

PUMPING SOLUTIONS FOR CARBON CAPTURE AND STORAGE

MEETING THE UNIQUE DEMANDS OF CO₂
CAPTURE, TRANSPORTATION AND INJECTION

 **CLYDEUNION®**
PUMPS



Celeros Flow Technology are a full lifecycle optimisation partner and advisor to the world's critical flow systems. Through our renowned pumps, valves and pipeline access brands, we manufacture and market products, components, services and technologies that are integral to meeting today's challenges and tomorrow's needs. Celeros FT offer an engineering environment where innovation is fostered, and the real needs of industry are understood, transforming ideas into powerful solutions to help customers meet their goals, overcome business challenges and thrive in a complex, constantly changing marketplace.

YOUR SUSTAINABLE LIFECYCLE PARTNER

The energy sector has a major role to play in the fight against climate change. The transition and improvement of the existing energy infrastructure in parallel to the development of new uses and sources, is crucial in this fight. Celeros FT is committed to paving the way for a more sustainable future by developing products for emerging energy applications, such as carbon capture and storage, new nuclear and renewable energy. Simultaneously, we remain dedicated to supporting our existing customers in their journey to decarbonise their operations.

Celeros FT's full lifecycle solutions are designed to minimise emissions, optimise operational efficiency and deliver sustainable returns. Together, we can create a safer, more resilient and cleaner energy future.

SPECIALISED PUMPING SOLUTIONS

ClydeUnion Pumps is the culmination of a long and eventful engineering legacy. Through the highly respected, ground-breaking core companies from which we originate, we can claim a 140-year history. Today we play an instrumental role in securing the vital energy and water resources that a sustainable society will rely on in the future.

Our engineered-to-order pumping technology is used to carry out all kinds of critical industrial functions. The vast majority of nuclear power plants currently in operation around the world employ our reactor feed pumps.

We are also a valued flow control engineering partner to the oil & gas industry – supporting upstream, downstream, transportation and offshore exploration activities. Other key areas we address include seawater desalination, waste water treatment, mining and steel production.

ClydeUnion Pumps is trusted worldwide for supplying reliable and robust engineering solutions for the most hostile and remote environments, meeting the unique demands of CO₂ capture, transportation and injection.

- 1 CARBON CAPTURE
- 2 CARBON COMPRESSION
- 3 CARBON TRANSPORTATION
- 4 CARBON INJECTION

CARBON CAPTURE AND STORAGE (CCS)

ClydeUnion Pumps recognises Carbon Capture and Storage (CCS) as a pivotal solution in global efforts to reduce greenhouse gas emissions and combat climate change.

THE PROCESS

Power plants burning coal or other fossil fuels are responsible for a significant portion of CO₂ emissions. Carbon capture and storage (CCS) technology offers a way to prevent the release of this gas into the atmosphere.

When fossil fuels are combusted, they generate molecules of CO₂ among other gases. In a carbon

capture system, prior to being released through the smokestack, the gas mixture is subjected to a process where a specific chemical binds solely with CO₂ molecules. This chemical is subsequently heated to release the captured gas, resulting in a pure stream of carbon dioxide.

This purified CO₂ is then compressed and sent through a pipeline to a well, and the chemical agent is recycled for repeated usage. Upon reaching the well, the CO₂ is injected deep underground, where it disperses within porous layers of rock and sand.



CO₂ CAPTURE PROCESSES AND PUMPS

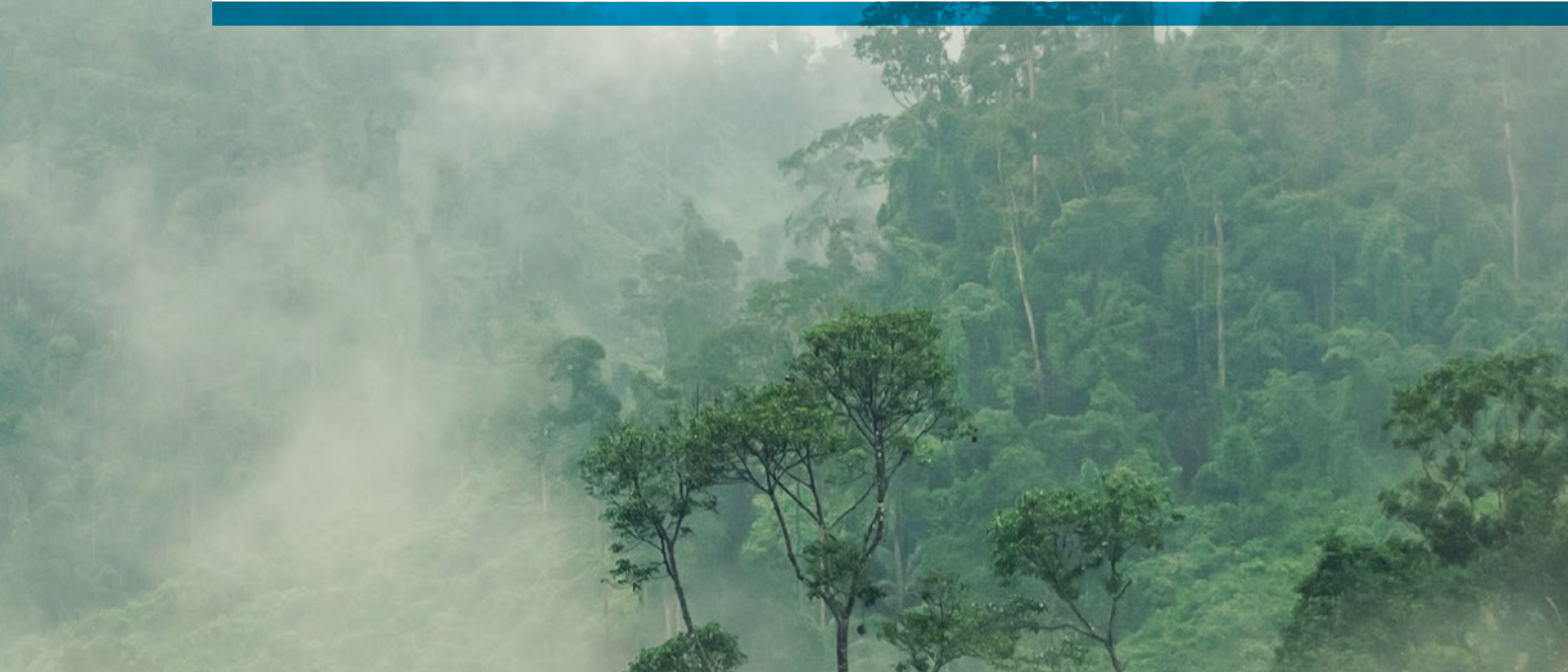
CARBON CAPTURE INVOLVES SEPARATING CARBON DIOXIDE FROM FLUE GASES

Before CO₂ can be moved or stored it must be captured and separated from the burning fossil fuel emissions where it is compressed and stored into a liquid form.

Our high performance range of API 610 centrifugal and API 674 reciprocating pumps provide reliable solutions for solvent, water and auxiliary pump applications in CO₂ capture processes. These comprehensive ranges include overhung, between bearings and vertically suspended centrifugal options and a range of reciprocating models,

offering first class flexibility and integrity.

Where API compliance is not required, our high quality industrial standard ANSI or pump ranges further provide reliable, economic solutions for CO₂ capture processes as they are manufactured in a plant whose Quality Management System was certified as being in conformity with ISO 9001:2015 by certification body. Both ranges offer some of the most comprehensive application coverage available through an extensive array of configurations and hydraulics.



KEY PROCESSES

Post-combustion capture:

For post combustion CO₂ is separated from the emissions produced during a combustion process. In this process pumps must handle lean and rich solvents as well as water, across a range of temperatures. A variety of solvents may be used, such as amines, ammonia, ethers or potassium carbonate.

Pre-combustion capture:

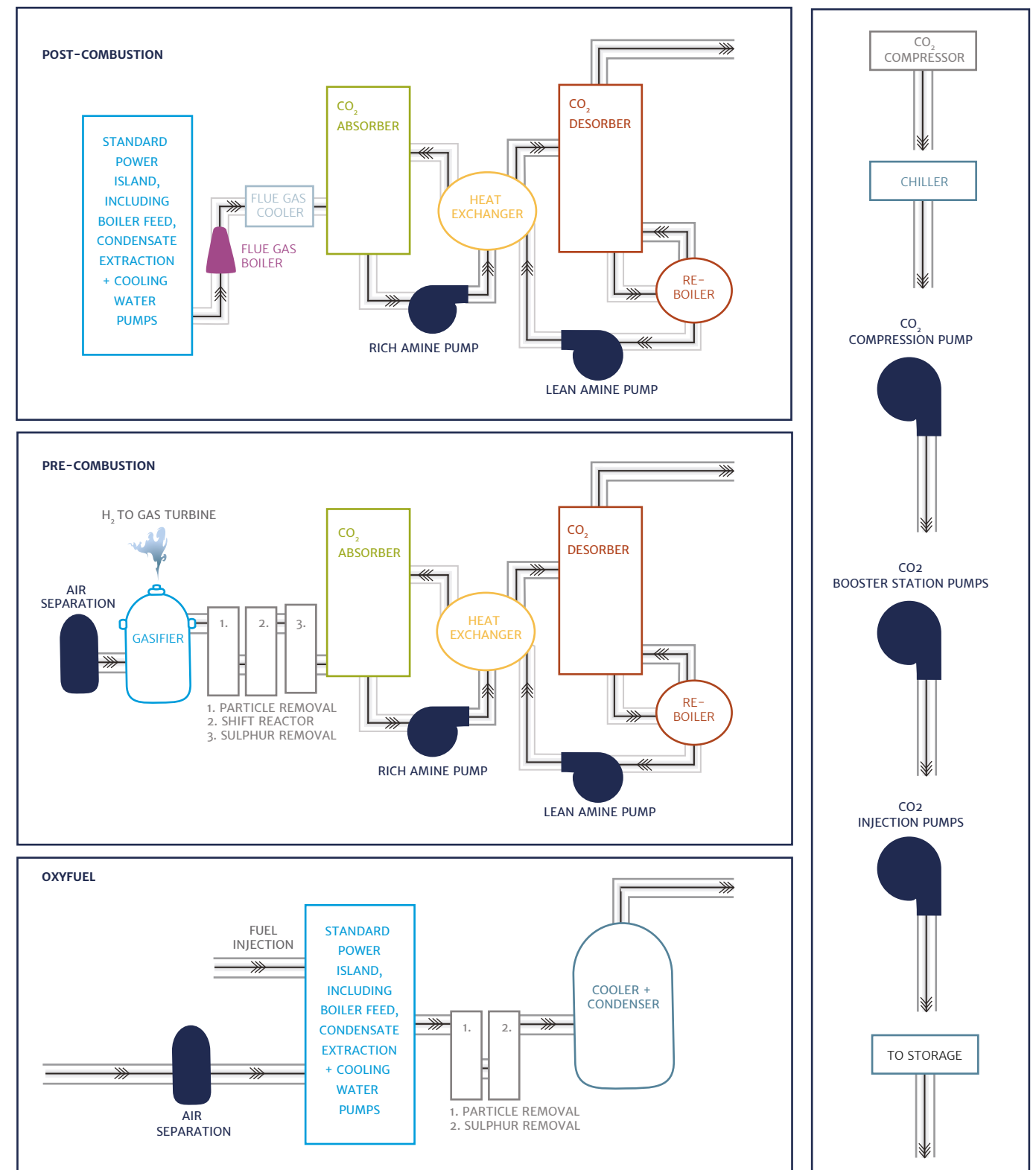
The fuel is converted into a gas mix of hydrogen and CO₂ before it is burnt. Following CO₂ separation, the remaining hydrogen rich mix can serve as a fuel source. For pre-combustion processes, pumps must handle similar fluids across a range of temperatures and pressures.

Oxyfuel combustion capture:

For Oxyfuel combustion the fuel undergoes combustion within an environment primarily composed of pure oxygen, as opposed to ordinary air. This leads to the production of a more concentrated CO₂, facilitating a more cost-effective capturing process.

CARBON CAPTURE PROCESSES

POST-COMBUSTION, PRE-COMBUSTION AND OXYFUEL COMBUSTION PUMPING TECHNOLOGY





PUMPING SOLUTIONS FOR CO2 TRANSPORTATION AND INJECTION

ENSURING THE SAFE AND EFFICIENT TRANSPORTATION OF CO2 CONFIGURATIONS

CO2 transportation often involves long distances and various pipeline configurations.

ClydeUnion Pumps have a range of centrifugal pumps which are engineered to maintain consistent flow rates and pressures, enabling the reliable transportation of CO2 over extended distances.

These pumps are designed with robust construction and advanced hydraulic systems to withstand the challenges of pipeline transportation, ensuring the safe and efficient movement of the captured CO2:

- Robust construction
- Advanced hydraulic systems
- Consistent flow rates
- Consistent pressures

CONTROLLED INJECTION TO SECURE LONG-TERM CO2 STORAGE

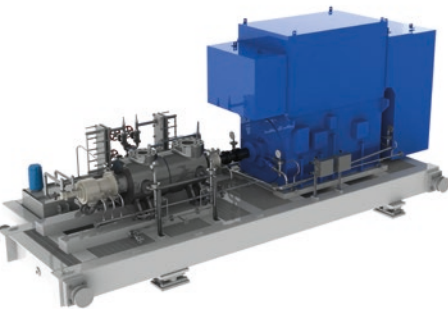
Once the CO2 is transported to its designated location, it is introduced deep underground, where it disperses through porous rock and sand layers.

Our API 610 Standard Centrifugal pumps are engineered to handle the high-pressure requirements of CO2 injection, ensuring precise and controlled delivery into the storage wells.

CCS SELECTION MATRIX						CAPTURE	COMPRESSION	TRANSPORT	INJECTION
CUP DESIGNATION		FLOWS UP TO M3/HR	USGPM	HEADS UP TO M FT					
API 610 STANDARD CENTRIFUGAL						SUITABLE FOR			
Single stage API end suction pump	CUP-OH2	1,700	7,500	350	1,148				
Single stage API vertical in-line pump	CUP-OH3	1,365	6,000	305	1,000				
Single stage API vertical in-line pump	CUP-OH4	1,365	6,000	335	1,100				
Multi-stage API vertical diffuser / turbine single case pump	CUP-VS1	7,000	31,000	600	1,900				
Single stage sump pump	CUP-VS4	450	2,000	160	520				
Multi-stage API vertical diffuser / turbine double case pump	CUP-VS6	7,000	31,000	3,000	9,824				
Single / two stage API axially split between bearings pump	CUP-BB1	15,000	66,000	1,000	3,300				
Single / two stage API radially split between bearings pump	CUP-BB2	3,500	15,410	500	1,650				
Multi-stage API axially split	CUP-BB3	2,750	12,000	3,350	11,000				
Multi-stage API barrel radially split pump	CUP-BB5V	2,800	12,350	4,100	13,600				
INDUSTRIAL STANDARD CENTRIFUGAL						<td></td> <td></td> <td></td>			
Single stage end suction pump	ISOGLIDE	1,000	4,400	200	670				
Single stage large end suction pump	AQUAGLIDE	10,000	44,000	100	330				
Single stage axially split between bearings pump	UNIGLIDE	2,500	11,000	320	1,050				
Single stage axially split between bearings pump	UNIGLIDE-E	4,000	17,600	200	670				
Two stage axially split between bearings pump	DUOGLIDE	2,500	11,000	320	1,050				
Two stage axially split between bearings pump	DUOGLIDE-E	1,350	5,950	275	910				
Single stage vertical in-line pump	VCM	410	1,800	150	500				
API 674 OR INDUSTRIAL STANDARD RECIPROCATING PUMPS						<td></td> <td></td> <td></td>			
Power driven small (single acting plunger) - simplex/duplex/triplex	Small Power	17	75	6,900	23,000				
Power driven medium (single acting plunger) - triplex/quintex	Medium Power	87	385	6,900	23,000				
Power driven large (single acting) - triplex/quintex	Large Power	146	645	6,900	23,000				
Steam driven simplex (direct acting)	Simplex Direct Acting	160	705	6,900	23,000				
Steam driven duplex (direct acting)	Duplex Direct Acting	173	760	6,900	23,000				



CLYDEUNION PUMPS CCS OFFERING



CUP-BB5HP MULTI-STAGE API BARREL RADIALLY SPLIT

Designed for the high pressure, high temperature and high speed service needs of the energy market.

- Minimal downtime
- Highly efficient
- Low vibration
- Easy maintenance
- API 610 and API 682 standards

CAPTURE COMPRESS TRANSPORT INJECT

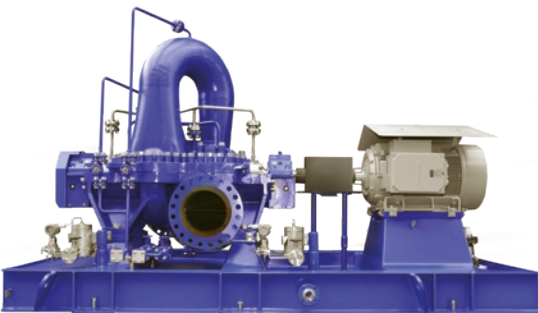


CUP-BB3 MULTI-STAGE API AXIALLY SPLIT

Specifically designed for heavy duty, medium and high pressure applications .

- Engineered for high pressure and high speed service
- Designed to handle any multi stage application
- Double volute construction for opmised bearing and seal life
- API 610 and API 682 standards

CAPTURE COMPRESS TRANSPORT INJECT

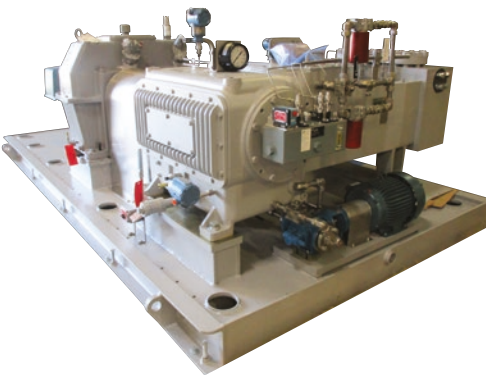


CUP-BB1 SINGLE / TWO STAGE API AXIALLY SPLIT BETWEEN BEARINGS PUMP

Engineered to maximise efficieny provide high reliability, and offer the widest performance flexibility

- Highly efficient
- Easy Installation and Maintenance
- Compact Design
- API 610 and API 682 standards

CAPTURE COMPRESS TRANSPORT INJECT

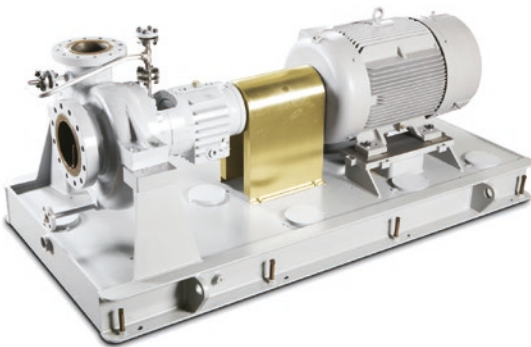


CUP-RECIPROCATING HEAVY DUTY, HORIZONTAL PUMPS

Designed for low maintenance to meet the heavy-duty requirements of continous operation.

- Easy maintenance
- Wide range of pumping applications.
- Meets heavy-duty requirements of continuous operation
- API 674 and ASME standards

CAPTURE COMPRESS



CUP-OH2 SINGLE STAGE API END SUCTION PUMP

Designed for exceptional performance and long life in the most demanding of process conditions.

- Exceptionally high rigidity baseplate design
- Meets stringent API noise and vibration limits
- Long bearing life: minimum 25,000 hour (L10)
- Bearing frame cooling fins provide optimum heat dissipation

CAPTURE COMPRESS



CUP-BB2 HEAVY DUTY, RADIALLY SPLIT, TWO STAGE PUMP

Designed to offer various benefits for industrial applications

- Highly efficient
- Easy maintenance
- Industry leading reliability
- API 610 standards

CAPTURE COMPRESS TRANSPORT INJECT

LIFETIME WORLDWIDE SUPPORT

Every product ClydeUnion Pumps supplies is supported by a full lifetime commitment. ClydeUnion Pumps provides a full aftermarket service, drawing on either its own engineers or fully trained and highly experienced service partners, depending on the location of the installation. ClydeUnion Pumps has service facilities in over 40 countries spread throughout Europe, America, Asia, the Middle East and Africa.

ClydeUnion Pumps after sales support extends across all of its legacy brands as well as new equipment, and provides full backup for obsolete products and for third party equipment. The parts ClydeUnion Pumps supply meet the original specification, or are upgraded where appropriate, and many components can be covered by a Rapid Response option which can have parts on site within 24 hours.

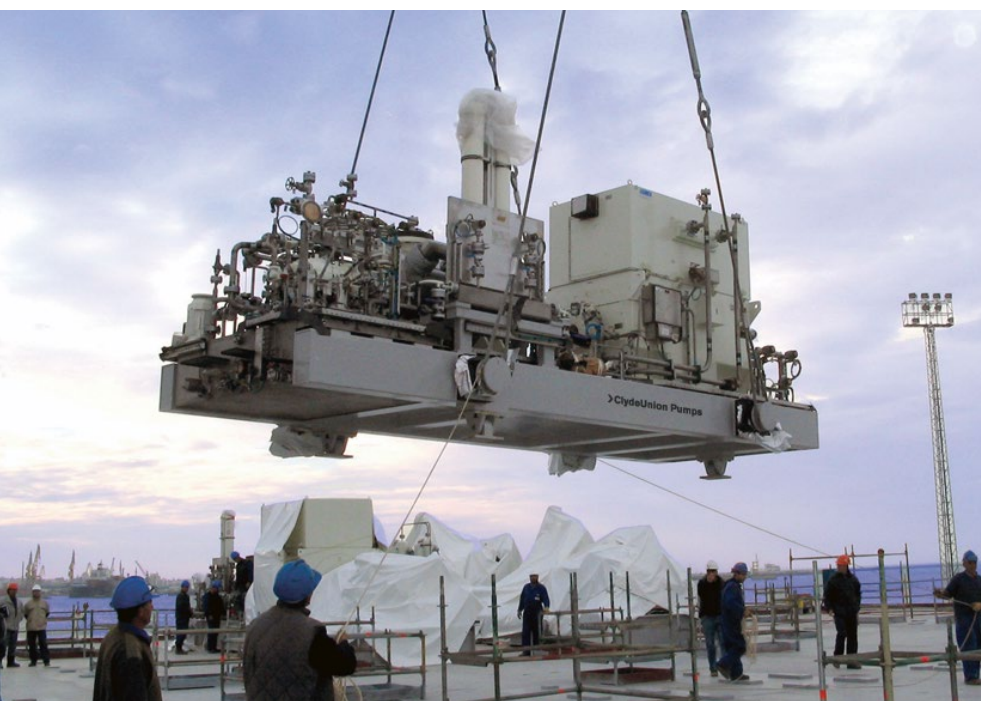
ClydeUnion Pumps after sales support is subject to the same supply chain management as the pump manufacturing. This provides customers with the lowest lead times and costs whilst meeting the highest standards of quality assurance. In addition to spare parts, routine servicing, overhauls and inventory control, the aftermarket support covers upgrades and comprehensive technical advice about the potential refitting of existing installations for greater efficiency and reliability. ClydeUnion Pumps can work with your own engineers to carry out meticulous inspections and advise on maintenance schedules, carry out full vibration analysis, pressure

and pulsation testing, and train your service personnel.

ClydeUnion Pumps history and breadth of experience, as well as its geographical coverage and expertise, make it the natural first choice for any pump related problem or enquiry, no matter what the location, the scale of the task or the original manufacturer.

We guarantee supply of parts for all heritage brands and/or obsolete products, including:

- Weir Pumps
- Clyde Pumps
- Union Pump
- Girdlestone
- Mather & Platt
- Harland
- Drysdale
- WH Allen
- Allen Gwynnes
- David Brown Pumps
- DB Guinard Pumps
- American Pump
- Pumpline



INSTALLATION + COMMISSIONING: TROUBLE FREE COMMISSIONING ANYWHERE IN THE WORLD



PARTS: ANY BRAND, ANY MATERIAL, ANYTIME



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