

Quality Assurance Procedures for Construction Materials Sampling & Testing - 24

1. PURPOSE

- 1.1 To prescribe policies, procedures, and guidelines to assure the quality of materials on all Colorado Department of Transportation (CDOT) construction projects are per 23 CFR and the FHWA Stewardship agreement.
- 1.2 The revision and/or development of terminology in the Design-Build Quality Assurance Program from Project Materials to Final Materials has caused CDOT to redefine terms and procedures that have been, implemented by the Department for decades on CDOT projects. CDOT intends to provide as much clarity as possible.

2. REFERENCES

- 2.1 AASHTO R 9 – Standard Practice for Acceptance Sampling Plans for Highway Construction
- 2.2 AASHTO R 10 – Standard Practice for Definition of Terms Related to Quality and Statistics as Used in Highway Construction
- 2.3 AASHTO R 18 – Standard Recommended Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- 2.4 AASHTO R 25 – Standard Practice for Technician Training and Qualification Programs
- 2.5 AASHTO R 38 – Standard Practice for Quality Assurance of Standard Manufactured Materials
- 2.6 AASHTO R 44 – Standard Practice for Independent Assurance (IA) Programs
- 2.7 ASTM D 3665 – Standard Practice for Random Sampling of Construction Materials
- 2.8 ASTM E 177 – Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods
- 2.9 Title 23 Code of Federal Regulations (CFR), Part 637, Subpart B, Quality Assurance Procedures for Construction

3. DEFINITIONS

- 3.1 *Acceptance* - The process whereby all factors used by the agency (i.e., sampling, testing, and inspection) are evaluated to determine the degree of compliance with contract requirements and to determine the corresponding value for a given product. (AASHTO R 10)
- 3.2 *Acceptance Sampling and Testing* – Sampling and testing are performed by the agency, or its designated agent, to evaluate the acceptability of the final product. Also called “verification sampling and testing” when specifically used to validate the contractor’s data. (AASHTO R 10)
- 3.3 *Accredited Laboratories* - Laboratories recognized by a formal accrediting body as meeting quality system requirements including demonstrated competence to perform standard test procedures. (AASHTO R 10) For CDOT, accredited means recognition by the AASHTO Accreditation Program (AAP).
- 3.4 *Certified Technician* – A technician certified by a CDOT recognized agency as proficient in performing certain duties. [A certified technician is, qualified. A qualified technician may or may not be certified.] (AASHTO R 10) CDOT specifies ACI, LabCAT, and WAQTC for the certification of technicians.
- 3.5 *Central Laboratory Samples and Tests* - Random representative samples are submitted to CDOT’s Central Laboratory and/or Region Laboratory to additionally, evaluate the quality of field-produced products and materials, and to perform tests not within the capabilities of the Field and/or Region Laboratories. (CDOT)
- 3.6 *Designated Agent* - An employee or employees of a state, a local agency, consultant, or independent laboratory, which is employed, paid by, and/or directly accountable to CDOT, or a public agency, excludes the Contractors or vendors’ personnel. (CDOT)
- 3.7 *Dispute Resolution* – Also called “conflict resolution.” The procedure used to resolve conflicts resulting from discrepancies between the agencies and contractors’ results of sufficient magnitude to impact payment. (AASHTO R 10)
- 3.8 *Independent Assurance (IA)* - Activities that are an unbiased and independent evaluation of all the sampling and testing (or inspection) procedures used in the quality assurance program. [IA provides independent verification of the reliability of the acceptance (or verification) data obtained by the agency and the data obtained by the contractor. The results of IA testing or inspection are not to be used as a basis for acceptance. IA provides information for quality system management]. (AASHTO R-10).
- 3.9 *IA Project Basis* – Based on the quantity, it may provide an easier way to monitor compliance and ensure that all materials are covered on an individual project. This is the normal sampling and testing frequency, per the IA Schedule, for Item 403 [Hot Mix Asphalt (HMA)]. (CDOT)

- 3.10 *IA System Basis* – Typically administered *Region-wide*. It is *personnel-related rather than project-related* and therefore allows easier tracking of individuals. This approach is usually applied on a time-based, rather than on a quantity-based frequency. This is an alternate sampling and testing frequency, per the IA Schedule, for Item 403 [Hot Mix Asphalt (HMA)] where the minimum frequency is based on an expanded unit of material production and a unit of time. (CDOT)
- 3.11 *IA Combination Basis* – To maximize the effectiveness of the IA program, the RME may choose to utilize both the Project and System Basis within their Region. Based on the number, size, location, or Construction phasing of HMA projects, the RME will have the option of choosing either the Project Basis or the System Basis for every project within their Region. If the Combination Basis is used, the RME will document the field tester’s name(s) and the quantity of HMA used for each project. (CDOT)
- 3.12 *Independent Contractor Quality Control (ICQC)* – This term was developed for Design-Build projects whereby the contractor’s test results may be utilized in the acceptance decision. (CDOT)
- 3.13 *LIMS*– Laboratory Information Management System. SiteManager® includes LIMS, which manages and tracks progress through each step of the sample lifecycle to expedite the overall testing process. (See; SiteManager® Materials) (CDOT).
- 3.14 *Owner Acceptance (OA)* – Synonymous with Agency Acceptance; however, Owner Acceptance will be CDOT’s preferred term. See Acceptance Sampling and Testing. (CDOT)
- 3.15 *Owner Verification Testing (OVT)* - The Department has the ultimate responsibility for verifying that the Project is designed and constructed in compliance with the Contract Documents. As such, the Department or its representative will perform owner verification sampling, testing, and inspection, and conduct audits to verify the Design – Build’s (D-B’s) compliance with the approved Plan from the D-B firm. (CDOT)
- 3.16 *Process Control (PC)* – Synonymous with (*and replaces the term*) “Quality Control.” The system is used by a Contractor to monitor, assess, and adjust its production or placement processes to ensure that the final product will meet the specified level of quality. Process Control includes sampling, testing, inspection, and corrective action (where required) to maintain continuous control of a production or placement process, (AASHTO R 10) and *to fulfill contract requirements*. (CDOT)
- 3.17 *Proficiency Samples* - Homogeneous samples that are distributed and tested by two or more laboratories. The test results are compared to assure that the laboratories are obtaining the same results. (i.e., as part of laboratory accreditation or round-robin testing). (CDOT)
- 3.18 *Qualified Laboratories* – Laboratories that are capable as defined by appropriate programs established or recognized by each Agency. [Accredited Laboratories are considered Qualified; however, a Qualified Laboratory may or may not be accredited.] Laboratories that participate in a qualification program, approved by CDOT, shall include provisions for checking testing equipment and maintaining records of all equipment calibrations and verification checks. All testing equipment used to conduct testing shall conform to the standards specified in the testing procedure. (CDOT)

- 3.19 *Qualified Manufacturer* – A commercial or industrial enterprise that uses components, parts, or raw materials to make a finished good in compliance with specific CDOT requirements or conditions. (CDOT)
- 3.20 *Qualified Technician* – A technician who has been determined to be qualified (i.e., meeting some minimum standard) to perform specific duties. [A qualified technician may or may not be certified.] (AASHTO R 10)
- 3.21 *Quality Assurance (QA)* – (1) All those planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service; or (2) making sure the quality of a product is what it should be. [QA addresses the overall process of obtaining the quality of service, product, or facility in the most efficient, economical, and satisfactory manner possible. Within this broad context, QA includes the elements of process control, independent assurance, acceptance, dispute resolution, etc. QA should be used to replace the term “QA/QC or QC/QA.” QA involves continued evaluation of the activities of planning, design, development of plans and specifications, advertising and awarding of contracts, construction, and maintenance, and the interaction of these activities.] (AASHTO R 10)
- 3.22 *Quality Control (QC)* – Synonymous with Process Control (AASHTO R 10) *in construction*. Quality control is still a valid term concerning Manufacturers. (CDOT)
- 3.23 *Random Locations* – Sampling locations determined using random numbers. (AASHTO R 10)
- 3.24 *Sample* – Also called materials sample when intended to mean: (1) a small physical quantity of material or a measurement obtained in some manner so that the portion (i.e., sample) is representative of the whole, or (2) a quantity of material fabricated in a lab on which future tests can be run. (AASHTO R 10)
- 3.25 *SiteManager® Materials* – AASHTO developed SiteManager®, which integrates the complete construction and materials management process. The SiteManager® Materials Management component provides materials-related information and assists materials laboratory operations for sampling, testing, and reporting for all materials. (CDOT)
- 3.26 *Stewardship Agreement, FHWA* – The Federal Highway Administration (FHWA) has stewardship and oversight responsibilities on Federal-aid programs. CDOT has assumed all project approval authority on National Highway System (NHS) projects, excluding the Interstate. The agreement is established through mutual consent and is reviewed annually. (CDOT)
- 3.27 *State Personnel* - An employee or (employees) of CDOT. (CDOT)
- 3.28 *Stratified Random Sample* - A sample in which each increment in the lot has an equal probability of being chosen. [Samples are taken at times or locations chosen by a method not influenced by opinion or judgment, thus eliminating any bias.] (AASHTO R 10) (CP 75)
- 3.29 *Test Result* – The value of a characteristic obtained by carrying out a specified test method. (AASHTO R 10)
- 3.30 *Vendor* - A supplier of project-produced material that is not the contractor. A vendor may or may not be the Manufacturer, but the distributor of a product. (CDOT)

- 3.31 *Verification Sampling and Testing* - Synonymous with Acceptance Sampling and Testing, when specifically used to validate the contractor's data. (AASHTO R 10) The use of "Project Verification Sampling & Testing Frequency" and "Point of Verification for Quality Determination" in the OA Frequency Guide Schedule for Minimum Materials Sampling, Testing, and Inspection is appropriate because the OA Tester is attempting to validate the contractor's Process Control data. (CDOT)

Note 1: Additional relevant definitions are in the FMM Appendix Chapter.

4. POLICY

- 4.1 *Quality Assurance Plan (QAP)* – It is the policy of CDOT to have a Plan, which will assure that materials, products, and workmanship incorporated in CDOT construction projects, and Local Agency projects, conform with the requirements of the approved plans and specifications, including any approved changes. The program must meet the criteria in 23 CFR, Subsection 637.207, and the FHWA Stewardship agreement.
- 4.2 *CDOT Capabilities* - CDOT shall maintain adequate, qualified staff to administer its Quality Assurance Program. CDOT shall also maintain a Central Laboratory. CDOT's Central Laboratory shall meet the requirements in Sub-section 637.209 (a) (2) of 23 CFR.
- 4.3 *Owner Acceptance (OA) 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 and may include results of process control sampling and testing. In the previous terminology, this was called CDOT's QA Program.
- 4.4 *Independent Assurance (IA) Program* - Independent Assurance samples and tests (and observations) or other procedures shall be performed by qualified sampling and testing personnel employed by CDOT or by contract its designated agent, which would be employed by an AASHTO Accredited Laboratory.
- 4.5 *Sampling and Testing* - All samples and tests used in the verification process are to be performed by qualified testing personnel employed by CDOT or its designated agent (employed by a Qualified Laboratory), contractor, and vendor. Also referred to as Quality Assurance (QA) testing.
- 4.5.1 *Random Samples* – All samples used for verification sampling and testing shall be stratified random samples. Additional samples may be taken at any point in the production for checking quality, but these will not be used for statistical evaluation.
- 4.5.2 *Test Results* - The results of verification tests will be used in the acceptance decision as specified in the contract requirements and all approved changes.
- 4.6 It will be the responsibility of the Region Materials Engineer (RME), under the direction of the Region Transportation Director (RTD), to implement those portions of the Quality Assurance Program applicable to CDOT Regions.

5. SCOPE OF THE QUALITY ASSURANCE (QA) PROGRAM

5.1 The Quality Assurance (QA) Program will provide for:

5.1.1 Owner Acceptance (OA) Program.

5.1.2 Independent Assurance (IA) Program.

5.1.3 Project Materials Certification.

5.1.3.1 Retention of sampling and testing records.

5.2 Quality Assurance (QA) Program Evaluation Checks:

5.2.1 Inspection and Accreditation of CDOT's Central Laboratory performed periodically (the number of months per cycle varies) by the National Reference Laboratory utilizing AASHTO R 18.

5.2.2 Reviews / Audits conducted biennially by the Central Laboratory and the FHWA (Subsections 7.11 and 11.12.3): Independent Assurance Sampling & Testing Program Review, Finals Materials Documentation Review & Acceptance Process Audit, Maintenance Finals Materials Documentation Review & Acceptance Process Audit, LA Finals Materials Documentation Review & Acceptance Process Audit.

6. OWNER ACCEPTANCE (OA) PROGRAM

6.1 OA Frequency Guide Schedule for Minimum Materials Sampling, Testing, and Inspection provides general guidance to personnel responsible for the program for each pay item.

Note 2: The CAR Report 250 lists minimum testing frequencies for materials on the project and updates in real-time. (Reference, OA sampling, testing checklist, and Certification checklist is the name of the document used for all SMM/LIMS projects). For a project not using SMM/LIMS, the CDOT Form 250 will be utilized. Within this Chapter, they are synonymous with intent.

6.1.1 Identification of the specific location (the point) in the construction or production operation at which verification sampling and testing are to be accomplished.

6.1.2 Reference to the specific procedures or project specifications for Project Verification Sampling and Project Verification Testing.

6.2 Project verification sampling and testing through the Owner Acceptance Program will be accomplished and documented on all CDOT construction projects according to the edition of the CDOT Field Materials Manual (FMM) in effect at the time of project advertisement.

6.2.1 The Field Materials Manual contains schedules, tables, nomographs, examples, etc. that aid in completing project verification sampling, testing, inspection, and proper documentation.

6.2.2 Subsections of the Field Materials Manual contain guidelines for using the CDOT Statistical Sampling and Acceptance Plan.

- 6.3 The results of all project verification (OA) tests will be made available to the FHWA Operations Engineer at the project or residency office when requested.

7. INDEPENDENT ASSURANCE (IA) PROGRAM

Note 3: The CAR Report Independent Assurance Sampling & Testing Checklist is the name of the document used for all SMM/LIMS projects. For a project not using SMM/LIMS, the CDOT Form 379 will be utilized. Within this Chapter, they are synonymous with intent.

- 7.1 The CDOT Materials Engineer will act in an advisory capacity to the Region Materials Engineer in carrying out this program, and either he or his designee will be the liaison with other CDOT Divisions, other organizations, consultants, designated accredited laboratories, and the FHWA.
- 7.2 The IA Program is an internal program to be administered and performed by CDOT personnel by designated agents from an AASHTO accredited laboratory. **This program is to be applied to all CDOT construction projects, CDOT Maintenance (MTCE) projects, and Local Agency construction projects regardless of whether they are on the NHS or not.**
- 7.3 Concerning non-SMM/LIMS projects, follow the guidelines and instructions in the “IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing”. The Region Materials Engineer will assign an individual from the Region Materials Laboratory to develop the CDOT Form 379, *Project Independent Assurance Sampling & Testing Schedule*. This person will determine the material items and the number of tests required for every project. The Region Materials Engineer, or his designee, will approve the CDOT Form 379 before distribution to the Project Engineer (approval signature not required).
- 7.3.1 Where more than one sampling location is permitted, the IA Tester reserves the right to further designate the sampling location.
- 7.3.2 IA System Basis Sampling and Testing on Item 403, if used instead of the Project Basis, should be indicated on Independent Assurance Sampling & Testing Checklist. (Additional information can be obtained in the IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing, Item 403).
- 7.3.3 Sampling, witnessing, testing and equipment checks on a project will be performed by the IA Tester, whether CDOT personnel or CDOT’s designated agent, who has no direct responsibility for project verification (OA) sampling and testing, using equipment other than that assigned to the project. All-Region IA testing of OA samples is to be performed in the Region on independent Region equipment by independent Region personnel. The only exception will be samples of binder or emulsion which will be tested at and by the CDOT Central Laboratory. The IA equipment should be independent of the OA process unless otherwise noted on the Independent Assurance Sampling & Testing Checklist.
- 7.3.4 All personnel performing sampling, observations, and testing on CDOT or Local Agency projects will be qualified personnel as noted in Section 8, *Sampling and Testing Personnel Qualifications*, and/or CP 10, *Qualification of Testing Personnel and Laboratories*.

- 7.3.5 Project Materials Lab (test trailer) inspections performed before construction commencing will review the existence of required equipment and their calibrations or verifications, as well as test procedures and the general organization of the field laboratory. This information will be documented on the CDOT Independent Assurance Sampling & Testing Checklist, listed as Item 620.03, and will show the date of the inspection(s). The inspection will be guided by CP 10 and will utilize the Field Lab & Personnel Qualification Checklist.
- 7.4 For Local Agency projects on the NHS, CDOT will administer the Independent Assurance testing as if it was a CDOT project.
- 7.4.1 For Local Agency projects not on the NHS, it is required that Independent Assurance testing be performed as stipulated in the CDOT IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing and within the Quality Assurance Procedures Chapter of the FMM. The Local Agency may use their established and documented procedures to independently verify the adequacy of testing equipment and personnel if their program is approved by the FHWA.
- 7.5 State personnel or designated agents employed by an AASHTO designated accredited laboratory, performing IA Sampling and Testing will be limited to witnessing no more than 20% of the QA tests performed. This is defined as no more than 20% of each test element. Witnessing more than this limit has the potential of involving the IA Tester in too many of the day-by-day project-level responsibilities and activities of the OA Tester. The concept of witnessing testing performed by OA Testers instead of the IA Tester performing the required test is to be minimized as much as possible or eliminated.
- 7.5.1 Project inspections performed during construction will check the project (OA) equipment to assure the equipment is adequate for the designated procedure. The equipment will also be checked at that time for the required calibration, if applicable, and that proper documentation of the verification checks are on file. The inspection will be guided by CP 10 and the Field Lab & Personnel Qualification Checklist.
- 7.5.1.1 The CDOT IA Stamp text which is applied to applicable CDOT forms states the following:
"Equipment used for the sampling & testing was inspected and found to be satisfactory. Sampling & testing complied with CDOT Procedures. IA testing was performed independently of field samples on independent equipment unless noted. Test results were reviewed with project personnel."
- 7.5.1.2 If any discrepancies to the project equipment are found by the IA Tester, they should be documented and reported to the Project Engineer at the earliest opportunity with a description of the repair or replacement needed. Appropriate notations should be made on the applicable reporting test form or a separate memo if required.
- 7.6 The IA System Basis for Sampling and Testing may be used in a Region. The testing and sampling frequency will be based on either a unit of production or a unit of time. (Additional information can be obtained in the IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing, Item 403). If it is used throughout the Region, it should last for the entire calendar year. If it is used for a project, it should be used for the entire project and last for its duration.

- 7.6.1 The Annual Report on Program Wide Independent Assurance Testing of Hot Mix Asphalt Materials using the System Basis will be developed by the Central Laboratory and sent to the FHWA summarizing the results of the IA System Based program, per CFR 23, Subsection 637.207 (2) (iv). The report for the previous calendar year is distributed before March 31st of the subsequent year.
- 7.6.1.1 Distribution List:
FHWA - Direct Recipient
Chief Engineer
Director of Staff Services
Regional Transportation Director
Region Materials Engineer
- 7.7 On CDOT projects the OA testing equipment will be evaluated by using equipment verification checks, testing split samples of verification or proficiency samples, or any combination of methods.
- 7.8 On CDOT projects the OA testing personnel will be evaluated by observation of sampling and testing procedures, along with testing splits of verification or proficiency samples, or any combination of the methods.
- 7.9 A prompt comparison will be made between the initial test results obtained from the OA Tester being evaluated and the Independent Assurance (IA) Tester, using the guidelines enumerated in the CDOT Field Materials Manual's IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing and Table One Comparison Precision Guide; and then documented as required.
- 7.9.1 Field reviews of IA samples will be documented by signing and dating entries on the applicable test reports by the IA Tester.
- 7.9.2 Initial split-sample test results that compare within the limits of the Comparison Precision Guide from the IA Frequency Guide Schedule (Table One) will not require any comments on the reporting form. Minor Differences do not need to be investigated.
- 7.9.3 If the initial split-sample test results have "Significant" Differences, the Region Materials Engineer or his designee will investigate to determine the probable cause of the difference.
- 7.9.3.1 This investigation may be as simple as having all testing personnel run their retained split of the sample. The results of the Region Materials Engineer's investigation must be documented on the appropriate CDOT form listed in the Schedule. The statement must reference the exact "difference", the cause of this difference, and the corrective action taken to remedy the issue. If necessary, the investigation may be attached to the appropriate form.
- 7.9.3.2 Prompt and appropriate action will be taken by the Project Engineer to correct or improve sampling and/or testing methods if the need is indicated.

- 7.9.4 The Project Engineer makes acceptance decisions based on verification (OA) sampling and testing, and factors relating to the quality of the material or product. What should not be incorporated into these statements is a recommendation for an acceptance decision at full price. IA testing is not to verify the quality but is meant to evaluate personnel and check equipment. However, these test results may be used by the Project Engineer to support his decisions.
- 7.10 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.”**
- 7.10.1 Exceptions to this statement, such as “Significant Differences”, have been previously commented on and documented when the test results were reported or are explained on this form or an attached sheet. The Independent Assurance Sampling & Testing Checklist may include supplemental attachments.
- 7.10.2 The Independent Assurance Sampling & Testing Checklist will be forwarded to the Project Engineer for acknowledgment through his Project Review signature.
- 7.11 A review of each CDOT Region’s IA Sampling and Testing Program will be performed every two years, at a minimum, by Central Laboratory Personnel and the FHWA. The purpose of the review will be the verification of compliance with 23 CFR, Part 637, Quality Assurance Procedures for Construction, and the applicable Sections of the CDOT Field Materials Manual.
- 7.11.1 The Biennial Independent Assurance Sampling and Testing Program Review with the Region Materials Engineer will be conducted to check IA program compliance, document problems, document the current inclusion of CDOT MTCE projects and LA projects into the program, and observe Region-by-Region uniformity. A minimum of two weeks, notice will be given to the Region Materials Engineer. Information on inspections is in the Inspection (Central-to-Region) Chapter.
- 7.11.2 The findings and recommendations of the review will be discussed with the CDOT Materials Engineer and will be reported to the FHWA.
- 7.11.3 Distribution List:
FHWA - Direct Recipient
Chief Engineer
Director of Project Support
Regional Transportation Director
Region Materials Engineer

8. SAMPLING and TESTING PERSONNEL QUALIFICATIONS

- 8.1 The Code of Federal Regulations (23 CFR) requires that persons conducting tests used in the acceptance decision or IA inspections be qualified. This includes employees of CDOT and designated agents conducting verification (OA) testing, PC testing used in the acceptance decision (PC-For-Pay) by contractor and vendor employees, and IA testing by employees of CDOT or designated agents of CDOT. The requirements that must be met for an employee to be qualified are defined in CP 10 of this manual.

9. LABORATORY QUALIFICATION PROGRAM

- 9.1 23 CFR requires that laboratories conducting tests used in the acceptance decision or laboratories conducting IA testing be qualified. This includes CDOT and designated agent laboratories conducting verification tests plus contractor and vendor laboratories conducting PC testing used in the acceptance decision. These laboratories are inspected by the Region Materials Laboratory, or a designated agent selected by the Region Materials Laboratory before project testing begins. The procedures for conducting inspections are described in CP 10 of this manual.

- 9.2 23 CFR requires that the CDOT Central Laboratory be accredited by AASHTO Re_source (AAP)/CCRL. Designated agents conducting IA sampling, testing, and inspections for CDOT must also be AASHTO accredited. The detailed accreditation requirements are in CP 10 of this manual.

9.2.1 Qualifications:

- 9.2.1.1 Central Laboratory and designated agents: The CDOT Central Laboratory and designated agents shall be AASHTO Re_source (AAP)/CCRL accredited.

- 9.2.1.2 **Annual Region Materials Laboratory Inspections:** Central Laboratory personnel shall perform an inspection of each CDOT Region Materials Laboratory annually.

The CDOT Region Materials Laboratories are:

- Region 1: Denver & HMA Mobile Lab
- Region 2: Pueblo & HMA Mobile Lab
- Region 3: Grand Junction & HMA Mobile Lab
- Region 4: Evans & HMA Mobile Lab
- Region 5: Durango, Alamosa & HMA Mobile Lab

Other permanent laboratories within the Regions are considered Project/Field Laboratories.

- 9.2.1.3 The Annual Region Materials Laboratory Inspections protocol is in the Inspection (Central-to-Region) Chapter.

- 9.2.2 Equipment Verification Checks: All laboratories performing IA testing shall conduct verification checks at the minimum frequencies required by the test procedure, equipment operating guides, or Verification schedule included in the Field Materials Manual's Inspections Chapter. The results of the equipment verification checks shall be recorded on CDOT Form 520 and retained for seven years. When testing HMA, the appropriate calibration checks specified in CP-L 5101 shall be used.

9.3 Verification Testing: CDOT Laboratories or their designated agent shall be allowed to perform verification testing if they meet the following requirements. All requirements include the verification of testing equipment function, review of equipment maintenance, and review of the records of all equipment calibrations and verifications.

9.3.1 Annual Inspection:

9.3.1.1 CDOT Laboratories: The Region Materials Laboratory shall conduct a check of project testing Field Laboratory equipment. The Central Laboratory may also conduct random Field Laboratory equipment inspections during project construction. The Resident Engineers, in cooperation with the Region Materials Engineer, shall be responsible for assuring that CDOT owned project testing equipment is acceptable for verification (OA) sampling and testing.

9.3.1.2 Designated Agent Laboratories: The Region Materials Laboratory or its designated agent shall conduct a check of project testing laboratory equipment. The Central Laboratory may also conduct random Field Laboratory equipment inspections during project construction. The Region Materials Engineer shall be responsible for assuring that project testing equipment is acceptable for verification (OA) sampling and testing.

9.3.2 Equipment Verification Checks: All laboratories performing verification (OA) testing shall conduct equipment verification checks on all testing equipment used. The results of the verification checks shall be recorded on CDOT Form 520 and retained for seven years. When testing HMA, the appropriate verification checks specified in CP-L 5101 shall be used.

9.3.3 If the actual laboratory in which the verification tests are performed holds current AASHTO accreditation, it shall be exempt from the requirements of Subsection 9.3.1 and 9.3.2.

9.4 Round Robins are conducted every year during the winter season. It provides all participating laboratories the opportunity to look at their test procedures and test results concerning other labs.

9.4.1 The Round Robin protocol is in the Inspection (Central-to-Region) Chapter.

10. LABORATORY ACCREDITATION

10.1 CDOT's Central Laboratory must be accredited. 23 CFR Part 637 requires that designated agent laboratories conducting IA testing be accredited. Accreditation requirements are detailed in CP 10 of this manual.

10.2 Central Laboratory Inspection. The CDOT's Central Laboratory will be inspected periodically by the AASHTO Re_Source (AAP)/CCRL Accreditation Program utilizing laboratory assessment and proficiency sample services provided by AASHTO Re_source/CCRL.

10.2.1 The AASHTO Re_source (AAP)/CCRL statistical reports and the report on Central Laboratory inspection will be reviewed by the CDOT Materials Engineer and Central Laboratory Program Managers, and copies will be furnished to the FHWA.

- 10.2.2 Any deficiencies in Central Laboratory procedures or equipment will be corrected at the earliest opportunity, and corrective actions documented when directed and furnished to the appropriate National Standards Reference Laboratory, and with copies furnished to the FHWA.
- 10.2.3 Any AASHTO Re_source Proficiency Sample(s) which have a rating of less than 3 (>2.0 Standard Deviations), will be reviewed by the CDOT Materials Engineer and Central Laboratory Program Managers. The cause of the low ratings will be investigated, and corrective action will be taken to prevent future occurrences. These actions will be reported, in writing, to AASHTO Re_Source/CCRL, with copies furnished to the FHWA, within 60 days of the date of AASHTO Re_source / CCRL inspection.

11. PROJECT MATERIALS CERTIFICATION

- 11.1 A CDOT Owner Acceptance Sampling & Testing Checklist (CAR Report 250) will be developed by the Documentation Unit of the Materials and Geotechnical Branch for all projects if they are administered by CDOT or by a local agency. On Design/Build projects the Engineer shall send the list of pay items and approximate quantities furnished by the Contractor to the Documentation Unit of CDOT Materials & Geotechnical Branch as soon as it is received.
- 11.2 The CDOT CAR Report 250 will list the minimum sampling and testing requirements for each product or material bid item, for both, verification (OA) tests and laboratory check tests. The original CAR Report 250 will remain in the Staff Materials project file with duplicate copies being distributed to the Region Materials Engineer, Resident Engineer, Project Engineer, or the Region's Local Agency Coordinator.
- 11.3 The Engineer will document actions taken by project personnel concerning acceptance decisions based on verification (OA) sampling and testing. Acceptance decisions include price reductions, corrective actions or removals, dispute resolution, etc.
- 11.4 The results of laboratory check tests will be evaluated using the same criteria detailed in (Table 1), IA Frequency Guide Schedule. They will be reported to the project personnel as follows:
- 11.4.1 Meets Acceptance Decision Criteria based on verification (OA) sampling and testing.
- 11.4.2 Minor Difference from Acceptance Decision Requirements: No further action is required.
- 11.4.3 Significant Differences from Acceptance Decision Requirements: Further action is required.
- 11.4.3.1 When laboratory check test results do not agree with the contract requirements, whether the check tests are performed at the Central or Region Laboratory, project personnel will be notified, and the reports, by computer reporting, will be forwarded as soon as possible.
- 11.4.3.2 The Project Engineer will investigate these Significant Differences and attempt to determine why the verification tests did not correlate with the check tests. The Engineer will determine and document the reason for the deviation or difference, and any corrective action taken.
- 11.5 The Project Engineer will document all project materials sampling and testing through the completion of the CDOT SM Report 250 and by signing and dating the last page.

- 11.6 The Region Materials Engineer will furnish the Project Engineer with a signed copy of the CDOT Independent Assurance Sampling & Testing Checklist, *Project Independent Assurance Sampling & Testing Schedule*. The responsibility for the review and completion of the CDOT Independent Assurance Sampling & Testing Checklist through to the final approval will reside with the Region Materials Engineer, as per Subsections 7.3 and 7.10.
- 11.7 To make the Final Materials Certification process more efficient it has been decentralized; therefore, the Final Materials Certification for each project is to be completed by region personnel.
- 11.7.1 Final Materials Certification. The three applicable Documentation Chapters of the Field Materials Manual provide specific guidelines for the completion of this aspect of the program.
- 11.8 The Project Engineer reviews and signs the developed CDOT Form 473, *Letter of Final Materials Certification*, both Page 1 and 2.
- 11.9 The Resident Engineer certifies on the CDOT Form 473, *Letter of Final Materials Certification*: The results of the tests on the acceptance samples indicate that the material incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications; and such results compare favorably with the results of the Independent Assurance sampling and testing. The signed CDOT Form 473 includes all the following attachments:
- 11.9.1 A copy of the Final Materials Certification - Explanation of Exceptions, Form 474.
- 11.9.2 A copy of the Independent Assurance Sampling & Testing Checklist.
- 11.9.3 A copy of the Final Materials Documentation Checklist, (Project Closure), Form 1199 Page 1. (This is not required for SiteManager® projects).
- 11.9.4 A copy of the Finals Materials Documentation Checklist, (Review or Audit), Form 1199 Page 2. (This is not required for SiteManager projects).
- 11.9.5 A copy of the CP 16, Evaluation of Materials Testing, Form 1324 (when applicable).
- 11.10 The Letter of Final Materials Certification (Form 473) will be distributed per the instructions in the applicable Documentation Chapter of this Manual. If any part of the CDOT Form 250 is used to explain exceptions or deviations of product or materials, that part must be attached to the completed Form 474, Explanation of Exceptions. If any of the last five sections [Documentation for Added Materials Items, Documentation for Deleted Materials Items, Summary of Laboratory Check Test Deviations, Summary of Sampling and Testing Deviations, and Summary of Project Price Reduction Documentation] contain information then these pages must also be attached.
- 11.10.1 The Explanation of Exceptions will address all materials deviations from the plans and specifications, and the subsequent action is taken, as well as any comparison differences between Quality Assurance test results, and Independent Assurance test results, and any missing tests.

- 11.11 The Region review process for a completed construction project's materials documentation, it is required that each region will follow the guidelines as defined in the current Field Materials Manual SMM_LIMS Documentation Chapter.
- 11.12 The CDOT Materials Engineer will establish a Materials Documentation Quality Review Team to audit each Region's Finals Materials Review and Acceptance Process.
- 11.12.1 The Materials Documentation Quality Review Team will consist of representatives from the Central Materials Laboratory and the FHWA, if they choose to participate, meeting with the CDOT Region Materials Engineer, the Region Finals Administrator, the Region Finals Materials Documentation Coordinator, and the Region LA Coordinator. The Region may invite other interested and knowledgeable individuals.
- 11.12.2 An audit of each CDOT Region's Finals Materials Documentation Process will be performed every two years, at a minimum. The audit will utilize both a questionnaire and an audit of a minimum of two randomly selected completed projects. This process will apply to the CDOT construction and MTCE programs and LA programs.
- 11.12.2.1 Additional reviews may be scheduled as deficiencies are identified and to accommodate contract dollar volume per Region.
- 11.12.3 The **Biennial Finals Materials Documentation Review and Acceptance Process Audit** with the Region Materials Engineer is to ensure compliance with the requirements of the Documentation Chapters of the Field Materials Manual and to identify areas for potential improvement. The **Biennial Local Agency Finals Materials Documentation Review and Acceptance Process Audit** with the Region LA Coordinator is to ensure compliance with the requirements of the Documentation Chapter of the Field Materials Manual and to identify areas for potential improvement. A minimum of four weeks of notice will be given to the Region Materials Engineer, the Finals Administrator, and LA Coordinator to provide a list of all applicable closed-out projects. A minimum of ten days will be provided for the selected projects to be made available.
- 11.12.3.1 The findings and recommendations of the audit will be discussed with the CDOT Materials Engineer and will be reported to the FHWA.
- 11.12.3.2 Distribution List:
- FHWA - Direct Recipient
 - Chief Engineer
 - Director of Project Support
 - Regional Transportation Director
 - Program Engineer
 - Resident Engineer
 - Region Materials Engineer
 - Maintenance Superintendent
 - State Maintenance Engineer

12. MAINTAIN QA PROGRAM REQUIREMENTS

- 12.1 It will be the responsibility of the CDOT Materials & Geotechnical Branch to maintain and periodically update the QA program as required.
- 12.2 The CDOT Materials Advisory Committee (MAC) will meet, as required, to review the Quality Assurance Procedures and recommend revisions.

13. FIELD MATERIALS DOCUMENTATION

- 13.1 It is the responsibility of the Project Engineer to accept or reject materials and/or products based on documentation submitted at the project level. The Central Laboratory personnel will act only in an advisory capacity to the project personnel in determining the acceptability of a product or material unless otherwise stated.
- 13.2 All Materials Forms must have the appropriate Project Number and Contract ID easily identified on them.
 - 13.2.1 Project Number: The Alpha-Numeric project identifier that incorporated the highway number.
 - 13.2.2 Contract ID: This is a five-digit numeric designator. (Before SiteManager® it was referred to as Project Code).
 - 13.2.3 Sample ID: All testing and certification documents shall have the SMM/LIMS Sample ID on the document or the first page of multiple pages.

Note 4: As accounting processes change, the project information identifiers may also change. Personnel should be aware of the most current method.

- 13.3 All documents and reporting Forms must be dated and signed by the appropriate and specified personnel.

Note 5: A Materials Bulletin will be issued with the revised text for Subsections 13.4 through 13.4.4. The guiding document will be Procedural Directive 21.1.

- 13.4 To comply with adequate field documentation as stated in the CDOT Construction Manual, project field worksheets should be handled in the following manner:
 - 13.4.1 The first Form will have a printed name and signature.
 - 13.4.2 Thereafter the Form can be initialed by the same person instead of applying a signature.
 - 13.4.3 If at any time the project personnel are changed, the above process will be started over.
 - 13.4.4 The final worksheet in any series of testing for any pay item will have the last Form signed, rather than initialed.

13.5 Where predominately computer forms or worksheets are being used on a project, sufficient information will be available in the project records to determine the responsible party performing the sampling, testing, documentation, and record-keeping.

14. DISTRIBUTION OF MATERIALS RECORDS and RETENTION OF SAMPLING and TESTING RECORDS

14.1 All originating materials (original document) records for construction projects are to be kept in the project file in the Region. These include, but are not limited to, COCs, CTRs, and all Forms that document test results for acceptance of materials or products used on construction projects.

14.2 These records may be made available to the public through a written request on CDOT Form 1092, *Request to Inspect Public Records*.

14.3 The appropriate Forms that aid in the identification of samples and provide instructions for testing of samples will either be processed electronically for a SiteManager[®] applicable project or if it is not a SiteManager[®] project the appropriate form will be attached to each sample submittal addressed to the appropriate laboratory.

14.4 The Central Laboratory personnel will provide acceptance details on products and materials that are stated in the OA Frequency Guide Schedule or other applicable documents that state the Central Laboratory is directly involved.

14.4.1 Do not send copies of product or materials forms, or associated documentation to any Staff Branch unless it is specified on the Form distribution or specifically addressed to do such in the Field Materials Manual.

14.5 Copies of product and/or materials reports for acceptance decisions and IA reports will be retained for all CDOT projects at the designated Region office for the period specified in CDOT's Records Retention Procedural Directive.

15. TRAINING PROGRAMS and SEMINARS for CDOT PERSONNEL

15.1 Region Materials Training Programs. Formal training courses in materials sampling and testing will be conducted in each Region as needed, by the Region Materials Engineer for new state personnel that is assigned to construction projects.

15.2 Annual refresher courses will be conducted on an as-needed basis in each Region by the Region Materials Engineer for CDOT personnel involved with construction products and materials sampling and testing.

15.3 Statewide Materials Training Programs: The Central Laboratory will conduct training programs on an as-needed basis in specific areas of materials engineering properties intended to address statewide concerns. This may include the sampling of materials and testing procedures. Central Laboratory personnel are also available to participate in region training programs when requested.

- 15.4 Materials engineering conferences may be scheduled by the Central Laboratory. Participants may include representatives from Region Materials and Region Construction Offices as well as Central Laboratory Program Managers and personnel from other Staff Branches. Each Region Materials Engineer may submit items during the construction year for the agenda.
- 15.5 The Concrete Unit of the Central Laboratory will define, coordinate, and support a program for CDOT personnel to assure the accuracy and conformance of compressive strength testing of concrete cylinders. The program shall include equipment checks, procedure checks, inter-lab testing, training, and ACI certification. The details of this program are in Chapter 600 of the Field Materials Manual.
- 15.6 The Nuclear Unit of the Central Laboratory will present the *School of Radiological Safety and Nuclear Gauge Operation* on a biennial basis for re-certification of materials testers, or annually as needed for new employees.

16. TERMINOLOGY AND ABBREVIATIONS

- 16.1 Titles having a masculine gender, such as he, his, him, are utilized for the sake of brevity and are intended to refer to persons of either sex.
- 16.2 Whenever an abbreviation is used, it is to be construed to be the same as the respective expression.
- 16.3 Whenever an acronym is used, it is to be construed to be the same as the respective expression.
- 16.4 Whenever the title, the Engineer, is mentioned it refers to the Chief Engineer of the Department acting directly or through an authorized representative, who is responsible for engineering and administrative supervision of the project.
- 16.5 The Staff Materials & Geotechnical Branch, Staff Materials, the CDOT Materials Lab, and the Central Laboratory are all synonymous with this publication; however, the CDOT Central Laboratory is a national reference, and the Staff Materials & Geotechnical Branch is a CDOT administrative reference.

17. EXAMPLES

- 17.1 Examples of the CDOT Form 250 (first and last three pages only), 379, 473, 474, (Page 1 & 2) referenced in this chapter can be found in the applicable Documentation for SMM/LIMS Chapter.
- 17.2 Example of the CDOT Form 1199 can be found in the Local Agency Chapter.
- 17.3 An example of CDOT Form 520 referenced in this chapter can be found in the Inspections (Central-to-Region) Chapter.
- 17.4 An example of CDOT Form 1092 is not provided in this Manual; however, it may be obtained through the CDOT Forms Catalog.