# Key PMR's

# Belt hardness measurement (for bucket elevators and belt conveyors)
# Procedure

## 1. PURPOSE

The hardness of a belt is a key indicator of its service life.  Specially those belts conveying material at elevated temperatures (above 60°C) will be subject to an accelerated process of hardening, that results in increased brittleness and a reduction of its service life (illustrated by the following graph).

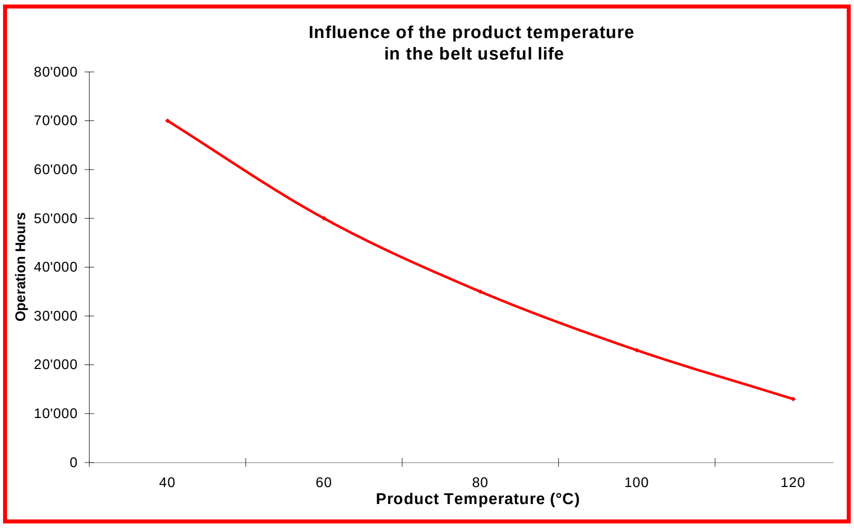


Figure #1.  Effect of conveyed material temperature on belt service life

Besides the appearance of cracks on the rubber (through which the conveyed material can wear the inside of the belt), the increased brittleness will hamper any required repair (i.e. hot splicing).

## 2. SAFETY

The conveyor (belt conveyor or bucket elevator) main drive must be properly de-energized. Use the local lock-out/tag-out/try-out procedure. For bucket elevators, the auxiliary drive has to be operated to access different sections of the belt; this maneuver has to be carefully coordinated and the auxiliary drive locked out while performing the actual measurement.

Perform a risk analysis to neutralize any possibility of accumulated material suddenly falling down while performing this measurement.

Wear all required Personal Protective Equipment (PPE) according to local regulations. This may include, but it is not limited to: hardhat, safety shoes, safety glasses, earplugs, gloves, protective clothing.

## 3. RESULTS AND ACCEPTABLE VALUES

The result of this measurement is a numerical value: the belt hardness. This is expressed in Shore A (for rubber).

Once the belt has reached a hardness of 85 Shore A, a replacement has to be ordered.

The belt should be replaced once the hardness reaches 90 Shore A.

## 4. FREQUENCY OF REALIZATION

This measurement should be performed at least once per year. For conveyors exposed to high temperature material (i.e. clinker) the frequency should be half-yearly.

Based on the trend and provided the temperature of the conveyed material is relatively constant, this frequency can be further fine-tuned.

## 5. STEP BY STEP PROCEDURE

## 5.1 Tools:

1 durometer (hardness tester with Shore A readings)
Form to record results

## 5.2 Steps:

1. Open the inspection door to gain access to the belt.
2. Choose a spot at least two buckets (or 1.5 meter) away from the splice.
3. Measure the hardness on the center and once on each side of the belt section (see Figure #2)


Figure #2. Measurement points for belt hardness (indicated by numbers): one in the middle of the belt section and the other towards the extremes

4. Record results.
5. Measure the belt thickness at the point where hardness was measured. The hardness may still be within range, but if the belt has worn out a failure can still happen!
6. Repeat Steps 2 to 4 on two other sections of the belt

**Tip:** the three sections should be evenly distributed along the belt.

## 6. OTHER ADVICE

The measurements will be more representative if repeated on the same belt sections.

There are analog and digital durometers. The following document provides references from devices used by plants that can be used as guide in the purchase of such an instrument.

Durometers Shore A.doc

The actual hardness values on when to order a belt may be influenced by the delivery time of the replacement. The right moment to place the order can thus be derived from the trended values.

## 7. CORRECTIVE ACTIONS IN CASE OF DEVIATIONS

In case the measured values exceed the recommendations outlined in section 3 (Results and acceptable values), the corresponding measures should be initiated (i.e. ordering a replacement or installing a new belt).

Analyze the trend on hardness development to detect if there was any sudden increase from the normal hardness behavior for that particular belt.