

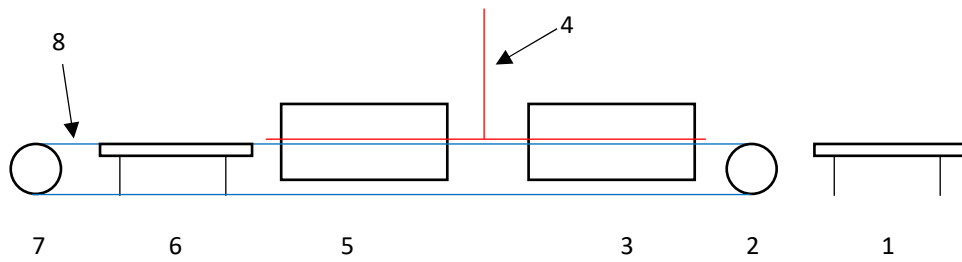
1.1 Annealing furnace

The annealing of the tubes in the annealing furnace softens them so that after further technological steps they can be prepared for drawing on the drawing machines.

Brief description of the machine	Continuous tubular annealing furnace with hydrogen atmosphere.	
Machine designation	ZH01	
Inventory number	D-9809	
Year of manufacture	1970-71	
Producer	BOREL SA	
Year of reconstruction	2019-20	
Technical parameters	max. temperature in retorts	1100 °C
	max. heating system temperature	1300 °C
	nitrogen gassing	400 - 750 °C
	hydrogen gassing	≥ 750 °C
	max. length of annealing tubes	5,0 m
	linear velocity	0,1 – 0,8 m/min
	length of the annealing furnace	6,0 m (effective length 5.5 m)
	length of preparation table	4,0 m
	length of cooling trough	4,0 m
	unloading table length	5,0 m
	total line length	22,0 m
	electric heating input	80 kW - 4 heating zones
	total power input	90 kVA
	circuit breaker	3x 160 A
	connection voltage	3PEN 50 Hz 400 V/TN-C-S
	consumption H ₂ *)	85 m ³ /hour
	consumption N ₂ *)	1,2 m ³ /hour
	insulation	Fibrothal, fiber insulation boards and fiber mats
	heating	heating system from Kanthal, type Fibrothal ROB
	number of retorts	5pcs (3pcs installed), producer Kanthal, type Kanthal APM
	retort dimension	outer Ø 50,8 mm, inner Ø 38,1, length 6,4 m
	continuous wires	Ø 4,5 mm, manufacturer Kanthal, type Nikrothal 70
	entrance to the annealing furnace	installed burner with automatic ignition (Kromschröder automatic burner)
	outlet from the annealing furnace	sealed with rice at the outlet + controlled extraction with a capacity below 10% of the lower explosive limit hydrogen
	supply of N ₂ , H ₂ to the furnace	installed controlled exhaust with output below 10% of the bottom explosive limits of hydrogen
	Note: There is a secondary electricity meter installed in the switchboard to measure the electricity consumption.	
Documentation	<ul style="list-style-type: none"> - overall documentation of the machine together with the operating instructions, - initial electrical inspection, 	

	<ul style="list-style-type: none"> - initial inspection of the gas distribution / pipes (hydrogen, nitrogen) together with the necessary fittings,
<p>Scope of reconstruction</p>	<ul style="list-style-type: none"> - complete new thermal insulation (Fibrothal) including heating elements, - new wiring, - new electrical switchboard for controlled gassing equipped with Siemens Simatic S7 control system, - new retorts (Kanthal APM type), - new gas distribution box for flushing nitrogen, safety nitrogen, hydrogen, natural gas and compressed air for control and operation of valves, - hydrogen combustion at the furnace inlet by a burner with automatic control, - safety features,
<p>Detailed machine description</p>	<p>The annealing process of the tubes takes place in the annealing line. It consists of a preparation - preparation table (1), where the bundle of tubes is wrapped and bound on a continuous wire (8) passing through retorts in a continuous annealing furnace (3). A driving take-off wheel (2) is located between the preparation table (1) and the annealing furnace (3). In the annealing furnace, the annealing process itself takes place at a temperature of about 1100 °C, or in retorts in a hydrogen atmosphere. The tube bundle then passes into a cooling trough (5) respectively into the cooling stainless steel tubes. Here, the annealed tubes are indirectly cooled by water through the wall of the stainless steel tubes, i.e. the annealed tubes are not in direct contact with the cooling water. A gas inlet (4) is located between the annealing furnace (3) and the cooling trough (5). Hydrogen is used as an inert annealing atmosphere during the annealing process. Nitrogen is used as a safety gas to 'purge' the air atmosphere from the annealing retort and cooling tube. The next step is the table (6) where the tube bundle is unwound from the continuous wire (8). Tying and untying of the tubes is carried out by the annealing line operator. At the end of the line is a driven take-off wheel (7). The reversing of the continuous wire (8) takes place under the cooling trough (5) and under the annealing furnace (3). Subsequently, the continuous wire (8) is returned to the annealing furnace (3) via the driving take-off wheel (2).</p> <p>The annealing of the tubes in the annealing furnace softens them so that after further technological steps they can be prepared for drawing on the drawing machines.</p> <p>The gas supply is led from external storage tanks located outside the production hall in the north-western part of the site. The piping penetrates the building at the northwest corner of the 1st floor perimeter wall, where the main shut-off valves are located, and from there it is routed along the west and south walls to a line located in the southeast part of the site. The pipework from the external storage tanks to the perimeter wall is routed under the internal company road.</p> <p><u>Note:</u> The number of retorts in the annealing furnace can be up to 5, currently we have 3 retorts installed.</p> <p>*) This is an approximate consumption of gases H₂, N₂</p>

Schematic picture of an annealing line



Legend:

- | | |
|---|--------------------------------------|
| 1 - preparation table | 5 - cooling trough |
| 2 - driving take-off wheel | 6 - table at the exit (tube untying) |
| 3 - annealing furnace | 7 - driven take-off wheel |
| 4 - gas inlet N ₂ , H ₂ | 8 - continuous wire |