



## Production and Testing of Large-Diameter Pipes

## THINKING AHEAD

1804. The Dillinger Hütte steel mill rolls its first steel plate. In 1845, a company which later becomes part of Mannesmannröhren-Werke produces continental Europe's first welded steel pipe. In 1991, these two steel industry pioneers – Aktien-Gesellschaft der Dillinger Hüttenwerke and Mannesmannröhren-Werke AG – decide to pool their experience and know-how and create EUROPIPE.

Our rich heritage in terms of steel technology and manufacturing expertise plus the dedication and hard work of our people enabled us to achieve some very demanding objectives.

Today we are the world-market leader in large-diameter pipe production for the oil and gas sector and have the most extensive manufacturing footprint in our industry. With four mills in Europe and the USA, producing annually over 3,000 kilometres of large-diameter pipe for pipeline projects throughout the world: onshore and offshore, in the arctic ice, the depths of the world's oceans and in the desert heat.

Our success is based on a simple principle: thinking ahead. Each and every one of our employees is committed to the philosophy of anticipating customer needs to make our products, processes and services even better. The ability to think ahead – this is the pledge of top performance with which we approach every challenge. And especially when it comes to creating products whose quality has shaped our market for many years.









## 3,000 KILOMETRES PER YEAR

Being world market leader requires special qualities, such as the flexibility to deliver pipe in any dimension and quantity to any place in the world. Being market leader also means having significant production capacities at your disposal. **EUROPIPE** has production sites at several locations in Europe and the Americas.

We operate a total of four high performance longitudinal weld pipe production lines: our 18-metre line in Mülheim an der Ruhr, Germany, and our 12-metre line in Dunkerque, France, use the UOE process, while our 12-metre lines in Mülheim an der Ruhr and at **Berg Steel Pipe (BSPC)**, Panama City/FL, USA, produce pipe by the three-roll bending method. **Berg Spiral Pipe (BSPM)** as well produces helically welded pipe in Mobile/AL, USA.

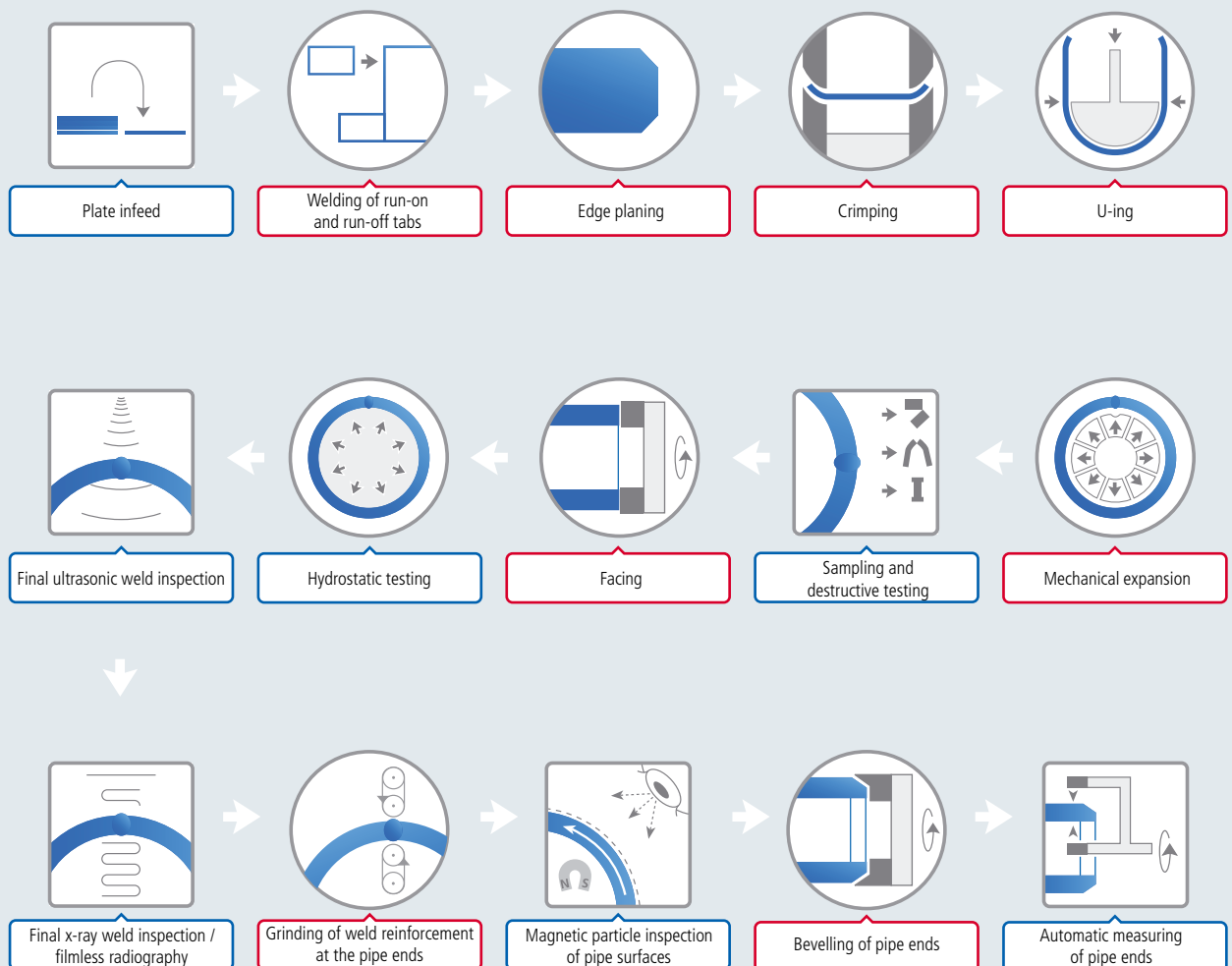
EUROPIPE Group's production range meets international standards and satisfies every customer's need. It includes longitudinally welded pipes in lengths of up to 18.3 m (60 ft) and wall thicknesses between 7 and 45 mm (0.276" to 1.770") with outside diameters extending from 508 to 1,524 mm (20" to 60"). Helically welded line pipe in lengths of up to 24.4 metres (80 ft) can be supplied in diameters ranging from 610 to 1,422 mm (24" to 56") and wall thicknesses from 8 to 20 mm (0.315" to 0.787").

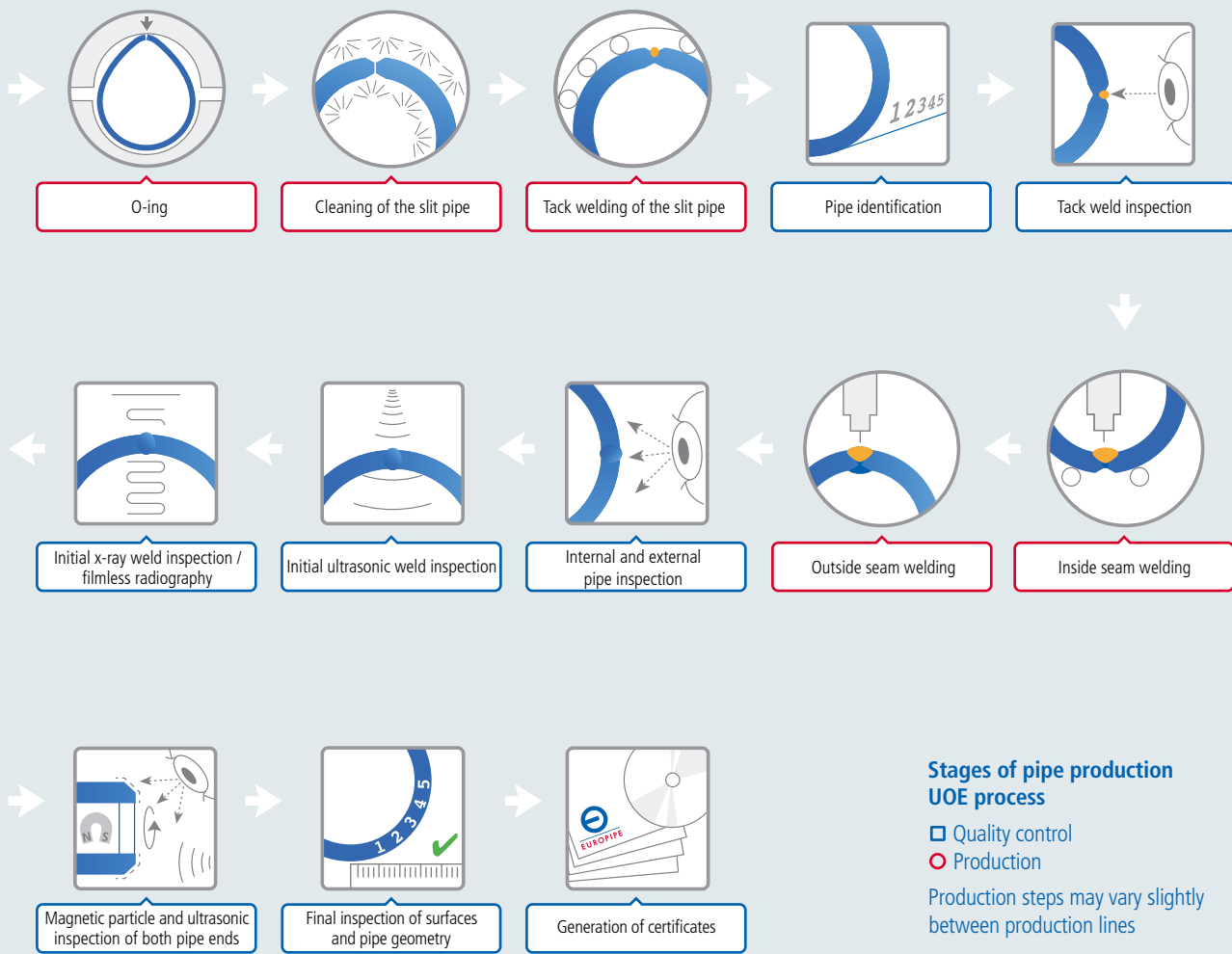
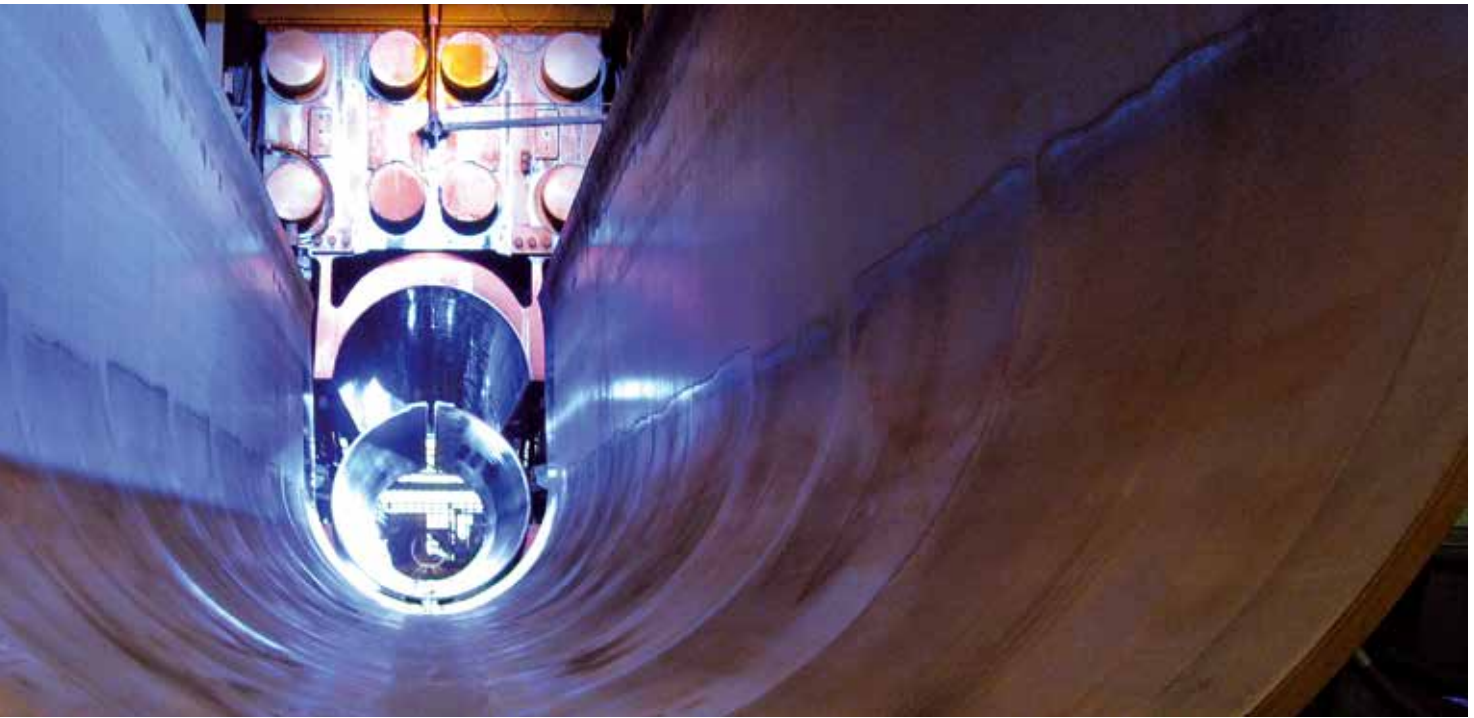
## 60,000 TONNES OF PRESSURE

Producing large-diameter pipe involves controlling immense forces, meeting extreme tolerances and guaranteeing quality under all circumstances. Comprehensive inspection and testing systems help us achieve, test and document this quality – step by step and with the utmost accuracy. Our quality control efforts are aided by PRODIS, an in-house developed **PRODUCTION** Control and Information System. This sophisticated, next-generation production control system for continuous quality assurance and release monitoring is unique anywhere in the world. It watches over every link in the production chain with maximum precision. It ensures pipe data tracking from the steel mill via the plate mill to the pipe mill and on towards the pipe storage site.

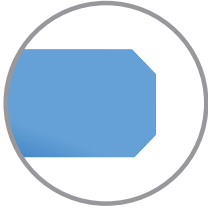


### LONGITUDINALLY SUBMERGED ARC WELDED (SAWL) PRODUCTION-FLOW





## EDGE PLANING



Edge planing

The edges of the plate are first planed parallel in the shape of a double Y bevel. Perfectly parallel and square edges as well as close width tolerances are essential for the forming operation. In addition, this is where the accuracy of the weld bevel and the quality of the seam are predetermined.

The production parameters are supplied by PRODIS.

## CRIMPING



Crimping

Over an area of approximately 200 – 400 mm, both edges of the plate are crimped simultaneously to the desired pipe radius. This operation ensures that the pipe meets even strongest requirements with respect to out-of-roundness, including the region of the longitudinal seam.

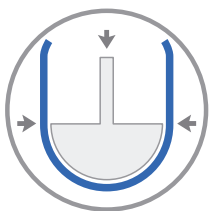
The necessary process data are provided by PRODIS. Our new crimping press in Mülheim an der Ruhr/Germany is able to process plate thicknesses of up to 50 mm.



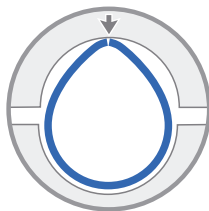




## FORMING



U-ing



O-ing

In the UO process, as the name suggests, the plate is first bent into a "U" and then into an "O". Forming in the U-ing press begins with the lowering of the die. The crimped plate is moved towards the die by side rollers. The U-shaped plate is then formed into a slit pipe in the O-ing press. This is precision work involving up to 60,000 tonnes of pressure – and is carried out using data provided by PRODIS.

In the three-roll bending process, the plate is formed to the desired radius by two lower rolls and one upper roll. Depending on steel grade and required pipe diameter, different upper roll diameters are used. The formed edges are subsequently rounded in the crimping machine.

## TACK WELDING OF THE SLIT PIPE



Tack welding of the slit pipe

Before submerged-arc welding takes place, the open edges of the slit pipe are tack welded together under shielding gas. This is done in frames (roller cages) which locate the edges exactly and prevent misalignment. The continuous tack weld also serves to retain the weld pool during subsequent submerged arc welding.

The production data for the tack welding operation have to be specified and the welding machine number assigned to each pipe – a job for PRODIS.

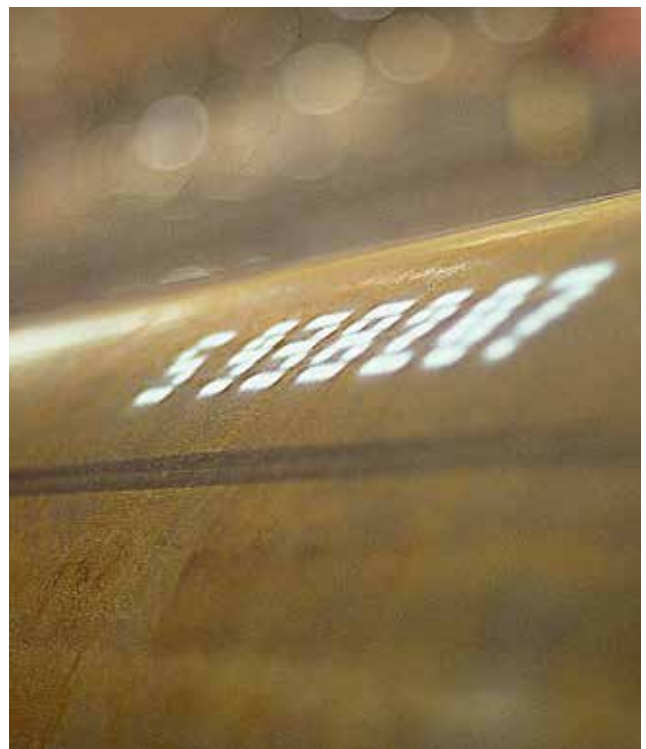
## PIPE IDENTIFICATION



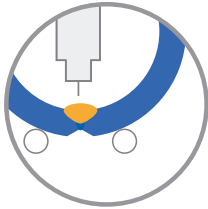
Pipe identification

PRODIS guarantees material tracking throughout the entire production process. For identification each pipe is marked with a pipe production number.

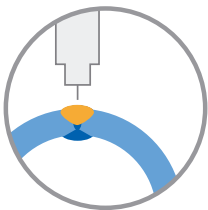
Additionally a line, marking the centre of the pipe, is the reference for late non-destructive testing of the weld seam.



## INSIDE AND OUTSIDE WELDING



Inside seam welding



Outside seam welding

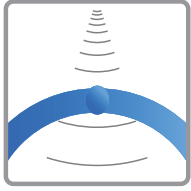
The longitudinal edges are joined in two passes. Run-on and run-off tabs are positioned at the pipe ends to stabilise the electric arc at the start and finish of the welding operation.

Inside welding is carried out first, followed by outside welding. The tack weld pass is completely fused. In submerged-arc multi-wire welding, up to five welding wires are arranged one behind the other. Consistency of weld quality is determined by various parameters: Welding wire and flux, amperage, voltage, welding speed, wire spacing, wire diameter, the angle of the wires relative to one another and to the weld groove, as well as flux height and width. A welding data monitoring system permits online supervision of the production process.

PRODIS provides the data for inside and outside welding and assigns the welding machine for each pipe.



## X-RAY WELD INSPECTION/FILMLESS RADIOGRAPHY



Initial ultrasonic weld inspection



Initial x-ray weld inspection /  
filmless radiography

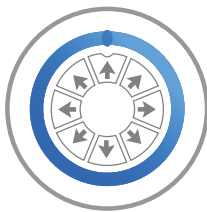
First, each seam is checked visually, inside and out. Our internal quality checks also include ultrasonic inspection of the entire seam, which can also be augmented by X-ray examination and manual ultrasonic testing.

Image processing capabilities coupled with support by automatic image evaluation software significantly improve the reliability of inspection and detection compared with conventional film-based methods. Any ultrasonic indications are checked automatically and with pinpoint accuracy. We are proud to be the only large-diameter pipe manufacturer, that conducts all radiography tests with digital technology. PRODIS optimises the inspection process, records the results and stores any deviations for subsequent follow-up.





## MECHANICAL EXPANSION

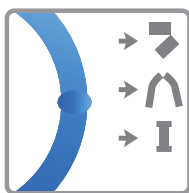


Mechanical expansion

The mechanical expander expands the pipes by plastic deformation in order to meet close tolerances on diameter, roundness and straightness. Perfect diameters and near perfectly round pipes reduce edge misalignment during girth welding and shorten cycle times during laying. Constant inside diameters result in uniform flow cross sections.

PRODIS provides the data for the mechanical expander and monitors compliance with tolerance requirements.

## SAMPLING AND DESTRUCTIVE TESTING



Sampling and destructive testing

In parallel with the nondestructive tests carried out in the large-diameter pipe mills, the mechanical-technological properties of the base metal and the weld are measured in accordance with agreed specifications. Complex analyses, full-scale tests and corrosion resistance examinations are carried out in affiliated laboratories and research institutes.

PRODIS plays a key part in this programme. The system controls and optimises the performance of the destructive tests, evaluates the results and decides on the release of a batch.

## HYDROSTATIC TESTING

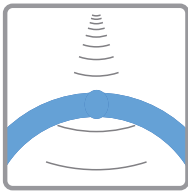


Hydrostatic testing

Pipes have to pass yet another demanding test while still in the mill: by means of internal water pressure, they are stressed close to their yield point – in other words, far above the operating pressures they will face in service. Hydrostatic testing is followed by acceptance testing using non-destructive inspection methods: renewed ultrasonic examination of the weld and X-raying of all weld ends.

PRODIS supplies the test data and monitors the results.

## FINAL ULTRASONIC AND X-RAY WELD INSPECTION

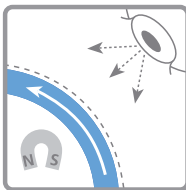


Final ultrasonic weld inspection

Hydrostatic testing is followed by acceptance testing using fast ultrasonic inspection of the complete weld length and weld volume. The UT-device is a modern computer-controlled and fully automated machine with up to 10 probes for longitudinal and 4 probes for transverse testing with the latest water nozzle technology.

PRODIS records the results of indications with precise coordinates for further re-check by X-ray inspection. In addition all pipe ends with a minimum length of 200 mm are X-rayed to meet all specifications and custom requirements.

## MAGNETIC PARTICLE SURFACE INSPECTION

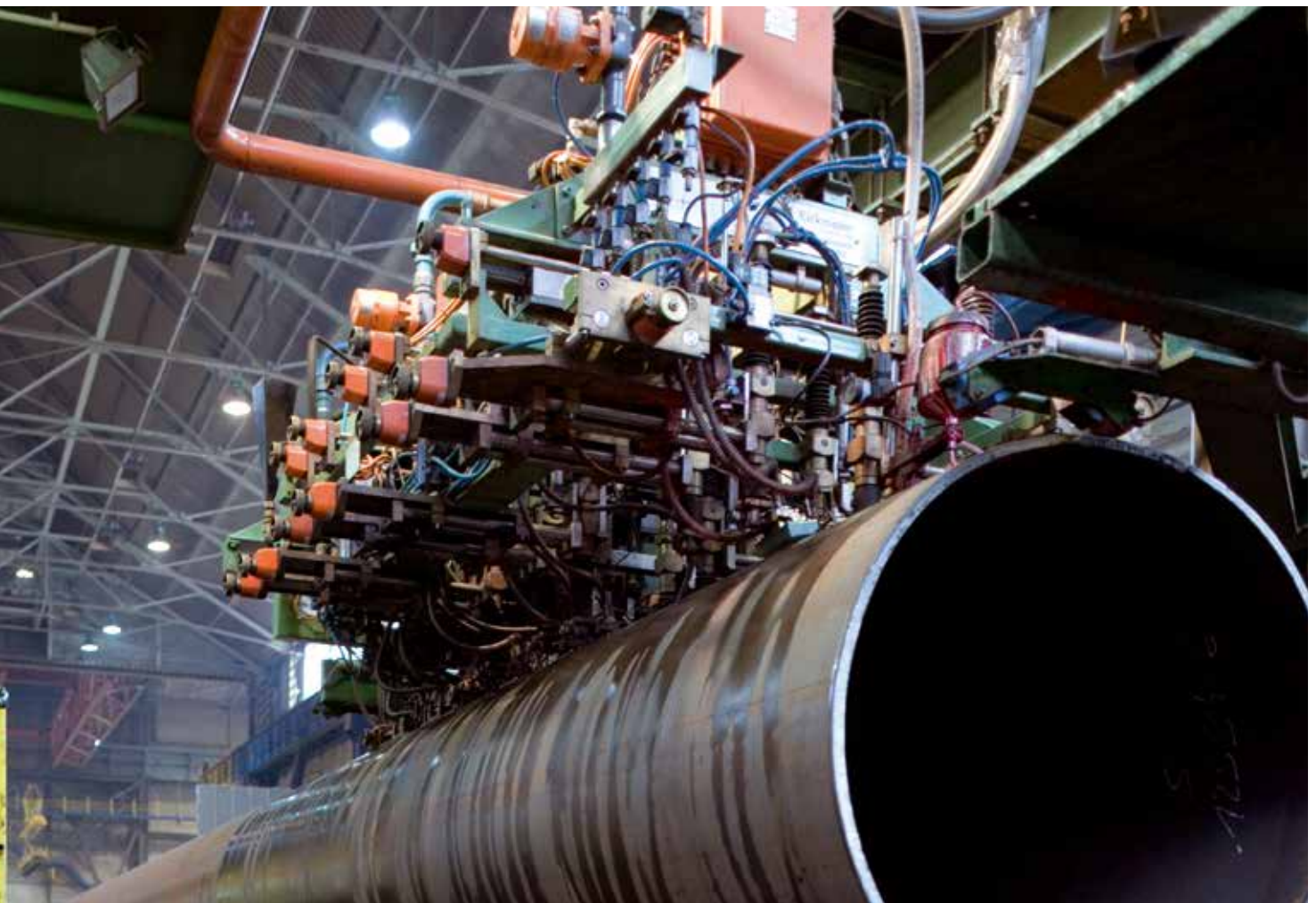


Magnetic particle inspection of pipe surfaces

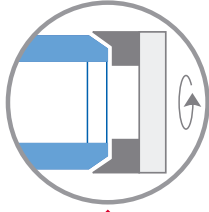
If required, internal and external surface inspection of the pipes can also be performed by magnetic particle inspection.

The results of this surface inspection are then transferred to PRODIS.





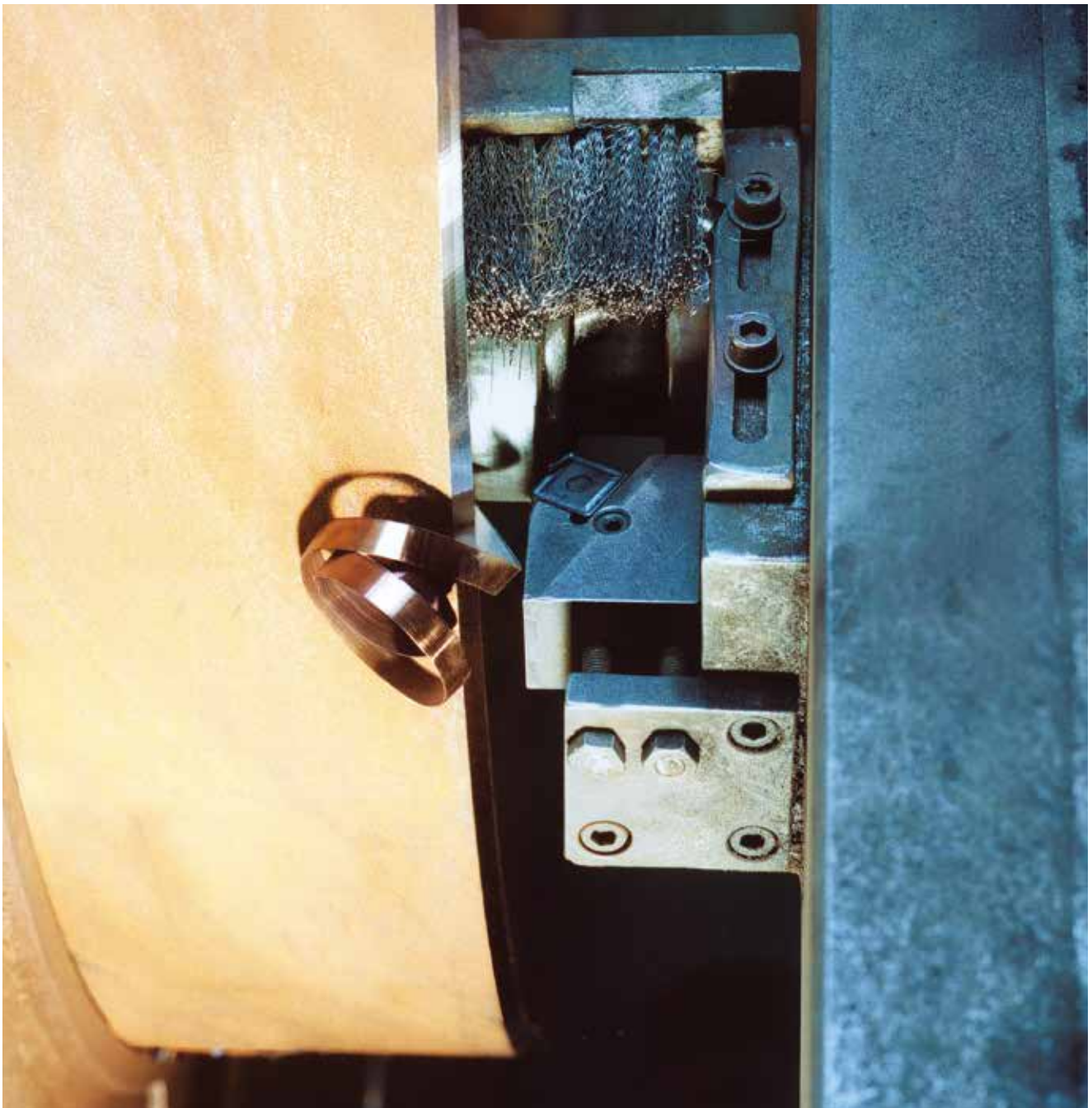
## BEVELLING OF PIPE ENDS



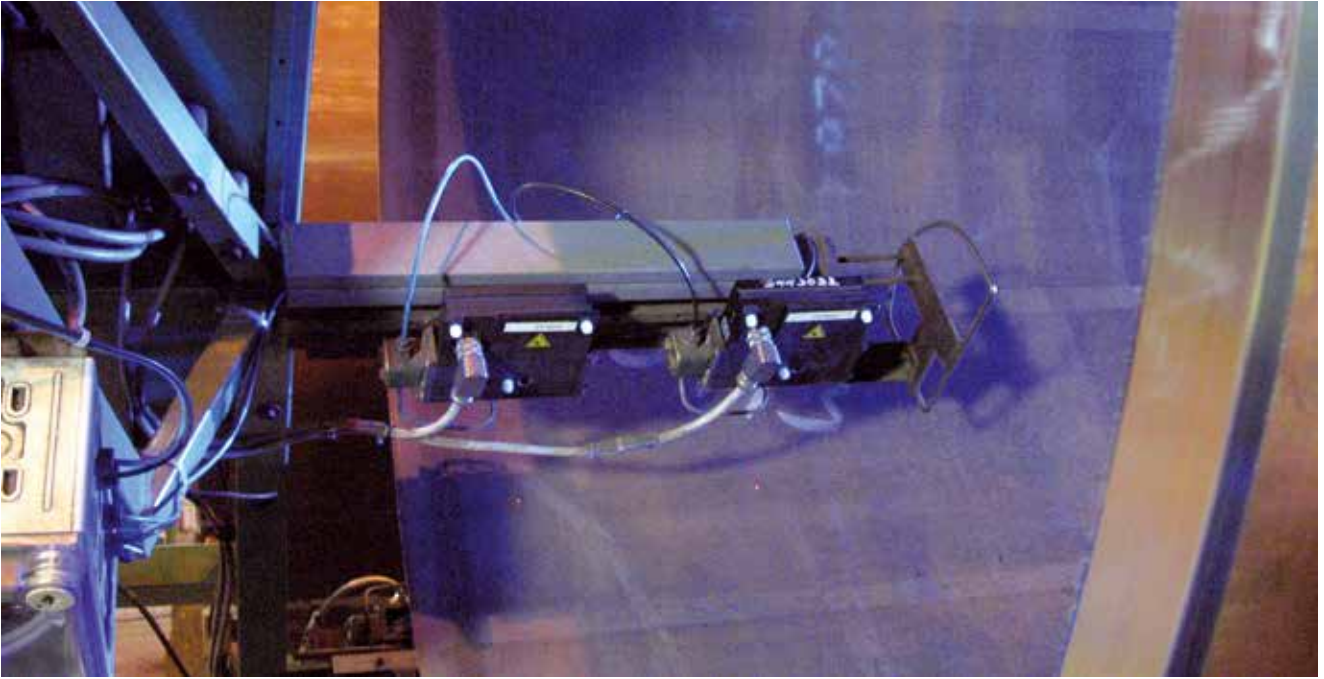
Beveling of pipe ends

At the pipe ends the internal and external weld reinforcement can be ground flush. In a final step, both pipe ends are bevelled simultaneously in a single operation to ensure that the finished pipe ends are square and parallel for girth welding in the field.

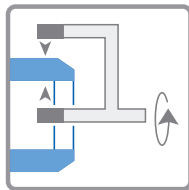
Here, too, PRODIS is indispensable. The system provides all production data for the beveling equipment.







## AUTOMATIC MEASURING OF PIPE END GEOMETRY



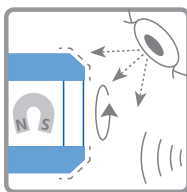
Automatic measuring  
of pipe ends

The geometry of all pipe ends is fully automatically measured with pipe end measurement equipment based on optical laser sensors.

The laser measuring device checks the inside and / or the outside dimensions of the pipe ends according to the QA/QC instructions for this pipe. Basically the following dimensions are checked and recorded by PRODIS: diameter, roundness, circumference, wall thickness and peaking of all pipe ends.

Customer requirements on QA/QC are linked to the PRODIS system. PRODIS checks the results against the QA/QC requirements. Only pipes whose ends fulfil all requirements of QA/QC instructions will be released.

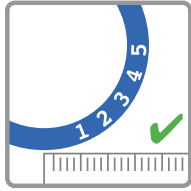
## MAGNETIC PARTICLE AND ULTRASONIC INSPECTION OF BOTH PIPE ENDS



Magnetic particle and ultrasonic  
inspection of both pipe ends

The pipe ends are non-destructively tested for laminations and inclusions by magnetic particle and ultrasonic inspection. Only perfect pipe ends permit defect-free girth welding in the field.

## FINAL INSPECTION OF SURFACE AND PIPE GEOMETRY



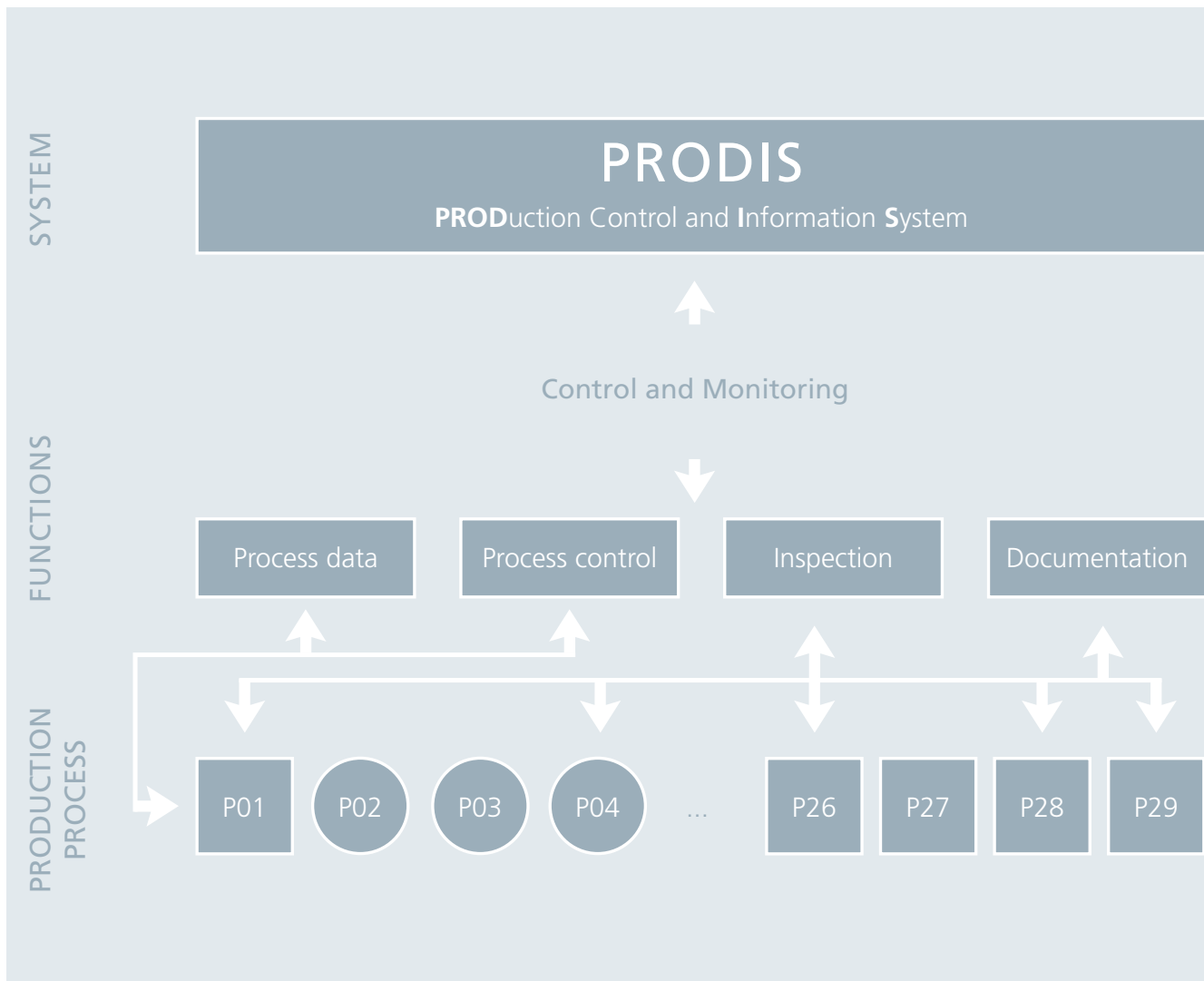
Final inspection of surfaces and pipe geometry

Internal and external pipe surfaces are examined visually. The pipe length and weight are measured automatically.

The final inspection includes additional checks of the entire pipe at diameter, wall thickness, bevel edges, roundness, etc. on the pipe body and ends.

PRODIS monitors the measurements and checks whether all requirements have been met. If the results comply with the specification, PRODIS assigns the customer pipe number.

In case of coating of the pipes, PRODIS automatically forwards all relevant pipe data to our coating partner MÜLHEIM PIPECOATINGS.



## GENERATION OF CERTIFICATES



Generation of certificates

Once all production and inspection steps have been carried out and all specification requirements have been fulfilled, the customer documentation is prepared. All results are listed, and certificates are produced.

This is another job taken care of by EUROPIPE's intelligent **PRO**duction Control and Information System, **PRODIS**.

## PIPE MARKING

After the final inspection, a marking robot turns the final product into a "customer pipe" by applying the customer specified marking.

## LOADING AND DESPATCH

All the test results are in. **PRODIS** checks them against specifications and, if they are positive, releases the pipe for despatch. The pipe is loaded and despatched to the coating plant, the port of export or to the destination given by the customer. **PRODIS** naturally also watches over the despatch operation.



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