# RETURN LOSS TESTING IN THE FIELD

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## SYSTEM RETURN LOSS SWEEPS

A system return loss sweep is the most common method of testing antenna and cable performance. The results of these measurements need to be analyzed carefully as each site is configured differently. These differences can drastically affect system return loss characteristics. Cable length, cable diameter, cable insertion loss characteristics, connectors, jumper cables and other components all influence the measured system return loss values. A reasonable system sweep should measure between –14 dB to –20 dB, depending upon the configuration. Site return loss specifications and base station equipment alarm thresholds should be set accordingly.

- **Larger diameter, low loss cable will generally sweep worse for return loss than high loss, narrow diameter cable** because the high loss cable absorbs more of the reflected signal, resulting in a smaller amplitude reflection received at the test equipment.
- **Long cable runs will sweep better than short rooftop applications** using the same logic.

Common return loss failures for a system sweep include:

- Loose or improperly torqued connectors.
- Moisture in connectors and cables caused by improperly applied or failed weather sealant.

## DISTANCE-TO-FAULT (DTF) MEASUREMENTS

**Distance** measurements for most pieces of DTF test equipment are very accurate. **However, many factors influence the return loss accuracy.** These include:

- The bandwidth of the measurements
- The quality of the calibration and the calibration components
- The quality of the cables being tested
- The length or relative phase of the transmission line components

In a DTF measurement, all frequencies in the sweep are mathematically summed together using an inverse Fast Fourier Transform (FFT) formula to determine the amplitude value at a given distance. Typically, **DTF amplitude measurements of the antenna will look considerably better than actual return loss values**. Distance-to-fault measurements are an excellent tool for troubleshooting problem sites. Site-commissioning baseline data can be compared to subsequent measurements to determine deteriorating site conditions such as cable/component aging, loose or damaged connectors, and changes due to seasonal temperature variations Although this is **not an accurate method for measuring return loss amplitude**, the accuracy of this response is not critical as long as it is repeatable when comparing subsequent measurements.

## ANTENNA STAND-ALONE MEASUREMENTS

**Testing the antenna by itself in a return loss sweep is the only truly accurate method of determining antenna return loss performance**.

- The antenna under test should be pointed skyward or with as few obstructions as possible when testing. Nearby objects can cause reflections back into the antenna that will give erroneous readings.
- The antenna must be removed from any enclosure unless the enclosure was included in the manufacturers tuning process (for example, EMS *Wireless'* AcCELLerator™ series).
- The antenna should be tested in an RF "clean" environment. In-band transmitters radiating from adjacent sectors or sites will cause spikes that could be interpreted as failures. These transmitters must be turned off prior to testing.
- Always ensure that the antenna connector is clean and dry before proceeding with measurements. Moisture in the connector from improper weather sealing **WILL** cause a return loss failure.
- Antennas can be tested while installed on the tower provided that the above criteria are met. In many cases, it is easier to bring the test equipment to the antenna than to remove and reinstall the antenna.

Most **EMS *Wireless*** antennas have a return loss specification of –16.5 dB. All frequencies within the operating bandwidth of the antenna should test at –16.5 dB or better. Test equipment calibrations can drift considerably with small temperature changes. This is especially troublesome when testing outdoors. Ensure the integrity of the calibration by testing a load of a known value or performing a new calibration before testing any system or component. **The accuracy of the measurement is only as good as the quality of the calibration.**