Training
Pressure Reactors

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BERGHOF

Products +
Instruments

1.1

Product Portfolio

Overview

Product Family

DAB

DB

BR | NR

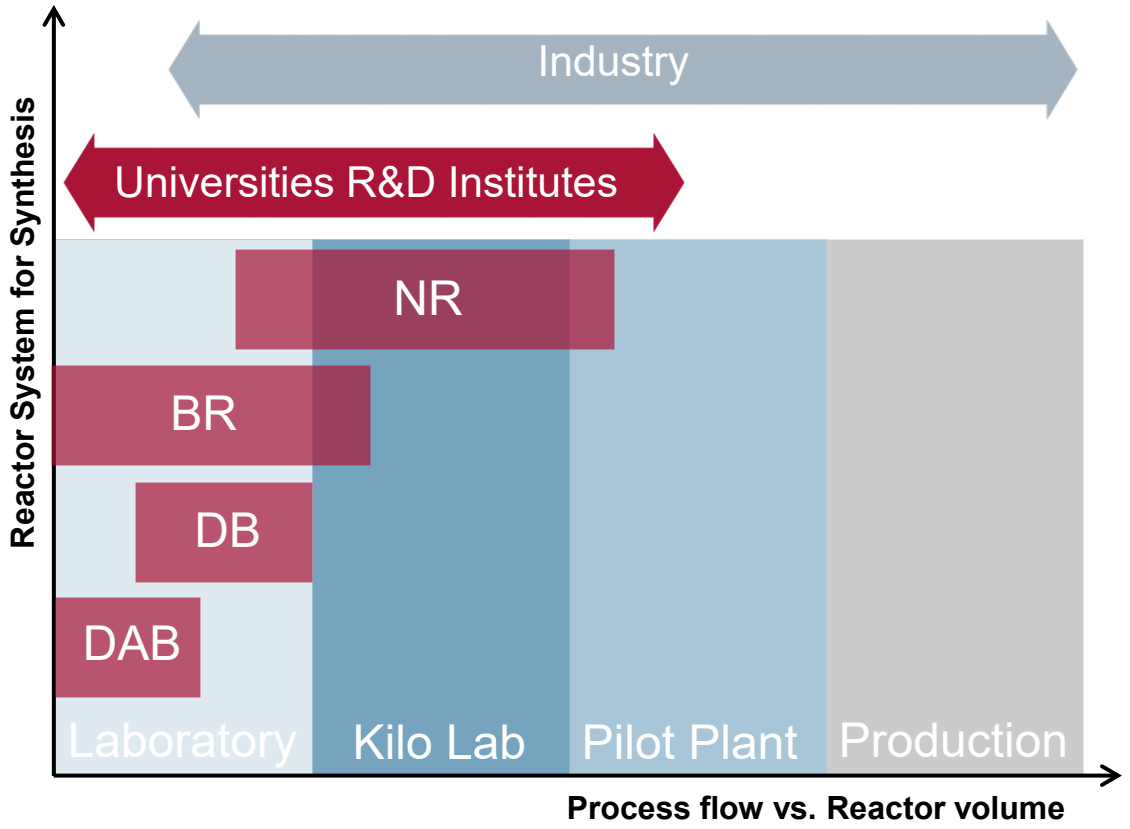
Flexibility, Accessories, Functionality, Volume

Handling, Corrosion Resistance, robustness

Range of Application

Process sizes:

- Laboratory reactors (from 10 mL up to 2 L)
- Kilo Lab reactors (from 1 L up to 20 L)
- Pilot Plant reactors (from 5 L up to 200 L)
- Production reactors (from 50 L up to >1000 L)



1.2

Product Portfolio

Digestec DAB Vessels

Simple Pressure Reactor? Digestec DAB-2/3

200 bar	250 °C	25 – 420 mL	3 vessel sizes

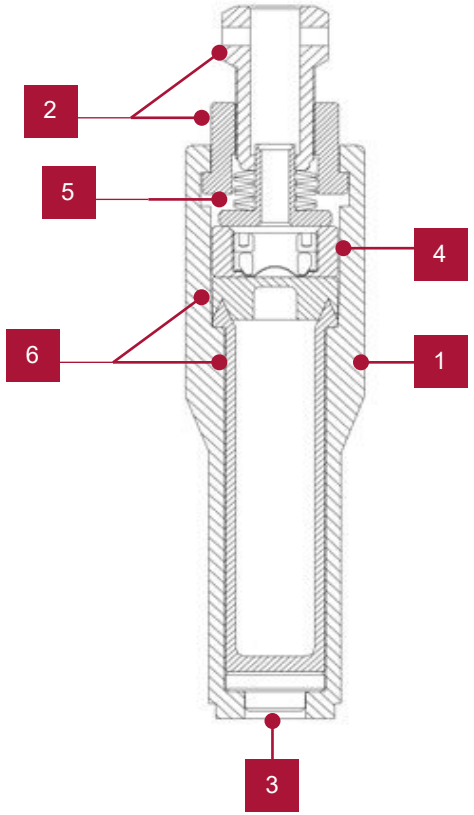
- High-quality stainless steel pressure vessels
- TFM-inserts, totally metal free
- Each pressure vessel is pre-examined by the TÜV
- Rupture discs as safety device
- Controlled ventilation of vessels during opening
- Simple handling
- Conventional heating via heating blocks
- Low costs

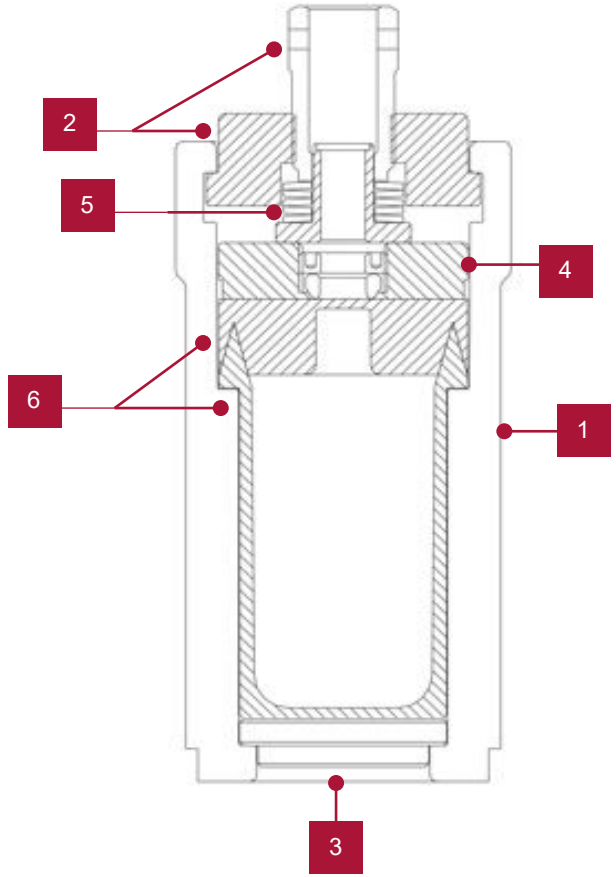
DAB-3 DAB-2

Design of Digestec Pressure Vessels DAB-2/3

200 bar	250 °C	25 – 420 mL	3 vessel sizes

1. Pressure vessel
2. Bayonett quick closure
3. Base plate
4. Rupture disc holder
5. Disc springs
6. PTFE liner with cap





Accessories of Digestec Pressure Vessels DAB-2/3

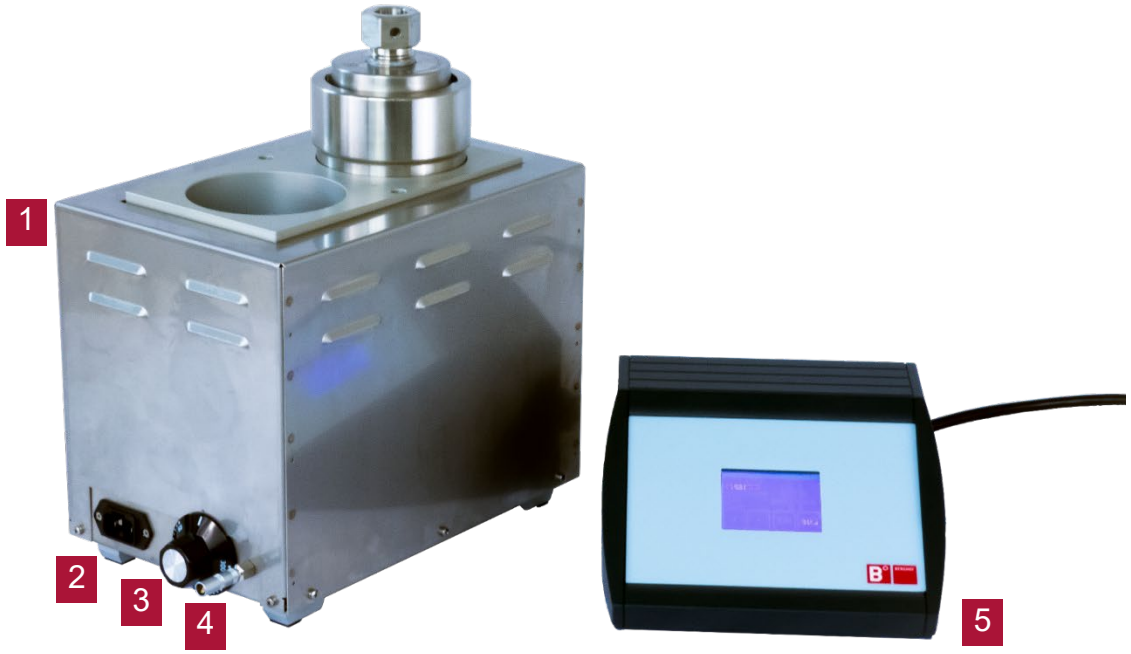
Mounting tool for DAB-2/3 (p/n 5218060)

1. Assembly station
2. Torque wrench
3. Socket
4. PTFE paste
5. Brush
6. Mandrel for exchanging of the disc springs
7. Face spanner wrench

DAH Heating Systems for Digestec Pressure Vessels DAB-2/3

DAH-406	DAH-412	DAH-902	DAH-904
6 positions	12 positions	2 positions	4 positions
DAB-2		DAB-3	

1. Heating block
2. Power socket
3. Adjustable overtemperature protection
4. Thermocouple
5. Controller



DAH-902 with BTC-1000

1.3

Product Portfolio

Highpreactor DB Series

But What if the Customer Wants to Measure *p* and *T* Inside the Reactor? → DB Series

200 bar	230 °C	300 – 2000 mL	6 vessel sizes

- High-quality stainless steel pressure vessels
- Complete PTFE lining
- Each reactor is build according to PED 2014/68/EU
- Rupture discs as safety device
- Pressure and temperature sensor available
- Stirring via magnetic stirring bar and hot plate (DB-300/500)
- Heating via double jacket (BTM) and/or electrical heating device (BHM) - see BR reactors

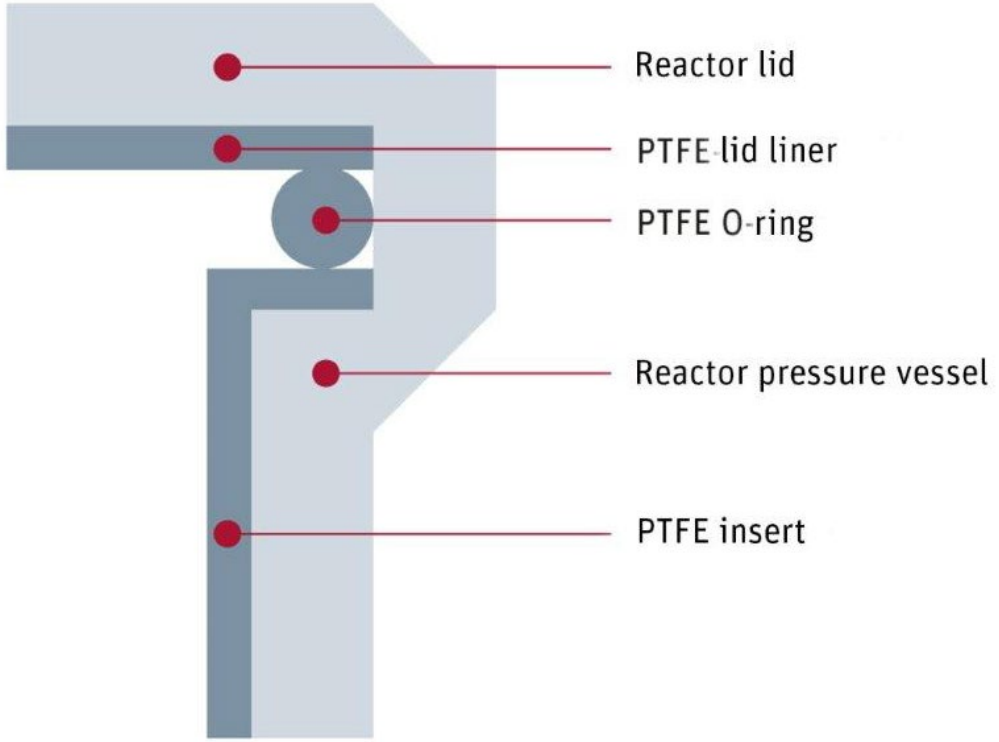
DB-500 DB-1000

Constructing Materials / Sealing

Liners made from PTFE for optimal chemical resistance

200 bar	230 °C	300 – 2000 mL	6 vessel sizes

- Removable PTFE inserts
- Hermetically sealed between lid linier and insert
- Dip tubes for thermocouple made from PTFE
- PTFE sealing
- *T* up to 230 °C
- *p* up to 200 bar



➢ all parts in contact with gas and liquid phase are protected against chemical attack

Design of Highpreactor DB Series

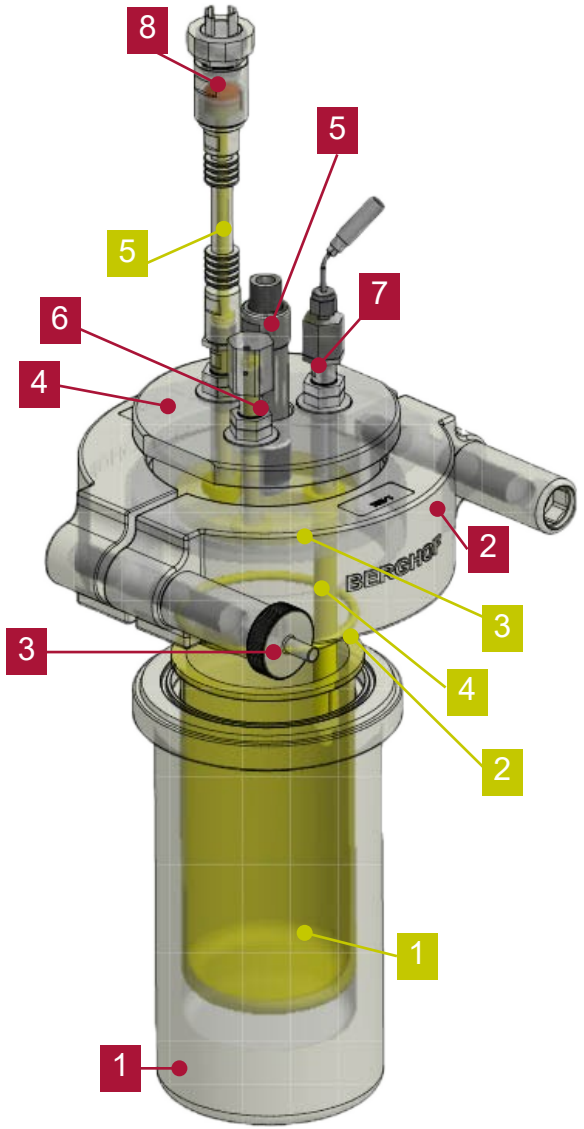
3D_DB-300

200 bar	230 °C	300 – 2000 mL	6 vessel sizes

1. Reactor vessel
2. Closing clamp
3. Opening tool
4. Reactor lid
5. Rupture disc holder
6. Vent valve
7. Dip tube for thermocouple
8. Pressure sensor

The following yellow parts inside the reactor are made of PTFE

1. Insert
2. O-ring sealing
3. Lid lining
4. Lining of the dip tube
5. Lining of the connections



1.4

Product Portfolio

Highpreactor BR Series

BR Reactors with and w/o PTFE Insert

200 bar	230 / 300 °C	25 – 5700 mL	11 vessel sizes

- High-quality stainless steel pressure vessels
- Each reactor is build according to PED 2014/68/EU
- **PTFE insert and PTFE lid lining**
- Rupture discs as safety device
- O-ring as sealing system
- **Quick closing system – no wrench needed**
- Various armatures, configuration acc. customer request
- Magnetic coupled overhead stirring with different stirrer geometries
- Heating via double jacket (BTM) and/or electrical heating device (BHM)

BR-500

BR-2000

Heating devices

200 bar	230 / 300 °C	25 – 5700 mL	11 vessel sizes

Two alternative heating devices

1. **BHM** „**B**erghof **H**eating **M**antle“
   - Electrical heating device with over temperature protection
   - Controller BTC/BDL needed
2. **BTM** „**B**erghof **T**hermostated **M**antle“
   - Double jacket for heating with oil / heating fluid
   - Heating circulator needed

BHM

BTM

Overview BR Reactor Series

BR-25/40

BR-100/200

BR-300/500/700

BR-800/1000/1500/2000

BR-4000

Accessories, Functionality, Volume, Diameter of Vessel and Lid

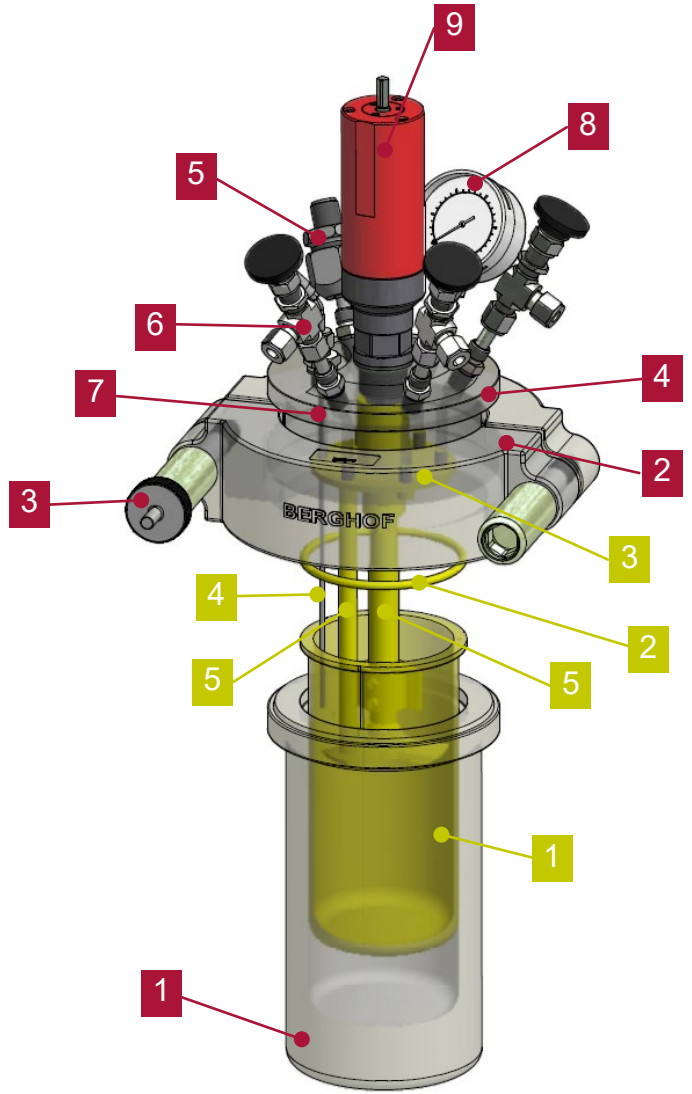
General Design of Highpreactor BR Series

200 bar	230 °C	25 – 5700 mL	11 vessel sizes

1. Reactor vessel
2. Closing clamp
3. Opening tool
4. Reactor lid
5. Rupture disc holder
6. Vent valve
7. Dip tube for thermocouple
8. Manometer / pressure gauge
9. Magnetic clutch

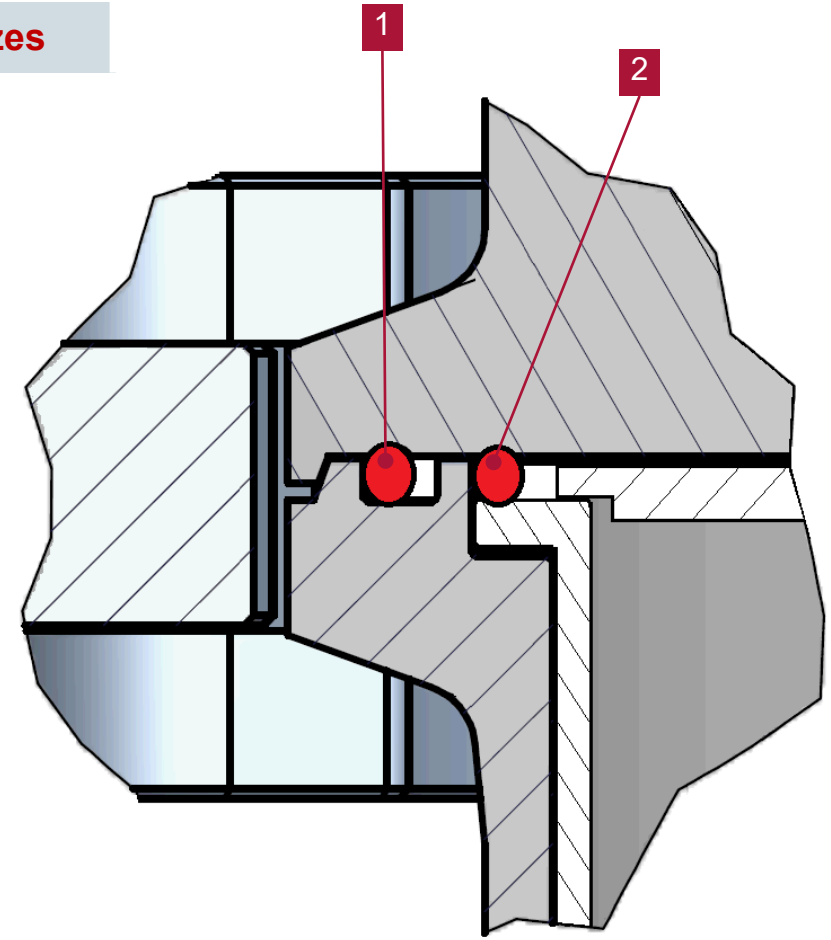
The following yellow parts inside the reactor are made of PTFE if needed

1. Insert
2. O-ring sealing
3. Lid lining
4. Lining of the dip tube
5. Sampling tube
6. Stirrer



Constructing Materials / Sealing

200 bar	230 / 300 °C	25 – 5700 mL	11 vessel sizes



Two alternative sealing positions at BR-300 and bigger

1. Outer O-ring for working with stainless steel reactors only
2. Inner O-ring for working with PTFE-lined reactors

Different materials of construction

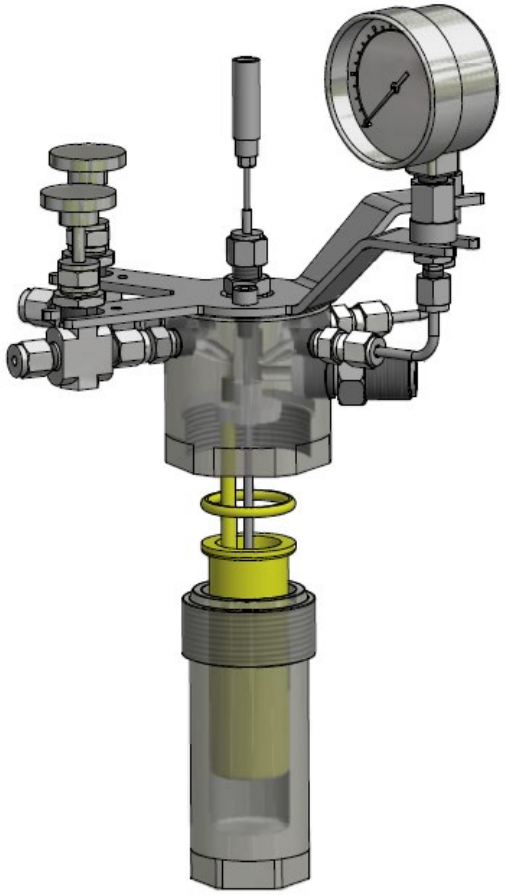
- Stainless steel 316Ti (1.4571) as standard material
- Hastelloy C-22 (2.4602)
- Other materials and coatings, e.g. Tantalum, on request

BR-25/40 Reactors with and w/o PTFE Insert

3D_BR-25

200 bar	230 / 300 °C	25 – 45 mL

Series	Volume vessel (metal-version)	Volume PTFE insert
BR-25	30 mL	25 mL
BR-40	45 mL	40 mL



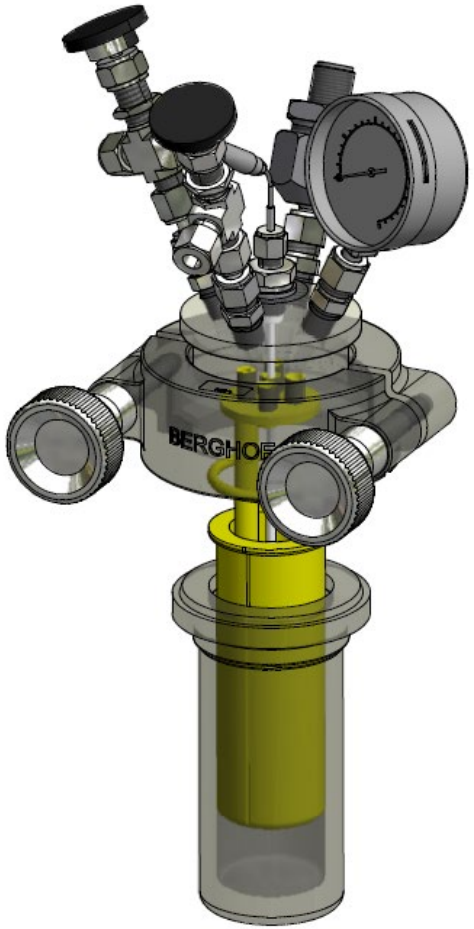
- Attention! Different vessels for reactors with or w/o PTFE
- Attention! With PTFE insert → 230 °C max
- Reactor lid as screw cap
- Stirring via magnetic stirring bar, no magnetic clutch available
- Heating via laboratory heating plate

BR-100/200 Reactors with and w/o PTFE Insert

3D_BR-100

200 bar	230 / 300 °C	25 – 200 mL

Series	Volume vessel (metal-version)	Volume PTFE insert
BR-100	100 mL	50/75/100/150 mL
BR-200	200 mL	200 mL



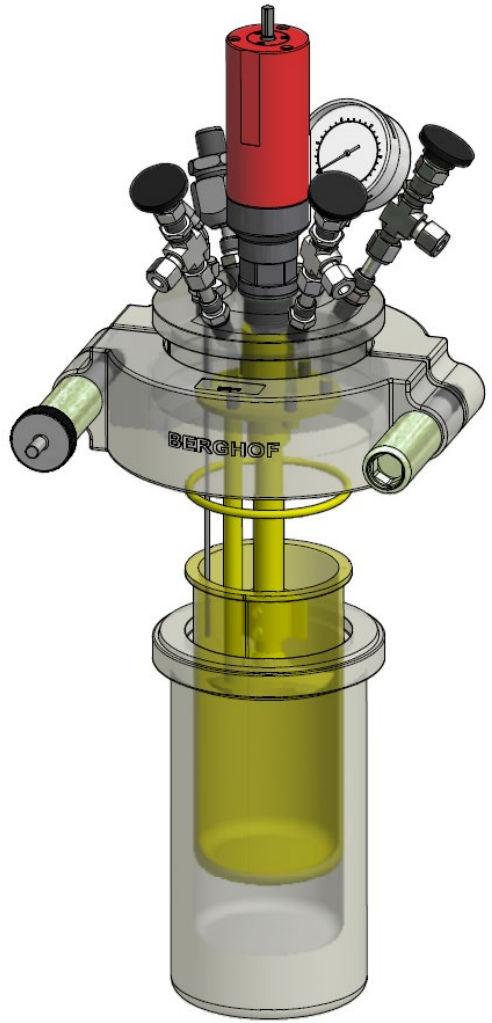
- Attention! Different vessels for reactors with or w/o PTFE
- Attention! With PTFE insert → 230 °C max
- Closing clamp
- Stirring via magnetic stirring bar, no magnetic clutch available
- Heating via laboratory heating plate

BR-300…2000 Reactors with and w/o PTFE Insert

3D_BR-1000

200 bar	230 / 300 °C	300 – 2200 mL

Series	Volume vessel	Volume PTFE insert
BR-300	400 mL	300 mL
BR-500	600 mL	500 mL
BR-700	900 mL	700 mL
BR-1000	1200 mL	1000 mL
BR-1500	1700 mL	1500 mL
BR-2000	2200 mL	2000 mL



- Magnetic coupled overhead stirring with bottom bearing
- Electric heating mantle (BHM) with controller and/or thermostated mantle (BTM)
- Attention! BR-300 without bottom bearing

BR-4000 Reactors with and w/o PTFE Insert

150 bar	230 / 300 °C	4000 / 5700 mL

Series	Volume vessel	Volume PTFE insert
BR-4000	5700 mL	4000 mL

- Magnetic coupled overhead stirring with bottom bearing
- Electric heating mantle (BHM) with controller and/or thermostated mantle (BTM)
- Closing clamp
- Lift system or laboratory cart for easy handling

1.5

Product Portfolio

Highpreactor NR Series

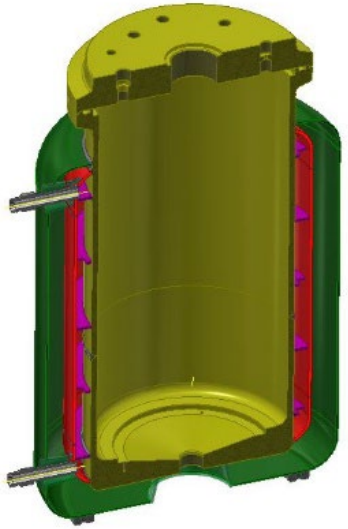
NR Reactors with and w/o PTFE Insert

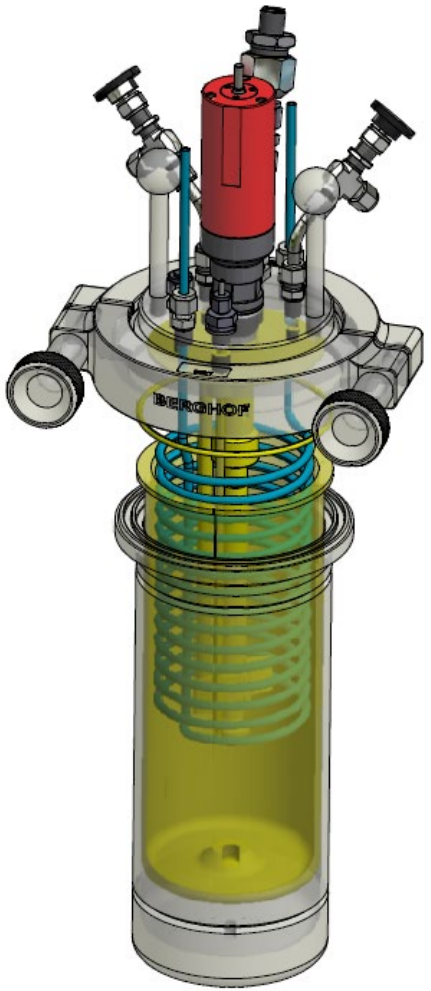
3D_NR-6000 PTFE

25 bar	230 / 300 °C	1500 – 11400 mL

Serie	Volume vessel	Volume PTFE insert
NR-1500	1800 mL	1500 mL
NR-3000	3500 mL	3000 mL
NR-6000	6900 mL	6000 mL
NR-10000	11400 mL	-

- Available with and w/o PTFE insert, except NR-10000
- Bottom drain valve is also available, but only w/o PTFE
- Magnetic coupled overhead stirring with bottom bearing
- Electrical heating mantle with controller or isolated double jacket, directly welded onto the reactor vessel
- Customization in size, materials and features possible





2.1

Applications

DAB, DB, NR and BR Systems

Examples of Applications
DAB Vessels

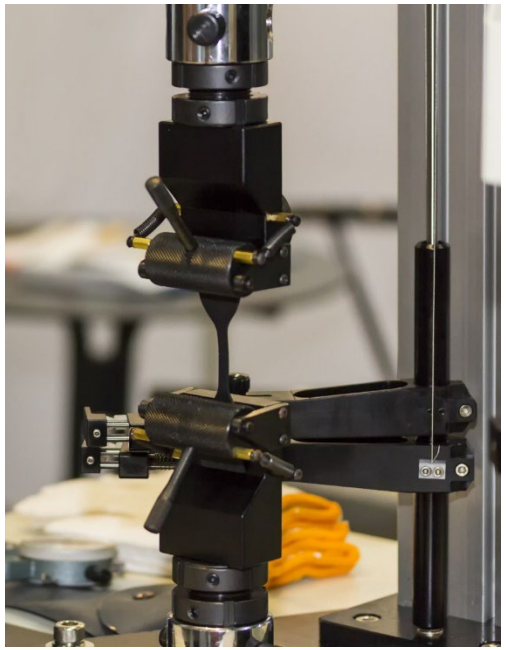
Material testing / Aging tests / Exposure tests

Specimens are treated in liquids / gases at elevated temperatures for defined time periods

Typical parameters:

- Specimen: Elastromers, Thermoplasts, Metal parts
- Liquids: cooling liquids, mineral oils, salt water, fuels
- *T* = 150 °C and *t* up to 1000 h

Customers: **Companies like Daimler / Mercedes Benz, Continental, Trelleborg, Baker & Hughes, ExxonMobil…**



Tensile test

DAB-3 XXL with specimen holder

Examples of Applications
DAB Vessels

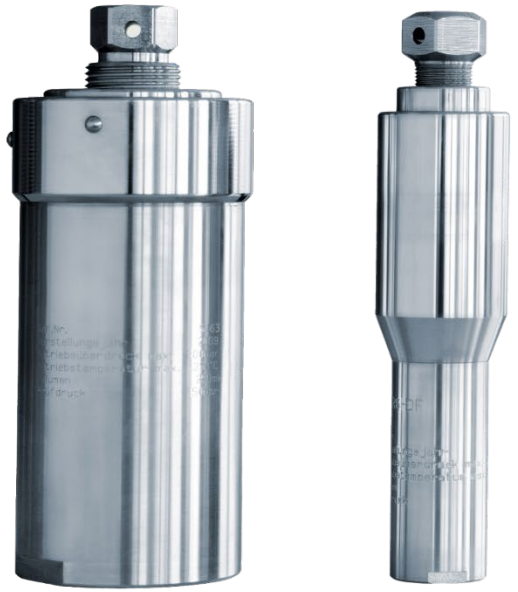
Solvothermal synthesis

Synthesis of porous and non porous solids under solvothermal conditions / crystallization step

Typical parameters:

- Products: Zeolites, mesoporous metal oxides, nanoparticles…
- Solvents: Water, Acids, Bases, Ethanol…
- *T* = 110 to 250 °C and *t* up to 168 h

Customers: **Academic research, Wacker, BASF, Evonik, Bayer, ExxonMobil, Shell…**



DAB-3 DAB-2

Examples of Applications
DB Vessels

Corrosion tests

Specimens are treated in liquids / gases at elevated temperatures for defined time periods

Typical parameters:

- Specimen: Metal coupons, metal parts…
- Liquids: cooling liquids, salt water, process water
- *T* = 150 °C and *t* up to 672 h

Customers: **Companies like Linde, Kurita, Daimler / Mercedes Benz…**

DB-500

Examples of Applications
DB Vessels

Digestion / Acid treatment

Digestion and/or acid treatment of rocks, metals, metal oxides, silicates…

Typical parameters:

- Liquids: concentrated inorganic acids / mixtures of acids
- *T* up to 230 °C and *t* up to 48 h

Customers: **Academic research, Rusal, Daimler / Mercedes Benz, Fraunhofer Institute…**

DB-1000

Examples of Applications
BR-25/40 and BR-100/200

Small scale synthesis

Organic and Inorganic small scale synthesis

Typical parameters:

- Reactions: Hydrogenations, Metathesis, Gas-liquid reactions…
- Solvents: Aqueous solutions, Alcohols, Alkanes, Aromatics…
- *T* up to 280 °C, *p* up to 180 bar and *t* up to 6 h

Customers: **Industrial and Academic research, Pharma research, Boehringer Ingelheim, Roche Diagnostics…**

BR-25 BR-100

Examples of Applications
BR-300…2000

Organic and Inorganic Synthesis

Organic and Inorganic synthesis

Typical parameters:

- Reactions: Hydrogenations, Polymerizations, Gas-liquid reactions…
- Solvents: Aqueous solutions, Alcohols, Alkanes, Aromatics…
- *T* up to 280 °C, *p* up to 150 bar and *t* up to 6 h

Customers: **Industrial and Academic research, Pharma research, Continental, Panacol, Wacker, Dow, Evonik, Bayer, BASF, Clariant…**

BR-500

Examples of Applications
BR-700 and 2000

Material testing / Aging tests / Exposure tests

Specimens are treated in liquids / gases at elevated temperatures for defined time periods

Typical parameters:

- Specimen: Elastromers, Thermoplasts, Metal parts
- Liquids: cooling liquids, synthetic oils, fuels
- *T* = 150 °C and *t* up to 1000 h

Customers: **Companies like Daimler / Mercedes Benz, Continental, Trelleborg, Baker & Hughes, ExxonMobil, Freudenberg, Vaxxilon, Schaeffler…**

Sample holder for BR-700 and BR-2000

Examples of Applications
BR-4000

Waste treatment

Sub-process of the treatment of industrial waste for recycling of precious metals

Typical parameters:

- Educts: cyanide solutions with precious metal ions
- Liquids: concentrated alkaline solutions like caustic soda and potash
- T = 200 °C and t up to 24 h

Electronic waste material before crushing / milling and treatment with cyanide solution

Customers: **Recycling companies like Remondis, Alba…**

Examples of Applications
BR-4000

Hydrothermal Carbonization

Conversion of biomass to brown coal

Typical parameters:

- Feedstock: All kinds of biomass
- Liquids: slightly acid solutions
- *T* = 230 °C and *t* up to 72 h at hydrothermal conditions

Customers: **Academic research and companies like Spina Group, Suncoal Industries…**

BR-4000

Thank you | 감사합니다

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