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Buffalo Tube Works

GENERAL ELECTRIC
COMPANY
SCHENECTADY, N. Y., U. S. A.

DATA FOLDER No. 86902

Title Cathode Nickel Base Metal Evaluation Work of the American Society for Testing Materials

By

Electronic Tube Engg. Div.

Information prepared for Electronic Tube Engg. Div.

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Cathode Nickel Base Metal Evaluation

Work of the American Society for Testing Materials

Summary:-

This is a brief history of that group now known as Section A, Sub-committee VIII, Committee B-4 of ASTM, and an evaluation of the projects of this group as an aid to Electronic Tube Design and manufacture.

I Beginnings of the Organization

On January 15th and 16th, '45 the Superior Tube Company sponsored a meeting of about sixty men representing 19 electronic tube companies, International Nickel Company, Superior Tube Company, Stupakoff, and Reynolds & Harris at the Commodore Hotel, New York City. The object of the meeting was to prepare a proper method of evaluation of nickel as a base metal for oxide coated cathodes in electronic tubes. It was apparent from the beginning that a great deal of fundamental work would be necessary to establish a proper basis for the evaluation of the material, and a sub-division of work seemed necessary. Accordingly, four groups were organized.

(1) Chemical Committee
(2) Metallurgical Committee
(3) A committee to decide on the design for a "standard diode".
(4) A committee to assemble and evaluate data.

At the same meeting it was suggested that this group, since it would probably require several years of organization, should affiliate itself with a national organization. ASTM was the logical choice. Consequently, the group asked to be made a section of ASTM, and was accepted.

II Objective

(1) The specific purpose of the ASTM, founded in 1898 and incorporated in 1902, is "the promotion of knowledge of the metals of engineering, and the standardization of objectives and the methods of testing". This purpose the society has aimed to achieve by organization of vendors and users of various materials into committees to decide upon the proper testing methods and test limits to be applied to any materials in question. A. S. T. M. policy has often necessitated joint research to determine the controlling factors in a particular material or process before test methods for control purposes can be intelligently devised.

(2) It has been the object of Section A Sub-committee VIII, Committee B-4 of ASTM to continue the organization started at the meeting in January '45 so that it may initiate sufficient basic studies to discover one or more unknown factors which control nickel for cathodes and finally establish methods and limits for the evaluation and acceptance of nickel to be used as the base metal for oxide coated cathodes.

III Program

(1) Section A Sub-committee VIII:-

The program has been one which has tended to integrate the work of the committee. However, for a proper consideration of the work at hand and the method of attack, it is best to consider the work of the individual groups, remembering that, to date, it has been necessary to attempt establishment on a firm foundation of the background knowledge required.

Much of the basic information required for this purpose in unknown. Through the cooperative research of consumers and producers of cathode nickel much of this basic information will be obtained. Further, it is necessary to check much of the superficial investigation and reported "facts" on cathode nickel given in former reports and discussions to ascertain the factors controlling the nickel as a base metal.

(a) Chemical group - It has been the object of the Chemical group to propose to the committee as a whole the proper methods of preparation of materials to be tested, standard methods of chemical analysis of nickel, evaluation of elements as to amounts, state of oxidation and gas content, and possible interface reaction. This work must be preceded by a basic understanding of the chemical reactions due to base metal.

(b) Metallurgical group - It has been the object of the metallurgical group to work in close cooperation in establishing standard methods for the analysis and evaluation of elements which would cause differences in processing of cathodes, and in establishing surface and intergranular conditions of the metal. The initial work here is also of a basic research nature.

(c) Diode group - It has been the object of this group to propose for use two types of diodes. The first is a factory diode built of standard radio tube parts and with standard processing to provide a practical and easily duplicated test medium for the evaluation of the base metal by actual emission tests through all of the companies involved in the organization.

It has been the second purpose of this committee to build a "standard laboratory diode" with all of the implied laboratory controls to give a medium for fine testing of very slight differences in base metal and for any advanced investigation which may be initiated in controlled nickel melts.

(d) The Data group - The compelation of the results of the various groups has fallen to the lot of this group. In addition, this group has established a standard form for reporting of all data on tests of cathode base metal which are now being carried out by the various companies. It has likewise proposed the establishment of a standard method of evaluating the various test results which are obtained by "weighting" initial test, initial rejection percentage, and life tests.

IV Results to Date

Since the initial meeting a great deal of work has been done by all of the groups in an attempt to establish the proper methods for evaluation of the base metal.

The Data group has, as noted above, already proposed test report forms and methods of evaluation of the various tests which can be given to either a standard factory diode or to almost any factory radio tube. As a result of these proposals it is expected that the tube companies using the forms which the committee has prepared will give information which will be more accurate and useful than that formerly obtained. Greater precision has already been demonstrated by use of a standard diode than could be obtained by the use of different tubes in factory testing of the same material. If the results of the work of this committee are to be utilized properly it is necessary that a standard diode be used so that the precision attained thereby may enter into all the reports.

The Diode group in proposing a standard factory diode, which has already been adapted and used by many of the companies interested in the test, has provided a simple and satisfactory method of giving direct emission tests for the usual samples of cathode nickel.

Some of the companies involved in this work will build, as a laboratory diode, copies of the tube used by Dr. Coomes' group at MIT in their laboratory tests on oxide coated cathodes.

The work of the chemical and metallurgical committees to date has been mostly basic. That is it has involved the study of the fundamental factors in the establishment of proper tests for base metal and in the production of better base metal.

Methods of cleaning base metal, preparation of the emission coating, and chemical analysis of the samples have been started.

Already it has been found that the standard methods for chemical analysis of nickel samples are not adequate for defining differences in cathode nickel. The work on proper chemical analysis of small samples of nickel for small amounts of other elements has been referred to committee E-3 of ASTM. (This illustrates one advantage in such a national organization).

Contamination tests with Fe and Si have indicated these elements are not necessarily detrimental to emission.

V Recommendations

While much of the work being undertaken is of a basic nature, it promises to lead to a real understanding of the limits which must be placed on cathode nickel to assure consistantly desirable results. There certainly is no record of these basic problems having been solved to this date, as witnessed by our recurring questions on the adequacy of our present nickel specifications. (No further changes should be made in nickel specifications until we have a firm basis for the limits on "impurities" which we place in the specifications.)

It is the opinion of the writer that G. E. Co. as a whole and the Electronic Tube Division in particular should not only remain an interested member in this group, but should take an even more active part in its program. This more active participation may take the form work on the testing of the various lots of cathodes in a standard factory diode and, perhaps, some work on the building of the laboratory diode, together with the supplying of information on these tests to the data committee in the forms prescribed. Our competition in the electronic tube field has certainly shown its continued interest in the works.

As a member of the chemical committee the writer has already given information to the group on a chemical analysis on a standard sample which was supplied by International Nickel Co. (analysis made by Works Lab., Schenectady). Special work on the gas content of cathodes is being undertaken in our Research Lab. Some studies of interface reaction may be done in cooperation with Research Lab. in the near future. Work on spectrophotometric analysis can be done on the Beckman in #269 as well as in Works Lab.

Mr. L. L. Wyman of our Research Lab. is the coordinator of all of the work of Committee B-4 for the G. E. Co. and it might be well to have one person interested in the study of cathode nickel responsible for coordination of all the work, and resultant information in the Electronic Tube Division.

Raymond E. Roth

R. E. Roth
6-19-46

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June 21, 1946

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