EVT – Equiviscous Temperature in Built-up Roofing

By ARMA

Built-up roofing (BUR) has been a highly successful roofing system for building owners for over a century. In recent years, there has been discussion in the industry regarding the Equiviscous Temperature (EVT) of roofing asphalts and the accuracy in product labeling for built-up roofing applications. The EVT is the suggested application temperature for built-up roofing systems that gives the asphalt the viscosity necessary to achieve proper interply mopping thickness and adhesion. It was developed and should be used for hot-mopped, unmodified, built-up roofing systems. Other systems, such as those using SBS modified membranes, may require a different application temperature.

Built-up Roofing Asphalt (BURA) is generally made to a specification generated by the American Society for Testing & Materials, Inc. (ASTM). ASTM has developed a standard specification for asphalt used in roofing (D312-00) that addresses the physical requirements for various types of roofing asphalts. The D312 standard recognizes that there are a variety of applications in addition to built-up roofing that use these types of asphalts, including construction of some types of modified bitumen systems, bituminous vapor retarder systems, and for adhering insulation boards in some other types of roofing systems. The EVT is not generally applicable to these other uses.

The physical requirements listed in D312-00 are listed in Table 1 below.

ARMA member companies produce BURA that adheres to the ASTM specification and strive to provide the most accurate data possible on their materials. Whether it is indicated on each carton, a bill of lading for bulk shipment, or a BURA Information Sheet included with the product (see example, page 28), the EVT is critical to help assure proper adhesion, waterproofing, and application rate in BUR systems. Product labels clearly identify manufacturers, type, flashpoint, EVT, production location, and production date.

The EVT is the temperature at which asphalt achieves its optimum viscosity of 75 centipoise for mechanical application or 125 centipoise for mopped application. ASTM 1079 stipulates that the EVT must be measured in the mop bucket or in the mechanical spreader; one should not attempt to achieve EVTs on the deck itself. Research to develop the current EVT was performed by the National Roofing Contractors Association (NRCA), the Trumbull Asphalt Division of Owens Corning, and Koppers Company, and detailed in NRCA *Technical Bulletin 2-91* in 1991. NRCA and ARMA still use that definition of EVT and it has withstood the test of time.

There are several properties that may influence the performance of bitumen, such as the softening point, penetration, ductility, flashpoint, and solubility.

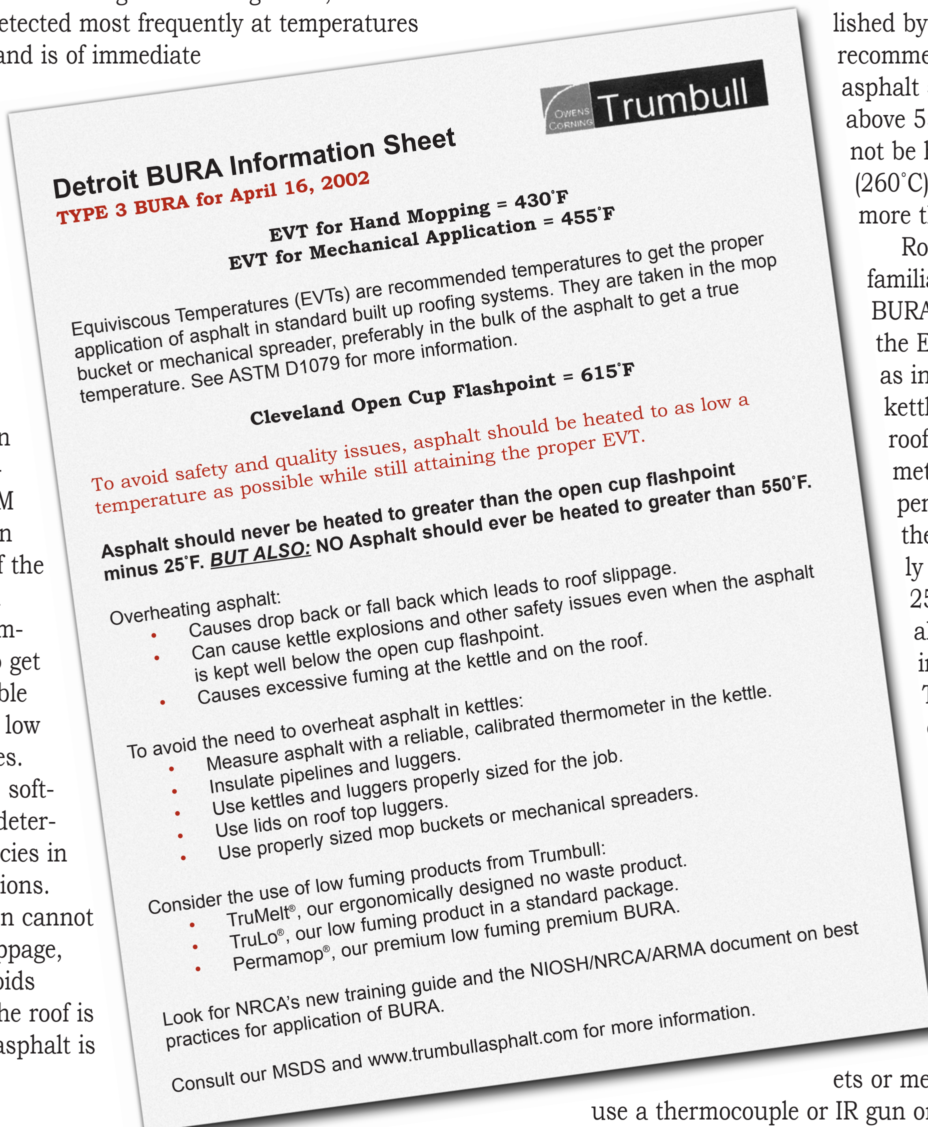
Softening Point

The softening point is the temperature at which a particular bitumen softens. Ring and ball softening point is in the ASTM BURA specification because it is one factor in determining resistance to flow of the asphalt at rooftop temperatures. Higher softening points allow BURA to be used on higher roof slopes without

	Type I		Type II		Type III		Type IV		Test Methods
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Softening Point ˚C (˚F)	57 (135)	66 (151)	70 (158)	80 (176)	85 (185)	96 (205)	99 (210)	107 (225)	ASTM D36
Flash Point ˚C (˚F)	260 (500)	-	260 (500)	-	260 (500)	-	260 (500)	-	ASTM D92
Penetration, Units, dmm:									
@ 0˚C (32˚F)	3	-	6	-	6	-	6	-	ASTM D5
@ 25˚C (77˚F)	18	60	18	40	15	35	12	25	
@ 46˚C (115˚F)	90	180	-	100	-	90	-	75	
Ductility @77˚F, cm	10.0	-	3.0	-	2.5	-	1.5	-	ASTM D113
Solubility in Trichoroethylene %	99	-	99	-	99	-	99	-	ASTM D2042

Table 1: physical requirements listed in D312-00.

slippage problems. One issue with softening point that needs to be kept in mind is the fact that when stored at high temperatures, asphalt can "drop back" or "fall back" to lower softening points. This phenomenon is really a reversal of the reactions that cause the increase in softening point during air blowing. The higher the storage temperature and the longer the storage time, the worse the drop back. It is detected most frequently at temperatures above 450˚F (232˚C) and is of immediate concern above 500˚F (260˚C). Clearly, this is a bigger problem with Type III (3) and IV (4) BURAs because their higher EVT numbers require hotter kettle temperatures.



Owens Corning Trumbull

Detroit BURA Information Sheet

TYPE 3 BURA for April 16, 2002

EVT for Hand Mopping = 430˚F
EVT for Mechanical Application = 455˚F

Equiviscous Temperatures (EVTs) are recommended temperatures to get the proper application of asphalt in standard built up roofing systems. They are taken in the mop bucket or mechanical spreader, preferably in the bulk of the asphalt to get a true temperature. See ASTM D1079 for more information.

Cleveland Open Cup Flashpoint = 615˚F

To avoid safety and quality issues, asphalt should be heated to as low a temperature as possible while still attaining the proper EVT.

Asphalt should never be heated to greater than the open cup flashpoint minus 25˚F. *BUT ALSO:* NO Asphalt should ever be heated to greater than 550˚F.

Overheating asphalt:
- Causes drop back or fall back which leads to roof slippage.
- Can cause kettle explosions and other safety issues even when the asphalt is kept well below the open cup flashpoint.
- Causes excessive fuming at the kettle and on the roof.

To avoid the need to overheat asphalt in kettles:
- Measure asphalt with a reliable, calibrated thermometer in the kettle.
- Insulate pipelines and luggers.
- Use kettles and luggers properly sized for the job.
- Use lids on roof top luggers.
- Use properly sized mop buckets or mechanical spreaders.

Consider the use of low fuming products from Trumbull:
- TruMelt®, our ergonomically designed no waste product.
- TruLo®, our low fuming product in a standard package.
- Permamop®, our premium low fuming premium BURA.

Look for NRCA's new training guide and the NIOSH/NRCA/ARMA document on best practices for application of BURA.

Consult our MSDS and www.trumbullasphalt.com for more information.

Penetration

Needle penetration is run at several temperatures in the ASTM specification and is an important measure of the rheology of the BURA material. Different temperatures are used to get a reading of how pliable the asphalt will be at low and high temperatures. Both penetration and softening point together determine slippage tendencies in the current specifications. Too high a penetration cannot only contribute to slippage, but can also cause voids between plies when the roof is walked on while the asphalt is still warm.

Flashpoint

Flashpoint is one critical measure of explosion hazards with BURA. It is the temperature at which an open cup of asphalt builds up enough combustible vapors over the surface to ignite in the presence of a flame or other ignition source. Asphalt should never be heated higher than 25˚F (14˚C) below its flashpoint. The minimum flashpoint in the ASTM specification is 500˚F (260˚C). Moreover, no asphalt, regardless of flashpoint, should ever be heated over 550˚F (288˚C).

Overheating

Overheating asphalt in an open kettle changes it through loss of volatiles and reactions, which can change its flexibility, its adhesive qualities, and resistance to weathering. The extent of the damage resulting from overheating depends on the temperature and the length of time the asphalt is maintained at the high temperature. Overheating can cause softening point reductions and slippage problems. It can also cause reductions in the EVT of the asphalt. Overheating can mean that the EVT drops to much lower levels than is being used to apply the asphalt and the result can be low interply mopping levels.

In addition to dropback concerns, overheating can cause explosions and fire and can lead to asphalt fume exposures for workers well above the TLV established by ACGIH and the exposures recommended by NIOSH. The asphalt should never be heated above 550˚F (288˚C), and should not be held between 500˚F (260˚C) and 550˚F (288˚C) for more than four hours.

Roofing contractors should familiarize themselves with the BURA type, the flashpoint, and the EVT. Good practices such as insulating the pipes used in kettle systems pumping to roofs, and other heat saving methods can reduce the temperature that is needed in the kettle. The kettle generally must be approximately 25˚F hotter than the EVT to allow for losses in a well-insulated system. Temperature measurement equipment should be checked at periodic intervals to ensure proper thermal treatment of the asphalt and that the asphalt is being applied at the proper EVT range. Be sure to measure the EVT where it was meant to be measured – in mop buckets or mechanical spreaders. Also, use a thermocouple or IR gun on an agitated surface to get a true bulk temperature. On-the-job conditions may warrant a phone call to the asphalt suppliers' technical service centers to verify the proper EVT and flashpoints. ■

About the Author

The **Asphalt Roofing Manufacturers Association (ARMA)** is the North American trade association representing the majority of the asphalt roofing industry's manufacturing companies of bituminous-based residential and commercial fiberglass and organic asphalt shingle roofing products, roll roofing, built-up (BUR) roofing systems, and modified bitumen roofing systems, and their raw material suppliers. ARMA is committed to serving the asphalt roofing industry and its consumers. For additional information, contact ARMA headquarters at: 1156 15th Street, NW, Suite 900, Washington, DC 20005. Telephone: 202/207-0917; fax: 202/223-9741; or visit the ARMA website at: **www.asphaltroofing.org.**

NEXT GENERATION POLYISO ROOF INSULATION

By Jared Blum

Polyisocyanurate insulation being installed on a roof deck. Photo courtesy of Firestone Building Products Co.

In the 21st century, building owners, architects, specifiers, and physical plant managers look for high quality building products that are cost effective, energy efficient, and supportive of the environment. While the roofing marketplace has a number of quality thermal insulation products, recent developments have made polyisocyanurate (polyiso), already the nation's leading roof insulation product, an even more appropriate choice for long-term building performance. Using non-ozone depleting and non-global warming blowing agents in the manufacture of the insulation, polyiso manufacturers now utilize the most advanced scientific method to assess the long-term thermal resistance (LTTR) of their insulation products.

Long Term Thermal Resistance (LTTR)

For architects and specifiers, providing R-values that accurately describe long-term thermal performance has been an issue of increasing importance. In the 1980s and 1990s, the polyiso industry used PIMA 101 (RIC/TIMA 281-1), a six-month conditioning procedure, to report R-value. This practice allowed for an "apples-to-apples" comparison of R-values from different manufacturers. During the past several years, polyisocyanurate rigid foam insulation manufacturers have participated in research projects in both the United States and Canada resulting in consensus laboratory methods that can be used to determine the design LTTRs of permeably-faced plastic insulating foams typically used as roof insulation.

In 2003, the members of PIMA, the Polyisocyanurate Insulation Manufacturers Association, transitioned to a new way to determine the thermal insulation efficiency of permeable-faced products. LTTR represents the most advanced scientific method to describe the long-term thermal resistance of foam insulation products using blowing agents such as hydrocarbons. LTTR has many advantages. It provides a technically supported, more descriptive measure of the long-term thermal resistance of polyiso insulation. It is an advanced test method, based on consensus standards in the United States and Canada. It applies to all closed-cell foam insulation with blowing agents other than air and provides a better understanding of the thermal performance of foam.

POLYISO THICKNESS (inches)	LTTR R-VALUE
1	6.0
1.5	9.0
2	12.1
2.5	15.3
2.7	16.6
3	18.5
3.5	21.7
4	25.0

The chart above provides a representative overview of LTTR values, confirmed by third-party testing, for third generation/zero ozone depletion potential (ODP) polyiso foam insulation.

Third Generation Blowing Agents:

On January 1st of this year, the polyiso industry began using new, zero ozone-depleting blowing agents in the manufacture of its foam insulation products. Blowing agents are one of the three basic components of polyiso insulation. The blowing agent is the ingredient that expands the foam and then remains contained in the closed cells, thereby enhancing the foam's thermal performance. This new generation of polyiso foam insulation is manufactured with hydrocarbon blowing agents instead of HCFC-141b.

The transition has been smooth, and product performance has continued to meet industry standards. In fact, PIMA manufacturing members have installed over one billion board feet of the new polyiso throughout North America over the past three years, and reported no difference in product performance. This is further supported by the extensive use of the new polyiso in Europe over the same time period, with similar results.

Polyiso foam insulation proves to be increasingly the product of choice for the commercial roofing industry, with an impressive 55% market share, according to a 2002 NRCA market survey. Its widespread use can be attributed to the fact that it is one of the most energy-efficient and cost-effective insulation materials used in roofing applications today, and to factors such as:

- The highest R-value per inch with long-term thermal performance validation;
- Compatibility with all types of roofing systems; and
- It meets both FM 4450 and UL 1256 for direct application over steel decks without a coverboard.

PIMA believes the dedication of its member manufacturers to innovation is a testament to the ingenuity and commitment of the industry in achieving the highest possible environmental performance for its products. The products' combination of zero ozone depletion and zero global warming potential, with their performance in reducing energy use and reducing CO_2 emissions, should solidify polyisos' place well into the 21st century. ■

About the Author

Jared O. Blum

Jared O. Blum is the President of the Polyisocyanurate Insulation Manufacturers Association (PIMA), the Washington-based national trade association representing manufacturers of polyiso foam insulation. The Association is committed to working independently and with public and private organizations to educate Americans about the critical importance of national energy conservation. To learn more about polyiso and PIMA, visit PIMA's website at www.pima.org.