# L-SERIES FRAME 6
# BASE MOUNTED COMPRESSOR

## Original User and Service Manual


**MODELS**:

L160-290C

215, 270, 335, 400 HP

LRS160-290C

160, 200, 250, 290 kW

13-25-640
Version 00
November 12, 2020

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# 1 FOREWORD

Gardner Denver screw compressors are the result of many years of research and development. This background and a high-quality standard ensure that the screw compressors we manufacture have long service lives with higher reliability and economic operation. Naturally, we also ensure that strict environmental protection requirements are met.

## 1.1 About these Operating Instructions

These operating instructions are written for operating and maintenance personnel.

These operating instructions are part of the compressor and must be stored near the compressor such that they are available at all the times.

These operating instructions contain all of the documentation required for safe operation and maintenance of the compressor. These include:

- Installing and connecting the compressor Commissioning and operating the compressor
- Replacing wear parts and consumable materials, such as filters and oil
- Identifying faults and clearing system malfunctions
- Performing regular visual inspections for damage
- Cleaning, maintenance, and repair of the compressor

The dealer's or manufacturer's shop, with its qualified and experienced personnel, is responsible for all repair work that exceeds typical maintenance and requires specialized technical knowledge.
All pressure values in these operating instructions are gage pressures (positive pressure).

**Target groups**

The target groups for these operating instructions are the operators, maintenance personnel, and electrical technicians.

After training, the **operator** is permitted to start up and shut down the compressor and activate the emergency-stop.

**Maintenance personnel** may, in conjunction with the information in these operating instructions, maintain the compressor, repair it, start it up and shut it down and activate the emergency-stop.

**Electricians** may electrically install the compressor, carry out direction of rotation checks and carry out electrical maintenance work.

**Safety requirements**

In addition to all the other information in these operating instructions, the general safety instructions in the Chapter “Safety Requirements” must absolutely be read.

## 1.2 Notes

**General notes**

The operating instructions must be read and applied by any person assigned to work with and on the compressor.

Regardless of these operating instructions, the laws, regulations, directives, and standards in force in the installed location and the country of use must be followed.

**Training**

Operator training at site is performed by authorized service technicians. These operating instructions serve as training documents, along with the repair instructions, which are provided only in conjunction with service training.

These measures ensure that the assigned work can be completed reliably.

**Guarantee**

Gardner Denver is not liable for the functional safety of the compressor if any actions are taken that are contrary to the intended use, or if used for any other purpose than those listed in the operating instructions.

Gardner Denver refuses any guarantee or liability for cases of:

- Operating errors.
- Use of the compressor other than as intended.
- Damages resulting from foreseeable misuse or failure to follow the operating instructions.
- Damages or injuries caused by third party components.
- Use of replacement or wear parts or consumable materials that are not provided or recommended by Gardner Denver.
- Inadequate maintenance. Modifications to the compressor.

The guarantee and liability conditions of the general terms and conditions of Gardner Denver are not expanded by the notes above.

**Warranty**

Conditions and exclusions to the warranty by Gardner Denver are indicated in our general terms and conditions, which were provided with the compressor. The document can also be sent again upon request.

**Copyright**



**Resale**

If the compressor is resold, these operating instructions must be provided to the new operator along with the compressor. If necessary, the operating instructions must be reordered from Gardner Denver by providing the order confirmation number. The compressor may not be resold without these operating instructions in any case.

## 1.3 Intended Use

The compressor uses the best available technology and meets applicable safety requirements at the time of sale, in the context of correct usage.

The design cannot prevent foreseeable misuse, nor all other residual risks, without limiting the functionality of correct usage.

The compressor is designed for the compression of atmospheric air (compressed air for driving pressure equipment). The compressor is not suitable for the compression of other gases.

The compressor is considered to be used correctly if the following points are also covered:

- The compressor is used in accordance with these operating instructions.
- The operator’s work procedures and operating instructions are followed.

Any other use, or use exceeding these limits, is considered to be improper. The manufacturer is not liable for any resulting damages. The user alone bears the entire risk.

Correct usage also includes following the operating instructions and complying with the inspection and maintenance instructions.

**Other provisions**

The use of the compressor can cause hazards to life and limb of the user or third parties, or damage to the compressor or other property, if the compressor:

- Is not used properly.
- Is operated by untrained personnel. Is modified or altered.
- The safety instructions are not followed.

The following apply in addition to these operating instructions:

- Applicable accident prevention regulations. Generally recognized safety rules.
- Country-specific regulations.

**Installation Site / Altitude**

The compressor is intended to be installed in a suitable compressor room.
**The compressor is not suitable for outdoor installation.**
Depending on the operating pressure, ambient humidity, and ambient temperature at which the compressor is operated, the permissible altitude of the installation site is limited. The permissible site altitude is determined by Gardner Denver for each individual case in consultation with the customer.

**Pressure equipment**

A pressure safeguard (pressure relief or the like) that conforms to the applicable specifications must be provided for the pressure equipment and systems installed in the compressed air supply network, considering the weakest pressurized component.

**Work environment**

The lighting intensity in the area of the compressor must be ≥ 200 lx in normal operation.
The lighting intensity must be ≥ 500 lx for inspection and maintenance work.
The ambient temperature for operation: See “Technical data”.

## 1.4 Foreseeable Misuse

**Incorrect usage and abuse**

The following rationally foreseeable applications (incorrect usage) do not comply with the intended use:

- Compressing gases other than atmospheric air.
- Operation outside of the permissible operating limits, even if exceeded for only a short time, or if not immediately detectable.
- Operation outside of the permissible ambient temperatures.
- Intake of non-atmospheric air (over pressure or under pressure).
- Use as a respiratory air compressor. Manipulation of sensor signals.
- Changing signals from sensors.
- Operation without protective and safety devices.
- Operation with defective, deactivated, or manipulated protective and safety devices, or safety values, or operation with other safety-related defects.
- Use by private users or users without technical training.
- Operation outside of industrial premises.
- Failure to comply with maintenance intervals.
- Failure to perform maintenance and repairs.
- Incorrectly executed maintenance and repairs.

**Limitations on use**

Operation of the compressor is not permitted:

- Outside of the permissible ambient temperatures.
- Above the permissible elevation of the installation site.
- On a foundation that does not have sufficient load capacity.
- In areas with explosive atmosphere.

## 1.5 Service

In case of questions or problems with compressor, consult your Gardner Denver representative. Trained technicians provide fast, technically accurate assistance.

### For questions

In case of questions or spare parts orders, please provide the model, identification, and year built, as indicated on the model rating plate. Providing these data ensures that you will receive the correct information or spare parts.

### Your Gardner Denver representative

Use the following table to record data about your local Gardner Denver representative.

| | |
|---|---|
| **Name:** | |
| **Contact person:** | |
| **Address:** | |
| | |
| **Telephone** | |
| **Fax** | |
| **Email:** | |

Table 1 Local Gardner Denver Representative

## 1.6 Rating Plate

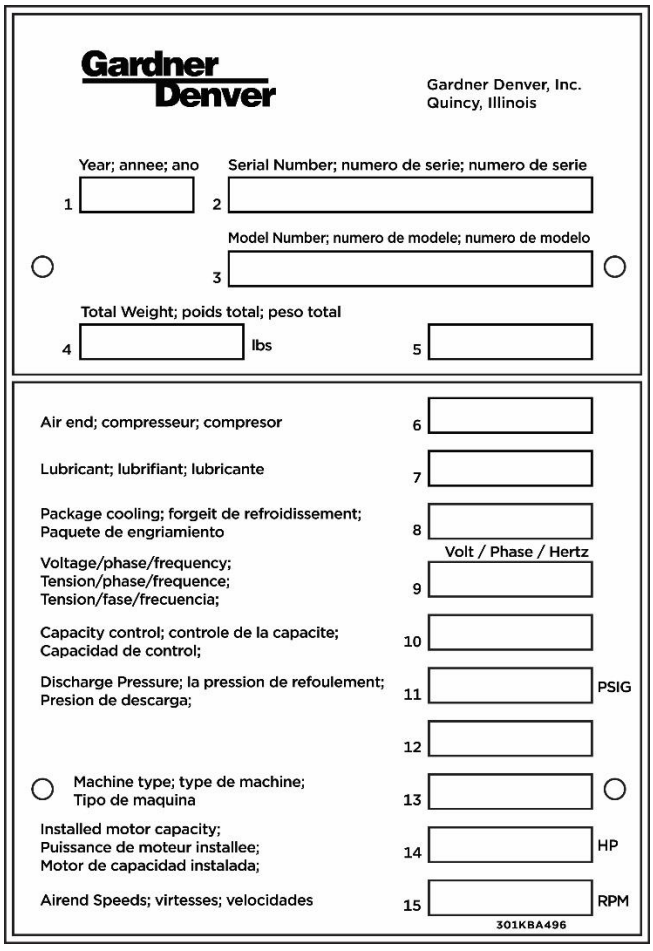



Figure 1-1 Rating Plate

# 2 SAFETY REQUIREMENTS

Every person involved with the operation, maintenance, and repair of the compressor must read and follow the safety requirements.

Gardner Denver accepts no responsibility for material damage or injuries that arise from non- observation of safety conditions or the failure to observe normal levels of care and attention, even where this is not expressly stated in these operating instructions.

## 2.1 General Safety Instructions

**Organizational measures**

The following organizational measures support the safe operation of the compressor:

- Only assigned personnel may work on the compressor. Personnel are trained and instructed on the compressor.
- Personnel must have read the operating instructions and particularly the Chapter “Safety Requirements”. During the assignment is too late. This applies in particular to personnel who are in action only occasionally, such as for maintenance.
- The responsibilities of personnel for operation, maintenance, and repair must be clearly defined.
- Personnel should be checked regular to ensure they are conscious of safety and hazards when working.
- Personnel in training, under instruction, being taught, or taking part in a general training program may work with the compressor only under the continuous supervision of an authorized person.
- For safety-related changes to the compressor or its operating behavior, the compressor must be stopped immediately and the fault must be reported to the responsible area or person.
- Faults, especially those that can compromise safety, must be corrected immediately.
- Otherwise the compressor must not be operated.
- All hazard warning signs on and near the compressor must be checked regularly for completeness and legibility. Missing hazard warning signs must be replaced immediately.
- The time frames from tests and inspections must be adhered to.
- The operating instructions must be updated to include instructions for supervisory or reporting obligations in reaction to special operating conditions, such as with respect to work organization, process flows, responsibilities, etc.

## 2.2 Warnings about Special Types of Hazard

**Electricity**

| ⚠ DANGER | |
|---|---|
|  | **Electric shock**<br>Deadly electrical voltage<br>➢ Exercise extreme caution when working with electrical equipment.<br>➢ Before starting maintenance work, disconnect the compressor and lock it out to prevent restarting. |

For all work on the compressor’s electrical equipment, the 5 safety rules for working on electrical systems must be followed.

The following instructions must also be followed:

- Work on the electrical equipment of the compressor may be done only by an electrician in accordance with electrical rules.
- The electrical equipment of the compressor must be inspected regularly. Defects, such as loose connections or scorched cables, must be corrected immediately.
- Only original fuses with the specified current rating may be used.

**Only for units with Variable Frequency Drives:**

Due to residual voltage in the capacitors, the electrical enclosure must not be opened until at least 10 minutes after disconnecting (main disconnect switch OFF). Follow the hazard warning sign on the electrical enclosure! See the “safety symbols” table.

**Noise**

The sound pressure level without the sound-proofing enclosure is approx. 95 dB(A). Remaining for long periods alongside the compressor without its sound-proofing enclosure can result in irreversible hearing impairment.

Only operate the compressor without the sound- proofing enclosure during test runs. Wear personal hearing protection.

The sound pressure level with sound-dampening enclosure is about: (See "Technical data".)
During normal operation the compressor may only be operated with a closed acoustic hood.

**Oil, Grease, and other chemical substances**

Follow the applicable safety requirements when handling oils, greases, and other chemical substances.

Use caution when handling hot materials, as there is a risk of burning or scalding.

| DANGER | |
|---|---|
|  | **Explosion hazard**<br>The compressor is not designed for operation in explosion hazard areas.<br>Operation of the compressor in explosion hazard areas is not permitted! |

## 2.3 Protective and Safety Devices

The compressor is equipped with the following protective and safety equipment.

Prior to commissioning, particularly after maintenance and repair work, all protective and safety devices must be installed and checked for proper function.

In addition, the inspection intervals required in the country of use must be complied with.

| NOTICE |
|---|
| Operation of the compressor is permitted only with complete, functional protective and safety devices in place. |

**Emergency Stop**

The emergency stop button can be used to bring the compressor to a safe condition in dangerous situations.

Emergency stop buttons are mounted:

- On the control panel of the compressor.
- Optional in a pedestal (control console).

**Using the Emergency Stop**

1. Press the <Emergency stop> pushbutton. The compressor is placed in a safe condition.
2. Rectify the fault that was the cause of the emergency-stop. See the "Troubleshooting" chapter.
3. Unlock <Emergency-Stop> button. Turn the pushbutton counter-clockwise.
4. Start up the compressor. See section "Commissioning after a fault" in the chapter "Commissioning and operation".

**Pressure Relief Valve / Check valve**

The compressor is protected from exceeding the permissible operating pressure by a pressure relief valve. The pressure relief valve opens at 15 bar / 218 psi.

The compressor is protected against backpressure from the compressed air network by means of a check valve on the pressure side.

**Protective covers and enclosure panels**

The cooling air fans are covered with protective mesh.

The coupling between the drive and the compressor is protected by a mesh guard.

The housing of the compressor is designed so that any broken parts that may be thrown off are retained within the compressor.

The compressor housing serves as a sound protection cover.

## 2.4 Residual Risks

**Hot surfaces**

Some parts of the compressor become hot in operation (up to 120°C / 248°F). A hazard warning sign on the compressor enclosure warns of this danger.

Before beginning maintenance and repair work, the compressor must have cooled off sufficiently.

**Personal protective equipment**

We recommend wearing the following personal protective equipment:

- Safety shoes
- Safety glasses whenever working with compressed air and open enclosure
- Hearing protection when the sound protection cover is open

## 2.5 Labeling of Safety Instructions

Safety instructions are used as special warning notices in the operating instructions, using the following names and symbols.

These special warning notices serve to protect against hazards and are close to the potential hazard in space and time:

- On the system, near the source of hazard
- In the operating instructions, before a sequence of actions or activities to be performed is described

**Structure of safety instructions**

The special warning notices in the operating instructions are structured as follows:

| ALERT WORD | |
|---|---|
| Safety symbol | **Hazard (consequences of hazard)**<br>Description of the hazard (source)<br>Protective measure (protection against hazard) |

**Components of safety instructions**

**Hazard (consequences of hazard)**: The hazard sequence tells the type of hazard.

**Description of the hazard (hazard source)**: The hazard source indicates the cause of the hazard.

**Protective measure (protection against hazard)**: The protection against the hazard describes the measures for preventing the hazard.

**Alert word**: The alert word classifies the severity of the hazard into four levels, emphasized graphically with different colors. The alert word is used in the safety instructions as described below.

**DANGER** Indicates an immediate dangerous situation that, if not prevented, will result in death or extreme (irreversible) injury.

**WARNING** Indicates a potential dangerous situation that, if not prevented, can result in death or extreme (irreversible) injury.

**CAUTION** Indicates a potential dangerous situation that, if not prevented, can result in slight or minor (reversible) injury.

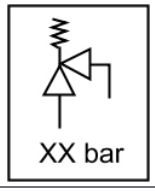
**CAUTION** Indicates information or recommendations that directly or indirectly relate to the safety of persons or equipment protection.

## 2.6 Safety Symbols

The safety symbols (hazard warning signs) can be used in the operating instructions and in the environment around the compressor.

| Safety Symbol | Meaning | Application / Behavior |
|---|---|---|
|  | General hazard | Warning of a general hazard.<br>Follow the warning and proceed with the required caution (e.g., protective clothing) and care. |
|  | Slip hazard | Warning of a slip hazard.<br>Use caution when walking, stepping, or climbing. |
|  | Component or system under pressure | Labeling of devices or areas in which the air pressure is substantially higher than in the normal atmosphere.<br>Do not open devices or chambers until the pressure has been equalized. |
|  | Do not operate with open doors or loose clothing. | It is not permitted to run the compressor with open doors or loose clothing, except for test runs. High sound pressure level, risk of injury!<br>Normal operation requires the enclosure to be closed. |
|  | Do not breathe in the compressed air from this unit | It is not permitted to use the compressed air produced by this compressor for breathing. Indrawn materials can be dangerous to health.<br>Do not use compressed air as breathing air. |
|  | Electrical voltage | Warning against dangerous electrical voltage.<br>Work on the electrical equipment of the compressor may be done only by an electrician in accordance with electrical rules. |
|  | System continues to run | The compressor continues to run for at least 30 second after the stop button is pressed.<br>Do not open the compressor enclosure until the compressor has stopped. |
|  | Read and follow the instructions for use | Before the machine is operated, the user (operator) must have read and understood the instructions for use (manufacturer's instructions for use).<br>Labeling of instructions to the user that additional information can be found in the (manufacturer's) operating instructions. |
|  | Bacterial contamination hazard | Warning of the presence of Legionella in the cooling water in an open-loop cooling water circuit<br>Continuous monitoring of the cooling water by maintenance personnel. |
|  | Caution: hot liquid | Warning of hot oil or hot coolant.<br>Allow the compressor to cool before opening the fluid circuit lines. |

| Safety Symbol | Meaning | Application / Behavior |
|---|---|---|
|  | Secure against being switched on again | Secure against being switched back on again during electrical work<br>Secure against being switched back on again when working on rotating parts<br>Secure against being switched back on again during repair work |
|  | Use hearing protection | Label for areas with elevated sound pressure level. Enter the area only with suitable hearing protection. |
|  | Warning about industrial trucks | Warning of industrial trucks traveling within the plant (e.g., forklifts) when transporting.<br>Do not perform any work in traffic lanes with limited visibility that are not secured or blocked off. Use or crossing of this traffic lane requires great caution. |
|  | Warning of suspended loads | Warning of suspended loads during transport.<br>During transport, no persons may be present in the hazard area. In particular, do not reach in or allow the feet to pass beneath the suspended compressor. |
|  | Warning of moving machine parts. | When performing maintenance work, it is necessary to check some functions with the enclosure open. Injury hazard due to rotational or translational motion.<br>Maintenance work may be performed only by specially trained technicians. |
|  | Warning against hand injuries | Hazard that the hands may be crushed, drawn in, or otherwise injured.<br>Keep clear. |
|  | Warning of automatic start | In normal operation the compressor can start automatically at any time. Operational readiness of the compressor is indicated by the green Enabled icons on the control panel.<br>Do not perform any work on the compressor when the green Enable icon is lit. |
|  | Warning of hot surfaces | Parts of the compressor become very hot when in operation (up to 235°C / 455°F). Risk of injury from hot surfaces.<br>Before beginning maintenance and repair work, the compressor must have cooled off sufficiently. |
|  | Suffocation warning | Suffocation hazard due to insufficient ventilation and exhaust of the compressor space.<br>The operator must provide sufficient ventilation and exhaust of the compressor room. |

| Safety Symbol | Meaning | Application / Behavior |
|---|---|---|
|  | Warning of a crushing hazard | Warning of crush hazards on a piece of equipment (e.g., a machine) or structural components (e.g., covers, enclosures, guards, fences) during transport.<br>Working at the labeled workstations requires increased vigilance. |
|  | Do not go beneath the load | Do not go beneath a suspended load. The driver is not allowed to drive the industrial truck if a person is located beneath the load. The driver must also make sure that no one stands or walks under the load.<br>The load must be transported so that it is sufficiently clear of the ground (max. 20 in above the ground). The driver is responsible for all travel and load movements of an industrial truck. |
|  | Lifting point | Labeling of lifting points.<br>Only the labeled lifting points may be used for transport. |
|  | Pressure relief valve | Opening pressure of the pressure relief valve (for value “xx” see the sticker on the control panel). |
|  | Check connection terminals and retighten if needed. For additional instructions, see the operating instructions. | Warning of loosened clamp connections. Clamping pressure can fade after some time.<br>Check the clamps regularly according to the safety guidelines and tighten as needed. |
|  | Electrical voltage<br>Residual voltage on the capacitors | Warning against dangerous electrical voltage.<br>Warning of stored energy in the form of capacitors. They carry deadly electrical voltage.<br>Do not open the electrical switch cabinet (compressors with variable speed drives) for 10 minutes after disconnecting the compressor.<br>Work on the electrical equipment of the compressor may be done only by an electrician in accordance with electrical rules.<br>Check the DC bus voltage at the system terminal strip of the frequency converter by measuring this between the +DC and -DC terminals (the exact position can be found in the supplied operating manual of the frequency converter), between the +DC terminal and the chassis as well as between the -DC terminal and the chassis.<br>The voltage must read zero in the case of all three measurements. |
|  | Spring tension | Warning of springs under tension in the interior of the intake regulator.<br>Before opening the intake regulator, read the repair manual. |

| NOTICE |
|---|
| All hazard warning signs must be present and in legible condition.<br>Check regularly and replace when needed. |

## 2.7 Transport and Installation

**Transport**

A suitable forklift with sufficiently long forks must be used to transport the compressor. Dependent on type, the compressor weighs up to 4,700 kg / 10,362 lbs.

Insert the forks only at the lifting points provided.

The compressor, even in its packed state, may not be transported by crane.

During transport, no person may be present in the hazard area. In particular, do not reach in or allow the feet to pass beneath the suspended compressor.

**Installation / Installation site**

The compressor must be installed with full contact on a foundation with sufficient structural strength.

The installation site (compressor room) must be sized so that the compressor is sufficiently accessible and the required cooling is ensured.

No flammable or explosive materials may be stored near the compressor.

## 2.8 Normal Operation

The compressor may be used only if it is in a technically pristine state, and it must be used as intended, with awareness of safety and hazards, by following the operating instructions.

Operate the compressor only if all protective and safety devices, sound dampeners, ventilation and exhaust devices, and cooling water supply (for water-cooled compressors only) are present and functional.

Check regularly that:

- All hoses and pipelines are in good condition and securely attached.
- There are no leaks (oil, coolant, or cooling water).
- The electrical connection lines are in good condition.
- Cooling water supply is provided (for water-cooled compressors only).

Behavioral rules for using compressed air.

- Do not use any method that involves questionable safety.
- Never play around with compressed air.
- Never direct compressed air at the skin or at other person.
- Never use compressed air to clean clothing.
- When using compressed air to clean equipment, use great care and also wear safety glasses as eye protection.

**Safety measures**

Operate the compressor only when the enclosure is closed.

Check the compressor at least once per shift for externally visible damage and defects. Report any changes (including to the operating performance) to the responsible location or person immediately.

Stop and secure the compressor immediately, if needed. Have faults repaired immediately.

Do not switch off or remove the exhaust and vacuum devices when the compressor is running.

**Remote control**

If there is a remote control, the compressor must bear a clearly visible sign with the following inscription: “Caution! The compressor is remotely controlled and could start without warning.”

In addition, safety precautions must be taken to ensure that no one is working on the compressor when it is remotely controlled.

## 2.9 Special Work

### Organizational

The maintenance work and intervals are specified in the operating manual, including information about replacing parts/partial equipment.

Maintenance and repair work may be performed only under supervision, or by a person qualified for this work.

Secure an ample working area, if needed.

Workshop equipment suitable for the work is absolutely required to perform maintenance and repair work.

### Safety measures

Personnel must not wear open, long hair, loose clothing, or jewelry, including rings. When the compressor is running, there is an injury hazard, such as due to jamming or drawing in. If needed or required by regulations, use personal protective equipment!

Perform only those maintenance and repair works for which you have sufficient training and where you feel comfortably sure of your ability.

Do not use machine parts as climbing aids. For maintenance work at greater heights, use fall protection.

### Maintenance / Fault Clearing

Perform any maintenance and repair work only when the compressor is switched off and the power grid supply is disconnected. Secure the compressor against being turned on accidentally.

Before opening the compressor enclosure:

- Allow the compressor to come to a stop.
- Wait for automatic pressure relief.
- Wait until the residual energy from the capacitors has dissipated.
- Cool the compressor down to room temperature.

### Cleanliness

Always pay attention to cleanliness during maintenance and repair work. Keep dirt away by covering parts and exposed openings with a clean cloth, paper, or tape.

Oil loss causes the floor to be slippery. Clean the work area thoroughly after completing the maintenance and repair work.

### Cleaning agents

Never use solvents or cleaning agents that can corrode the materials to clean the parts.

Take preventive action against vapors of solvents or cleaning agents that are hazardous to health.

### Weight / Lifting Gear

Carefully attach and secure heavy individual components and assemblies when replacing, so that they do not present a hazard. Use only suitable lifting gear that is in technically perfect condition, and a load handling device with sufficient load capacity. Do not stand or work beneath suspended loads.

### Spare parts

Use only original spare parts.

Spare parts must comply with the technical requirements stipulated by the manufacturer. This is guaranteed only when original spare parts are used.

### After completing maintenance and repair work

After maintenance and repair work is completed, ensure that no tools, loose parts, or rags have been left behind in the compressor (particularly in the drive motor or the drivetrain).

Rotate the drive several times in order to make sure that there is no mechanical fault in the compressor or the drivetrain.

Tighten all bolt connections that were loosened for the maintenance and repair work. Also check all the other bolt connections.

Before releasing the compressor for operation after maintenance and repair work, ensure that the operating pressures, temperatures, and time settings are correct, and that the control and shutoff device work perfectly.

If safety or protective devices must be removed, then they must be re-installed and checked for perfect function immediately after completing the work.

### 2.10 Modifications and Changes to the Machine

Do not make any modifications, additions, or reconfigurations of the compressor without prior consultation with Gardner Denver.

Unauthorized changes to the machine are not allowed for safety reasons.

Original parts are specially designed for the machine. We explicitly give notice that parts and special equipment not provided by Gardner Denver are also not approved by Gardner Denver. The installation and/or use of such products can therefore degrade active and/or passive safety.

Damage arising from the use of non-original parts or special equipment precludes the liability of the manufacturer. This also applies to the installation and adjustment of safety devices and valves, and for the welding of load-bearing or pressurized parts.

## 3 DESIGN AND FUNCTION

### 3.1 General Description

The compressor is an oil-lubricated, compressing, single-stage rotary screw compressor with one sound-proofed enclosure.

The main components are the drive motor, the compressor stage, the oil circuit and the electronic control.

Oil is injected into the compressor stage for lubrication, sealing and cooling.

The rolling bearings and gearbox are lubricated with oil.

**Principle of compression**

The compressor stages consist of a main rotor and a secondary rotor with spiral teeth that mesh with each other. Compression chambers bounded by the flanks of the teeth and by the compressor housing are formed. By rotating the rotors, the volume of the chambers is continuously reduced, until the compressed air is forced out the outlet port of the staged housing. Screw compressors are rotary forced displacement compressors, with no oscillating mass but with pulsating output.

**Electronic controls**

The main components of the electronic control system are the Touchscreen Display and panel mounted I/O Module.

A detailed description of the controller operation can be found in the controller manual provided with the package.

## 3.2 Construction of the Compressor

### Air Cooled

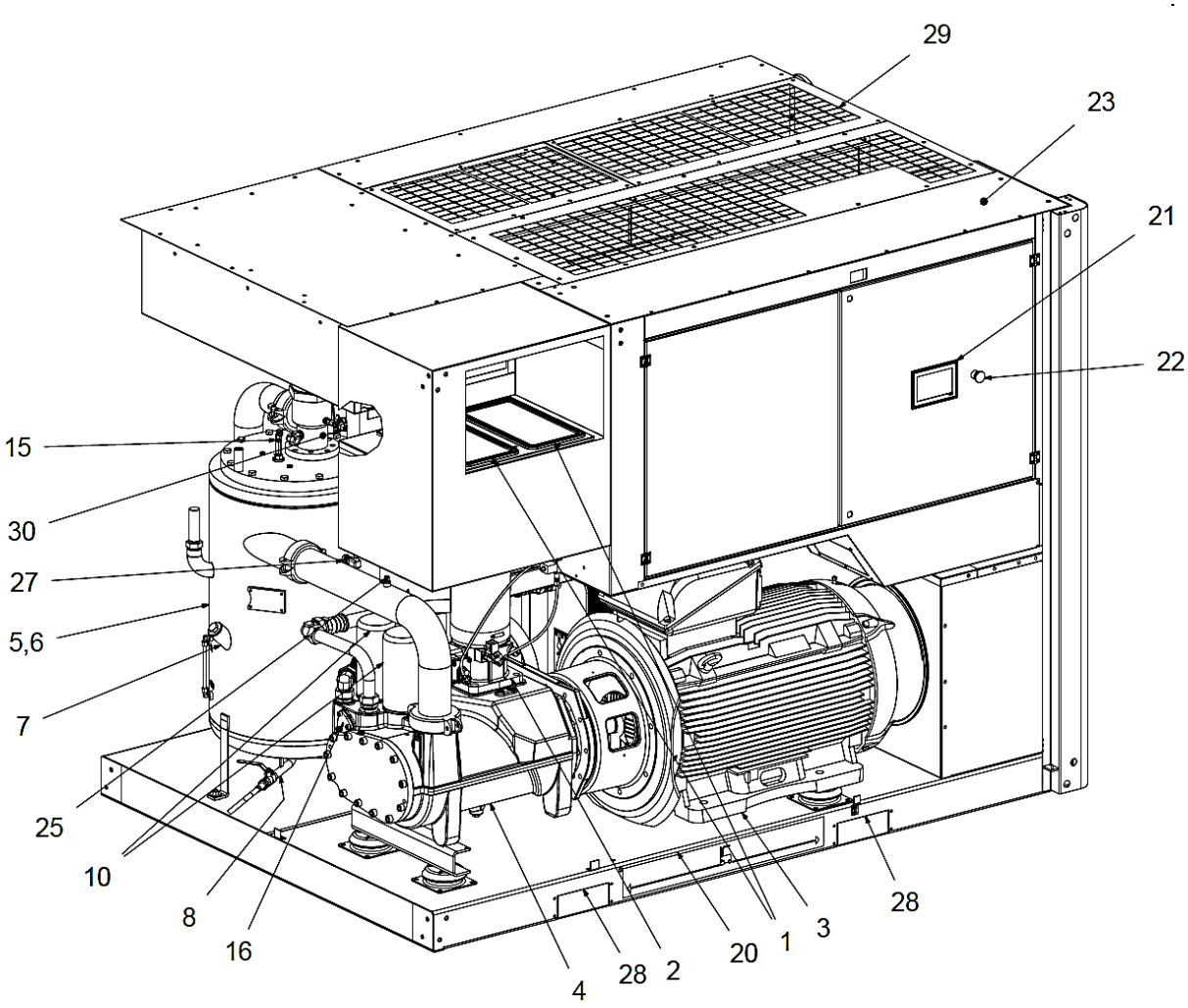



Figure 3-1 Air Cooled

1. Intake Filter
2. Suction Regulator
3. Electric Motor
4. Screw Compressor
5. Oil Reservoir
6. Fine Oil Separator
7. Oil Fill
8. Oil Drain
10. Oil Filter
15. Fine Oil Separator Extraction
16. Oil Temperature Regulator
20. Base Frame
21. Control Panel
22. Emergency Stop Button
23. Switch Cabinet
25. Final Compression Pressure Sensor
27. System Pressure Sensor
28. Fork Lift opening
29. Fan Guard
30. Pressure Relief for Cooler

**Air Cooled**

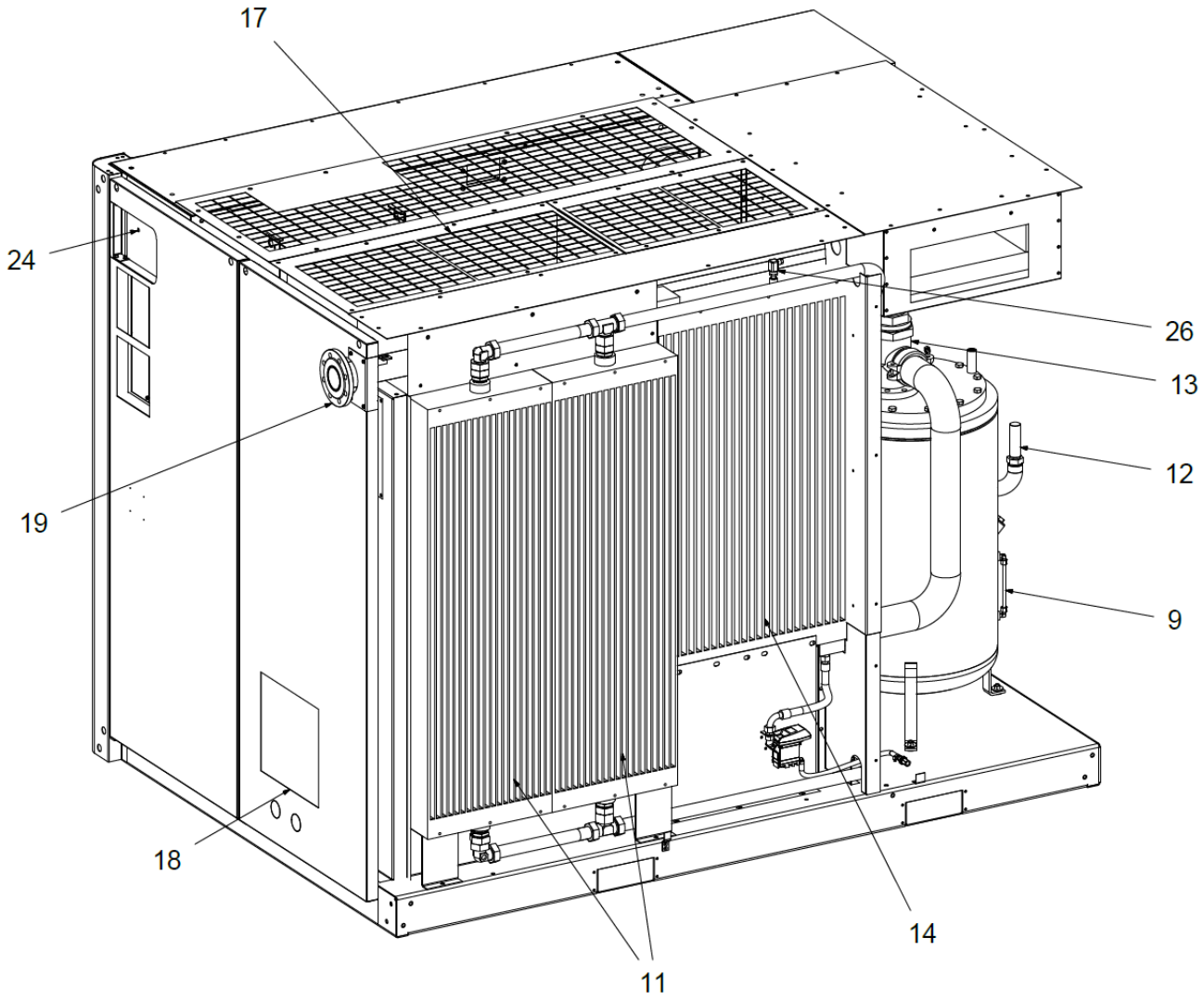



Figure 3-2 Air Cooled

| | | | |
|---|---|---|---|
| 9. | Oil Level Indicator | 17. | Cooling Fan |
| 11. | Oil Cooler | 18. | Cooling Air Inlet Filter Pad |
| 12. | Pressure Relief Valve | 19. | Compressed Air Outlet |
| 13. | Minimum Pressure and Non Return Valve | 24. | Cable Entry |
| 14. | Air Cooler | 26. | System Pressure Sensor |

**Water Cooled**

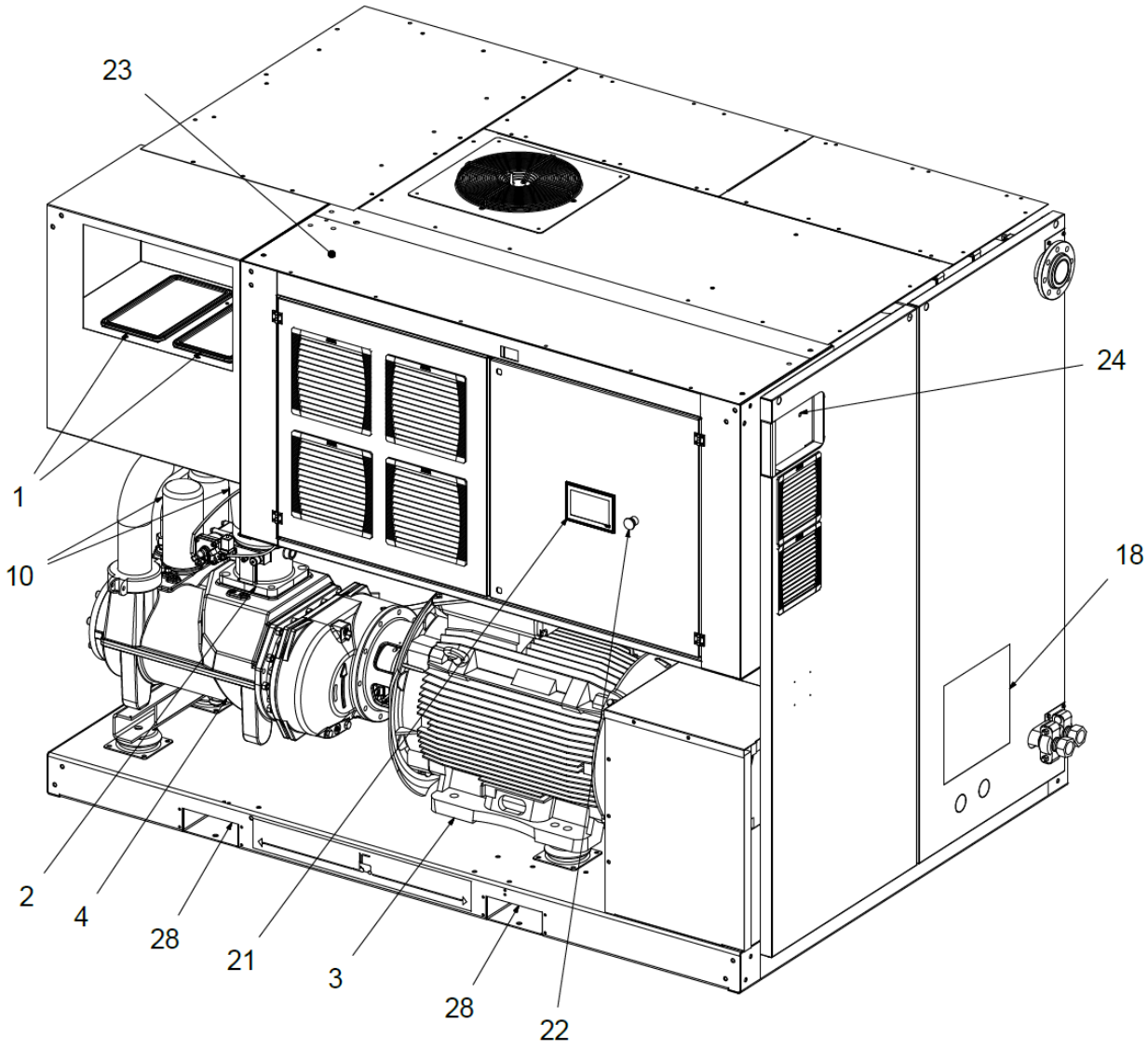



Figure 3-3 Water Cooled

1. Intake Filter
2. Suction Regulator
3. Electric Motor
4. Screw Compressor
10. Oil Filter
18. Cooling Air Inlet Filter Pad
21. Control Panel
22. Emergency Stop Button
23. Switch Cabinet
24. Cable Entry
28. Fork Lift opening

## Water Cooled

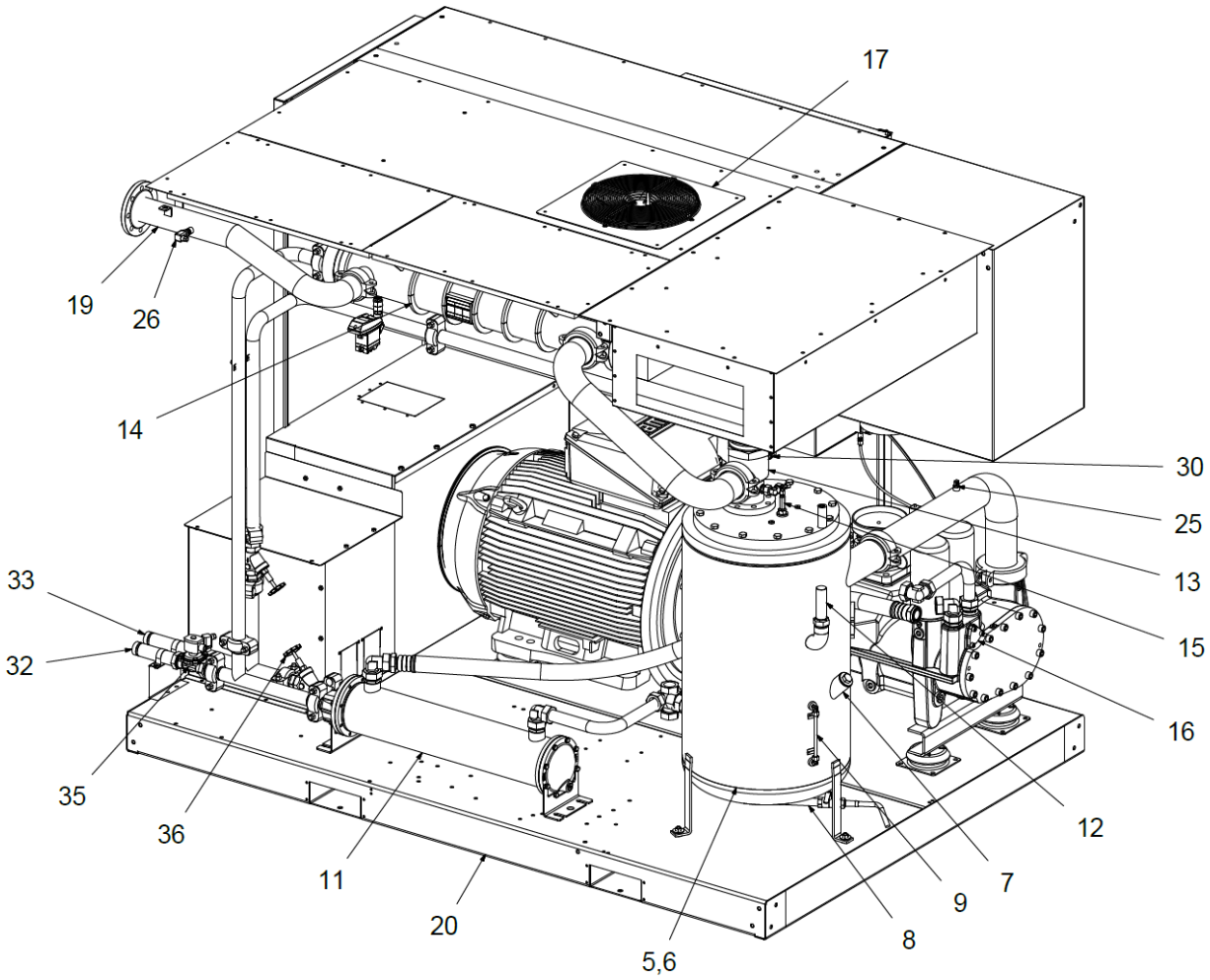



Figure 3-4 Water Cooled

5. Oil Reservoir
6. Fine Oil Separator
7. Oil Fill
8. Oil Drain
9. Oil Level Indicator
11. Oil Cooler
12. Pressure Relief Valve
13. Minimum Pressure and Non Return Valve
14. Air Cooler
15. Fine Oil Separator Extraction
16. Oil Temperature Regulator
17. Cooling Fan
19. Compressed Air outlet
20. Base Frame
25. Final Compression Pressure Sensor
26. System Pressure Sensor
30. Pressure Relief for Cooler
32. Cooling Water Inlet
33. Cooling Water Outlet
35. Cooling Water Solenoid Valve
36. Regulating Valve

## 3.3 System Schematic

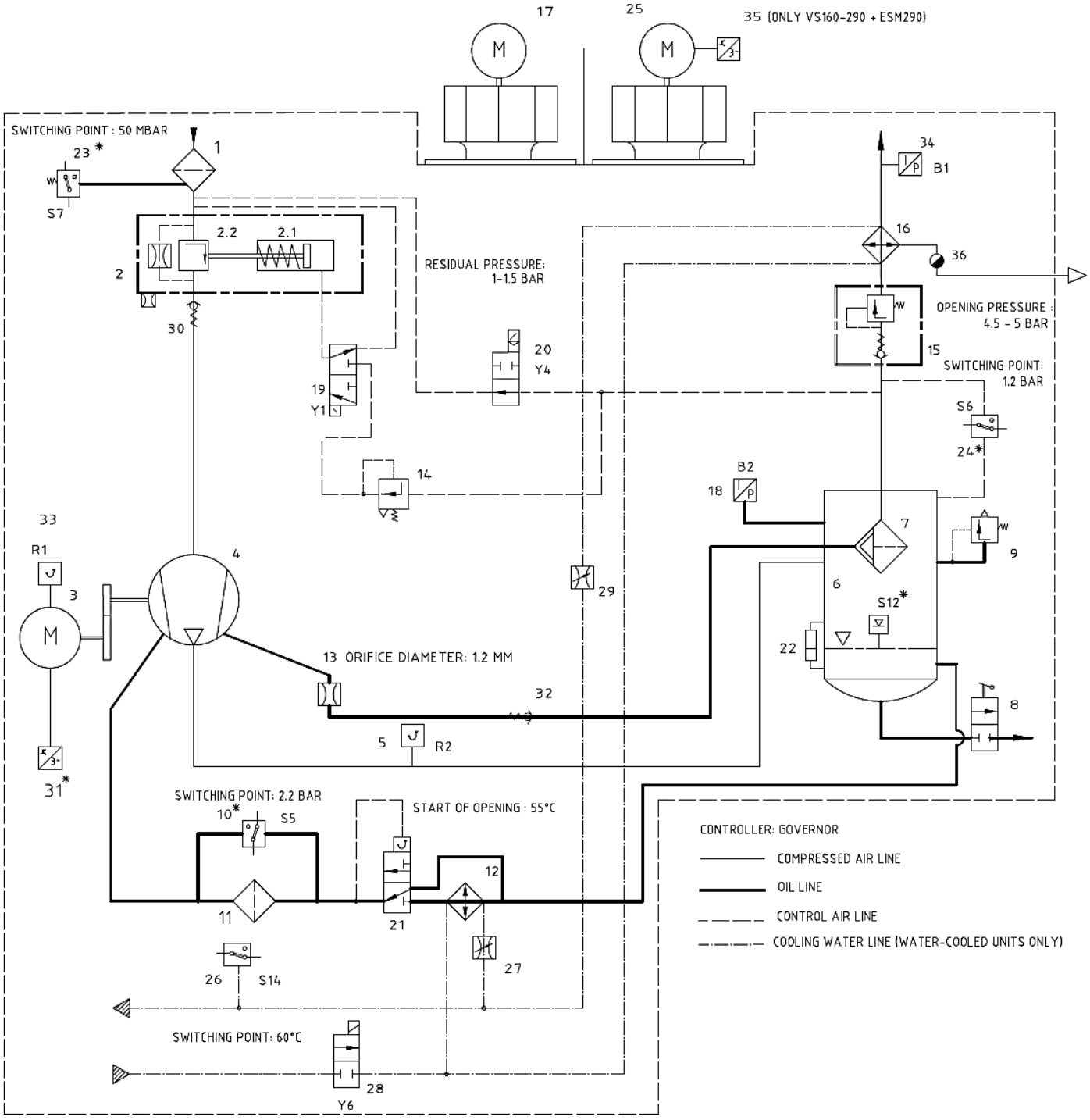



Figure 3-5: System schematic

**System Schematic**

1. Intake Filter
2. Intake Regulator
2.1. Actuator
2.2. Throttle Valve
3. Electric Motor
4. Airend Compressor
5. Final Compression Temperature Sensor (R2)
6. Pressure Reservoir
7. Oil Fine Separator Element
8. Oil Drain Outlet
9. Pressure Relief Valve
10. Oil Filter Monitor (S5)
11. Oil Filter
12. Oil Cooler
13. Throttle
14. Pressure Reducing Valve
15. Minimum Pressure Valve
16. Aftercooler
17. Cooling Air Fan (Aftercooler)
18. Final Compression Pressure Sensor (B2)
19. Solenoid Valve (Y1)
20. Pressure Relief Valve (Y4)
21. Oil Thermostat
22. Oil Level Indicator
23. Intake Filter Monitor (S7) *)
24. Fine Separator Monitor (S6)
25. Cooling Air Fan (Oil Cooler) Speed Regulated *)
26. Cooling Water Temperature Monitor (S14) (Water-Cooled version only)
27. Strainer (Water-Cooled only)
28. Cooling Water Solenoid Valve (Y6) (Water-Cooled only)
29. Throttle, Adjustable (Water-Cooled only)
30. Blow Off Valve
31. Frequency Converter (L160-290RS only)
32. Check Valve
33. Motor Temperature Check (R1)
34. Network Pressure Sensor (B1)
35. Frequency Converter Fan (Oil Cooler)
36. Condensate Drain

*) Option

## 3.4 Oil Circuit

The oil flows from the pressure reservoir (-6-) into the oil thermostat (-21-). With oil temperatures <131°F, the oil flows via the by-pass of the oil cooler directly into the oil filter (-11-) and is then injected into the screw compressor (-4-).

With oil temperatures of between 131°F and 158°F, the oil flow is divided and fed into the oil cooler (-12-) and the by-pass.

With oil temperatures above 158°F, the entire oil flow is directed via the oil cooler through the oil filter into the screw compressor.

The oil separated by the oil separator element (-7-) is fed through an oil scavage line to the screw compressor.

The entire oil circulation is based on a differential pressure in the system. Considering the pressure difference of approx. 29 PSI within the oil circuit, the oil is then injected into the screw compressor with approx. 116 PSI at a reservoir pressure of e.g. 145 PSI.

When the screw compressor is in the off-load mode, a sufficiently high pressure differential and thus the required oil injection quantity is achieved owing to the fact that when the intake regulator (-2-) is closed, a vacuum pressure occurs in the intake connection and at the place of injection.

Excess pressure of approx. 22 PSI (off-load pressure) is produced in the pressure reservoir at the same time.

## 3.5 Air Circuit

The intake air passes through the intake filter (-1-) and the intake regulator (-2-) into the screw compressor (-4-). During the compression process, the intake air is cooled via the injected oil. The developed air/oil mixture flows tangentially into the oil reservoir (-6-). After pre-separation and subsequent fine separation by the oil separator element (-7-), the compressed air with a low oil content is fed via the minimum pressure valve (-15-) and the aftercooler (-16-) into the consumer network.

## 3.6 System Control

(See also operating instructions for the compressor controller)

**Standstill of the system**

- If the plant is shut down, the intake regulator (-2-) is closed by a pressure spring at the actuator (-2.1-).
- The solenoid valve (-19- (Y1)) is de-energized.
- The oil separator vessel is released via pressure relief valve (-9-) to atmospheric pressure.
- The cooling water solenoid valve (-28- (Y6)) is closed in a de-energized state (only water-cooled units**).**

**Starting the system**

- The motor starts up in the Y-mode.
- The cooling water solenoid valve (-28- (Y6)) is supplied with power and opens (only water-cooled units).
- The intake regulator is closed.
- The compressor aspires a certain amount of air through an adjustable throttle valve (bypass valve) (-2.2-). Pressure builds up in the pressure vessel.
- The oil supply of the screw compressor takes place through a drop in pressure between the pressure vessel and the injection spot in the screw compressor.
- If the drive motor is switched over to Δ operation, the solenoid valve (-19-(Y1) switches over, since it is supplied with current.
- The air circulated in the system flows through the solenoid valve (-19- (Y1)) in the upper control area of the actuator (-2.1-). The blow off valve (-30-) is closed. The lower control space of the adjusting cylinder is ventilated.
- The throttle valve (-2.2-) in the intake regulator (-2-) opens.
- At a reservoir pressure of approx. 65 PSI the minimum pressure valve (-15-) opens.
- Compressed air is now delivered into the consumer network.
- The system is now in load running mode.

**Stopping the system**

- Solenoid valve (-19- (Y1)) is de-energized when the STOP button on the operating panel of the compressor controller touch screen is pressed.
- The upper control space of the actuator (-2.1-) is ventilated by the solenoid valve (-19- (Y1)), the pressure spring in the actuator causes the throttle valve (-2.2-) in the intake regulator to close.
- After 30 seconds, the electric drive motor (-3-) and the cooling air fan motor (-17-) are shut down. The cooling water solenoid valve (-28-) de-energized and closes (only water-cooled units).

**Automatic operation (open-close operation)**

- When the pressure reaches the unload set point at the network pressure sensor (-34- (B1)), solenoid valve (-19- (Y1)) is de-energized.
- The upper control space of the actuator (-2.1-) is ventilated by the solenoid valve (-19- (Y1)), the pressure spring in the actuator causes the throttle valve (-2.2-) in the intake regulator to close.
- The oil separator tank is relieved to blow down pressure (residual pressure) via the pressure relief valve (-9-).
- The screw compressor is now running in the offload mode.
- The cooling air fan motor (-17-) is switched on or off in dependence upon the final compression temperature (only air-cooled units).
- The cooling water solenoid valve (-28- (Y6)) is opened and closed depending on the compression end temperature (only water-cooled units).
- When the pressure at the network pressure sensor (-34- (B1)) does not fall to the load set point within the set motor run-on time (e.g. 120 seconds), the electric drive motor (-3-) and the cooling air fan motor (-17-) are shut down and the system is depressurized to atmospheric pressure. The cooling water solenoid valve (-28-) de-energizes and closes (only water-cooled units).
- The system is now in the “stand-by” mode and can restart at any time when the network pressure falls to the load set point (see section “Starting of the system”).
- When the pressure falls to the load set point before the set motor run-on time has elapsed, solenoid valve (-19- (Y1)) is energized again.
- The unit now changes over to on-load operation.

**⚠ WARNING**

Do not stop the Unit using the Emergency Stop Button unless there is a danger to the product or of personnel injury.

Using the Emergency Stop Button, disconnect, or breaker to stop the Unit will not all the Unit to go through an unloading sequence, and could result in damage to the Motor, Stater, or other electrical components. Damage caused in this manner is not covered by the manufacturer’s Warranty.

## 3.7 Heat Recovery L160-L290

| WARNING | |
|---|---|
| | **Contamination with Legionella**<br>➢ Health hazard with open-loop cooling systems.<br>➢ Continuous monitoring of water quality and germ count in the cooling circuit. |

**Heat recovery function schematic**

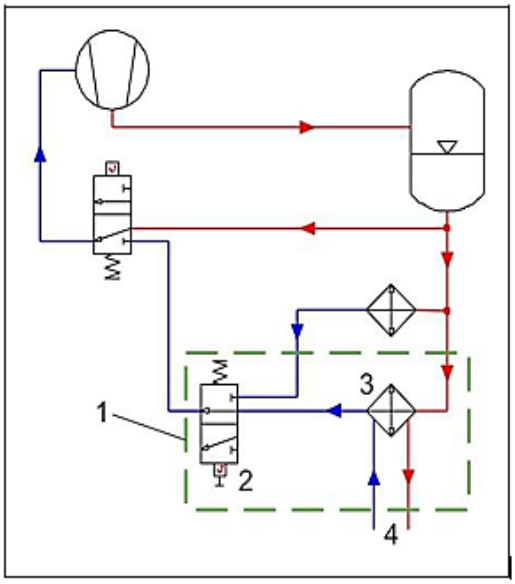



Figure 3-6

1. Heat recovery
2. Temperature regulator with switch-off function
3. Heat exchanger
4. Cooling water connection

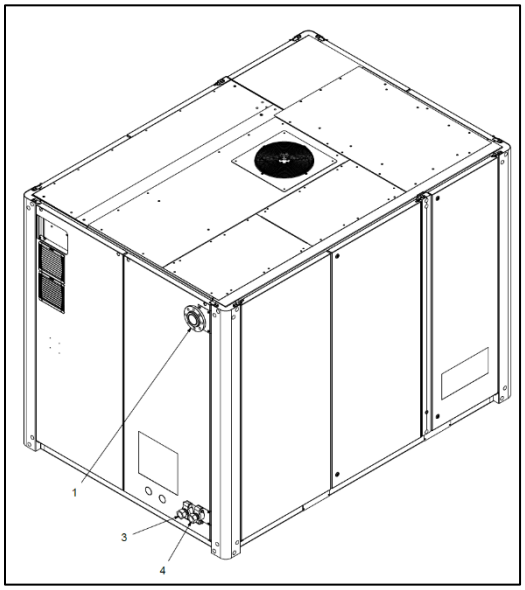



Figure 3-7 External Connections

1. Compressed Air Connection
3. Cooling Water Outlet
4. Cooling Water Inlet

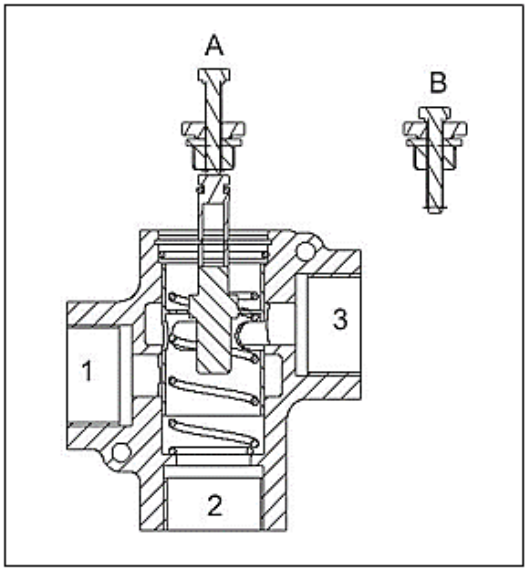



Figure 3-8 Switching Heat Recovery on and off

1. Connection from oil cooler
2. Connection to compressor
3. Connection from heat exchanger

A. Heat recovery switched on
B. Heat recovery switched off

Turning the hex screw clockwise to the stop (max. torque 3 Nm) switches the heat recovery off.
Turning the hex screw counter-clockwise to the stop (max. torque 3 Nm) switches the heat recovery on.

# 4 TRANSPORT AND INSTALLATION

## 4.1 Transport

**Delivery**

The compressor is bolted down to a shipping pallet and covered in plastic sheet packaging.
The center of gravity and lifting points are marked on the packaging.

**Receiving**

When received, check for shipping damage.

1. Check the delivery for visible damage.
2. Use the packing list to check the delivery for completeness.
3. Immediately inform the freight forwarder, insurance, and Gardner Denver of any missing parts or damage.

**Weight**

Dependent on type, the compressor weighs up to 4,700 kg / 10,362 lbs (gross). The weight is stated on the nameplate and is visible from the outside.

| ⚠ DANGER |
|---|
| **Danger to life**<br>Danger to life from tipping or falling parts.<br>➢ A suitable forklift with sufficiently long forks must be used to transport the compressor.<br>➢ Use forks only at the labeled lifting points.<br>➢ The compressor, even in its packed state, may not be transported by crane.<br>➢ During transport, no persons may be present in the hazard area. In particular, do not reach in or allow the feet to pass beneath the suspended compressor. |

**NOTICE**

**Property damage**

- Do not lift up or lash the compressor system by its enclosure.
- Note fork length of forklift.

**Transporting the compressor**

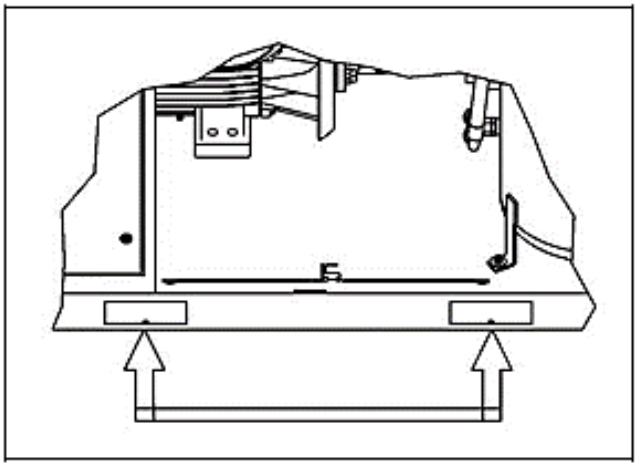


Figure 4-1 Lifting points

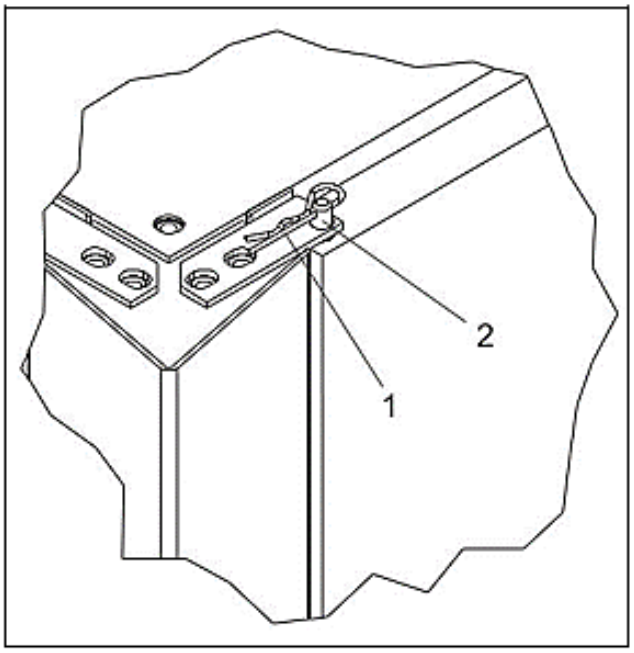



Figure 4-2

1. Wire pin
2. Hinge pin

**Before Transporting, the "R" Clips and doors must be removed as follows:**

A. Remove bolts from the transport pallet.
B. Pull wire pin
C. Remove doors
D. Lift the compressor off of the transport pallet.
E. Transport the compressor to the destination area.
F. Align the compressor and place it down.

### Weights

The following values are approximate. They apply to the screw compressor unit, including oil fill:

| Air Cooled Systems | Weight |
|---|---|
| L160 | 4186 kg / 9229 lbs. |
| L200 | 4415 kg / 9733 lbs. |
| L250 | 4625 kg / 10196 lbs. |
| L290 | 4650 kg / 10251 lbs. |
| L160RS | 4378 kg / 9652 lbs. |
| L200RS | 4573 kg / 10082 lbs. |
| L250RS | 4669 kg / 10293 lbs. |
| L290RS | 4684 kg / 10326 lbs. |

| Water Cooled Systems | Weight |
|---|---|
| L160 | 4120 kg / 9083 lbs. |
| L200 | 4330 kg / 9456 lbs. |
| L250 | 4490 kg / 9899 lbs. |
| L290 | 4490 kg / 9899 lbs. |
| L160RS | 4270 kg / 9414 lbs. |
| L200RS | 4460 kg / 9832 lbs. |
| L250RS | 4490 kg / 9899 lbs. |
| L290RS | 4520 kg / 9965 lbs. |

## 4.2 Storage

### Storing compressors.

The compressor should be stored in a dry area, heated if possible. This applies especially to the winter months.

**NOTICE**

**Damage to property**

Damage to property due to exceeding the permissible temperature range

- Where there is a risk that the permissible temperature limits of +2°C to +65°C / +36°F to +149°F could be exceed or underrun, contact Gardner Denver.

### Corrosion protection

All compressors are protected at the factory against corrosion for shipping and short-term storage prior to commissioning. If compressors are stored for longer than 6 months, additional preventive measures must be taken.

Compressors that will be out of service for an extended period of time must also be protected against corrosion.

## 4.3 Installation

### Requirements for the installation site

The compressor must be installed with full contact on a foundation with sufficient structural strength. The bearing surface must be level to within 3mm / 0.12".

The installation site (compressor room) should be of sufficient size that on side ("A") a clearance of 1m / 39” and on side ("B") a clearance of 1.5m / 59” may not be undershot. The clearance above the compressor should be 1.5m / 59” at least. There should also be appropriate access space for maintenance work.

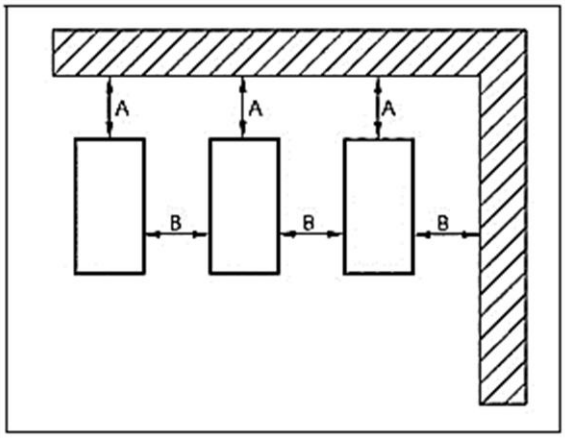



Figure 4-2 Installation / Clearances

- Set up the compressor so that there is sufficient access and that the required cooling is ensured.
- Do not block the air inlet.
- Avoid moisture.

**Ventilation and exhaust**

**DANGER**

**Danger of asphyxiation**
Danger from asphyxiation due to insufficient ventilation and exhaust.
- The operator must provide sufficient ventilation and exhaust of the compressor room.

In order to be able to dissipate the heat produced during operation, the compressor room must have sufficient volume and good ventilation.

The recommended minimum size of the compressor room is 60 m3 / 646 ft³.

The air inlet and outlet openings should have a minimum area of 1.8 m2 / 19 sq. ft.

The fresh air opening should be located as low as possible. The exhaust opening should be located as high as possible.

Cover ventilation openings with screens in order to prevent dirt from entering the compressor room.

The design of ventilation system is based primarily on the required amount of cooling air. (See "Technical data").

If local conditions are unfavorable, install air ducting. The flow speed of the cooling air should not exceed 5 m/s / 16.5 ft./sec. We recommend a minimum channel cross section of 1.8 m2 / 19 sq. ft.

**NOTICE**

In order to ensure good heat dissipation, the installed auxiliary fans should be designed for air volume about 15 to 20% greater than the required cooling air volume for the compressor.

When installing several compressors in one compressor room, use the sum of the required cooling air volumes for all the compressors in the room.

The following illustration shows the recommended ventilation requirements.

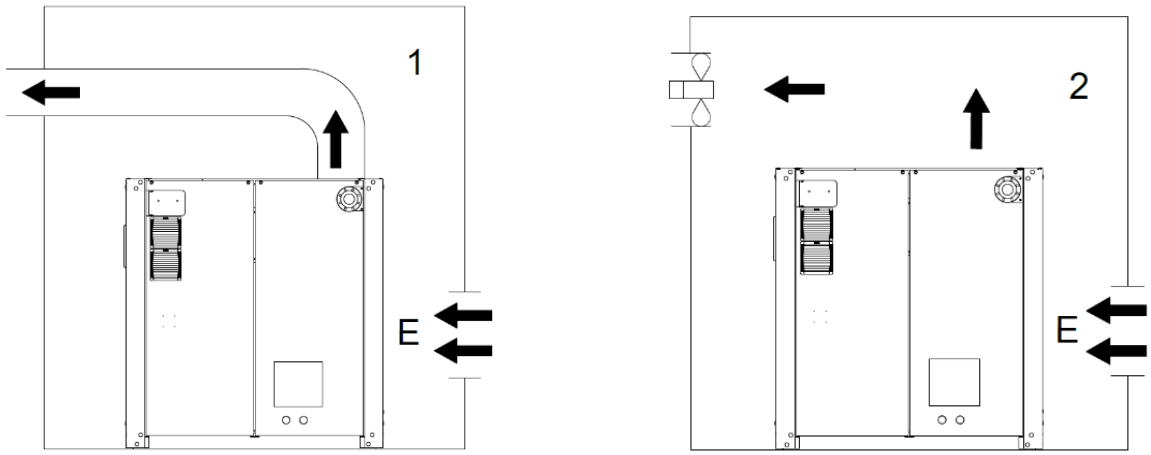



Figure 4-3 Compressor Room Ventilation

**DANGER**

**Risk of injury**
Danger from improper installation
- Consider the permissible load capacity of the foundation.
- Make sure the foundation is solid and flat.
- The compressor must be installed with full contact on a foundation with sufficient structural strength.
- The compressor must not be operated on the transport pallet.
- No flammable or explosive materials may be stored near the compressor.

1. Place the compressor down at the correct location.
2. Ensure that the bearing surface is even to within 3mm / 0.12".
   (The compressor does not have any leveling means fitted on it).

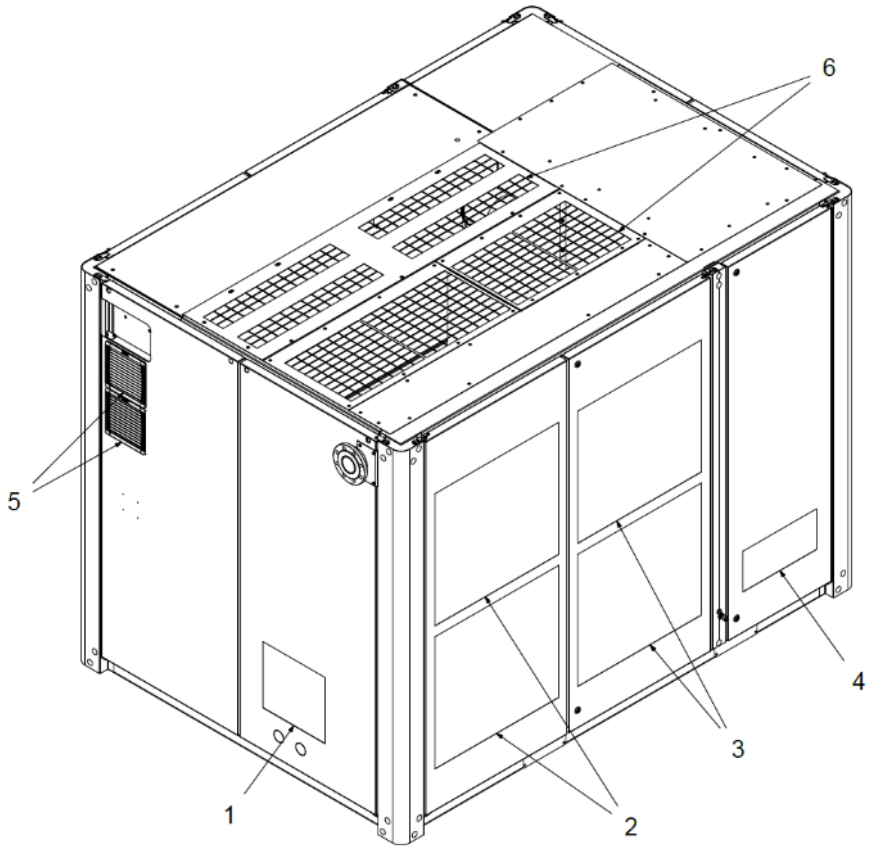



Figure 4-4

1. Cooling Air Intake, Motor
2. Cooling Air Intake, Oil Cooler
3. Cooling Air Intake, Air Cooler
4. Air Intake for Airend
5. Cooling Air Intake, Starter Box
6. Cooling Air Exhaust

# 5 PREPARING FOR COMMISSIONING

## 5.1 Piping

Remove all blank flanges, stoppers, caps, and desiccant bags before installing the piping.

Distributor piping and pipe connections must be the correct size and designed for the operating temperatures and pressures.

Label the compressed air and water lines according to local requirements.

Support all piping appropriately. Pipes must not bear any loads.

If compressed air hoses are used, they must be of the correct size and must be suitable for the operating pressure and temperature. Do not use worn, damaged, or substandard hoses.

A shutoff valve should be installed in the supply line, so that the compressor can be isolated for maintenance purposes.

The drain line running away from the condensate connection must be pitched at no greater than 5 / 16.4 ft. m.

An air tank of sufficient volume should be installed (as a buffer) between the compressor and the compressed air network. As a guideline for the tank capacity, select a size that is 10% of the supply volume. For example, a compressor with a supply volume of 10m³/min / 353 ft³/min requires a tank with a volume of 1 m³ / 35 ft³.

## 5.2 Compressed Air Connection

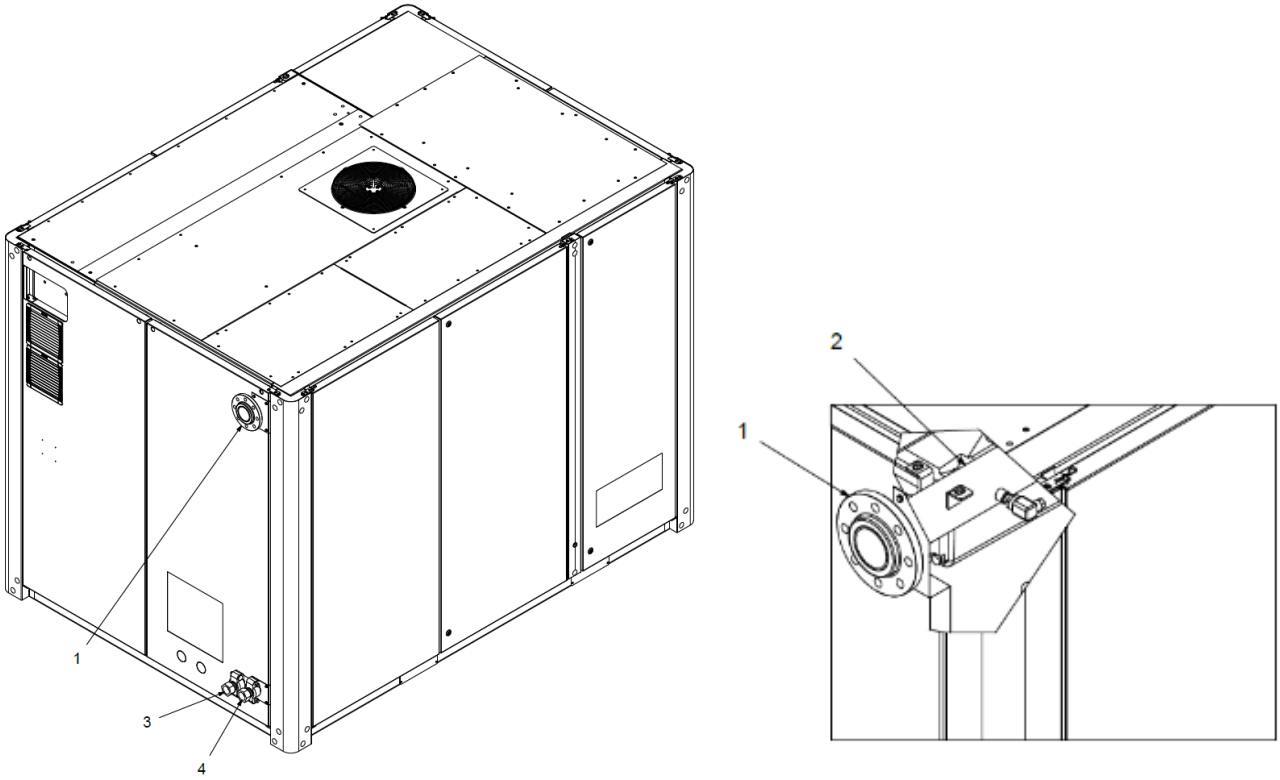



Figure 5-1 Compressed Air Connection

1. Compressed Air connection
2. Thread identification of compressed air connection
3. Cooling Water Outlet
4. Cooling Water Inlet

**WARNING**

**Risk of injury**

- A defective connection to the compressed-air system may jeopardize safe operation of the compressed-air system.
- When connecting the compressor outlet to the customer's existing compressed-air system, check that the necessary operating temperatures, operating pressures as well as the necessary connecting flange or connecting thread are appropriate and in perfect working order.
- For connections with hoses, take steps so that if an end breaks free it won't "whip" around dangerously.

**NOTICE**

After-coolers, separators, collecting reservoirs and the compressed-air lines must be equipped with drain facilities at their lowest points to drain collected liquids. These facilities have to be fitted to allow the observance of the draining of such liquids.

Hand-operated drain facilities have to be actuated in accordance with the operating instructions. Automatic drain facilities have to be checked for proper function at regular intervals. When draining condensates into a collecting line, which also collects the condensate from other machines, make sure that the collecting line is free from back pressure at all lines.

When draining condensate, observe the corresponding regulations for waste water disposal.

**Check the connection flange**

The pressure connection comprises a DIN / ANSI B16.5 flange.

The connection is identified by a stamp on the outside of the flange plate: DN80, PN16 / 3"-8 NPT

1. Read the connection ID.
2. Ensure that the connection and the flange match each other.

**Connect the compressor to the compressed air network.**

The compressor is fully assembled at the factory. The connection to the compressed air network should be made with a flexible line, that is, a compressed air hose or compensator.

Use only hose couplings and connectors of the correct type and size.

1. Ensure that the supply line can be connected with no tension.
2. Connect the connection line to the compressed air connection of the compressor.
3. Secure hose lines.

## 5.3 Cooling Water Connection

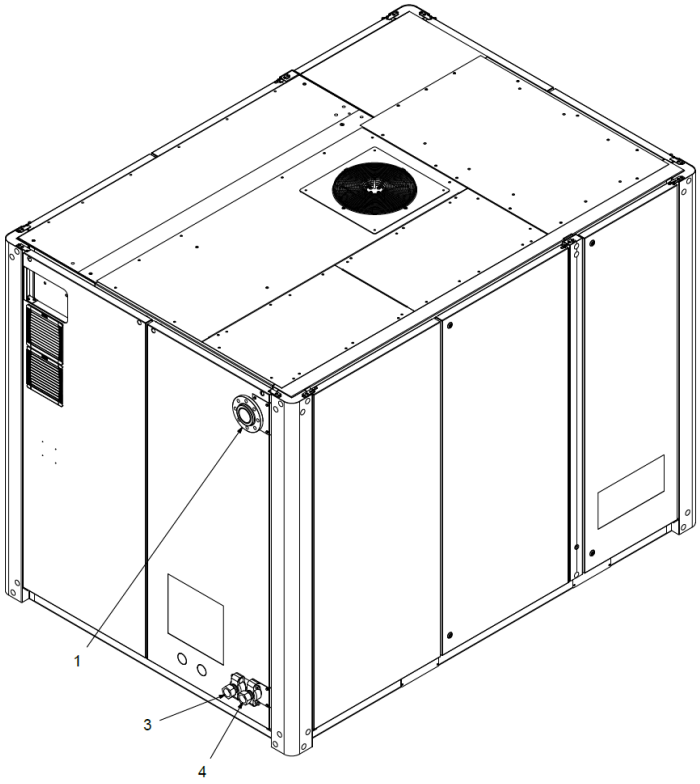



Figure 5-2 Cooling Water Connection

1. Compressed Air connection
3. Cooling Water Outlet
4. Cooling Water Inlet

| DANGER | |
|---|---|
| | **Contamination with Legionella**<br>**Risk of live threatening diseases. If open cooling towers are used in the cooling water circuit, it is possible for legionella (Legionella pneumophila) and other bacteria to grow and spread.**<br>➢ The growth and spread of bacteria must be prevented by corresponding service and water treatment methods. |

| ⚠ CAUTION | |
|---|---|
|  | **Environmental hazard! As a result of leakage in oil/water coolers, some oil may get into the cooling water circuit.**<br>The following items must be noted for operation of water-cooled screw compressor systems:<br>➢ Cooling water must not be discharged indiscriminately into public waste-water and drain systems. Uncontrolled overflow of oil-separator basins into public waste-water systems must be prevented.<br>➢ Waste-water law provisions must be carefully adhered to. |

| NOTICE |
|---|
| The cooling water must be drained if there is a danger of frost occurring or in case of a prolonged shutdown of the screw compressor system. Always perform maintenance, servicing and repair work carefully. Dismantled bundles of pipes have to be checked for integrity before being reinstalled. In the case of even the slightest damage, replace the pipe bundle. Always use new seals when carrying out assembly work. |

**Connect the compressor to the cooling water network**

The compressor is fully assembled at the factory. The connection to the cooling water network should be made with a flexible line, that is, a compressed air hose or compensator.

Use only connections that are the correct size.

1. Ensure that the lines can be connected with no tension.
2. Connect the connection line to the cooling water inlet and outlet of the compressor.
3. Shut-off valves must be installed at the cooling water inlet and cooling water outlet.
4. Secure hose lines.

Cooling water inlet and cooling water outlet:

- USA/CANADA version: 1 1/2" NPT
- European version: EN 10226-1 Rp 1 1/2
- Permissible cooling water data Max. cooling water pressure: 10 bar / 145 psi
- Min. cooling water inlet temperature: 5°C / 41°F
- Max. cooling water inlet temperature: 42°C / 107°F
- Max. cooling water outlet temperature: 57°C / 134°F

| P [KW] | Δp [psi] | V [gal/min] |
|---|---|---|
| 160 | 13 | 39.6 |
| 200 | 16 | 47.5 |
| 250 | 19 | 52.8 |
| 290 | 34 | 60.7 |

Chart 5-1: Cooling water requirement at maximum power and (**ΔT** = 10K)

**Δp:**

Cooling water outlet pressure = Cooling water inlet pressure - Δp

This data is based on fresh water and the cooling-water quality recommended by Gardner Denver. Please contact Gardner Denver if the cooling-water data diverges from this.

The flow of cooling-water for the water cooler at commissioning can be adjusted by means of a manual control valve.

| NOTICE |
|---|
| Wherever possible, the cooling water outlet temperature should be below 57°C / 135°F, if possible, in order to prevent excessive lime sediment. |

**NOTICE**

The information set out below is intended for guidance and may differ under certain conditions of operation. The total composition and the operating temperature are always decisive. Warranty claims may not be derived from this.

| Constituent elements of water / characteristic values | | Circulating water | Pass- through water |
|---|---|---|---|
| pH value (at 77°F) | | 6 – 9 | 6 – 9 |
| Carbonate hardness | CaCO3 | < 100 mg/l<br>(5.6 °dH) | < 50 mg/l<br>(2.8 °dH) |
| Total hardness | | < 2 mmol/l<br>< 200 ppm<br>< 11.5 °dH<br>< 20 °fH | < 0.5 mmol/l<br>< 50 ppm<br>< 2.8 °dH<br>< 5 °fH |
| Chloride | $Cl^-$ | < 200 mg/l | < 50 mg/l |
| Sulphate | $SO_4^{2-}$ | < 200 mg/l | < 50 mg/l |
| Nitrate | $NO_3^-$ | < 100 mg/l | < 100 mg/l |
| Organic substances (KMnO4 absorption)<br>free aggressive carbonic acid | CO2 | < 25 mg/l<br>< 20 mg/l | < 10 mg/l<br>< 20 mg/l |
| Silicium oxide | SiO2 | < 10 mg/l | < 10 mg/l |
| free chloride | Cl2 | < 4 mg/l | < 2 mg/l |
| Oxygen | O2 | < 2 mg/l | < 2 mg/l |
| Ammonium | $NH_4^+$ | < 1mg/l | < 1mg/l |
| Iron | Fe | < 0.2 mg/l | < 0.2 mg/l |
| Manganese | Mn | <0.1 mg/l | <0.1 mg/l |
| Sulphide | $S^{2-}$ | 0 | 0 |
| Ammoniac | NH3 | 0 | 0 |
| Conductivity | | > 50. < 800<br>µS/cm | > 50. < 200<br>µS/cm |

## 5.4 Electrical Connection

**DANGER**

**Risk of strong damages and fire on the electric power components.**

- **The power supply to the compressor side has to be fitted for industrial equipment and fulfilling the requirements of NFPA 79. Any kind of operation outside of the stated limits of NFPA 79 is inadmissible.**
- **The electrical connection should be made by a qualified electrician.**

**DANGER**

**Electric shock**

Dangerous and deadly electrical voltage

- Work on the electrical equipment may be performed only by specialized electrical technicians.
- Only units with Variable Frequency Drives, there is a risk of electric shocks due to charged capacitors! Isolate the compressor and wait 10 minutes before touching any electrical parts.
- Check the DC bus voltage.

**WARNING**

If local regulations are stricter than the values given below, observe the stricter regulations.

If the electrical connection is made to a non-earthed three-phase system (IT network), please see the corresponding notes in the included frequency converter documentation.

If a residual current device (RCD) is used to monitor the earthing connection in the system for earth faults, to prevent interruptions only Type B devices (adjustable trip setting and delay) may be used.

**NOTICE**

**Disturbances in the electrical supply grid**

Speed-controlled compressor system with variable speed drives can cause disturbances in low-voltage grids. For this reason, this drive system is not intended for use on the public low-voltage grid that feeds residential areas.

The compressor system is completely finished at the factory according to EN 60204 (Industrial Machinery).

- The power supply to the compressor must be suitable for industrial equipment and must meet all requirements of EN60204-1/IEC60204-1. If the installation conditions deviate from the conditions as described in EN 60204, consult Gardner Denver.
- Provide the electrical connection and protective measures according to VDE, BS, or local requirements. As a rule, additional regulations from the corresponding power company must also be complied with.
- A main switch must be fitted on-site upstream of the compressor (DIN EN 1012 - 1) insofar that such a switch has not already been fitted in the factory as a special accessory. The main disconnect switch must meet the requirements of the safety standard EN 60 204-1 (Electrical Equipment for Machinery) and EN 60947-2 (Low Voltage Equipment).
- The compressor must be protected by suitable line fuses according to EN 60269-1 (Low Voltage Directive).
- If other electrical circuits are run to the electronic controller afterward, such as lighting, heating, or the like, that are not disconnected by the main disconnect switch, then these excepted electrical circuits must be labeled and run separately per EN 60204. Warning labels must also be installed near the main disconnect switch and near these circuits.
- Should an electrical connection to an unearthed AC electrical circuit (IT network) be made, observe the instructions in the supplied documentation of the frequency converter (only RS compressors).

## Electrically connect the compressor

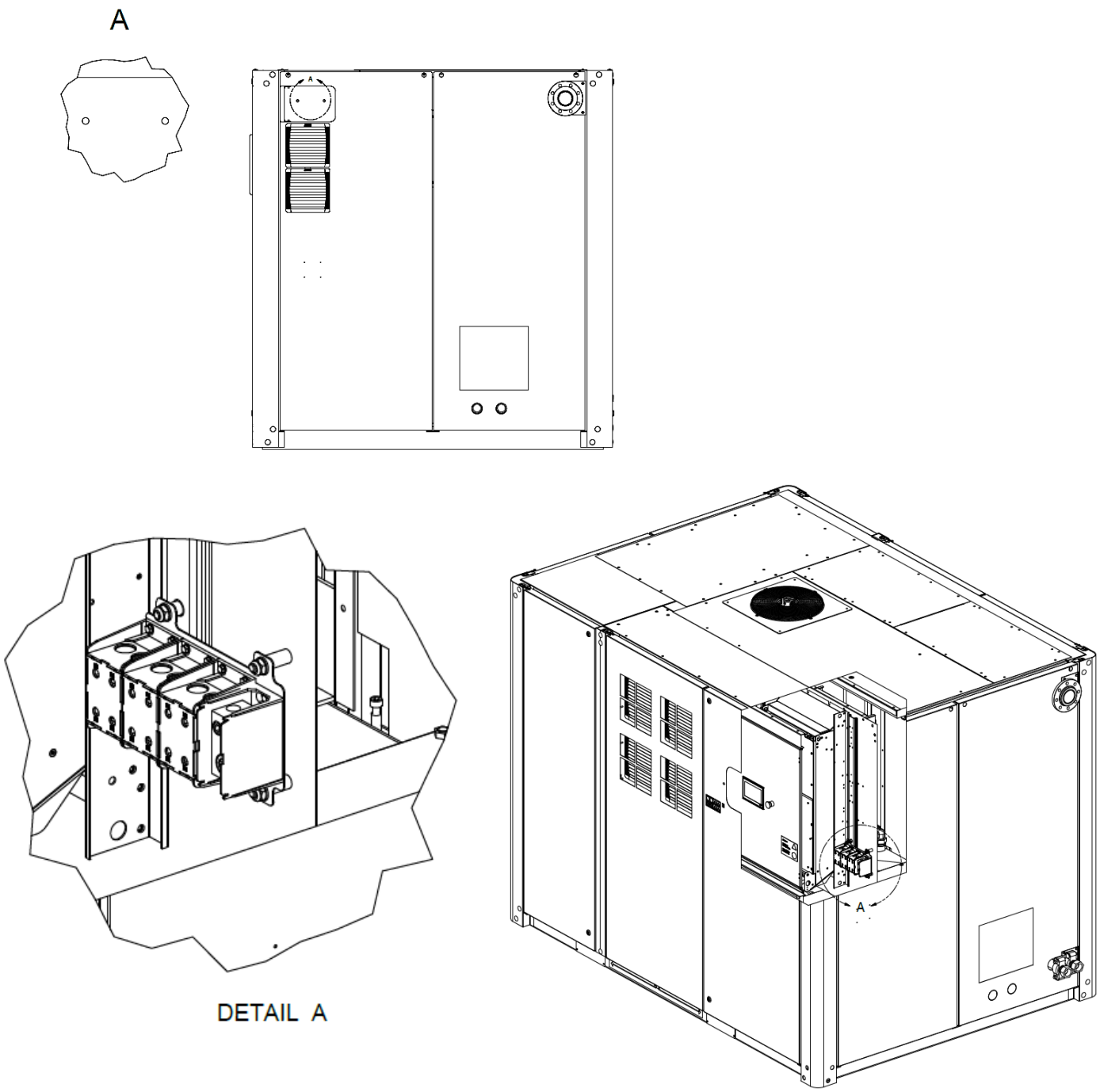



Figure 5-3 Electrical connection

1. Install a customer supply line cover.
2. Run the supply lines through the openings in the electrical enclosure (A).
3. Connect the supply lines; see Detail A and wiring diagram.
4. Tighten the cable screws.

Variable speed units are supplied with terminal blocks to land incoming power conductors. Terminal blocks are pre-wired to the line side of the Variable Frequency Drive for convenience. The final installation is up to the discretion of the installer's certified electrical contractor and local electrical codes.

## 5.5 Check the Setting of the Fan Overload Protection Switch(es).

1. Check the setting of the motor protection switch in accordance with the enclosed circuit diagram for the compressor.
2. Set the protection switch to the value stated in the table corresponding to the mains voltage and frequency.

## 5.6 Check the Oil Level.

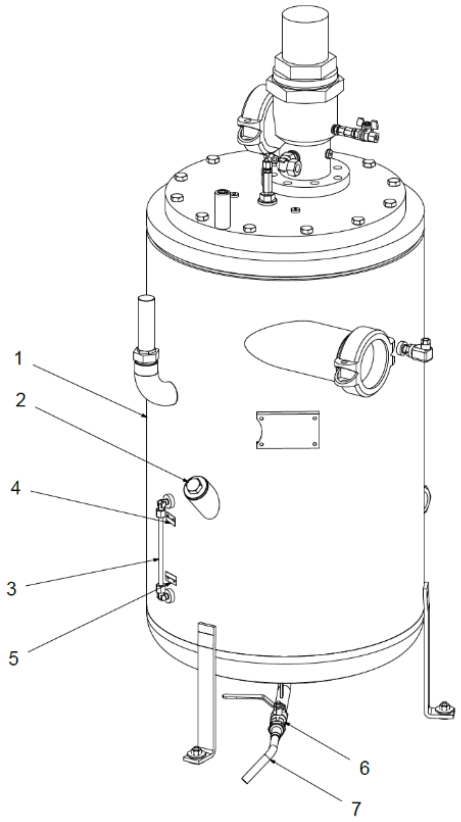



Figure 5-4 Oil level

1. Oil reservoir
2. Oil filling G 1 1/2”
3. Oil level indicator
4. Maximum Oil level
5. Minimum Oil level
6. Bleed ball valve R 3/4”
7. Drain hose

**Check the oil level as follows:**

Shut off the compressor with the STOP button.

Wait at least 5 minutes until the oil has settled, i.e. until the air has bubbled out.

The oil level should be checked at each pause in operation and at regular intervals using the transparent plastic tube on the pressure reservoir.

The oil level must lie between the “maximum oil level” and “minimum oil level” marks on the oil reservoir.

If required, top up oil. Use Gardner Denver oil only.

Close the oil filler cap firmly.

Also see Maintenance and Service section.

# 6 COMMISSIONING AND OPERATION

## 6.1 First Commissioning

**DANGER**

**Risk of injury**
The direction of rotation of the drive motor can be checked only if the coupling cover is removed.

- Before switching on, ensure that there is no one in the hazard zone.
- Keep a safe distance away from rotating parts of the machine.
- Wear hearing protection.
- Operate the compressor only when the enclosure is closed, except for test runs.

**NOTICE**

Although every compressor has already undergone a test run at the factory, and has been checked thoroughly again prior to shipping, the possibility of transport damage cannot be eliminated.

- Check the compressor again for damage before commissioning and observe it during the first few hours of operation.
- When the compressor system is connected to a power source for the first time, always check the drive direction of the drive motor. The compressor controller provides a jogging function under the diagnostics menu. See the controller manual for additional instruction. Incorrect rotation of the compressor may cause serious damage, even during short periods of operation.
- When storing the screw compressor system or in the event of a longer period of downtime, if there is the risk of frost ( t < 34°F) the cooling water should be completely discharged.

**Preparations**
Check all electrical and electronic components and devices for water that may have penetrated or condensed. If any is found, contact Gardner Denver.
If the compressor has been stored for an extended period of time (up to 2 years), then switch on the main disconnect switch at least one hour prior to starting. This ensures that the capacitors are functional and prevents them from being damaged.
If the compressor has been stored for longer than 2 years, consult Gardner Denver.

**Perform initial commissioning as follows:**

- Remove transport guards, if fitted.
- Check the oil level in the pressure reservoir.
- Check setting of the fan overload protection switch(es). Only for units with Variable Frequency Drives.
- Check and re-tighten all connecting terminals of the electrical control.
- Open isolator valves between the screw compressor, reservoir and pipe.
- Ensure cooling water supply. Only on water-cooled units.
- Turn on the main power supply switch.
- After the power supply was switched on, the compressor controller will boot to the home screen. The fault shown on the display [power supply fault] must be acknowledged in the alarm screen prior to starting the unit.
- After the acknowledgement, the message [READY TO START] appears on the display, unless another fault is present.
- The factory settings of the Load, Target and Unload set points are saved in the compressor controller and depend on the pressure variant of the compressor (see nameplate fig. 1, stage pressures = maximum operating pressure). These settings can be checked or changed in the Settings -> Control menu (further information can be found in the compressor controller operating manual).
- Temporarily remove the panel in order to check the direction of rotation. Check the direction of rotation of the drive motor of the geared or direct drive compressor. Check the direction of rotation of the fan, see direction of rotation arrow on the fan.
- Use the jog motor function in the diagnostics menu to jog and check direction of rotation of the main and fan motor.
- With a wrong direction of rotation, de-energize/lock out and correct the direction of rotation.

## 6.2 Check the Direction of Rotation of the Drive Motor

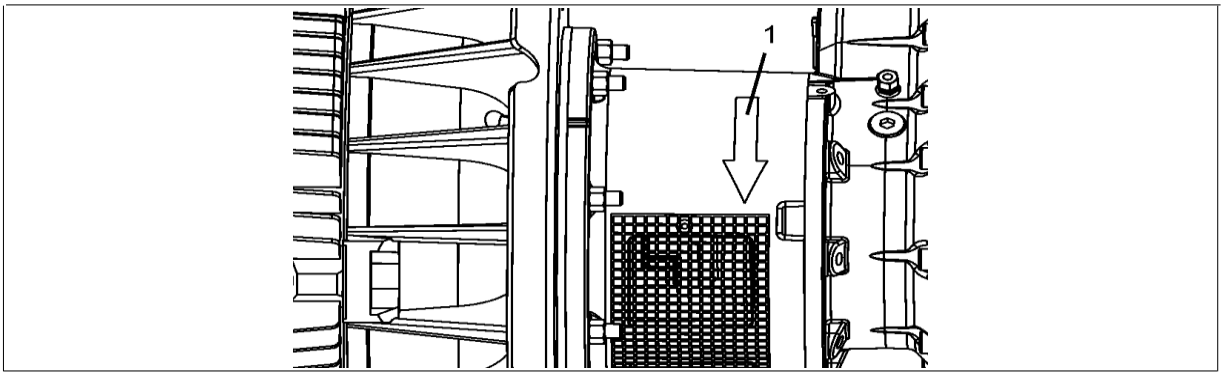



Figure 6-1 Drive motor direction of geared compressors

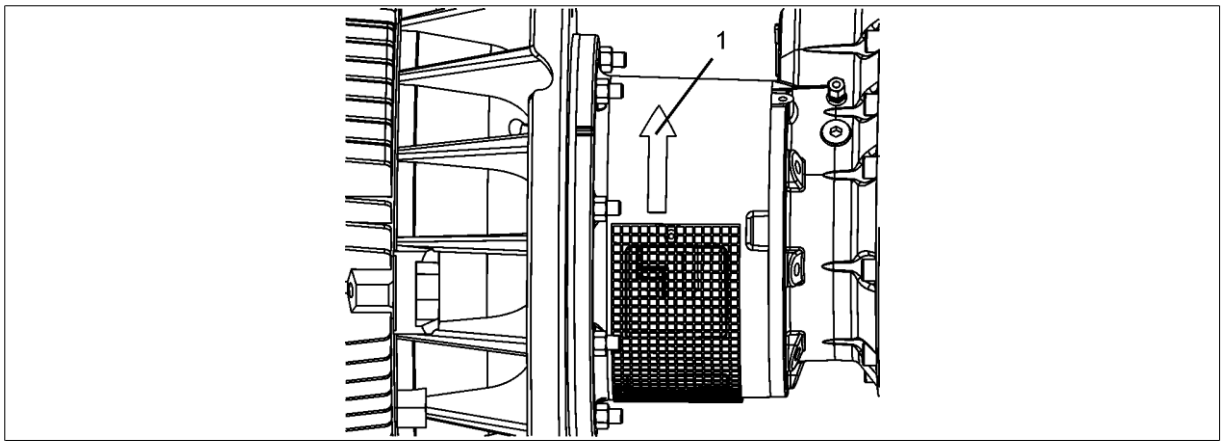



Figure 6-2 Drive motor direction of direct drive compressors

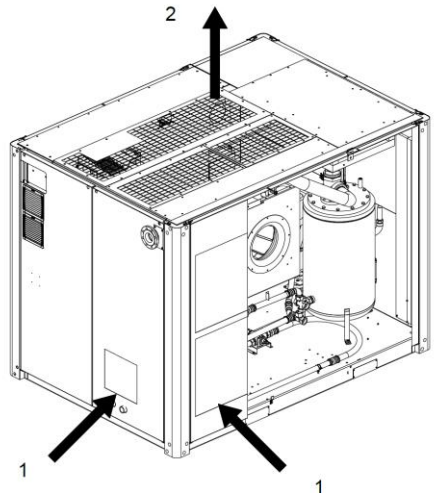



Figure 6-3 Air Cooled Units

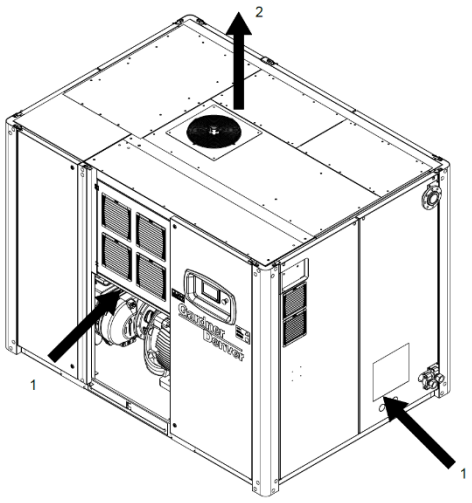



Figure 6-4 Water Cooled Units

1. Arrow “direction of rotation for compressor” (direction of rotation may deviate from this representative).

**Temperature start-up protection**

The screw compressor unit will not start up if the ambient temperature is lower than 34°F.

| NOTICE |
| --- |
| For switching the compressor off “normally”, use only the stop push-button, but not the EMERGENCY STOP push-button. After having been switched off, the compressor is after-cooled for 30 seconds (soft stop). |

## 6.3 Normal operation

Before commissioning the compressor all the electrical and electronic components and units should be checked for the ingress of water or condensation.
If the electronic control system was removed during shut down, it must be re-installed. Then proceed as described in “First Commissioning” section.

| NOTICE |
| --- |
| Only for units with Variable Frequency Drives: If the compressor has been in storage for a substantial period of time (up to 2 years), switch the main power supply switch on (ON) at least one (1) hour prior to commissioning. This ensures the operability of the capacitors and prevents any damage from occurring.<br>If the compressor has been in storage for longer than 2 years, please contact an authorized Gardner Denver Distributor prior to start-up. |

## 6.4 Display of the Compressor Controller


Figure 6-5 Controller display

1. Touchscreen Display
2. Start push-button [ I ]
3. Stop push-button [ O ]
4. Emergency stop

| ⚠ WARNING | |
| --- | --- |
| ⚠ | The compressor can be automatically started at any time when it is in enable mode. |

**Switching on**
Press start button < I > on the control panel.

- The compressor switches on.
- The compressor runs automatically (automatic mode).

**Operating states**
During automatic mode, the compressor can be in one of the following operating states:

- Ready to start (Standby) [Ready to start]
- Loaded operation [On-Load]
- Partial load operation (on-load operation at reduced speed only RS compressors) [On-Load]
- Idle [Off-Load]

**Observations during operations**
During operation the compressor must be regularly checked to ensure leak-tightness of the oil circuit. With water-cooled systems, this inspection is extended to the cooling water circuit.

**Condensate Drain**
The condensate drain on the aftercooler is actuated via sensor control.

**Switching off**
Press stop button < O > on the control panel, not the Emergency Stop button.

- After shutdown, the compressor has a run on time of 30-50 seconds (soft stop).

| NOTICE |
| --- |
| The unit may only be shut down using the emergency stop button in real emergencies. When shutting down normally, please use the O (STOP) key. |

**Emergency stop**

The emergency stop button is located next to the compressor controller. It is used to immediately shut down the unit. Only use the Emergency Stop button to shut down the unit in emergencies.

| ⚠ WARNING |
| --- |
| Do not stop the Unit using the Emergency Stop Button unless there is a danger to the product or of personnel injury.<br>Using the Emergency Stop Button, disconnect, or breaker to stop the Unit will not all the Unit to go through an unloading sequence, and could result in damage to the Motor, Stater, or other electrical components. Damage caused in this manner is not covered by the manufacturer's Warranty. |

**Using the emergency stop**

1. Press the <E-stop> button. The compressor is brought to a safe condition.
2. Correct the fault that was the reason for the emergency stop. See the "fault correction" chapter.
3. Unlock the <E-stop> button.
4. Start up the compressor. See the paragraph "Commissioning after a fault" in the chapter "Commissioning and operation."

## 6.5 Routine Commissioning

| ⚠ WARNING |
| --- |
| Rotating parts inside the unit may lead to injuries, e.g., cutting of finger or hand.<br>➢ Before commissioning make sure that no one is located in the danger zone of the motor/screw compressor!<br>➢ After doing work: Check that all safety equipment is reinstalled and that all tools have been taken out!<br>➢ Only operate the screw compressor with the coverings closed! |

Routine commissioning includes commissioning after maintenance:

- Check the oil level in the pressure reservoir.
- Open shut-off valves between the screw compressor, reservoir and pipe.
- Ensure cooling water supply for only water-cooled units.
- Turn on the main power supply switch.
- After the power supply was switched on, the compressor controller will boot to the home screen. The fault shown on the display [power supply fault] must be acknowledged in the alarm screen prior to starting the unit.
- After the acknowledgement, the message [READY TO START] appears on the display, unless another fault is present.
- Press START button [ I ].
- To switch off the compressor in the usual way use the STOP button and not the emergency STOP button. After shutdown the compressor has a run on time of 30-50 seconds (soft-stop). The time remaining is counted down on the display.

**Temperature start-up protection**
The screw compressor unit will not start up if the ambient temperature is lower than 34°F.

## 6.6 Commissioning after extended downtime

For commissioning after an extended idle period, consult Gardner Denver.

## 6.7 Commissioning after a fault

| NOTICE |
| --- |
| **Property damage**<br>Avoid switching on the compressor multiple times without clearing the fault, as this can lead to significant machine damage.<br>➢ Switch on the compressor only after the fault has been cleared. |

**Recommissioning after a fault (automatic shutoff)**

Faults are shown in the "Fault memory" display memory.

1. Switch off the main disconnect switch and secure it against switching on again.
2. Clear the fault. See the “fault correction” chapter.
3. Switch on the main disconnect switch.
4. Acknowledge the fault in the Fault memory menu.
5. After acknowledgement, the message [Ready to start] appears on the display, as long as no other fault is present.
6. Press the start button < I > on the control panel.
   - The compressor switches on.
   - The compressor runs in automatic mode.

# 7 CLEARING A FAULT

**Instructions for clearing a fault**

Potential causes and solutions are listed in the following tables.

The measures listed in these operating instructions for clearing faults may be performed only by specially trained personnel. Any other work beyond this must be performed by the manufacturer's service personnel! Work on the electrical equipment may be performed only by authorized electrical technicians.

Solutions are described in detail in repair instructions, which are transmitted as part of the operator training.

| NOTICE |
| --- |
| **Property damage**<br>Property damage due to incorrect/unsuitable measures for fault clearing.<br>➢ If the solutions listed here are not sufficient to clear the fault. Contact Gardner Denver.<br>➢ For fault and warning messages that are displayed on the display of the electronic controller, follow the instructions in the chapter "Fault/warning" in the operating instructions for the electronic controller. |

**Fault: Unit will not start**

| Potential root cause | Remedy |
|---|---|
| Missing operating or control voltage | Check fuses, main disconnect switch, and supply lines. |
| Fault not acknowledged | Acknowledge a fault in the electronic controller. |
| Pressure vessel not depressurized. | Wait for depressurization. Screw compressor does not start up when the vessel pressure is greater than the preset value. See factory setting “Start protection”. |
| Drive motor defective | Check connections, windings, etc. |
| Compressor defective | Rotate compressor by hand, replace if needed. |
| Ambient temperature < +1 °C / 33.8 °F | Ensure that the ambient temperature is at least +1°C / 33.8°F if necessary provide stationary heating |
| The remote control/timer control via terminal strip is activated | Deactivate remote control/timer control |
| Line pressure is above the lower switching point (L160-L290) or the nominal pressure (L160RS-L290RS) | Wait until the line pressure has fallen below the switching point / nominal pressure |

**Fault: Unit remains stopped during the run-up phase.**

| Potential root cause | Remedy |
|---|---|
| Short circuit in the compressor | Determine and correct the cause of the short circuit. Replace defective fuses. |
| Loose terminal connections | Check terminal connections and tighten if needed. |
| Switching on and off by hand has exceed the maximum number of motor switching cycles. | Avoid switching on and off frequently by hand. Allow the electric motor to cool down. |
| Intake regulator does not close completely | Make the intake regulator moveable, replace if needed. Check solenoid valves and pressure reducing valve. |

**Fault: Unit does not reach the set network pressure.**

| Potential root cause | Remedy |
|---|---|
| Network pressure sensor defective | Check the network pressure sensor, replace if needed. |
| Too much air captured | Throttle the removal, or switch on and use additional compressors. |
| Oil fine separator soiled | Replace oil fine separator cartridge |
| Air filter dirty | Replace air filter cartridge |
| Severe leaking | Check compressor. For example: Check for leaks. Pressure Relief Valve after checking is defective or open.<br>Condensate drain on test function. |
| Intake regulator does not open completely | Make the intake regulator moveable, replace if needed. Check solenoid valves and pressure reducing valve and replace if necessary. |

**Fault: Unit switches off.**

| Potential root cause | Remedy |
|---|---|
| Water inlet temperature too high (for water-cooled compressors only) | Check cooling water feed. |
| Ambient temperature too high | Ventilate the compressor room. |
| Electric motor defective | Check the electric motor and posistor. |
| Fan is defective | Check fans, replace if needed. |
| Sensor, connections, or lines defective | Check sensors, connections, and lines. |
| Supply cable cross section too small for electrical lines | Measure current draw; replace lines if needed. |
| Oil level too low | Top up oil in the pressure vessel |
| Oil injection pressure too low | Replace oil filter cartridge. Clean oil system |
| Oil temperature too high | Check oil cooler and fan / check oil temperature, check cooling water circuit (only for water-cooled systems) |
| Compressor defective | Replace compressor |

**Fault: Idle pressure too high**

| Potential root cause | Remedy |
|---|---|
| Compressor does not give relief | Check suction regulator, blow-off solenoid valve and pressure-retaining and non-return valve, and replace if necessary. |
| Intake regulator does not close completely | Make the intake regulator moveable, replace if needed.<br>Check solenoid valves and pressure reducing valve. |

**Fault: Oil in the air filter**

| Potential root cause | Remedy |
|---|---|
| Suction regulator non-return function defective | Check non-return valve; replace if necessary. |
| Continuous Emergency-Off deactivation | Emergency-Off may only be used for safety-related function problems |

**Fault: Pressure Relief Valve opens**

| Potential root cause | Remedy |
|---|---|
| Pressure Relief Valve defective | Replace pressure relief valve. |
| Network pressure sensor defective | Replace network pressure sensor. |
| Final compression pressure sensor defective | Replace final compression pressure sensor |
| Electronic controls defective | Replace electronic controller. |
| Oil fine separator soiled | Replace oil fine separator cartridge |
| Intake regulator does not close completely | Check solenoid valves and pressure reducing valve, replace if necessary.<br>Make the intake regulator moveable, replace if needed. |

| NOTICE |
|---|
| Also note the fault messages on the display of the operator panel.<br>The corresponding actions to clear the faults are described in the operating instructions for the electronic controls. |

# 8 MAINTENANCE AND SERVICE

Maintenance and service are decisive factors for the compressor to be able to meet the challenges of trouble-free operation and service life that it faces. Compliance with the specified maintenance interval and the careful performance of maintenance and care tasks are therefore mandatory.

Help is available from your responsible Gardner Denver representative, who can create an individualized maintenance plan.

## 8.1 General Notes

**Target group**
The measures listed in these operating instructions for clearing faults may be performed only by specially trained personnel.
Any other work beyond this must be performed by the manufacturer's service personnel!

**Safety**
Follow the safety instructions in the safety requirements chapter.

**DANGER**

**Electric shock**
leadly electrical voltage
- Exercise extreme caution when working with electrical equipment.
- Before starting maintenance work, disconnect the compressor and lock it out to prevent restarting.

**WARNING**

**Risk of injury from hot bleeder valve**
The outlet temperature of the compressed air can be as high as 90°C / 194°F.
- Allow the compressor system to cool down before opening the bleeder valve.
- Do not work on the compressor system when it is hot.

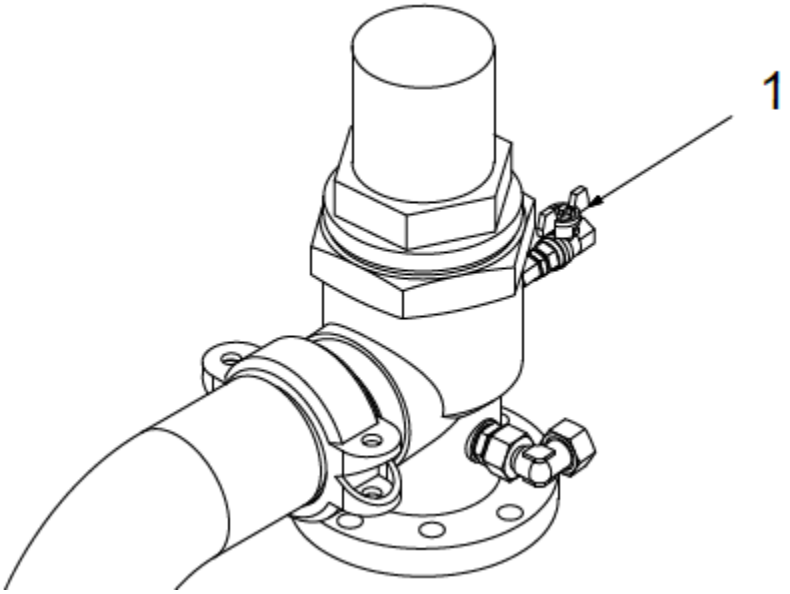



Figure 8-1 Bleeder valve position for air-cooled compressor systems

1. Bleeder Valve

**Protection measures for safe maintenance (Safety routine)**

For all maintenance work, if not expressly otherwise stated:

1. Lockout and Tagout.
2. Allow the compressor to come to a stop.
3. Wait for automatic pressure relief.
4. Close the shutoff valve (customer provided) in the supply line.
5. Wait until the residual electrical energy in the capacitors has dissipated (only units with Variable Frequency Drives).
6. Cool the compressor down to room temperature.
7. Wear personal protective equipment.
8. Follow instructions regarding hazardous materials.

**Manual pressure relief**

| ⚠ WARNING | |
|---|---|
|  | **Pressurized components**<br>Even when the compressor is relieved of pressure, the aftercooler remains pressurized.<br>➢ Perform pressure relief manually, before maintenance work is performed near the aftercooler. |

1. Close the shutoff valve (customer provided) in the supply line.
2. Lockout and Tagout.
3. Open the enclosure, create access.
4. Undo the lock screw on the closed air vent valve (ball valve at the pressure-retaining valve).
5. Relieve the pressure in the aftercooler by carefully opening the pressure relief valve.
6. Close the vent valve and screw in the sealing screw.
7. After maintenance work is complete, open the shutoff valve in the supply line.

**Test run**

After any maintenance work, a test run should be performed to locate any leaks, among other things. For each test run, proper and quiet performance of the compressor should also be ensured.

**Electrical components**

| ⚠ DANGER | |
|---|---|
|  | **Electric shock**<br>Dangerous electrical voltage<br>➢ Work on the electrical equipment may be performed only by specialized electrical technicians.<br>➢ Only units with Variable Frequency Drives, there is a risk of electric shocks due to charged capacitors! Isolate the compressor and wait 10 minutes before touching any electrical parts.<br>➢ Check the DC bus voltage. |

**Checking the DC bus voltage of the frequency inverter**

The DC bus voltage is measured at the grid terminal of the frequency inverter. The exact position of the “DC+” and “DC-” terminals can be found in the included operating instructions for the frequency converter.

1. Measure the voltage between terminals DC+ and DC-.
2. Measure the voltage between the terminal DC+ and the chassis.
3. Measure the voltage between the terminal DC- and the chassis.

The voltage must be zero for all three measurements.

**Water-Cooled compressors**

When operating water-cooled screw compressor units please observe the following points.

- In case of leakage a part of the oil in oil/water coolers may penetrate into the cooling water circuit. Cooling water must not be discharged into public sewage systems in an uncontrolled manner. Exclude uncontrolled overflow of oil from separating basins into public sewage systems. Carefully comply with the sewage regulations and guidelines.
- Carefully perform maintenance and repairs. Removed tube bundles must be checked for damage before reinstallation (and replaced even in case of minor damage). When assembling always use new seals.

## 8.2 Service

For any spare parts needed, the local Gardner Denver branch or representative retailer is available.

The local Gardner Denver subsidiary or the responsible dealer is available for any spare parts requirements.

It is important to provide the model name and serial number of the compressor in all communications.

| NOTICE |
| --- |
| Order spare parts on the basis of the separately provided spare parts list. |

## 8.3 Inspection of Protective and Safety Devices

**Protective covers and enclosure panels**

Ensure that all protective covers and enclosures of the compressor are installed correctly.

- Protective cover for cooling airfans
- Protective cover of the coupling between the drive and compressor
- Compressor housing; here especially the openings (doors)

**Pressure Relief Valve** must be in perfect condition. For example, it must not be blocked by dirt or paint.

**Emergency Stop Pushbutton / Emergency Stop Function**

The switching function of the contacts can be checked by an electrician.

| NOTICE |
| --- |
| The emergency stop function may be actuated only in dangerous situations. Otherwise increased wear, up to and including damage to the compressor, can be expected. |

**Functional check of the Pressure Relief Valve**

The functional checking of the pressure relief valve must be carried out by a safety specialist. The result of the functional check must be documented.

1. Lockout and Tagout.
2. Open the enclosure, create access.
3. Press start button < I > to allow the compressor to run under load.
4. Rotate the valve cap counter-clockwise until a clear blow-off is heard.
5. Turn the valve cap clockwise up to the stop. The valve must shut fully again.

| NOTICE |
| --- |
| **Hearing damage**<br>Increased sound pressure level when operated without noise-reducing enclosure.<br>➢ Wear hearing protection. |

| ⚠ WARNING | |
|---|---|
|  | **Risk of burns/scalding**<br>Risk of burns/scalding due to escaping hot oil (oil mist) / hot compressed air.<br>➢ Wear suitable protective clothing.<br>➢ Slowly unscrew the knurled cap.<br>➢ Do not unscrew the knurled cap too far out of the housing.<br>➢ Tighten the knurled cap to the stop again after every functional test. |

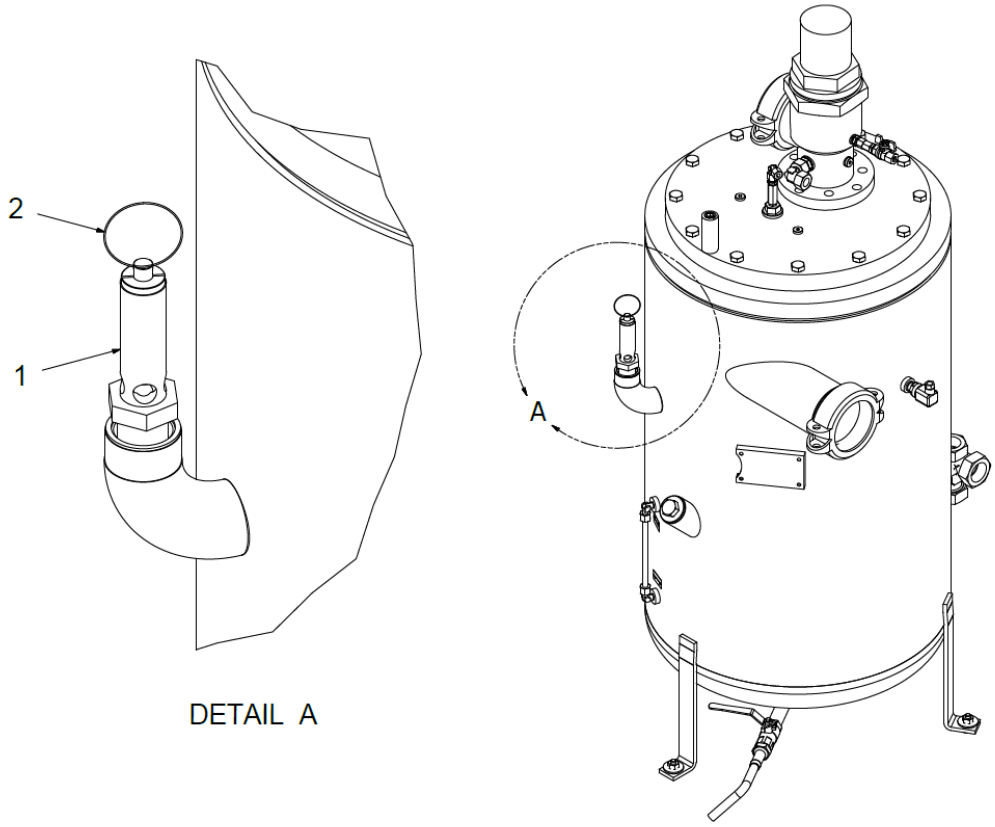



Figure 8-2 Pressure Relief Valve

1. Pressure Relief Valve
2. Pull Ring

## 8.4 Routine Maintenance

All maintenance work and testing listed in the maintenance plan must be performed and documented at the intervals listed.

All maintenance, repairs, and service work performed on the compressor must be documented.

Service and maintenance work should be performed by the local Gardner Denver representative.

### Cleanliness

The compressor room and the environment of the compressor must always be kept clean.

The compressor must be checked regularly for damage and excessive wear.

Spilled oil must be wiped up immediately. Oil traces must be removed immediately.

### Electrical connections

The condition of cables and terminals must be checked regularly.

- Watch for loose connections or worn wires. All connections must be clean and tight.
- Replace worn or damaged wires or cables immediately.

### Leak points

| ⚠ WARNING | |
|---|---|
|  | **Risk of injury due to high pressure**<br>➢ Do not use the hand to search for leaking points in the system.<br>➢ Always use paper or cardboard for this purpose. |

- If a leak is suspected, check the appropriate area for leaks.
- Immediately repair or replace damaged or leaking pipe and hose connections.

### Emission or leakage of consumable materials

The following consumables are used in the compressor:

- Compressor oil AEON 9000SP
- POLYREX EM lubricating grease

In case of accident or extended contact with consumable materials, follow the instructions on the material safety data sheets.

Prevent leakage of operating fluids.

Carefully clear up any operating fluids that escape. Observe the information in the hazardous substance data sheets!

### Oil coking in the lubricating oil system.

High oil temperatures reduce the service life of the oil, which can lead to oil coking in the oil lubrication system. Deposits of oil coke can cause damage to bearings and gearboxes.

## 8.5 Maintenance Schedule

**⚠ DANGER**

**High Voltage**
**Hazard of shock, burn or death**

- Work on the electrical equipment may be performed only by specialized electrical technicians.
- Only units with Variable Frequency Drives, there is a risk of electric shocks due to charged capacitors! Isolate the compressor and wait 10 minutes before touching any electrical parts.
- Be careful of the hot surfaces of machine parts when carrying out checks, making settings and doing maintenance.

**⚠ WARNING**

Some parts of the system will still be pressurized after the system has been switched off. Small parts propelled at high speed by compressed air can penetrate the skin or destroy an eye.
Only perform checks and maintenance after observing the following:

- Press the STOP button on the control panel and wait until the screw compressor comes to a stop and the screw compressor unit is depressurized.
- The pressure gauge shows no more than < 4.4 PSI.
- Shortly after shutting off the screw compressor unit a small residual pressure may remain.
- Therefore, before any maintenance work, the screw compressor unit must be relieved by slowly opening the screw plug (oil filling opening) with integrated air vent slots.
- Set the on-site main switch to “0” (OFF) and secure it against being switched on.

### Service Check List

#### Every 8 hours operation

1. Check air/oil reservoir oil level, add oil if required. **DO NOT MIX LUBRICANTS**.
2. Check operation of the machine, is it loading and unloading properly.
3. Check discharge pressure and temperature.
4. Check control panel for advisory text messages.

#### Every 125 hours operation

1. Check for dirt accumulation on oil/aftercooler core faces and the cooling fan. If cleaning is required, clean the exterior fin surfaces of the cores by blowing compressed air carrying a nonflammable safety solvent that will not damage aluminum in a direction opposite that of the cooling air flow. The cleaning operation will keep the exterior cooling surfaces clean and ensure effective heat dissipation.

### Service Change List

| Component | Change Interval |
|---|---|
| Oil Filter | Every **2000 hours** or **6 months,** whichever occurs first |
| Oil Sample | Every **2000 hours** or **6 months,** whichever occurs first |
| Lubricant | Change per recommendations of the Oil Analysis or hour Life rating of lubricant or as indicated by controller or **12 months,** whichever occurs first |
| Air/Oil Separator | Every **4000 hours** or **12 months,** whichever occurs first |
| Inlet Air Filter | Every **2000 hours** or **6 months,** whichever occurs first |
| Control Box Filter | Every **2000 hours** or **6 months,** whichever occurs first |
| Cabinet Air Filter | Every **2000 hours** or **6 months,** whichever occurs first |

| Maintenance Schedule | As indicated by Governor | Every 8 hours of operation | Every 125 hours of operation | Per oil analysis results | 6 months or 2000 hours | 12 months or 4000 hours | 18 months or 6000 hours | 24 months or 8000 hours | 30 months or 10000 hours | 36 months or 12000 hours | 42 months or 14000 hours | 48 months or 16000 hours | 54 months or 18000 hours | 60 months or 20000 hours | 66 months or 22000 hours | 72 months or 24000 hours | 78 months or 26000 hours | 84 months or 28000 hours | 90 months or 30000 hours | 96 months or 32000 hours | 102 months or 34000 hours | 108 months or 36000 hours | 114 months or 38000 hours | 120 months or 40000 hours |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Replace Oil Filter element | x | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Oil Sample | | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Replace Lubricant * | x | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Replace Air Filter element | x | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Replace Air/Oil Separator | x | | | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Replace Cabinet Air Filter Pad | | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Replace Control Box Filter (if app.) | | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Check Air/Oil Reservoir oil level | | x | | | | | | | | | | | | | | | | | | | | | | |
| Check operation of the machine, is it loading and unloading | | x | | | | | | | | | | | | | | | | | | | | | | |
| Check discharge pressure and temperature | | x | | | | | | | | | | | | | | | | | | | | | | |
| Check control panel for advisory text messages | | x | | | | | | | | | | | | | | | | | | | | | | |
| Check Pressure Relief Valve | | | | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Inspect, clean if necessary Cooler / Fan | | | x | | | | | | | | | | | | | | | | | | | | | |
| Inspect, clean if necessary Scavenge Line, replace check valve | | | | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Inspect, service if necessary Inlet Valve | | | | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Inspect, visually check for leakage Shaft Seal | | | | | x | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Inspect, re-grease if necessary Motor Bearings | | | | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Inspect, replace if necessary Min. Pressure/Check Valve | | | | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Inspect, replace if necessary Condensate Drains | | | | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Inspect, replace if necessary Solenoid Valves / Vacuum | | | | | | x | | x | | x | | x | | x | | x | | x | | x | | x | | x |
| Inspect, replace if necessary Blow-Down Valve | | | | | | | | x | | | | x | | | | x | | | | x | | | | x |
| Inspect, replace if necessary Thermistor Probes | | | | | | | | x | | | | x | | | | x | | | | x | | | | x |
| Inspect, replace if necessary Pressure Transducer | | | | | | | | x | | | | x | | | | x | | | | x | | | | x |
| Inspect, replace if necessary Control Valves and Pressure Regulator | | | | | | | | x | | | | x | | | | x | | | | x | | | | x |
| Inspect, replace if necessary Thermal Mixing Valve | | | | | | | | x | | | | x | | | | x | | | | x | | | | x |
| Inspect, replace if necessary The Drive Coupling Spider | | | | | | | | x | | | | x | | | | x | | | | x | | | | x |
| Inspect, replace if necessary Hoses | | | | | | | | x | | | | x | | | | x | | | | x | | | | x |

* Drain and change as indicated by Oil Analysis report, hour life rating of lubricant or every 12 months, whichever occurs first.

Electronic controls - Information regarding maintenance points for the electronic controller are found in the operating instructions for the electronic controller.

## 8.6 Maintenance Work

### 8.6.1 Filter Mats

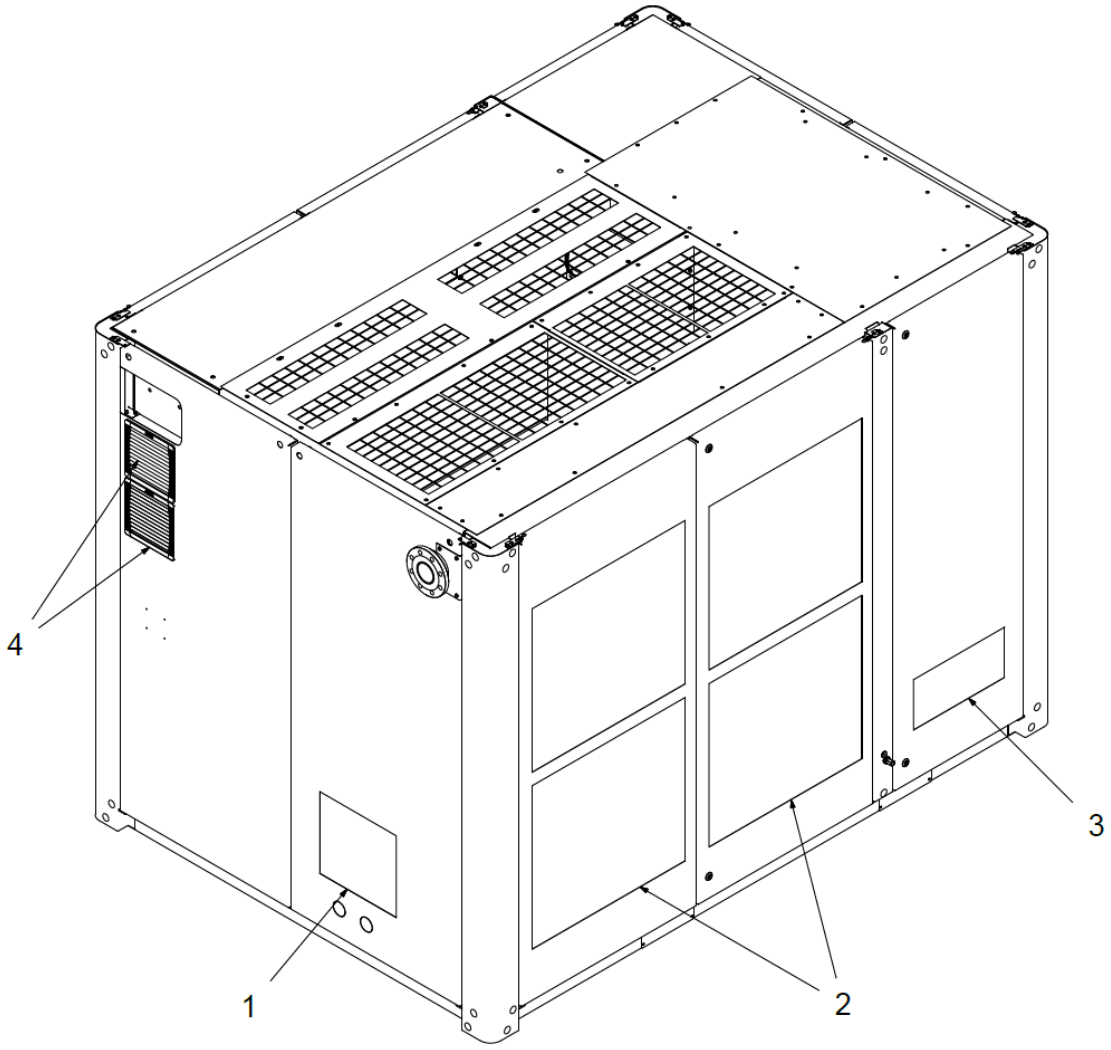



Figure 8-3 Filter mats

1. Motor Cooling Air Inlet
2. Oil Cooler and Aftercooler Cooling Air Inlet
3. Suction Air Compressor Inlet
4. Control System Inlet Filter

**Replacement times for the filter pad**

The operating modes and the quality of the suction air (e.g. dust content) have a significant impact on the service life of the filter pad.

The filter pad should be inspected for dust accumulation at least weekly; daily if possible.

In these usage scenarios, shorter replacement intervals are possible.

As soon as one of the filter pads shows a defect, it must be replaced.

### 8.6.2 Switch Cabinet Inlet Filter

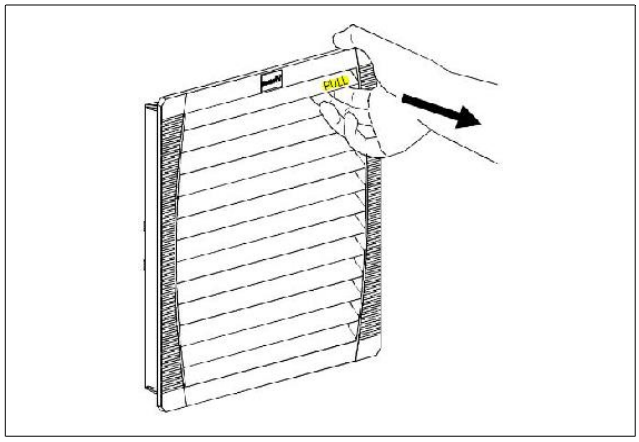



Figure 8-4 Louvered Grille

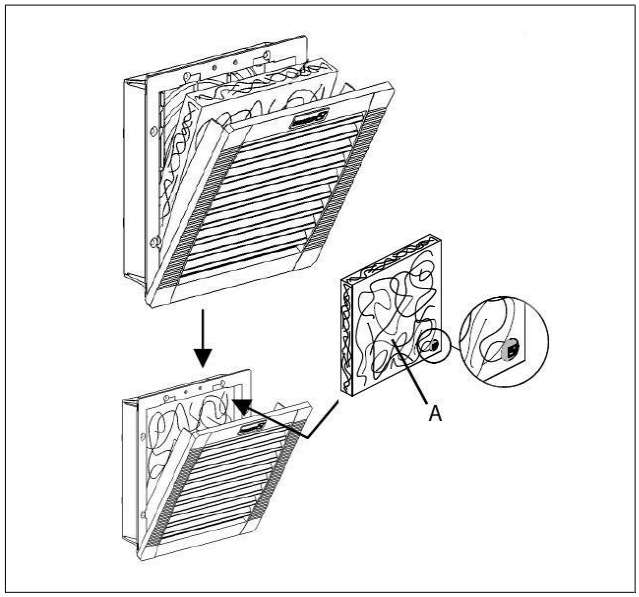



Figure 8-5 Filter Element Replacement

**Change inlet filter**

1. Open the mesh cover on the intake filter.
2. Remove dirty filter.
3. Insert new filter.
4. Close louvered grille.

**Replacement times for the inlet filter elements**

The operating modes and the quality of the suction air (e.g. dust content) have a significant impact on the service life of the filter elements.

The filter elements should be inspected for dust accumulation at least weekly; daily if possible.

If usage scenarios transpire with, for example, a high rate of dust accumulation, the replacement intervals must be shortened in relation to the maintenance plan.

### 8.6.3 Oil Change

**⚠ DANGER**

Air/oil under pressure will cause severe personal injury or death.
Shut down the compressor, relieve the system of all pressure, disconnect, lockout and tagout the power supply to the compressor package before removing valves, caps, plugs, fittings, bolts and filters.

**⚠ CAUTION**

**Fire hazard and slip hazard!**

- Do not spill any oil!
- Oil residue and other deposits must be removed from the compressor coolers which are exposed to hot air in accordance with the user manual.
- Look for leaks! Immediately take care of any spilled oil!

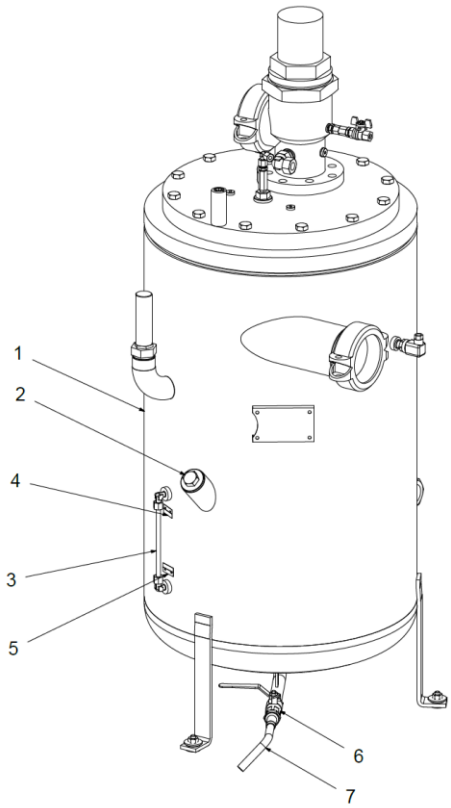
**NOTICE**

Catch the old oil, do not let it drain onto the floor! Dispose of it properly! Do not spill any oil! Look for leaks!

With these compressors, the frequency of the oil changes is closely related to how dirty the circulating oil is. Pay close attention that no foreign substances which can damage the oil (dust, steam, gases) make it through the air intake filter into the compressor unit's oil circuit. Very humid intake air and condensation inside the machine have an influence on the life span of lubricating oil so that the oil change times must also be reduced in this case. The change time intervals given are based on intake air which is normally available and if foreign substances (dust, steam, gases) are not present in large amounts.

When changing the oil, the old oil must be drained as fully as possible, because the used oil strongly decreases the life span of the new oil.

Different lubricating oils must not be mixed. When changing this type of oil, the oil must be completely drained from the oil circuit.




1. Oil reservoir
2. Oil filling G 1 1/2"
3. Oil level indicator
4. Maximum Oil level
5. Minimum Oil level
6. Bleed ball valve R 3/4"
7. Drain hose

Figure 8-6

The changing intervals can be found in the maintenance schedule.

**Perform oil changes as follows:**

- Turn off the screw compressor unit, secure it against accidental restarts and make sure that the demister vessel is depressurized.
- Slowly open the oil screw plug to relieve the screw compressor of any residual pressure in the system.
- Remove the oil screw plug.
- Open the oil drain from the pressure reservoir
- Drain the oil at operating temperature through the drain hose.
- Close the oil drain.
- Fill with oil up to the mark “maximum oil level”.
- Close the oil screw plug.
- Run the screw compressor for approximately 2 minutes.
- Check for leaks.
- Shut off the screw compressor.
- Wait at least 5 minutes until the oil has settled, i.e. until the air has bubbled out.
- Check the oil level.
- The oil level must lie between the “maximum oil level” and “minimum oil level”.
- If necessary, top up the oil.

**Changing times for lubricants**

Operating conditions (e.g., coolant temperatures), the type of operation and the quality of the intake air (e.g., dust content, ratio of gaseous foreign substances such as SO2 and solvent vapors) have a strong influence on the oil change intervals.

In these cases, the operational life of the oil must be checked by performing an oil analysis.

### 8.6.4 Changing the Oil Filter Cartridge

**⚠ DANGER**

Air/oil under pressure will cause severe personal injury or death.
Shut down the compressor, relieve the system of all pressure, disconnect, lockout and tagout the power supply to the compressor package before removing valves, caps, plugs, fittings, bolts and filters.

**⚠ CAUTION**

**Fire hazard and slip hazard!**

- Do not spill any oil!
- Oil residue and other deposits must be removed from the compressor coolers which are exposed to hot air in accordance with the user manual.
- Look for leaks! Immediately take care of any spilled oil!

**NOTICE**

Dispose of the oil filter cartridge properly, it is hazardous waste! Look for leaks!

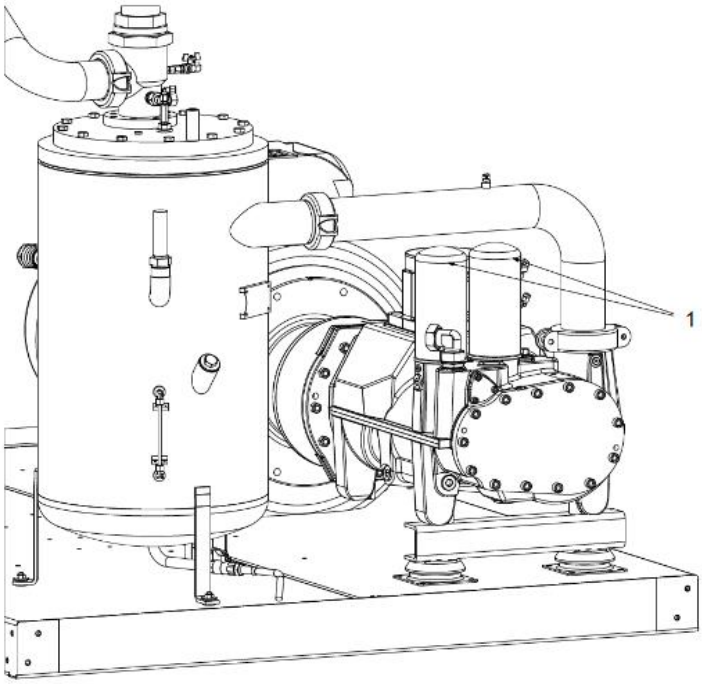



Figure 8-7 Oil filter

1. Oil filter

The changing intervals can be found in the maintenance schedule.

**Replace the oil filter cartridge as follows:**

- Switch off the screw compressor unit, secure it against an accidental restart and ensure that it is depressurized.
- Wait at least 5 minutes until the oil has settled, i.e. until the air has bubbled out.
- Unscrew the oil filter cartridge with a suitable tool.
- Dispose of the oil filter cartridge properly.
- Lightly oil the seal of the new oil filter cartridge.
- Screw on the new oil filter cartridge and tighten by hand (see the notes on the oil filter cartridge)
- Let the screw compressor unit run for approx. 2 minutes.
- Check for leaks.
- Check the oil level.
- If necessary, top up the oil.

**Changing times for oil filter cartridges**

Operating conditions (e.g., coolant temperatures), the type of operation and the quality of the intake air (e.g., dust content, ratio of gaseous foreign substances such as SO2 and solvent vapors) have a strong influence on the filter lifespan (air filter, oil filter, fine separator).

In these cases the intervals between changes may be shorter.

| ⚠ WARNING | |
|---|---|
|  | **Scalding hazard**<br>Scalding hazard from hot oil.<br>➢ Change the oil filter only when the compressor is stopped and not pressurized.<br>➢ Use caution when draining out the hot oil. |

### 8.6.5 Oil Fine Separator

**⚠ DANGER**

*Air/oil under* pressure will cause severe personal injury or death.
Shut down the compressor, relieve the system of all pressure, disconnect, lockout and tagout the power supply to the compressor package before removing valves, caps, plugs, fittings, bolts and filters.

**⚠ CAUTION**

**Fire hazard and slip hazard!**

- Do not spill any oil!
- Look for leaks! Immediately take care of any spilled oil!

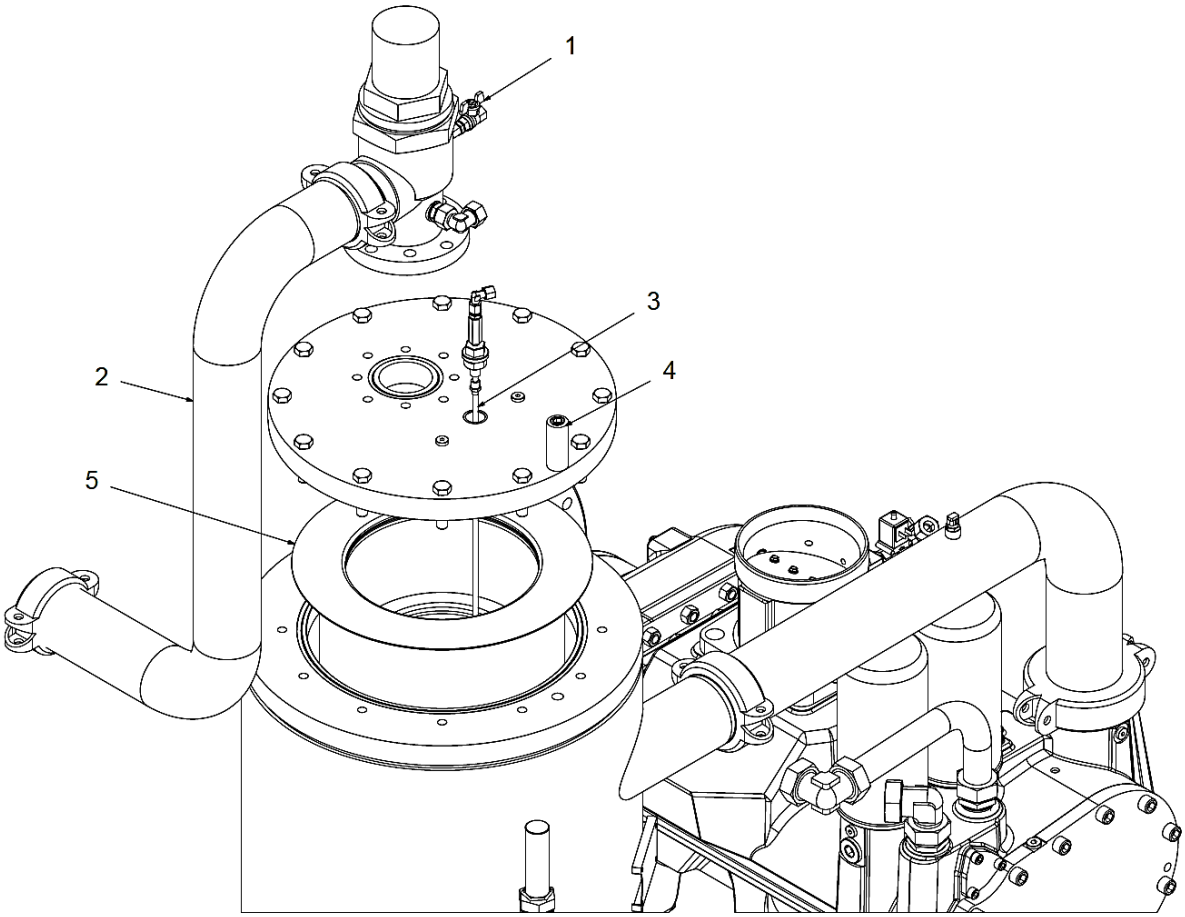



Figure 8-8 Oil Fine Separator

1. Pressure Relief Valve
2. Pressure Pipe
3. Suction Pipe
4. Reservoir Cover Lifting device
5. Oil Fine Separator

**Changing the oil fine separator**

The changing intervals can be found in the maintenance schedule.

If the fine oil separator is monitored (optional), then a differential pressure that is too high will be shown in the control panel of the compressor controller. When the corresponding warning lights up, it is time to change the fine oil separator.

**Replace the fine oil separator as follows (See Figure 8-8):**

- Switch off the compressor and ensure that it is depressurized.
- Detach the plastic oil extraction pipe.
- Detach the plastic control air line.
- Fully remove oil extraction with pressed in extraction tube.
- Loosen all hexagonal head screws from the pressure control valve.
- Loosen the two screws in the swivel direction of the pressure control valve and remove, then the valve can be swiveled inwards.
- Remove all hexagon screws on the circumference of the pressure reservoir's cover.
- The cheese head screw for lifting the reservoir cover must be screwed in clockwise until the cover is lifted off by some mm.
- Pivot the reservoir cover 180°.
- Remove the used fine oil separator.
- Clean all seals and if necessary remove and clean the O-ring.
- Install a new fine oil separator.
- Pivot the reservoir cover back to the starting position.
- Screw the cheese-head screw counter-clockwise until the reservoir cover is lying loosely on the pressure reservoir flange
- Screw in and tighten crosswise all hexagonal screws except for the two screws in the pivot area of the PMV.
- Pivot the PMV back to its starting position and install it with the corresponding screws.
- Then fit the missing hexagonal head screws in the reservoir cover and tighten to a tightening torque of 214Nm / 158 lbs ft. (screw strength class 8.8) or 95Nm / 70 lbs ft. (screw strength class 5.6).
- Tighten the cheese-head screw used to raise the reservoir cover for rotary protection (clockwise).
- Properly reinstall all lines to the pressure reservoir and the oil extractor which have been removed.

**Changing times for the fine oil separator**

Operating conditions (e.g., coolant temperatures), the type of operation and the quality of the intake air (e.g., dust content, ratio of gaseous foreign substances such as SO2 and solvent vapors) have a strong influence on the filter lifespan (air filter, oil filter, fine separator).

In these cases the intervals between changes may be shorter.

### 8.6.6 Air Filter

**DANGER**

Only perform checks and carry out work on the screw compressor when the unit is out of operation, depressurized, and secured from being switched on again!

**NOTICE**

Never operate the screw compressor system without an air filter (even briefly removing it can cause considerable damage to the machine)!

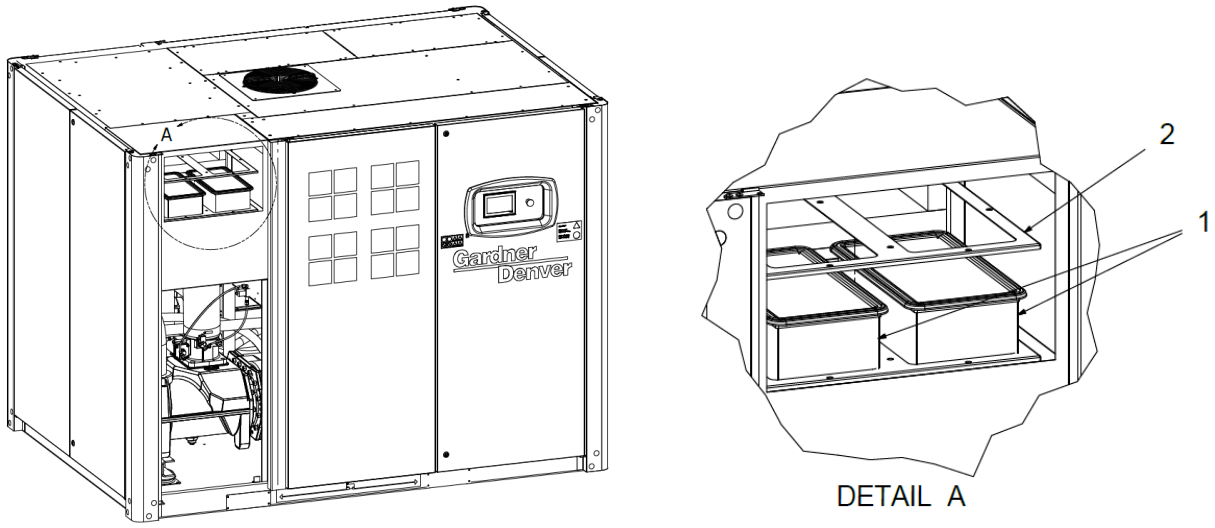



Figure 8-9 Air filter

1. Air filter
2. Pressing frame

The compressor is equipped with two air filters. The air filter serves to filter the intake air. The condition of the air filter must be checked through regular visual inspections.
As a standard, the air filter is provided with a visual in-take filter monitor, which indicates clogging of the air filter cartridge.
When the red service field of the intake filter monitor is visible and remains clicked into position while the screw compressor is out of operation, replace the air filter cartridge.

However, the air filter cartridge should be replaced per the Maintenance Schedule. Check air filter at least once a week or, if required, daily for the accumulator of dust. When carrying out maintenance work, make sure that no dirt gets to the clean air side of the air filter.

**Changing intervals for air filter cartridge**
The operating conditions (e.g., coolant temperatures), the operating modes and the quality of the intake air (e.g., content of dust, content of gaseous foreign substances such as SO2 and solvent vapors, etc.) have a strong influence on the service life of the filters (air filters, water filters, fine separators).
Where such conditions exist the filter element may require changing more frequently.

**Check the air filter**

1. Switch OFF the main disconnect switch and secure it against switching on again.
2. Open the enclosure, create access.
3. Check filter elements.
   - Replace filter elements if heavily soiled.
4. Close the enclosure.

**Change the air filter element**

**NOTICE**

**Property damage**
Operating the compressor without an air filter, even for a short time, can cause severe damage to the compressor.
- ➢ Never operate the compressor without an air filter.
- ➢ Dirt must not be allowed to enter the clean air side of the air filter!

1. Switch off the main disconnect switch
2. Open the enclosure, create access.
3. Release pressing frame.
4. Replace filter elements.
5. Attach pressing frame (hexagonal screw tightening torque < = 8Nm / 71 ft. lbs.
6. Close the enclosure.

### 8.6.7 Pressure Relief Valve

**⚠ DANGER**

When checking pressure relief valve, there is an explosive release of pressure.
Failure to perform this operation in a safe manner or without safety equipment may result in personal injury or death.
- ➢ Use the appropriate safety equipment, hearing and eye protection, and use safety precautions when performing this Pressure Relief Valve check on an operating machine.
- ➢ A defective pressure relief valve may result in pressure that is too high, breaking open parts of the system and causing serious or fatal injury.
- ➢ Never operate a screw compressor system with a defective pressure relief valve or without pressure relief valve!

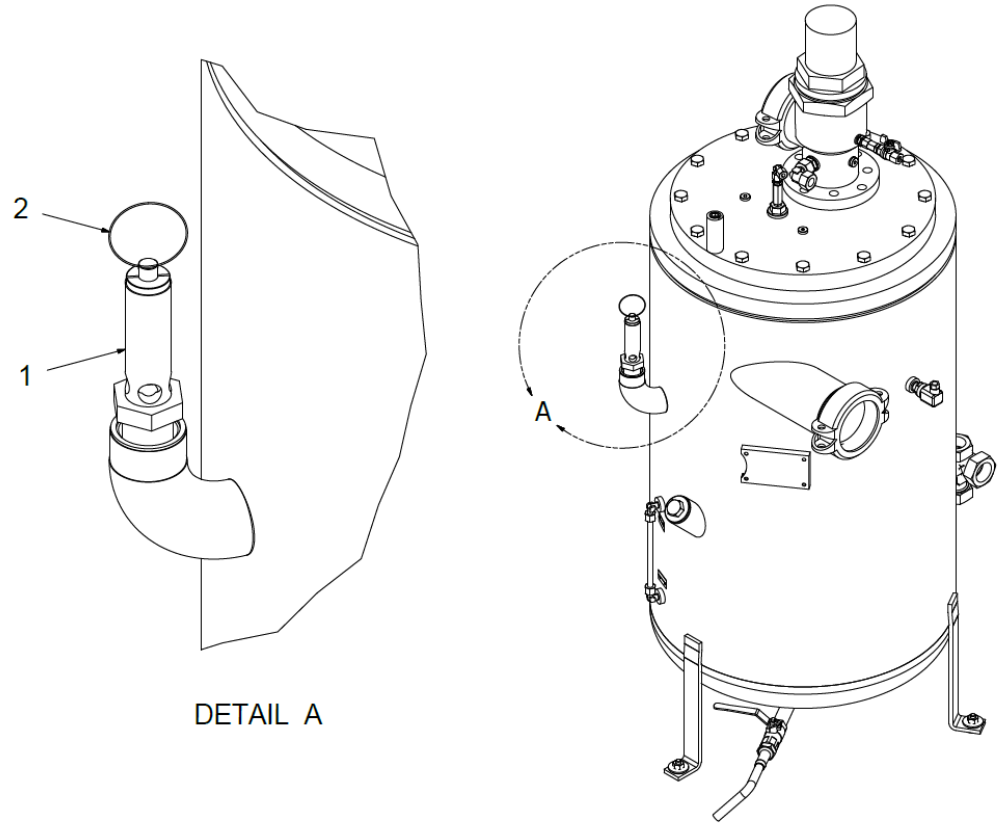



Figure 8-10 Pressure Relief Valve

1. Pressure Relief Valve
2. Pull Ring

The pressure relief valve has no user serviceable or repairable components.

**Testing the pressure relief valve**

The valve can be tested:

**1.** On a separate compressed-air system.
2. When raising the system operating pressure to its normal level.
3. Operating the pull ring.

Keep local legislation in mind when testing.

If the pressure relief valve doesn't close itself or is leaky, close the doors of the compressor and push the Stop Button. After the pressure in the pressure reservoir is reduced to ambient pressure, renew the pressure relief valve.

### 8.6.8 Connecting Terminals in the Switch Cabinet

| ⚠ DANGER | |
|---|---|
|  | **Electric shock**<br>Deadly electrical voltage<br>➢ Exercise extreme caution when working with electrical equipment.<br>➢ Before starting maintenance work, disconnect the compressor and lock it out to prevent restarting.<br>➢ Only qualified electricians may work on the control cabinet.<br>➢ Only perform checks and carry out work on the screw compressor when the unit is out of operation, depressurized, and secured from being switched on again!<br>➢ Push the STOP button on the compressor controller. After the soft-stop time (30 sec.), set the on-site main switch to “0” (OFF) and secure it against being switched on.<br>➢ Only units with Variable Frequency Drives, there is a risk of electric shocks due to charged capacitors! Isolate the compressor and wait 10 minutes before touching any electrical parts.<br>➢ Disconnect the system from the mains and wait 10 minutes before touching electrical components. The power capacitors need this time to discharge. |

The connecting terminals in the switch cabinet have to be checked and, if required, re-tightened during first commissioning and afterward according to the maintenance schedule.

### 8.6.9 Maintenance Instructions and Lubricant Recommendations for Fixed Compressors

**Lubricant recommendation**

Please note that proper lubrication can significantly increase the lifespan of your compressor system.

In accordance with valid accident prevention regulations, lubricating oils should be used whose characteristics correspond to the expected operating conditions.

Avoid mixing different lubricating oils, i.e. when changing the oil type, first completely drain the old oil from the oil circuit.

If seal temperatures are constantly above 195°F divide the oil change intervals given in Maintenance schedule by half.

The exact oil change schedule according to the actual operating conditions should be set by performing oil tests.

Material Safety Data Sheets (MSDS) are available for all Gardner Denver lubricants from your authorized Gardner Denver distributor or by calling Gardner Denver-USA at 1(800) 682-9868.

**The following types of oil are to be used:**

- AEON 9000SP
- AEON 9000TH (optional)
- AEON 6000FG-46 (optional)
- AEON 9000FG (optional)

**Motor Lubrication**

Long time satisfactory operation of an electric motor depends in large measure on proper lubrication of the bearings. The following chart show recommended grease qualities and regreasing intervals for ball bearing motors. For additional information refer to the motor manufacturer's instructions. The following procedure should be used in regreasing:

1. Stop the unit.
2. Disconnect, lockout and tagout the unit from the power supply.
3. Remove the relief plug and free hole of hardened grease.
4. Wipe lubrication fitting clean and add grease with a hand-operated grease gun. Only enough grease should be added to replace the grease used by the bearing. Too much grease can be as harmful as insufficient grease. The grease cavity should be about 1/2 full.
5. Leave the relief plug temporarily off. Reconnect the unit and run for about 20 minutes to expel the excess grease.
6. Stop the unit. Replace the relief plug.
7. Restart the unit.

**Electric Motor Regreasing Interval**

| Type of Service | Typical | Rating | Relubrication Interval |
|---|---|---|---|
| Standard | One or Two Shut Operation (Non-Continuous) | Up to 150 HP (112kW) | 18 Months |
| | | Above 150 HP (112kW) | 12 Months |
| Severe | Continuous Operation | Up to 150 HP (112kW) | 9 Months |
| | | Above 150 HP (112kW) | 6 Months |
| Very Severe | Dirty Locations, High Ambient Temperature | Up to 150 HP (112kW) | 4 Months |
| | | Above 150 HP (112kW) | 3 Months |

# 9 APPENDIX

## 9.1 Decommissioning

**Routine decommissioning**

Routine decommissioning includes, for example, decommissioning for maintenance work.

1. Lockout and Tagout.
2. Close the shutoff valves between the compressor and the compressed air network.
3. Relieve the pressure in the aftercooler by carefully opening the pressure relief valve.

**Decommissioning for an extended period of time.**

For decommissioning for more than six months, contact Gardner Denver.

**Final decommissioning**

In order to prevent renewed commissioning of the compressor or misuse by unknown persons, the compressor must be rendered unusable.

The compressor is made unusable by removing the electronic controller. Consult Gardner Denver.

## 9.2 Consumables and Auxiliary Materials

The compressor contains approximately 120 liters / 31.7 gal of oil.

There are two grease cartridges in the lubricator of the drive motor.

**Material safety data sheets**

When handling consumables and auxiliary materials, the associated material safety data sheets must be adhered to.

Lubricating oil: AEON 9000SP
Lubricating grease: MOBIL POLYREX EM

| NOTICE |
| --- |
| The following aspects must be taken into account for storage of storing compressors.<br>The compressor should be stored in a dry building which should be heated if possible. This is particularly true during the months of winter.<br>The coolant is to be completely drained where there is a risk of frost (t < 34°F) (compressor stage, coolers, system containers, water filters, storage containers, RO unit, lines, and valves).<br>If there is a risk that the temperature will fall or rise above the limits of 14°F to 149°F, the electrical controller must be removed and stored in ambient temperatures of 41°F to 86°F. |

## 9.3 Disassembly

**⚠ WARNING**

**Damage to health**
Risk of damage to health from consumables and auxiliary materials
Consumables and auxiliary materials can cause irreparable damage to health, induce allergies, or irritate mucous membranes.

- ➢ Follow the locally applicable operating instructions and hazardous material safety data sheets when handling consumables and auxiliary materials.
- ➢ Avoid direct contact with consumables and auxiliary materials. Wear personal protective equipment.
- ➢ In case of injuries associated with consumables and auxiliary materials, consult a physician and indicate the material involved.

Keep the safety data sheet for the causative material available.

**⚠ CAUTION**

**Slip hazard**
Slip hazard due to spilled consumables

- ➢ Clean up escaped consumable materials immediately.
- ➢ Avoid direct contact with consumables. Wear personal protective equipment.

**Prerequisites**

- The compressor is shut down.
- The compressor is electrically disconnected.
- The main disconnect switch is switched to OFF and secured against restarting.
- The compressor is not pressurized.
- Liquids and greases are removed to the greatest extent possible.

**⚠ DANGER**

**Electric shock**
Deadly electrical voltage

- ➢ Work on the electrical equipment may be performed only by authorized electrical technicians.

1. Disconnect the feed cables. See wiring diagram.
2. Remove the feed cables.
3. Apply seal plugs to the feed line openings.

**Removing the pipework**

1. Disconnect the compressed air connection.
2. Disconnect the condensate drain lines.
3. Allow the condensate to drain out completely.
4. Clean up any escaped condensate immediately.

**Draining the lubricating oil**

1. Open the enclosure, create access.
2. Place a suitable container below the oil drain.
3. Open the drain valve and allow oil to drain out completely. Dispose of the lubricating oil.
4. Close the drain valve.
5. Close the enclosure.

**Remove the oil filter**

1. Remove all oil filters in the lubrication system. Dispose of the filters.
   - Oil filter
   - Oil fine separator

**Remove the air filter**

1. Remove all filter elements and filter mats. Dispose of filter elements and filter mats.
   - Air filter cartridge
   - Filter mat
   - Switch cabinet cooling air inlet filter
   - Control air filter

## 9.4 Disposal

**General**

The compressor must be dismantled and removed by technicians. The applicable local safety and environmental protection regulations must be complied with.

When disposing of materials that are hazardous to health, the instructions on the corresponding material safety data sheets must be followed.

Packaging materials, cleaning agents, and used or residual consumables must be fed to recycling in accordance with the regulations applicable at the installation site.

## 9.5 Installation Plan

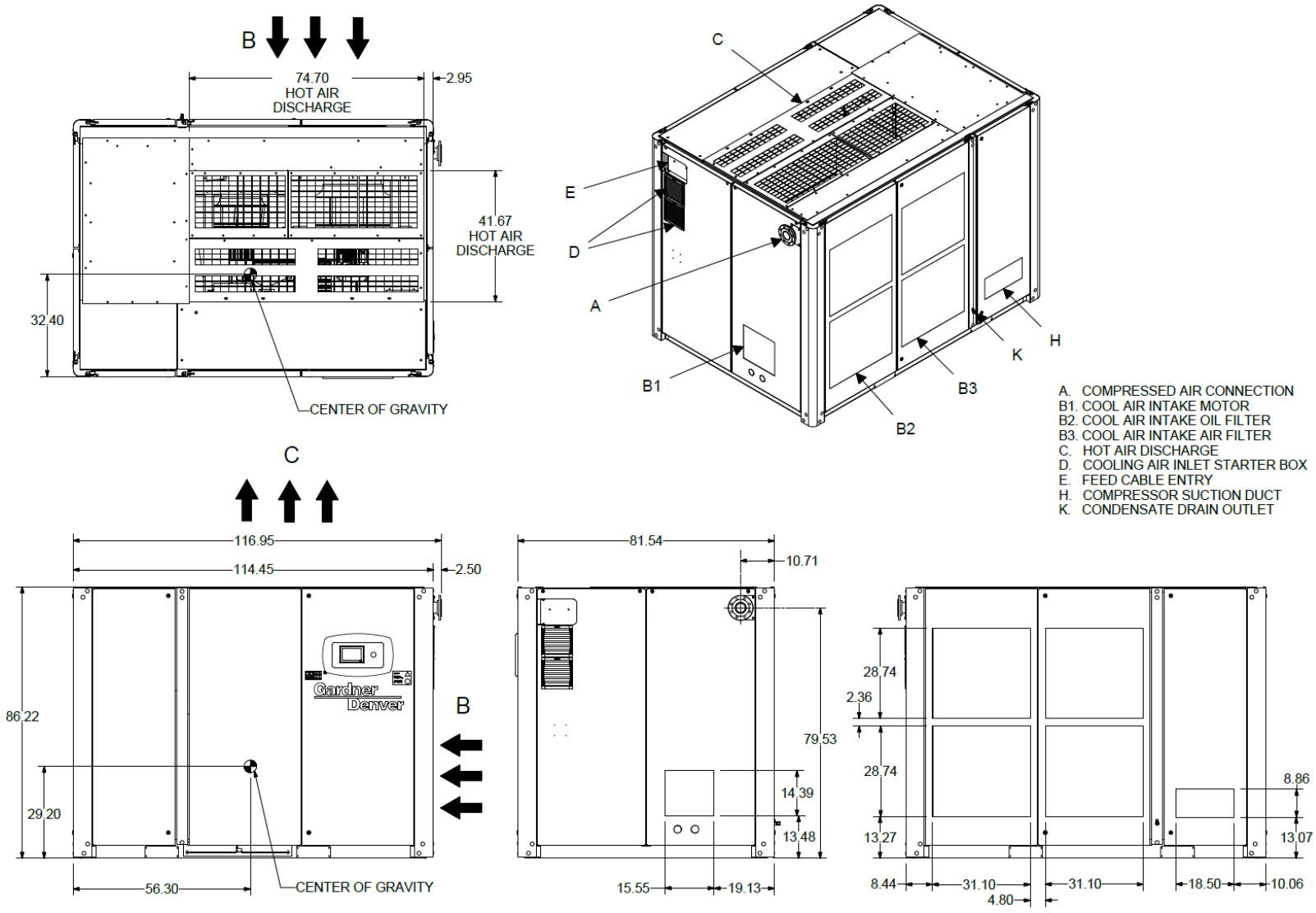



Figure 9.1 Air-Cooled Unit (all dimensions in inches)

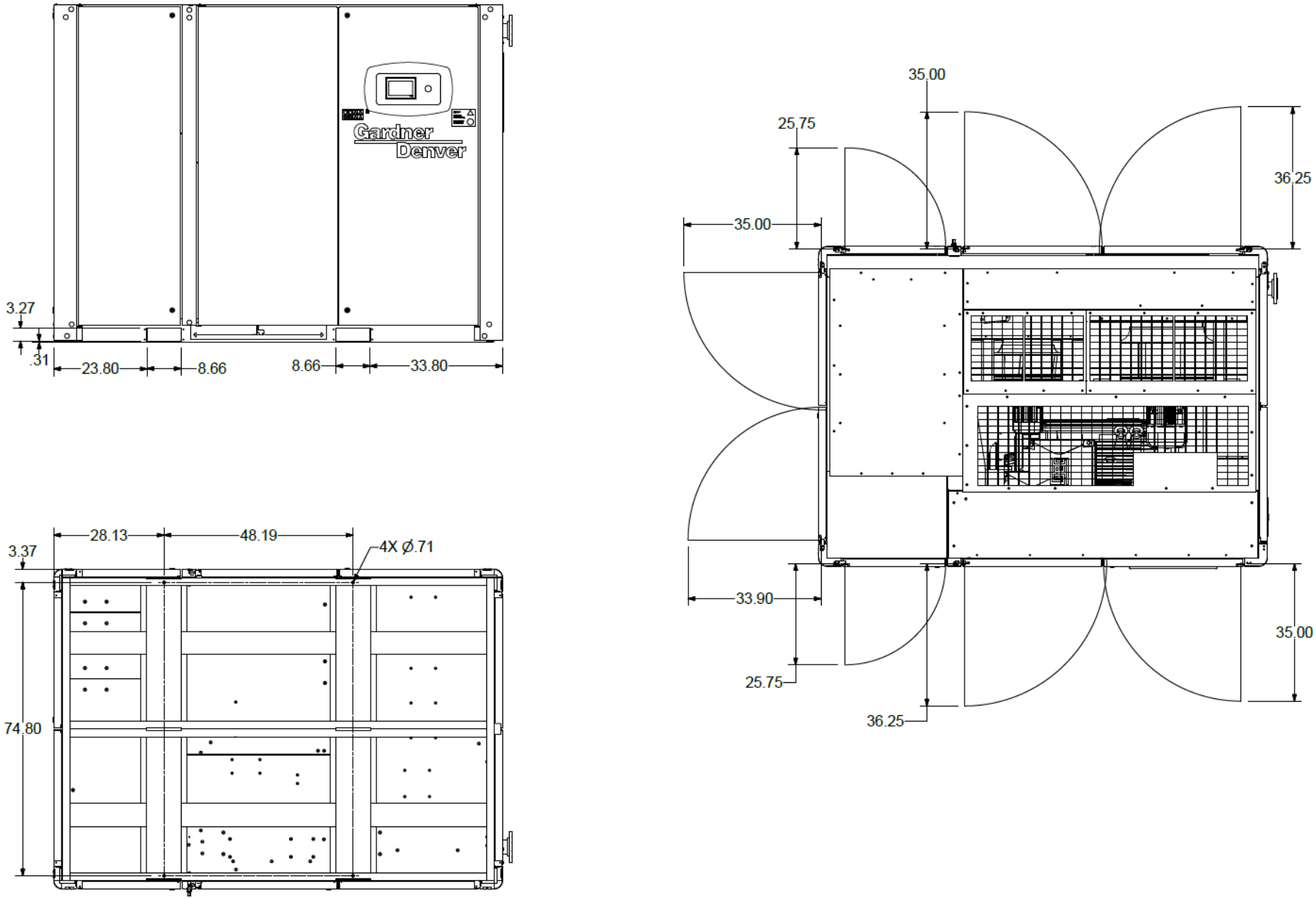



Figure 9.2 Air-Cooled Unit (all dimensions in inches)

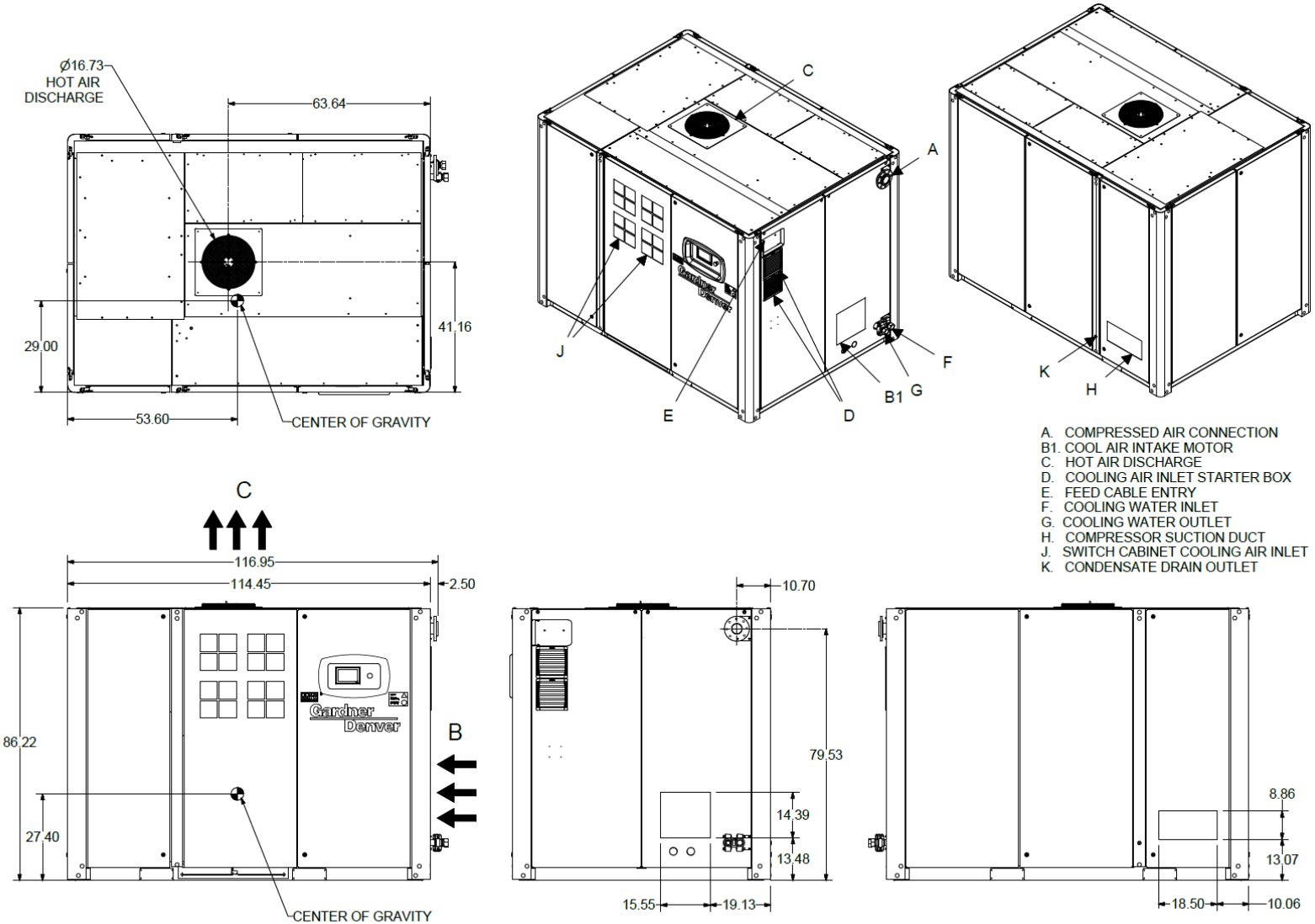



Figure 9.3 Water-Cooled Unit (all dimensions in inches)

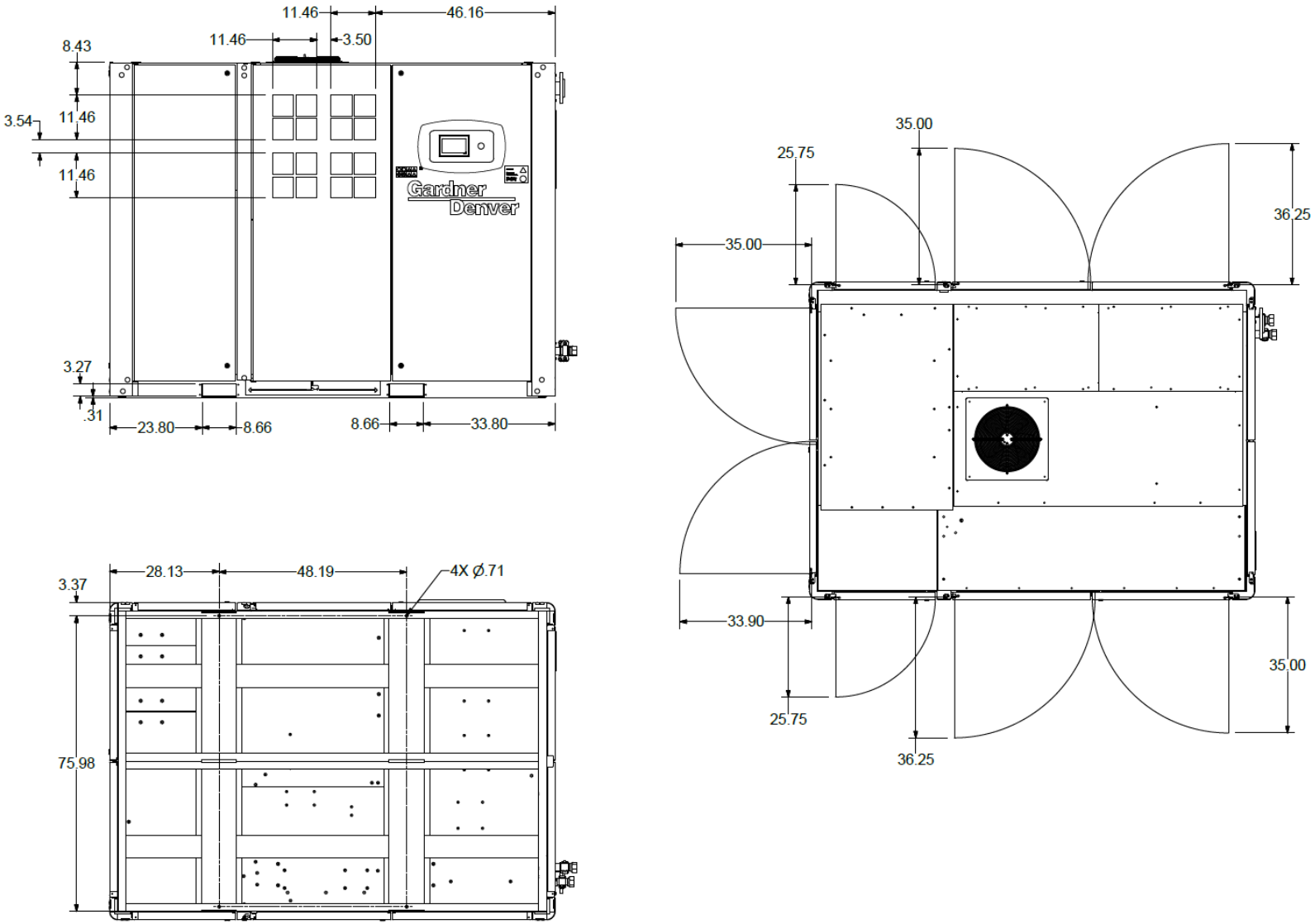



Figure 9.4 Water-Cooled Unit (all dimensions in inches)

**NOTES:**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