From the Help Desk – January 2026

Note – this is the fifth of an ongoing series of related articles that will each take a look at some facet of radio selection, installation, or operation as suggested by actual questions received from Club members or other amateur operators.

Q: Why are different numbers sometimes given as the dividend when calculating wire lengths for dipole antenna construction? For example, sometimes we are told to divide the frequency in megahertz into 300, or sometimes into 984, or other times we are told to use 285, or maybe 934. Other times we see values used like 150 or 492, or else we see 142, while other times we might see 467 used. None of this makes any sense. Is there an explanation for all of the different numbers we are given?

A: While it may seem somewhat confusing at first, there really is a reason for it all. We must remember that while antenna length is based upon wavelength, it most often is *not* a full wavelength or even a full fractional wavelength. The basic equation for calculating *wavelength,* abbreviated with the Greek letter $lambda\ (\lambda),$ is $\lambda = \frac{c}{f_{MHz}}$ where c is the speed of light in free space and f_{MHz} is the frequency of the pertinent signal, given in megahertz.

When it comes to antenna design, however, we must derate c by a certain percentage due to the higher density of the material of which the antenna driven elements are constructed as compared to the *"free space"* density at which c is normally stated. Bear in mind that "free space" implies that the signal is propagated through a vacuum. Even transmitting a signal through air will slow it down a little bit, but not enough to worry about. However, that is not the case when we send the radio signal through a metal element. The derating percentage most often used is 5%.

The two metals most frequently used in amateur radio antenna construction are aluminum and copper. Copper has a density and therefore a volume per unit mass of about three times that of aluminum, making aluminum the material of choice for most large antenna elements. On the other hand, copper or copper-clad steel wire is most often used in wire antennas. However, when it comes to radio wave propagation, copper and aluminum have propagation characteristics that are fairly similar to each other. Further variations in the dividend value are derived from the fractional wavelength dimension at which the specific antenna element is sized. Table 1 below provides some common antenna element length equations and their method of derivation. When the term "metal" is used, the reference is to either copper or aluminum, interchangeably.

Table 1 - Antenna element cut lengths

Equation	Derivation	Notes
$\lambda = \frac{300}{f_{MHz}}$	full wavelength in free space	standard full-wave wavelength equation, providing λ in meters
$\lambda = \frac{285}{f_{MHz}}$	full wavelength in metal element	full-wave wavelength equation, providing λ in meters, derated 5%
${}^{\lambda}/_{2} = \frac{150}{f_{MHz}}$	half wavelength in free space	standard half-wave wavelength equation, providing $\lambda/2$ in meters
${}^{\lambda}/_{2} = \frac{142.5}{f_{MHz}}$	half wavelength in metal element	half-wave wavelength equation, providing $\lambda/2$ in meters, derated 5%
${}^{\lambda}/_{4} = \frac{75}{f_{MHz}}$	quarter wavelength in free space	standard quarter-wave wavelength equation, providing $\lambda/4$ in meters
${}^{\lambda}/_{4} = \frac{71.25}{f_{MHz}}$	quarter wavelength in metal element	quarter-wave wavelength equation, providing $\lambda/4$ in meters, derated 5%
$\lambda = \frac{984}{f_{MHz}}$	full wavelength in free space	standard full-wave wavelength equation, providing λ in feet
$\lambda = \frac{934.8}{f_{MHz}}$	full wavelength in metal element	full-wave wavelength equation, providing λ in feet, derated 5%
${}^{\lambda}/_{2} = \frac{492}{f_{MHz}}$	half wavelength in free space	standard half-wave wavelength equation, providing $\lambda/2$ in feet
${}^{\lambda}/_{2} = \frac{467.4}{f_{MHz}}$	half wavelength in metal element	half-wave wavelength equation, providing $\lambda/2$ in feet, derated 5%
${}^{\lambda}/_{4} = \frac{246}{f_{MHz}}$	quarter wavelength in free space	standard quarter-wave wavelength equation, providing $\lambda/4$ in feet
${}^{\lambda}/_{4} = \frac{233.7}{f_{MHz}}$	quarter wavelength in metal element	quarter-wave wavelength equation, providing $\lambda/4$ in feet, derated 5%

The decimal values in the dividends of the various table entries may be encountered as rounded whole-number values, and depending upon exactly what derate percentage is used, the values may appear as other values that are fairly close to the base value. For example, if a 5.5% derating factor is used instead of an even 5%, the dividend of 285 for the full-wave λ in free space would become 283.5, while a 4.5% derate factor would yield 286.5 as the new dividend value.

As can now be readily seen, these equations can use a wide variety of values, but in any event, these values are intended only to produce a *starting point* for the final cutting and tuning of the antenna.

I hope that this has helped to shed some light on the confusion that results when we look at the various cut lengths recommended for the design and construction of your newest homebrew antenna.