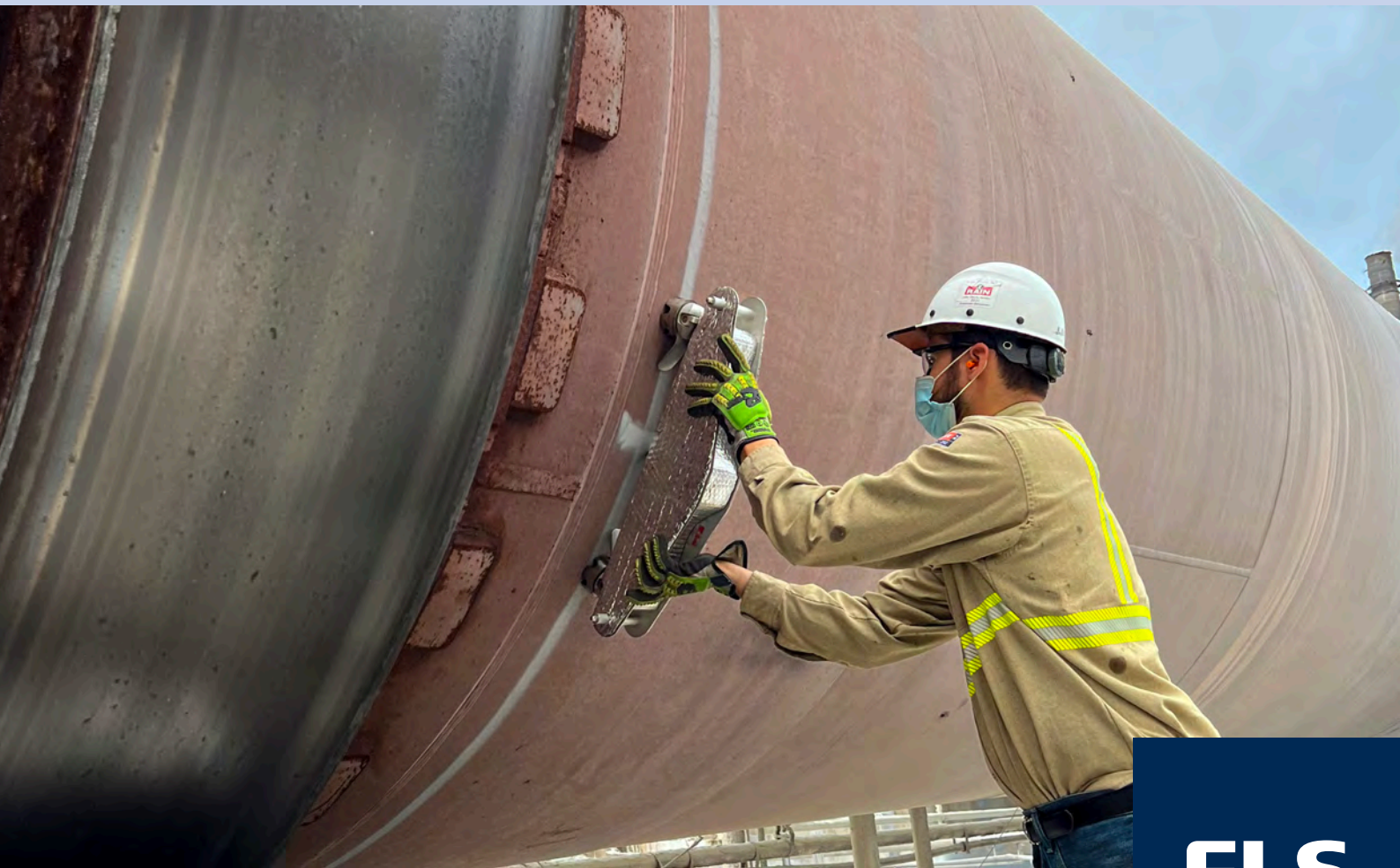


Specialised Services- Installation, capabilities and maintenance services Sioux City, Iowa

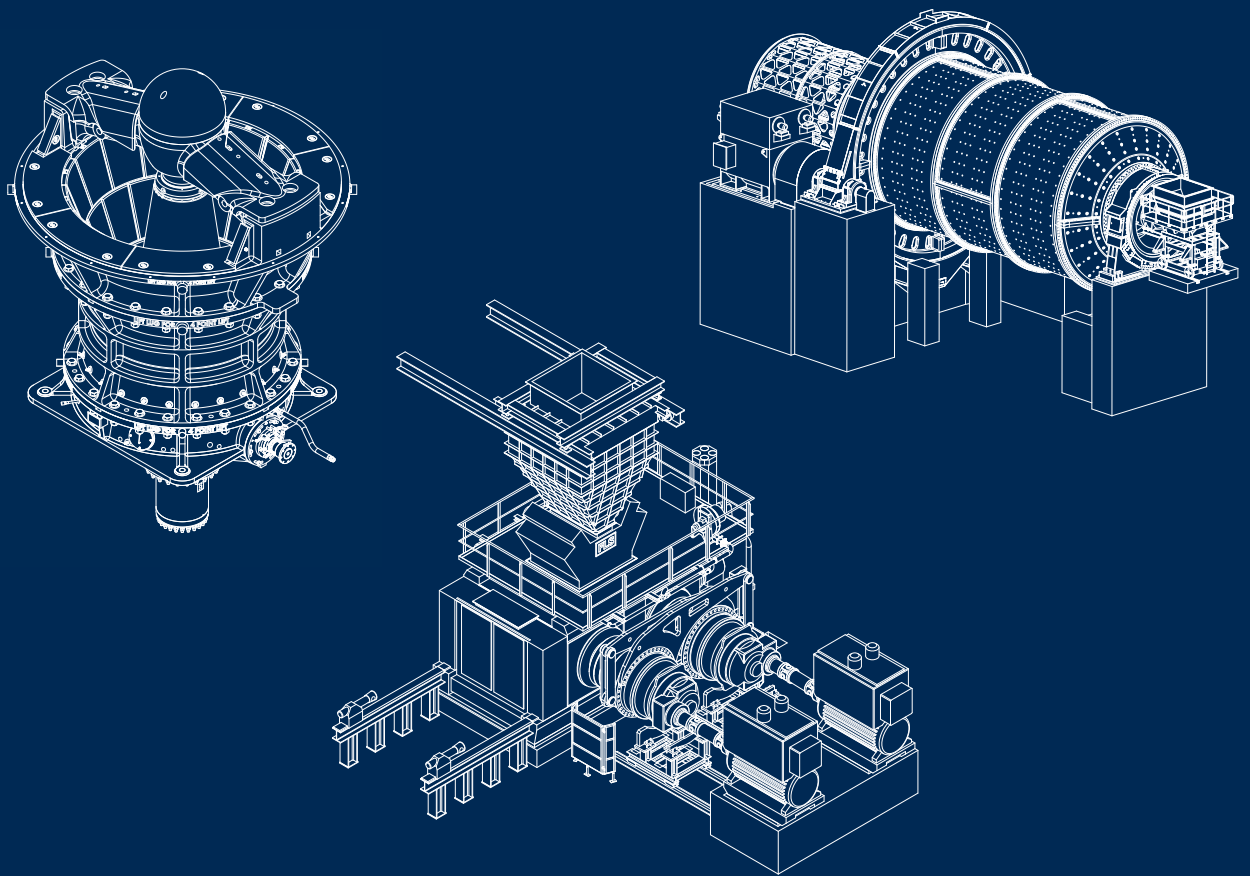


FLS

The skills you need to get the job done

In a demanding environment, where productivity is everything, you need to know that there are specialists you can turn to. FLS skilled engineers, millwrights and mechanics are here to help.

From new part manufacturing to reconditioning, installation and even training, we are committed to minimizing plant downtime – not just for the duration of the project, but for the long-term.



Key benefits

- Best practices in safety
- Environmentally responsible manufacturing
- Expert advice and troubleshooting
- Specialized equipment and patented alignment methods
- One-stop-shop for parts and installation



Hot and cold kiln alignment Do the work now to prevent failure later?

Your kiln and dryer rollers are subject to significant stresses. Wear and vibration create deformations that can lead to disaster if left unchecked. Given the cost of kiln outages, every effort should be made to keep on top of maintenance and reduce downtime to a minimum.

With more than 50 years' experience manufacturing and repairing rotary kiln and dryer trunnion rollers and thrust rollers, our Specialised Services Team is committed to maximizing kiln availability. Our alignment services are a key component of your preventive maintenance strategy, helping to identify and correct any issues that could become failures. Understanding the influence of the different measurements included in these reports helps kiln operators and maintenance staff determine the most efficient mode of operation, and fully prepare for maintenance stops.

Cold alignments

Cold Alignment Analysis is applicable for all types of rotating equipment using anti-friction bearings on the supporting rollers such as dryers, coolers, granulators and more. It requires a 2-day stop, during which we perform a mechanical inspection, including geometric measurements, to analyse the dryer condition.

The highest priority is to identify the true root causes of any actual or potential issues, and to deliver a report with recommendations that give you long-lasting problem solving – ultimately giving you the knowledge you need to act before a problem becomes critical.

Benefits

- Optimize dryer availability and achieve more stable operation
- Reduce axial load on the bearings and thrust rollers
- Reduce unforeseen production stoppages
- Reduce maintenance costs
- Increase productivity

FLS 2-pier cold alignment analysis programme

Dryer axis

- Establish the center line
- Measure base / shaft elevations
- Measure tire & roller diameters
- Measure existing offsets
- Tire migration

Supporting measurements and comprehensive visual inspection

- Visual condition check of all dryer components
- Tire position on supporting rollers
- Supporting rollers & tire profiles

Kiln drive

- Visual drive inspection
- Root clearance check if possible

Corrective action

- Carry out roller shimming & moves with plant assistance
- Realign pinion if necessary #
- Skew correction of rollers
- Trial run of the unit

Engineering study*

- Load on bearings
- Bending stresses in tires
- Contact pressure between supporting rollers and tires
- Bending stresses in dryer shell
- Shell stress calculation due to reduced shell thickness

* Optional #Additional

Hot alignments

Our comprehensive hot kiln alignment gives you a clear diagnosis of the state of your kiln without requiring any downtime. Using advanced measurements and specialist tools, we deliver a full kiln analysis looking at the key problem areas. We also conduct an engineering study, which looks at kiln stiffness, stresses and potential overload. Again, we seek to identify the true root causes of any actual or potential issues, which typically fall within four areas: kiln axis misalignment, high kiln shell ovality or shell flex, kiln crank failure and kiln axis misbalance.

Using state-of-the-art software, we create detailed, interactive 3D rotating models of your kiln shell, which let you see any areas of damage or weak spots, with different colors indicating the varying degree of severity. We include these detailed models in your final report, giving you the insight you need to prepare an appropriate preventive maintenance plan.



Patented Thrust Monitor Alignment - Take control of roller alignment

The most common problem with roller supported units, particularly those using anti-friction bearings, is thrust control. Excessive axial thrust causes premature bearing failure, high rolling surface wear, and vibration. Resolving roller alignment (both skew and slope) is essential for reliable operation.

Traditional alignment services cannot give real time feedback, so the results of any adjustments will not be seen until much later when the equipment is put back into production. With Thrust Monitor alignment, we align the rollers while the equipment is rotating, enabling us to observe the thrust loads as they change in response to bearing adjustments. These observations can be made using our patented Axial Thrust Monitor system, which displays axial force generated by roller skew while the equipment is rotating.

Thrust Monitoring alignment is performed as a service and is best carried out after a tire and roller reconditioning for optimum results. By rotating the equipment in both directions, the neutral position can be determined, and the dryer adjusted accordingly.

Permanent thrust monitoring

Alternatively, you can install a Permanent Thrust Monitor system, which brings alignment monitoring into the control room and gives you the continuous insight you need to optimize the availability and performance of your kiln.

This enables you to see the effects on roller alignment in real time – from changes in product load, shell temperatures and speed of rotation – making it possible to tune alignment under "live" operating conditions. The benefits are obvious: abrupt change or slow deterioration in the support roller bearings can be immediately detected. Once operating parameters are established, alarm set-points define when roller loads exceed normal operating conditions.

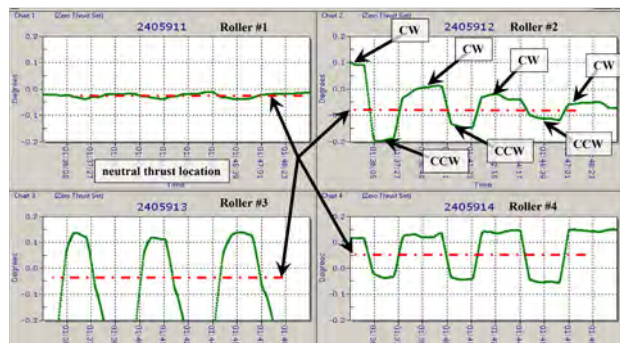
On-going real time graphic trends are continuously recorded for subsequent analysis. LED indicators at the local panel show each support roller's thrust condition and visually calls attention to thrust and skew management. Such close and continuous management ensures reduced bearing loads and rolling surface wear, cutting maintenance costs and increasing productivity.

FLS Hot Kiln Alignment Analysis Program:

Kiln axis	<ul style="list-style-type: none"> Vertical kiln axis Horizontal kiln axis
Shell ovality / shell flexing	<ul style="list-style-type: none"> Shell flexing near the tires Tire migration
Kiln crank	<ul style="list-style-type: none"> Mechanical crank Thermal crank Tire throw Shaft deflection Polar diagram Kiln shell runout & deformation
Axial balance	<ul style="list-style-type: none"> Evaluation of support roller thrust Hydraulic thrust device visual inspection Skewing and inclination of supporting rollers
Kiln drive	<ul style="list-style-type: none"> Visual drive Inspection Root clearance check (if possible) Pinion temperature profile Axial runout & radial runout of gear (if possible)
Supporting measurements and comprehensive visual inspection	<ul style="list-style-type: none"> Visual condition check of all kiln components Tire position on supporting rollers Supporting rollers & tire profiles Checking tire retainer's wear
Report presentation	<ul style="list-style-type: none"> Present summary report of kiln findings while at site Generate shell flexing & polar graphs for analysis
Corrective action	<ul style="list-style-type: none"> Skew correction of rollers Correcting kiln misalignment
Engineering study*	<ul style="list-style-type: none"> Load on bearings Bending stresses in tires Contact pressure between supporting rollers and tires Bending stresses in dryer shell Shell stress calculation due to reduced shell thickness

* Optional

THRUST MONITOR ALIGNMENT



Repair and installation services

Whether reconditioning an old part, or installing a new one, you need experienced hands-on-deck to ensure a smooth process. Our skilled engineers, millwrights and technicians are used to projects of all kinds:

- From setting base frames to complete kiln shells
- From installing seals to drive gears
- From replacing rollers to replacing tires

No repair is too big or too small. Most importantly, our experienced crew ensure that your projects are completed safely and on time. In addition to complete unit installation, we perform repairs and installation services on equipment including:

- Ball Mills/ SAG Mills (gears, drives, slide rings and more)
- HPGR (High-pressure grinding rolls)
- Vertical Mills
- Thickener/clarifier rake arms/drives/rebuilds
- Gyrotory crusher
- Reciprocating grate coolers
- Separator system upgrades/repairs
- Pneumatic transport equipment/chutes/piping
- Drum, Belt Filters
- Process air fans install/upgrade
- Conveyors/bucket elevators
- Packing Plants
- Bag House / Precipitators



Drive and gear
modernisation
- before



Drive and gear
modernization
- after



Safe and certified welders and millwrights



Thickener and clarifier modernisation



**Kiln shell
installation**



**Equipment
restoration**

Reconditioning services

As your rotary kiln, dryer, calciner or cooler ages, the wearing surfaces of riding rings and carrying rollers will become concave and/or convex during normal usage and may show pitting, surface spalls, cracks marks, etc.

Our resurfacing services correct these problems without requiring costly kiln stops. We resurface the worn faces of riding rings and support rollers in-situ, while the kiln is in normal production, enabling you to improve kiln health without disrupting productivity.

Regular preventive resurfacing helps you avoid wear issues, including:

- Unwanted vibrations
- Inability to control axial thrust
- Increased power consumption
- Alignment problems
- Reduced bearing life
- Damage to bases and drive and tire-retaining components

Our resurfacing process allows for corrective adjustment of support rollers, which improves mechanical stability, reduces energy consumption and lowers operating costs.





Check the condition of the thrust rollers

- Is the unit against the uphill or downhill thrust roller?
- Is there spalling or ridging on the roller surface?

Check the condition of the drive system

- Has the pattern of gear contact changed?
- Are there any loose or missing flange bolts or gear mounting lugs?
- Is the automatic gear lubrication system functioning properly?
- Is there adequate gear lubrication?
- Are there any unusual sounds coming from the drive system?
- Is there any new noticeable vibration?

Roller Manufacturing & Rebuilds

Our FLSmidth facility in Sioux City, Iowa, has been manufacturing and repairing rotary kiln and dryer trunnion rollers and thrust rollers for over 50 years. FLSmidth manufactures specialized engineered-to-order solutions and supports all OEM brands. Our skilled machinists have average 20+ years of experience with proven workmanship quality and as-promised delivery.

This facility exemplifies FLSmidth's commitment to safety, quality and environmental responsibility.

Roller Rebuilds/ Sleeving

Rollers with damaged shafts can be repaired by having the shaft replaced and the OD trued up concentric with the shaft.

In addition, all sizes of worn carrying rollers can be rebuilt to original dimensions with our proprietary shrink fit sleeving process. Sleeving is generally an economical repair alternative for carrying rollers which are 24 inches diameter or larger. This can provide up to 50% savings over the price of a new roller. The sleeving process fixes the repair sleeve more positively than press-fit sleeves and provides a secure repair job. Even carrying rollers with badly tapered surfaces, scored, broken or undersized shafts, excessive wear, spalls, cracked surfaces, or reduced outside diameters can be restored.

To ensure a sleeve that wears as long as a new carrying roller, we heat treat or normalize all sleeves to customer specifications. In addition, you will find the uniform hardness and strength of our seamless forged sleeves is far superior to the uneven hardness found with weld build-up or fabricated sleeves.

This FLSmidth process has over 30 years of proven performance with 100% success.

Roller Maintenance Tips

Keeping dryers, coolers, and other roller-supported equipment in good condition requires constant monitoring. There are certain maintenance tasks that must be completed on a daily, monthly, semi-annual, and annual basis to avoid serious problems that could cause downtime and lost production.

We recommend that one person from your maintenance staff be appointed to complete preventive maintenance tasks on a regular basis. All observations should be recorded so that a chronological listing of the maintenance tasks performed on your rotary unit is available. FLS offers seminars for training on roller condition monitoring and maintenance as well.

Rotary Equipment Preventive Maintenance Guide

Weekly maintenance tasks

1. Check graphite block lubrication
 - Are holders clean and free of product or dirt contamination?
 - Is the graphite block free and loose in its holder?
 - Is the graphite providing an adequate supply of lubrication?
2. Check creep or gap of tires on all piers
 - Has level of creep increased since the last inspection?
3. Lubricate between the filler bars and tire ID.
4. Check the condition of the rollers at each pier
 - Are the rollers thrusting uphill or downhill?
5. Clean the pier tops of dirt, oil or product spillage.

Monthly maintenance tasks

- Check for pitch line separation of gear and pinion.
- Check for pitch line run-out of gear and pinion.
- Check condition of welds on gear flange and mounting lugs.
- Check for excessive ring and roller wear.
- Lubricate the drive coupling.
- Semi-annual maintenance tasks
- Change gear lube and clean sump and gear area if needed.
- Change grease on pinion shaft and support roller bearings.
- Change grease in thrust roller bearings
- Inspect shell for cracks under rings.
- Check radial alignment of gear and pinion
- Inspect drive coupling grid members

Annual maintenance tasks

1. Check the alignment of the unit
2. Adjust the rollers to a neutral position to re-train the unit.
3. Weld repair cracks in shell, wedges, filler bars or support bands.
4. Clean and inspect gear
 - Check gear teeth for abnormal wear.
 - Change gear lubrication.
 - Check drive train couplings for wear and replace if needed.
 - Check and repair welds on gear flange or mounting lugs and gear if needed.
 - Check for loose nuts or bolts on gear mounting flange.
 - Inspect, clean repack and change lubrication on pinion bearings.
 - Check brush rigging and electrical components of drive motor.
 - Take samples of gear box oil and send to a laboratory to detect oil contamination.
5. Clean and inspect support roller bearings.
6. Clean and grease the support roller adjustment screws and wrap them in burlap.

When periodic maintenance tasks are performed, problems can be easily discovered. Most problems can be solved immediately but a few require outside maintenance assistance. If you spot any of the following problems, call your equipment supplier or maintenance vendor immediately.

- Convex-concave wear on tires and carrying rollers that is causing control problems or reduced bearing area
- Spalling, excessive galling, or metal breakage on tires or rollers
- Severe tapers on tires
- Gear bottoming out or excessive vibration



OEM quality parts manufacturing

In addition to our rebuild services, we manufacture OEM-standard new rollers for all types of kilns, dryers, coolers and similar roller supported equipment:

- Support rollers
- Thrust rollers
- Roller bases
- Feed-end discharge-end shell seals
- Shell sections
- All types & styles of tire mounting hardware
- Tires - solid or split styles
- Gears & pinions
- Guards, hoods, ducting

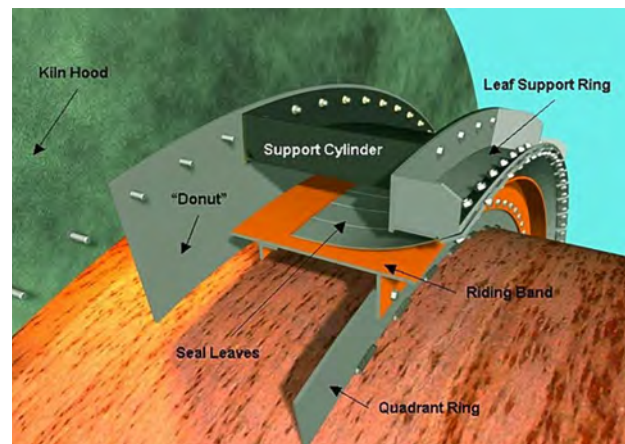
Our extensive experience with all makes and sizes of rotary equipment enables us to offer both new and rebuilt replacement parts, according to an evaluation of your needs. We want to maximise the service life of your equipment, so if we can refurbish or rebuild – we will. Otherwise, you have the peace of mind of knowing your new part has been custom-built by expert machinists with a wealth of experience.



EnviroSeal - a cost-effective kiln seal modification

Replacing a pneumatic seal with the FLS Enviro Seal can save you hundreds of thousands of dollars in fuel consumption each year, as well as reducing kiln maintenance costs. Its inverted leaf design provides a tight seal, while the removal riding band and leaf support ring are cut to the rotational axis of the unit, minimising flexing.

Dust or product accumulation around the leaves is eliminated by integrating a spill hopper into the mounting cylinder. The low-maintenance design ensures maximum kiln availability, ensuring your seal never gets in the way of your productivity.



Expertise on hand

When quoting for a new part we look at the whole design to see if there is anything more or different that could be done to upgrade performance, whether that be an engineered solution, or a more conventional route to improvement. Inspections can also be performed as needed to assess condition and part performance.

Diagnostic services and training

Preventive maintenance is key to keeping costs down and equipment availability up. In order to truly get ahead of maintenance tasks, you must seek early diagnosis of any issues that could become failures. Our range of diagnostic services supports this endeavour by providing in-depth insights about various aspects of equipment health and performance.

Services include:

- Rotary Equipment Load Studies
- Engineering upgrades of rotary equipment
- Rotary Kiln/dryer/calcliner/ cooler mechanical inspections
- Rotary kiln/dryer/calcliner/shell profile, ovality analysis



Engineering studies

An engineering study will help identify kiln stresses and give you insight into problem areas that need addressing, as well as ways in which kiln performance and component life can be optimised.

With access to the latest design standards, as well as a global network of kiln design, operation and maintenance specialists, we have the knowhow to optimise and improve the performance of your equipment.

The basis of this study is your OEM drawings, general arrangement or assembly drawings of gears and/or sprockets, bases, supporting rollers, riding rings or bearings, plant generated drawings or information, or other written specifications. We take this information – or estimated values, where no standard is available – and use it to perform a series of calculations and analysis. In addition, we take measurements on site to compare with baseline data – ultimately writing up a report that covers:

- Base frame size and elevation relative to the kiln centreline
- Design slope vs. modified slope and required modifications
- Support roller assembly bearing sizes and design life
- Riding ring ovality, bending stress and rolling surfaces pressure
- Support roller shaft bending stress
- Shell deflection and bending stresses

The resulting report can be used to plan and prepare for maintenance actions, or adjust operating parameters for optimum performance and availability. Engineering studies can be carried out as part of a kiln alignment, or independently.



Training matters

However advanced your operation, maintenance remains in human hands – meaning the best path to optimisation is to upskill your maintenance teams. We run training courses both at our Sioux City facility and at your site, upon request, enabling you to benefit from our many decades of experience. Training can be tailored to your needs, or you can join one of our popular seminars.

Mechanical Maintenance of Rotary Kilns/Dryers

This seminar comprises 3 days of presentations and a 1/2-day of hands-on training, including roller adjustments, ovality measurements and documented inspection on our full-scale 3-pier training kiln.

Most aspects of kiln and dryer mechanical maintenance are taught by engineers with 30+ years of experience in the rotary equipment industry. Maintenance Seminars are designed for plant engineers, planners, and maintenance and production personnel.

- Topics covered include:
- Roller adjustments
- Alignment: multi-pier units
- Alignment: 2-pier units with thrust monitor method
- Tires and rollers
- Shell
- Bearings
- Seals
- Reconditioning tires and rollers
- Lubrication
- Drives
- Pneumatic Transport (for kiln seminar only)

At the end of the seminar, you earn a continuing education credit from Western Iowa Technical Community College.



“Excellent service and very quick responses and results on two urgent requests within a matter of a few days - one of which was at the end of the business day and both nearing the holiday weekend. The level of service and rapid responses we received allowed us to get the urgent parts we needed by early the next morning in both cases, highlighting the FLS Specialized Services team as a true partner of choice for our site.”

Procurement Manager

Fertilizer company in Southwestern, USA.



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