

DB-300 - DB-2000

High Pressure Reactor System



Leerseite

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General Information on this Manual

- This user manual describes the high pressure laboratory reactor from Berghof Products + Instruments GmbH. It contains product specific information, current as of the date of publication of this manual.
- This manual guides the user in the safe and proper use of the Speedwave4 system. Familiarity with the relevant chapters of this handbook is required for safe and intended use of the equipment.
- Read this instructional manual carefully prior to operating the equipment. After unpacking, carefully check the equipment for mechanical damage and missing parts. Should you find any damage incurred during shipment, contact the manufacturer immediately and do not operate the equipment.
- This instructional manual does not include repair instructions. Should repairs be required, please contact your representative or Berghof Products + Instruments GmbH.

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You can reach us at:

Berghof Products + Instruments GmbH

Harretstrasse 1

72800 Eningen

Deutschland

T +49.7121.894-202

F +49.7121.894-300

E-mail: laboratorytechnology@berghof.com

www.berghof-instruments.com

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1. General Notes

Please read this instruction manual carefully before operating your high pressure digestion system. Failure to follow these instructions could result in damage to the equipment as well as personal injury.

Safety instructions are described in section 'Danger Categories and Signal Words'. These safety notes must be heeded in all cases!

1.1. Danger Categories and Signal Words

The signal words described below are used in connection with warnings throughout this manual. For your own safety and to avoid property damage, you must strictly heed these warnings!

The safety signals are printed in boldface or are otherwise marked throughout this manual and have the following meanings:



Means that failure to follow the safety instructions **is likely to cause** severe personal injury, death or severe property damage.



Means that failure to follow the safety instructions **may cause** severe personal injury, death or severe property damage.



Means that failure to follow the safety instructions **may cause** personal injury or some property damage.



This symbol indicates that this is important information regarding the product or refers to a part of the manual, which requires particular emphasis.

1.2. Qualified Users

Only Qualified Users should operate this equipment. Qualified Users with respect to this manual are relevantly schooled and trained specialists with a basic knowledge of chemistry and technology. They should be trained in the relevant legal regulations for handling of chemicals.

1.3. Proper Use



Explosion hazard!

The unit is not designed for the use with substances / solutions, gas- / liquid mixtures or similar, which can form explosive mixtures and substances under operating conditions. (E.g., perchloric acid, solvent / air mixtures in certain concentrations, etc.)



Observe all operating instructions!

Always exercise particular care when handling pressurized vessels. Always comply with the operating instructions and all legal requirements as well as general safety regulations related to handling the individual chemical substances involved.

The operator may only permit knowledgeable and properly trained personnel to operate the pressure laboratory reactor and its accessory equipment and must ensure that other employees or third parties are not endangered.

The operator must prepare appropriate operating instructions in order to ensure that personnel operating the pressure laboratory reactor or equipment receive proper instruction.

All locally applicable regulations governing the operation of the laboratory reactor must be complied with.

→ Application area

The high pressure laboratory reactor is employed as a reaction vessel for chemical reactions and material tests which are performed under excess pressure. Increased pressure can be produced by the addition of gases or by heating the reaction solution in the sealed vessel.

Prerequisites for the proper and safe operation of the pressure laboratory reactor include qualified handling as well as proper transport, storage, setup, and application, together with careful maintenance.

The system may only be used within the context of data and applications specified in this documentation and the associated user manuals.

The high pressure laboratory reactor may only be used:

- Properly
- In a technically flawless condition
- Without unauthorized alterations or modifications
- By qualified users

Please also observe all regulations published by professional/trade associations, the TÜV, VDE regulations, or corresponding national regulations.

1.4. General Safety Information

Using the high pressure laboratory reactor involves taking into account various safety precautions which go beyond those for general laboratory practices. The following general safety information should therefore be read carefully prior to using the system, and should be observed at all times.

We can assume no liability for damages resulting from improper handling of a failure to comply with this information.

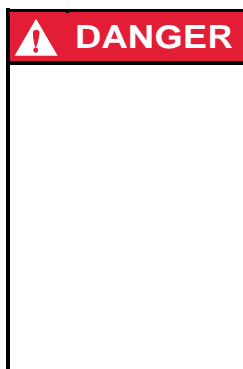


Explosion hazard !

The unit may never be employed without proper over-pressure protection. The unit is not designed for the use with substances / solutions, gas- / liquid mixtures or similar, which can form explosive mixtures and substances under operating conditions. (E.g., perchloric acid, solvent / air mixtures in certain concentrations, etc.)

Special, grease-free valves must be employed if oxygen is used. Under no circumstances may any grease be subsequently applied to these valves.

Adequate explosion protection must be provided in the immediate vicinity of the pressure laboratory reactor whenever flammable substances are employed. Any vapors generated by the flammable liquids which may escape from the over-pressure protection (e.g., rupture disc or pressure release valve) must be safely extracted in accordance with local requirements. This also applies should the rupture disc be activated. If the pressure laboratory reactor is set up under an extractor, the latter must be equipped with adequate explosion protection.



Improper use!

Should a directly hazardous situation develop while the pressure laboratory reactor is in operation, e.g., as the result of an unexpected reaction or dangerous effects from the outside, all requisite countermeasures must be immediately initiated and, if necessary, the reactor must be taken out of service.

A complete and detailed inspection of the pressure laboratory reactor must be performed if the operational fault resulted in the permissible pressure being exceeded by more than 10%, or if the permissible operating temperature was significantly exceeded, or if the pressure laboratory reactor or its fittings were damaged.

! DANGER




Pressure Vessels

Use only spare parts authorized by Berghof Products + Instruments GmbH for use with the pressure laboratory reactor. These can be obtained either from your local representative or directly from Berghof Products + Instruments GmbH (Refer to the "Repairs / Customer Service" section for contact addresses).

Never open the pressure laboratory reactor while it is under pressure. Never use force to open the vessel.

Hot gases and vapors can escape from the pressure vessel when it is opened! Always wait until the vessel has cooled to room temperature before opening it.

Always exercise extreme caution when working with toxic substances. Always comply with all relevant spec sheets and safety precautions!

The reactor may not be operated without its PTFE insert when working with strong acids (e.g., nitric acid, hydrochloric acid, sulfuric acid, phosphoric acid, hydrofluoric acid). If necessary, a Hastelloy reactor is to be used where the fittings also require protection against corrosion as is the case, for example, when these types of acids are heated or if gaseous acids are employed.

Perform regular visual inspections of all pressure laboratory reactors' components to detect any damage (corrosion, cracking, etc.).

All applicable legal regulations governing the use of pressure reactors must be observed.

! WARNING




Always wear personal protective equipment!

Always wear personal protective equipment during work which may involve contact with chemicals, that is, when working with acids, pressure vessels, during cleaning, etc.!

! WARNING

Max. operating temperature and operating pressure!

The maximum interior temperature and maximum operating pressure may not be exceeded (refer to the "Technical Specifications" section). Exceeding the maximum temperature will result both in a reduction of the pressure laboratory reactor's pressure resistance as well as possibly damaging the seals.

! WARNING

Accessories!

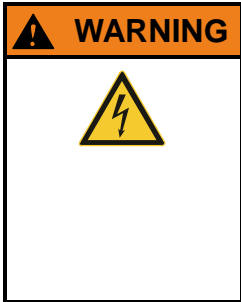
The laboratory reactor may only be used in conjunction with the specified heating systems.

Never allow liquids, particularly toxic compounds, to spill on hot parts.

! WARNING

Quenching

Quenching the vessel with water or oil, especially under internal pressure, must be strictly avoided!



Accessories use low voltage 230V!

The heating systems must always be connected to a ground conductor. The enclosed power cable ensures the grounding, given that the socket outlet is equipped with a protective grounding conductor. If it is necessary to use an extension cord to connect the system to the power supply, only a three-wire cord with a ground connection may be employed.

Repairs and service may only be performed by properly trained and qualified personnel.



Only use approved supply cords!

Do not exchange the detachable mains supply cord with a cord of inadequate rating. Use only approved and undamaged supply cords.



Emissions!

Should the over-pressure protection (e.g., rupture disc or pressure release valve) activate, gases which may be hazardous to individuals will be suddenly released into the atmosphere. Always make sure the opening of the over-pressure protection is never directed towards individuals. Preferably, a pressure hose should be connected to the over-pressure protection to safely discharge the gases.



Ventilation

Users are responsible for assuring that appropriate ventilation of toxic gases is assured.

Make sure that all ventilation procedures conform to applicable laws.

1.5. Legal Requirements



The user is responsible for ensuring that the current regulations are respected. The set of rules in this chapter is only an overview.

Within the European Union, 2014/68/EU (Pressure Equipment Directive) and 2014/29/EU (Simple Pressure Vessels Directive) bring the various national technical requirements into line. In the German Code, these have been included in the 6th and 14th Equipment and Product Safety Act. This enacted harmonized characteristics requirements. However, harmonized technical rules or adapted national construction requirements (e.g. AD-2000 in Germany) may also apply.

Manufacturers of pressure equipment are free to select among these regulations based on their countries!

1.5.1. Recurring inspection, Responsibility for technical inspection, maximum inspection periods according BetrSichV 2015

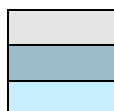
The laboratory reactor can be operated either as a pressure vessel or as an experimental autoclave. The classification must be carried out by the operator.

The following applies to pressure vessels:

No.	Vessel	Test-group	V, [Liter]	PS, [bar]	PS*V, [bar*Liter]	§15 Examination for commissioning	§16 Recurring inspections		
							External Inspection	Internal Inspection	Strength Test
1.	DB-300		0,40	200	80				
2.	DB-500		0,64	200	128				
3.	DB-700		0,99	200	198				
4.	DB-1000	III	1,24	200	248		2 years	5 years	10 years
5.	DB-1500	III	1,75	200	350		2 years	5 years	10 years
6.	DB-2000	III	2,24	200	448		2 years	5 years	10 years

Table 1: Pressure vessels

Legend:



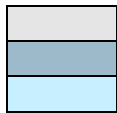
No test group according to BetrSichV
 Person qualified for examination
 Approved body according to §37 ProdSG

The following applies to experimental autoclaves:

No.	Vessel	Test-group	V, [Liter]	PS, [bar]	PS*V, [bar*Liter]	§15 Examination for commissioning	§16 Recurring inspections		
							External Inspection	Internal Inspection	Strength Test
1.	DB-300		0,40	200	80				
2.	DB-500		0,64	200	128		2 years	5 years	10 years
3.	DB-700		0,99	200	198		2 years	5 years	10 years
4.	DB-1000	III	1,24	200	248		2 years	5 years	10 years
5.	DB-1500	III	1,75	200	350		2 years	5 years	10 years
6.	DB-2000	III	2,24	200	448		2 years	5 years	10 years

Table 2: Autoclaves

Legend:



- No test group according to BetrSichV
- Competent person
- Approved body according to §37 ProdSG

After **each** use, the experimental autoclave must be examined by a competent person.

The special risk involved with pressure vessels has led to them being classified in the German Equipment and Product Safety Act (ProdSG) under “systems requiring monitoring”.

Under Section 3 of the BetrSichV 2015, ‘Additional requirements for systems requiring monitoring’:

The operator is to ensure that the result of the inspection and testing are documented according to §§ 15 and 16. If the inspection and testing is done by an approved monitoring office, a certificate of inspection for the result of the inspection is to be requested. At minimum, records and inspection certificates must give information about:

- System ID
- Inspection and testing date
- Type of inspection and testing
- Basis of inspection and testing
- Scope of inspection and testing
- Effectiveness and functioning of the protective measures
- Result of the inspection and testing
- Date until next required inspection and testing according to § 16 paragraph 2.

→ Country specific regulations

If the pressure vessel was manufactured in accordance with the national regulations of the countries listed below, the following inspection periods apply.

Recurring inspection								
	D	F	B	I	L	NL	GB	S
In years	5*	1,5-3	1-3	1-2	5	4	2,17	3

See Table 1 and 2

Operation of pressure equipment is regulated by the European Union’s individual member states. In Germany, this is regulated by the Ordinance on Industrial Safety and Health, supplemented by a secondary body of technical rules.

The operator must comply with all locally applicable operating regulations. With regard to the recurring inspections, operators within the European Union may choose to abide by either their national requirements or by the German requirements. This is possible because the reactor has been manufactured in accordance with the AD-2000 body of rules and these rules are recognized throughout the EU. Therefore, an inspection period of 5 years applies to all Berghof pressure laboratory reactors employed within the European Union.

Regarding competent persons

The technical regulations for operating safety, TRBS 1203, specify the requirements for the necessary expertise needed by a person qualified under § 2, Abs. 7 BetrSichV.

Vocational training:

For the purposes of this Ordinance, a competent person means a person who has the technical knowledge necessary for inspecting the work equipment because of his/her vocational training, professional experience and current activity on the job.

Professional experience:

Professional experience requires that the qualified person has used the equipment to be tested and inspected in practice for a proven length of time in a professional environment and knows the functions and operation of it to the necessary extent. Furthermore, there were sufficient occasions to actually undertake the inspections and testing, e.g., as a result of a risk assessment and from daily observation.

Participation in inspections and testing of work equipment has led to an accumulation of experience concerning the performance of the inspections or similar tests, and the necessary knowledge for handling the testing instruments as well as evaluating the test results has been acquired.

Professional experience includes the ability to evaluate whether a recommended testing procedure is suitable for inspecting and testing the work equipment. This also includes detecting hazards involved through the testing activity and the work equipment to be tested.

Recent professional activity:

Recent professional activity in the sense of § 2 Abs. 7 BetrSichV includes activity in the context of the forthcoming inspection and testing as well as adequate training.

The execution of multiple inspections and testing per year (keeping testing skills up-to-date) belongs to recent professional activity.

In the event of lengthier interruptions of the inspection and testing activity, experience in inspection and testing should be renewed and necessary technical skills refreshed by participating in inspection and testing done by other parties.

The competent person must have knowledge about the state of the art regarding the work equipment to be tested and the hazards which might occur and keep this knowledge up-to-date. Familiarity with the operational safety regulations and their technical regulations and other statutory occupational safety regulations (e.g., ArbSchG, GefStoffV) and the associated technical regulations as well as regulations with requirements relating to the properties (e.g., ProdSG, relevant ProdSV), with provisions of the accident insurance carrier and other regulations (e.g., standards, recognized test principles) is required so that the safe state of the work equipment can be properly evaluated.

Additional qualifications for inspecting pressure systems that require monitoring according to Annex 2, Sec. 4, No. 3 BetrSichV:

- Relevant technical vocational training.
- At least one-year experience with manufacturing, assembling, operating or maintaining the equipment or system components to be inspected and tested.
- Current state of knowledge about pressure hazards by participation in a training or instruction.

1.5.2. Categories (Test group)

The pressure equipment referred to in Article 4 (1) of PED 2014/68/EU shall be classified by category in accordance with Annex II to the increasing risk potential.

The reason for this classification lies in the energy stored in the pressure vessel. This energy can be expressed as the pressure content product.

- Pressure content product: $P \times V = [\text{bar} \times \text{l}]$; (1 bar x l for gases, this corresponds to approx. 100 Joules)
- Charging medium (fluid): Gases store a greater amount of energy than liquids. However, liquids heated beyond their boiling point store additional energy in the form of heat.

Pressure equipment is subdivided into the following categories on the basis of this pressure content product and the charging media (fluid):

Application of the categories of danger according to the CLP regulation

Assignment of the substance properties to fluid groups:

Fluid group 1:

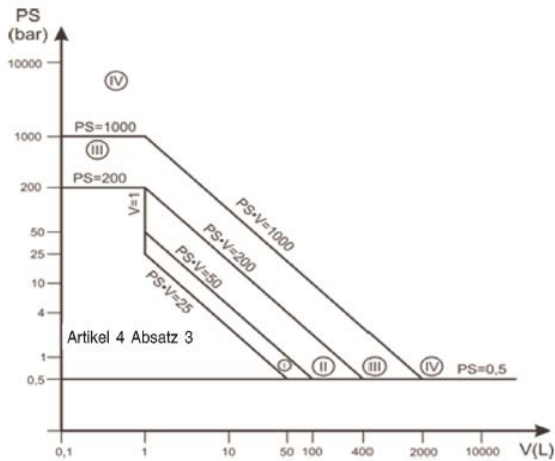
- explosive substances / mixtures according to Annex I, No. 2.1.
- flammable gases according to Annex I, No. 2.2.
- oxidizing gases according to Annex I, No. 2.4.
- flammable fluids according to Annex I, No. 2.6 (category 3 fluids only if $TB > TFl$ and $TFl < 55 \text{ }^\circ\text{C}$).
- pyrophoric fluids according to Annex I, No. 2.9.
- oxidizing fluids according to Annex I, No. 2.13.
- Acute toxic substances according to Annex I, No. 3.1.2 Categories 1 and 2.

Fluid group 2: all substances which do not belong to fluid group 1.

Because the pressure laboratory reactors described in this manual are intended for use in chemical laboratories, they generally fall under Group 1 – Hazardous Fluids!

As the following diagram illustrates, the Berghof pressure laboratory reactors with a volume smaller than 1000 ml and a max. operating pressure of 200bar cannot be assigned to any specific category. These must be designed, manufactured, and tested in accordance with Art. 4 Para. 3 (PED 2014/68/EU). Such reactors do not require CE certification and may not carry a CE symbol.

→ [Conformity Assessment Diagram](#)



1.5.3. TÜV/CE Mark

The minimum requirements for the conformity evaluation procedure can be deduced from this category.

Berghof Products + Instruments GmbH applies the following process for this purpose:

- EC type examination test: By the TÜV as an authorized testing center
- Conformity with design: Pressure test of every reactor by the TÜV as an authorized testing center

This methodology ensures that all reactors are designed, manufactured, and tested in accordance with the directive 2014/68/EU and the AD 2000 body of rules. This is confirmed by the TÜV seal, the conformity declaration and, to the extent that the reactors may be so designated, by the CE symbol.

1.5.4. Operation



If the reaction progression is not precisely known or if unanticipated pressure increases or exothermic reactions may occur (test autoclave), the unit must be set up in a special reactor chamber.

→ Operators Responsibilities

Based on the classification into the above-cited categories, the following obligations arise for the operator § 15 Inspection prior to putting into service, § 16 Recurrent inspections:

- The recurring inspections of test autoclaves must be performed by an approved body if the product of the maximum permissible pressure, P, and the relevant volume, V, is greater than 100 bar x liter.
- The recurring inspections must be performed at least every 5 years.

This test includes:

- Check the documentation (manufacturing documents, test book)
- Internal inspection (the determination of the actual state, the comparison of the actual state with the desired state, and the evaluation of the deviation of the actual state from the desired state)
- Functionality
- Pressure test

Special test regulations according to BetrSichV Annex 2, Section 4, No. 6.19:

In the case of pressure vessel and connected pipelines for flammable gases and gas mixtures in liquid state, which are applied to the walls of the vessels and pipelines

- which have corrosive effect, external tests must be carried out every two years by an approved body
- which have no corrosive effect, external tests must be carried out every two years by a competent person.

Experimental autoclaves for which the expected pressures and temperatures during experiments are not known with certainty are to be set up in specially protected chambers or behind safety walls so that they are protected from outside exposure and so that employees and others are safe in the event that the experimental autoclaves fail. There are safety precautions in this pressure equipment for experimental purposes which do not help in the event that pressure and temperature becomes excessive. Watching the safety and measurement equipment and operating the experimental autoclaves must be done in a safe place.

Measures for protecting persons have been undertaken to avoid extreme heating by the heat load which could result in failure of the pressure-loaded wall sections, equipment parts relevant for safety and/or supporting components of pressure equipment or its parts.

Protective measures are, e.g.:

- Safety distance
- Safety wall
- Ground cover
- Fire protection insulation
- Fixed fire extinguishing systems
- Sprinkler systems

The recurring inspections of experimental autoclaves must be performed by an approved body if the product of the maximum permissible pressure, P , and the relevant volume, V , is greater than 100 bar x liter.

1.6. Operating regulations and Characteristic Requirements

1.6.1. National Regulations, Laws, Ordinance, Technical Rules

- Ordinance on Industrial Safety and Health concerning the protection of safety and health in the provision of work equipment and its use at work (Ordinance on Industrial Safety and Health - Betriebssicherheitsverordnung–BetrSichV)
- Hazardous Substances Ordinance (Gefahrstoffverordnung – GefStoffV)
- Act on making products available on the market (Product Safety Act - Produktsicherheitsgesetz – ProdSG)
- Fourteenth Ordinance on the Product Safety Act (Pressure Equipment Regulation - 14. ProdSV)
- TRBS 1201 Part 2: Tests for hazards caused by steam and pressure
- TRBS 1203: Competent persons
- TRBS 2141: Risk posed by steam and pressure - General requirements
- TRBS 2141 Part 3: Risk posed by steam and pressure upon release of media

1.6.2. International Regulations

- Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment
- Directive 2014/29/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of simple pressure vessels
- Corresponding national provisions

1.6.3. Applicable Documents

AD 2000 code, in particular:

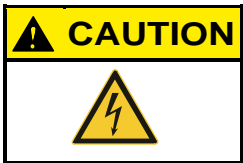
- Datasheet HP 30: Execution of pressure test
- Datasheet HP 512 R: Construction regulations - Design examination, final testing and pressure testing of piping

1.7. Safety

The Berghof Pressure Laboratory Reactors are tested with overpressure according to AD 2000 code and supplied with respective certificate.

In the following situations, the unit must be disconnected from the mains power supply and be locked out to prevent accidental use:

- If the unit evidences visible signs of damage
- If unit parts or components are found to be loose
- If the unit fails to operate
- If the unit is to be stored for extended periods of time under unfavorable conditions (e.g., outdoors, in very moist or humid environments)



The housing cover may only be removed by authorized trained personnel!
The instrument must be disconnected from the power outlet before being serviced.

1.8. Information on Disposal

→ Disposal within the EU

European Community

Electrical and electronic products should not be mixed with general household waste. Berghof Products and Instruments GmbH accepts its electrical and electronic instruments from on a free of charge basis for proper treatment, recovery and recycling from their business users. If you wish to discard electrical and electronic products, please contact your local representative or Berghof Products and Instruments GmbH (laboratorytechnology@berghof.com). They will provide further information. Disposing of this product correctly will help to protect our environment.

→ Disposal outside the EU

Countries outside the European Union

This regulation is only valid in the European Union



Products of Berghof Products + Instruments GmbH are **not** used in private households.

1.9. Warranty / Limitation of Warranty

Limited Warranty

Each product manufactured by Berghof Products + Instruments GmbH is warranted to conform to Berghof Products + Instruments GmbH's applicable specifications on the date on shipment. The warranty period is twelve (12) months after the date of delivery, unless another period is specified. The warranty does not extend to damages due to improper installation, improper maintenance, abuse, accident, negligence, alteration, misuse, ordinary wear and tear, or the like. Claims for replacement of parts caused by ordinary wear and tear are excluded, as are claims for replacement of parts meant to be expended during the operation of the equipment.

Remedies

Under the limited warranty, Berghof Products + Instruments GmbH repairs or replaces any products which Berghof Products + Instruments GmbH determines to be defective and covered by this limited warranty. This is the sole and exclusive remedy. If Berghof Products + Instruments GmbH determines that repair or replacement fails its essential purpose, the purchaser will, at its option, be entitled to a refund of the purchase price for the products in question or a credit therefore.

All warranty claims must be accompanied by a description of the claim, which description must be attached to the equipment claimed to be defective. Claim descriptions must include the claimants name, address, department (if applicable) and telephone number.

The equipment should be returned in its original packaging, to the extent possible. We regret that Berghof Products + Instruments GmbH cannot be held responsible for damage caused during shipping due to improper packaging.

Limitation of warranty

Except as expressly set forth above, there are no other warranties hereunder, whether expressed or implied, arising by operation of law or otherwise, including without limitation, the warranties of merchantability, fitness for a particular purpose and any warranties arising under course of performance, course of dealing or usage of trade.

Under no circumstances will Berghof Products + Instruments GmbH be liable for any consequential, exemplary, incidental, indirect or special damages, or lost profits, expenses or losses arising out of or related to the sale or use of any of its products regardless of whether the liability resulted from any general or particular requirement or need which Berghof Products + Instruments GmbH knew or should have known of.

1.9.1. Caveat emptor

Berghof Products + Instruments GmbH does not accept any warranty for wearing parts (e.g. seals, Belleville washer and bearings) for the improper usage, storage and handling.

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2. Device Description

2.1. Basic Instrument

The high-pressure laboratory reactor is employed as a reaction vessel for chemical reactions and material tests which are performed under excess pressure. The pressure is built up by heating the reaction solution in a closed vessel.

Depending on the individual reactor design, materials used in its construction include CrNiMo stainless steel (material no. 1.4571, in accordance with DIN, or 316TI, in accordance with AISI) and isostatically compression-molded PTFE / PFA. This provides the complete apparatus with a very long service life, even where aggressive acids are employed or under extreme laboratory conditions. The precise design and construction of your particular pressure laboratory reactor can be found in the device documentation provided with the unit.

Normally, each pressure reactor comprises:

- The actual pressure reactor, equipped with a PTFE insert and lid cladding
- The installed fittings which, for safety reasons, always include at least one rupture disc as overpressure protection device and a vent valve (resp. LC-Key)
- An immersion tube for measuring the interior temperature, e.g., with the aid of a NiCrNi thermocouples or PT-100 sensor, as well as
- Accessories (heater with temperature control, etc.) possibly

The pressure laboratory reactor is sealed by means of a conical flange lock with a fitted O-ring.

Pressure and temperature sensors are available to track the progression of temperature and pressure in the unit and, when employed in conjunction with an electronic analysis device, these also permit the progression of these values to be recorded by a PC as well as displaying them on a digital temperature and pressure monitor.

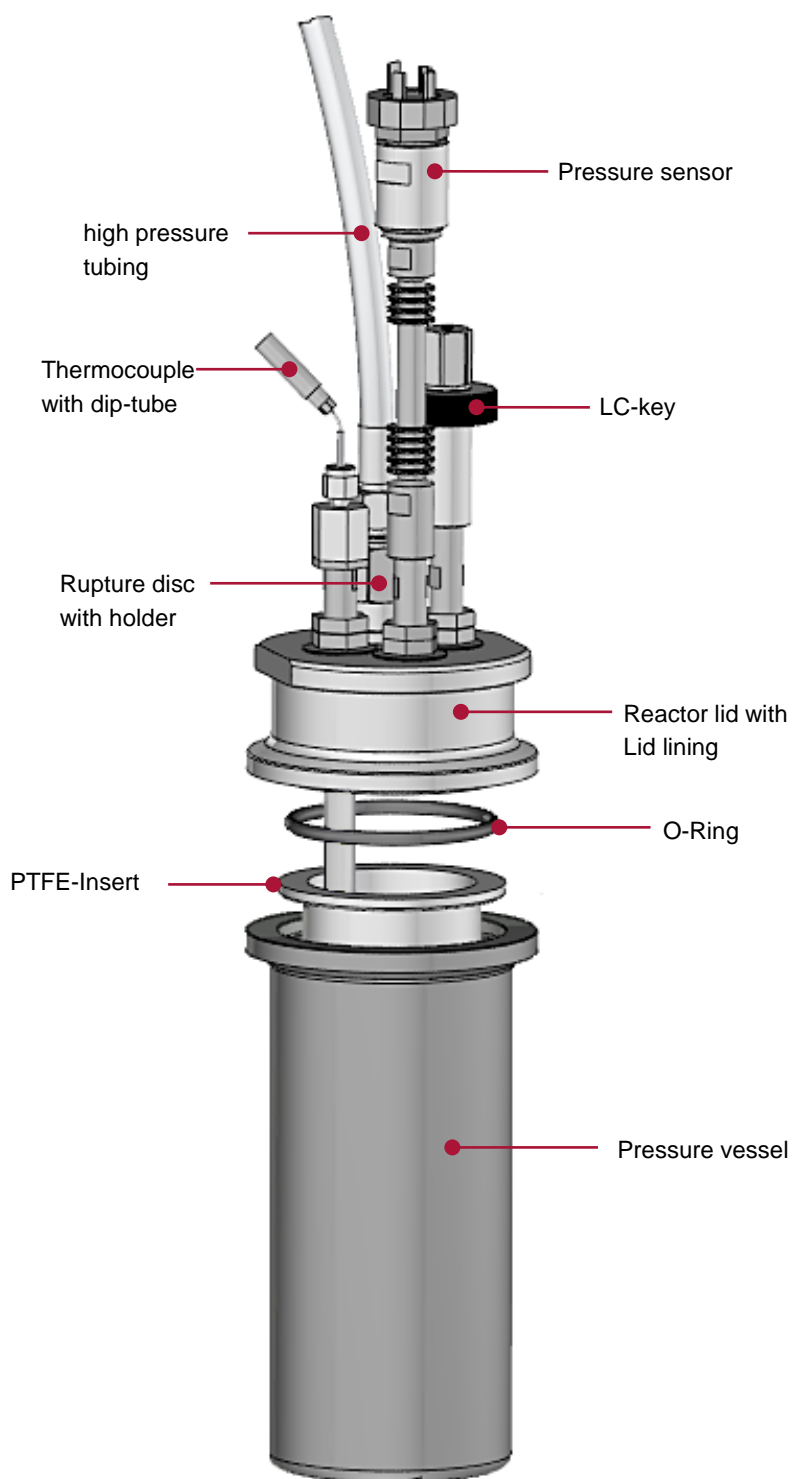
Accessories

The BTC-1000 or BTC-3000 Controllers are available to regulate the heating systems and thus the temperature of the laboratory reactor. Connections for NiCr/Ni thermal elements are provided as the standard sensor input. Heating power (up to a maximum of 3,000 Watts) is controlled by means of a wear-resistant semiconductor relay. Heating power is automatically switched off in case of sensor breakage or an interruption in the compensation line.

The pressure laboratory reactor has been designed, constructed, and tested in accordance with the 2014/68/EU device guideline according to the AD-2000 body of rules. (see accompanying certificate)

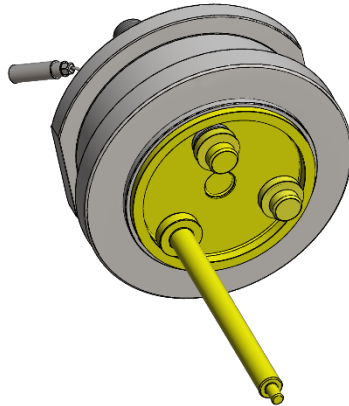
Reactor

Berghof reactor systems are modular in design and are configured according to customer requirements. A possible reactor configuration is illustrated below by way of example:



2.2. Lining

The PTFE lining especially designed for the DB-Reactors allows operation with corrosive media such as strong mineral acids at high temperatures and high pressures.



2.2.1. Technical Specification

High pressure reactor	
General	
Vessel	
Material	Stainless steel: 1.4571 (316Ti) with PTFE-Insert
Maximum filling quantity	max. 80 % of internal vessel volume
Max. permissible temperature* (Operating temperature)	-40 ... +230 °C (-40 ... +446°F) The operating temperature is limited by PTFE parts (for example, vessel insert, dip tube), the fittings and the seals used.
Max. permissible pressure (Operating pressure)	+200 bar The operating pressure is further limited by the inserted rupture disk, the tolerance of the rupture disk, as well as the used fittings such as e.g. pressure gauge.
Seal	
Material	PTFE, FPM (z. B. Viton®), FFKM and several more
Lid	
Material	Stainless steel: 1.4571 (316Ti) with PTFE-Insert

Reactor			
DB-Series	DB-300	DB-500	DB-700
Pressure vessel			
Weight (without lid)	4 kg	6 kg	8,5 kg
Volume PTFE-Insert	0,3 ml	0,5 ml	0,8 ml
Internal height PTFE-Insert	100 mm	170 mm	260 mm
Internal diameter PTFE-Insert	63 mm		

Reactor			
DB-Series	DB-1000	DB-1500	DB-2000
Pressure vessel			
Weight (without lid)	11 kg	13 kg	16 kg
Volume PTFE-Insert	1,0 l	1,45 l	1,87 l
Internal height PTFE-Insert	180 mm	260 mm	340 mm
Internal diameter PTFE-Insert	84 mm		

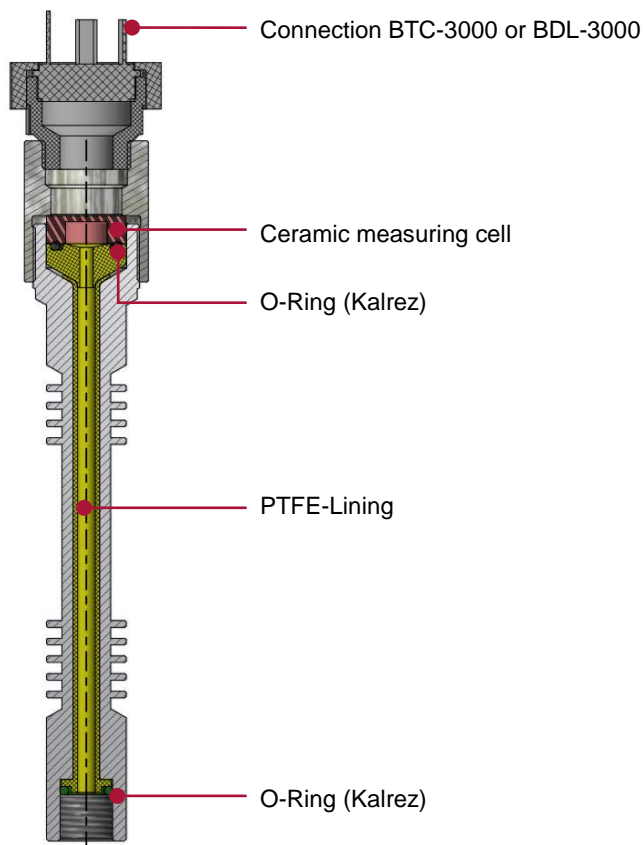
Each laboratory reactor is subjected to a pressure- and leakage test and is delivered with a corresponding inspection certificate.

For more information, please refer to the accompanying documents, such as test and inspection certificates, declaration of conformity and material certificate.

2.3. Pressure sensor

The DSK-1 Ceramic sensor has been specially designed in order to enable an electronic pressure measurement when operating with corrosive media.

The pressure sensor is connected Berghof Controller BTC-3000 or BDL-3000 by using the appropriate connection cable.



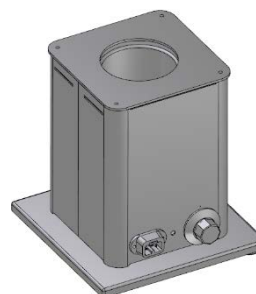
2.3.1. Technical Specification

Pressure sensor	
	DSK-1
Material (wetted parts)	Al ₂ O ₃ , PTFE
Power supply	9 - 35 V (Controller dependent)
Signal	4 – 20 mA
Pressure range	0 – 200 bar
Accuracy	1 %
Operating temperature	10 – 50 °C

2.4. Electric Heating Jacket

Electric heating jacket with a heating ring, coated stainless steel safety hood as well as an integrated adjustable overheat protection. The heating jacket exterior is insulated and clad. The temperature is controlled by measurement of the interior temperature of the high-pressure laboratory reactor in conjunction with a BTC-1000 or 3000 temperature regulator. For this purpose, a special connecting cable for the supply power to the heating jacket is supplied.

Technical Data				
Electric heating jacket for	BHM-300 DB-300	BHM-500 DB-500	BHM-700 DB-700	
Material	Stainless steel with powder coating			
Internal diameter	92,6mm			
Power	600 W	1000 W	1000 W	
Temperature range	0 – 320 °C (32 – 608 °F)			
Overtemperature protection	Adjustable: 50 – 320 °C (122 – 608 °F)			
Heating connection	To controller 230 V / 50 Hz via 3 –pin connection			
Temperature sensor	NiCr-Ni DIN 43710			
Protection	IP 54			



Technical Data				
Electric heating jacket for	BHM-1000 DB-1000	BHM-1500 DB-1500	BHM-2000 DB-2000	
Material	Stainless steel with powder coating			
Internal diameter	117,8 mm			
Power	1500 W	2000 W	2000 W	
Temperature range	0 – 320 °C (32 – 608 °F)			
Overtemperature protection	Adjustable: 50 – 320 °C (122 – 608 °F)			
Heating connection	To controller 230 V / 50 Hz via 3 –pin connection			
Temperature sensor	NiCr-Ni DIN 43710			
Protection	IP 54			



Safety information on the unit



This safety information label is located on the bottom plate of the device.

2.5. Controller

2.5.1. Temperature Controller BTC-1000

The Berghof Temperature Controller BTC-1000 is operated via a touch screen. Capacity regulation takes place via a PID controller. The PID controller can be configured by the customer.

The built-in data logger allows the parameters to be documented on a PC.

For further information, see BTC-1000 user manual.

2.5.2. Temperature Controller BTC-3000

The easy-to-use BERGHOF temperature controller unites all control and regulating parameters in a single, compact unit. All process parameters are easily accessible. The built-in data logger allows the parameters to be documented on a PC.

For further information, see BTC-3000 user manual

2.5.3. Datalogger BDL-3000

The data logger BDL-3000 can also serve to document temperature and pressure progressions of 2 Berghof high pressure reactors. In a special version BDL-3000 is available for up to 8 reactors, too

For further information, see BDL-3000 user manual.

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3. Setup and Commissioning

3.1. Standard Delivery

Because of the modular nature of the pressure laboratory reactor, there is no generally applicable standard delivery. Therefore, please check the shipping documentation with regard to the completeness of your specific unit.

3.2. Transport and Storage

The laboratory reactor may only be moved once all pressure has been released. Please observe the ambient conditions described below.

3.3. Ambient Conditions

Pressure equipment must be set up in such a way that neither operators nor others are endangered. All safety zones mandated by national ordinances in the country of use must be complied with.

The pressure laboratory reactor must be set up in such a way that:

- It is accessible and can be viewed from all sides for any required visual inspections
- The seal (nameplate) is clearly visible
- The pressure reactor and its accessories can be operated from a safe and secure position
- It is protected against mechanical influences from the outside and that damage to the unit cannot be anticipated
- Access by unauthorized individuals is not possible
- Possible openings such as the overpressure protection or valves do not endanger people



If the reaction progression is not precisely known or if unanticipated pressure increases or exothermic reactions may occur (experimental autoclave), the unit must be set up in a special reactor chamber.

The setup location must meet the following requirements:

Ambient conditions	
Ambient temperature	+10°C (50°F) to +40°C (104°F) during operation -40°C (-40°F) and +70°C (158°F) during shipping and storage
Max. rel. humidity	85%
Space requirements	Depending on reactor size and configuration
Load bearing capacity	*
Electrical connection	230 V; 50/ 60 Hz

*Due to the modular nature of the laboratory reactor, no general load bearing capacity can be given. Therefore, please refer to the shipping documents.

3.4. Unpacking and Inspection

Open the shipping packaging and carefully remove it. Please save all packaging in order to be able to return the unit to the manufacturer in its original packaging, should service be required.

Also remove all other components and accessories and inspect the delivery to make sure it is complete.

Inspect the system for shipping damage such as cracks, scratches, dents, etc.



Visible damage!

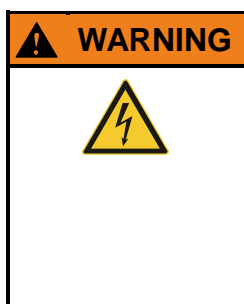
For safety reasons, never operate the unit if it exhibits visible signs of damage. Contact your local, authorized representative or Berghof Products + Instruments GmbH to obtain the required service (Refer to the “Repairs / Customer Service” section for contact addresses).



Should any components be missing or damages be detected, contact your local, authorized representative or Berghof Products + Instruments GmbH directly (Refer to the “Repairs / Customer Service” section for contact addresses).

3.5. Installation

The pressure laboratory reactor is fully assembled at delivery. All PTFE linings specified fittings and options have already been installed and mounted. However, you should check them to make sure they have not been jarred loose during shipping. If necessary, retighten any loose fittings.



Accessories use low voltage 230V!

The heating systems must always be carefully connected to a ground conductor. This is ensured by the included power supply unit, provided that the wall outlet employed is connected to a corresponding ground circuit. If an extension cord must be used to connect the system to the mains power supply, make sure it is a three-wire cord with a ground wire.

Repairs and service may only be performed by properly trained and qualified personnel.

3.5.1. Connections

A high-pressure hose can be connected to the over-pressure protection to safely dissipate any gases which may be released should the rupture disc be activated.



Emissions!

Should the over-pressure protection activate, gases which may be hazardous to individuals will be suddenly released into the atmosphere. Always make sure the opening of the over-pressure protection is never directed towards individuals. Preferably, a high-pressure hose should be connected to the over-pressure protection to safely discharge the gases.



In accordance with §14 of the operational safety ordinance, the operator must perform an inspection prior to commissioning. In other countries in which the unit is set up, corresponding local ordinances regarding such inspections prior to commissioning must be observed



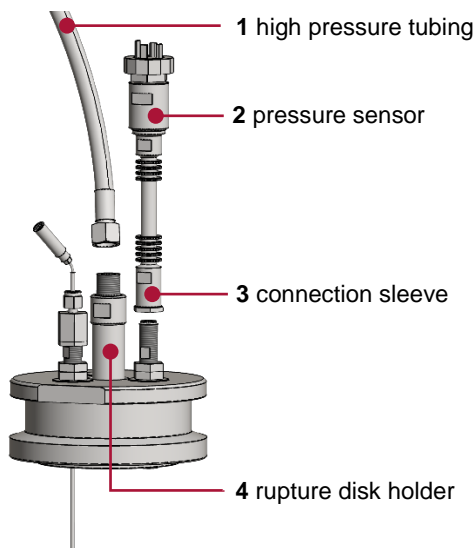
Ventilation

Users are responsible for assuring that appropriate ventilation of toxic gases is assured.

Make sure that all ventilation procedures conform to applicable laws.

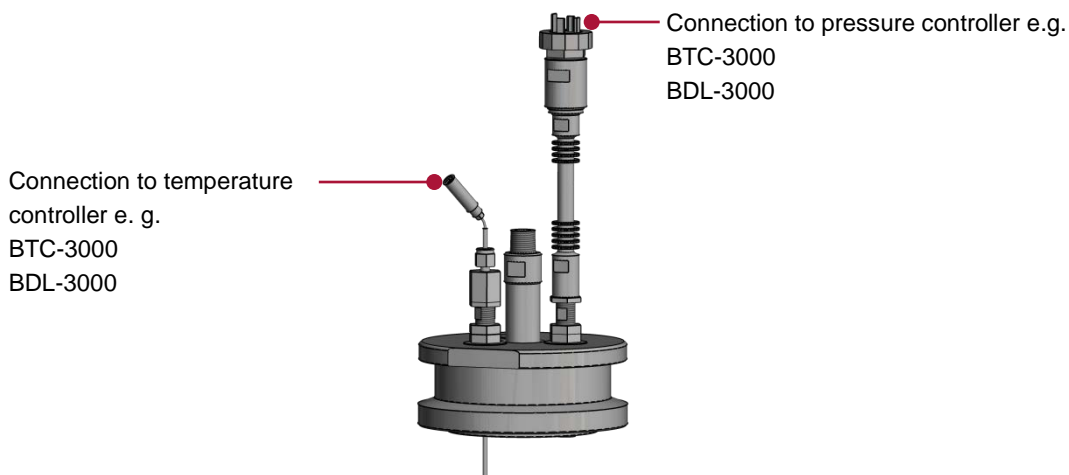
Connections on the reactor

- Screw on the high pressure tubing (1) on the rupture disk holder (4).
- Connect the other end of the high pressure tubing (1) on an appropriate ventilation
- Screw on the pressure sensor (2) carefully by hand, then tighten the connection sleeve (3) a quarter turn using a fork spanner.
- Check the reactor for leakage. Tighten if necessary



Connections to the controller

To control the heating process and pressure measurement of Berghof highpressure reactors, make the connections as shown in the graphic illustration below to the Berghof controllers.



NOTICE

Pressure sensor connector
 Never unscrew the connector of the pressure sensor, otherwise the wiring can be damaged.

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4. Operation

4.1. Opening and Closing the reactor



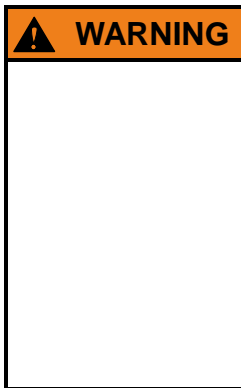
Pressure vessel!

Never open the high-pressure laboratory reactor while it is under pressure. Never use force to open the vessel.

Hot gases and vapors can escape from the pressure vessel when it is opened! Always wait until the vessel has cooled to room temperature before opening it.

Use an exhaust system.

Always exercise extreme caution when working with toxic substances. Always comply with all relevant spec sheets and safety precautions!



General operating instructions!

Pressure vessels must be closed in such a way that all components intended in their design can be properly employed. Sealing surfaces must be clean and undamaged.

Locking screws must be tightened carefully and uniformly and only to the extent required to create a seal. All indicated torque values must be observed.

Locking screws may not be tightened or loosened while the high-pressure laboratory reactor is under pressure.

Only open pressure vessels in vertical position.

The maximum filling volume must not be exceeded.



Always wear personal protective equipment!

Always wear your personal protective equipment during work which may involve contact with chemicals, that is, when working with acids, pressure vessels, during cleaning, etc.!

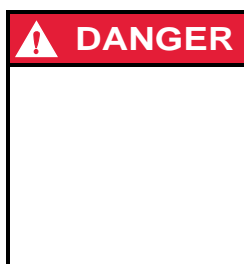
Cooling

Wait until the reactor has cooled to room temperature.

Venting

See chapter 4.1.1. Opening the Safety Lock

4.1.1. Opening the Safety Lock



Mounting the LC-Key

The correct mounting of the opening key to the provided media connection is safety-relevant. The Lock Clamp may only be opened with the LC-Key provided. The removal of the LC-Key from the media connection on the reactor lid ensures that the reactor is pressureless when the Lock Clamp is opened. The LC-Key must not be affected by other components, such as a combination fitting with valves.



Emissions

When the opening key is unscrewed, if applicable hazardous gases can escape through the lateral bore or the thread!



Adhesions of dangerous substances

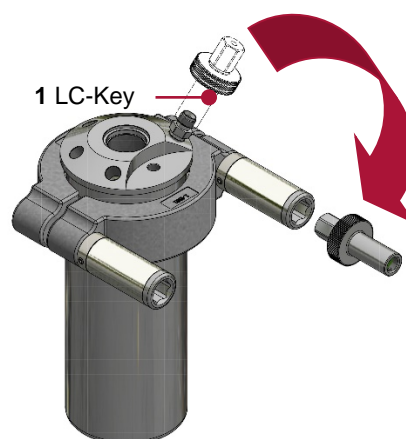
Dangerous substances may adhere to the media connection of the LC-Key! Clean the LC-Key after unscrewing. Wear personal protective equipment.

Before opening the safety lock, the opening key (LC-Key) has to be removed from the pressure system first. This guarantees that the container will be depressurized when it is opened. This LC-Key is mounted on the cover and integrated into the pressure system. The LC-Key is built into the tee part or a screw connector. To be able to open the left / right hand screw and therefore the entire Lock Clamp, this opening key (the forced depressurization mechanism) is need to unlock them. The LC-Key is inserted into the hand screw to permit the hand screw to be removed.

The LC-Key ensures that the Lock Clamp can only be opened when the pressure container is entirely free of pressure.

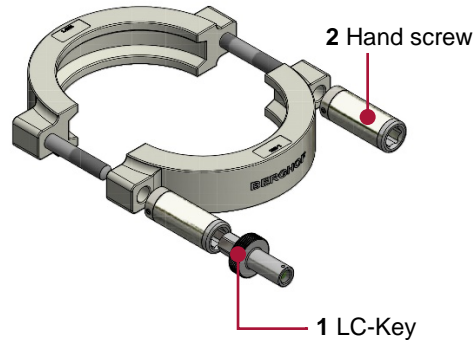
Procedure remove LC-Key

- Vent the reactor with the opening key (1), by slowly unscrewing the LC-Key (1) by manually turning on the knurling. Should a gas emission be audible, wait for relief of the pressure. In such a case do not turn the LC-Key (1) further
- remove LC-Key (1)

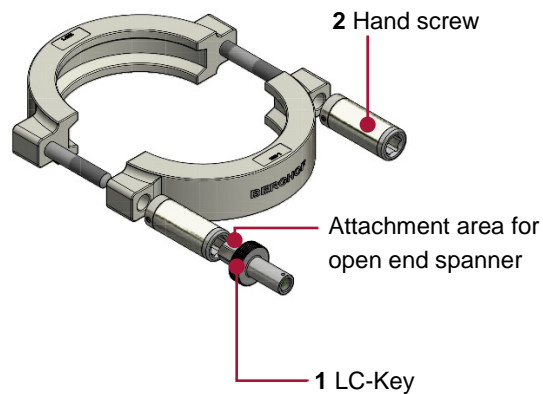


Procedure Open Lock Clamp:

- the pressure-free reactor is opened on the Lock Clamp, using the LC-Key (1) by evenly loosen both hand screws (2). (This means alternately and in small increments). In doing so, hold the back half tightly.
- pull out forward the front half of the Lock Clamp

**4.1.2. Closing the Safety Lock****Procedure Close Lock Clamp:**

- place the back part of the Lock Clamp around the reactor and reactor lid
- stick the front part of the Lock Clamp on the setscrew while holding back the rear Lock Clamp
- screw in both hand screws (2) evenly with the LC-Key (1) alternating between the two gradually and tighten both hand screws hand-tight
- both Lock Clamps must be parallel. The gap between the two clamping rings left and right must be the same.
- assemble the LC-Key (1) to the provided media connection



* Depending on the seal used, a higher tightening torque may be required. If necessary, use an open end spanner (SW 18) for assistance. This can be applied on the hexagon socket of the LC-Key. For FKM and FFKM a tightening torque of appr. 2 Nm is required (= hand-tight).

4.1.3. PTFE-Insert

Before operation, make sure the PTFE-Insert has been carefully dried in order to prevent the formation of a gas blanket between the reactor vessel and the PTFE-Insert when the reactor is heated.

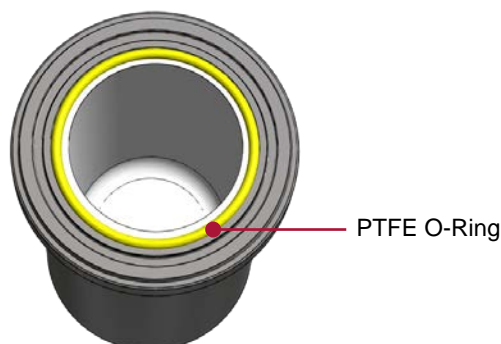


A gas cushion between the PTFE-Insert and the pressure vessel can lead to a deformation of the PTFE-Insert during the heating process. Should such a deformation have occurred, this can be reversed by heating the reactor with the water-filled PTFE-Insert to about 180 ° C (356 ° F.) and subsequent slow cooling.

4.1.4. O-Ring

Carefully position the O-ring on the edge of the PTFE-Insert before installing the reactor lid. Visually inspect the O-ring before installing it. Deformed O-rings can be returned to their original shape by heating (refer to the `Maintenance and Service` section)

Reactor with PTFE-Insert



If the high-pressure reactor is operated with a PTFE insert, the O-ring is placed on the edge of the PTFE insert cover.

The groove in the reactor flange is not used as a sealing variation.

4.2. Filling the Reactor Vessel



Always wear personal protective equipment!


Always wear your personal protective equipment during work which may involve contact with chemicals, that is, when working with acids, pressure vessels, during cleaning, etc.!


Pay attention to the maximum filling quantity (see chapter 2.2.1 Technical Specification).

An excessively high filling quantity in the case of liquids can produce a very high hydraulic pressure as a result of the thermal expansion, which leads to the rupture disk being triggered.

Reaction material can be added to the PTFE insert either outside the reactor vessel or once it has been placed in the reactor vessel. Note the maximum fill volume (see chapter 2.2.1 Technical Specification). Make sure the external walls and seal surfaces stay clean during filling.

4.3. Operation

<div style="background-color: red; color: white; padding: 2px; text-align: center;">⚠ DANGER</div> <div style="text-align: center; margin-top: 10px;">  </div>	<p>Explosion hazard!</p> <p>The unit may never be employed without proper over-pressure protection (e.g., rupture disc or pressure release valve).</p> <p>The unit is not designed for the use with substances / solutions, gas- / liquid mixtures or similar, which can form explosive mixtures and substances under operating conditions. (E.g., perchloric acid, solvent / air mixtures in certain concentrations, etc.)</p> <p>Special, grease-free valves must be employed if oxygen is used. Under no circumstances may any grease be subsequently applied to these valves.</p> <p>Adequate explosion protection must be provided in the immediate vicinity of the high-pressure laboratory reactor whenever flammable substances are employed. Any vapors generated by the flammable liquids which may escape from the over-pressure protection (e.g., rupture disc or pressure release valve) must be safely extracted in accordance with local requirements. This also applies should the rupture disc be activated. If the high-pressure laboratory reactor is set up under an extractor, the latter must be equipped with adequate explosion protection.</p>
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<div style="background-color: orange; color: black; padding: 2px; text-align: center;">⚠ WARNING</div> <div style="text-align: center; margin-top: 10px;">  </div>	<p>Always wear personal protective equipment!</p> <p>Always wear your personal protective equipment during work which may involve contact with chemicals, that is, when working with acids, pressure vessels, during cleaning, etc.!</p>
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<div style="background-color: yellow; color: black; padding: 2px; text-align: center;">⚠ CAUTION</div>	<p>Emissions!</p> <p>Should the over-pressure protection activate, gases which may be hazardous to individuals will be suddenly released into the atmosphere. Always make sure the opening of the over-pressure protection is never directed towards individuals. Preferably, a high-pressure hose should be connected to the over-pressure protection to safely discharge the gases.</p> <p>Secure the reactor against possible recoil should the rupture disc break by, for example, screwing the heating jacket onto the base.</p>
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The max. operating pressure up to 150° C (302°F) should lay approx. 10% below the rupture disc's nominal bursting pressure. At temperatures above 150° C (302°F), the max. operating pressure should lie approx. 20% below the rupture disc's nominal bursting pressure.

The rupture disc's nominal bursting pressure can be found in the supplied test reports.

4.4. Heating

i NOTICE

Maintain maximum internal temperature!

Do not exceed the maximum interior temperature of 230° C (446°F) when using a PTFE-Insert.

The reactor is heated in the heating jacket designed for this purpose and into which the pressure vessel has been carefully inserted, without tilting. In general, the thermal sensor in the reactor provides the actual value signal for the temperature regulator.

i NOTICE

Overtemperature protection

The heating jacket is equipped with an adjustable over-temperature protection which prevents a jacket temperature of 320° C (608°F) from being exceeded.

Temperature Control

A special procedure is required to regulate the temperature of autoclaves with a PTFE insert due to the very slow reaction time of the regulating path. Recommended regulating PID parameters can be found in the corresponding manuals.

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5. Maintenance, Troubleshooting and Service

All required inspection, maintenance, and repair work must be performed in compliance with the local ordinances.

No damaged components such as stripped, cracked, or broken screws, bent or broken nuts, bent clips or straps, damaged seals, etc. may be reused and must be replaced.

Any repair work which might compromise the safety of the pressure vessel such as welding, hot or cold forming that alter the reactor material properties may only be carried out in compliance with local ordinances.

5.1. Cleaning



Pressure vessel!

Never open the high-pressure laboratory reactor while it is under pressure. Never use force to open the vessel. Never use tools to open the vessel!

Hot gases and vapors can escape from the pressure vessel when it is opened! Always wait until the vessel has cooled to room temperature before opening it.

Always exercise extreme caution when working with toxic substances. Always comply with all relevant spec sheets and safety precautions!



Always wear personal protective equipment!

Always wear your personal protective equipment during work which may involve contact with chemicals, that is, when working with acids, pressure vessels, during cleaning, etc.!



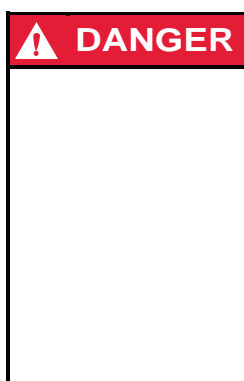
Despite the fact that all the high-pressure laboratory reactor components are manufactured from high-grade stainless steel and the vessel and lid may be lined with PTFE, indications or wear and corrosion resulting from aggressive reaction materials and their vapors cannot be ruled out.

It is therefore essential that the PTFE-Insert be cleaned after each use and, if necessary, boiled in a solvent solution. The exterior of the PTFE-Insert should also be carefully cleaned because, for example, the chloride content of oils and sweat from user's hands promote corrosion on stainless steel (1.4571). The pressure vessel and fittings should also be rinsed off from time-to-time. After rinsing, make sure all components are completely dry before reinstalling them. In particular, there must be no moisture between the PTFE-Insert and the pressure vessel in order to prevent the formation of gas blankets during subsequent operation.

5.2. Maintenance

The high-pressure laboratory reactor is to be regularly serviced by competent personnel in order to ensure that it remains hermetically sealed in the long-term under the intended operating conditions and anticipated mechanical, chemical, and thermal loads. Based on the operating instructions and experience, the operator should note the required maintenance and inspection measures in the operating instructions themselves. In particular, monitoring and ensuring the following are an essential part of the required inspection and maintenance tasks:

- Pressure tightness
- Ambient conditions and safety zones
- Identification and other labels
- Proper operation of all safety and alarm equipment
- Wall thickness where the unit is subject to corrosion



Pressure Vessel!

Use only pressure vessels and spare parts authorized by Berghof Products + Instruments GmbH for use with the laboratory reactor. These can be obtained either from your local representative or directly from Berghof Products + Instruments GmbH (Refer to the "Repairs / Customer Service" section for contact addresses).

Never open the high-pressure laboratory reactor while it is under pressure. Never use force to open the vessel.

Hot gases and vapors can escape from the pressure vessel when it is opened! Always wait until the vessel has cooled to room temperature before opening it.



General operating instructions!

Locking screws must be tightened carefully and uniformly and only to the extent required to create a seal. All indicated torque values must be observed.

Locking screws may not be tightened or loosened while the high-pressure laboratory reactor is under pressure.



Always wear personal protective equipment!

Always wear your personal protective equipment during work which may involve contact with chemicals, that is, when working with acids, pressure vessels, during cleaning, etc.!

5.2.1. Seal

In order to ensure a proper reactor seal, the seal surfaces in the locking area must be kept clean and smooth.

PTFE O-rings will deform after multiple exposures to increased pressure and temperature. They can, however, be returned to their original shape by allowing them to sit in a heating cabinet for 3-4 hours at 300-320°C (572- 608°F).

The O-ring should be replaced regularly after several uses.

5.2.2. Rupture disc



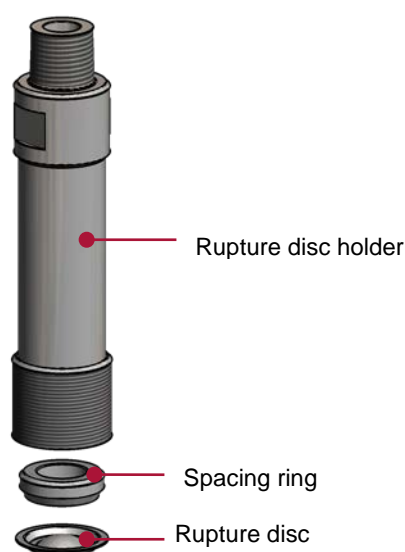
Use only specified spare parts!

Only rupture discs with a bursting pressure equal to or less than the high-pressure laboratory reactor's maximum operating pressure may be installed in the holder.

Only OEM rupture discs specified by Berghof Products + Instruments GmbH for your specific reactor may be used. These can be obtained from your local representative or directly from Berghof Products + Instruments GmbH (refer to the "Repair / Customer Service" section for the contact address).

After being placed under extreme pressure loads several times, the rupture disc may become fatigued, thus altering its activation pressure. This component should then be replaced. The valve threads should also be lightly lubricated from time to time by using a PTFE paste.

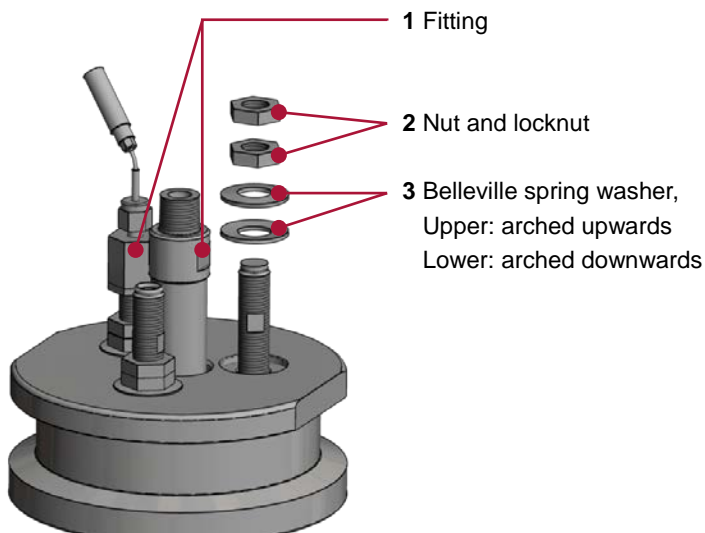
- Install a new rupture disc as shown in the illustration on the right.
- The bulge of the rupture disc must face upwards.
- The valve threads should also be lightly lubricated by applying a thin layer of PTFE paste.
- If a rupture disc has activated the lid lining must also be replaced.



5.2.3. Lid Lining

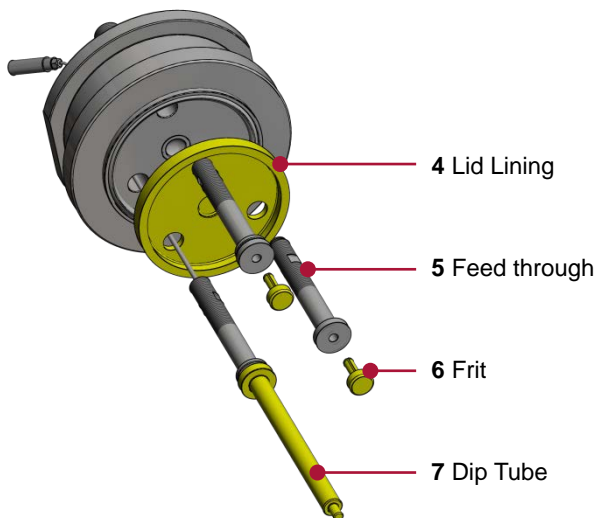
To replace the lid liner, the fittings and their special screw connections must be removed first.

- Unscrew the fittings (1)
- Unscrew nut and locknut (2)
- Remove the Belleville spring (3)



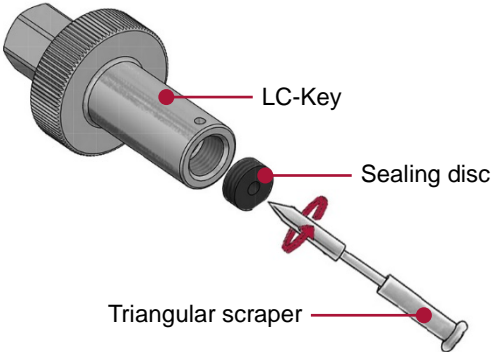
- Remove the frits (6)
- Pullout feed throughs (5)
- Remove the lid lining (4) and dip tube (7)

Reassembly in reverse order
 Please note:
 Screw in the pressure sensor and the release valve carefully by hand, then tighten them a quarter turn using a fork spanner.



5.2.4. LC-Key

The sealing disc, which is located in the LC-Key, is to be removed by using a triangular scraper and replaced.



5.2.5. Recurring Inspection

See chapter, 1.5 - Legal Requirements

5.2.6. Inspection

See chapter, 1.5 Legal Requirements.

To test the pressure tightness of the high-pressure laboratory reactor and its fittings, the reactor system may be filled with pressurized nitrogen and inspected. The tightness can be checked e.g. by means of leak detection agent or by immersion in water. However, the reactor must then be carefully dried afterwards.

5.3. Troubleshooting


Fault	Possible cause	Corrective action
Pressure loss	Damaged O-rings	Replace the O-rings.
	Deformed PTFE O-ring	Regenerate the PTFE O-ring (refer to the "Maintenance" section)

You can obtain technical support from your regional Berghof representative or directly from Berghof Products + Instruments GmbH by contacting:

Berghof Products + Instruments GmbH
 Harretstr. 1
 72800 Eningen
 Germany
 T +49.7121.894-171
 F +49.7121.894-300
 E-Mail: service.bpi@berghof.com
www.berghof-instruments.com

Please provide your unit's serial number with all repair questions or repair orders. The serial number is located on the nameplate.

5.4. Repairs / Customer Service

<p>⚠ WARNING</p> 	<p>Accessories use low voltage 230V!</p> <p>The heating systems must always be connected to a ground conductor. This is ensured by the included power supply unit, provided that the wall outlet employed is connected to a corresponding ground circuit. If an extension cord must be used to connect the system to the mains power supply, make sure it is a 3-wire cord with a ground wire.</p> <p>Repairs and service may only be performed by properly trained and qualified personnel.</p>
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→ [Berghof Service](#)

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Please provide your unit's serial number with all repair questions or repair orders. The serial number is located on the nameplate.

5.4.1. Reshipment



Cleaning and decontamination methods

Before using any cleaning or decontamination methods except those specified by Berghof Products + Instruments, users should check with Berghof Products + Instruments or your regional Berghof representative that the proposed method will not damage the equipment.

Customers wishing to return instrumentation and/or associated materials to Berghof Products + Instruments GmbH or regional representative for repair, maintenance, warranty, inspection or trade-in purposes are advised that all returned goods must be certified as clean and free from contamination.

→ [Safety and Health Declaration](#)

The customer's responsible body is required to fill in and sign the form "Safety and Health Declaration" and to display this declaration on the exterior of the shipping container.

This document is available at:

Berghof Service (see contact data above)

Outside the Federal Republic of Germany goods may only be returned to us via our authorized representative. Before returning the goods, please contact our service department.

5.4.2. Safety and Health Declaration

Return shipments of instruments and equipment not having decontamination certificates display on the exterior of the shipping container will not be processed and will remain unopened, in a sealed condition, until a determination of decontamination is received.

5.5. Nameplates

Reactor (Example)


CE 0036	B⁺ BERGHOF
Behälter Vessel	Products + Instruments GmbH Harretstrasse 1 72800 Eningen www.berghof.com Germany
Typ Type	DB - 1000
Fabrikationsnummer Serial number	
Herstellungsjahr Year of manufacture	
Zul. max. Druck (PS) Max. allowable pressure	200 bar
Zul. min./max. Temperatur (TS) Min./Max. allowable temperature	-40...+230 °C
Prüfdruck (PT) Test pressure	343 bar
Volumen Volume	1,2 L

*)

*) Prüfdruck / Test pressure:

Werkstoff-Nr.	Prüfdruck, bar
1.4571	343
2.4602	355
2.4610	293
2.4819	318

Electrical heating jacket (BHM)

Manufacturer and address	B⁺ Berghof Products+ Instruments GmbH Harretstrasse 1 D - 72800 Eningen www.berghof.com	type: BHM-300	Model
Berghof design drawing number	design drawing no.: 53-0142-19-00-00-001	voltage: 230 V	Supply voltage
CE Designation	CE	current: 3 A	
QR Barcode		frequency: 50 Hz	
		part no.: 5708970	Part number
		S/N: 000071	Serial number
		WEEE no.: DE 81298483	WEEE Registration
		Germany date: 0116	Manufacturing date

6. Appendix

6.1. Declaration of conformity

6.1.1. Pressure Vessel (DB-Reactor)

The current EC-Declaration of Conformity for the DB-Reactors are enclosed with the delivery.

6.2. Conversion Table

Conversation of units			
Dimension	Unit	Conversion	
Temperature	°C =	$(°F - 32°) / 1.8$	
	°F =	$1.8 * °C + 32°$	
Length	1 cm =	0.3937 inch	
	1 inch =	2.540 cm	
Volume	1 ml =	0.06102 inch ³ = 2.642*10 ⁻⁴ gallon	
	1 inch ³ =	16.387 ml = 43.29*10 ⁻⁴ gallon	
	1 gallon =	3785 ml = 231 inch ³	
Pressure	1 bar =	14.504 psi	= 0.1 Mpa
	1 psi =	0.06895 bar	= 0.0068948 Mpa
	1 Mpa =	10 bar	= 145.04 psi
Weight	1 kg =	2.2046 lb.	
	1 lb. =	0.4536 kg	

6.3. Abbreviation

Plastics	
Abbreviation	Technical term
PE	Polyethylene
PFA	Perfluoralkoxy
PP	Polypropylene
PTFE	Polytetrafluorethylene
TFM™-PTFE	Modified Polytetrafluorethylene
Kalrez® (FFKM)	DuPont™ Perfluoroelastomer
Viton® (FPM)	DuPont™ Fluoroelastomer

Metals	
Abbreviation	Technical term
SS	Stainless steel with the corresponding material number
HC-4	Hastelloy C4