

Memorandum 6M-3940

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Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
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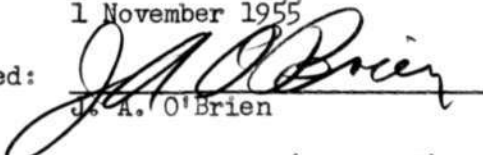
SUBJECT: RESULTS OF THE SYSTEM TEST (PHASE II) PERFORMED ON THE
AN/FSQ-7 (XD-1) DURING JULY, AUGUST, AND SEPTEMBER 1955

To: N. H. Taylor

From: J. D. Crane

Date: 1 November 1955

Approved:


J. A. O'Brien

Abstract: A system test (phase II) was performed on the magnetic tapes and fifteen addressable drum fields. Reliability figures for the central computer before drums and tape units were placed under surveillance showed that the computer continued to operate correctly about 90 to 95% of the time. Interruptions occurred every two to seven hours depending on the mode of computer operation. After drums and tapes were included, the interruptions occurred every one to three hours and the percentage of usable assigned time remained about the same.

Precision resistors continue to be the only components which showed excessive failure rates; most of these failures were in the drum frames. Extensive work is being done to correct this situation.

Voltage margins are adequate; only one specific case requires improvement.

Performance of both core memories has improved since the last evaluation in June 1955.

The fifteen addressable drum fields and the magnetic tapes (including the tape adapter frame) performed all the operations specified in the system test specifications.

A few minor mechanical deficiencies (labels, markings, covers, etc.) still exist.

1.0 INTRODUCTION

The second in a series of system tests to be performed on the AN/FSQ-7 (XD-1) was conducted during the months of July, August, and September. This test consisted of four demonstration runs and a survey of the performance of the central computer, magnetic tapes, and fifteen addressable drum fields.

1.1 Demonstration Runs

Each of the four demonstration runs lasted about three hours; Air Force and MIT representatives attended these demonstrations. Computer operation was controlled by IBM engineers.

1.2 Performance Records

Records of computer performance and circuit margins were compiled for the months of July, August and September. Basic data for this analysis was taken from log book summaries and margin check reports issued by IBM. Drum reliability studies began on 22 August.

2.0 EQUIPMENT AND LOGICAL FUNCTIONS SUBMITTED FOR ACCEPTANCE

A list of equipment and instructions included in the test are presented in "XD-1 System Test Plans for Magnetic Tapes and the Auxiliary Memory Drum Fields," 11 August 1955 by Messrs. H. L. Kurkjian and F. D. Schulman of IBM.

The following list of equipment is presented in this report to furnish the reader with an over-all view of the equipment being tested.

1. Four magnetic tape units (including manual controls and circuits in the central computer associated with tape operation).
2. Fifteen magnetic drum fields (including manual controls and central computer circuits associated with operation of these drum fields).

<u>Drum</u>	<u>No. of Fields</u>	<u>Octal Code</u>
AMA	6	02 through 07
AMB	6	10 through 15
MIXD	2	20 & 21 (spares)
MIXD	1	26 (1C own)
	<u>15</u>	Fields Total

3.0 RESULTS OF ACCEPTANCE TEST DEMONSTRATION

Test Demonstrations were run on 23 August, 25 August, 30 August and 1 September 1955.

3.1 Logical Completeness

The equipment performed all of the specified logical functions. All of the required programs ran successfully.

3.2 Physical Completeness

All of the specified equipment was delivered and installed. It was noted, however, that some minor mechanical deficiencies or inadequacies existed (see table I).

3.3 Reliability During Demonstration Runs

A summary of reliability during the four test runs is as follows:

Total Time	10.77 hours
Lost Time	.52 hours
Number of Failures	7

Percentage of Usable Assigned Time 95.5%

Mean Good-Time Between Failures 1.5 hours.

Four of the failures (2 drum parities and 2 halt errors) were unexplained, but operator error was the most reasonable explanation for their occurrence. One unexplained core memory parity occurred. Also, a tape unit failed to make the transition from high-speed to low-speed rewind. Seven minutes were lost when tape parity errors were noted. A possible explanation for the tape parities is that they occurred near the end of tape where dirt and tape damage are most likely to cause trouble.

4.0 XD-1 PERFORMANCE DURING JULY, AUGUST AND SEPTEMBER 1955

The XD-1 log book entries were kept by IBM engineers for the period including 1 July 1955 through 2 October 1955. These records were used as the source material for preparing this study of computer performance.

4.1 Equipment Included in Records

Failures which occurred in the equipment under test (see Section 2.0) and the equipment included in the first system test (see MIT Memorandum 6M-3853) are included in this reliability study. The study of drum reliability includes all component failures which occurred in the drum control frame (frame 21) and the drum housing frame (frame 22). Consequently, drum reliability studies were not confined to the

fifteen drum fields under test. As the various pieces of equipment were added to the system they were included in the reliability studies. A list of the equipment included in the intervals shown in the reliability figures (see Fig. I, II and III) is as follows:

Interval	Dates	Equipment
"A"	13 June - 4 July	Central computer equipment listed in System Test Phase I (reported previously in 6M-3853).
"B"	5 July - 22 August	Same as "A" above.
"C"	22 August - 2 October	All equipment in "A" plus the additional equipment for System Test, Phase II.

4.2 Limitations of the Record System

Log entries for the central computer are quite complete, and drum system-failures are now being recorded as part of the XD-1 log on IBM cards. The reliability figures reflect the usefulness of the equipment during its various applications; most of the time included in this system test was spent on routine maintenance and testing recent equipment installations.

4.3 Results of the Reliability Study

A comparison of the results of XD-1 reliability studies for the period including 13 June through 2 October 1955 is summarized in bar-graph form in Figs. I, II and III. The only components which showed excessive failure rates were resistors (see Fig. II). These failures were most prevalent in power cathode follower circuits located in core memory II (frame 10) and the main drum control frame (frame 21).

A decrease in reliability was expected when interruptions resulting from drum and tape failures were included in reliability studies. This is evident in the "mean good-time between failures" indication in Fig. I.

Group 61 (MIT) used about 4% of the assigned computer time. Reliability during this application was as follows:

	<u>4 July - 22 Aug.</u>	<u>22 Aug. - 2 Oct.</u>
Percentage of Useful Assigned Time	93%	87%
Mean Good-Time Between Failures	1.9 hrs.	1.19 hrs.

5.0 MARGINS AND MARGIN HISTORY

Margins on most of the circuits submitted for test were greater than $\pm 20\%$ of the supply voltage or within the bounds determined by safety limits.

5.1 Margins Which Were Less than $\pm 20\%$ of Supply Voltage

Circuits which did not meet the arbitrary $\pm 20\%$ criteria but were considered to be satisfactory are as follows:

<u>Basic Circuit</u>	<u>Margins (% of supply voltage variation allowed)</u>	<u>Marginal Check Voltage</u>
bFF (Flip-Flop)	$\pm 16\%$	-150 volts
DWa (Drum Writer)	$\pm 10\%$	-300 volts

One instance where a margin needs to be improved is as follows:

1. The positive margin on the address register gates (m.c. line +90 volts 4A1) is only +14 volts - it should be 25 volts.

6.0 SUMMARY

The performance of the magnetic tapes and the fifteen drum fields during the system tests (including demonstration runs and the reliability period) was satisfactory. Records show that the computer was operating correctly about 90 - 95% of the time and errors occurred about every two to seven hours (depending on the mode of computer operation) before tapes and drums were included in reliability calculations. Addition of tapes and drums affected the reliability by decreasing the time between failures to one to three hours. New log book forms were instituted on 22 August 1955 to facilitate entries of alarm indications; this situation was slightly responsible for an increase in the number of failure or failure indications noted.

Programs designed to test the logic of the equipment under test all ran correctly. No drum failures were noted during the extended demonstration runs; tapes, however, showed parity alarms.

6.1 Card Machines

No special tests other than normal operation were made on card machines during this period. Improved maintenance methods and use of a different card indicated an increase in reliability during normal operation (such as operation by Group 61, MIT). More data regarding the operation of the card machines will be gained as maintenance people exercise the equipment using the strenuous tests which were included in the system tests performed in June 1955.

6.2 Core Memories I and II

Improvement in core memory operation has been satisfactory. This improvement resulted in increased reliability.

6.3 Voltage Margins

With one exception, the voltage margins appear to be good.

6.4 Components

One-percent precision resistors continue to be the principle component failure category. Other components, including tubes and diodes have been giving little trouble.

6.5 Physical Deficiencies

This report points out deficiencies other than those noted previously which are corrected or are being corrected.

TABLE I

Minor Mechanical Deficiencies and Omissions Noted on XD-1

- A. Markings Not Complete on Frames and/or Plug-In Units
1. Labels on audio selector and volume control.
 2. Z module circuit breaker labels.
 3. Frame designations (installation of top covers obscures view to existing markings).
 4. Tube designations (some plug-in units and also memory driver panels).
 5. Serial numbers and function designations (Xa, Xb, etc.) for core memory driver panels.
 6. Filament meter label on a.c. and d.c. power panel.
 7. Printer, punch, and reader unit-designations.
- B. Weak Design
1. "Diode cans" used in the drum frame are not mechanically stable.
- C. Miscellaneous
1. No fuse cover on printer.

Signed: _____

John D. Crane
John D. Crane

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Drawings attached

A-75692
A-75693
A-75694

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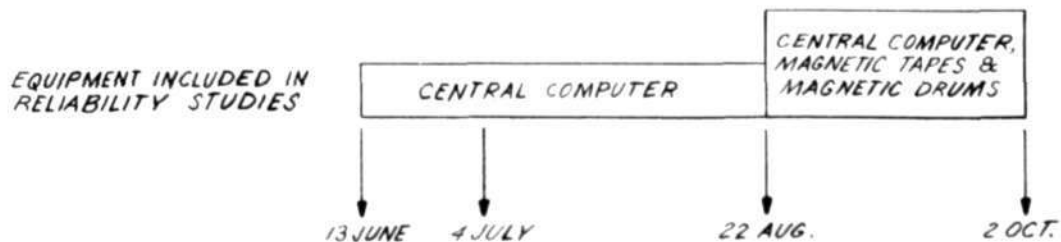
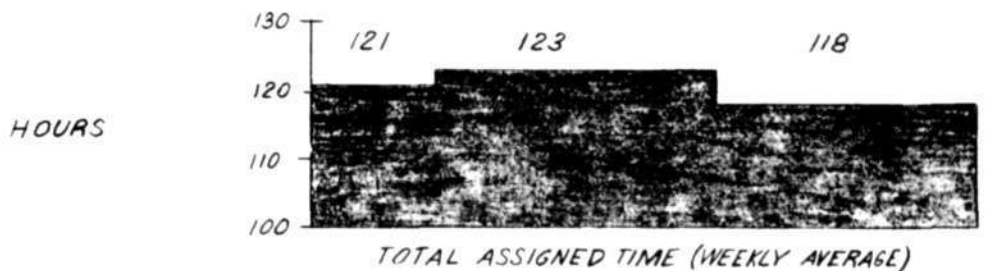
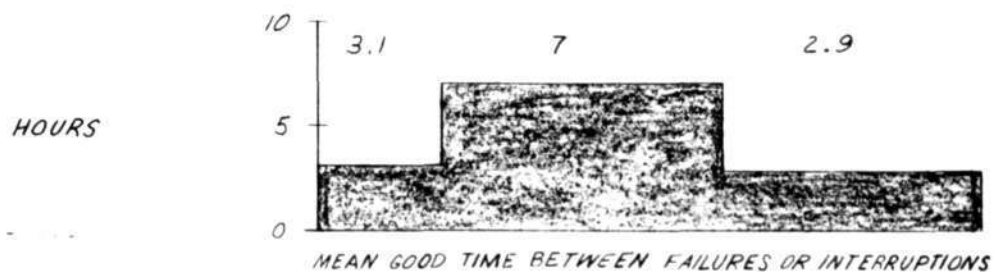
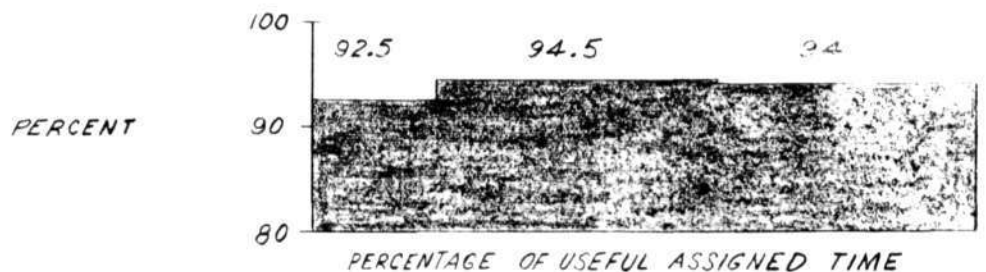


FIG. 1
AN/FSQ-7 (XD-1) RELIABILITY,
13 JUNE 1955-2 OCTOBER 1955

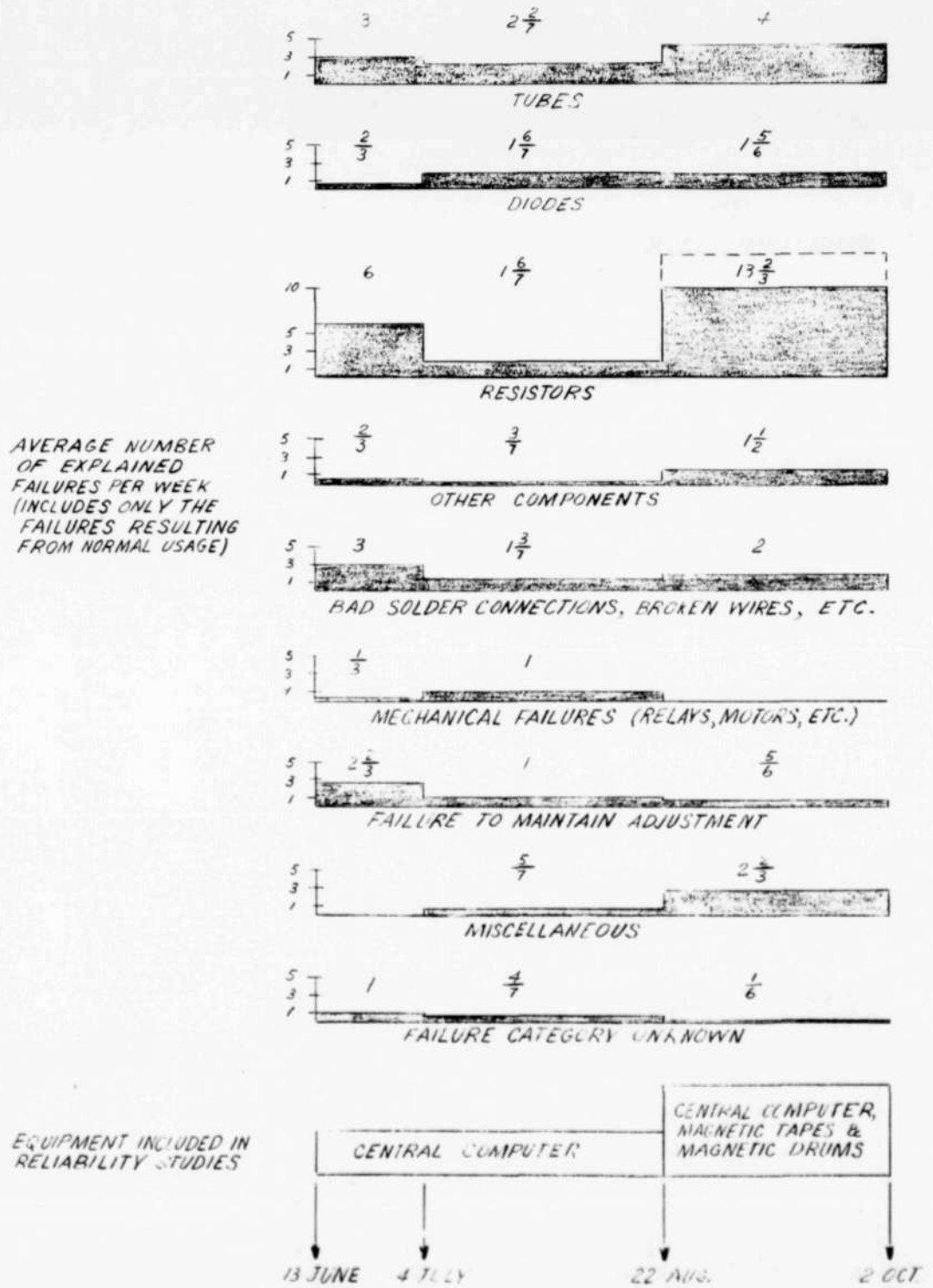


FIG. 2
EXPLAINED FAILURES IN AN/FSQ-7 (XD-1),
13 JUNE 1955 - 2 OCTOBER 1955

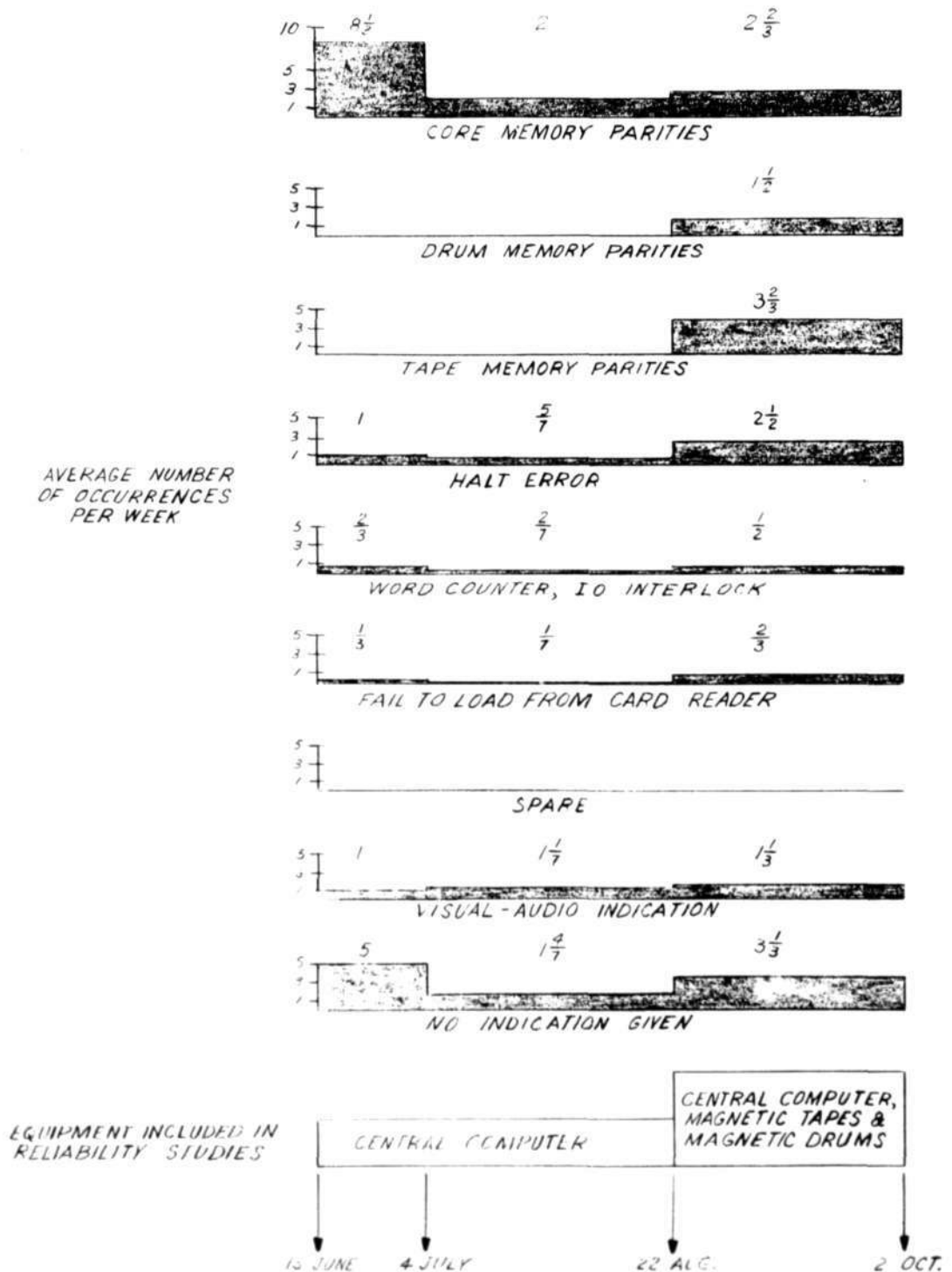


FIG. 3

UNEXPLAINED FAILURES IN AN/FSQ-7 (XD-1),
13 JUNE 1955-2 OCTOBER 1955