Sauer Compressors

NAVAL MARINE

Dependable up to 500 bar – anywhere, anytime, anygas.

Sauer Compressors for the Naval Marine

- **High-Pressure Compressors**
- **Medium-Pressure Compressors**
- **Low-Pressure Compressors**
- **Non-magnetic Compressors**

Sauer Compressors for the Naval Marine are developed on the basis of the philosophy that for the maritime market and especially for the navy market special demands exist. This is the reason that maritime or navy users require different solutions compared to industrial applications.

As a result Sauer Navy compressors were developed especially for use on submarines and naval combat ships. This development was based upon established expertise in the production of navy compressors as well as long experience in the production of commercial compressors.

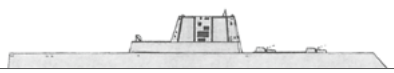
The main requirements of development are:

- small space requirements
- light weight
- reduction of noise and vibration
- high shock resistance
- high reliability
- long maintenance intervals
- easy service

Sauer Compressors for the Naval Marine are the answer to these requirements as they incorporate all special features which are vital for naval applications. Constant innovation, such as the development of the 5000 range with 100 % balanced free inertial forces, ensures the technical leadership necessary for future naval applications.

UPON REQUEST SAUER CAN PROVIDE YOU A FULL REFERENCE LIST

More than 18 Aircraft Carriers, e. g. the **USS Dwight D. Eisenhower** equipped with 4 x WP 5000



More than 115 Destroyers and Frigates, e. g. the **USS Zumwalt** equipped with 3 x Hurricane WP 4341 and 2 x Mistral WP 65L

More than 200 submarines, e. g. **Astute Class** of the Royal British Navy equipped with 2 x WP 5000 and 1 x WP 3232

Naval Know-How for the World Market

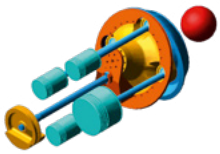
Sauer Compressors can look back on a more than 130-years-old history and more than 60 years of experience in developing and manufacturing special compressors for the navies.

Starting as supplier to the German Navy, Sauer quickly gained a world-wide reputation as a reliable manufacturer of navy compressors. Today more than 55 Navies rely on Sauer compressors.

The reasons for this success are:
- reliability of the compressors
- knowledge of the special naval demands
- credibility of the company

The Sauer compressor product range for naval applications is based on 3 different design principles:

- Sauer WP-Design
- ELGI-Sauer EK-Design
- Girodin-Sauer TGM-Design with swash plate technology



OUR RANGE

4-stage water-cooled high-pressure compressors **up to 400 barg**

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2- to 4-stage air-cooled high-pressure compressors **up to 400 barg**

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Breathing-air compressors air-cooled **up to 420 barg**

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Control- and working-air compressors **up to 10 barg**

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Accessories for high, medium and low pressure

Accessories

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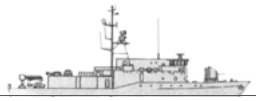
More than 730 Corvettes and Fast Attack Crafts, e. g. the Brazilian **Inhauma** equipped with 2 x WP 4262

More than 220 Miscellaneous Vessels, e. g. the Royal British Navy **Wave Knight** with 2 x Typhoon WP 200 and 2 x Hurricane WP 4330



More than 140 MCMV, e. g. the German **MJ 332** equipped with 2 x WP 3232–600

Sauer High-Pressure Compressors – water-cooled up to 400 bar

The Sauer Navy compressors of the *5000 series* have been specially designed for the use on combat ships, destroyers, frigates or submarines. They are available with AC- or DC-motor and can be delivered for surface ships or special highly sophisticated submarine versions. Their special feature is the vertical crankshaft with the 4 cylinders radially arranged around it with the motor direct coupled on top of the compressors.
As an alternative for submarine applications, Sauer offers the unique axial swash type compressor of the TGM design with low space requirement and lowest structure-borne noise emission.
The EK 2 – designed, qualified and manufactured by ELGI-Sauer based on a russian design – offers water-cooled high-pressure compressor technology at smallest space and weight and is especially suited for small vessel.

Technical Data

Water-cooled compressors ▪ radial/star type ▪ WP 5000/5500

Type	Stages	Cylinder	Speed rpm	Charging Capacity m³/h (FAD)	Power required kW	Weight kg	Length mm	Width mm	Height mm	Frequency Hz
WP 5500 @ 250 barg	4	4	1,170 1,470 1,770	56 68 82	17.2 21.6 26.0	930	970	810	1,325	60 50 60
WP 5000 @ 250 barg	4	4	1,170 1,470 1,770	115 145 175	34.4 43.2 52.0	1,650	1,215	1,095	1,570	50 60 50
WP 5000 @ 400 barg	4	4	1,170 1,470 1,770	120 150 180	43.0 53.0 62.0	1,650	1,215	1,095	1,700	50 60 50

Water-cooled compressors ▪ vertical single piston ▪ EK type

Type	Stages	Cylinder	Speed rpm	Charging Capacity m³/h (FAD)	Power required kW	Weight kg	Length mm	Width mm	Height mm	Frequency Hz
EK 2 A 2 @ 150 barg	3	1	870 970	14.2 16.2	6.1 7.1	370	1,150	640	715	60 50
EK 2 A 2 @ 200 barg	3	1	870 970	14 16	6.3 7.3	370	1,150	640	715	60 50

Water-cooled compressors series ▪ vertical/in-line type ▪ WP 3230 – 4262

Type	Stages	Cylinder	Speed rpm	Charging Capacity m³/h (FAD)	Power required kW	Weight kg	Length mm	Width mm	Height mm	Frequency Hz
WP 3230–500 @ 230 barg	3	2	970 1,170	25 30	8.0 10.0	650	1,400	750	1,180	50 60
WP 4253/4254 @ 250 barg	4	2	750	80	29.0	1,700	1,700	770	1,280	50/60
WP 4261/4262 @ 250 barg	4	2	750 1,200	80 130	29.0 48.0	1,700 1,800	1,700 1,750	770 770	1,280 1,280	50/60 50/60
WP 4261/4262 @ 350 barg	4	2	800 1,200	80 130	33.0 56.0	1,700 1,800	1,700 1,750	770 770	1,280 1,280	50/60 50/60

Water-cooled & axial swash plate type compressors TGM (Girodin-Sauer)

Type	Stages	Cylinder	Speed rpm	Charging Capacity m³/h (FAD)	Power required kW	Weight kg	Length mm	Width mm	Height mm	Frequency Hz
TGM 15/20 @ 250 barg	4	4	1,070	15	6.5	360	1,000	650	780	50/60
TGM 15/30 @ 250 barg	4	4	1,350	23	7.0	360	1,000	650	780	50/60
TGM 60 @ 250 barg	4	4	620 850	60 80	20.0 28.0	1,100	1,135	940	1,300	50/60
TGM 100 @ 250 barg	4	4	1,050	100	37.0	1,100	1,135	940	1,300	50/60
TGM 2 x 100 @ 250 barg	4	2 x 4	1,050	200	75.0	3,600	1,200	1,700	1,400	50/60

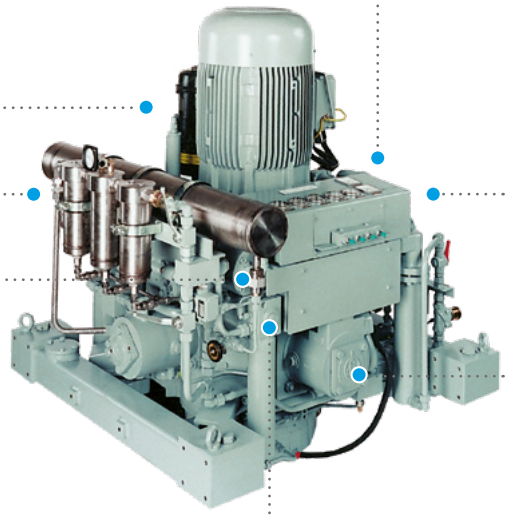
Performance data with 5 % tolerance, referred to 20° C and an air pressure of 1,013 mbar. Charging capacity according to international navy standards. Water-cooled & axial swash plate type compressors TGM (Girodin-Sauer)

WP 5000 with AC motor and IMD (integrated membrane dryers)

Special suction and delivery dampers available for lowest air borne and pipe noise.

Vertical arrangement of the crankshaft with cylinders radial round it ensures lowest vibration and structure borne noise values.

If requested the compressor can be equipped with a low maintenance Interstage Membrane Dehydrator (IMD) or traditional desiccant dryer in a module.



Material selection for cooling water circuit suitable for most aggressive seawater conditions.
Avoidance of dissimilar material combination in all parts of the circuit.

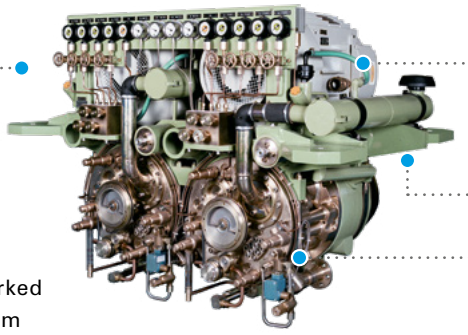
Straight cooler tubes, drawable to both sides of the cooler for easy cleaning and installation. The floating design prevent heat stress in the bundle and consequential damages.

Dry cylinder liners and hermetic separation of the water circuits from the oil – and air circuits for highest reliability.

High-efficient separators after each cooler for best air quality. Oil content in the high-pressure air of less than 3 ppm.

TGM 60 – double unit as installed in French Scorpène Class Submarines

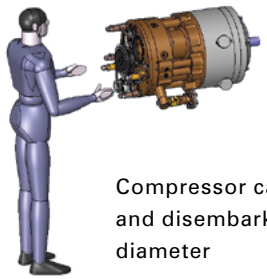
All maintenance and operation can be performed from one side.



Electrical Motor

Base frame with mounting on centre of gravity level

Compressor in swash plate design



Compressor can easily be embarked and disembarked through 800 mm diameter

EK 2 compressor with 3 stages in one cylinder

Compact water-cooled high-pressure compressor

Sauer High-Pressure Compressors – air-cooled up to 400 bar

In the year 1955 Sauer delivered the first air-cooled light weight high-pressure compressor WP 3231 N, which can still be seen in the German Museum in Munich as first of its kind. Since then Sauer has delivered more than 1000 air-cooled HP compressors for navy applications which due to their special design, work to full satisfaction of the users.

Main features of air-cooled Sauer high-pressure compressors are:

- Light weight
- Robust design
- Low and easy maintenance
- Maximum pressure 400 barg
- To be delivered in non-magnetic version upon request
- Suitable for breathing air supply
- Driven by AC-, DC- or diesel engine
- Available in semi- or non-magnetic design
- Suitable for ambient temperatures up to +60°C

Technical Data

Air-cooled compressors

Final pressure 40 barg

Type	Stages	Cylinder	Speed rpm	Charging Capacity m^3/h	Power required kW	Weight kg	Length mm	Width mm	Height mm	Frequency Hz
Mistral WP 22L	2	2	1,150 1,450 1,750	15.9 20.0 24.0	3.7 4.6 5.7	120	812	600	630	60 50 60
Mistral WP 45L	2	2	1,170 1,450 1,750	38.0 48.0 58.0	8.0 10.0 12.0	310	1,210	745	820	60 50 60
Mistral WP 65L	2	2	1,170 1,450 1,750	52.0 66.0 80.0	10.2 12.8 15.4	320	1,250	745	820	60 50 60
Passat WP 81L	3	3	1,170 1,470 1,770	63.0 79.0 96.0	13.7 15.8 18.9	415	1,345	945	900	60 50 60

Final pressure 250 barg (data for higher pressures upon request)

Type	Stages	Cylinder	Speed rpm	Charging Capacity m^3/h	Power required kW	Weight kg	Length mm	Width mm	Height mm	Frequency Hz
WP 3232	3	3	1,170 1,470	11.0 14.2	5.3 6.8	291	920	710	970	60 50
Hurricane WP 4331	4	4	1,470 1,770	30.0 36.0	14.2 17.2	480	1,350	720	930	50 60
Hurricane WP 4341	4	4	1,470 1,770	54.0 65.0	20.5 24.1	530	1,350	860	860	50 60
Hurricane WP 4351	4	4	1,470 1,770	100.0 120.0	38.0 47.0	900	1,700	990	1,080	50 60

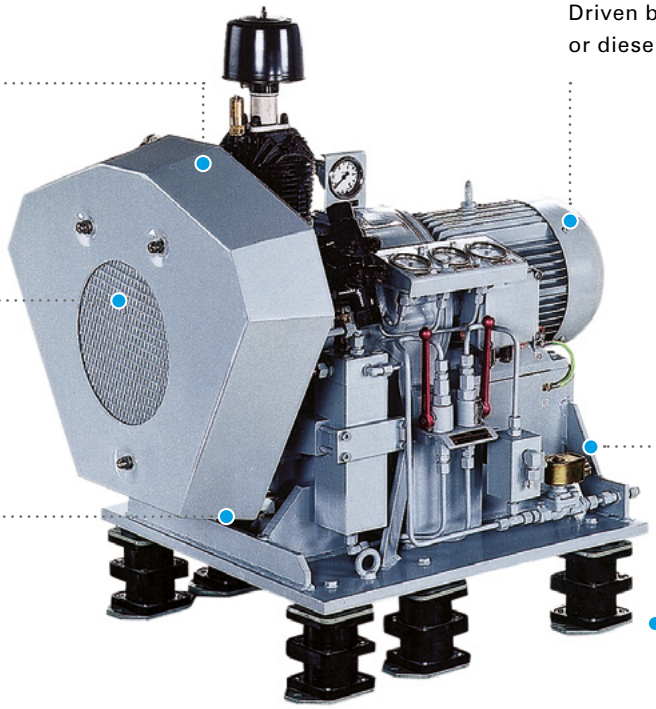
Performance data with 5 % tolerance, referred to 20°C and an air pressure of 1,013 mbar. Charging Capacity according to international navy standards. Performance data on final pressure deviating from above pressures upon request. Maximum pressure 350 barg.

WP 3232 in non-magnetic version for use in MCMV.

Highly efficient compressor valves for longest maintenance intervals. Easy to maintain.

Suitable for ambient temperatures up to 60°C without reduction of performance

Non-magnetic design with less than 20 nt disturbance uncompensated available upon request

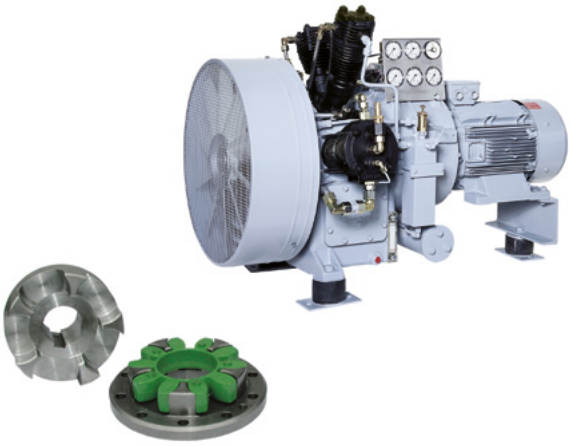


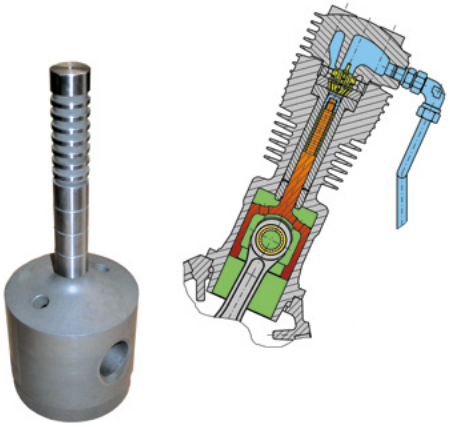
Driven by AC-, DC- or diesel engine.

Sturdy and robust design. Comparably low weight due to air-cooled design.

Shock-proof according to all international navy standards.

The well-known Sauer quality – some details





All Sauer Compressors are of direct-drive design. Advantages vs. v-belt drive:

- less maintenance
- higher reliability
- higher efficiency
- less noise
- Simple maintenance due to piston and cylinder each made in one piece
- Low blow-by due to use of multiple classic piston rings
- Best clearance between piston and liner for high reliabilitiy and high temperatures

Sauer Breathing-Air Compressors – air-cooled up to 420 bar

Sauers' quality and leading position in the market for Navy compressors with vertical crankshaft of the series are well known. With the introduction of the unique high-pressure compressor block *Tornado* this quality and performance is now also available for breathing air compressors. Sauers' Navy breathing air compressors can be delivered according to several shock and vibration standards from simple LRoS rules to highest Navy standards like US Mil Std 901 or German BV0432 and 044.

The heart of each breathing air station is the robust compressor block – a block which is designed to withstand highest demands as they occur for naval applications such as inclination, shock, vibration and last but not least high temperatures and continuous operation.

The vertical arrangement of the running gear of the *Tornado* types WP 3215 and WP 4325 has been adopted from the water-cooled WP 5000 compressors which are used in submarines, frigates and aircraft carriers. It ensures lowest noise emission and structure-bourne noise.

The Sauer breathing air compressor for Navy has everything required for a complete installation: fully automatic electronic control, noise insulation down to 72 db(A), integrated filter, demistor and condensate collecting tank.

Filtration can be delivered according to all international standards such as DIN EN 12021, BS 4275 and BS 4001 or US CGA Grade D+E and Navy standard FS Grade A+B.

Technical Data

TORNADO and HURRICANE series

Final pressure 350 barg (max. 420 barg)										
Type	Stages	Cylinder	Speed rpm	Charging Capacity l/min	Power required kW	Weight kg	Length mm	Width mm	Height mm	Frequency Hz
Tornado WP 4325 ComSilent	4	4	1,170 1,470 1,770	400 500 600	8.4 10.0 12.0	595	1,580	775	1,525	60 50 60
Hurricane WP 4341 ComSilent	4	4	1,170 1,470 1,770	1,000 1,200 1,500	15.5 19.0 23.0	1,280	2,200	1,450	1,750	60 50 60
Tornado WP 4325 shock-proof	4	4	1,170 1,470 1,770	400 500 600	8.4 10.0 12.0	580	990	1,180	1,215	60 50 60
Hurricane WP 4341 shock-proof	4	4	1,170 1,470 1,770	1,000 1,200 1,500	15.5 19.0 23.0	780	1,240	1,400	1,400	60 50 60

Performance data with 5 % tolerance, referred to 20 °C and an air pressure of 1,013 mbar. Breathing air charging rate for stand-alone units as per international naval standard.

Tornado WP 4325 ComSilent.
Proven Sauer quality ready to use in an complete and silent module.

Side covers easy to remove for inspection and maintenance.

Optimized cooling air flow: Compressed air treatment and filtration in cold air stream.

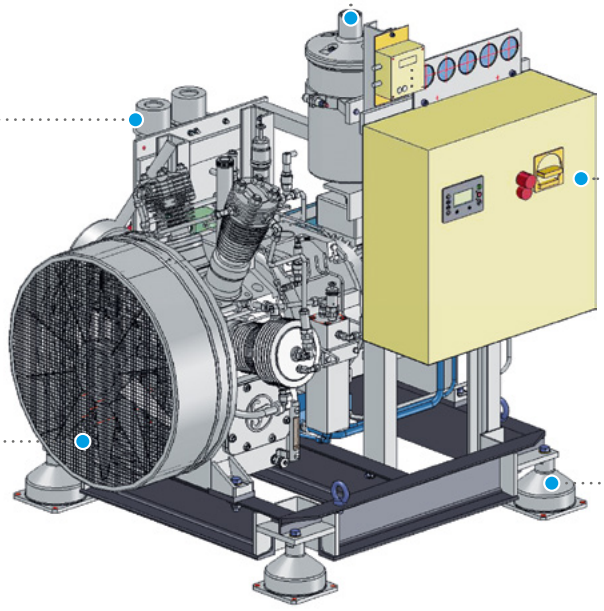
Integrated demister vessel.

Breathing air filtration suitable for all international standards.

Front door: Easy access to control unit, condensate collecting tank and filter accessories.

Integrated condensate demister and -collecting tank (20 litres).

Hurricane WP 4341 Shock-Proof.
Compact breathing-air unit to meet the requirements of demanding naval specifications.



Integrated demister vessel

Integrated control and starter unit

Breathing-air filtration mounted on the unit as per international standards.

Air cooling up to + 60 °C ambient temperature

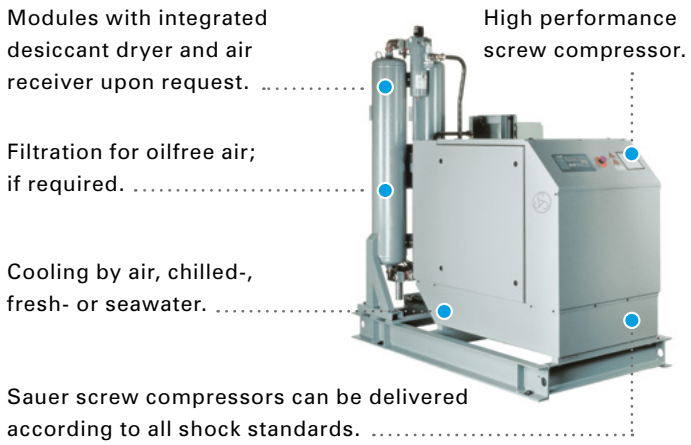
Shock-proof as per all international navy standards

Sauer Control- and Working-Air Compressors up to 10 bar

For control- and working-air applications Sauer can deliver special screw- and piston compressors in naval design. Sauer low pressure air compressors can be delivered according to several shock and vibration standards from simple LRoS rules to highest Navy standards like US Mil Std 901 or German BV0432 and 044. Cooling is available for both screw- and piston compressors by seawater, fresh- or chilled water as well as by air. If required special air treatment can be included in the scope of supply either to be delivered separately or attached to the compressor in a module.

As an alternative to the screw compressors of the SC range Sauer offers direct driven and frequency controlled screw compressors of the SD range. This alternative offers lower maintenance and higher reliability due to missing V-belts. It also allows smaller air receivers due to soft capacity adaption as per the actual demand. The highly reliable Sauer piston compressors offer same advantages and technology as the well-known 30 barg starting-air compressors.

Low-pressure compressor station
with integrated desiccant dryer.
Shock-proof, sea-water cooled version.



Technical Data

Screw type compressor V-belt driven				Technical Data for a final pressure of **8 barg**				Dimensions		
Type	Version	Final pressure max. barg	Motor speed rpm	Charging* Capacity m³/h	Power consumption kW	Heat Dissipation kJ/sec	Weight kg	Length mm	Width mm	Height mm
SC 26	50 Hz 60 Hz	10	2,930 3,530	148 177	16.0 19.2	17.6 21.1	450	1,270	795	1,070
SC 42	50 Hz 60 Hz	10	2,960 3,550	234 280	28.6 34.3	31.5 37.8	580	1,270	795	1,170
SC 52	50 Hz 60 Hz	10	2,980 3,555	278 334	33.4 40.0	36.7 44.0	595	1,270	795	1,170

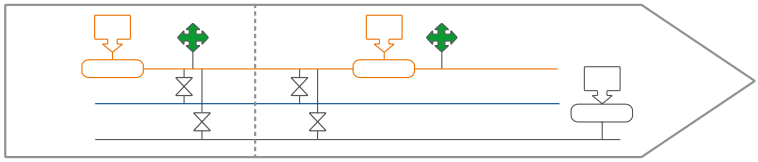
Piston compressor					Technical Data for a final pressure of **8 barg**				Dimensions		
Type	Final pressure max. barg	Stages	Cylinder	Speed rpm	Charging Capacity m³/h	Power consumption kW	Heat Dissipation kJ/sec	Weight kg	Length mm	Width mm	Height mm
Mistral WP 146L air-cooled	10	2	2	1,170 1,470 1,770	116 150 175	17 21 25	19 23 28	850 850 850	1,420	870	880
Mistral WP 226L air-cooled	10	2	2	1,170 1,470 1,770	220 280 330	30 36 42	33 40 46	880 880 880	1,735	1,030	1,020
Typhoon WP 200 water-cooled	15	2	2	1,170 1,470 1,770	144 177 214	23 28 34	30** 37** 45**	770 800 800	1,500	1,000	890

Performance data with 5% tolerance, referred to 20° C and an air pressure of 1,013 mbar. Capacity of screw-type compressors according to DIN-ISO 1945. Weights and dimensions for standard units with three-phase A. C. motor, IP 54, and flexible mounting. Water-cooled screw-type compressors upon request.
* Larger capacity up to 2,000 m³/h or capacity for other final pressures upon request. | ** Cooling water demand for delta Δ t = 10 °C

Accessories for Central High Pressure Air Systems

The selection of a centralized high pressure air system in your warship will provide lowest lifetime-costs and is a prerequisite for an up-to-date and affordable warship design.

The centralized air-system provides air for all consumers via a ring-main directly or if required through pressure reducing stations. It is versatile and flexible even if in a later stage of the design or operation other consumers requiring air supply will be installed. Space and weight is considerably lower than an alternative “point of use” system which requires dedicated air compressors for each application in a warship. Whilst also initial costs are reduced – the major savings in design and operation will come through the reduced number of compressors installed.



- **lowest capital costs**
- **lowest ILS costs**
- **lowest maintenance costs**

- **Pressure reducing stations in shock-proof design to generate medium-pressure and low-pressure air from the centralized up ring-main.**

Reduced number of maintenance intensive o-ring sealings

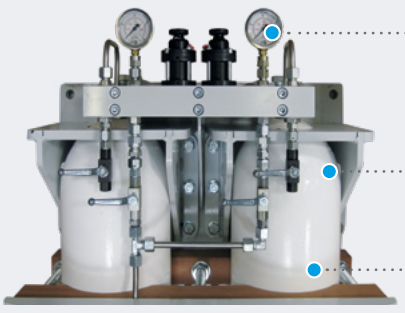
Standard valves and fittings – easy to maintain

- **Breathing-air filtration systems as per all international naval standards**

Cartridge housings made of stainless steel

Single or multiple cartridges available

- **High-pressure bottle racks with multiple standard 50 litre bottles in shock-proof design**



Equipped with pressure gauges, safety valves and drainage

Easy to exchange standard 50 litre bottles

Vertical arrangement for reliable drainage of receiver

- **Breathing-air filling boxes to protect crew in shock-proof design**

Filling panel for 200 and 300 barg

Approved as NFPA 1901

Sauer Compressors

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