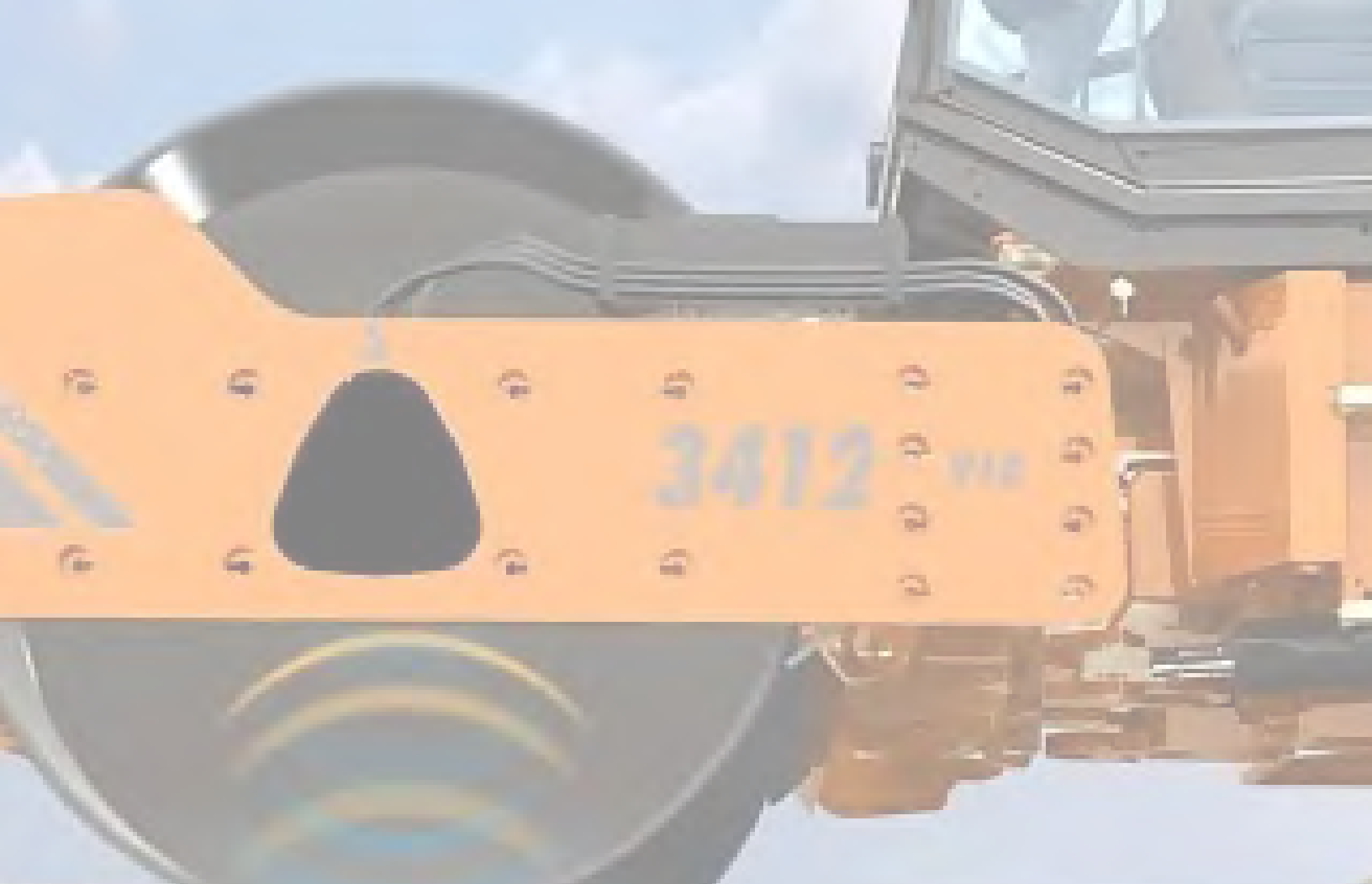


Intelligent Compaction Essentials

Office of Construction Standards

Caltrans

March 2017

This Intelligent Compaction Essentials is a collection of all specifications, forms, samples, and flow processes that may be used in construction of Hot Mix Asphalt and Cold-In-Place Recycling using intelligent compaction.

The package is intended to assist Caltrans and contractor personnel to administer Caltrans current intelligent compaction specifications on state projects.

The content may be updated or changed frequently as the technology changes.

For latest specifications and other IC related documents, please visit

www.dot.ca.gov/hq/construc/ic

For obtaining the latest version of VETA software, please visit:

www.intelligentcomapction.com

Content: Page

Intelligent Compaction

Cold-In-Place Recycling

Section 30-6. Use to incorporate intelligent compaction requirements in CIR projects.

Use bid item: 306100A Intelligent Compaction (Cold In Place Recycling) LS

Replace section 30-6 with:

30-6 PAVEMENT RECYCLING WITH INTELLIGENT COMPACTION

30-6.01 GENERAL

30-6.01A Summary

1

Section 30-6 includes specifications for compaction of cold in-place recycling (CIR) utilizing intelligent compaction. This is a pilot project for evaluating intelligent compaction and the Department will not consider a VECP that substitutes the processes or equipment specified in this section 30-6. Intelligent compaction does not waive any specifications for CIR.

2

Intelligent compaction uses vibratory steel drum rollers with intelligent compaction equipment and static pneumatic tire rollers equipped with automated machine guidance system that provide the roller operator with real time information for quality control and produce data for standardized Veta software. For Veta software, go to:

www.intelligentcompaction.com

3

Use Veta software to analyze the data for coverage uniformity and intelligent compaction measurement values.

4

Submit documentation that the technicians have completed 1 of the following Department authorized training courses within the last 12 months:

1. Intelligent compaction data analysis
2. Intelligent compaction Equipment

Intelligent compaction quality control technician must complete both trainings. Access the approved list of IC Training programs, Intelligent Compaction Quality Control Technicians, and Data Analysis Technicians at:

www.dot.ca.gov/hq/construc/ic

5. Use if electronic design files are available. Delete paras. 6, 7, and 8. Insert Caice (.kcm), Civil 3d (.dwg), or landxml (.xml).

The Department furnishes project plan layout files in _____ format. You may create project layout files for the intelligent compaction system, automated machine guidance system and Veta software from the existing pavement using the GPS rover calibrated for the project site

6. Use if electronic design files are not available and project layout sheets are included in the project plans. Delete paras 5, 7, and 8.

Create project layout files from the project plans or you may create project layout files for the intelligent compaction system, automated machine guidance system and Veta software from the existing pavement using the GPS rover calibrated for the project site.

7. Use if electronic design files or project layout plans are not available and as built plans must be used. Delete paras 5, 6 and 8

Create project layout files from the as built plans or you may create project layout files for the intelligent compaction system, automated machine guidance system and Veta software from the existing pavement using the GPS rover calibrated for the project site.

Create project layout files for the intelligent compaction system, automated machine guidance system and Veta software from the existing pavement using GPS rover calibrated for the project site.

9

Project layout files must delineate the CIR construction area of the project.

30-6.01B Definitions

10

action limit: The minimum and maximum values of a quality control measurement that can be interpreted as representing acceptable performance with respect to the parameter being tested. Values less than the minimum or greater than the maximum action limit or level indicate that corrective action must be taken by the contractor.

all passes data: Compaction data that contain measurements from all passes.

automated machine guidance roller: Rollers equipped with measurement devices installed by the roller manufacturer or a post manufacture retrofit system including GPS, temperature sensor, on-board documentation system, and displays.

bonded layer: Pavement structural section material bonded in a matrix by asphalt, cement, or any other stabilization agent.

California coordinate system of 1983 (CCS83): A set of 6 geographic zones or coordinate systems designed for specific regions of the State of California, the boundaries of which follow county lines. CCS83 is based on NAD83. When a project crosses state plane zone boundaries, a single zone will be used for the entire project.

compaction data: Data collected by intelligent compaction equipment and automated machine guidance compaction equipment.

coordinated universal time (UTC): A time measurement system commonly referred to as Greenwich Mean Time (GMT) based on a 24-hour time scale from the mean solar time at the Earth's prime meridian (zero degrees longitude) located near Greenwich, England

coverage: Roller single pass over a given area.

dynamic cone penetration test: ASTM D6951 is used to assess in situ strength of undisturbed soil and compacted materials or both.

dynamic cone penetration index: The vertical movement of the dynamic cone penetration cone produced by one drop of the hammer, expressed in inch per blow.

final coverage: Compaction data that contain the last pass measurements for a given area.

foot: Unit of measurement equal to U.S. survey foot.

geodetic coordinates: A coordinate system to describe a position in longitude, latitude, and altitude above the imaginary ellipsoid surface based on a specific geodetic datum. The NAD83 datum is required for use with CCS83 State Plane Coordinates.

global positioning system (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. GPS refers to all GPS-related signals including US GPS, and other Global Navigation Satellite Systems (GNSS). GPS satellite signals are subject to interference from canyons, buildings, trees or even fencing. Not all locations are suitable for GPS techniques, and it is your responsibility to determine if the site conditions are practical for GPS, and to notify the Engineer if they are not.

GPS base station: A single ground-based system consisting of a GPS receiver, GPS antenna, and telemetry equipment (typically radio and radio antenna or cellular phone) to provide L1/L2 differential GPS correction signals to other GPS receivers.

GPS correction service subscription: A service that can be subscribed to receive differential GPS correction signals for higher accuracy GPS positioning without the need of a GPS Base Station. Signals are normally received via cellular wireless data services. Examples of GPS correction service subscriptions are: Trimble VRS™, Leica Smart RTK™, Topcon TopNet™, OmniSTAR™, and California Real Time Network (CRTN).

GPS rover: A portable L1/L2 GPS antenna, mount, and receiver with telemetry equipment for Real Time in-situ point measurements.

GPS site calibration or localization: A process to establish a relationship between the observed GPS coordinates and the known grid coordinates.

grid: A Cartesian system of XY (or North-East) coordinates utilizing the California State Plane Coordinates, known as the California Coordinate System of 1983 (CCS 83).

intelligent compaction measurement value: A generic term for measurements of resistance to deformation of underlying material based on the responses of the roller drum vibrations in units specific to the roller manufacturer.

intelligent compaction equipment: Measurement devices installed by the roller manufacturer or a post manufacture retrofit system including accelerometer, GPS, temperature sensor, on-board documentation system, and displays.

intelligent compaction roller: Rollers equipped with measurement devices installed by the roller manufacturer or a post manufacture retrofit system including accelerometer, GPS, temperature sensor, on-board documentation system, and displays**.**

intelligent compaction target value: Compaction target values established at test strip or specified that are used by roller operator to monitor compaction and in data analysis to generate compaction quality control report.

network real time kinematic (Network RTK): A system of multiple bases in real-time to provide high-accuracy GPS positioning within the coverage area that is generally larger than that covered by a single GPS base station.

real time kinematic global positioning system (RTK-GPS): A system based on the use of carrier phase measurements of the available GPS signals where a single GPS base station or RTK network provides the corrections in order to achieve centimeter-level accuracy in real time.

roller pass: The area covered by one width of the roller in a single direction.

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

30-6.01C Submittals

30-6.01C(1) General

11

At least 15 days before mapping the existing pavement, you must register with the Department's secure file sharing system. To obtain information on the registration process, send an e-mail with your contact information to the following electronic mailbox address:

IC@dot.ca.gov

12

Forms for intelligent compaction submittals are available at:

http://www.dot.ca.gov/hq/construc/ic/

30-6.01C(2) Intelligent Compaction Training

30-6.01C(2)(a) Just-In-Time Training

13

Submit a list of names participating in the just-in-time training at the time of the mix design submittal. Identify each participant's name, employer, title, and role in intelligent compaction.

14

At least 10 days before just-in-time training, submit:

1. Just-in-time training presentation and handouts for review
2. Completed Intelligent Compaction Field Operations Just-In-Time Training Checklist form
3. Completed Geospatial Data and Analysis Just-In-Time Training Checklist form
4- Name of Instructor

30-6.01C(2)(b) Intelligent Compaction Quality Control Technician Training

15

At least 15 days before performing intelligent compaction, submit the name of your intelligent compaction quality control technician independent of CIR production crew and the corresponding certification of training.

30-6.01C(2)(c) Data Analysis Technician Training

16

At least 5 days before CIR production, submit the name of your data analysis technician and corresponding certification of training.

30-6.01C(2)(d) GPS Site Calibration or Localization Report and Check Testing

17

Submit GPS site calibration or localization report and check testing results for compaction rollers within 1 business day of calibration, localization or check testing.

30-6.01C(3) Reports and Information

30-6.01C(3)(a) General

18

If unable to submit or upload report and information within the specified time, notify the engineer of the actions being taken to submit and upload information timely.

30-6.01C(3)(b) Reports

30-6.01A(3)(b)(i) Mapping Existing Pavement

19

At least 5 working days before sampling for mix designs for CIR, submit:

1. Hard copy of completed Intelligent Compaction Cold-In-Place Recycling Mapping Summary Report
2. Adobe pdf file of the mapping report by email to the Engineer using one of the following mapping procedures:
   - 2.1. Mapping with intelligent compaction roller for the existing pavement determined by mapping the existing pavement under section 30-6.03B(1).
   - 2.2 Mapping with coring and dynamic cone penetration determined by mapping the existing pavement under section 30-6.03B(2).

30-6.01C(3)(b)(ii) Test Strip

20

Within 1 business day of test strip submit:

1. Hard copy of Intelligent Compaction Cold-In-Place Recycling Test Strip Submittals Summary
2. Adobe pdf file of the test strip report by email to the Engineer
3. Adobe pdf file of Intelligent Compaction Cold-In-Place Recycling Quality Control Report Checklist form by email to the Engineer

30-6.01C(3)(b)(iii) CIR Compaction

21

Within 1 business day of CIR compaction submit:

1. Hard copy of completed Intelligent Compaction Cold-In-Place Recycling Compaction Quality Control Report Summary
2. Adobe pdf file of compaction quality control report by email to the Engineer
3. Adobe pdf file of Intelligent Compaction Cold-In-Place Recycling Quality Control Report Checklist form by email to the Engineer

30-6.01C(3)(b)(iv) Information

22

Within 3 business days of mapping, test strip, or CIR compaction:

1. Submit information on a digital medium to the Engineer.
2. Upload information to the Department's secure file sharing system
3. After uploading the compaction information to the Department's file sharing system, send an email notification of your electronic submittal to the Engineer and IC@dot.ca.gov with the appropriate completed checklist form as an attachment:
   3.1. Intelligent Compaction Cold-In-Place Recycling Mapping Information Checklist
   3.2. Intelligent Compaction Cold-In-Place Recycling Test Strip Information Checklist
   3.3 Intelligent Compaction Cold-In-Place Recycling Quality Control Report Checklist

30-6.01C(3)(c) Data and Software Analysis Results

30-6.01C(3)(c)(i) General

23

Not Used

30-6.01C(3)(c)(ii) Data

24

Submit mapping, test strip and compaction data elements in a format that is readable by Veta software. You may combine roller data for multiple rollers operating in echelon into a section file.

25

Name the data file using:

YYYYMMDD_TTCCCRRR_DB_L_B_E_TOR_TC_T_Data

where:

YYYY = year
MM = Month, leading zero
DD = Day of month, leading zero
TT = District, leading zero
CCC = County, 2 or 3 letter abbreviation as shown in section 1-1.08 no leading zero
RRR = Route number, no leading zeros
DB = Traffic direction as NB, SB, WB, EB or PM for mapping

L = Lane number from left to right in direction of travel
B = Beginning station to the nearest foot (i.e., 10+20) or beginning post mile to the nearest hundredth (i.e., 25.06) maximum 6 characters with no leading zero.
E = Ending station to the nearest foot (i.e., 14+20) or ending post mile to the nearest hundredth (i.e., 28.06) maximum 6 characters with no leading zero
TOR = Type of reclamation “CIR” for cold in place recycling or "FDR" for full depth reclamation
TC= Type of compaction "PM" for mapping, "IC" for initial compaction or "SC" for supplemental compaction
T= Type of roller "R" for rubber tire or "SV" for steel drum with vibratory, "SS" for steel drum static, "SS-SV" for single roller combination of steel drum static and vibratory on.

26

Use the following header information for each compaction data file or section:

Item No.	Description
1	Section Title
2	Machine Manufacture
3	Machine Type
4	Machine Model
5	Drum Width (inch)
6	Drum Diameter (inch)
7	Machine Weight (ton)
8	Name index of intelligent compaction measurement values
9	Unit index for intelligent compaction measurement values
10	Reporting resolution for independent intelligent compaction measurement values – 90 degrees to the roller moving direction (inch)
11	Reporting resolution for independent intelligent compaction measurement values – in the roller moving direction (inch)
12	CCS83 Zone
13	Offset to UTC (hrs)
14	Number of compaction data points

27

Use the following data field names for each compaction 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 or degrees-minutes-seconds)	94.85920403
4	Latitude (decimal degrees or degrees-minutes-	45.22777335
5	Easting (foot)	6,096,666.000
6	Northing (foot)	1,524,166.650
7	Elevation (foot)	339.9450
8	Roller pass number	2
9	Direction index	1 forward, 2 reverse
10	Roller speed (mph)	2.0
11	Vibration on	1 for yes, 2 for no
12	Frequency (vpm)	3500.0
13	Amplitude (inch)	0.0236
14	Intelligent compaction measurement values	20.0

Note: Provide either items 3 and 4 or items 5 and 6

28

The GPS coordinate for each compaction data point recorded in data files must be at the center of the drum or center of the roller in front.

29

The size of the data mesh after post processing must be less than 1.5 feet by 1.5 feet in the X and Y directions.

30-6.01C(3)(c)(iii) Software Analysis Results

30

Analyze the compaction data daily using Veta software and include nuclear gauge data point tests, target values for passes, and intelligent compaction measurement values. For a sublot report, use sublot length of 528 feet.

31

For test strips and daily compaction quality control reports you must create and apply a boundary filter for the area of CIR to be analyzed to exclude extraneous intelligent compaction data. The boundary filter may be applied in the preprocessed raw roller data or created and applied in the Veta software analyses. Create the boundary in Veta software analyses by either importing GPS coordinates measured in the field from the boundary of the area of CIR production or by using the project layout and applying a filter to limit the analysis to the area CIR production.

32

Name report files and post processed Veta software files using:

YYYYMMDD_TTCCCRRR_DB_L_B_E_TOR_TC_T_TYPE

where:

YYYY = year
MM = Month, leading zero
DD = Day of month, leading zero

TT = District, leading zero
CCC = County, 2 or 3 letter abbreviation as shown in section 1-1.08 no leading zero
RRR = Route number, no leading zeroes
DB = Traffic direction as NB, SB, WB, EB, or PM for mapping
L = Lane number from left to right in direction of travel
B = Beginning station to the nearest foot (i.e., 10+20) or beginning post mile to the nearest hundredth
(i.e., 25.06) maximum 6 characters with no leading zero
E = Ending station to the nearest foot (i.e., 14+20) or ending post mile to the nearest hundredth (i.e., 28.06) maximum 6 characters with no leading zero
TOR = Type of reclamation "CIR" for cold in place recycling or "FDR" for full depth reclamation
TC = Type of compaction "PM" for mapping, "IC" for initial compaction, "SC" for supplemental compaction
T = Type of roller "R" for rubber tire, "S" for steel drum or "R-S" if data combined.
TYPE = Mapping report use "MAPPING_REPORT" for *.pdf files
Test strip report use "TS_REPORT" for adobe pdf files
Compaction quality control report use "QC_REPORT" for adobe pdf files
Post processed Veta software files use "VETA"

33

Plots must be scaled to be legible and must be 11 by 17 inches.

30-6.01C(3)(d) Mapping

30-6.01C(3)(d)(i) General

34

Not Used.

30-6.01C(3)(d)(ii) Mapping With Intelligent Compaction Roller

35

Analyze the intelligent compaction mapping data using Veta software. Use the project layout to create a boundary of the area of mapping.

36

Report of mapping with intelligent compaction roller must include:

1. Mapping results on Intelligent Compaction Cold-In-Place Recycling Mapping Report Summary form
2. Color layout plots of intelligent compaction measurement value for the existing pavement
3. Color layout plots of intelligent compaction measurement value for soft areas with intelligent compaction measurement values equal or less than 2 standard deviation of the average intelligent compaction measurement value of the existing pavement
4. Final coverage histogram of intelligent compaction measurement value
5. Final coverage histogram of intelligent compaction measurement value for a 528 foot sublot

37

Mapping information must include:

1. Adobe pdf file of mapping report
2. Project layout and/or mapping boundary which can be imported to Veta software
3. Electronic data from compaction rollers in file format readable by Veta software
4. Post processed Veta file *.vetaproj used for creating the mapping report of the existing pavement
5. Intelligent Compaction Cold-In-Place Recycling Mapping Information Checklist

30-6.01C(3)(d)(iii) Mapping with Coring and Dynamic Cone Penetration

38

Use the results of dynamic cone penetration to identify each layers of structural section.

39

Report of mapping with coring and dynamic cone penetration must include:

1. Plot of pavement structural section profile based on cores
2. Plot of pavement unbonded layer dynamic cone penetration index profile
3. Locations of unbonded layer zone classified as "B" and "C"

40

Mapping information must include:

1. Adobe pdf file of mapping report.
2. Dynamic cone penetration index and the corresponding GPS coordinates which can be imported into Veta software

30-6.01C(3)(e) CIR Test Strip

41

Test strip report must include:

1. Completed Intelligent Compaction Cold-In-Place Recycling Test Strip Report Summary form
2. Nuclear gauge density readings and the corresponding GPS coordinates
3. All passes compaction curves from Veta software
4. All passes correlation analysis plot from Veta software
5. Field compaction curve density versus number of passes
6. Color layout plot of distribution of intelligent compaction measurement value over test strip
7. Color layout plot of distribution of pass count over test strip

42

Test strip information must include:

1. Adobe pdf file of the test strip report from data analysis performed using Veta software
2. Test strip boundary which can be imported to Veta software
3. Nuclear gauge density readings and the corresponding GPS coordinates which can be imported into Veta software
4. Electronic data from compaction rollers in file format readable by Veta software
5. Post processed Veta file *.vetaproj used for creating the test strip report
6. Adobe pdf file of Intelligent Compaction Cold-In-Place Recycling Test Strip Information Checklist

30-6.01C(3)(f) CIR Compaction

43

For each day of production, prepare a CIR compaction quality control report that includes:

Completed Intelligent Compaction Cold-In-Place Recycling Compaction Quality Control Report Summary form

Veta software analysis report results for:

   2.1. Percent compliance with target roller passes
   2.2. Percent compliance with target CIR intelligent compaction measurement value of steel drum roller with vibratory on
3. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on.
4. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on for a 528 feet sublot.
5. All passes histogram for each roller
6. Color layout plots of:
   6.1. Roller passes for each roller
   6.2. Intelligent compaction measurement value for final coverage of intermediate compaction when required.

7. Quality control density measurements and corresponding GPS coordinate.

44

Plots must include quality control density testing locations and test results.

45

Compaction information must include:

1. Adobe pdf file of the compaction quality control report from data analysis performed using Veta software
2. Project layout data files which can be imported to Veta software
3. Boundary data files which can be imported to Veta software
4. Nuclear gauge density readings and the corresponding GPS coordinates which can be imported into Veta software
5. Electronic data from compaction rollers in file format readable by Veta software
6. Post processed Veta data file *.vetaproj used for creating the compaction quality control

30-6.01D Quality Assurance

30-6.01D(1) General

46

Not Used

30-6.01D(2) Prepaving Meeting

47

The Intelligent compaction quality control technician must attend the CIR prepaving meeting.

30-6.01D(3) Technical Representative

48

A technical representative from the intelligent compaction equipment manufacturer and automated machine guidance system or post manufacture retrofit system must be on site during the initial setup and verification testing of the compaction rollers and the 1st 2 days of CIR production. If requested, the technical representative must assist the Engineer with data management using Veta software including compaction data input and processing.

30-6.01D(4) Intelligent Compaction Training

30-6.01D(4)(i) Just-In-Time Training

49

Provide just-in-time training onsite or near the job site for your personnel and Department project personnel. Provide an enclosed facility with electrical availability for visual presentations. Schedule the just-in-time training with the Engineer at a mutually agreed time and place.

The Just-In-Time Training Instructor must be in possession of a valid certification of Intelligent Compaction Quality Control Technician.

50

The just-in-time-training for intelligent compaction is divided into 2 sessions:

1. Intelligent compaction field operations
2. Intelligent compaction geospatial data and analysis

30-6.01D(4)(ii) Intelligent Compaction Field Operations Just-In-Time Training

51

Intelligent compaction field operations just-in-time training must be at least 2 hours in duration and include the following topics

1. Background information for the specific intelligent compaction system and automated machine guidance system to be used.
2. Setup and checks for compaction systems including:
    2.1. GPS receiver
    2.2. GPS base station
    2.3. GPS rovers
    2.4. Rollers
3. Operation of the intelligent compaction system and automated machine guidance systems on the rollers including:
    3.1. Setup data collection
    3.2. Start/stop of data recording
    3.3. On-board display options
4. Monitoring and communication
5. Action limits to be used by the roller operators for:
    5.1 Intelligent compaction measurement value
    5.2 Number of passes

52

The following personnel must attend field operations just in time training:

1. Roller operators
2. Intelligent compaction quality control technician
3. Technical representative
4. CIR foreman

30-6.01D(4)(iii) Intelligent Compaction Geospatial Data and Analysis Just-in-Time Training

53

Intelligent compaction geospatial data and analysis just-in-time training must be at least 2 hours in duration and include the following topics:

1. Cover specification requirements for submittal of reports and information including file naming requirements Report Preparation
2. Report submittals
3. Information Submittals
4. Corrective actions to be taken when coverage and uniformity requirements are not met

54

The following personnel must attend intelligent compaction geospatial data and analysis just in time training:

1. Technical representative
2. Compaction quality control technicians
3. Data analysis technician
4. CIR foreman

30-6.01D(5) Quality Control

30-6.01D(5)(i) General

55

For CIR placed under section 30-5, use intelligent compaction rollers and automated machine guidance rollers for documenting that CIR compaction complies with roller passes target values established at test strip.

56

The number of roller passes, temperature, and intelligent compaction measurement values are report only and not used for compaction acceptance.

30-6.01D(5)(ii) Quality Control Technician

57

During mapping, test strip, and CIR compaction, provide a full time intelligent compaction quality control technician.

58

The quality control technician is responsible for oversight of the following:

1. GPS site calibration or localization and upload to GPS receivers
2. GPS check testing for the compaction rollers and rovers
3. During test strip construction, determining the target values for compaction roller passes and target values for intelligent compaction measurement values
4. Construction operation monitoring of the compaction rollers
5. Quality control testing for compaction
6. Backing up compaction data twice per day
7. Downloading data from rollers at the end of the work shift
8. Exporting final coverage and all-passes data to Veta software compatible form by using vendor specific intelligent compaction software
9. Monitoring daily compaction quality control report results for compliance with the requirements in these specifications and taking corrective action when necessary for compliance.
10. Daily set-up, take-down, of GPS and compaction roller components

30-6.01D(5)(iii) Data Analysis Technician

59

Provide an intelligent compaction data analysis technician who is responsible for performing the following:

1. Analyzing the data from the compaction rollers using Veta software and producing reports.
2. Submitting and uploading intelligent compaction reports and information.

30-6.01D(5)(iv) IC Test Strip

30-6.01D(5)(iv)(1) General

60

A test strip is used to establish CIR intelligent compaction target values for the following:

1. Number of roller passes for initial compaction for each type of roller
2. Number of roller passes for supplemental compaction for each type of roller
3. Intelligent compaction measurement value based on break over point density for CIR

61

The target number of roller passes is based on your roller pattern established to achieve break over point density.

30-6.01D(5)(iv)(2) Establishment Target Value for Intelligent Compaction Measurement Value

62

On the 1st day of CIR production and within a 500 foot portion of the CIR test strip specified in section 30-5.01D(4)(b), construct IC test strip. Use handheld rover to establish boundary for the 500 foot section. Use handheld rover to establish 3 randomly selected nuclear gauge density test locations.

63

Establish intelligent compaction target values for initial and supplemental compaction as follow:

1. After each roller pass, use a nuclear gauge to measure the density at 3 preselected random locations throughout the covered 500 foot section. Record the roller pass number and density readings.
2. Establish the density of the tests strip for each coverage by averaging the density at the 3 locations
3. Continue roller passes and collecting nuclear gauge density readings until the density remains constant, or decreases. The break over density target value is the maximum density on the plot of

test strip density versus number of passes for each coverage target value. The target number of roller passes is the number of passes for each roller in reaching the break over density.

4. After reaching break over density, use an intelligent compaction vibratory steel drum roller to make a last coverage of test strip with vibration on set at low amplitude. Use a nuclear gauge to measure the density at 10 randomly selected locations throughout the 500 foot section. Record the density readings, and the GPS coordinates for each test location. Average the density readings and compare with break over point target value. Either of the following may apply based on the density test results:
   4.1. If the last coverage produces an increase in density above the break over point density, continue rolling with steel drum roller with vibration on until a new break over point density is determined. Use this new break over point density for production. Use pneumatic tire rollers to repair any damage caused by the intelligent compaction vibratory steel drum roller.
   4.2. If the last coverage produces a reduction in the compaction below the break point density:
   4.2.1. The requirement of maximum density will be waived on the 500 foot portion of the test strip.
   4.2.2. Use pneumatic tire rollers to repair any damage caused by the last single pass of the intelligent compaction vibratory steel drum roller.
5. Use Veta software to create a compaction curve that relates the roller all passes to the intelligent compaction measurement values. The target value for intelligent compaction measurement value corresponds to last pass of the steel drum vibratory roller with vibration on based on your roller pattern.

30-6.02 MATERIALS

64

Not Used

30-6.03 CONSTRUCTION

30-6.03A General

65

Before CIR production, upload the project layout file into the compaction data analysis software and depending on the roller manufacturer, the on-board documentation system.

30-6.03B Equipment

30-6.03B(1) General

66

Use intelligent compaction rollers and automated machine guidance rollers for initial and supplemental compaction.

30-6.03B(2) Rollers

67

For mapping existing pavement, the mapping roller must meet the following:

1. Be minimum 3 feet wide single or double-drum vibratory steel rollers with accelerometers mounted in or about the drum to measure the relative stiffness of the pavement.
2. Have GPS radio and receiver units mounted on roller to monitor the steel drum roller locations.
3. Include an integrated on-board documentation system that is capable of displaying real-time color-coded maps, including the stiffness response values, vibration frequencies, roller drum amplitude, roller location, roller speeds and capable of transferring stored data from a USB port.

68

For CIR, in addition to the requirements in section 30-5, intelligent compaction roller must meet the following:

1. Be double-drum vibratory steel rollers with accelerometers mounted in or about the drum to measure the interaction between the rollers and compacted materials in order to evaluate the applied compactive effort.
2. Be equipped with non-contact temperature sensors for measuring surface temperatures.

3. With vibratory on, produce output that represents the stiffness of the material based on the vibration of the roller drums and the measured response from the underlying materials.
4. Have GPS radio and receiver units mounted on each intelligent compaction roller to monitor the steel drum roller 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, including the stiffness response values, vibration frequencies, roller drum amplitude, roller location, number of roller passes, roller speeds and capable of transferring data from a USB port.

69

For CIR, in addition to the requirements in section 30-5, automated machine guidance pneumatic tire rollers must meet the following:

1. Be equipped with non-contact temperature sensors for measuring surface temperatures.
2. Have GPS radio and receiver units mounted on each automated machine guidance roller to monitor the roller locations and track the number of passes of the rollers.
3. Include an integrated on-board documentation system that is capable of displaying real-time color-coded maps of roller location, number of roller passes, roller speeds and capable of transferring data from a USB port.

30-6.03C Global Positioning System

70

GPS must be real time kinematic using one of the following:

1. GPS base station
2. Network real time kinematic (RTK)
3. Satellite-based augmentation station system capable of providing position accuracy within 0.25 foot.

71

You may use other high precision positioning systems in lieu of GPS. The positioning system must meet or exceed the precision specified for GPS.

72

GPS used must provide a minimum 90 percent coverage of job site.

73. Insert the zone number. Caltrans Survey manual: http://www.dot.ca.gove/hq/row/landsurveys/SurveysManual/Manual_TOC.html

GPS devices for this project must be set to the same consistent datum, coordinate system, CCS83 zone, and site calibration or localization. The CCS83 zone must be set to zone no. __.

74

You may use UTM coordinate system if your roller on-board documentation system and display are not compatible with CCS83. Notify the engineer if you will use UTM coordinate system.

30-6.03D Correction Signal Source

75

Provide either a GPS base station correction signal or a GPS correction service subscription. The GPS correction signal must be received by the GPS receivers on the compaction roller and the rovers during operations with a survey tolerance of not greater than 0.25 foot in both X and Y horizontal directions.

76

Install GPS repeaters at selected locations to relate the GPS correction signal to resolve GPS shadows.

30-6.03E Survey Control Points

77. Provide Project Control Map in project plans. Delete paras 78–79.

Survey control points are indicated on the project control map in the project plans.

78. When no Project Control Map, provide survey control points in Supplemental Project Information. Delete paras 77 and 79.

Survey control points are included in supplemental project information.

79. Use if survey control are not available prior to project advertisement. Delete paras 77–78.

Request horizontal survey control points at least 15 days before GPS site calibration or localization. Survey control points will be provided at least every mile.

30-6.03F GPS Site Calibration or Localization, Check Testing

80

Before mapping the existing pavement, perform a GPS site calibration or localization to the survey control points.

81

Whenever the GPS base station is moved to a new location, verify GPS base station position by measuring the position of two known points using a rover. Perform a GPS site calibration or localization if the position of known points and measured positions differ by more than 3 centimeters.

82

At least 2 business days before start of production, perform roller verification testing by conducting roller check testing.

83

Before the start of daily production and using the same datum, conduct check testing for the proper setup of the GPS, the GPS of the rollers and the GPS rover:

1. On a location nearby or within the project limits, the GPS base station, if required by the GPS, must be established and the compaction 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. Verify the roller GPS coordinates by:
    - 3.1. Stopping the roller at a location
    - 3.2. Marking the location of both ends of the roller drum or the outside of the front tires on the surface with a tee
    - 3.3. Recording the GPS measurements from the roller ensuring the distance offsets are applied so that the GPS coordinate is at the center of the front drum or center of front axle.
    - 3.4. Moving the roller from the marked location
    - 3.5. Finding the mid-point of the 2 marked ends of the roller and mark this location on the surface. This marked location is the theoretical center of the front drum or the front axle.
    - 3.6. Using the GPS rover to measure GPS coordinates of the marked location and record the GPS measurements
    - 3.7. Computing the difference between recorded compaction roller GPS coordinates and GPS rover recorded GPS measured coordinates. The differences of the coordinates in grid must be within 0.50 foot in both the horizontal axes X and Y

30-6.03G Mapping Existing Pavement

84

Before sampling for mix design, map the existing pavement using intelligent compaction roller or coring and dynamic cone penetration testing.

30-6.03H Mapping Existing Pavement with Intelligent Compaction Roller

85

Map the existing pavement with a single pass over the entire pavement using a mapping roller. Use low vibration amplitude and the same settings, including speed and frequency, throughout the section.

30-6.03I Mapping Existing Pavement with Coring and Dynamic Cone Penetration

86

Obtain data for mapping the existing pavement structural section and unbonded layer stiffness as follows:

1. For structural section mapping, at 500 feet intervals obtain 6 inch cores of the bonded layers of the existing pavement at following locations:
   1.1. Center of each lane
   1.2. Center of each shoulder
   1.3. If cores show significant differences between consecutive intervals, such as different types of material or a variation of overall pavement thickness by more than 50 percent, the interval will be halved and cores will be taken at the half interval. Additional cores and dynamic cone penetration testing at the half interval will be change order work.
2. Remove and log the core of the pavement structural section
3. Use GPS rover to measure and record coordinates of each core location
4. At each core hole, perform ASTM D6951 using dual mass hammer (8.0 kg) on the unbonded layer for each location
5. Analyze dynamic cone penetration results in terms of the dynamic cone penetration indices as for each location as follow:
   5.1. Calculate dynamic cone penetration index for each 5 blows over the depth of 1.5 feet below the bonded layer or refusal. Refusal is 0.1 inch or less per blow.
   5.2. Calculate average and standard deviation of the dynamic cone penetration of indices at each core hole to identify uniform section and problem areas based on average dynamic cone penetration index shown in table below:

Average dynamic cone penetration Index (inch/blow)	Unbonded layer zone	Unbonded layer stiffness description
<0.7	A	Relatively strong
0.7-1.2	B	Marginal strength
>1.2	C	Weak, potentially wet

87

Map the existing pavement structural section and unbonded layer stiffness description as follows:

1. For each set of cores taken, plot the accumulative dynamic cone penetration index for over the depth of 1.5 feet below the bonded layers.
2. For each set of cores taken along the longitudinal axis of the area to be cold in place recycled, plot a pavement thickness profile and a lift thickness profile. Profiles will be electronically plotted at a horizontal scale of 1 inch equals 100 feet, and a vertical scale of 1 inch equals 1 foot.
3. For each set of cores taken transverse to the roadway of the area to be cold in place recycled, plot transverse pavement thickness and lift thickness cross sections. Transverse cross sections will be electronically plotted at a horizontal scale of 1 inch equals 5 feet, and a vertical scale of 1 inch equals 1 foot.
4. For unbonded layer stiffness, plot core location coordinates and unbonded layer stiffness description category for each core taken along the roadway longitudinal axis to be cold in place recycled. Mapping must be electronically plotted at a horizontal scale of 1 inch equals 100 feet for longitudinal plot.
5. For unbonded layer stiffness, plot core location coordinates and unbonded layer stiffness description category for each core taken along the roadway transverse axis to be cold in place recycled. Mapping must be electronically plotted at a horizontal scale of 1 inch equals 5 feet.

88

Backfill core holes with commercial cold mix and compact the material.

30-6.03J CIR Compaction

89

During compaction, monitor each roller's compaction graphical user interface display for roller passes and intelligent compaction measurement values.

90

Use GPS rover to measure and record coordinates of each quality control nuclear gauge reading.

91

For each day of CIR production establish the boundaries of each lot of CIR production using the rover.

30-6.03K Roller Coverage

92

At least 90 percent of the CIR production area must meet or exceed the target number of passes for each roller type determined from the test strip for that area. When the daily compaction quality control report shows the target number of roller passes are not met, take corrective action and notify the Engineer of action taken.

30-6.03L CIR Intelligent Compaction Measurement Value

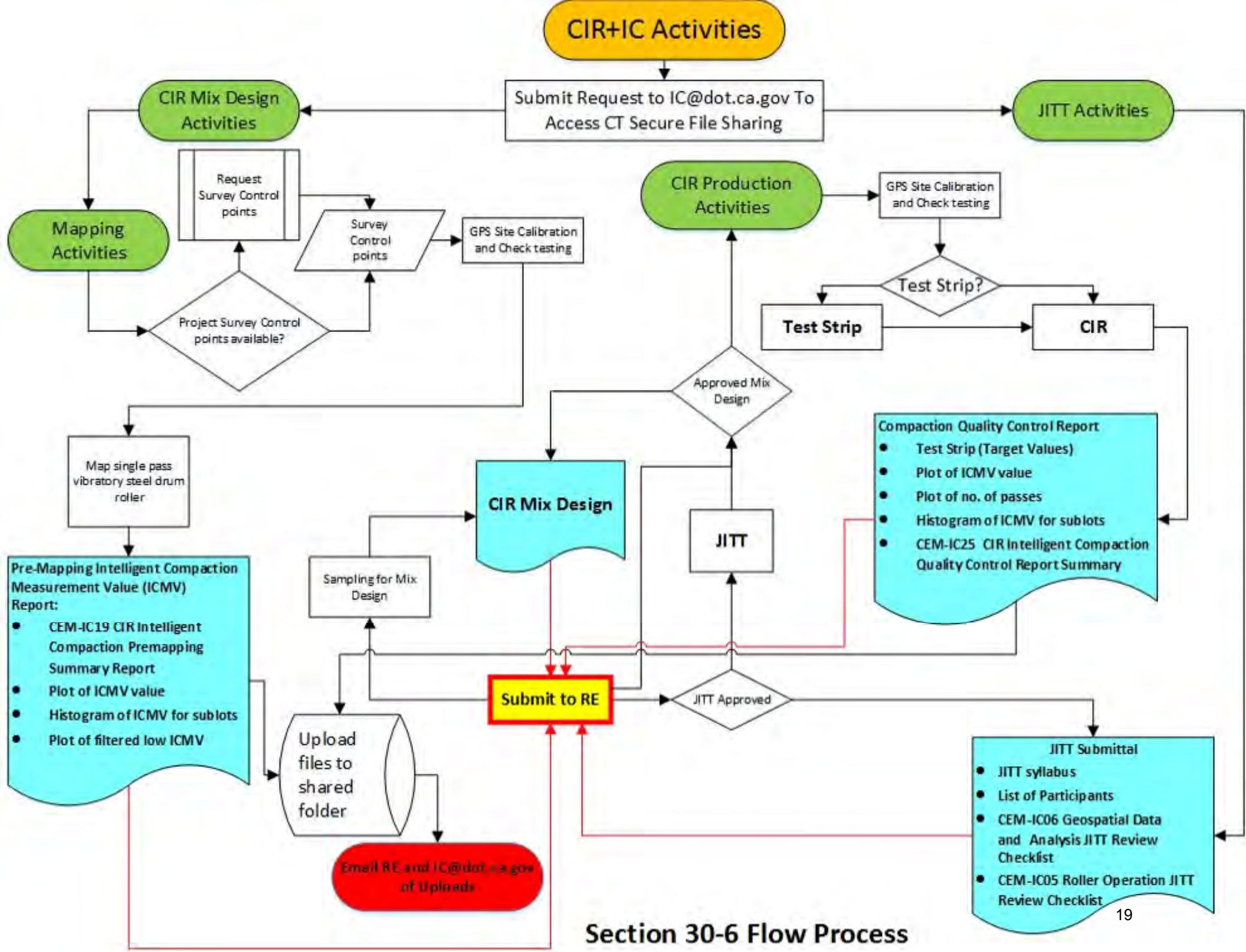
93

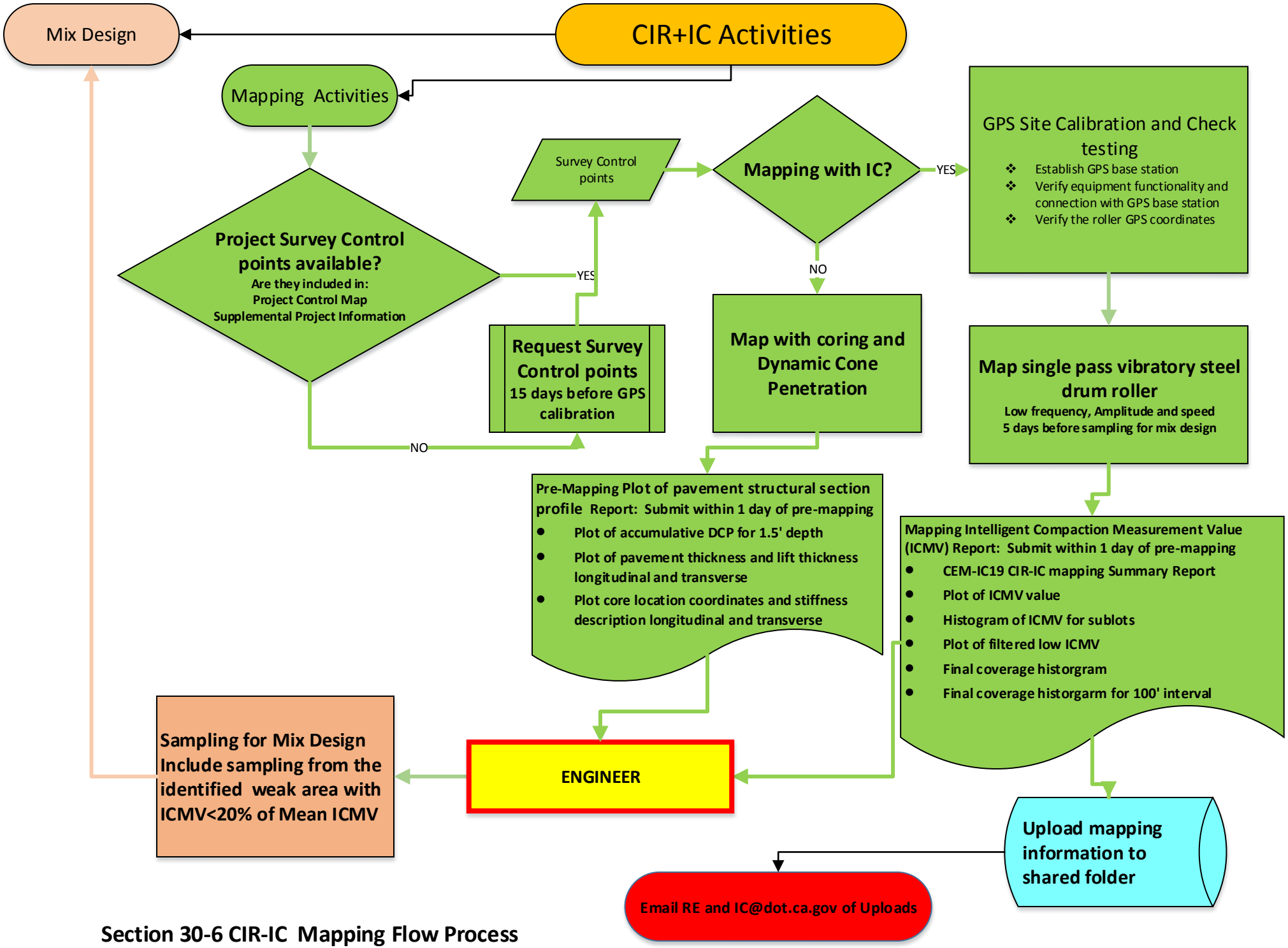
CIR Intelligent compaction measurement value is report only.

30-6.04 PAYMENT

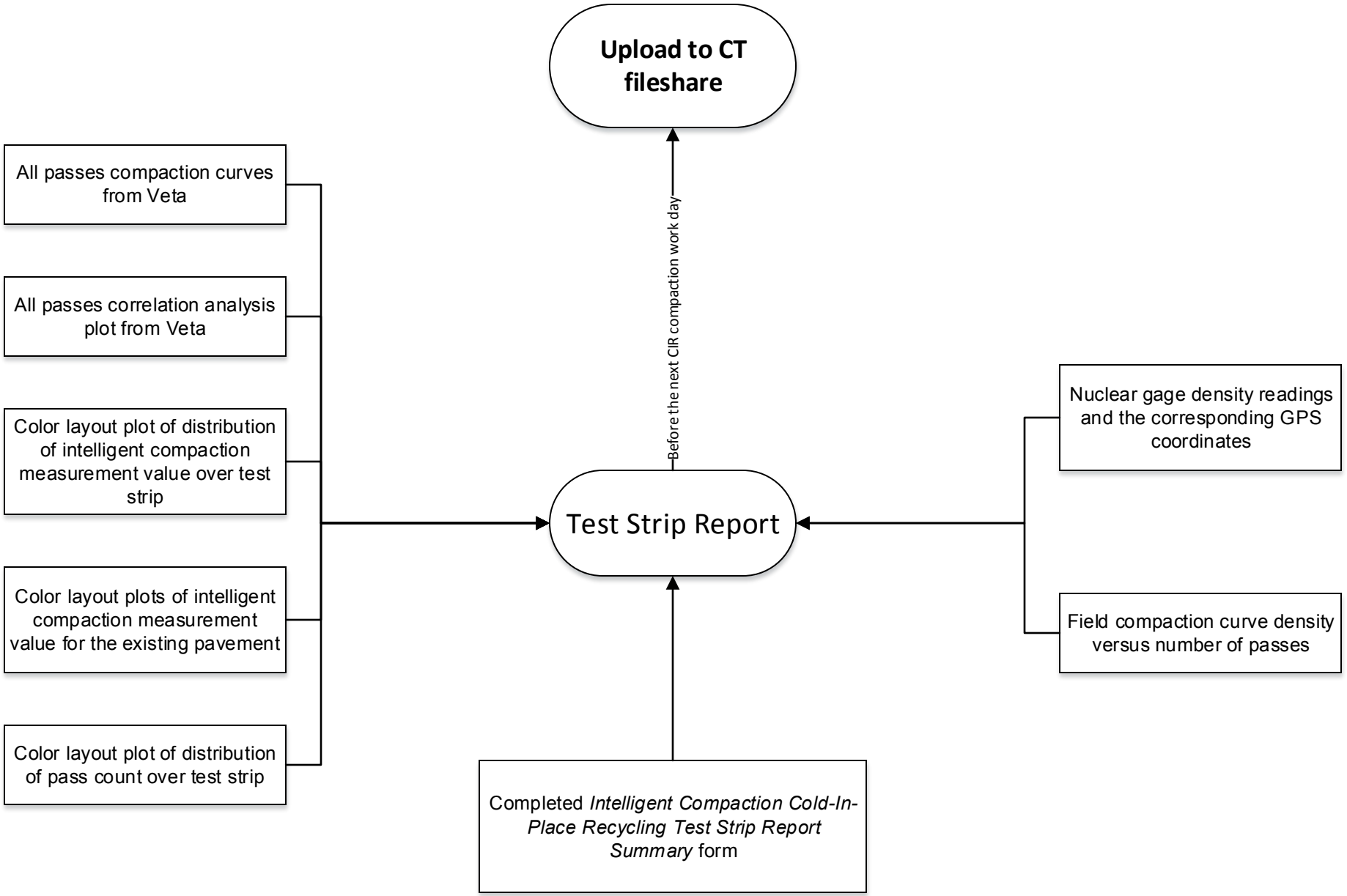
94

Not Used

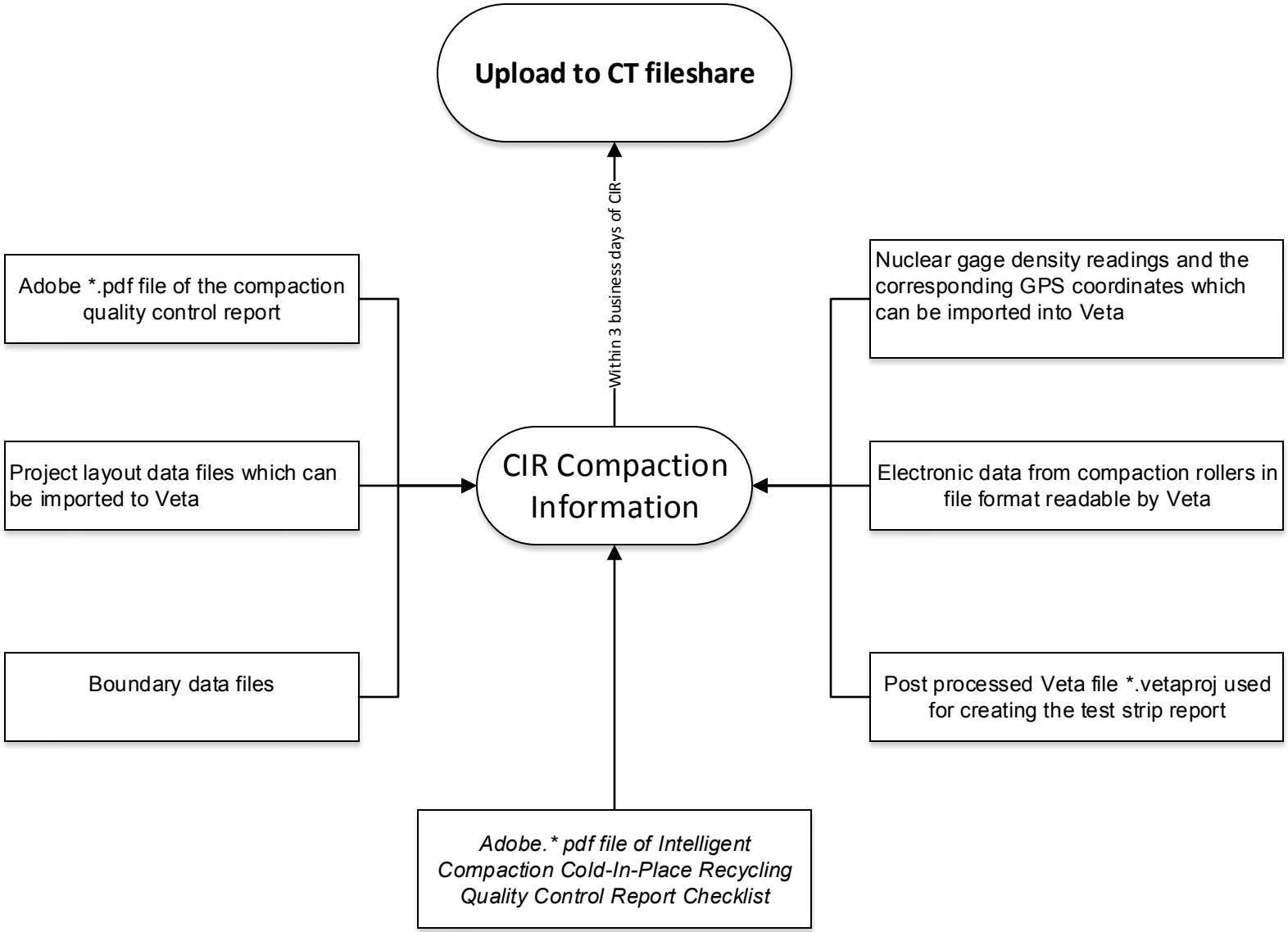

CIR+IC Activities
Submit Request to IC@dot.ca.gov To Access CT Secure File Sharing
CIR Mix Design Activities
JITT Activities
Mapping Activities
Request Survey Control points
Survey Control points
GPS Site Calibration and Check testing
Project Survey Control points available?
CIR Production Activities
GPS Site Calibration and Check testing
Test Strip?
Test Strip
CIR
Approved Mix Design
Map single pass vibratory steel drum roller
CIR Mix Design
JITT
Compaction Quality Control Report
Test Strip (Target Values)
Plot of ICMV value
Plot of no. of passes
Histogram of ICMV for sublots
CEM-IC25 CIR Intelligent Compaction Quality Control Report Summary
Sampling for Mix Design
Pre-Mapping Intelligent Compaction Measurement Value (ICMV) Report:
CEM-IC19 CIR Intelligent Compaction Premapping Summary Report
Plot of ICMV value
Histogram of ICMV for sublots
Plot of filtered low ICMV
Submit to RE
JITT Approved
Upload files to shared folder
Email RE and IC@dot.ca.gov of Uploads
JITT Submittal
JITT syllabus
List of Participants
CEM-IC06 Geospatial Data and Analysis JITT Review Checklist
CEM-IC05 Roller Operation JITT Review Checklist
Section 30-6 Flow Process



Section 30-6 CIR-IC Mapping Flow Process



Cold-In-Place Recycling Intelligent Compaction Test Strip Report Components



Cold-in- Place Recycling Intelligent Compaction Quality Control Information

SAMPLE
INTELLIGENT COMPACTION COLD IN PLACE RECYCLING MAPPING REPORT

Office of Construction Engineering
Caltrans
December 2015

Report of mapping with intelligent compaction roller must include:

1. Mapping results on *Intelligent Compaction Cold-In-Place Recycling Mapping Summary* form
2- Color layout plots of intelligent compaction measurement value for the existing pavement
3- Color layout plots of intelligent compaction measurement value for soft areas with intelligent compaction measurement values equal or less than to 10 percent of the average intelligent compaction measurement value of the existing pavement
4. Final coverage histogram of intelligent compaction measurement value
5. Final coverage histogram of intelligent compaction measurement value for a 528 foot sublot

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 1 OF 2

INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING PREMAPPING SUMMARY REPORT

CEM-IC19 (NEW 08/14/2015)

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize and report premapping information. For questions about this form send an email to: IC@dot.ca.gov

COLD-IN-PLACE RECYCLING (CIR) PREMAPPING INFORMATION

Premapping Location		Premapping Date
Beginning Station	Ending Station	
Veta Analysis Completed by	Veta Analysis by Email Address	Veta Analysis by Phone Number

Premapping Required Submittals (Check all that were submitted)

Veta Analysis Results

☐ Histogram of intelligent compaction measurement value (Interval length 100 feet)

Color Layout Plots

☐ Color layout plots of intelligent compaction measurement value

☐ Color layout plots of filtered low intelligent compaction measurement value

Data Files

☐ Data from premapping roller in file format readable by Veta Submit data within 3 business days of premapping	Data File Name:

Comments:

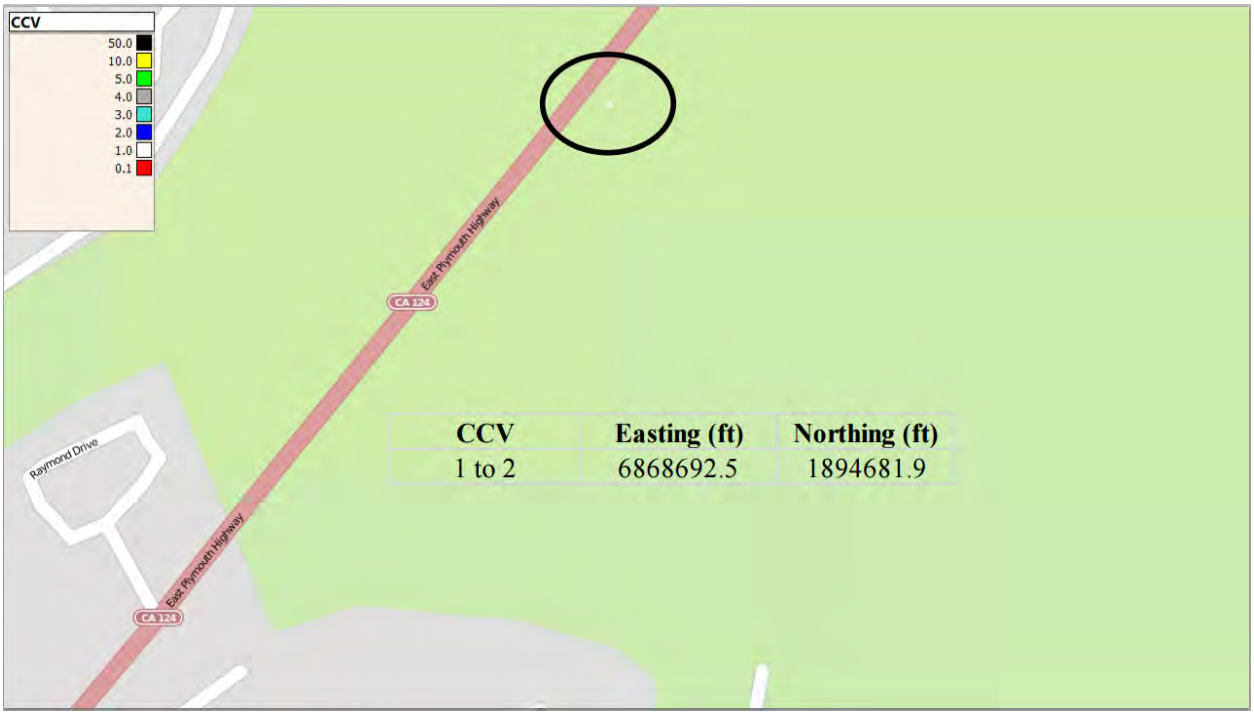
Note: To determine soft spots in the under laying material a filtered Veta analysis is required based on the average of the range of intelligent compaction measurement values.

Low Intelligent Compaction Target Value Report

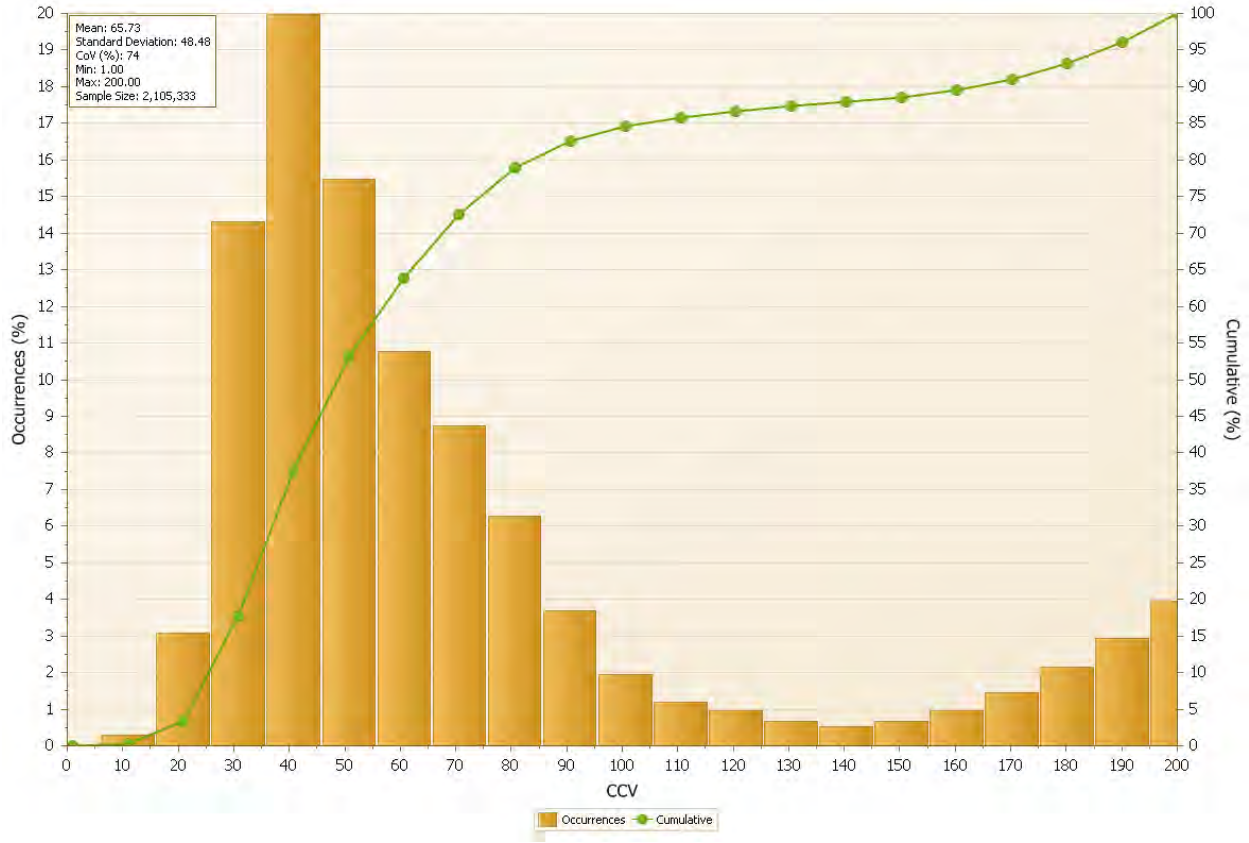
Minimum ICMV	Maximum ICMV	Average ICMV	Filter Target ICMV

Form CEM-IC9 -Intelligent Compaction Cold-In-Place Recycling Mapping Summary form

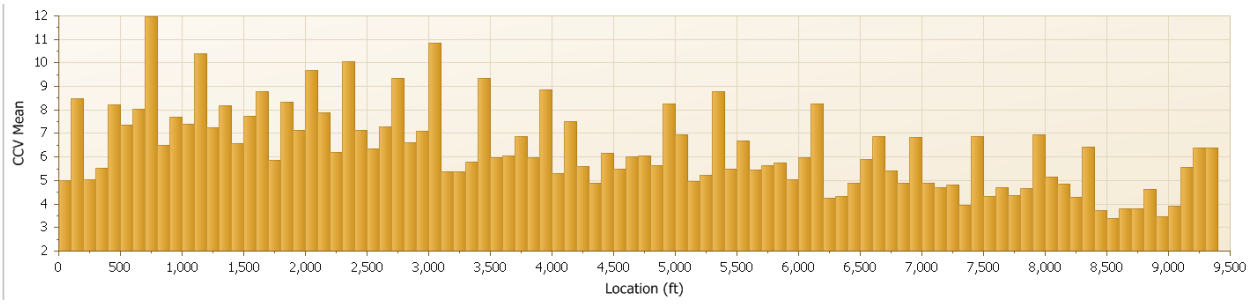
11”x17” Color layout plots of intelligent compaction measurement value for the existing pavement



Color layout plots of intelligent compaction measurement value for soft areas



Histogram Final Coverage intelligent Compaction measurement Value



Histogram of intelligent compaction measurement value for a fixed 100’ interval.

CIR-IC Test Strip

Goal: Establish Target Density, rolling pattern, and ICMV

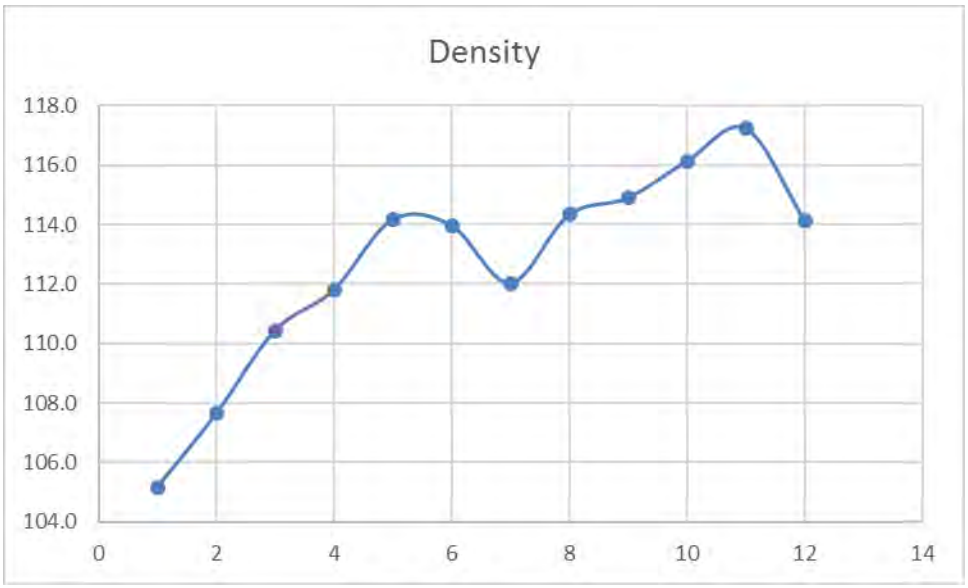
I. Field

A. Choose test Strip location

1. Within the test strip for CIR
2. 500 feet long
3. Use rover to establish test strip boundary
4. Establish 3 randomly selected nuclear gage density locations. Record the position of the density test locations using handheld rover.

B. Determine Break Over Point density and rolling pattern

1. After each coverage measure density at 3 preselected random location using nuclear gage and record
2. Record the pass (coverage) number
3. Record type of the roller
4. Calculate average density for each pass (coverage)
5. Plot average density vs. No. of passes
   a. Determine Break over point (maximum density) and the corresponding no. of passes
   b. Use intelligent compaction roller as the last coverage after reaching break over point
      (1) Measure density at 10 random location
         (a) If the average density is greater than break over point density
            i) Establish new break over point
               (1) Continue rolling using steel or rubber tire roller
               (2) Measure density at 10 random location
               (3) Plot average density vs. passes
               (4) Determine the break over point density
         (b) If the average density is lower than break over point density
            i) Stop rolling
            ii) Break over point is the previous density



II. VETA Analysis

A. Download the latest version of VETA from www.intelligent.com

B. Use vendor's software to combine all rollers data. If vendor's software cannot process Combine rollers data, separate analyses for steel drum and pneumatic tire roller

1. Steel drum vibratory IC roller
    a. Import all passes data (*,csv or *.pln) into VETA
    b. Enter the coordinate system
    c. Set up the test strip boundary as a filter location to exclude outside work data
        (1) Set the filter compaction mode to vibratory
    d. Enter or import the density reading corresponding to each pass
    e. Run analysis with test strip filter, for number of passes for IC roller
    f. Use compaction curve for all passes to determine the target ICMV corresponding to target No. of passes established in field for break over point
    g. Report

    Prepare and include the following

        (1) Complet form CEM-IC25
        (2) Excel spreadsheet of boundary coordinates
        (3) Excel spreadsheet of gage density readings and coordinates
        (4) Plot of field average density vs. number of passes
        (5) Plot of compaction curve for all passes
        (6) Plots of coverage for all passes and individual passes (11"x17")
2. AMG rubber tire roller
    a. Import all passes data (*,csv or *.pln) into VETA
    b. Enter the coordinate system

c. Set up the test strip boundary as a filter location to exclude outside work data

(1) Set the filter compaction mode to static

d. Enter or import the density reading corresponding to each pass

e. Run analysis with test strip filter, for number of passes for AMG roller

f. Use compaction curve for all passes to determine the target density corresponding to no. of passes established in field for break over point

g. Report

Prepare and include the following

(1) Complete form CEM-IC25

(2) Excel spreadsheet of boundary coordinates

(3) Excel spreadsheet of gage density readings and coordinates

(4) Plot of field average density vs. number of passes

(5) Plot of compaction curve for all passes

(6) Plots of coverage for all passes and individual passes (11'x17')

CIR INTELLIGENT COMPACTION TEST STRIP REPORT EXAMPLE

Office of Construction Engineering
Caltrans
November 2015

Test strip report must include:

1. Completed *CIR Construction Test Strip Submittals Checklist* form
2. Nuclear gage density per location and GPS measured coordinates per location
3. Field compaction curve density versus number of passes
4. All passes compaction curves from Veta
5. All passes correlation analysis plot from Veta
6. Final coverage correlation of density vs. pass count over test strip
7. Plot of distribution of pass count over test strip area
8. Plot of distribution of ICMV over test strip

INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING TEST STRIPE SUBMITTAL CHECKLIST

CEM-IC20 (NEW 07/31/2015)

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
FOR CONSTRUCTION ON STATE HIGHWAY IN IN SAN BERNARDINO COUNTY ON ROUTE 127 FROM 3.0 MILES NORTH OF ROUTE 15/127 SEPARATION TO 2.3 MILES NORTH OF SILVER LAKE ROAD AND 8.0 MILES NORTH OF SARATOGA SPRINGS ROAD TO SAN BERNARDINO/INYO COUNTY LINE In District 08 On Route 127	08-1E2204	08-SBd-127-3.0/10.5 37.7/41.47
	PROJECT IDENTIFIER NUMBER 0813000190	
	CONTRACTOR NAME Sully-Miller Contracting Co.	

Instruction: Use this checklist form to review the completeness of submittals of intelligent compact test stripe information. For questions about this form send an email to: IC@dot.ca.gov

COLD-IN-PLACE RECYCLING (CIR) TEST STRIP PLACEMENT INFORMATION

Test Stripe Placement Location Route 127 near Baker, CA		Test Strip Placement Date 9/22/15
Beginning Station 2081+91	Ending Station 2087+17	CIR Thickness 0.25'
IC Technical Representative(ICTR) Ryan Zenahlik, RDO Product Specialist		ICTR Phone Number 714-319-9059
IC Quality Control Technician (ICQCT) Joe Royster, Project Engineer		ICQCT Phone Number 714-722-0597

Test Strip Required Submittals (Check all that were submitted)

Veta Analysis Results

- [X] Veta analysis results as shown on intelligent compaction CIR construction daily submittal checklist
- [X] All passes compaction curves from Veta
- [X] All passes correlation analysis report from Veta

Color Layout Plots

- [X] Color layout plots as shown on the CIR construction daily submittal checklist

Additional Test Strip Information

- [X] Nuclear gage density per location
- [X] Nuclear gage correlation to core densities
- [X] GPS measured coordinates per density location

Data Files

- [X] Data files as shown on the intelligent compaction CIR construction daily submittal checklist

Intelligent Compaction Target Values Determined from Test Strip

- 4 Target number of roller passes for IC vibratory steel drum roller compaction
- 10 Target intelligent compaction measurement value
- 4 Roller pass number that is the basis for target intelligent compaction measurement value
- 5 Target number of roller passes for automated machine guidance pneumatic tire roller compaction

For IC vibratory steel drum roller final coverage after completion of pneumatic rolling provide the following information:

- 4 Target number of roller passes for IC vibratory steel drum roller compaction
- 10 Target intelligent compaction measurement value
- 4 Roller pass number that is the basis for target intelligent compaction measurement value

COMMENTS:

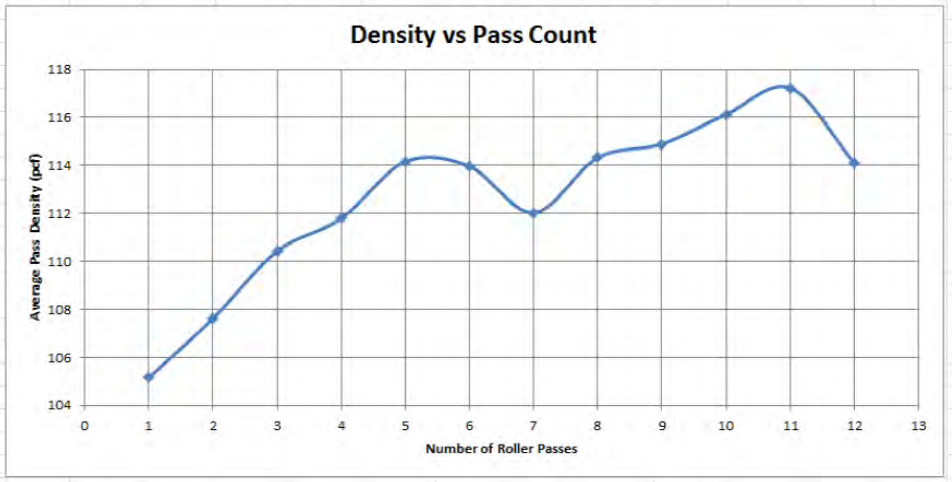
Resident engineer (print name)	Signature	Date

Test Strip field compaction curve density vs. number of passes

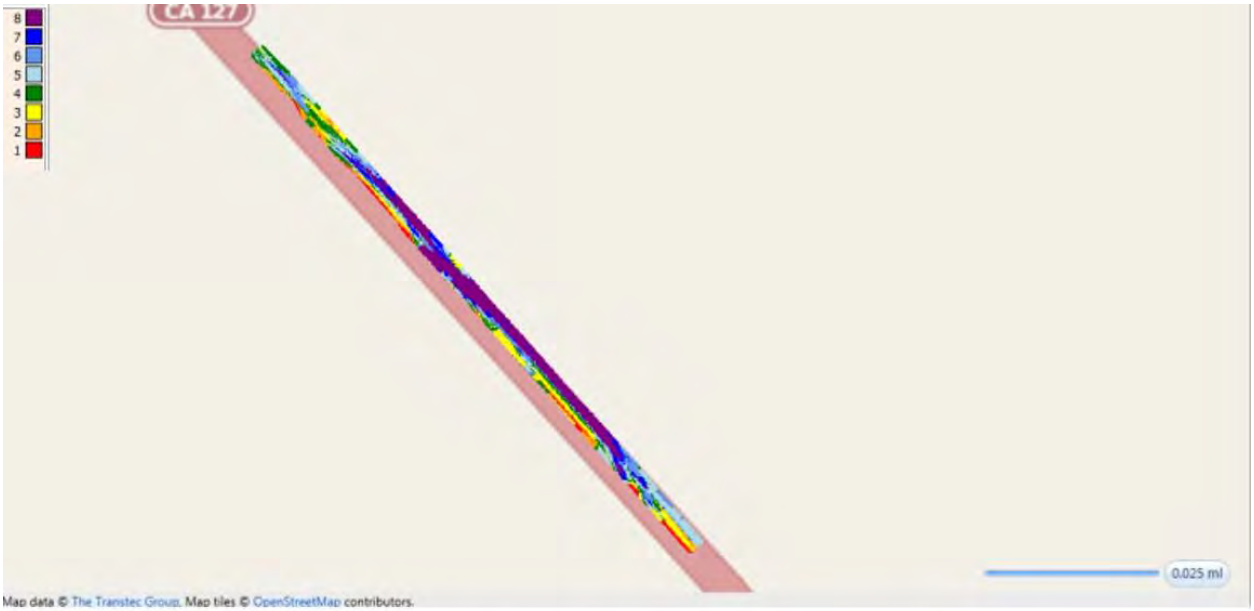
Density Tests										Profile Points				
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value	Pass	Avg.		ID	Date	Easting (ft)	Northing (ft)	Description
Vibe	1	9/22/2015	7057559.081	2475656.782	Density - Nuclear Gauge	106.1	1			1	9/22/2015	7057629.5	2475563	CL
	2	9/22/2015	7057550.741	2475665.927	Density - Nuclear Gauge	103.9	1	105.2		2	9/22/2015	7057603.5	2475591.25	CL
	3	9/22/2015	7057537.783	2475679.664	Density - Nuclear Gauge	105.5	1			3	9/22/2015	7057577	2475619.25	CL
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				4	9/22/2015	7057551	2475646.75	CL
Static	1	9/22/2015	7057519.931	2475699.226	Density - Nuclear Gauge	108.9	2			5	9/22/2015	7057524	2475677.5	CL
	2	9/22/2015	7057506.173	2475713.825	Density - Nuclear Gauge	105.4	2	107.6		6	9/22/2015	7057490.5	2475712.75	CL
	3	9/22/2015	7057491.452	2475729.326	Density - Nuclear Gauge	108.6	2			7	9/22/2015	7057468	2475737	CL
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				8	9/22/2015	7057427	2475781.25	CL
Vibe	1	9/22/2015	7057474.271	2475747.915	Density - Nuclear Gauge	111.2	3			9	9/22/2015	7057384.5	2475826.75	CL
	2	9/22/2015	7057456.261	2475767.772	Density - Nuclear Gauge	108.1	3	110.4		10	9/22/2015	7057364	2475849.25	CL
	3	9/22/2015	7057440.028	2475785.231	Density - Nuclear Gauge	112.0	3			11	9/22/2015	7057337.5	2475877.25	CL
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				12	9/22/2015	7057306.5	2475913.5	CL
Static	1	9/22/2015	7057425.178	2475801.24	Density - Nuclear Gauge	112.2	4			13	9/22/2015	7057287	2475935.5	CL
	2	9/22/2015	7057409.318	2475818.077	Density - Nuclear Gauge	110.1	4	111.8		13	9/22/2015	7057295	2475942.25	EP
	3	9/22/2015	7057403.709	2475814.451	Density - Nuclear Gauge	113.1	4			12	9/22/2015	7057315	2475923.25	EP
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				11	9/22/2015	7057347	2475887.75	EP
Static	1	9/22/2015	7057401.658	2475811.116	Density - Nuclear Gauge	114.2	5			10	9/22/2015	7057372	2475860.25	EP
	2	9/22/2015	7057413.91	2475797.88	Density - Nuclear Gauge	112.1	5	114.2		9	9/22/2015	7057394.5	2475836.25	EP
	3	9/22/2015	7057418.658	2475800.954	Density - Nuclear Gauge	116.2	5			8	9/22/2015	7057438	2475790.25	EP
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				7	9/22/2015	7057478	2475746	EP
Static	1	9/22/2015	7057435.314	2475782.544	Density - Nuclear Gauge	114.0	6			6	9/22/2015	7057501	2475721.75	EP
	2	9/22/2015	7057430.945	2475778.824	Density - Nuclear Gauge	112.0	6	114.0		5	9/22/2015	7057534	2475686	EP
	3	9/22/2015	7057447.657	2475761.739	Density - Nuclear Gauge	115.9	6			4	9/22/2015	7057562.5	2475656	EP
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				3	9/22/2015	7057588.5	2475627.75	EP
	1	9/22/2015	7057452.035	2475765.434	Density - Nuclear Gauge	115.2	1			2	9/22/2015	7057611.5	2475601.75	EP
	2	9/22/2015	7057471.127	2475743.314	Density - Nuclear Gauge	110.4	1	112.0		1	9/22/2015	7057639.5	2475571.25	EP
	3	9/22/2015	7057466.847	2475739.28	Density - Nuclear Gauge	110.5	1							
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
	1	9/22/2015	7057485.305	2475720.946	Density - Nuclear Gauge	114.0	2							
	2	9/22/2015	7057489.617	2475724.036	Density - Nuclear Gauge	112.7	2	114.3						
	3	9/22/2015	7057509.27	2475702.428	Density - Nuclear Gauge	116.3	2							
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
	1	9/22/2015	7057505.07	2475697.847	Density - Nuclear Gauge	116.9	3							
	2	9/22/2015	7057535.002	2475667.065	Density - Nuclear Gauge	112.3	3	114.9						
	3	9/22/2015	7057539.521	2475670.331	Density - Nuclear Gauge	115.5	3							
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
	1	9/22/2015	7057561.178	2475646.714	Density - Nuclear Gauge	118.5	4							
	2	9/22/2015	7057557.158	2475641.513	Density - Nuclear Gauge	112.2	4	116.1						
	3	9/22/2015	7057576.65	2475622.036	Density - Nuclear Gauge	117.7	4							
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
	1	9/22/2015	7057581.142	2475625.339	Density - Nuclear Gauge	117.5	5							
	2	9/22/2015	7057611.351	2475591.361	Density - Nuclear Gauge	117.0	5	117.2						
	3	9/22/2015	7057606.864	2475587.245	Density - Nuclear Gauge	117.2	5							
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
Vibe	1	9/22/2015	7057608.014	2475591.412	Density - Nuclear Gauge	114.9	7							
(Final	2	9/22/2015	7057604.088	2475602.313	Density - Nuclear Gauge	113.4	7							
Coverage)	3	9/22/2015	7057551.034	2475652.084	Density - Nuclear Gauge	114.1	7							
	4	9/22/2015	7057511.69	2475705.703	Density - Nuclear Gauge	114.5	7							
	5	9/22/2015	7057482.8	2475724.514	Density - Nuclear Gauge	113.9	7							
	6	9/22/2015	7057463.632	2475748.811	Density - Nuclear Gauge	113.8	7							
	7	9/22/2015	7057423.216	2475798.915	Density - Nuclear Gauge	115.0	7							
	8	9/22/2015	7057380.781	2475834.922	Density - Nuclear Gauge	113.3	7							
	9	9/22/2015	7057368.739	2475855.595	Density - Nuclear Gauge	114.5	7							
	10	9/22/2015	7057333.379	2475887.94	Density - Nuclear Gauge	114.1	7							

Density Gauge Readings with GPS Coordinates

Machine	Pass #	Density
Steel	1	105.2
Steel	2	107.6
Steel	3	110.4
Steel	4	111.8
Steel	5	114.2
Steel	6	114.0
Rubber	7	112.0
Rubber	8	114.3
Rubber	9	114.9
Rubber	10	116.1
Rubber	11	117.2
Steel	12	114.1

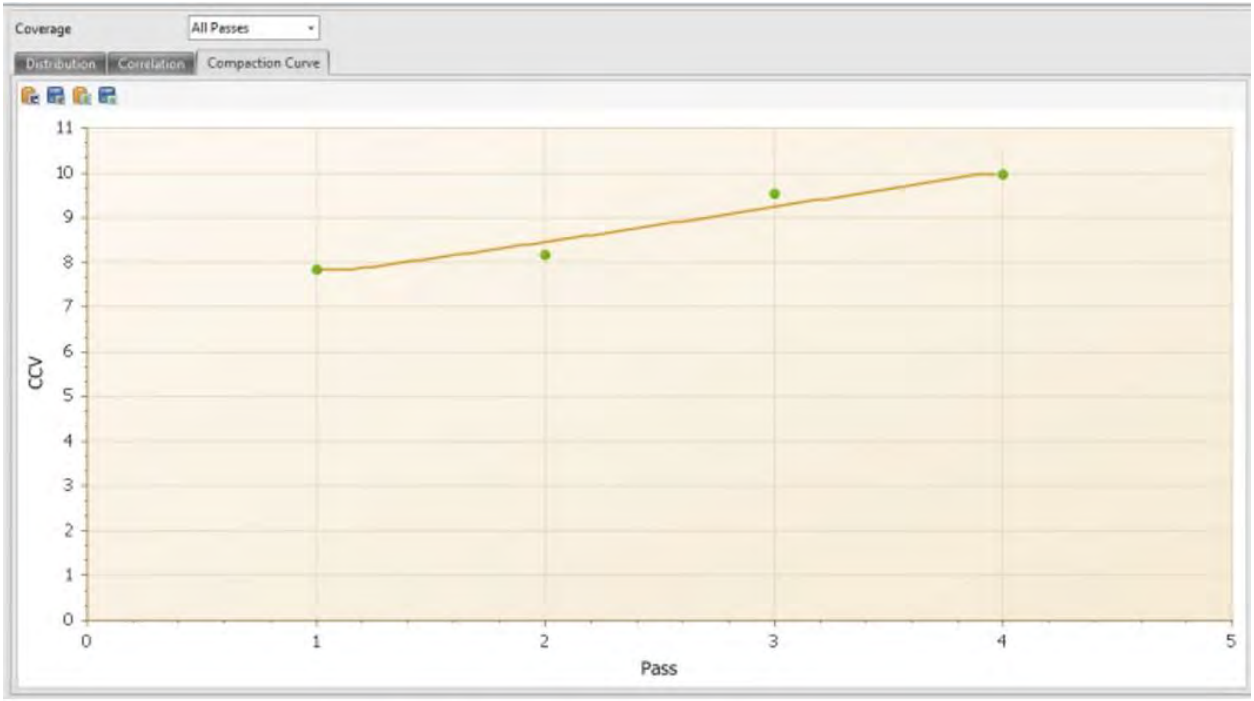


Test Strip field compaction curve density vs. number of passes

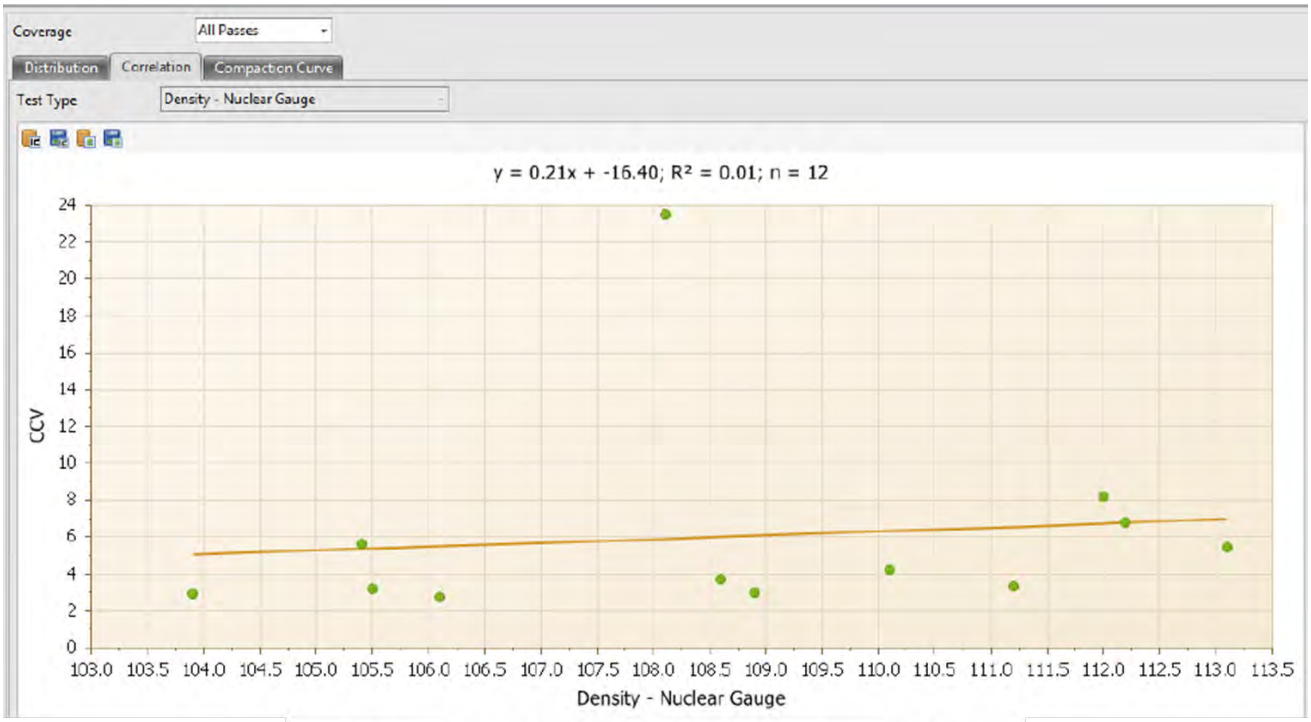


Distribution of Pass Count over Test Strip Area

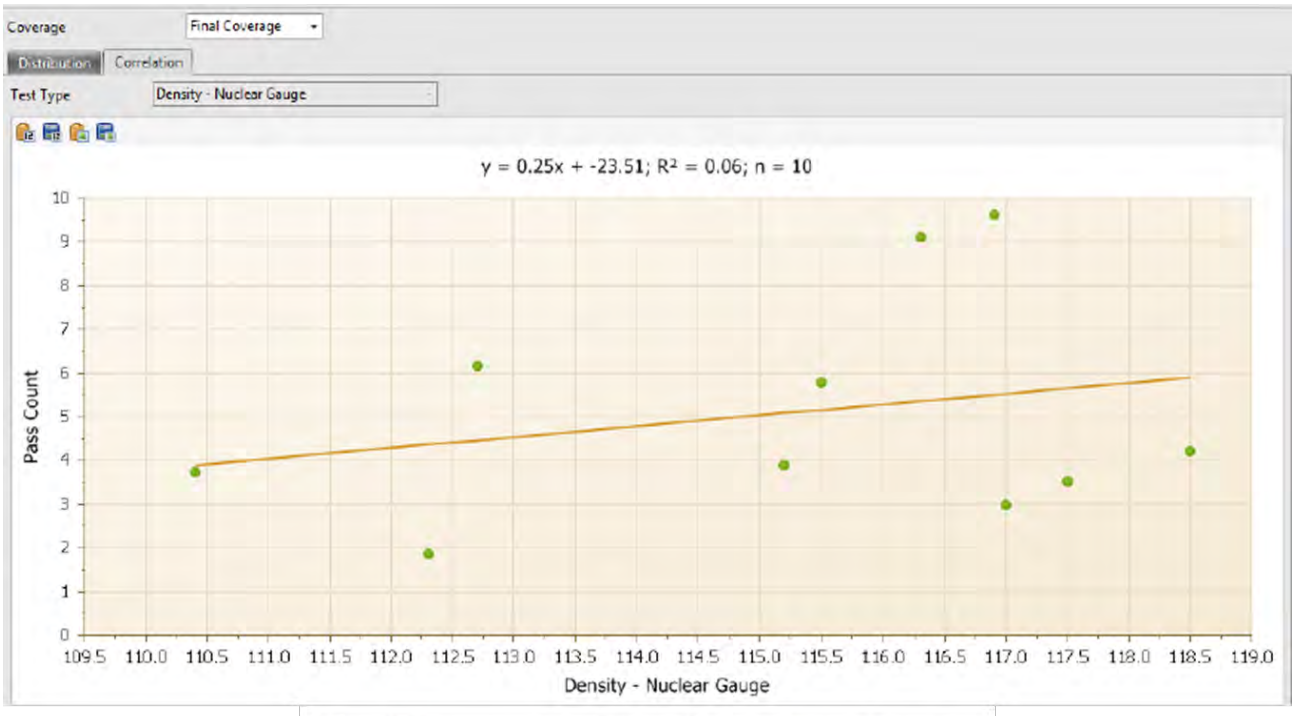
Distribution of CCV Values over Test Strip Area



All Passes Compaction Curve



All Passes Correlation – Density vs CCV



Final Coverage – Density vs Pass Count

COLD IN PLACE RECYCLING INTELLIGENT COMPACTION COMPACTION QUALITY REPORT SAMPLE

Office of Construction Engineering
Caltrans
November 2015

Compaction quality control report must include:

1. Summary of CIR compaction quality control results on *Intelligent Compaction Cold-In-Place Recycling Compaction Quality Control Report Summary* form.
2. Final coverage histogram of number of passes for each roller and when steel drum roller with vibratory on is used, include histogram of intelligent compaction measurement value
3. Final coverage histogram of number of passes for each roller for a 100 feet fixed interval, and when steel drum roller with vibratory on is used, include histogram of intelligent compaction measurement value for a fixed interval.
4. All passes Compaction Curve
5. Final Coverage Correlation density vs. pass count
5. Color layout plots of final coverage:
   5.1. Roller passes for each roller
   5.2. Intelligent compaction measurement value for steel drum roller with vibratory on
   5.3 Table of quality control density testing locations and results.

INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING COMPACTION QUALITY CONTROL REPORT SUMMARY

CEM-IC25 (NEW 06/21/2015)

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
FOR CONSTRUCTION ON STATE HIGHWAY IN IN SAN BERNARDINO COUNTY ON ROUTE 127 FROM 3.0 MILES NORTH OF ROUTE 15/127 SEPARATION TO 2.3 MILES NORTH OF SILVER LAKE ROAD AND 8.0 MILES NORTH OF SARATOGA SPRINGS ROAD TO SAN BERNARDINO/INYO COUNTY LINE	08-1E2204	08-SBd-127-3.0/10.5 37.7/41.47
In District 08 On Route 127	PROJECT IDENTIFIER NUMBER 0813000190	
	CONTRACTOR NAME Sully-Miller Contracting Co.	

Instruction: This form to be used by the contractor to summarize the daily cold-in-place recycling intelligent compaction quality control report information. For questions about this form send an email to: IC@dot.ca.gov

COLD-IN-PLACE RECYCLING (CIR) PLACEMENT INFORMATION

CIR Placement Location		CIR Placement Date
Route 127 between Baker and Shoshone, CA		9/10/15
Beginning Station: PM 10.5	Ending Station: PM 8.7	☒ Initial Compaction ☐ Supplemental Compaction
IC Quality Control Technician (ICQCT): Ryan Zenahlik, RDO Product Specialist		ICQCT Phone Number: 714-319-9059

DAILY COMPACTION QUALITY CONTROL REPORT SUMMARY

Note: Intelligent compaction target values are determined from test stripe.

Intelligent Compaction Vibratory Steel Drum Roller Number of Passes

4 Target number of roller passes | 82.43 Percent work area covered by minimum number of roller passes

Does the number of passes for IC vibratory steel drum roller compaction shown on final coverage histogram of number of passes show that at least 90 percent coverage of the CIR placement area met or exceed the minimum number of roller passes based on target value established at the test stripe?

☐ Yes ☒ No

If no, corrective action taken:

The steel drum roller was stopped several times because the computer stopped mapping, but continued after the first few hours with no issues. Our nuclear gauge tester assured us we were getting our required density.

Intelligent Compaction Measurement Value

10 Target intelligent compaction measurement value | 6.29 Daily average intelligent compaction measurement value

Does the daily average intelligent compaction measurement value for final coverage of IC vibratory steel drum roller meet or exceed the target intelligent compaction measurement value established at the test stripe?

☐ Yes ☒ No

If the answer is no, corrective action is not required because intelligent compaction measurement value is report only.

Automated Machine Guidance Roller

4 Target number of roller passes | 96.71 Percent work area covered by minimum number of roller passes

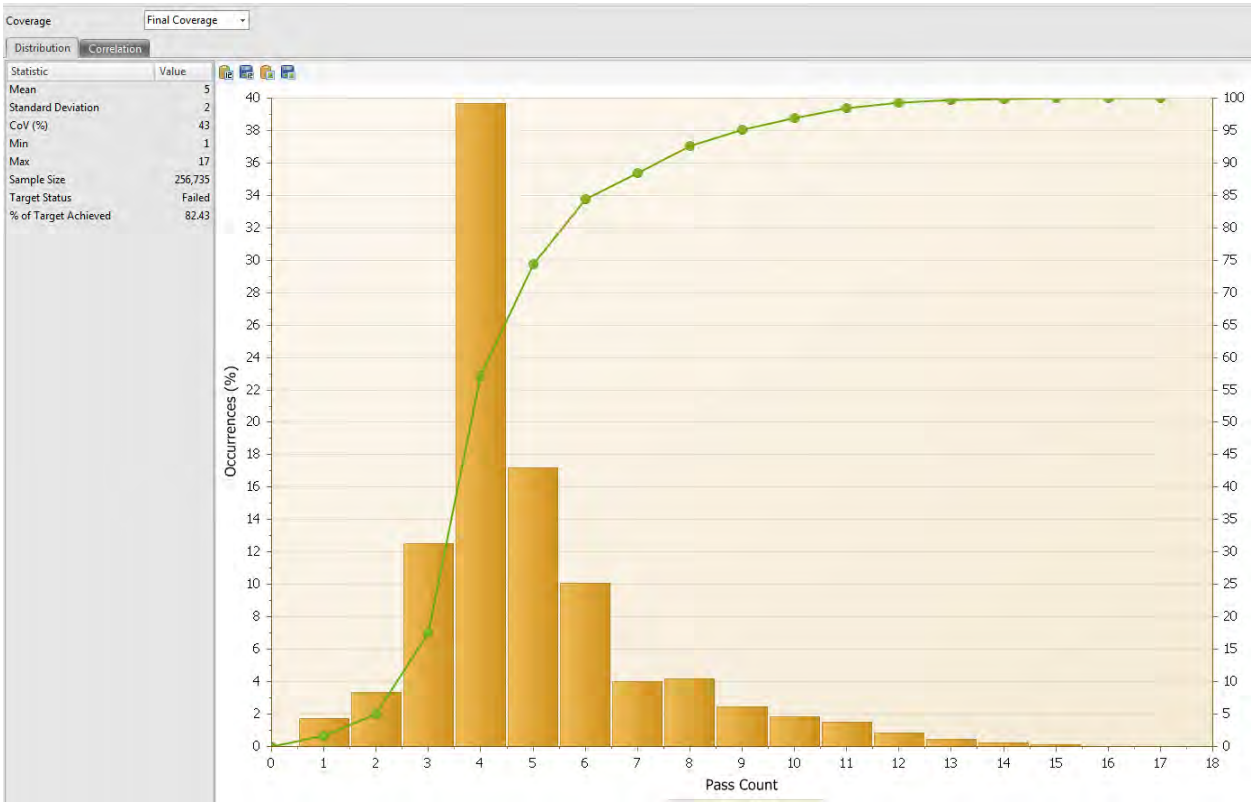
Does the number of passes for automated machine guidance roller shown on final coverage histogram of number of passes show that at least 90 percent coverage of the CIR placement area met or exceed the minimum number of roller passes based on target value established at the test stripe?

☒ Yes ☐ No

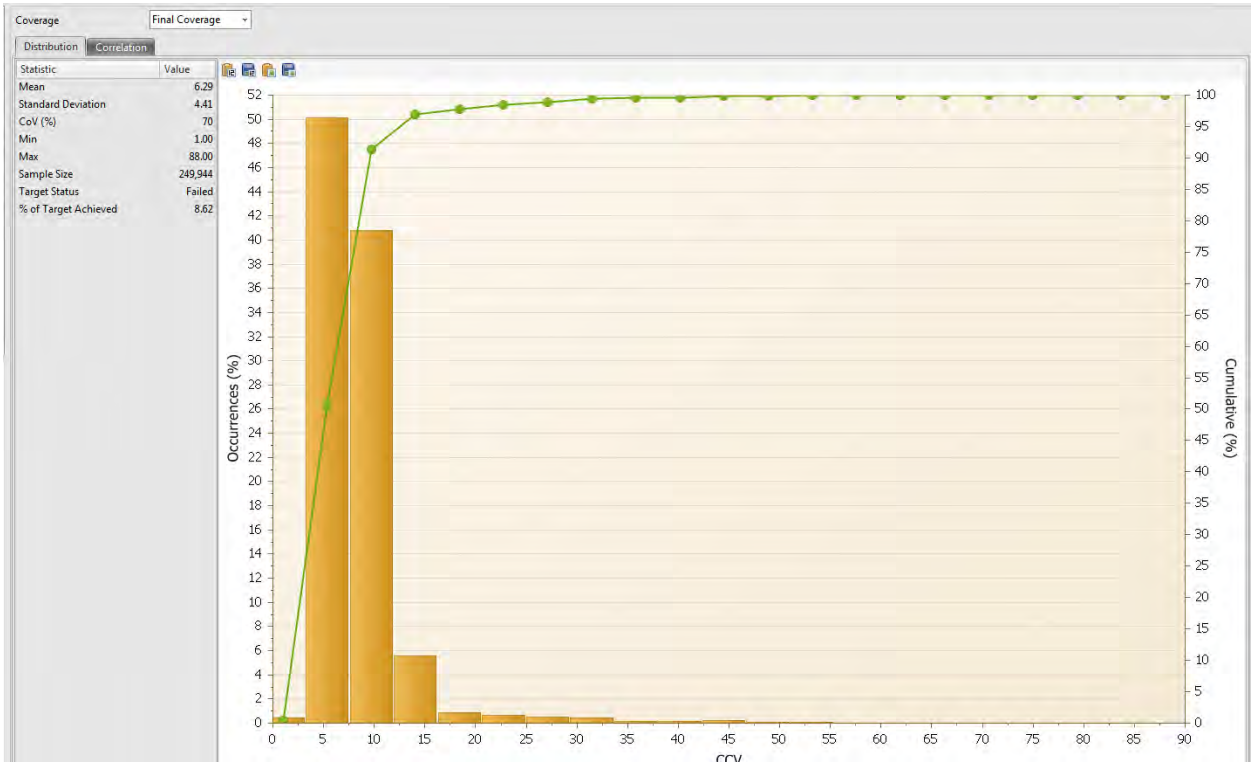
If no, corrective action taken:

Note: Results from intelligent compaction are for contractor quality control purposes and not to be used as Caltrans acceptance of CIR. When density is verified by contractor nuclear gage quality control test results, then corrective action for number of passes is not required.

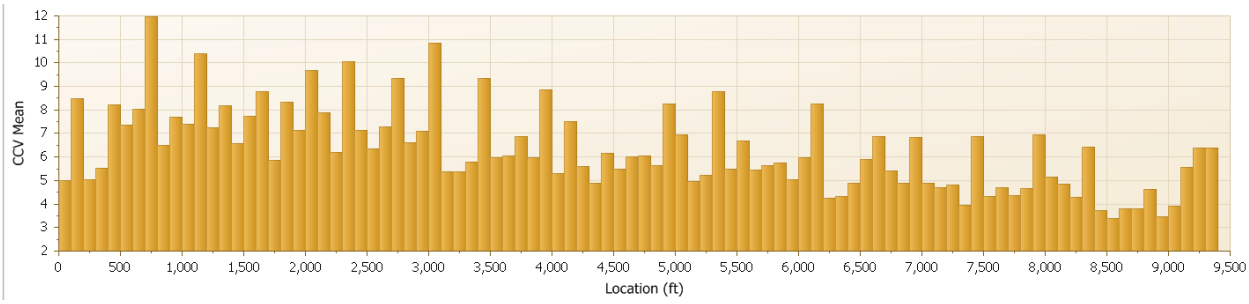
Updated 2015-06-21



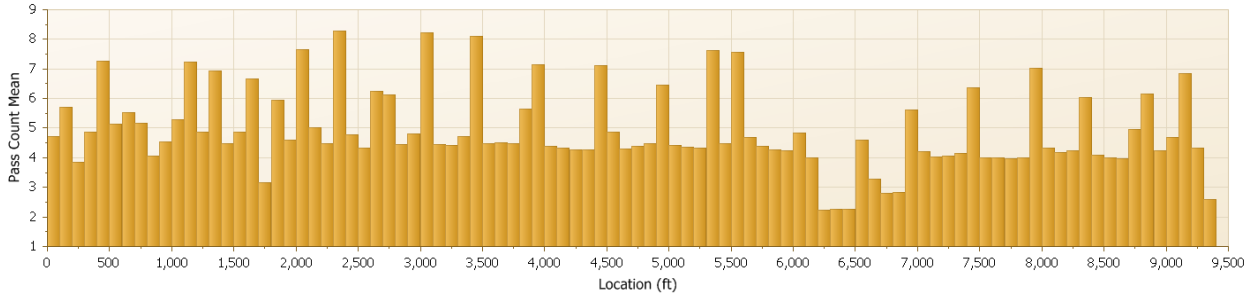
Histogram final Coverage Number of passes



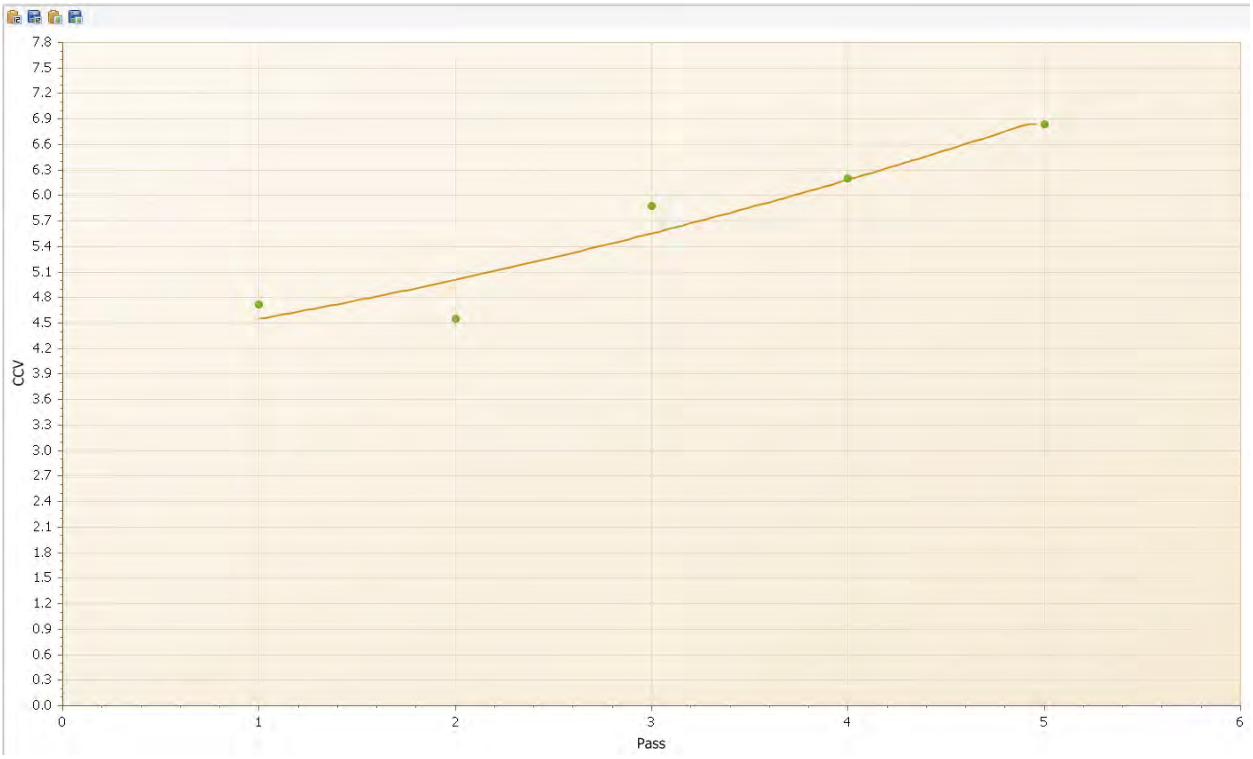
Histogram Final Coverage intelligent Compaction measurement Value



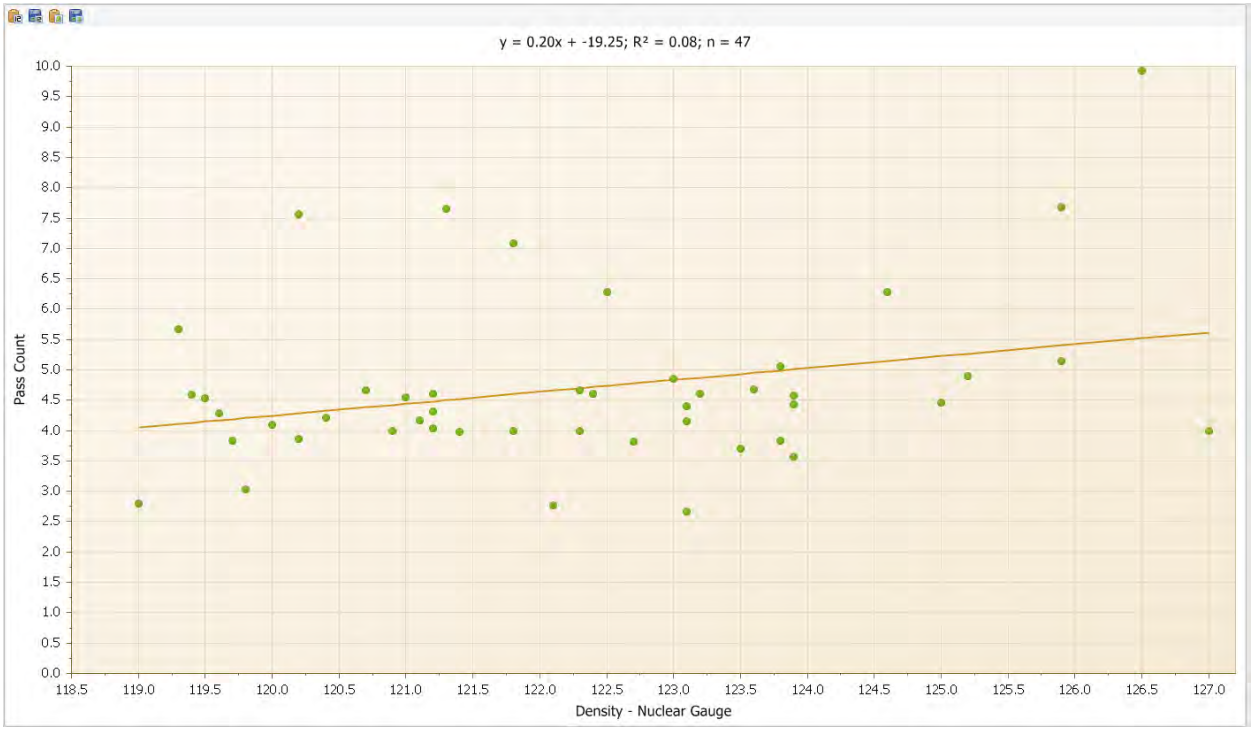
Histogram of intelligent compaction measurement value for a fixed 100’ interval.



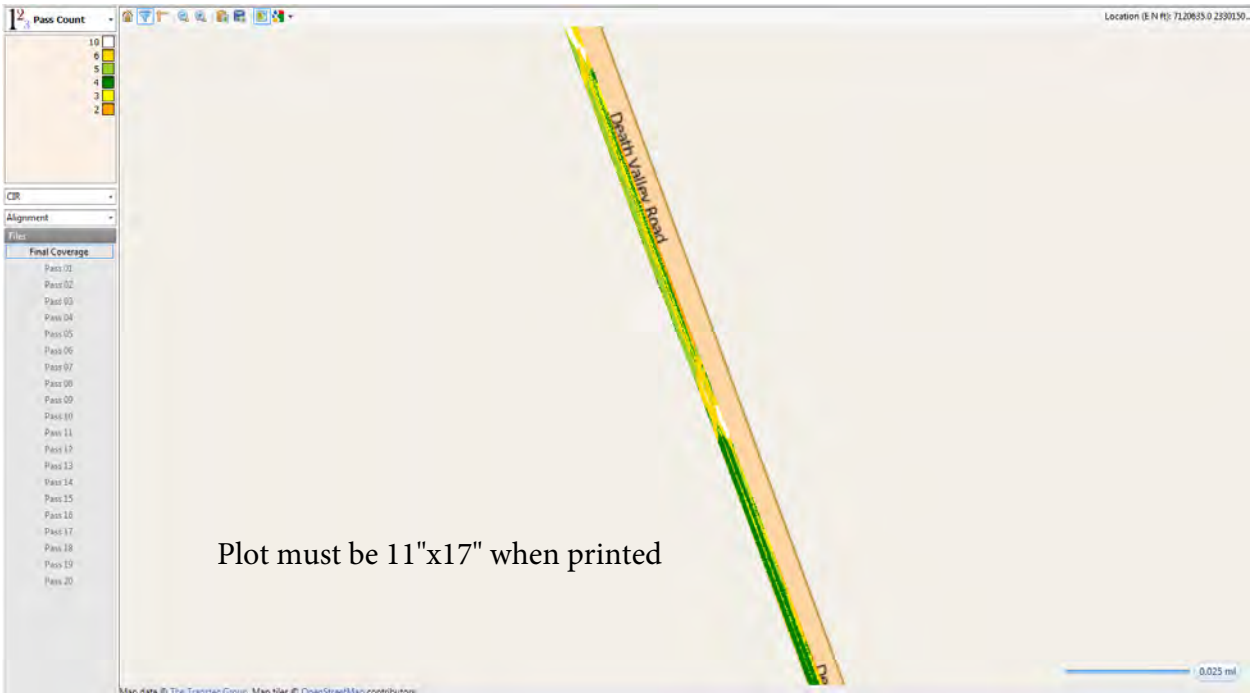
Histogram of Number pf passes for a fixed 5’ interval



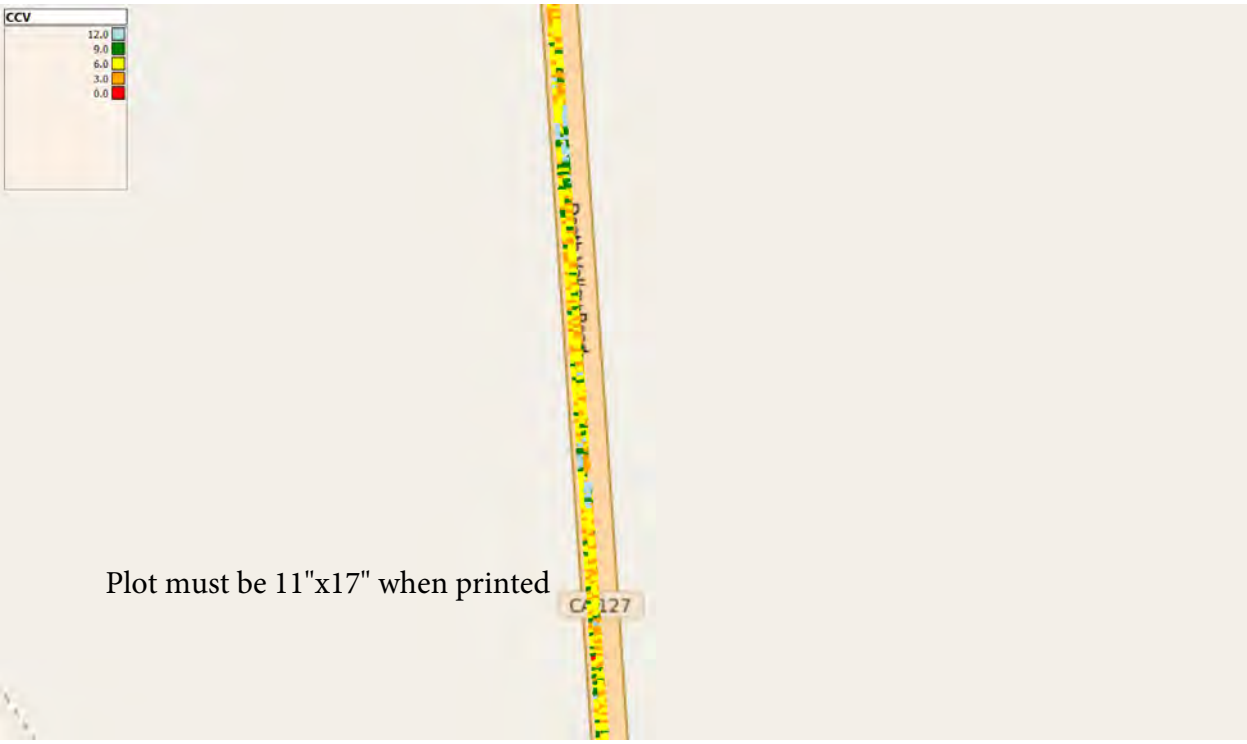
All passes compaction curve



Final Coverage correlation density vs. pass count



Plot of final coverage roller pass



Plot of final coverage ICMV value

Density Tests										Profile Points				
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value	Pass	Avg.		ID	Date	Easting (ft)	Northing (ft)	Description
Vibe	1	9/22/2015	7057559.081	2475656.782	Density - Nuclear Gauge	106.1	1			1	9/22/2015	7057629.5	2475563	CL
	2	9/22/2015	7057550.741	2475665.927	Density - Nuclear Gauge	103.9	1	105.2		2	9/22/2015	7057603.5	2475591.25	CL
	3	9/22/2015	7057537.783	2475679.664	Density - Nuclear Gauge	105.5	1			3	9/22/2015	7057577	2475619.25	CL
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				4	9/22/2015	7057551	2475646.75	CL
Static	1	9/22/2015	7057519.931	2475699.226	Density - Nuclear Gauge	108.9	2			5	9/22/2015	7057524	2475677.5	CL
	2	9/22/2015	7057506.173	2475713.825	Density - Nuclear Gauge	105.4	2	107.6		6	9/22/2015	7057490.5	2475712.75	CL
	3	9/22/2015	7057491.452	2475729.326	Density - Nuclear Gauge	108.6	2			7	9/22/2015	7057468	2475737	CL
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				8	9/22/2015	7057427	2475781.25	CL
Vibe	1	9/22/2015	7057474.271	2475747.915	Density - Nuclear Gauge	111.2	3			9	9/22/2015	7057384.5	2475826.75	CL
	2	9/22/2015	7057456.261	2475767.772	Density - Nuclear Gauge	108.1	3	110.4		10	9/22/2015	7057364	2475849.25	CL
	3	9/22/2015	7057440.028	2475785.231	Density - Nuclear Gauge	112.0	3			11	9/22/2015	7057337.5	2475877.25	CL
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				12	9/22/2015	7057306.5	2475913.5	CL
Static	1	9/22/2015	7057425.178	2475801.24	Density - Nuclear Gauge	112.2	4			13	9/22/2015	7057287	2475935.5	CL
	2	9/22/2015	7057409.318	2475818.077	Density - Nuclear Gauge	110.1	4	111.8		13	9/22/2015	7057295	2475942.25	EP
	3	9/22/2015	7057403.709	2475814.451	Density - Nuclear Gauge	113.1	4			12	9/22/2015	7057315	2475923.25	EP
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				11	9/22/2015	7057347	2475887.75	EP
Static	1	9/22/2015	7057401.658	2475811.116	Density - Nuclear Gauge	114.2	5			10	9/22/2015	7057372	2475860.25	EP
	2	9/22/2015	7057413.91	2475797.88	Density - Nuclear Gauge	112.1	5	114.2		9	9/22/2015	7057394.5	2475836.25	EP
	3	9/22/2015	7057418.658	2475800.954	Density - Nuclear Gauge	116.2	5			8	9/22/2015	7057438	2475790.25	EP
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				7	9/22/2015	7057478	2475746	EP
Static	1	9/22/2015	7057435.314	2475782.544	Density - Nuclear Gauge	114.0	6			6	9/22/2015	7057501	2475721.75	EP
	2	9/22/2015	7057430.945	2475778.824	Density - Nuclear Gauge	112.0	6	114.0		5	9/22/2015	7057534	2475686	EP
	3	9/22/2015	7057447.657	2475761.739	Density - Nuclear Gauge	115.9	6			4	9/22/2015	7057562.5	2475656	EP
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value				3	9/22/2015	7057588.5	2475627.75	EP
	1	9/22/2015	7057452.035	2475765.434	Density - Nuclear Gauge	115.2	1			2	9/22/2015	7057611.5	2475601.75	EP
	2	9/22/2015	7057471.127	2475743.314	Density - Nuclear Gauge	110.4	1	112.0		1	9/22/2015	7057639.5	2475571.25	EP
	3	9/22/2015	7057466.847	2475739.28	Density - Nuclear Gauge	110.5	1							
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
	1	9/22/2015	7057485.305	2475720.946	Density - Nuclear Gauge	114.0	2							
	2	9/22/2015	7057489.617	2475724.036	Density - Nuclear Gauge	112.7	2	114.3						
	3	9/22/2015	7057509.27	2475702.428	Density - Nuclear Gauge	116.3	2							
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
	1	9/22/2015	7057505.07	2475697.847	Density - Nuclear Gauge	116.9	3							
	2	9/22/2015	7057535.002	2475667.065	Density - Nuclear Gauge	112.3	3	114.9						
	3	9/22/2015	7057539.521	2475670.331	Density - Nuclear Gauge	115.5	3							
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
	1	9/22/2015	7057561.178	2475646.714	Density - Nuclear Gauge	118.5	4							
	2	9/22/2015	7057557.158	2475641.513	Density - Nuclear Gauge	112.2	4	116.1						
	3	9/22/2015	7057576.65	2475622.036	Density - Nuclear Gauge	117.7	4							
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
	1	9/22/2015	7057581.142	2475625.339	Density - Nuclear Gauge	117.5	5							
	2	9/22/2015	7057611.351	2475591.361	Density - Nuclear Gauge	117.0	5	117.2						
	3	9/22/2015	7057606.864	2475587.245	Density - Nuclear Gauge	117.2	5							
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value								
Vibe	1	9/22/2015	7057608.014	2475591.412	Density - Nuclear Gauge	114.9	7							
(Final	2	9/22/2015	7057604.088	2475602.313	Density - Nuclear Gauge	113.4	7							
Coverage)	3	9/22/2015	7057551.034	2475652.084	Density - Nuclear Gauge	114.1	7							
	4	9/22/2015	7057511.69	2475705.703	Density - Nuclear Gauge	114.5	7							
	5	9/22/2015	7057482.8	2475724.514	Density - Nuclear Gauge	113.9	7							
	6	9/22/2015	7057463.632	2475748.811	Density - Nuclear Gauge	113.8	7							
	7	9/22/2015	7057423.216	2475798.915	Density - Nuclear Gauge	115.0	7							
	8	9/22/2015	7057380.781	2475834.922	Density - Nuclear Gauge	113.3	7							
	9	9/22/2015	7057368.739	2475855.595	Density - Nuclear Gauge	114.5	7							
	10	9/22/2015	7057333.379	2475887.94	Density - Nuclear Gauge	114.1	7							

Density Gauge Readings with GPS Coordinates

Intelligent Compaction

Cold-In-Place Recycling

CT Construction Forms

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize and report mapping of existing pavement information. For questions about this form send an email to: IC@dot.ca.gov

Mapping information for cold-in-place recycling performed on:	Mapping Date

COLD-IN-PLACE RECYCLING (CIR) MAPPING INFORMATION

Mapping Location			
Beginning Station/Post Mile	Ending Station/Post Mile		

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Training certificate expiration date. __/__/____
Email address	Phone Number	

Mapping Information Preparer

Mapping Information Completed by (print name)	Signature	Date
Email Address	Phone Number	

Mapping with Intelligent Compaction Roller Information Submittals

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
☐ Adobe *.pdf file of the mapping report from data analysis performed using Veta software Mapping report file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Project layout/and or mapping boundary which can be imported to Veta Project layout file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Electronic data from compaction roller in file format readable by Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Post processed Veta file *.vetaproj File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Intelligent Compaction Cold-In-Place Recycling Mapping Information Checklist File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Contractor's Submittal Documentation Mapping Information

Submit information on a digital medium to the resident engineer within 3 business days of mapping existing pavement.	Submitted by (print name)	Date
Upload information to the Department's secure file sharing system within 3 business days of mapping existing pavement.	Submitted by (print name)	Date
Submit an Adobe *.pdf file of this form with notification of your electronic upload submittal to the resident engineer and IC@dot.ca.gov.	Submitted by (print name)	Date

Resident Engineers Review and Authorization of Mapping Information

This Section Is For Engineers Use

Information submittal reviewed by (print name)	Information submittal reviewed by (signature)	Date
Information submittal complies with the specification requirements? ☐ Yes ☐ No		
Contractor notified of accepted or rejected information submittal by (print name)		Date
The intelligent compaction mapping information submitted by the contractor complies with the specification requirements.		
Resident Engineer (print name)	Resident Engineer (signature)	Date

Updated 2016-03-30

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This checklist form is to be completed and submitted by the contractor with the test strip report to ensure a complete submittal. Use this checklist form to review the completeness of submittals of intelligent compact test strip information. For questions about this form send an email to: IC@dot.ca.gov

Intelligent compaction cold-in-place recycling test strip placed on:	CIR Test Strip Placement Date

COLD-IN-PLACE RECYCLING (CIR) TEST STRIP INFORMATION

CIR Test Strip Placement Location		Direction	Lane Number
Test Strip Beginning Station/Post Mile	Test Strip Ending Station/Post Mile	☐ Initial Compaction ☐ Supplemental Compaction	

Intelligent Compaction Quality Control Technician

Compaction QC Technician (print name)	Intelligent Compaction QC Training Completion Date:	Data Analysis Training certificate expiration date. __/__/____
Email address	Phone Number	IC Equipment Training certificate expiration date. __/__/____

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Data Analysis Training certificate expiration date. __/__/____
Email address	Phone Number	

Test Strip Report Submittal Preparer

Test Strip Report Submittal Completed by (print name)	Signature	Date
Email Address	Phone Number	

Intelligent Compaction Target Values Determined From Test Strip

_____Target number of roller passes for IC vibratory steel drum roller compaction

_____Target intelligent compaction measurement value

_____Roller pass number that is the basis for target intelligent compaction measurement value

_____Target number of roller passes for automated machine guidance pneumatic tire roller compaction

For IC vibratory steel drum roller final coverage after completion of pneumatic rolling provide the following information:

_____Intelligent compaction measurement value

_____Final roller pass number that is the basis for target intelligent compaction measurement value

COMMENTS:

Test Strip Report Submittals

Test Strip Report General Information

Contractor Submittal *Check all that were submitted*	Submittal Review *This Column For Engineer's Use*
☐ Nuclear gage density readings and the corresponding GPS coordinates which can be imported into Veta	The submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Field compaction curve versus number of passes	The submittal is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Veta Analysis Results

Contractor Submittal *Check all that were submitted*	Submittal Review *This Column For Engineer's Use*
☐ All passes compaction curves from Veta	The submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ All passes correlation analysis report from Veta	The submittal is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Color Layout Plots

Contractor Submittal *Check all that were submitted*	Submittal Review *This Column For Engineer's Use*
☐ Color layout plot of distribution of pass count over test strip	The submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Color layout plot of distribution of intelligent compaction measurement value over test strip	The submittal is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Test Strip Report Review

COMMENTS:

I have reviewed the intelligent compaction results shown on test strip report for compliance with the contract specifications and taken corrective action when required.

☐ See comments for corrective actions taken

Quality Control Manger (print name)	Signature	Date Reviewed

Contractor's Test Strip Report Submittal Documentation

Submit Adobe *.pdf file of the test strip report to resident engineer within 1 business day of CIR test strip placement.	Submitted by (print name)	Date
Adobe *.pdf file name of test strip report:	Test strip report file name	
Submit Adobe *.pdf file of this form to resident engineer within 1 business day of CIR test strip placement with the test strip report submittal.	Submitted by (print name)	Date

Resident Engineers Review and Authorization of Test Strip Report

This Section Is For Engineers Use

Test strip report reviewed by (print name)	Test strip report reviewed by (signature)	Date
Test strip report complies with the specification requirements? ☐ Yes ☐ No	☐ Test strip report is adequate	Date
If no: ☐ Test strip report does not comply with the specification requirements and must be resubmitted after addressing the comments shown above.	☐ Test strip report is rejected	Date
Contractor notified of accepted or rejected test strip report by (print name)		Date

The intelligent compaction test strip report submitted by the contractor complies with the specification requirements.

Resident Engineer (print name)	Resident Engineer (signature)	Date

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize the daily cold-in-place recycling intelligent compaction quality control report information. For questions about this form send an email to: IC@dot.ca.gov

Quality control report summary for cold-in-place recycling placed on:	CIR Placement Date

COLD-IN-PLACE RECYCLING (CIR) INFORMATION

CIR Placement Location		Direction	Lane Number
Beginning Station/Post Mile	Ending Station/Post Mile	☐ Initial Compaction ☐ Supplemental Compaction	

Intelligent Compaction Technical Representative

Compaction QC Technician (print name)	Company (print name)
Email address	Phone Number:

Intelligent Compaction Quality Control Technician

Compaction QC Technician (print name)	Intelligent Compaction QC Training Completion Date:	Training certificate expiration date. __/__/____
Email address	Phone Number	

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Training certificate expiration date. __/__/____
Email address	Phone Number	

Quality Control Report Preparer

Quality Control Report Completed by (print name)	Signature	Date
Email Address	Phone Number	

Activities Before Daily Production

☐ Check testing

GPS Measurement	X	Y
A-Roller		
B-Rover		
Difference (A-B)		

**Take corrective action if difference more than* 0.5 ft in any direction

COMMENTS:

Intelligent Compaction Target Values Determined From Test Strip

_____Target number of roller passes for IC vibratory steel drum roller compaction
_____Target intelligent compaction measurement value
_____Roller pass number that is the basis for target intelligent compaction measurement value
_____Target number of roller passes for automated machine guidance pneumatic tire roller compaction
If intelligent compaction vibratory steel drum roller is used after completion of pneumatic rolling provide the following information:
_____Intelligent compaction measurement value
_____Final roller pass number that is the basis for target intelligent compaction measurement value
COMMENTS:

DAILY COMPACTION QUALITY CONTROL REPORT SUMMARY

Daily CIR area completed Using IC_____(yd^2)

Intelligent Compaction Vibratory Steel Drum Roller Number of Passes

_____Target number of roller passes	_____Percent work area covered by minimum number of roller passes

Does the number of passes for IC vibratory steel drum roller compaction shown on final coverage histogram of number of passes show that at least 90 percent coverage of the CIR placement area meets or exceeds the minimum number of roller passes based on target value established at the test strip?

☐ Yes ☐ No

If no, corrective action taken:

Intelligent Compaction Measurement Value

_____Target intelligent compaction measurement value	_____Daily average intelligent compaction measurement value

Does the daily average intelligent compaction measurement value for final coverage of IC vibratory steel drum roller meets or exceeds the target intelligent compaction measurement value established at the test strip?

☐ Yes ☐ No

If the answer is no, corrective action is not required because intelligent compaction measurement value is report only.

Automated Machine Guidance Roller

_____Target number of roller passes	_____Percent work area covered by minimum number of roller passes

Does the number of passes for automated machine guidance roller shown on final coverage histogram of number of passes show that at least 90 percent coverage of the CIR placement area meets or exceeds the minimum number of roller passes based on target value established at the test strip?

☐ Yes ☐ No

If no, corrective action taken:
Note: Results from intelligent compaction are for contractor quality control purposes and not to be used as Caltrans acceptance of CIR. When density is verified by contractor nuclear gage quality control test results, then corrective action for number of passes is not required.

Updated 2016-04-01

Additional Intelligent Compaction Vibratory Steel Drum Roller Compaction

If roller pattern shown on *Contractors Establishment of Break Over Density* form includes addition rolling using IC vibratory steel drum roller after pneumatic rubber tire rolling provide the following information:
☐ Yes ☐ Not Required

_____Target number of roller passes	_____Percent work area covered by minimum number of roller passes

Does the number of passes for IC vibratory steel drum roller compaction shown on final coverage histogram of number of passes show that at least 90 percent coverage of the CIR placement area meets or exceeds the minimum number of roller passes based on target value established at the test strip?
☐ Yes ☐ No

If no, corrective action taken:

Intelligent Compaction Measurement Value

_____Target intelligent compaction measurement value	_____ Daily average intelligent compaction measurement value

Does the daily average intelligent compaction measurement value for final coverage of IC vibratory steel drum roller meets or exceeds the target intelligent compaction measurement value established at the test strip?
☐ Yes ☐ No

If the answer is no, corrective action is not required because intelligent compaction measurement value is report only.

Note: Results from intelligent compaction are for contractor quality control purposes and not to be used as Caltrans acceptance of CIR. When the daily average intelligent compaction measurement meets or exceeds the target value and density is verified by contractor nuclear gage quality control test results, then corrective action for number of passes is not required.

Compaction Quality Control Report Review

COMMENTS:

I have reviewed the intelligent compaction results shown on compaction quality control report for compliance with the contract specifications and taken corrective action when required.

Quality Control Manger (print name)	Signature	Date Reviewed

Compaction Quality Control Report Submittal Information

Submit hardcopy to resident engineer within 1 business day of CIR placement.	Submitted by (print name)	Date
Submit Adobe *.pdf file to resident engineer within 1 business day of CIR placement.	Submitted by (print name)	Date

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form is to be completed and submitted by the contractor to ensure a complete information submittal. The Engineer should use this form to verify that the submittals of the intelligent information are complete. For questions about this form send an email to: IC@dot.ca.gov

Intelligent compaction submittal information for cold-In-place recycling placed on:	CIR Placement Date

Cold-In-Place Recycling Information

CIR Placement Location		Direction	Lane Number
Beginning Station/Post Mile	Ending Station/Post Mile	☐ Initial Compaction ☐ Supplemental Compaction	

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Data Analysis Training certificate expiration date. __/__/____.
Email address	Phone Number	

Information Submittal Preparer

Information Submittal Completed by Email Address	Phone Number	
Information Submittal Completed by (print name)	Signature	Date

Intelligent Compaction Information Submittals

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
☐ Adobe *.pdf file of the CIR quality control report from data analysis performed using Veta software Quality control report file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Project layout which can be imported to Veta Project layout file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Daily boundary which can be imported to Veta Boundary file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Nuclear gage density readings and the corresponding GPS coordinates which can be imported into Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Intelligent Compaction Information Submittals

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
Intelligent Compaction Roller	
☐ Electronic data from compaction roller in file format readable by Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Post processed Veta file *.vetaproj File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
Automated Machine Guidance Roller	
☐ Electronic data from compaction roller in file format readable by Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Post processed Veta file *.vetaproj File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
COMMENTS:	

Contractor's Submittal Documentation for Intelligent Compaction Information

Submit information on a digital medium to the resident engineer within 3 business days of CIR placement.	Submitted by (print name)	Date
Upload information to the Department's secure file sharing system within 3 business day of CIR placement.	Submitted by (print name)	Date
Submit an Adobe *.pdf file of this form with notification email of your electronic upload submittal to the resident engineer and IC@dot.ca.gov.	Submitted by (print name)	Date

Resident Engineers Review and Authorization

This Section Is For Engineers Use

Intelligent Compaction Information

Information submittal reviewed by (print name)	Information submittal reviewed by (signature)	Date
Information submittal complies with the specification requirements? ☐ Yes ☐ No		
Contractor notified of accepted or rejected information submittal by (print name)		Date
The intelligent compaction information submitted by the contractor complies with the specification requirements.		
Resident Engineer (print name)	Resident Engineer (signature)	Date

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize and report mapping of existing pavement information. For questions about this form send an email to: IC@dot.ca.gov

Mapping report summary for cold-in-place recycling performed on:	Mapping Date

COLD-IN-PLACE RECYCLING (CIR) MAPPING INFORMATION

Mapping Location			
Beginning Station/Post Mile	Ending Station/Post Mile		

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Data Analysis Training certificate expiration date. __/__/____
Email address	Phone Number	

Mapping Report Preparer

Mapping Report Completed by (print name)	Signature	Date
Email Address	Phone Number	

Mapping Report Submittals for Mapping With Intelligent Compaction Roller

Data and Software Analysis Results

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
☐ Final coverage histogram of intelligent compaction measurement value	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Final coverage histogram of intelligent compaction measurement value for 528 foot sublots	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment

Color Layout Plots

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
☐ Plot of intelligent compaction measurement value over existing pavement	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Plot of intelligent compaction measurement value for soft areas with intelligent compaction measurement values equal or less than to 10 percent of the average intelligent compaction measurement value of the existing pavement	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Mapping Report Submittals for Mapping With Intelligent Compaction Roller

Locations with Low Intelligent Compaction Measurement Value

Note: To determine soft spots in the under laying material a filtered Veta analysis is required based on the average of the range of intelligent compaction measurement values.

Minimum ICMV	Maximum ICMV	Average ICMV	Filter Target ICMV

Locations Identified with Low Intelligent Compaction Measurement Value (ICMV)

	Location No.	ICMV	X Coordinate	Y Coordinate	
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	14				
	15				
	16				
	17				
	18				
	19				
	20				
	21				
	22				
	23				
	24				
	25				

COMMENTS:

Mapping Report Submittals for Mapping With Coring and Dynamic Cone Penetration	
Plots	
Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
☐ Plot of pavement structural section profile based on cores	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Plot of transverse pavement thickness and lift thickness cross sections based on cores	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Plot of pavement unbonded layer dynamic cone penetration index profile	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Plot of core location coordinates and unbonded layer stiffness description category for each core taken along the roadway transverse axis	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
COMMENTS:	

Mapping Report Submittals for Mapping With Coring and Dynamic Cone Penetration

Locations of Soft Spots in Under Laying Material

Note: Determine soft spots in the under laying material based on Dynamic Cone Penetration Index (DCPI) as shown in following table. Record locations below with either "B" or "C" unbonded layer zone.

	Unbonded Layer Stiffness			
	Average dynamic cone penetration Index (inch/blow)	Unbonded layer zone	Unbonded layer stiffness description	
	<0.7	A	Relatively strong	
	0.7-1.2	B	Marginal strength	
	>1.2	C	Weak, potentially wet	

Locations of Marginal Strength or Weak Unbonded Layer

	Location No.	DCPI	X Coordinate	Y Coordinate	
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	14				
	15				
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	25				

COMMENTS:

Mapping Report Review

COMMENTS:

I have reviewed the intelligent compaction mapping summary report for compliance with the contract specifications requirements.

Quality Control Manger (print name)	Signature	Date Reviewed

Contractor's Submittal Documentation Mapping Report

Submit Adobe *.pdf file of the mapping report to resident engineer within 1 business day of mapping existing pavement.	Submitted by (print name)	Date
Adobe *.pdf file name for quality control report:	Quality control report file name	
Submit Adobe *.pdf file of this form to resident engineer within 1 business day of mapping existing pavement.	Submitted by (print name)	Date

Resident Engineers Review and Authorization Mapping Report

This Section Is For Engineers Use

Mapping report reviewed by (print name)	Mapping report reviewed by (signature)	Date

Mapping report complies with the specification requirements?

☐ Mapping report is adequate

☐ Mapping report does not comply with the specification requirements and must be resubmitted after addressing the comments shown above.

Contractor notified of accepted or rejected quality control report by (print name)	Date

The intelligent compaction mapping report submitted by the contractor complies with the specification requirements.

Resident Engineer (print name)	Resident Engineer (signature)	Date

Intelligent Compaction

Hot Mix Asphalt

Section 39-2.08. Use for intelligent compaction pilot projects.

Most pilot projects will be HMA including OGFC that are placed under the method compaction specification 39-2.01C(15)(b).

Use bid item: 390030 Intelligent Compaction (Lump Sum)

Contact Ebi Fini at ebi.fini@dot.ca.gov for use of this pilot specification.

Replace section 39-2.08 with:

39-2.08 INTELLIGENT COMPACTION FOR HOT MIX ASPHALT

39-2.08A GENERAL

39-2.08A(1) Summary

1

Section 39-2.08 includes specifications for compacting HMA using intelligent compaction. This is a pilot project for evaluating intelligent compaction and the Department will not consider a VECP that substitutes the processes or equipment specified for intelligent compaction. Intelligent compaction does not waive any specifications for HMA.

2

Intelligent compaction uses vibratory steel drum rollers with intelligent compaction equipment and static pneumatic tire rollers equipped with automated machine guidance system that provide roller operator with real time information for quality control and produce data for standardized "Veta" software.

For Veta software, go to:

www.intelligentcompaction.com

3

Use Veta software to analyze the data for coverage uniformity, HMA temperature, and intelligent compaction measurement values.

4

Submit documentation that the technicians have completed 1 or both of the following Department authorized training courses within the last 12 months:

1. Intelligent compaction data analysis
2. Intelligent compaction equipment

Intelligent compaction quality control technician must complete both trainings. Access the approved list of IC Training programs, Intelligent Compaction Quality Control Technicians, and Data Analysis Technicians at:

www.dot.ca.gov/hq/construc/ic

5

Use intelligent compaction rollers and automated machine guidance rollers for breakdown and intermediate compaction.

6. Use if electronic design files are available. Delete paras 7, 8, and 9. Insert CAiCE (kcm), Civil 3D (dwg) or landxml (xml).

The Department furnishes project plan layout files in _____ format. You may create project layout files for the intelligent compaction system, automated machine guidance system and Veta software from the existing pavement using the GPS rover calibrated for the project site.

7. Use if electronic design files are not available and project layout sheets are included in the project plans. Delete paras 6, 8 and 9.

Create project layout files from the project plans or you may create project layout files for the intelligent compaction system, automated machine guidance system and Veta software from the existing pavement using the GPS rover calibrated for the project site.

8. Use if electronic design files or project layout plans are not available and as built plans must be used. Delete paras 6, 7 and 9.

Create project layout files from the as built plans or you may create project layout files for the intelligent compaction system, automated machine guidance system and Veta software from the existing pavement using the GPS rover calibrated for the project site.

9. Use if electronic design files, project layout plans and as-built plans are not available. Delete paras 6, 7 and 8.

Create project layout files for the intelligent compaction system, automated machine guidance system and Veta software from the existing pavement using GPS rover calibrated for the project site.

10

Project layout files must delineate the HMA construction area of project.

39-2.08A(2) Definitions

11

action limit: The minimum and maximum values of a quality control measurement that can be interpreted as representing acceptable performance with respect to the parameter being tested. Values less than the minimum or greater than the maximum action limit or level indicate that corrective action must be taken by the contractor.

all passes data: Compaction data that contain measurements from all passes.

automated machine guidance roller: Rollers equipped with measurement devices installed by the roller manufacturer or a post manufacture retrofit system including GPS, temperature sensor, on-board documentation system, and displays.

California coordinate system of 1983 (CCS83): A set of 6 geographic zones or coordinate systems designed for specific regions of the State of California, the boundaries of which follow county lines. CCS83 is based on NAD83. When a project crosses state plane zone boundaries, a single zone will be used for the entire project.

compaction data: Data collected by intelligent compaction equipment and automated machine guidance compaction equipment.

coordinated universal time (UTC): A time measurement system commonly referred to as Greenwich Mean Time (GMT) based on a 24-hour time scale from the mean solar time at the Earth's prime meridian (zero degrees longitude) located near Greenwich, England.

coverage: Single roller pass over a given area.

final coverage: Compaction data that contain the last pass measurements for a given area.

foot: Unit of measurement equal to U.S. survey foot.

geodetic coordinates: A coordinate system to describe a position in longitude, latitude, and altitude above the imaginary ellipsoid surface based on a specific geodetic datum. The NAD83 datum is required for use with CCS83 State Plane Coordinates.

global positioning system (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. GPS refers to all GPS-related signals including US GPS, and other Global Navigation Satellite Systems (GNSS). GPS satellite signals are subject to interference from canyons, buildings, trees or even fencing. Not all locations are suitable for GPS techniques, and it is your responsibility to determine if the site conditions are practical for GPS, and to notify the Engineer if they are not.

GPS base station: A single ground-based system consisting of a GPS receiver, GPS antenna, and telemetry equipment (typically radio and radio antenna or cellular phone) to provide L1/L2 differential GPS correction signals to other GPS receivers.

GPS correction service subscription: A service that can be subscribed to receive differential GPS correction signals for higher accuracy GPS positioning without the need of a GPS Base Station. Signals are normally received via cellular wireless data services. Examples of GPS correction service subscriptions are: Trimble VRS™, Leica Smart RTK™, STARFIRE™, Topcon TopNet™, OmniSTAR™, or California Real Time Network (CRTN).

GPS rover: A portable L1/L2 GPS antenna, mount, and receiver with telemetry equipment for real time in-situ point measurements

GPS site calibration or localization: A process to establish a relationship between the observed GPS coordinates and the known grid coordinates.

grid: A Cartesian system of XY (or North-East) coordinates utilizing the California State Plane Coordinates, known as the California Coordinate System of 1983 (CCS 83).

intelligent compaction measurement value: A generic term for all intelligent compaction measurements in units specific to each roller manufacturer.

intelligent compaction equipment: Measurement devices installed by the roller manufacturer or a post manufacture retrofit system including accelerometer, GPS, temperature sensor, on-board documentation system, and displays.

intelligent compaction roller: Rollers equipped with measurement devices installed by the roller manufacturer or a post manufacture retrofit system including accelerometer, GPS, temperature sensor, on-board documentation system, and displays.

intelligent compaction target value: Compaction target values established at test strip or specified that are used by roller operator to monitor compaction and in data analysis to generate compaction quality control report.

network real time kinematic (Network RTK): A system that uses multiple bases in real-time to provide high-accuracy GPS positioning within the coverage area that is generally larger than that covered by a single GPS base station.

real time kinematic global positioning system (RTK-GPS): A system based on the use of carrier phase measurements of the available GPS signals where a single GPS base station or RTK network provides the corrections in order to achieve centimeter-level accuracy in real time.

roller pass: Movement of the roller in either direction.

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

39-2.08A(3) Submittals

39-2.08A(3)(a) General

12

At least 15 days before performing intelligent compaction, you must register with the Department's secure file sharing system. To obtain information on the registration process, send an e-mail with your contact information to the following electronic mailbox address:

IC@dot.ca.gov

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Forms for intelligent compaction submittals are available at:

http://www.dot.ca.gov/hq/construc/ic/

39-2.08A(3)(b) Intelligent Compaction Training

39-2.08A(3)(b)(i) Just-in-Time Training

14

At the time of JMF submittal, submit a list of names participating in the just-in-time training. Identify each participant's name, employer, title, and role in intelligent compaction.

15

At least 10 days before the just-in-time training, submit:

1. Just-in-time training presentation and handouts for review
2. Completed Intelligent Compaction Field Operations Just-In-Time Training Review Checklist form
3. Completed Geospatial Data and Analysis Just-In-Time Training Review Checklist form
4. Name of Instructor

39-2.08A(3)(b)(ii) Intelligent Compaction Quality Control Technician Training

16

At least 15 days before performing intelligent compaction, submit the name of your intelligent compaction quality control technician independent of paving crew and corresponding certification of training.

39-2.08A(3)(b)(iii) Data Analysis Technician Training

17

At least 15 days before performing intelligent compaction, submit the name of your data analysis technician and corresponding certification of training

39-2.08A(3)(b)(iv) GPS Site Calibration or Localization Report and Check Testing

18

Submit GPS site calibration or localization report and check testing results for intelligent compaction rollers and automated machine guidance rollers within 1 business day of calibration or check testing.

39-2.08A(3)(c) Reports and Information

39-2.08A(3)(c)(i) General

19

If unable to submit or upload report and information within the specified time, notify the engineer of the actions being taken to submit and upload information timely.

39-2.08A(3)(c)(ii) Reports

39-2.08A(3)(c)(ii)(1) Test Strip

20

Within 1 business day of test strip submit:

1. Hard copy of completed Intelligent Compaction Hot Mix Asphalt Construction Test Strip Submittals Summary
2. Adobe pdf file of the test strip report by email to the Engineer
3. Adobe pdf file of Intelligent Compaction Hot Mix Asphalt Quality Control Report Checklist form by email to the Engineer

39-2.08A(3)(c)(ii)(2) HMA Placement

21

Within 1 business day of HMA placement submit:

1. Hard copy of completed:
   1.1 Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Method Compaction
   1.2 Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Density Requirement.
2. Adobe pdf file of the compaction quality control report by email to the Engineer
3. Adobe pdf file of Intelligent Compaction Hot Mix Asphalt Quality Control Report Checklist form by email to the Engineer

39-2.08A(3)(c)(iii) Information

22

Within 3 business days of test strip or HMA placement:

1. Submit information on a digital medium to the Engineer.
2. Upload information to the Department's secure file sharing system.
3. After uploading the compaction information to the Department's file sharing system, send an email notification of your electronic submittal to the Engineer and IC@dot.ca.gov with the appropriate completed checklist form as an attachment:
   3.1. Intelligent Compaction Hot Mix Asphalt Test Strip Information Checklist
   3.2. Intelligent Compaction Hot Mix Asphalt Quality Control Information Checklist

39-2.08A(3)(d) Data and Software Analysis Results

39-2.08A(3)(d)(i) General

23

Not Used

39-2.08A(3)(d)(ii) Data

24

Submit compaction data in a format that is readable by Veta software. You may combine roller data for multiple rollers operating in echelon into a section file.

25

Name the data file using:

YYYYMMDD_TTCCCRRR_DB_L_B_E_X_PT_TC_T_Data

where:

YYYY = year
MM = Month, leading zero
DD = Day of month, leading zero
TT = District, leading zero
CCC = County, 2 or 3 letter abbreviation shown in section 1-1.08
RRR = Route number, no leading zeros
DB = Traffic direction as NB, SB, WB, or EB
L = Lane number from left to right in direction of travel

B = Beginning station to the nearest foot (i.e., 10+20) or beginning post mile to the nearest hundredth (e.g., 25.06) no leading zero
E = Ending station to the nearest foot (i.e., 14+20) or ending post mile to the nearest hundredth (i.e., 28.06) maximum 6 characters with no leading zero
X = HMA layer number, 1, 2, etc.
PT = Pavement Type (e.g., HMA, RHMA, HMA-O, RHMA-O, RHMA-G, etc.) with maximum 6 characters
TC = Type of compaction "BC" for breakdown compaction, "IC" for intermediate compaction, "FC" for finish compaction. When combined use combination e.g. "BC-IC" for breakdown and intermediate compaction.
T= Type of roller "R" for rubber tire, "SV" for steel drum with vibrator on, "SS" for steel drum static, "SV-SS" for single roller combination of steel drum static and vibratory on.

26

Use the following header information for each compaction data file or section:

Item No.	Description
1	Section Title
2	Machine Manufacture
3	Machine Type
4	Machine Model
5	Drum Width (inch)
6	Drum Diameter (inch)
7	Machine Weight (ton)
8	Name index of intelligent compaction measurement values
9	Unit index for intelligent compaction measurement values
10	Reporting resolution for independent for intelligent compaction measurement values 90 degrees to the roller moving direction (inch)
11	Reporting resolution for independent intelligent compaction measurement values in the roller moving direction (inch)
12	CCS83 Zone
13	Offset to UTC (hrs)
14	Number of IC data points

27

Use the following data field names for each compaction 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 or degrees minutes-seconds)	94.85920403
4	Latitude (decimal degrees or degrees-minutes-seconds)	45.22777335
5	Easting (Foot)	6,096,666.000
6	Northing (Foot)	1,524,166.650
7	Elevation (Foot)	339.9450
8	Roller pass number	2
9	Direction index	1 forward, 2 reverse
10	Roller speed (mph)	2.0
11	Vibration on	1 for yes, 2 for no
12	Frequency (vpm)	3500.0
13	Amplitude (inch)	0.0236
14	Surface temperature (ºF)	270
15	Intelligent compaction measurement values	20.0

Note: Provide either items 3 and 4 or items 5 and 6.

28

The GPS coordinate for each compaction data point recorded in data files must be at the center of the front drum or center of the roller in front.

29

The size of data mesh after post processing must be less than 1.5 feet by 1.5 feet in the X and Y directions.

39-2.08A(3)(d)(iii) Software Analysis Results

30

Analyze the compaction data daily using Veta software and include nuclear gauge and temperature data point tests, target values for passes, HMA temperature, and intelligent compaction measurement values. For a sublot report, use sublot length of 528 feet.

31

For test strips and daily compaction quality control reports you must create and apply a boundary filter for the area of hot mix to be analyzed to exclude extraneous intelligent compaction data. The boundary filter may be applied in the preprocessed raw roller data or created and applied in the Veta software analyses. Create the boundary in Veta software by either importing GPS coordinates measured in the field from the boundary of the area of hot mix asphalt placed or by using the project layout and applying a filter to limit the analysis to the area of hot mix asphalt placed.

32

Name report files and post processed Veta files using:

YYYYMMDD_TTCCCRRR_DB_L_B_E_X_PT_TC_T_TYPE

where:

YYYY = year
MM = Month, leading zero
DD = Day of month, leading zero
TT = District, leading zero
CCC = County, 2 or 3 letter abbreviation shown in section 1-1.08
RRR = Route number, no leading zeros
DB = Traffic direction as NB, SB, WB, or EB
L = Lane number from left to right in direction of travel
B = Beginning station to the nearest foot (i.e., 10+20) or beginning post mile to the nearest hundredth (i.e., 25.06) maximum 6 characters with no leading zero.
E = Ending station to the nearest foot e.g., 14+20) or ending post mile to the nearest hundredth (i.e., 28.06) maximum 6 characters with no leading zero.
X = HMA layer number, 1, 2 …etc.
PT = Pavement Type (e.g., HMA, RHMA, HMA-O, RHMA-O, RHMA-G, etc.) maximum 6 characters.
TC = Type of compaction "BC" for breakdown compaction, "IC" for intermediate compaction or "FC" for finish compaction
T = Type of roller "R" for rubber tire or "S" for steel drum
TYPE = Test strip report use "TS_REPORT" for *.pdf files

Quality control compaction report use "QC_REPORT" for *.pdf files

Post processed Veta files use "VETA"

33

Plots must be scaled to be legible and must be 11 by 17 inches.

39-2.08A(3)(d)(iii)(1) Test Strip

34

Test strip report must include:

1. Completed Intelligent Compaction Hot Mix Asphalt Test Strip Report Summary form
2. Nuclear gauge density per location and corresponding GPS measured coordinates per location
3. All passes compaction curves from Veta software
4. All passes correlation analysis plot from Veta software
5. Field compaction curve density versus number of passes
6. All passes histogram for each roller
7. Color layout plots of:
   7.1. Roller passes for each roller
   7.2. HMA temperature for 1st coverage of breakdown compaction
   7.3. HMA temperature for final coverage of intermediate compaction
   7.4. Intelligent compaction measurement value for final coverage of steel drum with vibration "on"
8. Hot mix asphalt mat temperature readings with corresponding GPS coordinates

35

Test strip information must include:

1. Adobe pdf file of the test strip report from data analysis performed using Veta software
2. Adobe pdf file of Intelligent Compaction Hot Mix Asphalt Test Strip Information Checklist
3. Project layout data files which can be imported to Veta software
4. Test strip boundary data files which can be imported to Veta software
5. Nuclear gauge density readings and the corresponding coordinates which can be imported into Veta software
6. Electronic data from compaction rollers in file format readable by Veta software
7. Post processed Veta file * vetaproj used for creating the test strip report

39-2.08A(3)(d)(iii)(2) HMA Compaction

36

For each day of production, prepare a HMA compaction quality control report that includes:

1. Summary of HMA compaction quality control results on Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Method Compaction form or Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Density Requirement form.
2. Veta software analysis report results for:
   - 2.1 Percent compliance with target roller passes
   - 2.2 Percent compliance with target HMA temperature for 1st coverage of breakdown compaction
   - 2.3 Percent compliance with target HMA temperature for final coverage of intermediate compaction
   - 2.4 Percent compliance with target HMA intelligent compaction measurement value when measurement of intelligent compaction measurement value is required
3. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on
4. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on for a sublot
5. All passes histogram for each roller
6. Color layout plots of:
   - 6.1. Roller passes for each roller
   - 6.2. HMA temperature for 1st coverage of breakdown compaction
   - 6.3. HMA temperature for final coverage of intermediate compaction
   - 6.4. Intelligent compaction measurement value for final coverage of intermediate compaction when required
7. Quality control density measurements and corresponding GPS coordinate
8. Hot mix asphalt mat temperature readings with corresponding GPS coordinates

37

Plots must include quality control density testing and HMA mat temperature locations and test results.

38

Quality control compaction information must include:

1. Adobe pdf file of the compaction quality control report from data analysis performed using Veta software
2. Adobe pdf file of Intelligent Compaction Hot Mix Asphalt Quality Control Report Checklist form
3. Project layout data files which can be imported to Veta software
4. Boundary data files which can be imported to Veta software
5. Nuclear gauge density readings and the corresponding GPS coordinates which can be imported into Veta software
6. HMA mat temperatures and the corresponding GPS coordinates which can be imported into Veta software
7. Electronic data from compaction rollers in file format readable by Veta software
8. Post processed Veta file *vetaproj for the day of production

39-2.08A(4) Quality Assurance

39-2.08A(4)(a) General

39

For HMA placed under 39-2.01C(15)(b) and 39-2.02C method compaction, use intelligent compaction rollers and automated machine guidance rollers for documenting that HMA compaction complies with the method compaction requirements for the followings:

1. Number of roller passes
2. HMA temperature for 1st coverage of breakdown compaction
3. HMA temperature at the completion of intermediate compaction

40

Do not collect intelligent compaction measurement values when the compacted HMA layer is less than 0.15 foot.

41

When HMA thickness is 0.15 foot or greater, collect intelligent compaction measurement values which is correlated to the specified HMA target density at the test strip.

42

The number of roller passes, HMA temperature and intelligent compaction measurement values are report only and are not used for compaction acceptance.

43

39-2.08A(4)(b) Prepaving Meeting

The intelligent compaction quality control technician must attend the prepaving meeting.

39-2.08A(4)(c) Technical Representative

44

A technical representative from the intelligent compaction equipment manufacturer and automated machine guidance system or post manufacture retrofit system must be on site during the initial setup, verification testing of the compaction rollers and 1st 2 days of production.

39-2.08A(4)d) Quality Control Technician

45

During HMA compaction provide a full time intelligent compaction quality control technician independent of paving operation to be responsible for oversight of the following:

1. GPS site calibration or localization and upload to all GPS receivers.
2. GPS check testing for the compaction rollers and rovers.
3. Daily accuracy verification of the temperature sensor by comparing to a NIST traceable standard and taking corrective action when the accuracy of temperature sensor is not verified. The equipment temperature sensor measurement must be within ± 3 degrees F of NIST traceable standard.
4. Test section construction to establish target compaction pass counts and target values for the stiffness of the HMA using nuclear gauges, pavement cores, and intelligent compaction rollers.
5. Construction operation monitoring of the compaction rollers.
6. Quality control testing for pavement temperature and compaction.
7. Backing up data compaction data twice per day.
8. Downloading data from rollers at the end of the work shift.
9. Exporting final coverage and all-passes data to Veta software compatible form by using vendor specific intelligent compaction software.
10. Monitoring daily compaction quality control report results for compliance with the requirements in these specifications and taking corrective action when necessary for compliance.
11. Daily set-up, take-down, of GPS and compaction roller components.

39-2.08A(4)(e) Data Analysis Technician

46

Provide an intelligent compaction data analysis technician who is responsible for performing the following:

1. Analyzing the data from the compaction rollers using Veta software and producing reports
2 Submitting and uploading intelligent compaction reports and information

39-2.08A(4)(f) Intelligent Compaction Training

39-2.08A(4)(f)(i) General

47

Not Used

39-2.08A(4)(f)(ii) Just-in-Time Training

48

Provide just-in-time training onsite or near the job site for your personnel and Department project personnel. Provide an enclosed facility with electrical availability for visual presentations. Schedule the just-in-time training with the Engineer at a mutually agreed time and place.

The Just-In-Time Training instructor must be in possession of valid certifications required for Intelligent Compaction Quality Control Technician.

49

The just-in-time-training for intelligent compaction is divided into 2 sessions:

1. Intelligent compaction field operations
2. Intelligent compaction geospatial data analysis

39-2.08A(4)(f)(iii) Intelligent Compaction Field Operations Just-in-Time Training

50

Intelligent compaction field operations just-in-time training must be at least 2 hours in duration and include the following topics:

1. Background information for the specific intelligent compaction system and automated machine guidance system to be used.
2. Setup and checks for compaction systems including:
   2.1. GPS receiver
   2.2. GPS rovers
   2.3. Rollers
3. Operation of the intelligent compaction system and automated machine guidance systems on the rollers including:
   3.1. Setup data collection
   3.2. Start/stop of data recording
   3.3. On-board display options
4. Monitoring and communication
5. Action limits to be used by the roller operators for:
   5.1 HMA Mat Temperature
   5.2 Number of passes

51

The following personnel must attend the intelligent compaction field operations just in time training:

1. Roller operators
2. Intelligent compaction quality control technician
3. Technical representative
4. HMA foreman

39-2.08A(4)(f)(iv) Intelligent Compaction Geospatial Data Analysis Just-in-Time Training

52

Intelligent compaction geospatial data analysis just-in-time training must be at least 2 hours in duration and include the following topics:

1. Cover specification requirements for submittal of reports and information including file naming requirements report preparation
2. Report submittals
3. Information submittals
4. Corrective actions to be taken when coverage and uniformity requirements are not met

53

The following personnel must attend the intelligent compaction geospatial data and analysis just in time training:

1. HMA foreman
2. Intelligent compaction quality control technicians
3. Data analysis technician

39-2.08A(6) IC Test Strip

39-2.08A(6)(a) General

54

When HMA thickness is 0.15 foot or greater, a test strip is used to establish intelligent compaction target values. Establish intelligent compaction target values for the following:

1. Number of roller passes for breakdown compaction
2. Minimum temperature in degrees F for roller 1st pass of breakdown compaction
3. Number of roller passes for intermediate compaction
4. Minimum temperature in degrees F for completing intermediate compaction
5. Intelligent compaction measurement value

55

The target number of roller passes is based on your roller pattern established to achieve specified density.

56

To establish target minimum hot mix asphalt mat temperatures:

No table of contents entries found.1. Use Veta software to analyze the hot mix asphalt mat temperature for 1st pass of breakdown
compaction to establish the target minimum tempe
rature in degrees for the 1st pass of breakdown compaction.
2. Use Veta software to analyze the hot mix asphalt mat temperature for last pass of intermediate compaction to establish the target minimum temperature in degrees for F for the last pass of intermediate compaction.

39-2.08A(6)(b) Initial Establishment of Target Value for Intelligent Compaction Measurement Value

57

On the 1st day of placement of each layer of HMA, construct a test strip at least 500 feet long to determine the intelligent compaction target values. Use handheld rover to establish boundary for the 500 foot section. Use handheld rover to establish 3 randomly selected nuclear gauge density test locations. Nuclear gauges must be correlated with density cores under Part 2 of California Test 375.

58

Establish the target intelligent compaction measurement value within the test strip as follow:

1. After each coverage, use a nuclear gauge to measure the density of the HMA at 3 preselected locations throughout the covered 500 foot section. Record the density readings, and number of roller passes.
2. Establish the density of the tests strip for each coverage by averaging the density at the 3 locations.
3. Continue roller passes and collecting nuclear gauge density readings until the density remains constant, decreases, or reaches maximum specified density. The density target value is the maximum specified density or the maximum density on the plot of test strip density versus number of passes for each coverage target value. The target number of roller passes is the number of passes for each roller in reaching the maximum density.
4. When you determine that the density remains constant, decreases, or reaches maximum specified density, take an additional 7 randomly selected nuclear gauge readings. If the average density of the 10 locations determined for the last coverage indicates an increase in density by more than 3 percent,

then continue rolling and testing, except if the average density equals or exceeds the maximum specified density.
5. Use Veta software to create compaction curve and relate the number of target value for roller passes to intelligent compaction measurement values.
6. Use the Veta software generated correlation analysis report for all passes to establish production target intelligent compaction measurement value based on target density (percent theoretical maximum density) that meets the specified in-place compaction requirements.

59

If the last roller coverage of intermediate compaction is not done with the steel drum roller with vibration on, establish target intelligent compaction measurement value for the final roller pass of the steel drum roller with vibration on based on your test strip roller pattern.

39-2.08A(6)(c) Reestablishment of Target Value for Intelligent Compaction Measurement Value

60

Reestablish the target intelligent compaction measurement value by recording density readings versus measured intelligent compaction measurement value. During HMA placement within a 500 foot section, for the roller pass used as the basis for the target intelligent compaction measurement value use a nuclear gauge to measure the density at 3 random locations. Record the density readings, roller pass number, and the GPS coordinates for each test location. Use handheld rover to establish boundary for the 500 foot section.

61

Use the Veta software generated correlation analysis report to reestablish production target value for intelligent compaction measurement value based on target density (percent theoretical maximum density) that meets the specified in-place compaction requirements. If the last roller coverage of intermediate compaction is not done with the steel drum roller with vibration on, reestablish target intelligent compaction measurement value for the final roller pass of the steel drum roller with vibration on based on your roller pattern.

39-2.08B MATERIALS

62

Not Used

39-2.08C CONSTRUCTION

39-2.08C(1) General

63

Before the start of production upload the project layout file into the intelligent compaction data analysis software and depending on the roller manufacture, on-board documentation system of the rollers.

39-2.08C(2) Equipment

39-2.08C(2)(a) General

64

Not Used

39-2.08C(2)(b) Rollers

65

In addition to the requirements of section 39-2.01C(2)(a), each intelligent compaction roller must:

1. Be 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. With vibratory on, produce output that represents the stiffness of the material based on the vibration of the roller drums and the measured response from the underlying materials

4. Have mounted GPS receiver, antenna, and telemetry equipment to monitor the drum locations and track the number of passes.
5. Include an integrated on-board documentation system that is capable of displaying real-time color-coded maps, including the stiffness response values, vibration frequencies, roller drum amplitude, roller location, number of roller passes, roller speeds and capable of transferring data from a USB port.

66

In addition to the requirements in section 39-2.01C(2)(a), automated machine guidance pneumatic tire rollers must meet the following:

1. Be equipped with non-contact temperature sensors for measuring pavement surface temperatures.
2. Have GPS radio and receiver units mounted on each automated machine guidance roller to monitor the roller locations and track the number of passes of the rollers.
3. Include an integrated on-board documentation system that is capable of displaying real-time color-coded maps of roller location, number of roller passes, roller speeds and capable of transferring data from a USB port.

39-2.08C(2)(c) Global Positioning System

39-2.08C(2)(c)(i) General

67

GPS must be real time kinematic using one of the following:

1. GPS base station
2. Network real time kinematic (RTK)
3. Satellite based augmentation station system capable of providing position accuracy within 0.25 foot

68

You may use other high precision positioning systems in lieu of GPS. The positioning system must meet or exceed the precision specified for GPS.

69

GPS used must provide a minimum 90 percent coverage of project site.

70. Insert the zone number. Caltrans Survey manual:

http://www.dot.ca.gov/hq/row/landsurveys/SurveysManual/Manual_TOC.html

GPS devices for this project must be set to the same consistent datum, coordinate system, CCS83 zone, and site calibration or localization. The CCS83 zone must be set to zone no.____.

71

39-2.08C(2)(c)(ii) Correction Signal Source

72

Provide either a GPS base station correction signal or a GPS correction service subscription. The GPS correction signal must be received by the GPS receivers on the compaction roller and the rovers during operations with a survey tolerance of not greater than 0.25 foot in both X and Y horizontal directions.

73

Install GPS repeaters at selected locations to relate the GPS correction signal to resolve GPS shadows.

39-2.08C(2)(c)(iii) Survey Control Points

74. Provide Project Control Map in project plans. Delete paras 75–76.

Survey control points are indicated on the project control map in the project plans.

75. When no Project Control Map, provide survey control points in Supplemental Project Information. Delete paras 74 and 76.

Survey control points are included in supplemental project information.

76. Use if survey control are not available prior to project advertisement. Delete paras 74–75

Request horizontal survey control points at least 15 days before the GPS site calibration or localization. Survey control points will be provided at least every mile.

39-2.08C(2)(c)(iv) GPS Site Calibration or Localization and Check Testing

77

At least 2 business days before start of production, perform a GPS site calibration or localization to the survey control points.

78

Whenever the GPS base station is moved to a new location, verify GPS base station position by measuring the position of two known points using a rover. Perform a GPS site calibration or localization if the position of known points and measured positions differ by more than 3 centimeters.

79

At least 2 business days before start of production, perform roller verification testing by conducting roller check testing.

80

Before the start of daily production and using the same datum, conduct check testing for the proper setup of the GPS, the GPS on the rollers, and the GPS rover:

1. On a location nearby or within the project limits, the GPS base station, if required by the GPS, must be established and the compaction roller and the GPS rover must be 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. Verify the roller GPS coordinates by:
   - 3.1. Stopping the roller at a location
   - 3.2. Marking the location of both ends of the roller drum or the outside of the front tires on the surface with a tee
   - 3.3. Recording the GPS measurements from the roller ensuring the distance offsets are applied so that the GPS coordinate is at the center of the front drum
   - 3.3 Moving the roller from the marked location
   - 3.4. Finding the mid-point of the two marked ends of the roller and mark this location on the surface. This marked location is the theoretical center of the front drum or center of front axle.
   - 3.5. Using the GPS rover to measure GPS coordinates of the marked location and record the GPS measurements.
   - 3.6. Computing the difference between recorded compaction roller GPS coordinates and GPS rover recorded GPS measured coordinates. The differences of the coordinates in grid must be within 0.5 foot in both the horizontal axes X and Y.

39-2.08C(2)(c)(v) IC Temperature Sensor Calibration and Accuracy Verification

81

Before the start of daily production, calibrate the intelligent compaction temperature sensors and verify the proper setup of the temperature sensors on the rollers:

1 Power on the IC temperature sensors, a minimum of 10 minutes, before verifying measurements.
2. Collect and compare the temperature measurements from an independent NIST traceable standard device and the IC temperature sensors, front and rear when installed.
3. The temperature sensor measurements must compare within 5 degrees F. Take corrective action when the difference in temperature measurements is more than 5 degree F.

39-2.08C(3) HMA Compaction

39-2.08C(3)(a) General

82

Intelligent compaction does not apply to areas of hot mix asphalt placed under Bid Item "Replace Asphalt Concrete Surfacing" or areas shown as digouts.

83

During HMA compaction, monitor each roller's compaction graphical user interface display for roller passes, and HMA temperature. When HMA layer thickness is 0.15 foot or greater, monitor each roller's compaction graphical user interface display for intelligent compaction measurement value.

84

For every 4 hours of HMA placement, use a verified NIST traceable temperature measuring device and measure the temperature of the HMA at 3 random locations on 1st pass of breakdown and last pass of intermediate compaction. The temperature measuring device must be within ± 3 degrees F of NIST traceable standard. Use GPS rover to measure and record coordinates of each temperature test point reading.

85

For intermediate compaction of RHMA-G, use an intelligent compaction roller instead of the automated machine guidance pneumatic tire roller.

86

When HMA thickness is 0.15 foot or greater, use GPS rover to measure and record coordinates of each quality control nuclear gauge reading and corresponding pass number.

87

For each day of HMA placement establish the boundaries of the area for HMA placed using the rover.

39-2.08C(3)(b) Roller Coverage, HMA Temperature, and Intelligent Compaction Measurement Values

88

At least 90 percent coverage of the construction area must meet or exceed the target number of passes for each roller type. When the daily HMA compaction quality control report shows the specified or target roller passes are not met, take corrective action and notify the Engineer of action taken.

89

When the roller HMA temperature sensor indicates compaction temperatures are below target temperatures take immediate corrective action.

90

For HMA less than 0.15 foot in layer thickness, at least 95 percent of the collected temperature data within coverage of the construction area must be no more than 20 degrees F below the target temperatures specified. When the daily HMA compaction quality control report indicates less than 95 percent of the construction area is completed after HMA is more than 20 degrees F below the target temperature, implement corrective action before the next HMA placement day and notify the Engineer.

91

For HMA 0.15 foot or greater in layer thickness, at least 95 percent of the collected temperature data within coverage of the construction area must comply with the target temperatures established at the test strip. When the daily HMA compaction quality control report indicates less than 95 percent of the construction area is completed after HMA is below the target temperature, implement corrective action before the next HMA placement day and notify the Engineer.

92

For HMA 0.15 foot or greater in layer thickness, monitor the intelligent compaction measurement value against the target value established in the test strip. If intelligent compaction measurement value is 10 percent or more below the target value, verify that HMA compaction complies with density specified requirements with a nuclear gauge.

93

If the daily average intelligent compaction measurement value is 20 percent or more below the target measurement value, reestablish the target value for intelligent compaction measurement value.

94

For HMA 0.15 foot or greater in layer thickness, when density is verified, then the corrective action for number of passes and temperature is not required.

39-2.08D PAYMENT

95

Not Used

Hot Mix Asphalt
Intelligent Compaction Target Values
Method Compaction

IC Requirements	HMA Type A Unmodified Asphalt Binder	HMA Type A PG-M Asphalt Binder	RHMA-G
Breakdown Compaction Minimum Temperature °F 1st PASS	250	240	285
Breakdown Compaction Number of Passes	3	3	3
Intermediate Compaction Minimum Temperature °F Last Pass	190	180	250
Intermediate Compaction Number of Passes	3	3	3

Hot Mix Asphalt
Open Graded Friction Course (OGFC)
Intelligent Compaction Target Values
Method Compaction

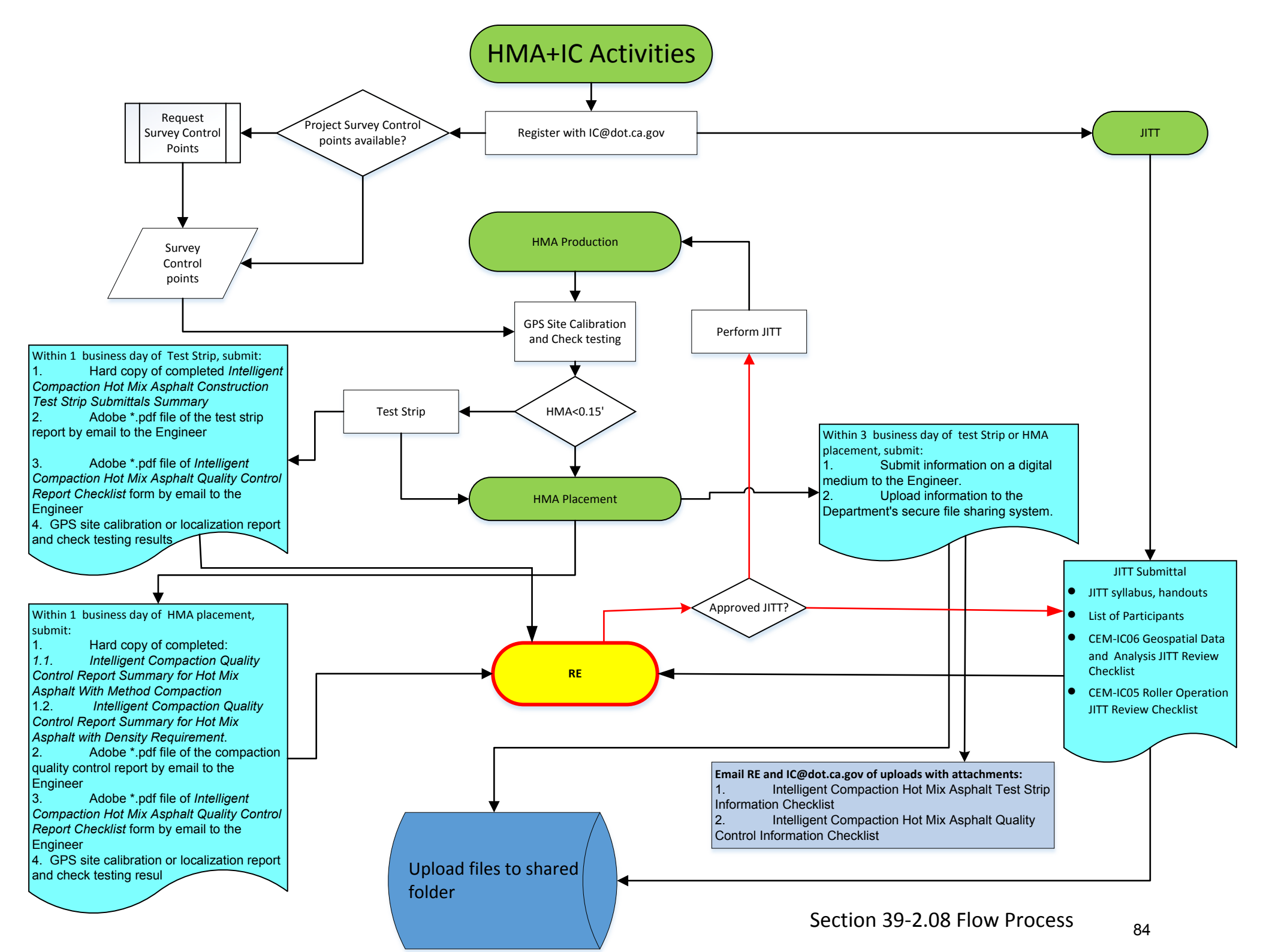
IC Requirements	OGFC Unmodified Asphalt Binder	OGFC PG-M Asphalt Binder	OGFC RHMA-O RHMA-HB
Breakdown Compaction Minimum Temperature °F 1st PASS	240	240	280
Complete Compaction Minimum Temperature °F Last Pass	200	180	250
Minimum Number of Passes	2	2	2

Warm Mix Asphalt
Intelligent Compaction Target Values
Method Compaction

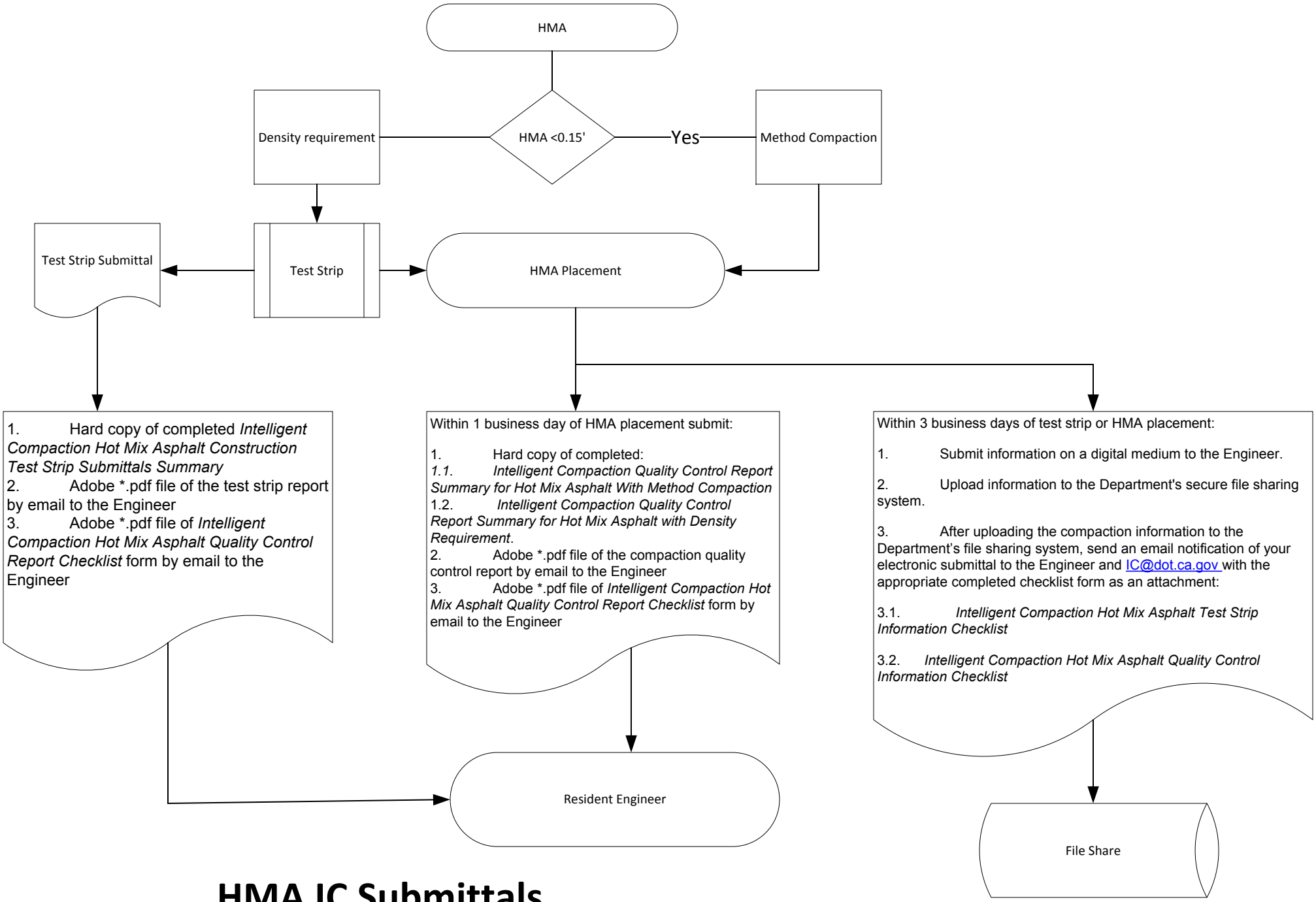
IC Requirements	HMA Type A Unmodified Asphalt Binder	HMA Type A PG-M Asphalt Binder	RHMA-G
Breakdown Compaction Minimum Temperature °F 1st PASS	240	230	260
Breakdown Compaction Number of Passes	3	3	3
Intermediate Compaction Minimum Temperature °F Last Pass	190	170	230
Intermediate Compaction Number of Passes	3	3	3

Warm Mix Asphalt
Open Graded Friction Course (OGFC)
Intelligent Compaction Target Values
Method Compaction

IC Requirements	OGFC Unmodified Asphalt Binder	OGFC PG-M Asphalt Binder	OGFC RHMA-O RHMA-HB
Breakdown Compaction Minimum Temperature °F 1st PASS	230	230	270
Complete Compaction Minimum Temperature °F Last Pass	190	170	240
Minimum Number of Passes	2	2	2



Section 39-2.08 Flow Process



HMA IC Submittals

SAMPLE
INTELLIGENT COMPACTION HOT MIX ASPHALT COMPACTION QUALITY CONTROL REPORT

Office of Construction Engineering
Caltrans
November 2015

Method Compaction

For each day of production, prepare a HMA compaction quality control report that includes:

1. Summary of HMA compaction quality control results on *Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt With Method Compaction* form or *Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Density Requirement* form.
2. Veta analysis report results for:
   2.1. Percent compliance with target roller passes
   2.2. Percent compliance with target HMA temperature for first coverage of breakdown compaction
   2.3. Percent compliance with target HMA temperature for final coverage of intermediate compaction
3. Final coverage histogram of number of passes for each roller
4. Final coverage histogram of number of passes for each roller for a fixed interval.
5. All passes histogram for each roller
6. Color layout plots of:
   6.1. Roller passes for each roller
   6.2. HMA temperature for first coverage of breakdown compaction.
   6.3. HMA temperature for final coverage of intermediate compaction.
8. Hot mix asphalt mat temperature readings with corresponding GPS coordinates.

37

INTELLIGENT COMPACTION QUALITY CONTROL REPORT SUMMARY
FOR HOT MIX ASPHALT WITH METHOD COMPACTION
CEM-IC15 (NEW 06/24/2015)

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize the daily hot mix asphalt method compaction intelligent compaction quality control report information. For questions about this form send an email to: IC@dot.ca.gov

HOT MIX ASPHALT (HMA) PLACEMENT INFORMATION

HMA Placement Location		HMA Placement Date
Beginning Station	Ending Station	HMA Type
IC Quality Control Technician (ICQCT)		ICQCT Phone Number

HMA Method Compaction Requirements

Determine the following requirements for HMA compaction based on the specifications for the type of HMA being placed.

IC Requirements	HMA Target Values		IC Requirements	OGFC Target Values
Breakdown Compaction Minimum Number of Passes			Minimum Number of Passes	
Breakdown Compaction Minimum Temperature °F 1st PASS			Breakdown Compaction Minimum Temperature °F 1st PASS	
Intermediate Compaction Minimum Number of Passes			Complete Compaction Minimum Temperature °F	
Intermediate Compaction Minimum Temperature °F				

DAILY COMPACTION QUALITY CONTROL REPORT SUMMARY

HMA/RHMA Compaction Veta Analysis Report Results

Does the number of passes for breakdown compaction roller results show that at least 90 percent coverage of the HMA placement construction area met or exceed the minimum number of roller passes specified for breakdown compaction?
☐ Yes ☐ No

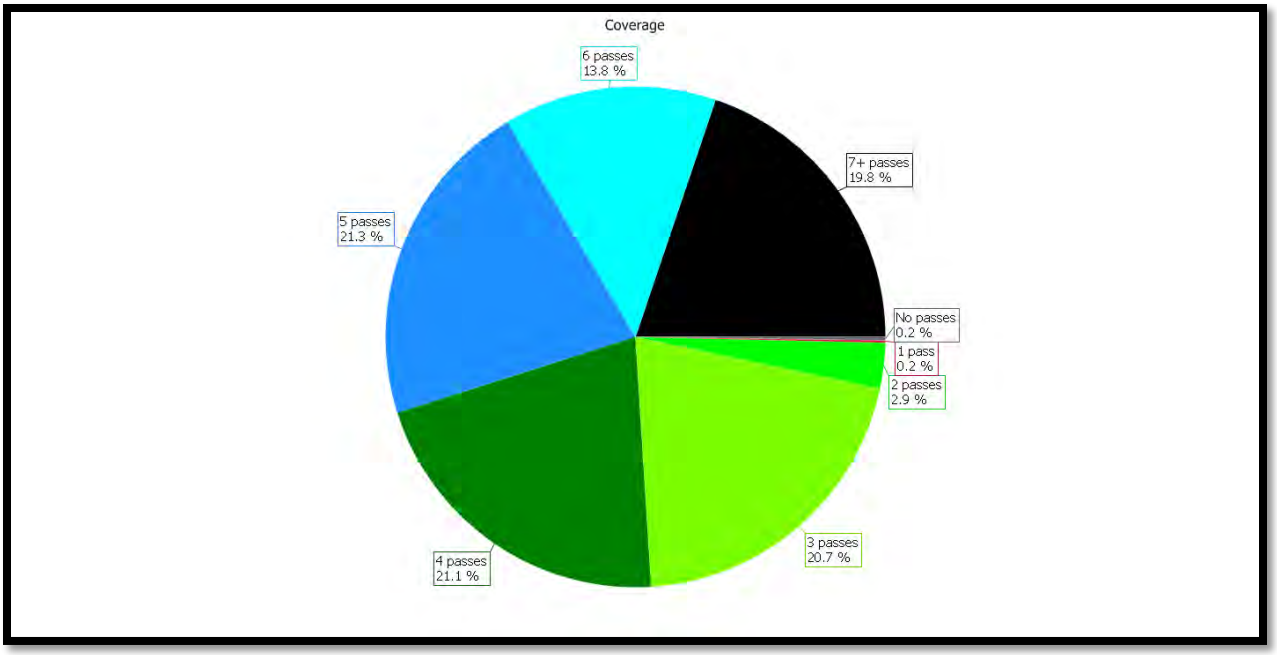
If no, corrective action taken:

Does the 1st PASS breakdown compaction temperature results show that temperature meet or exceed the minimum temperature specified based on the HMA type for at least 95% of the daily HMA placement area?
☐ Yes ☐ No

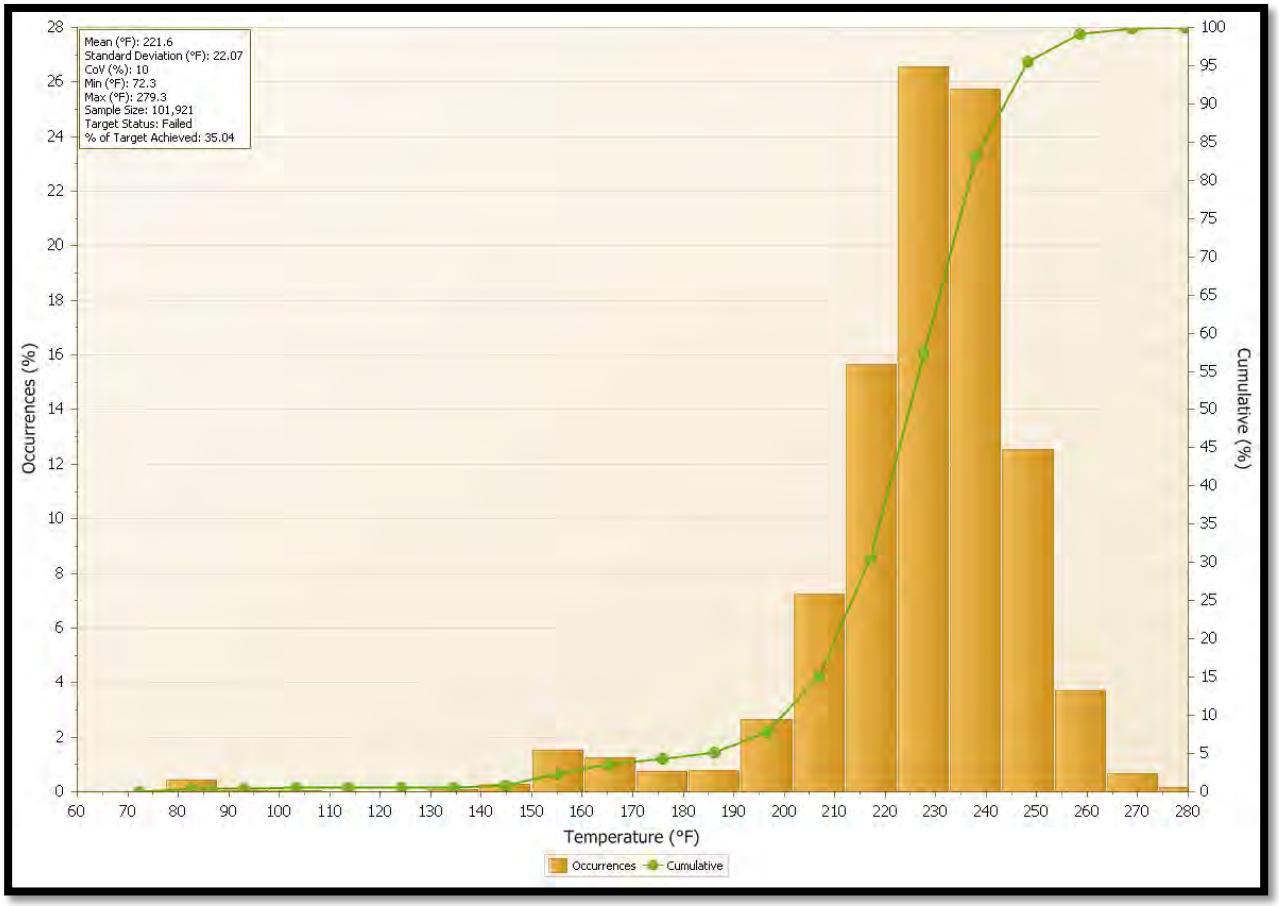
If no, corrective action taken:

Does the number of passes for intermediate compaction roller results show that at least 90 percent coverage of the HMA placement construction area met or exceed the minimum number of roller passes specified for intermediate compaction?
☐ Yes ☐ No

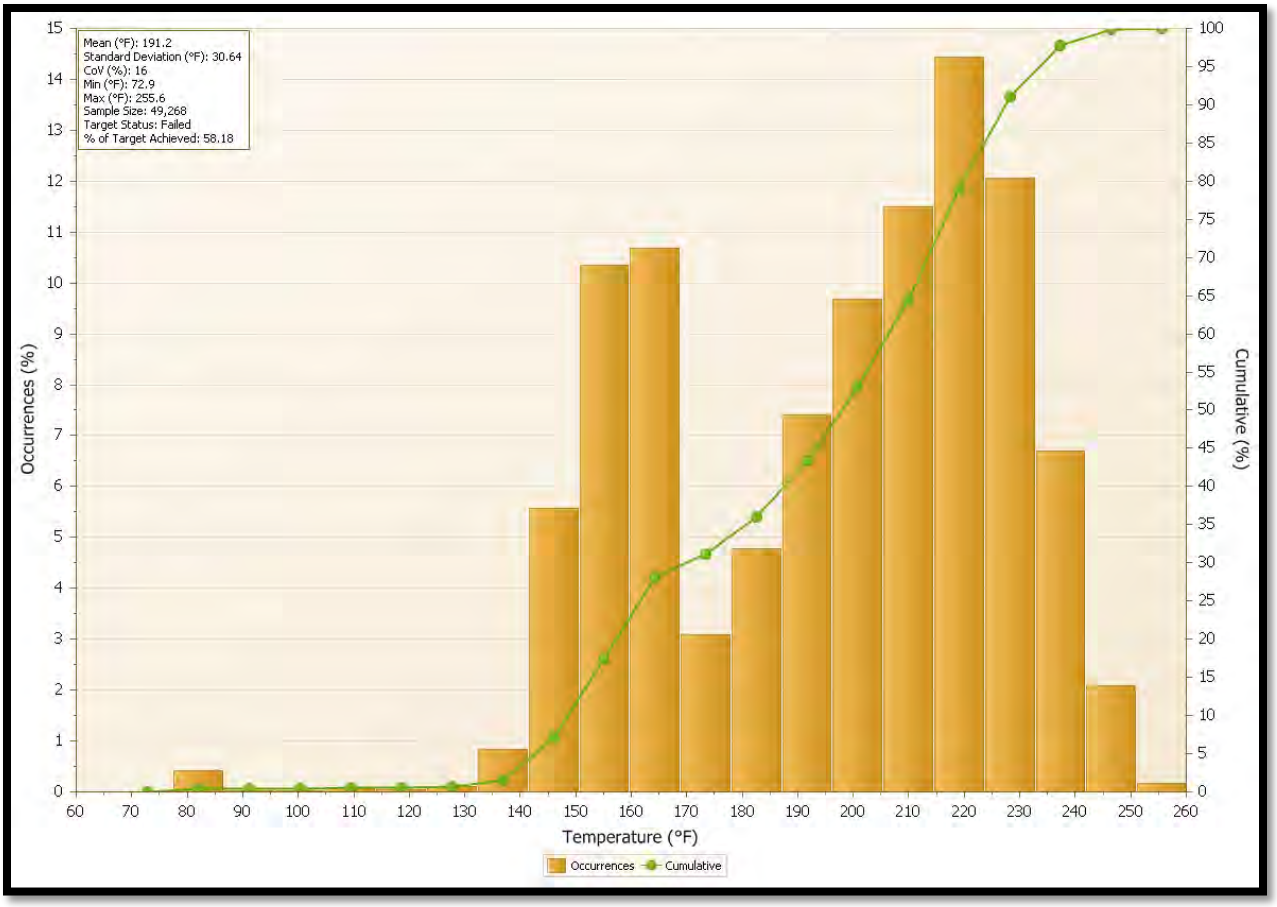
If no, corrective action taken:



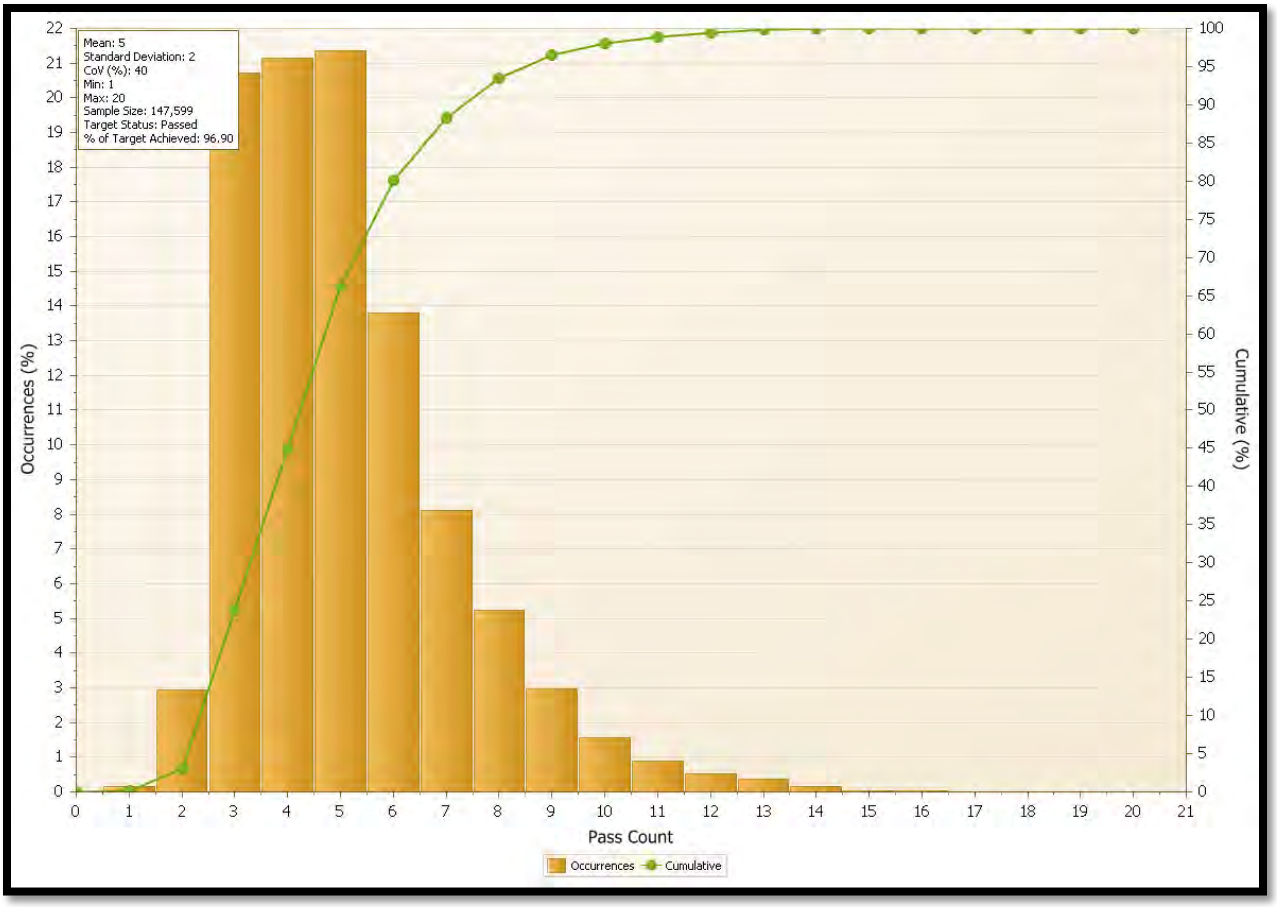
Percent compliance with target roller passes



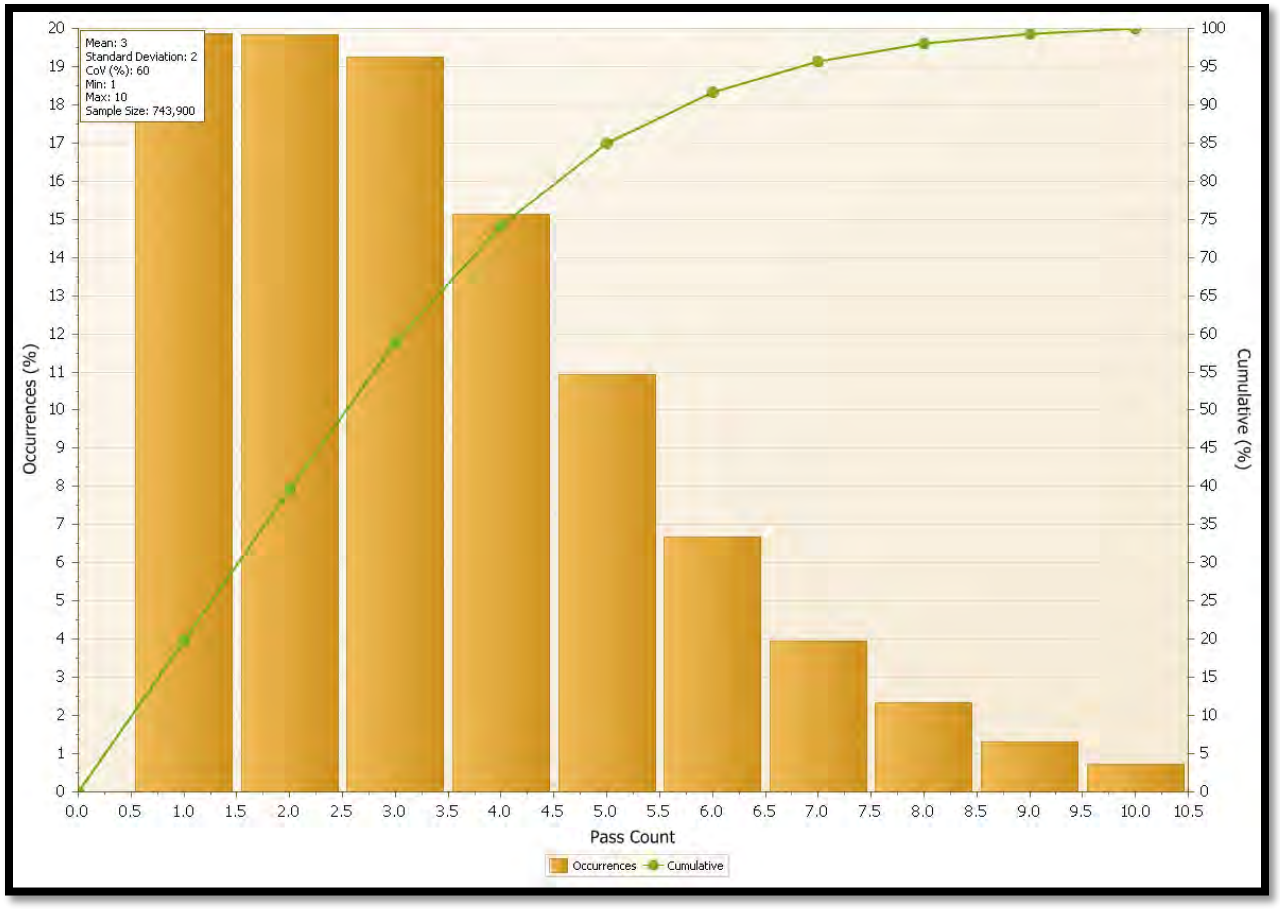
Percent compliance with target HMA temperature for first coverage of breakdown compaction



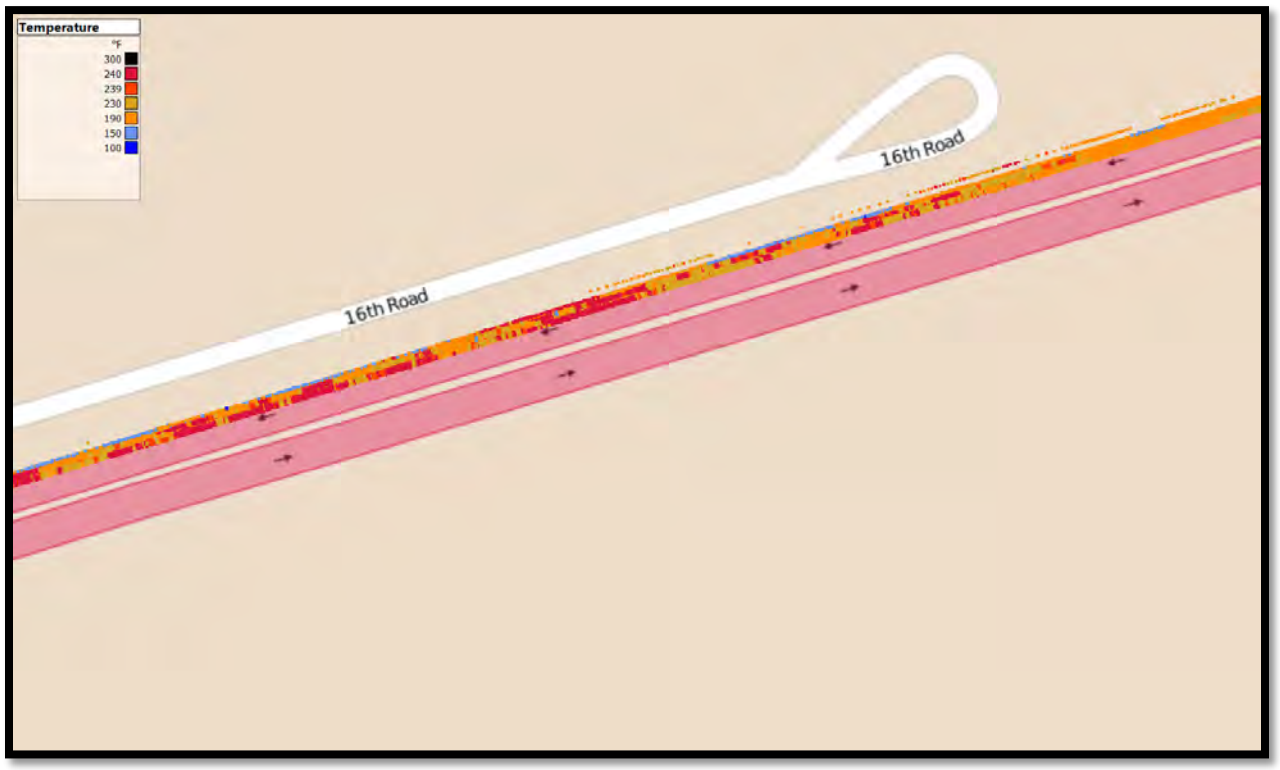
Percent compliance with target HMA temperature for final coverage of intermediate compaction



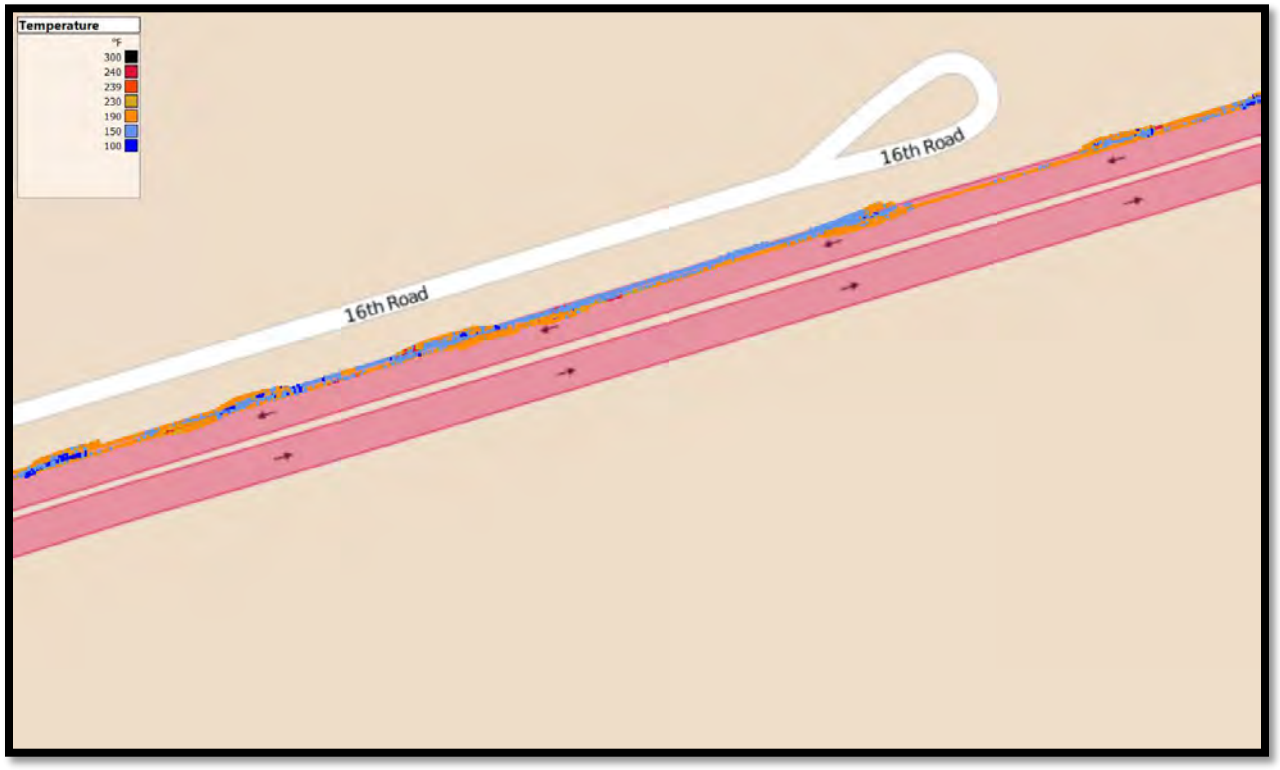
Final coverage histogram of number of passes for each roller



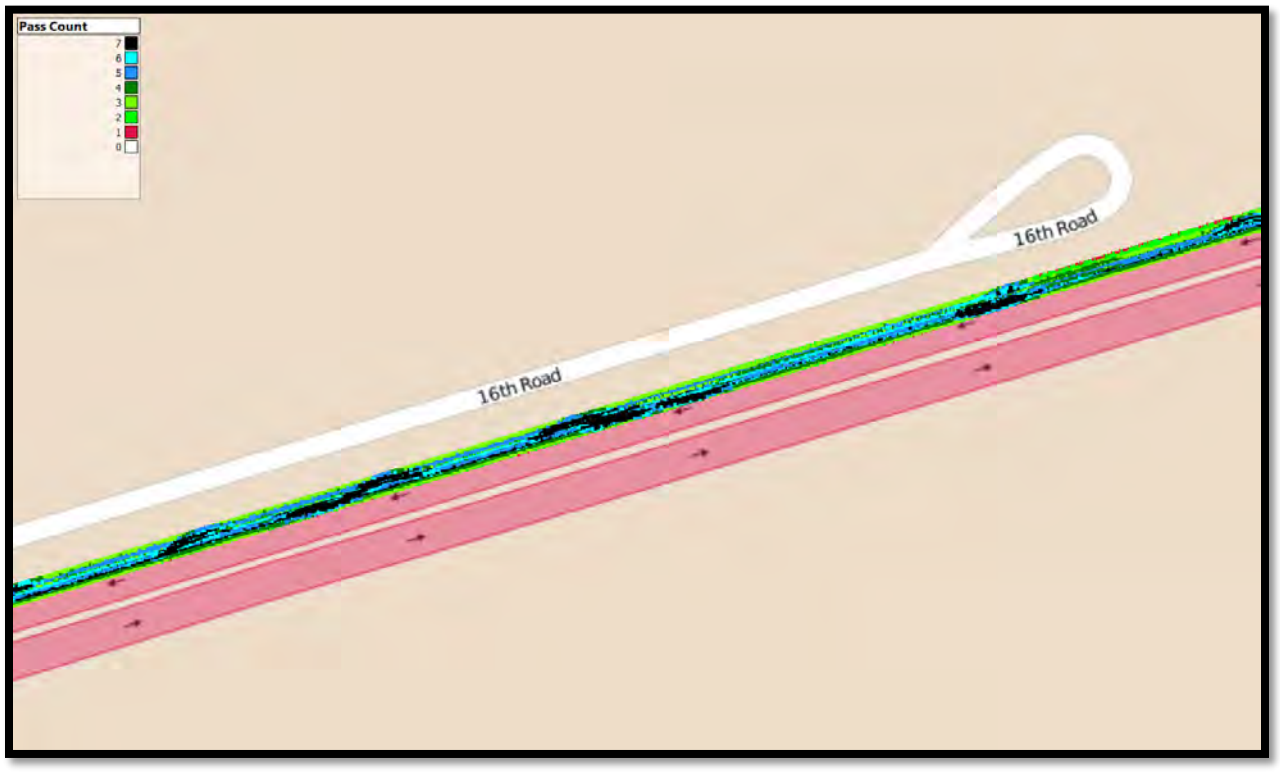
All passes histogram for each roller



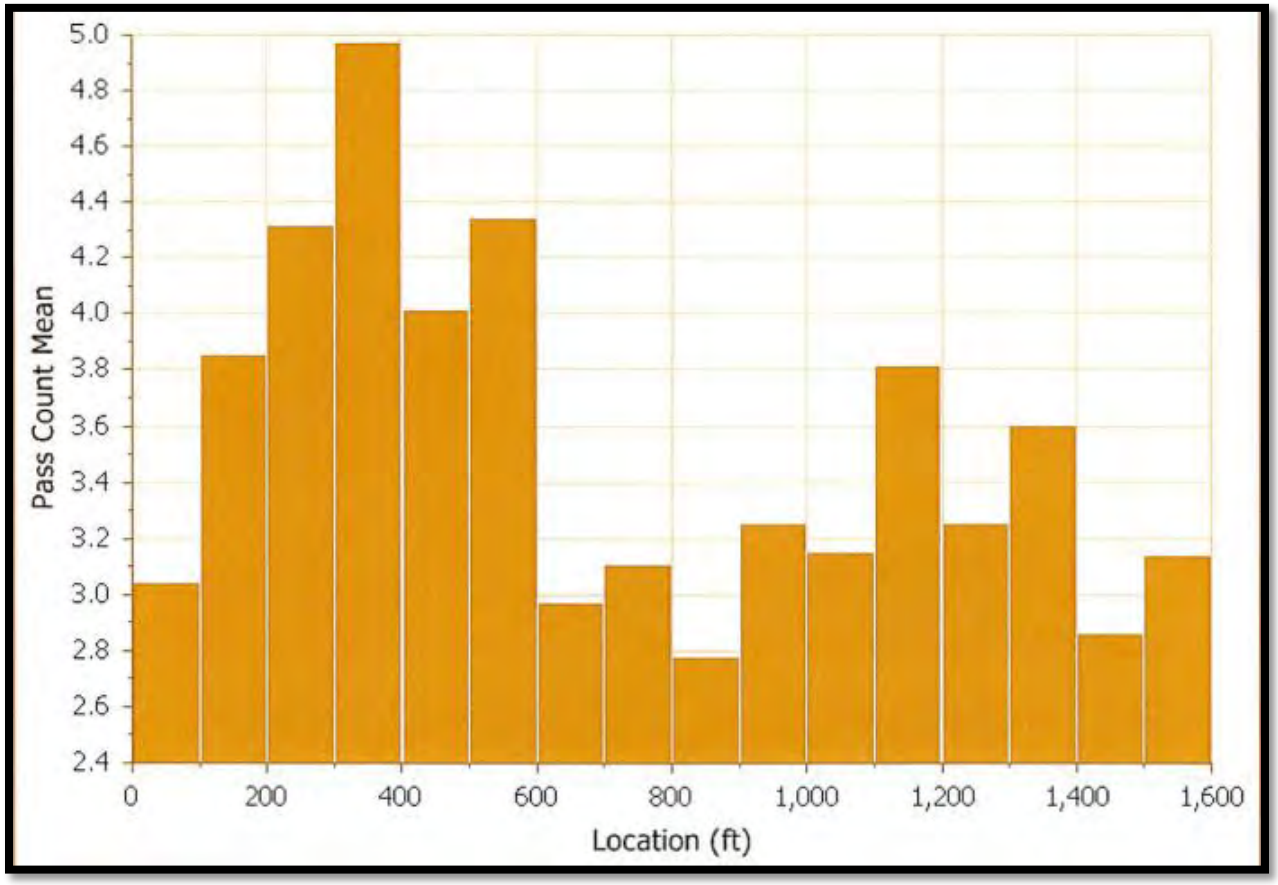
HMA temperature for first coverage of breakdown compaction.



HMA temperature for final coverage of intermediate compaction.



Roller passes for each roller



Final coverage histogram of number of passes for each roller for a fixed interval.

Break Down Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
1	09/12/15	6707143.447	2422187.275	Layer Moduli	237.1
2	09/12/15	6706573.992	2422092.686	Layer Moduli	235.5
3	09/12/15	6706561.677	2422098.211	Layer Moduli	249.8

Intermediate Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
4	09/12/15	6707143.447	2422187.275	Layer Moduli	225.9
5	09/12/15	6706573.992	2422092.686	Layer Moduli	212.2
6	09/12/15	6706561.677	2422098.211	Layer Moduli	221

Finish Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
7	09/12/15	6707143.447	2422187.275	Layer Moduli	167.5
8	09/12/15	6706573.992	2422092.686	Layer Moduli	158.5
9	09/12/15	6706561.677	2422098.211	Layer Moduli	164.4

Hot mix asphalt mat temperature readings with corresponding GPS coordinates

Density Requirement Compaction

For each day of production, prepare a HMA compaction quality control report that includes:

1. Summary of HMA compaction quality control results on *Intelligent Compaction Quality Control Report Summary for Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Density Requirement* form.
2. Veta analysis report results for:
   2.1 Percent compliance with target roller passes
   2.2 Percent compliance with target HMA temperature for first coverage of breakdown compaction
   2.3 Percent compliance with target HMA temperature for final coverage of intermediate compaction
   2.4 Percent compliance with target intelligent compaction measurement value

3. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on.
4. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on for a fixed interval.
5. All passes histogram for each roller
6. Color layout plots of:
   6.1. Roller passes for each roller
   6.2. HMA temperature for first coverage of breakdown compaction.
   6.3. HMA temperature for final coverage of intermediate compaction.
   6.4. Intelligent compaction measurement value for final coverage of intermediate compaction when required.
7. Quality control density measurements and corresponding GPS coordinate.
8. Hot mix asphalt mat temperature readings with corresponding GPS coordinates.

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Plots must include quality control density testing locations and results.

INTELLIGENT COMPACTION QUALITY CONTROL REPORT SUMMARY FOR HOT MIX ASPHALT WITH DENITY REQUIREMENT

CEM-IC16 (NEW 08/08/2015)

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize the daily hot mix asphalt intelligent compaction quality control report information. For questions about this form send an email to: IC@dot.ca.gov

HOT MIX ASPHALT (HMA) PLACEMENT INFORMATION

HMA Placement Location		HMA Placement Date
Beginning Station	Ending Station	
IC Quality Control Technician (ICQCT)		ICQCT Phone Number

DAILY COMPACTION QUALITY CONTROL REPORT SUMMARY

Note: Intelligent compaction target values are determined from hot mix asphalt test stripe.

Breakdown Compaction Vibratory Steel Drum Roller Number of Passes

_____Target number of roller passes | _____Percent work area covered by minimum number of roller passes

Does the number of passes for IC vibratory steel drum roller compaction shown on final coverage histogram of number of passes show that at least 90 percent coverage of the HMA placement area met or exceed the minimum number of roller passes based on target value established at the test stripe?

☐ Yes ☐ No

If no, corrective action taken:

Breakdown Compaction Intelligent Compaction Measurement Value

_____Target intelligent compaction measurement value | _____Daily average intelligent compaction measurement value

Does the daily average intelligent compaction measurement value for final coverage of IC vibratory steel drum roller meet or exceed the target intelligent compaction measurement value established at the test stripe?

☐ Yes ☐ No

If the answer is no, is the daily average intelligent compaction value at least 81 percent of the target measurement value?

☐ Yes ☐ No

If the answer is no, reestablish the intelligent compaction measurement value.

Intermediate Compaction Roller Number of Passes

_____Target number of roller passes | _____Percent work area covered by minimum number of roller passes

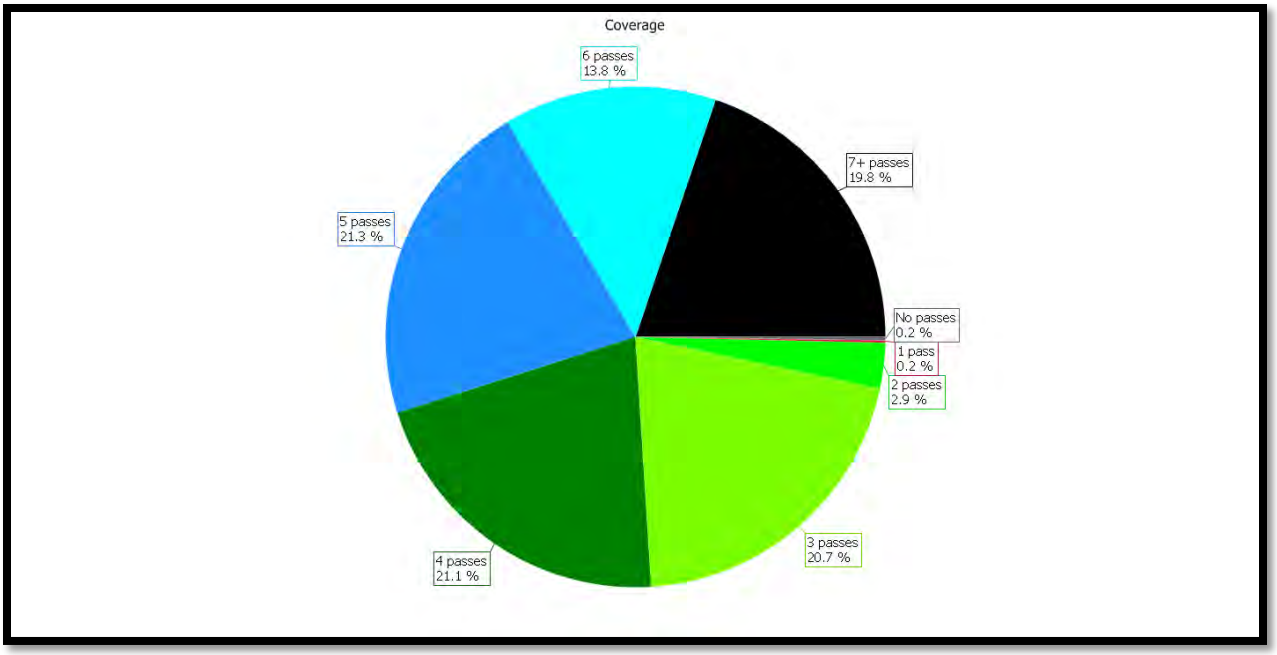
Does the number of passes for intermediate compaction roller shown on final coverage histogram of number of passes show that at least 90 percent coverage of the HMA placement area met or exceed the minimum number of roller passes based on target established at the test stripe?

☐ Yes ☐ No

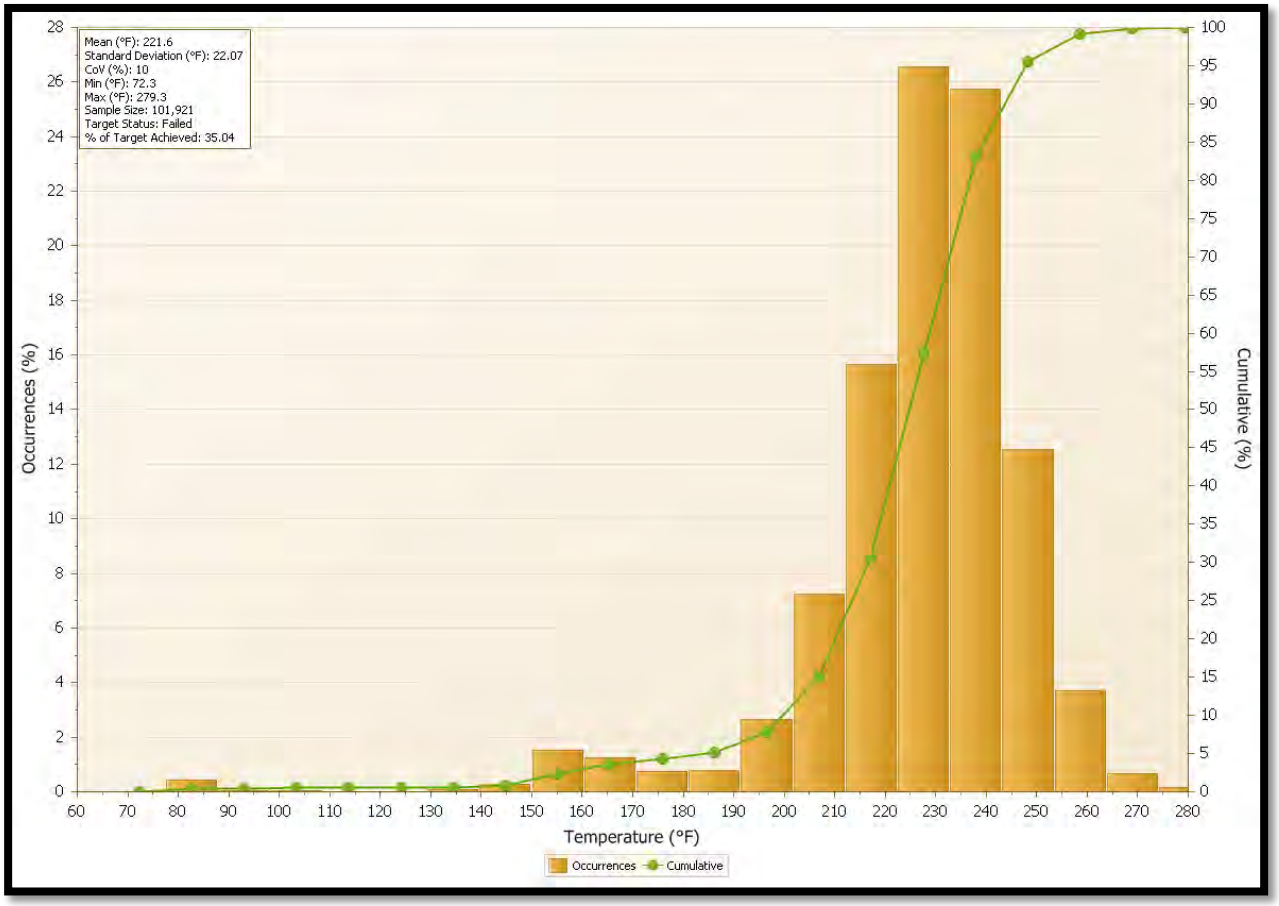
If no, corrective action taken:

Notes: 1) Results from intelligent compaction are for contractor quality control purposes and not to be used as Caltrans acceptance of HMA.
2) When the daily average intelligent compaction measurement meets or exceeds the target value and density is verified by contractor nuclear gage quality control test results, then corrective action for number of passes is not required.

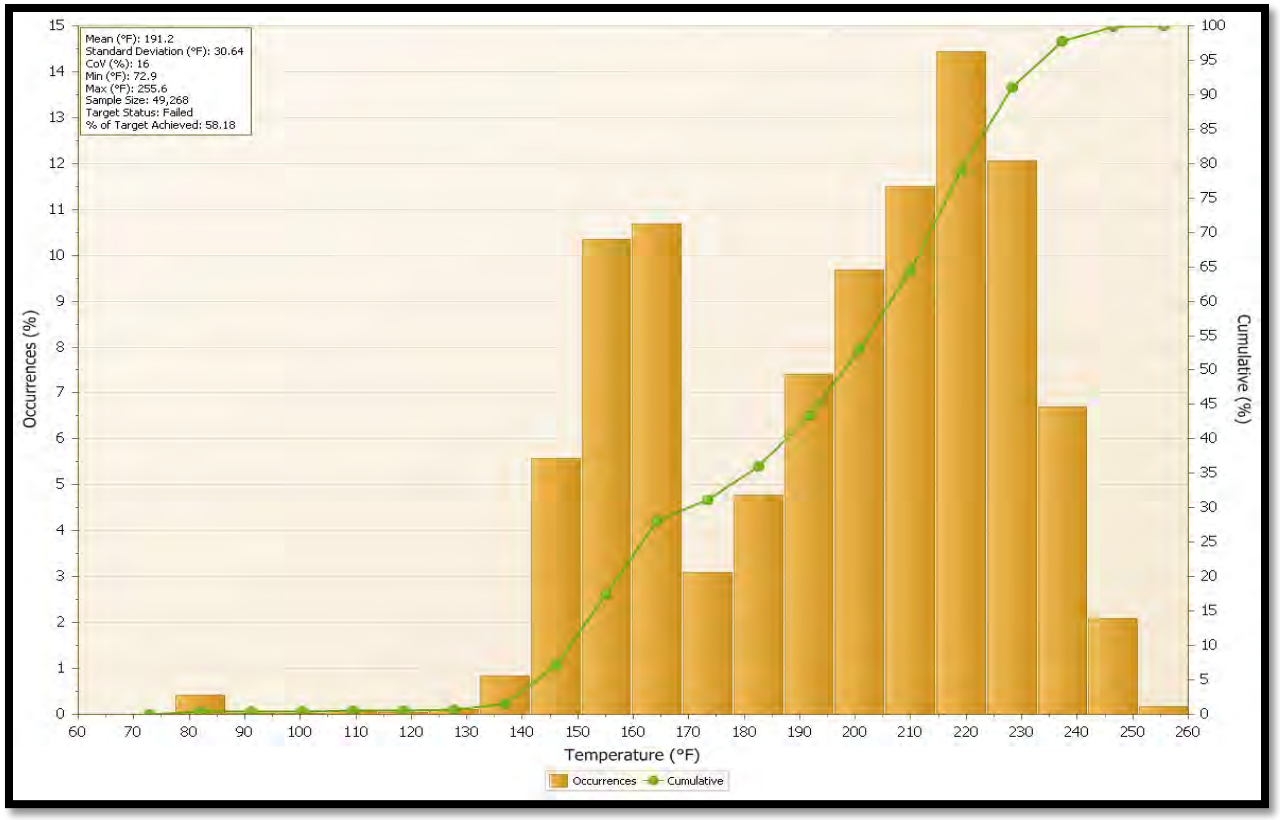
Updated 2015-08-08



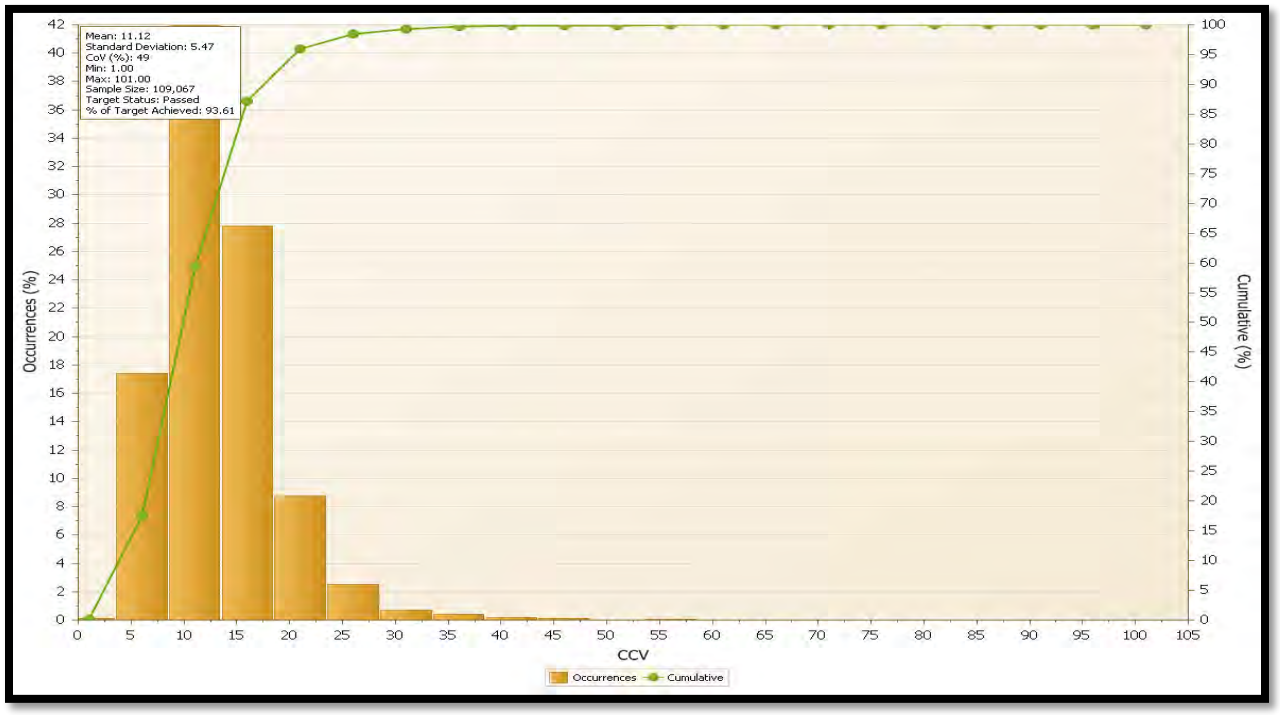
Percent compliance with target roller passes



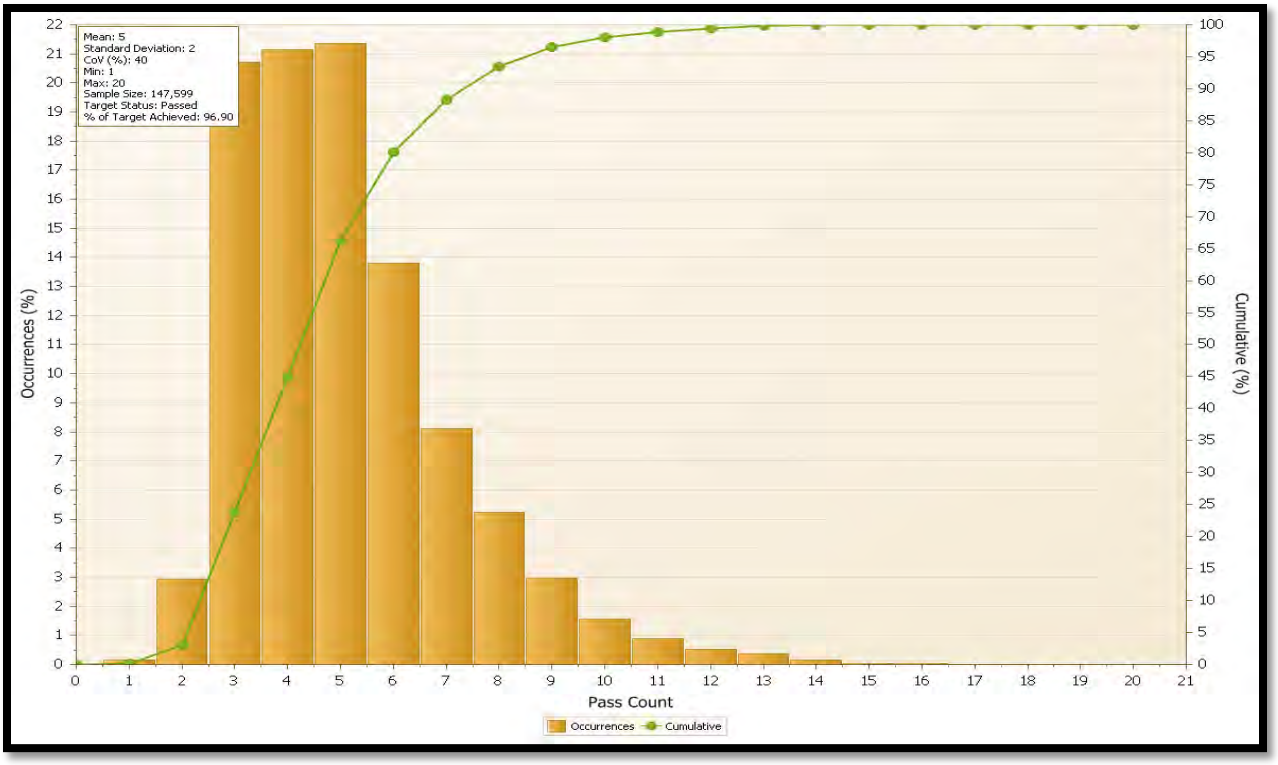
Percent compliance with target HMA temperature for first coverage of breakdown compaction



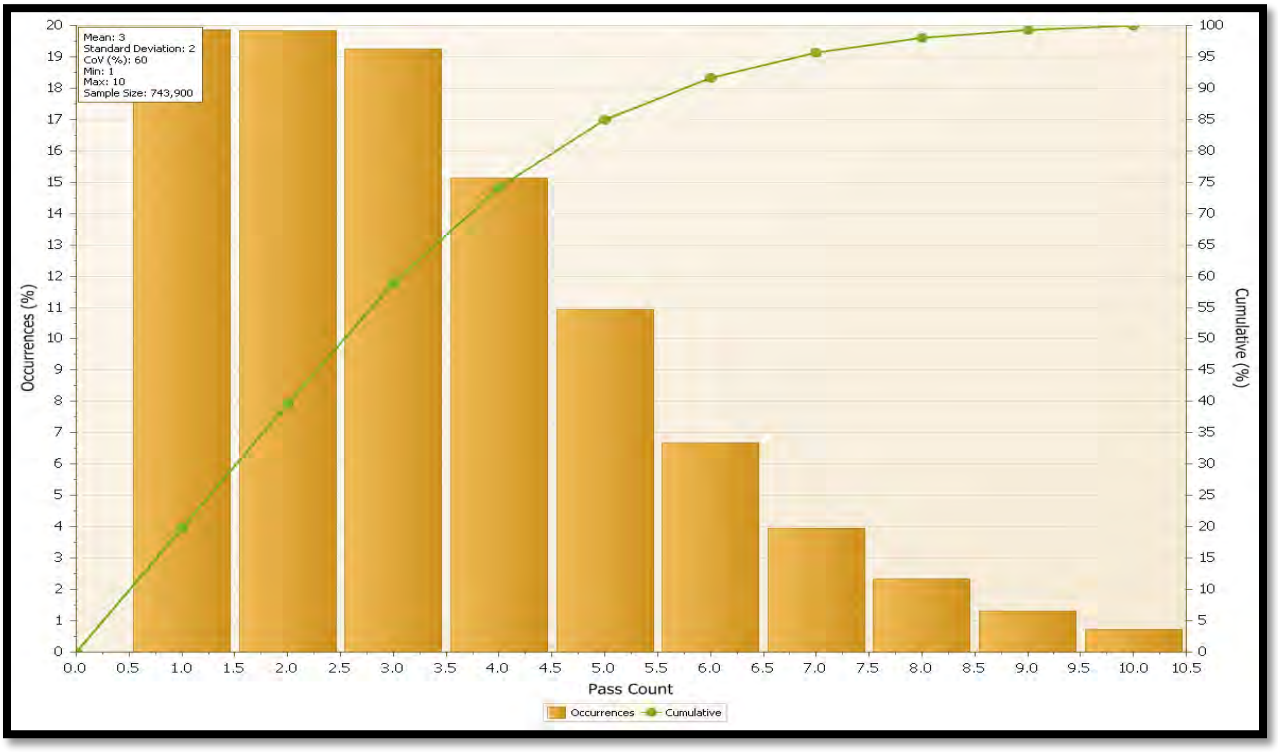
Percent compliance with target HMA temperature for final coverage of intermediate compaction



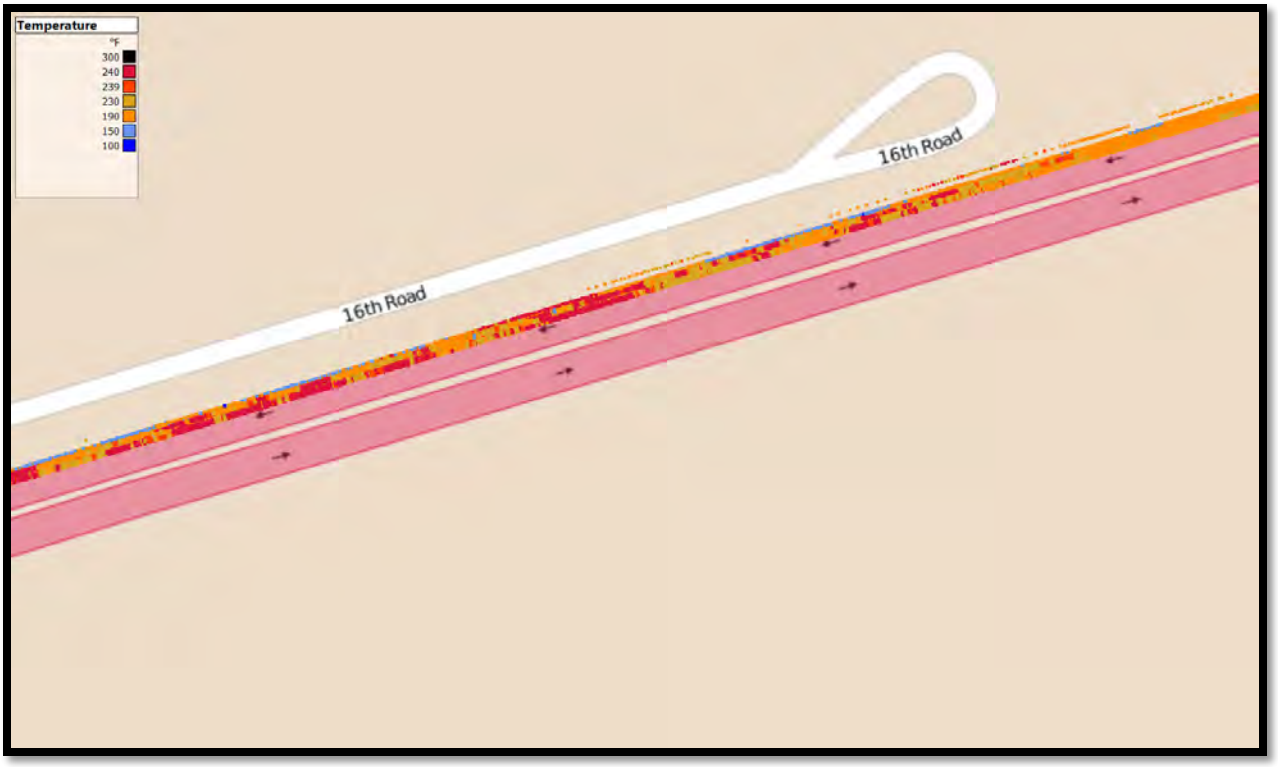
Percent compliance with target intelligent compaction measurement value



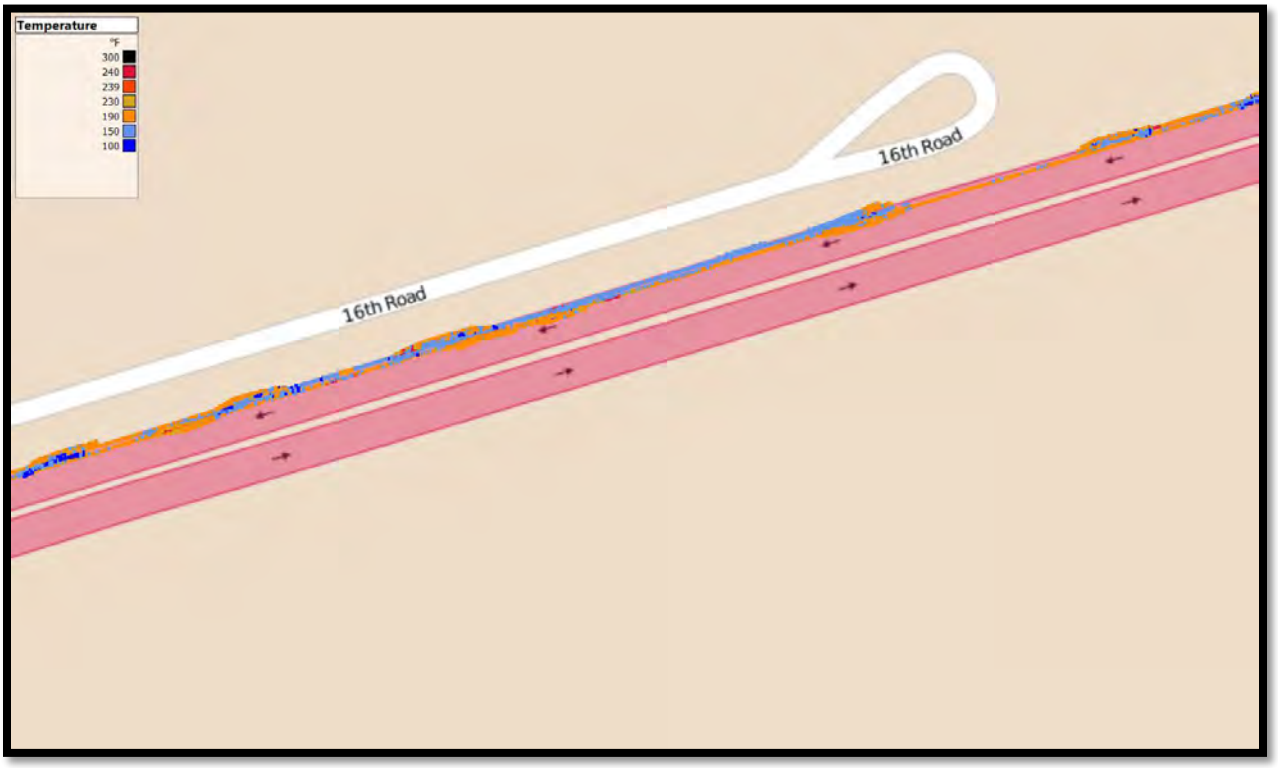
Final coverage histogram of number of passes for each roller



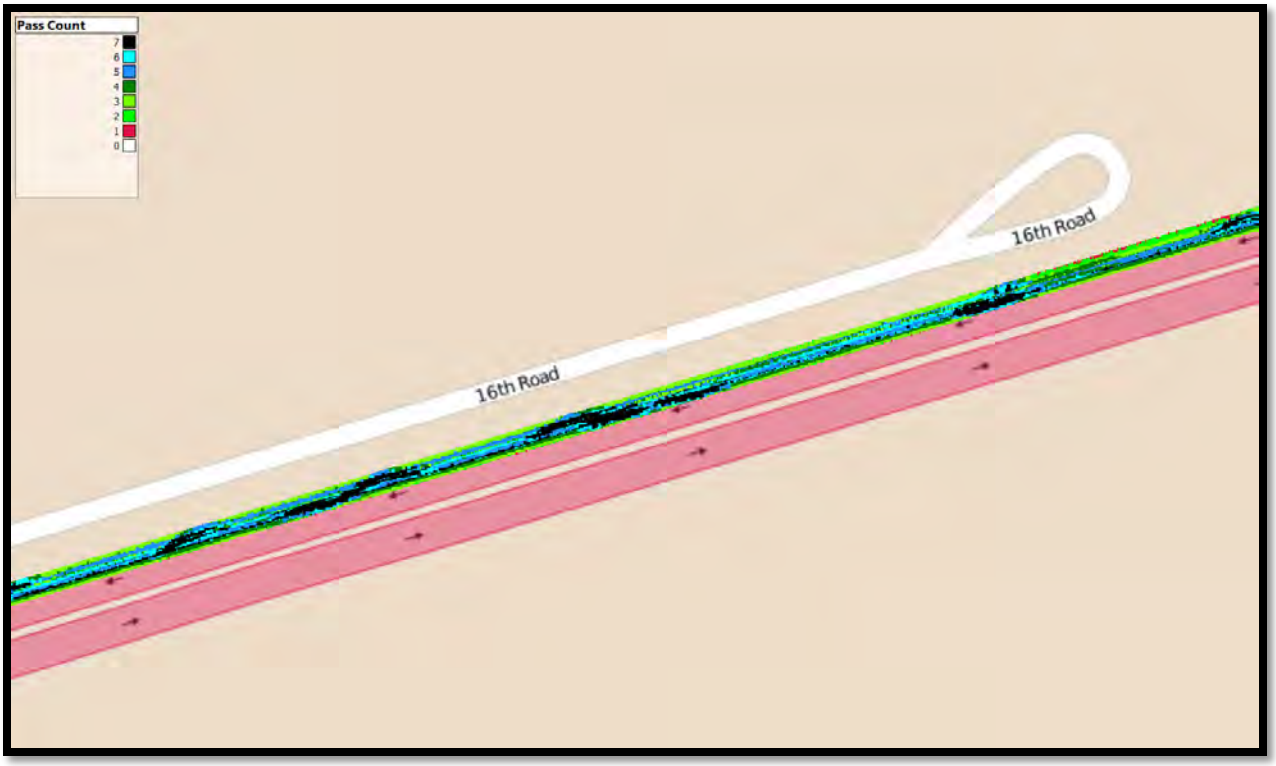
All passes histogram for each roller



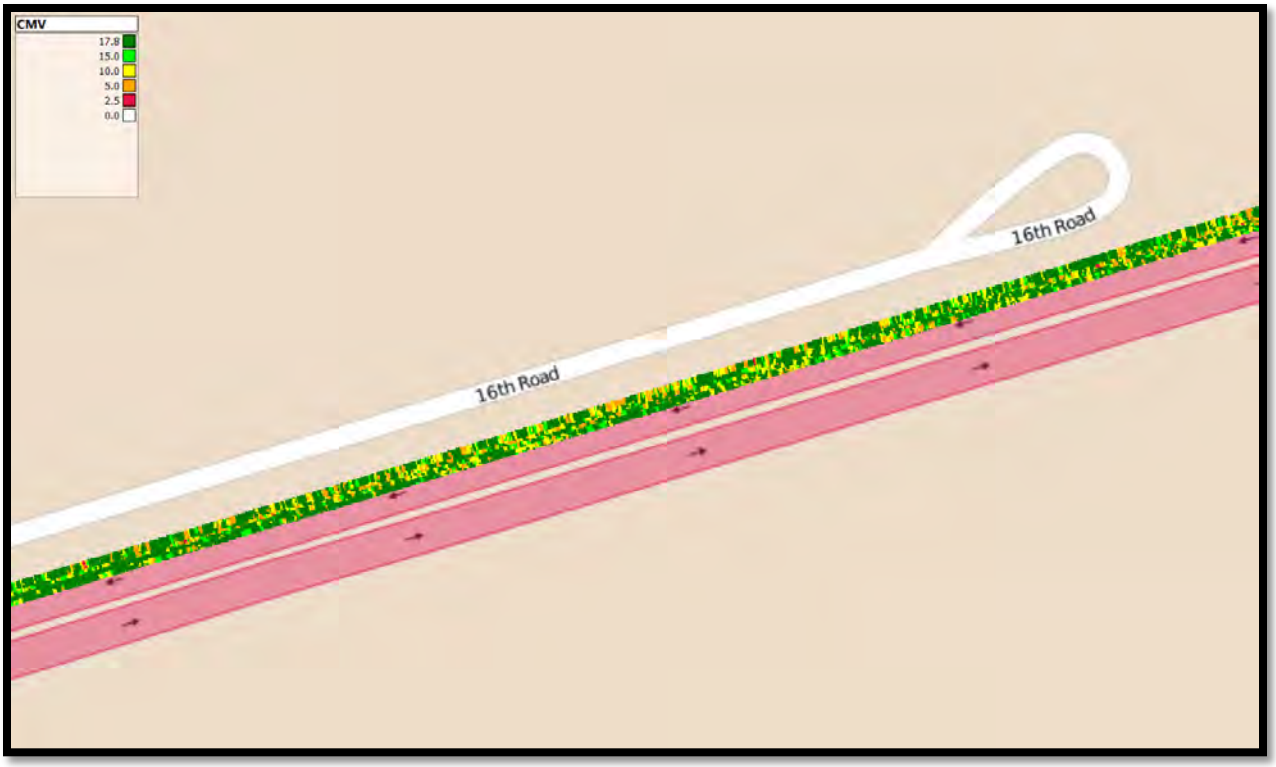
HMA temperature for first coverage of breakdown compaction.



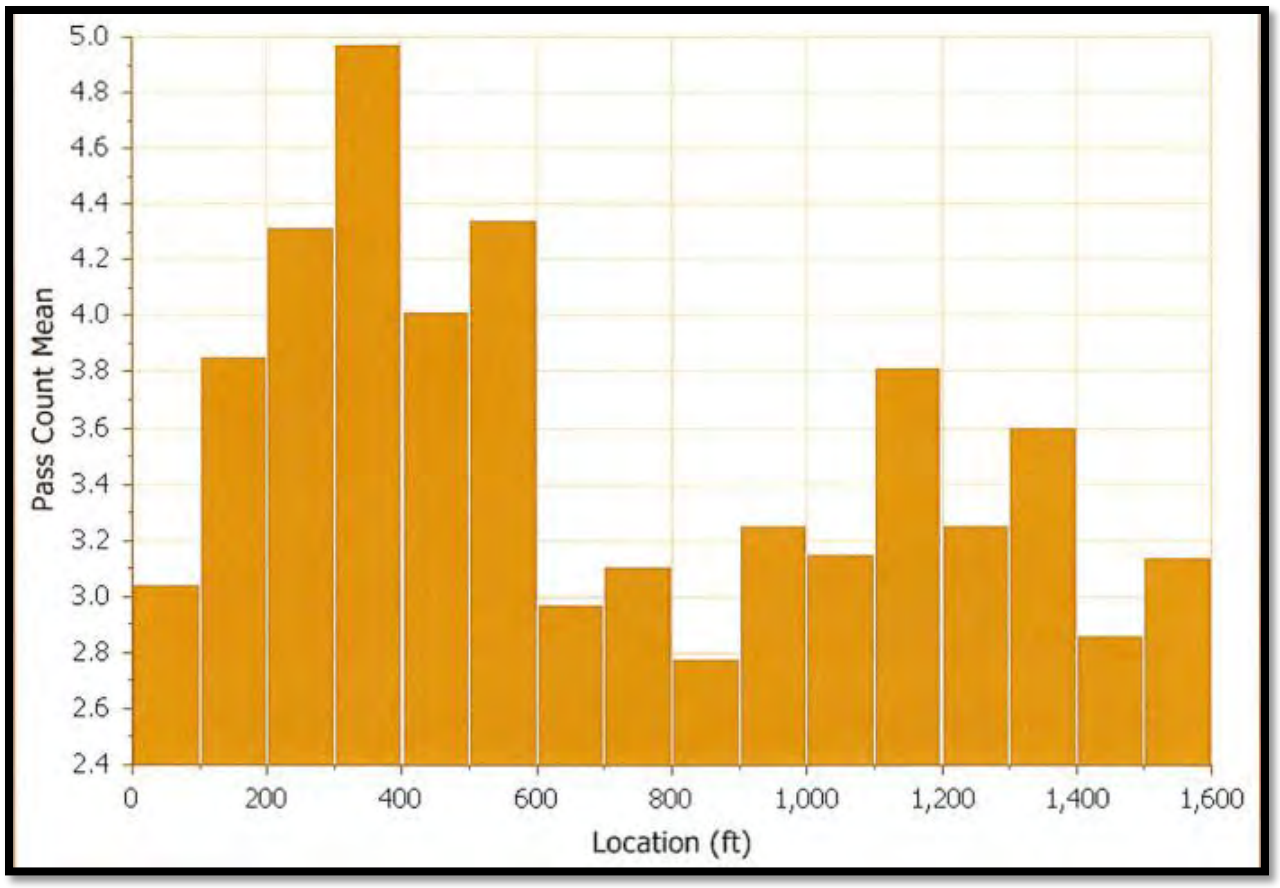
HMA temperature for final coverage of intermediate compaction.



Roller passes for each roller



Intelligent compaction measurement value of steel drum roller



Final coverage histogram of number of passes for each roller for a fixed interval.

Test Data Summary

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
1	09/12/15	6707864.854	2422263.488	Density - Nuclear Gauge	141.9
4	09/12/15	6707829.023	2422273.927	Density - Nuclear Gauge	138.1
5	09/12/15	6707395.953	2422213.652	Density - Nuclear Gauge	139
6	09/12/15	6707354.604	2422202.304	Density - Nuclear Gauge	137.6
2	09/12/15	6706957.282	2422145.005	Density - Nuclear Gauge	141
7	09/12/15	6706728.461	2422116.992	Density - Nuclear Gauge	141.8
8	09/12/15	6706705.126	2422111.303	Density - Nuclear Gauge	141.8
9	09/12/15	6706614.889	2422085.952	Density - Nuclear Gauge	140
3	09/12/15	6706559.636	2422090.126	Density - Nuclear Gauge	138.7
10	09/12/15	6706551.178	2422090.141	Density - Nuclear Gauge	143.7

Quality control density measurements and corresponding GPS coordinate.

Break Down Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
1	09/12/15	6707143.447	2422187.275	Layer Moduli	237.1
2	09/12/15	6706573.992	2422092.686	Layer Moduli	235.5
3	09/12/15	6706561.677	2422098.211	Layer Moduli	249.8

Intermediate Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
4	09/12/15	6707143.447	2422187.275	Layer Moduli	225.9
5	09/12/15	6706573.992	2422092.686	Layer Moduli	212.2
6	09/12/15	6706561.677	2422098.211	Layer Moduli	221

Finish Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
7	09/12/15	6707143.447	2422187.275	Layer Moduli	167.5
8	09/12/15	6706573.992	2422092.686	Layer Moduli	158.5
9	09/12/15	6706561.677	2422098.211	Layer Moduli	164.4

Hot mix asphalt mat temperature readings with corresponding GPS coordinates

HMA IC Test Strip- required for HMA with minimum thickness of 0.15’ or more.

Goal: Establish rolling pattern, and ICMV

I. Field

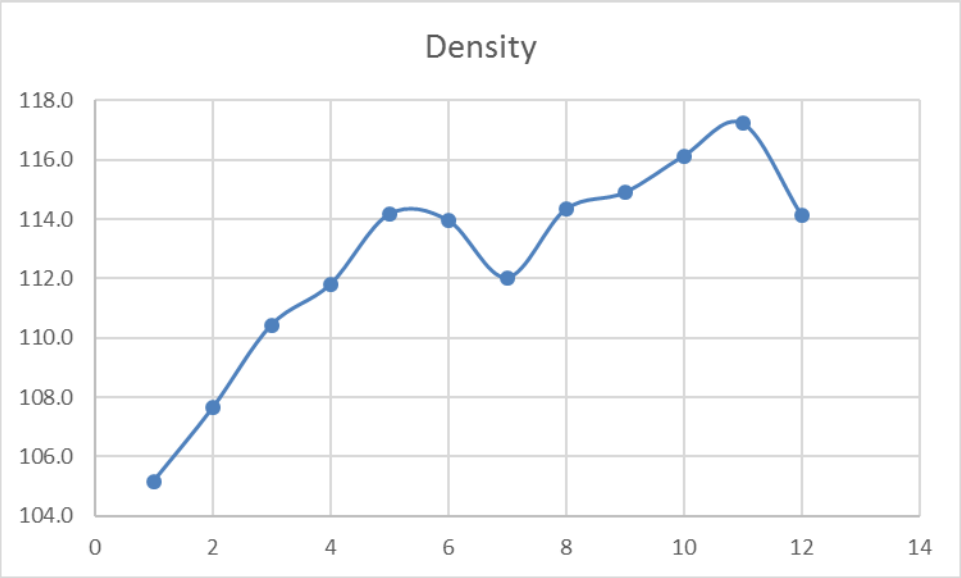
A. Choose test Strip location

1. 600 feet long
2. Use rover to establish test strip boundary
3. Correlate nuclear gages with density core
4. Establish 3 randomly selected nuclear gage density locations. Record the position of the density test locations using handheld rover.

B. Determine rolling pattern

1. After each coverage measure density at 3 preselected random location using nuclear gage and record.
2. Record the pass (coverage) number
3. Record type of the roller
5. Calculate average density for each pass (coverage)
6. Plot average density vs. No. of passes
   a. Determine the corresponding no. of passes when density stays constant or decreases within the specified density requirement (i.e. 91% to 97% maximum theoretical density).
      (1) Take an additional 7 randomly selected nuclear gage readings Average the 10 gage readings.
         (a) If the average density (10 locations) equals or exceeds the maximum specified density, the test strip density is established.
         (b) If the average density (10 locations) does not equal or exceeds the maximum specified density and the average density is greater than the previous average density by more than 3%
            i) Establish new test strip density till the average density
               (1) Continue rolling using steel or rubber tire roller
               (2) Measure density at 10 random location
               (3) Plot average density vs. passes
               (4) Determine the test strip density
               (5) If the average density (10 locations) equals or exceeds the maximum specified density or density is lower or higher by less than 3% than the previous density
                  i) Stop rolling

ii) Test strip density is established



II. VETA Analysis

A. Download the latest version of VETA from www.intelligent.com

B. Use vendor's software to combine all rollers data. If vendor's software cannot process Combine rollers data, separate analyses for steel drum and pneumatic tire roller

1. Steel drum vibratory IC roller
   a. Import all passes data (*,csv or *.pln) into VETA
   b. Enter the coordinate system
   c. Set up the test strip boundary as a filter location to exclude outside work data
      (1) Set the filter compaction mode to vibratory
   d. Enter or import the density reading corresponding to each pass
   e. Run analysis with test strip filter, for number of passes for IC roller
   f. Use compaction curve for all passes to determine the target ICMV corresponding to target No. of passes established in field for break over point
   g. Report

      Prepare and include the following

      (1) Complete form CEM-IC10
      (2) Excel spreadsheet of boundary coordinates
      (3) Excel spreadsheet of gage density readings and coordinates
      (4) Plot of field average density vs. number of passes
      (5) Plot of compaction curve for all passes
      (6) Plots of coverage for all passes and individual passes (11"x17")
2. AMG rubber tire roller

a. Import all passes data (*,csv or *.pln) into VETA

b. Enter the coordinate system

c. Set up the test strip boundary as a filter location to exclude outside work data

   (1) Set the filter compaction mode to static

d. Enter or import the density reading corresponding to each pass

e. Run analysis with test strip filter, for number of passes for AMG roller

f. Use compaction curve for all passes to determine the target density corresponding to target No. of passes established in field for break over point

g. Report

   Prepare and include the following

   (1) Complete form CEM-IC10

   (2) Excel spreadsheet of boundary coordinates

   (3) Excel spreadsheet of gage density readings and coordinates

   (4) Plot of field average density vs. number of passes

   (5) Plot of compaction curve for all passes

   (6) Plots of coverage for all passes and individual passes (11”x17”)

SAMPLE
INTELLIGENT COMPACTION HOT MIX ASPHALT TEST STRIP REPORT

Office of Construction Engineering
Caltrans
December 2015

HMA Test strip report must include:

1. Completed *Intelligent Compaction Hot Mix Asphalt Construction Test Strip Submittals Summary* form
2. Nuclear gage density per location and corresponding GPS measured coordinates per location
3. All passes compaction curves from Veta
4. All passes correlation analysis plot from Veta
5. Field compaction curve density versus number of passes
6. All passes histogram for each roller
7. Color layout plots (11”x17”) of:
   7.1. Roller passes for each roller
   7.2. HMA temperature for first coverage of breakdown compaction.
   7.3. HMA temperature for final coverage of intermediate compaction.
   7.4. Intelligent compaction measurement value for final coverage of intermediate compaction
8. Hot mix asphalt mat temperature readings with corresponding GPS coordinates

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STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 1 OF 4

INTELLIGENT COMPACTION HOT MIX ASPHALT TEST STRIP SUBMITTAL SUMMARY

CEM-IC10 (NEW 11/17/2015)

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form is to be completed and submitted by the contractor with the HMA test strip report to ensure a complete submittal. The Engineer should use this form to verify that the submittals of the intelligent compact test strip report and test strip information are complete.
For questions about this form send an email to: IC@dot.ca.gov

HOT MIX ASPHALT (HMA) TEST STRIP PLACEMENT INFORMATION

HMA Type	HMA thickness	HMA Test Strip Placement Date
HMA Placement Location	Beginning Station	Ending Station
IC Quality Control Technician (print name)	IC Quality Control Technician (email address)	IC Quality Control Technician (phone number)

Intelligent Compaction Target Values Determined From Test Strip

_____Target number of roller passes for breakdown compaction	Roller type: ☐ Steel vibratory ☐ Steel static ☐ Pneumatic
_____Target roller 1st pass minimum temperature breakdown compaction	
_____Target number of roller passes for intermediate compaction	Roller type: ☐ Steel vibratory ☐ Steel static ☐ Pneumatic
_____Target minimum temperature °F for completing intermediate compaction	
_____Target intelligent compaction measurement value	
_____Roller pass number that is the basis for target intelligent compaction measurement value	

COMMENTS:

Test Strip Report Required Submittals

Test Strip Report Completed by Email Address	Phone Number	
Test Strip Report Completed by (print name)	Signature	Date

Test Strip Report General Information

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
☐ Nuclear gage density per location	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ GPS measured coordinates per density location	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ HMA mat temperature measured per three locations	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ GPS measured coordinates per HMA mat temperature location	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Field compaction curve versus number of passes	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment

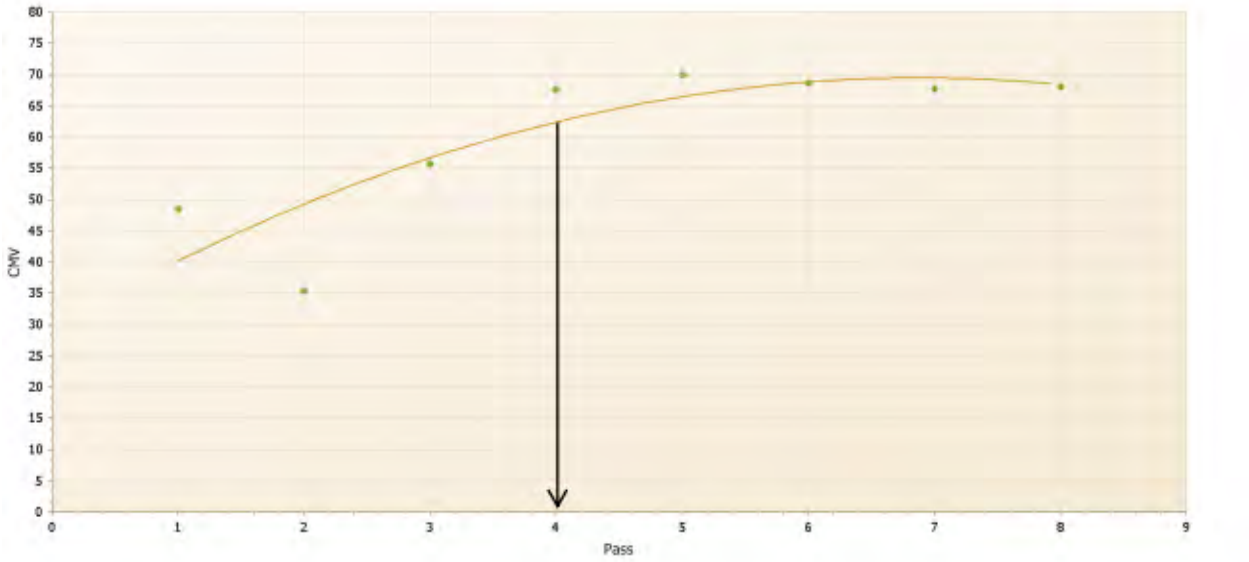
COMMENTS:

Intelligent Compaction Hot Mix Asphalt Construction Test Strip Submittals Summary form

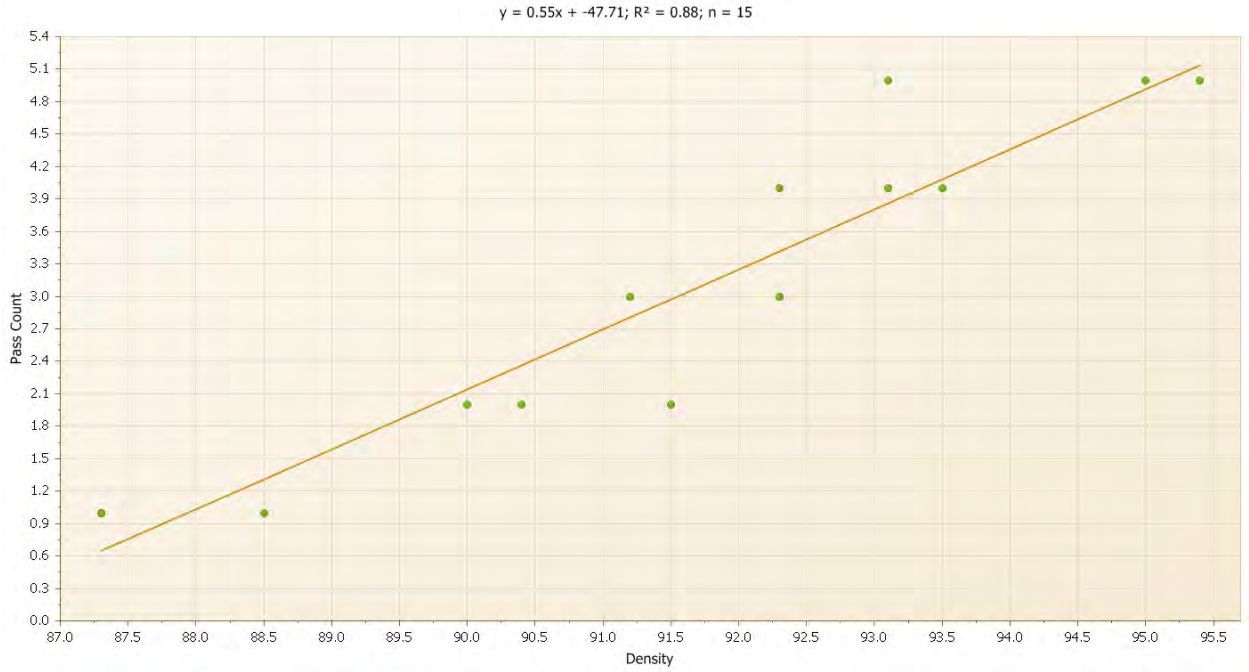
Tests

Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
Vibe	1	8/11/2015	6867980.418	1893928.092	Density - Nuclear Gauge	110.3
	2	8/12/2015	6867999.307	1893960.835	Density - Nuclear Gauge	112.4
	3	8/13/2015	6868027.574	1893990.064	Density - Nuclear Gauge	112.9
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
Vibe	1	8/11/2015	6867980.418	1893928.092	Density - Nuclear Gauge	115.2
	2	8/11/2015	6867999.307	1893960.835	Density - Nuclear Gauge	115.7
	3	8/11/2015	6868027.574	1893990.064	Density - Nuclear Gauge	115.1
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
Static	1	8/11/2015	6867980.418	1893928.092	Density - Nuclear Gauge	119.2
	2	8/11/2015	6867999.307	1893960.835	Density - Nuclear Gauge	117.6
	3	8/11/2015	6868027.574	1893990.064	Density - Nuclear Gauge	119.4
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
	1	8/11/2015	6867980.418	1893928.092	Density - Nuclear Gauge	121.3
	2	8/11/2015	6867999.307	1893960.835	Density - Nuclear Gauge	121.1
	3	8/11/2015	6868027.574	1893990.064	Density - Nuclear Gauge	122.2
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
	1	8/11/2015	6867980.418	1893928.092	Density - Nuclear Gauge	123
	2	8/11/2015	6867999.307	1893960.835	Density - Nuclear Gauge	124
	3	8/11/2015	6868027.574	1893990.064	Density - Nuclear Gauge	124.7
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
	1	8/11/2015	6867980.418	1893928.092	Density - Nuclear Gauge	127
	2	8/11/2015	6867999.307	1893960.835	Density - Nuclear Gauge	128.1
	3	8/11/2015	6868027.574	1893990.064	Density - Nuclear Gauge	128.4
Pnuematic	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
	1	8/11/2015	6867980.418	1893928.092	Density - Nuclear Gauge	126.2
	2	8/11/2015	6867999.307	1893960.835	Density - Nuclear Gauge	126.5
	3	8/11/2015	6868027.574	1893990.064	Density - Nuclear Gauge	126.9
Steel	ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
Vibe	1	8/11/2015	6867980.418	1893928.092	Density - Nuclear Gauge	127.5
	2	8/11/2015	6867999.307	1893960.835	Density - Nuclear Gauge	128.5
	3	8/11/2015	6868027.574	1893990.064	Density - Nuclear Gauge	129.1
	4	8/11/2015	6868077.65	1894048.11	Density - Nuclear Gauge	128
	5	8/11/2015	6868113.053	1894093.71	Density - Nuclear Gauge	130.1
	6	8/11/2015	6868272.015	1894287.386	Density - Nuclear Gauge	132.3
	7	8/11/2015	6868254.613	1894277.019	Density - Nuclear Gauge	124.7
	8	8/11/2015	6868230.111	1894247.078	Density - Nuclear Gauge	127.7
	9	8/11/2015	6868234.175	1894240.058	Density - Nuclear Gauge	127.1
	10	8/11/2015	6868217.908	1894231.752	Density - Nuclear Gauge	128

Nuclear gage density readings and the corresponding GPS coordinates



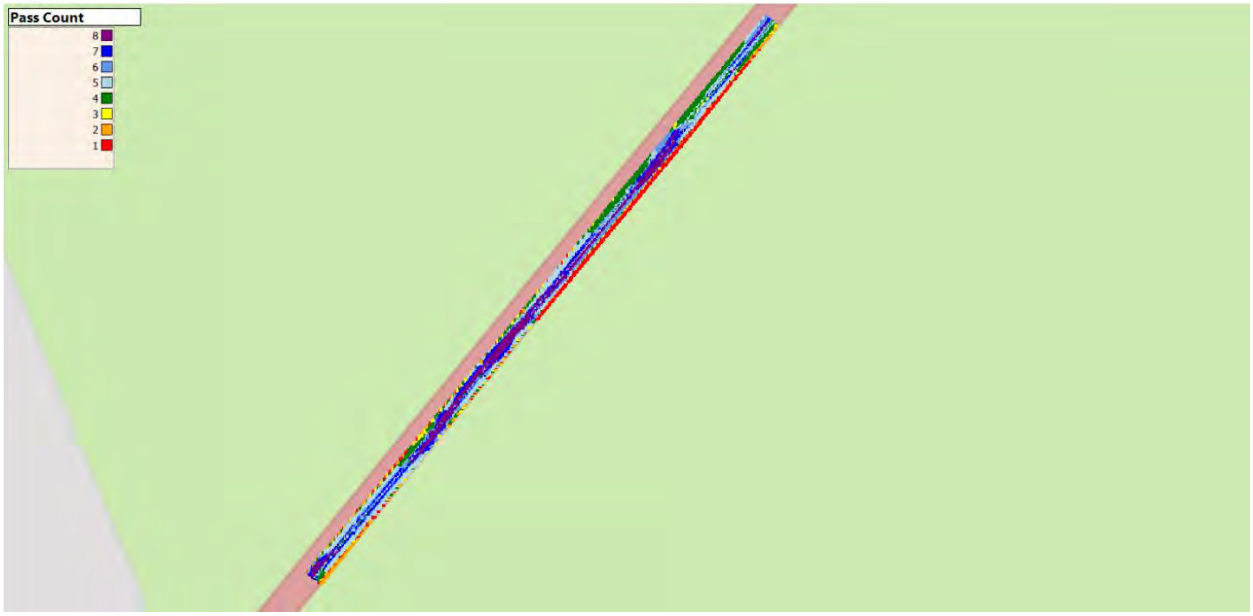
All passes compaction curves from Veta



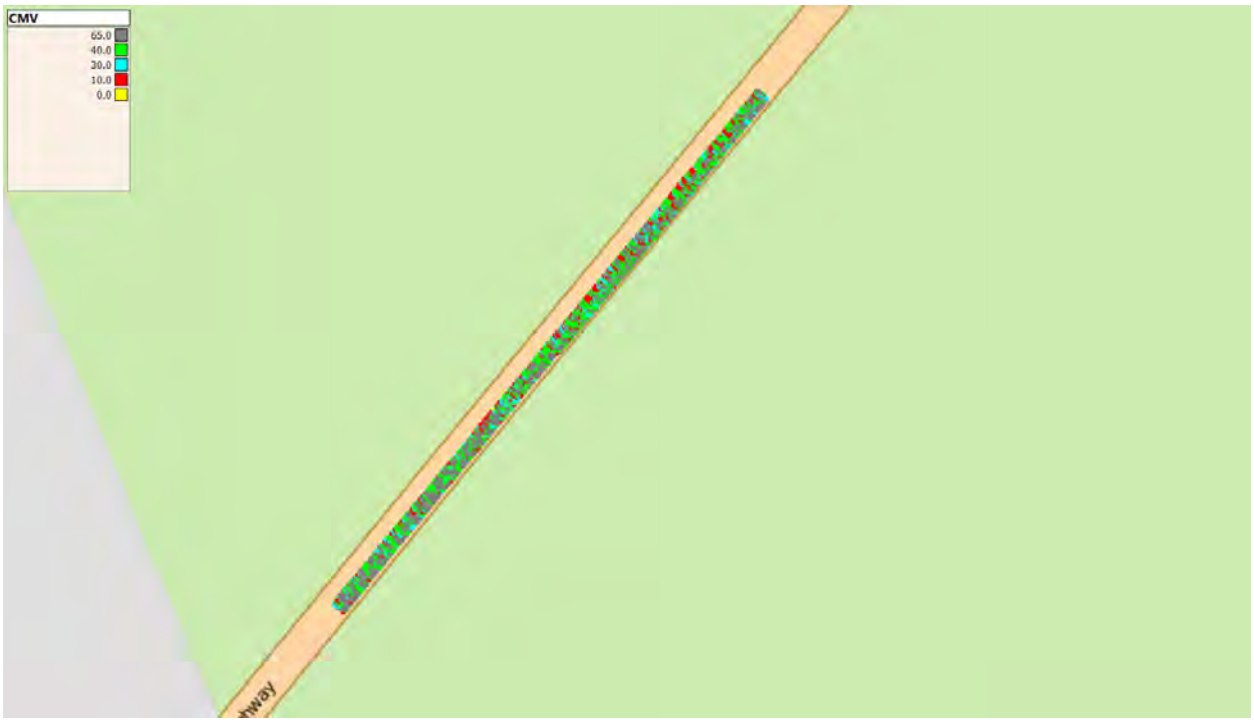
All passes correlation analysis plot from Veta

11”x17” HMA temperature for first coverage of breakdown compaction

11”x17” HMA temperature for final coverage of intermediate compaction



11”x17” Roller passes for each roller



11”x17” Intelligent compaction measurement value for final coverage of intermediate compaction

Break Down Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
1	09/12/15	6707143.447	2422187.275	Layer Moduli	237.1
2	09/12/15	6706573.992	2422092.686	Layer Moduli	235.5
3	09/12/15	6706561.677	2422098.211	Layer Moduli	249.8

Intermediate Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
4	09/12/15	6707143.447	2422187.275	Layer Moduli	225.9
5	09/12/15	6706573.992	2422092.686	Layer Moduli	212.2
6	09/12/15	6706561.677	2422098.211	Layer Moduli	221

Finish Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
7	09/12/15	6707143.447	2422187.275	Layer Moduli	167.5
8	09/12/15	6706573.992	2422092.686	Layer Moduli	158.5
9	09/12/15	6706561.677	2422098.211	Layer Moduli	164.4

Hot mix asphalt mat temperature readings with corresponding GPS coordinates

Density Requirement Compaction

For each day of production, prepare a HMA compaction quality control report that includes:

1. Summary of HMA compaction quality control results on *Intelligent Compaction Quality Control Report Summary for Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt with Density Requirement* form.
2. Veta analysis report results for:
   2.1 Percent compliance with target roller passes
   2.2 Percent compliance with target HMA temperature for first coverage of breakdown compaction
   2.3 Percent compliance with target HMA temperature for final coverage of intermediate compaction
   2.4 Percent compliance with target intelligent compaction measurement value

3. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on.
4. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on for a fixed interval.
5. All passes histogram for each roller
6. Color layout plots of:
   6.1. Roller passes for each roller
   6.2. HMA temperature for first coverage of breakdown compaction.
   6.3. HMA temperature for final coverage of intermediate compaction.
   6.4. Intelligent compaction measurement value for final coverage of intermediate compaction when required.
7. Quality control density measurements and corresponding GPS coordinate.
8. Hot mix asphalt mat temperature readings with corresponding GPS coordinates.

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Plots must include quality control density testing locations and results.

INTELLIGENT COMPACTION QUALITY CONTROL REPORT SUMMARY FOR HOT MIX ASPHALT WITH DENITY REQUIREMENT

CEM-IC16 (NEW 08/08/2015)

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize the daily hot mix asphalt intelligent compaction quality control report information. For questions about this form send an email to: IC@dot.ca.gov

HOT MIX ASPHALT (HMA) PLACEMENT INFORMATION

HMA Placement Location		HMA Placement Date
Beginning Station	Ending Station	
IC Quality Control Technician (ICQCT)		ICQCT Phone Number

DAILY COMPACTION QUALITY CONTROL REPORT SUMMARY

Note: Intelligent compaction target values are determined from hot mix asphalt test stripe.

Breakdown Compaction Vibratory Steel Drum Roller Number of Passes

_____Target number of roller passes | _____Percent work area covered by minimum number of roller passes

Does the number of passes for IC vibratory steel drum roller compaction shown on final coverage histogram of number of passes show that at least 90 percent coverage of the HMA placement area met or exceed the minimum number of roller passes based on target value established at the test stripe?

☐ Yes ☐ No

If no, corrective action taken:

Breakdown Compaction Intelligent Compaction Measurement Value

_____Target intelligent compaction measurement value | _____Daily average intelligent compaction measurement value

Does the daily average intelligent compaction measurement value for final coverage of IC vibratory steel drum roller meet or exceed the target intelligent compaction measurement value established at the test stripe?

☐ Yes ☐ No

If the answer is no, is the daily average intelligent compaction value at least 81 percent of the target measurement value?

☐ Yes ☐ No

If the answer is no, reestablish the intelligent compaction measurement value.

Intermediate Compaction Roller Number of Passes

_____Target number of roller passes | _____Percent work area covered by minimum number of roller passes

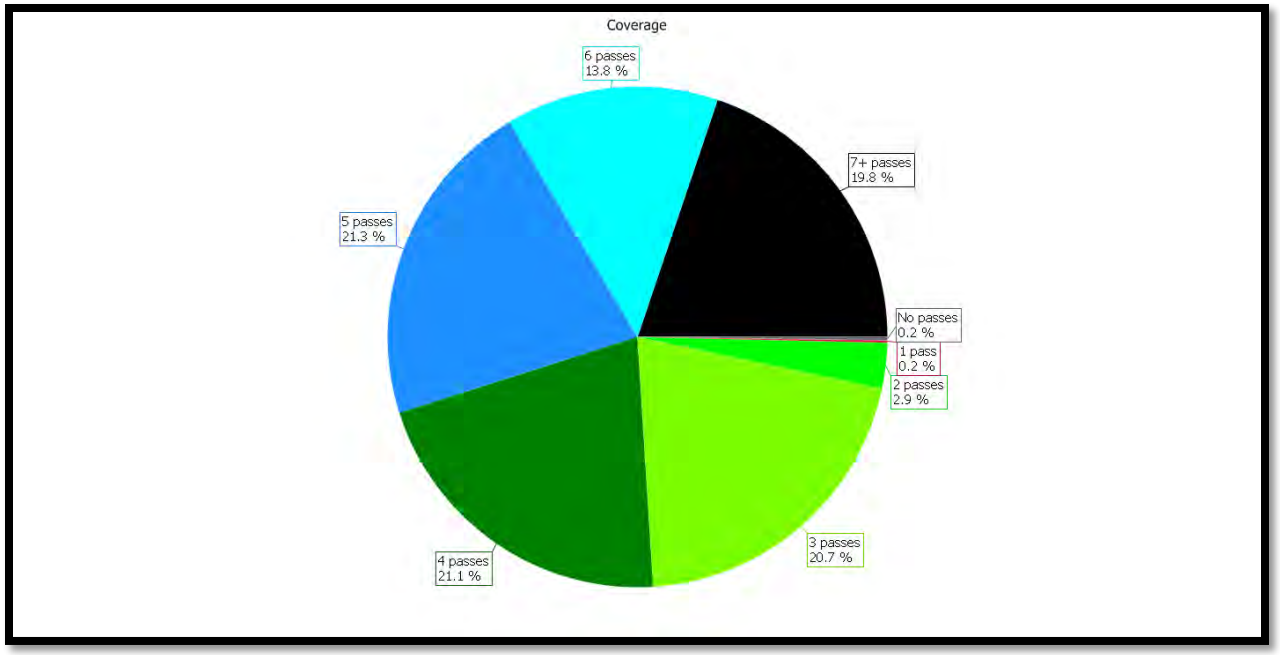
Does the number of passes for intermediate compaction roller shown on final coverage histogram of number of passes show that at least 90 percent coverage of the HMA placement area met or exceed the minimum number of roller passes based on target established at the test stripe?

☐ Yes ☐ No

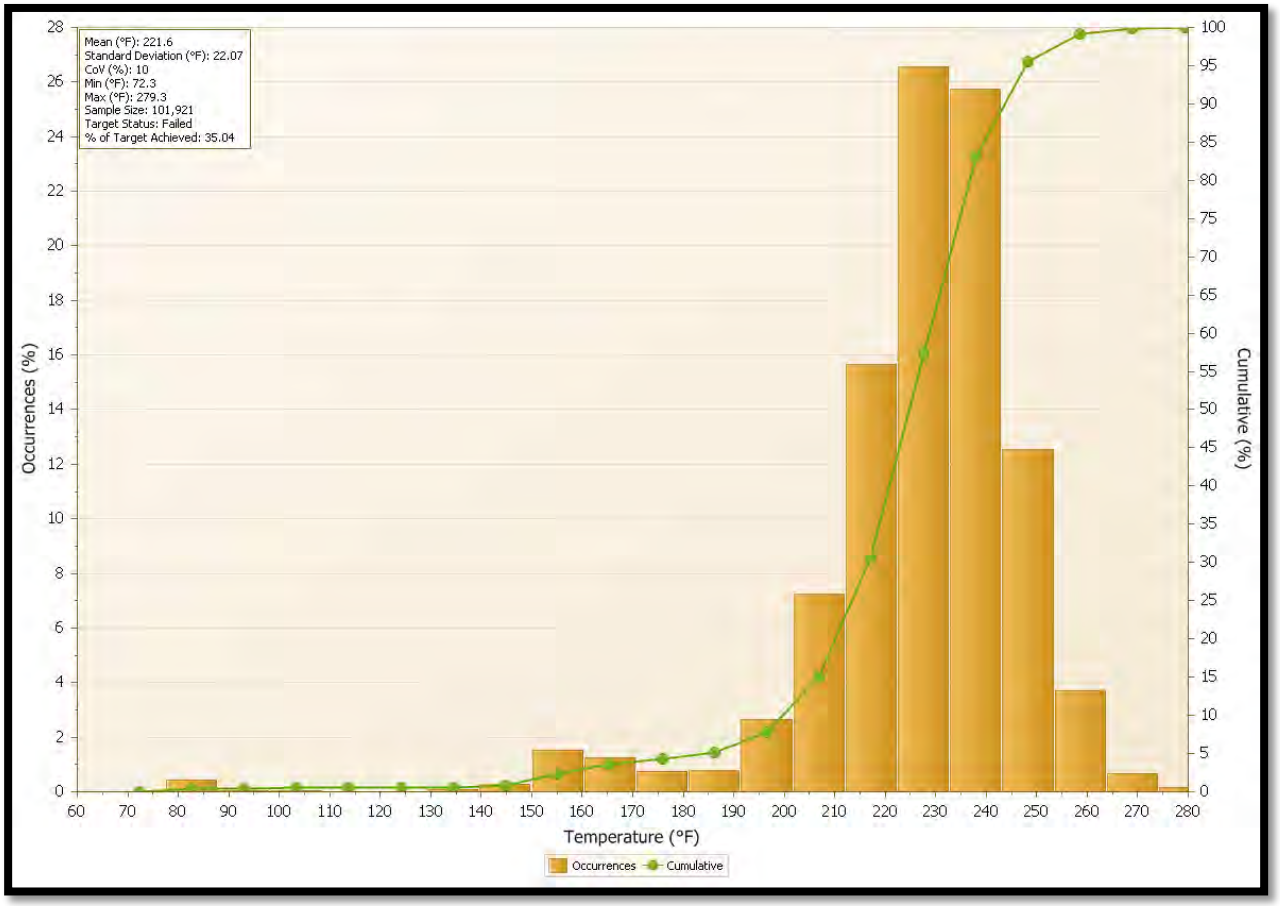
If no, corrective action taken:

Notes: 1) Results from intelligent compaction are for contractor quality control purposes and not to be used as Caltrans acceptance of HMA.
2) When the daily average intelligent compaction measurement meets or exceeds the target value and density is verified by contractor nuclear gage quality control test results, then corrective action for number of passes is not required.

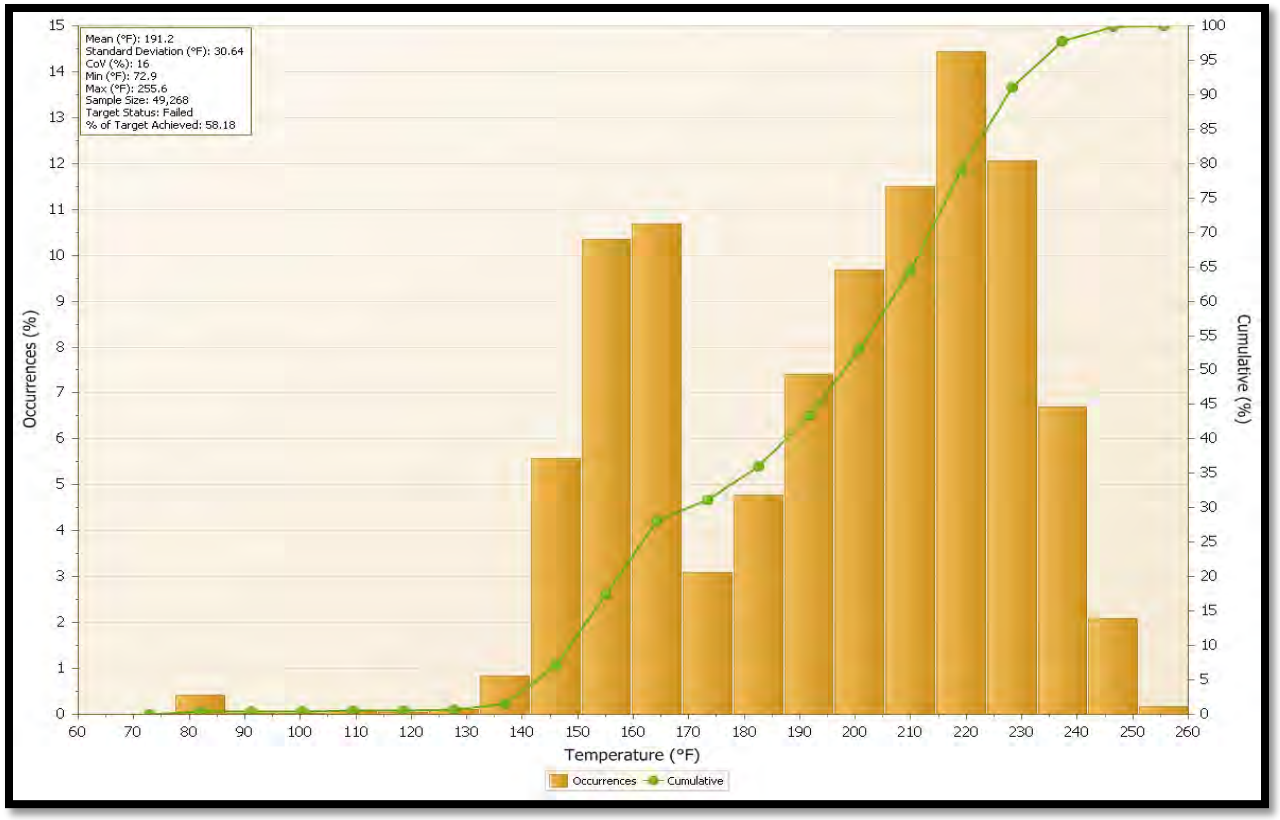
Updated 2015-08-08



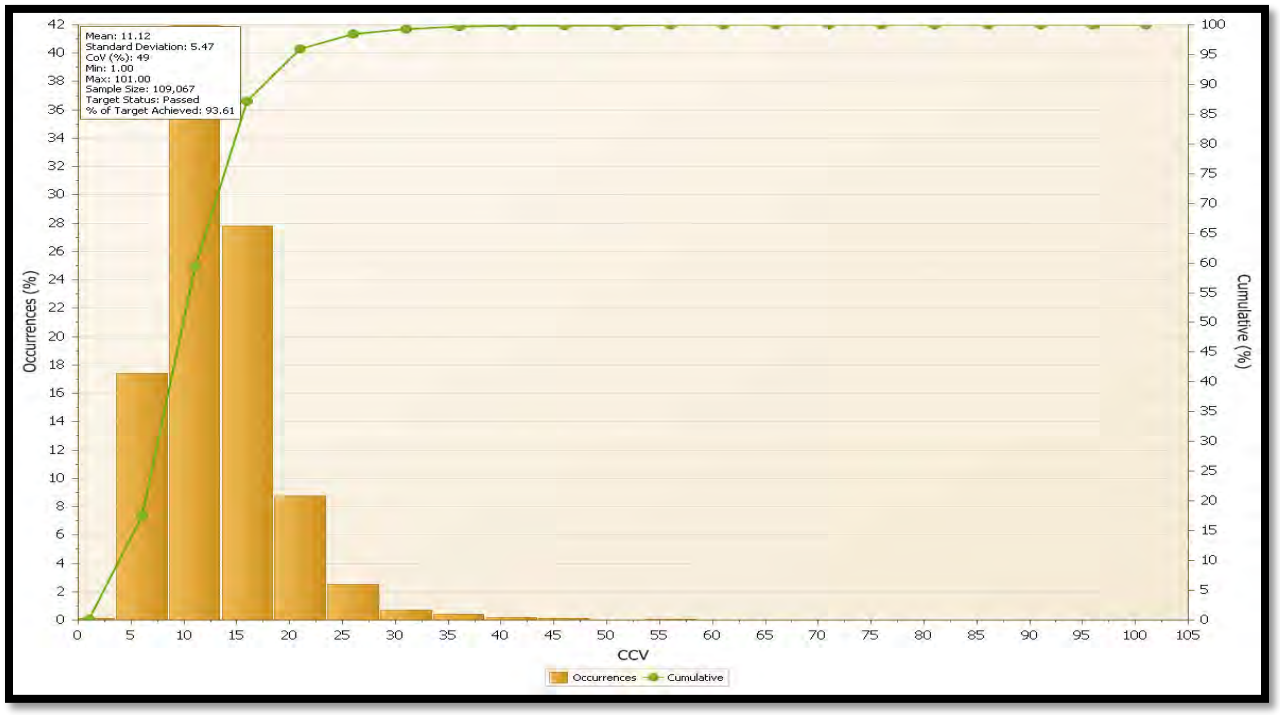
Percent compliance with target roller passes



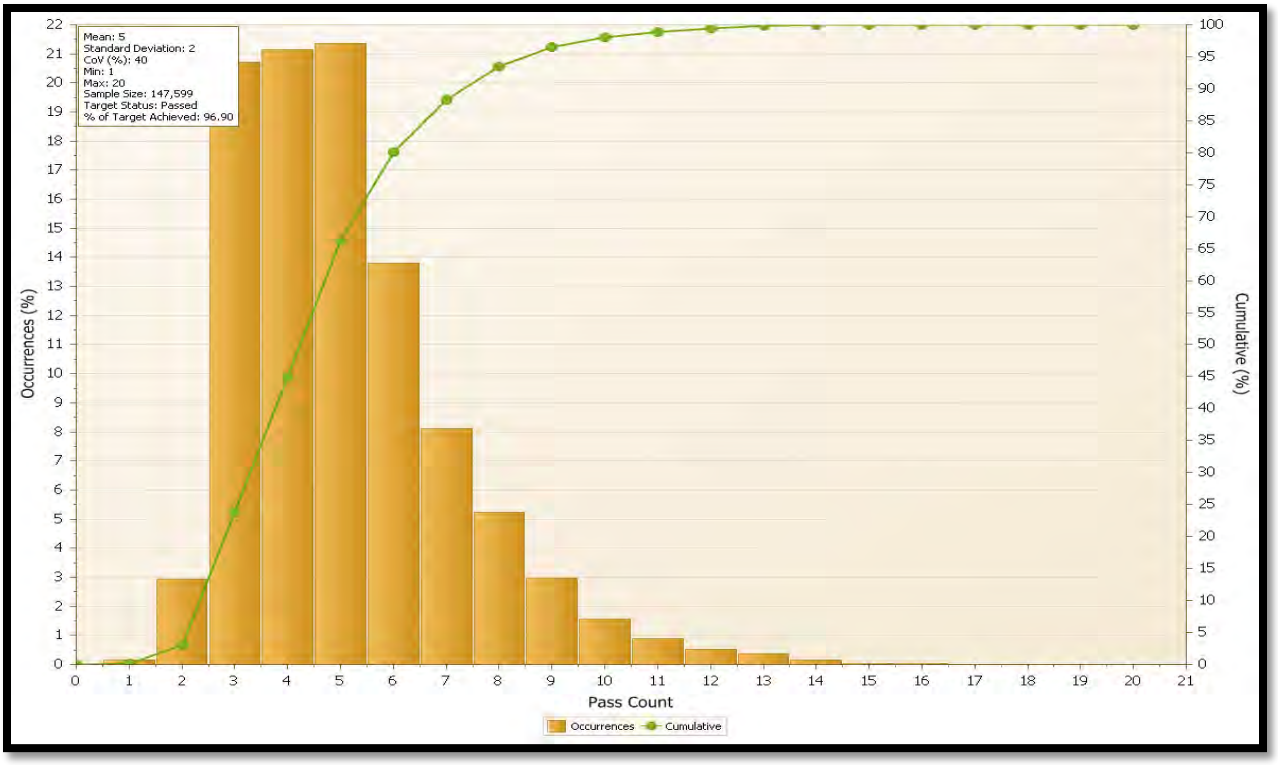
Percent compliance with target HMA temperature for first coverage of breakdown compaction



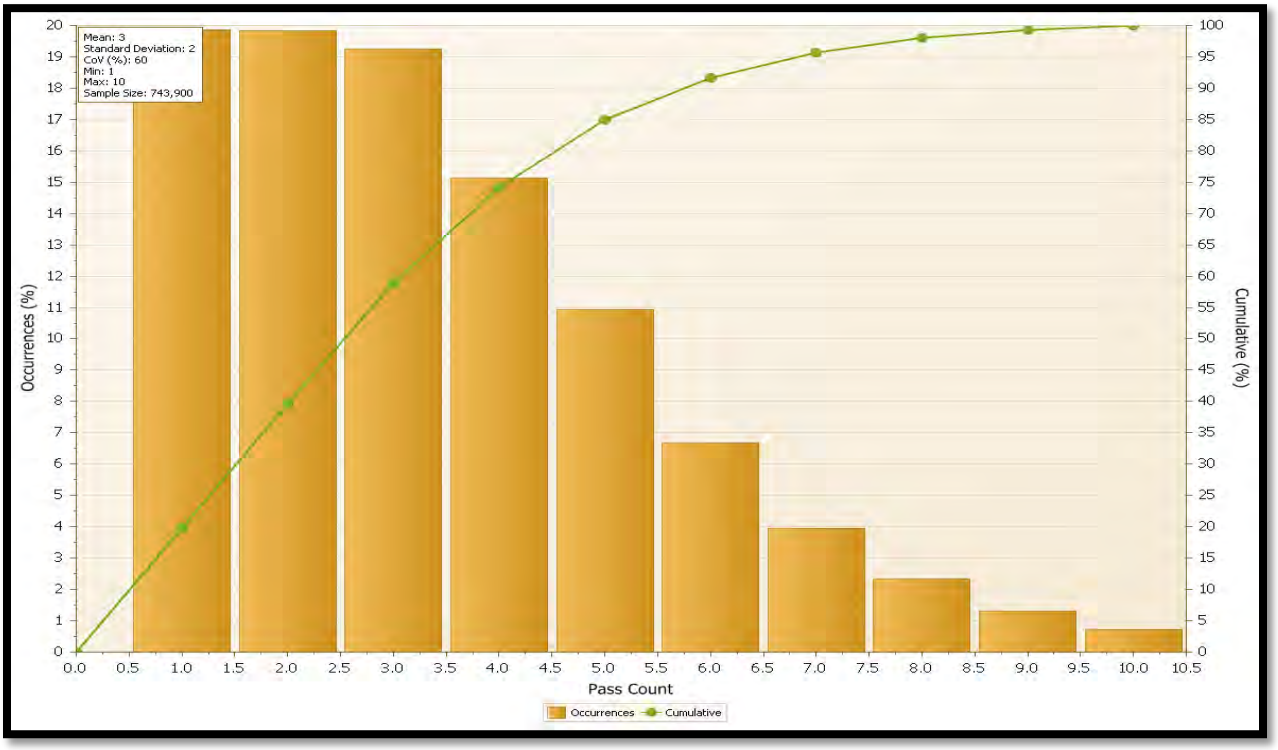
Percent compliance with target HMA temperature for final coverage of intermediate compaction



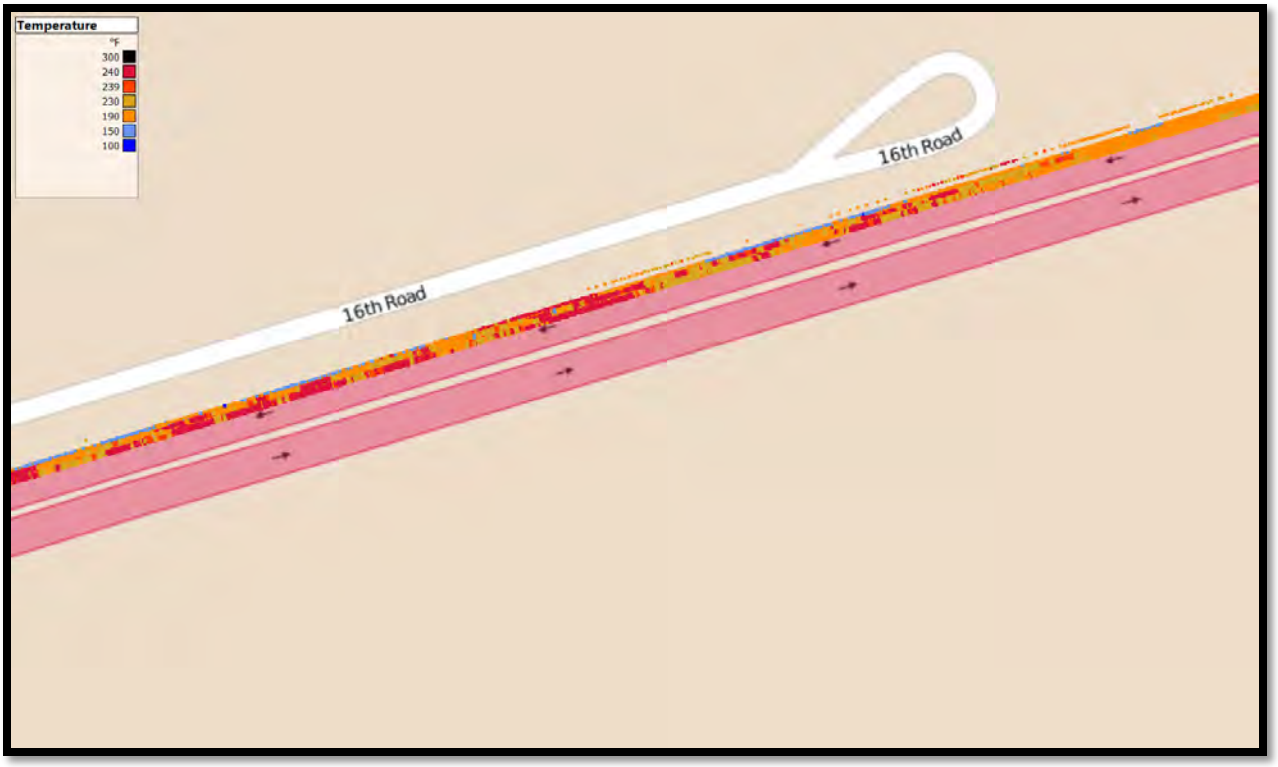
Percent compliance with target intelligent compaction measurement value



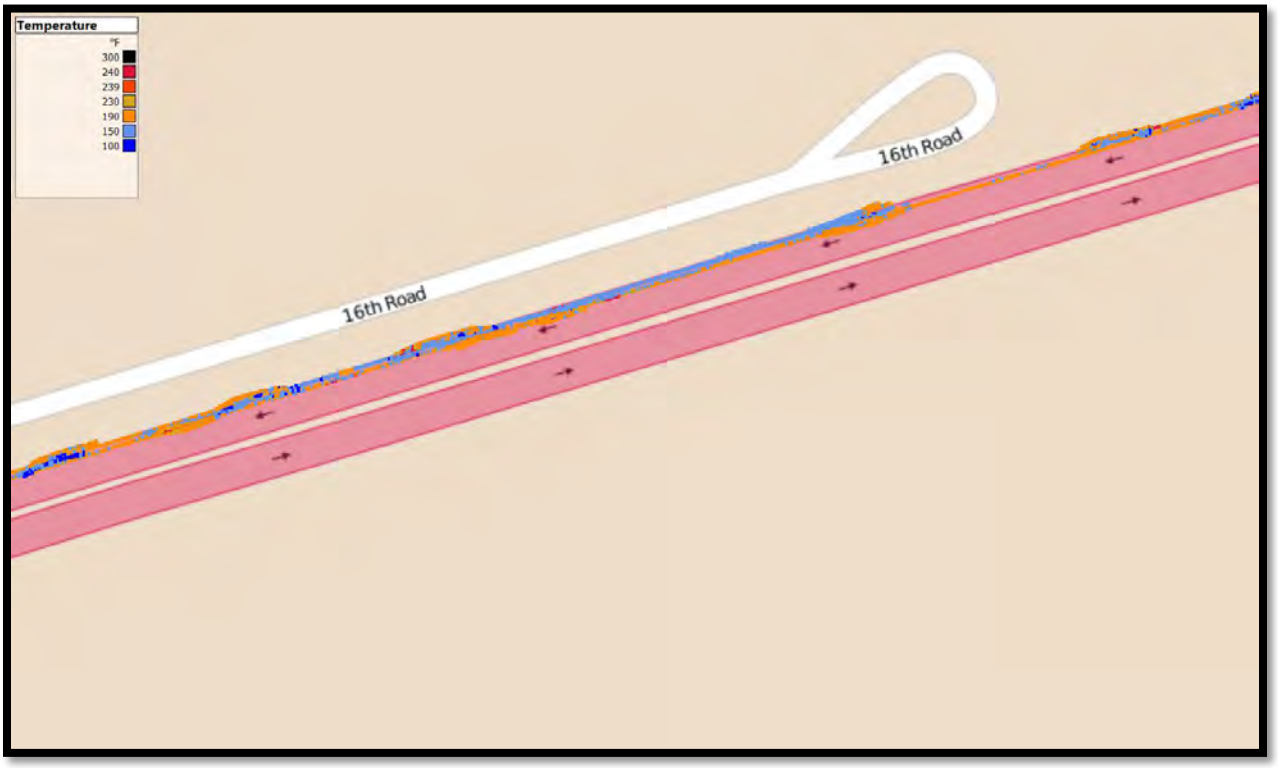
Final coverage histogram of number of passes for each roller



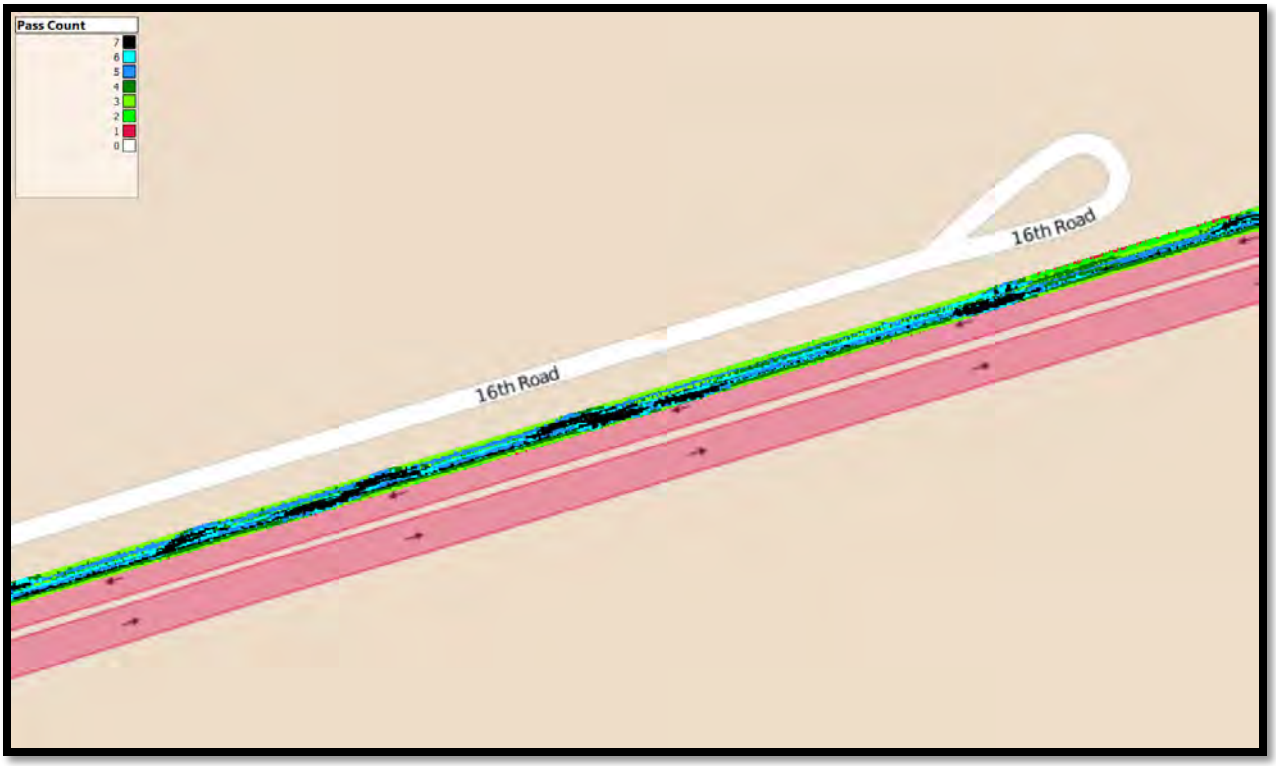
All passes histogram for each roller



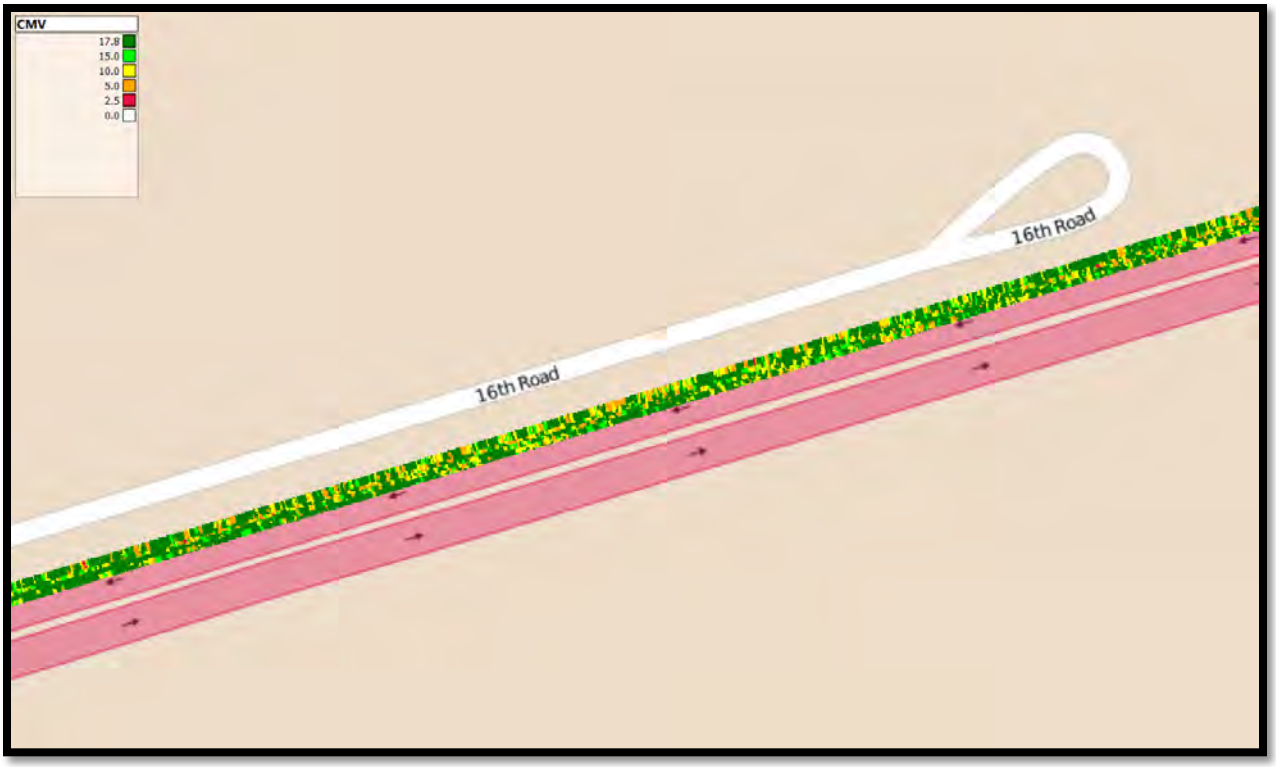
HMA temperature for first coverage of breakdown compaction.



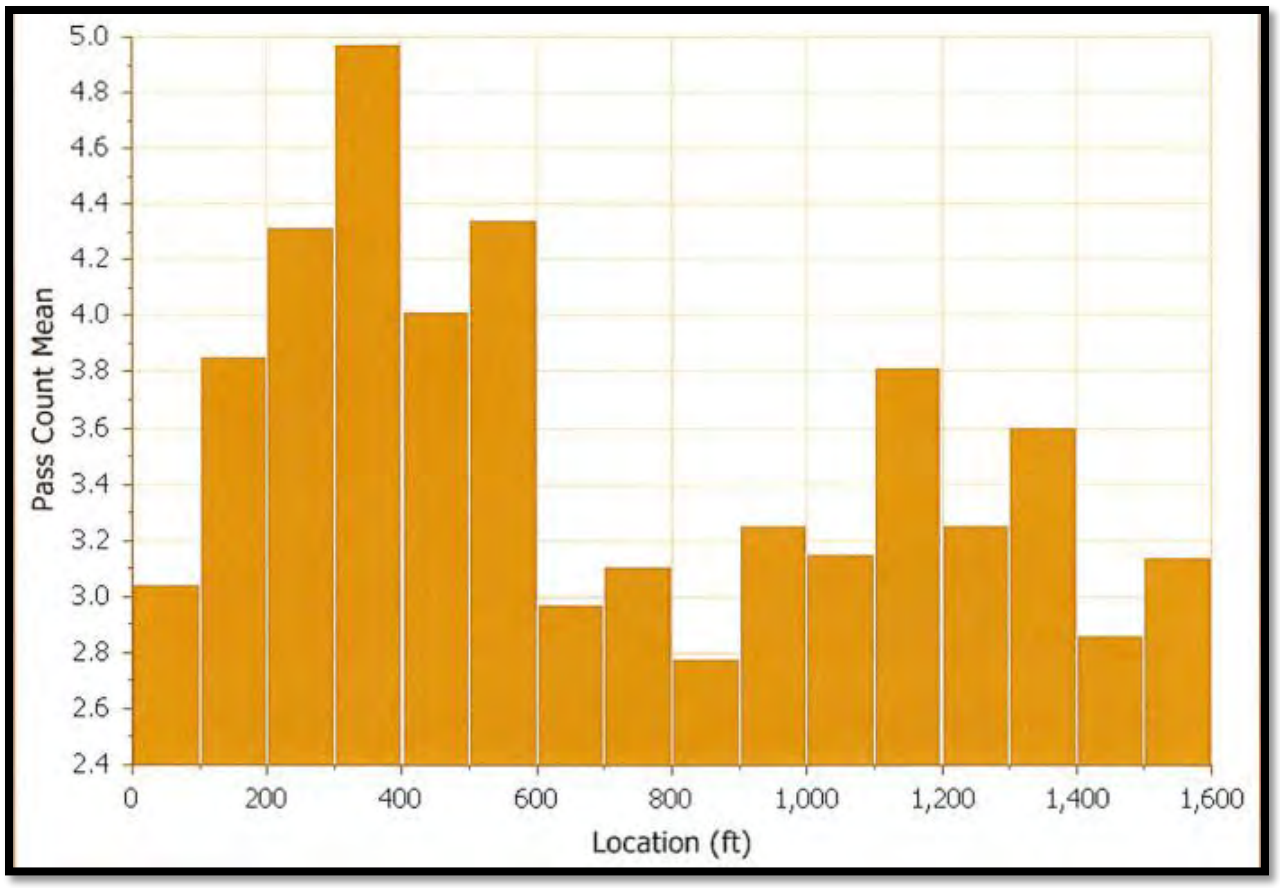
HMA temperature for final coverage of intermediate compaction.



Roller passes for each roller



Intelligent compaction measurement value of steel drum roller



Final coverage histogram of number of passes for each roller for a fixed interval.

Test Data Summary

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
1	09/12/15	6707864.854	2422263.488	Density - Nuclear Gauge	141.9
4	09/12/15	6707829.023	2422273.927	Density - Nuclear Gauge	138.1
5	09/12/15	6707395.953	2422213.652	Density - Nuclear Gauge	139
6	09/12/15	6707354.604	2422202.304	Density - Nuclear Gauge	137.6
2	09/12/15	6706957.282	2422145.005	Density - Nuclear Gauge	141
7	09/12/15	6706728.461	2422116.992	Density - Nuclear Gauge	141.8
8	09/12/15	6706705.126	2422111.303	Density - Nuclear Gauge	141.8
9	09/12/15	6706614.889	2422085.952	Density - Nuclear Gauge	140
3	09/12/15	6706559.636	2422090.126	Density - Nuclear Gauge	138.7
10	09/12/15	6706551.178	2422090.141	Density - Nuclear Gauge	143.7

Quality control density measurements and corresponding GPS coordinate.

Break Down Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
1	09/12/15	6707143.447	2422187.275	Layer Moduli	237.1
2	09/12/15	6706573.992	2422092.686	Layer Moduli	235.5
3	09/12/15	6706561.677	2422098.211	Layer Moduli	249.8

Intermediate Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
4	09/12/15	6707143.447	2422187.275	Layer Moduli	225.9
5	09/12/15	6706573.992	2422092.686	Layer Moduli	212.2
6	09/12/15	6706561.677	2422098.211	Layer Moduli	221

Finish Compaction Roller Temperatures

ID	Date	Easting (ft)	Northing (ft)	Test Type	Value
7	09/12/15	6707143.447	2422187.275	Layer Moduli	167.5
8	09/12/15	6706573.992	2422092.686	Layer Moduli	158.5
9	09/12/15	6706561.677	2422098.211	Layer Moduli	164.4

Hot mix asphalt mat temperature readings with corresponding GPS coordinates

Intelligent Compaction

Hot Mix Asphalt
CT Construction Forms

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form is to be completed and submitted by the contractor to ensure a complete test strip report submittal. The Engineer should use this form to verify that the required submittals for the intelligent compaction test strip report are received from the contractor. For questions about this form send an email to: IC@dot.ca.gov

Intelligent compaction hot mix asphalt test strip placed on:	HMA Test Strip Placement Date

HOT MIX ASPHALT (HMA) TEST STRIP INFORMATION

HMA Test Strip Placement Location		Direction	Lane Number
Test Strip Beginning Station/Post Mile	Test Strip Ending Station/Post Mile	HMA Type	HMA Thickness

Intelligent Compaction Quality Control Technician

Compaction QC Technician (print name)	Intelligent Compaction QC Training Completion Date:	Data Analysis Training certificate expiration date. __/__/____
Email address	Phone Number	IC Equipment Training certificate expiration date. __/__/____

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Data Analysis Training certificate expiration date. __/__/____
Email address	Phone Number	

Test Strip Report Submittal Preparer

Test Strip Report Submittal Completed by (print name)	Signature	Date
Test Strip Report Submittal Completed by Email Address	Phone Number	

Intelligent Compaction Target Values Determined From Test Strip

_____Target number of roller passes for breakdown compaction	Roller type: ☐ Steel vibratory ☐ Steel static ☐ Pneumatic
_____Target roller 1st pass minimum temperature breakdown compaction	
_____Target number of roller passes for intermediate compaction	Roller type: ☐ Steel vibratory ☐ Steel static ☐ Pneumatic
_____Target minimum temperature °F for completing intermediate compaction	
_____Target intelligent compaction measurement value	
_____Roller pass number that is the basis for target intelligent compaction measurement value	

COMMENTS:

Test Strip Report Submittals

Test Strip Report General Information

Contractor Submittal *Check all that were submitted*	Submittal Review *This Column For Engineer's Use*
☐ Nuclear gage density readings and the GPS corresponding coordinates which can be imported into Veta	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ HMA mat temperature readings and the corresponding GPS coordinates which can be imported into Veta	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Field compaction curve versus number of passes	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
COMMENTS:	

Veta Analysis Results

Contractor Submittal *Check all that were submitted*	Submittal Review *This Column For Engineer's Use*
☐ All passes compaction curves from Veta	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ All passes correlation analysis report from Veta	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Final coverage histogram of number of passes for each roller	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Final coverage histogram of intelligent compaction measurement value of steel drum roller with vibratory on	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
COMMENTS:	

Color Layout Plots

Contractor Submittal *Check all that were submitted*	Submittal Review *This Column For Engineer's Use*
☐ Plot of distribution of pass count over test strip for each roller	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Plot of HMA temperature for first coverage of breakdown compaction	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Plot of HMA temperature for final coverage of intermediate compaction	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Plot of distribution of intelligent compaction measurement value over test strip	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
COMMENTS:	

Test Strip Report Review

COMMENTS:

I have reviewed the intelligent compaction results shown on test strip report for compliance with the contract specifications and taken corrective action when required.

☐ See comments for corrective actions taken

Quality Control Manger (print name)	Signature	Date Reviewed

Contractor's Test Strip Report Submittal Documentation

Submit Adobe *.pdf file of the test strip report to resident engineer within 1 business day of HMA compaction test strip placement.	Submitted by (print name)	Date
Adobe *.pdf file name of test strip report:	Test strip report file name	
Submit Adobe *.pdf file of this form to resident engineer within 1 business day of HMA test strip placement with the test strip report submittal.	Submitted by (print name)	Date

Resident Engineers Review and Authorization of Test Strip Report

This Section Is For Engineers Use

Test strip report reviewed by (print name)	Test strip report reviewed by (signature)	Date

Test strip report complies with the specification requirements?

☐ Test strip report is adequate

☐ Test strip report does not comply with the specification requirements and must be resubmitted after addressing the comments shown above.

Contractor notified of accepted or rejected test strip report by (print name)	Date

The intelligent compaction test strip report submitted by the contractor complies with the specification requirements.

Resident Engineer (print name)	Resident Engineer (signature)	Date

Updated 2016-03-29

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form is to be completed and submitted by the contractor with the HMA test strip information to ensure a complete submittal. The Engineer should use this form to verify the required submittals for the intelligent compaction test strip information are received from the contractor.
For questions about this form send an email to: IC@dot.ca.gov

Intelligent compaction hot mix asphalt test strip placed on:	HMA Test Strip Placement Date

HOT MIX ASPHALT (HMA) TEST STRIP INFORMATION

HMA Test Strip Placement Location		Direction	Lane Number
Test Strip Beginning Station/Post Mile	Test Strip Ending Station/Post Mile	HMA Type	HMA Thickness

Intelligent Compaction Data Analysis

Data Analysis Technician	Data Analysis Technician email address	Data Analysis Training certificate expiration date. __/__/____
Data Analysis Technician Affiliation	Data Analysis Technician Phone Number	

Information Submittal Preparer

Information Submittal Completed by (print name)	Signature	Date
Information Submittal Completed by Email Address	Phone Number	

Test Strip Information Submittals

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
☐ Adobe *.pdf file of the test strip report from data analysis performed using Veta software Test strip report file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Project layout which can be imported to Veta Project layout file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Test strip boundary which can be imported to Veta Test strip boundary file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Nuclear gage density readings and the corresponding GPS coordinates which can be imported into Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ HMA mat temperature readings and the corresponding GPS coordinates which can be imported into Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Test Strip Information Submittals

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
Breakdown Compaction	
☐ Electronic data from compaction roller in file format readable by Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Post processed Veta file *.vetaproj File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
Intermediate Compaction	
☐ Electronic data from compaction roller in file format readable by Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Post processed Veta file *.vetaproj File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Contractor's Test Strip Information Submittal Documentation

Submit test strip information on a digital medium to the resident engineer within 3 business day of HMA compaction test strip placement.	Submitted by (print name)	Date
Upload test strip information to the Department's secure file sharing system within 3 business day of HMA compaction test strip placement.	Submitted by (print name)	Date
Submit an Adobe *.pdf file of this form with notification of your electronic upload submittal to the resident engineer and IC@dot.ca.gov.	Submitted by (print name)	Date

Resident Engineers Review and Authorization of Test Strip Information

This Section Is For Engineers Use

Test strip information submittal reviewed by (print name)	Test strip information submittal reviewed by (signature)	Date
Test strip information submittal complies with the specification requirements? ☐ Yes ☐ No		
Contractor notified of accepted or rejected test strip information submittal by (print name)		Date
The intelligent compaction test strip information submitted by the contractor complies with the specification requirements.		
Resident Engineer (print name)	Resident Engineer (signature)	Date

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize the daily hot mix asphalt method compaction intelligent compaction quality control report information. For questions about this form send an email to: IC@dot.ca.gov

Quality control report summary for hot mix asphalt placed on:	HMA Placement Date

Hot Mix Asphalt Information

HMA Placement Location		Direction	Lane Number
Beginning Station/Post Mile	Ending Station/Post Mile	HMA Type	HMA Thickness
Ambient Temp_____	Surface Temp_____	Paving Shift:	

Intelligent Compaction Technical Representative

Compaction QC Technician (print name)	Company (print name)
Email address	Phone Number:

Intelligent Compaction Quality Control Technician

Compaction QC Technician (print name)	Intelligent Compaction QC Training Completion Date:	Training certificate expiration date. __/__/____
Email address	Phone Number	

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Training certificate expiration date. __/__/____
Email address	Phone Number	

Quality Control Report Preparer

Quality Control Report Completed by (print name)	Signature	Date
Email Address	Phone Number	

Activities Before Daily Production

Breakdown Compaction Roller ID#_____ (*Veta Id Roller*)

☐ Check testing

GPS Measurement	X	Y
A-Roller		
B-Rover		
Difference (A-B)		

**Take corrective action if difference more than* 0.5 ft in any direction

☐ Temperature sensor accuracy verification

Temp. Measurement	°F
A- Roller Sensor	
B- Temp Device	
Difference (A-B)	

**Take corrective action if difference more than 5°F*

COMMENTS

IC Intermediate Compaction Roller ID#_____ (*Veta Id roller*)

☐ Check testing

GPS Measurement	X	Y
A-Roller		
B-Rover		
Difference (A-B)		

**Take corrective action if difference more than* 0.5 ft in any direction

☐ Temperature sensor accuracy verification

Temp. Measurement	°F
A- Roller Sensor	
B- Temp Device	
Difference (A-B)	

**Take corrective action if difference more than 5°F*

COMMENTS

HMA Method Compaction Requirements

The following requirements for HMA compaction are based on the specifications for the type of HMA being placed.

IC Requirements	HMA Target Values		IC Requirements	OGFC Target Values
Breakdown Compaction Minimum Number of Passes			Minimum Number of Passes	
Breakdown Compaction Minimum Temperature °F 1st PASS			Breakdown Compaction Minimum Temperature °F 1st PASS	
Intermediate Compaction Minimum Number of Passes			Complete Compaction Minimum Temperature °F	
Intermediate Compaction Minimum Temperature °F				

COMMENTS

DAILY COMPACTION QUALITY CONTROL REPORT SUMMARY

HMA/RHMA Compaction Veta Analysis Report Results

HAM tonnage placed within boundary _____

Does the number of passes for breakdown compaction roller results show that at least 90 percent coverage of the HMA placement of construction area met or exceed the minimum number of roller passes specified for breakdown compaction?

☐ Yes ☐ No

If no:

A_ What is the percentage coverage of HMA placement of construction area?:_____

B- What corrective action is taken?:

Does the 1st PASS breakdown compaction temperature results show that temperature meet or exceed the minimum temperature specified based on the HMA type for at least 95% of the daily HMA placement area?

☐ Yes ☐ No

If no:

A- What is the average temperature of HMA placement within construction area for first pass?:_____

B- What corrective action is taken?:

Does the number of passes for intermediate compaction roller results show that at least 90 percent coverage of the HMA placement construction area met or exceed the minimum number of roller passes specified for intermediate compaction?

☐ Yes ☐ No

If no:

A- What is the average temperature of HMA placement within construction area for last pass of intermediate compaction?:_____

B- What corrective action is taken?, corrective action taken?:

Does the final pass of intermediate compaction temperature results show that temperature meets or exceeds the minimum temperature specified based on the HMA type for at least 95% of the daily HMA placement area?

☐ Yes ☐ No

If no, corrective action taken:

OGFC Compaction Veta Analysis Report Results

Does the number of passes for compaction roller results show that at least 90 percent coverage of the HMA placement construction area met or exceed the minimum number of roller passes specified for compaction?

☐ Yes ☐ No

If no, corrective action taken:

Does the 1st PASS breakdown compaction temperature results show that temperature meet or exceed the minimum temperature specified based on the HMA type for at least 95% of the daily HMA placement area?

☐ Yes ☐ No

If no, corrective action taken:

Does the final pass of intermediate compaction temperature results show that temperature meet or exceed the minimum temperature specified based on the HMA type for at least 95% of the daily HMA placement area? ☐ Yes ☐ No
If no, corrective action taken:

Compaction Quality Control Report Review

COMMENTS:
I have reviewed the intelligent compaction results shown on compaction quality control report for compliance with the contract specifications and taken corrective action when required.

Quality Control Manger (print name)	Signature	Date Reviewed

Compaction Quality Control Report Submittal Information

Submit hardcopy to resident engineer within 1 business day of HMA placement.	Submitted by (print name)	Date
Submit Adobe *.pdf file of this form to resident engineer within 1 business day of HMA placement.	Submitted by (print name)	Date

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form is to be completed and submitted by the contractor to ensure a complete quality compaction submittal. The Engineer should use this form to verify that the submittals of the intelligent compaction report are complete. For questions about this form send an email to: IC@dot.ca.gov

Intelligent compaction information submittals for hot mix asphalt placed on:	HMA Placement Date

Hot Mix Asphalt Information

HMA Placement Location		Direction	Lane Number
Beginning Station/Post Mile	Ending Station/Post Mile	HMA Type	HMA Thickness

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Training certification expiration date: __/__/_____
Email address	Phone Number	

Report Submittal Preparer

Report Submittal Completed by (print name)	Signature	Date
Report Submittal Completed by Email Address	Phone Number	

Intelligent Compaction Report Submittals

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt for: ☐ *Method Compaction* ☐ *Density Requirement.*	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
Veta analysis report results for: ☐ Percent compliance with target roller passes ☐ Percent compliance with target HMA temperature for first coverage of breakdown compaction ☐ Percent compliance with target HMA temperature for final coverage of intermediate compaction ☐ Percent compliance with target HMA intelligent compaction measurement value when measurement of intelligent compaction measurement value is required Project layout which can be imported to Veta	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on.	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Final coverage histogram of intelligent compaction measurement value of steel drum roller with vibratory on.	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment

☐ Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on for a sublot.	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ All passes histogram for each roller	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
Color layout plots of: ☐ Roller passes for each roller ☐ HMA temperature for first coverage of breakdown compaction. ☐ HMA temperature for final coverage of intermediate compaction. ☐ Intelligent compaction measurement value for final coverage of intermediate compaction when required.	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Quality control density measurements and corresponding GPS coordinate	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ HMA mat temperature readings with corresponding GPS coordinates	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
COMMENTS:	

Contractor's Submittal Documentation for Intelligent Compaction Information

Submit hard copy of Summary of HMA compaction quality control report within 1 business day of HMA placement.	Submitted by (print name)	Date
Submit an Adobe *.pdf file of compaction quality control report to the resident engineer and IC@dot.ca.gov.	Submitted by (print name)	Date

Resident Engineers Review and Authorization of Intelligent Compaction report

This Section Is For Engineers Use

Report submittal reviewed by (print name)	Report submittal reviewed by (signature)	Date
Report submittal complies with the specification requirements? ☐ Yes ☐ No		
Contractor notified of accepted or rejected information submittal by (print name)		Date
The intelligent compaction report submitted by the contractor complies with the specification requirements.		
Resident Engineer (print name)	Resident Engineer (signature)	Date

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form is to be completed and submitted by the contractor to ensure a complete information submittal. The Engineer should use this form to verify that the submittals of the intelligent information are complete. For questions about this form send an email to: IC@dot.ca.gov

Intelligent compaction information submittals for hot mix asphalt placed on:	HMA Placement Date

Hot Mix Asphalt Information

HMA Placement Location		Direction	Lane Number
Beginning Station/Post Mile	Ending Station/Post Mile	HMA Type	HMA Thickness

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Data Analysis Training certificate expiration date. __/__/____
Email address	Phone Number	

Information Submittal Preparer

Information Submittal Completed by (print name)	Signature	Date
Information Submittal Completed by Email Address	Phone Number	

Intelligent Compaction Information Submittals

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
☐ Adobe *.pdf file of the HMA quality control report from data analysis performed using Veta software Quality control report file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Project layout which can be imported to Veta Project layout file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Daily boundary which can be imported to Veta Boundary file name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Nuclear gage density readings and the corresponding GPS coordinates which can be imported into Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ HMA mat temperature readings and the corresponding GPS coordinates which can be imported into Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
Comments;	

Intelligent Compaction Information Submittals

Contractor Submittal *Check all that were submitted*	**Submittal Review** *This Column For Engineer's Use*
Breakdown Compaction	
☐ Electronic data from compaction roller in file format readable by Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Post processed Veta file *.vetaproj File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
Intermediate Compaction	
☐ Electronic data from compaction roller in file format readable by Veta File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Post processed Veta file *.vetaproj File name:	Submittal is adequate? ☐ Yes ☐ No ☐ See Comment
COMMENTS:	

Contractor's Submittal Documentation for Intelligent Compaction Information

Submit information on a digital medium to the resident engineer within 3 business days of HMA placement.	Submitted by (print name)	Date
Upload information to the Department's secure file sharing system within 3 business day of HMA placement.	Submitted by (print name)	Date
Submit an Adobe *.pdf file of this form with notification of your electronic upload submittal to the resident engineer and IC@dot.ca.gov.	Submitted by (print name)	Date

Resident Engineers Review and Authorization of Intelligent Compaction Information

This Section Is For Engineers Use

Information submittal reviewed by (print name)	Information submittal reviewed by (signature)	Date
Information submittal complies with the specification requirements? ☐ Yes ☐ No		
Contractor notified of accepted or rejected information submittal by (print name)		Date
The intelligent compaction information submitted by the contractor complies with the specification requirements.		
Resident Engineer (print name)	Resident Engineer (signature)	Date

Updated 2016-03-30

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This form to be used by the contractor to summarize the daily hot mix asphalt intelligent compaction quality control report information. For questions about this form send an email to: IC@dot.ca.gov

Quality control report for hot mix asphalt placed on:	HMA Placement Date

Hot Mix Asphalt Information

HMA Placement Location		Direction	Lane Number
Beginning Station/Post Mile	Ending Station/Post Mile	HMA Type	HMA Thickness

Intelligent Compaction Technical Representative

Compaction QC Technician (print name)	Company (print name)
Email address	Phone Number :

Intelligent Compaction Quality Control Technician

Compaction QC Technician (print name)	Intelligent Compaction QC Training Completion Date:	Training certification expiration date: __/__/_____
Email address	Phone Number	

Intelligent Compaction Data Analysis Technician

Data Analysis Technician (print name)	Data Analysis Training Completion Date:	Training certification expiration date: __/__/_____
Email address	Phone Number	

Quality Control Report Preparer

Quality Control Report Completed by (print name)	Signature	Date
Email Address	Phone Number	

Activities Before Daily Production

Breakdown Compaction Roller ID#_____ (*Veta Id Roller*)

☐ Check testing

GPS Measurement	X	Y
A-Roller		
B-Rover		
Difference (A-B)		

**Take corrective action if difference more than* 0.5 ft in any direction

☐ Temperature sensor accuracy verification

Temp. Measurement	°F
A- Roller Sensor	
B- Temp Device	
Difference (A-B)	

**Take corrective action if difference more than 5°F*

COMMENTS

IC Intermediate Compaction Roller ID#_____ (*Veta Id roller*)

☐ Check testing

GPS Measurement	X	Y
A-Roller		
B-Rover		
Difference (A-B)		

**Take corrective action if difference more than* 0.5 ft in any direction

☐ Temperature sensor accuracy verification

Temp. Measurement	°F
A- Roller Sensor	
B- Temp Device	
Difference (A-B)	

**Take corrective action if difference more than 5°F*

COMMENTS

Intelligent Compaction Target Values Determined From Test Strip

_____Target number of roller passes for breakdown compaction

Roller type:
☐ Steel vibratory ☐ Steel static ☐ Pneumatic

_____Target roller 1st pass minimum temperature breakdown compaction

_____Target number of roller passes for intermediate compaction

Roller type:
☐ Steel vibratory ☐ Steel static ☐ Pneumatic

_____Target minimum temperature °F for completing intermediate compaction

_____Target intelligent compaction measurement value

_____Roller pass number that is the basis for target intelligent compaction measurement value

COMMENTS:

DAILY COMPACTION QUALITY CONTROL REPORT SUMMARY

Breakdown Compaction Vibratory Steel Drum Roller Number of Passes

HMA Tonnage placed within boundary_____

_____Target number of roller passes	_____Percent work area covered by minimum number of roller passes

Does the number of passes for IC vibratory steel drum roller compaction shown on final coverage histogram of number of passes show that at least 90 percent coverage of the HMA placement area meets or exceeds the minimum number of roller passes based on target value established at the test strip?

☐ Yes ☐ No

If no, corrective action taken:

Breakdown Compaction HMA Mat Temperature

_____Target 1st pass minimum temperature	_____Percent work area covered by minimum temperature

Does the 1st PASS breakdown compaction temperature results show that temperature meets or exceeds the target minimum temperature for at least 95% of the daily HMA placement area?

☐ Yes ☐ No

If no, corrective action taken:

Breakdown Compaction Intelligent Compaction Measurement Value

_____Target intelligent compaction measurement value	_____Daily average intelligent compaction measurement value

Does the daily average intelligent compaction measurement value for final coverage of IC vibratory steel drum roller meets or exceeds the target intelligent compaction measurement value established at the test strip?

☐ Yes ☐ No

If the answer is no, is the daily average intelligent compaction value at least 81 percent of the target measurement value?

☐ Yes ☐ No

If the answer is no, reestablish the intelligent compaction measurement value.

Intermediate Compaction Roller Number of Passes

_____Target number of roller passes	_____Percent work area covered by minimum number of roller passes

Does the number of passes for intermediate compaction roller shown on final coverage histogram of number of passes show that at least 90 percent coverage of the HMA placement area meets or exceeds the minimum number of roller passes based on target established at the test strip?

☐ Yes ☐ No

If no, corrective action taken:

Complete Intermediate Compaction HMA Mat Temperature

_____Target intermediate compaction HMA mat temperature	_____Percent work area covered by minimum temperature

Does the final pass of intermediate compaction temperature results show that temperature meets or exceeds the minimum target temperature for at least 95% of the daily HMA placement area?

☐ Yes ☐ No

If no, corrective action taken:

Additional Intelligent Compaction Vibratory Steel Drum Roller Compaction

If the roller pattern established at the test strip includes addition rolling using IC vibratory steel drum roller after pneumatic rubber tire rolling provide the following information:

☐ Yes ☐ Not Required

Roller Number of Passes

_____Target number of roller passes	_____Percent work area covered by minimum number of roller passes

Does the number of passes for IC vibratory steel drum roller compaction shown on final coverage histogram of number of passes show that at least 90 percent coverage of the HMA placement area meets or exceeds the minimum number of roller passes based on target value established at the test strip?

☐ Yes ☐ No

If no, corrective action taken:

Intelligent Compaction Measurement Value

_____Target intelligent compaction measurement value	_____ Daily average intelligent compaction measurement value

Does the daily average intelligent compaction measurement value for final coverage of IC vibratory steel drum roller meets or exceeds the target intelligent compaction measurement value established at the test strip? ☐ Yes ☐ No If the answer is no, is the daily average intelligent compaction value at least 81 percent of the target measurement value? ☐ Yes ☐ No If the answer is no, reestablish the intelligent compaction measurement value.
Note: **1) Results from intelligent compaction are for contractor quality control purposes and not to be used as Caltrans acceptance of HMA.** **2) When the density is verified by contractor nuclear gage quality control test results, then corrective action for number of passes is not required.**

Compaction Quality Control Report Review

COMMENTS:
I have reviewed the intelligent compaction results shown on compaction quality control report for compliance with the contract specifications and taken corrective action when required.

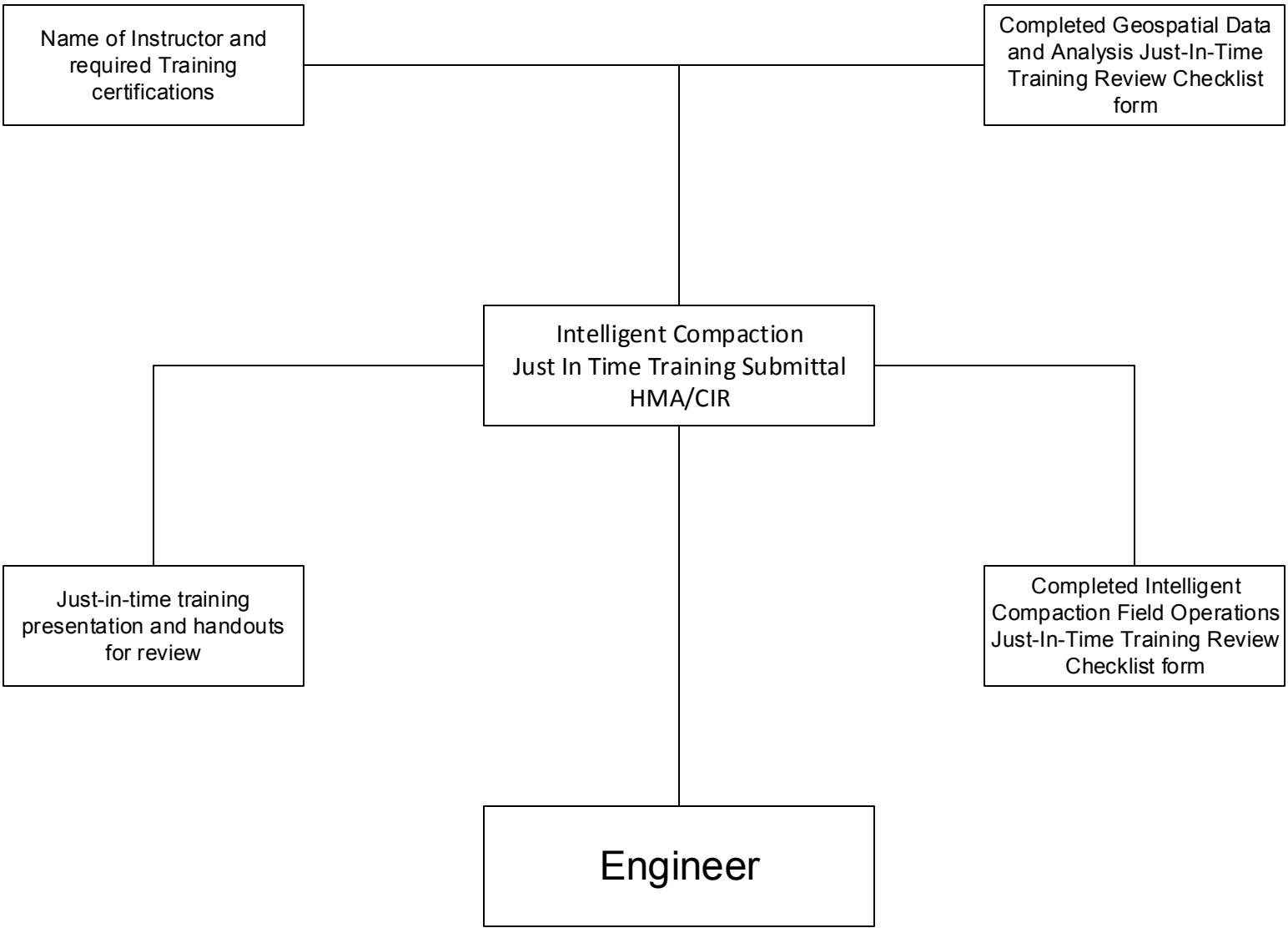
Quality Control Manger (print name)	Signature	Date Reviewed

Compaction Quality Control Report Submittal Information

Submit hardcopy to resident engineer within 1 business day of HMA placement.	Submitted by (print name)	Date
Submit Adobe *.pdf file of this form to resident engineer within 1 business day of HMA placement.	Submitted by (print name)	Date

Intelligent Compaction

Just- In- Time- Training



Just-In- Time Training Submittals

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: This checklist form is to be completed and submitted by the contractor with the proposed geospatial data and analysis just-in-time training to ensure a complete submittal. The Engineer will use this checklist form to review the proposed training to ensure the training meets the specification requirements before authorizing the training. JITT trainer must be in possession of valid training certificates as IC compaction quality control technician. For questions about this form send an email to: IC@dot.ca.gov

GEOSPACIAL DATA AND ANALYSIS JUST-IN-TIME TRAINING INFORMATION

JITT Trainer Name	JITT Trainer Phone Number	Data Analysis Training certificate expiration date. __/__/____
JITT Company/Consultant Name	JITT Trainer Email Address	

JITT Trainer Affiliation

☐ Contractor	☐ Roller Manufacturer	☐ IC System	☐ Consultant

JITT for Materials Type

☐ Hot Mix Asphalt	HMA Type	HMA thickness	☐ Cold In-Place Recycling	☐ Soils/ Aggregate Bases

JITT Training Content Provided Using (Check all that apply)

☐ PowerPoint Presentation	☐ Handouts: Procedural Manual, Equipment Manual or Guidance
☐ Computer Demonstration	☐ Field / Hands on Training

Proposed Training Schedule and Location

Training Date	Time	Training Location

GEOSPACIAL DATA ANALYSIS JUST-IN-TIME TRAINING CHECKLIST

The JITT presentation must include all of the following topics:

IC Vendor Software used to export IC data to Veta readable format_____

Background Information

These columns to be completed by the Contractor.		*This Column For Engineer's Use*
Training Topic	**JITT Presentation**	**JITT Submittal Review**
☐ What is Intelligent Compaction	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Information about the specific intelligent compaction system that will be used on the project.	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Information about the specific automated machine guidance system that will be used on the project.	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Veta Software Analysis Reports

These columns to be completed by the Contractor.		*This Column For Engineer's Use*
Training Topic	**JITT Presentation**	**JITT Submittal Review**
Premapping is only required for cold-in-place recycling.		
☐ Premapping Report	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____ ☐ Computer Demonstration	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment ☐ Not Required
Test strip is required for cold-in-place recycling and when hot mix asphalt thickness is 0.15 foot or greater.		
☐ Test Strip Report	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____ ☐ Computer Demonstration	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment ☐ Not Required
☐ Compaction Quality Control Report	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____ ☐ Computer Demonstration	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment

COMMENTS:

Intelligent Compaction Target Values and Corrective Action

(Describe the method for how target values will be established)

These columns to be completed by the Contractor.		*This Column For Engineer's Use*
Training Topic	**JITT Presentation**	**JITT Submittal Review**
☐ Number of passes	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Minimum temperature or temperature range	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment ☐ Not Required
☐ Intelligent compaction measurement values	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment ☐ Not Required

COMMENTS:

Specification Requirements for Temperature, Coverage and Uniformity	
☐ Temperature	For HMA, at least 95 percent coverage of the HMA placement area must meet or exceed the minimum temperature specified or determined from test strip.
☐ Coverage	For HMA, at least 90 percent coverage of the HMA placement area must meet or exceed the minimum number of roller passes specified or determined from test stripe. For cold-In-place recycling, at least 90 percent coverage of the CIR placement area must meet or exceed the target roller passes determined from test stripe.
☐ Uniformity	For HMA with density requirement, the daily average intelligent compaction measurement value for final coverage of intermediate compaction must be at least 80 percent of the target intelligent compaction measurement value established at the test stripe.

Proposed Corrective Actions When Requirements Are Not Met For Intelligent Compaction		
These columns to be completed by the Contractor.		*This Column For Engineer's Use*
Training Topic	**JITT Presentation**	**JITT Submittal Review**
☐ Coverage	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment
☐ Temperature	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment ☐ Not Required
☐ Uniformity	☐ Power Point Slides _____ - ____ ☐ Handout Pages _____ - ____	The submitted JITT is adequate? ☐ Yes ☐ No ☐ See Comment ☐ Not Required
COMMENTS:		

Contractor Submittal Information		
Just-In-Time Training Checklist Prepared by (print name)	Just-In-Time Training Checklist Prepared by (signature)	Date
Quality Control Manger (print name)	Quality Control Manger (signature)	Date Reviewed
Submit just-in-time training presentation and handouts for review at least 10 days prior to just-in-time training,	Submitted by (print name)	Date
Submit a list of names participating in the just-in-time training. Identify each participant's name, employer, title, and role in intelligent compaction.	Submitted by (print name)	Date
Resident Engineers Review and Authorization		
Just-In-Time-Training Reviewed by (print name)	Just-In-Time Training Reviewed by (signature)	Date

Proposed geospatial data and analysis just-in-time training complies with the specification requirements? ☐ Yes ☐ No	☐ Geospatial Data and Analysis Just-In-Time Training is Authorized	Date
If no: ☐ Proposed roller operator just-in-time training does not comply with the specification requirements and must be resubmitted after addressing the comments shown.	☐ Geospatial Data and Analysis Just-In-Time Training is Rejected	Date
Resident Engineer (print name)	Resident Engineer (signature)	Date
Contractor notified of accepted or rejected just-in-time training by (print name)		Date

PROJECT INFORMATION/NAME	JIITT TRANIING SESSION: ☐ Field Operations ☐ Geospatial Data and Analysis	IC JITT TRAINING FOR: ☐ Hot Mix Asphalt ☐ Cold In-Place Recycling ☐ Soils/ Aggregate Bases	CONTRACT NUMBER	CO/RTE/PM
			PROJECT IDENTIFIER NUMBER	
			CONTRACTOR NAME	

JITT Trainer Name*	JITT Trainer Phone Number	Date of Training	Time
JITT Company/Consultant Name	JITT Trainer Email Address	Training Location	
Data Analysis Training certificate expiration date. __/__/____	IC equipment Training certificate expiration date. __/__/____		

No.	Name	Title/Project Role	Phone Number	Email Address
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Geospatial Data and Analysis

The people who perform the following project roles must attend the training:

1. Intelligent compaction quality control technicians
2. Data analysis technician
3. HMA foreman/ CIR foreman

Field Operation

The people who perform the following project roles must attend the training:

1. Roller operators
2. Intelligent compaction quality control technician
3. Technical representative
4. HMA foreman/ CIR foreman

*JITT trainer must possess valid certifi8cates of training for IC compaction quality control technician.

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	

Instruction: Before authorizing just-in-time training for geospatial data and analysis use this checklist form to review the proposed training to ensure the training meets the specification requirements. JITT trainer must possess valid certificates of training for IC Quality Control Technician. For questions about this form send an email to: IC@dot.ca.gov

JUST-IN-TIME TRAINING FIELD OPERATION INFORMATION

JITT Trainer Name	JITT Trainer Phone Number	Data Analysis Training certificate expiration date. __/__/____
JITT Company/Consultant Name	JITT Trainer Email Address	IC Equipment Training certificate expiration date. __/__/____

JITT Trainer Affiliation

☐ Contractor	☐ Roller Manufacturer	☐ IC System	☐ Consultant

JITT for Materials Type

☐ Hot Mix Asphalt	HMA Type	HMA thickness	☐ Cold In-Place Recycling	☐ Soils/ Aggregate Bases

JITT Training Content Provided Using (Check all that apply)

☐ PowerPoint Presentation	☐ Procedural Manual or Guidance
☐ Equipment Technical Handout	☐ Field / Hands on Training

Proposed Training Schedule and Location

Training Date	Time	Training Location

Roller Information (Check all that apply)

The following information is required to determine if the proposed JITT is adequate and specific based on the rollers that will be used on the project.

IC Roller No. 1

☐ CATERPILAR Model No._____	☐ BOMAG Model No. _____	☐ Other_____ Model No. _____
☐ SAKAI Model No. _____	☐ HAMM Model No. _____	

Roller IC System

☐ Original Equipment Manufacturer	☐ Retrofit Topcon Model No._____	☐ Retrofit Trimble Model No. _____

IC Roller No. 2

☐ CATERPILAR Model No._____	☐ BOMAG Model No. _____	☐ Other_____ Model No. _____
☐ SAKAI Model No. _____	☐ HAMM Model No. _____	

Roller IC System

☐ Original Equipment Manufacturer	☐ Retrofit Topcon Model No._____	☐ Retrofit Trimble Model No. _____

Automated Machine Guidance Roller

☐ CATERPILAR Model No._____	☐ BOMAG Model No. _____	☐ Other_____ Model No. _____
☐ SAKAI Model No. _____	☐ HAMM Model No. _____	

Roller IC System

☐ Original Equipment Manufacturer	☐ Retrofit Topcon Model No._____	☐ Retrofit Trimble Model No. _____

FILED OPERATION JUST-IN-TIME TRAINING REVIEW CHECKLIST

The JITT presentation must include all of the following topics:

Background Information

☐ Information about the specific intelligent compaction system and automated machine guidance system that will be used on the project.

GPS Type (check one)

☐ GPS Base Station	☐ Network Real Time Kinematic	☐ Satellite Based Augmentation System

GPS Setup and Roller Check Tests

☐ GPS Base Station	☐ IC System Setup
☐ GPS Rovers	☐ Verification of the Roller GPS Coordinates
☐ GPS Receiver	☐ Accuracy verification of the roller temperature sensor

Demonstration and Operation of IC System and Automated Machine Guidance System

☐ Displays	☐ Setup Data Collection
☐ Color Code Description	☐ Start/stop of Data Recording
☐ On-Board Display Options	☐ Down Loading Data
☐ Setting Target Values	

COMMENTS:

JITT Reviewed by (print name)	Signature	Date

Updated 2016-04-01