

GLOBAL POSITIONING SYSTEM MACHINE CONTROL GRADING

****From Berlin STP 2935(1)
Berlin NH STP 2938(1)
Berlin NH STP 2947(1)**

- xx. DESCRIPTION. This specification contains requirements for grading construction using Global Positioning System (GPS) machine control grading techniques.

The Contractor shall use grading equipment controlled with a GPS machine control system in the construction of the roadway design and build the required surface models to facilitate GPS machine control grading.

The Contractor may use any type of GPS machine control equipment and systems that results in achieving the existing grading requirements and shall convert the electronic data provided by the Agency into the format required by the machine control grading system.

- xx. EQUIPMENT. The Contractor shall provide all equipment required to accomplish GPS machine control grading and use that equipment to generate end results meeting all of the Contract requirements.

- xx. CONSTRUCTION REQUIREMENTS.

(a) Agency 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) Following the award of the Contract, the Agency will make available the following electronic data files. The files that will be made available were originally created with the computer software applications MicroStation® (CADD software) and InRoads® (civil engineering software). The data files will be in the native formats and other software formats as described below. The Contractor will perform any and all necessary conversion of the files for the selected grade control equipment.

a. CAD Files.

1. InRoads® DTM files representing the design surfaces.

2. InRoads® ALG files containing horizontal and vertical geometry.
 3. MicroStation® alignment design file.
 4. MicroStation® cross section design files.
 5. MicroStation® ROW design file.
 6. MicroStation® Existing Ground topography design file.
- b. Machine Control Surface Model Files.
1. LandXML (ASCII format).
- c. Alignment Data Files.
1. Alignment Geometry Report (ASCII Report format).
 2. LandXML (ASCII format).

The Contractor is notified that VTrans utilizes the US Survey Foot as a basis for all engineering work. Particular care shall be taken to ensure that the US Survey Foot is utilized in any and all conversion/evaluation of the files provided. This includes any required conversion from MicroStation® DGN to AutoCAD® DWG; as well as from Bentley InRoads® to other engineering formats. The XML files shall also be checked to ensure that the US Survey Foot is utilized.

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 any bid on information obtained from these investigations and their professional interpretations and judgment.

The Contractor assumes all 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.

- (4) The Engineer will 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 will order such work to be redone, to the requirements of the Contract Documents, at no additional cost to the Agency.

(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. The Contractor's attention is directed to the possible inclusion of separate pay items requiring Contractor supply of GPS rover units within this Contract rendering the above duplication unnecessary.
- (2) Review and apply the data the Agency has provided to perform GPS machine control grading and build the 3D model to do the same.
- (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 Agency.
- (4) Convert the Agency's electronic data into a format compatible with the machine control system.
- (5) Manipulation of the Agency'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 required by 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 300 m (1000 feet). 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 and shall correct all deficiencies to the satisfaction of the Engineer at no additional cost to the Agency.

- (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 Agency.
- (10) Set hubs at the top of the finished subgrade at all hinge points on the cross section at 300 m (1000 foot) 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, superelevation 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 Regional Construction 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.

xx. METHOD OF MEASUREMENT. The quantity of Special Provision (GPS Machine Control Grading) to be measured for payment will be on a lump sum basis in the complete and accepted work.

xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (GPS Machine Control Grading) will be paid for at the Contract lump sum price. Payment will be full compensation for furnishing all labor, equipment, and material necessary in 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, machine control equipment, and for furnishing all materials, labor, tools, equipment, and incidentals necessary to complete the work.

The unit price bid shall include the costs of all labor, materials, and equipment necessary to satisfactorily complete the work, including required training and maintenance.

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 Contract items or be justification for granting Contract time extensions.

Partial payments will be made as follows:

- (a) The first payment of 50 percent of the Contract lump sum price for Special Provision (GPS Machine Control Grading) or 5 percent of the adjusted Contract price, whichever is less, will be made with the first biweekly estimate as determined by the Engineer pending progress on other Contract Items.
- (b) The second payment of 40 percent of the Contract lump sum price for Special Provision (GPS Machine Control Grading) or 5 percent of the adjusted Contract price, whichever is less, will be made on the first estimate following the completion of 50 percent of the Contract.
- (c) Payment of any remaining amount of the Contract lump sum price bid for Special Provision (GPS Machine Control Grading) will be made after the Contract Substantial Completion Date as determined by the Engineer.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.645 Special Provision (GPS Machine Control Grading)	Lump Sum