

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
AUTOMATED 3D POSITIONING FOR CONSTRUCTION

DES:JPL

1 of 3

APPR: DJL:DMG:10-08-13

a. Description. The Contractor may elect to utilize Automated Machine Guidance and/or Automated Machine Control (AMG/AMC) for the project for purposes of determining precise 3D locations for earth work activities and material placement. AMG/AMC is defined as the use of any electronic positioning system relying on Global Positioning Systems, total stations and/or lasers designed to guide and/or control machinery in operations such as earth excavation, material placement, grading, trimming and/or paving.

b. Materials. None specified.

c. Construction. At the preconstruction meeting, the Contractor must provide, to the Engineer, a notice of intent stating whether or not AMG/AMC will be used on the project. The intent statement must indicate the items of work which will utilize AMG/AMC. Within the intent statement the Contractor must also indicate past experience with AMG/AMC operations and include a general statement about how AMG/AMC will be employed on the project, the type of electronic equipment which will be used and the anticipated accuracy and precision expected to be achieved.

The Engineer will have 7 work days to accept or reject the Contractor's intent statement with regards to this special provision. The primary grounds for rejection will be the Engineer's determination that the equipment configuration is not suitable for the proposed site or work activities. If the Engineer denies the Contractor the right to employ AMG/AMC it is the Contractor's responsibility to employ the services of a consultant that is prequalified in construction staking to provide construction stakes for the staking items approved to be covered by AMG/AMC, at no additional cost to the Department.

The Contractor is responsible for generating a 3D model if a model is not provided by the Department as part of the contract. (Note that Reference Information Documents are not part of the contract). The Contractor must employ the services of a Professional Engineer or Professional Surveyor licensed by the State of Michigan to provide the Contractor with the model to be used in the Contractor's selected AMG/AMC equipment. The Professional Engineer or Professional Surveyor must provide a sealed document addressed to the Contractor and the Department, certifying that, "The electronic model(s) developed for the project is an accurate representation of the plans, specifications and intentions of the design."

Field verification, to determine suitability of any model provided, and existing project features is the responsibility of the Contractor. Features to be verified include, but are not limited to, driveways, intersections, structures, ties at project limits, ramp terminals, etc. If the Contractor determines the model information provided is not suitable to construct the project consistent with the plans and specifications or requires electronic formatting of files different than provided, it will be the responsibility of the Contractor to prepare such files prior to commencement of construction without additional charge to the Department. The finalized files must be submitted

to the Engineer for approval prior to use.

The finalized electronic surface files developed by the Contractor, for AMG/AMC operations, must be GEOPAK compatible and will use the following general guidelines:

In areas where horizontal curves are proposed with a radius of 250 feet or less, vertical curves, and/or superelevation is proposed, triangles should be derived from cross section spacing no greater than 5 feet. In all other areas, where the grade is linear, triangles should be derived from cross section spacing no greater than 25 feet.

The file should be checked to ensure that triangles do not cross grade breaks.

If the Contractor's system does not employ the use of triangle files, complete 3D line strings must be utilized, with vertex spacing or interpolation occurring at an interval no greater than 5 feet or rectangular files with offset spacing no greater than 5 feet.

The generation of the surface files must ensure that specified surface tolerances and ride quality are achieved. In areas where the subgrade does not parallel the final surface, development of a separate subgrade model is warranted and will be the responsibility of the Contractor's Engineer or Surveyor.

The Contractor must verify the control provided and placed by the Department. If the Contractor's AMG/AMC operations rely upon a site calibration to the control, the Contractor must provide the Engineer with a calibration report detailing the control points held and resulting residual values of the adjustment. Points found to be outliers to the adjustment must be reported to the Engineer.

If the Contractor's AMG/AMC operation requires a greater density of control than that provided in the project plan set, the Contractor will be responsible for densification of the control. If the additional control is required to support operations involving final material placement (i.e. stringless paving, trimming) the control points established will meet the specifications for intermediate control as defined by the Design Survey Manual subsections 7.7 and 7.8, with the Contractor relieved of the witnessing requirement defined in paragraph 3 of subsection 7.7.6. The Contractor will employ the services of a consultant that is prequalified in construction staking to perform control densification. Additional control establishment will be placed at a spacing that adequately supports the automated operation being performed, which generally requires spacing of 250 to 500 foot intervals. Prior to utilization of added control, the Contractor must provide the Engineer with a report of horizontal control points and benchmarks established. A report including the results of the adjustment to the supplemental control must be provided including the original control points held fixed and the resulting residual values.

The contractor staking items approved to be covered by AMG/AMC for this contract are listed in subsections 824.03.C and 824.03.D of the Standard Specifications for Construction.

The Department is responsible for all remaining contractor staking items listed in section 824 of the Standard Specification for Construction.

If the Contractor elects not to employ AMG/AMC or if the performance of the AMG/AMC equipment is inadequate in any area on the project due to site conditions, the Contractor must employ the services of a consultant that is prequalified in construction staking to provide

construction stakes for the aforementioned staking items which were approved to be covered by AMG/AMC.

At least 24 hours prior to commencement of AMG/AMC operations the Contractor must notify the Engineer so staff can be available to perform quality assurance (QA) on the results of the operations. The Engineer will provide independent QA for continuous AMG/AMC operations. The use of Contractor's AMG/AMC equipment is prohibited for the Engineer's QA checks.

Acceptance of the results of AMG/AMC operations will be based upon QA results falling within prescribed tolerances for each operation as independently determined by the Engineer based on observations performed at a maximum of 300 foot intervals, or at a shorter interval determined by the Engineer. If the Engineer determines that the required accuracy is not being met, the Contractor will be notified as soon as possible. The Contractor must suspend AMG/AMC operations and jointly evaluate the area of concern with the Engineer. Once the cause of the inaccuracies is determined, the Contractor must provide a written plan to address the concerns. Any re-work necessary due to inaccurate modeling, inadequate system configuration, equipment, software, or hardware problems is at the expense of the Contractor. The Contractor may resume AMG/AMC operations at the approval of the Engineer. If subsequent failures to meet specifications and accuracies are experienced, the Contractor will be suspended from AMG/AMC operations and conventional staking must be employed at no cost to the Department.

d. Measurement and Payment. If a design change results from a plan error, omission or unforeseen circumstance, which warrants a plan revision by the Engineer, the Contractor must generate a revised model and electronic files. The work to revise the model will commence after the Engineer issues a work order which includes the number of hours agreed upon between the Department and the Contractor. Hours not documented on the work order will not be paid for by the Department.

The cost associated with said modifications will be paid for at the contract unit price using the following pay item:

Pay Item	Pay Unit
Electronic Model Revisions.....	Hour

Electronic Model Revisions includes compensation for all necessary labor, equipment, software and incidentals needed to revise the Contractor's electronic model as a result of design changes made which warrant a plan revision.