Most methods used for lightning location require multiple station measurements. The goal of the work reported here is to locate the source of an atmospheric, or sferic, using the measurements made at a single station with two crossed magnetic loop antennas. Both of these antennas are required to estimate the direction between the source and station, however only a clear signal from a single antenna is needed for estimating the distance between the two. The distance estimation is done using the slow-tail of the sferic. The slow-tail is the extremely low frequency (ELF) component of the sferic which arrives later than the higher frequency components. According to Wait’s theory on modes and propagation of ELF radio waves, the first mode, where ELF components propagate, is characterized by a peak-shaped function. The delay between the start and peak of the function corresponds the slow-tail separation, \( t_s \). The slow-tail separation is defined by the time delay between the start of the sferic and the peak of the first quarter cycle of the slow tail. Wait showed the relationship between distance, \( \rho \), and \( t_s \) to be a quadratic function of the form \( t_s = (A + B\rho)^2 \). \( A \) and \( B \) vary depending on the waveguide conditions. The earth boundary of the waveguide remains relatively fixed while the ionosphere changes dramatically between day and night. Two different solutions for \( A \) and \( B \) are formulated for average daytime and nighttime propagation. The daytime solution gives a larger slope for \( \rho \) versus \( t_s^{1/2} \), therefore distance estimation is more precise with daytime data rather than nighttime. The constants originally proposed by Wait are based on the average height of the ionosphere and curve fitting some limited data. The amount of data collected and analyzed in this work is much larger and also contains a larger range of \( \rho \). This work supports Wait’s theory that the square root of the slow-tail does vary linearly with distance, solves for new constants to better fit the large data sample, and analyzes the effectiveness of distance estimation of sferics using a single station.