

Memorandum 6M-4270

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Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
Lexington 73, Massachusetts

SUBJECT: XD-1 SYSTEM OPERATION & RESULTS OF SYSTEM TESTS FROM 3 DECEMBER
1955 THRU 10 MARCH 1956

To: N. H. Taylor

From: C. W. Watt

Date: 28 March 1956

Approved: 
J. A. O'Brien

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Abstract: The reliability of the XD-1 system has in general improved since the last report was issued (Memo 6M-4100 covering November, 1955)

Overall reliability - up from 89% in December to 95% in February.

Mean-good time between failures: No appreciable change.

Lowest - 3.0 hours/biweekly period

Highest - 4.9 hours/biweekly period

Assigned time: Increased almost to the 168 hour per week limit during January, February and March.

The tape drives are giving excessive trouble; these are being studied actively by both MIT & IBM to try to determine the cause.

During January the Output System and the Auxiliary Drum System were successfully acceptance tested.

GENERAL

The fifth and sixth group of system tests on XD-1 were performed during January, 1956, and were designed by IBM to show the logical completeness of the Output System and the Auxiliary Drum system. Because of the speed with which the latter system was installed and tested by IBM, the test of this system occurred nearly a month before it was scheduled originally. The tests on each system and their results are discussed in sections 1 and 2, and section three is devoted to a summary of the operation of the whole XD-1 system over the period of the past three months.

I. OUTPUT SYSTEM TESTS

The tests performed and an outline of the programs used are described in the IBM document, "System Test for the XD-1 Output System" by R. F. Murray, dated January 6, 1956. The tests were divided into two demonstrations, each of slightly more than three hours. The first demonstration was run on January 26, 1956, and the second on January 31, 1956. The tests were observed by Lt. F. G. Camp for the Air Force and C. W. Watt for Lincoln.

A. Test Results

The output system passed satisfactorily all the tests specified in the above document. One error not specifically induced, occurred during the whole period. Its cause remained unexplained, but the symptoms suggested that it was not directly due to the output system. The diagnostic power of some of the programs used was demonstrated by deliberately inducing a trouble and using the procedure outlined in the program writeup to locate the pluggable unit giving the trouble. Such programs do not exist for every part of the machine, but where they do exist, they are powerful tools for the diagnosis of trouble.

B. Equipment Included in Test

The output system of XD-1 consists of an output control section and an output storage section. This equipment was complete when demonstrated. The latter can feed up to eight types of external equipment, but the specified complement of output equipment in XD-1 will feed only three, the Ground-to-ground phone lines, (or X-tell outputs), the Ground-to-Air phone lines (or G/A outputs), and the automatic teletype phone lines (or TTY outputs). The tests did not include the Digital Data Transmitters.

C. Description of Tests

The tests were designed to verify explicitly the logical functions of the output system as set forth in M-2697, "Output System Performance Specifications", and in M-2863, "Proposed Changes to Output System Performance Specifications," dated 1 March 1954 and 11 June, 1954, respectively. A summary of the tests performed, programs used, time required and expected results is included in the IBM write-up referenced above.

In brief, the following test conditions were set up for the system tests.

1. The G/G or X-Tel output was looped to one X-Tel input channel
2. The two G/A output phone lines were looped into one LRI input channel, and the G/A output message was modified in such a way that the LRI channel could accept it
3. One teletype output was fed to the teletype monitor and to the teletypes in the teletype room. Both separate and simultaneous operation of the loops were shown. In addition the various logical operations were demonstrated by special setups, and the internal frame loops in the output frames were shown.

D. Comments

1. During the program that exercised the three output sections simultaneously one failure occurred during the G/A section of the program in the form of a "parity no good" alarm. The trouble occurred only once, and could not be repeated. The IBM engineers were of the opinion that the trouble was not in the output system, but rather in the output buffer drum, and this seems probable.
2. During the G/A - LRI loop test it was pointed out by IBM that only channels 1-4 of LRI could be used reliably because of open coax jumper shields. This has now been corrected.

II. AUXILIARY DRUM SYSTEM TESTS

The tests performed and an outline of the programs used are described in the IBM document "XD-1 Systems Test for Auxiliary Drums", by W. E. Glass and W. E. Triest, date 1 January 1956. The test consisted of one demonstration period of two hours duration, which was held Thursday, February 2. It was observed by Lt. F. G. Camp for the Air Force, and C. W. Watt for Lincoln.

A. Test Results

The Auxiliary Drum System passed satisfactorily all the tests specified in the above document. The program AXD-01, which writes and checks the reading from all auxiliary drum fields, was run for one hour with no interruptions. During this period about 90 passes were made thru the program.

B. Equipment Included in Test

The 6 AXD drums, Frame 20, and the AXD marginal check and manual test equipment were demonstrated. All electronic equipment was complete. No power off light is provided on the maintenance console for the Auxiliary drums, however, and installation of covers on the frames is incomplete.

C. Description of Tests

The tests were designed to demonstrate the logical completeness of the Auxiliary Drum system and that it met the design specifications as set forth in the IBM document IM 70-2 "Drum System Specifications for XD-1". The following general areas were demonstrated:

1. The manual test facilities for the Auxiliary drums were shown. The patterns that can be written in manual test are limited in number by the pattern selector switch and the complement test switch. These were shown, as were the drum erase features.
2. The AXD key interlock, that disables the facility for writing on the Auxiliary Drums, was demonstrated.
3. Marginal checking circuit operation was shown.
4. Writing and reading on all drum fields was demonstrated.

D. Comments

The operation of all portions of the AXD system test was successful. Two right overflow alarms appeared about one half hour apart during the operation of AXD-01, with no effect. They appeared to be associated with the stepping of the real time clock to the end of its register, and were irrelevant to this test.

III. SYSTEM OPERATION DURING DECEMBER, JANUARY, AND FEBRUARY

The operational record of XD-1 is summarized on the three charts attached. These show the following:

A. Operational Time

This increased at a steady rate until the last two weeks of February, which averaged 163 out of 168 possible hours per week. This is almost the maximum, and because of the fact that 10 or 12 hours a week are usually used by IBM for installation and maintenance, the average time per week will probably stay about this figure for some time to come.

B. Overall Reliability

Despite the increase in equipment in use and the longer hours, the percentage of useful assigned time increased from 86% at the beginning of December to 96% during January. The mean-good time between errors increased, and then in March has decreased.

C. Component Reliability

Failures of precision resistors seem to be much less prevalent, and the numbers of failures that could be attributed to resistors dropped toward the end of the three month period, as the chart shows.

Failure of tubes and diodes seemed to be rather extensive; no particular trend can be noted on the charts.


D. Reliability of Various Areas of the Machine

More trouble was experienced in the use of the tape drives than in any other area of the machine. Despite the joint efforts of IBM and MIT the causes of this trouble have not yet been identified, and therefore it cannot be stated positively that the equipment is the prime cause. An intensive study of the failures is now being made as they occur, and group 67 has given programs that cause trouble to IBM to be run during Maintenance periods, in the hope that errors can be duplicated under controlled conditions. The troubles afflicting tape usage strikes hardest at Group 67, which uses tapes extensively in the checkout of the operational program. Most of the recorded failures occurred during their scheduled periods of operation, and hence did not affect the overall reliability figure nearly to the extent that they affected the Group 67 operations. For example, during a two week period toward the end of February, Group 67 reports that of thirty hours of scheduled operation using the tapes, twelve

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and one half hours or 42% were lost, mostly due to tape troubles, and this lost time caused duplication of effort during the remaining time that amounted to 22% of the allotted time. Thus only one third of this particular thirty hour period was available for useful work. It remains to be seen whether this lost time will finally be assessed against tapes or programs.


C. W. Watt

CWW:mf

Attachments:

SA-65751

SA-65752

SB-65753

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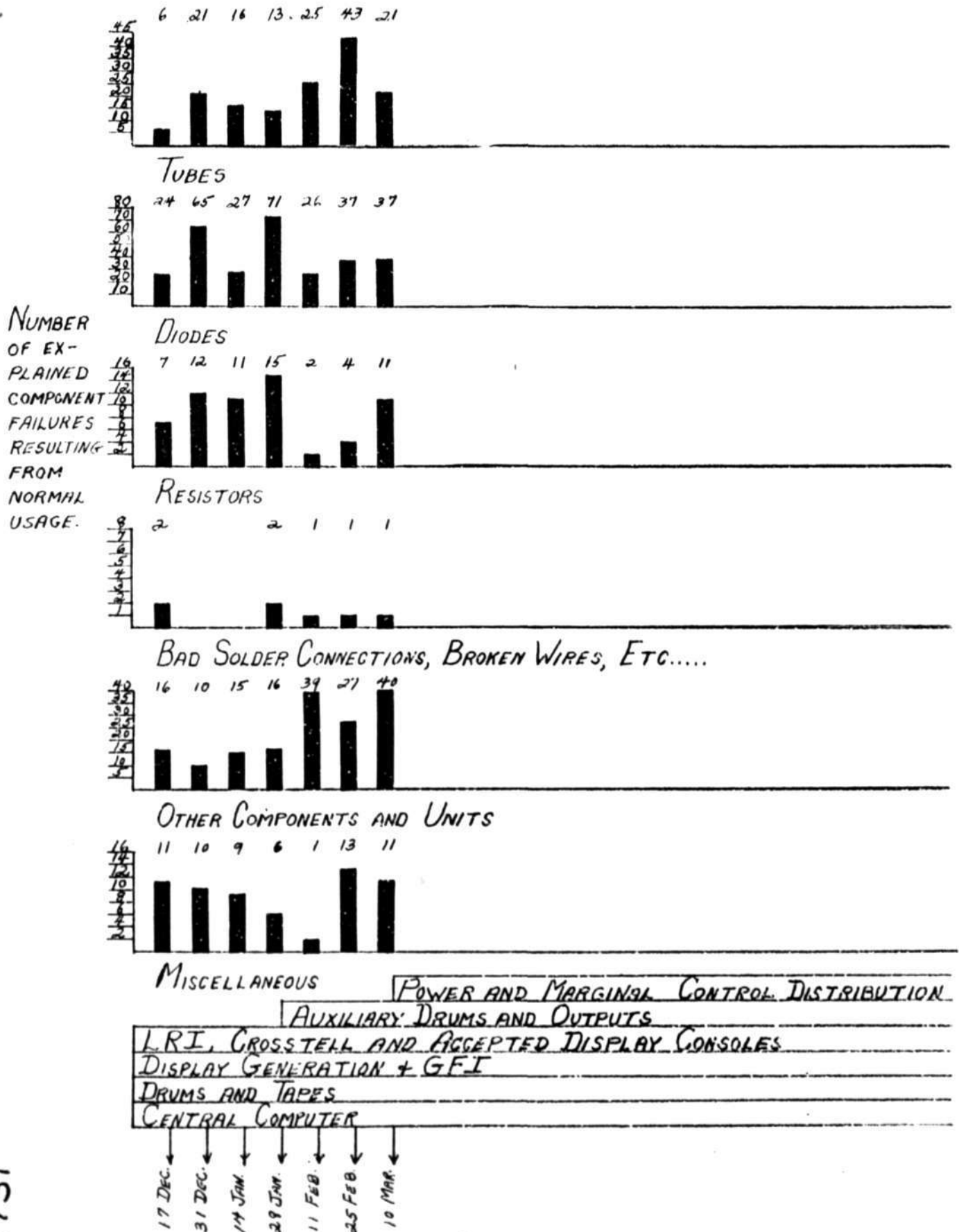
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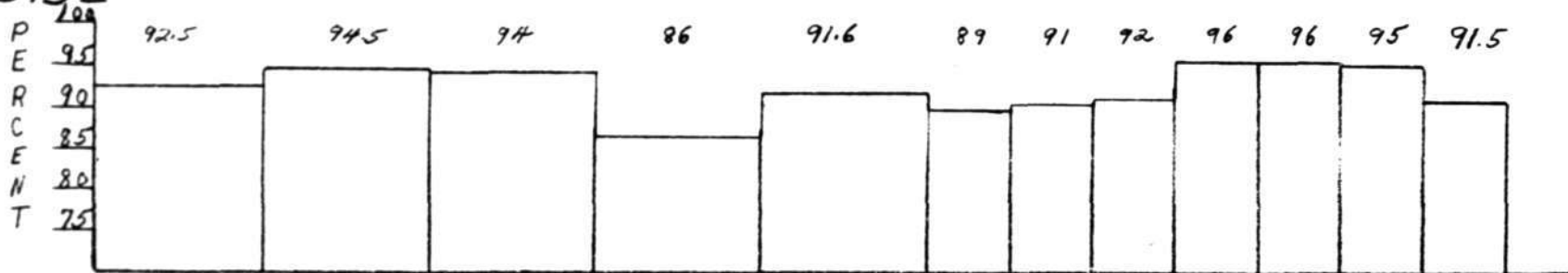
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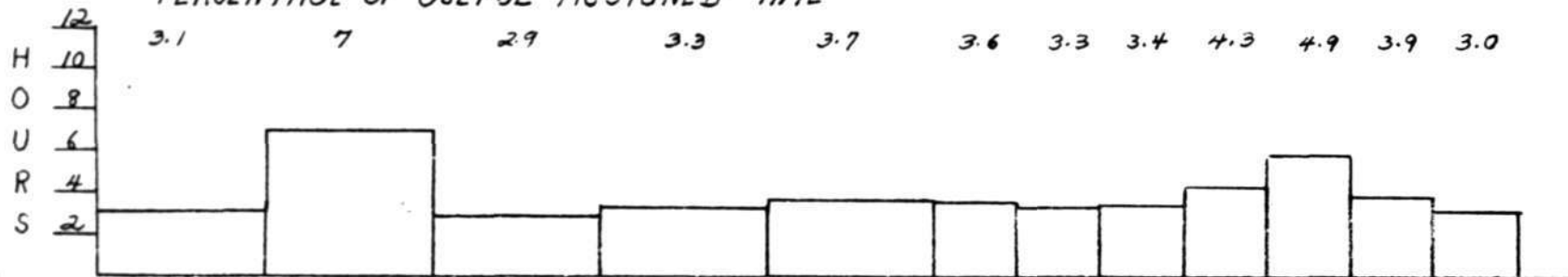
EQUIPMENT INCLUDED IN RELIABILITY STUDIES

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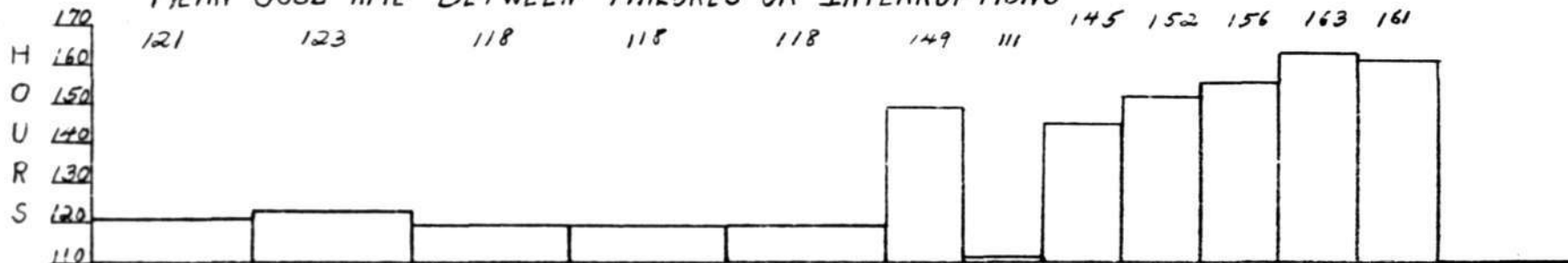
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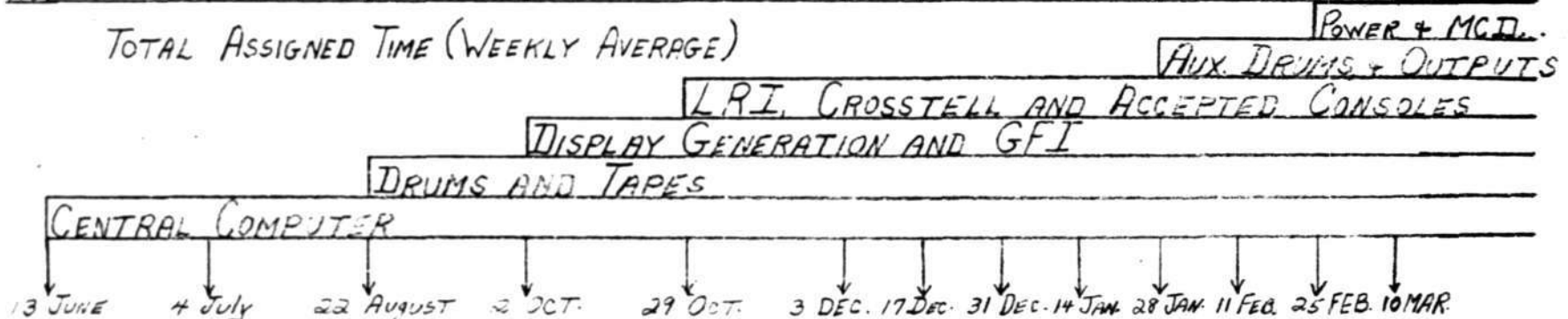
PERCENTAGE OF USEFUL ASSIGNED TIME



MEAN GOOD TIME BETWEEN FAILURES OR INTERRUPTIONS

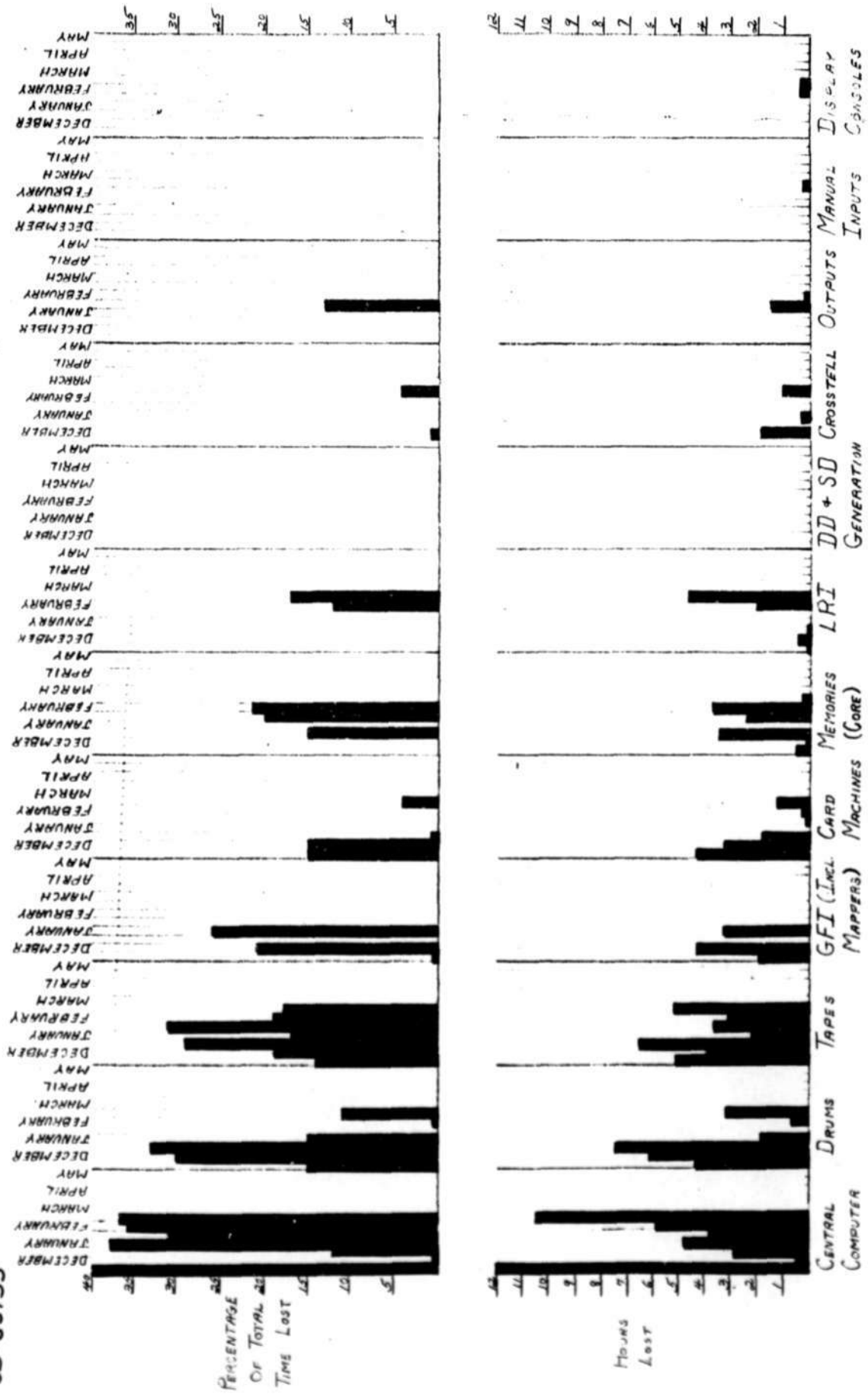


TOTAL ASSIGNED TIME (WEEKLY AVERAGE)



AN/FSQ-7(XD-1) RELIABILITY, 13 JUNE 1955-25 FEBRUARY 1956

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DISTRIBUTION AND PERCENTAGE OF LOST TIME BY AREAS