

INDEPENDENT ASSURANCE MANUAL

2020

AS REVISED

To be used on projects advertised after July 1, 2020



Colorado Department of Transportation

2020 CDOT Independent Assurance Manual

Introduction

The purpose of this manual is to provide an official guide to CDOT Independent Technicians, whether the individuals are CDOT personnel or consultant, for the sampling and testing of materials on construction projects and the subsequent documentation. It is not the intent to publish a complete summary of all sampling and testing methods and procedures. Further, applicable information may be found in either the referenced AASHTO or ASTM documents.

The testing frequency as shown in the Owner Acceptance (OA) Frequency Guide Schedule for Minimum Materials Sampling, Testing, and Inspection are considered to be the minimum necessary to have the degree of control desired. The Sampling and Testing Procedures have in many cases been modified to make them more applicable to Field testing conditions. Further unauthorized modifications should not be attempted. If a valid reason exists, a shortage of tests can be explained and the work accepted. However, improper test procedures cannot be explained nor accepted.

The testing frequency as shown in the Independent Assurance (IA) Frequency Guide Schedule for Evaluation of OA Sampling and Testing is to be established by the Region Materials Engineer.

It is not our intention to discourage efforts to find better or faster methods of testing. Many of the Colorado Procedures are the result of suggestions from field materials personnel. However, before using a procedure other than that listed, it must be approved by the Materials Advisory Committee (MAC) and the FHWA. In addition, the procedure used must be the same as that specified in the project specifications. If this rule is not followed, the acceptance or rejection action cannot be supported and may result in legal rulings against the Department in cases of litigation. The Frequency Guide Schedule for Minimum Materials Sampling, Testing, and Inspection current at the time of contract advertisement shall apply during the full course of that particular project.

We realize the critical importance of materials and the associated personnel, whether they are Process Control (PC) from the contractor, Owner Acceptance (OA) from CDOT, or Independent Assurance (IA) to any construction project. It is our intent to create a Field Materials Manual (FMM) that always reflects the most current and best procedures, and is as user-friendly as possible. Please take the time to review and read this publication, and provide us with the Comment Form or the FMM & CDOT Materials Forms Comment / Correction Form at any time. Download the Comment form to your computer and open the form using Adobe Acrobat. Follow the instructions and submit your comments. The form with your comments will be maintained for future reference.

It is critical to follow the *Documentation for SMM / LIMS – Project Materials to Final Materials* or the *Documentation for Design-Build Quality Assurance Program - Project Materials to Final Materials* which is applicable for the vast majority of CDOT projects.

The 2021 CDOT Independent Assurance Manual is currently updating and adding documents and instructions to meet the recommendations for updating manuals to comply with Procedural Directive 21.1 “Requirements for the Retention of Records for Specified Design, Construction, Engineering, and Specialty Groups (Paper and Electronic) eff. June 20, 2019 and Procedural Directive 508.1 “Requirements for the Use of the Professional engineer’s Seal” eff. May 21, 2019.

This is the first edition of the Independent Assurance Manual, and will be available in both a published print format and on the CDOT web site; future IA Manuals may only be available electronically as CDOT is moving toward a paperless work environment. CDOT is also implementing electronic signatures to facilitate the timely transmission of documents and project closure. Any changes prior to the issuance of the 2020 IA Manual will be conveyed through a CDOT Materials Bulletin.

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Date: 2020.07.06 09:44:02 -06'00'
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A centralized location for all CDOT Materials related documents and publications is at:
<http://www.codot.gov/business/designsupport/materials-and-geotechnical/>

A special thank you is extended to the members and participants of the Independent Assurance Meetings and who are constantly striving to improve testing methodology and CDOT specifications so that the roads in Colorado are progressively built better and are safer for the public.

SUMMARY OF: 2020 CDOT Independent Assurance Manual Listed Revisions, Additions, and Deletions

Changes to the 2020 IA Manual : Changes of significance within a particular CP or chapter will contain a “-xx” at the end of the title to coincide with the IA Manual edition, not the calendar year that changes or revisions were made. Changes to specific text (Sections &/or Subsections) from the previous year will have a **RED** side-bar in either the left or right margin. The 2020 revisions, additions and Deletions are highlighted in **RED**.

- Introduction: **Added PD 21.1 and PD 508.1 paragraph statement**
- Electronic Documents Chapter: **Added Electronic Documents Chapter**
- Adobe Sign Chapter: **Added Adobe Sign Instructions Chapter**

CDOT Independent Assurance Program Manual – 2020

1. SCOPE

- 1.1 The Independent Assurance (IA) Program Manual is a detailed document on what a CDOT IA Tester is required and expected to do as part of the CDOT IA Program. This Manual will act as a guide to assist an individual who has never been involved, either directly or indirectly, in Independent Assurance Testing (IAT). There is a minimum expectation that the individual who will fulfill these duties within each of the Regions has previous experience as an Owner Acceptance (OA) Tester. The purpose, therefore, is to provide the details necessary to ensure that the IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing in the Field Materials Manual (FMM) is followed, not only in the number and type of tests but also in the quality required by the program.
- 1.2 The IA Program Manual is predominantly written by IA Testers for IA Testers. Shared experiences of those seasoned IA Testers who have done this job and have done it well are included as a guide. A new IA employee should use these experiences to prevent lost time and minimize, if not avoid mistakes. Each Region's implementation of the program may vary slightly but only in style, not substance; therefore, a Region-by-Region audit of the program should indicate no deviations in the testing, sampling, and reporting of test results.

2. REFERENCES

- 2.1 AASHTO R 44-07 (2012), Standard Practice for Independent Assurance (IA) Programs
- 2.2 CDOT Field Materials Manual (current), Quality Assurance Procedures Chapter, Section 7 Independent Assurance (IA) Program

3. REQUIRED CERTIFICATIONS

- 3.1 LabCAT Level A, B, C and E
- 3.2 ACI Field Testing Technician Grade 1
- 3.3 ACI Concrete Strength Testing Technician
- 3.4 WAQTC
- 3.5 CDOT School of Radiological Safety and Nuclear Gauge Operation or equivalent.
- 3.6 Optional:
 - 3.6.1 ACI Aggregate Testing Technician Level 1 and 2
 - 3.6.2 ACI Concrete Laboratory Testing Technician Level 1 and 2

4. REFERENCE DOCUMENTS AND TEST METHODS PERFORMED

- 4.1 Colorado Procedures: CP 10, CP 16, CP 20, CP 21, CP 23, CP 25, CP 30, CP 31, CP 32, CP 37, CP 41, CP 43, CP 44, CP 45, CP 48, CP 51, CP 53, CP 55, CP 57, CP 75, CP 76, CP 80, CP 81, CP 82, CP 85

- 4.2 Colorado Procedures - Laboratory: CP-L 4211, CP-L 5101, CP-L 5109, CP-L 5115, CP-L 5120, CP-L 5302, CP-L 5303, CP-L 5304
- 4.3 AASHTO Procedures: AASHTO T 23, AASHTO T 99, AASHTO T 119, AASHTO T 121, AASHTO T 141, AASHTO T 152, AASHTO T 176, AASHTO T 180, AASHTO T 265
- 4.4 ASTM Procedures: ASTM C 39, ASTM C 192, ASTM C 617, and ASTM C 1231

5. EQUIPMENT

- 5.1 Equipment: It is expected that the IA tester will ensure that all equipment used for an IAT is different than that used to perform the OA testing. In the case of concrete cylinder strength testing, gradations, etc., this may not always be possible. Consult with your RME before using any equipment that may not satisfy these criteria. The below-referenced equipment lists what is required not its ownership.
- 5.2 Mobile Testing Equipment (Transported with IA personnel):
- Nuclear M/D Gauge
 - Air pressure meter
 - Slump test equipment
 - Unit Weight scale
 - Strength cylinders (beam molds should be supplied by the contractor for the IA Test)
 - Thermometers
 - Sample containers (buckets, sample bags, oil cans)
 - Calculator
 - Test CDOT Forms
 - Assurance Test stamp(s)
- 5.3 Lab Equipment:
- Ignition Oven and correction factor equipment
 - Nuclear AC Gauge
 - Thermometers
 - Hydraulic concrete press
 - Troxler or Pine Superpave Gyrotory Compactor
 - Splitter
 - Timers
 - Volumetric flasks
 - Balance
 - Vacuum pump
 - Water bath
 - Freezer
 - Aluminum or steel pans
 - Sieves
 - Shaker
 - Forced draft ovens
 - 4 lb. Hammer
 - 4" & 6" Soil Mold
 - 5.5 & 10 lb. Rammer
 - Sample Extruder
 - Mixing Tools

5.4 Computer Applications:

5.4.1 MS Office including Word, Excel, Outlook, and Access

5.4.2 Adobe Acrobat Pro DC

5.4.3 CDOT PC/OA Software/ SiteManager/LIMS

5.5 All equipment used in the IA program shall be verified as per the schedule in the Inspection Section of the current CDOT Field Materials Manual.

6. IA JOB FUNCTIONS / ACTIVITIES

6.1 Attends pre-construction, pre-paving, pre-pour, and/or pre-testing meetings. Follows Colorado Procedure 16 (CP 16), Standard Practice for Management of Consultant Materials Testing. Is CP 16 still recognized in the FMM?

6.2 Conducts Field Lab Inspection (CP 10) for all CDOT and Consultant QA testers' field laboratories.

6.3 Coordinates with the Region Owner Acceptance (OA) tester to determine the location and frequency of Independent Assurance (IA) sampling and testing.

6.4 Witnesses sampling of IA materials for testing by Process Control (PC) or OA.

6.5 Conducts material testing determined by the IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing in the Field Materials Manual (FMM).

6.6 Develop CDOT Form 379 for Local Agency projects on the National Highway System (NHS) in the Region using the IA Frequency Guide Schedule.

6.7 Creates, completes, and reviews appropriate CDOT material testing forms including Form #: 82, 83, 84, 411, 427, 428, 565, 582, 1290, 1304, etc., including any other Region-specific material testing worksheets.

6.8 Assists OA tester with any documentation, materials, equipment questions and/or project material problems if a Region Head Tester or the Project Engineer is not available.

6.9 With the help of the Project Head Tester and the OA tester, monitors production quantities and any material quantity changes.

6.10 Obtain CDOT Form 379 from CAR Reports. Edits may be done to remove non-applicable tests or items.

6.11 Once the project is complete, IA personnel will initiate CDOT Form 473 and distribute it for signatures.

7. IA PROJECT / SYSTEM BASIS

- 7.1 IA Project Basis: see AASHTO R 44, Section 7; and CDOT FMM Quality Assurance Procedures Chapter Section 7
- 7.2 IA System Basis: see AASHTO R 44, Section 8; and CDOT FMM Quality Assurance Procedures Chapter Section 7.
- 7.3 IA Combination Basis: see AASHTO R 44, Section 9; and CDOT FMM Quality Assurance Procedures Chapter Section 7.

8. CDOT FORM 379LA DEVELOPMENT FOR LA PROJECTS

- 8.1 The individual developing the CDOT Form 379LA should acquire it from CDOT's Forms Catalog, <https://www.codot.gov/library/forms>.
- 8.2 Fill in Contract ID, Project Number, Project Engineer, Resident Engineer, and Project Location boxes. Add each Item Number, Item Identification, and # of samples Recommended, in the specified box on the form as follows (example only).
- 8.2.1 For Item 403, in the Item column place *403*, enter Item Identification, for example, *HMA (S-75) PG 64-22*. The item information can be found on project plans or project bid tabs. Also, in the Item Identification box enter a statement stating that the project is being tested using, *Project Basis (1/10,000) ton* or *System Basis (1/25,000 ton or every 2 months)*.

Below the Items Identification, enter the tests required, i.e. for a Voids project enter:

- HMA (S-75) PG 64-22
- % Asphalt, Gradation
- % Compaction, Maximum Specific Gravity
- Joint Density (if applicable)
- Air Voids
- Voids in Mineral Aggregate

This information can be found in the current year's FMM, IA Frequency Guide Schedule Chapter, under Item 403 in the Type of Test Required column.

To determine the number of tests required for each pay item, check project bid tabs or project plans for each pay item's plan quantity. Compare plan quantity to the Minimum Sampling Frequency schedule located in the current year's FMM, IA Frequency Guide Schedule Chapter. Enter the minimum number of tests required in the # of Samples Recommended column.

After the initial Item #, *403*, Identification, *HMA (S-75) PG 64-22 Project Basis* or *System Basis*, # of samples Recommended are filled out, skip a line and enter *% Asphalt*, on the next line enter, *Gradation*, on the next line enter, *% Compaction*, etc., until all of the information from the Type of Test Required column from the IA Frequency Guide Schedule is contained on the CDOT Form 379.

After the development of the CDOT Form 379LA, it should be signed and dated. Forward it to the independent reviewer for it to be verified, signed and dated. Before construction begins on the project, submit CDOT Form 379 to the Region Materials Engineer for approval, signature, and date. Then mail the signed copy to the Resident Engineer's unit for distribution to the project. Retain an original copy for the IA file.

When IA tests are completed, enter the CDOT Form # i.e. % Asphalt Form 1304, Gradation CDOT Form 565, % Compaction CDOT Form 427, in CDOT Form column. Then enter the CDOT form's Field Sheet number (usually found in the upper right corner of the form) in the appropriate column. Next, enter the date of the IA test or material sampling in the Date column. Finally, add the OA Tester's name and the IA Tester's name to the form in the appropriate columns.

- 8.3 When all of the recommended IA tests are completed fill in the number of tests completed for each item in the # of Samples Actual column. This number must match the number in the # of Samples Recommended column, if not; include a brief statement explaining the reason for the deficiency or the excessive testing. Any equipment that is used for both OA and IA testing should be noted on the CDOT Form 379. An example is the press used for CPL-5106 may be used for both IA and OA testing. The use of the same equipment for both OA and IA testing should be limited as much as possible. If the same equipment is used at a minimum an IA sample must be tested by an independent tester (a different individual).

Enter the lab Project Field Inspection Date and add any Remarks in the specified areas. Submit the CDOT Form 379 to the RME for a final review, signature, and date. The signed original is to be distributed to the Resident Engineer's unit to be added to the project files and for appropriate distribution. Retain a copy for the IA file.

9. ITEM 203

9.1 Test Methods:

- 9.1.1 CP 15 (Also referenced in CP 81.)
- 9.1.2 CP 23
- 9.1.3 CP 25
- 9.1.4 CP 75
- 9.1.5 CP 80
- 9.1.6 CP-L 5302

9.2 Procedure:

- 9.2.1 Contact the OA Tester or the OA Tester will contact the IA Tester to schedule IA testing on the construction project. Use CP 80, In-Place Density and Moisture Content by the Nuclear Method.
- 9.2.2 Meet with the OA tester at the construction site.
- 9.2.3 Standardize nuclear field M/D Gauge and nuclear IA M/D Gauge as per Section 8, Standardization.
- 9.2.4 Using CP 75 the OA tester randomly selects a test location.
- 9.2.5 The OA tester prepares the test site as per CP 80 Sections 8.2 through 8.2.5.
- 9.2.6 Then the OA tester places the gauge on the material to be tested as per CP 80 Section 8.3 thru 9.3.4.
- 9.2.7 The IA tester places the gauge on the same field test site that was prepared by the OA tester and runs the gauge as per CP 80 Section 8.3 thru 8.3.5.

- 9.2.8 The OA tester and the IA tester should calculate the dry density and the moisture content of the soil by following Section 9. Calculations require using CDOT Form 427.
- 9.2.9 The OA tester obtains a representative sample of material directly beneath the gauge and places it in a sealed container. The sample depth is not to exceed 2 inches greater than the depth being tested. The sample should be of sufficient size to obtain at least 7 lbs. of air-dried minus No. 4 material.
- 9.2.10 The soil sample is taken to the field lab by the OA tester and the IA tester to determine the percent plus No. 4 in the material. If there is 5% or more plus No. 4 material, a rock correction must be applied to the maximum dry density of the soil sample. The IA tester should observe the OA tester perform the one-point verification and verify that it matches the curve used.
- 9.2.11 If no soil curve is available for the sample, use the minus No. 4 portion from the material to develop a new moisture-density curve according to AASHTO T 99 or T 180, whichever is applicable.
CP-25
- 9.2.12 Use the dry density figure from the material compacted into the cylinder and the percent moisture figure of this same material to determine which moisture density relation curve to use by following CP 25 Section 3.4.2 through 3.4.6.
- 9.2.13 Once the maximum dry density for this material has been determined from the dry density curve then the OA tester and the IA tester can calculate the percent compaction.
- 9.2.14 Compare field test results and IA results, using Table One – Comparison Precision Guide located in the Field Materials Manual IA Frequency Guide Schedule Chapter. If soil compaction results are within the Minor Difference tolerance then they are considered to be acceptable for field and IA test comparisons. If a Significant Difference is noted all calculations must be checked as well as the OA M/D gauge standard log to be sure the gauge is not drifting. If there is still a discrepancy then a retest should be taken by both the OA and IA testers in the general area of the first test. If there is still a discrepancy with the second test then a complete investigation is conducted as to the cause of the difference.

9.3 Documentation:

- 9.3.1 All test results are documented on CDOT Form 427.
- 9.3.2 Stamp all forms with an Assurance Sample stamp.
- 9.3.3 Once you fill out the CDOT Form 427 you need to review it with the OA tester and Project Engineer and have them sign it. Give a copy of the CDOT Form 427 to the OA tester when you are finished for inclusion in the project files.

10. ITEM 304

10.1 Procedure – Gradation:

- 10.1.1 Contact the OA tester or have tester contact the IA tester to schedule IA testing on the construction project.
- 10.1.2 Meet with the OA tester at the construction site.
- 10.1.3 Obtain a gradation sample according to the OA tester's random sample schedule as per CP75.
- 10.1.4 This gradation shall be obtained by the OA tester as per CP 30. Most of the time the sampling of aggregate is done from processed windrow as per Section 4.3.5 in CP 30.

10.1.5 The OA tester will reduce the sample in half as per CP 32. IA will retain a sample to be run at the Region Lab while the OA runs theirs at the field lab as per CP 31.

10.2 Procedure – Compaction:

10.2.1 Contact the OA tester or have tester contact the IA tester to schedule IA testing on the construction project.

10.2.2 Meet with the OA tester at the construction site.

10.2.3 Standardize the field nuclear M/D Gauge and the IA nuclear M/D Gauge as per CP 80 Section 7.

10.2.4 Using CP 75 the OA tester randomly selects a test location.

10.2.5 The OA tester prepares the test site as per CP 80 Section 8.2 thru 8.2.5.

10.2.6 Then the OA tester places the gauge on the material to be tested as per CP 80 Section 8.3 thru 8.3.5.

10.2.7 The IA tester places the gauge on the same field test site that was prepared by the OA tester and runs the gauge as per CP 80 Section 8.3 thru 8.3.5.

10.2.8 The OA tester and the IA tester should calculate the dry density and the moisture content of the aggregate as per CP 80 Section 9. Calculations require using CDOT Form 427.

10.2.9 The OA tester obtains a representative sample of material directly beneath the gauge to a depth not to exceed 2 inches greater than the depth being tested.

10.2.10 The aggregate sample is taken to the field lab by the OA tester and the IA tester to determine the percent plus No. 4 in the material. The IA tester should observe the OA tester perform the one-point verification and verify it matches the curve used.

10.2.11 The maximum dry density for this aggregate material shall be as determined from the AASHTO T 180, moisture density relation curve. A rock correction must be applied to the maximum dry density of the moisture density curve.

10.2.12 Once the maximum dry density for this material has been determined the OA tester and the IA tester can calculate the percent compaction (CDOT Form 427).

10.2.13 Compare field test results and IA results, using Table One – Comparison Precision Guide located in the Field Materials Manual IA Frequency Guide Schedule Chapter. If aggregate compaction results are within the Minor Difference tolerance then they are considered to be acceptable for field and IA test comparisons. If a Significant Difference is noted, then a complete investigation is conducted as to the cause of the difference.

10.3 Documentation:

10.3.1 All test results are documented on CDOT Form 427.

10.3.2 Stamp all forms with an Assurance Sample stamp.

10.3.3 Once you fill out Form 427 you need to review it with the OA tester and Project Engineer and have them sign it. Give a copy of the Form #427 to the OA tester when you are finished for inclusion in the project files.

11. ITEM 403**11.1 Procedure: HMA Field Testing:**

- 11.1.1 Contact the OA tester or have tester contact the IA tester to schedule IA testing on the construction project. Timing the IA test and 10K samples may reduce testing amounts and also can be used to compare results with the Central laboratory.
- 11.1.2 Testing HMA: Accompany OA tester to the paving site or the supplier's batch plant. The contractor's representative must obtain a sample of HMA per CP 41 in a location determined by the Engineer or OA tester. No sampling is to be done by the OA or IA testers. This sample may be transported to the field laboratory and split, per CP 55, between the OA tester and the IA tester. For voids projects, a minimum of 1 filled sample can is required for IA testing. The OA tester must test the sample in the field laboratory or at the normal testing laboratory, using verified equipment. The OA tester must perform all relevant tests as specified by the project plans per all CDOT testing requirements. The IA tester is to test the split of this sample on independent equipment per the IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing in the Field Materials Manual (FMM).
- 11.1.3 The IA tester and the OA tester must witness sampling of the belt cut by the PC tester or contractor's representative. The gradation sampling must be following an approved method from CP 30. No sampling is to be done by the OA or IA testers. The OA tester should split the gradation sample at the field laboratory following CP 32 while it is witnessed by the IA tester. The OA tester retains one half of the gradation split for project acceptance and the IA tester retains the rest of the split for the IA test. The OA tester must test the sample in the field laboratory or at the normal testing laboratory, using verified equipment. If % AC is determined by the Ignition Oven a gradation may be run using the aggregate remaining after the burn-off is complete. An aggregate correction factor is required by both the IA tester and the OA tester to use the burn-off sample for gradation. Alternately, the 10K sample sent to the Central Lab may be used as the IA sample and compared to results generated in the Region.
- 11.1.4 The IA tester and the OA tester must witness sampling of the AC binder by the PC tester or contractor's representative. Under no circumstances should the OA or IA testers sample the binder because of the danger of burns and fire. Obtain a one-quart can of binder from the contractor's binder tanks using inline sampling for the IA. This will be done at the same time that a one-quart can of the binder is obtained from the contractor's binder tanks using inline sampling for the OA. One sample should be recorded and identified on a Form #411 by the IA tester as the IAT sample and submitted to the Central Laboratory Bituminous Laboratory with the rest of the lot by the OA tester. In the Remarks section of their respective CDOT Form 411, both the IA and the OA tester shall make a cross-reference to the other's sample LIMS ID.
- 11.1.5 Compaction: The OA and IA tester will perform a % compaction test on the same site on the paved roadway at a randomly selected site. After the OA tester has determined the random area for the test they must mark the footprint of the M/D Gauges with a lumber crayon or similar marking device. The OA tester must then test for % compaction of the asphalt mat per CP 81 or CP 44 and it is to be used as a project acceptance test. The IA tester must perform the % compaction test in the same location as the OA test as marked by the OA tester per CP 81 or CP 44 and compare percent compaction.

11.1.6 Test Evaluation: All OA and IA test results are evaluated using the Comparison Precision Guide located in the FMM's IA Frequency Guide Schedule Chapter. The uncorrected Wet Densities or percent compaction from CP 44 should be compared. The OA tester will use the correction determined by CP-82 for any results used for payment on the contract if CP 81 is used. If all results are within the Minor Difference tolerance column, all test results are considered to be acceptable for IA purposes. If a Significant Difference is noted, then a complete investigation is conducted as to the cause of the difference. Usually, a retest of the sample or location by both parties will resolve the most unacceptable results. The reason for the testing discrepancy must be documented in the IA test documentation. All original and retest results must be documented as part of the IA procedure, but only the acceptable test result will be used as the final IA test result. If the retest results do not meet the Minor Difference precision then a thorough check of the test equipment and tester's methods and procedures used in the testing must be completed. If testing differences are not resolved with the equipment and test procedure review, then contact the Project Engineer and/or Region Materials Engineer to discuss testing differences.

11.2 Documentation:

11.2.1 All test results are documented on CDOT forms as listed in the schedule for each item(s). The IA tester must stamp, sign, and date all OA and IA tester forms with the relevant IA Acceptance stamps, per the Region's requirements. The stamp language is specified in Section 7.5.1.1 of the Quality Assurance Procedures in the FMM.

11.2.2 Other duties the IA tester should perform during the IAT include:

11.2.2.1 Inspect all equipment used in the testing for cleanliness and wear.

11.2.2.2 Check field testing documentation by making sure all project books are setup by item number and that test worksheets are filed under the correct item number.

11.2.2.3 Check CDOT Form 250 for entries made and that entries are up to date.

Note: Some Regions utilize Head Testers that fulfill some of the above duties.

12. ITEMS 412, 507, 601, 606, 608, 609, 618 (PCCP)

12.1 Job Functions / Activities:

12.1.1 Meet with OA tester at the job site. Witness the sampling of a minimum one-cu/ft sample of fresh concrete using an approved method identified in the ASTM standards and the project special provisions. Depending on the placement of the concrete either the PC technician or the OA technician must transport the sample to a location where tests are to be performed or where test specimens are to be molded. The sample shall be combined and remixed to ensure uniformity.

12.1.2 Start tests for slump and air content within 5 minutes of obtaining the composite sample. Perform tests for slump and air content alongside the OA tester. Compare results and ensure that the results conform to the Precision Guide (Table One) in the IA Frequency Guide Schedule of the Field Materials Manual. If the OA and IA test results are not within the specifications a new sample must be obtained and retested by both the OA and IA testers. If a second test is not within specification then check all equipment for malfunction and correct calibrations.

- 12.1.3 Making concrete test specimens in the field: Start molding specimens for strength tests within 15 minutes of obtaining the composite sample. Mold cylinders or beams alongside the OA tester from the same sample and store for future comparison. The OA cylinders will then be cured as all other OA cylinders. The OA tester will deliver the cylinders to the appropriate testing facility and supply the IA tester with a report on the break strengths so that they can be retained in the IA project records. The IA tester should transport any cylinders or beams to the testing laboratory as soon as possible but within the transport specifications.
- 12.1.4 Item 412 allows compressive strength or flexural strength results. If compressive strength tests are used, then IA tests for sand equivalent are required. (IA frequency guide states at the request of Region Materials Engineer)

12.2 Documentation:

- 12.2.1 A computer program that can generate test results for compressive and flexural strengths.

13. IA PROJECT CLOSURE

13.1 Quality Assurance Procedures, Section 7.10

- 13.1.1 When all IA sampling and testing on the project is completed per the Independent Assurance Sampling & Testing Checklist, the Region Materials Engineer will certify through his Final Approval that: **“The Project Independent Assurance Sampling & Testing Schedule developed for this project has been substantially followed and the test results of the IA samples are within “Minor Differences” of the project acceptance sample test results.”**

Electronic Documentation - 20

CDOT is transitioning toward accepting all submittals, forms, project records and supporting documents in electronic format. This Manual reflects technology as of 7/01/2020. Users should work in partnership with CDOT staff to continue to advance this effort in between Manual updates.

1. **Description of Bentley Software Tools and Adobe Sign**

Adobe Sign

Adobe Sign is the electronic signature and professional seal software selected by CDOT and required for use on Project Records including Change Modification Orders (CMO), which facilitates automated workflows including the ability to route Project Records for acknowledgements, electronically sealing and/or signing. Adobe Sign is not the eSignature program selected for use on document requiring a CDOT Controller or State Controller signature (contracts).

Deliverables Management

CDOT uses a series of tools in the Bentley suite for design, construction and engineering documents. One of them is ProjectWise Deliverables Management. This is a cloud-based service that streamlines how a project team works with transmittals, submittals, and Requests for Information (RFI). It provides improved visibility into these processes and also retains confidentiality when legally required.

ProjectWise Deliverables Management is utilized to ensure that documents are submitted, completed and processed on schedule. Functions include: ensuring delivery to correct parties, enabling faster reviews and responses, automating an audit trail thereby increasing accountability with detailed recordkeeping, connecting entire supply chain through a secure cloud platform and leveraging project dashboards to monitor workflows and evaluate project performance. ProjectWise Deliverables Management is capable of handling reference files used in design.

Project Share

The Cloud-based software tool hosted in the Bentley / Microsoft Azure Cloud used for document collaboration. Project Share connects to and synchronizes with ProjectWise Explorer, such that files placed in a Project Share folder, which is synchronized with ProjectWise Explorer, are automatically copied to the same folder in ProjectWise Explorer. Note that Project Share is not used for DGN reference files in design.

ProjectWise Explorer

Bentley ProjectWise Explorer is the Electronic Document Management System (EDMS) for archiving all electronic Project Records set forth in the CDOT Record File Plans.

2. Definitions (Please also use the Definitions in the PDs if they are necessary for your Manual. The PDs are available in Word format in the Workshop Documents folder)

Adobe Acrobat DC. The software selected by CDOT and required for use in order to create and/or modify a PDF (portable document format) Project Record, to retain a record in an ISO Compliant format. By using Adobe Acrobat DC tools, the software “Smart Scans” Project Records to meet state and federal legal requirements prior to archiving in ProjectWise Explorer.

Adobe Sign. The electronic signature and professional seal software selected by CDOT and required for use on Project Records including Change Modification Orders (CMO), which facilitates automated workflows including the ability to route Project Records for acknowledgements, electronically sealing and/or signing.

Electronic Document Management System. (“EDMS”) ProjectWise Explorer which has been selected by CDOT as the EDMS for CDOT Project Records.

Form 950 “Project Closure”. This CDOT form provides notice of financial closure of the project. It includes notification to the FHWA that the project is closed and includes an electronically generated Project Record retention date.

ISO Compliant. A Record retained in a format approved by the International Organization for Standardization, a worldwide federation of national standards which refers to the ISO 19005 series of standards with PDF/A-1 approved as a minimum. Archiving an electronic Record in an ISO Compliant format ensures that it can be read in one hundred years, regardless of the hardware or software used to create the record. An ISO Compliant Record replaces microfilm as a method of archiving.

Naming Convention. A thread of acronyms that allows the CDOT Project Record to be correctly named and located in the ProjectWise Explorer locally-hosted or cloud-based EDMS.

Project Records. Engineering, Design, Specialty Group, and Construction Records pertaining to CDOT projects, including change modification orders (CMO). See § 24-80-101(1), C.R.S. “Record” shall also mean information that is inscribed on a tangible medium or that is stored in an electronic or other medium. See § 24-71.3-102(13), C.R.S. For further clarification, see relevant CDOT Records File Plans pertaining to Project Records.

Project Share. The Cloud-based software tool hosted in the Bentley / Microsoft Azure Cloud used for document collaboration. Project Share connects to and synchronizes with ProjectWise Explorer, such that files placed in a Project Share folder, which is synchronized with ProjectWise Explorer, are automatically copied to the same folder in ProjectWise Explorer.

ProjectWise Explorer The Bentley software system utilized by the Department for archiving

Record File Plan. CDOT's internal governing document developed by each division, program, or unit which contain the state and federal legal retention requirements for CDOT Records pertaining to the specific Records. Record File Plans include the correct location in ProjectWise Explorer for each Project Record.

Smart Scanning. The term CDOT uses to meet state and federal retention requirements for CDOT Project Records by utilizing Adobe Acrobat to make Project Records searchable, page aligned, and compressed. It also means archived in an ISO Compliant format. Note that some mediums, such as video files and image files cannot be archived in an ISO Compliant format. In this case, the files shall be retained in their original format.

3. Language for CDOT Legal Requirements Regarding Record Retention

CDOT's legal requirements to retain project records extend not only to CDOT employees but also the consultants, contractors and local agencies who work on CDOT project records. As a public agency, CDOT is legally required under state and federal law to retain certain Project Records for specified time periods. These time periods are set forth in the CDOT Record File Plans.

4. Language for Compliance with Procedural Directive 21.1 "Requirements for the Retention of Records for Specified Design, Construction, Engineering, and Specialty Groups (Paper and Electronic)" effective June 20, 2019.

General Reference to PD:

CDOT's requirements for Project Records are set forth in Procedural Directive ("PD") 21.1 "Requirements for the Retention of Records for Specified Design, Construction, Engineering, and Specialty Groups (Paper and Electronic)" effective June 20, 2019. The requirements of Procedural Directive (PD) 21.1 apply to CDOT employees and to contractors, consultants and local agencies who develop, transfer, augment, or are in any way involved with or responsible for CDOT records. It applies to all CDOT projects including local agency, P3, Innovative, Design-Build and CMGC projects.

Applicability

Procedural Directive 21.1 shall apply to all divisions, offices, and regions of CDOT engineers and project staff who develop, handle, or receive records. It also applies to all projects, including but not limited to capital engineering projects, local agency, P3, Innovative, Design-Build (DB) and Construction Management General Contracting projects (CMGC). It applies to all consultants, contractors and local agencies who develop, transfer, augment, or are in any way involved with or responsible for CDOT records.

Archiving Project Records in ProjectWise.

All active and future Project Records shall be archived in Project Share / ProjectWise Explorer Electronic Document Management System on an ongoing basis rather than at the conclusion of the project.

Phases or milestones from scoping to project closure shall be established for archiving purposes. Record File Plans indicate the correct archive location for these records. They are located in the Governing Documents folder under "5 – Record File Plans". For external users, a link to this file is included in all project share sites.

CDOT's EDMS for Project Records

Bentley ProjectWise Explorer is the Electronic Document Management System (EDMS) for archiving all electronic Project Records set forth in the CDOT Record File Plans.

If project consultants are using Aconex, the PM and CDOT Resident Engineer must develop a phased approach to migrate records into ProjectWise Explorer on an ongoing basis within 45 days of the project final acceptance.

Record Retention Schedules for Project Records

CDOT's Record File Plans contain a list of the public records that are required to be retained, as well as the electronic folder in ProjectWise Explorer where they will be archived. A link to the CDOT Record File Plans is made available in each Bentley Project Share site. This link will provide access for consultants, contractors and local agencies to CDOT Record File Plans.

CDOT's project records are created and retained in electronic format unless the record has a retention period of 3.5 years or less from the Form 950 closure date. If the retention period is shorter, the Project Engineer along with the Region Finals Administrator shall make the determination to retain documents in paper form.

Project Records that are subject to the following categories must be retained for seven years from the Form 950 close date (may be longer if FEMA requirements apply):

- Major project (CMGC, DB, P3 or other innovative contract projects)
- Subject of internal or external audit
- Litigation hold
- Emergency funded

Project Records must be archived according to milestones established by the project

engineer on an ongoing basis rather than at the conclusion of the project.

Smart Scanning (ISO Compliant Requirement)

Properly archiving Project Records means that they will be preserved in digital PDF format so that they can be read with original fidelity in one hundred years regardless of the hardware or software used to create them. This ensures that CDOT's most critical records with long-term or permanent retention requirements may be retained in digital form rather than paper or microfilm.

Project Records with retention periods longer than 3.5 years must be "Smart Scanned" prior to archiving. Training on Smart Scanning is available by registering through the Transportation Engineering Training Program ("TETP") website located here: <https://www.codot.gov/programs/tetp> Smart Scanning makes the Project Record searchable, compressed, page aligned, and in compliance with International Standard Organization's ("ISO") standard PDF/A-1b.

Project Records which do not need to be Smart Scanned are the following:

- (1) Project Records approved by the Project Engineer and CDOT Finals Administrator to be submitted in paper form. The CDOT Finals Administrator and Project Engineer may determine that Project Records with a retention period of 3.5 years or less from the CDOT Form 950 closure date can be provided to CDOT in paper form.
- (2) Videos, photos, image files, and other media formats which cannot be converted to PDF. Certain files are unable to be Smart Scanned and must be placed in ProjectWise Explorer in their original formats.

Paper Record Retention

If paper Project Records have a retention period of 3.5 years or less from the Form 950 project closure date, they may be scanned and retained electronically or retained in paper format until they have met their retention period. A Destruction Form shall then be completed. Once approved, the records may then be shredded or disposed of.

Project Records in paper form are now retained by the Regions for archiving until the Records meet their retention period. Headquarters no longer receives a copy.

Naming Conventions for File Names

Use standard naming conventions (PD 21.1 Appendix "A") and as noted in Record File Plans. For questions on naming conventions, ask CDOT Finals Administrators.

Adobe Sign: CDOT's Electronic Signature Software for Project Records.

Unless otherwise notified by the Chief Engineer, Adobe Sign is CDOT's approved electronic workflow signature software for "Project Records." This includes the use of Adobe

Sign for sealing with the professional engineer seal (see Procedural Directive 508.1 below, which sets forth requirements for sealing). Adobe Sign may not be utilized for any document which requires a signature from the CDOT Controller or State Controller.

For all Project Records that do not require a CDOT Controller/State Controller signature, Adobe Sign shall be used for both eSignatures and eSeals on Project Records. Note that Adobe Sign is permissible for use on contract modification orders ("CMO") given that CMOs do not require a signature by the Office of the State Controller. Adobe Sign work flows for Project Records will significantly cut down time routing paper records for signature, and will automatically archive the signed Project Record in ProjectWise.

Local Agency Records

On Local Agency projects with CDOT oversight, Local Agencies follow their own record retention schedules that adhere to the Inter-Governmental Agreement with CDOT. However, specific documents in the CDOT Record File Plans are required to be retained by CDOT and must be provided to the CDOT Local Agency Coordinator by the local agency or its representative. CDOT uses Bentley Project Share for this purpose so that the Local Agency can transmit the project record to the CDOT Local Agency Coordinator using the project-specific Project Share site. The Local Agency Coordinator will then archive the project record utilizing the synchronization function in Project Share, and the document will automatically be archived in the correct ProjectWise Explorer folder.

CDOT Responsibilities:

Resident Engineers:

- Must ensure that their staff are trained to properly archive records in the correct location and format.
- Include a provision requiring compliance with PD 21.1 in all task orders.
- Provide a copy of PD 21.1 with the Notice to Proceed.

Project Managers:

- Must fill out all attribute fields known at the time of project creation and thereafter when modifications occur. Attribute fields are filled out in SAP CJ20N (and, when launched, On Track).

Finals Administrators:

- Responsible for creating three electronic plan sets in PWZ Explorer: Award Set with watermark, Record Set with watermark, As-Constructed Plan with watermark.

Records Coordinators

- Records Coordinators are selected by their Appointing Authority to handle Project Records. Their responsibilities are set forth in PD 51.1 and in the Overview of Records Management and Records Coordinator Certification available through SAP/My Learning.

Engineering Contracts:

- Must include in contracts that PWZ Explorer is CDOT's EDMS for Project Records.
- Standards and Specifications Unit must include relevant requirements of PD 21.1 in project special provisions by January 2020 (deadline extended to July 30, 2020).

5. **Procedural Directive (PD) 508.1 "Requirements for the Use of the Professional Engineer's Seal"**

General Description

PD 508.1 defines the procedures for the use of the Professional Engineer seal by CDOT employees, consultants, contractors and local agencies who perform engineering work for CDOT.

All CDOT, local agency and consulting Engineers must utilize electronic sealing (rather than mechanical sealing on paper) by January 2020 unless an exception request and approval is granted by the Chief Engineer.

Beginning January 2021, no exemptions will be granted to the electronic sealing requirements.

Applicability

The requirements of PD 508.1 apply to CDOT employees and to contractors, consultants and local agencies who develop, transfer, augment, or are in any way involved with or responsible for CDOT records. It applies to all CDOT projects including local agency, P3, Innovative, Design-Build and CMGC projects. PD 508.1 must be read together with PD 21.1. Sealed Project Records must be retained in ProjectWise Explorer in conformance with the CDOT Record File Plans.

Engineering designs, Record Sets and Contract Modification Orders, contract drawings and specifications for CDOT projects prepared by COOT employees or by contractors or consultants who perform work for CDOT, or by local agencies who perform work for projects with COOT oversight and/or funding or federal funding passed through CDOT, shall be Sealed in accordance with Procedural Directive 508.1.

Legal Requirements for Sealing

CDOT's Sealing requirements are dictated by and adhere to the Sealing requirements for licensed engineers set forth in the AES Board Rules, 4 CCR 730-1, which have the effect of law. The AES Board Rules dictate which documents require a Seal. The AES Board Rules have the effect of law. These include Record Sets, Contract Modification Orders, VECP's M&S Standards and changes thereto.

To limit the scope of responsibility to one or more disciplines, a statement must be included adjacent to the Seal which limits responsibility to those portions of work done, such as: "My responsibility with respect to this standard plan revision is limited to-----"

Transmittal and storage of all CDOT project records shall adhere to the requirements of Procedural Directive 21.1 and CDOT's Record File Plans. The Sealed Record Set is required to be deposited in CDOT's ProjectWise Explorer. This will constitute the official record and will be retained permanently.

Responsibilities**Engineer in Responsible Charge:**

- Must seal respective documents for work within their scope of work, including local agencies. Must ensure that all seals are obtained on the record set. This includes the limitation of scope for each seal.
- The Engineer in Responsible Charge on a local agency project with COOT oversight is required to Seal all documents within the scope of their work. They shall be responsible for depositing the Seal Record Set into ProjectWise within 45 days of the award.

CDOT Resident Engineer:

- Is responsible for ensuring that all documents requiring Seals are obtained within 45 days of award of the construction project and archived in the correct PWZ Explorer folder.

Exclusions from Sealing Requirements

- Manufactured Components. Engineers may specify manufactured components (e.g., impact attenuators, products on the Approved Product List ("APL")), which are exempted by statute as part of design documents. Manufactured components for the purposes of this Procedural Directive shall consist of such items as a pump, motor, steel beam or other types of items that are manufactured in multiple units for selection and use in projects which must be designed by Engineers. Systems of manufactured components which are specific to a particular use or application must also be designed by an Engineer. The Engineer may show the manufactured component on the drawing or document and is responsible for the correct selection and specification of the manufactured component but is not responsible for the proper design and manufacture of the manufactured component.

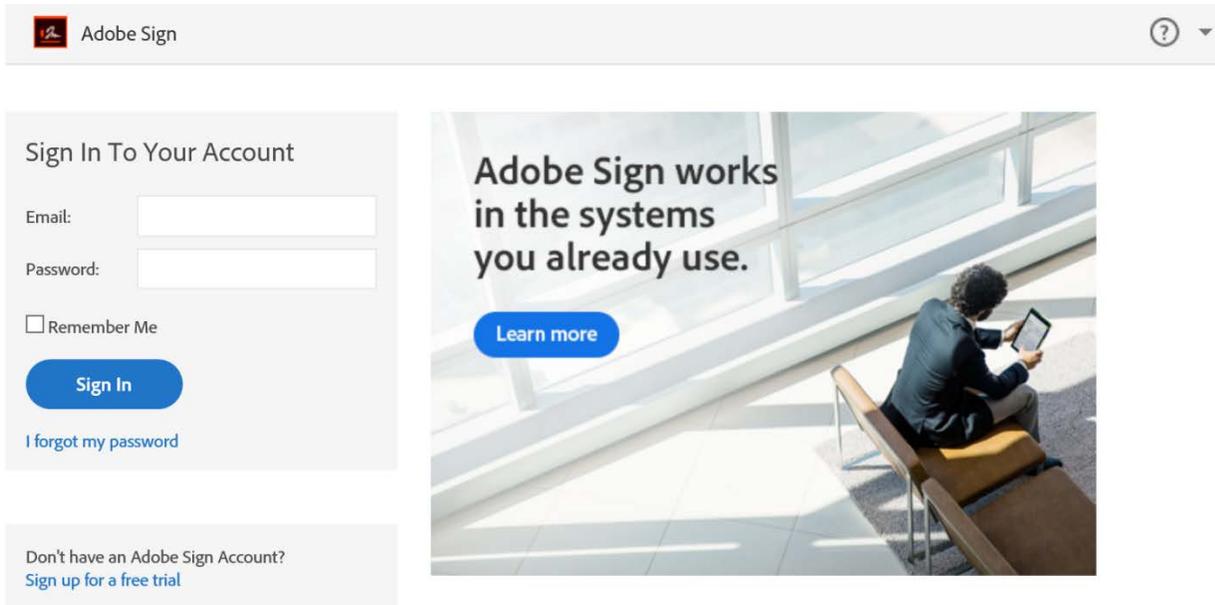
- Stormwater Management Plans
Stormwater Management Plans (SWMPs) and Erosion/Sediment Control Plans are excluded from the Seal requirement. Stormwater Management Plan sheets that do not contain engineering information (e.g. hydrology, hydraulics) are not considered "engineering drawings"; therefore, Sealing by a professional engineer is not required.

Engineering features (e.g., ditches, storm sewer and permanent water quality facilities) required for the management of stormwater on the project shall be included in the plans on separate sheets as details with the associated information which would require Sealing.

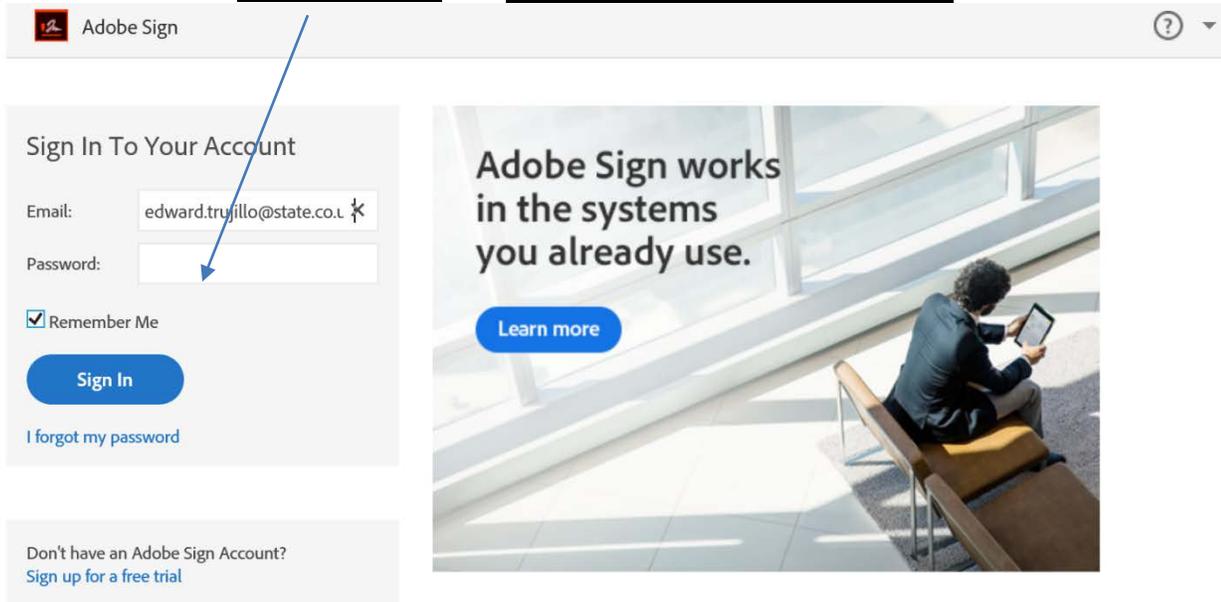
ADOBE Sign Log-in Instructions for the CDOT Forms 473/474-21

Open the following link to get started.

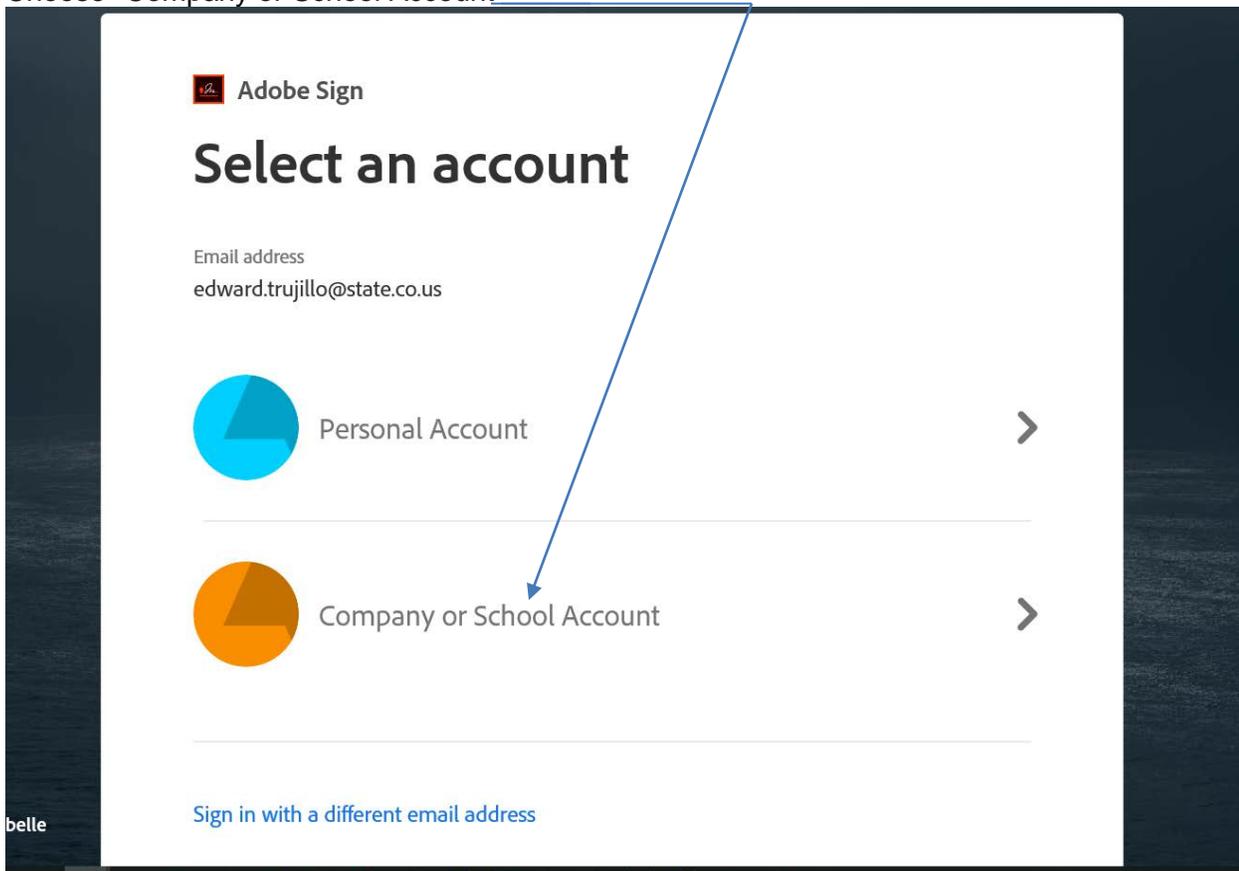
<https://secure.echosign.com/public/login>



Enter your CDOT E-Mail address no password is needed then check "Remember Me" check box, Place your cursor on the Password block and hit "ENTER" on your key board.



Choose "Company or School Account"



Enter your organizational account as follows and Sign in:



State of Colorado - SSO Portal

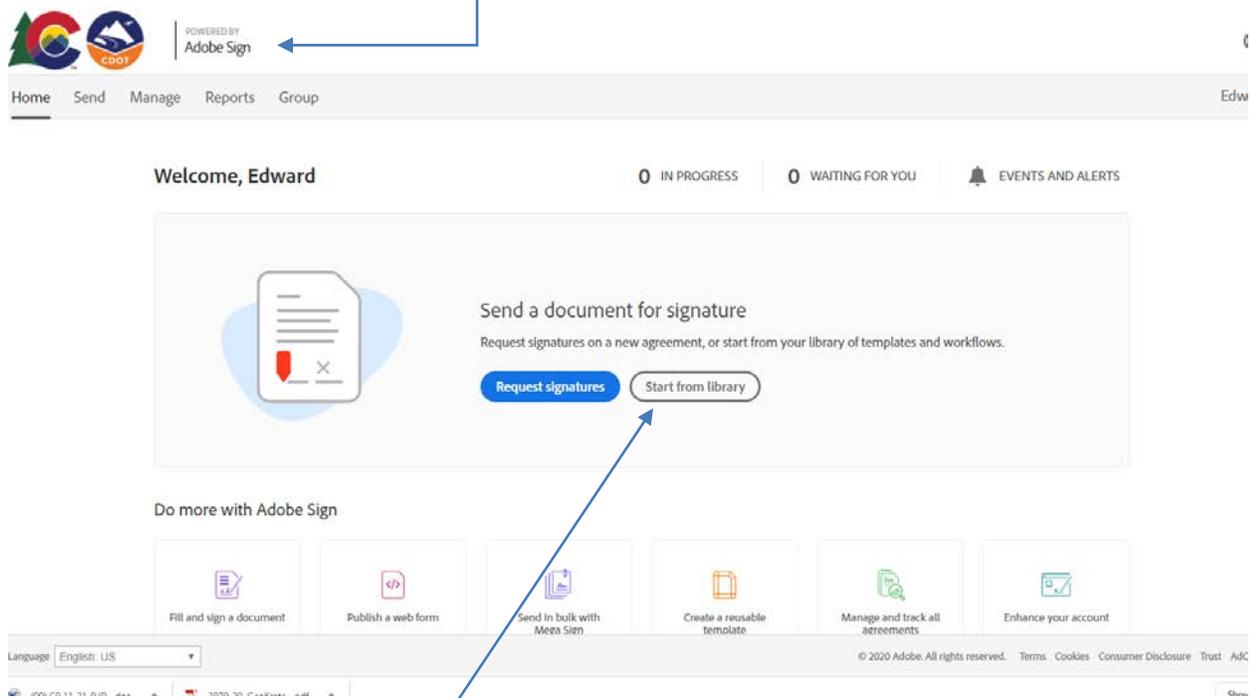
Sign in with your organizational account

 ✕

Sign in

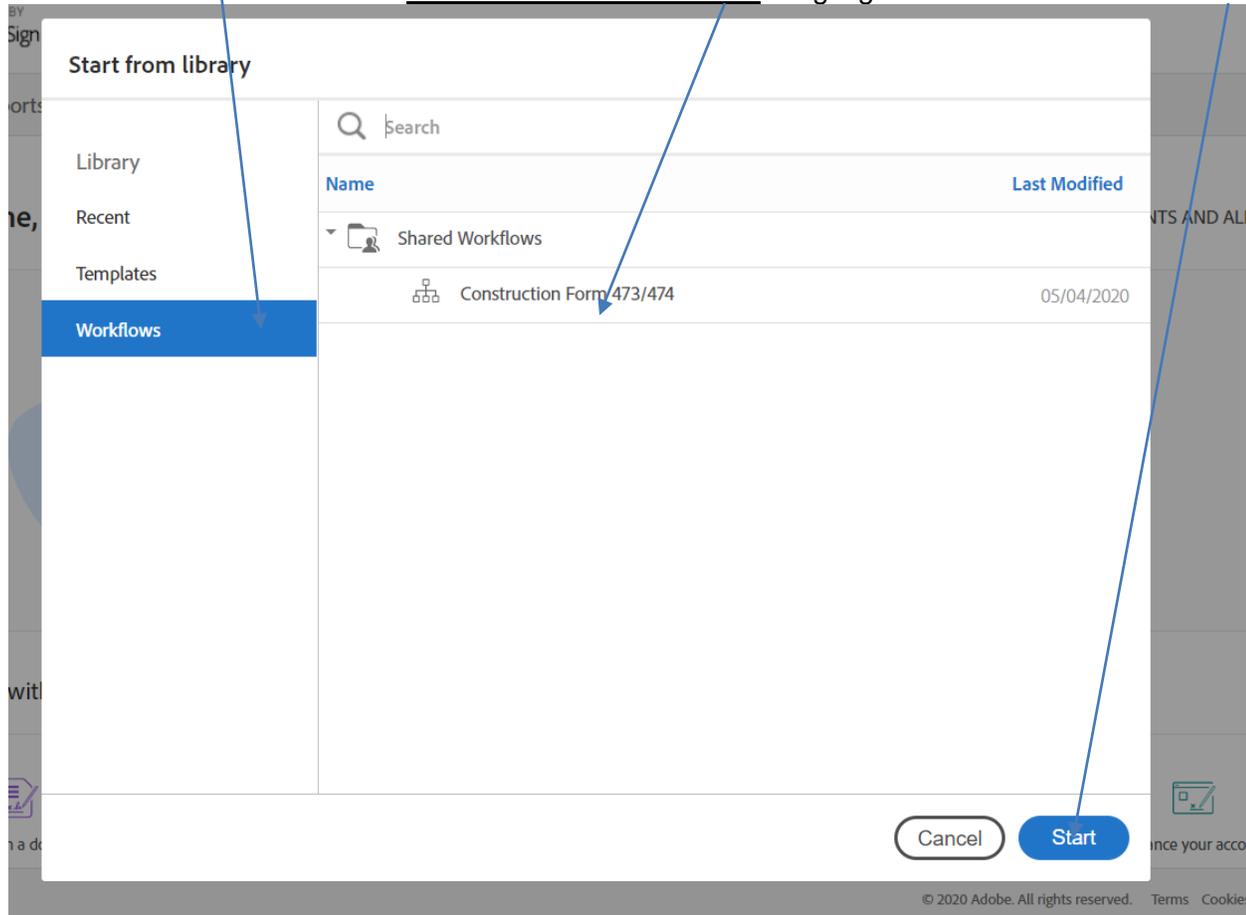
© 2013 Microsoft

You now have access to Adobe Sign, verify that the CDOT Logo is visible that will tell you that you have accessed the Adobe Sign program correctly.



Click on "Start from library" Box

Click on "Workflows" Then the shared workflows will be available for your use, click on the available workflow in this case it will be "Construction Form 473/474". Highlight the workflow and click on "Start"



Enter the e-mails in order of the list that has been given, starting with the Independent Assurance (IA) personnel responsible for initiating the Adobe Sign 473/473 form.

The screenshot displays the Adobe Sign interface for a workflow titled "Construction Form 473/474". At the top, there are logos for CDOT and Adobe Sign, along with navigation tabs: Home, Send, Manage, Reports, and Group. The user's name, Edward, is visible in the top right corner. Below the title, there is a section titled "How this workflow works?" with instructions on how to use the workflow. A "Guided Help" button is located on the right side. The main section is titled "Recipients" and contains a list of recipient roles, each with a corresponding input field and an "Email" button. A blue arrow points from the underlined text in the previous block to the "Myself" recipient field.

Recipients

IA (Independent Assurance Program) *

Myself [Email]

RME (Region Materials Engineer) *

Enter recipient email [Email]

Project Tester *

Enter recipient email [Email]

PE (Project Engineer) *

Enter recipient email [Email]

RE (Resident Engineer) *

Enter recipient email [Email]

Finals Material Coordinator or Finals Administrator *

Enter recipient email [Email]

Enter CC e-mail of persons not on the workflow list but that should get the signed document.

CC | [Hide](#)

Cc

Enter CC's emails

Document Name * Message Template ▾

Form 473/474

Message *

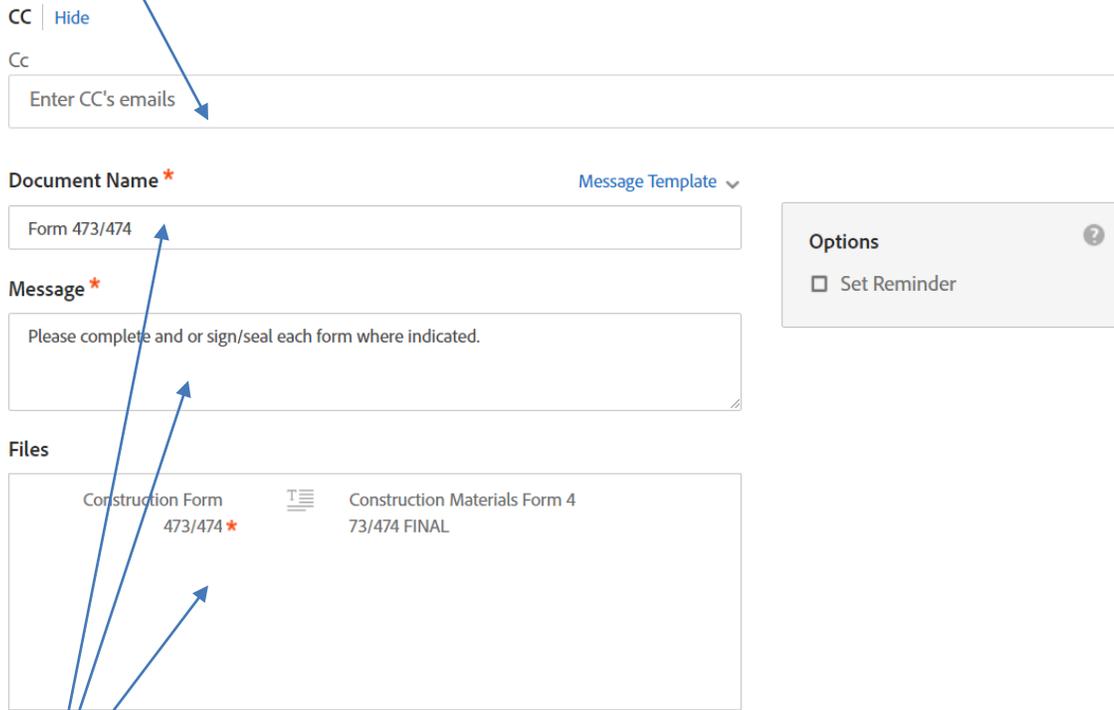
Please complete and or sign/seal each form where indicated.

Files

Construction Form 473/474 *	☰	Construction Materials Form 4 73/474 FINAL
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Options ?

Set Reminder



The * are required but should already be filled out with the appropriate information. When all is completed click "Send" and the document will automatically start circulating through the signing proces

Send



S.

Copy of Audit Report the date and time are in Greenwich Mean Time (GMT)
subtract 9 hours to get Mountain Standard Time.



audit report.pdf

EXAMPLE OF SIGNED CDOT 473/474 with Attachments

Double click to open the document:



Construction
Materials Form 473_

2020 Independent Assurance Tester Organization & Succession Plan

The Region Materials Engineer (RME) manages each Region’s Independent Assurance Program.

Region One	Region Two	Region Three	Region Four	Region Five
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First Tier IA Tester(s) – Active

Brian M. Kelly EPST III Lane Robertson EPST I	Charles Smith EPST III	Darren Phipps EPST III and Jen Kelly EPST II	Todd Mayhew EPST III and Paul Davila EPST II	Patrick Murphy EPST III (Durango) and Jacob Ramirez EPST I (Alamosa)
--	---------------------------	--	--	---

Second Tier IA Tester(s) – Replacements

Shared w/ 1 st Tier NPS Consultant	Robert Bergles EPST III	Shared w/ 1 st Tier	Mike Ellis Consultant	Lisa Wisner EPST III Durango & Alamosa
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Third Tier IA Tester(s) - Replacements

NPS Consultant	Richard Raebel EPST III	Andy Rosedahl EPST III	Dante Folino EPST I	Other Certified CDOT Personnel Durango &
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Reviewed at the 2020 January IA Committee Meeting.

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Appendix A1 - Materials Advisory Committee (MAC) Charter

PURPOSE

To oversee the Field Materials Manual, the Laboratory Manual of Test Procedures, Pavement Design Manual, MAC Task Forces and Task Groups. To review and approve all changes in the Schedules and test procedures in these manuals. To develop, review, approve, and propose to the Specification Committee specifications addressing materials problems and needs. To develop and implement programs, procedures, and policies to maintain the quality and statewide uniformity of materials incorporated into CDOT construction projects.

MEMBERSHIP

Voting Members:	Votes
CDOT Materials Engineer (Chairman)	1
Region Materials Engineers (*)	6
Central Laboratory Program Managers (**)	2
Applied Research and Innovation Branch	0
Total Vote	9

(*) There are 6 RMEs for the 5 Regions.

(**) Two of the 6 Program Managers from the Central Materials Laboratory, designated by the Materials & Geotechnical Branch Manager or per the respective specialty area.

Advisory members:

Representatives from Central Laboratory Program Subject Matter Experts, Standards & Specifications, Area Engineers, Staff Maintenance, FHWA, etc.

MEETINGS

Every two months, in odd months, on the 2nd Wednesday of the month (if possible). The meeting facilitation responsibilities will rotate among the five Regions. The host Region Materials Engineer (RME) will make arrangements for and preside at the meeting.

- The order of the Regions will be established through consensus between the MAC Chairman and the RMEs.
- The CDOT Materials Engineer will designate a person to be the Secretary of the MAC: to assist the Host Region, to create and distribute the Agenda, to take notes at the Meetings, write the Minutes, distribute the Minutes and the Executive Summary, and maintain the MAC on Teams web site.

SCOPE

1. Review and approve changes to the following:
 - Quality Assurance Procedures
 - Documentation, Project Materials to Final Materials [for SiteManager / LIMS, for Design-Build, for CDOT Maintenance & Local Agency]
 - Special Notice to Contractors
 - Owner Acceptance (OA) Frequency Guide Schedule for Minimum Materials Sampling, Testing, and Inspection
 - Independent Assurance (IA) Frequency Guide Schedule for Evaluation of OA Sampling & Testing
 - Colorado Procedures (CP's)
 - Chapters, 200 – 800, Inspections
 - Job Safety Analysis (JSA), Materials
 - Colorado Procedures - Laboratory (CP-L's)
 - MAC Task Force Charters
2. Provide oversight for the Field Materials Manual, Laboratory Manual of Test Procedures, Pavement Design Manual, materials research, Pavement Management System implementation, and sampling & testing of maintenance material.
3. Review, discuss, develop, and approve specifications addressing materials problems or needs. Specifications approved by the MAC are then forwarded to the Specification Committee for consideration.

GUIDELINES FOR MATERIALS ADVISORY COMMITTEE (MAC) MEETING

Overview - The focus of MAC meetings will be to conduct the responsibilities of the MAC as designated under the **Purpose** and **Scope** Sections of the Materials Advisory Committee Charter.

Conduct of Meeting - The host Region Materials Engineer (RME) will preside over the meeting and act as the meeting facilitator. The agenda topics will be handled in order and discussion shall remain focused on the topic as presented in the Agenda. Additional topics added after the meeting agenda has been distributed, will be discussed after the meeting agenda items have been addressed if time permits. Discussion on each topic will move toward a swift and efficient resolution of the problem with the Host acting as a facilitator if necessary. If substantial work is anticipated to resolve specific items, a task group can be formed to develop an action plan, which will resolve the question. When discussion on any topic begins to stray from the topic or significantly exceeds the allotted time for that topic, the presiding RME shall push for a resolution or move to the next Agenda item.

Who Attends - Attendance will be **Voting** and **Advisory** members of the Committee, as shown in the Charter. Guests (Contractors, suppliers, etc.) will attend only if invited by a MAC member for a specific Agenda topic only.

Guests that come for one topic and then leave shall be assigned a time slot, most likely after lunch. Guests invited for an *Education and Research* topic may be scheduled during lunch to maximize efficient time utilization. The guests' schedule will be taken into consideration. Discretion will be used when an excessive amount of time, minor importance, or more than one topic is requested. In some instances, guests may be placed at the end of the agenda.

Guests, Uninvited: The Open Meetings Law (C.R.S. 24-6-401) does not apply to advisory committees or other internal work groups at CDOT. There is no right for non-invitees to attend such meetings. Policy clarified at November 2017 MAC Meeting.

Agenda Topics - Only persons eligible to be voting members of the MAC may place topics on the agenda. Anyone else must work through these members to establish an agenda topic. The presenter of each topic shall lead the discussion on their topic and ask for a vote if necessary.

Agenda Topic Votes - Only Voting members of the MAC may “Make a Motion” or “Second a Motion”. Only voting members may participate in E- Votes (Votes by E- Mail). Votes require 6 in affirmation. *Abstaining from a vote is not a passive act. Except in illness a voting members who is missing must designate a proxy in advance to the MAC Secretary. The individual attending for the voting member should not designate themselves.*

Appropriate Topics & Discussion - Topics will normally address items listed under **Purpose** and **Scope** of the MAC Charter. Topics for the upcoming meeting need to be submitted during the Topic Solicitation period. Each agenda item will be given a number. Topics that are brief updates without the possibility of discussion can be posted in the Agenda without discussion and stipulated as “Non-Verbal”.

Documents Referenced for Topics - All referenced documents will be provided to the MAC Secretary as stipulated prior to the Meeting for distribution and presentation on the day of the MAC.

Agenda & Meeting Organization - The priority / order of the Agenda is:

- 1) The **Minutes** from the previous MAC Meeting will be approved by Vote.
- 2) The **Agenda** for the current MAC Meeting will be accepted or amended, if necessary, by the membership.
- 3) The **E-Vote Summaries** from between the MAC Meetings will be announced by the Facilitator. The intent is to read the e-vote into the Minutes not to further discuss the issue. If the topic needs any discussion it shall be an Old Business Agenda item.
- 4) **Task Force Business.** Task Forces need to inform the Committee of their current status. Informational updates with discussion and votes are frequently necessary. An update is required at a minimum of once per year.

Task Group Business. Task Groups being internal and of very limited scope need to inform the Committee of their current status within the applicable Old Business topic.

- 5) **Old Business.** This will include items that were on the last MAC agenda as either New Business or Additional Business. This will also include Old Business items that were not resolved at the previous MAC meeting because additional data needed to be gathered, or because it is long term in implementation. Items not discussed during the previous three MAC meetings (6 months) shall be considered new business if the topic is resumed.

- 6) **Education & Research.** Guest speakers, video presentations, etc. will occasionally be on the Agenda to assist in the sharing of relevant current information. If possible all Education & Research topics will immediately follow the lunch break at approximately 12:00.

- 7) **New Business.** This will be prioritized by the MAC Chairman based on the importance of the agenda item and associated with related topics.

- 8) **Additional Business.** Items that are received after the deadline for submittal. Unless these are “emergency” items, they will be placed at the end of the agenda and discussed in a priority order as time permits. Low priority items may be postponed and added to the next MAC’s agenda.

MAC Meeting Minutes and Executive Summary - The MAC Secretary may develop the draft version of the Minutes within two weeks after the date of the Meeting. Although distributed to all Meeting Attendees there should always be a response from the topic presenters, the MAC Facilitator, and the MAC Chairman. The MAC Chairman may develop an Executive Summary. The MAC Secretary shall distribute and post the final version of the MAC Meeting Minutes and the Executive Summary.

Appendix A - Independent Assurance (IA) Testers

Committee Charter - 14

PURPOSE

To review and aid in the development of the Independent Assurance (IA) Program and the Frequency Schedule for Independent Assurance Evaluation in the Field Materials Manual.

To receive and review procedures for testing materials used in the Field and recommend any necessary changes for implementation to the Materials Advisory Committee.

To establish and maintain statewide consistency between Quality Assurance and Independent Assurance Testers.

To establish and maintain consistency in the use of the Field Materials Manual.

MEMBERSHIP

Voting Members:

A member of the Documentation Unit of Staff Materials and one IA tester from each of the six Regions will be allowed to vote. Regions with more than one IA Tester shall share a vote.

Advisory Members:

FHWA and CDOT employees with experience or expertise in the tests performed by Field personnel or the Central Laboratory.

MEETINGS

Meetings will be on an annual basis and usually in January. The meeting will be held at a time close to the Materials Advisory Committee (MAC) meeting. If requested by the Committee, additional meetings may be required. The Pavement Design Program Engineer will host the meeting each calendar year. A member of the Documentation Unit will assist the Host, to create and distribute the Agenda, to take notes at the meetings, and produce and distribute the Minutes.

SCOPE

To share information and ideas related to sampling and testing of material incorporated into CDOT projects.

To review new ideas, develop and approve (by simple majority) suggested changes to the Field Materials Manual, specifications, or procedures addressing materials problems or needs. Suggested changes will be forwarded to the MAC for consideration.

GUIDELINES FOR THE INDEPENDENT ASSURANCE TESTERS COMMITTEE MEETINGS

Overview The focus of the IAT Meeting will be to conduct the responsibilities of the IAT Committee as designated under the **Purpose** and **Scope** sections of the Independent Assurance Tester Committee Charter.

Conduct of Meeting - The Chairperson will preside over the meeting. The agenda topics will be handled in order and discussion shall remain focused on the current topic. Additional topics added after the meeting agenda has been distributed, will be discussed after the meeting agenda items have been addressed if time permits. Discussion on each topic will move toward a swift and efficient resolution of the problem. If substantial work is anticipated to resolve specific items, a task force can be formed to develop an action plan, which will resolve the question. When discussion on any topic begins to stray from the topic, the Chairperson shall push for a resolution or move to the next agenda item.

Who Attends - Attendance will be **Voting** and **Advisory** members of the Committee, as shown in the Charter. Guests (Contractors, suppliers, etc.) will attend only if invited by an IAT member for a specific Agenda topic.

Agenda Topics - Only persons eligible to be voting members of the IAT Committee may place topics on the agenda. Anyone else must work through these members to establish an agenda topic. The presenter of each topic shall lead the discussion on their topic and ask for a vote if necessary.

Agenda Topic Votes - Only Voting members of the IAT may "Make a Motion" or "Second a Motion". Only voting members may participate in E- Votes (Votes by E- Mail).

Appropriate Topics & Discussion - Topics will normally address items listed under **Purpose** and **Scope** of the IAT Charter. Topics that are informational and require no decision, such as updates, shall generally be avoided. These can be handled by E-Mail.

Prioritization of IAT Agenda Items - Agenda items for the upcoming meeting need to be submitted at least 20 calendar days prior to the meeting. Each agenda item will be given a number. The priority for the Agenda is:

1. The **Minutes** from the previous IAT meeting will be approved by vote.
2. The **Agenda** for the current IAT meeting will be approved by vote.
3. The **E-Votes Summary** will be submitted for IAT Minute inclusion.
4. Matters considered "**emergency**" items as determined by the Chairperson shall have the top priority.
5. **Task Group Business**. Task Groups need to inform the Committee of current status. Informational updates with discussion and votes are frequently necessary.
6. **Guests** that come for one topic and then leave shall be assigned a time slot, most likely after lunch. The guests' schedule will be taken into consideration. Discretion will be used when an excessive amount of time, minor importance, or more than one topic is requested. In some instances guests may be placed at the end of the agenda.
7. **Old Business**. This will include items that were on the last IAT agenda but were not addressed because of lack of time. This will also include items that were not resolved at the previous IAT meeting because additional data needed to be gathered. Items not addressed at the last IAT meeting shall be considered new business.
8. **Education & Research**. Guest speakers, video presentations, etc. will occasionally be on the Agenda to assist in the sharing of relevant current information.

1. **New Business.** This will be prioritized by the Chairperson based on the importance of the agenda item and then associated with related topics.
2. **Additional Business.** Items that are **received after the deadline** for submittal. Unless these are “emergency” items, they will be placed at the end of the agenda and discussed as time permits

Appendix A - Flexible Pavement Operators Group (FPOG) Charter

PURPOSE

To review needed changes in the testing of flexible pavement and to share information with other flexible pavement testers. To review and aid in the development of Colorado Procedures (CPs) and Colorado Procedures - Laboratory (CP-Ls) that pertain to flexible pavement.

MEMBERSHIP

Voting Members:

A member of the Flexible Pavement Unit of Staff Materials designated by the Asphalt Program Manager and one representative designated by each Region Materials Engineer (RME) from each of the Regions will be allowed to vote.

Voting Members:	Votes
Flexible Pavement Unit (Staff Materials)	1
Region Labs	6
Total Votes	7

Note 1: There are six RMEs for the 5 Regions.

Advisory Members:

A Flexible Pavement Engineer and, as needed, CDOT employees with flexible pavement experience.

MEETINGS

The MAC authorized the FPOG to meet up to four times per year, ideally between September and March. The meetings will take place in Glenwood Springs or Denver. Regions will rotate hosting the meeting. The host Region will provide a Chairman to preside at the meeting and to make arrangements for the meeting. The Flexible Pavement advisory member will serve as Secretary to assist the Host Region, to create and distribute the Agenda, to take notes at the meetings, and produce and distribute the Minutes.

SCOPE

To share information and ideas related to the testing of flexible pavements
 To review ideas and approve (by simple majority) suggested changes to the following:

Colorado Procedures (CPs)
 Colorado Procedures - Laboratory (CP-Ls)

The Flexible Pavement advisory member then presents these approved changes to the Asphalt Program Manager for the MAC's consideration.

GUIDELINES FOR FLEXIBLE PAVEMENT OPERATORS' GROUP (FPOG) MEETINGS

Overview - The focus of FPOG meetings will be to conduct the responsibilities of the FPOG as designated under the **Purpose** and **Scope** sections of the Flexible Pavement Operators' Group Charter.

Conduct of Meeting - The Chairman from the host Region will preside over the meeting. The agenda topics will be handled in order and discussion shall remain focused on the current topic. Additional topics added after the meeting agenda has been distributed, will be discussed after the meeting agenda items have been addressed if time permits. Discussion on each topic will move toward a swift and efficient resolution of the problem. If substantial work is anticipated to resolve specific items, a task force can be formed to develop an action plan, which will resolve the question. When discussion on any topic begins to stray from the topic, the Chairman shall push for a resolution or move to the next agenda item.

Who Attends - Attendance will be **Voting** and **Advisory** members of the FPOG, as shown in the Charter. The RME from the host Region is encouraged to attend. Guests (Contractors, suppliers, etc.) will attend only if invited by a FPOG member for a specific Agenda topic.

Agenda Topics - Any FPOG member may place topics on the agenda. Anyone else must work through these members to establish an agenda topic. The presenter of each topic shall lead the discussion on their topic and ask for a vote if necessary.

Agenda Topic Votes – Only Voting members of the FPOG may “Make a Motion” or “Second a Motion”. Only voting members may participate in E- Votes (Votes by E- Mail).

Appropriate Topics & Discussion - Topics will normally address items listed under **Purpose** and **Scope** of the FPOG Charter. Topics that are informational and require no decision, such as updates, shall generally be avoided. These can be handled by E-Mail.

Prioritization of FPOG Agenda Items - Agenda items for the upcoming meeting need to be submitted at least 10 calendar days prior to the meeting to the Flexible Pavement advisory member at Staff Materials. Each agenda item will be given a number. The priority for the Agenda is:

1. The **Minutes** from the previous FPOG meeting will be approved by vote.
2. The **Agenda** for the current FPOG meeting will be approved by vote.
3. The **E-Vote Summary** will be submitted for FPOG Minute inclusion.
4. Matters considered "**emergency**" items as determined by the Chairman shall have the top priority.
5. **Task Force Business**. Task Forces need to inform the Flexible Pavement Operators' Group of current status. Informational updates with discussion and votes are frequently necessary.
6. **Guests** that come for one topic and then leave shall be assigned a time slot, most likely after lunch. The guests' schedule will be taken into consideration. Discretion will be used when an excessive amount of time, minor importance, or more than one topic is requested. In some instances guests may be placed at the end of the agenda.

7. **Old Business.** This will include items that were on the last FPOG agenda but were not addressed because of lack of time. This will also include items that were not resolved at the previous FPOG meeting because additional data needed to be gathered. Items not addressed at the last FPOG meeting shall be considered new business.
8. **Education & Research.** Guest speakers, video presentations, etc. will occasionally be on the Agenda to assist in the sharing of relevant current information.
9. **New Business.** This will be prioritized by the Chairman based on the importance of the agenda item and associated with related topics.
10. **Additional Business.** Items that are **received after the deadline** for submittal. Unless these are “emergency” items, they will be placed at the end of the agenda and discussed as time permits.

Appendix B- Task Force Management Guide

OVERVIEW The activities of a task force must be managed to accomplish the purpose of the task force. Keep the focus on the purpose of the task force and accomplish the tasks necessary to achieve this purpose with a series of action items. Various materials committees (MAC, AIF Steering, CDOT-ACPA Co-op, etc.) establish the purpose of each task force. At the first meeting of the task force make sure that this purpose is clearly understood by all task force members. Avoid expanding the purpose or scope of the task force without first consulting the committee that established the task force. The committee may decide that new problems identified by the task force are low priority or should be addressed by another task force.

PROBLEM SOLVING The activities of a task force are basically problem solving. Keep in mind the steps in problem solving, which are:

- Identify the problem
- Generate solutions
- Evaluate the advantages and disadvantages of each solution and make a decision
- Implement the solution
- Consider evaluating the solution one or two years later to make additional tweaks

PRIORITIES At the first meeting the task force should clarify priorities. Often there is an urgent need for a quick fix to the current specification followed by a longer-term effort to gather information and affect a more permanent reworking of the specification. As the work of the task force progresses make sure that the list of priorities is kept up-to-date.

IMPLEMENTATION TIMELINES Give consideration to timelines at which the final products will impact CDOT projects. The schedule of the Specification Committee is:

Specification Committee Schedule	
Meeting Dates	Quarterly Releases
March	February
June	May
September	August
December	November

Generally speaking, items approved by the MAC at its September Meeting, will be able to impact projects the following construction season. If urgent changes are needed, then items approved at the November MAC may make it into projects. This is possible, but not desirable. Items approved at the January MAC Meeting and beyond will not impact CDOT projects until the following construction season.

SCHEDULING It is not advisable to have meetings during the busy summer construction season for CDOT or industry representatives. However, after considering the implementation needs and the importance of the changes, meetings in the summer months may occur. Be sure to check with the CDOT and Industry Co-chairs for guidance on summer meetings.

It is in everyone's best interest to have as complete and comprehensive a product as possible. However, that is not realistic in many cases. It is often better to make incremental improvements. Several task forces have come up with an improved product. After experimenting with it on projects, the lessons learned are documented and a "Part 2" effort can be undertaken.

AGENDA Distribute a detailed agenda at least a week before each meeting. Start the agenda with a reminder of the date, time, and place of the meeting. Include a description of any decisions that need to be made with each topic. The last topic is establishing the date, time, and place of the next meeting.

SUPPORTING INFORMATION Distribute information to be discussed at least a week before the meeting so members have time to study that information. This information may be test data, research reports, etc. You shouldn't expect task force members to digest information just received and immediately make decisions.

CONDUCT OF THE MEETING As the person conducting the meeting, make sure that the discussion follows the agenda. New topics that arise may be discussed at the end of the meeting. Keep the discussion focused on the purpose of the task force. Try to base decisions on data. Sometimes data will indicate that a perceived problem does not exist. Try to draw out input from the quiet members of the task force. They may have valuable ideas. In addition, it is important to have buy-in by all task force members into whatever decisions the task force makes. Avoid having aggressive task force members dominate the discussion. The products of the task force should not only be workable but also should be a consensus that both industry and CDOT can be comfortable with. Within CDOT it is critical that task force products have statewide buy-in. A recurring problem with CDOT standards is lack of uniformity of statewide application that undermines the integrity and credibility of these standards.

Keep in mind that the Materials Advisory Committee and Specification Committee must approve any specification changes desired by the task force. The task force must develop the rationale and data needed to convince these technical committees.

Get commitments from task force member to do what needs to be done, to accomplish the purpose of the task force (action items). At the end of the meeting, review these action items. Define clearly who will do what by when. Finally, determine the date, time and place of the next meeting, if possible.

MINUTES Someone should take notes at the meeting and produce detailed minutes. It is best for the note taker to not be the person conducting the meeting. It's too much for one person. Good minutes help avoid rehashing the same items at each meeting. Include in the minutes, decisions made on each topic. It is also good to describe areas of disagreement and any action that will be taken to resolve the disagreement. Include action items, listing who will do what by when. The final item in the minutes is the date, time, and place of the next meeting. Distribute minutes to task force members within two weeks of the meeting. It's often good to send minutes to your supervisor to keep them informed and to let them know what you're up to.

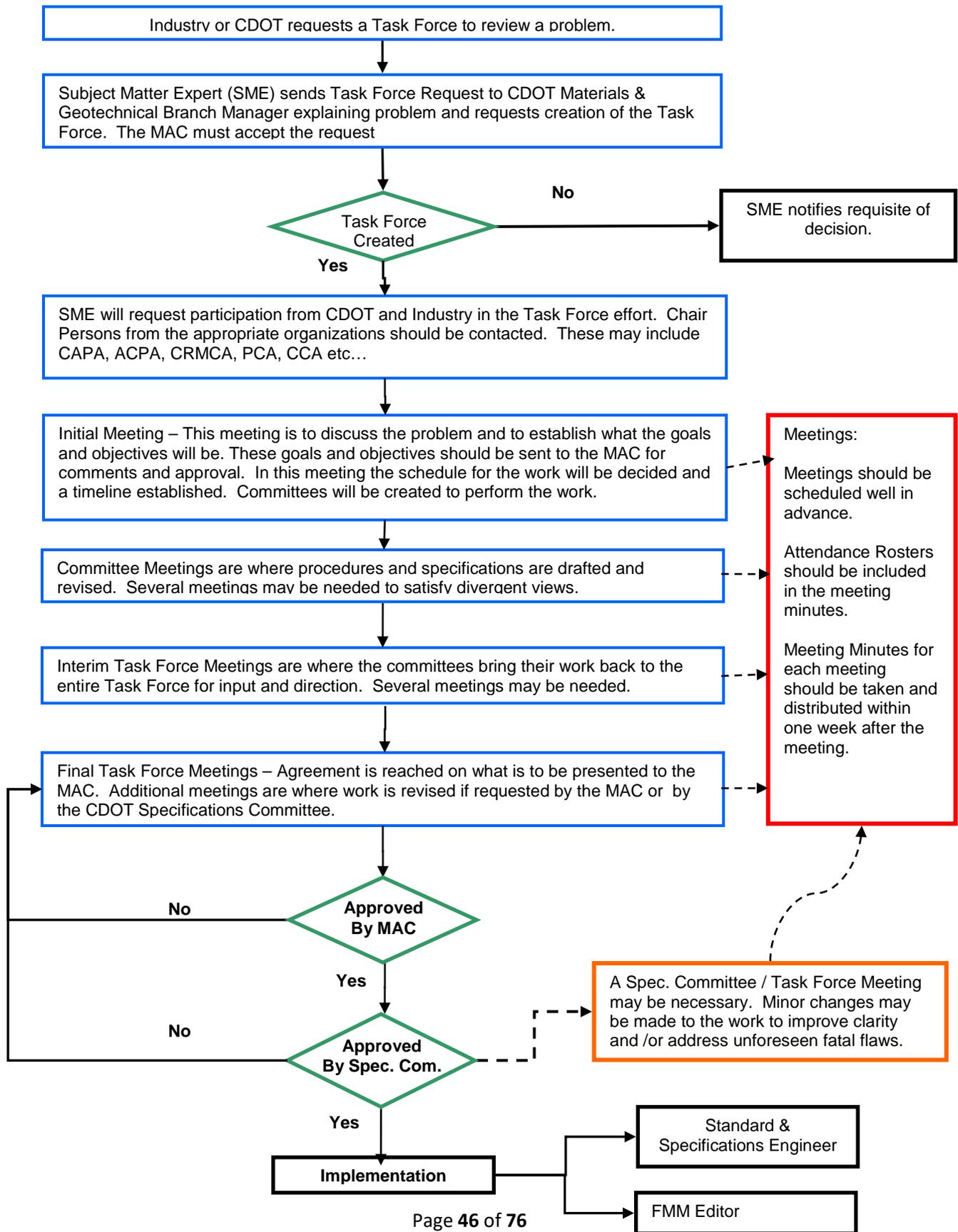
DOCUMENT TASK FORCE RESULTS Document the findings and changes made by the task force. This will be useful in the future to clarify the rationale behind CDOT specifications and standards. Documentation should include the purpose of the task force, problems identified, data collected, references reviewed, and finally changes made to CDOT specifications and standards. The MAC secretary shall maintain copies of this final report documenting task force results.

Some examples of successful products have been:

- Specifications and standards that are forwarded to the Specification Committee,
- Project selection guidelines that are forwarded to the Materials Advisory Committee and included in the Pavement Design Manual,
- Colorado procedures and practices that are forwarded to the Materials Advisory Committee and included in the Field Materials Manual,
- Research needs statements that are forwarded to the Research Branch for consideration as a formal research problem statement or a quick study, or

Information that is important enough to be shared broadly within CDOT is forwarded to the Project Development Area Engineers for distribution as a Construction Bulletin.

The Task Force Process and Best Practices



Appendix C - Personnel Roster, Staff Materials & Region Materials

<u>Office/ Name</u>	<u>Title</u>	<u>Telephone</u>
Materials & Geotechnical		
Branch		
Wieden, Craig	Materials & Geotechnical Engineer	303-398-6501
Gonzalez, Norma	Program Assistant	303-398-6502
	FAX	303-398-6504
Asphalt Pavement		
Program		
Stanford, Michael	Asphalt Pavement Engineer	303-398-6576
Vacant	Asphalt Support Engineer	303-398-6525
Lam, Johnny	Flexible Pavement & European Lab Manager	303-398-6533
Stephenson, Gregg	Bituminous - Chemical Lab Manager	303-398-6531
Concrete Pavement		
Program & etc.,		
Soils & Physical		
Properties Labs		
Prieve, Eric	Concrete & Phy Prop. Engineer	303-398-6542
		(Cell) 303-204-8926
Niculae, Valentino	Concrete Support Engineer	303-398-6549
Brown, Clay	Concrete Pavement Lab Manager	303-398-6541
		(Cell) 303-204-8926
Tchouban, Bryan	Soils Lab Manager	303-398-6590
Smith, Paul	CDOT Radiation Safety Officer (RSO), Pavement Deflection Technician [FWD], & M/D Gauge Calibration Tech	303-398-6547
		(Cell) 303-319-9557
Jiron, Kelvin	High Speed Profiler (HSP)	303-398-6548
Pavement		
Design Program		
Perkins, Melody	Pavement Design Engineer	303-398-6562
Vacant	Pavement Design Support Engineer	303-398-6562
Keith Uren	Pavement Design Support Engineer	
Brooks, Kyle	SiteManager Materials Trainer, QC/IA Program Manager	303-398-6528
Clark, Cheryle	SiteManager Materials / LIMS Support	303-398-6564
Trujillo, Ed	Materials Publication Manager, MAC Secretary, Product Evaluation Coordinator (PEC)	303-398-6566
Hernandez, Tony	Materials Documentation Manager (Accreditations & Form #250s)	303-398-6563

<u>Office/ Name</u>	<u>Title</u>	<u>Telephone</u>
Pavement Management Program		
Conroy, Laura	Pavement Management Engineer	303-398-6579
Farrokhyar, Ali	Project Level Pavement Management	303-398-6577
Scoville, Janeth	Pavement Management	303-398-6580
Chavez, Eric	Network Level Pavement Manager	303-398-6565
Soils & Geotechnical Program		
Thomas, David	Program Manager	303-398-6604
		Cell 303-807-7457
Nasiatka, Dave	Geotechnical Engineer	303-398-6586
		Cell 303-895-6485
Russell, Christopher	Geotechnical Engineer (Soils and PDA)	303-398-6587
		Cell 720-308-5462
Tarsar, Madeline	Geotechnical Engineer	303-398-6606
Pomeroy, Jamie	Geotechnical Engineer	303-398-6512
Zak, Steven	Drill Crew Foreman	303-365-7142
		Cell 720-793-4767
Geohazards Program		
Ortiz, Ty	Program Manager	303-398-6601
		Cell 303-921-2634
Group, Robert	Engineering Geologist	303-398-6589
Taylor, D. (Beau)	Engineering Geologist	303-398-6588
Oester, Nicole	Engineering Geologist	303-398-6603

Central Materials Laboratory, 4670 North Holly Street, Unit A, Denver CO 80216- 6408

<u>Office/ Name</u>	<u>Title</u>	<u>Location</u>	<u>Telephone</u>
<u>Region 1, North & Central Programs / Independent Assurance</u>			
Henry, Stephen	Region Materials Engineer	North Holly	303-398-6703
Mize, Issa	Asst. Region Materials Engineer	North Holly	303-398-6701
Jones, Macy	Pavement Designer	North Holly	303-398-6801
Ryal, Travis	Pavement Designer	North Holly	303-398-6507
Kelly, Brian M.	IA / Lab Manager	North Holly	303-398-6704
Collins, Robert	IA / Lab Technician	North Holly	303-398-6706
Robertson, Lane	IA / Lab Technician	North Holly	303-398-6705
FAX			303-398-6781

<u>Office/ Name</u>	<u>Title</u>	<u>Location</u>	<u>Telephone</u>
<u>Region 1, South & West Programs / OA</u>			
Chang, James	Region Materials Engineer	North Holly	303-398-6702 (Cell) 303-883-0500
Hussain, Shamshad	Asst. Region Materials Engineer	North Holly	303-398-6802 (Cell) 303-916-0890
Kevin Moore	Pavement Design	North Holly	303-398-6803
Gallegos, Michael	Region 1 Lab Manager	North Holly	303-398-6805 (Cell) 303-918-6134
Jones, Robert "Brett"	Region 1 Lab Technician	North Holly	303-398-6806
Young, Ronald	Region 1 Lab Technician	North Holly	303-398-6807
Eric Stephenson	Region 1 Lab Technician	North Holly	
FAX			303-398-6781
Region 1 Materials Laboratory, 4670 North Holly Street, Unit B & C, Denver CO 80216- 6408			
<u>Region 2</u>			
Pieper, Jody	Region Materials Engineer	5615 Wills	719-562-5532 (Cell) 719-248-2323
Mero, Jeri	Asst. Region Materials Engineer	5615 Wills	719-562-5509 (Cell) 719-248-2323
Bergles, Robert "Buster"	Region 2 Lab Manager	5615 Wills	719-546-5778 (Cell) 719-251-7834
Raebel, Richard "Rick"	Materials Document. Coordinator/ Region 2 Pavement Manager	5615 Wills	719-546-5787 (Cell) 719-251-9112
Smith, Chuck	IAT Lab	5615 Wills	719-546-5776 (Cell) 719-251-7825
Armendariz, Mike	Region 2 Lab Technician Mobile Lab Technician	5615 Wills	719-546-5776 719-546-5776
Vela, Derek	Region 2 Lab Technician	5615 Wills	719-546-5776
Schreiber, Mike	Colorado Springs Lab	*	719-227-3230 (Cell) 719-688-2089
Story, Daniel "Dan"	Lamar Lab	2402 S. Main (Microwave)	719-336-3228 719-688-5447 (Cell) 719-688-2095
Materials Lab FAX			
Colorado Springs FAX		*	719-227-3298
Lamar FAX		2402 S. Main	719-546-5701

Region 2 Materials Laboratory (Pueblo) 5615 Wills Blvd., Pueblo Colorado, 81008

*** Region 2 (Colorado Springs) 1480 Quail Lake Loop, Colorado Springs Co. 80906**

Region 2 (Lamar) 2402 S. Main, Lamar Co. 81052

Region 3

Golden, Coulter	Region Materials Engineer	2328 G Road	970-683-7561 (Cell) 970-596-0752
Moore, Babaft	Asst. Region Materials Engineer	2328 G Road	970-683-7563 (Cell) 719-661-2444
Mulumba, Jolene	Pavement Manager	2328 G Road	970-683-7567 (Cell) 970-642-8379
Kelly, Jen	IAT Lab	2328 G Road	970-683-7562 (Cell) 970-200-2880
Phipps, Darren	IAT Lab	2328 G Road	970-683-7566 (Cell) 970-623-9612

Office/ Name**Title****Location****Telephone**

Rosedahl, Andy	Region 3 Lab	2328 G Road	970-683-7570 (Cell) 970-250-4769
Rowell, Dawn	Region 3 Lab	2328 G Road	970-683-7572
Walz, Chance	Region 3 Lab	2328 G Road	970-683-7571 (Cell) 970-986-9635
Morgan, Cindy	Finals Administrator/ Materials Coordinator	2328 G Road	970-683-7575 (Cell) 970-270-2724
Morrison, Mary FAX	Data Technician	328 G Road	970-683-7560 970-683-7579

Region 3 2328 G Road, Grand Junction Co. 81501
Region 3 (Materials Lab) 2328 G Road, Grand Junction Co. 81505

Region 4

DeWitt, Gary	Region Materials Engineer	Region 4	970-350-2379 (Cell) 970-381-1446
Heimmer, Steve	Asst. Region Materials Engineer	Region 4	970-350-2380
Strome, Gary	Asst. Region Materials Engineer	Region 4	970-350-2382 (Cell) 970-381-3447
Moore, Brandon	Pavement Manager	Region 4	970-350-2383 (Cell) 970-290-8252
Gonser, Steve	Lab Manager	Region 4	970-350-2384
Cloephil, Brett	Lab Technician	Region 4	970-350-2385
Folino, Dante	Lab Technician	Region 4	970-350-2246 (Cell) 720-877-5381
Mayhew, Todd	IAT Lab	Region 4	970-350-2334 (Cell) 970-380-0123
Davila, Paul	IAT Lab	Region 4	970-350-2381 (Cell) 970-397-2894
FAX		Region 4	970-350-2390

Region 4 3971 W. Service Rd., Evans Co. 80620-2623

Region 5

Webb, Tim	Region Materials Engineer	Durango (Cell)	970-385-1625
Kemp, Beaux	Pavement Management Pavement Management	Durango (Cell)	970-385-1627
Murphy, Patrick	IA Lab Manager	Durango (Cell)	970-385-1624 970-759-5300
Maertín, Lisa	Lab Technician	Durango	970-385-1628
Ramirez, Jacob	IAT Lab	Alamosa (Cell)	719-587-6520 719-588-3031
FAX		Durango	970-385-1610
FAX		Alamosa	719-587-6521

Region 5 20581 US Highway 160 Durango Co. 81301
Region 5 (Alamosa) 1205 West Ave. Alamosa, Co. 81101

Appendix D - Definitions

NOTE: Definitions applicable to a specific material may be found in the respective chapter.

Acceptance Program - All factors that comprise CDOT's determination of the quality of the product as specified in the contract requirements. These factors include verification sampling, testing, and inspection.

Accredited Laboratory - A laboratory that is accredited by the AASHTO Accreditation Program.

Anionic - Negatively charged, i.e. emulsions

Batch - A unit or subdivision of a lot, such as a mixer load of concrete, a batch of bituminous mix, or a square yard of base course.

Bias - Constant error in one direction, which causes the average test result to be offset from the true average value.

Calibration - The act or process of determining the relationship between a set of standard units of measure and the output of an instrument or test procedure

Cationic - Positively charged, i.e. emulsions

Central Laboratory Check Samples and Tests. Random representative samples submitted to CDOT's Central and/or Region Laboratory to additionally evaluate quality of field produced products and materials, and to perform tests not within the capabilities of the Field and/or Region Laboratories.

Check Sample - A Replicate Sample, usually from Project Samples or Verification Samples, which is submitted to the Central or Region Laboratory for an independent check. Independent checks on HBP include: Hveem Stability (CP-L 5105), Lottman (CP-L 5109), and Air Voids (CP-L 5105). For Superpave mixes S, SX, and SG independent checks include: volumetric properties at N_{design} and Hveem Stability (CP-L 5106). The purpose of these samples is for the Central or Region Laboratory to verify acceptability and quality of field produced material and to perform tests that are not within the capabilities of the field.

Coefficient of Variation - The Standard Deviation divided by the mean.

$$CV = \frac{\sigma}{\bar{X}}$$

Comparative Sample - One of several samples resulting from a closely controlled small Batch or increment which has been thoroughly mixed and then reduced by quartering or splitting into a number of Replicate Samples. For CDOT purposes the Central Laboratory will make Groups of Comparative Samples on various materials. One or more will be sent to each participating Region Laboratory for testing to determine acceptability of procedures, methods, and equipment.

Control Chart - Chart or graph, usually conspicuously displayed in the field materials laboratory where an up-to-date plot of Control and Verification Test results is kept.

Control Sample - A sample taken during the process from any of the components for a manufactured (constructed) product before being incorporated into the final mixture, or a sample taken from the final mixture or product before the material has reached its final position and condition in the completed construction.

Correlation - A statistical relation between two or more variable such that systematic changes in the value of one variable are accompanied by systematic changes in the other.

Designated Agent - An employee or employees of the State, local agency, or a consultant or independent laboratory which is employed, paid by, and / or directly accountable to CDOT or a public agency excluding the contractors' or vendors' personnel.

F-test - Compares the population variances.

Group - Replicate Test Specimens taken from the same Batch Sample.

Independent Assurance Program (IA) - Refer to Definitions (Section 3) within the Quality Assurance Procedures Chapter.

Independent Assurance Sampling-Testing and Witnessing of Testing or Sampling - A sample taken and tested, or a sample that is witnessed only at a random location or time, the point to be designated by: Region Laboratory personnel, or project personnel, or CDOT's designated agent not associated with Project Verification Sampling and Testing; or the Contractor's (or his representative) not associated with Project Quality Control Sampling and Testing; or by an FHWA Engineer. The person who designates the point for sampling and who performs the actual test may physically do the sampling or project testing personnel may do the sampling in the presence of the IA person. Certain specified IA samples may be witnessed only. These samples are to be taken in the presence of both the project and IA personnel. These samples shall be taken by contractor's personnel or his representative. For more details and information, see the CDOT, Quality Assurance Program for Construction and Materials Sampling and Testing.

Lot - An isolated quantity of material from a single source. A measured amount of construction material assumed to be produced by the same process.

Mix Verification Testing – After the mix design has been approved and production commences, the Department will perform a minimum of three volumetric verification tests to verify that the field produced HMA conforms to the approved mix design.

Nominal – Representative value of a measurable property determined under a set of conditions, by which a product may be described.

Nominal Maximum - The size of aggregate in the smallest sieve opening through which the entire amount of specification aggregate is permitted to pass.

Note: For Item 403, Nominal Maximum size should be defined as: one sieve size larger than the first sieve to retain more than ten percent of the aggregate.

Nominal Value – A value assigned for convenient designation; existing in name only. An example being “2 by 4” lumber and one-inch pipe.

Owner Acceptance – Refer to Definitions (Section 3) within the Quality Assurance Procedures Chapter.

Owner Verification Testing – Refer to Definitions (Section 3) within the Quality Assurance Procedures Chapter.

Practice – A definitive procedure for performing one or more specific operations or functions that does not produce a test result.

Precision - A generic concept related to the closeness of agreement between test results obtained under prescribed like conditions from the measurement process being evaluated.

Process Control – Refer to Definitions (Section 3) within the Quality Assurance Procedures Chapter.

Professional Engineer Seals – Obtained or used by license holders in the State of Colorado and shall be capable of leaving an impression representation on the engineering work. For size and type specifications, see Subsection 5.5.1 of the Bylaws and Rules from the Colorado State Board of Licensure for Professional Engineers and Professional Land Surveyors.

Professional Engineer Stamps – Obtained or used by license holders in the State of Colorado and shall be capable of leaving a permanent ink impression. The permanent inked impression can be done with a variety of stamps including the traditional rubber stamp and pad, self-inking and pre-inked stamp all leaving a permanent inked impression. For size and type specifications, see Subsection 5.5.1 of the Bylaws and Rules from the Colorado State Board of Licensure for Professional Engineers and Professional Land Surveyors.

Proficiency Samples - Homogeneous samples that are distributed and tested by two or more laboratories.

Quality Assurance (QA) - Refer to Definitions (Section 3) within the Quality Assurance Procedures Chapter.

Quality Control (QC) - Refer to Definitions (Section 3) within the Quality Assurance Procedures Chapter.

Qualified Laboratories - Refer to Definitions (Section 3) within the Quality Assurance Procedures Chapter.

Random Sample - A sample drawn from a Lot in which each increment in the lot has an equal probability of being chosen.

Random Sample, Stratified - When a Lot is subdivided into approximately equal Sub-lots and samples are selected from each sub-lot by a Random process.

Reasonable Conformance - When construction and materials substantially comply with the plans and specifications. Clearly stated acceptance plans assist the Project Engineer in making his decision as to reasonable conformance.

Recycled Pavement – When used in the context of cold in-place recycled pavement or hot in-place recycled pavement, the asphaltic material is reworked within the foot-print of the roadway without removing it off site.

Repeatability - The range within which repeated measurements are made by the same operator on the same apparatus on Replicate Test Specimens. Essentially, the precision of the test.

Replicate Samples or Test Specimens - Multiple Samples or Test Specimens as nearly identical as possible, under the stated conditions, usually from a thoroughly mixed larger sample that has been reduced in size by quartering or splitting.

Reproducibility - The range within which check measurements by different operators on different apparatus should agree under definitely stated conditions. Usually performed on Test Specimens from Replicate Samples.

Sample - A small part of a Sub-lot or Batch, which represents the whole. A sample may be divided into several Test Specimens.

Split Sample - A sample taken and evenly divided to be tested by two or more individuals or laboratories.

Standard Deviation (s) - A measure of the dispersion of measurements from their average; the square root of the quantity of individual deviations from the mean, squared, summed, and divided by the number of samples minus 1.

$$s = \sqrt{\frac{\sum(\bar{X} - X)^2}{n - 1}}$$

Standardization - The adjustment of an instrument, prior to use, to an arbitrary reference value, or to a device that has been calibrated.

State personnel - An employee or employees of CDOT.

Sub-lot - The largest, clearly identifiable subdivision of a Lot. Usually specified in the Field Materials Manual Sampling Schedule as the largest quantity that may be represented by a single sample.

System Basis, IA - A system where the minimum frequency is based on a unit of material production and/or a unit of time.

t-test - Compares the population means.

Test Method – A definitive procedure for the identification, measurement, and evaluation of one or more qualities, characteristics, or properties of a material, product, system or service that produces a test result.

Test Portion – The part of a material sample required for testing.

Test Specimen - That part of a material Sample that is prepared and tested. Usually obtained by reducing the sample by quartering, splitting, or taking an aliquot (usually a liquid portion removed from the whole) quantity.

Variation - Differences, due to any cause, in measured values of a measurable characteristic.

Vendor - A supplier of materials incorporated into the project, which is not the contractor. May or may not be the Manufacturer.

Verification Sampling and Testing - Sampling and testing performed to validate the quality of the product for acceptance.

Verification Sample - A sample used to make a decision as to the acceptability of the material being sampled. Reasonable Conformance and amount of payment will be based on this sample. The specifications designate the point of verification sampling. Refer to the Schedule.

Viscosity - Low viscosity = more fluid, High viscosity = more stiff

Witness – To witness is to observe an act of work, verifying that the work was performed and performed correctly. After observation, witness is to testify by written and verbal communication protocols to CDOT Engineer in charge.

Appendix E – Acronyms

3R	Resurfacing, Restoration, Rehabilitation
AAP	AASHTO Accreditation Program
AASHTO	American Association of State Highway and Transportation Officials
ABC	Aggregate Base Course
AC	Asphalt Content
ACI	American Concrete Institute
ACPA	American Concrete Pavement Association
ACPA	American Concrete Pipe Association
AI	Asphalt Institute
AIF	Asphalt Industry Forum
AMPT	Asphalt Materials Performance Test
AMRL	AASHTO Materials Reference Laboratory
APA	Asphalt Pavement Analyzer
APL	Approved Product List
AQL	Asphalt Quality Level
AQV	APL – QML Verification
ARA	Asphalt Rejuvenating Agent
ARF	Access Request Form
ASTM	American Society of Testing and Materials
ATSSA	American Traffic Safety Services Association
BMP	Best Management Practices
CAGE	Colorado Association Geotechnical Engineers
CAPA	Colorado Asphalt Pavement Association
CAR	CDOT Application for Reporting
CBC	Concrete Box Culvert
CCA	Colorado Contractors Association
CCRL	Cement and Concrete Reference Laboratory
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CIP	Complete-in-Place
CIPR	Cold-in-Place Recycle
CIR	Cold-in-Place Recycle
COC	Certificate of Compliance
CM/GC	Construction Manager / General Contractor
CMO	Contract Modification Order
CP	Colorado Procedure

CP-L	Colorado Procedure – Laboratory
CPM	Counts Per Minute
CQL	Concrete Quality Level
CRS	Colorado Revised Statutes
CRSI	Concrete Reinforcing Steel Institute
CTP	Check Testing Program
CTR	Certified Test Reports
CTS	Compaction Test Section
D/A	Dust to Asphalt
DMS	Dynamic Message Sign
DRB	Dispute Resolution Board
DSR	Dynamic Shear Rheometer
EIS	Environmental Impact Statement
EOR	Engineer of Record
EPA	Environmental Protection Agency
EPE	Expert Product Evaluator
FAA	Fine Aggregate Angularity
FAPG	Federal Aid Policy Guide
FDR	Full Depth Reclamation
FHWA	Federal Highway Administration
FIPI	Finding In the Public Interest
FIR	Field Inspection Review
FMM	Field Materials Manual
FOR	Final Office Review
FPOG	Flexible Pavement Operators Group
FQC	Field Quality Control
FWD	Falling Weight Deflectometer
HAZMAT	Hazardous Material
HBP	Hot Bituminous Pavement
HIPR	Hot-in-Place Recycle
HIR	Hot-in-Place Recycle
HITEC	Highway Innovative Technology Evaluation Center
HMA	Hot Mix Asphalt
HSP	High Speed Profiler
IA	Independent Assurance Program
IAT	Independent Assurance Sampling and Testing
I/D P	Incentive/Disincentive Payment
IGA	Inter-Governmental Agreement
IRI	International Roughness Index

JMF	Job Mix Formula
JSA	Job Safety Analysis
LabCAT	Laboratory for Certification of Asphalt Technicians
LA	Local Agency
LACA	Local Agency Certification Acceptance
LCCA	Life Cycle Cost Analysis
LIMS	Laboratory Information Management System
LMTP	Laboratory Manual of Test Procedures
LOI	Loss on Ignition
LOS	Level of Service
LPA	Local Public Agency
MAC	Materials Advisory Committee
MCR	Minor Contract Revision
MLOS	Maintenance Level of Service
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MQL	Moving Quality Level
MRI	Mean Roughness Index
MSDS	Materials Safety Data Sheets
MUTCD	Manual on Uniform Traffic Control Devices
NCAT	National Center for Asphalt Technology
NCHRP	National Cooperative Highway Research Program
NDT	Non-Destructive Testing
NEPA	National Environmental Protection Act
NHS	National Highway System
NICET	National Institute for Certification of Engineering Technologies
NIST	National Institute of Standards and Technology
NOV	Notice of Violation
NPCA	National Precast Concrete Association
NPS	Non-Project Specific
NTPEP	National Transportation Product Evaluation Program
OA	Owner Acceptance
OGFC	Open Grade Friction Course
OIT	Office of Information Technology
OVT	Owner Verification Testing
PC	Process Control
PCCP	Portland Cement Concrete Pavement
PEC	Product Evaluation Coordinator
PF	Pay Factor

PG	Performance Graded
PPM	Parts Per Million
ProMIS	Project Management Information System
PS&E	Plans, Specifications and Estimate
PSI	Preliminary Site Investigation
PSP	Project Special Provision
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
QCP	Quality Control Plan
QIC	Quality Implementation Council
QL	Quality Level
QML	Qualified Manufacturers List
QPM	Quality Pavement Management
RAP	Reclaimed Asphalt Pavement (previously Recycled)
RAS	Reclaimed Asphalt Shingles
RE	Resident Engineer
RECP	Rolled Erosion Control Product
RMAEC	Rocky Mountain Asphalt Education Center
RME	Region Materials Engineer
ROD	Record of Decision
ROW	Right of Way
RSAR	Roadway Surface Accomplishment Report
RSO	Radiation Safety Officer
RTD	Region Transportation Director
RTFO	Rolling Thin Film Oven
SHRP	Strategic Highway Research Program
SMA	Stone Matrix Asphalt
SME	Subject Matter Expert
SMM	SiteManager® Materials
SOW	Scope of Work
SpG	Specific Gravity
SSD	Saturated Surface Dry
SSP	Standard Special Provision
SUPERPAVE	Superior Performing Asphalt Pavements
TCLP	Toxicity Characteristic Leaching Procedure
TCP	Traffic Control Plan
TRM	Turf Reinforcement Mat
VCA	Voids in Coarse Aggregate

VFA	Voids Filled with Asphalt
VMA	Voids in the Mineral Aggregate
VMA	Viscosity Modifying Admixture
VTM	Voids in Total Mix
WASHTO	Washington Association of State Highway and Transportation Officials
WAQTC	Western Alliance for Quality Transportation Construction
WCTG	Western Cooperative Test Group
WMA	Warm Mix Asphalt

Appendix F - Significant Publications

- AASHTO, Guide for Design of Pavement Structures
- American Concrete Institute
- Asphalt Institute, Performance Graded Asphalt Binder Specifications and Testing Superpave Series No. 1 (SP-1)
- Asphalt Institute, Superpave Level 1 Mix design
- Asphalt Institute, Superpave Series No. 2 (SP-2)
- Department of Natural Resources, Construction Materials Rules and Regulations
- CDOT, Construction Manual
- CDOT, Cost Data Books
- CDOT Field Materials Manual (FMM)
- CDOT Independent Assurance Manual (IA)
- CDOT, Local Agency Manual
- CDOT, Life Cycle Cost Analysis State-of-the-Practice
- CDOT, M & S Standards
- CDOT, Pavement Design Manual (PDM)
- CDOT, Pipe Material Selection Guide
- CDOT, Laboratory Manual of Test Procedures (LMTP)
- CDOT, Standard Specifications for Road and Bridge Construction
- Metropolitan Government Pavement Engineers Council (MGPEC) Pavement Design Standards and Construction Specification Manual
- Portland Cement Association, Design and Control of Concrete Mixes, Thirteenth Edition

Appendix G - Colorado Procedures - Laboratory Numeric Order-20

CP-Ls 2100 Chemical Unit Testing

- CP-L 2103 Determining the Sulfate Ion Content in Water or Water-Soluble Sulfate Ion Content in Soil
- CP-L 2104 Determining the Chloride Ion Content in Water or Water-Soluble Chloride Ion Content in Soil

CP-Ls 2200 Bituminous Testing

- CP-L 2202 Test of Protective Covering for Bridge Deck Waterproofing Membrane
- CP-L 2203 Pliability and Thickness of Prefabricated Reinforced Membrane
- CP-L 2210 Determining Toughness and Tenacity of Rubberized Asphaltic Materials
- CP-L 2211 Elastic Recovery
- CP-L 2212 Residue by Evaporation of Asphalt Emulsion
- CP-L 2213 Coating of Bitumen-Aggregate Mixtures
- CP-L 2214 Verification of Binder Acidity
- CP-L 2215 Effect of Heat and Air on a Moving Film of Asphalt

CP-Ls 3100 Soils Testing

- CP-L 3101 DELETED > Replaced by AASHTO T 190 on 01-14-2016
- CP-L 3102 DELETED > Replaced by CP-L 3101 on 01-14-2013
- CP-L 3103 Specific Gravity of Soils
- CP-L 3104 Determining the Durability of Shales for Use as Embankments
- CP-L 3105 Grain Size Analysis of Soil for AASHTO Classification
- CP-L 3106 Grain Size Analysis of Soil for Unified Soil Classification System
- CP-L 3107 Determining the Resilient Modulus of Cohesive (Type 2) Soils

CP-Ls 3200 Geology Testing

- CP-L 3201 Continuous Penetration Test

CP-Ls 4100 Concrete Testing

- CP-L 4101 Preparing Concrete Blocks for Testing Sealants, for Joints and Cracks
- CP-L 4102 Specific Gravity and Absorption of Fine Aggregate
- CP-L 4103 Unrestrained Shrinkage of Concrete

CP-Ls 4200 Physical Properties Testing

- CP-L 4209 Physical Testing of Quicklime, Hydrated Lime, and Limestone
- CP-L 4211 Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
- CP-L 4215 Determination of Percent Moisture in Rock Salt
- CP-L 4216 Determination of Salt Content of Sanding Materials

CP-Ls 4300 CP-L 4301 Surface Abrasion Resistance of Polyester Concrete
CP-L 4302 Methods of Test for Bonding Strength of Polyester Concrete to Concrete

CP-Ls 5100 Flexible Pavement Testing

CP-L 5100 HMA Testing Troubleshooting Guide
CP-L 5101 Verification of Laboratory Equipment Used to Test Bituminous Mixtures
CP-L 5106 Resistance to Deformation of Bituminous Mixtures by Means of Hveem Apparatus
CP-L 5109 Resistance of Compacted Bituminous Mixture to Moisture Induced Damage

CP-L 5110 Resilient Modulus Test (M_R)
CP-L 5111 Determining the Percent of Recycling Agent to Use for Cold Recycling of Asphalt Concrete
CP-L 5112 Hamburg Wheel-Track Testing of Compacted Bituminous Mixtures
CP-L 5114 French Rut Testing of Compacted Bituminous Mixtures
CP-L 5115 Preparing and Determining the Density of Bituminous Mixture Test Specimens Compacted by the Superpave Gyrotory Compactor
CP-L 5116 Linear Kneading Compaction of Bituminous Mixtures
CP-L 5117 Superpave Design for Hot Mix Asphalt
CP-L 5120 Determination of the Asphalt Binder Content of Bituminous Mixtures by the Ignition Method
CP-L 5140 Mix Design for Hot In-Place Recycling of Asphalt Pavements
CP-L 5145 Contractor Asphalt Mix Design Approval Procedures Utilizing RAP Millings from the Same Project
CP-L 5150 Adjusting Moisture Requirement to Hydrate Lime in Asphalt Mixes

CP-Ls 5300 Nuclear Unit Testing

CP-L 5301 Leak Wipe Procedure for Nuclear Gauges
CP-L 5302 Calibration of CDOT Nuclear Moisture / Density Gauges
CP-L 5303 Calibration Check of CDOT Nuclear Moisture / Density Gauges
CP-L 5304 Calibration of CDOT Nuclear Thin Layer Density Gauges
CP-L 5305 Leak Wipe Analysis for Nuclear Gauges
CP-L 5306 Certification of Consultant Nuclear Moisture / Density and Thin Layer Density Gauges

Note: CP-Ls 5900 series, Inspection, was transferred to the Staff Bridge Branch for their posting prior to the printing of the 2005 Laboratory Manual of Test Procedures publication.

Appendix H - Metric Conversion Tables

Conversion Factors - U.S. to Metric S.I.

Quantity	U.S.	Metric Unit (SI)	Multiply by
Length	mile	kilometer (km)	1.609 344
	yard	meter (m)	0.914 4
	foot	meter (m)	0.304 8
	foot	millimeter (mm)	304.8
	inch	millimeter (mm)	25.4
Area	acre	Hectares (ha)	0.404 685 6
	square yard	square meter (m ²)	0.836 127 36
	square foot	square meter (m ²)	0.092 903 04
	square inch	square millimeter (mm ²)	645.16
Volume	cubic yard	cubic meter (m ³)	0.764 555
	cubic foot	cubic meter (m ³)	0.028 316 8
	cubic inch	cubic millimeter (mm ³)	16 387.064
	gallon	Liter (L)	3.785 41
Mass	ton	metric ton (t)	0.907 184
	pound	kilogram (kg)	0.453 592
	ounce	gram (g)	28.3495
Temperature	°Fahrenheit	°Celsius	(°F-32) 5/9
Pressure	psi	kilopascals (kPa)	6.894 76

Conversion Factors - Metric S.I. to U.S.

Quantity	Metric Unit (SI)	U.S.	Multiply by
Length	kilometer (km)	mile	0.621 371
	meter (m)	yard	1.093 6
	meter (m)	foot	3.280 84
	millimeter (mm)	foot	0.003 28
	millimeter (mm)	inch	0.039 37

Area	Hectares (ha)	acre	2.471 054
	square meter (m ²)	square yard	1.195 99
	square meter (m ²)	square foot	10.763 91
	square millimeter (mm ²)	square inch	0.001 55
Volume	cubic meter (m ³)	cubic yard	1.307 95
	cubic meter (m ³)	cubic foot	35.314 72
	cubic millimeter (mm ³)	cubic inch	0.000 061
	Liter (L)	gallon	0.264 172
Mass	metric ton (t)	ton	1.102 31
	kilogram (kg)	pound	2.204 62
	gram (g)	ounce	0.035 274
Temperature	°Celsius	°Fahrenheit	(°C x 1.8) + 32
Pressure	kilopascals (kPa)	psi	0.145 038

Metric Decimal Prefixes

Prefix	Magnitude	Expression
kilo	10 ³	1000 (one thousand)
milli	10 ⁻³	0.001 (one thousandth)

For a more information on Metric S.I. units see CDOT's *Metric Conversion Manual*. Other good references include AASHTO R1-91 and ASTM E 380-92.

Sieve Sizes, English versus Metric

<u>English</u>	<u>Metric</u>
3"	76.2 mm
2 ½ "	63.5 mm
2 "	50.8 mm
1 ½ "	38.1 mm
1 "	25.4 mm
¾ "	19.0 mm
½ "	12.7 mm
⅜ "	9.51 mm
# 4	4.75 mm
# 8	2.36 mm
# 16	1.18 mm
# 30	600 mu
# 50	300 mu
# 100	150 mu
# 200	75 mu

Appendix I - Materials Testing Accuracy Criteria

The following table is the official testing accuracy criteria for the Colorado Department of Transportation and shall be strictly adhered to.

	MEASURE TO NEAREST	REPORT TO NEAREST
SOILS	Sieve Analysis	
	(Except -#200).....	1.0 g1%
	Minus No. 200.....	0.1 g0.1%
	Atterberg Limits.....	0.01 g1%
	Density.....	----0.1 lb/ft ³ (1 kg/m ³)
	Relative Compaction.....	0.1 lb/ft ³ (1 kg/m ³).....0.1%
	Moisture Content	
	D/M Gauge.....	0.1 lb/ft ³ (1 kg/m ³).....0.1%
	Dry Weight.....	0.1 g0.1%
	BASE AGGREGATES	Sieve Analysis
(Except -#200).....		1.0 g1%
Minus No. 200.....		0.1 g0.1%
Atterberg Limits.....		0.1 g1%
Density.....		----0.1 lb/ft ³ (1 kg/m ³)
Relative Compaction.....		0.1 lb/ft ³ (1 kg/m ³).....0.1%
Moisture Content		
D/M Gauge.....		0.1 lb/ft ³ (1 kg/m ³).....0.1%
Dry Weight.....		0.1 g0.1%
CONCRETE		Sieve Analysis
	(Except -#200).....	1.0 g1%
	Minus No. 200.....	0.1 g0.1%
	(*)Sand Equivalent.....	0.1.....1 (*)
	Moisture in Aggregate.....	0.1 g0.1%
	Air Content.....	----0.1%
	Fineness Modulus.....	----0.01
	Slump.....	----1/4 inch (5 mm)
	Compressive Strength.....	1 psi (0.01 MPa)10 psi (0.1 MPa)
	Flexural Strength.....	1 psi (0.01 MPa)5 psi (0.05 MPa)
Thickness.....	0.05 in (1.3 mm)0.1 in (2.5 mm)	
BITUMINOUS PVMT.	Moisture in Mix.....	0.1 g0.01%
	Sieve Analysis	
	(Except -#200).....	1.0 g1%
	Minus No. 200.....	0.1 g0.1%
	Asphalt Content	
	(CP-L 5120).....	0.1 g0.01%
	(CP 85).....	1.0 g0.01%
	Hveem Stability.....	----1
	Voids in Mineral Aggregate.....	----0.1%
	Air Voids.....	----0.1%
Lottman TSR.....	----1%	
Lottman Wet TS.....	1 lb.f (1 N)1 psi (1 KPa)	

Lottman Dry TS	1 lb.f (1 N)	1 psi (1 KPa)
Filler	0.1 g	0.1%
Specific Gravity	0.1 g	0.001
Specific Gravity		
D/M Gauge	----	0.001
Relative Compaction.....	0.01	0.1%

(*)Report to the next highest whole number per CP 37.

UNDERSTANDING CALCULATIONS AND ROUNDING IN MS EXCEL

UNDERSTANDING THE DIFFERENCE BETWEEN DISPLAYED VALUES AND UNDERLYING VALUES

A Microsoft Excel® numeric cell entry can maintain precision to only a maximum of 15 digits. This means you can enter numbers longer than 15 digits into a cell, but Excel converts any digits after 15 to zeros.

The values that appear in formatted cells are called *displayed values*; the values that are stored in cells and appear in the formula bar are called *underlying values*. The number of digits that appear in a cell, its displayed value, depends on the width of the column and any formatting that you have applied to the cell.

When performing calculations, Excel always uses the underlying value, not the displayed value.

UNDERSTANDING THE ROUND FUNCTION

MS Excel® ROUND function rounds a number to a specified number of decimal places, rounding digits less than 5 down and digits greater than or equal to 5 up. For example, the formula =ROUND(123.4567,3) returns 123.457. The number 123.457 is now the underlying value. Therefore, when performing calculations, the rounding function changes the values of the numbers that are operate on.

UNDERSTANDING CDOT FORMS

CDOT paper worksheet forms were made to conserve space and paper. The forms may have one or more test methods/procedures incorporated into the forms. Because of space limitations, it is not referenced to which method/procedure the test results are being reported. It is up to the material tester to determine which test methods/procedures are being tested to and documented. Rounding, of intermediate results, is to be performed if the result is referencing a specific stand-alone test method/procedure that was reported previously. For example, if a moisture content has a designated AASHTO or ASTM test method/procedure, the results were rounded and documented previously. The following calculations on the form are to use the rounded moisture content. Then the final reported result is to be rounded and reported. If the moisture content was not reported previously, but was calculated as an intermediate result, then use the underlying value.

Caution is needed when developing computerized worksheets using MS Excel® from CDOT forms. Each stand-alone AASHTO, ASTM, CDOT CP or CPL has a rounded reported result. Computerized worksheets are to be analyzed that incorporate stand-alone test methods/procedures or if the intermediate result (underlying value) is to be used.

ROUNDING OF TEST DATA FOR DETERMINING CONFORMANCE WITH SPECIFICATIONS

When calculating a test result from observed values and test data, rounding of intermediate values and quantities shall be avoided. As far as practicable with the calculating device used, carry out all calculations with the observed values exactly and round only the final result, which is reported as specified. Any final results used in further calculations shall be considered an intermediate quantity and the unrounded value is used.

EXAMPLE:

Find final results for Moisture Content, Dry Density and Percent Compaction:

A = Observed wet weight of the moisture sample

= 182.4 gr.

B = Observed dry weight of the moisture sample

= 166.8 gr.

MD = Moisture/density relationship

= 115.4 pcf

WD = Observed wet density value

= 119.3 pcf

MC = Moisture Content (%)

DD = Dry density (pcf)

C = compaction (%)

$$MC = \frac{(A - B) * 100}{B} = \frac{(182.4 - 166.8) * 100}{166.8} = 9.4\%$$

Unrounded is 9.35252

$$DD = \frac{(WD * 100)}{(100 + MC)} = \frac{(119.3 * 100)}{(100 + 9.35252)} = 109.1 \text{ pcf}$$

Unrounded is 109.09671

$$C = \frac{DD}{MD} = \frac{109.09671}{115.4} = 94.53 \rightarrow 95\%$$

% compaction, a passing test

Recalculated using rounded MC:

$$DD = \frac{(WD * 100)}{(100 + MC)} = \frac{(119.3 * 100)}{(100 + 9.4)} = 109.0 \text{ pcf}$$

Unrounded is 109.04936

Recalculated using rounded DD:

$$C = \frac{DD}{MD} = \frac{109.0}{115.4} = 94.45 \rightarrow 94\%$$

% compaction less than 95 thus, a failing test.

Caution When you change the precision of the calculations in a workbook by using the displayed (formatted) values, Excel permanently changes any constant values on the worksheets in the workbook. If you later choose to calculate with full precision, the original underlying values cannot be restored. It is advised to use full precision. If it is desired to use precision as displayed follow these default settings for the Excel workbook.

Excel 2007 & more current:

1. Click the **Office Button**, click **Excel Options**, and then click the **Advance** tab in the left column.
2. Under **When calculating this workbook**, select the **Set precision as displayed** check box.

Appendix J - Laboratory Test Time

Time listed is the interval from sample submittal at the Materials and Geotechnical Branch to the issuance of a report. Time spent while the sample is in transit is not included. Time spent while the report is in transit is not included. Test Time does not include weekends or state holidays.

ITEM NO.	DESCRIPTION	TEST TIME (WORKING DAYS)
203	EMBANKMENT	
	Gradation, Atterberg Limits, Moisture-Density Curve, Specific Gravity, R Value, and Classification.....	16
	(This test time excludes a preliminary soil survey with more than 10 samples. Call for actual turnaround time.)	
	Sulfate testing.....	5
	Chloride testing.....	15
	Soil Resistivity testing.....	6
	pH testing.....	5
	Pipe Type Material Selection testing.....	15
206	STRUCTURE BACKFILL, BED COURSE & FILTER MATERIAL	
	Class 1: Gradation, Atterberg limits, Moisture-Density Curve and Specific Gravity	13
	Class 2: Gradation, Atterberg Limits, Moisture-Density Curve and Specific Gravity	14
	Bed Course: Gradation	5
	Filter Materials: Gradation.....	5
	Sulfate testing per the Schedule	5
	Chloride testing.....	15
	Soil Resistivity testing.....	6
	pH testing.....	5
301	Deleted	
304	AGGREGATE BASE COURSE	
	Gradation, Atterberg Limits, Moisture-Density Curve	15
	Gradation, Atterberg Limits, Moisture-Density Curve, Abrasion.....	16
	Gradation, Atterberg Limits, Moisture-Density Curve, and R-Value	20
	Gradation, Atterberg Limits, Moisture-Density Curve, Abrasion and R-Value	21
307	HYDRATED LIME & LIME TREATED SUBGRADE	
	Hydrated Lime: Gradation.....	5
	Lime Treated Subgrade: Gradation, Atterberg Limits, PH, Optimum Lime Content, Moisture-Density Curve, and Unconfined Compression	20

ITEM NO.	DESCRIPTION	
403	HOT MIX ASPHALT PAVEMENT	
	Asphalt Content, Gradation, Stability, Lottman	7
	Gradation, Atterberg Limits, Specific Gravity	10
	Gradation, Atterberg Limits, Specific Gravity, Abrasion, Fractured Faces	12
	EuroLab: French and /or German Wheel Tracking Devices	9
409	COVER COAT MATERIAL	
	Gradation, Abrasion, Fractured Faces.....	6
411	BITUMEN	
	Asphalt Cement (not performance graded), Emulsion	5
	Performance Graded Asphalt Binder, Verification Testing	3
	Performance Graded Asphalt Binder, Complete Testing	6
412	PORTLAND CEMENT CONCRETE PAVEMENT	
	Aggregate Gradation & Abrasion	6
	Compressive Strength of Information Cylinders	*
	Compressive Strength at 7 Days	*
	Compressive Strength at 28 Days	*
	Compressive Strength of Drilled Cores	*
	Flexural Strength at 28 Days	*
	Mix Design, Review	3
	Sand Equivalent.....	5
	Note: * = The number of stipulated days plus 1 day for the report.	
504	MECHANICALLY STABILIZED EARTH WALLS	
	Gradation, Atterberg Limits, Moisture-Density Curve, Classification, Specific Gravity, and Direct Shear	14
506	RIPRAP	
	Specific Gravity.....	3
515	WATERPROOFING MEMBRANE	
	Various Laboratory Tests.....	11
601	STRUCTURAL CONCRETE	
	Aggregate, Gradation & Abrasion	6
	Aggregate Soundness with Sodium Sulfate	10
	Compressive Strength of Information Cylinders	1 *
	Compressive Strength at 7 Days	5 *
	Compressive Strength at 28 Days	20 *
	Compressive Strength of Drilled Cores	2 *
	Mix Design, Review	3 *
	Note: * = The number of stipulated days plus 1 day for the report.	
602	REINFORCING STEEL	
	Prestressing Strand	6

Appendix K - Establishing Lots or Process Control on the Project

A lot is any well-defined quantity of material produced by essentially the same process through continuous production.

The standard size lot consists of 5 samples, but a lot may include as few as 3 or as many as 7 samples due to changes in production or when total quantities require more or less than 5 tests.

Establishing lots is not difficult when the production process and materials sources are uniform. When production begins under good process control and there is little need for plant adjustment, the first 5 samples should be used to establish the quantity represented by the first lot. Thereafter, each lot should contain 5 samples. More than a single day's run may be included if there is no significant change in the production process or raw material.

When the production process is erratic or out-of-control, establishing lots becomes a problem.

Often, the first few samples at the beginning of the production run will be erratic or off-target, and several major adjustments may be required before production is resumed. In such cases, these first few samples should be Lot No. 1. Then, after production levels out, 5 sample lots are to be used.

After the 5 sample lots have become routine, only a major production change or a quantity of material for which more or less than 5 samples are required should be cause for altering the number of tests.

Appendix L - Random Sampling

The most important factor in obtaining information for the purpose of enforcing specifications is the action of sampling. It must be understood that unless the samples are chosen by probability sampling, the statistical methods may not be entirely applicable. Stratified Random Sampling should be used for this process. This is a method of random sampling that causes the samples to be spread more uniformly throughout the lot.

A predetermined schedule for random sampling should be developed for each project. If requested, the Central Laboratory will supply a schedule for random sampling. A random sampling schedule can also be developed using ASTM D 3665 and/or ASTM E 105 prior to start of testing. See also CP 75

It is realized that where scattered piecework is being done, such as tapers and gores, it may not always be possible to strictly conform to the above procedure. Judgment must be used and a reasonable attempt made to select samples without bias. Bituminous materials ordinarily shipped to the project in tank trucks are sampled in a slightly different manner than for most other materials. See Chapter 400 of the Field Materials Manual for a detailed description of the sampling and acceptance verification plan.

The location or time of sampling must be selected by a random method. This means the location or time of sampling must be predetermined without bias, such as by the use of a table of random numbers. Every load, ton, or square yard in the sub-lot must have an equal probability of being chosen. This means the sample location or time chosen must be accessible. It is not possible to obtain a probability sample from a stockpile of aggregates because samples cannot be taken from the interior of the pile. To sample such material properly, it must be sampled at randomly determined intervals either as it is placed in the pile or removed from the pile.

Appendix M - Sample-Processing Procedure

Samples which are received, tested, and reported by the CENTRAL LABORATORY, are processed in the following manner:

IDENTIFICATION

All materials and samples must be logged-in. Samples must be identified as to DATE RECEIVED, ITEM NUMBER, CONTRACT ID, PROJECT NUMBER, and NUMBER OF SAMPLES.

SELECTION

The selection of samples is handled by field project personnel. Staff Materials is responsible for the testing of samples submitted by field personnel. The only exceptions to this are samples of asphalt cement and liquid asphalt. In this case, one sample out of five is selected at random. If this sample meets specifications, the other four are discarded. If not, the other four samples are tested and reported.

CONDITIONING-

Samples which require conditioning will be conditioned per the appropriate test procedure.

STORAGE

Samples will be stored in the proper environment prior to testing. An example of this is concrete cylinders, which must be stored (cured) in a 100% humidity environment.

RETENTION

Samples of all materials will be retained at least 2 weeks or until all issues are resolved. There is no retention of concrete cylinders.

DISPOSAL

All materials which are not hazardous will be placed in the large roll-on / roll-off trash receptacle immediately behind the Laboratory. Materials which are hazardous will be handled per Staff Materials procedure for handling hazardous materials.

Appendix N - Use of Laboratory Check Tests on More Than One Project

Results of Laboratory Check Tests can be used and referenced to more than one project if the RME allows it and if the following criteria are met:

The source (pit, plant, supplier and design mix) of material must be the same.

Construction must occur at approximately the same time on each project.

Example: Placing asphalt pavements on two separate projects from the same supplier. (Asphalt cement, portland cement, ARA additives, etc.)

Document the referenced laboratory check test on a CDOT Form #157 listing:

- The Project Number from which the tests was referenced.
- Check Test ID Number (unique for this activity)
- The plant where the material was produced.
- All of the ingredients in the product.
- The date the material was placed (on both projects).
- The Design Mix Number (if applicable).

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