Key PMR's

Creep (relative movement) measurement Procedure

1. PURPOSE

In order to avoid shell constriction during the start-up of a kiln, a cold gap or clearance between the shell outer diameter and the tire inner diameter is required. The presence of this gap can be seen during operation as the creep or relative movement between tire and shell (the shell will turn slightly faster than the tire).

The creep must be kept within a range of 10 to 15 mm/revolution of kiln (the higher value used at hot tire stations or for tire inner diameters above 5 m). A creep value exceeding 30 mm/rev should be corrected, since this excessive clearance increases shell ovality and can lead to refractory bricks falling down on the tire area.

As can be inferred, this measurement is relevant for kilns with **loose (floating) tires**. Those equipped with the more modern splined (toothed) tires are not affected; there is virtually no creep and therefore the ovality measurement is not required .

Creep can be measured by different methods. The electronic one is the most recommended, since the reading can be visualized at the Central Control Room. This is particularly useful for alarming purposes and to monitor the creep during start-up of the kiln, which is the most critical phase.

2. SAFETY

This inspection is carried out with the kiln running! Pay close attention to the moving parts (shell, tires, rollers) to avoid hits/pinches and burns.

Use a long sleeved protective jacket and gloves, to protect yourself from the shell heat radiation.

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, long sleeved shirt or protective clothing.

3. RESULTS AND ACCEPTABLE VALUES

The result from creep measurement is a numerical value, expressed as milimeters per kiln revolution [mm/rev].

The creep should be on the range 10-15 mm/rev:

- 10 mm for smaller tires (< 5 m tire inner diameter) and those on the 'cold' stations of the kiln)
- 15 mm for bigger tires and 'hot' stations

Creep should not in any case exceed 30 mm/rev

Exceptions: wet kiln inlet tires and planetary cooler station behind the cooler should operate with a creep as close to zero as possible (since there is almost no temperature difference compared to the shell).

4. FREQUENCY OF REALIZATION

The creep should be measured on a daily basis, whether manually or automatically. In case of on-line systems, it is recommended to double-check the reading every week, by a manual creep measurement.

5. STEP BY STEP PROCEDURE

There are three possible ways to measure creep: manually (chalk method), graphically (pencil method) and automatically (on-line measurement).

5.1 Tools:

Chalk (for manual method), measuring tape.
Measurement device for graphical method (see Figure #1)
None for the automatic method (assuming the hardware and PLC logic have been implemented)

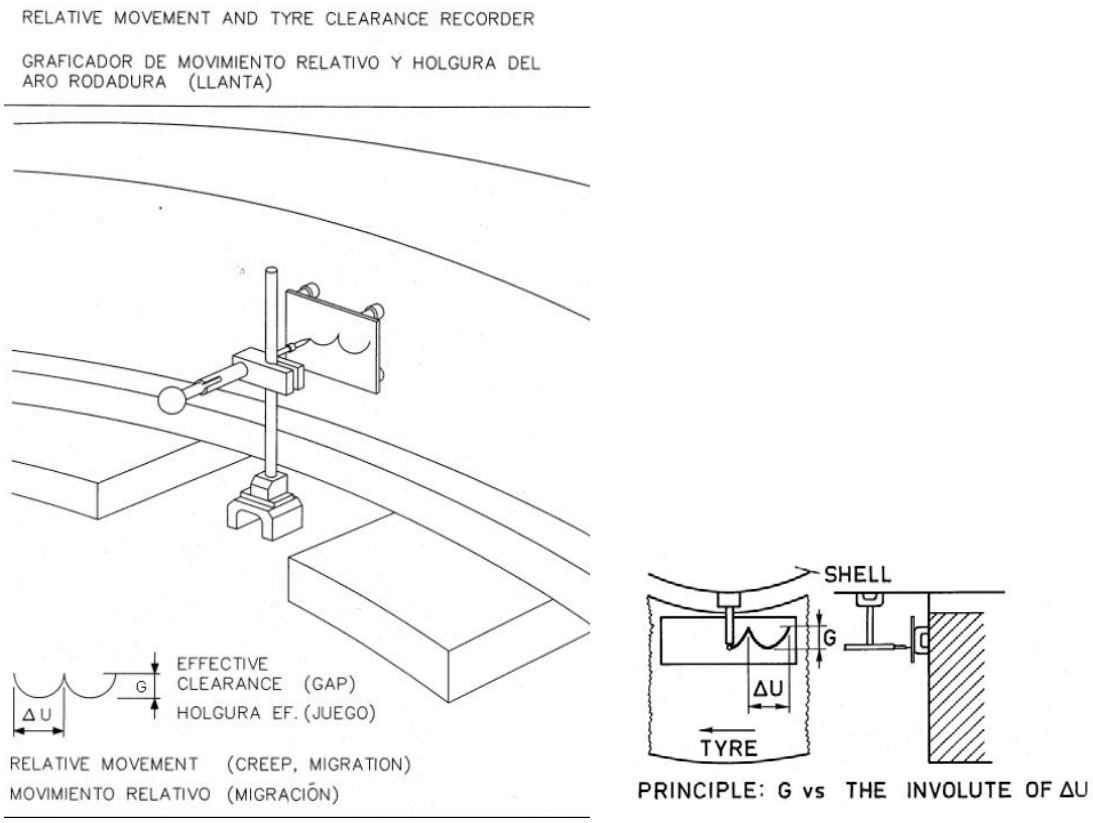

Figure #1. Creep measurement device for the graphical method and working principle. Note that G is the effective clearance or gap, which is made of the clearance and the shell vertical deformation (flattening at the top due to ovality). Relationship between G and ΔU is of: $G = \Delta U/(2 \text{ to } 2.5)$

5.2 Steps:

1. **Manual method**: draw a line from the tire side to the shell with the chalk.
2. Measure the separation between the line drawn on the tire and the one on the shell after ten kiln revolutions.
3. Calculate creep by dividing distance by the number of revolutions.

4. **Graphical method:** place measurement device on the kiln shell and the drawing surface on the kiln tire (as shown on Figure #1).
5. Retrieve both elements from the kiln after two or three revolutions (depending on size of the drawing board).
6. Measure the linear distance (period) between the extreme points of the curve (see Figure #1). This is the creep value.
7. For both methods, compare measured creep against recommended values.

6. OTHER ADVICE

With the manual method, measure creep on at least 10 revolutions for a more precise result.

Be aware that creep depends on shell and tire temperatures and therefore can vary accordingly. Never take a decision based on a single creep measurement; gather at least a daily sample during two weeks kiln operation.

The graphical method provides a measurement of the total clearance G; however, this value may vary according to the position on the tire and should not be used to base shimming calculations.

7. CORRECTIVE ACTIONS IN CASE OF DEVIATIONS

If the creep value is already close to 30 mm/rev, tire shimming will be most likely required.

On the other hand, take a look at refractory history. Fallen bricks are a sure sign that tire shimming is needed. Cross-check against the ovality measurement (shelltest results); a high creep implies a high shell ovality.

A training presentation on kiln tire shimming is available on HolSpace under the link:

https://web.holcim.com/livelink_815/livelink.exe/fetch/2000/3413/24748/261585/262187/262296/464350/Kiln_tire_shimming_E.pdf?nodeid=317083&vernum=0