

ALABAMA DEPARTMENT OF TRANSPORTATION

DATE: June 27, 2016

Special Provision No. 12-1882

SUBJECT: Intelligent Compaction and Thermal Profiling for Asphalt Pavements, Project Number NH-0013(535), Lauderdale County.

Alabama Standard Specifications, 2012 Edition, shall be amended by adding a new SECTION 413 as follows:

SECTION 413 INTELLIGENT COMPACTION AND THERMAL PROFILING FOR ASPHALT PAVEMENTS

413.01 Description

This work shall consist of compaction of asphalt pavement using Intelligent Compaction (IC) rollers within the limits of the work described herein or as shown in the plans. This work shall also consist of continuous thermal profiling of the asphalt mat immediately behind the paver during placement.

Definitions and terminology for intelligent compaction are given in AASHTO PP 81-14 -Section 3, "Intelligent Compaction Technology for Embankment and Asphalt Pavement Applications." Thermal profiling shall be performed in accordance with the requirements as given in AASHTO PP 80-14, "Continuous Thermal Profile of Asphalt Mixture Construction."

413.02 Materials

All asphalt pavements shall be designed and placed in accordance with Section 410, and as applicable Section 420, Section 423, and Section 424, subject to any exceptions contained herein. Quality Control/Quality Assurance (QC/QA) requirements as given in Section 106 are applicable to this Section, subject to any exceptions contained herein.

413.03 Equipment

(a) Instrumented Roller System

The fully instrumented IC Roller System shall be provided and set up by the original roller manufacturer on the breakdown and intermediate rollers. The breakdown and intermediate rollers shall meet the following requirements:

- IC rollers shall be self-propelled double-drum vibratory rollers equipped with accelerometers mounted in or about the drum to measure the interactions between the rollers and compacted materials in order to evaluate the applied compaction effort. IC rollers shall also be equipped with non-contact temperature sensors for measuring pavement surface temperatures.
- Global Navigation Satellite System (GNSS) radio and receiver units shall be mounted on each IC roller to monitor the drum locations and track the number of passes of the rollers.
- The IC rollers shall include an integrated on-board documentation system that is capable of displaying real-time color-coded maps of IC measurement values including the stiffness response values, location of the roller, number of roller passes, pavement surface temperatures, roller speeds, vibration frequencies and amplitudes of roller drums.
- The display unit shall be capable of transferring the data by means of a USB port and/or wireless transmission to the Cloud.

(b) Rover.

The Contractor shall provide for the Departments a survey grade GNSS Rover Receiver and Receiver Kit (Rover) for use during the contract. The survey equipment (rover) will be returned to the Contractor 90 days or less after the construction activities are completed. The Contractor or the GPS provider will provide training on the use of the Rover to the Department's personnel.

(c) Data Analysis Software.

Standardized data analysis software (Veta) is available for downloading from the website www.intelligentcompaction.com and it requires 64-bit operation systems. The software program will utilize the IC data received from the IC roller for analysis of coverage, uniformity, and stiffness of the asphalt materials during construction operations. IC data includes but is not limited to, IC-MV, pass counts, surface temperatures, roller speeds, vibration frequencies and amplitudes.

(d) Data.

The Contractor shall store the data either on an external computer and/or by cloud storage. The Contractor is responsible for verifying the GNSS coverage within the project limits. The Contractor shall download or transmit IC data a minimum of two (2) times per day during asphalt compaction operations. The data shall be date/time stamped which permits for external evaluation at a later time.

The Contractor shall submit IC raw data and the Veta Analysis results to the Department within 24-hrs of the collection of the data.

All GPS devices shall be set to the Universal Transverse Mercator (UTM) coordinate system Zone 16. If UTM-coordinates are not available, the State Plan Coordinate system may be used. The use of a local coordinate system shall not be used.

(e) GPS Check Testing.

Prior to the start of production, the Contractor and representatives of the GPS and IC roller manufacturer shall conduct the following to check the proper setup of the GPS, IC roller(s) and the rover(s) using the same datum:

1. On a location nearby or within the project limits, the GPS base station (if required by the GPS) shall be established and the IC roller and the GPS rover tied into the same base station.
2. Verification that the roller and rover(s) are working properly and that there is a connection with the base station.
3. Production shall not begin until proper GPS verification has been obtained within the maximum tolerance of 12 inches in the northing and easting directions. IC vendors' recommended verification process.
4. GPS check testing shall be conducted daily during production operations to ensure consistency and accuracy of GPS measurements for all GPS devices prior to the paving and compaction operations.

(f) Project Plan Files.

If available the Department will provide the project plan files to the Contractor for uploading into the on-board IC system computer. The project plan files shall consist of closed polygons in KMZ format in order to import to Veta for coverage analysis. The Department will provide survey grade points along the length of the project for IC GPS references. If plan files are not available, the Contractor and GPS provider shall use automatic points through the project and related to each in Veta.

413.04 Construction Requirements.

(a) Approval of Instrumented Rollers for Use

The Contractor shall provide a location and a proposed date for IC roller demonstration and certification(s) to the Engineer at least 14 calendar days in advance of beginning operations. The Department will evaluate the IC rollers in accordance with the procedures listed in AASHTO PP 81-14, Appendix A, "Intelligent Compaction Roller Approval for Use" and approve the rollers for use on the project.

(b) Establishment of the Rolling Pattern.

During the adjustment period (Article 106.09), the Contractor shall establish a roller pattern based on the differential mat temperatures as using the thermal in-place density measurement and the IC-MV values.

The IC-MV value shall be determined with a test strip to determine the number of sufficient passes to determine the optimum density. The test strip shall be a minimum of 500 feet. One evaluation location shall be randomly identified for each 100 feet. Each evaluation location shall be positioned away from the center of the lane due to potential overlap of rollers during compaction. After each of the passes the contractor shall collect a density measure with a nuclear gauge. Following completion of the trial section a compaction curve shall be constructed from the pass vs. density information. From this curve the number of passes to obtain optimum density and optimum IC-MV shall be determined. Cores shall also be collected by the contractor and turned over to the state for density testing for correlation with the IC and nuclear gauge.

(c) GPS Data Records and Formats.

The recorded GPS data, whether from the IC rollers or hand-held GPS rovers, shall be in the following formats:

- Time: The time stamp shall be in military format, hhmmss.ss in either UTC or local time zone. 0.01 second is required to differentiate sequence of IC data points during post process.
- GPS: Latitudes and longitude shall in ddmm.mmmmmmmm or decimal degrees, dd.ddddddd. . Longitudes are negative values when measuring westward from the Prime Meridian.
- Grid: Coordinates shall be in meters with at least 3 digits of significance (0.001 m or 1 mm).

When importing IC-MV data into the data analysis management program, the GPS data and associated IC measurements shall be stored with minimum data conversions and minimum loss of precisions. Users can then select unit of preference to allow real time unit conversion for the GUI display.

The following IC data and output shall also be included:

- Machine Manufacture
- Machine Type
- Machine Model
- Drum Width (m)
- Drum Diameter (m)
- Machine Weight (metric ton)
- Name index of intelligent compaction measurement values (IC-MV)
- Unit index for IC-MV
- Reporting resolution for independent IC-MVs - 90 degrees to the roller moving direction (mm)
- Reporting resolution for independent IC-MVs - in the roller moving direction (mm)
- UTM Zone
- Offset to UTC (hrs)
- Number of IC data points
- Height (m)
- Roller pass number
- Direction index
- Roller speed (kph)
- Vibration on
- Frequency (vpm)
- Amplitude (mm)
- Surface temperature (°C) -
- Intelligent compaction measurement values (IC-MV)

(d) Post-Process GPS Check.

The contractor shall follow the vendor-specific instructions to export IC-MV data to Veta-compatible formats. The Contractor shall import the IC roller data into Veta and enter GPS point measurements from the Contractor's rover's density gauge readings.

(e) On-Site IC Training.

The Contractor shall coordinate and provide for on-site training for Contractors and Agency personnel related to operation of the IC technology. Contractor's personnel shall include the paving superintendent, quality control manager, and the roller operator(s). Agency's personnel will include the project engineer and field inspector(s). Arrangements shall be provided that includes an enclosed facility with electrical availability and a projector for presentations and training shall be 4-8 hours in duration. On-site training shall be provided by qualified representatives from The Transtec Group, Inc. of Austin, Texas; Gallivan Consulting, Inc. of Carmel, Indiana; or equal in accordance with Asphalt IC on-site Training guidelines located at <http://www.intelligentcompaction.com/projects/specifications/>. A representative of the equipment manufacturer shall provide training for the operation of the specific IC Roller(s).

Agency Project Managers and the Contractors Quality Control Technicians need to bring 64-bit Windows Laptops to the training with the Veta software (version 4.0 or later) pre-installed. Veta can be downloaded from the Intelligent Compaction website: www.IntelligentCompaction.com

Minimum IC training topics shall include:

- Background information for the specific IC system(s) to be used.
- Setup and checks for IC system(s), GPS receiver, base-station (if not using virtual reference station), and hand held rovers.
- Operation of the IC system(s) on the roller (e.g., setup data collection, start/stop of data recording, and select on-board display options).
- Transferring IC data from the rollers(s) using USB connections or wireless to the cloud).
- Operation of vendor's software to open and view raw IC data files and exporting all-passes data files in Veta-compatible format.
- Operation of Veta software to import the above exported all-passes data files, inspection of IC maps, filter IC data, input point test data, perform statistics analysis, and produce reports for project requirements.
- Coverage and uniformity requirements.

Outcomes of the Training include the familiarity with the operation of the specific roller(s) manufacture of IC equipment, use of the on-board display screen for day time and night time paving operations, IC data retrieval, and the processing of the IC data into daily quality control reports

(f) Quality Control Personnel

The contractor shall designate the quality control manager who shall be responsible for conducting quality control, inspection activities, and liaison with the Engineer. The quality control manager shall have full authority to institute actions as necessary for successful implementation of the intelligent compaction work.

The contractor shall also designate the person or persons responsible for operating the IC roller(s) and attached IC equipment.

(g) Quality Control Requirements

The Contractor shall identify a quality control manager for the project and provide the contact information to the Engineer. The quality control manager shall be responsible, as a minimum, of the following functions:

- Daily GPS check testing for the IC roller(s) and rover(s).
- Control section construction establishment of the target compaction pass counts and target values for the strength of the materials using the standard testing devices; i.e., Nondestructive density gauges, pavement cores, and IC roller(s).
- Monitoring of the construction operations and the IC roller(s) during production and final evaluation operations.
- Quality control testing to monitor the pavement temperature and the required level of compaction.

- Daily download and analysis of the IC data from the roller(s).
- Daily set-up, take down and secure storage of GPS and IC roller components

(h) Thermal Profiling

The Department will provide the equipment, training and software necessary to collect the continuous thermal profile. The Contractor shall allow for the installation of the thermal profile equipment mounted on the paver. The thermal profiling data shall be Veta-compatible as given in AASHTO PP 80-14, Continuous Thermal Profile of Asphalt Mixture Construction.

1. Thermal Profiling Measurement

Thermal profiling measurements shall be coordinated with the IC measurements. Thermal profile measurements shall be calculated in sublots of 150 linear feet segments. A Lot shall be 1500 linear feet. Temperature measurements within two feet of the edge of the uncompacted mat will be eliminated from the differential calculation. Temperature readings below 170°F and above 400°F will be eliminated from the differential calculation.

2. Thermal Profiling Differentials

Thermal profile differentials shall be calculated as given in AASHTO PP 80-14. Thermal profile differentials less than or equal to 25°F shall be classified as "Good." Thermal profile differentials greater than 25°F but less than or equal to 50°F shall be classified as "Moderate." Thermal profile differentials greater than 50°F shall be classified as "Severe."

(i) Technical Assistance.

The Contractor shall coordinate for on-site technical assistance from the IC roller representatives during the initial seven (7) days of production and then as needed during the remaining operations. As a minimum, the roller representative shall be present during the initial setup and verification testing of the IC roller(s). The roller representative shall also assist the Contractor with data management from the rollers.

(j) IC Construction Evaluation Area.

IC Construction areas are defined as subsections of the project being worked continuously by the Contractor. The procedure for determining and documenting the limits of the construction area shall be provided to the Engineer. The magnitude of the evaluation areas may vary with production but shall be at least 1500 linear feet for evaluation for the full lane width. Partial construction areas of less than 1000 linear feet will be included in the previous area evaluation. Construction areas may extend over multiple days depending on the operations.

(k) IC Construction Operations Criteria.

A minimum coverage of 70% of the individual construction area shall meet or exceed the optimal number of roller passes and 70% of the individual construction area shall meet or exceed target IC-MV values determined from the test section. Construction areas not meeting the IC criteria (coverage and/or uniformity) shall be investigated by the Department prior to continuing with the paving operations.

The contractor may receive bonus pay (1.02) for the pay item placed if he achieves a 90% coverage by IC on the established roller pattern and the thermal profile differential is greater than 70% in the Good category, provided all other pay characteristics for the pay item are a pay factor of 1.0.

413.05 Method of Measurement.

Intelligent Compaction will be measured as a lump sum for providing for the Intelligent Compaction for Asphalt Mixtures on the project.

Partial Payments will be made according to the following schedule:

Schedule of Partial Payments for Intelligent Compaction		
Time of Payment	Amount of Payment	Accumulated Payment
Mobilization and Completion of Training	20% of the Original Contract Amount	20% of the Original Contract Amount
Completion of Base	40% of the Original Contract Amount	60% of the Original Contract Amount
Completion of Binder	20% of the Original Contract Amount	80% of the Original Contract Amount
Completion of Wearing Surface	20% of the Original Contract Amount	100% of the Original Contract Amount

413.06 Basis of Payment.

(a) Unit Price Coverage.

Payment for furnishing, calibration, and operation of the Intelligent Compaction process will be paid for at the contract lump sum price for Intelligent Compaction for Asphalt Mixtures. This item includes all costs related to providing the IC roller(s) including the fuel, roller operator, GPS/VRS system, Rovers (2) or any other equipment required for the IC process. All quality control expenses including the IC roller and GPS systems representative's support, On-site training facility and facilitators, and for the evaluation of IC-MV Data shall be included in the cost for the pay item within this section.

(b) Partial Payment.

Partial Payments will be made in accordance with the schedule noted in Article 413.05.

(c) Payment will be made under:

413-A Intelligent Compaction for Asphalt Mixtures - per lump sum.