

Which Furnace for Which Process?

Preheating for Forging

- Press Hardening
- Heating of sheet metals
- Preheating of molds

Hardening, Annealing

- Ageing
- Austempering
- Diffusion annealing
- Pack hardening
- Recovery annealing
- Coarse grain annealing
- Hardening
- Solution annealing
- Annealing
- Recrystallization annealing
- Stress-relieving
- Soft annealing

Quenching

- Water
- Air
- Oil
- Polymer

in Air

under Protective Gases, Reaction Gases or in Vacuum

in Salt Bath

Bogie hearth furnaces
page 44

Forced convection pit-type furnaces
page 40

Hot-wall retort furnaces
page 12 - 15

Salt-bath furnaces
page 60

Quench tanks
page 57

Bogie hearth furnaces gas-fired
page 47

Pit-type and top-loading furnaces
page 41

Cold-wall retort furnaces
page 16 - 21

Water quench tanks
page 72 - 75

Chamber furnaces gas-fired
page 48

Bogie hearth furnaces
page 44

Bogie hearth furnaces with annealing box
page 44



Salt-bath furnace TS 40/30 with exhaust gas collection at crucible rim see page 60



Water quench tank with powerful water-circulation

Chamber furnaces
page 49/50

Bogie hearth furnaces gas-fired
page 47

Chamber furnaces with annealing box
page 49

Top hat furnaces
page 54

Chamber furnaces gas-fired
page 48

Top hat furnaces with annealing box
page 54

Rotary hearth furnaces
page 62

Chamber furnaces
page 49/50

Rotary hearth furnaces
page 62

Continuous furnaces
page 64

Top hat furnaces
page 54

Rotary hearth furnaces
page 62

Continuous furnaces
page 64

Strand annealing furnaces
page 68

Wire annealing furnaces
page 68



Annealing furnace with electro-hydraulic lift door on transportable base for preheating of large steel sheets for the automotive industry see page 50



NRA 480/04S see page 12

Tempering, Annealing

Tempering Plants

- Tempering
- Precipitation annealing
- Ageing annealing
- Recovery annealing
- Solution annealing
- Preheating
- Reduced hydrogen annealing

- Solution annealing
- Quenching
- Artificial ageing

in Air

under Protective Gases, Reaction Gases or in Vacuum

in Salt Bath

Tempering Plants

- Chamber dryers
page 32
- Forced convection chamber furnaces > 560 liters
page 26
- Forced convection chamber furnaces < 675 liters
page 24
- Forced convection chamber furnaces with clean room technology, page 23
- Forced convection bogie hearth furnaces with annealing box, page 25
- Forced convection chamber furnaces with clean room technology, page 23
- Forced convection bogie hearth furnaces with annealing box, page 42
- Forced convection bogie hearth furnaces
page 42
- Forced convection pit-type furnaces with annealing box, page 39
- Forced convection pit-type furnaces
page 39/40
- Pit-type and top-loading furnaces
page 41
- Rotary hearth furnaces
page 62
- Continuous furnaces
page 64

- Hot-wall retort furnaces
page 12 - 15
- Forced convection chamber furnaces with annealing box, page 25
- Forced convection chamber furnaces with clean room technology, page 23
- Forced convection bogie hearth furnaces with annealing box, page 42
- Forced convection pit-type furnaces with annealing box, page 39
- Rotary hearth furnaces
page 62
- Continuous furnaces
page 64

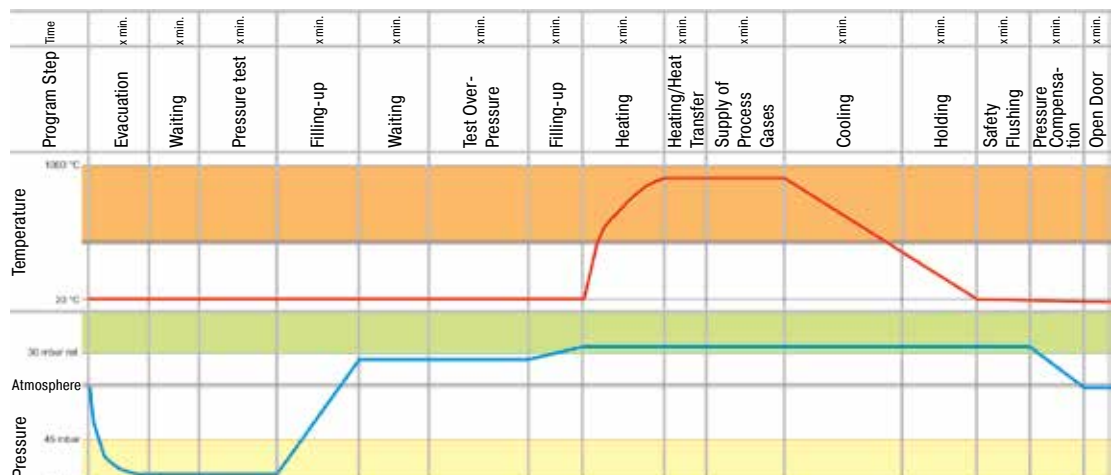
- Martempering furnaces
page 61

- Fully automatic tempering plant
page 72/73
- Manual tempering plant
page 74/75



Manual tempering plant for hardening of steel rods see page 74/75

Process flow chart



Which Furnace for Which Process?

Brazing/Soldering

Curing, Tempering, Drying

- Soft soldering
- Brazing
- High-temperature brazing
- Dip brazing of steel
- Dip brazing of aluminum

- Composites
- Molds
- Adhesive
- Plastics
- Lacquers
- PTFE
- Silicone
- Surface Drying
- Preheating
- Vulcanizing
- Conditioning

in Salt Bath

in Vacuum

under Protective Gases

Solvent Based

Water Based

Salt-bath furnaces
page 60

Hot-wall retort furnaces
page 12 - 15

Hot-wall retort furnaces
page 12 - 15

Hot-wall retort furnaces
page 12 - 15

Chamber dryers
page 32

Cold-wall retort furnaces
page 16 - 21

Cold-wall retort furnaces
page 16 - 21

Chamber dryers
page 32

Forced convection chamber furnaces
page 24

Forced convection chamber furnaces with annealing box, page 25

Forced convection chamber furnaces EN 1539
page 38

Ovens
page 36

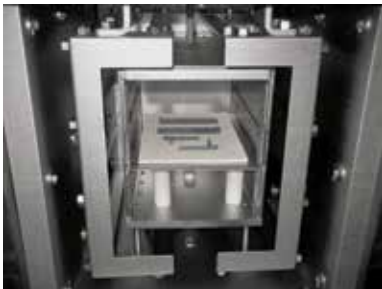
Chamber furnaces with annealing box, page 49

Forced convection bogie hearth furnaces
page 42

Forced convection pit-type furnaces
page 39/40

Rotary hearth furnaces
page 62

Continuous furnaces
page 64



Sintering of MIM titan parts in a VHT furnace



Brazing in a gas-supply box



VHT 500/22-GR H₂ with graphite insulation and heating see page 16

**Thermal/Thermo-Chemical Processes
 Surface Treatment, Cleaning**

**Sintering
 & Debinding**

- Carburizing
- Blueing (e.g. with water steam)
- Nitriding/nitrocarborizing
- Deoxidizing under hydrogen
- Pyrolysis
- Heat cleaning
- Oxidizing

- Debinding
- MIM
- CIM
- Sintering

in Powders

**under Protective
 Gases, Reaction Gases**

in Salt Bath

in Air

**under Protective Gases,
 Reaction Gases or in Vacuum**

Hot-wall retort furnaces page 12 - 15	Hot-wall retort furnaces page 12 - 15	Salt-bath furnaces page 60	Chamber furnaces NB .. CL, gas-fired page 52	Hot-wall retort furnaces page 12 - 15
Cold-wall retort furnaces page 16 - 21	Cold-wall retort furnaces page 16 - 21		Chamber furnaces N(B) .. BO page 53	Cold-wall retort furnaces page 16 - 21
Forced convection chamber furnaces page 24	Forced convection chamber furnaces with annealing box, page 25		Forced convection chamber furnaces N .. LS page 38	Retort furnaces for catalytic debinding page 22
Bogie hearth furnaces page 44	Forced convection bogie hearth furnaces with annealing box, page 42			
Bogie hearth furnaces gas-fired page 47	Bogie hearth furnaces with annealing box page 44			
Chamber furnaces gas-fired page 48	Chamber furnaces with annealing box page 49			
Chamber furnaces page 49/50	Overview annealing boxes page 58			
Top hat furnaces page 54				
Overview annealing boxes page 58				

Thermal Separation Processes

Process	..DB.. Debinding and sintering in oxidising atmosphere	..LS Debinding and sintering in oxidising atmosphere	..IDB.. Debinding inert atmos- phere	NB..CL Heat Clean- ing in inert atmosphere	..BO Heat Cleaning in oxidising atmosphere	NB..WAX Dewaxing and burn off
Avoid igniting	✓	✓	✓	✓		
Provoke igniting					✓	✓
Diluted atmosphere	✓	✓				
Inerted atmosphere			✓	✓		
Open combustion					✓	✓
O ₂ content	≥ 20 %	≥ 20 %	0-3 %	≤ 3 %	<> 20 % varies	<> 20 % varies
Vaporisation speed	slow	fast	slow	slow - fast	slow - fast	very fast
Loading / unloading	cold/cold	cold/cold hot/hot	cold/cold	cold/cold	cold/cold	> 750 °C/ > 750 °C
Tmax	1800 °C	450 °C	850 °C	500 °C	1400 °C	850 °C
Electrically heated	✓	✓	✓		✓	
Gas-fired				✓	✓	✓
External TNV	✓	(✓)	✓		✓	
Internal TNV				✓	✓	✓
External KNV	✓	(✓)	(✓)			



Blueing of drills in water steam atmosphere in a furnace of the NRA range see page 14