WOOL TESTING

Understanding through Science

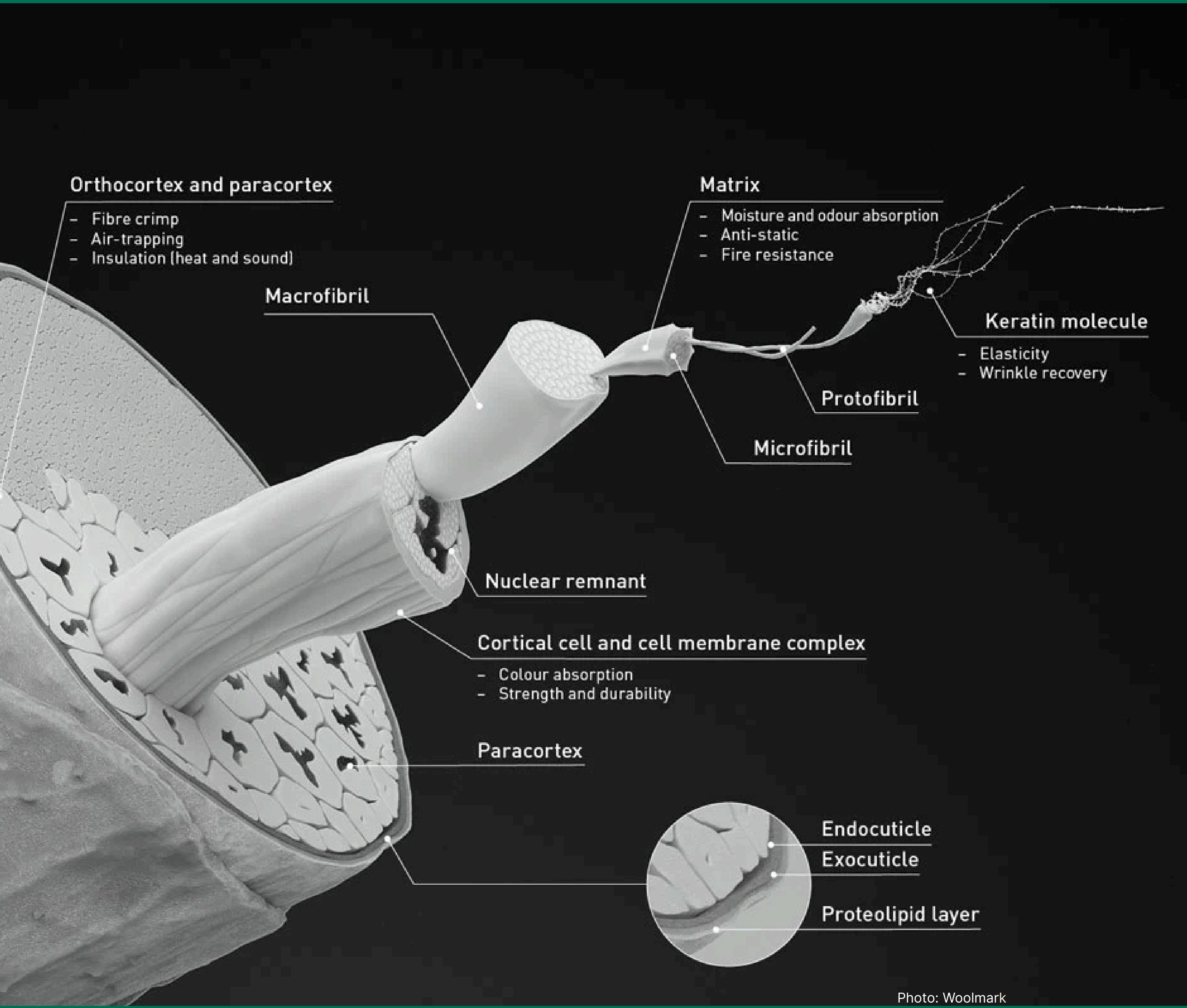


Photo: Woolmark

WOOL REVEALS ITSELF SLOWLY

Wool is not a quick study. Understanding it takes time, experience, and the passing of the seasons. It engages all the senses—sight, touch, smell, even sound. You must live with it through winter's cold and summer's heat to see how it shifts and adapts. It must be experienced in all its forms: greasy, clean, carded, combed, spun, woven, knitted, felted. It transforms with each process, and with it, your understanding grows. You can't get to know wool without being fully present to the experience. It's an analogue thing.

You'd think scientific wool testing, with its cold, precise appraisal would be the opposite. But it's not. Scientific testing is a partner and a mirror to the analogue experience—a calibrated reflection of what your senses are telling you. It doesn't replace intuition; it sharpens it. And testing teaches you about the properties of wool that you may have overlooked.

In this post, I'll share how wool testing has become a cornerstone of my work—how it bridges the gap between hands-on experience and scientific insight. From the first time I encountered Optical Fiber Diameter Analysis (OFDA) to integrating testing for manufacturing, quality assurance, and advocacy, this journey has shaped how I see and work with wool.

I hope this edition of my LATEST offers an interesting perspective into the science behind the fibre.

Photo iStock. Credit: Dejavu Designs

WHAT IS WOOL TESTING?

Wool tests are objective scientific measurements of wool's properties, using various instruments and techniques. They are carried out in a laboratory, on-farm or in a mill. They include diameter, length, colour, yield, and vegetable matter measurements to name a few. Collectively, these properties contribute to the overall value of wool, relative to the market price.

Scientific tests play a vital role in decision-making across the wool supply chain and around the world. Their purpose varies depending on whether one works upstream or downstream in the supply chain.

In global trade, wool test certificates provide buyers and brokers with objective quality assurance. For a manufacturer, testing helps match raw wool to the right processes, improving efficiency and reducing waste. On the farm, testing provides valuable feedback on fibre quality and flock health. They inform breeding, animal care, and shearing decisions —ultimately they contribute to improving wool's value and marketability.

BRIEF HISTORY OF WOOL TESTING

The earliest example of laboratory wool testing dates to the 1770s, when wool's fineness was measured in micrometers using a microscope. A wool sample was placed under the microscope on a piece of lined quartz and the fibre's diameter was measured against the lines. The microscope became the preferred instrument of measurement well into the 1930s.

The 1950s saw a breakthrough with Airflow technology enabling quick and accurate core testing of greasy and scoured commercial wool. The United States, Australia and other wool nations began developing their own wool testing methodologies using Airflow. From country to country, methods varied depending on how moisture and impurities in the wool were understood and calculated.

In 1965 the International Wool Textile Organization (IWTO) facilitated an agreement between technical and commercial IWTO members for a singular core testing process that could be used globally. The agreed upon testing method in 1965 forms the basis for calibrated wool testing used today.

Since 1999, Optical Fiber Diameter Analysis (OFDA) technology has been changing the landscape of testing for fineness of greasy wool. The advantage of OFDA is its relative portability and convenience. The OFDA 2000 comes in a carrying case and can be easily carried along with the wool grader. It's an ultra convenient and efficient way to integrate objective measurement into wool harvesting and classing systems, as well as informing breeding decisions.

Recent model OFDA 2000 in Pelican carrying case. Photo: OFDA.com

MY INTRO TO WOOL SCIENCE

My sensory evaluation of wool and my data literacy developed side by side—which is unusual in Canada. Most of our wool workers learn about wool from previous generations, through apprenticeships, on farms or in craft circles and guilds.

In the absence of those opportunities, testing offered a shorthand to understanding what I was feeling. It provided objective feedback which I feel accelerated my learning. While nothing replaces hands-on experience and coaching, testing added a valuable dimension for me —anchoring intuition in evidence.

My first exposure to wool testing came from Lisa Surber Ph.D. of LM Livestock Services. Lisa was teaching Wool Handling and Classing at the 2017 All Canadian Sheep Classic. Her course introduced us to Optical Fiber Diameter Analysis (OFDA) as a tool to understand wool fibre. She used OFDA reports to show how much information can be captured through scientific testing.

A few months later, I gave a wool talk to OSF District 9 in Renfrew Co., Ontario and asked producers to submit wool samples, which were sent to Lisa for OFDA testing. The reports were fascinating. Lisa helped me interpret the data and the results were my first proof that Canadian wool had value. OFDA gave me a way to peek behind the curtain of micron count.

Some might say that wool testing is a shortcut to *real* wool experience. While nothing can replace experiential learning, I think Canada abandoned its wool heritage a long time ago. We let go of skills, knowledge and leadership in our industry. Today, I'm doing my part to build a modern approach to wool management. Scientific testing is a cornerstone of that work

READING AND USING DATA

In this next section, I'll show you what wool test reports look like. There are quite a few complex elements to it. I'll pick a few highlights that might be interesting. I'll save the rest for another issue of my LATEST.

MICRON VS. COMFORT FACTOR

It's generally assumed that lower micron wool is inherently superior—but micron alone doesn't determine comfort or quality. A 29-to-32-micron fleece may seem coarse compared to superfine Merino, but if it has a low coarse edge and a high comfort factor, it can feel remarkably soft. This is where scientific testing helps: it allows us to look beyond the greasy staple and forecast wool's true potential. In fact, many Canadian mid-micron wools test surprisingly high in comfort factor.

While I'm not suggesting that 29 micron wool is appropriate for next-to-skin apparel, I would argue that a blanket made of 29 micron Canadian wool is just as luxurious as a merino wool blanket when the proper processing techniques are used.

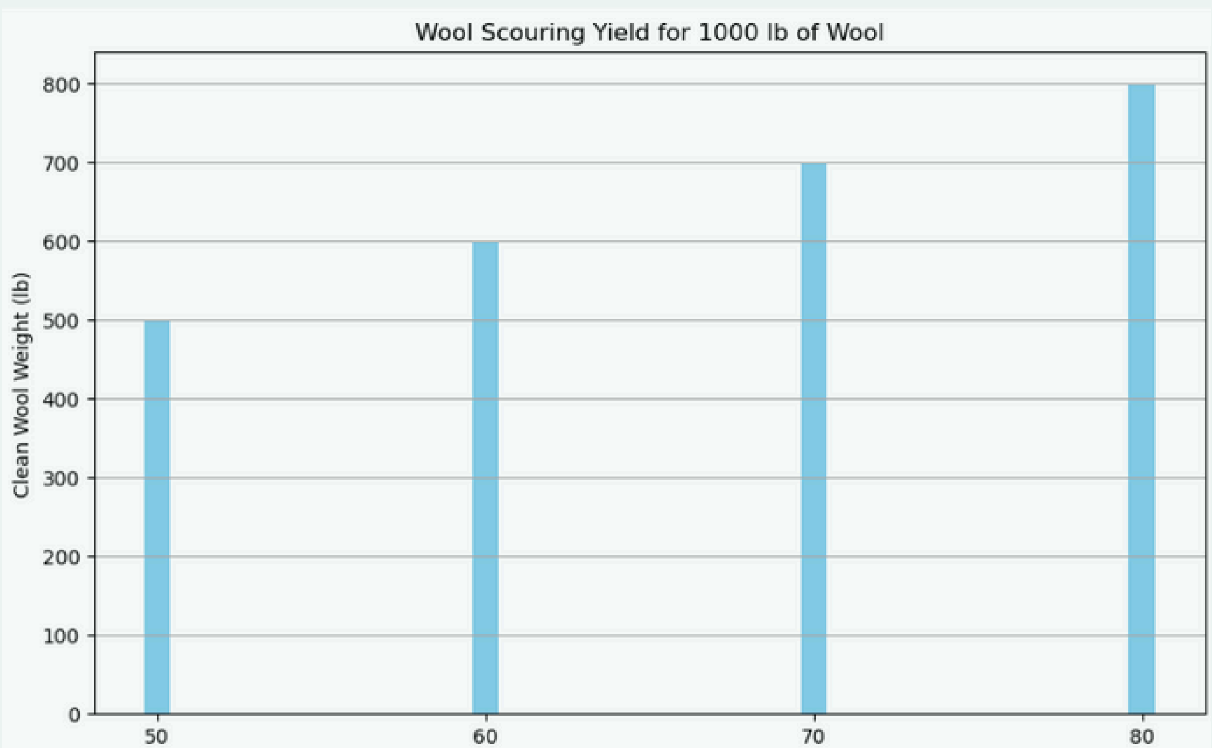
WOOL YIELD

Yield is a tricky metric—it means different things to different people in different places. In the simplest terms, yield refers to the percentage of usable fibre remaining after grease, dirt, and vegetable matter are removed. While OFDA testing doesn't directly measure yield, it's a critical factor in wool valuation that should never be overlooked.

Yield is typically assessed through lab scouring and is influenced by breed, environment, and how the wool is handled. It's also sensitive to humidity, which can cause it to gain or lose mass throughout the year and across regions and climates.

For me, yield is as important as micron or comfort factor because it directly correlates with processing cost. Wool is processed based on incoming "greasy" weight. If the yield is low—it means a large portion of the wool will be lost during processing. This will increase the cost per usable pound (or kilogram), and the volume (or amount) of finished product decreases. That has a direct impact on both efficiency and profitability.

The table below illustrates a simple yield metric on 1,000 lb of greasy wool.



The table shows 1,000 lb of greasy wool entering scouring. If yield is forecast at 80%, it means I can expect to have 800 lb of clean wool after scouring. If yield is 50%, I can expect to have 500 lb of clean wool.

Let's do some math:

I buy 1,000 lb of wool for $1.00/lb = $1,000
I send 1,000 lb of wool to scouring at $1.60 lb = $1,600
My total cost for output clean wool is $2,600

If yield is 80%, I have 800 lb of clean wool. ($2,600 / 800 = $3.25/lb)
If yield is 70%, I have 700 lb of clean wool. ($2,600 / 700 = $3.71/lb)
If yield is 60% I have 600 lb of clean wool. ($2,600 / 600 = $4.33/lb)
If yield is 50% I have 500 lb of clean wool. ($2,600 / 500 = $5.20/lb)

In my work, I typically see scouring yields around 60% - 68%. I've seen yields as low as 48% but that was easily corrected with improvements in wool sorting and skirting.

Yield on Canadian wool has everything to do with how the wool is sheared, sorted and skirted. Double cuts, putting tops and bellies in the same bag as good fleece, or not doing a nice skirting means that stuff gets into scouring that doesn't need to get into scouring.

TEST EXAMPLES

Below is an OFDA Report and an IWTO Report from the same farm using the same wool sample from 2024. Following the reports, I'll provide a summary of the result.

FARM PROFILE

Commercial crossbred flock. 800 head. Hybrid housing (pasture and confinement). Straw bedding. Combination annual and accelerated lambing. Grass, TMR (Total Mixture Ration) and mineral feed. Hay is round bale rolled out. Mechanized drive-thru for TMR. No bunk or bale feeders. Breed cross includes Coopworth, Dorset, East Friesian and Texel. Genetic software used for breeding decision making.

Wool Testing Authority Europe Ltd
Cibyn Industrail Estate
Caernarfon
Gwynedd
UK
LL55 2BD

Cust om er
J. UNDERHILL WOOL INC.
26 RUE LOCKWELL,UNIT 1
QUEBEC CITY GIR IV7

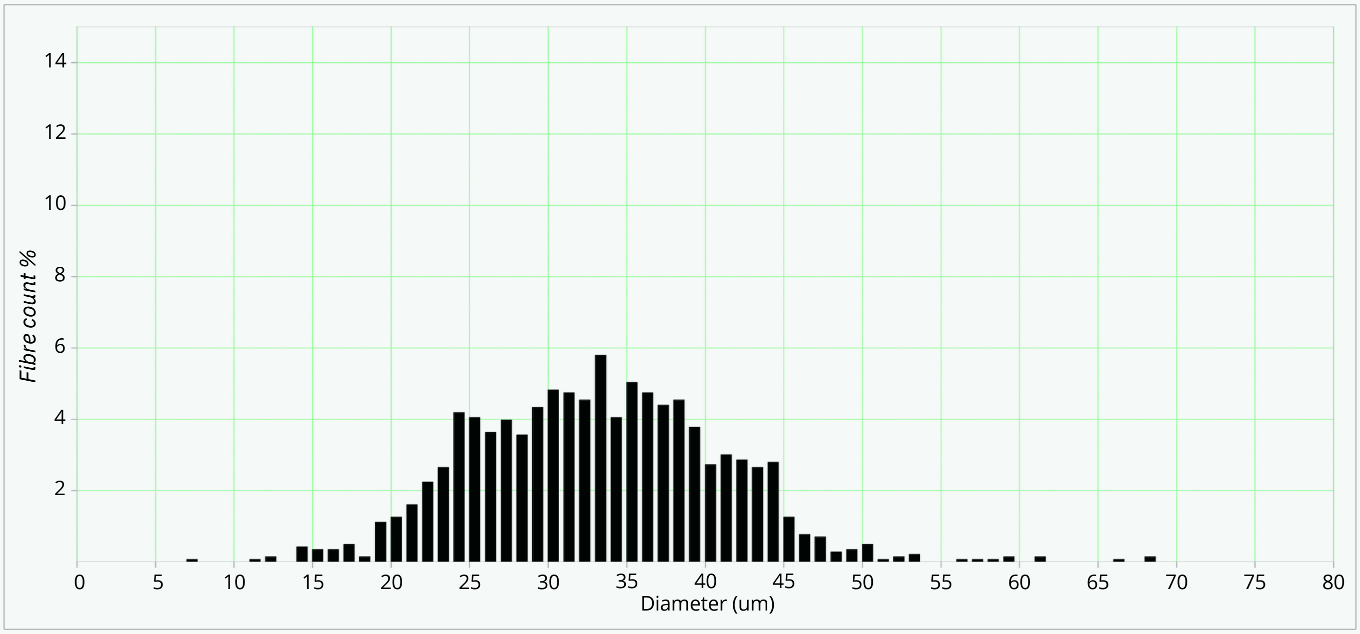
OFDA Test Report

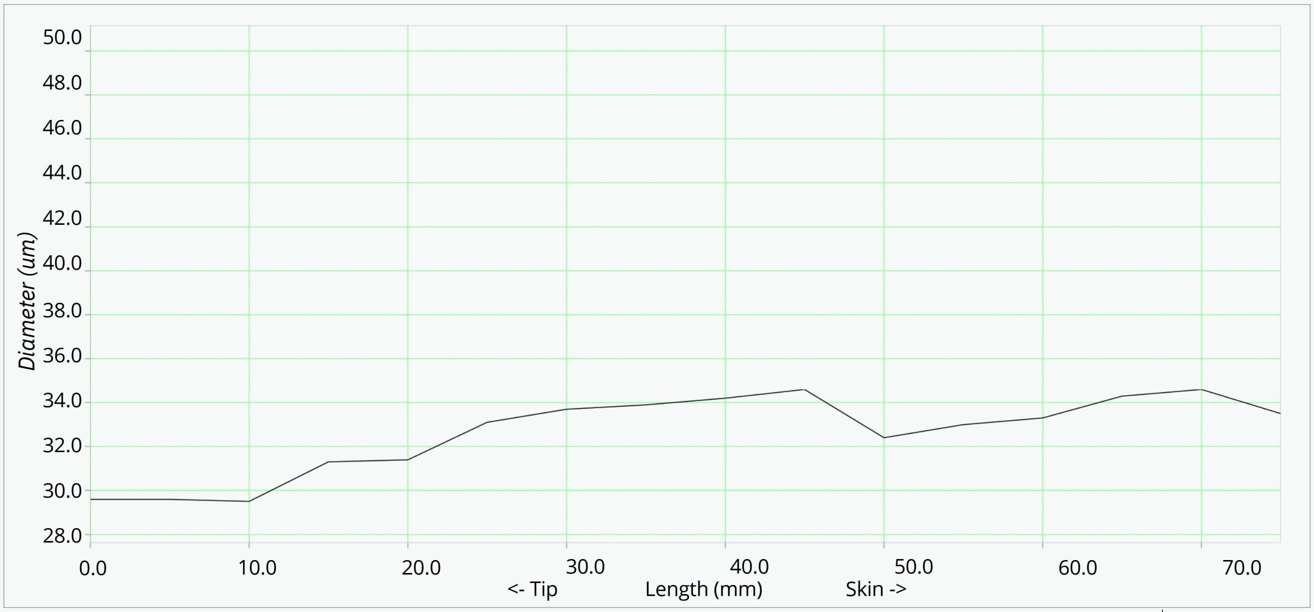
OFDA2307 v5.415 (Cal:4.6227W-1.20), Measured: 07May24, File: J. UNDERHILL WOOL (2) 07.05.2024.mes

Name : A004
Description : WOOL
Operator : IJ
Lot/client : LAINE OA WOOL

Diameter : 32.8 um
SD : 7.8 um
CV : 23.7 %
CE : 12.2 um
Comfort : 39.4 %
%<15um : 0.7 %
Spin fineness : 32.7 um
Curve : 44.1 deg/mm
Curve SD : 35.1 deg/mm
Num fibres : 1433

Staple length : 80.0 mm
Finest from tip : 10.0 mm
Mean diam ends : 31.6 um
Skin diam : 33.5 um
Min diam : 29.5 um
Max diam : 34.6 um
SD Along : 1.8 um
SD Across : 7.7 um



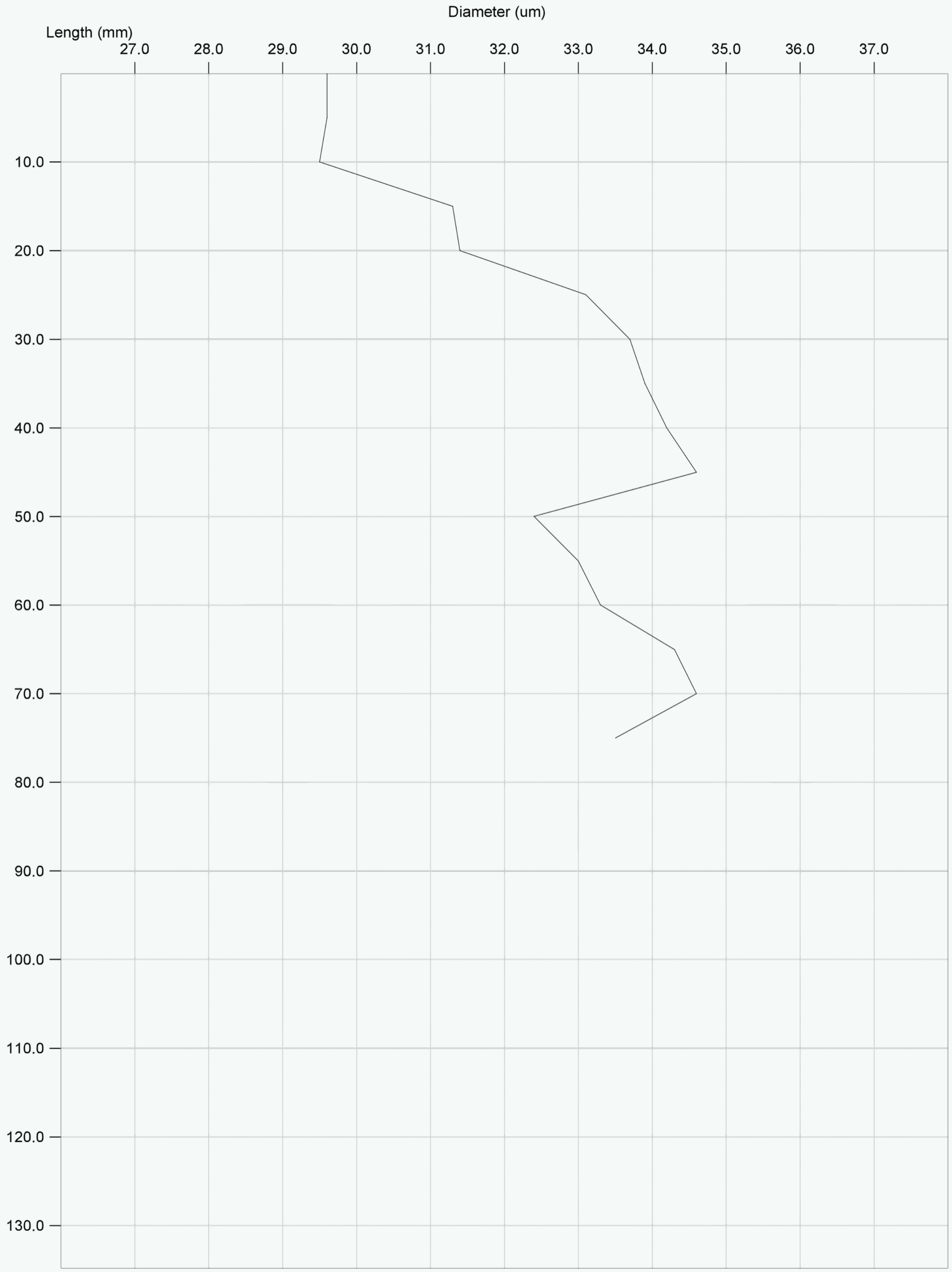


WTAE : Staple Graph

Date : 07May24
Sample ID : A004
Description : WOOL
Lot/Client : J.UNDERHILL WOOL INC.
Operator : IJ

OFDA2307:5.415 Cal: D = 4.6227*WH -1.20
Filename: J.UNDERHILL WOOL (2) 07.05.2024.mes

Diam	=	32.76[7.76] um
Min Diam	=	29.50 um
Max Diam	=	34.60 um
SD Along	=	1.77 um
Length (mm)	=	80.00 mm
Break Point	=	10.00 mm



WOOL TESTING AUTHORITY EUROPE LTD

Unit 7, Lon Barcud, Cibyn Industrial Estate, Caernarfon, Gwynedd LL55 2BD, Wales
Telephone: (+44) 1286 678097, Facsimile (+44) 1286 678039, E-mail: info@wtaeurope.com

Date01 May 2024

TEST REPORT

Test No1-00316090.B0

Brand: A004

Greasy Wool

Gross Mass	:	0Kg
Declared Tare	:	0Kg
Nett Mass	:	0Kg

Total Bales :1
Bale Numbers:

Fibre Fineness **Airflow (IWTO-28)**

Mean Fibre Diameter : 32.0 microns
(2 specimens)

Colour (IWTO - 56)

(4 specimens) Sampled :30 Apr 2024

D65/10; X: 62.3 Y: 65.7 Z: 51.3 Y-Z: 14.4

C/2(w); X: 60.4 Y: 61.9 Z: 56.0 Y-Z: 5.9

Yield Test Results

Wool Base (IWTO-19) (2 samples tested) : 57.28 %

Vegetable Matter Base (IWTO-19) : 0.2 %

(Including 0.00 % Hard Heads and Twigs)

Calculated Commercial Yields	%	Kg
IWTO Scoured Yield at 16% Regain	68.2	
IWTO Schlumberger Dry	***66.5***	
IWTO Scoured Yield at 17% Regain	68.8	
IWTO Clean Wool Content	68.6	
ASTM Clean Wool Fibre Present	66.6	
Japanese Clean Scoured Yield @16%	67.5	

For electronic verification go to http://verify.wtaeurope.com and enter the following code: **qs5-f93-rpd**

UKAS TESTING
2680

WOOL TESTING AUTHORITY EUROPE LTD
Unit 7, Lon Barcud, Cibyn Industrial Estate, Caernarfon, Gwynedd LL55 2BD, Wales
Telephone: (+44) 1286 678097, Facsimile (+44) 1286 678039, E-mail: info@wtaeurope.com

TEST REPORT
Length Report

Test No 1 -00316082.P 7

Greasy Wool

Date 30 Apr 2024

Brand: A004

Mass when sampled

0

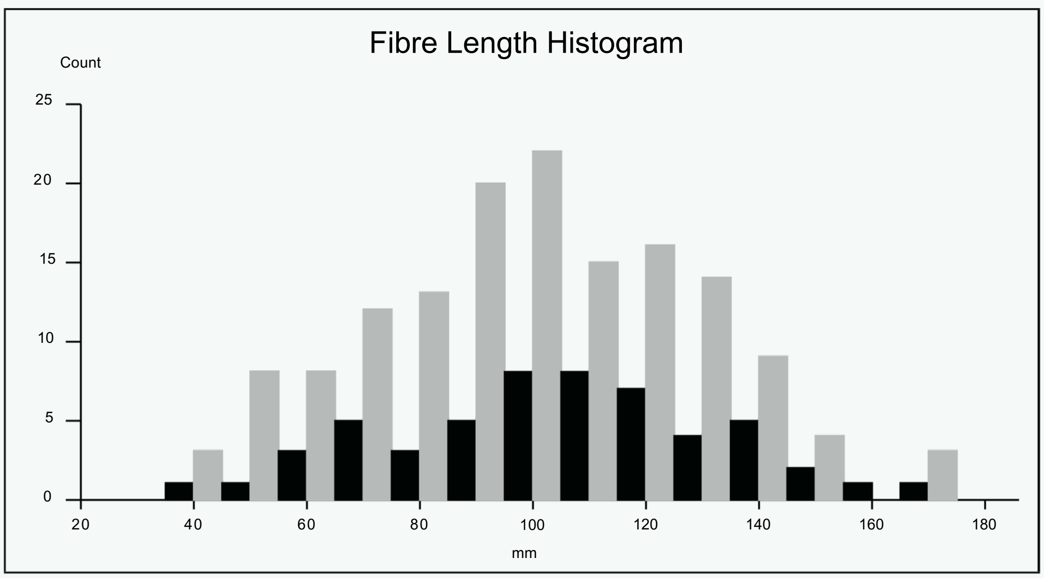
0

0

Total Bales : 0

Results :

Mean Length	110 mm
Standard Deviation	28.80 mm
Coefficent of Variation	26.20 %



THIS TEST REPORT APPLIES ONLY TO THE SAMPLES TESTED.
Except where the sample is drawn independently by WTA Europe Ltd, WTA Europe Ltd makes no warranty, implied or otherwise, as to the source of the tested sample. The above test results are not certified due to the adoption of modified and/or non-standard procedures designed to provide THE CLIENT WITH GUIDANCE INFORMATION ONLY. Except where precluded by law, no responsibility can be accepted by WTA Europe Ltd for any claim which may arise from any person acting on information contained herein.

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OFDA KEY METRICS

Diameter (32.8 μm):
The average fibre diameter is measured in microns. This is often the first number people look at, but it doesn't tell the whole story.

SD (7.8 μm):
Standard deviation of fibre diameter. A lower SD means the fibres are more uniform. There is less deviation from the shortest to the longest fibre.

CV (23.7%):
Coefficient of variation. This is SD expressed as a percentage of the mean diameter—another measure of consistency. Here, the wool sample shows a swing of 23.7% difference between the shortest and the longest fibre.

CE (12.2 μm):
Coarse edge. This indicates by how many microns fibres are coarser than the average—important for comfort.

Staple Length (80 mm):
The length of the wool fibre sample, which influences processing and end use. Staple is another word for the length of the lock of wool.

Comfort Factor (39.4%):
The percentage of fibres under 30 microns. Higher comfort factors generally mean softer wool.

%<15 μm (0.7%):
The percentage of ultra-fine fibres or fibres under 15 microns. This is more relevant in superfine wools.

Spin Fineness (32.7 μm):
A calculated value that estimates how the wool will behave in spinning—often close to the average diameter.

Curve (44.1 deg/mm):
Crimp frequency, which affects elasticity and loft.

IWTO KEY METRICS

IWTO Test Report for the same farm, from the same grab samples with tests executed within the same 2-day period. Notice how there are some slight deviations between laboratory testing and OFDA readings. For international trade, the IWTO reading is the true report. It's hard to say why there are slight differences. It could be that OFDA is not calibrated, or it could be there was a slight difference in the fibre sample. When in doubt, get your hands on the wool. Do a sensory evaluation and test again.

Micron 32 μ – The IWTO reading is slightly finer than OFDA.

Colour

D65/10; X: 62.3 Y: 65.7 Z: 51.3 Y-Z: 14.4
C2 (w); X: 60.4 Y: 61.9 Z:56.0 Y-Z: 5.9

These tests show a creamy wool that would take dyes relatively well. Some adjustments would be necessary for pastel colours.

Colour tests are a blend of two separate tests. D65 is intended to simulate daylight. C illuminant was an earlier attempt to produce daylight from incandescent illumination with filtering. You can dive deeper by reading this short article.

Level	Brightness Y		Level	Yellowness Y – Z	
	D65/10	C/2		D65/10	C/2
Very bright	>70	>66	Very white	<9	<-2
Bright	68-70	64-66	White	9-10.5	-2 – 0
Average	64-68	60-64	Slightly creamy	10.5-12.5	0-3
Slightly dingy	59-64	56-60	Creamy	12.5-14.5	3-6
Dingy	<59	<56	Quite yellow	14.5-16	6-8
			Heavily stained/yellow	>16	>8

Length

IWTO Mean Length: 110 mm - this differs from the OFDA reading by 30mm
Standard Deviation: 28.80 mm
Coefficient of Variation: 26.20%

The length reading on these sample tests require further study. Woolen processing cannot accommodate more than an 89 mm staple length. The OFDA reading showed a perfect 80 mm staple length. IWTO is showing 110 mm. In real world manufacturing, I'd send a sample to my processor for a hand/visual assessment before accepting this wool for a project.

Yield

More on yields - I told you yields were tricky things...

On the IWTO Report you'll notice the section "Yield Test Results" and under it there is a long list of percentages. Here's what that means:

Yield

Yield calculations start with a base amount of wool, recognizing that some residual mineral or grease will be present after scouring and some moisture will be lost and regained. In global wool trade, there are preferred methods for calculating yields depending on the region and the stakeholder.

Wool Base (IWTO-19): 57.28%
Vegetable Matter Base (IWTO-19): 0.2%
IWTO Scoured Yield at 16% regain: 68.2%
IWTO Schlumberger Dry: 66.5%
IWTO Scoured at 17% Regain: 68.8%
IWTO Clean Wool Content: 68.6%
ASTM Clean Wool Fibre Present: 66.6%
Japanese Clean Scoured Yield @16%: 67.5%

Schlumberger Dry is used in worsted spinning to calculate the percentage of top (useable wool) versus noil (waste wool). ASTM is a North American testing standard that allows for 13.64% moisture regain and 2.27% impurity while Japanese Clean Scour is a testing standard that allows for a 16% moisture regain and 1.5% impurity.

Given the precision of scientific measurement in the global wool industry, it's understandable how Canadian wool can be overlooked and undervalued. Yet, with modest refinements, it holds the potential to gain significant worth—emerging as a competitive domestic commodity. When paired with compelling national storytelling and skilled manufacturers who understand its unique qualities, Canadian wool can reclaim its place in the market.

CURIOUS ABOUT A CAREER IN WOOL SCIENCE?

I asked Lisa Surber of LM Livestock Services what it takes to be a wool scientist. Raised on a ranch in Alberta, Lisa earned her PhD in Ruminant Nutrition from Montana State University, where she began working in wool testing at the MSU Wool Lab in 2005. Her hands-on experience with sheep and strong scientific background proved invaluable. By 2009, she was managing the lab, and today she wears many hats—grader, classer, marketer, teacher, rancher, and scientist.

Lisa believes anyone can participate in wool testing, but accurate, responsible interpretation of data requires more: scientific curiosity, a working knowledge of the mechanics of science, some statistics training, and some exposure to wool. While hands-on experience isn't strictly necessary, she believes it's much harder to judge the accuracy of your results without a deeper understanding of wool.

CARE TO DIVE DEEPER?

Elisabeth VanDelden's 2017 Wool Academy podcast interviews Michael Jackson of Australian Wool Testing Authority. WoolWise, the website of the Australian Wool Education Trust is a wealth of information on science and testing. Woolmark is always helpful and inspiring. Australian Wool Innovation's podcast: The Yarn

IT TAKES A VILLAGE

Harriet Boon, Richard Snell, Graham Rannie and Don Metheral do not require machines to read wool. They are among Canada's finest wool appraisers. Dr. Lisa Surber (US) and Dr. Courtney Pye (UK) have taught me about the instruments of wool testing, as has my IWTO colleague Michael Jackson (AU), Managing Director of Australian Wool Testing Authority. Dr. Helen Knibb (ON), Lesley Prior (UK), Sarah Nettleton (NS), Leah Murray (ON), and Jenny Carnaghan (ON) lend a farmer's perspective to every conversation. Serge Lemieux, Ginette Blais, Danny Giguère, and Nadia Ducharme at Filature Lemieux in St-Éphrem share their skill, vision and 120 years of experience. It takes a village to raise an industry.