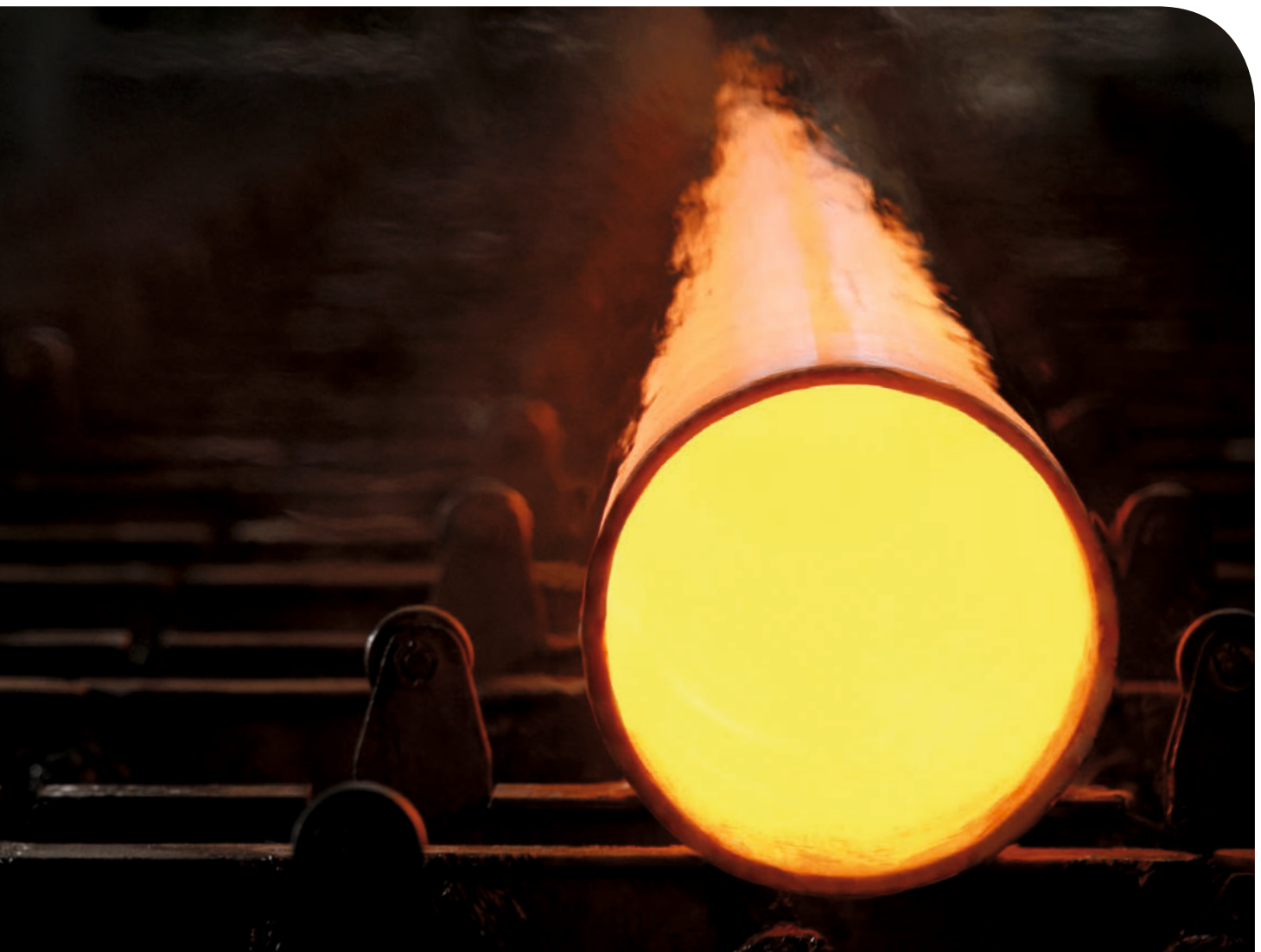


SEAMLESS TUBE PLANTS

Staying ahead with quality and cost efficiency



SMS GROUP

Leaders in plant construction and machine engineering

The SMS group unites global players in the construction of plants and machines for the processing of steel and NF metals, operating under the roof of SMS Holding GmbH. It consists of the two business areas, SMS Siemag and SMS Meer, as well as industrial participations. SMS Holding GmbH is responsible for strategic planning and control. The sole owner of the SMS group is Siemag Weiss GmbH & Co. KG, the holding of the Weiss entrepreneurial family.

FAMILY-OWNED AND WORLDWIDE PRESENT

As a family-owned company, the SMS group has built on solid values and a culture of responsibility for four generations. It holds a strong market position, while its decentralised structure ensures a fast and efficient response to individual customer demands. The SMS group combines the flexibility of company units that operate as medium-sized enterprises with the broad resources of an internationally active company – all to the benefit of the business partners. The decentralised corporate culture ensures that not only the individual units, but also the employees always think and act in an entrepreneurial manner.

BUILDING ON A STRONG BASIS

A long-term view, careful financial management, the focus on values, plus an understanding of the cycles of the machine and plant construction market have guided the group's strategic planning for decades. Also high on the agenda are investments in the areas of energy and environment technology, service and modernisation of plants as well as on-the-job training and qualification of core employees. On this basis, the SMS group creates tailor-made plant solutions which enable its business partners to keep well ahead of the competition.

SMS  **group**



SMS MEER BUSINESS AREA

The SMS Meer Business Area bundles its activities in the fields of steelmaking plants and continuous casting technology (long products), tube plants, long product rolling mills, forging technology, nonferrous metals plants, heat treatment technology and service. Starting with advisory services, followed by implementation and commissioning, and finally modernisations – the employees of the business area always combine their specialist knowledge with approachability and flexibility.

TOP QUALITY

The innovative solutions provide our customers with measurable benefits in their challenging markets. Whether steel for automotive parts, pipelines, heavy structural profiles, wheels for high-speed trains or aluminium for façade structures: the machines and plants tailored by the SMS Meer Business Area ensure the cost-efficient and flawless production of the necessary components.

INDIVIDUAL SOLUTIONS

The SMS Meer Business Area concentrates the competence of globally successful specialist firms under one roof to create a unique, full range of supplies and services for metal processing and associated fields. In doing so, the employees focus consistently on the needs of their business partners. They find individual solutions and fulfil the plant operators' expectations, both flexibly and reliably. This is verified by 17,000 successful reference projects the world over – in the last 50 years alone.



SEAMLESS TUBE PLANTS

Achieving a real market edge with a strong partner

Seamless steel tubes are an integral part of modern life. They are available in various grades – for everything from low to especially high stresses. They can be used for an almost unlimited range of applications - whether structural tubes and pipes in the construction industry, as oil field tubes or in a host of areas within the field of mechanical engineering or as precision tubes in the automotive industry.

VERSATILE RANGE

SMS Meer plants are used to produce seamless tubes with a vast range of diameters, wall thicknesses and steel grades. Depending on your needs, we offer various production methods – from the modern PQF® process to the traditional pilger process. At the same time SMS Meer is continuously working to optimize its plant and machinery even further. High cost efficiency, close product tolerances and a wide range of applications give SMS Meer customers a considerable competitive advantage.

OVER ONE HUNDRED YEARS OF SEAMLESS TUBE EXPERIENCE

SMS Meer already has more than 125 years of experience in the production of seamless tubes: Its roots go back as far as 1885, when brothers Reinhard and Max Mannesmann obtained the first patent for

the manufacture of seamless tubes – a pioneering invention. Together with Mannesmann, SMS Meer developed the first cross-rolling mills and pilger mills for the production of seamless tubes on an industrial scale. In the decades to follow the company continuously developed its technology further, launching innovative products on the market. The dimensional limits were extended, material properties optimized and the range of applications of the tubes expanded. And that's how it is today: Since its market launch in 2003 our pioneering PQF® technology has established itself worldwide as the new standard in seamless tube production – and is now the benchmark for quality and cost efficiency.

COMPREHENSIVE PROCESS KNOWLEDGE

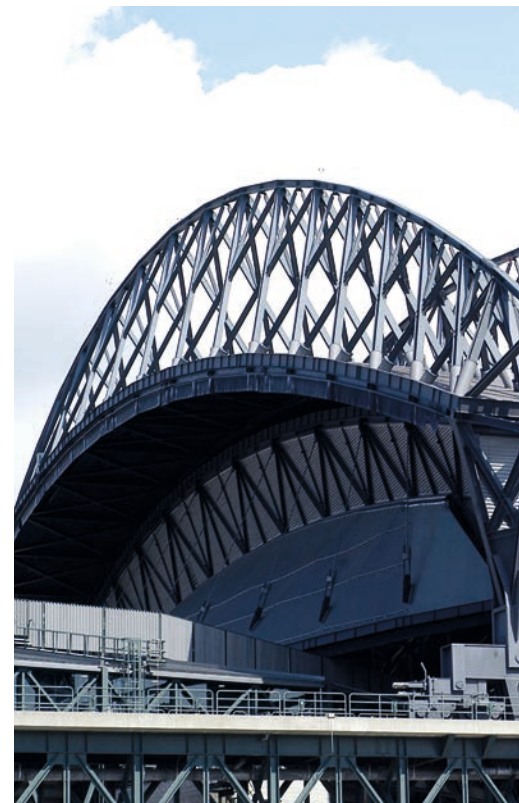
SMS Meer employees know the entire seamless tube production process – from the solid steel billet to the finished tube. They are specialists in their field and have extensive technical knowledge in the development, installation and maintenance of a wide variety of plant types. Together with the customer they select the optimal process and design the plant to meet all relevant requirements precisely. How our business partners benefit: They acquire integrated solutions and have a competent partner on hand for



FROM THE CUSTOMER'S VIEWPOINT

"The companies within the SMS group are extremely reliable partners. We have found the best possible supplier to meet our quality requirements and the team also worked side by side with us throughout the plant construction phase. This is just what I expect of a good business partner."

Christiano Caldeira, Vallourec & Sumitomo Tubos do Brasil, Brazil

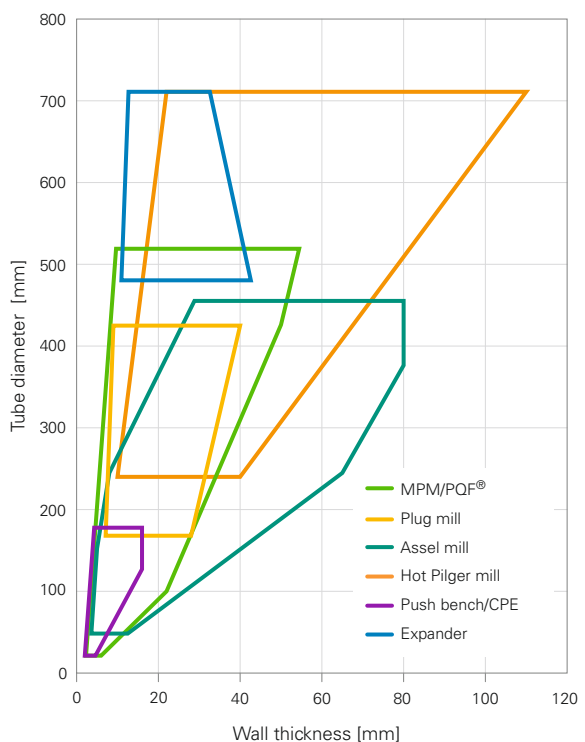


any requests they may have – regardless of which project phase they are in. This is where, for example, minimill concepts are realized; these are energy-saving integrated plants comprising the steel mill, continuous casting plants and rolling mill. It is here that tube experts call on the expertise of SMS Concast – the specialist for steelmaking and continuous casting technology which is part of the SMS Meer business area.

SATISFIED CUSTOMERS WORLDWIDE

In the past 50 years alone SMS Meer has implemented over 2000 seamless tube plant projects. Satisfied customers can be found all over the world – and their success on the market speaks for itself. Our commitment to our business partners goes way beyond successful commissioning of the plant: We continue to support you decades after the order has been completed with our extensive service range. Whether it's spare parts, maintenance or modernization: you can rely on SMS Meer – for the lifetime of your plant.

FIELDS OF APPLICATION OF SEAMLESS TUBE PROCESS



PORTFOLIO

The right solution for all stages of the process

Piercing, elongating and finish-rolling: these are the key stages in the production of seamless tubes. In the finishing line the tubes are then refined to produce high-quality end products. SMS Meer has the right machine for every stage and covers the whole diverse range of possible processes. Together with the customer we choose a solution which best fits their needs, tailored to the required tube diameters, qualities and rolling batch sizes.

Whether it's for precision tubes or solid tubes for pipelines: SMS Meer combines the machinery into integrated plant concepts and ensures all plant components are perfectly coordinated – meaning customers can produce cost-effectively and achieve the best possible results. SMS Meer also has an eye on the entire process chain, including the furnaces and reheating furnaces with either gas-heating or induction systems. Saws and machines for inside and outside descaling are just as much a part of our range as transportation and handling equipment or cooling beds.

CONTROL
CARTA®



STARTING MATERIAL

Steel billets of various dimensions and grades, continuously cast or rolled

- Billet preparation
- Billet saw
- Furnace technology
- Billet centering

PIERCING

from the billet to the hollow

- Cross-rolling mill
 - with Diescher disks
 - with guards
- Billet descaling
- Hollow inside deoxidation
- 3-roll piercing mill
- Cooling and quick-change systems for the piercing mandrel

ELONGATING/EXPANDING

from the hollow to the shell

- MPM/PQF® mandrel mill
- Assel mill
- Push bench/CPE/TPE™ mill
- Plug mill
- Hot pilger mill

SERVICE AND SUPPORT –



With our CARTA® and LASUS® measurement and control systems, SMS Meer offers reliable tools for managing the quality of the rolling process and products. Therefore mill operators can maintain the closest tolerances and increase the cost efficiency of their production processes – decisive factors for success on the seamless tube market.

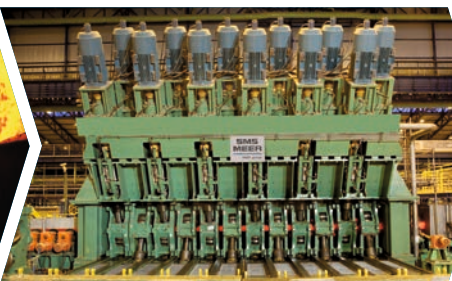
A SMOOTH START

Manufacturers who place their trust in SMS Meer receive more than just good technology: During the

installation and commissioning our staff monitor the erection of the plant and machinery and ensure they are perfectly tailored to the production processes. They also react quickly to any changes in the customer's requirements. As a result, SMS Meer ensures all final acceptance targets are met and provides support with the start-up of production. In this way, plant owners benefit from a high degree of planning security and a smooth start to production.

AND AUTOMATION

LASUS®, QAS



FINISH-ROLLING

from the shell to the tube

- Reheating furnace (induction/ gas-heated)
- High-pressure water descaling unit
- Sizing mill
- Stretch-reducing mill
- FPS technology
- Layer saws
- Rotary expander

FINISHING LINE

From the rolling mill to the loading station

- Straightening machines
- Upsetting presses
- Chamfering and threading machines
- Tube heat treatment line
- Tube sizing presses
- Hydrostatic pipe testers
- Groove dressing machines

PRODUCTS

Seamless tubes of various dimensions



Diameters: 21.3 mm to 720 mm
Wall thicknesses: 2 mm to 120 mm

FOR THE LIFETIME OF YOUR PLANT

CROSS-ROLL PIERCING MILLS

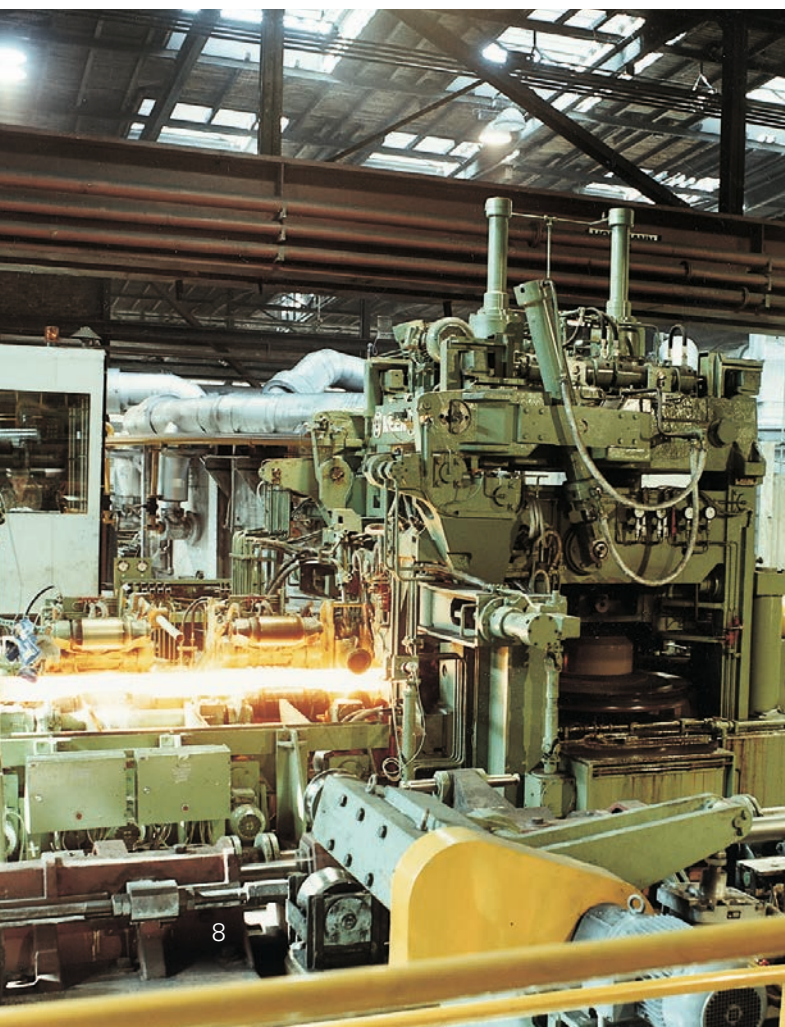
Quality right from the start



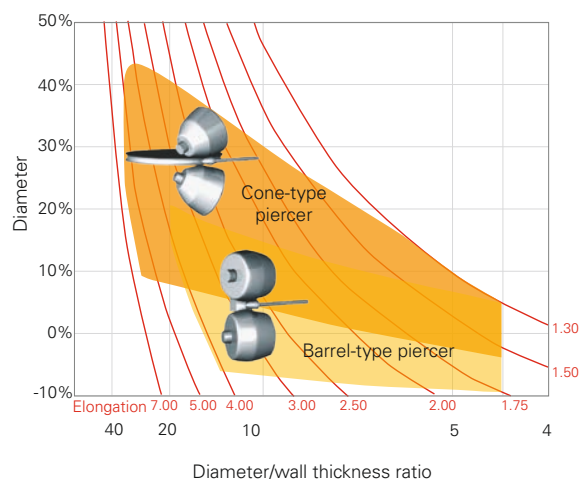
The piercing process is at the top of the process chain, which starts with the solid steel billet and ends with the seamless tube. It is of crucial importance for the subsequent quality of the finished tube: the billet must demonstrate excellent surface and tolerance characteristics straight after piercing. Only then is it possible to produce high-quality tubes with flawless surfaces and high dimensional accuracy. The high-performance cross-rolling mills from SMS Meer are perfectly designed for this, enabling particularly cost-effective production at the same time.

FOR LARGE BILLETS AND LOW TOLERANCES

Cross-roll piercing ranks as the leading piercing method for seamless tubes and offers considerable advantages compared to alternative methods such as piercing presses or press-piercing mills. Plant owners are able to process heavier billets as well as achieve measurably closer wall thickness tolerances.



WORKING RANGE OF BARREL AND CONE-TYPE PIERCING MILLS



The cross-roll piercing mill usually has two profiled working rolls which rotate in the same direction. Their axes are inclined vis-a-vis the horizontal rolling stock axis. Depending on the type of construction, guards or rotating guide disks (Diescher disks) are used to close the roll gap.

The round billets are initially heated to rolling temperature for piercing. The rolls in the tapered entry section of the cross-rolling mill hold the round billets and roll them over a mandrel in a helical motion. This is how the hollow is formed.

THREE ROLLS FOR EVEN BETTER QUALITY

As an alternative to the 2-roll piercing mill, 3-roll piercing mills are also used for the piercing process. This further improves the wall thickness quality of the hollow.

TYPICAL FRAME SIZES OF SMS MEER CONE-TYPE CROSS-ROLL PIERCING MILLS

Roll diameter at high point (mm)	Billet diameter (mm)
1,000	150–220
1,100	200–280
1,350	220–330
1,450	280–400
1,500	300–500

BENEFITS FOR THE ENTIRE PROCESS CHAIN

SMS Meer has continuously further developed the cross-roll piercing process. Today's high-performance cone-type piercers produce particularly thin-walled hollow billets. This brings with it advantages during the subsequent processing stages in the production of seamless tubes: the load on the stretching units is reduced and the units simplified and the production range can be increased. This enables tube manufacturers to produce more cost-effectively – even in the case of large dimensional ranges, small batch sizes and low capacities.



MANDREL MILLS AND MPM

Sound solutions since 1972



The continuous rolling process – using mandrel mills – has been successfully used as a method of producing seamless steel tubes since the 1970s. The mandrel mill comprises several 2-roll stands which roll the hollow longitudinally to form a shell. Here the diameter and wall thickness of the hollow billet are reduced with the aid of rolls and an inside tool – the mandrel bar – to the desired dimensions. Compared to alternative methods these mills ensure particularly high performance and product quality. SMS Meer customers use plants from three stages of development: conventional mandrel mills, Multistand Pipe Mills (MPM) and state-of-the-art PQF® (Premium Quality Finishing) mills.

MANDREL MILLS AND MPM SOUND SOLUTION FOR OIL FIELD AND BOILER TUBES

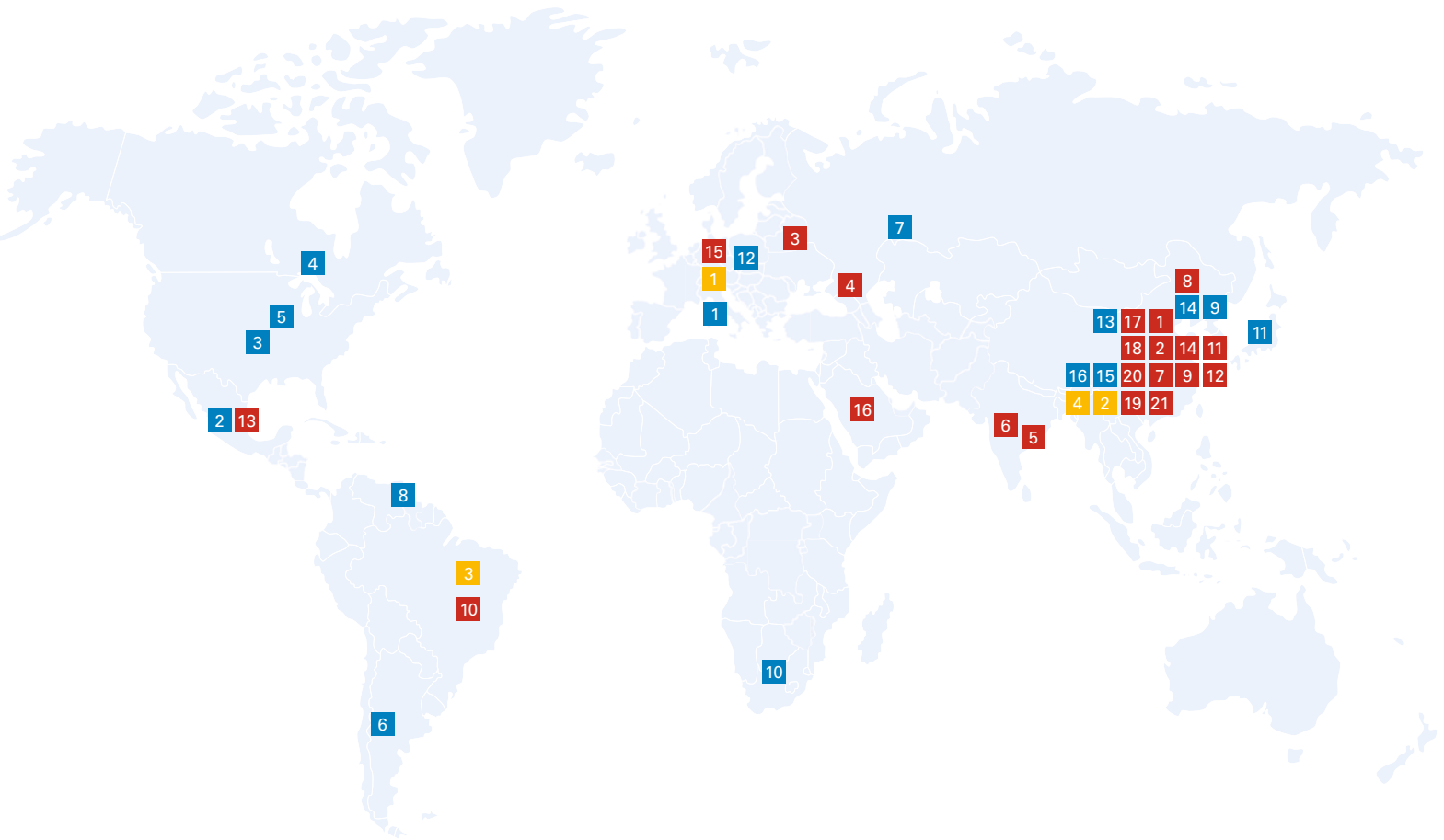
Both mandrel mills and MPMs (Multistand Pipe Mills) are used primarily for the production of oil field and boiler tubes with a dimensional range of up to 16 3/4". By contrast with mandrel mills, the mandrel bar in the case of the MPM method is retained and moved in a controlled manner during the rolling process. A further development in the MPM process now means that the rolls can be positioned hydraulically during

rolling. As a result, tube manufacturers are able to achieve better results and thus increase their output.

PQF®: THE NEW STANDARD IN THE PRODUCTION OF SEAMLESS TUBES

With the development of PQF® technology (Premium Quality Finishing) SMS Meer and SMS Innse succeeded in making a huge leap forward in mandrel mill innovation: The process uses hydraulically adjustable stands with three rolls instead of just two. Tube producers benefit from even higher product capacities with high product quality and efficiency at the same time. What's more, the process means they can reduce their production costs, increase output and enhance their flexibility in terms of the rollable dimensions and material grades.

The PQF® process was brought to market maturity in 2003 and within just a short period of time has established itself worldwide as the standard in seamless tube production. For example, PQF® mills are successfully used nowadays as a substitute for pilger mills up to a maximum tube diameter of 20" (508 mm) and have also proved successful in parallel operation with Assel mills.



GLOBAL REFERENCES

(based on year of order received)

MANDREL MILLS

1	7"	V&M Mühlheim	1972
2	7"	Baosteel	1979
3	7"	V&M Belo Horizonte	1995
4	4"	Hengyang Valin Steel Tube	1997

MPM – MULTISTAND PIPE MILLS

1	16"	Tenaris Dalmine	1978
2	13 3/8"	Tenaris Tamsa	1983
3	9 5/8"	US Steel Fairfield	1983
4	7"	Tenaris Algoma	1986
5	10 3/4"	V&M Star	1987
6	10 3/4"	Tenaris Siderca	1988
7	16 3/4"	TMK-Volzhsy	1989
8	9 5/8"	EBS de Tubos Acero Sin Costura (Sidor)	1990
9	14"	TPCO	1992
10	6 5/8"	ArcelorMittal South Africa	1993
11	16 3/4"	Sumitomo Metal Industries	1997
12	6 1/4"	W R Jednosc	1999
13	9 5/8"	Baotou Steel (Group)	2000
14	6 1/4"	Angang New Iron and Steel	2001
15	13 3/8"	Hengyang Valin Steel Tube	2002
16	14"	Chengdu (Pangang Group)	2003

PQF® – PREMIUM QUALITY FINISHING

1	6 5/8"	TPCO	2001
2	18"	TPCO	2005
3	6 5/8"	BMZ	2005
4	10 3/4"	TMK Tagmet	2006
5	7"	Jindal Saw Ltd.	2006
6	6 5/8"	ISMT	2006
7	9 5/8"	TPCO	2006
8	7"	Angang New Iron and Steel	2006
9	10 3/4"	Anhui Tianda Oil Pipe Co. Ltd.	2007
10	16"	Vallourec & Sumitomo	2007
11	18"	Yantai Baosteel	2008
12	10 3/4"	Jiangsu Xigang Group	2008
13	7"	Tenaris Tamsa	2008
14	14"	Tianjin Tianxin	2008
15	4"	V&M Riesa	2008
16	16"	ArcelorMittal Tubular Products Jubail Co.	2009
17	18"	Baotou Steel (Group)	2009
18	6 1/4"	Baotou Steel (Group)	2009
19	20"	Jiangsu Tianhuai Pipe	2009
20	7"	Hengyang Valin Steel Tube	2010
21	5 1/2"	TPCO	2011

PQF® – PREMIUM QUALITY FINISHING

High-performance plants for top quality results



Whether it's high-alloy steels or particularly thin-walled precision tubes – with PQF® technology manufacturers can produce even the highest-quality products efficiently and reliably. Less material is required than with conventional solutions and output is improved. As a result, tool costs remain low, with energy savings also made thanks to the low reheating requirements during the rolling process.

UNIFORM FORCE

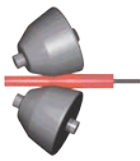
A PQF® mill consists of up to six stands, with three driven rolls each. The force is therefore applied more uniformly across the circumference of the rolls than it is with MPM technology featuring a conventional 2-roll arrangement. The advantage: Lower tolerance deviations in the roll gap, lower material strain during rolling and fewer negative influences during the rolling process. SMS Meer builds its PQF® mills based on the well-established ACO (Axial Change-Over) tunnel design, LCO (Lateral Change-Over) design and the BCO (Bilateral Change-Over) design. Each roll has a hydraulic adjustment system. This allows tube manufacturers to adjust the roll gap precisely within fractions of a second.

STABLE AND MANAGEABLE WITH ANY WALL THICKNESS

For mill operators state-of-the-art technology means: Tube production is even more stable and easier to manage and control. The lower material strain means that the product mix can be extended to include even thinner walls and higher alloy steel grades.

PQF® plants today produce seamless tubes with diameters of between ½" and 20" and wall thicknesses from 2 to over 40 mm. Depending on the product mix, annual outputs of more than 600,000 tons can be achieved. The tubes are used predominantly in the oil field and energy sectors.

PROCESS CHAIN IN A MODERN PQF® MILL



- ▼ Billet starting material
- ▼ Billet saws
- ▼ Rotary-hearth furnace
- ▼ **Cross-roll piercer with Diescher disks**
- ▼ Hollow descaling unit
- ▼ Hollow inside deoxidation



- ▼ **Multi-stand PQF® mill**
- ▼ Extracting mill
- ▼ Reheating furnace
- ▼ High-pressure water descaling unit



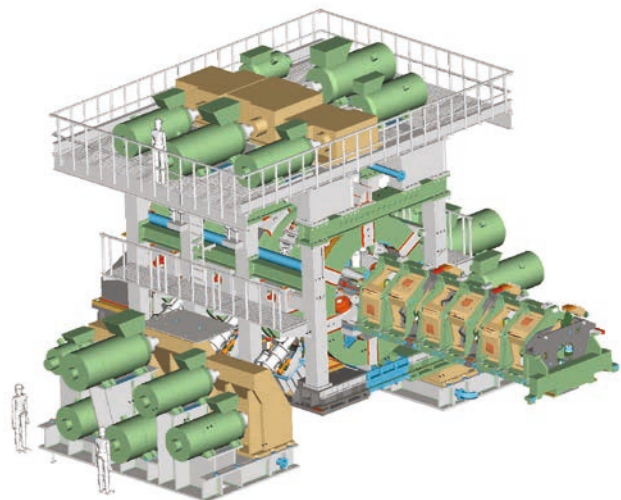
- ▼ **Stretch-reducing/sizing mill**
- ▼ Cooling bed
- ▼ Batch saws

PQF® seamless tube plants, examples of dimensions

	7" PQF®	10 3/4" PQF®	18" (20") PQF®
Billet			
Diameter [mm]	210	200–280	270–500
Hollow			
Diameter [mm]	230	224–324	301–510 (577)
Shell (PQF®)			
Diameter [mm]	195	194–291	254–477 (530)
Shell (extracting mill)			
Diameter [mm]	185	185–281	245–465 (510)
Finished tube			
Diameter [mm]	48.3–177.8	60.3–278	177.8–457 (508)
Wall thickness [mm]	3.2–22.0	3.9–34.0	5.5–45
Nominal annual production [t]	> 350,000	> 450,000	> 500,000

THE BENEFITS OF THE PQF® PROCESS AT A GLANCE:

- Higher-alloy steel grades can be rolled
- Lower mandrel bar wear
- More uniform temperature distribution in the shell after the rolling process
- Reduced "finning" at the shell ends and thus lower crop end losses
- Closer wall thickness tolerances
- **Improved tube quality**
- **Reduced manufacturing costs**

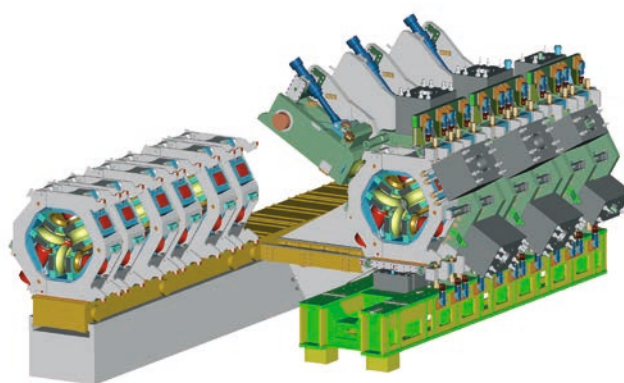


PQF® mill of ACO design

PQF[®] OF LCO AND BCO DESIGN

More flexibility for customers

The production of smaller batch sizes at competitive prices has become more important in recent years – which is why SMS Meer has expanded the design concept for its PQF[®] plants of ACO tunnel design to include two further alternatives: The LCO (Lateral Change Over) design and the BCO (Bilateral Change Over) design.

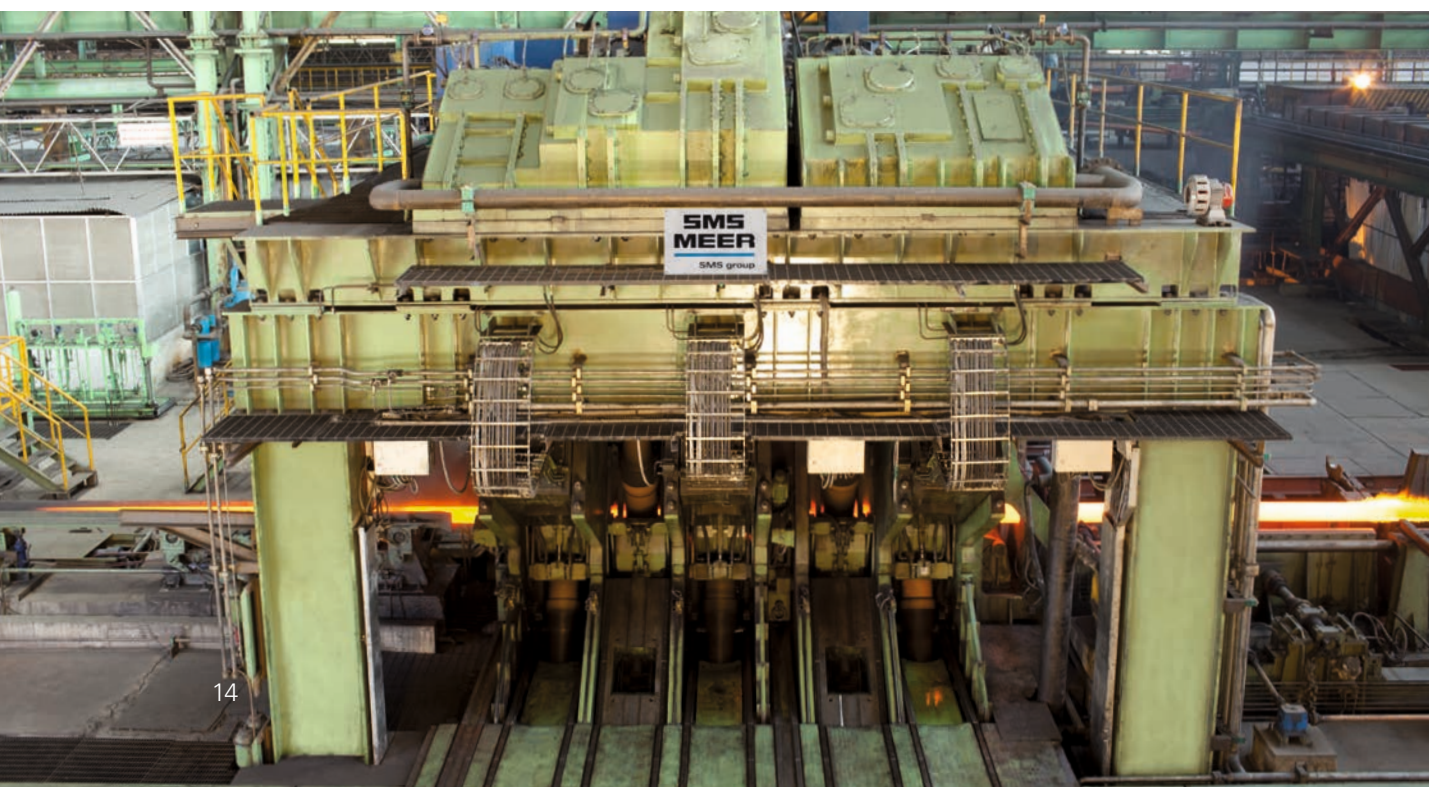


LCO design – stand change from the side

LCO: QUICK STAND CHANGE – EASY MAINTENANCE

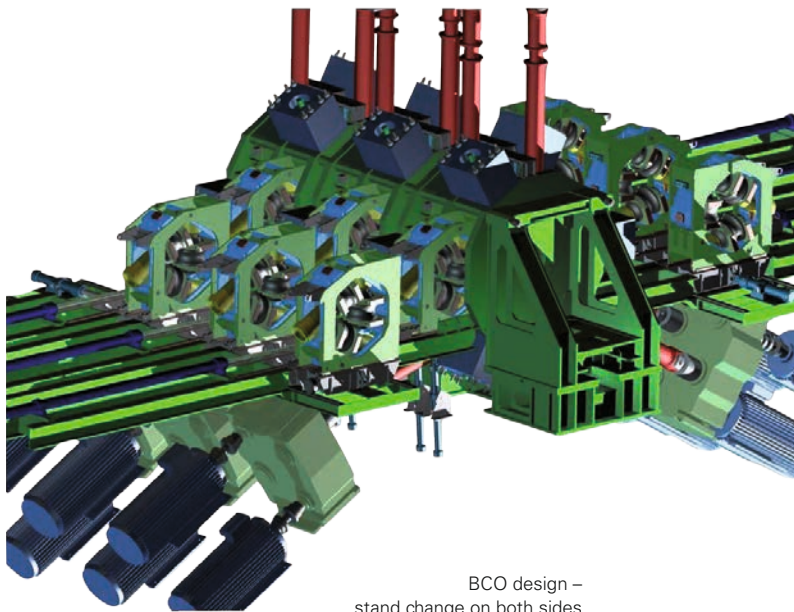
With the LCO design the individual stands are changed from the side. This system is already known from SMS Meer's stretch-reducing and sizing mills. Plant owners can switch to other formats in no time at all, and the plant itself is particularly easy to maintain and operate – as a result the availability of the plant increases and even small batch sizes can be produced cost-effectively.

Each stand is equipped with three levers which hold the chocks and rolls. The lever system enables the rolls to be swung out of the stand such that they can be changed within a short period of time. At the same time the levers ensure precise guidance of the rolls during adjustment, thereby guaranteeing optimum quality.



BCO: IMPROVED EFFICIENCY IN TUBE PRODUCTION

With the new BCO design variant the stands are changed on both sides of the mill. The rolling forces are therefore distributed symmetrically across the mill. The hydraulic capsules are rigidly connected to the mill stand frame. The compact and easily accessible design enhances the user-friendliness of the plant. The drive concept is simpler – there are no bevel gear stages. Such features improve the efficiency and flexibility of the tube production process.



BCO design – stand change on both sides



FROM THE CUSTOMER'S VIEWPOINT

"Continuous innovation is what makes SMS Meer so special: their new solutions improve our market prospects. With our state-of-the-art PQF® plant from SMS Meer we are able to produce up to 500,000 t seamless tubes – achieving both cost-efficiency and high quality at the same time."

Zhang Huming, Anhui Tianda Oil Pipe Company Ltd., China

ASSEL MILLS

Heavy-duty tubes

The Assel mill is a 3-roll cross-rolling mill used for producing medium and thick-walled tubes of high quality and dimensional accuracy. For this reason, they are mainly used for ball bearing tubes and general mechanical engineering pipes and tubes which need to be subsequently machined. The process was named after its inventor, Walter J. Assel. SMS Meer has continuously further developed this technology and thereby managed to double the maximum producible tube diameter. Today, tubes with an outside diameter of up to 460 mm and wall thicknesses of up to 80 mm can be produced on Assel mills.

HIGH-PERFORMANCE PLANTS FOR A WIDE RANGE OF DIMENSIONS

A feature of Assel mills are three rolls, offset at 120°, whose axes – as with cross rolling – are inclined towards the tube axis and cause the material to be fed forward. The rolls are conical at the base and feature a so-called shoulder in the rolling area. As part of the rolling process, a mandrel bar is inserted into the hollow – with the conventional Assel process it is free-running, and with high-performance Assel mills it is moved in a controlled manner.

SMS Meer has further developed this proven technology for such high-performance Assel mills. The technology has been improved and the dimensional range extended. For example, process limits were removed with the development of a roll ventilation device – including, among other things, the unwanted widening of the exit end of the tube shell, as previously described, which is caused by triangulation. Modern Assel mills are therefore able to produce medium and thin-walled tubes.

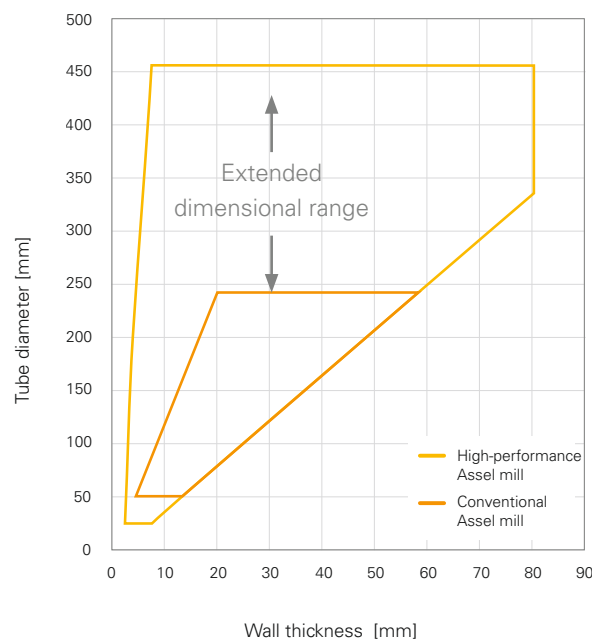
TANGIBLE BENEFITS IN THREE FORMING STAGES

The process chain schematic shows the characteristic features of a high-performance Assel mill:

- Piercing of the billet in a cone-type piercer
- Elongation of the hollow in an Assel mill with travelling, retained mandrel bar, using a quick closing and ventilation system for the working rolls.
- Finish-rolling in a stretch-reducing or sizing mill.

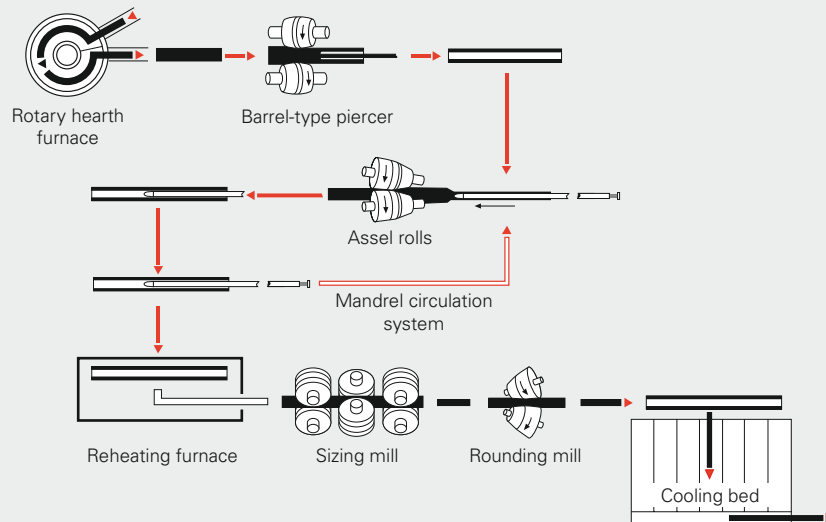
Since the high-performance Assel mill achieves a far better degree of roundness, there is no need for a rounding mill after finish-rolling. Overall, the benefits featured in the forming stages result in a considerable increase in the billet charge weights. This allows hot-finished tube lengths of up to around 80 m to be produced.

WORKING RANGE OF ASSEL MILLS

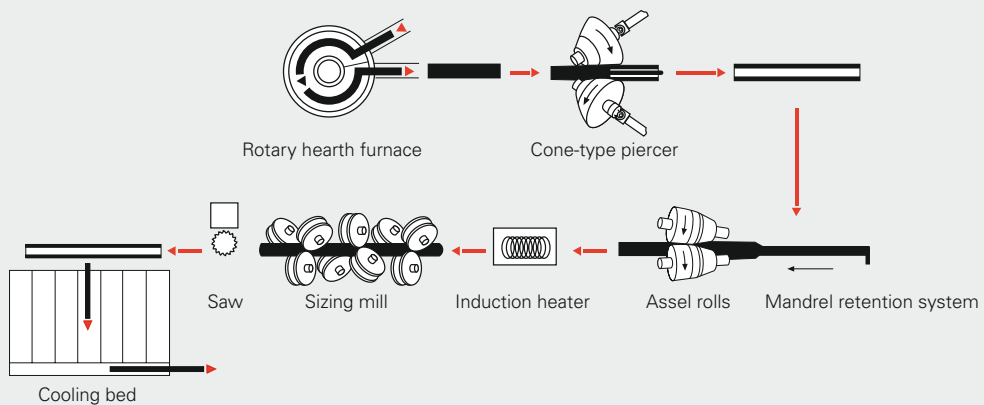




SCHEMATIC PROCESS CHAIN OF A "CLASSIC" ASSEL MILL



SCHEMATIC PROCESS CHAIN OF THE HIGH-PERFORMANCE ASSEL MILL



CPE AND TPE™ MILLS

The further development of the push bench process



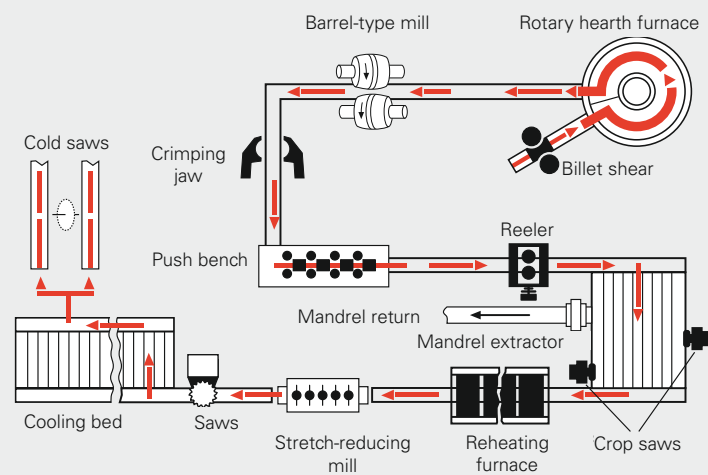
SMS Meer has further developed the push bench process into CPE (Cross-roll Piercing and Elongation) and TPE™ (Three-roll Piercing and Elongation). The product range is thereby extended compared to previous concepts and the processes offer substantial benefits in terms of both quality and cost efficiency. Both methods differ from the conventional push bench method in the first forming stage, the piercing process.

TANGIBLE COST SAVINGS THANKS TO FEWER PROCESS STAGES

With the CPE method the piercing press, elongator and hollow billet reducing mill are replaced by a high-performance, 2-roll piercing mill which acts as a piercing and prestretching unit. The process therefore requires fewer forming stages, so plant owners can reduce conversion costs measurably. At the same time they can use higher billet weights and achieve better wall thickness tolerances.



SCHEMATIC PROCESS CHAIN OF CPE PLANT



REDUCING MATERIAL LOSSES, IMPROVING OUTPUT

After cross-rolling, SMS Meer has included the use of a crimping jaw as an intermediate stage, before the hollows are stretched to form shells in the push bench. The jaw fixes the hollow on the end of the mandrel bar. In this way the pushing force of the mandrel bar can be transferred to the fully pierced billet.

Why it pays to use this technology: Before the tube shells are finish-rolled in the stretch-reducing mill, the front crimped end must be sawn off. This takes place with just 10% of standard tube dimensions. With the classical push bench method the ends are cut off in 100% of tube dimensions. The result: Output on CPE mills is considerably higher than with the conventional push bench method. Modern CPE mills, therefore, are a highly efficient, flexible and economic alternative in the production of tubes with medium to small diameters.

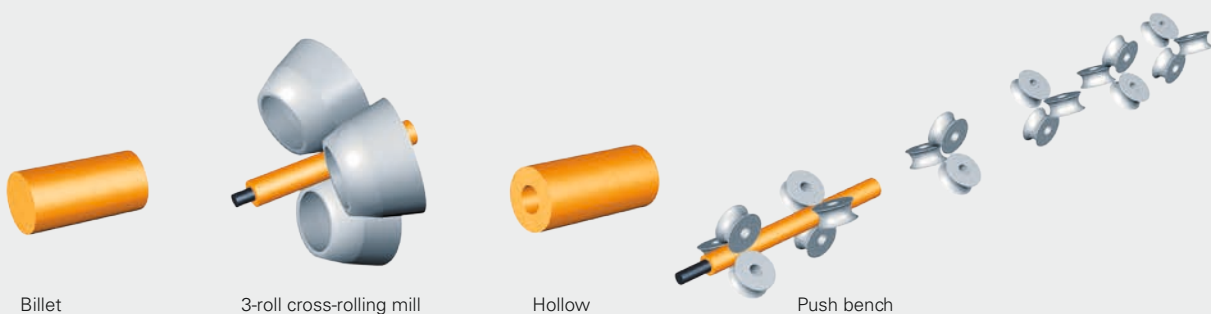
ACHIEVE MAXIMUM QUALITY

With TPE™ mills SMS Meer uses a 3-roll instead of a 2-roll cross-roll piercer. As a result, the quality of the hollow before the stretching process on the push bench is increased even further.

BENEFITS OF TPE™ MILLS AT A GLANCE

- Lower eccentricity
- Improved tube inside surface
- Improved structural properties
- Higher material output
- Use of conicast billets for all steel grades

SCHEMATIC PROCESS CHAIN OF THE TPE™ PLANT



PLUG MILLS

Classic solution for OCTG applications

SMS Meer plug mills enable the production of seamless tubes within a large dimensional and wall thickness range and are still used today for supplying the oil field industry. The plug mill process is also known as the Stiefel process, named after its inventor.

PIERCING PROCESS OPTIMIZED FOR LARGE-DIAMETER TUBES

SMS Meer plug mills usually start with a cross-roll piercing mill, in which the steel billet is pierced. For relatively large tube dimensions, SMS Meer uses an elongator as a prestretching unit between the piercing mill and plug mill. Its design and operation is the same as that of the piercing mill.

AUTOMATIC SEQUENCING FOR ELONGATION

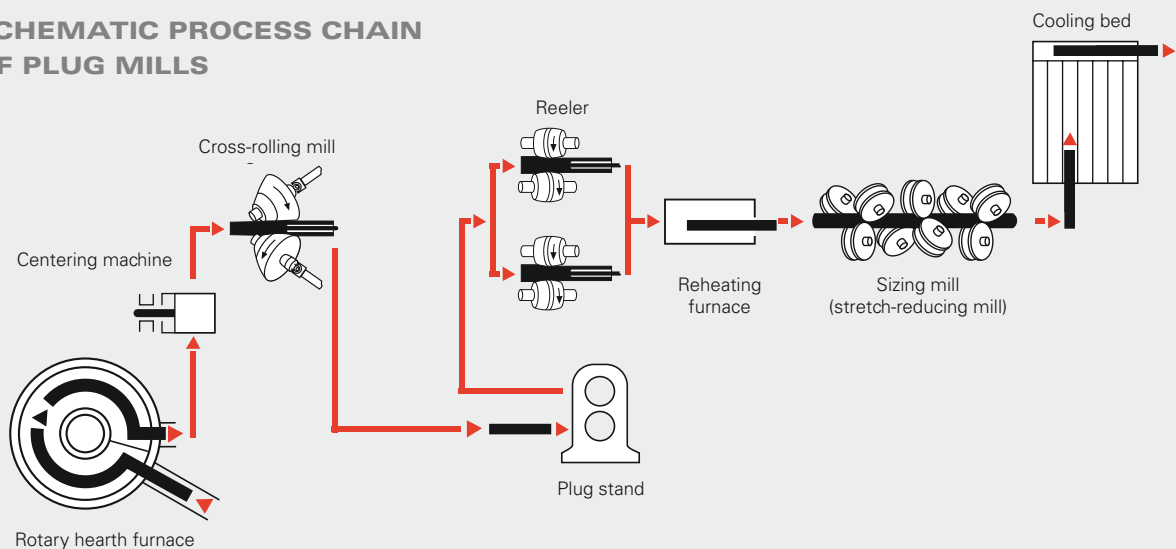
With the plug mill a pneumatic pusher inserts the hollow into the roll gap. There the billet is rolled out over the rolling plug to form a shell. Rolling usually takes place in two passes for which different plugs

are used in each case. After the first pass the working rolls are raised – stripper rolls then convey the shell back to the entry end. The shell is turned 90° and a plug with a slightly larger diameter inserted. Plant owners are able to operate and control the entire process easily: The plugs are changed automatically using a special device.

UNIFORMLY ROUND: EXPANDING AND FINISH-ROLLING

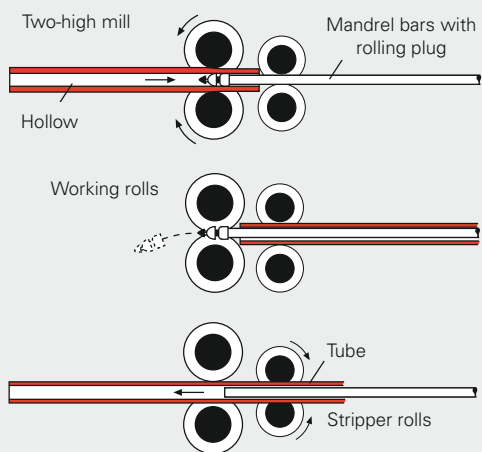
After the plug mill the tubes are further processed and slightly expanded in the reeler: this ensures a good degree of roundness and a more uniform wall thickness. In the last stage the tubes are sized to the precise outside diameter in the sizing mill or stretch-reducing mill.

SCHEMATIC PROCESS CHAIN OF PLUG MILLS





SCHEMATIC DIAGRAM OF PLUG MILL ROLLING





PREMIUM TUBES TO MEET THE HIGHEST DEMANDS

Situated just off the coast of Brazil is "Lula" – the second largest oil field ever. 8 billion barrels of crude oil will soon be extracted here from depths of up to 7 kilometers. This is only possible using premium seamless tubes which can

meet the high technical demands. That's why Vallourec & Sumitomo Tubos do Brasil have chosen the best plant technology: the PQF® process from SMS Meer. Reliability assured.



HOT PILGER MILLS

Classic systems for tubes up to 28"

A key feature of SMS Meer's hot pilger mills is the large dimensional range of rollable stock – even for high-alloy steel grades. The hot pilger rolling method is one of the oldest processes for elongating pierced billets into tube shells. Today, it is mainly tubes for the power generation, petrochemical and construction industries which are produced on hot pilger mills.

INTELLIGENT PILGER ROLL DESIGN

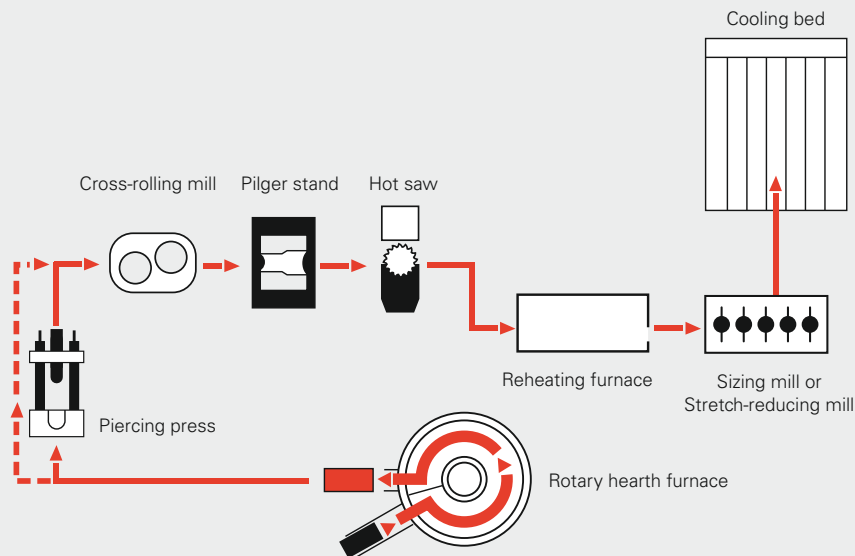
To pierce the billets SMS Meer uses cross-roll piercing mills or piercing presses with a downstream elongator. The hollow is first pushed over a cylindrical, smooth mandrel in the pilger mill. The diameter of the mandrel corresponds to the inside diameter of the desired tube. In the next stage a feeder mechanism guides the hollow and mandrel into the pilger rolls. Each roll

comprises two halves: One half is designed as a working pass – with a tapered roll groove portion and cylindrical parallel roll groove portion. The other half has a large opening for idling.

QUICK STEPS TO THE DESIRED WALL THICKNESS

The tapered portion of the work pass grips the hollow situated in the roll gap and shears off a so-called material wave. The parallel portion of the work pass then stretches this wave until the desired wall thickness is achieved. At the same time it is moved back with the mandrel towards the feeder mechanism. Once the idler pass releases the hollow, the latter is rotated 90° and pushed forward to the rolls again, and a new cycle begins. The process is repeated

SCHEMATIC PROCESS CHAIN OF A MODERN PILGER MILL



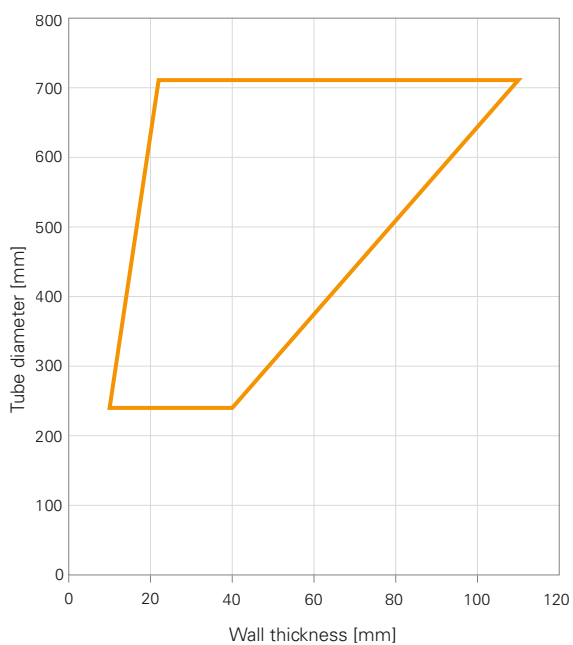
several hundred times with a short period until the shell is "finish-pilgered". In this way the pilger rolling method is similar to forging.

ATTAINING OPTIMUM RESULTS

Once the tube has left the pilger mill, a hot saw cuts off the remainder of the shell, the so-called bell end, and, if necessary, the uneven front end of the shell. The shells are then sized to the desired outside diameter in a sizing mill.



WORKING RANGE OF HOT PILGER MILLS



ROTARY EXPANDERS

For the largest diameter tubes

SMS Meer rotary expanders are used for producing seamless tubes with very large diameters which cannot be produced on a 'normal' seamless tube plant. The tubes are first heated then rolled to larger dimensions – using this technology plant owners can produce a wide spectrum of finished tube diameters and wall thicknesses from just a narrow range of primary products.

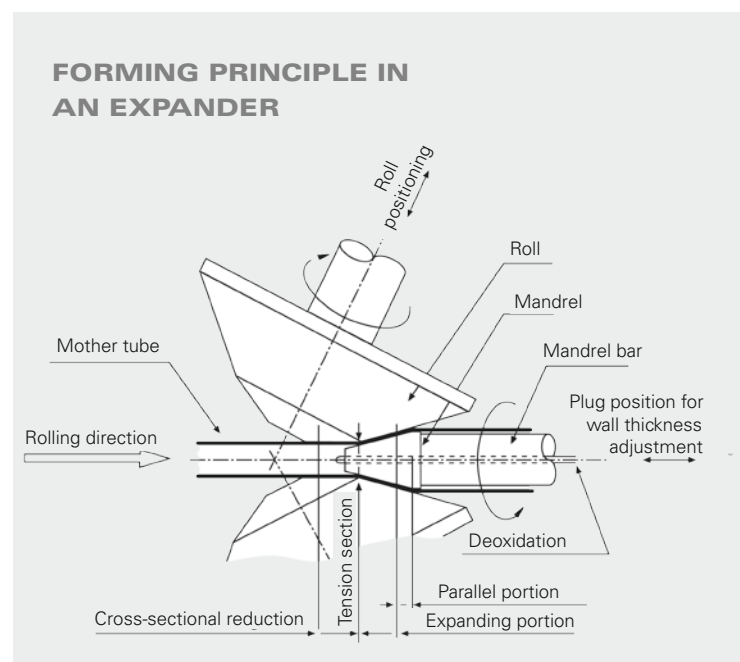
BASED ON THE PROVEN CROSS-ROLLING PRINCIPLE

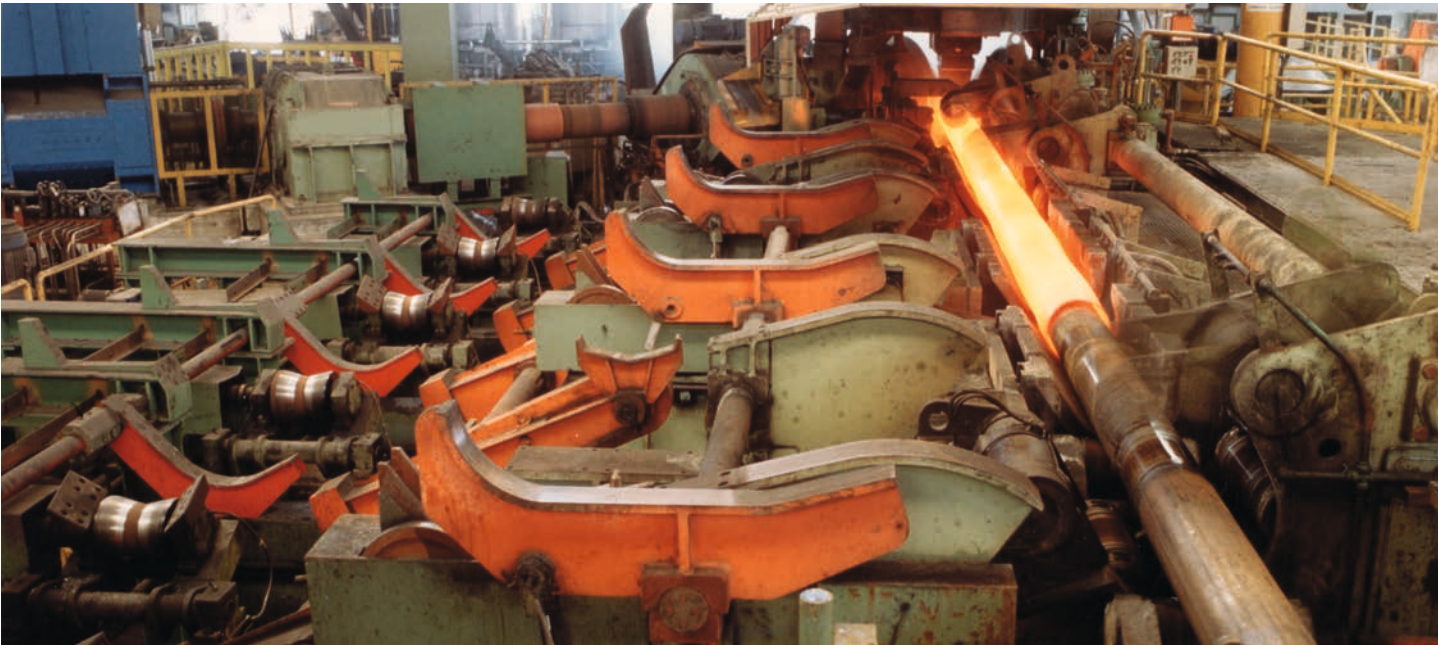
The rotary expander is a special kind of cross-rolling mill with conical, axially adjustable rolls. The tubes are expanded by rolling them over a plug. The position

of the rolls and mandrel here determines the wall thickness of the tubes. This can also be adjusted hydraulically during the rolling process.

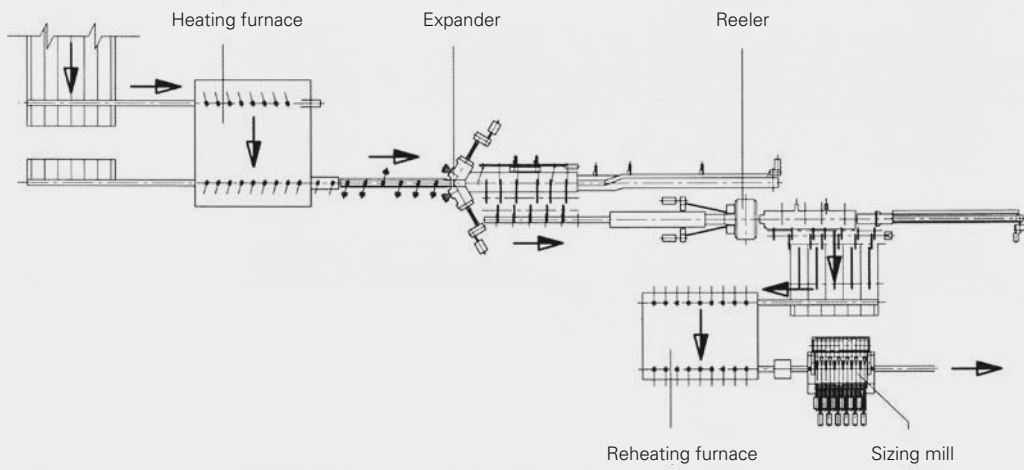
The process starts with seamless mother tubes and includes the following stages:

- Heating of the mother tube to a temperature suitable for hot rolling, expanding of the tubes in the rotary expander itself
- Levelling of the expanded tube in the reeler, in order to improve the wall thickness tolerances of the product.
- Sizing of the tube to their final dimensions in a sizing mill.





**TYPICAL LAYOUT OF
A COMPLETE EXPANDING LINE**



SIZING AND STRETCH-REDUCING MILLS

Efficiency that pays

Sizing or stretch-reducing is the last stage in the production of hot-rolled tube and plays a crucial role in terms of the variety and quality of the products. With solutions from SMS Meer tube manufacturers benefit here from a high degree of flexibility and reduced processing costs.

A PROCESS FOR MANY SHAPES

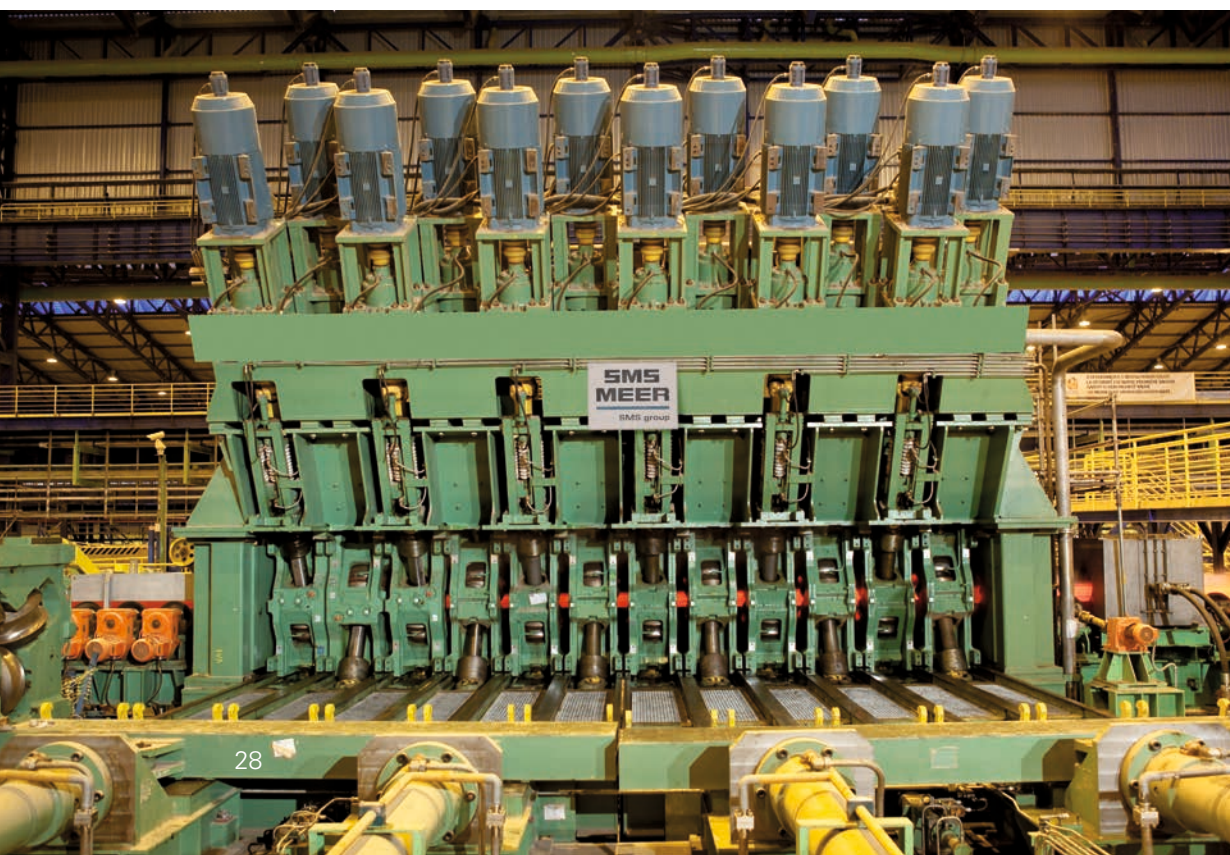
The diameter of the tube is reduced without an inside tool in the sizing mill and stretch-reducing mill (SRM for short). For this it passes through a variety of 3-roll stands. A smaller or larger number of stands is used depending on the diameter to be produced. During sizing, a low degree of longitudinal tension in the rolled stock is applied by using appropriate, fixed speed reduction from stand to stand. With stretch-reducing, on the other hand, the speed can be varied. Consequently, the longitudinal tension and therefore elongation of the rolling stock is deliberately altered and the finished tube wall thickness thereby adjusted.

By varying the stands and speed settings, plant owners can produce a broad spectrum of finished tube dimensions from just a few ingoing stock dimensions. Dimensional changes in the diameter and/or wall thickness of the tubes are carried out within short time intervals by means of stand changes and roll positioning.

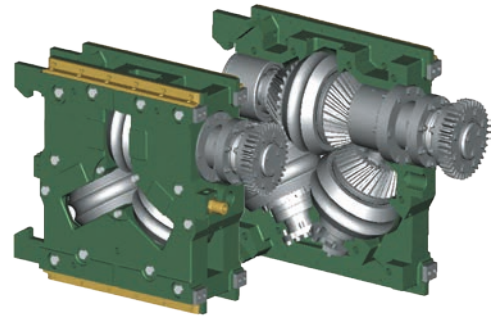
The high degree of flexibility offered by the process is used to minimize the machine and tool workload in the preliminary stage – the elongation process. Besides the roll speed, calibration of the rolls and their development from stand to stand play a crucial role in terms of the quality of the outer and inner surface of the stretch-reduced tube.

INDIVIDUAL ADJUSTMENTS TO SUIT THE PRODUCTION PROGRAM

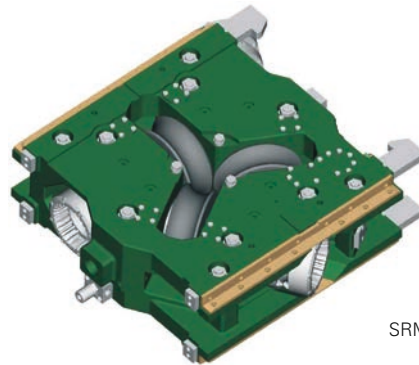
Sizing and stretch-reducing mills can essentially be used independently of the process application.



Rolling with variable tension is used today for a broad range of diameters and wall thicknesses. The stretch-reducing mill is adapted to the requirements of the production program in terms of the frame size, number of stand positions and drive system. While the frame size and number of stand positions determine the range of diameters and wall thicknesses, the drive system determines the possible speed variations and therefore a crucial parameter for process optimization. SMS Meer uses stands of varying frame size and type as well as different drive systems and is thus able to offer the right machine solution for all our customers' needs.



SRM I stand



SRM A stand



DESIGNS OF STRETCH-REDUCING MILL

I design

Each stand has only one drive, the rolls are coupled via bevel gear stages.

A design

Each roll has its own drive.

FPS TECHNOLOGY

Greater flexibility thanks to adjustable stands

The FPS (Flexible Precision Sizing) rolling system is a new development by SMS Meer. Here, stands with adjustable rolls are used: The finished tube diameter is determined using measuring technology, and the rolls are adjusted quickly and reliably by a computer-aided system. The flexibility achieved in this way enables small batches and close diameters to be rolled.

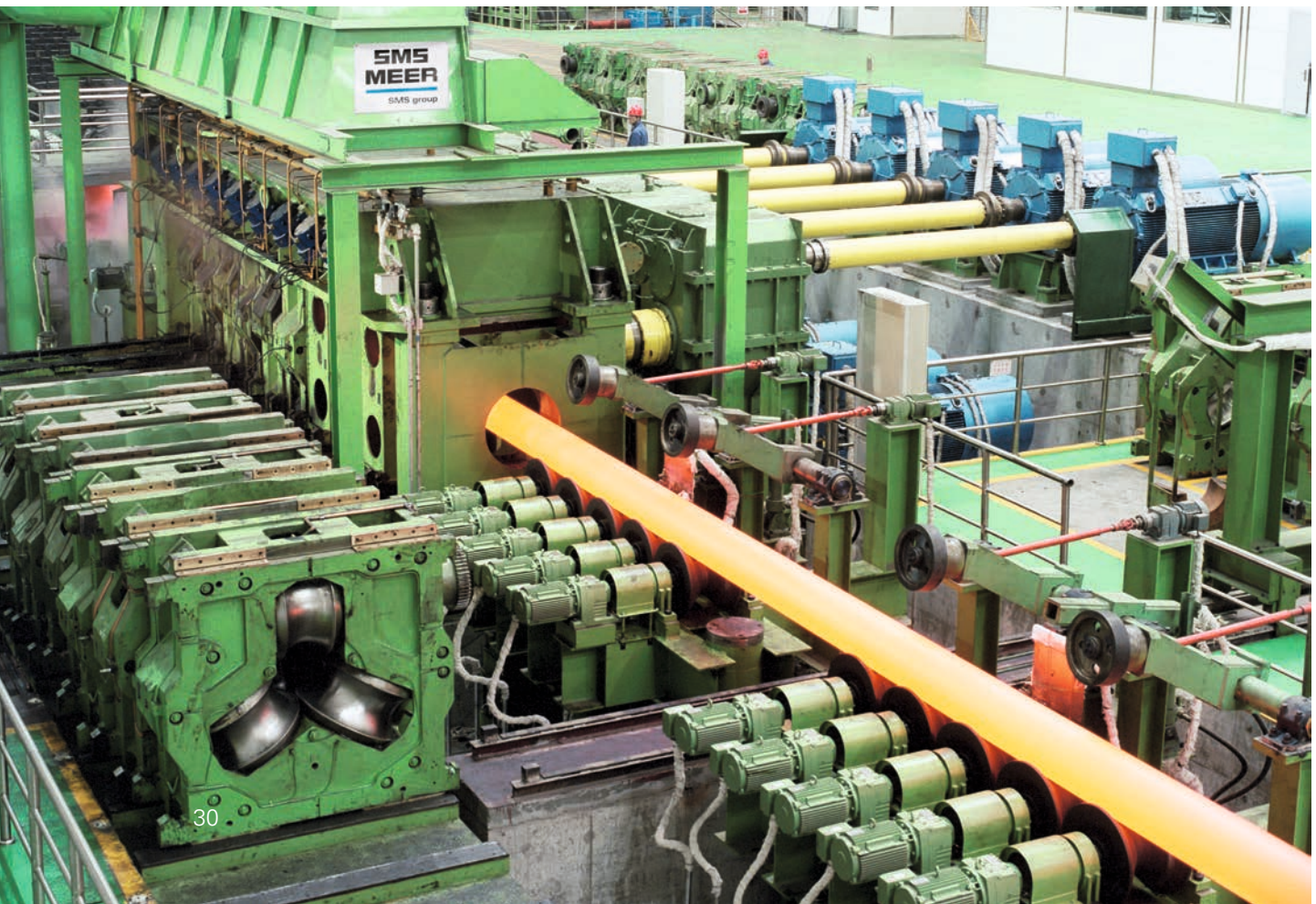
TANGIBLE BENEFITS THANK TO COMPUTER-AIDED POSITIONING

The computer-aided roll positioning system features many benefits: With FPS mill owners can quickly produce all conceivable diameters from the upper to the lower limits of the dimensional range. They can also roll much smaller batches than before, as well

as "exotic" finished diameters at reasonable cost levels. What's more, FPS also compensates for pass wear. Mill owners can purposefully and reliably set the desired diameter, reduce tool requirements and increase material output by doing away with cobbles and samples.

WIDE VARIETY OF APPLICATIONS

Two types of adjustable stand are used in stretch-reducing mills: The A stand with individually driven rolls is of a simpler design; the bevel gears for driving the three roll axes are not incorporated in the stand, but in the frame of the SRM. With the I stand the bevel gears are located on the roll axes in the stand itself. The FPS system has already been implemented for both types of design.

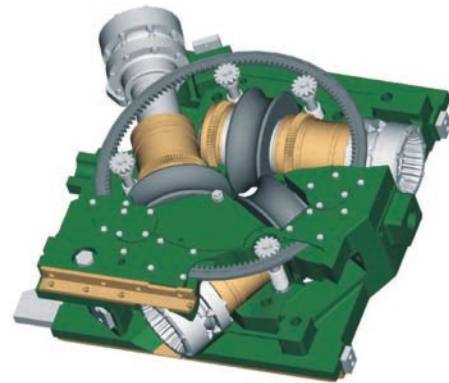


SMS Meer uses two different operations concepts for the FPS technology:

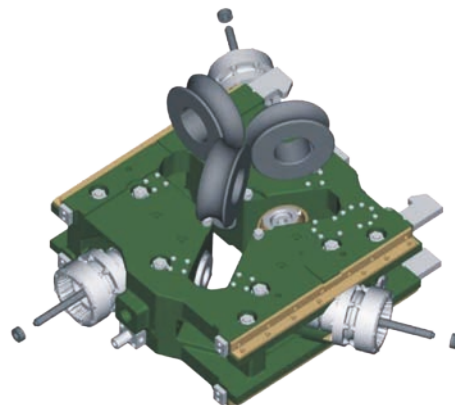
- Integrated, adjustable SRM final stands which are identical to the conventional SRM stands in terms of the outside diameters and, like standard stands, are connected directly to the SRM stands in front.
- Sizing block with adjustable rolls, whereby the FPS stands in the sizing block constitute their own forming section.

The sizing block can also be arranged downstream of other mills, such as, for example, a reducing or sizing mill with 2 or 3-roll stands. A sizing block with 4-roll stands would be feasible if there are special requirements in terms of roundness.

A modern quick roll change system reduces changing times, enhances the plant owner's flexibility and reduces costs.

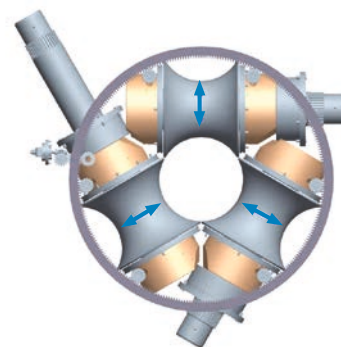
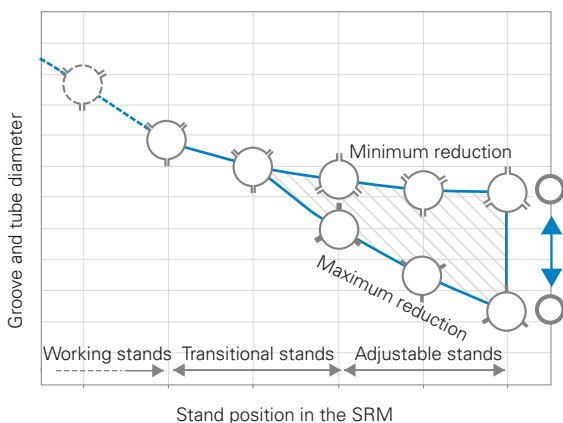


Adjustable SRM stand of A design



SRM stand with quick roll change system

ADJUSTMENT RANGE OF ADJUSTABLE STANDS



Operating principle of positioning mechanism

CARTA® TECHNOLOGY SYSTEM

Better planning and control of production processes

Optimum quality and cost-efficient production – those are the success factors in the manufacture of seamless tubes. With the CARTA® (Computer Aided Rolling Technology Application) planning and control system from SMS Meer customers can optimize their seamless tube production. The system covers the entire process chain of a modern seamless tube rolling mill, from piercing right through to finish-rolling. It also provides reliable support for process planning as well as process and tool management.

Plant owners achieve close tolerances in terms of the wall thickness and diameter, thereby reducing material losses and the costs of further processing. At the same time they can adapt production more quickly and flexibly to changes in market demand. The result: improved quality, lower costs and higher output – and therefore measurable advantages in the market.



MORE THAN JUST PROCESS CONTROL

The technology system makes use of the conventional systems for production planning, control and monitoring. The data from these is analyzed using special methods and compared to reference values. Maximum results can be attained by plant owners by using CARTA® across the entire production line. However, the system can also be used for individual rolling units only, in order to improve production in specific areas.

CARTA® offers plant owners a wide variety of possible uses: They can establish standards with the system, plan production sequences which are as cost-effective as possible, optimize ongoing operation, re-structure their quality management and learn from empirical data:

1. Creation of technologically optimized standards

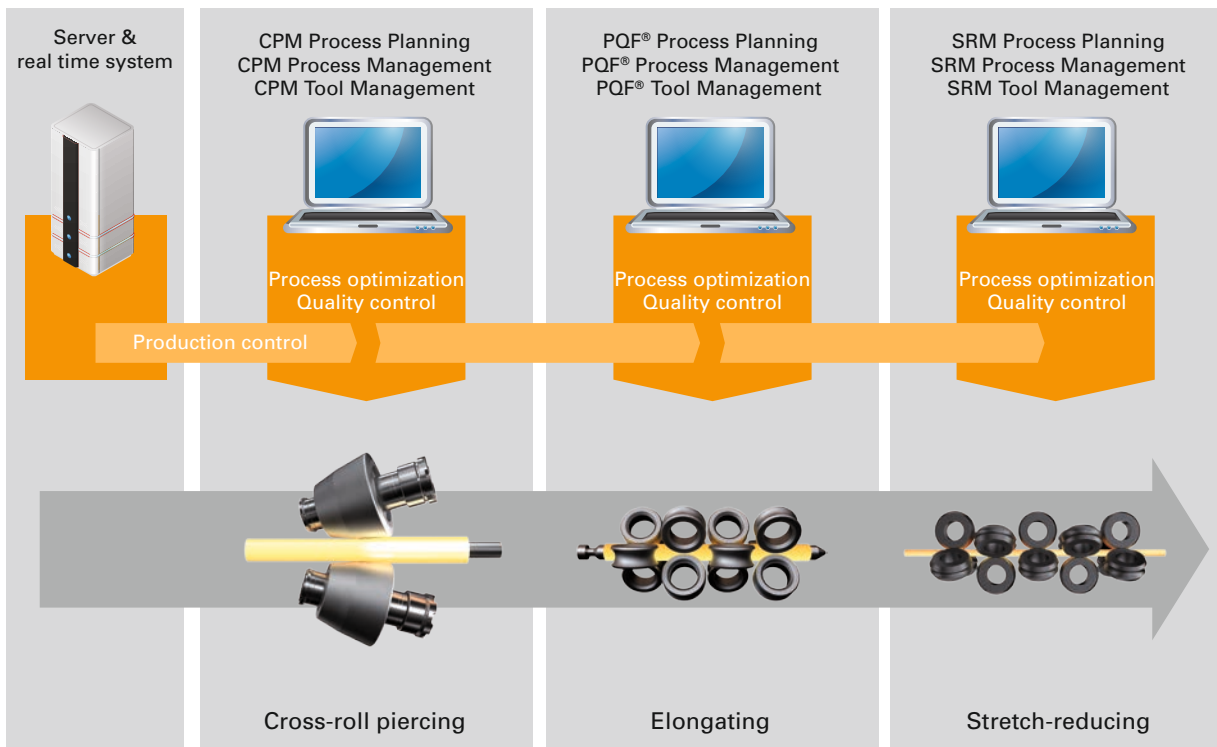
Even before the start of production, users can rely on CARTA® to generate rolling schedules (e.g. pass schedules, roll positions or speed adjustments) production data (e.g. throughput and material consumption) tool data.

For this SMS Meer has brought its expertise into the CARTA® system in the form of process models and computation methods.

2. Technological support with production planning

CARTA® helps plant owners optimize the preparation and organization of tube production. The advantage: Plant owners minimize changing times and standstill periods – thanks to, for example, the intelligent sequencing of rolling operations or the optimized provision of tools and change stands.

BASIC STRUCTURE OF THE CARTA® TECHNOLOGY SYSTEM



3. Optimization of ongoing production in real time

During production there are inevitably large deviations between setpoints and actual values. With CARTA® plant owners can permanently control the process and correct the adjustment and process control of the individual mills within seconds.

4. Technological support for quality control and assurance

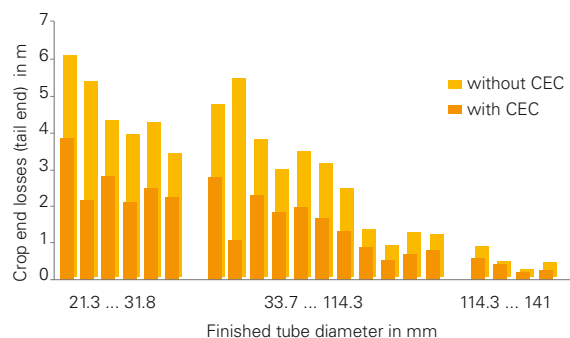
CARTA® collects information such as sensor signals, measurement data and operator inputs for automatic evaluation. The technological process models are used for interpreting information correctly and provide information on process optimization. The system gathers data for each individual tube which can be used for product certification.

5. Use of production experience

All data which CARTA® collects during production is automatically compressed and stored in an empirical database. The values can be analyzed later using various methods, allowing plant owners to learn

from experience and specifically optimize planning and production. A crucial advantage for flexible, competitive production. For with this data even small rolling lots can be quickly and cost-effectively produced to close wall thickness and diameter tolerances.

SRM PROCESS PLANNING: LOWER CROP END LOSSES THANKS TO CEC (CROP END CONTROL)



QAS UND LASUS®

Safeguarding quality – from the billet to the finished tube



To meet the strict requirements in terms of the quality and cost efficiency of seamless tubes, plant owners have to monitor their processes and products continuously. That's why SMS Meer equips mills with measuring and control systems throughout. Using the data collected plant owners can fine tune production with computer-aided systems. In this way they can achieve consistent product quality, from the billet through to the finished tube. Moreover, output losses are reduced and the plant availability increased.

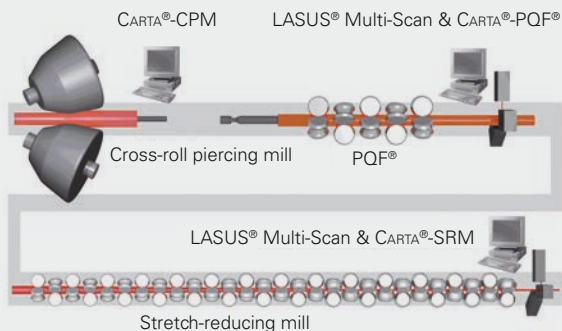
KEEPING AN EYE ON THE WHOLE PROCESS WITH QAS

The CARTA® technology system comprises a customized quality assurance system (QAS). It records all necessary measurement parameters during production and assigns them to individual tubes – from piercing through elongation right up to finish-rolling. Therefore plant owners can control the quality precisely throughout the entire seamless tube production process.

PRECISE WALL THICKNESS MEASUREMENTS WITH LASUS®

An essential measurement parameter for the quality of seamless tubes is the wall thickness. The LASUS® system (Laser Ultrasonic hot wall thickness measuring system) from SMS Meer provides reliable measurements for all forming stages. Tube producers can therefore achieve closer tolerances, fewer material losses and higher tube quality. The measuring principle is based on ultrasound technology, tried and tested over decades. What is special about the use of this technology for measuring the wall thickness of hot tubes is: The ultrasonic pulses are excited by a high-performance pulsed laser and recorded by a CW laser. As a result, plant owners can use the conventional ultrasonic pulse echo method already during production to obtain reliable readings – even at tube temperatures of over 1200 degrees Celsius.

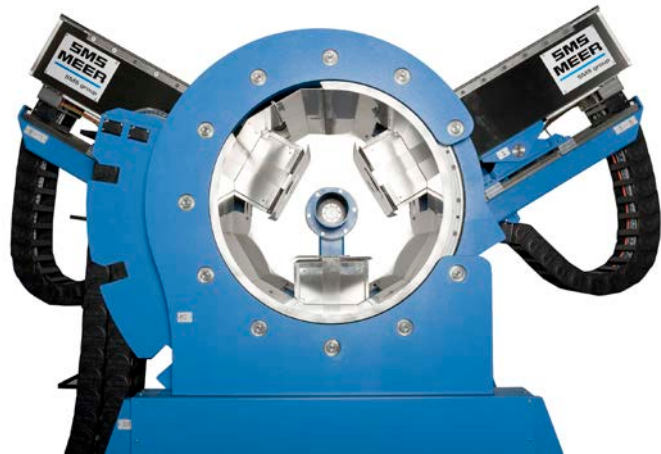
INCORPORATION OF LASUS® INTO A QAS





LASUS® MULTI-SCAN: MAXIMUM RESOLUTION

With the LASUS® system the measuring head is particularly compact. In addition to the proven 1-channel system, variants with a pivoting device are therefore also possible: LASUS® Multi-Scan can accommodate several pivoting heads, with the result that tube structures with a fixed phase position can also be measured. The system provides wall thickness measurements with a high local resolution and can even be used wherever a tool (mandrel bar) is used in the tube. The variety of possible system applications and the outstanding quality of the measurement data mean plant owners can attain a new quality standard in the production of seamless tubes.



LASUS® Multi-Scan equipped with three measuring heads



FROM THE CUSTOMER'S VIEWPOINT

"We the various seamless tube plants we have from SMS Meer we are able to offer all tube sizes. State-of-the-art technology, perfect system design and outstanding quality – these are things we can rely on with SMS Meer. We were also impressed with the good service we received."

Yu Lirong, Valin Hengyang Steel Tube, China

FINISHING LINES AND MACHINES

For finished seamless tubes with added value

Almost every tube requires special machining before it is used in practical applications: Line pipes must be able to withstand extreme conditions and be securely welded – oil field tubes and pipes must have standardized threads. Manufacturers who cover the entire value chain in their plants – from the billet through to the finished product – have clear competitive advantages: they offer products with added value. SMS Meer offers the necessary finishing equipment for this from a single source.

FULL SERVICE RANGE – FOR UPGRADES TOO

SMS Meer supplies individual machines right up to complete finishing lines. The solutions are precisely tailored to the customer's product range and the possibilities offered on site – for both new plants and plant upgrades too. The range of finishing lines ranges from high-performance straighteners through tube and pipe end finishing systems such as chamfering,

upsetting or threading, right up to hydrostatic testers which fulfil all standard certification procedures. All machinery is designed for fully automatic operation and monitored by intelligent automation solutions such as MES (Manufacturing Execution System). The SMS Meer product range also includes machining centres for the tube mill rolls. These too are ideally suited to the plants, reduce non-productive times and contribute towards consistently high tube quality.

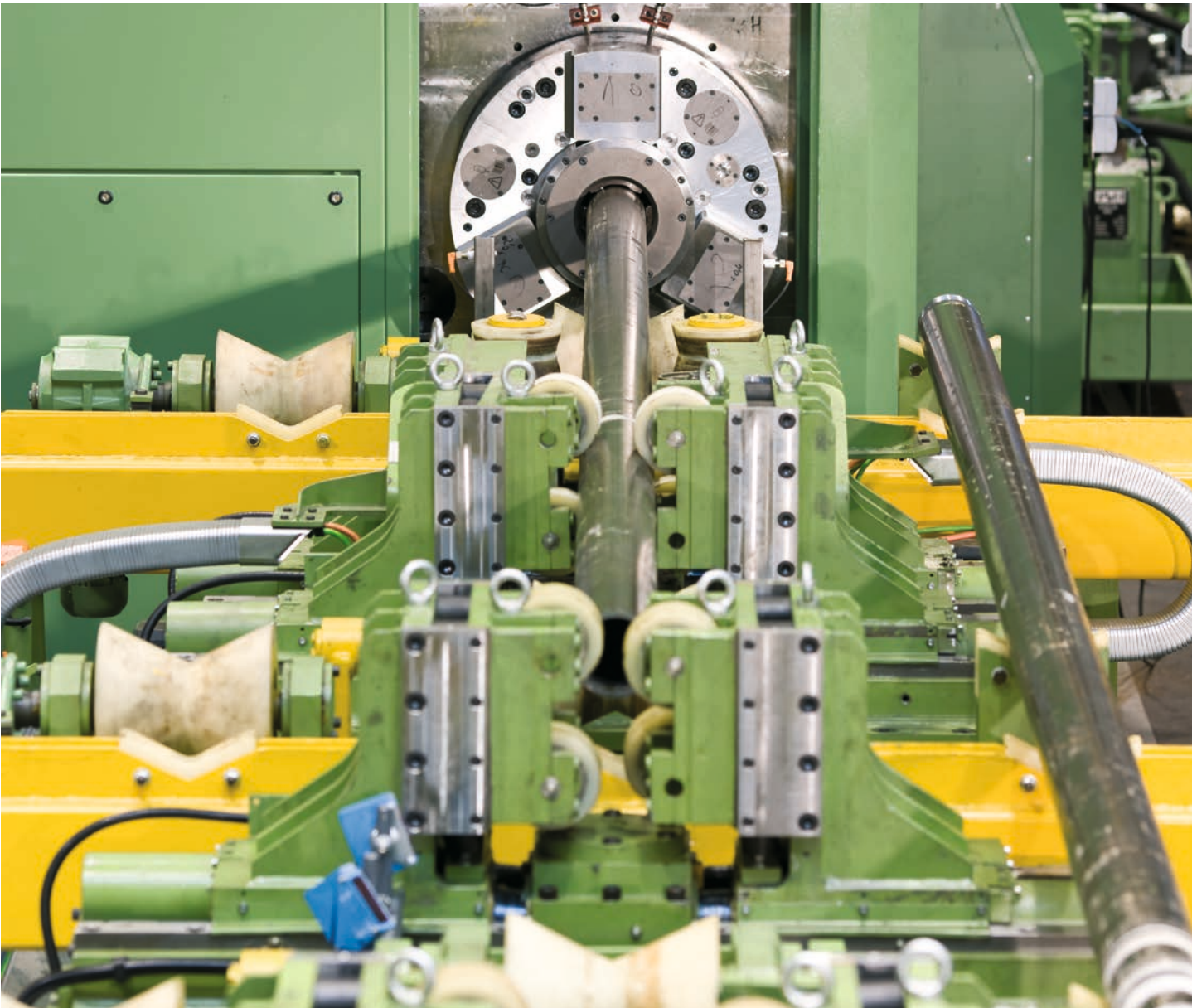
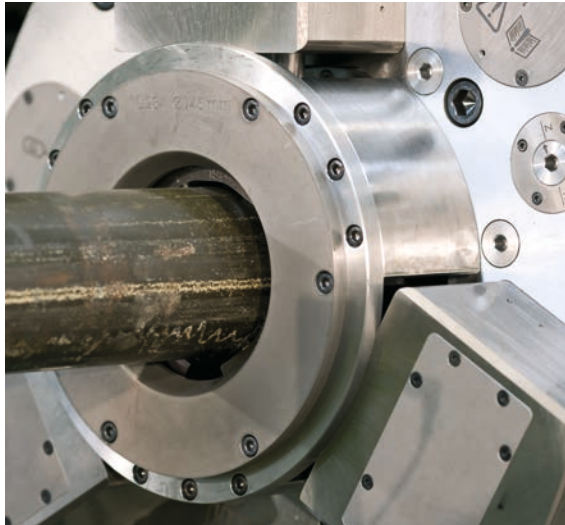
STRAIGHTENING MACHINES FOR MAXIMUM PRECISION

With high-performance cross-roll straightening machines from SMS Meer tube manufacturers achieve maximum straightness and roundness, ensuring they meet strict tolerance requirements. The automatically adjustable machine rolls enable fast and precise size changes. The straightening process is monitored by computer – consistently high product quality is guaranteed as a result.

THREADS TO INTERNATIONAL STANDARDS

SMS Meer offers a wide range of threading machines, with which tube manufacturers can produce high-quality end products to international standards such as API or GOST: The CTM-series machines with rotating tool are very productive and require little space. They cut high-precision threads on tubes with diameters of between 48.3 and 406 mm. The TCG series, with which the tubes rotate, stands out thanks to its high versatility and flexibility. The machines in various frame sizes machine tubes with diameters of between 48.3 and 660 mm and produce not only API threads but a variety of special joints and threaded sockets.







EFFECTIVE UPSETTING IN JUST ONE PASS

Upsetting presses from SMS Meer are reliable at forming tube ends in accordance with relevant standards. The machines are equipped with various tools and can thus produce even complex forms in just one pass, i.e. without reheating. The clamping jaws and upsetting tools work separately from each other – as a result the pass reductions can be carried out independently of the diameter tolerance of the tube.

FAST AND PRECISE TUBE END CHAMFERING

SMS Meer chamfering machines ensure burr-free, straight tube ends. Type RFA machines process tubes with diameters of more than 17 mm and are particularly efficient: they are able to keep pace with the production rate of a stretch-reducing mill, such that they can be perfectly connected in line and integrated into the entire process. Chamfering of tubes which are intended for the oil and gas industry and require subsequent welding in accordance with the API standard is also possible on the RFA machines.



FROM THE CUSTOMER'S VIEWPOINT

"Demand for our seamless tubes is so high, that we had sold our first few months' worth of production even before the commissioning of the new plant in Mexico. It's a good thing we can rely on SMS Meer: the entire plant was completed on time – from the saws for the raw material right through to the threading machines for casings and tubings in the tube finishing line at the end."

Sergio Tosato, Industrial Coordination Director, Tenaris S.A., Luxembourg



HEAT TREATMENT LINES FOR TUBE REFINING

In addition to rotary hearth furnaces for billets and shells and walking beam furnaces for reheating tubes, SMS Meer also offers complete heat treatment lines. The range comprises all necessary equipment, including cooling tank, descaling systems, cooling heads and cooling beds. Modern automation systems guarantee efficient processes and maximum quality with the refined tubes. Energy-saving inductive heating plants from SMS Elotherm round off the portfolio.

RELIABLE QUALITY CONTROL

SMS Meer hydrostatic tube testers enable all standard certification requirements to be fulfilled. The tubes are tested with water at pressures of up to

1,700 bar. In this way plant owners can reliably test the leak-tightness and material quality. SMS Meer supplies system variants for testing one or several tubes at the same time. The machines are designed and configured such that they meet all our customers' requirements.


HIGH PRODUCTIVITY THANKS TO PRECISION ROLLS

SMS Meer's range of finishing equipment also includes Becker roll dressing machines. They are precisely tailored to SMS Meer's rolling technology and also anchored in the integrated tube plant concept in terms of automation technology. For plant owners this means: ultra-precise ground or turned rolls for long-term high productivity and tube quality levels.

SERVICE

Taking care of everything – MEERcare®, MEERcoach®, MEERconsult®

The employees at SMS Meer do everything to ensure that customers are satisfied with the company's machines and plants for many years. The SMS Meer Service experts continue to look after them even after commissioning – a whole plant life long. With MEERcare®, MEERcoach® and MEERconsult®, SMS Meer offers services for machines, people and processes.

MEERcare®			MEERcoach®	MEERconsult®	
					
Spare Parts Service	Maintenance	Modernization	Field Service	Training & Coaching	Consulting & Implementation
Spare Parts	Equipment Check	Mechanical Components	Repairs	Assessment	Fact Finding Audits
eService	Condition Monitoring	Hydraulic Systems	Trouble Shooting	Standardised Trainings	Feasibility Studies
Spare Parts Management	Maintenance Service	Electrical Control Systems	24/7 Support	Individual Training	ecoplants Assessment
Warehousing	Remote Service	Automation Equipment		eLearning	Strategies & Concepts
		Value Added Components			Change Management
Full Service					

These services cover three specific areas:

- With **MEERcare®**, SMS Meer offers tailored service solutions – from spare parts, through emergency calls at short notice, regular maintenance measures through to comprehensive modernisation measures.
- **MEERcoach®** focuses on the people: The SMS Meer Service experts share their know-how with the customers and provide on-site support for the ongoing production.
- The **MEERconsult®** specialists analyse processes in preparation for their optimisation.

THE RIGHT PARTS IN THE RIGHT PLACE AT THE RIGHT TIME

The right spare parts have to be available at all times so that production doesn't come to a standstill. At the same time, capital tie-up and storage costs have to be kept low. That is why SMS Meer delivers spare and wear parts for all machines quickly and reliably.

A web-based, machine-specific parts catalogue makes the ordering process even easier. On request, SMS Meer also takes care of the whole spare part and stock management. The differing parts stocking concepts are always geared to the customers' individual needs.

CONTINUOUS HIGH PERFORMANCE

Whether one-off fact-finding, continuous monitoring via remote service or regular plant inspections: The SMS Meer Service experts analyse and service the plants. On request they even take over the complete maintenance. Plant owners thus ensure maximum plant availability and optimum production results.

ALWAYS UP-TO-DATE

Plant owners are engaged in dynamic markets. The demands on profitability, product quality and productivity have risen steadily for plant owners in recent years. New technologies and plants arrive on the market in ever shorter innovation cycles. Tailored and customised modernisation concepts from SMS Meer ensure that the plants run for decades: and that with reduced operating costs, higher productivity and improved product quality.

FIELD SERVICE

Even in emergencies, customers can rely on SMS Meer Service. The Service technicians help with troubleshooting and the necessary repairs. With short reaction times and high availability, they ensure that the plant is up and running again as quickly as possible.



CORPORATE SUCCESS THANKS TO TECHNICAL KNOW-HOW

Whether individual or standardised trainings – the MEERcoach® experts plan individually tailored training programmes and implement these together with the customer. The plant operators gain valuable know-how through time-tested formats and special e-learning offerings – for more operational reliability and more efficient processes.

HIGHER PROFITABILITY THANKS TO THE RIGHT ADVICE

More efficient processes, optimised technology and more effective use of resources – those are the goals of MEERconsult®. SMS Meer carries out feasibility studies to establish a sound basis for management decisions, or develops strategies and concepts for the optimisation of existing plants and processes.

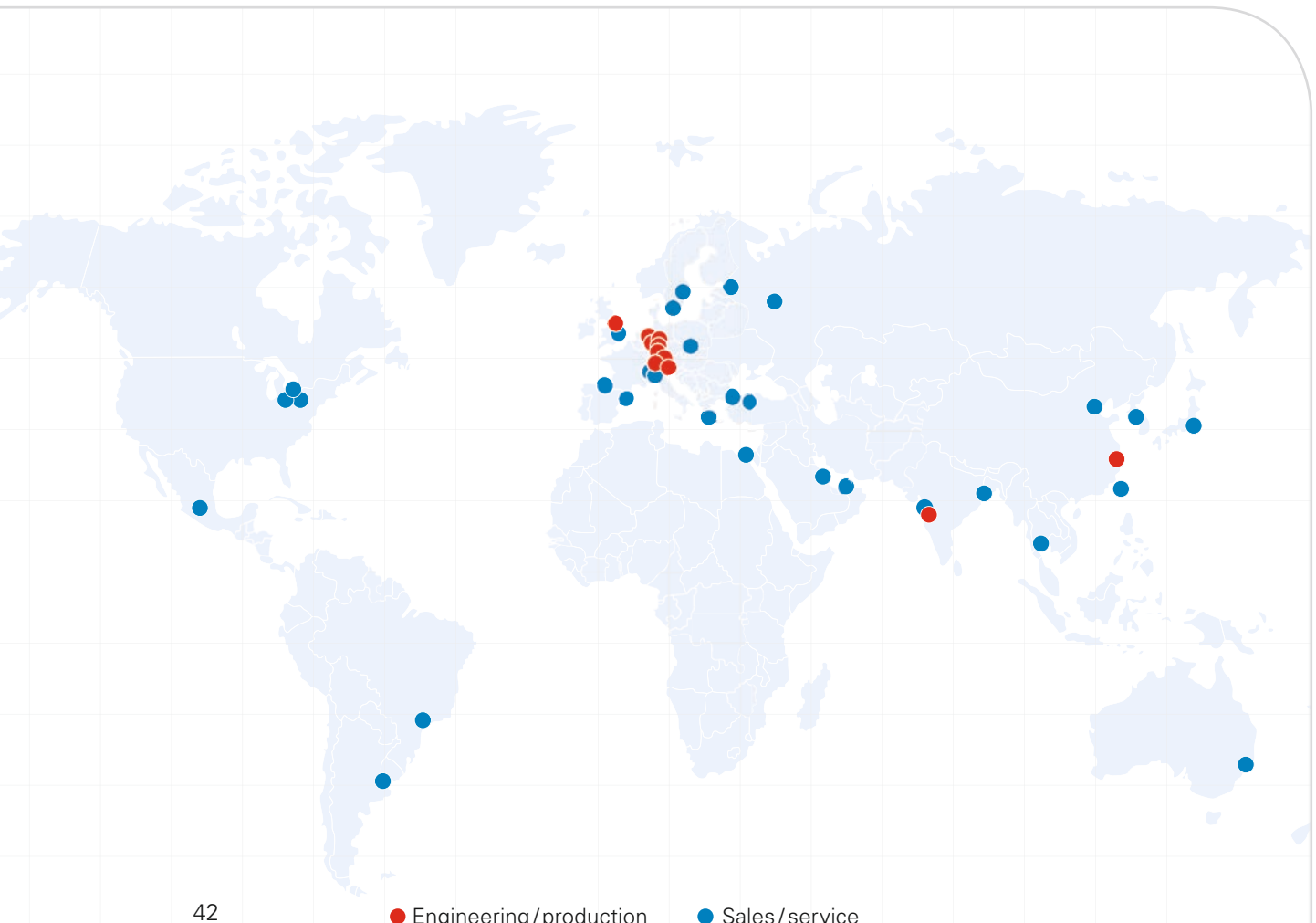
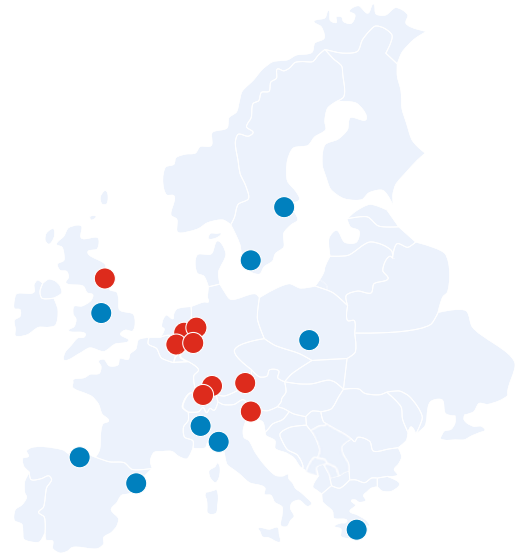


CLOSE TO CUSTOMERS

Think global, act local

The Business Area SMS Meer is represented world-wide. 17,000 reference installations demonstrate the market's confidence in the expertise, experience, reliability and flexibility of the company.

No matter where the customers work and what language they speak – the right people at SMS Meer are always on hand. In this way SMS Meer can support its business partners quickly and effectively.



SMS MEER GMBH

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