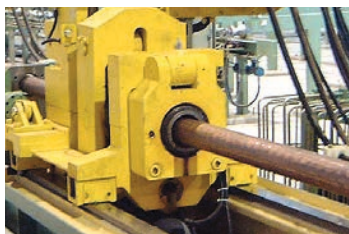


COPPER TUBE PRODUCTION

Integrated systems for all requirements



PRODUCTION OF COPPER TUBES

Integrated systems from a single source

The SMS group is a world leader when it comes to building plant and machinery for all areas of copper tube production – from the copper cathode right through to the finished tube.

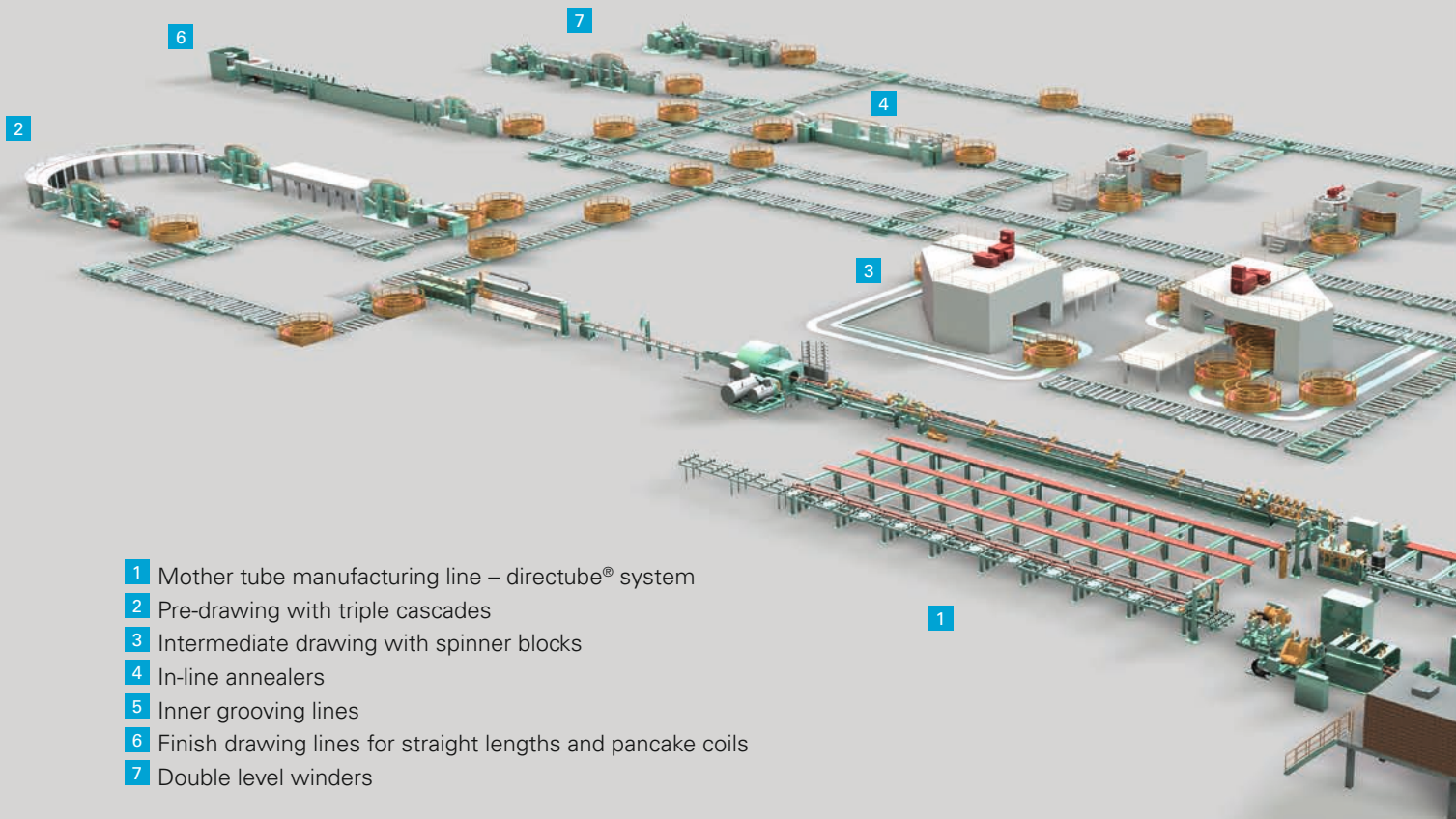
Using the technologies from the Schumag, Technica and MRB product brands as a basis, the SMS group has brought all the know-how and experience it has gained over the years under one roof.

As a result, SMS is able to serve plant owners better by offering them products that are right for them. Whether they are looking for a completely new

production line or a single machine – the SMS group is prepared for it.

SMS offers two manufacturing processes for the production of mother tubes for drawing applications:

- high production rates using the conventional process with billet casters and downstream extrusion presses
- low to medium capacities using the compact directube® process with horizontal shell caster and planetary rolling mill



- 1 Mother tube manufacturing line – directube® system
- 2 Pre-drawing with triple cascades
- 3 Intermediate drawing with spinner blocks
- 4 In-line annealers
- 5 Inner grooving lines
- 6 Finish drawing lines for straight lengths and pancake coils
- 7 Double level winders



Mother tubes are further processed by various methods of drawing, handling and finishing equipment which is also supplied by the SMS group. Such equipment includes:

- Two-carriage or caterpillar drawing units
- Spinner blocks
- Combined finishing lines
- In-line annealing systems
- Inner grooving lines
- Level winders
- Jumbo coilers

Furthermore, the SMS group supplies complete systems for the transport, storage, supply, loading and unloading of the tubes and baskets.

MATERIAL

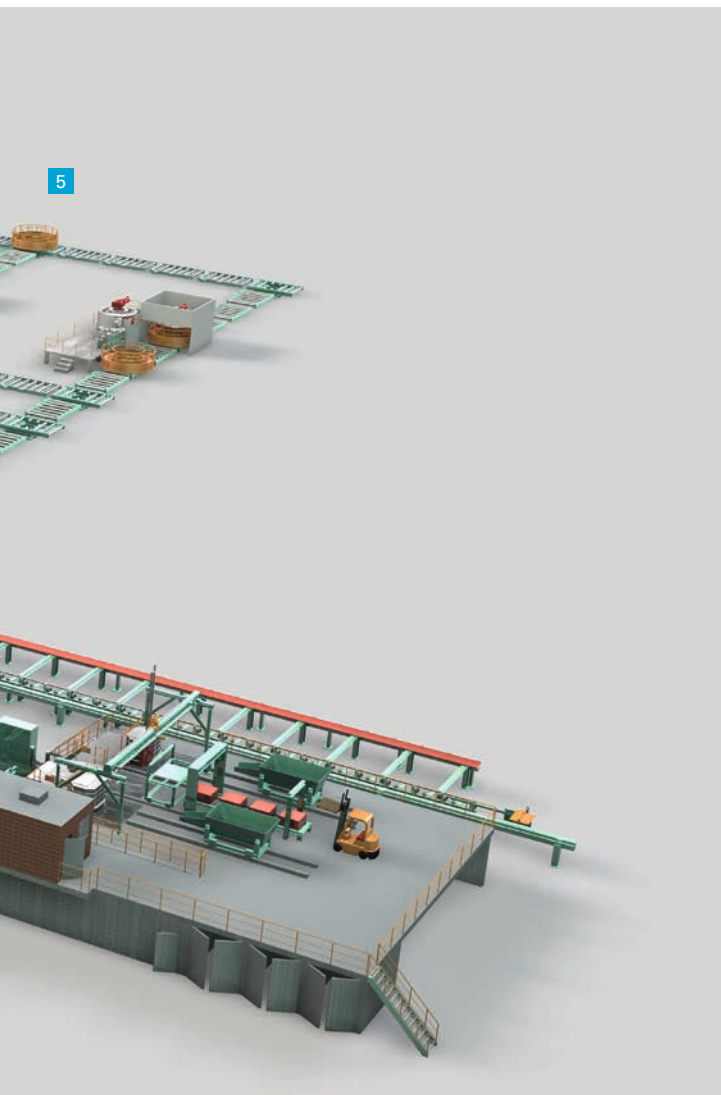
- Copper
- Copper alloys

APPLICATIONS

- Plumbing tubes in hard, half-hard or soft condition for water and gas, sanitary and air conditioning systems
- Industrial (HVAC) smooth or inner grooved for heat exchangers and cooling systems.

FORM OF FINISHED PRODUCTS

- Straight lengths
- Pancake coils
- Level wound coils (LWC)
- Jumbo coils



PORTFOLIO

Perfectly matched – from the melt
to the finished product

When it comes to copper tube production, the SMS group knows the whole process inside out – from melting through to packaging. Standalone machines can be combined to form integrated systems that meet every customer's requirements. Plant layouts are created where all components are perfectly matched in terms of both technology and economy.

COST EFFECTIVE PRODUCTION

The SMS group is a world leader for supplying equipment and systems for the production of copper tubes. To produce copper tubes cost-effectively, manufacturers put their trust in the directube® system as well in extrusion presses and pilger mills supplied by the SMS group. Downstream processing is carried out by drawing machines for preliminary, intermediate and finish drawing. The overall package is rounded off by handling systems, e.g. for tube and basket handling, storage, feeding, as well as loading and unloading.

CONTROL AND AUTOMATION



PREMATERIAL

- Extruded
- Pilgered
- Cast and rolled

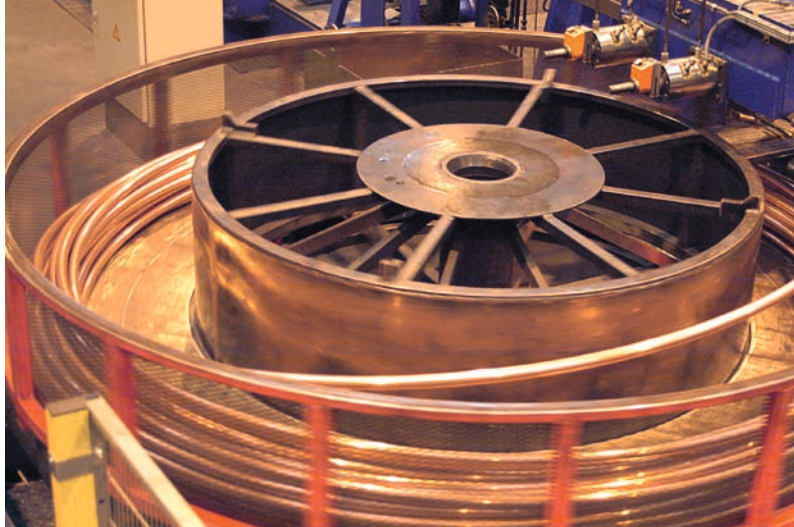
PREDRAWING

- Single cascade
- Double cascade
- Triple cascade

INTERMED. DRAWING

- Spinner blocks

CONSULTING AND SERVICE



CHARGING/MELTING/CASTING

- Cathode & scrap handling systems
- Melting furnaces
- Holding furnaces
- Horizontal and vertical continuous casting plants
- Tube milling and peeling machines

PSW ROLLING

- 3-roll design
- Continuous and semi-continuous feeding systems
- Single house rotor design

DRAWING

- Multi-pass cascade drawing lines
- Spinner blocks
- Combined drawing machines
- Combined drawing machines with in-line annealers

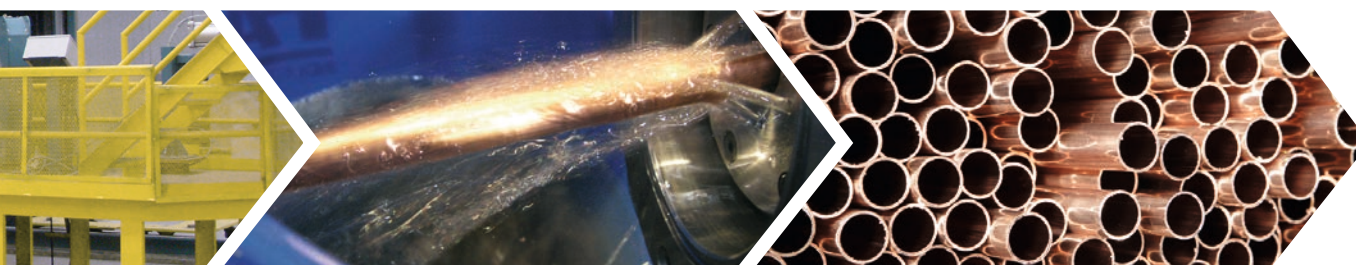
FINISHING

- Finishing lines for pancakes and straight lengths
- Sawing and deburring machines
- In-line annealing lines
- Inner grooving lines
- Single & double level winders
- Eddy current testing equipment
- In-line embossing & marking units

HANDLING

- Tube feeding systems
- Straight length storage systems
- Automatic bundling systems
- Automatic tube preparation stations
- Pay-off & recoiling stations
- Basket transport & storage systems
- Basket loading & unloading

OMATION



DRAWING

FINISHING

FINISHED PRODUCT

- Finish-drawing lines
- Level winders
- Tube cutting and straightening lines

- Straight lengths
- Pancake coils
- Level wound coils

CE - A PLANT-LIFE LONG

DIRECTUBE® PROCESS

Greater efficiency, fewer costs

The SMS group developed directube® to enable copper tube manufacturers to produce high-quality tubes on a highly efficient basis.

Starting from cathodes, directube® is used to produce mother tubes for further processing into the required sizes.

The directube® process essentially consists of:

- Melting of copper cathodes and process scrap
- Continuous shell casting on a multi-strand horizontal continuous casting plant
- Surface preparation of the shells
- Cross rolling of the shell on a planetary rolling mill (PSW) with in-line coiling

directube® is followed by tube drawing and finishing operations on continuous straight drawing machines, spinner blocks, finishing lines and level winders.

BENEFITS AT A GLANCE

- Reduced eccentricity
- A shorter production route with higher efficiency
- Lower copper input
- Lower process losses
- Lower operational costs
- Lower investment costs

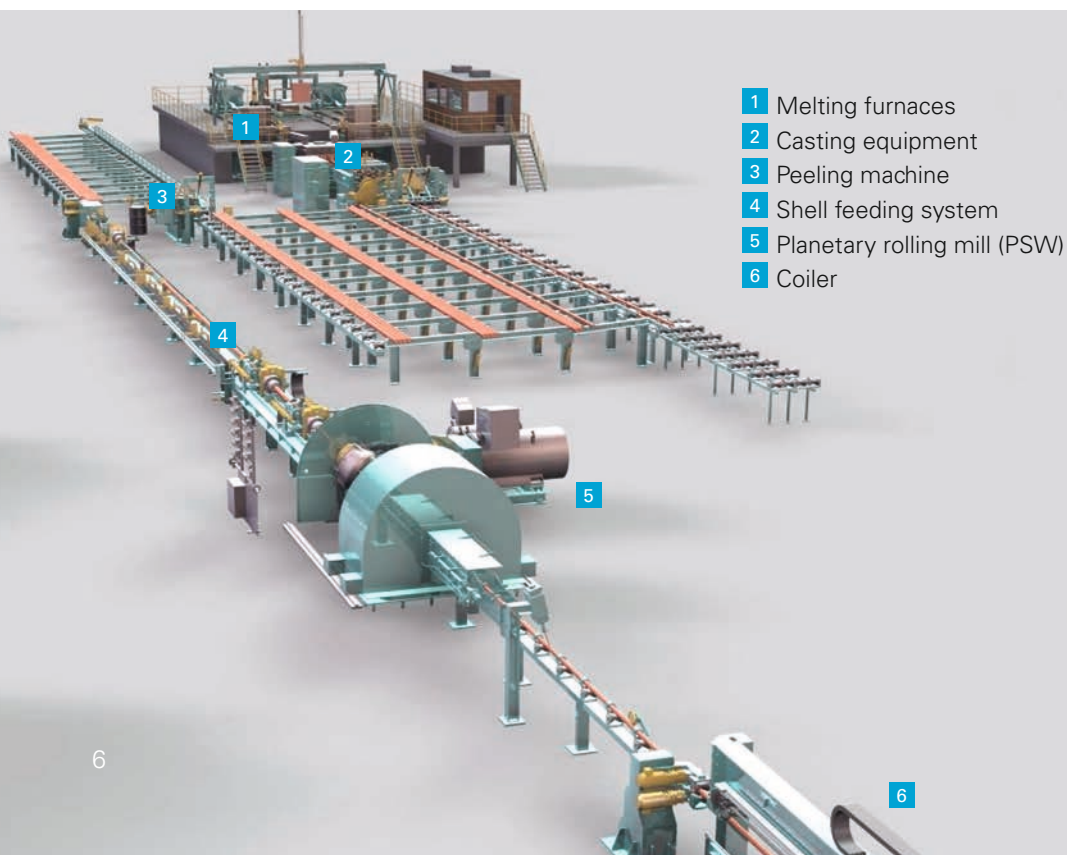
SIZES AND OUTPUTS

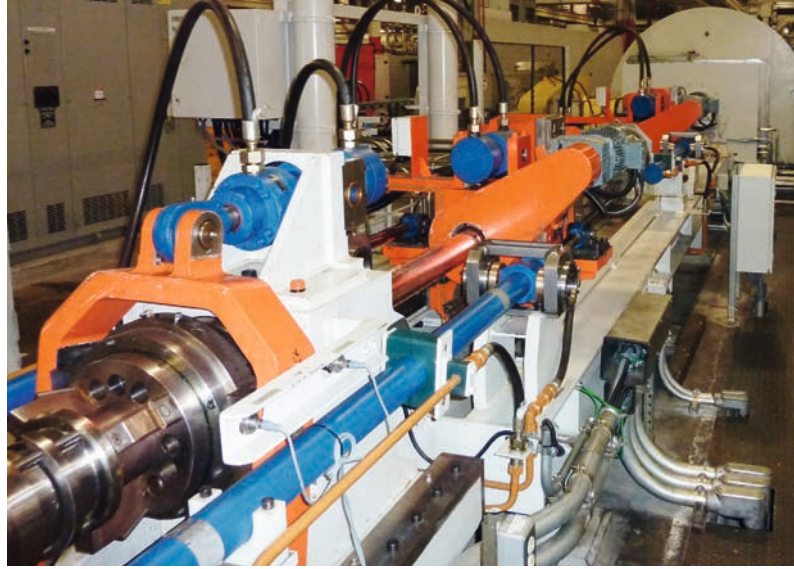
Casting

Casting diameter	90 – 150 mm
Shell lengths	up to 20 m

Rolling

Rolling diameter	from 48 – 90 mm
Rolling output	up to 1,300 m/hr
Coil weight	up to 1,200 kg



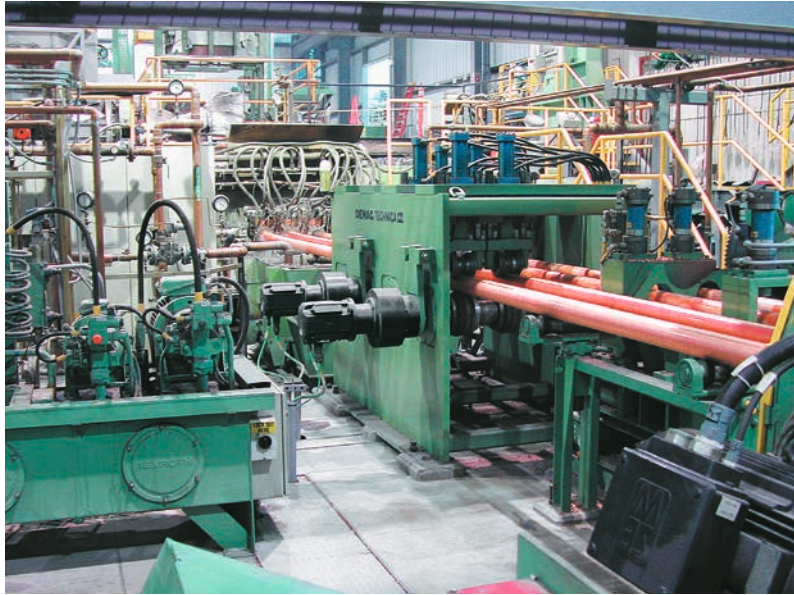


TECHNOLOGICAL HIGHLIGHTS OF DIRECTUBE®

- Fully automatic cathode charging means interference with the active top layer of charcoal is prevented, and therefore the pick-up of oxygen is avoided.
- The molten material is transferred through a special siphon nozzle that holds back slag particles.
- Specially-developed graphite molds generate a stirring motion that results in a consistent, fine grain structure.
- An automatic cooling water distribution system ensures stable solidification conditions, prevents operator errors and increases availability.
- Advanced secondary cooler design envelops the shell with open secondary cooling water which minimises surface oxidation. The system allows faster casting speeds to be achieved over that of conventional cooler concepts.
- Electric servo motors in the drawing device produce a very precise and reproducible movement of the shell out of the mold, resulting in perfect solidification – with no surface cracks.

PRODUCTIVITY & LIFE CYCLE COST

- Continuous and optimised semi-continuous reloading of the shells during rolling reduce temperature fluctuations in the rolls and mandrel, resulting in:
 - Even material properties over the whole length of the rolled shell
 - Higher availability of the equipment
 - Longer tool lives



- The new PSW rotor design with higher rigidity, increased dynamic load rating of the bearings together with simple and rapid exchange of the rotor results in higher availability and reduced eccentricity.
- A high-performance cooling section ensures a fine, evenly distributed grain structure with full recrystallisation.

EXPERIENCE

In addition to the technical solutions for design and manufacturing, the SMS group also provides the necessary process know-how for operation of the directube® equipment.

CONVENTIONAL SEAMLESS TUBE PROCESS

For higher capacities and multi-product mixes

MORE THAN 60 YEARS OF EXPERIENCES

SMS builds the key components for the conventional seamless tube process to produce all kinds of copper and copper alloy tubes:

- Shaft melting furnaces
- Holding furnaces
- Vertical and horizontal billet casters
- Extrusion presses (high ratio/low ratio)
- Cold pilger mills

For decades, two established production processes based on extrusion predominate in the manufacture of copper tube.

The low ratio extrusion combined with cold pilgering plays a dominant role in the manufacture of prime quality tubing.

The high ratio process combined with direct break-down drawing is predominantly used for the manufacture of copper tubes. The growing demand to increase coil weights results in larger extrusion presses with enormous production volumes.

Apart from that, the conventional seamless tube process can be used for larger tube sizes as well as for production of copper alloy tubes.

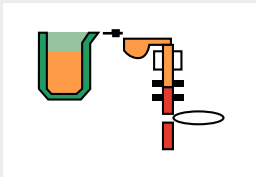




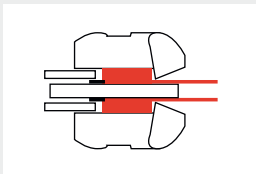
CONVENTIONAL SEAMLESS TUBE PROCESS:



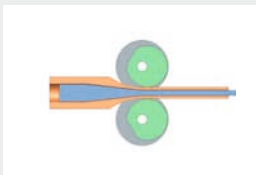
Shaft melting furnace



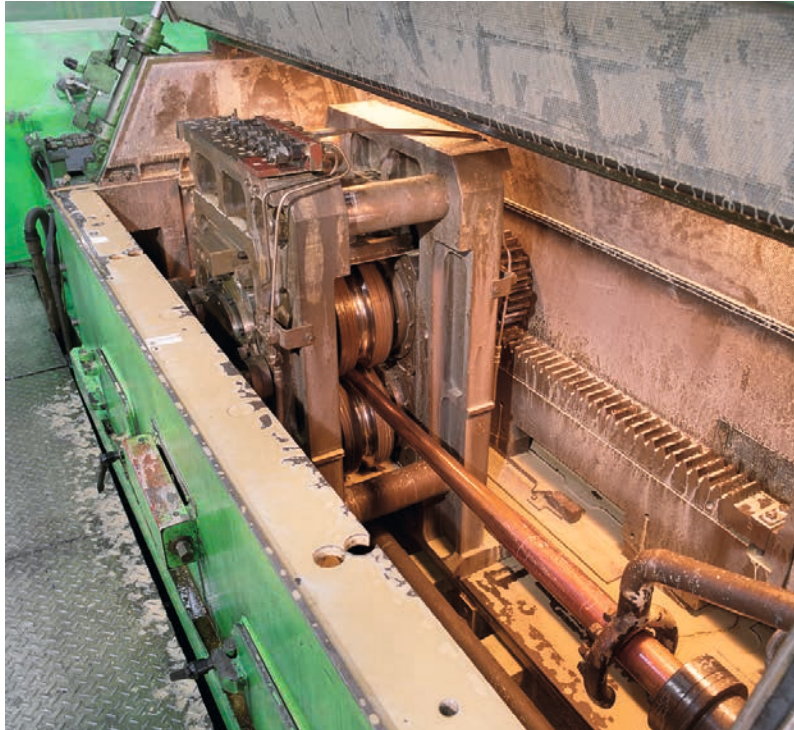
Continuous billet
caster



Extrusion press



Cold pilger mill



PRE-DRAWING

Decades of know-how

Throughout the history of the SMS group, tradition, know-how and innovation have always been closely inter-linked. The development of the cascade principle in 1982 was a milestone for the copper tube industry. The cascade will continue to play an essential role in a modern tube plant even in the future.

PRE-DRAWING ON CASCADES

Mother tubes can be produced by either of the following processes:

- Extrusion
- Pilgering
- Cast and roll
- Pre-drawn

and is delivered to the SMS pre-drawing line in either straight length or coil form.

The flexible, productive pre-drawing of tubes from copper or copper alloys is possible thanks to the cascade principle used by SMS.

QUALITY

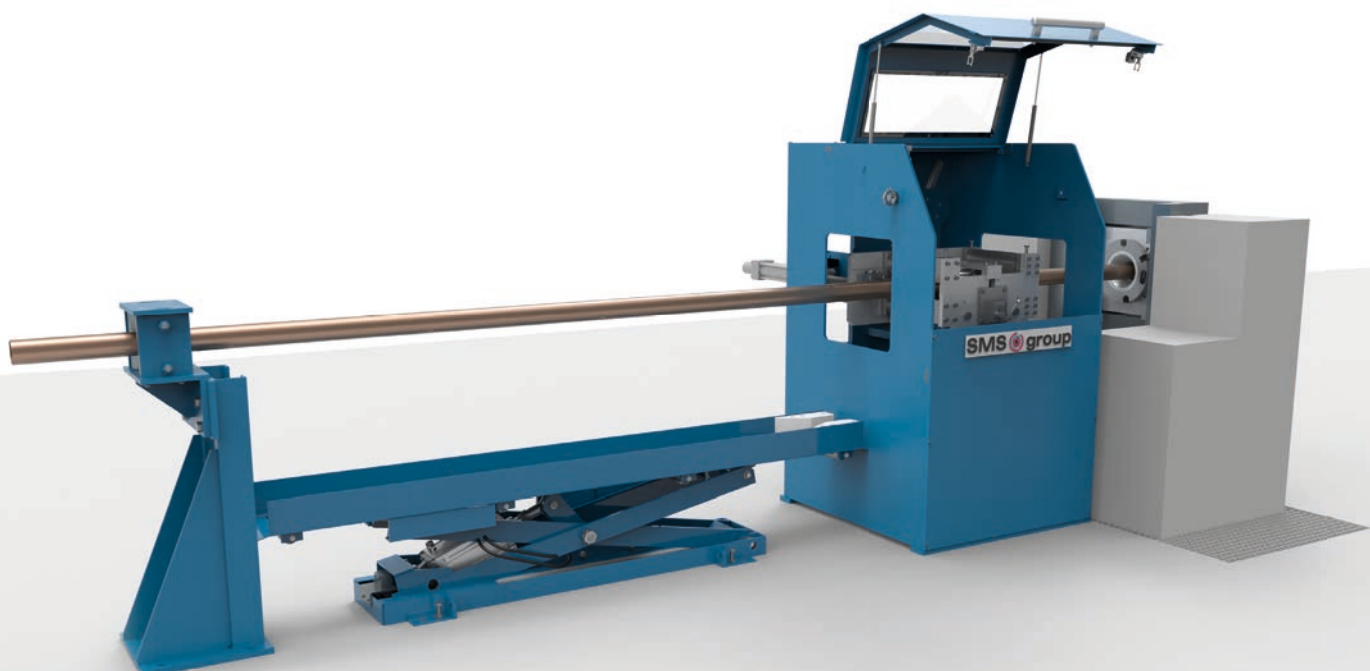
Thanks to the better forming conditions of the straight drawing process:

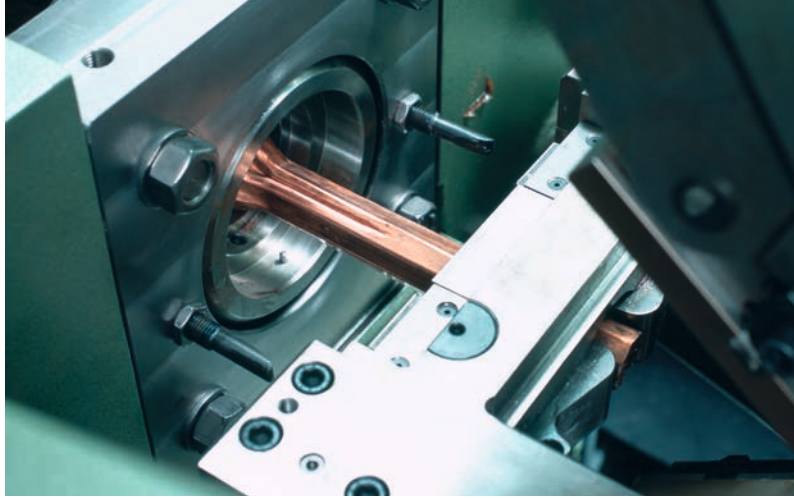
- Tube eccentricity is minimised
- Closer tolerances are achieved
- Reduced handling between drawing stages avoids the risk of any surface damage

FLEXIBILITY

Depending on production requirements, the cascades can be implemented as single, double or triple-line arrangements with floating mandrels. Drawing line arrangements can be selected to suit the type of material which will be processed:

- Straight length to straight length
- Straight length to coil
- Coil to coil



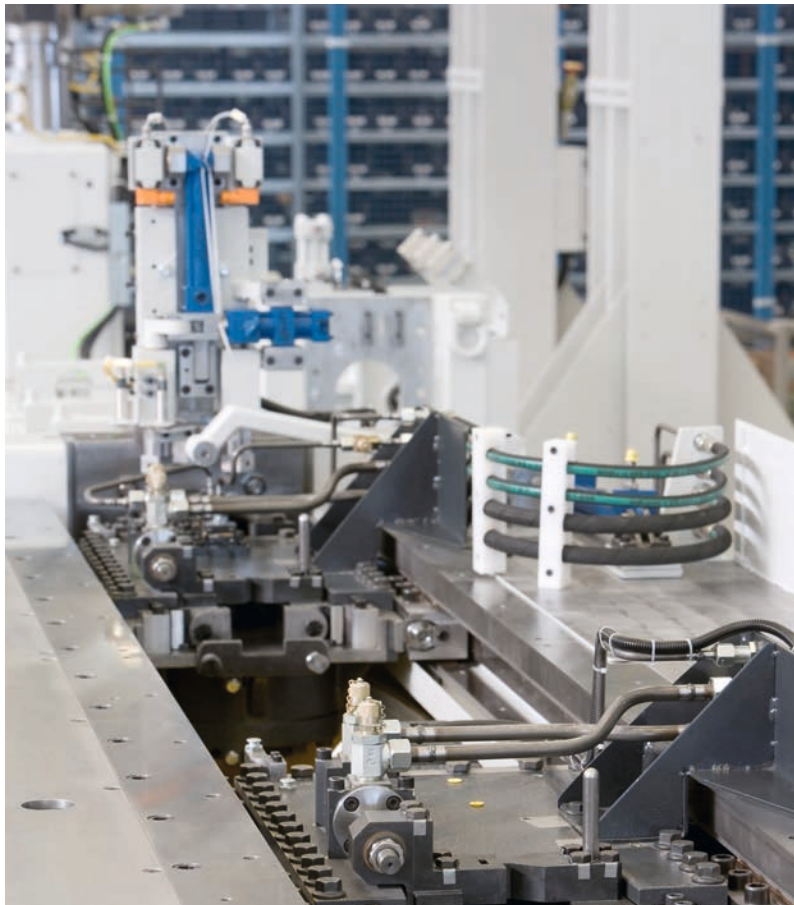


Depending on the required production capacity in the pre-drawing cascade the drawing units can be designed as:

- Conventional two-carriage drawing units for final drawing speed of up to 150 m/min
- Caterpillars for maximum drawing speeds of up to 500 m/min; can also be combined with tube coilers. The distinguishing characteristics are:
 - High performance and long service life thanks to toothed chain with pivot joints
 - Symmetrical flow of the forces in the frame/chain carrier system
 - Quick automatic tube drawing

ECCENTRICITY – PROCONTUBE

With the reduction in the eccentricity of tubes SMS is providing the solution to one of the most leading demands of the copper tube industry. The use of ProConTube upstream of a pre-drawing machine for drawing extruded tubes reduces eccentricity by 2 to 3 percentage points on average. The improvement in cross-sectional wall thickness uniformity allows closer tolerances to be maintained.



PRODUCTIVITY

- Pointing process carried out once
- No handling between drawing stages
- High degree of automation
- Less manpower
- Lower costs as a result of reduced material requirements due to improved tube concentricity and tighter tolerances



INTERMEDIATE DRAWING ON SPINNER BLOCKS

Cost-effective processes

Over the last two decades, no other spinner block type has drawn more copper tubes than the one supplied by the SMS group. With over 200 machines in operation worldwide, the SMS spinner block continues to be a reliable partner for tube manufacturers.

Spinner blocks enable an almost unlimited range of tube lengths to be drawn continuously. At the heart of the intermediate drawing process of a tube plant, the spinner affords customers the high speed and flexibility to meet their product mix demands. The machine

draws tube from basket to basket, reducing the tube dimensions in numerous passes, to obtain the desired tube size.

AN ESSENTIAL PART OF THE MODERN COPPER TUBE PLANT

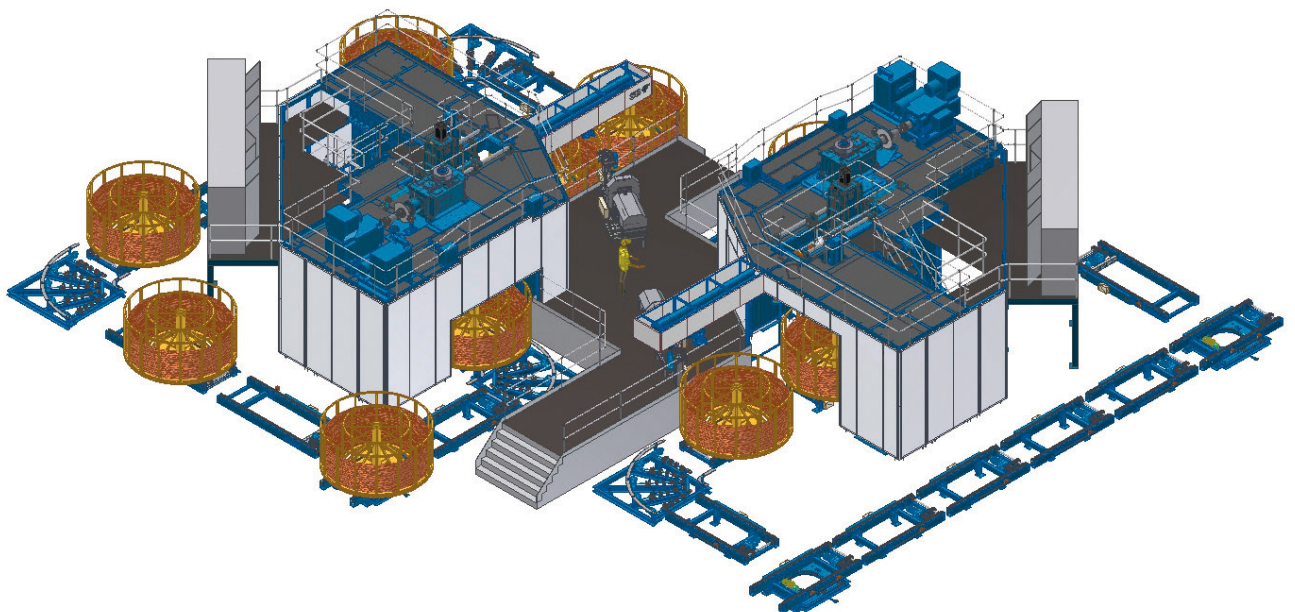
The SMS spinner block was designed with the user in mind. To enhance their competitiveness the SMS group continually develops its products. Plant operators benefit from the following advantages:

- Reduced civil construction cost
- Improved return on capital investment
- Minimised eccentricity through unique diebox design
- Reduced tube breaks
- Improved energy efficiency
- Shorter cycle times
- Automatic preparation & pointing





- Machine totally enclosed during operation to increase safety
- User friendly machine arrangement for multiple usage
- Significantly reduced manual workload
- Extensive use of pneumatics replacing hydraulics
- Grouped access points for services
- Self diagnostic maintenance schedule
- Easy access in case of maintenance



INNER GROOVING

Designed for high productivity

With our VNVG 2000 inner grooving lines plant operators can produce quality tubes cost-effectively. The growing demand for inner-grooved tubes led the SMS group to increase the productivity, quality and efficiency of its inner grooving lines. It was also able to reduce operator tooling and labor costs at the same time.

Speed

- Utilising a superb high-speed spindle, the grooving head can run at up to an unprecedented 49,000 rpm
- Line speeds of up to 100 m/min

Quality

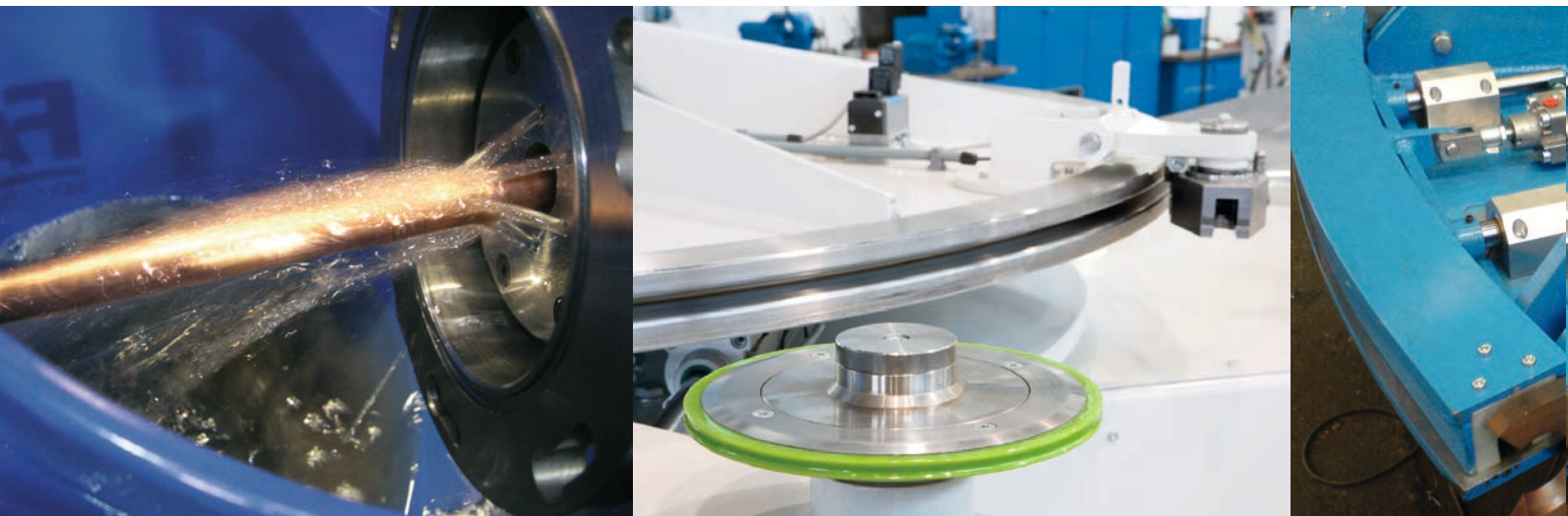
- Proven VNVG Veegroove technology gently draws the tube through the process
- Using a flying shear and without interrupting the drawing process, the quality of the tube is checked by means of samples taken at full plant speed
- Tailor-made lubrication system to suit the high speeds of the spindle motor, with flow and pressure monitoring

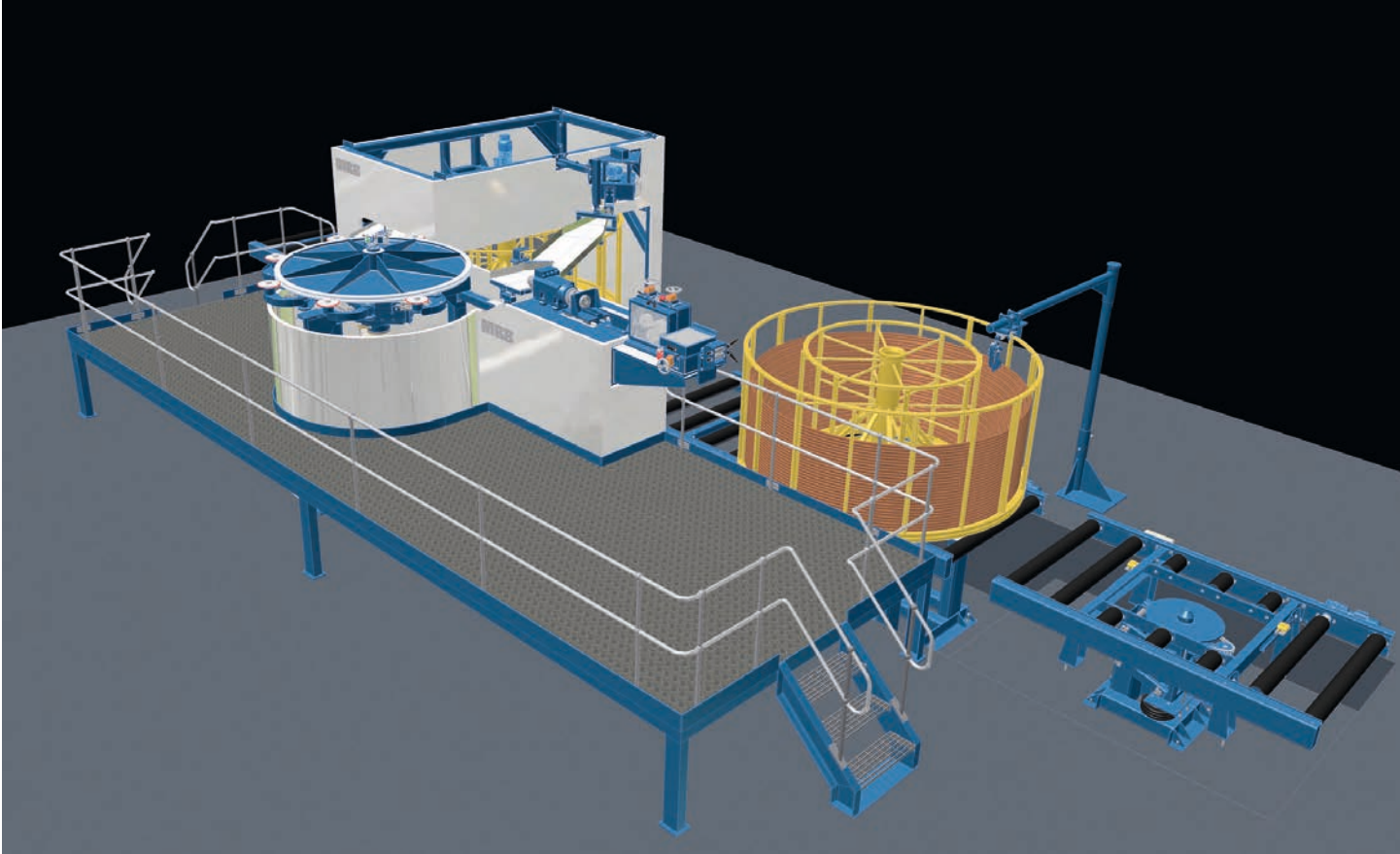
Efficiency

- Innovative reciprocating die technology extends tool life by up to 8 times normal levels
- Installation of several plants so that one operator can control multiple machines at the same time

VNVG VEEGROOVE WHEEL

Inner grooved tube is drawn using well proven VNVG Veegroove wheel. In this case the Veegroove is utilised to draw tube through the inner grooving unit for three-quarters of a turn before it coils into the empty basket.



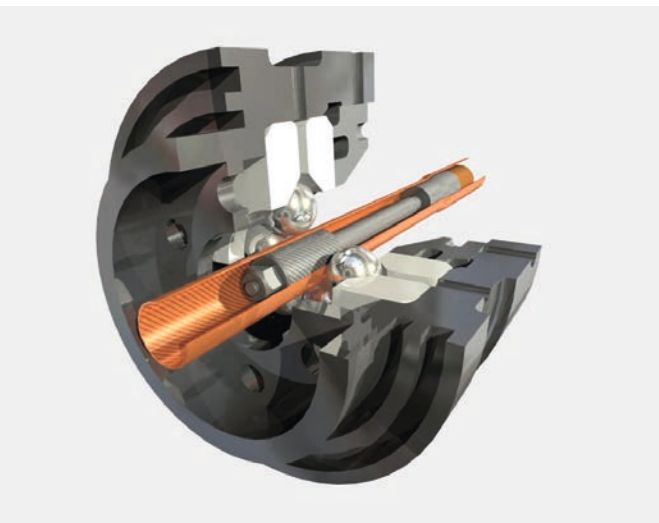


VNVG Veegroove technology offers high drawing speed and ensures smooth and safe processing of the tube. Hence, it is the perfect application for drawing and inner grooving of tubes.

Modular concept

A variety of options are available to customise and easily accommodate inner grooved tube into existing plant arrangements. Each line sold is individually structured, and can include the following modules:

- Tube preparation
- Pay off
- Straightening rolls
- Spindle motor
- Die holder
- Veegroove wheel
- Sample collection
- Take up



FINISH DRAWING

High speeds and precise manufacturing results

The most efficient way of producing high-quality end products at high drawing speeds is to manufacture them on combined drawing machines supplied by the SMS group.

During the process of continuous engineering, the SMS group has developed the high performance ROTUCUT® which cuts copper tubes using rotating knives. Here, copper tubes are cut using rotary blades. The cutter is known for its high-speed performance and precise cutting results.

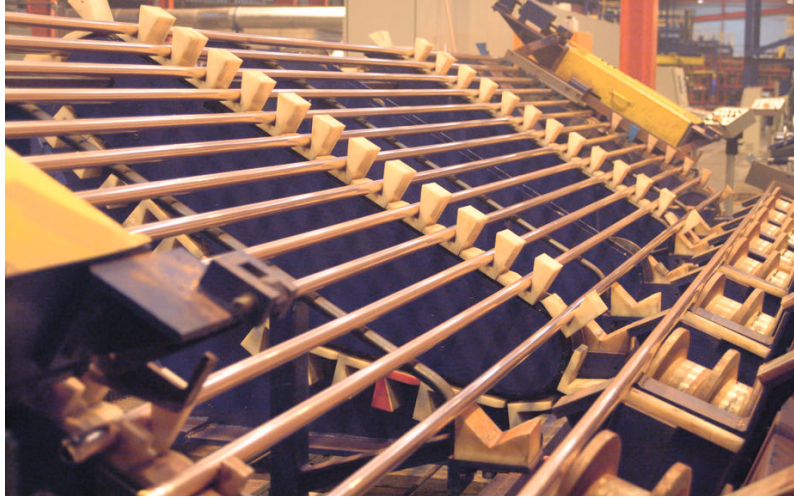
QUALITY

The final straight drawing step on the combined drawing machine gives the tube an optimum quality with regards to the cross-section circularity and concentricity. All the necessary processing steps on the combined drawing machine are carried out in line to create a finished end product in the form of a straight tube length or a pancake coil.

The manufacturing steps are:

- Decoiling
 - Speed controlled by optical systems
- Pre-straightening
 - Horizontal and/or vertical pre-straightener
- Drawing
 - With a motorised drawing die holder
 - With an integrated tube cleaning device
- Straightening
 - Vertical and horizontal straightener
- Testing
 - In-line, using an eddy current testing unit
- Marking, embossing, labeling
- Cutting
 - High-speed ROTUCUT® system, for chip-free cutting of the tubes to a precise length
 - Flying cutters such as a flying saw or shear





- Discharging
 - Sorting controller included
- Re-sawing and de-burring
 - Cutting the tube ends to exact lengths and de-burring by brushing
- Bundling
 - In-line bundling with:
 - Counting of the relevant number of tubes
 - Automatic bundling
 - Discharging to a collecting trough or transfer to master bundling system
- Pancake coiling

PRODUCTIVITY

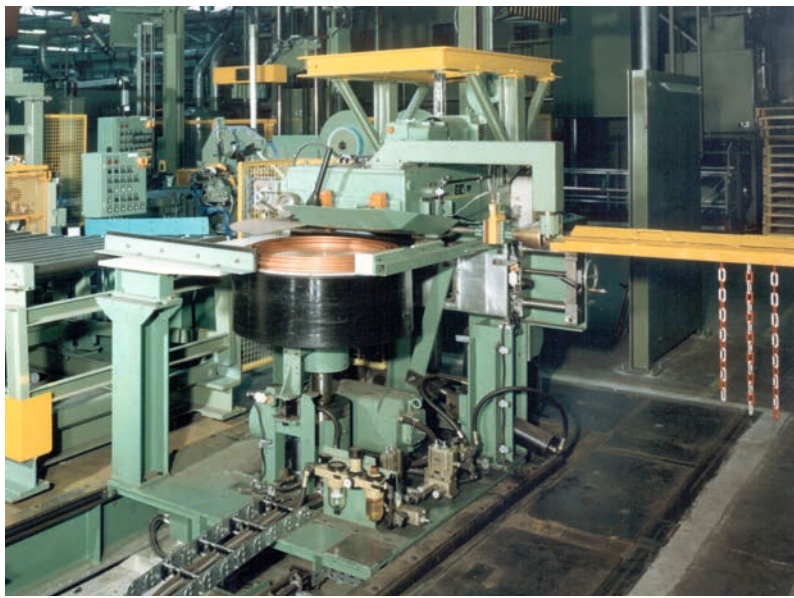
Capacity levels can be increased by up to 25 percent on the spinner blocks by transferring the time-consuming final drawing stage to the combined drawing line.

DRAWING UNIT

The finish drawing lines can be fitted with conventional two-carriage drawing units or with chain track drawing units.

The decision as to which machine type will be the most advantageous depends on the production requirements.

- Two-carriage drawing unit
 - Economic use for the production of various tube dimensions and small batch sizes, with drawing speeds of up to 150 m/min
- Chain track drawing unit
 - Drawing speeds of up to 300 m/min for high production volumes



HALF-HARD MANUFACTURING OF TUBES

Use of the combined drawing machine with two-carriage drawing unit or chain track drawing unit for continuous endless drawing in a sink drawing pass, fitted with:

- Tube end saw
- Tube connection station
- Material buffer facility
- In-line integrated induction heater with cooling section

SOFT ANNEALING OF TUBES

Inductive annealing lines for continuous soft annealing of tubes from coil to coil with throughput speeds up to 500 m/min:

- Pay-off reel for baskets with a dancer system
- Straightening and transport
- Testing unit
- In-line integrated induction heater with cooling section
- Transport unit
- Re-coiling into baskets

LEVEL WINDER

User-friendly and reliable

SINGLE AND DOUBLE-LEVEL WINDERS

SMS tube coilers meet the highest standards when it comes to winding plain or inner grooved copper tubes. The machine can be designed as a single or double-level winder.

The level wound coil is characterised by its high coil length and low wall thickness. The level-wound coil is compact and therefore ideally suited for transportation. To ensure this, extreme precision is required when the first tube layer is formed, a process which our machine performs automatically. Due to their high quality the coils are the preferred choice for use as industrial tubes in cooling and air-conditioning technology or in medical applications.

QUALITY

The tube coiler features technology which keeps tube ovality to a minimum across the entire size range. What's more, it guarantees high surface qualities at simultaneously high output levels.

SAFETY

Our level winders are manufactured on the basis of a comprehensive safety concept. The coiling station is encapsulated and monitored by sensors. In addition, a safety stop system – in the event of a tube breaker at high operational speeds – and a system for monitoring access to critical areas are also integrated.

OPERATION

The machine is operated by an intuitive control system with clear visualisation and recipe management. The high level of automation is achieved with the aid of motor-operated adjustment mechanisms. These are used for stepless variation of the coil width, automatic insertion and clamping of the leading end in the coil drum as well as the fast and easy strapping of the coils and automatic coil unloading.

PERFORMANCE DATA

- Coiling speeds of up to 600 m/min
- Workable tube diameter Ø 4 to Ø 35 (42) mm
- Coil weights of up to 600 kg
- Coil diameters of up to 1450 mm
- Coil widths of up to 650 mm

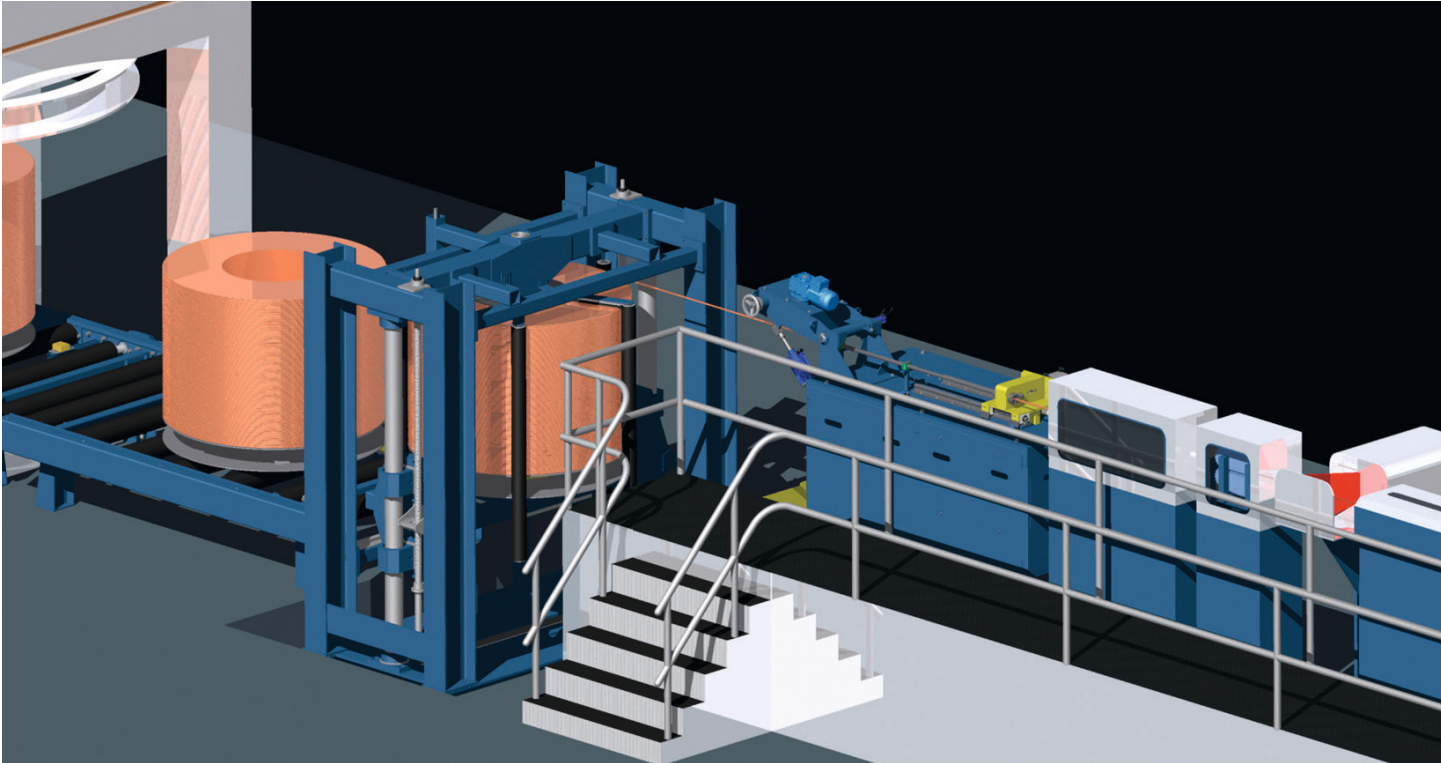
INDIVIDUAL SOLUTIONS FOR EVERY CUSTOMER

The system configuration of the level winders is adapted to meet plant operators' individual requirements.



JUMBO COILER

For large ACR coils



To meet the growing demand in the ACR market for larger coils of small-diameter tubes, the SMS group has developed the jumbo coiler. This line is able to produce a single, finished coil of up to 1,000 kg, depending on your incoming tube weight.

This process offers not only improved plant efficiency but gives customers a competitive edge on the market.

HIGH-QUALITY COILING

- Patented coiling system safely and neatly coils the tube
- Free standing coil with 'eye-to-the-sky' extraction at end-user site
- Minimal work hardening

Fully integrated line producing ready-for-dispatch coils

- Tube preparation
- In-line annealing
- Nitrogen back-purge
- Laser length measurement
- Wrapping, packaging and weighing
- Suitable for shipment on standard pallets

Customers can tailor the specification of their jumbo coiler to suit production requirements and to integrate with existing equipment in their plant.

PLANT LAYOUTS AND BASKET HANDLING

Flexibility and integration

With over 60 years working alongside leading manufacturers, the SMS copper experts have the experience and expertise to work in partnership with their customers to design and implement integrated solutions – whether it be for new plant concepts or changing existing facilities.

PLANT LAYOUTS

The design and layout of a copper tube plant is critical to its effectiveness and long term success. The SMS group offers its services to ensure the most efficient organisation of machines, transportation and storage to create the most dynamic processes.



BASKET HANDLING

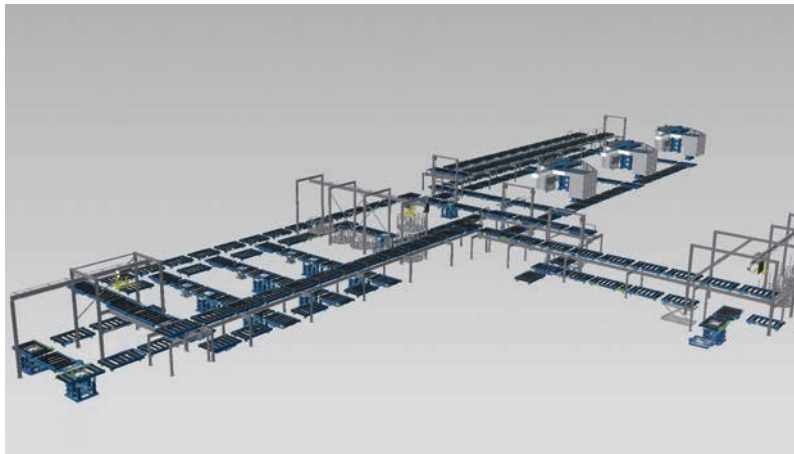
The SMS group is specialised in integrated logistics and offers everything from individual modules, to modern turnkey solutions allowing baskets and coils to be transported to desired locations in the factory.

Options available include:

- Conveyors and turntables
- Overhead conveyors, autostacking cranes loaders and unloaders
- Scissor lifts, elevators and hoists
- All linked and managed by state-of-the-art control systems

Key focuses of our handling concepts are:

- Maximising productivity
- Effective management of product mix
- Modular design for flexible solutions
- Maintenance friendly



NOTES

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