WHITEPAPER

CONVEYOR BELTING – WHO SETS THE STANDARDS?

MAY 8, 2019 | MARCEL DROETTBOOM | LEAVE A COMMENT 242 VIEWED

Conveyor belts are required to handle an extremely diverse range of demands from wear, tear and impact damage right through to ozone and ultra violet radiation. With those demands comes an almost bewildering range of test methods and quality standards applied to each nindividual demand. In this special feature, conveyor belt consultant Leslie David explains who sets the standards and defines the test methods as well as some enlightening insights as to what to avoid and what to insist upon when choosing conveyor belts for specific tasks.

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 brutally frank, mistakes can and do prove to be enormously expensive in more ways than one.

THE BITTERNESS OF POOR QUALITY REMAINS LONG AFTER THE SWEETNESS OF LOW PRICE IS FORGOTTEN

Although many view conveyor belts simply as long lengths of thick black rubber, in reality, manufacturing conveyor belts is a surprisingly complex science. Modern-day belts have to cope with an enormous variety of potentially destructive materials, operating conditions. enviromental and health & 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 constructions. This includes everything from straight-forward wear & tear, rip and impact damage to exposure to heat, oil, chemicals, ozone & UV, extreme cold and fire. And with those differing requirements comes an almost bewildering range of test methods and quality standards. In this special feature, I will explain 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 used in Europe. There are EN standards (European Norms), which are maintained by CEN (Committee European de Normalization) and there are ISO standards ISO (International Organization for Standardization). Both CEN and ISO are independent, non-governmental organizations. They are the world's largest developers of voluntary international standards. For example, the ISO membership consists of the quality standards organizations 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. The letters 'DIN' stand for 'Deutsches Institut für Normung', which means 'German Institute of Standardization'. They develop norms and standards as a service to German industry and are a highly respected non-profit organization that has been based in Berlin since 1917. Numerous DIN standards have actually been converted into EN or even ISO standards.

ISO (International Organization for Standardization)

CEN (Committee European de Normalization)

Although standards for conveyor belts vary between different countries, members of CEN are obliged to implement EN (European 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 significantly inferior or outdated.

Test Methods and Test Standards are not the same

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 standard). 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 against 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 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” used in the CE Marking are the abbreviation of French phrase “Conformité Européene” which literally means “European Conformity”. The term initially used was “EC Mark” but it 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 his sole responsibility, conformity with all of the legal requirements to achieve CE marking. The manufacturer is thus ensuring validity for that product to be sold throughout the EEA, although the mark does not mean that the product was 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 goods with CE marking is proof that the product meets strict EU standards even though no such standards exist.

Unfortunately, a very similar mark exists which the majority of consumers may mistakenly believe is a genuine CE mark of European conformity but actually means “China Export”, meaning that the product was manufactured in China.


CE Marking


China Export

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

As I touched on earlier, 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) that are needed to protect the belt carcass from whatever they have to convey. The primary rubber cover grades are:

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

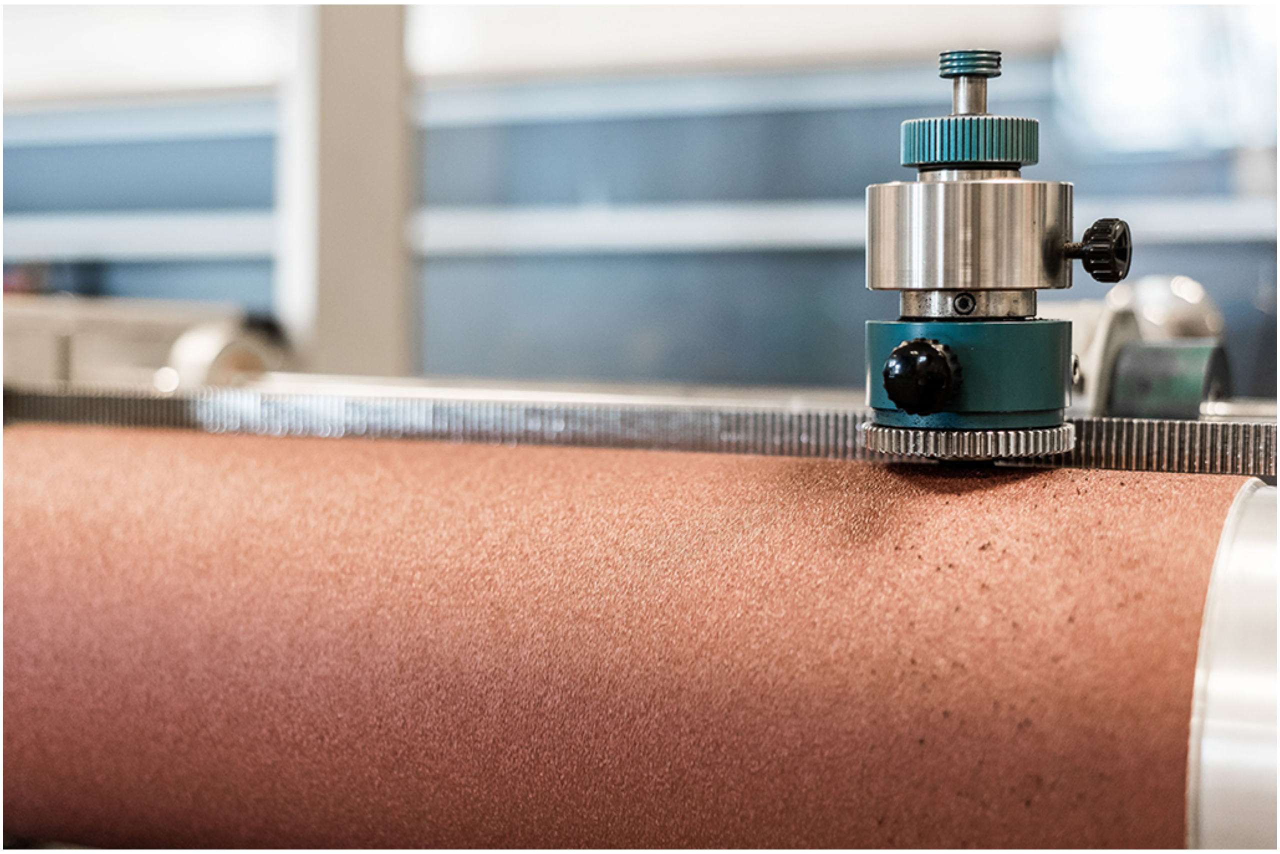
Rubber covers often need to be able to cope with a combination of factors, such as fire and oil. However, one that is common to all is the ability to resist abrasion (wear). The most commonly used belting also happens to be abrasion resistant, so that seems to be the best place to start.

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) 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, 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 mounted on a revolving drum. It is expressed as volume loss in cubic millimeters, for instance 150 mm^3.



ISO 4649 / DIN 53516 abrasion testing

The most important thing to remember when looking at abrasion test results is that higher figures represent a greater loss of surface rubber which 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. In other words, not the expected level of performance. This shortcoming applies to the data shown within the vast majority of technical datasheets provided by suppliers.

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 cause an acceleration of the ageing process that results in a hardening and cracking of the rubber covers.

The effects of heat damage

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 7 days. The reduction in mechanical properties is then measured. The three 'classes' of ageing within ISO 4195 are: Class 1 (100°C), Class 2 (125°C) and Class 3 (150°C). In order to maximise temperature resistance qualities, at least one manufacturer (**Dunlop**) also carry 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 enronments 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 resistance 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 indicating a test method reference number is designed to provide reassurance to the buyer but in reality is meaningless in terms of 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 (eg. 100mm X 1.6mm X 2mm 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 3 or 7 days at ambient or 70°C.

ASTM 'D' 1460 Testing

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. During my research I found it quite disturbing to note that only one manufacturer (**Dunlop** again I have to say) that makes any mention whatsoever concerning the actual test methods used to determine the oil resistance qualities of their 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 and 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.

Belt samples are frozen using liquid nitrogen

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 always ask for confirmation of the minimum operating temperature. Abrasion resistant belts can typically withstand -30 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 especially designed to withstand extreme cold.

Fire Resistant Belting

Because 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. For the purposes of this paper I will focus purely on 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 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 that was used as the basis during the creation of EN ISO 340.

ISO 340 fire resistance testing

EN/ISO 340 tests involve exposing 6 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) should be less than 15 seconds for each sample with a maximum cumulative duration of 45 seconds for each group of six test samples. This determines how 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 meters in 15 seconds. If you are at all unsure of what level of fire resistance you need then it is recommended to seek more detailed guidance.

Ozone & Ultra Violet Resistance

Ground level ozone seriously damages rubber

Although not an actual cover grade in its own right, there is no question that ALL rubber conveyor belts need to be fully resistant to the damaging effects of ozone and ultra violet light. This is because at ground level 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 a surface cracking and a marked decrease in the tensile strength of the rubber. Likewise, ultraviolet 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 (eg. 20% elongation) inside the ozone testing cabinet and exposed to highly concentrated levels of ozone for a period of time (eg.up to 96 hours). 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 (@ 40°C, 50 pphm and 20% strain) inside the ozone cabinet. Samples are closely examined for evidence of cracking at two-hourly intervals and the results carefully measured and recorded.

What to watch for: Despite its essential importance, my 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. My advice is to make ozone & UV resistance a constant requirement when selecting all conveyor belts.

Authors Comment

Quality standards and testing in the conveyor belt industry is a huge and often quite complex subject. In compiling this paper I have simply tried to provide a basic guide. Consequently, my final piece of advice would firstly be to never assume that 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 your company an enormous amount of time and money.

Leslie David, Conveyor Belt Consultant

More information on Dunlop Conveyor Belting

Google Search – Web

Google Search – Images

Dunlop Conveyor Belting on the Portal

Dunlop Conveyor Belting Videos on bulk-online

BELT CONVEYOR | CONVEYOR BELT | RESISTANCE | STANDARDS | TESTING