

# Group Presentation

Pfautler Group is a global leader in providing corrosion-resistant technologies, systems and services for the chemical, pharmaceutical and food industries

**Pfautler**   
Defining the standard



# Much more than Glass-Lined

Since 1884, Pfaudler Group has grown to be a truly global, multi-national and diverse company, employing over **1,500 employees** and **manufacturing facilities** on four continents.

In addition to the core business of **glass lined and alloy equipment**, the Pfaudler Group is present on the market with several branded product lines covering a broad portfolio that includes **fluoropolymers, sealing technologies, filters and dryers, engineered column systems, lab & process glass.**

Our **Systems** and **Services** capabilities allows us to support our Customers **from the lab to the full scale production plant**, including optimize and improve the whole life cycle of any process equipment normally used in the **chemical, pharmaceutical and food industries.**

## Pfaudler is more, Much More than Glass-Lined



# Our Group

**GMM Pfaudler**   
Defining the standard

**Pfaudler**   
Defining the standard

**Much More  
Than Glass-Lined**

**PFAUDLER**  
GLASS-LINED  
& ALLOY SYSTEMS

**EDLON**  
FLUOROPOLYMERS

**NORMAG**  
LAB & PROCESS GLASS

**MAVAG**  
FILTRATION & DRYING

**INTERSEAL**  
SEALING TECHNOLOGY

## Branded Product Lines

Representing a major product offering in the Group Portfolio.  
The specific expertise of each is summarized by the strapline.

# Our Business Functions



Help make the world around us.  
Much of what you see, taste and touch in the world,  
was created or improved using Pfaudler technologies



We design and build turn-key process systems



We provide 24/7 support for your entire plant



Our innovative spirit continuously drives us to develop the next great technology



# Our Group Mission & Vision

The Pfaudler Group offers a wide range of corrosion-resistant technologies, systems and related services for the chemical, pharmaceutical and food industries.

We support our Customers from the lab to the full scale production plant through innovative processes and comprehensive service offerings across the globe.

We are partnering with our Customers by **Defining the standard** in everything we do.

## Our Values

### Dynamic

We continually search for better solutions to ensure we meet the needs of our Customers and the challenges of tomorrow

### Innovative

We leverage our worldwide team's knowledge and expertise to create new technologies that deliver high value solutions for our Customers and shape the industry

### Professional

We pride ourselves on expert technical advice, rapid service response and on-time delivery that defines the standard for the industry

### Responsible

We actively support inclusion and diversity, protect the environment and maintain the highest standards of compliance and ethics in everything we do

### Trusted

We provide a proven reliability in all our technologies, services and solutions that reinforces our reputation as the trusted industry leader

# CONTENTS

Glass-lined & alloy systems  
**PFAUDLER**  
GLASS-LINED & ALLOY SYSTEMS

Filtration & Drying  
**MAVAG**  
FILTRATION & DRYING

Sealing Technology  
**INTERSEAL**  
SEALING TECHNOLOGY

Fluoropolymers  
**EDLON**  
FLUOROPOLYMERS

Lab & Process Glass  
**NORMAG**  
LAB & PROCESS GLASS

Much More  
Than Glass-Lined

Overview  
&  
global  
footprint

## CUSTOMER

**Pf** Systems

**Pf** Technologies

**Pf** Services

Manufacturing sites  
worldwide

**Pf**  
**Pfaudler**  
Defining the standard



# Group presence in Europe

**Pfaudler GmbH**  
Waghäusel, Germany



Glass lined equipment

**Pfaudler S.r.l.**  
Torre Di Mosto, Italy



Glass lined equipment

**Pfaudler Limited**  
Leven, United Kingdom



Glass lined equipment &  
Fluoropolymers

**Pfaudler Limited**  
Bolton, United Kingdom



Gaskets & PTFE components

# Group presence in Europe

**Mavag AG**  
Neunkirch, Switzerland



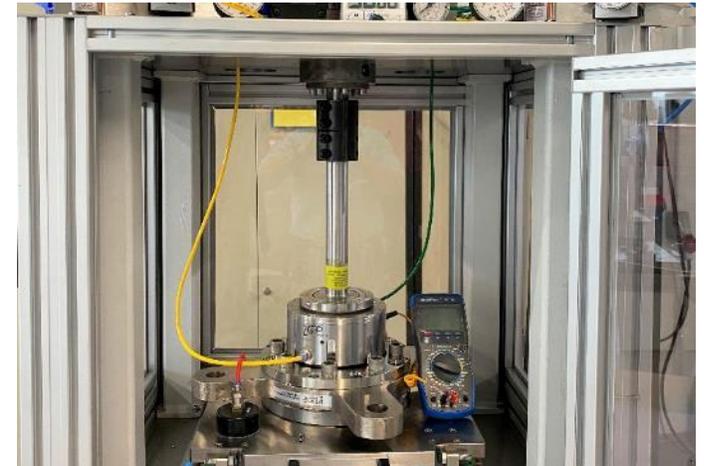
Filters, dryers & agitators

**Pfautler Normag Systems GmbH**  
Ilmenau & Hofheim, Germany



Glassware Parts & Systems

**Pfautler interseal GmbH**  
Hofheim-Wallau, Germany



Sealing Technology

# Group presence in the Americas

**GMM Pfaudler US Inc.**  
Rochester, NY, USA



Glass lined and alloy equipment

**Edlon Inc.**  
Avondale, Pennsylvania, USA



Fluoropolymers

**Pfaudler Ltda.**  
Taubaté, Sao Paulo, Brazil



Glass lined equipment

# Group presence in Asia

**Pfaunder Process Equipment Co. Ltd.**  
Li Yang City Jiang Su , PR China



Glass lined equipment

**GMM Pfaunder Ltd.**  
Mumbai, India



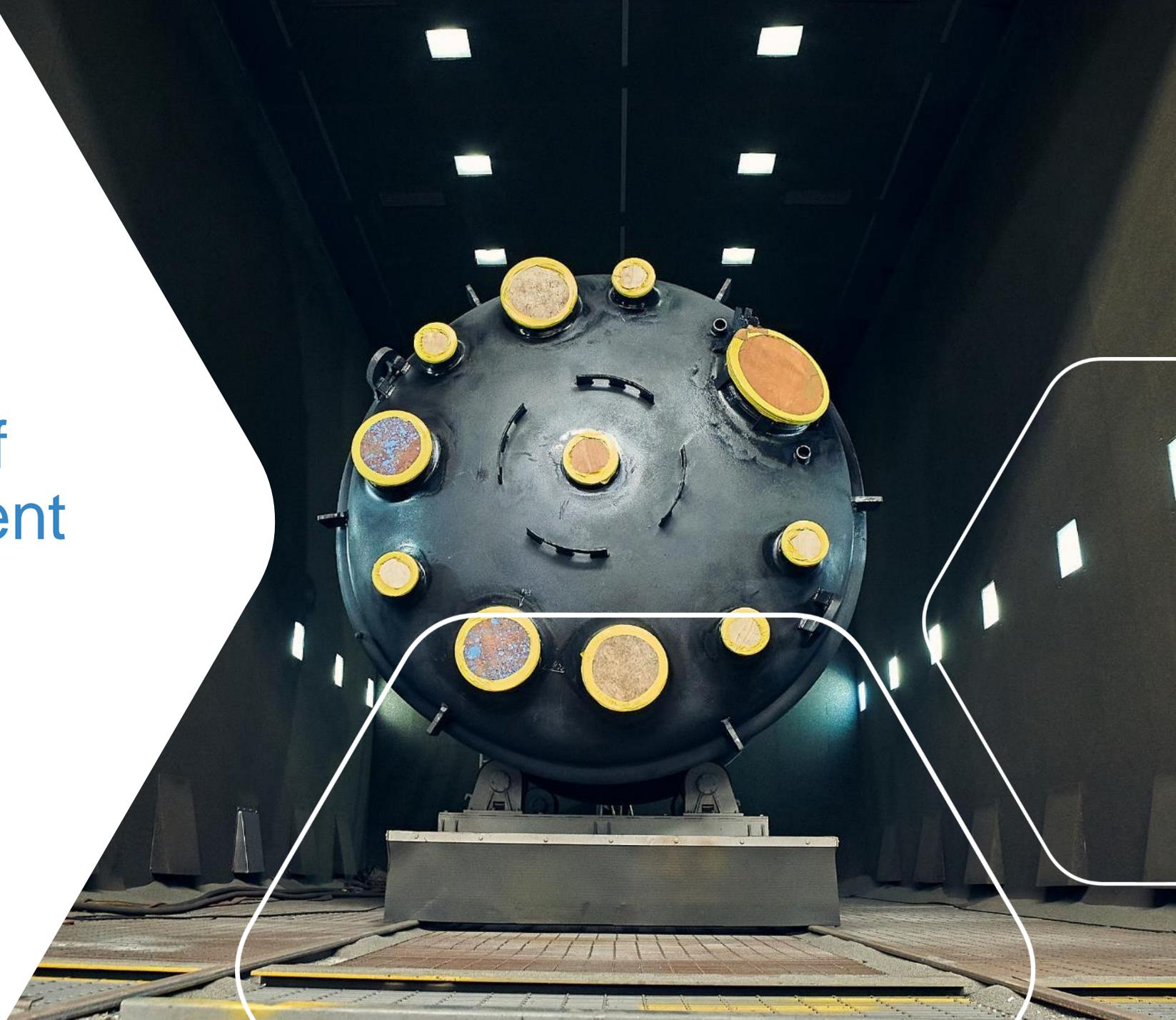
Glass lined & Alloy equipment

# PFAUDLER

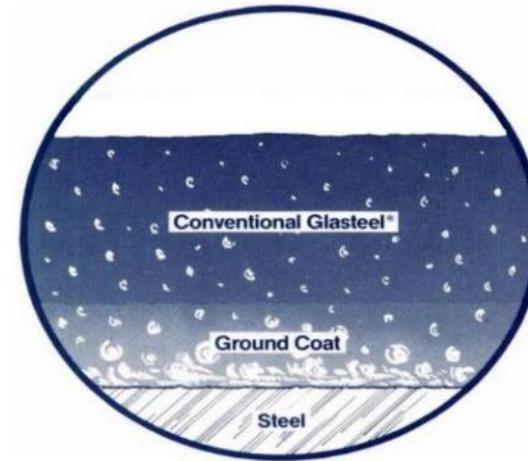
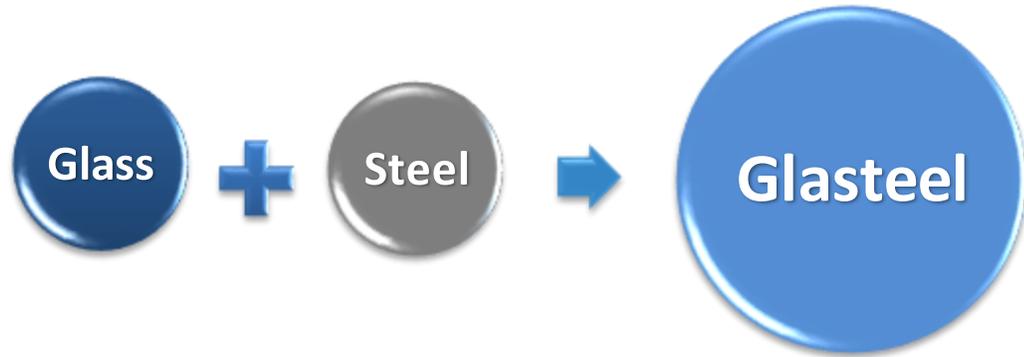
GLASS-LINED  
& ALLOY SYSTEMS

Worldwide leader of  
glass-lined equipment

**Pf**  
**Pfaudler**  
Defining the standard



# Pfaudler Glasteel® - What is it?



← Composite Material



# Pfaunder - Excellence in Glass Lining

## 4 primary types of glasses



European Patent  
EP 1231189

**PPG**  
Pfaunder  
Pharma  
Glass



**ASG**  
Anti Static  
Glass



**ARG**  
Abrasion  
Resistant  
Glass



**WWG**  
World Wide Glass  
(blue/white)



## And also special glasses

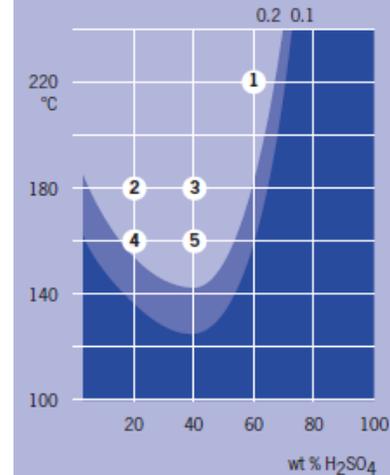
**P31** polymerizer glass, extra smooth surface

**V132** Glass for Stainless steel substrat

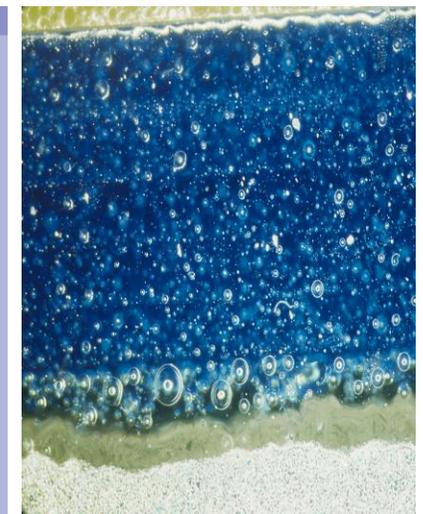


## EXCELLENCE IN

fig. 2 Sulphuric acid



corrosion resistance



manufacturing

# Pfaunder Glass-Lined Portfolio

## Glass-Lined Reactors

- DIN Reactors
- ASME Reactors
- Customized Reactors



## Probes, sensors

- Temperature
- pH / ORP
- Level indication
- Conductivity
- Corrosion monitoring



## Mixing technology

- ProSol®
- Cryo-Lock®
- Drives
- Sealing units



## Accessories

- Covers & Glasslook® & Sight Glasses Fillook®
- Pipes and fittings
- Sampling systems
- Valves



## Storage vessels and receivers

## Heat exchangers

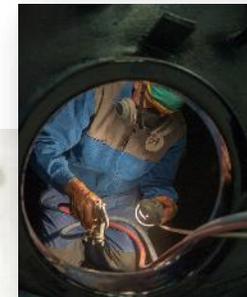
## Columns

## Conical tumble dryers



## Service

- Spare parts
- Repair service
- Reglassing



# Pfaunder Glass-Lined Reactors, Vessels and Equipment



Reactors



Storage Tanks and  
Receivers



Conical Dryer Blender CDBs

# Pfaunder Glass-Lined Mixing Systems

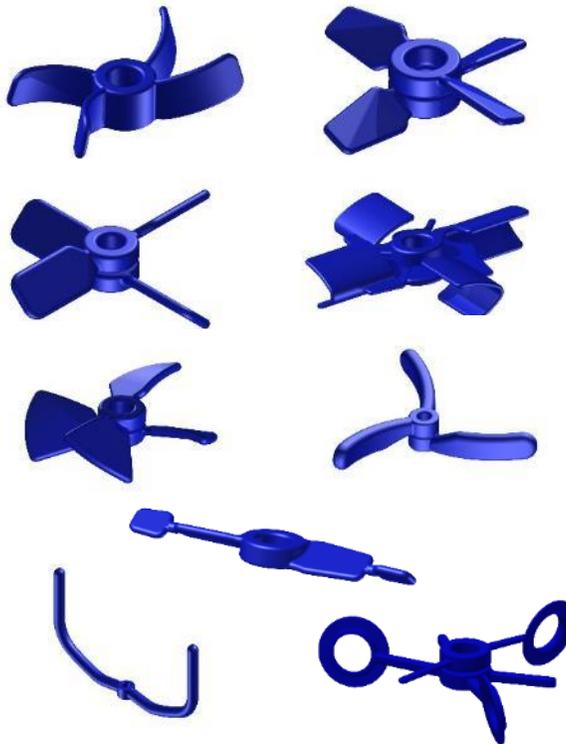
AR Drives



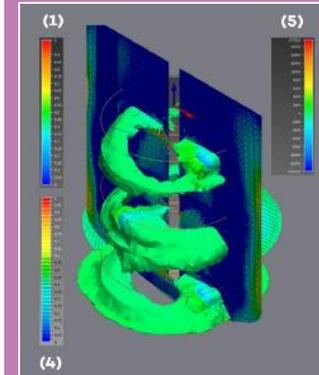
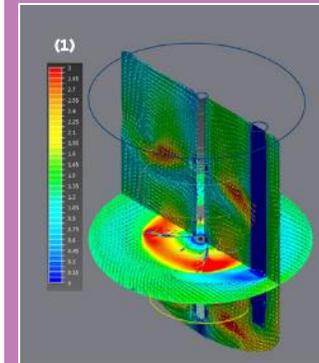
VSO Drives



Impellers



Mixing reviews and CFDs



Baffling



BaffleRing



C baffle



Quatro-Pipe

# Pfautler Glass-Lined Instrumentation

## Liquid analysis

- pH Sensors
  - Heavy duty
  - Hygienic design
- rH / Redox Sensors
- Combined pH/ ORP Sensors
- Conductivity Sensors



## Applications

Heavy duty (Chemical, Metal...) or hygienic processes (F&B, Pharma, others)

- High mechanical strength
- High temperatures and pressures
- Long life time, also @ CIP
- Low maintenance



## Temperature

- Temperature sensors
  - Pt100 inserted
  - Pt100 fused in the glass
  - Thermocouple fused in the glass



## Applications

Mainly in Glass Lined Apparatus such as reactors, tanks to monitor or control the temperatures.

# Pfautler Glass-Lined Instrumentation

## Corrosion detection

- Inline monitoring system
- Portable control unit (CDP)
- CryCo-Lock technology



## Applications

Mainly in Glass Lined or coated Apparatus such as Reactors, tanks to monitor the integrity of the protecting layer.



## Level control & Sampling sys.

- Level indication
  - Radar
  - Capacitive
- Limit level switch
  - Contacting
  - Capacitive
- Sampling systems



## Applications

Mainly in Glass Lined Apparatus such as Reactors, tanks to monitor or control the level, the product quality and to detect phase separations (aqueous/organic) when emptying.

**PFAUDLER**

GLASS-LINED  
& ALLOY SYSTEMS

High quality alloy  
process equipment

**Pfaudler**  
Defining the standard



# Pfautler Alloy Agitators and Vessels



Pressure Vessels



Agitated Reactors



Columns



Heat Exchangers

Alloy Agitators and Vessels are designed and made at the GMM Pfautler factory in India

# Capabilities of our Factory in India

**~30+ member  
design team**

## Familiar with various design standards...

- ASME Sec. VIII Div. 1
- ASME Sec. VIII Div. 2
- AD Merkblätter 2000
- API 650 / 660
- EN 13445
- PD 5500
- PED – (Directive 2014/68/EU)
- ATEX – (Directive 2014/34/EU)
- TEMA
- JIS

## ... leveraging different software solutions

- Design Software:
- HTRI Xist (Thermal Design) -7.2
- PVElite 2017 SP1
- Compress 2017, Built 7700
- DIMY
- CAD & FEM Software:
- Autodesk Inventor - 2017 (3D Drafting)
- AutoCAD - 2017
- Autodesk CFD - 2017
- Fatigue Analysis
- FEA Analysis
- Vibration Analysis

Design Engineering

# Factory Accreditations & Exotic Metallurgies

- DIN EN ISO 3834-2
- ISO 9001 : 2008
- U-stamp
- U2-stamp
- NB - Stamp
- R-Stamp
- IBR
- PDIL
- SELO
- Korean Stamp
- PED
- AD 2000 – Merkblatt HP0

## Accreditations



We have qualified welding procedures and specifications for executing projects involving exotic metallurgies

<b>Stainless Steel</b> (316L/304L/904L/316Ti/410) <b>Duplex Stainless Steel</b>	<b>Hastelloy</b> (C276/C22/B3)-Alloy 59	<b>Incoloy</b> (600/800/825)	<b>Cupro - Nickel</b>
<b>Monel 400</b>	<b>Chrome - Moly Steels</b>	<b>Low Alloy Steels</b>	<b>Clad Steels</b>
<b>Carbon Steel</b>	<b>Copper Alloys</b>	<b>Nickel Alloys</b>	<b>Titanium GR 2</b>

# Pfautler Tantalum Shell & Tube HEX and other process equipment

Tantec's competence in using **Tantalum** for pressure equipment, heat exchangers, plant components and other components is world renowned.

**Pfautler & Tantec** have formed a strategic partnership and are **working together** to supply tantalum process equipment in conjunction with glass-lined equipment and systems, for the chemical, pharmaceutical and process industry.

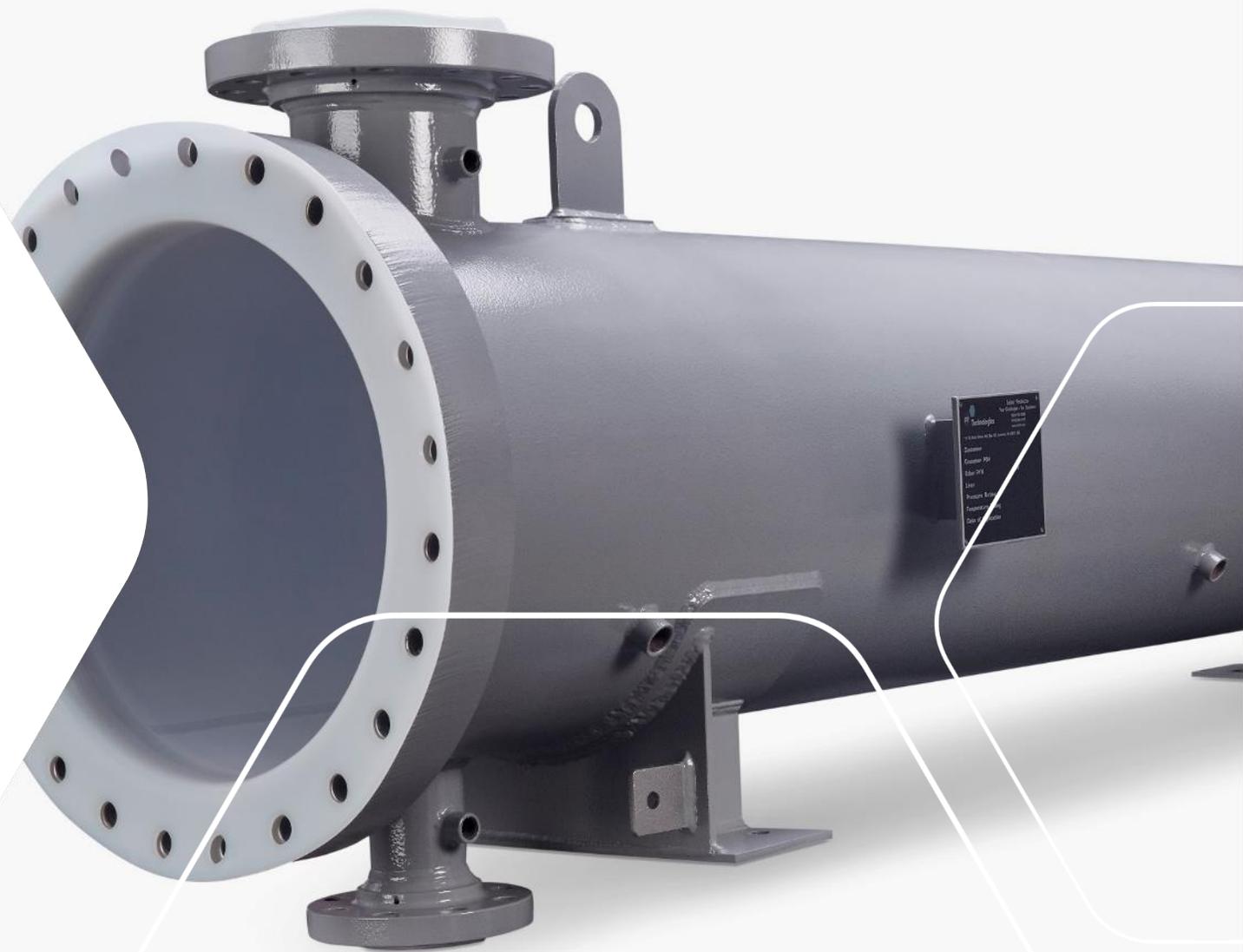
**Tantalum** is a complementary material of construction to glass-lined with similar **corrosion resistant** properties.



Shell & Tube Heat Exchangers



# Innovative Solutions using Fluoropolymers



# EDLON Fluoropolymers

## Applications

- High Corrosion Resistance (e.g. HF, Halogenated Chemicals)
- Ultra High Purity (range of ppt – „parts per trillion“)
- Low Friction and Non sticking

## Users (for instance)

- Chemical Process Industry
- Pharma Industry
- Electronics - Semiconductors
- Pulp & Paper and Converting
- Oil and Gas
- Nuclear energy



Rotolining



Rotomoulding



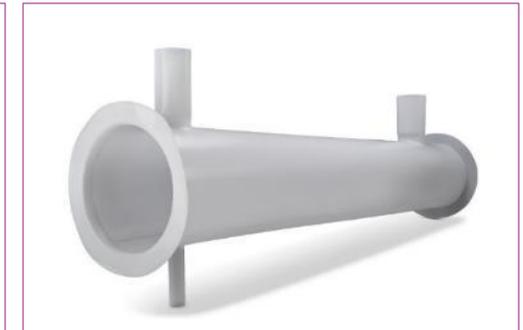
Roll Covers



Engineered Coatings



Column Internals



Lining: Loose or bonded - PureFusion™ Welding

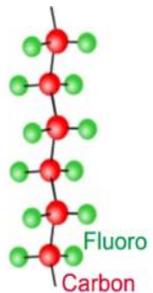
# Fluoropolymers – What are they?

FLUORINE containing polymers

Fully fluorinated Thermoplastic Fluoropolymers

Partially fluorinated Thermoplastic Fluoropolymers

- Fluorine gives the chemical resistance through Strong C-F bonds
- PTFE(Teflon®), PTFE(M) TFM™, PFA, FEP Partially fluorinated polymers
- ETFE (Tefzel®), ECTFE (Halar®), PVDF (Kynar®)

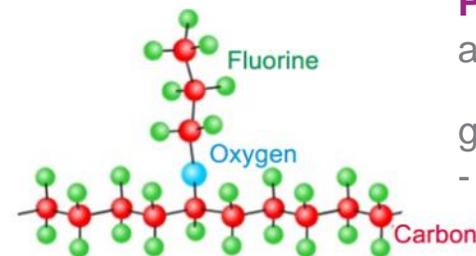


## PTFE

Is a linear polymer

general formula  
 $-[\text{CF}_2-\text{CF}_2]_n-$

Polytetrafluoroethylene (PTFE)



## PFA and Modified TFM

are branched PTFE polymers

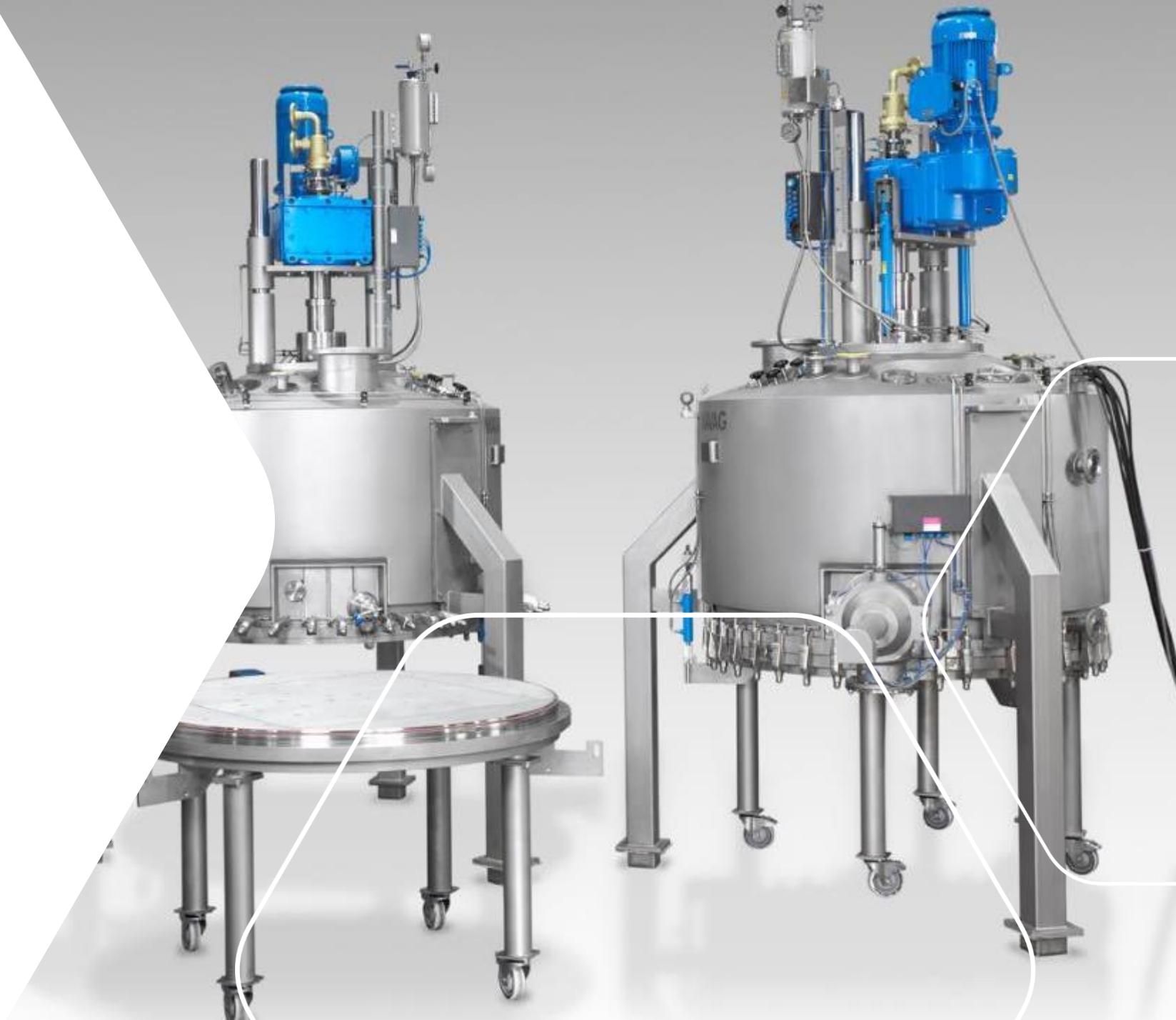
general formula  
 $-[(\text{CF}_2)_4 - \text{CF}(-\text{O}-\text{CF}_2-\text{CF}_2-\text{CF}_3)-(\text{CF}_2)_5]_n-$

Perfluoroalkoxy Polymer (PFA) & modified TFM™

**MAVAG**  
FILTRATION & DRYING

Competence in  
filtration & drying

**Pf**  
**Pfaudler**  
Defining the standard



# MAVAG Filtration, Drying and Mixing

MAVAG provides filtration, drying, vessel and mixing technology.

The supply of equipment and services include design, fabrication and installation, combined with efficient systems for pharmaceutical and biotech industries.

## Filtration

MAVAZWAG Filters & Filter-Dryers  
MAVALAB Pre-Engineered Filters  
FUNDA Centrifugal disc filters



# MAVAG Filtration, Drying and Mixing

## DRYING



MAVASPHERE Spherical Dryer  
MAVADRY Horizontal Dryer  
MAVAPAD Paddle Dryer



# MAVAG Filtration, Drying and Mixing

## MIXING



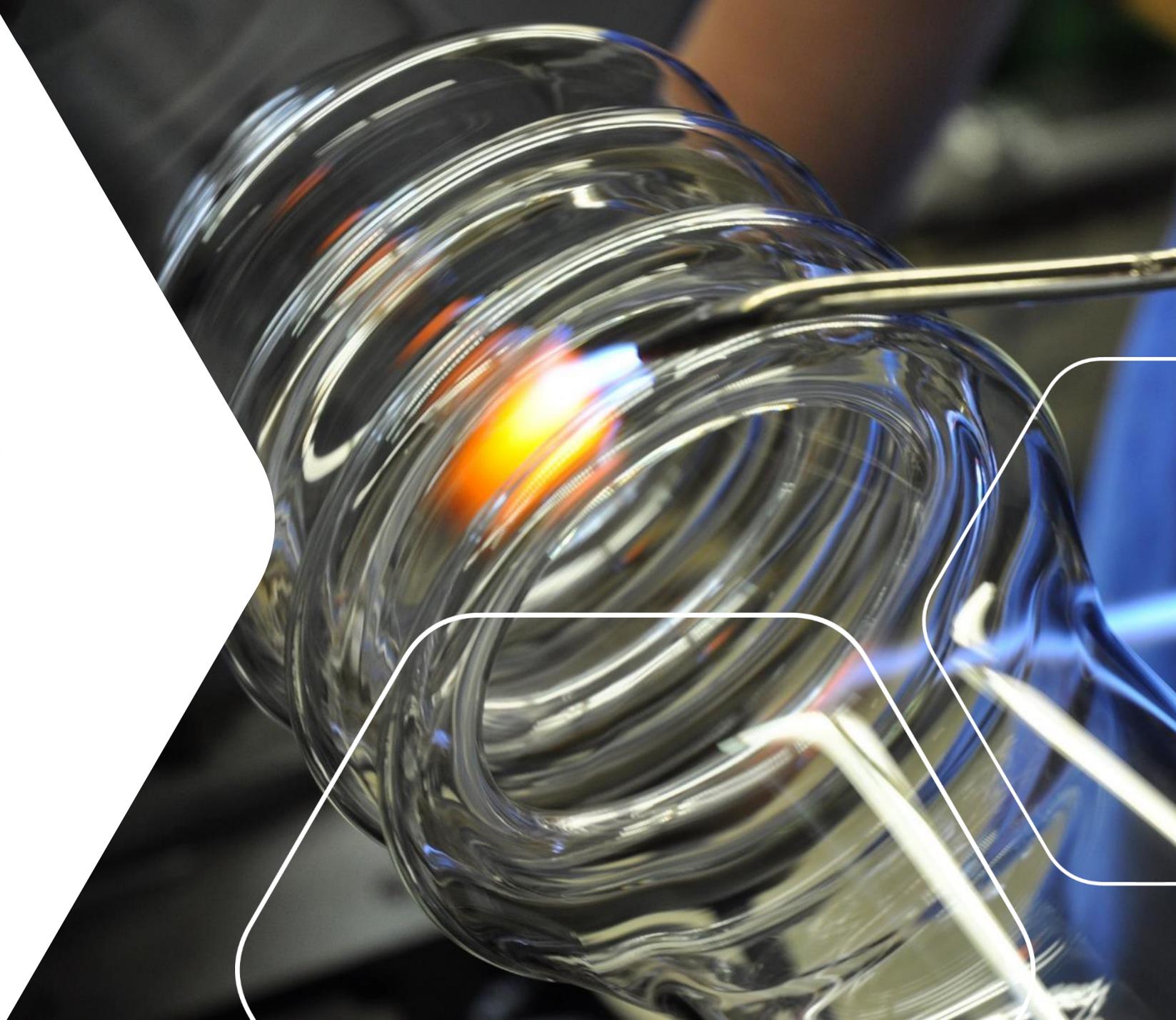
MDB Magnetic Agitators  
MTF Turbofoam Foam Separator  
MFR & MRGH Sterile Agitators



**NORMAG**  
LAB & PROCESS GLASS

The borosilicate 3.3  
glass specialist

**Pf**  
**Pfaudler**  
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# NORMAG Lab and Process Systems in Borosilicate Glass

High quality **NORMAG** glass components, apparatuses and units for the chemical and pharmaceutical industry and research, from the laboratory to the production scale.



## Process Units - Pre-assembled process units

- Reactor
- Evaporators
- Distillation
- Extraction
- Filter
- Crystallisation
- Absorption/ scrubber



## Laboratory & Teaching Units - Validated standard with many specific customized options

- Reactor
- Evaporators
- Distillation
- Extraction
- Filter
- Crystallisation
- Absorption/ scrubber



## High quality Components for lab & process

- Pipes & connection,
- valves
- Reactors
- Columns
- Parts for distillation
- Parts for extraction
- customized products

# A process unit example: Glass-lined reactor with Borosilicate Glass 3.3 distillation top



## Example: 2500 liters G/L reactor with glass top

- Glass-lined reactor for pharma application with jacket and insulation
- Allowable operating conditions (FV/+6bar; - 60°C/ +200°C)
- Agitator drive, ATEX-compliant, with frequency converter, double acting gas lubricated mechanical seal, glass lined single or multi stage stirrer – customized to process
- Bottom outlet valve, fully drainable, with Customer-specific adapter
- Condenser in borosilicate glass 3.3
- Distillation top DN 200 in borosilicate glass 3.3
- Feed vessels, cylindrical in borosilicate glass
- Vacuum and nitrogen distributors
- Instrumentation and bursting discs
- Stainless steel frame

**INTERSEAL**  
SEALING TECHNOLOGY

Innovation in  
sealing technology

**Pf**  
**Pfaudler**  
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# Sealing Technology Innovative Products

The dry9000<sup>®</sup> is a maintenance-free shaft seal applicable for the following industries



FOOD INDUSTRY



PHARMACEUTICAL INDUSTRY



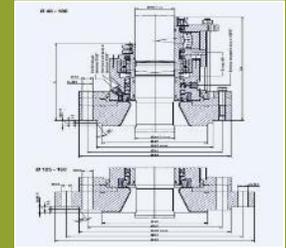
CHEMICAL INDUSTRY



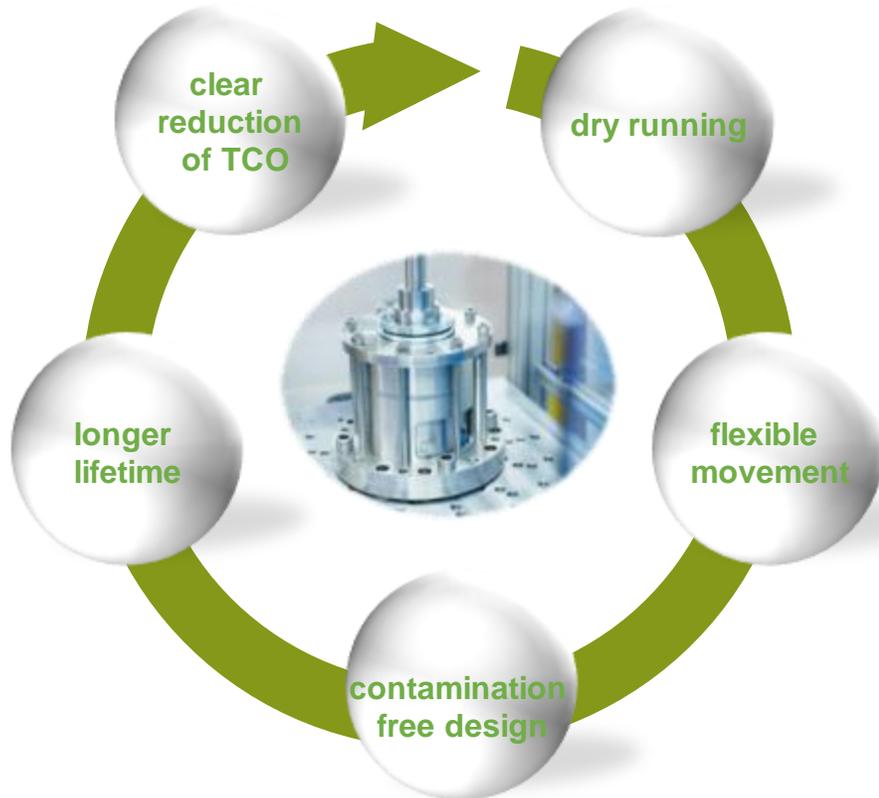
PETROCHEMICAL INDUSTRY

The dry9000<sup>®</sup> are designed for a great variety of requirements and ensure a 100% leak-tightness for agitators, mixers, dryers, filters and worm conveyors:

- dry9000
- dry9000 twin
- dry9000 twin+
- dry9000 twin E
- dry9000 twin E+
- dry9000 twin S
- dry9000 extend
- dry9000 steep



# Product benefits



## Advantages - DRY9000®

- No additional cost: pharma design included in standard version
- No loss of product: contamination free production
- CIP: Easy cleaning/sterilization
- FDA-confirmation
- GMP-Design
- ATEX-conformity in all classes
- No-start up requirements
- Easier to plan a revision
- Reduced effort for installation
- Fulfills all safety and environmental standard

## Saves Cost & Time – DRY9000®

- The lowest total cost of ownership (TCO) sealing technology for agitation & mixing
- No supply system needed
- No loss of product because of contamination
- No continuous cleaning of contaminated supply system
- No constant monitoring necessary due to dry running technology



# Our Systems Capabilities

**Pf**  
**Pfaudler**  
Defining the standard

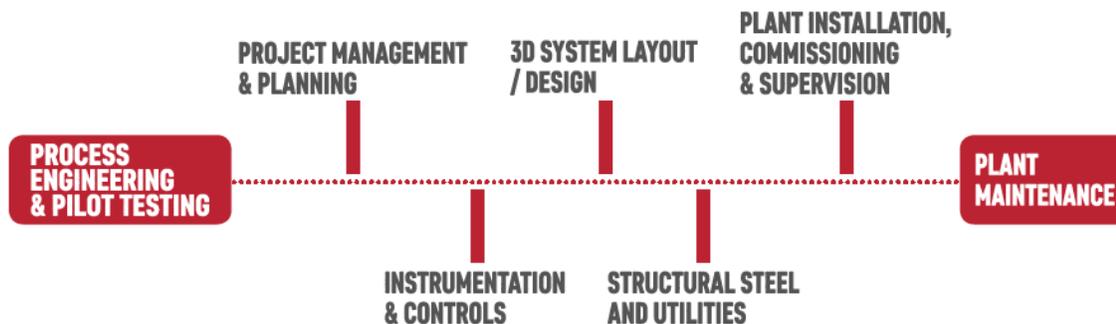


# Pfautler Process Systems Packages

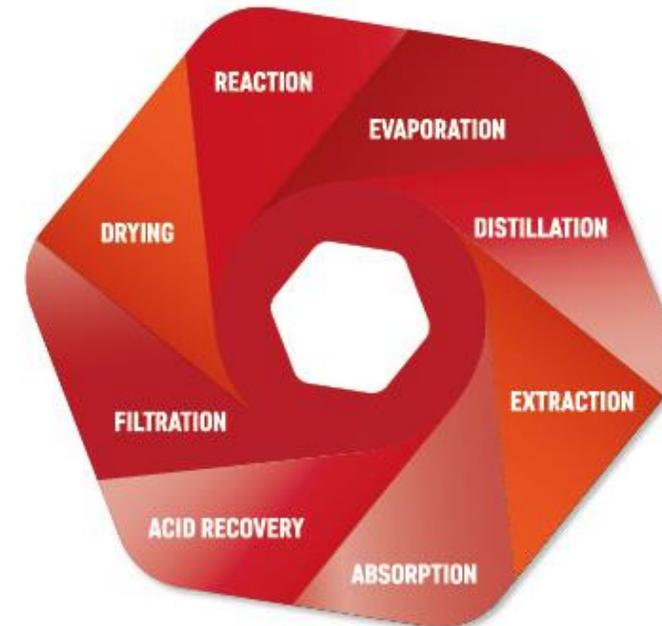
Pfautler's systems capabilities **are not limited** to the individual technologies themselves.

We can **combine** technologies and services into complete and efficiently **operating process systems**.

## FULL ENGINEERING PACKAGE



## DESIGN PROCESS TECHNOLOGY



Our **expertise** allows us **to design process technology** to solve complex requirements.

# Pfaunder Evaporating Units and Systems

Wiped Film Evaporators (WFE)  
glass lined or alloy



Wiped Film Evaporator Systems:  
Complete modular process systems,  
pre-assembled and tested



# Pfautler processes in Acid Recovery

## Our processes in Acid Recovery

- Spent Acids
- Nitric Acid
- Sulfuric Acid
- Organic Acids
- Hydrochloric Acid
- NOx Absorption
- Post treatment of Waste Water and Waste Gas streams



Acids play many different roles in a large number of sectors of the chemical process industries.

Recovery of spent sulfuric and nitric acid helps to reduce operating costs compared to total raw material and disposal costs, and is an environmentally sound practice.

Our **Glass-Lined, Glass** and **Fluoropolymer** technologies, along with our **Tantalum, Niobium, Zirconium** and **Silicon Carbide** exchangers are the materials of choice for handling hot, concentrated acids safely.

# Pfaunder Pilot Test Facility (Rochester, USA)

## Process Capabilities

- Multiple WFEs
- Jacketed/Agitated Feed Tank
- Circulated Flash Evaporation
- De-Gassers
- Distillation Column
- Reaction
- Condensers, Coolers and Heaters
- Multi Stage High Vacuum Equipment
- All Required Peripheral Equipment

Process Controlled via PLC/HMI

Utilities: Steam, Cooling Water, Tempered Water,  
Hot Oil On-site Sample Analysis



Guaranteed Performance of Commercial Scale  
System Based on Pilot Tests

# Pfautler Test Facility (Germany)

## Process Capabilities

- Concentration by evaporation under atmospheric or vacuum conditions
- Concentration by rectification under atmospheric or vacuum conditions
- Process optimization with regard to product quality and/or emissions
- Selection of suitable chemical agents
- Development of new processes

Guaranteed Process Performance

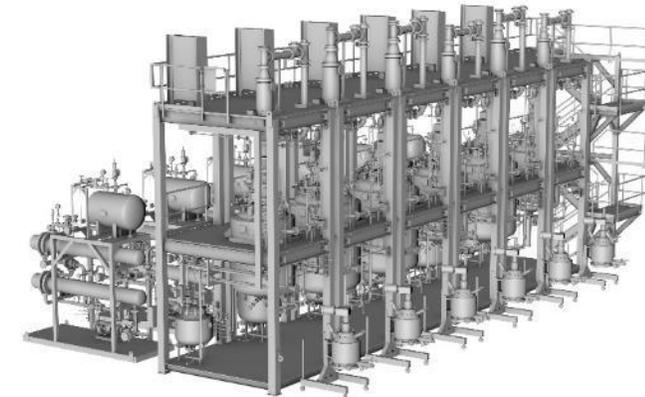
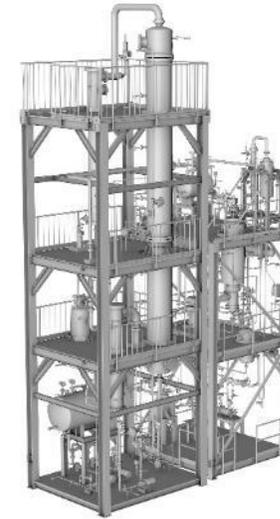


# Pfautler Engineering Services



## Engineering Services

- Process and equipment design according customers specification
- Tailor Made Solutions for special applications
- Process optimization with regard to energy consumption, product quality and/or emissions
- Consulting services in regard to MOC and special applications
- Development of new processes in cooperation with customers from lab to pilot scale
- up to industrial world scale facilities
- All engineering services from feasibility studies up to complete 3D modelling of the plant



# Pfaunder Modular Units



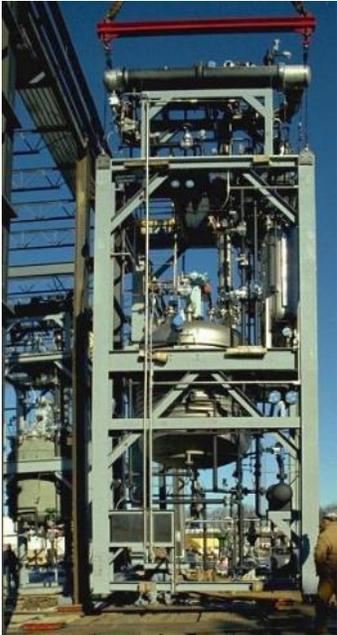
Reactor Systems



Column Systems



Heat Exchangers  
Ex: Acid Boiler,  
GL Shell,  
Tantalum Tube  
Sheet + Tubess,  
Alloy Heads



Thermal Control  
Units



Glass Lined & Alloy &  
Borosilicate Glass

# Putting All Our Expertise Together...

**1 THERMAL CONTROL UNITS**  
PFAUDLER

**2 GLASS STEEL REACTORS**  
TANKS  
RECEIVERS  
PFAUDLER

**3 GLASS STEEL & SILICON CARBIDE**  
HEAT EXCHANGERS  
CONDENSERS  
PFAUDLER

**4 GLASS LINED SENSORS**  
PFAUDLER

**5 HIGH ALLOY REACTORS**  
RECEIVERS  
TANKS  
HEAT EXCHANGERS  
PFAUDLER

**6 FLUOROPOLYMERS REACTORS**  
TANKS  
INTERNALS  
EDLON

**7 GLASS LINED COLUMNS**  
ALLOY COLUMNS  
PFAUDLER

**8 COLUMNS SYSTEMS**  
AND INTERNALS  
PFAUDLER  
FLUOROPOLYMERS  
EDLON

**9 WIPED & FALLING FILM EVAPORATORS**  
EVAPORATION SYSTEMS  
PFAUDLER

**10 REACTORS SYSTEMS**  
PFAUDLER

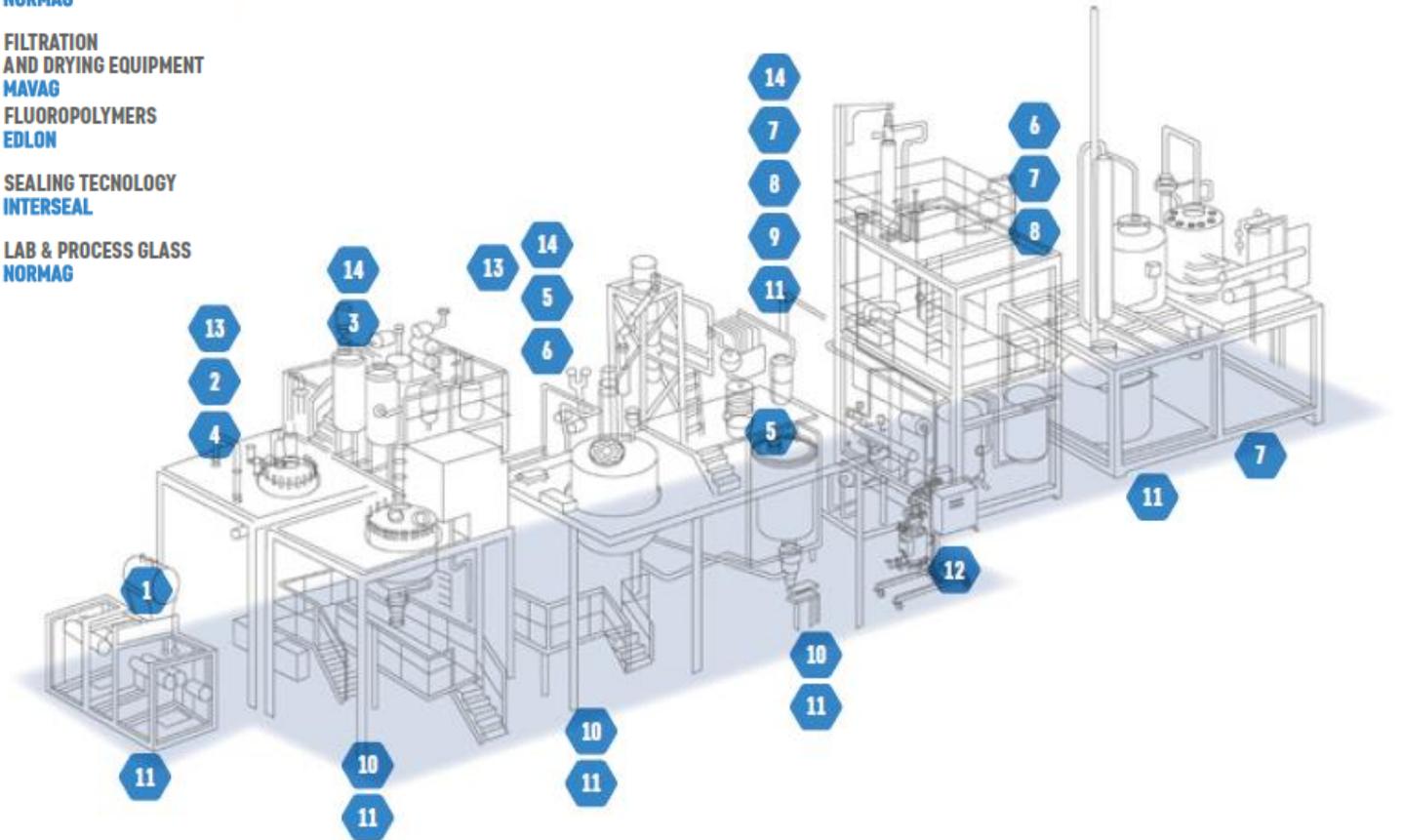
**11 MODULAR ASSEMBLIES**  
PFAUDLER  
NORMAG

**12 FILTRATION**  
AND DRYING EQUIPMENT  
MAVAG  
FLUOROPOLYMERS  
EDLON

**13 SEALING TECHNOLOGY**  
INTERSEAL

**14 LAB & PROCESS GLASS**  
NORMAG

**TYPICAL  
CHEMICAL  
PLANT**





# Global Services Capability



**Pf**  
Defining the standard



# Pfautler Services – Global technical support

Our **Pfautler Services** guarantee **fast and flexible service** response to maximize your equipment availability.

Our **highly-skilled engineers, technicians and sales team**, work with our clients upfront and during projects to optimize and improve the entire Lifecycle service support:



# Pfautler Services – Our complete service portfolio

Pfautler guarantees a global service during the whole process pre and post sales, with the largest service organization in our industry.

## Engineering

- Consultancy Services
- Pilot testing / toll operation
- Process engineering



## Maintenance and aftersales

- Maintenance
- Troubleshooting
- Glass inspection, reglassing and repair
- Shutdown services
- Repair
- Spare / Replacement Parts
- Sealing technology exchange
- Upgrades and process improvements
- Renewal program



## Installation, Commissioning, Start up

- Planning
- Project management
- Installations



# Pfautler Services – Reglassing and reconditioning

Pfautler has core expertise in the **service area** of full equipment refurbishing.

The reactors are completely reglassed, refurbished and comply with International and European regulations.

## Benefits

- ✓ Qualified damage assessment
- ✓ Long service life by the latest Pfautler glass
- ✓ Dismantling on site and transportation to Pfautler Reglass Center
- ✓ Upgrading easily possible
- ✓ Standard warranty as new vessels
- ✓ Reglassing of all glass-lined, including equipment from alternative suppliers



# Pfaunder Glass-Lined Accessories



# Pfautler Services – Machined PTFE & Engineered Plastic

Specialist at the forefront of the technological machining of PTFE & Engineered Plastics.

We manufacture & stock a wide variety of high performance plastics including:  
**Acrylic, Acetal, Nylon, Peek, Polyethylene, PTFE & more.**

## Product Range

- ✓ Bespoke Machined Components
- ✓ Semi-Finished Materials
- ✓ PTFE Envelopes
- ✓ PTFE Repair Sleeves
- ✓ Solid & Expanded PTFE Sheeting
- ✓ Soft-Cut Gaskets
- ✓ Spiral Wound Gaskets
- ✓ Gland Packing



# Access to Pfaudler – Technologies, Solutions & Services

A Global **Sales and Services Engineer Network** to support **YOU** in your daily work with all Pfaudler Products

Your «**Pfaudler Regional Sales Manager**» is your primary contact for all projects with regards to:

- ✓ Pfaudler Technologies
- ✓ Pfaudler Solutions

Your «**Pfaudler Service Centre Manager**» is close to your site for all:

- ✓ Pfaudler Services activities

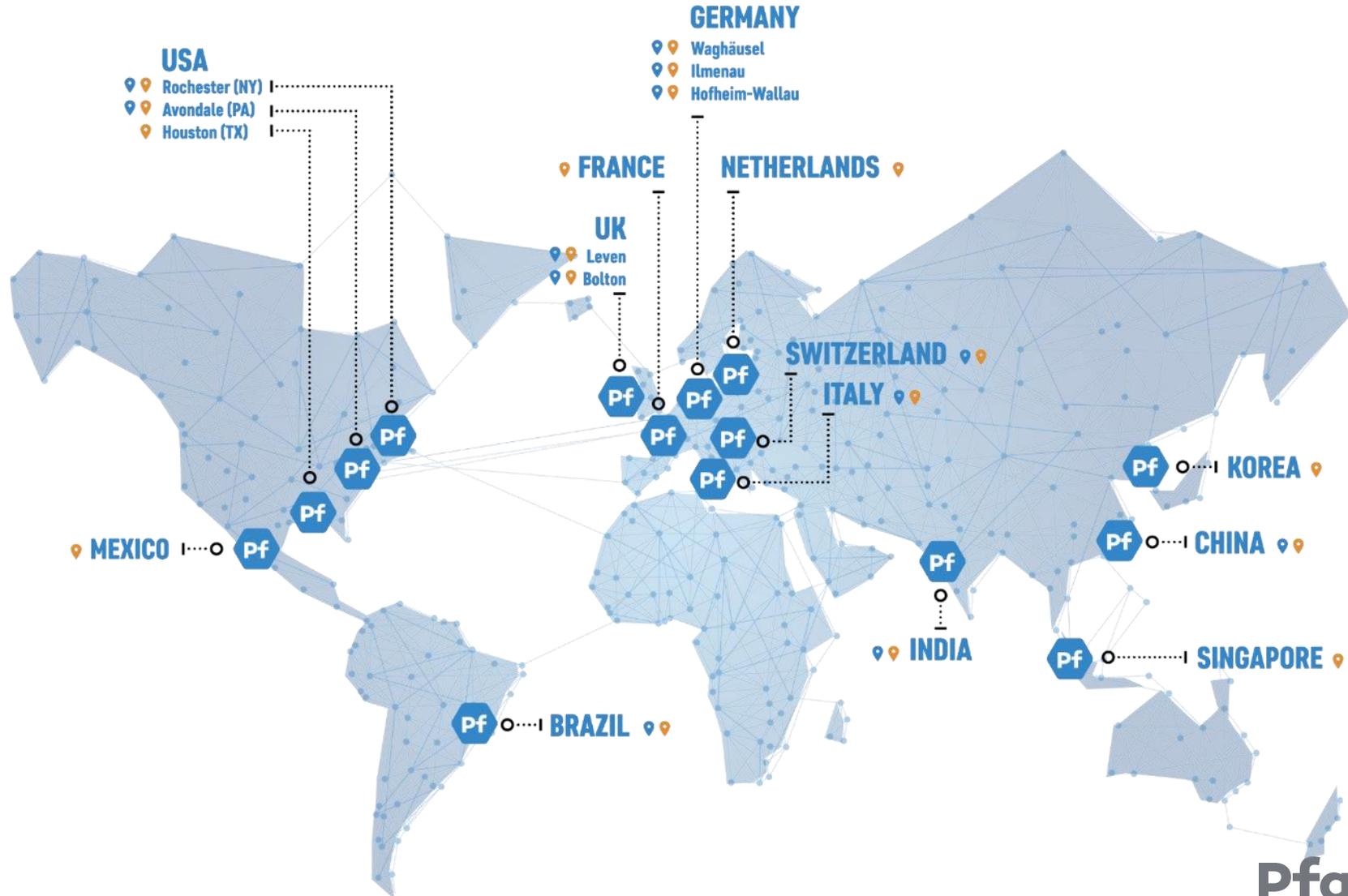


# Pfautler Group WorldWide Presence

Manufacturing Facilities

Sales & Services Organization

One single source of responsibility with access to the Pfautler network worldwide



Thank You

