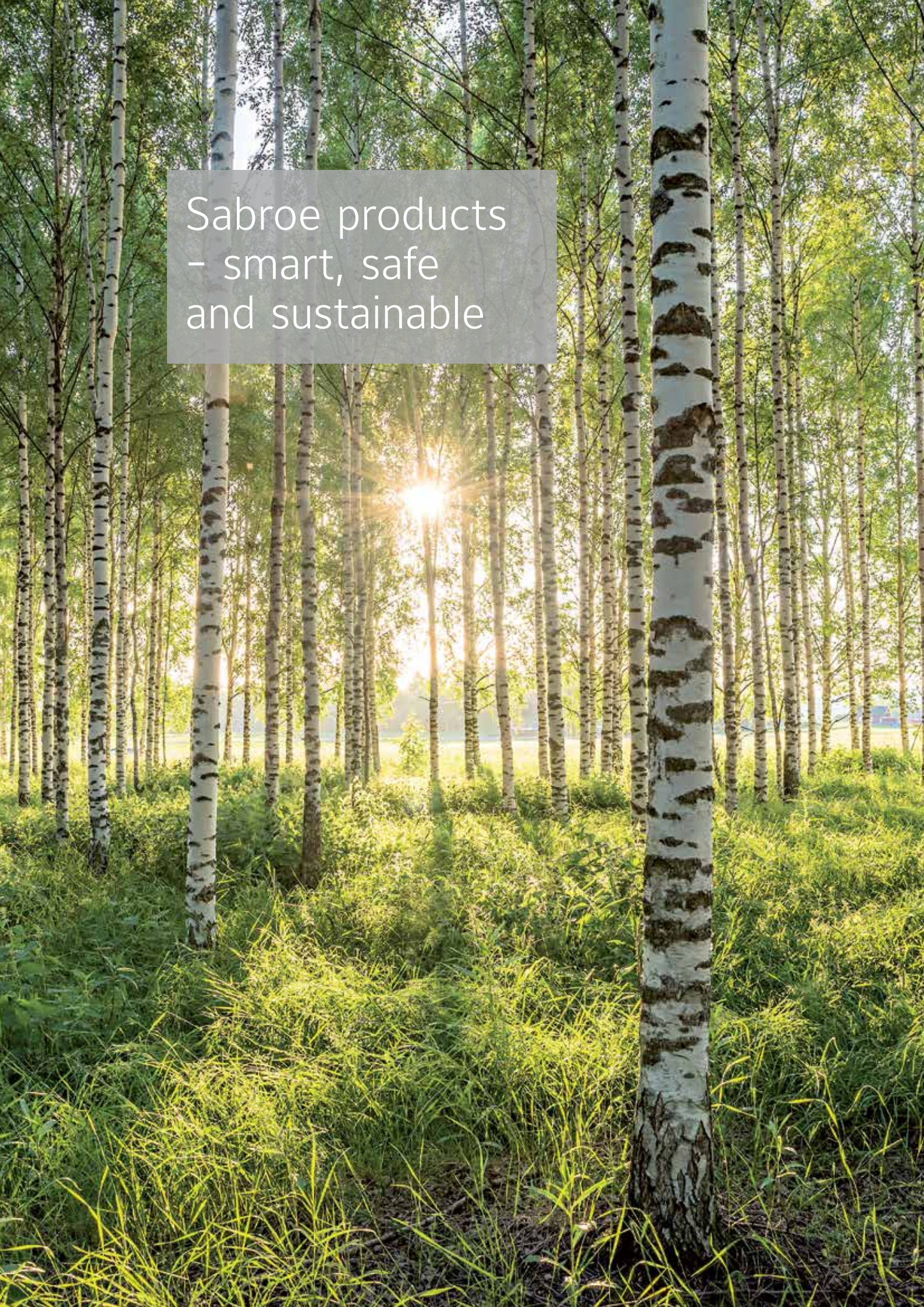
Sabroe Products 2023

Creating customer confidence

The power behind **your mission**

Johnson Controls



Sabroe products – smart, safe and sustainable

Contents

Sabroe – creating customer confidence for a better world

Our customers are our community. We work every day to keep their trust and support their environments so they succeed. Our rigorous engineering and testing enables consistently safe, reliable, and high-performing solutions. When our customers are confident, we are successful.

With a long history of product innovation, we always move forward with a focus on leading our customers to greener, safer, and more profitable solutions. We deliver the "heart" of our customers' processes and we take our role seriously – from the support of the world's healthy food supply to the energy that fuels our world.

We drive positive changes in the industries we serve as the world champions in green cooling and heating solutions, offering supreme flexibility and relentless quality.

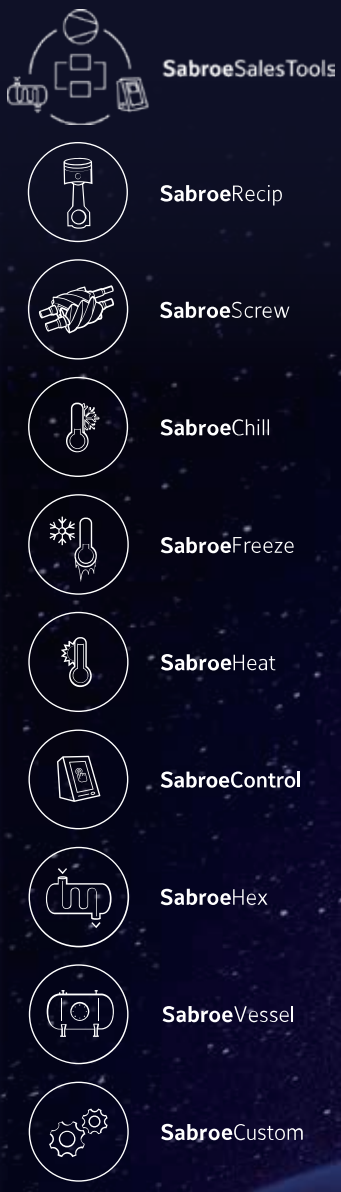
Part of Johnson Controls

The Sabroe product brand is owned by Johnson Controls, a pure play buildings leader serving customers in more than 150 countries.

This means we can provide Sabroe customers with a comprehensive range of products, systems, and services for meeting heating, ventilating, air conditioning, and refrigeration needs in industrial, commercial, and residential buildings of all kinds.

Sabroe is a registered trademark of Johnson Controls in the EU, the United States of America and other countries.

Other trademarks:
ChillPAC, UniSAB.



125 years of new ideas and better technology

We've proved we can repeatedly and consistently meet our customers' needs – regardless of size and complexity.

We listen to where your real difficulties lie and what you really want to achieve. With over 125 years of specialised knowledge and experience, we can be trusted to help you achieve it all.

2023 UniSAB 4
2023 HicaHP
2023 COMP2
2022 ChillPAC Air
2022 Chiller and Heat Pump Plant Control (CHPPC)
2022 Heat exchangers and vessels
2021 Heat pump 273, 63 bar

2020 SAB 193 & 233 40 bar
2019 TSMC, HPC Mk 5
2018 SMC Mk 5
2018 HPC 112-116
2017 DualPAC
2017 NS heat pump 40 bar
2017 Chiller Plant Controller (CPC)
2016 ComPAC
2015 HeatPAC HPX
2015 ChillPAC Mk 3
2013 SABflex
2011 SABlight
2011 iRIS

2010 HeatPAC
2007 UniSAB III
2006 SABcube
2006 CAFP
2005 SABscrew redesign
2004 ChillPAC
2002 Variable-speed drive

1995 Unisab II
1995 PAC
1994 SAB 202
1991 SAB 110

1989 Unisab I
1989 HPO, HPC
1988 Prosab II
1985 µProsab
1985 SAB 163
1982 SAB 128

1967 First heat pump
1965 CMO

1955 SMC

1929 SA

1897 First CO_2 compressor
1897 Introduction of natural refrigerants
1897 Sabroe founded

Sustainability is at the heart of our business and fundamental to everything that we do

UN Sustainable Development Goals

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries – developed and developing – in a global partnership.

Johnson Controls supports the goals adopted by the United Nations to end poverty, protect the planet and ensure prosperity for all. We promote sustainability through the way we do business, the solutions we provide and our engagement in society.

Accelerating our mission for a healthy, sustainable planet

As the global leader for smart, healthy and sustainable infrastructures, Johnson Controls has set new ambitious environmental, social and governance (ESG) commitments, science-based targets as well as a net zero carbon pledge. From the way we run our manufacturing plants to the work we do with our customers, we are constantly looking for new and innovative ways to ensure a more sustainable future for our planet.

Double
customers' annual avoided emissions by 2030 through Johnson Controls OpenBlue digitally-enabled products and services

Link executive **compensation** to sustainability and diversity goals to drive leadership accountability

Since **2002**
history of transparency sustainability data publicly reported

Direct **75%**
R&D investment
on new product development to sustainable solutions

Double
the representation of **women leaders** globally and minority leaders in the United States within 5 years

Achieve **net zero** CO_2
carbon emissions before 2040

Maintain a Board
diverse in gender, ethnicity, citizenship and skills

Sustainability oversight
elevated to Board of Directors (Governance & Sustainability Committee)

Use **100%**
renewable energy by 2040

Set 2030
science-based targets
consistent with the most ambitious 1.5°C IPCC scenario

Launch an initiative focused on underserved markets and increase spend with **women and minority owned businesses**

Elevate sustainability
as a key performance metric for preferred suppliers and create supplier sustainability council; provide training to help suppliers cut their emissions

launch initiative **to educate**
next generation of diverse sustainable building industry leaders; partnering with HBCUs

Non-Financial reporting align with recommendations of the task Force for Climate-related Financial Disclosures (TCFD)

Image: Dennis Borup Jakobsen

Achieve your green commitments with Sabroe solutions

Sabroe refrigeration and heating systems - such as chillers, heat pumps and other customised products - put companies in a better position to achieve their green commitments to the coming generations.

With Sabroe systems using natural refrigerants like ammonia and carbon dioxide, our industrial cooling and heating customers will obtain energy savings with the most energy-efficient products designed for virtually all types of industrial applications and projects.

Applied technology, shared benefits

We can supply the technology to help you make amazing things happen – good for the climate, good for business. Opting for heating or cooling solutions supplied by Sabroe means you and your company are part of the push to tackle climate change in all the many ways laid down in the SDGs.

Get in touch with our experts if you'd like help to roll back the environmental impacts of your heating or cooling setups.

The power of example

A few examples of groundbreaking low-impact heating/cooling solutions based on Sabroe technology and know-how:

- The new Sabroe HicaHP heat pump family features an industry-first, high-capacity screw compressor, delivering up to 95°C in high-pressure heat pump applications. This technology enables several sectors and industries to move away from fossil fuels towards electrification and renewable energy.
- Sabroe DualPAC and HeatPAC heat pumps reclaim waste heat, extract valuable thermal energy, and roll back CO_2 emissions by combining compressor and heat-exchanger technologies with patented Sabroe evaporator and condenser designs.
- Sabroe ChillPAC refrigeration plants deliver 1,400 kW of cooling effect using only 55 kg of ammonia refrigerant. This is a significantly lower charge than any other chiller in the market.

Nothing ends up in landfill

The Sabroe Factory has achieved Johnson Controls "Zero Landfill" status.

The Johnson Controls Total Waste Management Program ensures the waste streams from all our activities are treated, reduced, and/or recycled – so nothing ends up in landfills.
We want to prevent leaving behind problems for the generations to come.

Sabroe products – engineered to perfection

The equipment you need – now and in the future

We provide the equipment you need to put thermal transfers to work in industrial and commercial installations – from a full spectrum of refrigeration compressors of all kinds to industrial chillers and heat pumps.

Sabroe systems are designed to be versatile and future compatible, making it easy for you to repurpose, retrofit, expand, and upgrade your installations and your thermal management capabilities whenever the need arises.

Documented capabilities and performance

When you sign up for Sabroe solutions and equipment, we make sure you know exactly what you're getting. You don't just get average performance figures – you get exact, documented capabilities for your particular setup, as tested at the state-of-the-art Sabroe test centre in Denmark, prior to delivery.

Full satisfaction – no surprises

We're committed to full transparency and to helping our customers as much as possible. That's why we use the same data and documentation in all subsequent Sabroe calculations concerning your setup.

We document everything and share the results with you and your staff so there are no unwelcome surprises. That means you can put our specialist know-how to the best possible use.

Knowledge steers you away from risk

Reap the full potential of your equipment purchases

In the world of industrial refrigeration, the equipment you buy – whether standardised or individually customised – is just part of the overall picture.

You only reap the full potential of your equipment purchases when they are effectively integrated into your existing setup and when all the operating parameters are fine-tuned to ensure maximum cost-effectiveness.

Prevention is better than cure

With more than a century of heavyweight practical experience in everything even remotely related to industrial refrigeration compressors, Sabroe experts know pretty much all the on-site pitfalls, glitches, and bottlenecks likely to occur.

This means that when you specify Sabroe equipment, you get more than you'd normally expect.

Our unique combination of market-leader expertise and first-mover technology capabilities means that we know how to help prevent difficulties and downtime rather than spending time and money dealing with them once they've cropped up.

Sabroe Sales Tools – for easy product planning

Your optimum choice for selecting and configuring the best Sabroe products for both industrial cooling and industrial heating

As the market leader within both industrial cooling and industrial heating, Sabroe has a long history of enabling product configuration through our sales tools. For more than 40 years, COMP1 has been an industry-leading tool. Now, with the coming launch of COMP2, we are ready to meet the market demands of the future.

Sabroe sales tools for easy Sabroe product planning

With Sabroe sales tools, the well-known COMP1 and, especially, our newly developed COMP2, we are incorporating our 125 years of expert knowledge and experience within industrial refrigeration into a new platform.

A platform that lets you, as a client or contractor, easily configure the Sabroe products to fit your needs and demands for either heating or cooling, while relying on the software to provide the needed expert knowledge.

COMP1 and COMP2, as well as the supporting portfolio, cover everything from new product sales to service interval estimations and calculation of the total cost of ownership. It is an extensive portfolio of sales and selection tools dedicated to the onfiguration and performance evaluation of Sabroe products.

All the tools are continuously updated and part of a feedback loop from our R&D, our end-of-line testing and input from the market. This ensures transparency and ease of use for optimal calculations that enable sustainable long-term solutions for the customer.

The necessary link for a successful configuration of Sabroe products

The Sabroe suite of sales tools creates a link between customer expectations of heating and cooling capacities and the Sabroe product line. The tools provide a complete overview of the portfolio and enable easy and accurate calculations and configuration.

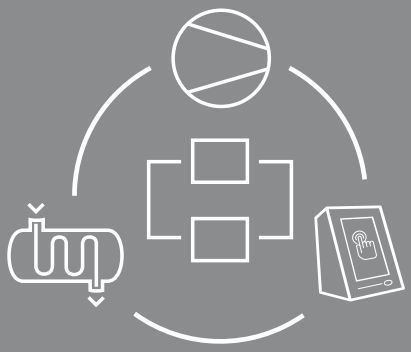
What to expect

We are constantly adapting and developing our suites and products to meet the market demands of today. Over the next couple of years, our focus will be on transitioning all data to COMP2 to make it the single point of entry for configuration and performance evaluation of all Sabroe products.

The idea behind COMP2

Focus on guided product selection

- Less need for expert product knowledge
- Less need for expert sales tool knowledge
- Trustworthy calculations aligned with real-world performance



Focus on customer demands

- Product configurations are based on customer demands
- Possible to address specific needs through product configurations
- Evaluates multiple product configurations simultaneously

Benefits leveraging the Sabroe sales tools suite

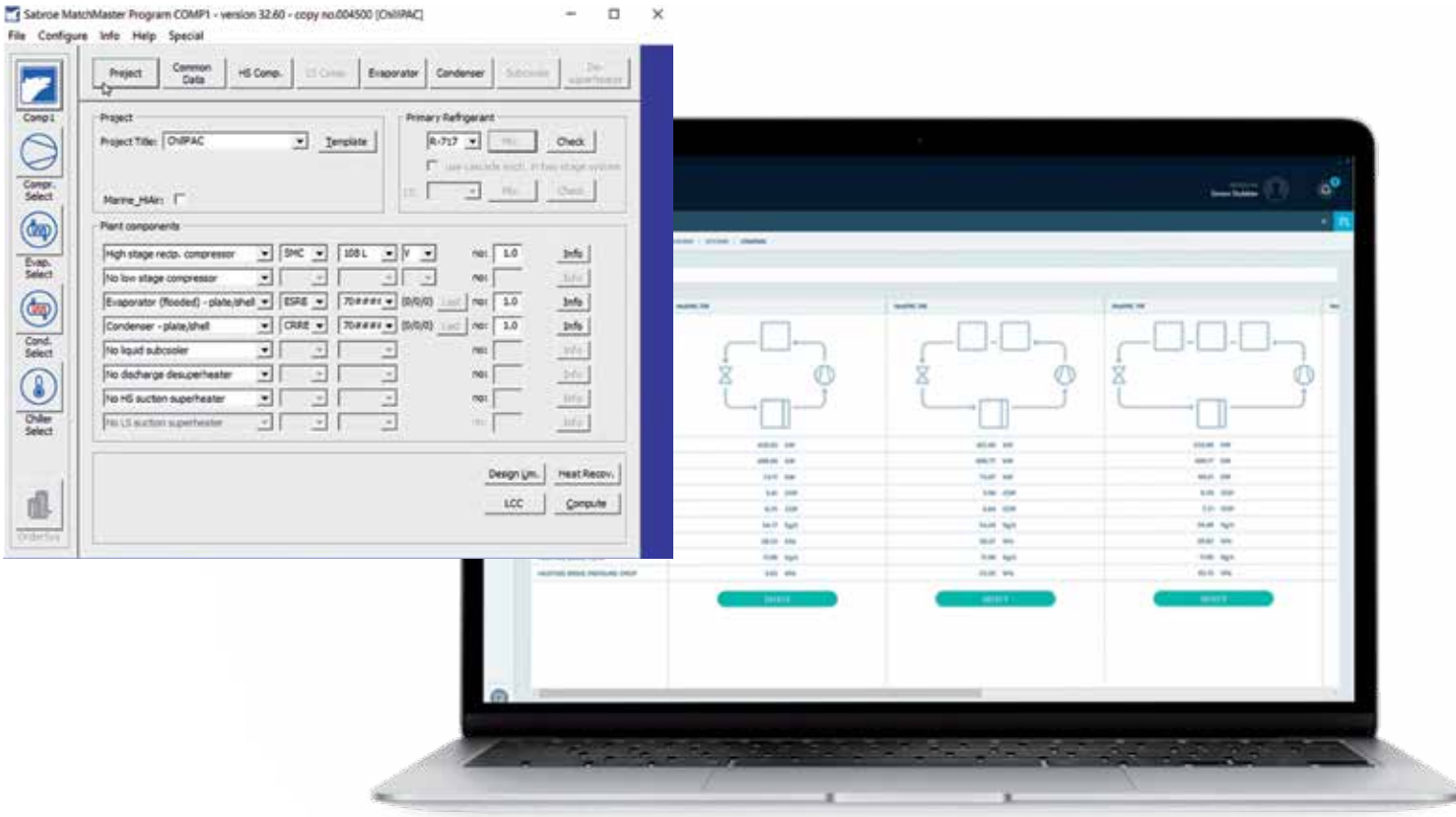
- Total overview of the Sabroe product line
- Easy to match your heating and cooling demands with the capacities of Sabroe products
- Reduction in calculation time per quotation
- Potential for more quotations in less time
- Ability to provide multiple solutions for the same demand

COMP1 – still going strong

COMP1 continues to be a key pillar when configuring Sabroe products for the industrial cooling and heating markets. The main focus in COMP1 is performance evaluation of predefined products. To ensure support for our legacy products and a smooth transition to the new platform, COMP1 will remain available for the coming years.

COMP2 – the next generation sales tool

As the demands for a sustainable future increase, with minimised costs and reliable uptime, so do the needs for efficient solutions for specific applications with low total cost of ownership. COMP2 is designed to help our clients face this challenge with a guided product selection tool based on customer demands with less need for expert product knowledge.



Compressors

Screw or reciprocating compressor?

There is no simple answer to this constantly recurring question. Both technologies are viable alternatives for use in almost all installations, and both types are normally capable of doing the job.

Our sole aim is to make sure you get the best out of your particular setup and the best profit margins from your operations.

And to do that we can supply state-of-the-art compressors of both types, covering the full scope of normal capacities.

Variable-speed drive – only using what's needed

The vast majority of Sabroe compressor models (both reciprocating and screw types) are available with variable-speed drives (VSD) to provide stepless control of your compressor capacity.

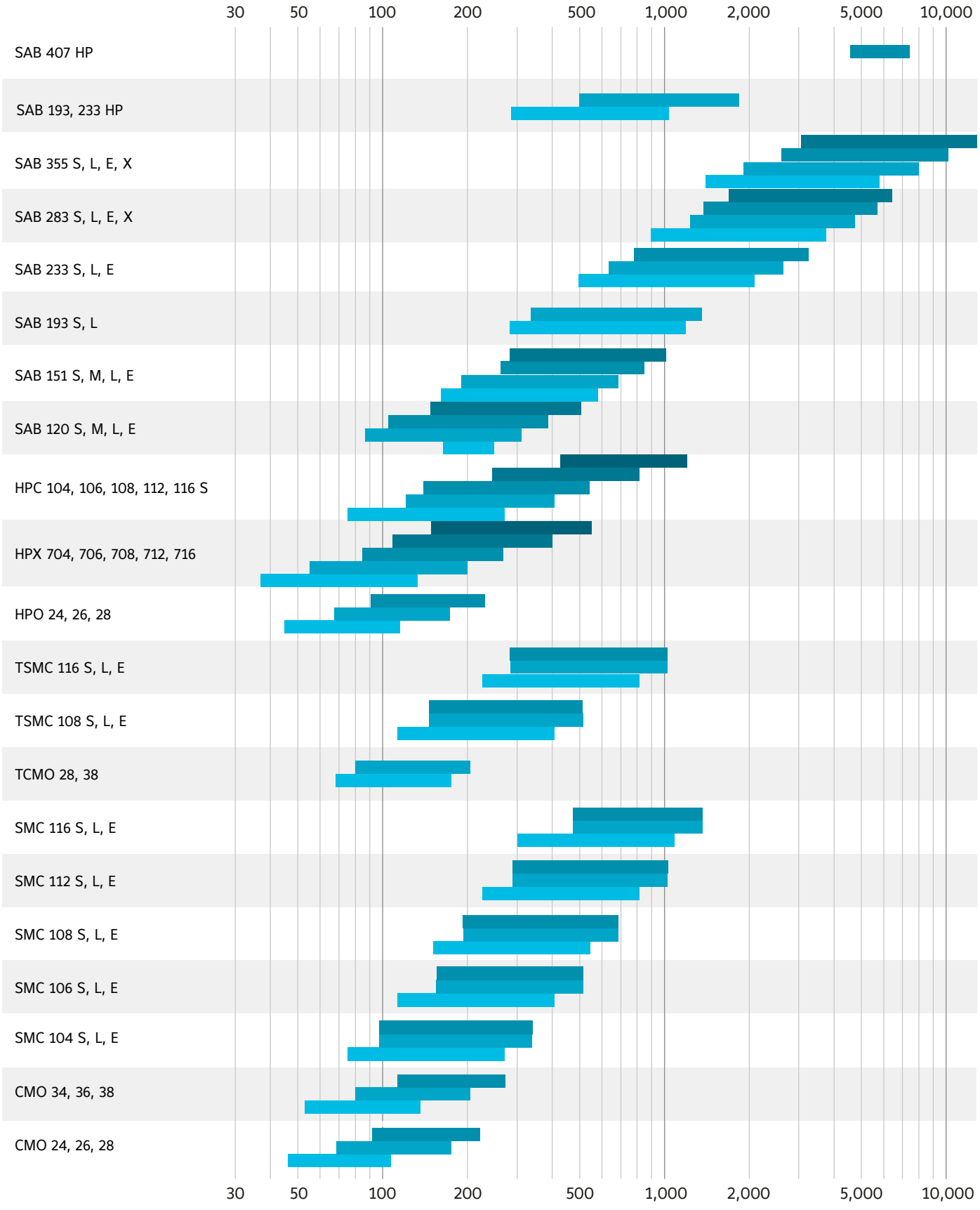
This helps you achieve maximum cooling effect using minimum energy, as well as keeping operating costs to an absolute minimum. The combination of a frequency converter, a VSD motor, and the UniSAB integrated systems controller makes it possible to run the drive motor at speeds that match the load at any given time.

This enables you to reduce energy costs by as much as 30 percent compared with traditional fixed-speed compressors.

The criteria you have to balance normally include:

- Required capacity
- Operating conditions
- Available space
- Part-load requirements
- Temperature levels
- Energy consumption
- Choice of refrigerant
- Environmental concerns
- Maintenance issues
- Peak vs average ratio

Sabroe compressor programme



Swept volume m³/h in maximum speed
(Reciprocating compressors at 50/60 Hz. Screw compressors at 50/60/70/100 Hz)

CMO 28 reciprocating compressor unit with UniSAB systems controller

Sabroe CMO reciprocating compressor units

Small single-stage compressors with swept volumes of 100–270 m^3/h

CMO compressor units are small units specially designed for use in smaller-scale refrigeration installations where reliability is a particular concern and uninterrupted service a big priority.

They are an economical, low-maintenance solution for smaller-scale, heavy-duty refrigeration installations, and are most commonly used as standalone units operating at full load, or as small backup compressors.

Range

Six different models are available to provide swept volumes of between 100 and 270 m^3/h.

Features	Benefits
High coefficient of performance (COP), with excellent performance, even under part-load conditions	Low power consumption, which greatly reduces operating costs
Special design ensures low noise and vibration	Wider range of possible mounting locations, and minimal expenditure on noise attenuation systems
Variable-speed drive (optional) provides stepless capacity control over the entire operating range	Power consumption and operating costs kept to a minimum
Repairs can be undertaken in situ without removing the compressor	Lower repair costs and less downtime
Easy to access for service, with limited spare parts requirements	Easy, inexpensive maintenance, which helps limit downtime and reduce operating costs

Technical data

Model	Number of cylinders	Swept volume		Nominal capacities* in kW Single/high stage				Unit dimensions in mm			Weight excluding motor	Sound pressure level	
		1500 rpm	1800 rpm	1500 rpm		1800 rpm						1500 rpm	1800 rpm
		m³/h	m³/h	-10/+35°C	0/+40°C	-10/+35°C	0/+40°C	L	W	H	kg	db(A)	db(A)
CMO 24	4	97	116	52	80	62	96	2150-2400	1050	1100	680	69	72
CMO 26	6	146	175	78	120	93	144	2200-2400	1150	1100	780	71	73
CMO 28	8	194	233	104	160	125	192	2250-2400	1200	1100	960	72	74
CMO 34	4	114	136	61	94	73	113	2150-2400	1050	1100	680	70	73
CMO 36	6	170	204	91	141	109	169	2200-2400	1150	1100	780	72	74
CMO 38	8	227	273	122	187	146	225	2250-2400	1200	1100	960	73	75

* Nominal capacities are based on:
1500 rpm at 50 Hz
1800 rpm at 60 Hz or VSD

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the compressor block.

Refrigerant: R717
Other refrigerants available on request.

Min./max. speed	R717
CMO 24-26-28	700-1800 rpm
CMO 34-36-38	700-1800 rpm

For R717
2K liquid subcooling and 0.5K non-usable suction superheat.

Design pressure, HP side: 28 bar
Design pressure, LP side: 21 bar
Differential pressure: 21 bar

Options

- UniSAB systems controller
- Variable-speed drive line (UniSAB always included)
- Gauges, thermometers and temperature/pressure control switches
- Extended cylinder capacity control
- Oil level regulator (for use in parallel systems)
- ATEX-compliant configuration
- Oil separators with coalescing element
- Special vibration dampening

SMC 116 single-beam reciprocating compressor unit with UniSAB systems controller

Sabroe SMC reciprocating compressor units

Large single-stage compressors with swept volumes of 200–1,350 m³/h

SMC compressor units are ideal for use in medium-sized refrigeration installations where reliable service is a major priority. They are particularly effective under part-load conditions.

Sabroe SMC compressors are world-renowned for their exceptional reliability, making them an economical, low-maintenance solution for heavy-duty refrigeration, using all common refrigerants. Our three-year warranty covers the complete unit, including compressor block, UniSAB, motor and coupling - for all refrigerants.

Range

Fifteen different models are available to provide swept volumes of between 200 and 1,350 m³/h.

Features	Benefits
High coefficient of performance (COP), with excellent performance under part-load conditions	Low power consumption, which greatly reduces operating costs
Variable-speed drive provides stepless capacity control over the entire operating range	Power consumption and operating costs kept to a minimum
Condition-based service intervals embedded in the controls equipment	Minimum downtime and low service costs due to extremely long service intervals
Easy to access for service, with limited spare parts requirements	Easy, inexpensive maintenance, which helps limit downtime and reduce operating costs
Optional special oil separator design based on coalescer technology	Low oil carry-over, which cuts back on oil costs
Configured without oil system	Small footprint and easy service access

Technical data

Model	Number of cylinders	Swept volume		Nominal capacities * in kW at 1500 rpm			Nominal capacities * in kW at 1800 rpm			Unit dimensions in mm			Weight excluding motor	Sound pressure level	
		1500 rpm	1800 rpm	Single/high-stage		Booster	Single/high-stage		Booster					1500 rpm	1800 rpm
		m^3/h	m^3/h	-10/+35°C	0/+40°C	-40/-10°C	-10/+35°C	0/+40°C	-40/-10°C	L	W	H	kg	db(A)	db(A)
SMC 104 S	4	226	271	127	195	35	153	235	42	2261-2865	1213	1229	1195	79	82
SMC 104 L	4	283	339	165	250	47	198	300	57	2261-2865	1213	1229	1215	80	83
SMC 104 E	4	339	N/A	203	306	58	N/A	N/A	N/A	2261-2865	1213	1229	1220	80	83
SMC 106 S	6	339	407	191	293	53	229	352	64	2286-2890	1267	1247	1380	81	83
SMC 106 L	6	424	509	247	375	71	297	450	85	2286-2890	1267	1247	1400	82	84
SMC 106 E	6	509	N/A	304	459	87	N/A	N/A	N/A	2286-2890	1267	1247	1410	82	84
SMC 108 S	8	452	543	255	391	71	306	469	85	2311-2915	1361	1247	1595	82	84
SMC 108 L	8	566	679	330	500	94	396	600	113	2311-2915	1361	1247	1630	83	85
SMC 108 E	8	679	N/A	406	612	116	N/A	N/A	N/A	2311-2915	1361	1247	1650	83	85
SMC 112 S	12	679	814	382	586	106	459	703	127	3279-3687	1475	1448	2255	83	85
SMC 112 L	12	848	1018	495	750	141	593	900	169	3279-3687	1475	1448	2280	83	86
SMC 112 E	12	1018	N/A	609	918	173	N/A	N/A	N/A	3279-3687	1475	1448	2330	83	86
SMC 116 S	16	905	1086	510	782	141	611	938	170	3329-3737	1536	1445	2505	84	86
SMC 116 L	16	1131	1357	659	1000	188	791	1200	226	3329-3737	1536	1445	2535	84	87
SMC 116 E	16	1357	N/A	812	1224	231	N/A	N/A	N/A	3329-3737	1536	1445	2590	84	87

* Nominal capacities are based on:
1500 rpm at 50 Hz.
1800 rpm at 60 Hz or VSD.

Refrigerant: R717
Other refrigerants available on request.

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the compressor block.

Min./max. speed	R717
SMC S	500-1800 rpm
SMC L	500-1800 rpm
SMC E	500-1500 rpm

For R717
2K liquid subcooling and 0.5K non-usable suction superheat.

Design pressure, HP side: 28 bar
Design pressure, LP side: 18 bar
Differential pressure: 21 bar

Options

- UniSAB systems controller
- Variable-speed drive line (UniSAB always included)
- Oil separator for low oil carry-over
- Gauges, thermometers and temperature/pressure control switches
- Extended cylinder capacity control
- Oil level regulator (for use in parallel systems)
- ATEX-compliant configuration
- Special vibration dampening

HPC 108 single-stage reciprocating compressor unit (50 bar) with UniSAB systems controller

Sabroe HPO/HPC/HPX high-pressure reciprocating compressor units

High-pressure hybrids of CMO and SMC reciprocating compressors, with swept volumes of 100–1,100 m^3/h

The blocks of the compressor units in the HPO/HPC/HPX range are cast in high-strength ductile iron, making them particularly strong and capable of operating under exceptionally high pressures.

This results in condensing temperatures of up to 90°C, and makes HPX and HPO/HPC compressors ideal for use in conjunction with heat pumps and hot water applications, and as an extra "supercharge" stage in traditional ammonia plants. The renowned Sabroe high-pressure compressors are ideal for use with either ammonia or CO_2 as refrigerant.

Sabroe high-pressure compressors provide exceptional reliability and big savings on operating costs, because they are based on the high-volume CMO and SMC compressors, and they share the majority of castings and parts. Our three-year warranty covers the complete unit, including compressor block, UniSAB, motor and coupling - for all refrigerants.

Features	Benefits
High coefficient of performance (COP), with excellent performance under part-load conditions	Low power consumption, especially under part-load conditions. This greatly reduces operating costs
Variable-speed drive (optional) provides stepless capacity control over the entire operating range	Power consumption and operating costs kept to a minimum
Provides exceptionally high condensing temperatures – up to 90°C	Matches radiator temperature in most domestic/commercial heating systems, making HPO/HPC/HPX units ideal in district heating, etc.
Designed for easy service access, and repairs can be undertaken in situ, without removing the compressor	Lower repair and maintenance costs, and less downtime
Special oil separator design based on coalescer technology	Low oil carry-over, which cuts back on oil costs

Range

Thirteen different models are available to provide swept volumes of between 100 and 1,100 m^3/h.

Technical data

Model	Number of cylinders	Swept volume		Nominal capacities in kW at 1800 rpm				Unit dimensions in mm			Weight excluding motor	Sound pressure level at 1800 rpm
		1500 rpm	1800 rpm	Heating R717		Cooling R717	Cooling R744					
		m³/h	m³/h	+35/+73°C	+35/+90°C	0/+55°C	-50/-10°C	L	W	H	kg	db(A)
HPO 24	4	97	116	332	N/A	83	116	1580–1930	835	985	510	77
HPO 26	6	146	175	497	N/A	125	174	1600–1950	940	985	550	78
HPO 28	8	194	233	663	N/A	167	232	1620–1970	940	985	580	80
HPC 104 S	4	226	271	786	N/A	198	214*	2261-2865	1305	1214	1340	83
HPC 106 S	6	339	407	1177	N/A	297	321*	2286-2890	1345	1260	1580	84
HPC 108 S	8	452	543	1569	N/A	396	428*	2311-2915	1486	1247	1660	85
HPC 112 S	12	679	814	2351	N/A	594	642*	3279-3687	1525	1448	2520	86
HPC 116 S	16	905	1086	3164**	N/A	792	856*	3329-3757	1525	1448	2600	87
HPX 704	4	111	133	380	356	95	133	2261-2865	1213	1214	1220	82
HPX 706	6	166	200	570	535	143	200	2286-2890	1267	1260	1440	84
HPX 708	8	222	266	760	713	190	266	2311-2915	1278	1260	1510	85
HPX 712	12	333	399	1140	1069	286	400	3279-3687	1345	1448	2430	86
HPX 716	16	443	532	1520	1426	381	533	3329-3737	1356	1445	2600	87

* at 1500 rpm
** 71°C condensing

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the compressor block.

Nominal capacities are based on:
1500 rpm at 50 Hz.
1800 rpm at 60 Hz or VSD.

Min./max. speed	R717	R744
HPO	700-1800 rpm	700-1800 rpm
HPC	500-1800 rpm	500-1500 rpm
HPX	500-1800 rpm	500-1800 rpm

For R717
2 K liquid subcooling and 0.5 K non-usable suction superheat.

For R744
2 K liquid subcooling and 10 K usable suction superheat for R744.

For HPO
Design pressure, HP side: 50 bar
Design pressure, LP side: 26 bar
Differential pressure: 25 bar.

For HPC
Design pressure, HP side: 50 bar
Design pressure, LP side: 26 bar
Differential pressure: 25 bar.

For HPX
Design pressure, HP side: 60 bar
Design pressure, LP side: 26 bar
Differential pressure: 40 bar.

Options

- Variable-speed drive line
- Gauges, thermometers and temperature/pressure control switches
- Extended cylinder capacity control
- ATEX-compliant configuration
- Special vibration dampening

TSMC 108 two-stage reciprocating compresor unit shown with closed flash inter-stage cooling system and UniSAB systems controller

Sabroe TCMO/TSMC
two-stage reciprocating compressor units

Two-stage versions of CMO and SMC reciprocating compressors, with swept volumes of 150–1,000 m³/h

Sabroe TCMO/TSMC two-stage reciprocating compressors are an economical operating alternative to single-stage compressors in smaller low-temperature refrigeration installations.

TCMO/TSMC compressor units are also ideal for medium-size industrial refrigeration installations that involve a big temperature range, such as freezer installations. Furthermore, these units are easy to customise with intermediate cooling systems.

Using a two-stage setup built together as a single unit helps avoid equipment duplication – and thus reduce costs

Our three-year guarantee covers the complete unit, including compressor block, UniSAB, motor and coupling - for all refrigerants.

Features	Benefits
Splitting the temperature lift into two separate stages reduces overall energy consumption	Two-stage installations are relatively cost-effective, which helps reduce energy costs
Relatively small footprint	Can be installed in relatively small locations, or where space is limited
High coefficient of performance (COP), with excellent performance under part-load conditions	Low power consumption, which greatly reduces operating costs
Variable-speed drive (optional) provides stepless capacity control over the entire operating range	Power consumption and operating costs kept to a minimum

Range

Eight different models are available to provide swept volumes of between 150 and 1,000 m³/h.

Technical data

Model	Number of cylinders low/high-pressure side	Swept volume		Nominal capacities* in kW -40/+35°C		Unit dimensions in mm			Weight excluding motor	Sound pressure level	
		1500 rpm	1800 rpm							1500 rpm	1800 rpm
		m^3/h	m^3/h	1500 rpm	1800 rpm	L	W	H	kg	db(A)	db(A)
TCMO 28	6 / 2	146	175	20	24	1400–1750	700	1000	500	68	70
TCMO 38	6 / 2	170	205	23	28	1400–1750	700	1000	500	69	71
TSMC 108 S	6 / 2	339	407	50	60	2311–2915	1052	1247	1746	80	82
TSMC 108 L	6 / 2	424	509	66	79	2311–2915	1052	1247	1781	81	83
TSMC 108 E	6 / 2	509	N/A	81	N/A	2311–2915	1052	1247	1796	81	83
TSMC 116 S	12 / 4	679	814	100	121	3329–3737	1327	1445	2791	81	83
TSMC 116 L	12 / 4	848	1018	133	159	3329–3737	1327	1445	2841	82	84
TSMC 116 E	12 / 4	1018	N/A	163	N/A	3329–3737	1327	1445	2891	83	84

* Nominal capacities are based on:
1500 rpm at 50 Hz.
1800 rpm at 60 Hz or VSD.

Refrigerant: R717
Other refrigerants available on request.

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the compressor block.

Min./max. speed	R717
TCMO	700-1800 rpm
TSMC S	700-1800 rpm
TSMC L	700-1800 rpm
TSMC E	700-1500 rpm

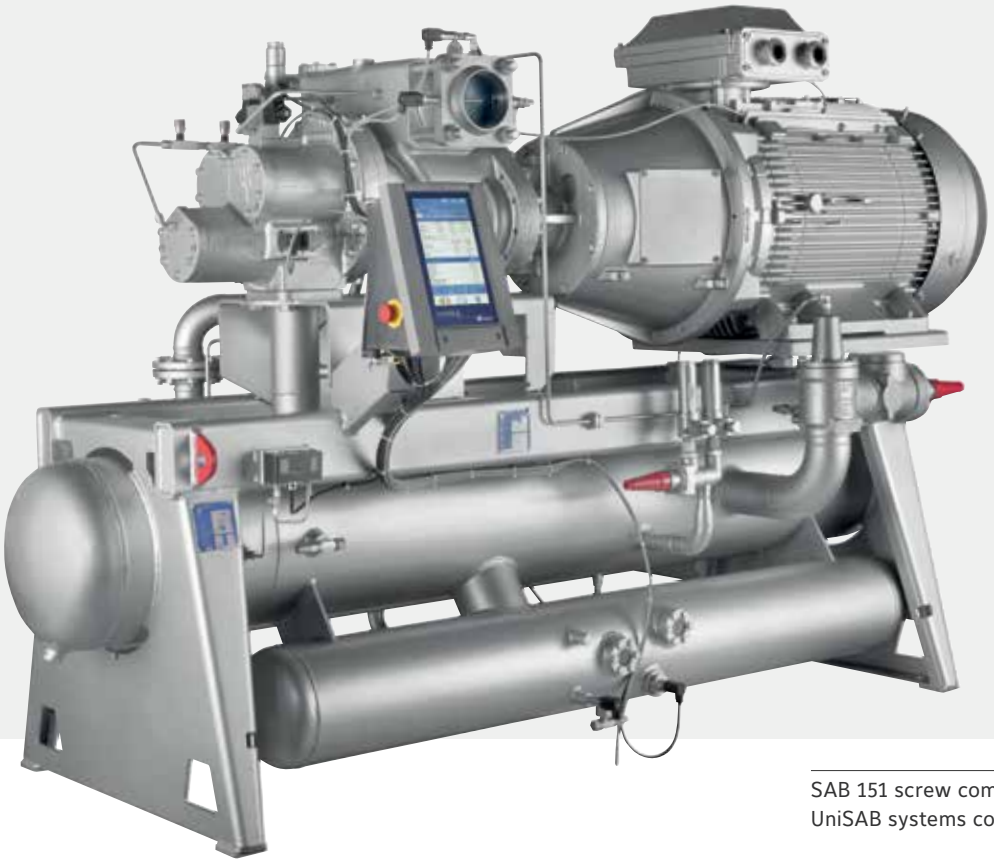
For R717
2K liquid subcooling, 0.5 K non-usable suction superheat and liquid subcooling in intermediate cooler to 10K above intermediate temperature.

For TCMO
Design pressure, HP side: 28 bar
Design pressure, LP side: 18 bar
Differential pressure: 25 bar.

For TSMC
Design pressure, HP side: 28 bar
Design pressure, LP side: 18 bar
Differential pressure: 25 bar.

Options

- UniSAB systems controller
- Gauges, thermometers and temperature/pressure control switches
- Oil level regulator (for use in parallel systems)
- ATEX-compliant configuration
- Special vibration dampening
- Intermediate cooling systems



SAB 151 screw compressor unit with UniSAB systems controller

Sabroe SAB screw compressor units

XJF single-stage compressors with swept volumes of 200–1,000 m³/h

Sabroe SAB screw compressors are designed and configured to tackle smaller-scale industrial refrigeration requirements where a combination of exceptional reliability, high performance and low operating costs is essential.

These small units can be used with all the most common refrigerants and process gases, and all the components are selected for good accessibility and ease of service, ensuring cost-effective maintenance.

Range

Eight different models are available to provide swept volumes of 200–1,000 m³/h.

Features	Benefits
Variable-speed drive and stepless capacity control ensures that capacity is always adjusted to suit requirements	Maximum part-load efficiency and lowest possible operating costs
SAB screw compressor units are all equipped with a UniSAB systems controller	More efficient operating profile, less downtime and longer service life
Cold Start valve lubricates the compressor, with no oil pump needed	Lower operating costs and less maintenance
SuperFilter II oil filter captures 99% of all particles larger than 5 microns	Longer bearing life, providing maximum reliability and savings on both maintenance and replacement
Space-saving design with small footprint	Significant reductions in space requirements

Technical data

Model	Swept volume		Nominal capacities in kW at 3600 rpm R717			Unit dimensions in mm	Weight excluding motor/ oil	Sound pressure level	
	at 3000 rpm*	at 3600 rpm*	High-stage	Booster	With economiser			3000 rpm	3600 rpm
	m³/h	m³/h	-10/+35°C	-40/-10°C	-40/+35°C	L x W x H	kg	db(A)	db(A)
SAB 120 S*	204	245	145	44	44	2200 x 1300 x 1500	1200	85	87
SAB 120 M	255	306	191	58	58	2200 x 1300 x 1500	1200	86	88
SAB 120 L	316	379	243	73	73	2200 x 1300 x 1500	1300	88	90
SAB 120 E	413	496	325	98	99	2200 x 1300 x 1500	1300	89	91
SAB 151 S	484	581	373	116	106	3000 x 1450 x 1800	2050	90	92
SAB 151 M	571	685	448	139	127	3000 x 1450 x 1800	2050	91	93
SAB 151 L	708	850	565	175	160	3000 x 1450 x 1800	2050	91	93
SAB 151 E	847	1016	680	211	193	3000 x 1450 x 1800	2050	92	94

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the compressor block.

2-pole motor:
3000 rpm at 50 Hz.
3600 rpm at 60 Hz or VSD.

*** 4-pole motor (for SAB 120 S):**
1500 rpm at 50 Hz.
1800 rpm at 60 Hz or VSD.

Min./max. speed	R717
SAB 120 S	1000-1800 rpm
SAB 120 M-L-E	1000-3600 rpm
SAB 151 S-M-L-E	1000-3600 rpm

For R717:
2 K liquid subcooling and 0.5 K non-usable suction superheat.

28 bar design pressure:
SAB 120 and SAB 151

Options

- Variable-speed drive
- Thermosyphon and water-cooled oil coolers, with 3-way oil temperature control valve
- Liquid injection oil cooling (EZ Cool)
- Dual SuperFilter II oil filters (on SAB 151 models only)
- Complete economiser systems
- Demand oil pump – controlled by UniSAB systems controller
- Sensors and transmitters for control by external PLC systems

SAB 233 screw compressor unit with UniSAB systems controller

Sabroe SAB screw compressor units

SGC single-stage compressors with swept volumes of 850–11,000 m³/h

The bigger models of Sabroe SAB screw compressors are specifically engineered to deal with larger-scale industrial refrigeration installations in which requirements prioritise exceptional reliability, high performance, and low operating costs. All the components are designed and configured to ensure low maintenance costs as a result of good accessibility and ease of service.

Like their smaller counterparts, these large-capacity compressor units can be used with all common refrigerants and process gases.

Range

Thirteen different models are available to provide swept volumes of 850–11,000 m³/h.

Features	Benefits
Variable-speed drive and stepless capacity control ensure that capacity is always adjusted to suit requirements	Maximum part-load efficiency and lowest possible operating costs
SAB screw compressor units are all equipped with a UniSAB systems controller	More efficient operating profile, less downtime and longer service life
Cold Start valve lubricates the compressor, with no oil pump needed	Lower operating costs and less maintenance
SuperFilter II oil filter captures 99% of all particles larger than 5 microns	Longer bearing life, providing maximum reliability and savings on both maintenance and replacement
Space-saving design with small footprint	Significant reductions in space requirements
Infinitely variable Vi and capacity control	Saves energy as the compressor matches the system pressures and the load requirements precisely

Technical data

Model	Swept volume		Nominal capacities in kW at 3600 rpm R717			Unit dimensions in mm	Weight excluding motor/oil	Sound pressure level	
	3000 rpm	3600 rpm	High-stage	Booster	With economiser			3000 rpm	3600 rpm
	m³/h	m³/h	-10/+35°C	-40/-10°C	-40/+35°C	L x W x H	kg	db(A)	db(A)
SAB 193 S	848	1018	653	194	193	3150 x 1500 x 1800	2700	84	86
SAB 193 L	1131	1358	872	260	258	3250 x 1500 x 1900	2800	84	86
SAB 233 S	1494	1792	1172	344	334	3700 x 1700 x 2100	4600	86	88
SAB 233 L	1880	2257	1477	484	421	3700 x 1800 x 2200	4750	86	88
SAB 233 E	2323	2788	1826	537	520	3700 x 1800 x 2200	4800	86	88
SAB 283 S	2676	3211	2096	616	597	3700 x 1800 x 2250	5500	88	90
SAB 283 L	3370	4044	2638	776	752	4150 x 1900 x 2650	5850	88	90
SAB 283 E	4055	4865	3159	929	901	4450 x 2100 x 2850	7650	88	90
SAB 355 S	4192	5031	3236	963	917	4550 x 2350 x 3500	10000	89	91
SAB 283 X	4580	5496	3592	1056	1025	4600 x 2100 x 2850	8950	88	90
SAB 355 L	5716	6860	4369	1299	1240	4700 x 2350 x 3500	10000	89	91
SAB 355 E	7275	8730	5550	1630	1576	4850 x 2350 x 3500	10200	89	91
SAB 355 X	9180	11016	NA	2053	1966	5000 x 2350 x 3500	10400	89	91

2-pole motor:
3000 rpm at 50 Hz.
3600 rpm at 60 Hz or VSD.
4200 rpm at 70 Hz or VSD.

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the compressor block.

Min./max. speed	R717
SAB 193	1000-4200
SAB 233	1000-3800
SAB 283	1000-3600
SAB 355	1000-3600

For R717:
2 K liquid subcooling and 0.5 K non-usable suction superheat.

28 bar design pressure:
SAB 193, SAB 233, SAB 283 and SAB 355

Options

- Variable-speed drive
- Thermosyphon and water-cooled oil coolers, with 3-way oil temperature control valve
- Liquid injection oil cooling (EZ Cool)
- Dual external oil filters (SuperFilter II type)
- Complete economiser systems
- Demand oil pump – controlled by UniSAB systems controller
- Sensors and transmitters for control by external PLC systems

SAB 193 high-pressure screw compressor unit with UniSAB systems controller

Sabroe SAB high-pressure screw compressor units

Variable-speed high-pressure screw compressor units with swept volumes of 1,000–7,350 m^3/hour

These unique high-pressure compressor units are ideal for large, site-built ammonia heat pump installations that require condensing temperatures up to 93°C.

Sabroe SAB high-pressure screw compressors are specially designed for variable-speed operation and maximum flexibility, doing away with the traditional capacity limitations of slide-valve technology. The capacity range of all SAB models extends from 1,000 rpm to 3,600 rpm.

The high-pressure configurations, all ductile iron-cased versions of the large Sabroe compressor units, provide substantial base load capacities along with providing exceptional flexibility in frequency converter operation. This ensures the robustness and reliability derived from the thousands of compressors in long-term service in refrigeration plants worldwide.

The high-pressure screw compressor units are configured as standard with Sabroe Vibration Monitoring system, which monitors the conditions of the bearings to secure optimum uptime on the compressors. Monitoring of motor bearings can also be included on request.

Range

Four models are available to provide swept volumes of between 1,000 and 7,350 m^3/h.

Features	Benefits
High-pressure units designed specifically for applications that use CO_2 or ammonia as refrigerant	Makes it possible to undertake freezing and defrosting in a single stage, or to utilise waste heat
Stepless, skip-free capacity control ensures that output always matches requirements	Lowest possible operating costs and rapid return on investment
Consistently high performance at both full and part load	Maximum part-load efficiency and low life cycle costs
Space-saving small footprint, with fewer moving parts and very low vibration	Exceptional reliability and low maintenance costs
Load-based service schedules	Optimised service/maintenance intervals, with a minimum of unscheduled downtime

Technical data, 40 bar

Model	Max. rpm	Swept volume at max. rpm	Capacities +10°C/72°C		Unit dimensions in mm	Sound pressure level
			Cooling	Heating		
		m^3/hr	kW	kW	L x W x H	db(A)
SAB 193 S HP	3600	1018	1266	1690	3150 x 1500 x 1800	90
SAB 233 S HP	3600	1791	2281	3021	3700 x 1700 x 2100	90

Technical data, 63 bar

Model	Max. rpm	Swept volume at max. rpm	Capacities +20°C/93°C		Unit dimensions in mm	Sound pressure level
			Cooling	Heating		
		m^3/hr	kW	kW	L x W x H	db(A)
SAB 407 S HP	3600	5510	7875	11877	8900 x 2000 x 4000	-
SAB 407 L HP	3600	7350	10503	15843	9200 x 2000 x 4000	-

Dimensions and sound pressure levels are guidelines only. Sound pressure levels measured in free field, over reflecting plane and one metre distance from the compressor block.

Min./max. speed	R717
SAB 193 S HP	1000-3600
SAB 233 S HP	1000-3600
SAB 407 S HP	1000-3600
SAB 407 L HP	1000-3600

All Sabroe high-pressure screw compressors are available on request.

Options

- Variable-speed drive
- Thermosyphon and water-cooled oil coolers, with 3-way oil temperature control valve
- Dual external oil filters (SuperFilter II type)
- Complete economiser systems
- Demand oil pump – controlled by UniSAB systems controller
- Sensors and transmitters for control by external PLC systems
- Sabroe Vibration Monitoring system (SVM) for electrical motor

Chillers

Chillers based on Sabroe core technologies

Chillers meet the demand for indirect cooling

Many industrial and commercial processes and installations require indirect rather than direct cooling. This is normally provided by special chiller units, in which a compressor cools a secondary refrigerant that then provides the desired cooling effect.

The use of secondary refrigerants – water, glycol, brine, etc. – is rapidly increasing because of the demand for safer installations and an intense, continuous focus on energy efficiency.

Another driver lies in both national and international legislation that requires the phasing-out of particular refrigerants because of their environmental impacts.

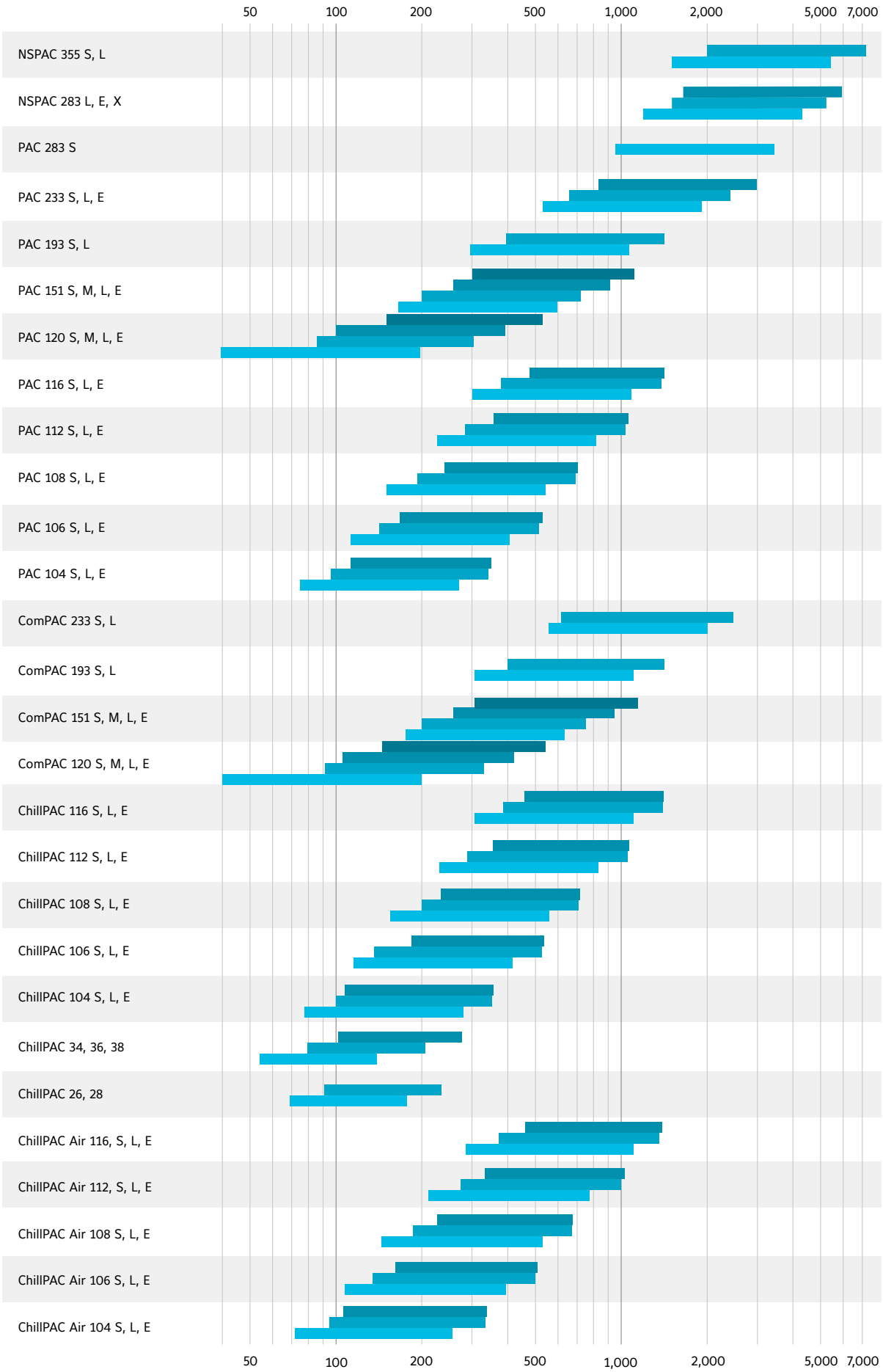
Meeting the demand for chillers

Sabroe therefore provides a range of energy-efficient standardised packaged chiller configurations, all based on high-efficiency Sabroe reciprocating and screw compressors that are world-renowned for their reliability. As a result, Sabroe chillers are at the forefront of this rapidly developing specialist market.

Compliance

All Sabroe chiller units are fully compliant with appropriate major international design codes and the specifications laid down by the most common classification societies. Approval in accordance with other technical requirements, specific national legislation or other classification societies' requirements is available on request.

Sabroe chiller programme



Capacities in kW at 7/12°C (cold side) and 30/35°C (hot side) in maximum speed, ChillPAC Air: 35°C ambient temperature
(Reciprocating compressors at 50/60 Hz. Screw compressors at 50/60/70/100 Hz)

ChillPAC 108 with VSD panel and UniSAB as standard

Sabroe ChillPAC chillers

Extremely compact packaged ammonia chillers based on reciprocating compressors, with a 60–1,400 kW capacity range

ChillPAC ammonia-based chillers feature an ultra-compact format so narrow that they can even pass through a normal doorway. This is achieved by having an extra-compact shell-and-plate evaporator/condenser, oil separator, and control system all built in and fully integrated into a unique vibration-resistant design.

This means ChillPAC units provide exceptional refrigeration capacity – taking full advantage of the many different models of ultra-reliable Sabroe reciprocating compressors – while only taking up a minimum of space. This makes ChillPAC units ideal in installations where space is limited, and where there are restrictions on the refrigerant charge used.

ChillPAC chillers are most cost-effective when fitted with a variable-speed drive (VSD) that makes it easy to deal with changing circumstances and different operating requirements.

Range

There are 21 different models in the standard ChillPAC range, with capacities ranging from 60 kW to 1,400 kW.

Features	Benefits
Factory-assembled, pre-tested packaged units based on Sabroe reciprocating compressors world-renowned for their reliability	Easy pre-commissioning makes installation and running-in both faster and cheaper. Factory acceptance test (FAT) available (optional)
Exceptionally compact design and fully integrated configuration result in less than half the footprint of bespoke chiller designs	Major savings on both weight and space, resulting in lower installation costs. Much less need for expensive separate machinery rooms
Indirect cooling and uncomplicated flooded evaporating system, using ammonia (R717) only	Greater safety and outstanding reliability
Exceptional COP and outstanding part-load performance	Greater cooling effect from a smaller refrigerant charge, and optimum load structure over the entire capacity range
Refrigerant charge 50% smaller than conventional chillers, because of special condenser/evaporator design	Higher output per unit kW/kg refrigerant, lower unit cost and lower installation costs

Options

- Variable-speed drive (VSD)
- Soft-starter or Y/D starter
- Desuperheater
- Subcooler
- External condenser
- Control panel mounted separately
- S and L models: 1800 rpm at 60 Hz or VSD
- Customer-witnessed factory acceptance test (FAT)
- Heater package for low-temperature heat pump operation
- Shunt solution for high-temperature difference
- Enclosure for outdoor installation

Water: inlet 12 °C, outlet 7 °C

Type	Cooling capacity	E-motor	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft cooling
	kW	kW	kg	kg	L	W	H	dB(A)	
ChillPAC 24 A	116	24	10	2500	2900	1000	2000	72	5.6
ChillPAC 34 A	137	30	10	2500	2900	1000	2000	72	5.6
ChillPAC 26 A	172	37	12	2600	2900	1000	2000	72	5.4
ChillPAC 36 A	200	45	13	2700	2900	1000	2000	73	5.3
ChillPAC 28 A	228	47	14	2700	2900	1000	2000	73	5.3
ChillPAC 38 A	268	61	16	3700	2900	1000	2000	74	5.3
ChillPAC 104 S-A	278	72	15	2900	2900	1000	2000	80	5.4
ChillPAC 104 L-A	353	74	21	3100	2900	1000	2000	83	5.5
ChillPAC 104 E-A *	359	73	19	3400	2900	1000	2000	80	5.2
ChillPAC 106 S-A	421	90	20	3500	2900	1000	2000	83	5.5
ChillPAC 106 L-A	534	108	27	3700	2900	1000	2000	79	5.6
ChillPAC 106 E-A *	540	110	27	4100	3100	1000	2000	81	5.3
ChillPAC 108 S-A	555	108	28	3900	2900	1000	2000	84	5.5
ChillPAC 108 L-A	709	142	31	4500	3100	1000	2000	85	5.5
ChillPAC 108 E-A *	719	164	34	3600	3300	1000	2000	84	5.3
ChillPAC 112 S-A	835	163	40	5400	4000	1000	2200	86	5.6
ChillPAC 112 L-A	1056	204	46	6000	4500	1000	2200	86	5.6
ChillPAC 112 E-A *	1074	222	50	6500	4600	1000	2200	84	5.3
ChillPAC 116 S-A	1109	222	51	6400	4500	1000	2200	86	5.6
ChillPAC 116 L-A	1405	303	53	7000	4700	1000	2200	87	5.6
ChillPAC 116 E-A *	1422	290	53	7400	5000	1000	2200	85	5.3

Ethylene glycol 30%: inlet -2 °C, outlet -8 °C

Type	Cooling capacity	E-motor	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft cooling
	kW	kW	kg	kg	L	W	H	dB(A)	
ChillPAC 24 C	59	19	10	2500	2900	1000	2000	73	3.4
ChillPAC 34 C	69	24	10	2500	2900	1000	2000	73	3.3
ChillPAC 26 C	86	30	10	2500	2900	1000	2000	73	3.3
ChillPAC 36 C	100	37	10	2600	2900	1000	2000	73	3.2
ChillPAC 28 C	113	39	11	2700	2900	1000	2000	74	3.2
ChillPAC 38 C	131	45	12	2900	2900	1000	2000	74	3.2
ChillPAC 104 S-C	139	45	13	2900	2900	1000	2000	78	3.3
ChillPAC 104 L-C	179	61	15	3000	2900	1000	2000	79	3.3
ChillPAC 104 E-C *	183	61	15	3300	2900	1000	2000	79	3.3
ChillPAC 106 S-C	205	66	16	3200	2900	1000	2000	80	3.3
ChillPAC 106 L-C	264	90	20	3400	2900	1000	2000	80	3.3
ChillPAC 106 E-C *	274	90	22	3600	2900	1000	2000	80	3.3
ChillPAC 108 S-C	272	90	22	3500	2900	1000	2000	82	3.3
ChillPAC 108 L-C	355	117	26	3900	3100	1000	2000	82	3.3
ChillPAC 108 E-C *	363	117	26	4500	3300	1000	2000	82	3.3
ChillPAC 112 S-C	406	131	32	4600	3800	1000	2200	83	3.3
ChillPAC 112 L-C	527	177	37	5400	4200	1000	2200	83	3.3
ChillPAC 112 E-C *	545	174	38	6000	4300	1000	2200	83	3.3
ChillPAC 116 S-C	537	177	38	5500	4200	1000	2200	83	3.3
ChillPAC 116 L-C	702	222	47	6200	4300	1000	2200	83	3.4
ChillPAC 116 E-C *	729	264	46	6700	4300	1000	2200	83	3.3

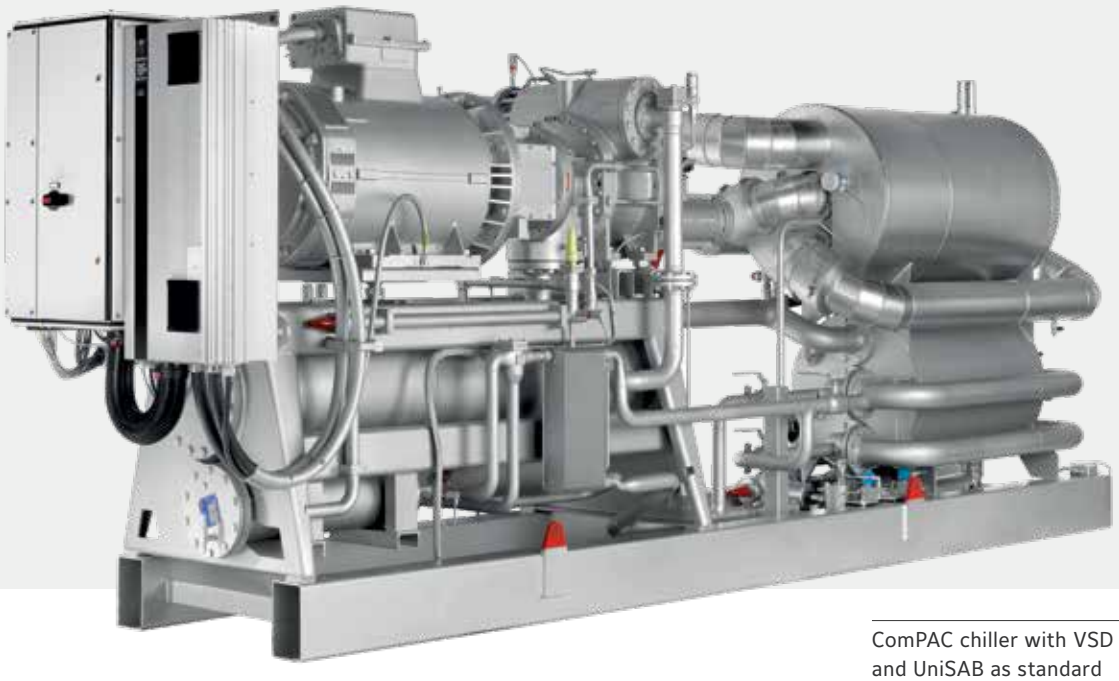
Condenser: water inlet 30°C, outlet 35°C.
The above data are only valid for the stated temperatures and operating conditions.

Capacities are nominal at 1800 rpm.
*Capacities are nominal at 1500 rpm.

CMO and SMC S and L models,
60 Hz or VSD operation possible.

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the unit.

Our products within the scope of eco-design, implemented according to regulation No 2015/1095 for low (-25°C) and medium (-8°C) temperatures and No 2016/2281 for high temperatures (+7°C), are in compliance. The harmonised standards EN 14511 series and EN 14825 have been used for testing and calculation. Value tolerances for selection tools comply with EN 12900.



ComPAC chiller with VSD panel and UniSAB as standard

Sabroe ComPAC chillers

Packaged ammonia chillers based on screw compressors, with a 100–2,300 kW capacity range

Sabroe ComPAC ammonia chillers based on plate-and-shell heat exchangers and the comprehensive Sabroe screw compressor programme (SAB 120-151 to SAB 193-233) are distinctive for their compact design. Frequency converter and panel solutions are supplied as standard.

As standard, ComPAC chillers use ultra-compact and extremely low-charge Sabroe-patented plate-and-shell heat exchangers.

Range

There are 13 different standard models in this range of ComPAC chillers – both high- and low-temperature versions.

A comprehensive range of equipment options are available to ensure the best possible performance and application versatility.

Features	Benefits
Factory-assembled, pre-tested packaged units based on renowned Sabroe screw compressors	Easy pre-commissioning makes installation and running-in both faster and cheaper. Factory acceptance test (FAT) available (optional)
Compact design with a very small footprint compared with bespoke chiller designs	Lower unit cost and lower installation costs
Indirect cooling and uncomplicated flooded evaporating system, using natural ammonia (R717) only	Major savings on both weight and space. Much less need for expensive separate machinery rooms
Exceptional COP and outstanding part-load performance	Greater safety and outstanding reliability
Small refrigerant charge, smaller than conventional chiller charges because of special condenser/ evaporator design	Greater cooling effect from a smaller refrigerant charge, and optimum load structure over the entire capacity range

Water: inlet 12 °C, outlet 7 °C

Type	Cooling capacity	E-motor	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft cooling
	kW	kW	kg	kg	L	W	H	dB(A)	
ComPAC 120 S-A	185	55	21	3600	4600	1200	2300	85	4.4
ComPAC 120 M-A	316	78	26	3800	4700	1200	2300	86	4.8
ComPAC 120 L-A	400	93	29	4000	4800	1200	2300	87	4.9
ComPAC 120 E-A	541	140	36	5200	5000	1200	2300	89	4.9
ComPAC 151 S-A	614	140	38	5500	5000	1200	2300	91	5.0
ComPAC 151 M-A	735	175	44	5800	5100	1200	2300	92	5.0
ComPAC 151 L-A	929	217	51	5900	5300	1200	2300	92	5.1
ComPAC 151 E-A	1111	269	59	6300	5600	1200	2300	93	5.0
ComPAC 193 S-A	1063	269	57	7100	5600	1500	2400	85	5.2
ComPAC 193 L-A	1447	327	159	7400	6100	1500	2400	85	5.4
ComPAC 233 S-A	1933	410	238	13000	7000	1500	2400	86	5.5
ComPAC 233 L-A	2314	536	297	15000	7100	1500	2400	86	5.2

Ethylene glycol 30%: inlet -2 °C, outlet -8 °C

Type	Cooling capacity	E-motor	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft cooling
	kW	kW	kg	kg	L	W	H	dB(A)	
ComPAC 120 S-C	108	55	21	3600	4500	1200	2300	85	2.7
ComPAC 120 M-C	177	78	26	3800	4600	1200	2300	86	2.9
ComPAC 120 L-C	224	93	29	4000	4700	1200	2300	87	2.9
ComPAC 120 E-C	297	114	36	5200	4900	1200	2300	89	2.9
ComPAC 151 S-C	344	140	38	5500	4900	1200	2300	91	3.1
ComPAC 151 M-C	408	175	44	5800	5000	1200	2300	92	3.1
ComPAC 151 L-C	515	217	51	5900	5200	1200	2300	92	3.1
ComPAC 151 E-C	617	269	59	6300	5500	1200	2300	93	3.1
ComPAC 193 S-C	594	217	57	7100	5500	1500	2400	85	3.2
ComPAC 193 L-C	795	327	71	7400	6000	1500	2400	85	3.2
ComPAC 233 S-C	1052	410	75	13000	6900	1500	2400	86	3.4
ComPAC 233 L-C	1361	536	225	15000	7000	1500	2400	86	3.4

Condenser: Water inlet 30 °C, outlet 35 °C.
All data and nominal capacities kW at 3600 rpm, except for ComPAC 120 S at 1470 rpm.

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the unit.

Options

- Variable-speed drive (VSD)
- Soft-starter or Y/D starter
- External condenser
- Control panel mounted separately
- Economiser option for low-temperature brine
- Customer-witnessed factory acceptance test FAT)
- Heater package for low-temperature operation
- Shunt solution for high-temperature difference

Our products within the scope of eco-design, implemented according to regulation No 2015/1095 for low (-25°C) and medium (-8°C) temperatures and No 2016/2281 for high temperatures (+7°C), are in compliance. The harmonised standards EN 14511 series and EN 14825 have been used for testing and calculation. Value tolerances for selection tools comply with EN 12900.

PAC 116 chiller with UniSAB systems controller

Sabroe PAC chillers

Packaged ammonia chillers based on reciprocating compressors, with a 50–1,400 kW capacity range

PAC ammonia-based chillers are fully integrated packaged units, designed to take full advantage of the many different models of ultra-reliable Sabroe reciprocating compressors. They are popular because there is such a wide range of different standard sizes, and they are also particularly easy to customise to meet specific requirements.

The integrated design, with the plate evaporator/condenser, oil separator, and control system all built in, means PAC units provide exceptional refrigeration capacity while only taking up a minimum of space. They are ideal for use in indirect cooling setups and in installations where it is important to use future-compatible natural refrigerants, such as ammonia.

The advanced technology and the well-matched integration of the component systems make these chillers so energy efficient that their low operating costs make them the most economical choice over the lifetime of a refrigeration plant.

Range

There are 21 different standard models in this range of packaged chillers, with capacities ranging from 50 kW to 1,400 kW.

Customised configurations are also available for use with remote air-cooled or evaporative condensers, and for twin or multi-packages, designed to provide particularly large cooling capacities.

Features	Benefits
Factory-assembled, pre-tested packaged units	Easy pre-commissioning makes installation and running-in both faster and cheaper. Factory acceptance test (FAT) available as an option
Comprehensive selection of compressor capacities, making it easier to match particular requirements	Avoid paying for greater capacity than needed
Very easy access for service	Improves safety, ensures maximum reliability and global sourcing of parts
Indirect cooling and uncomplicated flooded evaporating system, using ammonia (R717) only	Greater safety and outstanding reliability
Plate evaporator/condenser are easy to open and service	Routine checks/service can be carried out by operator's own staff

Water: inlet 12 °C, outlet 7 °C

Type	Cooling capacity	E-motor	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft cooling
	kW	kW	kg	kg	L	W	H	dB(A)	
PAC 104 S-A	272	61	48	3100	3300	1850	2300	77	5.2
PAC 104 L-A	346	74	49	3250	3300	1850	2300	77	5.3
PAC 104 E-A *	352	74	51	3400	3300	1850	2300	78	5.1
PAC 106 S-A	407	90	51	3500	3300	1850	2300	78	5.3
PAC 106 L-A	519	108	54	3550	3300	1850	2300	79	5.3
PAC 106 E-A *	528	113	57	3700	3550	1850	2300	79	5.1
PAC 108 S-A	543	117	54	3700	3300	1850	2300	79	5.3
PAC 108 L-A	692	142	58	3900	3550	1850	2300	80	5.3
PAC 108 E-A *	704	164	74	4300	3850	1850	2450	80	5.1
PAC 112 S-A	815	164	73	4650	4130	1850	2450	80	5.4
PAC 112 L-A	1037	205	78	5000	4130	1850	2450	81	5.4
PAC 112 E-A *	1055	222	84	5300	4550	1850	2450	81	5.2
PAC 116 S-A	1086	222	79	5350	4130	1850	2450	81	5.4
PAC 116 L-A	1383	279	98	5650	4900	1850	2450	82	5.4
PAC 116 E-A *	1407	291	137	6300	5750	2000	2600	82	5.2

Ethylene glycol 30%: inlet -2 °C, outlet -8 °C

Type	Cooling capacity	E-motor	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft cooling
	kW	kW	kg	kg	L	W	H	dB(A)	
PAC 104 S-C	131	45	47	3000	3300	1850	2300	76	3.1
PAC 104 L-C	172	61	48	3050	3300	1850	2300	77	3.2
PAC 104 E-C *	177	61	49	3200	3300	1850	2300	77	3.2
PAC 106 S-C	197	66	50	3250	3300	1850	2300	78	3.2
PAC 106 L-C	257	90	53	3450	3300	1850	2300	79	3.2
PAC 106 E-C *	265	90	54	3600	3300	1850	2300	79	3.2
PAC 108 S-C	262	90	53	3550	3300	1850	2300	79	3.2
PAC 108 L-C	343	117	57	3650	3300	1850	2300	80	3.2
PAC 108 E-C *	354	117	71	4100	3600	1850	2450	80	3.2
PAC 112 S-C	393	131	71	4400	4130	1850	2450	80	3.2
PAC 112 L-C	515	177	78	4600	4130	1850	2450	81	3.3
PAC 112 E-C *	531	174	79	5050	4130	1850	2450	81	3.2
PAC 116 S-C	525	177	77	5150	4130	1850	2450	81	3.3
PAC 116 L-C	686	258	86	5400	4130	1850	2450	82	3,3
PAC 116 E-C *	708	258	128	6000	4550	2000	2600	83	3.3

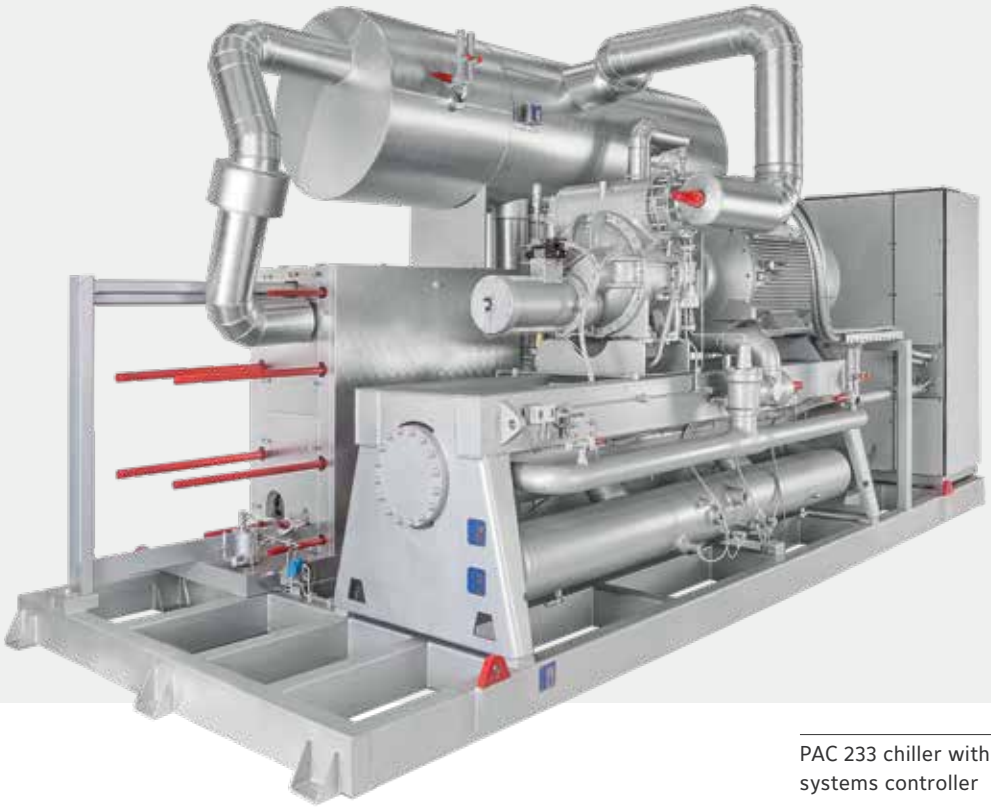
Condenser: water inlet 30 °C, outlet 35°C.
The above data are only valid for the stated temperatures and operating conditions.
Capacities are nominal at 1800 rpm.
* Capacities are nominal at 1500 rpm.
PAC S and L models, 60 Hz or VSD operation possible.

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the unit.

Options

- Variable-speed drive (VSD)
- Soft-starter or Y/D starter
- Desuperheater
- Subcooler
- External condenser
- Control panel mounted separately
- Customer-witnessed factory acceptance test (FAT)

Our products within the scope of eco-design, implemented according to regulation No 2015/1095 for low (-25°C) and medium (-8°C) temperatures and No 2016/2281 for high temperatures (+7°C), are in compliance. The harmonised standards EN 14511 series and EN 14825 have been used for testing and calculation. Value tolerances for selection tools comply with EN 12900.



PAC 233 chiller with UniSAB systems controller

Sabroe PAC chillers

Packaged ammonia chillers based on screw compressors, with a 100–7,200 kW capacity range

PAC ammonia-based chillers are fully integrated packaged units, designed to take full advantage of the many different models of ultra-reliable Sabroe screw compressors. They are popular because there is such a wide range of different standard sizes. They are also particularly easy to customise to meet specific requirements.

The integrated design, with the plate evaporator/condenser, oil separator, and control system all built in, means PAC units provide exceptional refrigeration capacity while only taking up a minimum of space. They are ideal for use in indirect cooling setups and in installations where it is important to use future-compatible natural refrigerants, such as ammonia.

The advanced technology and the well-matched integration of the component systems make these chillers so energy efficient that their low operating costs make them the most economical choice over the lifetime of a refrigeration plant.

Range

There are 19 different standard models in this range of packaged chillers, with capacities ranging from approx.
100 kW to 7,200 kW.

Customised configurations are also available for use with remote air-cooled or evaporative condensers, and for twin- or multi-packages, designed to provide particularly large cooling capacities.

Features	Benefits
Factory-assembled, pre-tested packaged units	Easy pre-commissioning makes installation and running-in both faster and cheaper. Factory acceptance test (FAT) available as an option
Comprehensive selection of compressor capacities, making it easier to match particular requirements	Avoid paying for greater capacity than needed
Very easy access for service	Improves safety, ensures maximum reliability and global sourcing of parts
Indirect cooling and uncomplicated flooded evaporating system, using ammonia (R717) only	Greater safety and outstanding reliability
Plate evaporator/condenser are easy to open and service	Routine checks/service can be carried out by operator's own staff

Water: inlet 12 °C, outlet 7 °C

Type	Cooling capacity	E-motor	R717 charge	Operational weight	Unit dimensions in mm			Sound pressure level	COP shaft cooling
	kW	kW	kg	kg	L	W	H	dB(A)	
PAC 120 S-A	195	55	38	4000	4310	1870	2260	82	4.4
PAC 120 M-A	317	81	40	4150	4310	1870	2260	83	4.8
PAC 120 L-A	402	96	50	4550	4310	1870	2260	84	4.9
PAC 120 E-A	538	140	54	4800	4560	1870	2360	86	4.9
PAC 151 S-A	617	140	55	5600	3800	2070	2360	88	5.0
PAC 151 M-A	741	167	59	5700	5700	2070	2360	89	5.1
PAC 151 L-A	933	222	75	6200	3940	2090	2450	89	5.1
PAC 151 E-A	1124	271	80	6350	4600	2090	2450	90	5.0
PAC 193 S-A	1076	222	81	6400	4600	2350	2450	82	5.2
PAC 193 L-A	1437	329	91	7000	5300	2350	2450	82	5.2
PAC 233 S-A	1931	393	167	11500	5500	2900	3200	83	5.4
PAC 233 L-A	2434	491	183	12500	6700	3000	3200	83	5.4
PAC 233 E-A	3009	619	211	15200	6700	3050	3400	84	5.4
PAC 283 S-A	4114	840	229	17000	7500	3400	3400	85	5.4
NSPAC 283 L-A	4348	890	350	20500	7300	3700	4500	83	5.4
NSPAC 283 E-A	5226	1070	391	25500	8500	3700	4700	83	5.4
NSPAC 355 S-A	5342	1130	410	28000	8500	4000	4700	83	5.2
NSPAC 283 X-A	4941	1220	450	30000	9100	4000	4700	83	5.4
NSPAC 355 L-A	7212	1540	700	40000	10000	4000	6000	83	5.2

Ethylene glycol 30%: inlet -2 °C, outlet -8 °C

Type	Cooling capacity	E-motor	R717 charge	Operational weight	Unit dimensions in mm			Sound pressure level	COP shaft cooling
	kW	kW	kg	kg	L	W	H	dB(A)	
PAC 120 S-C	108	55	37	4000	4310	1870	2260	82	2.6
PAC 120 M-C	176	81	39	4150	4310	1870	2260	83	2.9
PAC 120 L-C	223	96	48	4500	4310	1870	2360	84	2.9
PAC 120 E-C	299	115	52	4700	4310	1870	2360	86	2.9
PAC 151 S-C	343	140	53	5550	3940	2070	2360	88	3.1
PAC 151 M-C	412	145	56	5600	3940	2070	2360	89	3.1
PAC 151 L-C	520	222	71	6100	3940	2090	2450	89	3.1
PAC 151 E-C	625	222	76	6200	4290	2090	2450	90	3.1
PAC 193 S-C	601	222	77	6250	4600	2350	2450	82	3.2
PAC 193 L-C	803	273	85	6750	5000	2350	2450	82	3.2
PAC 233 S-C	1078	368	158	11250	5200	2750	3200	84	3.3
PAC 233 L-C	1359	491	170	12100	5800	2750	3200	84	3.3
PAC 233 E-C	1680	619	193	14700	6500	2800	3400	84	3.3
PAC 283 S-C	1928	650	206	16350	6700	3150	3400	86	3.3
PAC 283 L-C	2180	814	230	19000	7100	3700	3400	88	3.3
NSPAC 283 E-C	2906	980	374	24500	7300	3700	4500	84	3.3
NSPAC 355 S-C	2972	1050	380	26000	8000	4000	4700	84	3.2
NSPAC 283 X-C	3304	1150	400	28000	8500	4000	4700	84	3.3
NSPAC 355 L-C	4013	1450	600	38000	9500	4000	6000	84	3.2

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the unit.

Condenser: Water inlet 30°C, outlet 35°C.
All data and nominal capacities kW at 3600 rpm, except for:
PAC 120 S at 1470 rpm.

Options

- Variable-speed drive (VSD)
- Soft-starter or Y/D starter
- Desuperheater
- Subcooler
- External condenser
- Control panel mounted separately
- 3600 rpm at 60 Hz or VSD
- Up to 4200 rpm using VSD
- Customer-witnessed factory acceptance test (FAT)

Our products within the scope of eco-design, implemented according to regulation No 2015/1095 for low (-25°C) and medium (-8°C) temperatures and No 2016/2281 for high temperatures (+7°C), are in compliance. The harmonised standards EN 14511 series and EN 14825 have been used for testing and calculation. Value tolerances for selection tools comply with EN 12900.

ChillPAC Air – air-cooled ammonia chiller

Sabroe ChillPAC Air chillers

Air-cooled chillers for outdoor installation based on reciprocating compressors, with a capacity range between 300 and 1400 kW.

Sabroe ChillPAC Air uses ammonia as refrigerant and is a series of air-cooled chillers based on ultra-reliable Sabroe reciprocating compressors. It is a factory-assembled system for outdoor installation.

The chiller is made in a compact design, which is achieved by having an extra-compact shell-and-plate evaporator, an SMC compressor and double V-coil condensers to reduce the overall footprint. With the lowest possible refrigerant charge and superior efficiency, the chiller provides the customer with an attractive, economic and environmentally responsible air-cooled chiller product.

ChillPAC Air offers flexible and simple on-site installation for remote or local cooling needs, without any supplementary water-cooling assembly required.

ChillPAC Air is based on the popular, proven and well-known ChillPAC family philosophy, and it shares many components and benefits with the Sabroe ChillPAC chillers.

Features	Benefits
Factory-assembled, pre-tested packaged units based on Sabroe reciprocating compressors world-renowned for their reliability	Easy pre-commissioning makes installation and running-in both faster and cheaper. Factory acceptance test (FAT) available (optional)
Outdoor installation in weatherproof enclosure	Cooling capacity can be added without needing to build/rebuild a machine room
Easy to mount, install and connect	Low installation costs and rapid commissioning
Natural refrigerant R717	Future-safe refrigerant supporting sustainability and ensuring high efficiency
Exceptional COP and outstanding part-load performance	Greater cooling effect from a smaller refrigerant charge, and optimum load structure over the entire capacity range

Range

There are 15 different standard models in this range of air-cooled chillers, with capacities ranging from 300 to 1400 kW.

Water: inlet 12°, outlet 7°C

Type	Cooling capacity	E-motor	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level		COP shaft cooling
								Chiller	Condenser	
	kW	kW	kg	kg	L	W	H	dB(A)	dB(A)	
ChillPAC Air 104 S	264	72	43	6900*	10200	2300	3600	52	62**	4.42
ChillPAC Air 104 L	338	91	51	8200*	11500	2300	3600	53	62**	4.47
ChillPAC Air 104 E	344	91	51	8200*	11500	2300	3600	53	62**	4.35
ChillPAC Air 106 S	395	113	52	8500*	11500	2300	3600	53	62**	4.46
ChillPAC Air 106 L	508	136	62	9500*	13800	2300	3600	54	62**	4.52
ChillPAC Air 106 E	514	136	64	9700*	13800	2300	3600	55	62**	4.37
ChillPAC Air 108 S	521	136	60	9700*	13800	2300	3600	55	62**	4.45
ChillPAC Air 108 L	669	162	71	10300*	15000	2300	3600	55	62**	4.5
ChillPAC Air 108 E	681	200	76	10900*	16300	2300	3600	56	62**	4.36
ChillPAC Air 112 S	782	200	88	12400*	17500	2300	3600	56	62**	4.5
ChillPAC Air 112 L	1003	245	101	13600*	20000	2300	3600	57	62**	4.53
ChillPAC Air 112 E	1024	290	108	14600*	21000	2300	3600	57	62**	4.4
ChillPAC Air 116 S	1033	303	106	14800*	21000	2300	3600	57	62**	4.48
ChillPAC Air 116 L	1322	347	***	***	***	***	***	58	62**	4.5
ChillPAC Air 116 E	1339	350	***	***	***	***	***	58	62**	4.34

* Without condenser base frame
** 55 dB option is also available
*** On request, depending on condenser configuration

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field. All sound measuring has been carried out according to ISO 9614-2 at a distance of 10 m.

Capacities are nominal and based on water temperature 12/7°C and ambient temperature 35°C

Capacities are nominal at 1800 rpm (E models: 1500 rpm)

Options

- Low-noise condenser
- Condenser with water spray system
- Condenser with adiabatic pad system
- Condenser base frame
- Variable-speed drive (VSD) for optimum COP
- Winter packages for low ambient temperature locations
- Customer-witnessed factory acceptance test (FAT)
- Special requirements on request

Sabroe enclosure for outdoor installation

Sabroe enclosure for ChillPAC and HeatPAC units

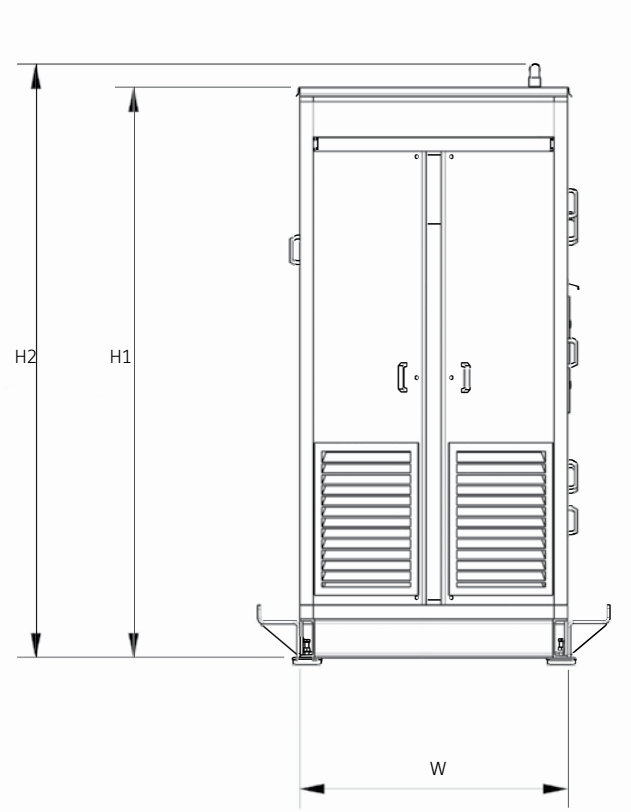
Add additional capacity to your existing cooling or heating system, without rebuilding your machine room.

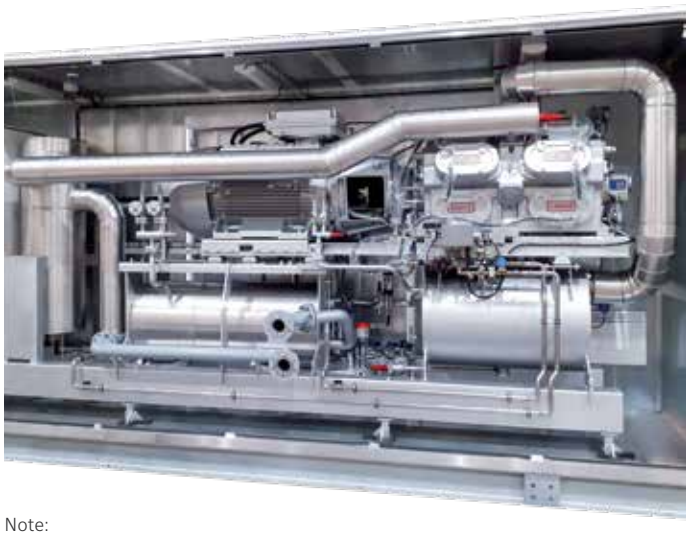
The Sabroe enclosure is specifically developed for ChillPAC and HeatPAC units, and its design preserves the compact design that the two units are known for. The enclosure is equally suitable for outdoor installation and as sound enclosure in a machine room.

Outdoor installation of a ChillPAC or HeatPAC in the enclosure further provides great flexibility for remote cooling or heating – exactly where you need it.

Sound reduction with enclosure: 17 dB(A)
(Tolerance of +/- 3 dB)

Features	Benefits
Easy to mount, install and connect	Low installation costs and rapid commissioning
Safety control panel included	Compliant electrical control with alarm levels, siren and alarm signals
Insulated wall panels, doors, floor and roof	Optimum indoor environment for the equipment
Heating and ventilation	Controlled temperature both during operation and at standstill
Sealed floor with drain and outside plates of aluzinc	Safe installation where controlled drainage is required, excellent corrosion resistance
Compliance with PED and DS/EN 378	Saves time and project cost





Ambient temperature: -15°C to +40°C.

Model	Dimensions in mm			Weight
	L	W	H1/H2	Kg
Low	4023	1370*	2661/2778*	1210
	5011	1370*	2661/2778*	1360
	6000	1370*	2661/2778*	1510
	6988	1370*	2661/2778*	1760
High	4023	1370*	2916/3033*	1250
	5011	1370*	2916/3033*	1400
	6000	1370*	2916/3033*	1550
	6988	1370*	2916/3033*	1800

* See the drawing above.

Note:
The enclosure is not defined as a machine room, because a person cannot stay inside it with the doors closed. Nevertheless, it fulfills machine room requirements for gas detection, ventilation and ATEX.

CAFP unit controlled and monitored by UniSAB systems controller

Sabroe CAFP CO_2/NH_3 low-temperature chiller

Compact packaged freezer systems using reciprocating or screw compressors, with a 100–2,500 kW capacity range

The highly customisable Sabroe CAFP freezer systems are using CO_2 on the low-temperature side and NH_3 (ammonia) on the high-temperature side, giving you the best of both worlds.

CO_2 has its strength at low temperatures, and NH_3 at high temperatures. A combination of both provides the user with a system, which is working on natural refrigerants and at the same time ensuring high efficiency and safety. The ammonia charge has been reduced to an absolute minimum and, instead of ammonia, CO_2 is distributed to the user production area. CO_2 has a high volumetric cooling capacity and this goes hand in hand with high efficiency.

These packaged systems are built around Sabroe reciprocating compressors that use CO_2 as refrigerant, which gives them eight times greater cooling capacity than corresponding compressors using ammonia. This in turn makes the low-temperature compressor much smaller, and the whole package considerably more compact than traditional two-stage ammonia-based freezer systems. The compact design means the CAFP package can be installed even when space is limited.

Compared with other solutions for low temperatures, a CAFP unit uses significantly less power in the temperature range down to −54°C.

This results in energy savings of as much as 15 percent compared with traditional two-stage ammonia systems, and up to 45 percent compared with single-stage setups. Alternatively, the higher capacity can be used for a higher throughput on the freezer equipment.

Range

There are six standard models in this range of freezer systems, with capacities ranging from 100 kW to 800 kW.
On request, we offer units up to 2,500 kW.
All CAFP units are operationally tested with refrigerant before dispatch. Factory acceptance test (FAT) available.

Features	Benefits
Compact design and technology that require small footprint	Big savings on installation costs
High COP and extremely low power consumption, even at part load	Low operating costs
Use of CO_2 as low-temperature refrigerant reduces piping complexity	Reduces installation costs
Very small ammonia charge, located on the unit itself	No risk of ammonia leaks in production areas, cold stores and working areas
CO_2 is a simple, inexpensive natural refrigerant	Low operating costs

Technical data

Model	Evaporation temperature	Cooling capacity	Power consumption	Compressors R744/R717	Minimum R717 charge (approx.)	Minimum R744 charge (approx.)	Unit dimensions in mm	Weight	Sound pressure level	COP shaft cooling
	°C	kW	kW		kg	l	L x W x H	kg	dB(A)	
CAFP 80	-50	84	64	HPO 24 / SMC 104 S	120	300	5500 x 2400 x 3000	7000	78	1.3
CAFP 80	-45	108	74	HPO 24 / SMC 104 L					80	1.5
CAFP 80	-40	138	84	HPO 24 / SMC 104 E					79	1.7
CAFP 80	-35	159	87	HPO 24 / SMC 106 S					79	1.8
CAFP 120	-50	125	95	HPO 26 / SMC 106 S	120	350	5700 x 3200 x 3300	10000	80	1.3
CAFP 120	-45	162	110	HPO 26 / SMC 106 L					80	1.5
CAFP 120	-40	203	126	HPO 26 / SMC 106 E					80	1.6
CAFP 120	-35	246	134	HPO 26 / SMC 108 L					82	1.8
CAFP 160	-50	166	127	HPO 28 / SMC 108 S	120	350	5900 x 2900 x 3300	11000	80	1.3
CAFP 160	-45	214	147	HPO 28 / SMC 108 L					82	1.5
CAFP 160	-40	271	167	HPO 28 / SMC 108 E					82	1.6
CAFP 160	-35	337	183	HPO 28 / SMC 112 L					83	1.9
CAFP 200	-50	196	150	HPC 104 / SMC 106 E	180	350	5900 x 3100 x 3800	14000	80	1.3
CAFP 200	-45	255	174	HPC 104 / SMC 108 E					82	1.5
CAFP 200	-40	321	193	HPC 104 / SMC 112 L					82	1.7
CAFP 200	-35	379	206	HPC 104 / SMC 112 L					83	1.8
CAFP 300	-50	300	222	HPC 106 / SMC 112 L	300	800	6300 x 3200 x 3900	16000	82	1.4
CAFP 300	-45	381	258	HPC 106 / SMC 112 E					82	1.5
CAFP 300	-40	468	279	HPC 106 / SMC 116 L					83	1.7
CAFP 300	-35	553	299	HPC 106 / SMC 116 L					83	1.9
CAFP 400	-50	392	293	HPC 108 / SMC 112 E	400	800	6500 x 3700 x 4000	19000	82	1.3
CAFP 400	-45	484	324	HPC 108 / SMC 116 L					83	1.5
CAFP 400	-40	616	370	HPC 108 / SMC 116 E					83	1.7
CAFP 400	-35	729	395	HPC 108 / SMC 116 E					83	1.9

Condenser: water inlet 25°C, outlet 30°C.
Capacities are nominal, 1500 rpm at 50 Hz.
Power consumption applies to compressors only.
Refrigerant charge depends on application.

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the unit.

Options

- Variable-speed drive
- Titanium plates in condenser
- Oversized CO_2 pump separator for high CO_2 evaporator volume
- Oversized CO_2 pumps for higher circulation rate
- Oversized ammonia condenser for higher cooling water temperature
- Fully welded shell-and-tube cascade cooler
- External interstage load, including a brine cooler on the R717 side of the cascade cooler
- Special version for use with remote condenser
- Configurations for use with HFC refrigerants instead of ammonia on high-pressure side

Standard equipment

- Double control panel including UniSAB systems controller
- CO_2 pump separator including two pumps (one standby)
- Shell-and-tube cascade cooler with double-tube sheet to minimise any risk of CO_2 and ammonia mixing
- Standstill cooling unit, with separate control panel and power supply to limit CO_2 pressure
- Automatic oil recovery system in both circuits
- Water-cooled condenser (plate heat exchanger type) on ammonia side
- Insulation of all cold parts

Reducing emissions, recovering heat

Times are changing, expectations are pivoting and Sabroe compressor capabilities are at the forefront of paving the way to new capabilities and levels of energy efficiency.

Increasing global demand for industrial heat pumps

There is now widespread demand for industrial heat pumps all over the world. One of the key drivers for this lies in legislative pressures as well as good-governance ESG decisions determined to reduce CO_2 emissions. One big source of these emissions is equipment such as boilers and furnaces that produce the large volumes of steam and warm water essential for countless industrial processes.

The potential of recovering heat on site

Decision-makers and technical experts everywhere are beginning to fully appreciate the potential of recovering thermal energy and exploiting temperature differences, reducing energy consumption by getting more out of valuable heat that's "already paid for" and on site.

Why heat pumps work

Heat pumps can quickly and effectively collect a lot of thermal energy that would otherwise simply be discharged into the surrounding air – and therefore wasted.

As just one example, many industries use compressed air in their production setups, and in some industries as much as a third of overall energy consumption is associated with the equipment needed to provide this compressed air. Once it has been compressed, the air is normally cooled and dehumidified. Heat pumps can be used to recover the considerable amounts of valuable thermal energy released by doing all this – and the same applies to the heat from any refrigeration and cooling equipment used.

Exploit waste heat from other processes

Another example lies in the many installations used for food processing and production. Here, waste heat from other processes can be recovered and put to effective use to meet requirements for high temperatures, in an inexpensive way with only limited environmental impacts.

Reduce CO_2 emissions while saving money with Sabroe heat pumps

Sabroe heat pumps can be used to supply a wide range of different temperatures and in this way help owners and operators save money while reducing CO_2 emissions and limiting the financial penalties now increasingly associated with these emissions.

Heat pumps

Heat pumps based on Sabroe core technologies

Sabroe heat pumps for commercial and industrial use are the result of intensive pioneer work on the idea of reaping energy benefits from using heat pumps in industry – long before heat pumps became fashionably greentech.

Sabroe heat pumps are the ideal solution for effectively exploiting low-temperature waste heat and turning it into hot water (up to 95°C) using only a minimum of electrical energy.

Ammonia as refrigerant

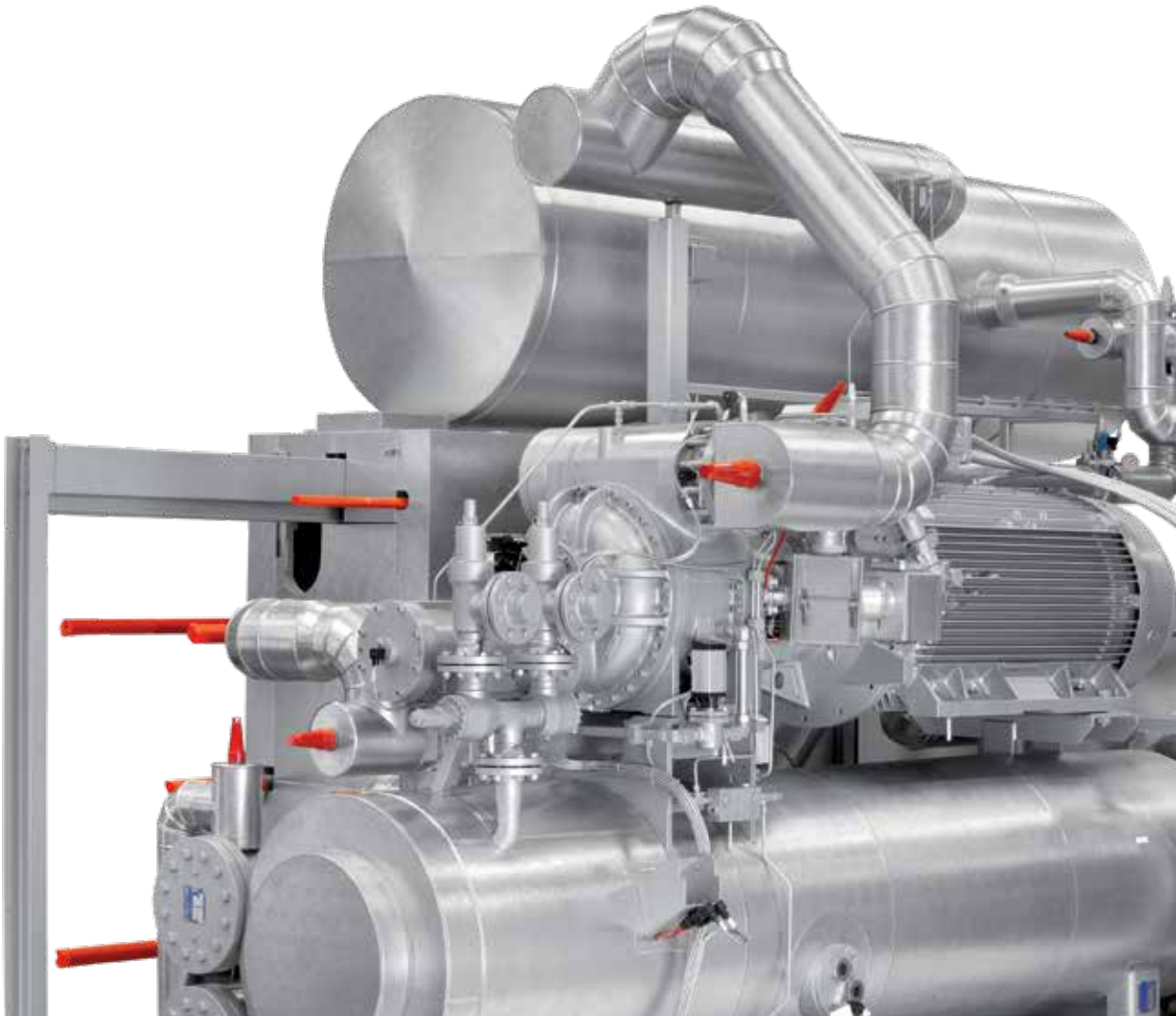
Sabroe industrial heat pumps use ammonia (R717) as refrigerant. Each unit is customised for the specific use and the particular installation, making sure that a minimum of thermal energy is used to provide maximum effect.

Compliance

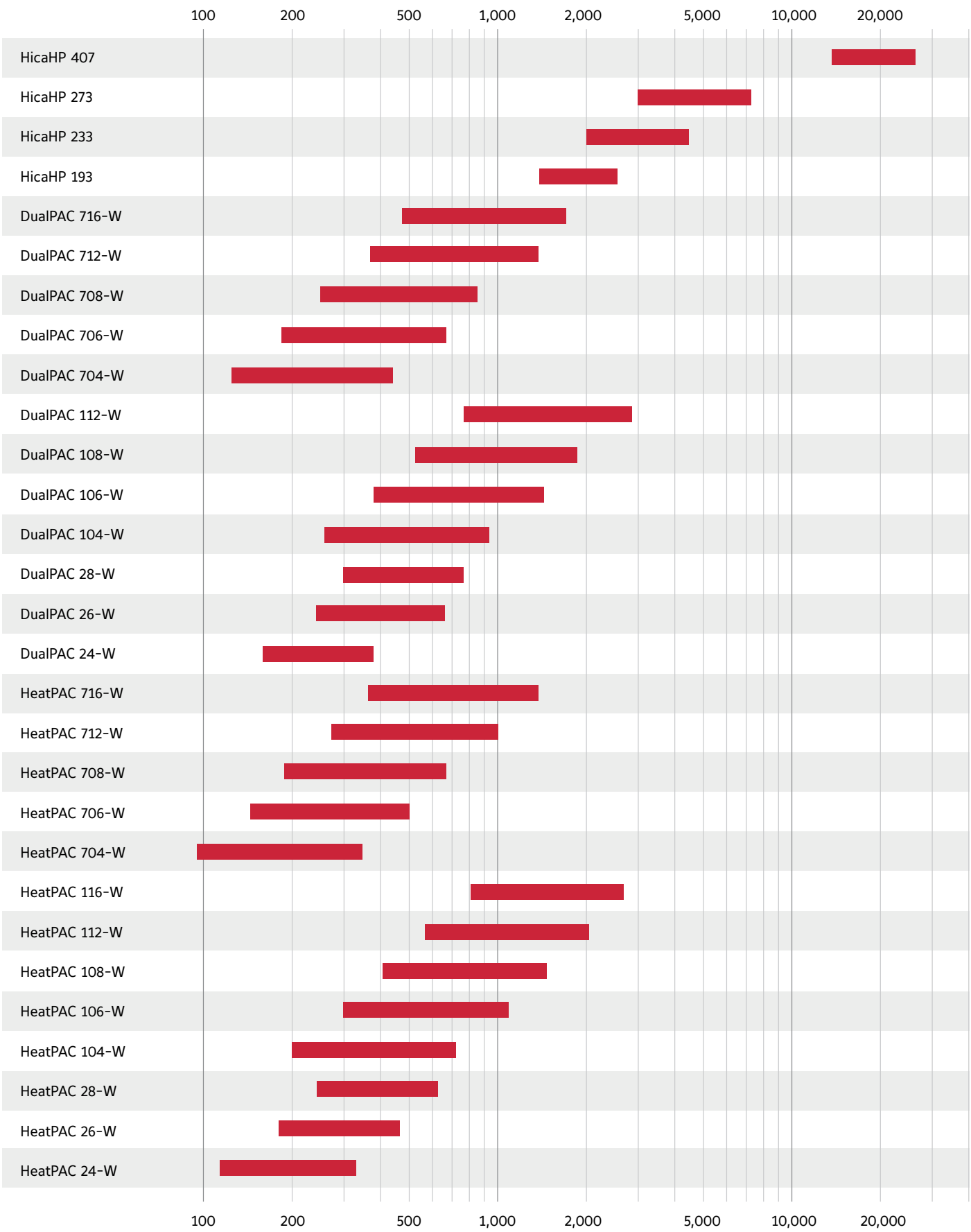
All Sabroe heat pumps are fully compliant with appropriate major international design codes and the specifications laid down by the most common classification societies.

Approval in accordance with other technical requirements, specific national legislation or other classification societies' requirements is available on request.

Customised single-stage heat pump with compressor



Sabroe heat pump programme



Heating capacity in kW

HeatPAC HPX with panel-mounted UniSAB systems controller

Sabroe HeatPAC heat pumps

Single-stage high-pressure ammonia-based heat pumps, using a reciprocating compressor, with a 300–2,700 kW capacity range

HeatPAC units are extremely compact heat pumps based on ultra-reliable Sabroe HPO/HPC/HPX high-pressure reciprocating compressors achieving up to 40 bar differential pressures and up to 60 bar design pressures. Using ammonia as refrigerant, Sabroe HeatPACs provide a low-cost supply of hot water at up to 90°C, ideal for sterilisation, pasteurisation, and many other heating processes.

These highly customisable integrated units are based on a unique vibration-resistant design, featuring an uncomplicated flooded evaporating system. With the uniquely combined desuperheater, condenser, and subcooler design, Sabroe HeatPACs offer superior efficiency. The units provide exceptional heat pump capacity from the smallest possible footprint, and with only a very small refrigerant charge.

Sabroe HeatPAC heat pumps are the ideal solution for effectively exploiting low-temperature waste heat and turning it into hot water (up to 90°C) using only a minimum of electrical energy.

These units are designed to provide a cost-effective way to tackle the need for cooling and heating at the same time, providing an extremely high coefficient of performance (COP).

Range

There are thirteen standard models in this range of heat pump systems, with capacities ranging from 300 kW to 2,700 kW.

Features	Benefits
Factory-assembled, pre-tested packaged units based on Sabroe reciprocating compressors world-renowned for their reliability	Easy pre-commissioning makes installation and running-in both faster and cheaper
Compact single-stage configuration weighs less and takes up less space than bespoke and/or two-stage heat pump designs	Low installation cost. Easy to mount even in confined spaces or unconventional locations
Exceptional COP and outstanding part-load performance	High energy-efficiency, low operating costs
Service and maintenance based on load-based service schedules	Improved reliability, longer service intervals, minimal downtime, low cost of ownership
Variable-speed drive (VSD) and UniSAB compressor package controller as standard	Outstanding part-load performance and maximum operating flexibility

Water condenser inlet 60 °C, outlet 70 °C and evaporator inlet 39 °C, outlet 34 °C

Type	Heating capacity	Cooling capacity	E-motor	Power consumption (shaft)	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft heating
	kW	kW	kW	kW	kg	kg	L	W	H	dB(A)	
HeatPAC 24-W	307	260	55	47	38	3100	3900	1000	2000	76	6.5
HeatPAC 26-W	461	391	79	71	48	3900	4100	1000	2000	78	6.5
HeatPAC 28-W	615	521	114	95	55	4200	4300	1000	2000	79	6.5
HeatPAC 104-W	725	611	136	112	73	5100	4500	1000	2000	82	6.5
HeatPAC 106-W	1087	916	207	168	87	5600	4900	1000	2000	83	6.5
HeatPAC 108-W	1432	1206	253	224	104	6200	5300	1000	2000	84	6.4
HeatPAC 112-W	2078	1742	399	338	121	8800	5700	1000	2100	85	6.2
HeatPAC 116-W	2663	2224	487	444	130	9800	6000	1000	2100	85	6.0

Water condenser inlet 70 °C, outlet 90 °C and evaporator inlet 39 °C, outlet 34 °C

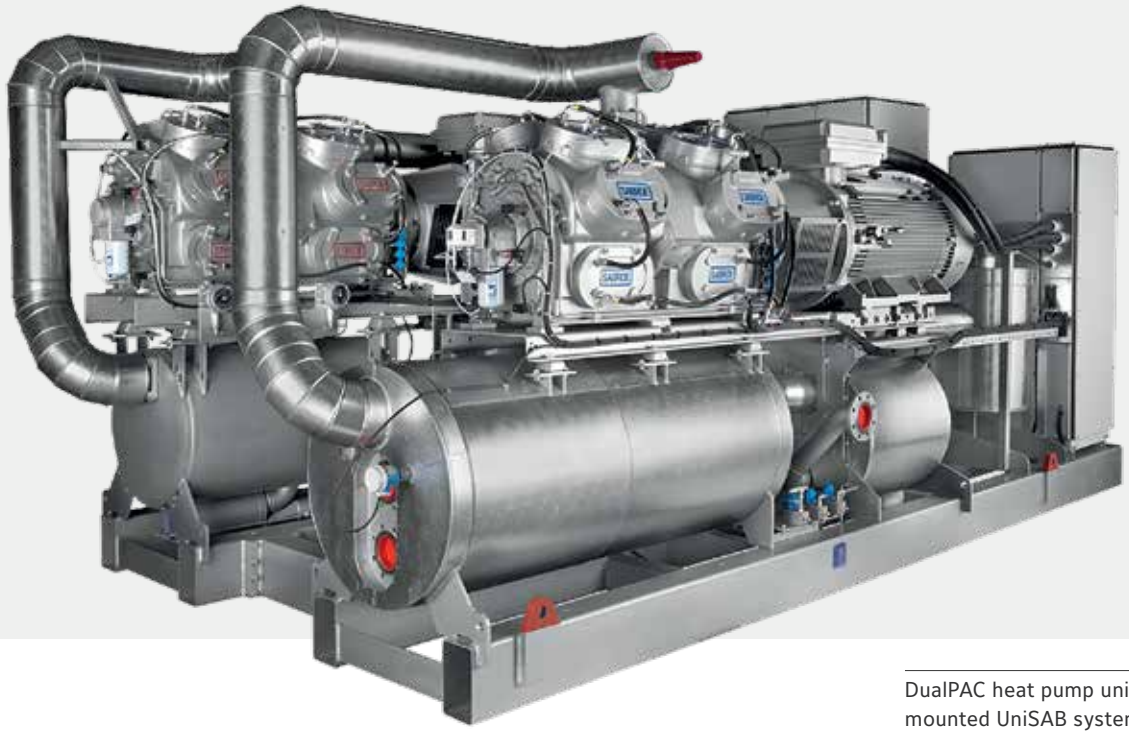
Type	Heating capacity	Cooling capacity	E-motor	Power consumption (shaft)	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft heating
	kW	kW	kW	kW	kg	kg	L	W	H	dB(A)	
HeatPAC 704-W	341	269	97	77	35	3500	3800	1000	2100	83	4.4
HeatPAC 706-W	511	403	136	116	44	4200	4000	1000	2100	84	4.4
HeatPAC 708-W	682	537	172	154	54	5000	4400	1000	2100	85	4.4
HeatPAC 712-W	1023	805	271	232	73	6250	5200	1000	2100	86	4.4
HeatPAC 716-W	1346	1059	347	308	88	7000	6000	1000	2100	86	4.4

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the unit.

W = Heat pump unit water/water.
All data and nominal capacities kW at 1800 rpm.
All HeatPACs: 60 Hz or VSD operation possible.

Options

- Cascade evaporator
- Desuperheater
- Subcooler
- Variable-speed drive (VSD)
- Soft-starter or Y/D starter
- Control panel mounted separately
- Customer-witnessed factory acceptance test (FAT)
- Enclosure for outdoor installation



DualPAC heat pump unit with panel-mounted UniSAB systems controllers

Sabroe DualPAC heat pumps

Two-stage ammonia-based heat pumps with capacities of up to 3,000 kW

Sabroe DualPAC heat pumps combine ChillPAC and HeatPAC units into one single heat pump, using an ingenious modular system that makes it possible to achieve high temperature lifts, with the advantages of compact design and attractive operating economics. The DualPAC configuration is optimised for use in district heating and ground-source cooling.

The DualPAC is a two-stage high-temperature heat pump configuration that uses ammonia as refrigerant. It is designed with the aim of providing the best possible performance and versatile operating conditions. This unique setup ensures maximum flexibility in both configuration and capabilities, because all standard ChillPAC and HeatPAC models can be used.

DualPAC is an exceptional heat pump for utilising low source temperatures and supplying high temperatures at high capacity. The unique heat exchangers and vessels ensure minimum refrigerant charge as well as the highest possible efficiency.

Range

There are seventeen different models in the range of DualPAC heat pumps, with capacities ranging from 400 kW to 3,000 kW.

Features	Benefits
Stepless, skip-free capacity control ensures that output always matches requirements	Lowest possible operating costs and maximum return on investment
Consistently high performance at both full and part load	Maximum part-load efficiency and low life cycle costs
Unique two-stage solution featuring patented purpose-designed open inter-stage cooler	Ultra-low refrigerant charge and small footprint
Space-saving footprint, with fewer moving parts and very low vibration	Exceptional reliability and low maintenance costs
Service and maintenance based on load-based service schedules	Improved reliability, longer service intervals, minimal downtime, low cost of ownership

Condenser: water inlet: 50 °C, outlet 70 °C | Evaporator: water inlet 30 °C, outlet 20 °C

Type	Heating capacity	Cooling capacity	Power consump-tion (shaft)	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft heating
	kW	kW	kW	kg	kg	L	W	H	dB(A)	
DualPAC 24-W	434	345	90	53	5800	3500	3000	2000	82	4.8
DualPAC 26-W	652	519	134	60	6200	3700	3000	2000	83	4.9
DualPAC 28-W	869	692	178	71	6500	3750	3000	2000	84	4.9
DualPAC 104-W	1039	827	213	78	7500	5000	3000	2000	84	4.9
DualPAC 106-W	1557	1232	325	103	9200	5500	3000	2000	85	4.8
DualPAC 108-W	2075	1625	450	119	12500	6000	3000	2200	86	4.6
DualPAC 112-W	2895	2266	628	132	16000	7500	3000	2200	86	4.6
DualPAC 704-W	498	395	102	53	7000	4200	3000	2100	86	4.9
DualPAC 706-W	747	594	153	64	8500	4500	3000	2100	86	4.9
DualPAC 708-W	996	789	206	78	10000	5000	3000	2100	87	4.8
DualPAC 712-W	1494	1180	312	106	13500	5500	3000	2100	88	4.8
DualPAC 716-W	1991	1559	433	118	16500	6100	3000	2100	89	4.6

Condenser: water inlet: 70 °C, outlet 90 °C | Evaporator: water inlet 15 °C, outlet 5 °C

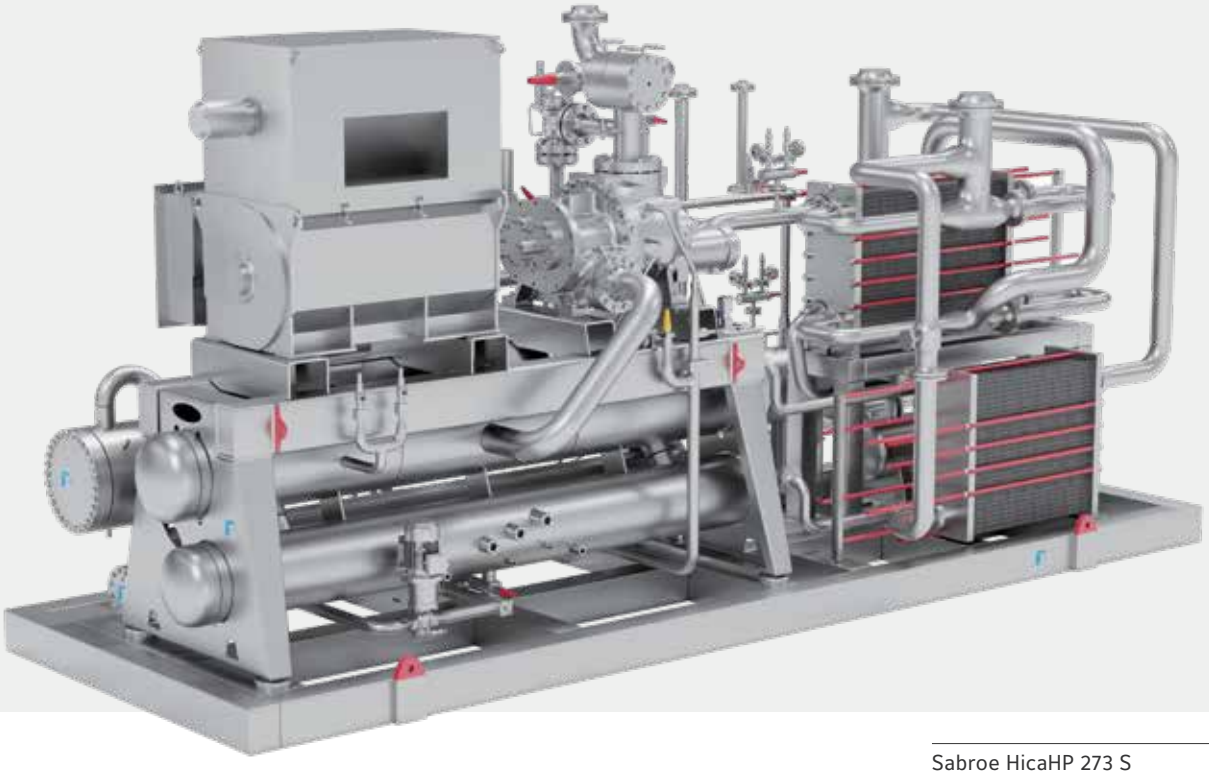
Type	Heating capacity	Cooling capacity	Power consumption (shaft)	R717 charge	Dry weight	Unit dimensions in mm			Sound pressure level	COP shaft heating
	kW	kW	kW	kg	kg	L	W	H	dB(A)	
DualPAC 704-W	460	318	150	57	7000	4200	3000	2100	86	3.1
DualPAC 706-W	690	476	223	65	8500	4500	3000	2100	86	3.1
DualPAC 708-W	920	623	298	75	10000	5000	3000	2100	87	3.1
DualPAC 712-W	1381	940	445	102	13500	5500	3000	2100	88	3.1
DualPAC 716-W	1841	1243	608	114	16500	6100	3000	2100	89	3

W = Heat pump unit water/water
Please contact your Sabroe representative for availability.

Dimensions, weight and sound pressure levels are guidelines only.
Sound pressure levels measured in free field, over reflecting plane and one metre distance from the unit.

Options

- Variable-speed drive (VSD)
- Soft-starter or Y/D starter
- Desuperheater
- Subcooler
- Control panel mounted separately
- Shunt solution for high-temperature difference
- Customer-witnessed factory acceptance test (FAT)



Sabroe HicaHP 273 S

Sabroe HicaHP Heat pumps

Ammonia-based heat pumps using screw compressors with capacities ranging from 2 MW to 25 MW, delivering up to 95°C.

Sabroe HicaHP (high capacity heat pumps) are compact heat pumps optimised to enable large-scale heat pump installations to support your path to net zero.

By using the environmentally friendly natural refrigerant ammonia, HicaHP can deliver high water temperatures of up to 95°C at a high capacity yet with minimum energy needed to operate the compressor.

HicaHP heat pumps are optimised at 40 bar or 63 bar design pressure, enabling a supply temperature up to 72°C or 95°C respectively, offering an optimal solution for various temperature needs.

To achieve 95°C supply, HicaHP uses a unique high-pressure compressor developed and designed specifically for high-pressure heat pump applications. These compressors have optimised rotor profiles in a design that ensures exceptional reliability, low deflection, high efficiency and long service life.

Features	Benefits
Factory-assembled, pre-tested packaged units, including capacity test (407: compressor test only)	Easy pre-commissioning makes installation and running-in both faster and cheaper
Newly developed, short and robust rotor profile, specifically for heat pump operation	Increased lifetime and service intervals, minimising total life cycle cost
Based on solutions to reduce vibrations and supply a compact and flexible design	Increased reliability and uptime resulting in low life cycle cost
Small, space-saving footprint, with fewer moving parts and very low vibration level	Exceptional reliability, low maintenance costs and very easy access for service
Condition-based service schedules, which help improve safety and ensure maximum reliability	Optimised service/maintenance intervals, minimal unscheduled downtime

Range

There are five different models in the range of HicaHP heat pumps, with capacities ranging from 2 MW to 25 MW.

Single-stage HicaHP

Model	Cold side In/out	Hot side In/out	Heating capacity	Cooling capacity	Power consumption	Sound pressure level	COP heating
	°C	°C	kW	kW	kW	db(A)	
HicaHP 193 S	20/12	50/72	1690	1266	424	84	3.9
HicaHP 233 S	20/12	50/72	3021	2281	740	86	4.0
HicaHP 273 S	40/30	65/95	4325	3150	1175	84.3	3.6
HicaHP 407 S	40/30	65/95	14385	10258	4127	-	3.5
HicaHP 407 L	40/30	65/95	19274	13807	5467	-	3.5
HicaHP 273 S	50/40	65/95	5375	4166	1209	84.3	4.3
HicaHP 407 S	50/40	65/95	17937	13660	4278	-	4.2
HicaHP 407 L	50/40	65/95	23986	18271	5715	-	4.2

Two-stage HicaHP

Model	Cold side In/out	Hot side In/out	Heating capacity	Cooling capacity	Power consumption	Sound pressure level	COP heating
	°C	°C	kW	kW	kW	db(A)	
HicaHP 273 S/283 S	25/15	60/95	6750	4765	1985	86.6	3.4
HicaHP 273 S/283 L	20/10	60/95	7260	4885	2375	86.4	3.1
HicaHP 273 S/283 L	15/5	60/95	6450	4241	2209	86.2	2.9

Sound pressure levels are guidelines only.

Options

- Different oil cooler layouts based on customer needs
- Economiser operation for increased efficiency
- High-voltage motors
- Complete economiser system
- Customer-witnessed factory acceptance test (FAT)

Sabroe controls


Package operating value
Section
Pressure
Temperature
Superheat
Discharge
Oil
Oil-filter differential
Compressor
Step capacity
Capacity
Motor
Current
Hours
System operating values
Process Out
Process In
User 1 input
Motor
LPMP reference output
DX reference output
Compressor
Active shutdown:
Stopped
Active warning:
Active times:
Compressor
Capacity
Manual
UniSAB® 4
SABROE

Control systems for every requirement

Matching operations to conditions

One of the most effective ways to improve the overall efficiency of your refrigeration setup is to make sure your processes and operations are always in tune with constantly changing operating parameters and equipment status, as well as unpredictable weather and climate conditions.

Sabroe control solutions and monitoring systems combine to leverage the effectiveness and operational reliability of all kinds of industrial refrigeration and heat pump applications, as well as the efficiency of the industrial processes of which they are a part.

These systems enable you to take fully informed decisions when dealing with changes in – and changes to – operating conditions. Reliable, easy-to-use features help you improve the energy efficiency of your operations, reduce your operating costs and boost your return on investment.

Sabroe control and monitoring solutions combined with Johnson Controls' OpenBlue suite of connected solutions make it easy to harvest, collate and apply operating data to service solutions, such as remote diagnostics, predictive maintenance, advanced risk assesment and more.

Efficiency
Uptime
Best practices
Connectivity
Compliance

UniSAB

Web

Chiller and Heat Pump Plant Controller

Condensing Pressure Optimiser (CP Optimiser)

Sabroe panels

Integrated Standard Automation Concept (ISAC)

Release: May 2023

UniSAB 4

The new UniSAB controller generation for industrial refrigeration compressors, heat pumps and chillers. It's Sabroe, naturally.

After many years in service, the time has come to say thank you to UniSAB III and pass on its legacy to UniSAB 4.

Sabroe UniSABs are cutting edge and industry leading on asset protection and the ability to limit the total cost of equipment ownership. The UniSAB offers proven reliability for the compressor as well as the controller itself, and wins indisputably on all the parameters most important to owners of IR equipment – highest possible plant uptime, yield accuracy, lowest possible total cost of equipment ownership and, not least, cost effectiveness.

UniSAB 4 is 125 years of expertise packaged in new powerful hardware, with IoT connectivity capabilities and a 10" colour touchscreen for quick, intuitive on-screen navigation. Novel, yet already reputable with its acknowledged compact design inherited from its distinguished predecessor, the UniSAB III.

Selected UniSAB 4 highlights

- New powerful hardware with more inputs and outputs
- Same footprint and cable-wire plug configuration as UniSAB III
- 10" colour touchscreen
- Embedded web browser
- User screens as mobile-friendly responsive web pages
- Secure internet connection
- Flexible and user configurable Multisab++ sequencing system
- Industrial communication protocols
- Available for retrofit
- UniSAB 4 is fully integrated with Johnson Controls OpenBlue services

UniSAB 4. More capable. More flexible. More efficient.

Technical data

Enclosure:	IP55 box version, IP55 panel version
Ambient temperature:	0-55°C box version
Ambient humidity:	10-90% non-condensing
Power supply:	100-240 VAC, 50-60 Hz
Dimensions (H x W x D):	380*300*210 mm
Max. own consumption:	20 VA
Max. supply fuse:	10 A
Weight:	6.5 kg
Cable entry:	Flanges included
Compliance:	CE
Approvals:	Marine DNV/GL UL, cUL

System information

Operating system:	Linux
Graphical user interface:	10.1" colour touchscreen. Web server, embedded web browser, cyber secure IoT connectivity.
Communication protocols:	Modbus TCP via on-board Ethernet interface. Profibus DP via optional serial interface card. Profinet (future).
Inputs/outputs:	18 digital in, 25 digital out, 25 analogue in, 5 analogue out.

Application support

Compressors supported:	Fixed and variable speed reciprocating compressors, with or without solenoid activated unloading system. Fixed and variable speed screw compressors, with or without automatic capacity slide and VI-slide system.
Applications supported:	Industrial chiller applications. Industrial heat pump applications. Pump circulation and self-circulation refrigerant systems. DX systems.
Refrigerants:	12 preloaded refrigerant tables, e.g. R717, R600, R290, R744 and a universal.
Languages:	19 preloaded languages, e.g. English, Danish, French, German, Spanish.
Main features:	Advanced compressor protection and limiter system. Dynamic service interval computations. Smart, efficient capacity regulation systems for automatic control of capacity steps, capacity slide, VI-ratio and motor speed, curbing the wear of parts, securing the yield accuracy and optimising performance of the single package. Special heat pump compressor protective features. Built-in Multisab++ sequencing system for effective load distribution among multiple UniSAB 4s and UniSAB IIIs on compressors in a refrigerant pressure system or water temperature system, curbing wear, optimising performance, securing maximum plant uptime and yield accuracy of the total machine room compressor base. Remote control of capacity, remote setpoint, remote process sensor, outdoor compensation sensor. Automatic switching of parameter sets via digital inputs or communication interface (e.g. for seasonal switching between cold and hot side control of chillers/heat pumps) (future function). Condenser capacity control signal (future function). Control of pumps and valves on hot and cold side of heat pumps (for control of source/sink water energy and temperatures) (future function).

SVM system

Sabroe Vibration Monitoring system (SVM)

Automatic vibration monitoring system for Sabroe screw compressors

SVM provides accurate, continuous monitoring of the bearing vibration levels in Sabroe screw compressor packages, adding significant extra safety margins and potentially extending the service life of these crucial compressor components. Planning service life can now be based on the real condition of these bearings, rather than on mere projections.

SVM offers on-screen trending and inspection of vibration levels, commissioning tool for determination of the vibration level threshold values (for alarm and shutdown), remote monitoring opportunities, and it is also Johnson Controls OpenBlue ready.

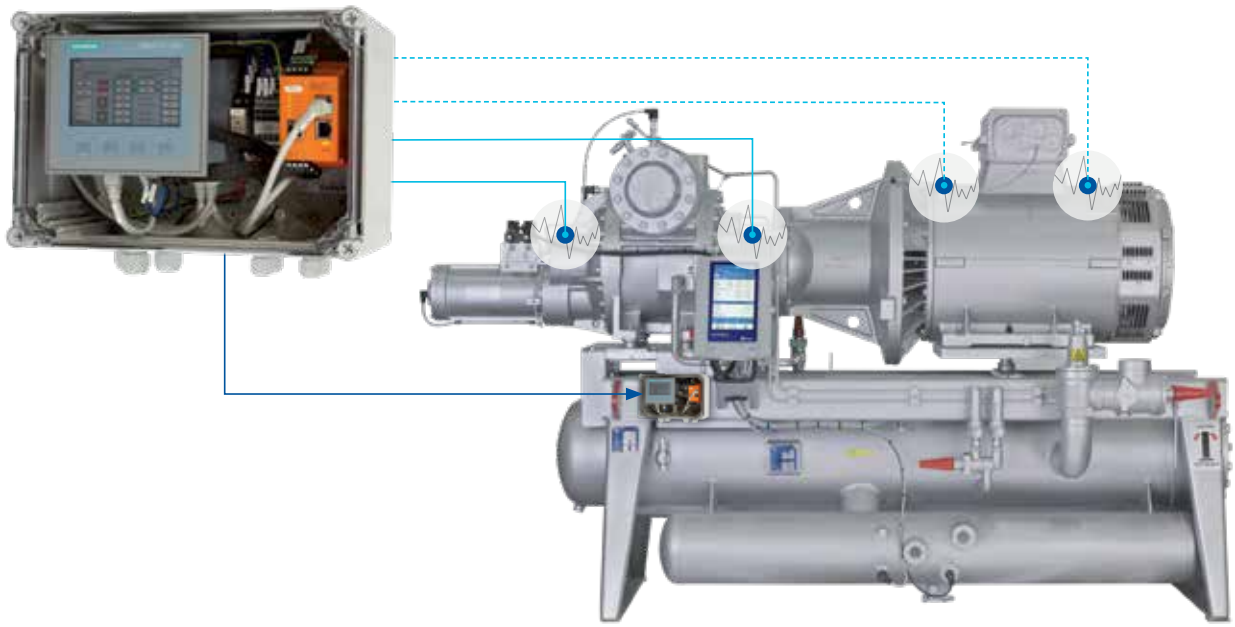
With the connected speed feedback signal and preprogrammed bandwidth for broadband monitoring, SVM can filter away the harmless lobe passing frequencies that might give misleading signal levels and focus only on the frequency ranges that give the best early indications of bearing fatigue. With the 1X rotational speed function, SVM may also be able to capture sudden imbalance (e.g. in the coupling), giving SVM a chance to stop the compressor before it causes a major breakdown.

SVM's potential free contact output for protective machine shutdown is connected to the safety circuit in the UniSAB III, but the generic signal design enables conventional hardwired integration with any design of electrical starter circuits.

The SVM package includes two factory-mounted accelerometers for the compressor, but it is also possible to add two additional accelerometers for compressor motor bearing monitoring.

With the SVM system, the conventional 6-month vibration analysis – normally recommended to make sure the screw compressor components comply with expected vibration levels, based on the full-spectrum baseline established at start-up – is no longer required.

Advantages	Benefits
SVM receives motor speed data from the variable-speed drive (VSD), enabling SVM to ignore normal lobe passing frequencies and detect only for damaging frequencies	Suppresses misleading signals and therefore avoids false alarms and shutdowns
Constant monitoring of bearing vibration development ensures the best possible preventive monitoring of bearing conditions	The standard recommended 6-month vibration analysis, using the Sabroe VibraGuard tool, is no longer required
Early warning of any increasing bearing fatigue	Paves the way to effective repair planning that avoids costly disruption of plant operations
UniSAB III systems controller automatically shuts down the compressor before any vibration level reaches a critical threshold	Less risk of severe equipment damage



Installation and operation

SVM is available factory mounted only.

For installation in hazardous areas, please contact your Johnson Controls sales representative.

Technical data	
Main component	IFM VSE153 vibration analysis module Siemens PLC type S7-1200 Siemens touch panel type KTP400 Basic 4"
Power supply	24V DC, min. 800mA
Dimensions HxWxD	300 x 200 x 186 mm
Ingress protection	IP55
Compliance	CE
Enclosure	Plastic – Ensto OABP302018T
Cable connections	4 x M16, 3 x M20
Ambient temperature	-40°C to 70°C

Ordering information	
SAB-Vib01	SVM kit, including 2 accelerometers for the compressor, 1 SVM box, mounting and cable installation on the compressor unit
SAB-Vib02	Danfoss MCB101 I/O expansion module (required for Danfoss VSD)
SAB-Vib03	Two accelerometers for the motor (optional)
SAB-Vib04	Addition to box for support of a second compressor, including vibration sensors for the compressor. Vibration sensors for no. 2 motor and I/O module for no. 2 Danfoss VSD is not included and must be added separately

Sabroe VSD panel

Sabroe VSD panel

Electrical panel solution for refrigeration compressor units with variable-speed drive (VSD)

Sabroe VSD (variable-speed drive) panel solutions are the ideal way to integrate the unique Sabroe combination of refrigeration compressor unit know-how with electrical and controls experience and technologies. This paves the way to optimising the operation of refrigeration compressor units, and thus bring down here-and-now operating costs as well as longer-perspective lifecycle costs for the owner.

Sabroe VSD panels are integrated electrical panel solutions with a built-in frequency inverter and additional control equipment that together make them very easy to integrate into your overall power supply and control system.

Adding an optional UniSAB systems controller makes the VSD panel a complete plug-and-play controls and motor drive solution, ready to ensure your compressor package delivers maximum cooling power with minimum lifecycle costs.

Factory-mounted units provide the best value for money, because delivering complete pre-vetted units ensures trouble-free operation and an electrical installation in full accordance with relevant standards and best practice. It also ensures end-users big savings on the man-hours required for configuring the overall equipment setup.

Features	Benefits
Competitively priced electrical panel solution for variable-speed drive of compressors, chillers and heat pumps	Easy to opt in for the Sabroe VSD panels, which will save you additional shop-stops
The optimised compact design fits the Sabroe small footprint package philosophy	Saves valuable space and leaves room for other important purposes
Pre-vetted, documented, and intelligently engineered solutions, containing everything needed for easy, compliant integration	Saves a lot of time on electrical engineering, design, documentation, installation, and commissioning
Can be combined with UniSAB III systems controller, making an efficient and flexible integrated compressor control and speed-drive solution	An extremely low lifecycle cost of the compressor package

The VSD panels are available for the Sabroe compressor, chiller and heat pump units specified below. These panels are available as standard for power configurations up to 450 kW. Configurations up to 1000 kW are available on request.

Factory-mounted

- ChillPAC chillers
- PAC chillers
- HeatPAC heat pumps

Separate delivery for site mounting

- ChillPAC chillers
- PAC chillers
- HeatPAC heat pumps
- Screw compressors (all VSD-enabled)
- Reciprocating compressors (all VSD-enabled)

Retrofit

Sabroe VSD panels are also ideal for retrofit of the existing electrical starter systems. Sabroe VSD panels are mounted in a standardised painted-steel cabinet, and include the following equipment:

- Electrical engineering, documentation and parameter settings list for the frequency inverter
- Danfoss FC102 frequency inverter, including RFI filter
- High-frequency common mode filter for bearing current suppression
- UniSAB controller for panel mounting (optional – must be selected separately)
- Main circuit breaker
- Control voltage transformer
- Emergency stop and emergency stop safety relay
- Motor protection
- Current feedback signal to UniSAB
- Relays for signals to UniSAB
- Hour counter
- Terminals for interlock with pumps, etc.
- MCB for control voltage to panel
- MCB for control voltage to UniSAB
- MCB for power to immersion heater in oil separator
- Cable inlet/outlet in panel bottom.

Technical data			
Nominal output	**Dimensions in mm**		
kW/amp	**W**	**H**	**D**
22/44	816	1434	624
30/61	816	1434	624
37/73	816	1434	624
45/90	816	1434	624
55/106	816	1434	624
75/147	816	1434	624
90/177	816	1434	624
110/212	816	1626	624
132/260	816	1626	624
160/315	816	1818	624
200/395	816	1818	624
250/480	816	1818	624
315/600	816	1818	624
355/658	1200	2202	816
400/745	1200	2202	816
450/800	1200	2202	816

Technical data	
Power supply:	3x400 V, 50/60 Hz, +/-10%
Earthing/supply system:	TN-S
Partitioning:	Form 1
Colour:	Light grey
Ingress protection class:	IP54
Compliance:	CE

Sabroe A-frame VSD panel

Sabroe A-frame VSD panel

Electrical panel solution for refrigeration screw compressors with variable-speed drive (VSD)

Sabroe panel solutions for screw compressor units fitted with variable-speed drive are the ideal way to integrate the unique Sabroe combination of refrigeration compressor know-how with electrical and controls experience and technologies. This paves the way to optimising the operation of refrigeration compressor units, and thus bring down here-and-now operating costs as well as longer-perspective life cycle costs for the owner.

The Sabroe A-frame VSD solution for screw compressors is a compact split solution with a separate panel and VSD. The panel includes a UniSAB systems controller as standard.

The A-frame VSD solution is mainly intended for applications where both the inverter and panel are mounted directly onto the compressor unit, or where the inverter is positioned in a different place than the control panel.

Factory-mounted units provide the best value for money, because delivering complete pre-vetted units ensures trouble-free operation and an electrical installation in full accordance with relevant standards and best practice. It also ensures end-users big savings on the man-hours required for configuring the overall equipment setup.

Features	Benefits
Competitively priced solution for variable-speed drive of A-frame screw compressors	Easy to opt in for the Sabroe A-frame VSD solution, which will save you additional shop-stops
The optimised compact design fits the Sabroe small footprint package philosophy	Saves valuable space and leaves room for other important purposes
Pre-vetted, documented and intelligently engineered solutions, containing everything needed for easy, compliant integration	Saves you a lot of time on electrical engineering, design, documentation, installation and commissioning
The combination of a UniSAB III systems controller and VSD makes an efficient and flexible integrated compressor control and speed-drive solution	An extremely low life-cycle cost of the compressor package

The A-frame VSD solution is available for the Sabroe screw compressor units specified below. These panels are available as standard for power configurations from 90 kW to 315 kW.

Factory-mounted (90-315 kW)

- SAB 120–151 series
- SAB 193 S
- ComPAC

Separate delivery for site mounting

- SAB 120–151 series
- SAB 193 S

Retrofit

Sabroe A-frame VSD panels are also ideal for the retrofit of existing electrical starter systems.

Sabroe A-frame VSD panel solutions comprise a frequency inverter and a control panel in a standardised painted-steel cabinet containing the following equipment:

- Electrical engineering, documentation, and parameter settings list for the frequency inverter
- UniSAB controller
- Main circuit breaker
- Control voltage transformer
- High-frequency common mode filter for bearing current suppression
- Emergency stop and emergency stop safety relay
- Motor protection
- Current feedback signal to UniSAB
- Relays for signals to UniSAB
- Hour counter
- MCB for control voltage to panel
- MCB for control voltage to UniSAB
- MCB for power to immersion heater in oil separator
- Cable inlet/outlet in panel bottom

Technical data - panel	
Power supply:	3x400 V, 50/60 Hz, +/-10 %
Earthing/supply system:	TN-S
Partitioning:	Form 1
Colour:	Light grey
Ingress protection class:	IP54
Compliance:	CE
Dimensions in mm:	W 600 x H 950 x D 400

Technical data - frequency inverter	
Type:	Danfoss FC102
Filter included:	RFI/EMI and common mode
Ingress protection class:	IP54
Dimensions in mm:	W x H x D
90 kW:	370 x 770 x 330
110-160 kW:	325 x 901 x 378
200-315 kW:	420 x 1060 x 378

Sabroe softstarter FSD panel

Sabroe softstarter FSD panel

Electrical panel solution for refrigeration compressor units with fixed-speed drive (FSD)

Sabroe panel solutions for compressor units fitted with fixed-speed motors are the ideal way to integrate the unique Sabroe combination of refrigeration compressor know-how with electrical and controls experience and technologies. This paves the way to optimising the operation of fixed-speed refrigeration compressor units, and bring down here-and-now operating costs as well as longer-perspective lifecycle costs for the owner.

Sabroe softstarter FSD panels are integrated electrical panel solutions with a built-in softstarter and additional control equipment that together make them very easy to integrate into your overall power supply and control system.

Adding an optional UniSAB systems controller makes the softstarter FSD panel a complete plug-and-play controls and motor starter solution, ready to supply the motor and ensure that the fixed-speed compressor unit delivers maximum cooling power at a minimum life cycle cost.

Sabroe softstarter FSD panels are an advanced electronic alternative to conventional Y/D starters, enabling a smoother start and (in some setups) making it possible to reduce the starting current better than a Y/D starter.

Factory-mounted units provide the best value by ensuring trouble-free operation and an electrical installation in full accordance with relevant standards and best practice. It also ensures end-users big savings on the man-hours required for configuring the overall equipment setup.

Features	Benefits
Competitively priced electrical panel solution for fixed-speed drive of compressors, chillers and heat pumps	Easy to opt for the Sabroe softstarter FSD panels, which will save you additional shop stops
The optimised compact design fits the Sabroe small footprint package philosophy	Saves valuable space and leaves room for other important purposes
Pre-vetted, documented and intelligently engineered solutions, containing everything needed for easy, compliant integration	Saves you a lot of time on electrical engineering, design, documentation, installation, and commissioning
Can be combined with UniSAB III systems controller, making an efficient and flexible integrated compressor control and motor start solution	A very low lifecycle cost of the compressor package

Softstarter FSD panels are available for the Sabroe compressor, chiller and heat pump units specified below. These panels are available as standard for power configurations up to 560 kW. Configurations above this are available on request.

Factory-mounted

- ChillPAC chillers
- PAC chillers
- HeatPAC heat pumps
- ComPAC

Separate delivery for site mounting, all on request

- ChillPAC chillers
- PAC chillers
- HeatPAC heat pumps
- All screw compressors
- All reciprocating compressors

Technical data - panel	
Power supply:	3x400 V, 50/60 Hz, +/-10 %
Earthing/supply system:	TN-S
Partitioning:	Form 1
Colour:	Light grey
Ingress protection class:	IP54
Compliance:	CE

Technical data			
Nominal output	**Dimensions in mm**		
kW	**W**	**H**	**D**
15	600	600	200
22	600	600	200
30	600	600	200
37	600	800	300
45	600	800	300
55	600	800	300
75	800	1000	300
90	800	1000	300
110	800	1000	300
132	800	1000	300
160	800	1200	300
200	1000	1400	300
250	1000	1400	300
315	1000	1400	300
355	1000	1800	400
400	1000	1800	400
450	1000	1800	400
500	1000	1800	400
560	1000	1800	400

Retrofit

Sabroe softstarter FSD panels are also ideal for the retrofit of existing electrical starter systems. Sabroe softstarter FSD panels are mounted in a standardised painted-steel cabinet and include the following equipment:

- Electrical engineering and documentation
- ABB softstarter
- In-line contactor for breaking power supply in case of emergency stop
- UniSAB controller for panel mounting (optional – must be selected separately)
- Main circuit breaker
- Control voltage transformer
- Emergency stop and emergency stop safety relay
- Motor protection
- Current feedback signal to UniSAB
- Relays for signals to UniSAB
- Hour counter
- Terminals for interlock with pumps, etc.
- MCB for control voltage to panel
- MCB for control voltage to UniSAB
- MCB for power to immersion heater in oil separator
- Power inlet in panel top

Sabroe Y/D starter panel

Sabroe Y/D starter FSD panel

Electrical panel solution for refrigeration compressors with fixed-speed drive (FSD)

Sabroe panel solutions for compressor units fitted with fixed-speed motors are the ideal way to integrate the unique Sabroe combination of refrigeration compressor know-how with electrical and controls experience and technologies. This paves the way to optimising the operation of fixed-speed refrigeration compressor units and thus bring down here-and-now operating costs as well as longer-perspective lifecycle cost for the owner.

Sabroe Y/D starter panels are integrated electrical panel solutions with conventional Y/D starters and additional control equipment that together make them very easy to integrate into your overall power supply and control system.

Adding the optional UniSAB systems controller to the panel makes the Y/D starter panel a complete plug-and-play controls and motor starter solution, ready to supply the motor and ensure that the fixed-speed compressor package delivers maximum cooling power at a minimum life cycle cost.

Factory-mounted units provide the best value for money, because delivering complete units ensures trouble-free operation and an electrical installation in full accordance with relevant standards and best practice. It also ensures end-users big savings on the man-hours required for configuring the overall equipment setup.

Features	Benefits
Competitively priced electrical panel solution for fixed-speed drive of compressors, chillers and heat pumps	Easy to opt for the Sabroe Y/D starter FSD panels, which will save you additional shop stops
The optimised compact design fits the Sabroe small footprint package philosophy	Saves valuable space and leaves room for other important purposes
Pre-vetted, documented and intelligently engineered solutions, containing everything needed for easy, compliant integration	Saves you a lot of time on electrical engineering, design, documentation, installation, and commissioning
Can be combined with UniSAB III systems controller, making an efficient and flexible integrated compressor control and motor start solution	A very low lifecycle cost of the compressor package

Y/D starter FSD panels are available for the Sabroe compressor, chiller and heat pump units specified below. These panels are available as standard for power configurations up to 560 kW. Configurations above this are available on request.

Factory-mounted

- ChillPAC chillers
- PAC chillers
- HeatPAC heat pumps
- ComPAC

Separate delivery for site mounting, all on request

- ChillPAC chillers
- PAC chillers
- HeatPAC heat pumps
- All screw compressors
- All reciprocating compressors

Retrofit

Sabroe Y/D starter FSD panels are also ideal for the retrofit of existing electrical starter systems.

Sabroe Y/D starter FSD panels are mounted in a standardised painted-steel cabinet and include the following equipment:

- Electrical engineering and documentation
- Y/D starter
- UniSAB controller for panel mounting (optional – must be selected separately)
- Main circuit breaker
- Control voltage transformer
- Emergency stop and emergency stop safety relay
- Thermal overload motor protection
- Current feedback signal to UniSAB
- Relays for signals to UniSAB
- Hour counter
- Terminals for interlock with pumps, etc.
- MCB for control voltage to panel
- MCB for control voltage to UniSAB
- MCB for power to immersion heater in oil separator
- Power inlet in panel top

Technical data	
Power supply:	3 x 400 V, 50/60 Hz, +/-10 %
Earthing/supply system:	TN-S
Partitioning:	Form 1
Colour:	Light grey
Ingress protection class:	IP54
Compliance:	EN60 204-1

Technical data			
Nominal output	**Dimensions in mm**		
kW	**W**	**H**	**D**
15	600	600	200
22	600	600	200
30	600	600	200
37	600	800	300
45	600	800	300
55	600	800	300
75	800	1000	300
90	800	1000	300
110	800	1000	300
132	800	1000	300
160	800	1200	300
200	1000	1400	300
250	1000	1400	300
315	1000	1400	300
355	1000	1800	400
400	1000	1800	400
450	1000	1800	400
500	1000	1800	400
560	1000	1800	400

Sabroe Chiller and Heat Pump Plant Controller

The shortcut to obtain full control of uptime, efficiency and life cycle cost

With the Sabroe Chiller and Heat Pump Plant Controller (CHPPC), the parameters to maximise uptime and efficiency and minimise the lifecycle cost of the equipment is available at your fingertips.

Decades of experience with total integration and daily operation of chiller plants is reflected in the advanced, comprehensive, user-friendly and configurable library of automation functions serving to provide control of the parameters that are paramount to optimisation of the chiller plant as a whole, and not limited to the single chiller.

The CHPPC has been extended to include advanced heat pump plant functions developed to secure a stable and efficient heat pump plant with maximum uptime and the lowest possible lifecycle cost.

Chiller and heat pump plant types now supported by the CHPPC:

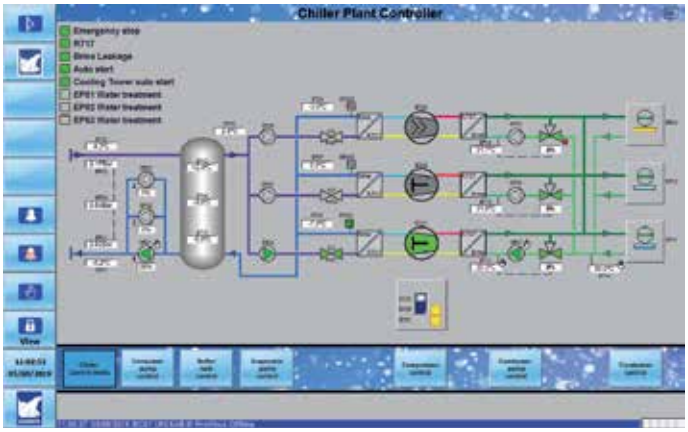
- Pure chiller plants with a conventional heat rejection side
- Pure water-to-water heat pump plants
- Combination plants where the heat pumps are also serving cooling purposes on the cold side

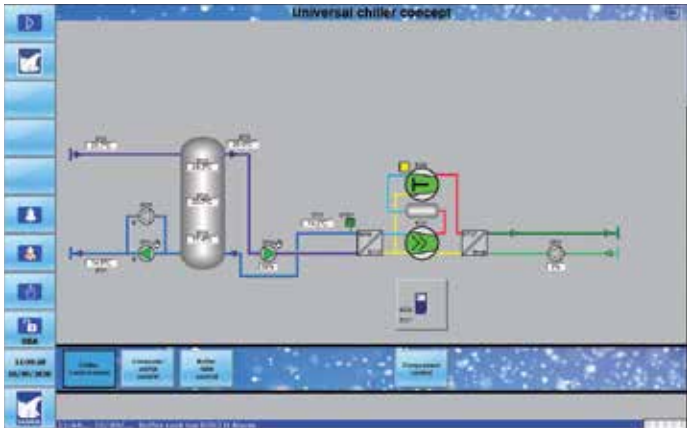
The CHPPC functions are brought to life with industrial PLC hardware and a 12" colour touch panel for intuitive and quick customisation to fit the actual plant design and daily operation, all built into a control panel for wall mount.

Remote access

Chiller and heat pump plant

Features	Benefits
Advanced and intuitive on-screen configuration	Instant customisation to fit the actual plant design
Pre-engineered, pre-programmed, pre-tested and fully documented electrical control panel with all inputs and outputs internally wired and connected to user-terminals	Provides a huge saving on time and cost related to designing, programming, documenting, installing and commissioning bespoke plants
Advanced functions with a wealth of user features for fully informed decisions, limp mode operation and quick faultfinding	Reduces the time spent on daily inspection routines and interventions to a minimum
Remote connection ready	Peace of mind with remote diagnosis and operation





Chillers and heat pumps are controlled by UniSAB

Cold side	The chiller and heat pump units	Hot side
Distribution pumps (up to three) incl. diff. pressure control	Remote monitoring of UniSAB IIIs on up to four compressors, distributed in four 1-stage or two 2-stage chillers/heat pumps	Fan speed and pump control for air-cooled and evaporative condensers and for dry coolers and cooling towers
Evaporator pumps and shut-off valve (up to four)	Any mix of screw and reciprocating compressors	Shut-off valves in glycol systems
Monitoring of temperatures and pressures in water system	Control signals from CHPPC to UniSABs	Condensing pressure optimisation
Monitoring of temperatures and level switch in buffer tank	Historical data, trends and event analysis of UniSAB III data on central touch panel	Noise reduction with week calendar (fan speed reduction)
Remote start/stop of chillers from buffer tank temperature	Bearing vibration monitoring	Rapid mixing of make-up water during standstill
Monitoring of the functioning of switches, motors and valves	Motor winding and bearing temperature monitoring	Monitoring of the functioning of switches, motors and valves
Leak detection signal from glycol sensor	Leak detection signal from NH_3 gas detector	Low-temperature protection of condenser circuit
Special for heat pumps		
Temperature and flow stabilisation with shunt pumps, shunt valves, in-line pumps or recycle pumps	COP optimisation through dynamic intermediate pressure in 2-stage heat pumps	Temperature control with shunt pumps, shunt valves or in-line pumps
Cooling power calculation	Superheat control	Heating power calculation
Common utilities		
Remote connection ready (Internet, LAN). Can be delivered with wireless internet modem on request.		
Profinet, Modbus TCP and OPC-UA protocols supported as standard. Others on request.		
Rich data monitoring of VSD pumps with external VSD through Profinet communication (Danfoss and ABB VSDs with Profinet interface supported).		

Control panel specifications	
Cabinet	1200 x 800 x 300 mm (HxWxD) painted steel plate, IP44
Connectivity	Touch panel: Ethernet interface for remote monitoring and operation PLC: Ethernet/Profinet interface for software service and connectivity to VSDs
Main components	Main switch, 24V DC power supply, relays and terminals, Siemens S7-1500SP PLC, and 12-inch Siemens Comfort touch panel

Sabroe CP Optimiser

Automatic device for balancing R717 condensing pressure against compressor efficiency

Many refrigeration systems that use R717 (ammonia) as refrigerant and feature an evaporative condenser are operated using a fixed set point to maintain a constant condensing pressure. This is rarely ideal, as the energy consumption of the compressors typically increases by 3 percent for every degree Celsius the condensing pressure rises. Shaft power consumption is directly influenced by condensing pressure. This impacts overall operating costs and plant efficiency.

Reducing condensing pressure improves compressor efficiency, but doing so also requires energy. Maximum overall efficiency stems from the best possible balance between compressor energy consumption and the energy required to reduce condensing pressure. The figure below indicates the sum total displacement of the energy consumption, if the condensing pressure deviates from optimum.

The CP Optimiser automatically calculates this energy balance, taking into account changing loads and conditions. This paves the way to considerable savings on energy bills, which means the CP Optimiser normally pays for itself within a matter of months.

Features	Benefits
Automatic operation based on inputs from just two sensors – temperature and humidity	Substantial reduction in compressor energy consumption, resulting in lower operating costs
Output signal can be connected directly to PLCs and frequency converters	Easy to integrate with modern monitoring and control systems to ensure maximum efficiency
No time-consuming programming or complicated technical setup required	Easy to commission and operate, and helps eliminate human error
No manual intervention or special operator skills required	Virtually no maintenance, calibration or attention necessary after commissioning
No special requirements for integration into new or existing R717-based refrigeration setups	Straightforward, inexpensive way to boost operating efficiency and reduce running costs

Where it is used

The CP Optimiser is highly recommended for inclusion in all new installations.

Installing the CP Optimiser in existing installations provides immediate savings on electricity costs.

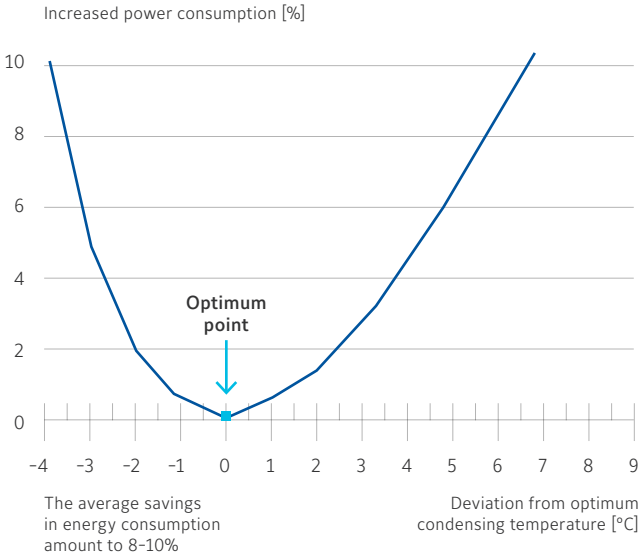
The CP Optimiser works with the following equipment:

- Evaporative condensers
- Air-cooled condensers
- Dry cooler
- Open cooling towers

Mounting

The CP Optimiser unit is a small box of electronics that is easy to mount in virtually any convenient location, either indoors or outdoors.

The unit only requires a 24-volt DC power supply and data from appropriate sensors for measuring temperature and relative humidity.



Technical data	
Supply voltage:	24-volt DC
Inputs:	Temperature 4–20 mA/0–50°C
Relative humidity:	4–20 mA/0–100% RH
Outputs:	Set point signals configurable to 4–20 mA or 0–10 volt DC
Dimensions (H x W x D):	115 x 90 x 55 mm
Enclosure:	IP54
Cable connections:	4 x PG7

Integrating the CP Optimiser

Temperature and relative humidity sensors are not included with the Sabroe CP Optimiser, but are available as optional equipment. Controller (PLC) not included.

Integrated Standard Automation Concept (ISAC)

Monitoring and control interface configuration system for industrial refrigeration installations

ISAC is unique Johnson Controls software that provides a toolbox for designing and configuring refrigeration control and monitoring setups of virtually all kinds. It provides an effective way to integrate SCADA graphics with PLC functionality to ensure effective, reliable monitoring and control of both large and small industrial refrigeration installations.

ISAC modules provide standardised, pre-vetted solutions for almost any installation, based on consistent, industry-standard data inputs and outputs that ensure seamless, glitch-free exchanges of data between many different kinds of equipment, regardless of capacity, configuration or manufacturer.

Features	Benefits
Extensive Sabroe practical experience is embedded in all ISAC modules	Ensures rapid, cost-effective application of best practice
All modules are designed as modular building blocks and based on standardised interfaces and data exchange configurations	Minimises the time required for design, planning, configuration and service
Each module designed and tested individually to eliminate technical incompatibilities	Greater safety, greater reliability and lower operating costs
Supports a wide range of standard configurations, ranging from single touch screens to multiple workstations	Easy to scale to the exact functionality required
Based on standardised components with a very high degree of documentation, for maximum consistency and efficiency	High saving potential on commissioning, running in and system optimisation, as well as on energy consumption

Where and how ISAC can be used

The ISAC system is easily scalable to meet a broad spectrum of refrigeration plant configurations. It provides advanced, flexible control functions with intuitive user features designed for the best match with the performance and technical requirements of each installation.

The ISAC system toolbox is designed to enable controls application engineers with only basic PLC and SCADA programming skills to build advanced, structured, and error-free program applications.

Once engineers are familiar with the toolbox and how to use it, ISAC makes it possible to build applications much faster than with conventional programming methods.

Extensive field and factory testing of the ISAC toolbox ensures error-free modules and paves the way to smooth, effective commissioning without the usual subsequent adjustments and fault corrections.

Access to the ISAC toolbox requires membership of the ISAC user community, and the ISAC community administrators provide new members with free training courses.

ISAC is easily applicable to both new and existing refrigeration setups, including extension schemes and retrofits of complete refrigeration plants.

Standard features

- Defrost queue, automatic temperature-controlled defrost time, multiple room temperature control setups, etc.
- Automatic equalisation of running hours in installations with multiple pumps and fans
- Differential pressure control of NH_3 pumps
- Manual control possibility of all motors, valves and other actuators
- Hour counters for all motors
- Historical trending
- Alarm and shutdown monitoring

ISAC is based on – and completely compatible with – industry-standard Siemens S7 hardware and GE IFIX Proficy SCADA software.

Heat exchangers and vessels

Heat exchangers and pressure vessels based on Sabroe core knowledge

Sabroe has 125 years of experience designing and supplying components for refrigeration and heat pump systems. A heat exchanger is a key component in both systems, and we offer an extensive range of Sabroe heat exchangers and presssure vessels for both land-based and marine-based installations.

Dedicated factory and design department

In 2016, Johnson Controls acquired the Hungarian manufacturing plant FMF, which has now become our dedicated heat exchanger and vessel production facility. Together with our inhouse construction team, they can provide approvals and documentation for the following: PED, EAC, DNV, LRS, BV, ABS, MOM, DOSH, KGS and KR. Other approvals can be supplied on request.

The approvals and documentation packages are made in accordance with the following codes: CODAP, EN 13445, AD 2000, PD 5500, ASME and BSERR 20-037.

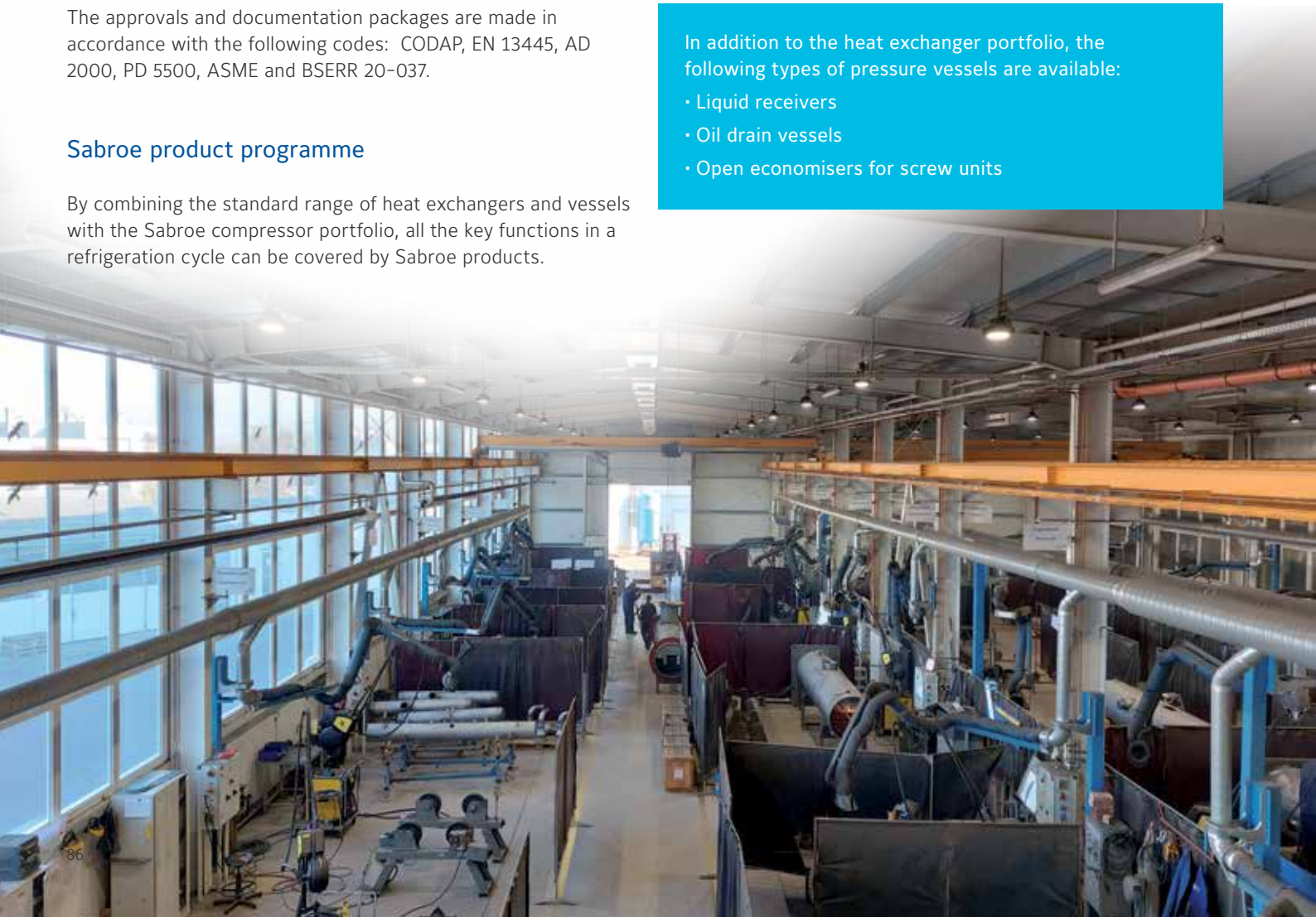
Sabroe product programme

By combining the standard range of heat exchangers and vessels with the Sabroe compressor portfolio, all the key functions in a refrigeration cycle can be covered by Sabroe products.

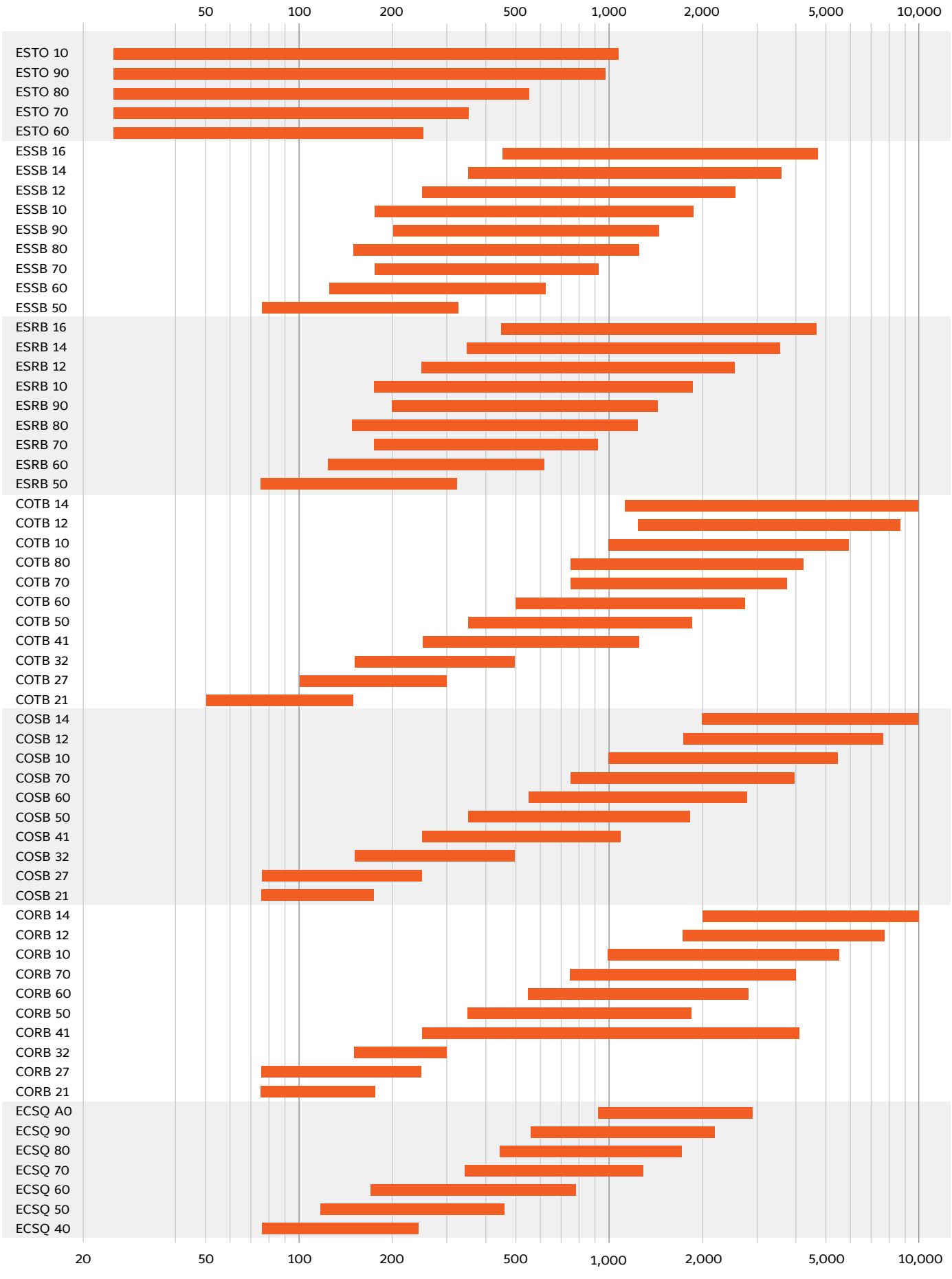
The Sabroe heat exchanger product range covers:
- Evaporators
- Condensers
- Oil coolers
- Suction gas superheaters
- Desuperheaters
- Closed economisers
- Cascade units

The entire Sabroe heat exchanger range is based on shell-and-tube technology. The shell-and-tube platform allows for a wide range of different configurations to ensure an excellent fit between capacity and brine flow. All designs have a proven track record and have been thoroughly tested in the Sabroe test centre.

In addition to the heat exchanger portfolio, the following types of pressure vessels are available:
- Liquid receivers
- Oil drain vessels
- Open economisers for screw units



Sabroe heat exchanger programme



Calculations are based on a 5K temperature change on the secondary side
and a maximum temperature difference between secondary outlet and refrigerant of 5K

ECSQ cascade coolers shown with welded and flanged end covers

Sabroe ECSQ shell-and-tube cascade cooler

ECSQ is designed for R717/R744 operation. It has an integrated liquid separator and a capacity range between 60 kW and 6,000 kW.

The ECSQ series combines Sabroe's smart boiling and condensing heat transfer technology using a horizontal shell-and-tube heat exchanger for in-tube condensing and boiling on the shell side.

The exchanger is primarily designed to condense R744 on the tube side and evaporate R717 on the shell side. However, there is full compatibility with other refrigerants that comply with the materials.

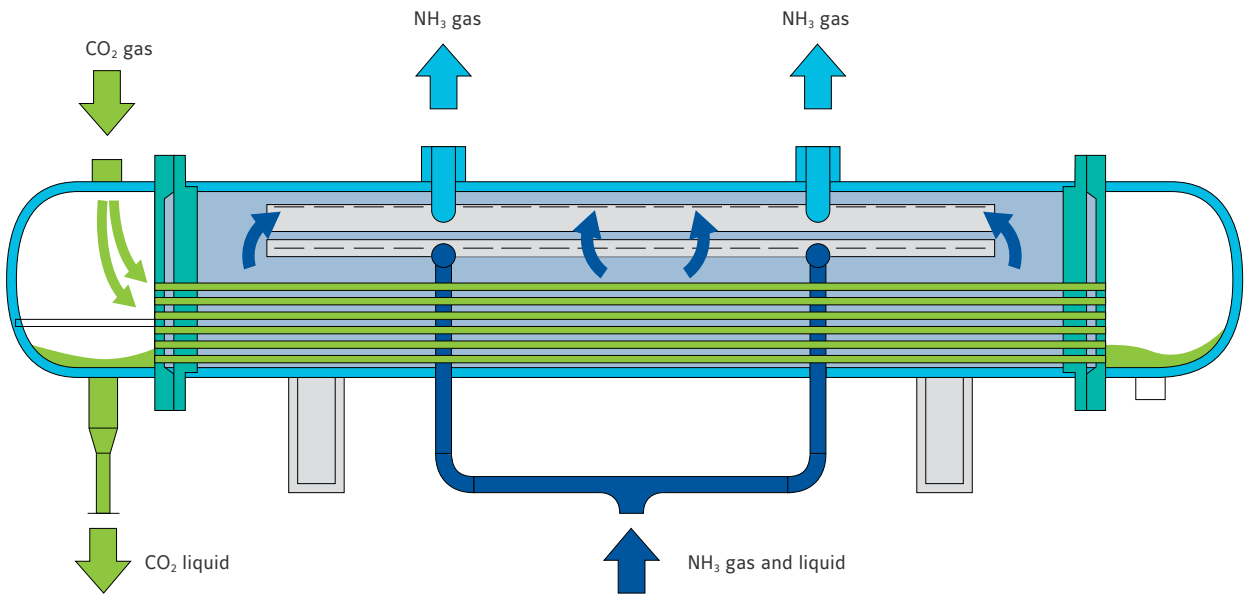
Range

The ECSQ cascade heat exchanger is available in more than 100 different configurations. The configuration of the series is based on 125 years of unrivalled experience in the supply of refrigeration components and systems.

The ECSQ cascade heat exchanger is approved for operation between 50°C and -40°C and 21/-1 barg on the shell side, and between 100°C and -40°C and 40/-1 barg on the tube side.

Features	Benefits
Integrated liquid separator on the evaporating shell side	It eliminates the need for a conventional liquid separator and reduces the overall footprint of the installation
Ø 10 mm pipes and internal flow guides	There is minimal refrigerant charge and highly efficient heat transfer on the shell side in contrast to conventional shell-and-tube designs
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions

ECSQ working principle



ECSQ – Capacity and product range

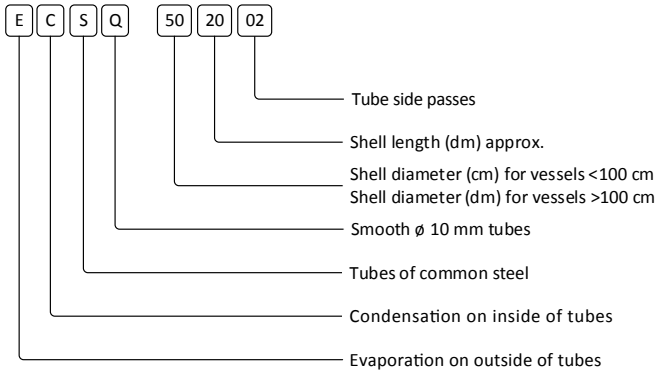
Type	Shell diameter	Shell length*	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet		Capacity range**
	mm	m		Size	Count	Size	Count	Size	Count	Size	Count	kW
4020A1	390	2/3	1/2	DN25-DN32	1	DN40-DN50	1	DN25-DN40	1	DN50-DN26	1	75-165
5020A1	492	2/3/4	1/2	DN32-DN40	1	DN65-DN0	1	DN40-DN65	1	DN65-DN100	1	100-350
6020A1	594	2/3/4/5	1/2	DN32-DN65	1	DN65-DN100	1	DN40-DN80	1	DN65-DN125	1	175-600
7030A1	684	2/3/4/5/6	1/2	DN40-DN65	2	DN80-DN125	2	DN65-DN100	1	DN100-DN150	1	350-975
8030A1	793	2/3/4/5/6	1/2	DN50-DN80	2	DN80-DN125	2	DN80-125	1	DN100-DN150	1	450-975
9030A1	890	2/3/4/5/6	1/2	DN50-DN100	2	DN100-DN150	2	DN80-DN150	1	DN125-DN200	1	450-1275
A040A1	992	4/5/6	1/2	DN65-DN100	2	DN125-DN150	2	DN100-DN150	1	DN125-200	1	900-2000

* Unit length (excluding end covers)
** Capacity range: R717 shell side evaporation at -10°C,
R744 tube side condensation at -5°C.
Standards: PED (DNV, LRS as options).

Options

- Double tube-plate for leakage protection and leakage detection
- Flanged or fully welded end covers
- Non-PED approvals on request (DNV, LRS, etc.)
- Oil drain or oil sump for oil return

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the ECSQ product line, the name of a given configuration can be identified by the key below.



CORB condenser with flanged end covers

Sabroe CORB shell-and-tube condenser

CORB is designed for condensation on the shell side outside the tubes and heating of a secondary fluid on the tube side. The capacity range is between 50 kW and 10,000 kW.

The heat exchanger is designed for heating of secondary fluid mediums like water, ethylene, propylene glycol and other non-corrosive mediums.

Range

The CORB condenser is available in more than 100 different configurations. The CORB is designed with stainless steel pipes.

The heat exchanger can be configured with 1 to 6 passes on the secondary side to match the capacity demand and secondary flow. All connections, except 1-pass, are equipped with counter flanges. The reversing covers are equipped with connections for drain and air purging.

The CORB exchanger is approved for operation between 100°C and -10°C and 40/-1 barg on the shell side, and between 100°C and 0°C and 10/0 barg on the tube side.

Features	Benefits
1 to 6 passes on the secondary side	Various configurations of tube patterns accommodate different flow and capacity ratios
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Stainless tube material	Can withstand operation with standard brines and operate with all natural refrigerants

CORB – Capacity and product range

Type	Shell diameter	Shell length	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet		Capacity range*
	mm	m		Size	Count	Size	Count	Size	Count	Size	Count	kW
21XXYY	207	1.5/2/2.5	1/2/4	DN40	1/2	DN32	1/2	DN80/DN125	1	DN80/DN125	1	75-100
27XXYY	260	2/2.5/3	1/2/4	DN40/DN50	1/2	DN32/DN40	1/2	DN100-DN150	1	DN100-DN150	1	75-175
32XXYY	311	2/2.5/3/4	1/2/4	DN50/DN65	1/2	DN40/DN50	1/2	DN125-DN200	1	DN125-DN200	1	150-350
41XXYY	403	2/2.5/3/4/5	1/2/4	DN65-DN80	1/2	DN50-DN80	1/2	DN150-DN250	1	DN150-DN250	1	250-850
50XXYY	492	2.5/3/4/5/6	1/2/4	DN80-DN100	1/2	DN 65-DN100	1/2	DN200-DN300	1	DN200-DN300	1	350-1500
60XXYY	594	2.5/3/4/5/6	1/2/4	DN100-DN125	1/2	DN80-DN100	1/2	DN250-DN400	1	DN250-DN400	1	550-2250
70XXYY	684	3/4/5/6	1/2/4	DN125-DN150	1/2	DN100-DN125	1/2	DN300-DN500	1	DN300-DN500	1	750-3250
10XXYY	992	3/4/5/6	1/2/4/6	DN150-DN200	1/2	DN100-DN150	2	DN500-DN700	1	DN500-DN700	1	1000-4500
12XXYY	1190	4/5/6	1/2/4/6	DN200-DN250	2	DN150-DN200	2	DN600-DN800	1	DN600-DN800	1	1750-6000
14XXYY	1384	4/5/6	1/2/4/6	DN250-DN300	2	DN200	2	DN700-DN900	1	DN700-DN900	1	2000-10000

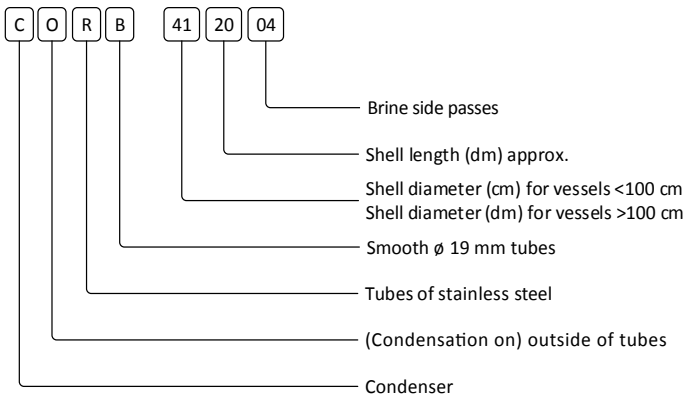
* Calculations are based on a 5K temperature change on the secondary side and a maximum temperature difference between secondary outlet and refrigerant of 5K.

Options

- Single or double connections on the refrigerant/shell side
- Single or double connections on the brine/tube side
- Brine connections from DN80 to DN300

Type designation for CORB

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the CORB product line, the name of a given configuration can be identified by the key below.



COSB condenser with flanged end covers

Sabroe COSB shell-and-tube condenser

COSB is designed for condensation on the shell side outside the tubes and heating of a secondary fluid on the tube side. The capacity range is between 50 kW and 10,000 kW.

The heat exchanger is designed for heating of secondary fluid mediums like water, ethylene, propylene glycol and other non-corrosive mediums.

Range

The COSB condenser is available in more than 100 different configurations. The COSB is configured with common steel pipes and is a cost-optimal alternative to the CORB condenser.

The unit can be configured with 1 to 6 passes on the secondary side to match the capacity and secondary flow. All connections, except 1-pass, are equipped with counter flanges. The reversing covers are equipped with connections for draining and air purging.

The COSB exchanger is approved for operation between 150°C and -10°C and 40/-1 barg on the shell side, and between 80°C and 0°C and 10/0 barg on the tube side.

Features	Benefits
1 to 6 passes on the secondary side	Various configurations of tube patterns accommodate different flow and capacity ratios
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Common steel tube material	Cost-effective option for systems without corrosive elements in the brine

COSB – Capacity and product range

Type	Shell diameter	Shell length	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet		Capacity range*
	mm	m		Size	Count	Size	Count	Size	Count	Size	Count	kW
21XXYY	207	1.5/2/2.5	1/2/4	DN40	1/2	DN32	1/2	DN80/DN125	1	DN80/DN125	1	75-100
27XXYY	260	2/2.5/3	1/2/4	DN40/DN50	1/2	DN32/DN40	1/2	DN100-DN150	1	DN100-DN150	1	75-175
32XXYY	311	2/2.5/3/4	1/2/4	DN50/DN65	1/2	DN40/DN50	1/2	DN125-DN200	1	DN125-DN200	1	150-350
41XXYY	403	2/2.5/3/4/5	1/2/4	DN65-DN80	1/2	DN50-DN80	1/2	DN150-DN250	1	DN150-DN250	1	250-850
50XXYY	492	2.5/3/4/5/6	1/2/4	DN80-DN100	1/2	DN 65-DN100	1/2	DN200-DN300	1	DN200-DN300	1	350-1500
60XXYY	594	2.5/3/4/5/6	1/2/4	DN100-DN125	1/2	DN80-DN100	1/2	DN250-DN400	1	DN250-DN400	1	550-2250
70XXYY	684	3/4/5/6	1/2/4	DN125-DN150	1/2	DN100-DN125	1/2	DN300-DN500	1	DN300-DN500	1	750-3250
10XXYY	992	3/4/5/6	1/2/4/6	DN150-DN200	1/2	DN100-DN150	2	DN500-DN700	1	DN500-DN700	1	1000-4500
12XXYY	1190	4/5/6	1/2/4/6	DN200-DN250	2	DN150-DN200	2	DN600-DN800	1	DN600-DN800	1	1750-6000
14XXYY	1384	4/5/6	1/2/4/6	DN250-DN300	2	DN200	2	DN700-DN900	1	DN700-DN900	1	2000-10000

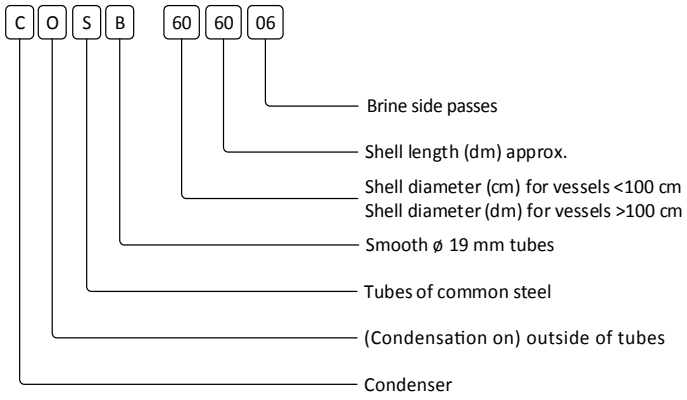
* Calculations are based on a 5K temperature change on the secondary side and a maximum temperature difference between secondary outlet and refrigerant of 5K

Options

- Single or double connections on the refrigerant/ shell side
- Single or double connections on the brine/tube side
- Large range of brine connection sizes

Type designation for COSB

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the COSB product line, the name of a given configuration can be identified by the key below.



COTB titanium condenser with flanged end covers

Sabroe COTB shell-and-tube condenser

COTB is designed for condensation on the shell side outside the tubes and heating of corrosive fluids on the tube side. The capacity range is between 50 kW and 10,000 kW.

The heat exchanger is designed for heating of secondary fluid mediums like water, ethylene and propylene glycol with a key focus on heating of corrosive mediums similar to brackish water for heat pumps and offshore applications.

Range

The COTB condenser is available in more than 100 different configurations. The COTB is configured with titanium pipes and designed for operation in the most demanding applications.

The unit can be configured with 1 to 6 passes on the secondary side to match the capacity and secondary flow.

All connections, except 1-pass, are equipped with counter flanges. The reversing covers are equipped with connections for drain and air purging.

The COTB exchanger is approved for operation between 120°C and 0°C and 40/-1 barg on the shell side, and between 100°C and 0°C and 10/-1 barg on the tube side.

Features	Benefits
1 to 6 passes on the secondary side	Various configurations of tube patterns accommodate different flow and capacity ratios
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Titanium tube material	Allows operation with corrosive brines and working mediums

COTB – Capacity and product range

Type	Shell diameter	Shell length	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet		Capacity range*
	mm	m		Size	Count	Size	Count	Size	Count	Size	Count	kW
21XXYY	207	1.5/2/2.5/3/3.5	1/2/4	DN50	1	DN40	1	DN80/DN125	1	DN80/DN125	1	50-100
27XXYY	260	2/2.5/3/3.5	1/2/4	DN32/DN40	1	DN 25/DN32	2	DN100-DN150	1	DN100-DN150	1	100-200
32XXYY	312	2/2.5/3/3.5	1/2/4	DN50	1	DN32/DN40	2	DN125/DN200	1	DN125/DN200	1	150-350
41XXYY	403	2/2.5,3,4/5	1/2/4	DN65	1	DN32/DN40/DN50	2	DN150/DN250	1	DN150/DN250	1	250-1000
50XXYY	493	2/2.5/3/4/5/6	1/2/4	DN65/DN80	1	D50-DN80	2	DN200-DN300	1	DN200-DN300	1	350-1500
60XXYY	594	2/2.5/3/4/5/6	1/2/4	DN80-DN100	1	DN65-DN80	2	DN250-DN400	1	DN250-DN400	1	500-2250
70XXYY	684	3/4/5/6	1/2/4	DN100-DN125	1	DN80-DN100	2	DN200-DN350	1	DN200-DN350	1	750-3000
80XXYY	793	3/4/5/6	1/2/4	DN125-DN150	1	DN100	2	DN200-DN350	1	DN200-DN350	1	750-3500
10XXYY	992	3/4/5/6	1/2/4	DN150	1	DN100-DN150	2	DN200-DN350	1	DN200-DN350	1	1000-5000
12XXYY	1190	4/5/6	1/2/4/6	DN200	1	DN150	2	DN200-DN350	1	DN200-DN350	1	1250-7500
14XXYY	1384	4/5/6	1/2/4/6	DN200	1	DN200	2	DN200-DN350	1	DN200-DN350	1	1750-10000

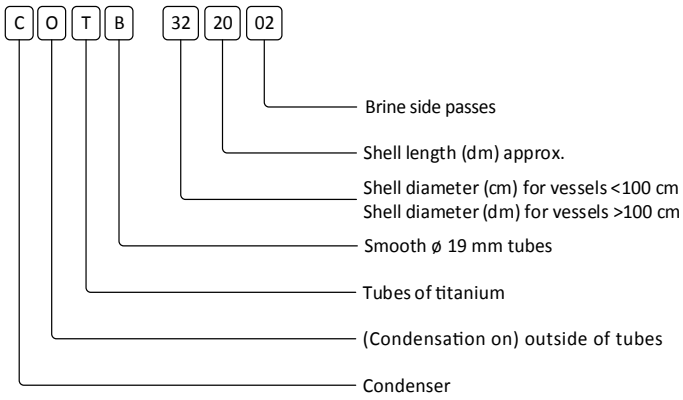
* Calculations are based on a 5K temperature change on the secondary side and a maximum temperature difference between secondary outlet and refrigerant of 5K

Options

- Single or double connections on the refrigerant/ shell side
- Single or double connections on the brine/tube side
- Brine connections from DN100 to DN350

Type designation for COTB

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the COTB product line, the name of a given configuration can be identified by the key below.



ESRB evaporator shown with oil collection pot

Sabroe ESRB shell-and-tube evaporator

The ESRB evaporator is designed for flooded evaporation of refrigerant outside the tubes and cooling of a secondary fluid on the tube side. The capacity range is between 100 kW and 6500 kW.

The heat exchanger is designed for cooling of secondary fluid mediums like water, ethylene, propylene glycol and other non-corrosive mediums.

The integrated liquid separator reduces the overall footprint of the installation and ensures a high heat transfer coefficient while protecting the compressor from any liquid slugging.

Range

The ESRB evaporator is available in more than 100 different configurations. The ESRB is configured with stainless steel pipes.

The unit can be configured with four different tube patterns depending on sensitivity in case of overcharging. A-models have the lowest tube count, and D-models have the highest number of tubes per diameter.

The ESRB exchanger is approved for operation between 50°C and -40°C and 29/-1 barg on the shell side, and between 50°C and -30°C and 10/0 barg on the tube side.

Features	Benefits
Integrated liquid separator	An external liquid separator is not needed, and the overall footprint of the installation is reduced
Four different tube patterns	Various configurations of tube patterns accommodate different system designs
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Stainless tube material	Can withstand operation with standard brines and operate with all natural refrigerants

ESRB – Capacity and product range

Type	Shell diameter	Shell length	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet		Capacity range*
	mm	m		Size	Count	Size	Count	Size	Count	Size	Count	kW
50YYXX	500	2/3/4/5/6	1/2/3/4	DN32	1/2	DN65	1/2	DN100-DN200	1	DN100-DN200	1	75-250
60YYXX	600	3/4/5/6	1/2/3/4	DN40	1/2	DN80	1/2	DN100-DN250	1	DN100-DN250	1	125-500
60YYXX	680	3/4/5/6	1/2/3/4	DN50	1/2	DN100	1/2	DN100-DN300	1	DN100-DN300	1	175-750
80YYXX	793	3/4/5/6	1/2/3/4	DN50	1/2	DN100	1/2	DN100-DN350	1	DN100-DN350	1	150-1100
90YYXX	890	3/4/5/6	1/2/3/4	DN65	1/2	DN125	1/2	DN100-DN400	1	DN100-DN400	1	200-1250
10YYXX	992	3/4/5/6	1/2/3/4/6/8	DN65	1/2	DN125	1/2	DN100-DN450	1	DN100-DN450	1	175-1700
12YYXX	1190	3/4/5/6	1/2/3/4/6/8	DN80	1/2	DN150	1/2	DN100-DN450	1	DN100-DN450	1	250-2300
14YYXX	1348	3/4/5/6	1/2/3/4/6/8	DN100	1/2	DN200	1/2	DN100-DN450	1	DN100-DN450	1	350-3250
16YYXX	1584	5/6	1/2/3/4/6/8	DN100	2	DN200	2	DN200-DN450	1	DN200-DN450	1	450-4250

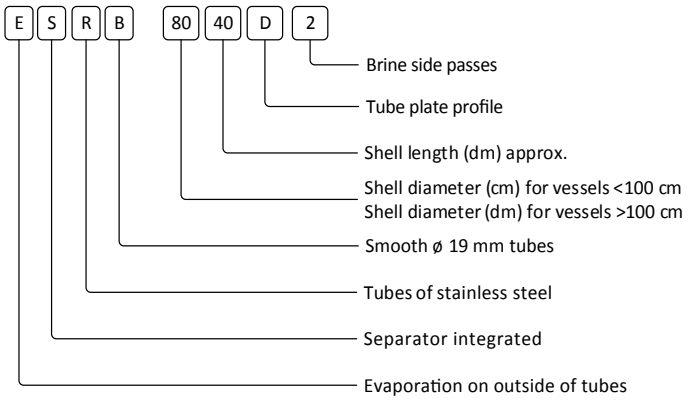
* Calculations are based on a 5K temperature change on the secondary side and a maximum temperature difference between secondary outlet and refrigerant of 5K

Options

- Single or double connections on the refrigerant/ shell side
- Single or double connections on the brine/tube side
- Brine connections from DN100 to DN450

Type designation for ESRB

All shell-and-tube heat exchangers from Sabroe follow a standard naming key. For the ESRB product line, the name of a given configuration can be explained by the illustration below:



ESSB evaporator shown with oil collection pot

Sabroe ESSB shell-and-tube evaporator

The ESSB evaporator is designed for flooded evaporation of refrigerant outside the tubes and cooling of a secondary fluid on the tube side. The capacity range is between 100 kW and 6500 kW.

The heat exchanger is designed for cooling of secondary fluid mediums like water, ethylene, propylene glycol and other non-corrosive mediums.

The integrated liquid separator reduces the overall footprint of the installation and ensures a high heat transfer coefficient while protecting the compressor from any liquid slugging.

Range

The ESSB evaporator is available in more than 100 different configurations and is the cost-optimal alternative compared to ESRB. The ESSB is configured with common steel pipes.

The unit can be configured with four different tube patterns depending on sensitivity in case of overcharging. A-models have the lowest tube count, and D-models have the highest number of tubes per diameter.

The ESSB exchanger is approved for operation between 50°C and -30°C and 24/-1 barg on the shell side, and between 50°C and -30°C and 10/-1 barg on the tube side.

Features	Benefits
Integrated liquid separator	An external liquid separator is not needed, and the overall footprint of the installation is reduced
Four different tube patterns	Various configurations of tube patterns accommodate different system designs
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Common steel tube material	Cost-optimal solution for systems without salts or chlorines in the brine

ESSB – Capacity and product range

Type	Shell diameter	Shell length	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet		Capacity range*
	mm	m		Size	Count	Size	Count	Size	Count	Size	Count	kW
50YYXX	500	2/3/4/5/6	1/2/3/4	DN32	1/2	DN65	1/2	DN100-DN200	1	DN100-DN200	1	75-250
60YYXX	600	3/4/5/6	1/2/3/4	DN40	1/2	DN80	1/2	DN100-DN250	1	DN100-DN250	1	125-500
60YYXX	680	3/4/5/6	1/2/3/4	DN50	1/2	DN100	1/2	DN100-DN300	1	DN100-DN300	1	175-750
80YYXX	793	3/4/5/6	1/2/3/4	DN50	1/2	DN100	1/2	DN100-DN350	1	DN100-DN350	1	150-1100
90YYXX	890	3/4/5/6	1/2/3/4	DN65	1/2	DN125	1/2	DN100-DN400	1	DN100-DN400	1	200-1250
10YYXX	992	3/4/5/6	1/2/3/4/6/8	DN65	1/2	DN125	1/2	DN100-DN450	1	DN100-DN450	1	175-1700
12YYXX	1190	3/4/5/6	1/2/3/4/6/8	DN80	1/2	DN150	1/2	DN100-DN450	1	DN100-DN450	1	250-2300
14YYXX	1348	3/4/5/6	1/2/3/4/6/8	DN100	1/2	DN200	1/2	DN100-DN450	1	DN100-DN450	1	350-3250
16YYXX	1584	5/6	1/2/3/4/6/8	DN100	2	DN200	2	DN200-DN450	1	DN200-DN450	1	450-4250

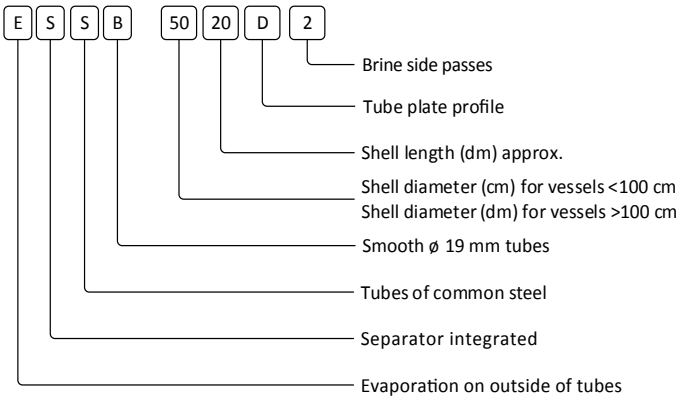
* Calculations are based on a 5K temperature change on the secondary side and a maximum temperature difference between secondary outlet and refrigerant of 5K

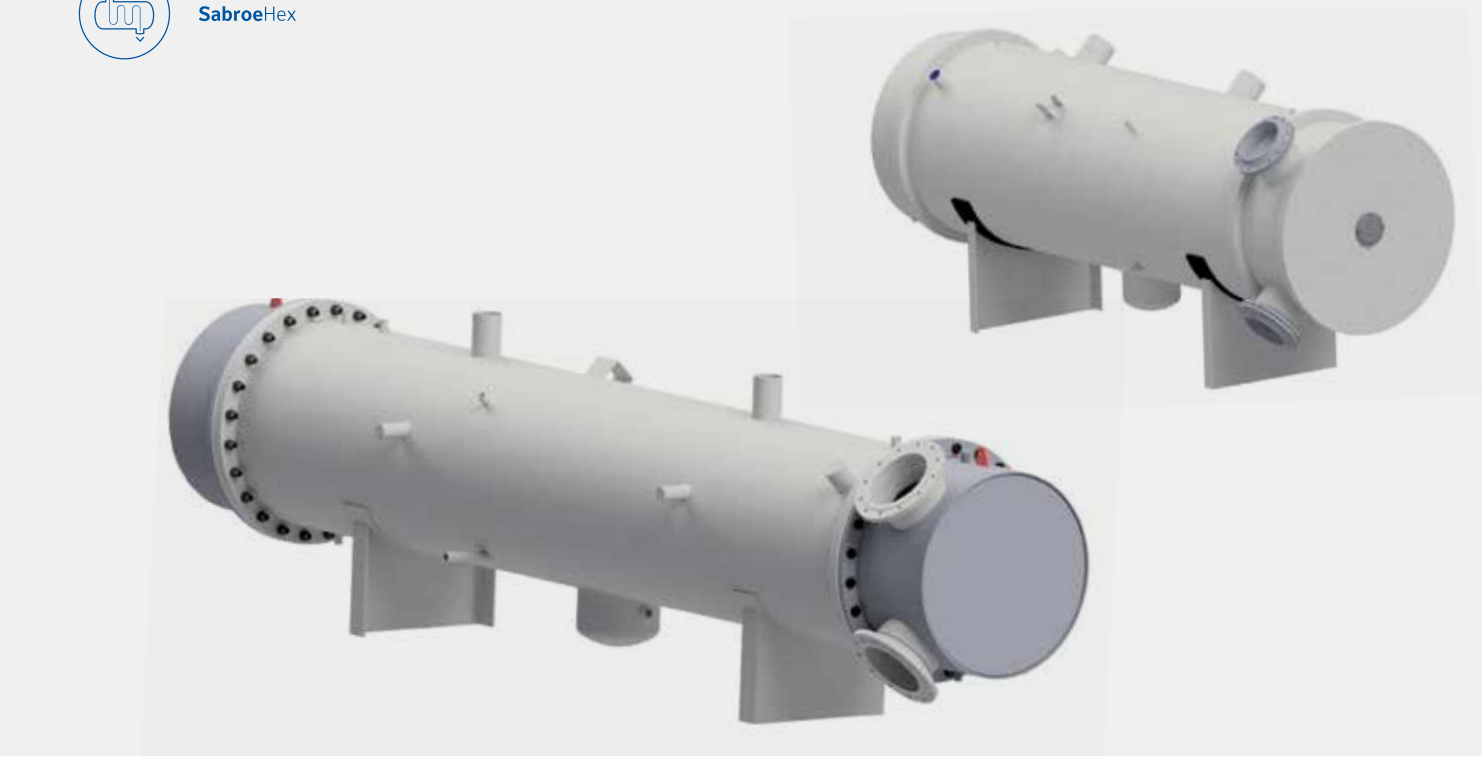
Options

- Single or double connections on the refrigerant/ shell side
- Single or double connections on the brine/tube side
- Brine connections from DN100 to DN450

Type designation for ESSB

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the ESSB product line, the name of a given configuration can be identified by the key below.





ESTO titanium evaporator with integrated liquid separator

Sabroe ESTO shell-and-tube evaporator

The ESTO evaporator is designed for flooded evaporation of refrigerant outside the tubes and cooling of corrosive fluids on the tube side. The capacity range is between 100 kW and 6500 kW.

The heat exchanger is designed for cooling of secondary fluid mediums like water, ethylene and propylene glycol with a key focus on cooling of sea or brackish water for heat pump and offshore applications.

The integrated liquid separator reduces the overall footprint of the installation and ensures a high heat transfer coefficient while protecting the compressor from any liquid slugging.

Range

The ESTO evaporator is available in 10 different configurations and uses titanium tubes to be able to withstand corrosive brines and secondary fluids.

The unit can be configured with two different tube patterns depending on sensitivity in case of overcharging.

The ESTO exchanger is approved for operation between 80°C and -40°C and 29/-1 barg on the shell side, and between 80°C and -30°C and 10/0 barg on the tube side.

Features	Benefits
Integrated liquid separator	An external liquid separator is not needed, and the overall footprint of the installation is reduced.
Two different tube patterns	Various configurations of tube patterns accommodate different system designs
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Titanium tube material	Allows operation with corrosive brines and working mediums

ESTO – Capacity and product range

Type	Shell diameter	Shell length	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet		Capacity range*
	mm	m	Count	Size	Count	Size	Count	Size	Count	Size	Count	[kW]
6030A2	600	3	2	DN25	1	DN65	1	DN150	1	DN150	1	25-50
6030B2	600	3	2	DN32	1	DN80	1	DN150	1	DN150	1	25-225
7030A2	700	3	2	DN40	1	DN100	1	DN200	1	DN200	1	25-325
7035B2	700	4	2	DN40	1	DN100	1	DN200	1	DN200	1	25-325
8035A2	800	4	2	DN50	1	DN125	1	DN250	1	DN250	1	25-425
8035A4	800	4	4	DN40	1	DN125	1	DN250	1	DN250	1	25-525
8040B2	800	4	2	DN50	1	DN150	1	DN250	1	DN250	1	25-950
8040B4	800	4	4	DN65	1	DN200	1	DN300	1	DN300	1	25-950
9040A2	900	4	2	DN65	1	DN200	1	DN300	1	DN300	1	25-950
1040A1	1000	4	1	DN65	1	DN200	1	DN350	1	DN350	1	25-1050
1040A2	1000	4	2	DN65	1	DN200	1	DN350	1	DN350	1	25-1050

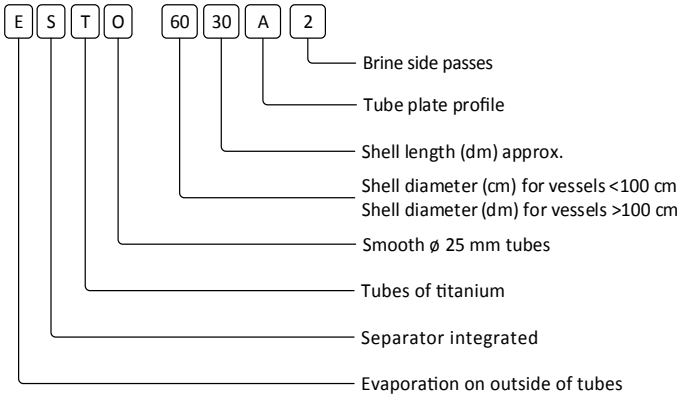
* Calculations are based on a 5K temperature change on the secondary side and a maximum temperature difference between secondary outlet and refrigerant of 5K

Options

- Brine connections from DN100 to DN300
- Coated end covers

Type designation for ESTO

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the ESTO product line, the name of a given configuration can be identified by the key below.



DISS desuperheater

Sabroe DISS shell-and-tube desuperheater

DISS is designed for desuperheating of discharge gas inside the tubes on the tube side and heating of a secondary fluid or refrigerant on the shell side.
The capacity range is between 50 kW and 10,000 kW.

The desuperheater is a horizontal, closed shell-and-tube heat exchanger, designed to heat water in a closed circuit on the outside of straight steel tubes by cooling high-pressure gas inside tubes with star insert. The desuperheater can be built into the pressure gas line between the compressor and the condenser in cooling and heat pump units.

Range

The DISS evaporator is available in five different configurations. It is configured with common steel pipes with a star insert for optimal heat transfer.

The DISS exchanger is approved for operation between 120°C and 0°C and 40/-1 barg on the shell side, and between 100°C and 0°C and 10/-1 barg on the tube side.

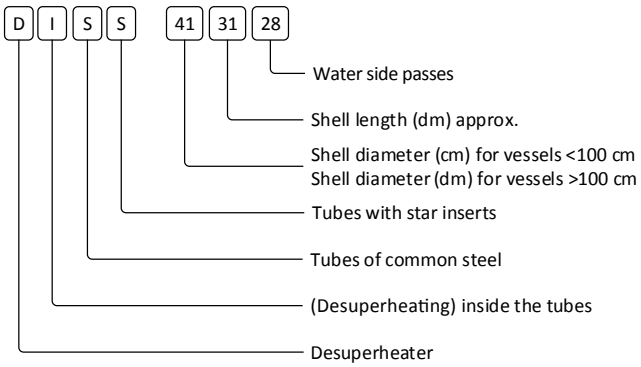
Features	Benefits
Low pressure drop on the refrigerant side	Less required compressor work compared to a plate-and-plate solution
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Star insert	High heat transfer from discharge gas to cooling media

DISS – Capacity and product range

Type	Shell diameter	Shell length	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet	
	mm	m		Size	Count	Size	Count	Size	Count	Size	Count
163160	159	3.181	60	DN50	1	DN50	1	DN65	1	DN65	1
213146	207	3.181	46	DN65	1	DN65	1	DN100	1	DN100	1
273140	260	3.181	40	DN80	1	DN80	1	DN125	1	DN125	1
323128	312	3.181	28	DN100	1	DN100	1	DN150	1	DN150	1
413122	407	3.181	22	DN125	1	DN125	1	DN200	1	DN200	1

Type designation for DISS

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the DISS product line, the name of a given configuration can be identified by the key below.



OWSG oil cooler

Sabroe OWSG shell-and-tube oil cooler

The OWSG heat exchanger is designed for cooling of oil in screw compressor applications. The capacity range is tailored to fit the Sabroe screw compressors.

In addition to oil cooling, the OWSG desuperheater is also suitable for installation as a subcooler or a liquid cooler, if needed.

Range

The OWSG oil cooler is available in more than 100 different configurations. It is configured with common steel pipes, which are suitable for systems incorporating anti-corrosion and anti-scaling measures.

The OWSG oil cooler is approved for operation between 120°C and 0°C and 26/-1 barg on the shell side, and between 65°C and 0°C and 10/0 barg on the tube side.

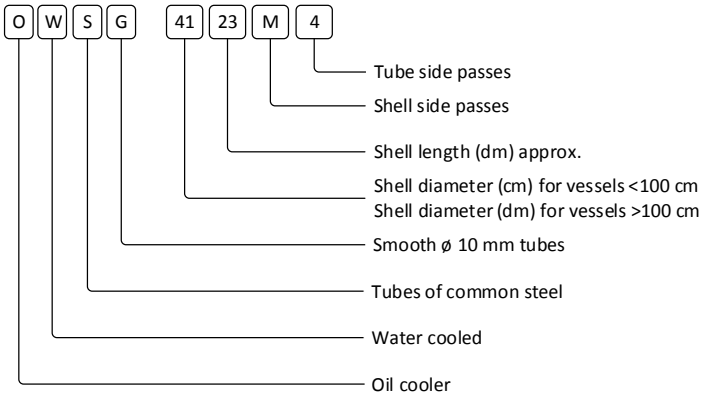
Features	Benefits
Low pressure drop	Less power needed to circulate cooling water
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Oil on either shell or tube side	Extended range of configurations and connection points

OWSG – Capacity and product range

Type	Shell diameter	Shell length	Shell side passes	Tube side passes	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet	
	mm	m			Size	Count	Size	Count	Size	Count	Size	Count
1115YY	107	1.582	25-55	2	DN32	1	DN32	1	DN32	1	DN32	1
1315YY	132	1.582	21-47	2	DN32	1	DN32	1	DN40	1	DN40	1
1615YY	159	1.582	13-41	2/4	DN20	1	DN20	1	DN50	1	DN50	1
1619YY	159	1.962	17-53	2/4	DN32	1	DN32	1	DN50	1	DN50	1
1623YY	159	2.342	21-43	2/4	DN50	1	DN50	1	DN50	1	DN50	1
2115YY	207	1.582	9-19	2/4	DN20	1	DN20	1	DN80	1	DN80	1
2119YY	207	1.962	19-33	2/4	DN32	1	DN32	1	DN80	1	DN80	1
2123YY	207	2.342	19-39	2/4	DN50	1	DN50	1	DN80	1	DN80	1
2719YY	260	1.962	13-31	2/4	DN32	1	DN32	1	DN100	1	DN100	1
2723YY	260	2.342	15-39	2/4	DN50	1	DN50	1	DN100	1	DN100	1
3219YY	312	1.962	13-25	2/4	DN50	1	DN50	1	DN125	1	DN125	1
3223YY	312	2.342	15-29	2/4	DN50	1	DN50	1	DN125	1	DN125	1
4119YY	403	1.962	11-21	2/4	DN50	1	DN50	1	DN150	1	DN150	1
4123YY	403	2.342	13-27	2/4	DN50	1	DN50	1	DN150	1	DN150	1

OWSG type designation

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the OWSG product line, the name of a given configuration can be identified by the key below.



EOSE economiser shown with feet for easy on site installation

Sabroe EOSE spiral flash economiser

EOSE is a closed flash economiser with an integrated separator, designed for operation with ammonia. The capacity range is tailored to fit the Sabroe screw compressor range.

The economiser is a horizontal, closed shell-and-spiral heat exchanger, which subcools the liquid from the condenser before expansion, and thus improves the overall system efficiency.

Range

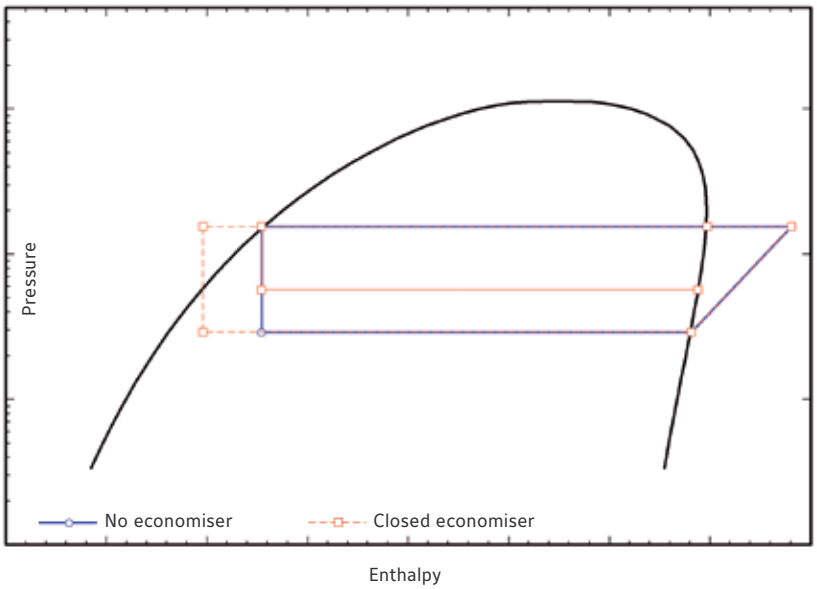
The EOSE closed flash economiser is available in five different configurations. The five standard configurations are designed to match the Sabroe screw compressor product range.

The EOSE unit is approved for operation between 50°C and -40°C and 26/-1 barg on the shell side, and between 50°C and -40°C and 26/-1 barg in the cooling spiral.

Features	Benefits
Subcooling of condenser liquid	Increased cooling capacity with the same amount of compressor work
Calculation and product selection via COMP1	Simplified product selection and evaluation of thermal performance in part-load conditions
Integrated liquid separator	As an external liquid separator is not needed, the overall footprint of the installation is reduced

EOSE – Capacity and product range

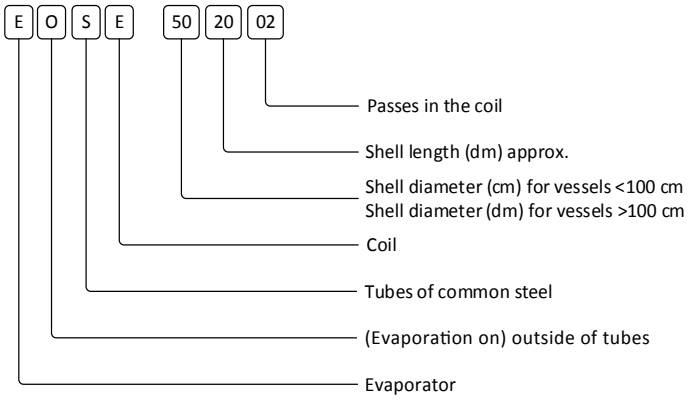
Type	Shell diameter	Shell length	Shell side inlet		Shell side outlet		Tube side inlet		Tube side outlet	
	mm	m	Size	Count	Size	Count	Size	Count	Size	Count
41601	403	1.788	DN32	1	DN50	1	DN15	1	DN15	1
51601	492	1.818	DN50	1	DN65	1	DN20	1	DN20	1
61602	594	1.819	DN25	1	DN65	1	DN32	1	DN32	1
62002	594	2.175	DN25	1	DN65	1	DN32	1	DN32	1
82002	793	2.219	DN25	1	DN65	1	DN65	1	DN65	1

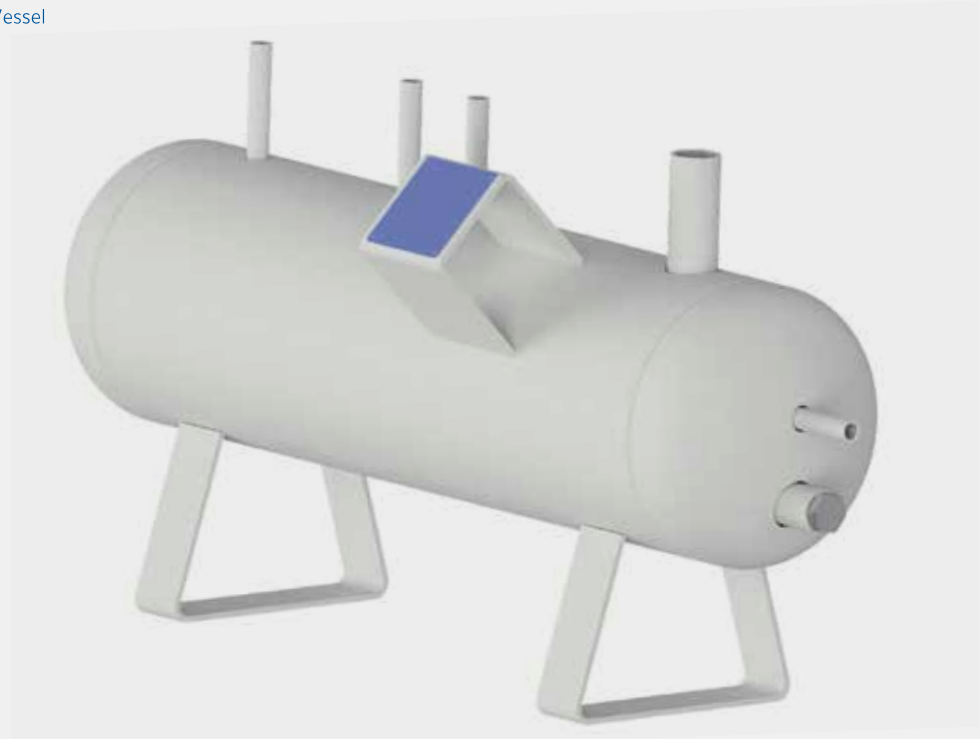


The figure illustrates the impact of installing a closed economiser. Subcooling the liquid out of the condenser increases the cooling capacity of the system.

EOSE type designation

All Sabroe shell-and-tube heat exchangers follow a standard key for naming and identification. For the EOSE product line, the name of a given configuration can be identified by the key below.





Oil drain vessel with standard connections

Sabroe vessels receivers and oil vessels

Vertical and horizontal receivers and oil drain vessels for site installations

The Sabroe vessel and heat exchanger product range includes both vertical and horizontal receivers for onsite installations. The series of receivers also includes oil drain vessels.

Receivers

If the standard range of Sabroe vessels does not contain a product that fully matches a given application, a special vessel can be manufactured according to customer specifications. The maximum diameter for receivers is 2400 mm. For all standard receivers, the following applies:

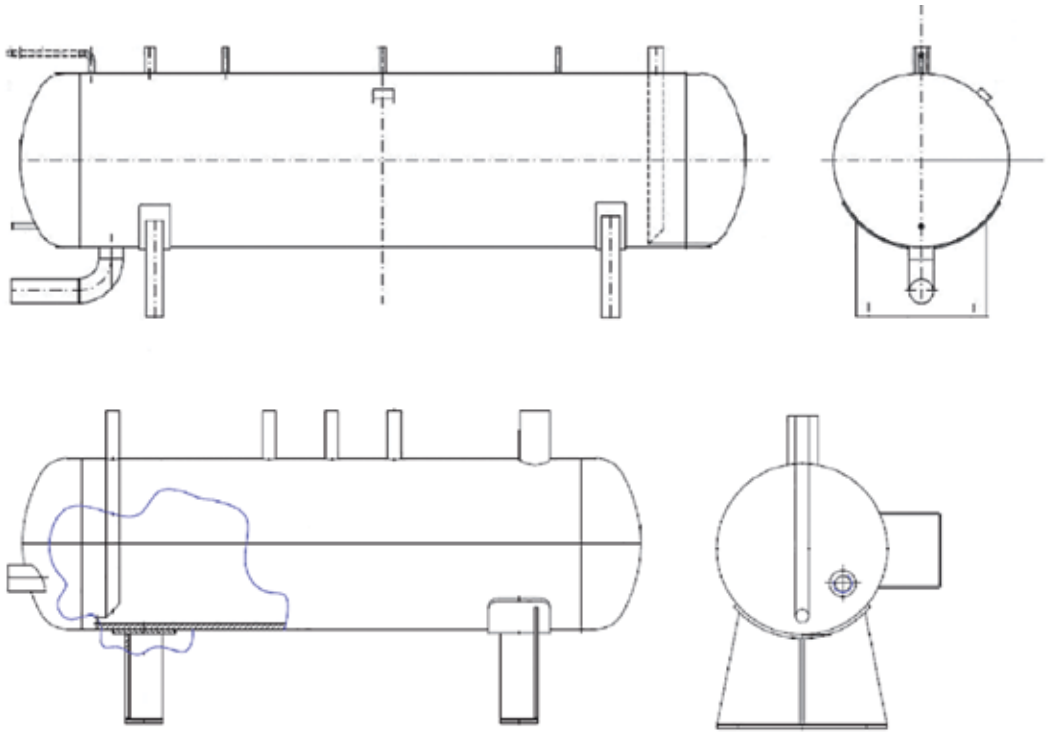
- Carbon steel
- Design pressure: 24 bar
- Design temperature: -40/+50°C
- Acceptance according to module H1
- Variable number of connections (2-12)
- Legs included

Oil drain vessels

In addition to the series of horizontal and vertical receivers, the Sabroe product line also includes oil drain vessels. The standard product range contains two models, one with a heating element and one without.
The following applies to both oil drain vessels:

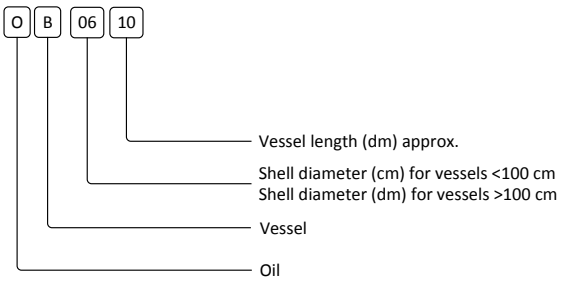
- Carbon steel
- Design pressure: 24 bar
- Design temperature: -40/+50°C
- Acceptance according to module H1
- Legs included

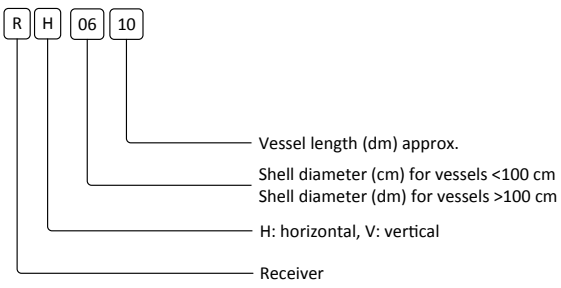
Features	Benefits
In-house design department	We can approve and produce vessels based on customer designs
Dedicated heat exchanger and vessel factory	We can produce units with shell diameters up to 2400 mm



Type designation

Like all Sabroe vessels and heat exhangers, the receivers follow a standard key for naming and identification. Oil drain vessels can be identified by the keys below.





SVER open economisers shown with feet for easy on-site installation

Sabroe SVER open flash economiser

SVER is an open flash economiser with an integrated separator designed for operation with most refrigerants. The capacity range is tailored to fit the Sabroe screw compressor range.

The function of the economiser is to cool the liquid refrigerant (subcooling) from the condenser before it is led to the evaporator. The subcooling obtained by installing an economiser improves the efficiency of the refrigeration plant.

Range

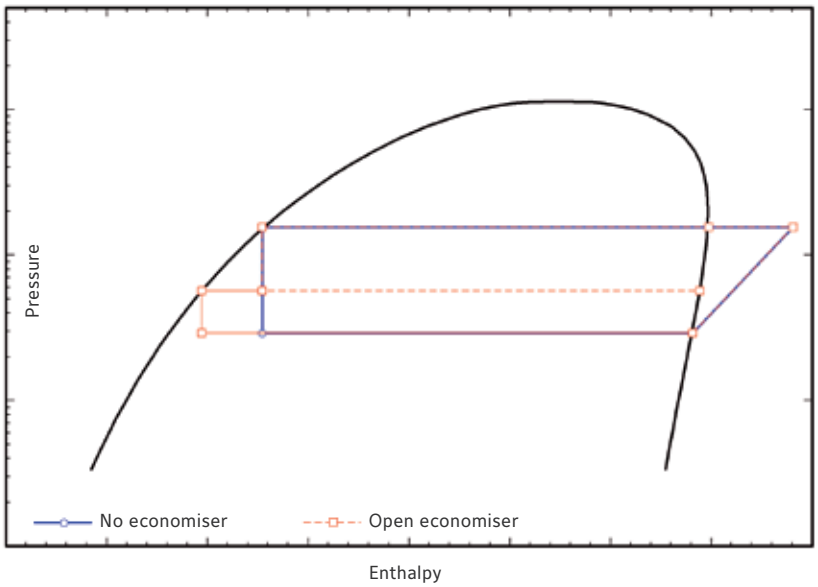
The SVER closed flash economiser is available in five different configurations. The five standard configurations are designed to match the Sabroe screw compressor products range.

The SVER unit is approved for operation between 80°C and -40°C and 26/-1 barg.

Features	Benefits
Subcooling of condenser liquid	Increased cooling capacity for the same amount of compressor work.
Calculation and product selection via COMP1	Simple selection of SVER type for Sabroe screw compressors
Integrated liquid separator	External liquid separator not needed, and the overall footprint of the installation is reduced

SVER - Capacity and product range

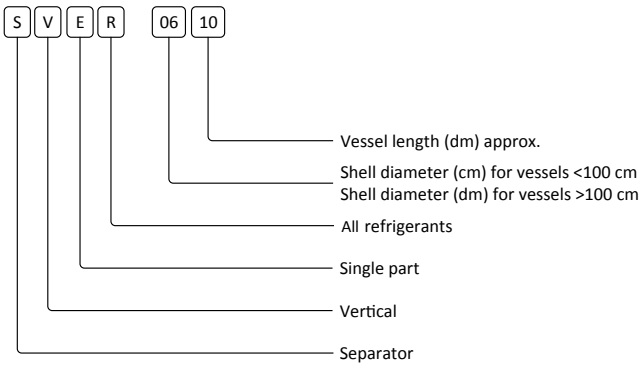
Type	Shell diameter	Unit height	Flash inlet		Liquid outlet		Eco port	
	mm	mm	Size [mm]	Count	Size [mm]	Count	Size [mm]	Count
0307	309	1455	73.7	1	54.5	1	54.5	1
0408	403	1175	107.1	1	70.3	1	70.3	1
0509	496	1580	120.6	1	82.5	1	82.5	1
0610	597.6	2095	146	1	107.1	1	107.1	1
0814	800	2610	270	1	130	1	130	1



The figure illustrates the impact of installing an open economiser. By separating the liquid and gas in the open flash economiser, the condenser liquid is subcooled and the cooling capacity of the system is increased.

SVER type designation

All Sabroe vessels follow a standard key for naming and identification. For the SVER product line, the name of a given configuration can be identified by the key below.



Sabroe customised solutions

Sabroe customised solutions

The Sabroe portfolio of standard industrial refrigeration solutions is extremely comprehensive. Sometimes, however, this just isn't enough to meet a customer's very specific operating requirements or installation environment. In such cases, we partner with our customers to customise one or more Sabroe solutions to comply with the particular requirements.

Sabroe customised solutions feature maximum flexibility to support the engineering of solutions that comply with any special customer requirement. These are just some of the options normally available – ask Sabroe experts about more.

- Compliance with special design codes and national technical requirements
- Wide range of refrigerants and gases
- Special brines and secondary refrigerants

- Special configurations for installation in:
  - Hazardous environments
  - Explosive environments
  - Corrosive environments
  - Low and high ambient temperatures

- Special compressor units for gas transfer
- Dual compressor packs
- Customised chiller and heat pump packages
- High-temperature heat pumps
- High-capacity chillers and heat pumps
- Ultra-low temperature process cooling
- Skid-mounted systems – single or modular
- Special heat exchangers and vessels

- Associated systems, including ventilation, hydraulic solutions, etc.
- Special control systems including PLC, and any type of SCADA control system architecture
- Special instrumentation
- Special electrical panels
- High-voltage motors

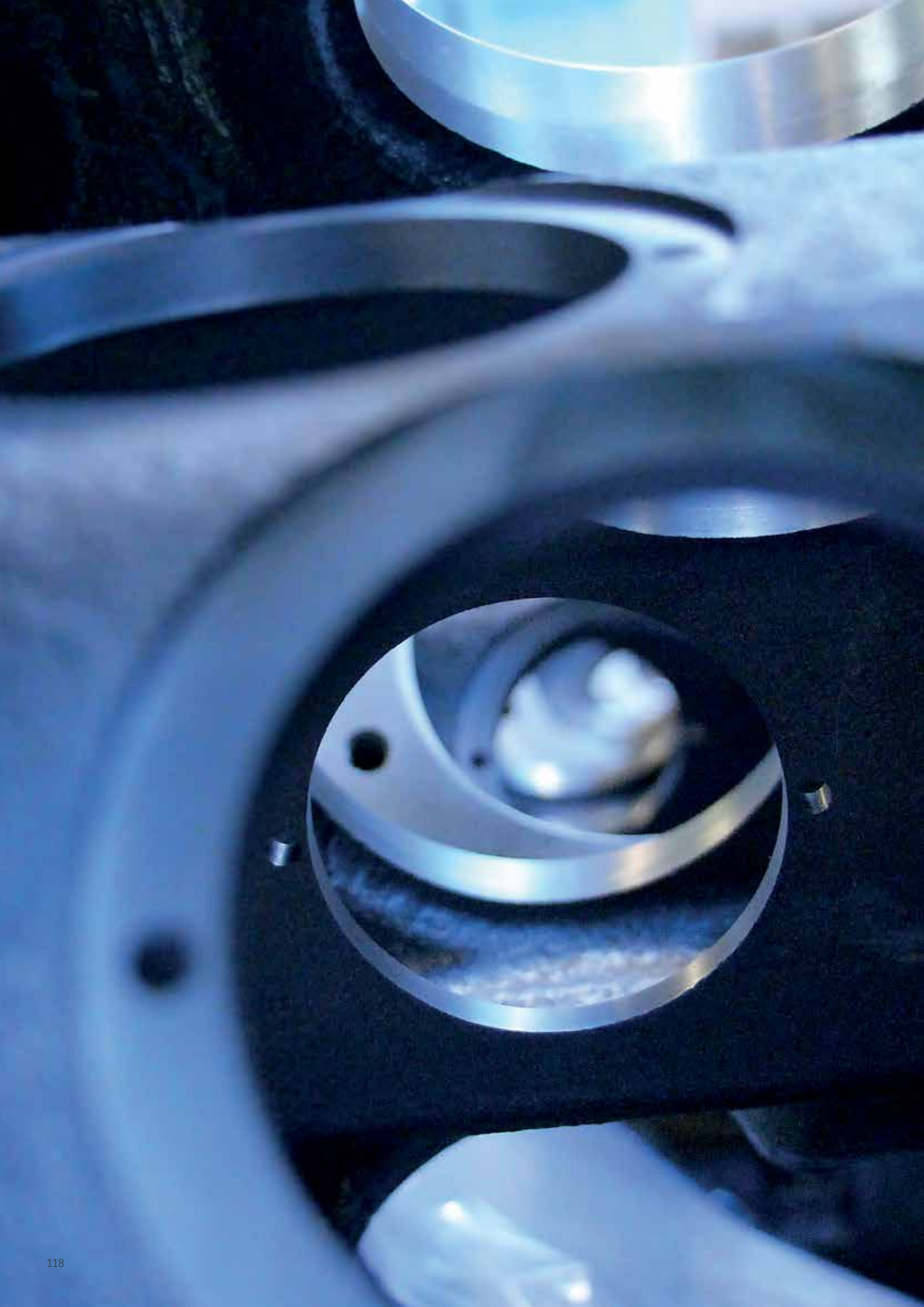
In Sabroe customised solutions, research and development go hand in hand with ingenuity and experience. Each project is managed by a matrix team consisting of the appropriate specialists and other highly skilled staff.

Great flexibility throughout ensures product quality and appropriate technical compliance as well as on-time, on-spec delivery.

All Sabroe customised products are subject to factory acceptance testing (FAT) in the Sabroe End-of-Line test centre (EOL). This means we carry out extensive checks on capacity, performance, vibration, and control functions prior to delivery. Any customer is welcome to participate in or supervise these tests.

Multiple configurations, many options, maximum capability - you decide exactly what best suits your operating priorities.

AfterMarket solutions



Long service life saves you money

Tested to ensure reliability

Sabroe products and systems are renowned for exceptional reliability and technological advantages, backed by our ability to meet even the most demanding customer requirements.

One of the big advantages of doing business with Johnson Controls is that our compressor, chiller, and heat pump products are all systematically tested before delivery. This ensures rapid, glitch-free commissioning and a bare minimum of interruption to your operations.

Industrial Refrigeration Parts Centre

The Industrial Refrigeration Parts Centre provides round-the-clock aftermarket support services that enable both owners and providers of Sabroe equipment all over the world to maximise their return on investment, and to ensure the long-term efficiency and stability of their operations.

Making the most of an effective worldwide logistics infrastructure and rapid-response inventory management, the Parts Centre dispatches any part to wherever in the world it may be needed, within just 24 hours (if the part is in stock).
IRpartssupportdk@jci.com

EasyParts – online ordering of Industrial Refrigeration parts

- 40,000 items, of which approx. 6,000 are in stock
- Easy item search and ordering
- Integrated enquiry system for technical support and warranty
- Shipment tracking and invoice download

https://easyparts.johnsoncontrols.com

AfterMarket Solutions (AMS)

The AfterMarket Solutions facility is the overhaul, repair, re-manufacturing, and stock centre for Johnson Controls industrial refrigeration companies throughout the world.

The AMS centre makes it easy to significantly extend the service life of your Sabroe equipment to minimise downtime and to reduce the operating costs of refrigeration installations by replacing worn screw and reciprocating compressor blocks, or getting existing blocks overhauled or repaired – all with a minimum of practical bother and service interruption.

Attractive retrofit options are also available.
AfterMarketSolutions@jci.com

SABROE Frick STAL REFRIGERATION Gram Refrigeration

SMC Long-life upgrade kit

Sabroe AP1000 air purger

Improves performance and reduces operating costs for all types of industrial ammonia refrigeration equipment

The AP1000 Air Purger is specially designed to maintain the efficiency of an ammonia-based refrigeration setup by removing any air present in the refrigerant charge. Air is an uncondensable gas that reduces the effective surface of the condenser and evaporators, resulting in poorer refrigeration performance and higher operating costs.

Any air entering the refrigeration equipment also contains moisture. The mix of water, oxygen, and ammonia tends to break down the compressor oil, resulting in loss of viscosity and lubricating properties and premature wear of compressor parts.

Removing air restores any gradual loss of refrigeration capacity, thus making it possible to either increase any production related to refrigeration output, or to reduce energy consumption. Typical performance improvements average 5–10 percent of the overall refrigeration capacity, or a corresponding 5–10 percent reduction in power consumption.

The AP1000 features an easy-to-connect control box connected to both the air purger and up to 16 purge points, via settings entered with the four-inch touchscreen on the front of the electrical panel. The box is prepared for connecting additional purge box modules if more than 16 purge points are required.

Features	Benefits
Protects against gradual reductions in cooling capacity	Greater cooling capacity
Constantly purges efficiency-sapping air from refrigeration equipment	Reduced energy consumption for refrigeration equipment (normally 5–10%)
Uncomplicated design	Rapid return on investment (normally less than 12 months for medium-sized plants)
No maintenance required	Less oil decomposition and fewer unexplained refrigeration equipment stoppages
Easy to install	More stable operation Lower refrigeration service and maintenance costs

Installing the AP1000 air purger

Installation of the air purger, as illustrated below, is fairly simple. A solenoid valve must be fitted in each purge point line and connected to the control box.

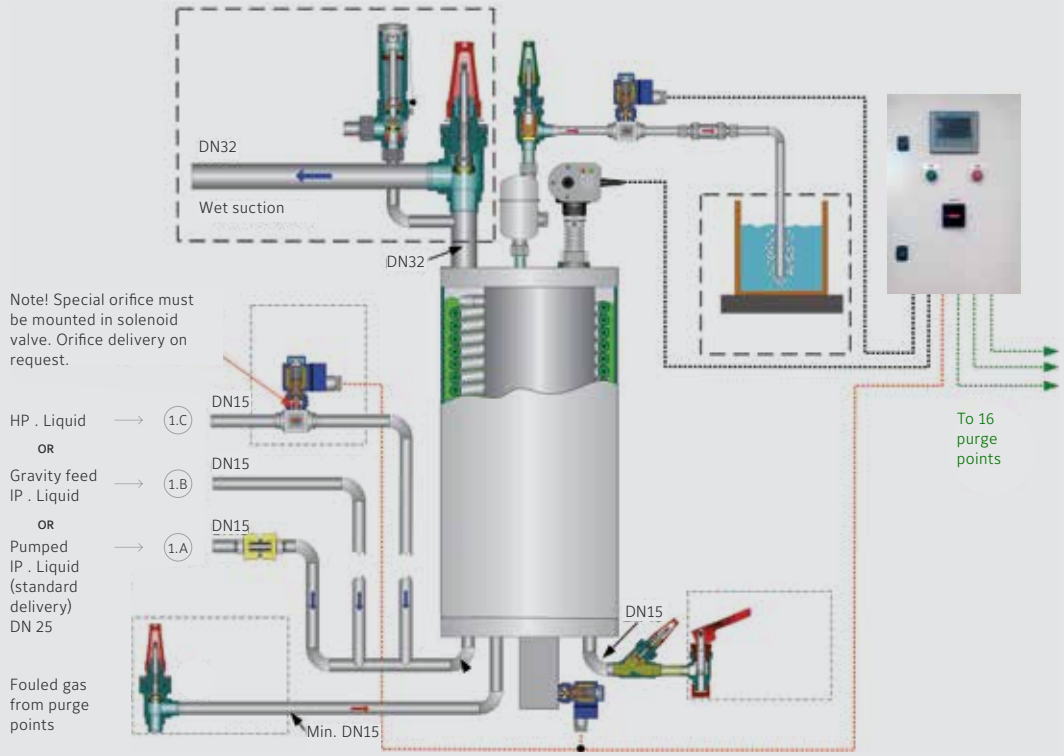
How to operate

The control box monitors the level indicator in the vessel as well as controls the three solenoid valves on the air purger itself and up to 16 solenoid valves mounted in purge lines. Settings for the on and off periods of the purge point solenoid valves are entered on the touch panel.

Remote monitoring and control of the air purger:

- Green lamp indicates purge active
- Red lamp indicates fuse fault
- Remote activation of the air purger (potential-free "HP compressor running" signal to digital input)
- Remote monitoring of fuse fault (potential-free contact)

Air purger type AP1000



Technical data for the AP1000 air purger	
Material	Carbon steel/Stainless steel
Dimensions H x W x D	1300 x 550 x 370 mm
Weight	80 kg
Condensing capacity	10 to 13 kW
Refrigerant	Mainly suited for R717
Ingress protection	IP65

Part numbers
4385.010 Carbon steel without controls
4385.020 Stainless steel without controls
4385.031 Controls for AP1000

Technical data for the control box	
Power supply	230VAC 50HZ
Dimensions H x W x D	500 x 400 x 300 mm
Encapsulation/Ingress protection	Painted-steel plate/IP66
Contents	Main switch Siemens S7-1200 PLC Siemens KTP400 Basic 4-inch Lamps indicating operation and fault Relays on outputs
Output voltage for solenoids	230 VAC 50 Hz
Compliance	CE/PED

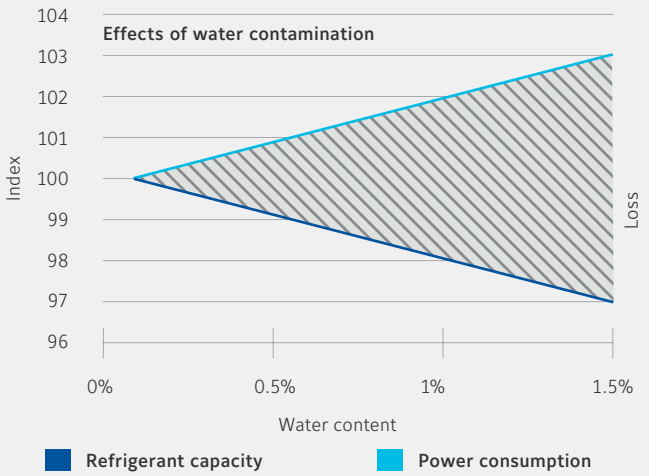
Sabroe WDO Water, Dirt, and Oil Purifier

For removing any water, dirt, and oil present in the refrigerant charge

WDO Purifiers maintain refrigeration plant efficiency by reducing the amounts of water and oil in the refrigerant. This in turn makes it possible to roll back operating costs as well as any risk of unscheduled plant shutdowns.

WDO Purifiers reduce water contamination in ammonia plants, as well as benefiting refrigeration capacity, power consumption and operating costs. Any water contamination present in the refrigerant will almost certainly have a negative impact on the overall plant performance.

For a typical ammonia-based refrigeration setup, removing unwanted water can help reduce power consumption by as much as 5–10 percent. For a medium-sized plant, a WDO Purifier normally has a payback time of less than 12 months.



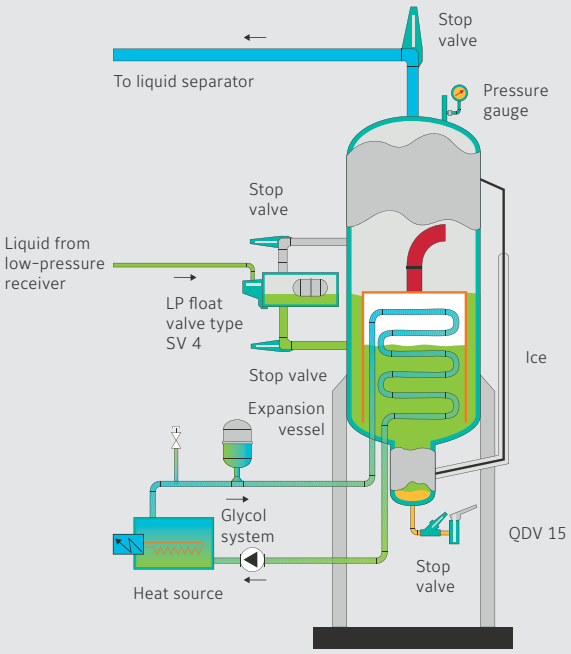
Features	Benefits
Removes oil and dirt from your refrigeration installation	Reduces operating costs and keeps system components operating at maximum efficiency
Removes any water present in the ammonia refrigerant	Less corrosion of mechanical parts, along with fewer breakdowns and unscheduled service interruptions
Fewer oil changes needed	Prevents any water present in the refrigerant degrading the lubricating oil and reducing operating efficiency and service life

Sabroe WDO-HE (insulated)

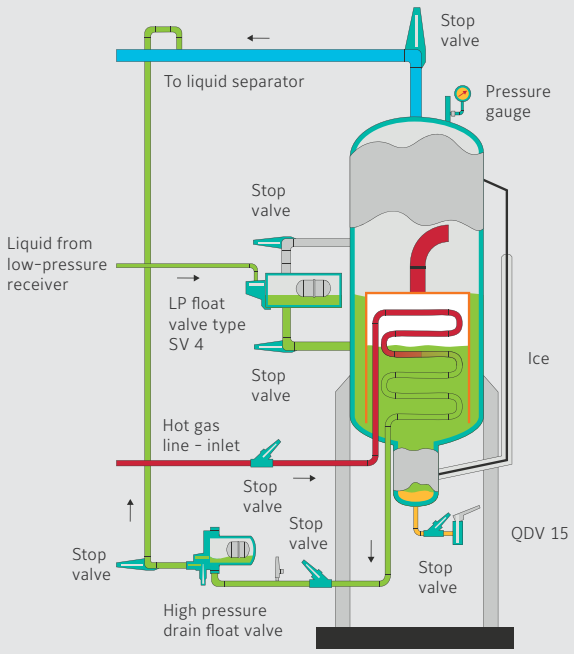
Sabroe WDO-HG (not insulated)

Two versions available

WDO-HE with electrical heating element



WDO-HG for hot gas



Technical data	
Refrigerant charge	35 kg
Maximum operating pressure	25 bar
Surface of R717 separator	1.2 m²
Capacity	15 kW (approx.)
Compliance	CE/PED
Operating limits	
Lowest operating temperature	-50°C
Highest operating temperature	50°C
WDO-HE	
Unit dimensions H x W x D	2000 x 800 x 1100 mm
Weight, empty	389 kg
WDO-HG	
Unit dimensions H x W x D	1800 x 750 x 700 mm
Weight, empty	221 kg
Power supply (for WDO-HE version only)	
Voltage	3 x 400 V, 50 Hz
Consumption	6.5 amp
Maximum fuses in supply	16 amp

Part numbers
WDO-HE (insulated)
4245.001 WDO HE (electrically heated)
WDO-HG (not insulated)
4245.002 WDO HG (hot-gas heated)

Sabroe AP1200 + WDO1200 purging system

New feature: Controller with signal of water content and purged air timer

Removes any air, water and other impurities that are present in an ammonia refrigerant charge

Sabroe AP1200 + WDO1200 purging system

The very powerful AP1200 + WDO1200 is a combined air and water purging system that can handle all sizes of industrial refrigeration systems that use ammonia (R717) as refrigerant and ensure no air, water and other impurities are left in the system.

The AP1200 + WDO1200 purging system uses excess thermal energy from the air purger to remove any water, dirt or oil (WDO) that might be present in an ammonia refrigerant charge.

This enables you to tackle multiple refrigerant contamination problems at once at relatively low cost.

By installing an AP1200 + WDO1200 purging system, you reap the full benefits of clean ammonia with consistent specifications, for use at the heart of your refrigeration system.

This whole purging system is easy and cheap to install, operate, and service.

It is also ideal as a low-cost, energy-effective way to boost operating efficiency as well as to avoid and prevent unpleasant surprises, service interruptions, and possible breakdowns in your key processes.

Features	Benefits
The amount of purged air can be determined from controller with purge timer and capacity table	Normally reduces refrigeration equipment energy consumption by as much as 5-10%
Relation between air and water content in system becomes visible	Reduces operating costs and keeps the refrigeration system and its components operating at maximum efficiency
Helps prevent undesirable chemical reactions in all systems in a refrigeration installation	More stable operation as well as lower service and maintenance costs
Warning signals when ready for pump down and water drainage from controller	Fewer oil changes needed, improved operating efficiency and longer service life for equipment and installations
Low installation costs as AP1200 + WDO1200 can use the same connections	Easy and cheap to install, operate and service

How to install

Due to its small footprint, an AP1200 + WDO1200 purging system can be installed where it is most convenient on site.

It is very easy to install as only three shared connections are needed – for wet suction, low-pressure liquid and an input line for the fouled gas.

AP1200

The AP1200 works automatically when connected to a controller.
The amount of purged air can be determined from a controller with purge timer and capacity table. This makes sure that the pressure inside is high enough and the temperature low enough for the gaseous ammonia in the inner chamber to condense.

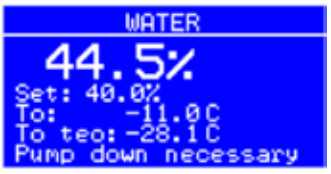
When the air purger is filled with non-condensable gas, the controller opens the air purge connection and releases air until high liquid level is restored. It then closes the air purge connection again.

WDO1200

The WDO1200 works automatically, but requires manual draining of the sludge and water reservoir when it is full.

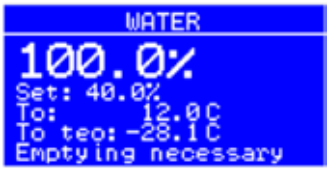
A WDO unit evaporates – and thus purifies – the liquid ammonia by exploiting the refrigerant's particular properties, pressure and temperature, with no additional energy inputs needed. The ammonia evaporates before water, leaving dirt, oil and other contaminants to settle in the sludge reservoir.

When the controller display shows the alarm **Pump down necessary,** it means that the water percentage is higher than the set point 40%.



The WDO1200 then holds back the water dissolved in the liquid ammonia.

When the controller display shows the alarm **Emptying necessary,** it means that the water reservoir temperature is higher than the evaporation temperature (approx. 12°C) and the water must be drained off. This is also a manual operation.



Technical data	
Refrigerant charge	35 kg
Maximum operating pressure	25 bar
Surface of R717 separator	0.748 m²
Capacity	12 kW (approx.)
Compliance	CE/PED
Operating limits	
Lowest operating temperature	-50°C
Highest operating temperature	50°C
AP1200	
Unit dimensions H x W x D	1374 x 302 x 330 mm
Weight, empty	51 kg
WDO1200	
Unit dimensions H x W x D	1340 x 588 x 344 mm
Weight, empty	46 kg

Part numbers
AP1200 + WDO1200 purging system without controls
4385.200 AP1200 + WDO1200 stainless steel combined without controls
AP1200 without controls
4385.150 AP1200 stainless steel without controls
Controls for AP1200/WDO1200
4385.060 Controls for AP1200/WDO1200 16 purge point
4385.061 Controls for AP1200/WDO1200 32 purge point

Sabroe AP100 + Mini WDO
combined air and water purger

Removes any air and water present in an ammonia refrigerant charge

The AP100 + Mini WDO is a combined air and water purger specially designed for use in small industrial refrigeration systems and industrial chiller units – of all sizes – that use ammonia (R717) as refrigerant.

AP100 + Mini WDO units use excess thermal energy from the air purger to remove any water, dirt or oil (WDO) that might be present in an ammonia refrigerant charge. This enables you to tackle multiple refrigerant contamination problems at once at relatively low cost. Installing an AP100 + Mini WDO unit means you reap the full benefits of clean ammonia with consistent specifications, for use at the heart of your refrigeration systems.

This whole purging system is easy and cheap to install, operate, and service. It is also ideal as a low-cost, energy-effective way to boost operating efficiency as well as to avoid and prevent unpleasant surprises, service interruptions, and possible follow-on breakdowns in your key processes.

Features	Benefits
Uses energy often wasted in an air purger to provide additional water purging capabilities	Normally reduces refrigeration equipment energy consumption by as much as 5–10%
Constantly purges efficiency-sapping air and water from your refrigeration system	Reduces operating costs and keeps the refrigeration system and its components operating at maximum efficiency
Helps prevent undesirable chemical reactions in all systems in a refrigeration installation	More stable operation as well as lower service and maintenance costs
Prevents any water present in the refrigerant from degrading the lubricant oil	Fewer oil changes needed, improved operating efficiency and longer service life for equipment and installations
Only three connections needed – wet suction, low-pressure liquid, and fouled gas line	Easy and cheap to install, operate and service

The mounting plate shown above is standard equipment

The mounting stand shown above is an optional extra

How to install

An AP100 + Mini WDO unit can be mounted on a special supporting frame, freestanding or mobile.

It is very easy to install because only three connections are needed – for wet suction, low-pressure liquid, and an input line for the fouled gas.

AP100

The AP100 works automatically when connected to a control panel and/or level switch.

When powered on, a timer delay ensures that the air purge solenoid valve cannot open during the first 10–30 minutes of running (depending on the timer setting). This makes sure the pressure inside is high enough and the temperature is low enough for the gaseous ammonia in the inner chamber to condense.

When the air purger is filled with non-condensable gas, the liquid level switch opens the air purge connection and releases air until high liquid level is restored, and then closes the air purge connection again.

Technical data	
Material	Stainless steel
Dimensions HxWxD	1200 x 620 x 360 mm
Weight	28 kg
Capacity	
Nominal ammonia evaporating capacity of the water purger:	2 kW (approx.)
Nominal ammonia capacity of the air purger:	2 kW (approx.)
Compliance	CE/PED

Part numbers
4385.100 AP100 + Mini WDO - no controls
4385.101 AP100 + Mini WDO - incl. level switch for 1 pp (stand-alone)
4385.102 AP100 + Mini WDO - incl. control panel for 16 pp

Mini WDO

The Mini WDO works automatically, but requires manual draining of the sludge reservoir and water reservoir when these are full.

A WDO unit evaporates – and thus purifies – the liquid ammonia by exploiting the refrigerant's particular properties, pressure, and temperature with no additional energy inputs needed. The ammonia evaporates before water, leaving dirt, oil, and other contaminants to settle in the sludge reservoir.

When the sludge reservoir temperature is higher than the evaporation temperature (10–15°C), this reservoir must be drained. This is a manual operation.

The water purger also holds back the water dissolved in the liquid ammonia. When the water reservoir temperature is higher than the evaporation temperature (10–15°C), this water must be drained off, after a pump down. This is also a manual operation.

Sabroe End-of-Line test centre

Full satisfaction – no surprises

Not only are Sabroe systems at the forefront of industrial refrigeration technology, they're also backed by state-of-the-art facilities for pre-delivery, pre-commissioning testing.

We rigorously test the performance of every chiller and heat pump unit before it leaves the factory, so you can be 100 percent sure it lives up to your expectations in full when it arrives. You're entitled to expect full transparency – and we make sure Sabroe systems deliver.

Testing in the factory – not on site

The unique Sabroe End-of-Line (EOL) test centre, located in Denmark, is a purpose-built facility comprehensively equipped with state-of-the-art monitoring and testing equipment.

We can conduct a comprehensive range of tests, ranging from a full-blown Factory Acceptance Test (FAT) to any specific test package you may prefer. You and your staff are, of course, welcome to witness every stage of tests and trial runs to make sure everything performs as intended, with no unwelcome surprises.

All Sabroe chiller and heat pump units are tested before dispatch

Documented capabilities

Rigorous pre-commissioning testing gives you comprehensive, reliable documentation of the performance and capabilities of the exact equipment you'll be receiving – not just generic approximations.

Solid, dependable documentation helps you and your technical staff plan effective implementation and integration with other equipment. And all the pre-delivery tests help save you time, money, and hassle with commissioning and running-in. With Sabroe product deliveries, you get what you ordered – and it works as you expected.

Solid, dependable documentation helps you and your technical staff

High-performing and reliable equipment that lasts


SABROE

About Johnson Controls
At Johnson Controls, we transform the environments where people live, work, learn and play. From optimizing building performance to improving safety and enhancing comfort, we drive the outcomes that matter most. We deliver our promise in industries such as healthcare, education, data centers and manufacturing. With a global team of 105,000 experts in more than 150 countries and over 130 years of innovation, we are the power behind our customers' mission. Our leading portfolio of building technology and solutions includes some of the most trusted names in the industry, such as Tyco®, YORK®, *Metasys*®, Ruskin®, Titus®, Frick®, PENN®, Sabroe®, Simplex®, Ansul® and Grinnell®.

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