State	Date Last Reviewed	Agency Website	Contact
Virginia	IS-143 – 3/2022	www.dot.state.va.us	Engineering@asphaltpavement.org

BMD Implementation Summary Table

BMD Approach	Applicable Mixture Type	Rutting Test	Cracking Test	Performance Testing for Production Acceptance
Approach A & D	Surface Mixtures	APA	Cantabro, IDEAL-CT	Yes, "Pass/Fail"

STATE-OF-THE-PRACTICE

The Virginia Department of Transportation (VDOT) allows two BMD approaches for the design and production of surface mixtures in special provisions, *Balanced Mix Design (BMD) Surface Mixtures Designed using Performance Criteria (October 26, 2021 Edition)* and *High Reclaimed Asphalt Pavement (RAP) Content Surface Mixtures Designed using Performance Criteria (October 20, 2020 Edition)*. Note that "high RAP surface mixtures" refer to asphalt mixtures containing 30 percent RAP or more, while the current Superpave mix designs allow no more than 30 percent RAP in surface mixtures. The first BMD approach is based on the "Performance + Volumetric Optimized (P+VO)" criteria, where the mix design is required to meet both the existing volumetric and performance test requirements. This corresponds to the Volumetric Design with Performance Verification approach. The second BMD approach requires the "Performance Only (BP)" criteria, where the mix design is purely based on the mixture performance test results with no requirements on aggregate gradation (except NMAS), virgin binder grade, and volumetric properties. This approach is essentially the Performance Design approach.

The mixture performance tests used in both BMD approaches are APA, Cantabro, and IDEAL-CT for the evaluation of rutting resistance, overall durability, and cracking resistance, respectively. The APA test is conducted in accordance with AASHTO T 340 at 64°C. For mix design, the specimens are conditioned for 2 hours at the design compaction temperature prior to compaction. Test criterion is a maximum 8.0 mm rut depth at 8,000 passes. Cantabro is conducted per AASHTO TP 108 on N_{design} specimens that have been conditioned for 2 hours at the compaction temperature prior to compaction. Test criterion is a maximum Cantabro mass loss of 7.5 percent. IDEAL-CT is conducted in accordance with ASTM D8225. Different from the APA and Cantabro tests, IDEAL-CT requires specimens conditioned for four hours at the compaction temperature on loose mix prior to compaction. Test criterion is a minimum CT_{index} of 70. In addition to meeting all the performance test criteria at the design binder content, the contractor is required to conduct supplementary performance testing at different binder contents: 1) APA at 0.5% above the design binder content, 2) Cantabro at 0.5% below the design binder content, and 3) IDEAL-CT at 0.5% above and 0.5% below the design binder content. Furthermore, the contractor is required to test a set of long-term aged IDEAL-CT specimens (by aging the loose mix for 8 hours at 135°C in addition to 4 hours at the compaction temperature) at the design binder content and submit the results with the JMF for mix design approval. All the supplementary performance test results are for informational purposes only.

Mixture performance testing is also required for production acceptance using the same test criteria as mix design approval. The APA, Cantabro, and IDEAL-CT tests will be conducted on “hot-compacted” plant-produced mix specimens with minimal cooling and reheating. According to the 2021 BMD special provision for standard surface mixtures (i.e., those with less than 30% RAP), the contractor is responsible for conducting the Cantabro and IDEAL-CT tests for every 2,000 tons of production and must report the results to VDOT within one week of sampling. Furthermore, the contractor is required to provide “hot-compacted” specimens to VDOT for Cantabro and IDEAL-CT testing at a 1/4,000-ton frequency, as well as the APA testing at a frequency of one test per project. Production acceptance is primarily based on asphalt binder content and gradation. However, if the average performance test results from production fail the criteria used for mix design approval, VDOT may require that production be stopped until corrective actions are taken by the contractor.

The 2020 BMD special provision for high RAP surface mixtures also requires mixture performance testing during production, but at different frequencies as the 2021 special provision for standard surface mixtures. During production, the contractor is responsible for Cantabro and IDEAL-CT testing at a frequency of one test every 1,000 tons, while VDOT is responsible for conducting the Cantabro, IDEAL-CT, and APA tests at a 1/2,000-ton frequency using “hot-compacted” specimens provided by the contractor. It should be noted that as of March 22, 2022, this special provision for high RAP surface mixtures has not been used in VDOT’s project contracts for 2022.