Finishing of Wool Knitwear

The finishing stage is a very important and integral part in the manufacture of wool knitwear, because finishing and how well it is carried out can and does dramatically impact upon the handle, appearance and wear performance of the final knitted garment.

1 Objectives

Generally there are three main objectives when finishing wool knitted products. These include,

- Relaxation of the knitted structure in order to release strains and tensions imposed during the spinning and knitting process. This is to minimise the potential for further relaxation so that no noticeable further shrinkage occurs during subsequent domestic laundering.

- Improving both the handle and appearance of the final knitted product thereby making it ready and attractive for sale.

- Removal of additives such as processing aids which were applied during manufacture to assist in processing e.g. Spinning lubricants. This is more important in the case of woollen spun knitwear such as Shetland and Lambswool which normally contain significant amounts of processing oil. Inadequate removal (Woolmark recommends less than 1.5% by weight Total Fatty Matter remaining), can lead to increased soiling, and the garment developing a smell during garment storage, due to the residual oil become rancid due to oxidation.

In addition to the above main objectives, finishing also provides an opportunity and a convenient point for applying added value or adding functional finishes to wool knitwear. For example; Easy Care, Stain and shower resistant etc.

2 Types of wool knitwear

The actual finishing procedure carried out is dependent upon the type of wool knitwear, and the requirements of the retailer or buyer, which in turn is dependent upon the requirements or expectations of the consumer.

Generally, knitwear produced from wool can be classified into two main types: These include “Woollen spun knitwear” and “Worsted spun knitwear”.

Woollen spun knitwear includes Lambswool and Shetland type wool products knitted from yarns spun on the woollen system. These types of knitwear in

the final state after finishing are characterised by having a slightly raised and fuzzy surface appearance due to the garments having received a "milled" finishing during the finishing operation.
In the case of worsted spun knitwear, popularly referred to in some cases as Merino, which is wool knitwear produced from yarns spun on the worsted system. This type of knitwear is characterised by having a very smooth surface appearance and texture, with very clear definition of the knitted stitches. Therefore it's essential during the finishing operation to avoid any disruption of the knitted fabric surface. Therefore if wet finishing or "washing" is carried out it tends to be very gentle, thus avoiding any milling action.

3 Finishing Routes

Finishing of wool knitwear can be normally classed into two categories; these include "Wet Finishing" and "Dry Finishing". The latter is sometimes referred to as a "Steam Finish only".

There is a third type of finishing route, called "Solvent Finishing", where instead of using water, the knitwear is finished in an industrial dry cleaning machine using an organic solvent. However in the wool finishing industry, generally this is not so common practice.

In the case of woollen spun knitwear, and the need to remove significant amounts of processing's oils from the garments, it is essential that the wet finishing route is carried out. In addition in order to obtain the characteristic raised and fuzzy surface, at the same time developing an improved handle, prolonged washing, or an additional washing stage known as milling is carried out. This is conducted by the controlled washing in warm water containing detergent of the garments or knitted pieces in an industrial washing or knitwear finishing machine. Following this the garments are then hydro-extracted, tumble dried before steam pressing.

In the case of worsted spun knitwear, which are often made from fine Merino wool yarns, there is the option as to whether to carry out wet finishing followed by steam pressing, or just to carry out steam pressing alone i.e. Dry finishing.

Garments are frequently finished a partially made-up state, for example, as body-sleeve combinations without neck trims or as garment blanks with separate neck ribs, pockets etc. The reason for this is to eliminate relaxation shrinkage, which may differ between the components of the garment. In some cases if garments are linked or made up prior to finishing then the differing relaxation shrinkages may cause puckering.

Trims, which are to be wet finished, should be bagged in either polypropylene or polyester mesh bags.

4 Finishing Machines

With the exception of side paddle machines, which are often used in addition to finishing for the piece dyeing of knitwear, most wet finishing machine used for wool knitwear, are based on a rotary drum, rather like a big version of a domestic rotary drum washing machine.

Although the basic action is essentially the same, rotary drum finishing machines can and do vary considerably in their severity of mechanical action and the degree of control by automation. I.e. Some machines have an in-built computer whereby all parameters such as speed, time, temperature and chemical additions can be set and controlled etc, whilst others in the main rely on the skill of the operator.

In addition some of the more modern machines are combined washers and extractors; this saves the garment having to be unloaded, and loaded into a separator hydro-extractor prior to tumble drying.

In practice wool knitwear can be wet finishing in each type of machine, but it must be remembered that firstly in comparison to knitwear made from Cotton and man-made fibres etc, that wool and knitwear made from can be regarded as being delicate, and can more easily suffer from mechanical damage (Holes, seam slippage etc) during the wet finishing operation. Secondly with the exception of say machine washable or Easy Care wool, wool has a unique and natural tendency for felting to occur, which can result upon over finishing.

Because of this, when wool knitwear is being wet finished it essential to set up the machine in terms of its mechanical severity so that it exerts a relatively gentle washing action. In addition greater care needs to be applied in the control of other finishing parameters, such as temperature, cycle time etc.

In addition to the actual wet finishing machine, the temperature, load, cycle time of the tumble dryer should be carefully controlled.

5 Finishing Chemicals

The most important chemical used in the wet finishing process is the water. For optimum results the water should be clean i.e. crystal clear, and be extremely soft. Ideally of zero hardness, but at least I have a Total Hardness factor of less than 20 ppm

Although sequestering agents can assist, by far the best way is to soften the water, using a proprietary water softening plant.

Hard water can cause allsorts of problem, with the main one causing precipitation of oils, grease and even the detergent, with the net result that this precipitated matter is re-deposited on the garment, often causing discoloration and severely affecting the handle.

Most detergents used in the finishing of wool knitwear tend to be, readily water soluble and either anionic or non-ionic in their ionic nature. Many detergents especially formulated for the finishing of wool knitwear, are available today from leading textile auxiliary manufactures or suppliers.

To assist with removal of stubborn oil, inorganic salts such as Sodium Bicarbonate and Sodium Sulphate (Suggest 1 gram per litre of each), can be added along with the detergent.

At the last stage of the wet finishing operation, normally a softener is applied to enhance the hand feel of the wool garments. The most effective on wool tend to be Cationic in nature. Generally suitable cationic softeners for wool split into two types i.e. Non-silicone and Silicone types. As a generalisation non-Silicone softeners tend to give a slightly greasy but bulky handle, whilst silicone types tend to give a silkier, smooth but leaner feel. Ultimately the actual desired handle is dependant upon the customer, which is usually the retail buyer. However the amount of softener applied should be carefully controlled (normally up to 3 % product on the weight of material maximum), because the presence of excessive softener on wool knitwear can lead to inferior pilling performance.

6 Finishing Procedures

6.1 Woollen Spun Knitwear

Prior to finishing, woollen spun knitwear such as “Shetland” and “Lambswool”, has a rather lean and harsh handle, unattractive appearance and a high residual oil or total fatty matter content, i.e. typically in the region of 5-10% o.w.w. However, these are overcome, or improved, by “scouring” and “milling”.

The purpose of scouring is simply to remove or reduce the amount of residual oil, (<1.5% o.w.w. for garments carrying for example a Woolmark

label), and milling is to improve both the appearance and handle of the product. This is achieved by the fact that during milling, which can be considered as a controlled method of washing, due to the mechanical action the yarn swells and begins to burst. This allows individual wool fibres to migrate to the surface, whilst at the same time the strains and tensions induced during manufacture (i.e. during the spinning and knitting stages, etc.), which are responsible for relaxation shrinkage, are released causing the knit structure to consolidate.

The resultant effect is that the garments have a characteristic "fuzzed" surface or milled finish, which is much more attractive, and a noticeable softer handle.

6.1.1 Finishing Procedures (Woollen Spun Knitwear)

The actual scouring and milling procedures adopted can vary considerably between companies. The reason for this is that in addition to the possibility that companies may have different types of machines, there are many other variables to consider. These include, for example:

- Degree of finish required on the garment
- Yarn type and its count and twist
- Type and amount of residual oil
- Colour (darker shades require longer milling times).
- Knit cover factor (Knitting density)

6.1.2 Typical finishing recipe (Woollen Spun Knitwear)

Generally, scouring and milling are carried out separately i.e. a two stage process, and a typical method is as follows:

Scour:	Set bath at 40°C Add 3-6% detergent L: R = 20-30: 1 Run 2-15 minutes (depending upon machine etc.) Drain Rinse in warm water at 40°C
Mill:	Set bath at 40oC Add 1-3% non-ionic detergent L: R = 20-30: 1 Run 2-40 minutes (depending upon machine etc.) Drain Rinse well
Hydro:	As much water as possible should be removed in order to Reduce drying time.
Tumble Drying:	It is important to establish a standard minimum time. Suggested temperature for medium to deep shades is 70-90oC, whereas for paler shades and some mixture or multi-coloured garments, the temperature should not exceed 60oC.

6.2 Worsted Spun Knitwear

Unlike woollen spun knitwear, garments produced from worsted yarns only contain a minimal amount of residual oil, because only a small amount is added during yarn manufacture. Therefore, it is not essential to scour worsted spun garments, although it can be done.

The main objective in finishing worsted spun knitwear is to relax the garments, as with woollen spun knitwear, by releasing the strains and tensions and thereby removing the possibility of relaxation shrinkage occurring when the consumer first subjects the garment to washing.

The removal of the strains and tensions responsible for relaxation shrinkage can be done, in the case of worsted spun knitwear, by either “dry” finishing using steam, or by “wet” finishing, which involves a light aqueous scouring operation. In the latter case it is essential that garments are subjected to a very gentle scour to avoid any disturbance of the surface of the knit structure. The reason for this being that one of the main attributes of worsted spun knitwear is that it has a very clean, even surface with each knitted loop clearly seen. Any surface cover on worsted spun knitwear is regarded as unacceptable, and any fibres protruding from the surface can lead to the promotion of pilling during subsequent wear.

6.2.1 Finishing Procedures (Worsted spun wool knitwear)

As described earlier above worsted spun knitwear can either be “dry” finished or “wet” finished.

Dry Finishing simply involves blowing steam through the fabric while it is under minimal tension in order to relax it. The advantage of dry finishing is that in comparison to wet finishing, it is rapid and less expensive. The disadvantage is that it does not allow for the possibility of an anti-cockle treatment to be carried out, or much scope for further modification to the fabric handle i.e. application of a softener.

For dry finishing of knitted fabrics a number of purpose built finishing machines (Novakust, Bisio, Montirama etc.) are available. Although these machines are primarily designed to handle fabrics in roll form, such as those produced on circular knitting machines, certain manufacturers supply attachments to enable garment panels i.e. fully fashioned knitwear, to be finished. Alternatively, knitted panels can simply be dry finished on a press, by adopting the basic principle of blowing steam through the fabric to fully relax it, then pressing the fabric to set it in the relaxed state.

Wet Finishing of worsted spun wool knitwear involves a very gentle scour, almost a static soak, without any milling cycle. After the scour the garments are rinsed with clean water before hydro-extraction and tumble drying.

6.2.2 Typical Finishing Procedure (Worsted spun wool knitwear)

Scour	Set bath at 40oC 0.5-1.0 % Detergent (On weight of wool) L: R 30:1 Run 2-5 min's Drain Rinse well
Hydro-extraction	As for woollen spun knitwear (2.2.1)
Tumble drying	as for woollen spun knitwear (2.2.1)

6.3 Final Pressing

After the completion of the finishing operation the garments are given a final steam pressing to remove creases, ensure that the garments dimensions are correct and overall make them presentable for sale.

Although hand held irons are still used for this, the most effective is a flat steaming table (large enough for knitwear), which incorporates a vacuuming device.

A typical final pressing sequence for wool knitwear is

(a) Place garment on steaming table

(b) Apply steam (4 bar condensate free minimum) to make garments pliable.

(c) Remove creases and crush marks and mould garments to shape

(d) Check garment dimensions and readjust if necessary

(e) Further steam to remove remaining stubborn creases and crush marks

(f) Final check using tape measure of garment dimensions

(g) Vacuum to remove moisture and cool the garment

(h) Place carefully on a side table to allow garments to condition before packing.

Note: Although some stretching of the garments is required to both remove creases and to set the dimensions of the garment, excessive stretching (Recommend a maximum of 5%) should be avoided. Stretching of wool garments induces potential for relaxation shrinkage, and an excessive amount will lead to notable shrinkage of the garment by the consumer upon domestic laundering.

