Following types are available:

<table>
<thead>
<tr>
<th>model</th>
<th>usable heating chamber dimensions [mm]</th>
<th>usable furnace volume [dm³]</th>
<th>dimensions of furnace [mm] WxDxH</th>
<th>dimensions of switch cabinet [mm] WxDxH</th>
<th>heating power [kw]</th>
<th>electrical supply [A] 3~</th>
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<tr>
<td>ISO 140/140*</td>
<td>Ø140 x H140</td>
<td>2</td>
<td>750/1280/2070</td>
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<td>ISO 240/250*</td>
<td>Ø240 x H250</td>
<td>11</td>
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<td>50</td>
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<tr>
<td>ISO 320/350*</td>
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<td>860/1520/2310</td>
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<td>100</td>
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<td>ISO 450/600</td>
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<tr>
<td>ISO 450/1000</td>
<td>Ø450 x H1000</td>
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<td>1600/3160/6020</td>
<td>2000 x 400 x 2100</td>
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<td>400</td>
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<tr>
<td>ISO 175/250/400</td>
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<td>1000/1450/1400</td>
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<td>50</td>
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<tr>
<td>ISO 250/300/500</td>
<td>W250 x H300 x D500</td>
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<td>1100/1500/1800</td>
<td>1200 x 400 x 2100</td>
<td>65</td>
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<tr>
<td>ISO 330/330/500</td>
<td>W330 x H330 x D500</td>
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<td>1250/1980/2380</td>
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<td>200</td>
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<tr>
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<td>2150/2700/2380</td>
<td>2400 x 400 x 2100</td>
<td>390</td>
<td>630</td>
</tr>
</tbody>
</table>

* laboratory version

**MUT ADVANCED HEATING** GmbH designs and manufactures customized thermal processing equipment and systems since 1994 for industries, such as: glass and ceramic, metal processing, powder metallurgy, carbon and chemical processing industries.

We design systems for state of the art processes, such as: sintering, debinding, joining techniques, heat treatment of aggressive substances as well as for high-pressure and hot gas treatment.

With in-house competence in mechanical design, process and safety techniques, electrical design and software development we are a skilled and reliable partner to our customers. MUT is distinguished in its industry by a high level of vertical integration.

**ISO**

Integrated Sintering and Debinding Oven

Sintering and thermal debinding in one process step for:

- Powder Metallurgy PM
- MIM; PIM; CIM; 3D-Print
- Additive Manufacturing AM
- Technical Ceramics
- Joining Technology
- Research and Development R&D
- Special applications that require exceptional pure atmospheres
ISO Integrated Sintering and thermal debinding Oven

MUT’s ISO furnace series is on the market since 2004. The furnace concept has been continuously improved and optimized to meet our customers’ expectations. A lot of experiences from the last years have been incorporated.

**Functional description of ISO furnace principle**

The principle of this furnace type is the integration of a hot wall furnace advantages into a cold wall furnace, which is specially designed for a combined process of debinding and sintering. At the hot wall furnace the atmosphere determining wall is hot (i.e., retort furnace), at the cold wall furnace the atmosphere determining wall is cold (e.g., classical vacuum furnace). The compromise solution of a hot muffle and corresponding disadvantage will be eliminated. During furnace operation the parts will be heated inside the furnace chamber up to debinding temperature by using the outside heating elements. A temperature gradient is generated between outside and inside furnace chamber. It generates a thermal flow to the inside and works against diffusion of contamination (e.g., debinding gases). This prevents that the debinding gases which discharge from the parts will not collect in the furnace insulation, respectively on the cooled vessel wall. The decomposition products will exit the inside furnace chamber via an insulated exhaust pipe (see picture left side). After debinding is completed, the inside furnace chamber will be heated up to the sintering temperature by using the inside heating elements. The inside part of the furnace is working as a cold wall furnace. A temperature gradient from the inside to the outside combined with a gas flow to the same direction prevents a contamination of the working chamber. (no contamination coming back, see picture right side)

The special edition “TiPerfect” is an optimal equipment with very low leakage rates for the heat treatment of sensitive material as well as titanium based alloy.

**Benefits of ISO furnace series to the user:**

- Debinding and sintering without logistic intermediate step
- By using the ISO furnace technology the user will get the following distinguished material during properties during debinding:
  - Residue-free drive out binding material
  - Protection of insulation and vessel against contamination
- Possibility to use protective purge gas and vacuum debinding during sintering:
  - Sintering under special pure gas atmosphere (e.g., low remaining oxygen; low remaining carbon)
  - No contamination induced back into hot zone (e.g., Mo-Heaters) during maintenance:
    - Cleaning of outside insulation without disassembling of hot parts
    - Easily accessible maintenance places covered by service doors
- Very high process stability and good reliability of operation without accident during long operation period
- Easy up-scaling to increase usable furnace space without risk of process
- Fast gas change rates
- Short cycle times
- Modular charging racks
- Accurate process gas flow settings via mass flow controller
- Easy process setting change without technical problems
- Vertical lifting loading flange via gear drive (bottom loader)
- Inside bottom heater from size Ø 360
- Vacuum-tight vessel made from stainless steel
- Insulation, respectively on the cooled vessel wall. The inside part of the furnace chamber works against diffusion of contamination (e.g., debinding gases). This prevents that the debinding gases which discharge from the parts will not collect in the furnace insulation, respectively on the cooled vessel wall. The decomposition products will exit the inside furnace chamber via an insulated exhaust pipe (see picture left side). After debinding is completed, the inside furnace chamber will be heated up to the sintering temperature by using the inside heating elements. The inside part of the furnace is working as a cold wall furnace. A temperature gradient from the inside to the outside combined with a gas flow to the same direction prevents a contamination of the working chamber. (no contamination coming back, see picture right side)

**Benefits of ISO furnace series to the user:**

- ISO combines the advantages of classical hot wall oven and classical cold wall oven
- Vacuum-tight vessel made from stainless steel
- Two separate heating systems (different heating systems possible)
  - Outside heater (hot wall oven for debinding)
  - Insulation (cold wall oven for sintering)
- Two separate gas inlets and exhaust systems as well as vacuum suction lines
  - Inside gas exhaust for discharge of binder during vacuum debinding / partial pressure operation / / processgas operation
  - Outside gas inlet to prevent binder condensation
  - Outside gas exhaust for discharge of gas during vacuum operation / partial pressure operation / gas process operation during sintering
- Inside gas inlet to supply the product with clean gas
- Optional high vacuum operation for hermetic access of sintering chamber
- Inside and outside insulation fixed on supporting retort, thereby easy to maintain
- Different heating systems (Mo, W, C, Oxi) possible
- Furnace series is usable for laboratory and production application
- Short cycle time by using fast cooling unit
- Standard in ATEX conform design
- Efficient concept for binder collection using screw pump for vacuum debinding

Please configure your furnace according to your application:

The clearly arranged configurator shows all available possibilities. Our application specialists will help you to choose the optimal facilities that are necessary for the manufacturing process of your product.

## Furnace atmospheres and final temperatures

<table>
<thead>
<tr>
<th>Atmosphere</th>
<th>fibre</th>
<th>molybdenum</th>
<th>tungsten</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air / O₂</td>
<td>1800</td>
<td>300</td>
<td>450</td>
</tr>
<tr>
<td>N₂</td>
<td>1800</td>
<td>1550</td>
<td>1700</td>
</tr>
<tr>
<td>Ar</td>
<td>1800</td>
<td>1700</td>
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<tr>
<td>H₂</td>
<td>1500</td>
<td>1700</td>
<td>2200</td>
</tr>
<tr>
<td>Vacuum</td>
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<td>1700</td>
<td>2200</td>
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