

Design-Build Quality Assurance Program Project Materials to Final Materials - 21

1. INTRODUCTION

1.1 GENERAL

The intent of this chapter is to provide statewide consistency and a programmatic approach to quality assurance for Design-Build projects where the Contractor's quality control test results may be used in the acceptance decision and to provide the Region personnel guidance on the documentation of the material from the beginning of the Design-Build (D-B) project to the closure of the project files. The D-B delivery is often used for large, complex, fast-paced projects. It can also be used for smaller less complex projects in a streamlined D-B format. While project management and quality management require some adjustment to address these typical D-B project characteristics, it should be understood that the fundamental principles of quality assurance do not go away with this alternative contracting method. The materials documentation on a D-B project needs to be accurate, complete and processed within the officially established time frame after the issuance of the project's Final Acceptance Letter per Section 105.21 (b).

The primary shift in responsibility with D-B is the assignment of the design function to the Contractor. This allows more construction risk to be appropriately shifted to the Contractor, as the Designer on the D-B Team is the Engineer of Record and now owns responsibility for the design. There is no change in the core quality assurance functions of quality control and Owner Acceptance (OA) on D-B projects. CDOT must retain its responsibility for the effective construction acceptance function along with the fundamental quality assurance principles or requirements of Title 23, Code of Federal Regulations, Part 637 (23 CFR 637.207(b)) for Federal-Aid Highway projects. This chapter is intended to provide clear guidance for proper quality assurance roles and responsibilities. The definitions of quality assurance used in this Manual are found in AASHTO R 10-2011, *Standard Practice for Definition of Terms Related to Quality and Statistics as Used in Highway Construction*. In today's practice, the term quality assurance refers to the overall activities of both the Contractor and CDOT. It is the overall system for assuring project quality. Under the quality assurance umbrella, the Contractor's responsibility is quality control and CDOT's responsibility is "Acceptance."

The CDOT Quality Assurance Plan (QAP) consists of a quality control program, an owner acceptance (OA) program, and an independent assurance (IA) Program. The QAP allows for the use of the Contractor's performed test results, referred to as Independent Contractor Quality Control (ICQC), as part of an acceptance decision if those results are validated by the Owner Verification Testing (OVT) results performed by the Department or a representative for CDOT. The CDOT QAP clarifies federal requirements relating to quality assurance and statistical analysis procedures.

The QAP, as stated, is comprised of several components and the relationships between the parties and functions are shown in Figure 1.

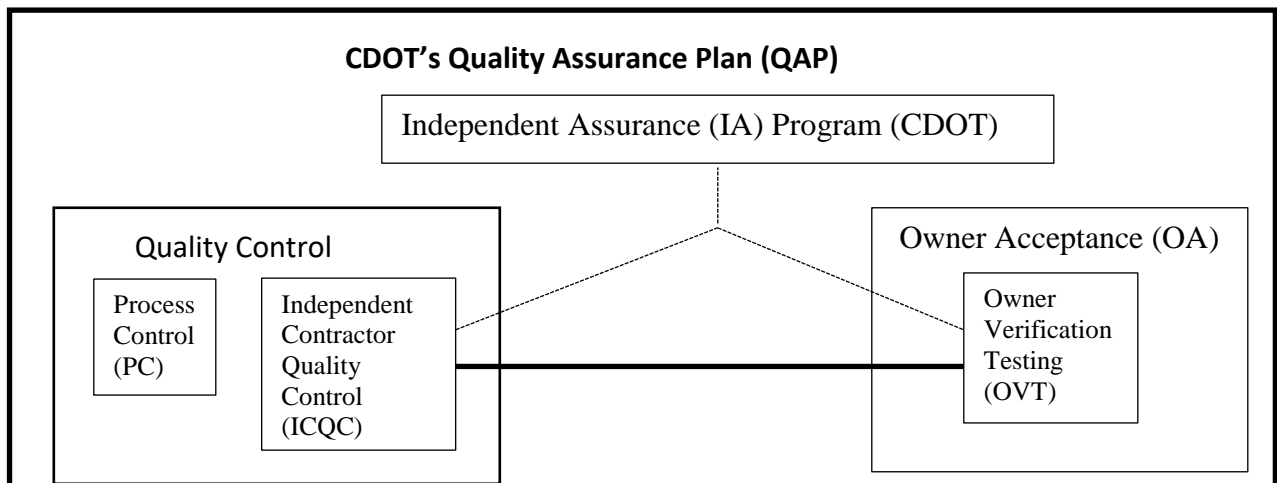


Figure 1 – Components and Relationship in CDOT's QAP

Acceptance may consist of OA testing or OVT verifying and validating ICQC testing.

1.2 Conflict of Interest

To avoid the appearance of a conflict of interest, any independent qualified laboratory shall perform only one of the following types of testing on the same project.

- A. Process Control testing (PC);
- B. Independent Contractor Quality Control testing (ICQC);
- C. Owner Verification Testing* (OVT);
- D. Independent Assurance testing* (IA); or
- E. Referee testing* (See Subsection 3.5.2 for more information).

* CDOT may perform OVT, IA, and Referee testing as long as separate equipment and personnel are performing the tests.

2. QUALITY CONTROL

2.1 General

The Contractor is responsible for the quality of the Work as imposed by the Contract. Project quality will be enhanced through the daily efforts of all the workers involved with the Work, supported by the Contractor's quality control plan. The Contractor's PC shall not be part of the acceptance program; this is strictly for the Contractor's internal production control only.

2.1.1 Reporting, Record Keeping, and Documentation

The Contractor's team and the Department's personnel shall maintain construction workmanship and materials quality records of all inspections and tests performed. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action, and corrective actions taken. These records shall cover both conforming and defective or deficient features, and shall include a statement that all products and materials incorporated in the Work are in full compliance with the terms of the Contract Documents.

2.2 Design-Build Process Control (PC) Requirements

The Contractor shall establish a documented systematic approach to define the processes, methods, procedures, and documentation for delivery of PC on the Project. These methods and procedures shall clearly define the authority and responsibility for the administration of the PC plan.

The Contractor's team and Subcontractors' construction workforce are all considered to be members of the Contractor's Process Control staff as each is responsible for the quality of the Work. Personnel responsible for performing Process Control inspection shall be knowledgeable and trained to perform their duties. Qualified personnel and laboratories performing Process Control sampling and testing shall be knowledgeable in the testing methods and procedures in accordance with Colorado Procedure (CP) 10.

Although not used for acceptance, PC testing and inspection shall ensure quality has been incorporated into all elements of the Work prior to requesting acceptance testing and inspection. Sampling and testing of all materials during the production or manufacturing processes shall be performed by personnel who hold the required certifications as specified in this Manual for the appropriate material. This effort by the Contractor will support CDOT's QAP in that only materials meeting the specifications are supplied for ultimate incorporation into the Work. Minimum PC sampling and testing guidelines are located in this Manual in the chapter entitled *OA Frequency Guide Schedule for Minimum Materials Sampling, Testing, and Inspection* [tab entitled, Schedule (Owner Acceptance)].

2.3 Independent Contractor Quality Control (ICQC)

When CDOT uses Contractor Quality Control in the acceptance decision, both the ICQC and OVT testing make up the Department's acceptance decision. Section 3.2 describes the sampling and testing requirements for both the ICQC and OVT groups. Section 3.3 describes materials acceptance specific to ICQC requirements and Section 3.4 describes Owner Verification Testing, statistical analysis, and reporting requirements specific to OVT requirements. The Department's verification sampling and testing are divided into three levels based on the material and method.

Level 1 provides continuous analysis for those materials and tests shown in Table 1 that are strong indicators of performance. Examples include compressive strength for hydraulic cement concrete, percent soil compaction for embankment, and percent asphalt content for hot-mix asphalt (HMA). The OVT frequency is approximately 10 percent of the ICQC testing frequency. A minimum of three OVT results is required. F-tests and t-tests are to be performed on these material categories on a continuous basis with the addition of each OVT result. The p-values (from the F-tests and t-tests) are reported for each analysis and are tracked over time. The p-value is a probability value ranging from 0 to 1 and is an indication of the probability that OVT data does not validate the ICQC test data. To implement this concept, the critical p-value is set equal to the level of significance (or alpha value) for each material category as shown in Table 2. When the calculated p-value is above the established p-value, then statistical validation occurs. This approach of tracking p-values over time enables the Department to efficiently monitor the validation status of each analysis category daily in "real-time" and allows for more timely action to address non-validation.

Level 2 provides an independent verification process for those materials shown in Table 3 that are secondary indicators of performance. An example is the temperature test for hydraulic cement concrete. The OVT frequency should be a minimum of one material test every three months during construction and will be plotted with the ICQC results of the same material.

Level 3 provides observation verification for those materials that only require very few ICQC tests or tests on materials whose risk of failure does not affect the long-term performance of the facility. Under the Level 3 approach, the Department does not perform tests but observes the ICQC test performance for equipment and procedural compliance with the test procedure or obtains a copy of the Certificate of Compliance (COC) or Certified Test Results (CTR). The frequency of this testing is a minimum of once per project per test method, or periodically as determined by the CDOT Region Materials Engineer. For Level 3, the Department's representative observing the ICQC technician performing the test enters his observational findings and retains a copy of the COC or CTR in the appropriate section of the materials books for record-keeping purposes (See Section 16, Organizational Guide for Project Material Books, in the CDOT FMM Chapter entitled Documentation – CDOT Maintenance and Local Agency).

If the Department chooses to shift the risk to the Contractor and include the Contractor's performed tests, the Department will use the sampling and testing frequency shown in Table 1: *Level 1 - Owner Verification Testing Schedule for Minimum Materials Sampling, Testing, and Inspection* with level of significance shown in Table 2: *Level of Significance for F-tests and t-tests* along with the sampling and testing frequency shown in Table 3: *Level 2 - Owner Verification Testing Schedule for Minimum Materials Sampling and Testing* within this chapter.

3. QUALITY ACCEPTANCE PROGRAM

3.1 General

There are two types of acceptance on D-B projects.

The first type of acceptance is CDOT performed Owner Acceptance (OA) where acceptance testing and inspection are performed by the Department or its representative. If the Department chooses to perform all of the acceptance testings, the sampling and testing frequency is defined by the *OA Frequency Guide Schedule for Minimum Materials Sampling, Testing, and Inspection* as shown in the *CDOT Field Materials Manual*.

The second type of acceptance is when the Department uses contractor quality control tests performed by the Contractor's Independent Contractor Quality Control (ICQC) firm. This type of project acceptance program will require the Contractor to perform the quality inspection, sampling, and testing similar to the Department's requirements for acceptance and will require the Department to implement an OVT program for the project. When the Department uses this method, ICQC and OVT together are the basis for the acceptance decision. CDOT may use ICQC results for acceptance when they are statistically validated and/or verified by the OVT results. ICQC is performed by the Contractor's firm and OVT is performed by the Department or its representative.

The ICQC portion of the Contractor's Quality Control plan shall include the internal procedures used by the Contractor's team to ensure that the Work is inspected and tested to verify compliance with the released-for-construction plans, approved shop drawings, working drawings, and specifications and approved Change Orders. The ICQC program shall be completely separate from the PC program.

3.2 Sampling and Testing

This section provides guidance on sampling, testing, inspection, and acceptance requirements to be used in the acceptance decision. References in the Contract to a Colorado Procedure (CP), test designation of the American Association of State Highway and Transportation Officials (AASHTO), the American Society for Testing and Materials (ASTM), or any other recognized national organization means the latest revision of that test method or specification for the work in effect on the proposal due date.

3.2.1 Sample Types and Uses

The F-tests and t-tests described in subsection 3.4.3.1 – Statistical Analysis are only valid when using random independent samples. However, split samples may be used outside of the statistical analysis for owner corroboration of the ICQC tests under the Department's Check Testing program defined in Colorado Procedure (CP) 13. This CP defines a comparison process for performing and analyzing split samples between the Department and ICQC and is necessary during the startup operation of the QAP. These samples will be analyzed by the Department in accordance with CP-13 and the results discussed with the ICQC firm to assure laboratory and technician test results compare favorably. Split samples may also be performed throughout the life of the project as necessary to investigate non-validating material categories and verify or realign testing equipment and personnel. The Department's OVT may observe any sampling and/or testing performed by the Contractor. Members of the D-B team or ICQC team may also observe the sampling and/or testing performed by the OVT and should report any discrepancies to the Project Engineer.

3.2.3 Quantities and Testing Frequency

The ICQC firm shall continuously track and record the quantity of material incorporated into the Project and shall generate a weekly report to ensure ICQC compliance with the Minimum Sampling and Testing Schedule. The Department shall use the report to verify compliance of the ICQC and OVT frequencies.

At a minimum, the ICQC firm shall perform material sampling and testing at random locations and frequencies in this Manual in the *Schedule for Owner Acceptance (OA)*. ICQC tests are required to be independent of the OVT tests. To verify ICQC test results, OVT tests shall be performed at a frequency identified in Tables 1 and 3. However, if the ICQC increases their tests above the minimum shown in the *Schedule for Owner Acceptance (OA)*, then the OVT schedule should be adjusted to a frequency no less than 10 percent of the ICQC.

3.3 Independent Contractor Quality Control (ICQC) Requirements for Materials Acceptance

The Contractor's ICQC shall establish a documented systematic approach to define the processes, methods, procedures, and documentation for material incorporated into the Work. These methods and procedures shall clearly define the authority and responsibility for the administration of the ICQC. The ICQC must develop and maintain a robust document control system for materials sampling and testing, construction inspections, Non-Compliance Records (NCRs), etc. which is acceptable to the Department.

The ICQC testing shall be performed by personnel who hold the required certifications as specified in this Manual for the appropriate material and shall be responsible for entering materials test data into CDOT's SiteManager® Materials and Laboratory Information Management System (SMM/LIMS) database and shall be independent of the PC. The responsible technician and his/her supervisor shall sign the daily test reports and the results of the daily tests shall be entered into the database and electronically signed within 24 hours of test completion. This electronic reporting is intended to allow the Contractor and the Department to make timely and accurate decisions on workmanship and material quality issues.

3.4 Owner Verification Testing (OVT) Requirements

3.4.1 General

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 D-B's compliance with the approved Plan from the D-B firm.

3.4.2 Owner Verification Testing and Inspection

The Owner Verification Testing (OVT) and inspection will be performed by the Department or a qualified firm hired by the Department. OVT Level 1 testing shall be performed at the frequency shown in Table 1. However, if the ICQC increases their tests above the minimum shown in the *Schedule for Owner Acceptance (OA)*, then the OVT schedule should be adjusted to a frequency no less than 10 percent of the ICQC. OVT Level 2 testing shall be performed at the frequency shown in Table 3. On some D-B projects, the Department may decide to perform the acceptance tests. In this case, the Department will perform the tests at the frequency shown in the "OA Frequency Guide Schedule".

**Table 1: Level 1 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
203 EMBANKMENT Unclassified Excavation (Complete In Place)	IN-PLACE DENSITY / MOISTURE CONTENT	1 per 15,000 cu. yds. or fraction thereof of testable material as described in Subsection 203.07 of the CDOT Standard Specifications.		CP 80aa		In the compacted lift.
206 STRUCTURE BACKFILL (Class 1)	IN-PLACE DENSITY / MOISTURE CONTENT	1 per 1,500 cu. yds. or fraction thereof.		CP 80aa		In the compacted lift.
301 PLANT MIX BITUMINOUS BASE	IN-PLACE DENSITY / MOISTURE CONTENT	1 per 15,000 tons or fraction thereof.		CP 80aa		In the compacted lift.
304 AGGREGATE BASE COURSE	IN-PLACE DENSITY / MOISTURE CONTENT	1 per 20,000 tons (10,000 cu. yds.) or fraction thereof for each class.		CP 80aa		In the compacted lift.
306 RECONDITIONING	IN-PLACE DENSITY / MOISTURE CONTENT	1 per 50,000 sq. yds. or fraction thereof.		CP 80aa		In the compacted lift.

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			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
HYDRATED LIME 307	GRADATION	1 per 500 tons of lime or fraction thereof.		CPL 4209	Retain CTRs in the project files.	
PROCESSING LIME TREATED SUBGRADE 307	IN-PLACE DENSITY	1 per 50,000 sq. yds. or fraction thereof.		CP 80aa		In the compacted lift.
	THICKNESS	1 per 10,000 sq. yds. or fraction thereof.		C 174	If the measurement is <0.5" from plan thickness, 2 additional cores shall be taken in that lot and the average of 3 cores will determine the thickness of that lot.	In the compacted lift.
	pH	1 per 50,000 sq. yds. or fraction thereof.	CP 30	G 51	pH will be determined after % lime has been established based on unconfined compressive strength pH.	
PROCESSING CEMENT TREATED SUBGRADE 308	IN-PLACE DENSITY	1 per 50,000 sq. yds. or fraction thereof.		CP 80aa		In the compacted lift.
	THICKNESS	1 per 10,000 sq. yds. or fraction thereof.		C 174	If the measurement is <0.5" from plan thickness, 2 additional cores shall be taken in that lot and the average of 3 cores will determine the thickness of that lot.	In the compacted lift.

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			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
310 PROCESS ASPHALT MAT for BASE COURSE	IN-PLACE DENSITY	1 per 30,000 sq. yds. or fraction thereof.		CP 80aa		In the compacted lift.
310 FULL DEPTH RECLAMATION of HOT MIX ASPHALT	IN-PLACE DENSITY	1 per 30,000 sq. yds. or fraction thereof.		CP 80aa		In the compacted lift.
403 STONE MATRIX ASPHALT (SMA)	BULK SPECIFIC GRAVITY	1 per 10,000 tons or fraction thereof.		CP 44	Use SSD specimens	
	BULK SPECIFIC GRAVITY of the JOINT	1 per 50,000 linear feet or fraction thereof.		CP 44L	Use SSD specimens	Longitudinal Joint
	MAXIMUM SPECIFIC GRAVITY	1 per 10,000 tons or fraction thereof.	CP 41 CP 55	CP 51		
	IN-PLACE DENSITY	1 per 5,000 tons or fraction thereof.		CP 44		In the compacted lift.
	ASPHALT CONTENT	1 per 10,000 tons or fraction thereof.	CP 41 CP 55	CP 85 or CPL 5120		Plant discharge, at/or behind the paver.

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PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
403 HOT MIX ASPHALT (HMA)	BULK SPECIFIC GRAVITY	1 per 10,000 tons or fraction thereof.		CP 44	Use SSD specimens	
	BULK SPECIFIC GRAVITY of the JOINT	1 per 50,000 linear feet or fraction thereof.		CP 44L	Use SSD specimens	Longitudinal Joint
	VOIDS IN MINERAL AGGREGATE	1 per 10,000 tons or fraction thereof.	CP 41 CP 55	CP 48aa		
	MAXIMUM SPECIFIC GRAVITY	1 per 10,000 tons or fraction thereof.	CP 41 CP 55	CP 51		
	IN-PLACE DENSITY	1 per 5,000 tons or fraction thereof.		CP 81		In the compacted lift.
	ASPHALT CONTENT	1 per 10,000 tons or fraction thereof.	CP 41 CP 55	CP 85 or CPL 5120		Plant discharge, at/or behind the paver.
	DENSITY OF TEST SPECIMEN	1 per 10,000 tons or fraction thereof.	CP 41 CP 55	CPL 5115		Plant discharge, at/or behind the paver.
405 HOT IN-PLACE RECYCLING TREATMENTS (all types)	IN-PLACE DENSITY	1 per 50,000 sq. yds. or fraction thereof.		CP 81		In the compacted lift.
	BULK SPECIFIC GRAVITY	1 per 10,000 tons or fraction thereof.		CP 44	Use SSD specimens (Virgin HMA Only)	
	BULK SPECIFIC GRAVITY of the JOINT	1 per 50,000 linear feet or fraction thereof.		CP 44L	Use SSD specimens (Virgin HMA Only)	Longitudinal Joint
	VOIDS IN MINERAL AGGREGATE	1 per 10,000 tons or fraction thereof.	CP 41 CP 55	CP 48aa	(Virgin HMA Only)	
	ASPHALT CONTENT	1 per 10,000 tons or fraction thereof.	CP 41 CP 55	CP 85 or CPL 5120	(Virgin HMA Only)	Plant discharge, at/or behind the paver.

**Table 1: Level 1 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
406 COLD BITUMINOUS PAVEMENT (RECYCLE)	IN-PLACE DENSITY	1 per 50,000 sq. yds. or fraction thereof.	CP 41 (Meth. C)	CP 53		Windrow or roadway after rolling is finished
409 COVER COAT MATERIAL	FRACTURED FACES	1 per 50,000 tons or fraction thereof.	CP 30	CP 45		Spreader or last point of the stockpile.
412 PORTLAND CEMENT CONCRETE PAVEMENT FLEXURAL STRENGTH	TEXTURE DEPTH	1 per 5,000 sq. yds. or fraction thereof.		CP 77b		
	UNIT WEIGHT	1 per 25,000 sq. yds. or fraction thereof.	CP 61	T 121		
	THICKNESS	1 per 25,000 sq. yds. or fraction thereof.	CP 68	T 148		
	AIR CONTENT	1 per 25,000 sq. yds. or fraction thereof.	CP 61	T 152		
	FLEXURAL STRENGTH	1 per 50,000 sq. yds. or fraction thereof.	CP 61	T 97-28		
412 PORTLAND CEMENT CONCRETE PAVEMENT COMPRESSIVE STRENGTH	TEXTURE DEPTH	1 per 5,000 sq. yds. or fraction thereof.		CP 77b		
	UNIT WEIGHT	1 per 25,000 sq. yds. or fraction thereof.	CP 61	T 121		
	THICKNESS	1 per 25,000 sq. yds. or fraction thereof.	CP 68	T 148		
	AIR CONTENT	1 per 25,000 sq. yds. or fraction thereof.	CP 61	T 152		
	COMPRESSIVE STRENGTH	1 per 25,000 sq. yds. or fraction thereof.	CP 61	C 39-28		

**Table 1: Level 1 – Owner Verification Testing,
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PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
503 DRILLED CASSIONS	COMPRESSIVE STRENGTH	1 per 500 cu. yds. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 152		
503 MICROPILE	COMPRESSIVE STRENGTH	1 per 100 cu. yds. or fraction thereof.	CP 61	C 109-28	Use 2" cubes	
507 CONCRETE SLOPE and DITCH PAVING	COMPRESSIVE STRENGTH	1 per 500 cu. yds. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 152		
601 STRUCTURAL CONCRETE	COMPRESSIVE STRENGTH	1 per 500 cu. yds. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 152		
603 CULVERTS and SEWERS	IN-PLACE DENSITY	1 per 1,500 cu. yds. or fraction thereof.		CP 80aa		In the compacted lift.

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			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
604 MANHOLES, INLETS, and METER VAULTS	COMPRESSIVE STRENGTH	1 per 500 cu. yds. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 500 sq. yds. or fraction thereof.	CP 61	T 152		
	IN-PLACE DENSITY	1 per 500 cu. yds. or fraction thereof.		CP 80aa		In the compacted lift.
606 GUARDRAIL and BRIDGE RAIL	COMPRESSIVE STRENGTH	1 per 5,000 linear. ft. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 5,000 linear. ft. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 5,000 linear. ft. or fraction thereof.	CP 61	T 152		
608 CONCRETE SIDEWALK	COMPRESSIVE STRENGTH	1 per 10,000 sq. yds. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 10,000 sq. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 10,000 sq. yds. or fraction thereof.	CP 61	T 152		
609 CONCRETE CURB and GUTTER	COMPRESSIVE STRENGTH	1 per 10,000 sq. yds. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 10,000 sq. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 10,000 sq. yds. or fraction thereof.	CP 61	T 152		

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PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
LIGHT STANDARD FOUNDATION 613	COMPRESSIVE STRENGTH	1 per 100 cu. yds. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 100 cu. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 100 cu. yds. or fraction thereof.	CP 61	T 152		
LIGHT STANDARD FOUNDATION (SPECIAL) and HIGH MAST FOUNDATION 613	COMPRESSIVE STRENGTH	1 per 500 cu. yds. or fraction thereof.	CP 61	C 39-28		
	UNIT WEIGHT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 152		
SIPHONS 616	IN-PLACE DENSITY	1 per 1,500 cu. yds. or fraction thereof.		CP 80aa		In the compacted lift.
WATERLINE PIPE 619	IN-PLACE DENSITY	1 per 1,500 cu. yds. or fraction thereof.		CP 80aa		In the compacted lift.
DRAINAGE PIPE 624	IN-PLACE DENSITY	1 per 1,500 cu. yds. or fraction thereof.		CP 80aa		In the compacted lift.
SHOTCRETE 641	COMPRESSIVE STRENGTH	1 per 500 cu. yds. or fraction thereof.	CP 61	C 39-28		
	AIR CONTENT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 152		

3.4.3 Material Validation Reporting

For projects that have been identified by FHWA as a Project of Division Interest or a Project of Corporate Interest based on the FHWA and CDOT Stewardship and Oversight Agreement, the Department will submit quarterly reports to the FHWA for concurrence with project compliance with the approved QAP. The report will be submitted 3 weeks after D-B has provided all quarterly inspection and testing documentation. Each report shall cover a period of construction not greater than three months.

3.4.3.1 Statistical Analysis

F-tests and t-tests will be used in accordance with CP 14 to analyze ICQC and OVT data of Level 1 materials. The F-test is a comparison of variances between the ICQC and OVT population to determine if there is a significant difference. The t-test is a comparison of means from the ICQC and OVT population to determine if there is a significant difference. The type of material and the recommended level of significance are shown in Table 2. **F-tests and t-tests comparisons shall be performed by CDOT OA Personnel or CDOT OVT Personnel Only.**

Before performing any statistical analyses, it is important to ensure that the data contained in each analysis is in reasonable compliance with the underlying assumptions of the F-test and t-test.

Table 2: Level of Significance for F-tests and t-tests

Materials Item	Level of Significance (α)
Unclassified Excavation (Item 203), Structure Backfill (Item 206), Plant Mix Bituminous Base (Item 301), Aggregate Base Course (Item 304), Reconditioning (Item 306), and In-Place Density Testing (Items 603, 604, 616, 619, and 624)	0.01
Hydrated Lime, Processing Lime Treated Subgrade (Item 307), Processing Cement Treated Base (Item 308), Processing Asphalt Mat For Base Course and Full Depth Reclamation of HMA (Item 310)	0.01
Stone Matrix Asphalt and Hot Mix Asphalt (Item 403)	0.025
Hot In-Place Recycling (Item 405) and Cold In-Place Recycling (Item 406)	0.01
Cover Coat Material (Item 409)	0.01
Portland Cement Concrete Pavement (Item 412)	0.025
Drilled Caisson and Micropile (Item 503) and Concrete Slope and Ditch Paving (Item 507)	0.01
Structural Concrete (Item 601, 604, 606, and 613)	0.025
Concrete Sidewalk (Item 608) and Curb and Gutter (Item 609)	0.10
Shotcrete (Item 641)	0.10

While there are default OVT sampling and testing frequencies shown in Tables 1 and Table 3 for each material, each project has its own unique conditions that may warrant project-specific modifications to the default level for the item and level of significance for the F-tests and t-tests as shown in Table 2.

**Table 3: Level 2 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
203 EMBANKMENT MATERIAL Unclassified Excavation and Borrow (Complete in Place)	MOISTURE-DENSITY CURVE	1 per 15,000 cu. yds. or fraction thereof of testable material as described in Subsection 203.07 of the CDOT Standard Specifications		CP 23 T 99 or T 180	Moisture-Density Curve shall be performed on the soil found at The proposed location for CP 25	
	PERCENT RELATIVE COMPACTION	1 per 15,000 cu. yds. or fraction thereof of testable material as described in Subsection 203.07 of the CDOT Standard Specifications.		CP 25	CP 25, Subsection 3.4.8, for 1-point check requirements.	In the compacted lift.
206 STRUCTURE BACKFILL (CLASS 1 and 2)	MOISTURE-DENSITY CURVE	1 per 15,000 cu. yds. or fraction thereof.		CP 23 T 99 or T 180	T180 for Class 1. T 99 or T 180 for Class 2.	
	PERCENT RELATIVE COMPACTION	1 per 15,000 cu. yds. or fraction thereof of testable material as described in Subsection 203.07 of the CDOT Standard Specifications.		CP 25	CP 25, Subsection 3.4.8, for 1-point check requirements.	In the compacted lift.
	GRADATION	1 per 15,000 cu. yds. or fraction thereof.	CP 30	CP 31		In-Place, before compaction.
	ATTERBERG LIMITS	1 per 15,000 cu. yds. or fraction thereof.		T 89 T 90		
206 MECHANICAL REINFORCEMENT OF SOIL and FILTER MATERIAL (All Classes)	GRADATION	1 per 15,000 cu. yds. or fraction thereof for each Class.	CP 30	CP 31		In-Place.

**Table 3: Level 2 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
206 BED COURSE MATERIAL	MOISTURE-DENSITY CURVE	1 per 15,000 cu. yds. or fraction thereof.		CP 23 T 180		
	PERCENT RELATIVE COMPACTION	1 per 15,000 cu. yds. or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 15,000 cu. yds. or fraction thereof.	CP 30	CP 31		In-Place.
	ATTERBERG LIMITS	1 per 15,000 cu. yds. or fraction thereof.		T 89 T 90		
301 PLANT MIX BITUMINOUS BASE and PERMIABLE ASPHALT TREATED BASE	MOISTURE-DENSITY CURVE	1 per 15,000 tons or fraction thereof.		CP 23 T 180		
	PERCENT RELATIVE COMPACTION	1 per 15,000 tons or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 15,000 tons or fraction thereof.	CP 30	CP 31		In-Place.
	ATTERBERG LIMITS	1 per 15,000 tons or fraction thereof.		T 89 T 90		

**Table 3: Level 2 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
304 AGGREGATE BASE COURSE (All Classes)	MOISTURE-DENSITY CURVE	1 per 20,000 tons or fraction thereof.		CP 23 T 180		
	PERCENT RELATIVE COMPACTION	1 per 20,000 tons or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 20,000 tons or fraction thereof.	CP 30	CP 31		In-Place.
	R-VALUE	1 per 20,000 tons or fraction thereof.		CPL 3101	1 R-Value per class	
	ATTERBERG LIMITS	1 per 20,000 tons or fraction thereof.		T 89 T 90		
306 RECONDITIONING	MOISTURE-DENSITY CURVE	1 per 50,000 sq. yds. or fraction thereof.		CP 23 T 99 T 180		
	PERCENT RELATIVE COMPACTION	1 per 50,000 sq. yds. or fraction thereof.		CP 25		In the compacted lift.
307 PROCESSING LIME and CEMENT KILN DUST TREATED SUBGRADE	MOISTURE-DENSITY CURVE	1 per 50,000 sq. yds. or fraction thereof		CP 23 T 99 T 180	The moisture content of mixture at the start of compaction shall be at 2 ± 1% above optimum moisture content.	In the compacted lift.
	PERCENT RELATIVE COMPACTION	1 per 50,000 sq. yds. or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 50,000 sq. yds. or fraction thereof.	CP 30	CP 31	1" – 100% passing #4 – 60% passing Dry sieving after final mixing.	
	UNCONFINED COMPRESSIVE STRENGTH	1 per 50,000 sq. yds. or fraction thereof.		D 5102 (Proc. B)	Tests shall be conducted on samples cured in a moist environment for 5 days at 100 F.	
	ATTERBERG LIMITS	1 per 50,000 sq. yds. or fraction thereof.		T 89 T 90	Reduce by ½ original PI.	

**Table 3: Level 2 – Owner Verification Testing,
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PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
310 PROCESSING ASPHALT MAT FOR BASE	MOISTURE-DENSITY CURVE	1 per 30,000 sq. yds. or fraction thereof		CP 23 T 180	The moisture content of mixture at the start of compaction shall be at $2 \pm 1\%$ above optimum moisture content.	In the compacted lift.
	PERCENT RELATIVE COMPACTION	1 per 30,000 sq. yds. or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 30,000 sq. yds. or fraction thereof.	CP 30	CP 31	1" – 100% passing #4 – 60% passing Dry sieving after final mixing.	
403 HOT MIX ASPHALT and STONE MATRIX ASPHALT	GRADATION	Aggregate: 1 per 10,000 tons or fraction thereof of mix produced.	CP 30	CP 31HMA aa		Aggregate from the cold feed, pugmill discharge, extraction, or product of CP-L 5120.
	AGGREGATE MOISTURE	Aggregate: 1 per 10,000 tons or fraction thereof of mix produced.	CP 30	CP 33		Aggregate from the cold feed.
	THERMAL SEGREGATION	1 per 10,000 tons or fraction thereof.		CP 58		Behind paver.
	FIELD CORRECTION OF DENSITY	1 per 10,000 tons or fraction thereof.		CP 82	From core samples	In the compacted lift
	LIME PROPERTIES	Hydrated Lime: 1 per 50,000 tons or fraction thereof of mix produced.		CPL 4209		
	BINDER PROPERTIES	Asphalt Cement: 1 per 10,000 tons or fraction thereof of mix produced.		T 315		
	MINERAL FILLER	1 per 50,000 tons or fraction thereof of mix produced.		T 37	For Stone Matrix Asphalt when a mineral filler is used.	

**Table 3: Level 2 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
405 HOT MIX ASPHALT USED IN HOT-IN-PLACE RECYCLE	GRADATION	Aggregate: 1 per 50,000 tons or fraction thereof of mix produced.	CP 30	CP 31HMAaa		Aggregate from the cold feed, pugmill discharge, extraction, or product of CP-L 5120.
	AGGREGATE MOISTURE	Aggregate: 1 per 50,000 tons or fraction thereof of mix produced.	CP 30	CP 33		Aggregate from the cold feed.
	THERMAL SEGREGATION	1 per 50,000 tons or fraction thereof.		CP 58		Behind paver.
	LIME PROPERTIES	Hydrated Lime: 1 per 50,000 tons or fraction thereof of mix produced.		CPL 4209		
406 COLD BITUMINOUS PAVEMENT (RECYCLE)	GRADATION	1 per 50,000 sq. yds. or fraction thereof.	CP 30	CP 31		
	IN-PLACE DENSITY	1 per 50,000 sq. yds. or fraction thereof.	CP 41 * (Meth. C)	CP 81		
407 BLOTTER MATERIAL	GRADATION	1 per 2,000 tons or fraction thereof.	CP 30	CP 31		Spreader or the last stockpile prior to placement.
409 COVER COAT MATERIAL	GRADATION	1 per 5,000 tons or fraction thereof.	CP 30	CP 31		Spreader or the last stockpile prior to placement.

**Table 3: Level 2 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
410 SLURRY SEAL COAT	GRADATION	1 per 5,000 tons or fraction thereof.	CP 30	CP 31		Spreader or last point of the stockpile.
	FRACTURED FACES	1 per 25,000 tons or fraction thereof.	CP 30	CP 45		Spreader or last point of the stockpile.
411 ASPHALT CEMENT	BINDER PROPERTIES	1 per 500 tons of liquid or fraction thereof.		T 315	When asphalt cement is paid for separately	
412 PCCP	TEMPERATURE	1 per 25,000 sq. yds. or fraction thereof.	CP 61	C 1064		
420 SEPARATION MATERIAL	GRADATION	1 per 500 tons or fraction thereof.	CP 30	CP 31		
503 DRILLED CAISSON	TEMPERATURE	1 per 500 cu. yds. or fraction thereof.	CP 61	C 1064		
507 CONCRETE SLOPE and DITCH	TEMPERATURE	1 per 500 cu. yds. or fraction thereof.	CP 61	C 1064		
507 ASPHALT SLOPE and DITCH	GRADATION	1 per 5,000 tons or fraction thereof.	CP 30	CP 31HMAaa		Aggregate from the cold feed, pugmill discharge, extraction, or product of CP-L 5120.
	ASPHALT CONTENT	1 per 5,000 tons or fraction thereof.	CP 41 CP 61	CP 85		

**Table 3: Level 2 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
601 STRUCTURAL CONCRETE	TEMPERATURE	1 per 500 cu. yds. or fraction thereof.	CP 61	C 1064		
603 CULVERTS and SEWER PIPE	MOISTURE-DENSITY CURVE	1 per 1,500 cu. yds. or fraction thereof.		CP 23 T 180 or T99		In the compacted lift.
	PERCENT RELATIVE COMPACTION	1 per 1,500 cu. yds. or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 1,500 cu. yds. or fraction thereof.	CP 30	CP 31		
	ATTERBERG LIMITS	1 per 1,500 cu. yds. or fraction thereof.		T 89 T 90		
604 MANHOLES, INLETS, METER VAULTS, CABINETS	TEMPERATURE	1 per 500 cu. yds. or fraction thereof.	CP 61	C 1064		
	PERCENT RELATIVE COMPACTION	1 per 500 cu. yds. or fraction thereof.		CP 25		In the compacted lift.
604 FENCES, GATES, and CABINETS	TEMPERATURE	1 per 500 cu. yds. or fraction thereof.	CP 61	C 1064		
	COMPRESSIVE STRENGTH	1 per 500 cu. yds. or fraction thereof.	CP 61	C39-28		
	UNIT WEIGHT / YIELD	1 per 500 cu. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 500 cu. yds. or fraction thereof.	CP 61	T 152		

**Table 3: Level 2 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
608 SIDEWALKS (PCCP)	TEMPERATURE	1 per 10,000 sq. yds. or fraction thereof.	CP 61	C 1064		
609 CURB and GUTTER (PCCP)	TEMPERATURE	1 per 10,000 cu. yds. or fraction thereof.	CP 61	C 1064		
610 MEDIAN COVER MATERIAL	TEMPERATURE	1 per 1,000 sq. yds. or fraction thereof.	CP 61	C 1064		
	COMPRESSIVE STRENGTH	1 per 1,000 sq. yds. or fraction thereof.	CP 61	C39-28		
	UNIT WEIGHT / YIELD	1 per 1,000 sq. yds. or fraction thereof.	CP 61	T 121		
	AIR CONTENT	1 per 1,000 sq. yds. or fraction thereof.	CP 61	T 152		
613 LIGHTING	TEMPERATURE	1 per 500 cu. yds. or fraction thereof.	CP 61	C 1064		
616 SIPHONS	MOISTURE-DENSITY CURVE	1 per 1,500 cu. yds. or fraction thereof.		CP 23 T 180 or T99		In the compacted lift.
	PERCENT RELATIVE COMPACTION	1 per 1,500 cu. yds. or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 1,500 cu. yds. or fraction thereof.	CP 30	CP 31		
	ATTERBERG LIMITS	1 per 1,500 cu. yds. or fraction thereof.		T 89 T 90		

**Table 3: Level 2 – Owner Verification Testing,
Schedule for Minimum Materials Sampling, Testing, and Inspection**

PAY ITEM	TYPE OF TEST	PROJECT VERIFICATION SAMPLING & TESTING FREQUENCY	PROCEDURES		REMARKS	POINT OF VERIFICATION FOR QUALITY DETERMINATION
			PROJECT VERIFICATION SAMPLING	PROJECT VERIFICATION TESTING		
619 WATER LINES	MOISTURE-DENSITY CURVE	1 per 1,500 cu. yds. or fraction thereof.		CP 23 T 180 or T99		In the compacted lift.
	PERCENT RELATIVE COMPACTION	1 per 1,500 cu. yds. or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 1,500 cu. yds. or fraction thereof.	CP 30	CP 31		
	ATTERBERG LIMITS	1 per 1,500 cu. yds. or fraction thereof.		T 89 T 90		
624 DRAINAGE PIPE	MOISTURE-DENSITY CURVE	1 per 1,500 cu. yds. or fraction thereof.		CP 23 T 180 or T99		In the compacted lift.
	PERCENT RELATIVE COMPACTION	1 per 1,500 cu. yds. or fraction thereof.		CP 25		In the compacted lift.
	GRADATION	1 per 1,500 cu. yds. or fraction thereof.	CP 30	CP 31		
	ATTERBERG LIMITS	1 per 1,500 cu. yds. or fraction thereof.		T 89 T 90		

3.5 Dispute Resolution

Through the life of the project, there may be statistically significant differences in material test results or statistical sample populations between the ICQC and the OVT. Due to the natural variability in construction materials testing and unavoidable biases in sampling and testing, these differences are often difficult to avoid. It is important to recognize the difference between material quality and statistical validation.

Material quality is measured by whether a test passes or fails and is an indication of whether the material will perform its intended purpose. Engineering judgment may be used to substantiate the use of material failing to meet the specification if the material still meets the intended purpose and does not affect the service life equivalent to design service life. Statistical validation is a measure of whether or not there is a statistically significant difference between the ICQC and OVT populations. It does not represent the quality of material being incorporated into the Project. It does, however, affect how the Department can use the test results for acceptance.

3.5.1 Non-Validation and Status of Material Quality

When ICQC results do not statistically validate the OVT test results as outlined in Subsection - 3.4.3.1 Statistical Analysis and CP 14, the Region Materials Engineer (RME) will investigate the source of non-validation. The ICQC and OVT firms shall assist in the investigation. The RME, or independent laboratory, will provide the Department's Project Manager with a probable cause of the non-validation and a resolution recommendation. If the non-validation persists over two consecutive analyses, a non-compliance records (NCR) process shall be issued by the Department to formally document and seek resolution to the non-validation.

In addition to the need to investigate the non-validation, the material in question has to be immediately evaluated to determine if it can be left in place or has to be removed, reworked or repaired. The material in question will be evaluated using the process described in this section. There are four possible combinations of passing and failing results between the ICQC and OVT results and the F-test and t-test results when they are not statistically validated.

1. Both the ICQC and OVT results pass specification limits:
Although statistical validation has not occurred, both the ICQC and OVT results are passing the established specification limits. Thus, material quality in question is considered acceptable.
2. ICQC results fail and OVT results pass specification limits:
The acceptance of material is subject to one of the two scenarios below.
 - The Project Engineer may exercise approved Engineering Judgment to accept the material if results from all other levels of related OVT material, within the same process, pass specification limits.
 - The ICQC firm needs to provide the Department an explanation of the error and/or proposed correction for acceptance of materials through the NCR process.

3. Both the ICQC and OVT results fail the specification limits:

Material may be left in place if the Department determines that Engineering Judgment may be used to accept the material or if the material is accepted through the NCR process. Results from all other levels of related OVT material, within the questionable area, will be included in the Judgment decision.

The acceptance of material is subject to one of the two scenarios below.

- When the OVT result indicates reasonable conformance with specification requirements for the process in question. The ICQC shall provide to the Department an explanation of the error and/or proposed correction for acceptance of material through the NCR process.
- When the OVT result and/or the results of other levels of related OVT that do not indicate reasonable conformance with the specification requirement for the process in question, Then the ICQC must perform additional testing within the process in question to identify the problem area, based on the results of ICQC testing, all local OVTs of related materials, and subsequent investigation discussions between the Department and the D-B. A determination will be made by the Project Engineer as to the material's outcome and documented through the NCR process.

4. The ICQC results pass but OVT results fail specification limits:

Material may be left in place if the Department determines that Engineering Judgment may be used to accept the material or if the material is accepted through the NCR process. The results from all other levels of related OVT material, within the questionable area, will be included in the Judgment decision. Material that is not statistically validated by OVT cannot be accepted solely on the basis of the ICQC test results. If the material is reworked, ICQC must perform a fixed-independent test at the OVT failed test location followed by random-independent tests by both the ICQC and the OVT.

This is subject to the Department's response in the two scenarios below.

- When the OVT result indicates reasonable conformance with specification requirements for the process in question - the ICQC shall provide to the Department an explanation of the error and/or proposed correction for acceptance of material through the NCR process.
- When the OVT result and/or the results of other levels of related OVTs does not indicate reasonable conformance with specification requirement for the process in question , the ICQC must perform additional testing within the process in question to identify the problem area. Based on the results of ICQC testing, all local OVTs of related materials, and subsequent investigation discussions between the Department and the D-B, a determination will be made by the Project Engineer as to the material's outcome and documented through the NCR process.

3.5.2 REFEREE TESTING

Disputes over specific test results may be resolved in a reliable, unbiased manner by referee testing and evaluation performed in accordance with CP 17. The decision by the referee laboratory shall be final and binding on both parties.

4. INDEPENDENT ASSURANCE PROGRAM (IA)

4.1 General

With most DB projects, the pace of construction is extremely quick. Staffing curves are normally established to bring construction inspectors and testing technicians to the project at optimal periods based on the volume of anticipated work. Careful administration of the Independent Assurance (IA) program is essential to the success of the overall project so that unnecessary delays are not encountered, and testing technicians and laboratories are evaluated in a timely manner. This IA program evaluates all sampling and testing procedures, personnel, and equipment used as part of an acceptance decision. Samples and test results from this program are used to independently analyze the reliability of the acceptance program by ensuring that tests are performed by qualified personnel and that laboratory facilities and equipment are adequate to perform the required sampling and testing methods. To ensure that the IA program evaluates the sampling procedures, testing, and testing equipment the samples taken by this program shall be either split samples or proficiency samples. The IA tester will observe the acceptance sampling and testing procedure of the ICQC and OVT. Any equipment used to perform Quality Acceptance (QA) testing in making an acceptance decision will be evaluated by IA sampling and testing personnel. This evaluation includes calibration checks and split-sample tests.

The Department may choose to use the System Basis approach to the IA program on a project-by-project basis. The System Basis approach uses the frequency of IA activities on time, regardless of the number of tests, quantities of materials, or numbers of projects tested by the individual being evaluated. When the System Basis approach is used, the Department will evaluate all ICQC and OVT testers on the project as soon as practical. ICQC and OVT testers will be evaluated for all Level 1 and Level 2 material items they are currently qualified to test. Testers will be re-evaluated on an annual basis.

When the Department uses ICQC in the QAR, the testing frequency for the IA program will be no less than 10 percent of the ICQC and no less than 10 percent of the OVT for all Level 1 and Level 2 testable items. When the Department performs the acceptance tests, the minimum number of samples and tests required can be found in the chapter entitled IA Frequency Guide Schedule for Evaluation of OA Sampling & Testing.

CDOT has the option of designating an independent laboratory that is not associated with the contractor or any subcontractor on the project. This firm will administer the IA program on its behalf and follow the procedures outlined in the Field Materials Manual. When this option is utilized, personnel from the independent laboratory must be qualified by CDOT and the laboratory must be accredited. Laboratory accreditation is a two-fold process. First, each laboratory will require accreditation through the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program (AAP). Second, each laboratory will be accredited in specific CDOT test methods applicable to the DB project.

4.2 Responsibility of the Region Materials Laboratory

The Region Materials Laboratory will be responsible for the implementation and administration of the Independent Assurance Sampling and Testing Program in their Region. The Region Materials Laboratory shall address, at the minimum the following requirements:

- Establish the minimum required IA sampling and testing for the project. The approximate number of samples and tests will be developed prior to the beginning of construction on the D-B Project. To determine the approximate number of samples and tests, the Regional Materials Engineer will use the IA Frequency Guide Schedule in the Field Materials Manual along with Table 1 and Table 3 of this chapter for DB projects with ICQC, or the IA Frequency Guide Schedule Chapter in the Field Materials Manual when CDOT performs the acceptance testing. The Regional Materials Engineer will notify the ICQC and OVT Firms of the anticipated number of IA samples and tests on the CDOT Form 379.
- The Region IA personnel will review the ICQC and OVT independent random sampling procedures for testing.
- The IA personnel will observe the sampling and testing procedures and compare them to the Department's standard procedures.
- The Region IA personnel will compare the IA test results from the split sample with the appropriate ICQC and OVT test results. The Comparison Precision Guide will be used to identify discrepancies. The IA personnel shall report the IA test results to the Region Materials Engineer and the Department's Project Manager as soon as they are completed. Any discrepancies in procedures or test results shall be identified and explanations included in the test report.
- The Region Materials Engineer may increase the frequency of IA sampling and testing at any time during the construction. Any discrepancies will be resolved prior to the signing of the Final Materials Documentation Checklist (Form 473).

4.3 Responsibility of the ICQC and OVT Firms

Documentation retention will be for a minimum of four years after the acceptance of the project. When the Project Basis Approach is used, the ICQC and OVT Firms will be responsible for:

- Gathering a summary of approximate quantities from the contractor prior to construction.
- Notifying the Region Materials Engineer when construction activities requiring IA sampling and testing in accordance with the frequency shown on the Independent Assurance Sampling and Testing Checklist (Form #379) are scheduled. This notification, normally one week in advance, is imperative due to the number of IA samples that require split sampling.
- Notifying the Region Materials Engineer of plan changes which will affect anticipated IA sampling and testing.

When the System Basis Approach is used, the ICQC and OVT Firms will be responsible for:

- Maintaining documentation of all individuals qualified under their authority who perform required tests for acceptance of materials. Documentation to be maintained includes:
 - A. Sampling and testing personnel qualification in an electronic format that lists all the testing procedures the individual has been qualified to perform;
 - B. A qualification worksheet listing the key elements of the test method. The evaluator conducting the observation uses the form to record the results;
 - C. Copies of the qualification certificates issued with expirations dates; and
 - D. Results of annual proficiency testing results.
- If the IA sampling was not accomplished due to the lack of notification by the ICQC or the OVT Firms, they shall provide a written explanation to the Region Materials Engineer of the causes and corrective actions implemented to prevent a recurrence.

5. REPORTING

5.1 Documentation

Documentation will be maintained in the Department's SMM/LIMS when possible. Exception reports or copies of screens showing test results are to be used for reporting purposes. Also, results entered into the SMM/LIMS are to be accumulated under the appropriate Item Number and Material Code. The procedures referenced are to be followed as indicated for CDOT projects that use electronic documentation. The materials documentation procedure begins at the Materials and Geotechnical Branch in the Documentation Unit with the creation of the *Materials Documentation Record*, CAR Report #250 Quality Assurance and Certification Checklists, and at the Region Materials Laboratory with the review of the Project Independent Assurance Sampling Checklist, CAR Report #379. Final Materials Documentation is to be prepared and reviewed as provided in this Manual. Details on Documentation procedures for individual items are contained in the applicable Chapters and Sections of this Manual and they cover most situations encountered; however, exceptions may require special attention.

The Department has stipulated that the Letter of Final Materials Certification #473 will be signed by the Project Engineer, the Region Materials Engineer, and the Resident Engineer within 30 calendar days of the project's acceptance to ensure that the quality of the project is maintained and to avoid legal and contractual conflicts.

Note: SiteManager® Materials and Laboratory Information Management System (SMM/LIMS) Training Manuals, User Guides, Quick Reference Sheets, and CDOT Superusers Contact Information are available at the following Web Site: <https://sites.google.com/a/state.co.us/sitemanager-materials/>

The Project Engineer, as the representative of the Chief Engineer, is responsible for Materials Documentation on the Project. The Project Engineer or his/her designee should take measures to ensure that Documentation Procedures of the Department and the Region are followed. All referenced documentation activities within the *Before Construction*, *During Construction*, and *After Construction* sections found in the Chapter entitled "Documentation for SMM/LIMS" are the responsibility of the Project Engineer.