

Using Hardline in a Ham Station

What's Hardline? "Hard line" is applied to several forms of heavy coaxial cable designed for permanent installation. They are characterized by solid shields, a foam dielectric, high power handling, and much lower loss than ordinary coax cables. An early form of "hard line" was Heliac, a trademark of the Andrew Corporation (now owned by Commscope). It got its name from the ridged spiral shield, which was solid copper. Sometime around the late '70s Andrew and the rest of the industry transitioned from spiral ridges to annular ones (that is, concentric).

Hard line is first described by the inner diameter of its shield, and the most common diameters of interest to hams are 1/2-inch and 7/8-inch. For all practical purposes, loss in coax is primarily due to the resistance of the conductors (although dielectric loss begins to appear around 500 MHz, and becomes increasingly significant above 1GHz). Thanks to skin effect, loss is primarily driven by the outer diameter of the center conductor, the inside diameter of the shield, and the resistivity of these conductors. 1/4-inch and 1/2-inch hard line have a solid center conductor, often copper coated aluminum, while the center conductor of 7/8-inch and larger hard line is a hollow tube. Some lines, including most designed for CATV use, have an aluminum shield. The use of aluminum reduces weight with some compromise in the loss characteristics. Aluminum hard line is also prone to kinking, so handling during installation is critical.

Over the years, hard line has been built with rather varied mechanical properties – the outer and inner diameter of the center conductor, the outer and inner diameter of the shield, the spiral or annular shield, the difference between the minimum and maximum diameters of the shield, even the "pitch" of the spiral and the spacing between rings. Every hard line requires a connector that fits it mechanically, and maintains essentially constant impedance through the connector.

One of the first issues a ham faces when using hard line is finding suitable connectors. Hard line connectors can be expensive, and for older cables can be quite hard to find (or to even identify part numbers of which connector fits which cable). The most important characteristic of a connector is that it must fit the particular hard line that you have. Connectors for cables with spiral shields screw onto the shield, while connectors for cables with annular shields have mating components that apply clamping compression to hold the connector in place. The part of the connector for cables with a hollow center conductor is threaded to screws into the center conductor, self-tapping as it goes. The part of the connector for most solid center conductors is soldered to the cable.

Most hard line connectors are re-useable without compromising performance, so don't rule out buying used connectors from reputable dealers and other hams. Installation varies from one connector to another; if instructions aren't packed with the connector, search the internet for a pdf for the connector(s) you need to install. Tools needed are a hack saw, knife, pliers, wrenches, sometimes a soldering iron.

One of the major purposes of this applications note is to help identify cables, suitable connectors, and sources for those connectors. There are often multiple connector types for every cable, differing in connector type and generation; over the years, newer mechanical designs have made installation easier and faster, but older generation connectors work equally well. Type N connectors are most often used by hams on hard line, and are readily available for coax that will mate to hard line. Commercial installations have mostly migrated to a newer 7/16-in DIN type that are considered superior but mating connectors for ham coax types are quite expensive, and not worth the added cost for most ham applications.

<u>1/2-in 50 Ω Cables</u>	<u>Shield i.d./o.d. Type</u>	<u>Center</u>	<u>Vf</u>	<u>Connectors</u>
Andrew FSJ4-50B	.460"/.480" Annular Cu	.140" Cu/Al	0.81	44ASW, F4NM
Cablewave FLC12-50J	.450"/.540" Annular Cu	.190" Cu/Al	0.88	FLC12-50NM, NF
Andrew LDF4-50A	Annular Cu	.189" Cu/Al	0.88	L4NF, NM, PNF, PNM
Andrew FHJ4-50B	Spiral Cu	.170" Cu/Al	0.79	44AN, 44AW, 44AU, 45AP
<u>7/8-in 50 Ω Cables</u>		<u>Center i.d./o.d.</u>		
Andrew FHJ5-50A	Spiral Cu	.25"/.31" Cu	0.79	45AN, 45AW, 45AU, 45AP
Cablewave FLC78-50J	Annular Cu	.29"/.357" Cu	0.88	FLC 78-50 NM, NF
RFS LCF78-50JA	Annular Cu /0.99	Tubular .37 Cu	0.89	
Decibel/ATG DBC078F5P	Annular Cu	.29"/.355" Cu	0.89	Parts for LDF5-50A work
Andrew LDF5-50A	Annular Cu /0.98"	.29"/.343" Cu	0.89	L45N, L5NF,
Andrew VXL5-50	Annular Cu /0.98	Tubular Cu .35"	0.88	V5TNF
Andrew AVA5-50	Annular Cu /1"	Tubular .372 Cu	0.91	AL5NF, AL5NM, A5NF, A5NM, 78EZNF, 78EZNM,

Notes:

- 1) Cablewave FLC78-50-series connectors fit LDF5-50A and will work with DBC078F5P. They are very nice connectors.
- 2) Davis RF carries RFS Cellflex UHF Male and Female connectors for LDF4-50A. RF Industries also makes UHF Male and Female connectors for LDF4-50A.
- 3) Surplus Sales of Nebraska sells mostly surplus/discontinued connectors.
- 4) The RF Connection and RF Parts sell both surplus/discontinued connectors and new connectors for current products.
- 5) Davis RF and The Antenna Farm sell new connectors for current products.
- 6) Always check auction sites for hard to find connectors.
- 7) The center conductor of Andrew VXL5-50 has a pronounced interior ridged thread.