NO. 1001

TECHNICAL BULLETIN

BITEC BITUMEN TECHNOLOGY TM

Why Determine Tensile Strength and Percent of Elongation?

OVERVIEW

Tensile strength and elongation are two test results which are commonly seen in all published modified bitumen manufacturer's literature. This information is very important in that it tells what the membrane will do as far as "work" performance. (Work performance being the amount of distortion the membrane will undergo without destruction.)

All roofing membranes whether conventional BUR, modified bitumen, PVC, EPDM, etc. undergo stresses and strains which cause the membrane to distort or deform. Much of this occurs at details such as: pipe penetrations, parapet walls and area dividers. A membrane, over its lifetime, will undergo many cycles of stress; normally due to changes in atmospheric temperature. The membrane must be able to cope with the forces it encounters in order to protect the system from intrusion by water.

Testing for tensile strength and elongation is performed using a mechanical testing apparatus (Instron). Specimens of membrane are stretched to the breaking point, using this device, and in doing so, the tensile strength and elongation is determined.

The following are definitions of terms used in this procedure:

Tensile Strength

Tensile strength is defined as the force required to break the specimen or cause complete separation of constituents in a linear direction.

Elongation

Elongation is defined as the distance (in percent) the membrane will stretch from its original size to the point at which it breaks.

Work

(Also Load-Strain Product, Load Strain Modulus) - Work is defined, in the case of modified bitumen products, as the amount of energy the membrane can withstand before destruction occurs. Visually given in Newtons (N), this quantity is easily determined by multiplying the tensile at break by the elongation as a percent.

For example: If a specimen of membrane has a tensile strength of 150 lbf. and an elongation of 10% you do the following:

Multiply 150 X 10 = 1500

1500 is your Load-Strain Product in lbf.

To convert to Newtons;

Multiply 1500 X 4.448222.
Hence - 6672 N.

There is much debate as to whether tensile strength or elongation should be considered the most important. Neither are singularly important, but together they are extremely important.

To show you how important "work" is, several examples are provided on the back.

Fig. 1 is a typical chart read-out from pulling a fiberglass reinforced modified bitumen membrane. The tensile obtained is 185 lbf and elongation is 14%.

Fig. 2 is a typical chart read-out from pulling a polyester reinforced modified bitumen membrane. The tensile obtained is 105 lbf and elongation is 55%.

From the charts, let's compute the load-strain product or "work" which the respective membranes can perform.

Fig. 1: (Fiberglass Reinforced)
185 X 14 = 2,590 Load-Strain Product

Fig. 2: (Polyester Reinforced)
105 X 55 = 5,775 Load-Strain Product

It can be easily seen that the polyester reinforced membrane can perform more "work" than can the fiberglass reinforced membrane. In order to get the same amount of "work" out of the fiberglass membrane as compared to the polyester membrane, the tensile of the fiberglass membrane would have to be 413 lbf with an elongation of 14% or a tensile strength of 185 lbf with an elongation of 31%.

As you can see the "work" that the membrane can perform is very important in regards to how well the membrane will perform in the field.

It is a "give and take" situation...

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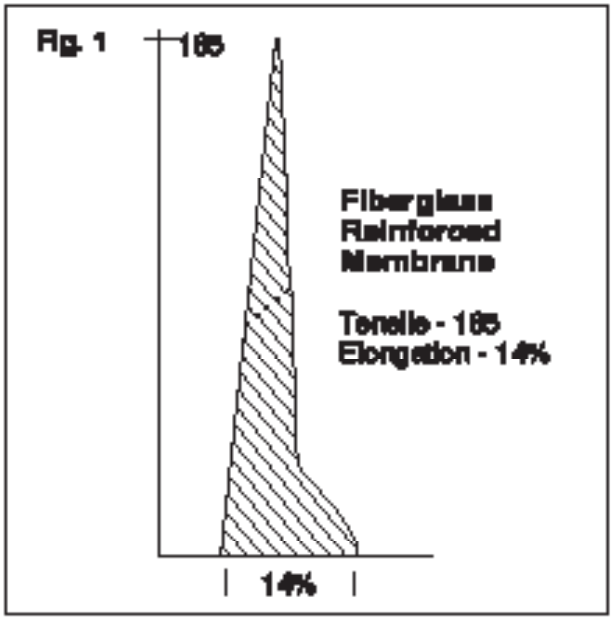

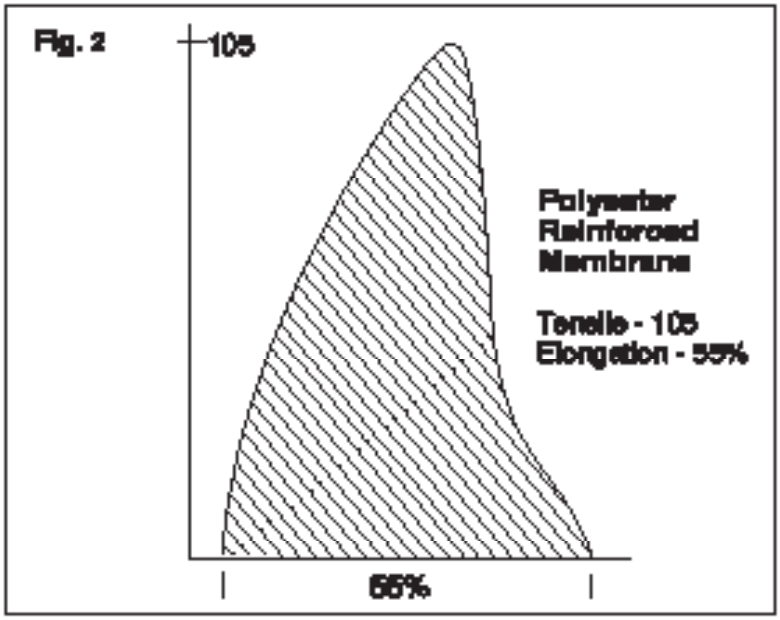

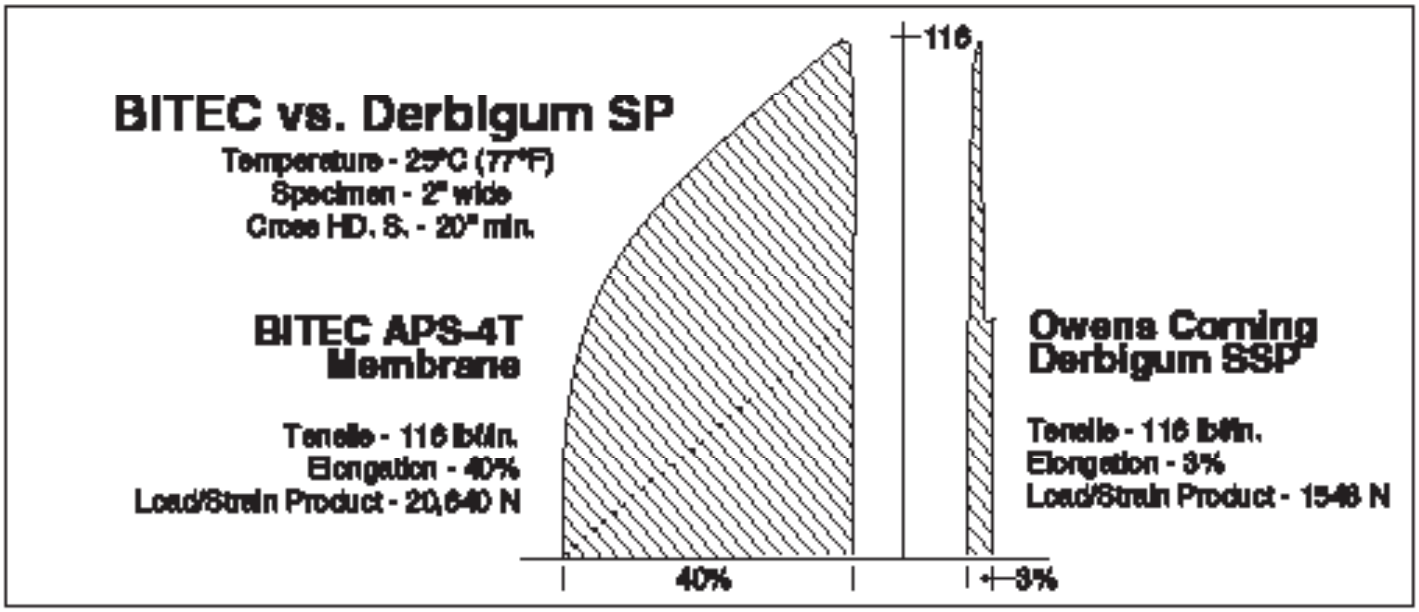

Note: Shaded area in the curve is the “work” performed.

Bitec, Inc.
P.O. Box 497
No. 2 Industrial Park Dr.
Morrilton, AR 72110
Phone: 1-800-535-8597
Fax: 501-354-3019
www.bi-tec.com