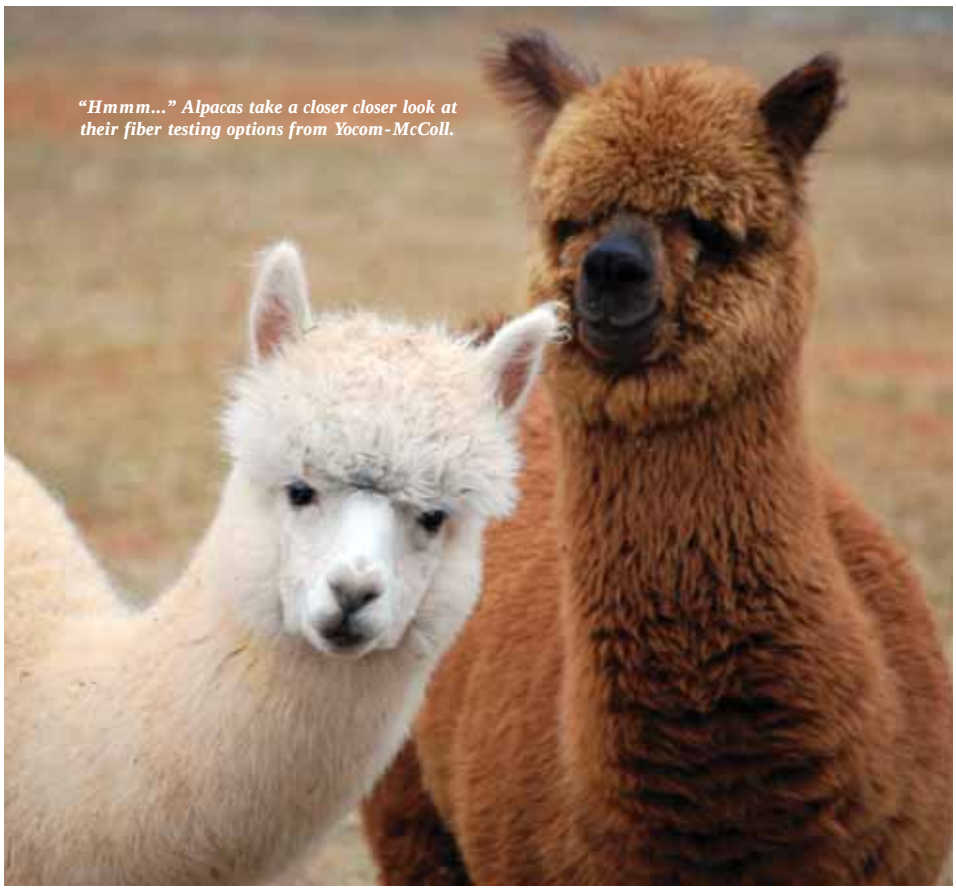
A Closer Look at Fiber Testing



"Hmmm..." Alpacas take a closer closer look at their fiber testing options from Yocom-McColl.

Photo courtesy of Mary Clare Hughes, Gem View Farm & Fiber, Powhatan, VA

By Angus and Margaret McColl

Alpacas aren't the only ones who might feel they are "wandering out in the weeds" when trying to make sense of histogram reports. Deciding whether a Laserscan or an OFDA100 report or perhaps a staple profile test from the OFDA2000 will provide the most relevant information requires an understanding of how each instrument operates and the data it reports.

Asking the question "what is everyone else doing" is only natural, but a better question might be "how do I make the most of these results in my herd management plan?" Certainly not as natural a question in conversation, but in the long run it is one that might help to establish a breeder's reputation for animals with consistently high quality fiber.

Which test will give me the lowest fiber diameter? Are these good results or bad results? Fiber testing is not intended to answer these questions without at least considering age, sex, and level of nutrition. The selection of animals with the potential for fine fiber in a breeding program or the market value of objectively measured fleece for an end product does not have a simple "one size fits all" answer.

Examples of one (large) sample tested on the three instruments, Laserscan, OFDA100 and then the OFDA2000, is easier to compare when the fiber tested is as fine and uniform as the following fiber results from a two year old, white huacaya male will demonstrate.

You will notice the Laserscan and OFDA100 data are very close in the two following reports although the results are not representing identical fibers tested.

The scale for each individual test is different. The vertical axis representing "percentage of observations" on the LaserScan report has been set for 2000 fibers. The percentages on this scale will vary with the distribution of fiber diameters in each sample tested.

The OFDA100 instrument is operated by taking "a double pass" or two times across a 70mm square slide. Depending on the number of fibers in focus on the slide, the number of fibers measured can rise to several thousand fibers more than are measured on the LaserScan. The vertical scale will be scaled to accommodate the range of fibers measured so each histogram will fit our report format.

Now the Staple Profile Report (OFDA2000) is testing additional fibers from this same fine and uniform fiber sample from a two year old, white Huacaya male. This test is measuring fibers across and along the length of the staple to identify environmental influences which occurred during the growth period (ideally from the date of previous annual shearing).

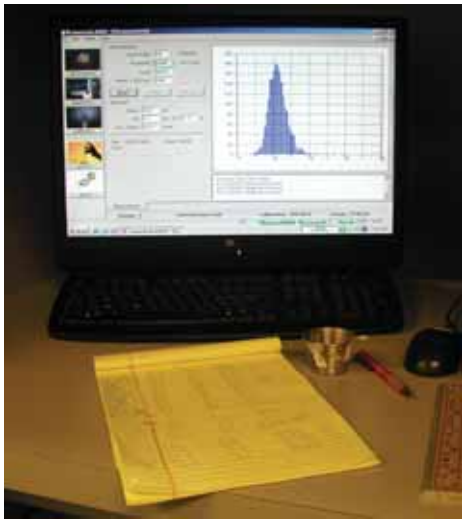
The OFDA2000 is not measuring the same number of individual fibers as either the Laserscan or the OFDA100. The OFDA2000 stops at 5mm increments to measure fiber diameters across and along the length of the staple. If stresses are minimized in the alpaca's environment, the staple profile will reflect fewer dramatic peaks and valleys and the standard deviation will remain low.

LaserScan

The Sirolan LaserScan instrument measures fibers by dispersing individual snippets (two millimeter lengths of fiber) in a solution of isopropanol and water and this fluid transports the fibers through a glass cell where each one intersects a laser beam. The LaserScan measures the change in the signal generated when the shadow cast by the fiber snippets falls on a light detector. The signals, which are directly proportional to the fiber diameter, are recorded electronically and analyzed almost instantaneously by computer.

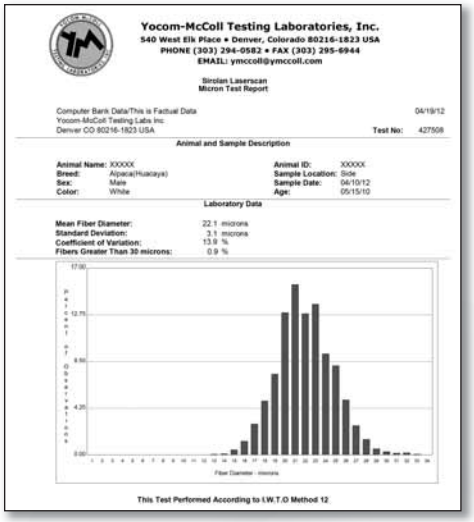
The micron test report includes administrative information provided by the identification sent in with the individual sample. The histogram will be scaled to fit our letter size report format. The bottom line (or horizontal scale) is measured either in one or two micron increments, with one micron equivalent to one millionth of a meter or 1/25,400 of an inch.

To analyze the micron test report histogram, find the Mean Fiber Diameter (MFD) on the horizontal scale showing fiber diameter in microns. Standard Deviation is a term representing an average of individual deviations (plus or minus micron values) from the mean or MFD. The smaller the Standard Deviation, the more uniform the population of fibers



Histogram display on computer screen of fiber measurements recorded by SIROLAN Laser Scan

measured. It is the most stable of variability measures and is used in the computation of other fiber statistics such as the Coefficient of Variation (CV).



Yocom-McColl Testing Laboratories, Inc.
540 West Elk Place • Denver, Colorado 80216-1823 USA
PHONE (303) 294-0582 • FAX (303) 295-6944
EMAIL: ymccoll@ymccoll.com

Sirolan Laserscan
Micron Test Report

Computer Bank Data/This is Factual Data — 04/19/12
Yocom-McColl Testing Labs Inc
Denver CO 80216-1823 USA — Test No: 427508

Animal and Sample Description

Animal Name:	XXXXX	Animal ID:	XXXXX
Breed:	Alpaca(Huacaya)	Sample Location:	Side
Sex:	Male	Sample Date:	04/10/12
Color:	White	Age:	05/15/10

Laboratory Data

Mean Fiber Diameter:	22.1 microns		
Standard Deviation:	3.1 microns		
Coefficient of Variation:	13.9 %		
Fibers Greater Than 30 microns:	0.9 %		

This Test Performed According to I.W.T.O Method 12

MFD, SD, CV, % Fibers>30 Microns (Mean Fiber Diameter and distribution)

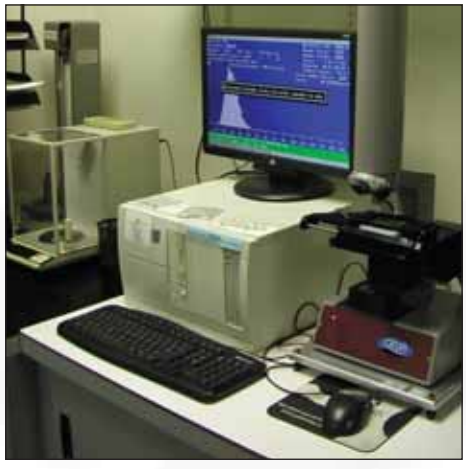
The Coefficient of Variation is the Standard Deviation divided by the Mean Fiber Diameter multiplied by 100 and reported as a percentage. The CV is used in the statistical analysis of different populations of fiber (different animals).

The percentage of fiber greater than 30 microns is also included in the report. In commercial application and breed selection, this data is of interest because it shows the coarse edge that determines the final use of the fiber. It has a relationship to the strength of the yarn processed from the raw fiber and influences "prickle" factor, the scratchy quality associated with coarser fibers.

The sample date is added to the report to identify the age of the animal at the time the sample was taken. A test report without a sample date is not as helpful as one confirming that the test results represent fiber taken when the animal was a specific age. The date of birth alone is insufficient to state that fact.

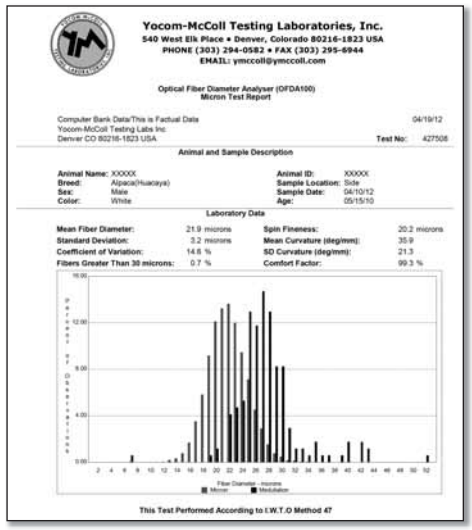
OFDA100 (Optical Fibre Diameter Analyser)

OFDA100 was approved as an IWTO standard in 1995. Mark Brims and his company, BSC Electronics, designed the instrument. It uses a video camera to produce electronic images of magnified fibers which are distributed over a horizontal glass slide. Software analyzes the fiber images and derives measurement of diameter of a large number of longitudinal fiber sections. OFDA100 also measures and calculates the distribution of fibers (SD and CV) as well as mean fiber diameter and several other fiber diameter related characteristics. Both of these methods provide the wool and textile industry with high volume testing applications.



OFDA100 software analyzes fiber images and derives AFD, SD, and CV measurement of 2000 to 4000 longitudinal fiber sections. OFDA100 also

Yocom-McColl used the OFDA100 instrument in completing an Alpaca Research Foundation Study in 2004, entitled "Fiber Characteristics of U.S. Huacaya Alpacas" with co-investigators Dr. Christopher Lupton, Texas A&M University, and Dr. Robert Stobart, University of Wyoming, later published in the Small Ruminant Research Journal 64 (2006) 211-224. This study sought to define the ranges of quality attributes of domestically-produced huacaya alpaca fiber using internationally accepted methods to objectively measure most of the important fiber characteristics on 606 huacaya alpaca fiber samples.



Yocom-McColl Testing Laboratories, Inc.
540 West Elk Place • Denver, Colorado 80216-1823 USA
PHONE (303) 294-0582 • FAX (303) 295-6944
EMAIL: ymccoll@ymccoll.com

Optical Fiber Diameter Analyser (OFDA100)
Micron Test Report

Computer Bank Data/This is Factual Data — 04/19/12
Yocom-McColl Testing Labs Inc
Denver CO 80216-1823 USA — Test No: 427508

Animal and Sample Description

Animal Name:	XXXXX	Animal ID:	XXXXX
Breed:	Alpaca(Huacaya)	Sample Location:	Side
Sex:	Male	Sample Date:	04/10/12
Color:	White	Age:	05/15/10

Laboratory Data

Mean Fiber Diameter:	21.9 microns	Spin Fineness:	20.2 microns
Standard Deviation:	3.2 microns	Mean Curvature (deg/mm):	35.9
Coefficient of Variation:	14.6 %	SD Curvature (deg/mm):	21.3
Fibers Greater Than 30 microns:	0.7 %	Comfort Factor:	99.3 %

This Test Performed According to I.W.T.O Method 47

MFD, SD, CV, % Fibers>30 Microns (Mean Fiber Diameter and distribution)Curvature (deg/mm), Percentage of Medullated Fibers on white/beige fiber, Spin Fineness, Comfort Factor (reverse of % Fibers>30 Microns or "Prickle Factor").

Genetic Selection Tool

Yocom-McColl uses both LaserScan and OFDA100 to test fiber of individual animals. We report mean fiber diameter, diameter distribution and uniformity (standard deviation and coefficient of variation), and fibers greater than 30 microns on LaserScan histograms. Using the OFDA100, we measure all of the above plus medullation on white or light-colored animals and also report spin fineness, curvature, curvature distribution, and comfort factor. "Comfort factor" is the percentage of fibers greater than 30 microns subtracted from 100%, a marketer's positive "spin" on the original term "prickle factor".

We test individual animals using two millimeter snippets obtained across the base of the two inch square submitted sample. In this way, we are able to provide estimates of the genetic uniformity of the sample at a precise environmental time.

The Laserscan tests 2,000 individual snippets per sample either core sampled (minicored) or guillotined. When guillotined at the base of the staple, all fibers measured were produced at the same time and in the same environment. Such a measurement indicates the genetic fineness and uniformity of the animal (at a specific age) that can be extremely valuable for selection purposes.

This was the method used in screening all of the alpacas imported from South America in the 1990's. It was used in conjunction with an ARI Point system

developed by Yocom-McColl for young animals to help to identify genetic potential for fiber quality. The base of staple testing has continued to be used by most alpaca breeders in the U.S. in their breeding selection programs.

Optical Fibre Diameter Analyser (OFDA2000) Staple Profile Measurement

Yocom-McColl has added a bench model OFDA2000 early in 2011, the latest model upgrade that is approximately 20% faster and measures 20% more fibers per test. It is operated under standard laboratory conditions, 20°C, and 65% relative humidity (+2% RH). This OFDA2000 instrument uses the same basic technology as its parent, the OFDA100, with the exception of measuring multiple fibers in profile.

Laboratory bench model operated under standard conditions under standard conditions for testing textiles, 20ºC, and 65% relative humidity (+2% RH). This OFDA2000 operates on staple profile or OFDA100 mode.

Under standard laboratory conditions, the OFDA2000 bench model can also be operated as an OFDA100 and as an OFDA100 is approved by IWTO but does not have the capability to measure medullation. Yocom-McColl has developed software to emphasize the individual animal's staple profile that can be used as a management tool.

The OFDA2000 does not measure relaxed staple length. Yocom-McColl measures mean staple length on an Agritest staple length meter instrument according to IWTO 30 on relaxed, conditioned staples. Sample staples are conditioned in staple trays for eight hours and tested under standard conditions to eliminate the moisture variation from samples received from the wide variety of climatic conditions exhibited by the alpaca fiber received at the lab for testing.

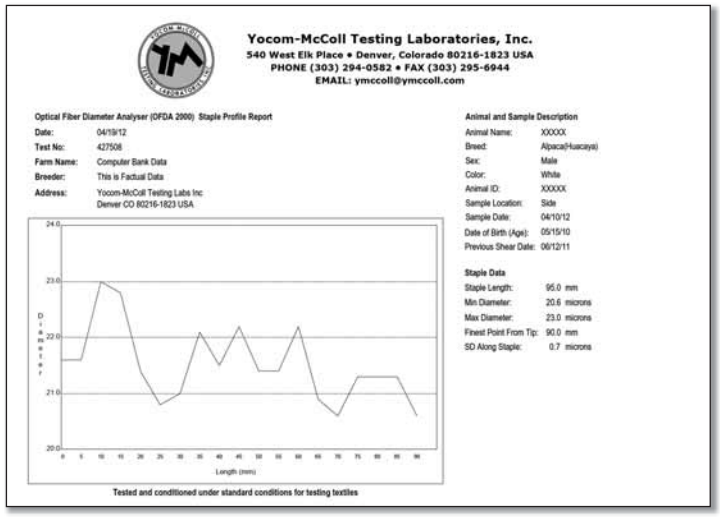
The OFDA2000 measures Mean Fiber Diameter (MFD) at five millimeter (5mm) increments across and along the length of the staple, starting this procedure at the tip of the staple.

On the staple graph (profile), the tip measurement starts at zero millimeters (0mm) on the left corner of the x-axis (horizontal axis). The Mean Fiber Diameter of the staple is displayed in micron increments on the y-axis (vertical axis) and the micron increments vary as the graph is generated to fit a letter size (8.5" x 11") in landscape format.

A normal distribution histogram is also generated using the measurements obtained in five millimeter (5mm) increments from the staple profile.

The staple profile report also documents finest point from the tip (in mm) in the staple length and that can be at the tip itself. It also documents minimum and maximum fiber diameter. To use the staple graph (profile) as a management tool, both the current and the previous shearing dates must be known in order to pinpoint timing of events that cause an increase or decrease in MFD of the staple.

Staple profile reports are useful for interpreting and correlating the effects of aging, animal health, pregnancy/nursing status, dietary changes, and management practices on the MFD of the staple produced during the growth period under consideration. The most influential "environmental factor" is usually the level of nutrition. Overfed animals will have coarser fiber but even less desirable is an underfed animal with brittle fiber prone to stress breaks, although it will likely have a "fine" fiber diameter.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Optical Fiber Diameter Analyser (OFDA 2000) Staple Profile Report

Date:	04/19/12
Test No:	427508
Farm Name:	Computer Bank Data
Breeder:	This is Factual Data
Address:	Yocom-McColl Testing Labs Inc Denver CO 80216-1823 USA

Animal and Sample Description

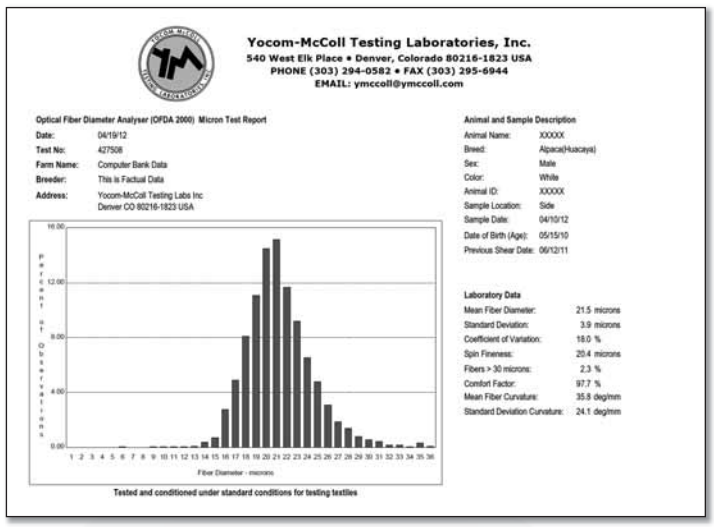
Animal Name:	XXXXX
Breed:	Alpaca(Huacaya)
Sex:	Male
Color:	White
Animal ID:	XXXXX
Sample Location:	Side
Sample Date:	04/10/12
Date of Birth (Age):	05/15/10
Previous Shear Date:	06/12/11

Staple Data

Staple Length:	95.0 mm
Min Diameter:	20.6 microns
Max Diameter:	23.0 microns
Finest Point From Tip:	90.0 mm
SD Along Staple:	0.7 microns

Diameter
Length (mm)
Tested and conditioned under standard conditions for testing textiles

Two page horizontal format report, fiber diameter and staple profile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540 West Elk Place • Denver, Colorado 80216-1823 USA
PHONE (303) 294-0582 • FAX (303) 295-6944
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Optical Fiber Diameter Analyser (OFDA 2000) Micron Test Report

Date:	04/19/12
Test No:	427508
Farm Name:	Computer Bank Data
Breeder:	This is Factual Data
Address:	Yocom-McColl Testing Labs Inc Denver CO 80216-1823 USA

Animal and Sample Description

Animal Name:	XXXXX
Breed:	Alpaca(Huacaya)
Sex:	Male
Color:	White
Animal ID:	XXXXX
Sample Location:	Side
Sample Date:	04/10/12
Date of Birth (Age):	05/15/10
Previous Shear Date:	06/12/11

Laboratory Data

Mean Fiber Diameter:	21.5 microns
Standard Deviation:	3.9 microns
Coefficient of Variation:	18.0 %
Spin Fineness:	20.4 microns
Fibers > 30 microns:	2.3 %
Comfort Factor:	97.7 %
Mean Fiber Curvature:	35.8 deg/mm
Standard Deviation Curvature:	24.1 deg/mm

Percent of Observations
Fiber Diameter - microns
Tested and conditioned under standard conditions for testing textiles

Measurements taken along the length of the fiber can vary dramatically and consequently show high variability in OFDA2000 test results which could eliminate a genetically uniform alpaca from consideration in a breeding program.

FIBER TESTING TERMINOLOGY

Normal Distribution

The graph of a normal distribution, the normal curve, is a bell-shaped curve. Many biological phenomena including animal fiber diameter distributions for single-coated animals, result in data distributed in a close approximation to normal. Statistics applicable to normally distributed populations (mean, standard deviation, and coefficient of variation) are used to define these fiber diameter distributions. The normal curve is symmetric about a vertical center line. This center line passes through the value (the high point of the bell) that is the mean, median and the mode of the distribution. A normal distribution is completely determined when its mean and standard deviation are known.

Mean Fiber Diameter (MFD)
Fiber diameter is measured in microns. One micron is equal to one millionth of a meter or 1/25,400th of one inch. Mean Fiber Diameter (MFD) is in common use internationally and it is the most important measurement in the commercial wool and fiber industry.

Standard Deviation (SD)
SD characterizes dispersion of individual measurements around the mean and is an important measure of variability. In a normal population, 68% of the individual values lie within one SD of the mean, 95% within two SD's and more than 99.5% within three SD's. Since SD tends to increase with increasing MFD, some people prefer to use CV (=SD*100/MFD) as a method of comparing variability about different sized means.

Coefficient of Variation (CV)
The measure of variability derived from dividing the Standard Deviation (SD) by the Mean Fiber Diameter (MFD) and used to compare uniformity between different populations. It is useful in ranking uniformity of individual animal fleeces regardless of mean fiber diameter.

Fibers Greater Than 30 microns
The percentage of the fibers measured over 30 microns, also known as the Prickle Factor or the coarse edge. It will increase as the Mean Fiber Diameter and Standard Deviation increase and is not raw data but information useful to processors of commercial lots of wool or fiber.

Medullated Fibers
A medullated fiber is an animal fiber that in its original state includes a medulla. A medulla in mammalian hair fibers is the more or less continuous cellular marrow inside the cortical layer and appears in most alpacas to varying degrees and in all ranges of fiber diameter from fine to coarse.

The histogram showing medullation on the OFDA100 report is displayed on the same scale as the mean fiber diameter for ease of viewing. Medullation measurement can be performed using either a projection microscope or the OFDA100. The OFDA100 measures opacity and therefore only white or beige fibers can be measured. A reasonable assumption is that colored fibers have similar levels of medullated fibers as their white and very light counterparts.

Spin Fineness
Geneticists adjust measurements all the time for the effects of age, sex, and other variables. It provides an estimate of the performance of the wool or fiber when it is spun into yarn. This information is intended for mills which process large commercial lots and is included on these individual animal reports because the data is available but it is not intended for individual animal selection.

The formula used normalizes the equation so that he Spinning Fineness is the same as the MFD when the CV is 24%. The value of 24% was chosen because this is a typical CV value for an Australian Merino wool sale lot or consignment.

Mean Curvature (deg/mm)
Fiber curvature is related to crimp. Mean Curvature (MC) is determined by the measurement of two millimeter (2mm) snippets in degrees per millimeter (deg/mm). Finer fiber diameter is often associated with a higher mean curvature. The greater the number of degrees per millimeter, the finer the crimp and also the greater the resistance to compression. However, in commercial processing, curvature is not one of the alpaca fiber's strengths.

Our 2005 Alpaca Research Foundation study of 606 huacayas found the mean curvature to be 33.2 degrees per millimeter with a range from 15.4 to 52.5 deg/mm. In comparison, low curvature in fine wool is described as less than 50 deg/mm, medium curvature as the range of 60-90 deg/mm, and high curvature as greater than 100 deg/mm.

SD Curvature (deg/mm)
Standard Deviation of Curvature is data available from OFDA100 analysis but its value has not been agreed upon by researchers and its priority is low among fiber stats for individual animals.

Comfort Factor
Comfort factor is the percentage of fibers over 30 microns subtracted from 100 percent. Ten percent of fibers over 30 microns corresponds to a comfort factor of 90 percent. This term was derived as a wool marketing decision to place a "positive spin" on the old Prickle Factor, which you will remember is… the percentage of fibers over 30 microns. It is included on these individual animal fiber diameter reports upon breeder request, but it is not new information, it is just more comfortable terminology.

Summary
Comfortable terminology is clever marketing and a good thing, but comfortable fiber that is fine and uniform is the name of the game. The genetic potential of the animals that produce fine and uniform fiber is revealed in the details of objective fiber testing.

CQ

About the Author
Angus McColl is owner of Yocom-McColl Testing Laboratories, Inc., Denver Colorado. He graduated from the University of Wyoming after emigrating to the U.S. from Scotland and formed Yocom-McColl as an independent wool and animal fiber testing facility with Ira Yocom in 1963. The lab utilizes ASTM (American Society for Testing and Materials) and IWTO (International Wool Textile Organisation) procedures and methods when testing fibers and operates Sirolan LaserScan, OFDA100, and OFDA2000 instruments for the measurement for wool and fiber testing. In 1995, McColl was added as a technical advisor to the Alpaca Registry Screening Committee and helped to develop a points system for fiber standards of imported alpacas. McColl completed the "Fiber characteristics of the Huacaya Alpaca" study with Dr. Christopher Lupton and Dr. Robert Stobart for the Alpaca Research Foundation in 2005 to help establish a comprehensive profile of U.S. huacaya alpaca fiber characteristics. Angus McColl and Dr. Christopher Lupton also completed a study, "Measurement of Luster in Suri Alpaca Fiber" for the Suri Network and the Alpaca Research Foundation (ARF) using SAMBA systems designed by Bossa Nova Technology, published in 2011 in the Small Ruminant Research Journal.