

Operating manual SAB 202

Screw compressor unit






Manual for SAB 202

The screw compressor and the unit may be fitted with different equipment, depending on their functions and requirements.

Part of this equipment is described in this manual although it may not be fitted on your particular unit.

In the table, the x mark indicates which equipment is fitted on your particular unit with the compressor number stated below.

Compressor	SM <input type="checkbox"/> LM <input type="checkbox"/> SF <input type="checkbox"/> LF <input type="checkbox"/>	
Compressor no.		
Refrigerant	<input type="checkbox"/> R717 <input type="checkbox"/> HFC/HCFC: _____ <input type="checkbox"/> Other: _____	
Control	Transducers and manual regulation of Vi slide	
	UNISAB II and manual regulation of Vi slide	
	UNISAB II and automatic regulation of Vi slide	
Oil filter	Internal	
	External	
Oil cooling	Water cooled oil cooler <input type="checkbox"/> OWRF <input type="checkbox"/> OWTF Other: _____	
	Refrigerant cooled oil cooler	OOSI
	Refrigerant injection in compressor	<input type="checkbox"/> HLI <input type="checkbox"/> BLI
Oil separator	With 1 discharge valve	
	With 2 discharge valves	
Oil temp.reg.	Thermostatic oil valve	
Economizer system (ECO-system)	With vessel type	HESS
	With closed system and vessel type	EOSE
	With open system and vessel type	SVER
Ex-execution	Compressor and unit are  safeguarded	

Introduction to operating manual

The purpose of this manual is to describe:

- Dangers resulting from failure to comply with safety precautions when operating the equipment and performing maintenance tasks.
- How to start, operate and stop the equipment safely.
- How to act when problems occur during operation.
- Scheduled maintenance tasks for the equipment and when/how to carry them out safely.

This manual is primarily intended for operators and service engineers.

In order to prevent accidents, assembly and disassembly of components should be carried out by authorised personnel only.

- It is important that the operating personnel familiarize themselves with the contents of this manual in order to ensure proper and efficient operation. Sabroe Refrigeration (YORK Denmark ApS) - hereafter referred to as Sabroe Refrigeration - is not liable for

damage occurring during the warranty period where this is attributable to incorrect operation.

Sabroe Refrigeration's manual concept covers six standard manuals: Engineering, Operating, Service, Installation and commissioning, Transport, and Spare parts.

Therefore, reference may be made to sections which are not part of this manual.

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Contents

Manual for SAB 202	1
Introduction to operating manual	2
Contents	3
Areas of application of screw compressor unit	5
Application	5
Application of combustion engines	5
Signs and Warnings	6
Identification of Sabroe Refrigeration equipment	6
Unit pipe system name plate	7
Compressor name plate	8
Vessel name plate	9
Signs in instructions	10
The sign: CAUTION	10
The sign: HIGH VOLTAGE	10
The sign: The temperature of tangible surfaces	11
The sign: Internal protection	11
Other warning signs	11
Emergency stop	12
Safety at service	12
Warnings in instructions	13
Texts marked with Danger!	13
Texts marked with Warning!	13
Texts marked with Caution!	13
Safety precautions	14
General safety instructions and considerations	14
Personal safety	14
Work area safety	14
Tool safety	14
Operation safety	15
Maintenance safety	15
Lubricating oils	17
Refrigerants	17
Cooling water systems	17
Noise data for screw compressors	18
Operating instructions	19
Safety precautions	19
Ventilation	19
Pressure	19
Hot and cold surfaces	19
UNISAB II reading, safety and capacity regulating system	19
Valves for operating the compressor	20

Preparations before start	21
Starting	21
Principle drawing - position during operation	23
Checks to be performed during operation	24
Operations log	25
Stopping routine	26
Brief stop	26
Shutting down for long idle period	26
Problems	26
Fault finding	26
Maintenance instructions	27
Maintenance of the compressor unit	27
General	27
Major service intervals	28
Checking the oil	29
Visual inspection	30
Oil level	30
Oil level glass	30
Oil change	30
Oil charging	31
Motor lubrication	34
Replacing motor bearings	34
Major overhaul of the compressor	34
Final disposal	35
Safety precautions	35
Disposal of machine parts	35
Disposal of oil and refrigerant	35
Disposal of electrical components	35
Disposal of batteries	35
Appendices	36
References to instructions	36
Index	37



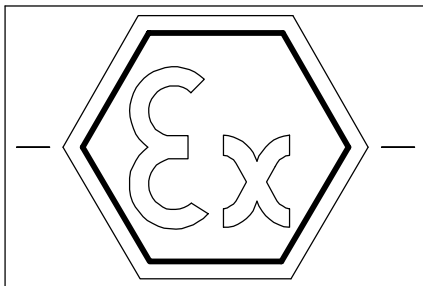
Areas of application of screw compressor unit

Application

To prevent unintentional application of the compressor, which could injure personnel or damage the equipment, the following must be observed:

- The compressor must only be used as a refrigeration compressor with the number of revolutions per minute and within the operating limits specified in the manuals or in a written agreement with Sabroe Refrigeration.
- The compressor must only be used with the following refrigerants: R717, R22, R134a, R404A, R507, R600, R600A, R290 and LPG. Other HFC refrigerants must only be used in accordance with Sabroe Refrigeration's instructions. All other types of gas must only be used with a written permission from Sabroe Refrigeration.
- The compressors are approved for application in potentially explosive atmospheres provided they have been fitted with explosion-proof equipment. This can be seen from the Ex name plates fixed on each unit. See Fig. 1.

Fig. 1



Please note that special tools which do not cause any sparks must be used for ALL maintenance work on the compressor.

Warning!

The compressor must NOT be used:

- For evacuating the refrigeration plant of air and moisture.
- For putting the refrigeration plant under air pressure in view of a pressure testing.
- As an air compressor.

Warning!

Sabroe Refrigeration is not liable for injuries to personnel or damage to equipment resulting from using the equipment for other purposes than the ones stated above.

Application of combustion engines

If combustion engines are installed in rooms containing refrigeration machinery or rooms where there are pipes and components containing refrigerant, make sure that in case of leakage the combustion air for the engine comes from an area in which there is no refrigerant gas.

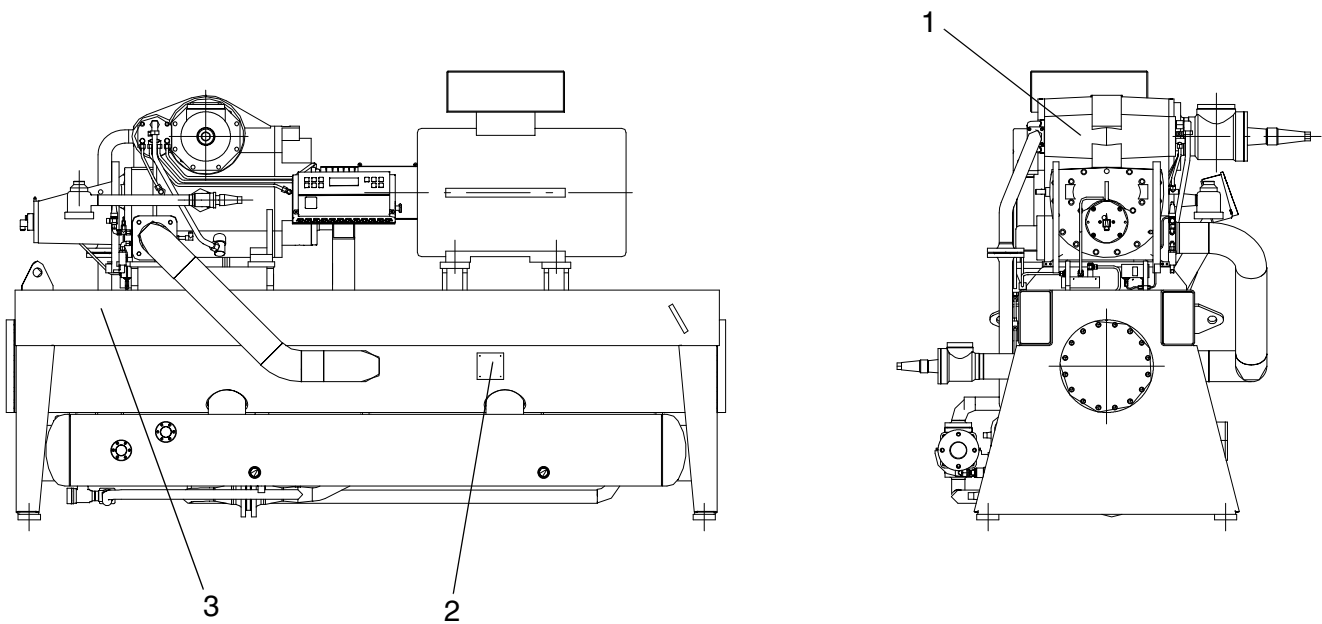
Failure to do so involves a risk of lubricating oil from the combustion engine mixing with refrigerant. At worst this may lead to corrosion and damage of the engine.

Signs and Warnings

Identification of Sabroe Refrigeration equipment

All Sabroe Refrigeration equipment can be identified by one or several name plates positioned as illustrated in the following drawing:

Fig. 2 SAB 202 screw compressor unit, position of name plates




1. Compressor name plate
2. Vessel name plate
3. Unit pipe system name plate



Unit pipe system name plate

Fig. 3 Unit pipe system name plate

 Christian X's Vej 201 8270 Højbjerg, Denmark		2516-328	
Unit pipe system	Type	<input type="text"/>	Year <input type="text"/>
Identification No.	<input type="text"/>		
Design code	<input type="text"/>		
Approval No.	<input type="text"/>		
Pressure system	LP	HP	
Fluid/group	<input type="text"/>	<input type="text"/>	
Allowable pressure Max.	PS	<input type="text"/>	bar
Leak test pressure	PT	<input type="text"/>	bar
Design temperature Min./max.	TS	<input type="text"/>	°C
CE 0062			

The unit pipe system name plate is positioned on the frame. The name plate contains the following information:

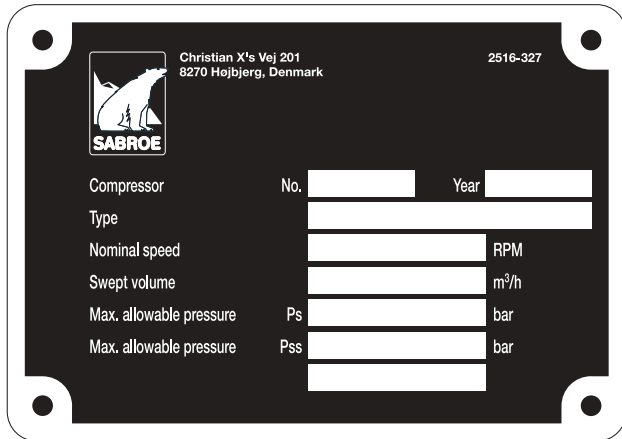
- **Type**
Manufacturer's type designation.
- **Year**
Year of manufacture.
- **Identification no.**
Individual no. for identification of supplied pipe system.
- **Design code**
For PED orders: EN 378-2

If the unit has been approved by an authority, the design code will be shown here.

- **Approval no.**
If the unit has been approved by an authority, the approval no. will be shown here.
- **Pressure system**
Low pressure side of compressor piping is referred to as **LP**.
High pressure side of compressor piping is referred to as **HP**.
- **Fluid/Group**
Refrigerant designation according to ISO817 or fluid group according to directive 67/548/EEC.
- **Max. allowable pressure, PS**
Shows max allowable pressure relative to atmospheric pressure for which the pipe system has been designed.
- **Leak test pressure, PT**
Shows the pressure with which the pipe system has been leak tested.
- **Design temperature, TS**
Shows min and max temperatures for which the pipe system including components has been designed.
- **CE xxxx**
The four digits compose the registration no. of the notified body in charge of the assessment modules for the vessel.

Compressor name plate

Fig. 4 Compressor name plate



The compressor name plate is positioned on the compressor. The plate contains the following information:


- **Compressor no.**
Compressor manufacturing number.

- **Year**
Year of manufacture.
- **Type**
Manufacturer's type designation.
- **Nominal speed**
Shows rotational speed of drive shaft at typical running condition.
- **Swept volume**
Shows swept volume of compressor in m³/h at nominal speed.
- **Max allowable pressure, Ps**
Shows max. working pressure of compressor.
- **Max allowable pressure, Pss**
Shows max allowable pressure at compressor standstill.



Vessel name plate

Fig. 5 Vessel name plate

 Christian X's Vej 201 8270 Højbjerg Denmark		2516-326	
Beholder/Vessel/Behälter	Nr. No. No.		År Year Jahr
Type/Type/Typ			
Beregningsnorm/Design code/ Berechnungsnorm			
Godkendelsesnr. Approval No. Abnahmenummer	/CAT.		
Side/Side/Seite Medie/Fluid/Medium		Svøb/Shell/Mantel	Rør/Tube/Rohr
Tilladigt tryk Allowable pressure Zulässiger Druck	PS	/	/ bar
Tilladigt temperatur Allowable temperature Zulässige Temperatur	TS	/	/ °C
Volumen/Volume/Volumen	V		l
 0062			

The vessel name plate is positioned on the shell of the vessel. The name plate contains the following information:

- **Vessel no.**
Vessel number stated by Sabroe Refrigeration.
- **Year**
Year of manufacture.
- **Type**
Manufacturer's type designation.

- **Design code**
Shows the design code according to which the vessel was manufactured.
- **Approval no./CAT**
Shows the approval no. of the vessel issued by the relevant authority as well as the category according to PED 97/23/EEC, Article 9.
- **Side**
Refers to the columns "Shell" and "Tube".
- **Fluid**
Shows the refrigerant designation according to ISO817.
- **Allowable pressure, PS**
Shows min and max pressure relative to atmospheric pressure for which the vessel or vessel part has been designed.
- **Allowable temperature, TS**
Shows min and max temperatures for which the vessel has been designed.
- **Volume**
Shows volume of the vessel in litres.
- **CE xxxx**
The four digits compose the registration no. of the notified body in charge of the assessment modules for the vessel.

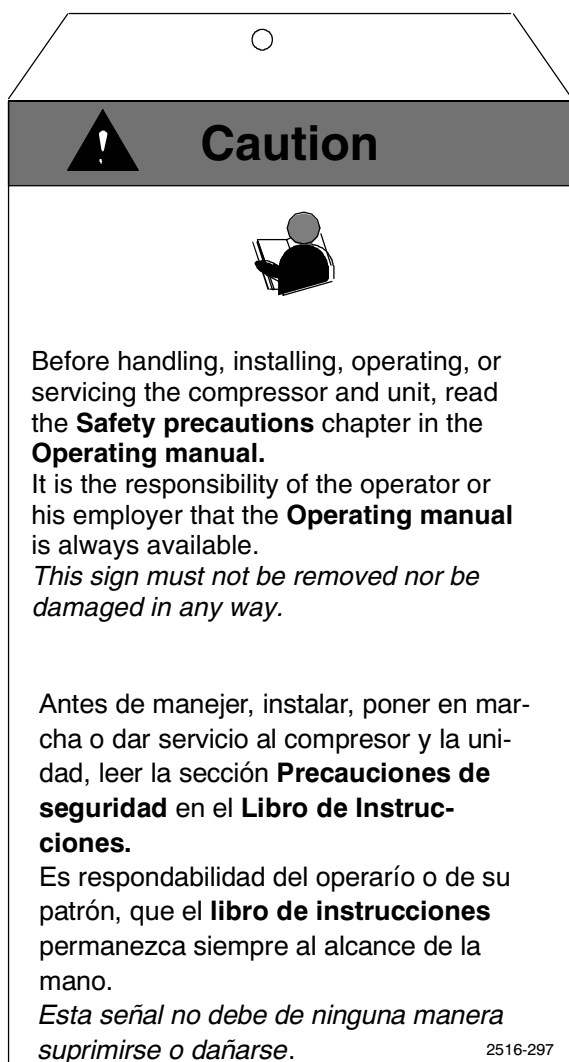
Signs and Warnings

In the following section, all signs which may be found on the equipment are described. The number of signs, however, may vary from product to product.

Signs in instructions

The sign: CAUTION

A **CAUTION** tag like the one illustrated below is fixed to the compressor. The sign imposes the users to read the *Safety precautions* chapter in the manual before handling, operating, or servicing the compressor and unit.



The sign: HIGH VOLTAGE



HIGH VOLTAGE!

Before working on any electrical circuits, turn the main switch “OFF” and lock it. Dismantle the main fuses to the compressor unit.

Unless expressly stated in applicable Sabroe Refrigeration documentation or by a Sabroe Refrigeration field service representative, do NOT work with the electrical power “ON”. Any work with the electrical power “ON” should be performed by a Sabroe Refrigeration field service representative. The customer and subsequent transferees must make sure that any other person performing work with the electrical power “ON” is trained and technically qualified.



The sign: The temperature of tangible surfaces

When a compressor is working, the surfaces which are in contact with the warm discharge gas will also get warm. However, the temperature depends on the refrigerants used as well as the operating conditions of the compressor. Often the temperature exceeds 70°C [158°F], which for metal surfaces may cause skin burns even at a light touch.

Consequently, the compressors are equipped with yellow warning signs signalling that pipes, vessels, and machine parts will become so hot during operation that your skin will get burnt if you touch them for one second or more.

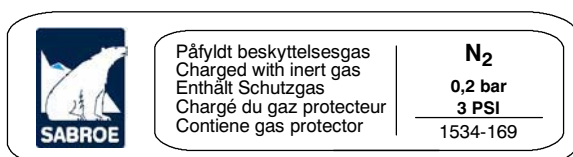


The sign: Internal protection

Compressor blocks and units are usually delivered **without** any refrigerant or oil.

To protect the compressors against internal corrosion, they are delivered evacuated of all atmospheric air and charged with Nitrogen (N₂) to an overpressure of **0.2 bar [3 psi]**.

In such cases a yellow sign is affixed to a visible spot on the compressor.



Other warning signs



Hazardous substance!



Dangerous noise level, use hearing protectors!



Internal overpressure!



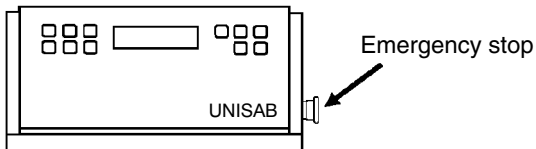
Cold surfaces!



No step

Emergency stop

Fig. 6 Emergency stop



Safety at service

Before dismantling or servicing a compressor or unit, attention should be paid to the following points:

- Read the section *Safety precautions* in this manual before opening the compressor and other parts of the refrigeration plant.
- Make sure that the motor cannot start up inadvertently. It is recommended to remove all main fuses.
- Switch off all electric components on the compressor/unit before the dismantling/servicing.
- Make sure that there is neither overpressure nor any refrigerant in the part to be dismantled. Close all necessary stop valves.
- Use appropriate gloves as well as eye and face protection and make sure to have a gas mask ready for use.
- Use the prescribed tools and check that they are properly maintained and in good working condition. In ATEX classified areas, use tools especially suited for this purpose.



Warnings in instructions

This section describes warnings used in instructions pertaining to Sabroe Refrigeration equipment.

Information of importance to the safety of personnel or equipment is given at three levels.

- Danger!
- Warning!
- Caution!

There is an important distinction between these three levels. As shown below, however, the principle is the same at all three levels.

Note: Information is sometimes given in a note. A note is used to emphasize information but is never used for information vital to the safety of personnel and equipment.

Texts marked with Danger!

The example below shows how information vital to the safety of involved personnel is presented.



Risk of electrical shock! Always turn off the main switch before servicing the unit! Contact with high voltage may cause death or serious injury.

Failure to observe information marked with Danger! may cause death or serious injury to personnel or even to a third party.

Texts marked with Warning!

The example below shows how information of importance to the safety of involved personnel or of major importance to the safety of equipment is presented.



Risk of damage to compressor! Always consult your supplier before using a compressor under operating conditions outside the specified working range.

Texts marked with Caution!

The example below shows how information of importance to the safety of equipment is presented.



Risk of incorrect viscosity! Always make sure that all oils used are mixable without causing chemical reactions. Chemical reactions might have serious effects on the viscosity.

Failure to observe information marked with Caution! may cause damage to equipment.

Safety precautions

Important!

The safety precautions for this Sabroe compressor have been prepared to assist the operator, programmer, and maintenance personnel in practising good shop safety procedures.

Operator and maintenance personnel must read and understand these precautions completely before operating, setting up, running, or performing maintenance on the compressor/unit.

These precautions are to be used as a supplement to the safety precautions and warnings included in:

- a. All other manuals pertaining to the compressor/unit.
- b. Local, plant, and shop safety rules and codes.
- c. National safety rules and regulations.

General safety instructions and considerations

Personal safety

Owners, operators, maintenance, and service personnel must make constant day-to-day safety procedures a vital part of their job. Accident prevention must be one of the principal objectives of their job, regardless of the activity involved.

Know and respect the compressor/unit. Read and carry out the prescribed safety and checking procedures.

Make sure that everyone working for, with or near you fully understands and - most importantly - complies with the following safety precautions and procedures when operating the compressor/unit.

Observe the safety warnings on the compressor/unit.

Use safety equipment. Wear appropriate gloves as well as eye and face protection when working with parts containing refrigerant and/or lubricating oil. Safety shoes with slip-proof soles can help avoid injuries. Keep safety equipment in good condition.

Never operate or service this equipment under the influence of alcohol, drugs or other substances or if in a condition which decreases alertness or impairs judgment.

Work area safety

Always keep your work area clean. Dirty work areas with such hazards as oil, debris or water on the floor may cause someone to fall on the floor, into the machine or onto other objects resulting in serious personal injury.

Make sure your work area is free of hazardous obstructions and be aware of protruding machine parts.

Always keep your work area tidy so that you can escape in case of a dangerous situation.

Report any unsafe working conditions to your supervisor or safety department.

Tool safety

Always make sure that hand tools are in proper working condition.

Remove hand tools such as wrenches, measuring equipment, hammers, etc. from the compressor/unit immediately after use.



Operation safety

Read and understand all safety instructions before setting up, operating, or servicing the compressor. Assign only qualified personnel instructed in safety and all machine functions to operate or service this compressor.

Operators and maintenance personnel must carefully read, understand and fully comply with all warnings and instruction plates mounted on the machine. Do not paint over, alter or deface these plates or remove them from the compressor/unit. Replace all plates which become illegible. Replacement plates can be purchased from Sabroe Refrigeration.

Warning!

Safety guards, shields, barriers, covers and protective devices must not be removed while the compressor/unit is operating.

Warning!

All safety features, disengagement and interlocks must be in place and function correctly before the equipment is put in operation. Never bypass or wire around any safety device.

Keep all parts of your body off the compressor/motor/unit during operation. Never lean on or reach over the compressor.

During operation, pay attention to the compressor unit process. Excessive vibration, unusual sounds, etc. can indicate problems requiring your immediate attention.

Maintenance safety

Do not attempt to perform maintenance on the compressor unit until you have read and understood all the safety instructions.

Assign only qualified service or maintenance personnel to perform maintenance and repair work on the unit. They must be trained by Sabroe Refrigeration or be similarly qualified according to EN 378. They should consult the service manual before attempting any service or repair work and contact Sabroe Refrigeration in case of questions. Use only Sabroe Refrigeration original spare parts; other parts may impair the safety of the compressor/unit.

Before removing or opening any electrical enclosures, covers, plates, or doors make sure that the main switch is in the **OFF** position and the main fuses are dismantled. If possible, post a sign at the switch indicating that maintenance is being performed. Dismantle the main fuses to the unit.

Danger **HIGH VOLTAGE!**

Before working on any electrical circuits, place the main switch of the compressor/unit in the "OFF" position and lock it. Dismantle the main fuses to the compressor unit. Unless expressly stated in applicable Sabroe Refrigeration documentation or by appropriate Sabroe Refrigeration field service representative, do NOT work with the electrical power "ON". If such express statement or advice exists, work with the electrical power "ON" should be performed by a Sabroe Refrigeration field service representative. The customer and subsequent transferes must make sure that any other person performing work with the electrical power "ON" is trained and technically qualified.

**FAILURE TO FOLLOW THIS INSTRUCTION
MAY RESULT IN DEATH OR SERIOUS
ELECTRIC SHOCK.**

Safety precautions

When maintenance is to be performed in an area far away from the main switch and the switch is not locked, all start buttons must be tagged with **“DO NOT START”** tags.

Adequate precautions such as warning notices or other equally effective means must be taken to prevent electrical equipment from being activated when maintenance work is being performed.

When removing electrical equipment, place a number or a labelled tag on all wires which are not already marked. If wiring is replaced, make sure that the new wiring is the same type, length, size and has the same current carrying capacity.

Close and fasten all guards, shields, covers, plates, and doors securely before reconnecting power.

An electrician must analyse the electrical system to determine the possible use of power retaining devices such as capacitors. Such power retaining devices must be disconnected, discharged or made safe before maintenance is performed.

Working space around electrical equipment must be clear of obstructions.

Always provide adequate lighting for work and maintenance to be carried out.



Lubricating oils

Warning!

When charging oil, follow the safety instructions given by the oil supplier (MSDS: Material Safety Data Sheet). Always avoid direct contact with the oil as this may cause skin allergies. Always use protective equipment - goggles and gloves - when charging oil.

Refrigeration compressors are lubricated by one of the following oil types depending on the refrigerant plant type, and operating conditions.

- Mineral oil (M oil)
- Alkyl benzene-based synthetic oil (A oil)
- Polyalphaolefine-based synthetic oil (PAO oil)
- Mixed A and PAO oil (AP oil)
- Polyalkylen glycol-based synthetic oil (PAG oil)
- Ester oil (E oil)

See the section *Selecting lubricating oil for Sabroe Refrigeration compressors* in the oil recommendation for Sabroe compressors.

When changing oil on the compressor or draining oil from the vessel of the refrigeration plant, always collect the used oil in containers marked “waste oil” and send them to an approved incineration plant. It is **not** recommended to reuse oil.

Refrigerants

Great caution must be exercised when dealing with refrigerants. The supplier of the refrigeration plant has a duty to inform user and operator about the dangers of the refrigerant used. Safety data sheets etc. must be available to the operator.

Cooling water systems

Warning!

The recirculation water system may contain chemicals or biological contaminants, including legionella, which can be harmful if inhaled or ingested. Water systems should only be operated with an effective biological treatment programme.

Note:

These instructions only provide general information. The owner of the refrigeration plant is responsible for ensuring that all codes, regulations, and industry standards are complied with.

Safety precautions

Noise data for screw compressors

Evaporating temperature = -15°C
 Condensing temperature = +35°C
 Refrigerant = R22/R717
 Number of revolutions = **2950 rpm.**
 *Number of revolutions = **6000 rpm.**

Evaporating temperature = -35°C
 Condensing temperature = -5°C
 Refrigerant = R22/R717
 Number of revolutions = **2950 rpm.**

	Compressor block	LW	LP
Mk1	SAB 110 SM	98	81
	SAB 110 SF	98	81
	SAB 110 LM	98	81
	SAB 110 LF	98	81
Mk2	SAB 110 SM	-	-
	SAB 110 SF	-	-
	SAB 110 LM	-	-
	SAB 110 LF	-	-
	SAB 110 LR*	-	-
	SAB 110 SR*	-	-
Mk3	SAB 128 M	100	82
	SAB 128 F	104	86
	SAB 128 R*	104	86
Mk4	SAB 128 M	-	-
	SAB 128 F	-	-
	SAB 128 R*	-	-
Mk3	SAB 163 M	103	85
	SAB 163 F	105	87
	SAB 163 R*	105	87
Mk4	SAB 163 M	-	-
	SAB 163 F	-	-
	SAB 163 R*	-	-
Mk1	SAB 202 SM	105	86
	SAB 202 SF	106	87
	SAB 202 LM	105	86
	SAB 202 LF	107	88
Mk1	SAB 283 L	107	87
	SAB 283 E	108	88
Mk1	SAB 355 L	109	89
Mk1	SAB 81	103	84
	SAB 83	104	85
	SAB 85	105	86
	SV 87	106	86
	SV 89	108	87

Compressor unit	LW	LP
SAB 163 BM	106	88
SAB 163 BF	110	92



Operating instructions

Safety precautions



A number of safety considerations which must be read before operating the unit in question are presented in the following. General safety instructions/regulations must be studied carefully. Failure to do so may result in personal injury or even death. Moreover, the equipment may be damaged or destroyed.

Ventilation

Before operating the unit, always check the function of the ventilation system used in the area where the compressor unit is located (machine room).



Pay close attention to the fact that large amounts of escaping (or released) refrigerant entail risk of suffocation. Safety sheets explaining the risks associated with the relevant refrigerant should be supplied by the supplier of the plant.



Body contact with leaking liquid refrigerant entails high risk of injuries caused by intense cold. The

safety sheets supplied by the supplier of the plant also explain the risks generally associated with refrigerants.

Pressure



A compressor unit comprises a pressurized system. Never loosen threaded joints (such as a union nut) while the system is under pressure and never open pressurised system parts.

Hot and cold surfaces



A compressor unit contains both hot and cold system parts. Always wear and use appropriate safety equipment.

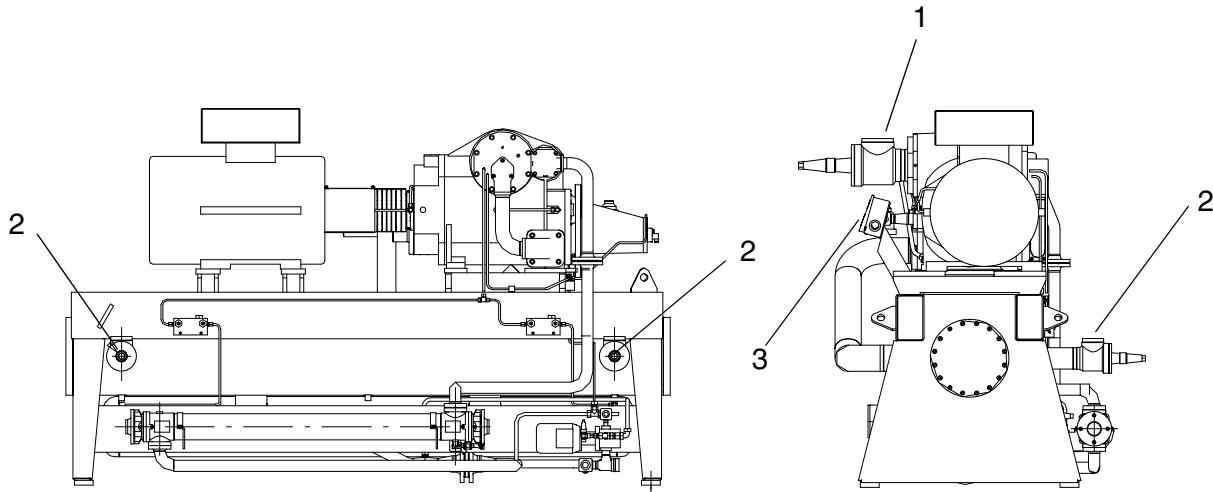
Never use your hands or other parts of your body to search for leaks.

UNISAB II reading, safety and capacity regulating system

The UNISAB II control system is described in a separate manual and will be delivered with all units equipped with UNISAB II.

Valves for operating the compressor

Fig. 7



2

Pos.	Description	Pcs.
1	Suction stop valve	1
2	Discharge stop valve	2
3	Control equipment	1



Preparations before start

1. Turn on the control voltage. The emergency stop button on the side of the control equipment cabinet must be in the ON position (pulled out), see Fig. 8. If the system fails to start, check the fuses, see Fig. 9.

Fig. 8 Operator's panel

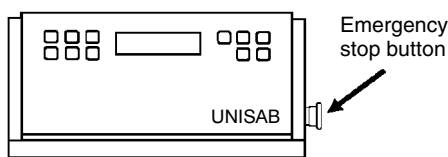
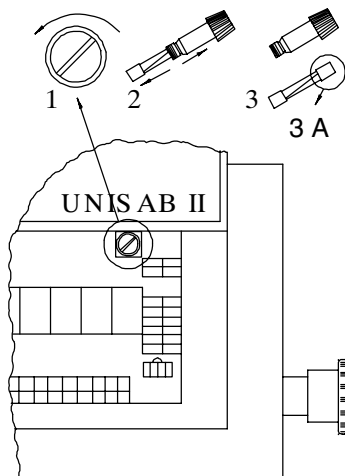


Fig. 9 The fuses and their position



2. Check the oil level in the oil separator. It must not be higher than the upper sight glass. Oil must be added when the level reaches the lower sight glass.

The correct level appears only when the unit is in operation.

If the oil level is too low, the cause must be identified.

3. Make sure that all valves are positioned in accordance with the following table *Position during operation*.
4. The oil return valve (52) is a viscosity-controlled return valve with a built-in throttle valve. The throttle valve regulates the oil flow amount.
5. Check that the compressor capacity control system is in minimum slide pos. 0-4%. This can be checked on the UNISAB II display.

Starting

Before starting the screw compressor unit, always read the section *Preparations before start*.

Reset any alarm in accordance with the instructions for the control system.

Operating instructions

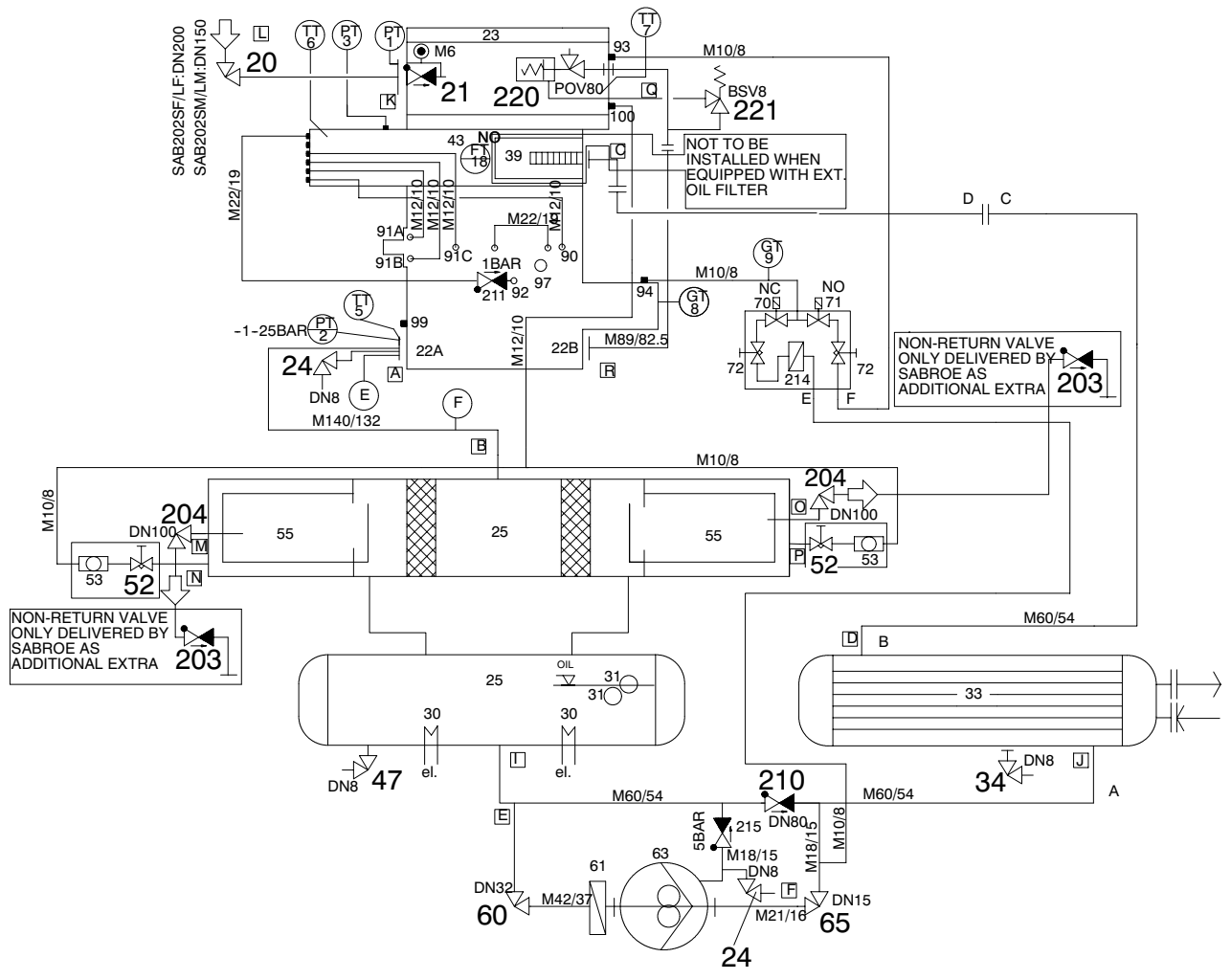
Table 1 Position during operation

Pos. no.	Qty	Designation	Position during operation
20	1	Stop valve suction line	Open
21	1	Non-return valve suction line	Is opened by the suction gas flow
24	1	Air purge valve/ oil charging	Closed
34	1	Drain valve (oil side)	Closed
35	1	Drain valve (refrigerant side)	Closed
47	1	Service valve for oil drainage	Closed
52	2	Oil return valve/Throttle valve	Opens automatically (See <i>Oil return system for fine filter element</i>)
60	1	Stop valve	Usually open Is also used for oil charging (See section 11, <i>Maintenance</i>)
64	1	Stop valve for air purging of pump	Usually closed (See section 11, <i>Maintenance</i>)
65	1	Stop valve	Usually open See pos. 60
203	2	Non-return valve in discharge pipe	Is opened by the suction gas flow
204	2	Stop valve after oil separator	Open
210	1	Non-return valve	Is opened by the oil flow
220	1	Compressor protection valve	Closed
221	1	Pilot valve for pos. 220	Closed



Principle drawing - position during operation

Fig. 10



Checks to be performed during operation

1. Choose a suitable picture from the display to follow the data which are to be checked. After setup, check that oil pressure is obtained and that the evaporating and condensing pressure lie within the permissible ranges.
2. Check the other operating data.
3. Listen for knocking valves or other abnormal noises indicating that pipes are poorly clamped or vibrating for some other reason. If necessary, submit a report so that remedial measures can be taken.
4. Check the pressure drop across the oil filter. If it exceeds 0.7 bar, replace the filter as soon as possible to prevent the compressor unit from being stopped.
5. Check the oil level in the oil separator.
6. Perform the steps described in the section *Daily maintenance*.

Monitoring of operation

To ensure unproblematic operation, it is recommended to enter the following routines in a log-book. The service engineer will need this information in connection with e.g. an error report.

Daily reading of:

- Suction pressure
- Condensing pressure
- Oil differential pressure
- Oil level
- Suction gas superheating
- Discharge pipe temperature
- Oil condition (check colour, whether the oil foams, whether temperature is normal)
- kW consumption
- Oil collection from shaft seal

It is also recommended to make an operations log for the entire refrigeration plant, see example in Table 2.



Operations log

Compressor type _____
 Compressor no. _____
 Refrigerant _____
 Compr. local no. _____
 Oil type _____

Table 2 Monitoring the operation

Machine room or system designation				Date:				
Check list	Normal level		Data registered at					
	From	To	04.00 am	08.00 am	12.00 am	04.00 pm	08.00 pm	12.00 pm
Suction pressure								
Suction temperature								
Superheating, suction gas								
Discharge pressure								
Discharge temperature								
Oil pressure, compressor								
Oil pressure, filter								
Oil temperature								
Oil temperature, separator								
Oil level								
Charged oil, litre								
Operation time (hours)								
Capacity piston position (%)								
Volume ratio								
Capacity load (%)								

Stopping routine

Brief stop

The compressor can be stopped at any capacity setting. However, under normal conditions it is recommended to reduce the capacity to a minimum before stopping the compressor.

Leave all valves in their in-operation positions as stated in the table, *Position during operation*, Table 1, unless servicing or repair work is to be performed.

Do not turn off power to the screw compressor unit as the oil heater must be connected to keep the correct oil temperature.

Shutting down for long idle period

The compressor can be stopped at any capacity setting. However, under normal conditions it is recommended to reduce the capacity to a minimum before stopping the compressor.

The valves can be left in their in-operation positions. However, to permit servicing and repair work, the necessary valves must be closed.

If necessary, the refrigerant can be moved to parts of the system where no intervention will take place. Note that the system parts which are shut down must not be filled to the top with liquid refrigerant.

If the screw compressor unit is exposed to vibrations during a long idle period, the compressor and motor bearings may be damaged. To prevent this, the motor and the compressor should be started for a short period of time once a week, i.e. in operation approx. 30-60 min.

Problems

Some frequently encountered errors that can be remedied by the operator are described below.

In more complex situations, please call in skilled personnel who have access to the appropriate documentation.

Fault finding

The compressor does not start.

1. No demand for chilling (refrigeration). Wait until the temperature rises and the compressor starts automatically.
2. Incorrect set point setting. Check the set point and, if necessary, change the setting.
3. One of the following digital entries has not been activated:
 - External start permission/immediate stop and/or
 - External start/Normal stop.
4. Oil temperature too low.
Wait until the temperature is high enough (40°C [104°F]). Check that the heating element is turned on and functioning properly.
5. Restarting delay.
6. Emergency stop activated.

If an alarm caused by a tripped monitor occurs, call in experienced personnel who have access to the document entitled Fault-finding instructions.



Maintenance instructions

Maintenance of the compressor unit

General

To ensure that the compressor unit operates without problems throughout a long service life, the system of maintenance presented in the following instructions must be followed.

Maintenance can be divided into 3 groups:

1. Daily maintenance

Daily maintenance consists of visual inspections. When familiar with the normal noise and vibration of the unit, compare each day's performance with previous observations. Make comparisons with the available diagrams etc. to make certain that the operating data lie within the permissible ranges.

- Inspect the compressor unit and check that both noise and vibration are normal.
- Enter the observed operating data into the operations log, see the table *Monitoring the operation*. Check that all operating values are within the permissible ranges. Compare them with previous values to detect trends. If necessary, submit a report so that a closer check can be made.
- Check the oil level in the oil separator (Screw compressor unit).
- Check the oil level in the compressor (Reciprocating compressor unit).
- Check the oil pressure.

- Check the refrigerant charge.
- Search for leaks if there is even the slightest suspicion that there may be a leak. Conducting a manual check right at the compressor unit itself is always the best way to check for:
 - a) leakage of oil and/or refrigerant,
 - b) leakage of cooling water or brine,
 - c) abnormal vibrations.
- Do not wait for the monitoring equipment to issue an alarm. Searching for leaks is explained in greater detail later in this section.



Warning!

Daily maintenance is normally conducted by operating personnel. Other maintenance and service tasks which require the refrigeration system to be opened must only be conducted by authorised personnel.

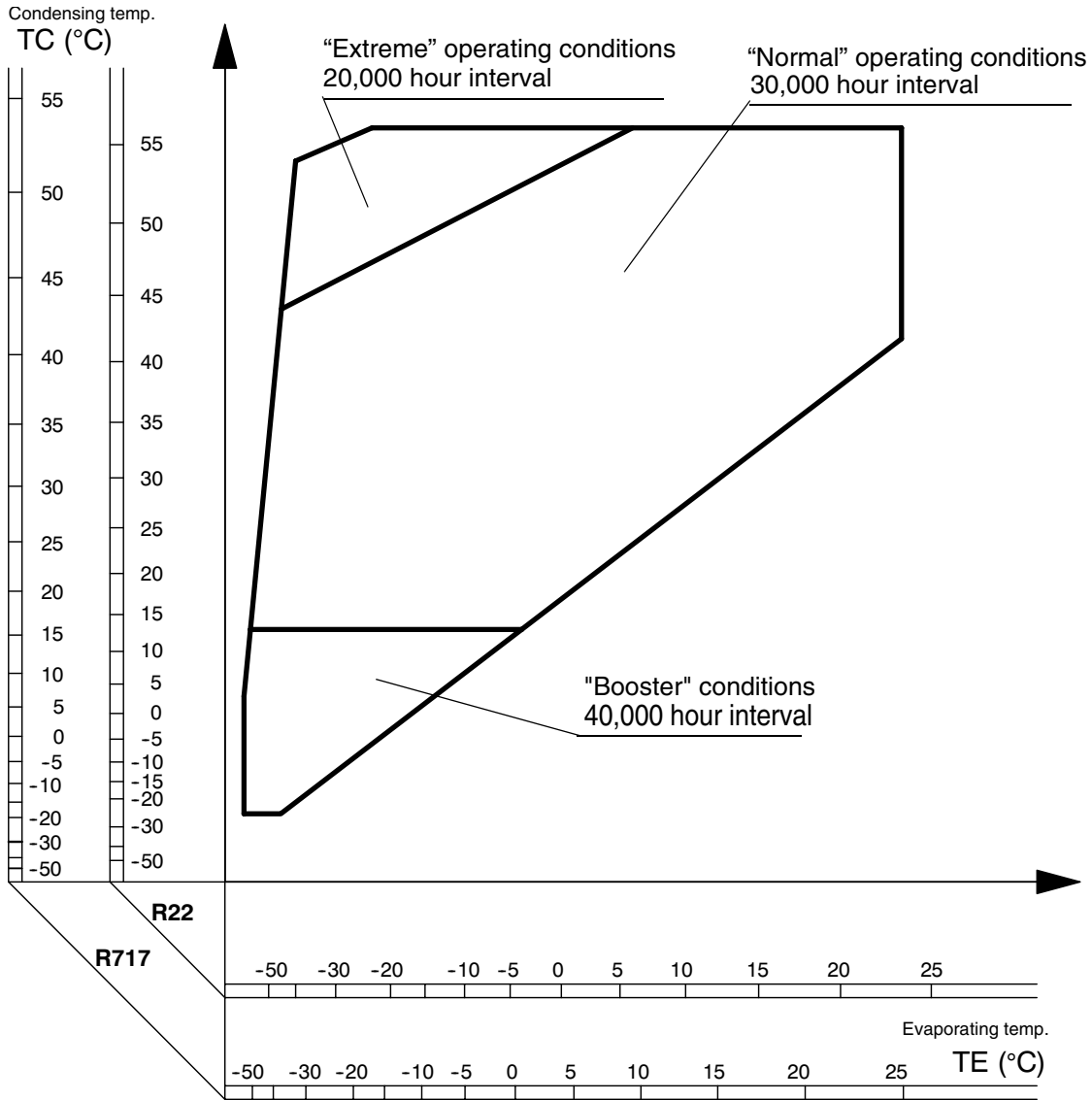
2. Periodic maintenance

Motor lubrication and other routine maintenance tasks are usually based on running time. Note, however, that these can be conducted more frequently if necessary.

3. Major overhaul

For major maintenance tasks such as compressor overhauls, the usual procedure is to call in the supplier's service personnel.

Major service intervals





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Checking the oil

Operating hours between main inspections See chart for main inspections						Service schedules Number of operating hours from initial start-up and after each main inspection (see footnote)
20,000h		30,000h		40,000h		
HCFC	R717	HCFC	R717	HCFC	R717	
						50
	●	●	●	●	●	200
●	●	●	●	●	●	1,000
●	●	●	●	●	●	2,500
●	●	●	●	●	●	5,000
●	X	●	X	●	X	10,000
X	●	X	●	X	●	15,000
☆	☆	●	X	●	X	20,000
		●	●	●	●	25,000
		☆	☆	X	X	30,000
				●	●	35,000
				☆	☆	40,000

- It is advisable to assess the oil as described in the section “Activities during service inspection” in the Service manual.
- X It is advisable to assess the oil as described in the section “Activities during service inspection” in the Service manual.
If this assessment is not made, the oil charge **must** be replaced with fresh oil.
- ☆ The oil charge must be replaced with fresh oil.
-  Service schedules after initial start-up of compressor.
-  Service schedules after each main inspection.

Note:

It is not advisable to reuse oil drained from compressor or plant. This oil has absorbed the moisture in the air and is likely to cause operating problems.

Always turn off the power to the heating rod before draining off oil.

Visual inspection

Inspect the unit to make sure that there are no refrigerant or oil leaks.

Oil level

The oil separator in the screw compressor unit is fitted with an oil receiver. The compressor takes the oil used for lubrication, cooling, sealing, and regulation from this receiver. It is thus very important that there is enough oil available in the oil receiver.

Oil can be added under pressure by using a Sabroe Refrigeration 4541-001 oil filling pump. Use oil of the prescribed grade only.

Check the oil level in the oil receiver. It must not be higher than the upper sight glass. Oil must be added when the level reaches the lower sight glass. The correct level appears only when the unit is operating.

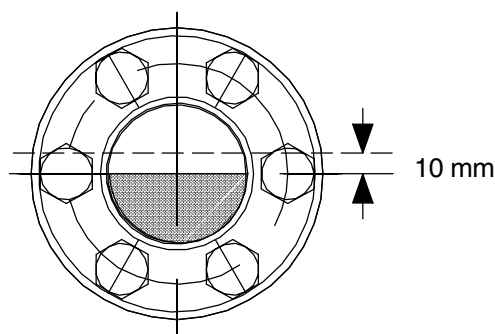
If the oil level is too low, check for leaks. If there is no leakage, the oil can still be collected in the system.

Call in a service company to investigate any problems.

Oil level glass

It must always be possible to see the oil level in one of the two oil level glasses pos. 31, see piping diagram. The oil level will rise approx. 10 mm if the indicated amount of oil is charged:

Type		Amount of oil per 10 mm Litres
Compressor	Unit	
SAB 202	OHU 4131D OHU 6031	8



The *Oil charge* table indicates the amount of oil in the compressor unit but it does **not** include the amount of oil circulating in the plant. Particularly in HFC/HCFC systems with large quantities of refrigerant, the amount of oil dissolved in refrigerant must be considered.

Consequently, it is important - during the operating period after initial start-up - to be aware that the oil level may sink rather quickly until the oil contents in the refrigeration system has stabilized.

Oil change

As stated in the table *Checking the oil*, the oil in the unit must be changed after a specific number of operating hours or when an oil analysis shows that the oil needs to be changed.

We advise you to let Sabroe Refrigeration's service organization change the oil as it is recommended to replace all filters in the unit at the same time.



Oil charging

Oil charging is carried out by means of a portable oil charging pump, see Fig. 11.

Oil charging is carried out in the following way:
 The high-pressure hose, pos. 7, is connected to the charge valve, pos. 24, on the unit via the non-return valve, pos. 12, and the correct reduction nipple. See also Fig. 12. The free end of the suction hose from the pump, pos. 1, is placed together with the bypass hose, pos. 2, in the oil barrel. The ball valve, pos. 9, and the charge valve, pos. 24, will open and the pump, pos. 5, will start. The oil will now circulate until the system is free

from air bubbles after which the ball valve, pos. 9, will close. The oil will now be charged to the unit.

When the desired amount of oil has been charged, the pump will stop and the charge valve, pos. 24, will close. Open the ball valve, pos. 9, carefully so that the pressure is equalized. The hoses can now be dismantled. Loosen the non-return valve carefully so that the remaining pressure is equalized. Remember to mount the cap nut on the charge valve and to seal the oil barrel if there is any oil left.

Fig. 11

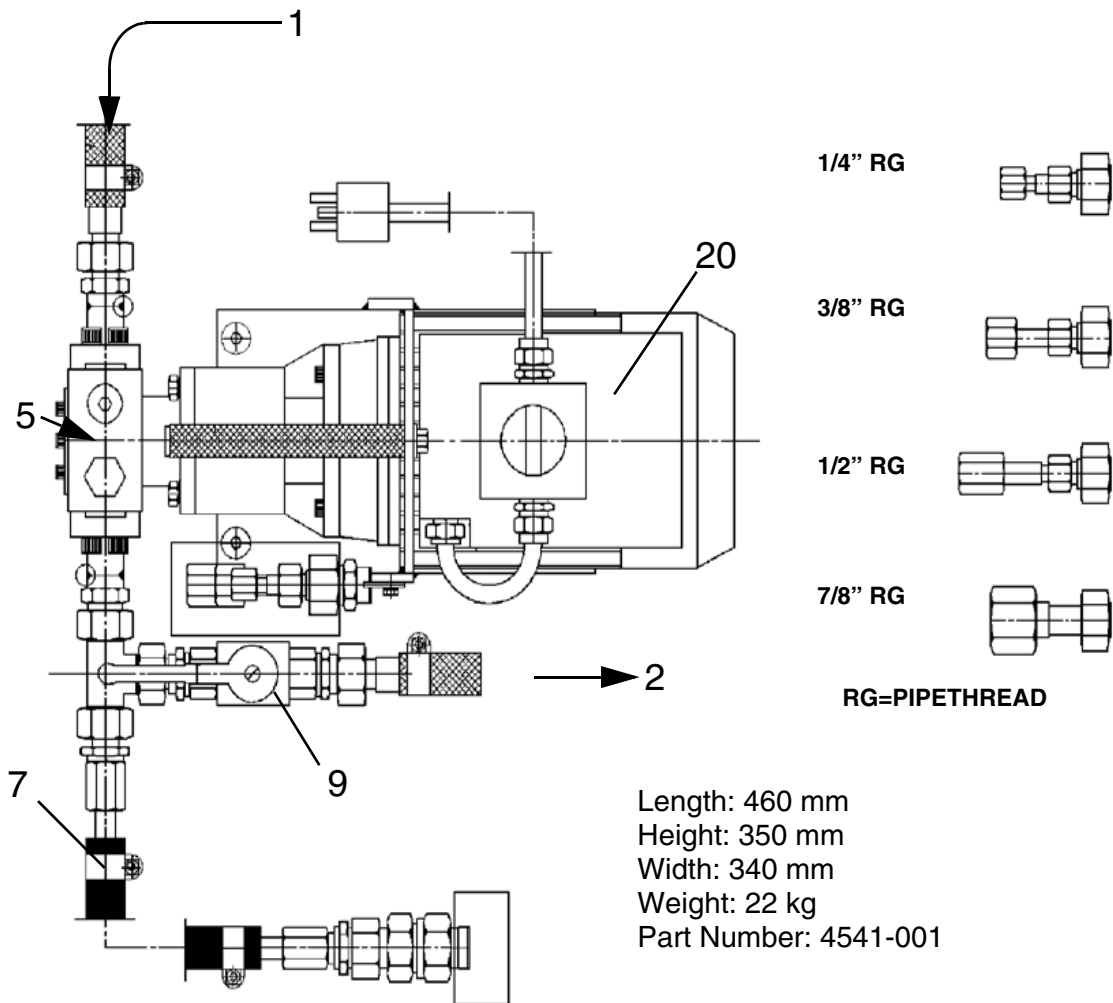


Fig. 12 Piping diagram for oil charging

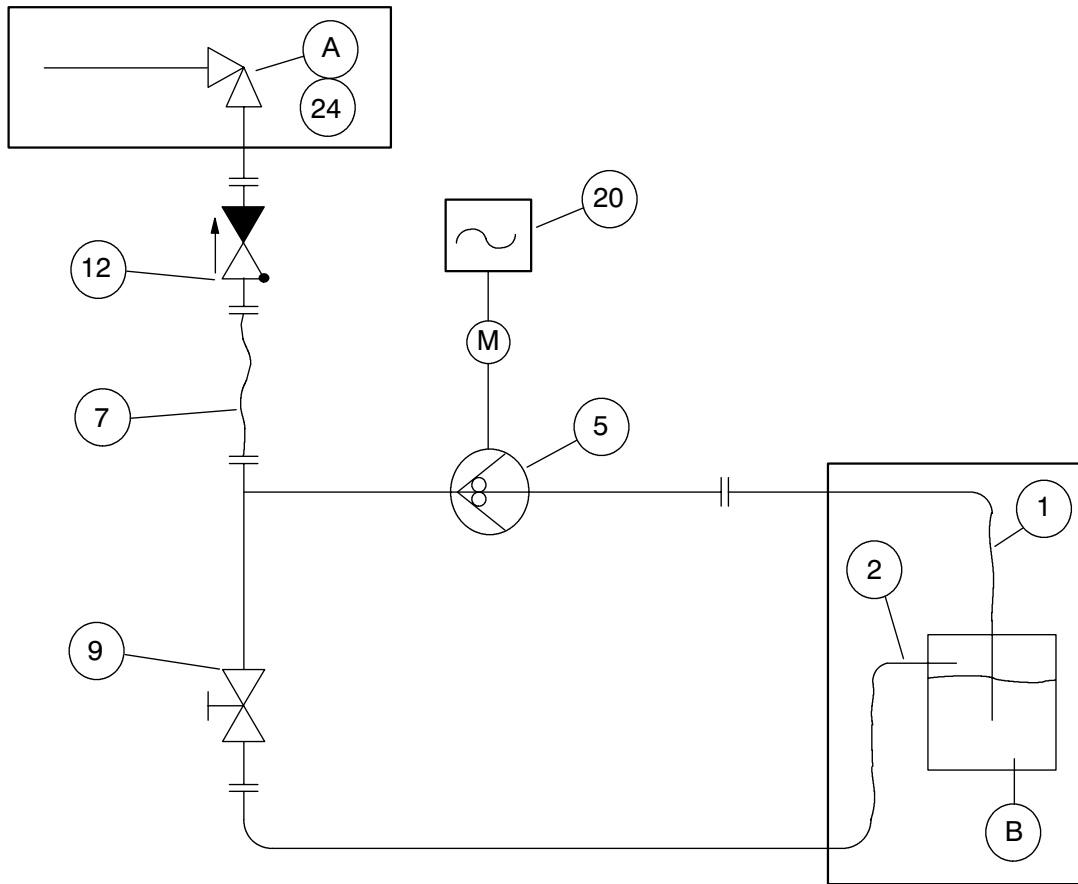




Table 3 Oil charge (oil level at the middle of upper sight glass during operation)

Oil cooler type	Litres	Oil separator Litres	Compr. pipes Litres	Total, unit Litres
	SAB 202	SAB 202	SAB 202	SAB 202
OOSI 1614	11	180	25	216
OOSI 2114	20			225
OOSI 2714	31			236
OOSI 3214	48			253
OOSI 4114	86			291
OGRF 1205	4	180	25	209
OGRF 1210	7			212
OGRF 1217	12			217
OGRF 2008	14			219
OGRF 2012	21			226
HLI	0			205

Comment: Be sure always to have approx. 25% extra oil available to refill at first start-up.

Motor lubrication

In connection with electric motors, it is absolutely essential to lubricate the bearings correctly and use the appropriate type of grease.

For correct service, please follow the instructions of the motor manufacturer.

Replacing motor bearings

Please contact Sabroe Refrigeration's service organisation.

Major overhaul of the compressor

Please contact Sabroe Refrigeration's service organisation.



Final disposal

Safety precautions



Before dismantling the plant, read the safety precautions carefully. Failure to do so may result in personal injury or even death.

Dismantling a cooling unit to be scrapped must be carried out safely.

Authorised refrigeration personnel must participate in the first part of the dismantling process as fundamental knowledge of refrigeration systems and the risks involved is required.

Before dismantling the plant, refrigerant and oil must be drained into suitable containers. Disconnect all electrical connections to the unit and remove fuses in the main switchboard.

During the dismantling process, the individual machine parts and components must be sorted to ensure proper disposal.



Be very careful when using cutting tools such as angle grinders or flame cutters during the dismantling process as pipes and the like contain oil residue which may ignite. Refrigerant residue also involves a great risk as HFC and HCFC refrigerants develop toxic gasses when heated. Make sure that there are no air traps as heating results in a pressure rise.

Disposal of machine parts

When dismantling the plant, it is important to sort the parts to be disposed of. Compressor, frame, containers, etc. belonging to the category of iron and metal scrap must be brought to an approved scrap dealer who complies with the prevailing national rules and regulations.

Disposal of oil and refrigerant

Oil and refrigerant must be brought to a receiving station for hazardous waste for destruction or regeneration. This also applies to used oil filters. The receiving station must comply with the prevailing national rules and regulations.

Disposal of electrical components

Electrical and electronic products, e.g. wiring, panels, hardware, etc. must be brought to a receiving station approved to handle electronic waste. The receiving station must comply with the prevailing national rules and regulations.

Disposal of batteries

Used batteries from e.g. the backup of the computer control must be brought to a receiving station for destruction. The receiving station must comply with the prevailing national rules and regulations.

Appendices

All relevant instructions for products supplied by sub-suppliers are collected here.

References to instructions

The instructions from Sabroe Refrigeration and sub-suppliers must as far as possible be copied from the original instructions; firstly, to avoid errors and secondly, to avoid losing the right to claim damages.



Index

A	Appendices	36
C	Caution	
	Texts marked with Caution	13
	Charging of Oil	32
	Charging of oil	31
	Compressor name plate	8
D	Danger	
	Texts marked with Danger	13
E	Emergency stop	12
F	Final disposal	35
	Fuses and their position	21
H	High voltage	15
	Hot and cold surfaces	19
M	Maintenance instructions	27
	Maintenance safety	15
O	Oil Charge	33
	Operating instructions	19
	Operator's panel	21
P	Personal safety	14
	Pressure	19
S	Safety at servicing	12
	Safety instructions	
	High voltage	15
	Maintenance safety	15
	Personal safety	14
	Tool safety	14
	Work area Safety	14

Safety precautions	14
Screw compressors	18
Sign	
CAUTION	10
Cold surfaces	11
Dangerous noise level	11
Hazardous substance	11
HIGH VOLTAGE	10
Internal overpressure	11
Internal protection	11
Temperature of tangible surfaces	11
Signs in instructions	10
Starting	21
Stopping routine	26
T Tables for noise data	18
Tool safety	14
U Unit pipe system name plate	7
V Ventilation	19
Vessel name plate	9
W Warning	
Texts marked with Warning	13
Warnings in instructions	13
Work area safety	14