

2022 CDOT Field Materials Manual

Introduction

The purpose of this manual is to provide an official guide to CDOT Field Materials 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 is 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. We intend 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 Corrections JotForm or the Adobe Pdf Comment Correction Form at any time. To submit your comments or corrections download the Comment Correction JotForm follow the link: <https://form.jotform.com/edward.trujillo/FMM> complete the form attach your documents and submit, a copy will be sent to edward.trujillo@state.co.us for review. To submit your comments or corrections using the Comments and Corrections Adobe Pdf form, download the form to your computer and open the form using Adobe Acrobat. Complete the form and attach your supporting documents to the form and submit the completed form to edward.trujillo@state.co.us. The forms with your comments will be maintained with the FMM, CP, Section, or chapter 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 CDOT Field Materials Manual will be 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

Though the CDOT Field Materials Manual (FMM) has been available in both a published print format and on the CDOT website; future FMM’s 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 before the issuance of the 2022 FMM will be conveyed through a CDOT Materials Bulletin.

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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/>

FMM Documents: A special thank you is extended to the members and participants of the MAC Meetings and the associated task forces 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 2022 CDOT Field Materials Manual

Listed Revisions, Additions, and Deletions

Changes to the 2022 FMM: Changes of significance within a particular CP or chapter will contain a “- xx’ at the end of the title to coincide with the FMM 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** sidebar in either the left or right margin. The **2022** revisions, additions, and Deletions are highlighted in **RED**.

- FMM Manual- 2021-2022 FMM Updates: Updated Format to a single page format on the 2020 version.
- Cover Page Updates: 2021-2022 Updates- Updated CDOT Logo, **Updated date on Cover Page**.
- CP Comments Form: 2021-2022 FMM Update: Updated format and added e-signature block, using "Jotform" PD21.1 requirements, **Shortened the "JotForm" link, and changed the name**.
- Comments Corrections Form: 2020-2022 FMM Update: Updated format and added e-signature block, **Revised Comments and Corrections form for Adobe DC use**.
- Table of Contents: 2021-2022 Update: Added new Comments Form Added CP63, Added Electronic Documents Chapter. **CP 52 HMA Mix Design Checklist**
- QA Procedures 2020-2021 FMM updates: Subsections 3.19, 5.2.2, 7.2, 7.5.1.1, 7.11.1, 11.9.1, 11.11, 11.12.2, 11.12.3.2, 13.2.3, 17.1.
- Documentation for SMM / LIMS: 2021-2022 FMM updates, 3.1, 3.1(8), 3.2(17a,b), Added the CDOT Form 473,474 in Adobe Sign Guidelines and updated the forms. **Updated the entire chapter to meet the new process to allow Consultants access to SMM/LIMS. Section 5,(17) added language on the use of the Adobe Sign 473/474 document approved by the MAC for use starting 1 July 2021. Removed the Adobe DC473/474 instructions and moved them to the Local Agency chapter. Added the ProjectWise/Share examples for project documentation.**
- Adobe Acrobat Sign instructions: 2021-2022 FMM update Added new chapter with instructions. PD 21.1 Requirements. **Materials Advisory Committee approved the use of the Adobe Acrobat Sign 473/473 document starting 1 July 2021. Table**
- Documentation for Design-Build: 2020-2021- 2022 FMM Updates-Section 4 total rewrite, edit & re-format. 3.4.3.1 Statistical Analysis., **Section 3.3 Independent Contractor Quality Control (ICQC) Added language to permit CAR reports. Table 1: Level 1 Owner Verification Testing, remove "aa" "bb" reference from CP80 in Items 310, Add "28 days" to Item 412 Flexural Strength, Item 503 Compressive Strength, Item 507 Compressive Strength, Item 601 Compressive Strength.**
- Documentation for Maintenance & LA- 2020-2022 FMM Updates: updated the CDOT Form 473LA, 473M and CDOT 474. **Section 13, Added Acrobat DC instructions for the CDOT form 474.**

SUMMARY OF 2022 CDOT Field Materials Manual Listed Revisions, Additions, and Deletions

- Contractors, Special Notice: 2021-2022 FMM updates 4.1G, Note 1, 7.3.a.(Products needing Pre-Inspection), APL User Guidance- 6, 9, Notes 5,6,7, 8,9.10, APL Category Edits- Adhesives Note 5, Cement Blended (TypeL, MS) (IL, HS),(IT, MS),(IT, HS), PCCP Grout, Region Approved Plant Mix Grout, Class DR [Pre-Packaged], Environmental Sound Wall, Alternate Traction Device Note 6, Mastic Note 7, Delineator Post Marker Note 8, Concrete Pre-cast Barrier (Type7), Cable Barrier MASH09 TL-3 to meet 2020 compliance, Traffic Control Lighting, Sight Standards. The contractor's APL Verification Forms signatures and explanations were added. **Section 7.3.b, 7.3.c, and Examples Letters, Notices, and Forms section added electronic stamp instructions. PD 21.1 requirement. Section 7.30d added the Approved Products List "Category Search" drop-down menu reference. Updated APL category list.**
- OA Frequency Guide Schedule: 2020-2021-2022 FMM updates- Added CDOT Form Links. Item 203, Item 409, Item 412, Item 420, Item 502, Item 506, Item 601, Item 612. 203, Item 208 reference CDOT Form 157, Item 212 reference CDOT Form 157, Item 411, Item 412 Pavement Smoothness, Item 601,606, Item 607, Item 627. **Edit title spelling "Frequency", Add to page 1, "CDOT Form 43 referenced is generated from the CAR reporting system.", Item 203,206, CP 25. 304,306,307 T85., Item 207 language added (Michael Stanford)., Item 403, Sample Size "Micro Deval requires 2 full bags from Cold feed", Item 412 Add Sand Equivalent Test. Item 607, Added "Footing or Bases Small Projects", Item 614 Added Sign Posts - Concrete Small Projects. Updated the entire schedule to show AQL/CQL reports and forms used for testing and distribution.**
- IA Frequency Guide Schedule: 2020-2021-2022 FMM Updates- Item 203, Item 403, Item 409, Item 412, Item 503, Added Note 4. Item 403, Table IA-1 "Type of Test" Column removed "Nominal Maximum". Added "Flat and Elongated" to Table IA-1. **Item 403-411 Asphalt Cement Materials "March MAC Topic", Item 412 Sand Equivalency "March MAC Topic", Table IA-1, Comparison Precision Guide, Flat & Elongated Minor/Significant difference "March MAC Topic.**
- CP 10: 2020-2021 FMM Updates- Section 2.3, 6.19 Note 2. Added new CP 10a (Field Lab & Personnel Qualifications Checklist Form) Add Line to Table 10-1, E-Learning Technician Training Program. Add Line to Table 10-1, Edits to Table 10-1 Sampling & Testing Personnel Qualifications, ¹ E-Learning Technician Training Program.
- CP 11 (Intro to QML) 2021 FMM update: Added Precast Structures, new tab to FMM Manual.
- CP 11-1 (Asphalt Binder) 2021 FMM update: CP 11-1 new tab to FMM.
- CP 11-2 (Asphalt Emulsion) 2021 FMM update: CP 11-2 new tab to FMM.
- CP 11-3 (Hydraulic Cement) 2021-2022 FMM update: CP 11-3 new tab to FMM. **Referenced Documents Section 1.1, Deleted ASTM C1157 Standard Performance Specification for Hydraulic Cement.**
- CP 11-4 (Fly Ash) 2021 FMM update: CP 11-4 new tab to FMM.

SUMMARY OF 2022 CDOT Field Materials Manual Listed Revisions, Additions, and Deletions

- CP 11-5 (Hydrated Lime) 2021 FMM update: CP 11-5 new tab to FMM.
- CP 11-6 (Reinforcing Steel): 2021-2022 FMM Updates- Steel Reinforcing Bars and Steel Dowel Bars, Scope paragraph 2. Added a new tab to FMM Manual. **Scope Re-write Eric Prieve.**
- CP 11-8 (Epoxy-Coater) 2021 FMM update: Section 1.1, 6.3, 9.8.1, 9.8.1.1, 10.1, 11.4. Added new Pre-Cast Checklist and Pre-Cast certification letter. CP 11-8 new tab to FMM.
- CP 12A: 2021 FMM Updates- addition of Section 13 "Submittal of PC Notebook". CP 12A new tab in the 2021 manual.
- CP 12B: 2021 FMM update: CP 12B new tab in the 2021 FMM.
- CP 12C: 2021 FMM Updates: Addition of Section 7 "Submittal of PC Notebook". CP 12C new tab in the 2021 FMM.
- CP 13: 2021-2022 FMM Updates-Changes to Table 13-1, HMA Air Voids, In-Place Density HMA, Longitudinal Joint Density, Flexural Strength PCCP. CP 13 new tab to the manual. **Table 13-1 Column 2 Asphalt Content (Ignition Method) CP-L 5120- (Maximum Difference) Edit 0.69%**
- CP 14: Last Update 2020-2021 FMM: CP 14 new tab to the manual, Materials Bulletin January 2020
- CP 15: Last Update 2021-2022 FMM: CP 15 new tab to the manual, Materials Bulletin January 2020. **Revised the OA/PC Certified Nuclear Gauge Consultant Nuclear Gauge Assignment Form.**
- CP 16: 2021-2022 FMM Updates- CP 16 new tab to the manual, Materials Bulletin January 2020. **CDOT Form 1324 revised.**
- CP 17: 2022 FMM Update- **Revised Process Documentation Worksheet with CDOT Form 417**
- CP 20: Last Update 2008
- CP 21: Last Update 2008
- CP 23: Last Update 2013
- CP 24: 2020 FMM Update- 2.1
- CP 25: 2020-2022 FMM Update- 3.5 Changed 10,000 yds³ to 5000 yds³, **Added revisions from Chris Russell, Soils & Geotech Engineer.**

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- CP 26: Last Update 2014
- CP 30: Last Update 2009
- CP 31: 2020 FMM Update- Subsection 3.1.3.1
- CP 32: Last Update 2003
- CP 33: Last Update 2012
- CP 37: 2020 FMM Update- 2.7
- CP 41: 2020-2022 FMM Update- 13.1, Added to Section 4.3 "Note: CP 75 applies only to OA testing and that PC testing needs only to meet or exceed the minimum frequencies that are specified in Table 106-1 of the CDOT Standard Specification for Road and Bridge Construction."
- CP 42: Last update 2005
- CP 43: 2020 FMM Update- 15.1
- CP 44: 2020 FMM Update- The Title, Percent Relative Compaction to, "Just Percent Compaction"
- CP 45: 2020 FMM Update- 7.1
- CP 46: Last update 2008
- CP 47: Last update 1990
- CP 48: 2020 FMM Update- 4.1.1, Note 2
- CP 50: Last update 2014
- CP 51: 2021 FMM Update- The Title, added the word "Theoretical", Scope 1.1, 3.3, 3.6, 3.9.1, 6.4, Method B title update 10.2
- CP 52: 2021-2022 FMM Update- Subsection 2.2, 2.3, 3.1, 3.2, 3.2.2, 3.3, 4.2, 4.3, 4.3(1), 4.3 (2), 4.3(6), 6.1, 8.2 delete CDOT Procedural Directives 25.2, 51.2, 51.3 and replace with 25.1.
- CP 53: 2021 FMM Update- 1.1 deleted Method C reference, Deleted Method C (8,9), 11.1 deleted the mention of Method C, 13.1.
- CP 54: Last update 2013
- CP 55: Last update 2018

SUMMARY OF 2022 CDOT Field Materials Manual Listed Revisions, Additions, and Deletions

- CP 56: 2020 FMM Update-Title, "Guidelines for Using Theoretical Maximum Specific Gravity (RICE) of Project-Produced HMA to Change the Target Specific Gravity for Compaction Compliance".
- CP 57: 2020 FMM Update- 4.2, 6.3 New Form
- CP 58: Last update 2007
- CP 59: 2021 FMM Update- 3.3 Deleted, 8.1 delete CDOT Procedural Directives 25.2, 51.2, 51.3 and replace with 25.1, Update with electronic Forms.
- CP 61: 2020-2022 FMM Update: 4.2.1., **Section 4.2.4 "Refer to Subsection 4.2.2"**
- CP 62: 2021- 2022 FMM Update- 6.3 delete CDOT Procedural Directives 25.2, 51.2, 51.3 and replace with 25.1. Section 7 Update. **Updated Sections 2.3, 2.3.1, 3.2, 4.3.1, 4.4, 5.2.1, 5.2.2, 5.2.3, 5.3**
- CP 63: 2021 FMM Update- New Addition of CP 63 added.
- CP 65: 2020 FMM Update- Text within Example 1 & 2 Table 65-1, Table 65-2, Table 65-3, Table 65-4, Subsection 7.1, 7.6.1, text within Example 3.
- CP 67: 2021 FMM Update - Section 6.1
- CP 69: Last update 2018
- CP 71: Last update 2001
- CP 74: 2021-FMM Update-Added "Smoothness Acceptance Data Submittal Form", Updated Section 5.4.
- CP 75: Last update 2008
- CP 76: 2022 FMM Update- **Updated the "Checklist for Field Bituminous Equipment Calibration"**
- CP 77: Last update 2018
- CP 78: 2022 FMM Update- **3.2.1,4.1.1, 4.2, 4.2.1, 5.1.2, 6.3, 6.6, 9.2, 9.3 Verified web link.**
- CP 79: 2020-2022 FMM Update- Added MIT Scan Images for Uncut Dowel Baskets. **Revised Title deleted "Uncut Dowel Baskets"., Updated Section 1.1**
- CP 80: Last update 2013
- CP 81: Last update 2018
- CP 82: 2020 FMM Update- New text for Note 6
- CP 85: Last update 2013

SUMMARY OF 2021 CDOT Field Materials Manual Listed Revisions, Additions, and Deletions

- Chapter 200: 2021 FMM Update- Added "guide" paragraph at the top of the first page.
- Chapter 300: 2021 FMM Update- Added Change to Note: Forms are currently in development. The statement added "Contact Ed Trujillo Edward.trujillo@state.co.us 303-398-6566 for assistance with any CDOT form."
- Chapter 400: 2021 FMM update: Updated Forms, Added "guide" paragraph on top of the first page.
- Chapter 500: 2021 FMM update: Updated Forms, Added "guide" paragraph on top of the first page.
- Chapter 600: 2021-2022 FMM update: Added Eric Prieve revisions to chapter 600. Updated Forms, Added "guide" paragraph on top of the first page.
- Chapter 700: 2021 FMM update: Updated Forms, Added "guide" paragraph on top of the first page.
- Chapter 800: 2020 FMM Update- Deleted Chapter 800, A copy of Chapter 800 will be located with each Nuclear Gauge. Additional copies will be located with each Region Radiation Safety Officer and the Region Safety Officer.
- Materials Forms – Instructions & Examples: 2020-~~2022~~ FMM Update- previously Appendix O, a new chapter. Added Change to Note: Forms are currently in development. Contact Ed Trujillo Edward.trujillo@state.co.us 303-398-6566 for assistance with any CDOT form. **Updated Forms List.**
- Electronic Documents 2021 FMM: Added new chapter Introduction to ProjectWise/Projectshare as per 21.1/508.1.
- JSA: 2021 FMM Update: AASHTO Test Method T90, T190. CP-L Test Method 4301, 4302. Update Note: Regions review and update all Job Safety Analysis (JSA) documents.
- AASHTO / ASTM Online: 2022 FMM Update- Added New Instructions for CDOT personnel needing to register to IHS Markit. Added a link to the webpage with instructions.
- Inspections: 2020 FMM Update- Table of Contents (V) Protocol for the Audit of Region Materials Finals Review and Acceptance Process by the Central Materials Laboratory.
- Protocol for Round Robin Materials Testing of CDOT Region & Consultant Laboratories: Last update 2018.

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- The protocol of the Audit of Region Materials, IA Sampling and Testing Program by the Central Materials Laboratory: 2021 FMM Update - Update all AMRL references with the "AASHTO Re:source" reference. Update the distribution list.
- The protocol of the Audit of Region Materials, Finals Materials Review and Acceptance Process by the Central Materials Laboratory: 2021 FMM Update- Update all AMRL references with the "AASHTO Re:source" reference. Update the distribution list.
- The protocol of the Audit of the Local Agency, Finals Materials Review and Acceptance Process by the Central Materials Laboratory: 2021 FMM Update: Update all AMRL references with the "AASHTO Re:source" reference. Update distribution list.
- Appendix A (MAC Charter) revisions as noted: 2021 FMM Update: Membership change from 10 to 9 with the Research Group removed e-vote to follow. Scope, Guests and Guests Uninvited, Appropriate Topics & Discussion, Taskforce Business, MAC meeting minutes, and Executive Summary.
- Appendix A (FPOG): Last update 2018.
- Appendix B Task Force Management Guide: Last update 2018
- Appendix C (Statewide Roster): 2022 FMM Update- Updated region contact information names and phone numbers.
- Appendix D (Definitions): 2020 FMM Update- Owner Acceptance (OA), Owner Verification Testing (OVT).
- Appendix E 2021 FMM Update: AV, AQV, EPE, PEC, OA, OVT, QAP
- Appendix F (Significant Publications): 2021 FMM Update- An updated reference to "Asphalt Institute manual MS-2"
- Appendix G (Colorado Procedures): 2020 FMM Update- Added CP-L 4301, CP-L 4302.
- Appendix H Metric Conversion Tables: 2020 FMM No updates
- Appendix I 2020 FMM update: (Materials Testing Accuracy Criteria): Changed % Soils Relative Compaction (Report to Nearest 0.1%), Base Aggregate Relative Compaction (Report to Nearest 0.1%)
- Appendix J 2021 FMM update: (Laboratory Test Time): Deleted 301 Plant Mix Bituminous Base. Add 409 Flat and Elongated. Added 601 Aggregate Soundness with Sodium Sulfate.

SUMMARY OF 2021 CDOT Field Materials Manual Listed Revisions, Additions, and Deletions

- Appendix K (Establishing Lots or Process Control on the Project) 2020 FMM No updates.
- Appendix L (Random Sampling): 2020 FMM No updates.
- Appendix M (Sample-Processing Procedure): 2020 FMM No updates.
- Appendix N: (Results of Laboratory Check Tests): 2020 FMM Update- Added "Results of Laboratory Check Tests can be used and referenced to more than one project of the RE allows it and if the following criteria are met"