

Joint Army-Navy Tube Standardization Program*

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Summary—The steps taken by the Bureau of Ships and the Signal Corps to effect standardization of radio tubes are recounted briefly. The procedures for handling tube problems, including the JAN-1 Tube Subcommittee, its duties and reasons therefor, are described. Tube specifications, preferred lists, special selection, and type approvals are among the subjects discussed.

THIS war depends to an amazing extent upon electronics. The many advances in radio and related equipments now in use by our Armed Forces would not have been possible without electronic tubes. It is not desired to minimize the importance of circuit and related developments, but without tubes, these circuits and developments would not be possible.

Consequently, it was evident at an early stage that careful attention should be given to electron-tube matters in order to secure best results. Before entering the conflict, the Army and Navy each had its own systems of tube nomenclature, which were unrelated to the Radio Manufacturers Association and other commercial type numbers. Radio engineers, hurriedly called into government service, had to contend with these unfamiliar Army and Navy numbers which were so unsuited to the desirable qualities of interchangeability, common stockpiles, joint inspection, and general efficiency.

The Navy was the first to do away with its special nomenclature for tubes by adopting the use of RMA and commercial type numbers in 1940.

Early in 1942 work was begun to prepare a joint Army-Navy specification for tubes which would be based upon the use of RMA and commercial type numbers, and the Army decided to do away with the special nomenclature which it had been using.

Through the use of a single specification for both major branches of the Armed Services, it was felt that greatly improved results could be obtained by the elimination of more than one specification per tube type by the easy interchangeability, which would result between Army and Navy tubes, and by the possibility of creating joint stockpiles. Furthermore, it could save manpower by eliminating dual inspection at a manufacturer's plant, since, because of their familiarity with this common specification, either Army or Navy inspectors could inspect for either branch of the service.

It was, at first, planned to prepare these joint specifications by combining the previous Army and Navy specifications for each type. Thus if the vacuum-tube specification for a particular tube called for a plate-current range of from 4 to 8 milliamperes, and the former Navy specification specified from 5 to 9 milliamperes,

the joint specification would require 5 to 8 milliamperes. This plan was later dropped in favor of basing each specification on actual needs of the Services, as well as upon good engineering practice and production capabilities.

Naturally, in a venture of this sort, the first specification which resulted, after several months' work by representatives of the Navy and the Signal Corps, was not perfect. The JAN-1 Specification for Tubes, Radio Electron, as it was named, was put into use by the Signal Corps and Bureau of Ships in March, 1943, but caused such a multitude of objections and suggested changes, due to insufficient test equipment and lack of data in the tube manufacturer's plant to enable him to know how closely his product could be controlled, that the granting of waivers to help manufacturers through this transition period was authorized. At the same time the tube manufacturers were requested to work together to recommend changes in the specification which would make it more acceptable to them. This joint action was necessary to insure that the Services had but one coordinated specification suggestion from Industry to consider for each type. Through the able assistance of the RMA, the various tube manufacturers assembled their comments and suggestions, after a considerable amount of time spent by the representatives of these manufacturers in meetings of the various RMA Tube Committees. These suggestions were then conveyed to the Army and Navy engineers working on the specification and several joint Industry-Service meetings took place for further discussion of uncertain or questionable points. By the latter part of 1943 a revision of the original specification was completed and issued, entitled Joint Army-Navy Specification JAN-1A for Radio Electron Tubes. This specification is now mandatory for all Signal Corps and Navy tube contracts.

There are quite a few tube types for which JAN Specifications have not yet been written, but these are being completed as promptly as possible. With but few exceptions, all but some of the special purpose and classified high-frequency types are not yet specified, but procurement of these is being made on temporary Army or Navy specifications, written to conform to the JAN style.

In a brief résumé, the preceding remarks have brought us up to the present. Now the working organization, its duties, and aims will be described.

Joint Army-Navy specifications, of which the Radio Electron Tube Specification is the first, are controlled and authorized by a JAN Committee comprised of members of the Army Service Forces and Naval Office of Procurement and Materiel. This committee has authorized a subcommittee to handle the tube specification and has specified its duties. It is known as the JAN-1

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Tube Subcommittee. Its members are representatives of the various Service organizations concerned and are as follows:

1. The Navy—Bureau of Ships.
2. The Signal Corps Aircraft Signal Agency, a division of which is well known as the Aircraft Radio Laboratory.
3. The Signal Corps Ground Signal Agency, comprising Camp Evans Signal Laboratory and the Laboratories in and near Fort Monmouth.
4. The Signal Corps Standards Agency, which is essentially a branch of the Office of the Chief Signal Officer.
5. The issuance of tube type approvals under the JAN-1A Specification after qualification tests have been made.
6. The compiling and revising of the Army-Navy preferred lists of vacuum tubes.
7. The recommending of security classifications for vacuum tubes.
8. Co-ordination with Canadian Armed Services in their use of the JAN-1A Specification.
9. Co-ordination with the RMA on tube numbering and test methods.

It may now be well to take up some of these duties in detail in order to indicate their scope and method of handling.

At this time the actual representatives are:

Mr. J. W. Greer for the Navy

Lieutenant E. A. Anderson for the Signal Corps Ground Signal Agency

Captain F. D. Langstroth for the Signal Corps Standards Agency, chairman

Captain C. W. Martel for the Signal Corps Aircraft Signal Agency

All have had technical experience in the radio-tube industry. Other personnel from any of these member organizations may be brought in by the regular representative if needed.

The Signal Corps Standards Agency acts as the secretariat for the Army members of the JAN-1 Tube Subcommittee, as well as co-ordinating and administrative center for Army matters that come under the jurisdiction of this subcommittee. The JAN-1 Tube Subcommittee meets regularly twice each month, but may be called together by the Signal Corps Standards Agency or the Bureau of Ships whenever required. For instance, special meetings have been held to discuss with various manufacturers, suggestions which had been made in connection with certain types which they produce. If a particularly urgent matter arises, the subcommittee members may be asked for a decision by telephone or telegraph, so that there is no time lost in securing an answer to important problems.

The official duties of the JAN-1 Tube Subcommittee as supplied by the JAN Committee are as follows:

1. To prepare and establish standard tube specifications and ratings.
2. To review, revise, and correct these specifications as required by technical improvements, changes in Service requirements, etc.
3. To co-ordinate tube-specification matters with the Services and Industry.
4. To supervise the distribution of the specifications to all concerned.

In addition to these duties which apply directly to the JAN-1A Specification, the members of the subcommittee have additional duties as follows:

1. The consideration of proposed tests to determine if the resulting tubes are equivalent to those which meet tests required by the JAN-1A specification.

First it is desirable to explain the method by which these electron-tube matters are referred to the JAN-1 Tube Subcommittee. Any electron-tube manufacturer, equipment manufacturer, Service laboratory, or other government organization concerned with JAN tubes may originate a matter requiring action by the subcommittee. This matter should then be sent to the Signal Corps Standards Agency or Bureau of Ships depending upon the Service branch most concerned. Army contractors and subcontractors will follow the usual procedure of submitting their problems through the prime, or equipment, contractor to the contracting officer or laboratory concerned, which will forward them to the Signal Corps Standards Agency with their recommendations. Navy contractors may contact the Bureau of Ships, Code 930A, directly. The Bureau of Ships will then pass these subjects on to the Signal Corps Standards Agency where all such matters will be put on the agenda of the next subcommittee meeting unless immediate action is requested. After action by the JAN-1 Tube Subcommittee, its decision on the matter will be transmitted by either the Signal Corps Standards Agency or Bureau of Ships to the organization which made the original request.

The IRE Standards on Electronics of 1938 are used, where applicable, for references in the JAN-1A specification and it is hoped that these standards will be brought up to date soon to include all of the tube characteristics for which present military equipments have created a need for standardization. The results of the work of the recently organized Subcommittee on Advanced Developments of the IRE are awaited with interest by the JAN-1 Tube Subcommittee.

The duty of preparing and establishing JAN tube specifications is carried out in co-operation with the tube manufacturers, Service laboratories, and other organizations concerned. Requirements which the tube must meet in order that it operate satisfactorily in all equipments are compiled and compared with tests and test limits suggested by the manufacturers. The final specification as adopted combines these two viewpoints into a set of tests and limits which come as closely as possible to satisfying equipment requirements without causing the manufacturer undue hardship through

excessive rejections, complicated production or test equipment, or similar factors which would adversely affect production. In some cases several conferences between equipment engineers, JAN-1 Subcommittee members, and tube manufacturers' representatives may be necessary before a specification is mutually satisfactory.

Naturally all concerned must have a say in what tests will be required for each tube. Any one service organization or tube or equipment manufacturer cannot alone write a specification which will be sure to be suitable for all users of the tube. It may seem reasonable that the services which use the tube should write the specifications to insure that the tubes will then meet the Service needs, but this is not satisfactory, for the tube manufacturers must also have an opportunity to comment, in order to insure that the specification can be met through its being in accordance with good production and engineering design and practice, even though this may not allow the Services to make as "tight" a specification as they might prefer. In other words, it is sometimes necessary to sacrifice the ultimate in desired performance in order that the tube can be produced with reasonable efficiency and by more than one tube manufacturer. After this complete co-ordination with all concerned, the resulting specification as written, insures the best possible operation of the tube in the equipments using it, without including requirements which would cause excessive production difficulties.

In securing co-ordination with the tube manufacturers on problems of a general nature which affect all, the JAN-1 Tube Subcommittee has worked, and will continue to work, with the various RMA tube committees. These RMA groups are made up of engineers from the tube manufacturers and comprise committees on receiving tubes, transmitting tubes, cathode-ray tubes, etc. Matters which arise are referred to the appropriate RMA committee through the Electron Section of the RMA Engineering Department. The recommendations of the RMA committee are then considered by the JAN-1 Tube Subcommittee and adopted as completely as possible consistent with Service requirements. Furthermore, some of the RMA tube committees are carrying on investigations requiring appreciable time and data gathering, with a view to recommending improved tests for and information regarding the use of tubes under less usual operating conditions.

Tube specifications do not necessarily remain fixed after their initial acceptance by the JAN-1 Tube Subcommittee, because improved design and production techniques, and changed equipment requirements may involve specification changes. Thus the subcommittee's duties include that of reviewing and correcting specifications as necessary. If errors are found in the JAN-1A specification or if it is desired to recommend changes, the information should be sent either to the Signal Corps Standards Agency or to the Bureau of Ships, Code 930A. This will insure that they are referred to the JAN-1 Subcommittee for consideration. In submitting

recommended changes it is necessary that complete reasons for the recommendations together with substantiating data be included.

From the preceding description, it will be seen that the specification is handled in a manner which enables it to reflect the latest in government and industry advancements and requirements.

The JAN-1A Specification does not bear any security classification since specifications for confidential types are issued individually to those organizations which have need for them. Such specifications must be kept in accordance with government security regulations.

The JAN-1A Specification is available to any contractor or government organization which requires it. The distribution of the JAN-1A Specification is not, however, unlimited, due to practical considerations such as preparation and printing time, distribution problems, and cost. In order to insure that the specification is properly distributed, all requests for copies must be approved by the JAN-1 Tube Subcommittee. Requests for copies may be sent either to the Signal Corps Standards Agency or the Bureau of Ships.

It is well to point out that the JAN-1A Specification is still incomplete in that all tube characteristics are not necessarily controlled by the required tests. Therefore, any tube application which requires the control of less frequently used tube characteristics should be checked against the specification to insure that it provides tests to control those characteristics. For example, the following tube characteristics are not usually controlled by the specification:

1. Triode and suppressor cutoff characteristics of pentodes.
2. Plate-current cutoff tolerances for types used as resistance-capacitance oscillators.
3. Radio-frequency characteristics of types originally designed for audio-frequency circuits.

If a particular equipment requires the control of characteristics not now controlled, the matter should be brought before the JAN-1 Tube Subcommittee together with data to enable the formulation of a suitable test. The subcommittee will then do all possible to arrange for specification revisions to accomplish the desired result.

At this point it is well to call attention to the fact that special tube selection is extremely undesirable. Directives from the headquarters of both the Bureau of Ships and the Signal Corps state that special selection of tubes will not be permitted but that equipments must meet performance requirements with any and all tubes which pass the JAN tests for the types involved. When a tube requires replacement in the field any tube of the correct type which is in stock *must* work satisfactorily. If the tube being replaced was specially selected by the equipment manufacturer in order to enable his equipment to pass acceptance tests, the tubes in Service stocks may not give good results and thus the equipment may be

inoperable at a time when it is most needed. The idea of including selected spare tubes with the equipment is not feasible due to the fact that tubes may have a shelf life and that it is very probable that the spares will become separated from the equipment during field operations. Special stocks of selected tubes are not wanted due to the additional handling and space required. Furthermore special selection is undesirable because of its adverse effect on production efficiency. It is definitely a military liability.

Fortunately the majority of radio engineers recognize the evils of special tube selection and are doing all possible to eliminate it by proper equipment and circuit design, but all design engineers are requested to give this their continued attention. The preceding remarks to the effect that care should be taken to insure that the JAN-1A Specification controls all important tube characteristics are, therefore, particularly applicable to the prevention of special tube selection.

The JAN-1A Specification provides for type approval of each tube type produced by each tube manufacturer. The purpose of requiring that a tube manufacturer secure type approval for each type that he wishes to sell to the Government is to provide a check on his ability to produce those tubes satisfactorily, and to allow the Services to check the accuracy and capabilities of his test equipment as well as the suitability of the tube for use by the Armed Services. Then, when the Contracting Officer places a contract with a manufacturer holding type approval for the required types, he knows that the contractor can actually make and test those types satisfactorily.

Complete information regarding the obtaining of tube type approval is contained in Form TAI-1, which may be secured from either the Bureau of Ships or the Signal Corps Standards Agency. However, a brief description of the procedure will be given.

1. The manufacturer writes to the Signal Corps Standards Agency in triplicate stating that he wishes to submit type JAN-_____ for type approval. This letter must include complete information concerning the tube, test data, photographs, and other data required by Form TAI-1.

2. The Signal Corps Standards Agency advises him of the laboratory which will perform the tests and authorizes him to ship the tubes there.

3. The laboratory performs the tests and submits complete data with recommendations to the Signal Corps Standards Agency. The laboratory may correspond with the manufacturer, if necessary, during the performance of the tests.

4. The Signal Corps Standards Agency notifies the manufacturer of the outcome of the tests and issues type approval certificate, if warranted. If not warranted, additional samples may be submitted after the manufacturer has provided proof that suitable changes have been made in the tubes.

It should be understood that each manufacturer

should obtain type approval for each type of his own manufacture that he wishes to sell for ultimate use by either the Signal Corps or the Navy. However, a manufacturer cannot secure approval for a type which he purchases from another manufacturer and resells. The JAN-1A Specification describes the correct method for marking tubes to indicate that their manufacturer holds type approval for them. It may be well to call attention to a basic requirement that, regardless of who sells the tube, the type-approval marking must be that of the actual manufacturer of the tube and is to be used only when that manufacturer has been granted type approval for that type.

An important function of the JAN-1 Tube Subcommittee is the handling of requests for waivers to the JAN-1A Specification. A tube manufacturer may find that he cannot make a required test due to lack of equipment; an equipment contractor may encounter a long delay in securing a particular type if all JAN tests are complied with, but can secure quick delivery of that type if it is tested to broader limits which still permit it to give proper operation in the particular equipment concerned. Such situations often arise. If they are referred to the Bureau of Ships or the Signal Corps Standards Agency through proper channels, the JAN-1 Tube Subcommittee will consider them and decide whether the tube will meet the requirements of the JAN-1A Specification. Decisions required to keep up production may be secured within a few hours by telephone and teletype concurrence of the JAN-1 Tube Subcommittee members.

Two types of waivers known as Type 1 and Type 2 are provided. Type 1 waiver may apply to any or all tube manufacturers who are concerned with the tube type affected and allows the use of the JAN marking. The Type 2 waiver applies to a particular manufacturer, a particular equipment, a particular contract, a specified number of tubes, and/or a specified length of time. Tubes supplied under a Type 2 waiver cannot be marked JAN.

Requests for Type 1 waivers should be sent directly to the Signal Corps Standards Agency or Bureau of Ships, Code 930A. Requests for Type 2 waivers should be made through the channels normally used in requesting approval for technical changes in contracts.

Over a year ago, the Army and Navy jointly issued a Preferred List of Vacuum Tubes. The first revision was made early in 1943 (the current revision is dated February 15, 1944) and included both a confidential and an unclassified listing. The object of these Preferred Lists, which must be aimed for in all developments, is to reduce number of types used by the Services. With fewer types required there are important savings to the Services in space and manpower for handling stock; also tube manufacturers can, by concentrating on the production of those types, achieve greater production efficiency, higher quality, and lower shrinkage. The JAN-1 Tube Subcommittee members revise these Preferred Lists from time to time on the basis of each type's wideness of application, ease of production, and available production

capacity. If a development requires tube characteristics which can be shown to be lacking in any of the preferred types, a waiver of the Preferred Lists may be requested from either the Bureau of Ships or Signal Corps Standards Agency. Thus, the fact that the use of the Army-Navy Preferred List of Vacuum Tubes is mandatory does not serve as an obstacle to new developments in tubes and equipments.

Since some of the tubes now in use and being developed incorporate features, the knowledge of which might benefit the enemy, it is necessary to assign a security classification to them. The JAN-1 Tube Subcommittee members are, by virtue of their close contact with personnel concerned with tube work for the government, fully cognizant of the tube features which should be withheld, so are called upon to recommend types for classification, or for removal from their security classification, after there is no longer need for restricting information concerning them.

Although the RMA continues to assign type numbers for new tubes, the JAN-1 Tube Subcommittee members work in co-operation with RMA regarding arrangements and plans for handling this work.

The most recent addition to the work of the subcommittee is that concerned with the use of the JAN-1A Specification by Canada. The Canadian Services require the use of this specification in all contracts using tubes which are placed after January 1, 1944. The Canadian Services will administer the specification through a joint Industry-Government committee and will co-ordinate all actions with the JAN-1 Tube Subcommittee in order to assure a yet broader standardization of tubes.

Thus has been achieved a single specification for use with all tubes procured by the United States Signal Corps, the United States Navy, and the Canadian Armed Services. After the transition stage, during which existing tube stocks will be used up, all tubes purchased and stocked by the organizations just named will be fully interchangeable. This one factor alone is of tremendous importance in the field, where replacements are needed in a hurry. Army tubes will now work in Navy equipments and vice versa, without resulting in loss of valuable time while maintenance personnel try to find out if, for example, the type VT-100 called for

in a certain Army set can be replaced by Navy type 38807. Now, regardless of which organization purchased the tubes, the type number JAN-807 has taken the place of those two former designations, and pooling of Army and Navy stocks causes no maintenance problems. Of course full use of JAN type numbers is being made in marking equipment sockets.

Furthermore, by pooling their requirements in the JAN-1A Specification the Army and Navy have been able to improve the quality of some of their tubes. The manufacturer no longer is obliged to make the same tube meet two different sets of limits, so he can now concentrate on making that tube better. Already reports have been received from fighting fronts telling of the superior characteristics and quality of American tubes. The value of this joint effort is becoming manifest.

Through the use of preferred types, the tube manufacturer is further aided by the opportunity to specialize on a few types. Due to the existence of older equipments which required a wide variety of types, the full effect of the Preferred-List program cannot be felt for some time, but there are few who do not subscribe to the program as one of real value.

Lastly, the Services are working more closely with tube manufacturers than ever before. The manufacturers are consulted in all tube matters which affect tube production and it seems safe to say that there is greater co-operation in this respect than ever before. This is as it should be, and the JAN-1 Tube Subcommittee members are happy to have had the opportunity to aid in bringing this about. Their aim is to give the United States Army and Navy the world's best tubes in the vast quantities required. We appreciate the fine co-operation of industry in helping us to achieve this. If, in addition to meeting the requirements of this war, this specification is so satisfactory that it will be kept as standard in the commercial production which follows the victory, we shall feel that we have been successful. The Services are desirous of co-operating with industry to continue this tube standardization after the war.

In closing, it is interesting to quote from a report on Lessons in Signal Operation from Burma. "American tubes are superior because they are (1) sturdier and (2) standardized and interchangeable."