INTELLIGENT COMPACTION CONSTRUCTION GUIDANCE

State of California Department of Transportation
Division of Construction
Office of Construction Engineering
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Contents

Introduction................................................................................................................................................1

Chapter 1—Hot Mix Asphalt
Before Work Begins......................................................................................................................................4
During the Course of Work...........................................................................................................................6
Intelligent Compaction Daily HMA Construction Submittals.................................................................7
Compaction Quality Control Report Verification.........................................................................................8

Chapter 2—Cold In-Place Recycling
Before Work Begins.....................................................................................................................................10
During the Course of Work..........................................................................................................................14
Intelligent Compaction Daily CIR Construction Submittals.................................................................14
Compaction Quality Control Report Verification.........................................................................................15

Chapter 3—Soils, Aggregate Bases and Subbases

Under Construction

Chapter 4—Veta User Instructions for Compaction Quality Control Report

Under Construction

Chapter 5—Intelligent Compaction Resources
Webpage..................................................................................................................................................17
Contact Information................................................................................................................................17
Appendix

Appendix A - Just in Time Training

Just in Time Training Information .................................................................18
CEM-IC05 Intelligent Compaction Roller Operation JITT Review Checklist ...............19
CEM-IC06 Intelligent Compaction Geospatial Data and Analysis JITT Review Checklist ......................21
CEM-IC07 Intelligent Compaction Just-In-Time Training Attendance .........................23
JITT Evaluation Form ..................................................................................24

Appendix B – Contractor Intelligent Compaction Submittals

Example Premapping Intelligent Compaction Measurement Value Layout ..................25
Example Compaction Quality Control Report ..................................................26

Appendix C - Forms

CEM-IC10 Intelligent Compaction Hot Mix Asphalt Test Stripe Submittal Checklist ..........33
CEM-IC11 Intelligent Compaction Hot Mix Asphalt Construction Daily Submittal Checklist ..........34
CEM-IC12 Intelligent Compaction Hot Mix Asphalt Compaction Quality Control Report Verification Checklist ........................................................................................................35
CEM-IC15 Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt With Method Compaction ........................................................................39
CEM-IC16 Intelligent Compaction Quality Control Report Summary for Hot Mix Asphalt With Density Requirement ........................................................................41
CEM-IC20 Intelligent Compaction Cold-In-Place Recycling Test Stripe Submittal Checklist ..........43
CEM-IC21 Intelligent Compaction Cold-In-Place Recycling Construction Daily Submittal Checklist ....44
CEM-IC22 Intelligent Compaction Cold-In-Place Recycling Compaction Quality Control Report Verification Checklist ........................................................................45
CEM-IC25 Intelligent Compaction Cold-In-Place Recycling Compaction Quality Control Report Summary ..................................................................................47

The intelligent compaction forms are available in Adobe *.pdf at:
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

![Diagram showing the flow of data and processing from IC data, Vendor’s software, Spot Tests and GPS data, to Compaction Quality Control Report.]

- Plot of number of passes along the project layout
- Plot of temperature along the project layout
- Plot of ICMV along the project layout
- Histogram of temperature for final coverage (proof)
- Histogram of ICMV for final coverage (proof)
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 preparing meeting[39-1.01D(7) Preparing 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 preparming 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 analysis

Use 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) Preparing 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 pre-paving 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 Intelligent Compaction Roller

- If IC roller is used to map the existing pavement, based on the layout plots of the intelligent compaction measurement value identify areas that show lower intelligent compaction measurement value relative to the project. See example premapping plot in Appendix B, note the areas shown red have low stiffness and two failed culverts were identified on this project based low stiffness.

Identifying Weak Underlying Layers
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.

![DCP Analysis](image)

- Base on your review of the results of the premaping, 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:
  o If density decreases break over point is verified.
  o 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 devise monitoring is available consult with the contractor about viewing the real time IC results on the intelligent compaction quality control technician mobile devise 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
# ROLLER OPERATION JUST-IN-TIME TRAINING REVIEW CHECKLIST

**STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION**

**PROJECT INFORMATION NAME**

<table>
<thead>
<tr>
<th>PROJECT IDENTIFIER NUMBER</th>
</tr>
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<tbody>
<tr>
<td>CONTRACT NUMBER</td>
</tr>
<tr>
<td>CO/RTE/PM</td>
</tr>
</tbody>
</table>

**CONTRACTOR NAME**

---

**ROLLER OPERATION 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**

- [ ] Contractor
- [ ] Roller Manufacturer
- [ ] IC System
- [ ] Consultant

**JITT for Materials Type**

- [ ] Hot Mix Asphalt
- [ ] HMA Type
- [ ] HMA Thickness
- [ ] Cold In-Place Recycling
- [ ] Soil/Aggregate Bases

**JITT Training Content Provided Using**

- [ ] PowerPoint Presentation
- [ ] Procedural Manual or Guidance
- [ ] Equipment Technical Handout
- [ ] Field/Hands On Training

**Proposed Training Schedule and Location**

<table>
<thead>
<tr>
<th>Training Date</th>
<th>Time</th>
<th>Training Location</th>
</tr>
</thead>
</table>

**Roller Information**

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**

- [ ] CATERPILLAR Model No.
- [ ] BOMAG Model No.
- [ ] Other
- [ ] SAKAI Model No.
- [ ] HAMM Model No.

**Roller IC System**

- [ ] Original Equipment Manufacturer
- [ ] Retrofit Topcon Model No.
- [ ] Retrofit Trimble Model No.

**IC Roller No. 2**

- [ ] CATERPILLAR Model No.
- [ ] BOMAG Model No.
- [ ] Other
- [ ] SAKAI Model No.
- [ ] HAMM Model No.

**Roller IC System**

- [ ] Original Equipment Manufacturer
- [ ] Retrofit Topcon Model No.
- [ ] Retrofit Trimble Model No.

**Automated Machine Guidance Roller**

- [ ] CATERPILLAR Model No.
- [ ] BOMAG Model No.
- [ ] Other
- [ ] SAKAI Model No.
- [ ] HAMM Model No.

**Roller IC System**

- [ ] Original Equipment Manufacturer
- [ ] Retrofit Topcon Model No.
- [ ] Retrofit Trimble Model No.
<table>
<thead>
<tr>
<th>ROLLER OPERATION JUST-IN-TIME TRAINING REVIEW CHECKLIST</th>
</tr>
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<tbody>
<tr>
<td>The JITT presentation must include all of the following topics:</td>
</tr>
</tbody>
</table>

**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 Receivers
- [ ] Verification of the Roller GPS Coordinates
- [ ] Accuracy verification of the roller temperature sensor

**Demonstration and Operation of IC System and Automated Machine Guidance System**
- [ ] Displays
- [ ] Color Code Description
- [ ] On-Board Display Options
- [ ] Setup Data Collection
- [ ] Start/Stop of Data Recording
- [ ] Down Loading Data

**COMMENTS:**

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JITT Reviewed by (print name) | Signature | Date
---|---|---

Updated 2015-04-08
### GEOSPATIAL DATA AND ANALYSIS JUST-IN-TIME TRAINING REVIEW CHECKLIST

**CEM-IC06 (NEW 07/31/2015)**

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</tbody>
</table>

**Instructions:** 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: [JC@dot.ca.gov](mailto:JC@dot.ca.gov)

#### GEOSPATIAL DATA AND ANALYSIS JUST-IN-TIME TRAINING INFORMATION

<table>
<thead>
<tr>
<th>JITT Trainer Name</th>
<th>JITT Trainer Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>JITT Company/Consultant Name</td>
<td>JITT Trainer Email Address</td>
</tr>
</tbody>
</table>

#### JITT Trainer Affiliation
- [ ] Contractor
- [ ] Roller Manufacturer
- [ ] IC System
- [ ] Consultant

#### JITT for Materials Type
- [ ] Hot Mix Asphalt
- [ ] HMA Type
- [ ] HMA Thickness
- [ ] Cold In-Place Recycling
- [ ] Soil/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

<table>
<thead>
<tr>
<th>Training Date</th>
<th>Time</th>
<th>Training Location</th>
</tr>
</thead>
</table>

#### GEOSPATIAL DATA AND ANALYSIS 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.

- **Roller Data Retrieval and Analysis**
  - [ ] Transferring raw compaction data from the rollers using USB connections.
  - [ ] Processing of raw compaction data to readable Veta format.
  - [ ] Operation of vendor’s software to open and view raw compaction data files.
  - [ ] Export all-passes and final coverage in Veta-compatible format.
  - [ ] 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**
  - [ ] Import the exported all passes, final coverage and proofing data files
  - [ ] Import project layout
  - [ ] Import compaction point test data
  - [ ] 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
  - [ ] Review of the compaction layouts
  - [ ] Perform statistical analysis
  - [ ] Generate specified reports
## Intelligent Compaction Target Values

**Describe the methods for how target values will be established for the following:**

- [ ] Number of passes
- [ ] Minimum temperature or temperature range
- [ ] Intelligent compaction measurement values

### Coverage and Uniformity Requirements

- **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 80 percent coverage of the HMA placement area must meet or exceed the minimum number of roller passes specified or determined from test strip.
  - 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 strip.

- **Uniformity**
  - For HMA with density requirement, the daily average intelligent compaction measurement value for final coverage of intermediate compaction must be at least 90 percent of the target intelligent compaction measurement value established at the test strip.

### Proposed Corrective Actions

**Description of the proposed corrective actions to be taken when requirements are not met for the following:**

- [ ] Temperature
- [ ] Coverage
- [ ] Uniformity

### COMMENTS:

<table>
<thead>
<tr>
<th>JTT Reviewed by (print name)</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
</table>

Updated 2015-07-31
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.
### INTELLIGENT COMPACtion HOT MIX ASPHALT TEST STRIP SUBMITTAL CHECKLIST

**CEM-IC10** (NEW 07/31/2015)

<table>
<thead>
<tr>
<th>PROJECT INFORMATION NAME</th>
<th>CONTRACT NUMBER</th>
<th>CORTE/PM</th>
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<tbody>
<tr>
<td>PROJECT IDENTIFIER NUMBER</td>
<td>CONTRACTOR NAME</td>
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</tr>
</tbody>
</table>

**Instruction:** 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: [JC@dot.ca.gov](mailto:JC@dot.ca.gov)

#### HOT MIX ASPHALT (HMA) TEST STRIP PLACEMENT INFORMATION

<table>
<thead>
<tr>
<th>HMA Type</th>
<th>HMA Thickness</th>
<th>HMA Test Strip Placement Date</th>
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<table>
<thead>
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<th>Ending Station</th>
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<table>
<thead>
<tr>
<th>IC Technical Representative (CTR)</th>
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<th>CQCT Phone Number</th>
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</thead>
<tbody>
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</tbody>
</table>

#### Test Strip Required Submittals (Check all that were submitted)

- **Veta Analysis Results:**
  - Veta analysis results as shown in intelligent compaction HMA construction daily submittal checklist
  - All passes compaction curves from Veta
  - All passes correlation analysis report from Veta

- Color Layout Plots Submitted
  - Color layout plots as shown in the HMA construction daily submittal checklist.

- **Additional Test Strip Information**
  - Nuclear gage density per location
  - Nuclear gage correlation to core densities
  - GPS measured coordinates per density location

- **Data File:**
  - 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 1st 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
## Intelligent Compaction Hot Mix Asphalt Test Strip Submittal Checklist

<table>
<thead>
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<th>Project Information Name</th>
<th>Contract Number</th>
<th>CORTE/PM</th>
<th>Project Identifier Number</th>
<th>Contractor Name</th>
</tr>
</thead>
</table>

**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: JC@dot.ca.gov

### HOT MIX ASPHALT (HMA) Test Strip Placement Information

<table>
<thead>
<tr>
<th>HMA Type</th>
<th>HMA Thickness</th>
<th>HMA Test Strip Placement Date</th>
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<thead>
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<th>HMA Placement Location</th>
<th>Beginning Station</th>
<th>Ending Station</th>
<th>ITR Technical Representative (CTR)</th>
<th>ITR Phone Number</th>
<th>IQC Technical Representative (ICQCT)</th>
<th>ICQCT Phone Number</th>
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</tbody>
</table>

### Test Strip Required Submittals

- **Veta Analysis Results Submitted** (Check all that apply)
  - [ ] Veta analysis results as shown on intelligent compaction HMA construction daily submittal checklist
  - [ ] All passes compaction curves from Veta
  - [ ] All passes correlation analysis report from Veta

- **Color Layout Plots Submitted** (Check all that apply)
  - [ ] Color layout plots as shown on the HMA construction daily submittal checklist.

- **Additional Test Strip Information Submitted** (When required, check all that apply)
  - [ ] Nuclear gage density per location
  - [ ] Nuclear gage correlation to core densities
  - [ ] GPS measured coordinates per density location

- **DATA FILES** (Check all that apply)
  - [ ] 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 1st 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*
### HOT MIX ASPHALT (HMA) PLACEMENT INFORMATION

<table>
<thead>
<tr>
<th>HMA Type</th>
<th>HMA Indentify</th>
<th>HMA Placement Date</th>
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<tbody>
<tr>
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</tbody>
</table>

- Method Compaction
- Density Required
- Warm Mix Asphalt
- IQCCT Phone Number

### COMPACTATION QUALITY CONTROL REPORT VERIFICATION

**HMA 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.

<table>
<thead>
<tr>
<th>IC Requirements</th>
<th>HMA/VR HMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakdown Compaction Minimum Temperature °F 1st PASS</td>
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</tr>
<tr>
<td>Breakdown Compaction Minimum Number of Passes</td>
<td></td>
</tr>
<tr>
<td>Intermediate Compaction Minimum Temperature °F 6th PASS</td>
<td></td>
</tr>
<tr>
<td>Intermediate Compaction Minimum Number of Passes</td>
<td></td>
</tr>
</tbody>
</table>

Verify from the compaction quality control report that the following compaction requirements have been met:

**HMA Compaction Verification**

- 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?
  - Yes [ ] No [ ] If not, notify the contractor that corrective action is required.

- Does the number of passes shown on final coverage histogram of number of passes for breakdown compaction roller show that at least 80 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, notify the contractor that corrective action is required.

- 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?
  - Yes [ ] No [ ] If not, 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?
  - Yes [ ] No [ ] If no, notify the contractor that corrective action is required.
**COMPACT QUALITY CONTROL REPORT VERIFICATION**

<table>
<thead>
<tr>
<th>OGFC Method Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IC Requirements</th>
<th>OGFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakdown Compaction</td>
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<tr>
<td>Minimum Temperature °F</td>
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<tr>
<td>1st PASS</td>
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</tr>
<tr>
<td>Complete Compaction</td>
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</tr>
<tr>
<td>Minimum Temperature °F</td>
<td></td>
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<tr>
<td>Minimum Number of Passes</td>
<td></td>
</tr>
<tr>
<td>Intermediate Compaction</td>
<td></td>
</tr>
<tr>
<td>Minimum Number of Passes</td>
<td></td>
</tr>
</tbody>
</table>

Verify from the compaction quality control report that the following compaction requirements have been met:

**OGFC Compaction Verification**

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 OGFC type?

- [ ] Yes
- [ ] 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?

- [ ] Yes
- [ ] 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?

- [ ] Yes
- [ ] No

If no, notify the contractor that corrective action is required.
### Compaction Quality Control Report Verification

**HMA Density Required**

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.

- **Intelligent Compaction Target Values Determined from Test Strip**
  - Target number of roller passes for breakdown compaction
  - Target roller 1st 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.

Verify from the compaction quality control report that the following compaction requirements have been met:

- 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 HMA placement area, meet or exceed the target minimum temperature based on the HMA test stripe?
  - Yes [ ] No [x] 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?
  - Yes [ ] No [x] 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?
  - Yes [x] 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?
  - Yes [x] 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?
  - Yes [x] 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?
  - Yes [ ] No [x] 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.

<table>
<thead>
<tr>
<th>Compaction quality control report reviewed by (print name)</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident engineer (print name)</td>
<td>Signature</td>
<td>Date</td>
</tr>
</tbody>
</table>
### Specifications Compaction Requirements Information

#### HMA Type A and RHMA-G

<table>
<thead>
<tr>
<th>IC Requirements</th>
<th>HMA Type A Unmodified Asphalt Binder</th>
<th>HMA Type A PG-M Asphalt Binder</th>
<th>RHMA-G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakdown Compaction</td>
<td>250</td>
<td>240</td>
<td>285</td>
</tr>
<tr>
<td>Minimum Temperature °F 1st Pass</td>
<td></td>
<td></td>
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<tr>
<td>Breakdown Compaction Minimum Number of Passes</td>
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<tr>
<td>Intermediate Compaction</td>
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<td>250</td>
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<tr>
<td>Minimum Temperature °F 6th Pass</td>
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<tr>
<td>Intermediate Compaction Minimum Number of Passes</td>
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<td>3</td>
<td>3</td>
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</table>

#### Open Graded Friction Course (OGFC)

<table>
<thead>
<tr>
<th>IC Requirements</th>
<th>OGFC Unmodified Asphalt Binder</th>
<th>OGFC PG-M Asphalt Binder</th>
<th>OGFC RHMA-O RHMA-HB</th>
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</thead>
<tbody>
<tr>
<td>Breakdown Compaction</td>
<td>240</td>
<td>240</td>
<td>290</td>
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<tr>
<td>Minimum Temperature °F 1st Pass</td>
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<td></td>
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</tr>
<tr>
<td>Complete Compaction Minimum Temperature °F Last Pass</td>
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#### Warm Mix Asphalt

#### HMA Type A and RHMA-G

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<tr>
<th>IC Requirements</th>
<th>HMA Type A Unmodified Asphalt Binder</th>
<th>HMA Type A PG-M Asphalt Binder</th>
<th>RHMA-G</th>
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</thead>
<tbody>
<tr>
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<td>290</td>
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<tr>
<td>Minimum Temperature °F 1st Pass</td>
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<td>Breakdown Compaction Number of Passes</td>
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<td>3</td>
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<tr>
<td>Intermediate Compaction</td>
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<td>170</td>
<td>290</td>
</tr>
<tr>
<td>Minimum Temperature °F Last Pass</td>
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<tr>
<td>Intermediate Compaction Number of Passes</td>
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<td>3</td>
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#### Open Graded Friction Course (OGFC)

<table>
<thead>
<tr>
<th>IC Requirements</th>
<th>OGFC Unmodified Asphalt Binder</th>
<th>OGFC PG-M Asphalt Binder</th>
<th>OGFC RHMA-O RHMA-HB</th>
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</thead>
<tbody>
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<td>Breakdown Compaction</td>
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<tr>
<td>Minimum Temperature °F 1st Pass</td>
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<tr>
<td>Complete Compaction Minimum Temperature °F Last Pass</td>
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<td>170</td>
<td>240</td>
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<tr>
<td>Minimum Number of Passes</td>
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<td>2</td>
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### INTELLIGENT COMPACTION QUALITY CONTROL REPORT SUMMARY
FOR HOT MIX ASPHALT WITH METHOD COMPACTION
CEM-IC15 (NEW 06/24/2015)

<table>
<thead>
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<tbody>
<tr>
<td></td>
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</tbody>
</table>

**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@dor.ca.gov

### HOT MIX ASPHALT (HMA) PLACEMENT INFORMATION

<table>
<thead>
<tr>
<th>HMA Placement Location</th>
<th>HMA Placement Date</th>
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<tbody>
<tr>
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<table>
<thead>
<tr>
<th>Beginning Station</th>
<th>Ending Station</th>
<th>HMA Type</th>
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<table>
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<th>ICQCT Phone Number</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

### HMA Method Compaction Requirements

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

<table>
<thead>
<tr>
<th>IC Requirements</th>
<th>HMA Target Values</th>
<th>IC Requirements</th>
<th>OGFC Target Values</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Minimum Number of Passes</td>
<td>Breakdown Compaction Minimum Temperature °F</td>
<td>Breakdown Compaction Minimum Temperature °F</td>
</tr>
<tr>
<td>Intermediate Compaction Minimum Number of Passes</td>
<td>Complete Compaction Minimum Temperature °F</td>
<td>Intermediate Compaction Minimum Temperature °F</td>
<td></td>
</tr>
</tbody>
</table>

### 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 exceeded 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 85% 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 exceeded the minimum number of roller passes specified for intermediate compaction?

- [ ] Yes
- [ ] No

If no, corrective action taken:
### 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 80% of the daily HMA placement area?

- [ ] Yes
- [x] 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 80% of the daily HMA placement area?

- [ ] Yes
- [ ] No

If no, corrective action taken:

### Quality Control Report Information

<table>
<thead>
<tr>
<th>Veta Analysis Completed by</th>
<th>Veta Analysis by Email Address</th>
<th>Veta Analysis by Phone Number</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Quality Control Report Completed by (print name)</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
</table>

### 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.

<table>
<thead>
<tr>
<th>Quality Control Manager (print name)</th>
<th>Signature</th>
<th>DateReviewed</th>
</tr>
</thead>
</table>

### Compaction Quality Control Report Submittal Information

- Submit hardcopy to resident engineer within 1 business day of HMA placement.
- Submit Aotea Portal to resident engineer within 1 business day of HMA placement.
- Submit Aotea Portal to [IC@dot.ca.gov](mailto:IC@dot.ca.gov) within 1 business day of HMA placement.

Submitted by (print name) Date

Updated 2015-06-24
### Intelligent Compaction Quality Control Report Summary

**For Hot Mix Asphalt with Density Requirement**

**CEM-IC16 (NEW 08/08/2015)**

#### Project Information

<table>
<thead>
<tr>
<th>Project Information Name</th>
<th>Contract Number</th>
<th>Contract/FM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### HOT MIX ASPHALT (HMA) Placement Information

<table>
<thead>
<tr>
<th>HMA Placement Location</th>
<th>HMA Placement Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IC-QCT Station Number (ICQCT)</th>
<th>ICQCT Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Target number of roller passes</th>
<th>Percent work area covered by minimum number of roller passes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Target intelligent compaction measurement value</th>
<th>Daily average intelligent compaction measurement value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Target number of roller passes</th>
<th>Percent work area covered by minimum number of roller passes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 gauge quality control test results, then corrective action for number of passes is not required.
### Additional Intelligent Compaction Vibratory Steel Drum Roller Compaction

If roller pattern shown on Contractors Establishment of Break Over Density form includes additional rolling using IC vibratory steel drum roller after pneumatic tire rolling provide the following information:

- [ ] Yes
- [x] Not Required

#### Roller Number of Passes

<table>
<thead>
<tr>
<th>Target number of roller passes</th>
<th>Percent work area covered by minimum number of roller passes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 strip?

- [x] Yes
- [ ] No

If no, corrective action taken:

#### Intelligent Compaction Measurement Value

<table>
<thead>
<tr>
<th>Target intelligent compaction measurement value</th>
<th>Daily average intelligent compaction measurement value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 strip?

- [x] Yes
- [ ] No

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

- [ ] Yes
- [x] 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

<table>
<thead>
<tr>
<th>Veta Analysis Completed by</th>
<th>Veta Analysis by Email Address</th>
<th>Veta Analysis by Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Signature</td>
<td>Date</td>
</tr>
</tbody>
</table>

### Compaction Quality Control Report Review

- **COMMENTS:**

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

<table>
<thead>
<tr>
<th>Quality Control Manager (print name)</th>
<th>Signature</th>
<th>Date Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Compaction Quality Control Report Submittal Information

1. Submit hardcopy to resident engineer within 1 business day of HMA placement:
   - Submitted by (print name): Date
2. Submit Acoste *:portie to resident engineer within 1 business day of HMA placement:
   - Submitted by (print name): Date
3. Submit Acoste *:portie to IC@dot.ca.gov within 1 business day of HMA placement:
   - Submitted by (print name): Date

Updated 2015-08-08
### INTELLIGENT COMPACTION COLD-IN-PLACE RECYCLING TEST STRIPE SUBMITTAL CHECKLIST

**CEM-IC20 (NEW 07/31/2015)**

<table>
<thead>
<tr>
<th>PROJECT INFORMATION NAME</th>
<th>CONTRACT NUMBER</th>
<th>CORTE/PM</th>
<th>PROJECT IDENTIFIER NUMBER</th>
<th>CONTRACTOR NAME</th>
</tr>
</thead>
</table>

**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: JCI@dot.ca.gov

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

<table>
<thead>
<tr>
<th>Test Strip Placement Location</th>
<th>Test Strip Placement Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning Station</td>
<td>Ending Station</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IC Technical Representative (ICIR)</th>
<th>ICIR Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC Quality Control Technician (ICQCT)</td>
<td>ICQCT Phone Number</td>
</tr>
</tbody>
</table>

### Test Strip Required Submittals (Check all that were submitted)

- Veta Analysis Results:
  - ✔️ Veta analysis results as shown on intelligent compaction CIR construction daily submittal checklist
  - ✔️ All passes compaction curves from Veta
  - ✔️ All passes correlation analysis report from Veta

- Color Layout Plots:
  - ✔️ Color layout plots as shown on the CIR construction daily submittal checklist

### Additional Test Strip Information

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

### Data File:

- ✔️ 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**
<table>
<thead>
<tr>
<th>CIR Location</th>
<th>CIR Compaction Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning Station</td>
<td>Ending Station</td>
</tr>
<tr>
<td>CIR Quality Control Technician (CQQCT)</td>
<td>Job Phone Number</td>
</tr>
<tr>
<td>Veta analysis performed by</td>
<td>Veta performed by email address</td>
</tr>
</tbody>
</table>

**COMPACTION QUALITY CONTROL REPORT** (Check all that apply)

- [ ] Compaction QC report submitted
- [ ] Partial submittal of compaction QC report
- [ ] Was compaction QC Report submitted within 1 business day of HMA placement?

**Veta Analysis Results Submitted** (Check all that apply)

- [ ] Final coverage histogram of number of passes for each roller
- [ ] Final coverage histogram of intelligent compaction measurement value of steel drum roller with vibratory on
- [ ] Final coverage histogram of number of passes for each roller for a fixed interval
- [ ] Final coverage histogram of intelligent compaction measurement value of steel drum roller with vibratory on for a fixed interval
- [ ] All passes histogram for each roller

**Color Layout Plots Submitted** (Check all that apply)

- [ ] Roller passes for each roller
- [ ] Intelligent compaction measurement value for final coverage of compaction for steel drum roller with vibratory on.

**Additional Information Submitted**

- [ ] Quality control nuclear gage density per location
- [ ] GPS measured coordinates per nuclear gage density location

**DATA FILES** (Check all that apply)

- [ ] Data files submitted
- [ ] Data files not submitted
- [ ] Partial submittal of data files
- [ ] Were data files submitted within 3 business days of CIR production?

- [ ] Post processed Veta data file type *vetaproj used to create the compaction quality control report
- [ ] 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
### Intelligent Compaction Cold-In-Place Recycling

**Compaction Quality Control Report Verification Checklist**

**CEM-IC22 (NEW 7/31/2015)**

| Project Information Name | Contract Number | CORTE/FM
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Identifier Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractor Name</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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

#### Cold-In-Place Recycling (CIR) Information

<table>
<thead>
<tr>
<th>CIR Location</th>
<th>CIR Compaction Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning Station</td>
<td>Ending Station</td>
</tr>
<tr>
<td>Initial Compaction</td>
<td>Supplemental Compaction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CIR Quality Control Technician (IQQT)</th>
<th>IQQT Phone Number</th>
</tr>
</thead>
</table>

#### 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
- Target number of roller passes for 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**

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.

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?
- [ ] Yes  [ ] 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?
- [ ] Yes  [ ] 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?
- [ ] Yes  [ ] No  If no, notify the contractor that corrective action is required.
## CIR Compaction Verification Continued

If roller pattern shown on Contractors Establishment of Break Over Density form includes additional 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.

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, 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?

- [ ] Yes  - [ ] 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 gauge quality control test results are showing adequate density.

### COMMENTS:

<table>
<thead>
<tr>
<th>Resident engineer (print name)</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
</table>

Updated 2015-07-31
### Intelligent Compaction Cold-in-Place Recycling Compaction Quality Control Report Summary

CEM-IC25 (NEW 06/21/2015)

<table>
<thead>
<tr>
<th>Project Information Name</th>
<th>Contract Number</th>
<th>CORTE/FM</th>
<th>Contractor Name</th>
</tr>
</thead>
</table>

**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**
- **Initial Compaction**
- **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.

<table>
<thead>
<tr>
<th>Intelligent Compaction Vibratory Steel Drum Roller Number of Passes</th>
<th>Percent work area covered by minimum number of roller passes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target number of roller passes</td>
<td>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?</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>If no, corrective action taken:</td>
<td></td>
</tr>
</tbody>
</table>

#### Intelligent Compaction Measurement Value

<table>
<thead>
<tr>
<th>Target intelligent compaction measurement value</th>
<th>Daily average intelligent compaction measurement value</th>
</tr>
</thead>
<tbody>
<tr>
<td>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?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>If the answer is no, corrective action is not required because intelligent compaction measurement value is report only.</td>
<td></td>
</tr>
</tbody>
</table>

#### Automated Machine Guidance Roller

<table>
<thead>
<tr>
<th>Target number of roller passes</th>
<th>Percent work area covered by minimum number of roller passes</th>
</tr>
</thead>
<tbody>
<tr>
<td>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?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>If no, corrective action taken:</td>
<td></td>
</tr>
</tbody>
</table>

**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*
### Additional Intelligent Compaction Vibratory Steel Drum Roller Compaction

If roller pattern shown on Contractors Establishment of Break Over Density form includes additional rolling using IC vibratory steel drum roller after pneumatic rubber tire rolling provide the following information:

- **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?

- **Yes**
- **No**

If no, corrective action taken:

### Intelligent Compaction Measurement Value

- **Target intelligent compaction measurement**: ___
- **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.

**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

<table>
<thead>
<tr>
<th>Veta Analysis Completed by</th>
<th>Veta Analysis by Email Address</th>
<th>Veta Analysis by Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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 Manager:** (print name)  
**Signature:**  
**Date Reviewed:**

### Compaction Quality Control Report Submittal Information

- **Submit hard copy to resident engineer within 1 business day of CIR placement:** 
  - Submitted by: (print name)  
  - Date: 

- **Submit Adobe PDF to resident engineer within 1 business day of CIR placement:** 
  - Submitted by: (print name)  
  - Date: 

- **Submit Adobe PDF to IC@dot.ca.gov within 1 business day of CIR placement:** 
  - Submitted by: (print name)  
  - Date:

Updated 2015-06-21