Mount the scaled model antenna on the aircraft model at the intended installation location.

Measure the antenna gain for all azimuth angles (for top and bottom antennas).

Confirm that the scaled antenna meets the success criteria of §3.3.4.1.1 above.

3.3.4.5 Theoretical Calculations of Antenna Gain

The gain characteristics of the antenna as mounted on the actual airframe may be determined by a combination of radiation pattern calculations, and measurements designed to validate those calculations. When using such techniques to determine the gain of a multi-element antenna, it is necessary to show that the calculations include the inherent characteristics of the antenna elements and their drivers, splitters, or combining networks and any effects due to mutual coupling between those elements.

3.3.4.5.1 Validation of Theoretical Calculations

If radiation pattern calculations are used to prove the success criteria of §3.3.4.1.1 above, the manufacturer of the antenna must provide corroborating data demonstrating the success of the calculation technique in predicting the antenna gain on an airframe roughly similar in size and complexity to the airframe under qualification. Such data must be obtained by comparison with selected gain measurements made

(a) on a full-size airframe using a calibrated ramp test antenna range, or

(b) on a scaled model airframe as indicated in 3.3.4.4.

3.3.4.5.2 Distance Area Calculations

The extent to which the antenna installation minimizes obstructions in the horizontal plane and minimizes effects of reflecting objects, may be judged by the distance to such objects and their sizes. If the distances and sizes satisfy the condition given here, then the antenna installation may be considered validated with regard to antenna gain. The condition is: For target aircraft at zero degree elevation angle and at azimuth bearing between –90 degrees and +90 degrees,

$$\frac{A_1^2}{l^2 D_1^2} + \sum \frac{A_2^2 G_2^{\,l}}{l^2 D_2^2 G_2} + \sum \frac{A_3 G_3^{\,l}}{4p D_3^2 G_3} < 0.02$$

where $l = 0.9$ ft. is the free space wavelength at 1090 MHz. The first term is applicable only if there is a metallic obstruction between the target and the ADS-B antenna. The distance in feet to the obstruction is denoted D_1 and the area in ft^2 of the obstruction projected in the direction of the ADS-B antenna is denoted A_1. The second term is a summation over flat metallic reflectors, if any, that are oriented so as to cause a specular reflection between the ADS-B antenna and the target. The distance to the reflector, in feet, is denoted D_2, the area, in square feet, of the reflector, projected in the direction of the ADS-B antenna is denoted A_2, the antenna gain in the direction of the reflector is denoted G'_2 and is dimensionless (i.e. gain in dB = 10 log G'_2), and the antenna gain in the direction of the target is denoted G_2 and is dimensionless. The third term is a summation over all other metallic objects that may cause reflections between the ADS-B antenna and the target.