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'Special' Tube Types

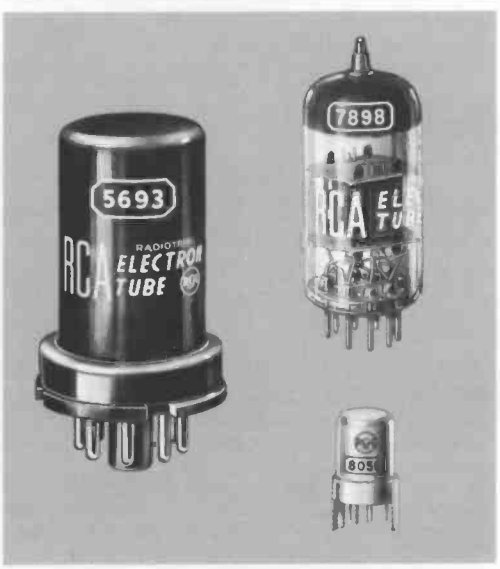
And the Amateur Radio Operator

By L. W. Aurick, K3QAX/W2QEX*

RCA Electronic Components and Devices

Radio amateurs are experimenters by nature and definition. As experimenters, they possess few inhibitions to trying something new. Many significant contributions to the field of communications have been made by hams who didn't know that something was "impossible."

This inherent enthusiasm for the new and different has made itself felt in the area of electron tubes. In some instances, it has resulted in the development of new tube types expressly for amateur service. Sometimes, however, it has inadvertently fostered the propagation of misleading information.



Rumors spread fast in amateur circles, but never so fast as when someone suggests that the "plugging-in" of a new tube will automatically increase power output or sensitivity. Such claims, of course, usually stem from "word-of-mouth" recommendations rather than from reliable published data.

Generally, the choice of a tube type for a particular application involves investigative procedures and precise conclusions that can be made only by an experienced engineer. It is not within the scope of this paper, therefore, to tell the ham how he might assume a highly specialized engineering role. Rather, this discussion is intended to provide the radio amateur with some relevant facts that will help him to better evaluate the many claims and recommendations he encounters. Included in this paper are some of the problems involved in making a selection; and a few clues as to why a local radio-parts distributor may not even have heard of some "special" tube type — let alone stock it.

Proper Tube Selection a Composite Judgment of Many Criteria

In his initial selection of a tube type for a particular application, the professional circuit designer first considers where and how the

*Lancaster, Pennsylvania

tube is to be employed. He usually enjoys a relative freedom of choice in this task, because there are frequently several types available which can be expected to perform the required function in a specific application. Beyond this, however, careful consideration must be given numerous other criteria, including initial tube cost, circuit complexity, and circuit reliability.

The initial cost of a tube is always an important criterion in the choice a designer must make. The ultimate selling price of the equipment will bear a direct relationship to this cost. Because cost most often is directly related to reliability, however, it cannot be considered separately but must be included as an integral part of component reliability. Certainly, the intended use of a piece of electronic gear will, in large measure, dictate the reliability required from both the component and the overall system.

What is Reliability?

In simple terms, reliability is a measure of the capability of a given component to perform a specified function for a specified time. Thus, reliability depends on the requirements of the particular application. For example, a tube designed for use in a missile might be required to have a functional life of only one minute, yet demand extremely high performance assurance for that single minute. In this case, reliability would be the prime consideration and the cost secondary.

On the other hand, tubes used in home-entertainment instruments such as television receivers, hi-fi units, and tape recorders can have somewhat less stringent reliability requirements because results of failure are not so serious. While such tubes must perform their particular functions for a reasonable length of time, it is equally important that their initial cost — as well as replacement cost — be reasonable. It is quite possible, however, that entertainment-type tubes might accumulate amazingly long periods of service. (RCA frequently receives reports of old-line home instruments which are still functioning satisfactorily with their original tube complements.)

Receiving-type tubes designed primarily for home-instrument applications are called "commercial" receiving tubes, and those intended for use in communications or industrial equipment are called "industrial" receiving tubes. This paper confines its discussion to three classifications of industrial-receiving tubes known as "premium" types, "mobile-communications" types, and "special red" types.

"Premium" Tubes

Designed especially to meet the requirements of particular military specifications or critical industrial applications, RCA "premium" tubes must pass very rigid environmental tests. These might include tests for shock, vibration, glass strain, microphonics, stability, high altitude, and any other conditions to which they might be subjected in actual use. In applications other than those for which premium tubes are specifically designed, however, there are no guarantees that these industrial types will provide better performance than their commercial counterparts or prototypes.

The popular 12AT7 type, for example, is used in many receiving applications, including mixer, oscillator, and audio stages. In the hope of improving receiver performance, the ham might be tempted to replace this prototype, or original, tube with one of its more sophisticated premium versions. There is a strong possibility that such substitution would result only in disappointment.

To illustrate, among the premium types that might replace the 12AT7 are Military Types 12AT7WA and 12AT7WB.[1] Each of these types was designed to meet an individual military specification, the details of which are not readily available to non-military customers. If even the tubes themselves were available, there is no ironclad assurance that they would perform better, or last longer, in their non-military assignments than the prototype 12AT7. In addition, their cost would be considerably more than the commercial type.

Another premium type which evolved from the 12AT7 is the 6201. This type is physically and electrically similar to the 12AT7, but is subjected to special tests to assure dependable performance under conditions of shock and vibration, and in "on-off" control applications involving long periods of operation in cutoff situations. Although the 6201 undoubtedly could be used as a replacement for the 12AT7 in most applications, the substantial increase

[1]The letter designation, "W," following a type number indicates that the type has been tested to a particular military specification. Not all military types, however, carry the "W" designation.
The letter designations, "A," "B," or "C," indicate improved versions of a type that is "unilaterally interchangeable" with all previous versions. For example, type 6L6GB replaces type 6L6G, but this does not necessarily mean that type 6L6G can always be used as a replacement for type 6L6GB. Going a step further, it is also possible that neither of the two latter types would work properly in a 6L6GC socket.

in price would buy few, if any, operational benefits for the average amateur.

"Mobile-Communications" Tubes

As their name implies, "mobile-communications" tubes are those RCA industrial receiving-type tubes which are included in the broad category of types which operate from 3-cell or 6-cell storage batteries or battery charger systems. In this category are the types which function from nominal 6-volt and 12-volt systems.

Mobile-communications types are designed for use in specific applications, and their advantages in such usage do not necessarily extend to other applications. To cite an example, the wider heater-voltage range of mobile-communications tubes (from 10 volts to 15 volts for the 12-volt types) provides no additional capability in amateur receivers which operate from a well-regulated, line-operated AC power supply.

In the RCA line of mobile-communications tubes are two types which are similar to the 12AT7. The 7898, which has slightly higher maximum-plate-voltage and plate-dissipation ratings, is recommended for use with 6-cell (12-volt) storage-battery systems. The 6679/12AT7—a double-branded type[2]—is recommended for 3-cell (6-volt) systems.

"Special-Red" Tubes

Although the four tube types in the RCA "special-red" family are not used in amateur equipment, they should be given mention because of the particular philosophy they represent.

RCA "special-red" tubes signify the ultimate in tube design for circuits that require the highest degree of confidence.

Denoting a special category of "premium" tubes, they are subjected to the most stringent tests and are designed to meet the requirements of critical industrial and military applications where long life, extreme dependability, and exceptional stability are paramount. Carrying a warranty for 10,000-hour life (approximately two years), these tubes have been given a distinguishing red color on their bases and metal-envelope shells — hence the name, "special-red." All are octal-based types.

The 5690 is a full-wave vacuum rectifier each section of which has an independent heater and cathode. This type is rated for service at altitudes up to 60,000 feet.

The "special-red" types 5691, 5692, and 5693 are similar to the 6SL7-GT, the 6SN7-GT, and the 6SJ7, respectively — three commercial-receiving tube types with which the average ham is well acquainted.

The Cost Differential

Although many of the differences between industrial receiving-type tubes and their commercial counterparts and prototypes may appear to be minor, the former require refinements in design, testing, or manufacturing which usually make higher selling prices mandatory. In some instances, for example, the structures of the tubes might have to be strengthened to assure reliable service in "ruggedized" military or industrial equipment. In other instances, tubes might have to undergo an extensive series of special tests to assure close control of certain characteristics. Such procedures inevitably contribute to higher manufacturing costs, and thus result in higher prices for all users.

Whether or not the additional advantages offered by a "special" industrial tube type offset its higher price is a decision that the individual amateur radio operator must make in the light of his own equipment, operating objectives, and pocketbook.

Conclusion

As stated previously, the professional circuit designer selects a particular tube type for his equipment only after careful evaluation of numerous criteria, including specific function, cost, reliability, and circuit complexity. In the long run, the amateur radio operator should find it beneficial to follow a similar approach to tube selection.

Despite the fact that an individual might be willing to pay a higher price for a "better" tube, there is no justification for assuming that the use of such a tube will automatically improve the performance of a given circuit.

If the amateur is satisfied with the performance of his equipment, the most logical way to maintain this stable performance is by replacing worn-out tubes with new ones bearing the same number in either original, double-branded, or improved "A" and "B" versions.

While substitution of these later versions for worn-out prototypes may not always help the individual situation, it will not hurt it either.

[2]A double-branded tube can be used to replace those tubes bearing the individual brand numbers. As this interchangeability is "unilateral," the individual types do not necessarily replace the double-branded type.

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"Product Guide for RCA Power Tubes" (PWR-506A) gives you tabulated data of technical information on specific tube types. Ask your RCA Industrial Tube Distributor for a copy.

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