SUMMARY

Yarn were spun on different spinning systems, that is, Ring, Rotor, Siro, Repco and Doubler from different fibres such as polyester, cotton, viscose, wool and their blends (48/52, 67/33, 70/30) in a range of count (9.8 tex to 31.1 tex). These yarns were dry and wet spliced on the Schlafhorst Autoconer equipped with pneumatic splicer (DZ₁/DS₁) under optimum splicing conditions.

An idealised mathematical model of the spliced yarn was considered to predict the load-elongation behaviour of the yarn.

The structure of the splice was investigated by studying the longitudinal view of the yarn on the projectina. Cross-sectional studies of the splice region were made on the projectina to evaluate the location of fibres in the joint of the two yarn ends. Analysis of the longitudinal and transverse studies revealed the structure of the splice comprising of (i) Twisting (ii) Wrapping (iii) Tucking/Intermingling. Longitudinal study of splice confirmed the presence of twisting and wrapping but this study does not confirm intermingling. The cross-sectional study helped in confirming fibre intermingling in the spliced region.
Twisting:

The two yarn ends comprising the splice are twisted around the body of the yarn. Each yarn strand twists on the body of the yarn on either side of the middle of the splice. Microphotograph reveals the structure of the yarn strands as a ribbon of parallel fibres which provide compactness due to twisting. The cross-section distinctly shows the fibres of the two yarn strands separately without any intermingling of the fibres. The two clusters of fibres rotate due to twisting and complete circular rotation.

Wrapping:

The tail-end of each yarn strand is tapered and terminates with few fibres. The tail end makes a good wrapping of several turns and thus prevents fraying of the splice. The fibres of the twisting yarn embrace the body yarn and thus act as a belt. This helps in giving a clean appearance to the splice and prevents fraying of the yarn strands. Thus wrapping supplements strength to the splice.

Tucking/Intermingling:

The middle portion of the splice shows a region (2-5mm) having no distinct order. The fibres from each of the yarn end intermingle in the middle of the splice zone thus tucking
the fibres of the two yarn strands. Initially the fibres of the two strands are in separate groups but gradually some fibres of one strand intermingle with the fibres of the other strand. Progressive cross-sections of the middle portion of the splice zone show that the number of intermingling fibres increase and the fibres of the two strands intermingle for about two turns.

Mechanism of Splice:

The two splice strands are a ribbon of untwisted fibres in each direction. The fibres of each strand-end have maximum mobility; somewhere in the middle of the spliced zone of the fibres in both the splice strands will have sufficient mobility to permit fibre intermingling. The tip end of each splice strand being tappered has fewer fibres; so only wrapping takes place at the edges of the splice zone. Twisting has a dual role - to promote fibre tucking at the interface of two splice strands and generate transverse forces to provide frictional resistance to slippage of the tucked/intermingled fibres between the two strands of the splice.

An attempt was made to obtain quantitative contribution of the three splice elements to the splice strength. The
load-elongation behaviour of the normal yarn, spliced yarn, spliced yarn without wrapping and spliced yarn without wrapping and twisting was obtained to estimate the relative contribution of Twisting, Wrapping and intermingling. It is observed that intermingling/tucking contributes maximum towards the strength of the spliced yarn (52%). The contribution of twisting is also significant (33%). However, the contribution of wrapping is small (about 15%).

Intermingling/Tucking contributes maximum to the elongation of the splice. The contribution of twisting towards the elongation of the splice is also significant. Wrapping contributes the minimum towards the splice elongation. The relative contribution of wrapping, twisting and intermingling is comparable for the work of rupture.

The effect of splicing on the relevant physical and mechanical properties of the spliced yarn was studied. The physical and mechanical properties evaluated were - diameter, mass per unit length and packing density of the spliced zone/yarn and yarn breaking strength/elongation.

The strength and quality of the splice is affected by machine parameters such as the design of air prism, moisture in the air; and fibre/yarn parameters such as
staple length, fibre type, fibre/yarn tex, twist and spinning system etc. The effect of these parameters is studied on the breaking strength/elongation and diameter of the splice.

Dry and wet splicing was compared for the polyester yarns. The breaking load retention for the wet spliced yarn is significantly greater than the dry spliced yarn. The maximum strength retention was achieved in wet splicing for yarn spun from long staple fibres and for coarse counts. Splicing increases the diameter of the splice zone by about 25-33% but the packing coefficient is lower (72-85% of the normal yarn). The retention of breaking strength and extension varies from 55 to 87% and 78 to 91% depending on the yarn and fibre respectively. The splicing of polyester spun yarn gave maximum retention of breaking strength compared to viscose, cotton and woollen yarn. Coarse yarns spun from cotton, polyester, and wool fibres gave higher retention of breaking strength but marginal increase in extension. An increase in the twist of cotton spun yarn gave in-significant increase in the breaking load and extension even though higher pneumatic pressure was used for the high twisted yarn.
Spliced yarn from longer fibres gave significantly better retention of breaking strength than the yarn spun from short staple fibres. It was observed that blending of polyester to cotton or wool improves the properties of the spliced yarn because of the superiority of the polyester splice. However, blending of polyester to viscose does not significantly affect the splicing performance of the P/V blended yarn. The retention of breaking strength of the rotor spun spliced yarn from 100% cotton, P/C and P/V blends varied from 54 to 71%, being much lower compared to the spliced ring spun yarns. The retention of breaking strength of the spliced doubled yarn is lower than the spliced ring spun yarn. The splice strength is maximum for Siro yarn and minimum for Repco spun yarn compared to the yarn prepared on the doubler.