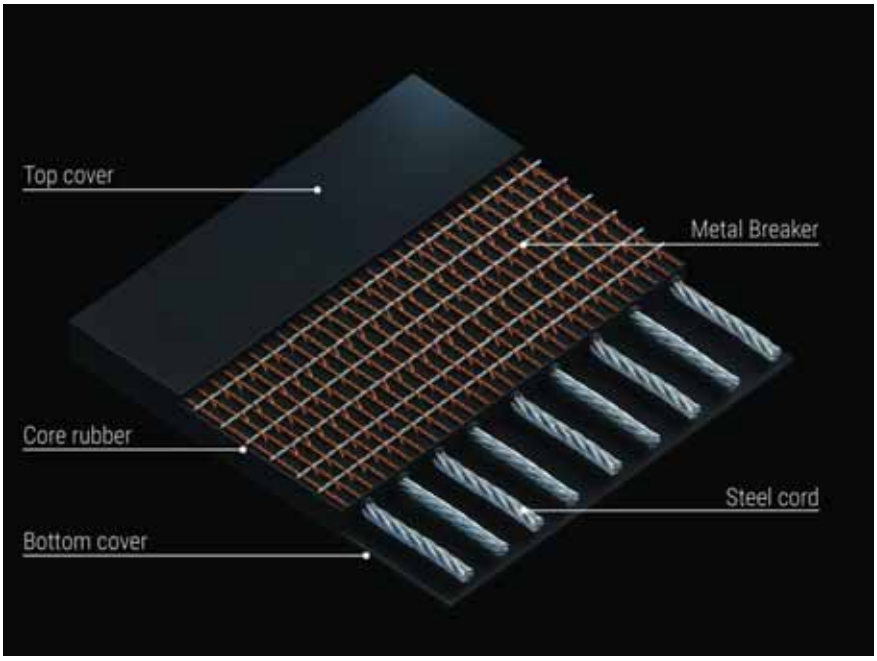
Reducing the risk of steelcord heartbreak in stockyard conveyor systems

A guide to use of steelcord conveyor belt rip detection systems and rip-stop breakers

Because of its innate strength, good handling characteristics and low elongation (stretch), steelcord belting is primarily used to convey materials over long distances — and is very popular in stockyard conveyor systems. In many cases, this can be over several kilometres. Compared to conventional multi-ply belting, steelcord belts are appreciably more costly to manufacture and, especially because of the longer lengths involved, can be a very substantial investment indeed.

On the plus side, provided that the belt has been manufactured using good quality abrasion and ozone/UV resistant rubber, a steelcord belt should justify the initial outlay by providing a long working life. On the downside, steelcord belting does have an Achilles heel. The actual steel cords themselves are naturally very strong but they cannot prevent a trapped foreign object from penetrating through the rubber covers between the cords and ripping the belt longitudinally. A steelcord belt can quite easily be ripped apart over its entire length in a matter of minutes. *Here, Les Williams provides an insight into the two most effective ways of providing rip protection and damage limitation.*



Rip detection systems

The cost of replacing a steelcord belt, both in monetary terms as well as lost production, can have very serious consequences. On one sadly infamous occasion, an object as seemingly harmless and innocuous as a wooden broomstick became trapped at the conveyor head. It penetrated the belt and ripped four kilometres of steelcord belt from end to end.

Because of the huge variety of different specifications, steelcord belts are almost invariably made to order. A typical lead-time is generally 18 weeks or more. In an effort to minimize the amount of damage caused, a growing number of operators use rip detection monitoring systems.

Rip detectors work by using detection loops that are embedded at pre-determined intervals in the belt during the manufacturing process. A transmitter and receiver are positioned on the conveyor structure opposite each other on either side of the belt. This is usually behind the loading position to provide protection in the area where there is the greatest exposure to risk. Multiple detection locations are also possible. The transmitter sends electro-magnetic signals to the receiver at regular intervals. When a signal is not received by the receiver, caused by a damaged detection loop for example, then an alarm is triggered or, depending on the type of system, the conveyor is automatically stopped.

Having the metal detection loops fitted during the manufacturing process is, of course, an additional expense and the detection systems themselves can also be quite costly. Even if the receiver is linked to the conveyor drive and automatically stops the belt when damage is being indicated, for optimum safety they should still be physically monitored. If someone is not able to quickly respond to an alarm then an enormous amount of damage can occur. In many cases, detection systems with an automated stop function can be over-sensitive and prone to raising false alarms. If this happens too frequently then there is a tendency for operators to simply over-ride the system.

Using breaker plies to increase rip resistance

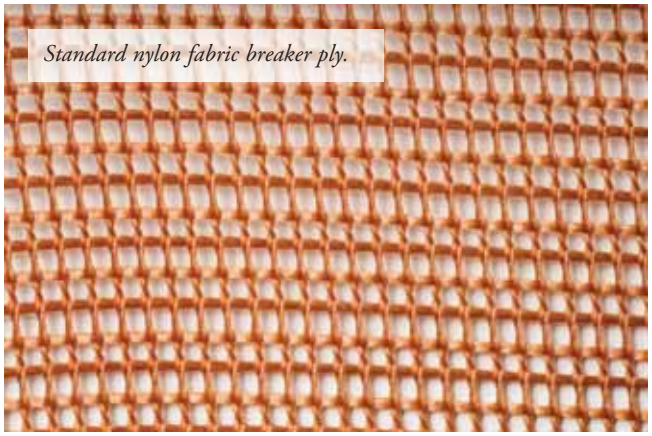
Breaker plies are designed to provide a significantly increased resistance against longitudinal ripping. Ultimately, the use of breakers is one of damage limitation. The breaker ply performs two functions — firstly it can help prevent the penetration of the belt by a foreign object. Secondly, the breaker ply acts as a barrier if an object does actually penetrate between the steel cords and starts to rip along the length of the belt. As with detection loops, breaker plies are embedded in the rubber covers during the manufacturing process. There are numerous types and strengths of breaker used. The lighter weight versions are designed to simply absorb and dissipate energy whereas stronger, heavier weight breakers can actually stop the belt and limit the amount of damage even more effectively. These are commonly referred to as 'rip stop' breakers.

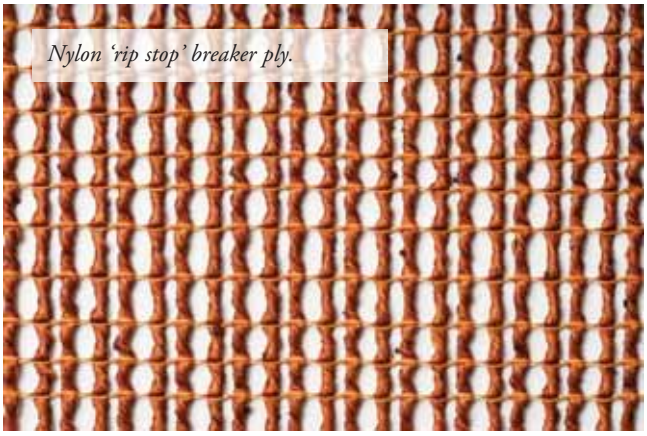
Types of breaker

Breakers generally fall into two different categories or types — 'fabric breakers' (also referred to as textile breakers) and 'steel breakers'. Both types are usually embedded in the top cover above the steel cords over the full width and length of the belt, effectively creating a protective layer. It is also possible to have two breaker plies with one located above and the other positioned below the steel cords. However, having breaker plies in both the top and bottom covers can sometimes cause troughing problems in relatively narrow belts because of the increased cross rigidity.

A wide range of textile fabrics (mostly nylon) in various strengths and densities are used to make fabric breakers. Depending on the application and the type of material being conveyed, nylon fabric breakers often prove to be more effective than steel when it comes to actually minimising the length of a rip. The reason for this is that the nylon strands are able to stretch. As the trapped object is being pulled through the belt the strands of the breaker stretch and gather together into a bundle that can eventually become strong enough to stop the belt.

Steel breaker plies consist of transversal


Standard nylon fabric breaker ply.


Nylon 'rip stop' breaker ply.

steel wires held in position by longitudinal binder wires. As with fabric breaker plies, there are a wide range of strengths based on the size and pitch of the steel wires. As I touched on earlier, although having a steel wire breaker would logically seem to imply a much greater strength compared to a fabric breaker ply, this is not necessarily the case. The steel breaker wires do not stretch so they cannot pull together to create a thicker barrier in the same way that fabric plies can. However, the advantage of a steel breaker is that very sharp trapped objects (dolerite rock or slate for example) do not cut through the steel wires as easily as they can through conventional nylon fabrics.

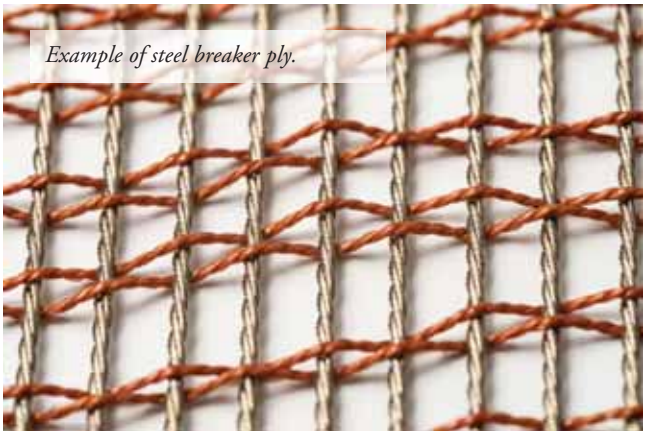
Positioning of the breaker ply

There is often much debate about precisely where the breaker ply layer should be located in the top and bottom covers in relation to the steel cords. There is also a question as to whether or not the measurement of the thickness of the cover should include the thickness of the breaker. Fortunately, ISO 15236-1 (Steelcord conveyor belts — Design, dimensions and mechanical requirements for conveyor belts for general use) provides a good explanation and also makes a pretty clear distinction between what should be technically considered as being a breaker ply and what should be regarded as conventional transversal belt reinforcement.

According to ISO 15236-1, a breaker ply should be positioned at a distance of between 1mm and 3mm from the longitudinal cords. The width of the breaker ply should be at least 10mm from the belt edge but no more than 100mm less than the width of the belt. On this basis the breaker ply is regarded as part of the cover, which means that the cover thickness is measured from the cords.

However, if the ply is less than 1mm distance from the longitudinal cords then it is considered to be a weft transversal reinforcement and therefore part of the actual carcass. This means that the cover thickness is measured outwards from the surface of the ply.

As far as steelcord belts are concerned, the preference does seem to be to position the breaker as close to the actual steel cords as possible. Theoretically, this extends wear life because it maximizes the amount of rubber cover that would have to be worn away by abrasion before the breaker ply is reached.


Example of steel breaker ply.

Clear and precise belt specifications

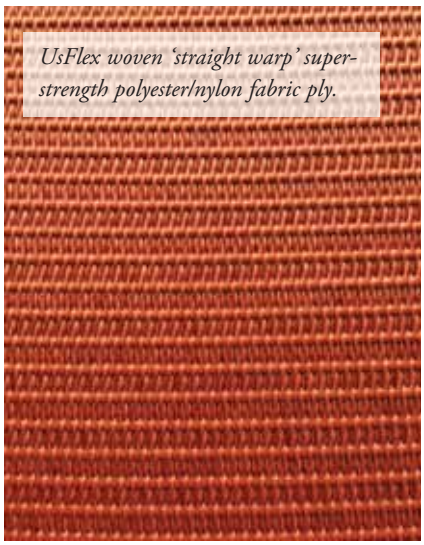
One thing that is certain is that the buyer must provide specifications to potential suppliers that could not be subject to interpretation or misunderstanding. This especially includes whether or not the thickness of the breaker ply is included in the measurement of the thickness of the top cover. This is essential not only in terms of the anticipated operational lifetime of the belt but also, very importantly, it is needed to ensure that all potential suppliers are providing quotations based on exactly the same specifications.

UsFlex breaker

In addition to the conventional fabric and steel breaker plies there is also a third, very effective option available. Netherlands-based Dunlop Conveyor Belting also manufactures steelcord belts constructed with a breaker ply comprising of a specially adapted version of its unique UsFlex woven 'straight-warp' polyester/nylon fabric ply. Because they have vastly superior rip, tear and impact resistance compared with conventional rubber multi-ply belts, Dunlop UsFlex single and two-ply belts have a long and very well established track record as a 'problem solver' belt used for particularly demanding conditions.

What creates these strengths is a very cleverly engineered ply construction that consists of extremely strong strands of polyester running longitudinally and heavy-duty nylon transverse strands held in position by a strong yarn. The strands are completely straight in both directions and are not interlocked in the conventional manner. Laboratory tests prove that the UsFlex fabric has a rip resistance that can quite easily be up to five times greater than conventional fabric ply material, making it a particularly effective breaker ply.

As with conventional breaker plies, the UsFlex fabric layer is embedded above the steel cords. This means that in addition to


UsFlex woven 'straight warp' super-strength polyester/nylon fabric ply.

its enormous rip resistance it also provides extremely effective impact protection of the steel cords because the fabric dissipates the peak point of impact energy over a much wider area.

The best of both worlds?

Some operators, including some of the biggest users of steel cord belting in the world, choose to have breakers and rip detection systems. The breakers are fitted in the top cover and the detection loops are fitted in the bottom cover below the cords. What is important to bear in mind is that because rip detection systems use electro-magnetic signals they cannot function if a steel breaker ply is fitted. So if you want to use an early warning detection system backed up by rip breakers to help minimise the amount of damage then it is only fabric breakers that can be used.

Choosing the best type of breaker for you

Budget restraints aside, choosing the best type of breaker is similar to selecting the most appropriate belt specification because in both cases the single most important factor is the type of material being carried. As mentioned earlier, if the materials being conveyed are very sharp (slate, granite, dolerite etc) or simply may contain very sharp foreign objects (mining tools for example) then the best option is to use steel breakers.

If the materials are relatively blunt then fabric breakers are generally the best choice. In either case, if heavy materials such as large rocks are being dropped on to the belt surface then the choice of having a full UsFlex breaker-ply layer would, in my opinion, be the one to go for.

Rubber multi-ply belting

This guide is primarily intended for users of steelcord belts due to the propensity of steelcord belts to get ripped longitudinally by trapped objects. However, fabric and steel breakers can of course also be used in conventional rubber multi-ply belts. The main benefit of having a breaker ply in a multi-ply belt is that it increases the belt's impact resistance. If the working conditions are demanding and the belt is being used to convey heavy and/or sharp materials then it is much more economical in the long run to fit a fabric ply belt that has been specifically engineered for the purpose rather than use breakers.

Making the best choice

As is so often the case, choosing the most effective rip detection and rip damage limitation system is usually determined by the available budget. It is primarily a question of balancing actual bottom line costs against the very real risk of damage and potentially huge financial consequences that such damage can entail including replacing the belt and the loss of production. With steelcord belts often costing many tens of thousands of euros, those additional outlay costs need to be considered very carefully indeed. Obviously, I cannot advise on budgetary matters but what I do believe is that it is better to have some form of 'insurance' rather than none at all. If your budget will stretch to it then having rip stop breakers will at least minimize the risk of steelcord heartbreak.