

MITTAL

production programme

# Spiral Welded Pipes



Mittal Steel Ostrava a.s.

production programme

## Spiral Welded Pipes



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# Tube Plant



## History

On the 21st November 1999, fifty years have passed exactly since the time, when the first seamless tube was rolled at the Tube Plant in the territory of the district of Ostrava-Kunčice. Production during the past fifty years reached the remarkable 11.5 million tons of seamless tubes, spiral welded pipes and welded pipe products, just in the anniversary year.

In the course of this period the Tube Plant has gone through the rough development, the result of which is not only a dominant position on the home market, but also a wide range of customers outside the Czech Republic.

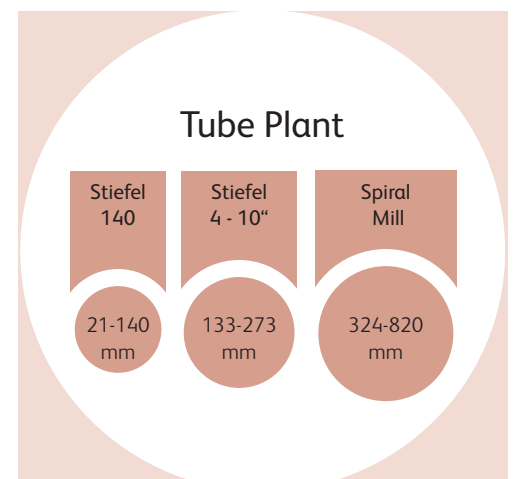
Permanent emphasis is laid on the quality increase, and certification by the renowned companies. The Tube Plant has been authorized to use the API Monogram since the year 1957 continually. It was the first Plant in the Czech Republic, which has obtained the Quality Assurance System Certificate according to ISO 9001.

Much attention is also paid to the improvement and protection of the environment, which was also evidenced by the environmental management certification according to ISO 14001 of the year 1999.

On 2003 the company was privatized by the LNM Holdings and in February 2005 it was renamed Mittal Steel Ostrava a.s. The company is a part of the global group with the annual production more than 70 million tons of steel.

The tube rolling mill in Ostrava will keep its position of the leader within the Mittal Steel Company featured by advanced technical level and excellent references for its supplies.

The collapse resistant casing pipes with gas-tight connection according to licence HSC and the welded pipes for high pressure pipelines covered with external polyethylene coating reinforced with a cement-fiber layer are considered our top products.



## History

- 1949** Commencement of manufacture of the seamless tubes at the Stiefel 4 - 10" mill.
- 1957** The right to use the API (American Petroleum Institute) monogram on the oil pipes manufactured obtained.
- 1959** The rotary-hearth furnace installed, which substituted hard work of handle-workers.
- 1960** The second seamless tube rolling mill Stiefel 140, and spiral mill of own construction, supplying Družba oil pipe-line construction with pipes were put into operation. The first bitumen coating shop was built at the same time.
- 1961** Operation of the tensile tube reducing mill behind the Stiefel 140 mill started.
- 1963** The electromagnetic non-destructive tube leakage testing implemented.
- 1965** The X-ray equipment for continuous radioscopic control of welds (firm Muller) put in operation.
- 1966** The world-unique rotary piercing mandrel feeder for rolling at the "Automatic" has been developed, installed, and patented.
- 1968** The billet surface peeling for improvement of the tube surface quality started.
- 1969** The second bitumen insulation shop, the so-called New Juting Shop, constructed in the Spiral Mill.
- 1971** The crack detection line CIRKOGRAF for tubes of 89 - 133 mm diameter constructed, the heat treatment shop for production of oil pipes of higher strength grades (N80, P110, G105) opened.
- 1972** Commencement of manufacture of the oil threaded joints BUTTRESS.
- 1976** Operation of the newly-built coupling shop started.
- 1977** The ROTOMAT 2 crack detector at Stiefel 4 - 10" installed, manufacture of the two-layer seamless tubes for the pressed-air conveyed filling in the OKD mines commenced.
- 1978** DEFECTOMAT installed at Stiefel 140.
- 1980** ROTOMAT 3 crack detection line installed at the treatment shop.
- 1982** New rotary-hearth furnace installed at Stiefel 4 - 10".
- 1990** Control of piercing machines automated at Stiefel 4 - 10", use of PVC foil in the bitumen insulation implemented.
- 1991** Heat-treatment shop furnace operation converted to PC control, welding unit no. 1 at the Spiral Mill reconstructed to three-roll bending system, and coil preparation mechanized.
- 1992** Automation of rolling at the automatic, and of smoothing machine at Stiefel 4 - 10", also the welding unit no. 2 at the Spiral Mill was reconstructed.
- 1994** Rolling from the continuously cast round billets of own production implemented, steel purity significantly improved, and considerable saving of production cost reached.  
The new varnishing line opened at Stiefel 140. KRAUTKRÄMMER ultrasonic crack detector for testing welds and also tube body installed at the Spiral Mill.
- 1995** Tubes of 18 m length manufactured at the Spiral Mill for the first time, LINSINGER saw for accurate cutting of billets installed, first supplies of welded pipes from micro-alloy thermomechanically processed steel grades.
- 1996** Installation of MAGNEMAG finishing line at Stiefel 4 - 10", and ROTOMAT 4 crack detector at Stiefel 140.
- 1997** Modernization of piercing machine no. 1 at Stiefel 4 - 10" (high-pressure descaling, controlled drive 7.2 MW).
- 1998** Modernization of the tube reducing mill at Stiefel 140 (accurate induction heating, extension by 7 stands, drive reconstruction, new flying saw with the increased length accuracy). Stiefel 4 - 10" - new threading machines for manufacture of HSC threads, varnishing line. Steel purity improvement of welded tubes by starting production of the continuously cast slabs for strip rolling at NOVÁ HUŤ, a.s.
- 1999** Construction of PE coating line for three-layer coating of tubes of 159 - 1220 mm diameter, line for inside and outside cement mortar coating.
- 2000** Start of manufacture of pipes with new coatings, manufacture of welded pipes from strips, rolled at the new P 1500 Steckel Mill.
- 2003** Developing of the special cement insulation (FZM-S) suitable for tube protrusion.
- 2004** Qualification of the procedure for welding of tubes of the steel X70 (L485 MB).
- 2005** Introduction of seamless tubes production of the steel X60 with low CE and first supplies of welded tubes made of L415 MB and L450 MB steel grades.

# Spiral welded pipes - assortment

## Dimensional standards

EN 10220:2002	“Seamless and welded steel tubes – dimensions and masses per unit length“
ISO 4200:1991	“Welded and seamless steel tubes with bare ends“
ČSN 42 5738:1979	“Spiral welded steel pipes“
DIN 2458:1981	“Welded steel tubes“
EN 10219-2:1997	“Cold formed welded structural hollow section of non-alloy and fine grain steels - Part 2: Tolerances, dimensions and sectional properties“
EN 10217-1:2002/A1:2005	“Welded steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties“
EN 10217-5:2002/A1:2005	“Welded steel tubes for pressure purposes - Technical delivery conditions - Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties“
API Spec 5L:2004	“API Specification for line-pipes“
GOST 8696:1974	“Electrically spiral-welded steel tubes“
PN 79/H-74244:1979	“Welded steel pipes“

## Technical delivery conditions

API Spec 5L:2004	“API Specification for line-pipes“
ČSN 42 0144:1979	“Spiral welded steel pipes“
DIN 1615:1984	“Welded circular tubes of plain carbon steels without special requirements“
DIN 1626:1984	“Welded circular tubes of plain carbon steels for special requirements“
DIN 1628:1984	“Welded circular tubes of plain carbon steels for extra-high requirements“
DIN 17120:1984	“Welded circular tubes of common structural steels, determined for steel structures“
DIN 17172:1978	“Steel tubes for long-distance pipeline for conveyance of combustible liquids and gases“
EN 10208-1:1996	“Steel tubes for combustible liquid pipeline“ - part 1: requirements according to the class A
EN 10208-2:1997	“Steel tubes for combustible liquid pipeline“ - part 2: requirements according to the class B
EN 10217-1:2002/A1:2005	“Welded steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties“
EN 10217-5:2002/A1:2005	“Welded steel tubes for pressure purposes - Technical delivery conditions - Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties“
EN 10219-2:1997	“Cold formed welded structural hollow section of non-alloy and fine grain steels - Part 2: Tolerances, dimensions and sectional properties“
GOST 8696:1974	“Electrically spiral-welded steel tubes“
PN 79/H-74244:1979	“Welded steel pipes“

## Steel grade

ČSN 42 5738:1979	11 375, 11 378, 11 425, 11 523
DIN 1615:1984 (1626, 1628)	St 33 (St 37.0, St 37.4, St 44.0, St 44.4, St 52.0, St 52.4)
ČSN EN 10208-1:2000	L210GA, L235GA, L245GA, L290GA, L360GA
ČSN EN 10208-2:1999	L245NB, L245MB, L290NB, L360NB, L290MB, L360MB, L415MB, L450MB, L485MB
EN 10217-1:2002	P195TR1, P235TR1, P265TR1, P195TR2, P235TR2, P265TR2
EN 10219-1:1997	S235JR, S275J0H, S275J2H, S355J0H, S355J2H
ČSN EN 10025:1990 supplement A1:1993	S235JR, S235JRG2, S235JRG3, S275JR, S275J2G3, S355J2G3
DIN 17120:1984	RSt 37-2, RSt 37-3, RSt 44-2, RSt 44-3, St 52-3
DIN 17172:1972	StE 290.7, StE 360.7, StE 290.7 TM, StE 320.7 TM, StE 360.7 TM, StE 385.7 TM, StE 415.7 TM
API Spec 5L:2004	A-PSL1, B-PSL1, B-PSL2, X42-PSL1, X42-PSL2, X46-PSL1, X46-PSL2, X52-PSL1, X52-PSL2, X56-PSL1, X56-PSL2, X60-PSL1, X60-PSL2
GOST 8696:1974	VSt 3 sp
EN 10217-5	P235GH, P265GH*
PN 79/H-74244:1979	G235, G295, G355

Note: Tubes according to EN 10208-2 comply with the requirements of EN 1594

Tubes according to EN 10217 comply with requirements of SE 97/23 pro ressure equipment

\* Deliveries of these grades has to be agreed before order

## Length

Tubes are supplied in length of 8 to 12.3 m for wagon transport, in length of 8 to 13.5 m for truck transport, in fixed length (e.g. 12 m +/- 500 mm) or in accurate length with the tolerance of +50/-0 mm, (by agreement +25/-0 mm). The minimum length of the tubes as per special requirement is 6 m and maximum length is 18 m. The tubes of the length 8 m with required water pressure test are manufactured in double length and then parted by flame cutting, i.e. one end is bevelled and the other is cut-off perpendicularly.

## Finish of pipe-ends

- ends are flame-cut perpendicularly, with the accuracy of +50/-0 mm
- ends are cut-off perpendicularly
- ends are bevelled for welding according to the requirements of the individual standards (e.g. DIN 2559/22)

## Dimensions and weight produced according to EN 10220:2002, (ISO 4200:1989), EN 10208:1996

Outside diameter mm	Wall thickness (mm)							
	5.6	6.3	7.1	8	8.8	10	11 <sup>1</sup>	12.5 <sup>1</sup>
Weight (kg/m)								
323.9	44.0	49.3	55.5	62.3				
355.6	48.3	54.3	61.0	68.4				
406.4	55.4	62.2	69.9	78.6	86.3	97.8	107	121
457	62.3	70.0	78.8	88.6	97.3	110	121	137
508	69.4	77.9	87.7	98.6	108	123	135	153
(559)	76.4	85.9	94.6	109	119	135	149	169
610	83.5 <sup>3</sup>	93.8	106	119	130	148	162	184
(660)		102 <sup>3</sup>	114	129	141	160	176	200
711		110 <sup>3</sup>	123	139	152	173	190	215
762				149	163	185	204	231
813				159 <sup>3</sup>	175	198	218	247

<sup>1</sup> Tubes can be ordered by previous agreement      <sup>3</sup> For the ratio of D/t > 100 roundness is not guaranteed

## Dimensions and weight produced according to ČSN 42 5738:1979 and PN 79/H-74244:1979

Outside diameter mm	Wall thickness (mm)							
	5	6	7	8	9	10	11	12
Weight (kg/m)								
324	40.1	48.0	55.0	63.5				
377	46.8	56.0	65.1	74.2				
426	52.9	63.3	73.7	84.0	94.3	104.5	114.7	124.8
530	65.9	79.0	92.1	105.0	117.8	130.7	143.5	156.2
630		94.1	109.6	125.1	140.5	155.8	171.1	186.4
720			125.4	143.1	160.8	178.4	196.0	213.5
820					183.4	203.5	223.7	243.7

## Dimensions and weight produced according to DIN 2458:1981

Outside diameter mm	Wall thickness (mm)							
	5.6	6.3	7.1	8	8.8	10	11	12.5
Weight (kg/m)								
323.9	44.0	49.3	55.5	62.3				
355.6	48.3	54.3	61.0	68.4				
406.4	55.4	62.2	69.9	78.6	86.3	97.8	107	121
457	62.3	70.0	78.8	88.6	97.3	110	121	137
508	69.4	77.9	87.7	98.6	108	123	135	153
(559)	76.4	85.9	94.6	109	119	135	149	169
610	83.5 <sup>2</sup>	93.8	106	119	130	148	162	184
(660)		102 <sup>2</sup>	114	129	141	160	176	200
711		110 <sup>2</sup>	123	139	152	173	190	215
762				149	163	185	204	231
813				159 <sup>2</sup>	175	198	218	247

<sup>2</sup> For the ratio of D/t > 100 roundness is not guaranteed  
Note: not standardized O.D. 368, 419.1, 462 a 521 mm can be ordered by previous agreement

## Dimensions and weight produced according to API Spec 5L 43E:2004

Outside diameter		Wall thickness (in / mm)								
		0.219/5.6	0.250/6.4	0.281/7.1	0.312/7.9	0.344/8.7	0.375/9.5	0.406/10.3	0.438/11.1 <sup>1</sup>	0.469/11.9 <sup>1</sup>
in	mm	Weight (lb.ft <sup>-1</sup> / kg.m <sup>-1</sup> )								
12	323.9	29.31/43.96	33.38/50.11	37.42/55.47	41.45/61.56					
14	355.6	32.23/48.33	36.71/55.11	41.17/61.02	45.61/67.74					
16	406.4	36.91/55.35	42.05/63.13	47.17/69.91	52.27/77.63	50.17/85.32	54.57/92.96	67.62/100.63	72.80/108.20	
18	457	41.59/62.34	47.39/71.12	53.18/78.77	58.94/87.49	64.87/96.18	70.59/104.84	76.29/113.53	82.15/122.05	
20	508	46.27/69.38	52.73/79.16	59.18/87.70	65.60/97.43	72.21/107.12	78.60/116.78	84.96/123.41	91.51/136.01	97.83/145.58
22	559		58.07/87.21	65.18/96.63	72.27/107.36	79.56/118.06	86.61/128.73	93.63/139.37	100.86/149.97	107.85/160.55
24	610		63.41/95.26	71.18/105.56	78.93/117.30	86.91/129.00	94.62/140.68	102.31/152.32	110.22/163.93	117.86/175.40
26	660			77.18/114.31	85.60/127.04	94.26/139.73	102.63/152.39	110.98/165.02	119.57/177.62	127.88/190.19
28	711			83.19/123.24	92.26/136.97	101.61/150.67	110.64/164.34	119.65/177.98	128.93/191.58	137.90/205.15
30	762 <sup>1</sup>				98.93/147.37	108.95/162.31	118.65/176.76	128.32/191.17	138.29/206.01	147.92/220.36
32	813 <sup>1</sup>					116.30/173.26	126.66/188.69	136.99/204.09	147.64/219.95	157.94/235.29

<sup>1</sup> Tubes can be ordered by previous agreement

# Manufacture of spiral welded steel pipes with Ø 323.9 - 820 mm



## Feed-stock

Pipes are manufactured of the carbon and microalloy steels, processed by the secondary metallurgy, for achievement of the low content of impurities and high homogeneity of chemical composition. All steel grades, used for manufacture of welded tubes, are fully killed of low phosphorus and sulphur content, high toughness and ageing resistance.

Slabs of such prepared steel are continuously cast and steel strips in coils are hot rolled of them at the up-to-date P 1500 Steckel mill, according to CSN EN 10051 Standard.



## Inlet section of aggregate

After decoiling, the steel strip is straightened, the natural edges are cut to the constant width, necessary for manufacture of the accurate diameter. At the bigger wall-thicknesses, the weld edges are milled into X profile.

## Strip Forming

Strip edges are prebent in such a way so that the roofing effect after strip forming should be eliminated. At the angle of the inlet section adjustment, the strip is pushed into the caliber, which works on the principle of the three-roller bending machine. The caliber enables forming of the required diameter, including the possibility of control of the own (residual) stress.



## Inside and outside welding

Weld edges of the manufactured pipe are at first inside welded by the submerged-arc welding process. According to the diameter and wall thickness, there is used the inside single-wire or twin-wire welding in so-called tandem arrangement. Outside weld is made on the next thread. Thus a high-quality, double-sided butt welded joint is reached, at which the weld coefficient  $v = 1$  is guaranteed.

## Pipe cutting

An endless pipe is manufactured on the welding machine, which is flame-cut to piece lengths. Samples for destructive testing are also taken at this workplace.

## Cutting off and bevelling

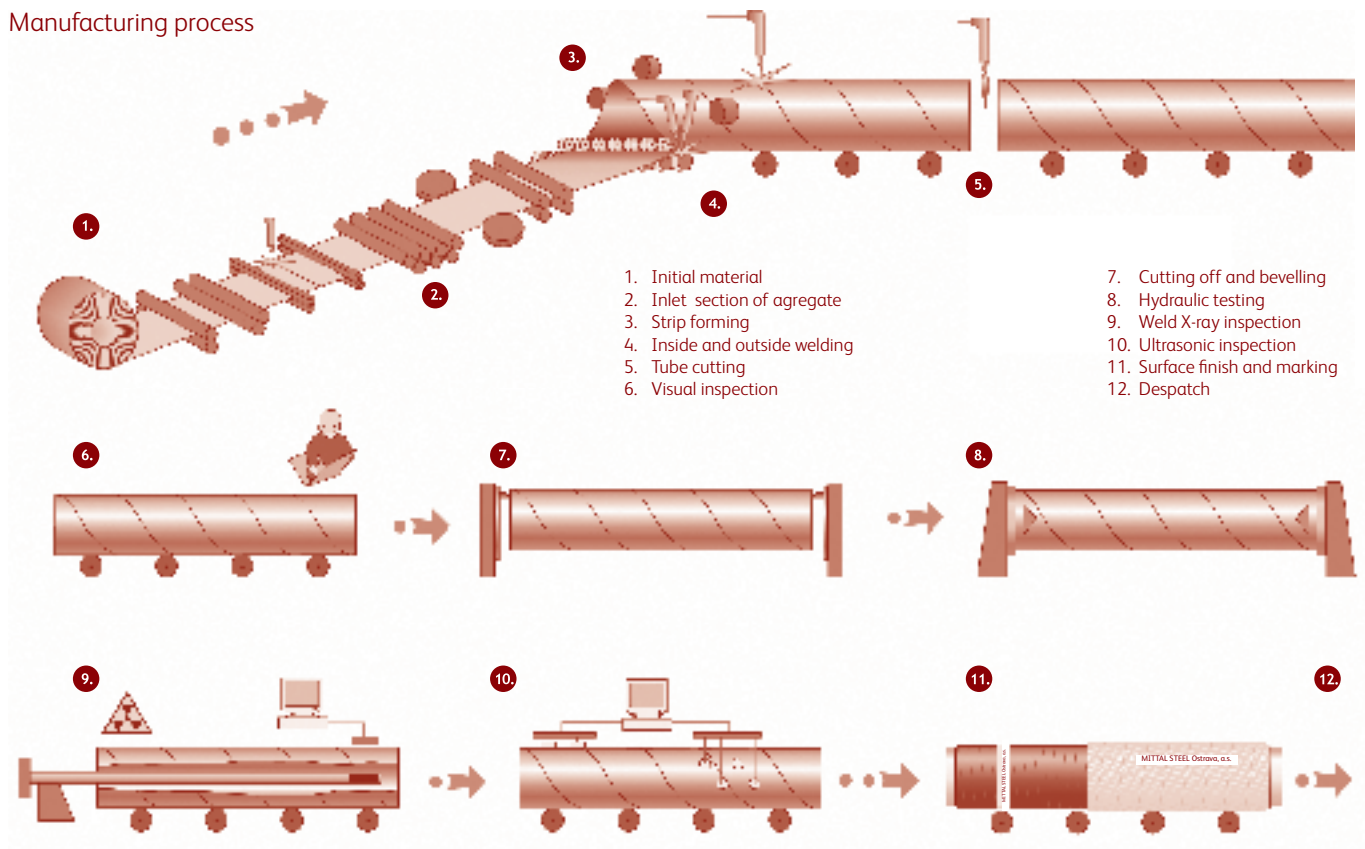
There follows the pipe-end machining by the bevelling machines, whereby the pipes with bevel of  $30^\circ$  and  $1.6 \pm 0.8$  root-face are delivered most often.

## Visual Inspection

The pipe inspection is a part of the finishing activities, including the visual inspection, done by the personnel, trained according to EN 473 and SNTC-1A, dimensional checking, and stamping the manufacturing numbers and supplementary data. A part of this workplace is also performance of special repair-welding of the weld breaks by the welders, qualified according to DIN EN 287, and ASME Code Sect. IX in compliance with qualified welding procedures.



## Manufacturing process



# Manufacture of spiral welded steel pipes with Ø 323.9 - 820 mm



## Quality control

### Destructive testing

Tubes are divided into the test groups of 50 (100) pcs each. The specified number of samples is taken out from each test group for mechanical tests. The tensile-tests, guided-bend tests of welds and impact tests are performed most often. Moreover, the DWT, HIC tests, welded joint hardness measuring, and metallographic analyses are performed according to the customers' requirements. The tests are performed by the independent, state accredited testing laboratory. This laboratory is, among others, also equipped with the H<sub>2</sub>S testing room for the HIC/SSC tests.



### Hydraulic testing

All pipes are subject to the hydraulic leakage test, whereby the testing overpressure level and the time of a delay are chosen according to the purpose of tube use, e.g. pursuant to DIN 2413, or EN 10208 Standard requirements. The course of testing is digitally sensed and stored, including the automatic evaluation of the test. At the same time, there is possible to print the graphic record of the course of test.

### Non-destructive testing

The scope of nondestructive testing is usually set by standards, and corresponds to the purpose of use. The Spiral Mill is equipped for doing the NDT after the testing with water pressure, ultrasound and X-ray.

### Weld X-ray Testing

Tubes are checked at the workplace equipped with the SEIFERT 160 kV X-ray-TV chain, equipped with the CCD sensor. According to the standard requirements, the checking is chosen either of the entire weld length in the dynamic regime, or in static regime with the possibility of recording the individual photographs at VISTA PLUS III equipment. Weld-seams are inspected according to the EN 10246-10, SEP 1916 and API 5L standards. By means of the digitizing circuits, it is possible to achieve the high-quality pictures with the sensitivity, corresponding to the fine grain X-ray film.



### Ultrasonic Testing

The workplace is equipped with the KRAUTKRAMMER SNUP/OPR facility, which makes possible to do quite automatically the testing of weld, the ultrasonic inspection of the heat-affected weld zone and basic material, and mark the places of indications with the colour spray. Welds are checked according to the EN 2046-9, SEP 1916 or API Spec 5L requirements, basic material according to EN 10246-15 or SEL 072. In addition to this facility, there is bevel ends laminarity ultrasonic test performed at this workplace by means of the handy device KRAUTKRÄMMER USN-50.



### Residual magnetism

A part of nondestructive testing is the residual magnetism measuring at the bevelled surfaces, and performance of the efficient demagnetization.

## Surface finish and marking

Pipes are supplied with natural (so-called black) surface, or with the anticorrosion protection with polyethylene or bitumen. On the customer's request, the natural surface can be varnished with the bitumen varnish, or the coating can be reinforced with the fibre-cement mortar.



Pipes are durably marked by stamping, whereby each pipe has a manufacturer monogram and manufacturing number stamped. According to further requirements, also the steel grade or heat number are stamped. At the same time, there is possible to sign the pipes on the inside surface on the request, whereby the sign bears also further information, as a diameter x wall thickness, tube length, and a contract number (code).



## Dispatch

Pipes are despatched to the customer by railway wagons, or trucks. Pipes are always in bulk, the individual layers are separated by wooden underlays and protected against shift with the wooden scotches.

Pipes with polyethylene coating are interlaid with plastic strips, and the platform wagons with tilting jacks are preferred.



## Utilization

Spiral-welded steel pipes serve for transmission of the liquid and gaseous combustible media (up to the working pressure of 10 MPa), for potable and service water distribution, constructions of hot-water distributions, and for structural purposes - posts, piles. They are approved for utilization at construction of the stable pressure vessels.





# Commercial references

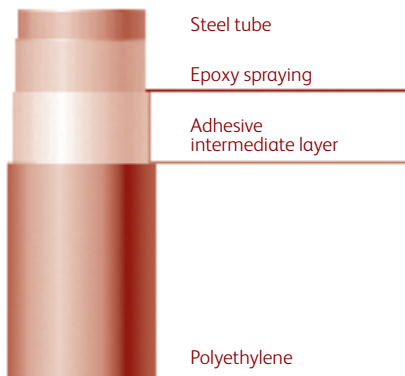
The most important customers of spiral welded pipes in the period 2003 - 2005

Firm	Seat	Pipe diameter	Steel Grade
TOWARZYSTWO FINANSOWE SILESIA	Katowice	508	EN 10208-2; L415MB
ARGENTO KFT.	Budapest	323.9 - 610	EN, DIN; St 37.0 – L415MB, L450 MB
THYSSENKRUPP	Torun	323.9 - 610	EN, DIN; St 37.0 – L415MB
FEROIMPEX D.O.O.	Vukovar	323.9 - 711	DIN, API 5L; St 37.0 – X52 PSL2
SYSTEMTUBE	Košice	323.9 - 813	EN, DIN, API Spec 5L; St 37.0 – L485MB, S355J2H, X52 PSL2
FRANKSTAHL ROHR-UND	Wien, Praha, Wulfrath	323.9 - 813	EN, DIN, API Spec 5L; St 37.0 – L415MB, X52 PSL2
INCOS SPOLS R.O.	Praha	323.9 - 813	DIN, API Spec 5L; St 37.0 – St 52.0, B PSL2
TOPHAM EISEN UND STAHL HANDEL	Wien	323.9 - 813	EN, DIN, API Spec 5L; St 37.0 – St 52.0, L360NB, B PSL2
BBM NEDERLAND B.V.	Meerkerk	323.9 - 813	EN, DIN, API Spec 5L; S235JRH, St 37.0 – St 52.0, L360NB, X42 PSL2
POWERPIPE SYSTEMS AB	Hisings Karra	323.9 - 813	DIN; St 37.0
LOHARENS ING.-BAU GMBH	Bad Oeynhausen	406.4 - 711	EN, DIN; S235JRG2, RSt 37-2, St 37.0 – St 52.0
SALZGITTER STAHLHANDEL GMBH	Düsseldorf	323.9 - 813	EN, DIN, API Spec 5L; St 37.0, L360NB, S355J2G3, B PSL2
BBM STAHLROHRHANDEL GMBH	Halle / Saale	323.9 - 813	EN, DIN, API Spec 5L; St 37.0 – St 52.0, S235JRH, S355J2G3, B PSL2
EUROFERROMETALL	Bratislava	457 - 813	DIN; St 37.0 – St 52.0
UNISER RURY STALOWE-STEEL PIPES	Slupsk	457 - 813	EN, DIN; St 37.0 – L415MB
RSH ROHR UND STAHLHANDEL	Erfurt	323.9 - 711	DIN; St 37.0 – St 52.0
ASKONY EXPORT-IMPORT	Krompachy	324 - 813	EN, DIN, ČSN; S235JRH – S355J2G3, L360MB – L485MB, 11 375.0 – 11 523.0
IZOSTAL	Zawadzkie	323.9 - 711	EN, DIN; St 37.0, L360MB
SAFCO ING.PAUL ZINNIEL	Kleinwetzdorf	508 - 711	DIN; St 37.0
RATIO METAL TRADE LTD. INTERNATIONAL	Dublin	323.9 - 813	EN, DIN; St 37.0 – St 52.0, L360MB, L415MB

# Pipe surface protection

## Outside surface protection

### Polyethylene coating



This is an insulation, exceeding by a good mechanical resistance, high electric resistance, and expected service life of 50 years. High voltage resistance at the holiday test 25 kV is guaranteed. Tubes can be cold bent, including the insulation. The insulation is manufactured according to DIN 30 670.

### Certification

The polyethylene insulation was tested by Ústav využití paliv (Institute of Fuel Utilization) in Běchovice, and based on the Protocol of Testing, it was certified for the purposes of gas industry by GAS, s.r.o. firm. The TSÚS Bratislava Product Certificate was also issued, with validity for the Slovak Republic. Coating of small diameter tubes according to DIN 30 670 can be provided, as per agreement at external suppliers.

### Used technology

Mechanical outside surface grit-blasting, tube heating, electrostatic spraying by epoxide powdered primer and powdered adhesive (copolymer), infra-red reheating, coating with the polyethylene hose by means of the circular extruding head (the so-called ring-circular extrusion).

### Tubes ø 159 - 1220 mm

### Type of coating

Normal (DIN 30 670-N-n), reinforced thickness (DIN 30 670 -N-v), normal (N) material - low-density polyethylene LDPE.\*)

\*) - In black color, as per agreement can be supplied also in yellow color.  
- Special (DIN 30670-S-n) increased thickness (DIN 30670-S-V), special (S) material – high-density (HDPEW) or medium-density (MDPR) polyethylene.

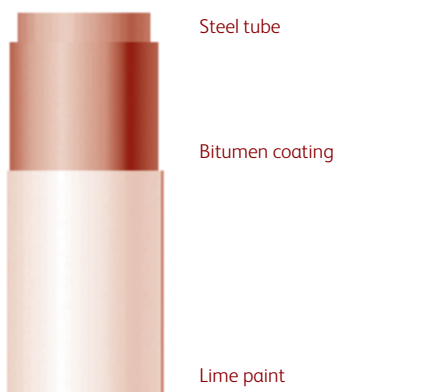
### Range of length

6 - 18 m

### Finishing operations

Protection of ends by plastic covers, end painting by protective varnish, marking the data by means of ink-jet spraying device. Tubes are coated in the newly-built polyethylene coating line.

### Outside bitumen coating



This is a classical bitumen coating, marked especially by a low price and good service life.

### Type of coating

The coating according to the Company Standard KN 42 0023 corresponds to ČSN 42 00 22 requirements for the reinforced tube coating. Use of PVC tape is characteristic for this insulation, which significantly improves the absence of coating porosity.

### Dimensional range

Outside tube diameter 159 - 820 mm  
Tube length 8 - 12.5 mm

### Tubes ø 159 - 820 mm

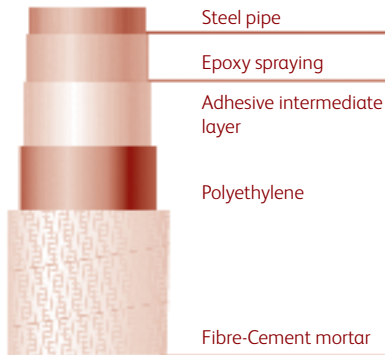
### Typical properties

Porosity 35 kV  
Bendability  $R_{min.} = 50D$

### Used technology

On the tubes coated with bitumen varnish priming coat, the liquid bitumen insulating mixture is applied, into which one PVC tape layer, and one layer of fiber-glass, soaked in bitumen, are coiled. The finished coating is white poured with lime milk.

## Outside fibre-cement mortar protection



It is produced according to the Company Standard KN 42 0025, which follows from the requirements of the German regulation by the Association of water piping and gas line builders (DVGW) GW-340. Main task of this insulation is to enable laying pipeline in rough terrain, i.e. e.g. in rocky mountain terrain, or everywhere, where the sub-base material transport is difficult. Special design FZM-S allows direct use of the tube for horizontal thrust boring without excavation.

### Used technology

Plasticized mortar mixture is applied on the tube outside surface by pressure pump, and is covered with wrapping of woven polypropylene fabric with the defined strength properties. Cement mortar contains chipped polypropylene fibre, improving the long-term plasticity and coherence of insulation, and liquefying agent, improving workability of mortar and strength properties.

### Type of protection

The protection corresponds to:

- Normal design FZM-N, which is not determined for the pipe thrust-boring without the use of protector pipe.
- Special design FZM-S with increased adhesion in the axial direction suitable for thrust boring.
- Both types of FZM insulation can be delivered as per agreement in yellow colour (coloured mortar ensures the colour stability even if on damaged surface).

## Tubes $\varnothing$ 159 - 820 mm

The protection corresponds to the FZM-N finish according to the German marking. It is not determined to the pipe jacking without the use of protector pipe.

### Dimensional assortment

Outside tube diameter	159 - 820 mm
Tube length	6 - 14 m

### Typical properties

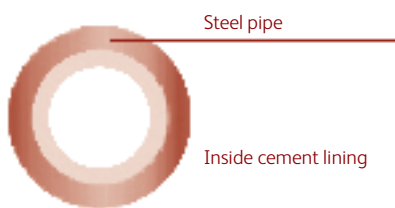
Minimum layer thickness	7 mm
Average layer thickness	9 mm
Tensile strength	42 MPa
Tensile strength at bending	7 MPa
Impact resistance	min. 150 J
Bendability	$R_{min.} = 50D$

### Certification

The cement mortar protection was certified as a new product by Technický a zkušební ústav stavební, a.s. Praha (Testing and Control Building Institute), detached workplace Brno.

## Inside surface protection

### Inside cement lining



### Type of lining

Inside cement mortar lining complies with the DIN 2614 standard requirements, application method II (by slinging), cement type N, type of ends A or B, or socket ends according to DIN 2460. The lining is determined to the transport of potable or waste water. Transport of aggressive waste waters must be consulted with manufacturer of the lining.

### Used technology

Cement mortar is applied inside of the rotating tube by slinging head, at the diameter of 89 - 159 mm it is a steel rod without head. After application of the required layer, the uniform layer thickness and smooth surface is reached by fast rotation of the tube. Before dispatching, the regime of the concrete layer maturing is followed, and visual inspections are performed.

### Dimensional assortment

Outside pipe diameter	89 - 820 mm
Pipe length	7 - 13 m

### Typical Properties

Minimum layer thickness	3 mm
Compression strength	40 MPa
Tensile strength at bending	7 MPa

## Tubes $\varnothing$ 89 - 820 mm

### Certification

Inside cement mortar lining is certified by Technický a zkušební ústav stavební, a.s., Praha (Testing and Control Building Institute), detached workplace Brno.

Pipes are supplied in two types of finish, according to their connecting:

- pipes with weld bevels and inside insulation, ended 5 mm from the end (without the necessity of reinsulating after welding)
- pipes with flared-out end for creating a socket joint. These tubes can be connected by single fillet weld along the flared-out end.

# Polyethylene coating ø 159 - 820 mm



The installed line makes possible to coat pipes in the O.D. range 159 - 820 mm with the three-layer coating pursuant to the DIN 30 670 Standard in normal design (maximum operating temperature 50°C) or in special design (operating temperature 80/90°C, increased surface hardness). Thus, it covers the entire assortment of the spiral welded pipes, part of the seamless tube assortment, and leaves the space for coating of pipes, supplied by other manufacturers.

## Grit-blasting machine

The grit blasting takes a course in the mechanical grit-blasting machine, equipped with two throwing wheels, operating with metal crushed material. The surface quality after grit-blasting corresponds to the SA 2 1/2 degree according to ISO 8501-1.

## Induction heating

The mid-frequency induction heating has 750 kW output, which is sufficient for heating of 10 t of pipes per hour. By passing the pipe through the inducting coil, it is heated to the application temperature, which is usually the temperature between 170 and 200 °C. The pipe temperature is continually measured by the infra-red sensor, and displayed on the control desk.



## Epoxy coating

The pipe enters the spraying booth, where the powdered epoxy is sprayed in the electrostatic field with 60 - 100 µm thickness, which melts down immediately, and cures during 30 - 60 seconds, whereby a high adherence to the steel surface is reached.

## Pipe pre-heating

The whole line starts with the intake bed, from which the tubes are conveyed to the grit-blasting machine. Before the blasting itself, the tubes are heated by the natural gas burners to the temperature of 50-80 °C, that is sufficiently above the dew point temperature.

## Visual inspection

After the grit blasting, the pipes undergo the visual inspection, during which possible surface defects are removed by grinding. The surface roughness is measured.

## Interoperational bed

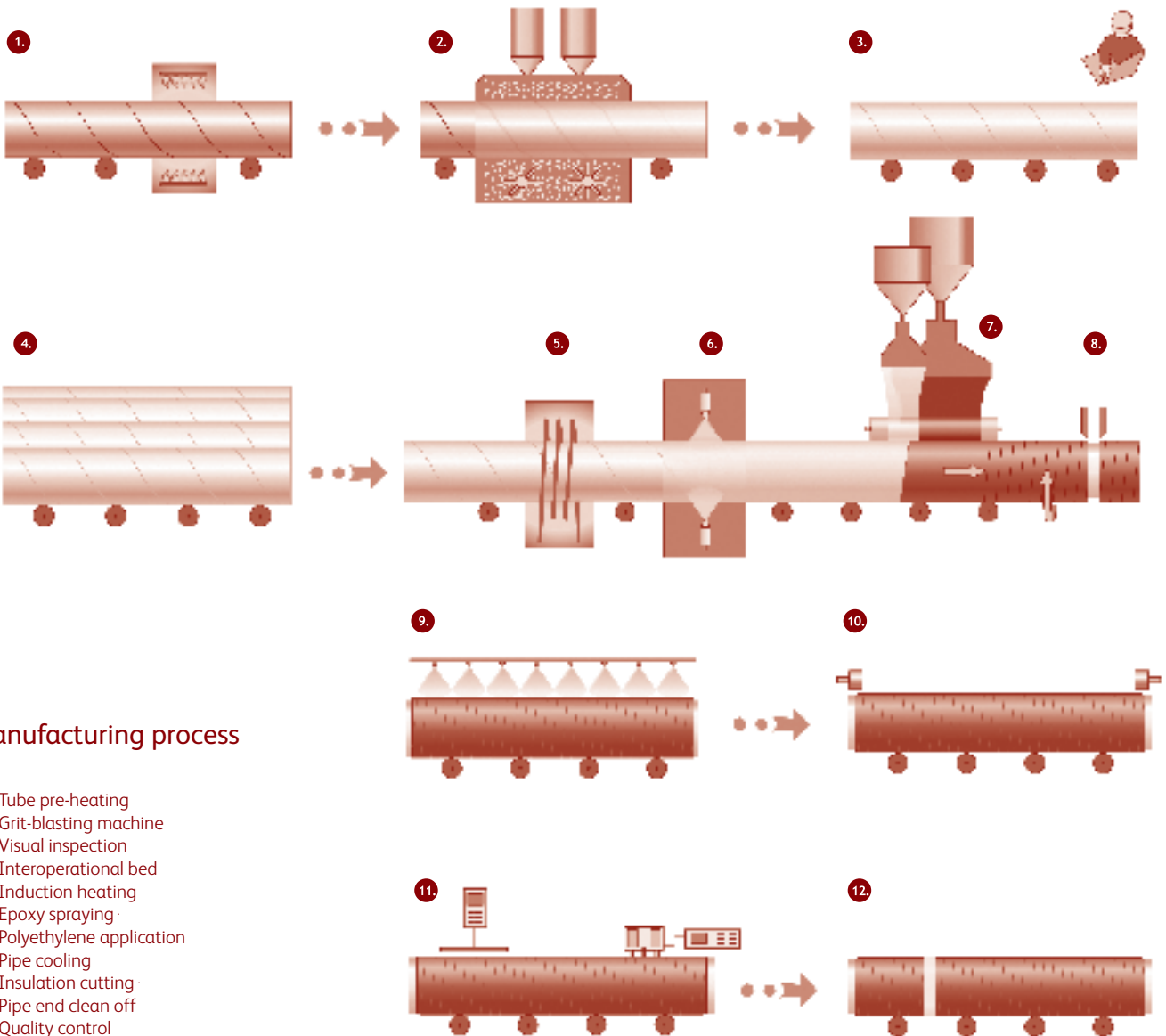
Pipes then get by the reversible roll table to the interoperational bed, which serves as a storage bin. The insulation process itself is continual, and it requires the continuous feed of pipes.



## Polyethylene application

Directly behind the spraying booth, there follows the application of the second layer - the so-called adhesive intermediate layer. This is the question of 250 µm thick adhesive layer, the function of which is to create the chemical bond between the epoxy and upper polyethylene layer. Coating itself is done by forcing-out the adhesive substance through the extruder flat nozzle into the thin strip, which is wrapped on the tube in semi-liquid condition.

Behind the adhesive substance nozzle, there is a wider nozzle, which extrudes the polyethylene foil. This is wrapped on the tube over the adhesive substance layer with multiple over-lapping. The wrapped layers are pressed on the tube by a roller of special silicon rubber, which makes possible to reach a high press, and presses the plastic also into the places of weld toe. With regard to the extrusion temperature, a mutual full melting of the individual over-lapped layers becomes, so the coating is quite homogeneous on the cut.



## Manufacturing process

1. Tube pre-heating
2. Grit-blasting machine
3. Visual inspection
4. Interoperational bed
5. Induction heating
6. Epoxy spraying
7. Polyethylene application
8. Pipe cooling
9. Insulation cutting
10. Pipe end clean off
11. Quality control
12. Marking

# Polyethylene coating ø 159 - 820 mm



## Coating cutting

Pipes go through the facility one by one, so it is necessary to cut the insulation by means of shearing jig. At the same time, the jig cuts the insulation off at the required distance from the pipe end (typically 140 +/- 10 mm).

## Pipe cooling

Immediately after the plastic application, there follows the cooling section, which reduces the surface temperature quickly by means of laminar and spray cooling, and enables the pipe transport on the roll table, and further handling without the risk of coating damage. After throwing out the pipe on the delivery bed, the cooling water residues are poored out of the pipe.



## Pipe-end clean off

There follows the pipe end clean up to the distance of 100 - 150 mm, which is performed by combination of cutting off the part of insulation, and grinding in the smooth transition of coating on the pipe. The non-coated pipe ends are protected from corrosion by the colourless varnish, and plastic protectors or caps are put on the bevels.

## Quality control

For each new combination of the insulating materials, the complex laboratory tests are performed in the Institute of Fuel Research and Utilization in Běchovice, which serve as the basis for product certification.

## Visual inspection

Each tube is checked visually on the coating compactness.

## Coating thickness measuring

Further, the coating thickness measuring is performed on the whole pipe length and surface, at 12 points at least. At the spiral-welded pipe, there are performed the additional 4 insulation measurements above the weld. The measurement is performed by the magnetic or ultrasonic apparatus. The Table shows the required values according to DIN 30 670 Standard.



## Minimum coating thickness in mm

Outside diameter (mm)	Finish DIN 30 670 - N - n	
	normal thickness (mm)	Reinforced thickness (mm)
D < 114.3	1.8	2.5
114.3 ≤ D < 273	2	2.7
273 ≤ D < 508	2.2	2.9
508 ≤ D < 762	2.5	3.2
D ≥ 762	3	3.7

## Peeling test - minimum values

Finish	Testing temperature	Minimum values
DIN 30 670 - N	20±5°C	35 N/cm
	50±5°C	15 N/cm
DIN 30 670 - S	20±5°C	35 N/cm
	50±5°C	25 N/cm

## All-surface holiday test

The all-surface holiday test is performed under the testing voltage of 25 kV, the task of which is to check the absence of coating porosity. The test is performed with automatic holiday detector with round electrode and DC current supply Buckleys and with the tube passing through in the line, or by the hand spark crack detector with direct earthing and flat conduit terminal, on pipe rotating on the positioner.



## Impact resistance test of coating

In addition to these tests, there is performed the impact resistance test. The test consist in throwing down a weight of exact mass, equipped with the spherical impact surface of 25 mm radius, from the height of 1 m. The weight mass is set by standard according to the tube diameter. After thirty impacts, there is performed the electro-spark test at the tested surfaces, where no punctures must be indicated.

## Marking

In accordance with the standard requirements, the stickers are stucked on the tube ends, with the designation of the manufacturer, and coating type. The stickers single out by colour the coating thickness: yellow for normal thickness, and red for thickened thickness. The pipe ends are varnished for short-term protection, and equipped with mechanical protections of the bevelled surfaces.



## Peeling test

The coating peeling test on the pipe end is performed once a shift. The test is done by the COESFELD portable apparatus by tearing off the scored coating strip of 2 cm width at the specified speed. The measured tear-off power is converted per 1 cm

## Guaranteed coating properties DIN 30 670 - N

Operating temperature	max. 50°C
High voltage failure resistance	min. 25 kV
Peeling power	min. 35 N/cm at 20±5°C min. 15 N/cm at 50±5°C
Impact resistance	min. 10 Nm
Indentation hardness	max. 0.2 mm
Coating elongation	min. 200%
Specific electric resistance	min. 108 Ωm <sup>2</sup>

# Outside fibre-cement mortar protection ø 159 - 820 mm



At present, all gas pipe-line underwater passages, pipe jackings and sections, passing through the rocky landscape, are protected with the reinforcement of the polyethylene coating by the fibre-cement mortar cover (FZM-N). Special coating (FZM-S) is used for thrust boring of tube to the excavation-free placing.



## Fibre - cement mortar preparation

The basis of the equipment is a mixer with the built-in balance and mechanical transport of cement and sand from two outside silos. Mixer charging is from above, the finished mixture is then discharged through the bottom directly into the funnel of the cement mixture working pump. The pump drives the mixture by the pressure hose in the truck for outside coating. The truck then travels at optional speed along the rotating pipe.

The coating mixture is made of cement, sand, potable water, liquefying agent for better conveyance through hose, and chipped polypropylene fibres. The task of these fibres is partly to prevent the mixture leakage through the wrapping, partly they considerably improve the resistance of the resulting coating against crumbling, and its plastic properties. During manufacturing of FZM-S the mortar is enriched with special components improving the properties of the coating (strength and adhesion). Yellow color is reached by added color pigments.

## Cement mixture application

On the outside insulation truck, there is a stand with laminating polypropylene strip decoiler, and cement feed hoseholder with the application tail. The coating itself is performed by coiling the laminating strip on the rotating pipe, and mortar application between the coiled strip and the pipe surface, at the simultaneous truck travel. The travel speed and revolutions correspond to the required strip overlapping of 60 %, and achievement of the required cement layer. At the same time, the coating has been mechanically smoothed by means of a wiper, so that the required surface flatness should be reached. The insulation ends are cut off into the conical transition.



## Outside cement-fibrous coating layer thickness

DN diameter (mm)	Minimum layer thickness (mm)
159-820	7

### Hardening of coating

During outside coating, each pipe is handled separately, with maximum care, and the pipes are stored until hardening by laying down on the non-coated ends.

During the first 24 hours, the coating is moistured, and after 72 hours, on condition that the ambient temperature will never drop under 5°C, the pipes can be safely despatched from the plant.

Otherwise they could be despatched no sooner than after 5 days. The declared strength properties are reached after 7 days.

### Pipe inspection and marking

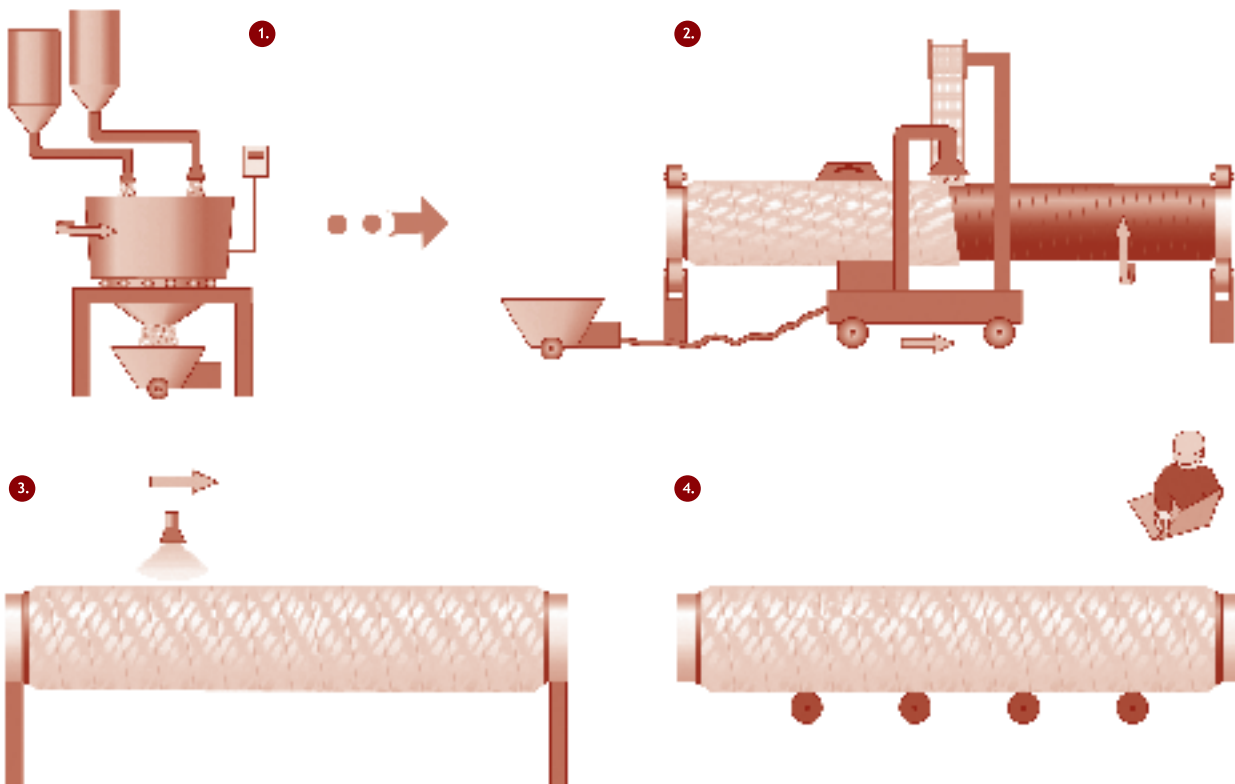
The finished coating complies with the requirements of the Company Standard KN 42 0025, which follows from the German regulation DVGW GW 340.

The following tests are performed: the mortar spilling test at the jarring table - each mixer, once a week the analysis of fresh mortar, once a year mortar strength under pressure, once a year mortar tensile bending strength, visual inspection of coating and thickness measuring.

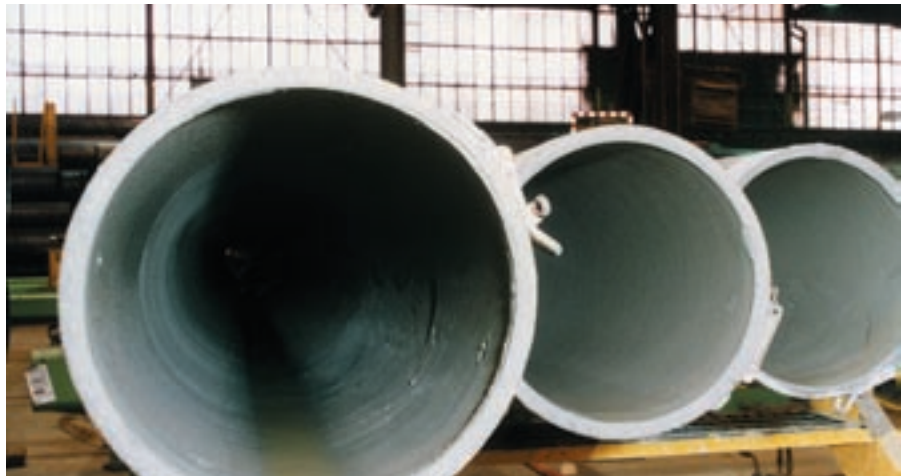


## Manufacturing process

1. Fibre-Cement mortar preparation
2. Cement mixture application
3. Hardening of coating
4. Pipe inspection and marking



## Inside cement lining ø 89 - 820 mm



The cement mortar is also used for lining of the pipe inside surface. It serves here primarily as a lasting, hygienically unexceptionable lining of piping for conveyance of potable water. Lining has two major tasks, to prevent the steel pipe corrosion, and reduce clogging of pipeline with incrustations.



### Mortar preparation

The basis is a mixer, common for both types of the cement lining. Mixer charging is from above, the finished mixture is then discharged through the bottom directly into the funnel of the working pump, which drives the mixture in the rod for inside cement lining.

### Cement mortar application

For the inside surface lining, a truck is used, carrying the twelve-meter lance, equipped at the end with the torketing head holder, and cement conveyance in hose. There are several torketing heads, and they differ especially in their size and performance, according to the pipe diameter. Steel lance without the head is used for the diameter of 89 - 159 mm. The compressed-air drive is common at all heads. The truck makes possible to change the height position of the lance according to the individual diameters, and to control the feed rate during the application. The positioners make a part of the facility, which make possible rotation of the coated pipe by the hydraulic motor, with the possibility of large range of revolutions. At the mortar spraying itself, the truck runs out of the pipe, and the pipe is rotating slowly, at the same time. The mortar is rendered step by step on the pipe wall.



### Pipe rotation

After finishing this operation, the pipe is spinned to the maximum speed, at which the acceleration of gravity on the inside pipe diameter achieves the value of almost 10 G. The result of centrifuging is, as was said already, a very smooth surface and improvement of adhesion of the mixture to the metal surface. The surface roughness has impact on the losses in pressure, and pipeline choking during its operation.

## Inside cement lining layer thickness

Outside diameter (mm)	Minimum thickness (mm)	Maximum thickness (mm)
$D < 159$	3	8
$159 \geq D < 323.9$	4	9
$323.9 \geq D < 610$	5	10
$610 \geq D < 820$	6	13

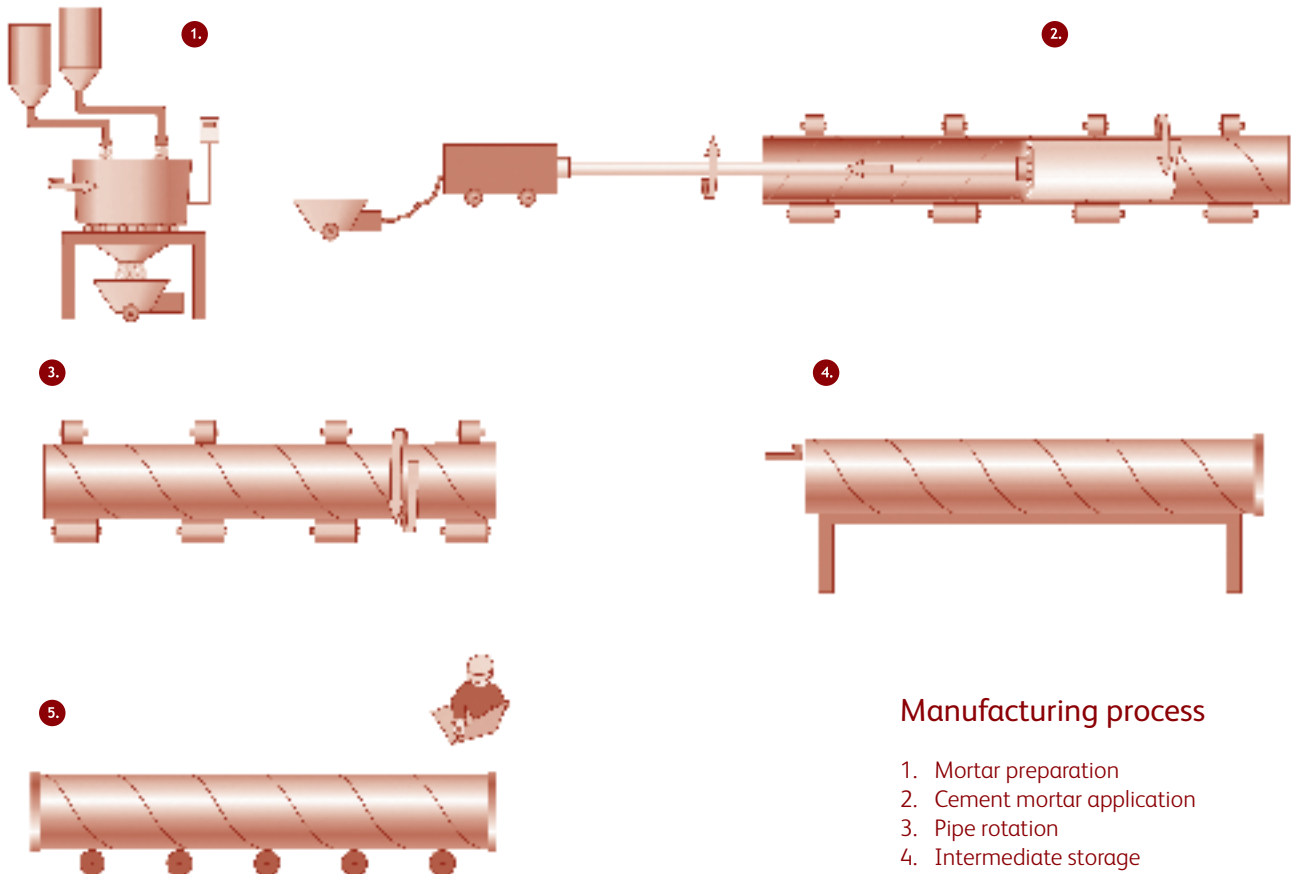


### Intermediate storage

Pipes with freshly applied mixture are carefully rolled down a bed, and they are not transported anywhere during 24 hours, at the minimum. Immediately after the application, the ends are finished according to the customer's requirement, and the faces are covered with foil, to prevent fast drying and surface cracking. Sprinkling with water is performed according to the need. The dispatch to the customer is suitable after 7 days storage in the manufacturing Plant, at the earliest.

### Output inspection

There is performed the visual check of cracks, and layer thickness measurement. Table shows the correct thickness values. Further, a sample is taken from each mixer for the spilling test, and the fresh mortar analysis is performed once a week according to DIN 2614.



### Manufacturing process

1. Mortar preparation
2. Cement mortar application
3. Pipe rotation
4. Intermediate storage
5. Output inspection

# Socket pipes

Spiral welded pipes with socket joint are determined for simple connecting of water main.

## Used technology

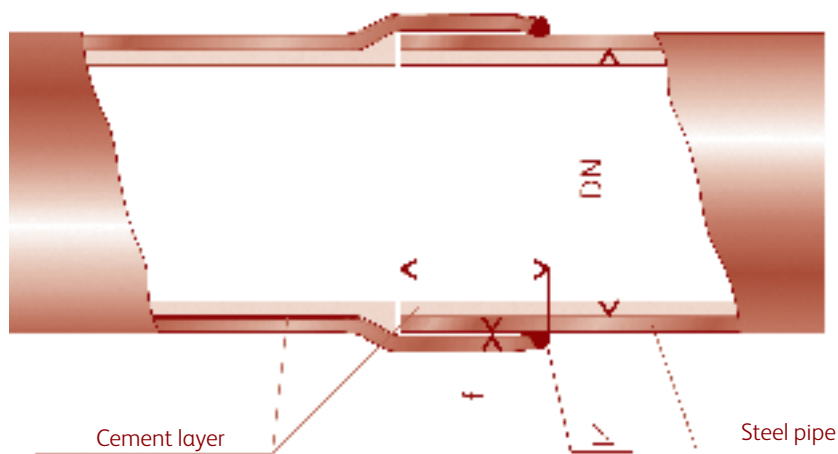
Sockets are manufactured by cold flaring-out of pipe ends. The pipe ends are perpendicularly cut-off. Joining is made by sliding the pipe end in socket and welding by the peripheral fillet weld, which is easier and also enables the utilization of less experienced welders.

## Lining type

These pipes are delivered according to DIN 2460 Standard, and are coated with the outside polyethylene coating according to DIN 30 670-N-n and inside cement mortar lining according to DIN 2614. It is sufficient to complete the lining of the inside surface in the jointing places, e.g. by the heat contractible packing. The joint doesn't require any additional treatment of the pipe inside surface.

## Checking

Pipes are manufactured and tested according to DIN 2458 / DIN 1626, utilization of the admissible calculation stress in weld  $v_N=1.0$ .



## Steel grades

	maximum thickness
St 37.0	8.0
St 44.0	6.3

## Dimensions and weight of produced pipes DIN 2458/DIN 1626

Nominal inside diameter	Outside pipe diameter	Wall thickness	Weight per meter	Depth of sliding t	Clearance in joint f	Nominal pressure of piping PN acc. to the used steel	
						St 37.0	St 44.0
DN	(mm)	(mm)	(kg/m)	(mm)	(mm)		
300	323.9	5.6	44.0	105	2	40	50
350	355.6	5.6	48.3	115	2.5	32	40
400	406.4	5.6	55.4	120	2.5	32	32
500	508	5.6	69.4	130	3	25	30
600	610	6.3	93.8	130	3	25	25
700	711	6.3	109	130	3	20	20
800	813	8.0	158.8	130	3	20	20

Notes:

# Correct way how to place your order

If your order should be satisfied quickly and correctly, it has to include the data, which represent a technically unambiguous order, and shall enable to avoid possible misunderstandings.



## For the steel pipe:

### Outside diameter x wall thickness - steel grade

e.g.: 610 x 6.3 - St 52.0

e.g. If you are not sure about the choice of steel grade, wall thickness, or pipe finish standard, let us know the purpose of use of pipes in the order.

### Dimensional standard, technical finish standard

e.g.: DIN 2458, DIN 1626

### Pipe length

- production length (6 - 18 m)

- fixed length ( $\pm 500$  mm)

- accurate length (+25/-0 mm)

### Finish of ends

- perpendicularly flame-cut

- perpendicularly cut-off (e.g. DIN according to 2559/22)

- with the bevel for welding

## For coating:

### Polyethylene coating

- normal thickness 3L-PE DIN 30 670-N-n

- reinforced thickness 3L-PE DIN 30 670-N-n

### Outside fibre-cementcoating

KN 42 0025 - FZM-N, KN 42 0025 - FZM-S

### Outside bitumen coating

KN 42 0023.20

### Inside cement lining

ZM-DIN 2614-N-II type of ends B

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