Broad-band antennas.
- (2) High-efficiency, automatically tunable matching networks at the base of the antenna.
- (3) Fixed matching networks at the base of the antenna with switching arrangements to cover the band.
- (4) A fixed matching network at the base of the antenna to cover the low-frequency region.

c. INSTALLATION OF GROUND STRAPS.

— The installation of RF ground connections should be performed with the same care as used in making "hot" or "live" connections. If a ground strap performs its proper function, it carries current substantially equal to that carried by the center conductor of the transmission line. With shipboard transmitters, copper strap is recommended for RF grounding. The Bureau has found that a piece of solid strap is superior to copper braid when conducting RF currents. Where flexibility is needed, a slightly longer strap in the form of a half-loop can be used.

BuShips Instruction 9670.16, dated 2 January 1953, provides the following minimum requirements for the grounding of electronic equipment installed on ships:

"All electronic equipment whose DC resistance from case to ground exceeds 0.01 ohm, shall be grounded by the use of straps as follows:

- (1) On units requiring sound isolation, the straps shall be copper braid, not less than 1/2 inch wide.
- (2) On other units, the strap shall not be less than 0.020 inch thick by 1/2 inch wide, sheet copper or brass.
- (3) The surface at the points of attachment of the straps shall be thoroughly cleaned to insure a metal-to-metal contact.

(4) The straps shall be as short as possible with only enough loop allowed to permit satisfactory deflection of shock or sound isolation mounts.

(5) The strap connections shall be locked to prevent loosening from vibration.

(6) Only one strap will be required for each unit unless tests indicate more are needed."

Static or DC ground straps are necessary when the transmitting equipment is shock mounted. This is primarily a measure of protection for personnel against injury from stray voltages, static charges, or high DC potentials. As in the case of RF grounds, a solid copper strap should be used and all connection points should be scraped clean and tightly secured. The equipment should be grounded to the deck or bulkhead.

Aboard ship where transmitters and antennas are unbalanced to ground coaxial line or a trunk should be used from the antenna lead-in to within a few inches of the transmitters' output terminals. A good RF ground connection should be made from the outer conductor or shell to the transmitter case. BuShips drawing RE 66D 2071 shows the proper method for bonding the trunk to the transmitter case. The transmitter case should also be bonded to the deck or bulkhead with a ground strap.

. SAFETY PRECAUTIONS.— Antennas for transmitting shall be installed so as not to be readily accessible to unauthorized persons. A minimum clearance of 10 feet for low-power antennas and 12 feet for medium and high-power antennas shall be allowed above spaces normally accessible to personnel. (See Bureau of Standards Handbook H30, National Electrical Safety Code.)

Antenna lead-in conductors shall be installed and protected to prevent personnel from readily coming into accidental contact with them. Lead-in conductors shall be securely fastened to suitable insulators which provide a clearance of at least 2 inches from the nearest surface. If the lead-in has an

effectively grounded metal sheath, such as coaxial cable, it may be attached directly to any surface.

The antenna lead-in should be provided with a grounding switch for lightning protection. If no conducting path between the antenna and ground is provided in the connected equipment, means shall be provided for draining static charges from the antenna system.

In wire antenna installations the connectors, clamps, shackles, etc., shall be strong enough to withstand a load which will break the antenna wire itself. A safetylink which will release the wire before it breaks shall be used in all wire transmitting antenna installations (refer back to Figure 2-22).

3. ANTENNA TRUNKS

a. GENERAL. - When other types of RF transmission lines are not specified, an antenna trunk is installed between the radio transmitter and its antenna. An antenna trunk is basically a coaxial line. It consists of a solid inner conductor, supported by stand-off insulators in the center of a metallic trunk. The cross section of the trunk may be rectangular, square or circular in shape. The 9 x 11 inches rectangular trunk is commonly used in shipboard installations. A typical shipboard antenna trunk installation is shown in Figure 2-54.

The trunk is used for shielding purposes, for mechanical protection of the antenna bus and also to prevent personnel from accidentally coming in contact with the antenna bus. In exposed locations the trunk should extend high enough so that personnel cannot accidentally come in contact with antenna lead-in. Figure 2-55 shows these clearances.

A list of trunk sizes and fittings used with some of the shipboard transmitters is given in Table L-8.

b. TRUNK SIZES. - Antenna trunks are made in several sizes in order to accommodate radio transmitters having different power outputs. The following rectangular trunks are commonly used in shipboard installations:

(1) 6 x 8 inches for transmitters in the frequency range of 2 to 30 mc and having a power output of less than 100 watts.

(2) 9 x 11 inches for transmitters of a frequency range of 175 kc to 30 mc and a power output of 100 to 500 watts.

(3) 18 x 20 inches for transmitters of a frequency range of 175 to 600 kc and a power output of 500 watts or greater.

c. TRUNK MATERIAL

(1) PREFERRED MATERIAL. - Transmitter antenna trunks shall be fabricated of sheet steel conforming with Military Specification MIL-S-16113, (Grade M, Type I) of a minimum thickness of 0.094 inch with a copper cladding of 0.008 inch on one side (inside) only. This material is listed as items 945A (Std. Navy Stock No. G47-S-67425-5310), 946 (Std. Navy Stock No. G47-S-67425-5510), and 947 (Std. Navy Stock No. G47-S-67425-5610) in Section 47, General Stores Section of the Catalog of Navy Material. It is recommended that orders be made up of items 946 and 947, as these larger sizes are more economical and will limit the number of items to be carried in stock.

(2) SUBSTITUTE MATERIAL. - When the above copper-clad steel is not available, it is permissible to substitute aluminum for use in fabricating radio transmitter antenna trunks. In general, aluminum should be used only for special installations; i.e., in mine craft where the magnetic signature must be kept low.

The aluminum should be 61 ST 6 in accordance with Federal Specification QQ-A-327 with a minimum thickness of 0.125 inch. The inside and outside of fabricated trunks shall be treated with a zinc chromate primer, the outside to be painted as required.

d. INNER CONDUCTOR. - The inner conductor of the antenna trunk shall be copper tubing in accordance with Federal Specification WW-T-799. It shall

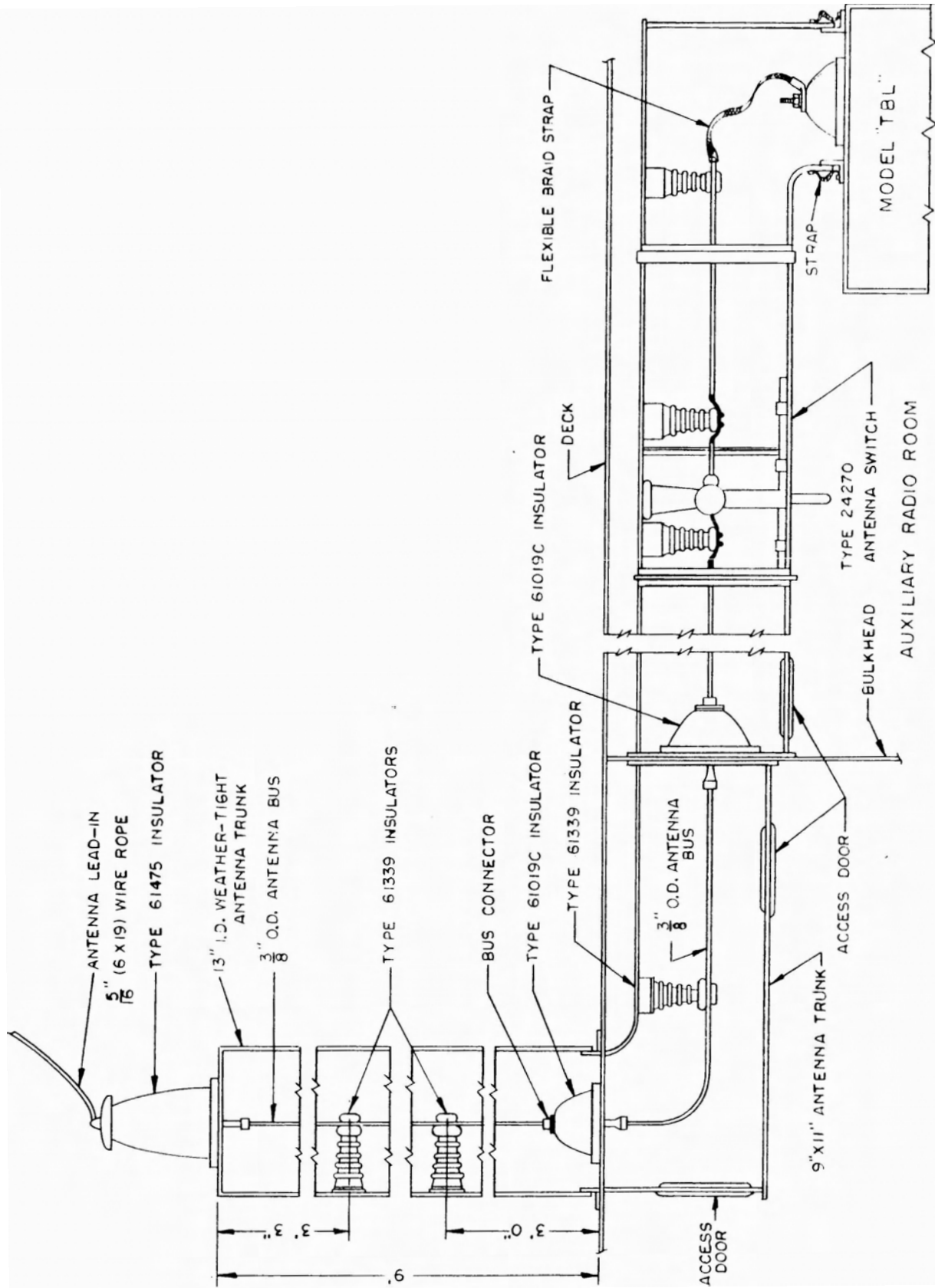
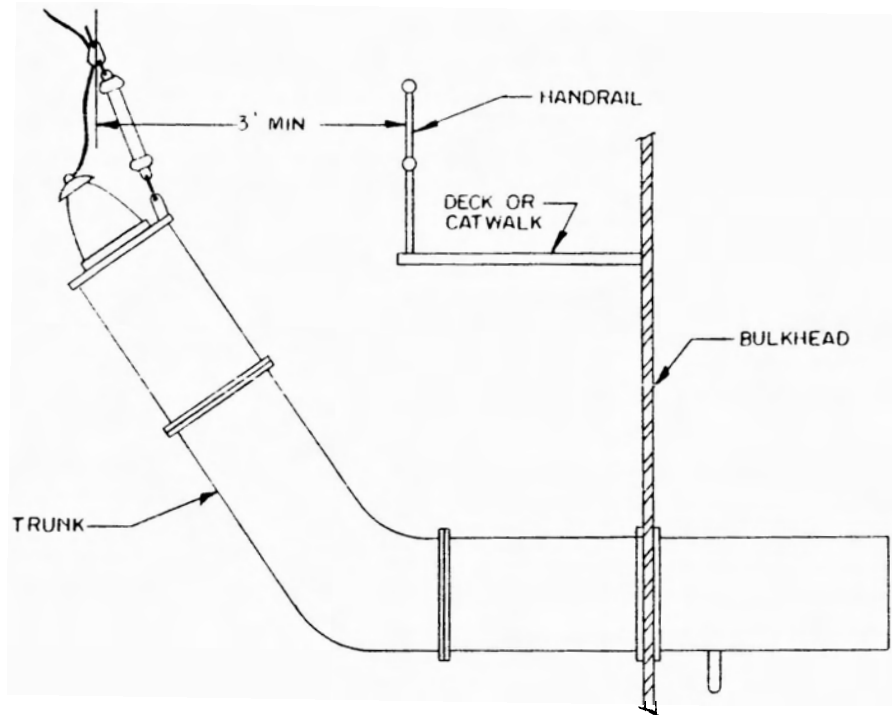


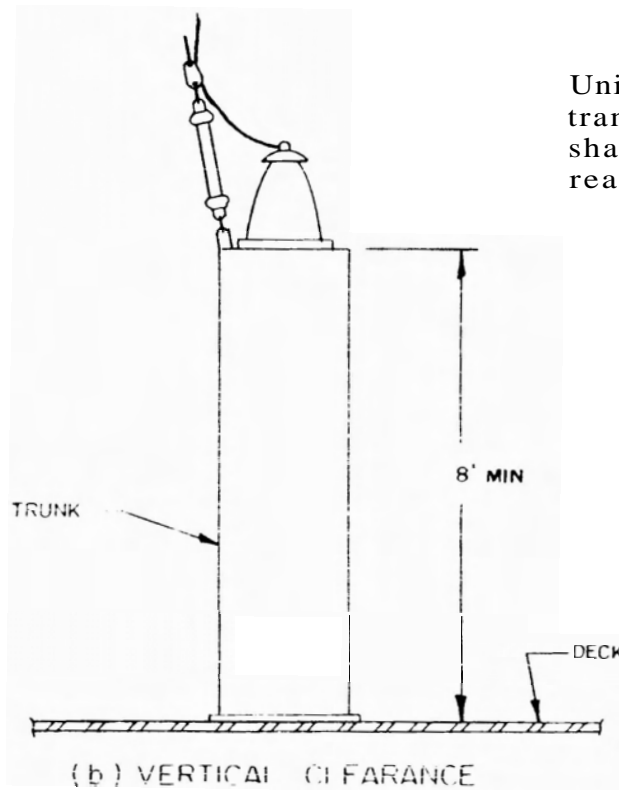
Figure 2-54. Typical Antenna Trunk Installation



(a) HORIZONTAL CLEARANCE

NOTE

Uninsulated portion of transmitting antennas shall be out of normal reach of personnel.



(b) VERTICAL CLEARANCE

Figure 2-5.i. Clearances For Antenna Trunks

TABLE 2-8. TYPICAL SHIPBOARD RADIO TRANSMITTING ANTENNA SYSTEMS

Transmitting Equipment (Model)	Antenna Bus (OD)	Standoff Insulators		Trunk Size (Inches)	Disconnect Device	Bulkhead & Deck Insul. (Inside)	Envelope Insulator (Outer Side)	Antenna Wire (OD)	Strain Insulators (Type)
		Type	Approx. Spacing						
TAD	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TAJ	3/8"	61339	48"	9 x 11	24270	61019C	61475	7/16"	61493
TAQ	3/4"	61338	60"	18 x 20	RE66F 312	61475	61475	7/16"	61493
TBA	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TBK	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TBL	3/8"	61339	48"	9 x 11	24270	61019C	61475	5/16"	61493
TBM	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TBN	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TBU	3/4"	61338	60"	18 x 20	RE 66F 312	61475	61475	7/16"	61493
TCE	3/8"	61175A	48"	6 x 8	24206	61019C	61475	5/16"	61481
TCH	3/8"	61175A	48"	6 x 8	24206	61471	61019C	5/16"	61481
TCJ	3/8"	61339	48"	9 x 11	24270	61019C	61475	7/16"	61493
TCK	3/8"	61339	36"	9 x 11	24270	61019C	61475	5/16"	61493
TCO	3/8"	61175A	48"	6 x 8	24206	61471	61471	7-#18	61481
TCP	3/8"	61175A	48"	6 x 8	24206	61471	61019C	7-#18	61481
TCQ	3/8"	61175A	48"	6 x 8	24206	61471	61471	7-#18	61481
TCS	3/8"	61175A	48"	6 x 8	24206	61471	61471	7-#18	61481
TCU	3/8"	61175A	48"	6 x 8	24206	61019C	61019C	5/16"	61481
TCX	3/8"	61175A	48"	6 x 8	24206	61471	61471	7-#18	61481
TCZ	3/8"	61175A	48"	6 x 8	24206	61019C	61019C	5/16"	61481
TDA	3/8"	61339	48"	9 x 11	24270	61019C	61019C	7/16"	61493
TDB	3/8"	61339	36"	9 x 11	24270	61019C	61019C	5/16"	61493
TDE	3/8"	61175A	48"	6 x 8	24206	61019C	61019C	5/16"	61481
TDJ	3/8"	61339	36"	9 x 11	24270	61019C	61019C	5/16"	61493

be free of kinks, dents, rough spots or other deformations. If it is necessary to join sections of the inner conductor to form a continuous length, a copper sleeve shall be fitted over the ends of the inner conductor and soldered.

e. **INSULATORS.** - The types of insulators used with the various size trunks are shown in Table 2-8. Descriptions and drawings of these insulators are given in Section 2-7 of this chapter.

Stand-off insulators shall be mounted on soft rubber pads, 1/4 inch thick and of the same outer dimensions as the insulator base.

A bulkhead insulator shall be used to support the inner conductor whenever the trunk passes through a watertight bulkhead or deck.

An entrance insulator shall be used to terminate the antenna end of the trunk.

These insulators shall be mounted with bolts, studs or screws; brazing or welding is not acceptable.

f. **INSTALLATION**

(1) Antenna trunks shall be continuous both mechanically and electrically from the transmitter to the antenna end of the trunk.

(2) They shall be as short and as free from bends as practicable.

(3) The inside corner of all trunk bends shall have a minimum radius of 3 inches.

(4) Access doors or removable sections shall be provided to permit inspection and maintenance of all stand-off and bulkhead insulators enclosed in the trunk.

(5) Each seam, with the exception of bolted access covers, and joints in which continuity of shielding or electrical conductivity must be maintained shall be welded.

(6) The inside of the trunk shall be free of , , , water or oxidation. All plane surfaces shall be smooth; screws, bolts, burrs or sharp edges shall not protrude from the inside surfaces of trunks. All joints shall be free

of rough or jagged edges or slag resulting from welding.

(7) The inside and outside of the trunk shall be treated with a zinc chromate primer; the outside is to be painted as required. Galvanizing of antenna trunk is not permissible.

(8) Paint, varnish, shellac, grease or any other form of coating shall not be applied to the inner conductor, to any metallic portion of any insulator in contact with the inner conductor, nor to any portion of ceramic or phenolic insulating materials forming a part of the antenna system.

(9) The transmitter end of the trunk shall be bonded to the transmitter by at least two straps in accordance with BuShips drawing RE 66D 2071. The straps shall be sheet copper or brass not less than 0.02 inch thick by 1/2 inch wide. The straps shall be as short as possible with only enough loop allowed to permit satisfactory deflection of transmitter cabinet.

4. **THREE-INCH COAXIAL LINE (RG-162/U)**

In recognition of the problems of shipyards in making "coaxial installations" from rectangular trunks, a program has been initiated for improving and simplifying transmitting antenna installations aboard ship. As a start, a special 3-inch broadband coaxial transmission line has been developed. It has been given the designation RG-162/U. This line is discussed more fully in another chapter of this manual (Chapter 3, "Antenna Multicouplers").

This line is supplied in 10-foot and 20-foot straight sections with couplings for joining sections of the line. Connectors are also supplied for joining the inner conductors of the line and for aligning the sections of the lines.

Since this is a rigid line, 45-degree and 90-degree bends are available to allow flexibility in installation. An end seal is used to provide a pressure-tight fitting at the end of the transmission line as well as a means for attaching the antenna lead-in.

During handling and assembly of this line the outer conductor must not be dented or bent in any manner. Also the interior of the line must be kept clean of any foreign material such as flux, chips, dust, etc. It is recommended that the line be supported every 5 feet when long lengths are installed.

Some of the characteristics of the RG-162/U coaxial transmission line

are given below:

Characteristic	
Impedance	175 ohms
Outside Diameter	3.125 inches
Wall Thickness	0.049 inches
Inner Conductor	
Diameter	0.156 inches,
Spacing Teflon	
Spacers	18 inches
Frequency Range	upto 2200 mc

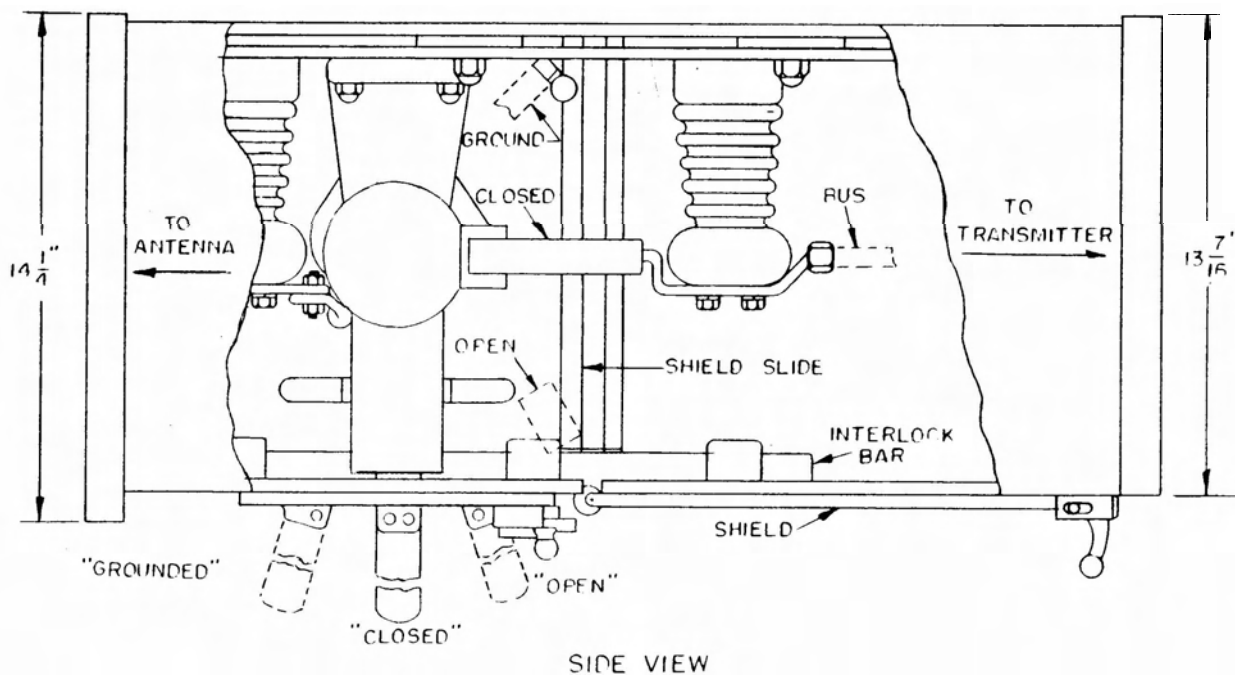
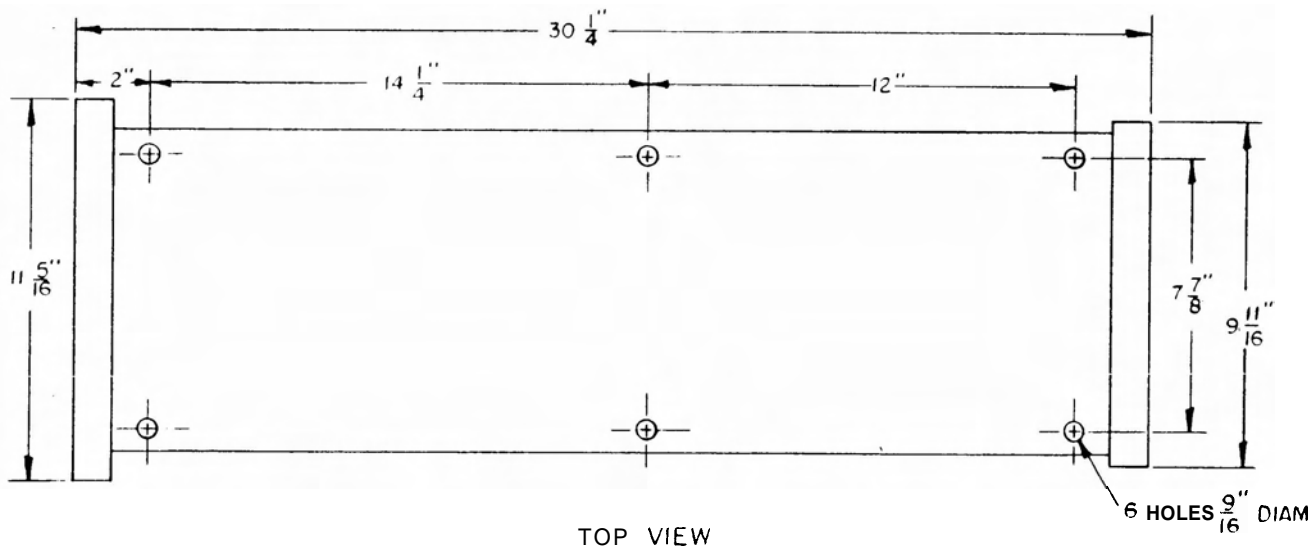


Figure 2-56. Navy Type 24270 Antenna Switch

5. ANTENNA DISCONNECT SWITCHES

a. GENERAL. - Antenna disconnect switches are used in shipboard installations to disconnect the antenna from the radiotransmitter. The switch is usually a large knife switch installed overhead adjacent to the transmitter. A disconnect switch serves two purposes: it grounds the antenna as well as breaking the circuit between the transmitter and antenna.

b. TYPES. - Antenna switches shall be of the type specified or fabricated in accordance with the BuShips type plan. The types of switches most commonly used in shipboard installations are as follows:

(1) NAVY TYPE-24270 ANTENNA DISCONNECT SWITCH (Figure 2-56). - This disconnect switch is essentially a section of 9" x 11" transmitting antenna trunk containing a single-pole, three-position knife switch. The three positions are marked on the cover: "GROUND", "CLOSED" and "OPEN". This switch has a shield, or blanking-off plate, which is inserted into the trunk section of the switch between the switch mechanism and the bus leading to the transmitter. An interlock prevents the shield from being inserted into the slide except when the switch is in the grounded position. After the shield has been inserted into the slide, it locks the operating handle in the grounded position. This prevents closing the switch again before the shield has been removed. The trunk section of the switch is fabricated of copper-clad steel (cladding 0.008" thick, inside only).

- (a) Capacity: 200 amperes at 15000 volts.
- (b) Standard Navy Stock Number: 17-S-534-8777.
- (c) ESOS Stock Number: N16-S-12100
- (d) Reference Drawing: RE 24J 161A

(2) NAVY TYPE-24206 ANTENNA DISCONNECT SWITCH (Figure 2-57). - It is a single-pole, double-throw knife

switch. It has two positions: "CLOSED" and "GROUNDED". The switch contains two NT-61175A Insulators as supports. It has two compression type terminals for clamping on a 3/8" OD copper antenna bus.

- (a) Capacity: 200 amperes at 7500 volts.
- (b) Standard Navy Stock Number: 17-S-53636-1073,
- (c) ESOS Stock Number: N16-S-12075
- (d) Reference Drawing: RE 24F 146

(3) NAVY TYPE-24223 ANTENNA DISCONNECT SWITCH (Figure 2-58). - This switch is a single-pole, double-throw knife switch with a "CLOSED" and a "GROUNDED" position. It has a bus bar clamp type terminal on either end for connecting to a 3/8" OD antenna bus. The switch is supported by two NT-61174B Insulators.

- (a) Capacity: 100 amperes at 2500 volts.
- (b) Standard Navy Stock Number: 17-S-53632-2513.
- (c) ESOS Stock Number: N16-S-12060
- (d) Reference Drawing: RE 24F 147

c. INSTALLATION. - It is suggested that when any bar type antenna disconnect switch (drawing RE 66F 311) presently installed in many 9" x 11" antenna trunks is in need of repair, that it be replaced by the installation of a Navy Type 24270 antenna disconnect switch as an alteration equivalent to repair.

NOTE

This does not imply that all such switches must be replaced; the cost involved in such a procedure must be considered. It is not necessary to replace switches that are in good working order unless specifically directed to do so by the bureau.

SECTION 2-6

UHF ANTENNA INSTALLATIONS

1. GENERAL

With the increasing use of ultra-high frequency radio equipment in Naval vessels, the antenna location problem has become very difficult. Experience has shown that extreme care must be taken in selecting UHF antenna locations. Of great importance is the fact that the antenna must be "in the clear". This is because mast structures, stanchions, other antennas, railings, stacks, and other metallic structures affect the antenna pattern.

In shipboard installations, it is very desirable to cover 360 degrees in azimuth with both transmitting and receiving antennas. If this can be accomplished, transmitted signals will be received with the same strength at a given distance regardless of the respective headings of the ships. It is also very important to obtain sufficient signal strength at the receiving antenna. Sufficient signal strength is dependent upon the amount of noise present on the frequency of the received signal and upon the signal-to-noise ratio.

In order to obtain what approaches full coverage in azimuth and also give usable signals at ranges from 15 to 20 miles, the necessity of having UHF antennas as high as possible cannot be over-emphasized.

As a result of having to vie for favorable or the more-favorable positions with beacons and radar equipments, it has become necessary in some instances to accept compromise locations for the UHF antennas. However, at least one of the UHF antennas should be mounted in a high, clear position. Physical limitations and electronic requirements prevent installing all the UHF antennas in a similar position. The UHF multi-

couplers should help to alleviate this condition. With multicouplers, it is possible to operate several equipments simultaneously into the same antenna.

2. INSTALLATION

a. TYPES OF ANTENNAS. - Many UHF failures can be traced to the antenna. If the antenna is full of water or if its insulator is painted, it will not work. It is important that the antenna be installed vertically, as all Navy UHF communication equipments use vertical polarization. Two new UHF antennas, the AT-150/SRC and the AS-390/SRC, have been developed and are available for replacement of the Type 66147 antenna. The AS-390/SRC is designed for mounting on top of a mast, whereas the AT-150/SRC should be mounted at the end of a yardarm or bracket. These new antennas offer a much better impedance match to the transmission line throughout the band, and they also produce a more uniform radiation pattern. It is recommended that these two antennas be used wherever possible for installations or for replacement of Type 66147 antennas.

b. LOCATING THE ANTENNA. - Having a good antenna is not sufficient; it must be installed in a location that permits it to radiate uniformly. Directivity is probably one of the major faults in the UHF system. A general rule for insuring good UHF antenna coverage is to locate the antenna in the clear. This is not too difficult for a single antenna, but unfortunately an installation will usually consist of several antennas.

The mast and objects on the mast such as ladders, brackets and stays cause variations in the antenna pattern. It has been found that little improvement can

be effected by increasing the antenna spacing from the mast after 9 feet separation has been obtained. Best results are obtained when mast extensions are installed to elevate the UHF antennas to a high, clear position. Every ship should be provided with at least one UHF antenna that projects in the clear above the radar on the mast.

The bracket or stub mast used to support the antenna can cause severe pattern distortion. Best patterns are obtained with stub masts when AS-390/SRC antennas are installed atop the masts. When it is necessary to use AT-150/SRC antennas, they should be at least 4 feet from the nearest vertical section of the support mast or mounting bracket (see Figure 2-59). Horizontal members of the support brackets will not interfere with the vertically polarized radiation.

Another consideration in the installation of UHF antennas is the interference caused by spurious radiations from transmitters. Tests have shown that a horizontal spacing of at least 21 feet or a vertical spacing of at least 4 feet should be maintained between receiving and transmitting antennas (see Figure 2-59).

To prevent directivity effects on the patterns of nearby UHF antennas, a spacing of 6 to 8 feet should be maintained between antennas (see Figure 2-59).

It has been found that a VHF antenna installed close to and in the field of a UHF antenna will cause holes in the pattern of the UHF antenna; whereas, another UHF antenna installed in the same location as the VHF antenna will not.

Figures 2-60 and 2-61 indicate the regions surrounding other antennas in which it is not recommended to install UHF antennas. As a rule, the larger the object, the greater is the separation required.

c. TRANSMISSION LINES. — The transmission lines used in UHF installations are 50-ohm solid-dielectric coaxial cables. Since maximum power efficiency is required in UHF communications, it is recommended that RG-18/U be used. This applies to receivers as

well as transmitters. Transmission lines should be checked to insure that no sharp bends or clamp pinches are present. Open and short-circuited tests should be performed frequently to determine the condition of the line. A typical UHF installation is shown in Figure 2-62.

d. INSTALLATION RULES. — The following general rules can be applied to all UHF antenna installations.

(1) Keep vertical UHF antennas at least one wavelength away from any vertical conductors.

(2) If possible, detune any vertical conductors within two wavelengths of the antenna.

(3) Mount antennas as far out from supporting structures as practicable. Wider antenna-supporting structures and associated gear require a greater outrigger distance between the antenna and mast than narrow supporting structures, for the same distortion in the resulting antenna pattern.

(4) Keep all conductors as close to the supporting structure as possible, to reduce the shadow angle through the structure.

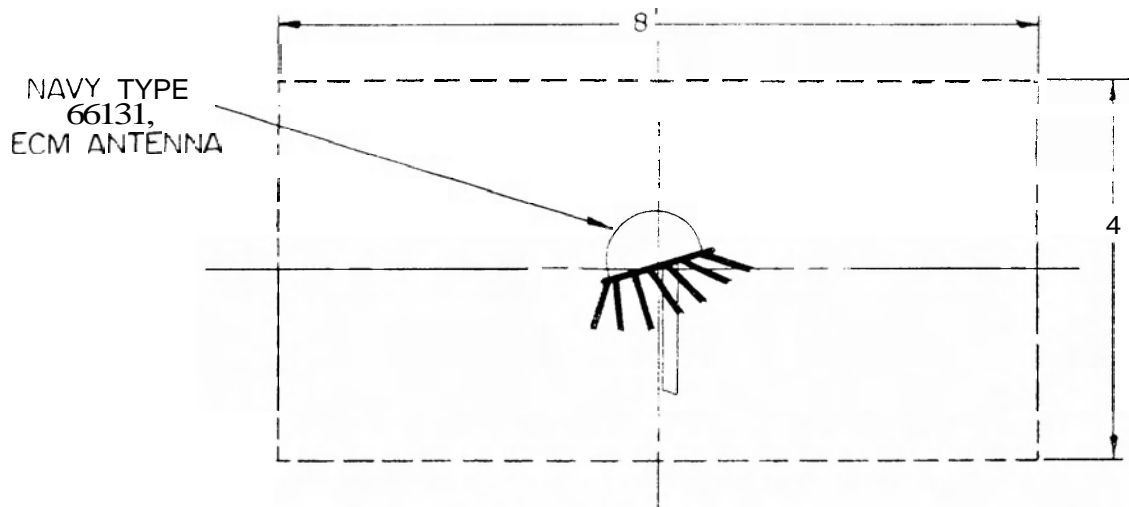
(5) Make the supporting structure electrically narrow by breaking up with insulators all closed loops, especially those smaller than one wavelength.

(6) Pay attention to angles moderately above the horizon from the antenna, if aircraft communication is involved.

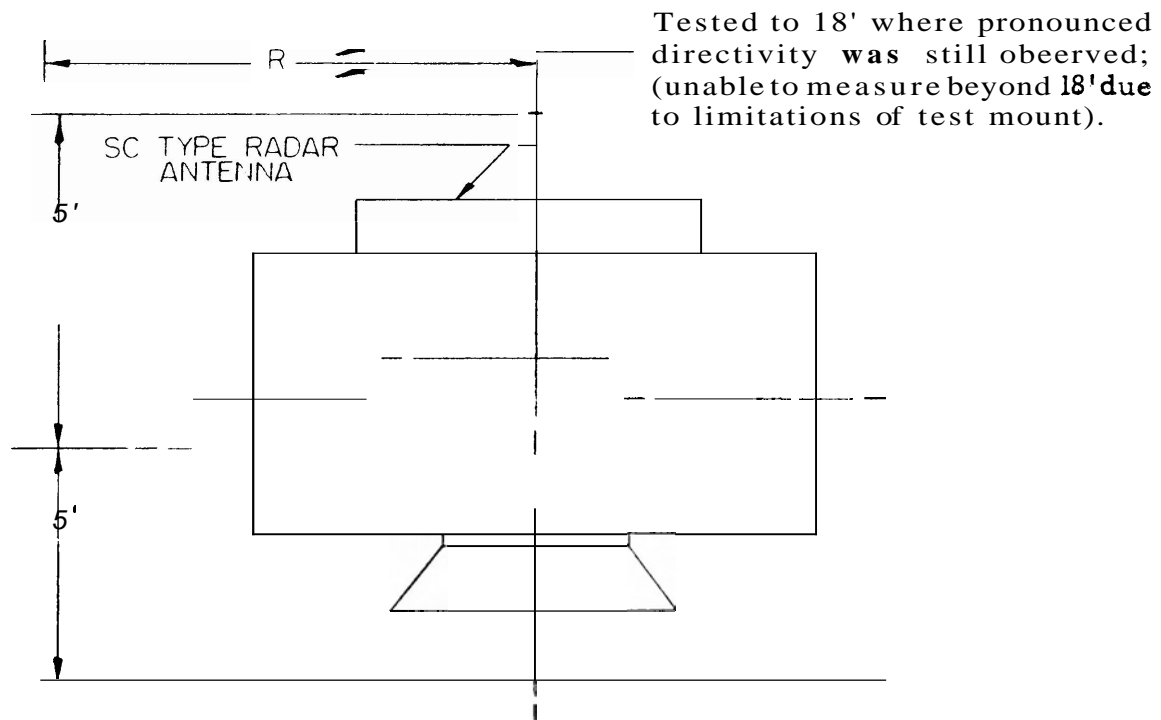
(7) Check the resulting antenna patterns, preferably at several frequencies within the range of the equipment. Do this both for surface and for elevated targets if the equipment may be used for communication with aircraft.

(8) It is desirable when planning a UHF antenna system to install at least one AS-390/SRC antenna atop a staff or mast. This antenna can usually be completely "in the clear". Type AT-1501 SRC antennas are designed for mounting at the end of a horizontal support such as a yardarm or bracket. The brackets, arms, mast extensions, etc. that the UHF antennas are mounted on should be hinged or pinned so that the antennas are accessible for servicing.



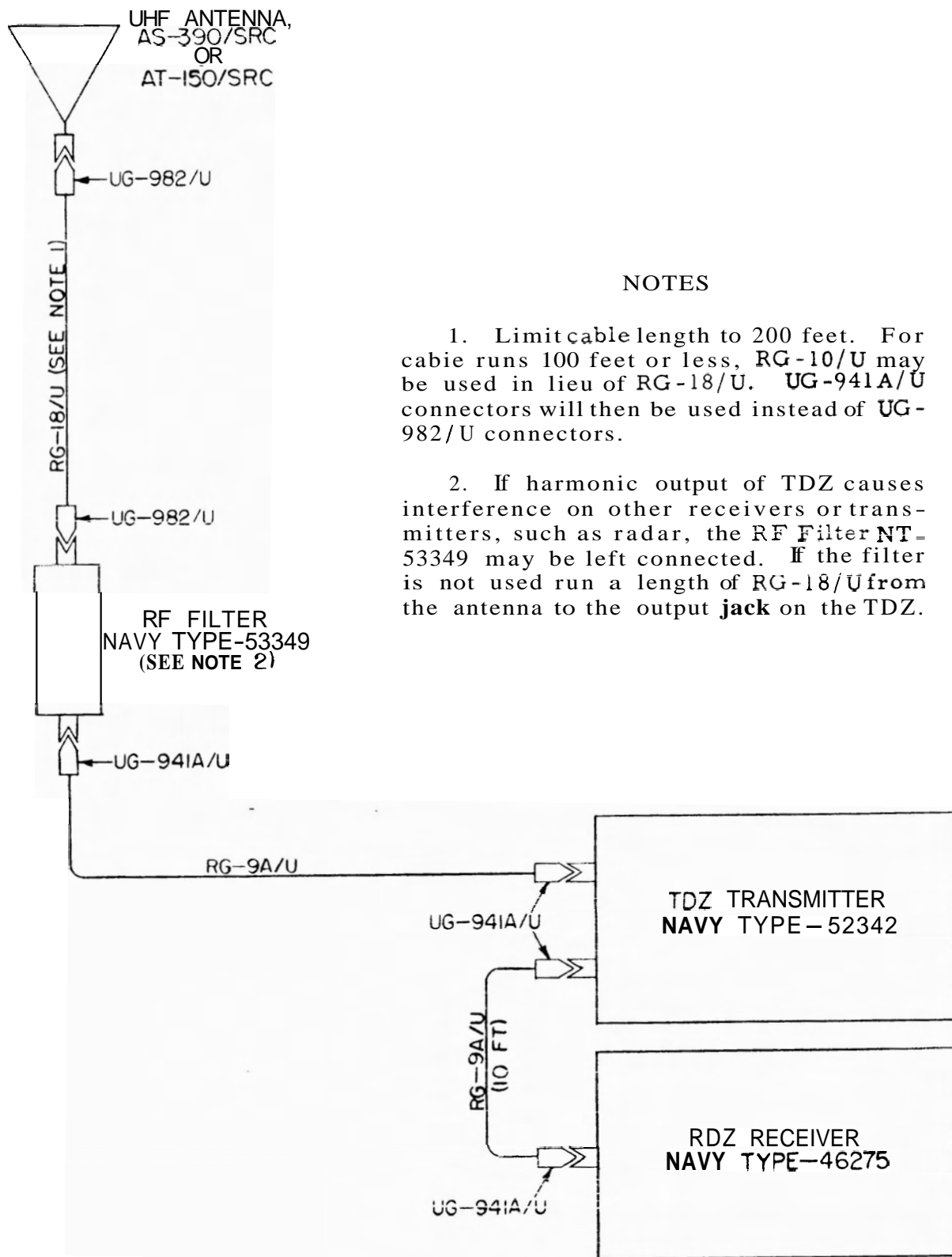


Region surrounding Type 66131 Antenna within which installation of UHF antennas is not recommended.



Region surrounding SC type radar antenna within which installation of UHF antennas is not recommended.

Figure 2-61. Recommended Clearances Around Radar and ECM Antennas



NOTES

1. Limit cable length to 200 feet. For cable runs 100 feet or less, RG-10/U may be used in lieu of RG-18/U. UG-941A/U connectors will then be used instead of UG-982/U connectors.
2. If harmonic output of TDZ causes interference on other receivers or transmitters, such as radar, the RF Filter NT-53349 may be left connected. If the filter is not used run a length of RG-18/U from the antenna to the output jack on the TDZ.

Figure 2-62. Typical UHF Installation

5

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7

INDEX

Subject	Figure or Table No.	Page
A		
Antenna clamps.....	2-8
Antenna clamps for 5/16" (6x19) wire rope.....	2-18	2-10
Antenna clamps for 7-#18 antenna wire.....	2-17	2-9
Antenna disconnect switches.....	.....	2-63
General.....	.....	2-63
Types.....	.....	2-63
Installation.....	.....	2-63
Antenna entrance assemblies.....	2-47	2-44
Antenna insulators, types of.....	.....	2-72
Strain insulator.....	.....	2-72
Standoff insulator.....	.....	2-73
Entrance insulator.....	.....	2-73
Feedthruinsulator.....	.....	2-73
End Seal.....	.....	2-73
Antenna leakage resistance.....	.....	2-94
Antenna maintenance.....	.....	2-93
Antenna rigging photographs.....	.....	2-97
Antenna safety link.....	2-22	2-15
Antenna switch, Navy Type-24206.....	2-57	2-64
Antenna switch, Navy Type-24223.....	2-58	2-65
Antenna switch, Navy Type-24270.....	2-56	2-52
Antenna transfer panel, Navy Type-23406, front view of.....	2-49	2-47
Antenna transfer panel, Navy Type-23406, right side view of.....	2-50	2-48
Antenna transfer panel SB-364/S.....	.....	2-50
Antenna transfer panels.....	.....	2-43
Antenna transfer panels, Table of fittings suppliedwith.....	2-7	2-50
Antenna trunks.....	.....	2-57
Antenna turnbuckles.....	.....	2-8
Antenna wire and fittings, list of.....	2-4	2-29
Antennas, receiving.....	.....	2-39
Antennas, transmitting.....	.....	2-55
Antenna, UHF.....	.....	2-66
Antennas, whip.....	.....	2-31
Antennas, wire.....	.....	2-1
C		
Cable straps.....	.....	2-43
Clamps, antenna.....	.....	2-8
Connectors, wire rope.....	.....	2-2
D		
Disconnect switches, antenna.....	.....	2-63

Subject	Figure or Table No.	Page
E		
End Seals.....	.....	2-73
End Seal, MX-1203/U.....	2-77	2-89
End Seal, MX-1460/U.....	2-78	2-90
End Seal, MX-1461/U.....	2-79	2-91
End Seal, MX-1465/U.....	2-80	2-92
Entrance assemblies, antenna.....	2-47	2-44
Entrance Insulators.....	.....	2-73
Entrance Insulator, NT-61471.....	2-65	2-77
Entrance Insulator, NT-61019C.....	2-66	2-78
Entrance Insulator, NT-61276A.....	2-67	2-79
Entrance Insulator, NT-61475.....	2-68	2-80
Entrance Insulator, NT-61303.....	2-69	2-81
F		
Feedthru Insulators.....	.....	2-73
Feedthru Insulator, NT-61335.....	2-75	2-87
Feedthru Insulator, NT-61350.....	2-74	2-86
Feedthru Insulator, NT-61428.....	2-73	2-85
G		
Ground straps, installation of.....	.....	2-55
I		
Insulators, antenna.....	.....	2-72
General.....	.....	2-72
Types of antenna insulators.....	.....	2-72
Maintenance.....	.....	2-73
Insulator drawings.....	.....	2-74
M		
Maintenance of antenna insulators.....	.....	2-73
Visual inspection.....	.....	2-73
Cleaning insulators.....	.....	2-74
Material for antenna trunks.....	.....	2-57
Preferred material.....	.....	2-57
Substitute material.....	.....	2-57
Marking cables, receiving antenna distribution system.....	.....	2-43
P		
Padeyes.....	.....	2-8
Painting antennas.....	.....	2-94
General.....	.....	2-94

Subject	Figure or Table No.	Page
P		
Painting radar antenna hoods.. .. .	.....	2-95
Photographs - antenna rigging. ....	.....	2-97
Protective devices, receiving antenna. ....	.....	2-43
R		
Receiving antenna distribution systems. ....	.....	2-40
Receiving antenna transfer panels. ....	.....	2-45
Receiving antennas.. .. .	.....	2-39
RG-162/U, three-inch coaxial line.. .. .	.....	2-61
S		
Safetylinks. ....	.....	2-14
Safety precautions.. .. .	.....	2-95
Work on transmitting antennas.. .. .	.....	2-95
Stack gas warning. ....	.....	2-96
Warning signs.. .. .	.....	2-96
Safety precautions for mast workers.. .. .	.....	2-96
Safety precautions - transmitting antennas. ....	.....	2-58
SB-346/S, antenna transfer panel. ....	.....	2-50
Separation of antennas - transmitting antennas. ....	.....	2-55
Shackles. ....	.....	2-8
Stack gas warning.. .. .	.....	2-96
Standoff insulators.. .. .	.....	2-73
Standoff insulators, NT-61174B.	2-70	2-82
Standoff insulators, NT-61175A and -61176A.	2-71	2-83
Standoff insulator, NT-61339.	2-72	2-84
Standoff insulator, NT-61664C.	2-76	2-88
Staples and padeyes.. .. .	.....	2-8
Strain insulators.. .. .	.....	2-72
Strain insulators, NT-61479 and -61481.. .. .	2-63	2-75
Strain insulators, NT-61493 and -61494.. .. .	2-64	2-76
Stuffing tubes, receiving antenna distribution systems.. .. .	.....	2-43
Submarine receiving antenna transfer panel.	2-52	2-52
Switches, antenna disconnect. ....	.....	2-63
T		
Terminal boxes for receiving antenna system.. .. .	2-48	2-45
Three-inch coaxial line (RG-162/U). ....	.....	2-61
Transfer panel SB-346/S, antenna. ....	.....	2-50
Transfer panels, receiving antenna. ....	.....	2-43
Transmission lines, receiving antennas. ....	.....	2-40
Transmission lines, transmitting antennas. ....	.....	2-55
Transmission lines - UHF antennas.. .. .	.....	2-67

Subject	Figure or Table No.	Page
T		
Transmitting antennas - installation of.....	2-55
Separation of antennas.....	2-55
Length of transmission lines.....	2-55
Installation of ground straps.....	2-56
Safety precautions.....	2-56
Trunks, antenna.....	2-57
Turnbuckles, antenna.....	2-8
Turnbuckles for use with 5/16" (6x19) wire rope.....	2-19	2-11
Turnbuckles for use with 7-#18 antenna wire.....	2-20	2-12
U		
UHF antennas- installation.....	2-66
Type of antennas.....	2-66
Locating the antenna.....	2-66
Transmission lines.....	2-66
Installation rules.....	2-67
W		
Warning signs.....	2-96
Whip antennas.....	2-31
Wire antenna details.....	2-14
Wire antennas.....	2-1
Wire rope.....	2-1
Wire rope connectors.....	2-2