

There have been several books on vacuum techniques written at various technical levels for the engineer and the research scientist, but, until the publication of the present volume, the needs of the technician have been largely ignored. His background is usually mathematically limited, and his interest in the laws governing his work is in applying them as needed, rather than in their derivation. He does need to know the meaning of the various terms concerned, the units in which they are measured, and something concerning the limitations of their use.

In their first chapter, the authors have succeeded in concisely presenting, defining, and illustrating the principal relations governing the behavior of gases as they pertain to vacuum technique. Having once read this material, the reader will find it a convenient reference as the need arises. The concepts of the mean free path, the types of gas flow, volumetric and mass flow, conductance of pipes under viscous and molecular flow, and pump-down rate are well illustrated and explained quite simply, but adequately, for the authors' purpose.

The chapter on the "Components of a Vacuum System" gives a good description of typical commercially available hardware, as well as a description of the principles on which each type operates. The discussion of ports, lead-ins, and motion seals describes several types that have been designed, built, and used many times, but which may not necessarily be commercially available.

The discussion of "Techniques and Procedures" presents the problem of putting components together to attain a complete system having the desired performance characteristics. The interrelation of the parts of the system is emphasized. Sample calculations for the selection of components are carried out showing how they are selected. Leak detection and leak detectors are logically introduced at this point. The operation of the mass-spectrometer leak detector and the initial operation of a typical system are given in such detail that they become general operating instructions. Estimates of performance of the sections of the equipment are given for the guidance of the technician in determining if there is trouble and where it may be. All through the discussion little details of a system assembly are pointed out, such as the manner of mounting gauges and arranging for trapped volumes to be pumped, providing ports for the connection of a leak detector to the system, and the like. These items are each rather small in themselves but add to the overall performance of the system and the convenience of working with it. These techniques are frequently overlooked even by experienced people because they are in the nature of details. The treatment of "Ultra High Vacuum" emphasizes those elements of construction that are different from those used for the high-vacuum region and explains the factors that necessitate the difference in approach. Practical differences are pointed out with regard to joints, lead-ins, motion seals, outgassing, backstreaming, and pumping speed.

The last chapter deals with the properties of materials used in vacuum systems. A great many different materials, from pure metals, alloys, and insulators to plastics and elastomers, are noted with very pertinent comments on their advantages, disadvantages, and par-

ticular properties. For the vacuum expert there is little that is new, but for the beginning technician this review should be very valuable, both immediately and for future reference.

The appendixes are quite extensive, ranging from the metric system and temperature scales to a table of cements and adhesives and their properties; also included is a very good discussion of soldering and brazing materials and techniques, and an extensive vapor-pressure table, and an excellent presentation of flange, gasketing, and welding design giving general dimensions. Much of this material appears scattered through the literature but has not been brought together in one place.

The beginning vacuum technician should find this volume very helpful in his daily work and should make it easier for him to tackle the more advanced books.

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ONLY AN INTRODUCTION

Title Radiation Effects in Electronics

Publisher American Society for Testing and Materials

Pages 236

Price \$5.00

Reviewer Richard F. Shea

The contents of this book resulted from a joint effort of ASTM Committee E-10 on Radioisotopes and Radiation Effects and the Niagara - Finger Lakes Section of the American Nuclear Society. It consists of the major portion of the transactions of the Joint ANS-ASTM Conference on Radiation Effects in Electronics held in Syracuse, N.Y. from October 5-7, 1964. It includes an Introduction, 12 papers on various aspects of radiation-induced phenomena in electronic devices and circuits, and remarks on correlation studies.

The papers describe radiation effects on materials, devices (such as bipolar and field-effect transistors, solar cells, diodes, and traveling-wave tubes), and complete electronic equipment. As would be expected, the majority of the papers deal with radiation effects on semiconductor devices.

There is a good combination of theory and application data in most of the papers from which the reader can obtain a good basic understanding of the fundamental radiation phenomena in such devices as diodes and transistors. Both transient and permanent radiation effects are discussed and the applicable mechanisms are also described. Formulas are given for the determination of the magnitude of these effects as a function of exposure to various forms of irradiation. Considerable data are included illustrating the effects of specific irradiations on certain transistor types. Since these articles were written on the period 1962 to 1963, the results do not necessarily represent potentialities of currently available transistors which possess greatly improved radiation resistance over the earlier devices. The basic mechanisms are still the same, however, and the fundamental theory can still be applied to the newer devices.

The reader who expects to be able to design radiation-hardened equipment based on the contents of this little book is going to be disappointed. It is more in the nature of a state-of-the-art resumé and guide for more detailed study. There is no index, but this is not a serious drawback in a book of this type. The one paper on radiation-hardened equipment design is little more than a description of the program, its objectives, and the results achieved, with little or no details as to the methods by which they were achieved.

There is considerable material on correlation between various forms of radiation. Nevertheless, as Dr. van Lint points out in his concluding comments, there is still room for a great deal of study before a consistent picture emerges. The need for such correlation is obvious, as the environment to which equipment is to be exposed is too often not reproducible in the laboratory. If results can be obtained from irradiation with x rays or readily available particles that can be shown to correlate reasonably well with the effects found in space environments for example, design and testing problems will be greatly simplified.

While there is a great profusion of information and data on radiation effects in the literature, its very mass complicates the problem of retrieval. Any extraction of the basic material from this mass is welcome. While this volume does not go very deeply into the subject, it still should provide a good basis for the designer who is becoming involved in the growing field of radiation environment. It is only an introduction, however, and a great deal of additional study will be required before one can predict the full effects of radiation environments on electronic equipment.

Richard F. Shea, a consulting electronics engineer, is well-recognized as an authority on circuit applications of transistors and other solid-state devices. He has authored or edited four textbooks on transistor circuitry since 1953. From 1937 to 1963 he was with the General Electric Company, where he was responsible for integrating the advances in electronics into the nuclear field, including application of transistors and other semiconductor devices into nuclear and process instrumentation at KAPL. His BS degree (electrical engineering) was granted by Massachusetts Institute of Technology in 1924.

SHORT OF COMPREHENSIVE

Title Handbook of Vacuum Physics

Vol. 1, Parts 1-3 Gases and Vacua \$6.00 viii + 208

Vol. 2, Part 1 Physical Electronics \$6.00 vii + 178

Vol. 3, Parts 1-3 Technology \$6.00 viii + 191

Vol. 3, Part 4 Technology \$3.00 viii + 270

Editor A. H. Beck

Publisher Pergamon

Reviewer John Strong

Editor Beck sets out to cover the essentials of the many different scientific disciplines involved in the use of vacuum apparatus, or in work on the diverse applications of high-vacuum technology in research or industry. The topics range from quantum theoretical aspects of solid-state, thermionic, and photoelectric physics, to commercially available pumps, gauges, and materials. This range is so great that it can be met only by a series of long articles, each prepared by an expert, giving an up-to-date survey of his subject.

These books do not constitute the whole of the material that will be published eventually. When the whole is published, it will be possible to issue binders to assemble it all into volumes as originally planned.

The books contain physics related to vacuum work, tables of properties of materials and of the performance of equipments that are commercially available, and practical procedures.

The work will serve as a most welcome guide to the literature for instruction on procedures, as a stimulant to ingenuity (substituting for visits to research laboratories, etc.), and as a kind of seed catalogue for planning. It is unfortunate for the reader that those whose wares are advertised had not participated fully enough, on the side of finance, to let the books sell inexpensively, as paperbacks should.

I find that the writing ranges through a spectrum, including categories suggesting that the author is an experienced experimental physicist, is an engineer—now become a busy manager, or is only a reporter of techniques. In any instance where this characterization might be taken as derogatory, it should apply to the physics, not the sentence structure, for meanings are rarely obscure. I found the exposition particularly clear in Morgan's Vol. 2, the part I am least qualified to judge scientifically. This is the only book that is indexed. Dayton's long article on the quantitative behaviorism of vacuum systems is excellent.

I was disappointed not to find some of my own pets, for example:

1. a recommendation for use of Koroseal tubing—it can be pushed onto glass tubes that are heated just above the plastic's melting point, to form a fused connection—a long length on a McLeod gauge can be