



STAPLE STRENGTH VARIATION – CVSS & SS25%

Background

Staple Length, Staple Strength and Position of Break are important measurements that assist in the prediction of processing performance. The Trials Evaluating Additional Measurements (TEAM) have provided the wool industry with a model that allows wool buyers and processors to predict top length from these (and other) raw wool measurements. In recent years, staple strength has played a significant role in the valuation of fine wool due to its influence in processing performance. Consequently, many supply contracts now stipulate a minimum acceptable staple strength.

The Staple Length & Strength Test

The Length and Strength test includes an extensive sampling process involving mechanical grab and tuft sampling equipment to obtain a representative sample. NZWTA uses the industry-leading ATLAS (Automatic Tester of Length And Strength) instruments for testing, with a minimum of four instruments used to test at least 60 staples for the certification of each sale lot. The following data is reported on Test Certificates and in auction catalogues:

- average staple length (SL)
- average staple strength (SS)
- variation in length (CVL)
- the percentage of staples breaking at the tip, middle and base positions



Fig 1: A series of staples prepared for length and strength measurement

Staple Strength Measurement

Staple strength is recorded in Newtons per kilotex (N/ktex). The involves measuring the **force** (in *Newtons*) required to break each staple along with the **linear density** of each staple. The linear density of each staple is calculated from its mass (in *milligrams*) and length (in *millimetres*). The reported staple strength is also dependent on the yield and vegetable matter of the wool being measured.

The complexity of the strength calculation is why the traditional ‘flick test’ performed by flicking a staple of wool between your fingers is often a poor indicator of the actual staple strength.

Although there is no single staple strength figure that suits all end-users, generally the higher the average staple strength, the better.

Staple Strength Variation

The Co-efficient of Variation is designed to provide an indication of the variation relative to the average (mean), and is calculated as follows:

$$\text{Co-efficient of Variation} = \frac{\text{Standard Deviation}}{\text{Mean}}$$

Variability in fibre diameter and staple length measurements are commonly reported using Co-efficient of Variation measurements - CVD and CVL respectively.

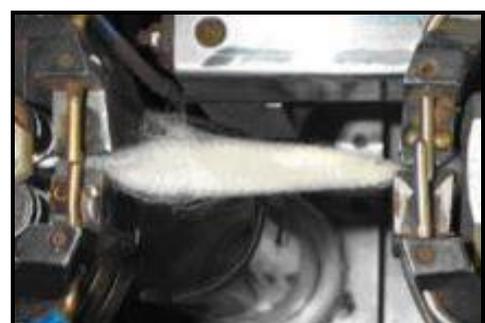


Fig 2: A Staple about to be broken in the ATLAS jaws



The Co-efficient of Variation of Staple Strength (CVSS), however, is not readily reported as part of staple length and strength testing. Instead, the **SS25%** is a term which is used to provide information on the degree of tenderness within a lot. This tends to be more relevant than a CVSS measurement as processors are more concerned with the proportion of **tender** staples within a lot or consignment rather than the overall level of variation.

SS25% = The Average Staple Strength of the Weakest 25% of Staples

Consequently, the average Staple Strength does not tell the full story. There can be considerable variation in the strength results between individual staples within a lot and this will have implications for processing and product performance. Figures 3 and 4 reveal Staple Strength histograms of two lots with an average Staple Strength of 40 N/ktex (generally considered ‘sound’ by the wool trade), but with markedly different variation in the staple strength measurements of individual staples.

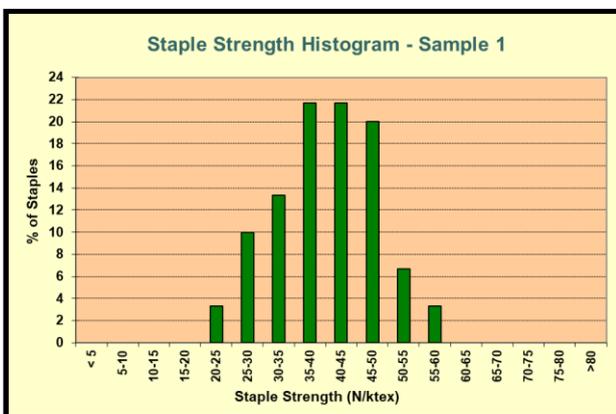


Fig 3: Example of relatively uniform staple strength

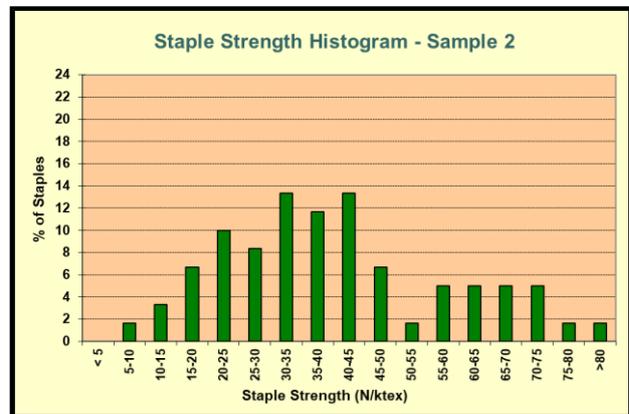


Fig 4: Example of more variable staple strength

The following table illustrates the relationship between Staple Strength, CVSS and the SS25% calculation for Samples 1 and 2:

	Sample 1	Sample 2
Mean Staple Strength (average of all staples)	40N/ktex	40 N/ktex
CV Staple Strength (variation across all staples)	20%	45%
SS25% (mean strength of the weakest 25% of staples)	30 N/ktex	20N/ktex

Although Samples 1 and 2 have the same *average* Staple Strength, nearly one third of the staples in Sample 2 could be classed as very tender (<20N/ktex) or tender (<30N/ktex). The average Staple Strength of the weakest 25% of staples (SS25%) in Sample 2 is only 20N/ktex. It is able to achieve an average Staple Strength of 40N/ktex due to the influence of some very sound staples measuring in excess of 60 N/ktex. Conversely, Sample 1 has far fewer tender staples, with an SS25% of 30 N/ktex.

This example shows why SS25% may be a useful tool for:

- identifying the amount of tender wool throughout a lot or flock;
- assisting breeding strategies to minimise or eliminate tender wool; and
- providing key information on likely processing performance.

For more information on Staple Length and Strength testing, contact **NZWTA** on **+64 6 835 1086** or email: testing@nzwta.co.nz