Cold-Wall Retort Furnaces up to 2400 °C

VHT 500/22-GR H_2 with CFC-process box and extension package for operation under hydrogen

VHT 8/18-KE with fiber insulation and molybdenum disilicide heating elements

Heat treatment of copper bars under hydrogen in VHT 08/16 MO

VHT 8/18-GR - VHT 500/18-KE

The compact furnaces of the VHT product line are available as electrically heated chamber furnaces with graphite, molybdenum, tungsten or $MoSi_2$ heating. A wide variety of heating designs as well as a complete range of accessories provide for optimal furnace configurations even for sophisticated applications.

The vacuum-tight retort allows heat treatment processes either in protective and reaction gas atmospheres or in a vacuum, subject to the individual furnace specs to 10^{-5} mbar. The basic furnace is suited for operation with non-flammable protective or reactive gases or under vacuum. The H_2 version provides for operation under hydrogen or other flammable gases. Key of the specification up is a certified safety package providing for a safe operation at all times and triggers an appropriate emergency program in case of failure.

Alternative Heating Specifications

The following heating systems are available for the different application temperatures:

VHT ../GR with Graphite Insulation and Heating

- Suitable for processes under protective and reaction gases or under vacuum
- Tmax 1800 °C or 2200 °C (2400 °C as additional equipment)
- Max. vacuum up to 10^{-4} mbar depending on pump type used
- Graphite felt insulation

VHT ../MO or ../W with Molybdenum or Tungsten Heating

- Suitable for high-purity processes under protective and reaction gases or under high vacuum
- Tmax 1200 °C, 1600 °C or 1800 °C (see table)
- Max. vacuum up to 5 x 10^{-5} mbar depending on pump type used
- Insulation made of molybdenum rsp. tungsten radiation sheets

VHT ../KE with Fiber Insulation and Heating through Molybdenum Disilicide Heating Elements

- Suitable for processes under protective and reaction gases, in air or under vacuum
- Tmax 1800 °C
- Max. vacuum up to 10^{-2} mbar (up to 1300 °C) depending on pump type
- Insulation made of high purity aluminum oxide fiber

Standard Equipment for all Models

Basic version

- Standard furnace sizes 8 - 500 liters
- A water-cooled stainless steel process reactor sealed with temperature-resistant o-rings
- Frame made of stable steel profiles, easy to service due to easily removable stainless steel panels
- Housing of the VHT 8 model on castors for easy repositioning of furnace
- Cooling water manifold with manual stopcocks in supply and return lines, automatic flowmeter monitoring, openloop cooling water system
- Adjustable cooling water circuits with flowmeter and temperature indicator and overtemperature fuses
- Switchgear and controller integrated in furnace housing
- H 700 PLC control with clearly laid out 5.7“ touchpanel control for program entry and display, 10 programs each with 20 segments
- Over-temperature limiter with manual reset for thermal protection class in accordance with EN 60519-2
- Manual operation of the process gas and vacuum functions
- Manual gas supply for one process gas (N_2 or Ar) with adjustable flow
- Bypass with manual valve for rapid filling or flooding of furnace chamber
- Manual gas outlet with overflow valve (20 mbar relative)
- Single-stage rotary vane pump with ball valve for pre-evacuating and heat treatment in a rough vacuum to 5 mbar
- Pressure gauge for visual pressure monitoring

Additional equipment

- Tmax 2400 °C
- Housing, optionally divisible, for passing through narrow door frames (VHT 08)
- Manual gas supply for second process gas (N_2 or Ar) with adjustable flow and bypass
- Inner process box made of molybdenum, tungsten or CFC, especially recommended for debinding processes. The box is installed in the furnace with direct gas inlet and outlet and provides for better temperature uniformity. Due to a change in gas supply direction after debinding a clean process atmosphere for sintering is achieved.
- Charge thermocouple with display
- Temperature measurement at 2200 °C models with pyrometer and thermocouple, type S with automatic pull-out device for precise control results in the low temperature range (VHT 40 and larger)
- Two-stage rotary vane pump with ball valve for pre-evacuating and heat-treating in a vacuum to 10^{-2} mbar
- Turbo molecular pump with slide valve for pre-evacuation and for heat treatment in a vacuum to 10^{-5} mbar including electric pressure transducer and booster pump (only VHT.../MO)
- Other pumps on request
- Heat exchanger with closed-loop cooling water circuit
- Automation package with graphic touch panel H 3700
  - 12" graphic touch panel H 3700
  - Input of all process data like temperatures, heating rates, gas injection, vacuum at the touch panel
  - Display of all process-relevant data on a process control diagram
  - Automatic gas supply for one process gas (N_2, argon or forming gas) with adjustable flow
  - Bypass for flooding and filling the chamber with process gas controlled by the program
  - Automatic pre- and post programs, including leak test for safe furnace operation
  - Automatic gas outlet with bellows valve and overflow valve (20 mbar)
  - Transducer for absolute and relative pressure
- MFC flow controller for alternating volume flow and generation of gas mixtures with second process gas (only with automation package)
- Partial pressure operation: protective gas flushing at controlled underpressure (only with automation package)
- PC control via NCC with corresponding optional documentation and connection to customer PC networks

Graphite heating chamber

Molybdenum heating chamber

Tungsten heating chamber

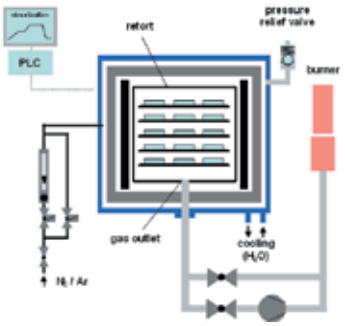
Ceramic fiber insulation

Thermocouple, type S with automatic pull-out device for precise control results in the low temperature range

VHT 40/16MO H_2

VHT 40/22 GR with motor-driven lift door and front frame for connection to a glove box

Turbo-molecular pump



VHT gas supply diagram, debinding and sintering

H_2 Version for Operation with Hydrogen or other Reaction Gases

In the H_2 version the furnaces can be operated under hydrogen or other reaction gases. For these applications, the systems are additionally equipped with the required safety technology. Only certified and industry proven safety sensors are used. The furnaces are controlled by a fail-safe PLC control system (S7-300F/safety controller).

- Certified safety concept
- Automation package (see additional equipment above)
- Redundant gas inlet valves for hydrogen
- Monitored pre-pressures of all process gases
- Bypass for safe purging of furnace chamber with inert gas
- Pressure-monitored emergency flooding with automated solenoid valve opening
- Electric or gas-heated exhaust gas torch for H_2 post-combustion
- Atmospheric operation: H_2-purging of process reactor starting from room temperature at controlled over pressure (50 mbar relative)

Additional equipment

- Partial pressure operation: H_2 flushing at underpressure in the process reactor starting from 750 °C furnace chamber temperature
- Retort in the process chamber for debinding under hydrogen

Single-stage rotary vane pump for heat treatment in a rough vacuum to 20 mbar

Two-stage rotary vane pump for heat treatment in a vacuum to 10^{-2} mbar

Turbo-molecular pump with booster pump for heat treatment in a vacuum to 10^{-5} mbar

Process Box for Debinding in Inert Gas

Certain processes require charges to be debinded in non-flammable protective or reactive gases. For these processes we fundamentally recommend a hot-wall retort furnace (see models NR... or SR...). These furnaces can ensure that the formation of condensation will be avoided as throughly as possible.

If there is no way to avoid the escape of small amounts of residual binder during the process, even in the VHT furnace, the furnace should be designed to meet this contingency.

The furnace chamber is equipped with an additional process box that has a direct outlet to the exhaust gas torch through which the exhaust gas can be directly vented. This system enables a substantial reduction in the amount of furnace chamber contamination caused by the exhaust gases generated during debinding.

Depending on the exhaust gas composition the exhaust gas line can be designed to include various options.

- Exhaust gas torch for burning off the exhaust gas
- Condensation trap for separating out binding agents
- Exhaust gas post-treatment, depending on the process, via scrubbers
- Heated exhaust gas outlet to avoid condensation deposits in the exhaust gas line

VHT 8/16 MO with hydrogen extension package and process box

	VHT ...-../GR	VHT ...-../MO	VHT ...-18/W	VHT ...-18/KE
Tmax	1800 °C or 2200 °C	1200 °C or 1600 °C	1800 °C	1800 °C
Inert gas	✓	✓	✓	✓
Air/Oxygen	up to 350 °C	-	-	✓
Hydrogen	✓[3]	✓[3]	✓[3]	✓[1,3]
Rough vacuum and fine vacuum (>10^{-3} mbar)	✓	✓	✓	✓[2]
High vacuum (<10^{-3} mbar)	-	✓	✓	✓[2]
Material of heater	Graphite	Molybdenum	Tungsten	$MoSi_2$
Material of insulation	Graphite felt	Molybdenum	Tungsten/Molybdenum	Ceramic fiber

[1]Up to 1400 °C
[2]Depending on Tmax
[3]Only with safety package for flammable gases

Model	Inner dimensions of process box in mm			Volume
	w	d	h	in l
VHT 8/..	120	210	150	3,5
VHT 40/..	250	430	250	25,0
VHT 70/..	325	475	325	50,0
VHT 100/..	425	500	425	90,0
VHT 250/..	575	700	575	230,0
VHT 500/..	725	850	725	445,0

Model	Inner dimensions in mm			Volume	Max. charge	Outer dimensions in mm			Heating power in kW[4]			
	w	d	h	in l	weight/kg	W	D	H	Graphite	Molybdenum	Tungsten	Ceramic fiber
VHT 8/..	170	240	200	8	5	1250 (800)[1]	1100	2000	27	19/34[3]	50	12
VHT 40/..	300	450	300	40	30	1600	2100	2300	83/103[2]	54/100[3]	134	30
VHT 70/..	375	500	375	70	50	1700	2500	2400	105/125[2]	70/130[3]	160	55
VHT 100/..	450	550	450	100	75	1900	2600	2500	131/155[2]	90/165[3]	210	85
VHT 250/..	600	750	600	250	175	2300	2800	2800	180/210[2]	125/220[3]	on request	on request
VHT 500/..	750	900	750	500	350	2500	3200	3000	220/260[2]	on request	on request	on request

[1]With the switching system unit removed
[2]1800 °C/2200 °C
[3]1200 °C/1600 °C
[4]Depending on furnace design connected load might be higher