



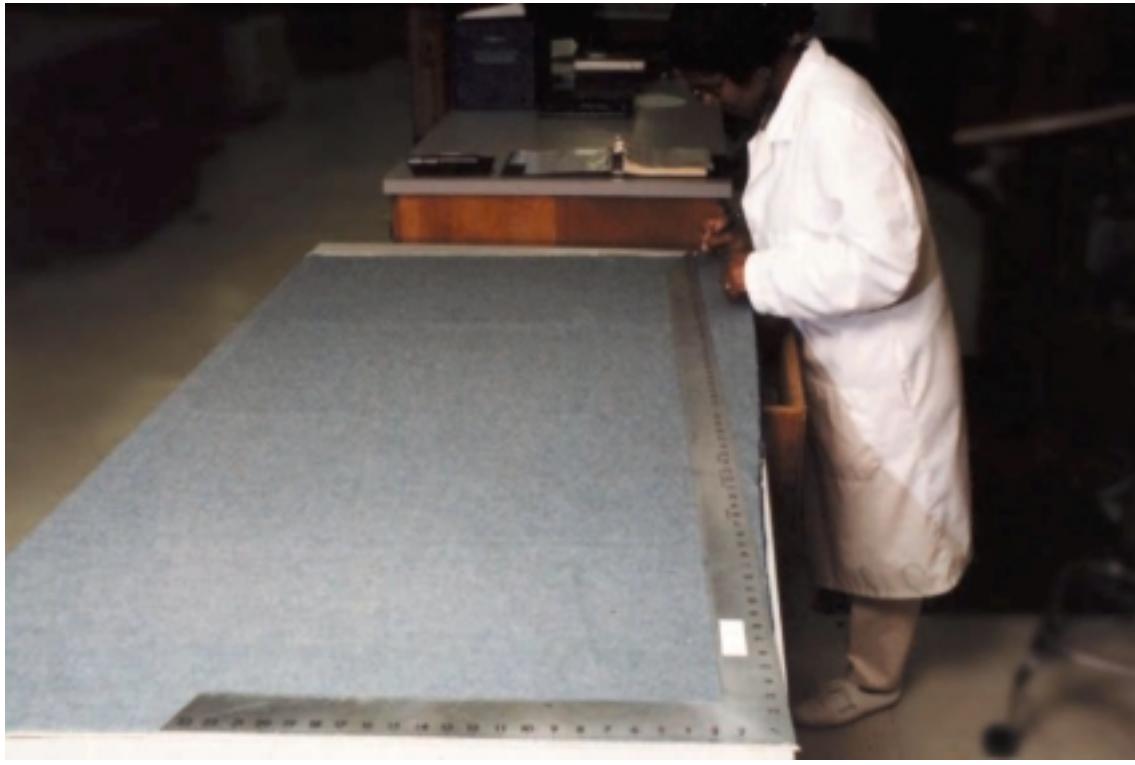
Recommendations for the Prevention of Leg Twist

Introduction

The Technical Support and Product Quality departments of Cone Mills have assembled this information to assist our customers in the avoidance of leg twist in finished garments. Twisted legs have long been a source of frustration and concern for jean manufacturers. Twisted leg(s) occur when the fabric moves more than 2.54 centimeters (1 inch) out of alignment in the leg of a garment from the knee to the garment hem. This garment condition occurs in garment finishing and most often not observed until the final pressing stage. There are numerous causes for leg twist, including improper cutting and sewing practices and incorrect skew control in fabric finishing (*see a complete list of causes beginning on page no. 38*). The following information explains some of the causes and preventative measures that can substantially lower the incidence of twisted legs in garment manufacturing. Cone Mills has drawn upon more than 100 years of denim manufacturing experience as well as a cooperative effort with some of the worlds largest jean manufacturers to develop this information.



Twisted Leg

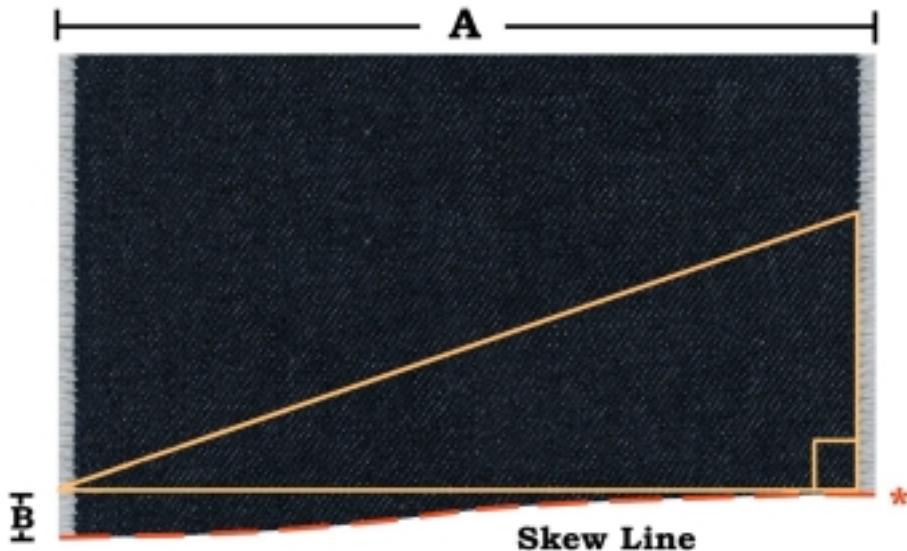


Fabric Skew

Denim producers, including Cone Mills, intentionally introduce skew into heavyweight denim in the finishing process. Fabric skew is determined as the percentage difference from the filling yarn, or pick line, to a direct, horizontal line across the width of the fabric (*see fig. 1 page no. 32*). During weaving, the filling yarn is inserted at right angles to the warp yarns. When fabric is washed the filling yarns shift as a result of the twill weave. In order to prevent this movement of the filling yarns after washing, most denim manufacturers purposely skew the fabric under tension and proper conditions. This process prevents fabric movement in the direction of the twill line during garment wet processing. Excessive movement cause twisted legs, however, twisted legs will not occur if movement is limited to 3% or less.

Cone Mill's Product Quality Department has developed standards for skew through laboratory tests and closely working with garment manufacturers. The standards in use are based on the construction and twill direction of the fabric. Previous studies have concluded that a skew level of 8% (+/- 3) across the width of a basic 3x1 14.5 Oz. Right hand twill fabric is sufficient to counteract the inherent movement of the denim after washing and relaxation.

Measuring Fabric Skew (fig. 1)



*----The fabric is cut following 1 filling yarn from selvage to selvage.

SKEW IN HEAVY WEIGHT DENIM

A fabric condition that is the result of filling yarns being angularly displaced from a line perpendicular to the edge of the fabric. Skew is usually reported in percent.

$$\text{SKEW \%} = \frac{\text{B}}{\text{A}} \times 100$$

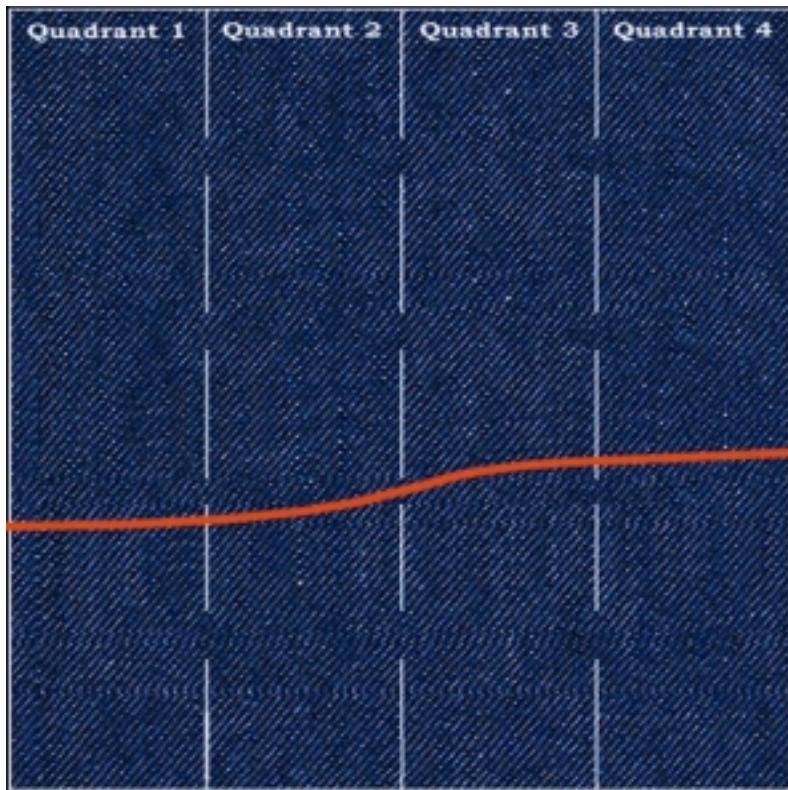
WHERE A = FULL CUTTABLE WIDTH
B = INCHES OF SKEW

Best Practices to Avoid Twisted Legs

Quadrant Cutting

All twill weave fabric has a natural tendency to skew in the same direction of the twill. In order to compensate for this tendency, denim manufacturers insert skew in the fabric to prevent the occurrence of twisted legs in garment production.

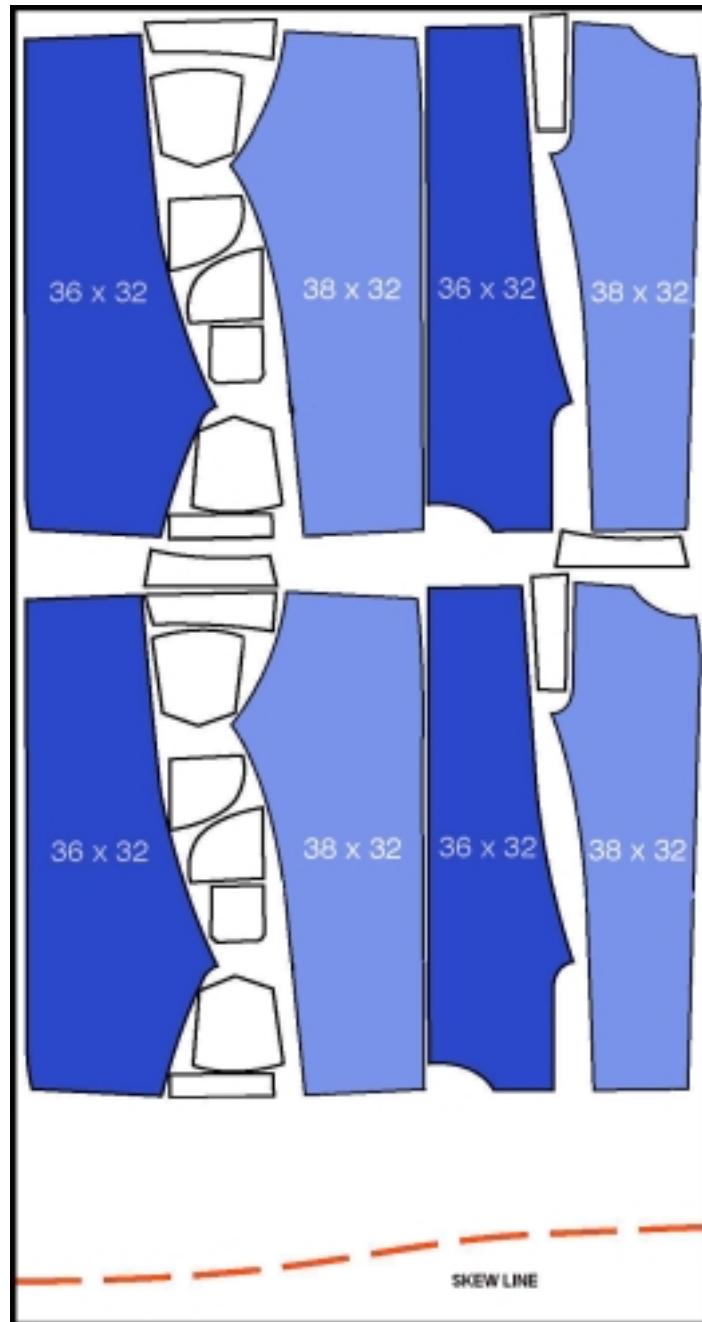
Variations in the skew exist in heavy weight denim from roll-to-roll as well as from selvage-to-selvage within the same roll. For example, if the fabric is divided into 4 equal segments (quadrants) from selvage-to-selvage, differences are found in the amount of skew between each of the 4 quadrants (*see fig. 2 below*).



(fig. 2)

Because of skew variation, we recommend that front leg panels and back leg panels be positioned on the marker so that they are not cut from the same quadrant for the same leg of a garment. Panels cut from quadrant one and quadrant four should never be sewn together. The example on page 34 (fig. 3) depicts a layout that will minimize fabric loss while insuring twisted legs will not occur during garment manufacturing.

Continuous Pair Spreading Face to Face (*Pair Back Spreading*)



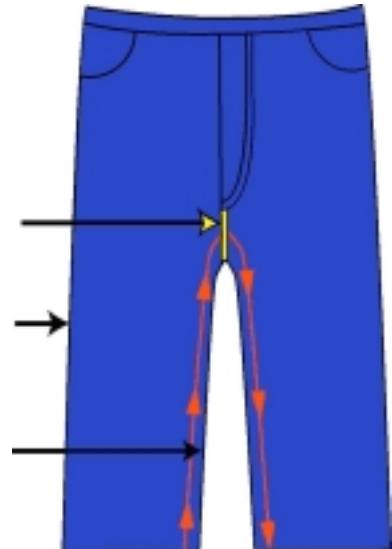
(fig. 3)

Note: This diagram is not meant to be an exact marker, but represents the findings made during a four-year leg twist investigation with a major jeans manufacturer.

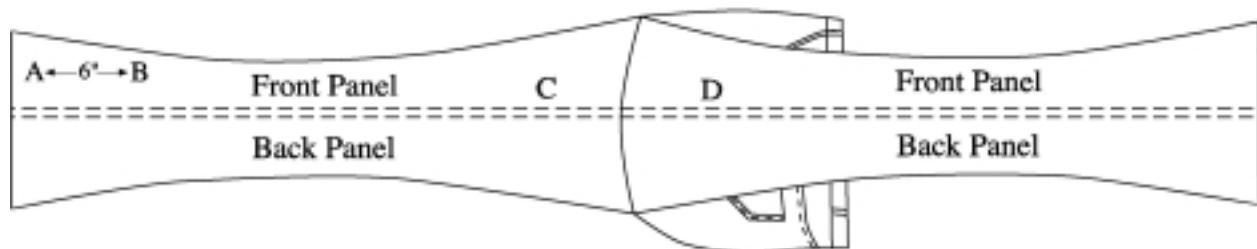
Proper Sewing Cycle

After thorough investigation, major jeans manufacturers have developed a recommended sewing process that has substantially reduced the problem of twisted legs in their production. The following diagram describes these recommendations (fig. 4).

- 1) The Join Crotch is sewn first so as to have one piece to handle instead of two panels.
- 2) The side seam is sewn to join the front and back panels. The pants are then turned right side out.
- 3) The inseams of a garment are sewn using a continuous felled seam starting at the bottom of the left leg. The recommended method of sewing inseams is shown below (fig. 5).



(fig. 4)

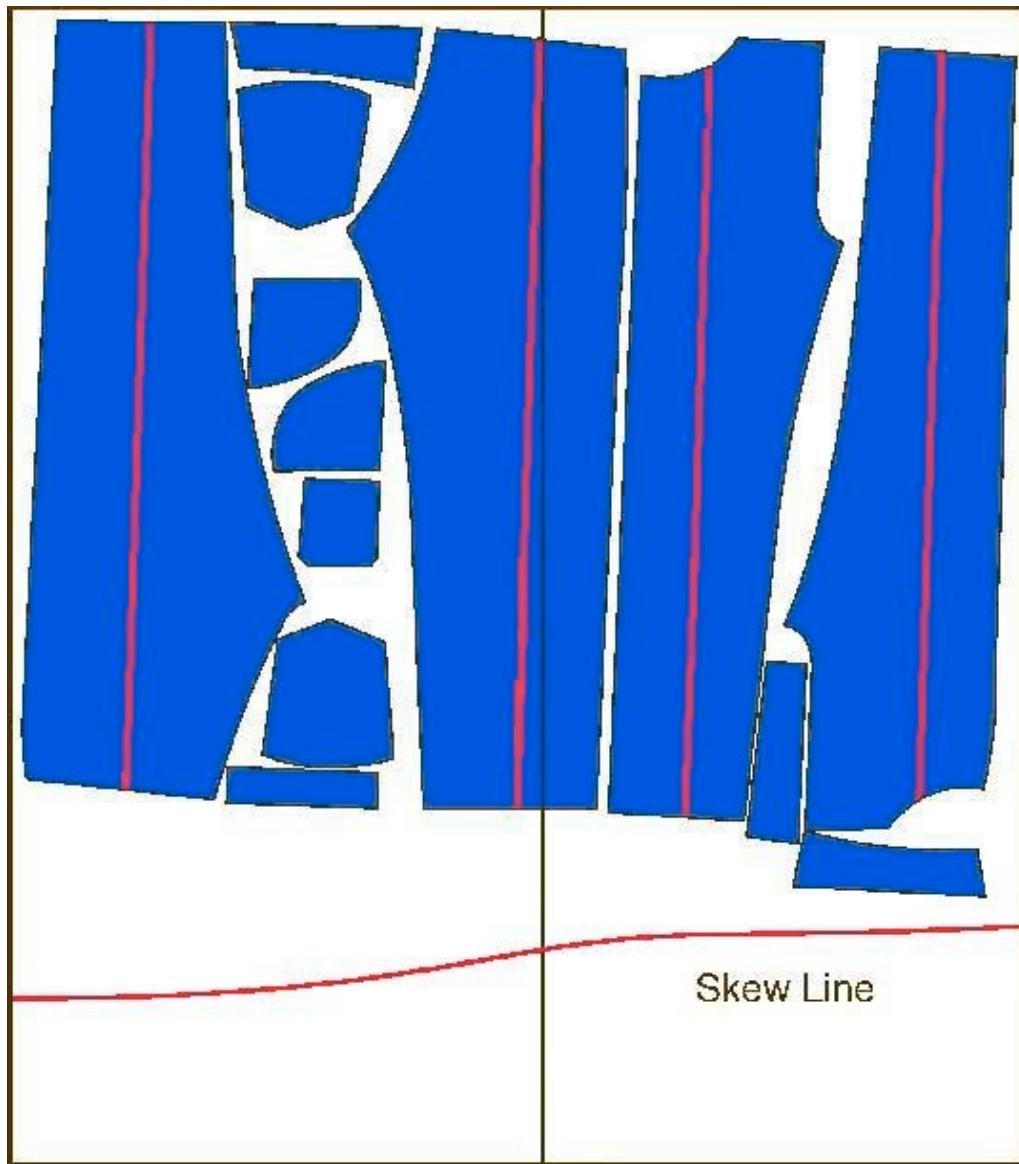


(fig. 5)

- Sew from A to B approximately six inches with light hand pressure on Front Panel and no pressure on Back Panel. Allow the fabric to feed naturally from B to C.
- Sew from C to D with light pressure on Back Panel and feed in Front Panel during the sew cycle. Complete the seam with no added pressure.

Panel Tilt

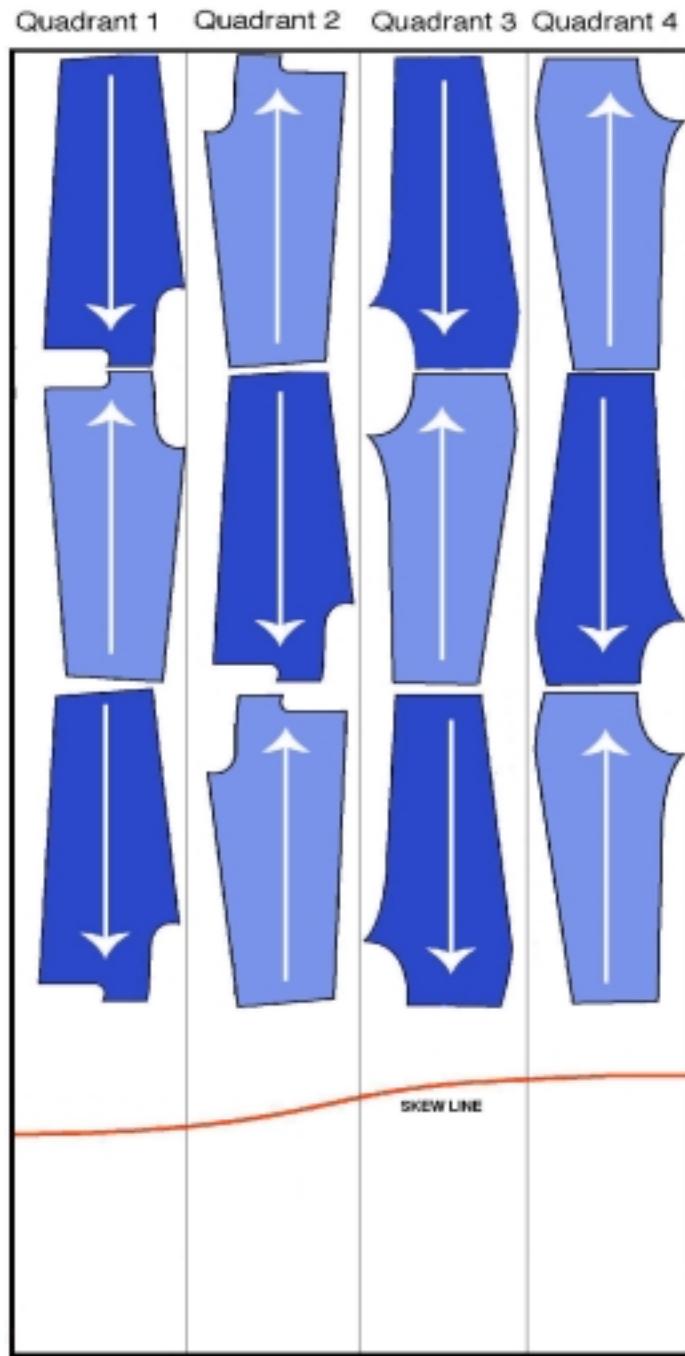
Another cause of leg twist in garments is panel tilt: when markers are angled slightly on the cutting table off grain to the fabric (fig.6). Studies have demonstrated that a panel tilt of greater than 1 degree contributes greatly to twisted legs. In no case should panel tilt exceed 1 degree and preferably be aligned directly on the straight grain of the fabric.



(fig. 6)

Sewing Panels Cut in the Same Direction

All leg panels within a garment should be sewn from leg panels cut in the same direction (fig. 7). In the diagram, the appropriate front panel pairs and back panel pairs cut in the same direction should be used to construct a garment. The diagram represents *pair-back spreading* method of spreading.



(fig. 7)

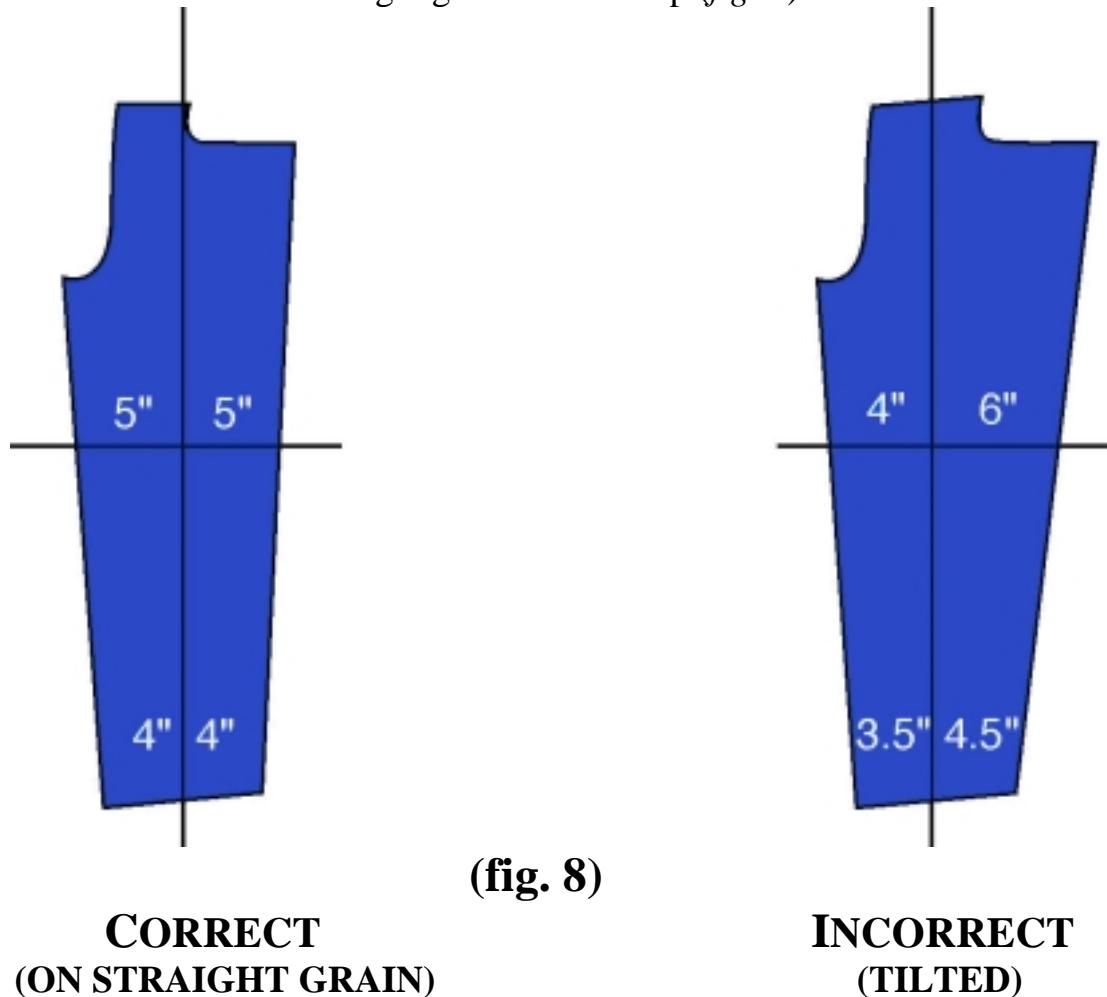
Causes for Leg Twist Other than Raw Materials

CUTTING

- **Cutting Errors (Out of Tolerance)** -- Operator cuts off line from the marker or tilts knife, resulting in over-sizing, or short or long panels.

PATTERN

- **Tilted Markers** -- The marker is not properly aligned with the fabric grain. Refer to panel tilt diagram (*page no. 36, fig. 6*).
- **Tilted Pattern** -- Pattern is tilted on the marker, laid out improperly, not on straight grain of the warp (*fig. 8*).



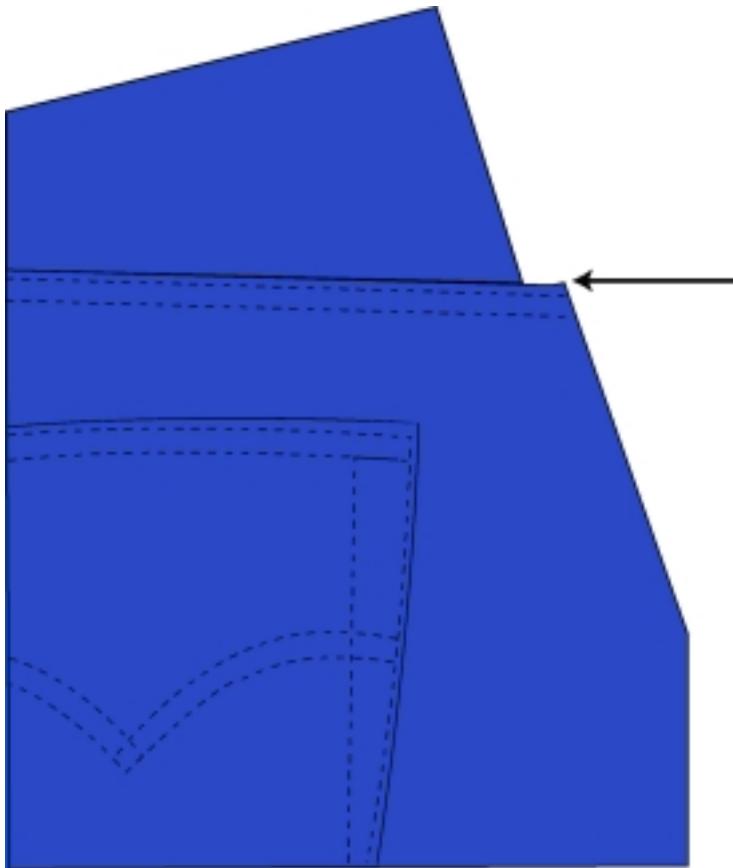
(fig. 8)

**CORRECT
(ON STRAIGHT GRAIN)**

**INCORRECT
(TILTED)**

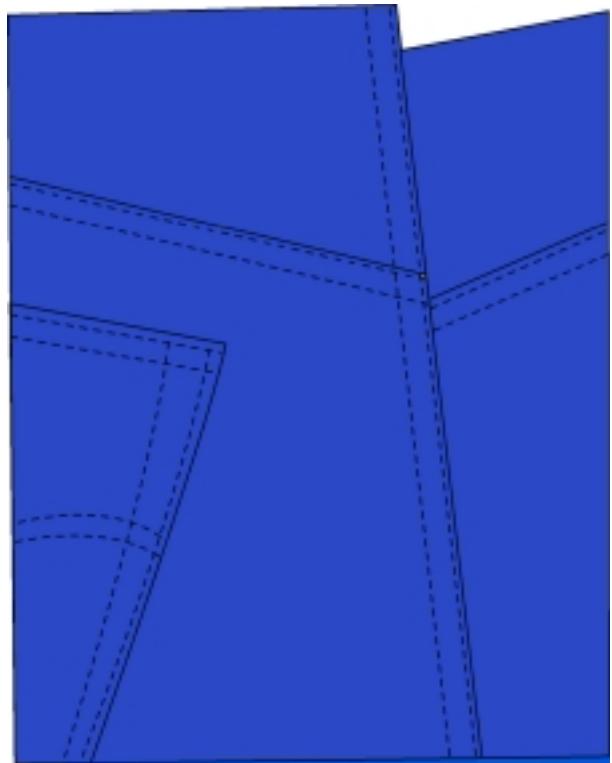
SEWING

- **Mis-Alignment** – Two panel edges do not meet at either the start or end of the seam (fig. 9-10)



(fig. 9)

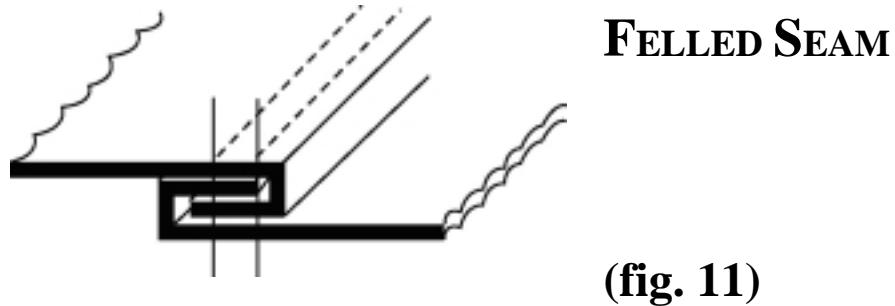
Risers – At the end or start of sew the back riser and back panels are attached unevenly.



(fig. 10)

Seatseam – At end or start of sew right and left backs of seatseam are not even.

- **Overloading Felling Folder** – A felling folder is designed to fold fabric down from the top of one panel and up from the bottom of the other panel locking the two folds of fabric together, making a felled seam (*fig. 11*). When too much fabric is placed into the top of the fold, it will push the bottom fabric out of its folder (resulting in a raw edge on the bottom). The same result is seen when overloading of the bottom folder (resulting in a raw edge on the top). These results may contribute to gathering and twisted legs.

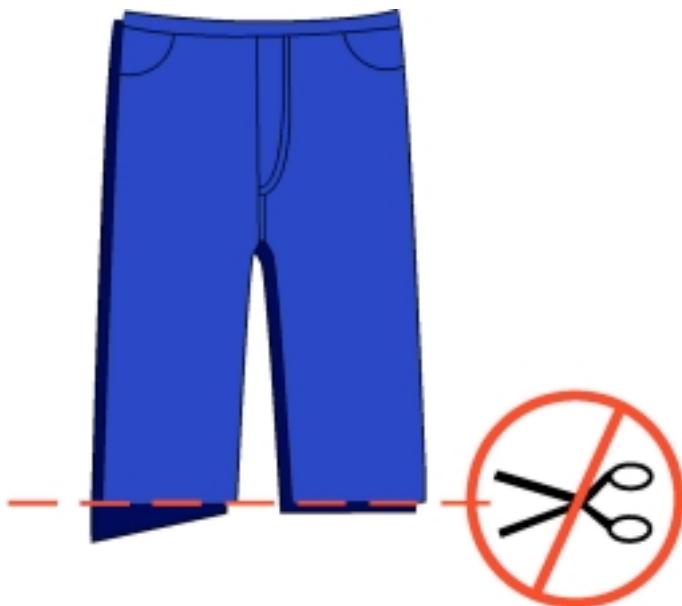


- **Notches on Close Pockets** – A cut in the front pocket facing that must be matched with the front pocket edge (after the front pocket is top-stitched) to prevent uneven runout.
- **Trim-Off** – Operator trims off runout to make panels fit (*see page 41 fig. 12*)
Examples are:

- 1) Join Crotch – At the end or start of sew the right and left fronts are joined together and do not match perfectly.
- 2) Inseam – At the end or start of sew the front and back panels are joined together at the inside and do not run out evenly.
- 3) Outseam – At the end or start of sew the front and back panels are joined together at the outside and do not run out evenly.

FINISHING

- **Washing** – Overloading washing machines or stretching and twisting garments while removing the garments from the washing machine.



(fig. 12)

Conclusion

Cone Full Width Skew Standards

Cone Mills' Product Quality Department has developed skew standards after extensive research in conjunction with major jean manufacturers. The standard for basic 3x1 14.5 Oz. right hand twill is:

	Standard	Maximum	Minimum
3x1, 14.5 Oz., RHT	8.0	11.0	5.0

For standards on other products, please consult with your Cone Mills Sales Representative.

Quality Requirements

The procedures and recommendations listed in this publication were developed in an effort to assist customers in preventing leg twist on Cone Mills supplied products. This information was developed from a long-term study between Cone Mills in partnership with major jean manufacturers supplied by Cone.

We believe this information is accurate when followed by customers will prevent leg twist. In the event leg twist occurs Cone is committed to assist the customer in resolution of the problem.