Bob's TechTalk #9
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Coaxial Connectors (Part II of III):

BNC, TNC and RCA Phono Connectors

Last month we looked at the UHF and "N" series of connectors. This month we'll look at the BNC series of connectors and the inexpensive RCA Phono connectors. We'll also take a quick look at the TNC series, a derivative of the BNC.

The BNC Connector:

The BNC connector is almost universally used for commercial test equipment and is finding its way into top-line audio and video equipment as well. It features high performance and a quick-connect / disconnect bayonet style. Hams favor it for many construction projects. Here are its properties:

Impedance: BNC connectors are available in 50 ohm and 75 ohm constant impedance styles. The 50-ohm style is often used for 75-ohm impedance at lower frequencies (<30 MHz). Unlike the "N" connector, 50 and 75-ohm connectors mate with each other without damage.

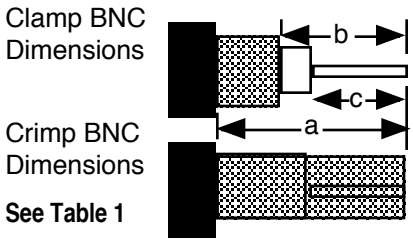
Size: Three of five. Well sized for RG-58/U and RG-59/U size coax.

Voltage/Power handling: 500 volts peak.

Frequency Range: Up to 4 GHz at low SWR (<1.3:1) for the 50-ohm series. Up to 4 GHz at an SWR below 2:1 for 75-ohm series.

Cost: Two to three of five. Low-cost versions are available such as the Amphenol RFX series. BNC connectors are readily available.

Weather Handling: Varies; clamps with gaskets and crimp types with shrink tubing are weather resistant. However additional weather proofing is recommended for permanent outdoor installations.



The BNC connector was developed after WWII, in the late 1940's. The connector utilizes bayonet coupling that makes removal and installation quick and easy and insures a solid contact when engaged. BNC stands for Bayonet Neill Concelman after the primary developers. The 75-ohm series comes in two types and was developed for more critical 75-ohm use and computer networks. Both types of the 75-ohm BNC connectors mate with each other as well as the 50-ohm series. Like "N" series connectors, BNC is available in both clamp and crimp styles. Amphenol also makes BNC connectors in Suretwist® and Quicktrim® proprietary styles. The first style requires no soldering; the cable is stripped properly and the connector is twisted on. The second style requires soldering or crimping of the center pin, with simple installation of the connector body.

Because of the large use of BNC connectors in audio, test equipment and computer networking, low cost crimping tools are available. However, if you're going to be installing a lot of BNC connectors, a more expensive crimping tool is recommended. Normally the center pin requires a 0.068 hex crimp and

Top: UG-88C/U Clamp-Type BNC Connector in assembly order (Amphenol).
Bottom: Pasternack PE4016 Crimp-type BNC Connector (Both fit RG-58/U)

the outer ferrule requires a hex crimp of 0.178" (for RG-174/U sizes), 0.213" (for RG-58/U sizes), 0.255" (for RG-59/U sizes) or 0.324" (for RG-6/U sizes).

To install a BNC crimp-type connector on RG-58/U or 59/U, strip the cable to the specified dimensions. Place the ferrule over the cable. Crimp on the center pin so that the pin rests flush with the cable dielectric. Flare the braid out slightly and slide the pin into the connector body so the inner ferrule section of the body slides under the braid. Then, slide the ferrule up against the connector body and crimp it in place. If you're using RG-62/U, 71/U or 210/U cable, trim an additional 0.039" of insulation from the center conduct and slide the supplied bushing over the center conductor prior to crimping on the center conductor. If you're using thin RG-174/U type cable, slit the outer jacket back 0.1" and slide the metal spacer/Teflon sleeve over the cable dielectric and under the braid, butting the center pin against the dielectric.

Clamp-type BNC connectors install similarly to the "N" type described last month. First place the nut, washer and gasket over the cable. Be sure they are oriented properly. The groove in the gasket should point towards the end the connector will be installed on. After trimming the outer insulation and inner dielectric to the proper dimension for the connector part number you're using, comb out the braid until it lies flat along the cable. Place the clamp over the cable and braid so it presses against the cable insulation. Now fold the braid back over the clamp and trim the braid so that it ends at the shoulder in the clamp (normally about 1/8th inch.) Solder the pin to the center conductor, butting it against the dielectric. With RG-62/U type cable that has the spiral air-core dielectric, trim an additional 0.032" off the dielectric and install the bushing before soldering on the center pin. Finally insert the cable and pin into the connector body, making sure the gasket mates properly with the clamp. Install the nut and tighten. Amphenol recommends a torque of about 15 inch-pounds. Check that the shoulder of the center pin is flush with the inside back of the connector body.

BNC Clamp-Type Cable Trim Dimensions:

Amphenol Part #	Mil Part# and Connector Type	Cable RG-/U	a.	b.	c.
31-2	UG-88/U Plug	58	0.312	-	0.094
31-202	UG-88C/U Plug	55, 223	0.274	-	0.094
31-3202	UG-88E/U Plug	55, 58, 223	0.250	-	0.094
31-212	UG-260B/U Plug	59, 62, 210	0.250	-	0.094
31-2-RFX	(none) Plug	58, 141, 142	0.315	-	0.118

BNC Crimp-Type Cable Trim Dimensions:

Amphenol Part #	Connector Type	Cable RG-/U	a.	b.	c.	Tool
31-317, 318 & 318-RFX	Jack (317), Blkhd Jack (318)	174, 188, 316	0.593	0.250	0.156	1
31-320	Plug	58, 141	0.593	0.250	0.156	2
31-320-RFX	Plug	58, 141, 142A	0.630	0.303	0.156	2
31-321	Plug	59, 62	0.593	0.250	0.156	3
31-321-RFX	Plug	59, 62	0.630	0.303	0.156	3

Tool: Crimping tool hex cavity size (**ID**: pin, ferrule): **1**: 0.068, 0.178; **2**: 0.068, 0.213; **3**: 0.068: 0.255 (inches).

Table One

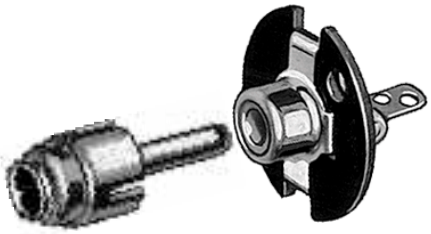
Since BNC connectors are so popular, adapters are available to mate them with virtually every other RF connector. There are also numerous adapters within the series such as tees, right-angle adapters, male-to-male and female-to-female adapters, etc.

The TNC Connector:

Twist-on Right-angle TNC connector

The TNC, developed in the fifties, is a derivative of the BNC connector. Instead of a bayonet, the TNC threads together (hence the "T"!) Though it is used with coax from 50 to 93 ohms, The TNC connector has 75-ohm constant impedance. It is similar in size to the BNC but has a slightly higher voltage rating (600 volts peak), higher frequency handling (up to 11 GHz) and higher vibration capability. With all these advantages, it lacks the quick connect / disconnect bayonet feature that makes the BNC so ideal for test equipment and other environments where connections are changed often. Still, the TNC is a good choice for lower power RF connections that are semi-permanent and need a reliable low-loss connector. They are popular enough to be handled by Radio Shack. Installation is similar to the BNC connector.

The RCA Phono Connector:



Size: Two of five. Well sized for RG-58/U, RG-59/U and RG-62/U type coax.

Voltage/Power handling: 250 volts working. The Switchcraft RF-Jax and RF-Plug series have been used successfully to 1 kW at 30 MHz under ideal conditions.

Frequency Range: Up to 30 MHz.

Cost: one of five.

Weather Handling: None.

The RCA phono connector is very popular in the consumer electronics industry. It is used for audio in-out and video in-out on recorders, TV monitors and stereos. These connectors are designed for audio and video frequencies. They can be used on HF successfully, but are recommended only for the least critical RF uses. Due to their size, they are ideal where space is at a premium. The Switchcraft RF-Jax and RF-Plug series are designed specifically for RF use.

Heathkit used this type of connector successfully in amateur gear for lower level RF signals such as VFO input and connecting BFO, HO and LMO signals between transmitter and receiver (such as on the SB300 / SB400 twins.) The simplest style of the phono connector such as the Switchcraft 3504M is also the best suited for RF. The coax can be trimmed; the center conductor soldered to the pin, and the braid then soldered directly to the shell around the whole body of the connector. Two piece phono plugs are not recommended for RF with the exception of those similar to the Switchcraft 3507, that have a metal shield and sleeve terminal for the braid.

I was unable to find any history on this type of connector. The first time I recall seeing one was on an RCA Victrola record changer

designed to play the large-hole 45-RPM records of the fifties.

The phono connector is ideal for inexpensive QRP rigs. However, the connector does not hold up to repeated insertion and removal without degradation. Cracks in the shell of the one-piece plug and loosening of the center contact in the jack are common after repeated use. Fortunately the connectors are usually easy and inexpensive to replace. For simple low frequency and power projects, these connectors are worth considering.

Next month we'll continue exploring more of the RF coaxial connectors available to hams. The SMA and F-type and perhaps some others will be covered.

73, from AF6C

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