

## **Winds of Change for Roofing Slate Testing**

**By David Large**

**For several decades, specifiers, architects, consultants, roofing contractors, distributors, quarriers and building owners have found the entanglements of ASTM C406 roofing slate testing a colorful issue. The color, unfortunately, has always been a shade of grey...a land of compromise.**

**Recent initiatives are about to change this situation for our industry, and revisions pending before ASTM along with additional new tests and changes proposed for ASTM to consider, will continue to protect building owners with strong material and fabrication quality requirements, while enhancing the testing process and methods for laboratories to test natural roofing slate. This will lead to clearer production requirements for quarries, more precise supplier specifications and measurable benchmarks for material supplied on projects to be evaluated in order for ASTM's coveted S1 rating to be achieved. This will allow for natural roofing slate to be specified and installed with more confidence, and produce smoother construction schedules for our clients.**

**At the same time, it is necessary to recognize that natural roofing slate is truly a unique material when it comes to testing its physical properties for durability. Testing laboratories making decisions that reflect on our industry, company, personal reputations, projects and products should earn the right to wield this power. To meet this end, a select few have been chosen for this recognition by our association based on their experience and third party credentials.**

**To begin to tell the story of where we are going, it is necessary to revisit where we have been. In our National Slate Association Winter 2004 Newsletter, Jonathon Hill writes of the short falls of current ASTM testing from our industry's point of view. These shortfalls included the relative inexperience of many labs and lab technicians in testing of slate, inconsistency of results from ASTM C120 Modulus of Rupture testing, and the well-intentioned changes made to the C120 and C406 Standard Specification for Roofing Slate by ASTM over the past 20-30 years which removed the originally intended subjective evaluations. He also points out that the origins of the current ASTM Test Methods and Specifications are from the world of the 1930s and with changes in extraction and fabrication methods, demand for thicker materials, emergence of third-world foreign suppliers and changes in the marketing of slate, the tests are not necessarily relevant to the world we operate in today. Jon summarizes the net result appropriately as "ASTM C406 compliant is synonymous with undefendable lawsuit".**

**Jon closes his article with the acknowledgement that ASTM Committee C18 was making efforts to address issues related to C120 Modulus of Rupture Testing and that the National Slate Association was considering recognizing a very short list of independent testing laboratories as NSA approved labs. It is here that the winds of change story begins.**

**ASTM International (ASTM, formerly American Society for Testing and Materials), based in West Conshohocken, Pennsylvania, is a not-for-profit, world-recognized organization that establishes and monitors material test methods, specifications, terminology and practices to create standards in an enormous number of areas and industries. From disposable diapers to nuclear reactors, sports equipment to sports cars - stone, cement, asphalt, plastics, paints and chemicals: all are covered under various ASTM standards. These standards are the foundations on which our products and projects are built in North America. In part, ASTM's mission statement includes the goal that their standards "contribute to the reliability of materials, products, systems and services".**

**Each ASTM committee is made up of volunteers who develop, present, discuss and vote on ballots to accept or reject changes to, or creation of standards in a general material classification. The make up of each committee's membership will probably determine how progressive (or sedentary) the committee will be in any particular area under their committee scope. In my experience, ASTM does not create or change standards as a result of receiving general or vague complaints from our industry; however, they do effect change when supplied with constructive and technically sound ideas and information.**

**The committee which governs standards for natural roofing slate, ASTM C18 Dimension Stone Committee (as the name implies) is made up of interested parties to the natural stone industry. Members come from the sales, marketing, manufacturing, technical or engineering side of a particular category of stone, such as granite, marble, limestone and slate, or they are architects, consultants, engineers and senior testing laboratory staff who deal with a broad range of stone types and applications. As a committee, these people are responsible for the standards of all materials under the committee's jurisdiction, and for our purposes, specifically responsible for ASTM C406 Standard Specification for Roofing Slate.**

**ASTM C406, among other requirements, consists of three separate tests that are used to determine the physical properties of natural slate and subsequently applies an expected service life for that specific material. These tests are C121 Water Absorption of Slate, C217 Weather Resistance of Slate and C120 Flexure Testing of Slate. Based on the results of these three tests, roofing slate is graded as S-1 (over 75 years), S-2 (40 to 75 years) or S-3 (20 to 40 years). ASTM C406 also references C119 Standard Terminology Relating to Dimension Stone, and C120 refers to C99 Standard Test Method for Modulus of Rupture of Dimension Stone.**

An ASTM standard must be reviewed, and re-approved, at a minimum interval of five years; however, it can be reviewed at any time, at the committee's discretion. The two numbers following the standard's designation i.e. C120-00 indicates the year the standard was adopted or last revised. A number in parentheses indicates the year of last re-approval. It is important to ensure that you note the most recent editions of ASTM documents when referring to standards for your projects. ASTM publishes the approved C406 standards in November of each year in their Annual Book of ASTM Standards. This book contains all standards, as approved by ASTM, up to six months prior to the publication date. Standards that are approved between the annual editions are available separately and should be referred to as the most recent standard. At the time of writing, the current approved and useable standards related to roofing slate are C406-00, C120-00, C121-90 (Reapproved 1999), C217-94 (Reapproved 1999), C99-87 (Reapproved 2000) and C119-04a. Note: There is a new C406-05 approved but it is waiting for an approved revision to C120 before it can be referenced in the field.

ASTM C120 Flexure Testing of Slate has been under heavy scrutiny from within, and without, ASTM for some time. Of the three ASTM tests for roofing slate, C120 is the one that most often brings confusion, misunderstanding, incompetence and frustration to our tables. Recognizing the need for change in this test method, ASTM Committee C18 has recently reviewed, and is in the approval process, of making significant changes to the test as it relates to roofing slate that will require roofing slates of 3/16-1/4" thickness to achieve a minimum breaking load of 575 pounds force rather than the current 9000 PSI modulus of rupture. The 575 breaking load requirement is derived from the mathematical formula used to yield a modulus of rupture of exactly 9000 PSI and a specimen thickness of 7/32", a thickness exactly midway between the minimum 3/16" and maximum 1/4" thickness allowable in modulus of rupture testing. Other variables of the MOR equation are predetermined by the required physical dimensions of the test specimens and the setup of the test stand.

The motivation behind this change recognizes that the mathematical formula used to calculate MOR for roofing slate appears to penalize, rather than favor, thicker slates over thinner slates. This aberration would indicate that it would be better to put a 3/16" thick slate on a roof rather than a 3/8" thick slate from the same source. The MOR test also yielded results that were not repeatable and even exhibited wide variations in results from duplicate tests on the same specimen. The intent of the original test was to ensure that standard roofing slates carry a specific minimum physical strength to resist breaking under light foot traffic, accidental impact and wind uplift. It also, by the test requirements themselves, intentionally precluded the passing of slates of less than 3/16" thickness, effectively keeping them out of the market. In this regard, we are unchanged from the 1930s and still not ready to see 1/8" thick slates on our roofs. The pending revision will ensure physical strength, while eliminating some of the mystical mathematical aspects of the former test.

**Wording of the pending C120 change also takes into consideration that a significant number of quarriers no longer produce their roofing slate “on grain”, meaning with the grain running the long dimension of the slate. “On grain” slate would normally yield the material’s highest breaking strength across the short dimension of the slate shingle. Due to changes in quarry and fabrication practices it has become more efficient and economical to produce roofing slates of random grain orientation than on grain. There would be an automatic penalty to be paid by these producers, in order to meet the breaking-load requirements of ASTM, if they choose to produce random-grain slates. This penalty would typically take the form of requiring thicker material to meet the breaking-load requirement. Note: There will be those that could make a case against the practice of producing random-grain roofing slate, but that issue will be left to another time.**

**Additionally, the pending changes to C120 include an increase of the sample size from a minimum of six specimens to a minimum of ten specimens, to average results over a broader sample range. It is worth noting that C120 does not allow for test results to be adjusted for a sample where a specimen exhibits a dramatic variance from the average of the other specimens in the sample. This is a common occurrence and frequently related to isolated fracture damage, flaws or condition of one specimen not representative of the original material. In practice, these slates would be culled at the time of installation by the ringing process. Test methods for all types of dimension stone, with the exception of slate, allow for adjustments for these “outliers” and in fact, as recently as 1985, C120 allowed for the exclusion of a specimen with a result 25% below the remaining samples’ average, if after examination, it was determined that the failure was due to a physical flaw in the specimen.**

**The pending C120 change also makes an effort to give improved guidance as to the equipment that must be used for the preparation of test specimens to minimize damage to the material that affects test results unfairly.**

**These pending changes to C120 and their impact on C406 are a step in the right direction, but the winds of change need to keep on blowing.**

**In a continuing effort to improve the relevance of C406 and C120 standards for our industry, further changes have been recommended to the ASTM C18 committee and they have requested comment by the National Slate Association as part of the evaluation process. Briefly, these changes include rewording the introduction of C120 to better describe the use of explosives in quarrying operations and their possible impact on ASTM stone testing. It proposes changes in the specimen dimensions to eliminate the potential of incorrectly marking specimens during the preparation and testing process.**

The recommendations propose the elimination of the maximum specimen thickness (currently 1/4") to allow for the testing and supply of thicker slates on projects when the material does not have the required breaking load strength at 3/16 – 1/4" or it cannot be split at that thickness due to the nature of the stone. The ASTM test results would be specific to slates of the tested thickness with a tolerance of minus 1/16". It would then fall on all parties involved to ensure that the material delivered, met this specified thickness requirement. As the existing weathering and water absorption tests would still apply, the building owner would get the weathering and absorption they are looking for, plus the necessary physical strength of an S-1 grade roofing slate.

The recommended changes also include rewording of the Preparation of Specimens, Marking and Measuring, and Procedures sections to clarify equipment to be used, critical measurements, positioning of specimens in the test stand and reporting of information. These recommended changes, among other things, would specify the specimen cutting equipment as "The saw blade shall be a continuous rim, diamond impregnated type, mounted to a water-cooled sliding bed saw capable of making a clean cut with no lacerated edges."

We will take the opportunity in a future NSA newsletter to update you on these and other ASTM activities.

After all this, we still need somebody who can do the testing. As outlined earlier in this article, the National Slate Association has selected three test labs that have exhibited the expertise, interest and resources to conduct ASTM roofing slate testing in a capable manner. It is believed that these laboratories will keep pace with the changes that are expected to continue in ASTM roofing slate standards and also be a source of expertise for our industry in the area of testing. The association recognizes these three laboratories and would suggest that members, and others interested in natural roofing slate testing, seek their services for your materials or projects. These laboratories are:

Amber Consulting, Pittsford, VT	802-775-1650
St. Lawrence Testing, Cornwall, ON	613-938-2521
Wiss, Janney Elstner Associates, Northbrook, IL	847-272-7400

Instead of "Winds of Change for Roofing Slate Testing", I now see that I should have titled this article the "Long-Winded Change for Roofing Slate Testing". I look forward to hearing any comments, ideas or concerns of our members (or non-members) regarding ASTM or slate standards in general. Thank you for indulging me.

**Dave Large is Sales Manager of North Country Slate and a member of ASTM Committee C18, sitting on the C18.01 Test Methods and C18.03 Material Specifications sub-committees. He is also a member of the ASTM C18.03-04 Slate Task Force. He is a founding member of the National Slate Association, a member of their Standards Committee and sits on the Board of Directors. He is also a proud member of the roofing slate industry.**