TPS TECHNITUBE®
RÖHRENWERKE GMBH

HEAT EXCHANGER & CONDENSER TUBES

(incl. Bending) ex Stock

INTRODUCTION

TPS-Technitube Röhrenwerke GmbH is one of the leading manufacturers of High Quality Tubes.

Since almost 25 years TPS Technitube Stock and Shutdown Service stores Heat-Exchanger and Condenser Tubes in Carbon Steel, Low Alloy Steel, Aluminium Brass, Admiralty Brass, Copper-Nickel Alloys and Stainless Steel.

These material grades are available in fix lengths up to 19600 mm. Further to the stocking of the material the TPS STOCK department arranges the cutting, deburring, bending (if applicable), testing, packing and dispatching of the tubes.

The dispatch can be arranged within some hours during the week and within 48 hours during the weekend.

The following material grades are available in all common sizes:
ASTM/ASME A/SA 179 • ST 35.8/I DIN 17175 • P235GH TC1 EN 10216-2
ASTM/ASME A/SA 199 T 5 • ASTM/ASME A/SA 213 T 5
ASTM/ASME A/SA 199 T 9 • ASTM/ASME A/SA 213 T 9
ASTM/ASME A/SA 199 T 11 • ASTM/ASME A/SA 213 T 11
ASTM/ASME B/SB 111 Alloy C68700 • BS 2871 Part 3 CZ 110
ASTM/ASME B/SB 111 Alloy C44300 • BS 2871 Part 3 CZ 111
ASTM/ASME B/SB 111 Alloy C70600 • BS 2871 Part 3 CN 102
ASTM/ASME B/SB 111 Alloy C71500 • BS 2871 Part 3 CN 107
ASTM/ASME A/SA 213 TP 304/304L • 1.4301/1.4306 EN 10216-5
ASTM/ASME A/SA 213 TP 316/316L • 1.4401/1.4404 EN 10216-5
ASTM/ASME A/SA 213 TP 321 • 1.4541 EN10216-5
ASTM/ASME A/SA 213 TP 316Ti • 1.4571 EN 10216-5

TPS-Technitube Röhrenwerke GmbH is your No. 1 for High Quality Heat Exchanger tubes ex stock.

We stock the Heat Exchanger tubes for you – you save a lot of time and money!

Please test us – we will solve your delivery problems!

For enquiries please contact:

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TPS Headoffice

TPS Stock

Stock Sizes and Grades

Tube OD in / mm	Thickness WT		ASTM A 179	ST 35.8/I DIN 17175 P235GH TC1 EN 10216-2	ASTM A 192	ASTM A 334 Gr. 1	ASTM A 334 Gr. 3	ASTM A 334 Gr. 6	ASTM A 199/ A 213 T5	ASTM A 199/ A 213 T9	ASTM A 199/ A 213 T11
	BWG/SWG	INCH									
3/8"	20 BWG / 20 SWG	0.035"/0.036"	x	x	x	x					
3/8"	18 BWG / 18 SWG	0.049"/0.048"	x	x	x	x					
1/2"	16 BWG / 16 SWG	0.065"/0.064"	x	x	x	x					
5/8"	18 BWG / 18 SWG	0.049"/0.048"	x	x	x	x					
5/8"	16 BWG / 16 SWG	0.065"/0.064"	x	x	x	x					
5/8"	14 BWG / 14 SWG	0.083"/0.080"	x	x	x	x					
3/4"	16 BWG / 16 SWG	0.065"/0.064"	x[2)]	x[2)]	x[2)]	x[2)]					
3/4"	14 BWG / 14 SWG	0.083"/0.080"	x[2)]	x[2)]	x[2)]	x[2)]	x	x	x[2)]	x	x[2)]
3/4"	12 BWG / 12 SWG	0.109"/0.104"	x[2)]	x[2)]	x[2)]	x[2)]			x		x
3/4"	10 BWG / 10 SWG	0.134"/0.128"	x	x	x	x					
1"	16 BWG / 16 SWG	0.065"/0.064"	x	x	x	x					
1"	14 BWG / 14 SWG	0.083"/0.080"	x	x	x	x					x
1"	12 BWG / 12 SWG	0.109"/0.104"	x[2)]	x[2)]	x[2)]	x[2)]		x	x[2)]	x	x
1"	11 BWG / 11 SWG	0.120"/0.116"	x	x	x	x					
1"	10 BWG / 10 SWG	0.134"/0.128"	x[2)]	x[2)]	x[2)]	x[2)]					
1 - 1/4"	12 BWG / 12 SWG	0.109"/0.104"	x	x	x	x			x		
1 - 1/4"	10 BWG / 10 SWG	0.134"/0.128"	x	x	x	x			x		
1 - 1/2"	12 BWG / 12 SWG	0.109"/0.104"	x	x	x	x			x		
1 - 1/2"	10 BWG / 10 SWG	0.134"/0.128"	x	x	x	x			x		
10,00 mm	1,00 mm		x[1)]	x[1)]	x[1)]	x[1)]					
10,00 mm	1,50 mm		x[1)]	x[1)]	x[1)]	x[1)]					
12,00 mm	1,00 mm		x[1)]	x[1)]	x[1)]	x[1)]					
12,00 mm	1,50 mm		x[1)]	x[1)]	x[1)]	x[1)]					
14,00 mm	1,50 mm		x[1)]	x[1)]	x[1)]	x[1)]					
14,00 mm	2,00 mm		x[1)]	x[1)]	x[1)]	x[1)]					
15,00 mm	1,50 mm		x[1)]	x[1)]	x[1)]	x[1)]					
16,00 mm	1,50 mm		x[1)]	x[1)]	x[1)]	x[1)]					
16,00 mm	2,00 mm		x[1)]	x[1)]	x[1)]	x[1)]					
18,00 mm	1,50 mm		x[1)]	x[1)]	x[1)]	x[1)]					
18,00 mm	2,00 mm		x[1)]	x[1)]	x[1)]	x[1)]					
20,00 mm	2,00 mm		x[1) 2)]	x[1) 2)]	x[1) 2)]	x[1) 2)]					
20,00 mm	2,50 mm		x[1)]	x[1)]	x[1)]	x[1)]					
25,00 mm	2,00 mm		x[1)]	x[1)]	x[1)]	x[1)]					
25,00 mm	2,50 mm		x[1) 2)]	x[1) 2)]	x[1) 2)]	x[1) 2)]					

1) Average wall thickness
2) High Quantity available

Stock Sizes and Grades

ASTM B 111 C68700 BS 2871/3 CZ 110	ASTM B 111 C44300 BS 2871/3 CZ 111	ASTM B 111 C70600 BS 2871/3 CN 102	ASTM B 111 C71500 BS 2871/3 CN 107	ASTM A 213 TP 304/ TP 304L	ASTM A 213 TP 316/ TP 316L	ASTM A 213 TP 321	ASTM A 213 TP 316 Ti	Tube OD mm	Thickness WT mm
								9,53 mm	0,89 / 0,91 mm
								9,53 mm	1,245 / 1,219 mm
								12,70 mm	1,651 / 1,626 mm
x	x							15,88 mm	1,245 / 1,219 mm
x	x							15,88 mm	1,651 / 1,626 mm
								15,88 mm	2,108 / 2,032 mm
x[2)]	x[2)]	x	x[2)]	x	x	x		19,05 mm	1,651 / 1,626 mm
x[2)]	x[2)]	x	x[2)]	x	x	x		19,05 mm	2,108 / 2,032 mm
x								19,05 mm	2,769 / 2,642 mm
								19,05 mm	3,404 / 3,251 mm
x					x			25,40 mm	1,651 / 1,626 mm
x				x	x			25,40 mm	2,108 / 2,032 mm
					x			25,40 mm	2,769 / 2,642 mm
								25,40 mm	3,048 / 2,946 mm
								25,40 mm	3,404 / 3,251 mm
								31,75 mm	2,769 / 2,642 mm
								31,75 mm	3,404 / 3,251 mm
								38,10 mm	2,769 / 2,642 mm
								38,10 mm	3,404 / 3,251 mm
								10,00 mm	1,00 mm
								10,00 mm	1,50 mm
								12,00 mm	1,00 mm
								12,00 mm	1,50 mm
								14,00 mm	1,50 mm
								14,00 mm	2,00 mm
								15,00 mm	1,50 mm
								16,00 mm	1,50 mm
								16,00 mm	2,00 mm
								18,00 mm	1,50 mm
								18,00 mm	2,00 mm
						x[1)]	x[1)]	20,00 mm	2,00 mm
						x[1)]	x[1)]	20,00 mm	2,50 mm
						x[1)]	x[1)]	25,00 mm	2,00 mm
								25,00 mm	2,50 mm

Carbon Steel

STANDARD GRADE	ASTM A 179	ASTM A 192	DIN 17175 ST 35.8/I	EN 10216-2 P235GH TC1	NFA 49-215 TU 37 C
C	0,06 - 0,18	0,06 - 0,18	0,17 max.	0,16 max.	0,18 max.
Mn	0,27 - 0,63	0,27 - 063	0,40 - 0,80	1,20 max.	0,30 - 0,80
P	0,035 max.	0,035 max.	0,040 max.	0,025 max.	0,045 max.
S	0,035 max.	0,035 max.	0,040 max.	0,010 max.	0,045 max.
Si		0,25 max.	0,10 - 0,35	0,35 max.	0,05 - 0,27
Cr				0,30 max.	
Mo				0,08 max.	
Ni				0,30 max.	
Al				0,020 min.	
Cu				0,30 max.	0,25 max.
Sn					0,03 max.
Cr+Cu+Mo+Ni				0.70 max.	
Yield Strength N/mm2	180 min.	180 min.	235 min.	235 min.	220 min.
Tensile Strength N/mm2	325 min.	325 min.	360 - 480	360 - 500	360 - 450
Elongation (%)	35 min.	35 min.	25 min.	25 min.	Rm (A-2)>10500 min.
Hardness HRB	72 max.	77 max.			

Low Alloy Steel

STANDARD GRADE	ASTM A 213 T 5	ASTM A 199 T 5	DIN 17176 12 CrMo 195	BS3604 Part 1 Grade 625	NFA 49-215 TU Z 10 CD5 05
C	0,15 max.	0,15 max.	0,08 - 0,15	0,15 max.	0,17 max.
Mn	0,30 - 0,60	0,30 - 060	0,30 - 0,60	0,30 - 0,60	0,30 - 0,65
P	0,025 max.	0,025 max.	0,025 max.	0,030 max.	0,035 max.
S	0,025 max.	0,025 max.	0,020 max.	0,030 max.	0,035 max.
Si	0,50 max.	0,50 max.	0,50 max.	0,50 max.	0,10 - 0,55
Cr	4,00 - 6,00	4,00 - 6,00	4,00 - 6,00	4,00 - 6,00	3,90 - 6,10
Mo	0,45 - 0,65	0,45 - 0,65	0,45 - 0,65	0,45 - 0,65	0,40 - 0,65
Cu					0,25 max.
Sn					0,030 max.
Al				0,02 max.	
Yield Strength	min. 205	min. 170	min. 175	min. 170	min. 205
N/mm2					
Tensile Strength	min. 415	min. 415	410 - 540	450 - 600	410 - 560
N/mm2					
Elongation (%)	min. 30	min. 30	min. 22	min. 20	min. 22
Hardness HRB	85 max.	85 max.			

Aluminium Brass (Alloy 687)

STANDARD GRADE	ASTM B 111 C68700	BS 2871 / PART 3 CZ 110 (TA)	DIN 17660/1785 CuZn20Al2	NFA 51102 CuZn22Al2	JIS H3300 C6870 (T)
Cu	76,0 - 79,0	76,0 -78,0	76,0 - 79,0	76,0 - 79,0	76,0 - 79,0
Al	1,80 - 2,50	1,80 - 2,30	1,80 - 2,30	1,80 - 2,50	1,80 - 2,50
Pb	0,07 max.	0,07 max.	0,07 max.	0,07 max.	0,05 max.
Ni			0,10 max.		
Fe	0,06 max.	0,06 max.	0,07 max.	0,06 max.	0,05 max.
Zn	Rem.	Rem.	Rem.	Rem.	Rem.
As	0,02 - 0,06	0,02 - 0,06	0,02 - 0,035	0,02 - 0,06	0,02 - 0,06
P			0,01 max.		
Mg			0,005 max.		
Mn			0,10 max.		
Total Impurities		0,3 max.	Others Total 0,10 max.	0,03 max.	
Yield Strength N/mm2	125 min. (O61)		150 - 230 (F39) 120 - 180 (F34)		
Tensile Strength N/mm2	345 min. (O61)		390 min. (F39) 340 min. (F34)		375 min. (O)
Elongation (%)			45 min. (F39) 55 min. (F34)		40 min. (O)
Hardness Hv5		85 - 110		80 - 130	
Grain Size (mm)	0,010 - 0,045	0,050 max.	0,010 - 0,050	0,010 - 0,045	0,010 - 0,045

Admiralty Brass (Alloy 443)

STANDARD GRADE	ASTM B 111 C44300	BS 2871/PART 3 CZ 111 (TA)	DIN 17660/1785 CuZn28Sn1	NFA 51102 CuZn29Sn1	JIS H3300 C4430 (T)
Cu	70,0 - 73,0	70,0 -73,0	70,0 - 72,5	70,0 - 73,0	70,0 - 73,0
Sn	0,90 - 1,20	1,00 - 1,50	0,90 - 1,30	0,90 - 1,20	0,90 - 1,20
Pb	0,07 max.	0,07 max.	0,07 max.	0,07 max.	0,05 max.
Ni			0,10 max.		
Fe	0,06 max.	0,06 max.	0,07 max.	0,06 max.	0,05 max.
Zn	Rem.	Rem.	Rem.	Rem.	Rem.
As	0,02 - 0,06	0,02 - 0,06	0,02 - 0,035	0,02 - 0,06	0,02 - 0,06
P			0,01 max.		
Mn			0,10 max.		
Total Impurities		0,30 max.	Others Total 0,10 max.	0,03 max.	
Yield Strength	105 min. (O61)		140 - 220 (F36)		
N/mm2			100 - 170 (F32)		
Tensile Strength	310 min. (O61)		360 min. (F36)		315 min. (O)
N/mm2			320 min. (F32)		
Elongation (%)			45 min. (F36) 55 min. (F32)		30 min. (O)
Hardness Hv5		80 - 105		80 - 120	
Grain Size (mm)	0,010 - 0,045	0,050 max.	0,010 - 0,050	0,010 - 0,045	0,010 - 0,045

All mechanical properties at room temperature.

U-TUBES

Your advantages, if you purchase U-tubes from TPS

You save time and money

· only one contact person
· avoiding transport damages to the long initial tubes on the way to the bending company
· no extra costs for the carriage to the bending company
· benefit from time saving due to the parallel production of the initial tubes and the U-tubes
· spare tubes on request which we stock for you
· saving space and time for assambling the heat exchangers as the U-tubes can be removed radius-wise from the wooden combs

Surface quality

· You receive tubes which are free from oil and grease as well as free from debris
· You receive a metallic bright surface without discolouration on the inner and outer tube

Heat treatment of bending area

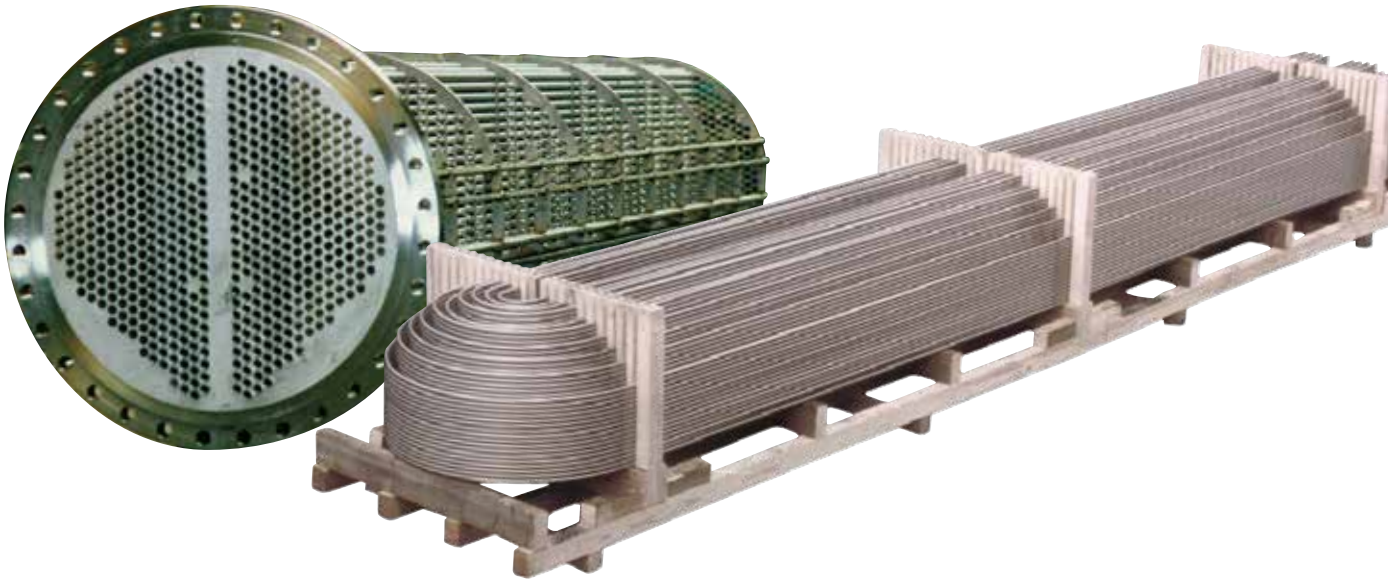
· You can choose between solution or stress relief annealing depending on the material standard and grade
· On demand, we also provide the annealing charts

Packing

· The U-tubes are secured to the transport-rack using wooden combs in order to avoid damage
· Your incoming material inspection is faster and more efficiently due to the accurate packing sorted by radius

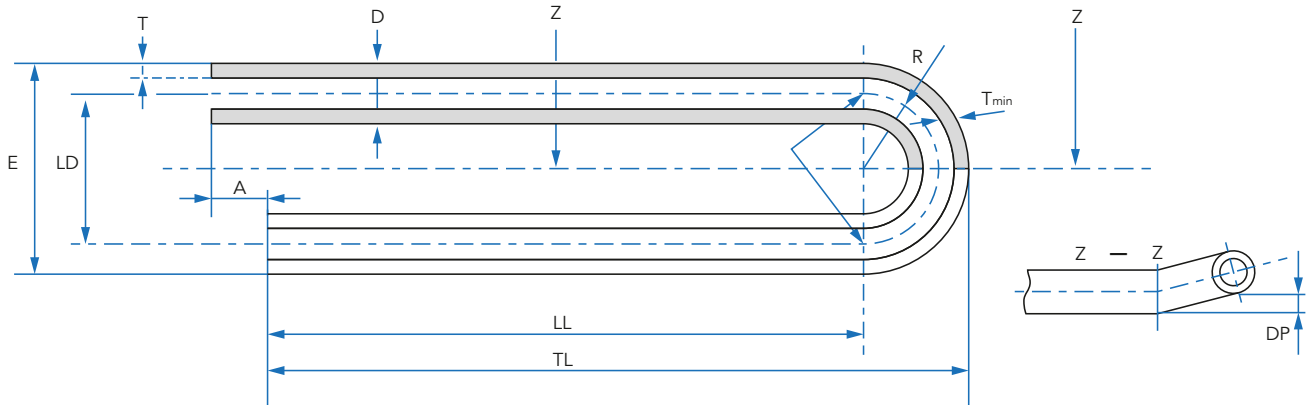
Quality

· You receive a detailed test certificate with all the important measures of the bend along with the inspection certificate 3.1
· You are given a warranty of up to 3 years*



* In line with our General Terms and Conditions of Sale we guarantee defect free materials and good workmanship

The bending of the straight tubes is carried out according to the applicable specifications DIN28179, TEMA RCB-2.31, ASTM A/ASME SA 688, ASTM B/ASME SB 163 and/or acc. customer´s specification. Usually seamless tubes of austenitic, ferritic, martensitic and Duplex steels as well as nickel alloy tubes with radii from 1,5D can be bent.
For radii <1,5D tolerances (deviating from the tolerance standard) for ovality/flattening and minimum wall in the bending area have to be agreed. Bending of titanium tubes is possible from radius 2D up.



Meaning of measurements and symbols:

A	leg length difference
E	(2R + D): 2x radius plus outside diameter
D	nominal outside diameter
D_{max}	max. outside diamater
D_{min}	min. outside diamater
LD	leg length distance measured from points of tangency
LL	leg length
TL	total length

R	centerline bend radius
R_{min}	min. radius
T	nominal wall thickness
T_{min}	min. wall thickness in outside bending area
SW	smalles wall thickness of straight tube
O	ovality
DP	deviation from plane of bend
Z	section

TOLERANCES

Radii tolerance

R 1,5xD - R 200 +/- 1,0 mm
R > 200 - R 400 +/- 1,5 mm
R > 400 +/- 2,0 mm

Wall thinning of bending area

acc. DIN 28179 $T_{min} \geq \frac{SW \times (2\,R + D)}{2 \times (R + D)}$ mm

According to TEMA R-2.3 1 for radii from 1,5D: max. 17% wall thinning based on the minimum wallthickness of the straight tube.

Tolerance on straight leg length

straight leg ≤ 5000 mm - 0/+ 3 mm
straight leg > 5000 mm ≤ 8000 mm - 0/+ 5 mm

Difference in leg length

leg length ≤ 5000 mm - 0/+ 3 mm
leg length > 5000 mm - 0/+ 5 mm

Tolerance on ovality

Allowable deviation from ovality in %

R ≤ 4 D $O = \frac{D}{5\,R} \times 100$
R > 4 D ≤ 5 %

The deviation O of the ovality is calculated as follows:

$$O = 200 \times \frac{D_{max} - D_{min}}{D_{max} + D_{min}}$$

Flattening on bend (TEMA RCB-2.31 only)

Flattening does not exceed 10% of the nominal diameter

Tolerance on total length

≤ 6000 mm - 0/+ 5 mm
> 6000 mm - 0/+ 8 mm

Deviation from plane of bend DP

R ≤ 300 mm ≤ 1,5 mm
R > 300 mm ≤ 2 mm

HEAT TREATMENT PROCEDURE OF BENDING AREA

General

According to the German regulation AD-Merkblatt HP7/3, U-Tubes with a radius > 1,3 D are usually not subject to heat treatment after bending.
Should a heat treatment be required, it has to be agreed before order placement.

Cleaning of tube surface

Before the heat treatment of the tube, its surface in the zone that will be annealed is going to be cleaned in order to remove any residue.

Procedure

The bend and maximum 300 mm of the leg will be heated to material-specific temperature through an electric resistance heat treatment.

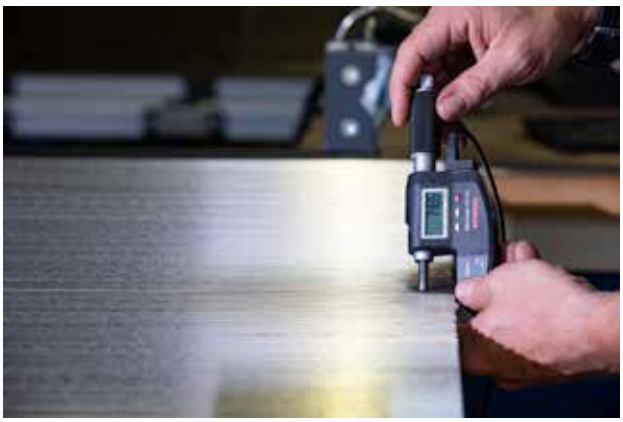
The measurement of the temperature is going to be accomplished by an automatic infrared camera. The tube interior is going to be rinsed with protective gas to avoid oxidation.

A light oxide layer is permitted according to ASTM A 688. The discolouration on the outer tube surface will be mechanically removed on request.

Method

Solution annealing:
Heating to a temperature according to the material specification, followed by rapid quenching.

Stress relieving:
Rapid heating to a temperature between 550 - 650°C, followed by slow cooling in still air.



INSPECTION, DOCUMENTATION & PACKING

Dimensional inspection

The bending radius, the run-out respectively the flattening in the bending area, the wall thinning in the tension zone as well as the overall length are going to be documented once at each machine setting.
Furthermore a test bend of the smallest radius is going to be cut in 4 segments and the minimum wall is going to be documented in the tension zone. On all other radii the measurement of the wall thickness in the tension zone will be performed by an ultrasonic wall thickness measuring device.

Tightness Test (optional)

Upon agreement, it is possible to perform a tightness test with demineralized water (deionate) on the U-tubes with a maximum pressure of 400 bar.
The pressure will be held at least 5 seconds.

Dye Penetrant Test (optional)

Dye penetrant testing of the bending area can be agreed indicating the corresponding radii.

Cleanliness

The cleanliness of the inside and outside surface is inspected on each U-tube.

Test of free passage

Upon agreement, it is possible to prove the free passage by a ball passage test according to DIN 28179.

Marking

In addition to the marking of the tube, a label that includes the information about the radius and the amount of the tubes is going to be attached at the first layer of each radius.

Packing

The standard packing consists of transport racks with combs and foil protection (in case of transport by truck without reloading). Other packing has to be arranged during the order placement. The removal by radius is assured. If requested, the tube ends may be protected with plastic plugs.

Documentation according to EN 10204

- Inspection Certificate 3.1 or
- Inspection Certificate 3.2
  (by Third Party Inspection Company)
- Bending Report
- other documentation on request


Headquarter


Project Office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TPS TECHNITUBE® RÖHRENWERKE GMBH

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