Certification: Bituminous Mix Designer

Background

The MnDOT Technical Certification Program is mandated by the FWHA Code of Federal Regulations [Code 23 CFR Ch. I (4–1–11 Edition) Title 23. Part 637]. For Minnesota and MnDOT to receive federal funding for highway and bridge projects, we must have a Quality Control, Quality Assurance, and Independent Assurance Program in place that ensures qualified and certified technicians are testing and inspecting materials used on those projects. Minnesota also has chosen to extend this requirement to all state and some local government aid highway projects.

The types of materials that are tested are aggregate (rocks), concrete, bituminous (asphalt), soil, and various other materials used in roadway and bridge construction.

MnDOT has four Specialty Units, each responsible for materials used on the roadways and bridges. MnDOT staff at these Units work collaboratively with each other, the Technical Certification program staff, industry representatives, and people working in the field. These Specialty Units are 1) Concrete, 2) Bituminous (asphalt), and 3) Grading & Base (soil, sand, and rocks) at the Maplewood Office of Materials and Road Research, and 4) the Oakdale Bridge Office.

There are three key levels to the materials Sampling and Testing process, done by people with **Tester** certifications (formerly known as Level 1 certifications).

> *Quality Control* (QC) is done by qualified and certified **Testers** who work for the **contractor** (the company that is building the road or bridge) or a **producer** (the company that supplies the materials). At designated times throughout the project, the Testers sample, test, and record and report on the roadway and bridge materials to make sure they are meeting the specifications described in the contract.
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> *Quality Assurance* (QA) is done by qualified and certified **Testers** who work for the **"owner" of the roadway or bridge project** (MnDOT or other designated agencies). QA Testers test the same materials as the QC Testers, using what is known as "companion samples" that are split and shared by QC and QA testers. This QA testing is also done at designated times, but less often than the QC testing. The goal is for the owner to verify that the contractor/producer test results are accurate and confirm that the materials meet the specifications in the contract. These Testers are typically MnDOT staff, consultants hired by MnDOT, or county/city personnel.
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> The *Independent Assurance* Program (IA) provides a layer of oversight to the testing process on federally funded projects. The **IA staff members** do an independent, unbiased evaluation of all the **sampling procedures, testing procedures, and testing equipment** used to determine the quality of the products specified in every roadway or bridge project contract. Each MnDOT District has at least one IA staff member responsible to review and report on all Federal Aid projects in their district. As part of this work, they check the testing equipment, including the calibrations, and conduct annual reviews of all project Testers, both those doing Quality Control (for contractors and producers) and Quality Assurance (for MnDOT and other agencies).

In the system, there also is another important layer of oversight that is done by **Inspectors**. The Inspector holds an advanced certification (formerly known as Level 2), serves in a decision-making role providing project supervision or oversight (e.g., Chief Inspector, Mix Designer, etc.), and is employed by MnDOT or other designated agencies. The role of the Inspector is to represent the Project Engineer and **oversee, inspect, and evaluate** the **production and placement** of the roadway and bridge materials, as described in MnDOT plans, specifications, and contracts. It is the Inspector who gives final approval to the placements of materials, when the specifications have been met, and then authorizes payment from the owner to the contractor.

Use of this Certification

The **Bituminous Mix Designer Certification** is required for 1) agency/owner personnel who design, adjust, verify and/or approve bituminous mix designs and/or their related calculations, and 2) contractor personnel who are responsible for the design, adjustment, calculations, and submittal of bituminous mix designs and/or who supervise quality control testing. Bituminous Mix Designers are required for projects funded by the federal or Minnesota state governments.

People who have and use this certification typically work at MnDOT and local agencies (counties and cities), consultants, contractors (the private businesses who are contracted to do construction work), and producers (bituminous plants that supply the materials).

Requirements and Relationship to Other Technical Certifications Courses

Prerequisites needed before beginning the course→	**Bituminous Mix Designer Certification**	→ Is one of the prerequisites for other certification courses
Aggregate Production Bituminous Plant Tester At least one year of experience as a Bituminous Plant Tester is suggested but not required	Requirements: Attend course (5 day), pass exam (70% or higher), pass performance exam (successful completion of the required 2360 Mix design, submitted within one year of the last day of class) Expiration: after 5 construction seasons (see Certification Card for expiration date) Recertification: yes, if completed before the certification expiration date; attend Recertification course and pass exam (70% or higher) (Note: additional requirements potentially starting in 2023)	None

Certification Course Description

This advanced 5-day course focuses on why and how to create bituminous mix designs to ensure the materials meet roadway construction quality requirements. These include instructions focused on attaining the proper AC content, gradation, compaction, crushed particles, air voids, density, and durability.

Instruction includes lecture, demonstration, videos, discussion, and practice activities. Quizzes, course resources, and content reviews are included to help participants prepare for the written exam and performance. [Note: Depending on participants' prior knowledge and experience, they may want to do additional practice and review before taking the class and/or the exam.]

NOTE: Upon successful completion of the course and written examination, the student **must** develop a bituminous mix design (2360) and submit it with all required documentation and related mixture materials to the MnDOT Maplewood Lab for verification. Submittals must be delivered to the MnDOT Maplewood Lab no later than one year from the date of the last day of class. If the mix design is not submitted and verified within that one year, the individual will be required to re-attend and successfully complete the class again, including verification of a submitted mix design, to be eligible for certification in this area.

Recertification Course Description

This 1-day recertification course reviews core knowledge and skills from the initial certification course and provides information on any recent changes to the relevant specifications and test procedures.

Instruction includes lecture, demonstration, discussion, and practice activities. Participants will also have an opportunity to discuss lessons learned in the field. Quizzes, course resources, and content reviews are included to help participants prepare for the written exam.

[Note: People who have had little or no experience working with their certification since their prior class will want to either 1) review the course content before taking the recertification class or 2) take the initial certification course instead. The recertification course is **not** a complete re-teaching of the content but a review with updates for people who have a solid base of the required knowledge and skills.]

Objectives

A summary of the knowledge, skills, and attitudes students must demonstrate to receive and do the work of this certification:

Materials Testing & Inspecting (Note: #1-6 in all Certifications)

1. Know the basic **history** and **purpos**e of roadway and bridge materials testing and inspection
2. Know the Quality Control (QC), Quality Assurance (QA), and Independent Assurance (IA) roles and responsibilities of people at MnDOT, consultants, other government agencies, and private companies (contractors, and producers)
3. Know the role of the **Tester** who samples and tests materials used in the roadway or bridge project to determine if the materials meet the required specifications.
4. Know the proper use of materials **testing for acceptance** (how to document and report when a test procedure shows the material tested does meet the required specifications and to how to communicate that information effectively)
5. Know the documentation and reporting requirements for **materials exception** (what to do when a test procedure shows a material does not meet the required specifications, how problems are resolved, and how to communicate this information effectively)
6. Know the role of the **Inspectors** who oversee, inspect, and evaluate the production and placement of the roadway and bridge materials and how they authorize payment

Key Background, Terms, Tools, and Formulas for the Certification

Safety, Tools, Calculations

7. Know about **safety** hazards related to the specific work and job sites of this certification; know how to follow safe operating procedures and to report unsafe conditions to supervisors.
8. Know and be able to use any special **tools** used for this certification's test procedures, including equipment for sampling, splitting, gradation, washing, drying, and weighing
9. Understand and use the **calculations**, formulas, and units of measurement used for this certification, including basic math, use of algebraic formulas, English and metric measures for weight and volume and how to convert from one to another, if needed

Bituminous Mix Properties

10. Know how to and be able to **document** bituminous mixture properties by utilizing the most up to date MnDOT resources, including the Bituminous Test Summary workbook and tabs, Daily Diaries, and Incentive/Disincentive Worksheets
11. Know which **specification** to use for the particular material being tested, where to find the specification, and how to submit documentation for test procedures completed

12. Know how to and be able to properly assess bituminous mixture properties, using the proper testing and evaluating equipment and conducting **test procedures** from the prerequisite certifications (Aggregate Production Tester, Bituminous Plant Tester), as defined in the MnDOT Lab Manual and the MnDOT Bituminous Manual
13. Know key **content** related to this certification, including RAP (recycled asphalt pavement), additives used to improve the material, and naming conventions and acronyms for materials and tests used in this work

Mix Design Process

Mix Design Basics (Ch. 1)

14. Understand the **need for** designing **proper asphalt mixtures**
15. Know the **history** of the specifications and how they developed over the years

Asphalt Cement (Ch. 2)

16. Learn how **asphalt cement** is made and modified for different traffic situations

Aggregate Blending (Ch.3)

17. Understand the **aggregate mixture requirements** and why they exist
18. Know how to **blend** multiple **aggregates** to achieve the desired aggregate properties in the mixture
19. Be able to **calculate** aggregate blend properties used in an asphalt mixture

Asphalt Batching and Volumetrics (Ch. 4)

20. Determine the **quantity** of asphalt cement **needed** for a particular mixture
21. Understand how to **batch and test** the trial mixes in the laboratory
22. Be able to **calculate** a variety of **volumetric properties** used in analyzing an asphalt mixture
23. Understand the **changes** needed **to vary** the **volumetric properties** as required

Production Considerations (Ch. 7)

24. Understand how the **mixture ingredients** may need to be **adjusted** during production
25. Know where to find **various resources** that will be needed
26. Know how to complete the identification and **submittal** of samples

Mix MDR Submittal

27. Know how and what to **submit** to MnDOT for **initial** certification mix design **acceptance**
28. Know how and what to **submit** to MnDOT for **routine** mix design **acceptance**

Other Mix Types (Ch. 5 and Ch 6)

29. Be familiar with other mix types, such as Stone Matrix Asphalt (SMA), UTBWC, Warm Mix Asphalt, Porous Asphalt, and Superpave 5
30. Be familiar with Marshall Mix Design how it relates to mixes used outside of MnDOT (e.g., used by FAA at airports and some neighboring states)

Recertification

31. In addition to all the objectives above, the technician will be familiar with all certification area updates from the past 4-5 years, including any changes to specifications and test procedures.