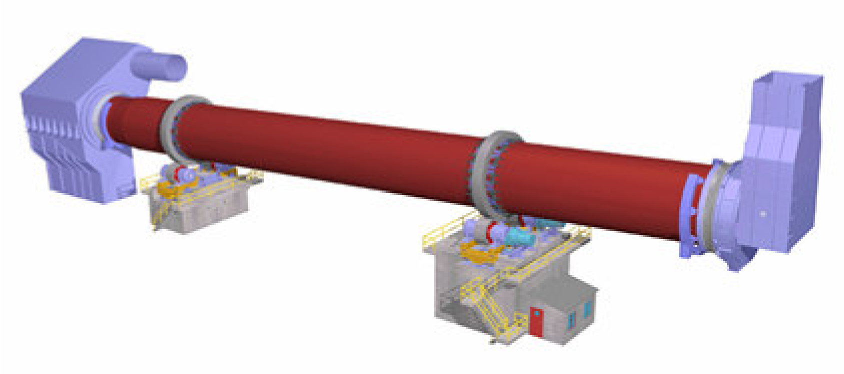
Rotary Kiln Maintenance Seminar



Kiln Supports

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Kiln Supports

- Types of Kiln Supports
- Roller Adjustments
- Roller Inclination
- Roller and Tire Defects
- Roller and Tire Re-conditioning

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Types of Kiln Supports

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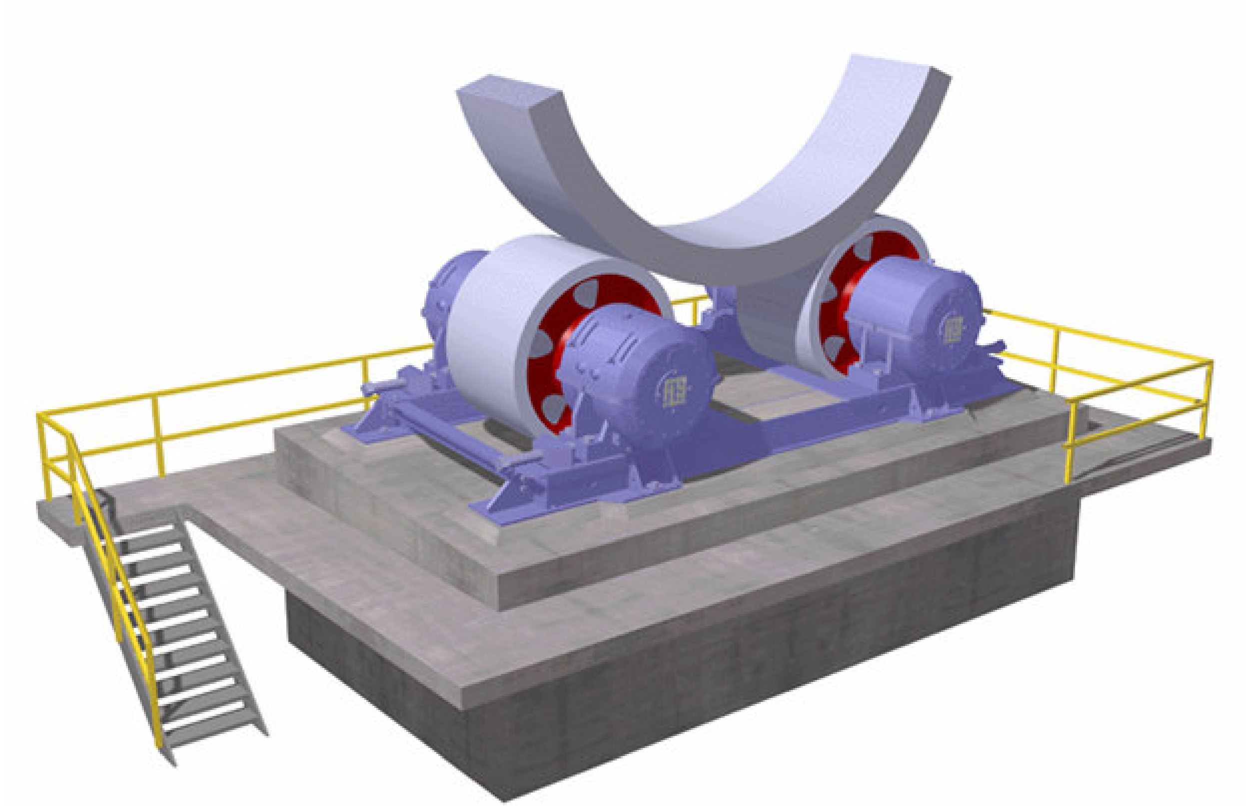
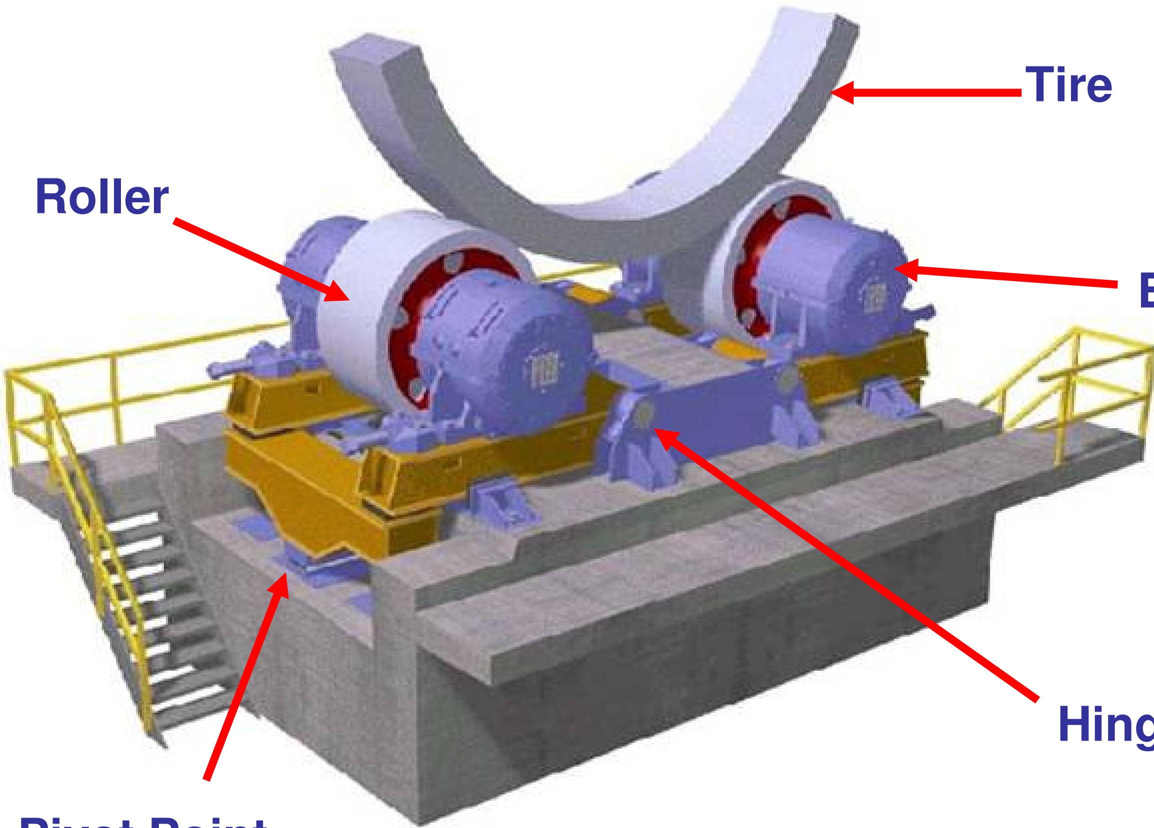
Rigid Kiln Support



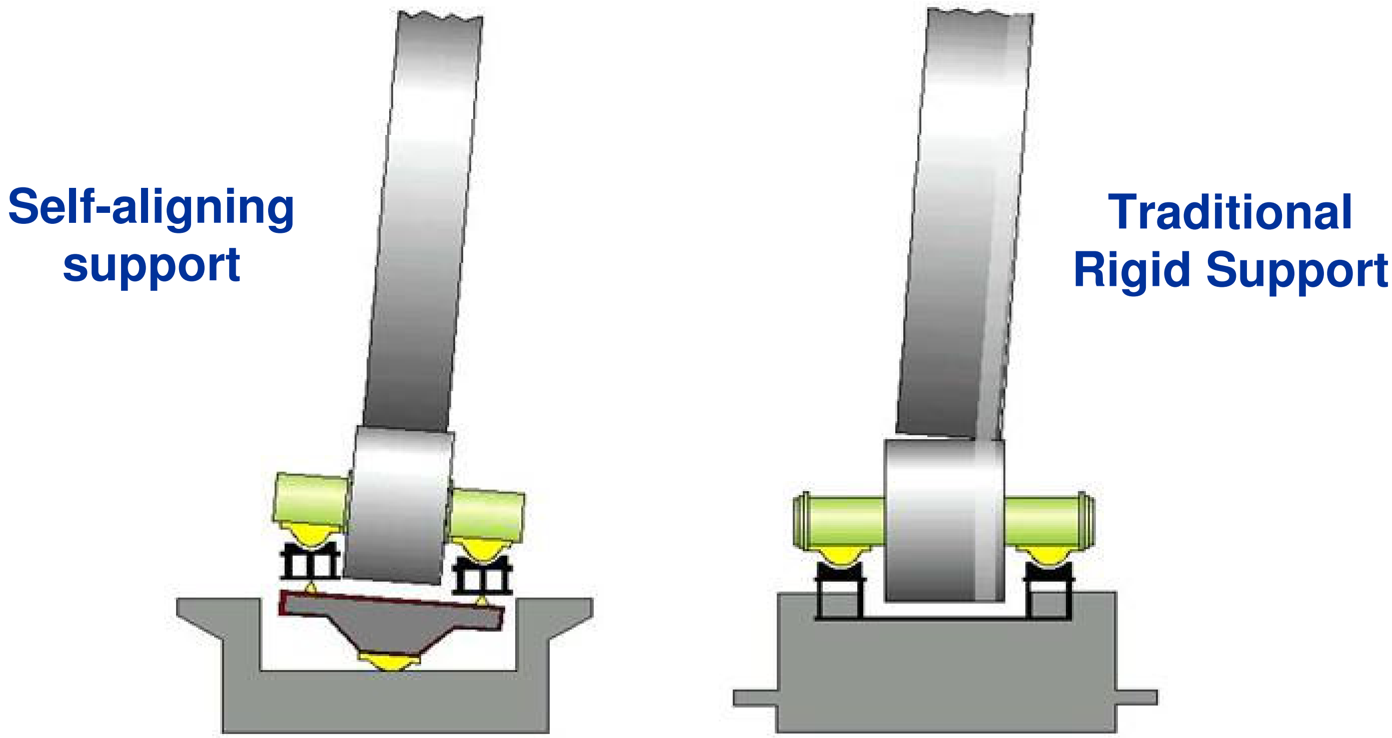
A kiln support consists of two rollers with bearings mounted on a base frame. This rigid support is the most common.

Self-Aligning Kiln Support



On this support the bearings are mounted on a pivoting frame.

Self-Aligning Kiln Support



A self aligning support maintains continuous contact between tire and roller as the kiln turns. As a result, there is less hertz pressure on the roller and components can be sized more economically.

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Self-Aligning Kiln Support

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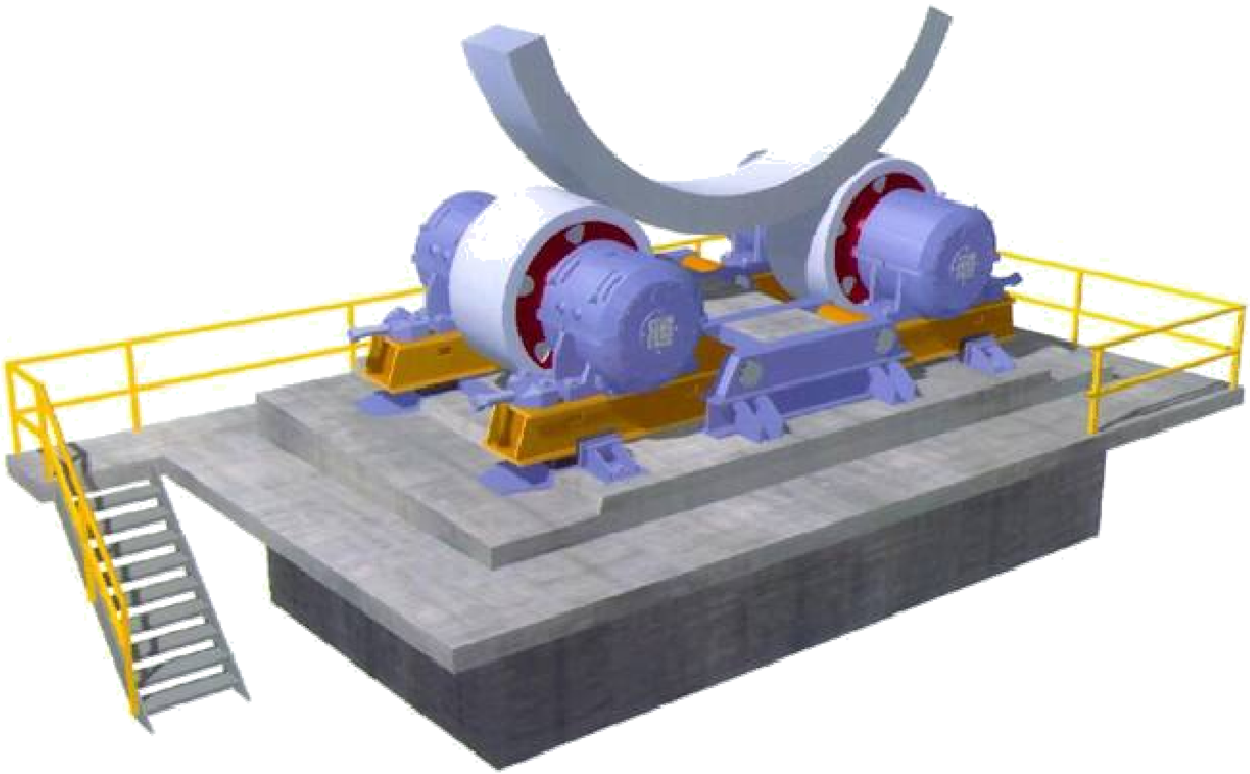
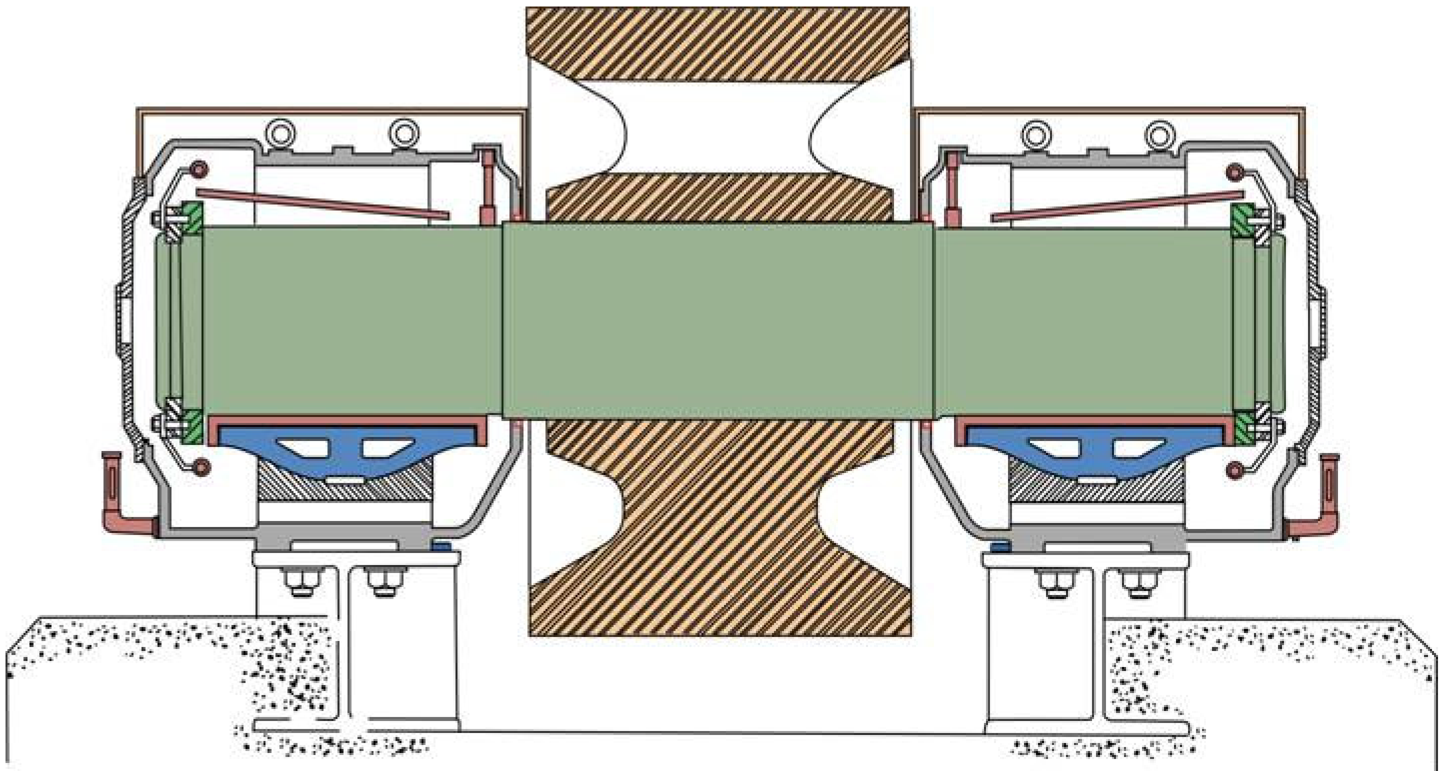
FLS Kiln Support Type SRB



FLS Kiln Support Type RA



FLS kilns have supports with self aligning bearings in spherical sockets.

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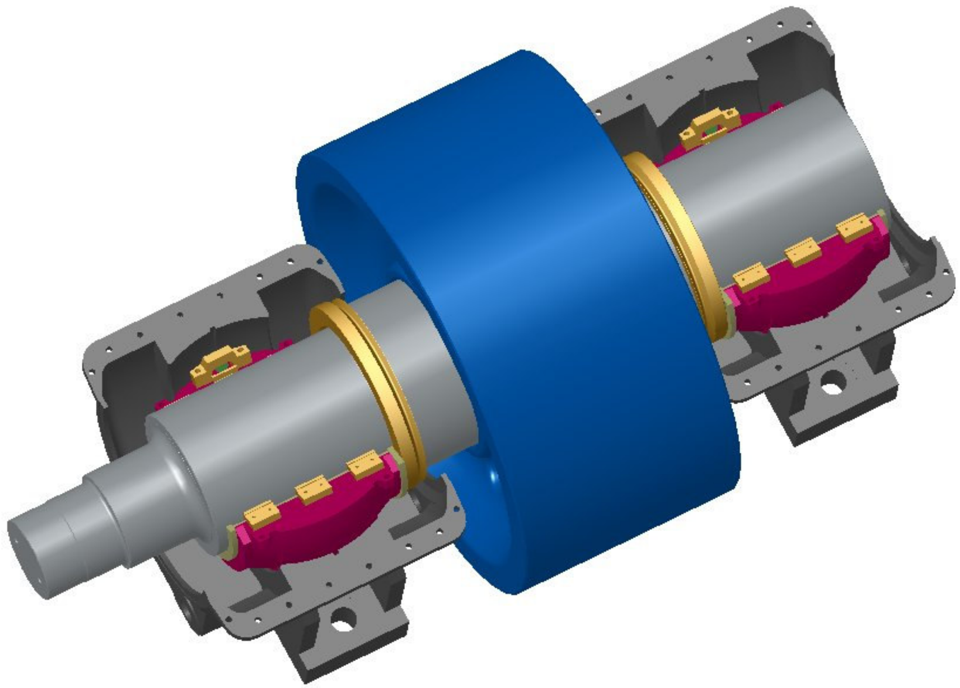
FLS Kiln Support Type RB



The RB support is similar to the RA support, except the bearing takes the thrust load next to the roller on a thrust ring.

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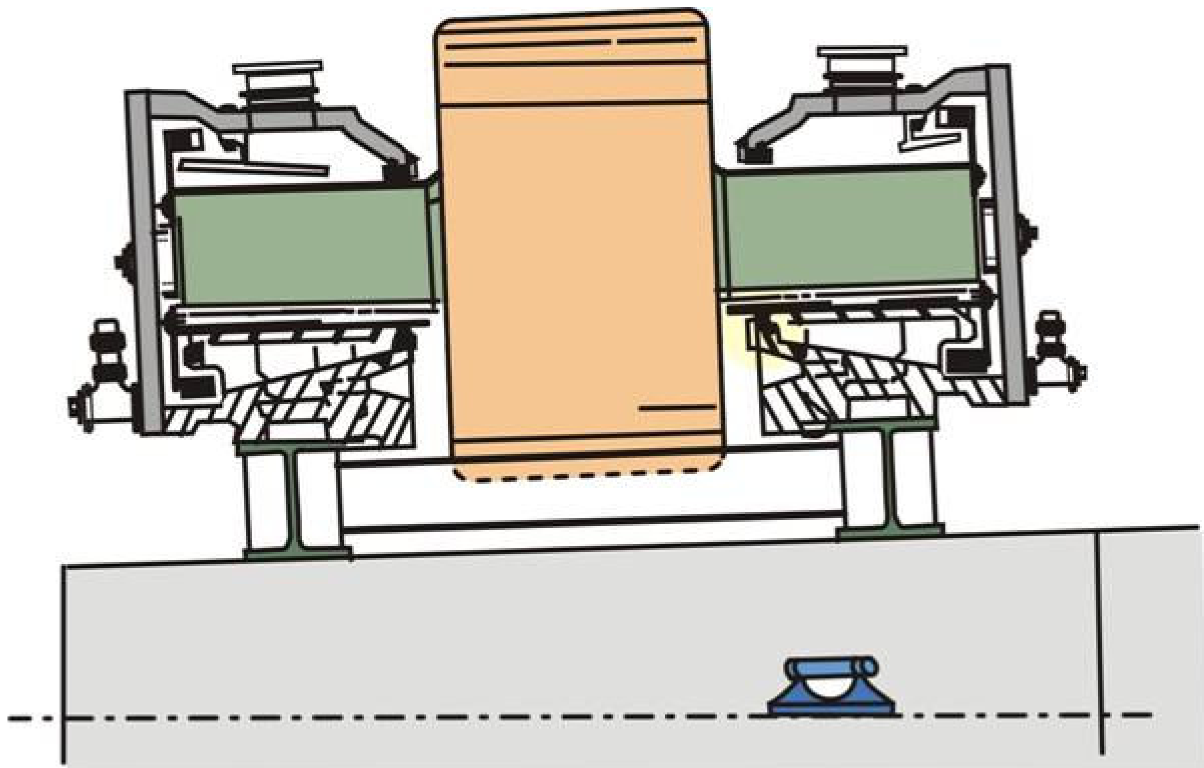
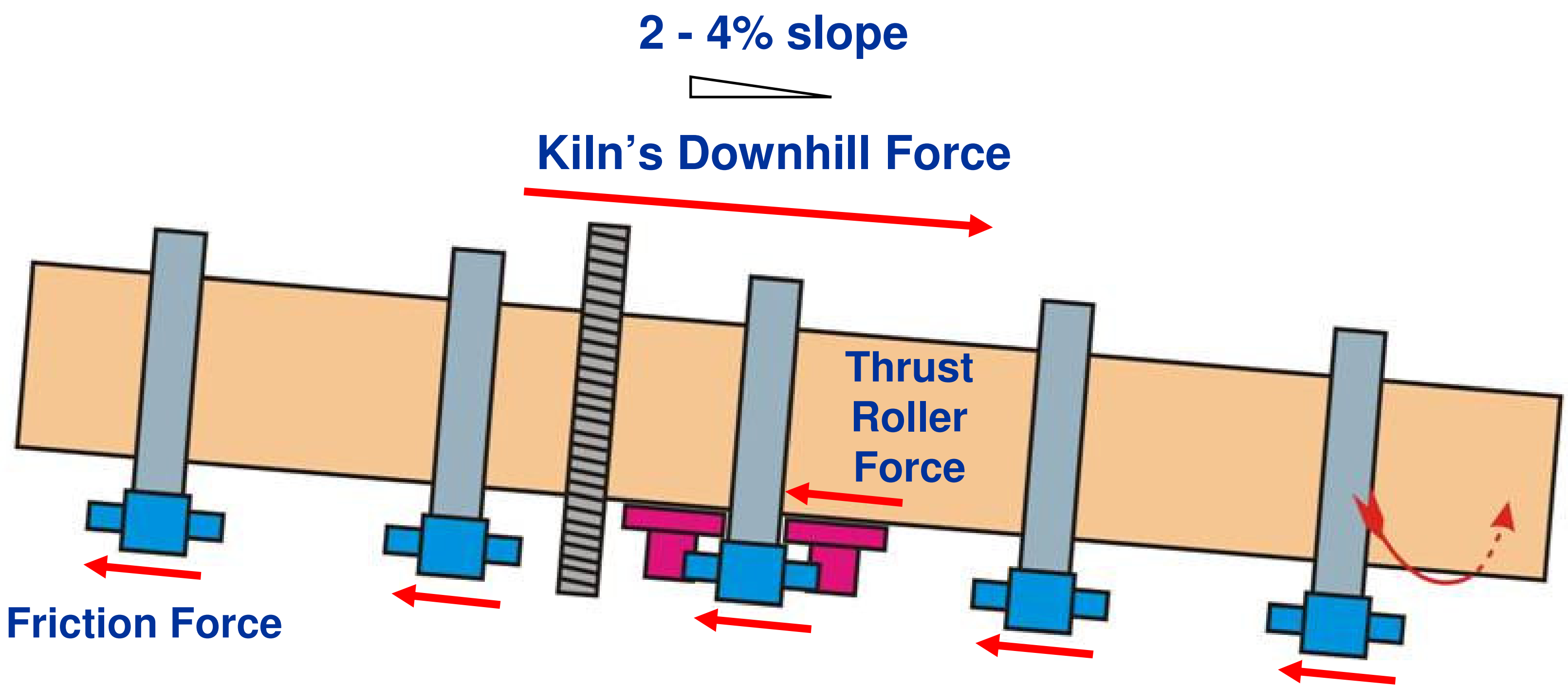
Fuller Kiln Support



The Fuller support has rigid bearings.

Roller Adjustments

Axial Forces on a Kiln



A kiln on a slope will tend to move downhill as it turns. That downward movement is resisted by both the friction force between rollers and tires, and by the force on the thrust roller.

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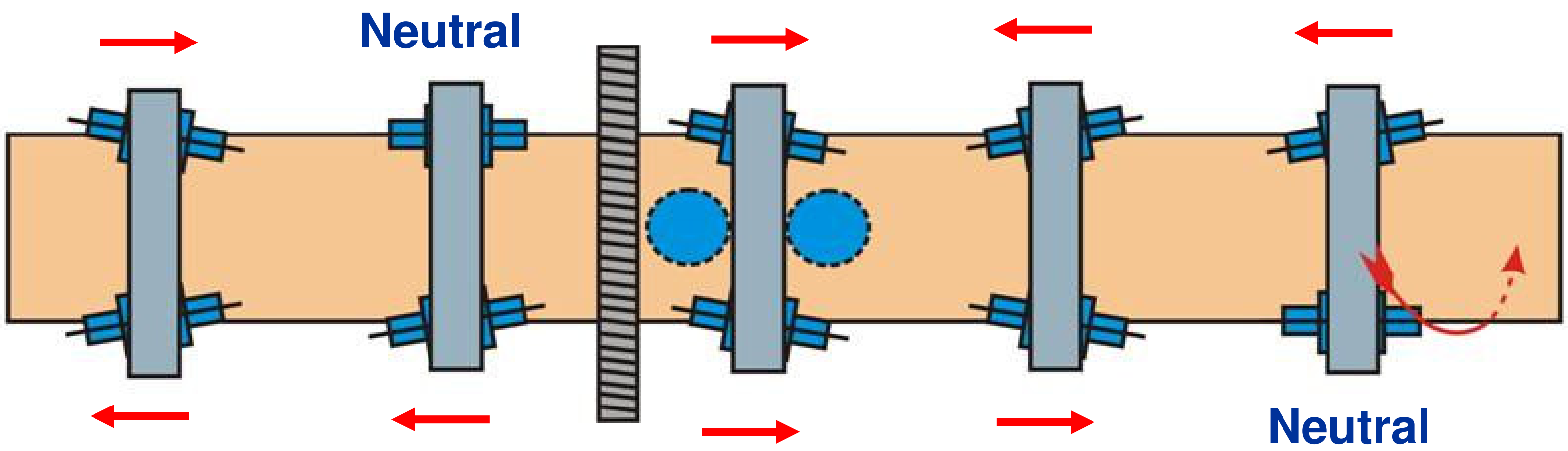
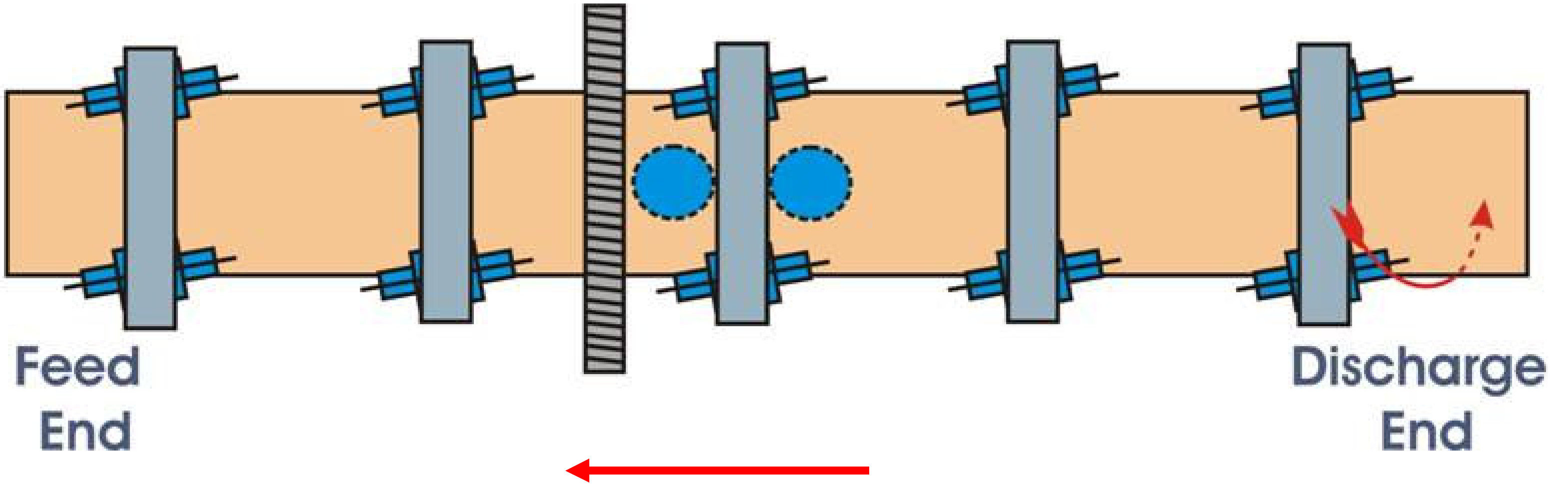
Roller Friction Force



When a kiln roller is not exactly parallel to the kiln axis, it imparts an axial thrust force to the kiln. The direction of this force (uphill or downhill) depends on how the roller is skewed, and on the direction of kiln rotation.

Roller Adjustment Counter-Clockwise Kiln



To reduce the load on the thrust roller, all rollers should be skewed to push the kiln uphill, *never downhill*. Shown above are the correct adjustments for a kiln that turns counter-clockwise (looking from the burner floor).

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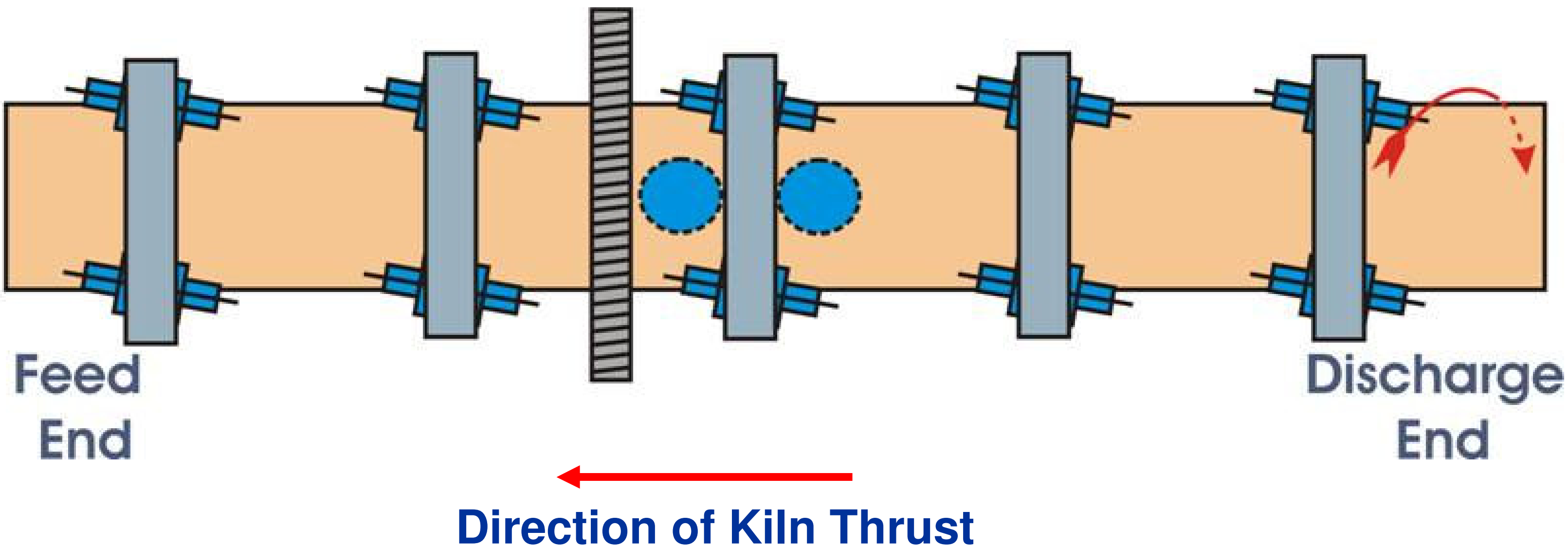
Roller Adjustment Clockwise Kiln



These are the correct adjustments for a clockwise turning kiln.

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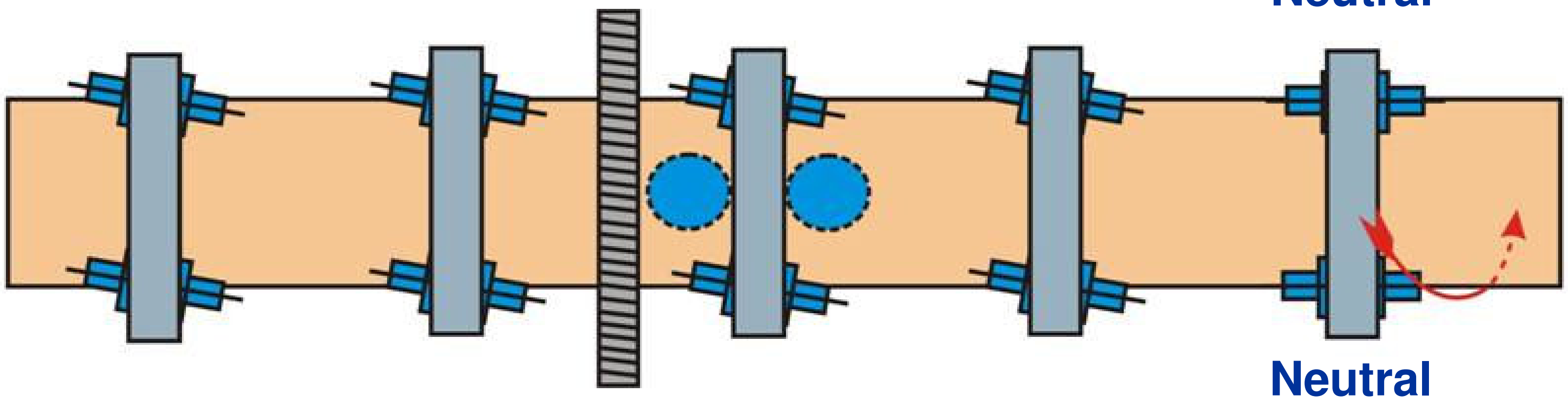
Roller Adjustment



Rollers on the discharge pier are often adjusted for neutral thrust. This avoids excessive roller wear caused by dust from the kiln seal.

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Good Roller Adjustment

- All Rollers Pushing ***Uphill***
- All Rollers Pushing ***Equally***
- Kiln ***Floating*** Between Upper and Lower Thrust Rollers (or, ***correct pressure*** on hydraulic thrust cylinder)

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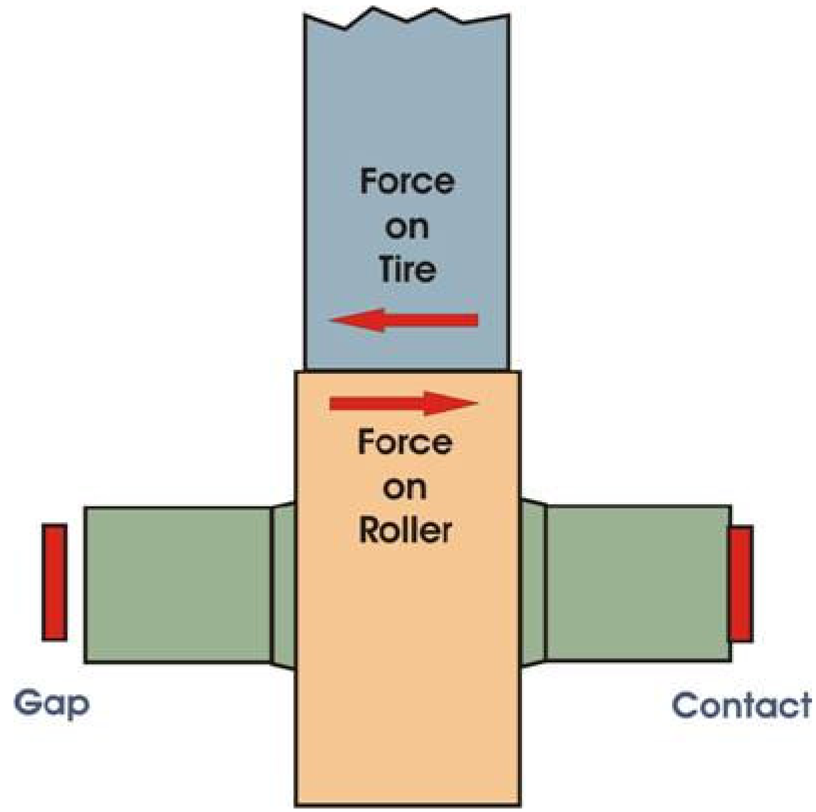
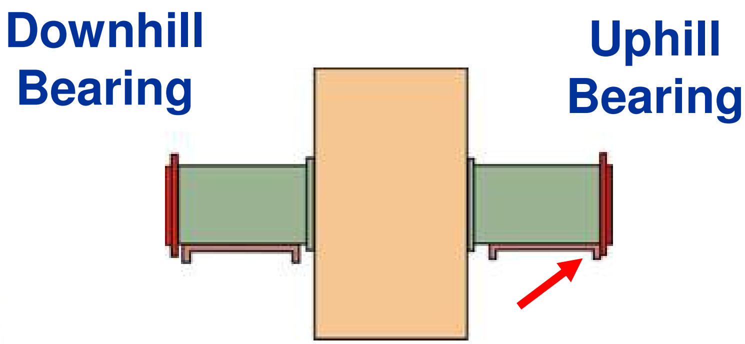
Roller -Tire Forces



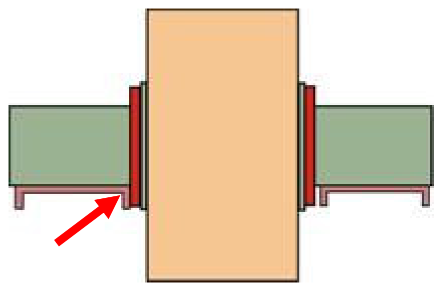
When the force on the tire/kiln is uphill, the force on the roller is downhill. The direction of thrust can be determined by observing the contact or gap at the thrust stop inside the bearing.

Bearing Thrust Arrangements



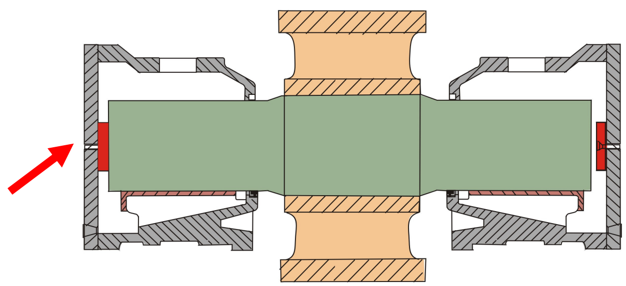
FLS Type RA

Takes Thrust Load on Thrust Collar



FLS Type RB

Takes Thrust Load on Thrust Ring



Fuller

Takes Thrust Load on Thrust Washer

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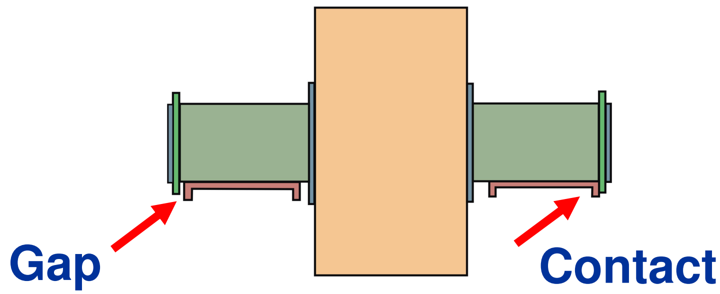
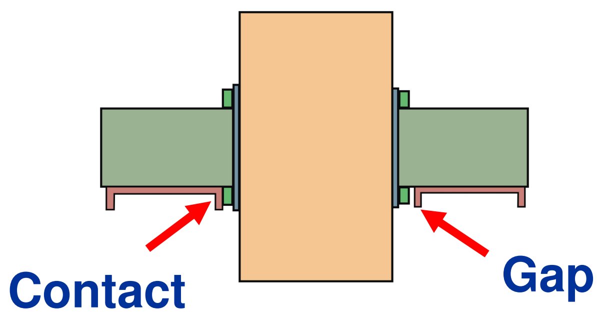
Bearing Thrust Arrangements

FLS Type RA



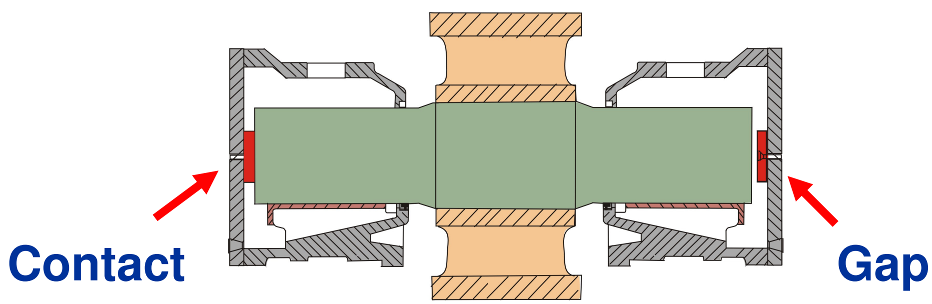
Direction of Force on Kiln

FLS Type RB



Direction of Force on Roller

Fuller



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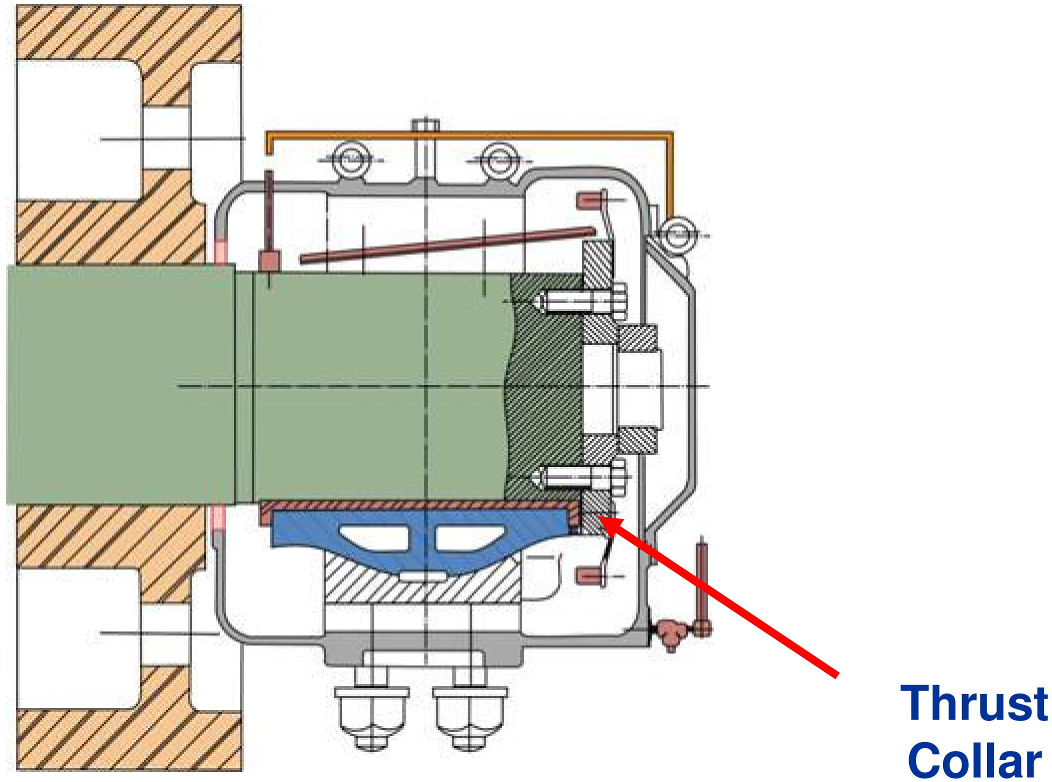
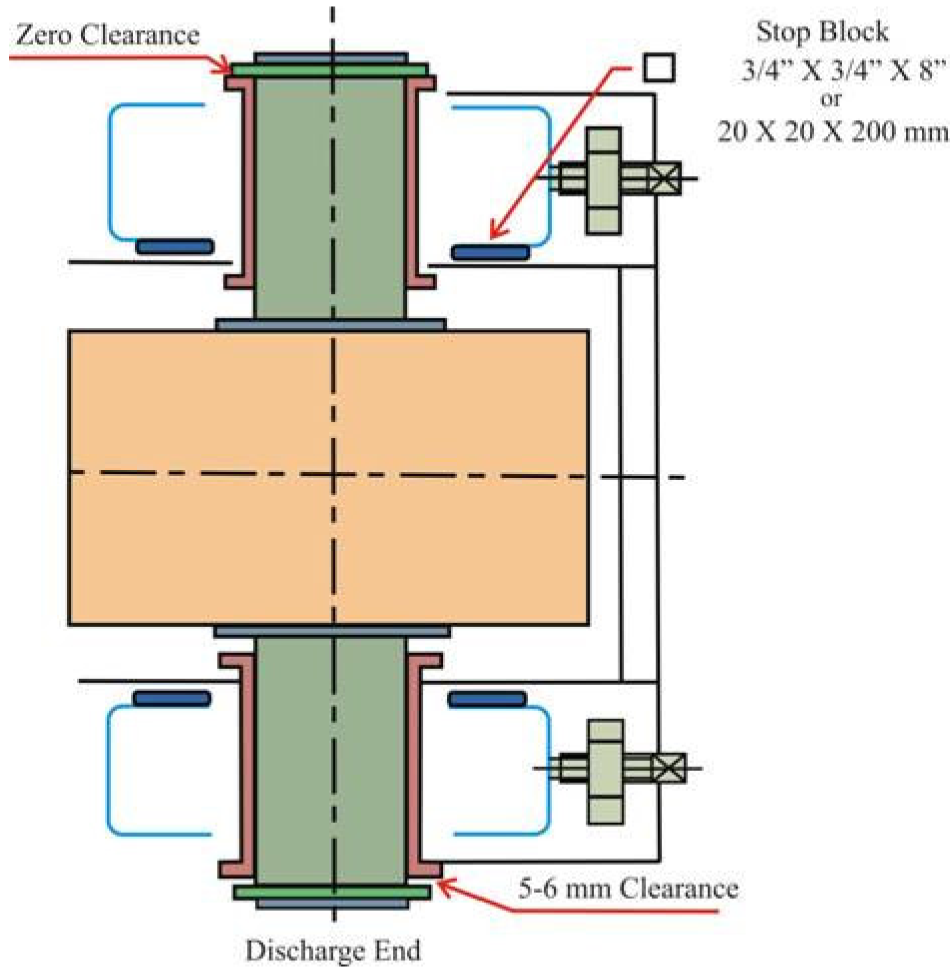
FLS Bearing Type RA

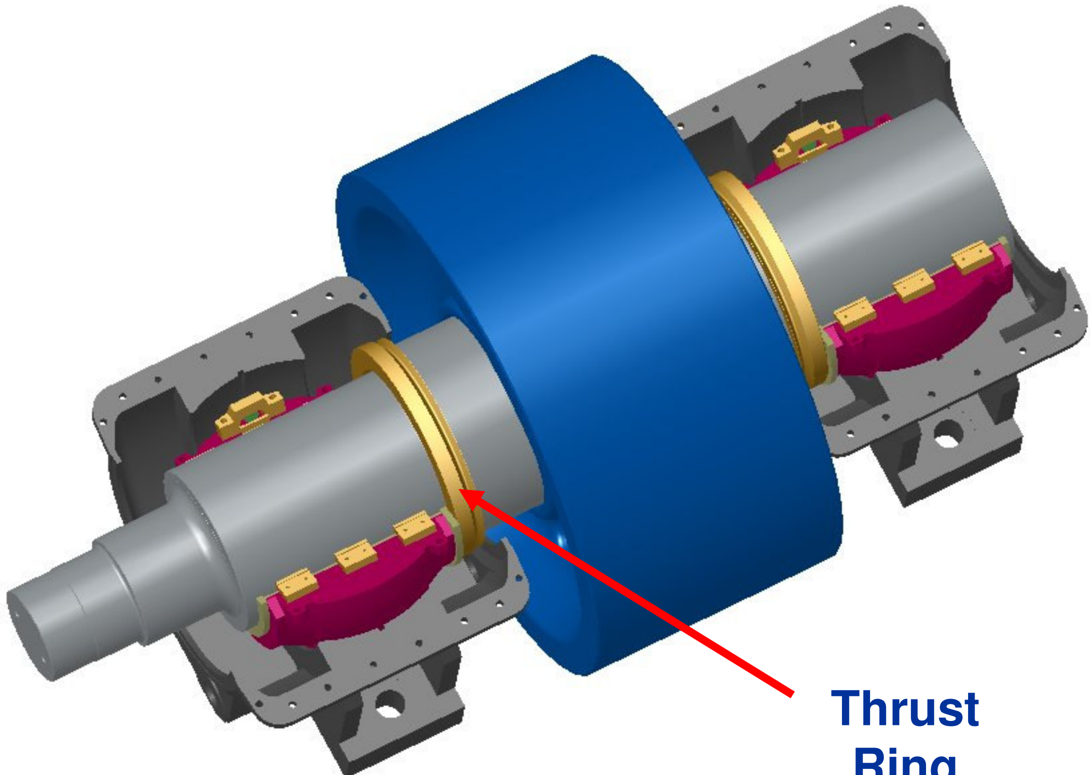


The RA bearing takes the thrust load on a thrust plate which is bolted to the end of the shaft.

FLS Bearing Type RA



FLS Bearing Type RB



The RB bearing takes the thrust load at a ring which is shrunk onto the shaft.

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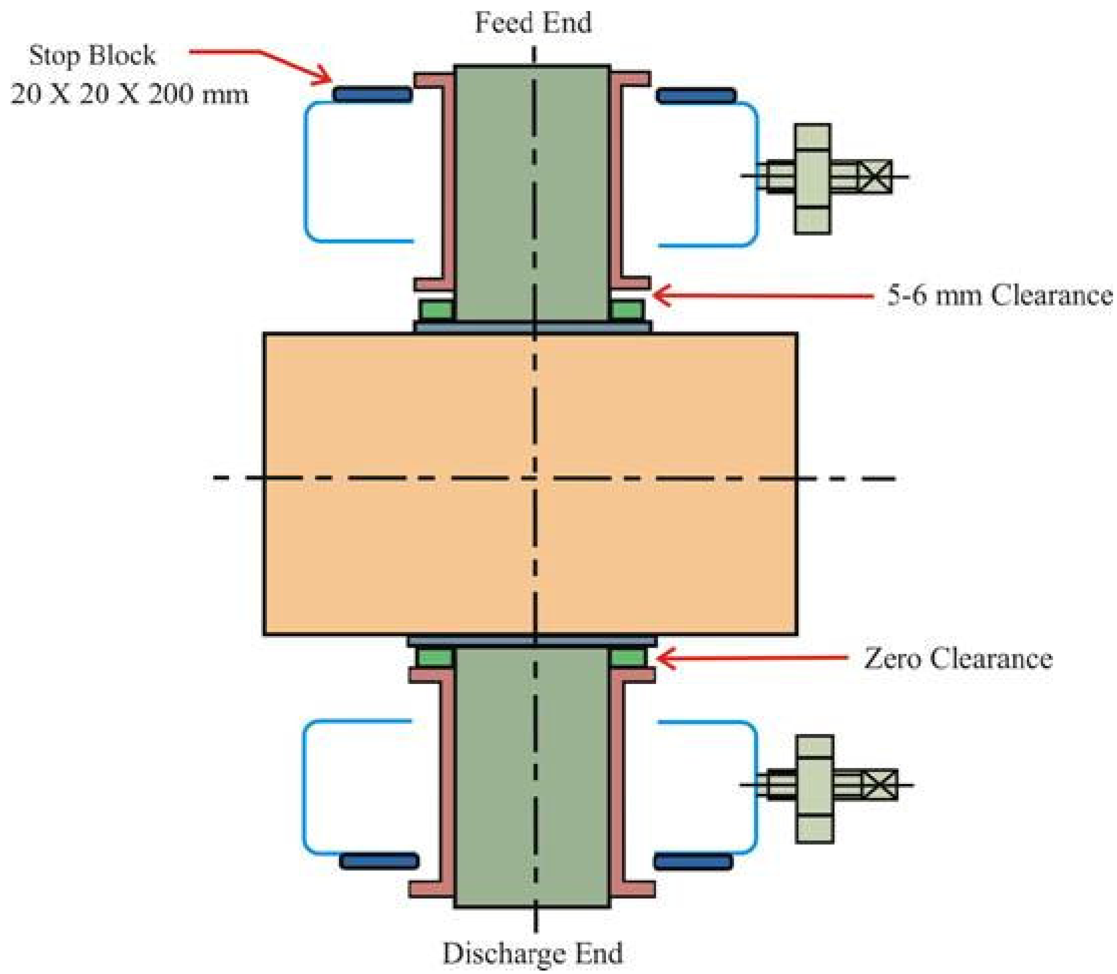
FLS Bearing Type RB



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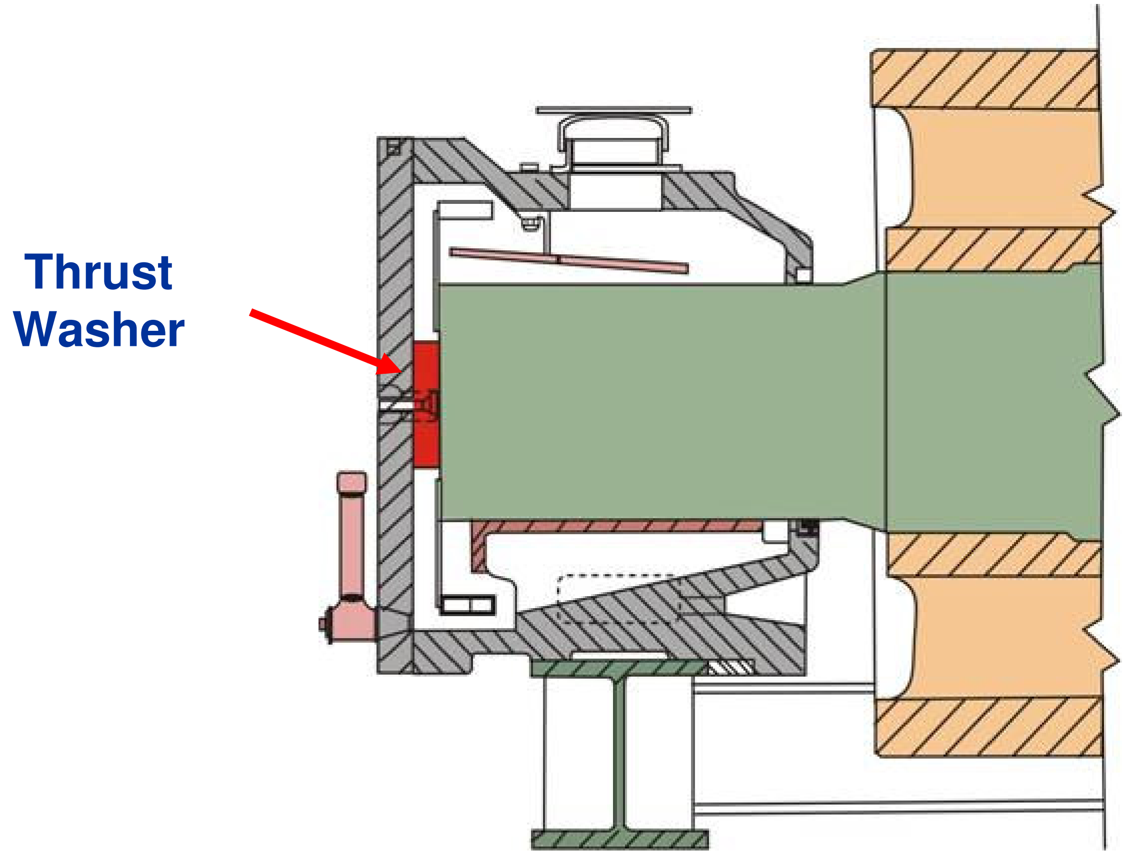
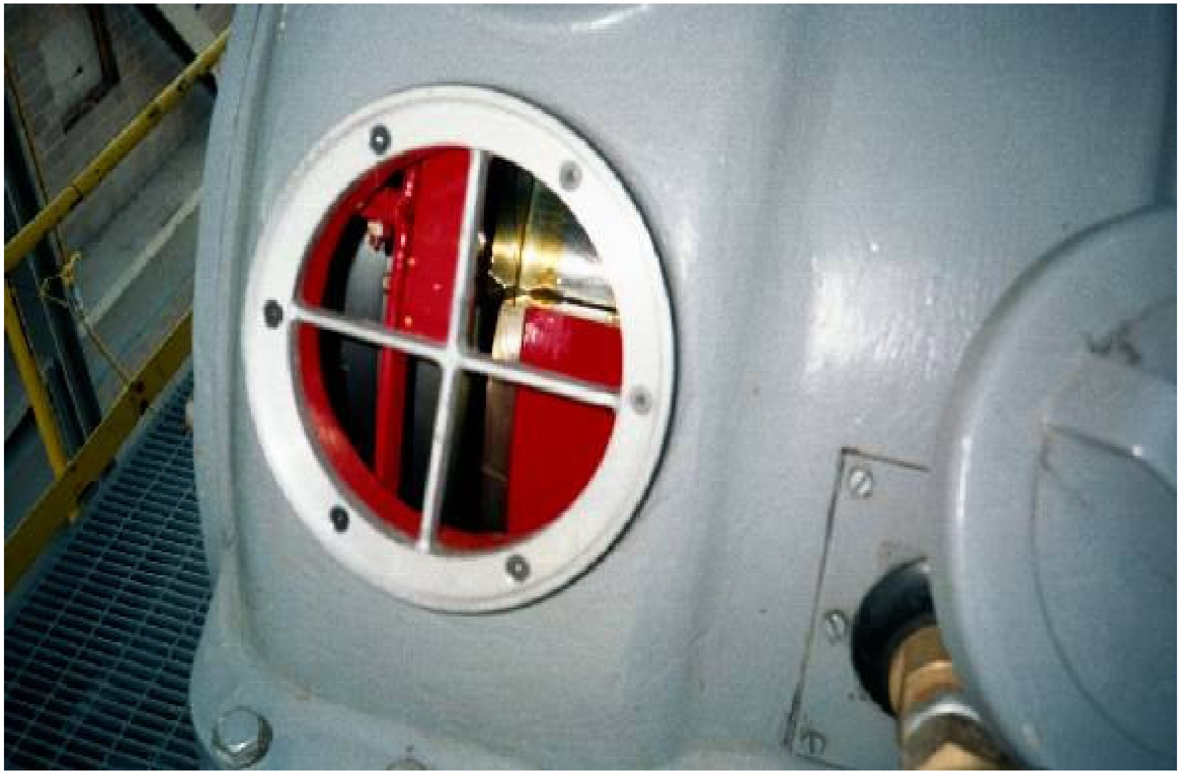
Fuller Bearing



The Fuller bearing takes the thrust load on a thrust washer which is bolted onto to the housing end cover.

FLS Bearing Type RA



The direction of roller thrust in an RA bearing is determined by observing the gap between thrust plate and bronze bearing liner. Contact in the uphill bearing and a gap in the lower bearing indicates that the roller is pushing the kiln uphill.

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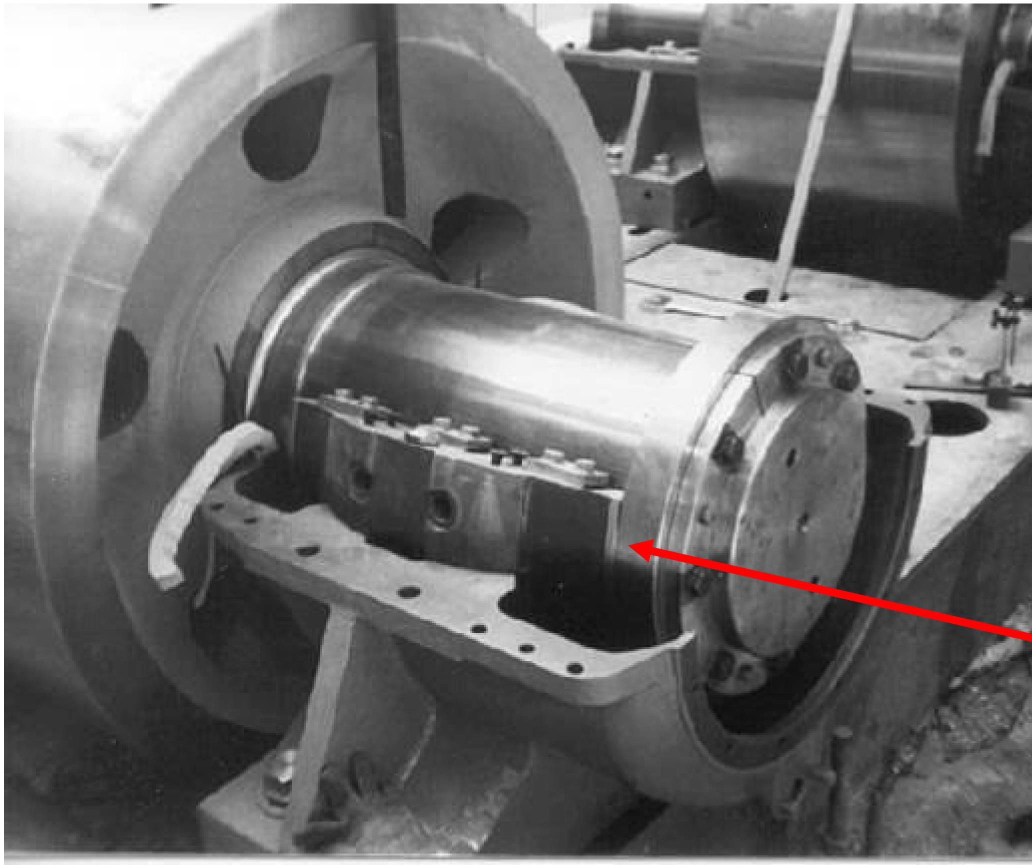
FLS Bearing Type RA



Contact

For FLS bearings type RA, there should always be _contact_ between thrust plate and bronze bearing liner on the _uphill_ bearing. This indicates that the roller is pushing the kiln uphill.

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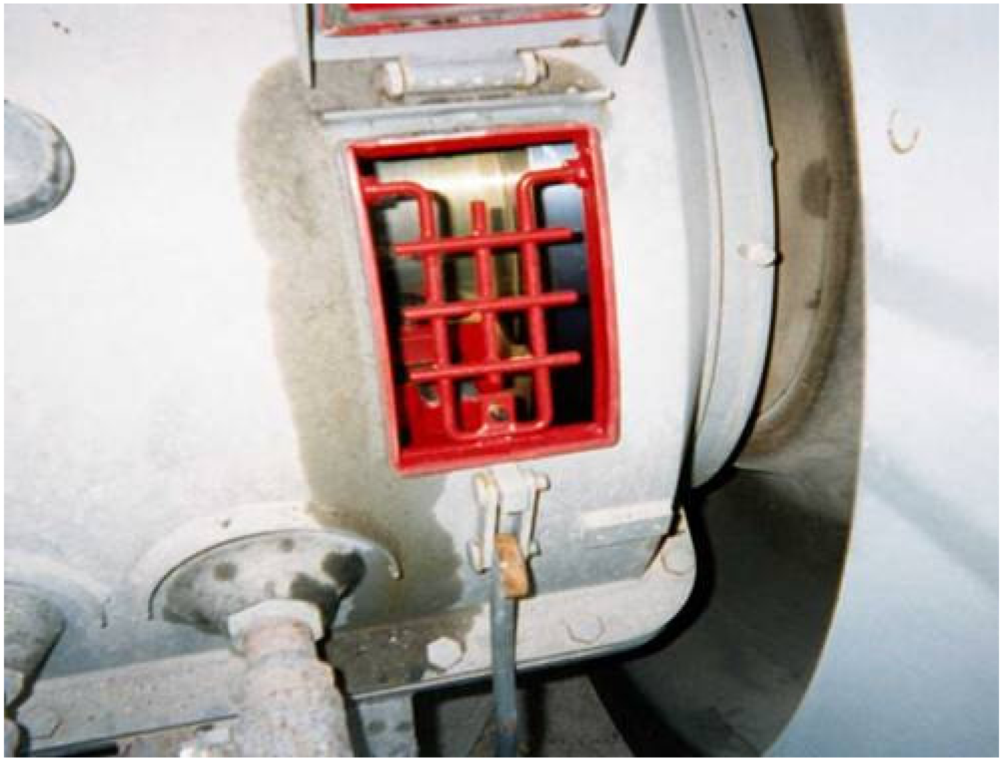
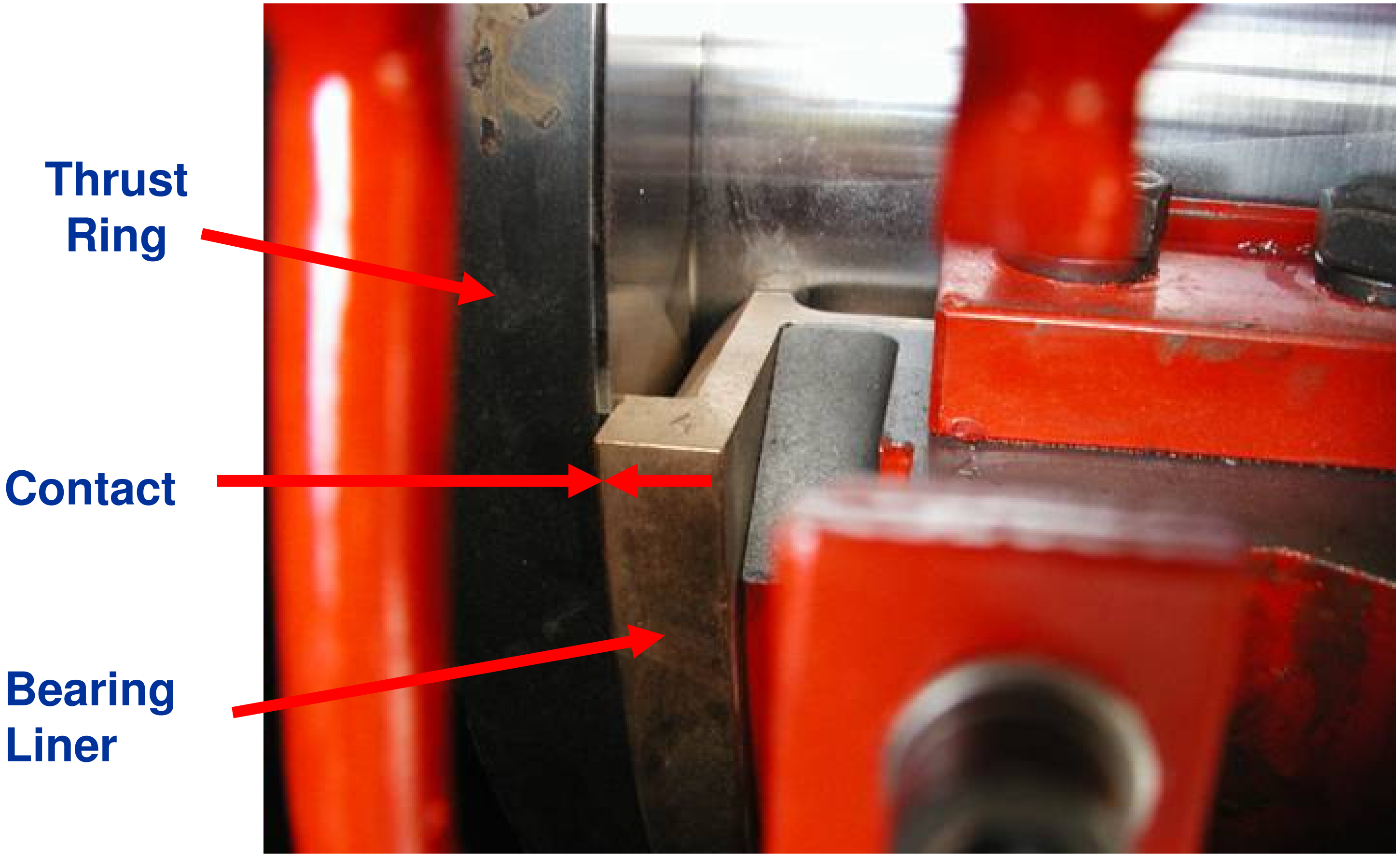
FLS Bearing Type RB



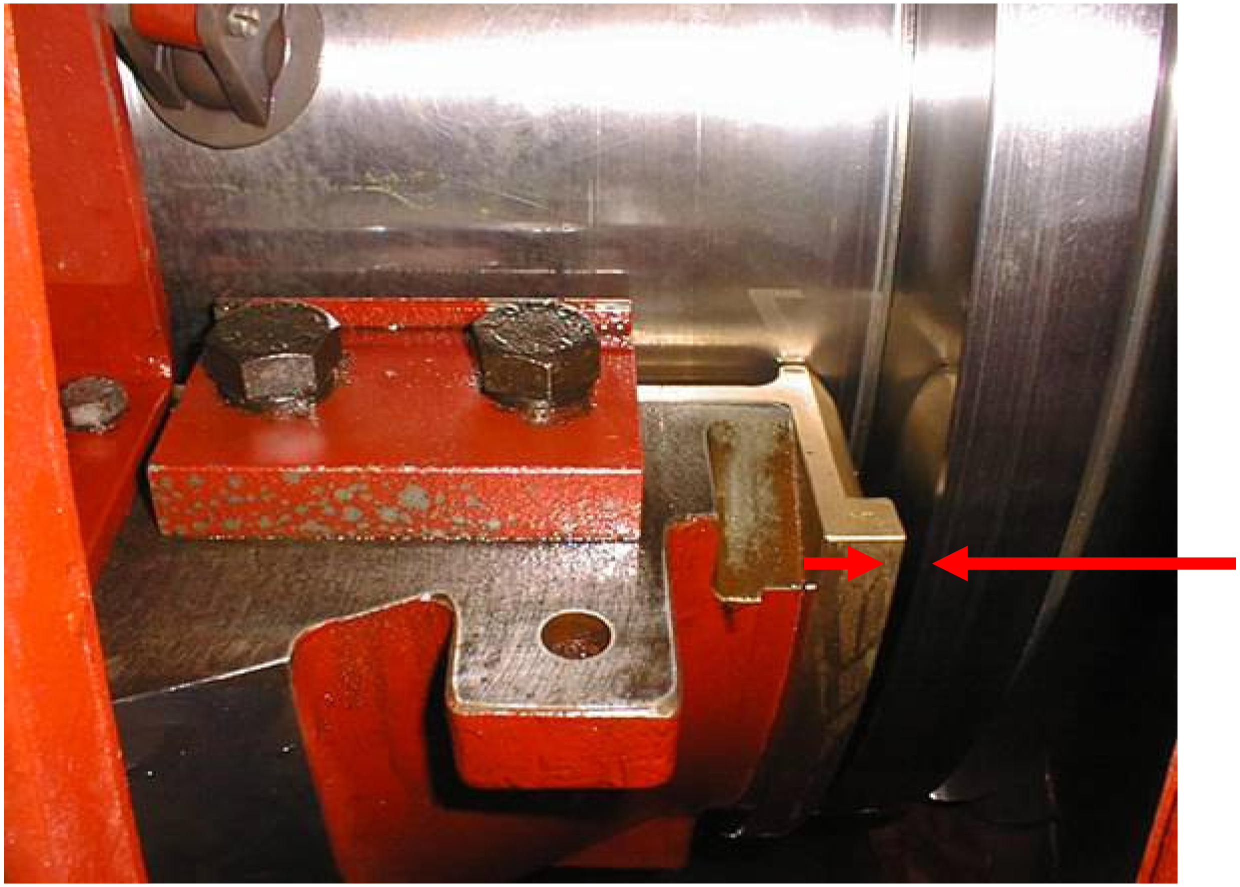
Direction of roller thrust in an RB bearing is determined by observing the gap/contact between thrust ring and bronze bearing liner.

FLS Bearing Type RB



For FLS bearings type RB, there should always be *contact* between thrust ring and bronze bearing liner on the *downhill* bearing. This indicates that the roller is pushing the kiln uphill.

FLS Bearing Type RB



Gap

For FLS bearings type RB, a *gap* should always be present on the *uphill* bearing. This indicates that the roller is pushing the kiln uphill.

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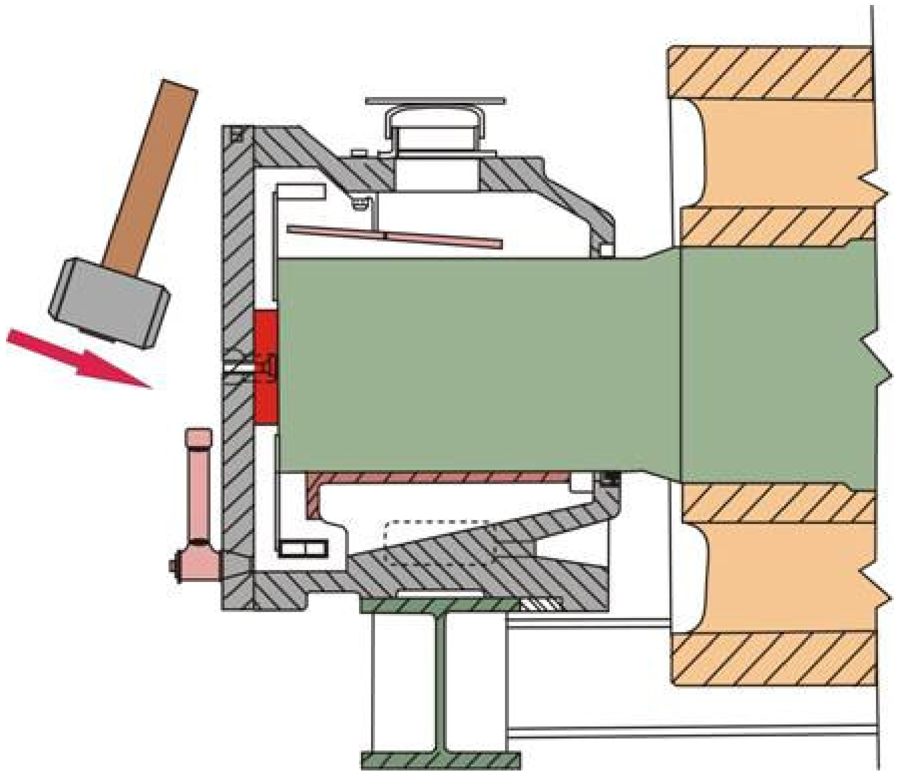
Fuller Bearing



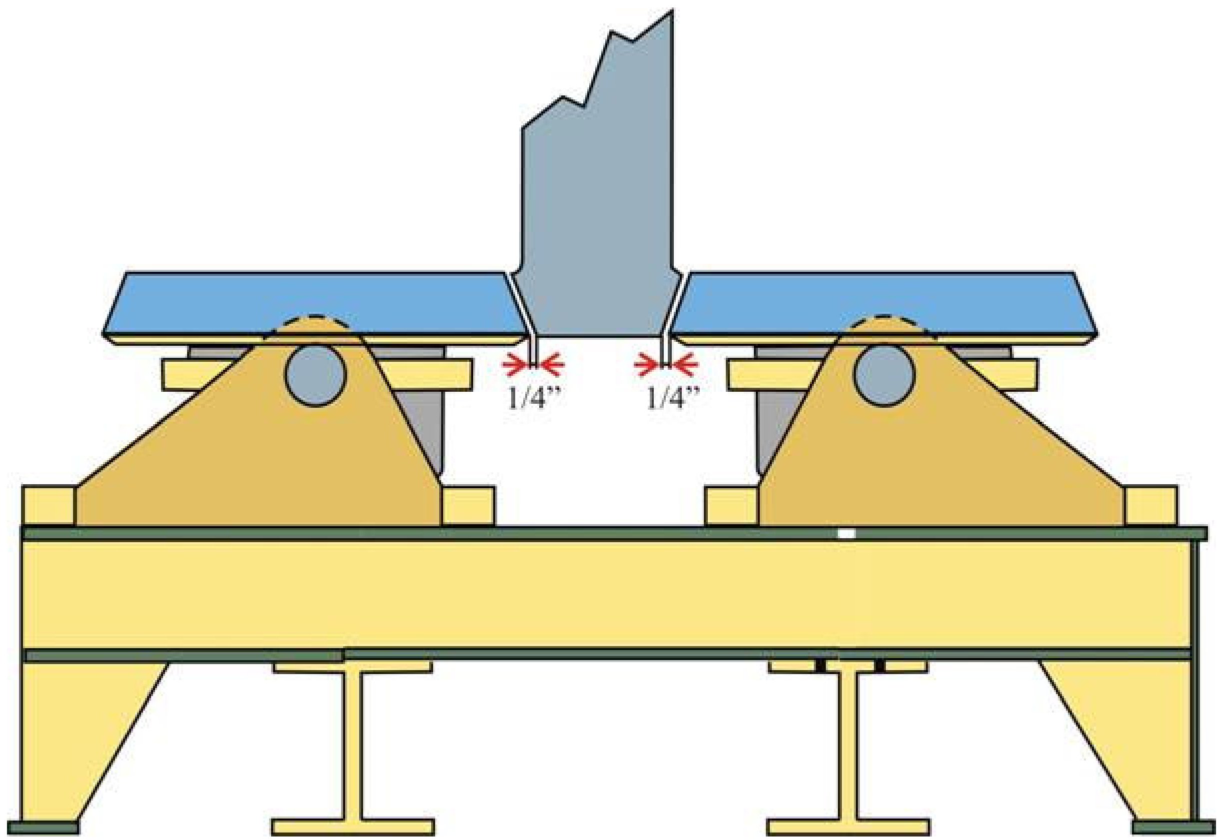
For Fuller bearings, thrust direction is checked by rapping the bearing end cover with a hammer. A solid sound indicates contact, a hollow sound indicates a gap.

Measuring Roller Thrust

Graphite Block

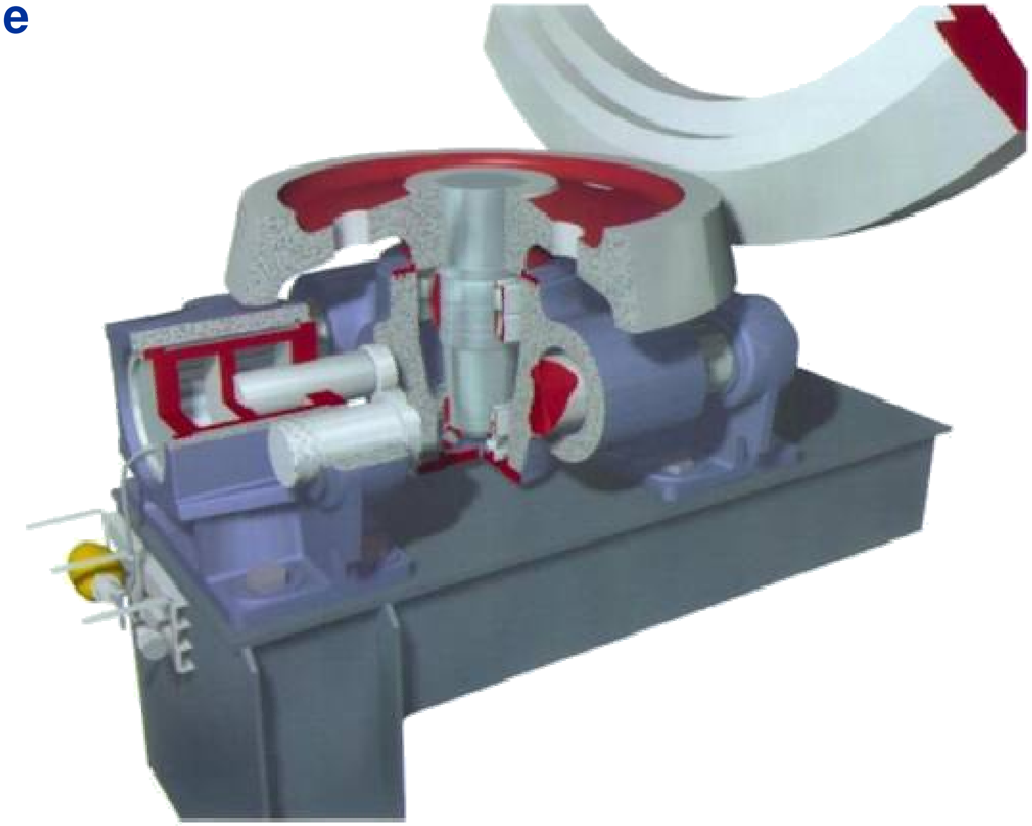
Important! Rollers and tire surfaces must be completely free of oil when skewing adjustments are made. Only graphite block lubrication is permitted.

Roller Adjustment



Rollers should be adjusted to "float" the kiln between the upper and lower thrust rollers.

Roller Adjustment



For kilns with hydraulic thrust rollers, support rollers are adjusted to keep the hydraulic pressure within specification.

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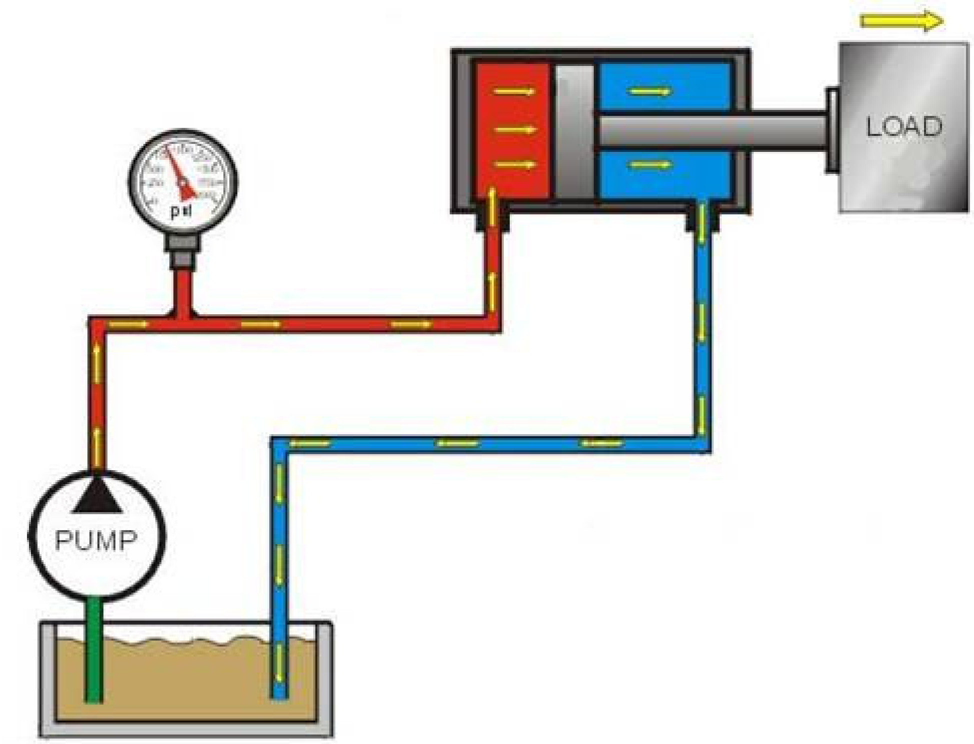
Hydraulic Pressure



Force = Pressure x Area

Area = (Piston Diameter)^2 x ✋
4

The force on the thrust roller can be calculated from the hydraulic pressure indicated on the gage.

Calculation of Hydraulic Pressure When All Rollers Are Neutral

- **Calculate the weight of the rotating parts of the kiln (shell, tires, gear, refractory, material load).**
- **Multiply by the % kiln slope to get the force on the thrust roller.**
- **Divide by the total piston area of all thrust rollers.**

Example:

- **1000 short ton kiln x 2,000 pounds/short ton = 2,000,000 pounds**
- **2,000,000 pounds x 3% slope = 60,000 pounds force on thrust roller**
- **Area of single 10" diameter piston =** $\frac{(10)^2 \times \pi}{4} = 78.5 \text{ inches}^2$

$$\text{Pressure} = \frac{60{,}000}{78.5} = 764 \text{ PSI}$$

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Roller Adjustment

Rollers are skewed by moving bearings in or out as required. Note that the adjusting screws shown are greased and wrapped to prevent corrosion.

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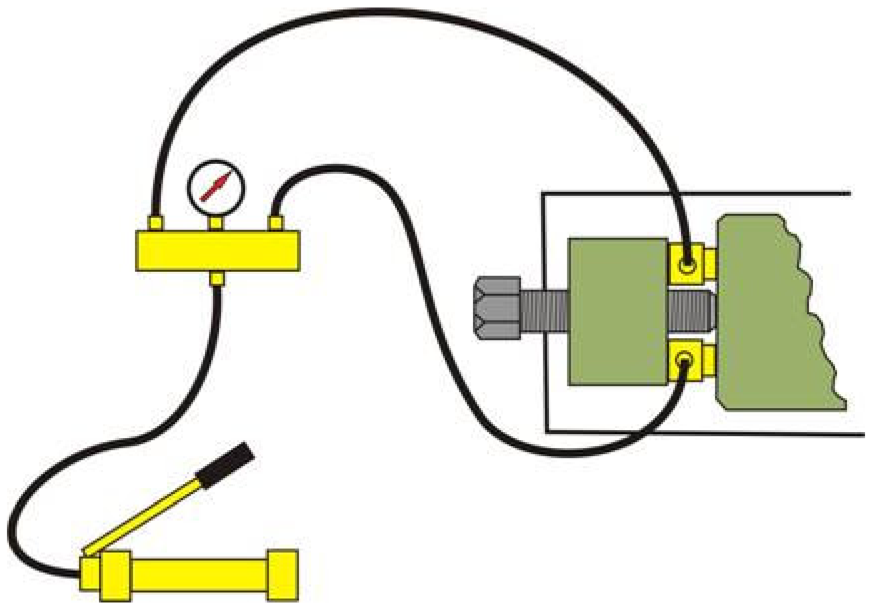
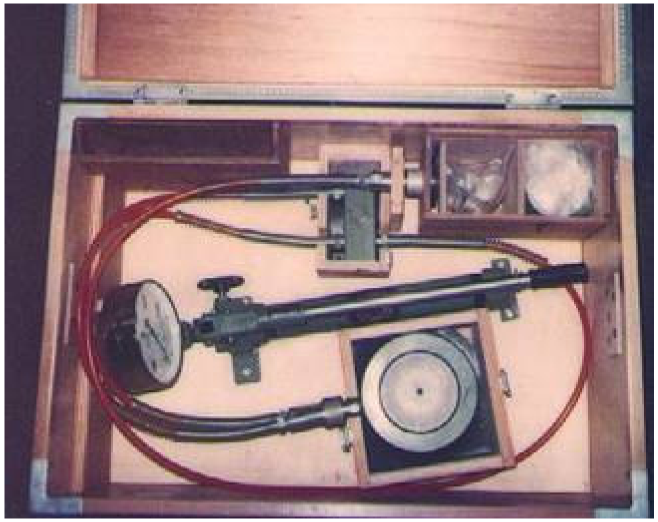
Jacks for Roller Adjustment





Pancake Jacks are available with forces over 100 tons to aid in pushing bearings in for roller adjustment.

Roller Adjustment

Moving a bearing out is easier.
A small jack may be needed.

Roller Adjustment

•Always measure and record every bearing adjustment. To keep from changing the kiln center, make equal and opposite movements on each bearing.

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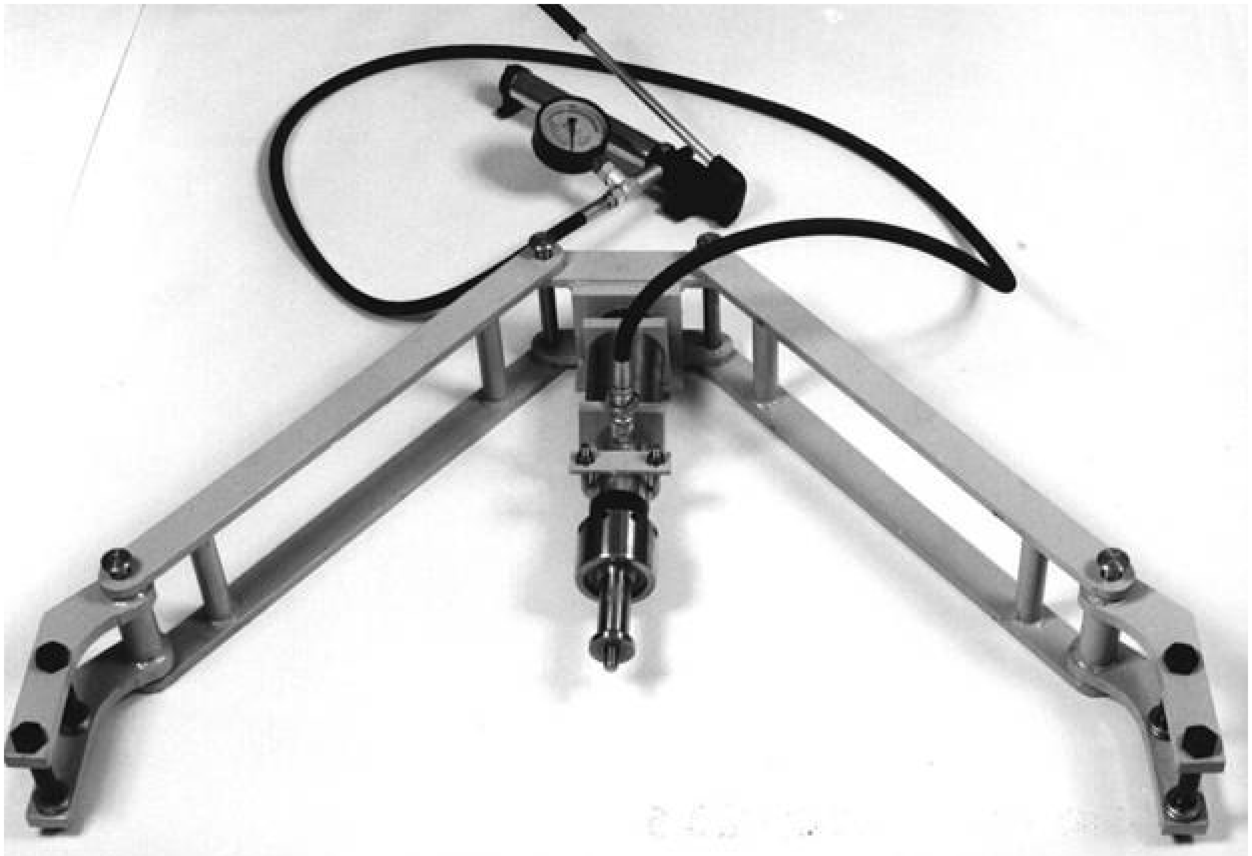
Measuring Roller Thrust



Measuring precise roller thrust is possible on FLS bearings using this “axial measuring device”.

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Measuring Roller Thrust

The axial measuring device consists of a hand jack with pressure gage, a mounting fixture, and an adapter with bearing to enable readings when the roller is turning.

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Measuring Roller Thrust

The jack is pumped up until the roller begins to move uphill off its thrust stop. At this point a pressure reading is taken and the reading is then converted to tons force.

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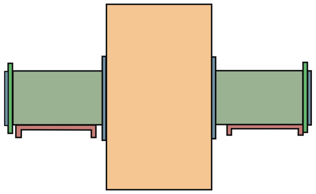
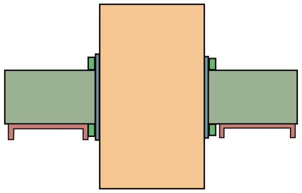


FLS

Type RA

Bearing d x t	Permissible axial pressure (tonnes-bar) max. - min.	Axial pressure to be adjusted (tonnes-bar) mean
120 x 180	0,3 - 0,1	0,2
	18 - 6	12
150 x 220	0,5 - 0,1	0,3
	30 - 6	18
180 x 260	0,6 - 0,1	0,35
	36 - 6	21
210 x 300	0,8 - 0,2	0,5
	48 - 12	30
240 x 350	1,1 - 0,2	0,65
	66 - 12	39
280 x 400	1,5 - 0,3	0,9
	90 - 18	54
320 x 460	2,0 - 0,4	1,2
	120 - 24	72
360 x 510	2,5 - 0,5	1,5
	150 - 30	90
400 x 570	3,0 - 0,6	1,8
	180 - 36	108
450 x 650	4,0 - 0,8	2,4
	240 - 48	144
500 x 720	5,0 - 1,0	3,0
	300 - 60	180
560 x 800	6,0 - 1,2	3,6
	360 - 72	216
630 x 900	7,5 - 1,5	4,5
	452 - 90	271
710 x 1000	8,0 - 2,0	5,0
	482 - 120	300
850 x 1150	8,0 - 2,0	5,0
	482 - 120	300

Bearing d x t	Permissible axial pressure (tonnes-bar) max. - min	Axial pressure to be adjusted (tonnes-bar) mean
240 x 290	1,0 - 0,2	0,6
	60 - 12	36
280 x 340	1,3 - 0,3	0,8
	78 - 18	48
320 x 390	1,7 - 0,3	1,0
	102 - 18	60
360 x 430	2,0 - 0,4	1,2
	120 - 24	72
400 x 480	2,5 - 0,5	1,5
	150 - 30	90
450 x 540	3,2 - 0,6	1,9
	192 - 36	114
500 x 600	4,0 - 0,8	2,4
	240 - 48	144
560 x 680	5,0 - 1,0	3,0
	300 - 60	180
630 x 760	6,4 - 1,3	3,8
	384 - 78	228
710 x 850	8,0 - 1,6	4,8
	482 - 96	288
790 x 950	8,0 - 1,6	4,8
	482 - 96	288
880 x 1060	8,0 - 1,6	4,8
	482 - 96	288
970 x 1160	8,0 - 1,6	4,8
	482 - 96	288
1060 x 1270	8,0 - 1,6	4,8
	482- 96	288
1150 x 1380	8,0 - 1,6	4,8
	482 - 96	288
1240 x 1490	8,0 - 1,6	4,8
	482 - 96	286
1340 x 1610	8,0 - 1,6	4,8



FLS

Type RB

Data assumes a jack piston with 16.6 cm^2 surface area.

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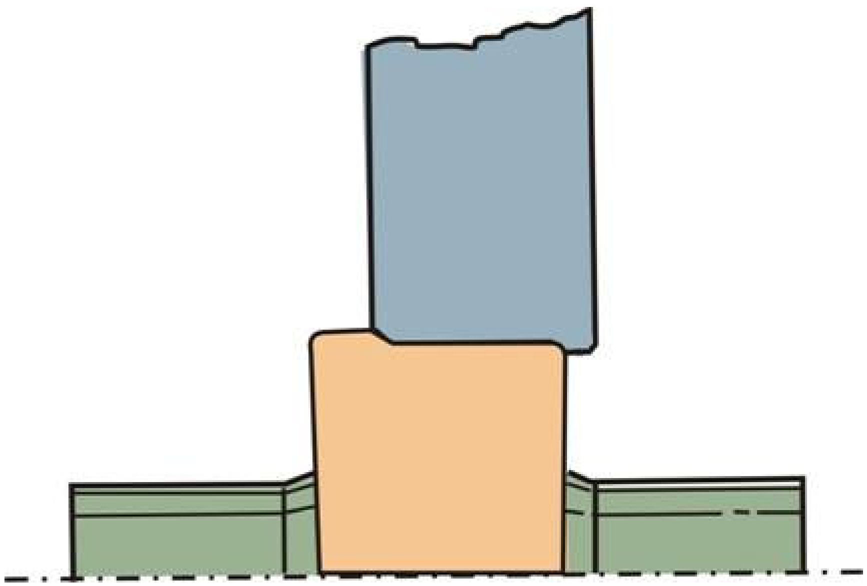
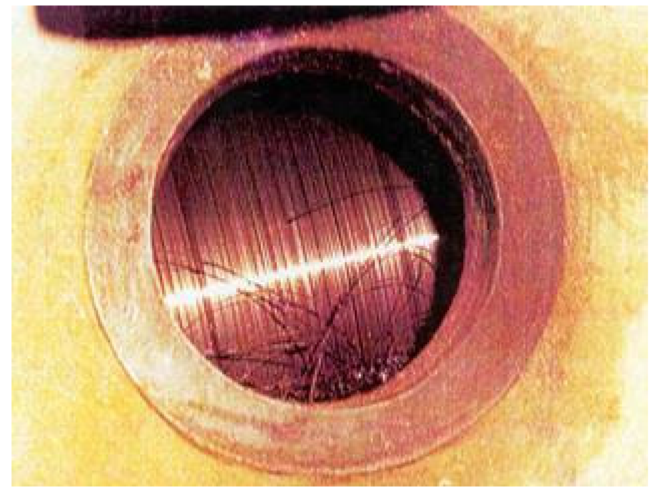
Measuring Roller Thrust



Step-worn Roller and Tire



Grooved Roller Shaft

Caution! It may not be possible to accurately measure roller thrust if tire and roller surfaces are not cylindrical or if roller shafts or bearings are grooved.

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Determining Roller Thrust Trial and Error Method

- Find the roller's neutral point (parallel to kiln axis) by adjusting the roller skew in small increments until the bearing thrust contact/gap changes from one bearing to the other.
- Once the neutral point is determined, make a small adjustment to push the kiln uphill.
- While making an adjustment of an individual roller, always observe the kiln's thrust rollers to ensure that they are not being overloaded.

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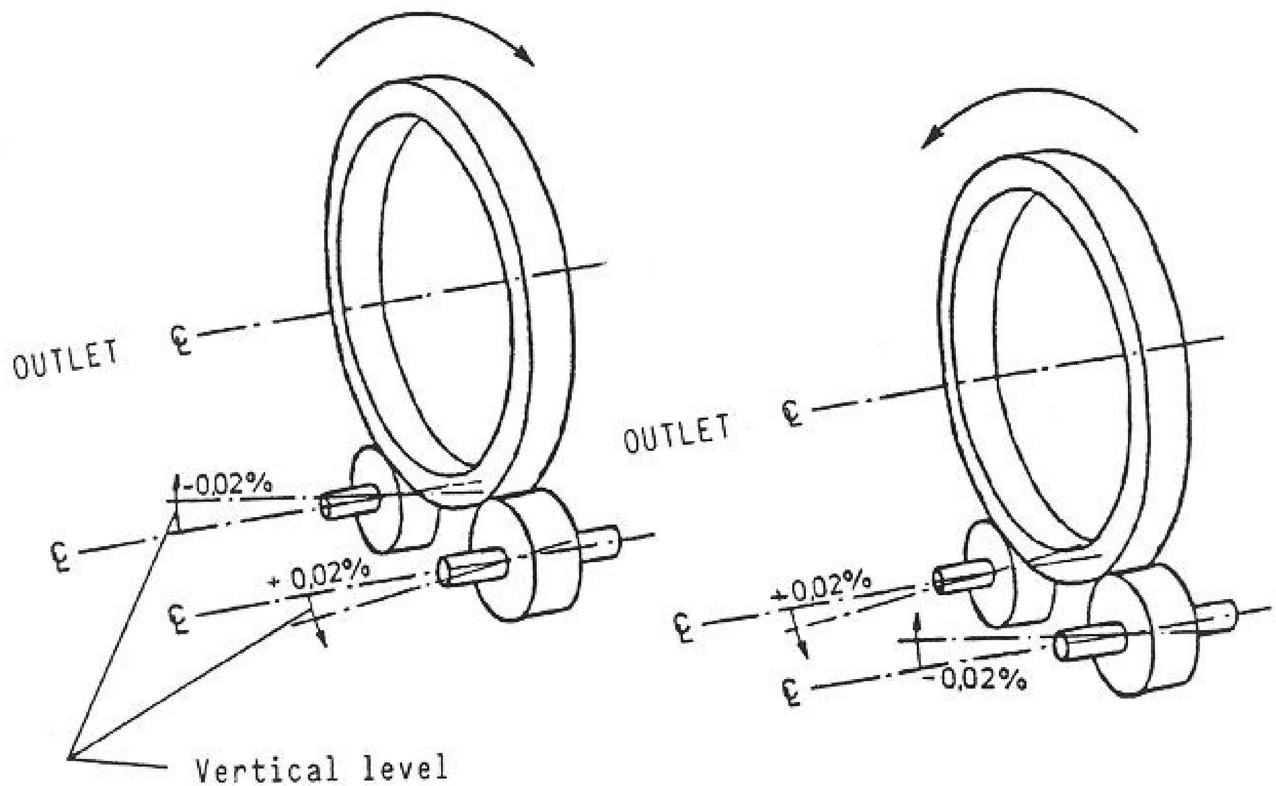
Roller Inclination

Roller Inclination



Just like horizontal skewing, vertical skewing of a roller, i.e., having a roller slope different than the kiln slope, will also create a thrust force.

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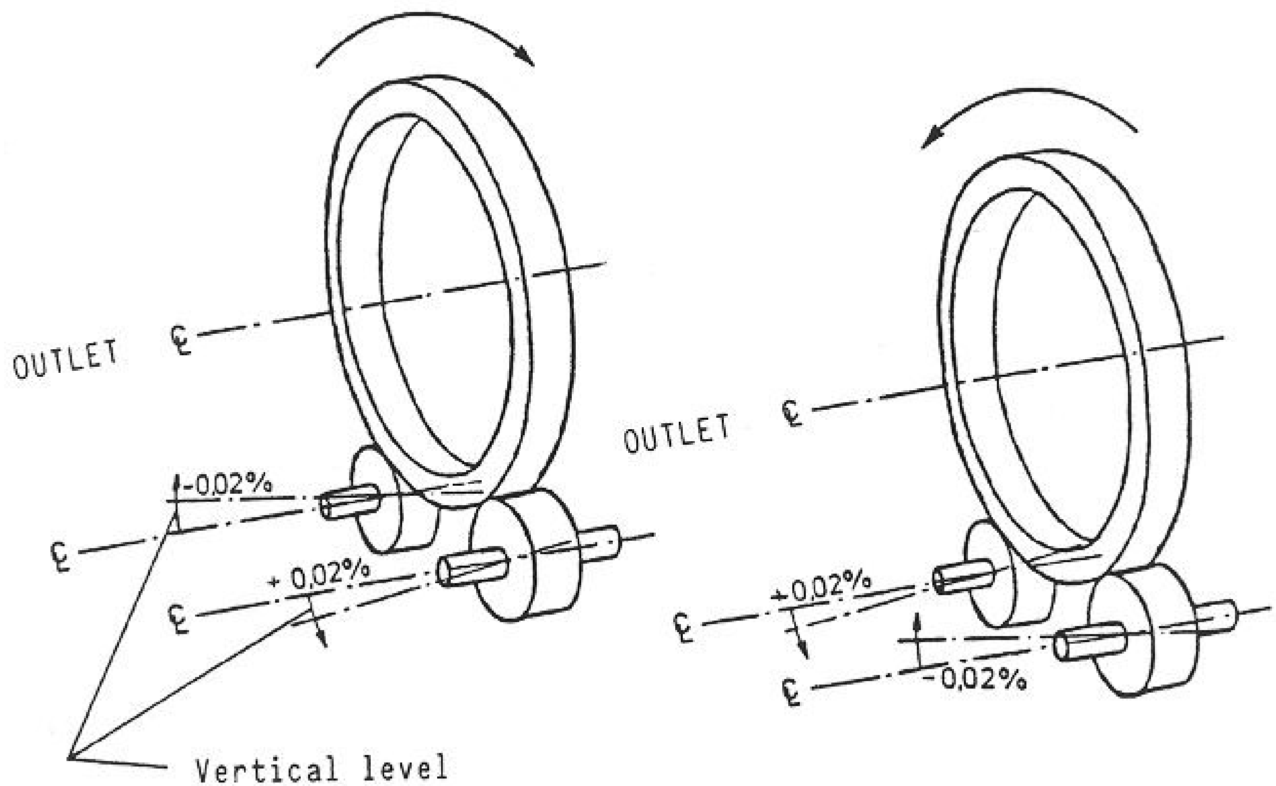
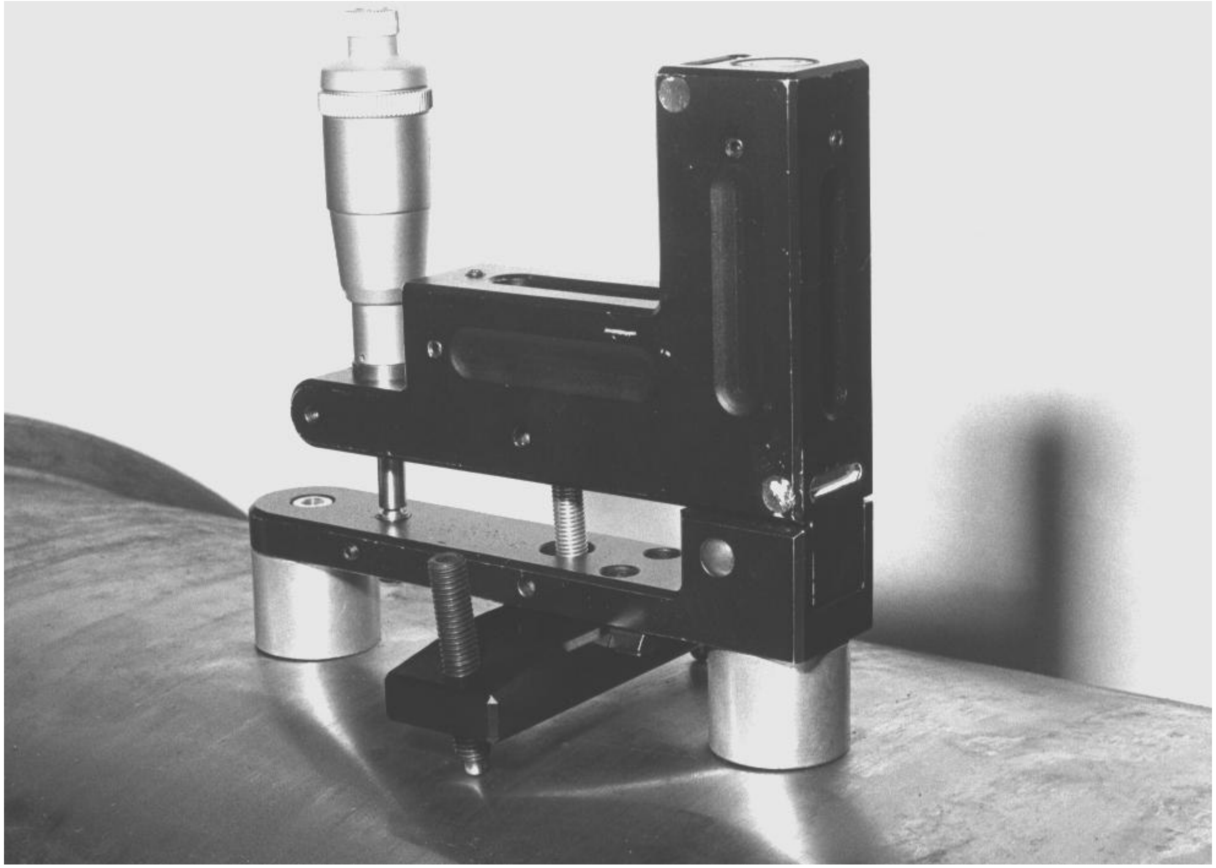
Roller Inclination



Roller slope must not deviate from the kiln slope by more than 0.02% (0.04% for old kilns). The direction of allowable deviation must be such that the roller pushes the kiln uphill.

Measuring Roller Slope



Roller slope is measured with an inclinometer.

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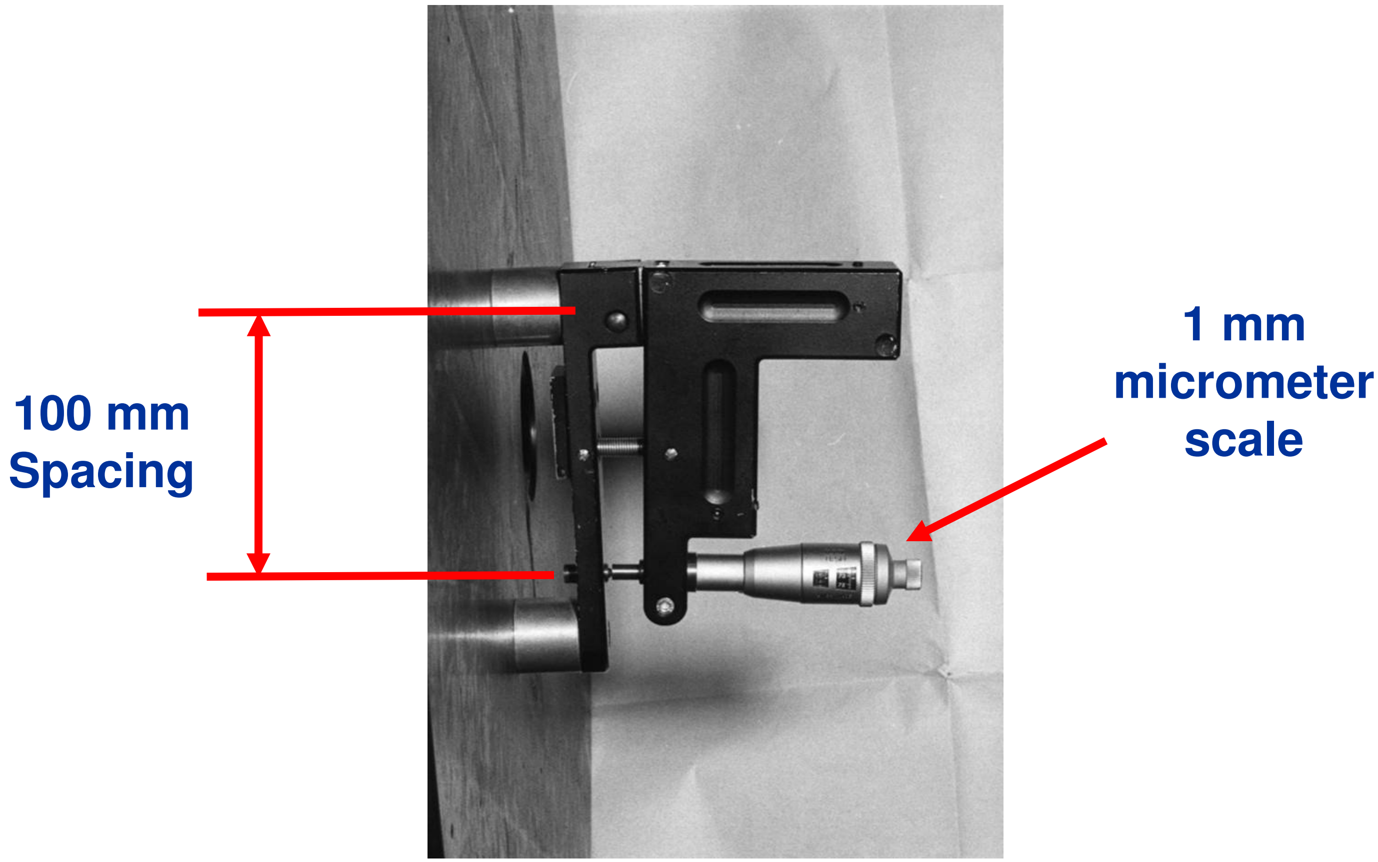
Inclinometer



Due to its dimensioning, the inclinometer reads the percent slope directly.

Inclinometer

When the leveling bubbles are centered, the percent slope is read on the micrometer dial.

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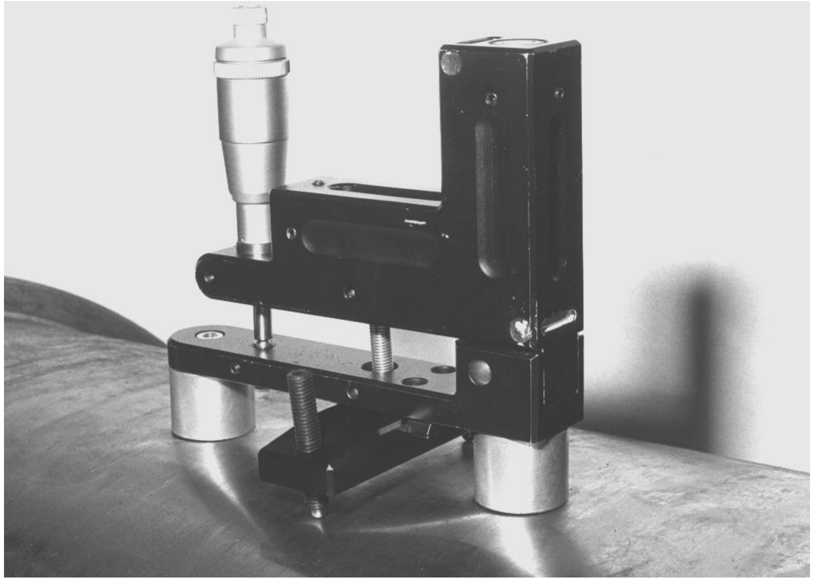
Inclinometer

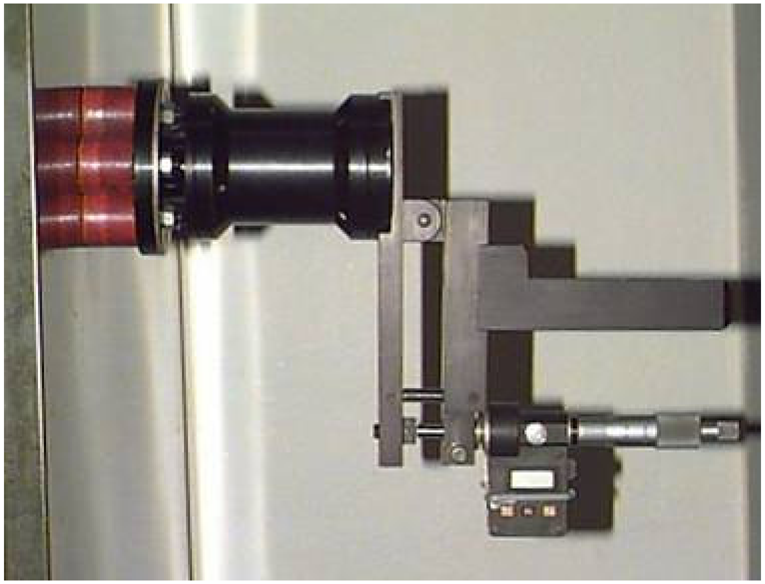


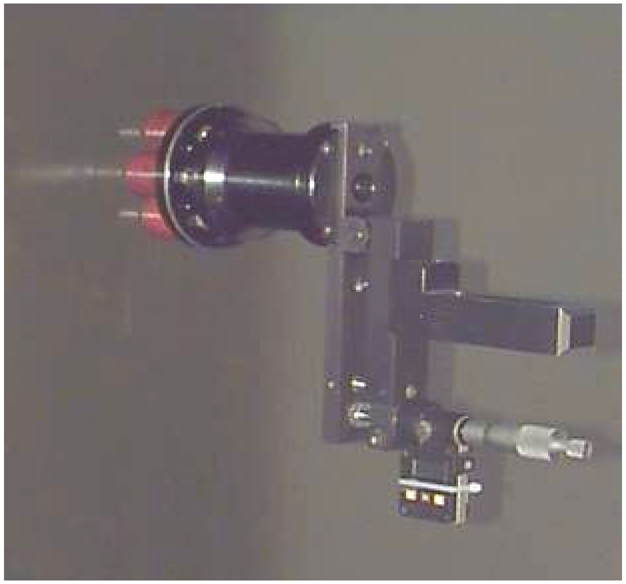
Magnets allow mounting the inclinometer on horizontal or vertical surfaces. The inclinometer has a precision bubble level for each position.

Inclinometer

Check the roller slope with the inclinometer mounted on the shaft end. Take readings on both ends of the shaft and average them to eliminate the effect of roller shaft deflection.

Inclinometer





This arrangement can be used to measure the roller slope while the kiln is turning.

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Inclinometer

Using an inclinometer on a precision straight edge across a kiln base to determine the correct slope.

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Roller and Tire Defects

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Tire and Roller Defects

If kiln rollers are skewed too much the wear rate can be quite severe.

Tire and Roller Defects

Excessive hertz pressures on under-designed or poorly cast tires and rollers can result in severe pitting.

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Tire and Roller Defects

The old practice of running a roller in a water bath is now thought to promote surface pitting and is no longer recommended.

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Tire and Roller Defects

When rollers are misaligned or conical-shaped, the kiln load is spread over too small an area. This causes high surface stresses resulting in pitting.

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Tire and Roller Defects

A defect on a roller may transfer to the tire, and vice-versa.

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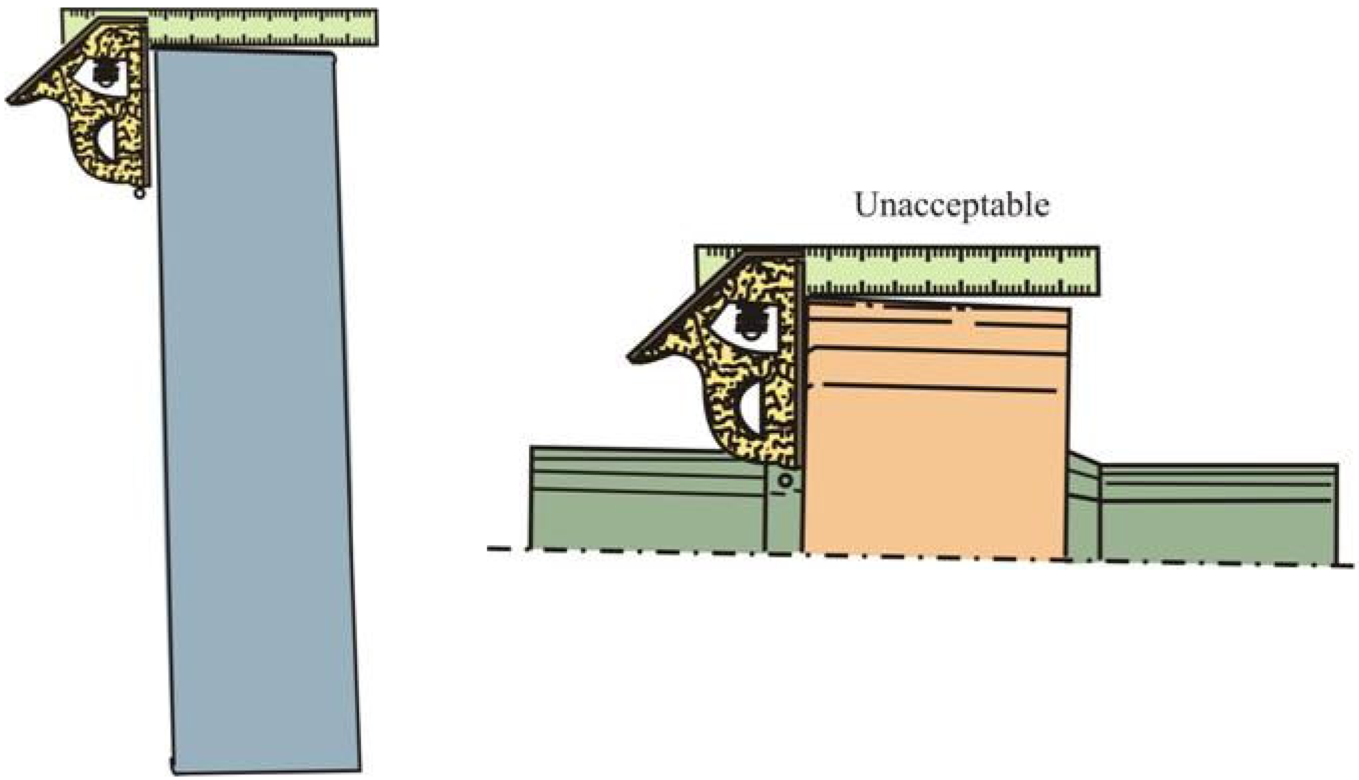
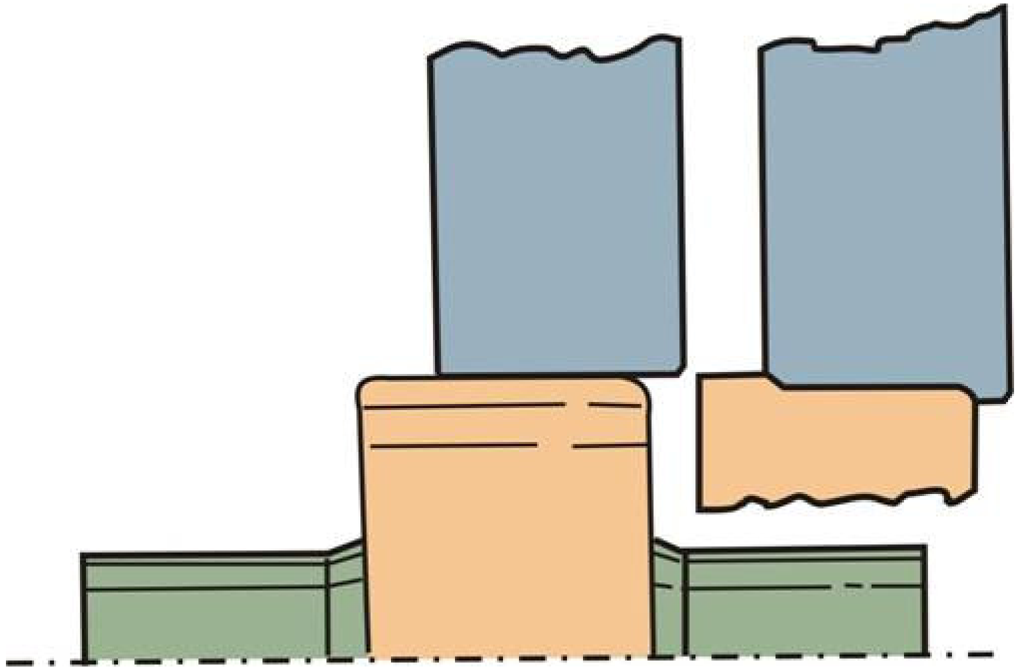
Tire and Roller Defects



Roller or tires may wear to a conical shape.

Tire and Roller Defects



A tire running off the roller for a long time will wear into a step pattern.

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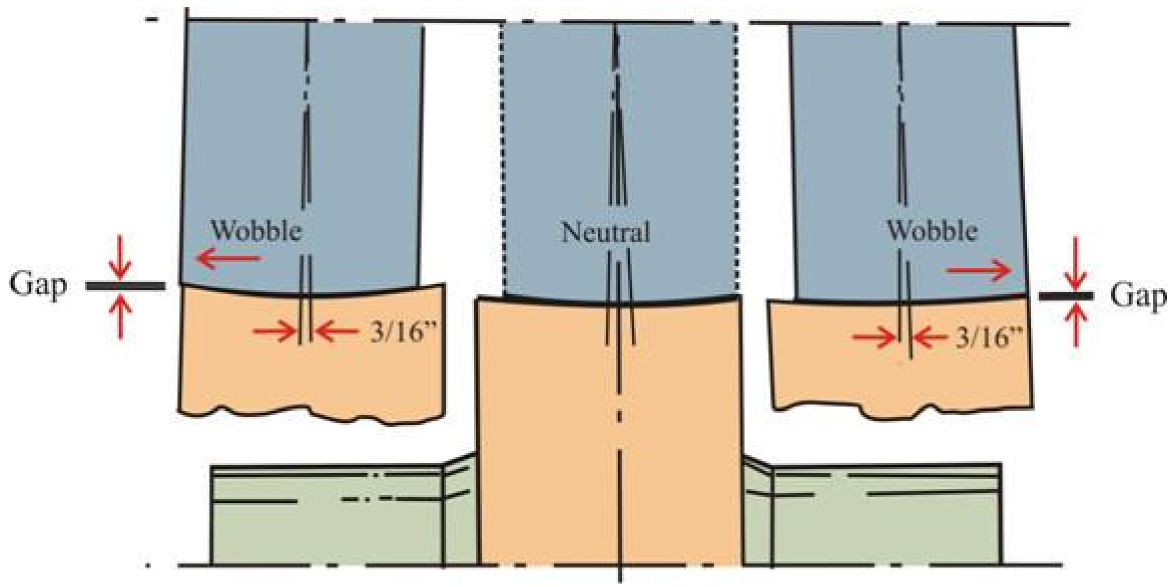
Tire and Roller Defects



Tire wobble can create a concave roller surface.

Roller and Tire Re-conditioning

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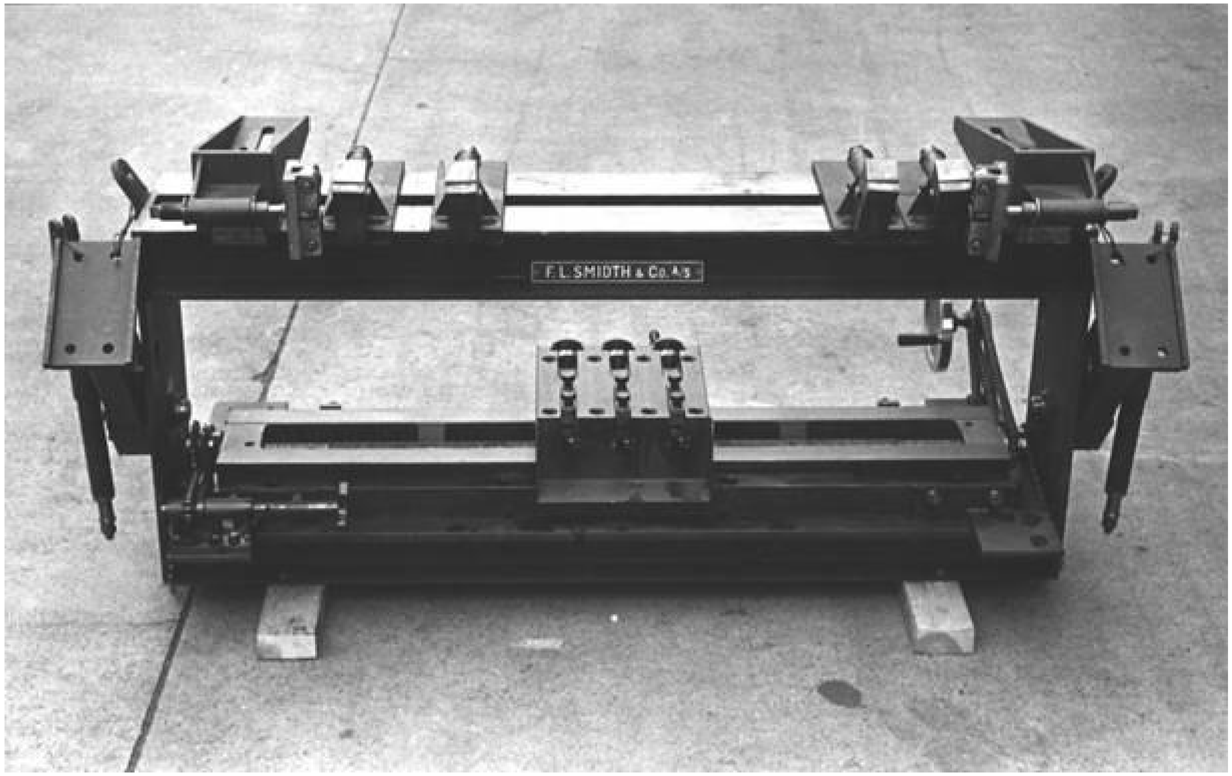
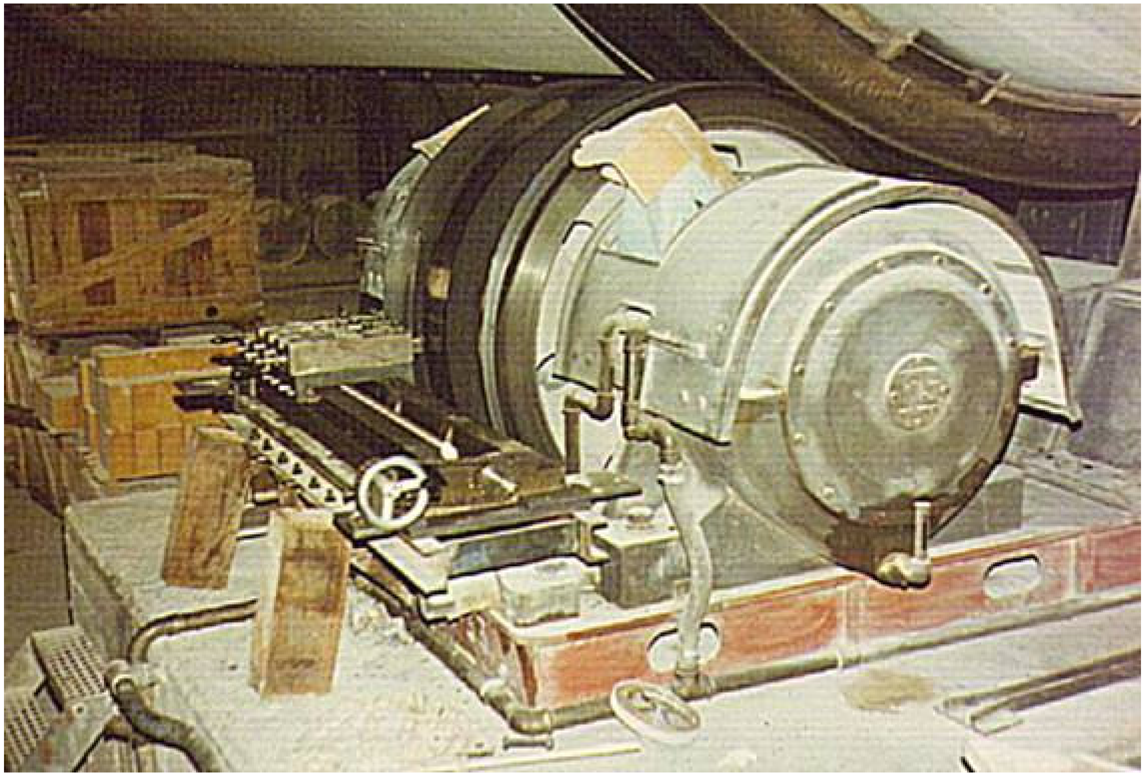
Roller and Tire Re-conditioning



Rollers and tires may be re-conditioned by machining or grinding. Shown above is a lathe adapted for this purpose.

Roller and Tire Re-conditioning



Rollers are re-conditioned while the kiln is in operation.

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Roller and Tire Re-conditioning

Machining a kiln tire while the kiln is in operation.

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Roller and Tire Re-conditioning

The machinist is protected with a heat shield.

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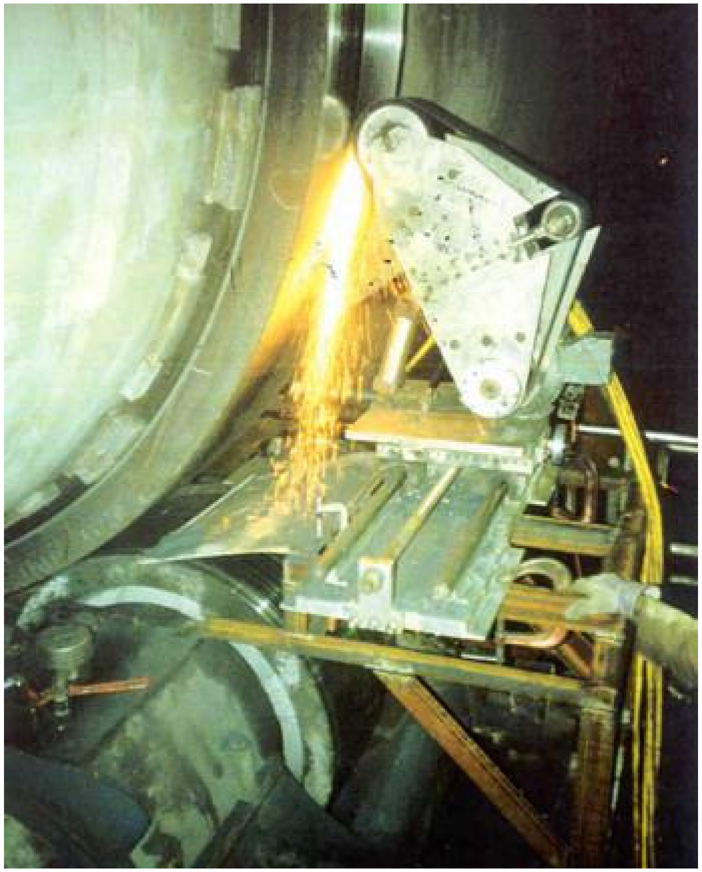
Roller and Tire Re-conditioning

This roller is being resurfaced by grinding rather than machining.

Roller and Tire Re-conditioning



Re-surfacing a tire by grinding

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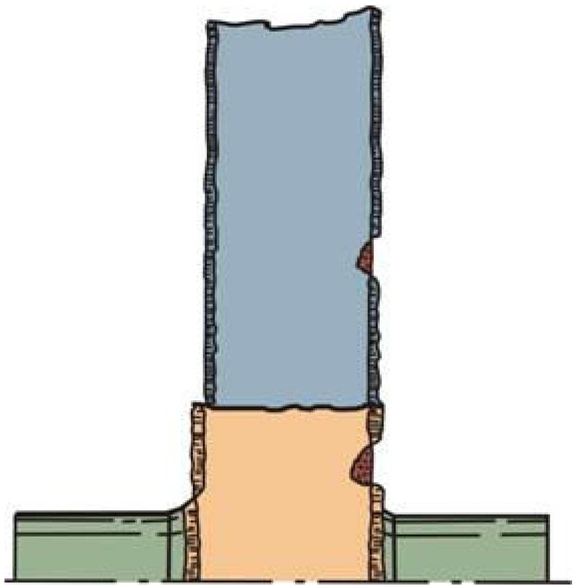
Roller and Tire Re-conditioning



Tire and roller edge defects must also be removed. Edges should then be chamfered.