Section 39-1.35. Use for intelligent compaction pilot projects.

Pilot projects must be HMA including OGFC that are placed under the method compaction specification 39-3.04.

Replace section 39-1.35 with:

39-1.35 HOT MIX ASPHALT COMPACTED WITH INTELLIGENT COMPACTION

39-1.35A General

39-1.35A(1) Summary

1

Section 39-1.32 includes specifications for compaction of the asphalt mixtures utilizing Intelligent Compaction (IC) rollers. IC is a process that uses vibratory rollers equipped with a measurement devices and documentation system that automatically records various critical compaction parameters in real time during the compaction process. IC uses roller vibration measurements to assess the mechanistic properties of the underlying compacted materials to ensure optimum compaction is achieved through continuous monitoring of the operations.

2

Standardized data analysis software (Veda) is available on the website www.intelligentcompaction.com. The software program will utilize the IC-MV data from the IC roller for analysis of coverage, uniformity, and stiffness values during construction operations.

3

Use IC roller for the initial breakdown compaction and intermediate compaction.

4. Use if electronic design files are available delete para 5.

The Department will furnish project plan layout files in _____format.

5. Use if electronic design files are not available delete para 4.

You most create project layout file to be used by IC system from the project plans.

39-1.35A(2) Definitions

6

ECEF XYZ: Earth-Centered, Earth-Fixed Cartesian X, Y, Z coordinates.

Geodetic Coordinates: A non-earth-centric coordinate system to describe a position in longitude, latitude, and altitude above the imaginary ellipsoid surface based on a specific geodetic datum. WGS-84 and NAD83 datum are required for use with UTM and State Plans, respectively.

GPS: A space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth to determine the location in geodetic coordinates. In this specification, GPS is referred to all GPS-related signals including US GPS, and other Global Navigation Satellite Systems (GNSS).

GPS Base Station: A single ground-based system that consists of a GPS receiver, GPS antenna, radio and radio antenna to provide L1/L2 differential GPS correction signals to other GPS receivers within a range limited by radio, typically 3 miles (4.8 Km) in radius without repeaters.

GPS Correction Service Subscription: A service that can be subscribed to receive VRS signals in order to achieve higher accuracy GPS positioning normally via cellular

wireless data services; i.e., without the need for a ground-based base station. Examples of GPS Correction Service subscriptions are: Trimble VRS™, Trimble VRS NOW™, or OmniSTAR.

Grid: Referred to ECEF XYZ in this specification.

GUI Display: Graphical User Interface Display

Hand-Held GPS rover: A portable GPS radio/receiver for in-situ point measurements.

Network RTK: Network RTK is a system that use multiple bases in real-time to provide high-accuracy GPS positioning within the coverage area that is generally larger than that covered by a ground-based GPS base station; e.g.., VRS™.

Real Time Kinematic Global Positioning System: Real Time Kinematic Global Positioning System (RTK-GPS) is based on the use of carrier phase measurements of the available GPS signals where a single reference station or a reference station network provides the real-time corrections in order to achieve centimeter-level accuracy.

State Plane Coordinate: A set of 124 geographic zones or coordinate systems designed for specific regions of the United States. Each state contains one or more state plane zones, the boundaries of which usually follow county lines. The current State Plane coordinate is based on NAD83. Issues may arise when a project crosses state plane boundaries.

Geodetic Coordinates: A non-earth-centric coordinate system to describe a position in longitude, latitude, and altitude above the imaginary ellipsoid surface based on a specific geodetic datum. WGS-84 and NAD83 datum are required for use with UTM and State Plans, respectively.

UTC: Coordinated Universal Time (UTC) is commonly referred to as Greenwich Mean Time (GMT) and is based on a 24 hours' time scale from the mean solar time at the Earth's prime meridian (zero degrees longitude) located near Greenwich, England.

UTM Coordinates: Universal Transverse Mercator (UTM) is a 2-dimentional Cartesian coordinates system that divides the surface of Earth between 80°S and 84°N latitude into 60 zones, each 6° of longitude in width and centered over a meridian of longitude. Zone 1 is bounded by longitude 180° to 174° W and is centered on the 177th West meridian. The UTM system uses projection techniques to transform an ellipsoidal surface to a flat map the can be printed on paper or displayed on a computer screen. Note that UTM is metric- based.

39-1.35A(3) Submittals

39-1.35A(3)(a) General

7

With the JMF submittal as specified in section 39-1.03C, submit:

Manufacturer and model of the IC rollers you propose to use

39-1.35A(3)(b) Just in Time Training

8

With the JMF submittal, submit a list of names participating in the just in time training. Identify each participant's name, employer, title, and role in the production and placement of HMA compacted with IC.

39-1.35A(3)(c) Data and Software Analysis Results

9

Submit the electronic data from IC rollers and the data analysis software within one business day of HMA placement.

10

Essential IC Data Information and IC Data Elements must be available for post processing.

11

Essential IC Data Header Information for Each Data File or Section:

Item No.	Description
1	Section Title
2	Machine Manufacture
3	Machine Type
4	Machine Model
5	Drum Width (m)
6	Drum Diameter (m)
7	Machine Weight (metric ton)
8	Name index of intelligent compaction measurement values (IC-MV)
9	Unit index for IC-MV
10	Reporting resolution for independent IC-MVs – 90 degrees to the roller moving direction (mm)
11	Reporting resolution for independent IC-MVs – in the roller moving direction (mm)
12	UTM Zone
13	Offset to UTC (hrs)
14	Number of IC data points

12

Essential IC Data Elements for Each Data Point:

Item No.	Data Field Name	Example of Data
1	Date Stamp (YYYYMMDD)	20080701
2	Time Stamp (HHMMSS.SS -military format)	090504.00 (9 hr 5 min. 4.00 s.)
3	Longitude (decimal degrees)	94.85920403
4	Latitude (decimal degrees)	45.22777335
5	Easting (m)	354048.300
6	Northing (m)	5009934.900
7	Height (m)	339.9450
8	Roller pass number	2
9	Direction index	1 forward, 2 reverse
10	Roller speed (kph)	4.0
11	Vibration on	1 for yes, 2 for no
12	Frequency (vpm)	3500.0
13	Amplitude (mm)	0.6
14	Surface temperature (^{O}C) -	120
15	Intelligent compaction measurement values	20.0

13

Items 3 and 4 can be exclusive with items 5 and 6, and vice versa. Item 14 is only required for asphalt application. The size of data mesh after post-processing shall be less than 18 inches (450 mm) by 18 inches (450 mm) in the X and Y directions.

39-1.35A(4) Quality Control and Assurance

39-1.35A(4)(a) General

14

Not Used

39-1.35A(4)(b) Technical Representative

15

A technical representative from the roller manufacturer must be on site during the initial 7 days of production and then as needed during the remaining operations. As a minimum, the roller representative must be present during the initial setup and verification testing of the IC rollers. The roller representative must also assist the Contractor with data management using the data analysis software including IC data input and processing.

39-1.35A(4)(c) Just in Time Training

16. Edit the number of state personnel if necessary.

Provide just in time training onsite or near the project site for your personnel and State project personnel related to operation of the IC technology. Schedule the just in time with the Engineer at a mutually agreed time and place. Provide training materials for 4 state personnel including the resident engineer and field inspectors. Arrangements must be provided that includes an enclosed facility with electrical availability for visual presentations.

17

The training should be 4-8 hours in duration and include the following topics:

1. Background information for the specific IC system(s) to be used
2. Setup and checks for IC system(s), GPS receiver, base-station and hand held rovers

3. Operation of the IC system(s) on the roller; i.e., setup data collection, start/stop of data recording, and on-board display options
4. Transferring raw IC data from the rollers(s); i.e., via USB connections
5. Operation of vendor's software to open and view raw IC data files and exporting all- passes and proofing data files in Veda-compatible format
6. Operation of Veda software to import the above exported all-passes and proofing data files, inspection of IC maps, input point test data, perform statistics analysis, and produce reports for project requirements
7 Coverage and uniformity requirements

18

The following personnel must attend the just in time training:

1. Project Manager
2. Superintendent
3. Technical representative for IC rollers
4. IC Quality Control Technicians
5. Roller Operators
6. HMA paving foreman

39-1.35A(4)(d) Quality Control

19

IC provides quality control for the number of roller passes and that the compaction is completed above the specified HMA temperature for initial compaction and intermediate compaction.

20

IC-MV values are report only and not to be used for compaction acceptance.

39-1.35A(4)(d)(i) Quality Control Technician

21

During HMA compaction provide a full time quality control technician to be responsible for the following functions:

1. Daily GPS check testing for the IC roller(s) and rover(s).
2. Test section construction to establish 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).
3. Monitoring of the construction operations and the IC roller(s) during production and final evaluation operations.
4. Quality control testing to monitor the pavement temperature and the required level of compaction.
5. Daily download and analysis of the IC data from the roller(s).
6. Daily set-up, take down and secure storage of GPS and IC roller components

39-1.35B MATERIALS

22

Not Used

39-1.35C CONSTRUCTION

39-1.35C(1) General

23

Prior to the start of production upload the project plan file into the IC Data analysis software and depending on the roller manufacture, the on-board IC computer.

39-1.35C(2) Equipment

39-1.35C(2)(i) Intelligent Compaction Rollers

24

Intelligent compactions rollers must:

1. 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.
2. Be equipped with non-contact temperature sensors for measuring pavement surface temperatures.
3. Produce output from the roller which is designated as the Intelligent Compaction Measurement Value (IC-MV) which represents the stiffness of the materials based on the vibration of the roller drums and the resulting response from the underlying materials.
4. Have GPS radio and receiver units mounted on each IC roller to monitor the drum locations and track the number of passes of the rollers.
5. 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.
6. Have a display unit capable of transferring the data by means of a USB port.
7. Have an on-board printer capable of printing the identity of the roller, the date of measurements, construction area being mapped, percentage of the construction area mapped, target IC-MV, and areas not meeting the IC-MV target values.

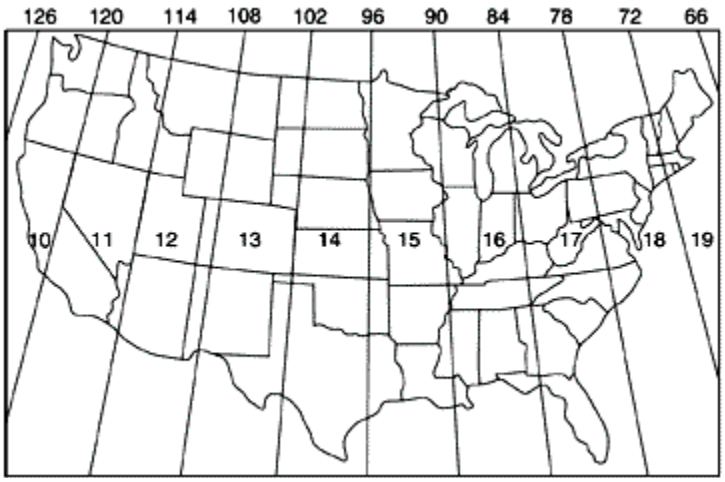
39-1.35C(C)(ii) GPS Base Station

25

Ground mounted or virtual GPS base units that record values in northing, easting, and the elevation data in feet (meters) using the Universal Transverse Mercator (UTM) coordinate system along with the longitude/latitude of the measurement values must be provided. The GPS base station shall broadcast updated correction data to the GPS receivers on the IC roller and the hand-held rovers during operations with a survey tolerance of not greater than 1.6 in. (40 mm) in both the horizontal (x and y) directions.

26. Insert the zone number.

All GPS devices for this project must be set to the same consistent coordinate datum/system no matter whether GPS or Grid data are originally recorded. The UTM coordinates system divides the surface of the Earth between 80°S and 84°N latitude into 60 zones, each 6° of longitude in width and centered over a meridian of longitude. Zone 1 is bounded by longitude 180° to 174° W and is centered on the 177th West meridian. UTM must be set to zone no. ____ N for this project.



27

The state coordinate system may be used instead of the UTM coordinate system.

39-1.35C(3) GPS Check Testing

28

Prior to the start of production, and before start of daily production 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) must be established and the IC roller and the GPS rover tied into the same base station.
2. Verify that the roller and rover are working properly and that there is a connection with the base station.
3. There are two options for comparing the roller and rover coordinates. Production must not begin until proper GPS verification has been obtained. IC manufacturer recommended verification process can be used to augment either of the following options:
   3.1. GPS measurement shall be conducted while the IC roller is stationary. The GPS coordinated from the roller on-board display shall be recorded ensuring that the distance offsets are applied correctly to the center of the front drum (e.g., the measurement is at the roller GPS receiver position). Place the hand-held GPS receiver on top of the GPS receiver mounted on the IC roller and record the coordinates from the hand-held receiver display. The differences of the coordinates between the IC roller GPS receiver and hand-held GPS receiver shall be within 2 inches (50 mm) in both the horizontal axes (X and Y). The check for the vertical axis is not required.
   3.2. A location shall be marked on ground. Move the IC roller so that the center of the front drum is on top of the marked location. Record the GPS measurements from the IC roller ensuring the distance offsets are applied so that the GPS coordinate is at the center of the front drum. Move the IC roller from the marked location and use a hand- held rover to measure at the marked location. The differences of the coordinates in grid shall be within 6 inches (150 mm) in both the horizontal axes (X and Y). On some IC systems, distance offsets are applied to the roller GPS measurements from the on-board display and the coordinates may be on the left or right side of the drum. In those cases move the IC roller so that the left or right side of the front drum axle is flushed with the marked location. Place the hand-held rover right on the marked location and check the difference of both coordinate records. The final GPS coordinate for each IC data point recorded in data files need to be at the center of the front drum.

39-1.35C(4) Roller Coverage Requirement

29

A minimum coverage of 90% of the construction area must meet or exceed the number of roller passes specified.

30

When roller HMA temperature sensor indicates compaction temperatures are below specified temperatures take corrective action and notify the Engineer.

39-1.35D PAYMENT

31

Pay Item	**Unit**
HMA Intelligent Compaction	LS

This item includes all costs related to providing the IC rollers, GPS system and other equipment required for the IC process. Item includes all quality control procedures including IC rollers and GPS systems, technical representatives support, on-site just in time training and IC data processing using VEDA software to produce daily compaction reports.