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Memorandum M-776

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Project Whirlwind
Servomechanisms Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: BI-WEEKLY REPORT, PART TWO, February 4, 1949

To: 6345 Engineers

From: Jay W. Forrester

6.0 MATHEMATICS

(P. Franklin)

The mathematics group is considering the calculation of coordinates from observations of distances from fixed stations for a moving object. Codes for using the constancy of the velocity to improve the position are under way. Studies on conformal mapping continue.

(P. Rabinowitz and E. Reich)

The flow diagram for the ship position problem as described in C-56-1 has been somewhat revised and a code is being prepared accordingly.

Some numerical investigations of Bieberbach's method have been carried out. A polynomial of the twelfth degree to approximate the function mapping a square into a circle was computed by inverting a twelfth-order matrix. As the matrix contained many zero elements the inversion was not particularly difficult.

(N. Daniloff)

The problem of target location in the plane using one transmitter and two receiving stations has been re-examined following a suggestion of Professor Franklin which obviates the necessity of solving a quadratic equation. A workable solution has been obtained. This is being implemented by drawing up a suitable program of orders.

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8.0 STORAGE TUBES

8.1 Tube Construction and Testing

8.1.1 Tube Construction and Processing

(F. H. Caswell, T. F. Clough and P. Youtz)

The thirteenth and fourteenth storage tubes, ST67 and ST68, in the beryllium mosaic-on-mica series were processed satisfactorily and delivered to the test group. At least for the next fortnight we will continue to build one tube a week in this series. We have prepared a very satisfactory beryllium mosaic on glass. This will be put into a storage tube early next week. At present we plan to build three storage tubes in the beryllium mosaic-on-glass series so that we can compare these tubes with the beryllium mosaic-on-mica series.

Another electron beam analyzer tube, RT50, to study the properties of the electron guns, was processed and turned over to the test group. We have always been interested in a series of beryllium strip tubes which simulate our beryllium mosaic tube with leads to each conducting area. This series was to be used for life, stability and contamination studies. All tubes in this series except one have had leakage paths of the order of 10^9 and 10^{10} ohms in the storage assembly. This low resistance has made testing rather unsatisfactory. We will temporarily abandon this series of tubes until we can put more time on our techniques to reduce these leakage paths.

(R. Shaw)

Tests have been made on various means of reducing the hazard to personnel of possible shattering of storage tubes. A covering of self-vulcanizing rubber tape was found to have poor adhesion to the glass and a rather crude appearance. Monsanto butyral lacquer No. L-6481 has the advantage of being transparent; however, many coats would be required for adequate protection. It is planned to try sheet rubber, vulcanized onto the tube envelope, as soon as samples are available. In the meantime, Scotch electric tape, obtained from the stock room, gives entirely adequate protection in case of two-inch diameter envelopes, and if applied carefully, is not too objectionable from the standpoint of

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8.11 Tube Construction and Processing (Cont'd)

appearance. A test on a full-size envelope will be made as soon as possible.

A satisfactory beryllium mosaic on glass was produced in ET113 and is being assembled into a storage tube.

The storage tube drafting group has been modifying existing drawings, illustrating memoranda, detailing the polariscope and laying out a tube-processing oven and its associated equipment.

(J. S. Palermo)

The inventory of mechanical components remains ahead of the proposed construction schedule of the Tube Priority List. Two more sets of evaporation target components for Be-Dee and Be-Strip tubes have been ordered and procured. The last three (3) glass target surfaces were sprayed and baked, ready for use, February 3, 1949.

Calcium tungstate dusting technique on stainless steel has been attempted with favorable results. The present binder used, however, does not seem adequate to wet the surface, and therefore a new or improved binder must be formulated.

(W. E. Pickett)

With the glass components on hand and those scheduled to be made in the next period, no unusual difficulties should be encountered in meeting the current tube priority list. On hand are two complete storage tube envelopes which should meet the tentative program of two storage tubes a week. The components for evaporating tubes will enable us to meet the present schedule.

During this last period, emphasis has been placed on building up our inventory of ten-pin stems used in storage tubes.

The length of time needed to fabricate this ten-pin stem and the available time in the glass shop that can be devoted to building this stem has been such in the last period as to prevent the construction of other glass components.

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8.11 Tube Construction and Processing (Cont'd)

We have received eighteen flat-press stems from a local vender. In the next period these stems will be inspected and if found suitable for use in building storage tubes and evaporating tubes, will be used in our tube construction. If found suitable, these flat-press stems should relieve some of the work load in the glass shop. An evaporating tube will be first built using these stems and until built and tried, no opinion can be formed as to using these stems.

The use of these stems will in no way affect our need for ten-pin stems used in the storage tubes.

The glass shop has two evaporating tubes completed and ready for processing when a vacuum system is available for them.

(M. I. Florencourt)

Construction and processing notes have been issued on the following tubes:

ST69	E-183
ST63	E-184
ST68	E-186
RT50	E-191

Construction Sheet 6 has been added to provide records of the few construction details needed on the new group of unmounted high velocity guns; construction sheet 7 has been added for records of surface baking. Recording sheets for anodizing and time charts for tube life-tests (neither numbered) have also been prepared. Construction Sheet 1-1 has been revised to 1-2 to provide more room for baking records of the dagged envelopes.

Data on surface to screen spacing of all the beryllium mosaic on mica tubes has been compiled and has been added to the weekly storage tube summary sheet.

(E. S. Prohaska)

The base for the polariscope has been detailed and is being checked. Its fabrication does not involve any problems. Most of the stock required is on hand. Completion of the polariscope assembly can be expected within the next two weeks.

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8.12 Tube Testing

(N. S. Zimbel)

ST57 is at present on life test in the High Repetition Rate Write-Read Unit. In this test, the surface is subjected to a continuous bombardment of holding gun electrons. In addition to this, during a period extending from 1700 hours of one day to 0800 hours of the next day, one particular spot is subjected to the write (+) high velocity beam.

Tests on the TV unit show that after 208.5 operating hours (during which the high velocity gun was biased on for a total of over 75 hours) the following held true:

1. The high velocity gun cathode current at zero bias reduced from 2.15 ma. to 1.6 ma.
2. The holding gun cathode current at zero bias reduced from 7.5 ma. to 6.2 ma.
3. Positive switching is evidenced at 300V rather than 185V.
4. Negative switching occurs at 74V rather than at 55V.
5. If a positive array is written on a negative background and then erased, the after-storage pattern shows that the supposedly erased spots are still slightly positive with respect to the background. This after-storage could be eliminated by making the whole surface positive and then re-stabilizing the cathode potential.

Standard tests are being perfected to compare the characteristics of the areas subjected to the two types of life test. These tests are designed to indicate:

1. Changes in first crossover point.
2. Changes in minimum write and read pulse durations.
3. Variance of read signal amplitude with pulse schedule frequency.
4. An investigation of the effect of overdriving the holding gun at the completion of the read schedule.

At the earliest possible date signal plate switching during the read operation will be introduced in order to simulate more closely the conditions used in the TV set and the storage tube reliability tester.

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8.12 Tube Testing (Cont'd)

(J. H. McCusker)

Tests are now being run on RT47 and RT50, beam analyzer tubes. The pressure in RT47 was initially 2×10^{-4} mm Hg. The cathode current of the holding gun was initially 3 ma., but decreased rapidly to 0.6 ma. The diameter of the holding gun beam was initially about 5 inches, but decreased rapidly to about one inch. The pressure decreased during testing to 2×10^{-6} mm Hg. The cathode current and the diameter of beam then increased to their original value. The pressure in RT50 is about 5×10^{-7} mm Hg.

High Velocity Gun

Accelerating Voltage	1st Grid Bias	RT47		RT50		Max. curr. density $\mu\text{a}/\text{cm}^2$
		Diam. in inches 3 db	Diam. in inches 20 db	Diam. in inches 3 db	Diam. in inches 20 db	
1500	0	.03	.09	.16	.19	750
1000	0			.14	.18	400
1500	-21			.06	.11	1300

This table shows some results obtained on the high velocity guns. The diameter of the high velocity beam has been arbitrarily defined as the distance along a diameter of the beam between points where the current is 3 db and 20 db below its maximum value. The increase in diameter of the beam for RT50 as compared to that for RT47 is perhaps due to the better pressure in RT50. The increase in current density with an increase in the first grid bias is being investigated further. The direction of the current of the high velocity gun measured in the Faraday cage of RT47 was electron current away from the cage. The results on RT47 may therefore not be correct, due to gas in the tube.

The velocity distribution of both the high velocity and holding gun beam currents of RT47 were measured, but the results were poor. The velocity distribution of the high velocity beam current of RT50 at 1500 volts accelerating potential is uniform to within 50 volts of the cathode

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8.12 Tube Testing (Cont'd)

potential when dispersion effects due to the lens action between the target and the cage may cause an apparent decrease in the velocity of the electrons.

An alternating voltage of 60 cycles has been applied to the horizontal deflection plates of the research tube so that the beam current and diameter could be observed on an oscilloscope.

(A. H. Ballard)

ST56 has now been on life-test for a total of 350 hours. The majority of its life has been under static conditions, the surface remaining stabilized at its negative potential. Its performance is still satisfactory but somewhat poorer than it once was.

The most noticeable effect has been an increase in the minimum holding gun voltage for stable storage. Positive spots will not stabilize below 135 volts as compared with 75 volts formerly. It has also been necessary to increase writing time from 1.5 microseconds to the range of 4 - 5 microseconds.

Plans for enlarging the relay test position on benches #3 and #4 have been shelved temporarily to give space and equipment priority to the r-f readout system. The relay test position on bench #5 will continue to be used for life testing and single-pulse tests in the interim.

(C. L. Corderman)

ST63 and ST68, the two latest Be-on-mica storage tubes, have been given initial tests. ST63 has a short between one of the vertical deflection plates and Ag, and consequently was unsatisfactory for TV presentation of the surface. Because of insufficient scanning voltage, the whole target could not be covered. The characteristics of ST68 are similar to previous tubes of Be on mica.

Standard tests as outlined in E-178 were run on ST48, 56, 57, 60, and 68, and pictures of tests concerning after storage were taken on those tubes.

The memo covering tests on ST40 and ST48 was completed and will be issued soon.

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8.12 Tube Testing (Cont'd)

Plans for a life test rack for storage tubes are being considered. The proposed design will accommodate 3 or 4 storage tubes and have provisions for measuring cathode currents, electrode voltages, and allow TV viewing with a reasonable compromise between flexibility and the amount of equipment required.

8.13 Storage Tube Reliability Tester

(J. O. Ely, L. J. Nardone, and R. L. Sisson)

Testing and adjusting on the storage tube reliability tester have been continued for the past two weeks. Some improvements have been made on the video readout panel. The panel was operated with ST60 up to February 2, 1949, and with ST68 starting on February 3, 1949. Operation was with a 16 x 16 array on both tubes, ST68 giving the better results. Changes in control sequence were tried to note the effects on operation.

At present the storage tube reliability tester is shut down for the installation of the r-f readout system. Testing and adjustment will continue when installation is completed.

(J. A. DiGiorgio)

Planning, design and procurement have been carried on for the additional 4 storage tube mounts. Construction requisitions have been made.

The control circuits and deflection voltage generators have been in continuous operation. Tests and adjustments have been made for the past two weeks.

8.2 Storage Tube Research**8.22 Anodizing**

(E. S. Prohaska)

The Brown Recorder had been working very erratically, so we overhauled the drive mechanism and the slip clutch. It appears that ninety percent of the trouble resulting in faulty printing can be corrected by cleaning and readjusting the slip clutch.

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8.22 Anodizing (Cont'd)

A report describing the anodizing and its control equipment is very nearly completed.

8.23 Output System Circuits

(C. H. R. Campling)

The 10 MC pulser for the HV gun is undergoing tests at present in conjunction with an output-amplifier designed by W. J. Nolan. Prior to these tests several minor modifications were made on the pulser. The number of d-c voltages required has been reduced to four, namely, +500V, +250V, +120V, and -150V. R-f filters have been built into all d-c and filament lines. A 100-ohm, 40-watt, balanced terminator has been built for the Twinax cable which is used with the pulser.

The pulser must also be tested with a suitable circuit for coupling to the grid of the HV gun. Such a circuit has been designed and built by J. O. Ely. Tests on this circuit probably will start immediately.

(W. J. Nolan)

An r-f amplifier for use in the storage tube reliability tester has been constructed, completing the equipment believed necessary for the application of r-f output to this unit.

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11.0 FACILITIES AND CENTRAL SERVICE11.1 Publications

(J. N. Ulman, Jr.)

The following material has been received in the Library,
Room 217, and is available to 6345 Personnel.

6345 Reports

<u>No.</u>	<u>Title</u>	<u>No. of Pages</u>	<u>No. of Drwgs.</u>	<u>Date</u>	<u>Author</u>
E-154-1	Further Development of Beryllium Evaporation Tubes	4	2	1-26-49	{H. Klemperer {M. Florencourt
E-181	Research Tube 47 - Construction and Processing	2	-	1-21-49	M. Florencourt
E-182	Storage Tube 61 - Construction and Processing	2	-	1-21-49	M. Florencourt
E-183	Storage Tube 69: Construction and Processing	2	-	1-19-49	M. Florencourt
E-184	Storage Tube 63: Construction and Processing	3	-	1-25-49	M. Florencourt
E-186	Storage Tube 68: Construction and Processing	3	-	1-27-49	M. Florencourt
E-188	Tube Characteristic Drawings	5	-	2-1-49	A.M. Falcione
M-737	Changes in Test Storage Switch	2	1	12-17-48	{J.M. Salzer {R.P. Mayer
M-750	Representation of Delays in Block Diagrams	1	-	1-4-49	J.M. Salzer
M-760	Testing of Storage Tube 45	7	11	1-18-49	A.H. Ballard
M-763	Bi-Weekly Report, Part I, 1-21-49	18	-	1-21-49	
M-764	Bi-Weekly Report, Part II, 1-21-49	17	-	1-21-49	
M-765	Eastman Conference - January 25, 1949	3	-	1-26-49	H.R. Boyd
M-767	Progress Report: Development of a Low-Speed Analogue for Flip-Flop Analysis	2	-	1-31-49	J.M. Hunt
M-768	Navy Logistics: - Note for Members of the ONR Committee Studying the Application of Computers	7	-	1-28-49	W. Welchman
M-770	6345 Personnel	3	-	2-1-49	
M-771	Changing Graded Drawings of One-of-a-Kind Units for WWI	2	-	2-1-49	A.M. Falcione
M-772	Sylvania - MIT Design Correspondence	1	-	2-2-49	H. Fahnestock
M-773	Computer Shut Down	2	-	2-3-49	{H. Fahnestock {N.H. Taylor

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<u>No.</u>	<u>Title</u>	<u>No. of Pages</u>	<u>No. of Drwgs.</u>	<u>Date</u>	<u>Author</u>
A-82	Property Accounting Procedures	2	-	1-25-49	R. Fairbrother
C-89	Applications Study Group Working Notes, January 20-27	2	-	1-21-49	W.G. Welchman
C-90	Applications Study Group Working Notes, January 27 to February 1	4	-	1-28-49	W.G. Welchman
C-91	A Ballistic Problem	2	-	1-31-49	P. Franklin
C-92	Applications Study Group Working Notes, February 1-8	2	-	2-2-49	W.G. Welchman

Library Files

.004	European Scientific Notes, 15 December 1948				London ONR
47	Technical Information Pilot, Number U1849-1926				Lib. of Congress
113	<u>General Radio Experimenter</u> , January, 1949; "Measurements on I-F Transformers with the Type 916-A R-F Bridge				General Radio Co.
134	Eastman Kodak Monthly Progress Report No. 6, Photographic Digital Reader-Recorder				(R.D. O'Neal A.W. Tyler
180	Document Office Bulletin, January 18, 1949 and Index to Bulletins, Volume I				(MIT Electronics Research Lab
198	Interim Engineering Report on Radio Control Transmitter Model AN/ARW-55 and Radio Control Receiver Model AN/ARW-56; 12-1-48 to 1-1-49				Collins Radio Co. Res & Dev Board
219	Glossary of Guided Missile Terms, Committee Report				
220	Additional Free-Flight Tests of the Rolling Effectiveness of Several Wing-Spoiler Arrangements at High Subsonic, Transonic, and Supersonic Speeds; by H. Kurt Strass				NACA
221	Intact Stability Study Programmed for a Digital Computer; Master's Thesis, January, 1949				C.W. Adams
222	The Status of High-Speed Digital Computing Systems				H.D. Huskey
223	Selective Alteration of Digital Data in a Magnetic Drum Computer Memory; ONR Report				(Engineering Research Assoc. Inc.
224	The Application of the Method of Chaplygin to the Solution of Integral Equations (In Russian)				D.U. Panov
225	Investigation of Horn Balances on a 45° Sweptback Horizontal Tail Surface at High Subsonic Speeds; by H. S. Johnson and R. F. Thompson				NACA
226	Analytical Considerations Regarding a Control-Surface Balance Arrangement for Subsonic and Supersonic Flight; by T. A. Toll and G. H. Adair				NACA
227	Evaluation of Electronic Test Equipment TS-257(XA)/ARW				NAMTC
228	Reduction of Film Breakage and Camera Jams in the Askania Cine-Theodolite				NAMTC
229	Accuracy of NAMTC Phototheodolite System				NAMTC
230	Investigation of Target P/A Premature Parachute Release				NAMTC
559	Technical News Bulletin, January, 1949				(National Bureau Of Standards

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UNCLASSIFIEDReports and Publications (Continued)Books

<u>No.</u>	<u>Title</u>	<u>Author</u>
	Mathematical Tables from Handbook of Chemistry and Physics A Short Table of Integrals	C.D. Hodgman B.O. Pierce

11.2 Standards Committee

(H. B. Morley)

Distribution list for standards sheets has been revised to conform with personnel changes and imminent termination of Sylvania production.

Revised standards issued:

6.051A Drawings for knobs and dials
Class 7 Index

11.3 Purchasing and Stock

(H. B. Morley)

Efforts are being made to coordinate procurement with the forthcoming WWI production requirements. To facilitate this, Sylvania was requested to submit lists showing quantities of stock which will be available from them. The first of these lists, covering resistors, capacitors, chokes and sockets, was received this week.

Preliminary investigation of outside sources for engraving panels seems to indicate that costs would be excessive. Further inquiry is being made in an effort to locate a place where this work can be done at reasonable cost.

New Products and Items of General Interest:

Mr. Keim of Welwyn Electronics, the distributor of the high stability deposited-carbon resistors mentioned in the last report, will be at the laboratory on January 11. Personnel interested in discussing applications of these resistors should contact this office.

A local manufacturer's representative called to exhibit samples of extruded plastic forms. They specialize in special

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11.3 Purchasing and Stock (Continued)

forms to customer specifications, and showed samples of a protective cathode ray tube cover, a bus bar cover, and various types of rods and tubing.

A sample of a new BNC connector has been received - a panel angle connector combining the functions of a UG-290/U and a UG-306/U.

(R. Fairbrother)

Specification sheets for non-standard transformers are being prepared. This information when complete, will be posted in the stockroom for the information of interested parties.

The stockroom no longer inspects manufactured units coming from the Barta Building shops. This function has been transferred to Nickerson's test group working with Kenosian and Murch. The stockroom will continue to carry out all inspection of components.

11.4 Electronic Construction

(A. R. Curtiss)

One high voltage and two holding gun power supplies were serviced.

A 10 mc. amplifier and detector was constructed and a modulated test oscillator was worked on.

A simulated electrode configuration of a high velocity gun (ratio 10:1) has been prepared for use in the electrolytic tank.

Work is progressing on a second TV setup. The Belmont TV set has been modified and provisions are being made for rack mounting the tube and associated equipment.

A pair of storage tube test racks remain as a fill-in job.

(A. Taylor)

Construction has been running on schedule.

The construction group is no longer doing any drafting.

A sample terminal board has been made up to comply with WWI standards as concerns soldering, wiring and general quality. After this is approved by the persons concerned, it will be retained by the construction group as a standard of comparison.

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11.5 Drafting

(C. W. Watt)

Some thought has been put into the simplification of production drawings and parts lists for the remainder of WWI construction. Standards S 1.111, S 1.112 and S 1.113 on production drawings for electronic assemblies have been issued to the drafting department. Standards are now being prepared on general drafting procedures, and for parts lists for WWI drawings.

(H. R. Boyd)

C. Watt and A. Falcione are rapidly completing plans for simplifying the drawings to be used for manufacture within our shops. The aim is to retain all standards but omit all unnecessary items, drawings and duplications in general.

(A. M. Falcione)

Tube Characteristics - Engineering Note E-188 was issued February 1, 1949, listing drawing numbers for each tube type and description of its respective characteristic. Prints will be made and bound in a folder for the three building files.

Drafting Procedures - During the past few weeks, the following factors were weighed and decisions made which necessitate changes in our drafting procedure:

- A. Reduction of Sylvania work on WWI.
- B. Reduction of production drawings required for WWI as described in Memo M-479.
- C. The balance of the computer is to be constructed in our own shops.
- D. Production control schedules.

In order to meet the requirements for drafting because of the above conditions, it has become necessary to make changes in our procedures to expedite the transferred required pertinent information to the shop with the least possible delay. A Class 1 Standards Book has been started listing the new standards for WWI Drafting Procedure. Additions and revisions will be made from time to time, as conditions require. The new policy will be to save drafting time by use of a simplified system of making drawings with minimum changes in quality standards.

Memo M-771 was issued February 1, 1949, on the new procedure for changing drawings of one-of-a-kind units.

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11.5 Drafting (Continued)

Parts lists preparation is being taken over by R. Fairbrother. The typing will be divided between several secretaries. An extra column for cumulative quantities will be added making a combined parts list and bill of materials.

A revised and improved layout template has been designed which will save considerable time on video layouts.

The new procedures require close cooperation between Drafting and Design Engineers.

11.6 Unclassified

(J. C. Proctor)

Two air compressors have been received from the Navy. Although not new, both are in excellent condition. The larger of these has been installed in place of our old compressor, and has been serving the building for about a week. The smaller was temporarily installed in the furniture storage room to carry the load during the change over. This will be left connected to the line as an emergency supply until data can be obtained on a third compressor which is expected. When this arrives the better of the two will be permanently connected as a stand-by unit.

(L. Prentice)

Machine shop and metal shop - All of the work scheduled before the introduction of production control has been completed.

We have assisted in the installation of the DeVilbiss Compressor and line up of 100 HP generator. This work is still in progress.

In the future it has been deemed wise to keep all jigs and fixtures and templates used in the sheetmetal shop. Some time has been spent in marking jigs with the drawing number of the part with which it is used; this will be continued.

All dies or fixtures made up on order of other departments other than our own will be delivered to them for storage.

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12.0 GENERAL

Changes in Staff Personnel:

Termination: Walter S. Rogers
Transfer: Edward S. Prohaska (to Building 32)
Staff Appointment: Charles W. Adams (transfer from
student non-staff).

Changes in Non-Staff Personnel:

Terminations: John Corkhill, James Fandel, Harold Lovett
and Patricia Wolfe.
Transfer: Arthur Clifford (from Dynamic Analysis and
Control Laboratory on loan).

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