Dual frequency receivers are required for precision surveys to correct for the effects of ionospheric refraction where the magnitude of the error may range from 1 to 10 ppm. The receivers must record the phase of the satellite signals, the receiver clock times and the signal strength or quality of the signal. The phase center of the antenna, which is constant and unique to the antenna model, should be known from the manufacturer. It is best not to use different antenna models during a survey, as the phase center will create a bias in the elevations of survey points. If the receiver does not have a known phase center database relating to antenna type, the user should have the ability to enter the measurement components for the phase center height of the antenna. The measurement components are a measured height above a survey point to a mark on an adapter (or to a corner of the antenna) and the fixed constant distance from an adapter mark to the phase center of the antenna (provided by the manufacturer). **Figure 10-A,** is an example from the NGS illustrating the different antenna measurements required for different antenna types. ***Fixed Height Tripods are recommended for use during *GNSS missions to avoid measurement or transcription errors.*** These GNSS receivers should be programmable and have several I/O ports. The software should be able to convert the data to RINEX-3 format for use with other GNSS systems and software.

Sec. 10.03 **GNSS Networks and Accuracy Standards**

In general, the GNSS Network will consist of known points and all points to be surveyed, allowing loop closures to be calculated from processing procedures utilizing data from a minimum of two sessions that form a loop. A known point would be a point that has a known position and/or elevation. A HARN Station, a CORS site, a NGS vertical station, a USGS monument tied to NAVD88 datum or, especially in VDOT's case, an existing survey station from an existing project, would be considered a known point. A minimum of three known points shall be included in the observing scheme. The three known points should be based on or originate from a common datum. In some cases, it is acceptable to use available software to convert elevations to the NAVD88 datum. The location of the new control points shall depend on the optimum layout to carry out the required needs of the survey.

The "**Geometric Geodetic Accuracy Standards and Specifications for Using GNSS Relative Positioning Techniques**", version 5.0 by the Federal Geodetic Control Committee (FGCC), is VDOT's source for the definition of accuracy standards and the specifications and procedures to achieve those standards. When requested, any surveyor performing a GNSS survey for VDOT that must comply with an accuracy standard, shall adhere to the standards and specifications as published by the FGCC.

The accuracy standard for the survey will depend on several factors.
These factors include, but are not limited to:

- number of receivers available for the project
- the "mission plan" or observation scheme
- satellite availability and geometry
- signal strength
- network geometry
- observation duration

* Rev. 7/15