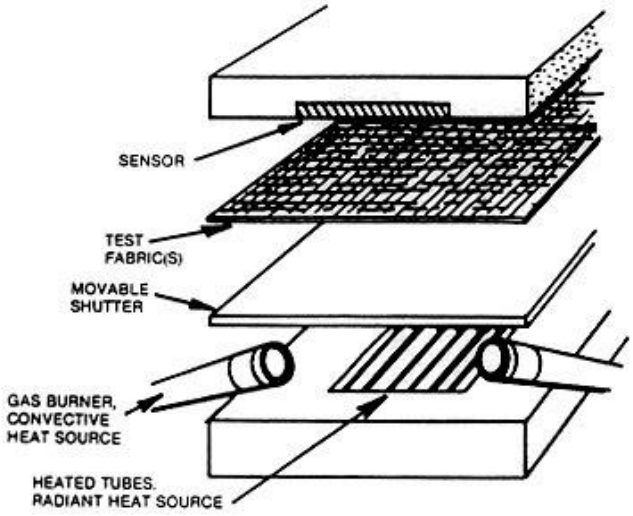
TECHNICAL DATA

THERMAL PROTECTIVE PERFORMANCE
Commonly known as theTPP Test

In the 1986 revision of NFPA 1971, *Protective Clothing for Structural Fire Fighting,* a new test method for measuring thermal protection was introduced and a minimum thermal protective performance (TPP) rating of 35 was established. This sophisticated test method replaced the requirement for a minimum composite thickness and its purpose is to measure the rate at which convective and radiant heat penetrate through the composite system - outer shell, thermal liner, and moisture barrier - to cause a second degree burn to the human skin. This TPP test and the minimum value of 35 has carried through all subsequent revisions to NFPA 1971.

So how does this TPP test work? The illustration below is of a standard TPP tester. The three layers that make up the turnout system are placed beneath the sensor, which records skin temperature. These composite layers are oriented in the same order in which they are found in the protective system; i.e. the thermal layer is next to the sensor and the outer shell is next to the energy source, with the barrier layer between the two. The movable shutter enables the technician to control the exposure, during which gas burners provide actual flame. At the same time, the heated tubes provide radiant heat and a flashover situation can be simulated. The point at which the heat transferring through all three layers is enough to cause a second degree burn is determined graphically, by using a recorder chart of the sensor readings. During testing, the recording continuously traces the average temperature rise on paper, which is depicted as a curved line representing higher and higher temperatures as more heat penetrates through the sample materials to the sensor.



As the test is being performed, the tracing is compared with a second curve, called the Stoll curve, which records the second degree burn point of human skin as a function of heat and time. The point of intersection between these two curves is the actual TPP rating. For the purpose of measuring time to burn, which we call escape time, the TPP rating is divided in half as a rough estimate of the approximate number of seconds until the human tissue reaches the second degree burn point. Thus, the NFPA minimum requirement of a TPP rating of 35 equates to approximately 17½ seconds until 2nd degree burn in a simulated flashover situation.

It is important to remember that the TPP rating is dependent upon the component materials specified and is not an independent function. To illustrate this point, imagine that fabrics are actually numbers and that you order a #5 outer shell with a #3 thermal liner and a #2 moisture barrier, and specify that the combination must total 12. By totaling the numbers (i.e. materials) you ordered, we can only come up with a 10, not a 12, regardless of how hard we try! To reach the 12, it would be necessary to make a change to the materials specified. Since materials are not numbers, there will always be some variation in the measurements. For example, in any textile industry there are tolerances for the weights of fabrics; specific to the NFPA 1971 standard, there is no weight requirement for any of the three layers. Instead, the standard sets minimum performance requirements, and as long as the individual layers meet all of the performance requisites, weight is not a determining factor. We do want to point out, however, that because material weights vary, it is possible for the same combination to yield different TPP ratings from test to test. For example, if the 7.5 oz. Pbi shell fabric is running slightly higher (say 7.8) and the 7.2 oz. Caldura Aralite and the 4.0 oz. RT7100 are also on the heavier side (say 7.4 and 4.3 respectively) then your total TPP test rating will be higher on that particular composite test. For this reason, we caution our customers to take all of the NFPA requirements into consideration when making choices, and to not base your decision on this one single test value. In general, we actually prefer to provide a range; however, the standard only dictates a minimum rating of 35 and so the third party test result is reported as an average, yielding only one number.

There was a time when a popular misconception was that if 35 is good, a rating of 40, 50, or even 60 must be better. However, recognizing that the way to increase your TPP rating is to add more insulation, usually by specifying heavier material components, a higher TPP may not always be “better”. Generally speaking, added insulation will mean increased weight of the total system, resulting in greater heat stress for the firefighter and lower total heat loss (THL) of the composite. The question you must ask yourself is whether the added seconds of protection in the event of a flashover environment is really a good trade-off against today’s lighter weight systems and higher THL values. Finally, it is important to remember that by selecting the three material layers to be used in your system, you have automatically specified the TPP and THL values, since these are a function of the materials chosen and not a design or construction feature.

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