Brittle yarns

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Splicing is a violent process; it blasts fibres with air at a pressure of around 7 bar, at supersonic speed. Such speeds and pressures are essential, to create the required degree of intermingling of the fibres. Intermingling requires that the fibres be bent repeatedly, so that they wrap around each other on a micro-scale. Conventional fibres, such as nylon, can survive such treatment with minimal damage.

If the bending modulus of the fibre increases, the fibres resist distortion, and intermingling becomes more difficult. For successful splicing, high modulus fibres must be exposed to more violence – higher air pressure and greater flow rate. Fibres like glass and carbon have high modulus, but they are brittle; at the pressures needed for normal splicing, they are destroyed by the air blast. Conventional splicers cannot make joints in carbon. They damage the fibres so badly that the environment is filled with flying, electrically-conducting fragments.

Yarns used in composites tend to be big; a typical apparel yarn may have a count of 100 tex, but glass yarns for composites may exceed 10000 tex. Filament damage increases as the diameter of the yarn increases, because bigger yarns need more air flow, by virtue of their mass.

So on one hand, big, stiff yarns for composites need high air pressures and harsh treatment. On the other hand they are brittle, demanding low air pressures and delicate handling.

This was the technical problem which has been resolved by Airbond research.

The same principles can be applied to carbon as was successful with heavy glass. The splicer makes a series of small splices over a length of around 150 mm., using a low air pressure. By this means, the carbon is not damaged, simply because each portion of the yarn is exposed for only a few milliseconds, and the forces applied by the low-pressure air are moderate.

This is the principle lying behind the design of the all the Airbond composites splicers - Models 113, 114, 701, 121 and 122.