

# THE VACUUM TUBE

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## The First Metal GE Tubes

**T**he definitive study of the origins of the all-metal receiving tube appeared in this journal in the mid-'70s [1]. The author, Bro. Patrick Dowd, interviewed former engineers from RCA. He described the joint General Electric-RCA origin of the metal design in detail. However, with help from other sources, it is possible to cover a new aspect of the story, the production of very early metal tubes by GE.

### Origins Simplified

Hoping not to oversimplify, the basic idea is that tube designers at GE, looking for a "unique selling proposition" for their re-entry into radio production for the 1935

season, found that a tube could be built in a steel shell. They went through various prototypes in 1933-34 and came up with designs for tubes to equip all the positions in a receiver.

At that point, RCA owned the former GE tube plant at Harrison, NJ. This was a result of a 1930 transfer that was part of an antitrust settlement [2]. GE had a tube-development facility at their Nela Park (Cleveland) lamp plant, but RCA was clearly better equipped for production.

RCA management agreed on a venture to complete development of the metal tube and go into manufacture. They abandoned a promising development of their own, the "bullet" tube. The latter, of which 20-some types were in the works, was a metal-glass design (glass bulb inside a metal shell) using a small, early version of the RCA-patented octal base.

"Technology transfer" occurred late in 1934. RCA secretly equipped part of the Harrison works with new machinery, including an electrical welder to join the tube shell to its base ring. In the following seven months, RCA engineers worked out production techniques, starting with dismally low yields [3] from leaky lead-out seals, low emission, and other troubles.

A little later, the situation had improved enough so that GE and RCA could hold an announcement meeting for receiver makers at Harrison on April 1, 1935. Industry reaction varied wildly. Some receiver makers (Atwater Kent and Stromberg-Carlson, say) signed up, Crosley put out a press release praising RCA's product, whereas Philco bitterly denounced it to their dealer network.

GE's receivers, by contract, were to use RCA-made tubes through 1936. Some independent tube makers (Ken-Rad especially)



*RCA's first steel-stamped metal tubes (stampings whitened for clarity). Includes both versions of the 5Z4 and the abandoned 6D5.*

bought machinery and went into production. Others, apparently seeking to avoid plant investment at a time of great overcapacity in the industry, adopted the MG (metal-glass) design and called it the “perfected metal tube.” Proponents of the MG design included Triad and Arcturus.

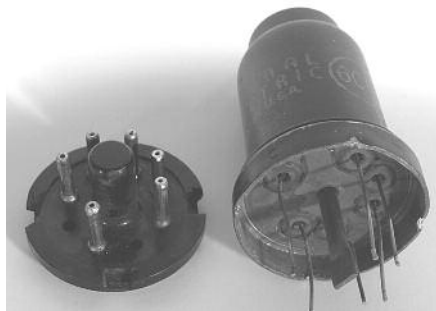
The first RCA production was steel-stamped (no ink) with the RCA “meatball,” the designation “Radiotron / Made in U. S. A. / Cunningham,” and type number in an octagon. The line consisted of nine types, including two versions of the 5Z4 rectifier. A tenth type, the 6D5 power triode, was abandoned early.

The metal design came under cost competition from octal-based glass tubes. RCA’s intention was to use metal in all new types and to duplicate some existing types in metal. The 1C5, 6C8, and 6T7, familiar to us as glass “G” types, were planned as metals. So was the A2016, a repackaging of the original “single-plate” 2A3 in an oversized shell of 1½” diameter.

Bell Labs apparently bought a shell welder and experimented with the metal concept. Their people were originally unimpressed with the idea, but seized on it ca. 1940 in designing the famous 723A/B radar klystron of WWII. Sylvania countered with their glass Loktal design in 1938, and RCA fought back with miniature tubes the next year.

## Early GE Production

What’s not widely appreciated is that GE



*GE-branded 6C5 with eyelet lead-out seals, steel exhaust tube, and plain base.*

made metal tubes in parallel with RCA for a while [4]. The Nela Park works was the site. This may have been done as protection in case RCA couldn’t overcome the production problems. A few apparently GE-made tubes are still “out there” in collector circles.

The GE “family photo” shows some of these. They are distinctive in several ways:

A. Stamped in orange ink on the shell are the type number in a circle, the GE monogram, “GENERAL / ELECTRIC” in a Deco-ish font, “Made in U. S. A.,” and “LICENSED AS STATED ON CARTON.” The license notice is softer than RCA’s “LICENSED ONLY AS INDICATED ON CARTON.”

B. The base is plain, without the molded-in license notice used by essentially everybody else.

C. An original-style two-part shell is



*GE orange-stamped metals: 6A8, 6C5, 6F5, and two 6K7 variants.*

used, with a weld seam between the shell and base ring.

D. On the 6C5, the shell is the early-style stepped design.

E. The tubes generally have the original-style individual eyelet seals for the leads and the steel exhaust tube, such as were used by RCA before converting to the glass-button-stem construction about 1936. The button stem had lead-out wires molded into a disc of glass and a glass exhaust tube. Not all these GE tubes seem to be eyeletted.

Per suggestions from collectors Bob Deuel and Jim Cross, a strong magnet was used to detect the steel exhaust tube inside the locating key. It appeared to be present on six out of nine tubes examined. (Today's small rare-earth magnets are the best for this use, but a conventional carpenter's stud-finder also works.

Efficacy of the magnet idea was confirmed by gently prying the base off one sample. This trick does not work on the "single-ended" metal series (6SK7 and the like) because, while using button stems, they have a steel shield inside the locating key.)

To get an idea of the relative original use of these tubes by GE (independent of who

made them), here is a tabulation of the tubes used in the 1935 and 1936 model years. The "original nine" types are shown underlined.

These are "hash totals" reflecting only the number of times that a particular tube appeared in the schematics in the Rider manuals. They do suggest the relative popularity of a given tube. The survival of tubes to the present is "modulated" by the failure rate: early 5Z4s and 6F6s, being power tubes, did not hold up well, and are relatively rare now (based on experience with the RCA steel-stamped line), while 6A8s and 6K7s were survivors.

The RCA product appeared in radios of several makers besides RCA Victor, while the GE version may have been restricted to their own sets. No tube has yet been seen with a setmaker's private brand and distinctive GE features like the plain base.

GE had a special carton for the renewal market. Its design featured the GE monogram, "RADIO TUBE," and "The original metal tube designed and developed by GENERAL ELECTRIC."

At any rate, it appears that the tube world has a new collectible. The RCA tubes are uncommon but available here-and-there. The GE ones are simply rare. "Collect the set!"

| <b>Tube</b> | <b>1935<br/>10 models</b> | <b>1936<br/>17 models</b> |
|-------------|---------------------------|---------------------------|
| 5W4         | 3                         | 6                         |
| <u>5Z4</u>  | 6                         | 6                         |
| <u>6A8</u>  | 4                         | 11                        |
| <u>6C5</u>  | 2                         | 2                         |
| <u>6F5</u>  | 6                         | 8                         |
| <u>6F6</u>  | 7                         | 9                         |
| 6H6         | 3                         | 11                        |
| 6J7         | 7                         | 4                         |
| <u>6K7</u>  | 4                         | 18                        |
| 6L6         |                           | 3                         |
| <u>6L7</u>  | 1                         | 2                         |
| 6Q7         |                           | 2                         |
| 6X5         |                           | 1                         |
| 25A6        |                           | 1                         |
| 25Z6        |                           | 1                         |

REFERENCES

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