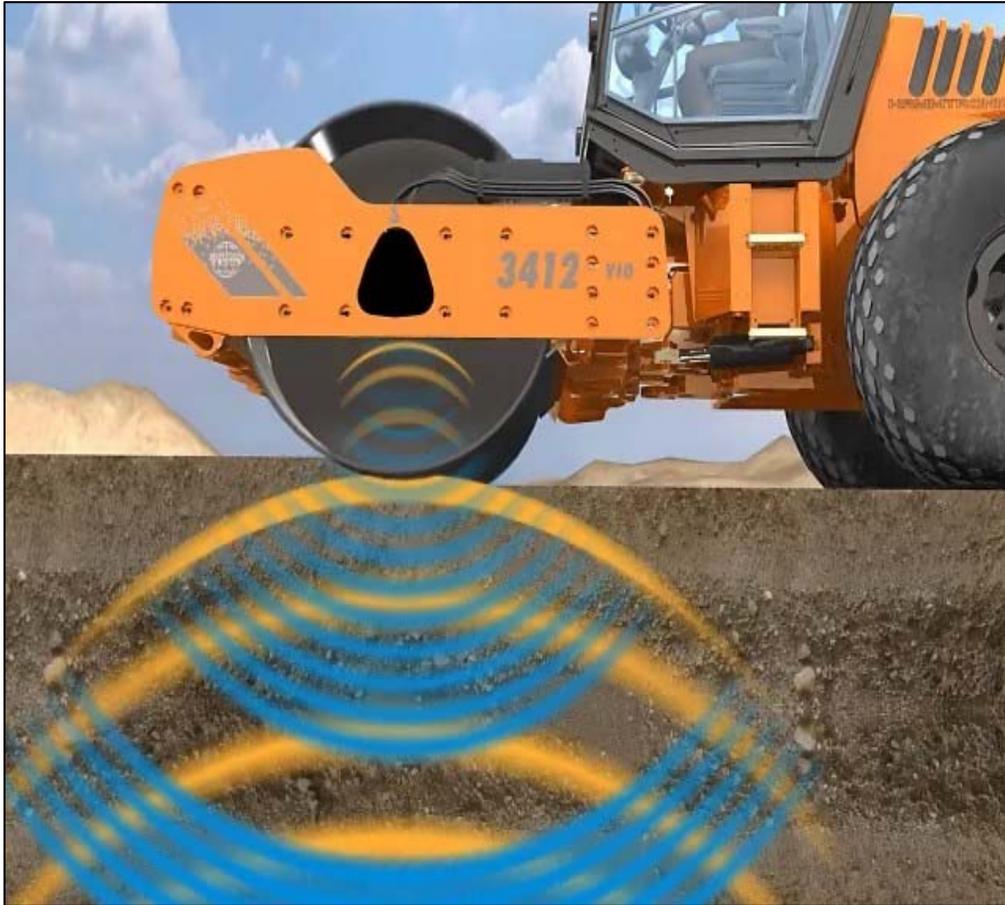


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INTELLIGENT COMPACTION CONSTRUCTION GUIDANCE



State of California Department of Transportation

Division of Construction

Office of Construction Engineering

August 2015

INTELLIGENT COMPACTION CONSTRUCTION GUIDANCE

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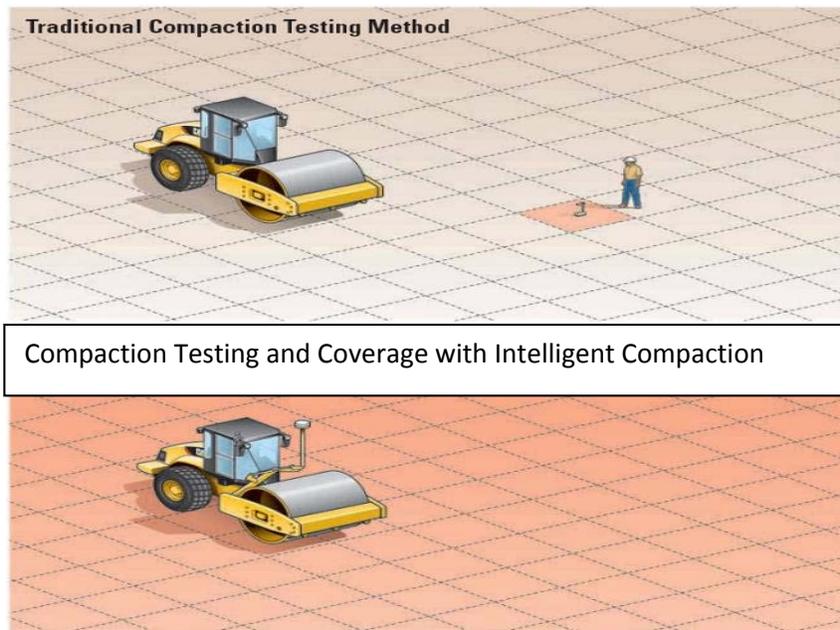
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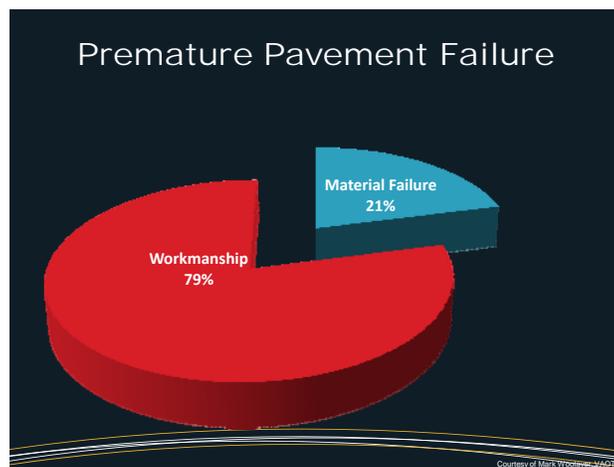
www.dot.ca.gov/hq/construc/ic

Introduction

This guidance is prepared to assist the Caltrans construction personnel to administer Caltrans intelligent compaction specifications. Compaction is one of the most important processes in roadway construction. Pavement materials must be compacted to optimum densities to ensure adequate support, stability, and strength—achieving these densities uniformly is the key to long lasting roadway performance. Current procedures using conventional compaction equipment and spot location density testing may result in inadequate and/or non-uniform material densities.

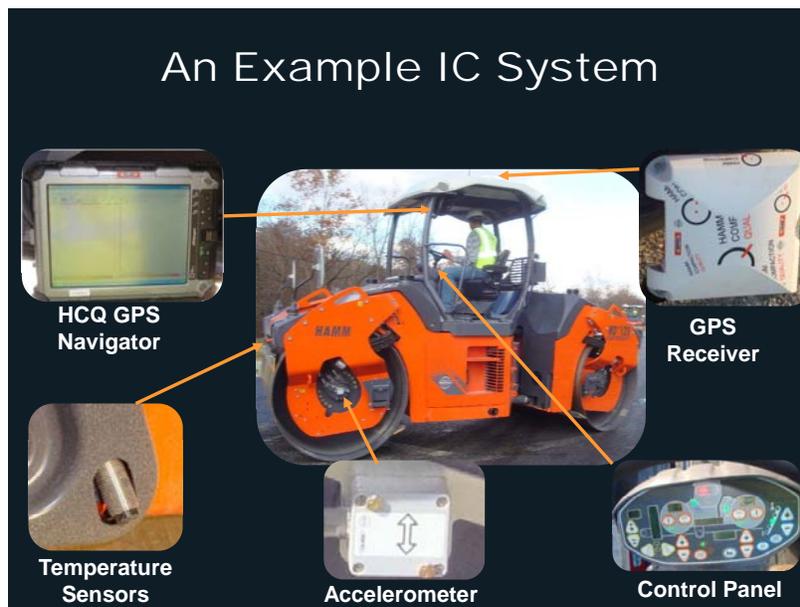


Inadequate compaction is one of the major factors in premature pavement failure.



Intelligent compaction rollers facilitate real-time quality control for compaction by monitoring roller passes, surface temperature and material stiffness that allow for timely adjustments to the compaction process. Intelligent compaction rollers maintain a continuous data record of precise location of the roller using GPS, the number of roller passes, and material stiffness measurements. Intelligent compaction rollers must be vibratory rollers equipped with the following features:

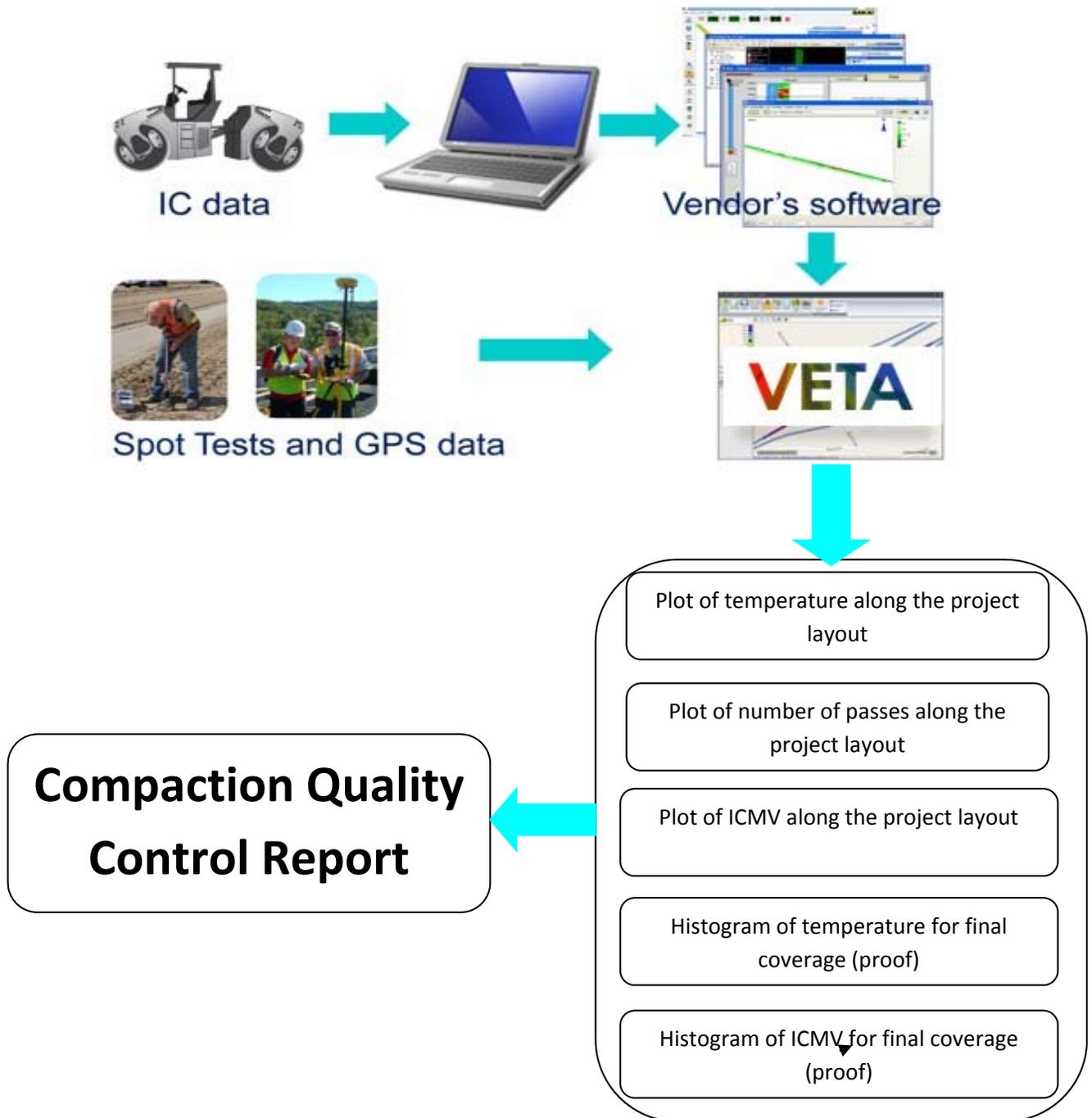
1. Include an integrated on-board documentation system that is capable of displaying real-time color-coded maps, including the stiffness response values, vibration frequencies, roller drum amplitude, roller location, number of roller passes, roller speeds and capable of transferring data from a USB port.
2. Be equipped with non-contact temperature sensors for measuring pavement surface temperatures.
3. An accelerometer mounted in or about the drum to measure the interactions between the rollers and compacted materials in order to evaluate the material stiffness.
4. Controls for vibration frequencies and roller drum amplitude,
5. Have mounted GPS receiver, antenna, and telemetry equipment to monitor the drum locations and track the number of passes



The data can be processed using Veta software to create a daily compaction quality control report to ensure that specification required roller passes, material temperature and material stiffness based on material density are met. Prior to Veta release 3.0 on June 5th 2015 this

software was called Veda. The following IC data process shows the flow of data and processing required from the roller data collection to the completed compaction quality control report.

IC Data Process Flow Chart



Chapter 1

HOT MIX ASPHALT

Intelligent compaction is specified using a Non-Standard Special Provision Section 39-8 “Intelligent Compaction of Hot Mix Asphalt.” 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. IC rollers and automated machine guidance rollers are used in compaction of hot mix asphalt for breakdown and intermediate compaction for both method compaction and for HMA with density requirement.

The requirements for HMA compaction are shown in Section 39 “Hot Mix Asphalt,” of the Standard Specifications. Intelligent compaction does not waive any specifications for HMA but provides the means and methods necessary for the contractor to improve compaction and document quality control of HMA compaction.

BEFORE WORK BEGINS

- Determine if IC for HMA is required on a project by reviewing the bid item list for bid item 390030 Intelligent Compaction and section 39 of the special provisions for section 39-8 Intelligent Compaction for Hot Mix Asphalt.
- Review the project plans for a Project Control Map and Supplemental Project Information to determine if survey control points information has been provided. If survey control points information has not been provided, request survey control points from district surveyor upon receipt of a request from the contractor.
- In consultation with the contractor, verify the GPS coverage for the project site. If GPS coverage is less than 90 percent of the project site, contact district surveys to confirm lack of GPS coverage. The contractor may need to use GPS repeaters or other measures for to obtain GPS coverage of 90 percent or more.
- Verify the coordinate system that the contractor will be using {39-8.03B(3) Global Positioning System}. Contractor has the option of using UTM system in lieu of CCS83 coordinate for projects prior to July 2016.
- Verify if HMA is placed under method compaction or there is a density requirement. HMA with minimum thickness of 0.15’ is compacted and accepted based on density requirement. HMA with thickness less than 0.15’ is compacted under method compaction.

- Review the list of Just In Time Training (JITT) participants submitted by the contractor and ensure that at a minimum the following are participants are shown:

Roller operation JITT:

1. Project manager
2. Superintendent
3. Technical representative
4. Intelligent compaction quality control technicians
5. Roller operators
6. HMA foreman

Geospatial data and analysis JITT:

1. Technical representative
2. Intelligent compaction quality control technicians
3. HMA foreman

- During the prepaving meeting {39-1.01D(7) Prepaving Meeting} review the IC specification and establish the expectations for timely submittal of compaction quality control reports and electronic data files. The IC technical representative {39-8.01D(2) Technical Representative} and the compaction quality control technician {39-8.01D(4)(c) Quality Control Technician} must attend the prepaving meeting. Discuss the specified responsibilities of both the IC technical representative and IC quality control technician.
- Review both of the contractor's JITT submittals to verify the completeness of the proposed JITT. The JITT for IC is divided into two sessions:
 1. Roller operation
 2. Intelligent compaction geospatial data and analysisUse form 1 (Appendix A) in this guidance to assist in your review of the contractor's JITT submittal. Notify the contractor of any deficiencies found in the proposed JITT. Confirm the date and location of the JITT.
- Attend the JITT and confirm that JITT is conducted according to JITT submittal. Use JITT evaluation form (Appendix A) to document the JITT and provide input to HQ Construction and the contractor. Discuss any shortcomings of the JITT with the contractor.
- Ensure that at least 2 business days before start of production, GPS site calibration or localization is done using the survey control points. If there are problems with GPS calibration that involve the survey control points contact District surveys for assistance.
- Ensure that the technical representative will be available for your questions about intelligent compaction rollers. A technical representative is required from the intelligent

compaction equipment manufacturer and automated machine guidance system or post manufacture retrofit system to answer any questions and resolve issues about the initial setup and verification testing of the compaction rollers.

- Ensure that at least 2 business days before start of production, roller verification testing is completed by the contractor by performing roller check testing. Ensure that the compaction roller GPS coordinates and GPS rover recorded GPS measured coordinates during check testing are within 0.5 foot in both the horizontal axes X and Y. Any problems identified during roller check testing need to be corrected prior to starting HMA placement.

DURING COURSE OF WORK

The IC results are not to be used for compaction acceptance, however as a quality control requirement, the contractor must use IC to monitor the HMA compaction process including coverage, number of passes, and temperature. When HMA layer thickness is 0.15 foot or greater, the contractor must also monitor the intelligent compaction measurement value against the test strip established target intelligent compaction measurement value as quality control to achieve uniform material stiffness.

- Ensure the intelligent compaction quality control technician is available on site and that daily check testing has been performed before starting HMA placement.
- Ensure that the technical representative from the intelligent compaction equipment manufacturer and automated machine guidance system manufacturer or post manufacture retrofit system is available for your questions during the first 2 days of HMA production. The technical representative must be available to answer questions about intelligent compaction issues or with data management including input of roller compaction data into Veta and any Veta data processing issues.
- Ensure when the HMA layer thickness is 0.15 foot or greater, that on the first day of HMA placement the contractor conducts an IC test stripe {39-8.01D(5)(b) Test Strip} to determine number of roller passes for breakdown compaction and number of roller passes for intermediate compaction and target intelligent compaction measurement value. HMA placement may continue after placement of the test stripe. When a test strip is required the contractor must submit:
 1. Test strip data including:
 - 1.1. Nuclear gage density per location
 - 1.2. GPS measured coordinates per location
 - 1.3. Nuclear gage correlation to core densities
 2. All passes compaction curves from Veta
 3. All passes correlation analysis report from Veta

Use Form CEM-IC04 “Intelligent Compaction HMA Construction Test Stripe Submittal Checklist” (Appendix C) to assist in documenting that all test strip submittals are received.

- Verify that IC system is operating by viewing the display screen on the roller. If real time mobile device monitoring is available consult with the contractor about viewing the real time IC results on the intelligent compaction quality control technician mobile device or providing other access to State personnel for viewing real time IC results.
- Ensure the intelligent compaction quality control technician is monitoring HMA compaction and recording HMA mat temperature and that GPS coordinates at a minimum of three locations for every 4 hours of paving.
- Ensure when the HMA layer thickness is 0.15 foot or greater, that when quality control nuclear gage readings are taken for HMA density that GPS coordinates are recorded for each nuclear gage reading location.

INTELLIGENT COMPACTION HMA CONSTRUCTION DAILY SUBMITTALS

Intelligent compaction can only be successful as a method for improving compaction if Caltrans receives the required documentation to substantiate that the contractor is in compliance with the requirements of the specifications.

- Ensure that within 1 business day of HMA placement the contractor submits:
 1. Hardcopy of the compaction quality control report from data analysis performed using Veta software.
 2. Adobe *.pdf file of the compaction quality control report from data analysis performed using Veta software.
 3. Post processed Veta data file *.vetaproj used for creating the HMA compaction quality control report for the roadway only.
- Ensure that within 3 business days of HMA placement the contractor submit electronic data from compaction rollers in file format readable by Veta.
- Use Form CEM-IC11 “Intelligent Compaction HMA Construction Daily Submittal Checklist”(Appendix C) to assist in documenting that all HMA intelligent compaction submittals are received.
- If the contractor does not submit the above submittals, direct the contractor to stop HMA work until the submittals are received.

COMPACTION QUALITY CONTROL REPORT VERIFICATION

It is important to verify the contractor's intelligent compaction quality control report results, when the quality control report is received on the day following HMA placement, so that contractor can be notified and take immediate corrective actions to correct any deficiencies and improve compaction. See Appendix B for a typical compaction quality control report and how to interpret the report results.

- Ensure that for each day of HMA placement, the HMA compaction quality control report includes the following:
 1. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on.
 2. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of the steel drum roller with vibratory on for a fixed interval.
 3. All passes histogram for each roller
 4. Color layout plots of:
 - 4.1. Roller passes for each roller
 - 4.2. HMA temperature for first coverage of breakdown compaction.
 - 4.3. HMA temperature for final coverage of intermediate compaction.
 - 4.4. Intelligent compaction measurement value for final coverage of intermediate compaction when required.
- For projects with bid opening starting in May 2015 a requirement that a summary of the daily HMA compaction quality control results was added to the compaction quality control report. Ensure that for each day of HMA placement, the HMA compaction quality control report contains a summary of daily HMA compaction quality control results shown on either *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.
- Review the compaction quality control report for compliance with the requirements for HMA placed under section 39-1.03O(2) method compaction, the compaction documenting that HMA compaction complies with the compaction requirements for the followings:
 1. Number of roller passes
 2. HMA temperature for first coverage of breakdown compaction
 3. HMA temperature at the completion of intermediate compaction
- Use Form CEM-IC13 “HMA Intelligent Compaction Quality Control Report Checklist” (Appendix C) to assist in reviewing the contractor's daily compaction quality control report. Notify the contractor when corrective actions are required because HMA temperature or number of passes does not meet the specified requirements.

- When HMA thickness is 0.15 foot or greater, review the compaction quality control report for compliance with target intelligent compaction measurement value that is correlated to the specified HMA target density. Notify the contractor when corrective actions are required because HMA daily average intelligent compaction measurement value does not meet the specified requirements.

Chapter 2

COLD IN-PLACE RECYCLING

Intelligent compaction for Cold In-Place Recycling (CIR) is specified using a Non-Standard Special Provision Section 30-6 “Pavement Recycling with Intelligent Compaction.” 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.

The requirements for CIR compaction are shown in project special provisions Section 30-4 “Cold In-Place Recycling.” Intelligent compaction does not waive any specifications for CIR but provides the means and methods necessary for the contractor to improve compaction and document quality control of CIR compaction.

BEFORE WORK BEGINS

- Determine if IC for CIR is required on a project by reviewing the bid item list for bid item 306100A Intelligent Compaction (Cold In Place Recycling) and section 30 of the special provisions for section 30-6 Pavement Recycling with Intelligent Compaction.
- Review the project plans for a Project Control Map and Supplemental Project Information to determine if survey control points information has been provided. If survey control points information has not been provided, request survey control points from district surveyor upon receipt of a request from the contractor.
- In consultation with the contractor, verify the GPS coverage for the project. If GPS coverage is less than 90 percent of the project site, contact district surveys to confirm lack of GPS coverage. The contractor may need to use GPS repeaters or other measures for to obtain GPS coverage of 90 percent or more.
- Verify the coordinate system that the contractor will be using {39-8.03B(3) Global Positioning System}. Contractor has the option of using UTM system in lieu of CCS83 coordinate for projects prior to July 2016.
- Review the list of JITT participants submitted by the contractor and ensure that at a minimum the following are participants are shown:

Roller operation JITT:

1. Project manager
2. Superintendent
3. Technical representative
4. Intelligent compaction quality control technicians
5. Roller operators
6. CIR foreman

Geospatial data and analysis JITT:

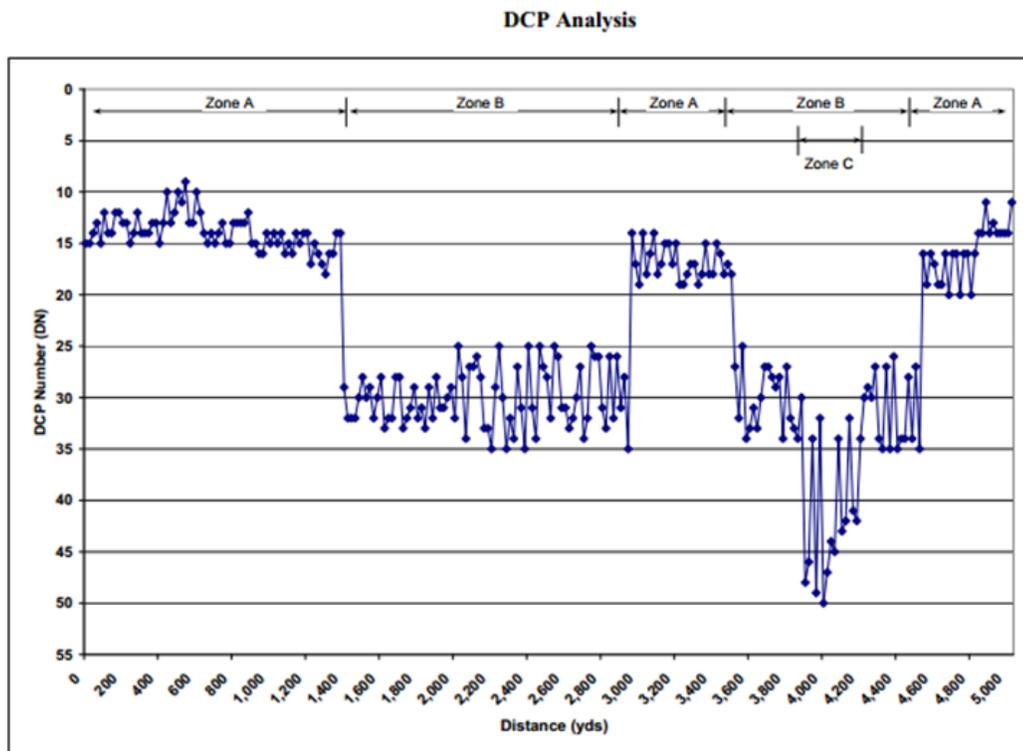
1. Technical representative
 2. Intelligent compaction quality control technicians
 3. CIR foreman
- During pre-paving meeting {39-1.01D(7) Prepaving Meeting} review the IC specification and establish the expectations for timely submittal of compaction quality control reports and electronic data files. The IC technical representative {39-8.01D(2) Technical Representative} and the compaction quality control technician {39-8.01D(4)(c) Quality Control Technician} must attend the prepaving meeting. Discuss the specified responsibilities of both the IC technical representative and IC quality control technician.
 - Review contractor's JITT submittals to verify the completeness of the proposed JITT. The JITT for IC is divided into two sections:
 1. Roller operation
 2. Intelligent compaction geospatial data and analysis

Appendix A in this guidance includes forms to assist in your review of the contractor's JITT submittal. Notify the contractor of any deficiencies found in the proposed JITT. Confirm the date and location of the JITT.

- Attend the JITT and confirm that JITT is conducted according to JITT submittal. Use JITT evaluation form (Appendix A) to document the JITT and provide input to HQ Construction and the contractor. Discuss any shortcomings of the JITT with the contractor.
- Ensure that at least 2 business days before start of CIR premapping or production, GPS site calibration or localization is done using the survey control points. If there are problems with GPS calibration that involve the survey control points contact District surveys for assistance.
- Ensure existing pavement premapping is completed at least 10 business days before any work for CIR mix design, the contractor must map the existing pavement using either the intelligent compaction roller or coring and dynamic cone penetration testing.

Mapping Existing Pavement with Coring and Dynamic Cone Penetration

- If pavement coring and dynamic cone penetration testing are used to map the existing pavement, check pavement thickness identified by cores and determine if the pavement thickness is sufficient for the planned CIR thickness. A minimum of one inch of existing pavement must remain after cold planning. Identify areas that are labeled as zone B and C in the plot of pavement structural section profile because these represent areas of weak underlying layers that may be candidate for remediation. The following is an example plot of the dynamic cone penetration index.



- Base on your review of the results of the premapping, if potential areas of weak underlying materials are identified then take any of the following actions:
 - You may direct the contractor to perform more detailed coring to identify the boundary of weak areas.
 - Consult the district material engineer to suggest a remediation plan for underlying weak areas.
- Ensure that the technical representative will be available for your questions about intelligent compaction rollers. A technical representative is required from the manufacture of intelligent compaction equipment and automated machine guidance system or post manufacture retrofit system to answer any questions and resolve issues about the initial setup and verification testing of the compaction rollers.

- Ensure that at least 2 business days before start of production, roller verification testing is completed by the contractor by performing roller check testing. Ensure that the compaction roller GPS coordinates and GPS rover recorded GPS measured coordinates during check testing are within 0.5 foot in both the horizontal axes X and Y. Any problems identified during roller check testing need to be corrected prior to starting CIR placement.

DURING COURSE OF WORK

The IC results are not to be used for compaction acceptance, however as a quality control requirement, the contractor must use IC to monitor the CIR compaction process including coverage, number of passes, temperature and intelligent compaction measurement value.

- Ensure the intelligent compaction quality control technician is available on site and that daily check testing has been performed before starting HMA placement.
- Ensure that the technical representative from the intelligent compaction equipment manufacturer and automated machine guidance system manufacturer or post manufacture retrofit system is available for your questions during the first 2 days of HMA production. The technical representative must be available to answer questions about intelligent compaction issues or with data management including input of roller compaction data into Veta and any Veta data processing issues.
- Ensure that on the first day of CIR placement the contractor conducts an IC test stripe {30-6.01A(4)(d)(iii) IC Test Strip} to determine roller pattern to reach break over point and target intelligent compaction measurement value based on measured density. To determine the roller pattern for CIR the contractor must after each coverage of test stripe, use a nuclear gage to measure the density at 3 randomly selected locations throughout the 500 foot section. Break over point is established for the test strip by averaging the density of the 3 locations for each coverage. To verify that break over point has been reached, the contractor must use the intelligent compaction vibratory steel drum roller to make a final coverage with vibration on set at low amplitude:
 - If density decreases break over point is verified.
 - If density increases contractor must continue rolling.Contractor must use Veta to create a compaction curve that relates the final coverage of intelligent compaction roller passes to the intelligent compaction measurement values. CIR placement may continue after placement of the test stripe.
- Verify that IC system is operating by viewing the display screen on the roller. If real time mobile device monitoring is available consult with the contractor about viewing the real time IC results on the intelligent compaction quality control technician mobile device or providing other access to State personnel for viewing real time IC results.

- Ensure the intelligent compaction quality control technician is monitoring CIR compaction and when quality control nuclear gage readings are taken for CIR density that GPS coordinates are recorded for each nuclear gage reading location.

INTELLIGENT COMPACTION CIR CONSTRUCTION DAILY SUBMITTALS

Intelligent compaction can only be successful as a method for improving compaction if Caltrans receives the required documentation to substantiate that the contractor is in compliance with the requirements of the specifications.

- Ensure that within 1 business day of CIR placement the contractor submits:
 4. Hardcopy of the compaction quality control report from data analysis performed using Veta software.
 5. Adobe *.pdf file of the compaction quality control report from data analysis performed using Veta software.
 6. Post processed Veta data file *.vetaproj used for creating the HMA compaction quality control report for the roadway only.
- Ensure that within 3 business days of CIR placement the contractor submit electronic data from compaction rollers in file format readable by Veta.
- Use Form CEM-IC21 “Intelligent Compaction CIR Construction Daily Submittal Checklist”(Appendix C) to assist in documenting that all CIR intelligent compaction submittals are received.
- If the contractor does not submit the above submittals, direct the contractor to stop CIR work until the submittals are received.

COMPACTION QUALITY CONTROL REPORT VERIFICATION

It is important to verify the contractor’s intelligent compaction quality control report results, when the quality control report is received on the day following CIR placement, so that contractor can be notified and take immediate corrective actions to correct any deficiencies and improve compaction. See Appendix B for a typical compaction quality control report and how to interpret the report results.

- Ensure that for each day of CIR initial and supplemental compaction, compaction quality control report is provided by the contractor that includes:
 1. 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

2. Final coverage histogram of number of passes for each roller for a fixed interval, and when steel drum roller with vibratory on is used, include histogram of intelligent compaction measurement value for a fixed interval.
 3. All passes histogram for each roller
 4. Color layout plots of:
 - 4.1. Roller passes for each roller
 - 4.2. Intelligent compaction measurement value for steel drum roller with vibratory on
- For projects with bid opening starting in May 2015 a requirement that a summary of the daily HMA compaction quality control results was added to the compaction quality control report. Ensure that for each day of HMA placement, the HMA compaction quality control report contains a summary of daily HMA compaction quality control results shown on either *Intelligent Compaction Cold-In-Place Recycling Compaction Quality Control Report Summary* form.
 - Review the compaction quality control report for compliance with the requirements for number of roller passes in section 30-6.01C(6)(a) roller coverage.
 - Review the compaction quality control report intelligent compaction measurement value against the target intelligent compaction measurement value that is correlated to the CIR density break over point. The intelligent compaction measurement value is report only and should not be used to determine compaction compliance.

Chapter 3

SOILS, AGGREGATE BASES AND AGGREGATE SUBBASES

This chapter is under development and will be released when pilot projects are being constructed.

Chapter 4

VETA USER GUIDE FOR COMPACTION QUALITY CONTROL REPORTS

This chapter is currently under construction.

Contact Ebi Fini for information about target release date.

Chapter 5

RESOURCES

Visit Caltrans Intelligent Compaction website here:

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

Caltrans Intelligent Compaction Subject Matter Expert:

Contact Ebi Fini at 916-227-5396, ebi.fini@dot.ca.gov

Send requests for additional information to:

ic@dot.ca.gov

INTELLIGENT COMPACTION JUST-IN-TIME TRAINING (JITT)

The contractor is required to submit the content of JITT for your review and authorization.

The JITT for intelligent compaction is divided into two sessions:

1. Roller Operation-

Goal: Train roller operators in operation of IC equipped rollers

Outcome: Rollers operators can use roller displays to monitor temperature, no. of passes and stiffness of the compacted material, and comply with the established rolling pattern.

Attendees: The following people must attend the training:

1. Project manager
2. Superintendent
3. Technical representative
4. Compaction quality control technicians
5. Roller operators
6. HMA foreman

2. Intelligent compaction geospatial data and analysis –

Goal: Train compaction quality control technician and other staff about:

1. Use of IC as a quality control process
2. Positional systems
3. Verify and calibrate of IC units in the field
4. Retrieval and processing of IC data.

Outcome: Project staff is familiar with GPS, including daily calibration, performing field quality control based on the IC real time data IC data, data retrieval and process for project specific IC equipment, preparation of daily quality control report, and be able to troubleshoot the GPS and IC systems.

Attendees: The following people must attend the training:

1. Technical representative
2. Compaction quality control technicians
3. HMA foreman

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
ROLLER OPERATION JUST-IN-TIME TRAINING REVIEW CHECKLIST
CEM-IC05 (NEW XX/01/2012)

PAGE 1 OF 2

PROJECT INFORMATION/NAME		CONTRACT NUMBER	CO/RTE/PM
		PROJECT IDENTIFIER NUMBER	
		CONTRACTOR NAME	
<p>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. For questions about this form send an email to: IC@dot.ca.gov</p>			
JUST-IN-TIME TRAINING ROLLER OPERATION INFORMATION			
JITT Trainer Name		JITT Trainer Phone Number	
JITT Company/Consultant Name		JITT Trainer Email Address	
JITT Trainer Affiliation			
<input type="checkbox"/> Contractor	<input type="checkbox"/> Roller Manufacturer	<input type="checkbox"/> IC System	<input type="checkbox"/> Consultant
JITT for Materials Type			
<input type="checkbox"/> Hot Mix Asphalt	HMA Type	HMA thickness	<input type="checkbox"/> Cold In-Place Recycling
			<input type="checkbox"/> Soils/ Aggregate Bases
JITT Training Content Provided Using (Check all that apply)			
<input type="checkbox"/> PowerPoint Presentation		<input type="checkbox"/> Procedural Manual or Guidance	
<input type="checkbox"/> Equipment Technical Handout		<input type="checkbox"/> Field / Hands on Training	
Proposed Training Schedule and Location			
Training Date	Time	Training Location	
Roller Information (Check all that apply)			
<i>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.</i>			
IC Roller No. 1			
<input type="checkbox"/> CATERPILAR Model No. _____	<input type="checkbox"/> BOMAG Model No. _____	<input type="checkbox"/> Other _____	
<input type="checkbox"/> SAKAI Model No. _____	<input type="checkbox"/> HAMM Model No. _____	Model No. _____	
Roller IC System			
<input type="checkbox"/> Original Equipment Manufacturer	<input type="checkbox"/> Retrofit Topcon Model No. _____	<input type="checkbox"/> Retrofit Trimble Model No. _____	
IC Roller No. 2			
<input type="checkbox"/> CATERPILAR Model No. _____	<input type="checkbox"/> BOMAG Model No. _____	<input type="checkbox"/> Other _____	
<input type="checkbox"/> SAKAI Model No. _____	<input type="checkbox"/> HAMM Model No. _____	Model No. _____	
Roller IC System			
<input type="checkbox"/> Original Equipment Manufacturer	<input type="checkbox"/> Retrofit Topcon Model No. _____	<input type="checkbox"/> Retrofit Trimble Model No. _____	
Automated Machine Guidance Roller			
<input type="checkbox"/> CATERPILAR Model No. _____	<input type="checkbox"/> BOMAG Model No. _____	<input type="checkbox"/> Other _____	
<input type="checkbox"/> SAKAI Model No. _____	<input type="checkbox"/> HAMM Model No. _____	Model No. _____	
Roller IC System			
<input type="checkbox"/> Original Equipment Manufacturer	<input type="checkbox"/> Retrofit Topcon Model No. _____	<input type="checkbox"/> Retrofit Trimble Model No. _____	

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
ROLLER OPERATION JUST-IN-TIME TRAINING REVIEW CHECKLIST
 CEM-IC05 (NEW XX/01/2012)

PAGE 2 OF 2

ROLLER OPERATION JUST-IN-TIME TRAINING REVIEW CHECKLIST		
<i>The JITT presentation must include all of the following topics:</i>		
Background Information		
<input type="checkbox"/> Information about the specific intelligent compaction system and automated machine guidance system that will be used on the project.		
GPS Type (check one)		
<input type="checkbox"/> GPS Base Station	<input type="checkbox"/> Network Real Time Kinematic	<input type="checkbox"/> Satellite Based Augmentation System
GPS Setup and Roller Check Tests		
<input type="checkbox"/> GPS Base Station	<input type="checkbox"/> IC System Setup	
<input type="checkbox"/> GPS Rovers	<input type="checkbox"/> Verification of the Roller GPS Coordinates	
<input type="checkbox"/> GPS Receiver	<input type="checkbox"/> Accuracy verification of the roller temperature sensor	
Demonstration and Operation of IC System and Automated Machine Guidance System		
<input type="checkbox"/> Displays	<input type="checkbox"/> Setup Data Collection	
<input type="checkbox"/> Color Code Description	<input type="checkbox"/> Start/stop of Data Recording	
<input type="checkbox"/> On-Board Display Options	<input type="checkbox"/> Down Loading Data	
<input type="checkbox"/> Setting Target Values		
COMMENTS:		
JITT Reviewed by (print name)	Signature	Date

Updated 2015-04-08

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
GEOSPACIAL DATA AND ANALYSIS JUST-IN-TIME TRAINING REVIEW CHECKLIST
CEM-IC06 (NEW 07/31/2015)

PAGE 1 OF 2

PROJECT INFORMATION NAME		CONTRACT NUMBER	CO/RTE/PM
		PROJECT IDENTIFIER NUMBER	
		CONTRACTOR NAME	
<p>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. For questions about this form send an email to: IC@dot.ca.gov</p>			
GEOSPACIAL DATA AND ANALYSIS JUST-IN-TIME TRAINING INFORMATION			
JITT Trainer Name		JITT Trainer Phone Number	
JITT Company/Consultant Name		JITT Trainer Email Address	
JITT Trainer Affiliation			
<input type="checkbox"/> Contractor	<input type="checkbox"/> Roller Manufacturer	<input type="checkbox"/> IC System	<input type="checkbox"/> Consultant
JITT for Materials Type			
<input type="checkbox"/> Hot Mix Asphalt	HMA Type	HMA thickness	<input type="checkbox"/> Cold In-Place Recycling
			<input type="checkbox"/> Soils/ Aggregate Bases
JITT Training Content Provided Using (Check all that apply)			
<input type="checkbox"/> PowerPoint Presentation		<input type="checkbox"/> Procedural Manual or Guidance	
<input type="checkbox"/> Equipment Technical Handout		<input type="checkbox"/> Field / Hands on Training	
Proposed Training Schedule and Location			
Training Date	Time	Training Location	
GEOSPACIAL DATA AND ANALYSIS JUST-IN-TIME TRAINING REVIEW CHECKLIST			
The JITT presentation must include all of the following topics:			
Background Information			
<input type="checkbox"/> Information about the specific intelligent compaction system and automated machine guidance system that will be used on the project.			
Roller Data Retrieval and Analysis			
<input type="checkbox"/> Transferring raw compaction data from the rollers using USB connections.			
<input type="checkbox"/> Processing of raw compaction data to readable Veta format.			
<input type="checkbox"/> Operation of vendor's software to open and view raw compaction data files.			
<input type="checkbox"/> Export all-passes and final coverage in Veta-compatible format.			
<input type="checkbox"/> Demonstrate the procedure to use the vendor's software to create boundary for the area of hot mix asphalt daily production.			
Demonstrate Operation of Veta Software			
<input type="checkbox"/> Import the exported all passes, final coverage and proofing data files			
<input type="checkbox"/> Import project layout			
<input type="checkbox"/> Import compaction point test data			
<input type="checkbox"/> Demonstrate the procedure for creating the boundary if using the Veta software to create boundary for the area of hot mix asphalt or cold in-place recycling daily production			
<input type="checkbox"/> Review of the compaction layouts			
<input type="checkbox"/> Perform statistical analysis			
<input type="checkbox"/> Generate specified reports			

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
INTELLIGENT COMPACTION JUST-IN-TIME TRAINING ATTENDANCE SHEET
CEM-IC07 (NEW XX/01/2012)

PROJECT INFORMATION/NAME		JITT TRAINING SESSION: <input type="checkbox"/> Roller Operation <input type="checkbox"/> Geospatial Data and Analysis		IC JITT TRAINING FOR: <input type="checkbox"/> Hot Mix Asphalt <input type="checkbox"/> Cold In-Place Recycling <input type="checkbox"/> Solis/ Aggregate Bases		CONTRACT NUMBER	COURT/CPM
JITT Trainer Name		JITT Trainer Phone Number		Date of Training		Time	
JITT Company/Consultant Name		JITT Trainer Email Address		Training Location			
No.	Name	Title/Project Role	Phone Number	Email Address			
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
Geospatial Data and Analysis The people who perform the following project roles must attend the training: 1. Technical representative 2. Compaction quality control technicians 3. HMA/CIR foreman				Roller Operation The people who perform the following project roles must attend the training: 1. Project manager 2. Superintendent 3. Technical representative 4. Compaction quality control technicians 5. Roller operators 6. HMA/CIR foreman			

Insert Intelligent Compaction JITT Evaluation Form Here
Evaluation form is under development contact Ebi Fini.

Example Intelligent Compaction Premapping

Example Compaction Quality Control Report

The contractor must submit a hard copy of Compaction Quality Control Report (CQCR) presenting the data collected by the intelligent compaction rollers and/or automated machine guidance pneumatic tire rollers graphically. The specification requires that the contractor must provide a hardcopy and an Adobe *.pdf file of the CQCR.

The following is a discussion of the CQRC specifics for compaction of Cold In place Recycled material and hot mix asphalt

Cold In Place Recycling

CQCR for CIR must include the following

Initial Compaction

For initial compaction, the quality control report must include:

1. 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
2. Final coverage histogram of number of passes for each roller for a fixed interval, and when steel drum roller with vibratory on is used, include histogram of intelligent compaction measurement value for a fixed interval.
3. All passes histogram for each roller
4. Color layout plots of:
 - 4.1. Roller passes for each roller
 - 4.2. Intelligent compaction measurement value for steel drum roller with vibratory on

Supplemental Compaction

For supplemental compaction, the quality control report must include:

1. 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
2. Final coverage histogram of number of passes for each roller for a fixed interval, and when steel drum roller with vibratory on is used, include histogram of intelligent compaction measurement value for a fixed interval.
3. All passes histogram for each roller
4. Color layout plots of:
 - 4.1. Roller passes for each roller
 - 4.2. Intelligent compaction measurement value for steel drum roller with vibratory on

HMA Construction

Caltrans Section 39 Hot Mix asphalt of the standard specification requires HMA with thickness less than 0.15' be constructed under method compaction with specified temperature and no. of passes: See form 2 for details.

For each day of production, contractor must prepare and submit an 11"x17" hard copy of a HMA CQCR that includes:

1. Final coverage histogram of number of passes for each roller and histogram of intelligent compaction measurement value of steel drum roller with vibratory on.
2. 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.
3. All passes histogram for each roller
4. Color layout plots of:
 - 4.1. Roller passes for each roller
 - 4.2. HMA temperature for first coverage of breakdown compaction.
 - 4.3. HMA temperature for final coverage of intermediate compaction.
 - 4.4. Intelligent compaction measurement value for final coverage of intermediate compaction when required.

Example CIR Compaction Quality Control Report is under development and should be available August 2015.

Example CIR Compaction Quality Control Report is under development and should be available August 2015.

Example HMA Compaction Quality Control Report is under development and should be available August 2015.

Example HMA Compaction Quality Control Report is under development and should be available August 2015.

Example HMA Compaction Quality Control Report is under development and should be available August 2015.

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
INTELLIGENT COMPACTION HOT MIX ASPHALT TEST STRIPE SUBMITTAL CHECKLIST
 CEM-IC10 (NEW 07/31/2015)

PAGE 1 OF 1

PROJECT INFORMATION/NAME		CONTRACT NUMBER	CORTE/PM
		PROJECT IDENTIFIER NUMBER	
		CONTRACTOR NAME	
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			
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 Technical Representative(ICTR)		ICTR Phone Number	
IC Quality Control Technician (ICQCT)		ICQCT Phone Number	
Test Strip Required Submittals (Check all that were submitted)			
Veta Analysis Results			
<input type="checkbox"/> Veta analysis results as shown on intelligent compaction HMA construction daily submittal checklist			
<input type="checkbox"/> All passes compaction curves from Veta			
<input type="checkbox"/> All passes correlation analysis report from Veta			
Color Layout Plots Submitted			
<input type="checkbox"/> Color layout plots as shown on the HMA construction daily submittal checklist.			
Additional Test Strip Information			
<input type="checkbox"/> Nuclear gage density per location			
<input type="checkbox"/> Nuclear gage correlation to core densities			
<input type="checkbox"/> GPS measured coordinates per density location			
Data Files			
<input type="checkbox"/> Data files as shown on the intelligent compaction HMA construction daily submittal checklist			
Intelligent Compaction Target Values Determined from Test Strip			
____ Target number of roller passes for breakdown compaction			
____ Target roller 1 st pass minimum temperature breakdown compaction			
____ Target number of roller passes for intermediate compaction			
____ 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:			
Resident engineer (print name)		Signature	Date

Updated 2015-07-31

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
INTELLIGENT COMPACTION HOT MIX ASPHALT TEST STRIPE SUBMITTAL CHECKLIST
 CEM-IC10 (NEW 07/31/2015)

PAGE 1 OF 1

PROJECT INFORMATION/NAME		CONTRACT NUMBER	CORTE/PM
		PROJECT IDENTIFIER NUMBER	
		CONTRACTOR NAME	
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			
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 Technical Representative(ICTR)		ICTR Phone Number	
IC Quality Control Technician (ICQCT)		ICQCT Phone Number	
Test Strip Required Submittals			
Veta Analysis Results Submitted (Check all that apply)			
<input type="checkbox"/> Veta analysis results as shown on intelligent compaction HMA construction daily submittal checklist			
<input type="checkbox"/> All passes compaction curves from Veta			
<input type="checkbox"/> All passes correlation analysis report from Veta			
Color Layout Plots Submitted (Check all that apply)			
<input type="checkbox"/> Color layout plots as shown on the HMA construction daily submittal checklist.			
Additional Test Strip Information Submitted (When required, check all that apply)			
<input type="checkbox"/> Nuclear gage density per location			
<input type="checkbox"/> Nuclear gage correlation to core densities			
<input type="checkbox"/> GPS measured coordinates per density location			
DATA FILES (Check all that apply)			
<input type="checkbox"/> Data files as shown on the intelligent compaction HMA construction daily submittal checklist			
Intelligent Compaction Target Values Determined from Test Strip			
____ Target number of roller passes for breakdown compaction			
____ Target roller 1 st pass minimum temperature breakdown compaction			
____ Target number of roller passes for intermediate compaction			
____ 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:			
Resident engineer (print name)		Signature	Date

Updated 2015-07-31

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
INTELLIGENT COMPACTION HOT MIX ASPHALT
COMPACTION QUALITY CONTROL REPORT VERIFICATION CHECKLIST
 CEM-IC12 (NEW 07/31/2015) PAGE 1 OF 4

PROJECT INFORMATION NAME		CONTRACT NUMBER	CO/RTE/PM
		PROJECT IDENTIFIER NUMBER	
		CONTRACTOR NAME	
<p>Instruction: Use this checklist form to help review the contractor's daily hot mix asphalt intelligent compaction quality control report. Page 4 shows compaction temperatures and passes required based on the 2010 Revised Standard Specifications. For questions about this form send an email to: IC@dot.ca.gov</p>			
HOT MIX ASPHALT (HMA) PLACEMENT INFORMATION			
HMA Type	HMA Thickness	HMA Placement Date	
HMA Placement Location	Beginning Station	Ending Station	
<input type="checkbox"/> Method Compaction	<input type="checkbox"/> Density Required	<input type="checkbox"/> Warm Mix Asphalt	
IC Quality Control Technician (ICQCT)		ICQCT Phone Number	
COMPACTION QUALITY CONTROL REPORT VERIFICATION			
HMA Method Compaction			
<p><i>Determine the following requirements for HMA compaction based on the specifications for the type of HMA being placed. Page 4 of this form summarizes the compaction temperatures and passes required based on the 2010 Revised Standard Specifications but you should verify that the requirements in your contract.</i></p>			
IC Requirements	HMA/RHMA		
Breakdown Compaction Minimum Temperature °F 1 st PASS			
Breakdown Compaction Minimum Number of Passes			
Intermediate Compaction Minimum Temperature °F 6 th Pass			
Intermediate Compaction Minimum Number of Passes			
Verify from the compaction quality control report that the following compaction requirements have been met:			
HMA Compaction Verification			
<p>Does the 1st PASS breakdown compaction temperature shown on the layout plot of HMA temperature for first coverage of breakdown compaction, for at least 95% of the daily HMA placement area, meet or exceed the minimum temperature specified based on the HMA type? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.</p>			
<p>Does the number of passes shown on final coverage histogram of number of passes for breakdown compaction roller 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? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.</p>			
<p>Does the last pass of intermediate compaction (6th PASS) temperature shown on the layout plot of HMA temperature, for at least 95% of the HMA placement area, meet or exceed the minimum temperature specified based on the HMA type? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.</p>			
<p>Does the number of passes shown on final coverage histogram of number of passes for intermediate compaction roller show that at least 90 percent coverage of the HMA placement area met or exceed the minimum number of roller passes specified for intermediate compaction? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.</p>			

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 2 OF 4
INTELLIGENT COMPACTION HOT MIX ASPHALT
COMPACTION QUALITY CONTROL REPORT VERIFICATION CHECKLIST
 CEM-IC12 (NEW 07/31/2015)

COMPACTION QUALITY CONTROL REPORT VERIFICATION			
OGFC Method Compaction			
Determine the following requirements for HMA compaction based on the specifications for the type of HMA being placed. Page 4 of this form summarizes the compaction temperatures and passes required based on the 2010 Revised Standard Specifications but you should verify that the requirements in your contract.			
IC Requirements	OGFC		
Breakdown Compaction Minimum Temperature °F 1 st PASS			
Complete Compaction Minimum Temperature °F			
Minimum Number of Passes			
Intermediate Compaction Minimum Number of Passes			
<i>Verify from the compaction quality control report that the following compaction requirements have been met:</i>			
OGFC Compaction Verification			
Does the 1 st PASS breakdown compaction temperature shown on the layout plot of HMA temperature for first coverage of breakdown compaction, for at least 95% of the daily HMA placement area, meet or exceed the minimum temperature specified based on the OGFC type? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.			
Does the last pass of compaction temperature shown on the layout plot of HMA temperature, for at least 95% of the HMA placement area, meet or exceed the minimum temperature specified based on the OGFC type? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.			
Does the number of passes shown on final coverage histogram of number of passes for each roller meet or exceed the minimum number of roller passes specified for at least 90 percent of the HMA placement area? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.			

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
INTELLIGENT COMPACTION HOT MIX ASPHALT
COMPACTION QUALITY CONTROL REPORT VERIFICATION CHECKLIST
 CEM-IC12 (NEW 07/31/2015)

PAGE 3 OF 4

COMPACTION QUALITY CONTROL REPORT VERIFICATION		
HMA Density Required		
<i>Determine the following requirements for HMA compaction based on the specifications for the type of HMA being placed. For HMA that is accepted based on density requirements the intelligent compaction requirements are established by the contractor completing a test strip.</i>		
Intelligent Compaction Target Values Determined from Test Strip		
____ Target number of roller passes for breakdown compaction		
____ Target roller 1 st pass minimum temperature °F breakdown compaction		
____ Target number of roller passes for intermediate compaction		
____ 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		
HMA Compaction Verification		
Note: Results from intelligent compaction are for contractor quality control purposes only and Caltrans acceptance of HMA placed with density requirements is based on HMA density of cores. 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 and temperature is not required.		
<i>Verify from the compaction quality control report that the following compaction requirements have been met:</i>		
Does the 1 st PASS breakdown compaction temperature shown on the layout plot of HMA temperature for first coverage of breakdown compaction, for at least 95% of the HMA placement area, meet or exceed the target minimum temperature based on the HMA test stripe? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.		
Does the number of passes shown on final coverage histogram of number of passes for intermediate compaction roller show that at least 90 percent coverage of the HMA placement area met or exceed the minimum number of roller passes specified for intermediate compaction? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.		
Does the temperature shown on the layout plot of HMA temperature for the last target number roller pass of intermediate compaction, for at least 95% of the HMA placement area, meet or exceed the target minimum temperature based on the HMA test stripe? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.		
Does the number of passes shown on final coverage histogram of number of passes for intermediate compaction roller show that at least 90 percent coverage of the HMA placement area met or exceed the minimum number of roller passes specified for intermediate compaction? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.		
Does the daily average intelligent compaction measurement value for final coverage of intermediate compaction meet or exceed the target intelligent compaction measurement value established at the test stripe? <input type="checkbox"/> Yes <input type="checkbox"/> No If the answer is no, is the daily average intelligent compaction measurement value for final coverage of intermediate compaction less than 20 percent under the target intelligent compaction measurement value established at the test stripe? <input type="checkbox"/> Yes <input type="checkbox"/> No If yes, the daily average intelligent compaction value is within the tolerance allowed by the specifications. If no, notify the contractor that a new test stripe is required.		
Compaction quality control report reviewed by (print name)	Signature	Date
Resident engineer (print name)	Signature	Date

Updated 2015-07-31

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
INTELLIGENT COMPACTION HOT MIX ASPHALT
COMPACTION QUALITY CONTROL REPORT VERIFICATION CHECKLIST
 CEM-IC12 (NEW 07/31/2015)

Instruction: This page is to assist in determining the HMA compaction specification temperature requirements (2010 Revised Standard Specification) that apply when verifying the intelligent compaction quality control report.

Specifications Compaction Requirements Information (Check HMA type that applies)			
HMA Type A and RHMA-G			
IC Requirements	<input type="checkbox"/> HMA Type A Unmodified Asphalt Binder	<input type="checkbox"/> HMA Type A PG-M Asphalt Binder	<input type="checkbox"/> RHMA-G
Breakdown Compaction Minimum Temperature °F 1 st PASS	250	240	285
Breakdown Compaction Minimum Number of Passes	3	3	3
Intermediate Compaction Minimum Temperature °F 6 th Pass	190	180	250
Intermediate Compaction Minimum Number of Passes	3	3	3
Open Graded Friction Course (OGFC)			
IC Requirements	<input type="checkbox"/> OGFC Unmodified Asphalt Binder	<input type="checkbox"/> OGFC PG-M Asphalt Binder	<input type="checkbox"/> OGFC RHMA-O RHMA-HB
Breakdown Compaction Minimum Temperature °F 1 st PASS	240	240	280
Complete Compaction Minimum Temperature °F Last Pass	200	180	250
Minimum Number of Passes	2	2	2
Warm Mix Asphalt HMA Type A and RHMA-G			
IC Requirements	<input type="checkbox"/> HMA Type A Unmodified Asphalt Binder	<input type="checkbox"/> HMA Type A PG-M Asphalt Binder	<input type="checkbox"/> RHMA-G
Breakdown Compaction Minimum Temperature °F 1 st 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)			
IC Requirements	<input type="checkbox"/> OGFC Unmodified Asphalt Binder	<input type="checkbox"/> OGFC PG-M Asphalt Binder	<input type="checkbox"/> OGFC RHMA-O RHMA-HB
Breakdown Compaction Minimum Temperature °F 1 st PASS	230	230	270
Complete Compaction Minimum Temperature °F Last Pass	190	170	240
Minimum Number of Passes	2	2	2

Updated 2015-07-31

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 1 OF 2
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 1 st PASS		Breakdown Compaction Minimum Temperature °F 1 st 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:

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 2 OF 2
INTELLIGENT COMPACTION QUALITY CONTROL REPORT SUMMARY
FOR HOT MIX ASPHALT WITH METHOD COMPACTION
 CEM-IC15 (NEW 06/24/2015)

HMA/RHMA Compaction		
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? <input type="checkbox"/> Yes <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> No		
If no, corrective action taken:		
Does the 1 st 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? <input type="checkbox"/> Yes <input type="checkbox"/> 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? <input type="checkbox"/> Yes <input type="checkbox"/> No		
If no, corrective action taken:		
Quality Control Report Information		
Veta Analysis Completed by	Veta Analysis by Email Address	Veta Analysis by Phone Number
Quality Control Report Completed by (print name)	Signature	Date
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 to resident engineer within 1 business day of HMA placement.	Submitted by (print name)	Date
Submit Adobe *.pdf file to IC@dot.ca.gov within 1 business day of HMA placement.	Submitted by (print name)	Date

Updated 2015-06-24

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 1 OF 2

**INTELLIGENT COMPACTION QUALITY CONTROL REPORT SUMMARY
 FOR HOT MIX ASPHALT WITH DENSITY REQUIREMENT
 CEM-IC16 (NEW 08/08/2015)**

PROJECT INFORMATION/NAME		CONTRACT NUMBER	CO/RTE/PM
		PROJECT IDENTIFIER NUMBER	
		CONTRACTOR NAME	
<p><i>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.</i></p>			
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			
<i>Note: Intelligent compaction target values are determined from hot mix asphalt test stripe.</i>			
Breakdown Compaction Vibratory Steel Drum Roller Number of Passes			
___ Target number of roller passes		___ Percent work area covered by minimum number of roller passes	
<p>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?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>			
<p>If no, corrective action taken:</p>			
Breakdown Compaction Intelligent Compaction Measurement Value			
___ Target intelligent compaction measurement value		___ Daily average intelligent compaction measurement value	
<p>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?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>If the answer is no, is the daily average intelligent compaction value at least 81 percent of the target measurement value?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>If the answer is no, reestablish the intelligent compaction measurement value.</p>			
Intermediate Compaction Roller Number of Passes			
___ Target number of roller passes		___ Percent work area covered by minimum number of roller passes	
<p>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?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>			
<p>If no, corrective action taken:</p>			
<p>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.</p>			

Updated 2015-08-08

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
INTELLIGENT COMPACTION QUALITY CONTROL REPORT SUMMARY
FOR HOT MIX ASPHALT WITH DENSITY REQUIREMENT
 CEM-IC16 (NEW 08/08/2015)

PAGE 2 OF 2

Additional Intelligent Compaction Vibratory Steel Drum Roller Compaction		
If roller pattern shown on <i>Contractors Establishment of Break Over Density</i> form includes addition rolling using IC vibratory steel drum roller after pneumatic rubber tire rolling provide the following information: <input type="checkbox"/> Yes <input type="checkbox"/> 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 met or exceed the minimum number of roller passes based on target value established at the test stripe? <input type="checkbox"/> Yes <input type="checkbox"/> 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 meet or exceed the target intelligent compaction measurement value established at the test stripe? <input type="checkbox"/> Yes <input type="checkbox"/> No If the answer is no, is the daily average intelligent compaction value at least 81 percent of the target measurement value? <input type="checkbox"/> Yes <input type="checkbox"/> 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 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.		
Quality Control Report Information		
Veta Analysis Completed by	Veta Analysis by Email Address	Veta Analysis by Phone Number
Quality Control Report Completed by (print name)	Signature	Date
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 to resident engineer within 1 business day of HMA placement.	Submitted by (print name)	Date
Submit Adobe *.pdf file to IC@dot.ca.gov within 1 business day of HMA placement.	Submitted by (print name)	Date

Updated 2015-08-08

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION		PAGE 1 OF 1
INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING TEST STRIPE SUBMITTAL CHECKLIST		
CEM-IC20 (NEW 07/31/2015)		
PROJECT INFORMATION/NAME		CONTRACT NUMBER
		CORTE/PM
		PROJECT IDENTIFIER NUMBER
		CONTRACTOR NAME
<p>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</p>		
COLD-IN-PLACE RECYCLING (CIR) TEST STRIP PLACEMENT INFORMATION		
Test Strip Placement Location		Test Strip Placement Date
Beginning Station	Ending Station	CIR Thickness
IC Technical Representative(ICTR)		ICTR Phone Number
IC Quality Control Technician (ICQCT)		ICQCT Phone Number
Test Strip Required Submittals (Check all that were submitted)		
Veta Analysis Results		
<input type="checkbox"/> Veta analysis results as shown on intelligent compaction CIR construction daily submittal checklist		
<input type="checkbox"/> All passes compaction curves from Veta		
<input type="checkbox"/> All passes correlation analysis report from Veta		
Color Layout Plots		
<input type="checkbox"/> Color layout plots as shown on the CIR construction daily submittal checklist		
Additional Test Strip Information		
<input type="checkbox"/> Nuclear gage density per location		
<input type="checkbox"/> Nuclear gage correlation to core densities		
<input type="checkbox"/> GPS measured coordinates per density location		
Data Files		
<input type="checkbox"/> Data files as shown on the intelligent compaction CIR construction daily submittal checklist		
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:		
____ 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		
COMMENTS:		
Resident engineer (print name)		Signature
		Date

Updated 2015-07-31

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 1 OF 1
INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING CONSTRUCTION DAILY SUBMITTAL
CHECKLIST
 CEM-IC21 (NEW 07/31/2015)

PROJECT INFORMATION NAME		CONTRACT NUMBER	CO/RTE/PM
		PROJECT IDENTIFIER NUMBER	
		CONTRACTOR NAME	
<p>Instruction: Use this checklist form to review the completeness of submittals of intelligent compact daily compaction report and intelligent compaction data files. For questions about this form send an email to: IC@dot.ca.gov</p>			
COLD-IN-PLACE RECYCLING (CIR) INFORMATION			
CIR Location		CIR Compaction Date	
Beginning Station	Ending Station	<input type="checkbox"/> Initial Compaction <input type="checkbox"/> Supplemental Compaction	
IC Quality Control Technician (ICQCT)		ICQCT Phone Number	
Veta analysis performed by	Veta performed by email address	Veta Analysis by Phone Number	
COMPACTION QUALITY CONTROL REPORT (Check all that apply)			
<input type="checkbox"/> Compaction QC report submitted	<input type="checkbox"/> Partial submittal of compaction QC report	<input type="checkbox"/> Was compaction QC Report submitted within 1 business day of HMA placement?	
Veta Analysis Results Submitted (Check all that apply)			
<input type="checkbox"/> Final coverage histogram of number of passes for each roller			
<input type="checkbox"/> Final coverage histogram of intelligent compaction measurement value of steel drum roller with vibratory on			
<input type="checkbox"/> Final coverage histogram of number of passes for each roller for a fixed interval			
<input type="checkbox"/> Final coverage histogram of intelligent compaction measurement value of steel drum roller with vibratory on for a fixed interval			
<input type="checkbox"/> All passes histogram for each roller			
Color Layout Plots Submitted (Check all that apply)			
<input type="checkbox"/> Roller passes for each roller			
<input type="checkbox"/> Intelligent compaction measurement value for final coverage of compaction for steel drum roller with vibratory on.			
Additional Information Submitted			
<input type="checkbox"/> Quality control nuclear gage density per location		<input type="checkbox"/> GPS measured coordinates per nuclear gage density location	
DATA FILES (Check all that apply)			
<i>Note: Data files must be submitted within 3 business days of CIR production.</i>			
<input type="checkbox"/> Data files submitted	<input type="checkbox"/> Data files not submitted	<input type="checkbox"/> Partial submittal of data files	<input type="checkbox"/> Were data files submitted within 3 business days of CIR production?
<input type="checkbox"/> Post processed Veta data file type *.vetaproj used to create the compaction quality control report			
<input type="checkbox"/> Electronic data from compaction rollers for all passes and final coverage in file format readable by Veta			
COMMENTS:			
Resident engineer (print name)		Signature	Date

Updated 2015-07-31

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING
COMPACTION QUALITY CONTROL REPORT VERIFICATION CHECKLIST
 CEM-IC22 (NEW 07/31/2015)

PAGE 1 OF 2

PROJECT INFORMATION/NAME	CONTRACT NUMBER	CO/RTE/PM
	PROJECT IDENTIFIER NUMBER	
	CONTRACTOR NAME	
<p>Instruction: Use this checklist form to help review the contractor's daily cold-in-place recycling intelligent compaction quality control report. For questions about this form send an email to: IC@dot.ca.gov.</p>		
COLD-IN-PLACE RECYCLING (CIR) INFORMATION		
CIR Location		CIR Compaction Date
Beginning Station	Ending Station	<input type="checkbox"/> Initial Compaction <input type="checkbox"/> Supplemental Compaction
IC Quality Control Technician (ICQCT)		ICQCT Phone Number
COMPACTION QUALITY CONTROL REPORT VERIFICATION		
For CIR the intelligent compaction requirements are established by the contractor completing a test strip.		
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 roller pattern shown on <i>Contractors Establishment of Break Over Density</i> form includes addition rolling using IC vibratory steel drum roller after pneumatic tire rolling provide the following information:		
____ 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		
CIR Compaction Verification		
<p>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.</p>		
Verify from the compaction quality control report that the following compaction requirements have been met:		
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? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.		
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? <input type="checkbox"/> Yes <input type="checkbox"/> No If the answer is no, the intelligent compaction measurement value is for information only so you don't have to take any action. Ensure that the contractor nuclear gage quality control test results are showing adequate density.		
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? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.		

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INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING
COMPACTION QUALITY CONTROL REPORT VERIFICATION CHECKLIST
 CEM-IC22 (NEW 07/31/2015)

CIR Compaction Verification Continued		
<i>If roller pattern shown on Contractors Establishment of Break Over Density form includes addition rolling using IC vibratory steel drum roller after pneumatic tire rolling verify from the compaction quality control report the following for the additional IC Vibratory steel drum rolling.</i>		
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? <input type="checkbox"/> Yes <input type="checkbox"/> No If no, notify the contractor that corrective action is required.		
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? <input type="checkbox"/> Yes <input type="checkbox"/> No If the answer is no, the intelligent compaction measurement value is for information only so you don't have to take any action. Ensure that the contractor nuclear gage quality control test results are showing adequate density.		
COMMENTS:		
Resident engineer (print name)	Signature	Date

Updated 2015-07-31

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 1 OF 2

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
	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

COLD-IN-PLACE RECYCLING (CIR) PLACEMENT INFORMATION

CIR Placement Location	CIR Placement Date
Beginning Station	Ending Station
	<input type="checkbox"/> Initial Compaction
	<input type="checkbox"/> Supplemental Compaction
IC Quality Control Technician (ICQCT)	ICQCT Phone Number

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

____ Target number of roller passes	____ Percent work area covered by minimum number of roller passes
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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:

Intelligent Compaction Measurement Value

____ Target intelligent compaction measurement value	____ Daily average intelligent compaction measurement value
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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

____ Target number of roller passes	____ Percent work area covered by minimum number of roller passes
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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

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION PAGE 2 OF 2
INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING COMPACTION QUALITY CONTROL REPORT
SUMMARY
 CEM-IC25 (NEW 06/21/2015)

Additional Intelligent Compaction Vibratory Steel Drum Roller Compaction		
If roller pattern shown on <i>Contractors Establishment of Break Over Density</i> form includes addition rolling using IC vibratory steel drum roller after pneumatic rubber tire rolling provide the following information: <input type="checkbox"/> Yes <input type="checkbox"/> 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 met or exceed the minimum number of roller passes based on target value established at the test stripe? <input type="checkbox"/> Yes <input type="checkbox"/> 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 meet or exceed the target intelligent compaction measurement value established at the test stripe? <input type="checkbox"/> Yes <input type="checkbox"/> 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.		
Quality Control Report Information		
Veta Analysis Completed by	Veta Analysis by Email Address	Veta Analysis by Phone Number
Report Completed by (print name)	Signature	Date
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
Submit Adobe *.pdf file to IC@dot.ca.gov within 1 business day of CIR placement.	Submitted by (print name)	Date

Updated 2015-06-21