

Appendix I:

Iowa DOT: *Developmental Specifications for GPS Machine Control Grading*



**DEVELOPMENTAL SPECIFICATIONS
FOR
GLOBAL POSITIONING SYSTEM MACHINE CONTROL GRADING**

**Effective Date
October 16, 2012**

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

12010.01 GENERAL.

- A.** This specification contains requirements for grading construction using Global Positioning System (GPS) machine control grading techniques. Use this developmental specification in conjunction with Section 2526 of the Standard Specifications.
- B.** The Contractor has the option of using grading equipment controlled with a GPS machine control system in the construction of the roadway embankment.
- C.** The plans indicate the areas of the project where the Contracting Authority is providing electronic surface models of the roadway embankment construction. The Contractor may construct remaining areas with conventional construction survey techniques. The Contractor may, at no additional cost to the Contracting Authority, build the required surface models to facilitate GPS machine control grading for those areas.
- D.** The Contractor may use any type of GPS machine control equipment and systems that results in achieving the existing grading requirements. Convert the electronic data provided by the Contracting Authority into the format required by the machine control grading system.

12010.02 EQUIPMENT.

Provide all equipment required to accomplish GPS machine control grading. Use equipment that generates end results meeting the Standard Specifications.

12010.03 CONSTRUCTION.

A. Contracting Authority Responsibilities.

- 1.** The Engineer will set the initial horizontal and vertical control points in the field for the project as indicated in the contract documents.
- 2.** The Engineer will provide the project specific localized coordinate system. The control information utilized in establishing the localized coordinate system, specifically the rotation, scaling, and translation can be obtained from the Engineer upon request.

3. The Contracting Authority will make available the following electronic data files with the proposal form. This information is available for a fee at: <http://www.ia.bidx.com/main/index.html>. The Contractor will be required to purchase an online account to obtain the electronic data. The files that are made available were originally created with the computer software applications MicroStation (CADD software) and GEOPAK (civil engineering software). The data files will be in the native formats and other software formats as described below. Perform necessary conversion of the files for the selected grade control equipment.
- a. CAD Files:
 - GEOPAK TIN files representing the design surfaces.
 - GEOPAK GPK file containing all horizontal and vertical alignment information.
 - GEOPAK documentation file describing all of the chains and profiles.
 - MicroStation primary design file.
 - MicroStation cross section files.
 - MicroStation ROW data file.
 - MicroStation photogrammetry and text files.
 - b. Machine Control Surface Model Files:
 - ASCII format.
 - LandXML format.
 - Trimble Terramodel format.

Note: TIN files and surface model files of the proposed finish grade include the topsoil placement where required in the plans.

- c. Alignment Data Files:
 - ASCII format.
 - LandXML format.
 - Trimble Terramodel format.

No guarantee is made that the data systems used by the Engineer will be directly compatible with the systems the Contractor uses.

Apply Article 1105.04 of the Standard Specifications with the additional clarification that information shown on the plans governs over the provided electronic data.

The electronic information is not to be considered a representation of actual conditions to be encountered during construction. Providing the Contractor this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered, including but not limited to site visits, and basing the bid on information obtained from these investigations and the their professional interpretations and judgment. The Contractor assumes the risk of error if the information is used for any purposes for which the information was not intended.

Any assumptions the Contractor makes from this electronic information is at their risk.

The Contracting Authority will develop and make available electronic data to the Contractor for review as part of the contract documents. Ensure the electronic data will function in the machine control grading system.

4. The Engineer may perform spot checks of the machine control grading results, surveying calculations, records, field procedures, and actual staking. If the Engineer determines the work is not being performed in a manner that will assure accurate results, the Engineer may order such work to be redone, to the requirements of the contract documents, at no additional cost to the Contracting Authority.

B. Contractor's Responsibilities.

1. Provide the Engineer with a GPS rover (with the same capabilities as units used by the Contractor) for use during the duration of the contract. At the end of the contract, the GPS rover unit will be returned. Provide the Engineer 8 hours of formal training on the Contractor's GPS machine control systems.
2. Review and apply the data the Contracting Authority has provided to perform GPS machine control grading.
3. The Contractor bears all costs, including but not limited to the cost of actual reconstruction of work, that may be incurred due to errors in application of GPS machine control grading techniques. Grade elevation errors and associated quantity adjustments resulting from the Contractor's activities are at no cost to the Contracting Authority.
4. Convert the Contracting Authority's electronic data into a format compatible with the machine control system.
5. Manipulation of the Contracting Authority's electronic data is taken at the Contractor's own risk.
6. Check and recalibrate, if necessary, the GPS machine control system at the beginning of each work day.
7. Meet the same accuracy requirements as conventional grading construction as detailed in the Standard Specifications.
8. Establish secondary control points at appropriate intervals and at locations along the length of the project and outside the project limits and/or where work is performed beyond the project limits as required at intervals not to exceed 1000 feet (300 m). Determine the horizontal position of these points using static GPS sessions or by traverse connection from the original baseline control points. Establish the elevation of these control points using differential leveling from the project benchmarks, forming closed loops. Provide a copy of all new control point information to the Engineer prior to construction activities. The Contractor is responsible for all errors resulting from their efforts. Correct all deficiencies to the satisfaction of the Engineer at no additional cost to the Contracting Authority.
9. Preserve all reference points and monuments that are established by the Engineer within the project limits. Reestablish reference points that have not been preserved at no additional cost to the Contracting Authority.
10. Set hubs at the top of the finished subgrade at all hinge points on the cross section at 1000 foot (300 m) intervals on mainline and at least two cross sections on the side roads and ramps. Establish these hubs, using conventional survey methods, for use by the Engineer to check the accuracy of the construction.
11. Provide controls points and conventional grade stakes at critical points such as, but not limited to, PC's, PT's, super elevation points, and other critical points required for the construction of drainage and roadway structures.
12. At least one week prior to the preconstruction conference, submit to the Engineer for review a written machine control grading work plan which includes the equipment type, control software manufacture and version, and the proposed location of the local GPS base station used for broadcasting differential correction data to rover units.

12010.04 METHOD OF MEASUREMENT.

None.

12010.05 BASIS OF PAYMENT.

- A. Payment for GPS Machine Control Grading will be the lump sum contract unit price.
- B. Payment is full compensation for all work associated with preparing the electronic data files for use in the Contractor's machine control system, the required system check and needed recalibration, training for the Engineer, and all other items described in Article DS-12010.03, B.
- C. Delays due to satellite reception of signals to operate the GPS machine control system will not result in adjustment to the contract unit price for any construction items or be justification for granting contract extensions.