AD 268416

PRODUCTION ENGINEERING MEASURE FOR POLYOPTIC SEALING OF HYDROGEN THYRATRON TUBES

SIGNAL CORPS CONTRACT NUMBER: DA-36-039-SC-81289
SIGNAL CORPS ORDER NUMBER: 7636-PP-59-81-81
PD NUMBER: 59-PB/IPM-25

PLACED BY: U.S. ARMY SIGNAL SUPPLY AGENCY
INDUSTRIAL PREPAREDNESS ACTIVITY
PRODUCTION DEVELOPMENT DIVISION
225 SOUTH 18th STREET
PHILADELPHIA 3, PENNSYLVANIA

Contractor: CHATHAM ELECTRONICS
Division of Tung-Sol Electric Inc.
Livingston, New Jersey

PRODUCTION ENGINEERING MEASURE FOR

POLYOPTIC SEALING OF HYDROGEN THYRATRON TUBES

NINTH QUARTERLY PROGRESS REPORT

Period Of

July 1, 1961 - September 30, 1961

The object of this contract is to investigate the application of Polyoptic Sealing to Automatic Sealing and Exhausting techniques, and to investigate other means of protective sealing such as by the use of an intermediary enamel or glass frit. An attempt will also be made to effect true Polyoptic Sealing where bulb and buttons of near perfect fits may be sealed at bake temperature without local overheating.

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PREPARED BY: _____

APPROVED BY: _____

CONTRACTOR: Tung-Sol Electric Inc.
Chatham Electronics Division
Livingston, New Jersey

DATE: October 27, 1961

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PURPOSE

The investigation of the Polyoptic Process and its application to the VC 1258 Hydrogen Thyratron were made in a previous study contract with encouraging results. ("Industrial Preparedness Study on Low Temperature Glass Sealing (Polyoptics) of Tubes", Signal Corps Contract No. DA-36-039-SC-72700, Order No. 50809-PHILA-56-81).

The purpose of the subject contract is to continue the evaluation of the Polyoptic Sealing Process using a hard glass, production tube, 7190 Hydrogen Thyratron which is a "reliable" miniature type.

The following course of investigation will be followed:

1. The use of automatic sealing and exhausting equipment.
2. The investigation of other means of low temperature sealing such as by the use of an intermediary enamel or glass frit.
3. An investigation to affect true Polyoptic Sealing where we will attempt to seal at tube bake temperature by employing near perfect button to bulb fits without the use of local overheating.
4. The comparison of electrical and mechanical properties of polyoptic tubes with those of flame sealed tubes before and during life testing.

5. A study of the yield and labor hours on all phases of the chosen polyoptic process.

6. A list of tooling and equipment requirements.

ABSTRACT

Life tests are continuing. All tubes required to have been made on the automatic exhaust machine have either completed life test or are presently being tested. The present results show no essential difference in survival rates between the two types of seals.

No further work on variations in sealing techniques has been done but consideration is given to an extension of the high temperature bake process investigation.

Initial work has begun in determining the proper techniques for polyoptic sealing on trolley exhaust.

PROGRESS

.. Polyoptic Sealing

Life tests of type 7190 hydrogen thyratrons sealed by the polyoptic process and sealed by the conventional flame method are continuing. Both groups of tubes were processed on the same automatic exhaust machine. Figures 1 and 2 show life test totals accumulated to the end of this report period. The annual vacation shutdown occurred during this time; the tubes did not operate during the vacation period.

Trouble with the automatic exhaust machine continued into this quarter. We were unable to produce tubes that passed the type 7190 initial tests. This trouble appeared to be associated with the gas dosing mechanism.

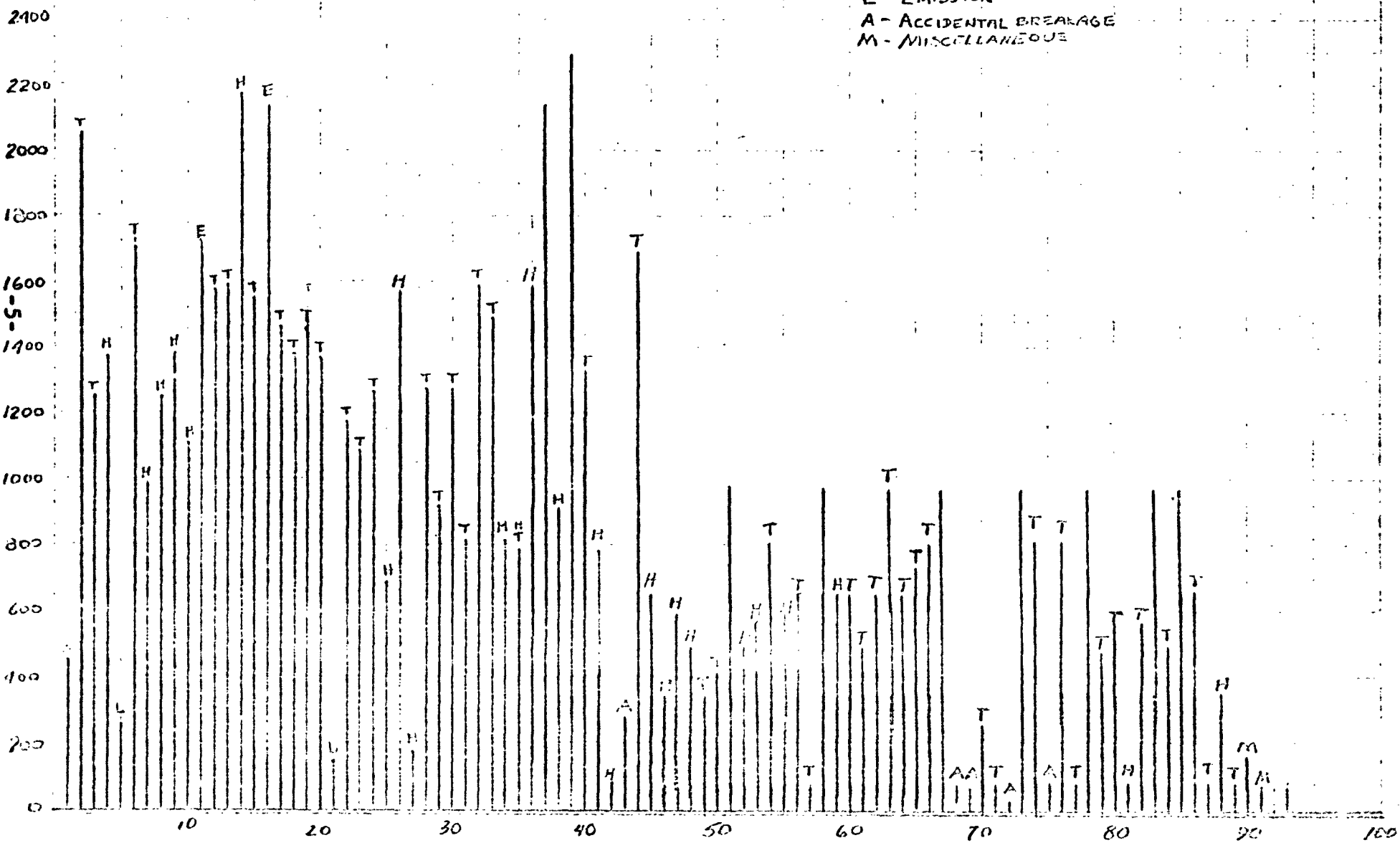
A cold trap was placed in the gas filling system and tubes that passed initial tests were obtained from the machine. The problem of filling tubes to a constant gas density through a cold trap, which was mentioned in the Fourth Quarterly Report, does not appear to be of as much importance as having some protection from oil vapor entrained by the hydrogen being injected into the tube. The rotary gas dosing mechanism, like the rotary automatic exhaust machine, depends on an oil film for its vacuum seal and is subject to considerable variation in the quality of its operation. The ..

TOTAL RUNNING LIFE TEST HOURS OF POLYOPTIC 7190's PROCESSED ON AUTOMATIC EXHAUST MACHINE

LINES WITHOUT A LETTER ON TOP REPRESENT TUBES WHICH ARE STILL RUNNING

REASONS FOR FAILURE:
- H - HYDROGEN CLEAN UP
- T - TAD (ANODE DELAY TIME)
- L - SEAL LEAK
- E - EMISSION
- A - ACCIDENTAL BREAKAGE
- M - MISCELLANEOUS

FIGURE 1



TOTAL RUNNING LIFE TEST HOURS OF FLAME SEALED 7190's PROCESSED ON AUTOMATIC EXHAUST MACHINE

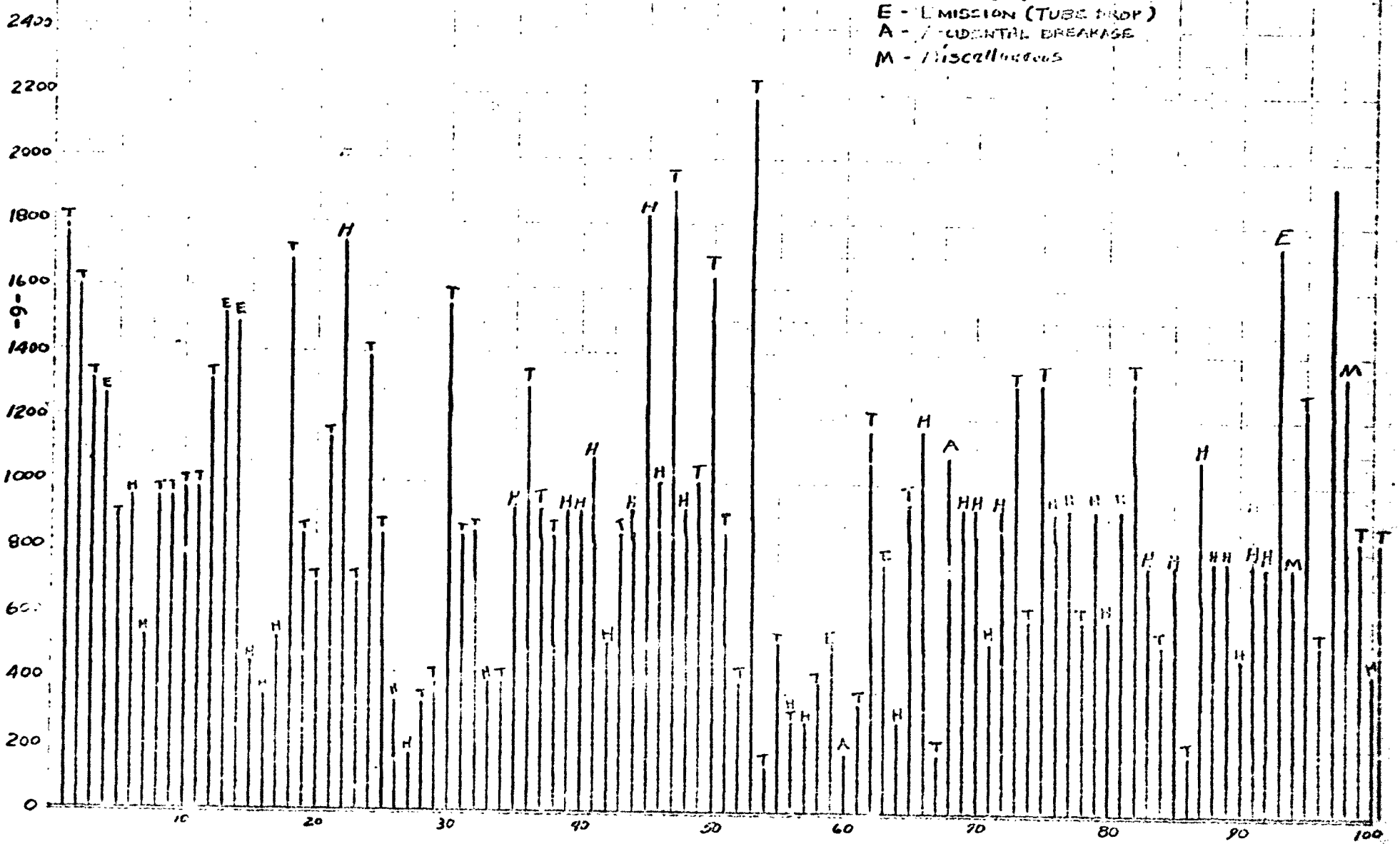
LINES WITHOUT A LETTER ON TOP REPRESENT TUBES WHICH ARE STILL RUNNING

REASONS FOR FAILURE:

H - HYDROGEN CLEAN UP
T - TAD (ANODE DELAY TIME)
L - SEAL LEAK
E - EMISSION (TUBE DROP)
A - ACCIDENTAL BREAKAGE
M - Miscellaneous

LIFE TEST HOURS

FIGURE 2



the pumps on the machine was also replaced in order to improve the vacuum at several of the index points.

Sufficient tubes to fulfill the contractual requirement for life test tubes made on the automatic machine were placed on life test just at the end of the report period. They have not accumulated enough hours to show on the status plot, Figure 1.

B. Special Status Report

During this report interval, the first of two special reports required by the contract was prepared and distributed. This report was essentially a summary of progress to date in the area of sealing techniques. The report concluded that the original method of polyoptic sealing, the method involving local heating of the seal region, performed best of all methods tried. This method produced the only tubes able to be put on life test with the exception of a few tubes made by the high temperature bake method which were not altogether satisfactory. Further investigation into the high temperature bake method using a combination of glasses was recommended.

C. Sealing by Other Than the Local Heating Method

No further work has been done toward developing seals using cements, frits, or other intermediaries. No further work has been contemplated toward using the true polyoptic method. Some thought toward further trials of the high temperature bake method has been

suggested as a new line of attack: the use of glasses for the bulb and stem which have differing softening points. A study of available glasses having properties distributed in the proper directions is being made and some type 3320 (Corning) glass is being obtained for a trial.

D. Trolley Exhaust

A group of tubes has been processed on the trolley system. Modifications were necessarily made in the standard factory type 7190 exhaust schedule to allow for the sealing of the tube during the exhaust operation. There is evidence that the polyoptically sealed tubes require a higher gas filling pressure than flame sealed tubes when processed on the trolley system. This possibility is presently being studied.

Several tubes were also exhausted on the trolley system using a schedule which duplicated that found to give the optimum tube on the automatic machine. These tubes did not perform well on the short test given them. They were initially good but appeared to need more gas in order to have a satisfactory life.

The work on the trolley system is being done in anticipation of modifications in the contract which will reguire tubes to be processed on such a system.

E. Parts Preparation

No new methods or processes have been introduced into the glass parts preparation operations during the past quarter.

CONCLUSIONS

As more test data are accumulated, the gap between the performance of the polyoptically sealed and the flame sealed tubes has closed. Study of Figures 3, 4, and 5 show that there is little choice between the two methods of sealing so far as tubes made on the automatic exhaust machine are concerned. As time goes by, it appears more likely that these tests have not really compared the two methods of sealing but have only shown the range of quality to be expected from the automatic exhaust machine used for the tests.

The flame sealed tubes were processed more or less continuously and placed on life test as they were completed and as sockets became available. Figure 2 shows that no particular trend in life duration is observed to be a function of time of being put on life test. However, Figure 1 shows that the performance of the last approximately 50 percent of the tubes to be placed on life test is considerably poorer than the first half of the tubes. These latter tubes were made during several different runs on the machine, placed on the shelf for a time, tested, and started on life test. Although they appeared normal initially the tubes beyond number 40 have shown a comparatively poor life with a substantial percentage not lasting 500 hours.

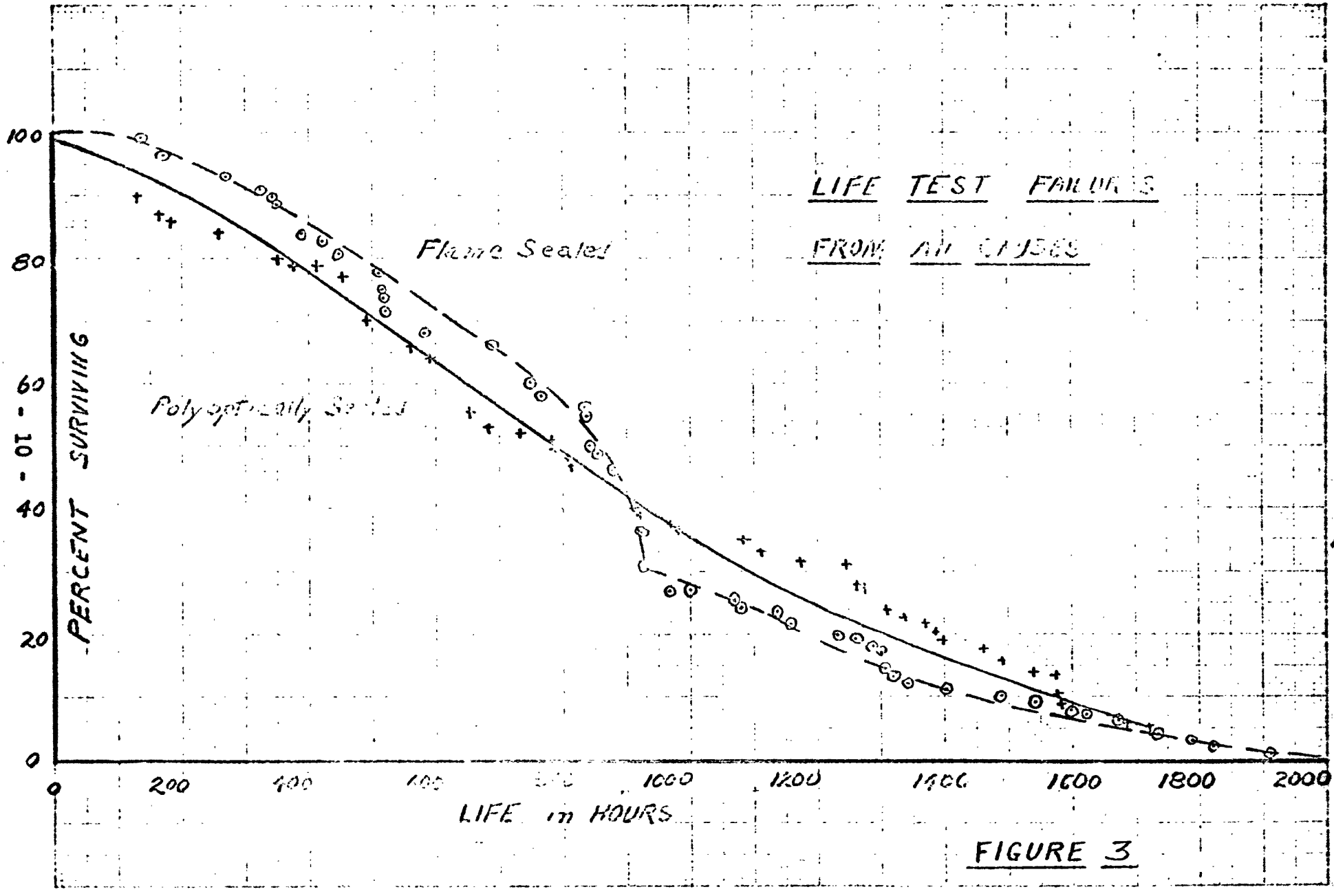

LIFE TEST FAILURES
FROM AIR CAVITIES
Flame Sealed
Polyoptically Sealed
PERCENT SURVIVING
100
80
60
40
20
0
0
200
400
1000
1200
1400
1600
1800
2000
LIFE in HOURS

FIGURE 3

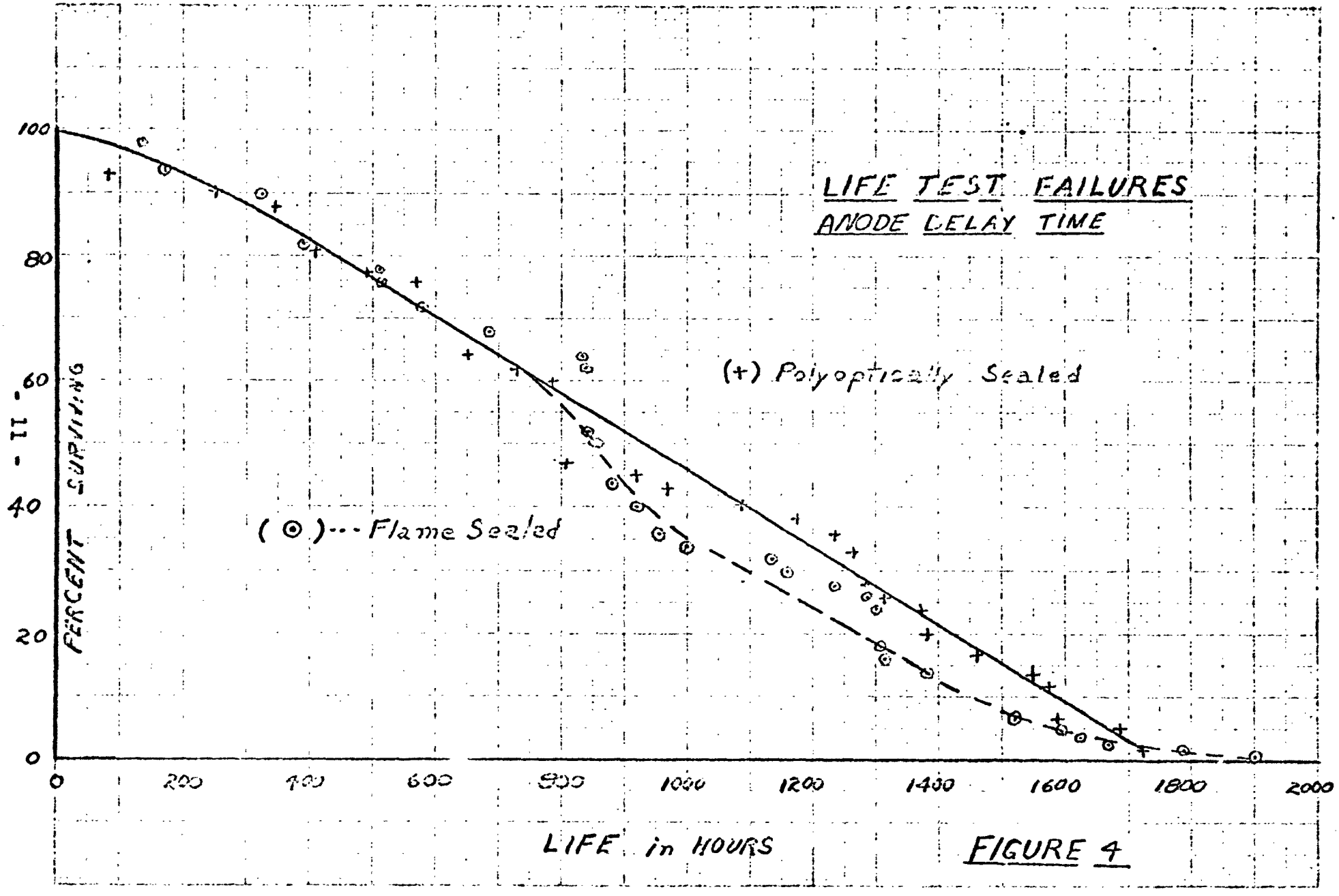

LIFE TEST FAILURES
ANODE DELAY TIME
(+) Polyoptically Sealed
(⊙)--- Flame Sealed
PERCENT SURVIVING
LIFE in HOURS
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000

FIGURE 4

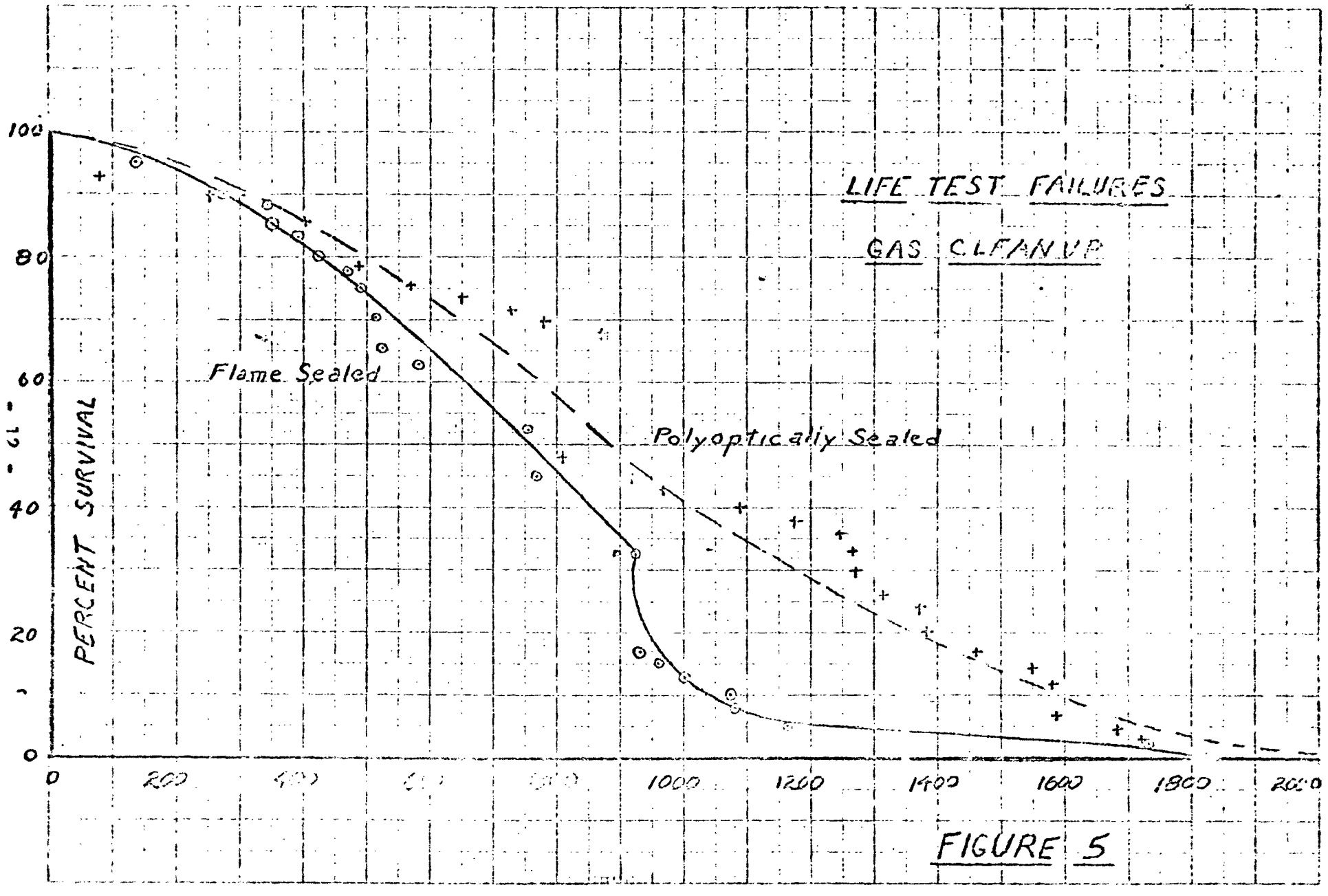

LIFE TEST FAILURES
GAS CLEANUP
PERCENT SURVIVAL
100
80
60
40
20
0
Flame Sealed
Polyoptically Sealed
0
200
1000
1200
1400
1600
1800
2000

FIGURE 5

Because the flame sealed tube group was almost completely tested at the time of the last quarterly report, the change from a survival ratio of approximately four to three in favor of the polyoptically sealed tubes to the present ratio of about one to one has been caused by the early failures in the last half of the polyoptically sealed life test group. This obvious difference in the performance of a group of tubes does not invalidate the life test since they were initially good tubes and were representative of part of the quality range obtained by this processing method.

If a similar test of polyoptically sealed tubes processed on a trolley system should show a substantially better average life, then we could be certain that the results of these present tests were caused by the exhaust machine.

PERSONNEL LIST

		Hours Spent On Contract
Ward W. Watrous	Department Head	---
C. L. Shackelford	Project Engineer	151
Gilbert Dixon	Engineer	152
Robert Tancredi	Technician	416
Fred Roth	Technician	104
M. Leibruder	Exhaust Operator	79
Anthony Autullo	Electronic Technician	127