Division 6 - Lincoln Laboratory
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SUBJECT: JOINT MIT-IBM MEETING ON MEMORY-CORE MEASUREMENTS, September 1-2, 1953

To: Jay W. Forrester

From: D. R. Brown

Date: September 4, 1953

Abstract: A two-day joint meeting was held to discuss measurement and evalua-
           tion of ferrite memory cores by MIT and IBM. During the first day,
           at Poughkeepsie, the specifications for selection of cores for the
           WWI bank-B memory and the second MTC memory were reviewed. The
           cores are selected to have disturbed-one voltages within plus or
           minus 15 percent of the mean. Modified specifications for RCA-
           Victor cores were discussed. Plans for a "round-robin" on core
           measurements were made to coordinate measurements at MIT, IBM,
           (Plant 2 and High Street), General Ceramics, and RCA Victor. During
           the second day, at RCA Victor in Camden, measurements and progress
           by RCA were discussed. The cores there look good after preliminary
           observations, but techniques and test equipment must be improved
           to permit refined evaluation.

A meeting at IBM Plant 2 held on the morning of September 1, 1953,
was attended by J. Goetz, J. Johnson, H. Heath, N. Edwards, J. Crowe, M. Haynes,
N. Tarnoff, D. Brown, and J. McCusker.

McCusker discussed the selection of memory cores for the WWI bank-B
memory and the second MTC memory. The MIT semiautomatic core tester is being
used to select good cores. Refer to Engineering Note E-563, page 7:

4.0 Electrical Specifications

    4.1 Test Conditions

    4.11 The Current Pulse

        Overshoot and droop have not been determined and their magni-
tudes are uncertain. The current pulse amplitude, I_p, is determined approxi-
mately 1 microsecond after the reference time. Both overshoot and droop
probably exceed the specified 2 percent.

            T_d = 2.0 microseconds

            T_r = 0.2 microsecond

            T_f = 0.3 microsecond

    4.12 The Pulse Sequence

        The basic prf used is 10,000 cps. n = 8 and 64.

4.2   The Pulse Response

The pulse response is measured at a temperature between 23 and 25C.

I_m amp	T_m μs	T_p μs		$_r V_1$ v	
		min	max	min	max
0.920	---	---	---	0.130	---
0.835	0.6	0.53	0.67	0.100	0.130
0.750	---	---	---	0.070	---

The peak amplitude of $_r v_1$ must fall within the limits specified at the middle current. At the two extreme currents, $_r V_1$ is not determined, but the peak amplitude of $_r v_1$ must exceed the minimum specified for $_r V_1$.

During the month of August, General Ceramics shipped over 130,000 cores to MIT. The total number of cores tested is 46,235 and the number of cores accepted is 28,551, a yield of 62 percent. Samples of each lot shipped from General Ceramics are being evaluated for delta voltages, but this evalua-tion has not been able to keep up with the semiautomatic core testing. Most of the cores delivered to the magnetic-memory section at MIT have been selected only according to the specifications listed above.

Successful operation of the semiautomatic core tester has required many refinements in measurement technique. The nonlinear response of the pre-amplifier in the Tektronix Type-513 scope has required the design and use of a special preamplifier. The semiautomatic core tester is calibrated daily. The Weston Model 931 meter used with the current calibrator is checked against a potentiometer and the precision resistor for measurement of current is checked against a four-dial Wheatstone bridge.

During the afternoon, standard cores from MIT were measured on the core testers at Plant 2 and High Street. At Plant 2, poor current waveforms prevented an accurate check with the MIT cores. No standards were available for checking the voltmeters used or the current-measuring resistor. McCusker was able to duplicate readings obtained at MIT within 5 millivolts. This difference could easily be due to an error in scope calibration or drift in the current-measuring resistor.

Goetz, Edwards, and Brown discussed specifications for RCA Victor cores. Referring again to Engineering Note E-563, pages 6 and 7, the specifications might be modified in the following manner. The inside diameter of the core should not be below 0.050 inch. The outside diameter should not increase beyond 0.100 inch. The mid-range value of I_m should be held to 0.82 ampere. Switching time, T_s, should be between 1.00 and 1.25 microseconds.

Any sampling time, T_m, will be accepted provided the following conditions
are met: (1) the ratio of $_rV_1$ to $_rV_z$ should be greater than 125, (2) the
ratio of $_rV_1$ to $_rV_{hl}$ should be greater than 250, and (3) the ratio of $_rV_1$ to $_rV_{hl}$
minus $_rV_{hz}$ should be greater than 500. The minimum mean value of $_rV_1$ should
not be below 0.1 volt. Acceptable cores should be within plus or minus 10
percent of this mean.

A "round-robin" for the purpose of establishing an agreement on
memory-core measurements should begin during the week of September 7. MIT
will conduct the first "round-robin". Core testers will be visited in the
following sequence: MIT, IBM, General Ceramics, and RCA. The person con-
ducting the "round-robin" should have standard cores and curves showing the
following: $_rV_1$ vs. I at standard temperature, $_rV_1$ vs. temperature at I_m,
T_s vs. temperature at I_m. In addition, the following data should be available:
$_rV_z$ at standard temperature, $_rV_{hl}$ and $_rV_{hl}$ minus $_rV_{hz}$ at standard temperature.
When the person conducting the "round-robin" arrives at a particular test
location, the standard cores should be measured by the people who normally
operate the equipment at that location. Some test equipment should be carried
by the person making the "round-robin". This equipment might include a standard
voltmeter or potentiometer, a resistance bridge, a current calibrator, an
oscilloscope, etc. A "round-robin" will be conducted each week by MIT, the
Tube and Component Analysis Laboratory, and Project High, in turn.

The second day was spent at RCA Victor, Building 1, in Camden.
Those participating included: J. Goetz, J. Johnson, R. Blessing, N. Edwards,
D. Brown, and J. McCusker. The core tester at RCA employs two Model V and
two Model VI core drivers. The waveforms from the Model V core drivers
were very poor; so poor that the Model VI drivers were used to provide read
and half-read pulses. Waveforms from the current calibrator were also poor.
Again, accurate measurements could not be made. No standards were available
for checking the voltmeter or the current-measuring resistor. McCusker
was able, however, to obtain agreement within 5 millivolts after adjusting
the current waveform so that symmetrical response of the core was obtained
in a simple read-write mode. MIT will send four good Model V core drivers
to RCA as soon as possible.

A short conference was held at RCA which included, besides those
mentioned previously, R. Beshgetoor, A. Harding, G. Hipskind, and D. Koch.
Harding explained that he had had some trouble with batches recently because
the calcium content was excessive. Calcium has now been reduced to the point

where it will not cause trouble and successful batches can now be made.
Harding is conducting a series of experiments varying the molding pressure.
He believes he will have to modify his press to obtain higher molding pressures
before satisfactory cores are obtained. The current series of experiments
should be finished by the end of the week of September 7. Preliminary observa-
tion of some of Harding's recent cores look good. Samples from three recent
batches were turned over to MIT for detailed measurements at MIT.
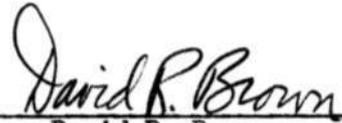
Signed _____David R. Brown_____
David R. Brown

DRB/jk

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