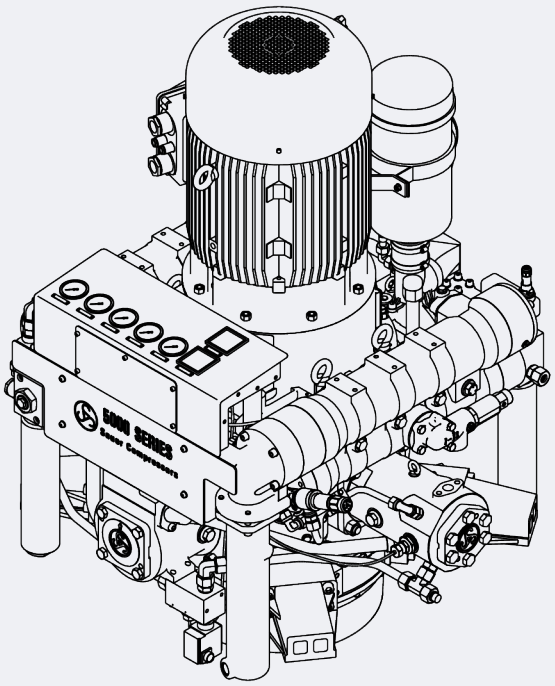
Sauer Compressors



- *High pressure compressor*
- *Sea-water-cooled*

OPERATING INSTRUCTIONS

Sauer-Compressors
Type: WP5000N
Order no. | Series: 5000

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

EN 09 | 2019

www.sauerusa.com

Sauer Compressors

Original operating instructions
Edition: 25 / 09 / 2019
Edited by: Sauer USA – Technical Documentation

Sauer Compressors

Dear Customer,

Thank you for choosing a Sauer compressor.

“Dependable up to 500 bar – anywhere, anytime, anygas” is what we promise our customers – and what we demand of ourselves. Over many years, Sauer compressors have proved their worth in numerous industrial, naval, commercial shipping and petro industry applications.

Through maintaining close contacts with you, our customers, and listening to your current and future requirements we can continually evolve both our products and our company. That way, we create sustainable values using our high degree of technical competence.

Please familiarise yourself with the information and instructions contained in this Operations and Maintenance Manual for the product you have purchased. This will help to ensure long-term, optimal and smooth operability.

If you have any questions about our products, suitable accessories, service or spare parts’ concepts, we would be delighted to help you in person. Simply get in touch via **service@sauercompressors.de** or visit our website: **www.sauercompressors.de**.

Harald Schulz
Managing Director

Edition: 07/2019
Edited by: J.P. Sauer & Sohn Maschinenbau GmbH – Technical Documentation

Sauer Compressors

Table of contents

TABLE OF CONTENTS

1 General

1.1 Foreword

These operating instructions describe how to operate the Sauer-Compressor WP5000 and provide operating personnel with the following essential information:

- Design and function
- Safe transportation
- Commissioning
- Operation
- Decommissioning and disposal
- Compliance with technical safety regulations

These operating instructions and the associated maintenance instructions cap proper use and maintenance. Any other work must be performed by specialist personnel authorized by Sauer USA.

1.2 Target group

These operating instructions are aimed at all personnel who perform work with or on the compressor or the compressor system, e. g.:

- operation including preparatory actions for operation, fault correction during operation, disposal of auxiliary materials and operating materials, and disposal of the entire compressor or compressor system.
- Servicing work, inspection and maintenance
- Transportation

Personnel who carry out this work must have read and understood the operating instructions first.

Actions or activities that are not described in these instructions may only be carried out by Sauer-Service or by specialist personnel authorized by Sauer USA.

1.3 Information on technical documentation

Technical documentation as part of the product

The features, function and accessories depend on the specific model and the product options, and on the country-specific regulations in the country of sale. Figures may show products that are not mentioned or are not available as standard.

The descriptions, figures, specified weights and technical data are non-binding and are state of the art at the time of printing. Sauer USA reserves the right to make changes to the design, fea-tures, look and technology without prior notification as part of the continuous further development of the products.

All safety information in these operating instructions must be observed, along with the statutory and insurance association regulations at the place of use. These operating instructions are compiled with the utmost care, but var-iations to figures or dimensions, calculation errors, printing errors, or incom-pleteness cannot be ruled out. Therefore, Sauer USA accepts no liability for the accuracy and completeness of the informa-tion in these operating instructions. Sauer USA guarantees that the Sauer-Compressor will function correctly within the framework of its general terms and conditions of business. Sauer USA provides no warranty beyond this. No liability beyond that specified in the general Sauer USA terms and conditions of business will be accepted. For further infor-mation on the guarantee and liability, see *Chapter 1.6 'Warranty and lia-bility' on page 10*.

Optimisation of the doc-umentation

We are continuously working on optimising our documenta-tion. Do you have any questions, comments or proposals for improving this documentation? Please contact us at: betterdoc@sauercompressors.de

Storage location for instructions

The operating instructions and maintenance instructions must always be kept on or in the immediate vicinity of the Sauer-Compressor. The operating instructions and the maintenance instructions must be freely available to the operator and the maintenance personnel.

1.4 Related documentation

- In addition to these operating instructions, observe the following addi-tional documentation:
  - Maintenance instructions for the Sauer-Compressor WP5000
  - Spare parts catalogue for the Sauer-Compressor WP5000
  - Oil recommendation for Sauer-Compressors
  - Quotation specification and installation drawing
- Depending on the features of the Sauer-Compressor, the following docu-mentation may also be relevant:
  - Plant description for the compressor system
  - Operating instructions for the electronic compressor control
    If the compressor controller has not been supplied by Sauer USA, the requirements set forth in the prin-ciple wiring diagram, Appendix "Principle wiring diagram" will apply.
  - Operating instructions for components available as options from Sauer USA
  - Operating instructions for components available as options from sup-pliers

The documents are part of the documentation folder supplied.

Supplementary documentation includes:

- Generally applicable, statutory and other binding regulations under European and national legislation.
- Accident prevention and environmental protection regulations applicable in your country.

1.5 Product identification

The Sauer-Compressor WP5000 is identified by the nameplate. The nameplate is attached to the guard plate.

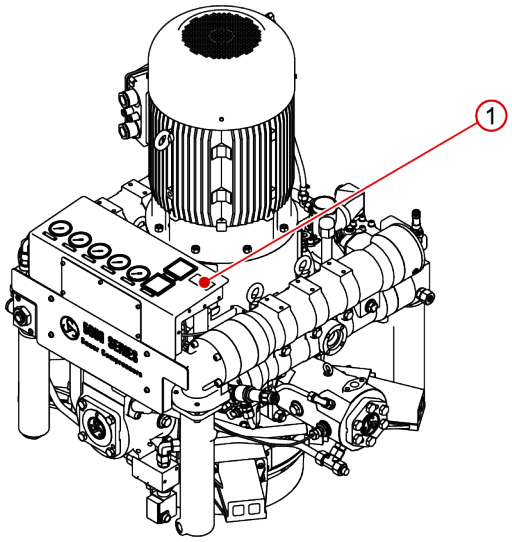


Fig. 1: Location of nameplate

1 Nameplate

The following specifications for the Sauer-Compressor are stated on the nameplate:

- Compressor type
- Serial number
- Year of construction
- direction of rotation
- Rated speed in rpm
- Filling capacity in m^3/h
- Inlet pressure in bar
- Final pressure in bar
- Motor power in kW

Note the specifications. Have this information to hand when ordering spare parts and for any inquiries to Sauer-Service.

1.6 Warranty and liability

The CE marking documents that the Sauer-Compressor WP5000 has been manufactured in compliance with the valid EU directives.

Sauer USA accepts no liability for damage resulting from improper use.

Sauer USA reserves the right to reject contrac-tually agreed warranty and liability claims if they can be attributed to at least one of the following causes:

- Use of the machine in a manner or for a purpose other than that specified
- Use of spare parts not manufactured or approved by Sauer USA
- Use of spare parts that are not genuine Sauer spare parts
- Operation of the Sauer-Compressor with faulty or improperly installed safety and/or protective devices
- Failure to observe the operating instructions and all associated documentation
- Unauthorised modifications to the Sauer-Compressor or to the control system
- Inadequate monitoring of machine parts subject to wear
- Maintenance and repairs carried out improperly and contrary to the Sauer operating and maintenance instructions
- Force majeure.

The operating instructions and maintenance instructions must always be kept on or in the immediate vicinity of the Sauer-Compressor.

1.7 Copyright

1.8 Type approval and genuine Sauer spare parts

The WP5000 is a high pressure compressor. Use only genuine Sauer spare parts to guarantee safe and reliable operation.

- Type approval for the Sauer-Compressor is valid on the condition that only parts and components specified and qualified by Sauer USA are used. Type approval is provided by the classi-fication body and the EC Declaration of Conformity or EC Manufacturer's Declaration. Failure to observe these requirements may void type approval.
- Only the use of genuine Sauer spare parts guarantees compliance with these specifications and thus also reliable, safe functioning of the Sauer-Compressor.
- If non-genuine Sauer spare parts are used, Sauer USA reserves the right to refuse liability for personal injury or damage.
- Genuine Sauer Spare Parts are supplied with a Certificate of Conformity and a Certificate of Authenticity. A sample of this document is provided in the appendix. If spare parts are supplied without this certificate, there is a risk that they are not genuine Sauer spare parts.
  In this case, contact Sauer-Service for advice.

1.9 Sauer-Service

In case of technical questions and any queries regarding spare parts orders, maintenance and repairs, contact Sauer-Service.

For any enquiries to Sauer-Service, have the following specifications for the Sauer-Compressor to hand:

- Compressor type
- Serial number
- Year of construction

The specifications can be found on the nameplate of the Sauer-Compressor.

Contact

Postal address:	Sauer Compressors USA 245 Log Canoe Circle Stevensville, MD 21666
Telephone (international):	410-604-3142
E-mail:	*service@sauerusa.com*
Web:	*www.sauerusa.com*

1.10 Instructions for reading

To allow fast and safe operation of the product, standard safety instructions, pictograms, symbols, means of representation, terms and abbreviations are used. These are explained in the following sections to ensure understanding.

All technical information in this documentation relates to the standard models tested under ISO 1217 Appendix C, and describes their standard functions.

The term "compressed air" is used in this documentation for all gases that can be properly compressed using the Sauer-Compressor. These gases are specified in the acceptance test certificate.

Features, function and accessories depend on the specific model and the product options, and on the country-specific regulations in the country of sale. As a result, minor variations cannot be ruled out.

Always observe all safety information in this documentation, along with the statutory and insurance association regulations at the place of use.
↳ *Chapter 2.1 'Function of safety instructions' on page 15*

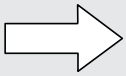
1.10.1 Means of representation in text

In these operating instructions, the following means of representation are used in the text to improve the comprehensibility of the documentation:

Means of representation	Meaning
Bold	Important terms in running text
"Quotation marks"	Chapter references and terms to be emphasised
↳ *Chapter 1.10 'Instructions for reading' on page 12*	Cross-reference in document
■ ■	An individual, independent action or multiple actions whose order is not important.
1. 2. 3.	Actions that must be carried out in the specified order. The numbers stipulate that the actions follow on from one another.
- - -	General bullet points are indicated using a dash.

1.10.2 Means of representation in graphics

In these operating instructions, the following means of representation are used in graphics to improve the comprehensibility of the documentation:

Means of repre-sentation	Meaning
	Direction of flow of a medium (compressed air, gas, cooling water) towards the compressor
	Direction of flow of a medium (compressed air, gas, cooling water) away from the compressor
	Direction of movement of a compressor part or an action
	Direction of force action of the motor, if this is not shown
	Correct
	Incorrect

1.10.3 Pictograms used

To ensure safe operation of the Sauer-Compressor, it is essential that the operating instructions have been read and understood, and that all instructions are followed.

Pictograms are used in the document to indicate hazards and information.

Pictogram	Meaning
	The general warning pictogram indicates safety instructions that warn of potential hazards with a high, medium and low risk of personal injury and damage. The safety instructions and all other hazard symbols used in the document are described in detail: ↳ *Chapter 2.1 'Function of safety instructions' on page 15*.
	This warning pictogram indicates the risk that the compressor can start up unexpectedly in automatic mode.
	This warning pictogram indicates an electrical hazard due to live parts.
	This warning pictogram indicates the hazard caused by hot surfaces on the compressor.
	This pictogram indicates important general information, and provides supplementary information to ensure optimal operation.
	This pictogram indicates important environmental information.

2 Safety

2.1 Function of safety instructions

Safety instructions are divided into the categories of hazard information, commands and proscriptions. Hazard information is intended to protect against hazardous situations and/or damage. Commands and proscriptions are intended to prevent hazardous situations from occurring in advance.

2.1.1 Hazards

Hazards and risks of potential injury and damage are indicated by a pictogram, the signal words DANGER, WARNING, CAUTION, and NOTE, and the adjacent text.

In this documentation, safety instructions precede every sequence of actions that involves a risk of injury or damage. The actions described to avert the risk must be observed.

The safety instructions have a grey background to differentiate them from the normal text.

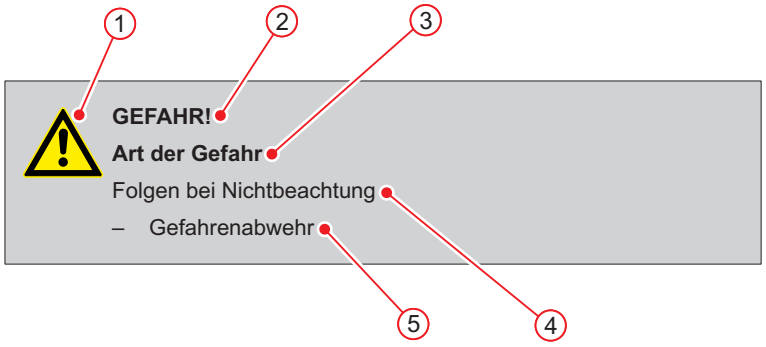


Fig. 2: Layout of safety instructions

1 Warning sign - Draws attention to the risk.
2 Signal word - Indicates the severity of the risk.
3 Type of risk - Specifies the nature or source of the risk.
4 Consequences - Describes the consequences of non-compliance.
5 Prevention - Specifies how the risk can be averted.

Hazard levels

DANGER!
Danger
Indicates an immediate hazard with a high risk, which will result in death or serious physical injury if it is not avoided.

WARNING!
Warning
Indicates a possible hazard with a medium risk, which may result in death or (serious) physical injury if it is not avoided.

CAUTION!
Caution
Indicates a hazard with a low risk, which could result in minor or moderate physical injury if it is not avoided.

NOTICE!
Attention
Indicates a possibility of incorrect operation, which may cause damage to the product.

2.1.2 Proscriptions

Smoking, fire and naked flames prohibited.

Smoking and the use of naked flames is strictly prohibited in areas with a risk of explosion. No work that could produce sparks is to be carried out in the vicinity.

No unauthorised access

2.1.3 Information and commands

Information that is important for the protection of operating and maintenance personnel is emphasised using commands in the text.

Hearing protection
Wear protective equipment to protect the hearing against damage, predominantly caused by excessively loud noises.

Protective gloves
Wear protective gloves.

Protective helmet
Wear protective helmet.

Safety boots
Wear safety boots.

Safety goggles
Wear protective equipment to protect the eyes against harmful influences.

Work clothing
Wear clothing to prevent against harmful influences.

2.2 General hazards

This chapter describes the safety instructions for the basic hazards that can be caused by the Sauer-Compressor.

To guarantee safety, ensure compliance with all safety regulations.

2.2.1 Mechanical hazards

WARNING!
Risk of injury from pre-tensioned components
Elastic elements and pre-tensioned components (e. g. pneumatic cylinders, pressure reservoirs or pressure reducing valves) can lead to injuries.

– Wear the specified personal protective equipment to minimise the risk of injury.

WARNING!
Risk of injury due to high pressure
Components are pressurised and can lead to significant injuries (e. g. valves, pipes, hoses, pressure reducing valves, strainers).

– Local health and safety laws, standards and regulations, e. g., BGR 500, must be observed.
– Wear the specified personal protective equipment to minimise the risk of injury.

WARNING!
Risk of injury due to automatic starting
The Sauer-Compressor can start automatically and expectedly from a standstill. This can lead to injuries when working on the compressor. If the Sauer-Compressor is stopped, this does not mean that it is switched off. The Sauer-Compressor can start unexpectedly at any time.

– Always maintain a distance to the Sauer-Compressor, even when the Sauer-Compressor is stopped.
– Wear the specified personal protective equipment when working near the Sauer-Compressor.
– Disconnect the Sauer-Compressor from the power supply and secure it against being switched back on again before beginning any work on it.

CAUTION!
Risk of injury due to escaping cooling water
Escaped cooling water can lead to injuries due to slipping.

– Connect the cooling water supply lines properly.
– Keep the working area clean.

CAUTION!
Risk of injury on housing and components
Edges and corners of the housing and components can lead to injuries.

– Wear the specified personal protective equipment to minimise the risk of injury.

CAUTION!
Risk of injury due to tripping or slipping
Contamination from oil, water or tools lying around or poorly routed cables and lines can lead to injuries.

– Ensure the required order and tidiness in the workplace.
– Keep the working area clean.
– Wear the specified personal protective equipment to minimise the risk of injury.
– All lines and cables (e.g. electrical cables, cooling water piping, condensate, pressure and drainage lines) must be routed in such a way that they do not represent a tripping hazard.

2.2.2 Electrical hazards

WARNING!
Danger when working on live parts
There is a significant risk of injury when working on electrical connections and the live parts of the Sauer-Compressor.

– Only carry out work on live parts of the Sauer-Compressor when the power supply is disconnected and secured against being reconnected.
– All work on the electrical system may only be carried out by specialist electricians.
– Secure live cables against direct contact.
– Install live cables in line with the applicable standards and directives.

WARNING!

Risk of injury due to electric fault currents

Electrical faults such as short-circuits can result in significant injuries.

– Make sure that safety equipment to detect short circuits and disconnect all connection phases are properly installed.
– Ensure that the operator network has the required level of protection.

2.2.3 Thermal hazards

WARNING!

Risk of burns from hot surfaces.

The cylinders, motor, pressure lines and cooling water piping have hot surfaces. Contact with hot surfaces can cause serious injuries.

– Keep a safe distance away from the Sauer-Compressor.
– Wear the specified personal protective equipment to minimise the risk of injury.
– Allow the Sauer-Compressor to cool down before beginning maintenance work.

2.2.4 Hazards due to noise

WARNING!

Hazard due to high sound pressure

The high sound pressure of the Sauer-Compressor during operation can lead to loss of hearing and other physiological impairments.

– Wear the specified personal protective equipment to minimise the risk of injury.

2.2.5 Hazards due to materials and other substances

CAUTION!

Hazard due to flammable materials

The cylinders, motor, pressure lines and cooling water piping have hot surfaces. If flammable materials come into contact with hot surfaces, they can easily ignite.

– Assemble the Sauer-Compressor in such a way that the hot surfaces cannot come into contact with flammable materials.

2.3 Proper use

Proper use of the product is assumed if the product is used in accordance with the specifications in the associated product documentation and within its performance limits (see data sheet, documentation, subsequent safety instructions).

WARNING!

Risk of death due to improper use

Improper use can lead to potentially fatal injuries and cause significant damage.

– Only operate the Sauer-Compressor in line with its proper use.

- Only use the Sauer-Compressor for compressing the specified gas/ medium (see acceptance test certificate). Any other use of the Sauer-Compressor is classed as improper.
- Only operate the Sauer-Compressor for the proper purpose, with an awareness of safety and hazards, in line with the operating instructions and in perfect technical condition.
- Resolve any faults that could impair safety immediately.
- Only operate the Sauer-Compressor after proper fault resolution / repair.
- Do not make any modifications to the construction of the Sauer-Compressor: ↬ *Chapter 2.10 ‘Unauthorised modifications’ on page 28*.
- Do not use the Sauer-Compressor at ambient temperatures outside the values specified in the technical data. Any other use is considered improper or requires the express written approval of Sauer USA.
- Observe all safety regulations, preventive protection measures and local specifications.
- Observe the operating instructions and comply with the specified maintenance, inspection and service intervals.

2.4 Foreseeable misuse

The Sauer-Compressor is only designed for its intended use ↬ *Chapter 2.3 ‘Proper use’ on page 20*.

Any other or additional use is considered improper. Sauer USA accepts no liability for any damage occurring as a result. The operator bears sole liability for all risk.

In particular, ensure that the following types of misuse are prevented:

- Do not compress any media other than the specified gas (see acceptance test certificate).
- Operation at ambient temperatures outside the values specified in the technical data.
- Make sure that the Sauer-Compressor is only operated within the operating and installation conditions set out in the operating instructions.

2.5 Operator responsibility

General obligations

- The operator has an obligation to produce a risk assessment for the work areas on the Sauer-Compressor and to use this as a basis for work instructions.
- The operator has an obligation to issue work instructions for work on and around the Sauer-Compressor.
- Personnel must be regularly and verifiably instructed in compliance with the work instructions.

Operating and maintenance personnel responsibility

- The operator must appoint an employee who will be responsible for safe operation of the machine and for coordination of all work on the machine.
- The operator must clearly set out their personnel's duties in terms of operation, setting up, servicing and repairs.
- The operator must train the operating and service personnel at regular intervals.

Health and safety responsibility

- The operator must provide the required personal protective equipment ↳ *Chapter 2.9 'Personal protective equipment' on page 27*.
- The operator must issue a work instruction on use of the personal protective equipment.
- The operator has an obligation to regularly monitor the wearing of personal protective equipment during working hours.
- The operator must provide documented health and safety training for the operating and maintenance personnel.
- The operator must attach the required warning, command and proscription symbols that apply to the entire plant area in clearly visible positions at the access points.
- To prevent accidents on the Sauer-Compressor caused by inadequate lighting, the operator must ensure that the workplace is adequately lit.

Plant safety responsibility

- If the Sauer-Compressor is supplied without a control system, the operator is responsible for the control system.
  - The operator must ensure that the control system disconnects all connecting lines in the event of power failure.
  - The operator must ensure that the Sauer-Compressor does not automatically start operation when the power supply is restored after a power failure.
  - The operator must ensure that the required emergency stop mechanisms are installed and that their accessibility is guaranteed.
- The operator must ensure that safety equipment is installed to detect an electrical short circuit and disconnect all connection phases.

2.6 Markings on the Sauer-Compressor

The following warning and command symbols must be attached to the Sauer-Compressor and indicate hazardous areas on or around the Sauer-Compressor.

WARNING!

Hazard due to missing safety markings

Missing safety markings can cause a risk of serious injury.

- Safety markings must not be altered or removed.
- Check the safety markings regularly.
- Replace damaged or lost safety markings immediately with an approved replacement.

Safety markings on the Sauer-Compressor

The following safety markings are attached at the corresponding hazard points on the Sauer-Compressor:

WARNING!

Warning of hazardous electrical voltage

The live parts of the compressor still carry a voltage even when the compressor is turned off.

- Do not touch any live parts.

WARNING!

Risk of injury due to automatic starting

The Sauer-Compressor can start automatically and expectedly from a standstill. This can lead to injuries when working on the compressor. If the Sauer-Compressor is stopped, this does not mean that it is switched off. The Sauer-Compressor can start unexpectedly at any time.

- Always maintain a distance to the Sauer-Compressor, even when the Sauer-Compressor is stopped.
- Wear the specified personal protective equipment when working near the Sauer-Compressor.
- Disconnect the Sauer-Compressor from the power supply and secure it against being switched back on again before beginning any work on it.

WARNING!

Warning of hot surface

Parts of the Sauer-Compressor can get very hot.

- Keep a safe distance away from the Sauer-Compressor.
- Wear the specified personal protective equipment to minimise the risk of injury.
- Allow the Sauer-Compressor to cool down before starting work.

Commands on the Sauer-Compressor

Hearing protection

Wear protective equipment to protect the hearing against damage, predominantly caused by excessively loud noises.

Operating instructions

Read the operating and maintenance instructions.

Other markings on the Sauer-Compressor

direction of rotation

Observe the crankshaft direction of rotation.

Location of markings

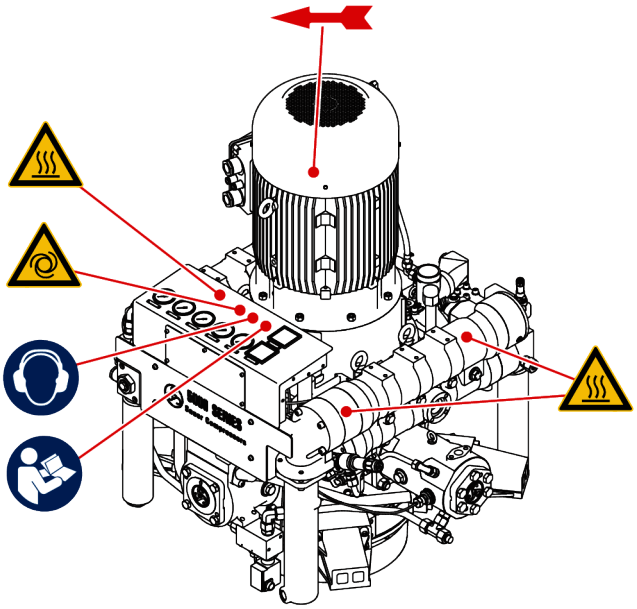


Fig. 3: Location of markings

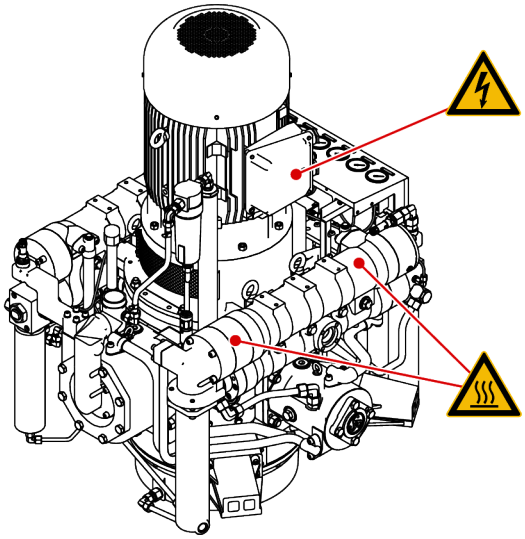


Fig. 4: Location of markings

	Hazard due to automatic starting		Direction of rotation of crankshaft
	Hazard due to hot surface		Read operating instructions
	High voltage hazard		Wear hearing protection

2.7 Safety and protective devices

The safety devices on the Sauer-Compressor consist of safety valves.

The Sauer-Compressor is supplied with a compressor control. Protective equipment that is connected to the compressor control, e. g. emergency stop switches, is described in the compressor control documentation.

The connection drawings for the electrical installation are in the appendix.

WARNING!

Hazard due to improper installation of electrical protective equipment

Missing or improperly installed electrical protective equipment can result in potentially fatal injury.

– If the Sauer-Compressor is supplied without a compressor control, the operator must ensure proper installation of the electrical protective equipment that is connected to the compressor control.

WARNING!

Hazard due to missing or faulty safety equipment

Missing or faulty safety equipment can lead to potentially fatal accidents and serious damage.

– Do not disable or remove safety equipment.
– Do not adjust the settings on the safety equipment.
– Do not remove the sealing.
– Safety valves may only be replaced by trained and authorised personnel.
– Regularly inspect all safety equipment on the Sauer-Compressor.

Compressed air safety valves

The Sauer-Compressor is equipped with 3 stage pressure safety valves and 1 final pressure safety valve. These safety valves protect the compressor against excessively high pressure in the medium that is being compressed.

The safety valves are installed at the following locations:

- Compression stage 1: on the pressure duct of compression stage 1
- Compression stage 2: on the pressure duct of compression stage 2
- Compression stage 3: on the cooler insert of compression stage 3.
- Compression stage 4: on the cooler insert of compression stage 4.

Cooling water safety valve

The cooling water circuit is protected with 2 cooling water safety valves. The cooling water safety valve protects against excessively high pressure in the cooling water circuit. A cooling water safety valve is located on both cooler housings. If the permitted cooling water pressure is exceeded, the cooling water safety valve opens and the cooling water escapes.

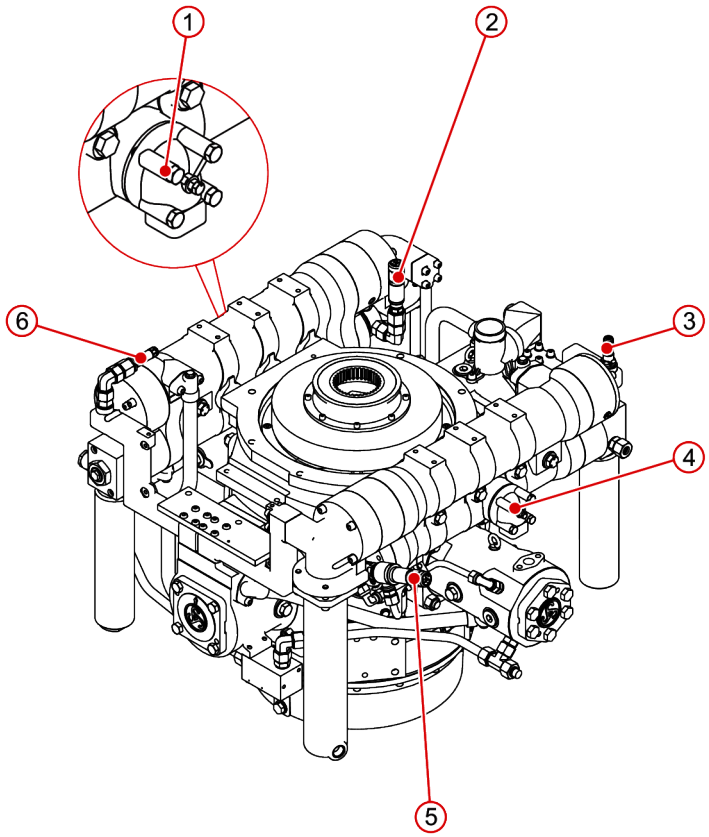


Fig. 5: Safety and protective devices

1 Bursting disc
2 Stage pressure safety valve for compression stage 3
3 Stage pressure safety valve for compression stage 1
4 Bursting disc
5 Final pressure safety valve for compression stage 4
6 Stage pressure safety valve for compression stage 2

2.8 Requirements for operating and service personnel

Operating and service personnel are subject to the following conditions:

General requirements

- All work on and with the machine may only be carried out by "qualified personnel".

  "Qualified personnel" are personnel who:
  - have the technical training, knowledge and experience, as well as familiarity with the applicable standards, that enables them to assess the work to be carried out and identify potential hazards.
  - have the same level of knowledge as after completing specialist training due to several years of experience in a similar area.
- Work on and with the machine may only be carried out by personnel authorised to do so by the operator.
- Persons whose responsiveness is impaired, e.g. by narcotics, alcohol, medication or similar, may not carry out any work on the Sauer-Compressor.
- Observe any regional age regulations.

Requirements for personnel

- Reading and understanding the following documents:
  - Health and safety regulations
  - Operator's work instructions
  - Sauer-Compressor operating and maintenance instructions
- Proper performance of duties assigned by operator.
- Using personal protective equipment ↬ *Chapter 2.9 'Personal protective equipment' on page 27*.
- Familiarisation with the safety equipment ↬ *Chapter 2.7 'Safety and protective devices' on page 25* and safety regulations ↬ *Chapter 2.2 'General hazards' on page 17*.
- Observe the safety instructions in the supplier documentation.
- Observe the following regional laws, standards and regulations:
  - Equipment and Product Safety Act
  - Industrial Health and Safety Ordinance
  - Accident prevention regulations for compressors
  - VDE regulations
  - Environmental protection regulations
- Observe regulations issued by the relevant classification body.

Definition

"Authorised personnel for operation" are the operator's trained and instructed specialist personnel.

"Authorised personnel for servicing" are the trained specialist personnel from the operator and the manufacturer.

2.9 Personal protective equipment

This chapter describes the personal protective equipment that must be worn by operating and service personnel.

The operator must provide the operating and service personnel with the following personal protective equipment ↬ *Chapter 2.5 'Operator responsibility' on page 21*:

Protective equipment:
- Protective helmet
- Hearing protection
- Safety goggles
- Protective gloves
- Work clothing
- Safety boots

2.10 Unauthorized modifications

WARNING!

Hazard due to unauthorised modifications

Modifications to the Sauer-Compressor can result in potentially fatal injuries and irreparable damage to the machine.

– Do not make any unauthorised modifications to the Sauer-Compressor.

Any modifications should only be planned in consultation with Sauer USA.

All planned modifications must be approved by Sauer USA in writing.

2.11 Environmental protection instructions

This section deals with how to handle the materials that are produced during operation, servicing and repair work.

For waste products, define and assign the waste code based on the following table (waste catalogue ordinance).

Waste material is only to be disposed of by authorised disposal companies. Observe all European, national and local regulations and ordinances.

Dispose of the following materials in an environmentally sound manner in line with the applicable legislation:

Material / Component	Waste disposal
Oils	As hazardous waste
Greases	As hazardous waste
Condensate containing oil	As hazardous waste
Cooling water with frost and corrosion protection (only for water-cooled compressors)	As hazardous waste
Cleaning agents (only for water-cooled compressors)	As hazardous waste

Material / Component	Waste disposal
Diesel fuel (only for compressors with diesel engine)	As hazardous waste
Steel/iron	As scrap metal
Electrical cables	As scrap electronic waste
Electronic components	As scrap electronic waste
Plastics and other packaging materials	As hazardous waste

3 Technical data

This chapter sets out the general technical data for the Sauer-Compressor WP5000.

The specific details for the Sauer-Compressor can be found in the quotation specification and the installation drawing, including:

- Final pressure
- Speed
- Total weight and centre of gravity
- Dimensions
- Connection information for the medium to be compressed, the cooling water and the condensate
- Electrical connection specifications

3.1 General technical data

Designation	Data
Compressor type	WP5000
Number of cylinders	4
Number of compression stages	4
Speed	1780 rpm
Operating pressure	350 bar / 5075 psi
Rotation direction (viewed from motor to compressor)	Clockwise
Cooling	Sea-water-cooling

3.2 Technical data for valves and safety equipment

Set pressures for the compressed air safety valves

Designation	Data
Compression stage 1	6 bar
Compression stage 2	20 bar
Compression stage 3	95 bar
Compression stage 4	5% above operating pressure

Solenoid drain valves

Designation	Data
Supply voltage	115 V AC
Power consumption	14 | 8W / DC | W / AC
Setting	Valve is currentless open.

Cooling water solenoid valve

Designation	Data
Supply voltage	Not supplied.
Power consumption	
Setting	Valve is .

3.3 Technical data for switches and sensors

Switches

Tab. 1: Oil pressure switch

Designation	Data
Supply voltage	24 V DC
Setting	opens at 1 bar falling approximately 15 s delay on start instruction
Signal	Switch contact

Tab. 2: Compressed air temperature switch compression stage 3

Designation	Data
Voltage	150 - 480 V AC
Setting	> 80 °C
Signal	Switch contact

Further information about the wiring can be found in the appendix, in the block circuit diagram and in the principle wiring diagram.

3.4 Operating conditions

Specification	Data
Permitted ambient temperature during operation	+5 to +55 °C | +41 to +131 °F

3.5 Emissions

Specification	Data
Sound pressure level in free field at 1 m distance in compliance with DIN 45635	max. 87 dB(A)
Resonance frequency of anti-vibration resilient mount ↳ *Chapter 6.3.2 'Foundation' on page 66*	approx. 7 - 11 Hz

NOTICE!
The compressor foundation provided must not be exposed to vibrations at a frequency of 7-11 Hz from neighbouring machines. Otherwise, there is a risk that the standard anti-vibration resilient mount may be destroyed by resonance vibration.

1. Check beforehand whether there are vibrations of the machine founda-tion in the range from 7 - 11 Hz.
2. If in doubt, contact Sauer USA to deter-mine whether a different anti-vibration resilient mount can be used.

3.6 Consumables

Information about the oil specification ↳ *Oil recommendation for Sauer-Compressors*.

Specification	Data
Total oil quantity	28 l
Oil quantity between dipstick markers	8 l
Oil pressure range	1.8 to 5 bar
Oil switch-off pressure	< 1 bar
Maximum permitted cooling water temperature at cooling water inlet	+34 °C

4 Design and function

This chapter describes the general design of the Sauer-Compressor and its functioning. The individual assemblies are described according to their functionality.

Details of components and spare parts including their part numbers can be found in the spare parts catalogue.

4.1 Compressor design

This chapter provides an overview of the Sauer-Compressor and its components.

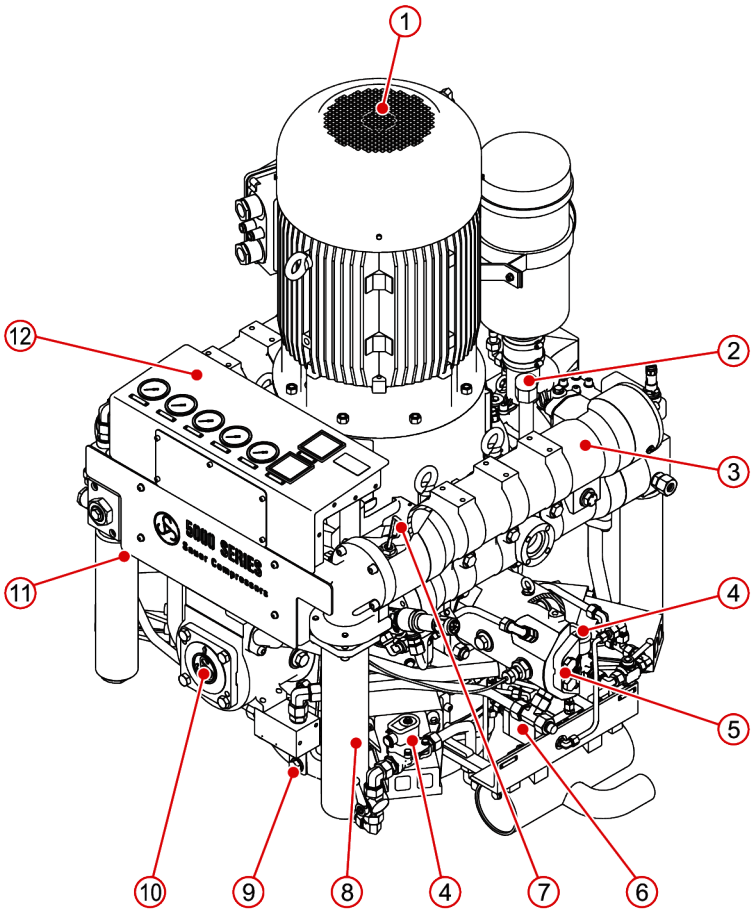


Fig. 6: Compressor design - front

1 Electric motor[1)]
2 Oil filler
3 Cooler compression stages 1, 4
4 Drainage outlet solenoid valve
5 Cylinder compression stage 4
6 Pneumatic drain valve
7 Oil dipstick
8 Condensate separator compression stage 1
9 Oil drain screw
10 Cylinder compression stage 2
11 Condensate separator compression stage 3
12 Gauge panel

[1)] The electric motor is not supplied as standard.

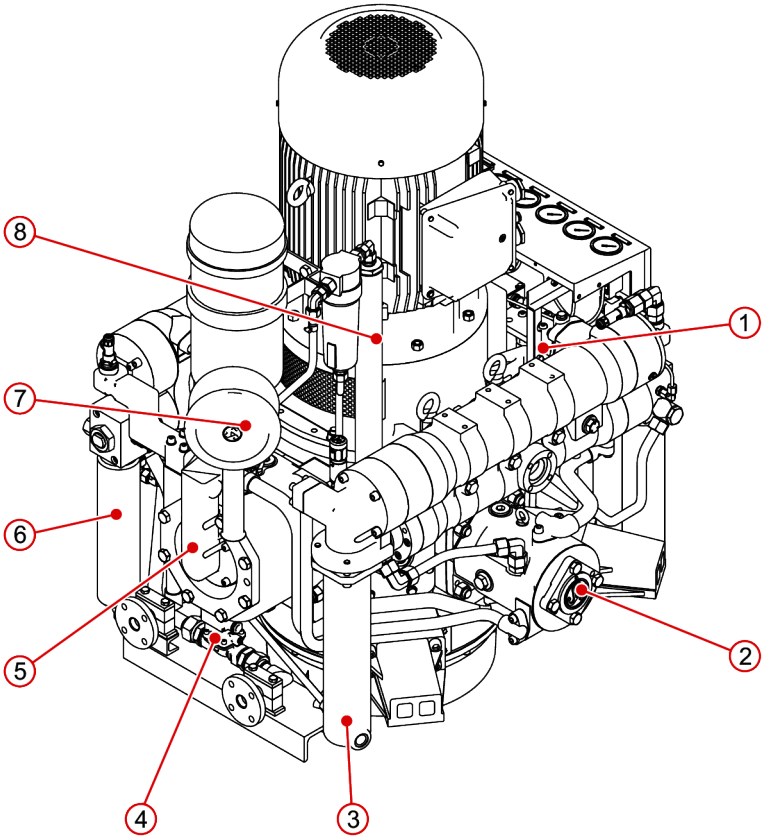


Fig. 7: Compressor design - rear

1 Cooler compression stage 2, 3
2 Cylinder compression stage 3
3 Condensate separator compression stage 2
4 Cooling water piping
5 Cylinder compression stage 1
6 Condensate separator compression stage 4
7 Air filter
8 Crankcase vent

4.1.1 Longitudinal section through crankcase

The longitudinal section provides an insight into the crankcase and shows the positioning of the individual components.

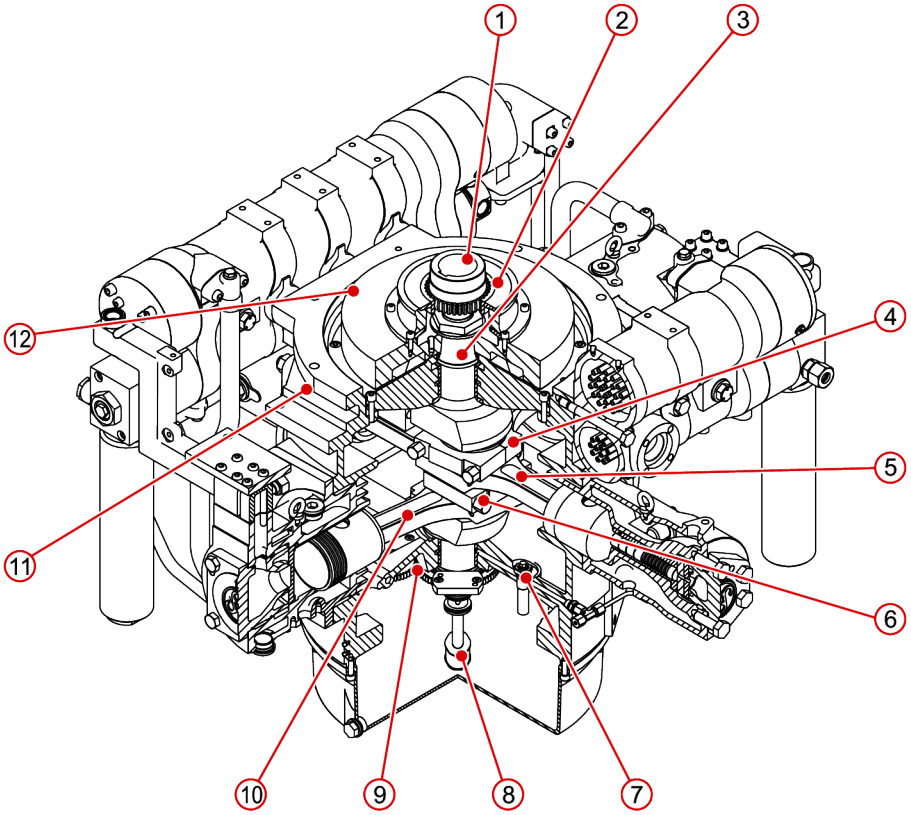


Fig. 8: Longitudinal section through crankcase

1 Coupling hub spacer ring (motor side)
2 Coupling hub flexible flange (compressor side)
3 Crankshaft
4 Connecting rod compression stage 1
5 Connecting rod compression stage 4
6 Connecting rod compression stage 3
7 Pressure relief valve
8 Oil strainer
9 Oil pump
10 Connecting rod compression stage 2
11 Crankcase
12 Flywheel

4.1.2 Cross-section through crankcase

The cross-section shows an example of the layout of compression stage 1. The layout of compression stages 2, 3 and 4 is the same.

Layout of the compression stages: ↳ *Chapter 4.2 'Functional description of compressor' on page 39*

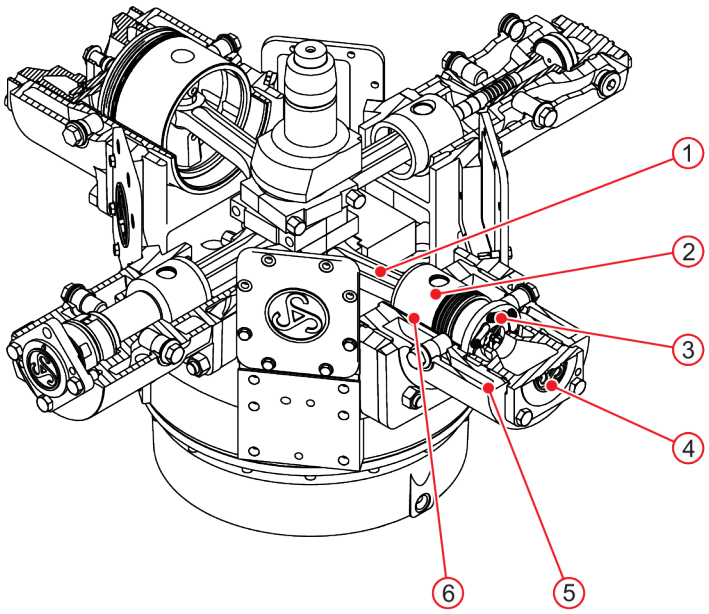


Fig. 9: Cross-section through crankcase

1 Connecting rod
2 Piston
3 Valve
4 Valve cover
5 Cylinder
6 Cylinder liner

4.2 Functional description of compressor

This chapter describes the general functioning and the processes on the Sauer-Compressor.

4.2.1 Compression

Functional description

The medium to be compressed is fed to compression stage 1 via an air filter and a downstream dry air filter, and it is compressed to the final pressure in compression stages 1, 2, 3 and 4.

Air that leaks into the crankcase during operation is fed via the crankcase vent to mix with the intake air in the cylinder of compression stage 1.

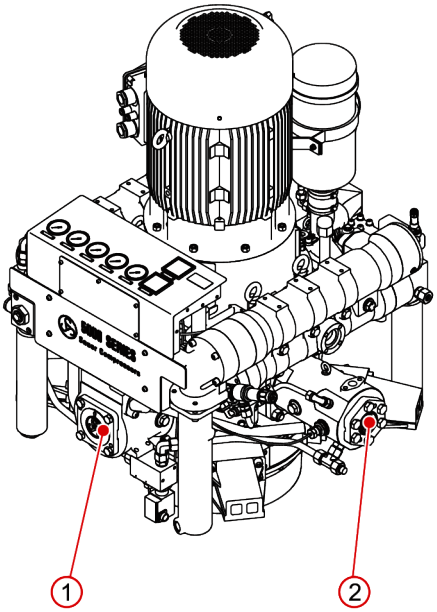


Fig. 10: Compression stages - front

1 Compression stage 2
2 Compression stage 4

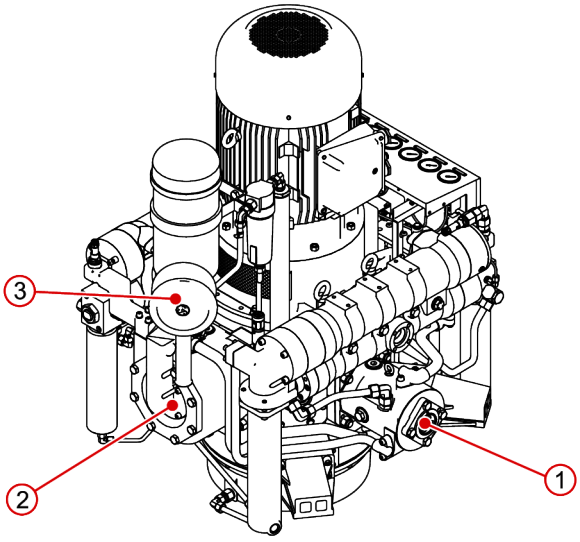


Fig. 11: Compression stages - rear

1 Cylinder compression stage 3
2 Cylinder compression stage 1
3 Air filter

monitoring The final pressure is monitored by a final pressure sensor. The final pressure is also monitored by a final pressure switch.

A temperature switch after compression stage 3 protects the compressor from excessively high temperature. A temperature switch in front of the adsorption dryer protects the adsorption dryer from an excessively high air inlet temperature.

A pressure sensor after compression stage 3 monitors the stage pressure at compression stage 3.

For further information on switches and sensors: *Chapter 4.6 'Sensors and switches' on page 51*

Measurement ranges of switches and sensors: *Chapter 3.2 'Technical data for valves and safety equipment' on page 31*

Safety valves

Each compression stage is protected by a downstream safety valve.

Further information about the safety valves:

Limit values for safety valves: *Chapter 3.2 'Technical data for valves and safety equipment' on page 31*

4.2.2 Cooling

4.2.2.1 Cooling water circuit

Functional description

The compressed air and the cylinder housings and cylinder liners of the compression stages are cooled by cooling water flowing through them.

After the cooling water inlet and outlet are opened, the cooling water flows through all cylinder housings and the cooler for the compressed medium.

If the Sauer-Compressor is stopped, the cooling water supply is interrupted by the cooling water solenoid valve at the cooling water inlet to prevent over-cooling.

Monitoring the cooling circuit

The cooling water thermostatic valve controls the flow of cooling water depending on the temperature of the cooling water at the cooling water outlet.

If the cooling water temperature is too low, the cooling water thermostatic valve closes and interrupts the cooling water supply. The cooling water that is in the Sauer-Compressor circulates until the minimum temperature has been reached. Then the cooling water thermostatic valve opens.

Further information about the cooling water thermostatic valve: *Chapter 4.7 'Valves' on page 53*

Limit values for the cooling water temperature: *Chapter 3.6 'Consumables' on page 33*

Bursting disc

The cooling water circuit is equipped with 2 bursting discs. These bursting discs protect against excessively high pressure in the cooling water circuit. The bursting discs are located in front of the bursting disc flange on both cooler housings. If the permitted cooling water pressure is exceeded, the bursting disc breaks and the cooling water escapes.

Location of the bursting discs:

4.2.2.2 Cooler

Functional description

The compressed medium in each compression stage passes into the cooler and is cooled in cooler tubes there by cooling water flowing around it.

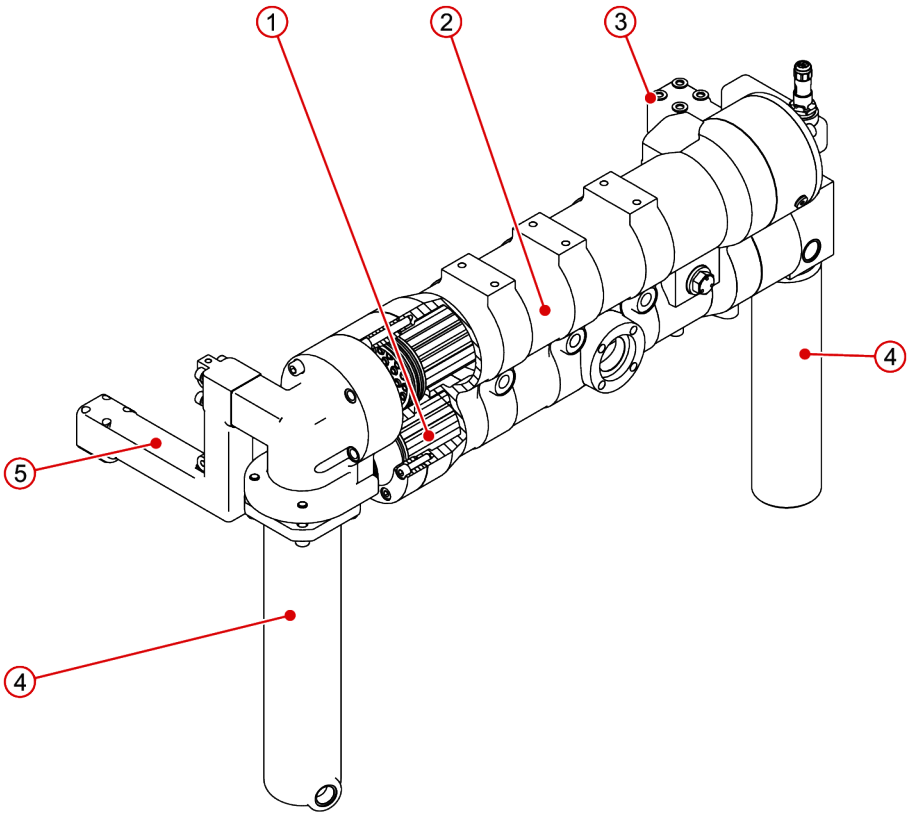


Fig. 12: Cooler unit - Example of cooler compression stage 1

1 Cooler tubes
2 Cooler housing
3 Cooler compressed air inlet
4 Condensate separator
5 Cooler compressed air outlet

4.2.3 Condensate separation and drainage system

4.2.3.1 Condensate separation

Functional description

After each cooling cycle, the compressed medium flows through a condensate separator. The compressed and cooled medium includes condensate that contains oil and water, and these are separated from the compressed medium in the condensate separator.

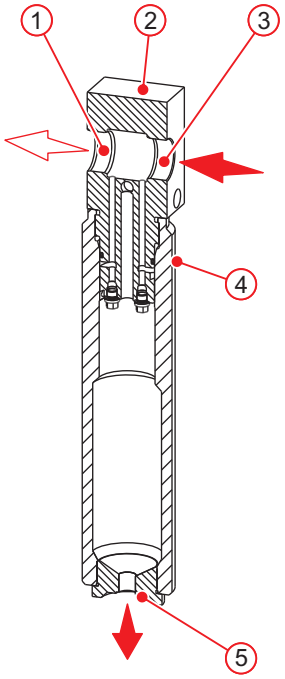


Fig. 13: Condensate separator (example)

1 Pressure outlet
2 Separator head
3 Pressure inlet
4 Separator housing
6 Condensate outlet

The condensate is separated out of the air flow by the swirling that the air flow undergoes as it flows through the condensate separator head. The swirling throws oil and water droplets onto the wall of the condensate separator, thus separating them from the compressed medium. The oil and water droplets accumulate in the lower section of the condensate separator.

4.2.3.2 Drainage system

Functional description

The solenoid drain valves behind the condensate separators of compression stages 1 and 2 open at regular intervals to drain the accumulated condensate. The solenoid drain valves are operated by the compressor control.

Pneumatic drain valves allow the condensate to drain out of compression stages 3 and 4. The pneumatic drain valves are controlled by the pressure in compression stage 2.

When the solenoid drain valve in compression stage 2 opens, the pressure in compression stage 2 falls. This change in pressure opens the pneumatic drain valve in compression stage 3. The loss of pressure in compression stage 3 opens the pneumatic drain valve in compression stage 4. When the solenoid valve in compression stage 2 closes, the pressure in compression stage 2 increases and closes the pneumatic valve in compression stage 3. The rising pressure in compression stage 3 immediately closes the pneumatic valve in compression stage 4.

The condensate is discharged into the condensate demister through the drain valves. The condensate demister separates the air that is ejected through the solenoid drain valves from the condensate that is carried with it. The condensate drains into a collection vessel provided by the operator. The air escapes into the surrounding atmosphere.

The solenoid drain valves are open by default. If the compressor control or the solenoid drain valves develop a fault, the compressor would be drained constantly, and pressure could not be built up. Drainage for compression stages 1 and 2 can be blocked using the stop valves for compression stages 1 and 2 so that the compressor can be operated under load. In order to drain compression stages 1 and 2, the stop valves must be opened.

Observe the information for correct connection of the drainage lines ↬ Chapter 6.4 ‘Connecting the compressor’ on page 66.

Observe the information in the quotation specification and installation drawing.

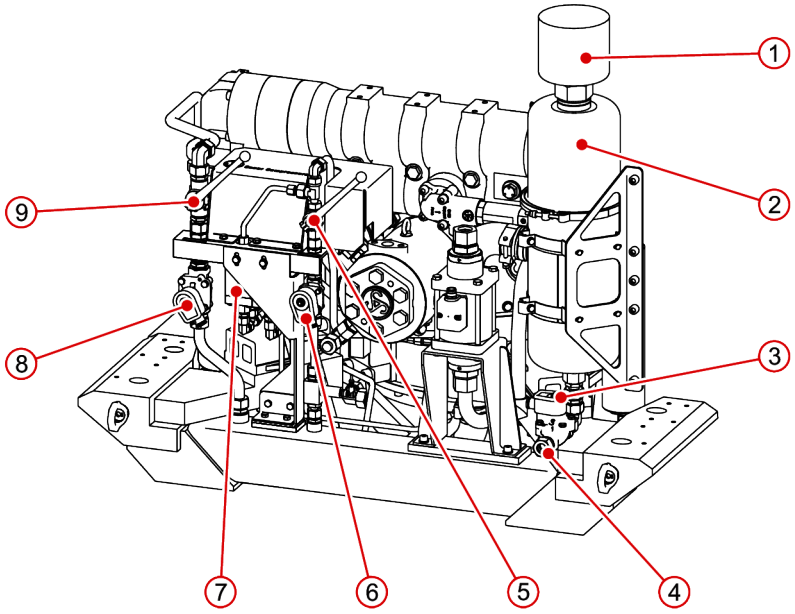


Fig. 14: Drainage system

1 Silencer
2 Condensate demister
3 Drainage outlet solenoid valve
4 Drainage outlet
5 Drainage system stop valve compression stage 1
6 Solenoid drain valve compression stage 1
7 Pneumatic drain valves compression stages 3 and 4
8 Solenoid drain valve compression stage 2
9 Drainage system stop valve compression stage 2

4.2.4 Oil lubrication

Functional description

The oil pump draws the oil from the crankcase through the oil strainer. A proportion of the oil is pumped into the crankshaft. There, the oil passes through holes to reach the crankshaft bearing and connecting rod bearings. Another part of the oil is fed via a lubricating oil piping to the cylinder in compression stage 4.

The gudgeon pin bearings and pistons are lubricated by the oil mist and splash oil present in the crankcase. The splash oil flows back into the oil sump through openings in the crankcase.

A technical overview of the oil circuit can be found in the appendix.

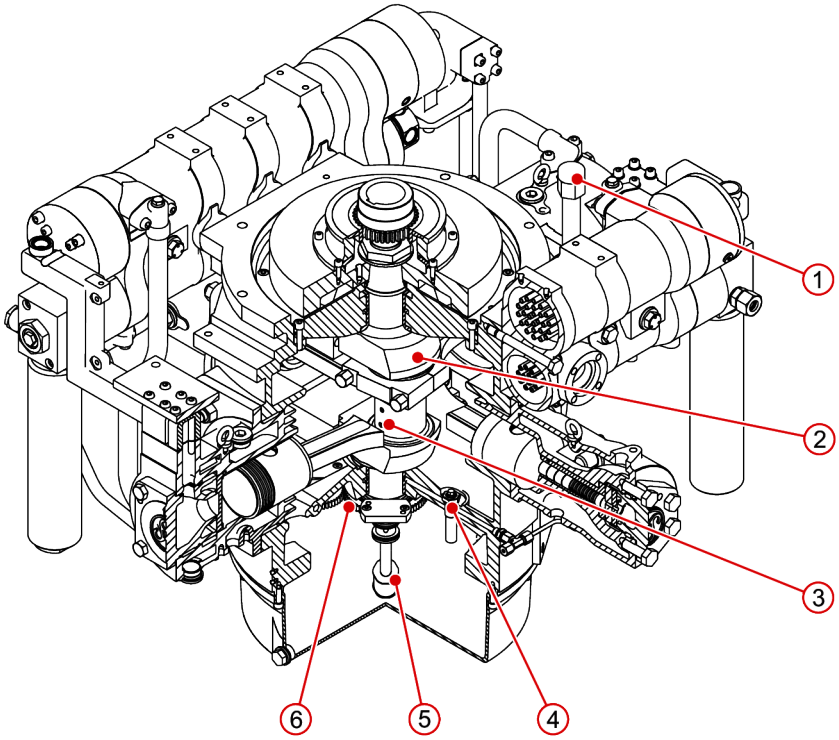


Fig. 15: Oil lubrication of the compressor in the crankcase

1 Reducing union
2 Non-return valve
3 Connecting rod bearing
4 Pressure relief valve
5 Thread fitting
6 Drive pinion

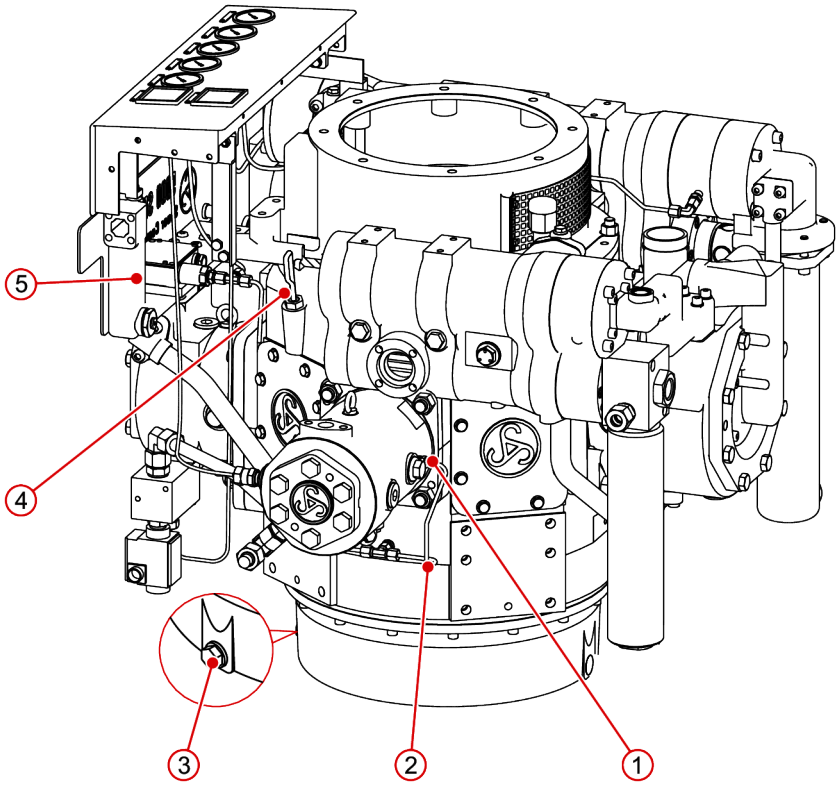


Fig. 16: Compressor oil lubrication

1 Non-return valve
2 Pressure relief valve
3 Plug
4 Oil dipstick
5 Cover plate

monitoring

An oil pressure switch monitors the oil pressure. If the pressure falls below the alarm limit, the compressor control stops the compressor and issues a general alarm.

Limit values of switches and sensors: ↳ *Chapter 4.6 'Sensors and switches' on page 51*

Oil lubrication pressure relief valve

The oil lubrication system has a pressure relief valve in the crankcase. If the oil pressure rises above the limit value, the oil is fed directly into the crankcase by the pressure relief valve.

Location of the pressure relief valve: Fig. 15

Limit value of the pressure relief valve: ↳ *Chapter 3.6 'Consumables' on page 33*

4.3 Drive

The Sauer-Compressor is driven by an electric motor. The electric motor is screwed onto the crankcase using a flange and a intermediate housing. Force is transmitted by a flexible coupling.

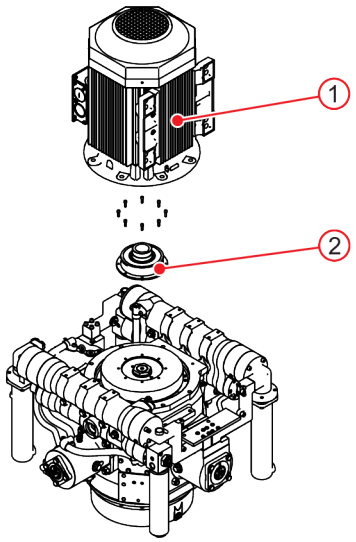


Fig. 17: Sauer-Compressor drive

1 Electric motor
2 Flexible coupling

4.4 Compressor control

The Sauer-Compressor WP5000 is controlled and monitored by an electrical compressor control.

The compressor control is not supplied by Sauer USA as standard. The principle wiring dia-gram and the minimum requirements contained in this for a compressor control must be observed.

The principle wiring diagram can be found in the appendix.

Optionally, Sauer USA supplies a suitable compressor control.

4.4.1 Legal requirements

The compressor control must comply with the legal requirements.

- CE certificates of conformity or manufacturer's declarations are included, based on separate risk assessments.
- The compressor control shuts off the power supply to the machine immediately in the event of faults such as short circuits.
- All metallic machine components are connected with one another using protective conductors, earth or equipotential bonding. This ensures that electric fault currents are safely discharged. The operator's network must also be protected.
- In case of faults, the control sets the machine to a hazard-free idle condition. All connecting lines are disconnected.
- The control is designed in such a way that the machine does not start operation automatically when the power supply is restored after a fault. In this case, the machine must be restarted manually.
- Emergency stop mechanisms are installed.

  The positioning, accessibility and reachability are selected to ensure that an emergency stop can be carried out on the machine in any situation by operating the emergency stop pushbutton.

4.4.2 Displays and controls

The compressor control is not supplied by Sauer USA as standard. The following displays and controls must be installed on the front of the corresponding compressor control:

Displays, controls	Description
“Operation” indicator lamp	Lights up when the compressor is running.
“Temperature gauge" fault indicator symbol	Lights up if the compressor has shut down because the temperature at final pressure was too high.
“Overcurrent” fault indicator lamp	Lights up if the compressor has shut down because of excessive motor current.
Operating mode selector	■ “Manual” mode: Start the compressor manually. The compressor starts up and continues to run until it is manually turned off again. ■ Selector position “0”: Turn the compressor off manually. Any pending fault messages are reset. ■ “Auto” switch position: The compressor starts and stops with the opening and closing of a remote contact (e.g. pressure switch for the pressure receiver).
Main switch	Disconnects the power supply from the compressor control to the compressor. A main switch should be installed if required by local law and regulations.
Emergency stop pushbutton	Compressor emergency stop

4.4.3 Operational requirements

This chapter explains the operational requirements for the compressor control.

The compressor control is not supplied by Sauer USA.

- The cooling water flow must be interrupted when the Sauer-Compressor is stopped.
- The cooling water solenoid valve must be closed when the Sauer-Compressor is stopped.
- The solenoid drain valves must be open when the Sauer-Compressor is stopped.
- The solenoid drain valves must close around 15 seconds after starting.
- The solenoid drain valves must open at defined intervals, thus draining the Sauer-Compressor.
- The Sauer-Compressor must be stopped immediately by the control if sensors or switches signal values above or below the following set limits:
  - Oil pressure reaches lower limit value.
  - Final pressure reaches upper limit value.
  - Temperature of the compressed air after compression stage 3 reaches the upper limit value.

Further requirements can be found in the accompanying wiring diagram.

4.5 Compressor monitoring and protection

The compressor monitoring and protection system consists of several pressure gauges and temperature gauges on the gauge panel.

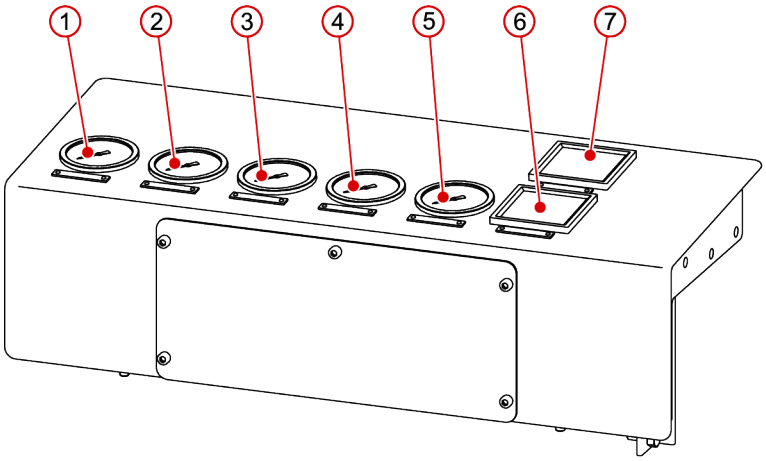


Fig. 18: Gauge panel on the Sauer-Compressor

1 Pressure gauge compression stage 1
2 Pressure gauge compression stage 2
3 Pressure gauge compression stage 3
4 Pressure gauge compression stage 4
5 Oil pressure gauge
6 Cooling water temperature gauge
7 Temperature gauge compression stage 3

4.6 Sensors and switches

Sensors and switches monitor pressure and cooling of the compressed medium as well as the oil pressure in the Sauer-Compressor.

Location of switches and sensors:

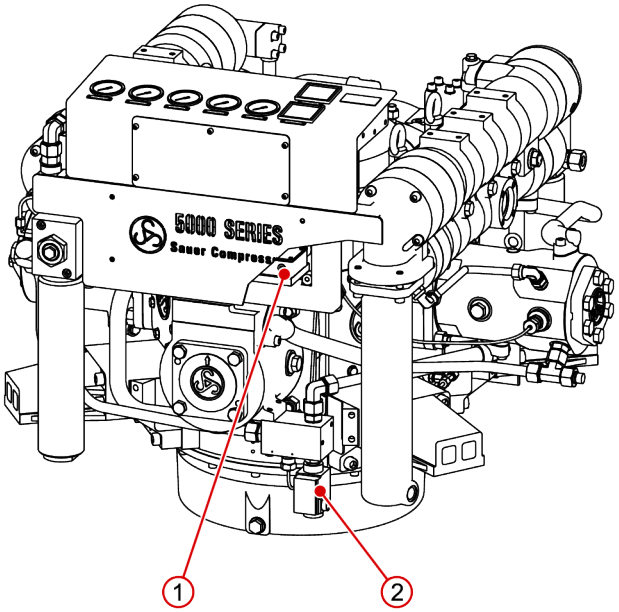


Fig. 19: Sensors and switches

1 Oil pressure switch
2 Temperature switch

Sensors/Switches	Description
Oil pressure switch	Measurement of oil pressure
Temperature switch compression stage 3	Measurement of the temperature after compression stage 3

- An oil pressure switch monitors the lubrication of the Sauer-Compressor. If the level falls below the limit value, a fault message is displayed by the compressor control and the compressor is stopped.
- A temperature switch monitors the outlet temperature of the compressed medium after compression stage 3. If the temperature rises above the limit value, the compressor control outputs a fault message and stops the compressor.

Adjustment ranges of switches and sensors: ↳ *Chapter 4.6 'Sensors and switches' on page 51*

The sensors and switches are wired to the compressor unit terminal box.

Observe any additional information for proper connection of the compressor terminal box. ↳ *Chapter 6.4 'Connecting the compressor' on page 66*

4.7 Valves

This chapter describes the valve types fitted on the Sauer-Compressor:

- Safety valves
- Solenoid drain valves
- Pneumatic drain valve
- Drainage system stop valve
- Cooling water solenoid valve
- Non-return valve

4.7.1 Safety valves

Position of safety valves:

Limit values for safety valves: *Chapter 3.2 'Technical data for valves and safety equipment' on page 31*

The following safety valves are triggered in response to excess pressure of the relevant medium:

- Compressed air safety valves

4.7.2 Solenoid drain valves

The solenoid drain valves are operated by the compressor control. When starting the Sauer-Compressor, the solenoid drain valves are opened for around 15 seconds. After this time, the solenoid drain valves close and the Sauer-Compressor builds up pressure.

In automatic mode, the solenoid drain valves open at preset intervals *Chapter 3.2 'Technical data for valves and safety equipment' on page 31*. The condensate is discharged at high pressure through the drainage lines *Chapter 4.2 'Functional description of compressor' on page 39*.

Location of solenoid drain valves: *Chapter 4.2 'Functional description of compressor' on page 39*

Technical data for solenoid drain valves: *Chapter 3.2 'Technical data for valves and safety equipment' on page 31*

Design

The Sauer-Compressor WP5000 uses two solenoid drain valves with different dimensions, adapted to the respective compression stages.

4.7.3 Pneumatic drain valve

The pneumatic drain valve is controlled by the solenoid drain valves. When starting the Sauer-Compressor, the pneumatic drain valve is opened for about 15 seconds. After this time, the pneumatic drain valve closes and the Sauer-Compressor builds up pressure.

In automatic mode, the pneumatic drain valve opens every 15 minutes. The condensate is discharged at high pressure through the drainage lines *Chapter 4.2 'Functional description of compressor' on page 39*.

Position of drain valves: *Chapter 4.2 'Functional description of compressor' on page 39*

4.7.4 Manual drain valves

In the event of malfunctions of the compressor control or a power supply failure, the compressor can be operated manually. The drainage system for the 1st and 2nd compression stage must then be controlled using manual drain valves.

In normal operation, the stop valves must be open so that the compressor can start up under a reduced load. If the compressor control fails, the solenoid drain valves open. Once the compressor has reached its working level, the drainage stop valves are closed and the compressor builds up pressure. The drainage stop valves are opened regularly to drain the compressor.

Position of drain valves: *Chapter 4.7 'Valves' on page 53*

4.7.5 Cooling water solenoid valve

The cooling water solenoid valve is operated by the compressor control and is located at the cooling water inlet.

The cooling water solenoid valve is currentless open, i.e. when the Sauer-Compressor is stopped, the cooling water solenoid valve closes and shuts off the cooling water feed.

4.7.6 Non-return valves

The Sauer-Compressor WP5000 has a compressed air non-return valve at the pressure outlet.

The compressed air non-return valve prevents a back flow of compressed air from the connected pressure reservoir or consumer.

4.8 Interfaces and connections

The Sauer-Compressor WP5000 has the following interfaces for different media

Designation	Description
Motor electrics	The electrical connection for the drive motor is located in the motor terminal box.
Compressor electrics	The electrical connections for controlling and monitoring the compressor are located on the compressor terminal box.
Pressure inlet	The air to be compressed is sucked in freely via an air filter.

Designation	Description
Pressure outlet	The compressed air is discharged at the pressure outlet.
Drainage system	Condensate containing oil is produced during compression and cooling. This condensate is separated in condensate separators after each compression unit. The condensate is discharged from the condensate separators at regular intervals through the drain valves and drainage lines.
Cooling water inlet	The cooling water supply is connected to the cooling water inlet.
Cooling water outlet	The cooling water drain is connected to the cooling water outlet.

Information about connecting the interfaces during commissioning:
↳ *Chapter 6.4 ‘Connecting the compressor’ on page 66.*

5 Transportation and storage

This chapter describes the requirements for safe transportation and storage of the Sauer-Compressor.

5.1 Safety instructions for transportation

DANGER!

Risk of injury due to suspended load during transportation.

The heavy weight of the Sauer-Compressor means that there is a significant risk of injury during transportation.

- Ensure that no personnel are within the danger area of the suspended load and the transport equipment.
- Only use appropriate transport and lifting equipment to transport the Sauer-Compressor.
- Only lift the Sauer-Compressor at the lifting eyes provided.
- Secure the Sauer-Compressor against slipping and tilting, particularly when driving on slopes and ramps.
- Observe the specific details of the weight and centre of gravity of the Sauer-Compressor in the installation drawing.

WARNING!

Risk of injury when working on the Sauer-Compressor

Because of the heavy weight of the Sauer-Compressor there are special requirements for the surfaces where the compressor is positioned and for the transport equipment.

- Only position the Sauer-Compressor on an even, solid surface.
- Observe special requirements for the characteristics and load-bearing capacity of the surface where the Sauer-Compressor is positioned: ↬ *Chapter 6.3 'Installation' on page 66*.

5.2 Packaging for transportation and shipping

The Sauer-Compressor is wrapped in plastic film and packaged on a pallet for transportation by land or air. For shipment by sea, the Sauer-Compressor is wrapped in a special film and packed in a wooden case.

If specifically requested, the Sauer-Compressor is shrink-wrapped in a special packaging for shipping and packed in a wooden case. Indicator plugs are attached to the special packaging. These indicator plugs show whether the storage conditions inside the special packaging are okay. Inspection flaps are used in the wooden case through which the indicator plugs on the special packaging can be controlled.

- After delivery of the Sauer-Compressor, check the packaging for damage immediately.
- Report any damage to the packaging immediately to the haulage company and Sauer USA.
- Check the content for damage and completeness after unpacking.
  The enclosed delivery note provides information about the content.

ENVIRONMENT!
Dispose of the packaging material in line with the applicable regulations. Refer to the instructions in *Chapter 2.11 'Environmental protection instructions' on page 28*.

5.3 Transportation

Observe the following transportation instructions:

- Transport markings on the original transportation case.
- Only transport the Sauer-Compressor with appropriate transport equipment, e. g. a crane with sufficient load-bearing capacity or a forklift truck.
- The lifting gear used must be fitted with safety hooks.
- Use the designated sling points for transporting the Sauer-Compressor.

Information about the required load-bearing capacity of the transport equipment, the sling points and the centre of gravity of the Sauer-Compressor is provided in the transport drawing in the appendix.

5.4 Storage

As standard the Sauer-Compressor is preserved and packaged in the factory prior to delivery. *Chapter 5.2 'Packaging for transportation and shipping' on page 58*

Leave the Sauer-Compressor in the original packaging if it has to be stored before installation. In this case, make sure that the original packaging is not damaged.

5.4.1 Storage conditions

Data	Value	Unit
Temperature	+5 to +40	°C
Relative humidity	30 to 95	% (non-condensing)

Store the Sauer-Compressor as follows:

- In a dry area, under a roof and protected from dew formation.
- Protected against contamination.
- Protected against vibrations and abrupt impacts.

As specified in DIN 20066, high pressure hoses can be stored for 2 years after delivery. In active use, the service life of high pressure hoses is 6 years including storage.

5.4.2 Storage periods

The standard factory preservation enables the Sauer-Compressor to be stored in the undamaged original packaging for a maximum of 12 months between the delivery date and commissioning. Additional preservation measures are not necessary in this case.

When 12 months have elapsed, intermediate preservation of the Sauer-Compressor is required. ↬ *Chapter 9.4 'Intermediate preservation' on page 85*

6 Commissioning

This chapter describes the requirements for proper installation and commissioning of the Sauer-Compressor.

6.1 Safety instructions for commissioning

DANGER!

Hazard due to incorrect installation

Improper installation or assembly can lead to serious injury or damage.

- Only assemble the Sauer-Compressor as specified in the operating instructions, the quotation specification and the installation drawing.
- Connection of the power supply, the pressure lines and the cooling water piping (with water-cooled compressors) may only be carried out by trained and authorised personnel.

WARNING!

Danger when working on live parts

There is a significant risk of injury when working on electrical connections and the live parts of the Sauer-Compressor.

- Only carry out work on live parts of the Sauer-Compressor when the power supply is disconnected and secured against being reconnected.
- All work on the electrical system may only be carried out by specialist electricians.
- Secure live cables against direct contact.
- Install live cables in line with the applicable standards and directives.

NOTICE!

Damage due to overheating

The temperature in the room must not be allowed to rise above the specified values ↳ *Chapter 3.4 ‘Operating conditions’ on page 32*. Otherwise there is a risk of overheating.

- During installation, observe the specified ambient conditions along with the heat generated by the Sauer-Compressor itself and by other machines at the installation location.
- If necessary, install a ventilation and/or air extraction system at the installation location.

If the cooling water inlet or outlet temperature is too high, there is a risk of overheating. The optimum cooling water temperature values are listed in the chapter ↳ *Chapter 3.4 ‘Operating conditions’ on page 32*.

NOTICE!

Damage due to supercooling

The temperature in the room must not be allowed to fall below the values specified in the technical data ↳ ↳ *Chapter 3.4 'Operating conditions' on page 32*. There is a risk of condensate forming inside the Sauer-Compressor if the values fall below.

– During installation, observe the specified ambient conditions along with the heat generated by the Sauer-Compressor itself and by other machines at the installation location.
– If necessary, heat the installation location.

NOTICE!

Damage due to direct fresh air flow

If a fresh air flow blows directly onto the Sauer-Compressor, the Sauer-Compressor cools down too quickly. There is then a risk of condensation forming. Condensation causes damage to the Sauer-Compressor.

– Install the Sauer-Compressor in such a way that the fresh air flow does not blow directly onto it.

NOTICE!

Damage to the anti-vibration resilient mount

If the excitation of the compressor foundation by other machines is between 7 and 11 Hz, there is a risk that the anti-vibration resilient mount will be damaged by resonance vibrations.

– When planning the installation location, make sure that the excitation of the foundation is not between 7 and 11 Hz.

NOTICE!

Damage due to incorrectly installed hose lines

Incorrectly installed hose lines result in an increased load on the materials. This can cause leaks in the system and damage the pipelines.

– Follow the rules for installing hose lines.

NOTICE!

Damage due to incorrectly installed drainage lines

Incorrectly installed drainage lines can result in the condensate flowing back to the compressor, causing damage to the Sauer-Compressor.

– Follow the rules for installing drainage lines.

NOTICE!

Damage to the Sauer-Compressor due to lack of oil

Unless the order explicitly states otherwise, the Sauer-Compressor is supplied without oil. The compressor must not be started without oil.

– Before starting the compressor, please verify the compressor oil level via sight glass or dipstick.
– Be sure to fill to appropriate level, if necessary.

NOTICE!

Coking of compressor valves, pipelines and fittings.

Use only oils recommended and tested by Sauer USA. The recommended oils reduce the level of coking in the compressor valves and the upstream pipelines and fittings to a minimum.

Lubricants other than those specified may only be used after approval from J.P. Sauer & Sohn Maschinenbau GmbH. Otherwise the guarantee is void.

NOTICE!

Damage due to incorrect direction of rotation

If the direction of rotation of the motor is incorrect, the compressor is not lubricated. There is a risk of piston seizure.

– Check the direction of rotation of the motor before commissioning.
– When checking the direction of rotation, allow the motor to run for a maximum of 5 seconds.

NOTICE!

Damage due to test run

Setpoint variations during the test run must be corrected before damage to the Sauer-Compressor can occur.

– Only carry out the test run until the end of a drainage interval.

NOTICE!

Damage due to unnecessary activation of the safety valve

In general, safety valves are not designed to be activated repeatedly or for long periods. When the opening pressure is reached, the pulsating gas pressure in the piston compressor causes the sealing element in the safety valve to strike the finely polished sealing surfaces hard and repeatedly; this damages the surfaces. Consequently, this can cause the safety valve to be actuated prematurely. It is even possible that significant leaking may occur below the opening pressure.

– Avoid actuating the safety valve often or unnecessarily during commissioning and recurring tests.
– Testing on a valve test stand using air that is not pulsating leads to differing opening pressure results and is therefore unsuitable.

Therefore, consequential damage to safety valves due to repeated, unnecessary activation thereof will not be recognised as a basis for complaint or notice of defect.

Different installation conditions are only permitted with prior written approval from Sauer USA. Non-compliance voids all warranty entitlements.

After commissioning, complete the commissioning certificate and send it to Sauer-Service. The commissioning certificate can be found in the appendix to these operating instructions or can be downloaded from the Sauer website.

6.2 Commissioning instructions

Measures before commissioning

Before commissioning, make sure that:

- all work on the Sauer-Compressor is complete.
- no tools or materials have been left around the Sauer-Compressor.
- there are no personnel in the danger zone around the Sauer-Compressor.

Special measures for systems with downstream dryer

NOTICE!

During initial commissioning or re-commissioning after preservation of the compressor, preservation oil from the compressor may lead to impurities in the dryer circuit, which could result in malfunctions on the dryer.

– Before commissioning the dryer, remove the preservation oil from the compressor pressure lines as set out in the description below.

WARNING!

Risk of injury when working on the Sauer-Compressor

If the Sauer-Compressor is not shut down, depressurised and secured against being restarted, there is a significant risk of injury when working on it.

– Before starting any work, shut down the Sauer-Compressor and secure it against being restarted.
– Make sure that the system is depressurised.

1. Make sure that the system is depressurised.
2. Disconnect the compressor pressure line at an appropriate point in front of the non-return valve at the compressor outlet. Specifications for the non-return valve installation location can be found in the P&I diagram supplied.
3. Position and secure a suitable collecting container (e.g. old air filter or trough) in front of the open pressure line to catch the preservation oil / compressed air mixture blown off. If necessary, extend the pressure line to the collecting container.

NOTICE!

Damage due to incorrect direction of rotation

If the direction of rotation of the motor is incorrect, the compressor is not lubricated. There is a risk of piston seizure.

– Check the direction of rotation of the motor before commissioning.
– When checking the direction of rotation, allow the motor to run for a maximum of 5 seconds.

4. Switch on the compressor and immediately check that the compressor rotation direction is correct.
5. Blow off the preservation oil / compressed air mixture into the collecting container and collect the preservation oil.
6. Switch off the compressor after around 15 minutes.
7. Reconnect the pressure line to the pipeline system.

Measures during operation

Ensure that the duration of operation is measured and recorded so that the maintenance intervals (↳ maintenance schedule) can be observed.

Measures after commissioning

Immediately after commissioning the Sauer-Compressor:

- make sure that the operating and display instruments, along with all monitoring, indicating and alarm systems, are functioning correctly.
- check the pressure readings to ensure that the specified pressure ranges are maintained.

6.3 Installation

6.3.1 General installation conditions

The following conditions must be met:

- The installation location must be dry and free from dust.
- Ensure that the installation location is ventilated in such a way that the heat generated during operation can be extracted.
- The room temperature must be within the range defined in the technical data. ↬ *Chapter 3.4 'Operating conditions' on page 32*
- The Sauer-Compressor must be easily accessible at all times.
- The special requirements for the foundation at the installation location must be observed. ↬ *Chapter 6.3.2 'Foundation' on page 66*
- The instructions in the installation drawing must be followed.

Sauer USA will be happy to advice on installing your Sauer-Compressor. For more infor-mation, contact Sauer-Service.

6.3.2 Foundation

The standard anti-vibration resilient mount supplied on the Sauer-Compressor has a resonance frequency of around 7-11 Hz. This design of the mount guarantees good structure-borne noise insulation from the foundation.

Contact Sauer-Service to clarify whether a different anti-vibration resilient mount can be used.

6.4 Connecting the compressor

6.4.1 Pipes and hose lines

Precise specifications for all interfaces, the pipes and hose lines, and the lines and connections provided by the operator, can be found in the quotation specification and installation drawing.

Connect the following lines on the Sauer-Compressor to the plant operator's lines:

- Pressure outlet
- Cooling water inlet
- Cooling water outlet

Use flexible hose lines for the connections between the lines on the Sauer-Compressor and the plant operator's lines.

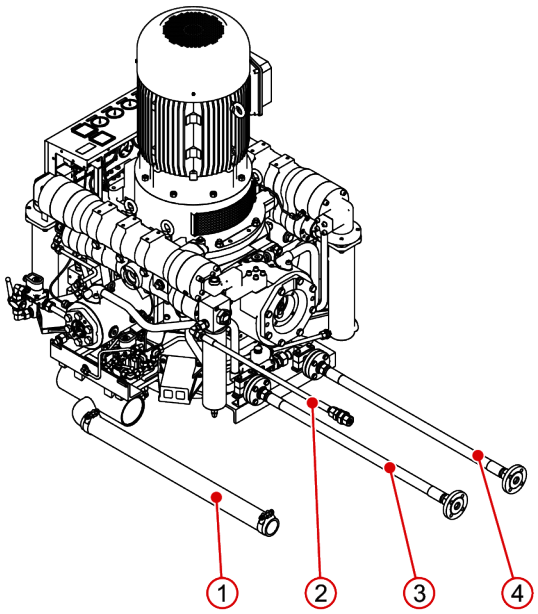


Fig. 20: Line connections

1 Compressed air hose
2 High pressure hose
3 Hose line
4 Hose line

6.4.1.1 Specifications for line connection

The flexible hose lines between the Sauer-Compressor and the plant operator's lines reduce the transmission of movement, pulsation and vibrations.

Observe the following rules when connecting the lines:

- Install the hose lines without tension: Fig. 21.
  If the hose lines are under tension, the material is subjected to higher loads. Vibrations, pulsation and movement are transmitted to the system behind.

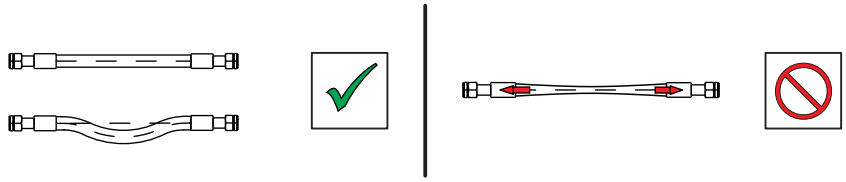


Fig. 21: Connect and fit hose lines without tension

- Install the hose lines without twisting: Fig. 22.
  Twisted hose lines can stiffen, subjecting the material to higher loads.

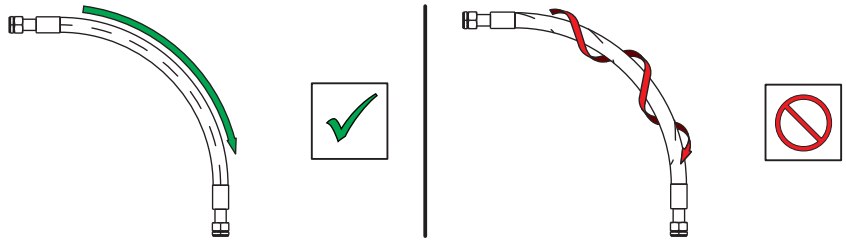


Fig. 22: Install hose lines without twisting

6.4.1.2 Position of drainage lines

ENVIRONMENT!
Accumulated condensate contains oil. It may only be disposed of in compliance with applicable legal regulations.

Sauer USA supplies conden-sate tanks for collecting the condensate, and oil/water sepa-ration systems for separating the oil from the condensate. For further information, contact Sauer-Service and the Sauer Sales department.

Observe the following rules for connecting the drainage lines:

- Route individually running drainage lines directly into the condensate collection tank provided.

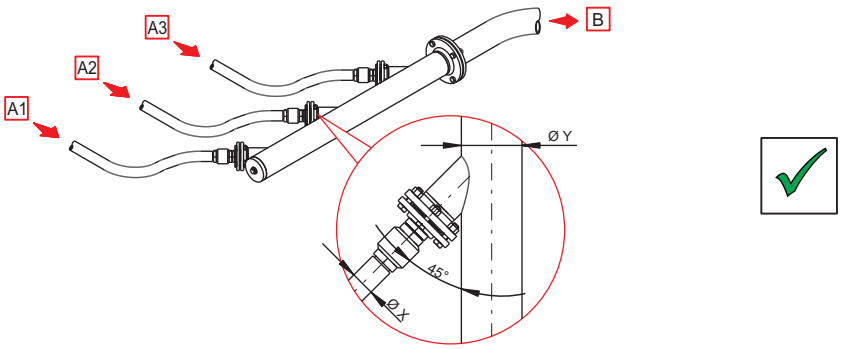


Fig. 23: Ensure that connections have a sufficient cross-section

A1 Drainage line of compressor 1
A2 Drainage line of compressor 2
A3 Drainage line of compressor 3
B Main drainage line

- If the drainage lines from multiple compressors run together into a main drainage line, ensure that the main drainage line is of sufficient dimensions.

  The main drainage line must be capable of discharging the quantity of condensate produced without any backing up that could cause an increased pressure in the lines.

  The drainage lines must not come together at right angles. Bring together the drainage lines at an angle of around 45° in the direction of flow.

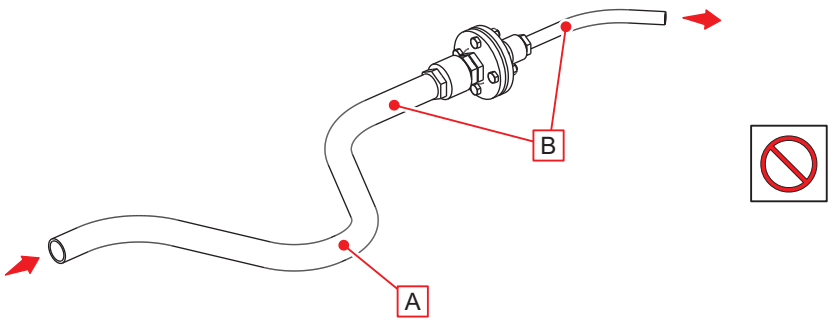


Fig. 24: Avoid bends and constrictions

A Avoid sharp bends along the course of the drainage lines. Sharp bends can lead to backing up of the condensate being drained.
B The diameter of the drainage lines may not be reduced.

6.4.2 Control and electrics

6.4.2.1 Control and electrics

The switches and circuits for controlling the valves and the motor are pre-wired on the compressor or motor terminal box.

The principle wiring diagram for the compressor control can be found in the appendix.

6.5 Commissioning

This chapter describes the work that has to be carried out during initial commissioning of the compressor.

6.5.1 Filling with operating materials

6.5.1.1 Oil

The work instructions for filling the compressor with oil can be found in the maintenance instructions.

For oil specification, see "Oil recommendation for Sauer-Compressors".

6.5.1.2 Frost and corrosion protection

The cooling water circuit must contain sufficient quantities of antifreeze and anti-corrosion agents.

- Use standard commercial anti-corrosion agents to treat the cooling water. Manufacturers of these anti-corrosion agents include oil manufacturers, for example.
- Follow the usage instructions for the anti-corrosion agents.
- Adding preservation oils to the cooling water is not permitted.
- Ethylene glycol can be added to the cooling water as an antifreeze. This is frequently included in anti-corrosion agents.

Antifreeze is only useful for short stoppages with no heating of the cooling water. For longer stoppages when there is a risk of frost, the cooling water must be drained or heated.

6.5.2 Checking operating requirements

Before starting for the first time, make sure that:

- The electrical connection matches the data on the nameplate.
- All interfaces on the compressor have been connected correctly.

- All connecting lines between the compressor and the adjacent system are properly installed.
  - Pressure lines
  - Cooling water piping
  - Drainage lines
- The cooling water piping is open.
- The oil level is correct. Check the oil level with the dipstick
- All tools and foreign objects have been removed from the compressor area.
- The entire system is clean.

6.5.3 Venting the coolers

Air bubbles in the cooling water circuit can lead to local overheating. The coolers in the individual compression units must be vented prior to initial commissioning:

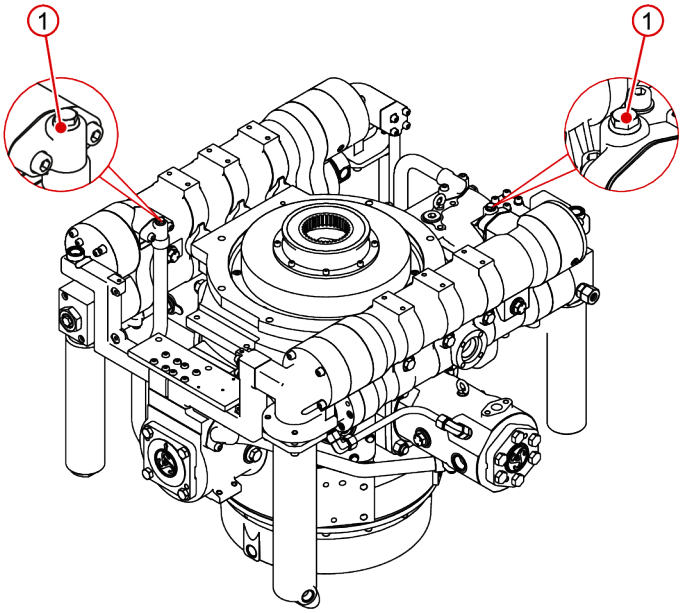


Fig. 25: Venting the coolers

1 Plugs for venting the coolers

1. Open the cooling water piping until the cooling water circuit is filled slowly.
2. Unscrew the plug on the cooler for compression stage 1 until cooling water flows out with no bubbles. Then screw the plug back in.
3. Repeat the process on the cooler for compression stage 2.

6.5.4 Checking the crankshaft direction of rotation

1. Turn on the power supply.
2. Set the compressor control to manual mode.
3. Press the start pushbutton on the compressor control.
   ⇨ The Sauer-Compressor starts.
4. Immediately check the direction of rotation of the motor at the fan or the flexible coupling element. The direction of rotation must correspond to the direction arrow. *Chapter 2.6 'Markings on the Sauer-Compressor' on page 22*
5. Press the stop pushbutton on the compressor control.
   ⇨ The compressor stops.
6. Turn off the power supply.
7. If the direction of rotation of the compressor does not match the direction arrow, the polarity of the electric motor must be changed.
8. Prepare the compressor for the test run.

6.5.5 Performing a test run

1. Turn on the power supply.
2. Open the cooling water piping.
3. Set the compressor control to manual mode.
4. Press the start pushbutton on the compressor control.
   ⇨ The compressor starts. The solenoid drain valves close after around 15 seconds and the compressor generates pressure.
5. Read off the values displayed on the oil pressure gauge and the pressure gauges for all compression units.
6. Compare the values with the setpoints. *Chapter 7.3 'Routine operation of the Sauer-Compressor' on page 77*
7. Check that automatic periodic drainage is functioning correctly. The solenoid drain valves must drain the condensate every 15 minutes for around 15 seconds. This is indicated by a drop in pressure on the pressure gauges.
8. Monitor the cooling water temperature. The temperature of the cooling water at the cooling water outlet must be within the specified range. *Chapter 3.6 'Consumables' on page 33*
9. Press the stop pushbutton on the compressor control.
   ⇨ The compressor stops.
10. Close the cooling water piping.
11. Turn off the power supply.
12. If any setpoint variations occurred during the test run, perform troubleshooting. *Chapter 10.2 'Detecting faults' on page 89*
13. Resolve the causes of the setpoint variations.

14. Complete the commissioning certificate and send a copy to the Sauer USA Service department. The commis-sioning certificate can be found in the appendix.

If all parameters are in the specified range and the test run on the compressor has been completed successfully, the compressor can start operation.

7 Operation

7.1 Safety instructions for operation

CAUTION!

Risk of injury due to Sauer-Compressor starting unexpectedly

In automatic mode, the Sauer-Compressor is switched on automatically. Consequently, there is a risk of serious injury when working on the compressor.

– Only carry out work on the Sauer-Compressor if the Sauer-Compressor is disconnected from the power supply and is secured against being restarted.

WARNING!

Hazard due to incorrect operation

Work on and with the machine may only be carried out by personnel authorised to do so by the operator.

– If the work is not carried out by authorised personnel, injuries may occur and the machine may be damaged.
– Only personnel trained and thoroughly familiar with the compressor operation should be authorised to operate the compressor.

WARNING!

Risk of injury on compressor

Wear the specified personal protective equipment to minimise the risk of injury.

WARNING!

Hazard due to undetected damage

If damage is not detected, it can lead to injuries and significant consequential damage.

– Check the Sauer-Compressor for externally visible damage before commissioning.

7.2 Safety equipment

The installed safety equipment guarantees safe and fault-free operation of the Sauer-Compressor.

7.2.1 Electrical safety equipment

The sensors or switches for temperature and pressure are pre-wired on the terminal box as standard. They are connected to a compressor control. The operator must ensure that the legally required safety devices are set up, and must check that the safety devices can be reached.

DANGER!

Hazard due to missing or incorrectly installed safety equipment

If the compressor control is not supplied as part of the Sauer-Compressor package, the operator must ensure that the safety equipment is set up, can be reached and functions correctly.

Conversion of the signals from the Sauer-Compressor into optical, acoustic or mechanical safety or sensor signals is operator-specific. In any case, the compressor control must provide the legally required functions for controlling machines.

For further information, refer to the operating instructions for the installed compressor control and the specifications in the principle wiring diagram.

7.2.1.1 Emergency stop requirements

The emergency stop function stops the Sauer-Compressor immediately. This does not disconnect the Sauer-Compressor from the power supply.

→ To disconnect the Sauer-Compressor from the power supply, set the main switch to "0".

7.2.1.2 Signalling device requirements

The sensor outputs sensor and switch signals. These signals are converted by the compressor control and can be adapted to a wide range of requirements.

Sauer USA will be happy to advise on selecting and setting up the appropriate com-pressor control.

For further information, contact Sauer-Service.

7.2.2 Mechanical safety equipment

The safety devices on the Sauer-Compressor consist of safety valves.

7.3 Routine operation of the Sauer-Compressor

The information in this chapter is designed to help you in your day-to-day use of the Sauer-Compressor.

7.3.1 Starting the Sauer-Compressor

NOTICE!

Damage due to frequent starting

If an electric motor is frequently started and stopped, there is a risk that it will overheat.

– Compressor units with a drive capacity of more than 50 kW should not be started more frequently than 6 to 10 times per hour where possible.
  Ensure that the pressure receiver is of sufficient size so that the required operating pressure is available over a sufficient period.

NOTICE!

Damage due to short operating time

If the continuous operating time of the Sauer-Compressor is too low, the Sauer-Compressor does not reach its operating temperature. This results in condensation inside the Sauer-Compressor, leading to serious consequential damage to the pistons, cylinders, valves and bearings.

– Ensure that
  – the continuous operating time of the Sauer-Compressor is at least 15 minutes so that the compressor reaches its operating temperature.

To turn on the Sauer-compressor, proceed as follows:

1. Turn on the power supply at the main switch.
2. Open the cooling water piping.
   ⇨ The Sauer-Compressor is ready for operation.
3. Set the mode selector to "Auto" or "Manual".

   or

   Press the start pushbutton.
   ⇨ The Sauer-Compressor starts.

7.3.2 Turning off the Sauer-Compressor

To turn off the Sauer-Compressor:

Set the mode selector to "0".

or

Press the stop pushbutton.

7.3.3 Monitoring and inspecting the system

To ensure fault-free operation, you should carry out the following work at regular intervals. The frequency of the work depends on operator-specific requirements.

NOTICE!

Damage due to unsupervised operation

Irregularities and setpoint variations can lead to significant consequential damage to the Sauer-Compressor.

– Watch out for irregularities and setpoint variations during routine operation.

The work instructions for filling the Sauer-Compressor with oil can be found in the maintenance instructions.

- Keep the entire area around the system clean and tidy.
- Watch out for abnormal operating noise.
- Check all connections, pipelines and electrical cables for damage.
- Watch out for leaks of compressed air, oil or condensate on the Sauer-Compressor and in the pipelines.
- Monitor the temperature of the cooling water at the cooling water outlet.
  The temperature of the cooling water at the cooling water outlet must be within the specified range *Chapter 3.6 'Consumables' on page 33*.
- Check the pressure gauges for the compression units on the gauge panel.
  The pressures in the compression stages must correspond to the specified setpoints *Chapter 7.3 'Routine operation of the Sauer-Compressor' on page 77*.
- Monitor the pressure gauge for the oil pressure.
  The oil pressure must be within the specified range *Chapter 3.6 'Consumables' on page 33*.
- Check the oil level in the Sauer-Compressor once a week when stopped. If necessary, top up the oil.
- If any irregularities or setpoint variations occur, perform troubleshooting and resolve the causes *Chapter 10.2 'Detecting faults' on page 89*.

7.3.4 Compression stage diagram

Use the compression stage diagram to determine the setpoints for the individual compression stages: *Chapter 7.3 'Routine operation of the Sauer-Compressor' on page 77*. Depending on the final pressure for the compression stage 4, use the compression stage diagram to find the permitted pressures for the compression stages 1, 2 and 3. Depending on the pressure of the last stage, the pressure of the individual compression stages can be read from the diagram.

The pressure values indicated are reference values only. Variations are possible depending on operating conditions.

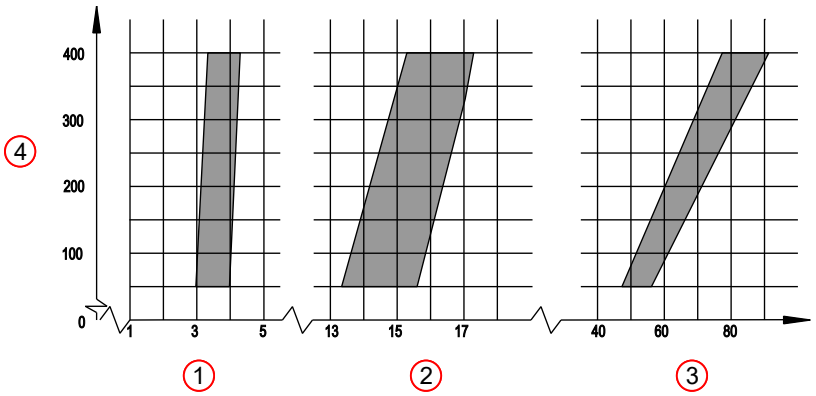


Fig. 26: Compression stage diagram

1 Compression stage 1 pressure (bar)
2 Compression stage 2 pressure (bar)
3 Compression stage 3 pressure (bar)
4 Compression stage 4 pressure (bar)

7.3.5 Manual mode

In the event of malfunctions of the compressor control or a power supply failure, the compressor can be operated manually.

In manual mode the monitoring devices of the compressor control are not in operation. The compressor must be observed continuously and switched off if the specified setpoints are exceeded or fallen below: *Chapter 7.3 'Routine operation of the Sauer-Compressor' on page 77*

The reason why the operating values of the compressor were above or below the acceptable range limits must be discovered and corrected before the compressor can be returned to normal operation. *Chapter 10.2 'Detecting faults' on page 89*

Operating the compressor manually

1. Check whether the manual drain valves for compression stage 1 and 2 are open.
2. Turn on the power supply at the main switch.
3. Open the cooling water piping.
4. Set the mode selector to "Manual".
5. Start the compressor.

6. After around 15 seconds, close the manual drain valves for compression stages 1 and 2.
7. The manual drain valves for compression stages 1 and 2 will open for 15 seconds every 15 minutes to drain the compressor.
8. Check the displays on the gauge panel constantly, and compare these values with the specified setpoints.

> **NOTICE!**
> **Damage due to unsupervised operation**
> Irregularities and setpoint variations can lead to significant consequential damage to the Sauer-Compressor.
> – Watch out for irregularities and setpoint variations during routine operation.

9. When the set value for the final pressure switch is reached, operation must be ended. When starting the compressor again, the compressor must again be restarted in manual mode.

Terminating operation

1. Let the compressor continue running for approx. 3 minutes with the manual drain valves for compression stages 1 and 2 open.
2. Stop the compressor.
3. Turn off the power supply at the main switch.
4. Close the cooling water piping.

8 Maintenance

8.1 Maintenance work

Maintenance instructions

The maintenance work required for effective preventive maintenance of the Sauer-Compressor is described in separate maintenance instructions.

The maintenance schedule in the maintenance instructions provides you with an overview of the successive maintenance intervals and the maintenance work to be carried out.

Maintenance work is explained step by step in the appropriate sections of the maintenance instructions.

8.2 Ordering spare parts

Order the Sauer spare parts or Sauer maintenance kits required for the maintenance work from Sauer-Service. Specify the following information in the order:

- Part number
  The part number for Sauer spare parts can be found in the spare parts catalogue.
- Main specifications of the Sauer-Compressor
  The main specifications for the Sauer-Compressor are shown on the nameplate.
- Number of operating hours

The spare parts catalogue and operating instructions are also available on CD. To save time, you can fill out the order form contained therein, print it and send it off.

Compressor type:	
Serial number:	
Year of construction:	

Only genuine Sauer spare parts

- *are subject to continuous quality assurance and ongoing development. conform to the latest technical developments.*
- *guarantee the long service life of your Sauer-Compressor.*
- *meet the conditions of warranty by Sauer USA.*

9 Decommissioning

If the Sauer-Compressor is not likely to be used for a longer period, the decommissioning instructions must be followed.

9.1 Safety instructions for decommissioning

NOTICE!

Damage due to improper storage

Improper decommissioning and storage can result in consequential damage to the Sauer-Compressor.

– The Sauer-Compressor must only be decommissioned and disassembled by trained technicians employed by the operator.

WARNING!

Danger when working on live parts

There is a significant risk of injury when working on electrical connections and the live parts of the Sauer-Compressor.

– Only carry out work on live parts of the Sauer-Compressor when the power supply is disconnected and secured against being reconnected.
– All work on the electrical system may only be carried out by specialist electricians.
– Secure live cables against direct contact.
– Install live cables in line with the applicable standards and directives.

WARNING!

Risk of injury due to high pressure

Components are pressurised and can lead to significant injuries (e. g. valves, pipes, hoses, pressure reducing valves, strainers).

– Local health and safety laws, standards and regulations, e. g., BGR 500, must be observed.
– Wear the specified personal protective equipment to minimise the risk of injury.

DANGER!

Hazard due to incorrect disassembly

If the Sauer-Compressor has not been properly uninstalled or disassembled, this can lead to serious injury or damage.

– The power supply, pressure lines and cooling water piping (in the case of water-cooled compressors) may only be disconnected by trained and authorised personnel.

9.2 Temporary decommissioning

If the Sauer-Compressor is to be decommissioned **for a limited period of up to 6 months**, the following preventive measures should be taken to protect the Sauer-Compressor:

- A test run of at least 30 minutes should be carried out every four weeks.

Additional measures for corrosion prevention and intermediate preservation are not then required.

9.3 Long-term decommissioning

If the original packaging has been removed or the Sauer-Compressor has already been in operation, follow the following instructions:

If it is not possible to shrink-wrap the Sauer-Compressor in plastic film, intermediate preservation is required after 6 months.

Storage period between 6 and 12 months

- For storage of **between 6 and 12 months** in a heated, dry room no additional measures are required.
- For storage in a location with significant temperature fluctuations or higher humidity, the Sauer-Compressor should be shrink-wrapped in plastic film and a desiccant added.

Storage period over 12 months

For a storage period **of over 12 months**, note the following requirements:

- Shrink-wrap the Sauer-Compressor in vacuum packaging made of moisture-absorbing special film or aluminium-coated plastic film with a desiccant.
- Ensure that the packaging contains moisture indicators to monitor the condition of the packaging.
- Pack the Sauer-Compressor in a wooden case to prevent damage to the vacuum packaging.
  The wooden case must have an inspection window for checking the vacuum packaging.
- Check the condition of the packaging through the inspection window in the wooden case every 6 months.

9.4 Intermediate preservation

Intermediate preservation is carried out using one of the recommended preservation oils. ↳ "Lubricants and preservation oils for Sauer-Compressors" chapter

9.4.1 Intermediate preservation for Sauer-Compressors in original packaging

Uninstalled, e. g. stored Sauer-Compressors require intermediate preservation if the storage time exceeds 12 months. In this case, contact Sauer-Service for advice.

9.4.2 Intermediate preservation for decommissioning of longer than 12 weeks

If the Sauer-Compressor is scheduled to be decommissioned for longer than 12 weeks, Sauer USA recommends preserva-tion with a preservation oil. If this preservation is carried out, periodic test runs are not needed.

A detailed description of the individual work steps can be found in the maintenance instructions.

If the installed Sauer-Compressor has a very short running time, as is the case with an emergency unit for example, intermediate preservation may be necessary.

In this case, contact Sauer-Service for advice.

Use one of the preservation oils specified in the "Oil recommendation for Sauer-Compressors".

9.4.3 Commissioning after storage

If the maximum storage time is exceeded, the Sauer-Compressor must be inspected for possible damage before commissioning ↳ *Chapter 5.4.2 ‘Storage periods’ on page 59*.

A detailed description of the individual work steps can be found in the maintenance instructions. ↳↳ Chapter 9.4.2 ‘Intermediate preservation for decommissioning of longer than 12 weeks’ on page 85

9.5 Disassembly

NOTICE!

Damage to the Sauer-Compressor

The following work should be carried out independently with the authorisation of Sauer USA.

Otherwise, contact the Sauer-Service department.

A detailed description of the individual work steps can be found in the maintenance instructions.

1. Turn off the Sauer-Compressor and secure it against being turned on again.
2. Make sure that the Sauer-Compressor is depressurised.

   To do this, check the pressure displays on the pressure gauges of each compression stage.
3. If fitted, turn off the main switch to disconnect the power to the Sauer-Compressor and the compressor control.
4. Close the cooling water supply.
5. Disconnect the mains supply cables.
6. Disconnect the connections between the compressor control and the Sauer-Compressor.
7. Disconnect the connections between the cooling water supply and the Sauer-Compressor.
8. Drain the liquids and dispose of in an environmentally sound manner.
   - Oil
   - Condensate
   - Cooling water

9.6 Environmentally sound disposal

Dispose of the various materials and consumables in an environmentally sound manner *Chapter 2.11 'Environmental protection instructions' on page 28*.

10 Troubleshooting

This chapter enables you to carry out initial troubleshooting and to resolve the causes of irregularities and setpoint variations.

10.1 Safety instructions for troubleshooting

WARNING!

Risk of injury when working on the Sauer-Compressor

If the Sauer-Compressor is not shut down, depressurised and secured against being restarted, there is a significant risk of injury when working on it.

- Before starting any work, shut down the Sauer-Compressor and secure it against being restarted.
- Make sure that the system is depressurised.

WARNING!

Risk of injury due to high pressure

The condensate collection tank and condensate drains are intermittently under high pressure and can lead to significant injuries.

- Only use connection components that are designed for the relevant thermal and mechanical loads and comply with the applicable standards and directives.
- Install protective covers to protect against direct spraying of liquids.
- Install and secure the condensate drains so that they cannot whip around and to prevent uncontrolled escape of condensate.

WARNING!

Danger when working on live parts

There is a significant risk of injury when working on electrical connections and the live parts of the Sauer-Compressor.

- Only carry out work on live parts of the Sauer-Compressor when the power supply is disconnected and secured against being reconnected.
- All work on the electrical system may only be carried out by specialist electricians.
- Secure live cables against direct contact.
- Install live cables in line with the applicable standards and directives.

WARNING!

Risk of injury due to electric fault currents

Electrical faults such as short-circuits can result in significant injuries.

– Make sure that safety equipment to detect short circuits and disconnect all connection phases are properly installed.
– Ensure that the operator network has the required level of protection.

WARNING!

Risk of burns from hot surfaces.

The cylinders, motor, pressure lines and cooling water piping have hot surfaces. Contact with hot surfaces can cause serious injuries.

– Keep a safe distance away from the Sauer-Compressor.
– Wear the specified personal protective equipment to minimise the risk of injury.
– Allow the Sauer-Compressor to cool down before beginning maintenance work.

WARNING!

Risk of injury due to automatic starting

The Sauer-Compressor can start automatically and expectedly from a standstill. This can lead to injuries when working on the compressor. If the Sauer-Compressor is stopped, this does not mean that it is switched off. The Sauer-Compressor can start unexpectedly at any time.

– Always maintain a distance to the Sauer-Compressor, even when the Sauer-Compressor is stopped.
– Wear the specified personal protective equipment when working near the Sauer-Compressor.
– Disconnect the Sauer-Compressor from the power supply and secure it against being switched back on again before beginning any work on it.

CAUTION!

Risk of injury from safety equipment

Direct contact with safety valves can result in injury. When blowing off a safety valve, hot air or hot gas escapes at high pressure.

– Wear the specified personal protective equipment to minimise the risk of injury.
– Avoid direct contact with the safety valves and maintain a safe distance from them.

CAUTION!

Hazard due to contact with lubricant, oils and condensate containing oil

Contact with lubricants and oils can result in injury when working on the Sauer-Compressor.

– Wear the specified personal protective equipment to minimise the risk of injury.
– Wash affected areas of skin immediately with suitable cleaning agent and running water.
– In case of contact with the eyes or mucous membranes, immediately wash the affected areas under running water.

CAUTION!

Risk due to inhalation of hazardous gases and vapours

Inhalation of gases and vapours can result in injuries when working on the Sauer-Compressor.

– Always ensure a sufficient fresh air feed is provided when working on the Sauer-Compressor.

10.2 Detecting faults

If faults occur, take the following action:

- Take a reading of the pressure on the pressure gauges of the compression units and compare it with the setpoints from the compression stage diagram.
- Monitor the pressure gauge for the oil pressure. The pressure must be higher than 1 bar.
- Attempt to locate the fault and assign it to a fault category.
- Establish the fault, the probable cause and the measures taken to resolve the fault. See chapter for details.

If the malfunction cannot be rectified, do not operate the compressor any more. Fill out the damage report log and contact Sauer-Service.

The damage report log is included as an appendix to these operating instructions.

10.3 Resolving faults / Fault table

Faults are combined into the following fault groups:

- General: Compressor does not start or turns off.
- Safety component trips
- Pressure outside setpoints
- Mechanical damage to compressor

The possible faults, their causes and instructions for resolving the faults are described in the following sections.

10.3.1 Compressor does not start or turns off

Fault description	Cause	Remedy
Compressor does not start or turns off.	No power supply/no control voltage.	■ Check fuses; replace faulty fuses.
Compressor has been turned off, low oil pressure switch has tripped.	Oil level too low.	■ Check oil level and top up, if necessary. Check for leaks.
	Oil too viscous.	■ Fill with oil according to the oil recommendation. Check whether room temperature is > +5 °C.
	Oil strainer blocked.	■ Clean oil strainer.
	Lubricating oil piping blocked.	■ Clean lubricating oil piping.
	Oil pump faulty or leaking.	■ Check oil pump. If necessary, eliminate leak and/or replace oil pump.
Compressor was switched off by overcurrent relay.	Excessive current drawn.	■ Check power supply and electrical connections. The compressor can be started again after a cooling period. ■ Check whether the crankshaft can easily be turned by hand. If the crankshaft is difficult to turn, the fault may be caused by piston seizure or bearing damage. If the crankshaft can be turned easily, there may be an electrical problem with the motor.
	Piston seizure	■ Check cylinders and pistons for any score marks and replace, if necessary.

10.3.2 Safety component trips

Fault description	Cause	Remedy
Compression stage 1 safety valve blowing off - pressure above set value.	Compression stage 2 valve is not working properly.	■ Check compression stage 2 valve and replace if faulty.
	Gasket between suction and pressure side of compression stage 2 is faulty.	■ Replace gasket.
Compression stage 1 safety valve blowing off - pressure below set value.	Safety valve faulty.	■ Replace safety valve.

Fault description	Cause	Remedy
Compression stage 2 safety valve blowing off - pressure above set value.	Compression stage 3 valve is not working properly.	■ Check compression stage 3 valve and replace if faulty.
	Gasket between suction and pressure side of compression stage 3 is faulty.	■ Replace gasket.
Compression stage 2 safety valve blowing off - pressure below set value.	Safety valve faulty.	■ Replace safety valve.
Compression stage 3 safety valve blowing off - pressure above set value.	Compression stage 4 valve is not working properly.	■ Check compression stage 4 valve and replace if faulty.
	Gasket between suction and pressure side of compression stage 4 is faulty.	■ Replace gasket.
Compression stage 3 safety valve blowing off - pressure below set value.	Safety valve faulty.	■ Replace safety valve.
Compression stage 4 safety valve blowing off - pressure above set value.	Valve in pressure line to storage tank is closed.	■ Open valve to storage tank.
	Set value for final pressure monitoring is too high.	■ Lower the set pressure.
Safety valve of compression stage 4 blowing off - pressure below set pressure.	Safety valve set too low or is faulty.	■ Replace safety valve.

10.3.3 Pressure outside setpoints

Fault description	Cause	Remedy
Pressure gauge for compression stage 1 showing excessive pressure.	Valve of compression stage 2 leaking.	■ Check compression stage 2 valve and replace if faulty.
Pressure gauge for compression stage 2 showing excessive pressure.	Valve of compression stage 3 leaking.	■ Check compression stage 3 valve and replace if faulty.
Pressure gauge for compression stage 3 showing excessive pressure.	Valve of compression stage 4 leaking.	■ Check compression stage 4 valve and replace if faulty.
Pressure gauges for all compression stages showing insufficient pressure.	Compression stage 1 valve leaking.	■ Check compression stage 1 valve and replace if faulty.
	Air filter very dirty.	■ Replace air filter insert.
Pressure gauges for all compression stages showing no pressure.	No voltage at solenoid drain valve of compression stages 1 and 2.	■ Check power supply to solenoid drain valve.
	Solenoid drain valve of compression stages 1 and 2 faulty.	■ Check solenoid drain valve and replace if faulty.

10.3.4 Mechanical faults

Fault description	Cause	Remedy
Solenoid drain valve does not close.	No power supply.	■ Check fuses, replace blown fuses.
	Solenoid faulty.	■ Replace solenoid.
	Foreign matter in solenoid drain valve.	■ Clean solenoid drain valve.
Pneumatic drain valve does not close.	Foreign matter in drain valve.	■ Clean the pneumatic drain valve.
	Gaskets worn.	■ Replace gaskets.
Air escaping at pressure lines.	Gaskets at connections leaking.	■ Replace faulty gasket.
	Cutting ring unions leaking.	■ Switch compressor off. Wait until all parts are depressurised; check the pressure gauge for this. Tighten all leaking unions. Check again and if necessary replace affected line.
Compressor has been switched off, temperature switch has tripped due to excessively high compressed air temperature.	Inadequate cooling due to insufficient cooling water.	■ Check the onboard supply of cooling water.
	Cooler contaminated due to lime scale formation.	■ Clean cooling water chambers with a descaling agent.
Cooling water outlet temperature too high.	Tension in v-belts too low.	■ Adjust the v-belt tension
	Air bubbles in the cooling water circuit.	■ Bleed the cooling water circuit.
	Cooling water supply blocked.	■ Check cooling water supply.
	Cooling water inlet temperature too high: Temperature > 32 °C.	■ Check cooling water inlet temperature; check whether sufficient quantities of cooling water are being supplied.
	Cooling water piping blocked.	■ Check that cooling water is flowing.
	Cooler housing or cooling water piping leaking.	■ Repair or replace leaking parts, replace gaskets.
	Scaling in cooler.	■ Clean cooling water chambers with a descaling agent.
Abnormal compressor noise.	Connecting rod bearing faulty.	■ Check connecting rod bearing and replace, if necessary. Check lubricating oil supply.
	Gudgeon pin bearing faulty.	■ Check gudgeon pin bearing and replace, if necessary.
	Crankshaft bearing faulty.	■ Check crankshaft bearing and replace, if necessary.
	Motor bearing faulty.	■ Check motor bearing and replace, if necessary.

Fault description	Cause	Remedy
Oil leaking from crankcase.	Gasket or shaft seal faulty.	■ Slight traces of oil on the housing or oil drops under the compressor are harmless. Wipe off with a lint-free cloth. ■ If leaks are substantial, establish which gasket is faulty and replace it.
	Screw connections loose.	■ Tighten screw connections.
Air escaping at drainage hole on cooler housing of compression stage 1 or 2.	Gas-side o-ring in cooler housing faulty.	■ Replace o-ring.
Water escaping at drainage hole on cooler housing of compression stage 1 or 2.	Water-side o-ring in cooler housing faulty.	■ Replace o-ring.
Water in the oil.	Compressor is not reaching operating temperature - unfavourable room ventilation.	■ Change room ventilation so that fresh air is not blown directly onto the compressor.
	Compressor is not reaching operating temperature - compressor running hours too short.	■ Extend compressor running hours.
	Inadequate drainage.	■ Check drainage lines for clear flow. ■ Check drainage interval setting.
Safety valve in cooling water circuit trips.	Leaks in cooler.	■ Replace cooler insert.
	Pressure peaks in the cooling water circuit cause the safety valve to trip.	■ Determine the cause of the pressure peaks and eliminate these causes (start-up of additional powerful pumps, actuation of electromagnetic stop valves or shuttle valves, or similar causes)
Premature fracture of valve plates, valve springs or plates due to corrosion.	Inadequate drainage.	■ Check drainage lines for clear flow. ■ Check drainage interval setting. **Note:** Impact impressions in the valve plate from the sealing seat are normal.
Message in the compressor control "Humidity in compressed air outlet" (dew point sensor fault)	Filter in the dew point sensor contaminated.	■ Replace filter in the dew point sensor. Remove the dew point sensor and disassemble the filter from the dew point sensor. Wear gloves and only take hold of the filter at the black marking. Replace the composite gasket between the filter and the sensor element.

11 Operating materials

11.1 Safety instructions for handling operating materials

WARNING!

Health hazard due to operating materials

Operating materials are harmful to health. They contain toxic and corrosive elements.

Observe the following instructions to prevent injury to yourself and other personnel:

- Do not inhale vapours. In closed rooms, always ensure sufficient ventilation to prevent poisoning.
- Do not allow operating materials to come into contact with the skin, eyes or clothing. If contact occurs, clean the affected areas of skin with soap and water to prevent chemical burns or other injuries. In case of contact with the eyes, rinse thoroughly with plenty of clear water.
- Fire, naked flames and smoking are prohibited when handling operating materials as they are highly flammable.
- Observe the instructions and warning notices on the containers.

NOTICE!

Coking of compressor valves, pipelines and fittings.

Use only oils recommended and tested by Sauer USA. The recommended oils reduce the level of coking in the compressor valves and the upstream pipelines and fittings to a minimum.

Lubricants other than those specified may only be used after approval from Sauer USA. Otherwise the guarantee is void.

11.2 Lubricants and preservation oil for Sauer-Compressors

A detailed description of the oil types approved by Sauer USA and their operating ranges for different compressor types is included in the accompanying "Oil recommendation for Sauer-Com-pressors".

This oil recommendation does not apply with oil-free compressors.

If you need a new copy, please contact Sauer-Service.

NOTICE!

The oil types set out in "Oil recommendation for Sauer-Compressors" represent a complete list of the oils that have yielded entirely positive operating results.

High product quality and long service life can only be guaranteed if the oils listed are used with due consideration for the conditions of the specific application.

Product names may vary by country.

NOTICE!

If an oil is used that is not included in this list, contrary to the recommendations of Sauer USA, the warranty coverage for the Sauer-Compressor will automatically become null and void.

Use of an oil not included in this list can result in failure and irreparable damage to the compressor.

If you need help in selecting the correct oil, please contact the Sauer-Service department.

12 Spare parts and accessories

12.1 Layout and content of the spare parts catalogue

A detailed description of the critical and optional spare parts available from Sauer USA can be found in the separate spare parts catalogue enclosed for this Sauer-Compressor.

Layout of the spare parts catalogue

The content is sorted by assemblies.

Explanation of captions in spare parts catalogue:

Standard assemblies, optional assemblies, optional loose accessories

The header contains the following information:

- Part number
- Designation of the assembly

Specifications in the parts list

Item no.	Part no.	Designation	Quantity
Item number of the component in the graphical representation	Number under which the component can be ordered from Sauer-Service	Designation of the component	Quantity of this component in the respective assembly

12.2 Optional accessories

In addition to genuine Sauer spare parts, Sauer USA also supplies a wide range of accessories for your Sauer-Compressor and special equipment for your entire compressor system, e. g.:

- Gauge panel
- Fully automatic compressor control
- Adsorption dryer
- Refrigeration dryer
- Filter
- Sound-proof canopy
- Pressure receiver
- Couplings

13 Glossary

ANSI	American National Standards Institute
ANSI Z535.6-2006	ANSI standard for the design of safety information in operating instructions
BGR	Insurance association regulations
BGR 500	Berufsgenossenschaftliche Regeln für Sicherheit und Gesundheit bei der Arbeit (BGR): Betreiben von Arbeitsmitteln [German trade association regulations for occupational health and safety: Use of work equipment.]
compressed air	The term "compressed air" is used in this documentation for all gases that can be properly compressed using the Sauer-Compressor. These gases are specified in the enclosed acceptance test certificate 3.1.
dB(A)	Weighted sound pressure level in decibels
DIN	Deutsches Institut für Normung [German Standardisation Institution]
e. g.	For example
EN	Europäische Norm [European Standard]
Fig.	Figure
GmbH	Gesellschaft mit beschränkter Haftung [company with limited liability]
ISO	International Organization for Standardization
VDE	Verband der Elektrotechnik Elektronik Informationstechnik e.V. [Association for Electrical, Electronic & Information Technologies]

14 Index

W

Appendix

A Declaration of Conformity

Sauer Certificate of Conformity and Authenticity

With this Sauer Certificate of Conformity and Authenticity we

Sauer Compressors USA

certify that the items, total no. _____ and only these items which

have been delivered with attached **Original Sauer Shipping Note**

number _____ are

Genuine Sauer Spare Parts

with proven, guaranteed and traceable quality. Any handwritten or other change resp. revision in any way on the **Original Sauer Shipping Note** or this **Certificate**, or the attachment of other non Original Shipping Notes will make this Certificate invalid. In this case there are justified evidences that grey market spares of inferior quality have been delivered.

If you want to be informed about your advantages when using Genuine Sauer Spare Parts or in case of doubts, please contact our Service Department:

Phone: 410-604-3142
Fax: 410-604-3209
E-mail: service@sauerusa.com
or visit our website www.sauerusa.com

B Certificate of conformity and authenticity

Sauer Certificate of Conformity and Authenticity

With this Sauer Certificate of Conformity and Authenticity we

Sauer Compressors USA

certify that the items, total no. _____ and only these items which

have been delivered with attached **Original Sauer Shipping Note**

number _____ are

Genuine Sauer Spare Parts

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Phone: 410-604-3142
Fax: 410-604-3209
E-mail: service@sauerusa.com
or visit our website www.sauerusa.com

C Commissioning certificate

D Notification of claim

Warranty Claim Form

245 Log Canoe Circle
Stevensville, Maryland 21666

T 410.604.3142
F 410.604.3209

www.sauerusa.com

Company / Vessel:

Point of Contact:

Phone Number: Email:

Street Address:

City: State: Zip :

Compressor Model: Serial Number:

Date Received: Operating Hours:

Oil Type:

Description of Problem:

E Oil recommendation