Objective measurement of wool: criteria, methods and materials

A Ingleton
IMPORTANT DISCLAIMER

This document has been obtained from DAFWA's research library website (researchlibrary.agric.wa.gov.au) which hosts DAFWA's archival research publications. Although reasonable care was taken to make the information in the document accurate at the time it was first published, DAFWA does not make any representations or warranties about its accuracy, reliability, currency, completeness or suitability for any particular purpose. It may be out of date, inaccurate or misleading or conflict with current laws, polices or practices. DAFWA has not reviewed or revised the information before making the document available from its research library website. Before using the information, you should carefully evaluate its accuracy, currency, completeness and relevance for your purposes. We recommend you also search for more recent information on DAFWA's research library website, DAFWA's main website (https://www.agric.wa.gov.au) and other appropriate websites and sources.

Information in, or referred to in, documents on DAFWA's research library website is not tailored to the circumstances of individual farms, people or businesses, and does not constitute legal, business, scientific, agricultural or farm management advice. We recommend before making any significant decisions, you obtain advice from appropriate professionals who have taken into account your individual circumstances and objectives.

The Chief Executive Officer of the Department of Agriculture and Food and the State of Western Australia and their employees and agents (collectively and individually referred to below as DAFWA) accept no liability whatsoever, by reason of negligence or otherwise, arising from any use or release of information in, or referred to in, this document, or any error, inaccuracy or omission in the information.
Objective measurement of wool

criteria, methods and materials

An outline of some of the technical aspects of the objective measurement of wool—processes that will mean major cost savings to the wool industry.

by A. Ingleton, Instructor, Sheep and Wool Branch

Objective testing is the scientific measurement of the important chemical and physical properties of wool. The important properties are those considered by the manufacturers when purchasing their stocks.

At present, percentage vegetable matter (V.M.) clean wool content (yield) and average fibre diameter are the only properties measured objectively on a large scale. Other characteristics important in processing are fibre length in tops, distribution of fibre diameters, and wool colour after scouring.

Commercial testing houses in Australia* follow methods laid down by the International Wool Textile Organisation (IWTO) and use only instruments approved by that body. They are prepared to guarantee their measurements to within plus or minus 0.5 per cent with a 95 per cent confidence limit.

The following discussion deals with sampling techniques and describes the methods presently employed by the testing houses.

Sampling

Effective measurement depends on whether the sample accurately represents the total quantity being assessed. Two methods of sampling are used:

Core sampling: The main form of wool sampling is core sampling, done either pre or post-sale.

A tube with a cutting head, 16 mm to 22 mm in diameter, is forced vertically through the bale 8 cm from the side. Every bale must be cored at least once from top to bottom, and a minimum of 1 kg per lot obtained. Samples are thoroughly blended before being measured in the laboratory, and sub-samples carefully taken to avoid bias. Where sellers or buyers require certificates of the results, each bale is weighed at the time of coring.

Mid-side sampling:

Used where fibre diameter and clean wool weight are required from individual sheep. A 0.25 kg sample is taken from over the third rib halfway between the mid-line of the back and belly. Wool from this area is most typical of the whole fleece.

Measurement of fibre diameter

Fibre diameter is expressed in microns (a micron is 0.001 mm). Instruments at present in use and approved by the IWTO are the air flow meter, sonic fineness meter and projection microscope.

Projection Microscope: Used for measuring the diameter of individual fibres. Snippets of wool fibre 0.4 mm long are mounted on a slide and the image, magnified 500 times, is projected on a screen where the diameters of individual fibres are measured. For the results to be acceptable by international standards, 600 fibres are measured, a tedious and time-consuming task. This instrument is used when a distribution of fibre diameters, as well as the average diameter, is desired.

Air flow meter: The instrument most commonly used by commercial testing firms is the air flow meter. It measures the average diameter of fibres from a 2.5 g sample of scoured and carded wool that has been stored in a conditioning room at a constant relative humidity of 65 per cent and temperature of 20°C.

* The commercial testing houses in W.A. are:
The Australian Wool Testing Authority (A.W.T.A.),
Wool Testing Services Ltd. (W.T.S.),
Supervise—Auscore Ltd.
The principle of the air flow meter is that the permeability of a given mass of fibre compressed to a constant volume is related to mean fibre diameter. The 2.5 g sample (20,000-40,000 fibres) of scoured wool is compressed to a constant volume in a chamber with perforated ends, and a current of air is passed through the sample. Resistance to air flow is measured by the height of the float on the flowmeter scale. Resistance to air flow is determined by total surface area, and with circular or near-circular fibre the surface area is inversely proportional to the fibre diameter. For example, in a sample of given weight the finer the fibres the greater the number of fibres in the sample, thus the larger surface area.

Sonic meter: This instrument was developed by the Division of Textile Physics, CSIRO.

Air is oscillated through a compressed mass of wool fibres and impinges on a transducer. An output voltage is generated which is related to the permeability of the mass of fibres. The oscillating flow of air is produced by a loud speaker, hence the name “sonic fineness meter”.

There are two models of this instrument available, one for laboratory use and a smaller lower-priced version suitable for use in the shearing shed.

Below is the Australian standard conversion table showing microns and equivalent wool quality numbers.

### Measurement of yield
Samples are scoured, dried, and weighed and sub-samples are tested for vegetable matter, ash and alcohol extractives. These non-wool constituents are subtracted from the dry scoured wool content to give the dry weight of wool fibres free from all impurities, and known as wool base, expressed as a percentage by weight of greasy core sample.

The wool base is converted to IWTO Clean Wool Content by the addition of standard percentages of ash plus alcohol extractives, plus a moisture content of 17 per cent. Estimated commercial top and noil yield is then calculated mathematically by use of a standard 8 to 1 Top to Noil ratio, plus a direct deduction for processing loss, and an

### Australian Standards

<table>
<thead>
<tr>
<th>Air-flow mid point</th>
<th>Count</th>
<th>Range μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.0</td>
<td>80s</td>
<td>16.0-17.5</td>
</tr>
<tr>
<td>19.0</td>
<td>70s</td>
<td>18.0-19.5</td>
</tr>
<tr>
<td>21.0</td>
<td>64s</td>
<td>20.0-22.0</td>
</tr>
<tr>
<td>23.0</td>
<td>60s</td>
<td>22.0-24.0</td>
</tr>
<tr>
<td>25.0</td>
<td>58s</td>
<td>24.0-26.0</td>
</tr>
<tr>
<td>27.0</td>
<td>56s</td>
<td>26.0-28.5</td>
</tr>
<tr>
<td>30.0</td>
<td>50s</td>
<td>28.5-31.0</td>
</tr>
<tr>
<td>33.0</td>
<td>46s</td>
<td>31.5-34.5</td>
</tr>
<tr>
<td>35.0</td>
<td>44s</td>
<td>34.5-36.0</td>
</tr>
<tr>
<td>38.0</td>
<td>40s</td>
<td>36.0-39.0</td>
</tr>
</tbody>
</table>

Journal of Agriculture Vol 14 No 2, 1973
allowance for percentage of vegetable matter present.
Yield is usually assumed to mean a quantity of clean fibre expressed as a percentage of greasy weight. However, there are various ways to express yield. These are specified under two main headings—washing and combing.

Washing yield is the percentage by weight of scoured wool plus an allowance of 16 per cent moisture regain. It includes any residual grease and dust remaining after scouring, also vegetable matter present.

Combing yield is the percentage by weight of combed Top recovered from any parcel of greasy wool. It is further defined by type of combing machine used—Bradford Combing Yield (Noble combs) or Schlumberger Combing Yield (Schlumberger combs). It is also specified whether oil has been added.

The most commonly used at present is the Schlumberger Dry Combing Yield.

Definitions
Top—A continuous band of combed fibres laid parallel in an untwisted condition with all noils removed.
Noils—Short, broken fibres removed during the combing process.
Tear—Ratio of Top to Noil after combing. Tear of 8 to 1 is 8 kg top to 1 of noil. Best Merino wools can give a tear ratio of 15 to 1.

Measurement of vegetable matter content (V.M.)
The burr, seed, twigs, leaves and grasses that may be present in scoured wool are expressed as a percentage by weight of greasy sample tested. V.M. is calculated from the oven-dry weight of vegetable matter (ash and alcohol extractive free) that is present in the scoured wool. A scoured sample of known weight is added to a boiling solution of one part sodium hydroxide (caustic soda) to ten parts water. Within two minutes the wool fibre is dissolved; the solution is then filtered, the vegetable matter recovered, oven dried, weighed and the percentage V.M. calculated.

At Ryde, in New South Wales, the CSIRO Division of Textile Physics has produced a prototype which completely mechanises the testing process. Wool samples are fed into the machine, and all testing and recording of results is automatic.

The Bureau of Agricultural Economics has estimated that when the effects of objective measurement are integrated over the components of clip preparation, marketing, processing and in-store operations, savings could amount to $16 a bale, compared to systems based on subjective appraisal.
WOOL BROKER'S SAMPLE LINE

Left:
The hydraulically operated claw on the grab sampler extracts a random sample from every bale in a lot. This representative sample is displayed with the accredited test house certificate for the buyers' inspection before sale.

Below:
Sampling line, showing the grab sampler (right) and core sampler (left) developed by CSIRO.
In the automatic core sampler (Model T), the bale is compressed by a hydraulic ram and the sampling tubes are pushed through it to extract full-length cores; compressed air then forces the cores into a plastic container. When sampling of each sale lot is completed the container is immediately sealed by the test house operator. All sampling operations are supervised to maintain IWTO standards.