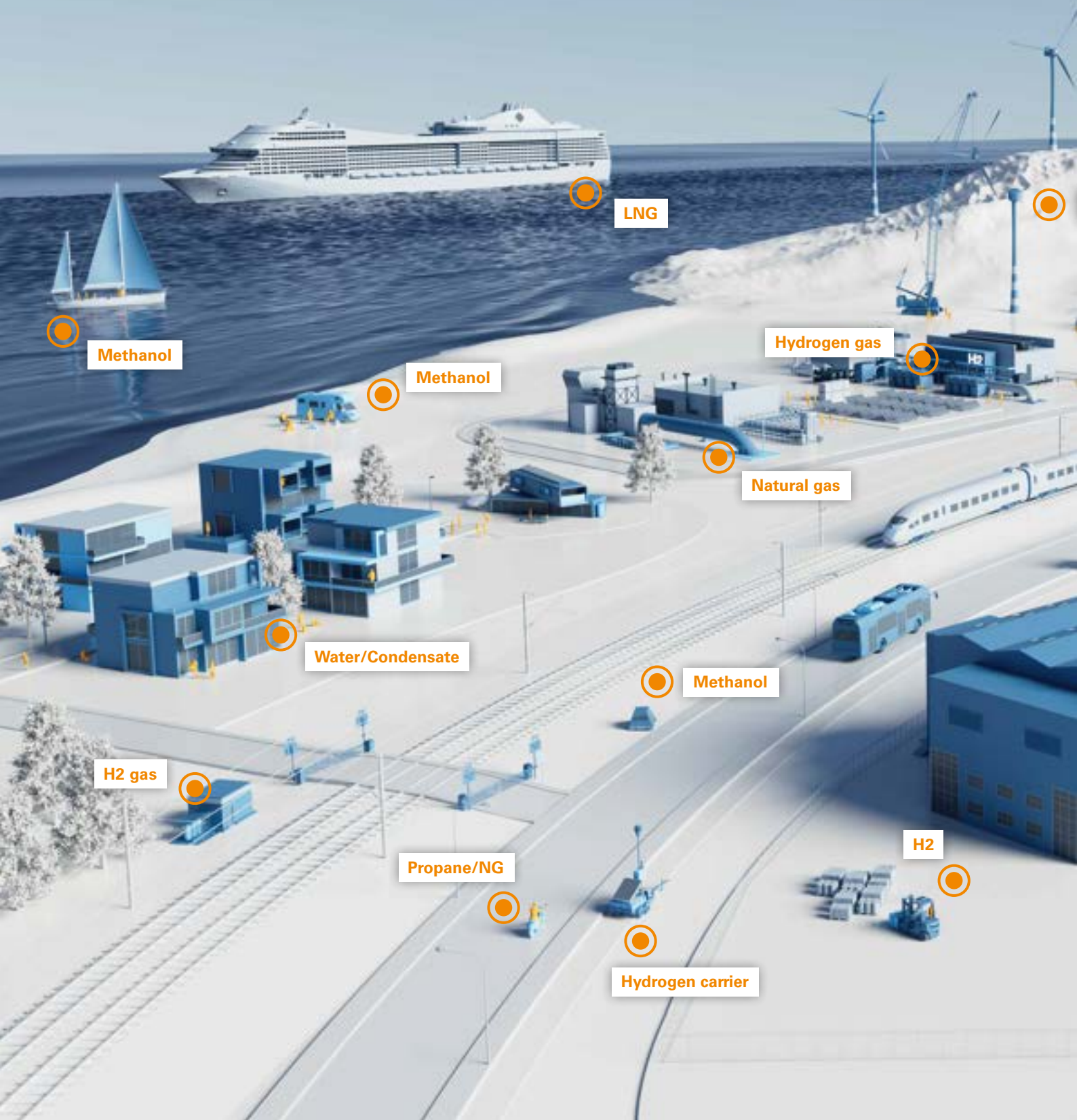




PUMPS FOR HYDROGEN  
TECHNOLOGY  
ENERGY-EFFICIENT.  
SAFE. DURABLE.

# TOMORROW'S ENERGY SYSTEMS. WITH PUMPS BY KNF.





Hydrogen will be an essential component in future energy systems. However, hydrogen and hydrogen carriers can be very demanding media across their entire process chain – from generation to conversion into electrical energy in fuel cells. KNF pumps ensure that everything runs smoothly. Across all areas.



# FULL STEAM AHEAD WITH HYDROGEN AND FUEL CELLS

## **The hydrogen economy is on the rise**

Political stakeholders across the globe are discussing the widespread implementation of a hydrogen economy, while the technology is being developed. When it comes to safety, reliability and efficiency, the requirements for small-scale hydrogen-based energy supplies for end users are very similar to the requirements for large-scale industrial systems. Expectations are high. And sometimes their fulfillment depends on something unexpected – the proper handling of the many liquid and gaseous media involved in the process. Efficient, parametrizable and energy-saving pumps are the key components in many areas.

## **Two decades of co-engineering in hydrogen technology**

For more than 20 years, we have been developing liquid pumps and gas pumps for all areas of hydrogen technology including fuel cells. Our modular pumps are precisely tailored to specific applications in terms of materials and technology. Our forte is co-engineering with our customers, taking our tried-and-tested pump series as the starting point.

Across the world, KNF has been a reliable partner for decades – both in research and industry. Our diaphragm pumps are indispensable components in many hydrogen projects in laboratories and in series production. Our flexible modular system has proved time and again that it can meet new requirements within very short innovation cycles.

## **“Digital Customization” for efficiency**

Like existing fossil fuel-based technology, new technology based on hydrogen depends on maximum efficiency. Our pumps consume very little energy – and they are durable and easy to maintain. In fact, many of our liquid pumps and gas pumps do not require any maintenance at all. When it comes to total cost of ownership, they certainly set a high standard.

In many applications, though, the fact that our pumps are highly parametrizable is what makes them most attractive. More specifically, our brushless DC motors allow us to implement the most favorable operating profiles – down to the smallest detail. We call this unique function of our diaphragm pumps “Digital Customization.”



## Interface

# 1

A single supplier for liquid pumps and gas pumps reduces your interface coordination and sourcing efforts. This can be achieved with KNE.

## Experience

# > 20

years of pump solutions for hydrogen and fuel cell projects for research and industry.



Is hydrogen the coal of the future?  
One thing is for certain:  
H<sub>2</sub> is a very important  
source of energy.

### Our pumps

- operate energy efficiently
- are suitable for hydrogen and hydrogen carriers such as methanol or ammonia
- are gas tight
- are highly configurable
- can be parameterized with individual, custom-fit pump curves
- have a low total cost of ownership



# H2 – PUMPS FOR THE KEY ELEMENT OF THE ENERGY TRANSITION

## Hydrogen is fit for the future

Flexible and widely available, hydrogen is considered to be one of the most promising energy sources for a sustainable future! When used as an energy source, the only emission it produces is water. But whether it is sustainable depends on how H<sub>2</sub> is produced. If it is produced carbon-neutrally, the carbon dioxide emissions decrease. But if it is produced using electric power from fossil fuels such as natural gas, coal or oil, more CO<sub>2</sub> is released into the atmosphere. To distinguish between the different sources of electricity and production methods, hydrogen is categorized into green, blue, turquoise and gray types to illustrate the degree of its climate impact.

## We know hydrogen

KNF has years of experience with hydrogen, regardless of how it is produced. Our market-leading pump technology also meets the high requirements of this particular chemical element. Be it robust materials, high gas tightness, explosion safety or durability. Our pumps can do it.

## Across the entire value chain

Production, storage, distribution, usage – from laboratory scale to large-scale industrial use. Reliable KNF pumps are already helping to make everyday hydrogen use a reality today at many points along the value chain, such as in test stands for the performance qualification of electrolyzers, electrolysis itself and the hydrogen purification process. Wherever hydrogen is generated, stored or used, safety is the top priority.

We are very proud of the fact that our gas sampling pumps are used in thousands of portable and stationary systems for detecting dangerous hydrogen-oxygen mixtures or H<sub>2</sub> leaks every day and that their users have so much confidence in our products.



Reliability is what counts in daily use with hydrogen. KNF makes it possible.



**Hermetically sealed**

**$6 \times 10^{-6}$   
mbar x l/s**

With no dynamic seals whatsoever, our pumps are extremely gas tight as standard. And they can even be optimized on a case-by-case basis using specific basic materials and special connections.

**Custom-fit**

**100%**

The opportunities for adapting our pumps are almost endless – from the specifications and test conditions to packaging and logistics. Starting from a lot size of one.

Not only for green hydrogen – KNF pumps are suitable for any type of hydrogen production.

**Customized H2 pumps from KNF**

- A wide range of liquid pumps and gas pumps to suit specific applications
- A selection of materials compatible with hydrogen
- Ex-proof pumps for transfer, compression and evacuation

# FUEL CELLS – ENERGY FROM HYDROGEN

## Powering ahead

Fuel cells are one way of exploiting the energy in hydrogen. It is converted into electrical energy, providing us with low-emission electricity and heat. There is huge flexibility involved in this process. A fuel cell can convert hydrogen directly or produce it from hydrogen carriers using a reformer. The main advantages of methanol and ammonia as hydrogen carriers relate to logistics and storage. Fuel cells with a reformer can also be operated with natural gas, LNG, biogas and other special gases. This flexibility means that the scope of the fuel cells' portable and stationary applications for energy self-sufficiency is broadened considerably. Whether they are used in a fork lift, building technology or communications engineering, the priority for fuel cells is always the same. They need to be efficient.

## Efficient fuel cells with KNF

The flows of liquid, gas and air determine the functionality of a fuel cell. If they are carefully coordinated, controlled and maximized, the fuel cell will perform more efficiently. KNF pumps are suitable for all media flows. As well as being exceptionally leak-tight, they are designed with the specific properties of fuels in mind. For example, methanol evaporates quickly. But KNF pumps are self-priming so that even fuel cells operated with methanol can be relied upon to start back up after extended downtime. KNF pumps transfer, meter and recirculate as balance-of-plant components with maximum efficiency.

## Liquid pumps and gas pumps from KNF for all types of fuel cells

	Type	Acronym	Electrolyte	Energy carrier	Efficiency	Use
900 – 1000 °C	Solid oxide fuel cell	SOFC	Zirconium dioxide	Hydrogen Natural gas	50 – 60%	CHP/cogeneration
ca. 650 °C	Molten carbonate fuel cell	MCFC	Carbonate mixture	Hydrogen Natural gas	45 – 60%	CHP/cogeneration
170 – 250 °C	Phosphoric acid fuel cell	PAFC	Concentrated phosphoric acid	Hydrogen Natural gas	35 – 45%	CHP
120 – 200 °C	High temperature PEM fuel cell	HT-PEM		Hydrogen	35 – 50%	Small systems Off-Grid
70 – 90 °C	Direct methanol fuel cell	DMFC	Polymer membrane	Methanol	20 – 30 %	Leisure area Small devices
70 – 90 °C	Polymer electrolyte membrane fuel cell	PEM		Hydrogen	40 – 50%	Automotive Small systems
60 – 100 °C	Alkaline fuel cell	AFC	Potash	Ultra-pure hydrogen	ca. 60 %	Military Aerospace





Turn up the heat: KNF pumps are also put to use in cogeneration plants operated by fuel cells, providing a reliable supply of low-emission energy to buildings and leisure facilities.

## Energy-efficient

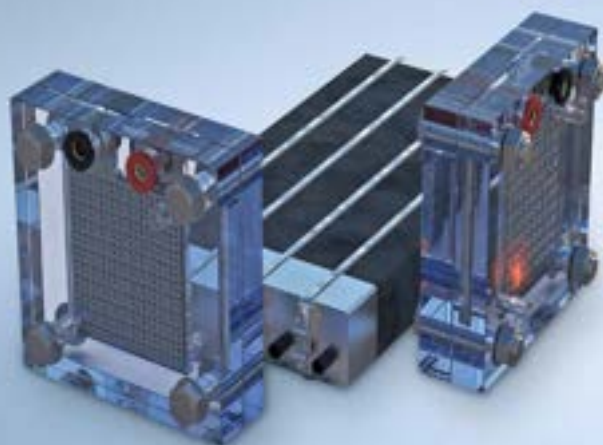
# < 1 %

of the total energy of a fuel cell system, that low can be the power requirement of KNF pumps in order to perform at their best.

## Low maintenance

# <

KNF pumps require little to no maintenance, which keeps the overall operating costs down.



# FLEXIBLE, CUSTOM-FIT, COST-EFFECTIVE – FROM STANDARD TO HIGH-END

Every application is different and some are one of a kind. Our modular system is designed to give you a high degree of flexibility, speed and reliability. You can be sure that every gas and liquid pump supplied by KNF will exactly meet your requirements, no matter how complex or unusual these might be.

### **Series models – the first step to customized pumps**

KNF offers a range of up to 90 series models designed for handling gases and liquids. The specifications of these are described in our data sheets.

### **The KNF modular system for creating customized pumps**

By selecting and combining a variety of options, ranging from the material used to make the pump components that come into contact with the media, to the drive and the mechanical elements such as the connections and wiring, it is easy to tailor every series model to meet application-specific requirements.

The configurations created by the KNF modular system are based on tried and tested individual components, meaning that developing customized pumps is quick and inexpensive.

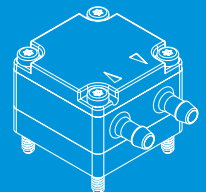
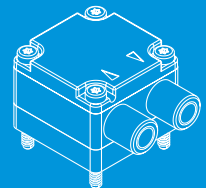
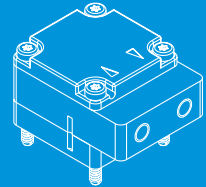
### **Project pumps – precisely designed for the application**

We support your development project by providing you with sample pumps quickly and easily. In consultation with you, our employees from the sales, engineering, and product management divisions determine the modifications to be made to the product's standard technical parameters.

## MATERIAL OPTIONS

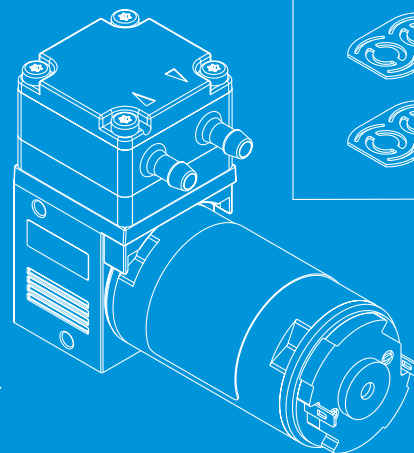
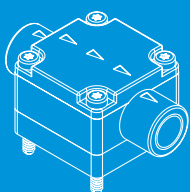
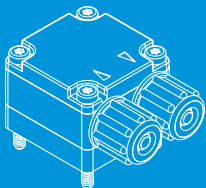
Valve/Diaphragm:  
EPDM, FKM, FFKM,  
HNBR, stainless steel  
and others

Pump head:  
PP, PPS, fluoroplastics,  
stainless steel,  
aluminum and others



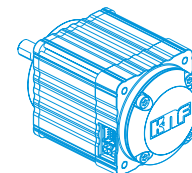
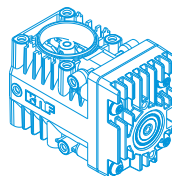
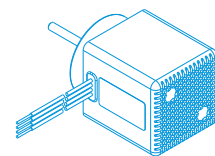
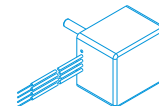
## MECHANICAL OPTIONS

Circuit points and connections

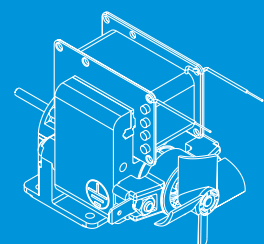
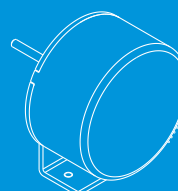
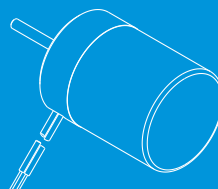


## MOTOR OPTIONS

"DIGITAL CUSTOMIZATION" sets our brushless DC motors apart, allowing for their unique configuration. And we do mean unique. We develop and produce these motors ourselves or as part of an exclusive development partnership with a leading motor manufacturer. These motors map complex operating profiles, including required safety parameters. Your advantage: high energy efficiency, precisely controlled target variables and simple control via digital signals.



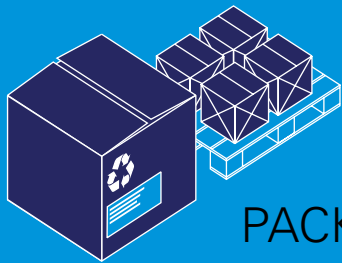
Explosion-proof versions and all common voltage configurations available.  
Motor types: DC, DC-B, AC.





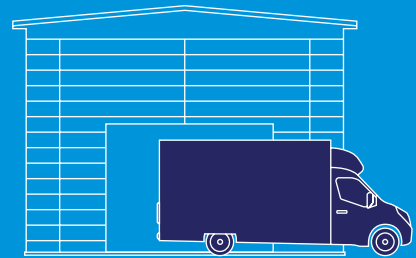
# FLEXIBLE SUPPORT FROM START TO FINISH – YOUR ADDED VALUE IS OUR PRIORITY

WITH KNF, FLEXIBILITY DOESN'T STOP AT THE TECHNICAL SOLUTION. WE FULFILL YOUR INDIVIDUAL REQUESTS EVERY STEP OF THE WAY UNTIL DELIVERY AND SERVICE.



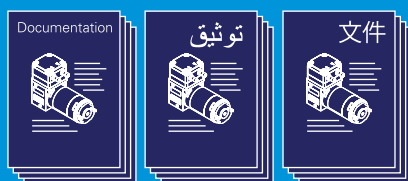
## PACKAGING

We'll be happy to implement any measures that make life easier for your goods receiving department, as well as to support your efforts toward recycling and environmental protection.



## LOGISTICS

We support all types of production lot ordering – including Kanban, VMI, CMI, B2B and others.



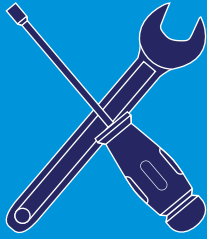
## DOCUMENTATION

Together, we'll define the type, scope and design of the documentation.



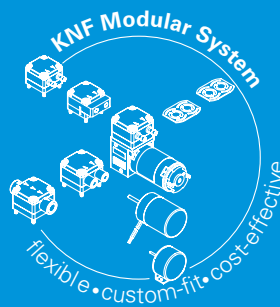
We inspect and test 100% in line with your requests.





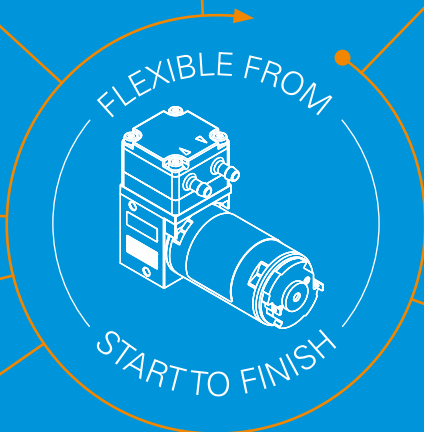
## SERVICE

We implement custom-fit service concepts for you. It is important to us to minimize the overall running costs of our pumps, and we take this into account in the pricing of replacement parts.



~3,000

customized adaptations are carried out at KNF every year for all our customers worldwide – quickly and inexpensively thanks to our modular system. We also develop exclusive pumps and drive concepts for individual customers.



## “ASSEMBLY AND ENGINEERING IN ONE”

We will provide you with the pump as an assembly. This may include completing steps in the production process or installing components such as a valve block, sensors, tubing etc.

≥1



## PRODUCTION

You can rely on the flexibility and quality of our support for every order with KNF, from large lot sizes to a single pump.

FOR HYDROGEN TECHNOLOGY

# KNF LIQUID PUMPS AND GAS PUMPS FOR HYDROGEN AND FUEL CELLS

Thanks to the KNF modular system, each of our series models can be quickly and cost-effectively adapted to suit the specific needs of an application.

## AT A GLANCE: OUR PUMP PERFORMANCE

### LIQUID PUMPS

max. flow rate at atm. pressure (l/min)	max. pressure (bar rel.)	max. suction height (mH <sub>2</sub> O)
12.4	16	7

### GAS PUMPS

max. flow rate at atm. pressure (l/min)	max. pressure (bar rel.)	max. vacuum (mbar abs.)
250	12	0.5

### MICRO GAS PUMPS

max. flow rate at atm. pressure (l/min)	max. pressure (bar rel.)	max. vacuum (mbar abs.)
16	3	40

### SWING PISTON PUMPS

max. flow rate at atm. pressure (l/min)	max. pressure (bar rel.)	max. vacuum (mbar abs.)
24	7	100

### EX-PROOF PUMPS

max. flow rate at atm. pressure (l/min)	max. pressure (bar rel.)	max. vacuum (mbar abs.)
220	9	25







Scan the QR code to find the perfect KNF liquid pump or gas pump for your project in no time.

