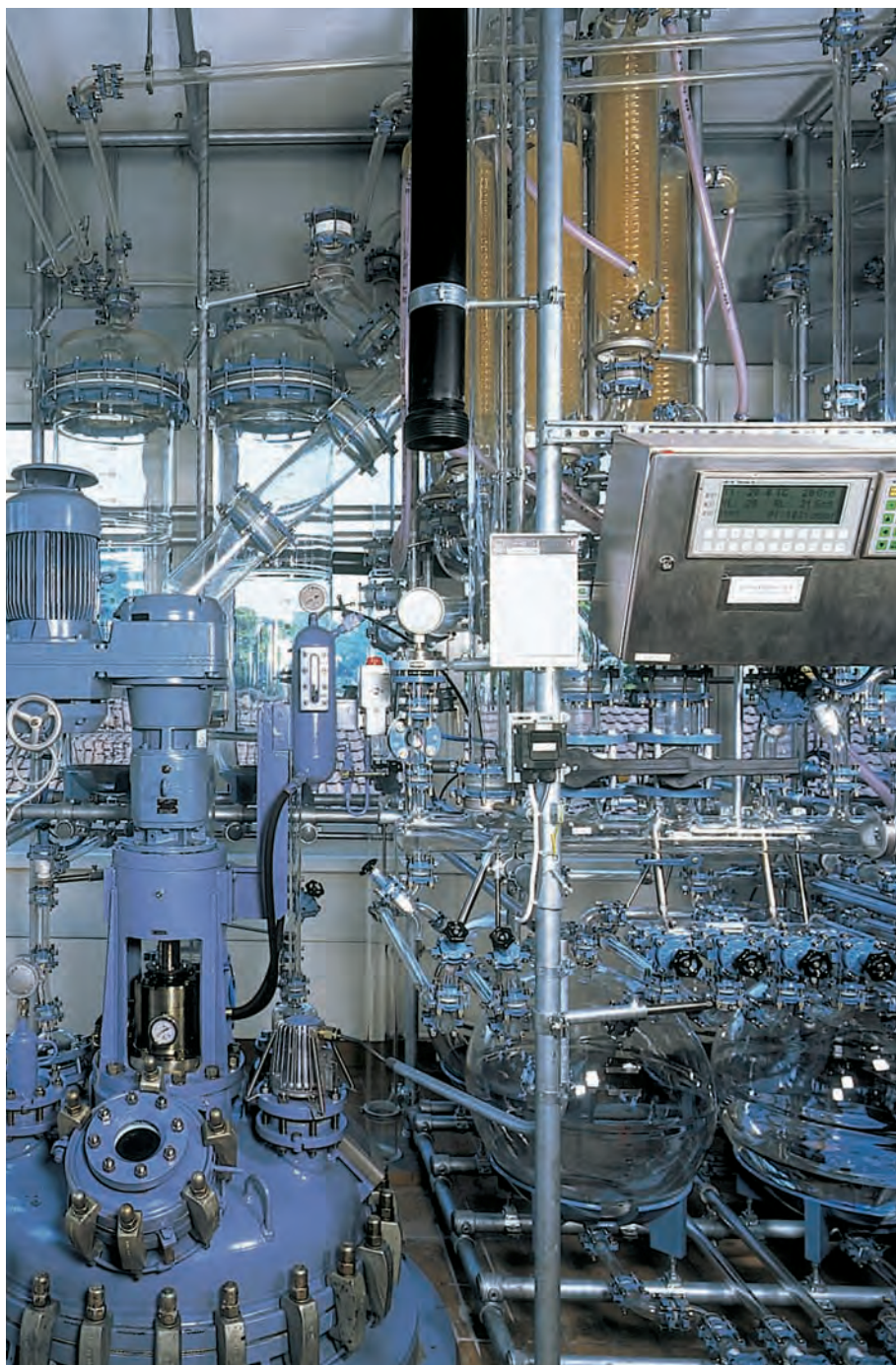


# Engineering – Production – Installation

## Process equipment for production scale in chemistry and pharma



- complete sets
- engineering
- manufacturing
- installation

### Applications

- reaction
- mixing
- distillation / reflux
- azeotropic distillation
- rectification
- absorption

BÜCHI – THE WAY TO GET RESULTS!



 **büchiglasuster**  
switzerland Pilot Plant and Reactor Systems

# Büchi AG – Process equipment with tradition

Büchi AG is a leading manufacturer of process equipment for the chemical and pharmaceutical industry.

## Company history:

- 1946: founded by Hermann Sr. and Jakob Büchi in Uster, Switzerland
- 1949: development of flexible glass connection system, break-through as plant manufacturer for chemical production in Switzerland
- 1980: development of pilot plant and laboratory reactor range (pressure, glass, metal)
- 1981: starting export business

## Büchi AG today:

- complete plant manufacturing for chemical and pharmaceutical industry (from design to installation)
- worldwide sales network, local service organizations
- glass plants from laboratory to production scale
- pressure reactors for laboratory and small-scale production
- continuous innovation leading to up-to-date technology

## Technology and know-how

Production plants for (fine-) chemicals and pharmaceuticals require stringent standards regarding corrosion resistance. The plants need to be cleaned easily and efficiently.

These requirements are met by using borosilicate glass, glass lined steel vessels and PTFE (sealing material). These materials offer:

- excellent chemical resistance, particularly to strong acids
- smooth, nonporous surfaces
- physiological safety, inert behaviour
- easy process supervision and improvement due to transparency of glass

## Glass plants with flexible «büchiflex» glass connection

The complete system with «büchiflex» glass components from DN15 – DN600 guarantees fast deliveries from stock.

The «büchiflex» connection features:

- tightness, pressure- and vacuum stability
- operational safety and functionality
- mechanical stress-free, easy and time saving installation and maintenance

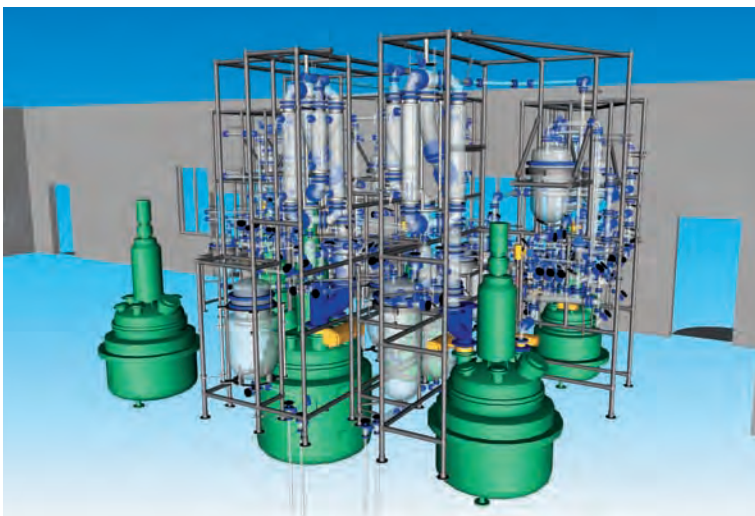
## Planning – efficient, custom tailored, clear

We use modern 3D technology for plant design. This allows time saving data transfer during the design phase and generates clear and understandable plant drawings. By using as many standard components as possible we can reduce the total lead time for entire plants or spare parts to a minimum.

In general a complete plant consists of a glass lined, agitated reactor vessel (from various suppliers) and a glass overhead with feed vessel, condenser, phase separator and receivers.

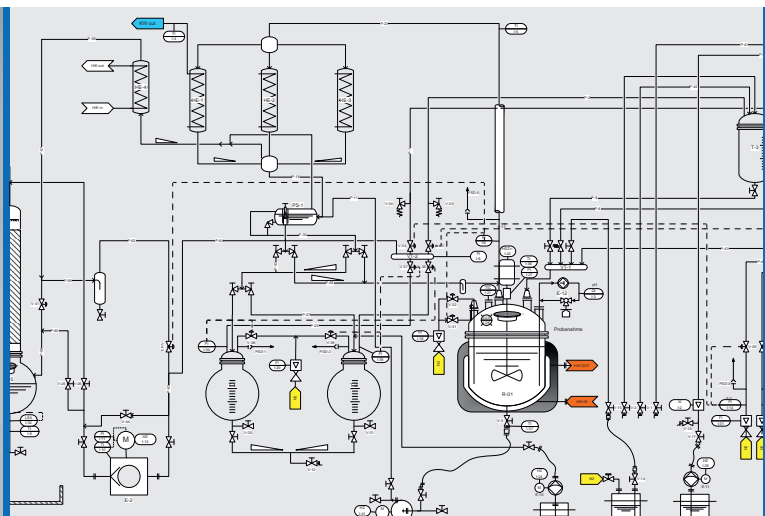
## Approvals, certificates

CE declarations of conformity (PED/ATEX) as well as declarations on FDA conformity are part of the documentation to validate our equipment for cGMP applications.



3D engineering  
3D Planung

«büchiflex» glass connection  
«büchiflex» Glasverbindung



PID drawing



Glass piping

# Components

## Heat exchangers – Spiral condensers – Shell and tube condensers

Depending on the plant size and type of process as well as a result of the required heat exchange area, different types of condensers are used:

- «büchiflex» spiral condensers for smaller production reactors (often up to 630 liters) offer easy cleanability
- shell and tube condensers with heat exchange areas of up to 23m<sup>2</sup> for large reactors – the inner tubes are made of borosilicate glass or silicon carbide (SiC, with outstanding heat transfer values)



Glass-spiral condensers in parallel configuration

optional safety chamber for shell and tube heat exchanger

### Universal chemical resistance

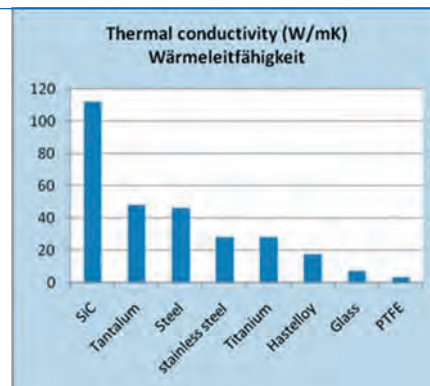
All Büchi condensers are suitable for long-term operation as condensers or after-coolers for highly corrosive medias and can be used in multi-purpose plants or as stand-alone units.



Shell and tube heat exchanger with glass tubes (without safety chamber)

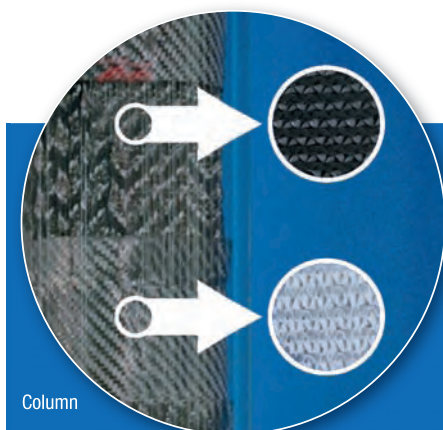
### Shell and tube heat exchangers with glass or SiC inner tubes

Shell and tube heat exchangers are available with inner tubes in borosilicate glass or silicon carbide (SiC) in sizes up to 23m<sup>2</sup>. SiC offers outstanding heat transfer characteristics and allows for a compact design of the plant.

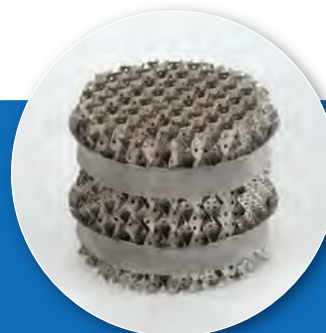


## Columns

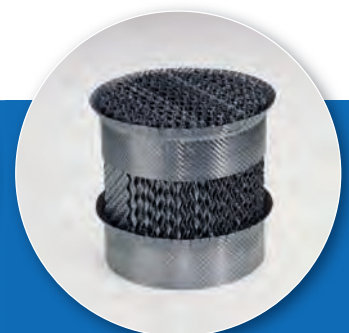
Columns up to DN 600 are available. Depending on the required separation capacity and processed media they are equipped with nonmetallic packing material or with structured packings.



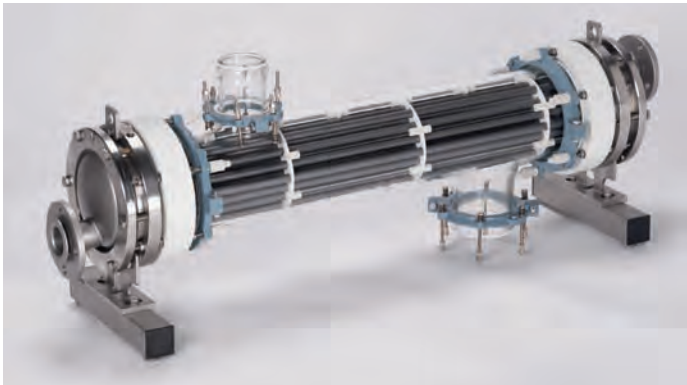
Column



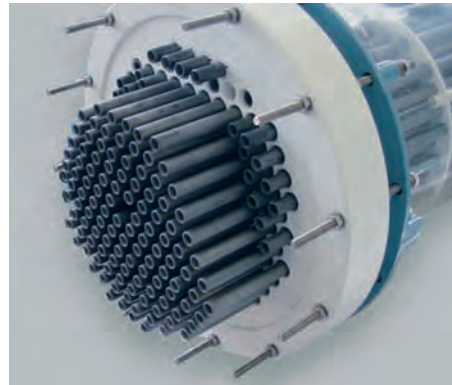
Stainless steel



Hastelloy



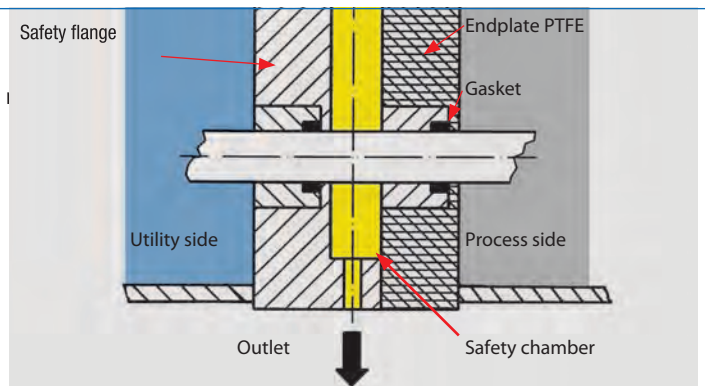
Shell and tube heat exchanger with SiC tubes (with safety chamber)



SiC Tubes

### Safety chamber

The safety chamber adds an additional separation between the cooling media and the process side and allows a higher cooling media pressure.



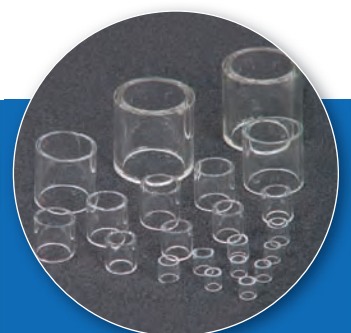
Ceramic



Pall rings

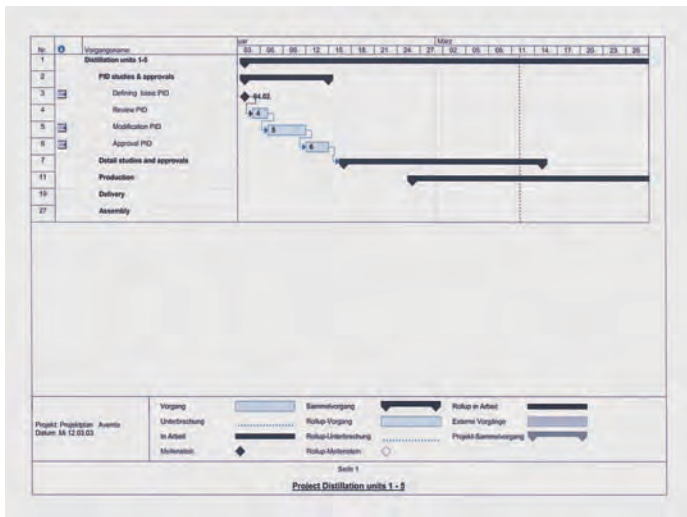


Saddle packing

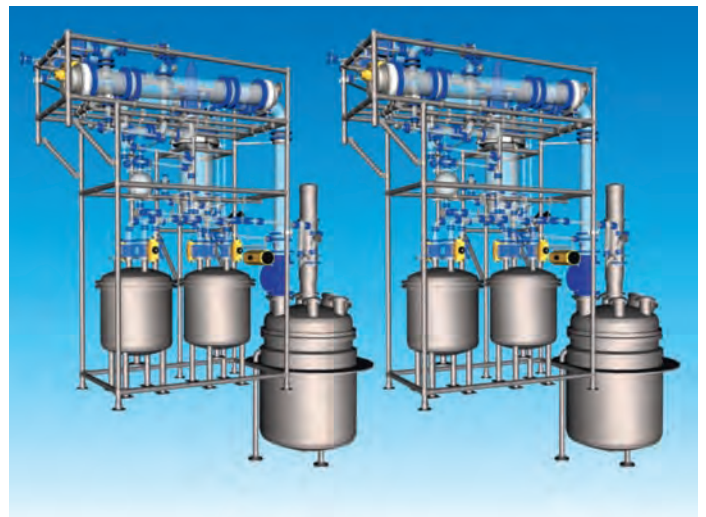


Raschig rings





Project management



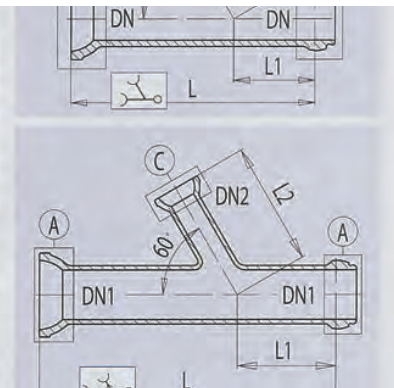
3D-CADplanning



DN	L [mm]	L <sub>1</sub> [mm]	L <sub>2</sub> [mm]	Bestell-Nr. Art. No./no de cde
15	150	50	100	10.03600.0000
25	150	50	100	10.03610.0000
40	200	75	125	10.03620.0000
50	300	100	200	10.03630.0000
70	300	100	200	10.03640.0000
100	300	100	200	10.03650.0000
150	450	150	300	10.03660.0000

DN <sub>1</sub>	DN <sub>2</sub>	L [mm]	L <sub>1</sub> [mm]	L <sub>2</sub> [mm]	Bestell-Nr. Art. No./no de cde
25	15	150	50	75	10.03800.0000
40	25	200	75	100	10.03810.0000



Catalog / spare parts

Documentation of Certification

# Processes

## Reaction, stirring, mixing

Glass lined reactors (DIN-reactors AE or BE) are suitable for a variety of processes such as chemical reactions (atmospheric or under pressure), gas dispersion, mixing of liquids/solids, crystallization and heating/cooling. Extractions and phase separations can also be performed with the proper fittings on the bottom discharge valve. Büchi supplies complete systems with glass lined reactors from various suppliers. Fittings and instrumentation on the reactor are also included, as well as distributors and collectors.

## Distillation

A stirred reactor commonly serves as reboiler. Vapors ascend to the condenser via the vapor line and the condensate either descends back into the reactor or passes into the receivers. The number of «büchiflex» spiraltube condensers or shell-and-tube condensers with borosilicate glass or SiC tubes required will depend on the size of the plant.

## Azeotropic distillation

The condensate mixture exiting the condenser is continuously separated in the phase separator (provided the phases are immiscible). One phase returns to the reactor while the other proceeds to the receivers. The size of the plant determines whether vertical or horizontal phase separators are employed.

## Rectification

Rectification columns in sizes up to DN600 with a range of nonmetallic packings or with structured packings depending on the separation performance and corrosion resistance can be supplied. The reflux ratio is controlled by various configurations of appropriate valves. Condensation takes place in shell-and-tube condensers with borosilicate glass or SiC tubes.

## Absorption

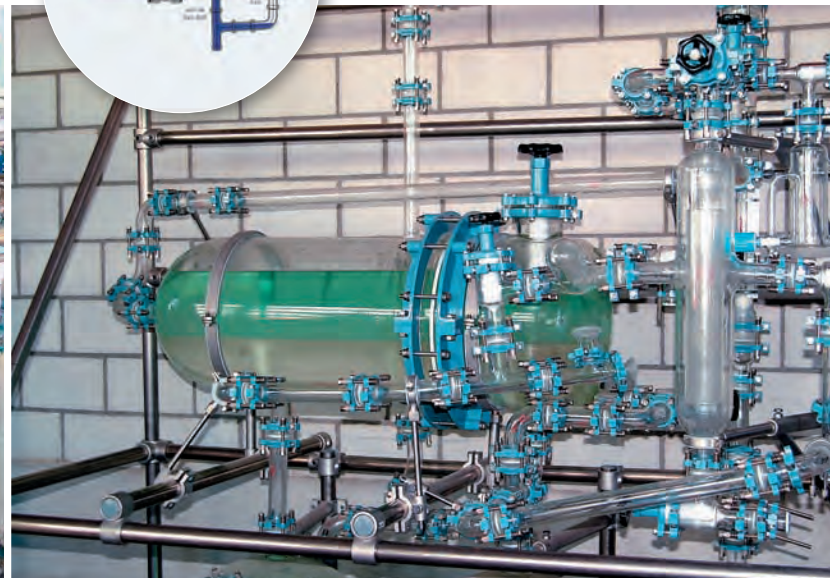
Non-condensable vapors and gases can be removed from off-gases in scrubbers. When strong acids are present, in particular, absorption columns made of borosilicate glass with ceramic packing or structured packing are recommended. Multiple columns with various absorption liquids and corresponding piping with valves are used, depending on the vapors and gases in question.

## Other apparatus / processes

- circulation reboilers
- falling-film evaporators
- (mobile) mixing vessels
- mobile transport vessels
- separator vessels
- glass piping (waste water, exhaust, transfer)

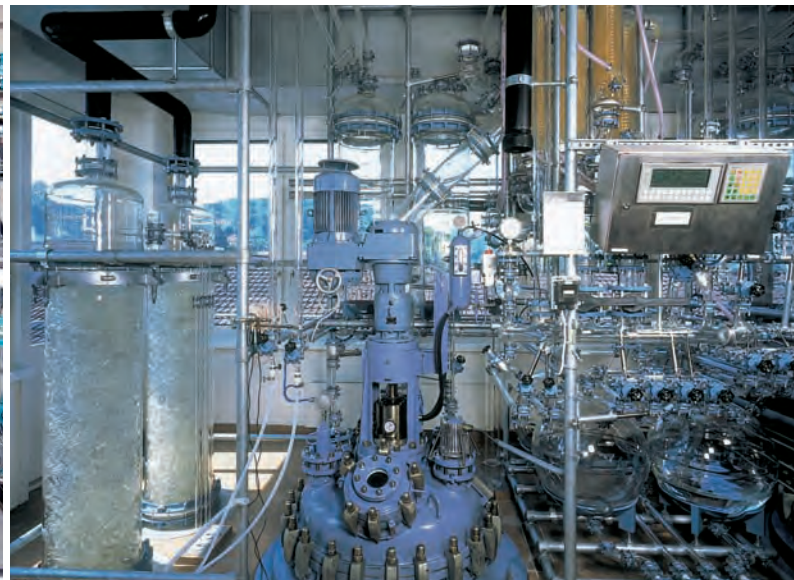


SiC heat exchanger  
*SiC Rohrbündelwärmetauscher*



Phase separator  
*Phasenabscheider*





Gas scrubber



Falling-film evaporator

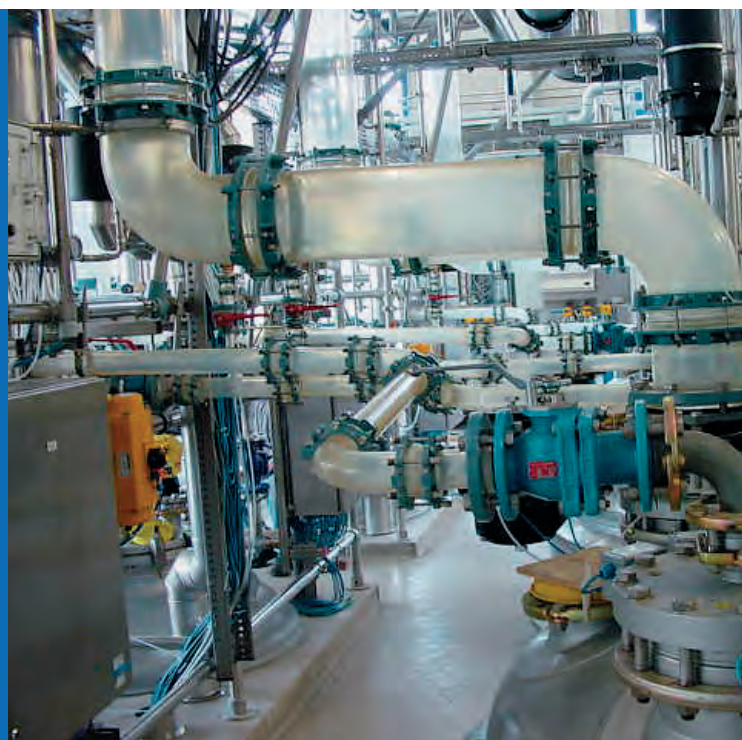
## Examples



cGMP facility with 800 liter AE / BE reactors and glass upper section for API production  
*cGMP Anlage mit 800 Liter AE / BE Reaktoren und Glasaufbau für API Produktion*



4000 liter BE reactor with coated glass upper section  
*4000 Liter BE Reaktor mit beschichtetem Glasaufbau*



DN300 vapor line with protective glass coating  
*DN300 Brüdenleitung mit Schutzbeschichtung*



Distillation overhead with SiC shell and tube heat exchangers



1000 liter cryogenic reactor with glass upper section



DN400 liquid/ liquid extraction column capacity 800kg/h

## Standard configurations

Reactor DIN	Heat ex- change area	Spiral condenser	Tubular Heat exchanger	Tubular Heat exchanger	Secondary condenser	Feed vessel	Receivers	Phase seperator	Vapor duct	
AE/BE	m <sup>2</sup>	m <sup>2</sup>	Glas m <sup>2</sup>	SiC m <sup>2</sup>	m <sup>2</sup>	l	l	l	DN	
100	0.85	2.6	2 x 1(3)	-	-	0.6	50	2 x 50	1	70
160	1.25	3.9	3 x 1(3)	-	-	1.0	50	2 x 50	1	70
250	1.65	4.8	3 x 1(6)	-	-	1.3	100	2 x 100	3	100
400	2.45	7.8	6 x 1(3)	-	-	1.3	150	2 x 200		150
630	3.1	9.3	6 x 1.6)	-	3.2	1.6	200	2 x 200		200
1000	4.6	-		12.5	4.0	1.6	500	2 x 200		200
1600	7.35	-		16.0	5.0	1.6	500	2 x 500		200
2500	9.6	-		20.0	6.5	1.6	*Email	*Email		300
4000	13.5	-		23.0	8.0	1.6	*Email	*Email	100	300

\*Email = glass lined steel

The table above is only an example /

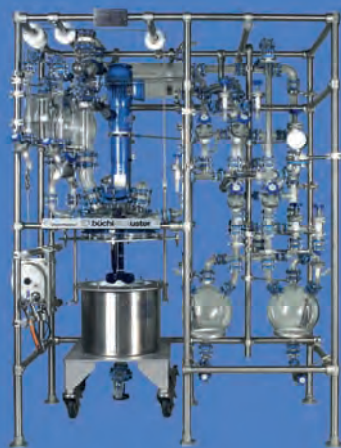
## Büchi process equipment – from laboratory to production scale

«miniPilot»



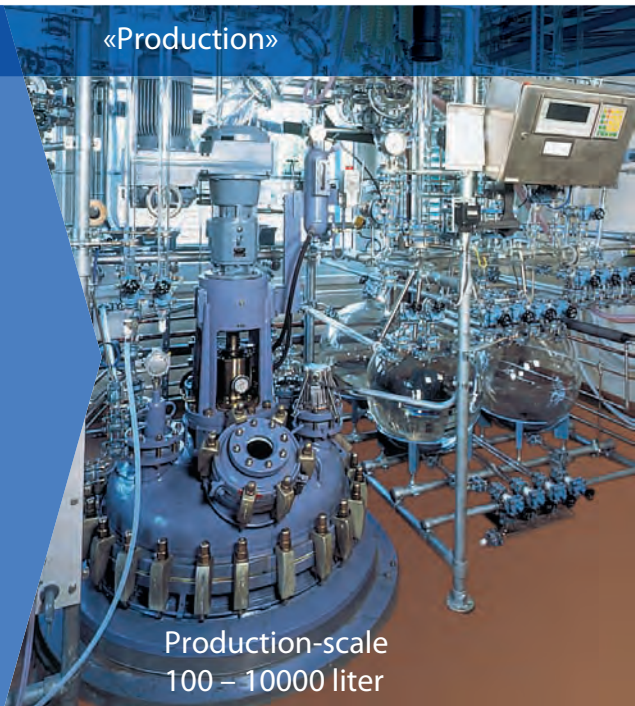
Lab-scale  
5 – 15 liter

«chemReactor»



Pilot-scale  
15 – 250 liter

«Production»



Production-scale  
100 – 10000 liter



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Hersden, Canterbury, Kent. CT3 4NH

Tel: 01227 710274

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Web: www.kenkimble.com



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Pilot Plant and Reactor Systems