Coaxial Connector Handbook

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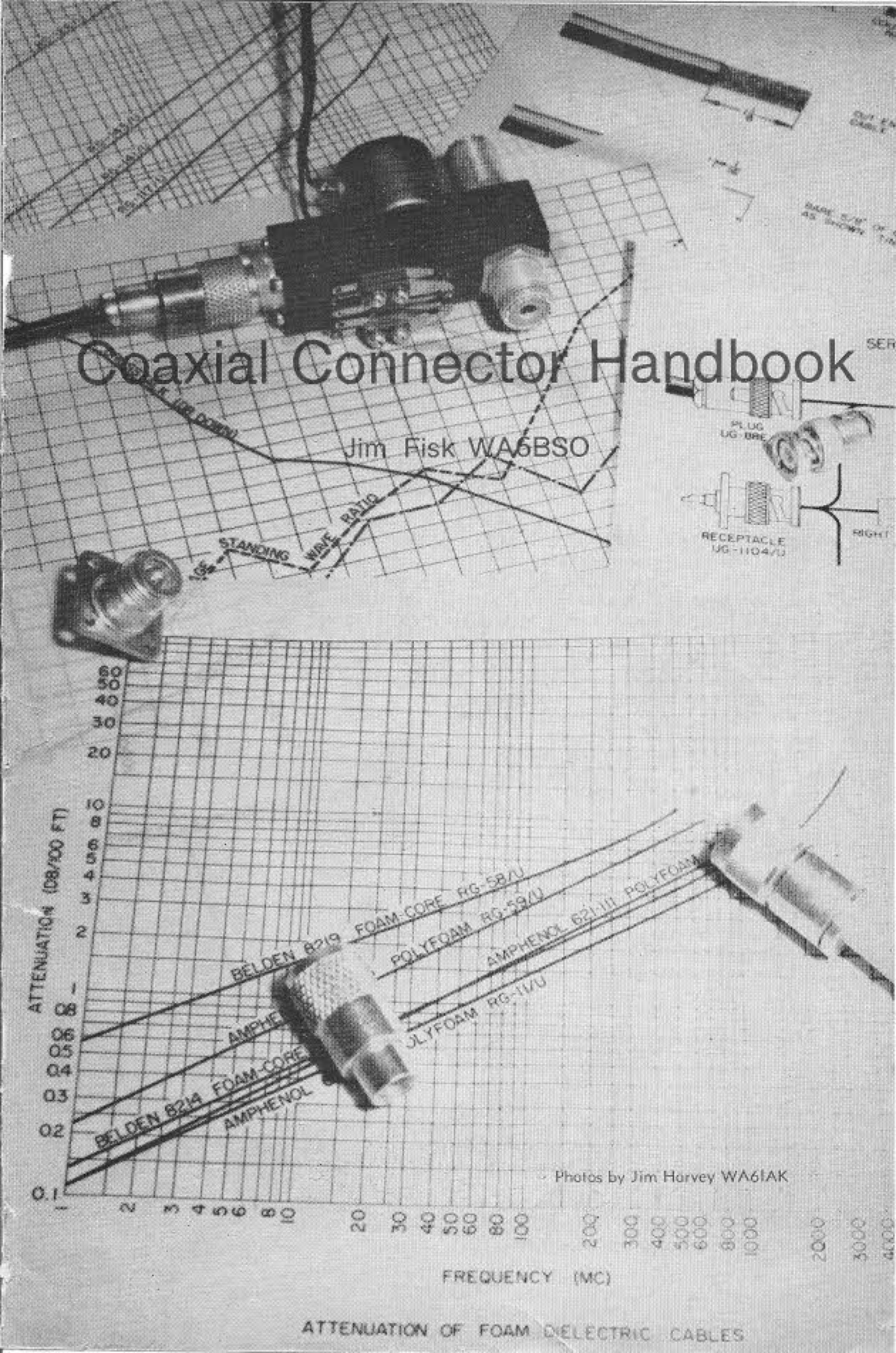


Photos by Jim Harvey WA6IAK

ATTENUATION OF FOAM DIELECTRIC CABLES

Coaxial Connector Handbook

At the lowest audio frequencies and dc, coaxial cable connections consisting of simple solder joints to both conductors are sufficient in many cases. However, as the frequency of operation is increased into the low megacycle range, such connections allow leakage of rf energy and it is necessary to provide 360° contact with the outer conductor to completely contain the conducted electromagnetic field within the confines of the cable. At these frequencies the characteristic impedance of the section of line represented by the inner and outer diameters of the connector is generally not too important; the familiar series UHF connectors or "phono" connectors are illustrative of connectors suitable for these frequencies.

As the frequency of operation is increased beyond 150 mc, it becomes increasingly important that the characteristic impedance of the connector be the same as that of the cable. Also, any physical discontinuities such as the pin diameter of the connector differing from the cable inner conductor diameter must be held to a minimum. Common physical discontinuities such as steps or radial grooves in conductors act like shunt capacitors or series inductors respectively.

The adverse effect of these reactive components increases with frequency; therefore, to maintain a given standard of performance, the physical size of the discontinuities must be effectively made smaller and smaller as frequency is increased. Unfortunately it is not always possible to avoid all discontinuities and at the same time maintain a strong mechanical joint. In those cases where it is impossible to avoid discontinuities in the connector, they are compensated for by deliberately placing another compensating discontinuity in the same vicinity.

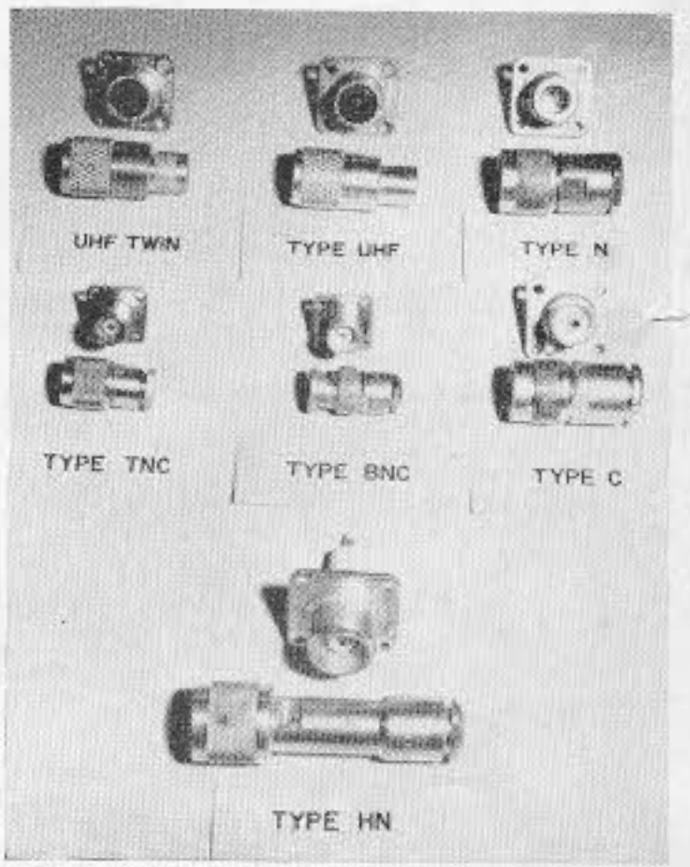
Types of coaxial connectors

Standardization of coaxial connectors has immeasurably aided in the selection and use of these devices. A direct result of this standardization is that a connector made by one manufacturer is directly interchangeable with similar connectors made by any other company.

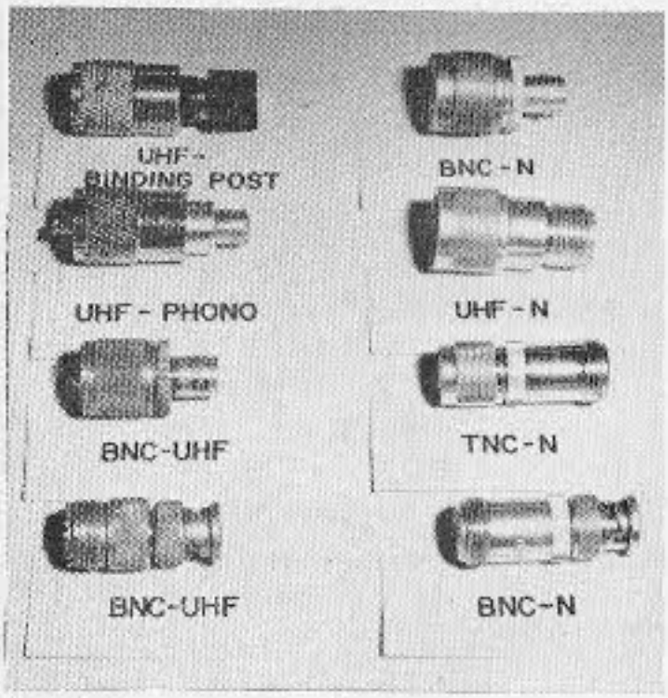
Coaxial connectors may be categorized by the method of coupling and cable size with which they may be used as shown in **Table 1.** Essentially, there are three methods of coupling; threaded, bayonet, and push-on. The five major cable sizes are subminiature, small, medium, medium-large and large. Although the various coaxial connectors were designed specifically for the cable sizes shown in **Table 1,** some types may be used with other cables. The Type N for instance, is available in configurations that are suitable for small, medium, medium-large and large coaxial lines.

Most major types of connectors are available in several different configurations within the series, based upon contact arrangement and cable clamping mechanisms. The three main divisions are "standard," "improved," and "captivated contact."

The "standard" connector employs a sleeve type or grooved silicone gasket which allows metal-to-metal braid clamping. The "improved" type used a "V" groove silicone rubber gasket which also provides metal-to-metal clamping but provides a better grip on the cable with minimum braid deformation and better SWR. In most cases the improved connectors may be used at considerably higher



Various coaxial connectors.



Straight between-series adapters.

frequencies than the standard versions. For example, standard Type N connectors have an upper frequency limit of 3500 mc whereas the improved version may be used to 10,000 mc.

"Captivated contact" connectors were designed to keep the center contact in a fixed position within the connector. This type is recommended for cables using Teflon dielectric and Teflon or fiberglass jackets. These cables, although excellent for high temperature applications, are difficult to use because the inner conductor has a tendency to shift when subjected to rapid environmental changes or mechanical stresses. The technique for captivating the contact provides protection against undesirable equipment disconnections.

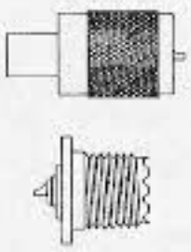
Connectors are also available with clamping devices for subminiature cables and semi-flexible cables such as Phelps Dodge Foamflex. Coaxial connectors are attached to these cables through the use of barbed collets or clamps within the connector. The barbs may be machined into the clamp or a helically grooved sleeve is screwed over a barbed, helically coiled wire wound around the cable. The barbs are embedded in the cable's outer conductor and provide a rigid base for mounting the desired connector.

In addition to these variations, many manufacturers have "polarized" connectors available for the more popular types. These connectors are used to prevent careless or improper connections. The polarization is accomplished by reversing the normal insulation and inner contact assemblies. These connectors will not mate with normal connectors and the selected mating connector must also be polarized.

Two other types of connector construction that are worthy of mention are the crimped and wedged clamping types. The crimped connectors require no soldering and assembly time is reduced as much as 60%. These connectors are often used in large production facilities, and are the least expensive and simplest to assemble of all the connectors that require special tools. Unfortunately, the tools required are quite expensive and the crimped connectors are economical only where large quantities are involved.

One type of wedged clamping connector available is Automatic Metal Products "Wedge-eze" illustrated in **Fig. 1.** This connector is economical, simple to assemble and does not require special tools for assembly. Another advantage over standard crimp types is that these connectors may be reused whereas the crimp styles are usable only once. In the Wedge-eze connector, the wedge-body assembly is placed over the cable dielectric, forcing the braid and outer jacket up over the conical section of the body. The nylon wedge cap then effectively clamps the braid and jacket to the connector as it is screwed on.

Types of connectors



UHF The UHF series was originally designed for use with medium sized cables such as RG-8/U, but reducing adapters were later introduced to permit usage with smaller cables. These non-constant impedance, non-weatherproof connectors are generally satisfactory for use up to about 200 mc and in some specific non-critical cases up to 500 mc. They may be used at peak voltages up to 500 volts. These connectors are made in two sizes, UHF small which is ⅝ inch in diameter and UHF large, one inch in diameter. Plugs, receptacles and adapters were included in the original design, but jacks were not in demand and were not developed. This series also includes twin contact connectors (both large and small) for use with twin coaxial cables such as RG-22/U.

Although this series is the most common coaxial connector found in amateur equipment, it is no longer approved for use on any new equipment built for the Armed Services. The complete family of UHF (single contact) connectors is illustrated in **Fig. 2.**