

THE VACUUM TUBE

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Metal Tubes — Tube Inflation

75 Years of Metal Tubes

The year 2010 marks the 75th anniversary of GE's and RCA's joint announcement introducing the all-metal radio tube. The two companies held a conference for manufacturers on April 1, 1935 at the RCA works at Harrison, New Jersey. RCA promoted the new device at the annual Institute of Radio Engineers meeting in July, and had production going in time to supply GE with tubes for the latter's Fall 1935 line of radios.

The April session introduced five still-familiar tubes: the 6A8, 6C5, 6H6, 6J7, and 6K7. Also included was the soon-abandoned 6D5, the "Edseltron" of power triodes. The 5Z4, 6F5, 6F6, and 6L7 soon rounded out the "original nine" types.

Industry reaction was mixed. For tubemakers, the innovation threatened existing product lines. It also potentially required substantial investment in new production machinery and development of new skills at a time when the industry was suffering from overcapacity.

For set manufacturers, the new tubes offered a "unique selling proposition," but only if their suppliers could deliver the new style in quantity. Philco bitterly attacked the metal concept in the *Philco Serviceman* and in its advertising, whereas Crosley sent out a press release lavishly praising it. *Radio-Craft* put out a "Special Metal Tube Number" in October.

The new tube led to a burst of innovation over the next four years. The independent U. S. tubemakers rushed out metal-glass MG types (the "perfected metal tube," or a glass tube in a steel shell). "G" tubes soon appeared, being existing big-pin types transplanted to octal bases. Then Hytron scaled-down the "G" types into what it called the "bantam" format (our "GT") in 1938. Sylvania introduced its all-glass Loktal style the same year. But the ultimate winner was RCA's miniature format of late 1939.

RCA had sweeping plans to, in essence, convert its whole line of receiving tubes to metal format. There were at least 28 developmental metal types that never appeared commercially, due to cost pressure from the rest of the industry.

The most notable abandoned type was the A2016, a "single-plate" 2A3 repackaged in an oversized metal shell.

The new RCA-patented octal base had pins left out if the tube was simple enough not to need them. The numbering of the pins was not the straight one-through-eight scheme that we know today. Instead, an omitted pin position was not counted. The figure, taken from RCA's April 1935 data handout, shows the pin numbering of the 6C5 and 6D5 triodes. The heater was on Pins "1" and "4," vs. our "2" and "7." This practice, fortunately, lasted only a few months.

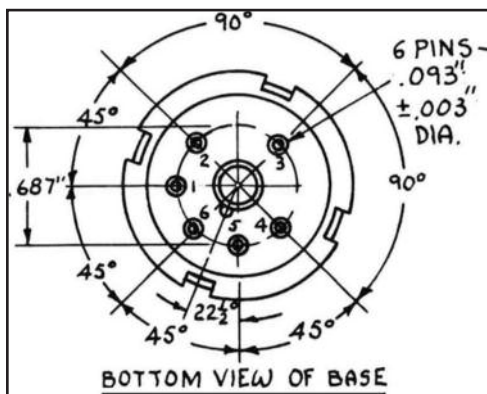
Bro. Patrick Dowd's 1976 two-part article in the then-*OTB* on the metal format, gathered from interviews with GE and RCA developers, introduced metal-tube history to tube collectors and started a tradition of collecting the "original nine." Early-production tubes of this series are quite distinctive: the type number and brand are steel-stamped (embossed) into the shell. Anyone needing a copy of Dowd's article is welcome to contact the writer.

"Tube Inflation" in 30s Radios

The marketing of radios in the 1930s was a complicated business. Under Depression conditions, a niche opened for inexpensive "midget" or "mantel" sets. Makers of more conventional receivers had to scramble to fend off competition from the new low-end brands and models.

One way to give the impression of a high-quality design was to sell on the basis of the tube count ("more is better"). The proud buyer got bragging rights to the tube count in his set. There was a strong temptation to expand the number of tubes without actually adding function or appreciably raising the cost of production.

One example is the Philco 38-116 console, a massive 15-tube job. It uses a 6J5G, connected as a diode, as an AVC rectifier, even though there is a 6R7G first-audio tube in which the diodes went unused. It uses two more 6J5Gs, diode-connected, in a discriminator circuit for automatic frequency control. This is poor engineering: in a discriminator the balance between diodes is important, and a single 6H6G would have done better.



Base drawing of early 6C5 showing original pin numbering scheme.

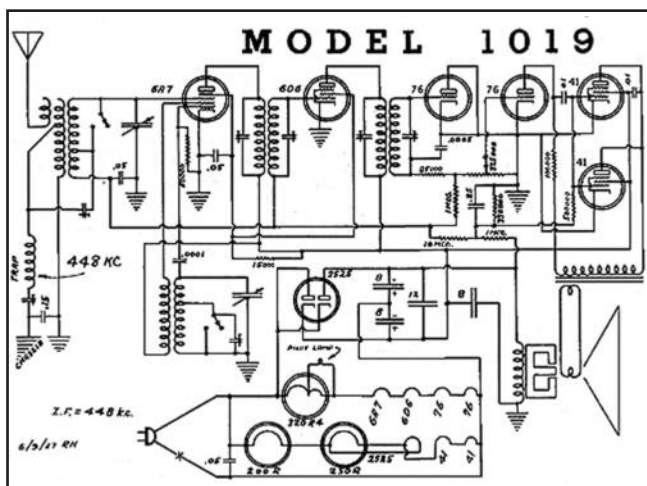
A particularly vivid example of tubeflation is the Kadette 1019, an AM-SW table model from 1937 (Rider's Vol. 8, page "8-6 International"). This set contains the extraordinary number of ten "tubes." Of these, three are glass-bulbed ballasts. The detector/first-audio function involves a diode-connected 76 into another 76, instead of the obvious single 75. The output stage uses a pair of 41s wired in parallel in place of the normal 43 or 25B5. The Kadette models 56X and 86X were basically the same radio, but with the extraneous stuff omitted.

One may suspect tube inflation in the application of a 6H6 as detector and 6F5 as audio amplifier. As part of RCA's initial metal-tube line, they appeared in time for set designers to incorporate them into sets for the 1935-36 model year. The 6Q7 duodiode-triode combined these two, but was not available until early 1936. However, several manufacturers, RCA Victor and GE among them, continued to use the separate tubes despite the arrival of the 6Q7.

The massive 25-tube

Zenith Stratosphere (1000Z) used a whole litter of 45s—eight of them in push-pull parallel—in the audio output. This would have been a good place to use a pair or quad of 2A3s, probably giving better audio quality. By contrast, in other top-of-the-line radios every tube "did something," whether as a volume expander or meter driver or whatever. The Crosley 3716 "WLW" console used eight 6N6 output tubes, but they were divided among separate power amplifiers for low, medium, and high frequencies. The elegant Scott line similarly used lots of tubes (up to 48!), but there was no waste.

Jacking up the tube count was not a uniquely U. S. practice. In Canada, Rogers made the 2X3G rectifier, a single diode equal to half of a 5Y3G. Some of their radios (e. g., the Model 13/80 of 1938-39) used a pair of these. Others (the 12/146) used a quad of them, a function better suited to a single 5Z3. Rogers also had an apparently upsized version, the 2Y3, as



The Kadette Model 1019 is a vivid example of tube inflation (see text).

found in the Model 13/95 set.

Arrival of the “magic eye” tube boosted the count, even though the tube had nothing to do with the performance of the radio. Juicing-up the tube total was normally done with the simplest tubes: monodes (ballasts), diodes, or triodes. More complex tubes would have taken extra wiring labor and used more supporting components. Inflation applied almost exclusively to AC-powered home radios. In farm sets there wasn't enough battery power available, and in auto receivers there wasn't sufficient space to fool around with extra tubes.

Attempts to go in the other direction using complex multiple-function tubes were generally failures. *The following types became available in the late 30s.*

These types made it logical to build a two-tube radio, for example, a 12B8GT as tuned RF stage and detector, plus a 32L7GT or

70L7GT output and rectifier. A three- or four-tube superhet was equally possible. The 3A8GT figured, along with a 1A7GT and 1Q5GT, in the Motorola B-150 bicycle (!) radio. However, these tubes were commercial failures that are rare today.

(This mini-survey came from use of a novel feature on the Web. Go to John Okolowicz' www.grillecloth.com, click on “Radio Finder,” type in the tube to be checked-up, and watch the brands and models roll in!)

Type	Functions	Models Using
1B8GT	Diode-triode-power pentode (1H5 + 1T5)	0
1D8GT	Diode-triode-pentode	6
3A8GT	Diode-triode-pentode (\approx 1H5 + 1N5)	9
12B8GT	Triode-pentode (\approx 6F5 + 6K7)	8
25B8GT	Triode-pentode (\approx 6F5 + 6K7)	5
25D8GT	12B8 + diode	3
32L7GT	Rectifier + beam power tube	7