Cut resistance testing using SATRA STM 610

by Nathan Wright

Suitable for international standards, including ASTM 1790-04, ISO 13997 and EN 388.

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There are a number of published cut test methods available for assessing material cut resistance. One method specified in ASTM 1790-04, EN ISO 13997:1999 and EN 388 involves a straight blade drawn across a small piece of the fabric until cut-through occurs (figure 1). The principle of this test is to vary the load required to be applied to the blade in order to facilitate cut-through in a known distance. The blade travels only a short distance, which means that blunting of the blade plays a much less significant part than in some other methods.

A SATRA STM 610 blade cut tester consists of a straight blade (of known sharpness) fitted to a carriage, which is capable of horizontal movement to draw the blade across the sample. The fabric sample is mounted on a curved surface. In turn, this is placed on top of a series of levers in order to apply a force from below the sample holder onto the blade, which simulates a mass being placed on top of the blade itself. The blade is drawn across the sample at a set speed, with the distance travelled until cut-through (referred to as 'stroke length') being recorded. Typically, cut-through is indicated by the point where electrical contact is achieved between the blade and the holder. Therefore, where fabrics include steel threads, it is necessary to place a sheet of thin paper or plastic film between the sample holder and the fabric to prevent electrical contact through the fabric itself.

Figure 1: The STM 610 blade cut tester consists of a straight blade which is drawn across the sample mounted on a curved surface

The test procedure begins by carrying out a number of cuts using a variety of masses applied to the blade to gain a suitable range of cut lengths. This is, typically, five cuts in the range of 5-15mm, five cuts in the range of 15-30mm and five cuts in the range of 30-50mm (cut lengths below 5mm or above 50mm are ignored). Using this data, a scatter graph can be drawn by plotting stroke length against applied load.

From this graph, an estimate can be gained for the applied load necessary to gain a 20mm stroke length before cut-through by plotting a trend line through the data points (an exponential plot often gives a fairly good correlation). Using this estimate, a further five cut tests are carried out, with the graph re-plotted. If the average of these five cuts is within a suitable tolerance from 20mm (± 2mm), a further estimate is taken from the new graph and recorded as the final result. If the average of the five cuts is outside the tolerance, the new estimate is used for a further five cuts, with the results used for a final re-plot. The final estimate from this third graph then becomes the final test result. The test result is based on the estimated force required to generate a 20mm stroke length, in newtons.

Blades for this test are made to a specification set by the test method. Each batch is checked for average sharpness, defining a sharpness correction factor. Batches of blades with too low a value for sharpness, or with too great a variation in sharpness, are rejected. When blades are accepted, each batch is assigned with a correction factor, which is used to normalise the results of each cut test. For instance, a blade sharpness correction factor of 0.5 would result in each stroke length being halved. A new blade is used for every single cut test – and discarded after use – to ensure that blunting does not play a significant factor in the results.

How can SATRA help?

Please email james.corton@satratechnology.com for further information on cut resistance testing