

## Gas Supply Systems/Vacuum Package for Tube Furnaces

When equipped with different gas supply systems, most tube furnace product lines can be adapted for operation with non-flammable or flammable gases or for vacuum operation.



Fiber plug with protective gas connection, suitable for many laboratory applications (gas supply system 1)

### Gas Supply System 1

#### For Non-Flammable Protective or Reactive Gases in Static Tube Furnaces, not Gas-Tight

Gas supply system 1 is a basic version for static tube furnaces, for operation with non-flammable protective or reactive gases. This system is not completely gas-tight and can therefore not be used for vacuum operation.

#### Standard Equipment

- Available for RD, R, RT, RHTC, RSH and RSV tube furnaces
- Two plugs made of porous, non-classified ceramic fiber incl. protective gas connections
- The standard working tube supplied with the furnace can be used
- Gas panel for one non-flammable protective or reactive gas (N<sub>2</sub>, Ar, He, CO<sub>2</sub>, air, forming gas\*)
- Shut-off valve and flow meter with manual valve
- Supply of gas with 300 mbar required

#### Additional Equipment

- Additional gas panels for further non-flammable gases
- Automatic segment-related switching on/off by a magnetic valve
- Bottle pressure reducer for use with bottled gas



Flange with heat radiation protection insert (gas supply system 15)

### Gas Supply Systems 15 and 2

#### for Non-Flammable Protective or Reactive Gases in Static Tube Furnaces, Gas-Tight

For increased atmospheric purity requirements in the working tube in static tube furnaces we recommend one of these gas-tight gas supply systems with stainless steel flanges on the end of the tube is recommended.

The less expensive gas supply system 15 for furnaces up to 1300 °C and working tubes to 120 mm diameter is available for R, RSH and RSV tube furnaces. It includes contact protection on the flange and a stainless steel type 1.4301 heat radiation protection insert for the tube ends to protect the seals. A heat radiation protection package cools the flanges and a water connection is thus not required. With this variant, the tube must not be opened while it is hot. It is also not suitable for applications with a turbomolecular pump to achieve high vacuum. Gas supply system 2 is the correct choice for this type of application.

Gas supply system 2 with water-cooled flanges is available for R, RHTC, RHTH, RHTV, RSH and RSV furnaces. Cooling water supply with NW9 hose connector to be provided by the customer.

#### Standard Equipment

- Extended gas-tight working tube made of C 610 for furnaces up to 1300 °C or C 799 for temperatures above 1300 °C
- Two vacuum-tight stainless steel flanges with KF flange on the outlet side
- Mounting system on furnace for the flanges



Water-cooled vacuum flange (gas supply system 2)

\* Country-specific regulations for permissible mixture ratios must be observed.

- Gas panel for one non-flammable protective or reactive gas (N<sub>2</sub>, Ar, He, CO<sub>2</sub>, air, forming gas\*)
- Shut-off valve and flow meter with manual valve
- Supply of gas with 300 mbar required
- Check valve in the gas outlet to prevent air entering

#### Additional Equipment for Gas Supply Systems 15 and 2

- Additional gas panels for further non-flammable gases
- Automatic segment-related switching on/off by a magnetic valve
- Bottle pressure reducer for use with bottled gas
- Vacuum package for a maximum final pressure of up to  $5 \times 10^{-5}$  mbar

#### Other Additional Equipment only for Gas Supply System 2

- Quick-locks for water-cooled flanges
- Air-water heat exchanger for closed loop water circuit
- Window for charge observation

## Gas Supply Systems 25 and 26

### for Non-Flammable Protective or Reactive Gases in Rotary Tube Furnaces, Gas-Tight

Gas supply systems for non-flammable protective and reactive gases are also available for RSRB and RSRC rotary tube furnaces.

#### Standard Equipment

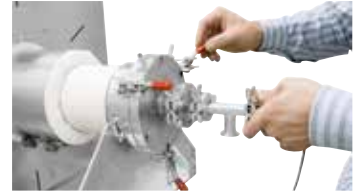
- Gas panel for one non-flammable protective or reactive gas (N<sub>2</sub>, Ar, He, CO<sub>2</sub>, air, forming gas\*)
- Shut-off valve and flow meter with manual valve
- Supply of gas with 300 mbar required

Gas supply system 25 for rotary tube furnaces for batch operation (RSRB) also includes gas-tight rotary lead-outs on the gas inlet and outlet as well as a gas cooler at the outlet. A check valve is also installed at the gas outlet to prevent air entering the tube.

For gas supply system 26 for rotary tube furnaces for continuous processes (RSRC) the furnace must also be equipped with a feeding system.

#### Additional Equipment

- Additional gas panels for further non-flammable gases
- Automatic segment-related switching on/off by a magnetic valve
- Bottle pressure reducer for use with bottled gas
- Vacuum package for a maximum final pressure of up to  $5 \times 10^{-2}$  mbar



Water-cooled stainless steel flanges with quick locks as additional equipment



Window as additional equipment for gas-tight flanges



Gas panel for one non-flammable protective or reactive gas (N<sub>2</sub>, Ar, He, CO<sub>2</sub>, air, forming gas\*)

\* Country-specific regulations for permissible mixture ratios must be observed.

### Gas Supply System 3 for Hydrogen Applications in Tube Furnaces above 750 °C

Gas supply system 3 allows for the operation in a hydrogen atmosphere at temperatures above 750 °C. From 750 °C, hydrogen can be introduced into the working tube. At program end or when the temperature falls below 750 °C, the working tube is purged with nitrogen to prevent the formation of an explosive hydrogen/oxygen atmosphere. The purging volume is at least five times the volume of the tube. Surplus hydrogen is burnt off in an exhaust gas torch.



Example of an over-temperature limiter

#### Standard Equipment

- Available for R, RHTC, RHTH, RHTV, RSH, RSV, RSRB and RSRC tube furnaces
- Gas panel for hydrogen and nitrogen
- Automatic segment-related switching on/off by a magnetic valve
- Nabertherm Controller to regulate the temperature curve and switch the gas supply system
- Additional safety controls with touch panel to monitor hydrogen gassing only above 750 °C
- Exhaust gas torch with temperature monitoring
- Over-temperature limiter with digital display as over-temperature protection for the furnace and charge
- Temperature monitoring at the gas inlet
- Emergency purge container for nitrogen

#### Additional Equipment

- Additional gas panels for further non-flammable gases
- Gassing via program-related controllable mass flow controllers
- Bottle pressure reducer for use with bottled gas
- Air-water heat exchanger for closed loop water circuit (not for RSRB and RSRC)



Gas panels with mass flow controllers

### Gas Supply System 4 for Hydrogen Applications in Tube Furnaces from Room Temperature

Gas supply system 4 allows operation with a hydrogen atmosphere starting at ambient temperature. During hydrogen operation, a pressure of approx. 30 mbar is ensured in the working tube. At the gas outlet the hydrogen is burnt off in an exhaust gas torch. Equipped with a safety PLC control system, pre-purging, hydrogen inlet, operation, fault monitoring and purging at the end of the process are carried out automatically (with at least five times the volume of the tube). If a malfunction occurs, the tube is immediately purged with nitrogen and the system is automatically switched to a safe status.

#### Standard Equipment

- Available for R, RHTC, RHTH, RHTV, RSH, RSV, RSRB and RSRC tube furnaces
- Gas panel for hydrogen and nitrogen
- Automatic segment-related switching on/off by a magnetic valve
- Control via safety PLC control system with touch panel
- Exhaust gas torch with temperature monitoring
- Over-temperature limiter with digital display as over-temperature protection for the furnace and charge
- Excess pressure monitoring
- Emergency purge container for nitrogen



Example of a torch

**Additional Equipment**

- Additional gas panels for further non-flammable gases
- Operation with other flammable gases
- Gassing via program-related controllable mass flow controllers
- Bottle pressure reducer for use with bottled gas
- Air-water heat exchanger for closed loop water circuit (apart from RSRB and RSRC)



Furnace-unrelated measuring device for a pressure range of  $10^{-3}$  mbar or  $10^{-9}$  mbar

**Assignment of Gas Supply Systems to Furnace Models**

Model	Gas supply system						
	1	15	2	25	26	3	4
RD	●						
R	●	●	●			●	●
RT	●						
RHTC	●					●	●
RHTH			●			●	●
RHTV			●			●	●
RSH	●	●	●			●	●
RSV	●	●	●			●	●
RSRB				●		●	●
RSRC					●	●	●



Single-stage rotary vane pump



Two-stage rotary vane pump

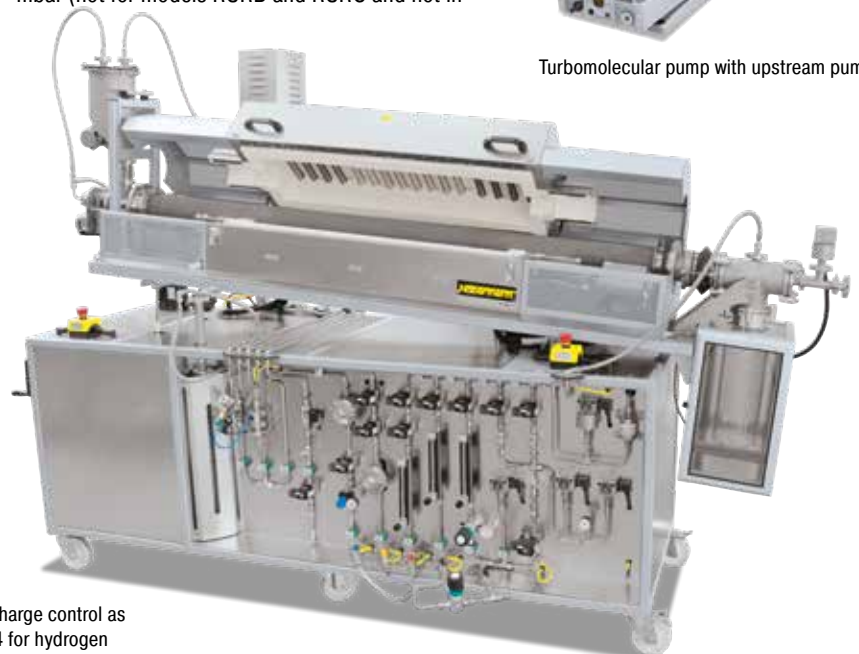


Turbomolecular pump with upstream pump

**Vacuum Package**

The vacuum package enables the working tube to be evacuated for vacuum operation in tube furnaces. It consists of an intermediate component for the gas outlet, a ball valve, a pressure gauge and a manually operated vacuum pump that is connected to the gas outlet by a corrugated stainless steel hose. A gas-tight furnace system is required for the use of a vacuum package, e.g. with the gas-supply packages 15, 2, 25 or 26. To protect the vacuum pump, only cold stage evacuation is allowed. The pump can then remain switched during the running program. The maximum ultimate pressure in the working tube depends on the type of pump.

- Single-stage rotary vane pump for an achievable ultimate pressure of approx. 20 mbar
- Two-stage rotary vane pump for an achievable ultimate pressure of approx.  $5 \times 10^{-2}$  mbar
- Turbomolecular pump system, consisting of a diaphragm pump with downstream turbomolecular pump for an achievable ultimate pressure of up to approx.  $5 \times 10^{-5}$  mbar (not for models RSRB and RSRC and not in combination with gas supply package 15)



Rotary tube furnace RSRC 120/1000/11 H<sub>2</sub> with three-zone control, charge control as well as FeCrAl working tube, feeding system and gas supply system 4 for hydrogen operation