

2 Delivery scope for fulfilling the requirements from the requirements

Item no.	Designation	Pcs.
1	Loading lifting table as roller conveyors Ø 900 mm with weight control	1
2	HTF infeed as transverse transfer carriage with roller table, rollerways with absolute value encoder Ø 900 mm with height control	1
3	High-temperature roller hearth furnace Type DRGs 90x30 (HTF). Gas heated. Protective gas operation.	1
4	Roller conveyor 1 with lifting table behind HTF Ø 900 mm	1
5	Roller conveyor 1 with lifting table in front of the oil quenching bath Ø 1.200 mm	1
6	Roller conveyor 2 in front of the oil quenching bath Ø 1.200 mm	1
7	Portal manipulator double axles and electric chain hoist	1
8	Oil quenching bath, Type AB 120x50/1 for fixture Ø 1.200 mm – ca. 10 m³	1
9	Roller conveyors in front of the oil-washing machine Ø 900 mm, max. 300 kg	2
10	Two-zones (3 treatment steps, 2 tanks) oil washing machine Ø 900 mm: injector flood washing + spray washing & Drying zone (circulation air 130°C)	1
11	Roller conveyor with lifting table downstream of the oil washing machine Ø 900 mm, 1.300 mm to 1.000 mm	1
12	Transverse transport with driven roller conveyor in front of the Low-temperature continuous furnace (LTF) Ø 900 mm	1
13	Roller conveyor downstream of the transverse transport for lock out to measuring Ø 900 mm	1
14	Roller conveyor downstream of the transverse transport for lock in after measuring Ø 900 mm	1
15	Buffer roller conveyors in front of the LTF Ø 900 mm	1
16	LTF Type DAOE 1 – 90x90x40 / 1*12, max. 300 kg	1
17	Buffer roller conveyors downstream of the LTF Ø 900 mm	1
18	Air cooling station with 3*1 bays and driven roller conveyor including 1x cooling air fan Ø 900 mm	1
19	Unloading lifting table with stopper unit Ø 900 mm	1
20	Complete access facilities, platforms, stairs, and access ladders	1
21	Safety equipment such as safety screens	1
22		
23	Declaration of CE-Conformity	1
24	Documentation in national language + German	1
25		
26		
27		
28	Submerges pump for the washing machine	1

29	Double bag filter in the oil washing machine incl. piping, etc.	1
30	Switch off at peak current	1
31	Pressed welded gratings as underlay 900x900x5 mm, additionally welded with inert arc outside	50

4 Description of plant (basic machine, ancillary units, general equipment, technical assemblies and further requirements (specific to the machine))

4.1 General informations

General	
Output	540 kg/h (net)
Operation mode	Martensitic
Transport general	Direct on transportation rollers
	Direct on pressed welded gratings as underlay 900 x 900 x 5 mm
Usable diameter	Only rings: max. Ø 900 mm
	Fixture incl. ring: max. Ø 1.200 mm
Usable height	Only rings: - one layer: max. 156 mm - two layer: max. 312 mm
	Fixture incl. ring: max. 500 mm
Batch load	Only rings: - one layer: max. 108,6 kg - two layer: max. 217,2 kg
	Fixture incl. ring: max. 1.800 kg
Mesh grids	Necessary for washing machine and all further components

4.2 Loader / feeding machine

4.2.1 Loading lifting table as roller conveyors

General	
Number	1
Kind of loading	Manual loading from three sides
Effective width	900 mm
working height	650 mm – height of HTF (1.217,5 mm)
Check of the dimension	Maximum weight by scale
Documentation	Weight of each batch

4.2.2 HTF infeed as transverse transfer carriage with roller table

General	
Number	1
Effective width	900 mm
Level of height	Height of HTF (1.217,5 mm)
Check of the dimension	Maximum height by scale

4.3 High temperature furnace (HTF)

Design	
Type	Roller hearth furnace Type DRGs 90 x 30
Number of fans	Min. 2, executed with Harting plugs
Insulation	<ul style="list-style-type: none"><li>- Bottom: Bricks</li><li>- Side wall: Bricks</li><li>- Ceiling: Bricks</li><li>- Resistant: &gt; 5 years</li><li>- The temperature of the outside furnace wall (HTF: 850 °C): max. 40 K above temperature of the shop floor (exception: design / function-based heat transfers such as door openings, peeping windows, ducts)</li></ul>
Peeping window	4x HTF Reasonable peeping windows are required. Gage-glasses with nitrogen rinsing (without carbon disposal) permit the view onto the hardening good inside the furnace.
Sluice	First door of the furnace (entrance) is gas tight, entrance sluice N <sub>2</sub> flooded.
Furnace top	Accessible with stairs and ladder
Position of ex-flap	Entrance and outlet sluice
Position gas panel	Left side
Position operation panel	Right side
Number of batch positions	1x entrance sluice; 4 +1 HTF; 1x outlet sluice

Gassing	
Gassing positions	<ul style="list-style-type: none"><li>- Zone 2: 1 lance</li><li>- Zone 3: 1 lance</li></ul>
Gas connections per zone	<ul style="list-style-type: none"><li>- Zone 2: methanol, nitrogen</li><li>- Zone 3: methanol, nitrogen, propane, air</li></ul>
Methanol inlet	No irritation of temperature
Flame curtain	located at furnace entrance and outlet
Gas panel	
Propane C3H8	Solenoid valve (proportional)
Methanol CH3OH	Flow meter for every zone min/max sensors for flow surveillance
Nitrogen N2	Flow meter for every zone min/max sensors for flow surveillance
Soot burning	Switchable at panel

Carbon-potential regulation	
Range of operation	0,85 % +/- 0,05 % Carbon
Measurement system	Lambda probe (redundant)
Number of lambda probes	2
Lambda probe position	2 parallel probes in Zone 3 Probes surveil each other (adjustable deviation tolerance), only one probe regulates C-level.
Regulation principle	The lambda probe measures online in the furnace atmosphere. The regulation of the carbon potential is done by adding a proper amount of propane in the same zone.
Apparatus for shim test	One shim test for zone 2, one shim test for zone 3 (close to regulation probe). Tubes inclusive connection for gas analyzer. All other zones (incl. both sluices) have connections for gas analyzer.
Correction factor	Differences between displayed carbon potential and measured carbon potential of the shim test can be compensated in the regulation system.

Heating / Temperature regulation	
Heating zones	4
Temperature	max. 880 °C, automatic shut down of heating
Working temperature	800 - 850 °C
Cooling	Rapid cooling of the furnace with air injection in the jet tube.
Burner	Recuperation type, efficiency $\geq 70\%$
Radiant tube	Ceramic (SiC) / max load: 40 kW/m <sup>2</sup>
Temperature constancy / uniformity	$\pm 5\text{ °C}$ in material during temperature uniformity
Temperature regulation	1 thermocouple (double head) 100 mm over hardening material in each heating zone.
Thermocouples	Thermocouples Type K with additional bore for test thermocouple, mounted in a protection tube.
Thermocouple online control	The 2 thermocouples control each other. The max. difference between both measured values is 5 °C

Parts transportation system	
Parts transportation	Rollers
Transportation rollers	Heat resistant steel, dismountable, powertrain control
Fast feeding and rewards feeding	Function to fast feeding and rewards feeding the basket for take out parts from front door manual / maintenance.
Emergency power transformation	Quickly transfer automatically to emergency power for the rollers running when normal power is cut off.
Roller manual turn	Manual handle with measurement to turn the rollers manually for emergency case.
Max. deviation of furnace time	$\pm 3\%$ of set point

4.4 Transport HTF to fixture quenching

4.4.1 Roller conveyor 1 with lifting table behind HTF

General	
Number	1
Effective width	900 mm
working height	height of HTF (1.217,5 mm) – 1.000 mm
Set-up	Table with bracings for free lift

4.4.2 Roller conveyor 1 with lifting table in front of the oil quenching bath

General	
Number	1
Effective width	1.200 mm
working height	height of HTF (1.217,5 mm) – 650 mm
Maximum weight	max. 1.800 kg
Set-up	Dripping tray at the bottom of the table

4.4.3 Roller conveyor 2 in front of the oil quenching bath

General	
Number	1
Effective width	1.200 mm
working height	650 mm
Maximum weight	max. 1.800 kg
Set-up	Dripping tray at the bottom of the table

4.4.4 Portal manipulator double axles and electric chain hoist

Design	
Number of cranes	2
Execution	electrical
Kind of lifting	Chain hoist or similar
Lifting capacity	1.800 kg
Portal	Steel construction
Control	Located control station (identical Wuppertal)

4.5 Oil quenching bath for fixture quenching (martensitic)

Design	
Execution	media-tight, single-walled <div></div> elevator covered with plates (not gas-tight)
Heating	electrical
Cooling	expandable plate cooler
Cooling power	Set point of temperature should be reached again within one cycle time
Working temperature	50 – 90 °C
Thermocouples	Double head thermocouples Type K with additional bore for test thermocouple, mounted in a protection tube.
Thermocouple online control	The 2 thermocouples control each other. The max. difference between both measured values is 5 °C
Temperature uniformity	± 5 °C
Temperature increase	max. 20 °C with maximum batch weight
Quenching	Directed by elevator
Agitation	Enough homogenic agitation. The volume flow shall prevent local overheating of quenching medium. Agitation frequency-controlled.
Sampling point	Accessible during all operational states
Level control	Redundant inspection of different levels (min. min., min., max., max. max.). Warning when levels are reached.
Elevator (lift-down operation)	frequency controlled, adjustable hub and frequency, bath overlap min. 200 mm
Addition of oil	Manual addition
Nitrogen purging	Two positions on the top. Each position with two valves (n. o.). Software integration together with CO2 extinguisher <div></div> <div></div>

4.6 Oil washing process

4.6.1 Roller conveyors in front of the oil washing machine

General	
Number	2
Effective width	900 mm
working height	1.300 mm
Maximum weight	max. 300 kg
Set-up	Dripping tray at the bottom of the table
Check of the dimension	Maximum height by scale

#### 4.6.2 Oil washing machine

Design	
Effective width	900 mm
working height	1.300 mm
Maximum weight	max. 300 kg
Active zones	<ul style="list-style-type: none"> <li>- Washing and rinse 1 and rinse 2 (chamber 1)</li> <li>- Drying (chamber 2)</li> </ul>
Carry over	No mix of fluids from washing / rinse 1 tank to rinse 2 tank
Process	Washing by spraying, drying by blow off with hot air
Washing result	no visible residuals, dry (as technical possible)
Reflux screen	In all tanks (mesh size max. 1 mm)
Fresh water feeding	<ul style="list-style-type: none"> <li>- Feeding in tank rinse 2</li> <li>- Cascade to washing / rinse 1</li> <li>- Time controlled</li> <li>- Water supply tube equipped with electrical pneumatic valve</li> </ul> Bypass in water supply tube with manual ball valve
Water level control	2 controlled water levels (min / max) for each tank, overflow tank only max level
Nozzles	Adjustable and easy to dismantle
Exhaust	No escaping steam at entrance and exit (as small as possible)
Materials	All metal parts which get in touch with washing medium must be made of stainless steel or water resistant
Accessibility	Pumps, filters and level switches are assembled for easy access, maintenance doors in active zones, motors are plugged
Safety base tub	Stainless steel 2,5 mm, leakages are detected

Washing	
Design	Flood washing with case
Pump pressure	1-2 bar, visible on manometer
Mass flow	min. 350 l/min
Temperature	Adjustable up to 80 °C
Bag filters	In main flow, blocked filter is controlled by pressure switch with adjustable limits
Oil separation	<ul style="list-style-type: none"> <li>- Oil separator at washing tank</li> <li>- Filling with floater in balance tank</li> <li>- Filling balance tank via overflow in washing tank</li> </ul>
Water	Tank 1

Rinse 1	
Pump pressure	1-2 bar, visible on manometer
Mass flow	min. 350 l/min
Temperature	Adjustable up to 80 °C
Water	Tank 1

Rinse 2	
Pump pressure	1-2 bar, visible on manometer
Mass flow	min. 350 l/min
Temperature	Adjustable up to 80 °C
Water	Tank 2

Air blowing	
Medium	Compressed air
Blowing knives	From top + bottom, air flow adjustable



Dry	
Medium	Hot air
Temperature	Adjustable up to 20 °C
Position temperature sensor	As close as possible to the hot air exit

#### 4.6.3 *Roller conveyor with lifting table downstream of the oil washing machine*

General	
Number	1
Effective width	900 mm
working height	1.300 mm – 1.000 mm
Maximum weight	max. 300 kg
Set-up	Dripping tray at the bottom of the table

### 4.7 Measuring and transport to LTF

#### 4.7.1 *Transverse transport with driven roller conveyor between washing machine, measuring station and LTF*

General	
Number	1
Effective width	900 mm
working height	1.000 mm
Maximum weight	max. 300 kg
Set-up	Dripping tray at the bottom of the table

#### 4.7.2 *Lock in and lock out roller conveyor to measuring station*

General	
Number	1 + 1
Effective width	900 mm
working height	1.000 mm
Maximum weight	max. 300 kg
Set-up	Possibility to lock out the batches at the lateral transport before tempering and lock in the batches back to the lateral transport that they can go into the tempering furnace. Conveyors must be implemented in the working safety.

### 4.8 Tempering process in LTF

#### 4.8.1 *Buffer roller conveyor in front of the LTF*

General	
Number	1
Effective width	900 mm
working height	1.000 mm
Maximum weight	max. 300 kg

#### 4.8.2 *Low temperature continuous furnace (LTF)*

Design	
Circulation zones	4 or more
Insulation protection	Insulation must be protected from oil
Number of batch positions	1*12 (one track with 12 positions)
Oil outlet	Possible to drain easily

Heating / Temperature regulation	
Heating	Electrical
Temperature	max. 300 °C
Temperature constancy / uniformity	$\pm 5\text{ }^{\circ}\text{C}$
Temperature regulation	1 double thermocouples in each heating zone
Thermocouples	Thermocouples Type K with additional bore for test thermocouple, mounted in a protection tube
Heating zones	min. 4
Thermocouple online control	The 2 thermocouples control each other. The max. difference between both measured values is 5K

Transporting system	
Transportation	chain
Through put time	120 - 360 min
Max. deviation of furnace time	$\pm 3\%$ of set point

#### 4.8.3 Buffer roller conveyor downstream of the LTF

General	
Number	1
Effective width	900 mm
working height	1.000 mm
Maximum weight	max. 300 kg

#### 4.9 Air cooling station

Design	
Type	Cooling down by air blowing
Requirement	Cool down: $< 60\text{ }^{\circ}\text{C}$
Design	<ul style="list-style-type: none"> <li>- min. 3 active positions</li> <li>- with two fans (operation frequency tested by start-up)</li> </ul>
Effective width	900 mm
working height	1.000 mm
Maximum weight	max. 300 kg

#### 4.10 Unloading lifting table with stopper unit

General	
Number	1
Kind of loading	Manual unloading from three sides
Effective width	900 mm
working height	1.000 mm – 650 mm

## 5 Control, hardware and software

Visualization	Panel: TIA Portal V14; PC: WIN CC
Operation panel	Work station + panel
Documentation	The process data (temperatures, treatment times, carbon level, and alarms) is saved in a data bank and can be allocated to the respective work order.
Receipts	100 heat treat receipts can be edited and saved in a data bank. The receipts can be called and loaded to the machine automatically.
Heat treat certificate	The system must generate a heat treat certificate for every single work order. The certificate includes all heat treat data (temperatures, treatment times, carbon levels, quality effecting alarms).
Display of every charge on a screen in a layout of the furnace line	Every charge is green and turns to red when a failure occurs. Red charges will be stated by a red light and an acoustic-alarm when leaving the tempering furnace.
Manuel / Automatic	Switchable
Production data	Wienstroth focus system and Host computer possible
Controller	Local computer
Host computer	Connection for data recording <span style="border: 1px solid red; padding: 0 10px;"> </span> , superior
Emergency stop	Two ways: Emergency stop (record of alarm), all dangerous moving parts stop, easy restart of system after acknowledgement
CP343	Included
SPS	F-SPS
Interface	Barcode scanner to be provided