

Memorandum 6L-204

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

SUBJECT: SECOND SOURCE ON TUBES

To: R. R. Everett

From: N. H. Taylor

Date: 25 May 1955

In a letter dated 28 April 1954 from J. W. Forrester to C. McElwain, it was stated that certain tubes; namely, Z-2177 and improved SR-1782A/3002h20 (Prototype 7AK7) are important components in the FSQ-7 which should have a second source.

Subsequent action has led to a recommendation that a second source for each of these types be set up. This note emphasizes two minimum requirements on any such program if it is to meet over-all System requirements. They are:

1. Interchangeability of tubes from the two sources.
2. Process and quality control at each source.

1. Interchangeability

The history of electronic equipment concerning interchangeability of tubes secured from separate sources is very poor. The reasons behind this poor interchangeability stem from the difficult problem of specifying all the characteristics which are needed to meet "end use" circuit specifications. It is difficult to state a single case where this has been achieved. There have been hundreds of failures.

The best solution to this problem is to set up a second source which will furnish an exact copy of the first source in design, process control, and quality control. Such a source should be under cognizance and perhaps direct control of the prime as to variations in design, process and quality control items.

Many have pointed out the difficulty of realizing such close coordination of two sources on tubes. It should be emphasized that the problems involved, while difficult, are small compared to the ramifications to systems performance if true interchangeability is not obtained.

Systems Ramifications of Poor Interchangeability

The FSQ-7 has been designed with wide margins for extreme reliability. These margins are provided and measured as a means of doing preventive maintenance by a system of marginal checking designed into the system. Tubes which vary significantly from each other will use up this

margin and reflect in a first order way on the reliability of the FSQ-7. If poor interchangeability is allowed to exist, the large effort put into obtaining these wide circuit margins will essentially be nullified. Without these wide margins of performance, large electronic systems just will not perform.

2. Process and Quality Control

The overriding requirement in selecting the two tubes used widely in FSQ-7 was freedom from intermittents which could exist if these types were made very carefully. A major factor in building tubes free of intermittents is the process and quality control measures used during construction.

Tube engineers at Lincoln Laboratory and IBM have been working with the prime sources of these two types for years. (MIT has worked with Sylvania since 1948 to improve the tube situation.) Many techniques have been developed by the prime sources to minimize the problem of intermittents and there is considerable danger that lack of close liaison in design, process and quality control can result in inadequate tubes from an intermittent viewpoint.

It should be noted that the premium price paid for these tubes results from properly carrying out this function of process and quality control. Serious differences in this area may produce tubes which look alike when new, but which differ greatly in a few thousand hours.

This is an intangible part of our present specification. The buyer must rely to a large extent on the understanding and integrity of the manufacturer to exercise adequate controls. The user must not force the manufacturer to cut corners here in order to effect a lower price. This point cannot be overemphasized.

Systems Ramifications of Poor Process and Quality Control

The digital computer is vulnerable to intermittents. They often cannot be found by preventive maintenance, yet are still apparent in tubes. They must be eliminated at the manufacturing source. If not, the system can become a useless lump of helpless electronics. An intermittent tube costs hundreds of dollars to find in a large system. We must pay enough for our tubes to eliminate them.

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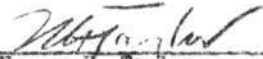
Conclusions

Second sources of tubes can cause trouble, if:

1. They are not interchangeable
2. They are not free of intermittents.

Therefore, it is recommended that second sources be set up under cognizance of prime sources to benefit by their experience. To achieve these aims it may be necessary for a prime source to guarantee the second source to be as good as their own.

Signed


Norman H. Taylor

NHT/rb

cc: X S.H. Dodd
J.W. Forrester
B.B. Paine
S. Tricken
P. Youts