

Memorandum M-1740

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Digital Computer Laboratory  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

SUBJECT: VISIT TO IBM, POUGHKEEPSIE, NEW YORK

To: N. H. Taylor

From: C. W. Watt and B. B. Paine

Date: December 3, 1952

Abstract: About one full working day was spent discussing component and production problems with the members of the Vacuum Tube Analysis Lab and with shop personnel. Emphasis was placed on trying to decide what phases of component study should be undertaken first, for maximum mutual benefit. IBM inspection and test techniques were studied.

A visit to IBM was arranged at our request to enable us to increase our knowledge of their component studies and shop practices. We spent Tuesday, November 25 talking with Jack Goetz, Bob Blessing; Dave Crawford, and Harold Ross; and Wednesday morning, November 26, in studying the inspection and test methods used in the production of the 604 and 701 computers.

Discussions with the Tube Analysis Group.

Goetz stated that the main thing he wanted to come out of our discussions was a plan of attack on the problem of evaluating components for WWII (or Project High, as they call it). He asked which component needed first attention. We said "crystals".

Accordingly he called in Crawford and Ross and we discussed what a meaningful crystal analysis might include. Their experience with crystals includes the following:

1. They have been testing samples of crystals from a large number of manufacturers. Special tests have been mostly confined to studying the effect of humidity on back resistance. Crystals of only three manufacturers so far seem to be impervious to moisture: Sylvania, Radio Receptor, and CBS-Hytron.
2. They have no field reports of crystal life, as none of their equipment in commercial use today uses crystal diodes.
3. They are using about 12,000-15,000 crystal diodes in each 701 computer being built and have designed a very clever automatic crystal tester for inspection of the large numbers of crystals needed, using the same basic test circuit as the one being considered for use here - the Heath-Crawford circuit which portrays the static characteristics of the diode on a scope.

Their proposals for systematic evaluation and life tests were discussed, and included tests of representative samples of all makes of crystals at low ( $0^{\circ}\text{C}$  or less), room ( $20^{\circ}\text{C}$ ), and high ( $55^{\circ}$  or  $60^{\circ}\text{C}$ ) temperatures. It was suggested also that the maximum reverse voltage be maintained continuously on some of the diodes being tested, that the maximum forward current be kept flowing through others, that a square wave be used on a third group, and that a fourth group be kept on the shelf, all in conjunction with the temperature tests.

It was agreed that environmental testing might tell us something about the components to be used in WWII. This testing might be done either by I.B.M. or by D.C.L., but it seemed best that this load be split among the two. Since I.B.M. already are set up to do crystal testing, they might be the obvious ones to do that phase of the program. Crawford and Ross agreed to prepare a proposal on what crystal tests they thought should be performed, both as regards a selection of manufacturer and as regards acceptance testing, and would send it to us for consideration and criticism by qualified people here. Discussions on resistor, capacitor, and other component testing and evaluation were of a general nature. Part of this work might be done here.

#### Visits to 604 and 701 Computer Assembly Lines

We wanted to find out the assembly and inspection methods used by I.B.M. on their computers which are made in production-line quantities. Bill Bowen showed us the techniques employed in the manufacture of the 604 commercial computer and Dick Johnson took us around the 701 Electronic Data Processing Machine assembly line.

The 604 computer is composed almost entirely of plugable units, each of which consists of a tube and the associated small components. This unit is about an inch square with a miniature tube socket and a loop handle on top, with about 3" of space below the tube socket for mounting the small components on plastic support rings. The means of connection to the plugable unit is a novel miniature plug. The mounting panels into which the units are plugged contain only the sockets for them, the power supply and signal wiring, by-pass capacitors, and potentiometers.

The plugable units themselves are tested by connecting them into an operating circuit and hitting the loop handle with a hammer while observing the output wave form and measuring the plate current. There is no inspection of solder connections or testing of the individual small components done at I.B.M., except for spot checking on an occasional unit. The mounting panels are wired by several girls and then all the soldering on one panel is done by one of five operators. Later, the soldering is inspected and the presence of the proper number and color of wires is determined by use of checking cards, one card for each column of sockets on the mounting panel. The proper card is held next to the row to be checked and the wires going to each connection on the socket are compared with the number of colored lines coming from each pin position on the checking card. When the plugable units are inserted into the mounting panel, and it is made ready for operation, more hammering tests are done on the whole assembly. The testing of the small components may be done by the subcontractor who assembles the plugable units. At any rate it

was not done at I.B.M.; but, no one was clear on this. Tubes were tested individually on automatic testers at the plant.

In the 701 computer there are plugable units, but each of these units may include sockets for several tubes. The components are mounted in much the same way as they are in the 604 computer, with the leads soldered to notched metal strips, which may be used as jumpers between the components, or which may be cut if jumpers are not required. The plugable unit mounts on its panel by inserting the unit and then turning a slotted shaft which protrudes from the tube-socket deck, causing a cam to slide the contacts on the plug sideways to make connection with the contacts on the socket of the mounting panel. This eliminates the need for large insertion and withdrawal force due to the large number of contacts on the connector. All of the components in the plugable unit are tested individually, and in some cases a resistor is color coded to indicate in which part of the tolerance range its resistance value falls. The mounting panels are wired in much the same fashion as those in the 604 computer, but each soldered joint in the plugable unit and on the mounting panel is inspected individually. The mounting panel with the plugable units installed undergoes a hammering test, while the currents are being measured and the output wave forms are being observed.

The casual nature of the inspection of the 604 computer may be due to its intended use, which is entirely commercial. If the machine should fail to perform for a customer, he would turn off the machine and call one of the company's customer engineers. The customer makes no attempt to service the machine himself. In fact, all access doors are locked. The 701 computer is intended for more critical military uses and the inspection done on it seemed far more adequate.

Several types of jigs were being used in the assembly of both computers, and these may be of interest to us for use in our own shop. We will contact the manufacturer to obtain information on them.

The trip enabled us to become better acquainted with the people at I.B.M. dealing with problems similar to our own in component evaluation, and allowed us to see exactly to what extent their component testing program has progressed.

Signed: BB Paine

Signed: Crowatt

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