Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: SYMPOSIUM ON PROGRESS IN QUALITY ELECTRONIC COMPONENTS, WASHINGTON D.C., MAY 5, 6, 7, 1952.

TO: J. W. Forrester

FROM: C. W. Watt & B. B. Paine

DATE: May 13, 1952

ABSTRACT:

The program of the symposium is outlined, and summaries of certain papers of interest to the laboratory are presented.

INTRODUCTION:

A symposium on "Progress in Quality Electronic Components" was attended in Washington D.C. on May 5, 6, 7th. This was sponsored by the AIEE, the IRE, and the RTMA, and was a followup to the symposium held two years ago on "Improved Quality Electronic Components". There were ten sessions, covering two and one half days. The papers presented are listed below, with short summaries of some more pertinent ones.

Monday, May 5, 1952

Session 1, ELECTRONICS TODAY
Chairman, A. V. Astin, Acting Director
National Bureau of Standards,
Washington, D.C.

1. "Electronic Production Requirements from Industry's Viewpoint"
Glen McDaniel, President,
Radio-Television Manufacturers Assoc.
Washington, D. C.

A plea for more system coordination in Armed Forces procurement of complicated electronic equipment thru use of a Project Manager for a whole system. Industry has recommended this to the Air Force, which seems receptive.

2. "Electronics in the Defense Production Program."
J. A. Milling, Chairman, Electronics Production Board.
Defense Production Administration,
Washington, D. C.

3. "Some Factors in Today's Electronics Production"
Capt. Rawson Bennett, USN, Bureau of Ships
Department of the Navy,
Washington, D. C.

4. "Reliability of Military Electronics"
Edwin A. Speakman, Vice Chairman, Research and Development Board
Department of Defense,
Washington, D. C.

60% of electronic equipment in the Armed Forces is not operating reliably. Complexity has increased many fold in the last 15 years. Examples: 1. A destroyer in 1937 used 60 vacuum tubes; in 1944, 820 tubes; in 1952, 3200 tubes. 2. A 40 plane B50 Mission of average magnitude requires that 10,000 tubes operate reliably for 15 hours under adverse conditions.

The Research & Development Board has a strong appreciation of the need for added reliability and has a full time coordinator of equipment reliability on its staff.

5. "Electronic Components in Continental Europe"
Lt. Col. C. B. Lindstrand, USAF, Electronics Production Resources Agency,
Department of Defense,
Washington, D. C.

Deposited carbon resistors are being made in Germany by Resista in the range from 1/20 to 40 watts. One development that has not yet been duplicated in this country is a capless construction for these resistors. The pigtail leads are embedded in the ceramic form, and connection is made to them by fired silver coatings and solder. This construction provides improved noise characteristics, as low as 0.2 microvolts/volt. Stability is 0.1—2% over a period of 3000 hours shelf life.

6. "Electronic Components in Great Britain"
G. W. A. Dummer, Telecommunications Research Establishment,
London, England

An excellently made film was presented showing in detail how stamped wiring assemblies are being made with special machines by Telecommunications Research Establishment in England. Strong emphasis was placed on the desirability of Unitization of equipment in complex systems to make assembly by these improved techniques profitable, to simplify soldering methods, and to increase reliability by minimizing mechanical troubles due to faulty soldering and assembly. The method used there seemed overly complicated and inflexible, but the concept needs reiterating.

Session 2, BASIC MATERIALS
Chairman, Professor John H. Koenig,
Rutgers University
New Brunswick, N. J.

1. "Recent Developments in Ceramic Dielectrics"
   Edward J. Smoke,
   Rutgers University
   New Brunswick, N. J.

2. "Metallic Refractories, New Materials for the Electrical Industry"
   Robert Steinitz
   American Electro Metal Corp.,
   Yonkers, N. Y.

3. "Some Flurorochemicals for Electrical Applications"
   N. M. Bashara
   Minesota Mining and Manufacturing Co.
   St. Paul, Minn.

4. "Manufacture of Mica Paper for Insulation"
   R. L. Griffeth and E. R. Younglove
   Mica Insulator Co.
   Schenectady, N. Y.

   Synthetic mica sheets have been made by bonding small flakes of real mica with a suitable plastic and running the result off in continuous sheets from a paper manufacturing machine. Many varieties of domestic micas can be used. It was claimed that when this process is perfected it will make the USA almost completely independent of foreign sources of mica.

5. "Progress in the Use of Teflon, Including Soldering and Cementing"
   M. A. Rudner
   U. S. Gasket Co.
   Camden, N. J.

   Teflon, a flurocarbon, can be used in a wide variety of ways useful to the electronics industry.

Session 3, ADVANCES IN MINIATURIZATION
Chairman, Cledo Brunetti
Stanford Research Institute
Palo Alto, California

1. "Compact Assembly Methods"
   S. F. Danko
   Signal Corps. Engineering Laboratories
   Fort Monmouth, N. J.

   The "autosembly" process, developed by the Signal Corps Laboratories at Fort Monmouth was outlined. It seems a much more flexible way of producing printed wiring than that described by Dummer, (above). Nothing much new was presented. We are currently investigating the method here.

2. "Reproducibility of Printed Components"
W. H. Hannahs & J. Eng
Sylvania Electric Products, Inc.
Bayside, Long Island, N. Y.

3. "Miniaturized Components for Transistor Application"
P. S. Darnell
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

A number of components of small size and low voltage rating are currently being developed by Bell Laboratories for use with transistors. It was emphasized that none are on the market now, except a few varieties of miniature resistors and tantalum electrolytic capacitors.

Tuesday, May 6, 1952

Session 4, RESISTORS
Chairman, Professor Ernst Weber,
Polytechnic Institute of Brooklyn
Brooklyn, N. Y.

1. "Adhesive Tape Resistors"
B. L. Davis
National Bureau of Standards
Washington, D. C.

Resistors printed on adhesive plastic tape have been designed especially for use with the etched foil type of printed wiring, ("autosembly" process, above). Such resistors may be pretested like any other component, and it is claimed they can be assembled without solder. A bureau of Standards Circular, #530, describes them. They are not available commercially as yet.

2. "Metallic Film Resistors"
C. T. Graham
Polytechnic Research & Development Co.
Brooklyn, N. Y.

A resistor has been developed using an evaporated chromium coating on a glass tube, and with terminals consisting of a deposit of platinum "metallic luster." $\frac{1}{8}$, 1, and 2 watt units may be manufactured economically to MIL-R-10509 specifications, having a temperature coefficient of -.0025%/°C., and drift after shelving for two years of 0.086%.

3. "E-C Glass Resistors"
James K. Davis
Corning Glass Works
Corning, N. Y.

Corning type "EC" coating may be applied to glass rods with a film thickness of the order of a wavelength of light to produce an extremely stable resistor. Apparently all the data presented was the result of tests on two resistors only. ½, 1, and 2 watt units in values up to 0.1 megohm may be commercially available early in 1953.

4. "Stability of Standard Composition Resistors"
C. K. Hooper
Westinghouse Electric Corporation
Baltimore, Md.

An excellent study of standard JAN-R-11 composition resistors of three manufacturers was made, showing clearly the limitations of these resistors, especially with respect to temperature and load cycling. The author has agreed to send us a copy of his data so that we can include it in the D. C. L. Standards Book. This is one of the best analyses of the limitations of much-used components that we have ever seen.

5. "Borocarbon Resistors"
George Kende
International Resistance Company
Philadelphia, Pa.

A short history of the deposited carbon resistor since its first development in Germany about 1930 was given, followed by a description of the improvement of stability gained in such resistors by the inclusion of Boron in the deposited film. It was claimed that borocarbon resistors approach wirewound resistors in temperature stability, and are about 3:1 better than regular deposited carbon resistors in this characteristic.

Session 5, CAPACITORS AND INDUCTORS
Chairman, J. K. Sprague
Sprague Electric Company
North Adams, Mass.

1. "Capacitors for High Temperature Operation"
John W. Schell
Erie Resistor Corporation
Erie, Pa.

Low and high temperature tests were made on ceramic capacitors of three manufacturers. Present ceramic capacitors will not last more than 1000 hours at 105°C at any D.C. voltage, it is claimed. Studies were made of possible improvements, and these are embodied in Signal Corps report W36-039-SC-44575; we are sending for a copy.

2. "Expected Performance of Glass Capacitors"
Gail Smith
Corning Glass Works
Corning, N. Y.

Corning has developed glass dielectric capacitors expressly as substitutes for JAN-C-5 micas. Thin films of Corning 8871 glass, as thin as 0.0005" and with K of 8.5 are used as the dielectric. This provided negligible drift, good retrace, and temperature coefficient of 120 ppm/°C. Capacitances up to 10,000 pf. are made, in cases somewhat smaller than corresponding micas.

3. "Tantalytic Capacitors"
L. W. Foster
General Electric Company
Hudson Falls, N. Y.

Tantalytic electrolytic capacitors are much smaller and lighter than corresponding aluminum capacitors, and may have somewhat longer life under adverse conditions. They are also much more expensive, and so are chiefly useful only where size and weight are of prime concern.

4. "Progress in Size and Performance of Transformers"
G. E. Walter
General Electric Company
Fort Wayne, Ind.

A rather complete scheme for accelerated life testing of small transformers was outlined, and a modification of this may be adopted for the laboratory.

5. "Ferrite Inductor Cores"
W. W. Stifler, Jr
Ferroxcube Corporation of America
Saugerities, N. Y.

Some idea of the reproduceability of Ferrite shapes was given, but otherwise there was nothing new.

Session 6, MISCELLANEOUS COMPONENTS
Chairman, John H. Miller
Weston Electrical Instrument Corp.
Newark, N. J.

1. "Selection of Fuse Protection for Electronic Circuits"
E. V. Sundt.
Littlefuse, Inc.
Chicago, Ill.

2. "Design Factors Influencing the Reliability of Relays"
J. R. Fry
Bell Telephone Laboratories, Inc.
New York, N. Y.

Methods used to increase relay reliability include;
a. Oven drying of spacers between leaves.
b. Use of cellolose acetate for insulation between layers of coil to eleminate electrolytic corrosion.
c. Use of hermetic sealing to minimize dust on contacts.
d. Use of twin contacts.

Hermetic sealing doesn't eliminate the dust problem because wear of relay produces dust inside the seal. Twin contacts do not reduce incidence of dust failure to the extent probability would suggest, but do reduce it by a factor of 10 on the average.

3. "Vibrators for the Armed Services"
K. M. Schafer
P. R. Mallory & Co., Inc.
Indianapolis, Ind.

4. "Indicating Instruments to Use Under Severe Conditions"
F. X. Lamb
Weston Electrical Instrument Corp.
Newark, N. J.

5. "Influence of Wire and Cable on Improved Components"
F. M. Oberlander
Radio Corporation of America
Camden, N. J.

6. "Teflon Wire"
C. E. Dodge, Jr.
Warren Wire Company
Pownal, Vermont

Session 7, DESIGN AND PRODUCTION METHODS
Chairman, M. R. Briggs
Westinghouse Electric Corporation
Baltimore, Md.

1. "Production Problems Concerning Polyester Plastic Embedments"
D. G. Heitert
Emerson Electric Manufacturing Company
St. Louis, Mo.

Names of several potentially interesting plastics were mentioned.

2. "Heat Transfer from Electronic Components"
Walter Robinson
Ohio State University Research Foundation
Columbus, Ohio

Components should be rated exclusively on the surface temperature at which they operate in any application rather than on the ambient temperature, which is difficult to define.

3. "Packaging Principles Employing Plastics and Printed Wiring to Improve Reliability"
W. J. Clarke & N. J. Eich
Bell Telephone Laboratories Inc.
Murray Hill, N. J.

A number of points concerning the use of etched wiring methods were discussed. Much information on use of plastic embedment techniques was given which is of particular interest to people designing equipment for use under severe conditions but probably not to us. (The experience in the use of etched wiring, however, can be of help to us if we go to this technique).

Session 8, AN EVENING WITH TRANSISTORS
Chairman, J. A. Morton
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

1. "The Transistors Development Status at Bell Telephone Laboratories, with Demonstration"
W. R. Sittner
Bell Telephone Laboratories, Inc.
Allentown, Pa.

Life of point contact transistors can be estimated at from 75,000 to 100,000 hours, if the 20,000 hour tests already made are extrapolated. Generation of 0.1 micro-second pulses using a 6 volt power supply was demonstrated. The type A-1764 diode has properties useful in high-speed switching circuits.

2. "Demonstration of Miniaturized Components for Transistor Applications"
P. S. Darnell (See session 3, #3)
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

3. "Transistor Power Amplifiers, with Demonstration"
R. F. Shea
General Electric Company
Syracuse, N. Y.

Audio amplifier demonstrations were made.

4. "Availability of Transistors"
Lt. Col. W. F. Starr, USA
Electronics Production Resources Agency
Department of Defense
Washington, D. C.

A chart showing the manufacturers of transistors today and their ability to produce was distributed. Copies were brought back and given to Jacobs' group.

Wednesday, May 7, 1952

Session 9, ASPECTS OF RELIABILITY
Chairman, J. A. Chambers
Motorola Inc.
Phoenix, Ariz.

This was the most interesting session of the symposium to us, perhaps because it emphasized some of the things we have been thinking ourselves.

1. "Electronic Failure Prediction"
James H. Muncy
National Bureau of Standards
Washington, D. C.

NBS has developed a method of marginal checking communication equipment.

2. "Component Failure Problem in Navy Electronic Equipment"
M. M. Tall
Vitro Corporation of America
Silver Spring, Md.

The Vitro Corporation has made an analysis of component failure in Navy electronic equipment, and its findings are published in Vitro Corp. report #25, which we have. Some conclusions are:

a. Tube to other component failure ratio is about 10:1 when equipment is new. Decreases with age of equipment.
b. Resistor failure accounts for about 25% of all failures.
c. Capacitors account for 13.7% of total failures.
d. Higher rates of failure appear for components used in small quantities.
e. Component improvement seems to be a major factor in improving reliability.

The above findings are for shipboard equipment which have to operate under conditions of heat, shock, and vibration, and often excess moisture.

3. "How Can the Reliability of Electronic Systems Be Improved Now"
W. Wagenseil
Hughes Aircraft Company
Culver City, California

This paper contained some of the most usable ideas presented, and was very much in line with our own thinking. Hughes Aircraft has examined component failures in a large variety of equipment of their own manufacture, and has analysed 200,000 failures in other Government equipment. The results showed no apparent pattern of failure, and the only trend evidenced was that the quantity of failures in any equipment varied with the complexity of the equipment, as common sense would suggest. In government equipment analysed 60%-70% of all failures were blamed on tubes while in Hughes equipment 30% were ascribed to tubes, 11% to resistors and 6% to poor wiring. The conclusion arrived at was that attention to the details will improve the chances of overall reliability very greatly.

To assure that components are used most effectively Hughes Aircraft employs 60 parts application engineers to service the needs of between 3000 and 4000 research and design engineers. These engineers are experts on components and their applications and inspect all designs to be sure good components are used in the right places. (Our own Standards and Parts Reliability program is for this same purpose. When our standards book is completed it will be, we hope, a parts application handbook for all our staff to use.)

4. "Component Part Specifications"
D. E. Brown
Vitro Corporation of America
Silver Spring, Md.

MIL and JAN specs for electronic components are procurement specs. 70 are now issued and 100 more are in preparation. Much inconsistency exists between them. The Armed Forces Electro Standards Agency (ASESA) is now preparing an omnibus test spec. which collects the information from the various individual specs. This will be issued soon.

5. "A Component Manufacturer Looks at Reliability"
Leon Podolsky
Sprague Electric Company
North Adams, Mass.

The points made in 3, above, were reemphasized. A component parts group impowered to approve all components and permitted to have free liaison with manufacturers was recommended.

Session 10, ELECTRON TUBES
Chairman, C. R. Banks
Aeronautical Radio, Inc.
Washington, D. C.

1. "Sealed-in-Glass Germanium Diodes"
   J. W. Dawson
   Sylvania Electric Products, Inc.
   Boston, Mass.

   Crystals manufactured during humid months seem to give less stable operation than others. Crystal bodies with press-fit sealing are very poor under even moderately humid conditions. Those with wax impregnation are better, but the glass-sealed units now available are ideal. (Note that the speaker is a Sylvania man.) Methods were described for detecting leaks in crystals.

2. "Reliable Ruggedized Subminiature Tubes"
   P. T. Weeks
   Raytheon Manufacturing Co.
   Newton, Mass.

   The development of rugged subminiature tubes by the evolutionary process was described. Examples are the evalution of the 5784WA ruggedized subminiature dual control pentode from the 6AS6, and the 5702WA from the 6AK5.

3. "Methods for Achieving Maximum Reliability in Vacuum Tube Applications"
   R. L. Kelly
   Radio Corporation of America, Tube Dept.
   Harrison, N. J.

   Various methods of living with some of the inherent defects of tubes are described. (Preburning to stabilize contact potential of cathode, reduction of secondary emission of grids, minimizing heater-cathode leakage, etc.)

4. "Failure of Vacuum Tubes from Interface Formation"
   W. H. Kliever
   Minneapolis-Honeywell Regulator Co.
   Minneapolis, Minn.

   Interface formation in tubes used in furnace control circuits was described. Nothing new to us was presented.

The full text of all the papers presented will be published in August 1952, and a copy will be available here.

Copies to:

Taylor	Corderman
Brown	Best
Rich	Kirshner
Dodd	Jacobs
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C. W. Watt

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