"FOAMING TEST" FOR WATER PURITY

In addition to this document, the following three related technical publications are available from CPI to provide guidance in the design and maintenance of liquid-cooling systems for high-power microwave vacuum electron devices (VEDs):

AEB-17	Recommendations for Cooling High-Power Microwave Devices
AEB-31	Water Purity Requirements in Water- and Vapor-Cooling Systems
AEB-32	Cleaning and Flushing Water- and Vapor-Cooling Systems

Each document addresses a different aspect of the concern about proper design and care of cooling systems; together, they should answer the most common questions concerning liquid cooling. If additional information is needed, please contact the CPI Engineering Department.

INTRODUCTION

One of the many factors affecting life and operating efficiency of vapor-cooled vacuum electron devices is the purity of the water in the cooling system. The presence of impurities may be indicated by "foaming," which will inhibit heat transfer and thereby lower system cooling efficiency. This publication lists the impurities that may cause foaming and describes how to perform a foaming test.

FOAM-PRODUCTING IMPURITIES

Impurities that most frequently produce foaming are:

1. Cleaning-compound residue
2. Detergents
3. Joint-sealing compounds
4. Oily rust preventives in pumps and other components
5. Valve-stem packing
6. Tap-water impurities

FOAMING TEST

Perform this test after each system cleaning, modification, or water change.

Equipment

1. 1/2 × 4" glass test tube with rubber stopper
2. 1-pint glass or polypropylene bottle with cap

Procedure

1. Fill cooling system with water, and circulate until thoroughly mixed (about 30 minutes).
2. Drain sample of water into bottle, and cool to room temperature.
3. If water sample stands for more than 1 hour, slowly invert capped bottle about ten times. Avoid shaking the bottle, as this will create air bubbles in the water.
   NOTE: When water is static, foaming impurities tend to collect at the surface. This step mixes the sample without generating foam.
4. Using sample water, rinse the test tube and stopper three times.
5. Half fill the test tube with sample water.
6. Vigorously shake the test tube for 15 seconds.
7. Allow the sample to stand for 15 seconds.
8. Observe the amount of foam remaining on top of the water, and compare it with Figures 1A, 1B, and 1C.

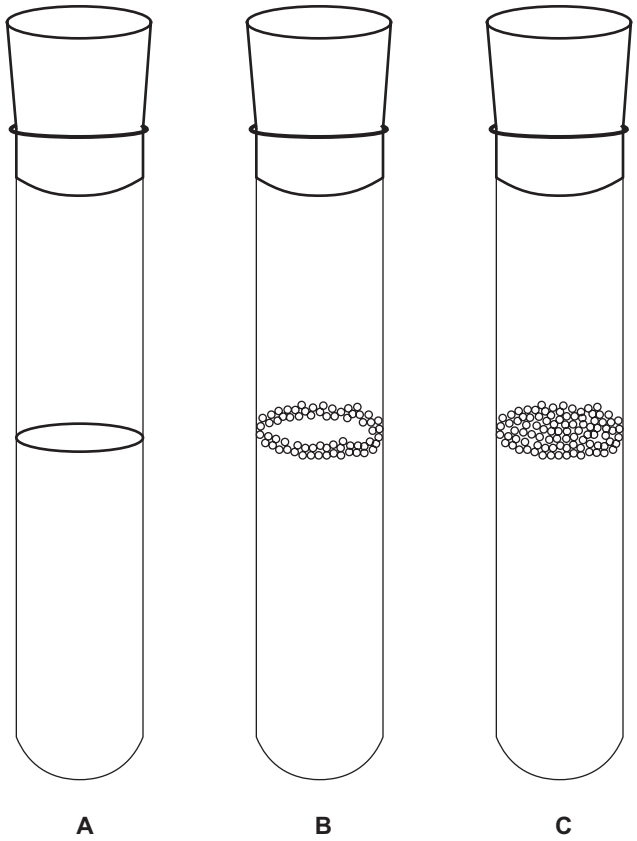

Figure 1. COMPARISON OF SAMPLE WATER FOAM DEPTHS

Evaluation

Figure 1a. A completely foam-free water surface and test-tube wall indicates that no foam-producing impurities are present.

Figure 1b. If the water surface and test-tube wall are partly covered with foam but the water-surface center is clear, the impurity level is temporarily acceptable. A second test should be conducted in about one week.

Figure 1c. If the foam layer completely bridges the inside of the test tube, the system should be flushed and cleaned.

CLEANING

Refer to CPI Publication AEB-32, "Cleaning and Flushing Water- and Vapor-Cooling Systems," for the appropriate cleaning and flushing procedures.