### Which Furnace for Which Process?

This catalog describes furnaces working under non-flammable or flammable gases or under vacuum. For furnaces working under air please see our catalog „Thermal Process Technology I“.

#### 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
- Bogie hearth furnaces*
- Chamber furnaces gas-fired*
- Top hat furnaces*
- Rotary hearth furnaces*
- Continuous furnaces*

### in Air
- Forced convection pit-type furnaces*
- Pit-type and top-loading furnaces*
- Chamber furnaces gas-fired*
- Chamber furnaces gas-fired*
- Top hat furnaces*
- Rotary hearth furnaces*
- Continuous furnaces*

### under Protective Gases, Reaction Gases or in Vacuum
- Hot-wall retort furnaces page 16 - 25
- Cold-wall retort furnaces page 26 - 32
- Chamber furnaces with annealing box page 43 - 59
- Top hat furnaces with annealing box page 83*

### in Salt Bath
- Salt-bath furnaces page 38 - 40
- Quench tanks page 80 - 81
- Water quench tanks*

### Quenching
- Water quench tanks*
- Water
- Air
- Oil
- Polymer

* See also catalog Thermal Process Technology I
## Tempering, Annealing

- Tempering
- Precipitation annealing
- Ageing annealing
- Recovery annealing

## Solution annealing
- Preheating
- Reduced hydrogen annealing

### in Air
- Chamber dryers*
- Forced convection chamber furnaces > 560 liters*
- Forced convection chamber furnaces < 675 liters page 60 - 61*
- Forced convection chamber furnaces with clean room technology*
- Forced convection bogie hearth furnaces*
- Forced convection pit-type furnaces page 66 - 68
- Pit-type and top-loading furnaces*
- Rotary hearth furnaces*
- Continuous furnaces*

### under Protective Gases, Reaction Gases or in Vacuum
- Hot-wall retort furnaces page 16 - 25
- Forced convection chamber furnaces with annealing box, page 60 - 64
- Forced convection chamber furnaces with clean room technology*
- Sealed forced convection chamber furnaces page 65
- Forced convection bogie hearth furnaces with annealing box, page 83*
- Forced convection pit-type furnaces with annealing box, page 66 - 68*
- Rotary hearth furnaces*
- Continuous furnaces page 37

### in Salt Bath
- Martempering furnaces page 41
- Forced convection chamber furnaces with annealing box, page 60 - 64
- Forced convection pit-type furnaces with annealing box, page 66 - 68*
- Rotary hearth furnaces*

## Tempering Plants

- Solution annealing
- Quenching
- Artificial ageing

### in Air
- Tool shop hardening systems, page 70 - 72
- Hot-wall retort protective gas hardening system page 20
- Fully automatic tempering plant*
- Manual tempering plant*

### under Protective Gases, Reaction Gases or in Vacuum
- Protective gas hardening system, page 73
- Hot-wall retort protective gas hardening system page 20
- Fully automatic tempering plant*
- Manual tempering plant*

**Notes:**
* Semi-automatic tempering plant with retort furnace NR 50/11 and water quenching
### Which Furnace for Which Process?

#### Brazing/Soldering

<table>
<thead>
<tr>
<th>Process</th>
<th>Furnace Type</th>
<th>Pages</th>
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<tbody>
<tr>
<td>Soft soldering</td>
<td>Cold-wall retort furnaces</td>
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<td>Brazing</td>
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<td>26 - 32</td>
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<td>High-temperature brazing</td>
<td>Hot-wall retort furnaces</td>
<td>16 - 25</td>
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<td>Dip brazing of steel</td>
<td>Hot-wall retort furnaces</td>
<td>16 - 25</td>
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#### Curing, Tempering, Drying

<table>
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<td>Chamber dryers*</td>
<td>60 - 61*</td>
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<tr>
<td>Molds</td>
<td>Chamber dryers*</td>
<td>60 - 61*</td>
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<tr>
<td>Adhesive</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
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<tr>
<td>Plastics</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
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<tr>
<td>Lacquers</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
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<tr>
<td>PTFE</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
</tr>
<tr>
<td>Silicone</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
</tr>
<tr>
<td>Surface Drying</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
</tr>
<tr>
<td>Preheating</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
</tr>
<tr>
<td>Vulcanizing</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
</tr>
<tr>
<td>Conditioning</td>
<td>Forced convection chamber furnaces</td>
<td>60 - 61*</td>
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### In Salt Bath

<table>
<thead>
<tr>
<th>Furnace Type</th>
<th>Pages</th>
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<tr>
<td>Salt-bath furnaces</td>
<td>38 - 40</td>
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### In Vacuum

<table>
<thead>
<tr>
<th>Furnace Type</th>
<th>Pages</th>
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<td>Hot-wall retort furnaces</td>
<td>16 - 25</td>
</tr>
<tr>
<td>Cold-wall retort furnaces</td>
<td>26 - 32</td>
</tr>
<tr>
<td>Tube furnaces</td>
<td>34 - 35**</td>
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### Under Protective Gases

<table>
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<th>Furnace Type</th>
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<tr>
<td>Cold-wall retort furnaces</td>
<td>26 - 32</td>
</tr>
<tr>
<td>Tube furnaces</td>
<td>34 - 35**</td>
</tr>
<tr>
<td>Forced convection chamber furnaces</td>
<td>60 - 64</td>
</tr>
<tr>
<td>Chamber furnaces with annealing box</td>
<td>43 - 59</td>
</tr>
<tr>
<td>Forced convection pit-type furnaces with annealing box</td>
<td>66 - 68</td>
</tr>
</tbody>
</table>

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* See also catalog Thermal Process Technology
** See also catalog Laboratory
*** See also catalog Advanced Materials
Thermal/Thermo-Chemical Processes
Surface Treatment, Cleaning

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

**Thermal Separation Processes**

<table>
<thead>
<tr>
<th>Process</th>
<th>( \text{DB..} )</th>
<th>( \text{LS} )</th>
<th>( \text{IDB..} )</th>
<th>( \text{CL} )</th>
<th>( \text{BO} )</th>
<th>( \text{WAX} )</th>
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<td>Debinding and sintering in oxidising atmosphere</td>
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<tr>
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<td>✓</td>
<td>✓</td>
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<tr>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Dewaxing and burn off</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

- Avoid igniting
- Provoke igniting
- Diluted atmosphere
- Inerted atmosphere
- Open combustion
- \( O_2 \) content: \( \geq 20 \% \) \( \leq 20 \% \) \( > 20 \% \) \( \leq 3 \% \)
- Vaporisation speed: slow fast slow - fast very fast
- Loading / unloading: cold/cold hot/hot cold/cold cold/cold cold/cold cold/cold cold/cold cold/cold hot/hot
- Tmax: 1800 °C 450 °C 850 °C 500 °C 1400 °C 850 °C
- Electrically heated
- Gas-fired
- External TNV
- Internal TNV
- External KNV

**Sintering & Debinding**

- Additive manufacturing
- Debinding
- MIM
- CIM
- Sintering

**in Powders**
- Hot-wall retort furnaces page 16 - 25
- Cold-wall retort furnaces page 26 - 32
- Forced convection chamber furnaces page 60 - 61
- Bogie hearth furnaces page 83*
- Chamber furnaces page 43 - 59*
- Top hat furnaces page 83*

**under Protective Gases, Reaction Gases or in Vacuum**
- Hot-wall retort furnaces page 16 - 25
- Cold-wall retort furnaces page 26 - 32
- Forced convection chamber furnaces page 60 - 61
- Retort furnaces for catalytic debinding page 21
- Forced convection chamber furnaces with annealing box***

**in Salt Bath**
- Salt-bath furnaces page 38 - 40
- Chamber furnaces***
- Chamber furnaces gas-fired***
- Forced convection chamber furnaces NA .. LS*
- Chamber furnaces with annealing box page 83*

**in Air**
- Chamber furnaces with annealing box page 43 - 59