

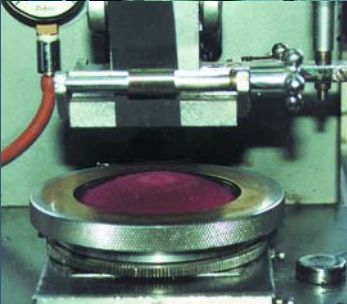
# testing the wool clip



field micron moisture regain colour fastness soxhlet extraction scoured dry wool sampling supervision length strength comfort  
stogram flammability testing vegetative matter base ash content length after carding carpet testing data processing certification fleece measurement



melbourne  
launceston  
fremantle  
sydney  
newcastle  
adelaide  
geelong  
goulburn  
portland  
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## INTRODUCTION

AWTA Ltd, and its objective measurement services, have played an increasingly important part in the marketing of Australian wool since the formation of the Authority as a statutory body in 1957 and its subsequent transfer to the private sector in 1982.

AWTA Ltd has played a major role in providing a bridge between the research and commercial application of testing technology, by facilitating further research and development, sponsoring and participating in practical trials, and developing and implementing relevant national and international standards, procedures, methods and technology, providing major benefits to all segments of the wool industry in Australia and overseas.

This brochure has been designed to provide a comprehensive summary of the major services AWTA Ltd provides to the industry, and descriptions of the processes used to achieve test results.

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## COMPANY STRUCTURE

The Australian Wool Testing Authority was established in 1957 by the Commonwealth Government in response to requests from the Australian Wool Industry, and was created as a Statutory Authority reporting to the Minister for Primary Industry. The first meeting of the Authority was held on 12th December 1957.

Following the formation of the Australian Wool Board in 1962, AWTA was established as a separate division within that organisation on the 1st July 1963. AWTA retained the same status within the Australian Wool Corporation when it was formed by the amalgamation of the Australian Wool Board and the Australian Wool Commission on 1st January 1973.

AWTA Ltd was established as a Company Limited by Guarantee on the 14th May 1982 to enable the functions of the statutory AWTA to be transferred to the private sector. AWTA Ltd commenced operation on 1st July 1982.

AWTA Ltd's company structure is unique within the wool industry, being a company limited by guarantee but without shareholding. A Board of Directors, representing all sectors of the Wool Industry, governs the operations of AWTA Ltd ensuring the continued impartiality of the Company. The sectors represented are:

- Australian Council of Wool Exporters Inc
- Australian Wool Processors Council Inc
  - Wool Scourers & Carbonisers Group of Australia
  - Wool Textile Manufacturers of Australia Group
- Australian Wool Research & Promotion Organisation
- Private Treaty Wool Merchants of Australia Inc
- The National Council of Wool Selling Brokers of Australia Ltd
- Wool Council of Australia Inc

Due to the absence of shareholders, AWTA Ltd retains all profits within the company. The benefit of this is that it allows AWTA Ltd to minimise fee increases, invest in new technology and continue to conduct valuable research and development.

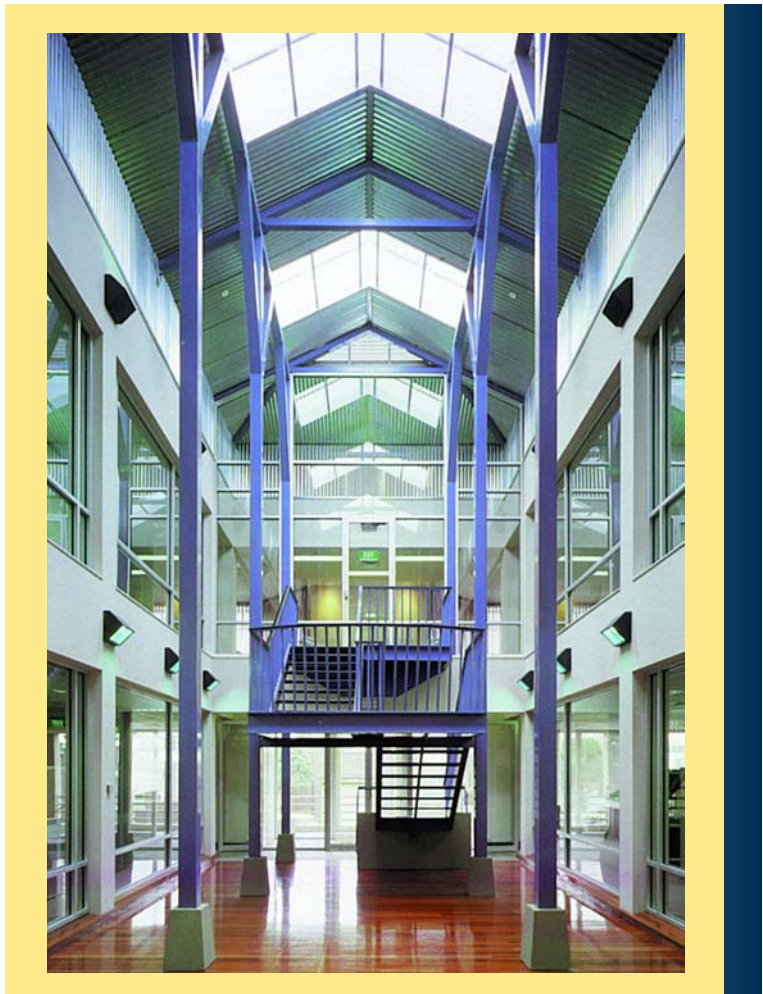
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As a result:

- Virtually all Australian Wool is now measured prior to sale.
- Wool is prepared for sale according to objective rather than subjective clip preparation standards, with some growers preparing classed lines on the basis of individual fleece measurements.
- Wool is generally displayed for sale in sample boxes rather than the old showfloor technique.
- Wool is valued and bought with the aid of actual measurements for Fibre Diameter, Yield, Vegetable Matter Content, and Staple Length & Strength. Colour and Coefficient of Variation of Fibre Diameter are also available.

Measurement has also facilitated computerisation and the expansion of electronic data processing and market reporting, and the establishment of auction and individual clip databases which provide unparalleled and exhaustive information to all segments of the industry, with each having equal access to that information on a commercial basis.

Today, wool processors can confidently expect that wool purchased to their price and processing specifications, with the benefit of AWTA Ltd certification, will perform to their requirements, and growers are assured of being paid according to the objective specification of their wool.





## OPERATIONS & SERVICES

AWTA Ltd has 3 Raw Wool testing laboratories. They are situated in Melbourne, Sydney and Fremantle. The Melbourne laboratory services the Southern Region (Victoria, Tasmania and South Australia); the Sydney laboratory services the Northern Region (New South Wales and Queensland) and the Fremantle laboratory services the Western Region (Western Australia).

Each laboratory operates 24 hours a day, 5 days a week, and throughout Australia nearly 800 people are employed to provide services to customers.

### KEY SERVICES

WOOL GROWERS	Presale Core and Staple Testing Laserscan CVD, Curvature & Comfort Factor Fleece Measurement Service Clean Colour Testing
WOOL BROKERS	Presale Core and Staple Testing Laserscan CVD, Curvature & Comfort Factor Computer Services Grab Sampling Supervision Objective Lot Matching WOOLINK®
PRIVATE TREATY WOOL MERCHANTS	Presale Core and Staple Testing Laserscan CVD, Curvature & Comfort Factor Guidance Report Testing Post Sale Testing Computer Services Grab Sampling Supervision WOOLINK®
WOOL EXPORTERS	Post Sale Testing Laserscan CVD, Curvature & Comfort Factor Computer Services Guidance Report Testing Combined Certificates Objective Lot Matching WOOLINK®
WOOL SCOURERS & CARBONISERS	Condition & Yield Testing Laserscan CVD, Curvature & Comfort Factor Computer Services Clean Colour Testing Length after Carding WOOLINK®
WOOL PROCESSORS	Condition Testing Top Testing Yarn Testing Textile Testing Length after Carding WOOLINK®
TEXTILE TRADE	Fibre, Sliver, Yarn and Textile Testing Consumer Complaint Investigation Carpet Testing Fabric Testing Flammability Testing Textile Industry Consulting ISO 9000 Quality Assurance Systems Consulting RAPITEST® Geotextile Testing Laundry Watch Automotive Component Testing
RESEARCH ORGANISATIONS	Contract Research Equipment Development and Manufacture Industry Trial Participation

Our principal business is the certification of greasy wool for trading. Bales are sampled and weighed, and the samples tested for clean fibre content (Yield), Fibre Diameter, Vegetable Matter content, Staple Length & Strength, and Colour. Sampling and testing is conducted in accordance with the International Wool Textile Organisation (IWTO) regulations and methods, and results are issued as IWTO Certificates.

The integrity of AWTA Ltd Certificates is maintained by the company only certifying tests on samples that have been taken by AWTA Ltd Sampling Officers, or where sampling operations have been supervised on a full-time basis by AWTA Ltd Sampling Officers. The Australian National Committee of IWTO endorses this policy. Sampling is conducted in 38 cities and towns throughout Australia (see Map).

Many customers require a quick return of certified test results so that they can trade the wool. We provide 3 different levels of service to meet customer needs:

**Express Service:** 95% of Certificates are available the following morning.

**Fast Service:** 95% of Certificates are available within 3 days.

**Normal Service:** All Certificates are available within 5 days.

In addition to certification services, we offer a range of other services for our many groups of customers.







## ELECTRONIC DATA PROCESSING

Computers play an integral part in AWTA Ltd operations. Specialised software integrates on-line data from the sampling line, through the testing process to the issue of Certificates. Laboratory instruments and balances are connected to the computer system. Samples, sub-samples and specimens required for the testing process are identified by bar codes. Virtually all presale test information is transmitted electronically to wool brokers for inclusion in sale catalogues. At the conclusion of the sale, brokers advise AWTA Ltd electronically who purchased each lot and the test data is then transferred electronically and/or in hard copy to the buyer.

The system comprises large mainframe computers, personal computers and other data capture devices linked through local and wide area networks. The laboratories in Sydney, Melbourne and Fremantle; the regional offices in Brisbane and Adelaide; and the AWTA Ltd Head Office are all linked through these networks. As well as its use for the operations, the electronic data processing systems are vital for the accounting and management functions of the Company.

AWTA Ltd has also developed WOOLINK® as an information system for our customers. Key features of WOOLINK® include:

- Calculation of Objectively Matched Lots (OMLs) and Combined Certificates for export consignments.
- Advance notice of the specification of most of the wool coming on to the auction sales in a 2-week period.
- Key Test Data on production and the specification of all tested wools in Australia, state by state, with a historical database of 9 years.
- A range of electronic selling systems such as Tender, Spot Sale and Offer Board facilities.

## TEXTILE TESTING

Adjacent to the Melbourne Raw Wool laboratory is the AWTA Textile Testing Division laboratory. AWTA Textile Testing is the largest independent supplier of testing services to the textile industries and is certified to ISO 9001 and accredited ISO Guide 25 by NATA. It is able to provide a comprehensive range of textile and materials testing services on a wide variety of wool and non-woollen products.

For example:

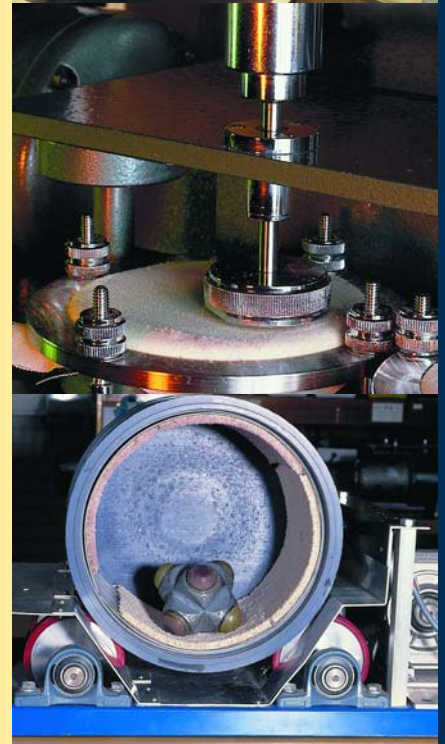
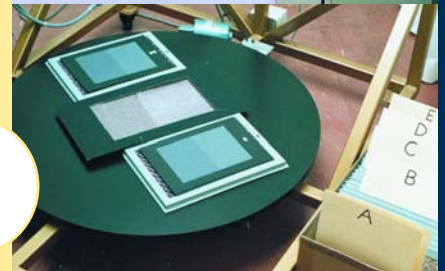
- semi-processed wool and yarn
- carpets, curtains, garments and interior textile fabrics
- flammability tests on building materials, interior textiles and garments, such as children's nightwear
- geotextile testing, flexible air-conditioning duct testing and component testing for the automotive industry

AWTA Textile Testing has also developed a number of innovative packages for its clients. These include:

- RAPITEST® which provides fabric and garment manufacturers with rapid information on a number of fabric qualities critical to the garment manufacture.
- LAUNDRYWATCH which gives commercial laundries quality control data to assist the monitoring of their performance.

Staff also provide consulting services and may be asked to give expert evidence in commercial/legal disputes.

The Division also acts as a major source of supplies and materials for quality control laboratories at textile processing operations throughout Australia and New Zealand.





## RESEARCH & DEVELOPMENT

Research & Development plays a major role in the business of AWTA Ltd. The R & D Division is based in Sydney and is the largest privately operated group of its kind in the wool industry. Its work falls into four main areas:

- development and enhancement of Test Methods and Regulations;
- participation in industry trials designed to evaluate the role of Raw Wool measurements in the prediction of processing performance;
- developing a fundamental understanding of the physics of specific measurement systems where required, in order to better enable the Company to improve existing Test Methods and to develop new Test Methods; and
- development, design and construction of testing equipment for in-house use and for sale. Most testing equipment at AWTA Ltd has been built and/or designed by AWTA Ltd staff.

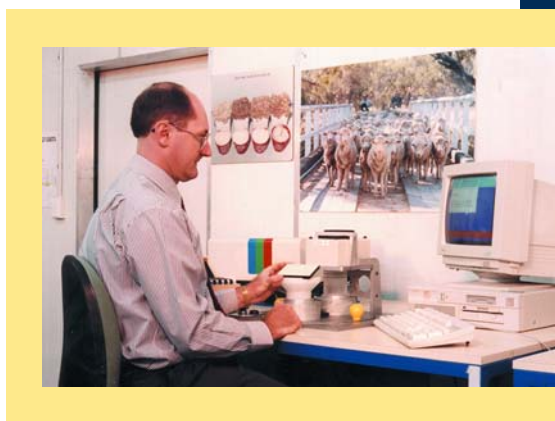
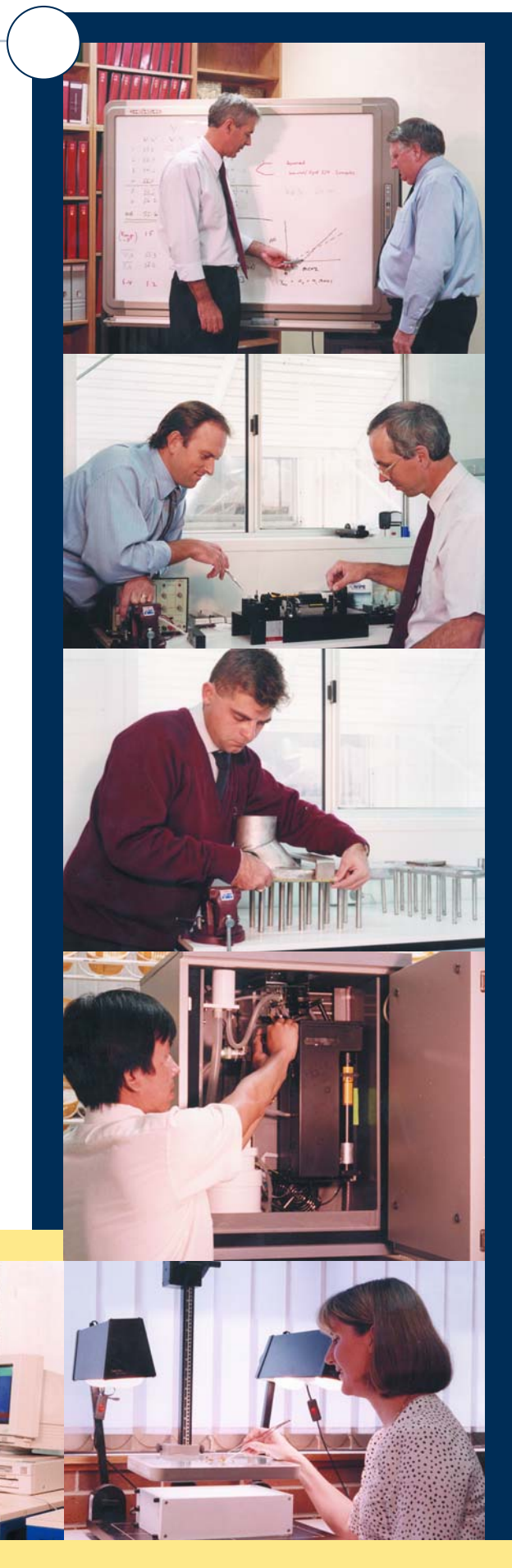
Research is often conducted in conjunction with other research organisations such as CSIRO, commercial processors, industry bodies and non-competing laboratories such as New Zealand Wool Testing Authority Ltd (NZWTA Ltd) and the Wool Testing Bureau South Africa (WTB SA).

AWTA Ltd played a major role in the Australian Objective Measurement Project (AOMP), which led to the introduction of Sale By Sample and Presale Testing in 1972, the Trials Evaluating Additional Measurement (TEAM) and the Australian Staple Measurement Adoption Programme (ASMAP).

Results of our research are normally reported at the twice-yearly International Wool Textile Organisation (IWTO) meetings and in appropriate journals.

The Development or Engineering Group is responsible for manufacturing equipment for use by the company's own laboratories as well as for sale to others. Although the group does manufacture the full range of AWTA Ltd's equipment, its principal activity over recent years has been the manufacturing and sale of the LASERSCAN instrument.

Testing equipment built by AWTA Ltd has been exported to Argentina, Belgium, China, New Zealand and South Africa.







## TECHNICAL STANDARDS

AWTA Ltd has achieved an international reputation for its technical standards. Its technical performance is monitored externally by NATA (National Association of Testing Authorities, Australia), by participation in inter-laboratory trials for Fibre Diameter and Fibre Length in wool tops conducted by Interwoollabs, and in trials for Fleece Measurement procedures conducted by RAMPOWER. AWTA Ltd is:

- Licensed by International Wool Textile Organisation (IWTO) to issue IWTO Test Certificates.
- Accredited by Interwoollabs for the measurement of Fibre Diameter and Fibre Length in Tops.
- Accredited by NATA to the international standards for laboratory performance, ISO Guide 25 and certified by NATA to the international Quality management standards, ISO 9001.
- Accredited by RAMPOWER for Fleece Measurement testing.

AWTA Ltd also participates in the interlaboratory round trials organised by the Independent Laboratories Round Trial Group (ILRT). This is the only significant trial of its kind that monitors the performance of Test Houses that issue IWTO Certificates for Raw Wool.

The 5 laboratories currently participating in the ILRT are:

- Australian Wool Testing Authority Ltd, Sydney
- Australian Wool Testing Authority Ltd, Melbourne
- Australian Wool Testing Authority Ltd, Fremantle
- New Zealand Wool Testing Authority Ltd, Napier
- Wool Testing Bureau SA, Port Elizabeth

The ILRT Group Members represent the largest independent wool testing laboratories in the world, and are collectively responsible for the testing of approximately 40% of the world's greasy wool production, and in excess of 80% of all greasy wool tested.

The objects and aims of the Group are:

- to develop co-operation between the Member's laboratories, with a view to ensuring the most correct and uniform application of approved sampling and testing methods as may be set out in the Specifications of IWTO and in any associated IWTO Regulations;
- to ensure that the Member's laboratories obtain accurate test results having a high level of precision, in their application of those specific IWTO Test Methods and procedures which are relevant to the Group's agreed annual work programme;
- to collect such precision data, with respect to those IWTO specifications being utilised in the ILRT programme, as is required or desirable, but having regard to the principle ILRT functions of harmonising and monitoring the technical performance of the Member's laboratories;
- to assist Member's laboratories in resolving disputes arising from differences in test results, by ascertaining the causes of any discrepancies; and
- to the extent feasible, to allow non-competing commercial laboratories to become participating laboratories in the interlaboratory round trials from time to time.

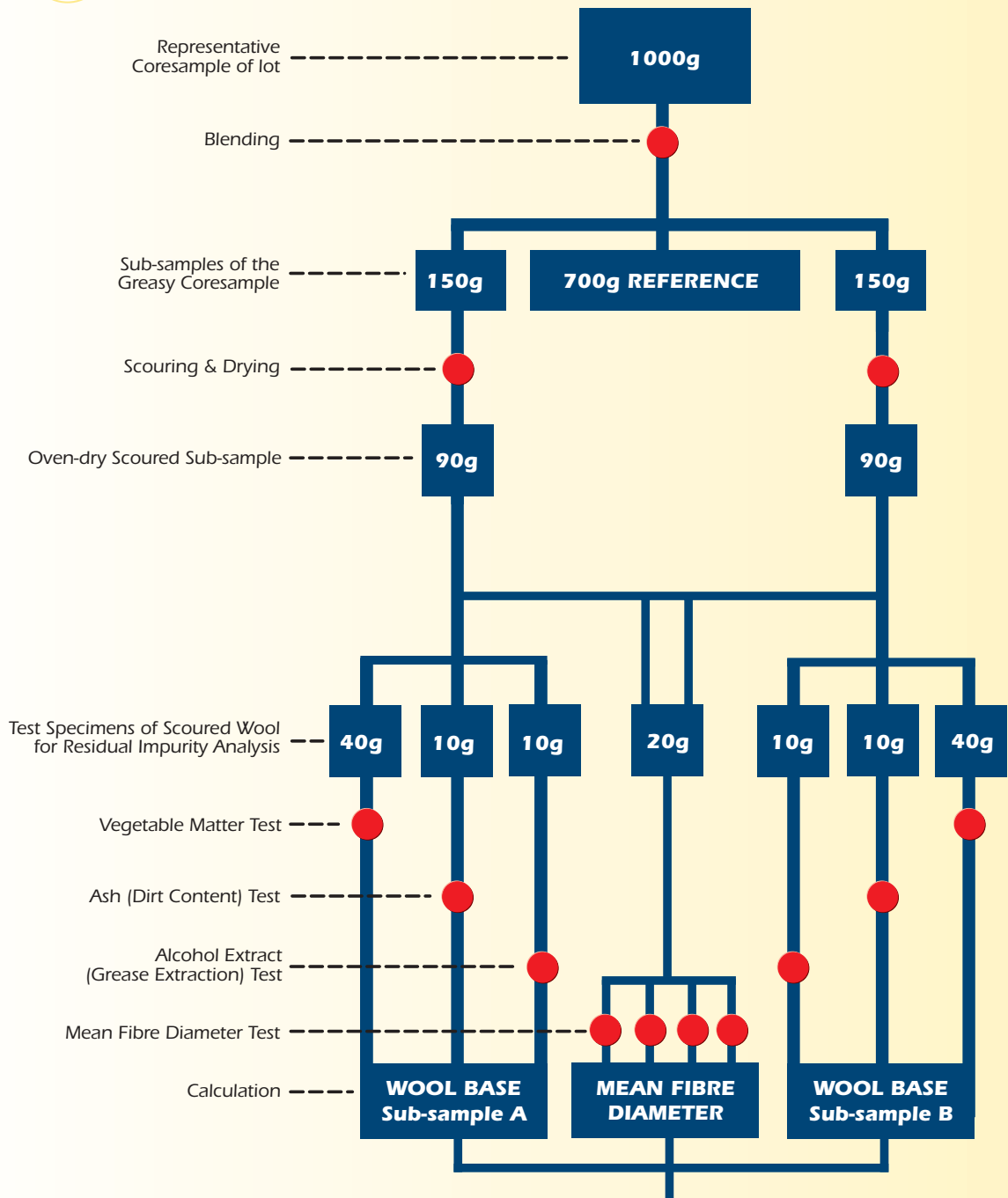
The ILRT Group Report is presented to every IWTO Conference, thereby placing the performance of each of the participating laboratories under regular technical and commercial review by the industry.







# PRESALE TEST CERTIFICATE PROCEDURE



Certification ---



Weights shown in the chart are typical of the weights of the samples, sub-samples and test specimens which occur in a presale test



## YIELD MEASUREMENT

Presale testing for Yield and Mean Fibre Diameter has been an integral part of the Australian wool selling system since the introduction of Sale by Sample in July, 1972. Today virtually all Australian wool is tested for Yield and Diameter, irrespective of the method of marketing, and is sold to the processor on test results. In fact, failure to provide presale test information results in reduced competition and in severe price penalties.

### Steps in Determining Yield

#### 1. Coring

Under the supervision of AWTA Ltd Sampling Officers, a coresample of approximately 1000g is taken from each sale lot. All bales in the lot are sampled, and the bale weights recorded at the time of sampling. At the same time, a grab sample is taken from the side of each bale for Length & Strength testing. The role of the Sampling Officer is to ensure that sampling is conducted in accordance with IWTO standards, and to ensure the samples are secured and returned to the laboratory.

#### 2. Batching

Once samples are received in the laboratory, AWTA Ltd Testing Officers place samples with similar testing requirements into a "batch". The batches then go through the testing process as a group.

#### 3. Greasy Sub-Sampling

The coresamples are tipped into a bucket where they are weighed, blended by air, and weighed again. The difference between the first and second weights is used to calculate a correction factor to compensate for any weight change as a result of the blending process.

Testing Officers then remove 2 or 3 sub-samples that weigh 150g each. Classed grower lots require only 2 sub-samples. However, bulk class, interlots and lots containing 40 bales or more have 3 sub-samples taken because of their increased greater variability.

The sub-samples are put into containers, together with their accompanying paperwork and sent onto scouring. From then on each sub-sample is treated individually.

After removing the 150g sub-samples from the bulk coresample, the remainder is packaged into an air-tight container and stored along with 30,000 other samples. Known as "keeper samples", they allow further testing, if required, on the lot without the need to recore the bales.

#### 4. Scouring

Sub-samples are placed in a washing machine that operates along the same principles as a commercial scour. Sub-samples are washed in hot water and detergent before being rinsed twice in cold water.

Scouring removes all the suint and 98% or so of the mineral content (sand & dirt) and wool grease. A fine mesh at the base of the scour retains all the wool and all the vegetable matter (VM). After washing, all the wool fibre and VM are removed from the scour and placed in a drying can. The cans are loaded into a centrifuge, which operates like the spin cycle on a washing machine, and spun to remove excess water.

#### 5. Drying

The drying cans are then loaded onto ovens that force hot air through the sample at 105°C. Electronic dryer monitors indicate when all the moisture has been removed from the wool. Each sub-sample is then removed from the oven, weighed and the oven-dried scoured weight recorded. By this stage the weight of the sub-sample is approximately 90g with about 60g having been removed from the wool as dirt, suint, grease and moisture.

#### 6. Residual Sub-Sampling

After scouring and drying, 3 contaminants remain in the wool. These include all the VM that was in the sub-sample, and a small amount of residual grease and residual dirt not removed during the scouring process. In order to determine Wool Base (WB), these 3 contaminants need to be quantified. At residual sub-sampling, specimens are taken from the dry scoured sub-sample and sent to the relevant area for further testing.





## 7. Dissolving and Vegetable Matter (VM) Dissection

40g specimens of wool are placed into each bowl of a dissolver. 600ml of a 10% solution of boiling caustic soda is injected into each bowl and agitated for 3 minutes. After this time, the wool has completely dissolved, but the VM is relatively unaffected. The solution is poured through a sieve to retain the VM. After rinsing, the VM is dried in an oven at 110°C.

The caustic soda affects the VM. The finer and softer particles of VM are more affected by the caustic soda than the harder ones. In order to correct for this, the VM, after drying, is separated into 3 categories, namely:

- Burrs (B);
- Seed and shive (which loses most weight during dissolving) (S); and
- Hard Heads and Twigs (which are less affected by caustic soda) (H).

Correction factors for each category have been pre-determined and are applied to the weights of the 3 categories identified so as to gain an estimate of the percentage of each VM category present. The total weight is used to calculate the Vegetable Matter Base (VMB).

In addition to the above VM categories, Testing Officers also identify and separate dag, sand, other alkali insolubles e.g. lamb marking rings, and pack material contamination. If Testing Officers find traces of contamination in the VM specimen (e.g. baling twine, pieces of cloth etc), action is taken with the broker that may see the offending bales unpacked in an attempt to find the source of the contamination.

## 8. Grease Extraction

About 99% of the grease present in wool is removed during the scouring process. To determine the quantity of residual grease remaining in the scoured wool, a 10g specimen is taken from the scoured sub-sample. Grease is washed from the specimen by hot alcohol, then the grease and alcohol are siphoned down into a clean pre-weighed flask. The grease accumulates in the flask as a result of this distillation process.

20 siphonings are required to remove all the residual grease from the wool. After distillation, an amount of moist grease remains in the flask. Flasks are placed into a hot oven for 6 minutes to rapidly dry the flask and grease before re-weighing. The actual amount of grease can then be determined.

AWTA Ltd has now introduced modern technology to replace this traditional grease extraction method. The laboratories use Near Infrared Reflection (NIR) Spectrophotometry to quickly measure the grease content remaining in the scoured sub-sample. The instruments are calibrated to a range of samples with different grease values. Thus, when an unknown sample is presented to the NIR, it rapidly predicts the grease value of that sample. The process is safer and quicker than the traditional method.

## 9. Wool and VM Ash

As with grease, about 99% of dirt present in a wool sub-sample is removed in the scouring process. To determine the quantity of residual dirt (mineral content) remaining in the scoured wool, a 10g specimen is removed from the dry scoured sub-sample. The specimen is packed into a crucible and then combusted in a furnace at a temperature of 800°C. The crucibles take about 2-3 hours to pass through the furnace during which time all organic matter is burned off, leaving only the mineral matter in the ash. The crucible contents are weighed and expressed as a percentage of the wool specimen weight.

## 10. Wool Base Calculation

Having accounted for all the residual contamination in the wool, the amount of clean, dry wool fibre or Wool Base (WB) in each sub-sample can now be calculated. The WB is calculated by expressing the weight of wool with all impurities removed as a percentage of the original greasy wool weight. The WB results of the 2 or 3 sub-samples are then averaged to give a final result for that particular sale lot. If the range in test results between the sub-samples is excessive, then a check test will be initiated from the "keeper" sample. By using this procedure, AWTA Ltd is automatically putting a quality control check in place to minimise errors.





## MAJOR VEGETABLE MATTER TYPES IN AUSTRALIAN WOOL

AWTA Ltd Categories are displayed as B, S, H ( or 1, 2, 3) in the left hand column of the auction catalogue. AWEX ID Category is a mandatory field in the AWEX type description.

### AWTA Ltd Categories

- B** - clover and medic burrs
- S** - seed material, shive, grasses, thistles
- H** - Hard Heads (bean burrs), sticks twigs

### AWEX - ID Categories

- B - burr
- E - seed
- S - shive
- N - Noogoora/Ring burr
- T - Bathurst Burr
- F - Bogan Flea

Barrel Medic



### BARREL MEDIC (*medicago truncatula*) **B B**

Also known as Clover Burr or Barrel Clover.

Barrel Medic is barrel shaped with 4 to 6 spined coils. The spines are thick and lie flat against the coils. This burr is easily distinguished from Burr Medic and Cutleaf Medic by its hard, woody appearance.

Burr Medic



### BURR MEDIC (*medicago polymorpha*) **B B**

Also known as Trefoil, Spiral Burr or Clover Burr.

The Burr Medic is a flat round seed-pod. It is typically about 4mm across but may be as small as 2mm or as large as 8mm. The pod consists of 2 to 3 spined coils, which enclose several light-brown kidney shaped seeds.

Burr Medic is very common in Australian wools and is one of the most troublesome types to processors. Not only do its protruding spines catch in the wool, making them difficult to remove, but also, if broken up during carding, its coils tend to unwind into thin 'eyebrow' shaped pieces which are even more difficult to remove and can persist into the finished product.

Cut Leaf Medic



### CUTLEAF MEDIC (*medicago laciniata*) **B B**

Also known as Barrel Medic, Clover Burr or Toothed Medic.

The Cutleaf Medic is barrel-shaped with 5 or 6 spined coils. The spines are shorter and stiffer than those of the more common Burr Medic.

Due to natural variations within types it is often difficult to distinguish between Cutleaf Medic and Burr Medic in wool. The name is derived from the plant (not the burr), as the plant has serrated leaves.

Small Burr Medic



### SMALL BURR MEDIC (*medicago minima*) **B B**

Also known as Woolly Burr, Trefoil or Clover Burr.

The Small Burr Medic is similar in appearance to the common Burr Medic, although it can be distinguished by its tighter coils and thinner spines. The thin spines break off easily, but when present they give the burr a hairy, or woolly, appearance.

Caltrop



### CALTROP (*tribulus* spp) **H E**

Also known as Bindi, Cat's Head.

Caltrop is a small hard seed casing. It is divided into 5 sections and each section has a sharp spine. In the example shown here, 4 spines have been broken off.

There are many other small, hard types resembling Caltrop and it is often difficult to identify them with any degree of certainty. In general, these types cause no problems during processing.

Carrot Seed



### CARROT SEED (*tragus australianus*) **S E**

Also known as Small Burr Grass or Marthaguy Burr.

Carrot seed is a small grass seed. It is divided into 2 parts which are pointed at the tip. Each part is covered with short, thick spines.

Because of its spines, Carrot Seed is difficult to remove during processing. In large numbers, it tends to form a mat of seed in the tips of the wool.



### **STORKSBILL** (erodium spp) **S E**

Also known as Corkscrew, Crowfoot or Wild Geranium.

Storksbill is a long, thin grass seed. Similar in appearance to Spear Grass, it has a covering of fine hairs and a single twisted awn. However, it is easily distinguished by its overall larger size and, in particular, its thicker awn.

Because Storksbill is generally thicker and stronger than Wire Grass and Spear Grass, it is more readily removed during processing.



### **DOCK** (rumex spp) **S E**

Also known as Clustered Dock, Swamp Dock, Red Dock or Sorrel.

Dock is a small seed which forms in clusters. The individual seeds break off and catch in the wool, often with their short stems remaining attached.

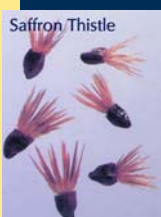
Dock is easily removed from wool during processing.



### **GALVANISED BURR** (bassia birchii) **H E**

Also known as Roly Poly, Bindy-eye or Stick.

Galvanised Burr is a hardened plant stem with spines protruding in clusters at intervals along its length. The stem resembles a small stick or twig and, apart from the spines, has a smooth surface.



### **SAFFRON THISTLE** (carthamus lanatus) **S E**

Also known as Thistle.

Saffron Thistle has a small, hard seed. It can be recognised by its flat, spreading bristles which are usually found intact. In wool, the seeds are often associated with the sharp spiked leaves which surround the seed pod. It is common in wheat growing areas.

Saffron Thistle is easily removed from wool during processing.



### **SPINY BURR GRASS** (cenchrus incertus) **S E**

Also known as Bayonet Grass or Gentle Annie.

Spiny Burr Grass is a small seed-pod. It consists of 2 outer sections which are covered with long, stiff spines and are joined at the base to partly enclose a third central section. Each section contains one small seed.

Spiny Burr Grass is a less common type and does not cause problems during processing.



### **SUBTERRANEAN CLOVER** (trifolium subterraneum) **B E**

Also known as Sub-Clover, Basket Burr or Barrel Burr.

Subterranean Clover has a small spherical seed-pod. It is typically about 4mm in diameter, but may be as small 2mm or as large as 8mm. The pod holds up to 5 smooth black seeds and is usually found intact.

Although Subterranean Clover is classified as Burr for testing purposes, its processing characteristics are not like those of the other Burr types. It tends to remain loose in the wool and is easily removed by carding. If damaged during processing, it breaks up into short pieces rather than unwinding into long 'eyebrows' like other Clover Burr and Medic types.



### **BARLEY GRASS** (hordeum leporinum) **S S**

Also known as Oats or Shive.

Barley Grass consist of 3 similar spikelets joined at a spoon-shaped tip. Each spikelet has 3 long, slender bristles that often break at some point along their length.

Barley Grass is one of the most common VM Types in Australian wool and is also one of the most troublesome to processors.

This seed penetrates deep into the fleece and sometimes through the skin, causing injury to the sheep.



Spear Grass



### **SPEAR GRASS** (*stipa* spp) **S S**

Also known as Corkscrew Grass, Shive or Plains Grass.

Spear Grass is a long, thin grass seed. The head is covered with fine hairs and has fine barbs at the tip. It has a single awn, which is usually twisted for part of its length. The corkscrew effect enables this grass seed to penetrate deep into the fleece.

Because of its similarity, Spear Grass causes the same types of problems as Wire Grass during processing.

Wild Oat



### **WILD OAT** (*avena* spp) **S S**

Also known as Black Oat or Shive.

Wild Oat is a hard, thick grass seed. It is covered with fine hairs and has a twisted awn protruding at an angle from its centre. The hairs and awn break off easily leaving a smooth seed.

Wire Grass



### **WIRE GRASS** (*aristida* spp) **S S**

Also known as Shive, Spear Grass or Feathertop Wire Grass.

Wire Grass is a long, thin grass seed. The head has a narrow groove and very fine barbs at the tip. It can be identified by its 3 awns, which no other major type has. The awns may be twisted into a long column rather than being separate as in the examples shown here.

Wire Grass is one of the most troublesome VM Types to processors. Its long, slender awns easily break off and, because of their fineness, are very difficult to remove during processing.

Noogoora Burr



### **NOOGOORA BURR** (*xanthium occidentale*) **H N**

Also known as Nog or Noogs.

Noogoora Burr has a hard, bean-shaped seed casing. Similar to Bathurst Burr in appearance, although longer, it can be identified by the 2 enlarged spines at its tip. Overall, its spines are stronger and more difficult to break off.

Noogoora Burr causes problems in processing, due to its hardness and size rather than causing any fibre loss. In carbonising, it is difficult to crush because it does not readily absorb acid like other vegetable matter. In carding, it can catch in the card teeth, blocking and sometimes damaging them.

Ring Burr



### **RING BURR** (*sida platycalyx*) **H N**

Also known as Monkey's Ring or Lifesaver Burr.

Ring Burr is a large distinctive seed-pod. It consists of many hard, flat segments joined to form a continuous ring. Each segment has several stiff spines and contains one small kidney-shaped seed.

Ring Burr is not a common type, being normally found in wool from certain areas of Queensland only. However, due to its hardness it causes problems similar to Noogoora Burr in carbonising.

Bathurst Burr



### **BATHURST BURR** (*xanthium spinosum*) **H T**

Also known as Beans or Cackle Burr.

Bathurst Burr has a hard, bean-shaped seed casing. It is covered with numerous hooked spines, which are slender and break off easily once the burr is dry. The burr holds 2 long seeds.

The hooked spines strongly attach the Bathurst Burr to wool. However, the burr is easily removed during processing because the spines break off. In many cases these burrs float off in the scouring process.

Bogan Flea



### **BOGAN FLEA** (*calotis hispidula*) **S F**

Also known as New England Crusher or Marthaguy Burr.

Bogan Flea is a small flea-shaped seed. It has a woody appearance with several spreading awns.

Bogan Flea initially forms as a spherical cluster of many seeds, about 5mm in diameter. Once on the sheep the cluster usually breaks up causing dense matting of the wool.





## FIBRE DIAMETER MEASUREMENT

Fibre Diameter of wool can be measured using a number of different technologies. AWTA Ltd uses the LASERSCAN for all fibre diameter certification and fleece measurement services.

### STEPS IN DETERMINING FIBRE DIAMETER

During the residual sub-sampling process for yield determination, 20g of scoured wool is removed for fibre diameter measurement.

#### 1. Analysing

The scoured sub-sample is carded using a Shirley Analyser. This removes vegetable matter and blends the fibres in an open web.

#### 2. Conditioning

The Shirley Analysed web is left in a controlled atmosphere room to condition to an environment of 20°C and 65% RH. Because wool swells as it absorbs moisture, the fibre diameter is dependent on atmospheric moisture content. Hence, for consistent measurement for certification purposes, the fibres must adjust to these standard conditions before measurement and certification.

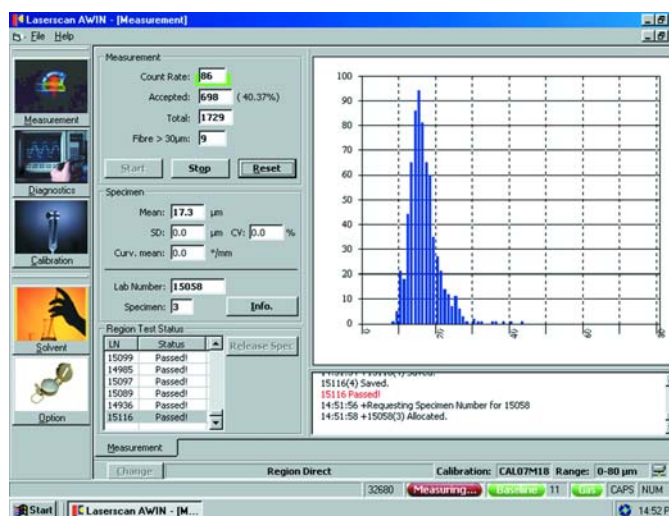
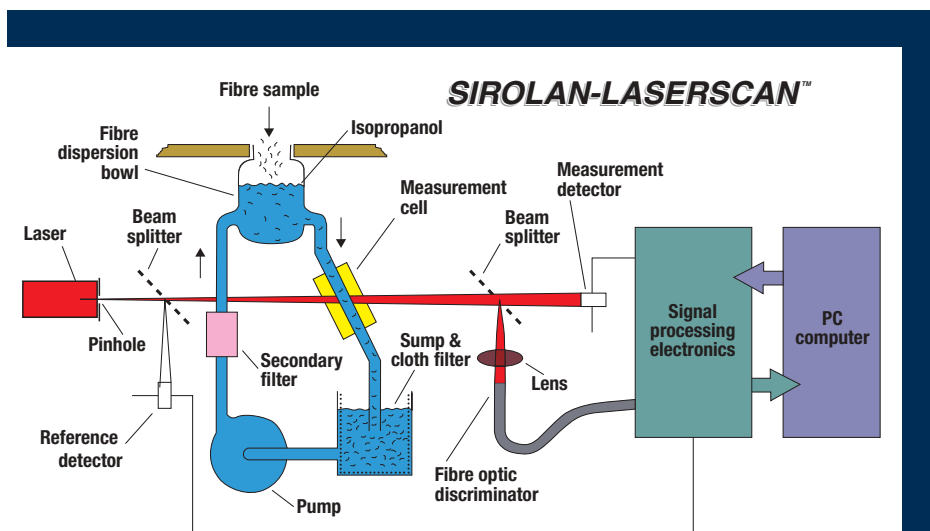
#### 3. Measurement

Mean Fibre Diameter is measured by Laserscan. Results are reported as micrometers (microns).

The conditioned web is split into 4 portions, each to be measured in at least 2 Laserscans. The web is placed into a mini-core set above the Laserscan. The cored snippets fall into the Laserscan and are automatically mixed into a solution within the instrument. The slurry of fibre snippets moves through tubing into a measurement cell where a laser beam shines on the individual fibres. The shadow cast by the fibre is measured electronically and stored in a "bin" representing the micron grouping measured by the instrument. After measurement, the fibres are caught in a cloth filter for subsequent removal. Each snippet is only measured once.

Each Laserscan is calibrated to an international series of wool tops that have been measured by the 100 or so laboratory members of Interwoollabs. Consequently, the "bin" to which an unknown fibre is allocated can be directly related to a micron value.

For each portion of the web 1000 fibres are measured. Hence, 4000 fibres are measured for the certified Mean Fibre Diameter result. Because the measurements are made on individual fibres, a distribution of the diameters in the sample can be accumulated and graphed as a Histogram. Also the Coefficient of Variation of Fibre Diameter can be calculated. In addition, for appraisal purposes, the Certificate can show the Mean Curvature of the fibres in the sample and the Comfort Factor of the sample.





## STAPLE LENGTH & STRENGTH MEASUREMENT

After Yield and Diameter, one of the most important characteristics that determines the value of combing wool is the average fibre length which will be achieved after processing. This length is known as Hauteur. Research has shown that Hauteur is closely correlated to the staple length and staple strength of the greasy wool.

Prior to the measurement of Staple Length & Strength, three levels of sampling occur:

- grab sampling;
- tuft sampling; and
- staple preparation.

### 1. GRAB SAMPLING

Grab sampling is conducted at the time of core sampling, under the supervision of AWTA Ltd Sampling Officers. Every bale is sampled with a minimum of 20 grabs taken from each sale lot, ensuring that the grab sample taken is representative of the wool that constitutes the sale lot. A reduced grabbing schedule can be used for 1, 2 and 3 bale grower lots.



### 2. MECHANICAL TUFT SAMPLING (MTS)

AWTA Ltd has MTS machines located throughout Australia in brokers' stores, as well as in the testing laboratories.

The purpose of the machine is to randomly draw approximately 60 tufts of wool from the grab sample and then package the tufts in a form suitable for transportation. This is achieved by spreading the grab sample in an even layer over the conveyor belt so that the full sample is conveyed under the sampling head in 20 equal steps. At each step, three tufts are mechanically drawn from the sample by jaws and blown onto a flyscreen belt which is wound onto a reel for shipment to the laboratory.

The jaws withdraw slowly for the first 200mm to ensure that tender staples are not broken. In addition, the jaws are heated to 60°C which is beyond the melting point of wool grease so as to reduce the risk of greasy tufts sticking to the jaws.

After tufting, the grab is placed in a sample box on the show floor where it becomes the display sample for buyers to appraise.

### 3. STAPLE PREPARATION

The purpose of this sampling stage is to randomly take one staple from each tuft and prepare it to a standard suitable for the measurement of its Length & Strength. A variety of staple shapes are acceptable, as are second cuts.

Of all the functions in the laboratory, staple preparation is the most manual and therefore requires the most stringent quality control. Testing Officers are trained to grasp the first staple end they identify in the tuft, and, having done so, remove any wispy fibres from either end and place it in the staple tray. Strict adherence to this procedure ensures that staples are chosen at random. Four Testing Officers prepare a single lot, further ensuring randomness of staple selection.

To confirm that operators are not imparting any bias on the results, they participate in regular quality control trials. In these trials the same lot is prepared by each operator, and any who differ significantly from the overall average are retrained and re-trialled before returning to commercial work.

Staple trays, containing the staples, are then moved to a controlled atmosphere room (20°C, 65%RH) and conditioned for 8 hours prior to measurement. The design of the trays allows the staples to relax while keeping them straight. This procedure ensures staples from all types of wool are measured under the same conditions.







#### 4. MEASUREMENT (ATLAS)

Length and Strength is measured using an instrument called the Automatic Tester of Length and Strength (ATLAS). These machines were originally designed and built by CSIRO. Manufacture is now undertaken by AWTA Ltd's Research and Development division.

Length is measured by conveying the staple, tip first, through a vertical array of eight light beams and then electronically measuring the distance the conveyor moved while the light beams were interrupted by the staple. All staples are measured for Length regardless of the staple dimensions. Length is measured in millimetres. The IWTO standard requires that a minimum of 55 staples are measured for Length to produce a certified result.

After Length measurement, the staple is picked up by two rubber belts which feed it through to a jaw which grips the tip of the staple. A jaw then moves away until the base of the staple is clear of the rubber belts. The base jaw then grips the base of the staple. The tip jaw moves away and the staple is broken in two. The peak force required to break the staple is measured in Newtons (N) by a force transducer attached to the stationary (base) jaw.

On its own, this information is of little value since the staples that are measured vary in thickness. All things being equal, thick staples require a greater force to break than thin staples. Therefore, the force required to break a staple must be related to staple thickness before it can be used more meaningfully.

Staple thickness is determined from the weight of the staple and the Length of the staple. That is, the more grams of weight per millimetre of Length, the thicker the staple. Staple thickness is measured in kilotex (ktex). The total Newtons of force is divided by the number of kilotex to give a Strength value per unit of thickness (N/ktex). This figure is known as the greasy Staple Strength because it was derived from the greasy staple weight. This is then converted to a measure of clean Staple Strength using the Wool Base and VM Base information.

Only staples longer than 50mm are measured for Strength. This is due to the fact that 25mm of the staple is held in the tip and base jaws and cannot be broken, so only the middle 25mm is measured on a 50mm staple. Strength measurements on staples shorter than 50mm are of very little value. A minimum of 40 staples must be measured for Strength in order to produce a certified result.

The weights of the tip and base portions are measured and are used to determine the weight of the staple and the Position of Break (PoB). For example, if the tip is very light and the base is very heavy, then the PoB is close to the tip.

The PoB is reported as the percentage of staples which break in the tip, middle and base thirds of the staple. From the processors point of view, the worst case is to have the majority of staples breaking in the middle, as this reduces the fibre Length in the processed top (Hauteur). However, this is only of major importance to the processor if the Staple Strength of the sale lot is low.

#### APPLYING STAPLE MEASUREMENT IN PROCESSING

Two major trials were conducted in the 1980's by AWTA Ltd, CSIRO and AWC together with 20 local and overseas processors. Known as the Trials Evaluating Additional Measurement (TEAM), these trials demonstrated that processing performance can generally be predicted from Staple Measurement together with the Core Test results.

The TEAM general formula for estimated Fibre Length in the top (Hauteur) derived from these trials is

$$H = 0.52xL + 0.47xS + 0.95xD - 0.19xM^* - 0.45xV - 3.5$$

where H = Hauteur (mm)

L = Staple Length (mm)

S = Staple Strength (N/ktex)

D = Fibre Diameter (microns)

M\* = Adjusted Percentage of Middle Breaks (%)  
(Where mid-breaks are less than 45%, M\* = 45%.)

V = Vegetable Matter Base (%)







## COLOUR MEASUREMENT

Colour measurements are useful because:

- There is a very poor relationship between the colour of greasy wool and the colour achieved after scouring. Greasy colour is strongly affected by wool grease and dust, both of which can be removed by scouring.
- They provide predictability of the colour of the raw processed product so that repeatable dyeing of colours in tops, yarns and fabrics can occur.
- They minimise the impact of price discounts for greasy wool where the greasy colour is appraised as not white.

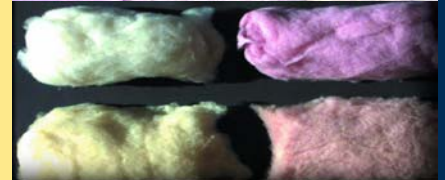
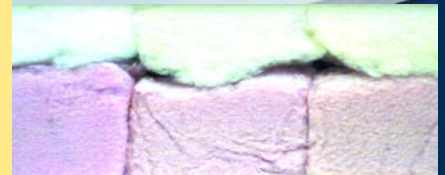
### 1. Measurement Process

Colour measurement is conducted on the same scoured and Shirley Analysed web used for Mean Fibre Diameter measurement. The web is presented to a spectrophotometer and the reflectance of light from the web is recorded. Natural light is made up of a range of different colours. The colour of the wool is determined by which of these colours is absorbed or reflected. The instrument is calibrated to a system universally used by paint and dye companies. The results are expressed as tristimulus values X, Y and Z. The colour is best expressed as Yellowness (Y-Z) units.

### 2. Range of Yellowness

Values for Yellowness can range from 7 to 18 units of Y-Z.

The majority of Australian fleece lines will fall in the range 7-12 units of Y-Z when scoured. The basic problem is that whilst a skilled appraiser may be able to detect a difference of 1 unit on the scoured wool, it is impossible to appraise these differences when the wool is in the greasy state.



### Range of Yellowness

Y - Z

◀ 7 8 10 12 13 15 16 18 ▶



Increasingly White

Increasingly Yellow

## FLEECE MEASUREMENT

Fleece Measurement results are used by growers and breeders to assist in the selection of superior animals for replacement breeding purposes, and for the sale of stud sheep by ram breeders. Fleece measurement results can also be used as a basis for classing individual fleeces into lines with strictly controlled ranges of Mean Fibre Diameter. This can enable growers to create speciality lines with greater accuracy than would be attained by visual selection alone. The Mean Fibre Diameter measurement gives growers the opportunity to select fleeces from the finest animals in their flock. As a result, the number of superfine sale lots tested by AWTA Ltd has increased significantly over recent years.

Fleece Measurement testing is conducted on a 20-50g sample of wool that has been removed from the midside of the sheep. For classing purposes the sample is taken from the ear-tagged animal a few weeks before shearing so that the results can be returned to the grower prior to the commencement of shearing.

AWTA Ltd offers a range of different fleece measurement services:

- Yield, Mean Fibre Diameter and Coefficient of Variation of Diameter (CVD)
- Mean Fibre Diameter and CVD only
- Staple Measurement
- Clean Colour

Recently, in-shed micron testing of fleeces as they are shorn has become popular. AWTA Ltd markets a Laserscan unit for rapid in-shed testing.





## AWTA LTD TEST CERTIFICATES AND REPORTS

### Yield, VM and Fibre Diameter

IWTO Test Certificates for commercial yield must show the Wool Base (WB) and the Vegetable Matter Base (VMB) (including % Hard Heads and Twigs (HH)) as well as the particular commercial yield calculation relevant to the wool trading negotiation. Unless a particular commercial yield basis is requested, the AWTA Ltd Certificate will include the 4 commercial yields that appear in the auction sale catalogues:

SCH DRY	IWTO Schlumberger Dry Top & Noil Yield (1%TFM)
SCD 17%	IWTO Scoured Yield, 17% regain
JCSY	Japanese Clean Scoured Yield
ACY	Australian Carbonising Yield

### IWTO Schlumberger Dry Top & Noil Yield (1%TFM)

IWTO Schlumberger Dry Top & Noil Yield (1%TFM) is the most commonly used commercial core test yield and predicts the amount of Top and Noil that can be combed from the greasy wool. It is the main yield basis for wools traded in Western Europe.

An allowance of 2.27% is made for residual ash and grease, 18.25% moisture regain is added to the Top and 16% moisture regain is added to the Noil. The Total Fatty Matter content (TFM) is 1% and a tear ratio (the conditioned weight of Top to the conditioned weight of Noil) of 8:1 is assumed. The conversion factor of 1.207 applied to WB takes account of these factors.

The yield includes an allowance (Processing Allowance) for fibres lost during processing. This fibre loss is directly related to the VMB minus the HH and is calculated according to the following formula:

$$\text{SCH DRY} = (\text{WB} \times 1.207) - \text{Processing Allowance}$$

where

$$\text{Processing Allowance} = 7.7 - 40.6 / (7.8 + \text{VMB} - \text{HH})$$

### IWTO Scoured Yield, 17% regain

IWTO Scoured Yield, 17% regain is calculated from WB and VMB. An allowance of 2.27% is made for residual ash and grease and 17% moisture regain is included. This yield estimates the "washing yield", i.e. the yield of product obtained after scouring but before any processing occurs to remove VM. It is commonly used in trade with Eastern Europe.

$$\text{SCD 17\%} = (\text{WB} + \text{VMB}) \times 1.1972$$

While not shown in the catalogue, an IWTO Scoured Yield, 16% regain is commonly used in trade with China.

### Japanese Clean Scoured Yield

Japanese Clean Scoured Yield is the normal basis for trade with Japan. An allowance of 1.5% is made for residual ash and grease, and 16% moisture regain is included. Although this yield has the VM deducted, no allowance is made for fibre loss that could occur during processing.

$$\text{JCSY} = \text{WB} \times 1.1777$$

### Australian Carbonising Yield

Australian Carbonising Yield is popular in Australia, Japan, Korea and Europe as the basis of trade in carbonising and carding types (lox, crutchings, lambs etc.). An allowance of 2.27% is made for residual ash and grease and 17% moisture regain is included. The yield calculation for WB and VMB allows for expected processing losses during carbonising.

$$\text{ACY} = (\text{WB} \times 1.1972) + (\text{VMB} \times 0.162) - 5.12$$

### Fibre Diameter

The AWTA Ltd Certificate normally includes Fibre Diameter results with the commercial Yield results. Consequently, the Certificate will also show Mean Fibre Diameter and Coefficient of Variation of Mean Fibre Diameter as measured by Laserscan. There is also a separate page of the Certificate repeating the Diameter results and showing a Histogram Graph of the fibre diameter distribution.

### Staple Length & Strength

IWTO Staple Test Certificates must show the Mean Staple Length, Coefficient of Variation of Staple Length, Mean Staple Strength and the Percentage of Breaks in the Tip, Middle and Base regions of the staples.

### Colour

The AWTA Ltd Colour Certificate shows the 3 tristimulus values X, Y and Z for the 2 methods that can be used to measure colour, and the important Y-Z value. The D65/10 measure is the result recognised by IWTO since January 2001.

Actual AWTA Ltd Certificates are shown on pages eighteen and nineteen.



# IWTO TEST CERTIFICATE

**AUSTRALIAN WOOL TESTING AUTHORITY LTD**  
Reg'd. Office: 70 Robertson Street, Kensington, Victoria 3031 P.O. Box 240, North Melbourne 3051 Tel: (03) 9371 4100 Fax: (03) 9371 4191

**IWTO TEST CERTIFICATE ORIGINAL**

3-05472646-P2 *CLASSED GROWER LOT		TEST METHODS IWTO-19,12				PAGE 1
THE BROKER LTD. HOBART 2 BALES		*THEGROWERBRAND		*AAAM		
REF. M99M 000123	*THEGROWERBRAND	*AAAM	BALE NO. 1	GROSS 120	*TARE 118	NETT 2
TOTAL BALE WEIGHTS:		146160	GROSS 241 KG	TARE 4 KG	NETT 237 KG	
TEST HOUSE GROSS	241 KG	TARE	4 KG	NETT	237 KG	

TEST RESULTS:

- WOOL BASE - 2 SUBSAMPLES 66.32 %
- MEAN FIBRE DIAMETER - 4 SPECIMENS 18.5 MICRONS
- COEFFICIENT OF VARIATION OF DIAMETER 20.5 %
- VEGETABLE MATTER BASE INCLUDING \*\*\*\* % HARD HEADS-TWIGS 0.5 %

CALCULATED COMMERCIAL YIELDS & CLEAN MASSES:

- IWTO SCHLUM DRY TAN YIELD (1.04TM) 77.2 % 183 KG
- IWTO SCoured YIELD at 17% REGAIN 80.0 % 190 KG
- JAPANESE CLEAN SCoured YIELD 78.1 % 185 KG
- AUSTRALIAN CARBONISING YIELD 74.4 % 176 KG

ADDITIONAL INFORMATION:

- VEGETABLE MATTER COMPOSITION (B) 0.1 (S) 0.4 (H) 0.0

CHARGE: \$ 62.50 GST @ 10% : \$ 6.25 TOTAL CHARGE: \$ 68.75

CONTINUED ON NEXT PAGE  
 TEST CONDUCTED AT MELBOURNE LABORATORY  
 Bales SAMPLED AT MELBOURNE ON 04.04.2002  
 AWTA LTD SERVICE TIME 1.2 DAYS  
 ISSUED ON 11.04.2002. PRINTED ON 11.04.2002 AWTH 1

13.9999 08 32593 0010

33150242 33100424

For and on behalf of Australian Wool Testing Authority Ltd

MICHAEL A. JACKSON B.Sc. (Hons)  
MANAGING DIRECTOR

DR. GEORG R. BELHARZ Dip.App.Sc., M.Sc., Ph.D.  
GENERAL MANAGER - LABORATORY OPERATIONS

CLIENT USE ONLY

The ORIGINAL and any OFFICIAL COPY of this Certificate are issued in accordance with the stated Test Method(s) and any directly associated Regulations. By authorising the application of the AWTA Ltd Seal, we hereby certify that the test results are within the precision limits of the Test Method declared. As far as is permissible by law, no other warranty is expressed or implied. On request, AWTA Ltd will make available sampling, weighing and/or testing details to any bona fide bearer or transferee of this Certificate. Photocopies and other reproductions are NOT recognised as Certificates. THIS CERTIFICATE SHALL BE RENDERED VOID IF AMENDED OR ALTERED.

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# IWTO TEST CERTIFICATE (CONTINUED)

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**IWTO TEST CERTIFICATE (CONTINUED) ORIGINAL**

3-05472646-P2 *CLASSED GROWER LOT		TEST METHOD IWTO-12				PAGE 2
THE BROKER LTD. HOBART 2 BALES				% OF FIBRES		
REF. M99M 000123	146160	MIC	% COUNT	0	5	10
*THEGROWERBRAND		10-	0.1250			
*AAAM		11	0.4500			
GROSS 241 KG	TARE 4 KG	12	1.0250			
NETT 237 KG		13	2.8250			
		14	6.2750			
		15	8.9500			
		16	11.6500			
		17	13.2000			
		18	12.2000			
		19	10.1500			
		20	9.9250			
		21	6.6750			
		22	4.7750			
		23	3.4750			
INSTRUMENT	= LASERSCAN	24	2.7500			
SUB-SAMPLING METHOD	= MINICORE	25	1.4000			
MEAN FIBRE DIAMETER	= 18.5 MICRONS	26	1.1750			
SD OF DIAMETER	= 3.8 MICRONS	27	0.6500			
CV OF DIAMETER	= 20.5 %	28	0.4500			
COMFORT FACTOR	= 98.8 %	29	0.3500			
NO. OF SPECIMENS	= 4	30	0.3000			
NO. OF FIBRES MEASURED	= 4000	31	0.2750			
		32	0.1250			
		33	0.1500			
		34	0.1250			
		35	0.0750			
		36	0.0500			
		37	0.1000			
		38	0.0250			
		39	0.0750			
		40	0.0750			
THE FOLLOWING INFORMATION IS FOR APPRAISAL PURPOSES ONLY:		41	0.0500			
		42	0.0250			
		43	0.0000			
MEAN FIBRE CURVATURE = 110 DEG/MM		44	0.0000			
		45+	0.0750			

13.9999 08 32593 0010

33150242 33100424

For and on behalf of Australian Wool Testing Authority Ltd

MICHAEL A. JACKSON B.Sc. (Hons)  
MANAGING DIRECTOR

DR. GEORG R. BELHARZ Dip.App.Sc., M.Sc., Ph.D.  
GENERAL MANAGER - LABORATORY OPERATIONS

CLIENT USE ONLY

The ORIGINAL and any OFFICIAL COPY of this Certificate are issued in accordance with the stated Test Method(s) and any directly associated Regulations. By authorising the application of the AWTA Ltd Seal, we hereby certify that the test results are within the precision limits of the Test Method declared. As far as is permissible by law, no other warranty is expressed or implied. On request, AWTA Ltd will make available sampling, weighing and/or testing details to any bona fide bearer or transferee of this Certificate. Photocopies and other reproductions are NOT recognised as Certificates. THIS CERTIFICATE SHALL BE RENDERED VOID IF AMENDED OR ALTERED.

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# COLOUR TEST CERTIFICATE

**AUSTRALIAN WOOL TESTING AUTHORITY LTD**  
Reg'd. Office: 70 Robertson Street, Kensington, Victoria 3031 P.O. Box 240, North Melbourne 3051 Tel: (03) 9371 4100 Fax: (03) 9371 4191

**COLOUR TEST CERTIFICATE ORIGINAL**

3-05472846 C8			TEST METHOD IWTO-56		PAGE 1
THE BROKER LTD.	HOBART	2 BALES	*THEGROWERBRAND	*AAAM	
REF. M99M 000123 *THEGROWERBRAND			BALE NO. GROSS *TARE NETT	BALE NO. GROSS *TARE NETT	
		146160	1 120 2 118 2	2 121 2 119	
TOTAL BALE WEIGHTS:			GROSS 241 KG TARE 4 KG NETT 237 KG		
TEST HOUSE GROSS	241 KG TARE	4 KG NETT	237 KG		

TEST RESULTS:

	C/2	D65/10
	=====	=====
1. COLOUR (X) :	63.9	68.7
2. COLOUR (Y) :	65.7	72.7
3. COLOUR (Z) :	65.7	64.5
4. YELLOWNESS (Y-Z) :	0.0	8.2

ADDITIONAL INFORMATION:

CHARGE: \$ 3.00 GST @ 10% : \$ 0.30 TOTAL CHARGE: \$ 3.30

NO FURTHER PAGES  
TEST CONDUCTED AT SYDNEY LABORATORY

13.9999 08 32593 0148 68.7 72.7 64.5 305472646 33144796 33:00424 ISSUED ON 11.04.2002, PRINTED ON 11.04.2002 AWTH 1

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MICHAEL A. JACKSON B.Sc. (Hons)  
MANAGING DIRECTOR

DR. GEORG R. BELHARZ Dip.App.Sc., M.Sc., Ph.D.  
GENERAL MANAGER - LABORATORY OPERATIONS

CLIENT USE ONLY

# IWTO STAPLE TEST CERTIFICATE

**AUSTRALIAN WOOL TESTING AUTHORITY LTD**  
Reg'd. Office: 70 Robertson Street, Kensington, Victoria 3031 P.O. Box 240, North Melbourne 3051 Tel: (03) 9371 4100 Fax: (03) 9371 4191

**IWTO STAPLE TEST CERTIFICATE ORIGINAL**

3-05473716-L2			TEST METHODS IWTO-7,30		PAGE 1
THE BROKER LTD.	HOBART	2 BALES	*THEGROWERBRAND	*AAAM	
REF. M99M 000123 *THEGROWERBRAND			BALE NO. GROSS *TARE NETT	BALE NO. GROSS *TARE NETT	
		146160	1 120 2 118 2	2 121 2 119	
TOTAL BALE WEIGHTS:			GROSS 241 KG TARE 4 KG NETT 237 KG		
TEST HOUSE GROSS	241 KG TARE	4 KG NETT	237 KG		

TEST RESULTS:

1. MEAN STAPLE LENGTH - 66 STAPLES 79 MM
2. COEFFICIENT OF VARIATION OF STAPLE LENGTH 12 %
3. MEAN STAPLE STRENGTH - 65 STAPLES 45 NEWTONS/KTEX
4. DISTRIBUTION OF POSITION OF BREAK:
 

BROKE IN THE TIP REGION	31 %
BROKE IN THE MIDDLE REGION	69 %
BROKE IN THE BASE REGION	0 %

ADDITIONAL INFORMATION:

CHARGE: \$ 24.00 GST @ 10% : \$ 2.40 TOTAL CHARGE: \$ 26.40

NO FURTHER PAGES  
TEST CONDUCTED AT MELBOURNE LABORATORY

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CLIENT USE ONLY



## GLOSSARY OF TERMS (ac – da)

**accuracy** - a measure of the closeness of a test result to the true value. The difference between accuracy and precision should be noted. (Also see bias, precision and confidence limits.)

**airflow** - a method of measuring the Mean Fibre Diameter of a sample of wool in which a test specimen (a measured mass of the scoured, dried and carded sample), after exposure to a conditioning atmosphere, is compressed to a fixed volume and a current of air is passed through it. The rate of flow is then adjusted so that the pressure drop across the sample equals a predetermined value. The rate of flow is an indicator of the mean fibre diameter of the wool in the sample. The instrument is calibrated to international standard wool tops of known fineness.

**appraisal** - an estimate of the value-determining characteristics of a parcel of wool, based on subjective judgement but sometimes assisted by objective measurements.

**area of dust** - the area of dust as a percentage of the total staple area. (Also see colour of dust.)

**area of wool** - the area of wool as a percentage of the total staple area. (Also see colour of wool.)

**“as is” colour** - the colour of wool without any cleaning of the sample. It may be expressed using tristimulus values or by two measurements, brightness and yellowness, derived from the tristimulus values. (Also see clean colour and base colour.)

**ash content** - the residue of a scoured wool subsample after it has been subjected to charring followed by heating to 800°C. It is expressed as a percentage of the subsample mass and is taken to represent the dirt (sand and soil) not removed during the scouring of the greasy subsample.

### **ATLAS (Automatic Tester of Length And Strength)**

- a computer-controlled instrument which measures the Staple Length, Staple Strength and Position of Break of individual staples. In operation, a continuous belt conveys each staple between an array of lights and an array of photocells, which detects the ends of the staple and enables the length (in millimetres) to be measured. The staple is then grasped by two sets of jaws and broken. The force required is measured in Newtons. The two pieces of the broken staple are individually collected and weighed and, from the masses, lengths and core test yield, the staple linear density (thickness) is calculated and expressed in kilotex; the Staple Strength is expressed as Newtons/kilotex (N/ktex). The masses of the two pieces are also used to calculate the Position of Break.

**average linear density** - the clean staple mass per unit of Staple Length at standard conditions.

**bale** - see conventional bale.

**baling surfaces** - the two surfaces upon which the main baling pressure has been applied to a bale. This usually means the cap and base of a bale.

**base (when referring to a wool bale)** - the permanently closed end of a wool bale on which baling pressure is applied. (Also see cap.)

**base (when referring to a staple)** - the end shorn from the skin of the sheep. (Also see tip.)

**base colour** - the inherent colour of greasy wool after the removal of residual contaminants eg. grease, dirt, suint and vegetable matter; or the contaminants following laboratory scouring, e.g. grease, dirt, suint and vegetable matter. (Also see base colour and clean colour.)

**bias** - a constant or systematic difference between a true value and corresponding test results. (Also see accuracy and precision.)

**branding substance** - a coloured (pigmented) product which may be a liquid, a spray, crayon or chalk, used to mark sheep for identification purposes.

**break** - a marked thinning of all the fibres in a staple, which produces a position of weakness; it is caused by sickness or stress, lack of nourishment, or a sudden change in the sheep's environment. (Also see position of break and tender wool.)

**brightness** - a measure of the intensity of reflectance of a surface in the green spectral region; one method of expressing brightness is in terms of the Y tristimulus value. (Also see yellowness.)

**bulk (when referring to sale lots)** - the main portion of a lot (in contrast to the sample).

**bulk (when referring to wool measurement)** - the space-filling capability of clean, carded wool. Bulk is expressed as the volume to which a defined pressure compresses a defined mass of wool. (Also see laboratory card and resistance to compression.)

**bulk classed lot** - a lot of raw wool comprising bales containing wool blended from various sources, the wool being from one country of origin.

**canary stain** - a bright yellow stain in a fleece, which is not removed by normal scouring processes.

**cap** - the end of a wool bale on which baling pressure is applied, normally closed by pinned flaps but which may be opened for inspection of the contents. (Also see base.)

**carbo (or carbonising) wools** - wools, typically short-stapled, with vegetable matter content so high that it cannot be removed economically by mechanical treatment; for such wools, the first treatment is usually carbonising.

**carbonise** - to treat wool with sulphuric acid, followed by baking, which embrittles burrs present so that they can be easily broken up, crushed and removed.

**card sliver** - a continuous strand of opened and loosely assembled scoured wool fibres, together with variable amounts of vegetable matter. Its linear density is approximately constant and it is without twist.

**character** - a subjectively-assessed characteristic of greasy wool related to crimp and staple definition.

**check test** - verification of documentation and calculations forming the basis of the IWTO Test Certificate on which a doubt has been raised and, if possible, a set of additional measurements made in accordance with the same standard IWTO Test Method as was adopted for the original test. Check testing is restricted to tests carried out by the Test House which conducted the original test. (Also see data verification and check test result.)



**check test result** - the result obtained by carrying out a check test. It may include all or part of the original test data, or it may be entirely new data or a combination of both. It is the result to be certified if the previous result is withdrawn.

**classed grower lot** - a lot of raw wool from an individual grower comprising bales classed from one clip.

**clean colour** - the colour of wool after scouring. It may be expressed using tristimulus values or by two measurements, brightness and yellowness, derived from the tristimulus values. Both brightness and yellowness can affect the dyeing potential of the wool. (Also see "as is" colour and base colour.)

**coefficient of variation (CV)** - a statistical measure of the variability exhibited within a set of values. It expresses the standard deviation as a percentage of the mean; the higher the CV, the greater the variability.

The coefficient of variation of a sample may be calculated from:

$$CV = \frac{S \times 100\%}{\bar{X}}$$

where CV = coefficient of variation

S = standard deviation of the sample

$\bar{X}$  = mean of the sample

Coefficient of Variation is often measured for Fibre Diameter and Staple Length.

**colorimeter** - an instrument used to determine the colour of wool by measuring the tristimulus values of the sample. (Also see spectrophotometer.)

**colour** - is determined by the tristimulus values as defined in the 1971 Commission International de l'Eclairage (CIE) publication, for illuminant D65 and the 10° observer. (Also see brightness and yellowness.)

**colour of dust** - the average colour of the dust area of a staple, categorised as brown, grey, red or pink. (Also see area of dust.)

**colour of wool** - the average yellowness (Y-Z) of the wool area of a staple. (Also see area of dust and colour.)

**combing wool** - wool suitable for conversion to yarn on the worsted system. Generally it is merino wool having a staple length of about 40 mm or greater, or crossbred wool having a staple length of about 75 mm or greater.

**comfort factor** - the percentage of fibres finer than 30 micron in a sample.

**commercial yield** - any of the yields, calculated from the Wool Base, Vegetable Matter Base and Hard Heads and Twigs Base as specified in Section 3.0 of the IWTO Core Test Regulations. Yields may be expressed either as net clean mass of a lot or delivery, or as the net clean mass expressed as a percentage of the net greasy mass.

**conditioning atmosphere** - a volume of air, capable of being maintained at standard temperature or humidity, or both, in which specimens are conditioned in accordance with IWTO-52. For wool testing this is usually a temperature of 20±2°C and a relative humidity of 65±3%. (Also see standard conditions.)

**confidence limits** - an expression of the precision of the mean of a set of values, usually associated with a stated probability, most often 95%. It is the interval around the mean within which, with the stated probability, the true value is expected to lie.

**consignment** - synonymous with delivery.

**conventional bale** - a bale of undumped wool of approximately 0.75m x 0.75m x 1.25m and weighing between 110 and 204kg. (Also see dump.)

**core** - all the material removed by a coring tube in one core-sampling operation. (Also see core sample.)

**coresample** - a representative sample of raw wool obtained from each bale in the lot by coring techniques.

**coretest** - the series of measurements, typically of Wool Base, Vegetable Matter Base and Mean Fibre Diameter, carried out on a core sample.

**coring machine** - equipment which uses hydraulic power to drive one or more pressure coring tubes into a bale of wool so that the tube reaches at least 93% of the length of the bale. Cores are automatically ejected from the tube.

**coring tube** - a tube of circular cross-section which is equipped with a sharpened, replaceable tip. The tip enables the tube to penetrate a bale of raw wool without rotation, remove a cylindrically-shaped portion of the wool and retain it without change in material or moisture content.

When part of a coring machine, the coring tube must penetrate at least 93% of the length of the bale. When operated manually, the tube must penetrate at least 47% of the length of the bale.

Very small diameter coring tubes may also be used to obtain fibre snippets for fibre diameter testing. (Also see minicore.)

**cotted wool** - wool that has become partially felted on the sheep's back; wool with a matted appearance.

**crimp** - the waviness of a fibre, expressed numerically as the number of complete waves per unit length; crimp is usually taken as an indicator of mean fibre diameter, the higher the number of crimps per unit length, the finer the wool. (Also see curvature.)

**crimp definition** - the degree of alignment of the crimp waves within a staple.

**crimp frequency** - the number of crimp waves per centimetre of Staple Length.

**crossover error** - an error generated when the results of two tests are transposed, either completely or in part. A crossover is distinct from a testing error and does not indicate an error arising from laboratory testing procedures.

**curvature** - a measure of crimp reported as degrees/mm. (Also see crimp.)

**data verification** - verification of documentation and calculations forming the basis of an IWTO Test Certificate on which a doubt has been raised. (Also see check test.)





## GLOSSARY OF TERMS *continued* (de – ra)

**delivery** - a bulk of raw wool covered by a single IWTO Test Certificate. If previously untested, all bales are sampled and tested as a group. If the component lots have been tested individually, the test results may be combined in accordance with IWTO-31.

**display box** - an open box large enough to hold and display a grab sample of wool for appraisal and evaluation purposes.

**display sample** - the grab sample taken from a single lot when it is placed in a display box.

**documentation error** - an error in clerical procedures such as recording data, calculation, typography or data transmission.

**dump** - the process of compressing bales, usually of greasy wool, to a density exceeding 500 kg/m<sup>3</sup> and restraining them with bands or wires.

**dumped bales** - bales prepared for transport overseas by the process of dumping.

**ethanol alcohol extractives** - material capable of being removed from a scoured sub-sample by reflux distillation with ethanol. It is taken as indicating the grease and wax remaining on the sub-sample after scouring. It is usually expressed as a percentage of the oven dry mass of the sub-sample.

**fault** - contamination, especially Vegetable Matter, in greasy and in semi-processed wool.

**fibre diameter** - the thickness of individual fibres; it is customary to quote an average value (Mean Fibre Diameter or MFD) in micrometres. (Also see fibre diameter distribution and micron.)

**fibre diameter distribution** - the distribution of fibre diameter in a wool sample. Distribution can be expressed in the form of a frequency table or as a frequency Histogram with data grouped into classes of one micrometre size, and integer micrometre values as midpoints of the class intervals.

The results may be expressed in a number of ways including Standard Deviation, Coefficient of Variation and the percentage of fibres coarser or finer than a given value, such as 30 µm.

**fineness** - see fibre diameter.

**grab machine** - a mechanical device capable of operating a set of jaws, which penetrate into the side of a wool bale and withdraw a representative grab sample of suitable mass. The jaws withdraw the entire sample in such a way as to avoid contamination of the wool by pack material, and to avoid damage to the pack.

**grab sample** - the greasy wool drawn from a bale by a single operation of a grab machine.

**grease** - wax component extruded from the wool follicles.

**greasy wool** - wool from the sheep's back or sheepskins which has not been scoured, solvent degreased or carbonised or otherwise processed. It contains grease and suint extruded from the follicles in the skin and dirt & Vegetable Matter picked up from grazing

**Hard Heads and Twigs Base (HH%)** - the oven-dry mass of ash-free, ethyl alcohol extractives-free hard heads and twigs, expressed as a percentage of the mass of the sample.

**hauteur (H)** - the average of the length-biased distribution of fibre length in a top. It is obtained by sorting a sample of the sliver into length classes and calculating the average of the number of fibres of each length class. Hauteur is usually regarded as a numerical average although this assumes no relationship between fibre length and fibre diameter.

**histogram** - a method of graphing the distribution of individual measurements.

**individual test** - a standard certifiable test on a lot of wool, carried out in strict accordance with an approved IWTO Test Method.

**interlot** - a lot of raw wool comprising bales matched before testing, normally from different clips, the wool being from one country of origin.

**IWTO Combined Certificate** - a certificate resulting from the mathematical combination of IWTO Test Certificates, calculated in accordance with the appropriate IWTO Test Method.

**IWTO Combined Certificate (by Subtraction)** - a certificate resulting from the mathematical subtraction of a separately tested and certified component from a consignment which is covered by an IWTO Test Certificate or an IWTO Combined Test Certificate, calculated in accordance with the appropriate IWTO Test Method.

**IWTO Test Certificate** - a certificate resulting from the testing of samples drawn in accordance with the relevant IWTO Test Regulations, and in accordance with the appropriate IWTO Test Method.

**keeper samples** - see test house samples.

**keratin** - the main constituent of wool. It is a complex of fibrous proteins characterised by high sulphur content with cystine being the predominant amino-acid present. Cross-linking between the cystine residues makes keratin more stable and less soluble than most proteins.

**kilopascal (kPa)** - the unit of pressure in the SI system is the pascal (newton per square metre). This unit proved to be inconveniently small for many purposes and the kilopascal (kPa), equal to 1000 Pa, is more commonly used. One pound per square inch is equivalent to 6.895 kPa.

**kilotex (ktex)** - the linear density of a staple expressed in grams per metre. It is the unit of thickness used in calculating Staple Strength for which the unit is Newtons per kilotex.

**laboratory card** - a machine capable of simulating the action of a commercial carding machine. (Also see Shirley Analyser.)

**laboratory sample** - the material which will be used as a basis for carrying out the measurement in the laboratory. It may be the total sample or it may be derived from the total sample by sub-sampling.



**Laserscan** - an instrument that detects shadows of fibre snippets in a laser beam as they are carried in solution through the beam, developed for improved performance in measuring Mean Fibre Diameter and fineness distribution.

**licensed laboratory** - a laboratory licensed by IWTO to issue IWTO Test Certificates. (Also see test house.)

An essential pre-requisite for licensing is that the laboratory is accredited by a recognised national laboratory accreditation body to ISO Guide 25 and that the national accreditation body itself enjoys a Mutual Recognition Agreement with similar institutions in other countries, in conformity with ISO Guide 57.

In addition, the laboratory must be situated in an IWTO member country and must be scrutinised and approved by the IWTO Licensing Panel.

**linear density** - the mass of clean fibre per unit length of a staple at standard conditions.

**lot** - any number of bales of wool, of similar mass and dimensions, prepared for sale as a single parcel in accordance with accepted trade practices.

**maximum probable difference** - the maximum difference which can be expected between two mean results measured successively by the laboratory, or two mean results obtained by two different laboratories.

**maximum retest range** - the difference between the values of a retest and the original Test Certificate or an earlier retest which, if exceeded, is deemed to indicate the likelihood of an error.

**mean** - arithmetic average; the mean of a set of values is calculated by dividing the sum of those values by the number of them. (For example, see mean fibre diameter).

The mean of a sample may be calculated from:

$$\bar{X} = \frac{\sum X_i}{N}$$

where  $\bar{X}$  = mean

$X_i$  = the  $i$ th measurement made on the sample

$N$  = is the number of items measured in the sample

**mean fibre diameter** - the arithmetic mean of all fibre diameter readings in a sample.

**mechanical tuft sampling machine (MTS)** - a device used to obtain, by mechanical means, representative tufts of staples from a grab sample.

**micrometre** - a unit of length measurement equal to one-millionth of a metre; it is the unit of measurement for the fibre diameter of wool. It is commonly called a micron.

The symbol ' $\mu\text{m}$ ' is used for micrometre.

**micron** - commonly used name for the unit of measurement of fibre diameter, correctly termed a micrometre ( $\mu\text{m}$ ).

**mid-side sample** - a shorn wool sample of approximately 30 grams taken from the mid-side of a sheep.

**minicore** - a sub-sample obtained by small-diameter coring tubes to provide a representative snippet sample of sufficient mass.

**newton** - the unit of force in the SI system; a force of one kilogram is equivalent to about 9.8 newton (N).

**noil** - the short fibres removed during the combing process; it comprises second cuts, pieces of broken fibres, neps, and is contaminated by small pieces of vegetable matter. (Also see top.)

**objective measurement** - a system in which the characteristics of greasy wool are specified by measurement rather than by descriptive terms resulting from subjective appraisal.

**objectively matched lot (OML)** - a lot of raw wool comprising individually tested classed grower lots exclusively matched after testing and certified only as agreed by IWTO and in accordance with the specific national restrictions.

**objectively matched interlot (OMI)** - a lot of raw wool containing individually tested Classed Grower Lots and one individually tested Interlot comprising a maximum of four single bale Classed Grower Lots, matched after testing and certified only as agreed by IWTO and in accordance with the specific national restrictions, the wool being from one country of origin.

**OFDA (Optical Fibre Distribution Analyser)** - an instrument for measuring fibre diameter mean and distribution using automated microscope and image analysis techniques.

**oven-dry mass** - the mass of material obtained by scouring a sample and exposing it to air at 105°C until equilibrium is reached, and corrected for the moisture content of the drying air.

**position of break (PoB)** - an indication of where a staple breaks during extension, determined by comparing the masses of clean wool in the broken portions of the staple. It does not imply that a break exists in the staple.

**precision** - an indicator of the repeatability of a measurement; it is often expressed in terms of confidence limits. (Also see accuracy.)

**projection microscope** - an instrument for measuring fibre diameter mean and distribution. Magnified images of the profiles of short lengths (snippets) of fibre are projected on a screen and their widths measured by using a graduated scale.

**raw wool** - wool fibre together with variable amounts of vegetable matter and extraneous alkali-insoluble substances, mineral matter, wool waxes, suint and moisture. It includes-

- (a) greasy wool;
- (b) wool which has been scoured, carbonised, washed or solvent degreased;
- (c) scoured skin wools; and
- (d) slipe wools.



## GLOSSARY OF TERMS *continued* [re – yi]

**recore check test** - a set of measurements, made in accordance with the relevant Test Methods, on a further sample of raw wool drawn from the delivery as part of the check testing procedures. A recore check test may only be conducted where a Certificate has not been delivered in relation to a contract.

**recore test** - a set of measurements, made in accordance with the same standard test method as that adopted for the original test, on a further coresample of raw wool drawn from a lot for which the test result is in doubt. Such sample material must be obtained by resampling bales in accordance with current sampling Standards or regulations. The recore test result must be adjusted for any declared or observed change in net greasy mass of the lot.

**regain** - the mass of moisture in a mass of textile fibres determined under prescribed conditions, expressed as a percentage of the clean oven-dry mass of fibre. Most wool is traded on the basis of its mass at regains specified by IWTO Regulations.

The IWTO Standard Regain is 19% for Tops combed in oil and 18.25% for Tops dry combed.

**regrab test** - a set of measurements made in accordance with the same standard test method as that adopted for the original test, on a further grab sample of raw wool drawn from a lot for which the test result is in doubt. Such sample material must be obtained by resampling all bales in accordance with the IWTO Staple Test Regulations.

**resistance to compression** - the force per unit area required to compress a fixed mass of scoured and carded wool to a fixed volume. The result is expressed in kilopascals. (Also see bulk.)

**retest** - a set of measurements made, in accordance with the relevant IWTO Test Methods, on a further sample of wool drawn from a delivery for which the original Certificate is in doubt. This differs from a recore check test in that duplicate coresamples, or duplicate samples and duplicate sets of staples, are drawn for possible testing by two separate Test Houses to resolve a disputed result. Such sample material must be obtained by recoring or grab sampling where applicable and reweighing all bales, in accordance with the IWTO Test Regulations.

**romaine** - the amount of noil produced during combing expressed as a percentage of the total top and noil. (Also see tear.)

**sale lot** - a number of bales of similar mass and from the same country of origin, containing greasy wool prepared for sale according to accepted trade practices. (Also see interlot, lot and objectively matched lot.)

**sample** - the wool drawn by appropriate methods from a lot, bulk or delivery. In order to issue IWTO Test Certificates, the sample must be drawn in strict accordance with the relevant IWTO Test Regulations to ensure that it is representative.

**sample container** - a container constructed so that there is no loss of material or undue exposure to the atmosphere, i.e. the sample stored therein shall not show a material change in its moisture content during storage before weighing.

**sealed container (for grab samples)** - a container which is closed in a manner which prevents unauthorised interference with the contents.

**sealed container (for coresamples)** - a container which is impermeable to moisture so that the contents are maintained without change to their moisture content.

**second cut** - a staple resulting from shearing an area on a sheep which has already been shorn. A second cut differs from a normal staple in that both ends are severed and no tip end is evident. In Staple Length measurement second cuts are considered as staples.

**shirley analyser** - a laboratory card used for removing vegetable matter from scoured wool and blending the fibres for subsequent measurement.

**snippet** - very short pieces of fibre, typically around 2 mm long, which have been cut to measure Fibre Diameter and related properties. (Also see minicore, Laserscan, OFDA and projection microscope.)

**spectrophotometer** - an instrument used to measure the reflectivity of a surface within the visible spectrum. It may be used, as an alternative to a colorimeter, to measure the colour of clean wool.

**standard conditions** - standard atmospheric conditions used to normalise test conditions for measurements, which are affected by temperature or humidity. For most wool measurements the standard conditions are a temperature of  $20 \pm 2^\circ\text{C}$  and a relative humidity of  $65 \pm 3\%$ . (Also see conditioning atmosphere.)

**standard deviation** - a measure of dispersion of individual results. Standard deviation is expressed in the units of measurement. (Also see variance and coefficient of variation.)

**staple** - a well-defined bundle of fibres which has been removed from a mass of greasy wool as a unit. In Staple Length and Staple Strength measurement, staples are considered to include second cuts.

**staple axis** - an imaginary line along a staple in the direction of the majority of its component fibres.

**staple length** - the length of a staple projected along its axis obtained by measuring the staple without stretching or disturbing the crimp of the fibres.

**staple strength** - the maximum force required to rupture a staple per unit of average linear density. (Also see ATLAS.)

**sub-sample** - the randomly drawn portion, representative of a sample from a lot to be tested, used for a specific test measurement.

**suint** - water soluble component (sweat) extruded from the wool follicles.





**tear** - the mass ratio of top to noil produced by combing. (Also see romaine.)

**tender wool** - wool for which a significant proportion of staples exhibit a marked weakness, at corresponding points in all the fibre of the staples. (Also see break, position of break.)

**test** - a set of measurements made on a sample of raw wool, in full accord with an IWTO test method.

**test house** - a laboratory which carries out tests in accordance with the current IWTO test methods and regulations. In order to issue IWTO Test Certificates the laboratory must be a licensed laboratory.

**test house samples** - in testing, that portion of raw wool retained by the test house after a test has been conducted (also known as keeper samples).

**test result** - the result which is obtained by applying a standard test method to a sample obtained in accordance with a standard sampling method and is-

- (a) shown on a Test Certificate;
- (b) issued by a test house; or
- (c) a component of a combined Certificate.

**test specimen** - a randomly drawn portion from and representative of a sub-sample, to be used for a specific test measurement.

**testing error** - an error in laboratory testing procedures.

**tip** - the end of a staple opposite to the end shorn from the skin. (Also see base.)

**tip length** - the number of millimetres from the staple tip to a point where the staple width is 75% of the average staple width.

Note: tip length is based on the amount of wool present in the tip; it does not reflect staple tip shape.

**top** - sliver that forms part of the starting material for the worsted and certain other drawing systems, usually obtained by the process of combing, and characterised by the following properties:

- (a) A substantially parallel formation of the fibres, essentially free of vegetable matter.
- (b) The absence of fibres so short as to be uncontrolled in the preferred system of drawing.
- (c) A substantially homogeneous distribution throughout the sliver of fibres from each length group present.

**total alkali-insoluble matter** - the oven-dry, ash-free, ethanol-extractives-free, alkali-insoluble matter present in a test specimen (expressed as a percentage of the mass of the test specimen). It comprises vegetable matter, together with any skin, dags, pack material, string and paper.

**total sample** - a representative sample of wool obtained by coring bales of raw wool. When issuing an IWTO Certificate, sampling must comply with the IWTO Core Test Regulations.

**transport container** - a lockable or sealable container in which samples are transported.

**tristimulus value** - one of the three reflectance readings obtained when using a colorimeter; specified by the Commission Internationale de l'Eclairage (CIE) as X (red), Y (green) and Z (blue). Y and Z are used in specifying the clean colour of wool.

**true value** - the absolute value of a characteristic for a bulk, e.g. a lot or a consignment; it is almost always unknown. Measurements of the characteristic are, in the absence of bias, normally distributed about the true value with a variance that is also unknown in a particular case. The mean of a set of measurements is the best estimate of the true value.

**tuft of staples** - a bundle of wool consisting of approximately 1 to 20 staples drawn in one action.

**variance** - the variance of a sample is the square of the standard deviation and is a measure of the distribution of values around the mean. It is expressed in the units of measurement squared. (Also see coefficient of variation.)

The variance of a sample may be calculated from:

$$S^2 = \frac{\sum (X_i - \bar{X})^2}{N - 1}$$

where  $S^2$  = variance (standard deviation squared)

$X_i$  = the  $i$ th value measured in the sample

$\bar{X}$  = mean of the sample measurements

$N$  = the number of items measured in the sample

**vegetable matter** - burrs (including hard heads), twigs, seeds, leaves and grasses present in wool.

**Vegetable Matter Base (VMB%)** - the oven-dry mass of ash-free, ethanol-extractives-free burrs (including hard heads), twigs, seeds, leaves and grasses present, expressed as a percentage of the mass of the sample.

**Wool Base (WB%)** - the oven-dry mass of wool fibre free from all impurities, i.e. ash-free, ethanol-extractives-free and free from all vegetable matter and other alkali-insoluble impurities, expressed as a percentage of the mass of the sample.

**yellowness** - the difference between the reflectances of a surface in the green and blue regions of the spectrum, expressed as the difference between the tristimulus values Y and Z; it is reported as (Y-Z). (Also see brightness and colour.)

**yield** - the amount of clean fibre, at a standard regain, that is expected to be produced when a delivery of raw wool is processed. The yield may be expressed both as a clean mass in kilograms and as a percentage of the mass of raw wool prior to processing.



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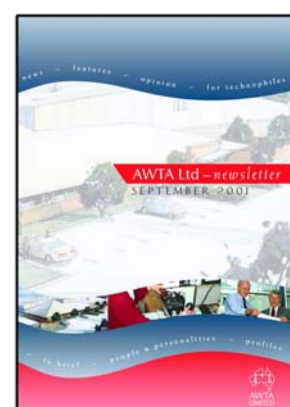
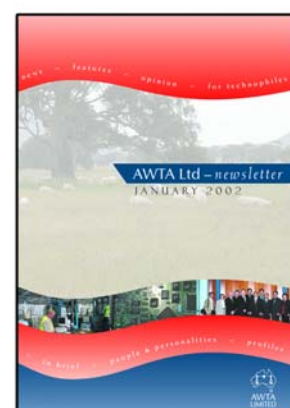
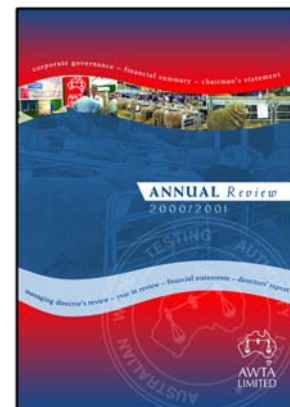
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