Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BI-WEEKLY REPORT, April 25, 1952

To: Jay W. Forrester

From: Laboratory Staff

1.0 SYSTEM OPERATION

1.1 Whirlwind I System

(H.F. Mercer) Operation

The following is an estimate by the computer operators of the usable percentage of assigned operation time and the errors due to the computer. This covers the period 10 April through 24 April.

Number of assigned hours	120
Number of transient errors	6
Number of steady state errors	4
Number of intermittent errors	36
Percentage of assigned time usable	78
Percentage of assigned time usable since March 1951	85

(S.H. Dodd)

The intermittent trouble as reported in the last bi-weekly has disappeared since the replacement of the wire-wound resistor cross-over network in the Flip-Flop in ES Control. The general computer reliability has been quite good since this trouble was eliminated.

A coil in the r-f pulser has been showing evidence of a charred coil form. A new coil with a hard glass form was installed to eliminate this trouble. An intermittent in the pulser was corrected by the addition of a standoff to give added mechanical strength.

The new control desk has been installed and most of the equipment planned for the desk is in operation.

(N. Daggett)

Another instance has occurred in WWI of arcover between turret lugs on a phenolic board. Distance between the lugs was approximately 3/8 inch. There was no appreciable soot accumulation

1.1 Whirlwind I System (continued)

(N. Daggett) (continued)

on this panel; however, there did appear to be some type of deposit surrounding a number of lugs on the panel. This may have been caused by heat decomposition of the phenolic where the lugs were originally soldered.

(H.L. Ziegler, A.J. Roberts)

Most ES time is being used to maintain the best operating conditions for the storage tubes in use. To aid in this the transfer characteristics for these tubes have been taken and, where indicated, the HV heater voltage has been raised to improve the characteristic.

Two tubes were replaced, both in the same digit and bank. The first replacement failed during the first twenty-four hours of use, apparently due to becoming gassy.

(H.F. Mercer)

Storage Tube Failures in WWI

The following storage tube failures were reported during this bi-weekly period:

Tube	Hours of Operation	Reason for Failure
ST-525	25	Gassy
ST-500	946	Weak HV gun and poor margins
RT-230-R2	2477	Weak HV Gun

Storage Tube Complement in WWI

Following is the storage tube complement of Bank B as of this date:

Digit	Tube	Hrs at Instal.	Hrs. of Operation
0	RT233	4722	2533
1	ST521	7059	196
2	RT247	5198	2057
3	RT234	4705	2550
4	ST516	6641	614
5	RT237	4714	2541
6	ST503	6417	838

1.1 Whirlwind I System (continued)

(H.F. Mercer)

Digit	Tube	Hrs. at Install.	Hrs. of Operation
7	ST508	6321	934
8	ST505	6176	1079
9	ST519	6624	631
10	ST504	6665	590
11	ST520	6639	616
12	RT258	5207	2048
13	ST517	6493	762
14	ST526-1	7228	27
15	RT255	5150	2105
16	ST506-1	6218	1037

ES Clock hours this date 7255.

(L.O. Leighton)

Component Failures in WWI

The following failures of electrical components have been reported since April 11, 1952:

Component	No. of Fail.	Hrs. of Operation	Reason for Failure
Crystal			
D-357	4	8962	2 drift 1 low R_b 1 oscillation
D-358	3	8000-9000	2 drift 1 change in characteristics
	1	10517	Change in characteristics
Resistors			
5000 ohm Nobeloy 1 watt	2	2213	Change in characteristics
Tubes			
6AS7	3	1000-2000	Mechanical
	4	3000-4000	3 mechanical 1 low I_b

1.1 Whirlwind I System (continued)

(L.O. Leighton) (continued)

Component	No. of Fail.	Hrs. of Operation	Reason for Failure
6AK5	5	2303	1 low I_b 2 mechanical 2 gassy
6AU6	1	4387	Low I_b
7AD7	2	2000-3000	Low I_b
	2	3000-4000	Low I_b
	2	9000-10000	2 mechanical
	5	10000-11000	3 mechanical 2 low I_b
7AK7	1	9000-10000	Change in characteristics
	1	10000-11000	Mechanical

1.2 Five-Digit Multiplier

(C.N. Paskauskas)

At about 2200 on April 23 the -100v supply for the multiplier developed a short circuit which blew the line fuses to this supply.

During the time repairs to the supply were being made, six toroidal pulse transformers were installed in the Accumulator of Digit #2 for a life test.

No components were replaced as a result of marginal checking during this period.

2.0 CIRCUITS AND COMPONENTS

2.1 Circuits by System Number

2.14 Input-Output

(R.H. Gould)

The simulation of the display operation for testing In-Out control has been successful and several difficulties with timing, polarity and amplitude have been corrected. The magnetic-tape read will be simulated next to test more of In-Out Control.

The reset Control panel of IOC is now undergoing resistance and voltage checks. Video checking on it will be started next week.

(A. Werlin)

The past bi-weekly period has been spent in designing the test panels for use in testing the Mod II plug-in units. The layouts have been made and construction of these panels will commence. Also the test specifications for the plug-in units have been formulated.

2.18 Electrostatic Storage Circuits

(B.R. Remis)

A thesis proposal concerning precise measurements of phase difference at 10 Mc, and a visual display of a curve of phase vs frequency, was written.

2.2 Vacuum Tubes and Crystals

2.21 Vacuum Tubes

(H.B. Frost, S. Twicken)

An additional circuit has been added to the new interface test set in order to reduce the average cathode current of the tube under test. A relay applies screen voltage for about 50 milliseconds out of each second, so that the current is reduced by a factor near 20 over steady state values. The relay also interrupts synchronizing pulses to the synchroscope, so that the scope is dark except when the tube is drawing current. This circuit has proven quite advantageous when examining tubes with high interface impedances, as the impedance changes rapidly with cathode current in this case.

2.21 Vacuum Tubes (continued)

(H.B. Frost, S. Twicken)

Considerable time has been spent in the preparation of a list of recommended vacuum tubes for new design. This list is now complete and will soon be included in the standards book. Vacuum tube test conditions and limits will also be included.

The interface measurement subcommittee of the ASTM cathode committee has requested two measurements which were made in this past period. In the first case, a group of standard adapters with simple R-C networks simulating interface impedance were tested. These adapters are being circulated among the various cooperating laboratories to determine the relative accuracy of measuring devices. A group of 6SN7 tubes with various amounts of interface impedance was also received and tested. These tubes will be tested three more times in the next few weeks to determine the repeatability of measurements so that changes caused by testing can be evaluated.

A reserve stock of tested 7AD7 and 7AK7 tubes is being built up for use in the new plug-in units. This stock should be ample when needed. A new preburning panel for 7AK7 tubes is being built to expedite testing.

(L. Sutro)

Each tube socket in Whirlwind is being classified into one of nineteen categories that indicates the use to which the tube in the socket is put. In the near future the card record of each tube in Whirlwind will be punched to indicate one of these nineteen categories. It will then be possible to seek correlation between tube life and tube use. The list of categories follows:

No. Punched	Meaning
none	Use determined by tube type, e.g., photo tube, VR tube.
1	Blocking oscillator.
2	Cathode follower.
3	Class A voltage amplifier.
4	Class A power amplifier.
5	Class C amplifier.
6	Diode clamp.
7	Flip-Flop
8	Gas tube pulse former.
9	Gas tube relay driver.
10	Gate generator, delay-line type.
11	Gate tube.
12	Gate tube in special applications, e.g., where it is normally on.
13	Indicator amplifier
14	Pulse amplifier normally on.

2.21 Vacuum Tubes (continued)

(L. Sutro) (continued)

No. Punched	Meaning
15	Pulse amplifier normally off or buffer amplifier.
16	Rectifier
17	Series regulator.
18	Switch tube.

Each category is intended to isolate a use that is known to affect tube life in a manner that is different from other uses. Thus a tube that might not appear to fit into any of the above categories can be placed in one that contains tubes suffering the same destructive conditions or one that contains tubes whose characteristics are allowed to change through a similar margin.

2.22 Transistors

(N.T. Jones)

The switching time test used by Bell, GE and Raytheon is being analyzed in connection with studies of hole storage. It has been observed that hole storage increases rapidly when the collector is saturated (or switched), as predicted. The relationship of hole storage time to circuit variables such as degree of saturation and collector supply voltage is yet to be determined.

Standard parameter specifications are being prepared. This will define the transistor characteristics necessary for Whirlwind experimental work.

The transistor group at the Sylvania Newton plant was visited with I. Aronson on Thursday April 24. Transistor specifications were discussed at that time.

(W.A. Klein)

John F. Jacobs has defined a set of transistor operators. These are being investigated for qualitative and quantitative properties. Eventually, these operators will be used in attempts to realize various Boolean functions. An M-note will be prepared, in cooperation with J.F. Jacobs, to report more fully on this work.

(I. Aronson)

Three Bell Labs type 1727 junction diodes were tested for variation of capacity with back voltage, frequency response to sine waves, and response to square waves.

2.22 Transistors (continued)

(I. Aronson) (continued)

Similar square wave tests were applied to the General Electric type G10B junction diode and to a Kemtron 1N38 shunted by a capacitor in an attempt to arrive at a suitable equivalent circuit for junction diodes.

A visit was made to the Sylvania transistor group at Newton by N.T. Jones and I. Aronson on April 24. N. Golden of Sylvania demonstrated some of his transistor test equipment and offered to furnish schematic diagrams of the units that are of interest to our transistor group.

Mr. Golden also promised that we would be among the first to receive engineering samples of the Sylvania transistors as soon as they are released.

(D.J. Eckl, R.J. Callahan)

A two-transistor flip-flop circuit has been operated successfully between 500 and 800 kc when triggered by positive pulses from a transistor amplifier. This same circuit has also been satisfactorily operated by single positive pulses applied to the two bases from separate amplifiers. Further work has been done on a transistor gate which is ready to be incorporated into the test accumulator. A more complete investigation into the properties of this gate is planned. The first amplifier panel and the A-register of the test accumulator have been constructed and are ready for testing.

2.3 Ferromagnetic and Ferroelectric Cores

(E.A. Guditz, W.N. Papian)

Ceramic Array I

The 8-by-8 portion of the array has been operating quite reliably in the old ("static") mode of operation, and also in a "cyclic" mode wherein an arbitrary information pattern is transferred progressively around the memory.

Some time was spent testing switch cores of different geometry and materials under operating conditions.

Preparations are now being made to operate the array as a full 16-by-16. Early results are expected during the next period.

2.3 Ferromagnetic and Ferroelectric Cores (continued)

(R.C. Sims)

Stepping Registers

The 4-core stepping register used by Buck and Guditz has been put into operation and some tests have been made. The problems of interest at the moment are concerned with the possible speed of operation of a stepping register and the effects of loading the cores in the register by having them switch other cores. From tests on this register, the speed of operation seems to be limited, practically, only by the switching time of the cores, which is about 4 microseconds for the cores used. Also, the operation is very sensitive to driving current, and hence to load. The next steps will be to see if the speed situation can be improved by using better cores and to try a couple of schemes to decrease the sensitivity to driving current and/or load.

(G. Briggs)

Magnetic Circuits

Theoretical work is being undertaken in connection with the problem of one core driving another, which in turn drives a third etc. Ferrite cores with non-linear characteristics are assumed, with connection links composed of windings in series with resistance and inductance, capacitance effects being neglected. The energy distribution along the line of cores as well as the input MMF to the series, all as a function of whether a "1" or a "0" is present in some core at some point in the line, are being calculated. In addition, the core cross-sectional area is allowed to vary from core to core in a monotonic manner, keeping the average core length ($2\pi r$) constant.

All of these questions are of great importance in coupling cores together in a computer, and not enough careful analysis has been undertaken to date.

(B. Widrowitz)

Metallic Array

A report on the development of this array is in preparation.

(R.E. Hunt)

Toroidal Winder

The toroidal winder is progressing satisfactorily. We will probably deliver it to the magnetics group in about one week.

2.3 Ferromagnetic and Ferroelectric Cores (continued)

(R.E. Hunt) (continued)

Performance is satisfactory now, but we wish to improve the tightness and uniformity of the windings. It will wind cores from 1" OD to 1/8" ID with from #30 to #40 wire. A typical performance would be winding 150 turns of #37 wire on a core having 3/16"ID and 3/8" OD. This can be done in less than 5 minutes from start to finish.

(D.R. Brown)

General Ceramics

General Ceramics has produced several new bodies and a new die, F-282. Bodies MF-1312, MF-1319, and MF-1320 are designed for switch cores; MF-1312 is most promising. All the new bodies have low coercivity, about 0.5 oersted. The new die is like F-259 but has about half the radial thickness. Pulse tests on the new materials have not been completed.

Laboratory for Insulation Research

Thirteen ring cores, F-108, have been received from the Laboratory for Insulation Research. These cores represent a range of pressure and mixture of raw and calcined material, but all have approximately the same composition. Half the cores were made with rather pure raw materials and half with General Ceramics raw materials. Only three of them have been tested on the hysteresis-loop tracer. They appear less rectangular than the General Ceramics square-loop bodies.

The measurements will be continued.

(J. McCusker, P. Baltzer)

One thousand MF 1118 ferrite cores were pulse-tested to check uniformity. The magnitude of the "disturbed-one" output voltage was used as the criterion. This voltage varied from 0.24 to 0.79 volts. 256 cores which were uniform to within approximately $\pm$ 5% were then selected for Olsen's memory array. An E-note is being propared on the results of this test.

(J.H. Baldrige)

Several iron determinations have been made on materials prepared in this laboratory and on reagents for use in synthesis. Quantitative analysis have been run on the lather materials for silica, calcium, magnesium, and combined oxides.

2.6 Component Analysis

(B.B. Paine)

A system for positive marking of components passing acceptance tests has been set up, and each lot of components intended for final equipment built by the shop or for WWI spares will be marked with test information.

A new General Radio Comparison Bridge has been received, and will speed up inspection of small components tremendously. Other time-saving equipment is on order.

3.0 STORAGE TUBES

3.1 Construction

(P. Youtz)

Work on one of the two new vacuum systems has been finished. The second new vacuum system will be completed before the end of this next bi-weekly period. These systems will be scheduled for ST processing as soon as they are operable.

A new activation and aging unit is under construction in the electrical shop. Since we were unable to procure ion gauge control units within the next six months, the electrical shop has undertaken to build two units.

The program to produce 500-series ST's as replacements for Bank B has not yielded tubes with satisfactory margins. Some of this trouble has been attributed to the collector-to-mosaic spacing in the target assembly. Research tubes to study the effect of closer collector-to-mosaic spacing have been assembled. These tubes will be processed and tested next week.

3.2 Test

(A.J. Cann, R.E. Hegler)

During this bi-weekly period, five tubes were available for pretest: ST529-1, ST530-1, ST531, ST532 and ST533.

Of the five tubes that were pretested, one was satisfactory, two were rejected and two were marginal.

ST529-1 was rejected because of a weak HV gun that could not be sufficiently reactivated, and ST531 was rejected because of an air inclusion.

ST530-1 was found to be satisfactory after A_3 was increased to 150V to give sufficient HG coverage.

In ST532, both guns were weak. The guns were reactivated to give the tube a marginal classification.

ST533 was found marginal because of the formation of a positive spot on ion current test under 17 seconds; also, the W SPG necessary to erase a positive array was over 100V. The mica would buckle in the vicinity of the target area which was difficult to erase. The mica would buckle with VHG = 190V.

3.2 Test (continued)

(T.S. Greenwood, C.L. Corderman)

During the last bi-weekly period, a revision of the block diagram of the STRT was made and sent to the drafting room.

Preparatory to the testing of single-square-per-spot tubes, d-c coupling circuits for the DVG's in the STRT were designed and tested in the horizontal 16's section. Satisfactory operation was obtained and the entire unit will be converted when a suitable supply of resistors is on hand.

A preliminary design model for a deflection control and rotation unit was completed and mounted in Mount #7 for use with single-square-per-spot tubes.

During this period four tubes were checked at the STRT: ST500, ST527, ST528 and ST530-1. ST500 was a reject from Whirlwind which had extremely poor margins.

ST527, ST528 and ST530-1, all new tubes, had similarly poor margins. The spot interaction area in each tube was extremely narrow in the W^- direction although of normal extent in the W^+ direction. The interaction area was poor over the whole surface of the tube but was noticeably poorer in the corner of the surface near the reference marker. This particular corner has been markedly different from the rest of the surface from time to time in different tubes, but has never been consistent enough to allow the cause to be determined. One possible cause might be that a temperature gradient exists in one or more of the ovens used in the bakeout. This phenomenon is under investigation.

(A.J. Stein)

In a reevaluation of the data taken with spot size test set-up it was noted that the spot size behaved differently for W^+ and W^- as V_k was increased over a range extending from 1500-2500 volts. At larger V_k the positive spot would increase in size, the negative spot would decrease. This leads to the belief that the fringe of the high velocity beam at the surface consists partially of low velocity secondaries. At higher bombarding velocities the number of these electrons will decrease, thus, fewer electrons will go to collector or surface depending on whether there is W^+ or W^- which in turn will cause the observed difference in spot size.

It was also noted that in RT260 the break between the gaussian and the first exponential region of the fringe occurs at about 1.0 microamps/cm^2. The maximum current density of the beam under the test conditions used corresponded to about 25 microamps/cm^2.

3.2 Test (continued)

(H.J. Platt)

The Alignment-Demonstrator is in the final stage of completion. Video cabling is almost finished and about 70% of the power wiring is complete. Barring unforeseen difficulties, the unit should be turned on next week.

The TV sweep generator has been completed and tested successfully. In addition, a control panel was designed and built after the block diagram was completed. It was necessary to construct two crystal mixers of the panel type since they had not arrived from Burroughs.

Several drawings of component parts of the Alignment-Demonstrator were sent to the drafting room.

(A.J. Cann)

The modified ST Laboratory power wiring has been completed and is operating. Rough drawings of the wiring have been submitted to Al Falcione.

Next week, a new deflection amplifier for the TVD will be designed to obtain the stability required for one-square-per-spot tubes.

4.0 TERMINAL EQUIPMENT

(E. S. Rich)

Terminal Equipment Planning

An analysis of the engineering manpower requirements for circuit design and testing work on the terminal equipment system covering the remainder of this year has been made. It appears that the present staff plus those hired but not yet joined can accomplish the minimum job outlined in the summary schedule finished two weeks ago. Some additional manpower will be needed if other work is to be undertaken within this period. At the present time there is not sufficient information to make meaningful estimates for the year 1953.

So that installation work will not become a bottleneck, Newitt has started preparation of specifications for the air conditioning system for Room 156. He will follow up on this until there is an engineer in Chan Watt's installation group to take over.

4.1 Typewriter and Tape Punch

(L. H. Norcott)

Parts for a tape comparer are now being fabricated by the machine shop, and modification of the two special "FL" readers for the comparer is well under way. The remaining work on the readers will be completed as soon as the necessary contact assemblies are received from the manufacturer.

Seventh hole feeler pins have also been added to the five additional "FL" readers now on hand. As soon as the contact assemblies are received, these standard "FL" readers will also be completed.

4.2 Magnetic Tape

(B. Ginsburg, K. McVicar)

Present work on the interim magnetic tape system is directed towards simplification of its operation. It is the ultimate goal of this work to permit operation of the system without a member of the magnetic tape group present to act as chaperone. This requires the addition of a few extra safety devices which will prevent damage to the equipment in case of blown fuses, tape breakage, etc., and perhaps the addition of some alarm circuits.

We are still having trouble with the d-c power which we get from the laboratory supplies. The +150 supply is the worst, frequently varying over a range of 25 volts, but several of the supplies vary by 10% or more. Apparently a good deal of this trouble is caused by overloading the supplies when both the interim magnetic tape system and the equipment in room 224 is turned on.

4.0 TERMINAL EQUIPMENT (Continued)

4.2 Magnetic Tape (Continued)

(B. Ginsburg, K. McVicar) (Continued)

A second tape unit is being checked for experimental purposes and to provide a spare for the one now operating. It was found that this unit was mechanically inferior to the one we have been using and some modifications are being made to improve its tape handling qualities. In addition, a representative from Raytheon is expected soon to give us some advice on how the units may be improved.

(J. W. Forgie)

A layout sketch for the magnetic tape drive control panel has been completed and sent to drafting. Design of the channel selection amplifier is complete, and a layout for this panel will be finished shortly.

Tests of the reading amplifier and switch panel are continuing as computer time is available.

(E. P. Farnsworth)

Computer output in Flexowriter code can now be recorded on magnetic tape at 125 characters per second and then printed out by transferring the tape reel to the print-out equipment. Relay switching of tape drive mechanisms in the computer will eventually eliminate the need for changing tape reels.

The storage capacity of the 1200 ft. tape reels, in excess of 50,000 Flexowriter characters, can be filled by the computer in 8 minutes of recording time. This quantity of information can be transcribed to printed page in about two hours of printer operation. Several transient errors per tape reel have been encountered to date.

4.3 Special Display

(F. E. Irish)

One cycle operation with the numerical display system has been achieved. It was found that one cycle is not sufficient to intensify the Dumont 304H oscilloscopes with a P.7 phosphor so as to produce 15 seconds of persistence. The exact number of cycles required to obtain this persistence has not been determined yet. It was thought to begin with that a 128 μsec cycle would be too short for use with the Dumont oscilloscopes, but it seemed to be a good length for use with the sixteen-inch scopes. The system will be tried with the sixteen-inch scopes during this coming bi-weekly period.

5.0 INSTALLATION AND POWER

5.2 Power Supplies and Control

(R. Jahn)

Whittemore Building D.C. Power Supplies

The ∕120 V.D.C. Power Equipment Co. rectifier has been put into service as a temporary ∕150 volt supply. A number of modifications have been made on the relay control circuits. A sketch incorporating these modifications and conforming to WWI drawing standards has been submitted to drafting.

Marginal Checking Generator Test Panel

Switches needed for the completion of this panel have been delivered, and the panel will be installed at the first opportunity.

(G. A. Kerby)

Continued with procurement of parts and revisions of rectifiers and regulators.

Enlarged the Whittemore power supply interlock to provide for all proposed units and all anticipated maintenance.

(J. J. Gano)

Old -150 Volt, 10 Ampere Supply

Experimental work on this supply which uses a passive filter has been completed. Both steady-state and dynamic performance have been improved severalfold. The following is a rough estimate of the performance:

	As Purchased	Present
Load Regulation, steady-state, no load to full load	5 volts	.3 volts
Load Regulation, dynamic (output volts for 10% step load)	3 volts	.13 volts
Line Regulation, dynamic (output volts for 5% step of supply voltage)	3 volts	.45 volts

The present performance is about half as good as the supply using an active filter. However, given an output capacitance corresponding to the ratio of the loads, it appears that the performance of the supply using a passive filter can be made to exceed that of the one using an active filter.

5.0 INSTALLATION AND POWER (Continued)

5.3 Video Cabling

(T. Leary)

118 cables for extending the main bus and for the in-out panels in AX4 have been completed by the shop. 80 cables for the display scopes on the temporary console and for temporary use in WWI are now being constructed.

8.0 MATHEMATICS, CODING, AND APPLICATIONS

8.1 Programs and Computer Operation

Progress during this bi-weekly period on each general applications problem is given below in terms of programming hours spent by laboratory personnel (exclusive of time spent by outsiders working on some of the problems), minutes of computer time used, and progress reports as submitted by the programmers in question.

4. Floating Point and Extra Precision Interpretive Subroutines (Programmed Arithmetic, PA): Frankovich, 30 hours; Helwig, 3 hours.

The 39,6,0 programmed arithmetic interpretive subroutine has been revised to work in the 38,6,0 number system. The three components of the "X" part of numbers expressed in this system need no longer agree in sign, thereby eliminating the usual sign agreement routine and effecting a considerable saving both in time and space. The 15,15,0 input conversion program has been revised to reject nullifies. It will also convert numbers written for the 24,6,0 input program so that a programmer can now have a program run in either number system. A 5-5-6 tape has also been prepared which consists of the 15,15,0 interpretive and output subroutines and is completely analogous to the similar tape for the 24.6,0 system.

8. Magnetic Flux Density Study: Helwig, 2 hours; WWI, 33 minutes.

The Runge-Kutta numerical solution for the non-linear magnetic tape problem is being reprogrammed for 24,6,0 computation. A numerical solution for $\Delta t = 0.1$ μsec was obtained using the (30,0,0) program. The results exhibit small oscillations. This program will be rerun for the parameter value $\Delta t = 0.01$ μsec as a check on the accuracy of the numerical solutions.

13. Point-by-Point Scope Plotting of Calibrated Axes (Output Camera, OC 2): Mackey, 3 hours; WWI, 19 minutes.

See Section 8.2.

21. Optical Constants of Thin Metal Films: Neeb, 7.5 hours; WWI, 32 minutes.

An error in the logic of the program for the evaluation of the sine, cosine, hyperbolic sine, and hyperbolic cosine was discovered. The program has been revised and is now waiting to be tested. If the results from this program prove to be satisfactory, it will be incorporated in the main program. The main program has been written and will be tested as soon as the trigonometric program is ready. The program for the infrared radiation on gold blocks is being written and should be completed within the next few days.

8.1 Programs and Computer Operation (continued)

23. Print-Out of Contents of Storage (Post Mortem Error Diagnosis, PM): Carr, 2 hours; Gilmore, 14 hours; WWI, 74 minutes.

Two post mortem routines are being written which deal with programs using the 24,6,0 number system. The first prints the contents of the interpretive routine's arithmetic element, its program register and its program counter. The second prints the contents of a given range of registers (flip flop control) as 24,6,0 numbers as well as printing every fourth or fifth storage location as an octal or decimal address depending on whether the program was octal or decimal.

24. Matrices, Determinants, and Systems of Linear Equations: Aronson, 10 hours; Carr, 12 hours; WWI, 37 minutes.

A program has been written to determine the largest eigenvalue (in absolute value) of symmetric, positive definite matrix of arbitrary degree. Also the relaxation and Gauss-Seidel programs are still under test. A program has been written for the solution of the linear system $Ax = b$ using the method of conjugate-gradients. It is planned to test this program in the forthcoming period.

26. Subroutine Orientation: Carr, 8 hours; WWI, 16 minutes.

A memorandum is now being reproduced explaining the method of automatic assembly which has been under test.

28. Ambipolar Diffusion: Gilmore, 5 hours; WWI, 78 minutes.

(The diffusion of electrons and ions in a plasma in the presence of space charge leads to two coupled 2nd order 2nd degree differential equations. Compatible valves of electron and ion concentration are desired.) There is still some difficulty in certain parameters meeting the criteria of the problem. Investigations are being made from intermediate printed data of these parameters.

30. Digitally-Controlled Milling Machine Program: Frankovich, 2 hours; WWI, 37 minutes.

Mr. Runyon's new tape preparation program is currently being tested on the computer. Parameter tapes prepared in the tape preparation room here and also on the Flexo equipment at the Servomechanisms Laboratory will be used.

37. n-th Root Approximation for Subroutines: Demurjian, 8 hours; WWI, 7 minutes.

38. Typewriter Print Out for Subroutines: Demurjian, 26 hours; Helwig, 2 hours; WWI, 13 minutes.

OT 2.4 was tested and completed. This subroutine prints out the decimal fraction equivalent of the (15,0,0) contents of the accumulator with the last digit containing round-off of additional digits. The number of digits can be changed depending on how many digits of accuracy is desired. The present output routines are being studied for similar characteristics that will be consolidated in the general output routine.

8.1 Programs and Computer Operation (continued)

38. Typewriter Print Out for Subroutines (continued)

Where more than one type of output is desired, it seems advisable at present to use different points of entry.

39. Subroutine Library Editing: Carr, 7 hours.

See Section 8.2.

40. Input Conversion Using Magnetic Tape Storage: Frankovich, 6.5 hours; Helwig, 18 hours; WWI, 6 minutes.

During the past two weeks there have been three meetings to discuss the vocabulary of the next magnetic tape conversion program. The discussions included: 1) floating address and preset parameter notation, 2) methods of storing multiple length numbers, 3) indication of changes in address sequence, 4) methods of indicating relative words in a subroutine, 5) control transfer indicators, 6) general preset parameters, 7) interpretive operation notation, and 8) methods of post mortem error diagnostic printing using magnetic tape and the logical information already present on the tape.

41. Binary Matrix Product Statistics: Carr, 5 hours; WWI, 403 minutes.

Results are satisfactory on the first part of this problem. A complete report is to be written up later.

42. Spherical Waves - Numerical Integration of Hyperbolic Partial Differential Equations via Characteristics: WWI, 29 minutes.

43. Generation of Random Numbers: WWI, 4 minutes.

45. Crystal Structure: Aronson, 23 hours; WWI, 59 minutes.

Three sets of crystal structure factor data have been submitted by Drs. Abrahams and Granville-Wells of the Insulation Research Group (M.I.T. E.E. Dept.). The corresponding electron densities have been computed and turned over to the originators. The results seem to be wholly satisfactory. The Fourier Synthesis Program is being revised in an effort to cut the time required to process a set of structure factors (at present about 20 minutes). The problem of computing the centroids of the peaks in the electron density map of a crystal cell is still being studied. It is hoped that some preliminary tests will be run in the near future. A series of lectures on the elements of coding for a large scale digital computer for crystalographers is being organized. The first meeting is tentatively set for May 7, 1952.

46. Torpedo Depth Response: Neeb, 0 hours; WWI, 35 minutes.

An error in the (24,6,0) program was found and corrected. The results from the program have not been analyzed as yet.

8.1 Programs and Computer Operation (continued)

47. Partial Differential Equations of Engine - Part I: Carr, 10 hours; WWI, 60 minutes.

The first test of the partial differential equation was made and, although several minor errors exist, it seems to be satisfactory.

48. Gust Loads on Rigid Airplanes in Two Degrees of Freedom: Helwig, 14 hours; WWI, 54 minutes.

The program for the computation of the response of an aircraft to a steep gust load was tested, but the printed results are not correct. It will be reprogrammed for 24,6,0 calculations so that the effects of round-off error can be evaluated.

50. Lattice Analogy Applied to Shear Walls: Galletly; WWI, 104 minutes.

51. Magnetic Tape Programming: Gilmore, 0 hours.

A program which tests the magnetic tape to printer procedure was written and tested with reasonable success. The computer time is not listed because it was assigned to the magnetic tape engineering group rather than the applications group. From the results of this and other test programs it would appear that one should be able to use this means of printed output within a month.

52. Oil Reservoir Depletion Analysis by Iteration: Kopley, 65 hours; Porter, 53 hours; WWI, 492 minutes.

The iterative analysis of the primary depletion of an oil reservoir has been programmed and run. Various criteria of convergence were tested. The results indicate that the process is not a convergent one and that a modification employing an averaging procedure will have to be used. However, before introducing this modification, the results of these first runs are being studied by Dr. Shreve of the Carter Oil Research Laboratory.

53. Solution of Schrodinger's Wave Equation which Contains a Singularity at the Origin: Gilmore, 17 hours; WWI, 153 minutes.

Another parameter of the present program has been operated. The program and its parameter were operated first using the regular 24,6,0 number system. In order to increase the precision it was then repeated with an additional modification which enabled the program to carry a 30,15,0 number in the interpretive routine's arithmetic element during the calculation of two important variables, and still perform ts instructions. Frank Verzuh of the MIT Statistical Services Department is in the process of checking the two sets of data with data produced by an IBM card programming calculator which used the same parameter values.

54. Optimizing the Use of Water Storage In a Combined Hydro-Thermal Electric System: Demurjian, 6 hours; WWI, 139 minutes.

The results for the first two runs have been checked and show promise of reliable magnetic tape operation. The program has been altered slightly to omit one of the generation checks. In this manner the computation can be carried forward without pausing for this

8.1 Programs and Computer Operation (continued)

54. Optimizing the Use of Water Storage In a Combined Hydro-Thermal Electric System (continued)

comparison. The values obtained by computer operation differ from those computed by desk calculator by less than one in the fourth decimal place. By means of the modified program the forthcoming results should be at least as reliable as those already received.

55. Solution of 2nd Order Non-Linear Ordinary Differential Equation: WWI, 49 minutes.

56. Determining Pupil Dates and Two Dramatic Aberrations in Optical Lens Systems: Helwig, 1.5 hours; WWI, 24 minutes.

The program for the calculation of the third order aberrations was tested and found to contain a conversion error. This will be corrected and the program rerun.

57. Runge-Kutta Differential Equations: Aronson, 10 hours; Carr, 2 hours.

Mr. N. Zierler of the Instrumentation Laboratory has written a program for generating "pseudo-random" digits using a hybrid "SWAC - Mid-square" system. He has also written a special test program for checking the distributions of selected groups of digits and for detecting certain periodicities in a sequence of binary digits. These programs have been checked in detail and tapes are being typed. It is planned to use Zierler's test program along with previously written tests to check the digit generation. Tape 294 (Tests for Randomness) has been revised for this purpose.

58. Determination of Energy Levels of Oxygen Molecule: Carr, 14 hours; WWI, 343 minutes.

The first eigenvectors have been determined in this problem. All eigenvalues except several hard-to-evaluate degenerate ones are available in the 9 x 9 case.

59. AEC Positron-Electron Calculation: Carr, 2 hours.

Word from Oak Ridge indicates that programming on this problem is continuing.

60. Calculation of Deuteron Energy Levels: Combelic; WWI, 110 minutes.

Tests of the arithmetic sections of the program have been completed satisfactorily. The full program has been assembled and a preliminary run indicates that the final results will be satisfactory.

63. M.I.T. Seismic Project: Briscoe; WWI, 82 minutes.

64. Solution of Fifth Order Ordinary Differential Equation: Frankovich, 6.5 hours; WWI, 430 minutes.

Another solution was obtained to the system of equations by using a seventh order integration scheme. This is being compared with solutions obtained previously by other methods.

8.1 Programs and Computer Operation (continued)

65. Solution of Third Order Ordinary Differential Equation: Frankovich, 4 hours; WWI, 127 minutes.

The solution was recomputed using the Runge-Kutta method, and is being analyzed by the originators.

66. Round-off Error Test: Perlis; WWI, 20 minutes.

67. A Method for Obtaining the Characteristic Values of Symmetric Matrices: Perlis; WWI, 24 minutes.

68. Logarithm and Exponential Subroutines: Wendroff; WWI, 4 minutes.

TOTAL COMPUTER TIME USED FOR PROGRAMS: 55 hours, 27 minutes

TOTAL COMPUTER TIME USED FOR CONVERSION: 1 hour, 7 minutes

TOTAL COMPUTER TIME USED FOR DEMONSTRATIONS: 2 hours, 55 minutes

TOTAL COMPUTER TIME USED: 59 hours, 29 minutes

TOTAL COMPUTER TIME AVAILABLE: 73 hours, 35 minutes

USABLE TIME PERCENTAGE: 80.8%

TOTAL NUMBER OF PROGRAMS OPERATED: 182

8.2 Subroutine Library

Below are listed all subroutines which have been suggested, worked on, or completed during this bi-weekly period.

Completed

LSR #	Tape #	Title	Programmer
TF 7.2t	T-1172	Sine-Cos x, x in radians, x in MRA (24,6,0)	Aronson
OT 2.4	T-936-3	Print C(AC) as Decimal Fraction, Round-off, sign and magnitude, point, single column Layout	Demurjian

Being Tested

IP	T-1168	(15,15,0) Input Conversion to handle nullifies and other superfluous characters	Frankovich
	T-1092	Generation of Random Numbers	Rotenberg

8.2 Subroutine Library (continued)

LSR #	Tape #	Title	Programmer
MT	T-988	Record Block on Magnetic Tape	Bagley
	T-989	Magnetic Tape Block Read I	Bagley
MT	T-1161	Magnetic Tape Block Read II	Bagley
		Being Written	
PA 2.3t		Operations on Real (38,6,0) Numbers (requires minimum time for interpreted instruction)	Frankovich
PA 10.1t		Operations on Real (38,6,0) Numbers	Frankovich
PA		Operations on Real (30,0,c) Numbers	Helwig
OC	T-939	(24,6,0) Display. Completely automatic indexing. No limit on number of numbers to be displayed. The numbers appear as $\pm.\lvert X\rvert/\pm\lvert Y\rvert$ where X can have 8 or fewer digits and Y has 2 digits. Either the F or D scope may be selected.	Kopley
OC	T-1165	Positive Decimal Number Display	Attridge, Mackey
		Suggested	
		Input and Output for Operations on Real (38,6,0) Numbers.	Frankovich
EX		$e^{\pm x}$ in (24,6,0)	Combelic

8.3 Procedures

(J. T. Gilmore)

A memorandum which will list all of the utility programs available in the computer room will be available some time during the next bi-weekly period.

9.0 FACILITIES AND CENTRAL SERVICES

9.1 Publications

(Anola Ryan)

The following material has been received in the Library, Room 217, and is available to laboratory personnel.

LABORATORY REPORTS

No.	Title	No. of Pages	Date	Author
E-457	Current Density Distribution in the Fringe Region of a Focused Electron Beam	5	4-8-52	C. L. Corderman
E-458	The Use of Boolean Algebra in Logical Design	31	4-15-52	R. C. Jeffrey I. S. Reed
E-460	The Ferro Magnetic Switch	3	4-16-52	D. A. Buck
M-1455	Bi-Weekly Report, April 11, 1952	36	4-11-52	
M-1457	WW II Block Diagrams Meeting of April 10	2	4-10-52	W. A. Hosier
M-1458	P. R. No. 2, M.S. Thesis: Current Distribution in the High Velocity Beam in the M.I.T. Electrostatic Storage Tube	2	3-1-52 to 4-15-52	A. N. Stein
M-1459	Preliminary Design of Transitor Test Accumulator and A-Register	3	4-15-52	D. Eckl
M-1462	P. R. No. 1, M.S. Thesis: The Display of Arabic Numerals on a Cathode Ray Tube	3	2-19-52 to 4-19-52	F. E. Irish
M-1463	Laboratory Standards Program	1	4-21-52	H. W. Hodgton

LIBRARY FILES

No.	Identifying Information	Source
51	Tracerlog, March, 1952	Tracerlab, Inc.
559	Technical News Bulletin, April, 1952	Nat. Bur. Standards
740	Accession List of Scientific & Technical Translations	ASTIA
884	P. R. No. 29, D.I.C. 6873	Servomechanism Lab.
969	Division-Arithmetic in a One's-Complement Computer	R. A. Leibler
1250	Research Reviews, April, 1952	ONR/Washington
1325	Quarterly Progress Report, April, 1952	Research Lab. Electronics
1396	Ch. II, Sampling Methods & Stockastic Processes in Numerical Analysis	J. H. Curtiss
1671	Nuclear Science Abstracts, April 15, 1952	Atomic Energy Comm.
1780	Baker Algorithms	P. Billingsley
1782	Methods of Measurements & Computation to Determine Trajectory Data From Askania Cinetheodolite Records	Naval Ordnance
1783	Addresses on a Computer Drum	D. Swift & H. Campaigne
1784	Condensation of a Series of Binary Numbers on Magnetic Tape	V. Vissering & D. Swift
1785	Tables of Sines to Seven Octal Places	
1786	Maintenance Minimization in Large Electronic Systems	Wm. D. McGuigan
1787	Discussion of the Complexity & Unreliability of Military Equipment & the Need for Simplification & Increased Life	A. S. Brown
1788	Printed Circuit Techniques (NBS Circular No. 468)	Dept. of Commerce
1789	Precision Resistors & Their Measurement (NBS Circ. No. 470)	" "
1790	Effect of Defense Program on Employment Outlook in Engineering	Dept. of Labor

9.1 Publications (Continued)

LIBRARY FILES (Continued)

No.	Identifying Information	Source
1791	A Study of Automatic Unitized Printed Circuit Techniques	Herlec Corp.
1792	Service Manual for Class 15 Electronik Instruments, Precision Indicator, Circular Chart & Strip Chart Types	Brown Instrument Co.
1793	Model Z-1, Zero Reader Flight Instrument, Operation and Service	Sperry Gyroscope Co.
1794	Office Robots (Article)	Fortune Mag., Jan. 1952

JOURNALS

Accessions List, Eastman Library
Electrical Communication, March, 1952
Industrial Laboratories, April, 1952
Oil & Gas Journal, April 14, 1952
Oil & Gas Journal, April 21, 1952

9.2 Standards, Purchasing, and Stock

(H.B. Morley)

Orders have been placed for all the aluminum needed for rack construction in room 156. Delivery on all items has been promised for June at the latest.

New personnel has been added to this department to cope with the increasing work load.

Plans are being formulated for cooperation with the Production Control Department so that the confusion existing heretofore will be minimized.

It is important that no material of any type should be picked up as petty cash purchases without previous authorization of this department.

Final preparations have been completed at the Whittemore Building to provide for the Purchasing Department, including desk and telephone arrangements so that the move may be made with the least confusion.

Many new catalogues are being received. Among new items of interest are the ANelex Corporation's High-Speed Printer and the Clary Multiplier Corporation Digital Read-Out Machine for printing electrical data.

(H.W. Hodgdon)

Standards sheets for capacitors, wire and cable, and some transformers are now being printed. These sheets together with those already printed, will bring to approximately 100 the number of standards sheets prepared to date. As soon as these are assembled into binders they will be distributed, and future additions will be distributed individually.

An outline of the Laboratory Standards Program has been issued as Memorandum M-1463, the text consisting of two enclosures which will be used as a foreword and introduction to the Standards Book.

The use of the Standards Book by Laboratory personnel will be the measure of its success or failure. The cooperation of everyone is solicited in making criticism of material included or suggestions for material to be added.

9.3 Construction

(C.W. Watt)

Production Control

Considerable time has been spent recently on setting up a new organization for Production Control. This work has one objective: to make Production Control a true service organization for the entire laboratory. As now visualized the organization will do two things:

1. Coordinate all shop work and thus reduce waste and inefficiency in the fabrication of parts and equipment for the lab.

2. Take the burden of detail work associated with having something constructed off of those responsible for research, design, and planning.

The numerous procedural details necessary to accomplish these objectives are being worked out, and the new system has begun to function. Floyd Manning is in charge of the shop scheduling phase of the work, and F.W. McEachern is assisting him. A memo will soon be issued outlining the responsibilities of the various people associated with the construction of equipment. Everyone is requested to cooperate with Manning and McEachern, for the system depends on cooperation for success.

(F.F. Manning)

Production Control

The following units have been completed since April 11, 1952:

1 ESD Termination Panel (Watt)
3 Indicator Units - (Breadboard) (Eckl)
30 D-C Power Cords (Corderman)
3 Pulse Delay (Burroughs Modification) (Olsen)
1 Pulse Generator (Breadboard) (Woolfe)
1 Single Turn Core Tester (Modification) (McCusker)
1 Power Cable 120' lg. (Mercer)
21 Black Lamicoid Labels (Caswell)
1 Core Tester Pulse Amplifier (Breadboard) (Best)
1 IOC Reset Control (O'Brien)
1 15A, 100-volt Variable D-C Power Supply (Hunt)
1 In-Out Switch Display Matrix (O'Brien)
6 Power Supply Filter (Breadboards) (Woolfe)
10 Special Crystal Mixer (Papian)
10 Special Polarity Inverters (Papian)
10 Special Pulse Switch (Papian)
115 Video Cables (Leary)

9.3 Construction (continued)

(F.F. Manning) (continued)

The following units are under construction:

1 Marginal Checking Generator (Gano)
10 D-C Circuit Breaker Boxes (Gano)
1 Standardizer Amplifier (Mercer)
1 2 Channel Gate Mixer Amplifier (Platt)
5 Storage Tube Mounts (Dodd)
2 ESD Output (Dodd)
6 Multivibrator Frequency Dividers
1 Vacuum Tube Processing Pwr Supply (Palermo)
6 Buffer Amplifiers (Breadboard) (Woolfe)
2 Filament Supplies for Vacuum Tube (Caswell)
40 Winding and Mounting Switch Cores (Olsen)
2 ION Gauge Control Chassis (Palermo)
35 Lab Bench Cabling (Hepp)
80 Video Cables (Leary)
1 Marginal Checking Generator (Gano)
3 D-C Outlet Box Modification (Platt)
30 D-C Power Cords (Jacobs)

9.4 Drafting

(A.M. Falcione)

1. New Drawings:

a. Control Unit Test Accumulator

A complete set of drawings for this unit is completed and graded. The circuit schematic drawing number, A-51182; Aluminum Panel, C-51242; Assembly and Parts List, D-51241. This unit is being built for John Jacobs' group.

b. Driver for Magnetic Core Tester

Complete drawings are now being drawn for this unit, which will be similar to the prototype which was built recently.

c. Magnetic Core Tester

Complete drawings for this unit are awaiting checking. The drawings are as follows: Circuit Schematic, C-50816; Aluminum Panel, C-50815; Chassis, E-50814; Assembly and Parts List, E-50921.

d. 420 In-Out Switch Paper Tape Unit Matrix

Circuit Schematic, D-51225; Assembly and Parts List, D-51254. The drawings for this unit will be completed before the next

9.4 Drafting (continued)

(A.M. Falcione) (continued)

Bi-Weekly Report.

2. Thesis Drawings:

Individual inter-office memorandums have been sent to all engineers writing a thesis this semester, requesting information regarding their thesis drawings, so that we may expedite the printing of the drawings and not wait until the last minute rush. The original copies of the thesis must be printed on 8-1/2 x 11, twenty pound bond (rag content), using double space with a 1 to 1-1/2 inch border on the left side for binding purposes. All thesis candidates are requested to contact the Drafting Supervisor at their earliest convenience regarding their drawings.

10.0 GENERAL

(J.C. Proctor)

New Staff

Robert H. Gerhardt, who received his BS in Electrical Engineering from Purdue University and his MS from Northwestern University, has recently joined Taylor's group. He was a Graduate Assistant in the Department of Electrical Engineering at Northwestern while working for his MS degree.

New Non-Staff

Mary Libby, a secretary, is now working with Proctor and Osborne.

Elaine Berry is a secretary assisting Anola Ryan in the Library.

Hilda Sheinberg is a secretary working with Morley in the Purchasing Department.

Elaine Halpern is a secretary assigned to Wieser's group.

Ann Collins is a new messenger in the Barta Building, replacing Pat Boyd who is now a telephone operator-receptionist in the Whittemore Building.

Ruth Barbarow is a detailer working with Falcione in the Drafting Room.

Arthur Dotoli is a laboratory assistant assigned to work with Prentice.

10.0 GENERAL (continued)

(J.C. Proctor) (continued)

Joseph Bennett is a laboratory helper working with Wiercinski.

Philip Frohock is a sheet metal technician working with Prentice.

Three new laboratory assistants have been assigned to work with Paul Grant in the Construction Shop. They are John Doyle, Robert Pitts, and James Mazza.

Alexander Boggs is a new janitor working in the Whittemore Building.