

AASHTO and ASTM Move Toward Harmony for Portland Cement

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The American Association of State Highway and Transportation Officials' (AASHTO) Subcommittee on Materials and ASTM International's Committee C01 on Cement recently passed ballot proposals to harmonize three of five significant differences between the provisions of the standard

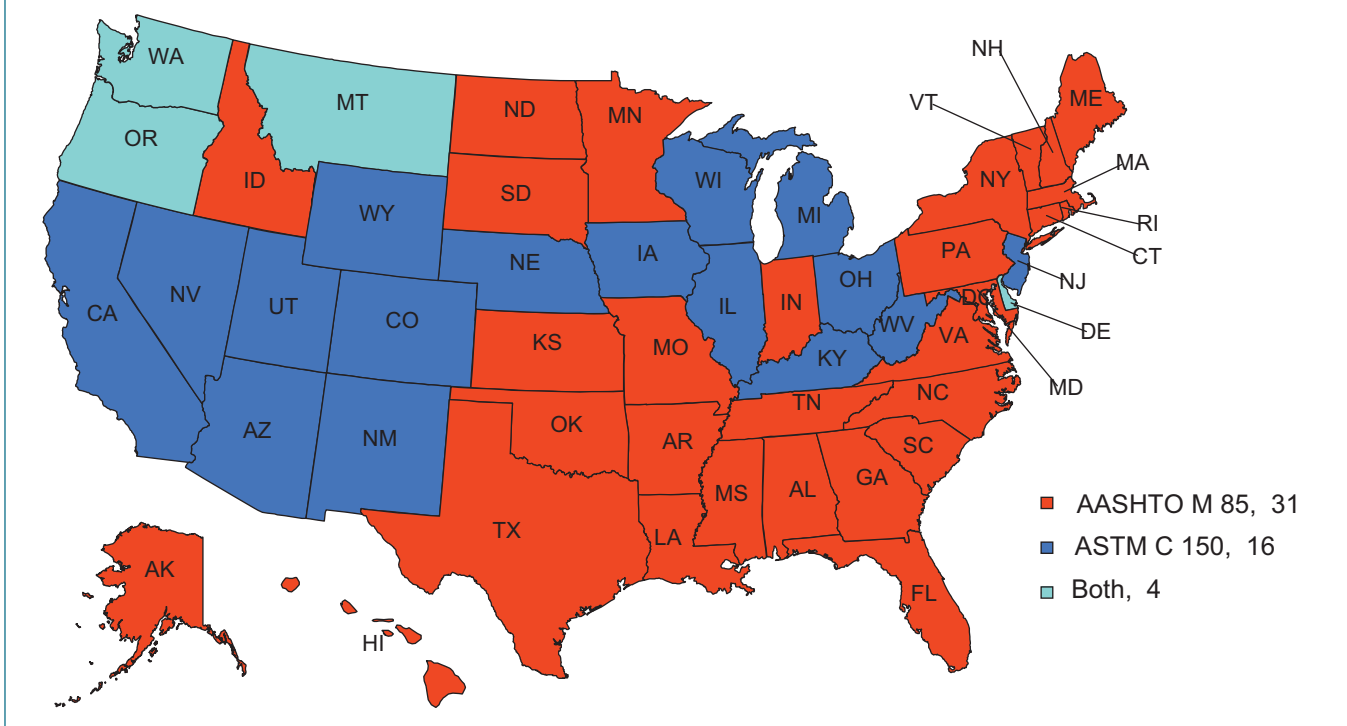
specifications for Portland cement, AASHTO M 85 and ASTM C 150, published by these organizations. As a result, the 2007 editions of these standards will have consistent provisions for fineness, Type II C_3S requirements (including Type II heat of hydration-related criteria), and use of up to 5 percent limestone in Port-

land cement. It is anticipated that revised standards will be published by the end of July 2007.

Currently, five significant differences exist between the two specifications:

1. AASHTO M 85 has maximum fineness (Blaine and Wagner) limits for Type I, II, IV and V cements;

Standard Used to Specify Portland Cement by State Departments of Transportation



zing Standards

2. AASHTO M 85 has a maximum limit of 58 percent tricalcium silicate (C_3S) for Types II and IIA;
3. AASHTO M 85 has a 1 percent processing additions limit;
4. ASTM C 150 provides for use of up to 5 percent limestone;
5. ASTM C 150 has removed the minimum 20 percent SiO_2 limit for Type II cement.

The 2007 editions of AASHTO M 85 and ASTM C 150 will have maximum average and single-sample Blaine fineness limits for Type II and Type IV cements of 420 m^2/kg and 430 m^2/kg , respectively. The two standards will not have a maximum tricalcium silicate (C_3S) limit for Type II cement, but will require Type II cement to meet the following heat index equation:

$$C_3S + 4.75C_3A \leq 100$$

For informational purposes, ASTM C 186 heat of hydration testing will be required at least every six months. Finally, both standards will have provisions for the use of up to 5 percent limestone in cement. Work continues to develop harmonization proposals to address differences in processing additions limits and Type II SiO_2 limits.

Harmonization - Making a Difference by Making Portland Cement Standards Consistent

These changes are the result of an ongoing, focused harmonization effort that was initiated in the summer of 2003. AASHTO M 85 and ASTM C 150 have existed as parallel standards for Portland cement since the 1940s. U.S. state departments of transportation reference either AASHTO M 85 or ASTM C 150 when specifying Portland cement for concrete construction. Currently,

out of 51 state departments of transportation (including the District of Columbia), 31 reference AASHTO M 85, 16 reference ASTM C 150 and four reference both.

While the provisions of AASHTO M 85 and ASTM C 150 have generally been consistent, there have also been some substantive differences and, prior to this harmonization effort, the number of differences seemed to be increasing. However, there are important benefits to users and producers in having consistent requirements in the two specifications. Benefits to users and owners include having Portland cement standards that meet product application needs and not having to worry about whether an "ASTM cement" was used when an "AASHTO cement" should have been used. Thus, user specification and quality assurance would be simplified.

For the concrete producer, the need to maintain different silo and/or sourcing for state highway projects would be eliminated. Quality control for concrete would be simplified, resulting in a more consistent product. Working with a similar product for a given type designation would enable the producer to better predict the performance of the concrete and the compatibility with other ingredients. For the cement producer, harmonization would eliminate the need for special production runs and storage requirements. Improved consistency could be expected from simplified quality control. The net effect would be better quality concrete!

Establishing a Process for Harmonization

Recognizing the benefits of harmonization, AASHTO Subcommittee on Mate-

rials Technical Section 3a on Hydraulic Cement and Pozzolanic Materials (AASHTO SOM TS3a) and ASTM Committee C01 on Cement (ASTM C01) established a Joint AASHTO-ASTM Harmonization Task Group (JAAHTG) consisting of four members each (subsequently expanded to six members each) from AASHTO TS3a and ASTM C01. Since November 2003, the JAAHTG has met monthly or bimonthly either by conference phone, Web conference or in person to consider existing significant differences between AASHTO M 85 and ASTM C 150 and to develop recommendations for having equivalent requirements in these two standards.

From the onset, task group members recognized that harmonization would need to be a collaborative effort, requiring direct and open communication and mutual understanding and consideration of user and producer needs. Harmonization would likely result in changes to both ASTM C 150 and AASHTO M 85 as a result of this collaborative approach, and the effort would be a long-term activity since standards must constantly change to remain relevant to the demands of the marketplace.

As task group members focused on developing harmonization proposals that meet the collective needs of AASHTO members and ASTM user, general interest and producer members, they agreed that a cement standard specification should:

1. Ensure concrete performance (recognizing that cement is only part of the concrete performance equation);
2. Provide a means of determining compliance;
3. Provide a consistent material;
4. Use simple, reliable testing and sampling methods;
5. Provide flexibility for optimization of available natural resources and manufacturing technology, and accommodate various user requirements;
6. Ensure understandable communication between buyer and seller.

Discussion revealed differences in the relative value various task group members place on these standardization attributes and differences in opinions held about the contribution of specific standards provisions toward meeting these expectations, but there is consensus that each of these expectations

stems from valid user, producer and general interest standardization needs.

Developing Solutions to Resolve Differences

From this foundation, the group proceeded to examine current differences, consider the reasons for provisions and collaboratively identify harmonization solutions that work for everyone. In March 2004, task group members agreed to focus attention on developing proposals to harmonize the fineness and Type II C_3S provisions of the standards. Task group members proposed, discussed, balloted and reviewed several concepts for harmonizing these differences between the two standards. By the end of the June 2005 task group meeting, members agreed to forward a harmonization proposal to the appropriate ASTM and AASHTO committees. The harmonization proposal would require changes to both AASHTO M 85 and ASTM C 150 and result in consistent fineness and Type II C_3S requirements. During the remainder of 2005 and 2006, this proposal was submit-

ted to the standards development processes of AASHTO and ASTM. Results of ballots from both organizations were considered by the joint task group and recommendations made to address negatives and comments. The original proposal was slightly modified during this process and, as of this spring, has passed the balloting requirements of both AASHTO and ASTM.

Toward the end of 2005, joint task group members agreed to consider the issue of the use of up to 5 percent limestone in Portland cement. The use of up to 5 percent limestone enables significant reduction in greenhouse gases emitted during the manufacture of Portland cement. Extensive data and experience indicate that, when optimized by the manufacturer, Portland cements containing up to 5 percent limestone provide comparable performance to cements without limestone. Therefore, in 2006 a harmonization proposal to have parallel provisions for the use of up to 5 percent limestone in AASHTO M 85 and ASTM C 150 was developed and submitted to both standards organizations. The proposal has passed ballot requirements of both organizations and

will be incorporated in the 2007 editions of AASHTO M 85 and ASTM C 150.

Continuing AASHTO-ASTM Harmonization Activities

The work of the Joint AASHTO-ASTM Harmonization Task Group continues. In addition to addressing remaining differences of provisions for processing additions and Type II SiO_2 limits, the task group is considering several issues highlighted by ballot responses and task group discussion. These include: clarification of the term "sample" as used in the fineness provisions, development of separate designations for cements with moderate sulfate resistance and moderate heat of hydration, and evaluation of sulfate content provisions for Portland cement.

This list of new work items highlights the fact that Joint AASHTO-ASTM Harmonization Task Group accomplishments go beyond this successful development of recommendations for resolving specific differences in AASHTO M 85 and ASTM C 150. This group has elevated the level of communication among AASHTO and ASTM members, established a culture of

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working together to develop provisions that meet collective needs and developed mechanisms for implementing improve-

ments to cement standards. Therefore, it has established a new paradigm that promises to enable significant technical advances to

both AASHTO M 85 and ASTM C 150, making these standards more effective and relevant to marketplace demands! ■

What Will Change in AASHTO M 85 and ASTM C 150 Portland Cement Standards?

(1) Harmonization of the **Type II C₃S requirement** will be achieved by including a mandatory provision in both ASTM C 150 and AASHTO M 85 that Type II cement meet the heat index equation:

$$C_3S + 4.75C_3A \leq 100$$

Changes to AASHTO M 85 Type II cement are the replacement of the existing mandatory 58 percent limit on C₃S and the optional requirements for the sum of C₃S + C₃A with a mandatory requirement to meet the heat index equation. Changes to ASTM C 150 Type II cement entail removal of the optional requirements for the sum of C₃S + C₃A, and addition of the requirement to meet the heat index equation.

There will be an additional requirement for ASTM C 186 informational testing for Type II cement for both AASHTO M 85 and ASTM C 150 at least once every six months.

(2) Harmonization of the **fineness requirements** will be achieved by requiring a maximum average Blaine fineness value of 420 m²/kg and a maximum individual value of 430 m²/kg for Type II and Type IV cements in both AASHTO M 85 and ASTM C 150. ASTM C 150 will change to include these maximum fineness criteria for Type II and Type IV cements. Changes to AASHTO M 85 entail removing the maximum fineness limits on Type I and Type V cement and increasing the fineness limits for Type II and Type IV cements from the existing maximum average value of 400 m²/kg and maximum individual value of 420 m²/kg. Both AASHTO M 85 and ASTM C 150 will exempt Type II cements from the maximum Blaine and Wagner fineness requirement, if the heat index equation yields a value of 90 or less.

(3) Harmonization for **limestone** will be achieved by permitting the use of up to 5 percent limestone in Portland cement and revising Section 5 (renamed Ingredients) in both standards. Changes to AASHTO M 85 are inclusion of provisions for use of up to 5 percent limestone, reorganizing and revising Section 5, and revision of the definition of Portland cement in Section 3. Changes to ASTM C 150 include reorganization and revision of Section 5 of ASTM C 150. Parallel revisions have also been made to the definition of Portland cement in the ASTM terminology standard, ASTM C 219. No changes will be made to the existing chemical or physical requirements of AASHTO M 85 or ASTM C 150.

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