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How long will Dura-Belt's urethane belts last?
(What kinds of abuse can cause them to fail prematurely?)

People often ask that question. The answer is that it depends on many different variables and how much abuse the belts are exposed to. We have seen some applications where belts last only a few days (e.g. in very high temperatures) and others that last for ten years or more. Generally, belts on powered roller conveyors last longer than belts on lineshaft conveyors because powered roller belts are not constantly in motion and because they do not continually rub against the edges of roller grooves like lineshaft belts do.

The longest O-ring belt lifespan I know is 13 years, and it was still working.

In 1964 Ermanco became the first major conveyor manufacture to use polyurethane o-ring belts so they have had the most experience with our belts. Now owned by MHS, one of the largest conveyor manufacturers, their warranty on both powered roller and lineshaft O-rings (i.e., slave Xeno belts) is "five years of running use". See https://durabelt.com/MHS_slave_Xneo_Warranty.php

We make the worlds strongest weld joints, so we warrant our belts against breakage at the weld for 10 years or the life of the belt, whichever is longer. See https://durabelt.com/warrantyinfo.php

We sell only through resellers so we do not get much feedback from end users. The longest test we did with an end user was 9 years. Each year for 9 years we followed 40,000 of our 3/16" HT Blue belts running 24/7 on powered roller conveyors in the Charlotte NC Postal Distribution Center. During this time the USPS provided an ideal environment with temperature and humidity controls, plus frequently scheduled preventive maintenance. No tote weighted more than 50 lbs and sensors/ PLCs immediately stopped rollers within 4 seconds after a jam or accumulation was detected, so they only had replaced about 100 belts. In the 9th year I visited the Center and inspected our belts. All 40,000 looked pristine – like they would last another 9 years. Unfortunately, the test ended shortly thereafter, when their powered roller conveyors were disassembled and transferred to many different locations throughout the US. Sadly, the USPS lost tracking ability so we could no longer follow our belts.

Below is a list of some factors that can affect belt life. There are probably more factors than I have listed here.

1. Hours of operation per week. Belts on conveyors that are run only one shift per week (40 hours) will last longer than belts on conveyors that are run more than one shift per week. The more shifts per week, the shorter will be the belt life.

2. Type of the conveyor. Belts on powered-roller conveyors tend to last longer than belts on lineshaft conveyors because powered-roller belts do not twist 90 degrees, so they do not rub on the roller edges as much. They also do not spiral, so there is less twisting, and they stop moving when no boxes are on top of them.

3. Poor quality belts. Belt manufactures can cut costs by using low grade urethane, by adding regrind or fillers to their raw material, by using inferior welding processes, by gouging their

welds, and/or by skimping on quality control. Consequently, some brands experience rather high breakage rates and/or become limp prematurely. Since we do none of the above and only make high quality belts, our belts should not suffer those problems. That is why we can afford to provide the "Worlds Longest Belt Warranty*"

4. Design of lineshaft conveyor. Belts on lineshaft conveyors with long center distances between roller and drive shaft would seem to last longer than on conveyors with short center distances because the belts enter the roller grooves at smaller angles and thus do not rub and abrade as much. They also flex less because each revolution of the belt takes longer. For example, Hytrol uses 14.5" long belts, whereas Interlake uses approx 12.5" long belts. Therefore, one would expect belts on Hytrol conveyors to last longer.

5. Weight of boxes. If everything else is equal, conveyors that move lighter boxes will put less strain on belts, so the belts will last longer. If the box weight is the same, but one conveyor has rollers that are on longer centers, then the weight per roller is more. Higher weight per roller means shorter belt life.

6. Soft bottoms. Boxes with extremely soft bottoms sag between the rollers and force the rollers to actually lift the box a little. This puts much greater tension on the belts, shortening their life.

7. Hard but inflexible bottoms. Boxes with steel or similar bottoms often are so rigid that they do not touch all the rollers because the tops of rollers are rarely at the exact same level. Consequently, some belts have to move more than their share of the load, so they are overstressed and fail sooner.

8. Boxes that rub against the frame. Sometimes boxes can rub against the conveyor frame. This makes belts work harder because they have to overcome the force of friction between the box and the frame. Such extra work will reduce belt life. Ways to prevent this include placing skate wheels along the frame and using box centering zones. Sanded strips of pine wood attached to the frame seem to have a lower coefficient of friction on card board boxes than slippery plastics like UHMW. Wedges made from sanded wood can push the boxes away from the frame.

9. PLC shut-off delay set too long (powered roller conveyors). Jammed boxes will bring slave rollers and belts to a halt. As soon as a sensor detects a box jam, the PLC (Programmable Logic Controller) must turn off its powered roller quickly -- within 4 seconds. Otherwise, the powered roller will continue to turn under the jammed box, forcing the belts to slip and overheat. Such abuse will eventually cause premature belt failure. You can mitigate this problem by using our rough green belts. They are designed to slip easier and heat up slower, but the trade off is lower drive, so you will not be able to move boxes as heavy as you would with smooth belts. (Contrary to what most people think, rough belts slip easier than smooth belts because they have less surface contact).

10. Speed. If everything else is equal, conveyors that move at slower speeds should have belts that last longer because they flex less. High speed makes belts flex rapidly, which causes internal heating. This reduces belt life, but not so much as to reduce their utility. One of our customers runs our ¼" belts at over 14,000 rpm (15000 ft/min, 75m/sec) to polish diamonds.

11. High temperature. The attached graph shows how urethane's physical properties decline as temperature increases. At 130° F (50° C) the physical properties are about 70% of what they would be at 70° F (21° C). That is why belts in automobile tire factories last only about 2000 hours. The temperature in such factories is 50° C day and night year round. We have one customer in England who runs belts at very high speeds that are sprayed with coconut oil at a constant temperature of 150° F (65° C). Those belts last only about two weeks, but the customer is happy because our belts last twice as long as others that they tested. For high temperature applications, we recommend using our high temperature urethane belts. They can work up to 230° F (110° C.)

12. High humidity. The most resilient and abrasive resistant type of urethane (ester based) is hygroscopic, i.e., it absorbs water. Water slowly reacts with the ester chemical bonds and breaks the long chain molecules, which make the belt stretch more. Under normal temperature and humidity conditions the affect is not noticeable. However, at 100% humidity and 100° F (37° C) the life of an ester based urethane belt will be less than half of what it would be at 60% humidity and 70° F (21° C). Additives can make ester based urethanes last longer in water, but they still will not last nearly as long as ether based urethanes. For high humidity or wet applications, we recommend using our nautical or jungle urethane (Cyclothane-E, which is ether based). It is extremely water resistant.

13. Low temperature. Urethane becomes more rigid (stiff) as the temperature declines. At low temperatures the belts have to work harder to overcome the increase in rigidity. This can theoretically shorten belt life. Below certain temperatures urethanes can become so rigid that some welds can snap. For low temperature applications (down to -5° F (-20° C), we recommend using our low temperature urethane (Cyclothane-E). At temperatures below that, especially for ice cream plants and sushi warehouses, our virgin Hytrel polyester works well.

14. Rapid acceleration or deceleration. If belts are speeding up or slowing down boxes, they have to overcome an additional force (F = ma) that can reduce their life. If the change in speed is too great, the momentum of the box and rollers may cause the belts to slip a little and squeak. If this happens, either adjust your PLC ramp up/down speed to eliminate the squeaking or switch to our rough green belts. Rough green belts are designed to slip without squeaking because they have a lower coefficient of friction.

15. Frequent starting and stopping (or stretching and relaxing). The higher the frequency of starting and stopping (or stretching and relaxing as occurs on pop-up diverters), the more the belt will be stressed, and the shorter will be its life. For longer life, pop-up diverters should be designed so they do not stretch or relax the belt when they move.

16. Dirty environment – Sticky dirt. Sticky dust or dirt can build up between the lineshaft and spool, increasing the break away force of the spool. This can increase the tension on belts, reducing their life span. If the spools get so dirty that they do no slip during accumulations or jams, the spools will keep spinning when the belts have stopped moving. This will abrade, melt and overheat the belts, causing them too fail prematurely. The belts will also cut grooves in the outside surface of the spools.

17. Dirty environment – Gritty dirt. Gritty dirt can abrade and scar the inside surface of lineshaft spools (i.e., their holes), reducing surface contact with the shaft. In such cases the spools will

tend to slip too soon, making it appear that the belts have lost their drive.

18. Chemicals. One customer let machine tool coolant drip on his rollers. His belts lasted only two weeks. Another customer in a food plant cleaned his belts each night with chlorine bleach. Those belts cracked and failed prematurely. Belts used in a battery factory were splashed with sulfuric acid and failed quickly. Any acid or base will cause belts to become limp. Urethane is very resistant to most oils, but many chemicals attack it. Also UV light can degrade regular urethane, but our Cyclothane-E is UV resistant. For other chemicals we recommend our Hytrel belts. They can resist most chemicals, including acids and bases. See http://www.durabelt.com/chemicalresistanceinfo.php

19. Oil on the shaft, belts or spools. If any lubricant gets on the shaft, belts or spools, the belts will appear to slip sooner. Sometimes grease or oil used to swage grooves is left in the roller grooves, causing the belts to slip. For oily environments, we recommend using our spring belts without a jacket. Unlike plastic and rubber, they do not slip.

20. Maintenance. Poor maintenance can shorten belt life. If some belts rub against frames or spool edges because the spools are not directly under the roller, those belts will fail sooner than other belts. If a bad belt is not replaced quickly, then the adjacent belts will have to work harder, so they will stretch more and fail sooner. Also, if slippery dust or lubricant gets on the belts, it must be cleaned off with mild solvents like alcohol, acetone or detergent. Otherwise the belts will appear to have become prematurely limp.

21. Human error. Sometimes even good maintenance can cause belt problems. One customer removed the spools to clean the shafts, but when he put the spools back on the shaft, he did not locate them directly under the rollers, so the belts rubbed against the outside edges of the spools. Since the outside edges move faster than the belts, they abraded the belts, so most of his belts failed prematurely.

22. Deliberate abuse. I noticed that some belts on a problem conveyor had jumped outside the spools and were riding on the bare shaft. I told the maintenance manager and he said that he knew about the problem, but he could not shut down the conveyor to put them back on the spools because the production manager would complain.

23. Over stretching during installation. Stretching 83A/85A belts more than 25% significantly exceeds their elastic range. Like over extending your muscles, this can injure the belts. For maximum drive and belt life we recommend installing belts in such a way that you do not stretch them beyond their installed length.

24. Faulty Spools. We have seen spools that failed prematurely and stuck to the shaft so when a box jammed, the spools overheated the belts and caused them to over stretch. Spools should be made from acetal polyoxymethylene (POM), but there are two types, copolymer and homopolymer. Our Delrin 500P copolymer works best because it is more heat and chemical resistant. It also is anti-splay, so there is less chance of it squeaking.

25. Running belts on a bare shaft. Belts that run on a bare shaft screw there way down the shaft and then snap back. This produces high frequency vibrations as the belt stretches and relaxes, causing standard belts to fatigue and abrade fairly quickly. Our anti-vibration belts reduce the

vibrations and increase belt life, but they are more expensive.

26. Roller length. Long rollers have slightly greater moments of inertia than short rollers, so the belts have to work harder to roll or stop them (see #14 above).

27. Rollers with coatings or sleeves These rollers have a greater moment arm if the groove is unchanged, so belts must work harder.

28. Roller wall thickness. Rollers with thick walls have slightly greater moments of inertia than rollers with thin walls, so the belts have to work harder to roll them.

29. Curves vs. Straight sections. Tapered rollers are usually more difficult to turn because the root diameter at the groove is less than on straight rollers. Also, the larger moment arm of tapered rollers is a lever that forces the belt to do more work. Therefore, belts used on conveyor curves will usually not last as long as belts used on straight sections.

30. Wobbling rollers. If the rollers' TIR is high (if they wobble), the belts have to lift the box a little. This greatly increases the force on the belts, causing them to fail prematurely. If you can see the rollers wobble, then this is a problem.

31. Bearing problems. If the bearings in rollers are defective or lower grade, or if the bearings are pressed on a shaft that is too large and binds the bearings, the belts will have to exert a greater force to overcome the additional friction. This will cause them to fail prematurely.

32. Bearing grease. Special grease is needed for high or low temperature operations. If the wrong grease is used or if no grease is used, the extra friction may affect belt life.

33. Tight bearings. Tight fitting balls and or seals can make bearing difficult to turn. They produce extra friction that can also cause the bearing to heat up. If the belt has to work harder to overcome the ball or seal friction, and/or if the heat from the bearing is transferred to the belt, belt life will be reduced. We recommend bearing clearance of C3. Shielded bearing also have much less drag than sealed bearings. If you must use sealed bearings, specify "light seals". Moderate or heavy seals can cause much extra drag.

34. Sticky bearings. If a sticky liquid (e.g. orange juice) spills on rollers and gets inside the bearings (liquids can penetrate shielded bearings), the "glue" will produce drag that can reduce belt life.

35. Inclines. If the conveyor is not level, the belts will have to exert a greater force to overcome the gravity vector. This will reduce belt life.

36. Boxes with all the weight on one side or corner. Such boxes often skew, rotate and jam or rub against the frame. Greater friction forces mean shorter belt life.

37. Boxes with protrusions out of the bottom. At one plant metal staples were sticking down out of boxes, forcing the rollers to lift the box each time a staple hit them. This can reduce belt life. Occasionally the sharp staples also made small cuts in the belts.

38. Boxes sticking to rollers. If a sticky substance (e.g. orange juice, soft drinks) spills on the rollers, boxes may stick to the rollers. This would typically occur after boxes have stopped moving (accumulated) on the rollers. When accumulation ends, the belts not only have to turn the rollers, but also need to break the "glue" that sticks the boxes to them. If this significantly increases the force necessary to turn the rollers, belt life can be reduced.

39. Moving sheet metal. Some conveyors move sheet metal that has sharp edges, which make small cuts in the belts, causing them to break.

40. Roller groove size. Some companies' roller grooves are wider and deeper than others. On lineshaft conveyors, wider grooves with rounded edges are definitely better than narrow grooves with sharp edges. The more a belt rubs against the edge, the more it will abrade and the shorter will be its life.

41. Roller grooves plated with zinc that cracks. We have seen rollers that have grooves where the zinc has cracked. This makes groove edges act like sand paper, which can abrade the belts rapidly. Sanding rough edges eliminates this problem.

42. Roller grooves with ridges that abrade. There are two ways to make grooves in rollers, the roll-in method and the crimp method. The crimp method can produce little ridges that run across the groove (parallel to the roller shaft, about half way between the top and bottom of the groove). If these ridges are sharp enough, they can abrade belts, especially on curves, where belts rub against the side of the groove.

43. Roller grooves not concentric with roller shaft. Recently a customer purchased rollers from a high quality roller manufacturer, known for its superior performing rollers, but the rollers had a defect that "had never occurred before". The grooves were deeper on one side than on the other, meaning the belts were trying to turn rollers that were off center. In other words, the belts would have to lift the boxes. Fortunately, the grooves were far off center, and the boxes were too heavy to be lifted by the belts, so nothing moved, and the customer quickly found the root of the problem. If the grooves were defective but slightly less off center, the problem might not have been detected immediately, and our belts would have been unjustly blamed. Therefore, please make sure your roller grooves are of the same depth all the way around the roller and are concentric with the roller axis.

44. Part time use. If a conveyor is only used for part of a year, it may get rusty from sitting idle. Overcoming the resistance caused by rust may reduce belt life. After sitting idle for several months, the belts will also take a set which may slightly reduce their life. Note that belts continue to stretch when under tension, even though the belts are not moving, but they stretch much less than if they were moving. To mitigate this problem, we recommend running the conveyor for a few minutes each month.

45. Percent stretch. Some companies use different amounts of stretch, 10% to 14% on standard 83A belts. They must have tested and found which amount works best for them. Perhaps the percent they choose is dependent on many of the variables above, e.g. center distance, spool design, and roller groove size. Perhaps the speed of the test, the weight of the boxes tested, or the amount of accumulation done during the test can influence the choice.

46. Over stretching belts during installation. Some companies facilitate belt installation by briefly over stretching them by 30% to 100% or more. This stretches belts beyond there elastic limit and shocks the material. Nothing good can happen as a result. Overstretching will immediately ruin some materials like high durometer (90+A) urethane belts, PVC belts, and Hytrel® polyester belts, used in low temperature applications. The softer the material, the more forgiving it is when overstretched. Nevertheless, even though soft belts may not immediately show the damage, their life may be reduced. If you are having difficulty installing belts on powered rollers, you may want to try our Speed Roller Installer©, which greatly facilitates roller installation.

47. Sensor reflectors fail, causing lagging sleeves to walk and abrade belts. Reflectors on MDR zones can wear off due to boxes rubbing against them, or if they became covered with dust, so they do not reflect the sensor signal. This makes the PLC software think there is always a box on the zone, so it turns the motor on when it should not. This ultimately causes boxes to jam. The MDR keeps turning but the boxes do not move, forcing the slave belts to stop moving. Consequently, some of the slaves slip. The resultant friction makes both the belts and rollers heat up. The heat causes some types of plastic lagging sleeves to expand and walk sideways on the rollers. When the sleeves rub against the belts, the friction causes the belts to abrade.

48. Loose lagging sleeves. As in #47 above, loose sleeves can walk sideways on rollers and rub against the belts, causing them to abrade. Lagging sleeves can become loose if they are not properly affixed (epoxied or glued) to the rollers or if their ID was too large for the rollers when they were installed.

49. Using a hook to overstretch belts during installation. Some installers like to facilitate the task of installing belts by grabbing them with a steel hook (e.g. made from 3/16" diameter wire) and stretching them 50% to 100%; then sliding the roller through the stretched belt and into the frame holes. This abuse often causes a kink (thin spot or notch where the cord becomes visibly smaller). It also violates the minimum pulley diameter, as well as stretches the belt beyond its elastic limit, which ruins the belt. When installing belts always drop the roller, slid the belt into the roller groove, and then use the roller as a lever to stretch the belt until the roller shaft pops into the frame. This way the belt is not over stretched.

Because of all the variables above and because our test conveyor is different from yours, we would probably get different results if we test the same belts that you are testing. Therefore, it is very hard to accurately predict how long our belts will last on your conveyors. The best thing that we can recommend is that you test them thoroughly.

Another approach would be to ask your customers or associates how long belts last for them. If you took a survey and kept good records, you would get a range of belt life that would help you predict. Since we do not sell to end users, but only to distributors, fabricators and equipment manufacturers, we cannot survey end users. All the customers mentioned above contacted us through their distributors, so we only know the ones that had problems. That would not be a good sample.

I have been solving conveyor problems for 20 years, yet every month it seems that I see at least one new problem. This is probably a reflection of the diversity of ways in which roller conveyors are used, not a weakness in this type of conveyor. Most of the time roller conveyors perform very well. Line shaft and powered roller conveyors are extremely human friendly – safe and quiet. However, when there is a problem, 99.9% of the time the problem is not the belts – at least not our belts.

Rather, the belts are a symptom of some problem with the conveyor, the boxes, the environment, or the operators.

The best way to solve a "belt problem" is to observe the conveyor in action. Sometimes you must watch for many hours, because some problems are intermittent, but sooner or later the cause of the problem will usually show itself.

If you ever have a belt problem that you cannot solve, kindly send several of the failed belts to us. We put the belts under the microscope and perform other analyses, but often by just looking at a belt we can tell you what is causing the problem and how to fix it.

If your engineers are designing new conveyor components that use belts, feel free to ask us to review their designs. We provide this service free. Many of our customers include us in their design reviews by emailing or faxing us CAD drawings. We often help them avoid costly design errors because we have seen many more than they have. In addition, we help them design conveyors that will maximize belt life. For more info please call me, Jim Hammond.

*To the best of our knowledge, our warranty is the world's longest definite duration warranty for urethane belting breaking at the weld joint. We also offer a 10 Year or Lifetime Belt Warranty, whichever is longer. See http://www.durabelt.com/warrantyinfo.php.