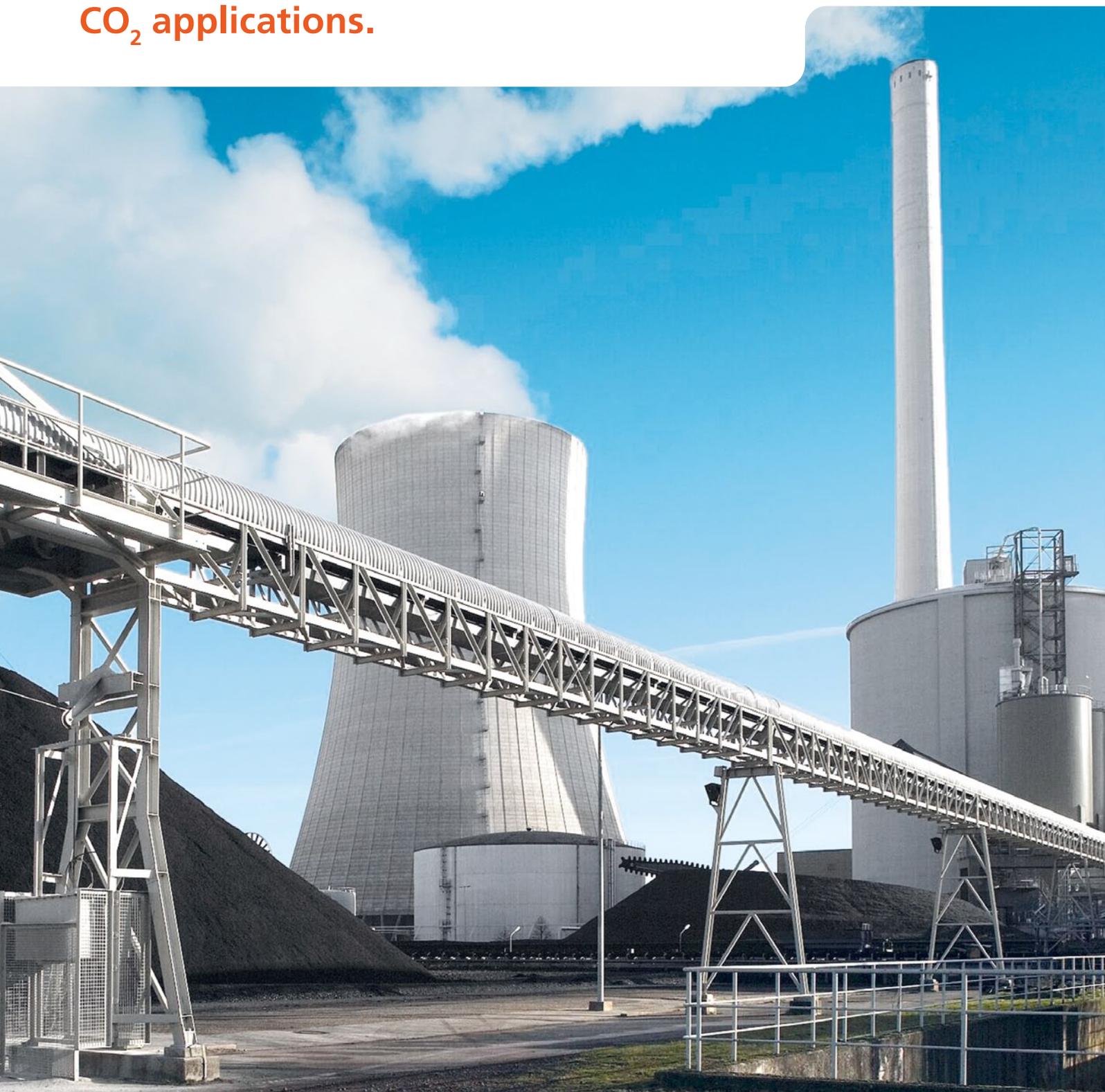


Pumps and valves for **CO₂ applications.**



KSB – your partner for CO₂ applications.

Providing increasingly crucial technologies

If industrial enterprises and energy providers are to achieve their ambitious climate protection goals, they will need to find a way to isolate, transport and safely store or process the CO₂ they produce. The separation and sequestration of CO₂ is known internationally as carbon capture and storage (CCS), and its subsequent use instead of storage is referred to as carbon capture and utilisation (CCU).

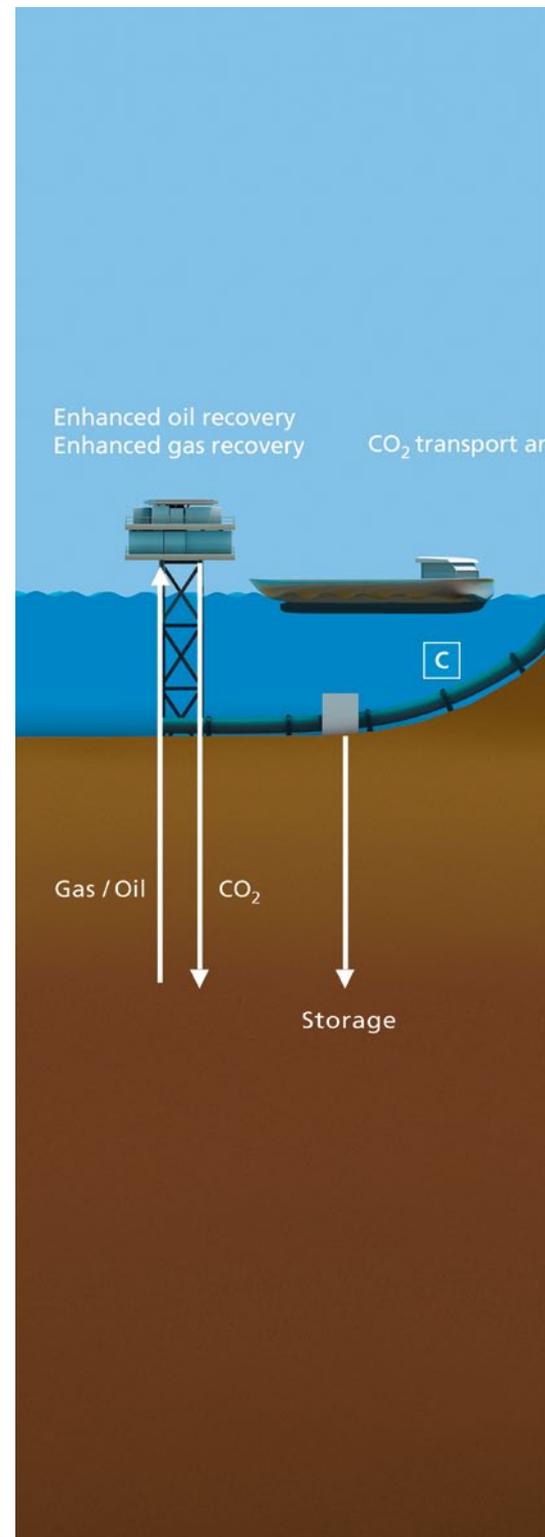
The full course of action is a process chain, the links of which consist of carbon capture, compression, transport and injection for subsequent storage or utilisation.

Perfect products, special consultancy

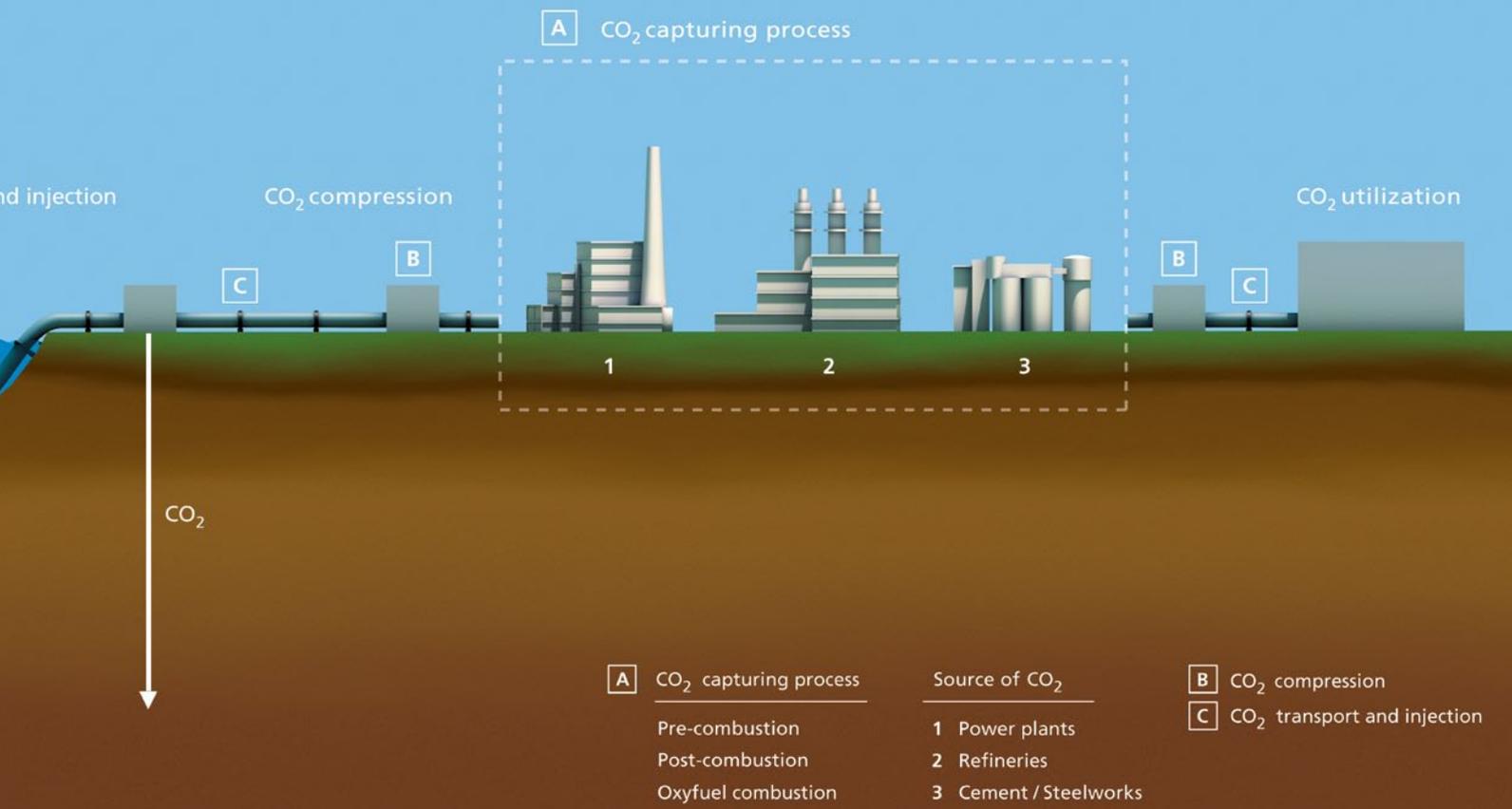
Our long-standing experience makes us your ideal partner for reliably and efficiently finding and implementing individual solutions for all points of the process, for all methods of capture and for all types of plant. As a global market leader for pumps, valves and systems, we also make a perfect partner for all operators, consultants and engineering contractors. With more than 15,000 employees and 160 service centres, we guarantee our customers' success by providing:

- State-of-the-art products characterised by minimal life cycle costs and an excellent eco-balance
- The kind of power plant engineering experience it takes to implement your particular set of requirements

Give us a call – have a talk with the specialists.



KSB solutions for CO₂ processes



**KSB pumps and valves:**

- A Pump for cooling-water circuits (burners)
- B Pump for cooling-water circuits (syngas)
- C Pump for flue gas scrubbing
- D Pump for feed-water and fresh-water applications
- E Pump for black-water treatment

- 1 Shut-off valve
- 2 Check valve

The **post-combustion** method.

The post-combustion process is a method of separating CO₂ out of flue gas from a combustion process. Several different variants are available, and there are physical as well as chemical methods for scrubbing the flue gas.

Readily retrofitted

First, the flue gas is relieved of its ash, sulphur and nitrogen oxides and cooled. Then, it is put through a scrubber (absorber), where a solvent captures the CO₂. The CO₂-laden solvent is then pumped through a desorber, where heat is added to separate the CO₂ from the solvent and make it ready for further treatment.

The solvent can be returned to the process.

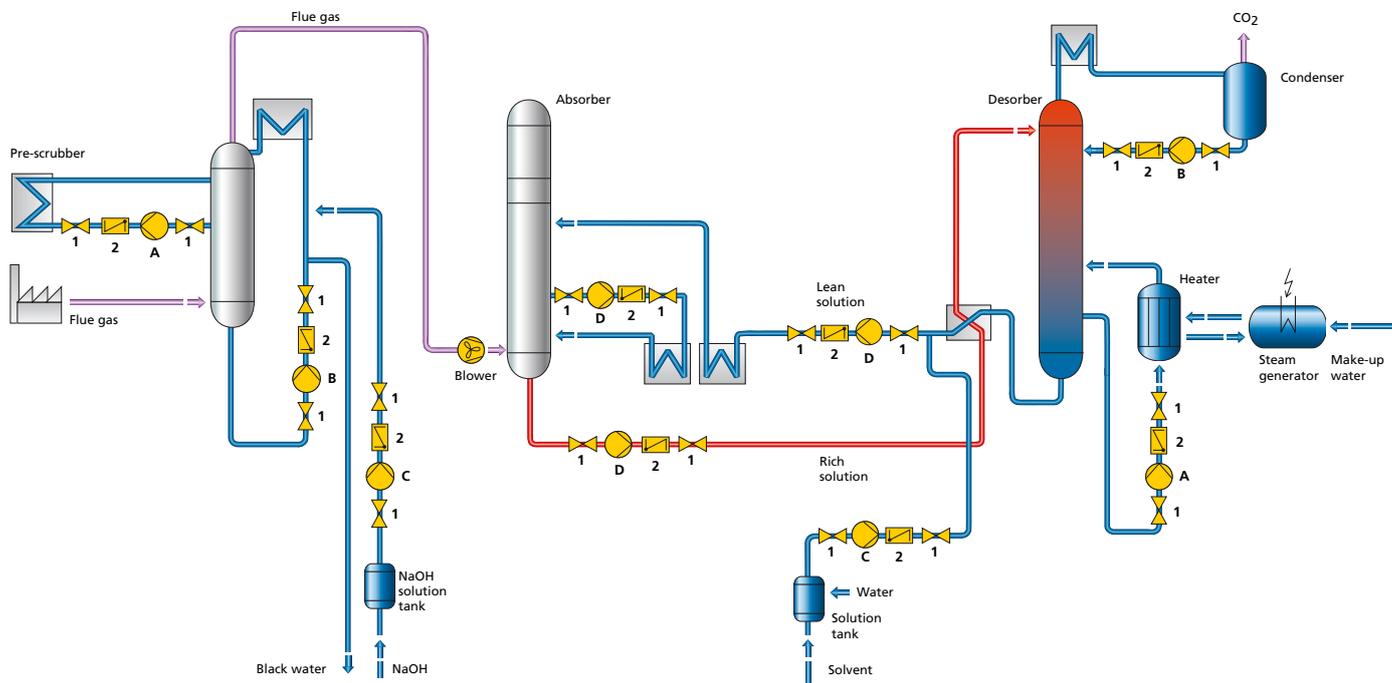


Post-combustion method

Pre-scrubbing

Absorption

Desorption



KSB pumps and valves:

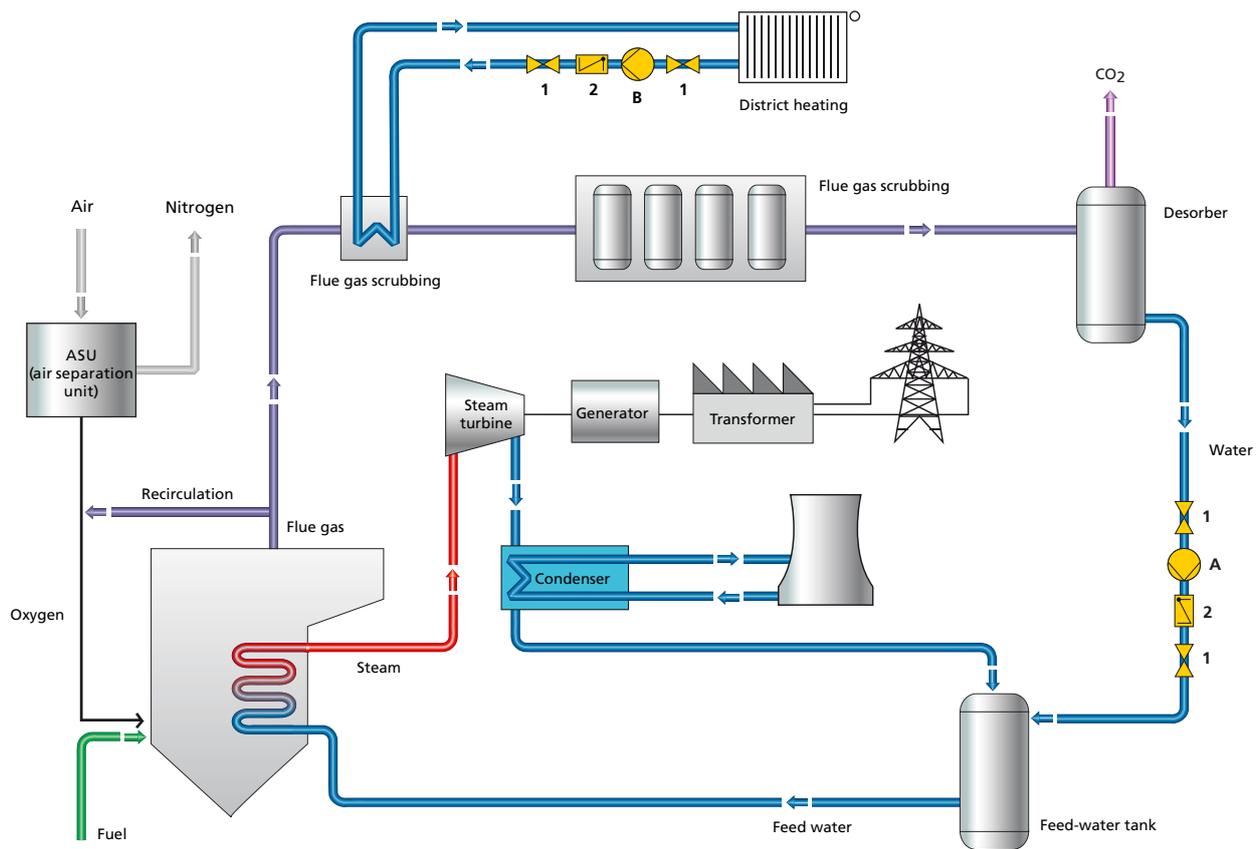
- A Pump for flue gas scrubbing
- B Pump for cooling-water circuits
- C Pump for solvent handling
- D Pump for solution transport

- 1 Shut-off valve
- 2 Check valve

The **oxyfuel combustion** method.

The term oxyfuel derives, of course, from ‘oxygen’ and ‘fuel’. As the name implies, this method of capture relies on the coal being combusted with oxygen instead of the usual air. The first step, then, is to break down the combustion air into oxygen and nitrogen. Fuel burned with oxygen yields a higher concentration of CO_2 in the fuel gas. Downstream, the ash, SO_2 , SO_3 and other impurities are removed from the flue gas, and the gas is cooled to such a low temperature, that its water content condenses, leaving behind very pure CO_2 that can be captured, compressed, transported and either stored or further processed.





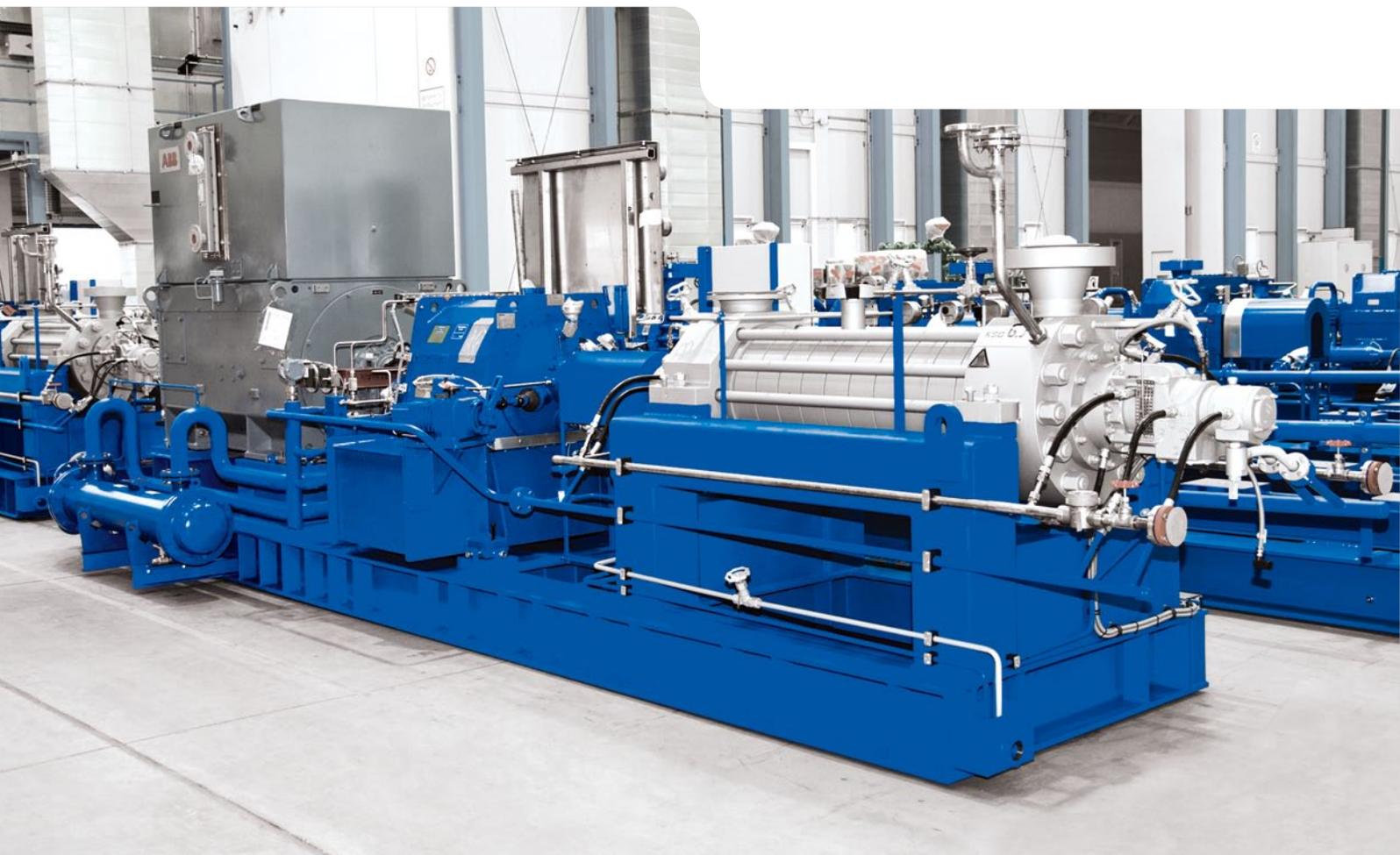
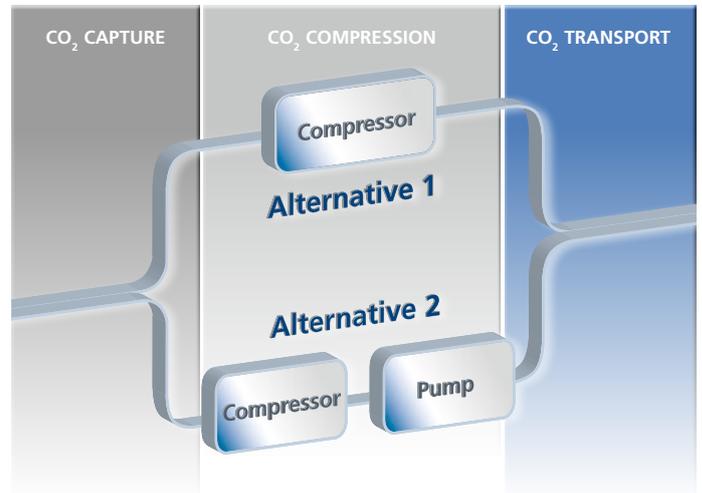
KSB pumps and valves:
 A Pump for cooling-water circuits
 B Pump for district heating

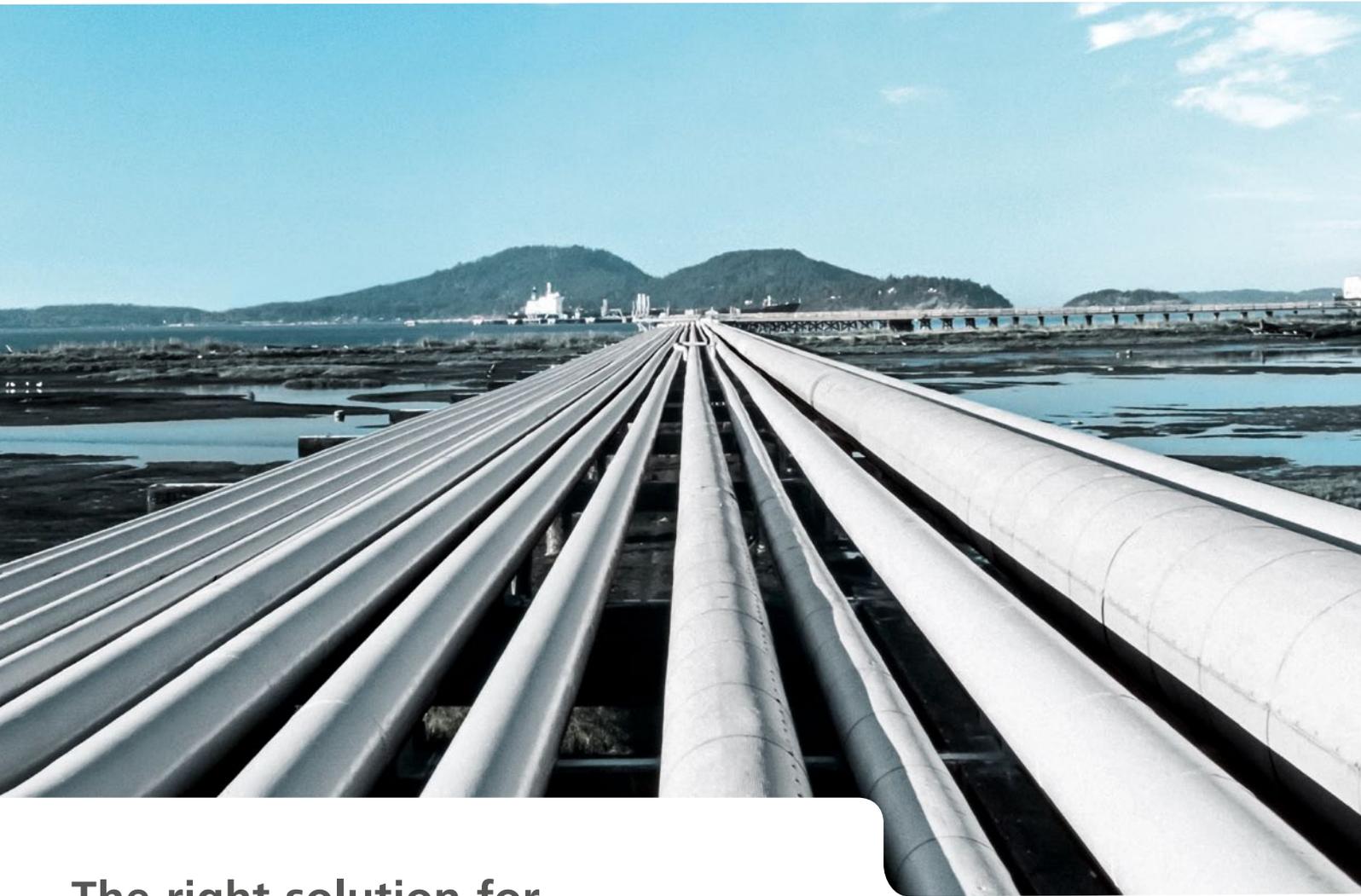
1 Shut-off valve
 2 Check valve

Lower energy costs via pumped compression.

Using a centrifugal pump to compress and convey supercritical fluid CO₂ offers numerous advantages. It enables circumvention of the last compression stages, so that there is less specific compression work and, hence, less energy is required. Since the process takes place at low temperatures, the heat losses are accordingly lower, and the material is not exposed to thermal stress.

The amount of energy needed for compressing CO₂ can be significantly reduced with the aid of a centrifugal pump. The potential savings on energy run as high as 23%.





The right solution for **transport and injection.**

CO₂ can only be moved over long distances by pipeline or ship. In either case, high-pressure pumps designed especially for such applications are needed.

Specially engineered high-pressure pumps are also needed for the underground injection of CO₂. In this process, CO₂ is injected into subterranean rock strata, the idea being to keep the greenhouse gas from escaping to the atmosphere.

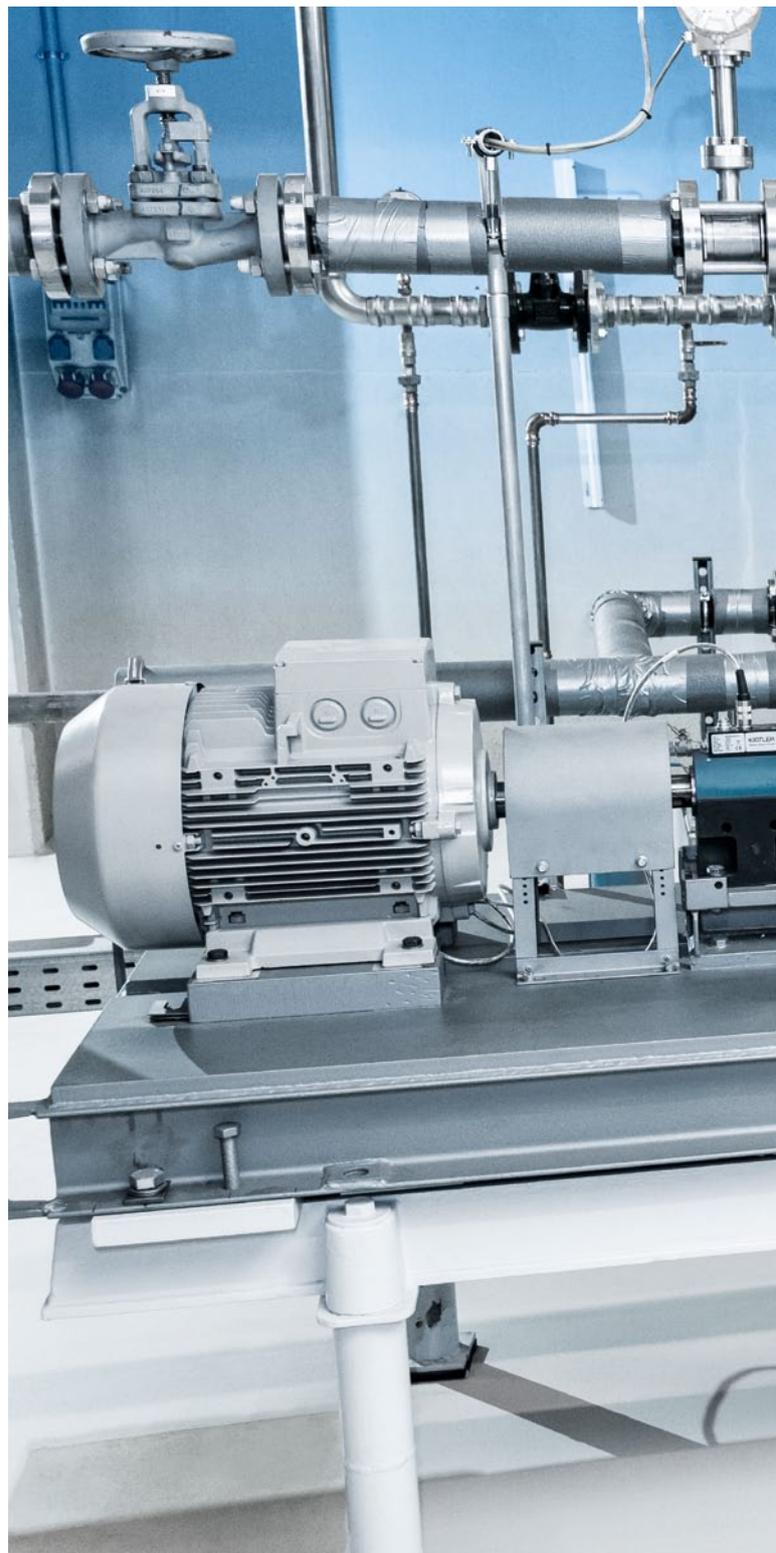
CO₂ can also be injected underground to enable tertiary recovery of crude oil or natural gas, as it increases the pressure prevailing in the oil reservoir and reduces the viscosity of the oil.

Heading toward your ideal solution – step by step: **KSB's CO₂ test facility.**

KSB's CO₂ test facility has produced solutions for a broad array of CO₂ pumping requirements. The facility's closed stainless-steel test loop can simulate any number of different situations with a single-stage centrifugal pump and collect valuable test results in the process.

As a compressible fluid, CO₂ imposes strict criteria on pump systems. The optimal design of such a system requires attention to the course of fluid density between the inlet and outlet of the pump. Such systems also have to be optimally sealed to prevent leakage and resultant ice formation. Double mechanical seals with barrier-fluid pressure control have already been put into successful shakedown operation in the test facility. Other barrier fluids and sealing systems are being tested right now. Also, the test facility's safety concept applies not only to proper sealing but also includes CO₂ detection.

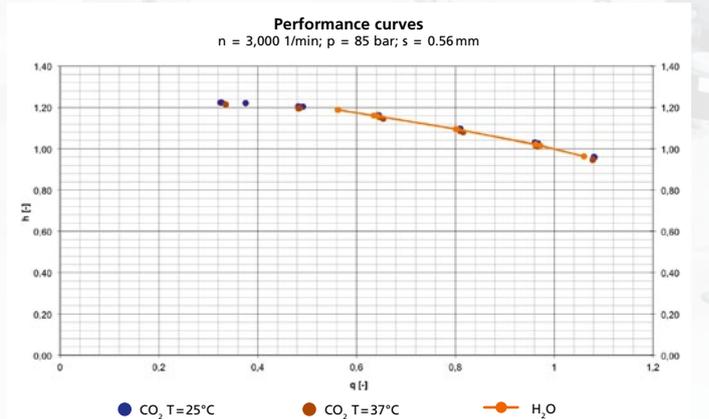
The test facility can be heated and cooled as necessary for measuring and comparing CO₂ in different states and mixtures. Admixtures can be injected, and the system pressure can be increased to 100 bar maximum. Temperatures, pressures, volume flow rates, shaft torques and densities are monitored with sensors and compared with existing data. This approach has given rise to a new technique for the appropriate hydraulic design of pumps.





Test results

- In the supercritical range up to 100 bar and for densities beyond 600 kg/m^3 , the pump maintains a constant output.
- The measured rise in temperature due to compression is in full agreement with the thermodynamic calculations.





Every single product means safety and reliability.

With pumps and valves by KSB, you are ideally equipped for any and all CO₂ applications. Technically mature, high-quality products and, not least, our experts' vast experience guarantee your equipment's smooth operation.

		HG/ HGM	CHTR	Multitec	RDLO/ Omega	KWP	HPK /HPK-L	HPH	
Separation systems	Pre-combustion	Cooling-water circuits (burners)					■	■	
		Cooling-water circuits (syngas)	■	■	■	■	■	■	
		Flue gas scrubbing						■	
		Feed-water and fresh-water applications	■			■			
		Black-water treatment					■		
	Post-combustion	Flue gas scrubbing			■		■		
		Cooling-water circuits				■	■		
		Solvent handling				■			
		Solution transport				■			
	Oxy-fuel	Cooling-water circuits				■			■
District heating					■				
Com- pres- sion/ trans- port	Liquefied-gas transport	■	■						



RPH	Mega CPK	SEZ/SNW/ PNW/PHZ/PNZ	ITUR CTN	ISORIA/ MAMMOUTH	DANAIS 150	PSA KHG	ECOLINE BLT 150-300	SISTO 20 / SISTO KB
■	■			■	■	■	■	■
■	■			■	■	■	■	■
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■					■	■		

Pumps for CO₂ applications.

HGB / HGC® / HGD

Boiler feed pump



DN	40–400
Q [m ³ /h]	max. 2,300
H [m]	max. 5,300
p [bar]	max. 560
T [°C]	max. 210
n [min ⁻¹]	max. 7,000

Data for 50 Hz operation.

Design: Horizontal, radially split, multistage ring-section pump with radial impellers; single or double entry.

Applications: Handling of feed water and condensate in power stations and industrial facilities, generation of pressurised water for bark-peeling machines, descaling equipment, snow guns, etc.

also available in 60 Hz

HGM®

Boiler feed pump



DN	25–100
Q [m ³ /h]	max. 274
H [m]	max. 1,400
p [bar]	max. 140
T [°C]	max. 160
n [min ⁻¹]	max. 3,600

Data for 50 Hz operation.

Design: Horizontal, radially split, product-lubricated, multistage ring-section pump with radial impellers; axial and radial single-entry inlet.

Applications: Handling of feed water in power stations, boiler feed water and condensate in industrial facilities.

also available in 60 Hz

CHTR

High pressure pump BB5 High pressure pump API 610



DN	50–150
Q [m ³ /h]	max. 900
H [m]	max. 2,500
p [bar]	max. 250
T [°C]	max. 400
n [min ⁻¹]	max. 7,000

Data for 50 Hz operation.

Design: Horizontal, high-pressure barrel-type pump with radial impellers; single and double entry; multistage; with flanges / weld-end nozzles to DIN; API 610 and ANSI.

Applications: In refineries, in the petrochemical industry and in steam generation plants.

also available in 60 Hz

Multitec®

High-pressure pump in ring-section design



DN	32–150
Q [m ³ /h]	max. 850
H [m]	max. 630 (1,000)
p [bar]	max. 63 (100)
T [°C]	-10 to 200
n [min ⁻¹]	max. 4,000

Data for 50 Hz operation.

Design: Multistage horizontal or vertical centrifugal pump in ring-section design; long-coupled and close-coupled variant; with axial or radial suction nozzle; cast radial impellers. ATEX-compliant version available.

Applications: Water and drinking-water supply systems; general industry; pressure-boosting systems; irrigation systems; in power stations; heating, filter, firefighting, reverse osmosis and washing plants; snow guns; etc.

also available in 60 Hz

PumpMeter • Hyamaster • PumpDrive

Omega®

Axially split volute casing pump DN 80–350



DN	80–350
Q [m ³ /h]	max. 2,880
H [m]	max. 210
p [bar]	max. 25
T [°C]	max. 80
n [min ⁻¹]	max. 2,900

*Temperatures up to 140°C upon request.

Design: Single-stage, axially split volute casing pump for horizontal or vertical installation; with double entry radial impeller; mating flanges to DIN EN or ASME.

Applications: For handling water with a low solids content, e.g. in waterworks, irrigation and drainage pumping stations, desalination systems for water extraction, power plants, firefighting systems, shipbuilding and district heating/cooling.

also available in 60 Hz

PumpMeter • Hyamaster

RDLO®

Axially split volute casing pump DN 350–700



DN	350–700
Q [m³/h]	max. 10,000
H [m]	max. 240
p [bar]	max. 25
T [°C]	max. 80
n [min⁻¹]	max. 1,500

Data for 50 Hz operation.

Design: Single-stage, axially split volute casing pump for horizontal or vertical installation; with double entry radial impeller; mating flanges to DIN EN or ASME.

Applications: For handling water with a low solids content, e.g. in waterworks, irrigation and drainage pumping stations, desalination systems for water extraction, power plants, firefighting systems, shipbuilding and district heating/cooling.

Hyamaster

also available in 60 Hz

KWP® / KWP®-Bloc

Non-clogging impeller centrifugal pump / close-coupled unit



DN	40–900 (1,000)
Q [m³/h]	max. 15,000 (18,000)
H [m]	max. 100
p [bar]	max. 10
T [°C]	-40 to 120 (max. 280)
n [min⁻¹]	max. 2,900

Data for 50 Hz operation.

Design: Horizontal, radially split volute casing pump in back pull-out or close-coupled design; single stage; single entry; available with various impeller types: non-clogging impeller, open multi-vane impeller or free-flow impeller. ATEX-compliant version available.

Applications: Handling of pretreated sewage, waste water and all types of slurries without stringy substances and pulps up to 5% completely dry.

Hyamaster

also available in 60 Hz

HPK® / HPK-L®

Hot water / thermal oil recirculation pump



DN	25–400
Q [m³/h]	max. 4,150
H [m]	max. 185
p [bar]	max. 40
T [°C] hot water	max. 240
T [°C] thermal oil	max. 400

Data for 50 Hz operation.

Design: Horizontal, radially split volute casing pump in back pull-out design to EN 22 858 / ISO 2858 / ISO 5199; single stage; single entry; with radial impeller. TÜV certification to TRD on option. ATEX-compliant version available.

Applications: Handling of hot water and thermal oil in piping or tank systems, particularly in medium-sized and large hot-water heating systems, forced circulation boilers, district heating systems, etc.

PumpDrive • Hyamaster

also available in 60 Hz

HPH®

Hot-water recirculation pump



DN	40–350
Q [m³/h]	max. 2,350
H [m]	max. 225
p [bar]	max. 110
T [°C]	max. 320

Data for 50 Hz operation.

Design: Horizontal, radially split volute casing pump in back pull-out design; single stage; single entry; with centreline pump feet and radial impeller. TÜV certification to TRD as an option. ATEX-compliant version available.

Applications: Handling of hot-water in high-pressure hot-water generation plants and for use as boiler feed and recirculation pump.

Hyamaster

also available in 60 Hz

RPH®

OH2 process pump to API 610



DN	25–400
Q [m³/h]	max. 4,150
H [m]	max. 270
p [bar]	max. 51
T [°C]	max. 450

Data for 50 Hz operation.

Design: Horizontal, radially split volute casing pump in back pull-out design to API 610 (10th edition) or ISO 13709 (heavy duty); with radial impeller; single stage; single entry; centreline pump feet; with inducer, if required. ATEX-compliant version available.

Applications: Refineries, petrochemical and chemical industry and power stations.

Hyamaster

also available in 60 Hz

MegaCPK

Standardised chemical pump with two bearing bracket variants



DN	25–250
Q [m³/h]	max. 1,160
H [m]	max. 162
p [bar]	max. 25
T [°C]	max. 400

Data for 50 Hz operation.

Design: Horizontal, radially split volute casing pump in back pull-out design to EN 22 858 / ISO 2858 / ISO 5199; single stage; single entry; with radial impeller. Also available as variant with ‘wet’ shaft. ATEX-compliant version available.

Applications: Handling of harsh liquids in the chemical and petro-chemical industries as well as in refineries.

PumpMeter • PumpDrive

also available in 60 Hz

SEZ® / SEZT / PHZ / PNZ

Cooling-water pump



Q [m³/s]	max. 22
H [m]	max. 100
p [bar]	max. 140
T [°C]	max. 40
n [min⁻¹]	max. 980

Data for 50 Hz operation.

Design: Vertical tubular casing pump with open mixed-flow impeller (SEZ), mixed-flow propeller (PHZ) or axial propeller (PNZ). Pump inlet with bell mouth or suction elbow; pull-out design available; discharge nozzle arranged above or below floor; flanges to DIN or ANSI standards available.

Applications: Handling of raw, pure, service and cooling water in industry, water supply systems, power stations and seawater desalination plants.

also available in 60 Hz

SNW / PNW

Cooling-water pump



DN	350–800
Q [m³/h]	max. 9,000
H [m]	max. 50
p [bar]	max. 10
T [°C]	max. 60
n [min⁻¹]	max. 1,500

Data for 50 Hz operation.

Design: Vertical tubular casing pump with mixed-flow impeller (SNW) or axial propeller (PNW), single stage, with maintenance-free Residur shaft bearings; discharge nozzle arranged above or below floor.

Applications: Irrigation and drainage systems, storm-water pumping stations, handling of raw and pure water, water supply systems and handling of cooling water.

also available in 60 Hz

ITUR CTN

Chemical vertical shaft submersible pump



DN	25–250
Q [m³/h]	max. 800
H [m]	max. 93
p [bar]	max. 16
T [°C]	max. 300

Data for 50 Hz operation.

Design: Radially split, vertical-shaft submersible pump with double volute for wet and dry installation, single or double stage, single entry, with radial impeller; model that can be heated available. ATEX-compliant version available.

Applications: Handling of chemically harsh liquids, also those that are slightly contaminated or with a low solids content; in the chemical and petrochemical industry.

also available in 60 Hz

Valves for CO₂ applications.

ISORIA® 10–25



PN [bar]	10–25
DN	40–1,000
T [°C]	-10 to 200

Description: Centred-disc butterfly valve with elastomer liner. With lever, manual gearbox and a pneumatic, electric or hydraulic actuator. Wafer type body (T1), semi-lug type body (T2), full-lug type body (T4) or U-section body with flat faces (T5). Body types T2, T4 and T5 are suitable for downstream dismantling and dead-end service with counter-flange. EN, ASME and JIS connections possible.

Application: Shut-off and control duties in all industrial and energy applications.

A m, e, h, p + AMTROBOX / AMTRONIC / SMARTRONIC

Mammouth



PN [bar]	6/10/16/20/25
DN	1,050–4,000
T [°C]	0 to 65

Design: Centred-disc butterfly valve with elastomer liner. With manual gearbox, electric, hydraulic actuator or counter weight. U-section / double flanged body with flat faces (T5). EN, ASME and JIS connections possible.

Applications: Water supply, water treatment, irrigation, disposal, desalination (reverse osmosis, MSF), industry. Cooling circuits, firefighting systems, shipbuilding, steel industry and power stations (water, thermal and nuclear). Shut-off and control duties in all industrial applications.

A m, e, h, p + AMTROBOX / AMTRONIC / SMARTRONIC

DANAIS® 150



PN [bar]	max. 25 or 150
or Class	150
DN	50–1,200
T [°C]	-50 to 260

Design: Double-offset butterfly valve with elastomer seat ring (also in fire-safe design) or metal seat ring. With lever or gearbox, pneumatic or electric or hydraulic actuator. Body made of cast steel or stainless steel. Wafer type body (T1) or full-lug type body (T4). Body type T4 is suitable for dead-end service and downstream dismantling. EN, ASME and JIS connections.

Applications: Petroleum, gas, chemical and petrochemical industry, nuclear power stations, sugar industry, paper industry, geothermal energy, shipbuilding, low-pressure steam and vacuum service. All applications requiring offset-disc butterfly valves.

A m, e, h, p + AMTROBOX / AMTRONIC / SMARTRONIC

PSA-KHG



PN	16/25/40/63/100/160/250
DN	15–1,200
T [°C]	-60 to 250

Design: Flanges (DIN/ASME), butt weld ends, socket weld or threaded ends, metal-seated primary seal, soft secondary seal, double block and bleed, fully welded design and with lever or gearbox.

Optional: Polyurethane coating, emergency seal, pneumatic or electric actuators and split body (bolted).

Applications: Gases to DVGW Worksheet G260/I and II and combustible liquids, general industry, petrochemical industry and all related industries, power stations, gas lines, gas plants, refineries, pipelines, gas storage facilities and tank farms.

ECOLINE BLT 150–300



Class	150–300
DN	½–8"
H [m]	max. 225
	15–200
T [°C]	-10 to 200

Design: Two-piece body, full bore, floating ball concept, flanged (RF) and elastomer sealing (also in fire-safe variant). With lever or gearbox, pneumatic or electric actuator. Design as per ASME B 16.34.

Applications: General industry, power stations, chemical and petrochemical industry and all associated branches of industry. Paper industry, food industry and pharmaceutical industry.

SISTO-KB / SISTO-20



DN	15–200
T [°C]	-20 to 160
DIN PIN	10, 16

Body material: grey cast iron, nodular cast iron, stainless steel
Lining material: hard rubber, soft rubber, polyamides, PTFE

Design: Diaphragm valve with flanges. Top-quality materials and innovative production processes ensure these valves' high operating reliability and availability. The diaphragm is the only seal element and provides reliable shut-off and sealing to atmosphere while also hermetically sealing all functional parts against the fluid handled.

Applications: General industry and power plants. Suitable for service water, air, oil, technical gases, harsh and abrasive products.

A m, e, p

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