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SUBJECT: EVALUATION TESTS ON THE XD-1 CENTRAL COMPUTER

To: N. H. Taylor

From: W. J. Canty, J. D. Crane and S. L. Thompson

Date: 21 January 1955

Approved:
J. A. O'Brien

Abstract: XD-1 is to be evaluated by a series of tests made over a period of a few weeks ending March 1, 1955. Existing XD-1 reliability programs will be used during most phases of test. Machine operation will be based on its logical and physical completeness, reliability, margin data, and its ability to withstand mechanical and thermal shock.

I. INTRODUCTION

The thoughts expressed herein represent in outline form a method of evaluating the progress of the XD-1 central computer towards its final goal. The first group of tests to be performed on XD-1 should be completed by March 1, 1955. For these tests, a group of reliability programs has been selected. These programs as a group should completely exercise all parts of the machine (with exception of the selection control frame) completed by that date. The programs are:

Card Machine Reliability	RCM 01
Hard Core Reliability	RCC 01
Program Control Reliability	RCC 02
Arithmetic Element Reliability	RAE 01
Divide Reliability	RAE 03
Manual Operations Reliability	RCC 03
Memory Reliability (Complement checkerboard check for one memory with instructions in Plugboard storage)	TMM 02

This note represents an expansion of 6M-3271, "XD-1 Test Specifications," by J. A. O'Brien, dated 7 January 1955. While this note is by no means intended to be complete in minute points of detail, it is hoped that it will present a logically complete method of evaluation of performance for the XD-1 Computer.

Most of the evaluation data for these tests will be taken from the maintenance logs and summaries thereof. A small amount of the

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The research reported in this document was supported jointly by the Department of the Army, the Department of the Navy, and the Department of the Air Force under Air Force Contract No. AF 19(122)-458.

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test may be made by the MIT test group.

The evaluation will be divided into five parts:

1. Programs which will test logical functions of the computer
2. Reliability:
   a. Test of equipment reliability over a prolonged period
   b. A run of specific programs on central computer for an extended period of time such as 8 hours.
3. History of Margins
   a. Daily marginal data
   b. Trends in margins
4. Shock tests
5. Analysis of completeness of computer
   a. Physical
   b. Logical

II. OUTLINE OF TESTS

1. Logic Test

a. In this test we expect to measure the ability of machine to perform all of its intended logical functions.

b. We will measure it by running for the most part, a series of reliability programs designed to exercise all parts of the machine.

c. We expect that the computer will at some time during the test period run through, at least once, each of the above-mentioned programs.

2. Reliability

a. In this test we will measure:

1. Equipment reliability over a prolonged period
2. Equipment reliability over a 1 shift period under closely controlled program conditions

b. We will measure the above qualities by:

1. Analysis of the XD-1 maintenance logs. Detailed breakdown of the number of failures, type of failures, time lost, etc., will be kept.

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2. Running a comprehensive set of reliability programs which will exercise all parts of the central computer. This comprehensive program will be made up of existing reliability programs which will be pieced together to suit our purposes. This set of programs will be run over a pre-scheduled period of 8 hours with data on program errors, downtime, etc., accurately kept. The use of integral programs, rather than a single composite program, is suggested. This would make fault analysis easier.

c. We expect that:

1. Equipment reliability will show improvements from the day data is started. During the period February 14-28 inclusive, the average time between failures will be greater than 10 hours (of clock time). The percentage reliability will be at least 75% for both scheduled and unscheduled periods. Definitions of percentage reliability and average time between failures will be given in a note soon to be published by J. D. Crane.

2. During the comprehensive pre-schedule 8-hour run, there will be no more than one failure. The computer must be in operating condition for at least 7 hours during the 8 hour test period.

3. Margins and Margin History

a. We expect to measure:

1. Margins on all available lines taken at first, manually, then at a later date automatically, using standard reliability programs for the most part. This test period is to start as soon as possible.

2. Marginal check history to expose units which deteriorate abnormally.

b. We will measure this by:

1. Setting up a daily routine as soon as possible of marginal checking on the computer. This routine will take approximately one hour per day; it will utilize, for the most part, presently available reliability programs. Manual MC methods will be used at first to get accurate MC data; then, at some time in the near future, these will be supplanted by automatic methods. Accurate MC data will be kept in the log.

2. Analysis of MC records over a relatively long period.

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c. We expect that:

1. All margins will be adequate as experience on Whirlwind I and MTC indicate.

2. No circuits will have abnormally deteriorating margins, etc.

4. Shock Tests

a. In this test we expect to measure:

1. Ability of tubes in computer to withstand mechanical shock.

2. Ability of pluggable units and frames to withstand mechanical shock.

3. Ability of computer to withstand the shock of power-off - power-on sequence.

b. We will measure the above qualities by:

1. A tube tap test. Tapping a large sample of tubes in the computer; this sample being evenly distributed throughout the modules of the machine while appropriate programs are run.

2. A P.U. jiggle test. That a large sample of P.U.'s will be vigorously moved (by grasping their handles) in a manner as to subject them to a large amount of vibration. That in addition, frames will be struck with some objects of large mass (604 hammer test) and with the machine stopped, a large number of pluggable units will be uncammed, removed and then replaced, and the machine will be restarted.

3. The power-off, power-on test -- the computer will be put in a power-off state for 1 hour and then returned to a power-on status. This test should be repeated two more times. It is expected that this test will take place over at least a three day period.

c. We expect:

1. That no more than 1% of the tubes tapped will exhibit tube tap shorts. This figure excludes tubes which exhibit microphonic tendencies as a result of the nature of the circuitry they are used in. Example: V1 of all sense amplifiers of memory.

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2. That 100% of the pluggable units vibrated in a manner so described above will not cause machine errors; likewise, no frames will be sensitive to vibration, and that 100% of all pluggable units removed can be re-inserted without failure of the unit or its connections.

3. That the average down time after each of the power-off, power-on sequences shall be no more than one-half hour.

5. Logical and Physical Completeness

Work in this section will consist of seeking out knowledge of the logical and physical state of the machine. A critique of the condition of XD-1 at the end of the test period (on 28 February 1955) will be made.

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