Technical Correspondence

Conducted By
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CHOOSING WIRE SIZE FOR TOROIDAL INDUCTORS

☐ "What size wire should I use to wind the toroidal inductors with?" is a question frequently asked by people duplicating various circuits and rigs I've designed. The answer is that, in most cases, you can base your choice on availability and convenience, within certain limits. But what are those limits?

Speaking only of toroidal inductors that are found in typical amateur transmitters, receivers and the like, we can describe an inductor by noting its apparent inductance (its inductance modified by stray capacitance) and Q at the frequencies of interest. That is, we could substitute another inductor having the same apparent inductance and Q and get the same performance. There are, of course, some exceptions to this rule, such as VFO tank inductors and others that may be sensitive to very small changes in temperature or physical movement.

To show what effect wire size is likely to have on these two parameters, I wound 22 turns of various sizes of wire on several T-50-6 powdered-iron cores, and measured the inductance and Q of each one at 14 MHz. A homebuilt test fixture having an approximate accuracy of 5% was used for the experiment. No. 21 wire, which would fit precisely on a single layer, was the largest used, and the turns were evenly spaced around the cores wound with smaller wire. The results of my tests are shown in Table 1.

Within the accuracy of the test fixture, and expected core-to-core variation, the inductors wound with wire nos. 21 through 26 are the same. There is a definite drop in Q for inductors wound with no. 28 and smaller wire, but even this drop in Q won't be noticeable unless the inductor is used in a critical application, such as a VFO tank or a high-Q filter. Single-tuned circuits, transmitter interstage and output matching and filtering networks, etc., are generally of low enough loaded Q that the difference in inductor Q is completely inconsequential. Rf transformers, which are generally wound on ferrite instead of powdered-iron cores, are even less sensitive to wire sizes unless extreme bandwidths (e.g., two or three decades) are required.

A rule of thumb that will lead to the highest Q is to use the largest wire size that will fit on a single layer, but which isn't so large that the wire won't conform well to the core. As you can see from the results of this experiment, using wire as much as several sizes smaller than specified will deliver equally good performance. — *Roy Lewallen, W7EL, Beaverton, Oregon*

Table 1
Wire Size Vs. Inductor Value

Wire Size (AWG)	*Apparent L (μH)*	*Q*
21	2.10	252
22	2.17	237
24	2.17	250
26	2.07	248
28	2.15	220
30	2.13	196
32	2.28	182

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