

# Linen Fabric Formation

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Traditionally linen has been used in the production of either relatively simple woven fabrics such as sheeting, towel, camric, sheers, drills and ducks or highly complex fabrics such as damasks. Industrial use includes filter cloth and canvas.

Over the past few decades, the trend in weaving sector has been toward greater versatility and scope in design. This has been in tune with the greater use of linen in apparel market that is more fashion oriented than the traditional market. Flax yarns are available in a wide range of counts and characteristics, depending on the nature of flax used and processing arrangements employed. It is important that the weaver chooses the appropriate yarn for each specific fabric type.

## The range of possible alternatives are:

- Dry spun yarn in 100 per cent flax, in grey, bleached or dry state, based on line or two fibres for several applications.
- Blend and fancy yarn in different colors and structures, aimed for use as upholstery fabric or wall coverings.
- Fine grey state or wet-spun bleached yarn or yarn based on bleached rove intended for high quality household linen as well as apparel fabric.
- Short fibre yarn, in blend with other natural fibres and or man made fibres, destined for use in apparel and other applications.
- Dry or wet-spun yarn for highly specific industries and technical end uses.

## The selection of suitable warp and weft yarn for each given end use is of great importance. Following are the brief guidelines:

- Warp yarn for fine apparel end use is generally of a wet spun line yarn in counts up to 66 tex. Varieties may include: grey yarn, bleached yarn, and yarn from degummed or bleach roves. Warp yarn should meet strict conditions with respect to tenacity, regularity and stretch. A tenacity of around 24 CN/tex is suggested.
- Weft for fine apparel is generally wet-spun or semi wet-spun yarn, with a similar count to the warp yarn, and with the same variants listed for warp yarn.
- In coarser apparel fabrics, the warp usually consists of wet-spun line or tow yarn with count ranging from 66 tex to 166 tex, for the weft yarn, a dry spun with in the same count range may be used.
- Several type of yarn can also be used as table linen. Weft spun yarn from pre-bleached rove, in counts up to around 41 tex will give a very fine fabric. A wet-spun yarn in the weft would suit coarser varieties.
- Wet-spun or dry spun line or Tow yarn in the count of about 250 tex, in both warp and weft are suited for table linen of more rustic type.
- Heavier yarn are generally used for well covering or upholstery fabrics, either wet-spun or dry spun in count ranging from 80 tex up to 380 tex.

Yarn arrives at the weaving section wound on packages of different sizes, depending on the yarn type, fine yarn are presented on small packages and coarser on larger packages. Slub and various other serious irregularities will generally have been removed electronically during winding.



Natural linen fabric for upholstery

The process of assembling the yarn required for the warp, in parallel form and to the required numbers, length and sequence is known as "warping". The two common methods are **direct beam warping and sectional, or mill warping**. In direct beam warping, the yarn required for each warp is wound directly onto either a single beam or more usually a succession of beams. In the later case, the respective yarn sheets are combined during a sizing operation prior to formation on the weaving beams. This system of warping, customary among West European linen weavers until recently, results in stoppages and lower quality of fabric. Blowing and suction devices are of much assistance in lowering the dust level.

The method of weft insertion on Rapier looms is considered to provide greater design scope by allowing different coloured and textured yarns to be used on the weft. This has created fresh opportunities for weaving new products, and in addition has addressed the demand for dyed linen yarn in order to produce interesting colour and weave effects.

Modern shuttle less looms are preferable for weaving linen yarns because of improved overall performance in term of efficiency, better fabric quality and lower noise level. Multi width weaving machines can be exploited when high productivity is desired.

## Applications of linen fabrics:

The bulk of linen and linen apparel is made from flax blends or flax yarns mixture. They are used in the production of apparel fabrics for spring and summer wear collections. Menswear include jackets, shirts and suits, and womens wear include blouses, suit, skirts and jackets. Garments made from 100% flax are for sale in most of the major apparel outlets in Europe and the US. Other linen products include upholstery, wall coverings, curtains, cushions and deck chair covers.

Table cloth, towel, napkins, bedding and embroidery are produced using 100% flax yarn or flax blends or mixture. Filter cloth, money bags for banks and other textile products of important industrial end uses are often produced from 100% flax yarn.



Linen for apparel

## Linen weaving: Technical aspects

The development of higher speed Ravier and projectile looms played a major role in improving linen weaving efficiency as well as allowing linen to be woven by companies that were not traditional linen weavers. Highly specialized linen weaving equipment was thus substituted by these new looms which due to small shed formed during the weaving process and the consequential low tension applied to the warp yarns were ideally suited to linen weaving. Thus Italian and French silk weavers Scottish Tweed weavers and Yorkshire worsted manufacturers diversified into the weaving of linen fabrics. The inherent qualities of the resultant fabric captured the attention of textile and fashion designer across Europe and this led to a much improved choice of designs, colour palettes, texture, blends and weight.

The consistently high average tensile strength of fine count flax yarn from bleach trove could render traditional beaming and sizing procedures obsolete. The elimination of these could be an advantage. Sizing is normally carried out to coat the Warp yarn with products such as starch base size in order to increase yarn strength and decrease yarn hairiness prior to weaving. The sizing is aqueous-based, slow and energy intensive, as the yarn has to be dried. After weaving the warp yarn remains coated with size which must be removed by a time consuming desizing process, usually using enzymes, before satisfactory bleaching, dyeing, printing or finishing can be carried out. If not desized properly, fabric faults can be generated during wet-processing as a result of uneven applications of dyes, finishes or chemical auxiliaries. In addition, the sizing process uses water and energy, and effluent is highly polluting in terms of its BOD (Bio-chemical Oxygen Demand) thereby increasing effluent treatment cost.

Traditionally linen fabrics were woven on rather specialized, often narrow-width, looms with narrow shed and with minimum stretching of warp yarn during operation. Innovations in weaving techniques, particular of those shuttleless varieties, were initially focused on weaving sectors other than linen. Ultimately, their applicability to linen weaving was recognized by traditional linen weavers and by the 1990, the bulk of weavers in Western European producing countries used high capacity shuttleless weaving techniques, although shuttle looms were still in some weaving factories.

Two particular innovations were of importance in the drive for the improved market share of linen in the late twentieth century. These were **precision yarn winding and precision sectional warping**. The former improved the running properties of yarns during warping and the latter allowed individual and tension control and thus cut down on the number of tension-related faults in the final woven fabrics.

Certain precautions needed to be taken when weaving flax yarns. Firstly, relative humidity should be in the range of 75 to 80 per cent, at a temperature within the range 20-22°C. A second consideration is dust, which results from yarn to yarn friction and yarn to machine parts friction, especially drop wire, heddles and reeds, where dust forms a deposit on the loom and on the warp yarn.

Sectional or mill warping is carried out by accumulating the warp ends required, in the form of a similar adjacent or overlapping section, around the surface of a cylindrical mill or swift, rotating on a horizontal axis. All sections are later withdrawn simultaneously on to beam. This method is standard where short length of warp is required, since it facilitates the use of relatively smaller number of supply packages.

Flax yarn from a given batch will have undergone similar prior processing and should not exhibit major colour variation.

However, with yarn from different batches, colour variation will often be evident. When warping grey yarns, care must be taken to avoid warp streaks. It is therefore advisable to ensure that bobbins from the same batch are used to complete a given warp.

Warps are generally sized to improve weavability. There is however, much debate on the merit of sizing flax yarn and traditions vary from one geographical region to another. Sizing is rarely of importance where yarns are of highly tenacity.

**Oiling or waxing of yarn** have also been recommended, since they lead to a reduction of pilling, an increased extension of break, a reduction of the friction coefficient, and also a reduction in the amount of dust created during the weave process. Sizing is considered necessary, when using dry spun yarn for the warp, especially when these are in the finer range of dry-spun counts.

## Practical hints for linen process

### 100% linen weaving

- ❖ The yarn should be perfectly compacted.
- ❖ Use flat plastic gloves when putting cones in warping creel.
- ❖ Wrap the warp beam immediately with flat plastic or nylon fabric.
- ❖ Pull linen yarn from Sizing Creel to Size Box from each Beam separately not collectively.
- ❖ Maximum drying cylinder temperature should be 65°C on passing.
- ❖ Abro tape should be fixed on each beam sheet at the exit of sheet from wet leasing roller.
- ❖ Leasing dry (Sizing).
- ❖ Denting at comb be done without sizing.
- ❖ Remove tape before processing.
- ❖ Put sheet in the Size Box.
- ❖ All tension settings should be 40% less (Sizing).
- ❖ No elongation or stretching (Sizing).
- ❖ Knotting should be ½ the normal speed (Warp Typing M/C).
- ❖ Cut knot size before passing the sheet on loom.
- ❖ Complete cleaning of loom specially dropper, Heald wire and Reeds.
- ❖ Use only Splicer in weaving and inspect fabric immediately after Doffing
- ❖ Inspection should be on roll only.
- ❖ No loose stacking.
- ❖ Sale only from rolls.

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