



# Quality Assurance Program for CDA / Design-Build Projects with a Capital Maintenance Agreement with Three Optional 5-Year Terms

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## SECTION 1 - INTRODUCTION

### 1.1 Overview

The Quality Assurance Program (QAP) for Comprehensive Development Agreement (CDA)/Design-Build Projects (hereafter referred to as “design-build” Projects) with a Capital Maintenance Agreement with Three Optional 5-Year Terms, established by the Texas Department of Transportation (TxDOT), ensures that materials and workmanship incorporated into the highway construction project are in reasonable conformance with the approved plans and specifications, including any approved changes.

Projects with risk profiles other than that of the capital maintenance agreements consisting of three optional 5-year terms must use a revised version of this document based on modifications to the Levels of Analysis in [Appendix D](#) and other changes discussed during a project-specific materials and inspection risk assessment workshop. Modifications will be agreed upon formally through the CQMP and OVTIP review and concurrence process with FHWA.

This program is developed based on 23 CFR 637B and Federal Highway Administration (FHWA) Technical Advisory T6120.3, available at the following links.

- [23 CFR 637 Subpart B](#)
- [Technical Advisory 6120.3](#)

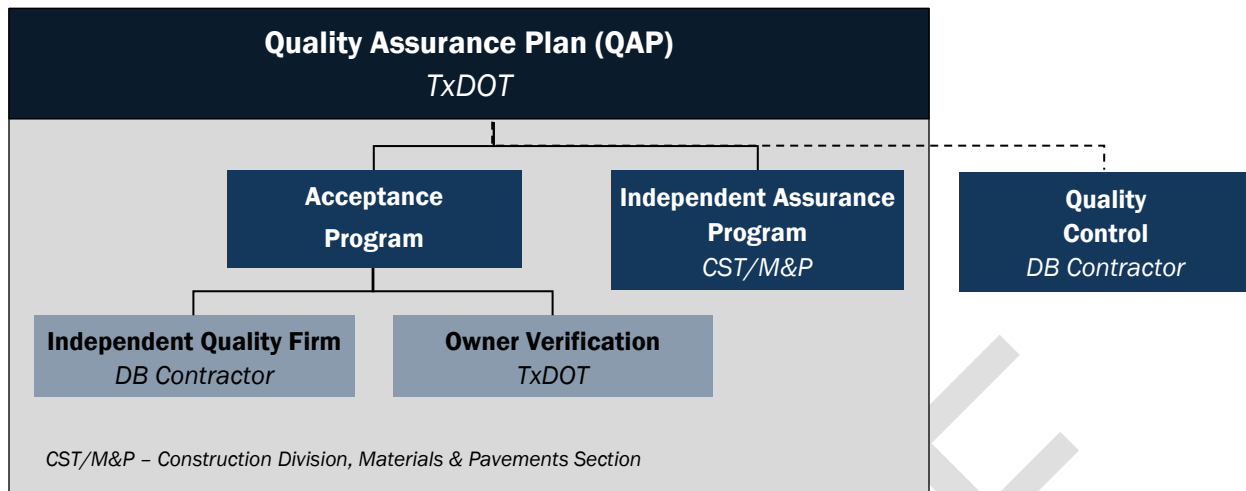
The QAP consists of a Quality Control (QC) Program ([Section 2](#)), an Acceptance Program ([Section 3](#)) and an Independent Assurance (IA) Program ([Section 4](#)). The QAP allows for the use of contractor-performed Independent Quality Firm’s (IQF) test results as part of an acceptance decision **if the IQF’s results are validated by the Owner Verification (OV) testing results performed by TxDOT.**

The purpose of the QAP is to provide statewide consistency and a programmatic approach to quality assurance for design-build projects where the design-build contractor’s (DB Contractor) test results are used in the acceptance decision, regardless of how the project is funded. It clarifies federal requirements relating to quality assurance and statistical analysis procedures. The content of this QAP is developed for projects with a capital maintenance agreement with three optional 5-year terms. Any modification to this QAP requires review and approval by TxDOT and FHWA ninety days prior to construction.

The use of DB Contractor test results as part of the acceptance decision should be carefully evaluated for each project because a significant TxDOT Owner Verification program is instrumental to its success.

Acronyms and definitions for terms used in the QAP are provided in [Appendix A – Acronyms and Definitions](#).

The QAP is comprised of several components, and the relationships between the parties and functions are shown in [Figure 1](#).



**Figure 1—Components and Relationship in the QAP**

## 1.2 Construction Quality Management Plan

DB Contractor’s Construction Quality Management Plan (CQMP) shall consist of both QC and IQF requirements with respect to performance of the Work. Requirements for the QC portion of the CQMP are described in Section 2 – Quality Control Program. Requirements for the IQF portion of the CQMP are described in Section 3 – Acceptance Program. The CQMP shall establish a clear distinction between QC and IQF activities, and the persons performing each function shall not be the same. DB Contractor shall submit the CQMP to TxDOT for review and approval.

## 1.3 Owner Verification Testing and Inspection Plan

TxDOT’s Owner Verification Testing and Inspection Plan (OVTIP) shall describe TxDOT’s commitments to perform owner verification (OV) of the DB Contractor’s IQF testing and inspection. Requirements for the OVTIP are described in Section 3 – Acceptance Program.

## 1.4 Conflict of Interest

To avoid an appearance of a conflict of interest, any non-TxDOT entity shall perform only one of the following types of testing on the same project:

- Quality Control testing;
- Independent Quality Firm testing;
- Owner Verification testing;
- Independent Assurance testing; or
- Referee testing.

## **SECTION 2 - QUALITY CONTROL PROGRAM**

### **2.1 General**

DB Contractor shall be responsible for the quality of the Work. Project quality will be enhanced through the daily efforts of all the workers involved with the Work, supported by DB Contractor's CQMP. DB Contractor's QC portion of the CQMP shall include the internal procedures used by DB Contractor to ensure that the Work is delivered in accordance with the Contract Documents. This involves the active participation of the entire workforce in working to achieve "quality" initially and to minimize or eliminate re-work. DB Contractor's QC shall not be part of the acceptance program.

### **2.2 DB Contractor Quality Control Requirements**

DB Contractor's CQMP shall establish a systematic approach to define the processes, methods, procedures, and documentation for delivery of QC on the Project. These methods and procedures shall clearly define the authority and responsibility for the administration of DB Contractor's QC plan.

#### **2.2.1 Staffing**

During periods of construction, DB Contractor shall assign an on-site Construction Quality Control Manager (CQCM) responsible for management of the quality control aspect of the CQMP. The CQCM shall not be involved with scheduling or production activities, and shall report directly to DB Contractor's management team. The CQCM shall see that the methods and procedures contained in the approved CQMP are implemented and followed by DB Contractor and Subcontractors in the performance of the Work. The CQCM shall be a Registered Professional Engineer in the state of Texas and approved by TxDOT.

DB Contractor's and Subcontractors' construction workforce are all considered to be members of DB Contractor's QC staff, as each member is responsible for the quality of the Work. Personnel responsible for performing the QC inspection shall be independent from IQF personnel, be knowledgeable in their duties, and receive documented training. Personnel performing QC sampling and testing shall be knowledgeable in the testing methods and procedures. IQF personnel shall not perform duties on behalf of QC personnel, although equipment can be shared between IQF and QC personnel.

Although not used for the acceptance decision, documented QC testing and inspection shall ensure quality has been incorporated into all elements of work prior to requesting IQF testing and inspection. The QC program should be sufficient in scope to remedy repeated discoveries—by TxDOT, IQF personnel, or DB Contractor's QC staff—of non-compliant Work. Repeated discoveries of non-compliant Work, Construction Deficiency Reports (CDRs)/Nonconformance Reports (NCRs) by the IQF, or, in the opinion of TxDOT, excessive use of Engineering Judgment shall be considered a breakdown of the QC program and shall be cause for investigation and corrective action prior to commencement of Work areas affected. Corrective action may include the addition of new QC procedures, revision to existing QC procedures, re-training of QC personnel, removal and replacement of QC personnel, or other such actions that will restore the effectiveness of the QC program.

## 2.2.2 CQMP Requirements

DB Contractor's CQMP shall clearly address, at minimum, how the DB Contractor's QC staff will address the following requirements.

- A. A construction QC organizational chart and staffing plan, which shall include the period of time that the QC staff members will be present on the site and the experience/knowledge/skill levels of QC staff.
- B. Procedures to ensure that the education, training, and Qualification of personnel performing CQMP activities are achieved and maintained and that all Work is performed in accordance with the approved designs, plans, and specifications.
- C. Procedures to ensure that DB Contractor, Suppliers, and Subcontractors designate individuals on each crew responsible for performing daily field inspections of their own Work and for preparing a daily QC report to document the inspection performed. Report forms to be used by the responsible QC personnel shall be included in the DB Contractor's CQMP.
- D. Documents specifying that all activities undertaken by or on behalf of DB Contractor affecting the quality of the Work shall be prescribed and accomplished by documented instructions, procedures, and appropriate drawings. Such instructions, procedures, and drawings shall include quantitative and qualitative criteria to be used to determine compliance.
- E. Procedures to ensure that elements of the Work are not started or continued without formal communication with the Independent Quality Firm Manager (IQFM). Inspection or hold points must be identified and communicated to the IQFM, CQCM, and TxDOT. Procedures to progress beyond the inspection or hold points shall be developed. The hold points shall include, at a minimum, those described in Appendix J. TxDOT shall be provided a minimum 24-hour notice in advance of all hold points. Milestones shall be established at convenient opportunities to inspect the Work and to prevent significant cost of correction. No work may be covered until it has been subject to a hold point acceptance by QA personnel. The IQFM and TxDOT may agree to modify established hold points to meet the needs of the project.
- F. Procedures for inspecting, checking, and documenting the Work. Inspection, examinations, and measurements shall be performed for each operation of the Work to assure quality.
- G. Procedures for identification and control of materials, equipment, and elements of the Work. These procedures shall ensure that identification of an item is maintained by appropriate means, either on the item or on records traceable to the item, as necessary, throughout fabrication, erection, installation, and use of the item.
- H. Procedures to ensure that materials, equipment, or elements of the Work that do not conform to requirements of the CDA Documents, the Governmental Approvals, applicable Law, or the Design Documents are not used or installed. These procedures shall include identification, documentation, segregation, disposition, and notification to TxDOT, and, if appropriate, Governmental Entities and other affected third parties, as well as procedures for TxDOT to review Nonconforming Work and Construction Deficiency Items.

- I. Procedures for processing a request for information (RFI) to resolve discrepancies and/or questions in the plans and specifications so that all changes are documented and approved by DB Contractor's design engineers and TxDOT.
- J. Procedures to indicate—by the use of markings such as stamps, tags, labels, routing cards, or other suitable means—the status of inspections and tests performed upon individual items of the Work.
- K. A program for coordination of all IQF inspections and testing with Governmental Entities and Utility Owners.
- L. A program to ensure performance of all testing required to demonstrate that all materials, equipment and elements of the Work will perform satisfactorily for the purpose intended and meet the standards specified in the CDA Documents. It shall specify written test procedures that include provisions for ensuring that all prerequisites for the given test have been met and that adequate test instrumentation is available and used. The CQMP shall require test results be documented and evaluated by the CQCM to ensure that test requirements have been satisfied.
- M. Measures to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly maintained, controlled, calibrated, certified, and adjusted at specified periods to maintain accuracy within industry standards.
- N. The preparation of all portland cement concrete, soil-lime treatment (stabilization or modification), soil-cement treatment, and hot mix asphaltic concrete mix designs by personnel who hold the required certifications as specified in the CDA Documents. Additionally, the designs shall be reviewed and sealed by a Registered Professional Engineer in the state of Texas attesting that the design meets TxDOT requirements for the specified class or grade for which it was prepared.
- O. Sampling and testing of all materials during the production or manufacturing processes so that only materials meeting the specifications are supplied for ultimate incorporation into the Work.
- P. Procedures to control the handling, storage, shipping, cleaning, and preservation of materials and equipment to prevent damage or deterioration.
- Q. Procedures to ensure that conditions adverse to quality—such as failures, malfunctions, deficiencies, defective material and equipment, deviations, and other Nonconforming Work and Construction Deficiency Items—are promptly identified and corrected. The procedures shall ensure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken shall be documented and reported in writing to TxDOT and to appropriate levels of DB Contractor's management to ensure corrective action is promptly taken.
- R. Measures to control the receipt and issuance of documents—such as instructions, procedures, training manuals and drawings, including changes thereto—that prescribe activities affecting quality. These measures shall ensure that approved documents, including authorized changes thereto, are reviewed for adequacy and approved for release by authorized personnel of DB Contractor and are distributed to and used at the location where the prescribed activity is performed. Changes to

documents shall be reviewed and approved by the same organizations that performed the original review and approval, unless TxDOT consents in writing to another responsible organization.

- S. Requirements and methods for controlling documents.
- T. Procedures for checking and verifying the accuracy and adequacy of construction stakes, lines, and grades established by the DB Contractor.
- U. Procedures for ensuring that construction alignment and grades are in accordance with the requirements contained in the current TxDOT Survey Guide.

### **2.2.3 Reporting, Record Keeping, and Documentation**

DB Contractor shall maintain construction workmanship and materials quality records of all inspections and tests performed per the approved CQMP. 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 supplies and materials incorporated in the Work are in full compliance with the terms of the Contract Documents. These records shall be furnished to TxDOT in format and content as specified in the CQMP.

QC inspection reports, process control material sampling/testing results, and control charts shall be updated within 48 hours following the inspection or test and be readily available for IQF and TxDOT review or audit.



## SECTION 3 - ACCEPTANCE PROGRAM

### 3.1 General

The testing and inspection frequencies for this QAP that are used in the Acceptance Program are based on a Project risk profile that includes the following:

- Public (TxDOT/FHWA) funding;
- Appreciable schedule acceleration, relative to conventional design-bid-build;
- Three optional 5-year capital maintenance terms – exercised by TxDOT; and
- Generic project conditions.

DB Contractor's CQMP shall include the internal procedures used by the IQF to ensure that the Work is inspected and tested to verify compliance with the Contract Documents. DB Contractor's IQF shall be separate from the DB Contractor's QC program.

TxDOT's Owner Verification (OV) program shall include internal procedures used by TxDOT to ensure that DB Contractor's IQF program is performed in accordance with the approved CQMP and to validate and/or verify IQF testing and inspection. TxDOT will decide the extent and applicable use of Engineering Judgment and will delegate engineering authority for such decisions to the Independent Quality Firm Manager (IQFM) in writing.

Under DB Contractor-performed testing and inspection, both the IQF's and OVF's testing and inspection results together are the basis for the acceptance decision. Contractor-performed IQF testing results may be used for acceptance when they are statistically validated and/or verified by the OV test results. IQF is performed by the DB Contractor, and the OV is performed by TxDOT.

#### 3.1.1 TxDOT-Performed Acceptance

The IQF can use results from TxDOT's Quality Monitoring Program (QMP). For materials listed on the Aggregate Quality Monitoring Program (AQMP), the IQF will be required to perform job control tests as defined by the TxDOT *DB Guide Schedule of Sampling and Testing*. Materials that are not monitored or not pre-approved by TxDOT under the QMP are subject to IQF and OV sampling and testing as part of the acceptance program. The IQF will audit and verify that materials delivered to the project site are in conformance with approved material submittals.

Under the QMP, DB Contractor shall furnish to TxDOT samples of materials to be incorporated into the Work at TxDOT's request. Manufacturers' warranties, guarantees, instruction sheets, parts lists, and other materials that are furnished with articles or materials incorporated into the Work shall be made available to TxDOT upon request.

**TxDOT Services.** TxDOT may perform the inspection and testing at all approved steel structure fabrication plants, pipe manufacturing plants, commercial precast prestressed and non-stressed concrete products plants, and any job site prestressed concrete plants.

As may be requested by the DB Contractor and agreed upon by TxDOT, the cooperative use of TxDOT resources for materials testing and inspection services at a point in Texas where the State routinely provides resident inspection services for its own highway materials, and at other locations throughout the contiguous United States, will be accepted by the DB Contractor. Upon election by the DB Contractor to use TxDOT services, the DB Contractor shall prepare work orders in full compliance with the terms of the Contract Documents.

## **3.2 Sampling and Testing**

This section provides FHWA and TxDOT's requirements for sampling, testing, and acceptance requirements to be used in the acceptance decision.

### **3.2.1 Sample Types and Uses**

Sampling is either random or fixed, depending on whether the location was selected randomly (random) or if a specific location was subjectively identified (fixed). Sampling is also either independent or dependent, based on whether the location was independently selected (independent) or whether it was based on the location of another sample (dependent/split). The F- and t- tests described in Section 3.5.3 – Reporting, Record Keeping, and Documentation are only valid when using random independent samples.

Split samples may be used outside of the statistical analysis for owner verification of contractor-performed IQF tests under TxDOT's Owner Verification Program. A comparison process for performing and analyzing split samples between OVF and IQF is necessary during the initial implementation of the QAP. TxDOT will analyze these samples and discuss the results with the IQF to assure laboratory and technician test results compare favorably. When the acceptable tolerance limits in Appendix B – Split Sample Tolerance Limits are exceeded, corrective actions for either or both parties will be identified and corrective actions will be incorporated as appropriate. This process will help provide initial alignment of the TxDOT and IQF laboratories and testing procedures.

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.

IQF and OVT will determine random sample locations using ASTM D3665.

### **3.2.2 Notification**

The DB Contractor shall, on a weekly basis, provide the IQF and TxDOT with a 3-week look-ahead schedule of planned activities as required in the Contract Documents. The DB Contractor shall also, on a daily basis, communicate changes to the scheduled work, for each current day to the IQF and TxDOT, and shall notify the IQF and TxDOT when materials are ready for sampling and testing.

### **3.2.3 Quantities and Testing Frequency**

The IQF shall continuously track and record the quantities of materials incorporated into the Project. The IQF will generate this report monthly to ensure compliance with TxDOT's *DB Guide Schedule of Sampling and Testing*. TxDOT shall use the report to verify compliance of both the IQF and OV testing frequency.

The IQF shall perform material sampling at locations and timing defined in TxDOT's *DB Guide Schedule of Sampling and Testing*. At a minimum, material sampling and testing shall be conducted at the frequency of sampling specified in TxDOT's *DB Guide Schedule of Sampling and Testing*. This minimum testing frequency must be met with random independent samples as defined in Section 3.2 – Sampling and Testing. During the start-up of new categories of work and when there are any concerns over the quality of material, the IQF shall conduct testing at a higher testing frequency as described in the preamble of TxDOT's *DB Guide Schedule of Sampling and Testing*.

While the testing of random independent samples is required to meet TxDOT's *DB Guide Schedule of Sampling and Testing* requirements, the IQF shall perform additional (fixed) tests when the quality of material is questionable at a location other than the randomly selected location. These fixed tests shall constitute an acceptance test, and a failing result shall be addressed in a similar manner to a failing random independent test. Fixed tests shall not count towards meeting minimum IQF testing frequencies.

TxDOT, or its designee, will perform oversight inspection and material verification sampling/testing. To verify IQF test results, OV testing shall be performed at a frequency shown in Appendix D – OVT Levels for Materials Testing Validation, subject to project-specific recommendations to be approved by TxDOT CST/M&P. OV testing frequency shall be established at TxDOT's sole discretion. Split sample testing defined in Appendix F does not replace or relieve the requirements found in Section 4 – Independent Assurance Program.

### **3.3 Risk-Based Inspection**

The OVF will implement a risk-based process for Owner Verification Inspection (OVI) for use in the acceptance decision, similar to Appendix D – OVT Levels for Materials Testing Validation. Risk-based inspection is a prioritizing and planning tool where elements of Work are identified for inspection based on their associated risk of failure. This approach allows the OVF to maximize the effectiveness of its inspection resources to oversee the IQF by concentrating on those assets that pose the highest risk of failure as compared to those assets that have limited consequences of failure or are inconsequential. In general, the higher the residual risk for the performance of the material after the DB Contractor's maintenance obligations expire, the higher the level of monitoring and verification that should be performed by the OVF.

#### **3.3.1 Defining Risks**

In risk-based inspection, risk is determined as the product of the probability of failure and the consequences associated with a failure. Consequences include short- and long-term functional failures, reduced design life, reduced safety, and increased maintenance cost. In conjunction with TxDOT and FHWA, the OVF will develop and conduct an OVI Risk Assessment Workshop, coupled with the OVT Risk Assessment Workshop, to define project-specific risks and provide details classifying three different tiers of appropriate levels of monitoring and verification for each element of Work constructed, based on their risk profiles.

### **3.4 DB Contractor Independent Quality Firm Requirements**

DB Contractor's CQMP shall establish a systematic approach to define the processes, methods, procedures, and documentation for delivery of IQF on the Project. These methods and procedures should be based on TxDOT's *DB Guide Schedule of Sampling and Testing* or greater, and parts of the TxDOT *Construction Contract Administration Manual* that apply to DB projects or greater, and shall clearly define the authority and responsibility for the administration of DB Contractor's IQF plan.

DB Contractor's IQF shall assign an on-site Independent Quality Firm Manager (IQFM) responsible for management of the quality aspect of the DB Contractor's CQMP, which may be used in TxDOT's acceptance decision if validated/verified by the OVF. The IQFM shall be a Registered Professional Engineer in the state of Texas and shall be an employee of the IQF. The IQFM shall report jointly to DB Contractor's management team and TxDOT. The IQFM shall not report to any person or party directly responsible for design or construction production.

#### **3.4.1 Authority of the IQFM**

The IQFM shall review, approve, authorize, examine, interpret, and confirm any methods or procedures requiring the Engineer's review, approval, authorization, examination, interpretation, confirmation, etc., as designated in the TxDOT Standard Specifications. The IQFM is considered the "Engineer" in the TxDOT Standard Specifications and/or Contract; however, the IQFM is not considered the Engineer of Record (EOR). Acceptance decisions by the IQFM must be verified through the Owner Verification program or through the NCR process.

#### **3.4.2 IQF Staffing**

The IQF inspection and materials sampling/testing staff shall be employed by the IQF and be under the direction of the IQFM to verify compliance with the Contract for any or all parts of the Work and the materials used by any member of DB Contractor's group. If approved in writing in advance by TxDOT, qualified individuals who are employees of or retained by manufacturers, Vendors, or Suppliers may inspect certain portions of Work.

The size of the IQF's staff shall reflect the volume of activities necessary for acceptance of the Work in progress and shall be maintained in accordance with the approved CQMP.

The IQF's staffing requirements shall be updated as necessary throughout the term of the Work to reflect changes in the actual construction schedule. DB Contractor shall ensure that adequate IQF staff is available and that CQMP activities are undertaken in a manner consistent with the Project Schedule and in a manner that will enable DB Contractor to achieve the Substantial Completion and Final Acceptance deadlines.

#### **3.4.3 IQF Training and Experience**

IQF inspection and materials sampling/testing staff shall have been trained in the applicable inspection and material sampling and testing procedures. The IQF's staff shall be experienced in highway inspection and materials testing. The training and experience of the IQF staff shall be commensurate with the scope, complexity, and nature of the activity to be inspected and tested as outlined by job classification within the CQMP. IQF personnel qualifications shall include appropriate TxDOT or State Highway Agency certification for

testing and inspection as well as appropriate nationally recognized certifications applicable to inspection or testing activities. IQF materials sampling/testing personnel must be qualified under the IA program described in Section 4 – Independent Assurance Program. Documentation of the training, certification, and experience shall be maintained by the IQF and available for review and audit.

#### **3.4.4 IQF Facilities and Equipment**

DB Contractor's IQF shall use a laboratory meeting the requirements described in Section 4 – Independent Assurance Program for quality testing. Unless otherwise approved by TxDOT, the laboratory or field laboratory shall be located on site or within 10 miles of the Project.

#### **3.4.5 CQMP Requirements**

DB Contractor's CQMP shall clearly address, at minimum, how the DB Contractor's IQF staff will address the following requirements.

- A. The CQMP shall comply with ISO 9001:2015 for quality systems, quality plans and quality audits, or most current version, as updated by the International Standards Organization, including methods and procedures that clearly define the authority and responsibility for the administration of DB Contractor's CQMP.
- B. Procedures for inspecting, checking, and documenting the Work for acceptance. Inspection, examinations, and measurements shall be performed for each operation of the Work to assure quality.
- C. Procedures to ensure that the education, training, and certification of personnel performing CQMP activities are achieved and maintained and that all Work is performed in accordance with the approved designs, plans, and specifications.
- D. Procedures to document and track the disposition of any identified noncompliance with the plans and specifications. These procedures shall include a clearly defined process for communicating identified noncompliances to TxDOT and the DB Contractor.
- E. Measures to ensure that purchased materials, equipment, and services conform to the Contract Documents, the Governmental Approvals, applicable Laws, Rules, and the Design Documents. These measures shall include provisions for source evaluation and selection, objective evidence of quality furnished by Subcontractors and Suppliers, inspection at the manufacture or vendor source, and examination of products upon delivery.
- F. Measures to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly maintained, controlled, calibrated, certified, and adjusted at specified periods to maintain accuracy within industry standards.
- G. A comprehensive system of planned and periodic audits of DB Contractor's CQMP to determine adherence to and the effectiveness of the CQMP. IQF personnel shall perform the audits in accordance with the written procedures or checklists. Audit results shall be documented, reviewed, transmitted to TxDOT, and acted upon by DB Contractor. Follow-up action, including re-audit of deficient areas following corrective action, shall be taken where indicated.

- H. The requirements and methods for controlling documents. DB Contractor's document control system shall be compatible with TxDOT's.
- I. Inspection of all Work to verify and document that the Work has been constructed in conformance with the released-for-construction plans, specifications, and approved working and shop drawings.
- J. Procedures on how IQF materials sampling and testing will be performed, including the processes for random sampling, tracking materials samples, processing materials samples, review and approval of test records, and tracking compliance with materials testing frequency.
- K. Procedures for addressing failed tests. For a failed random independent test, a fixed test at the original failing test location and a new random independent test at a new location in the same lot are required. For a failed fixed test, a new fixed test is required at the original failing test location.
- L. Procedures for reviewing IQF test results for compliance with mutually agreed-upon processes and naming conventions to ensure data integrity for accurate statistical analyses.
- M. Procedures for auditing of QC and IQF records, documentation, procedures, and processes to verify compliance with the Contract Documents and approved CQMP.
- N. Procedures for the review and approval of all portland cement concrete, soil-lime treatment (stabilization or modification), soil-cement treatment, and hot mix asphaltic concrete mix designs by a Registered Professional Engineer in the state of Texas.
- O. Procedures for ensuring IQF testing shall be performed at the frequency stipulated in the TxDOT *DB Guide Schedule of Sampling and Testing*.
- P. Procedures for ensuring IQF staff shall provide oversight and perform audits of the quality control inspection and materials sampling/testing operation.
- Q. Procedures for ensuring that pre-approved materials used on the project maintain their approved status on the AQMP. Materials which do not maintain AQMP approval shall be sampled and tested on a project-level basis, as defined by the TxDOT *DB Guide Schedule of Sampling and Testing*.

#### **3.4.6 Reporting, Record Keeping, and Documentation**

The DB Contractor shall document and maintain documentation showing how the IQF has complied with the CQMP requirements in Section 3.4.5.

The DB Contractor's IQF shall maintain electronically and transmit to TxDOT daily inspection reports within 24 hours after the work shift in a format acceptable to TxDOT. The daily inspection reports shall document the day's events, activities, inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed. The responsible inspector and supervisor shall sign the daily inspection reports.

The IQF shall be responsible for establishing an electronic system for recording all materials test results. The responsible technician and his/her supervisor shall sign the daily test reports and provide the results of the daily tests to TxDOT within 2 days of test completion. The IQF's materials test results will be electronically transmitted to TxDOT in an XML format

acceptable to TxDOT. Guidance on TxDOT requirements for XML data transfer is provided in Appendix C – IQF Data Transfer Requirements. This electronic reporting is intended to allow the DB Contractor and TxDOT to make timely and accurate decisions on workmanship and materials quality issues.

If the IQF inspection and testing source documents are paper and then changed to an electronic document for project-level use, the original source paper document must be kept for 3 years after FHWA final voucher on the project. The IQF inspection and materials test results shall be simultaneously transmitted to both TxDOT and the DB Contractor. The DB Contractor shall not receive the IQF inspection or materials test results prior to TxDOT.

### **3.5 Owner Verification Requirements**

#### **3.5.1 General**

TxDOT has the ultimate responsibility for verifying that the Project is delivered in compliance with the Contract Documents. As such, TxDOT will perform Owner Verification testing and inspection, and conduct audits to verify the DB Contractor's compliance with the approved CQMP.

TxDOT shall establish a system for managing the materials acceptance process. This process shall include the performance and approval of OV tests at the stipulated test frequency, review of IQF test results, performance of statistical analysis on OV and IQF test results, and any associated tasks arising out of the statistical analysis.

TxDOT's OV laboratory shall meet the requirements described in Section 4 – Independent Assurance Program.

#### **3.5.2 Owner Verification Testing and Inspection Plan**

TxDOT or its designated agent will develop a comprehensive Owner Verification Testing and Inspection Plan (OVTIP). If a designated agent develops the OVTIP, it shall submit the plan to TxDOT for approval. The OVTIP shall clearly address, at the minimum, how TxDOT's OV staff will address the following requirements.

- A. Methods and procedures that clearly define the authority and responsibility for the administration of the OVTIP.
- B. Procedures for overseeing and inspecting the Work for compliance with the DB Contractor's CQMP for each operation.
- C. Procedures to ensure that the education, training, and certification of personnel performing OV activities are achieved and maintained and that all Work is performed in accordance with the approved OVTIP.
- D. Procedures to oversee the status and disposition of any identified noncompliance with the plans and specifications.
- E. Measures to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly maintained, controlled, calibrated, certified, and adjusted at specified periods to maintain accuracy within industry standards.

- F. A system of planned and periodic audits of DB Contractor's CQMP to determine adherence to and the effectiveness of the CQMP. Audit results shall be documented, reviewed, and sent to TxDOT and the DB Contractor. Follow-up action, including re-audit of deficient areas following corrective action, shall be taken where indicated.
- G. A system of planned and periodic audits of the OV firm to determine adherence to and the effectiveness of the OVTIP. Audit results shall be documented, reviewed, and sent to TxDOT. Follow-up action, including re-audit of deficient areas following corrective action, shall be taken where indicated.
- H. Procedures for performing periodic inspection of Work to verify that the IQF has performed the Work in compliance with the released-for-construction plans, specifications, and approved working and shop drawings. The procedure should identify a target oversight inspection rate and methods for performing verification inspections for all QC and IQF inspectors.
- I. Procedures on how OV materials sampling and testing will be performed, including the processes for random sampling, tracking materials samples, processing materials samples, review and approval of test records, and tracking compliance with materials testing frequency.
- J. Procedures for reviewing IQF and OV test results for compliance with mutually agreed-upon processes and naming conventions to ensure data integrity for accurate statistical analyses.
- K. Procedures for ensuring that only tests performed by qualified IQF testing personnel are submitted to TxDOT.
- L. Procedures for auditing of QC and IQF records, documentation, procedures, and processes to verify compliance with the Contract Documents and approved CQMP.
- M. Procedures for reviewing portland cement concrete, soil-lime treatment, soil-cement treatment, and hot mix asphaltic concrete mix designs.
- N. Procedures for ensuring OV testing shall be performed at the frequency stipulated in this QAP.
- O. Procedures for performing statistical analyses in compliance with procedures outlined in this QAP.

### **3.5.3 Reporting, Record Keeping, and Documentation**

TxDOT will submit periodic reports to FHWA for concurrence of TxDOT's compliance with the approved QAP. Approved reports shall be distributed to the IQF after receiving FHWA concurrence. The reporting period for specific pay items or materials is dependent on the pace of construction and the number of tests performed in each analysis category, the time period of the sampling, and the specification and quality requirements. Each report shall cover a period of construction not greater than three months.

If the OVT inspection and testing source documents are paper and then changed to an electronic document for project-level use, the original source paper document must be kept for 3 years after FHWA final voucher on the project.

The quarterly report shall address the following areas:



- A. Statistical analysis results, to include specification requirements and status of validation process during start-up and completion of an item;
- B. Non-validation investigation, to include TxDOT's materials acceptance decision for materials represented by non-validated IQF test results;
- C. Non-conformance log;
- D. Engineering judgment log; and
- E. Construction certification.

### **3.5.3.1 Statistical Analysis**

F-tests and t-tests will be used to analyze OV and IQF data. The F-test is a comparison of variances to determine if the OV and IQF population variances are equal. The t-test is a comparison of means to determine if the OV and IQF population means are equal. In addition to these two types of analyses, independent verification and observation verification will also be used to validate the IQF test results. The type of analysis and recommended level of significance for specific tests are shown in Appendix D – OVT Levels for Materials Testing Validation.

Before performing any statistical analyses, it is important to ensure that the data contained in each analysis category are in reasonable compliance with the underlying assumptions of the F-test and t-test. The implementation of controlled vocabulary lists (CVLs) is essential to parse data into appropriate analysis categories.

### **3.5.3.2 Non-Validation Investigation**

If the OV test results do not validate the IQF test results, an investigation shall be conducted to determine the reason for non-validation. Assuming that the analysis categories were established appropriately, other areas for investigation include data integrity and accuracy, testing equipment and procedures, sampling variability, and material variability. Material quality when non-validation occurs is further discussed in Section 3.6 – Resolution of Differences in Materials Test Results. Results of the investigation should be reported for the non-validating categories.

### **3.5.3.3 Engineering Judgment**

Materials test results that indicate reasonable conformance with specification requirements, but did not meet the minimum specification requirements, may be adequate for their intended use. As such, TxDOT has allowed the IQF to exercise Engineering Judgment to accept such materials; however, each occurrence must be properly documented. Documentation shall include the location where the material is incorporated, the specification requirement, the recorded test value, and the Engineering Judgment applied to allow use of that material. If the IQF does not choose to exercise Engineering Judgment to accept failing materials or Construction Deficiency noted in CDRs, the Nonconforming Items in question may still be accepted through the NCR process, brought into conformance with specifications, or removed from the project.

The OV will also provide an Engineering Judgment disposition and documentation for any test result that fails to meet the minimum specification requirements and remains in place.

A project-specific Engineering Judgment Agreement must be drafted by the IQFM and approved by TxDOT following the guiding principles below.

The development of the Project must proceed with a reasonable approach to the quality duties of the IQF and the extension of the IQF's ability to render decisions in the field with regard to the Work performed. TxDOT recognizes that the IQF is an element of DB Contractor's team working to progress the development of the Project for TxDOT, and working alongside DB Contractor who is responsible for compliance. TxDOT recognizes that the IQF should be afforded the opportunity, in concert with their independent role, to render engineering decisions with respect to appropriate documents for inspection and testing as long as the following conditions are met.

- A. Engineering decisions will be delegated no lower than an engineer in charge of a section of the Project. This engineer may be an employee of TxDOT, TxDOT's Consultant, or IQF, and must be a Registered Professional Engineer in the State of Texas. Engineering decisions will be within an individual's area of expertise.
- B. Engineering Judgment to accept material or Work failing specifications will never be applied solely to promote "partnering" or to help out DB Contractor. The Project's quality will be regarded as the highest order of concern. Schedule is a secondary consideration with respect to quality delivery of the Project.
- C. If these guiding principles do not address the situation, the individual applying Engineering Judgment must provide a decision to TxDOT as to whether a material failing to meet specification requirements and not within applicable tolerances should be accepted, or not accepted, based on sound engineering principles, experience, and/or related results of applicable material tests.
- D. Engineering Judgment to accept materials or Work failing specification requirements will be applied only in cases where natural resources may be lost that will otherwise meet the intent of the design (i.e., strength tests versus slump requirements); rejection of material endangers quality or loss of a larger or more significant item (i.e., by rejecting load of concrete, a structure element subject to a cold joint, reflective cracking, etc.); or some other issue that unduly threatens the overall quality/schedule of the Project.
- E. Failed results of material tests may be accepted only for individual tests. Patterns of failure will not be accepted and will be considered a breakdown in Quality Control activities and will be addressed in the CQMP. Recurring use of Engineering Judgment for the same plan or specification deviation should result in process corrections to the construction operations to assure material and Work is conforming to plan and specification requirements. The intent of delegating Engineering Judgment to the IQF is not to allow widening of a specification requirement on a continuing basis.
- F. The IQFM may utilize Engineering Judgment to direct that an amount of acceptance testing greater than the required minimum be done when deemed necessary. The IQFM must document any variations from the prescribed frequencies.
- G. The individual making the Engineering Judgment will apply good engineering practices to ensure quality of accepted material by making additional tests, through engineering analysis, etc., and will document his/her acceptance and justification.
- H. Engineering Judgment in acceptance of material or Work not meeting specification requirements will be applied only to situations that are technically sound, in

consideration of localized conditions. Engineering Judgment will not be utilized to waive specifications for conditions that have project-wide implications. The acceptance of materials or Work not meeting specifications in one instance at a location will not become a corridor-wide or project-wide decision. Each situation will be judged on the merits of its unique characteristics.

- I. TxDOT may, at any time, remove Engineering Judgment authority from the IQFM in specific circumstances.
- J. TxDOT and FHWA have oversight agreements in place that require specific documentation relating to nonconforming material that is allowed to remain in place. Any instance of the application of these Guiding Principles will be accompanied by appropriate documentation.
- K. The IQF is encouraged but not required to consult with TxDOT prior to making acceptance decisions.
- L. IQF personnel are not placed, and do not appear to be placed, in a position that exhibits signs that they were pressured by DB Contractor to accept, approve, or continue the duties of the IQF scope of work as detailed in the Project under duress.

#### **3.5.3.4 Nonconformance and Construction Deficiency Logs**

Materials or Construction Deficiencies noted in CDRs that have not been corrected and that do not meet the minimum specification requirements may be adequate for their intended use; however, the incorporation of the material in question is subject to the review and approval by the EOR and must be documented through the Nonconformance Record (NCR) process.

DB Contractor shall identify, document, and report to TxDOT all instances of Work that have not been constructed with the strictest adherence to the approved drawings and specifications and within the requirements of the Contract Documents, the Governmental Approvals, and applicable Law. This reporting shall be in the form of an NCR as described below and shall be submitted to TxDOT in writing within 24 hours of DB Contractor obtaining knowledge of the same. DB Contractor shall simultaneously send a copy of each NCR to DB Contractor's EOR and the IQF.

The NCR shall clearly describe the element of Work that is non-conforming and the reason for the non-conformance. The engineer who stamped and sealed the drawings for the Work shall evaluate the effect of the Nonconformance on the performance, safety, durability, and effect of the long-term maintenance of the project and the specific element affected. If the EOR determines remedial actions are necessary, the proposed remedial action shall be documented and bear the stamp of the original responsible Registered Professional Engineer or the responsible Registered Professional Engineer from the same firm assigned to replace the original one.

DB Contractor will maintain a log of all NCRs and CDRs and submit this log to TxDOT and the IQF on a bi-weekly basis. Each NCR and CDR will be numbered sequentially, given a brief description, a status and, if it is not closed, an expected date for closure. All NCRs must be closed with the stamp of Design Firm's qualified engineer in charge and TxDOT approval or the responsible Registered Professional Engineer from the same firm assigned to replace the original one.

### **3.5.3.5 Construction Certification**

The DB Contractor shall provide a monthly written certification by the IQFM, delivered to TxDOT with each payment request, indicating that the CQMP and all of the measures and procedures provided therein are being fully complied with and are functioning properly. The IQF shall maintain and submit records monthly that include factual evidence that required activities and tests have been performed, including the following:

- A. Type, number, and results of CQMP activities, including reviews, inspections, tests, audits, monitoring of Work performance, and materials analysis;
- B. Related data, such as qualifications of personnel, procedures, and equipment used;
- C. Inspector or data recorder, the type of test or observation employed, the results and the acceptability of the Work, and action taken in connection with deficiencies;
- D. Nature of Nonconforming Work and Construction Deficiency Items and causes for rejection;
- E. Proposed corrective action for Nonconforming Work and Construction Deficiency Items;
- F. Corrective actions taken with respect to Nonconforming Work and Construction Deficiency Items; and
- G. Results of such corrective actions.

## **3.6 Resolution of Differences in Materials Test Results**

Through the life of the Project, there may be differences in materials test results or statistical sample populations between the IQF and TxDOT. Due to the natural variability in construction materials testing and unavoidable biases in sampling and testing, these differences are often difficult to avoid. When the differences between IQF and TxDOT sample populations are large enough, TxDOT's OV sampling and testing will not validate IQF test results. IQF test results that are not validated will not be used for TxDOT's acceptance of the material.

### **3.6.1 Non-Validation**

When OV independent test results do not statistically validate the IQF test results as outlined in Section 3.5.3.1 – Statistical Analysis (Level 1), or TxDOT determines that independent OV sampling and testing does not validate IQF test results (Level 2), TxDOT and the IQF will jointly investigate to determine the source(s) of non-validation. TxDOT and the IQF will adjust sampling and testing processes to correct any sampling and testing deficiencies, align testing procedures, calibrate equipment, and reduce testing bias as identified during the joint investigation. If the non-validation persists (over five consecutive Level 1 F- and t-analyses), a process NCR shall be issued to formally document and seek resolution to the non-validation.

A non-validation does not relieve the IQF and OV from addressing any failing test results included in the analysis or otherwise. All failing IQF tests, validating or not validating, must be accepted based on Engineering Judgment, NCR process, reworked, or removed and replaced.

### **3.6.2 Material Quality**

Non-validation indicates that the IQF test results are not statistically from the same population as the OV test results. Non-validation or validation does not address material quality. When the IQF test results are not validated by OV sampling and testing, TxDOT will work with the DB Contractor to immediately evaluate to determine if the material represented by the non-validation will remain in place; will remain in place with a price adjustment or assessed noncompliance points; will be reworked; or will be removed and replaced. TxDOT will determine material acceptance based on available OV test results included in the non-validating analysis, an estimated Percent within Limits (PWL) for the OV test analysis population based on the mean and standard deviation of the OV population, and TxDOT Engineering Judgment. TxDOT may increase the OV sampling frequency to provide additional OV data for potential continuing non-validation analyses.

If material is to remain incorporated into the Project, the material in question will be evaluated using the process described in this section. The appropriate IQF or TxDOT party may exercise Engineering Judgment to determine that the material will perform its intended purpose. There are four possible combinations of passing and failing results between the IQF and OV test results.

#### **3.6.2.1 Both the IQF and OV Test Results Pass Specification Limits**

Although statistical validation has not occurred, both the IQF and OV test results are passing the established specification limits. Thus, material quality in question is considered acceptable.

#### **3.6.2.2 IQF Test Results Fail and OV Test Results Pass Specification Limits**

Material may be left in place if the IQF determines that Engineering Judgment, as described in [Section 3.5.3.3](#), may be used to accept the material, or if the material is accepted through the NCR process.

#### **3.6.2.3 Both the IQF and OV Test Results Fail Specification Limits**

Material may be left in place if the IQF and TxDOT both determine that Engineering Judgment may be used to accept the material or if the material is accepted through the NCR process. The acceptance of material is subject to one of the two scenarios below.

1. OV test results indicate reasonable conformance with specification requirements. TxDOT exercises Engineering Judgment to concur with acceptance of material.
2. OV test results do not indicate reasonable conformance with specification requirement. TxDOT makes decision on acceptability based solely on OV test results and percent within limits (PWL) analysis. Based on the results of this analysis, a determination is made and documented on whether the material may be left in place.

If the material is reworked, IQF must perform a fixed test at the OV failed test location followed by random-independent tests by both IQF and OV. Random-independent test results representing material prior to rework should be excluded from new statistical analysis.

### **3.6.2.4 IQF Test Results Pass but OV Test Results Fail Specification Limits**

Material may be left in place if the IQF and TxDOT both determine that Engineering Judgment may be used to accept the material or if the material is accepted through the NCR process. This is subject to TxDOT response in the two scenarios below.

1. OV test results indicate reasonable conformance with specification requirements. TxDOT exercises Engineering Judgment to concur with acceptance of material.
2. OV test results do not indicate reasonable conformance with specification requirement.
  - a. TxDOT makes decision on acceptability based solely on OV test results and percent within limits (PWL) analysis, or
  - b. Both parties agree to referee testing as outlined in Section 3.6.3 – Referee Testing. Based on the results of referee testing, a determination is made and documented on whether the material may be left in place.

If the material is reworked, IQF must perform a fixed test at the OV failed test location followed by random-independent tests by both IQF and OV. Random-independent test results representing material prior to rework should be excluded from new statistical analysis.

### **3.6.3 Referee Testing**

Resolution of discrepancies over specific test results can be achieved in a reliable, unbiased manner by referee testing and evaluation performed by a referee laboratory. The referee laboratory shall be the CST/M&P central laboratory or an independent third-party testing laboratory qualified according to Section 4 – Independent Assurance Program, and approved by TxDOT. Referee testing is solely a TxDOT function; therefore, the third-party laboratory cannot be hired by the DB Contractor. The decision by the referee laboratory shall be final. Referee test results will be signed and sealed by a Professional Engineer registered in the state of Texas.

## SECTION 4 - INDEPENDENT ASSURANCE PROGRAM

### 4.1 General

TxDOT, or its designee, shall implement the Independent Assurance (IA) program. This IA program evaluates all sampling and testing procedures, personnel, and equipment used as part of an acceptance decision. The IA program evaluates the qualified sampling and testing personnel and testing equipment and is established using the system approach. The system approach bases 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.

This program provides uniform statewide procedures to ensure that tests are performed by qualified personnel and that laboratory facilities and equipment are adequate to perform the required sampling and testing methods.

The following frequencies and activities are required for evaluating sampling and testing personnel and equipment under the system approach to IA.

*Table 1: Independent Assurance Observation and Qualification Frequencies*

Frequencies and Activities	
Time	Activity
Prior to performing acceptance sampling and testing	Qualification is required under Sections 4.2 and 4.3 of this QAP.
Within 12 months after Observation and Qualification	Each qualified technician is required to participate in the first available proficiency or split sample for each test method requiring IA. Results must compare to the IA test results to within the established tolerance.
Within 24 months after Observation and Qualification	Each qualified technician is required to participate in one proficiency or split sample test for each test method requiring IA. Results must compare to the IA test results to within the established tolerance.
Within 36 months of Qualification	Qualification is again required under Sections 4.2 and 4.3 of this QAP.

*NOTE: For American Concrete Institute (ACI) certification, the above frequency is extended to 5 years for Concrete Field Technician – Grade I and Concrete Strength Technician. Maintaining technician qualification under the IA systems approach requires continuation of the above cycle of qualification and successful split or proficiency sample testing, as applicable.*

### 4.2 Independent Assurance Quality Plan

TxDOT or its designated agent will develop an Independent Assurance Quality Plan (IAQP). If a designated agent develops the IAQP, they shall submit the plan to TxDOT for approval. The IAQP shall clearly address, at minimum, how IA staff will address methods and procedures

that clearly define the administration of the IA program, including all requirements in this Section.

### **4.3 Personnel Qualifications**

Personnel performing tests on the Project must be qualified in the appropriate test methods.

#### **4.3.1 Required Certifications**

Sampling and testing personnel must obtain and keep current the following certifications unless otherwise waived by governing specifications.

- A. ACI Concrete Field Testing Technician – Grade 1
- B. ACI Concrete Strength Testing Technician
- C. TXAPA HMA Plant Production Specialist – Level 1A
- D. TXAPA HMA Roadway Specialist – Level 1B
- E. TXAPA HMA Mix Design Specialist – Level 2
- F. TXAPA Properties Specialist – SB 101
- G. TXAPA Field Specialist – SB 102
- H. TXAPA Materials Analysis Specialist – SB 103
- I. TXAPA Strength Specialist – SB 201
- J. TXAPA Compressive Strength Specialist – SB 202

Reciprocity may be granted to individuals who have been successfully qualified under another state's program. These situations will be considered on a case-by-case basis and must meet the approval of the Director of CST/M&P.

For those testing procedures not covered by the above certifications, the following personnel may qualify an individual to perform the required sampling and testing of materials:

- A. Qualified Independent Assurance Laboratory personnel who have been authorized by TxDOT to perform personnel qualifications.
- B. Construction Division, Materials and Pavements Section (CST/M&P) personnel.

#### **4.3.2 Provisional Certifications**

In the event the above listed certifications cannot be readily obtained due to course availability, schedule conflicts, or other extenuating circumstances, provisional certifications administered by the designated project IA laboratory will be allowed, per the following stipulations:

- A. Provisional certifications must be approved by the TxDOT project manager (PM);
- B. Provisional certifications will be valid for up to 6 months; and
- C. The candidate must show evidence of having enrolled in the required ACI or TXAPA course.



### 4.3.3 IQF, OV, and IA Personnel

Any individual who performs tests on materials for acceptance must be qualified to perform tests in the areas of hydraulic cement concrete, soils and aggregates, and bituminous materials.

Appendix E – Test Methods for Personnel Qualifications provides test methods for which individuals are to be qualified. There may be other tests required, based on project-specific specifications, which may require qualification.

To qualify, an individual must successfully perform the specific test and the necessary calculations required to determine specification compliance in the presence of an authorized evaluator. Successful performance is defined as demonstrating the ability to properly perform the key elements for each test method. If the individual fails to demonstrate the ability to perform a test, the individual will be allowed one retest per test method at the evaluator's convenience.

After successful performance of a test method, the individual must also pass a written examination (minimum score of 80%) administered by an authorized evaluator. An individual failing the written examination may request a retest. The retest must be scheduled and administered within 30 days of notification of failure. Failure to pass the second written examination shall be considered as failing the entire qualification.

If an individual fails to qualify on a specific test method or the qualification is revoked, the individual must obtain additional training before retesting on that specific test.

In addition, for tests for which CST/M&P requires an annual split/proficiency sample evaluation, the individual must participate in split/proficiency samples given by the qualification authority to validate the qualification. Appendix F – Test Methods for Split/Proficiency Evaluation provides a list of testing procedures required for split/proficiency evaluation. CST/M&P determines the qualification authority for the split/proficiency sample. Split sample results will be evaluated against TxDOT's acceptable tolerance limits shown in Appendix B – Split Sample Tolerance Limits. Proficiency sample test results must be within  $\pm 2$  standard deviations of the proficiency sample mean. If the comparisons of the test results do not comply with the tolerances, an engineering review of the test procedures and equipment will be performed immediately to determine the source of the discrepancy. Corrective actions must be identified and incorporated as appropriate, prior to the individual performing additional testing on that test method.

Under unique circumstances, the qualification authority may grant a verbal examination upon request. The reason(s) for requesting a verbal examination must be presented and documented prior to the individual being allowed to take the examination.

Unless otherwise stated, qualification of an individual is valid for not more than 3 years, after which the individual must be re-qualified. Under the IA system approach, annual split/proficiency will be required as specified in *Table 1: Independent Assurance Observation and Qualification Frequencies*.

#### 4.3.4 Documentation

The IA laboratory manager is 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. Copies of any qualification certificates issued by ACI and TXAPA;
- B. Copies of the qualification certificates issued by the IA laboratory with expiration dates;
- C. Original written examinations for test procedures administered to each technician by the IA laboratory, with clear identification of technician's name, qualifier's name, score, and date taken;
- D. Original performance examinations for test procedures administered to each technician by the IA laboratory, with clear identification of technician's name, qualifier's name, qualification status, and date;
- E. Results of annual proficiency testing administered by the IA laboratory for each technician.

Documentation retention will be for the life of the qualification. Qualification authority must be shown on the certificate given to each individual.

#### 4.3.5 Disqualification

Accusations of misconduct by testing technicians shall be made to the responsible TxDOT representative. The three levels of misconduct—neglect, abuse, and breach of trust—are defined in Table 2.

Table 2: Levels of Misconduct

Term	Definition
Neglect	Unintentional deviations from testing procedures or specifications
Abuse	Careless or deliberate deviation from testing procedures or specifications
Breach of Trust	Violation of the trust placed in the certified technician including, but not limited to: <ul style="list-style-type: none"><li>▪ Falsification of records;</li><li>▪ Being aware of improprieties in sampling, testing, and/or production by others and not reporting them to appropriate supervisors involved in the project;</li><li>▪ Re-sampling and/or retesting without awareness and consent of appropriate supervisors involved in the project; and/or</li><li>▪ Manipulating compensation and/or production.</li></ul>

Penalties may be implemented upon recommendation by the responsible TxDOT representative. Penalties may range from a reprimand to a permanent revocation of the certification.

Any technician found guilty of breach of trust will have their certification permanently revoked. Any technician with a revoked certification will be removed from the project and will not be allowed to be employed on any TxDOT project statewide.

## **4.4 Laboratory Qualifications**

Laboratories where IA, IQF, and OV tests will be performed must be qualified. [Appendix H](#) provides the minimum qualification requirements for laboratories

### **4.4.1 Laboratory Qualification Responsibility**

The CST/M&P central laboratory will be accredited by one of the following FHWA- and TxDOT-approved accrediting bodies:

- A. AASHTO Accreditation Program (AAP);
- B. Construction Materials Engineering Council (CMEC); or
- C. Laboratory Accreditation Bureau (L-A-B).

CST/M&P is responsible for overseeing the statewide laboratory qualification program and for qualifying the IA laboratory. The IA laboratory is responsible for qualifying IQF and OV laboratories.

### **4.4.2 Laboratories to be Qualified**

All laboratories performing testing for TxDOT require qualification. These include, but are not limited to the following:

- A. CST/M&P central laboratory;
- B. CST/M&P field laboratories;
- C. IA laboratory;
- D. Referee laboratory;
- E. IQF laboratory; and
- F. OV laboratory.

### **4.4.3 Qualification Process**

The laboratory qualifying authority will:

- A. Identify the scope of testing to be performed;
- B. Verify that manuals and/or test methods used to perform tests are available and up to date;
- C. Document that the laboratory has the required equipment to perform the tests; and
- D. Check the calibration/verification records for each piece of equipment, to include:

- a. Description of equipment
- b. Identification of any traceable standard used;
- c. Frequency of calibration;
- d. Date of last calibration;
- e. Date of next calibration;
- f. Procedure used to calibrate equipment; and
- g. Procedure used to identify equipment not in compliance.

In addition, all equipment may be subjected to calibration verification or other inspection by the qualifying authority.

#### **4.4.4 Independent Assurance Testing Equipment**

CST/M&P will qualify IA laboratory testing equipment used for IA sampling and testing according to Section 4.4 – Laboratory Qualifications.

The IA laboratory will qualify all other IQF and OV testing equipment and AASHTO-, CMEC-, or L-A-B-accredited commercial laboratory equipment used for IA sampling and testing.

The qualifying authority shall qualify testing equipment according to the following guidelines:

- A. Frequency for qualifying IA sampling and testing equipment will not exceed 1 year;
- B. Calibration/verification is required whenever the laboratory or equipment is moved; and
- C. IA equipment shall be other than that used for performing OV, IQF, or QC testing.

Any equipment used to perform OV and IQF sampling and testing in making an acceptance decision will be evaluated by IA sampling and testing personnel. This evaluation includes calibration checks and split or proficiency sample tests. The requirements for and frequency of equipment calibrations are shown in TxDOT's test procedures, as referenced in Section 4.4.5 – Calibration Standards for Laboratory Equipment. Acceptable tolerance limits for the comparison of test results from split or proficiency samples are shown in Appendix B – Split Sample Tolerance Limits.

#### **4.4.5 Calibration Standards for Laboratory Equipment**

The standards for calibration and the frequencies for laboratory equipment calibrations are given in:

- A. Tex-198-E, "Minimum Standards for Acceptance of a Laboratory for Soils and Flexible Base Testing";
- B. Tex-237-F, "Minimum Standards for Acceptance of a Laboratory for Hot Mix Testing"; and
- C. Tex-498-A, "Minimum Standards for Acceptance of a Laboratory for Concrete and Aggregate Testing."

#### **4.4.6 Frequency for Laboratory Qualification**

Laboratories are qualified at an interval not to exceed 3 years. Calibration/verification is required whenever the laboratory or equipment is moved.

#### **4.4.7 Documentation**

The Project Owner is responsible for verifying that laboratories are qualified to perform TxDOT testing. Documentation must be kept by the qualified laboratory and the Project Owner. Calibration records will be maintained for 3 years, unless another agency requires a longer period.

#### **4.4.8 Non-Compliance**

A laboratory that does not meet the above requirements is subject to disqualification. Any equipment in a qualified laboratory failing to meet specified equipment requirements for a specific test method shall not be used for that test method.

#### **4.4.9 Resolution of Disputes**

The next higher qualification authority will resolve disputes concerning calibration and verification of equipment. For disputes that cannot be resolved at the project level, CST/M&P will be the final authority.

#### **4.4.10 Laboratory Accreditation**

In addition to TxDOT laboratory qualification, IA, referee, and the central laboratories of IQF and OV firms shall be accredited by one of the following FHWA- and TxDOT-approved accrediting bodies:

- A. AASHTO Accreditation Program (AAP);
- B. Construction Materials Engineering Council (CMEC); or
- C. Laboratory Accreditation Bureau (L-A-B).

The accreditation must be maintained throughout the life of the project. A copy of the accreditation certificate(s) shall be transmitted to TxDOT upon receipt by the testing laboratory. The accreditation shall include all test methods equivalent to TxDOT's test methods shown in Appendix H – Minimum Qualification Requirements for Laboratories. The IA, referee, and central laboratories of the IQF and OV will be required to grant TxDOT permission to monitor the laboratories' accreditation status. In the event of a suspension or revocation in a required method, the laboratory shall provide formal documentation explaining why the suspension or revocation occurred and when it will be reinstated. In addition, the laboratory must participate in proficiency sample testing as specified by the accrediting body. The firm's central laboratory shall grant TxDOT permission to monitor the project laboratory's performance on proficiency samples and allow TxDOT to review corrective actions for low ratings.

The IQF and OV project/field laboratories do not have to be AASHTO, CMEC, or L-A-B accredited but shall implement and follow the quality management system of their accredited central laboratory. Project/field laboratories must be qualified by the project IA laboratory.

In order to perform a test at the project laboratory, the firm's central laboratory AASHTO accreditation must include the methods shown in Appendix H – Minimum Qualification Requirements for Laboratories. The project laboratory also must provide documentation that it has implemented the accredited central laboratory's quality system, including:

- A. A copy of the central laboratory quality manual revised to include project laboratory-specific location, test methods, and personnel; and
- B. Record of an internal audit by the central laboratory verifying compliance with the requirements of AASHTO R18-16, Section 5.6, Figures X1.3 and X1.4.

The IA qualification of the project laboratory will be based on review of the project laboratory quality manual and internal audit, and a laboratory visit to check equipment availability and calibration. Personnel qualification will be performed as discussed in Section 4.3 – Personnel Qualifications.

The project laboratory quality system will be updated for each new mobilization of laboratory equipment. In addition, the IA laboratory will perform a project laboratory qualification prior to the start of testing using the added equipment.

#### **4.4.11 Annual Report**

CST/M&P shall compose and submit an annual report to the FHWA Division Administrator summarizing the results of TxDOT's systems approach IA program. This report shall identify:

- A. Number of sampling and testing personnel evaluated by the systems approach IA testing;
- B. Number of IA evaluations found to be acceptable;
- C. Number of IA evaluations found to be unacceptable; and
- D. Summary of any significant system-wide corrective actions taken.

The IA laboratory shall compile and submit a project-level IA report to CST/M&P.

## SECTION 5 - DESIGN BUILD QAP IMPLEMENTATION GUIDE

The [Design-Build \(DB\) Quality Assurance Program \(QAP\) Implementation Guide](#) provides guidance for the finalization and implementation of DB QAP for Comprehensive Development Agreement (CDA) projects undertaken by the Texas Department of Transportation (TxDOT).

The guide covers four primary topics:

1. Finalization of the QAP;
2. Approval of the Owner Verification and Testing and Inspection Plan (OVTIP) and the Construction Quality Management Plan (CQMP);
3. Implementation of the approved DB QAP during construction; and
4. Closing out the project.

The primary objectives of the guide are to:

1. Provide consistency and practical guidance in the DB QAP implementation processes on TxDOT DB/CDA projects, and
2. Outline the processes for finalizing the DB QAP, approving the OVTIP and CQMP, implementing the approved DB QAP during construction, and closing out the project.

## Appendix A Acronyms and Definitions

The following terms and definitions are referenced in this manual and have the meanings set forth below.

<b>AAP</b>	AASHTO Accreditation Program
<b>AASHTO</b>	American Association of State Highway Transportation Officials
<b>ACI</b>	American Concrete Institute
<b>AMRL</b>	AASHTO Materials Reference Laboratory
<b>AQMP</b>	Aggregate Quality Monitoring Program
<b>CCRL</b>	Concrete and Cement Reference Laboratory
<b>CDA</b>	Comprehensive Development Agreement
<b>CDR</b>	Construction Deficiency Report
<b>CFR</b>	Code of Federal Regulations
<b>CST/M&amp;P</b>	Construction Division, Materials and Pavements Section
<b>CQCM</b>	Construction Quality Control Manager
<b>CQMP</b>	Construction Quality Management Plan
<b>CVL</b>	Controlled Vocabulary List
<b>EOR</b>	Engineer of Record
<b>FHWA</b>	Federal Highway Administration
<b>IA</b>	Independent Assurance
<b>IAQP</b>	Independent Assurance Quality Plan
<b>IQF</b>	Independent Quality Firm
<b>IQFM</b>	Independent Quality Firm Manager
<b>NCR</b>	Nonconformance Report
<b>OV</b>	Owner Verification
<b>OVTIP</b>	Owner Verification Testing and Inspection Plan
<b>QAP</b>	Quality Assurance Program
<b>QC</b>	Quality Control
<b>QMP</b>	Quality Monitoring Program
<b>RFI</b>	Request for Information
<b>SEP-15</b>	Special Experimental Project Number 15 or SEP-15 derives
<b>TxDOT</b>	Texas Department of Transportation



**Acceptance Program**—all factors that comprise TxDOT’s program to determine quality of the product as specified in the contract requirements. These factors include acceptance and verification sampling, testing, and inspection, and may include results of quality control sampling and testing.

**Aggregate Quality Monitoring Program (AQMP)**—governed by Tex-499-A, provides the requirements and procedures for the Construction Division, Materials and Pavements Section (CST/M&P) to accept aggregate products that have demonstrated continuing quality and uniformity.

**Construction Deficiency Items**—work features that are typically still “work in progress”; are not a finished product and that do not require a design change; and can be reworked in the field to be in compliance with the original requirements. These will be documented and reworked in accordance with the governing design and/or specifications and re-inspected by construction QC and QA staff for compliance.

**Construction Deficiency Report (CDR)**—a report of how Construction Deficiency Items have been documented and resolved.

**Contract Documents**—meaning set forth in the executed agreement between TxDOT and DB Contractor.

**Controlled Vocabulary List**—the list of agreed-upon nomenclature used to uniquely identify each QA and OV testing report.

**Design Firm**—the qualified Registered Professional Engineer’s firm responsible for the design of the Project.

**Design Documents**—all drawings (including plans, profiles, cross-sections, notes, elevations, sections, details and diagrams), specifications, reports, studies, calculations, electronic files, records and submittals necessary for, or related to, the design of the Project and/or the Utility Adjustments in accordance with the Contract Documents, the Governmental Approvals, and applicable Law.

**DB Contractor**—the entity identified in the Agreement to perform Work under the Project, together with its successors and assigns.

**Engineer**—when interpreting standards, policies, and specifications referenced in the Technical Provisions, the following apply.

- A. References to the project owner mean TxDOT.
- B. References to the Engineer in the context of provider of compliance judgment may mean the Engineer of Record, Design Quality Control Manager, the Independent Quality Firm, or it may mean a TxDOT representative, depending on the context, as determined by TxDOT in its sole discretion.

**Engineering Judgment**—determinations as to whether a material failing to meet specification requirements and not within applicable tolerances should be accepted, or not accepted, will

be based upon sound engineering principles, experience, and/or related results of applicable material tests, and be made by a Texas Licensed Professional Engineer.

**Engineer of Record**—the engineer who stamped and sealed the drawings for the Work.

**Final Acceptance**—the occurrence of all of the events and satisfaction of all of the conditions set forth in the CDA Documents, as and when confirmed by TxDOT's issuance of a certificate of Final Acceptance.

**F-test**—the statistical analysis to compare the variances of two sets of data.

**Governmental Approval**—any permit, license, consent, concession, grant, franchise, authorization, waiver, variance or other approval, guidance, protocol, mitigation agreement, or memoranda of agreement/understanding, and any amendment or modification of any of them provided by Governmental Entities, including State, local, or federal regulatory agencies, agents, or employees, that authorize or pertain to the Work or the Project, but excluding any such approvals given by or required from any Governmental Entity in its capacity as a Utility Owner.

**Governmental Entities**—any federal, State, or local government and any political subdivision or any governmental, quasi-governmental, judicial, public or statutory instrumentality, administrative agency, authority, body, or entity other than TxDOT.

**Independent Assurance Program**—all activities that are included in an unbiased and independent evaluation program for all the sampling and testing procedures used in the Acceptance Program.

**Independent Quality Firm**—the independent firm required as part of the DB Contractor's team responsible for performing independent material testing, inspection, and audits of the CQMP. IQF test results may be used as part of the acceptance decision if they are validated by the Owner Verification (OV) test results.

**Law or Laws**—Excludes Governmental Approvals, but includes:

- A. Any statute, law, code, regulation, ordinance, rule or common law,
- B. Any binding judgment (other than regarding a Claim or Dispute),
- C. Any binding judicial or administrative order or decree (other than regarding a Claim or Dispute),
- D. Any written directive, guideline, policy requirement, or other governmental restriction (including those resulting from the initiative or referendum process, but excluding those by TxDOT within the scope of its administration of the Contract Documents), or
- E. Any similar form of decision of or determination by, or any written interpretation or administration of any of the foregoing by, any Governmental Entity, in each case which is applicable to or has an impact on the Project or the Work, whether taking effect before or after the Effective Date, including Environmental Laws.

**Level of Significance (alpha)**—the probability of erroneously rejecting the null hypothesis when it should have been accepted.

**Nonconforming Work (Nonconformance)**—Work that does not conform to the requirements of the Contract Documents, the Governmental Approvals, applicable Law, or the Design Documents.

**Nonconformance Report (NCR)**—a report of how Nonconforming Work was accepted for incorporation into the Work.

**Plans**—the Final Design Documents.

**Proficiency Samples**—homogenous samples that are distributed and tested by two or more laboratories and/or personnel. The test results are compared to assure that the laboratories and/or personnel are obtaining the same results.

**Project**—meaning set forth in the Contract Documents.

**Qualification**—a quality, ability, or accomplishment that makes a person technically competent for a particular position or task.

**Quality Assurance**—all planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality.

**Quality Assurance Program**—the program for quality management and control of the Project and Work, as described in this document.

**Quality Control**—all contractor/vendor operational techniques and activities that are performed or conducted to fulfill the contract requirements.

**Random Sampling**—a process whereby each element of the population has an equal chance of being selected.

**Registered Professional Engineer**—a person who is duly licensed and registered by the Texas Board of Professional Engineers to engage in the practice of engineering in the state of Texas.

**Rules**—the Texas Administrative Code.

**Substantial Completion**—the occurrence of all of the events and satisfaction of all of the conditions set forth in the Contract Documents, as and when confirmed by TxDOT's issuance of a Certificate of Substantial Completion.

**Subcontractor**—any parties with whom DB Contractor has entered into any Subcontract to perform any part of the Work or provide any materials, equipment, or supplies for the Project on behalf of DB Contractor and any other party with whom any Subcontractor has further subcontracted any part of the Work, at all tiers.

**Supplier**—any Person not performing work at or on the Site who supplies machinery, equipment, materials, hardware, software, systems, or any other appurtenance to the Project to DB Contractor or to any Subcontractor in connection with the performance of the

Work. Persons who merely transport, pick up, deliver, or carry materials, personnel, parts, or equipment or any other items or persons to or from the Site will not be deemed to be performing Work at the Site.

**TxDOT Standard Specifications**—the *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges* adopted by the Texas Department of Transportation, including all revisions thereto applicable on the effective date of the Contract Documents.

**t-test**—the statistical analysis to compare the variances of two sets of data.

**Utility or utility**—a public, private, cooperative, municipal, and/or government line, facility, or system used for the carriage, transmission, and/or distribution of cable television, electric power, telephone, telegraph, water, gas, oil, petroleum products, steam, chemicals, hydrocarbons, telecommunications, sewage, storm water not connected with the drainage of the Project, and similar substances that directly or indirectly serve the public.

**Utility Owner**—the owner or operator of any Utility (including both privately held and publicly held entities, cooperative utilities, and municipalities and other governmental agencies).

**Vendor**—a supplier of project-produced material that is not the DB Contractor.

**Verification Testing**—sampling and testing performed to validate the quality of the product. The sampling and testing must be performed by qualified testing personnel employed by TxDOT, excluding the DB Contractor and vendor.

**Work**—all of the work required under the Contract Documents, including all administrative, design, engineering, real property acquisition and occupant relocation, support services, utility adjustment work to be furnished or provided by DB Contractor, reimbursement of Utility Owners for utility adjustment work furnished or provided by such Utility Owners or their contractors and consultants, procurement, professional, manufacturing, supply, installation, construction, supervision, management, testing, verification, labor, materials, equipment, maintenance, documentation, and other duties and services to be furnished and provided by DB Contractor as required by the Contract Documents, including all efforts necessary or appropriate to achieve Final Acceptance, except for those efforts which such Contract Documents expressly specify will be performed by parties other than the DB Contractor-related entities.

## Appendix B Split Sample Tolerance Limits

Split sample test results must be within the tolerances established below.

Procedure	Test Method	Tolerance
Determining Moisture Content in Soil Materials	Tex-103-E	±1% point
Liquid Limit of Soils	Tex-104-E	15% of mean <sup>1</sup>
Plastic Limit of Soils	Tex-105-E	15% of mean <sup>1</sup>
Plasticity Index of Soils	Tex-106-E	20% of mean <sup>1</sup>
Bar Linear Shrinkage	Tex-107-E	±2%
Particle Size Analysis of Soils, Part I	Tex-110-E	> No. 4 sieve: ±5% points ≤ No. 4 sieve: ±3% points
Moisture-Density Relationship of Base Materials	Tex-113-E	Density: 2.0 pcf of mean <sup>1</sup> Moisture Content: ±5% points
Moisture-Density Relationship of Subgrade, Embankment Soils, and Backfill Material	Tex-114-E	Density: 2.0 pcf of mean <sup>1</sup> Moisture Content: ±5% points
In-Place Density of Soils and Base Materials	Tex-115-E	±2.5%
Wet Ball Mill	Tex-116-E	10% of mean <sup>1</sup>
Compressive Strength for Disturbed Soils and Base Materials	Tex-117-E	10 psi of mean <sup>1</sup>
Molding, Testing, and Evaluating Bituminous Black Base Materials	Tex-126-E	±1.0%
Determining Soil pH	Tex-128-E	±0.1
Measuring the Resistivity of Soil Materials	Tex-129-E	±1,000 ohm-cm
Measuring Thickness of Pavement Layer	Tex-140-E	0.25 in.
Determining Sulfate Content in Soils - Colorimetric Method	Tex-145-E	±500 ppm
Soil Organic Content Using UV-Vis Method	Tex-148-E	±0.2%

Procedure	Test Method	Tolerance
Sieve Analysis of Fine and Coarse Aggregates	Tex-200-F	> 5/8" sieve: ±5% points (individual % retained) ≤ 5/8 - No. 200 sieve: ±3% points (individual % retained) Passing No. 200 sieve: ±1.6% points
Sand Equivalent Test	Tex-203-F	±5
Compacting Specimens Using the Texas Gyrotory Compactor (TGC)	Tex-206-F	±1.0% laboratory-molded density calculated in accordance with Tex-207-F
Determining Density of Compacted Bituminous Mixtures	Tex-207-F	Laboratory-molded density: ±1.0% Laboratory-molded bulk specific gravity: ±0.020 In-place air voids (cores): ±1.0%
Determining Moisture Content of Bituminous Mixtures	Tex-212-F	±0.2 mL
Determining Deleterious Material in Coarse Aggregates	Tex-217-F	±0.3%
Decantation Test for Coarse Aggregate	Tex-217-F	20% of mean <sup>1</sup>
Theoretical Maximum Specific Gravity of Bituminous Mixtures	Tex-227-F	±0.020
Determining Asphalt Content from Asphalt Paving Mixtures by the Ignition Method	Tex-236-F	±0.3%
Sieve Analysis of Concrete Fine and Coarse Aggregate	Tex-401-A	> No. 4 sieve: ±5% points ≤ No. 4 sieve: ±3% points
Fineness Modulus of Concrete Fine Aggregate	Tex-402-A	±0.2
Decantation Test for Concrete Aggregates	Tex-406-A	20% of mean <sup>1</sup>
Determining Deleterious Material in Concrete Mineral Aggregate	Tex-413-F	±0.3%
Air Content of Freshly Mixed Concrete by the Volumetric Method <sup>2, 3</sup>	Tex-414-A	±1.0%
Slump of Hydraulic Cement Concrete	Tex-415-A	±1 in.

Procedure	Test Method	Tolerance
Air Content of Freshly Mixed Concrete by the Pressure Method <sup>3</sup>	Tex-416-A	±1%
Compressive Strength of Cylindrical Concrete Specimens	Tex-418-A	17% of mean <sup>1</sup> (4 × 8 in.) 14% of mean <sup>1</sup> (6 × 12 in.)
Measuring Temperature of Freshly Mixed Portland Cement Concrete	Tex-422-A	2 °F
Coarse Aggregate Angularity	Tex-460-A	±5
Asphalt Content	Tex-228-F	±0.3%
	Tex-236-F	±0.3%
Maximum Theoretical Specific Gravity	Tex-227-F	±0.020
Laboratory-Molded Density	Tex-207-F	±1.0%
Laboratory-Molded Bulk Specific Gravity	Tex-207-F	±0.020
Moisture Content	Tex-212-F	±0.2 mL
In-Place Air Voids (Core)	Tex-207-F	±1.0%

1. The difference between compared test results shall not exceed the indicated percentage of the mean of the compared test results where the mean is the average of the two test results.
2. Required when volumetric method is used
3. Required only when air entrained concrete is specified

## **Appendix C**

### **IQF Data Transfer Requirements**

XML submission allows for the transfer of all IQF's laboratory test results into I2MS from other IQF data systems without additional levels of data entry. An example XML sample submission and I2MS Test Form Fields are available at the following link:

<http://ftp.dot.state.tx.us/pub/txdot-info/cst/I2MSTestFormFields.pdf>.

If there is a specific test that is not listed in the database that is required in I2MS, the schema and report set up will need to be submitted to TxDOT for approval, 60 days prior to testing submission.

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## Appendix D OVT Levels for Materials Testing Validation

### Start-Up Requirements

During start-up operations, in addition to random sample location testing, the IQF (Independent Quality Firm) and OVF (Owner Verification Firm) will perform split sample testing for all tests listed as Level 1 or Level 2. The OV firm will evaluate split sample results against TxDOT's split sample tolerance limits contained in Appendix B. For those test methods that do not validate during start-up operations, both the IQF and OV firm will collaborate to determine the cause(s) of the non-validation and will both take appropriate corrective actions during the early phases of material production to align the testing operations. For tests listed as Level 3, the OV firm will observe and review the IQF's initial start-up testing operations.

The level of significance ( $\alpha$ ) used for statistical analyses are provided below unless otherwise approved in writing by TxDOT.

Material Category	Level of Significance ( $\alpha$ )
Embankment, Subgrades, Backfill, and Base Courses	0.01
Asphalt Stabilized Base (Plant Mix)	0.01
Surface Treatments	0.01
Hydraulic Cement Concrete – Structural	0.025
Hydraulic Cement Concrete – Non Structural	0.01
Hydraulic Cement Concrete Pavements	0.025
Asphalt Concrete Pavement (Items 341, 342, 344, and 346)	0.025
Asphalt Concrete Pavement (Items 330 and 334)	0.01
Asphalt Concrete Pavement (Item 340)	0.025

**As a minimum, perform testing using the levels listed below.**

### Level 1 Tests: F and t-test and Split Samples

F- and t- Tests: The OV firm will perform continuous F- and t- test analyses on Level 1 tests with the OV testing frequency at approximately ten percent of the IQF testing frequency. The continuous analysis, as described in Appendix I – I2MS 3.0 Continuous Analysis Algorithm, will be run daily, with new OV test results being added to the OV sample population as older OV test results are removed. The analyses will be performed against the corresponding IQF sample population.

### Level 2 Tests: Independent Verification and Split Samples

Independent Verification: The OV firm will perform independent verification on Level 2 tests with the OV testing frequency three<sup>1</sup> per quarter with lower frequency tests missed during one quarter being specifically targeted the next quarter. This verification shall be performed by comparing the independent OV test results with a group of corresponding IQF test results as an independent check of the IQF test results.

### Level 3 Tests: Observation Verification

The OV firm will observe and review the IQF’s initial start-up testing operations and records, as appropriate, periodically during ongoing production operations to verify compliance with test procedures

OV Levels for Materials Testing Validation	Level 1	Level 2	Level 3
<b>EMBANKMENTS, SUBGRADES, BACKFILL, AND BASE COURSES</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NO.	TxDOT RECOMMENDED
EMBANKMENT (CUTS AND FILLS)	Liquid Limit	Tex-104-E	2
	Plasticity Index	Tex-106-E	1
	Linear Shrinkage	Tex-107-E	2
	Gradation	Tex-110-E	2
	Moisture/Density	Tex-114-E	3
	In-Place Density	Tex-115-E <sup>1</sup>	1
RETAINING WALL (NON-SELECT BACKFILL)	Liquid Limit	Tex-104-E	2
	Plasticity Index	Tex-106-E	1
	Linear Shrinkage	Tex-107-E	2
	Gradation	Tex-110-E	2
	Moisture/Density	Tex-114-E	3

<sup>1</sup> With the exception of Dynamic Cone Penetration and Falling Weight Deflection tests that will require as a minimum 10% of IQF frequencies.

OV Levels for Materials Testing Validation		Level 1	Level 2	Level 3
RETAINING WALL (SELECT BACKFILL)		In-Place Density	Tex-115-E <sup>1</sup>	1
		Gradation	Tex-110-E	2
		Resistivity	Tex-129-E	2
		pH	Tex-128-E	2
		Soundness	Tex-411-A	3
		In-Place Density	Tex-115-E <sup>1</sup>	1
UNTREATED SUBGRADE		Uniformity: Dynamic Cone Penetration <sup>2</sup>	ASTM D 6951	2
UNTREATED BASE COURSES		Liquid Limit	Tex-104-E	2
		Plasticity Index	Tex-106-E	1
		Linear Shrinkage	Tex-107-E	2
		Gradation	Tex-110-E	2
		Moisture/Density	Tex-113-E	3
		Wet Ball Mill	Tex-116-E	2
		Triaxial	Tex-117-E	2
		In-Place Density	Tex-115-E <sup>1</sup>	1
		Moisture Content	Tex-103-E	2
		Thickness	Tex-140-E	1
TREATED SUBGRADE AND BASE COURSES	Subgrade Before Treatment	Organic Content	Tex-148-E	1
		Sulfate Content	Tex-145-E	1
	New Base Material	Liquid Limit	Tex-104-E	2
		Plasticity Index	Tex-106-E	1
		Linear Shrinkage	Tex-107-E	2
		Gradation	Tex-110-E	2
		Wet Ball Mill	Tex-116-E	2
	Uncompacted Mixture	Triaxial	Tex-117-E	2
		Pulverization Gradation	Tex-101-E, Part III	2
		Moisture Content	Tex-103-E	2

OV Levels for Materials Testing Validation		Level 1	Level 2	Level 3
		Moisture-Density and Compressive Strength (Cement Treated Materials)	Tex-120-E, Part II	2
		Moisture-Density and Compressive Strength (Lime Treated Materials)	Tex-121-E, Part I	2
		Moisture-Density and Compressive Strength (Lime Fly-Ash Treated Materials)	Tex-127-E	2
	Compacted Mixture	In-Place Density	Tex-115-E <sup>1</sup>	1
		Thickness	Tex-140-E	1
		Uniformity: Falling Weight Deflection (for treated base only) <sup>2</sup>	ASTM D4694	2
		Uniformity: Dynamic Cone Penetration <sup>2</sup>	ASTM D6951	2
RECLAIMED ASPHALT PAVEMENT (RAP), CRUSHED CONCRETE, AND RECYCLED MATERIALS	Sulfate Content (Crushed concrete only)	Tex-145-E	2	
	Deleterious Material	Tex-413-A	2	
	Decantation	Tex-406-A	2	

1. OV Use of IQF Proctors

- During startup operations, test 5 split samples with the IQF and ensure that all values are within the split sample tolerance, currently set at 2.0 pcf of mean, as specified in Appendix B.
- The IQF must provide OV lab with complete curve data for all proctor tests. Prior to testing in-place densities, IQF shall furnish the selected curve for each in-place density point.
- The OV either agrees that the IQF proctor is representative of the material being tested or the OV will obtain in-place density values and sample the material to conduct a one-point proctor to ensure that proctor values are within 2.0 pcf of curve estimates.

2. With the exception of Dynamic Cone Penetration and Falling Weight Deflection tests that will require as a minimum 10% of IQF frequencies.

OV Levels for Materials Testing Validation	Level 1	Level 2	Level 3
<b>ASPHALT TREATMENT (Plant-Mixed) BASE</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
AGGREGATE	Gradation	Tex-110-E	2
	Liquid Limit	Tex-104-E	2
	Plasticity Index	Tex-106-E	1
	Linear Shrinkage	Tex-107-E	2
	Wet Ball Mill or L. A. Abrasion	Tex-116-E or Tex-410-A	3
	Coarse Aggregate Angularity	Tex-460-A, Part I	3
	Sand Equivalent	Tex-203-F	3
	Decantation	Tex-406-A	2
RECYCLED ASPHALT PAVEMENT (RAP)	Decantation	Tex-406-A	3
	Plasticity Index	Tex-106-E	3
RECYCLED ASPHALT SHINGLES (RAS)	Deleterious	Tex-217-E, Part III	3
COMPLETE MIXTURE	Lab-Molded Density	Tex-126-E	1
	Percent Asphalt	Tex-236-F	1
	Indirect Tensile Strength	Tex-226-F	3
	In-Place Air Voids	Tex-207-F	1
	Moisture Susceptibility	Tex-530-C	3
ROADWAY	Uniformity: Falling Weight Deflection	ASTM D4694	3

OV Levels for Materials Testing Validation	Level 1	Level 2	Level 3
<b>SURFACE TREATMENTS</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
AGGREGATE	Gradation	Tex-200-F, Part I	1
	Los Angeles Abrasion <sup>1</sup>	Tex-410-A	3
	Magnesium Sulfate Soundness <sup>1</sup>	Tex-411-A	3
	Surface Aggregate Classification <sup>1</sup>	Tex-499-A	3
	Pressure Slake <sup>1</sup>	Tex-431-A	3
	Freeze Thaw <sup>1</sup>	Tex-432-A	3
	Unit Weight	Tex-404-A	3
	24-hr. Water Absorption	Tex-433-A	3
	Crushed Face Count	Tex-460-A	2
	Deleterious Material	Tex-217-F	2
	Decantation	Tex-406-A	2
	Flakiness Index	Tex-224-F	3
	Micro-Deval Abrasion <sup>1</sup>	Tex-461-A	3
PRECOATED AGGREGATE	Asphalt Content	Tex-236-F	2

1. Testing needed only when the source is not on the Department's Aggregate Quality Monitoring Program (AQMP).

OV Levels for Materials Testing Validation		Level 1	Level 2	Level 3
<b>HYDRAULIC CEMENT CONCRETE – STRUCTURAL</b> (Classes: C, F, H, S, CO, K, LMC, or SS)				
MATERIAL OR PRODUCT		TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
MINERAL AGGREGATE	COARSE AGGREGATE	Decantation	Tex-406-A	2
		Sieve Analysis	Tex-401-A	2
		Deleterious Materials	Tex-413-A	3
		Los Angeles Abrasion <sup>1</sup>	Tex-410-A	3
		Magnesium Sulfate Soundness <sup>1</sup>	Tex-411-A	3
	FINE AGGREGATE	Sand Equivalent	Tex-203-F	2
		Organic Impurities	Tex-408-A	3
		Sieve Analysis	Tex-401-A	2
		Fineness Modulus	Tex-402-A	2
		Deleterious Material	Tex-413-A	3
	MINERAL FILLER	Acid Insoluble Residue <sup>1</sup>	Tex-612-J	3
		Sieve Analysis	Tex-401-A	3
CONCRETE		Compressive Strength	Tex-418-A	1
		Slump	Tex-415-A	2
		Entrained Air (When specified by plans)	Tex-416-A or Tex-414-A	1
		Temperature of Concrete	Tex-422-A	3

1. Testing needed only when the source is not on the Department's Aggregate Quality Monitoring Program (AQMP).

OV Levels for Materials Testing Validation		Level 1	Level 2	Level 3
<b>HYDRAULIC CEMENT CONCRETE – NON-STRUCTURAL</b> (Classes: A, B, D, or E)				
MATERIAL OR PRODUCT		TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
CONCRETE		Compressive Strength	Tex-418-A	2
		Entrained Air (When specified by plans)	Tex-416-A or Tex-414-A	2

OV Levels for Materials Testing Validation		Level 1	Level 2	Level 3
<b>HYDRAULIC CEMENT CONCRETE PAVEMENTS</b> (Classes: P, CO, LMC, K, or HES)				
MATERIAL OR PRODUCT		TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
MINERAL AGGREGATE	COARSE AGGREGATE	Decantation	Tex-406-A	2
		Sieve Analysis	Tex-401-A	2
		Deleterious Materials	Tex-413-A	3
		Los Angeles Abrasion <sup>1</sup>	Tex-410-A	3
		Magnesium Sulfate Soundness <sup>1</sup>	Tex-411-A	3
	FINE AGGREGATE	Sand Equivalent	Tex-203-F	2
		Organic Impurities	Tex-408-A	2
		Sieve Analysis	Tex-401-A	2
		Fineness Modulus	Tex-402-A	2
		Deleterious Material	Tex-413-A	3
	MINERAL FILLER	Acid Insoluble Residue <sup>1</sup>	Tex-612-J	3
		Sieve Analysis	Tex-401-A	3
		CONCRETE	Strength	Tex-448-A or Tex-418-A
Slump (Formed Pavement)	Tex-415-A		2	
Entrained Air (When specified by plans)	Tex-416-A or Tex-414-A		1	
Temperature	Tex-422-A		3	
Thickness	Tex-423-A		1	
Ride Quality	Tex-1001-S		1	

1. Testing needed only when the source is not on the Department's Aggregate Quality Monitoring Program (AQMP).



OV Levels for Materials Testing Validation	Level 1	Level 2	Level 3
<b>ASPHALT CONCRETE PAVEMENT (Items 341, 342, 344,346, 347, and 348)</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
COARSE AGGREGATE	Los Angeles Abrasion <sup>1</sup>	Tex-410-A	3
	Magnesium Sulfate Soundness <sup>1</sup>	Tex-411-A	3
	Gradation	Tex-200-F	3
	Micro-Deval Abrasion <sup>1</sup>	Tex 461-A	3
	Surface Aggregate Classification <sup>1</sup>	Tex-499-A	3
	Mix Design	Tex-204-F	3
	Decantation	Tex-217-F, Part II	3
RECLAIMED ASPHALT PAVEMENT (RAP)	Decantation	Tex-217-F, Part I	3
	Plasticity Index	Tex-106-E	3
RECYCLED ASPHALT SHINGLES (RAS)	Deleterious	Tex-217-F, Part III	3
FINE AGGREGATE	Linear Shrinkage	Tex-107-E	3
	Organic Impurities	Tex-408-A	3
	Gradation	Tex-200-F	3
MINERAL FILLER	Linear Shrinkage	Tex-107-E	3
	Gradation	Tex-200-F	3
COMBINED AGGREGATE	Sand Equivalent	Tex-203-F	3
COMPLETE MIXTURE	Asphalt Binder Content	Tex-236-F	1
	Voids in Mineral Aggregates (VMA)	Tex-204-F	3
	Gradation	Tex-236-F	2
	Boil Test	Tex-530-C	3
	Indirect Tensile Strength (Dry)	Tex-226-F	3
	Moisture Content	Tex-212-F, Part II	3
	Theoretical Maximum Specific Gravity	Tex-227-F	2
	Lab Molded Density	Tex-207-F, Parts I and IV	1
Drain-Down (Items 342, 346, 347)	Tex-235-F	3	

OV Levels for Materials Testing Validation	Level 1	Level 2	Level 3
ROADWAY	Hamburg Wheel Test	Tex-242-F	3
	In-Place Air Voids	Tex-207-F, Parts I and IV	1
	Segregation Profile	Tex-207-F, Part V	3
	Longitudinal Joint Density	Tex-207-F, Part VII	3
	Ride Quality	Tex-1001-S	1
	Thermal Profile	Tex-244-F	3
	Permeability (Items 342, 347, and 348)	Tex-246-F, Part I	3

1. Testing needed only when the source is not on the Department's Aggregate Quality Monitoring Program (AQMP).

OV Levels for Materials Testing Validation	Level 1	Level 2	Level 3
<b>ASPHALT CONCRETE PAVEMENT (Item 334)</b>			
Refer to DMS-9210, "Limestone Rock Asphalt (LRA)," for Testing Requirements for Item 330			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
COARSE AGGREGATE	Los Angeles Abrasion <sup>1</sup>	Tex-410-A	3
	Magnesium Sulfate Soundness <sup>1</sup>	Tex-411-A	3
	Gradation	Tex-200-F	3
	Micro-Deval Abrasion <sup>1</sup>	Tex-461-A	3
	Flat and Elongated Particles	Tex-280-F	3
	Crushed Face Count	Tex-460-A Part I	3
	Deleterious Material	Tex-217-F, Part I	3
	Decantation	Tex-217-F, Part II	3
FINE AGGREGATE	Linear Shrinkage	Tex-107-E	3
	Organic Impurities	Tex-408-A	3
	Gradation	Tex-200-F	3
MINERAL FILLER	Linear Shrinkage	Tex-107-E	3
	Gradation	Tex-200-F	3
COMBINED AGGREGATE	Sand Equivalent	Tex-203-F	3
COMPLETE MIXTURE	Asphalt Content	Tex-236-F	1

OV Levels for Materials Testing Validation	Level 1	Level 2	Level 3
	Voids in Mineral Aggregates (VMA)	Tex-204-F	3
	Gradation	Tex-236-F	2
	Boil Test	Tex-530-C	3
	Moisture Content	Tex-212-F Part II	3
	Hydrocarbon-Volatile Content	Tex-213-F	3
	Theoretical Maximum Specific Gravity	Tex-227-F	2
	Lab Molded Density	Tex-207-F	1
	Hveem Stability	Tex-208-F	1

1. Testing needed only when the source is not on the Department's Aggregate Quality Monitoring Program (AQMP).

ASPHALT CONCRETE PAVEMENT (Item 340)			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
<b>NOTE:</b> Item 340 should be used only for maintenance activities.			

## Appendix E Test Methods for Personnel Qualifications

Test Procedure	TXAPA Soils and Flexible Base Testing Certifications
	<b>Level SB 101</b>
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Parts I and II)
Tex-103-E	Determining Moisture Content in Soil Materials
Tex-104-E	Determining Liquid Limit of Soils
Tex-105-E	Determining Plastic Limit of Soils
Tex-106-E	Calculating the Plasticity Index of Soils
Tex-107-E	Determining Bar Linear Shrinkage of Soils
Tex-110-E	Particle Size Analysis of Soils (Part I)
Tex-116-E	Ball Mill Method for Determining the Disintegration of Flexible Base Material
Tex-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates
	<b>Level SB 102</b>
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Parts I and II)
Tex-103-E	Determining Moisture Content in Soil Materials
Tex-115-E	Field Method for Determining In-Place Density of Soils and Base Materials
Tex-140-E	Measuring Thickness of Pavement Layer
Tex-146-E	Conductivity Test for Field Detection of Sulfates in Soil
Tex-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates
	<b>Level SB 103</b>
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Parts I and II)
Tex-128-E	Determining Soil pH
Tex-129-E	Measuring the Resistivity of Soils
Tex-145-E	Determining Sulfate Content in Soils, Colorimetric Method
Tex-146-E	Conductivity Test for Field Detection of Sulfates in Soil
Tex-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates
	<b>Level SB 201</b>
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Parts I and II)
Tex-113-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade and Embankment Soil
Tex-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates

Test Procedure	TXAPA Soils and Flexible Base Testing Certifications
	Level SB 202
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Parts I and II)
Tex-117-E	Triaxial Compression for Disturbed Soils and Base Materials
Tex-120-E	Soil-Cement Testing
Tex-121-E	Soil-Lime Testing

Test Procedure	TxAPA Hot-Mix Asphalt Testing Certifications
	Level 1A
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregate (Parts I and II)
Tex-206-F	Compacting Specimens Using the Texas Gyrotory Compactor (TGC)
Tex-207-F	Determining Density of Compacted Bituminous Mixtures (Parts I, VI, and VIII)
Tex-212-F	Determining Moisture Content of Bituminous Mixtures (Part II)
Tex-217-F	Determining Deleterious Material and Decantation Test for Coarse Aggregates
Tex-221-F	Sampling Aggregate for Bituminous Mixtures, Surface Treatments, and Limestone Rock Asphalt
Tex-222-F	Sampling Bituminous Mixtures
Tex-225-F	Random Selection of Bituminous Mixture Samples (Parts I and II)
Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
Tex-233-F	Preparing Control Charts for Asphaltic Concrete Paving Projects
Tex-235-F	Determining Draindown Characteristics in Bituminous Materials
Tex-236-F	Determining Asphalt Content of Asphalt Paving Mixtures by Ignition Method
Tex-241-F	Superpave Gyrotory Compacting of Test Specimens of Bituminous Mixtures
Tex-500-C	Sampling Bituminous Materials, Pre-Molded Joint Fillers, and Joint Sealers (Parts II and III)
Tex-530-C	Effect of Water on Bituminous Paving Mixtures
	Level 1B
Tex-207-F	Determining Density of Compacted Bituminous Mixtures (Parts I, IV, V, VI, and VII)
Tex-222-F	Sampling Bituminous Mixtures
Tex-225-F	Random Selection of Bituminous Mixture Samples (Part II)
Tex-244-F	Thermal Profile of Hot Mix Asphalt
Tex-246-F	Permeability or Water Flow of Hot Mix Asphalt
Tex-500-C	Sampling Bituminous Materials, Pre-Molded Joint Fillers, and Joint Sealers (Parts II and III)

<b>Test Procedure</b>	<b>TxAPA Hot-Mix Asphalt Testing Certifications</b>
	<b>Level 2</b>
Tex-107-F	Determining Bar Linear Shrinkage of Soils
Tex-203-F	Sand Equivalent Test
Tex-204-F	Design of Bituminous Mixtures
Tex-205-F	Laboratory Method of Mixing Bituminous Mixtures
Tex-226-F	Indirect Tensile Strength Test
Tex-235-F	Determining Draindown Characteristics in Bituminous Materials
Tex-236-F	Determining Asphalt Content of Asphalt Paving Mixtures by Ignition Method
Tex-242-F	Hamburg Wheel Test
Tex-245-F	Cantabro Loss
Tex-280-F	Determining Flat and Elongated Particles
Tex-408-F	Organic Impurities in Fine Aggregate for Concrete
Tex-460-A	Determining Crushed Face Particle Count
Tex-461-A	Degradation of Coarse Aggregate by Micro-Deval Abrasion

<b>Test Procedure</b>	<b>American Concrete Institute (ACI) Certifications</b>
	<b>Concrete Field Testing Technician – Grade I</b>
Tex-407-A	Sampling Freshly Mixed Concrete
Tex-414-A	Air Content of Freshly Mixed Concrete by the Volumetric Method
Tex-415-A	Slump of Portland Cement Concrete
Tex-416-A	Air Content of Freshly-Mixed Concrete by the Pressure Method
Tex-417-A	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
Tex-422-A	Measuring Temperature of Freshly Mixed Portland Cement Concrete
Tex-447-A	Making and Curing Concrete Test Specimens (Part I)
	<b>Concrete Strength Testing Technician</b>
Tex-418-A	Compressive Strength of Cylindrical Concrete Specimens
Tex-448-A	Flexural Strength of Concrete Using Simple Beam Third-Point Loading
Tex-450-A	Capping Cylindrical Concrete Specimens

## Appendix F Test Methods for Split/Proficiency Evaluation

After observation and qualification, each qualified technician is required to participate annually in one proficiency or split sample test for each test method requiring independent assurance. Split sample test results must compare to the independent assurance test results to within the established tolerance as described in [Appendix B – Split Sample Tolerance Limits](#). Proficiency sample test results must be within  $\pm 2$  standard deviations of the proficiency sample mean.

The following table lists the test procedures required for evaluation.

Proficiency Sample Test Procedures	
Test Procedure	Description
Tex-104-E	Determining Liquid Limit of Soils
Tex-105-E	Determining Plastic Limit of Soils
Tex-106-E	Calculating the Plasticity Index of Soils
Tex-107-E	Determining the Bar Linear Shrinkage of Soils
Tex-110-E	Particle Size Analysis of Soils
Tex-113-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials
Tex-117-E	Triaxial Compression for Disturbed Soils and Base Materials
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregate
Tex-206-F	Compacting Specimens Using the Texas Gyratory Compactor (TGC)
Tex-207-F	Determining Density of Compacted Bituminous Mixtures
Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
Tex-236-F	Determining Asphalt Content of Asphalt Paving Mixtures by the Ignition Method
Tex-241-F	Compacting Bituminous Specimens Using the Superpave Gyratory Compactor (SGC)
Split Sample Test Procedures	
Test Procedure	Description
Tex-414-A	Air Content of Freshly Mixed Concrete by the Volumetric Method <sup>1, 2</sup>
Tex-416-A	Air Content of Freshly Mixed Concrete by the Pressure Method <sup>2</sup>
Tex-418-A	Compressive Strength of Cylindrical Concrete Specimens

1. Required when volumetric method is used
2. Required only when air entrained concrete is specified

## Appendix G Material Certification Example Letter

The intent of the material certification is to ensure that the quality of all materials incorporated into the project is in conformance with the plans and specifications, thus ensuring a service life equivalent to the design life. Any material represented by an acceptance test that does not meet the criteria contained in the plans and specifications is considered an exception. Exceptions should be investigated to determine if in fact the material is in reasonably close conformity with the plans and specifications. Nonconforming materials and workmanship will be tracked, monitored, and appropriately addressed. Submit a monthly IQFM Material Certification Letter in the FHWA Statistical Analysis Report. An example follows.

Date\_\_\_\_\_

To\_\_\_\_\_

From\_\_\_\_\_

Project No.\_\_\_\_\_

RE: Monthly IQFM Material Certification

This is to certify that:

The results of the tests used in the acceptance program indicate that the materials incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications.

Exceptions to the plans and specifications are as follows:

1. Description
2. Description

\_\_\_\_\_  
IQFM Signature Block



## Appendix H

### Minimum Qualification Requirements for Laboratories

All laboratories performing acceptance testing for TxDOT require qualification, at a minimum, in the test procedures identified in the tables below. Project-specific requirements may necessitate qualifications in additional test procedures. Qualification for IQF, OV, and IA central laboratories will be required through the AASHTO Accreditation Program (AAP) for those test methods identified in the tables below. The accreditation must be maintained throughout the life of the project and the laboratory must participate in the AASHTO Materials Reference Laboratory/Concrete and Cement Reference Laboratory (AMRL/CCRL) proficiency programs. The project laboratory is required to implement the approved quality system from the central laboratory at the project laboratory, and provide documentation that this is complete. In addition, TxDOT CST/M&P, or its designee, will qualify the laboratory in TxDOT test methods. The laboratory technicians must participate in the TxDOT Hot-Mix Asphalt and Soils statewide proficiency programs with the results documented as indicated in Section 4 of this QAP.

<b>Embankments, Subgrades, Backfill, and Base Materials</b>			
<b>ASTM</b>	<b>AASHTO</b>	<b>TxDOT</b>	<b>Description</b>
D421	T87	Tex-101-E	Preparing Soil and Flexible Base Materials for Testing
D2216	T265	Tex-103-E	Moisture Content in Soil Materials
D4318	T89 / T90	Tex-104-106-E	Liquid Limit; Plastic Limit; Plasticity Index
D427	---	Tex-107-E	Bar Linear Shrinkage
---	T311	Tex-110-E	Particle Size Analysis
D1140	---	Tex-111-E	Amount of Material in Soils Finer than the 75 $\mu$ m (No. 200) Sieve
D1557	T180	Tex-113-E	Compaction and Moisture-Density Relationship of Base Materials
D698	T99	Tex-114-E	Compaction and Moisture-Density Relationship of Subgrade, Embankment Soils, and Backfill Material
D6938	T310	Tex-115-E	Field Method for In-Place Density of Soils and Base Materials
---	---	Tex-116-E	Ball Mill Method for Disintegration of Flexible Base Material
---	---	Tex-117-E	Triaxial Compression for Disturbed Soils and Base Materials
D558	T134	Tex-120-E	Soil-Cement Testing
D5102	---	Tex-121-E	Soil-Lime Testing
---	---	Tex-124-E	Potential Vertical Rise
---	---	Tex-126-E	Laboratory Molded Density of Asphalt Treated Base
D4972	---	Tex-128-E	Soil pH

Embankments, Subgrades, Backfill, and Base Materials			
ASTM	AASHTO	TxDOT	Description
---	---	Tex-129-E	Resistivity of Soil Materials
---	---	Tex-140-E	Thickness of Pavement Layer
D2487	---	Tex-142-E	Laboratory Classification of Soils for Engineering Purposes
---	---	Tex-145-E	Sulfate Content in Soils— Colorimetric Method
---	---	Tex-146-E	Conductivity Test for Field Detection of Sulfates in Soil
---	---	Tex-148-E	Organic Content
D3740	---	Tex-198-E	Minimum Standards for Acceptance of a Laboratory (Soils/Base)

Bituminous Mixtures			
ASTM	AASHTO	TxDOT	Description
D3203	T269	Tex-206-F	Compacting Specimens Using the Texas Gyratory Compactor
D2726	T166	Tex-207-F	Density of Compacted Bituminous Mixtures (SSD Method)
D6752	T331	Tex-207-F	Density of Compacted Bituminous Mixtures (Vacuum Method)
D1560	T246	Tex-208-F	Test for Stabilometer Value of Bituminous Mixtures
D1461	T110	Tex-212-F	Moisture Content
D1461	T110	Tex-213-F	Determining Hydrocarbon Volatile Content of Bituminous Mixtures
D75	---	Tex-221-F	Sampling Aggregate for Bituminous Mixtures, Surface Treatments, and Limestone Rock Aggregate
D979	---	Tex-222-F	Sampling Bituminous Mixtures
D6931	---	Tex-226-F	Indirect Tensile Strength
D2041	T209	Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
---	---	Tex-235-F	Determining Draindown Characteristics in Bituminous Materials
D6307	T308	Tex-236-F	Asphalt Content by the Ignition Method
D3666	---	Tex-237-F	Minimum Standards for Acceptance of a Laboratory (HMA)
D6925	T312	Tex-241-F	Compacting Specimens Using the Superpave Gyratory Compactor
---	T324	Tex-242-F	Hamburg Wheel-Tracking Test
---	---	Tex-244-F	Thermal Profile of Hot Mix Asphalt
---	---	Tex-246-F	Permeability or Water Flow of Hot Mix Asphalt
---	---	Tex-530-C	Effect of Water on Bituminous Paving Mixtures

Aggregates			
ASTM	AASHTO	TxDOT	Description
D5444	T30	Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
C128	T84	Tex-201-F	Bulk Specific Gravity and Water Absorption of Fine Aggregate
D2419	T176	Tex-203-F	Sand Equivalent
---	---	Tex-204-F	Design of Bituminous Mixtures
---	---	Tex-217-F	Deleterious Materials and Decantation for Coarse Aggregate
---	---	Tex-224-F	Flakiness Index
D4791	---	Tex-280-F	Flat and Elongated Particles
C702	T248	Tex-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates
C136	T27	Tex-401-A	Sieve Analysis of Fine and Coarse Aggregate
---	---	Tex-402-A	Fineness Modulus of Fine Aggregate
C127	T85	Tex-403-A	Saturated Surface-Dry Specific Gravity and Absorption
C29	T19	Tex-404-A	Determining Unit Weight of Aggregate
C117	T11	Tex-406-A	Material Finer than the 75 µm (No. 200) Sieve in Mineral Aggregate
C40	T21	Tex-408-A	Organic Impurities in Fine Aggregate for Concrete
C566	T255	Tex-409-A	Free Moisture and Water Absorption
C131	T96	Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
C88	T104	Tex-411-A	Magnesium Sulfate Soundness
C142	T112	Tex-413-A	Deleterious Materials
---	---	Tex-431-A	Pressure Slaking Test of Synthetic Coarse Aggregate
---	---	Tex-432-A	Coarse Aggregate Freeze-Thaw
---	T103	Tex-433-A	Absorption and Dry Bulk Specific Gravity of Lightweight Coarse Aggregate
D5821	---	Tex-460-A	Crushed Face Count
D6928	T327	Tex-461-A	Micro-Deval Abrasion
C1077	---	Tex-498-A	Minimum Standards for Acceptance of a Laboratory (Concrete and Aggregate)
---	---	Tex-499-A	Aggregate Quality Monitoring Program (AQMP) Surface Aggregate Classification (SAC)
---	---	Tex-612-J	Acid Insoluble Residue

Hydraulic Cement Concrete			
ASTM	AASHTO	TxDOT	Description
C172	T141	Tex-407-A	Sampling Freshly Mixed Concrete
C173	T196	Tex-414-A	Air Content of Freshly Mixed Concrete by the Volumetric Method
C143	T119	Tex-415-A	Slump of Hydraulic Cement Concrete
C231	T152	Tex-416-A	Air Content by the Pressure Method
C138	T121	Tex-417-A	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C39	T22	Tex-418-A	Compressive Strength of Cylindrical Concrete Specimens
C1064	T309	Tex-422-A	Measuring Temperature of Freshly Mixed Portland Cement Concrete
---	---	Tex-423-A	Determining Concrete Thickness by Direct Measurement (Parts I and II)
C31	T23	Tex-447-A	Making and Curing Specimens
C78	T97	Tex-448-A	Flexural Strength of Concrete Using Simple Beam Third Point Loading
C617	T231	Tex-450-A	Capping Cylindrical Concrete Specimens
C1231	---	Tex-450-A	Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
C1077	---	Tex-498-A	Minimum Standards for Acceptance of a Laboratory (Concrete and Aggregate)

Miscellaneous Procedures			
ASTM	AASHTO	TxDOT	Description
E329	---	---	Standard Specification for Inspection and Testing
D6951	---	---	Dynamic Cone Penetrometer
D4694	---	---	Falling Weight Deflectometer

	Preferred test procedure for AASHTO Accreditation
	Acceptable test procedure for AASHTO Accreditation
	Test procedure qualified by TxDOT CST/M&P or designated IA Laboratory

# Appendix I

## I2MS 3.0 Continuous Analysis Algorithm

The following describes the I2MS 3.0 algorithm used in the continuous statistical analysis referenced in [Appendix D – OVT Levels for Materials Testing Validation](#).

### Categorizing for Analysis

When a test version record is saved to I2MS, the first step is to assign it to any applicable analysis categories. A test record must have Sample Type “Random-Independent” or “Random-Split” to be associated with any category<sup>2</sup>. Assignment to a category is made immediately when the record enters the system, but the record will not be included in any analyses until it is set “For Analysis” (i.e., it is Approved or intermediate break data is Reviewed).

Note: A new version of an existing record can actually belong to a different analysis category than a previous version if the header values were changed. This is not a problem, as an analysis run represents a snapshot of the current data in the system at the time the analysis was done.

### Finding Categories to Analyze

Every night, I2MS scans data in the system for categories that need to be analyzed. A category is triggered for analysis whenever a NEW OV record appears. A record is new if it is For Analysis and has never been analyzed before. Some examples of new OV records are:

- A test was added and approved today;
- A test was added a month ago and approved/reviewed today;
- A test that was added and analyzed last week was revised and reapproved. This new version has never been analyzed, so it will trigger an analysis the same as if it were the first version of the record.

### Analyzing a Category

The first step in the analysis is to find the date range of the analysis populations. The age of a record is determined by its SAMPLED DATE.

I2MS has a desired maximum number of days that can be configured in Project Settings. By default, this is 90 days. Also configurable is the desired maximum number of OV records to include in one analysis run. This defaults to 25 records.

The end date of analysis will always be the current date. The start date of the analysis is determined by the following.

---

<sup>2</sup> These restrictions can be reconfigured at the analysis-group level (e.g., Concrete, Asphalt) if the list of Sample types or the business rule changes.

- If there is an unanalyzed record for either the OVF or IQF that is OLDER than 90 days, the start date is that record's Sampled Date. Analysis will run on ALL records from that date forward.
- If there are fewer than 25 OV records within the previous 90 days, the start date will be 89 days before the current date (i.e., 90 days total in the analysis).
- If there are 25 OV records or more within the previous 90 days, use a smaller date range. The Sampled Date of the 25th OV record prior to the current date will be the start date of the analysis.

The next step is to pull all of the data points for the analysis. Pull values for all "For Analysis" OV and IQF records between the start date and the end date, using ONLY the latest versions of those records.

Finally, perform the F- and t- statistical analysis and save the P-values for review by the materials manager. The analysis requires at least two points from each population to calculate. If there are fewer than two data points for either OV or IQF, skip the analysis. The category will be picked up again the next time an approved OV record comes in.

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## **Appendix J**

### **Minimum Construction Hold Points**

The minimum milestones at which construction Independent Quality (IQ) hold points must be established include the following.

#### **Environmental Mitigation Measures**

- A. Prior to crossing any stream, dewatering, diverting watercourses, or building cofferdams
- B. Before beginning construction for conformance with the Storm Water Pollution Prevention Plan (SWPPP) and NPDES permit
- C. Bi-weekly and after each rainfall event of 1/2 inch or more, for monitoring and maintaining temporary erosion and pollution hold devices

#### **Embankments**

- A. One per shift per crew for drainage and utility installation with IQ pre-backfill inspection documentation for all associated work provided at the hold point
- B. After all clearing, grubbing, and excavation, prior to embankment placement
- C. Before beginning borrow pit excavation for permissions and materials testing
- D. Per specifications for lift requirements (applicable to all embankments, including walls)
- E. Prior to removal of surcharge
- F. Prior to placing embankment or MSE backfill on ground improvements

#### **Drainage**

- A. Before placing drainage pipe for bedding and pipe conditions
- B. After pipe placement and bedding compaction and before beginning backfill
- C. After backfill for roundness of pipe and other defects
- D. Before opening for structure grouting and pipe and structure cleanliness

#### **Structures**

##### **Bridges**

- A. At completion of bridge embankment settlement and before start of bridge foundation pile driving
- B. At IQ approval of pile-driving submittals (including design calculations, wave analysis, and hammer specification)
- C. After completion of pile driving at each structure support (pile group), including pile-driving results and records

- D. After excavation for drilled shafts and spread footings
- E. Before sonic logging drilled shafts
- F. Before beginning drilled shaft remediation, if needed
- G. Before placement of reinforced concrete in superstructure and substructure elements, including pre-drilled piling
- H. Before and after construction of MSE fill system behind abutments
- I. After removal of unsound bridge deck concrete from existing bridges
- J. Before and after structural steel erection
- K. Before allowing traffic below erected structural steel girders or concrete beams
- L. Before and after post-tensioning and grouting operations
- M. Before backfilling bridge components
- N. Before placement of reinforcing steel above permanent steel stay-in-place deck forms and above partial depth precast concrete deck panels
- O. Before filling full-depth concrete deck panels grout pockets

### **Walls**

- A. Before placement of leveling pad for any retaining wall system
- B. After placement of every 10 feet (measured vertically) of MSE wall panels or blocks
- C. Before placement of reinforced concrete
- D. After rebar placement but before final form placement for cast-in-place retaining walls
- E. Before backfilling at any type of retaining wall system
- F. Before and after post-tensioning and grouting operations for tie-back anchors and soil nails

### **Drainage Box Structures**

- A. After excavation for drainage box structures
- B. Before placement of reinforced concrete for drainage box structures
- C. After rebar placement but before final form placement for drainage box structures taller than 6 feet
- D. Before backfilling drainage box structures

### **Sign, Signal, Lighting, and ITS Support Structures**

- A. After installation of foundations for sign, signal, lighting, and ITS support structures



### **Temporary Structures**

- A. Prior to allowing traffic on, below, above, or adjacent to temporary structures, shoring, or bracing

### **Surfacing, Paving, and Concrete**

- A. After batch plants are set up, for calibration
- B. Before placement of each course above subgrade on permanent roadway components (treated base, granular base, etc.)
- C. Before placement of each lift of asphalt or PCC paving on permanent roadway components
- D. Before any placement of concrete

### **Traffic Devices and Management of Traffic**

- A. Before opening to traffic
- B. Before implementation of a full or partial closure on any roadway
- C. Before changing the traffic configuration or alignment on any roadway

### **Lighting**

- A. Before installation of High Mast light tower poles
- B. Before installation of lighting systems to any structural element

## Appendix K Archived Versions

The following archived versions of this document are available.

- Effective November 24, 2008–February 28, 2010:  
[ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap\\_db\\_1108.pdf](ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap_db_1108.pdf)
- Effective March 1, 2010–May 10, 2010:  
[ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap\\_db\\_0310.pdf](ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap_db_0310.pdf)
- Effective May 11, 2010–July 24, 2011:  
[ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap\\_db\\_0510.pdf](ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap_db_0510.pdf)
- Effective July 25, 2011–October 25, 2016  
[ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap\\_db\\_0711.pdf](ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap_db_0711.pdf)

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