

*[Title 10—DEPARTMENT OF]
[NATURAL RESOURCES]
[Division 30—Land Survey]
[Chapter 4—First and Second Order Horizontal and Vertical Control]*

**Title 2—DEPARTMENT OF AGRICULTURE
Division 90—Weights and Measures
Chapter 62— First and Second Order Horizontal and Vertical Control**

PROPOSED AMENDMENT

[10 CSR 30-4.050] **2 CSR 90-62.050 GPS Survey Guidelines**

PURPOSE: This rule prescribes the minimum procedures for first or second order Global Positioning System surveys.

- (1) Direct connections must be made to any adjacent observable National *[Geographic]* Spatial Reference System *[(NGRS)]* **(NSRS)** and/or Missouri Geographic Reference System (MO GRS) station located five kilometers (5 km) or less from any new station.
- (2) At least three (3) existing higher or equal order control points must be included in any proposed Global Positioning System (GPS) survey. Whenever possible these should be three (3) **three-dimensional (3-d)** control *[points]* **stations**. Otherwise two (2) sets of three (3) *[points]* **stations**, (three (3) **two-dimensional (2-d)** horizontal *[points]* **stations** and three (3) vertical control *[points]* **stations**) must be used. These control *[points]* **stations** should be chosen to be roughly equidistant on the periphery of the proposed project *[network]* so that they enclose as much of the *[proposed network]* **project** as possible.
- (3) Each new *[point]* **station** to be established by the proposed GPS survey must be occupied at least two (2) separate times to enable proper checking of blunders (for example, incorrect point, setup errors, incorrect antenna heights). A separate occupation is one *[where]* **in which** the antenna **and its supporting device (tripod) have** *[has]* been taken down and set up again and the receiver restarted.
- (4) Each *[point]* **station** must be connected by simultaneous occupations *[(that is, base line)]* **(baselines)** to at least three (3) other *[points]* **stations** in the network after outlier base lines have been rejected from the adjustment. Because it is generally easier to resolve the integer phase ambiguities over shorter base line, adjacent *[points]* **stations** should be connected wherever possible.
- (5) At least two (2) receivers must be used for relative positioning, although three (3) or more may be used for more efficient operation and increased station reoccupation and base line repeatability.
- (6) A preanalysis should be performed to determine the minimum occupation time required to achieve the required standard of accuracy. In addition, the most appropriate satellites to observe at each site should also be selected for receivers unable to track all of the “visible” satellites. The preanalysis should be specific for carrier phase relative positioning.
- (7) In order to meet second order accuracies, the carrier beat phase must be observed together with a time tag for each observation. Pseudo-range observations are not precise enough for control surveys and cannot be used.

(8) A detailed field log must be kept during observation taken at each station. At the very least the following information must be recorded:

- (A) Universal Time [*Correction*] **Coordinated** (UTC) date of observations;
- (B) Station identification (name and number);
- (C) Session identification;
- (D) Serial numbers of receiver, antenna, and data logger;
- (E) Receiver operator;
- (F) Antenna height and offset from monument, if any to one millimeter (1 mm). Note should be made [*of any deviation from standard method of measuring HI*] **as to whether the height is measured as a slant height or vertical height**;
- (G) Diagram illustrating stamping on the monument;
- (H) Other stations observed during session;
- (I) Starting and ending time (UTC) of observations;
- (J) Satellites observed (including time of changes); and
- (K) Completed field log data forms for each station occupation will be submitted either using those provided by the **Missouri Department of [*Natural Resources (DNR)*] Agriculture (MDA)** or some other type containing all necessary information [*found*] **included** on the [*DNR*] **MDA** forms.

(9) The raw data files for all station occupations must be submitted. Each file[, *called an R-file,*] will consist of one (1) set of raw observations for each station occupation session. For example, four (4) receivers operating during each of five (5) sessions will produce twenty (20) [*R-files*] **raw data files**. [*An example of a raw data file would be the DAT, ION, MES, and EPH files produced by a Trimble receiver during a station occupation.*]

(10) The unadjusted base line vector solution files for all observed base lines, non-trivial and trivial, will be submitted. [*These files are produced by post-processing software such as the OPT or FIX, FLT, and TRP files produced by Trimvec post-processing software.*]

(11) If station description information is not provided by [*DNR*] **MDA** it must be submitted for each station occupied. Station descriptions must include station name, county, township, range, section, United States Geological Survey (USGS) **7.5-minute** [*']* **quadrangle** name, date monumented, date of observations, complete descriptions of the station, azimuth and all reference monuments, a current "to reach" description, and any special information such as property owner name, address, and phone number. A sketch depicting the station and reference marks with dimensions and directions shown should accompany all narrative data. Examples of complete station description information may be obtained from [*DNR*] **MDA**.

(12) If the GPS survey project includes any surveys using conventional or terrestrial horizontal surveying techniques, copies of all field notes and associated data must be submitted. This would include eccentric point establishment and reduction. Polaris, solar, or direct observational data to establish azimuth marks shall also be submitted.

(13) When the GPS survey project includes surveys performed using conventional differential leveling techniques, copies of all field notes and associated data must be submitted. An example of this would be a vertical tie from a nonoccupied bench mark to a GPS station.

(14) A tabulation of the results of the repeat base line comparisons will be included in the project report.

(15) A minimally constrained (free) least squares, three dimensional (3-d) adjustment will be submitted in the form of the input and output files.

AUTHORITY: sections 60.451.3. and 60.461, RSMo 1986. Original rule filed May 3, 1994, effective Dec. 30, 1994.*

**Original authority: 60.451.3, RSMo 1984 and 60.461, RSMo 1984.*

PUBLIC COST: This proposed amendment will not cost state agencies or political subdivisions more than five hundred dollars (\$500) in the aggregate.

PRIVATE COST: This proposed amendment will not cost private entities more than five hundred dollars (\$500) in the aggregate

NOTICE TO SUBMIT COMMENTS: Anyone may file a statement in support of or in opposition to this proposed amendment with Missouri Department of Agriculture, Weights, Measures and Consumer Protection Division, Mr. Ronald G. Hayes, Division Director, PO Box 630, Jefferson City, MO 65102. Hand carried copies may be delivered to the Missouri Department of Agriculture, Weights, Measures and Consumer Protection Division, Mr. Ronald G. Hayes, Division Director, 1616 Missouri Blvd., Jefferson City, MO 65109. To be considered, comments must be received within thirty (30) days after publication of this notice in the Missouri Register. No public hearing is scheduled.