



INTRODUCTION

The high power levels at which klystron tubes operate require careful attention to the maintenance of water purity to assure the best possible heat dissipation. Any water containing contaminants that exceed the limits specified in this bulletin will cause corrosion and scaling. Ordinary tap water will not meet these specifications. Distilled water, however, will meet these requirements and is the recommended fluid to be used in klystron cooling systems. Periodic monitoring of water purity is necessary because the water can become contaminated by impurities from the cooling system components and from the surrounding environment. These impurities, when combined with the effects of high surface temperatures, result in a chemical reaction which causes corrosion and the formation of solids or scaling. Unchecked corrosion will attack the metals in the klystron and thus reduce its operating life. Scaling will prevent efficient heat transfer and will plug coolant passages. This will greatly increase the possibility of premature tube failure.

The recommendations given are based on a study of liquid-cooling problems conducted for Varian Associates by the Stanford Research Institute and on subsequent analyses and corrections of problems in several field operating situations.

WATER PURITY SPECIFICATION

1. The resistivity of the water shall be maintained at a level greater than $30 \text{ k}\Omega/\text{cm}^2$ at 30°C .
2. The pH factor shall be within the range of 6.0 to 8.0.
3. The particulate matter size shall not be greater than 50 microns (325 MESH).
4. The inlet water temperature shall not exceed 70°C and this temperature should be regulated to $\pm 5^\circ\text{C}$.

When the water fails to satisfy any one of these requirements, prompt action is necessary to correct these deficiencies. If the water is contaminated,

the system must be flushed and replaced with clean water. Specific recommendations are described in Application Engineering Bulletins AEB-17B and AEB-32. If the temperature of the water exceeds 70°C , the heat exchanger system should be checked or adjusted.

TESTS FOR PURITY

The recommended method for measuring resistivity, pH and particulate matter is by use of laboratory instruments. However, simple tests described here should provide enough information to determine purity.

1. *Appearance* of the water is a good general indicator. If the water looks turbid or tastes or smells brackish, it is good practice to change the water and flush the system.
2. *pH factor* is easily checked by using pH paper or Litmus paper. Sold under a variety of trade names, pH paper is available at aquarium or swimming pool equipment supply stores. Direction for use is usually printed on the packages.
3. *Particulate matter and impurities* can be checked by using the foaming test as described in Application Engineering Bulletin AEB-26.
4. *Accurate resistivity* should always be measured with a resistance bridge. Generally speaking, if the water does not pass the foaming test, the resistivity is too low.

MAINTAINING WATER PURITY

Continuous purification of the water is the recommended method for maintaining high quality water. Figure 1 shows a typical purification loop arrangement. Packaged systems such as this are available from a number of manufacturers.

In general, these systems consist of replaceable cartridges that provide the filtering, ion exchange, and organic solid removal functions. The system should include flow and pressure gauges and valves, and conductivity cells for continuous evaluation of the condition of the water and filters.

The size of the purification system should be in accordance with the manufacturer's recommendation.

An alternative to the expensive purification system would be flushing procedures which could be done on a planned maintenance schedule. The time interval between flushings would have to be adjusted to the local atmospheric conditions.

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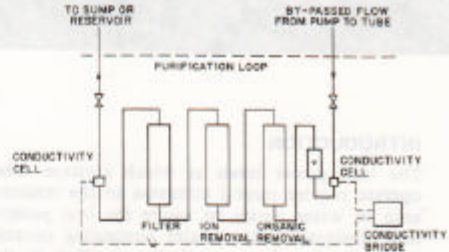


Figure 1. A Typical Purification-Loop Arrangement



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WATER PURITY SPECIFICATIONS

1. The conductivity of the water should be maintained at a level between 100 and 200 micro-mhos/cm.
2. The pH should be maintained between 7.0 and 8.0.
3. The total dissolved solids should be maintained at a level of 100 ppm or less.
4. The water should be free of any detectable amount of organic matter.