



INTRODUCTION

Klystron amplifiers have a reputation as reliable, long-lived devices, which provide many thousands of hours of trouble-free operation to the user. In liquid-cooled tubes the life of the tube can be increased even more by attention given the cooling system, and support equipment. Specific recommendations for the design and maintenance of liquid cooling systems have been provided in Varian Application Engineering Bulletin No. 17A. As pointed out in the above reference, one of the major problems in field operation of klystron cooling systems has to do with limiting the formation of corrosion products (copper oxide) in the cooling channels of the collector of the tube by chemical reaction between free oxygen-laden coolant and the hot copper channel wall. Specific differentiation is to be made between corrosion as described above, and scale formation, which can be caused by the use of other than clean distilled water, or as the by-product of electrolysis between dissimilar metals in the heat exchange system. The latter can be controlled, as noted in the Bulletin, by the use of on-line purification loops.

Oxide corrosion is controlled by limitation of the dissolved oxygen content of the coolant. In some operating situations it may be easier or more economical to institute a tube flushing procedure on a routine maintenance basis. The following information is presented as a guide to this approach to the problem.

EQUIPMENT (Refer to Figure 1)

- A. Tube mount stand
- B. Flare fittings for specific tube type
- C. Plastic or rubber hose
- D. Plastic funnel
- E. Plastic or rubber sheeting protective shroud
- F. Plastic catch basin (pail)
- G. Source of flushing water (at least 20 psi head)
- H. Flushing acid

PROCEDURE

1. Place the tube, collector down in a mounting stand which supports the tube from the collector pole piece. Since all flushing operations are to be performed in the reverse direction, connect the feed funnel to the *OUTLET* fitting on the collector, and the drain hose to the inlet fitting. Support the funnel at a point approximately two feet above the level of the collector fittings.
2. Completely protect the tube from the flushing solution by shrouding it with plastic or rubber sheeting material.
3. Slowly pour into the funnel a bulk of 5 gallons of a dilute solution of Muriatic acid in clear water. The solution should be formed of a mixture of 1 part by volume 24° Baumé Muriatic acid to 4 parts water, or in an equivalent ratio if acid of a different concentration is used.
4. Allow the tube to stand for 15 minutes, and then repeat step 3. The same solution may be used over again if any particulate matter removed in step 3 has been removed by decanting or straining.
5. Pour through the tube 5 gallons clean water.
6. Replace the funnel with a high pressure source of clean tap water, at 20 pounds or more head pressure, and flush the tube for 5 minutes.
7. Replace the tube in the transmitter and check the differential pressure required to provide the original flow rate condition as noted from operating log or from Test Data Sheet accompanying the tube in its shipping container.
8. Repeat steps 1 through 7 if tube is not back to normal as determined from step 7.

CAUTION: DO NOT GET MURIATIC ACID INTO EYES OR FACE. In case of contact with the body use water copiously for flushing and dilution.

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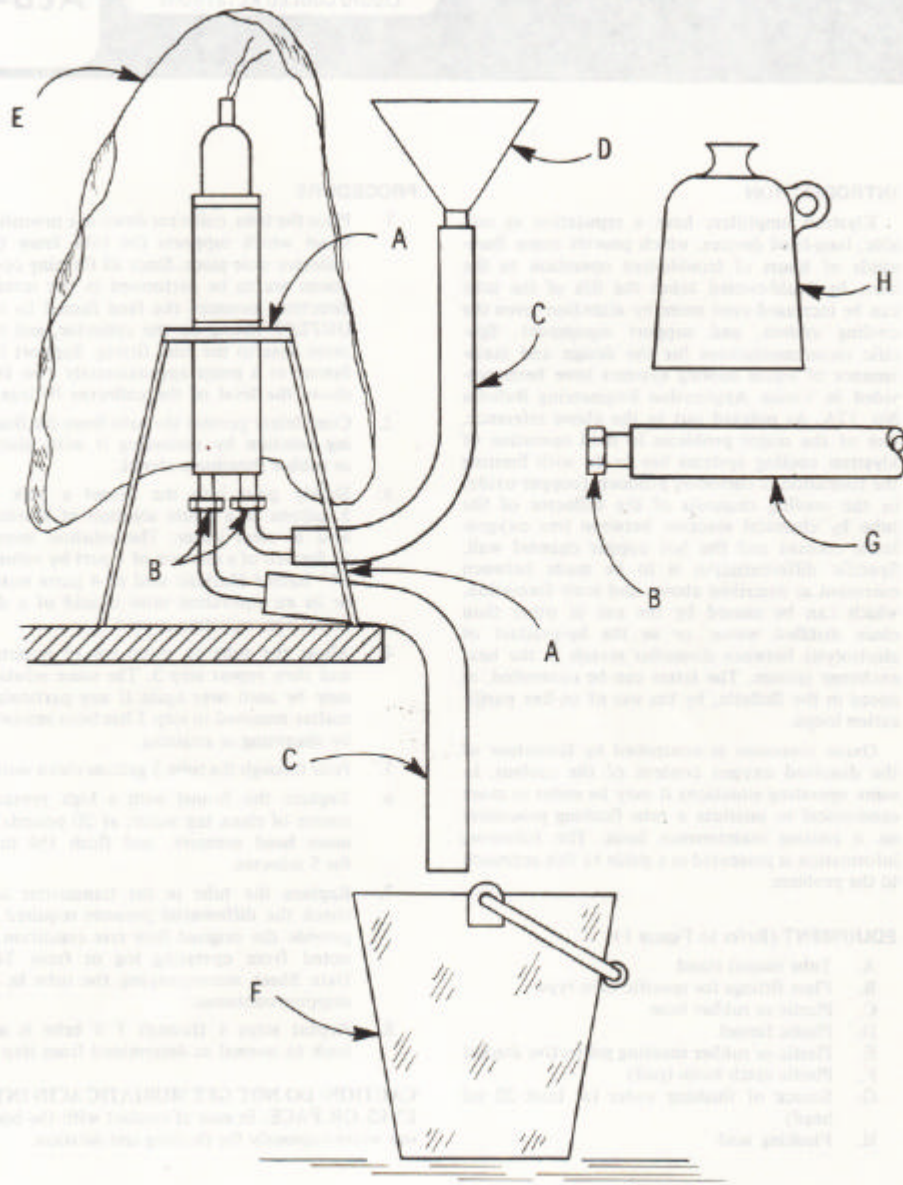


Figure 1