

Tech Note

Technical Notes from the Technical Committee, NIBA – The Belting Association

#23 Abrasion Resistance of Conveyor Belts

Abrasion resistance of conveyor belt covers is one of the most important properties of a belt. As conveyor systems have improved in quality in recent years because of better maintenance, alignment, and rip detection systems, premature or catastrophic failure has been reduced and gradual wear of the belt covers become a more common form of belt change out.

This technical note describes the different types of abrasion and common industry tests used for measuring abrasion.

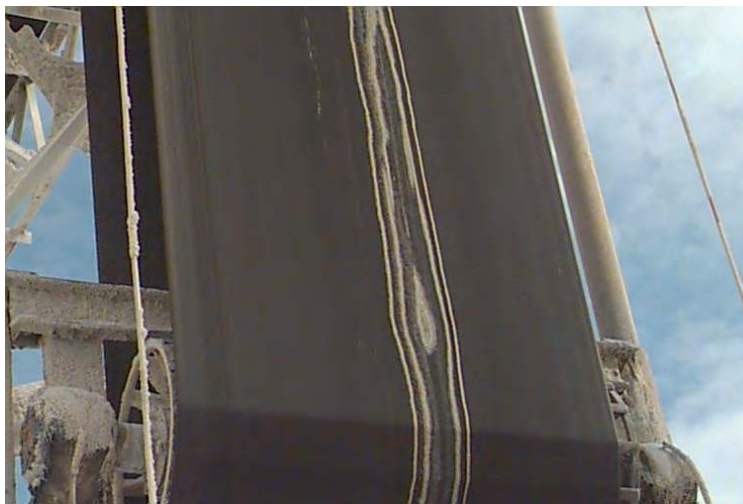
In general, there are two types of abrasion occurring in belt applications. The first and more common type of wear is caused by the conveyed material rubbing against the rubber or thermoplastic cover. The belt covers tend to wear smoothly and evenly. The type of material conveyed affects wear, for example coal is relatively not abrasive whereas in comparison, hard rock and taconite pellets wear covers extremely fast. Density of material and speed of material being conveyed affects the wear rate with heavier and faster speeds increasing the wear rate. Typical appearance of the smooth wear is shown below.



Tech Note

Technical Notes from the Technical Committee, NIBA – The Belting Association

Picture of pure abrasion wear failure mode is shown below. The belt has been worn down through the top cover and 3 plies.



The second and more aggressive type of abrasion is cutting and gouging where jagged or sharp surfaces from materials like limestone, granite, and ores will cut the belt cover and remove the cover in “chunks”. Typical appearance of the surface is shown below.



Tech Note

Technical Notes from the Technical Committee, NIBA – The Belting Association

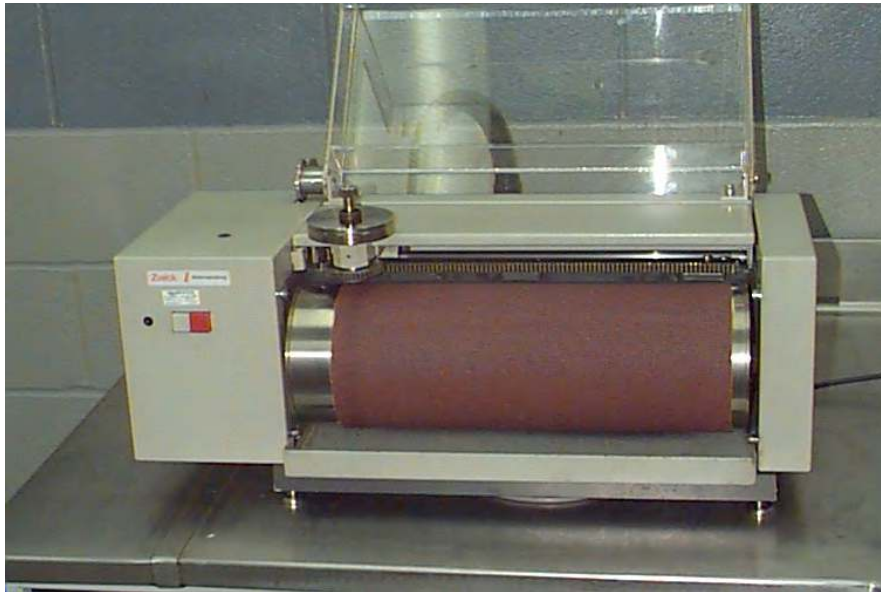
There are two common industry test methods used to measure belt cover wear under laboratory conditions.

The first and more common test method is often referred to as the “DIN abrasion test method”. It is based on the German test method DIN53516 and also ISO4649 test methods A and B. The test involves preparing a “puck” of the cover and subjecting this sample to abrasion against a rotating drum covered with sandpaper. The sample is pushed against the drum with a specific force, the sandpaper is a specific type and the speed of the drum and number of revolutions are controlled. The sample is weighed before and after the test and the volume loss is calculated and expressed in cubic millimeters.

The lower the number obtained, the better the abrasion resistance.

The test can be run two different ways – one in which the belt cover sample is rotated (ISO4649, method B) and one in which the belt cover sample is not rotated (ISO 4649, method A). It has been found that the **rotating test method is more severe and also more accurate and reproducible.**

A picture of the actual test machine is shown below:



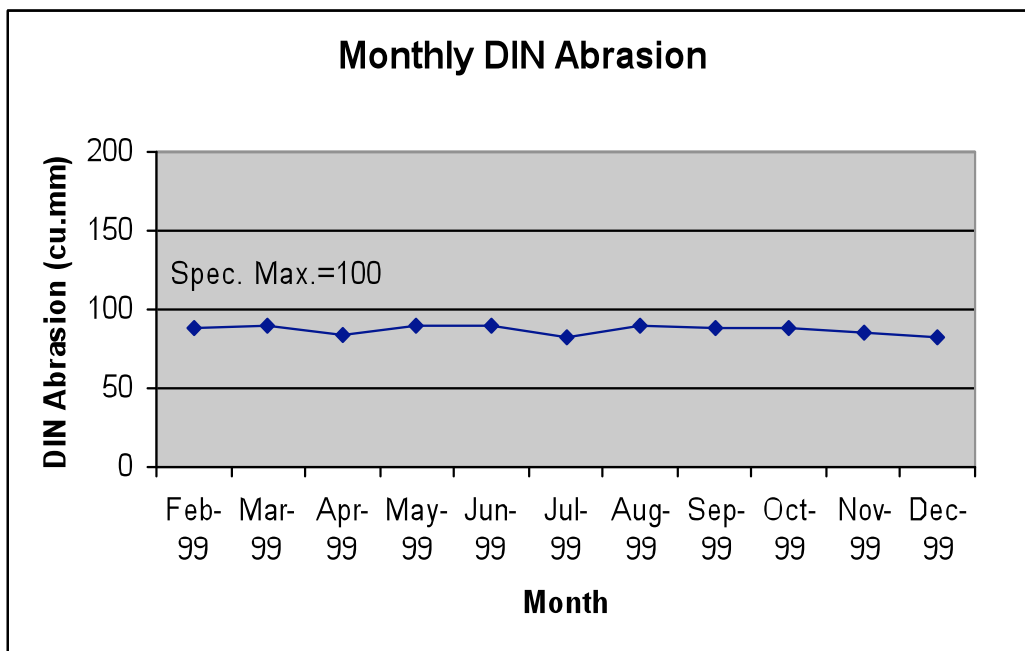
Tech Note

Technical Notes from the Technical Committee, NIBA – The Belting Association

A picture of the actual test sample is shown below:



This test is very reproducible and as an example, data is shown below for a belt manufacturers specific cover measured monthly over a 12-month period. Each test used a different lot of cover and frequently used different lab technicians.



Tech Note

Technical Notes from the Technical Committee, NIBA – The Belting Association

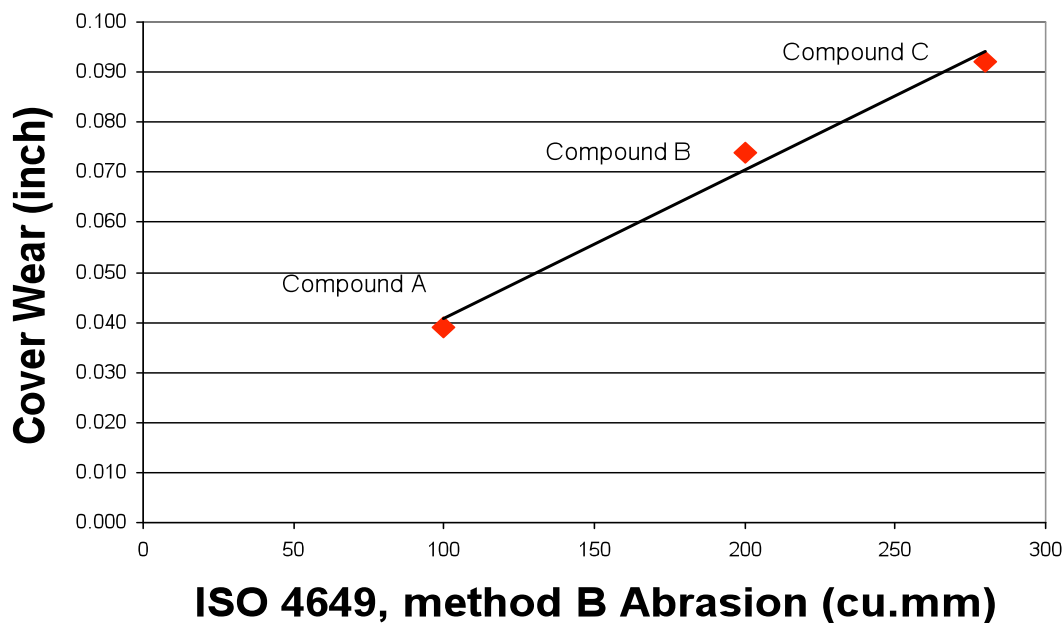
As can be seen, results are within +/- 10%, which is very good. A calibration test also exists which helps to ensure that the equipment is correct and reduce variation.

Typical belt covers obtain rotating abrasion values (ISO4649, method B) in the 100 to 300 range with highly abrasion covers less than 100.

This test is supposed to resemble the more common form of abrasion where rubbing of the conveyed material causes wear. In general the trend is correct where a low lab number will give better abrasion resistance than a high lab number. In actual application, the actual number and %improvement varies considerably between the lab and field and needs to be validated.

An example is shown below where a belt manufacturer measured the wear of three different covers with different lab abrasion numbers. As can be seen, the wear trend is similar, where the lower the lab abrasion number, the less the actual wear in service.

Wear Evaluation - 9 months service in coal



With regard to standards, there are no USA standards on conveyor belts using this abrasion test. In Germany, conveyor belt standards DIN 22102, part 1 specify four types of covers with non- rotating DIN abrasion maximum values:

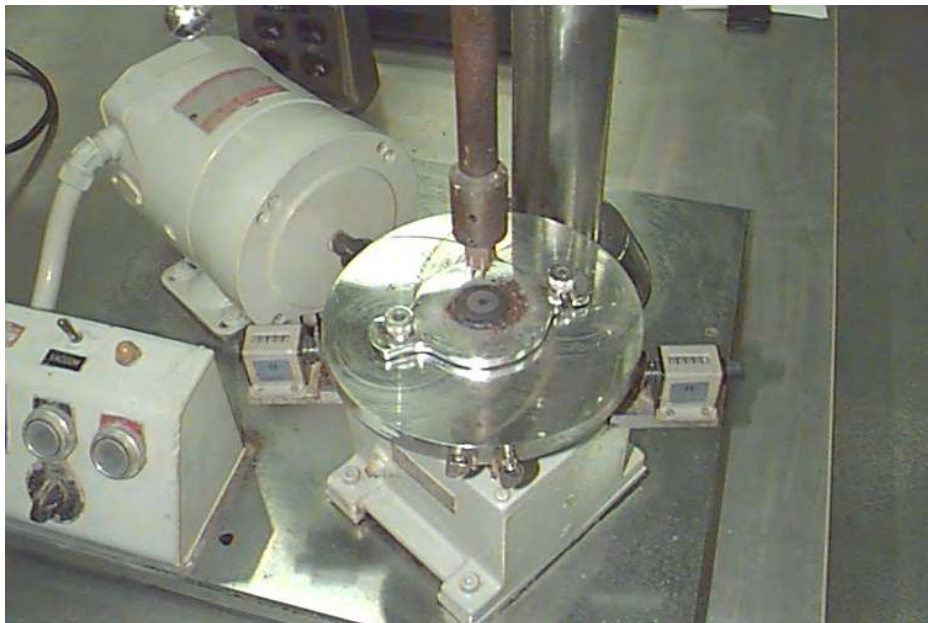
Tech Note

Technical Notes from the Technical Committee, NIBA – The Belting Association

<u>COVER TYPE</u>	<u>MAXIMUM ABRASION (Cubic mm)</u>
TYPE W	90
TYPE X	120
TYPE Y	150
TYPE K	250

The second test method commonly used to measure abrasion resistance of belt covers is the “PICO” abrasion test. This is an ASTM test method D2228. In this test, a pair of tungsten carbide knives is used to abrade the belt cover. The knives are lowered onto a “puck” shaped belt cover sample and the knives then rotate under controlled conditions of speed, time, and knife force. A dusting powder is also used to engulf the abraded belt cover particles and to keep knives free of oils etc. Again, the sample is weighed before and after the test and the volume loss is calculated. **The calculation is an abrasion index and in this case, the higher the number, the better the abrasion resistance.**

The test machine is shown below.



Tech Note

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The test sample is shown below:



This test is designed to duplicate cut and gouge type service, but unfortunately experience has not shown this to be the case. Typical belt covers have PICO values in the range of 25 to 100 with highly abrasion resistant covers in excess of 100. This tester also does not have desired reproducibility and more erratic values are obtained. Typically +/- 20% is found in test results. Currently, there are no USA or international belt standards on this test.

The subject of measuring cut and gouge has been studied for several years by belt manufacturers and several have in house test equipment, which is designed to give more relevant data on these types of service.

Finally, there are many system design recommendations to improve belt cover life both from an abrasion and a cut & gouge standpoint, regardless of compound. From an abrasion standpoint, the following guidelines should be used:

1. The faster the speed of the conveyor, the greater the wear. The material bounces and abrades in the loading zone until it gets up to the same speed of the belt. The higher the relative speed differential, the more wear will occur.
2. The shorter the center to center length of the system, the greater the wear. This is simply due to more cycles per hour.
3. The higher the angle of incline at the loading point of the conveyor, the greater the wear. The higher angle makes it tougher for the material to get up to the speed of the belt (i.e. 15° incline conveyor will wear faster than a flat conveyor)



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Tech Note

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4. The higher the angle of chute, the greater the wear. The more the material is being transferred to a conveyor belt in the horizontal direction instead of vertical, the less the wear. Therefore, a chute with a 30° angle will project the material at a greater horizontal velocity than a chute with a 90° straight down drop, reducing the wear.
5. The higher the drop height, the greater the wear.
6. The higher the feed angle from one conveyor to the next, the greater the wear. This means that a conveyor belt that is fed inline from another conveyor will wear less than one that is being fed at an angle.
7. Scraper tension is critical. Too loose and the material will not be removed from the cover. Too tight and the cover will get worn away significantly faster.

If the material being conveyed is large enough and/or sharp enough, cut and gouge damage to the cover will occur. From this standpoint, the following guidelines should be used:

1. The higher the drop height, the greater the damage to the belt cover and carcass. Installing bars in the crusher or chute to slow down the material when practical will reduce the material speed and impact energy.
2. Loading fines on to the belt before the large diameter material will reduce impact damage dramatically. The fines absorb the high impact energy, protecting the belt cover.
3. Impact idlers reduce the amount of impact damage to a belt in comparison to impact beds because the belt has more room to deflect.