



FULLER®

KILN LIFECYCLE SOLUTIONS

Spare Parts, Retrofits, Services

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Did you know that...

Since 1897, Fuller Technologies has supplied more than 2000 rotary kilns worldwide?

1. KILN TYPES

1.1 History

The kiln is the heart of the plant – what an entire cement plant is dimensioned around, and where most of the final chemical reactions take place. So, it's not surprising that a producer requires an ideal kiln solution. Since 1882 Fuller Technologies, formerly FLSmidth Cement, has supplied parts, single machinery, services and complete plants for the cement industry around the world. Fuller is a brand well known for high quality and reliability.

The first rotary kiln was supplied in 1897. Up to now development has taken place on a constant full scale and we are consequently capable of supplying state of the art equipment and spare parts to cover the entire cement plant. Today our ROTAX -2 (2-base) and 3-base kilns reflect our commitment to constantly expanding the limits of the pyro-technology. They are proven performers and they bring reliability and cost-effectiveness to the ambitious cement plant. Fuller ROTAX-2® and 3-base kilns deliver the best in rotary kiln designs. With the ideal temperature profile and material retention time, these rotary kilns play a key role in ensuring optimal clinker quality. Their maximum operating reliability and minimum operating costs help our customers stay competitive as well.

1.2 UNAX™ kiln

(Dry or wet process)

The UNAX kiln has taken its trademark name from the UNAX cooler – also known as a satellite cooler. Despite its old age, UNAX kilns still play an important role in cement production in some plants around the world.

UNAX kilns are usually relative long – up to more than 200 meters, and usually relative slow running – between less than 1 rpm up to about 3 rpm. Compared to modern kiln systems the UNAX kiln is considered to be uneconomically and is therefore not build anymore. Many UNAX kilns have been retrofitted with grate coolers.

1.3 ROTAX-2™

(Dry process)

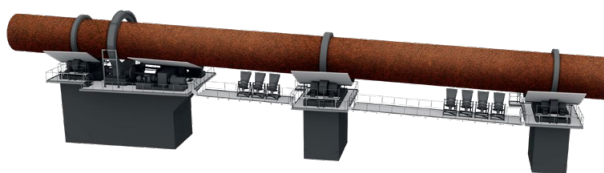


The trademark for Fuller's two base kiln is ROTAX-2. The ROTAX-2 kiln has two supports and is rotated by a friction drive transmitting the required torque through the supporting rollers and the live ring.

Amongst other things all ROTAX2 kilns are designed with tangential suspension which supports and increases the stiffness of the kiln shell to ensure low kiln shell ovality during operation. The tangential suspension for the ROTAX-2 kiln is different from the traditional live ring attachment system with supporting blocks which is standard on 3 base kilns.

1.4 3-Base kilns

(Dry or wet process)



Three Base kiln is the common denominator for kilns with 3 or more supports. The 3-base kiln is supplied with a conventional live ring attachment system with supporting blocks.

The torque required to rotate the kiln is transmitted through a girth gear drive. The normal rotation speed is between 3 and 5 rpm. The typical number of supports is 3, but can be more.

2. KILN SHELL SECTIONS

Kiln Shells

The kiln shell is of all welded design and made of high quality structural and boiler steel plates with varying thickness according to the length of the shell in order to achieve the optimum combination of stiffness and flexibility.

The kiln shell is supplied in sections, their length depending the transport and erection limitations.

All kiln sections are supplied with stiffening bracings (spiders) in order to preserve the circularity during transportation and to avoid deformations. Each shell sections are supplied with pre-chamfering on both sides for site welding. The experience indicates that a shell replacement is recommended if the shell thickness is down by 20-25% of the original thickness.



2.1 Outlet section

At the outlet end of the kiln the shell terminates in a cylindrical section of heavier, superior quality, normalized steel plate.

2.2 Transition section

The transition sections are kiln shell sections situated on each side of the heavy section, forming the connection between the standard kiln shells and the heavy sections. The transition sections are made of high quality boiler steel plate or structural steel plate.

2.3 Standard section

The standard sections are kiln shell sections situated between the transition sections and covers major of the kiln shell

2.4 Inlet section

Kiln inlet sections are conical in shape and made of high quality structural steel and have a flange for mounting inlet heat resistant, chrome nickel cast steel sectors and stainless-steel shovels.

2.5 Heavy section

The heavy shell sections are located directly above the kiln supports – each carrying a live ring. The heavy sections are made of superior quality pressure vessel

plate suitable for elevated temperatures. The heavy kiln shells are manufactured to the highest quality and accuracy standards – due to the strict measurements and tolerance requirements. This ensures a piece of equipment which is easily erected and fitted to the existing kiln – saving erection time.

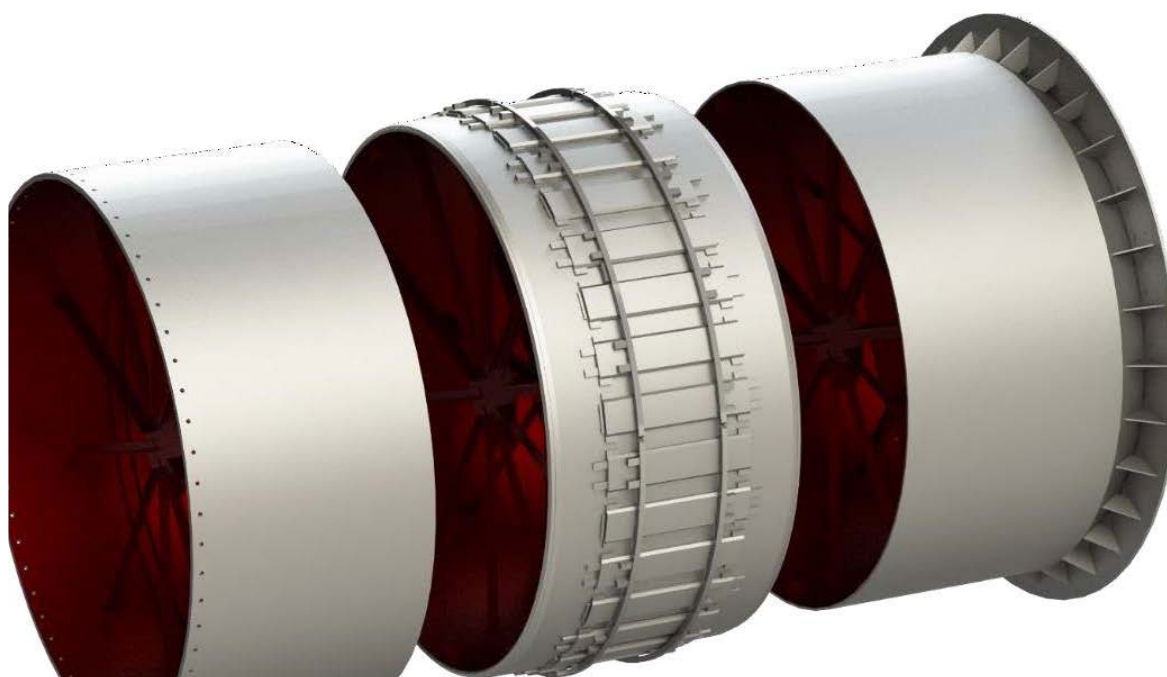
Heavy kiln sections are normally supplied with a live ring attachment system (supporting blocks). This system is either of bolted or welded construction. Both the systems are adjusted by shimming which ensures the correct live ring migration.

Heavy kiln shells with supporting blocks are always machined on the outside to secure circularity and the required dimensions.

2.6 Manufacturing quality standards

All grades are supplied from audited and approved suppliers with batch certificate 2.2 and 3.1 according to EN. The final grade selected depends on the application and the requirements on mechanical properties, creep resistance and corrosion resistance at elevated temperatures.

Each section is supplied from a Fuller Technologies approved foundry or workshop. All kiln shell deliveries are inspected by our QC inspectors to comply with our quality assurance standards.



3. LIVE RINGS

Our live rings – cast or forged – are always manufactured by foundries or workshops exclusively selected and certified by Fuller Technologies and are consequently in accordance with our Q&C division's high-quality standards and guidelines.

The quality of the live ring are closely monitored and examined throughout the manufacturing process in regards to the following:

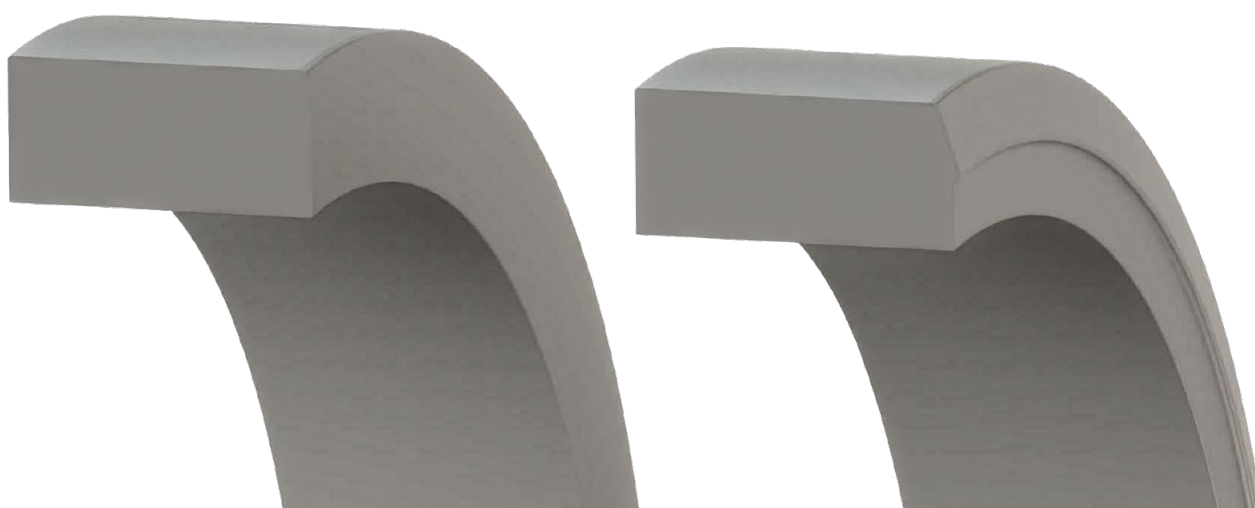
- **Material composition – ensuring correct additive and alloy content.**
- **Heat treatment**
- **Normalizing – Tempering - Stress relieving**
- **Machining**
- **Inspections**

All of the above mentioned factors are critical in the manufacturing process in order to secure a high

quality product which will grant the reliability of the absolute longest lifetime possible – this is additionally insured by frequent inspections executed by our team of very skillful & experienced inspectors throughout the entire manufacturing period.

It goes without saying that the inspection includes all necessary mechanical as well as ultrasonic tests. In addition, we carry out a proposal according to customers' requirements and add amongst others – a thorough calculation of the optimal dimensions of the live ring according to the present situation.

All physical parameters are taken into account and based upon these information –calculations optimizes the dimensions of the live ring according to today's optimum – ensuring that our customer's investments are valuable and future secured.



3.1 Live Ring suspension

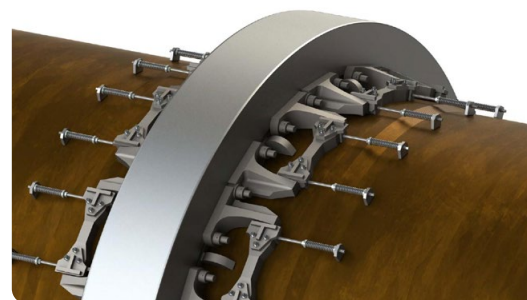
3.2 Tangential suspension

The tangential suspension system – when the kiln shell is fixed to the kiln tyre all the way around – is the standard solution for ROTAX-2 kilns and can be retrofitted to 3-base kilns. Its main function is to distribute the supporting forces along the entire circumference of the kiln.

This results in low ovality of the kiln – less than 0.2 % – and significantly longer refractory lifetime.

Because the kiln is suspended concentrically inside the tangentially suspended tyres, the kiln shell can expand freely, always leaving a gap between the kiln tyre and the kiln. The gap allows for fast heating of the kiln after standstills and it eliminates the risk of shell constriction and the need for tyre migration monitoring systems.

It ensures reliable transmission of drive power under any operating conditions. All parts of the tangential suspension are fully suspension, simplifying both inspection and maintenance.

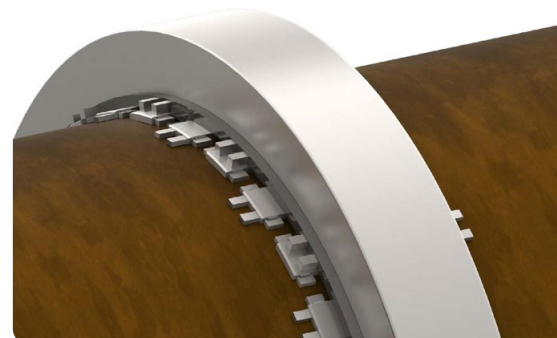


3.3 Welded supporting blocks

Welded supporting blocks is the standard support solution for 3 base kilns. The design of the welded supporting blocks includes loose – easy adjustable – supporting blocks kept in place by stop blocks welded to the kiln shell. The design allows for easiest shimming to compensate for wear and loose fitting. The loose fitting prevents possible crack formation due to thermal or mechanical stresses.

The live ring is kept in position by two wear rings held in place by a number of guide blocks welded onto the supporting blocks. The wear rings are prevented from rotating by a number of stop plates welded onto the sides of the rings – resting against the sides of the supporting blocks. When installed according to Instructions – cracks in the Kiln shell will not appear.

The supporting blocks are also available in a bolted version – largely similar to the welded supporting blocks – but it requires through-going holes in the kiln shell. This system is gradually being replaced by the welded solution because of the disadvantage of the bolted system i.e. that the brick lining has to be removed before the bolts can be accessed, which makes maintenance and replacement of the bolts difficult.



4. GIRTH GEARS

The girth gear drive consists mainly of the girth gear, the gear springs and the countershaft with the integrated pinion. The simple function of the girth gear drive is to link the drive station to the kiln shell by which the kiln shell can rotate depending on the load requirements.

4.1 Gear

The gear is connected to the kiln shell by a tangential spring mount.

The teeth have a precision-machined helical design meaning that the teeth are cut in a specific angle to improve the mechanical movement and to increase lifetime. However, Spur gear is also an option.

During rotation, lubrication provides the girth gear rim to work efficiently and to increase lifetime. The girth gear rim can be supplied in cast steel or ductile iron.



5. GIRTH GEAR SPARE PARTS

5.1 Pinion

The pinion is fixed accurately to mesh with the girth gear rim and the membrane coupling. This position is possible due to the fabricated base plate construction and the casted bearing housings, which the shaft is running in. The pinion's function is to transmit speed and torque received from the membrane coupling to the girth gear rim. The pinion is designed with precision-machined teeth and ground in a countershaft of special steel. The countershafts' ends are identical permitting the countershaft to be reversed utilizing the other tooth flank of the pinion. The countershaft runs in two heavy spherical roller bearings in bearing housings. The pinion can be supplied with build-in self-alignment feature as option.



Self-aligning pinion

The use of a self-aligning pinion ensures that an optimum contact pattern is achieved over the entire width of the tooth gearing. The self-aligning pinion compensates for any thermal distortion of the kiln shell and wobbling of the girth gear. In comparison to the rigid drive mechanism, the surface pressure of the girth gear and pinion are about 20% smaller due to the improved tooth contact.



5.2 Gear rim springs

The gear rim springs are suspended by bolt or pins to the gear rim and welded on the kiln shell. Given this construction, the kiln shell can expand and contract without distorting the kiln shell or the girth gear rim.

There are two different shapes of gear rim springs, which are referred as type I and V. The gear rim springs may be delivered with adjustable bolts, bushings, washers, hexagon nuts, spring flanges and lubrication nipples.



Type V



Type I

6. KILN DRIVES

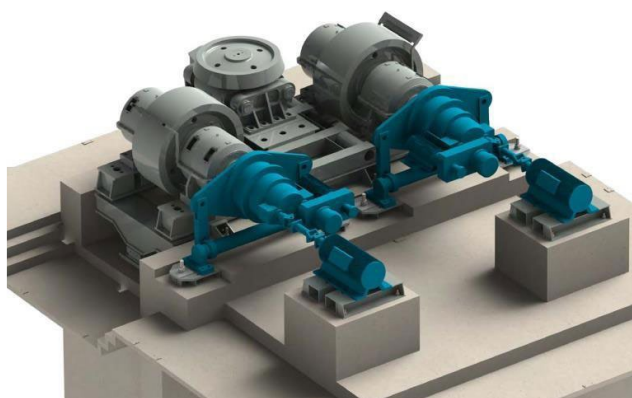
6.1 Main drives

While the ROTAX-2 and 3-base kilns share a number of proven components, the drive station is very different for the two kilns. In the ROTAX-2 kiln, an electromechanical direct drive on the support rollers replaces the electro-mechanical gear rim pinion drive used on the traditional 3-base kiln. The friction between the roller and the kiln tyre is sufficient to ensure the rotation of the kiln.

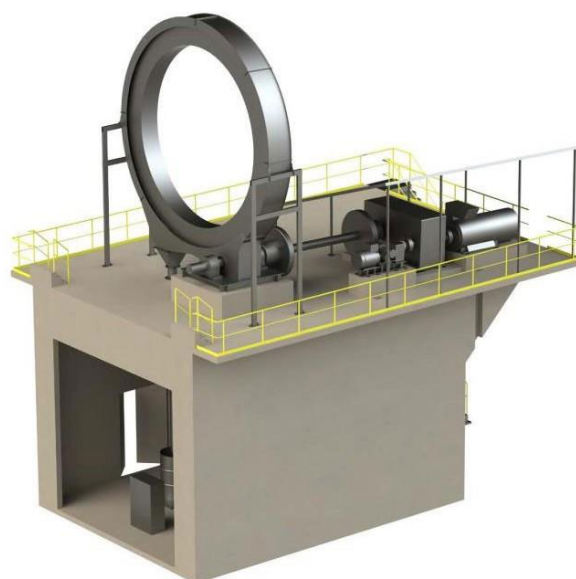
When driving directly on the supporting rollers, tangentially suspended tyres are used to transmit the

torque to the kiln shell. The straight-forward direct drive system requires only minimum maintenance, compared to the traditional girth gear and pinion mechanism. All ROTAX-2 kilns are driven through two of the rollers.

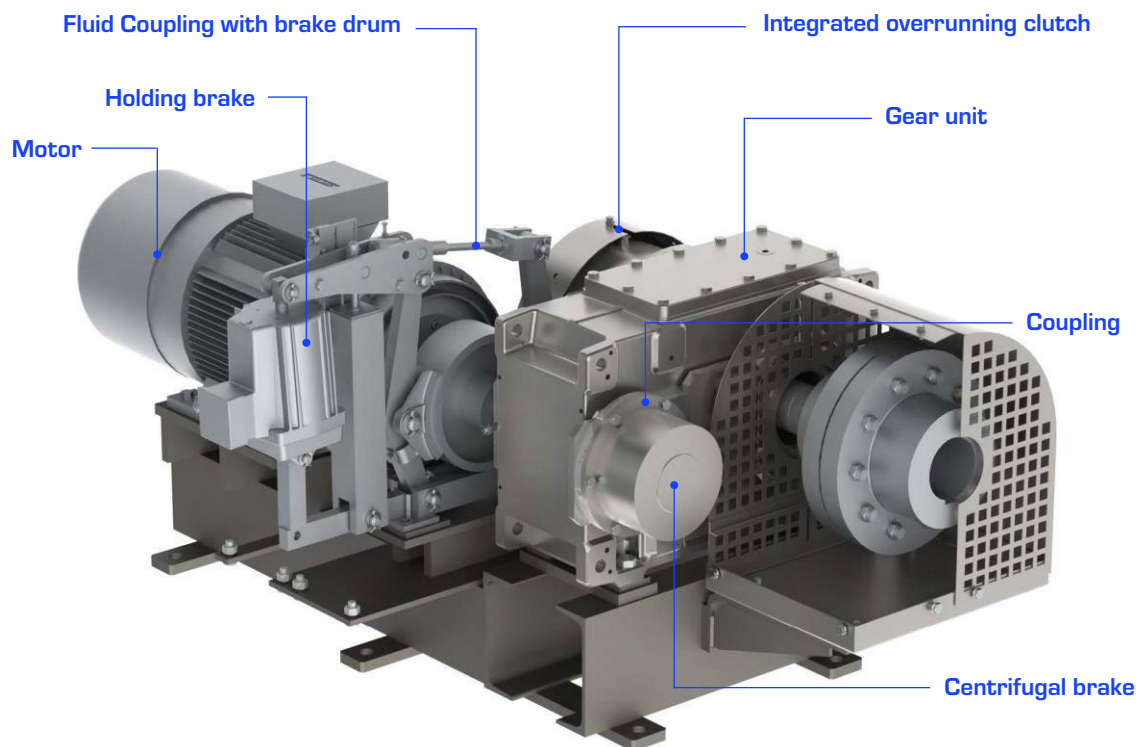
The 3-base kiln takes the classic approach to the drive station. The large gear rim has spring plates which are welded onto the kiln shell. The shell can then expand without distorting the shell and gear rim. An automatic spray lubrication system ensures adequate lubrication of the gear rim. A simple, proven solution, it features high-quality materials and precision engineering.



Electro-mechanical direct drive station for ROTAX-2 kilns



Drive station with pinion and girth gear for 3- base kiln



6.2 Auxiliary drive

The Fuller auxiliary drive is a device for stopping and slowly turning the kiln during power failure and repair work. Integration of an auxiliary drive secures a controlled rotation to the neutral position to avoid overloading of the main motor and gear components during unexpected stops.

The auxiliary drive features a gear unit, to transmit power from a separate electric motor to the high-speed shaft of the kiln main gear unit and an integrated over-running clutch between the output shaft and the main gear unit. To prevent uncontrolled runback of the kiln during stoppage, the auxiliary drive

contains a backstop mechanism located between the emergency drive and emergency gearbox.

The backstop consists of a drum brake and a centrifugal brake mounted on the emergency drive shaft and an integrated overrunning clutch mounted on the secondary shaft. The drum brake is electromagnetically released. The brakes are automatically engaged once the main shaft attempts to reverse the direction of rotation. The drum brake is designed to hold the reverse load of the kiln upon termination of forward motion. The auxiliary drive is fully automatic and does not need any manual operation for engaging or disengaging.

7. HYDRAULIC THRUST DEVICE

The automatic hydraulic thrust device (HTD) controls the kiln's axial motion. It is counteracting the slope of the kiln and ensures the desired axial position, between live ring and supporting rollers, as well as the girth gear and pinion. The hydraulic thrust device is designed to take up the full axial load of the kiln, so skewing of the support rollers is not needed. The result is smooth operation with improved lifetime for rolling components.

7.1 Guide roller

The guide roller is part of the hydraulic thrust device assembly. The guide roller and shaft are delivered together, as the guide roller is shrunk on the shaft. Guide roller and shaft are manufactured from high quality heat treated alloy steel with a hardness from between 200-240HB.

7.2 Bearing kit

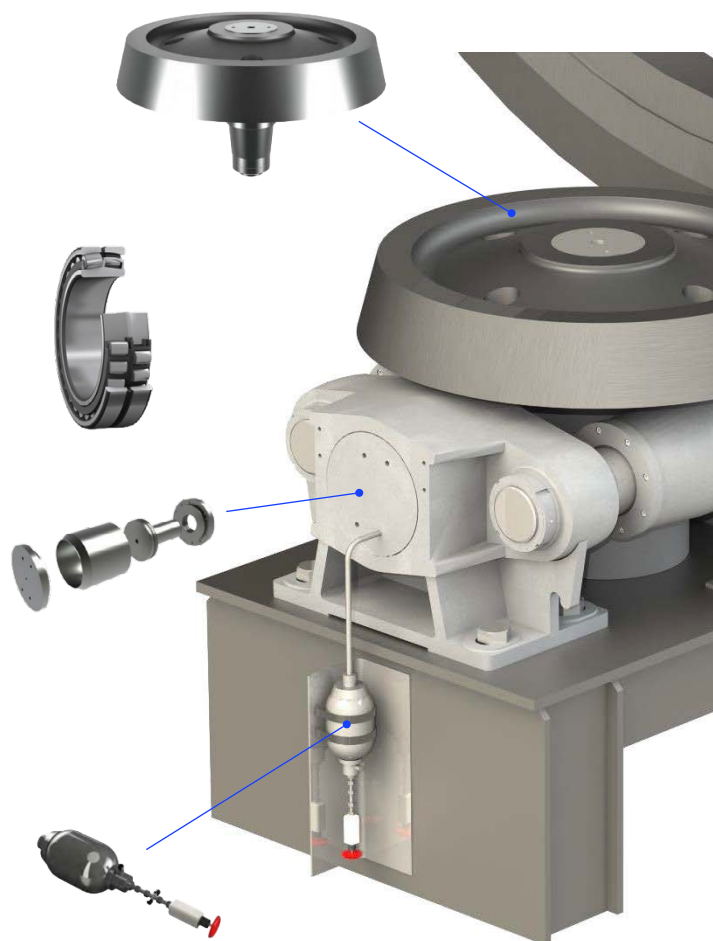
The bearing kit consists of respectively roller bearing, spherical thrust roller bearing and a spherical straight bore roller bearing. Furthermore, all related parts such as sealing ring, lock-nut, etc. Are included in the bearing kit.

7.3 Hydraulic cylinder

Through linear movement the hydraulic cylinder provides the power for the kiln axial motion. The cylinder operates through the pressurized oil from the pump station. The cylinder's driving force is the piston, which is attached to a piston rod that is enclosed in the cylinder's barrel. The bottom of the barrel is closed off by the cylinder cap, and the top is closed off by the head.

7.4 Accumulator

The integrated accumulator absorbs and neutralizes pressure variations in the hydraulic system during floating overload and tyre wobbling. This ensures a stable and smooth operation of the hydraulic system, and minimizes the risk of thrust roller damages. The accumulator and parts kit consist of all the relevant parts that are required for maintaining the accumulator system. The accumulator contains a rubber bladder which is charged with nitrogen gas. When the hydraulic pressure increases and decreases the gas is respectively compressed and expanded.



7.5 Seal kit hydraulic cylinder

The hydraulic cylinder kit consists of a wear ring and a guide ring which serves to guide the piston and piston rod of the hydraulic cylinder, absorbing transverse forces. At the same time it prevents metal to metal contact, which optimizes the performance of the sealing system and reduces wear. The kit also contains scraper rings which are installed in the sealing configuration of the hydraulic cylinder to scrape dirt, foreign particles, chips or moisture from the piston rods as they retract into the system. The scraper rings prevent contamination of the hydraulic medium that could damage wear rings, seals and other components.

7.6 Kiln displacement transducer, KDT

The KDT is installed for monitoring of kiln's axial position. The KDT is placed at the side of the thrust device, from where it sends signals to the control panel and provides an alarm if the kiln is moved from the pre-set position. It stops the kiln motor if the kiln position shifts beyond safe boundaries.

The KDT is a series of displacement transmitters based on a displacement sensor combined with an industrial signal conditioner incorporating a temperature-compensated excitation oscillator, amplifier, low-pass filter, and output stage. The sensing element consists of a single coil. A specialised winding technique enables a measuring range of up to 80% of the sensor body length.

The contactless electronic measuring principle eliminates mechanical wear within the sensing system, while Teflon bearings in the bore liner provide outstanding wear resistance (> 100 mio strokes.). All external surfaces are manufactured from highly corrosion-resistant stainless steel, and the housing also serves as effective electromagnetic shielding.

To ensure reliable operation in demanding industrial environments, all electrical connections are capacitor-filtered and protected against voltage transients. Combined with a watertight, laser-welded construction, these features provide excellent environmental compatibility. The KDT offers a range of calibrated output signals, which can be selected and configured by the user via the connector control pins.

7.7 Pump station

The pump station for the hydraulic thrust device is installed to supply the HTD with the required pressure for controlling the kiln's axial motion. Driven by a variable displacement piston pump varies the output flow to ensure a controlled pressure level in the system.



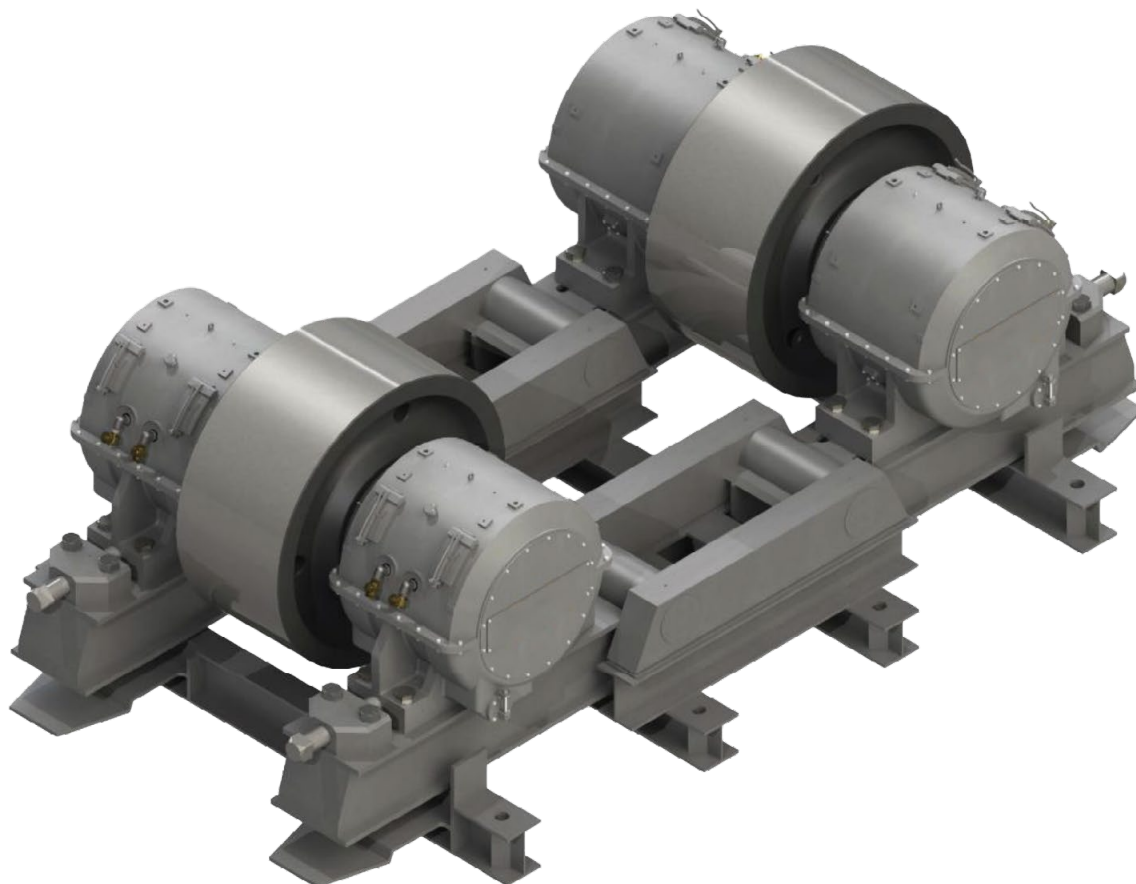
8. SUPPORTING ROLLERS ASSEMBLY

Each live ring is carried on two machined, alloyed cast steel supporting rollers. The rollers are shrunk onto the enlarged diameter of a heavy forged steel shaft. The supporting rollers are supported by bearing supports of either a rigid, semi rigid or self-aligning design. Graphite scrapers are mounted on non-drive rollers to ensure that the roller surface is properly lubricated at all times during operation.

Resurfacing of roller tires

Our offer resurfacing services which can reduce vibrations and lead to large energy savings and thereby lower operation costs. As wear progresses, it can result in vibrations, inability to control axial thrust,

increased power consumption, alignment problems and reduced bearing life. Without regular preventative resurfacing, issues such as premature bearing failure and damage to tire retaining components, bases, and drive components can occur. Rolled-over edges lead to edge cracks which can propagate into the tyre causing edge spall damage or the entire face of the tire to crack. Resurfacing allows for proper adjustment of support rollers and reduces power consumption. The Fuller resurfacing process improves mechanical stability, reduces energy consumption and lowers operating costs. We resurface the worn faces of support rollers and tyres in-situ, while the kiln/ rotary equipment is in normal production – there is no costly downtime and plant operation is uninterrupted.

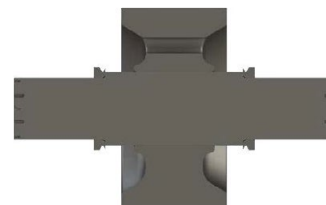
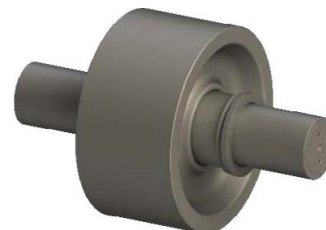


9. SUPPORTING ROLLER SPARE PARTS

9.1 Rollers

The Semi Rigid Base (SRB) supporting rollers, which are the latest design of Fuller supporting rollers, are of the single-body type with an anvil-shaped cross-section. The anvil shaped roller body is designed for optimum utilization of the material and effective transfer of the load from roller to shaft. The support roller shaft is designed for infinite life in fatigue loading, considering shrink-fit tolerance for relieving stress and bending of the shaft. The roller type is designed for all type of supports – friction drives as well as ordinary supports. The roller body is made of Cr-Mo-alloyed normalized and tempered forged steel with a hardness of 200-240 HB. The shaft is made of high grade forged carbon steel.

For overall easy handling, the rollers are manufactured with three holes for lifting. The holes and surrounding areas are also checked for induced stress concentration. The thrust rings thus to be shrunk fit to the shaft towards the roller, obtaining the axial load. All rollers are manufactured and inspected as per the Fuller manufacturing standard and NDT guidelines.



9.2 Rotary Kiln Bearing (RKB)

The RKB bearing design with spherical ball and socket is a well proven design. The principle has been used in Fuller kiln supporting roller bearings since 1918. The oil-lubricated self-aligning journal bearing, are equipped with bronze liners supported in water cooled cast iron bearing shell with spherical seating. The RKB bearings are hydrodynamic lubricated bearings, where lubrication is ensured by oil scoops rotating with the shafts and lifting the lubrication oil from the sump to an oil trough, distributing the oil over the journal. The bearings have cast iron bottom housings and mild steel top parts with observation openings and covers. The RKB bearing is suitable for all types of Fuller kiln supports and are the preferred bearing for new buildings and retrofits of other brands.



9.3 Bearing liner, RKB

The bearing liner is critical for the kiln operation. It is therefore essential not to settle for less than the best design and quality. The special bronze liners are a part of the hydrodynamic lubrication principle, which increases the liner lifetime. To control the operation temperature, and minimize the risk of hot bearings, the liner is resting in a water cooled spherical socket which allows the liner to adjust to the support roller misalignments. Fuller's special bronze bearing liners deliver a high-quality bearing solution that enhances operational reliability and provides a profitable investment for day-to-day operation.



10. BASEPLATE FOR SUPPORTING ROLLER ASSEMBLY

10.1 Rigid Support

The rigid support is used for 3-base kilns, i.e. diameter below 4.35 m. The rigid support is the basic and most simple of the three kiln supports in the our portfolio. At this type of support the four bearings at each support rest on – and are bolted to the machined surface of a large base plate welded up of heavy steel plates. The bearings are secured in transversal position by heavy retaining screws.



10.2 Semi-rigid support

The Semi-rigid support system is uniquely offered on 3-base kilns above 4.35 m diameter, providing alignment, flexibility and reduced stress on components. The four bearings of a support rest on and are bolted onto the machined surface of individual bedplates, welded up of steel plates and each supported, hinged, at the end towards the kiln centre line on a heavy shaft, parallel to the kiln axis and resting in two steel base bearings.



These eight bearings are welded, four and four, to two sectional steel frames, again resting on and welded onto two inner, longitudinal, fabricated foundation girders. Near their free ends, the hinged bedplates rest on outer, longitudinal, fabricated foundation girders through resilient intermediate pads. The girders are provided with side guide brackets for the bedplates to take up any longitudinal thrust from the kiln, transferred through rollers and bearings.

10.3 Self aligning support

The self-aligning support is used on the ROTAX 2 kilns. The roller support system has the appropriate amount of flexibility needed to provide maximum support when spreading the load from kiln to foundation. The advanced support system which is fully flexible and self-aligning follows the movement of the kiln. The support system leads to an even distribution of the load, eliminating the possibility of localized high stress areas. The increased allowable hertz pressure permits the use of smaller support rollers and tyres.



11. INLET AND OUTLET SECTORS

11.1 Inlet sectors

The inlet cone of the kiln is protected by a bolted-on nose ring of heat resistant, chrome nickel cast steel sectors with a castable refractory lining. The average life time of the refractory castable is between 6 to 18 months depending on quality of installation work and kiln operation. The steel sectors can be reused and have an average lifetime of 3-4 years. The inlet sectors are delivered bolts for fixation and with anchors to reinforce the casting.



11.2 Outlet sectors

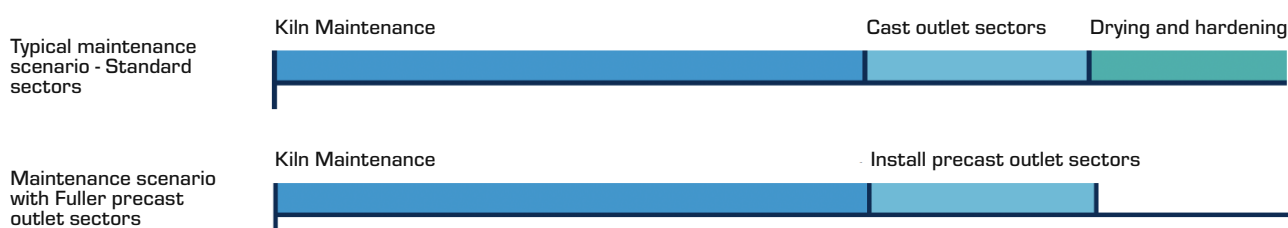
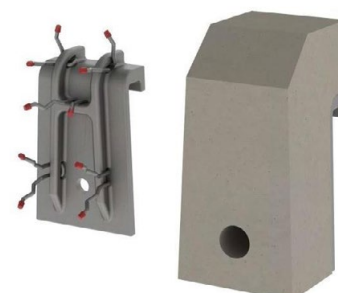
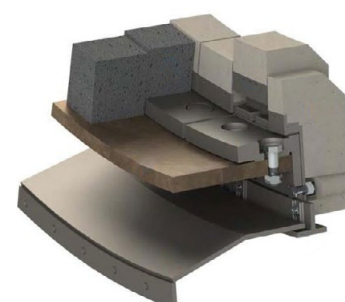
The outlet section of the kiln is protected by a bolted-on nose ring of heat resistant chrome nickel cast steel sectors protected by a castable refractory lining. Average life time of the refractory castable is between 8 to 10 months depending on quality of installation work and process conditions. The steel sectors can be reused and have an average lifetime of 3-4 years. The outlet sectors are delivered bolts for fixation and with anchors to reinforce the casting.



11.3 Replaceable precast outlet sectors

In contrast to the standard outlet sectors, this new concept offers a much more controlled casting process and faster installation. The new outlet sector system consists of permanent sectors (2) which are bolted directly to the kiln shell (1), two sets of hanging sectors (3) which are designed to be precast on site or at a local brickyard before installation. After being cast the hanging sectors with castable (6) can simply be hung onto the permanent sectors without the need for drying and hardening before start up. The system furthermore includes a set of closing sectors (4), to ensure an efficient seal towards the cowl shell (5), thus minimizing dust emissions from the kiln outlet.

The precast outlet sectors can be installed in any kiln. For Fuller kilns, the sectors can be installed without any modification to the kiln shell, and for other brands minor modification to be done depending on the existing design. The precast bricks are made of strong and very compact low porosity cement castable combining the best refractory properties from several natural high alumina raw materials. The castable has high mechanical strength and excellent shock and abrasion resistance. We supply all the necessary documentation and instructions to ensure a strong, uniform casting result every time.



12. KILN SEALS

12.1 Lamella seal inlet

The inlet lamella seal consists of two sets of spring steel lamellas with a layer of heat resistant fabric positioned between the lamellas. A spring tensioned module with counter weights applies radial pressure towards the outer lamellas which forces the inner set of lamellas against the cooling mantle to provide the seal. The layer of heat resistant fabric between the inner and outer lamellas helps to protect the outer set of lamellas and enables them to retain their elasticity. To prevent overheating of the kiln shell and sealing parts, a separate fan delivers cooling air to the space between the kiln shell and the cooling mantle. It also supplies air to the cooling air chamber, which cools down the shell surface of the kiln riser transition piece. If back spillage occurs, the scooping system collects the spillage in the bottom of the scooping chamber and, as the kiln rotates, lifts it and returns it to the kiln. In the smoke chamber, the exit gases will suspend the spillage and carry it up into the kiln riser pipe.



12.2 Lamella seal outlet

The outlet lamella seal consists of a non-rotating cylindrical ring of steel plates fitted around the kiln on the kiln hood. This cylindrical ring supports a number of special steel lamellas which slide on the circular cooling mantle surrounding the kiln outlet section. The outlet lamella seal consists of two sets of spring steel lamellas with a layer of heat-resistant fabric positioned between the lamellas. A spring tensioned module with counter weights applies radial pressure towards the outer lamellas which forces the inner set of lamellas against the cooling mantle to provide the seal. The layer of heat-resistant fabric between the inner and outer lamellas helps to protect the outer set of lamellas and enables them to retain their elasticity. The cooling mantle is constructed from heat-resistant plate and is positioned on the kiln shell and fixed by a number of spring plates. To prevent overheating of the outlet sectors and sealing parts, a separate fan supplies cooling air via a circular manifold to the space between the kiln shell and the cooling mantle. In the concentric dust chamber the escaping dust is collected and is then returned directly to the cooler via a chute. The outlet lamella seal can be retrofitted to all Fuller kilns and to most non-Fuller kilns.



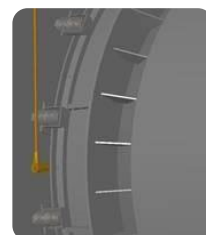
12.3 Lamella seal kit

The lamella seal kit consists of two sets of spring lamellas, the heat-resistant fabric and all the necessary parts and tools for installation.



12.4 Pneumatic kiln inlet seal

The pneumatic seal between the transition piece and kiln inlet consists of a seal plate with replaceable wear ring on which slides a wear ring bolted to the outer cone of the kiln inlet end. The seal plate is suspended on the transition piece in such a way that it can follow the axial oscillations of the kiln wear ring due to untrue running of the kiln inlet end. The movable seal plate has a ceramic fibre rope seal for the axial movement in relation to the stationary cylindrical plate in the opening of the transition piece. Pneumatic cylinders keep the seal plate with wear ring against the rotating wear ring on the kiln. The seal is lubricated in between the wear ring by graphite inserts.



12.5 Graphite seal

The Fuller kiln graphite seal is designed to optimize the operation pressure stability by preventing false air from entering the system. Furthermore, the seal reduces the release of hot gasses and dust particles from the kiln. Unlike other block seals on the market, our graphite seal uses a staggered arrangement with two rows of graphite blocks held in place by a spring tensioned module. This ensures an efficient seal against the outer air casing.

The design allows the graphite blocks to move independently with the radial movement of the kiln without the graphite blocks getting stuck or damaged. The graphite seal is designed to withstand radial runout up to ± 50 mm as standard – this can be increased on request. To reduce downtime during installation, the kiln graphite seal is designed with a modular frame that allows for a large amount of pre-assembly. To ensure optimal quality and the straightness of the flanges, all graphite seals are preassembled in the workshop to ensure the straightness of flanges.

Depending on the scope, the typical installation requires 7 to 10 days. The kiln graphite seal is highly flexible in design and easily adaptable to any size of kiln – regardless of whether the kiln is manufactured by Fuller. The graphite seal modules are designed to integrate with the existing casing and cooling mantle without any modification. Other existing equipment such as kiln shell, fans and hoppers can easily be adjusted, which helps keep the installation cost to a minimum.



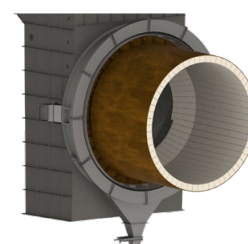
Spring tensioned graphic seal



Modular design

12.6 Graphite seal inlet

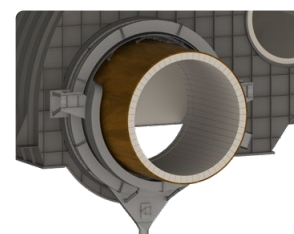
The kiln inlet graphite seal provides improved sealing effectivity and reliability – compared to traditionally kiln seals – at the interface between the kiln and preheater. The graphite seal design enables replacing the kiln inlet sectors without removing the seal parts. A cooling system consisting of a fan and a close ducting system keeps the temperature of the vital seal components at an acceptable level. The cooling air is distributed to the graphite rear flange and the air casing attached to the kiln riser. The design includes a shovel arrangement that reintroduces material spillage into the process. Casing, hopper and ducting will serve as a material buffer and guide the excess raw meal to a bin or conveyor system. The hopper is designed with a sloping plate to avoid dust building up at the graphite sealing.



Inlet seal

12.7 Graphite seal outlet

The kiln outlet graphite seal provides improved sealing effectivity and reliability – compared to traditionally kiln seals – at the interface between the kiln and the cooler. The cooling system is separated in to two independent systems, one for kiln shell and nose ring cooling and one for the graphite cooling. The nose cooling and kiln shell cooling is designed to increase the life time of the kiln outlet sectors and the outlet section. The system consists of a fan and simple ducting that provides cooling air in between the cooling mantle and kiln shell. The dust escaping from the kiln outlet is collected in the concentric dust chamber and returned directly to the cooler to either the first grate of the cooler or to an external drag chain via a chute.



Outlet seal

13. KILN SHELL COOLING

The kiln shell cooling fans system consists of a number of movable and stationary axial fans with outlet duct. Two axial fans are mounted on stationary supports on top of the heat shield for kiln support on the first two kiln supports from the kiln outlet with one fan on either side of both kiln tyres.

The movable fans are distributed with a total of four fans mounted on movable trolleys between the two first kiln supports and a total of three fans mounted on movable trolleys between the second and the third

kiln support. When using cooling fans to control the burning zone section, the ECS/CemScanner system can optionally be equipped with automatic control of the fans through the plant PLC system.

Fans are started when and where it is required by continuous temperature monitoring of the kiln sections. This option enables an optimized use of the fans to prevent uneconomical continuous operation of the fans, thereby increasing their service life.



14. UNAX INTERNALS

How to improve your planetary cooler

Planetary coolers still play an important role in the cement industry despite the introduction of modern grate cooler technology. We have developed a new generation of internal fittings that improve the performance of planetary coolers.

The rising costs of energy and labour combined with the development of more suitable materials and casting techniques both necessitate and enable better designs of planetary cooler internals. The key words are simplicity, durability and reliability – reducing the number of spare parts needed while extending the service life and optimizing the cooling effect of the internals.



Longer life

Many factors contribute to the overall service life. Although they are closely interrelated it is necessary to explain the effect of each factor separately:

Optimised ceramic cam lining

Using standard ISO bricks only in this zone increases lining stability.

Introduction of breaker lifters

Breaker lifters in the transition zone between the ceramic cam lining and the steel lifter zone reduce lump size in the cooler, which softens clinker impact on lifters and wear plates in the subsequent zones.

Improved lifter profile design to withstand clinker impact

The edges of the lifters have been reinforced and the termination angle chosen lowers the effect of clinker impact.

Material selection

Utilising its profound knowledge of materials and its process experience, We work closely with the customer in selecting the most suitable materials for the various cooler zones based on the following considerations:

- temperature/strength ratio
- high-temperature corrosion
- sigma phase formation
- abrasive wear

Improved design of cast wear plates

The wear plates overlap, protecting the cooler shell against excessive temperatures and wear. The loose wear plate design eliminates the risk of mechanical stresses.

Dam rings

Introducing dam rings in the cooler will increase the level of clinker, improve the retention time in the cooler and greatly reduce the abrasive and impact wear on lifters and wear plates. Dam rings are flexible and can be placed various places in the cooler to improve cooler efficiency.

Fewer types of spare parts

Higher efficiency

The lifters are designed to allow selecting appropriate sizes throughout the cooler for lower dust circulation. Their design also permits a "screwing" pattern of installation. Dam rings at the cooler outlet increase clinker retention time and improve overall cooler efficiency.

Fewer types of spare parts

The limited number of lifter and wear plate designs enable using the same design for different coolers. This eliminates the need to maintain a large and costly stock of replacement parts. The standardisation of cooler internals, which is a major feature of the new concept, allows us to maintain a sufficient stock of parts for swift delivery.



Shorter installation time

The fitting of new internals is simple and straightforward. The standard plates and lifters are easy to handle and lock into position. Compared with other designs, only a small number of bolts are needed, which also makes for shorter installation time.