# MICROWAVE ANTENNAS

# KS-15676 HORN REFLECTOR AND WAVEGUIDE SYSTEM

# MAINTENANCE

# IN-SERVICE AIR LEAK DETECTION AND CORRECTION

CONTENTS PAGE



## 1. GENERAL

**1.01** This section contains a description of leakage measurement and detection procedures applied to the KS-15676 Horn Reflector and Waveguide System. It establishes a maximum acceptable leakage rate and describes corrective action to be taken if this rate should be exceeded.

**1.02** This section is reissued for the following:

(a) To correct a reference in Fig. 2 and to revise Fig. 3, 4, and 7

(b) To include reference to the KS-21403 dehydrator

(c) To revise the manifold air pressure limits

(d) Minor editorial corrections.

This reissue does not affect the Equipment Test List.

**1.03** Air leakage rates, when kept below rates that will allow moisture or moist air to enter the antenna or the waveguide, will reduce moisture accumulations within the system and will reduce the load on the dehydrator. High-volume leakage in the system could indicate a major mechanical defect which could result in a major service failure.

**1.04** The KS-15676 Horn Reflector Antenna System (Fig. 2 and 5) is maintained under constant air pressure. Dried air is supplied to the system through a manifold. In a normally operating system, manifold air pressure may vary between 5 and ▶9◀ inches of water.

**1.05** Dry air under pressure is supplied to the system by an air dryer. At stations where more than six antennas are installed, air is usually supplied by one or more KS-16001 dehydrators, each of which will deliver up to 400 cubic feet of dried air per hour at a pressure of 6.7 inches of water at the manifold. Smaller numbers of antennas are usually supplied by a KS-16153 or KS-20183 dehydrator or by the newer KS-21403 air dryer. These three machines are rated at 100 cubic feet per hour. Pressure at the manifold is about 9 inches of water for the KS-16153, KS-20183, and KS-21403.

*Note:* The KS-16001, KS-20183, and KS-16153 dehydrators are rated manufacture discontinued (MD). The KS-21403 is the latest model.

**1.06** The flow of air to any antenna is limited by a 0.125-inch diameter orifice in the waveguide pressure window. In certain stations, larger orifices may have been used. If the pressure drop across the orifice is to be measured, the standard 0.125-inch diameter orifice must be used.

**1.07** A careful inspection should be made of new antennas to ensure that they are in good condition. Antennas which have been damaged in transit or in storage, or which are otherwise unsatisfactory, should be the subject of engineering complaints. Any necessary repair work should be adequate and permanent. Form E-6326 gives a detailed checklist for the inspection of a new or older antenna and waveguide systems. Refer to Fig. 1.

E-6326

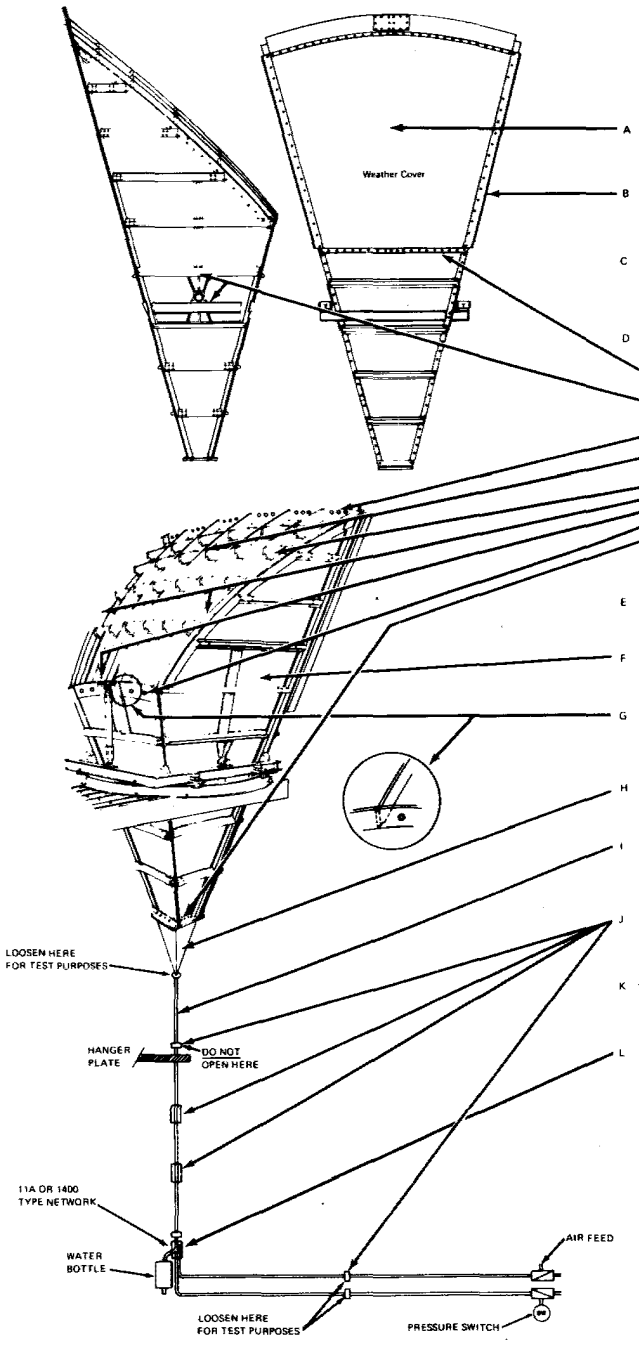
## DETAILED INSPECTION OF ANTENNA AND WAVEGUIDE LEAKAGE

BSP 402—421—506

STATION _____ TRANSMIT TO _____

MAKE _____ OR

SERIAL NUMBER _____ RECEIVE FROM _____




| | | State Conditions |
|---|---|---|
| A | Check weather cover for holes or cracks, indicate location. | |
| B | Indicate location of any old repairs and state condition. | |
| C | Remove all loose hardware that may have been left on or around antenna. | |
| D | Locate air leaks and indicate location on sketches.<br>Common Sources<br>(1) Around bolts securing the weather cover (Top, bottom and sides) (Note 1)<br>(2) Around bulb angle and mounting frame trunnion (Two sides)<br>(3) Around tapped holes for upper weather cover clamping bar<br>(4) Along the top of the center joint on antenna with a two part reflector.<br>(5) Loose rivets and corrosion under ribs.<br>(6) Along inner outside edge of reflector.<br>(7) Along drain trough at bottom of reflector.<br>(8) Around drain bushings.<br>(9) Around rivets at bottom of antenna feed horn. (Four sides) | |
| E | Check condition of caulking for cracks, checks, looseness, peeling and resilience. | |
| F | Check outer antenna shell for foreign matter, holes, signs of damage, and corrosion. (Two sides) | |
| G | Check water drain holes and remove any debris that may cause an obstruction | |
| H | Inspect feed horn for cracks, holes and loose bolts. (Four sides) | |
| I | Check circular flex waveguide for proper installation, dents, cracks, and deterioration of neoprene jacket. (NOTE 2) | |
| J | Make visual inspection of all waveguide bolts to see if any are missing or broken | |
| K | Check all circular and rigid waveguide for dents or other signs of damage | |
| L | Check networks and water traps to see that all hardware is secure | |

NOTE 1: If weather cover leaks around bolts or weather cover seal the antenna face bolts shall be tightened to 60 foot pounds starting with center bottom bolts and working each direction to the center top bolts.

NOTE 2: Look for separation of the neoprene jacket from the waveguide flange and cracks in the flange as an indication of defective waveguide. Feel all flex waveguide for dents.

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**Fig. 1—Detailed Inspection of Antenna and Waveguide System**

## 2. SAFETY PRECAUTIONS

**2.01** In most cases, certain work operations mentioned in this practice may be carried out by companies specializing in tower maintenance. A telephone company representative should be present to ensure satisfactory performance and to make necessary pressure and airflow measurements. In general, the precautions set forth here are directed toward the protection of telephone company personnel.

**2.02** While workmen are aloft on the towers, protective hats shall be worn by all ground personnel who are within a radius equal to 1/3 the tower height. Every effort should be made to avoid exposing ground personnel to the hazards of being struck by falling objects. Tools or items of material accidentally dropped from towers can inflict serious injury.

**2.03** Personnel not involved in work operations should remain at a safe distance (about 1/3 the height of the highest operation or more) when operations are being conducted aloft. Similarly, motor vehicles should be kept at a safe distance from the tower to avoid their being damaged by falling objects. Personnel working aloft should be instructed to exercise care to prevent tools or materials from falling and to avoid touching aircraft obstruction lighting fixtures. These fixtures will be quite hot when illuminated.

**2.04** It should be remembered that climbing towers is strenuous exertion. In order to avoid overexertion, personnel should not climb more than 25 feet without resting. The tower body belt and safety strap shall be worn when the tower is equipped with a tower ladder safety device. Standard body belts and safety straps shall be worn when the tower body belt and safety strap cannot be used while working aloft. Ice-coated towers shall not be climbed.

**2.05** When inspecting the antenna, avoid blocking the horn aperture (weather cover) when the system is operating. If the input power to the horn exceeds 150 watts, microwave radiation protective clothing must be worn while working in front of the horn aperture. If the input level to the horn is less than 150 watts, refer to Section 010-150-001 to determine whether a microwave radiation protective garment is required.

## 3. MEASUREMENT OF AIR-LEAKAGE RATES

**3.01** Measurements should be taken under stable weather conditions. For example, variations in system air pressure (and consequently in leakage rate) may occur when the sun emerges from, or goes behind, clouds. In some cases, it may be necessary to make leakage measurements over a period of several days before definite conclusions can be reached. A stabilizing period of approximately one hour should be observed before valid pressure or leakage indications can be expected.

**3.02** Leakage measurements may be made by either of two methods, depending on available equipment. Charts 1 and 2 outline these methods.

### CHART 1

### LEAKAGE MEASUREMENTS USING GAS METER

**APPARATUS:**

1—Rockwell No. 150 LPG Gas Meter (10-psi working pressure) with direct reading index in cubic feet and 1/2-inch NPT side connections

| STEP | PROCEDURE |
|---|---|
| 1 | If waveguide water traps are used, use tape to securely close the drain hole in the water trap. If vents are used in the pressure windows, these must also be taped. |

**CHART 1 (Cont)**

| STEP | PROCEDURE |
|---|---|
| 2 | Insert a Rockwell No. 150 LPG gas meter directly in the line at C between the manifold and the waveguide system to be measured. (See Fig. 2.) |
| 3 | Leakage in cubic feet will be indicated on the meter. |

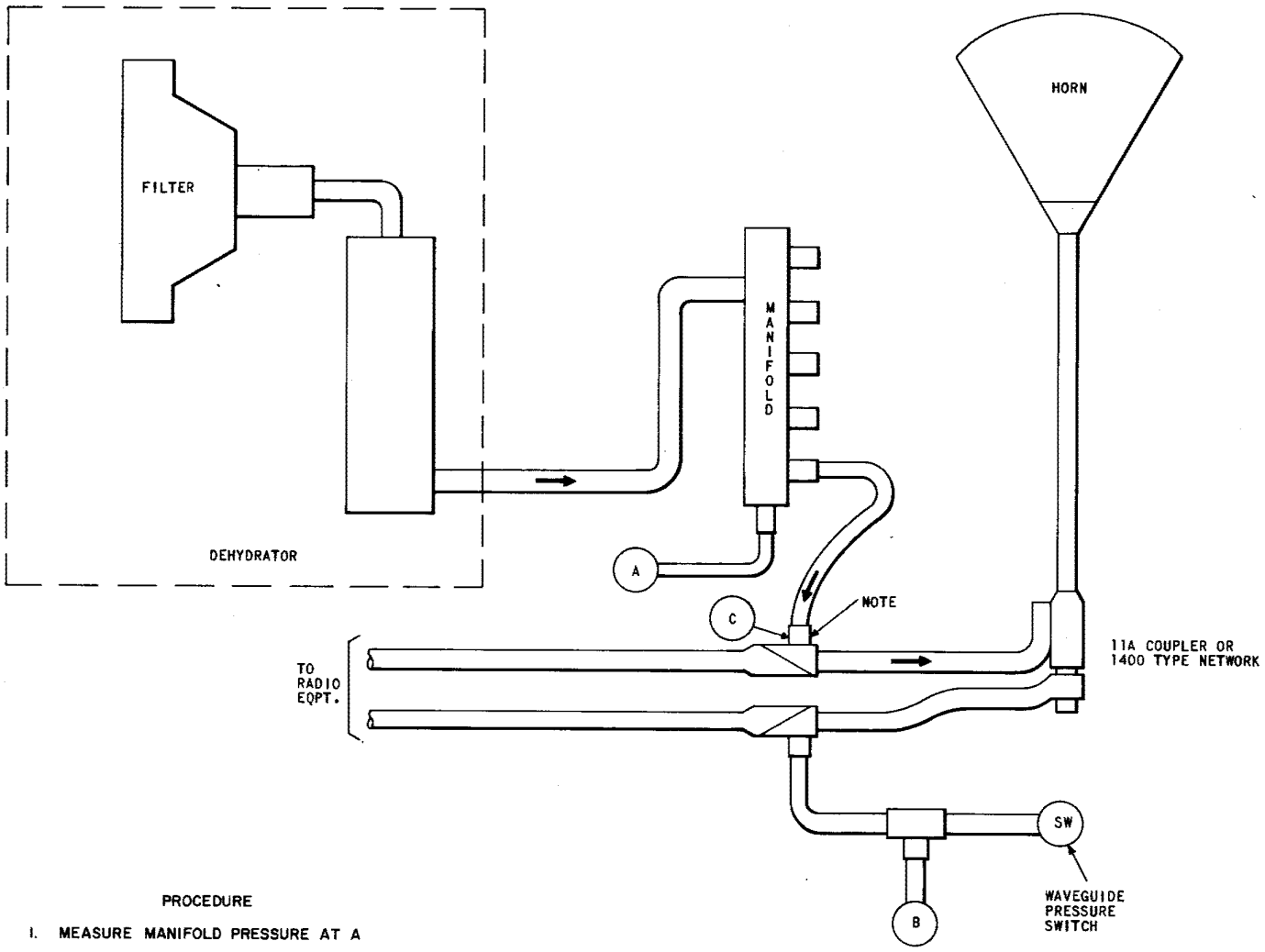


**Fig. 2—Air Pressure Measurement Setup**

**CHART 1 (Cont)**

| STEP | PROCEDURE |
|---|---|
| 4 | Divide the leakage by the number of hours to obtain the hourly rate.<br><br>***Requirement:*** A leakage rate of no more than 22 cubic feet per hour<br><br>***Note:*** TD-3 and TH-3 radio installations require that dry air from the station supply be fed through the indoor waveguides into the microwave transmitter-receiver bays. This air feed is introduced from the manifold to a special pressure flange ◗(ED-50455-50)◖ located beside the pressure window. The orifice used in this pressure flange is 0.028 inch in diameter to limit the air-flow if a waveguide run is opened for test purposes. A line of six bays (six transmitters and six receivers) connected to a pair of waveguide runs will ◗leak◖ approximately 4.8 cubic feet of air per hour. When measuring antenna leakage rates, do not include this indoor air feed. ◗On new installations, 10B, 11B, or 12B pressure windows have built-in provisions for applying dry air to indoor waveguides, thus the special flange is not required.◖ |
| 5 | Remove the tape seal from the waveguide water trap after the test is complete. |

**CHART 2**

**LEAKAGE MEASUREMENTS USING PRESSURE GAUGE**

Before using this method, check to see that the pressure window has the standard 0.125-inch diameter orifice. (In a few cases, larger-diameter orifices have been used.) ***This method cannot be used unless the pressure window has the standard orifice.***

**APPARATUS:**

1—Pressure Gauge, U.S. Gauge Co., Model No. 6336

| STEP | PROCEDURE |
|---|---|
| 1 | Seal the drain hole in the waveguide water trap, if present, with tape to prevent air leakage at this point. |
| 2 | Connect the Model No. 6336 gauge to the air distribution manifold such as at point A. (Refer to Fig. 2.) Note the gauge indication. |
| 3 | Remove the gauge from the manifold and connect it to the air valve at the end of the common air supply pipe as close to the orifice as possible (Point B, Fig. 2). The gauge |

**CHART 2 (Cont)**

| STEP | PROCEDURE |
|---|---|
| | may be connected in place of the waveguide pressure switch if a T connector has not been provided. Note the gauge indication. |
| 4 | Subtract the gauge indication noted in Step 3 from that noted in Step 2. The difference in readings indicates the pressure drop in inches of water across the 1/8-inch orifice at Point C.<br><br>***Requirement:*** A pressure drop below the line in Fig. 3 for the measured manifold pressure |
| 5 | Remove the tape seal from the waveguide water trap after the test is completed. |

## 4. LOCATING AIR LEAKS

**4.01** The following tools and materials are needed to detect air leaks and to perform maintenance procedures on the antenna and waveguide system:

1 Can—E Pressure Testing Solution

1—Torque wrench, 0 to 150-pound-feet capacity with 1/2-inch square drive

2—Ratchet wrenches with 1/2-inch square drive

1—1-1/16 inch socket with 1/2-inch square drive

2—9/16-inch sockets with 1/2-inch square drive

2—3/4-inch sockets with 1/2-inch square drive

1—Adjustable open-end wrench with a 3-inch capacity

2—1-7/16 inch open-end wrenches

2—1-1/16 inch open-end wrenches

2—9/16-inch open-end wrenches

2—3/4-inch open-end wrenches.

**4.02** The recommended method of detecting air leakage is by spraying the suspected area with solution and observing the area for the formation of bubbles.

**4.03** Water traps are frequent sources of leakage. They should be inspected before testing other portions of the system.

> ***Note:*** The drain hole in the water trap should be securely taped before making any tests, since the leakage rate from this source is between 5 and 6 cubic feet of air per hour. ***Remove the tape after all tests and repairs have been completed.***

**4.04** It is advisable to isolate air leakage either to the antenna or to the waveguide portion of the system. The flow of air to the antenna may be shut off by inserting an air blocking tool at the first waveguide flange below the antenna. Specifications for construction of an air blocking tool are outlined in Fig. 4. Instructions for the use of the air blocking tool will be found in Fig. 5.

> ***Caution: Air blocking tools should not be used at waveguide flanges where there is a restrainer or at the waveguide hanger plate.***

**4.05** If the leakage rate remains nearly the same after inserting the air blocking tool that isolates the antenna from the remainder of the system, the leakage is in the waveguide portion. Look for loose, broken, or missing bolts at the

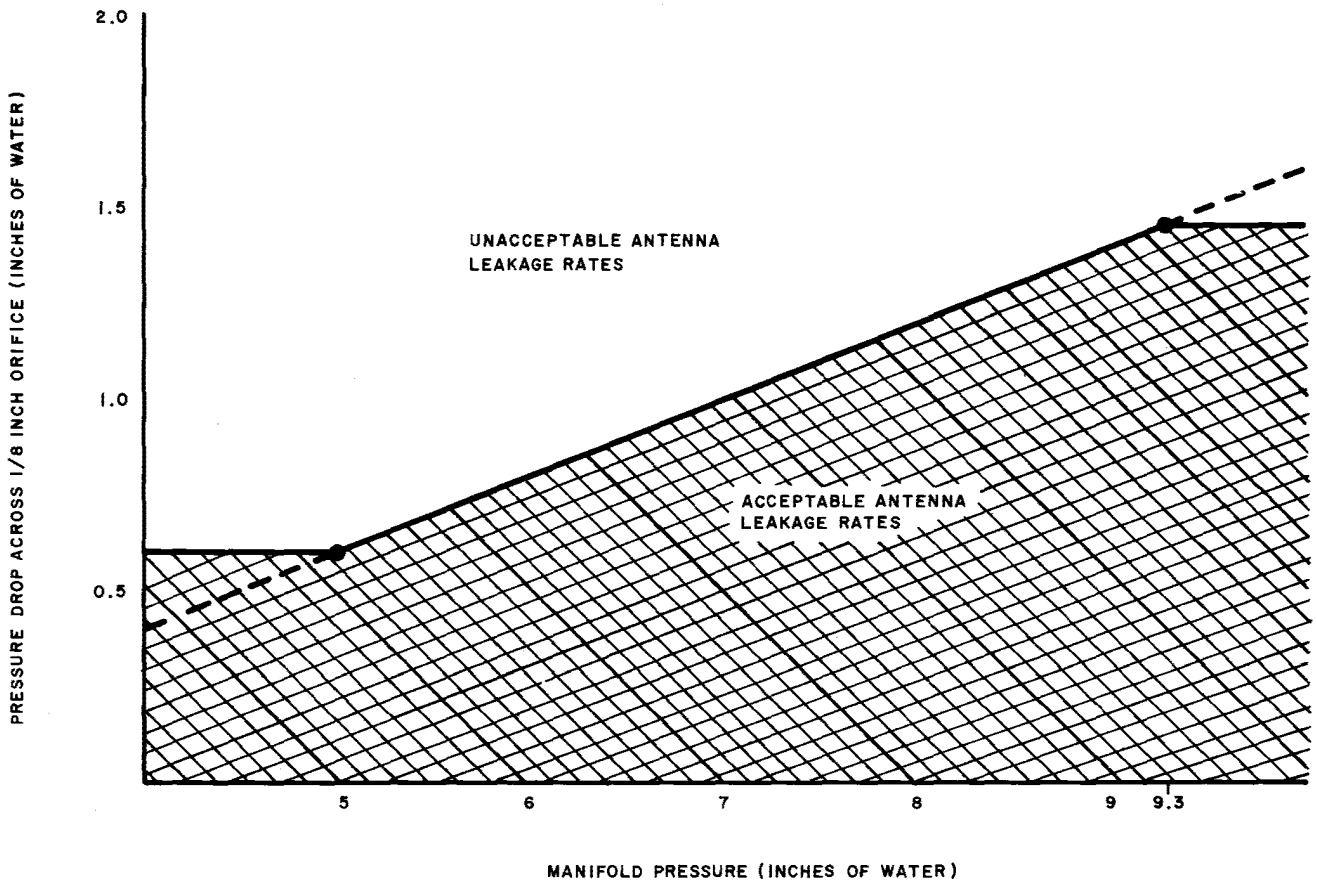


**Fig. 3—Air Leakage Chart**

flanges. Tighten or replace flange bolts as required. Refer to Fig. 1 for additional information on inspecting the remainder of the system.

***Caution: Circular waveguide bolts should be tightened only to a torque of 13.3 foot-pounds.***

**4.06** If the leakage rate is drastically reduced by inserting the air blocking tool, leakage is indicated in the antenna. Remove the air blocking tool and make a visual inspection of the antenna. (Refer to Fig. 1.) Figures 6 and 7 indicate areas in which leaks are commonly encountered. Use the testing solution to detect specific leaks and apply appropriate corrective procedures. See Section 402-421-201 for torque values to be used in tightening bolts.

**4.07** Under some conditions, a Halide gas detector may be used to locate air leaks. However, its sensitivity to various materials found in the vicinity of a radio station often limits its usefulness for this purpose and, hence, its use is not recommended.

**4.08** Ultrasonic leak detectors may prove useful in isolated cases. However, because of the low pressure used in the antenna system, it will experience limited success. Its use is not recommended.

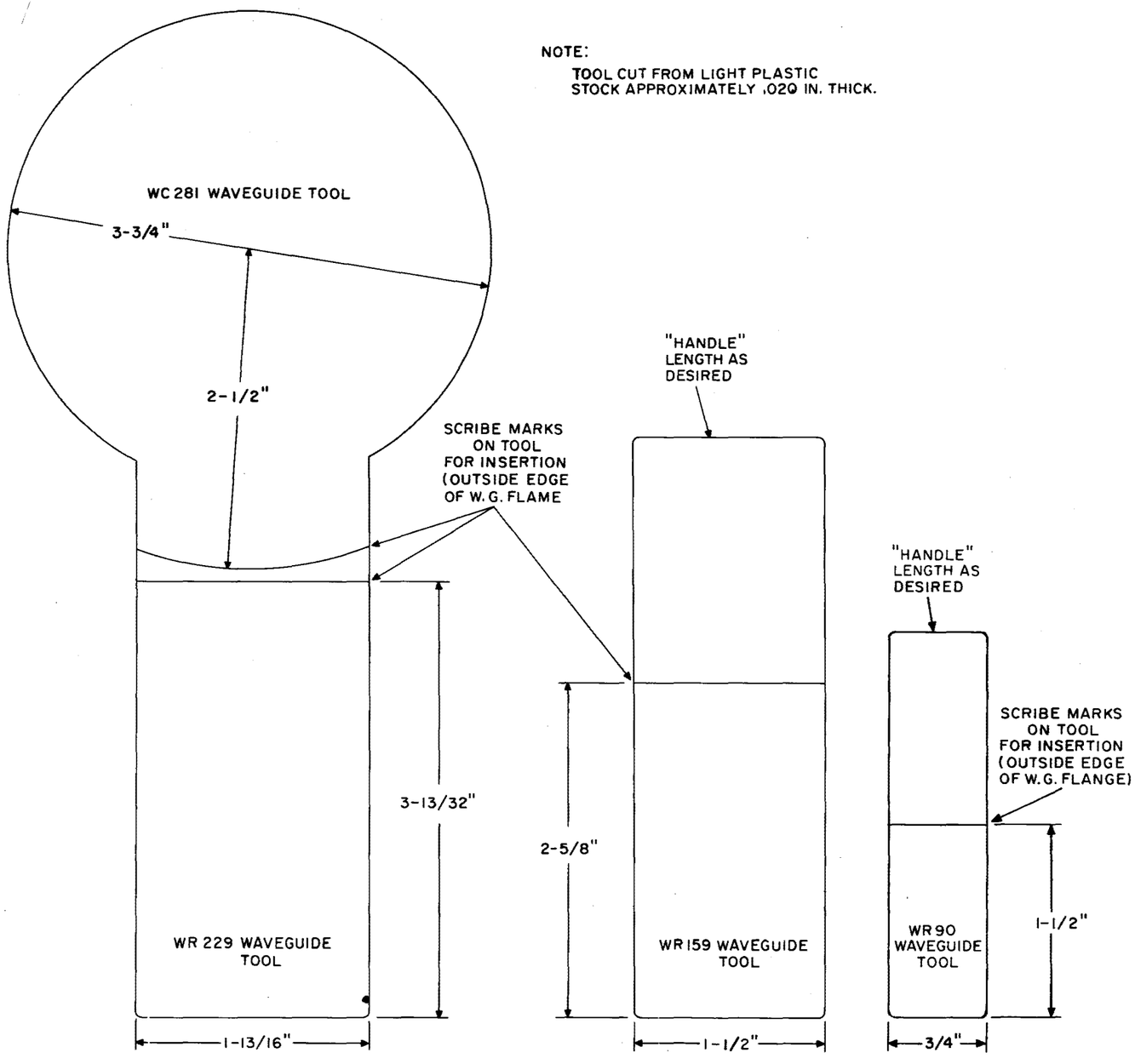


**Fig. 4—Template for Air Blocking Tool**

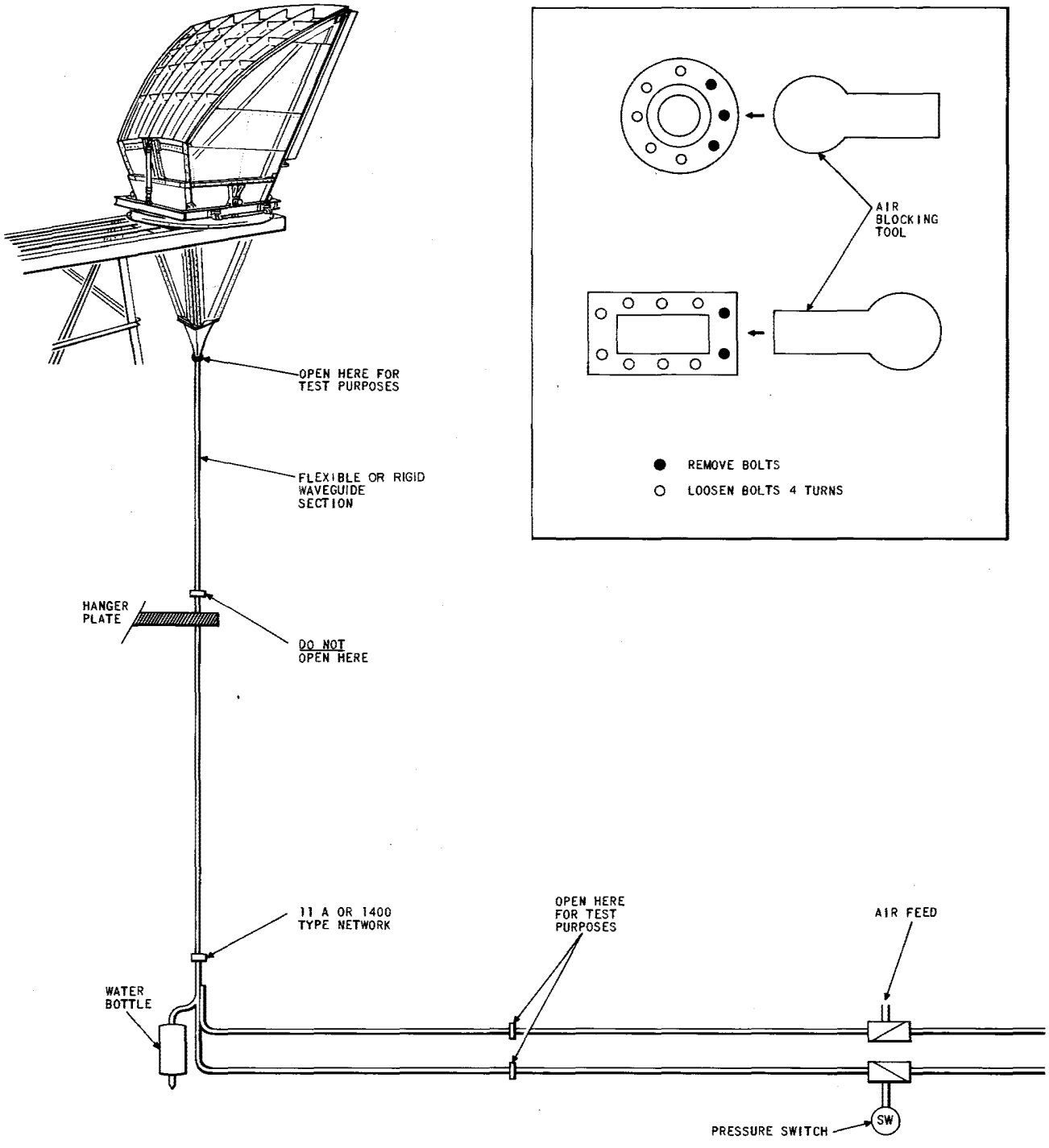


**Fig. 5—Use of Air Blocking Tool**

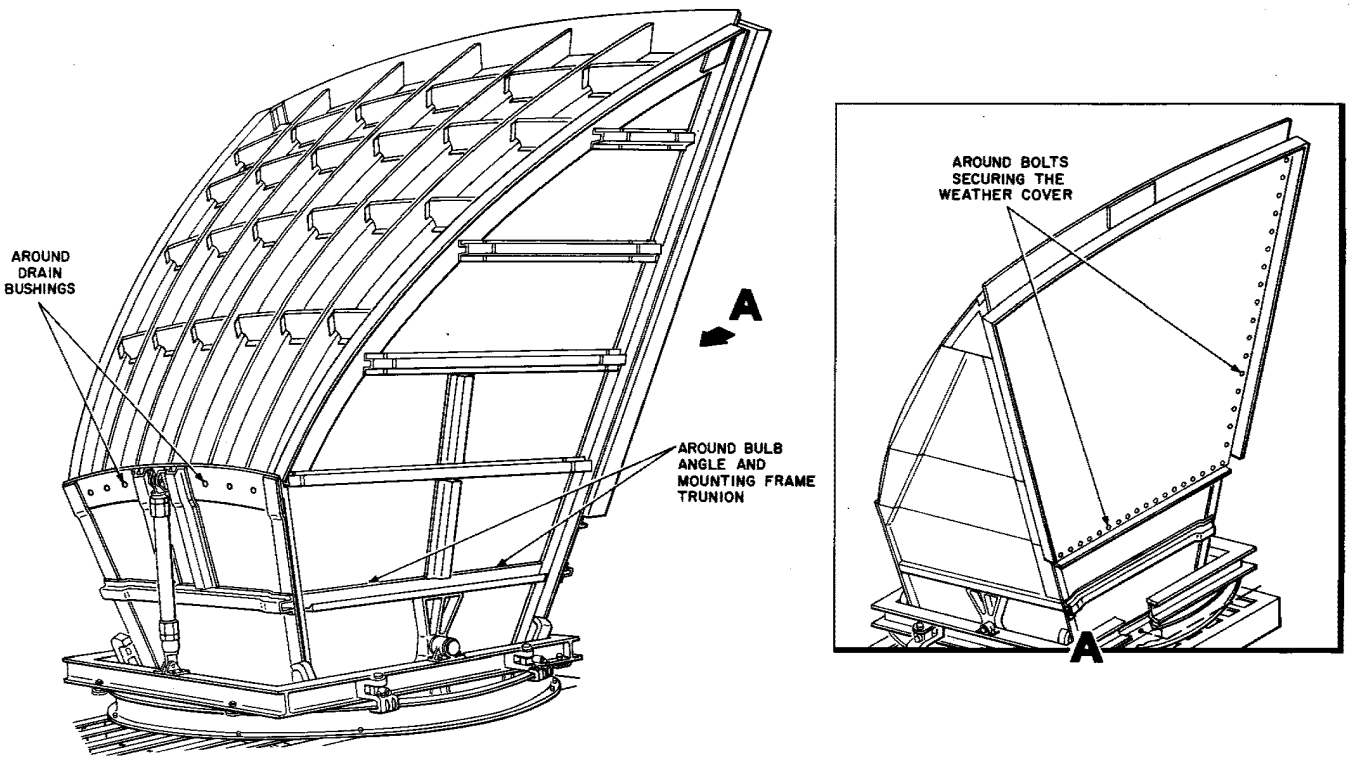


**Fig. 6—Common Source of Seal Leakage**

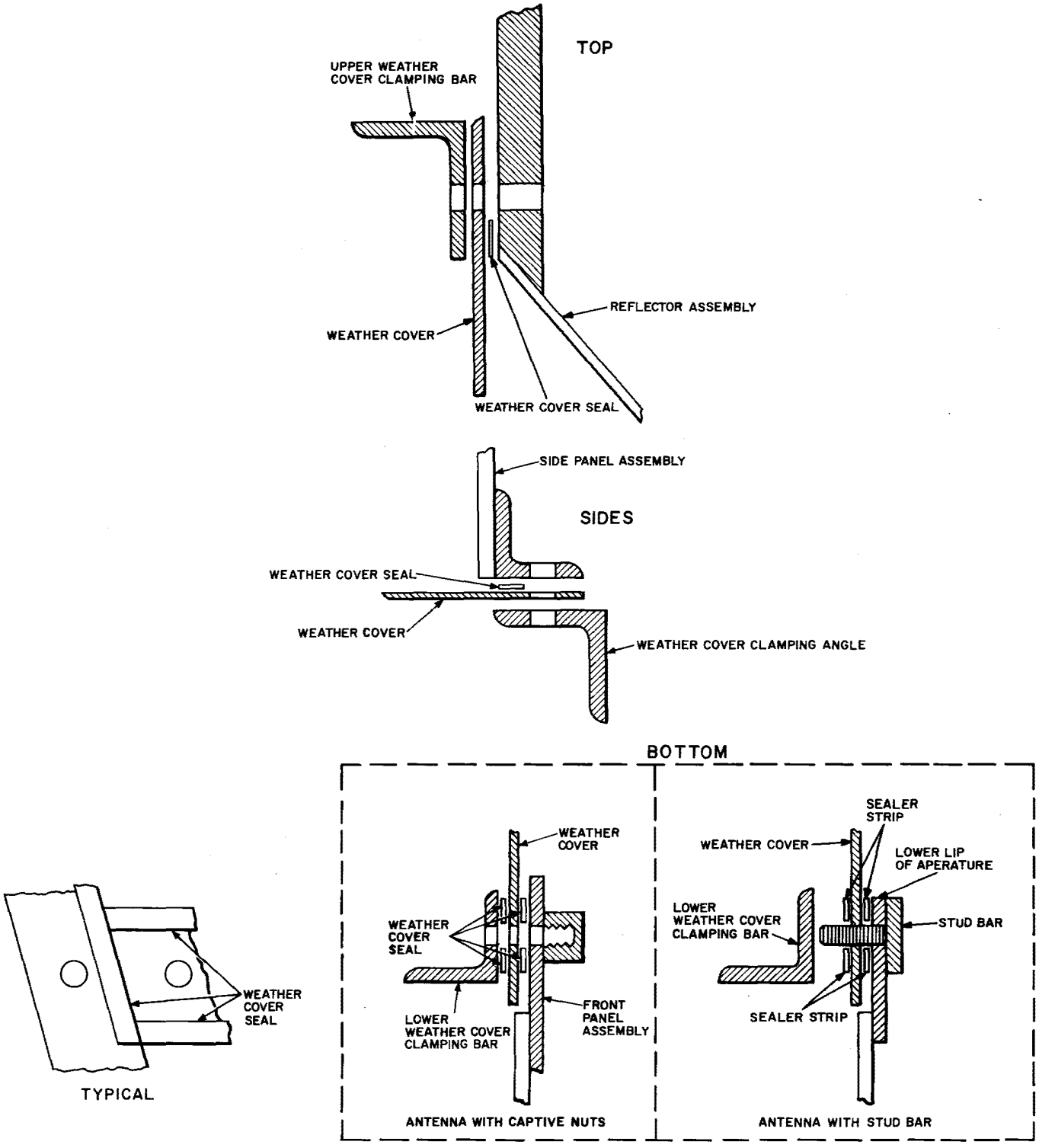


**Fig. 7—Location of Weather Cover Seals**