

ORGANIZATION OF COMMITTEE F-1 ON MATERIALS FOR ELECTRON TUBES AND SEMICONDUCTOR DEVICES

SCOPE.—The formation of specifications and methods of testing materials used in the construction of electronic devices, as well as the stimulation of research and standardization of nomenclature. Electronic devices include electron tubes of all kinds, electric discharge devices, and semiconductors.

CHAIRMAN: S. A. Standing, Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass.

VICE-CHAIRMAN: F. J. Biondi, Bell Telephone Labs., Inc., Murray Hill, N. J.

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SUBCOMMITTEES

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|--------------------------------|----------------------------|
| I. Cathode Materials | VI. Semiconductors |
| II. Insulators | VII. Luminescent Materials |
| III. Strip | VIII. Editorial |
| IV. Wire | IX. Materials Analyses |
| V. Metallic—Non-Metallic Seals | X. Control of Contaminants |

CURRENT ACTIVITIES OF SUBCOMMITTEE X ON CONTROL OF CONTAMINANTS

Chairman: D. E. Koontz, Bell Telephone Laboratories

Subcommittee X comprises four subdivisions—Sections A on Air-Borne Contamination, B on Surface Examination, C on Processing Liquids, and D on Sorbed Materials. A statement on the organization and activities of these sections follows.

SECTION A ON AIR-BORNE CONTAMINATION

Chairman: F. W. Van Luik, Jr., General Electric Co.

Section A is concerned with the measurement of air-borne contaminants within clean or ultraclean manufacturing facilities. These contaminants have been further subdivided into solid or liquid particulates and gases with the main emphasis initially on particulate contaminants.

The objective of the section is to establish standard techniques and apparatus for the evaluation of the concentration, size distribution and identification of air-borne particulates normally found within clean or ultraclean manufacturing facilities used to fabricate electronic devices.

Four task groups have been organized to evaluate techniques and apparatus within the four classic methods of air-borne contamination measurements:

1. Settling or gravity techniques, Chairman: E. Selby, Westinghouse Electric Corp.,
2. Filtration techniques, Chairman: Roy C. Post, Texas Instruments, Inc.,
3. Impaction Techniques (unassigned), and
4. Light Scattering Techniques, Chairman: F. W. Van Luik, Jr., General Electric Co.

A procedure and apparatus for filtration techniques has been proposed and is being evaluated in a series of comparison tests within several companies. A procedure to

evaluate light-scattering photometers has been drafted and will be evaluated.

Data, tests, and evaluation techniques for the settling method are under investigation.

A new group will be organized to consider gaseous contamination measurements.

SECTION B ON SURFACE EXAMINATION

Chairman: H. A. Stern, Radio Corporation of America

The objective of the section is to establish test procedures which will define the cleanliness of surfaces. Efforts are directed toward six major areas represented by task groups in each of the areas.

The Task Group on Conductivity Measurements, Dr. Edward B. Saubestre of Enthone Inc., chairman, is evaluating systems in which surface cleanliness is established by measuring the change in conductivity of a quantity of pure water in which the surface in question is placed. Several systems employing this principle have been evaluated and are being considered for standardization. This group is also responsible for the evaluation of the new Balsbaugh conductivity cell design, this undertaking being in conjunction with the efforts of Section C on Processing Liquids.

Mr. Elmer Selby of Westinghouse Electric Corp. is chairman of the Wettability Test Task Group. This group is reviewing the many procedures which reveal the presence of hydrophobic surface films. Two test methods are ready for standardization—a water break test and an atomizer test. The group will continue to investigate a series of wettability test procedures which have special application.

The Task Group on Microscopy Techniques, A. J. Borofsky of Sylvania Electric Products, Inc., chairman, has drafted a test

method for determining particulate contamination on surfaces.

The Task Group on Particle Identification Tests, headed by E. Romero of Radio Corporation of America, has the difficult task of formulating a standardized procedure to systematically identify particulate soils on surfaces.

The Task Group on Radiotracer Techniques, T. J. Bulat of Bendix Corp., chairman, is concerned with the use of these techniques in defining surface cleanliness. The group is developing a recommended practice involving the use of radioisotopes.

The Task Group on Surface Potential Measurements is under the leadership of D. Schimmel of Sylvania Electric Products, Inc. Application of this phenomenon to evaluation of surface cleanliness is relatively recent and, as a result, most of the applicable techniques have been developed by the members of the task group.

The section has also shown interest in areas allied to testing for cleanliness and has held an informal symposium on measuring the performance of ultrasonic cleaners.

SECTION C ON PROCESSING LIQUIDS

Chairman: Verity C. Smith, Barnstead Still & Sterilizer Co.

The section was organized in June, 1959, with six task groups, originally all relating to properties of pure water as a processing liquid. Later, the section embraced problems relating to organic solvents and hydrogen peroxide. Current task groups are organized as follows:

Groups relating to pure water:

Conductivity—Chairman, Dr. Robert Rosenthal, Industrial Instruments, Inc.

Biological Impurities—Chairman, Norman L. Hobbs, Wyeth Laboratories

Total and Suspended Solids—Chairman, Dr. Donald Manus, Texas Instruments, Inc.

Copper—Chairman, Dr. George Downing, Merck, Inc.

Organic Matter—Chairman, Thomas Manns, Lansdale Tube Co.

Groups relating to organic solvents:

Conductivity—Chairman, Sidney Balsbaugh, Balsbaugh Laboratories

Total Residue—Chairman, George Perry, General Electric Co.

Task Group on Hydrogen Peroxide: Chairman, Donald Duffy, Allied Chemical Corp.

Work of the section is of interest not only to the electronic industries but also to pharmaceuticals, ion exchange, filter and chemical industries. The section is coordinating its activities with those of ASTM Committee D-19 on Industrial Water.

Task Group Activities:

Conductivity.—The group has been concerned primarily with methods of standardizing conductivity cells used for measuring conductivity of high-purity water. For example, there is evidence that the platinum black commonly found on conductivity cells should not be used for water of this degree of high purity.

Biological Impurities.—Such impurities cause gelatinous residues to develop on processing facilities and components being processed. Development of methods for detecting and classifying this type of impurity is urgently needed and is the principal function of this group.

Total and Suspended Solids.—Water and other processing liquids used in the electronics industry should be handled and checked for contamination with far more care than that employed in either the pharmaceutical or atomic energy industries. For example, suspended matter in the primary loops of reactors is removed by various filtration systems down to the 5 μ range, with a tolerance mainly limited by the activity of those particles in the water. It is common in the electronics industry to remove particles down to 0.5 μ or lower, and even these small particles are cause for concern.

Therefore, Methods D 1069¹ developed by Committee D-19 has not been found entirely satisfactory for electronics use. The task group has suggested improvements in the

¹ Methods of Test for Suspended and Dissolved Matter (Suspended and Dissolved Solids) in Industrial Water and Industrial Waste Water (D 1069-58), 1958 Book of ASTM Standards, Part 10, p. 1065.

method and is working with Committee D-19 toward revision.

Copper.—Copper in extremely small amounts in water causes difficulties in the manufacture of cathode ray tubes such as used in television receivers. The task group has been working with Committee D-19 on Industrial Water in revising the methods for copper, D 1688,² and have now developed the method with a sensitivity to 1 part in 10⁹.

Organics.—Quantitative determination of organic contamination in water has so far proved quite difficult and many methods have been investigated, including insertion of a sample of water in a neutron flux with subsequent formation of carbon-14 and detection by radioactive counting. The task group is breaking new ground, as the literature reports little information on determination of total organics in water in the concentrations of concern to the committee.

Solvent Conductivity:

The task group is confronted with the problem of having to devise test procedures, as there is little reported experience that is useful.

Solvent Residue:

Certain solvents are found to polymerize when stored under various conditions. Detection of this type of impurity is one of the problems confronting the task group.

Hydrogen Peroxide:

This compound is normally considered a chemical reagent but so far as the committee is concerned, it is being considered as a solvent. One of the problems confronting the task group is the tin compounds which are added to hydrogen peroxide as stabilizers. The task group is cooperating with suppliers of hydrogen peroxide in developing test procedures that will properly characterize the material.

SECTION D ON SORBED MATERIALS

Chairman: J. L. Lineweaver,
Corning Glass Works

Sorbed materials were considered in the early activities of Section B on Surface Examination. However, it soon became ap-

parent that this subject could well justify the formation of a separate section under Subcommittee X on Contaminants for the following reasons:

1. The sorption of gases and ions is highly complex and depends upon the environment and the types of energies to which a given material is subjected.

2. The bulk of the material, as well as the surface, must be considered in studies of sorbed gases and ions.

3. In most cases, existing measuring techniques are rather involved and require expensive equipment normally found only in the research laboratory.

Accordingly, Section D was organized in February, 1960 to be concerned with all types of sorption processes whether they are surface localized or pertain to the bulk. Glasses, metals ceramics, and semiconductors in their role as device materials were included.

Literature searches were made to determine the degree of understanding of the various release mechanisms and the state of development and sensitivities of the various detection and measuring techniques. The subjects searched and those making the searches are listed:

Release Mechanism Searches:

- (a) Electrolysis; electron bombardment, by J. L. Lineweaver, Corning Glass Works
- (b) Ultraviolet, by T. E. Hanley, Naval Research Laboratory
- (c) Dissociation, by R. J. Bondley, General Electric Co.
- (d) Permeation, by V. O. Altemose, Corning Glass Works
- (e) Ion bombardment,³ by P. Youtz, M. I. T. Lincoln Laboratory
- (f) Thermal,³ by J. C. Turnbull, Radio Corp. of America

Test Method Searches:

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|---------------------------------|---|
| Mass spectrometry | } by J. Morrison, Bell Telephone Laboratories |
| Flash filaments | |
| Field emission | |
| Auger electrons | |
| Microanalysis of gas | |
| Evaporation analysis | |
| Vacuum microbalance | |
| Vacuum fusion | |
| Diffusion | |
| Low energy electron diffraction | |
| Inert gas fusion | |

² Method of Test for Copper in High-Purity Water (D 1688-59 T), 1959 Supplement to Book of ASTM Standards, Part 10, p. 314.

³ In preparation.

Vacuum microbalance, by S. P. Wolsky, Raytheon Mfg. Co.

Evaporation analysis, by J. L. Lineweaver, Corning Glass Works

Questionnaires on mass spectrometer calibration and getter evaluation showed interest in the establishment of standards in both areas. J. Morrison, acting as liaison with ASTM Committee E-14 on Mass Spectrometry reported on calibration procedure E 137 - 58 T⁴ but which specification does not appear adequate for the committee's needs. S. P. Wolsky, chairman of the American Vacuum Society Standards Committee on Partial Pressure Gauges, reported

that a group is working in this area and would keep Section D informed of its progress. Therefore, it was decided to postpone any work on mass spectrometer calibration to avoid duplication of effort.

Three task groups were organized in February, 1961, to establish standards for evaluating getters. These are as follows:

Flash Getters, J. S. Wagener, Kemet Co., chairman

Non-Flash Getters, E. I. Doucette, Ronson Metals Corp., chairman

Sorbents and Desiccants, H. E. Powell, Kimble Glass Co., chairman

The American Vacuum Society has organized a Standards Committee on Outgassing and duplication of effort between that group and Section D will be avoided since P. Váradi of Machlett Laboratories and J. L. Lineweaver are active in both groups.

⁴ Recommended Practice for Evaluation of Mass Spectrometers for Use in Chemical Analysis (E 137 - 58 T), 1958 Book of ASTM Standards, Part 7, p. 1447, and Part 8, p. 1496.