TEMSA

Mine, Machine Industry & Trading Inc.

Product Catalog

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Contents

About TEMSA 4

Our Vision 6

Partners 8

Xtek 11

Marichal Ketin 53

Corts 71

Hebei Metallurgical Rolls 81

Habets 95

Retek 123

Cometech 127

Pilsen Steel 133

NDC 151

About TEMSA

In the 70s our company was established as TEMSA Industry and Trading Company.
In 1986, TEMSA became TEMSA Mining & Machine Industry and Trading Company Inc.

We specialise in representing and marketing mining and steel industries' products with our established experience and knowledge. During the 80s, when Turkey was developing their mining industry, TEMSA took an important place with the world's famous electric and other mining equipment in Turkey. This equipment's training and support is still remembered by the mining industry.

With this same strategy, our company provides similar services to companies such as XTEK (which has a 100 year background) in the steel industry.

Our services basically covers mills' heavy duty transmissions, gears and gear boxes, shafts, pinions, couplings, universal joints, cranes, crane wheels, crane rope drums, brake drums, rollers, pinch rolls, wear plates, graphic electrodes, thickness measurement tools, knives, various size steel ropes and many other products.

Also, our company provides service, solving problems and find solutions with the knowledge and technology of our own and represented companies to help the local companies.

TEMSA INC.
Headquarters,
Ankara, TURKEY

Our Vision

With the last 30 years experience in the mining and steel industry, accumulated knowledge and completely authorised agency relations, ***our vision*** *is to provide our customers with finding solutions, transferring technology, improving their production and becoming a solution partner in the industry.*

Partners

Xtek
Solutions in Motion™

MK

CORTS
Präzision seit 1835

HMR

Habets
INDUSTRIAL COMPONENTS & SURFACE TECHNOLOGY

RETEK

COMETECH

PILSEN STEEL
OMZ GROUP

NDC

Xtek
Solutions in Motion™

Solutions in Motion™

Xtek

Solution in Motion™

Xtek, Inc. designs and manufactures custom machined parts and assemblies for heavy industries. Xtek focuses on 5 major product groups - Wheel, Gear, Coupling, Roll, and Below the Hook Lifting Products. We have dedicated regional service facilities for these products.

The company was founded in 1909 and is based in Cincinnati, Ohio, USA with plants in Hammond, Indiana; Hamilton, Ontario, Canada; and Plzen, Czech Republic. Xtek is an Employee Owned, ISO 9001 certified company.

Xtek is a member of AGMA, AIST, ASME and ASM.

Xtek World Headquarters, Cincinnati, Ohio

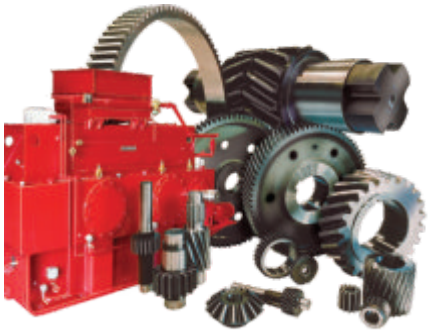
Specific products provided by Xtek include:

- Crane Wheels,
- Sheave Wheels,
- Brake Wheels,
- Custom Gearing,
- Mill Pinions,
- Gearboxes,
- Geared Spindle Couplings,
- Universal Joints,
- Motor Couplings,
- Cold Mill Work Rolls,
- Edger Rolls,
- Temperature Controlled Rolls,
- Downcoiler Pinch Rolls,
- Plate Mill Leveler Rolls,
- Rope Drums,
- Custom Below the Hook Lifting Equipment

Xtek provides engineering services, such as failure analysis, reverse engineering, upgrade design, mechanical inspection, non-destructive inspection service, in house manufacturing and heat treating, disassembly and assembly services and breakdown service.

Xtek products are found in heavy industry, to include Steel, Aluminum, Mining, Shipyards, Paper and Power Generation. Customers are serviced Worldwide.

Xtek : World Leader
in Components for Heavy Industry



Gearing & Gearboxes

- AGMA Class 15 capability
- TSP carburizing to 58-62 Hrc
- Gear diameters from 10”-100”
- Up to 100,000 pounds
- Reverse engineering and FEA analysis is available
- Gearbox reconditioning specialists

Gear Spindle Couplings & Universal Joints

- World leader in couplings
- All driveshaft products are custom designed for your application
- All wear components TSP carburized to 58-62 Hrc
- Reconditioning specialists

Roll Products

- Custom engineered specialty and processing rolls for rolling mill applications
- Specialty rolls for food processing, paper mills, and other industrial sectors
- Proprietary Bemcalloy™ pinch rolls available only from Xtek

BRADLEY LIFTING AVON ENGINEERING AN Xtek COMPANY

Below-The-Hook Lifting Products & Floor-Based Equipment

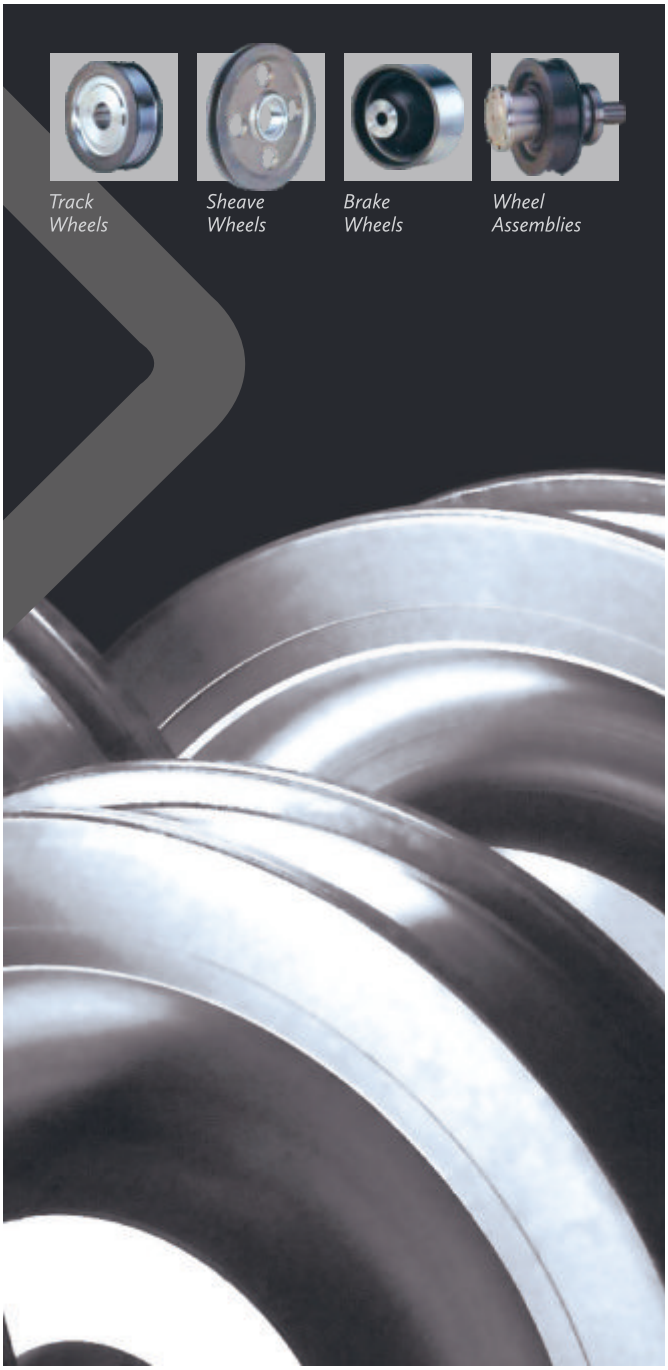
- Design & manufacture of heavy duty lifting and material handling equipment
- Multiple options for handling coil, slab, sheet, ingot, tube and specialty products
- Licensed, professional engineers on staff
- Lifter inspection services
- Repair and retrofitting of all lifter brands

Hardened Steel Wheels & Wheel Assemblies

- Xtek crane, brake and sheave wheels are the industry’s longest lasting wheel products
- Proprietary heat treatment provides industry’s best performing wheels
- Emergency breakdown services available

Xtek Wheel Products

Keeping industry on the move



Xtek is a company of people and ideas. In the course of serving heavy industry for almost 100 years, the Company has earned a reputation for excellence built upon its willingness to accept the tough assignment, to devise new techniques and processes when the old ways weren't good enough, and to back up its manufacturing expertise with application assistance to assure a level of performance that is second to none.

Over time, Xtek has become the first choice of managers responsible for increasing productivity for one simple reason. Reliable Xtek products perform as promised. And perhaps nowhere has Xtek's dependability, product superiority and value been more graphically demonstrated than in its family of heavy duty wheel products, each custom designed to individual customers's in-service requirements.

Xtek wheels have kept steel mills moving for almost a century.

Performance proven Xtek Wheels

Xtek wheels outperform all others because Xtek field engineers first listen to customer needs and concerns -then take the time to investigate service conditions and usage patterns and learn from their observations- and ultimately, to lead the way with creative solutions based on a lifetime of wheel performance tracking at customer facilities around the world.

Track Wheels

Xtek emphasizes the value of on-site evaluation because variables such as rail hardness, track alignment, environmental heat, friction, cleanliness, loading, and operator practices can all impact the life and safety of heavy duty industrial wheels.

Only when specific application demands have been determined and the desirable wheel characteristics isolated, can Xtek's engineers prescribe the best material selection, heat treating technique and optimum depth and location of case hardness on the critical surfaces of the wheel. That's the only way maximum wear life can be assured, under any given set of operating conditions. That's the Xtek way.

Xtek is a company committed to excellence through the practice of continuous improvement, utilizing a focused factory strategy to maintain an intense focus on wheel design and manufacture. Xtek encourages an on going dialogue between our staff and our customers to keep that focus sharp and attuned to the specific needs of individual applications.

The Xtek Advantage

Almost a century of heat treatment experience goes into each Xtek wheel.

Metallurgical experience. The key to Xteks's performance and productivity is the ability to select the best form of heat treatment from an entire range of options - to select the precise metallurgical process that will impart all of the qualities required by a customer's specific operating conditions. The result is optimum product life with minimum maintenance.

In terms of metallurgical expertise, Xtek is a master among apprentices. Xtek has been honing its metallurgical skills to suit operating conditions in steel mills, mines and many other industrial environments for almost a century. By comparison, most of the Company's competitors must be considered mere beginners when it comes to applying the technologies of deep case contour hardening.

Building The Perfect Track Wheel

Xtek's metallurgical superiority has made it the undisputed leader in the manufacture of hardened steel track wheels, and the Company has maintained its number one ranking over the years by doing one thing and doing it very well: Giving customers a wheel that lasts longer under existing operating conditions in their facility.

On the job, track wheels are replaced because of flange wear, flange breakage, and mechanical overloads characterized by pitting and spalling. Each of these in-service factors must be carefully considered before the combination of wheel design, material selection, hardness pattern and heat treating technology is selected. That's why every Xtek track wheel is specially designed and heat treated to maximize its resistance to the damaging forces at work in heavy industrial applications. That's why Xtek wheels perform as promised.

National Space Center: Xtek wheels are used where reliability is absolutely critical.

Every passenger using the historic San Francisco cable car system rides, in safety, on Xtek wheels.

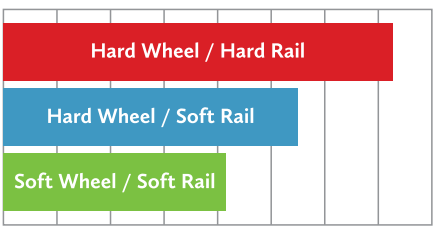
Track Wheels

Making the hard choice

The secret to slowing the effects of abrasive wear is to reduce the coefficient of friction between the wheel and the rail upon which it rides. Tests conducted by the Association of Iron and Steel Engineers (AISE) have demonstrated that the coefficient of friction can be reduced by as much as 40% by hardening the track wheel to 58-62 Rc.

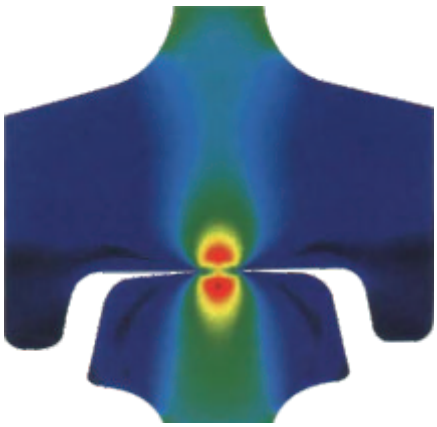
Moreover, because a hard surface tends to polish and become smooth with use, friction is furter reduced and track wheel wear rates are lowered even more. In a best case scenario, a hardened wheel on a hardened rail will optimize the life expectancy of both wheel components, while conversly, a soft wheel on a soft rail will fail soonest.

Relative wear life



The lesson is clear - if abrasive wear is causing maintenance problems in your track installations, switching to Xtek hardened steel wheels will extend the life of both the wheel and rail and will reduce related maintenance and downtime.

Pitting and spalling, a major wear factor limiting the useful life of track wheels on overhead cranes, can also be reduced by the choice of a wheel of proper hardness and heat treating technique to fit the application. Pitting and spalling are forms of metal fatigue caused by the extremely high subsurface stresses generated when track wheels are heavily loaded. Therefore, the heavier the load, the more critical wheel hardness becomes.



Stress components at the point of contact between wheel and rail are simulated by Finite Element Analysis (FEA).

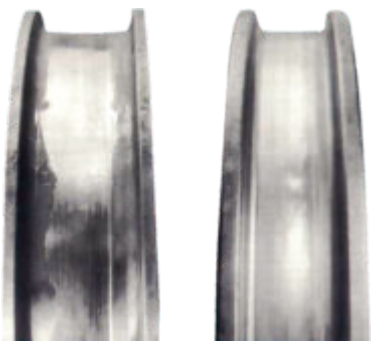
Load tests at a major university demonstrated the superiority of hardened wheels: after two million cycles, track wheels with a surface hardness of 35-39 Rc, loaded at 160,000 psi, began to show signs of metal fatigue, while wheels of 50-53 Rc carried 250,000 psi, and wheels of 60-63 Rc handled loads of 420.000 psi before the first appearances of contact stress wear were observed.

Wheel Treatment	Maximum Contact Stress, PSI
35 to 39 Rc	160,000
50 to 53 Rc	260,000
60 to 63 Rc	420,000

The implications for track wheel customers are clear. In mills, mines, cement plants, shipyards -in fact, anywhere heavy loads and higs stresses are encountered, the hard choice is the easy choice. Xtek.

Xtek Contour Case Hardened Wheels

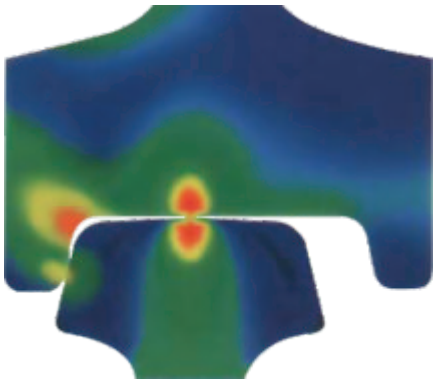
Over 40% of all wheel replacements are due to excessive flange wear and breakage. And while it has been demonstrated that increasing surface hardness will improve wear resistance, a hardness that is too deep in the flange area will actually increase the probability of breakage and wheel failure.



After 3,000,000 cycles, a competitor's wheel shows severe spalling, irregular wear and a deep groove. On right, The Xtek wheel shows no visible signs of wear after more than 12,000,000 cycles.

Durable Xtek track wheels are the performance standard in ports and shipyards around the world.

Just as a tough, ductile core beneath a hardened case helps to prevent spalling and pitting of the wheel tread, a ductile area backing up the hardened case of a flange will absorb shocks generated by



Side impacts during operation require tough, shock absorbent qualities in wheel flange walls. (FEA simulation)

span misalignment and badly worn joints between rail sections. Shocks which can stress wheel flanges to the point of catastrophic failure. All Xtek contour case hardened track wheels incorporate a differentially hardened flange designed to maintain critical ductile properties beneath the case. This valuable feature, which results from the Company's contour case hardening process, was developed over decades of metallurgical research and is vital to wheel flange toughness in service.

Where flange breakage is a major cause of crane wheel replacement, it becomes extremely important to specify a tough, ductile core as a requirement for any new wheels. Operator's needs are best served by insuring that all replacement wheels provide this vital protection - especially when high speeds, longer travel distances, and high loads are a factor. Make sure every track wheel that goes on your job is Xtek tough.

Satisfaction Guaranteed

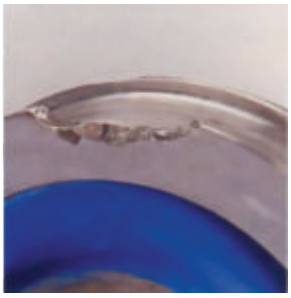
Many fortunate customers receive Xtek wheels as OEM equipment when they take delivery of a new crane, tundish car, bucket loader or other piece of rail-borne equipment. More often, Xtek track wheels are specified by our customers as replacements for ordinary, low-tech wheels that have failed in some way, usually because of frictional wear or flange breakage resulting from soft treads and the inappropriate selection of through hardening technology. As we will see later, changing over to Xtek contour case hardened, forged steel track wheels can have a signficant, positive impact on reducing maintenance costs, replacement costs, and the installation costs of new wheels.

Experienced machinists and the latest in CNC technology assure that concentricity and accuracy are built into every Xtek track wheel.

Over the years, thousands of customers have recognized the superiority of forged steel track wheels, and they specify Xtek whenever a need arises. Other users become converts when they receive a rebuilt track wheel assembly from the Xtek Service and Reconditioning Center in Cincinnati,

Xtek track wheel cross section demonstrates its hardened contour case (588-62 Rc), backed by a ductile support zone in both flange and tread.

Cross sections of a competitor's wheel graphically illustrates the perils of brittle, through hardened flanges.



The actual competitor's wheel from which the cross sections at left were taken.

Track Wheels

Ohio. Since 1995, our Service and Reconditioning Center has been supplying engineered solutions to customers chronic component problems, as well as providing 24/7 emergency service. Rebuilding wheel assemblies that come to us with inferior track wheels, among other problems, has become a large part of our business.

Wherever heavy loads have to be transported in an industrial setting, you'll find Xtek track wheels on the job an all kings of overhead cranes.

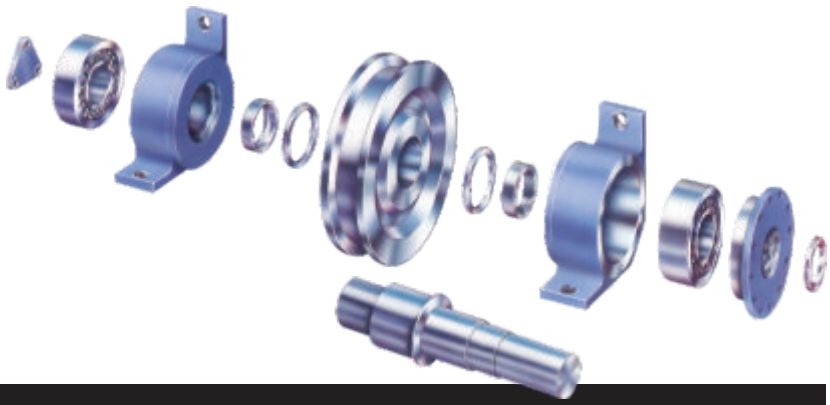
All rebuilt wheel assemblies leaving Xtek's Service and Reconditioning Center ride on our own contour case hardened, forged steel track wheels. Performance is how we gain new customers. Specify Xtek track wheels for your next replacement project or assembly rebuild.

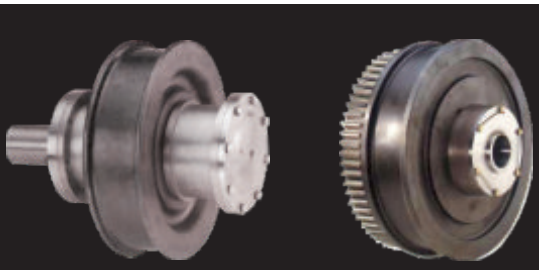
Wheel Assemblies

Xtek, The Single Source

In addition to replacement wheels, Xtek can furnish complete wheel assemblies with the added value of unifed design, quick change capabilty and superior bearing life. Xtek engineers routinely design solutions to problems inherent in old, orginal wheels and assemblies, while the Company's metallurgists employ their considerable expertise to produce the specific contour pattern in the case hardened wheel required for a particular assembly. The result is the perfect wheel for the assembly, and the perfect assembly for the job.

Xtek also manufactures the finest axles, shafts, bearing housings and mounting blocks available anywhere in the world. Moreover, when Xtek wheel assemblies are fitted with AP-style bearings originally developed for railroad use, these assemblies will perform millions of cycles without requiring lubrication. That means no bearing lubrication system. No downtime. Reduced maintenance. And most importantly, reduced cost.





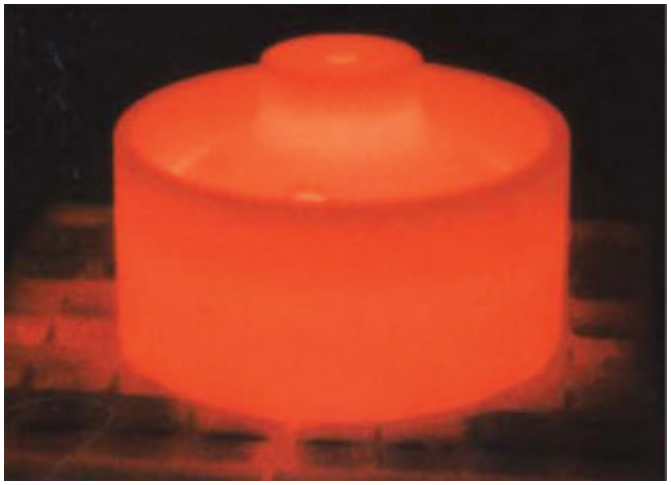
Day after day, year after year, Xtek wheel assemblies continue to succeed in the same hostile environments where others have failed. Thousands of Xtek contour case hardened wheel assemblies are hard at work in steel mills, cement plants, mines, shipyards, docks and many other tough industrial settings around the world. When reliability is a priority, make Xtek your single source supplier for total wheel assemblies.

Brake Wheels

Brake Wheel Basics

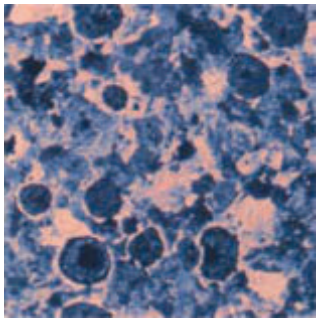
Friction. When you're pouring 300 tons of molten steel in a melt shop, you need it to hold your overhead crane in position to avoid disaster. Friction enables port cranes to unload valuable cargo from a freighter's hold and deposit it safely onto the dock.

In these and many other industrial applications, the friction between brake wheels and brake shoes no only brings equipment to a stop where it's needed, but also holds it in position so that important work can be completed. While in virtually every manufacturing system, friction is viewed as an enemy to be oiled, lubricated and polished out of existence, in critical braking systems, friction becomes a powerful force that can be harnessed to benefit production.

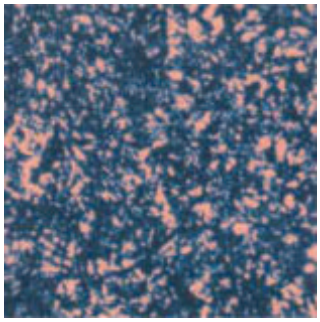


An Xtek brake wheel being heat treated.

In the design of brake wheels for any lifting and holding apllication, the side effects of friction -wear, thermal fatigue and cracking- must be overcome. The heat generated by the pressure of metal to shoe contact can produce thermal fatigue and cracking, ultimately causing the wheel to fail.



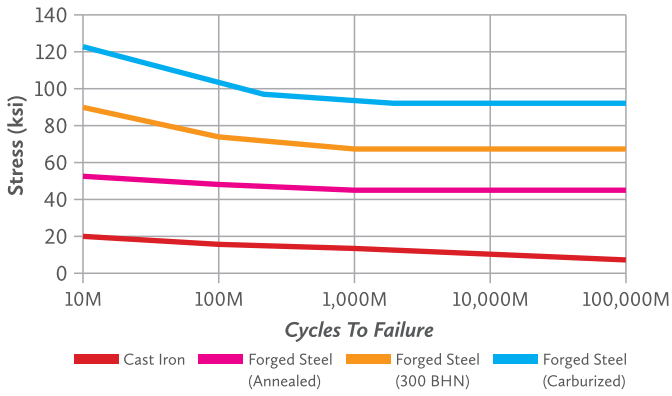
Microphotography showing the open, crack prone structure of ordinary cast iron brake wheels.



The microstructure of Xtek forged steel brake wheels exhibits a highly tempered martensitic structure, which substantially inhibit cracking.

Alternate heating and cooling is the culprit -a phenomenon which at first produces minute cracks in the wheel surface, and then gradually causes them to widen and deepen until fracturing results. A wheel properly designed to dissipate heat from the surface, one with an alloy chemistry matced to the rigors of job-specific operating conditions, and one properly heat treated to withstand thermal fatigue cracking, will significantly outcast "off-the-shelf" generic wheel designs.

Fatigue Resistance | Comparison of Stress vs. Failure

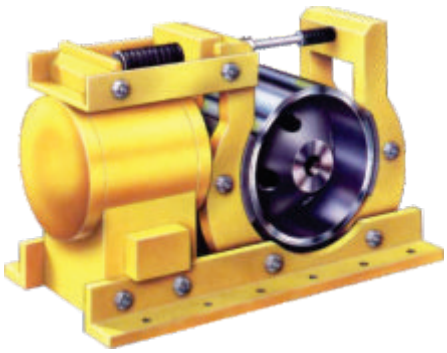


Brake Wheels

Xtek Reliability

An Xtek forged steel brake wheel is superior to all others because the balance of design elements, metal chemistry and heat treatment is specifically matched to individual operating conditions. That means every Xtek brake wheel will provide unsurpassed resistance to the effects of both frictional wear and thermal cracking. What's more, each Xtek brake wheel is dynamically balanced to minimize vibration. The result is longer product life and increased value. And because they are stronger, tougher and run truer, Xtek brake wheels are safer as well.

All Xtek wheels are manufactured from steel forgings, never from cast iron, a material proven to be prone to rapid, brittle and catastrophic thermal fatigue. High resistance to thermal fatigue, excellent abrasive wear characteristics and high fracture toughness are the qualities designed into every Xtek forged steel brake wheel. Qualities that give operators confidence that with Xtek, the brake wheels they place into service have absolutely the best chance of survival in hostile environments. Xtek brake wheels. Tough. Strong. Reliable.



To assure reliable, vibration-free performance, all Xtek brake wheels are dynamically balanced on sophisticated, computer controlled testing equipment.

Xtek forged steel brake wheels after heat treating and inspection, ready for final machining.

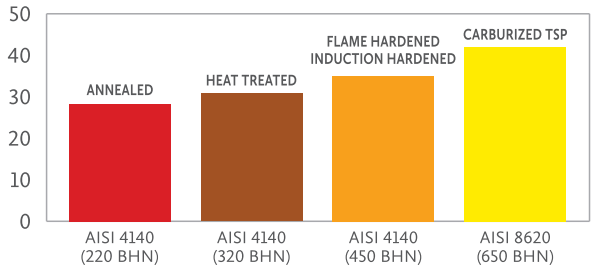
Sheave Wheels

Sheave Wheel Synergy

The deep, 64 Rc case resist wear, causing Xtek sheave wheels to outlast competitors' by a factor of 10 or more.

There are two very good reasons for specifying Xtek TSP® carburized sheave wheels to the exclusion of any other. Not only do Xtek sheaves last longer and require less maintenance, but wire rope used in tandem with Xtek wheels shows remarkable gains in longevity. In fact, on overhead cranes in the metals industry and on shipyard cranes, port cranes and in various mining applications, Xtek sheave wheels have been shown to increase wire rope life by as much as 5 times. The benefits of this synergistic effect are so apparent that over the years, many manufacturers of wire rope have chosen to recommend Xtek hardened steel sheaves to their customers as an economic way to prolong the life of their own products.

Wear Resistance | Comparison of Steels & Hardness

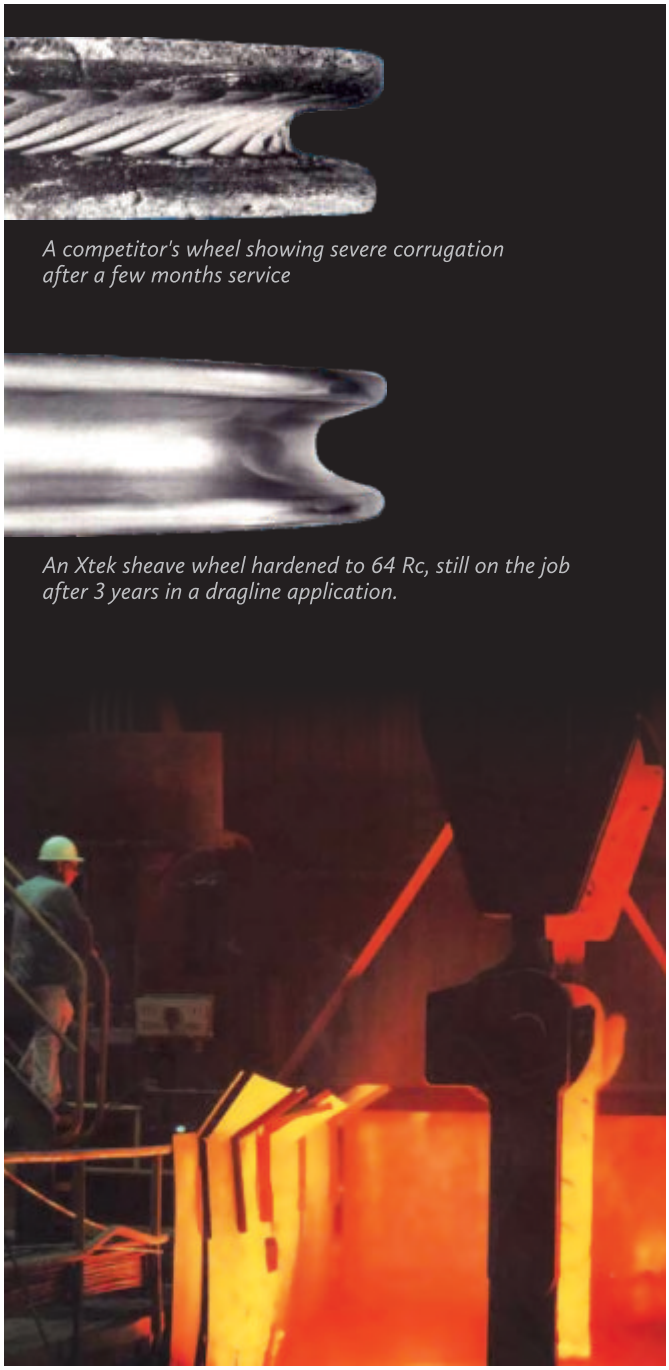


As an employee-owned company, every member of the Xtek team is commited to quality and service.

The Case for TSP

The TSP® carburizing process imparts a deep case hardness of greater than 64 Rc to the working surfaces of Xtek sheave wheels. This extremely hard, smooth finish effectively eliminates the effects of crushing and imprinting usually found on softer sheaves. Imprinting, caused by the compressive forces of wire rope under heavy loads, is the rapid development of strand impressions in the groove of ordinary sheave wheels. As a used rope stretches, or when a new rope is installed, the helix of the wire strands ceases to match the pattern imprinted in the groove of the sheave wheel. As a result, the sharp edged impressions begin to cut individual strands of the wire rope, progressively weakening it until it fails and must be replaced.

In comparison to the corrugation usually found in competitors' wheels after a tour of duty, the grooves of a forged steel Xtek TSP® hardened sheave wheel will actually become polished with use, further reducing friction and contributing to an average product life several times that of ordinary sheave wheels. In this way, Xtek's proprietary deep case TSP® carburization process prolongs the life of both elements of a cable carrying system, reduces the costs of downtime, extends the intervals between the cost of replacement and increases productivity.



A competitor's wheel showing severe corrugation after a few months service

An Xtek sheave wheel hardened to 64 Rc, still on the job after 3 years in a dragline application.

Xtek sheave wheels reward thier owners with superior performance, even in the most hostile environments.

Wheel Products

Above And Beyond

In addition to track, brake and sheave wheels for cranes and other operations, Xtek manufactures a complete line of related components, including rope drums, trunnions and rollers. Xtek wheel products are being used to retract the roof of Toronto's Skydome; to focus huge radio telescopes in Central America; to provide the rolling motion of large kilns and on all types of conveyors; and even on San Francisco's historic cable cars.

Xtek rope drums can be found on virtually every type of crane used by industry, including metal processing, shipyards and mining. Xtek's TSP® carburized rope drums are similar to sheave wheels in both their physical properties and customer benefits. Drums and rope both last longer, deferring the costs of replacement and reducing the costs of downtime and maintenance.

Xtek trunnions provide additional support to huge rotating kilns in the chemical, cement and food processing industries. And like other Xtek wheel products, the Company's trunnion assemblies, each manufactured to application specifications, produce a synergistic effect by increasing tire wear life.

Xtek rollers are used on conveyors, mining shovels and for many other types of equipment. Xtek uses the latest in CNC technology to produce matched sets of rollers, identical to each other in heat treatment and in mechanical tolerances, for years of smooth, trouble free operation.

Xtek carburized and hardened forged steel rope drums outperform all rivals in demanding crane applications.

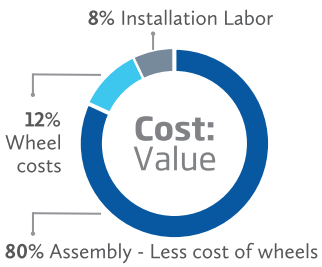
Focusing on Wheel Value

Every activity at Xtek begins with an awareness of our customers' need for value. That's why every wheel shipped from Xtek is custom designed and heat treated to succeed in individual customer applications. With a legacy of five generations of dedicated problem solvers, Xtek's metallurgists don't have to rely on one or two technologies to answer every customer need. Xtek will apply the best technology for the job, delivering wheels that will outlive competitive products while reducing maintenance, downtime and their attendant costs. With every wheel Xtek manufactures, Xtek produces value.

Wheel Economics

A look at Xtek's track wheel product line provides a graphic example of how Xtek saves maintenance costs for customers every day they're on the job. And in every case, installing high performance track wheels also makes sound economic sense, because the cost of wheels typically averages only 20% of the total cost of an assembly (actually, as low as 12% of the installation cost). That means a working track wheel must last at least as long as other replaceable components if a customer is to receive full value from his purchase.

Looking at the problem another way, the cost to recondition a demaged or worn out wheel assembly can easily amount to 75% of the cost of a brand new one. And that doesn't include the very real cost of maintenance and down-time. That's why Xtek stresses the importance of custom designing each wheel for each application.



The retractable roof of Toronto's Skydome rides on Xtek wheels.

Xtek At Work

A typical overhead crane provides a prime example of how Xtek wheel products perform in service. The only components that can stop a hard working crane from performing its tasks are the motor, mechanical and electrical drive systems, and its wheel products. Track wheels (and the rails they ride on), brake wheels (and brake pads), sheave wheels and rope drums (and their wire rope) -all benefit from Xtek's practice of on-site evaluation prior to final design. Environmental conditions, load factors and operator practices vary from installation to installation, placing very different demands on cranes designed to serve very similar purposes.

In Conclusion

Xtek's customer files contain hundreds of similar case histories, the result of a long-established tradition of turning competitors' failures into success stories. Xtek has become industry's number one supplies of hardened steel wheels for overhead cranes and other applications by training and developing field service engineers who take the time to listen to customers' problems and analyze the variables particular to the specific installation before making a recommendation.

Wheel products are not commodities at Xtek. Just as much care and effort support the design, metallurgy and manufacturing of this most basic mechanical form as is expended upon the Company's other engineered products. In effect, Xtek *has* reinvented the wheel. And what's more, we're proud of it.

When you install an Xtek track, sheave, brake wheel or wheel assembly -or for that matter, any heavy duty, engineered component from the shops of Xtek gears, couplings, universal joints, mill pinions or mill rolls- you're installing more than just a solution to immediate needs. You're installing lasting performance, reliability and value. In a name, Xtek.

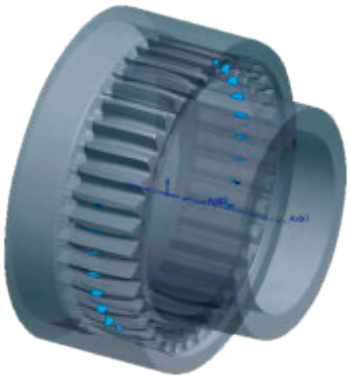
Gear Couplings

Geared toward superior performance & productivity

- **Customized to exceed the demands of each specific mill application**
- **Engineered for optimal performance and integrity**
- **Manufactured to the highest quality standards**
- **Metallurgically tailored to optimize material properties**
- **Thermally refined using the Xtek Tool Steel Process**

Engineering

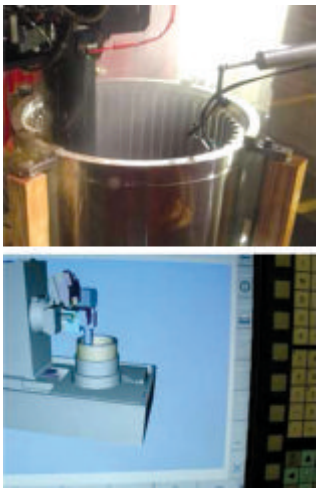
The Xtek gear couplings are highly engineered and customized products. The extensive engineering team is involved with every aspect of the gear coupling; from concept and design, through manufacturing, to evaluation and the eventual servicing and reconditioning. This engineering evolution, ensures that each gear coupling is optimized for peak performance.



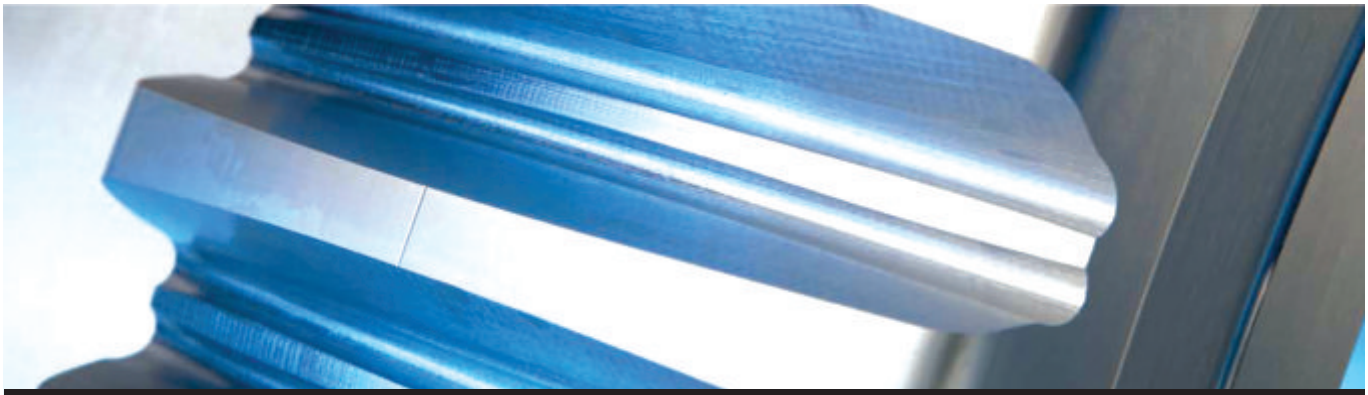
Model and FEA showing wear pattern and stress concentration points in a coupling ring gear and hub gear at a 3° operating angle.

Manufacturing

Xtek gear coupling components are machined to tight tolerances and stringent specifications on state-of-the-art machine tools. Many of the machine tools are customized for the machining of specific coupling components.



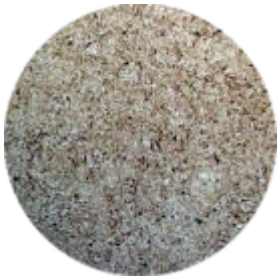
Coupling ring gear during finish grinding of the internal gear teeth.



Rolling Tons More than the Competition !

Metallurgy

Material selection is a primary function of the metallurgy group and writing the specific thermal processing cycles is a critical step in optimizing the material properties required in the gear coupling components.



Photomicrograph (100x) of case microstructure of coupling gear tooth produced by the Xtek TSP

Thermal Processing

The Xtek Tool Steel Process (TSP) have been in existence for over 100 years. These captive and exclusive thermal processes tailor the properties of each gear coupling component, resulting in metallurgically superior products.

Hub gear being removed from heat treatment furnace prior to quenching.

100 MONTH CAMPAIGN

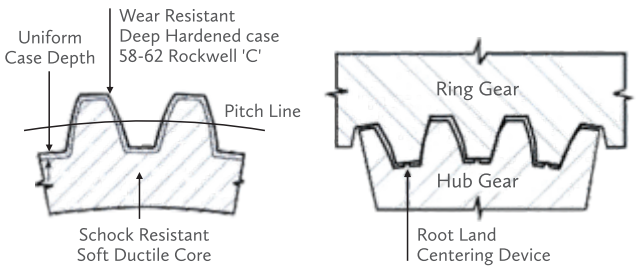
Xtek Gear Coupling Assemblies, serial numbers 4H-1 and 4H-2, are a set of roughing mill spindles in an 80" hot strip steel mill application. This set of spindles was in service for 100 months and rolled 52,500,000 tons of steel before being removed from service for "scheduled" maintenance. After a through inspection and evaluation, Xtek 4H-1 and 4H-2 received only minor reconditioning and were returned for service. An example of extreme performance and longevity of Xtek Gear Couplings.

Inspection photograph of Xtek "4H-2" TSP hard-finished roll end hub gear.

RING GEAR

Xtek TSP Unitized Ring Gear Design with Root Land Centering Device

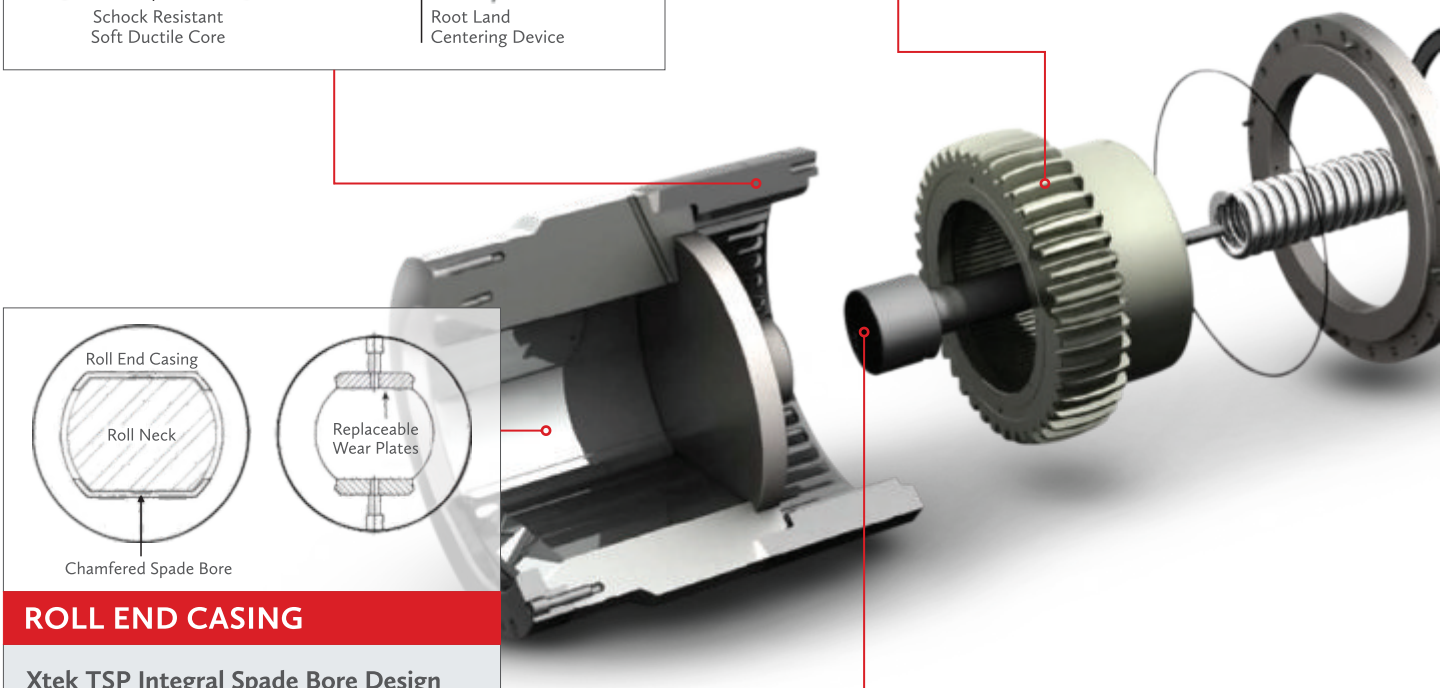
- Xtek TSP hardened case with surface hardness of 58 - 62 HRC
- Root Land Centering Device pilots with the tip of the mating hub gear tooth to ensure diametrical clearances and concentricity through the wide ranges of operating angularity.



HUB GEAR

Xtek TSP Hard-Finished Hub Gear with Splined Connection Option

- Xtek TSP hardened case with surface hardness of 58 - 62 HRC
- Double crowned tooth design ensures optimal load carrying capability at various operating angles with minimal contact stress.
- Multiple design options available
  - Hard-finished fully ground root
  - Welded-on or Bolted-on
  - Splined and interface fit
  - Splined and double piloted



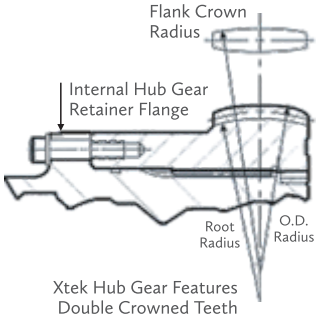
ROLL END CASING

Xtek TSP Integral Spade Bore Design with External Piloting Ring Option

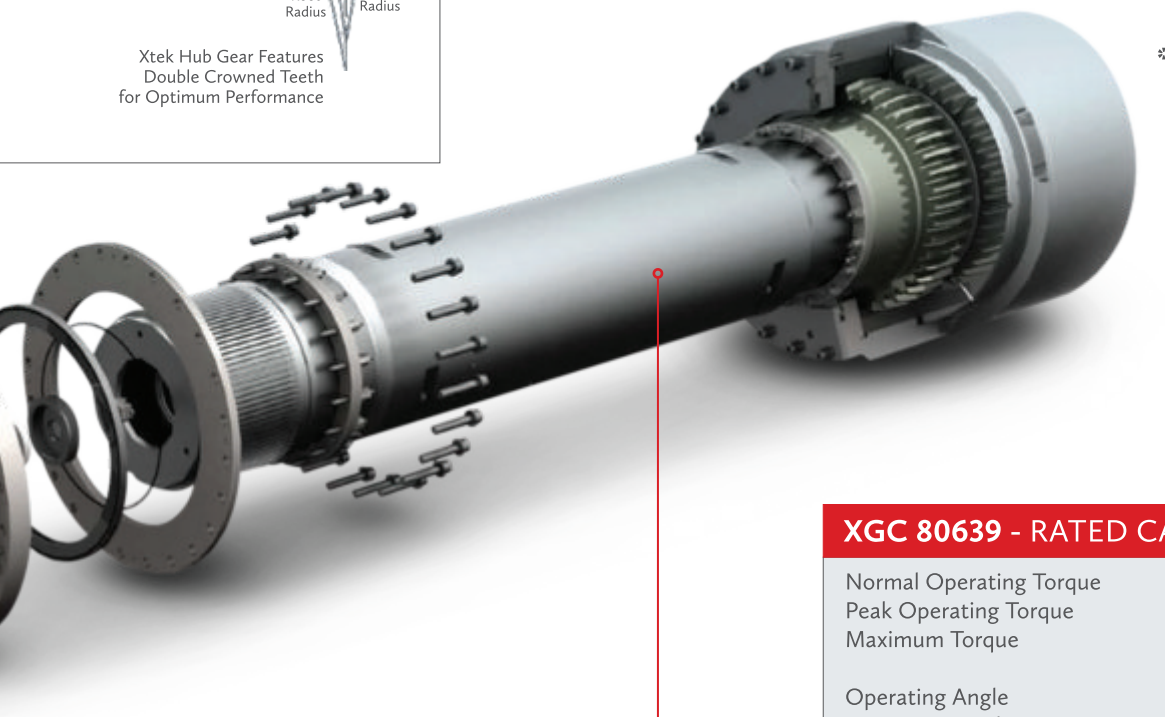
- Xtek TSP deep hardened case with minimum 0.250" case depth
- Precision ground wear surfaces for close tolerance fit between casing and roll drive spade
- Large chamfer for easy roll insertion
- Multiple design options available
  - Integral spade bore type
  - Replaceable keyed-type
  - External piloting ring
  - Internal piloting ring

THRUST COMPONENTS AND SPRING GUIDE ASSEMBLY

- Thrust components, including the thrust plate and thrust button, have an Xtek TSP hardened case with surface hardness of 58-62 HRC
- The spring guide assembly eliminates the need for a casing support system and is designed to keep the casing parallel with the roll neck during roll change
- Thrust plates are held in place by interference fits and require no internal bolts



Xtek Hub Gear Features
Double Crowned Teeth
for Optimum Performance



***XGC 80639 Shown**

XGC 80639 - RATED CAPABILITY

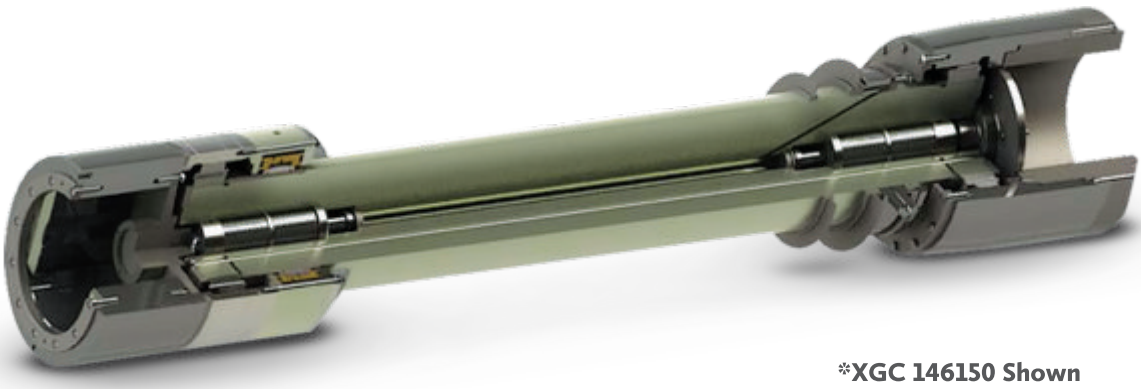
Normal Operating Torque	23,586,858 IN-LBS
Peak Operating Torque	29,545,643 IN-LBS
Maximum Torque	50,277,250 IN-LBS
Operating Angle	3 15
Max Static Angle	4
Operating Offset	6.265"
Max Static Offset	8.670"
Capability of Gearing at 3° 15'	
Normal Operating Torque	26,165,706 IN-LBS
Peak Operating Torque	36,229,437 IN-LBS
Maximum Torque	57,967,100 IN-LBS

SPINDLE

- Manufactured from medium carbon alloy steel and heat-treated to 280-320 BHN
- Splined ends to accomodate replaceable hub gears
- Telescoping options maintain axial force in the assembly at any shaft seperation
  - Central Coil Spring Assembly Option
  - Central Disc Spring Assembly Option

Telescoping Spindle Option

Xtek Oil Circulating Gear Coupling



*XGC 146150 Shown

- Internal oil-through-spindle technology is a superior solution for oil circulation in gear couplings
- The Xtek Ball-and-Socket Seal is of a dynamic design that utilizes high-performance materials *(See additional data at right)*
- Utilizes the same Xtek TSP gearing components as standard grease-type gear couplings
- Adaptable to existing roll end and drive end casing designs
- Maintains Xtek DriveWatch compatibility

The Xtek Advantages

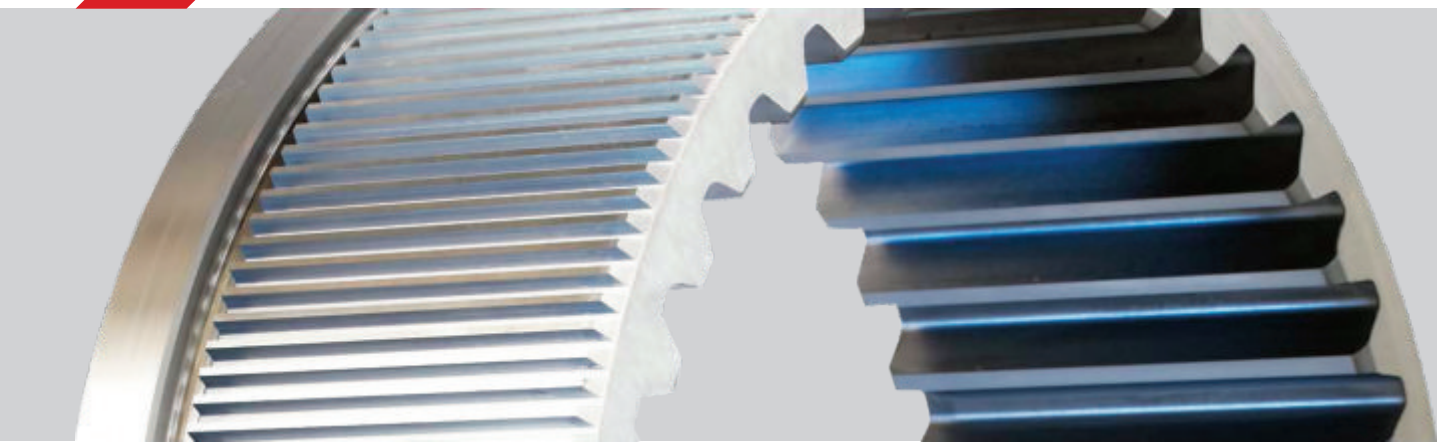
- Internal oit-through-spindle technology and Ball-and-Socket Seal eliminates the external oil re-circulating tube
- More reliable and maintenance friendly with less parts and fewer mechanical connections
- Less susceptible to damage during mill installation and operation
- Compatible with Xtek superior gearing components
- Modifiable from existing gear coupling designs
- Works with all spindle support systems

The Xtek Ball-and-Socket Seal

The Xtek Ball-and-Socket Seal was designed exclusively for the oil circulating gear couplings, with operating speeds and angles the mill applications have to offer. The seal is highly dynamic, articulating through multiple axes at any given angular rotation of the spindle. The use of high-performance, long lasting, wear materials and durable support components allow this seal to excell in service.

Product Spotlight

Xtek Gear Couplings model XGC 146150, serial numbers 7 (top) and 10 (bottom), in their second campaign after conversion to the Xtek oil circulating design.



Xtek Gear Coupling Management Programs **& Reconditioning** Services

Xtek offers gear coupling management programs and reconditioning services to all the mills that use geared spindle couplings. The programs focus on coupling tracking and scheduling, inventory services, and superior customer service.

Tracking and Scheduling

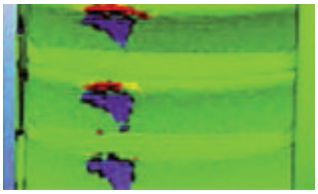
- Monitor all gear coupling activities and provide reports to illustrate status, history, and performance.
- All spindle shafts are marked with a permenent ID number for tracking
- Database tracks performance and history
- Information from database is the basis for performance enhancements and to develop maintenance schedules.

Inventory Services

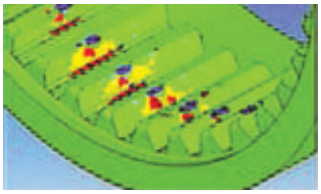
To support all reconditioning programs, Xtek has developed a Raw Material Family of Parts Inventory System. This system ensures that raw material necessary for production of long lead item components is present at Xtek. This eleminates the raw material lead time from the production schedule. This, in combination with the scheduled change out plans for the spindles in the mill, allows us to recondition the spindles in a timely manner.

Superior Customer Service

- Xtek ensures that dedicated individuals are available during the duration of the coupling management program
- Xtek local sales representatives are available as the initial point of contact for technical and commercial issues
- A service engineer and account manager are assigned to each specific program
- These individuals meet with mill personnel and make recommendations as required



The photograph at left is of a hard-finished hub gear that was removed for evaluation after 12 hours of operation. The photograph shows the polished areas of the hub gear teeth. The screen shot on the right is the solid model of the exact same hub gear after conduction an FEA on the part. The FEA shows the location of the contact stresses on the teeth after modeling it through the same angles and applied forces as the actual application. The consistency between the FEA results and the measurement of the actual part verify the accuracy of the analysis.

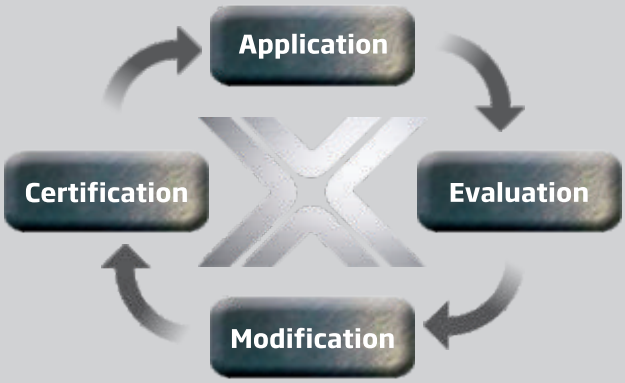


The photograph at left is of a standard finished ring gear after an extended campaign in the mill. The photograph shows the extent and location of the wear of the gear teeth. The screen shot on the right is the solid model of the exact same ring gear after conducting an FEA on the part. The FEA suggests that the teeth would wear and ultimately fail as a result of tooth interference under applied load. Confirming the accuracy of the models with confirmed evaluations helps in the development of gear component life expectancy after mill setup changes.

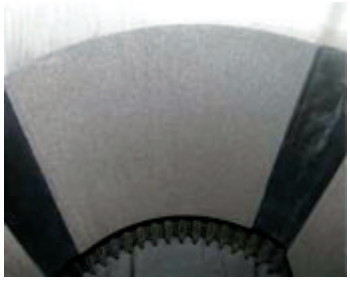
The Xtek Gear Coupling Reconditioning Cycle

The Xtek gear coupling reconditioning cycle is a perfect example of the Xtek Continuous Improvement Principle.

- The gear couplings are received from the application and prepared for servicing and reconditioning.
- Technicians, Inspectors, and Engineers collect and evaluate all the data, and make recommendations for improvement.
- Manufacturing performs the recommended modifications using standard operating procedures and quality standards.
- Technicians, Inspectors, and Engineers certify that the reconditioned assembly is ready for the next mill campaign.

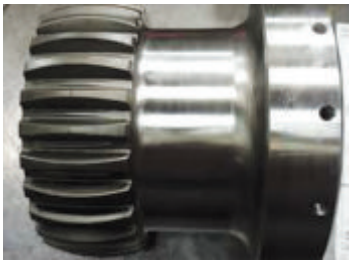


Extending mill campaigns and lowering operating costs



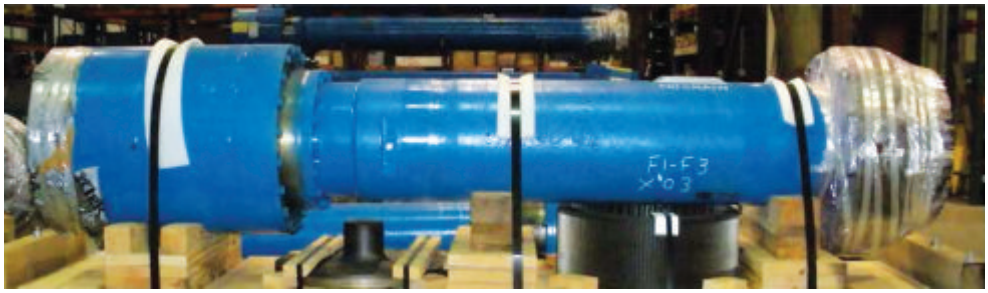
The as-machined surface of a TSP Roll End Casing following the Electro Discharge-Machining (EDM) process.

Coupling adapter and spindle weldment assembly, during the submerged arc welding (SAW) process. In many cases reconditioned gear coupling assemblies requires that replacement components are joined to modified components. All welding processes at Xtek are tightly controlled and utilize superior welding wires and flux combinations to produce the desired metallurgical properties.



Splined coupling adapter and hub gear at final inspection

A roll end casing during the 3D laser scanning process. The laser scanner verifies dimensions on finished parts, is used to generate solid models of complex parts, and is a vital part in generating engineering analyses that require high precision and accuracy.



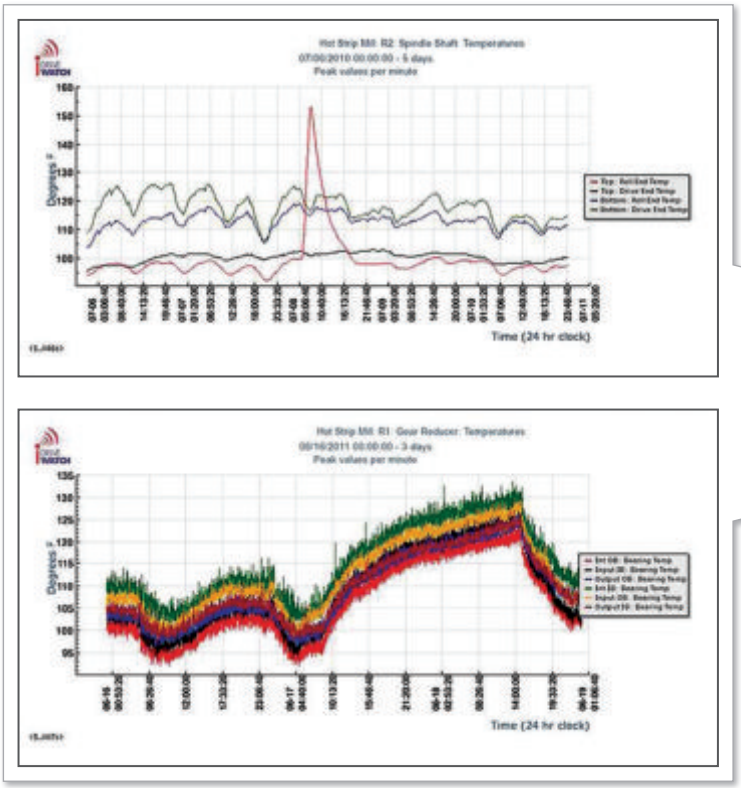
HSM F1-F3 Gear Coupling X-03, along with DE Thrust Plate and DE Ring Gear, ready for shipment.

Xtek DriveWatch

The Xtek DriveWatch System

is a comprehensive data acquisition, reporting, and analysis system. The system consists of all required hardware and software as well as analytical services to deliver unmatched value in the maintenance arena.

- On-board monitoring of torque and temperature on gear coupling assemblies.
- Data collected from the gear coupling assembly is transferred wirelessly to communicator boxes located throughout the mill.
- The communicator boxes are hard-wired to an Xtek DriveWatch Gateway server.
- The Xtek DriveWatch Gateway server sends data to offsite storage locations for longer-term trend analysis, and directly to other smart devices for real-time analysis and alert features.



Examples of trend analysis charts obtained from actual Xtek DriveWatch installation

Xtek DriveWatch communicator box located near the Hot Strip Mill Finishing Stands. The communicator box has been collecting gear coupling Torque, temperature, and vibration data for nearly a decade.

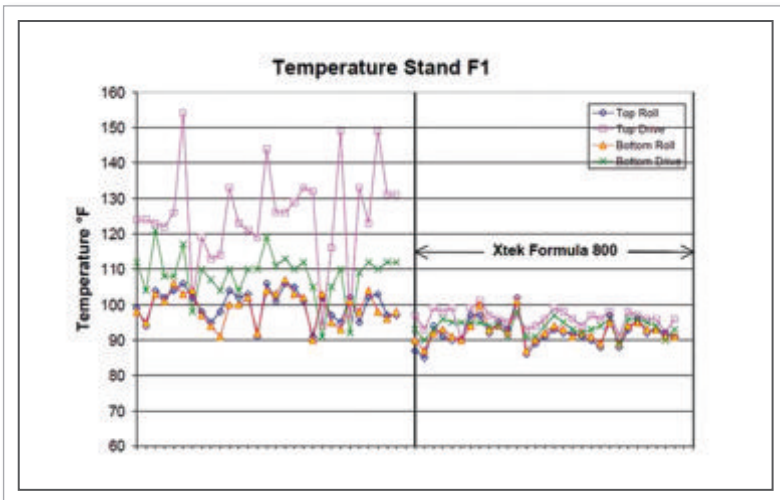
Xtek Formula 800 & Formula 1000

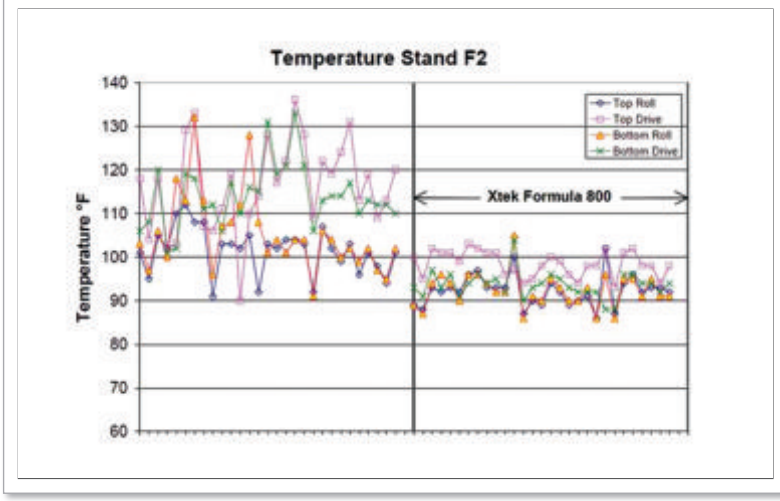
Xtek Formula 800 and Formula 1000 Ultra High Performance Greases

were developed specifically to extend gear coupling campaign lenght, reduce grease consumption, and reduce overall spindle operating cost per-ton.

- Formula 800 for high torque and high angle applications
- Formula 1000 for high speed and high angle applications

Xtek hard-finished hub gear after an extended campaign. With Xtek Formula 800 and proper greasing procedures in place, the hub gear showed only slight polishing of the gear teeth.





Examples of trend analysis charts obtained from actual Xtek DriveWatch installation. The charts show the significant drop in operating temperatures in the gear cavities of gear couplings after switching to Xtek Formula 800 Ultra High Performance Grease.

Gearboxes

Custom gear drives and gear drive reconditioning for demanding applications

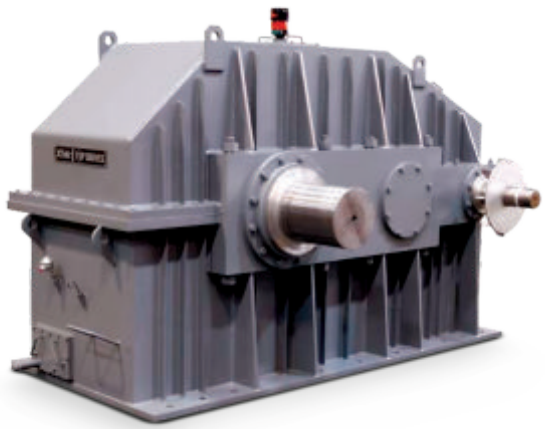
Industries Served

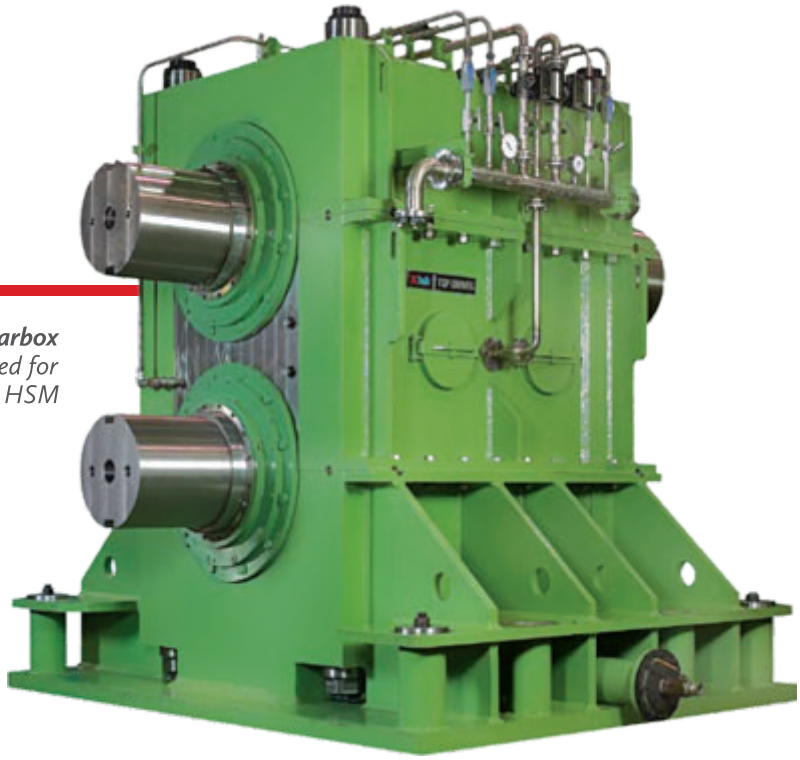
- Steel
- Aluminum
- Mineral Processing
- Power Generation
- Pulp and Paper
- Agriculture / Food Processing

For the past 40 years, Xtek has designed and manufactured some of the finest custom gearboxes seen in the industry today. Customers who choose Xtek can be assured that each gearbox is designed to perfection by highly trained engineers guaranteed to meet even the most demanding gearbox design specifications. In addition to our highly qualified design team, Xtek has exclusive heat treating capabilities, along with state of the art manufacturing facilities.

Gearing & Gearbox Capabilities

- AGMA Quality 15
- TSP Carburizing to 58 – 62 Rc.
- Gear diameters from 10" – 100"
- Up to 100,000 pounds
- Reverse Engineering and FEA Analysis



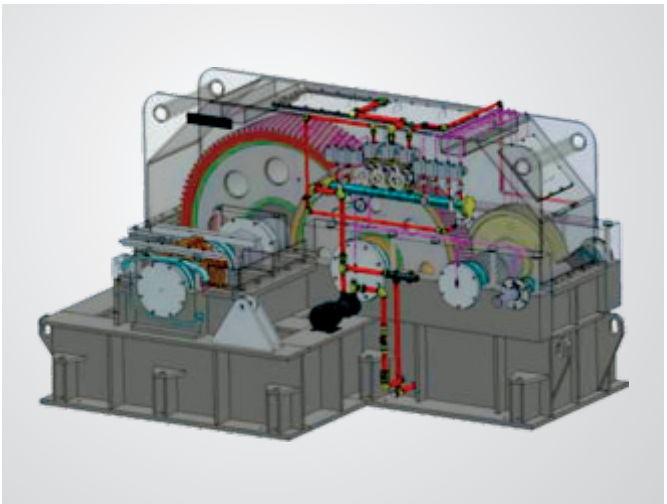


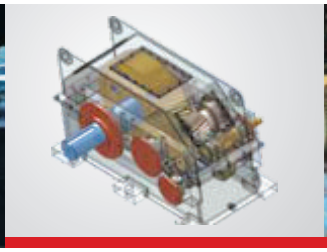
R2 Gearbox
designed for
Turkey HSM

Whether you need a single replacement gear, a set of gears, or a complete gearbox, you need Xtek's expertise in the design and manufacturing of those gears.

Our experienced engineers use the latest engineering software to evaluate and design custom gearing for your application.

Couple this with our metallurgical and manufacturing experience of over 100 years, add in quality that is unparalleled, and you get an Xtek gearing and gearboxes.





Engineering

Xtek manufactures new, high quality, custom engineered industrial gearboxes. We specialize in reconditioning gearboxes, which includes offering our customers material and design options to upgrade the capability of their gearboxes.

Every Xtek gearbox is designed in accordance with AGMA (American Gear Manufacturers Association) and AIST (Association for Iron and Steel Technology) specifications. Our engineers participate on committees that shape standards and define the best practices for manufacturing or reconditioning gearboxes.

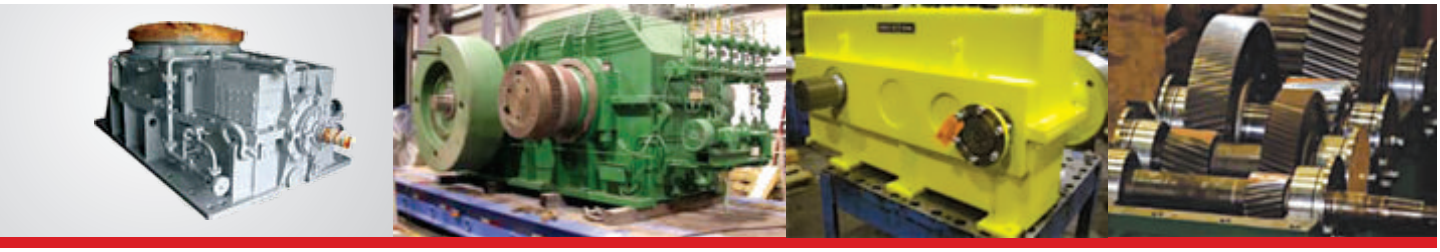
We utilize state of the art engineering tools to model and evaluate each gearbox that we process. Xtek employs a team of experienced mechanical, manufacturing and metallurgical engineers that allow us to be your complete gearbox solution company.

Heat Treatment

Requirements for increased productivity are common and require a fresh look at your gearbox requirements. Xtek specializes in improving gearbox performance by evaluating the material and heat-treatment of the entire drive train. The Xtek Tool Steel Process (TSP) is a special in-house heat treating process that significantly improves the strength and durability of your gearing, thus greatly improving the load capability of your gearbox. Xtek has the ability to make material and heat-treat recommendations based on specific problems you may be experiencing and the application. This is what Xtek has provided our customers for over 100 years!

Additional Services

- Reverse engineering
- Gear rating analysis
- Shaft analysis
- Bearing analysis
- Root cause analysis
- On-site engineering support
- DriveWatch™ - Mill Monitoring System



Gearbox
Reconditioning Services

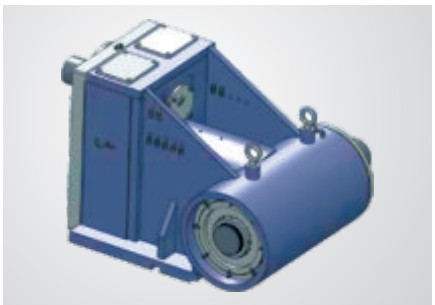
Many shops can disassemble and reassemble an industrial gearbox and call it Gearbox Repair. However, few can do it with the resources and quality that Xtek provides. No matter the original equipment manufacturer or whether or not drawings are available; our service engineers will evaluate each mechanical component of the gearbox and provide a complete analysis and gearbox repair plan.

From failure analysis (FEA) to reverse engineering, from on-site gear inspections to installation support, our service engineering team will work with you to not only repair, but to improve the performance of your gearboxes.

Xtek dedicated service facilities are located in Cincinnati, Ohio and Hammond, Indiana. These facilities are supported by in-house gear manufacturing and heat treating. Xtek provides 24 hour emergency service to our customers.

Our focus is on industrial gearboxes weighing from 1,000 to 100,000 pounds and operating at speeds of 1800 RPM or less. We service and repair all types of gearboxes (spur, helical, herringbone, bevel and worm).

Before Reconditioning



Engineering Drawing

Reconditioning Procedure

- Photograph upon receipt
- Disassemble complete
- Perform inspections
  - » Dimensional
  - » Photogammetry
  - » Wet magnetic particle (on-site certified inspectors)
  - » Hardness
- Detailed inspection report including:
  - » Upgrade options
  - » Engineering analysis
- All components to be manufactured or repaired on-site, to include heat-treatment
- Assembly and final inspection to include the following:
  - » Record bearing end play, gear backlash and gear contact pattern
  - » Perform no-load run test – monitor bearing temperatures, vibration and gear noise
- Paint per customer specifications
- Prepare for shipment

After Reconditioning

Bemcalloy™ Pinch Rolls

Engineered for optimal performance in hot strip mill coiling applications

Wear Resistance

Two wear mechanisms, abrasion and adhesion, occur in the pinch roll application. Abrasive wear results when a harder material removes particles from a softer surface. Adhesive wear, or frictional wear, results from the scuffing action between two contacting surfaces that become bonded and subsequently pulled from their respective surfaces. Both mechanisms cause pinch roll wear.

Application Requirements	Bemcalloy C141	Bemcalloy C1	Bemcalloy XA	Bemcalloy A3
Pickup Resistance	●●●●	●●●●	●●●	●●●
Wear Resistance	●●●	●●	●●●●	●
Corrosion Resistance	●●	●●	●●●●	●●
Thermal Stability	●●●●	●●●●	●●	●●●
Impact Strength	●●	●●	●●	●●●●
Tensile Strength	●●	●●	●●	●●●●

The Pinch Roll Unit

Purpose

- Catch the strip head end and direct it down into the coiler proper
- Provide driving force to direct the strip around mandrel until "cinch"
- Provide strip hold-down function during body of coil
- Provide and maintain strip tension after the tail end leaves the mill

Resistance to Pickup

Pickup is a condition whereby foreign material becomes adhered to the surface of the pinch roll during service. The condition causes mill downtime for pickup removal from the pinch rolls and/or scrapped coils due to poor surface quality.

Bemcalloy Completely Resists Pickup

The inherent lubrication properties of graphite in Bemcalloy along with the natural resistance to adhesion of dissimilar metals is the basis of the pickup resistance of Bemcalloy.

- Xtek Bemcalloy Pinch Rolls reduce mill downtime and coil rejections
- Xtek Bemcalloy Pinch rolls require no in-situ process grinding equipment

Bemcalloy Resists Both Adhesive and Abrasive Wear

The specific chemistry and heat treatment process used at Xtek metallurgically tailors the Bemcalloy microstructure to resist both abrasive and adhesive wear.

- Xtek Bemcalloy Pinch Rolls provide predictable and uniform wear
- Xtek Bemcalloy Pinch Rolls require less stock removal at grind

Attributes

- Excellent Wear Resistance
- Resistance to Pick-up
- Thermal Stability
- High Thermal Conductivity
- Resistance to Thermal Fatigue
- Resistance to Thermal Shock
- High Strength
- Through-hardening Capability

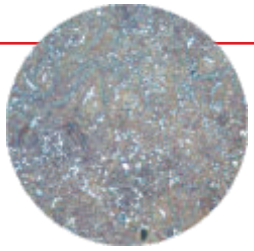
Bemcalloy C141

Composition

• Hypoeutetic Alloy Gray Cast Iron

Attributes

• Resistance to Pickup
• Very Good Wear Resistance
• Thermal Stability
• High Thermal Conductivity
• Resistance to Thermal Fatigue
• Resistance to Thermal Shock
• Through-hardening Capability



Optimal Hardness
Heat Treated
62-67 HSC
(46-50 HRC)

Carbon	Chromium	Molybdenum	Nickel	Niobium	Silicon
2.90/3.10	0.40/0.60	0.20/0.40	1.00/1.50	0.80/1.20	1.50/2.00

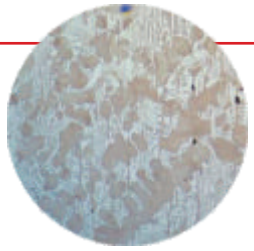
Bemcalloy C141

Composition

• Hardened White Alloy Cast Iron

Attributes

• Resistance to Pickup
• Exceptional Wear Resistance
• Corrosion Resistance
• High Thermal Conductivity



Optimal Hardness
Working Layer
67-72 HSC
(50-54 HRC)

Layer	Carbon	Chromium	Molybdenum	Nickel	Silicon
Working	3.45/3.70	1.45/1.70	0.20/0.30	1.45/1.70	0.15/0.30

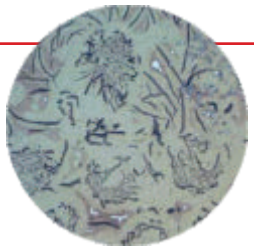
Bemcalloy C1

Composition

• Hypoeutetic Alloy Gray Cast Iron

Attributes

• Resistance to Pickup
• Good Wear Resistance
• Thermal Stability
• High Thermal Conductivity
• Resistance to Thermal Fatigue
• Resistance to Thermal Shock
• Through-hardening Capability



Optimal Hardness
Heat Treated
62-67 HSC
(46-50 HRC)

Carbon	Chromium	Molybdenum	Nickel	Niobium	Silicon
2.90/3.10	0.40/0.60	0.20/0.40	1.00/1.50	—	1.50/2.00

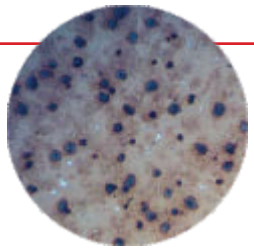
Bemcalloy C141

Composition

• Nodular Ductile Cast Iron

Attributes

• Resistance to Pickup
• Exceptional Wear Resistance
• Resistance to Thermal Fatigue
• Resistance to Thermal Shock
• High Tensile Strength
• High Impact Strength



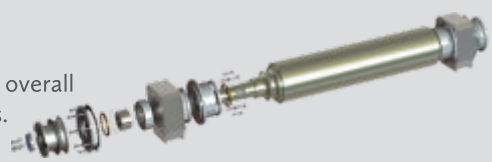
Optimal Hardness
Heat Treated
58-64 HSC
(44-48 HRC)

Carbon	Chromium	Molybdenum	Nickel	Niobium	Silicon
2.90/3.10	0.40/0.60	0.20/0.40	1.00/1.50	—	2.00/2.50

The Pinch Roll Reconditioning Services

Chargeable and recurring services include:

- Complete assembly evaluation and reconditioning
- Regrinding Services
- Re-sleeves of top pinch rolls
- Bearing diameter rebuilds
- Metallurgical evaluations
- Field engineering services



These services are critical factors in effecting the overall performance and total life costs of the pinch rolls.

The information obtained by doing these services is paramount in the continual product enhancement and development process.

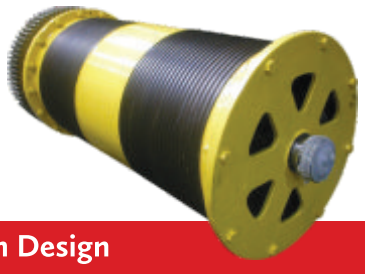
Rope Drums

Engineered for increased service life and safety

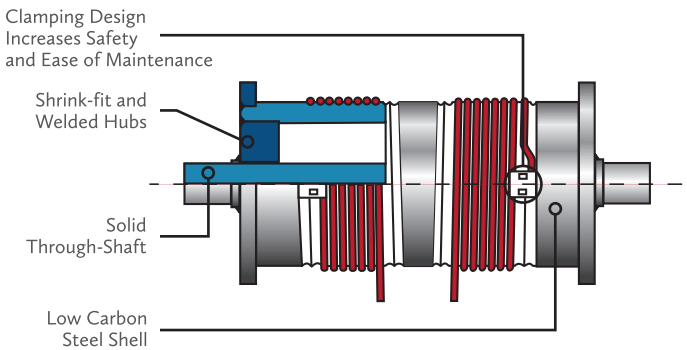
An Xtek Tool Steel Process (TSP) rope drum is manufactured from low carbon steel, which is carburized and hardened to produce a longer lasting rope drum. The Xtek TSP rope drum is designed to increase the life and to provide SAFE performance of the rope drum.

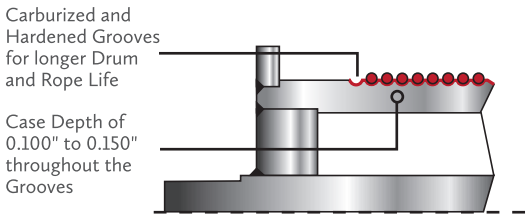
The hardened case of an Xtek TSP rope drum has a very uniform and wear resistant surface, which is typically hardened to 60 HRC minimum. The hardened and toughened case of the groove surface is approximately 0.100" to 0.150" deep. Hardened and toughened grooves lower the coefficient of friction between the rope and the grooves, decreasing groove wear, rope wear and related downtime costs.

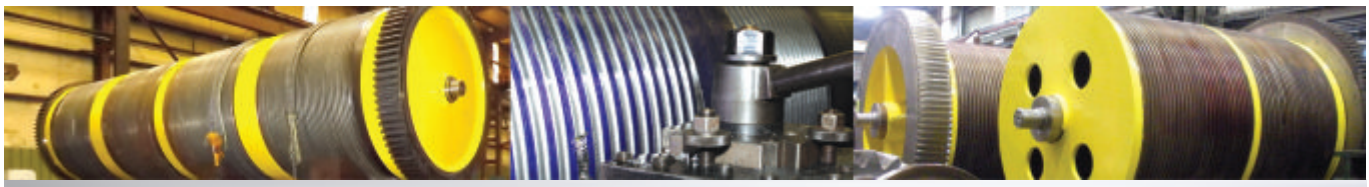
- Thicker Sleeve
- Solid Hubs
- Through Shaft



Xtek TSP Rope Drum Design







Benefits

- A significant increase in the life of the rope drum
- Reduced wire rope expense
- Less downtime
- Reduced maintenance costs
- R SAFE – elimination of welds and through shaft

provides a drum much more resistant to a catastrophic failure

Heat Treating Capabilities

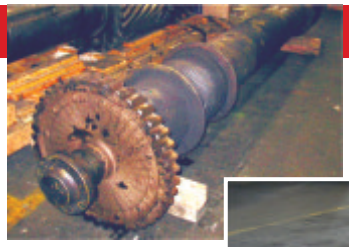
- TSP Carburized
- Flame Hardened or Annealed

Rope Drum Reconditioning Services

Xtek does an excellent job in reconditioning used rope drums. Common reconditioning opportunities are as follows:

- Re-grooving the sleeve (if the shell thickness is adequate)
- Replacing the drum gear
- Bearing and seal changes
- Shaft journal repairs or shaft replacement
- Replacing fabricated ends that have cracks (change to a solid hub design)

As an integral part of reconditioning a rope drum, Xtek engineering will evaluate the load capability of the drum to insure that any reduction in capability caused by reducing the thickness of the drum shell is within an acceptable level.



Before reconditioning

After reconditioning

Heavy Duyt Univesal Joints

Quality Products for the Mills

Recognized Standard of Excellence

Xtek and its Tool Steel Process (TSP) have been serving industry since 1909. This proprietary method of carburizing and heat-treating steel imparts exceptional qualities of wear resistance, strength and long life. All TSP carburized products possess a deep, uniformly hardened case, backed by a tough resilient core, for unsurpassed performance under the most demanding conditions.

Component Features and Options

- **Roll End Casing** – TSP carburizing supplies the best combination of surface hardness and case depth, thus providing the longest life for the casing bores. (See page 6). A precision ground spade bore provides increased casing and roll neck life.
- **Yoke** – A closed eye design (1 piece), long recognized as the most struc-turally sound design available. With cast yoke, we have more flexibility in the design, permitting us to offer such unique features as angled bolt designs and “pockets” under the ears of the yoke, which make assembly and disassembly much easier and faster to accomplish. A one-piece yoke has the advantage of no maintenance to verify if bolted connections have loosened and the elimination of precision matching of components for equal bearing loading.
- **Cross and Bearing Package** – Built tough for long life. All Xtek universal joint crosses are made from 9310 alloy steel, heat treated for extended wear. Long lasting, low maintenance Xtek crown rollers are 52100 steel, hardened to 62 – 65 HRC. Finally, four separate lube points on the cross ensure that proper lubrication gets to all bearing cups for smooth, trouble free running.
- **Seals** – Xtek’s unique, multi-lip bearing cup sealing system is the newest, most innovative approach to the age-old problems of lubrication leakage and contamination. For most sizes, we use our special 4-lip design, which has been proven to out-perform competitive products by a wide margin.

Univesal Joint
Applications

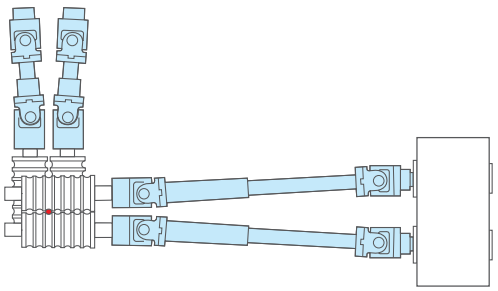
Quality Customer Service

Xtek's knowledgeable power transmission sales consultants are eager to join with all customers in the pursuit of more productive manufacturing systems. They provide customer support through all phases of implementation, from fact finding, to design and engineering, manufacturing, installation and performance tracking.

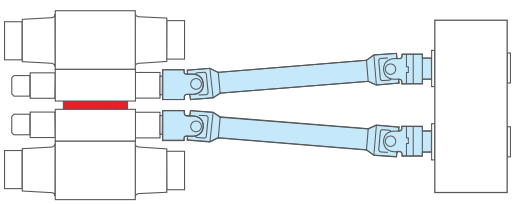
Our sales consultants are backed by a seasoned engineering staff that carefully matches product recommendations to customer specifications and system requirements. The Xtek engineering staff will:

- Perform a rating analysis–evaluating capacity and assigning safety factors to the customer application.
- Optimize product design using the latest engineering tools such as finite element analysis, which is used to simulate loads and to reduce stress in critical areas of the yoke and cross.
- Select the appropriate metallurgy and oversee heat treatment to obtain maximum performance from the material properties of individual components.

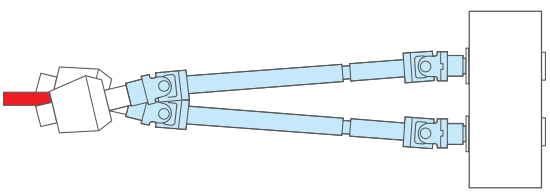
Xtek universal joints are manufactured and assembled in a modern facility meeting the requirements of ISO-9001 standards of quality and reliability. In addition to building new components to customer specifications, Xtek also rebuilds, reconditions, and when necessary, redesigns parts that have been in service and become worn or obsolete.



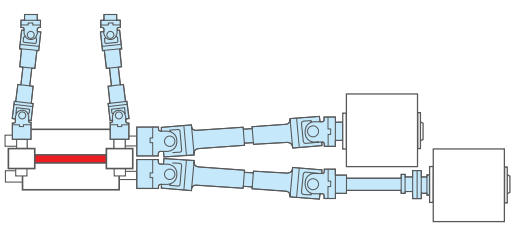
Rod and Bar Mills
- Roughers
- Vertical and Horizontal Stands
- Shapes and Structurals
- Bar Straighteners



Cold Finishing Mill
- 2 High, 4 High, 6 High
- C.V.C
- Tandem Finishers
- Reversing Finishers



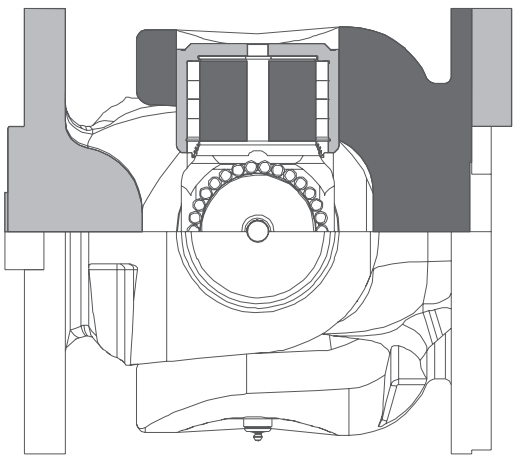
Tube Mills
- Piercers
- Elongaters
- Reelers
- Tube Straighteners



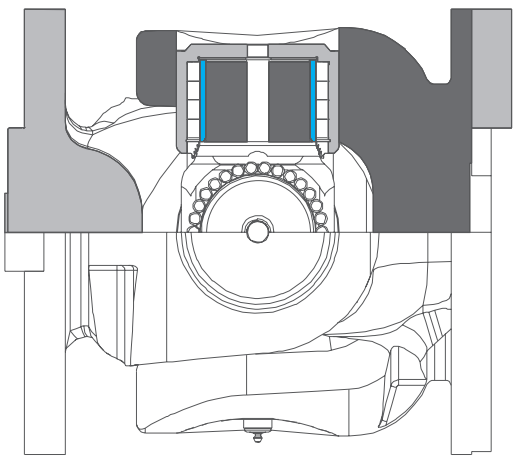
Primary Mills
- Reversing Roughers
- Horizontal Rolls
- Vertical Rolls
- Continuous Tandem Roughers
- Slabbing Mills

- **Conveyors**
- **Forming Rolls**
- **Coilers**
- **Levelers**
- **Tinning Mills**
- **Pickle Line**
- **Paper Mill**
- **Edger Mill**
- **Section Mill**
- **Continuous Wire Mill**
- **Continuous Caster**
- **Billet Mill**
- **Runout Tables**
- **Mining Equipment**
- **Temper Mill**
- **Skin Pass**
- **Scale Breaker**
- **Plate Shears**

Cross & Bearing
Configuration

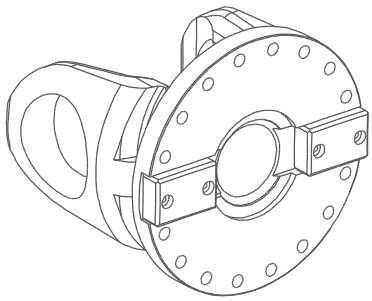


XT 55-55 and below Trunnion Type.
Rollers contact directly on the trunnion of the cross



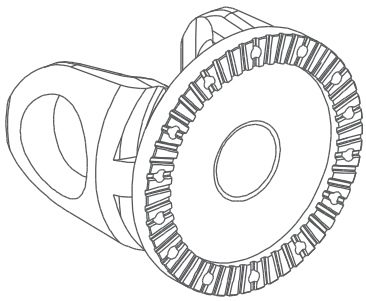
XT 60-60 and above Sleeve Type.
A sleeve is installed on the cross and rollers contact on the sleeve

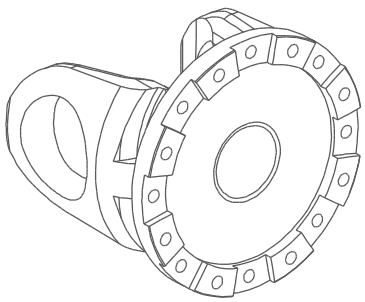
Flange
Design



Face Key

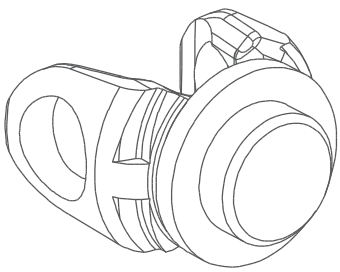
Hirth Serration



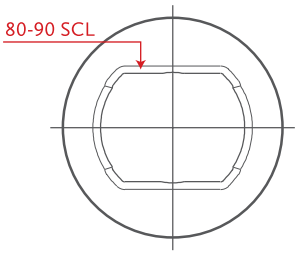


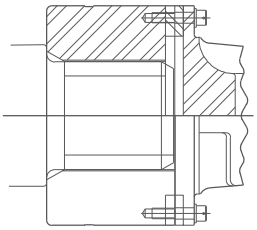
Integral Face Pad

Welded

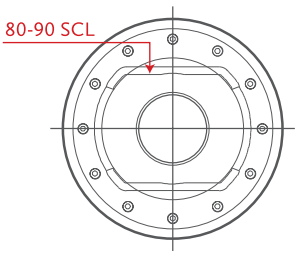


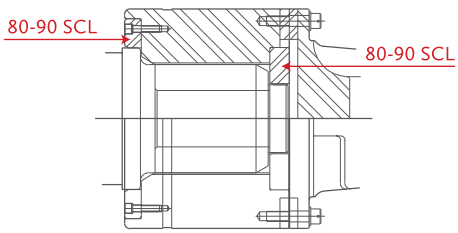
Roll End Casing
Design



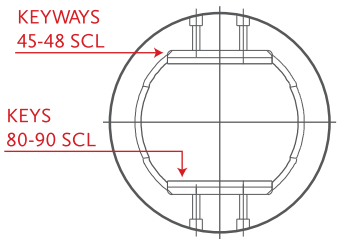


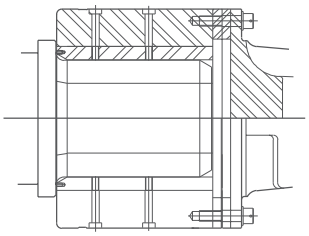
Integral Spade Bore Casing



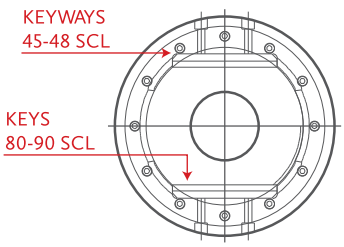


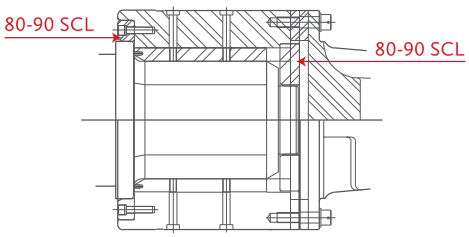
Integral Spade Bore Casing with Replaceable Pilot Rings



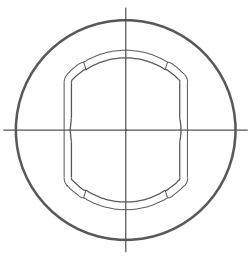


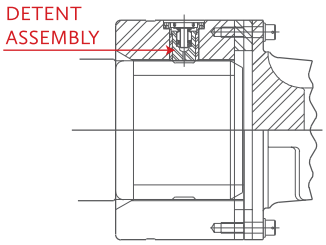
Casing with Replaceable Keys





Casing with Replaceable Keys and Pilot Rings

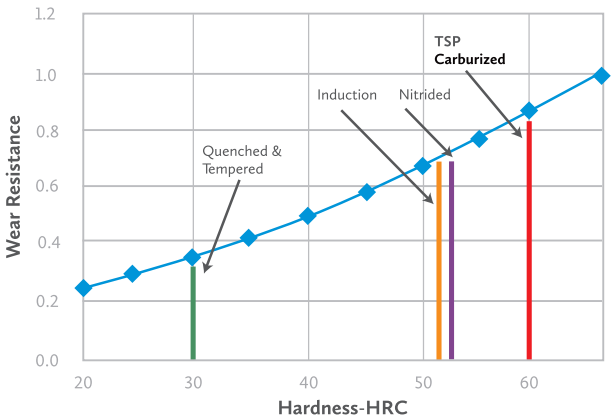




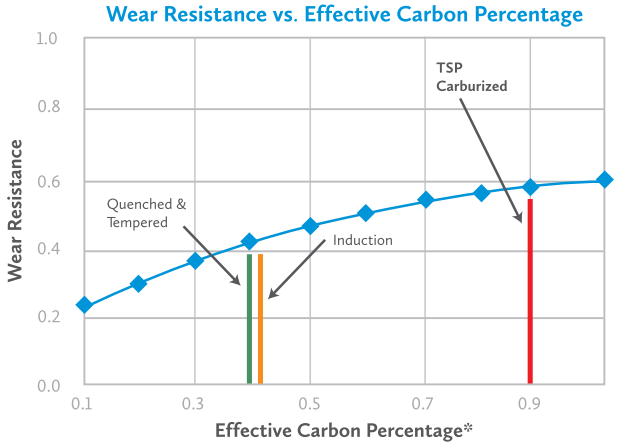
Casing with a Detent Assembly

Roll end casings are a critical link in the power transmission of a rolling mill. The durability of the casing is a function of metallurgy, geometry and application. Casing wear rate is inversely proportional to hardness level and carbon percentage. The figures below show the hardness, effective carbon content, case depth and the overall durability of materials commonly used for casings. Note that 4140 steel hardened to BHN 300 (HRC 32) has a significantly lower wear resistance than the much harder TSP Carburized steels.

Wear Resistance vs. Hardness

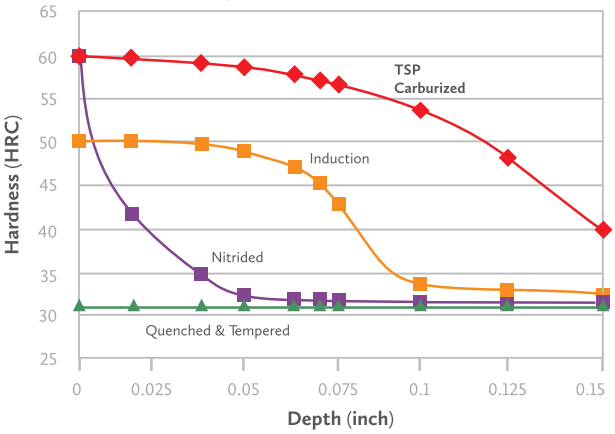


Wear Resistance vs. Effective Carbon Percentage

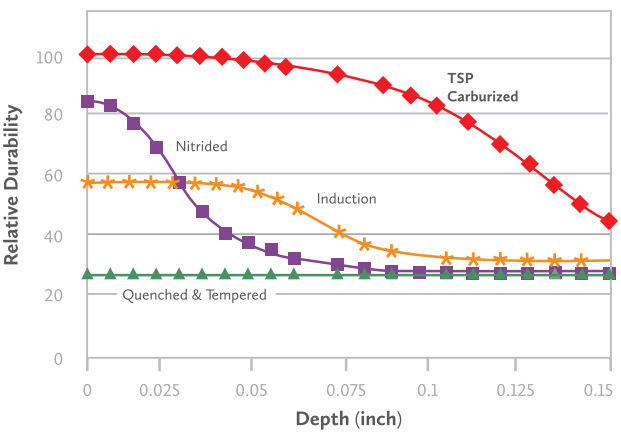


While induction hardened and nitrided steel have comparable hardness, the case depth of these treatments is relatively shallow and as the spade bore wears, the wear rate accelerates. The figure below at left shows typical case depths of various heat-treat methods. Note that carburizing leads to a dramatically greater case depth than other methods. In the figure below at right, durability with respect to wear depth of materials commonly used for spade bores is shown.

Case Depth of Various Heat Treatments



Durability vs. Wear Depth



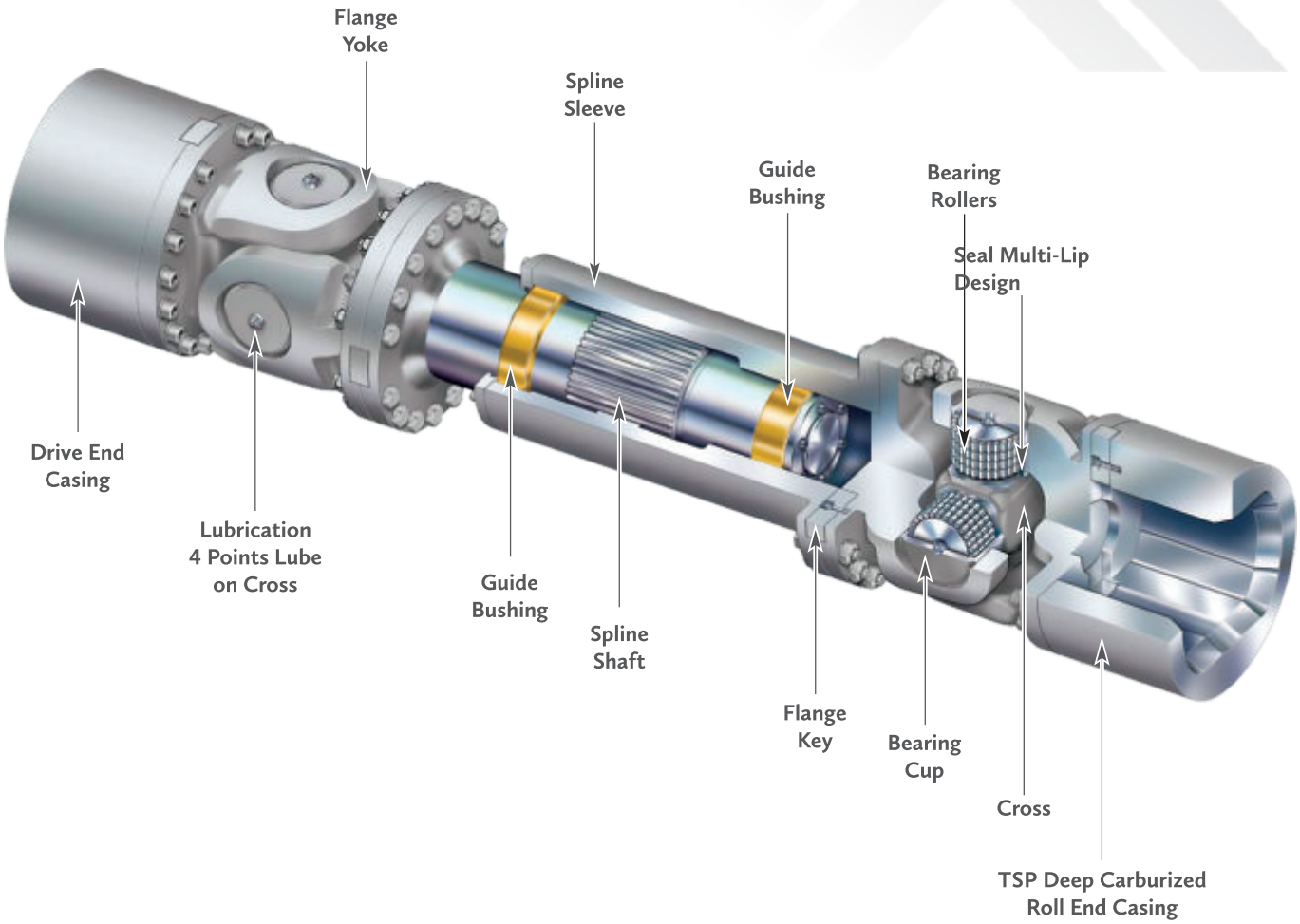
* Not Applicable to Nitriding Process

TSP Carburizing supplies the best combination of surface hardness and case depth, thus providing the longest life for casing bores.

Roll End Casing Life Factors:

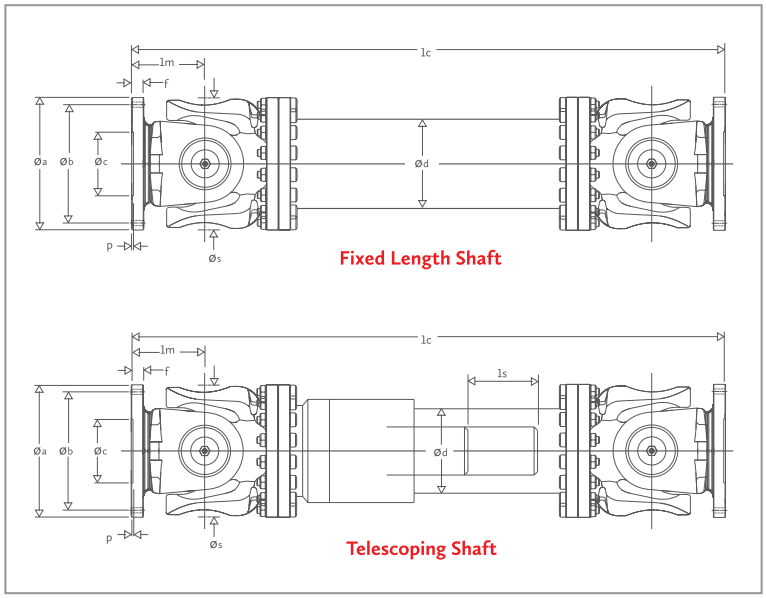
- **Hardness**
- **Case depth**
- **Carbon content**
- **Load-contact stress**
- **Surface finish**
- **Cycles**
- **Pilot stabilizing configuration**
- **Roll neck / casing bore configuration**
- **Operating environment**

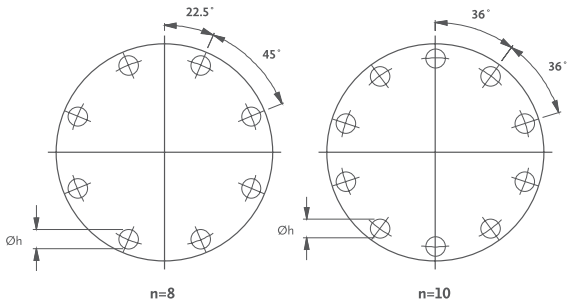
Complete Heavy Duty
Universal Joint Mill Spindles



Custom Design For Long Life and Ease of Maintenance

Engineering Data
XL-Series





Note: Following designs & options available upon request, identified by letter "X" at the end of the size number:

- **fixed**
- **short coupled**
- **long slip**
- **compact double flange type**
- **greater deflection angle**
- **oversized tube**
- **hole type yoke**
- **custom flange**

Tp peak torque
Tnrf non-rev fatigue torque
Trf reverse fatigue torque

angle maximum deflection
Øa flange diameter
Øb bolt circle diameter

Øc pilot diameter
Ød tube outer diameter
Øs swing diameter

ls slip length
lm flange - cross length
n bolt pattern

Øh hole diameter
f flange thickness
p pilot depth

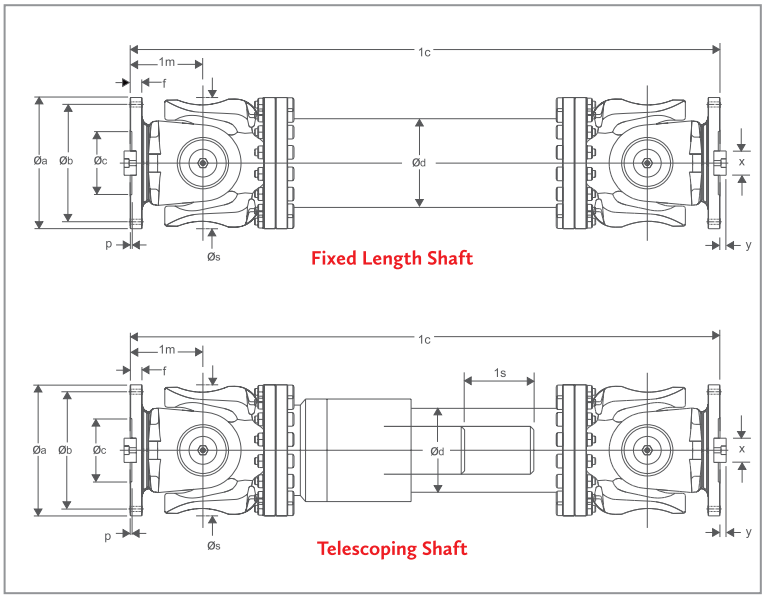
Universal Joint Driveshaft
XL Series - Extended Life

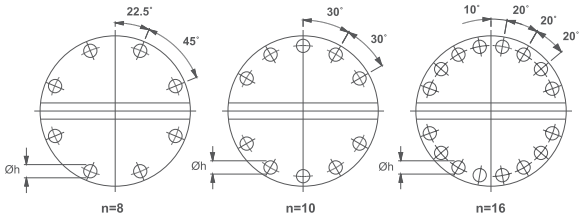
DRIVESHAFT SIZE			XL 22-20	XL 25-20	XL 25-25	XL 28-25	XL 28-28	XL 31-28	XL 31-31	XL 35-31	XL 35-35	XL 39-35	XL 39-39	XL 43-39
Torque Ratings	Tp	in.lbs	309,776		389,433		575,298		876,224		1,106,343		1,770,149	
		kNm	35		44		65		99		125		200	
	Tnrf	in.lbs	230,119		309,776		424,836		690,358		805,418		1,283,358	
		kNm	26		35		48		78		91		145	
	Trf	in.lbs	154,888		212,418		292,075		477,940		557,597		885,075	
		kNm	17.5		24		33		54		63		100	

Angle (degree)			15	15	15	15	15	15	15	15	15	15	15	15
Standard Dimensions	lc	in	35.43	35.43	37.80	37.80	40.94	40.94	45.35	45.35	48.82	48.82	51.97	51.97
		mm	900	900	960	960	1040	1040	1152	1152	1240	1240	1320	1320
	Øa	in	8.86	9.84	9.84	11.22	11.22	12.40	12.40	13.78	13.78	15.35	15.35	17.13
		mm	225	250	250	285	285	315	315	350	350	390	390	435
	Øb	in	7.72	8.58	8.58	9.65	9.65	11.02	11.02	12.20	12.20	13.58	13.58	15.16
		mm	196	218	218	245	245	280	280	310	310	345	345	385
	Øc	in	5.51	5.51	5.51	6.89	6.89	6.89	6.89	8.66	8.66	9.84	9.84	9.84
		mm	140	140	140	175	175	175	175	220	220	250	250	250
	Ød	in	5.50	5.50	6.00	6.00	6.50	6.50	8.00	8.00	8.75	8.75	9.63	9.63
		mm	139.7	139.7	152.4	152.4	165.1	165.1	203.2	203.2	222.3	222.3	244.5	244.5
	Øs	in	8.19	8.19	9.84	9.84	11.22	11.22	12.40	12.40	13.78	13.78	15.35	15.35
		mm	208	208	250	250	285	285	315	315	350	350	390	390
	ls	in	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
		mm	127	127	127	127	127	127	127	127	127	127	127	127
	lm	in	4.72	4.72	5.51	5.51	6.30	6.30	7.09	7.09	7.64	7.64	8.46	8.46
		mm	120	120	140	140	160	160	180	180	194	194	215	215
	n		8	8	8	8	8	8	10	10	10	16	16	16
	Øh	in	0.63	0.71	0.71	0.79	0.79	0.87	0.87	0.87	0.87	0.94	0.94	1.06
		mm	16	18	18	20	20	22	22	22	22	24	24	27
	f	in	0.59	0.71	0.71	0.79	0.79	0.87	0.87	0.98	0.98	1.26	1.26	1.26
		mm	15	18	18	20	20	22	22	25	25	32	32	32
	P	in	0.20	0.24	0.24	0.24	0.28	0.28	0.28	0.31	0.31	0.31	0.31	0.39
		mm	5	6	6	6	7	7	7	8	8	8	80	1

Part Number Designation: Example XL 22-20
XL = Xtek Life Series 22 = Flange Diameter (Øa) 20 = Tight Joint Swing (Øs)

Engineering Data
XT-Series





Note: Following designs & options available upon request, identified by letter "X" at the end of the size number:

- **fixed**
- **short coupled**
- **long slip**
- **compact double flange type**
- **greater deflection angle**
- **oversized tube**
- **hole type yoke**
- **custom flange**

Tp peak torque
Tnrf non-rev fatigue torque
Trf reverse fatigue torque
angle maximum deflection

Øa flange diameter
Øb bolt circle diameter
Øc pilot diameter
Ød tube outer diameter

Øs swing diameter
ls slip length
lm flange - cross length
n bolt pattern

Øh hole diameter
f flange thickness
p pilot depth
x width of key

y half thickness of key

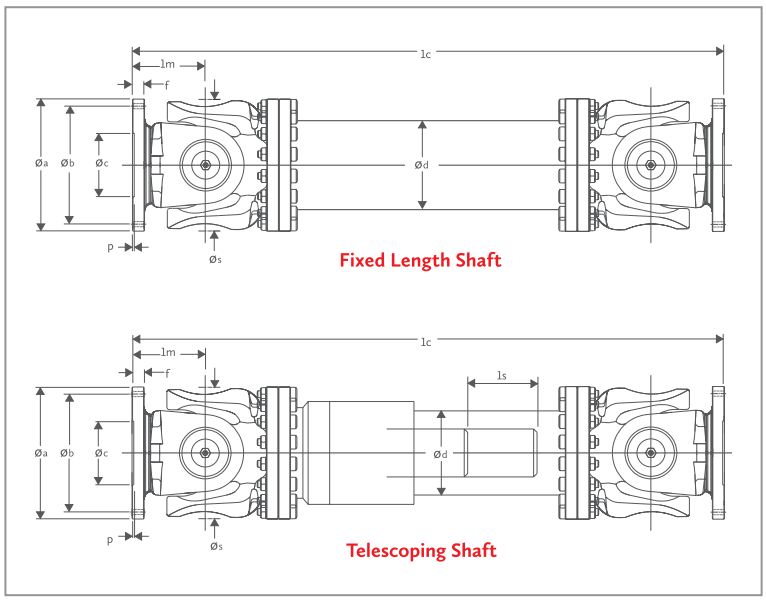
Universal Joint Driveshaft
XT Series - Heavy Duty

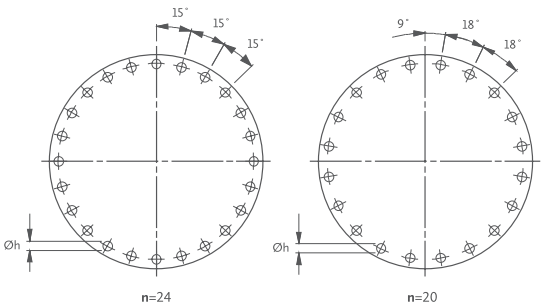
DRIVESHAFT SIZE			XT 22-20	XT 25-25	XT 28-28	XT 31-31	XT 35-35	XT 39-39	XT 43-44	XT 48-49	XT 55-55
Torque Ratings	Tp	in.lbs	424,836	637,254	920,477	1,309,910	1,858,656	2,566,716	4,602,387	5,664,477	9,116,267
		kNm	48	72	104	148	210	290	520	640	1030
	Tnrf	in.lbs	309,776	460,239	663,806	947,030	1,345,313	1,858,656	3,336,731	4,106,746	6,611,507
		kNm	35	52	75	107	152	210	377	464	747
	Trf	in.lbs	212,418	318,627	460,239	654,955	929,328	1,283,358	2,301,194	2,832,238	4,558,134
		kNm	24	36	52	74	105	145	260	320	515

Angle (degree)			15	15	15	15	15	15	15	15	15
Standard Dimensions	lc	in	36.22	40.75	45.47	49.80	52.76	60.04	73.03	76.97	87.60
		mm	920	1035	1155	1265	1340	1525	1855	1955	2225
	Øa	in	8.86	9.84	11.22	12.40	13.78	15.35	17.13	18.90	21.65
		mm	225	250	285	315	350	390	435	480	550
	Øb	in	7.72	8.58	9.65	11.02	12.20	13.58	15.16	16.73	19.37
		mm	196	218	245	280	310	345	385	425	492
	Øc	in	4.13	4.13	4.92	5.12	6.10	6.69	7.48	8.07	9.84
		mm	105	105	125	130	155	170	190	205	250
	Ød	in	6.00	6.50	7.99	8.74	8.84	10.50	12.75	14.01	16.50
		mm	152.4	165.1	203.0	222.0	224.5	266.7	323.9	355.9	419.0
	Øs	in	8.19	9.84	11.22	12.40	13.78	15.35	17.32	19.29	21.65
		mm	208	250	285	315	350	390	440	490	550
	ls	in	5.00	5.00	5.00	5.00	5.00	5.00	5.00	6.50	7.48
		mm	127	127	127	127	127	127	127	165	190
	lm	in	4.72	5.51	6.30	7.09	7.64	8.46	10.24	10.63	12.01
		mm	120	140	160	180	194	215	260	270	305
	n		8	8	8	10	10	10	16	16	16
	Øh	in	0.67	0.75	0.83	0.91	0.91	0.98	1.10	1.22	1.22
		mm	17	19	21	23	23	25	28	31	31
	f	in	0.79	0.98	1.06	1.26	1.38	1.57	1.65	1.85	1.97
		mm	20	25	27	32	35	40	42	47	50
	p	in	0.20	0.24	0.28	0.31	0.31	0.31	0.39	0.47	0.47
		mm	5	6	7	8	8	8	10	12	12
	x	in	1.26	1.57	1.57	1.57	1.97	2.76	3.15	3.54	3.94
		mm	32	40	40	40	50	70	80	90	100
	y	in	0.35	0.49	0.59	0.59	0.63	0.71	0.79	0.89	0.89
		mm	9.0	12.5	15.0	15.0	16.0	18.0	20.0	22.5	22.5

Part Number Designation: Example XT 22-20
XL = Xtek Torque Series 22 = Flange Diameter (Øa) 20 = Tight Joint Swing (Øs)

Engineering Data
XT-Series





Note: Following designs & options available upon request, identified by letter "X" at the end of the size number:

- **fixed**
- **long slip**
- **flange with hirth serration**
- **flange with face key**
- **flange with integral face pad**

Tp peak torque
Tnrf non-rev fatigue torque
Trf reverse fatigue torque

angle maximum deflection
Øa flange diameter
Øb bolt circle diameter

Øc pilot diameter
Ød tube outer diameter
Øs swing diameter

ls slip length
lm flange - cross length
n bolt pattern

Øh hole diameter
f flange thickness

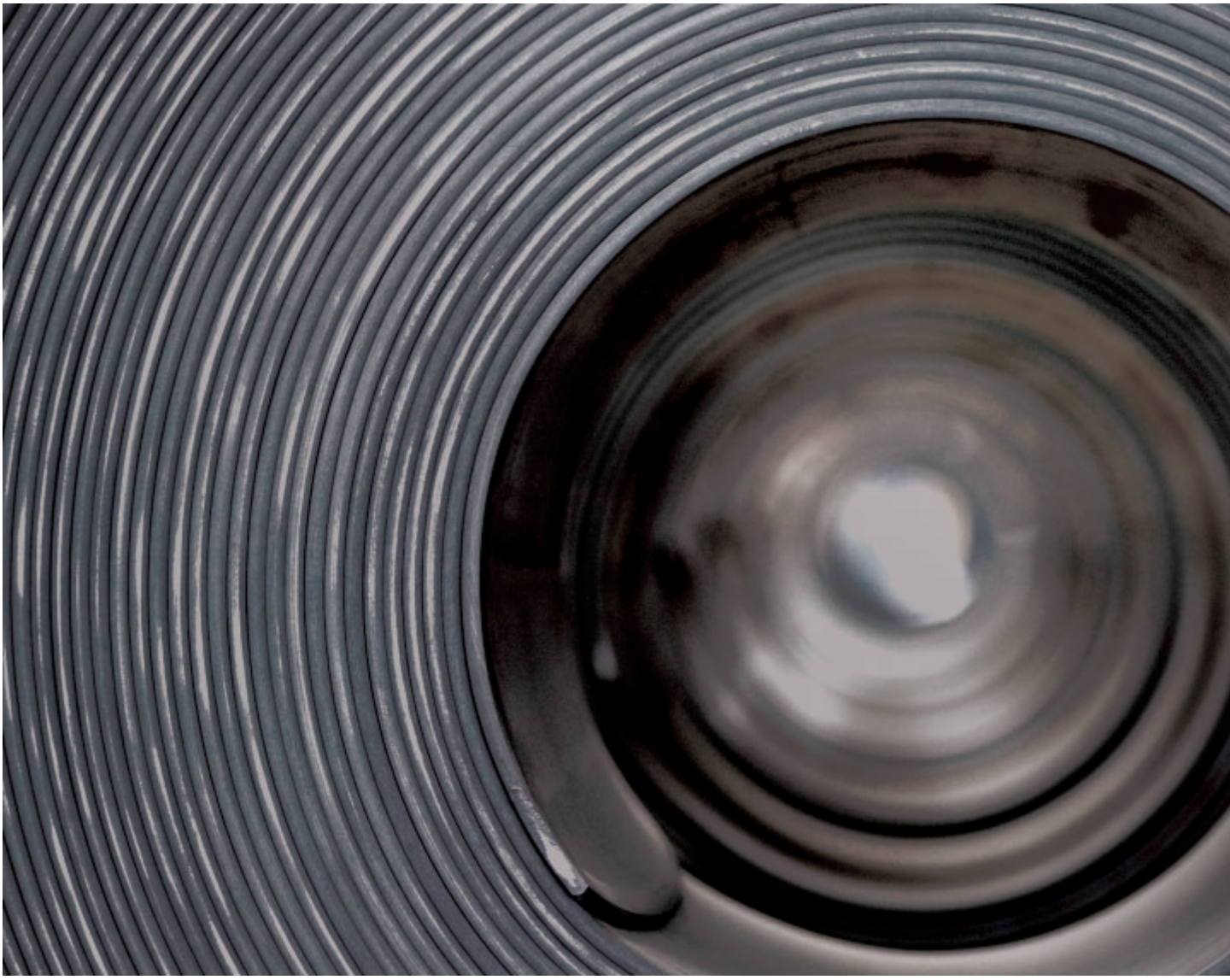
Universal Joint Driveshaft
XT Series - Heavy Duty

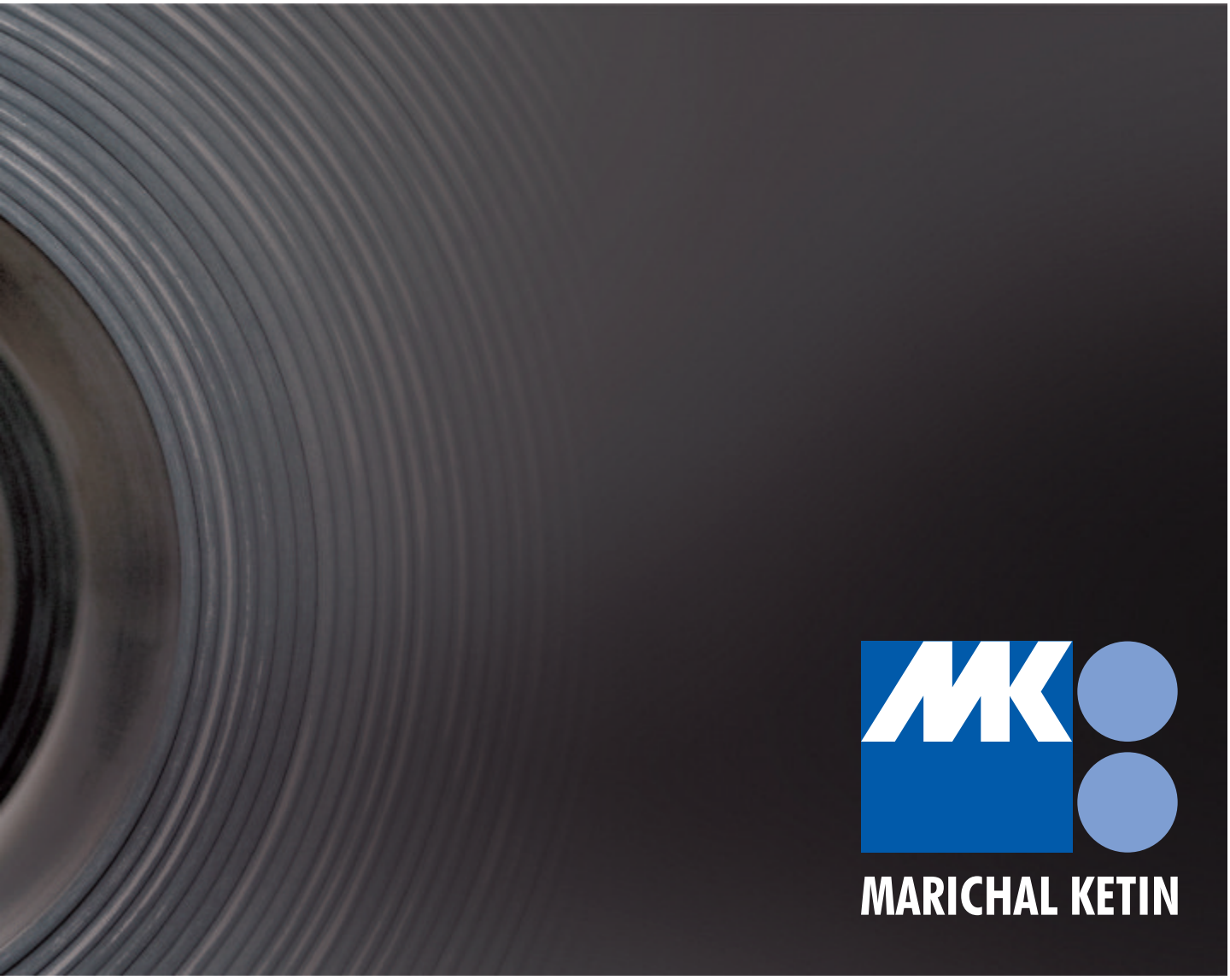
DRIVESHAFT SIZE			XT 60-60	XT 62-62	XT 64-64	XT 66-66	XT 68-68	XT 70-70	XT 76-76	XT 78-78	XT 80-80
Torque Ratings	Tp	in.lbs	10,620,894	11,063,431	13,453,132	13,895,670	14,249,699	14,957,759	23,454,474	24,339,549	25,136,116
		kNm	1200	1250	1520	1570	1610	1690	2650	2750	2840
	Tnrf	in.lbs	9,558,805	9,912,834	12,125,521	12,479,550	12,833,580	13,453,132	21,064,773	21,949,848	22,569,400
		kNm	1080	1120	1370	1410	1450	1520	2380	2480	2550
	Trf	in.lbs	6,195,522	6,461,044	7,788,656	8,054,178	8,319,700	8,673,730	13,630,147	14,161,192	14,603,729
		kNm	700	730	880	910	940	980	1540	1600	1650

Angle (degree)			15	15	15	15	15	15	15	15	15
Standard Dimensions	lc	in	107.28	108.27	112.20	118.11	120.08	122.05	135.83	137.80	139.76
		mm	2725	2750	2850	3000	3050	3100	3450	3500	3550
	Øa	in	23.62	24.41	25.20	25.98	26.77	27.56	29.92	30.71	31.50
		mm	600	620	640	660	680	700	760	780	800
	Øb	in	21.85	22.64	23.43	24.21	25.00	25.79	27.76	28.54	29.33
		mm	555	575	595	615	635	655	705	725	745
	Øc	in	18.90	19.69	20.47	20.87	21.65	22.44	24.41	25.20	25.98
		mm	480	500	520	530	550	570	620	640	660
	Ød	in	20.00	20.00	20.00	20.00	20.00	20.00	25.98	25.98	25.98
		mm	508	508	508	508	508	508	660	660	660
	Øs	in	23.62	24.41	25.20	25.98	26.77	27.56	29.92	30.71	31.50
		mm	600	620	640	660	680	700	760	780	800
	ls	in	9.84	9.84	9.84	9.84	9.84	9.84	9.84	9.84	9.84
		mm	250	250	250	250	250	250	250	250	250
	lm	in	13.39	13.39	14.17	14.57	14.57	14.57	16.54	16.54	16.54
		mm	340	340	360	370	370	370	420	420	420
	n		20	20	20	24	24	24	24	24	24
	Øh	in	0.98	0.98	0.98	0.98	0.98	0.98	1.22	1.22	1.22
		mm	25	25	25	25	25	25	31	31	31
	f	in	2.95	2.95	3.15	3.35	3.35	3.54	3.74	3.74	3.94
		mm	75	75	80	85	85	90	95	95	100

Part Number Designation: Example XT 22-20
XL = Xtek Torque Series 22 = Flange Diameter (Øa) 20 = Tight Joint Swing (Øs)


Xtek
Solutions in Motion™





MARICHAL KETIN

Your Quality Option

Company Overview

Ever since 1911, MK has been the leader in roll manufacturing.
In 1951, the first European compound static roll was cast by MK. In 1970, MK adapted the vertical spin casting process, its technology and manufacturing process. This on-going innovation process compells all MK personnel to adapt the most advanced technologies in casting, control and machining to roll manufacturing. This development in itself creates a specific roll quality assured by through knowledge of the process, enabling MK to be the first to introduce the latest and best adapted qualities on the market with the further asset of know-how from the most advanced Hot Strip Mills.

Product Mastery

Our range of activities includes the entire manufacture of cast rolls for the rolling of flat products.

The most common application of our products is use on Hot Strip Mills, Steckel Mills and Plate Mills.

The adaptation of the roll to each mill with its specific requirements is obviously considered standard procedure at MK. MK facilities enable the production of work rolls between 4 and 40 tons and a capacity of 8,500 tons annually of finished rolls that corresponds to 750 / 850 rolls with an average weight of 10 / 11 tons.

MK's proficiency in the vertical spin casting process, heat treatment, machining, and last but not least, full automatic ultrasonic control has achieved a mastery for ultimate quality.

Rolls Grades

Indefinite Chill double Pour ▸ HSM rear finishing stands, Plate Mills, Skin-Pass

- ICDP
- Micro-alloyed ICDP (Vega)
- ICDP special Heat Treatment

High chromium iron

- Comet 90 ▸ Front finishing stands / Skin-Pass
- Comet 70 ▸ Plate Mill work rolls, roughing work rolls rolls for checkered and tear plates

High Speed Steel (HSS) ▸ HSM front finishing stands

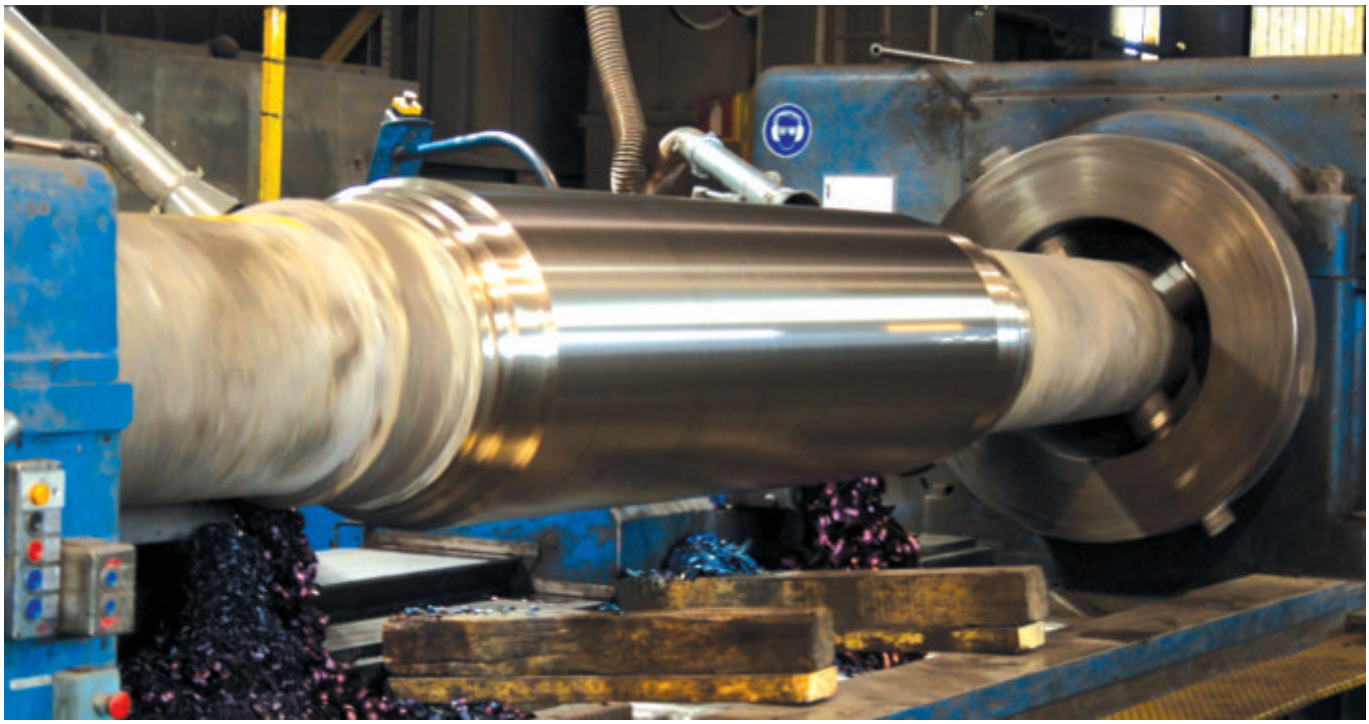
- Kosmos
- Aurora I, II

High chromium steel ▸ HSM roughing mills

- Galaxy

Semi-HSS and HSS for HSM roughing stands

- Zarya
- Sirius



Manufacturing Process

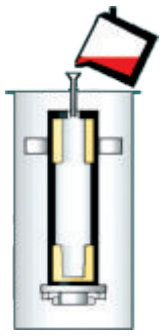
Raw Materials → **Induction Furnaces** → **Metal casting inside a vertical spinning machine**

Melting Process

3 induction furnaces
2 x 30 to , 1 x 13 to

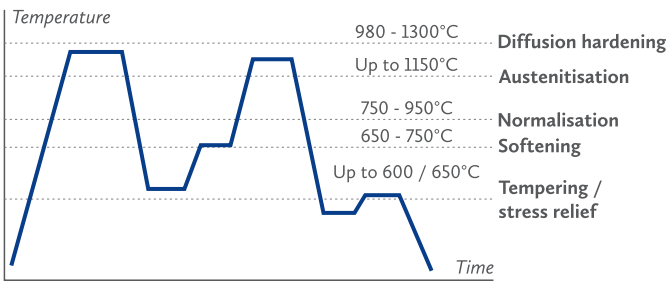
Vertical Spin Casting Process

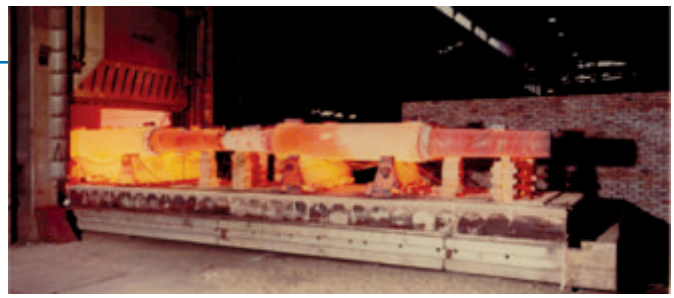
2 spin-casting machines
Up to 1350 mm finished diameter



Heat Treatment

8 Heat treatment furnaces
Total Capacity 750 tons





Main Objectives :

- Obtain desired microstructure and aimed hardness with a residual austenite content of < 5%
- Reduce the residual stresses to an acceptable non critical level

Heat Treatment → **Machining** → **Quality Control & Packaging**

Final Machining

Rough grinding
CNC finishing lathe
Final grinding

- 1 Waldrich rough grinder
- 2 Heyligenstaed CNC finishing lathes 16 & 40 T
- 2 Herkules rough machining lathes
- 2 Finish grinders Cincinnati & Waldrich
- 3 Milling machines Waldrich & Collet
- 2 Drilling machines
- 1 Vertical lathe Berthier

Rough grinding

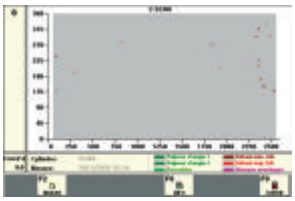
CNC finishing lathe

Final grinding

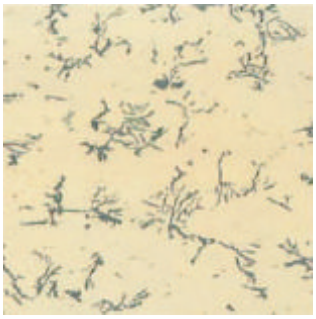
Ultrasonic Inspection

Purpose :
- Evaluation of the shell-core bonding conditions
- Evaluation of internal cracks within the shell
- Detection de porosities and inclusions in the shell
- Measurement of the usable shell thickness

ISO 9001 : 2008
BUREAU VERITAS
Certification



CORE MATERIAL Specifications



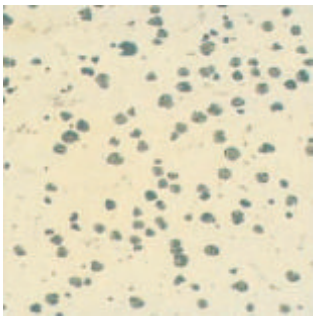
X 50

X 100

LAMELLAR GRAPHITE IRON

Shell Combination

- High Chromium Iron (COMET 70 / COMET 90)
- ICDP



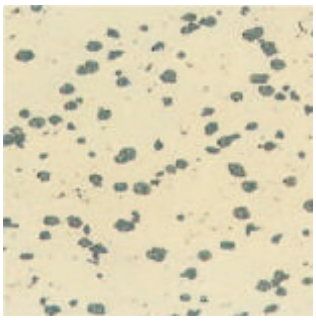
X 50

X 100

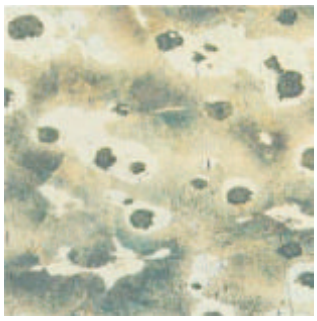
PEARLITIC GRAPHITE IRON

Shell Combination

- High Chromium Iron (COMET 70 / COMET 90)
- ICDP / VEGA



X 50



X 100

FERRITIC NODULAR GRAPHITE IRON

Shell Combination

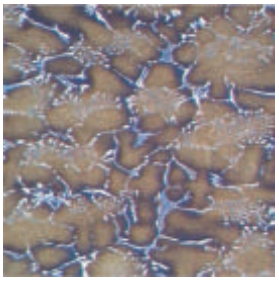
- High Chromium Steel (GALAXY / GALILEO)
- High Speed Steel (AURORA / KOSMOS / SIRIUS)
- Semi High Speed Steel (ZARYA)

	Lamellar Graphite Iron	Pearlitic Nodular Graphite Iron	Ferritic Nodular Graphite Iron
Structure			
• Matrix	Pearlite + Cemenite < 5%	Pearlite + Cemenite < 5%	Pearlite + Ferrite + Cemenite < 5%
• Graphite	Lamellar	Nodular	Nodular
Chemical Composition	%	%	%
C (Carbon)	2.8 / 3.5	2.8 / 3.5	3.2 / 3.8
Si (Silicon)	1.5 / 2.4	1.5 / 2.4	1.5 / 3.0
Mn (Manganese)	0.2 / 0.6	0.2 / 0.6	0.2 / 0.6
Ni (Nickel)	0.4 / 1.2	0.4 / 1.2	0.1 / 0.8
P (Phosphorus)	< 0.08	< 0.08	< 0.08
S (Sulphur)	≤ 0.02	≤ 0.02	≤ 0.02
Mechanical Properties			
• Tensile strenght Rt [MPa]	270 / 320	350/ 420	350 / 420
• Young modulus E [MPa]	130000 / 150000	175000 / 185000	165000 / 175000
• Ductility (traction) [%]	< 1	< 1	< 1
Thermal Properties			
• Expansion α (25-400°C) [10^{-6} 1/°C]	13.6 / 13.8	13.2 / 13.4	13.2 / 13.4
• Conducivity [W/m.K]	45 / 50	30 / 32	32 / 35
Hardness			
• Shore C (ShC)	35 / 40	38 / 45	32 / 37
• Vickers (HV)	235 / 275	260 / 300	215 / 250
• Equotip (LE)	520 / 555	540 / 575	500 / 530

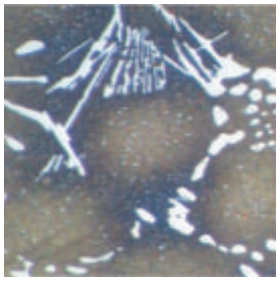
AURORA - High Speed Steel

SPECIFICITY

This new generation of high speed steel grade is characterized by a high content of alloying elements like Cr, Mo and V. Compared to the Kosmos grade, the W equivalent has been optimized in order to improve wear resistance, high temperature strength and hot hardness. Mechanical properties are also strongly improved. This grade is especially adapted for the rolling of special steels like stainless steel grades and provides excellent surface quality and extended campaign time compared to the standard grade. Aurora is submitted to a sophisticated heat treatment cycle which guarantees a homogenous structure with constant properties through the whole roll life.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm^2 (= 0.1 kgf / mm^2)

• Tensile strength Rt	800 / 1000	MPa
• Young modulus E	210000 / 220000	MPa
• Compressive yield strength $Rc^{0,25\%}$	2200 / 2400	MPa
• Compressive strength Rc	3200 / 3400	MPa
• Bending strength	1200 / 1500	MPa
• Ductility (compression)	8 / 10	%

Physical Properties

• Termal expansion (25-400°C)	α	12.0 / 12.5	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	18 / 22	W/m.K
• Specific heat (25-100°C)	Cp	500 / 550	J/Kg.K

Core Material Combination

• Ferritic nodular graphite iron

Hardness

• Shore	75 / 85	ShC
• Vickers	600 / 730	HV
• Equotip	740 / 790	LE

Characteristics

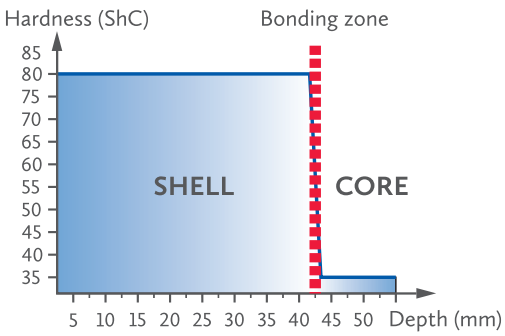
Wear resistance	★★★
Sticking - roll oxidation	★★★
Fire cracks	★★★
Slippage	★★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	1.5 / 2.5
Si (Silicon)	0.1 / 1.0
Mn (Manganese)	0.5 / 1.5
Ni (Nickel)	0.5 / 1.5
Cr (Chromium)	4.0 / 6.0
Mo (Molybdenum)	4.0 / 9.0
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
V (Vanadium)	4.0 / 8.0
W (Tungsten)	0.1 / 3.0

Hardness in Depth



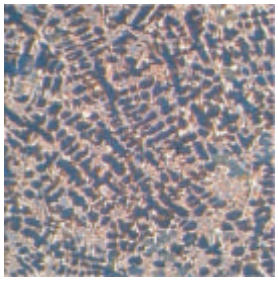
Applications

- Work rolls for the early finishing stands of Hot Strip Mills (convenitonal and Minimill)
- Work rolls for Steckel Mills

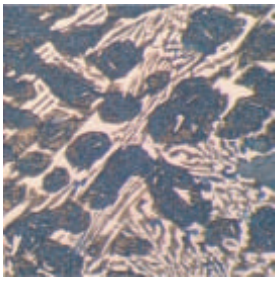
COMET 70 - High Chromium Iron

SPECIFICITY

The high Chromium iron grade COMET 70 is characterized by a Chromium content in the range of 12 to 17 % and a carbon content ranging from 2.1 to 2.6 %. This grade has, according to the requested hardness, a pearlitic or martensitic matrix and contains about 20 to 25 % of Chromium carbides (M_7C_3) which lead to its good wear resistance. By comparison to indefinite chill iron, the tensile properties are doubled, this led to big improvements regarding the appearance of fire cracks.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm² (= 0.1 kgf / mm²)

• Tensile strength Rt	600 / 800	MPa
• Young modulus E	210000 / 220000	MPa
• Compressive yield strength $Rc^{0,25\%}$	1600 / 1800	MPa
• Compressive strength Rc	2000 / 2800	MPa
• Bending strength	800 / 1000	MPa
• Ductility (compression)	5 / 10	%

Physical Properties

• Termal expansion (25-400°C)	α	12.8 / 13.2	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	18 / 22	W/m.K
• Specific heat (25-100°C)	Cp	460 / 480	J/Kg.K

Core Material Combination

- Pearlitic nodular graphite iron
- Lamellar graphite iron

Hardness

• Shore	60 / 85	ShC
• Vickers	390 / 680	HV
• Equotip	660 / 790	LE

Characteristics

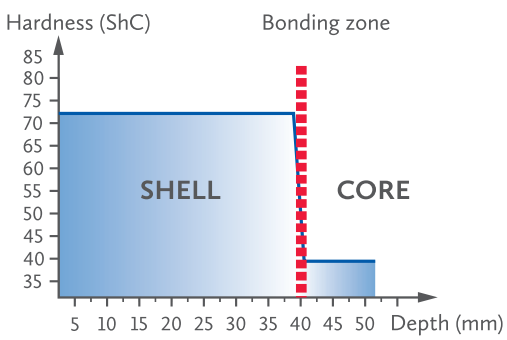
Wear resistance	★★★
Sticking - roll oxidation	★★
Fire cracks	★★★
Slippage	★★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	2.1 / 2.6
Si (Silicon)	0.4 / 0.8
Mn (Manganese)	0.8 / 1.3
Ni (Nickel)	1.0 / 1.5
Cr (Chromium)	12.0 / 17.0
Mo (Molybdenum)	0.8 / 1.5
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
Carbide %	20 / 25
Cr / C ratio	5.5 / 6.0

Hardness in Depth



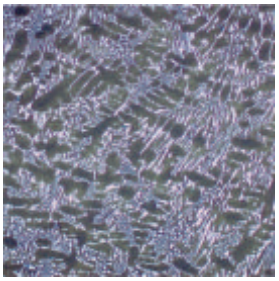
Applications

- Work rolls for Heavy Plate Mills
- Work rolls for Hot Mill roughing stands (Steel & Aluminium)
- Work rolls for the rolling of checkered and tear plates

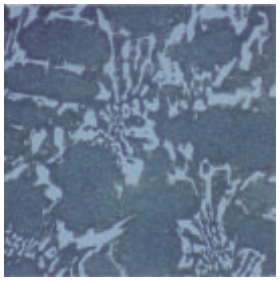
COMET 90 - High Chromium Iron

SPECIFICITY

The high Chromium iron grade is characterized by a Chromium content in the range of 16 to 19 % and a carbon content ranging from 2.7 to 2.9 %. This grade has a martensitic matrix and contains about 25 to 30 % Chromium carbides (M_7C_3) which lead to its good wear resistance. By comparision to indefinite chill iron, the tensile properties are doubled. This led to big improvements regarding the appearance of fire cracks. According to its applications, Cr & Mo content as well as heat treatment may be adjusted.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm² (= 0.1 kgf / mm²)

• Tensile strength Rt	700 / 800	MPa
• Young modulus E	210000 / 220000	MPa
• Compressive yield strength $Rc^{0,25\%}$	1600 / 1800	MPa
• Compressive strength Rc	2000 / 2800	MPa
• Bending strength	800 / 1000	MPa
• Ductility (compression)	5 / 10	%

Physical Properties

• Termal expansion (25-400°C)	α	12.7 / 12.9	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	16 / 20	W/m.K
• Specific heat (25-100°C)	Cp	460 / 180	J/Kg.K

Core Material Combination

- Pearlitic nodular graphite iron
- Lamellar graphite iron

Hardness

• Shore	65 / 90	ShC
• Vickers	500 / 800	HV
• Equotip	715 / 850	LE

Characteristics

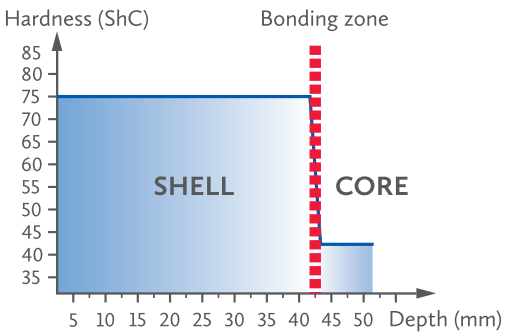
Wear resistance	★★★
Sticking - roll oxidation	★★
Fire cracks	★★★
Slippage	★★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	2.7 / 2.9
Si (Silicon)	0.4 / 0.6
Mn (Manganese)	0.9 / 1.1
Ni (Nickel)	1.2 / 1.4
Cr (Chromium)	16.0 / 19.0
Mo (Molybdenum)	1.2 / 2.0
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
Carbide %	25 / 30
Cr / C ratio	6

Hardness in Depth



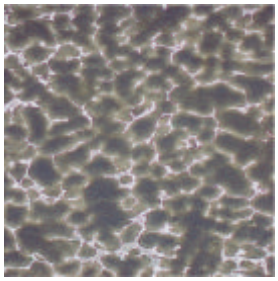
Applications

- Work rolls for front finishing stands of Hot Strip Mills
- Back-up and work rolls for Hot Skin-pass Mills

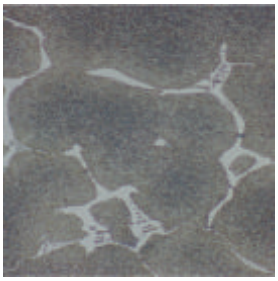
GALAXY - High Chromium Steel

SPECIFICITY

This grade has a matrix made of martensite. It contains less than 10% Chromium carbides (M_7C_3) and around 2% of Molybdenum carbides (M_2C) which provide a high wear resistance compared to other grades (Adamite, ICDP). Due to a compressive resistance reaching 3200 MPa, fire cracks resistance is strongly improved, compared to the high Chromium iron grade. Its oxydation behaviour makes it very suitable for the roughing stands of Hot Strip Mills.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm² (= 0.1 kgf / mm²)

• Tensile strength Rt	700 / 800	MPa
• Young modulus E	200000 / 210000	MPa
• Compressive yield strength $Rc^{0,25\%}$	1800 / 2000	MPa
• Compressive strength Rc	2600 / 3200	MPa
• Bending strength	1200 / 1400	MPa
• Ductility (compression)	10 / 15	%

Physical Properties

• Termal expansion (25-400°C)	α	11.8 / 12.0	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	16 / 18	W/m.K
• Specific heat (25-100°C)	Cp	460 / 500	J/Kg.K

Core Material Combination

• Ferritic nodular graphite iron

Hardness

• Shore	60 / 85	ShC
• Vickers	500 / 730	HV
• Equotip	690/ 790	LE

Characteristics

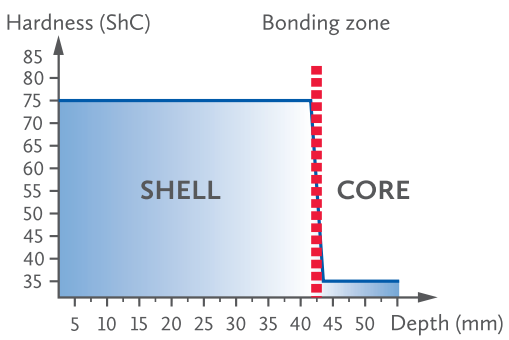
Wear resistance	★★★
Sticking - roll oxidation	★★
Fire cracks	★★★
Slippage	★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	1.2 / 1.5
Si (Silicon)	0.3 / 0.6
Mn (Manganese)	0.5 / 1.0
Ni (Nickel)	0.5 / 1.0
Cr (Chromium)	10.0 / 12.0
Mo (Molybdenum)	2.0 / 5.0
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
Carbide %	8 / 10
Cr / C ratio	10

Hardness in Depth



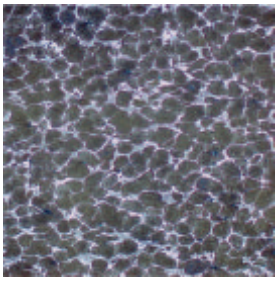
Applications

- Work rolls for continuous and reversing roughing stands of Hot Strip Mills
- Work rolls for the early stands of CSP® Mills

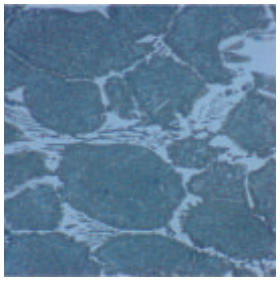
GALILEO - High Chromium Steel

SPECIFICITY

This grade is characterized by a martensitic matrix with a carbide content of 10/12%. The main carbides are of the M_7C_3 and M_2C type. The main properties of this grade are: **1.** Excellent mechanical properties, **2.** High temperature strength, **3.** High resistance to fire cracking, **4.** High resistance to oxidation/corrosion, **5.** High wear resistance, **6.** Perfect surface aspect after long runs. All these properties make it very suitable for plate mill rolling and some roughing mill applications.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm² (= 0.1 kgf / mm²)

• Tensile strength Rt	700 / 800	MPa
• Young modulus E	200000 / 210000	MPa
• Compressive yield strength $Rc^{0,25\%}$	1800 / 2000	MPa
• Compressive strength Rc	2600 / 3200	MPa
• Bending strength	1200 / 1400	MPa
• Ductility (compression)	10/ 15	%

Physical Properties

• Termal expansion (25-400°C)	α	12.0 / 12.4	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	16 / 18	W/m.K
• Specific heat (25-100°C)	Cp	480 / 500	J/Kg.K

Core Material Combination

• Ferritic nodular graphite iron

Hardness

• Shore	65 / 85	ShC
• Vickers	500 / 730	HV
• Equotip	690 / 790	LE

Characteristics

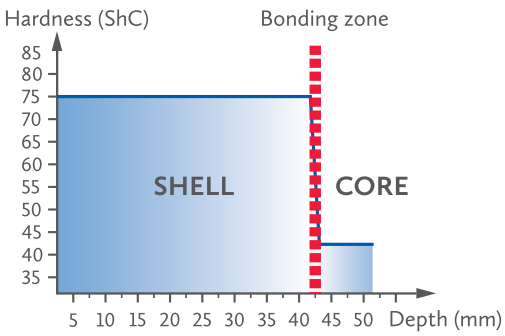
Wear resistance	★★★
Sticking - roll oxidation	★★
Fire cracks	★★★
Slippage	★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	1.5 / 2.5
Si (Silicon)	0.4 / 1.0
Mn (Manganese)	0.4 / 1.0
Ni (Nickel)	0.5 / 1.5
Cr (Chromium)	8.0 / 15.0
Mo (Molybdenum)	2.0 / 5.0
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
V (Vanadium)	0.1 / 1.0
Others	0.5 / 5.0

Hardness in Depth



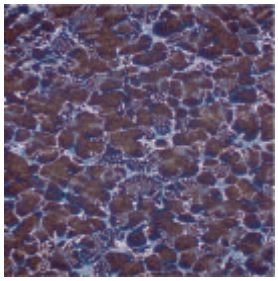
Applications

- Work rolls for continuous and reversing roughing stands of Hot Strip Mills
- Work rolls for Plate Mills

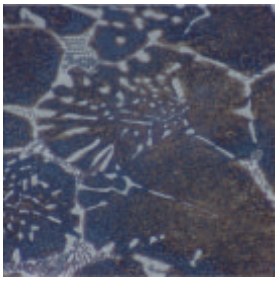
KOSMOS - High Speed Steel

SPECIFICITY

This grade which belongs to the high speed steel family is strongly alloyed with Cr, Mo, W and V. The martensitic matrix as well as the hard precipitated carbides of the M_7C_3, M_2C and MC type ensure a very high wear performance. Compared to Hi-Cr iron grade, extended rolling campaigns can be performed. A careful study of the alloying elements content allows to guarantee an improved resistance to rolling incidents.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm² (= 0.1 kgf / mm²)

• Tensile strength Rt	900 / 1000	MPa
• Young modulus E	200000 / 210000	MPa
• Compressive yield strength $Rc^{0,25\%}$	2000 / 2200	MPa
• Compressive strength Rc	3000 / 3200	MPa
• Bending strength	1200 / 1500	MPa
• Ductility (compression)	8 / 10	%

Physical Properties

• Termal expansion (25-400°C)	α	11.8 / 12.4	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	18 / 22	W/m.K
• Specific heat (25-100°C)	Cp	500 / 550	J/Kg.K

Core Material Combination

• Ferritic nodular graphite iron

Hardness

• Shore	75 / 85	ShC
• Vickers	600 / 730	HV
• Equotip	740/ 790	LE

Characteristics

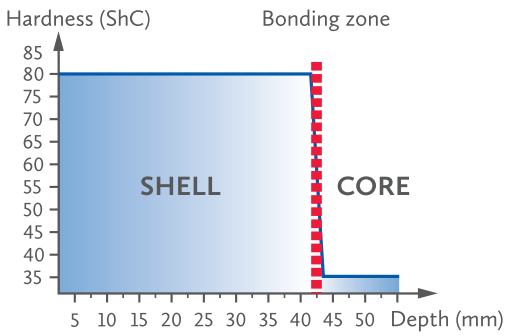
Wear resistance	★★★
Sticking - roll oxidation	★★★
Fire cracks	★★
Slippage	★★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	1.5 / 2.5
Si (Silicon)	0.1 / 1.0
Mn (Manganese)	0.5 / 1.5
Ni (Nickel)	1.0 / 2.5
Cr (Chromium)	4.0 / 8.0
Mo (Molybdenum)	2.0 / 8.0
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
V (Vanadium)	3.0 / 9.0
W (Tungsten)	2.0 / 8.0

Hardness in Depth



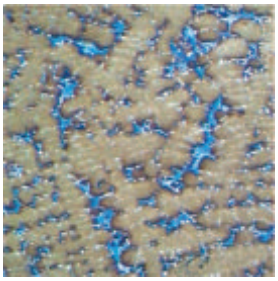
Applications

- Work rolls for early stands of Hot Strip Mills (conventional and CSP®)
- Work rolls for Direct Strip Casting Mills
- Work rolls for Steckel Mills

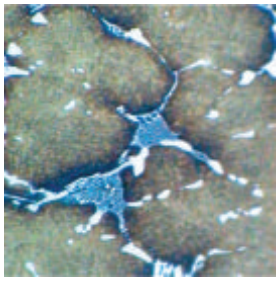
SIRIUS - High Speed Steel

SPECIFICITY

This generation of high speed steel grade is especially dedicated to roughing mill applications or early finishing stands of CSP® Mills. It is characterized by a high content of alloying elements like Cr, Mo, W and V. Compared to the Chromium steel grade, this grade offers not only an enhanced wear resistance but also an improved high temperature strength and a good resistance to fire cracks. This grade is also well adapted for the rolling of special steels like stainless steel grades and provides excellent surface quality and extended campaign time.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm^2 (= 0.1 kgf / mm^2)

• Tensile strength Rt	800 / 1000	MPa
• Young modulus E	210000 / 220000	MPa
• Compressive yield strength Rc$^{0,25\%}$	2200 / 2400	MPa
• Compressive strength Rc	3200 / 3400	MPa
• Bending strength	1200 / 1500	MPa
• Ductility (compression)	8 / 10	%

Physical Properties

• Termal expansion (25-400°C)	α	11.8 / 12.4	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	20 / 24	W/m.K
• Specific heat (25-100°C)	Cp	500 / 550	J/Kg.K

Core Material Combination

• Ferritic nodular graphite iron

Hardness

• Shore	72 / 82	ShC
• Vickers	580 / 690	HV
• Equotip	725 / 775	LE

Characteristics

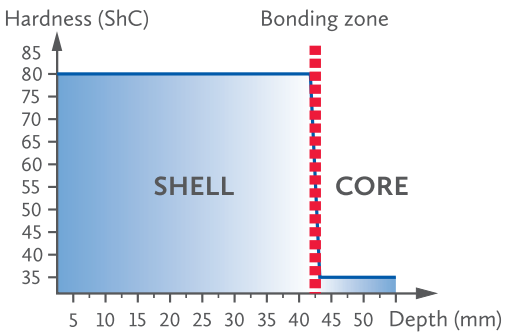
Wear resistance	★★★
Sticking - roll oxidation	★★★
Fire cracks	★★
Slippage	★★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	1.2 / 1.8
Si (Silicon)	0.1 / 1.0
Mn (Manganese)	0.5 / 1.5
Ni (Nickel)	0.5 / 1.5
Cr (Chromium)	4.0 / 6.0
Mo (Molybdenum)	3.0 / 6.0
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
V (Vanadium)	4.0 / 7.0
W (Tungsten)	1.0 / 4.0

Hardness in Depth



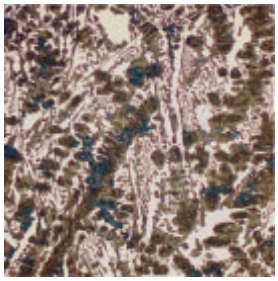
Applications

- Work rolls for continuous and reversing roughing stands of Hot Strip Mills
- Work rolls for Steckel Mill roughing stands
- Work rolls for the early stands of CSP® Mills

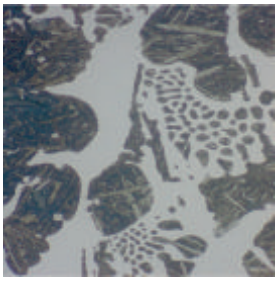
VEGA - Microalloyed Indefinite Chill Double Pour

SPECIFICITY

This new generation of Indefinite Chill Double Pour is characterized by a higher content of alloying elements enabling a higher content of MC type carbides in the structure. Compared to the traditional grade, the wear resistance could be strongly improved without negatively affecting the surface behaviour as well as the sensivity to rolling mill incidents. Mechanical properties are also slightly improved. The microstructure is still characterized by a free graphite content which is similar to the standard ICDP grade. The microalloyed ICDP is submitted to a special heat treatment cycle which guarantees a very low residual austenite content.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm^2 (= 0.1 kgf / mm^2)

• Tensile strength Rt	400 / 500	MPa
• Young modulus E	170000 / 180000	MPa
• Compressive yield strength $Rc^{0,25\%}$	1500 / 2200	MPa
• Compressive strength Rc	1900 / 2600	MPa
• Bending strength	600 / 700	MPa
• Ductility (compression)	1 / 3	%

Physical Properties

• Termal expansion (25-400°C)	α	13.2 / 13.4	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	16 / 22	W/m.K
• Specific heat (25-100°C)	Cp	500 / 550	J/Kg.K

Core Material Combination

• Pearlitic nodular graphite iron

Hardness

• Shore	75 / 85	ShC
• Vickers	600 / 730	HV
• Equotip	740/ 790	LE

Characteristics

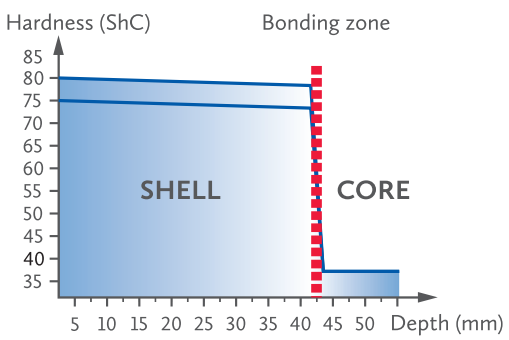
Wear resistance	★★
Sticking - roll oxidation	★★★
Fire cracks	★★
Slippage	★★★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	3.2 / 3.6
Si (Silicon)	0.1 / 2.0
Mn (Manganese)	0.8 / 1.5
Ni (Nickel)	4.2 / 4.5
Cr (Chromium)	1.3 / 2.0
Mo (Molybdenum)	0.3 / 1.5
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
V, Ti, Nb, Ta, Zr	< 2.0
Carbide %	35 / 45
Free Graphite %	1 / 3

Hardness in Depth



Applications

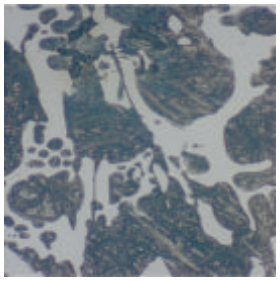
- Work rolls for rear finishing stands of Hot Strip Mills
- Work rolls for Steckel Mills
- Work rolls for Plate Mills

ICDP - Indefinite Chill Double Pour

SPECIFICITY

This quality which contains from 3.2 to 3.5% of carbon is characterized by a precipitation, at the same time, of graphite and carbides, which give rise to its name (Indefinite Chill). The Chromium and Silicon content may vary respectively from 1.3 to 1.9% and from 0.9 to 1.1%, depending on the type of application and the hardness required. This grade contains around 35/45% of iron carbides (M_3C) and 1 to 3% free graphite. The material presents good resistance to compression but pratically no tensile deformation under compression conditions. ICDP is characterized by an excellent resistance to slippage and stickage but a low resistance to wear compared to high Chromium grades.

X 100



X 500

Mechanical Properties

1MPa = 1 N / mm² (= 0.1 kgf / mm²)

• Tensile strength Rt	350 / 450	MPa
• Young modulus E	150000 / 170000	MPa
• Compressive yield strength $Rc^{0,25\%}$	1400 / 2200	MPa
• Compressive strength Rc	1800 / 2500	MPa
• Bending strength	600 / 700	MPa
• Ductility (compression)	1 / 3	%

Physical Properties

• Termal expansion (25-400°C)	α	13.2 / 13.4	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	16 / 20	W/m.K
• Specific heat (25-100°C)	Cp	500 / 550	J/Kg.K

Core Material Combination

- Pearlitic nodular graphite iron
- Lamellar graphite iron

Hardness

• Shore	65 / 85	ShC
• Vickers	500 / 730	HV
• Equotip	715 / 790	LE

Characteristics

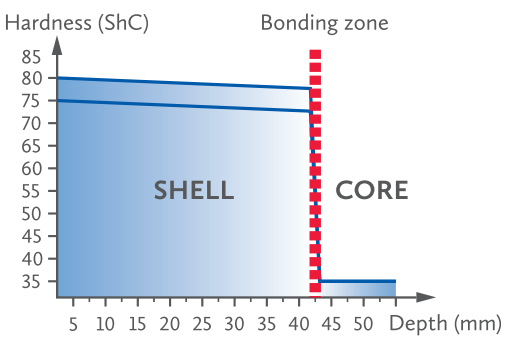
Wear resistance	★
Sticking - roll oxidation	★★★
Fire cracks	★★
Slippage	★★★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

C (Carbon)	3.2 / 3.5
Si (Silicon)	0.9 / 1.1
Mn (Manganese)	0.8 / 1.0
Ni (Nickel)	4.2 / 4.5
Cr (Chromium)	1.3 / 1.9
Mo (Molybdenum)	0.3 / 0.5
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
Carbide %	35 / 45
Free Graphite %	1 / 3

Hardness in Depth



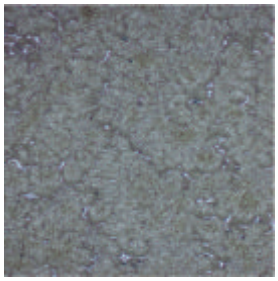
Applications

- Work rolls for rear finishing stands of Hot Strip Mills
- Work rolls for Steckel Mills
- Work rolls for Heavy Plate Mills
- Back-up rolls for Skin-pass Mills

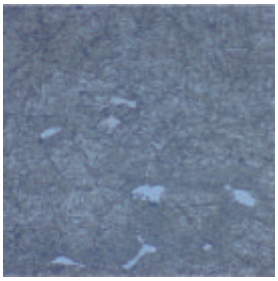
ZARYA - Semi-High Speed Steel

SPECIFICITY

This grade which belongs to the high speed steel family is alloyed with Cr, Mo and V. The high hardness martensitic matrix containing hard small carbides guarantees to that alloy a very high wear performance, an extremely fine fire crack network and a low tendency to slippage. Compared to traditional grades, longer rolling campaigns can be performed, better wear profile and smoother surface can be reached. Resistance to rolling incidents is also very high.



X 100



X 500

Mechanical Properties

1MPa = 1 N / mm² (= 0.1 kgf / mm²)

• Tensile strength Rt	900 / 1000	MPa
• Young modulus E	200000 / 210000	MPa
• Compressive yield strength $Rc^{0,25\%}$	2000 / 2200	MPa
• Compressive strength Rc	3000 / 3200	MPa
• Bending strength	1200 / 1500	MPa
• Ductility (compression)	8 / 10	%

Physical Properties

• Termal expansion (25-400°C)	α	11.5 / 11.8	10^{-6} 1/°C
• Thermal conductivity (25-100°C)	λ	20 / 25	W/m.K
• Specific heat (25-100°C)	Cp	500 / 540	J/Kg.K

Core Material Combination

• Ferritic nodular graphite iron

Hardness

• Shore	75 / 85	ShC
• Vickers	600 / 730	HV
• Equotip	740/ 790	LE

Characteristics

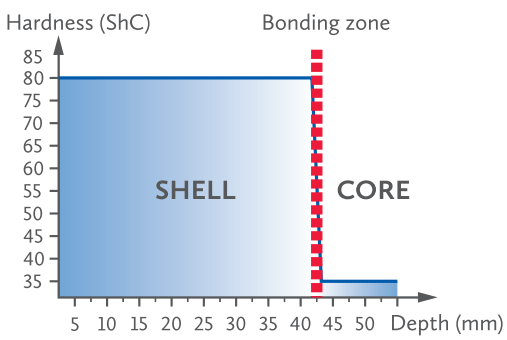
Wear resistance	★★★
Sticking - roll oxidation	★★
Fire cracks	★★★
Slippage	★★★

★★★ very good ★★ good ★ weak

Chemical Analysis [%-wt]

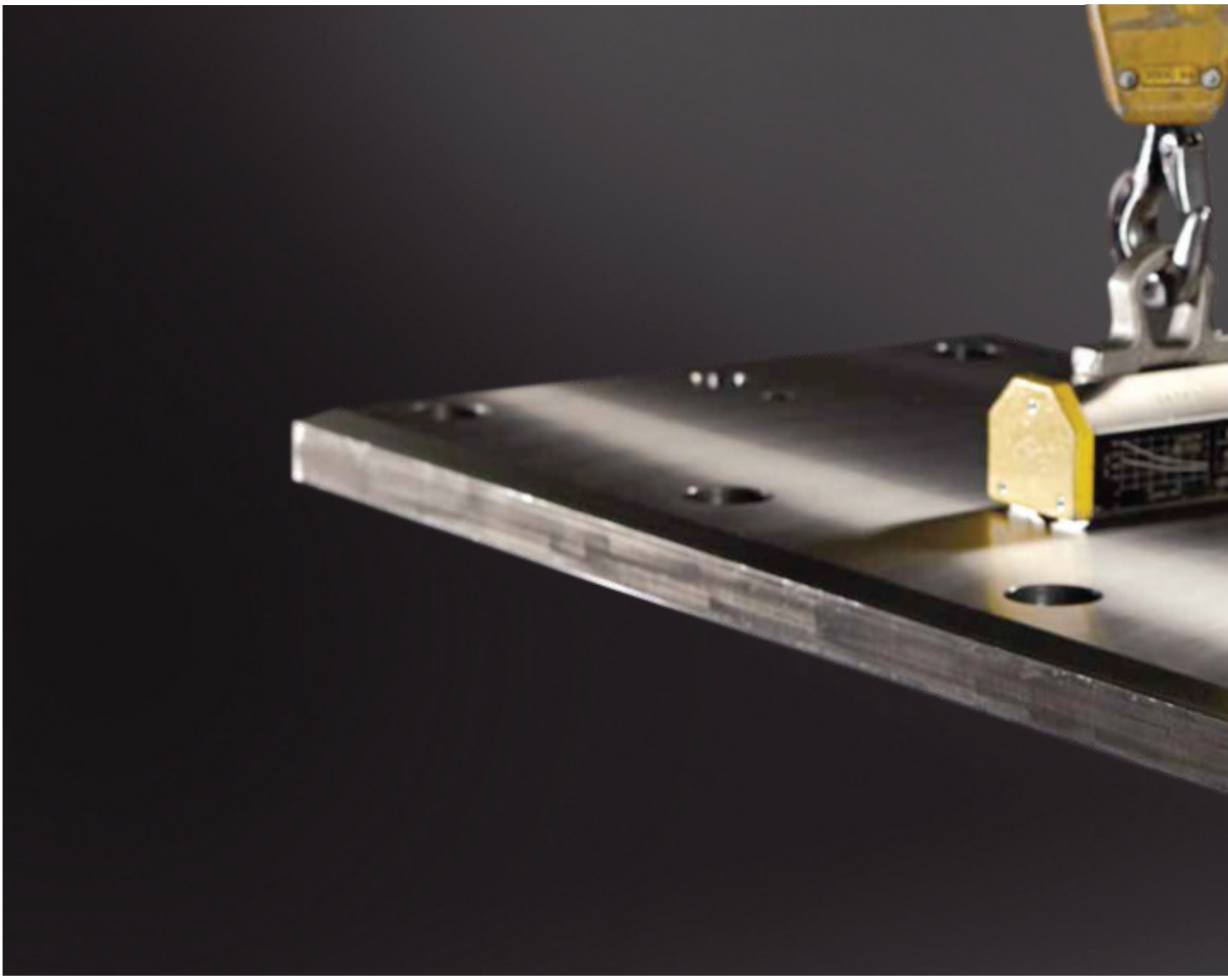
C (Carbon)	0.5 / 1.0
Si (Silicon)	0.2 / 1.0
Mn (Manganese)	0.2 / 1.0
Ni (Nickel)	0.5 / 1.5
Cr (Chromium)	5.0 / 10.0
Mo (Molybdenum)	2.0 / 4.0
P (Phosphorus)	< 0.05
S (Sulphur)	< 0.04
V (Vanadium)	0.2 / 1.0
Nb, W, Ti	< 2.0

Hardness in Depth



Applications

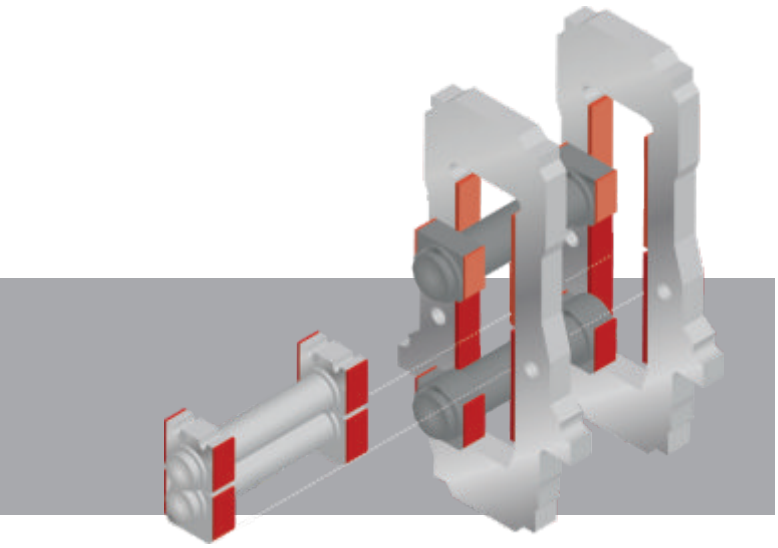
• Work rolls for continuous and reversing roughing stands of Hot Strip Mills



Precision Flat Bearings

Minimal wear, Maximum efficiency

Presicion Since 1835



CORTS is the leading international specialist for plant efficiency with a special focus on sintering plants and rolling mills: Our precision wear parts and guiding elements guarantee minimum wear and maximum precision thanks to our original CORTS compound steel and over 90 years of know-how in the field of wear protection and production.

As your partner for engineering services, we are pleased to offer you advice and assistance. We specialize on Problem Solving for spare parts and full turn key solutions.

The family business CORTS stands for precision “made in Germany” with a history of over 175 years. Founded as a tool smith, today we serve customers all over the world from our location in Remscheid. Our focus lies in the steel, aluminium and the mechanical engineering applications – our strength lies in optimising the mill stand and chock geometry and increasing the efficiency of the rolling process and production.

We rely on approximately 100 experienced and skilled employees, a close-knit network of international sales partners. Together we offer a wealth of experience and a solution oriented relationship to our customers.

1835

From a one-man company to the global market leader. From wood to steel. From product manufacturer to consulting and service-oriented solution provider. The central focus: Precision.

1905

With the rise of the industrial revolution at the beginning of the 19th Century, the craftsman business expanding into the CORTS enterprise.

1925

The industrial revolution was in full swing. CORTS laid the foundation for a steam engine, an industrial production, which in turn led to their ascent as the global market leader.

1957

In the course of the reconstruction after the 2nd World War, CORTS turned its attention to the aspiring steel industry, which experienced a boom in the course of the reconstruction and economic growth.

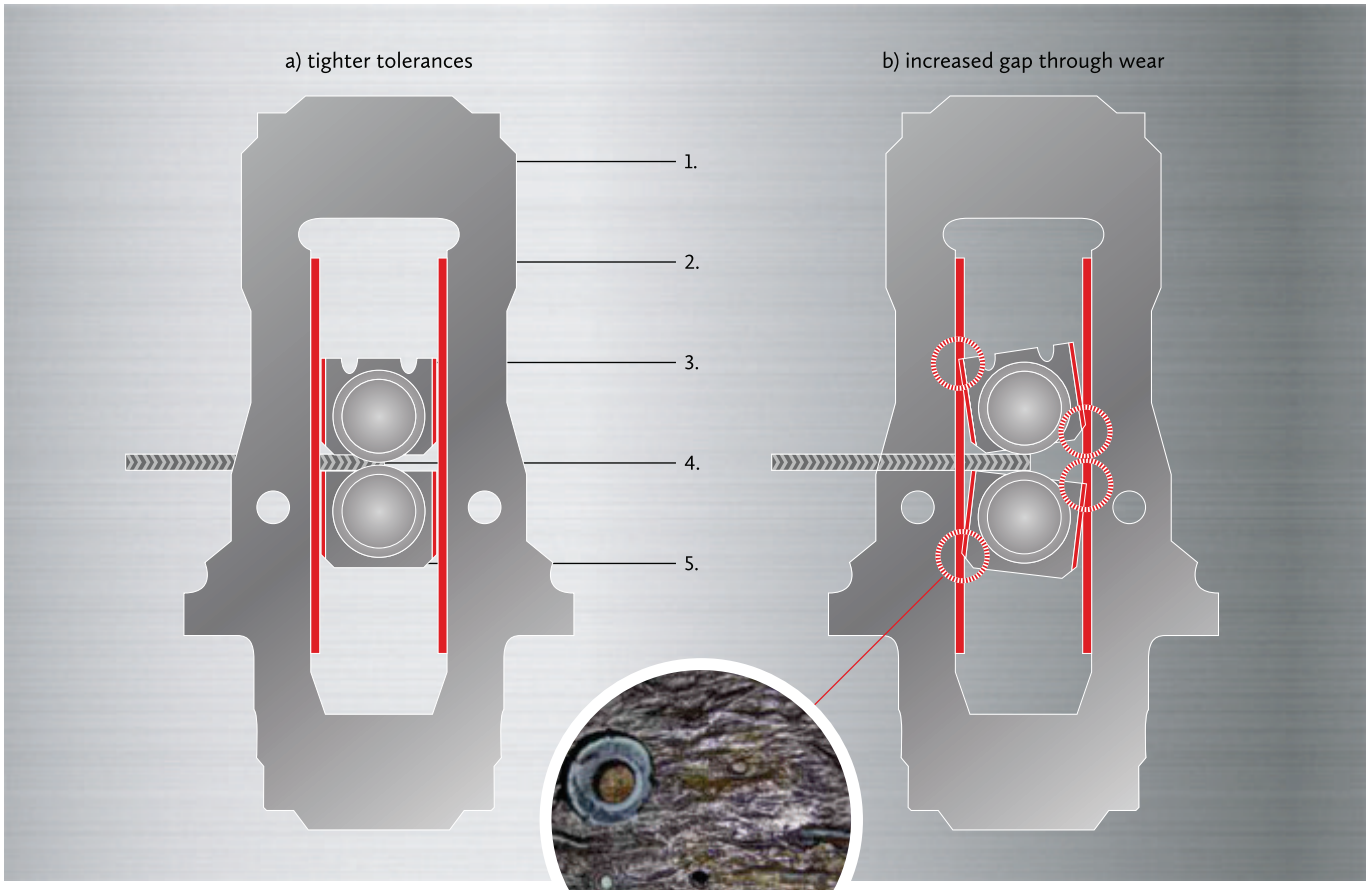
2005

Based on decades of experience increasing the efficiency of rolling mills, it was a logical step to establish CORTS Engineering GmbH & Co. KG, which develops pragmatic problem solving from spare parts through to complete turnkey solutions as your partner for engineering services.

2010

From the drawingboard to reality – The goal of CORTS Engineering is the detailed analysis and optimization of the mounting areas of CORTS products. CORTS has successfully conducted numerous turnkey refurbishments of mill stands and the related chock fleet. This creates the base for an efficient rolling operation with higher quality products lower maintenance costs and increased profits.

The Challenge of Wear



1. Mill stands
2. Housing Liner
3. Chock Liner
4. Rolled material (Kinetic energy f.r.t.l.)
5. Chocks

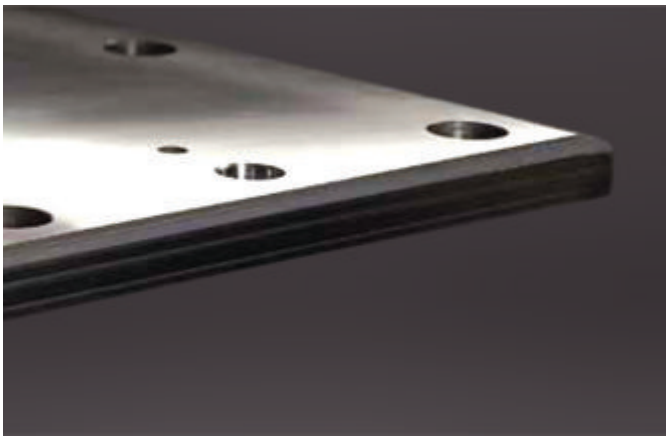
Abrasion and corrosion increases the total mill clearance between chock and housing. This bearing gap if further compromised by point loads and damaged surfaces.

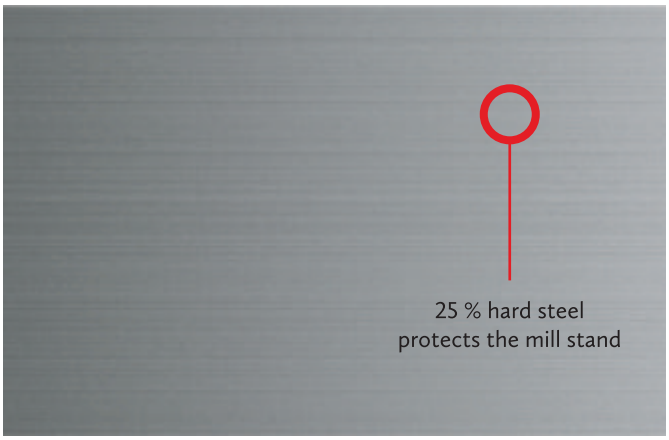
Rusted wear plates conventional quality

In today's competitive global markets, Rolling mills are faced with the challenge to guarantee the highest quality of the rolled product. Maintaining tight mill window clearances enables long term rolling mill efficiencies.

The problem: If milling stands and chocks are equipped with conventional wear plates made of C45, tool steel or bronze, the effects of abrasion, impact loads and corrosion leads to wear of the liner. This decrease in liner thickness increases the gap between chocks and housing which in turn damages other components and creates axial forces.

Competitive Advantage Through Precision



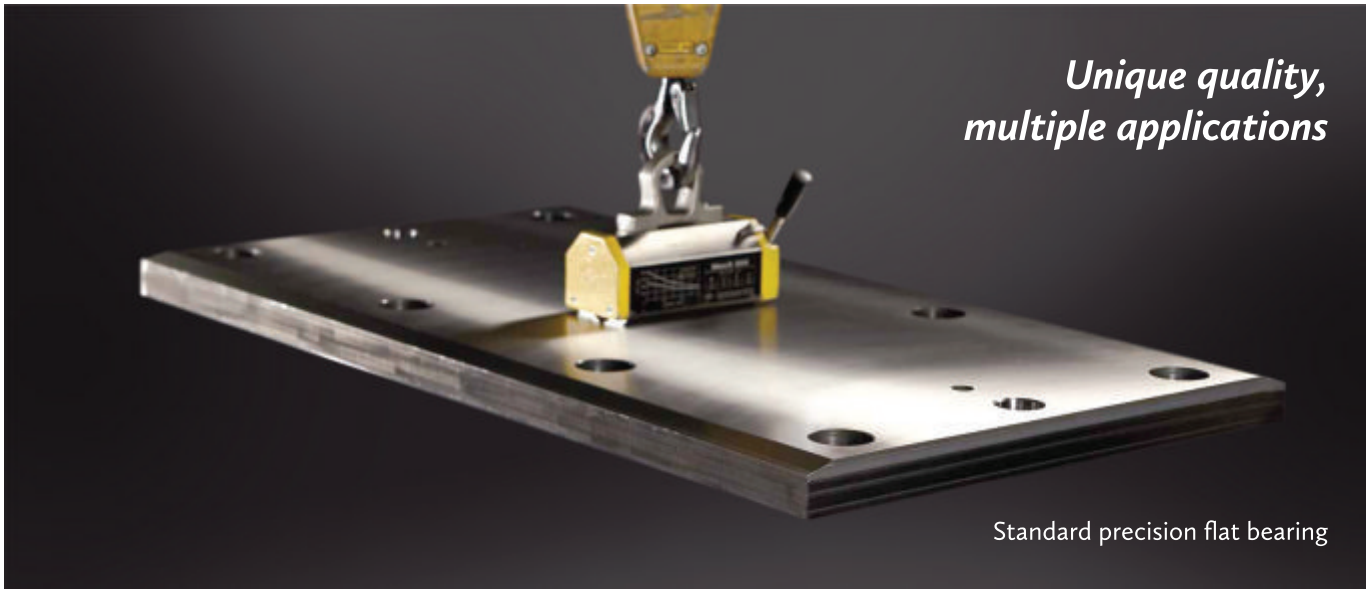


Precision flat bearings by CORTS

These issues lead to a tilting, oscillation and displacement of the chocks, horizontally and vertically (cross rolling). The work and back-up roller bearings, chock clamping mechanism and the chock bodies are exposed to excessive strain. The results are high repair and spare part costs along with unscheduled downtimes and rolling errors in the final product quality (chatter marks, ripples, skid marks, strip breaks, cobbles etc.).

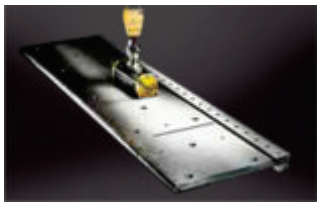
The CORTS solution:
Precision flat bearings made of CORC-g compound steel. The wear is significantly minimized as a result of the hard, abrasion and corrosion-protected guiding surface. A decisive competitive edge for every rolling mill.

CORTS Compound Steel

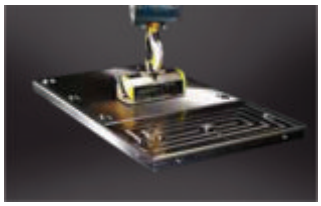


Surface-hardened pressure plate

Standard precision flat bearing



Wear plate for mill stand with shoulder



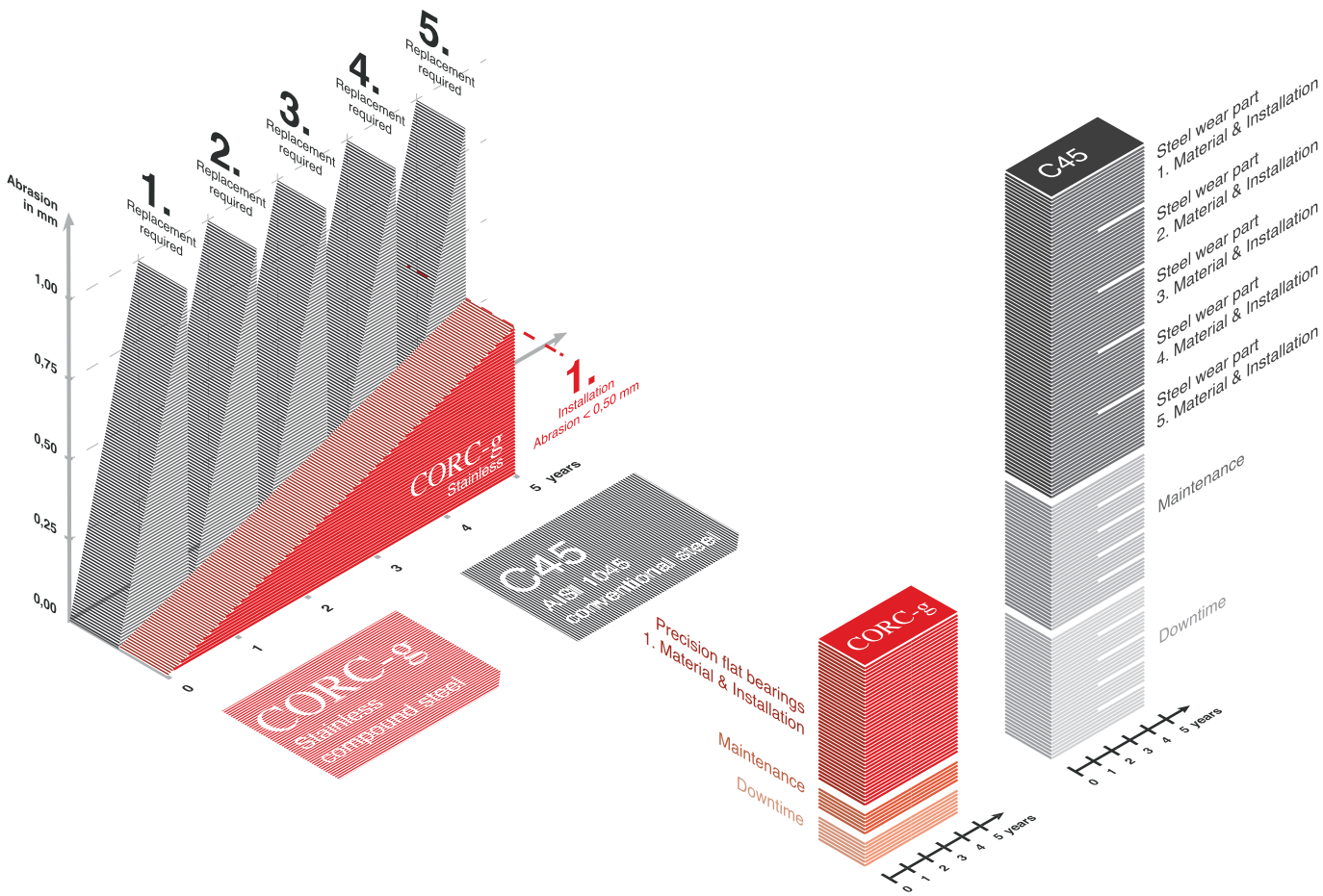
Wear plate with recess

Contrary to conventional, hardened wear parts, our precision flat bearings are made of original CORTS compound steel. Here the advantages of two different materials are united: The solid, hardened gliding surface is comprised of high quality bearing steel, optionally available in stainless and corrosion protected grades. The base material or shock absorbing portion is a low carbon ductile material. This unique material combination acts as protection against wear and corrosion – and offers protection of the mounting surfaces. Depending on the field of application, our precision flat bearings are either made out of "CORC-g-Standard", "CORC-g-Stainless" or "CORC-g-Tool Steel". "CORC-g-Standard" can be implemented in almost all areas and the gliding area has a very hard surface. "CORC-g-Stainless" should be implemented in areas where corrosion occurs in addition to abrasive wear. We also produce a through hardened tool steel (available in stainless) for other bearing elements such as roll change rails or bad plates.

The hardness of the gliding surfaces ranges from 56 to 62 HRc, depending on the chosen material and the thickness of this hardened layer makes up 25% of the overall material thickness.

Wear Parts With High-Quality CORTS Bearings

A decision that pays off



Wear is unavoidable due to the effects of abrasion and corrosion. The results are damaged components, plant shutdowns, less precision and lower levels of product quality. In order to control the wear in the past, different materials were used on chocks and housing so that the softer and worn components could be easily replaced. These wearing liners have to be replaced at regular intervals in order to guarantee the desired production precision and tight rolling mill window clearances. However, every replacement leads to the standstill of the plant, production losses and ultimately high costs of the frequent liner replacement.

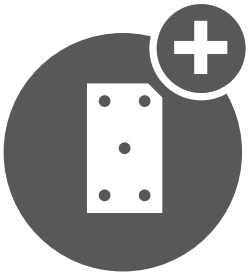
In comparison to conventional wear parts made of C45, hardened tool steel or bronze, our tailor-made precision wear parts made of CORTS compound steel are significantly less prone to wear. Furthermore, CORTS' products and 90 years of production know-how guarantee maximum precision for very long periods, while the machine bodies of the plants are protected. Based on the absence of wear, CORTS produces precision flat bearings and gliding liner elements rather then the traditional wear liner.

The initial purchase cost of our precision flat bearings for rolling mills is slightly higher conventional wear parts due to the high material quality and complex production process – mid-term and long-term the investment certainly pays off: Using components made from CORTS compound steel enables you to reduce wear, maintenance costs, and down-times to a minimum.

Mill operators and maintenance staff will benefit from permanent precision, optimal production quality and high plant efficiency while simultaneously reducing the Total Cost of Ownership.

Why CORTS?

Over 90 years
production know-how

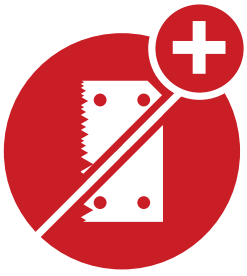


Exclusive supplier of
CORTS compound steel

Specialist for
rolling mill plant efficiency

Consulting expertise
and solution-oriented

Why Precision Flat Bearings
Made of CORC-g Compound Steel?



Minimal
wear

Long-term
precision

Minimum standstill
and downtimes

Significantly lower
maintenance costs

Constant highest
product quality

Improved
efficiency

CORTS Materials

The above arrangement of cleaning and lubricating keyways is a patented one.

CORC-g Standard

The specially alloyed wear surface, being 25% of the total thickness, is through hardened to 60-62 Rc, imparting a high degree of wear resistance.

The shock absorbing Mild Steel base material with a strength of 500-600 N/mm^2, hardness around 175 BHN, is 100% metallurgical bonded to the harder wear surface. This base material is readily weldable.

CORC-g Stainless

The specially alloyed Stainles Steel wear surface, being 25% of the total thickness, is through hardened to 58-60 HRc, imparting a high degree of wear and corrosion resistance.

The shock absorbing Mild Steel base material with a strength of 500-600 N/mm^2, hardness around 175 BHN, is 100% metallurgical bonded to the harder wear surface. This base material is readily weldable.

CORC-g Solid Steel

The material for and the hardening method applied to solid steel plates and liners are selected according to application and special requirements. A typical hardness is 50-55 HRc.

We are prepared any time to discuss with you personally the various applications of our products.

Presicion Flat Bearings
for Rolling Mills

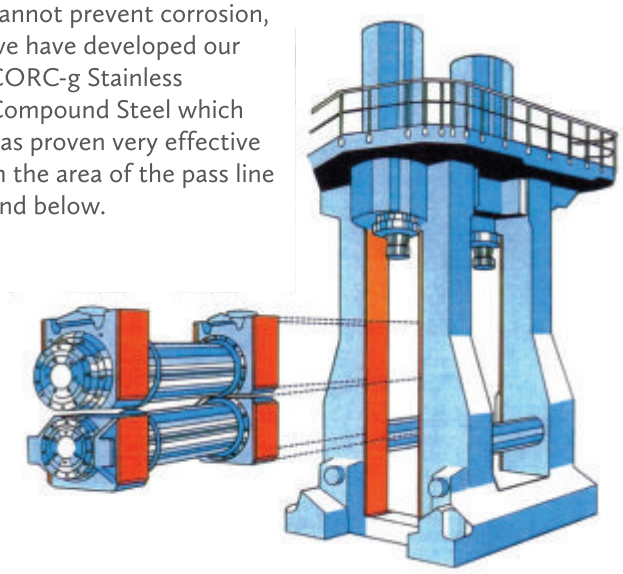
Main reasons for wear in rolling-mills are:

- **Impact Loads**
- **Abrasion**
- **Corrosion**

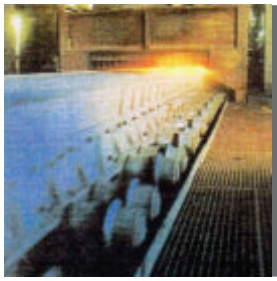
Abrasive Wear is mainly caused by Friction and Scale. To combat Abrasion, we recommend liners composed of CORC-g Standard - Hard against Hard.

Impact Wear occurs from the transfer of Energy from the rolling action of the mill. The shock absorbing portion of CORTS Compound Steel protects the machined surfaces of the housings and chocks. The wear portion with its high hardness and tensile strenght resists hammering and gauging caused by thrust forces.

Due to the influence in the work-roll and lower areas of high pressure cooling water in the lower areas of the housing, excessive corrosive conditions may occur.
Since hardness alone cannot prevent corrosion, we have developed our CORC-g Stainless Compound Steel which has proven very effective in the area of the pass line and below.



Heavy Duty Sealing
Systems for Sinter Plants



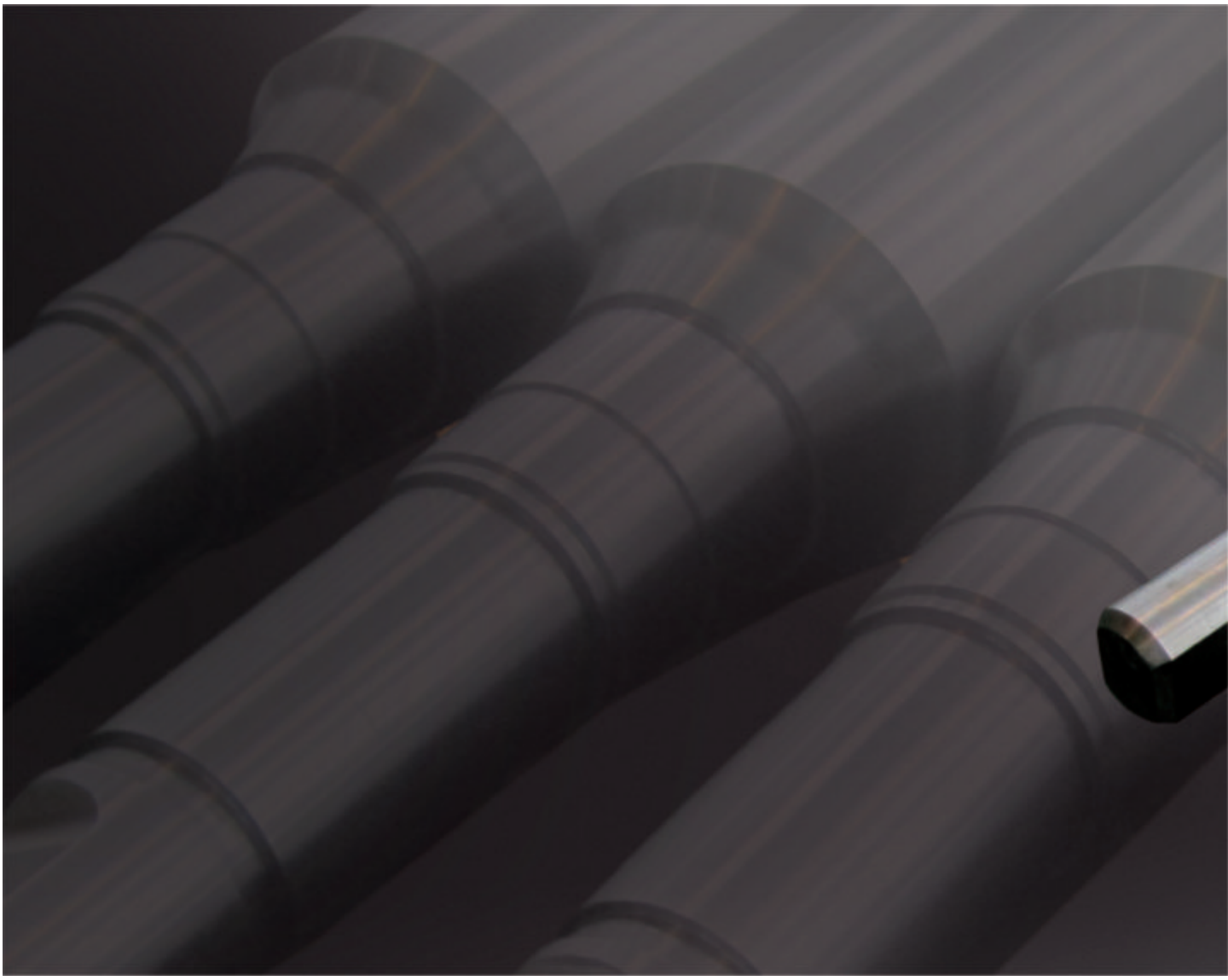
Extreme resistance to wear and indentation is provided by the chemical composition and the high hardness of the sliding surface.

An excellent, long lasting vacuum is guaranteed.

The high precision of CNC-produced CORTS Sinter-Rails ensures easy replacement.

Highly abrasive sintering dust creates a condition that greatly affects the profitably of a Sinter Plant.

CORTS Sinter-Rails, adopting the principle of Hard against Hard, considerably by strict wear resistance increases the service life time when compared to standard materials.



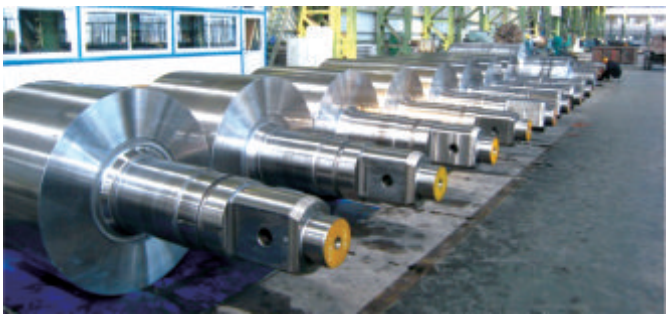
Steel Industry Solution Expertise

Hebei Metallurgical Rolls

Hebei Machinery

Hebei Machinery is a company focusing on mechanical and electrical product business worldwide. It has been serving the industry for almost 40 years since 1974. HMR, as a brand of Hebei Machinery, has been dedicated in providing superior metallurgical mill rolls and other parts for steel industry since 1988. As the first company offering metallurgical rolls to international market in China mainland, we have more than 20 years of experience. This allows us to well understand clients' requirement promptly and accurately.

We provide the most suitable, premium and cost effective products for various rolling line and rolling conditions. Our products have been sold to U.S., Germany, France, Australia, Brazil, Canada, Chile, Mexico, Korea, and other more than 20 countries. Being able to constantly provide top grade products and outstanding service, we have built incomparable reputation among our customers. U.S. currently as our biggest market, we have been supplying since 1989. There are more than 50 U.S. Steel mill place HMR as their main sourcing channel.



Metallurgical mill rolls as our major products, HMR has been committed to carry on developing of new technology to satisfy client ever-increasing demand. Our roll products including, Casting Iron/Steel Roll, forged roll, Hi-chrome roll and Carbide roll. The application covers:

Wire and Bar Mill: Wire rod, Rebar, Round and SBQ
Section Mill: Flats, Structural, Angle, H-beam and Channel.
Strip Mill: Welded Pipe Sheet, Nickel alloy, Stainless steel, Tinplate, Galvanized, Coated, Automobile sheet and non-ferrous
Pipe Mill: Seamless Pipe, HP Gas Pipe, and OCTG

Along with years of serving mill roll customers, we received load of appraise and acceptance. Thanks to our clients' recognition, we could extend our product structure to an even broad range, such as refractory, copper mold, Ingot mold, mill bearings and etc.

Customer Oriented Service

We beleive we are "The One" knows you best,

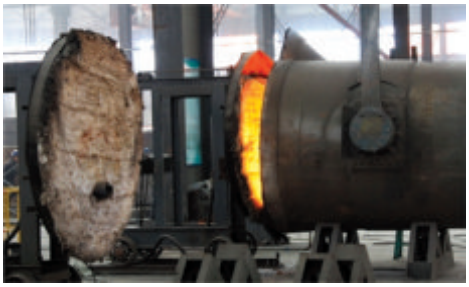
and we are "The One" eases you most!

Our organizational performance is not only valued by its sales volume. Building solid partnership with clients and gaining their satisfaction is more valuable to us. Every year, we send professional teams to visit clients' facilities in order to understand better their exclusive needs. All our engineers and technicians are specialists with years of experience. In the past years, along with the technology innovation and world economy's situation, we have been updating our products structure, range, and technique to provide more value-added and cost effective products. We received great compliment from our clients. Because HMR has been helping their facilities increased their production efficiency and guaranteed their operation functioning well.

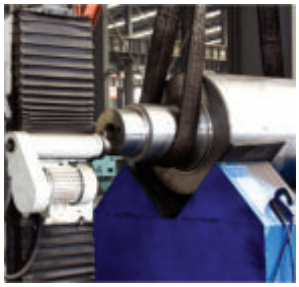
HMR has always been placing customers to a priority position.
Our customers can easily benefit from our comprehensive service system.

Production Facility







Packaging

All our packages are exclusively designed to guarantee the safety and quality of the products during long period mixture transportation. Considering the convenience of lifting, all our packages are easy for forklift truck operation. It also prevents damaging of the good during loading and unloading process.

The unique designed labels on the end each of our mill rolls are for product material recognition. Which could help clients to category and different them from each other.

SAFETY AND QUALITY

THE GOOD DURING LOADING AND UNLOADING PROCESS

Products
Mill Rolls

General Roll Recommendation for Wire Rod and Bar Mill

Position	Material	Hardness
Breakdown	Alloy Cast Steel	35 ~ 45 HSC
	Adamite	40 ~ 50 HSC
Roughing Stands	Pearlitic Nodular Iron	45 ~ 55 HSC
	TR1	45 ~ 55 HSC
	Adamite	40 ~ 50 HSC
	Graphite Steel	35 ~ 50 HSC
Intermediate Stands	Pearlitic Nodular Iron	55 ~ 65 HSC
	TR1	55 ~ 65 HSC
Pre-finishing & Finishing Stands	Pearlitic Nodular Iron	55 ~ 65 HSC
	Upper Bainite Iron	60 ~ 75 HSC
	Accicular Nodular Iron	65 ~ 78 HSC
	Indefinite Chill Iron	65 ~ 80 HSC
	Alloy Chill Iron	65 ~ 80 HSC
	High Speed Steel	75 ~ 85 HSC
	Tungsten Carbide	78 ~ 85 HSC

General Roll Recommendation for Section Mill

Position	Material	Hardness
Breakdown	Alloy Cast Steel	35 ~ 45 HSC
	Adamite	40 ~ 50 HSC
Roughing Stands	Alloy Cast Steel	35 ~ 45 HSC
	Adamite	35 ~ 50 HSC
	Graphite Steel	35 ~ 50 HSC
Pre-finishing & Finishing Stands	Ademite	45 ~ 60 HSC
	Pearlitic Nodular Iron	55 ~ 65 HSC
	Steel Based Adamite	55 ~ 65 HSC

* TR1 is this special material HMR came up in recent years. It is designed to be used at early and medium stands for long products with better wearing compare with traditional material.

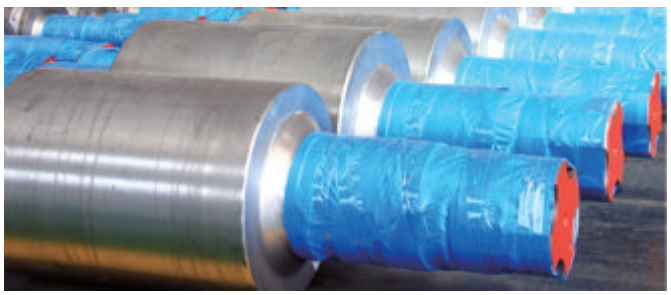
General Roll Recommendation for Strip Mill

Position	Material	Hardness
Roughing Stands	Alloy Steel	35 ~ 45 HSC
	Adamite	40 ~ 50 HSC
	Graphitic Steel	35 ~ 55 HSC
	Pearlitic Nodular Iron	45 ~ 60 HSC
Pre-finishing & Finishing Stands	Indefinite & Alloy Chill Iron	65 ~ 80 HSC
	Hi-Chrome Steel	60 ~ 70 HSC
	High Speed Steel	75 ~ 85 HSC



Forged Roll Application Selection

Mill Type	Roll Function	Material	Hardness
Cold Rolling Mill	Intermediate Roll	9Cr2M, MC3, MC5	70 ~ 85 HSC
	Work Roll	9Cr2MoR, 86CrMoV7, MC3, MC5	80 ~ 105 HSC
	Back-up Roll	60Cr3Mo, 9Cr2Mo, 86CrMoV7, 70Cr3NiMo	60 ~ 80 HSC
Sendzimir & Cluster Mill	Intermediate Roll	5H12	55 ~ 60 HSC
	Work Roll	Cr12Mo1V1, Cr12MoVCo	60 ~ 65 HSC
---	Forged Shaft	42CrMo, 36CrNiMo4	35 ~ 45 HSC




Products
Tungsten Carbide Rings & Composite Rolls
for Wire-Rod and Bar Mills

Tungsten carbide as a type of powder metallurgical tool steel, it contains tungsten metal compound and metal binder. Products made out of this type of material possess good thermal conductivity, higher modulus of elasticity and stable chemical property.

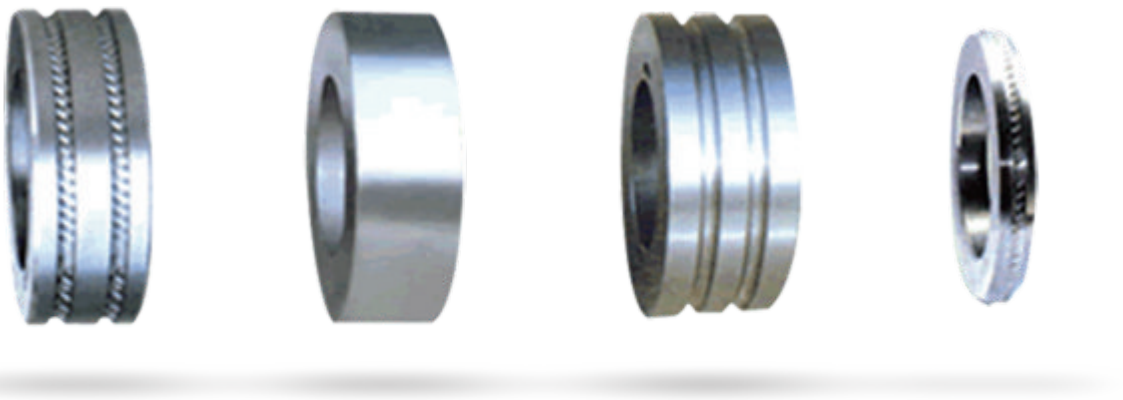
Compare to conventional material, Carbide rings and assembled rolls offer higher hardness, higher strength and better wearing. It is best suitable for high speed wire and rod mill. For years of developing and improvement, HMR's carbide rings and rolls are now successfully applied in high-speed wires, bar and rebar production. It greatly reduces the frequency of changing groove and roll. As a result, labor intensities greatly reduced and operation is more efficient.

With our specially designed fitting method, hydraulic lock nut is applied to roll assembling process. It generates certain pressure that keeps rings attached to the shaft tight and effective.

For ROUND BARS

For REBARS

For WIRE



Grade	Wc (%)	Co (%)	Ni (%)	Cr (%)	Density / cm^3	Hardness ≥ HRA	Bending Strength ≥ Nmm^2	Compressive Strength ≥ Nmm^2
HME6	94		6		14.9	88.0	2300	4200
HME8	92		8		14.7	87.5	2400	4100
HME10	89		10		14.3	86.5	2500	3900
HME14	86		14		14.0	85.0	2600	3600
HME18	82		18		13.6	83.0	2500	3300
HMR30	70		30		12.8	78.0	2200	2900
HMR24	76		24		13.1	80.0	2400	3000
HMR20	80		20		13.5	82.5	2500	3100
HMR18	82		18		13.7	83.5	2600	3200
HMR15	85		15		14.2	85.0	2700	3300
HMR12	88		12		14.3	86.5	2300	3400
HMR10	90		10		14.4	87.5	2400	3500
HMC26	74	26		--	12.9	80.0	2200	3000
HMC25	75	25		--	13.4	82.0	2400	3100
HMC18	82	18		--	13.6	83.5	2500	3200
HMC15	85	15		--	13.9	83.5	2400	3300
HMC12	88	12		--	14.1	85.0	2300	3400
HMC10	90	10		--	14.8	86.0	2500	3500

Specifications for Rings and Composite Rolls

Rings	External Diameter (mm) 145 ~ 480	Bore Diameter (mm) 87 ~ 280	Width (mm) 20 ~ 190
Composite Rolls	Diameter (mm) 285 ~ 480	Rolling Size 5 ~ 28	Width (mm) 50 ~ 190

Grade	Recommended Application
HMR30	Good impact resistance. Recommended for Rebar and pre-finishing 1 & 2 stand
HMR24	Good impact resistance. Recommended for Rebar and pre-finishing stand
HMR20	Good resilience and crack resistance. Recommended for finishing early stands
HMR18	Good resilience, corrosion resistance, good wear and crack resistance. Recommended for finishing medium and last stands
HMR15	Good resilience, corrosion resistance, good wear and crack resistance. Recommended for finishing medium and last stands
HMR12	Good wear and corrosion resistance. Recommended for finisher last three stands
HMC26	Good resilience, corrosion resistance and crack resistance. Recomemended for finishing stands and rebar
HMC25	Recommended for finisher 1 & 2 stands and pre-finishing stands. Also recommended for low rolling speed, less accurate/unstable rolling tech mills
HMC18	Good for various applications. Recommended for finishing early stands and most rear stands
HMC15	Commonly used for various application. Can be used on most stands and finishing last four stands
HMC12	Good wear, medium level impact resistance. Recommended for wire and rod finisher last two stands

Grade	Pre-Finishing Stands				Finishing Stands										Size Reducing Stands			
	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2	3	4
HMR10 HMC10																	○	○
HMR12 HMC12													○	○			●	●
HMR15 HMC15									○	○	○	○	●	●	○	○		
HMR18 HMC18					●	●	○	○	●	●	●	●						
HMR20 HMC25					○	○	●	●										
HMR24 HMC26	●	●	○	○										▲				
HMR30	○	○	●	●										▲				

● First Recommendation

○ Second Recommendation

▲ Rebar

HMR are Cobalt/Nickel serial. For PH< 7.2 cooling water

HMC are pure Cobalt serial. For PH> 7.2 cooling water

Products
Copper Mold

As one of the most important components of continuous casting machine, Copper mold's functions is to solidify the liquid steel pouring through submerged entry nozzel, and support rolling metal obtaining defined thickness. Therefore, it plays a critical parts of increasing continuing casting efficiency and steel quality.

General Roll Recommendation for Strip Mill

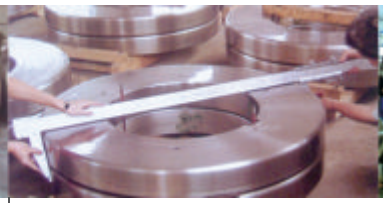
Shape	Size (mm)	Camber Radius	Thickness (mm)	Lenght	Tapper Design
Square & Rectangular Tube	**Square** 50 x 50 500 x 500 **Rectangular** (100-500) x 650	4000 ~ 17000 or Straight	6 ~ 50	700 ~ 1000	Single taper, double taper, triple taper, quadruplicate taper, parabolic taper and various selections based on customer specification
Round Tube	Φ110 - Φ1200	5000 ~ 17000 or Straight	10 ~ 50	700 ~ 1000	Double taper, quadruplicate taper, parabolic taper and various selections based on customer specification
Non-standard & Beam Blank Tube		6000 ~ 17000	12 ~ 50	780 ~ 1016	Single taper, double taper, triple taper, quadruplicate taper

Hi-Chrome Alloy Products

1. High Chromium Alloy Roll Series

It includes rolls, guide discs and heat-resistant steel products. The technology of this series has reached the forged steel standard which is produced by Japan and Germany. It maintains the same hardness from surface to core that there is no hardness drop in applications which leads to excellent performance and extraordinary usage. The life span of these products is about 2 times of forged steel product. The diameter can reach 3m with Max weight of 10tons.

Size Reducing Mill Roll

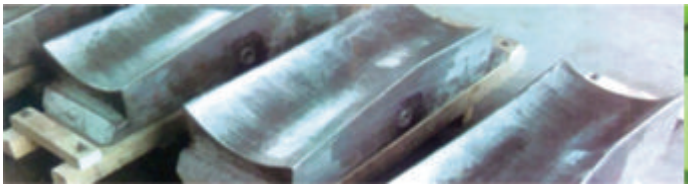


High Cromium Alloy Ring

Strengthening Rolls

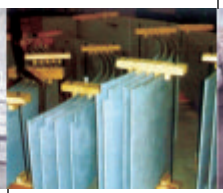
2. Heat Resistant Products

a. Alloy Guide Plate for Seamless Steel Pipe Mill



b. Heat Resistant Inner Lining for Rotary Furnace

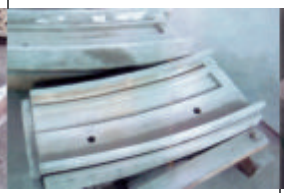
Grate of Sintering Furnace

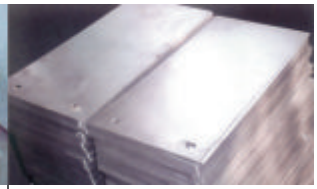


Heat / Wear Resistant Ring component for Rotary Furnace

Walking Beam of Furnace

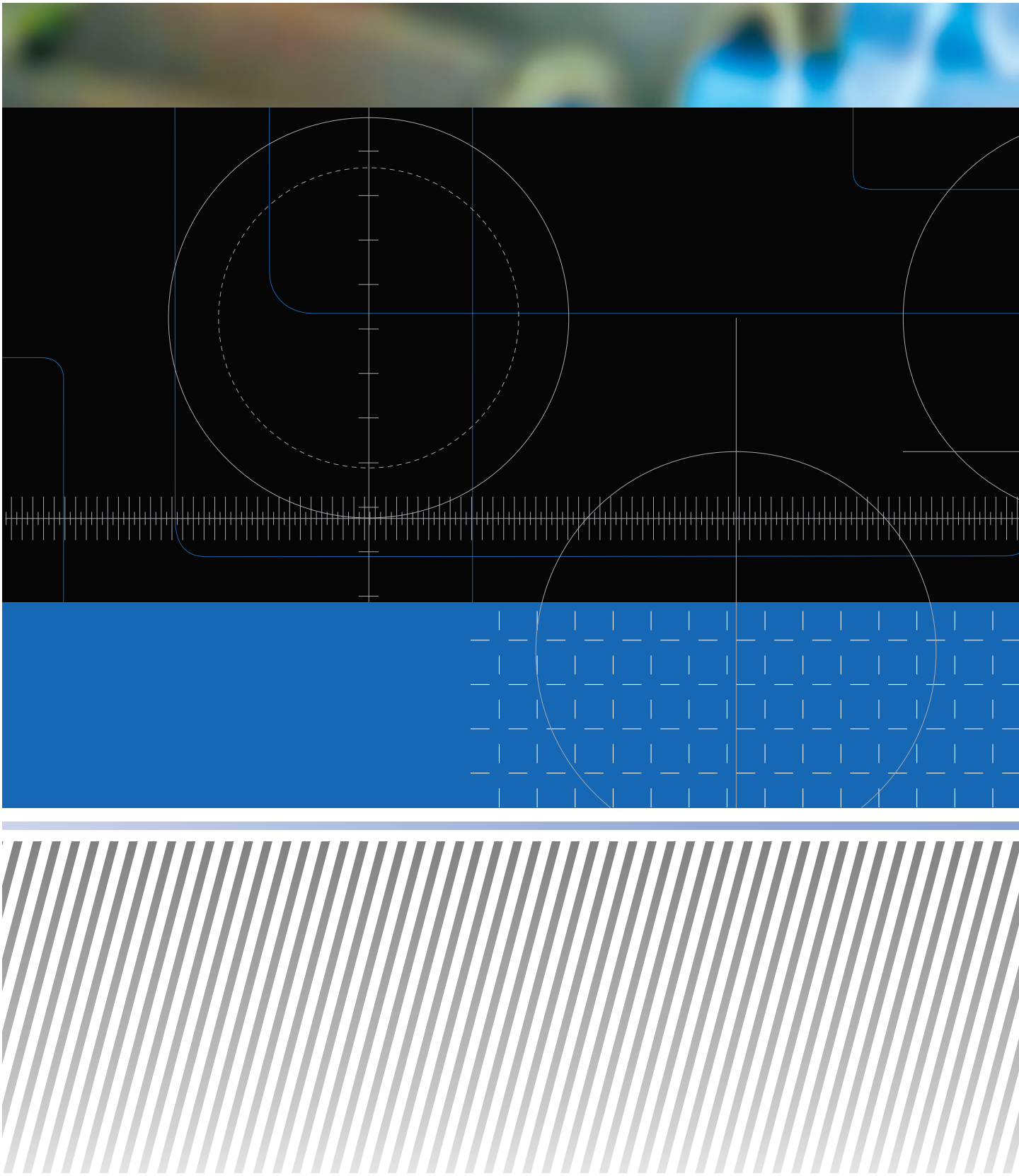
Heat Resistant Ring Component for Rotary Furnace





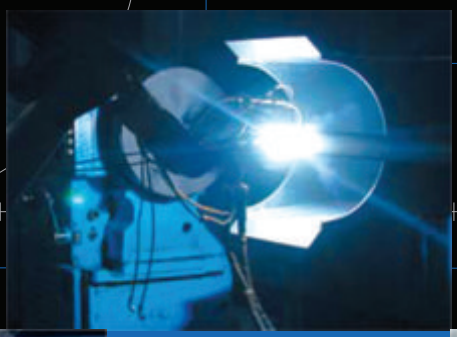
Heat / Wear Resistant Plate for Rotary Furnace

Inspection



Habets

INDUSTRIAL COMPONENTS & SURFACE TECHNOLOGY



Makes the Difference

Habets Industrial Components & Surface Technology

A world of difference

There is often a world of difference between the old and the new – a difference in quality and reliability as well as functionality. This applies to many things, and it also applies to the expensive components which keep your production processes up and running.

When these components reach the end of their normal lifespan, you generally have two options: making a major investment and replacing them or investing significantly less and having them reconditioned by a company specialised in this kind of work – a company that has built up an excellent reputation since 1944 as a leading supplier and service partner in the world of industrial components and surface technologies. Welcome to the world of Habets Industrial Components & Surface Technology.

We are a globally oriented organisation with over six decades of experience in metal machining, machine building, and reconditioning large industrial components. We also have over 40 years of experience with thermal spraying processes for extending the usable lifespan of components and have been active for many years as a producer and service partner for customer-specific process rollers such as conveyor belt rollers, transport rolls and guiding rolls. In themselves, these three areas of activity are not that unusual, but the fact that we carry out all three under one roof makes us a unique partner in the industry. Thanks to this combination and our extensive track record, we can make a difference for you as well!

Habets has been a leading specialist in machining and/or reconditioning large and complex industrial components for decades.

Meeting & Surpassing Client Expectations

Cost containment, extending tool life, quality, short delivery times, and excellent reliability are the most important reasons why our clients call on our expertise – clients who value our services even more when large and complex industrial components are involved. "Large, heavy, long and round" are our bread and butter. After all, our ultra-modern machine park is designed to handle these and more. The same is true of the approximately 65 professionals working with these machines – a good mix of experienced workers and enthusiastic younger ones, all of them with a "heart of steel." They bring a passion for excellence and an eye for detail to their daily work, regardless of whether it involves machining completely new parts or reconditioning worn-out components.

Thermal spraying can be part of the reconditioning process. It is a technology for extending the lifespan of industrial components, and we have specialised in it for over 40 years. We are proud to have become the first Dutch company that was awarded full GTS certification for HVOF, combustion powder, combustion wire and atmospheric plasma spraying. This certification is a quality hallmark awarded by the prestigious German association of thermal spraying companies, which has a great many leading European companies among its members.

Our unique combination of expertise in thermal spraying and (large-scale) machining processes makes us a valued partner in the following industries:

- steelwork and mills
- paper and printing
- chemical/petrochemical
- textiles
- offshore
- automotive
- trans-shipment
- ceramics
- dredging
- shipping
- energy

In each of these industries, we have the same goal: providing the very highest quality in terms of products and services. Our clients, mostly organisations dependent upon continuous operational processes, expect nothing less and deserve nothing less. Downtime is very expensive, so it is only logical that they demand predictable and reliable levels of performance in order to guarantee the continuity of their processes. For our part, we continually aim to not only meet but surpass their requirements and expectations in terms of product quality, cost and delivery time. To help realise this, we work on the basis of a quality management system which is ISO 9001:2000 certified.

Habets Industrial Components & Surface Technology

A world of difference

Thermal spraying unknown becomes unprecedented

Although the technology of thermal spraying is still relatively unknown, it has been in existence for over a century. In 1882, the Swiss Max Ulrich Schoop submitted his first patent application for a technique based on the melting of wires in a modified "pistol." Since then, the development of various spraying technologies has gone through a great many phases. We have been closely involved in these developments for over four decades, and look forward to sharing our experience and expertise in this area with you. Once you become familiar with it, we are sure you will no longer view it as an unknown but rather as a technology that can provide unprecedented benefits.

Combining technologies

Thermal spraying: the strongest link

Thermal spraying technology uses energy to heat the material to be sprayed, in wire or powder form, until it approaches its melting point, after which it is converted into a spray.

Compressed air or a detonation is used to spray the melted particles onto the work piece, which is thereby covered with an extremely longlasting and wear-resistant metal, ceramic or hard metal coating. This technology greatly extends the usable lifespan of machine components which are sensitive to wear and tear, corrosion, chemicals etc. In addition, thermally sprayed-on coatings can be used to make dimensional corrections. This means that we can restore your component to its original specifications with a very high level of accuracy. Finally, thermal spraying also significantly improves the surface quality of the part that has been sprayed. For example, a process roller that has undergone thermal spraying is much less likely to damage your products.
Regardless of whether they find use in the steel industry, chemical industry or paper industry, the components treated by us are always the strongest link in the chain.

Thermal spraying offers unprecedented possibilities when it comes to extending the usable lifespan of machine components and/or carrying out dimensional corrections.

Our thermal spraying processes:

- Autogenic (metal coatings for dimensional corrections or protection against corrosion)
- Plasma (ceramic coatings to improve corrosion resistance and wear resistance)
- Electric arc spray (repairs, zero layers)
- HP HVOF (carbide coatings to increase wear resistance)

Large-scale machining: our world

Our company is very much at home in the world of large-scale machining processes. Over the years, what originally began as just a few machines in a shed has grown into a highly specialised and complex operation that includes CNC turning, milling and boring, grinding etc. We are equipped to handle a very wide range of sizes and shapes, from components that are many metres in length to parts weighing many tonnes.

A powerful combination

Of course, there are many others who, like us, are specialised in machining processes, although few can process components as large and heavy as we do. Of course, there are also many others with expertise in thermal spraying processes, although few come close to matching our quality. But what really makes us unique is the combination of both these specialisations under one roof. It is this combination which enables us to provide our clients with a great deal of added value when it comes to manufacturing, repairing and servicing industrial components which have a lot to endure within their production processes – from bearing blocks to process rollers and from rolls to drive components.

Horizontal CNC turning up to:

- 8000 mm
- Ø 1600/1260
- 35/50 tonne

Vertical carousel turning up to:

- 1940 mm in height
- Ø 3600
- 25 tonne

CNC milling/boring up to:

- 8000 mm in length / 2000 mm in height
- 1000 mm working width/depth
- 25 tonne

Habets Industrial Components & Surface Technology

A world of difference

Well worth the effort

Thermal spraying:

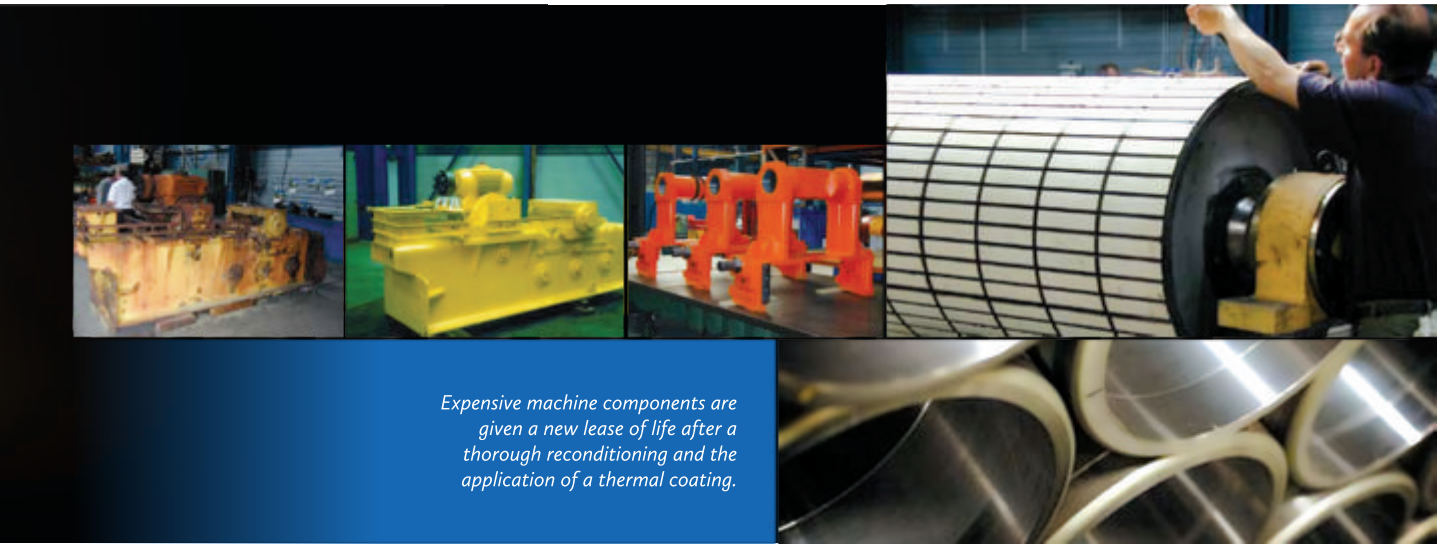
This process roller for a zinc line in the steel industry was equipped with a hard metal coating. The result: the client could be sure that the component would continue to retain its excellent characteristics in terms of wear resistance and surface quality for an unprecedented period of time.

Industrial components

This planetary carrier transfers wind energy to a generator. A high level of dimensional precision in combination with large size is essential for ensuring that this critical component of a windmill can function optimally.

Like new

This built-in element, thought by some to be “finished”, was completely reconditioned. After pretreatment, thermal spraying, and final treatment, your component is returned to you quickly and as good as new but for a fraction of the original price.



Expensive machine components are given a new lease of life after a thorough reconditioning and the application of a thermal coating.

Why Habets?

Having us recondition or machine your critical and expensive components provides you several benefits, the most important of which are:

ISO 9001 : 2008
BUREAU VERITAS
Certification

GTS-Zertifikat
THERMISCHES SPRITZEN

Extending tool life

By applying a thermal coating, we can significantly extend the tool life of your components, as they become more resistant to wear and tear, corrosion and chemicals.

Cost savings

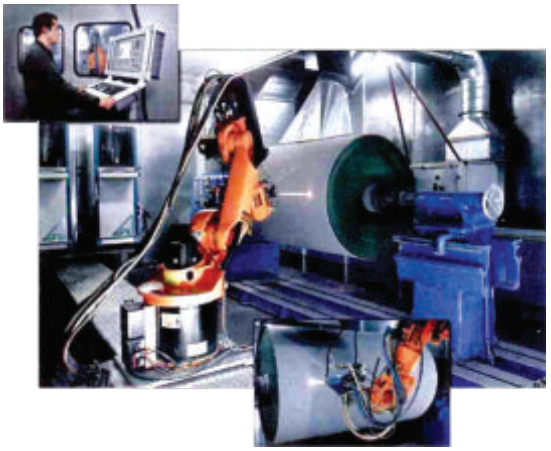
Our highly effective solutions for dimensional corrections and improvement of surface quality have a significant effect, in the short term as well as long term, on reducing the cost of your production equipment, increasing your output, and greatly reducing the risk of damage to your products.

Short delivery times

Whereas waiting times for components that are difficult to obtain can sometimes extend to years, we recondition your components so that they are as good as new and often even of better quality in a fraction of that time.

Precision Work from Habets

Since B.V. Mechanische Industrie Habets was founded in 1944, it has combined experience in the skilled trades with new technologies of thermal spraying. "Industrial components & Surface technology" stands in the new trademark, a part of the new corporate logo of the company which Arno Wendrich has managed since the beginning of 2007.
***"We have specialised in constructing new large, round and rotating machine parts for industry and in repairing existing ones. Our customers include Western European businesses, e.g. in the chemical, paper and steel industries as well as, to an increasing extent, from the energy sector. We build complete components for large machines or repair existing accessories,"* according to Wendrich.**



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Thermal spraying as repair

Thermal spraying has been one of the special fields of the company for over 30 years. It can be used as a quick type of repair. *"The delivery period for the steel in order to build a new component may be as much as one year. High costs may also arise. It is substantially more price-favourable to repair, for example, an existing roller bearing block or gear unit than to construct a new one. Furthermore, a repaired machine part has the same properties as a new one and will last just as long in normal use,"* according to the Sales Manager, Theo Linssen. In addition to the applications of oxy-fuel spraying with wire or powder, electrical wire spraying and plasma processes, Habets has offered its customers the high-velocity oxy-fuel spraying process since the beginning of 2000.

ISO Standard and GTS certificate

Since December 2007, Habets has had a quality management system according to ISO 9001:2000. Even before that, the business worked according to this Standard, only without an official certificate.
Habets is one of the few Dutch companies to belong to the International Gemeinschaft Thermisches Spritzen (GTS) and the sole Dutch company to have a GTS certificate. Director Wendrich: *"It is important to exchange expert knowledge and experience at the international level. In the GTS association, you can also cooperate on quality standards and improvement, environmental protection and more favourable working conditions. As a business, we are not standing still as far as product innovations or improvements are concerned. We have our own research and development department and also cooperate with RWTH Aachen, one of the leading technical universities in Europe. Together with the Institute for Surface Technology (I.O.T.), we are dealing with the development of very special areas of application."*

Prospects due to wind power

The increasing utilisation of alternative energies such as wind power is offering Habets the chance of further development in the production and/or maintenance of large machine parts, e.g. of wind power stations. *"This is a growing market"* explains Arno Wendrich. *"We have so many orders on hand that we would like to extend our personnel inventory of 65 employees. However, it is difficult to find good employees with heart for our specialist field, We are now training young, talented people ourselves."*

Source: B.V. Mechanische Industrie Habets, Nuth, Netherlands

Capabilities

Machining Capabilities

Multi-task machining centre Unicom 8000:			
	Milling, drilling, turing		
	In one setup	(CNC)	ø 3000 mm x 2300 mm
Turing:	Centre	(CNC)	ø 1600 / 1280 mm x 8000 mm
	Centre	(CNC)	ø 840 / 530 mm x 5000 mm
	Centre	(CNC)	ø 800 / 420 mm x 2700 mm
		(CNC)	ø 530 / 340 mm x 520 mm Powered tooling
	Vertical	(CNC)	ø 3600 mm x 1940 mm Powered tooling
	Vertical	(CNC)	ø 1400 mm x 1150 mm
	Centre		ø 2200 mm x 9500 mm
	Facing		ø 3000 mm x 700 mm
Milling:		(CNC)	8000 x 2000 x 1000 mm
Fine boring:	Floor type		4200 x 2000 x 1520/400 mm, spindle ø 125 mm
	Table type	(CNC)	1580 x 1500 x 1000/500 mm, spindle ø 125 mm
Grinding:	Cylindrical		ø 500 mm x 3000 mm
	Internal		ø 600 mm x 700 mm
	Profile and plain		1500 mm x 550 x 400 mm
	Centreless		ø 100 mm
Planning:			500 mm
Radial drilling:			ø 80 mm arm. 2000 mm
Keyseating:			90 mm x 500 mm
Honing:			910 mm x 1500 mm

Other Capabilities

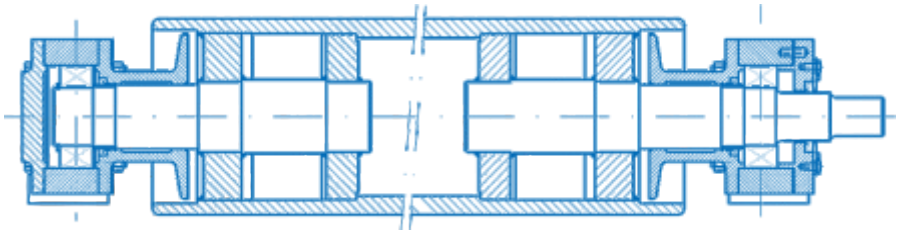
Thermal spraying	Combustion - (wire/powder), Arc-Plasma, (HP) HVOF-process
Welding (circumferential, longitudinal)	ø 2500 mm x 9000 mm max.
Welding U.P. and protective atmosphere	max. 600 Amp.
Hydr. pressing	350 T
Hydr. testing	500 Bar
Bright-hardening, heat treatment	
Grit blasting	Cabin size 6000 x 4000 x 2500 mm (L x W x H)
Balancing (static, dynamic)	max. 3000 kg.

Controll (Tests)

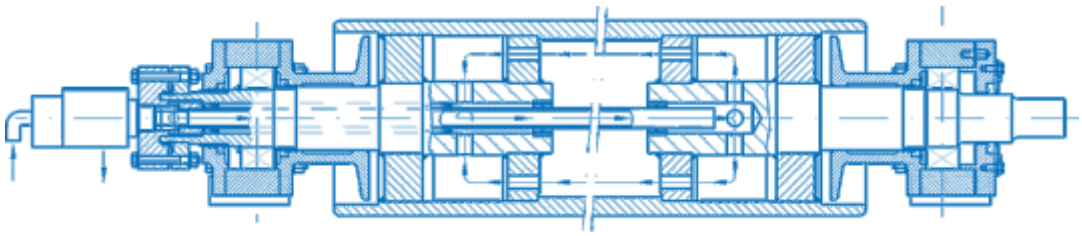
*** Hardness - Thickness - Roughness**	*** 3D measurement 3000 x 2000 x 6000 mm**
*** Vibrations and R.P.M.**	*** Die check and magnetic**
*** Microscopic inspection**	*** Particle inspection**

Habets High Grip (H.H.G)

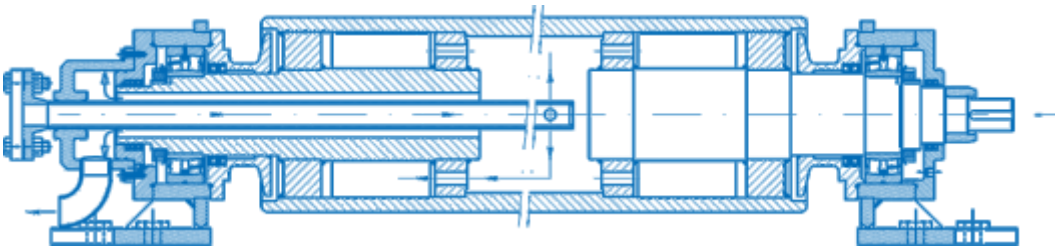
Runout Table Rolls For Hotstrip Mills



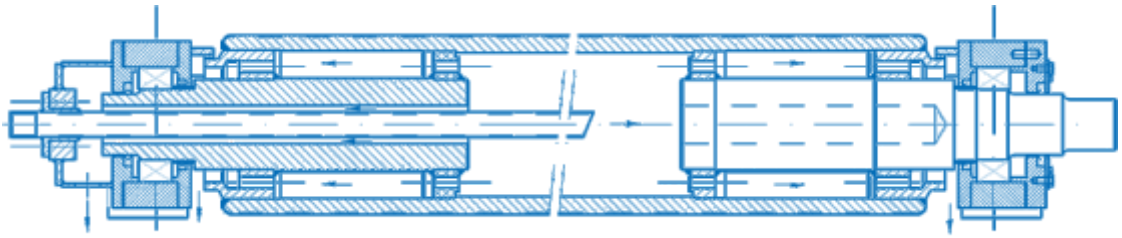
Standart Version



Internally Cooled Version (Demineralized Water)

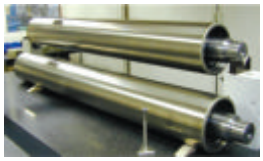


Internally Cooled Version (Normal Water)



Internally Cooled Version (Open)

World Class
Hot Strip Mill Products





Habets High Grip
Runout Table Roll

Habets Shaft ends
repair in weeks
back to specification



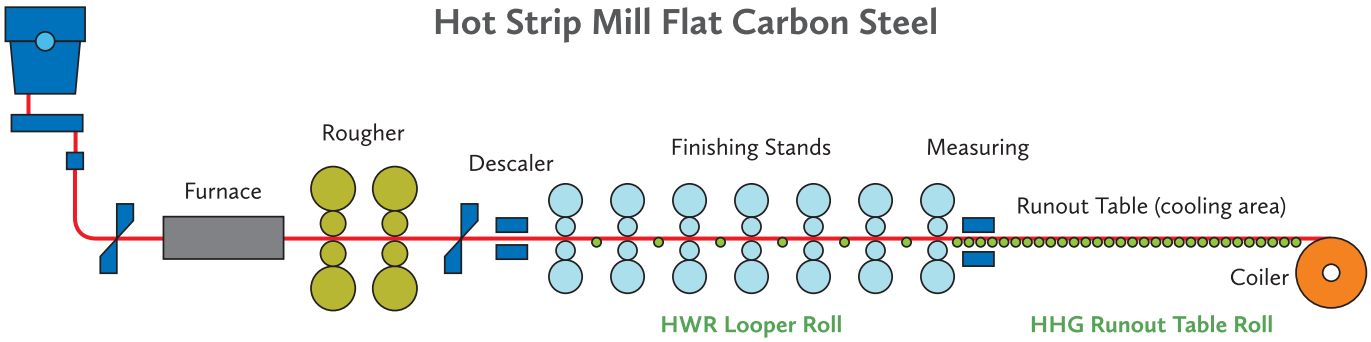



Habets Chock repair in weeks back to specification





Habets High Grip
Runout Table Roll



Habets delivers various products and services for its customers in the Steel Industry such as repair of chocks, repair of work and back-up roll shaft ends, pellet rolls and conveyor belt pulleys and idler rollers. Our main focus product for the steel industry is the **Habets High Grip Runout Table Roll for Hot Strip Mills**.

The Habets High Grip Runout Roll brings a **proven productivity increase** at numerous Hot Strip Mills world wide and therefore we are more than confident that it will also realize new/additional cost savings for your Hot Strip Mill. Imagine what substantial annual integral cost savings you can realize by using the Habets High Grip Runout Table Roll **with an average proven life time performance up to 80 million tons, while maintaining a reliable quality performance**.

We are proud to state that various major global steel manufacturers such as ArcelorMittal, Tata Steel and ThyssenKrupp Steel and contractors like SMS made their life much easier by choosing Habets as their partner for their Habets High Grip Runout Table Roll and due to this they benefit for many years of the higher productivity !

We kindly refer you to our reference list !

The productivity will be found, but not limited to, in several areas such as:

- Reduction of idle production hours due to less roll replacement,
- Improved steel output capacity and improved steel surface quality,
- Less roll purchasing costs,
- Less maintenance labor costs,
- and many more!

Base material	Steel
Type coating	Habets High Grip (HHG, wear resistant and corrosion resistant)
Guaranteed lifetime	Habets can realize various lifetimes. The optimum guaranteed lifetime shall be determined by both the customer and Habets

During the production of steel, your production components are subject to enormous loads and high temperatures. These conditions can significantly impact your production capacity and production yield unless your components are in the best possible condition. This is also true for your runout table roll, which must be wear and corrosion resistant furthermore the friction between the rollers and the steel strips must be at a maximum in order to guide the strip efficiently towards the coiler (pro-track).

To meet these demanding requirements, we developed the **Habets High Grip (HHG) Table Roll**, which has excellent performance characteristics in terms of wear resistance, corrosion resistance and grip between roll and steel strip (we kindly refer you to our History Chart). As a result of this you can benefit from significant savings on purchasing costs, maintenance costs, and also increase production output and expand your product portfolio. Please note that the Habets High Grip Runout Table rolls are available in versions with and without inner water cooling capabilities (we kindly refer to the sketches of the available versions).

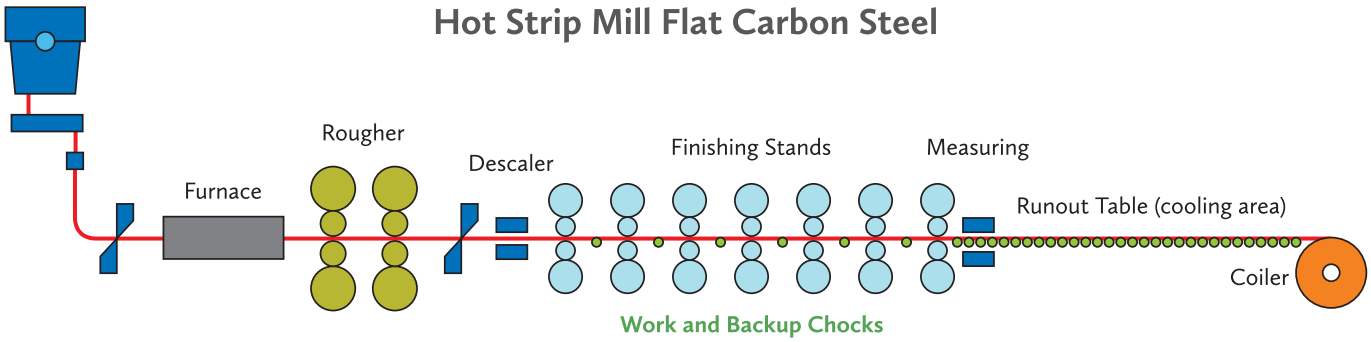
Various hot rolling mills have recognized the importance of working with a runout table roller which is always in the best condition, therefore they chose for the **Habets High Grip (HHG) Runout Table Roll.**

The Major Advantages of the HHG are (productivity areas) :

- Possible to roll thinner material, thus expanding your “product window”.
- Reducing the number of cobbles, saving substantial amounts of money.
- The visual steel defect marks will be less or even avoided.
- Improved tracking towards the coiler.
- Longer life time thus less purchasing and maintenance costs.
- The cooled versions of the Habets High Grip Runout Table Rolls decrease the pollution onto the thickness measurement equipment.

We can provide you with our expertise, allow us to consult with you the savings you can achieve by working with the **Habets High Grip (HHG) Runout Table Roll.**

Habets Chock Repair
For Hot / Cold Mills



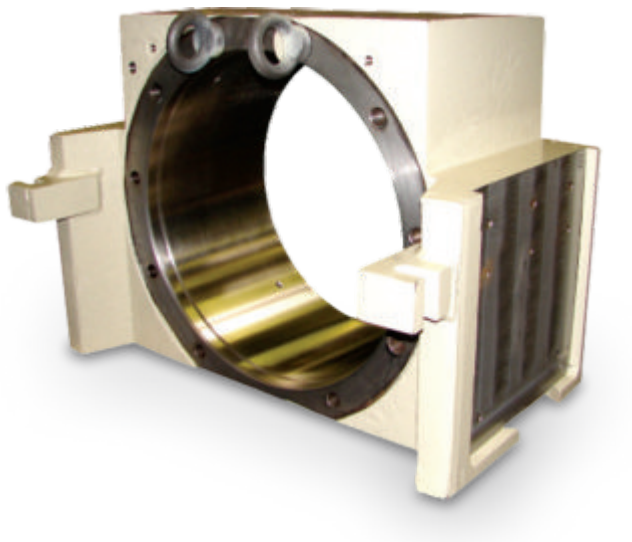
Habets delivers various products/services for its customers within the Steel Industry such as repair of work and back-up roll shaft ends, production of runout table and looper rolls, pellet rolls, conveyor belt pulleys and idlers. Yet a special activity is the **Habets refurbishment of chocks** for working and back-up rolls within Hot and Cold Strip Mills.

One of the applied repair methods, mainly used for the repair of bores and side faces, is thermal spraying. This process is very mild to the base material because the temperature of the chocks surface will not be higher than approximately 150 degrees Celsius.

The coatings as applied do have a double function, the first one is for restoring to drawing/specifications and the second one is for a better corrosion resistance.

Hot and Cold Strip Mills throughout Europe have recognized the benefits of this mild repair method, therefore they choose Habets to apply them for their critical components.

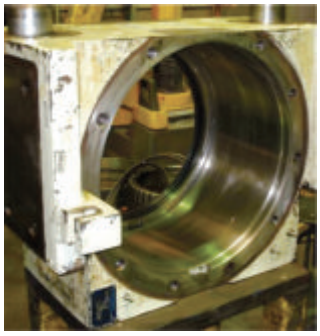
Beside the Thermal Spraying we, of course, do use the common methods like wear resist welding for other parts of the chock but these are generally applied for smaller areas.



The productivity will be found, but not limited to, in several areas such as:

- Proven repair method.
- No need for heat treatment and correcting machining for other parts.
- A better surface quality with self lubrication properties.
- An excellent corrosion resistance for longer lifetime thus cost saving.
- Available again within a short period of time.
- An excellent price / performance level.

Base mat. of the chock	Various grades of steel (any)
Applied process	Combustion spray
Type coating	Chromium steel and bronze

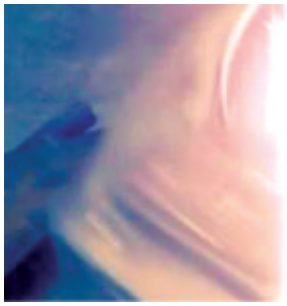


During the production of steel, your production components are subject to enormous loads and high temperatures. These conditions can significantly impact your production capacity and production yield unless your components are in the best possible condition. This is also true for your chocks. These must be within drawing specifications and must have a good resistance against wear and corrosion of the important surfaces.

To meet these requirements, we developed a coating with a character that carries the optimum of both, rigidity and corrosion resistance, within it. Characteristically for the side faces and the bores is the yellowish appearance. It would be an honour to let us explain this refurbishment method in detail to you.

Your benefits can be:
- Significant savings on purchasing costs.
- Less maintenance costs.
- Increase of production output.
- Expanding your product window.
- Reducing the number of cobbles, saving amounts of money.
- Available again on short notice.

Hot and Cold Rolling Mills throughout Europe, recognizing that their chocks must be in an optimal condition for as long as possible, have already chosen for the **Habets chock refurbishment method** many years ago.



Habets (Silent) Heavy Duty
Beltconveyor Rollers

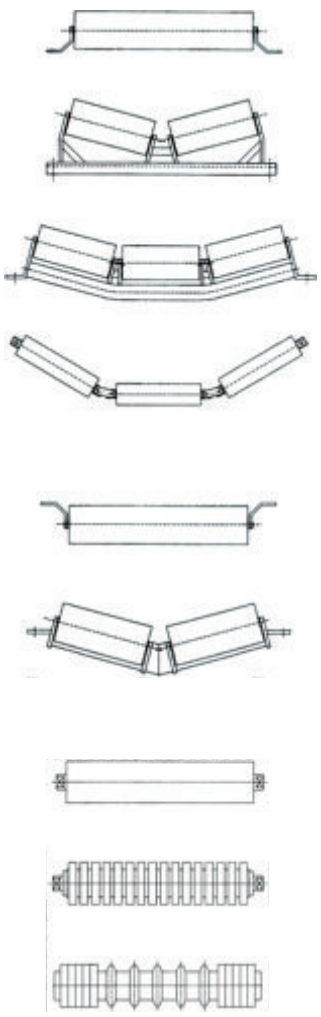
Habets delivers various products and services for its customers in the Steel Industry such as repair of chocks, repair of work and back-up roll shaft ends, pellet rollers and belt conveyor pulleys and belt conveyor rollers. The last two products are delivered to every main bulk handling company in the EU region as well. With respect to the environment and focusing on noise reduction Habets developed the **Silent H.H.D. belt conveyor roller®**.

The (silent) Habets Heavy Duty belt conveyor roller® with a **proven life time performance** of over 12 years in a 24/7 industrial environment maintaining a **reliable quality performance**. We are proud to state that various major companies in the Steel industry, bulk handling companies and various coal-fired power generating plants made their life much easier by choosing Habets as their partner for their (silent) H.H.D. belt conveyor roller®. And due to this they benefit no limits in use of their equipment.

The productivity will be found, but not limited to, in several areas such as:

- Reduction of idle production hours due to less roll replacement,
- Improved and stable capacity output,
- Less roll purchasing costs,
- Less maintenance labor costs,
- and many more!

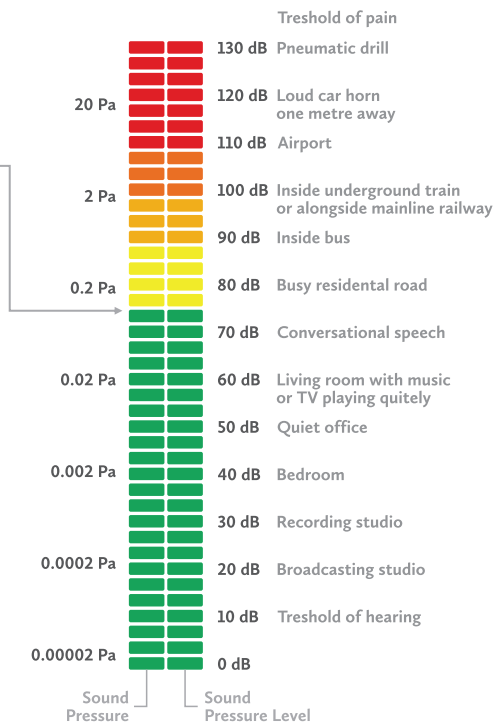
Product	Rollers for belt conveyors
Type	**H**abets **H**eavy **D**uty
Special Type	Silent H.H.D. roller®



Most bulk material handling companies do know what the importance is of reliable equipment that runs for a long time in a 24 / 7 environment without any problems. The **Habets Heavy Duty beltconveyor roller** is such a product. Throughout Europe it is supplied to steel companies, coal-fired power generating plants and bulk material handling companies like ore mines. For noise reduction, Habets offers them developed **Silent Habets Heavy Duty roller®** for beltconveyors. Lots of customers recognized the advantages of this reliable product and apply it for years already. On your request we are glad to explain, the advantages, more in detail.

Your advantages:

- Long lifetime (> 12 years) in a 24 / 7 environment.
- Less maintenance costs.
- Proven performance and lifetime.
- Noise reduction from over 100 to below 75 dB.
- Reliable during years without any maintenance.
- Stable and silent running.
- Provided with quality bearings



Thermal Spraying
Runout Table / Looper Roll for The Steel Industry

During the production of steel, your production components are subjected to enormous loads and high temperatures. These conditions can significantly impact upon your production capacity unless your components are in the best possible condition. This is also true of your transport rollers, which must always be able to withstand these heavy load factors. In addition, the rolls must be corrosion resistant and the friction between the rollers and the steel strips must be at a maximum in order to effectively guide the strip on its way to the coiler.

To meet these demanding requirements, we developed the Habets High Grip (HHG) roller, which has excellent performance characteristics in terms of wear resistance, corrosion resistance and grip between roll and steel strip. Depending upon the specific external environmental factors, the HHG roll looses only a minimal fraction of its extremely tough outer layer and can, on average, continue performing effectively for up to 50 million tonnes of steel. As a result, you benefit from significant savings on maintenance costs and can also increase production speed, making a significant expansion of capacity possible.

Metal Coating

Product	Looper roll and runout table roll
Basic material	Steel
Processes	Autogenic powder spraying
Type of coating	HHG (High grip, wear resistant)
Surface to be coated	In accordance with client specifications
Comment	Previously steel / stainless steel

The most modern hot rolling mill in Europe has recognised the importance of working with a roller table that is always in the best possible condition and has therefore provided it with Habets' High Grip (HHG) rollers.

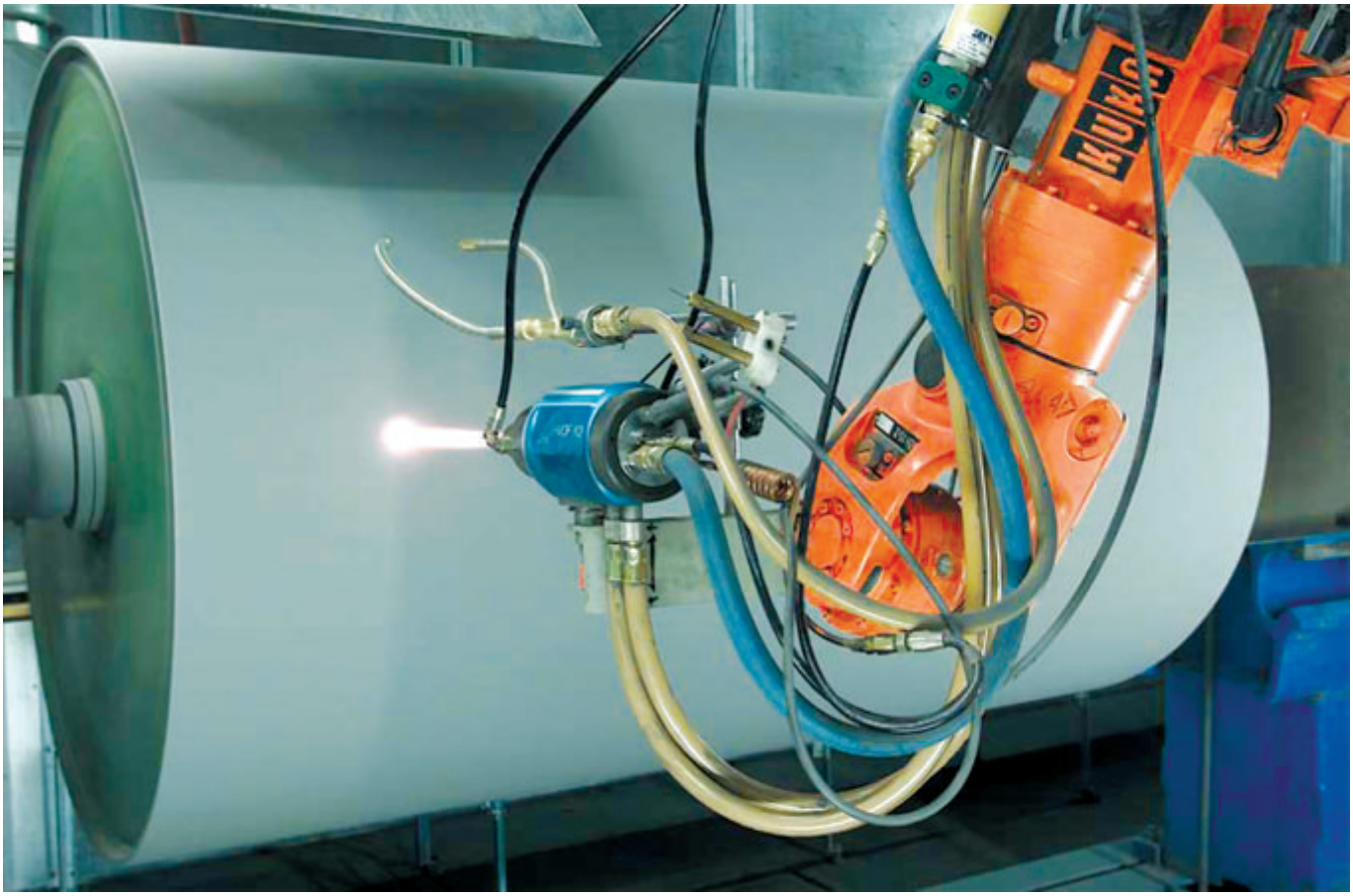
Advantages of the HHG roll:

- It becomes possible to roll thinner material, and thus expanding your "product window" and increasing your delivery options for your clients.
- Reducing the number of cobbles by using HHG rolls can save you large amounts of money.
- You can increase production speed and so raise your output.
- Improved tracking on the way to coiler
- Based on years of hands-on experience in various hot rolling mills

Typical characteristics of HHG Roll:

- Excellent wear resistance resulting in extended tool life.
- "High Grip" provides improved tracking on the way to coiler.
- "Out off passline" indication
- Robust and reliable construction

Thermal Spraying
Durable Industrial Coatings

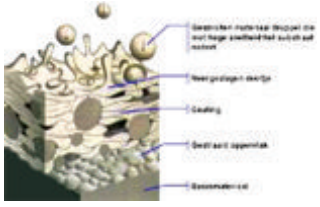


Within the industry, a great many demands are made of your process rollers. For example, they are subjected to heat, wear and tear, corrosion, chemicals etc. As a specialist in the production and reconditioning of machine components, Habets offers an extremely durable and long lasting solution in the form of unrivalled wear-resistant coatings.

The technology we use to realise this – thermal spraying – greatly extends the usable lifespan of production components that are sensitive to external loads and pressures. In addition, coatings applied via thermal spraying can be used for dimensional corrections, in which case the component can be restored to its original specifications. Last but not least, thermal spraying also results in a significant improvement of surface quality for the component treated, thereby minimising the risk of damage to your products. The techniques we use to implement dimensional corrections and improve surface quality, reduce the cost of your production equipment and increase your output, both in the short as well as long term.

Thermal Spraying

Product	All locations in the basic industry where damage, wear, tear & corrosion play a role
Basic material	(Mild) Steel
Processes	Autogenic, electric arc spray, atmospheric plasma, HP-HVOF spraying
Type of coating	Depending on the specific problem
Surface to be coated	In accordance with client specifications
Comment	Practically unlimited in terms of possibilities



Various factors can play a role in deciding to apply a corrective, wear resistant or corrosion resistant coating to your product. Increased resistance to wear and tear and to corrosion, cost, delivery time and availability are the most important. Carrying out repairs and improving surface quality with the help of the technologies utilised by Habets, in particular thermal spraying, has gained a prominent place within the basic industries. When it comes to increased wear resistance, fast delivery times and lower cost, our hands-on experience in combination with our R&D activities in this field often allow us to offer you a very effective and cost-effective solution. We would be happy to evaluate your specific "problem or case of damage" and to advise you accordingly.

The benefits of treating components via thermal spraying include:

- Compared to purchasing a new component, thermal spray treatment is generally more economical (price and lifespan) and delivery times are much shorter.
- There is usually no extra heat treatment or other treatment needed before or after thermal spraying.
- The process does not affect the characteristics of the product material.
- A worn-out product becomes a high-quality and valuable component once again.
- Thermal spraying technology has been successfully applied for decades within the various basic industries around the world.
- Years of successful practical experience in various sectors within a wide range of basic industries.

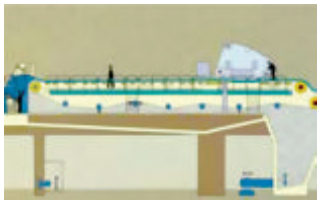
Thermal Spraying
Seeve Guiding Roll

During the production of paper, guiding rolls are subjected to extreme loads and chemical influences. Unless the rolls are in optimum condition and highly resistant, these conditions can significantly impact upon your production capacity and result in heightened wear and tear and the accelerated need for replacement of the rolls.

Habets Wear Resist (HWR) Carbidur or Ceramic offers you a high-quality coating which can withstand very heavy loads, high temperatures and other external influences. Treating your new or used rolls with HWR results in extended tool life, longer total lifespan, and significant reduction of maintenance costs.

Carbide or Ceramic Coating

Product	Seeve guiding roll
Basic material	Steel
Processes	HP-HVOF (high-speed spraying)
Type of coating	HWR Carbidur or Ceramic
Surface to be coated	In accordance with client specifications
Comment	Previously chromium plated



Most paper manufacturers in Europe realise how important it is to work with paper guiding rolls in their machines which continue to turn reliably and constantly for as long as possible. The Habets Wear Resist coating was developed specifically with this purpose in mind. Leading paper manufacturers in Europe have recognised this and are using the Habets HWR coating on their paper guiding rolls.

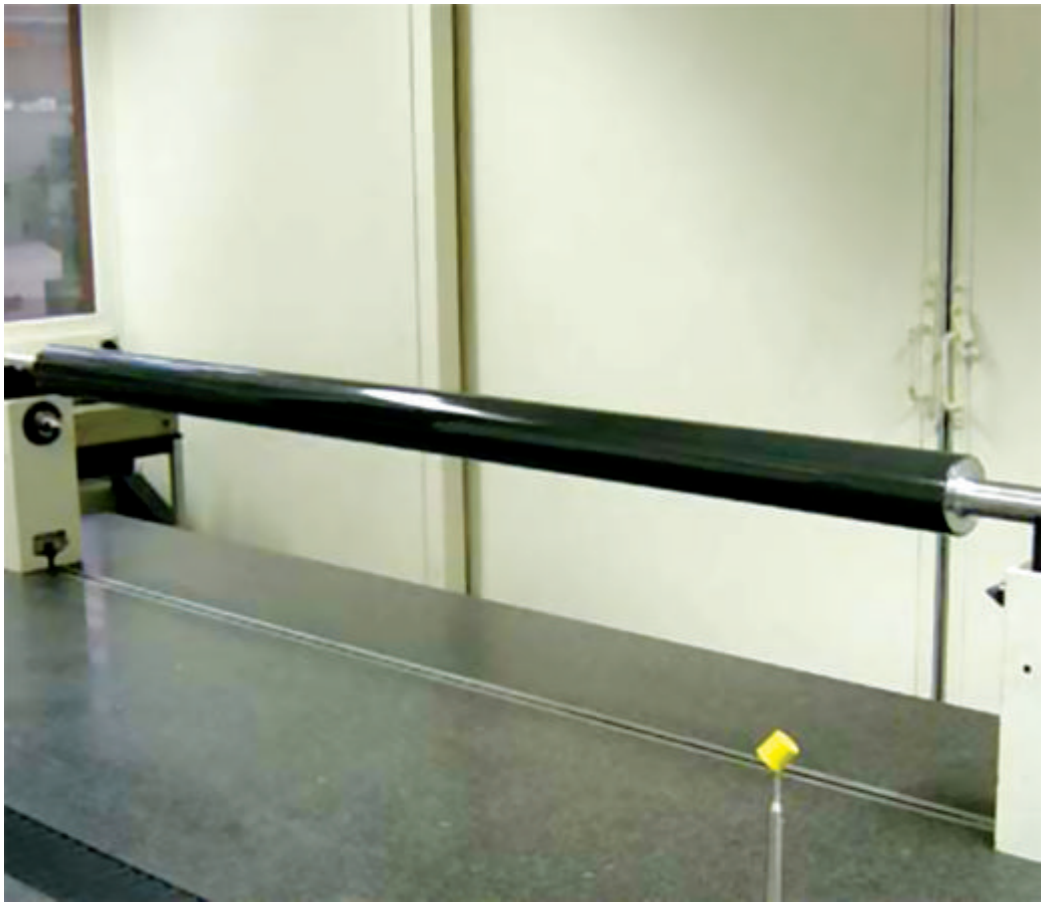
Advantages of working with rolls treated with HWR Carbidur coating:

- Extended tool life
- Lower maintenance costs
- Constant quality of roller surface
- Based on years of hands-on experience in various paper manufacturing facilities

Typical characteristics of HWR Carbidur and Ceramics coating:

- Excellent wear resistance resulting in longer tool life
- Excellent corrosion resistance
- Technology already proven in practice
- Applicable on used as well as new rolls

Thermal Spraying
Screen-bed Rolls For Pellets



As a pellet manufacturer, you are expected to produce pellets that fall within a specified diameter range. To realise this, the distance between the individual pellet rolls must remain as constant as possible for as long as possible. This, in turn, demands a great deal from the wear resistance characteristics of your pellet rolls.

The Habets Wear Resist roll (HWR) with ceramic coating was developed especially to be able to withstand the enormous wear and tear that accompanies the production of pellets. Thanks to the HWR coating, “regapping” is no longer necessary to deal with wear and tear or product that becomes stuck, and you end up with a more constant pellet diameter over longer periods of time. The result is a much longer tool life (> factor 3 compared to uncoated rolls) and therefore significantly increased production capacity.

Metal Coating

Product	Screen-bed roll for pellets
Basic material	Steel
Processes	Atmospheric Plasma spraying
Type of coating	HWR Ceramic
Surface to be coated	In accordance with client specifications
Comment	Previously chromium plated

Steel manufacturers in Europe realise how important it is to be able to produce pellets with a constant diameter. Habets has developed a solution for this in the form of their "HWR ceramic" coating. The rigorous requirements which must be met when it comes to wear and tear and "non-stick" are important reasons for choosing "HWR ceramic" as a solution. Regapping is no longer necessary, and a very substantial extension of the tool life is achieved.

Advantages of working with screen-bed rolls treated with HWR Ceramic coating:

- Regapping no longer necessary
- More constant pellet sizes for longer periods of time
- Longer tool life resulting in less downtime and higher output
- Lower maintenance costs
- Based on years of hands-on experience in various steel plants

Typical characteristics of HWR Ceramic coating:

- Excellent wear resistance resulting in extended tool life
- Excellent corrosion resistance
- Technology already proven in practice
- Constant quality of roll surface
- No "stick-on" resulting in a constant screen space
- Surface roughness value of the coating < 0.8 Ra

Thermal Spraying
Repair of Rolls For The Steel Industry

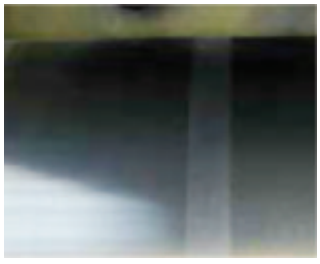
Replacing rolls before they have reached the end of their original usable lifespan is a very expensive affair. In addition, such rolls can often be reconditioned for a fraction of the replacement price.

Decades of hands-on experience with large-scale machining processes as well as a variety of thermal spraying technologies enables us to give your used rolls a new lease on life by reconditioning expensive components via thermal spraying. In addition to restoring components to their original dimensions, we can also recondition worn-out shaft journals and at the same time carry out modifications and/or add new components. The end result is a roll that comes back to you quickly with a new lease of life for a fraction of the replacement cost.

Metal Coating

Product	Roll for the steel industry
Basic material	Alloy steel
Processes	Autogenic spraying
Type of coating	Metallic
Surface to be coated	In accordance with client specifications
Comment	Previously via welding

Several factors can play a role when it comes to deciding whether to repair a roll/roll neck or not. The cost of replacing the damaged unit and availability/long delivery times are the most important factors. Repairing the unit via the “as good as new” method developed by Habets ensures that the roll reaches the end of its originally expected lifespan at a fraction of the cost of a new roll. We will be happy to examine any specific case of damage that may occur and advise you accordingly. Our method has been successfully applied in rolling mills throughout Europe.



Advantages of our unique repair method:

- Much shorter delivery time compared to purchasing a new roll
- A fraction of the price of a new roll
- No heat treatment necessary before or after repairs are made
- The repair process does not influence the characteristics of the roll
- Remaining value of the roll is fully utilised
- Based on years of hands-on experience in various hot/cold rolling mills

RETEK

High Tech Materials with High Quality

Company Overview

Retek Ltd. carries out its business professionally and acts in good faith to its partners. Our major priorities are: quality, stability, usage of high quality materials. Achieving our development objectives, profitability and quality, creates the required environment and the needed economic conditions for meeting needs of our staff, customers and all entities, related to the Company in some way.

ISO 9001:2008 CERTIFICATION™ Intertek

UKAS MANAGEMENT SYSTEMS 0142

Our operations have been expanded over the following major fields of business:

- Recycling of technical ceramics, refractory materials and graphite scrap;
- Ferrous and nonferrous metals and ferro-alloys;
- Graphite products;
- Consumables for crushers;
- Metallurgical equipment;
- Refractory materials;
- Raw materials for refractory materials and technical ceramics;
- Collecting, transportation, sorting, recycling and recovery of old and fresh graphite scrap and refractory scrap, generated by metallurgical industry, have emerged in recent years as a leading field of business.

Refractory Grade White Corundum /
White Fused Alumina / White Aluminum Oxide (WA)

White aluminum oxide powder is good grade raw material for high refractory and other ceramic additives, it has high purity, less heat emit, higher efficiency, acid and alkali resistance, good thermal stability.

Physical Analysis

Color	white
Hardness (mohs)	9.0
Melting Point (°C)	2250
Maximum service temperature (°C)	1900
True density (g/cm^3)	3.9

Chemical Analysis

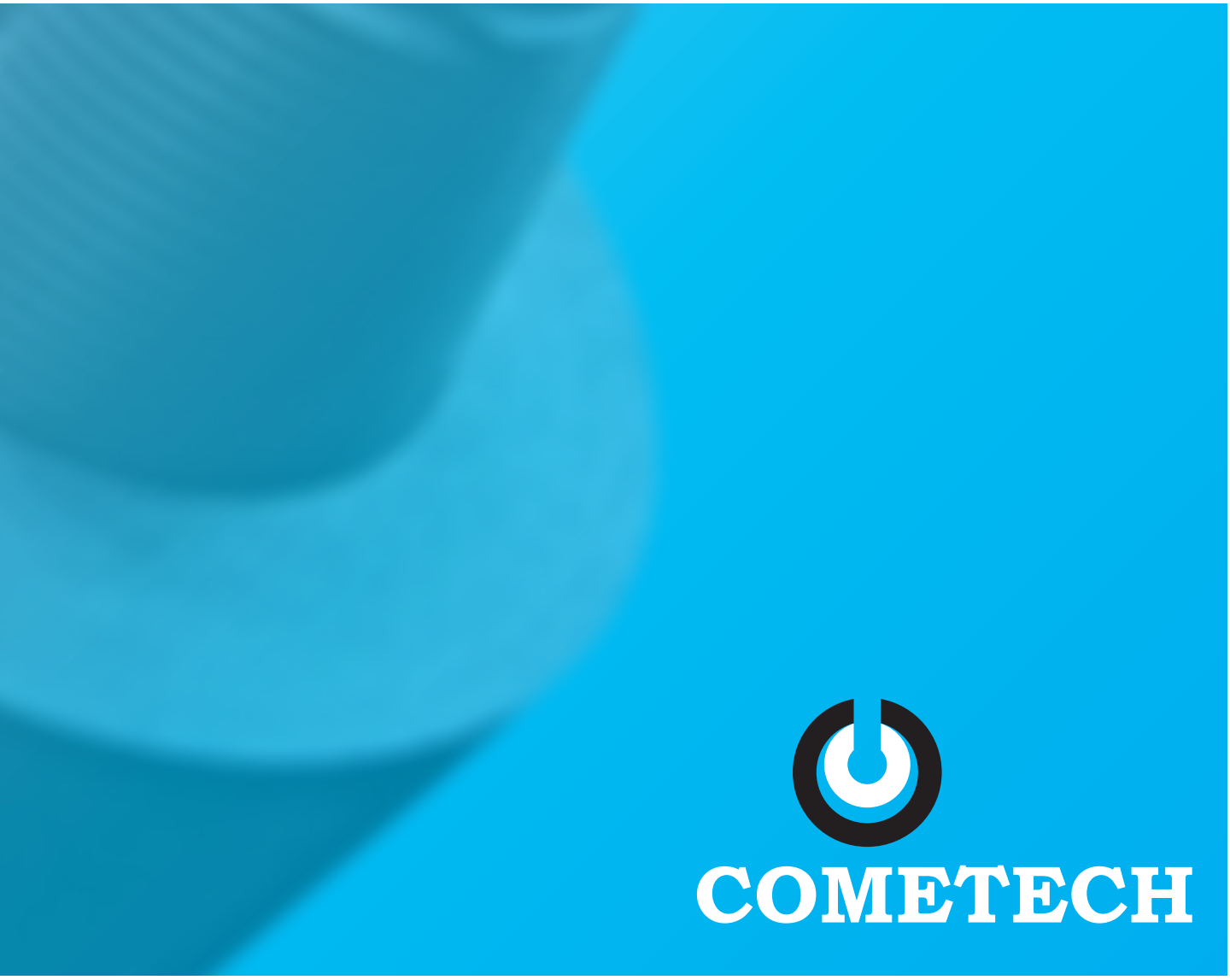
Al_2O_3	min 99,00%
Fe_2O_3	max 0.20%
CaO	max 0,05%
MgO	max 0,10%
Na_2O	max 0,20%
SiO_2	max0,35%

Sieve Analysis

63 - 90 µm	20%
15 - 63 µm	70%
0 - 15 µm	5%

Application

Precision casting, spraying and coating, medium body for chemical industry, special ceramics and high-grade refractory materials, fire resistant chemicals, 95 electrical porcelain, decorative porcelain and so on with daily life and special ceramic porcelain, as well as the military industry, electronics and other high-tech industry etc.



COMETECH

Solid Expertise,
Highest Quality

Company Overview

Cometech mainly specializes in modern pyrometallurgical technology found industrial applications in metallurgy, metal casting and recycling of precious metals.

The company manufactures and supplies high quality graphite products and materials, protective antioxidant coatings on graphite, ferro-alloys and special.

Our solid expertise and manufacturing experience allows us to offer a wide range of engineering services, including tonnage individual facilities and units for metal casting.

By continuously introducing new and advanced technological solutions in all aspects of our manufacturing, engineering and services, we strive to meet the highest quality requirements, cost of materials, labor and the protection of the environment to our customers.

ISO 9001 : 2008
BUREAU VERITAS
Certification

Products

- Protective Coating of Graphite Electrodes for EAF
- Regenerated Electrodes with Protective Coating
- Graphite Electrodes Coated with All
- Graphite Products

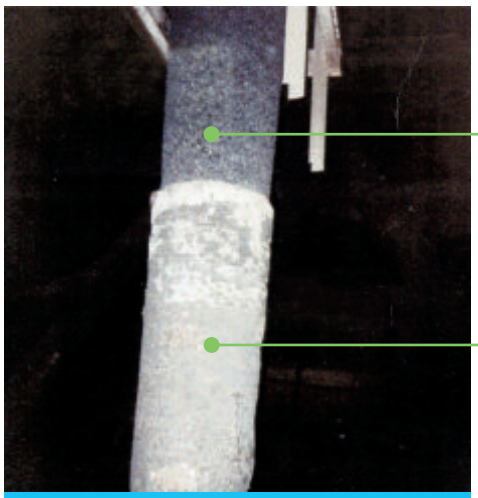
PRO-COMARC®

PRO-COMARC® coating on graphite EAF electrodes consist of Aluminium Based Alloys layers bonded by twin wire Electric Arc Sprying (EAS) and spraying in emulsion SiC, B2O3,TiO2 layers, all of them treated and fixed on the graphite surface, by means of DC Plasma Arc treatment.

The industrial benefit of PRO-COMARC® coating is the achivement of cost-effective graphite coating solution to minimize EAF electrode wear and corrosion and to increase current carrying capacity.

The PRO-COMARC® means multilayer coating (MLC) which is only film of 600-800 µkm physically and chemically bonded with graphite surface to give two new properties of the graphite EAF electrodes:

- **The graphite electrode is fully protected from oxidation until the coating is destroyed (delayed oxidation start).**
- **Because of the high conductivity of the Aluminum Alloy the operating electric conductivity is 7-10% higher.**



Oxidation above coating

25 MT ACEAF with 350mm MLC electrodes PRO-COMARC® (Fe-Al based)

The MLC electrode has the following advantages compared with conventional electrodes:

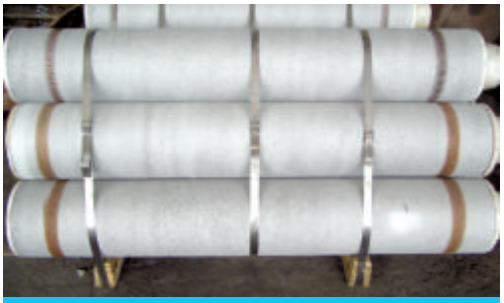
- Side oxidation of the electrode column is extremly low.
- Resistance to termoshocks is better.
- The increased cross section of the electrode tip makes a considerable reduction of the specific linear electrode consumption rate possible.
- More favorable current distribution in the nipple connections (reduced breakages by 15-20%).
- The high electric conductivity of the coating increases the total operating current carrying capacity of the UHP electrode by 20-25%, making possible electrode diameter reduction.
- Multi-Layer Coating makes possible EAF and LF to work with increased cross section of the electrode tip, which means considerable reduction of the specific linear electrode consumption rate.
- By PRO-COMARC® coating is also found possible to make effective regeneration of the rejected broken UHP electrodes from EAF using them like MLC electrodes in LF.

Due to its variable structure MLC electrode can be adapted to the requirement of AC and DC furnaces and Ladle furnaces and the specific consumption drops by 12 to 20%.

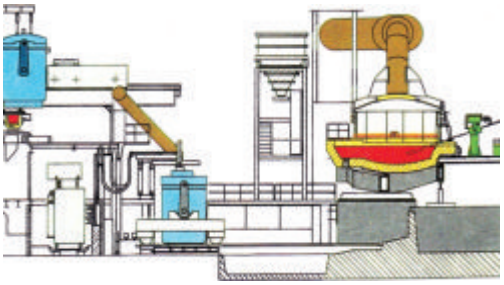
PRO-COMARC®

PRO-COMARC® coating system consisting of 2 wire feeder, sprayer, DC Plasma Arc device

100 MT Ladle Furnace



Al based MLC electrodes before shipping



Technical Parameters of the **Protective Coating**

Thickness of the coating	mm	0.5 - 0.8
Specific electrical resistivity	Ωu.m	0.07 - 0.10
Tightness to gas at 900°C	h	above 50
Temperature of coating decompression	°C	above 180
Delay of surface oxidation	h	10 - 20

1 Advantages of the graphite electrodes for coating

The compositon, structure and properties of the coating, and also used plasma-arc processing provides to the coated graphite electrode significant advantages:

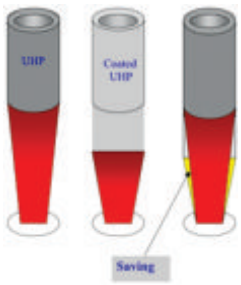
- The significant reduction in wear of the electrodes of the sideways oxidation, enables EAF to operate with a greater cross-sectional view of the working end (forehead) of the electrode. As a result of the reduced rate of wear of the electrode is achieved reduction of the total cost of the electrodes between 10-25%.
- The high electrical conductivity of the coating allows increasing of the current of the electrodes by 20 - 25% preserving the current diameter of the electrode or keeping of the same linear expenditure of the electrodes by a reduction of the diameter of the coated electrodes. Savings can reach 20 - 25%.
- Better distribution of the current in nipple connections corresponding to reduced losses due to breakage of current overload.
- Improved thermal stability of the entire electrode connection as a result of the increased thermal conductivity of the surface protective film.

PRO-COMARC®

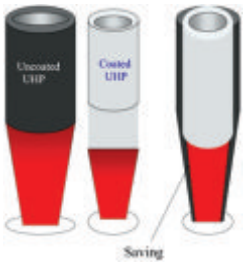
Application of graphite electrodes with multilayer coating

Our equipment allows us to produce a protective coating on the electrodes with a nominal diameter of 150 to 600 mm and lenght up to 2400mm.

In exchange for unsecured protected electrodes there are two fundamental possibilities:



1. Use of protected electrodes with the same diameter as unprotected. Withal, about half of the increased size of the foreheads of protected electrodes are realized as savings 15 - 20 %.



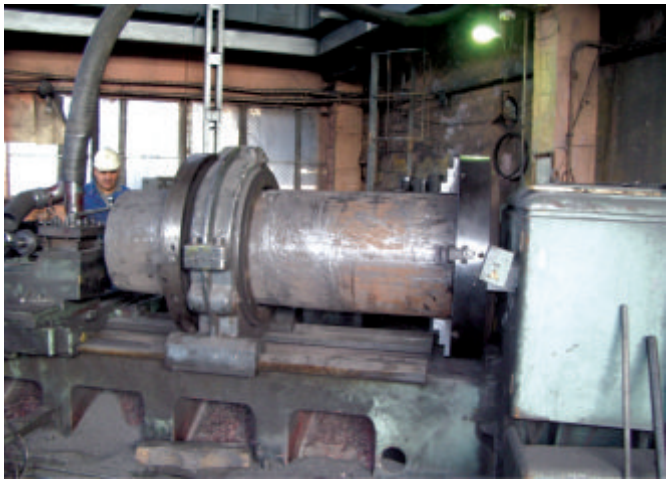
2. Using protected electrodes with reduced diameter, so that while working, the area of the forehead is the same. In that case, the savings due to the reduced cross-section, respectively, and the connection weight is up to 25%.

Important precondition for direct contact when using protected electrodes is sufficient pressure strength of the copper contact jaws to the coated electrode (recommended force is about 20 tons).

Otherwise we can offer contact graphite inserts.

2 Regenerated electrodes with protective coating

The possibility on improving performance characteristics of the graphite electrodes by applying a multilayer coating enables us to offer our customers refurbished graphite electrodes with the following sizes: from 150mm to 400mm (6" - 16"), as the same performance characteristics as the electrodes for "high power" (HP) and "ultra high power" (UHP).



Refurbished electrodes are made from used and broken UHP, including broken UHP electrodes and are made in few steps: drying, scraping, making new nipple sockets and coating. Refurbished electrodes with protective coating can be used in small electric arc furnaces, ladle-metallurgical furnaces and special furnace applications such as sumps and precipitants in nonferrous metallurgy.

PILSEN STEEL
OMZ GROUP

Your Steel Partner

Company Overview

The business activities of the PILSEN STEEL include production and sale of steel, ductile and grey-iron castings, ingots and finish-machined forgings for various industries, in particular power generation, shipbuilding and rolling mills.

The scope of the company activities allows for complete product making and processing "under one roof", i.e. starting with steel making, casting and forging through to rough and finish machining according to the customer needs.

Delivered to the company customers are complex project solutions with castings and forgings finish machined, surface treated and provided with the required quality certificates. Expertise and consulting services are available to those customers who can not define their detailed product specifications. The methods used for these purposes include reengineering, stress analysis, design of special purpose manufacturing processes and others.

Exports represent more than two thirds of the company production.

The products can be found in operation all over the world like the "London Eye" Ferris wheel on the bank of the Thames in London where PILSEN STEEL delivered the wheel shaft and other castings of total weight 200 t. PILSEN STEEL is also the world's biggest producer of windmill shafts and one of the biggest suppliers of large crankshafts for 4-stroke diesel engines.

The company target is to be reliable supplier of top-quality products to the global market.

1859

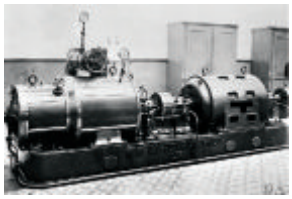
Count Waldstein founded ironworks in Sedlec near Plzeň

1869

Emil Škoda bought the Waldstein's engineering works

1904

The first Stream Turbine manufactured



1927

The first electric locomotive

End of World War II, 70% of the works destroyed by an air raid

1947

New pattern shop started operation

1990

Formation of the ŠKODA a.s. (joint-stock company)

1993

Company privatisation

2007

Merger of both metallurgical companies and rebranding on PILSEN STEEL s.r.o.

2013

Entrance of new investor VEB CAPITAL

Pilsen Steel Production Units

- **Steelmaking Shop**
- **Foundry Shop**
  - Pattern Shop
- **Forge Shop**
- **Machining Shop**

Forge Shop

PILSEN STEEL is able to produce forgings weight in the range of 1t up to 80t. The precision technique of forging was further improved by installation of new forging manipulator in December 2004.

Key competencies and competitive advantages

- World-class finish machining facility for heavy crankshaft machining
- Customized products, wide manufacturing capabilities, and minimizing market risk
- Market leadership in production of main shafts for windmills

Forge

Forge presses
33 MN, 120 MN (spacing 6.000 mm)

Testing Lab

Tensile test from 20 °C to 650 °C
Impact value test from -110 °C to 20 ° C

Heat Treatment

Horizontal furnaces : 9 x 6,5 x 4 m (Max.)
Vertical furnaces : Diameter 2,2 m - Depth 24 m (Max.)
Drivespace furnace : délka 22 m

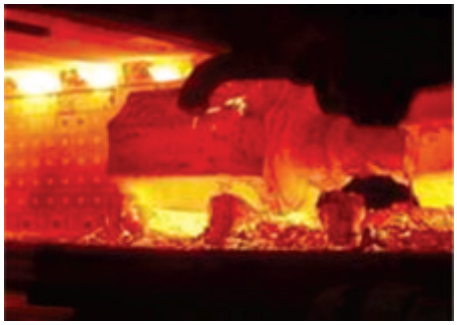
Water and oil tanks
Max. dimensions:
Vertical: diameter 4 m, depth 24 m
Horizontal: 8 x 9 x 10 m

Testing Lab

Tensile test, Impact test, Hardness test
NDT testing : UT Krautkrämer, Magnetic Particle test, Dye penetration test, Boroscopic test.

Further tests like transition temperature maesurement, creep and others are made in a co-operation with the former sister company Skoda Research Ltd.





Machining Shop

PILSEN STEEL has installed more than 80 machine tools for various purposes and of various characteristics of the forged products ensuring each item is finished to the highest standard.

Rough Machining

- **Lathes**
  Max. diameter of 4.000 mm over bed
  Max. machining diameter 3.300 mm
  Max. length 15.000 mm
  Max. weight 140 t

- **Vertical Lathes**
  Max. turning diameter of 12.500 mm
  Max. height 5.640 mm
  Max. weight 250 t

  Note: All parameters can not be guaranteed simultaneously

- **Milling Machines**
  Max. machining length of 16.000 mm
  Max. machining height of 5.000 mm
  Max. weight 160 t

Clean Machining

- **Lathes**
  Max. machining diameter of 2.650 mm
  Max. length 14.500 mm
  Max. weight 110 t
  Note: all parameters can not be guaranteed simultaneously
  Achieved tolerance IT6

- **Grinders**
  Max. machining diameter of 1.900 mm
  Max. length 10.000 mm
  Max. weight 110 t
  Achieved roundness 0.005 mm
  Achieved tolerance IT4

- **Grinding of Crankshafts**
  Main pins 125 to 500 mm
  Max. shaft length of 12.500 mm

- **Milling Machines**
  Max. machining length 6.000 mm
  Max. cutting height of 3.000 mm
  Max. weight 110 t

- **Deep-boring Machines**
  Max. workpiece diameter 3.000 mm
  Max. workpiece length of 15.000 mm
  Boring diameter of 40 - 400 mm

Steelmaking Shop

Our advanced steel making facilities we are able to produce a variety of super clean steel grades with close control of composition. Steel production plant consists of several technological operations including charge preparation, melting, steel refining and casting. Steel making process takes place in two electric arc furnaces with annual capacity of 150 thousands tons of steel and one ASEA – SKF refining.

Steel Melting Shop	50 t	70 t
Electric arc furnaces	EAF N.2	EAF N.5
Melting capacity/year	150 kt	

Iron Melting Shop	1 t	2 x 10 t
Melting capacity/year	max. 30 kt	

Ladle Metallurging			
Laddle	20 - 40	40 x 70	70 - 120
	Station	Operations	
ASEA - SKF	Preheating roof	Alloying Preheating Modification of nonferrous inclusion by Ca	Induction String
	Vacuum roof	Vacuum degassing VCD (Vacuum carbon desoxidation)	Argon refining
Caisson VOD	Vacuum caisson	VOD (Vacuum oxide decarburization) VCD	Argon bubling

Molten material is either poured into cast iron moulds (INGOTS) or into sand moulds (CASTINGS). A considerable proportion of the ingot production of carbon and low-alloy steel with the highest claims for quality of material is intended for the Forge Shop.

Ingots

Manufacturing program
The steel works can produce bottom-poured ingots up to the size I 195 (200 t) poured in controlled Ar atmosphere.

Production process
The raw materials for steel production include steel scrap, selected recyclable waste, various grades of pig iron and alloying additions. Crude steel is first smelted in an electric arc furnace and subsequently refined in the ASEA ladle (a duplex process). This method makes it possible to attain the following limits of impurities:

phosphorus	*max. 0.007%*
sulphur	*max. 0.005% (0.002%)*
hydrogen	*max. 1.0 ppm*
oxygen	*max. 25 ppm*
nitrogen	*max. 50 ppm*

The micro-purity of steel is guaranteed at the level of K4 (DIN 50602), max. 40 (20).

Foundry Shop

PILSEN STEEL produces high quality steel and ductile/grey iron castings according to customer specifications ranging from 1,5 t up to 180 t. Production portfolio is designed for various industries.

Key competencies and competitive advantages

- Rough machining capability
- Ability of socket welding on turbine castings
- Simulation of residual stresses in casting
- Casting substitution for weldmet
- Wide range of production

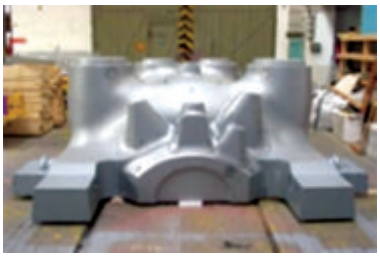
	Weight	Dimensions	Workmanship
Steel castings	5t up to 300t	max. diameter: 8 m (rings) max. height: 4 m max. lenght: ca. 10 m	rough machined
Gray & Nodular iron castings	1.5t up to 150t		rough machined

Pattern Shop

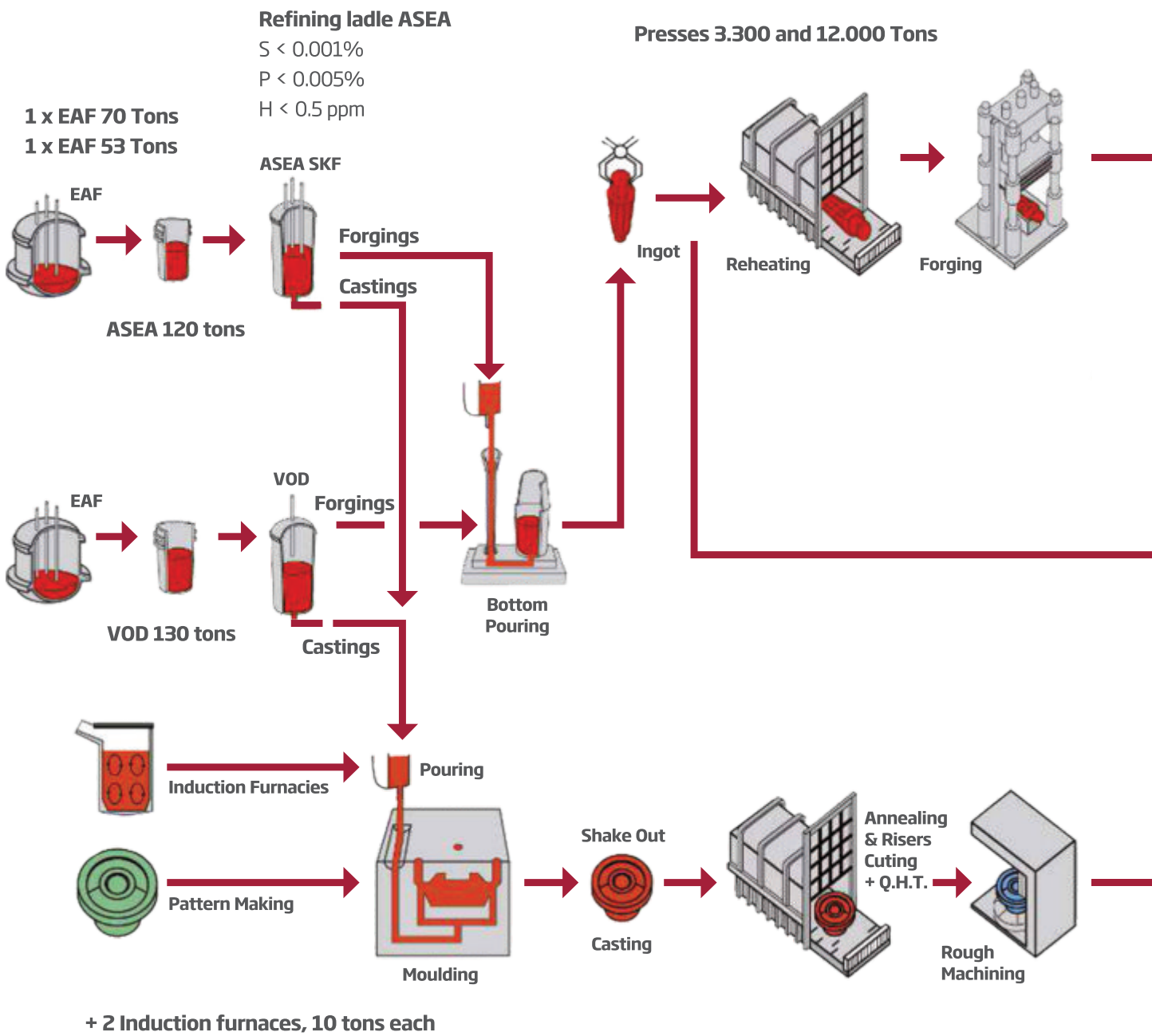
The pattern-shop is able to make any pattern device as regards size & length or complexity from traditional & plastic materials even the combination of wood and metal. Pattern shop produces pattern equipment and packing for the needs of foundry as well as for external customers.

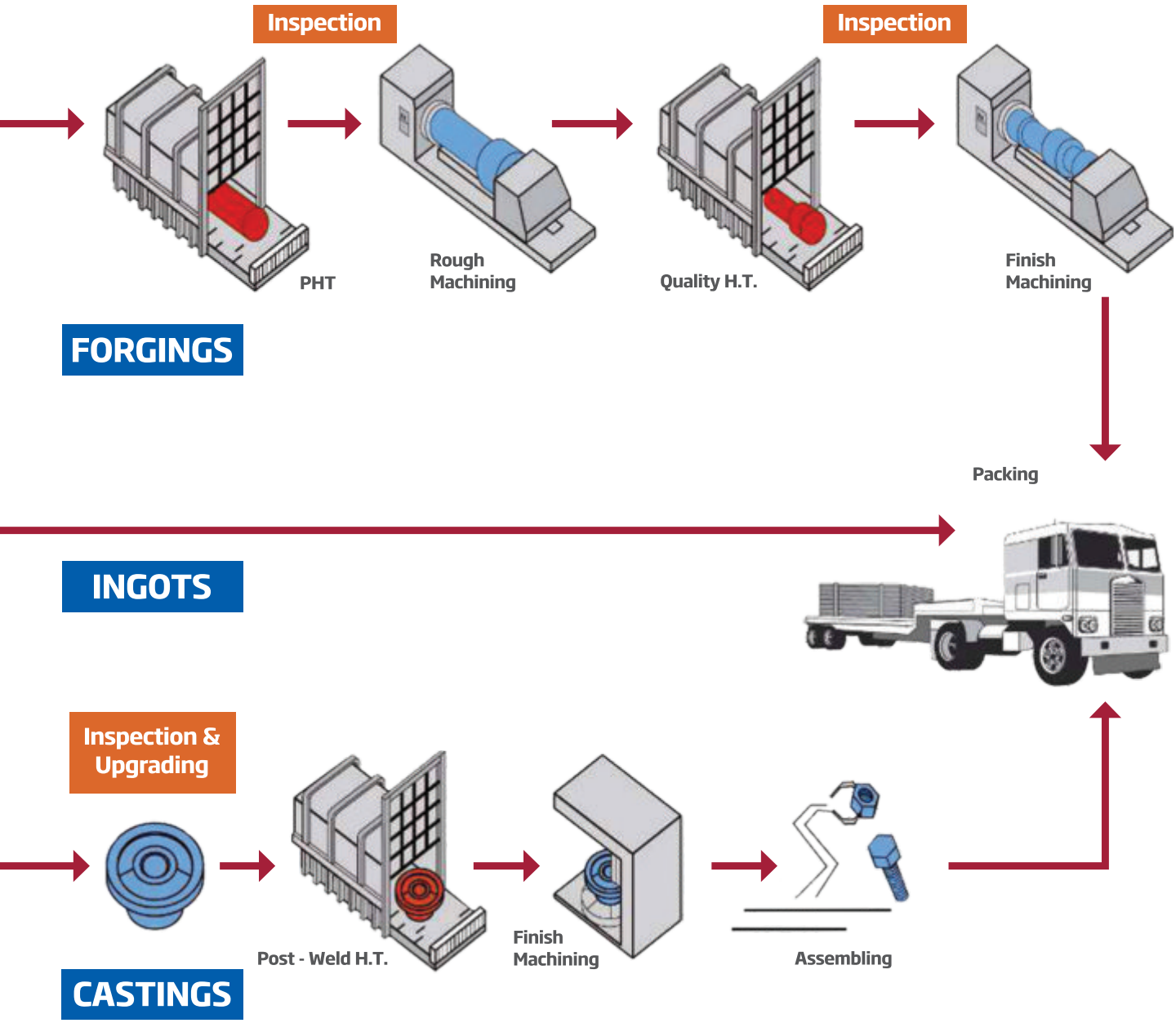
Products and Services	Technical Equipment
Patterns and core boxes for single piece as well as batch production	CNC machining center
Wooden moulds for laminating and forming plastic	All kinds of wood-working machines
Cast resin, polystyrene, wooden patterns	Hand electrical machines
Creating 3D models	Press for large format material
CNC milling	Sizing saw
Pattern modifications and repairs	Paint spray booth



Manufacturing Process




Inspection
Inspection
PHT
Rough Machining
Quality H.T.
Finish Machining
FORGINGS
Packing
INGOTS
Inspection & Upgrading
Post - Weld H.T.
Finish Machining
Assembling
CASTINGS

Products

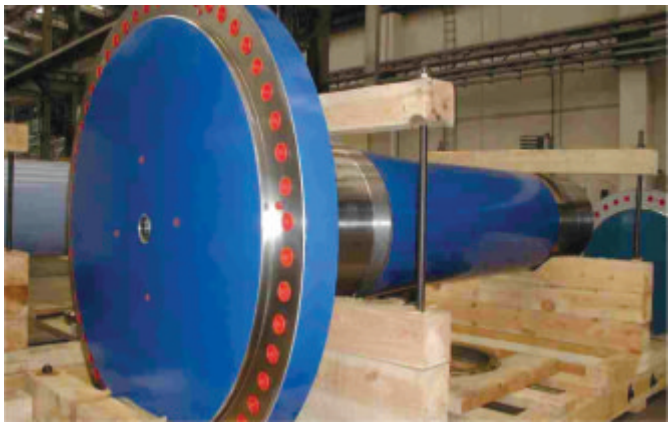
FORGINGS

PILSEN STEEL delivers a large variety of forgings up to 205 tons designed for a range of industries such as shipbuilding, wind power generation, rolling mills, nuclear, etc.

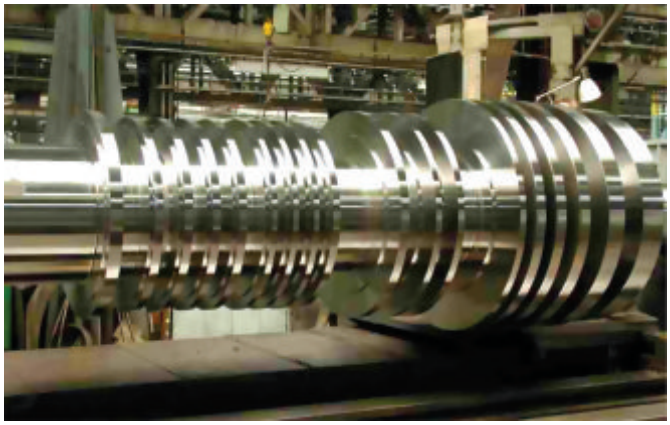
- **Crankshafts**
  heavy crankshafts for four stroke diesel engines, compressors and pumps
- **Windmill Shafts**
  shafts for wind power plants of all existing sizes
- **Rotor Forgings**
  for steam turbines and generators
- **Rolls**
  Forged work and back-up rolls
- **Ship Shafts**
  propeller shafts, intermediate shafts, rudder stocks
- **General Machinery**
  forgings for electric motors, oil & gas industry, excentric shafts for rolling mills, mechanical presses and all other possible shaped forging for industrial need

Crankshafts

Windmill Shafts



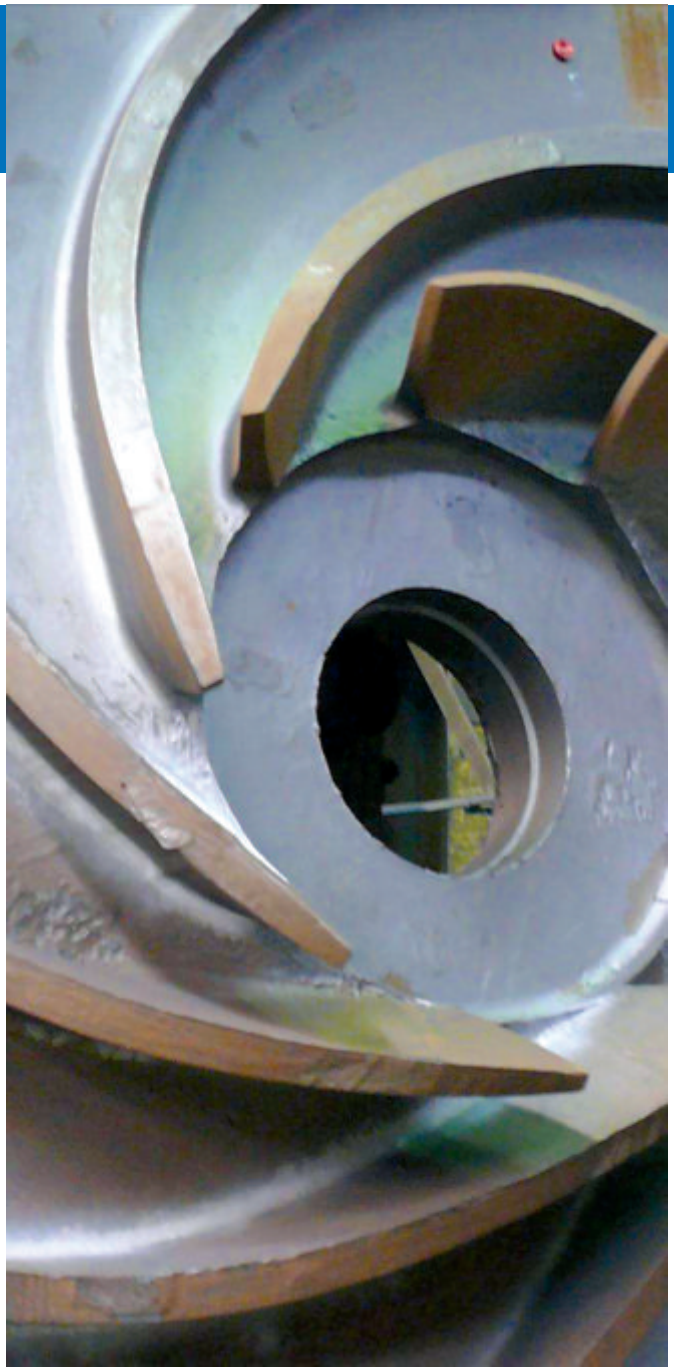
Rotors



Rolls

Other Forgings

Products

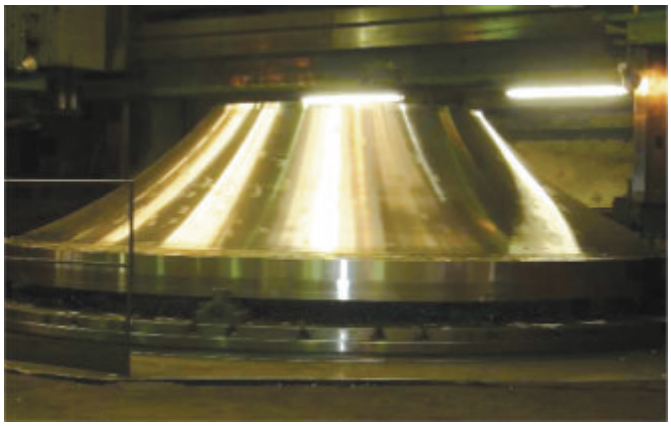


CASTINGS

PILSEN STEEL is in a position to supply high quality steel and ductile / grey iron castings weight in the range 1,5 up to 300 tons for the use of the entire engineering industry, as follows:

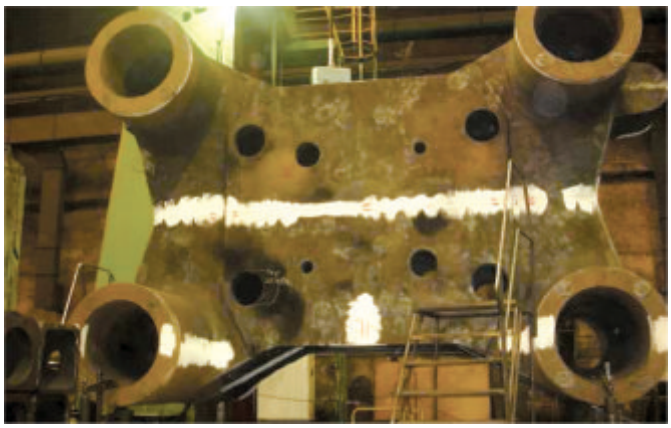
- **Power Generation**
  for steam, gas, wind and water turbines
  production range covers turbine casings including construction welding, inlets, blade carriers, valves, hubs, blades, crowns and bands
- **Engine Blocks, Compressors, Pumps, Gear Boxes**
- **Forming Machines**
  mill housings, parts of heavy presses, hammers, anvils, chocks and many other items
- **Machine Tools**
  all kind of castings for heavy lathes, milling machines, boring machines and all other types of large machine tools
- **General Machinery**
  any kind of steel and iron casting in the weight range 1 - 180 tons for all industrial applications
- **Patterns**
  any pattern as regardless its size, length or shape

Power Generation



Engine Blocks, Compressors, Pumps, Gear Boxes

Forming Machines



Products

INGOTS

PILSEN STEEL offers ingots for further forging or rolling. We are able to produce ingots up to 250 tons.

- **Bottom Poured**
- **Round Ingots**
  up to 27 tons
- **Polygonal Ingots**
  up to 140 tons
- **Carbon, Low & High Alloy Steel, Stainless Steel**

Steel parameters
S < 0.005% P < 0,01%
O < 20 ppm H < 1 ppm

Products

Stell, Castings & Forgings for
NUCLEAR PURPOSES

PILSEN STEEL can offer to supply a large variety of steel, iron, steel castings and forgings for nuclear purposes.

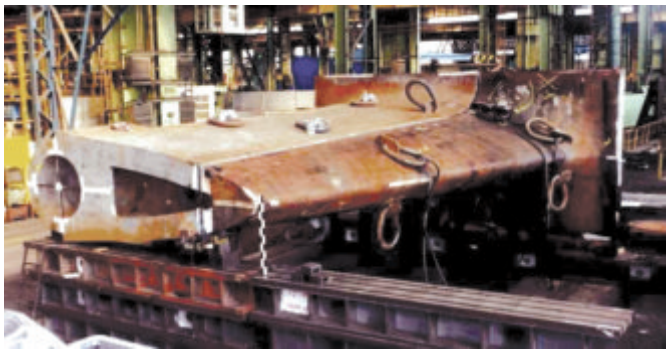
- PILSEN STEEL has a long tradition and experience in the production for conventional and nuclear energy industries. The complete VVER 440 MW and VVER 100 MW pressure vessels have been previously made for nuclear energetics.

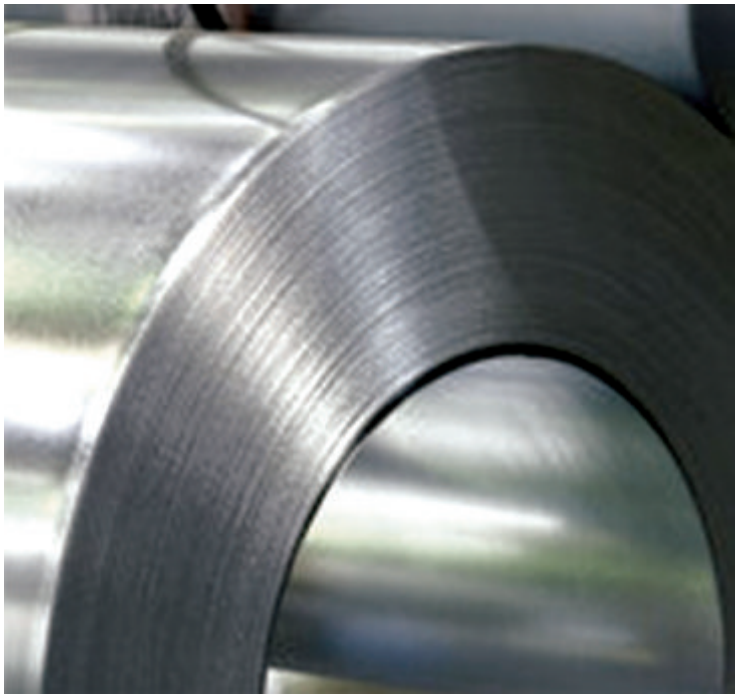
  Low, Mid and High-pressure rotors including components for completion of turboset, and forging and casting manufacture for primary and secondary circuits shall also be numbered among the products for nuclear energetics. Further products include cast and forged vessels for spent nuclear fuel.

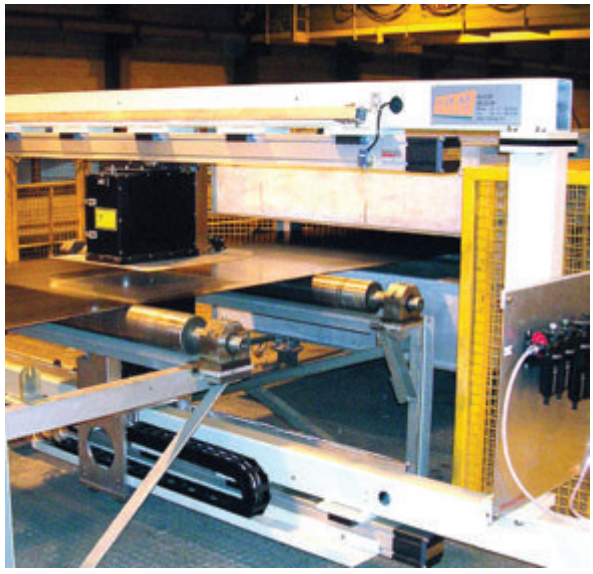
PWR Pressure Vessel - VVER1000

Nuclear Waste Casks

SHIPBUILDING







Advanced Measurement Solutions

The Measure of Quality

Company Overview

Combining industry-best performance and reliability with a global support structure

NDC develops and manufactures gauging and analyzer systems for a wide range of process industries. The company manufactures in USA, UK and Belgium and has direct sales and support operations in China, Japan, Germany, France, Italy and Brazil, and support and distribution in over 60 countries worldwide.

Our global client base consists of some of the world's most successful companies who rely on NDC to ensure that their product performance, process yield and quality meet the stringent standards demanded by their customers.

NDC Product Groups:

NDC Systems: Web gauging systems for the converting, extrusion, calendering and nonwovens industries, providing real-time measurement of key product parameters such as coating or lamination thickness, basis weight and product thickness.

NDC Sensors: Process instrumentation for the food, chemical and pharmaceutical, mineral and bulk materials and tobacco industries, providing on-line and at-line NIR (near infrared) measurements of constituents such as moisture, fat and protein content.

IRM Metals Gauging Systems: Rugged in-process gauging systems for the steel and non-ferrous metals industries, delivering rugged measurements of key parameters such as thickness, width and flatness, and sinter permeability and oxidation state.

NDC is part of Spectris plc, the leading supplier of productivity-enhancing instrumentation and controls.

Accurate, Reliable Performance

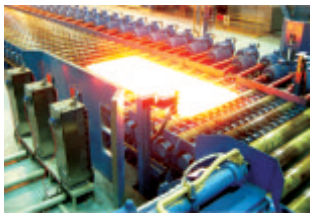
Rugged, maintainable application-matched gauges

that withstand hostile metals environments

► FVXR-1 X-RAY COATING WEIGHT GAUGE

Applications: Galvanizing lines (galvanized, galvannealed and galvalume), tin, copper and nickel coating lines

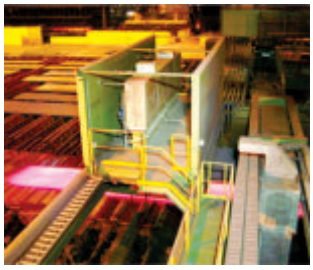
FVXR-1/O Zn	Galvanizing line, O-frame
FVXR-1/S Zn	Galvanizing line, split-frame
FVXR-1/O Zn/Al	Galvanizing line Zn and Al, O-frame
FVXR-1/O Sn	Tin coating lines, O-frame
FVXR-1/O Zn ICON	Galvanizing line, O-frame with % Fe sensor (galvannealed)
FVXR-1/O Zn HR	Galvanizing line, O-frame with ridge detection
FVXR-1/O Cu/Ni	Copper/Nickel lines, O-frame



► W10 OPTICAL WIDTH GAUGE (SIDE MEASUREMENT)

Applications: Continuous casters, reheat furnaces, hot mill roughers and plate mills (steel, aluminum, other metals)

W10x2	Basic width gauge version
W10x3 WS	Width gauge with skew measurement
W10x3 C	Camber gauge
W10x4xL	Width gauge with Skew, Camber and Length measurements



► W100 OPTICAL WIDTH GAUGE (TOP MEASUREMENT)

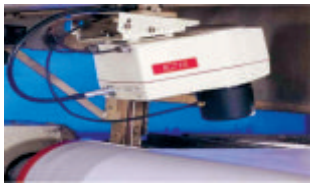
Applications: Hot mill roughers, finishers and coilers, steckel mills, plate mills, cold mills and process lines (steel)

W100	For strip
W100-P	For plate
W100-A	For cold mills and process lines
W100-PSG	Width gauge with plan-view (head and tail contour, camber and length)
W100-CSOT	Width gauge with crop shear set-point optimization
	All W100 gauges can include a Flatness measurement package

► ROMETER OPTICAL FLATNESS GAUGE

Applications: Hot mill finishers and coilers, steckel mills, plate mills, cold strip mills and process lines (steel)

ROMETER F200	2 or 3 planes, high performance measurement and control for strip and plate mills.
ROMETER FQC-1	Flatness measurement for quality control (hot strip mills)
ROMETER FQC-2	Flatness mapping for quality control (plate mills)
	All ROMETER gauges can include an integrated W100 width gauge



► IG710S NON-CONTACTING NEAR INFRARED GAUGE

Applications: Process lines

IG710S	Scanning optical coat weight gauge for water-based coatings. organic coatings, solvent-based coatings and polymer laminations

► SR710S NON-CONTACTING NEAR INFRARED GAUGE

Applications: Process lines

SR710S	Scanning optical coat weight gauge for clear and lightly pigmented thin organic laquer coatings, adhesive coatings. Wax on aluminum or steel and thin water-based coatings

Enhanced Metals Industry Solutions

From sinter mix to finishing coils

- Sinter Plant
- Continuous Caster
- Roughing Mill
- Hot Rolling Mill
- Finishing Mill
- Picking Line
- Cold Rolling Mill
- Electrolytic Tinning
- Galvanizing Line
- Process Line

In 2011 the IRM group was acquired by Spectris plc and merged with NDC to offer a complete range of metals measurement solutions from sinter mix to finished coils.

NDC's IRM Metals Gauging Systems group provides gauging systems that measure the flatness, width, thickness and coatings of metal strip and plate. These gauges have a sound reputation for their high-value measurements of flat sheet metal used in the manufacture of consumer goods and industrial materials. With NDC, these measurements are complemented by infrared technologies that provide expanded measurement capabilities for aqueous, organic, wax and oil coatings for the finishing processes. In addition, moisture can be measured throughout the sinter process.

Together, this new team delivers greater value to the metals industry through continued investment in new technologies, combined with a stronger customer support organization.

Excellence in Metals Gauging Measurement

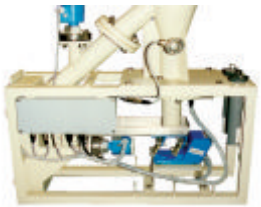
Complete metals gauging solutions

for superior results from your process

► CM710e NON-CONTACTING NEAR INFRARED GAUGE

Applications: Simple sinter, multi stage sinter line and coke breeze

CM710e	Infrared optical infrared moisture gauge for direct sinter mix measurement



► PERMAGNAG / PERMEAMETER SINTER PLANT CONTROL

Applications: Sinter plants

PERMAGNAG	Sinter magnetic gauge
PERMEAMETER	Raw mix permeabilty gauge

► T100 OPTICAL THICKNESS GAUGE FOR HEAVY MATERIALS

Applications: Continuous casters, reheating furnaces, hot mill roughers and plate mills (steel, aluminum and other metals)

T100-HD	Heavy duty centerline thickness gauge (Hot steel applications)
T100-HD Dual	Heavy duty dual gauge (2 C-Frames controlled by the same control cabinet)
T100-HP	High-performance thickness gauge (Aluminum hot mill and steel cold mill applications)
T100-HP Dual	High-performance dual gauge (2 C-Frames controlled by the same control cabinet)

► TVXR-1 X-RAY MEDIUM ENERGY THICKNESS GAUGE

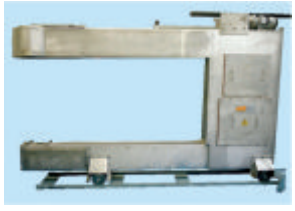
Applications: Hot and cold rolling mills and process lines

TVXR-1	Centerline gauge basic version
TVXR-1 P	Scanning gauge
TVXR-1 2F	Dual gauge (2 C-frames with one control cabinet)
TVXR-1 2F/P	Dual gauge with 1 centerline and 1 scanning C-frame
TVXR-1 Triple	Triple gauge for simultaneous centerline and profile measurement with centerline redundancy

► TVXR-2 X-RAY HIGH ENERGY THICKNESS GAUGE

Applications: Hot and cold rolling mills and process lines

TVXR-2	Centerline gauge basic version
TVXR-2 P	Scanning gauge
TVXR-2 2F	Dual gauge (2 C-frames with one control cabinet)
TVXR-2 2F/P	Dual gauge with 1 centerline and 1 scanning C-frame
TVXR-2 Triple	Triple gauge for simultaneous centerline and profile measurement with centerline redundancy



► TVXR-3 X-RAY HIGH ENERGY THICKNESS GAUGE

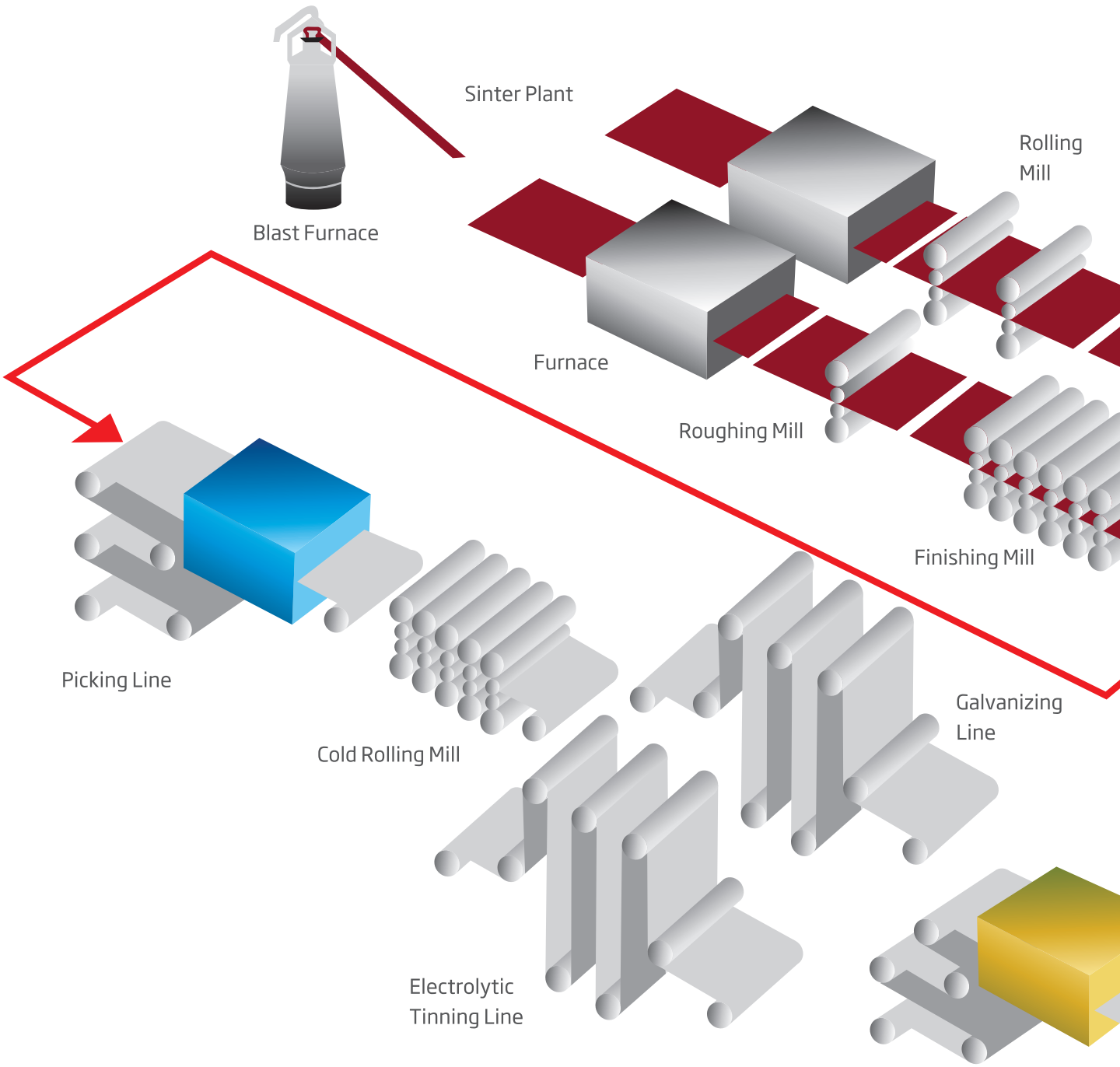
Applications: Hot rolling mill lines

TVXR-3	Centerline gauge basic version
TVXR-3 P	Scanning gauge
TVXR-3 2F	Dual gauge (2 C-frames with one control cabinet)
TVXR-3 2F/P	Dual gauge with 1 centerline and 1 scanning C-frame
TVXR-3 Triple	Triple gauge for simultaneous centerline and profile measurement with centerline redundancy

Proven, Capable Solutions

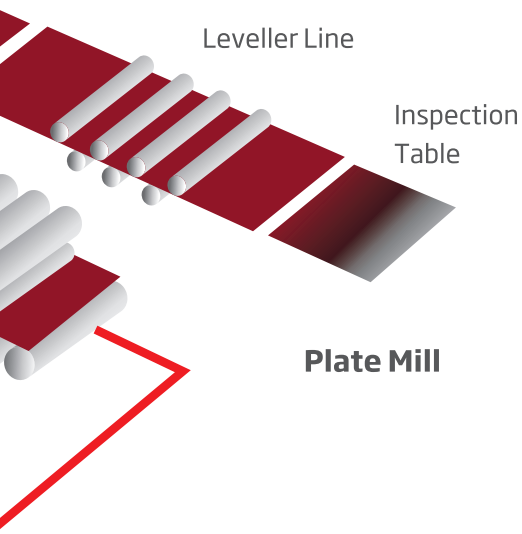
NDC applications for the metals industries

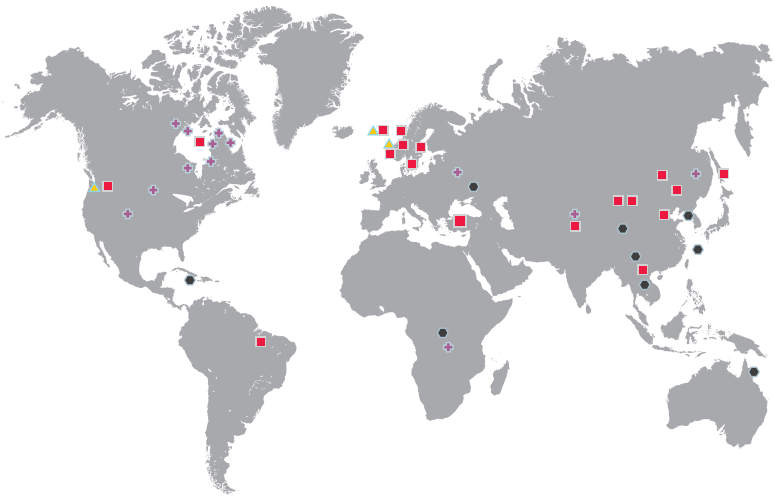
... the difference is experience



Metals gauging systems require a trained, professional service organization to help maximize the results throughout their lifecycle. Now that the combined IRM group/NDC customer support team has effectively quadrupled its metals service organization, it can offer substantially more service programs and greater resources. Customers can take advantage of the team's project management, system commissioning, customer training, spares logistics and maintenance programs in order to keep their systems operating at peak performance.

So contact our team today and let us show you how we can deliver the service you are looking for. Wherever your mill, we are close by to support you.





- Headquarters, Manufaturing & R+D
- Sales & Service
- Direct Service
- Trained Service Representation

Notes

Notes

www.temsa-inc.com

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