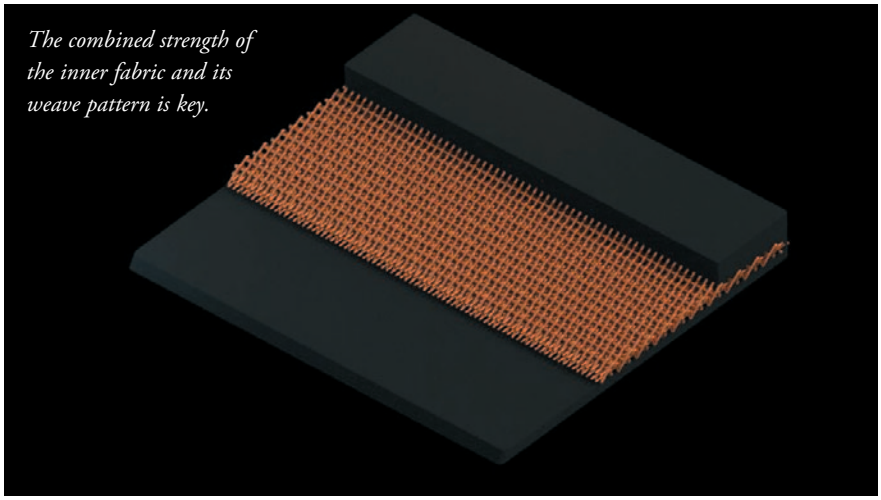
The pulse of the port

how modern conveying technologies keep global trade flowing

Time to go single?

The basic construction of the rubber conveyor belts used in docks, ports and terminals around the world has not really changed for over 120 years, *writes Jeremy Clark*. Although the rubber covers and the cotton inner ply layers are now synthetic, the basic construction and application principles have not. Put simply, the more aggressive and heavier the materials then the more layers and thicker outer covers that are required.

In multi-ply conveyor belts manufactured in accordance with ISO 14890, the declared longitudinal tensile strength is achieved through the combination of individual fabric plies working together under tension. For example, an 800/4-specification belt contains four layers of fabric reinforcement, most commonly polyester/nylon (EP). Each individual layer (ply) has a breaking strength of approximately 200N/mm. When bonded together to form the belt's carcass, their individual strengths effectively 'join forces'.



The combined strength of the inner fabric and its weave pattern is key.

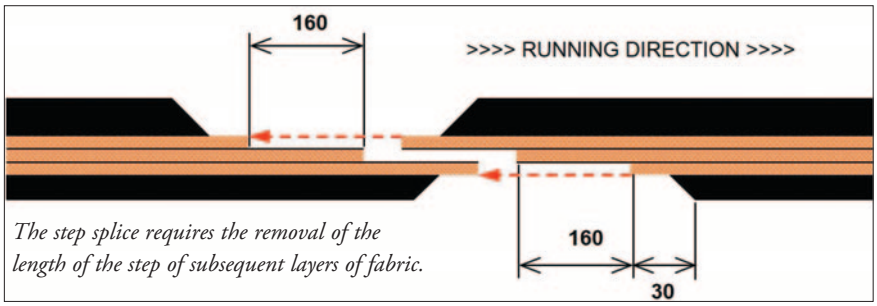
However, the true strength of a conveyor belt is not its thickness or number of plies, but the strength achieved by the combination of a specially engineered weave pattern and the physical properties of the ply fabric.

The number of plies needed to achieve a specific tensile strength needs to allow for the splice joint used to make the belt an endless loop. The most commonly used

method is the step splice, which necessitates the removal of the length of the step of subsequent layers of fabric plies so that the two belt ends can be overlapped and either glued or hot vulcanized together.

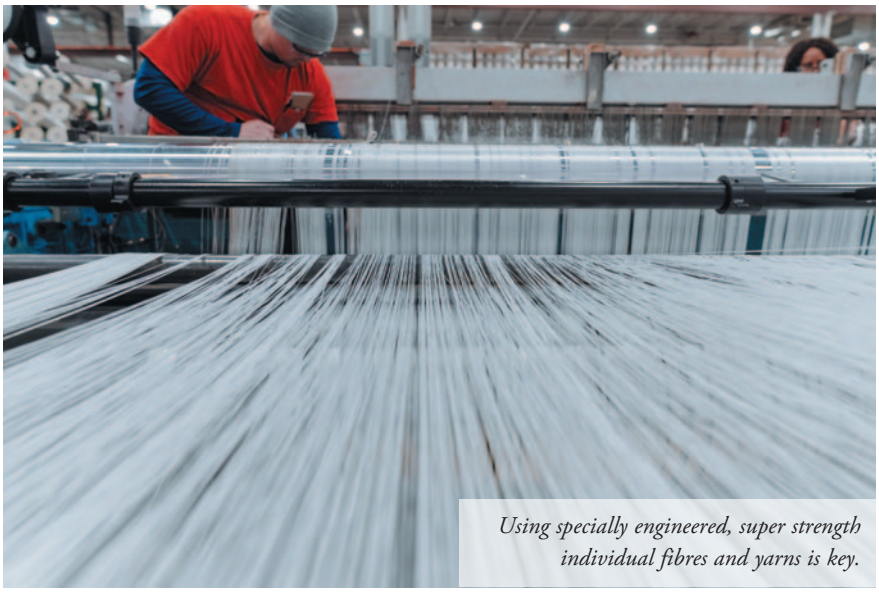
The disadvantage is that this creates a proportional loss of tensile strength equivalent to the strength of one ply. This means for example, that a step splice used to join a 3-ply belt loses 33% of the tensile strength while a 4-ply loses 25% and so on. In effect, every multi-ply belt needs to have at least one ply of greater individual tensile strength than would otherwise be necessary.

There are other disadvantages that I will come to a little later but to use a popular phrase to describe the current, almost unquestioned acceptance of the multi-ply construction, "it is what it is". However, at least one major manufacturer of multi-ply belts has invested the time and money to develop a lighter but stronger, more resilient belt that uses only a single- or dual-ply carcass construction.



The step splice requires the removal of the length of the step of subsequent layers of fabric.

Fenner Dunlop has its own weaving facilities in North America.



Using specially engineered, super strength individual fibres and yarns is key.

Less is more

North America and Europe-based Fenner Dunlop first introduced its highly successful single and dual-ply UsFlex belt more than two decades ago. Since then, the company has refused to rest on its laurels by continuing to develop and refine the concept. Fenner Dunlop's specific goal was to set itself further apart from the market dominating South and East Asia based mass manufacturers, by engineering belts that were dramatically more robust and longer lasting that could provide a much lower lifetime cost.

This was achieved by making the most of the huge advantage of having its own fabric weaving facility in the USA supported by R & D teams based on both sides of the Atlantic where it created super-strength fabrics specifically for single-ply belts (Ultra X and Nova X), together with UsFlex branded as the X Series belting.

They not only replace thicker, multi-layered belts, they also provide numerous advantages because despite being thinner and lighter, they are much more robust and resistant to damage than their multiple ply counterparts. In fact, the X Series carcasses possess a longitudinal rip resistance that is more than 500% greater than multi-ply belts of equivalent rating and up to 300% greater impact resistance compared to conventional belting.

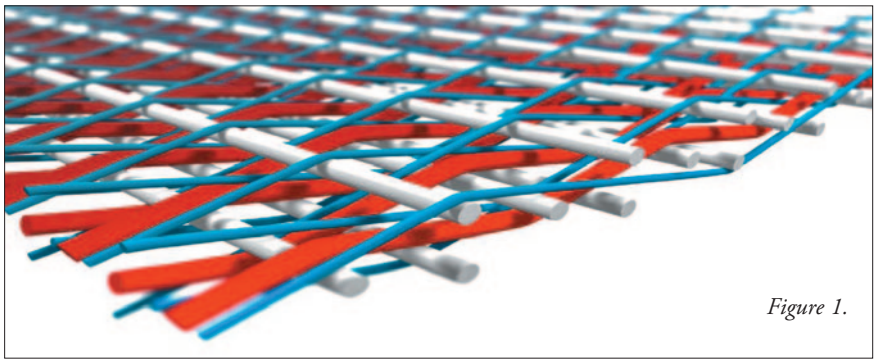


Figure 1.

The carcass fabric

The fabric is the working basis of the whole concept. Firstly, the individual fibres and yarns are engineered to the highest possible levels of quality and strength.

Next is the unique patterns used to weave the fibre strands and yarns together. The X Series has three versions of fabric.

Ultra X features a specially woven 'crimped warp' carcass (see Fig 1), combining crimped polyester warp yarns with strong binder and filler yarns, creating exceptional strength, stability, and impact resistance. All X Series fabrics are designed on the principle of lengthwise longitudinal strands with heavy strands running crosswise, held in position by a strong binder yarn. The UsFlex strands are even completely straight in both directions and not interlocked as in conventional fabrics, allowing the weft to float free from the warp. This creates a shock absorber effect by dissipating impact energy over a larger area, enabling the belt to withstand the kind of impact punishment that would destroy a normal multi-ply belt.

Equally important is its ability to resist rip and tear damage. The synthetic plies and unique weave patterns developed by Dunlop are usually even more effective than steel when it comes to minimising the length of a rip. When a strong, sharp object becomes trapped and penetrates the belt cover and carcass and begins to rip the belt longitudinally, the unique weave design allows the strands to gather in a bundle that becomes so strong that it can stop the belt in its tracks or even expel the trapped object.

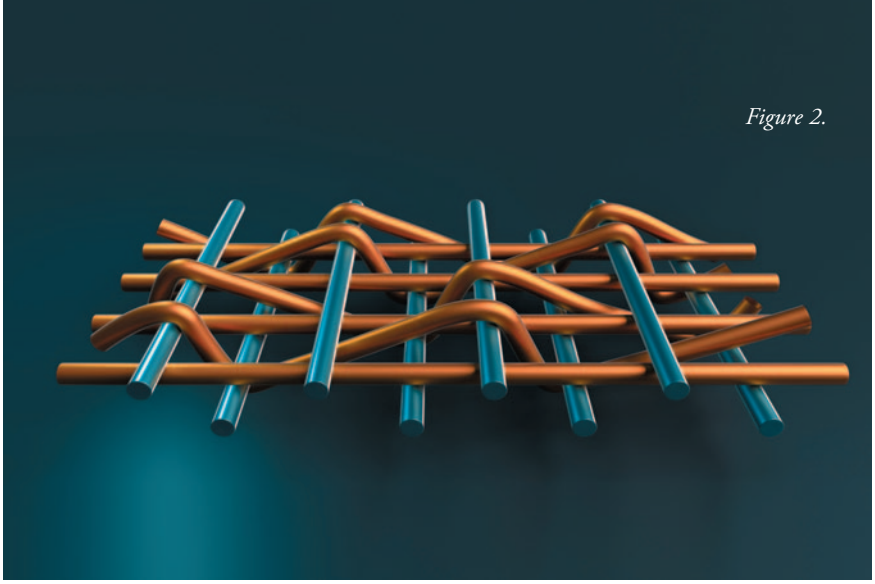


Figure 2.

Figure 3.

What fits where

Ultra X1 replaces multi-belts up to and including 400/3 while the Ultra X3 is designed to replace up to 630/3. The higher tensile strength Nova X4 is designed to replace up to 800/4 and Nova X6 can replace up to 1250/4 multi-ply belts. For the very toughest applications there is the heavier duty UsFlex, which employs a 'straight warp' carcass (see Fig 2) made of high-tenacity polyester fibres protected by polyamide weft lines.

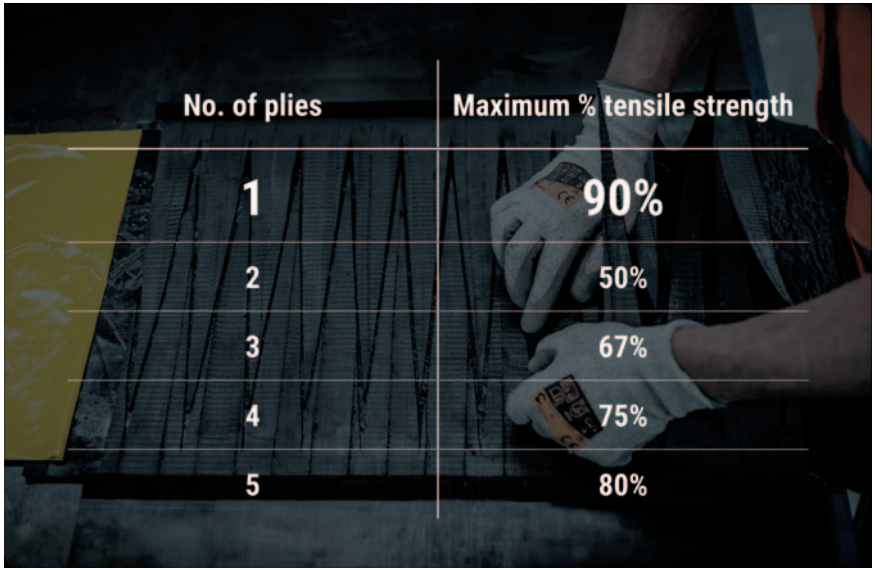
Greater splice efficiency: the idea that a single or dual-ply belt can possess the necessary tensile strength and also be considerably more resilient and durable may be difficult for some to comprehend. The answer lies in a combination of the amazing innate strength of the fabrics together with a much higher level of splice efficiency. Although a conventional step splice can be used to join a dual-ply UsFlex, single-ply constructions require a finger-splice joint. The enormous advantage of finger splice joints is that they retain up to 90% of the belt's original tensile strength.

Single and dual-ply belts joined by a step splice create equivalent tensile strengths and belt safety factors that are more than comparable to three- our four-layer conventional belting. For example, a 1m-wide Ultra X3 single-ply belt can pull up to

56 tonnes. A significant additional benefit of this method is that finger splice joints are stronger and more durable so the need to repair and re-splice joints is much less frequent.

Another advantage is that single and dual-ply belts are more flexible and therefore well suited for use on mobile conveyors, which are notorious for having small diameter pulleys. The continual flexing places greater dynamic stress on the inner carcass and splice joint, therefore seriously limiting the strength of belt that can normally be fitted.

The rubber to match: although the carcass is the backbone of all rubber conveyor belts, the quality of the rubber covers is ultimately crucial to performance and longevity because of the level of protection it gives to the inner carcass. Yet again, Dunlop had an advantage because the rubber compounds that it has developed over the years continue to be regarded as the benchmark for quality and durability, a position Fenner Dunlop is best placed to retain because it is one of the very few conveyor belt manufacturers that still makes its own rubber rather than outsourcing it.



The success of the X Series is an excellent confirmation of the old maxim that "If you want something done properly then do it yourself!"