Who Sets The Standards?

Leslie David discusses quality standards and testing methods in the conveyor belt industry.

The conveyor belt industry is a huge and highly competitive global market. To describe it as being cut-throat would not be an exaggeration. However, such a high level of competition does not always benefit the end-user, especially when the pursuit of winning orders can so easily compromise safety, quality of performance, and operational lifetime. To be frank, mistakes can and do prove to be enormously expensive in more ways than one.

Although many view conveyor belts simply as long lengths of thick black rubber, in reality manufacturing conveyor belts is a surprisingly complex science. Modern belts have to cope with an enormous variety of potentially destructive materials, operating conditions, environmental, and health and safety factors.

Consequently, there are a number of different belt carcass constructions (types of belt) and an even wider range of rubber compounds designed to protect those belt carcasses. This includes everything from straight forward wear and tear, rip and impact damage, to exposure to heat, oil, chemicals, ozone and ultraviolet (UV), extreme cold, and fire. And with those differing requirements comes an almost bewildering range of test methods and quality standards. This article will discuss who sets the standards and defines the test methods, as well as providing some guidance as to what to look out for when selecting conveyor belts for specific applications.

European and international standards

Globally, there are a number of different quality organisations who set standards for conveyor belting, but the most widely accepted standards (for all types of conveyor belt) are those

ISO 4649/DIN 53516 abrasion testing.

used in Europe. There are European Norms (EN) standards, which are maintained by Committee European de Normalization (CEN), and there are International Organization for Standardization (ISO) standards. Both CEN and ISO are independent, non-governmental organisations. They are the world's largest developers of voluntary international standards. For example, the ISO membership consists of quality standards organisations representing 168 countries. It is common to see the use of the prefix EN ISO, referring to ISO standards that have been adopted in full as the European standard.

It should be noted that, in many parts of Europe, some specific and longer established DIN standards continue to be more commonly recognised and accepted, especially in relation to abrasion-resistant belting. DIN stands for 'Deutsches Institut für Normung', which translates to English as the German Institute of Standardization. It develops norms and standards as a service to German industry and is a highly respected non-profit organisation that has been based in Berlin since 1917. Numerous DIN standards have actually been converted into EN or even ISO standards.

Although standards for conveyor belts vary between different countries, members of CEN are obliged to implement EN standards as their national standards without modifications, and have to withdraw any of their own national standards that may conflict with them. The standards applied in countries that are not members of CEN are in many cases found to be inferior or outdated.

Test methods and test standards

When assessing quality credentials, it is essential to differentiate between what is simply an approved method of conducting a particular test (test method standard) and the actual standards attained during that test (quality or performance standards). The fact that a belt has been tested according to a certain method (for example, EN ISO 4649 for abrasion resistance) means very little. What is important is the actual level of performance achieved during the testing, compared with the minimum acceptable level of performance dictated by the test standard. In other words, was the performance standard met? In the case of EN ISO 4649 abrasion resistance testing, the performance would typically be measured against the performance standards set within ISO 14890.

CE marking

Compliance with CE quality standards is increasingly being stipulated by purchasers of industrial conveyor belts. However, CE accreditation does not apply to conveyor belts, because they are not a product category that is subject to the specific directives that are required to be CE marked. Nonetheless, it is still worth having a basic understanding of the role of CE quality standards and how they can be used to mislead.

The letters CE in CE Marking are an abbreviation of French phrase 'Conformité Européenne' which literally means 'European Conformity'. The term initially used was EC Mark but this was officially replaced by CE Marking in the Directive 93/68/EEC in 1993. By placing the CE marking on a product, a manufacturer is declaring, on its sole responsibility, conformity with all of the legal requirements to achieve CE marking. The manufacturer thus ensures validity for that product to be sold throughout the European Economic Area (EEA), although the mark does not mean that the product has been made in the EEA.

The danger is that some conveyor belt manufacturers use CE marking to create an illusion of quality and safety, based on the understandable assumption that the marking is proof that a product meets strict EU standards, even though no such standards exist.

What to watch for

Unfortunately, a very similar mark exists that the majority of consumers may mistakenly believe is a genuine CE mark of European conformity. However, it actually represents 'China Export', meaning that the product was manufactured in China.

Dimensions and tolerances

In terms of dimensional standards and acceptable tolerances, such as length, width, thickness, etc., all textile fabric ply construction conveyor belts are subject to ISO 14890:2013. These specify the dimension requirements for rubber- and plastic-covered conveyor belting for general surface use on flat or troughed idlers.

Different tests for different demands

There are many different types of belt, and an even wider array of different types of rubber covers (commonly known as cover grades or cover qualities), which are needed to protect the belt carcass from whatever it has to convey. The primary rubber cover grades are as follows:

- Abrasion (wear) resistant.
- Heat resistant.
- Oil resistant.
- Extreme cold resistant.
- Fire resistant.

Rubber covers often need to be able to cope with a combination of factors, such as fire and oil. However, one that is common to all is the ability to resist abrasion (wear). The most commonly used belting also happens to be abrasion resistant, so that seems to be the best place to start.

Abrasion standards

The wear resistance quality of a conveyor belt is usually the single most important factor that will determine its operational lifetime and, consequently, its cost-effectiveness. There are two internationally recognised sets of standards for abrasion: EN ISO 14890 (H, D, and L) and DIN 22102 (Y, W, and X). As mentioned earlier, in Europe it is the longer-established DIN standards that are most commonly used. Generally speaking, DIN Y (ISO 14890 L) relates to 'normal' service conditions and DIN W (ISO 14890 D) is for particularly high levels of abrasive wear. However, DIN X (ISO 14890 H) is regarded as the most versatile because, in addition to resisting abrasive wear, it also has good resistance to cutting, impact (from high drop heights), and gouging, which is usually caused by heavy, sharp materials.

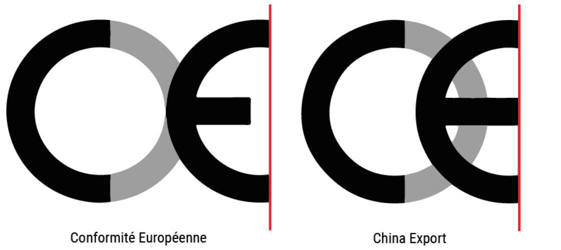
Abrasion testing

The test method for abrasion (ISO 4649/DIN 53516) is actually quite simple. Abrasion resistance is measured by moving a test piece of rubber across the surface of an abrasive sheet that is mounted on a revolving drum. It is expressed as volume loss in cubic millimetres.

The most important thing to remember when looking at abrasion test results is that higher figures represent a greater loss of surface rubber. This means that there is a lower resistance to abrasion. Conversely, the lower the figure, the better the wear resistance.

What to watch for

The technical datasheets provided by manufacturers and traders will almost invariably show the minimum standard demanded by a particular test. Unless stated otherwise, the data shown does not reflect the actual performance achieved during the test, or, in other words, not the expected level of performance. This fact applies to the data shown within the vast majority of technical datasheets provided by suppliers.



Left: Conformité Européenne, Right: China Export

The effects of heat damage.

ASTM 'D' 1460 testing.

Heat resistance

Of all the demands placed on industrial conveyor belts, heat is widely regarded as the most unforgiving and damaging. High temperature materials and working environments (especially those found within the cement industry) cause an acceleration of the ageing process that results in a hardening and cracking of the rubber covers.

Heat also has a very destructive effect on the carcass of the belt, because it damages the adhesion between the covers on the top and bottom of the carcass and also between the inner plies contained within the carcass. If the core temperature of the carcass becomes too high then the belt will quite literally start to fall apart. This is commonly referred to as de-lamination.

The temperature limits that a belt can withstand are viewed in two ways – the maximum continuous temperature of the conveyed material and the maximum temporary peak temperature. The two main classifications of heat resistance recognised in the conveyor belt market are T150, which relates to a maximum continuous temperature of 150°C, and T200, which is for more extreme heat conditions up to 200°C.

ISO 4195 testing

To provide the most accurate measurement of heat resistance, accelerated ageing tests are conducted by placing rubber samples in high temperature ovens for a period of seven days. The reduction in mechanical properties is then measured. The three classes of ageing within ISO 4195 are: Class One (100°C), Class Two (125°C), and Class Three (150°C).
In order to maximise temperature resistance qualities, Dunlop also carries out testing at 175°.

What to watch for

There are three key factors to consider when choosing a heat resistant belt. The most critical considerations are the actual temperature range of the materials being carried, the level of ambient temperatures of enclosed running environments, and the length of the conveyor. All of these factors can have a major influence on the speed of the ageing process. Success or failure will depend on two factors: having accurate temperature data to give to potential belt suppliers and, ultimately, the heat resistant qualities of the belt they supply.

Oil resistance

When oil penetrates rubber it causes it to swell and distort. This results in serious tracking and steering problems, as well as premature wear. The oils, fats, and greases that have these damaging effects can be divided into two distinct sources – mineral and vegetable/animal. There are two recognised test methods, both of which involve almost identical test procedures. These are ISO 1817 (2015) and the comparable, slightly less elaborate but equally tough American ASTM 'D' 1460.

Even some of the biggest manufacturers of belting in the world use the DIN reference number 22102 G when referring to oil resistant belting. This can be very misleading because the letter 'G' is simply used to denote oil (or grease) resistant belting. The fact is that DIN 22101 G does not actually contain any requirements, test methods, or limits specific to oil resistant belting. This is a classic example of how the practice of simply indicating a test method reference number is designed to be reassuring but is actually meaningless in respect to actual performance.

Test methods

The ISO 1817 and ASTM 'D' 1460 test methods are both used to measure the effect of oil (and other liquids and chemicals) on vulcanised rubber. Samples of rubber (e.g. 100 mm X 1.6 mm X 2 mm strips for the ASTM test) are fully immersed in the relevant test liquid for a specific period of time. The duration of immersion and the temperature at which the liquid and sample are kept can be varied, but the most common is either three or seven days at ambient temperature or 70°C.

The ambient temperature of the environment is controlled within specific guidelines. Changes in the geometry and dimensions of the specimen caused by absorption are then measured when the samples are removed.

What to watch for

Although there are no actual performance standards in existence, it is still important to look for actual references to the test methods used by the manufacturer/supplier. Only Dunlop seems to make any mention whatsoever of the actual test methods used to determine the oil resistance qualities of its belts.

Extreme cold resistance

When the ambient temperature falls below -0°C, rubber begins to lose its elasticity. As the temperature falls, the rubber continues to lose flexibility, as well as its ability to resist abrasion, impact, and cutting. Eventually, the belt is unable to trough and pass around pulleys, and the belt covers and the rubber in the carcass begins to crack. Ultimately, the belt will break because frozen rubber becomes as brittle as glass.

Testing for cold resistance

There are no current internationally recognised test methods for specifically determining a conveyor belt's ability to function in extremely cold conditions. Laboratory testing involves the use of a liquid nitrogen freezing cabinet to test samples at extreme low temperatures.

The elastic modulus of samples of rubber belts are first measured at an ambient temperature of 20°C. The samples are then placed inside the cabinet. The temperature in the cabinet is then gradually reduced by stages of 5°C. The elastic modulus is measured at each stage to determine when the decrease in flexibility of the rubber becomes too great, thereby identifying its lowest permissible ambient temperature.

What to watch for

Where there is a risk of extremely low temperatures, confirmation of the minimum operating temperature should always be sought. Abrasion resistant belts can typically withstand -30°C to -40°C. Other cover qualities (such as oil or fire) are usually only able to withstand a minimum temperature of -20°C. For temperatures lower than this, conveyors need to be fitted with belts specially designed to withstand extreme cold.

Fire resistant belting

As fire safety is such an important issue, there are numerous safety classifications and international standards, for which there are many different tests used to measure the self-extinguishing properties of conveyor belts. Test methods and performance standards vary enormously depending on whether a belt is for use above or below ground. This article considers purely the requirements for belts being used above ground. The reader is recommended to seek more detailed guidance if at all unsure of what level of fire resistance they need.

Basic testing

The basis of most tests for belting used in normal industrial applications is EN/ISO 340. This standard makes the distinction between fire resistance with covers (K) and fire resistance with or without covers (S). The relevance of 'with or without covers' is that wear reduces the amount of fire resistant rubber that protects the flammable carcass. Although no longer

Belt samples are frozen using liquid nitrogen.

Ground level ozone seriously damages rubber.

used in the current EN ISO 340, the market still commonly refers to grades 'K' for testing with covers and 'S' for testing with and without covers. This originates from DIN 22103, which was used as the basis during the creation of EN ISO 340.

EN ISO 340 tests involve exposing six individual samples of belt to a naked flame, causing them to burn. The source of the flame is then removed. A current of air is then applied to the test piece for a specified time after the removal of the flame. The time it takes for the belt sample to self-extinguish after the flame has been removed is then measured. The duration of continued burning (visible flame) must be less than 15 sec. for each sample, with a maximum cumulative duration of 45 sec. for each group of six test samples. This effectively determines the distance fire can be carried along a moving belt.

What to watch for

Even if a manufacturer states that their fire resistant belt has passed the ISO 340 test, the buyer should still exercise caution. A blazing conveyor belt can easily spread fire more than 40 m in 15 sec.

Ozone and UV resistance

Along with abrasion resistance, another quality common to all rubber belting is the ability to resist the damaging effects of ozone and UV. Although not an actual cover grade in its own right, there is no question that all rubber belts need to be fully resistant to ozone and UV light. This is because at low altitude ozone becomes a pollutant. Exposure increases the acidity of carbon black surfaces and causes reactions to take place within the molecular structure of the rubber. This has several consequences, such as surface cracking and a marked decrease in the tensile strength of the rubber. Likewise, UV light from sunlight and fluorescent lighting also accelerates deterioration, because it produces photochemical reactions that promote the oxidation of the surface of the rubber, resulting in a loss in mechanical strength.

EN/ISO 1431 international standards

To scientifically measure resistance to ozone, samples are placed under tension (e.g. 20% elongation) inside the ozone testing cabinet. There, they are exposed to highly concentrated levels of ozone for a period of time (e.g. up to 96 hours).

Samples are closely examined for evidence of cracking at two hour intervals and the results are carefully measured and recorded. Experience has determined that, to be adequately resistant, the pass criteria needs to be that the rubber sample does not show any signs of cracking after 96 hours (at 40°C, 50 pphm, and 20% strain) inside the ozone cabinet.

What to watch for

Despite its crucial importance, research has revealed that ozone and UV resistance is very rarely, if ever, mentioned by manufacturers. This is almost certainly because anti-ozonants need to be used during the mixing process of the rubber compounds and that, of course, costs money. The advice is to make ozone and UV resistance a constant requirement when selecting any rubber conveyor belt.

Conclusion

Quality standards and testing in the conveyor belt industry is a huge and often complex subject. This article provides a basic guide. The final piece of advice would be to never assume that seeing the presence of test method reference numbers or the logos of quality organisations necessarily means what they are designed to indicate. Secondly, it is always worthwhile to ask questions and request evidence of good practice and actual performance. Taking that little bit of extra care could easily save companies an enormous amount of time and money. ■

About the author

After spending 23 years in logistics management, Leslie David has specialised in conveyor belting for over 13 years. During that time, he has written numerous technical guidance bulletins and is one of the most published authors on conveyor belt technology in Europe.