RADAR HORIZON / LINE OF SIGHT

There are limits to the reach of radar signals. At the frequencies normally used for radar, radio waves usually travel in a straight line. The waves may be obstructed by weather or shadowing, and interference may come from other aircraft or from reflections from ground objects (Figure 1).

As also shown in Figure 1, an aircraft may not be detected because it is below the radar line which is tangent to the earths surface.

Some rules of thumb are:

Range (to horizon):

$R_{NM} = 1.23\sqrt{h_{radar}}$ *with h in ft*

Range (beyond horizon / over earth curvature):

$R_{NM} = 1.23\left(\sqrt{h_{radar}} + \sqrt{h_{target}}\right)$ *with h in ft*

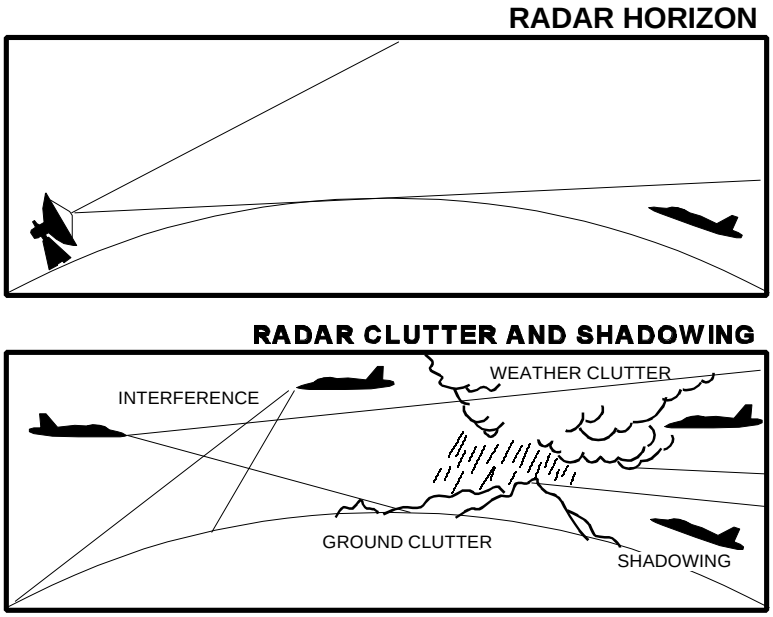

Figure 1. Radar Horizon and Shadowing

In obtaining the radar horizon equations, it is common practice to assume a value for the Earth's radius that is 4/3 times the actual radius. This is done to account for the effect of the atmosphere on radar propagation. For a true line of sight, such as used for optical search and rescue, the constant in the equations changes from 1.23 to 1.06.

A nomograph for determining maximum target range is depicted in Figure 2. Although an aircraft is shown to the left, it could just as well be a ship, with radars on a mast of height "h". Any target of height (or altitude) "H" is depicted on the right side.

See also Section 5-1 on ducting and refraction, which may increase range beyond these distances.

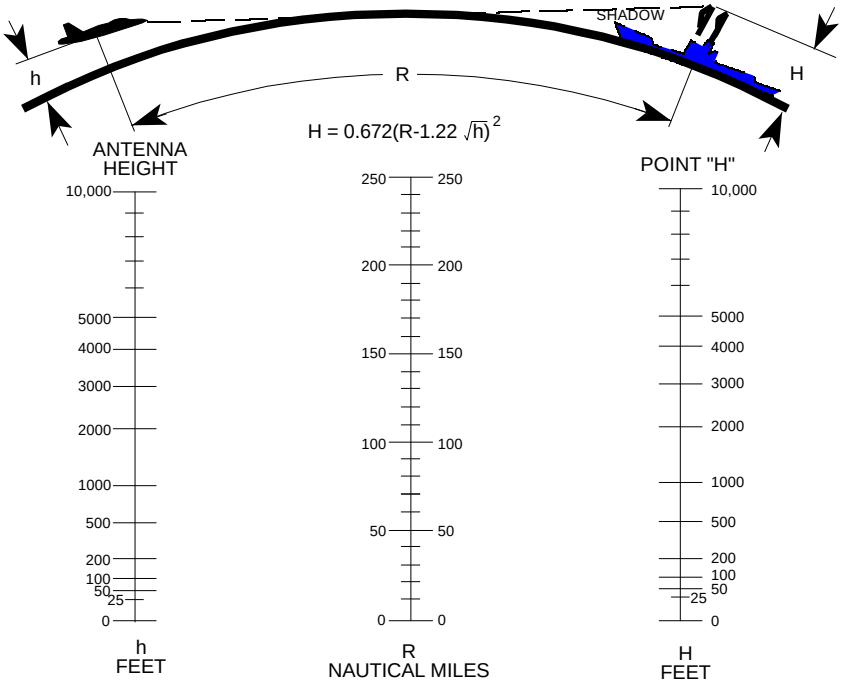

Figure 2. Earth Curvature Nomograph

This data was expanded in Figure 3 to consider the maximum range one aircraft can detect another aircraft using:

$$R_{NM} = 1.23\left(\sqrt{h_{radar}} + \sqrt{h_{target}}\right)$$

(with h in feet)

It can be used for surface targets if $H_{target} = 0$. It should be noted that most aircraft radars are limited in power output, and would not detect small or surface objects at the listed ranges.

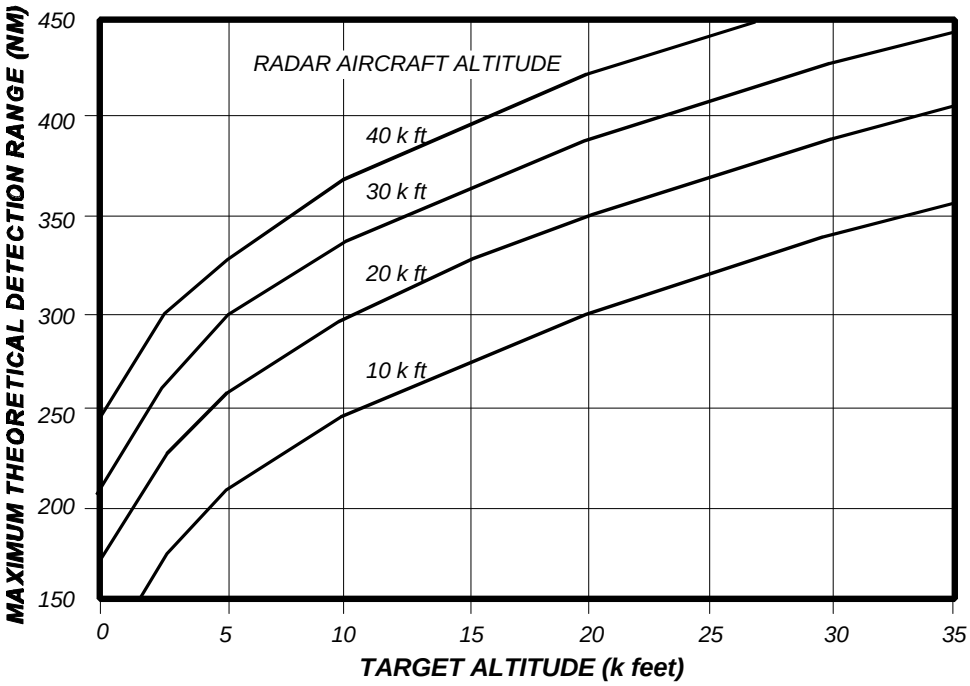

Figure 3. Aircraft Radar vs Aircraft Target Maximum Range

Other general rules of thumb for surface "targets/radars" are:

For Visual SAR:

$$R_{Visual}(NM) = 1.05\sqrt{Acft\ Alt\ in\ ft}$$

For ESM:

$$R_{ESM}(NM) = 1.5\sqrt{Acft\ Alt\ in\ ft}$$

Figure 4 depicts the maximum range that a ship height antenna can detect a zero height object (i.e. rowboat etc).

In this case "H" = 0, and the general equation becomes:

$$R_{max}\ (NM) = 1.23\ \sqrt{h_r}$$

Where h_r is the height of the radar in feet.

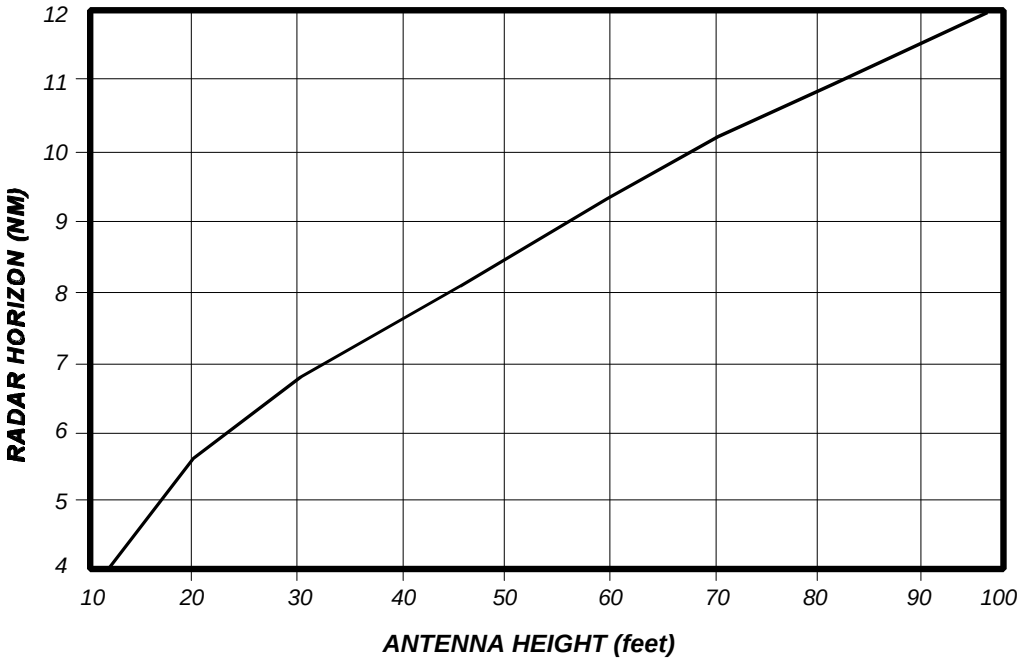

Figure 4. Ships Radar Horizon with Target on the Surface