Physics of Failure in Electronics

Edited by

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and

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Foreword

THIS VOLUME comprises the Proceedings of the Symposium on the Physics of Failure in Electronics, held 26 and 27 September 1962 in Chicago, Illinois. The symposium, which was sponsored by the Applied Research Laboratory of Rome Air Development Center and the Armour Research Foundation of Illinois Institute of Technology, was attended by some 350 people, representing a number of technical disciplines.

The need for, and the efforts currently under way to achieve high reliability in complex systems are well known; they need not be repeated here. What should be emphasized is that greater complexity and increasingly severe operating environments have so increased demands upon the individual component parts that it has become difficult, if not impossible, to demonstrate achievement of the required component reliability levels. That is, today's parts have mean times to failure of thousands of hours. The time and effort required to establish and/or demonstrate these reliability levels are orders of magnitude greater than those required for parts of just a few years ago. These efforts are currently taxing our resources. Clearly, the use of conventional techniques to demonstrate and measure the increased reliability level of future systems becomes increasingly time consuming and costly.

Equally disturbing is the fact that part reliability data, generated within the confines of current state of the art, do not in general yield information which can be extended to other situations. The large matrix tests now employed answer questions which are confined to the specific circumstances under which such tests are conducted. Changing materials, manner of fabrication, use conditions, application criteria, etc. negate previous results. There is little recourse but to repeat the tests to establish the new reliability values for the new situation.

These serious limitations have provided impetus to a fresh approach to component reliability: the study and application of the fundamental physics of failure as a means of (1) achieving higher reliability components and (2) predicting part reliability—with limited resort to mass test data. The symposium represents the first gathering devoted exclusively to exploring this approach to part reliability.

The objectives of the symposium were stated as follows: "We believe that this is an appropriate time to bring together research workers who

are concerned with the determination and enhancement of electronic part and device reliability so as to evaluate recent progress, to consider future directions of research, to examine critically the practicality of this approach, and to explore means for implementing the philosophy which has been advanced." It is encouraging to note that the symposium did indeed offer an exchange of expression between a number of essential disciplines, e.g., reliability engineers, physicists, metallurgists, component engineers, and mathematical analysts. Herein lies the forum by which these diverse technologies can examine each other's points of view and contributions to a common problem. If the reliability engineer obtained an appreciation for the contribution of the physicist; if the physicist obtained an appreciation for the reliability problem; if the papers conveyed the extent to which this approach is presently being investigated, the direction future effort will take, and the problems that must be solved, the goals set for this first symposium will have been met.

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