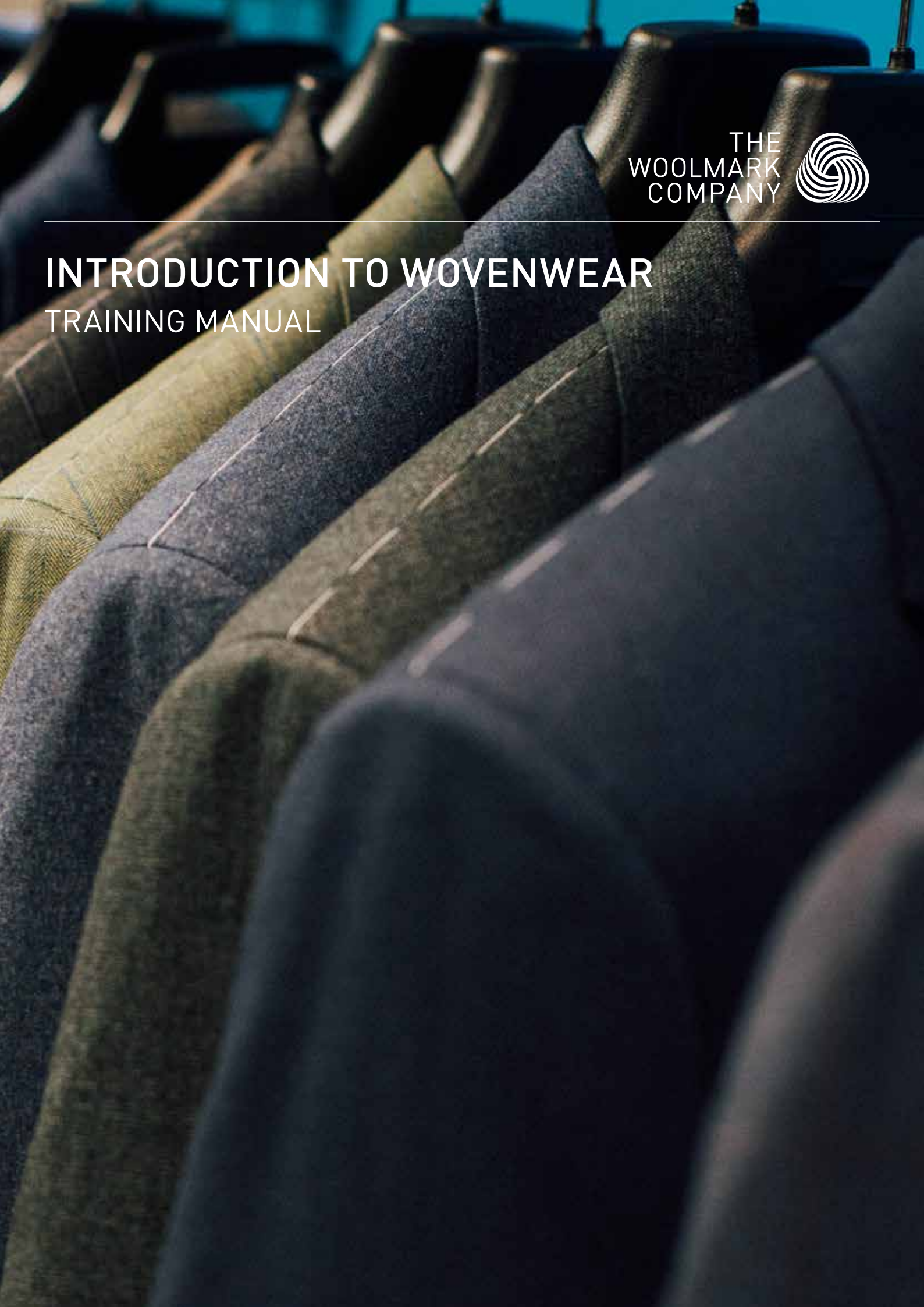


THE WOOLMARK COMPANY

INTRODUCTION TO WOVENWEAR

TRAINING MANUAL



CONTENTS

INTRODUCTION		4
1.	Benefits of Merino Wool in Wovenwear	5
2.	Australian Merino Wool	5
3.	Fibre Diameter	6
4.	Processing Pipeline	7
5.	Woollen Processing	7
6.	Worsted Processing	7
7.	Yarn Qualities	8
8.	Warp and Weft Yarns	8
9.	Fabric Qualities	8
10.	Weave Types	9
11.	Product Selection	10
12.	Dye Fastness	11
13.	Dimensional Stability	11
14.	Performance in Wear	12
15.	Stretch & Comfort	12
16.	Finishing	12
17.	Making up	13
18.	Summary	15

This short review aims to briefly cover some of the technical aspects which must be considered when producing quality Merino wool wovenwear. It begins with wool production in Australia and follows the processing route from fibre through yarn to making-up.

Particular attention is given to yarn selection, which is paramount to a quality woven product, along with the relationship between making-up and garment appearance.

Wool fabrics require slightly different finishing procedures to other fibres and these will also be covered.

01 BENEFITS OF MERINO WOOL IN WOVENWEAR

NATURAL
Merino wool is the natural fibre choice, made of a protein called keratin, the same protein as human hair.

BIODEGRADABLE
Under the right conditions Merino wool fibre takes only a few years to decompose.

RENEWABLE
Every year Australian Merino sheep produce a new fleece, which can be removed without harm to the animal.

FIBRE CRIMP
Merino wool is naturally crimped allowing for bulky yet light fabrics.

RESILIENCE
Merino wool fibres will return to their original state when bent or stretched, ensuring garments retain their shape during wear and laundering.

SOFTNESS
Australian Merino sheep are renowned for producing the finest wool. This fineness is the reason Merino wool garments have superior handle and superb drape.

COMFORT
Merino wool has the ability to respond to changes in temperature and humidity. The hygroscopic core of the wool fibre has the capacity to absorb up to 35% of its own weight in moisture (vapour) allowing humidity to move away from the body and evaporate.

02 AUSTRALIAN MERINO WOOL

The Australian Merino sheep derives its name and basic appearance from the famed Royal Merino Flocks of Spain, having been introduced to Australia by European settlers more than 200 years ago.

Australia is the world's largest producer of Merino wool. In 2010/11 Australia's 70 million sheep produced 345 mkgs of wool. The Australian wool clip is particularly suited to use in apparel, with 54% of annual production in 2010/11 being less than 20.6 micron. The finer a wool's diameter, the softer and more crimped it becomes. Crimp, the wave in the wool staple, contributes to the bulk and the lightness of wool fabrics.

Examination of a wool fibre under a microscope shows the scale structure which contributes to many of wool's performance qualities, for instance these scales are the cause of felting. Felting is the locking together of individual fibres during severe mechanical action (such as washing). The early stage of felting, known as milling, is an important step in creating the unique handle and touch of many woven wool fabrics.

03 FIBRE DIAMETER

TThe diameter of the wool fibres used in fabric is of fundamental importance. The following table shows the typical ranges of fibre diameter used in woven wool fabrics.

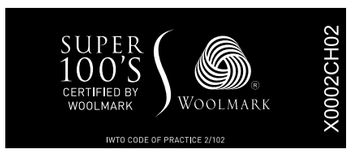
TYPE	DESCRIPTION	MICRON																						
		<15	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Worsted	Ultrafine worsteds Super S ›160's																							
Worsted	Superfine worsteds Super S 100's - 160's																							
Woollen	Lambswool jacketings																							
Worsted	Fine Merino suitings																							
Worsted	Trouser fabrics																							
Worsted	Flannels																							
Woollen	Dress fabrics																							
Worsted	Medium suitings																							
Woollen	Meltons																							
Woollen	Velour jackets/coats																							
Woollen	Heavy coatings																							
Woollen	Harris Tweed																							
Woollen	Donegals																							
Woollen	Thornproofs																							
Woollen	Cheviots																							

The micron of superfine and ultrafine worsted fabrics can be specified by a system, developed by the International Wool Textile Organisation (IWTO), known as "Super S". The Woolmark Company administers the Super S code of practice. The values are directly related to the mean fibre diameter of the entire fabric and range from Super 80's (<19.75 micron) to Super 250's (<11.25 micron).

The finer the wool fibre, the finer a yarn can be spun. In general both the softness and the bulk increase as the fibre diameter becomes finer. This applies to both worsted and woollen yarns.

Trying to spin fine yarns from wool with too high a fibre diameter leads to various challenges, not only does the fabric lose its softness, but yarns become irregular and therefore impact, negatively, on fabric appearance and performance.

The sample below is a label available to Woolmark licensees that are qualified to use both the logos of the Super S system and the Woolmark brand.



04 PROCESSING PIPELINE

The first step in creating yarn is to scour the greasy wool; this is essentially washing the wool in warm water to remove dirt and grease. The scoured and dried wool is then ready to process by one of two possible routes:

WOOLLEN ROUTE
Is shorter and used for heavier counts of yarn. In this case, fibres are randomly distributed in the yarn and are shorter than those used in a worsted yarn.

WORSTED ROUTE
Is typically used for finer counts of yarn. In this case the fibres are parallel to each other.

05 WOOLLEN PROCESSING

Scoured wool is blended and disentangled in a card; the fibres are separated out by a series of pinned rollers moving at different relative speeds. The opened out wool fibres are stripped off the last of these rollers to make a thin web of fibre. This web is then split into strips by a series of tapes. The fine ribbon of fibres which sticks to each tape is rubbed in the condenser to make a delicate and twistless strand called a slubbing. Strength is added to the slubbing by spinning.

Spinning draws out and twists the slubbing to make a yarn. This single strand is suitable for weaving as a weft yarn but it may need to be folded for a warp yarn. Folding is a process of twisting together two yarns using opposite twist to the original single yarns.

06 WORSTED PROCESSING

Worsted processing shares common steps with woollen processing, however the transformation route is longer.

Scoured wool is carded in a similar way to the woollen route, however it is removed from the card not as individual twistless slubbing but as a single thick sliver of fibres. The next stage is a repeated sequence of gilling in which a number of different slivers are blended and then drawn out to increase the regularity. Combing, a similar process, is the next stage in which the shorter fibres are removed and can be processed as noil. The resulting combed sliver is known as top. The final stage before spinning is then drawing out of the top to make a small package of fine sliver known as a roving. This is the equivalent of the slubbing produced in the woollen route but has taken more steps to achieve.

During spinning, the roving is drawn out to around 20 times its original length and twist is inserted to produce a fine worsted yarn. Any large knots or slubs are removed and replaced by fine splices before winding onto large packages. As with woollen yarns, worsted yarns destined for warps are generally two-fold.

Fabrics, like wool yarns, can be divided into two types - woollen and worsted. Whichever type is used in the fabric, there are four key attributes of a yarn that have an impact on the resulting fabric.

07 YARN QUALITIES

ATTRIBUTES	AFFECTS
Count (thickness)	• Fabric weight
Twist level (turns per metre)	• Weaving efficiency • Fabric performance • Fabric handle and appearance
Worsted or woollen	• Fabric handle and appearance
Ply (singles or two-fold)	• Weaving efficiency • Fabric performance • Fabric handle

08 WARP AND WEFT YARNS

A woven fabric comprises warp yarns which run along the length of the fabric and weft yarns which intersect across the warp yarns. A woven fabric can be made using the same yarns in both the warp and the weft but often this is not the case. Warp yarns need to be smooth and strong because they are placed under tension in the loom and are subject to abrasive forces during weaving. Weft yarns on the other hand do not need to be as strong and can be made weaker and softer.

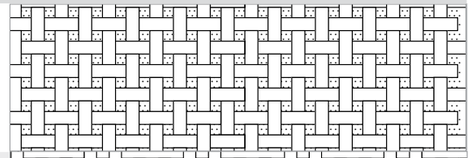
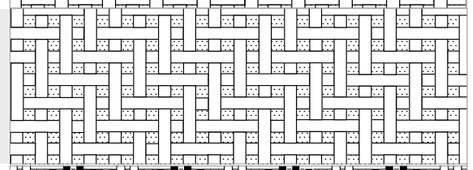
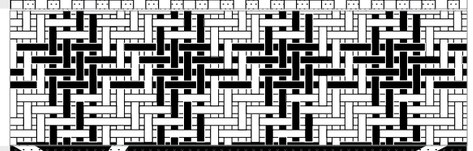
09 FABRIC QUALITIES

The choice of worsted or woollen yarns determines the type of fabric quality.

The suitability of a fabric for a particular end use is usually decided as a result of several compromises, however fabric design is very important.

WOOLLEN	WORSTED
Bulk and thickness	Fine and smooth
Hairiness/ surface pile	Clean surface appearance
Coarser, heavier qualities	Lightweight
Ideal for jacketing and coats	Used in suiting and trousers

10 WEAVE TYPES

TYPE	DESCRIPTION	
PLAIN WEAVE	• Simplest construction • Interlacing every warp stitch • No distinction between the 5 front (face) and reverse (back) of the fabric	
TWILL WEAVE	• Varying complexities: basic one is over 2 and under 2 • Characterised by a diagonal twill line • Face of fabric normally has twill line running from the top right to bottom left	
COLOUR AND WEAVE EFFECTS	Able to produce patterns in two or more colours through the combination of coloured yarns and design weave. e.g. hound's tooth	
JACQUARD WEAVING	Complex weaving allowing for great variety in patterning and coloration through the individual control of each warp yarn in the loom	

11 PRODUCT SELECTION

END PRODUCT	KEY REQUIREMENTS	WOOLLEN OR WORSTED	MOST IDEAL FABRIC TYPE
HIGH QUALITY SUITING	Soft handle, smooth touch and superior drape	Worsted	Colour woven, plain weaves, twills and gaberdines
SCHOOL WEAR	Low cost, abrasion and tear resistance, dark colours and easy care	Worsted	Solid shade twills and barratheas
CORPORATE WEAR	Low cost, abrasion and tear resistance, dark colours and easy care	Worsted	Solid shade, plain weave, twills and gaberdines
MEN'S TROUSERS	Next to skin comfort, abrasion resistance and seam strength	Worsted and some woollen	Twills, gaberdines and flannels
LADIES SUITS	Softness, fluid drape and piece-dyed for fashion colours	Worsted	Plain weaves and crepes
JACKETS	Softness, weave effects and drape	Worsted and woollen	All types
SCARVES AND SHAWLS	Softness and raised surface	Worsted and woollen	Plain weaves
TRAVEL WEAR	Good drape and wrinkle recovery and abrasion resistance	Worsted	Plain weaves, twills and panamas
OVERCOATS	Thickness for warmth, drawn-pile surface for luxury and resistance to pilling	Woollen and some worsted	Weft faced sateens, mouflons and velours

Also important is fabric weight which can range from 700g/linear metre (heavy coat fabrics) down to 100g/linear metre (ladies shirting). Over the years, average fabric weights have steadily decreased as central heating and air conditioning have made environments more comfortable. Australian Merino woolgrowers have responded to this trend by producing finer micron wool needed to make lightweight fabrics.

A typical average weight for worsted menswear is 350g/linear metre; the Woolmark definition of Merino Cool™ fabric (derived from Cool Wool) is <250g/linear metre.

12 DYE FASTNESS

One of the most important points to consider when sourcing a fabric is the fastness of the dyestuff; in other words its resistance to light, to dry rubbing and to laundering.

The detailed process of dyeing is an extensive topic that cannot be covered here. However it is worth considering the different stages in the pipeline at which dyeing can be carried out.

Woollen fabrics are nearly always dyed at the loose wool stage just before carding – called stock dyeing.

Worsted fabrics can be dyed at different stages in production and this can have an impact on fastness as well as a profound effect on delivery schedules. Dyeing can occur before spinning (top dyed) after spinning (yarn dyed) or in the fabric form (piece dyed). Generally, the later the wool is dyed the faster the end product can be delivered.

13 DIMENSIONAL STABILITY

There are several types of dimensional stability that should be known before the fabric is made up into the final garment.

RELAXATION SHRINKAGE
Occurs when the garment is wet-out in water during hand or machine washing. This is generally small and only occurs once.

DRYCLEAN SHRINKAGE
Occurs when the garment is drycleaned and should be very small.

FELTING SHRINKAGE
Occurs when the garment is machine washed or tumble-dried too intensively leading to irreversible shrinkage due to the fibres interlocking with each other.

HYGRAL EXPANSION
Occurs when the wool fibres absorb moisture vapour, leading to an increase in fibre diameter and fabric dimensions. This is common to piece-dyed fabrics.

STEAM SHRINKAGE
Occurs when the fabric is steamed by the maker-up and is similar to relaxation shrinkage.

HOT-HEAD PRESS SHRINKAGE
Occurs when fusibles are glued to the fabric and can lead to puckering if it is not compatible with the interlining.

14 PERFORMANCE IN WEAR

For a garment to give good service to the owner it must be able to withstand:

ABRASION
SEAM FAILURE
TEARING

All of the above are dependent on yarn twist, tightness of weave and weave structure. These should be tested before decisions are made about the type of garment to be made. The performance of the fabric has a major impact on the end product from which it can be made, for example a corporate wear garment needs fabric of better abrasion resistance than fabric for a shawl.

15 STRETCH & COMFORT

Wool fabrics are inherently extensible and will "give" and recover from bagging very quickly leading to excellent comfort and fit.

Additional stretch can be created by incorporating up to 4% elastane into the fabric during weaving; this permits fabric to stretch as much as 15–20% without distortion and makes closer fitting garments more comfortable.

16 FINISHING

Finishing has three purposes:

1. To relax the fabric structure so that no further shrinkage occurs during laundering.

2. To clean the fabric, removing oil and dirt accumulated during the manufacturing process.

3. To provide the desired surface appearance and handle, whether soft, smooth or milled.

It is also possible to add additional functionality during finishing for example easy care or flame retardancy.

There are three main stages in the finishing process:

PREPARATION
Crabbing or setting and singeing.

WET FINISHING
Scouring, milling, wet raising, (dyeing) and drying.

DRY FINISHING
Cropping/shearing, dry-raising, brushing, relaxation/sponging, pressing and decatising.

Not all of these processes are necessary and some can be performed more than once. The precise combination of processes and the conditions under which they are performed are part of the finisher's "art" and can be closely guarded secrets.

17 MAKING UP

Manufacturing wool fabrics into garments is a specialised business which brings together up to 25 components in a single garment like a jacket, all of which have to be compatible with each other.

The making up process can be divided up into four stages:

LAYING AND CUTTING
Normally done in a tension free state where several layers of fabric are cut at the same time with band knives.

FUSING OF INTERLININGS
A hot-head press is used to melt glue impregnated in the interlining so that it is fixed to the wool fabric.

SEWING
The various components are sewn together. To avoid seam-slippage great care has to be taken to ensure the stitch, the sewing thread and stitch density are compatible with the fabrics being joined together..

PRESSING
The garment is pressed at several stages during its manufacture to remove crease and develop the three dimensional shape of the final garment.

Wool fabrics need some special care during making-up because of the way the fabric absorbs and desorbs moisture and the following recommendations are made:

1. Fabrics are stored at relatively high humidity and made up in a workroom of 65-75% relative humidity in order to avoid problems of seam puckering due to hygral expansion.

2. The buck of the press should be properly padded with soft and resilient materials, such as silicone foam to avoid undesirable impressions of seams and pockets.

3. Wool fabrics are sometimes woven to relatively loose densities and consequently may suffer from seam slippage. To prevent or minimise seam slippage it is sometimes necessary to increase stitch density, sew on the true bias of the fabric, use a support fabric or use a zigzag lockstitch.

Many of the above potential problems can be avoided in lightweight fabrics if the fabric is supplied to the maker-up with a FAST (Fabric Assurance by Simple Testing) control chart which will indicate which making-up operations need the most care.

18 SUMMARY

In this review the different stages of garment manufacture have been examined very briefly. The Woolmark Company technical staff located across the globe are available to provide detailed guidance on all aspects of wovenwear production.



THE WOOLMARK COMPANY

WOOLMARK.COM

This publication should only be used as a general aid and is not a substitute for specific advice. To the extent permitted by law, we exclude all liability for loss or damage arising from the use of the information in this publication. The Woolmark and Woolmark Blend symbol are a Certification mark in many countries .

©2018 The Woolmark Company Pty Ltd. All rights reserved. GD1804_EN