

Pilling

Pilling: Pilling is a fabric surface fault characterized by little 'pills' of entangled fibre clinging to the cloth surface and giving the garment an unsightly appearance. The pills are formed during wear and washing by the entanglement of loose fibres where protrude from the fabric surface. Pilling can be considered to be the first sign of wear by light abrasion in a fabric, made from staple fibre yarns.

Pills: Pillar are small knots or balls of mixture of large number of small fibres accumulated at the surface of the fabric and entangled by the mild frictional action during processing or wearing. They are soft but firmly held on the surface of the material.

Mechanism of Pilling: Pilling happens due to wearing of the surface. The surface of the fabric when abraded, the constituent fibres from the yarn surface get liberated and become loose, and further abrasion bring out entanglement on its surface.

These loose fibres or entangles fibres form hard pills on the fabric surface giving an unsightly appearance. The appearance of pills is more prominent in the synthetic material and also materials blended with synthetic fibres.

Pilling Test

A number of Pilling test methods and instruments have been developed in various laboratories. After rubbing under controlled conditions, the pilling of the sample may be assessed **numerically** by counting the number of pills formed; alternatively, the **appearance** of the test specimen may be compared with standard sample and given some form of rating. There are at least three types of tester which are popular to conduct the pilling test. They are-

1. Martindale Abrasion Tester
2. I.C.I. Pill Box Tester.
3. (The Du Pont) Random Pilling Tester

1. Martindale Abrasion Tester:

The Martindale Abrasion Tester can be used for Pilling test as well. The normal sample holders are replaced with lightweight square holders which are keyed so that they may have vertical movement but cannot turn on their axes. An adjustment has to be made to convert abrasion into pilling in the tester. After a certain number of rubs the samples are examined and the number of pills counted. This may be repeated, say, in stages of 500 cycles up to 3,000 or 5,000 and the rate of development of pills noted.

2. I.C.I. Pill box tester

The Method of Test: A piece of fabric measuring 5"×5" is sewn so as to be a firm fit when placed round a rubber tube (6" long, 1¼" outside dia, and 1/8" thick). The cut ends of the fabric are covered by cellophane tape and four tubes are placed in a box (9"×9"×9") lined with cork 1/8" thick, which is then rotated at 60 rev/min for 5 hours.

For garments normally subjected to repeated washing as well as to wear, washing may be desirable prior to preparing the tubes of fabric. Hence, it is the practice to apply a standard hand wash in 0.5% soap at 45°C for 15 min to Terylene/Cotton and Terylene/Viscose shirt and dress fabrics.

After tumbling, the extent of pilling is assessed visually by comparison with the arbitrary standards 1, 2, & 3. Under test conditions fabrics of Standard 1 become hairy but do not pill, fabrics of Standard 2 become hairy and pill slightly, while fabric of Standard 3 become hairy and pill more severely. (Figure next page)

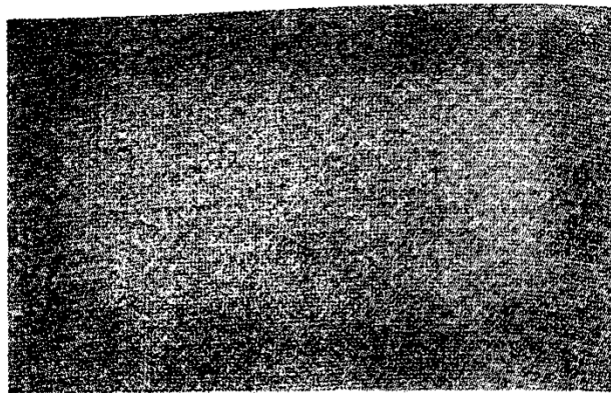
Another Ratting is (1) No pilling, (2) Slight but tolerable pilling (3) Moderate pilling of borderline acceptability (4) Unacceptable pilling (5) Extremely high pilling. Ratting varies depending on Testing Standards.

Interpretation of the result should be governed by the following principles:

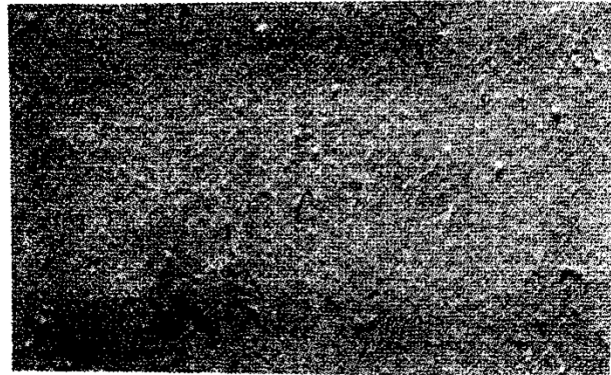
1. The extent of pilling, exemplified by appearance standard, will not be produced by every person but only by those who are particularly hard on their clothes.
2. Experience has shown that when pilling does occur is it usually limited to the most susceptible parts of a garments; e.g. collars, cuffs, pocket edges, front skirt panels. When, however, pilling is severe under the conditions of test, it is probable that the body of the garment will become an affected area, and that the number of persons who will produce the effects is also likely to increase.
3. From a pilling point of view, shirts, blouses, lingerie, and dresses are considered to be critical end-use. These garments will be frequently laundered between wearing, while medium and heavy weight garments will not normally be washed or cleaned with similar frequency. In this latter group, trousers and suits are considered to be more critical than skirts, costumes, and rainwater.



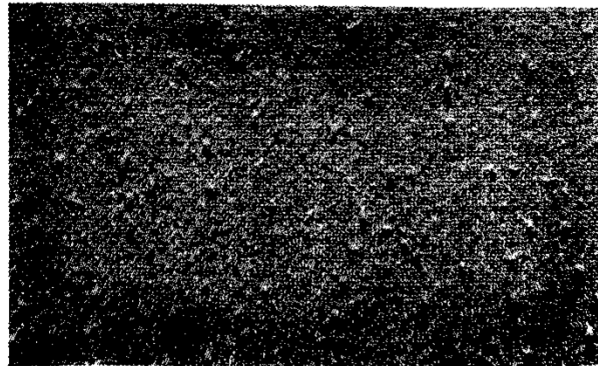
(I.C.I. Pill box Tester)



(a)



(b)



(c)

Figure 7.33. Pilling standards: (a) Standard 1; (b) Standard 2; (c) Standard 3 († original size)
(By courtesy of I.C.I. Ltd)

3. The du Pont Random Pilling Tester:

A six-unit tester is used, each unit consisting of a cylindrical chamber 6" long by 5¾" inside diameter, horizontally mounted, containing a two-bladed impeller which rotates at 1,200 rev/min. The inside of the chamber is lined with neoprene, about 1/8" thick, which can be changed when necessary. Into each unit three 5"×5" fabric samples are loaded together with a small amount of cotton lint, the latter being used because the pills which are formed bear a closer resemblance to pills formed during wear than those formed when the lint is absent.

After 1 hour whisking and tumbling the test fabrics are examined visually and compared with standard samples. Five ratings are used.

Factors Responsible for Pilling: (Study with effects)

1. Fibre Characteristics

- (a) Morphological Structure
- (b) Chemical Structure
- (c) Fibre Structure
- (d) Fibre Length
- (e) Fibre Fineness
- (f) Strength
- (g) Extensibility

2. Yarn Characteristics

- (a) Blend Composition
- (b) Count
- (c) Twist
- (d) Plying
- (e) Regularity (evenness) of yarn
- (f) Hairiness
- (g) Short fibres

3. Fabric Characteristics

- (a) Weave
- (b) Knitting
- (c) Intersection
- (d) Ends and Picks

4. Frictional or Abrasive Forces

Pill Formation During Wet Processing:

Pilling is caused on the fabric surface, where it comes in contact with an object in motion or by rubbing. In wet processing of textiles, these conditions exist in different stages such as drying, dyeing, printing, finishing etc.

Drying is one process which may cause pilling of the fabric. During drying, the water from the surface of the fabric evaporates and water from the core of the yarn comes onto the surface along with loose fibres to maintain equilibrium. Hence **improper drying temperature** may accelerate pilling.

Pilling may also be caused during drying due to abrasion between the layers of the fabric or due to **frictional contact with the rollers in motion**. Too much swelling together with high temperature may intensify pilling.

Calendaring is another process where some more pilling can take place due to abrasion with the rollers in motion. **Too much tension** can intensify such fault. The wearing forces on garments, too much tightness or too rough uses, may accelerate pilling.

Effects of Pilling:

Pilling rarely affects the actual durability of a fabric but it affects adversely in processing as well as to the physical properties of the fabric like appearance, handle etc

In dyeing, the pills are likely to absorb more dye resulting in deep shade in contrast to the ground and consequently cloth appears skittery. Further if it develops on the dyed garments during use, it will be lighter in shade resulting in skittery appearance of the materials.

In printing, the sharpness of the outlines of the printed design in the fabric will be spoiled in the presence of pills. Further if it develops on the printed fabric during wear, the printed pattern will not only be blurred but the beauty of the print will be lost.

In finishing, the presence of pills hamper to a great extent in the production of a clean and clear finish. They spoil the appearance of garment.

It also affects adversely the handle of the fabric and consequently deteriorates the comfort of the fabric.

The effect of such changes is dependent on the degree of pilling as well as on the severity of the process adopted. Thus pilling renders the materials unsuitable for domestic use.

Remedies:

1. Steps to be taken prior and during spinning and weaving:

(a) Fibres with cross section other than circular, dumb-bell, and artificially serrated cross section are the best.

(b) Longer staple length, coarser fibres, higher extensibility, greater crimp etc restrict the slippage of the fibres and hence control the tendency to pill.

(c) The common suitable blends of polyester and cellulosic fibres in order of decreasing pilling, are 80/20, 67/33, 50/50.

(d) Higher proportion of short fibres is problem so combing is essential to avoid this defect.

(e) Coarser denier, hard twist, lower hairiness of the yarn are desirable to control pilling. Ply yarn is better and ply yarn with hard doubling twist is the best.

(f) The tendency to pilling is greater, if protruding fibres are present in the yarn. By increasing the number of interlacements in weaving or knitting the loose fibres can be bound tightly at greater length and pilling can be reduced. Higher number of ends and picks minimize this fault.

2. Steps to be taken after weaving or knitting:

(a) Shearing and cropping

(b) Singeing

(c) Heat setting

(d) Surface carbonizing

3. Chemical Treatment:

(a) **Binding agents:** Resin or any such type of binding agents help in controlling pilling to a great extent. The binding agents hold the loose or protruding fibres on the surface of fabric firmly. There is very little possibility of these fibres to be removed and getting entangled on rubbing to form pills.

(b) **Hydrophilic agents:** Hydrophobicity or hydrophilicity plays an important role in pill formation. Thus treatment with a special polymer composition of acrylic type forms a hydrophilic non-tacky film of good cohesion which helps in eliminating undesirable pilling to a great extent.

[Any antipilling treatment should not reduce handle properties greatly]