

# Atlas Copco

Vacuum booster pumps  
ZRS 250, ZRS 500, ZRS 1200,  
ZRS 2600, ZRS 4200



Instruction Book

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Issue A

*Atlas Copco*

## EC DECLARATION OF CONFORMITY

We, Atlas Copco Airpower n.v., declare under our sole responsibility, that the product

Machine name: VACUUM BOOSTER  
Machine type: ZRS 250, ZRS 500, ZRS 1200, ZRS 2600, ZRS 4200  
Serial number: This declaration covers all product serial numbers from the date this Declaration was signed onwards.

Which falls under the provisions of article 12.2 of the EC Directive 2006/42/EC on the approximation of the laws of the Member States relating to machinery, is in conformity with the relevant Essential Health and Safety Requirements of this directive.

The machinery complies also with the requirements of the following directives and their amendments as indicated.

Directive on the approximation of laws of the Member States relating to		Harmonised and/or Technical Standards used
Machinery safety	2006/42/EC	EN 1012-2
Low voltage equipment	2006/95/EC	EN 60034-1

Atlas Copco Airpower n.v. is authorised to compile the technical file.

### Conformity of the product to the specification and by implication to the directives

Issued by: Engineering

Name: Andries Desiron

Signature:



Date: 01/06/2014

# Atlas Copco

## Vacuum booster pumps

ZRS 250, ZRS 500, ZRS 1200, ZRS 2600, ZRS 4200

### Instruction book

Original instructions

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This instruction book is valid for CE as well as non-CE labelled machines. It meets the requirements for instructions specified by the applicable European directives as identified in the Declaration of Conformity.

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## Associated Publications

Publication title	Publication number
Vacuum pump and vacuum system safety	6996 0222 10
Ultragrade 15, 19, 20 and 70 SDS	0017 5202 40

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# 1 Introduction


## 1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Atlas Copco ZRS 250, ZRS 500, ZRS 1200, ZRS 2600 and ZRS 4200 mechanical booster pumps.

Where appropriate, the title ZRS mechanical booster pump is abbreviated to ZRS pump, in the remainder of this manual.


You must use your ZRS pump as specified in this manual.


Read this manual before you install and operate your ZRS pump. Important safety information is highlighted as WARNING and CAUTION instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS is defined below.

	<b>WARNING</b> Warnings are given where failure to observe the instruction could result in injury or death to people.
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<b>CAUTION</b> Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.
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The units used throughout this manual conform to the SI international system of units of measurement.

	Warning – refer to accompanying documentation.
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	Warning – risk of electric shock.
---	-----------------------------------

	Warning – hot surfaces.
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## 1.2 Description

### 1.2.1 Overview

The ZRS pumps are compact and have high pumping speeds. You must use the ZRS pump with a suitable backing pump delivering at least 1/10th of volumetric capacity of the booster pump. The ZRS pumps can operate with a maximum continuous inlet pressure of 1000 mbar. You can achieve lower system pressures by the use of two or more ZRS pumps in series.

On all ZRS pumps, the hydrokinetic drive/gearbox is connected to the pump outlet by a pressure equalisation passageway, and forms an integral part of the vacuum system. The connecting passageway has a filter which removes debris and so prevents contamination of the lubricating oil and bearings. For an even cleaner system, you can evacuate the end-cover/gear cover by connection of the evacuation port (Figure 1, item 5 or Figure 2, item 6) to the pump-inlet or to an external vacuum pump.

The ZRS pumps uses hydrocarbon oil Ultragrade 20. The ZRS pumps must not be used to pump hazardous chemicals or dusty processes.

All of the ZRS 2600 and ZRS 4200 model pumps have an after-cooler in the pump-outlet, to reduce the exhaust gas and rotor temperature.

The ZRS pumps are safe to handle non-flammable gases and vapours within the normal operating parameters of the pumps, as defined in this manual.

All of the ZRS pumps have ISO-F inlet-flange and outlet-flange connections.

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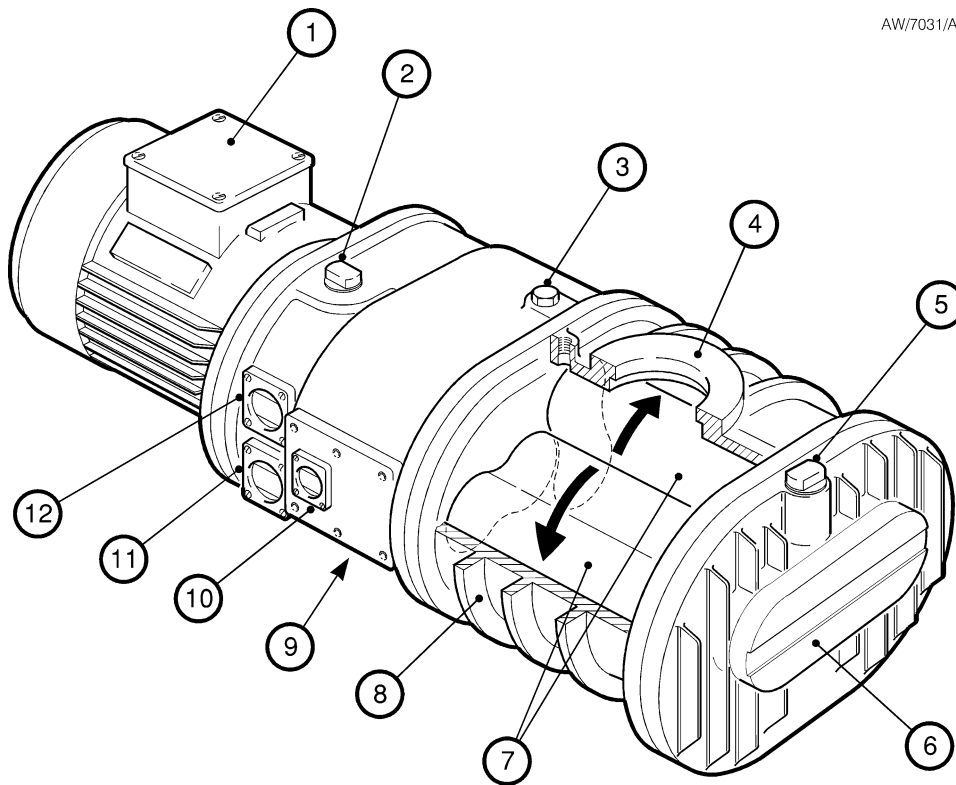


Figure 1 – ZRS 250 and ZRS 500 pump variants

Reference	Designation	Reference	Designation
(1)	Terminal-box	(7)	Rotors
(2)	Shaft-seal reservoir vented oil filler-plug	(8)	Stator housing
(3)	Hydrokinetic drive/gearbox oil filler-plug	(9)	Hydrokinetic drive/gearbox oil drain-plug (under the pump)
(4)	Inlet-flange	(10)	Direction of rotation sight-glass
(5)	External evacuation point	(11)	Oil-level sight-glass (hydrokinetic drive/gearbox)
(6)	End-cover	(12)	Oil-level sight-glass (shaft-seal reservoir)

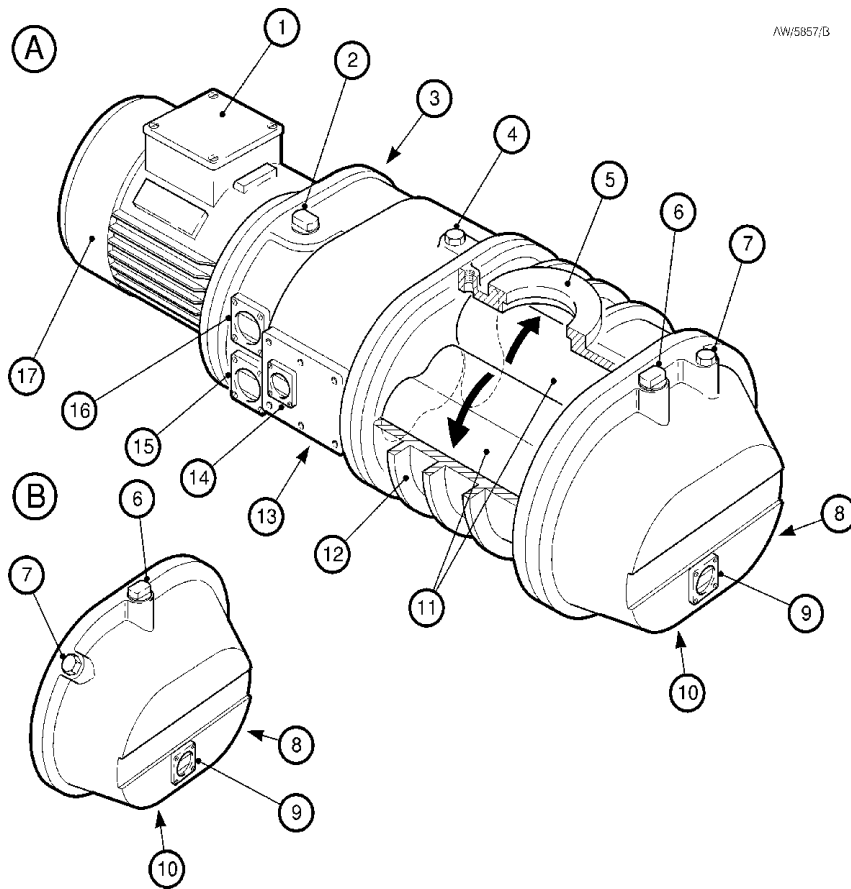


Figure 2 – ZRS 1200, ZRS 2600 and ZRS 4200 pump variants

Reference	Designation	Reference	Designation
(1)	Terminal-box	(10)	Gear-cover oil drain-plug (under the pump)
(2)	Shaft-seal reservoir vented oil filler-plug	(11)	Rotors
(3)	Cooling-water connection	(12)	Stator housing
(4)	Hydrokinetic drive/gearbox oil filler-plug	(13)	Hydrokinetic drive/gearbox oil drain-plug (under the pump)
(5)	Inlet-flange	(14)	Direction of rotation sight-glass*
(6)	External evacuation point	(15)	Oil-level sight-glass (hydrokinetic drive/gearbox)
(7)	Gear-cover oil filler-plug	(16)	Oil-level sight-glass (shaft-seal reservoir)
(8)	Cooling-water connection	(17)	Motor fan cover
(9)	Oil-level sight-glass (gear-cover)		

\* ZRS 1200 pumps only.

(A)	ZRS 2600 and ZRS 4200 pumps	(B)	ZRS 1200 pumps
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### 1.2.2 General construction

The ZRS pumps are positive displacement Roots vacuum pumps. The pump mechanism is driven by a three-phase electric motor through a hydrokinetic drive (see [Section 1.2.4](#)).

The ZRS pumps are all fitted with safe area motors. All of the motors are air-cooled.

The pump shafts and rotors are made of cast SG iron. The internal and external shaft-seals are made of polytetrafluoroethylene (PTFE) or fluoro-elastomer.

The pump-bearings, gears and seals are lubricated by oil fed from reservoirs in the hydrokinetic drive/gearbox. A series of seals stops the oil from reaching the vacuum side of the ZRS pump. The hydrokinetic drive/gearbox is evacuated. You can inspect the oil-levels through sight-glasses which are fitted to the hydrokinetic drive/gearbox. Oil-filler, oil-drainage and external evacuation connections are provided on the hydrokinetic drive/gearbox.

The timing gears on ZRS 1200, ZRS 2600 and ZRS 4200 model pumps are lubricated by oil inside the gear-cover. An oil-filler connection is provided and you can inspect the oil-level through a sight-glass fitted to the gear-cover.

### 1.2.3 Principle of operation

The ZRS pump is shown in [Figure 1](#) and [2](#). The motor-shaft drives one of the rotors through the hydrokinetic drive. The 1:1 gears inside the hydrokinetic drive/gearbox drive the second rotor in the opposite direction inside the stator housing. A small, accurately gauged, clearance is maintained between the rotors and between each rotor and the stator wall. This clearance allows the ZRS pump to operate at high speed without mechanical wear and without the need for lubrication inside the swept volume.

### 1.2.4 Hydrokinetic drive

The hydrokinetic drive consists of a fluid-coupling which connects the electric-motor shaft to the rotor. This system is configured so that when the gas-load is high, the rotational speed of the rotors is reduced. As the gas-load decreases, the rotors accelerate to full speed. This allows continuous operation of the ZRS pump over the vacuum range without the risk of overloading the motor and removes the need for bypass-valves and associated pipelines.

The fluid-coupling is not viscosity sensitive. The ZRS pumps have fluid-coupling drives which are specifically designed for the type of oil used in the pump.

## 2 Technical Data

### 2.1 Operating and storage conditions

**NOTE**

For operation between -20 °C and 5 °C, we recommend that the ZRS pump is operated continuously except when shut-down is necessary for maintenance purposes. Note also the cooling-water requirements given in [Section 2.6](#).

Because of the flexibility of the hydrokinetic drives, there is a wide range of backing pumps which are suitable for use with the ZRS Mechanical Booster pumps.

Table 1 – Operating and storage conditions

Ambient operating temperature range	5 to 40 °C
Ambient storage temperature range	-20 to 80 °C
Maximum ambient operating humidity	90% RH
Protection degree (as defined by IEC 529)	IP55

### 2.2 Performance

Table 2 – Performance data

Rotational speed:				
50 Hz electrical supply		0 to 2900 rpm		
60 Hz electrical supply		0 to 3500 rpm		
Maximum outlet pressure		1000 mbar absolute, $1 \times 10^5$ Pa		
Pressure differential across ZRS pump (determined by the hydrokinetic drive):				
Pump	50 Hz electrical supply		60 Hz electrical supply	
ZRS 250	0 to 180 mbar	0 to $1.8 \times 10^4$ Pa	0 to 150 mbar	0 to $1.5 \times 10^4$ Pa
ZRS 500	0 to 110 mbar	0 to $1.1 \times 10^4$ Pa	0 to 90 mbar	0 to $9 \times 10^3$ Pa
ZRS 1200	0 to 90 mbar	0 to $9 \times 10^3$ Pa	0 to 75 mbar	0 to $7.5 \times 10^3$ Pa
ZRS 2600	0 to 80 mbar	0 to $8 \times 10^3$ Pa	0 to 67 mbar	0 to $6.7 \times 10^3$ Pa
ZRS 4200	0 to 60 mbar	0 to $6 \times 10^3$ Pa	0 to 50 mbar	0 to $5 \times 10^3$ Pa

## 2.3 Mechanical data

Table 3 – Mechanical data

Dimensions	See <a href="#">Figure 3 to 7</a>	
Mass:	ZRS 250	69 kg
	ZRS 500	106 kg
	ZRS 1200	149 kg
	ZRS 2600	401 kg
	ZRS 4200	481 kg

## 2.4 Electrical data

**NOTE**

*Motor data can be found on the motor rating plate and in the terminal box of the motor.*

Table 4 – Electrical data

Electrical supply voltage	200/380 V 50 Hz or 400 V 50 Hz or 200/380 V 60 Hz or 230/460 V 60 Hz
Number of phases	3
Full load current ratings	Refer to motor rating plate
<b>Pump(s)</b>	<b>Power</b>
ZRS 250	2.2 kW
ZRS 500	2.2 kW
ZRS 1200	3 kW
ZRS 2600	11 kW
ZRS 4200	11 kW

## 2.5 Lubrication data

**NOTE**

*Safety Data Sheets for the oil and grease specified below are available on request.*

*Table 5 – Lubrication data*

Recommended oil type	Ultragrade 20		
Recommended grease type*	Fomblin AR555		
Oil capacity:	<b>ZRS 250</b>	<b>ZRS 500</b>	<b>ZRS 1200</b>
Gear-cover	-	-	1.25 l
Hydrokinetic drive/gearbox	1.5 l	1.5 l	2.4 l
Shaft-seal reservoir	0.125 l	0.125 l	0.125 l
	<b>ZRS 2600</b>	<b>ZRS 4200</b>	
Gear-cover	3.5 l	3.5 l	
Hydrokinetic drive/gearbox	6.5 l	6.5 l	
Shaft-seal reservoir	0.45 l	0.45 l	

\* For use with ZRS 250 and ZRS 500 pumps

## 2.6 Cooling-water data

**NOTE**

*You can operate the ZRS 1200 pump continuously without cooling-water if the inlet pressure is kept below 5 mbar ( $5 \times 10^2$  Pa) and the pumpdown time is no longer than 10 minutes.*

*Table 6 – Cooling water supply data: ZRS pumps*

Recommended cooling-water flow (with inlet temperature of 20 °C)	
ZRS 1200 pumps	3 l/min
ZRS 2600 pumps	6 l/min
ZRS 4200 pumps	6 l/min
Recommended cooling-water supply pressure	2 to 6 bar gauge, 3 to 7 bar absolute, $3 \times 10^5$ to $7 \times 10^5$ Pa
Permissible temperature range	5 to 35 °C



## 2.7 Noise and vibration data

Table 7 – Noise and vibration data

Vibration level	< 1.8 mm/s r.m.s. in the range 10 to 1000 Hz			
Continuous A-weighted sound pressure level measured at 1 metre from the ZRS pump*:				
<b>ZRS 250</b>	<b>ZRS 500</b>	<b>ZRS 1200</b>	<b>ZRS 2600</b>	<b>ZRS 4200</b>
70 dB(A)	70 dB(A)	70 dB(A)	75 dB(A)	75 dB(A)

\* The noise level was measured in accordance with ISO2151 and with the pump running at <0.1 mbar on 50 Hz supply. Running on a 60 Hz supply or at higher inlet pressures will increase the noise level.

## 2.8 Connections

Table 8 – Connections

Cooling-water connections:					
Inlet		G3/8 male			
Outlet		G3/8 male			
Vacuum Connections:					
	<b>ZRS 250</b>	<b>ZRS 500</b>	<b>ZRS 1200</b>	<b>ZRS 2600</b>	<b>ZRS 4200</b>
Inlet	DN63 ISO-F	DN100 ISO-F	DN160 ISO-F	DN160 ISO-F	DN250 ISO-F
Outlet	Suitable for DN40 ISO-KF	DN63 ISO-F	DN100 ISO-F	DN100 ISO-F	DN100 ISO-F

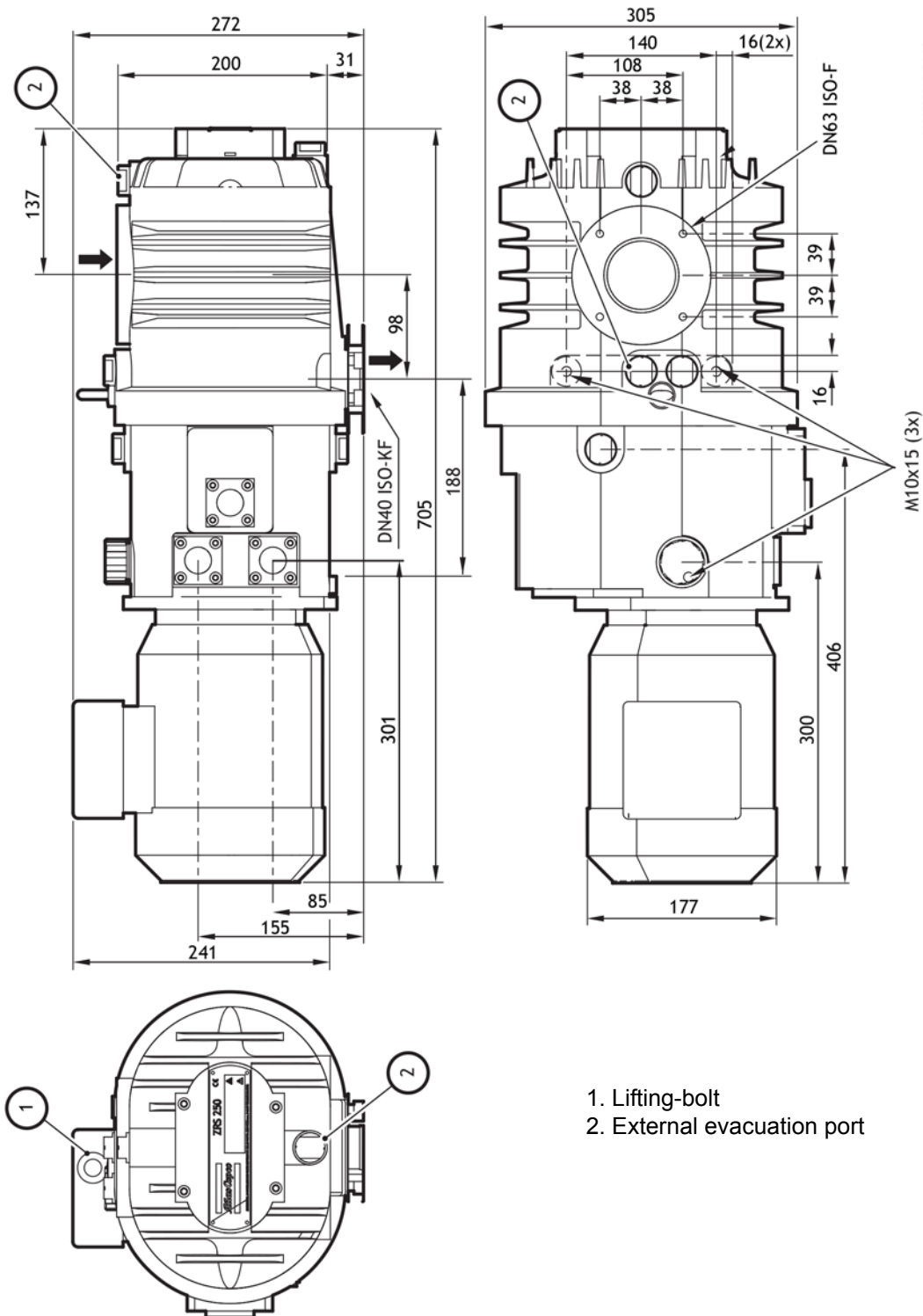
## 2.9 Materials of construction of components exposed to pumped gases

Table 9 – Materials of construction

Stator and headplates	Grey cast iron, grade 250 (BS1452)
Rotors	SG iron, grade 420/12 (BS2789)
Hydrokinetic drive/gearbox cover	Aluminium LM25TF (BS1490)
Housing O-rings	Viton
Hydrokinetic drive/gearbox shaft-seals	Viton
Internal pump shaft-seals	PTFE (polytetrafluoroethylene)
Hydrokinetic drive/gearbox cooling coils	Copper/brass
ZRS 1200, ZRS 2600 and ZRS 4200 after-cooler	Copper/brass
Headplate jointing compound	Loctite 518

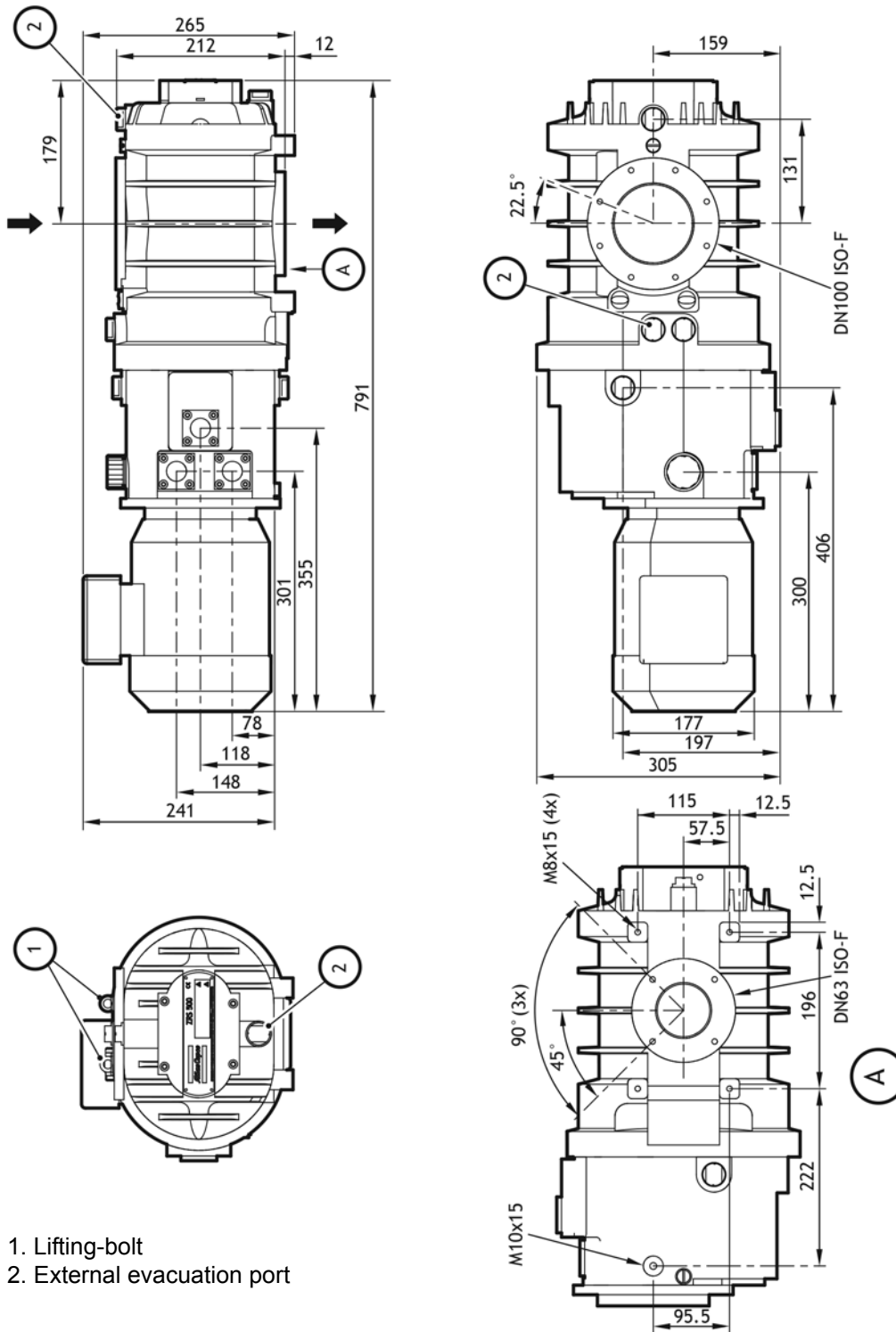
## 2.10 Azide Compatibility

I The ZRS pumps are not Azide compatible as they are fitted with copper cooling coils which are exposed to process.



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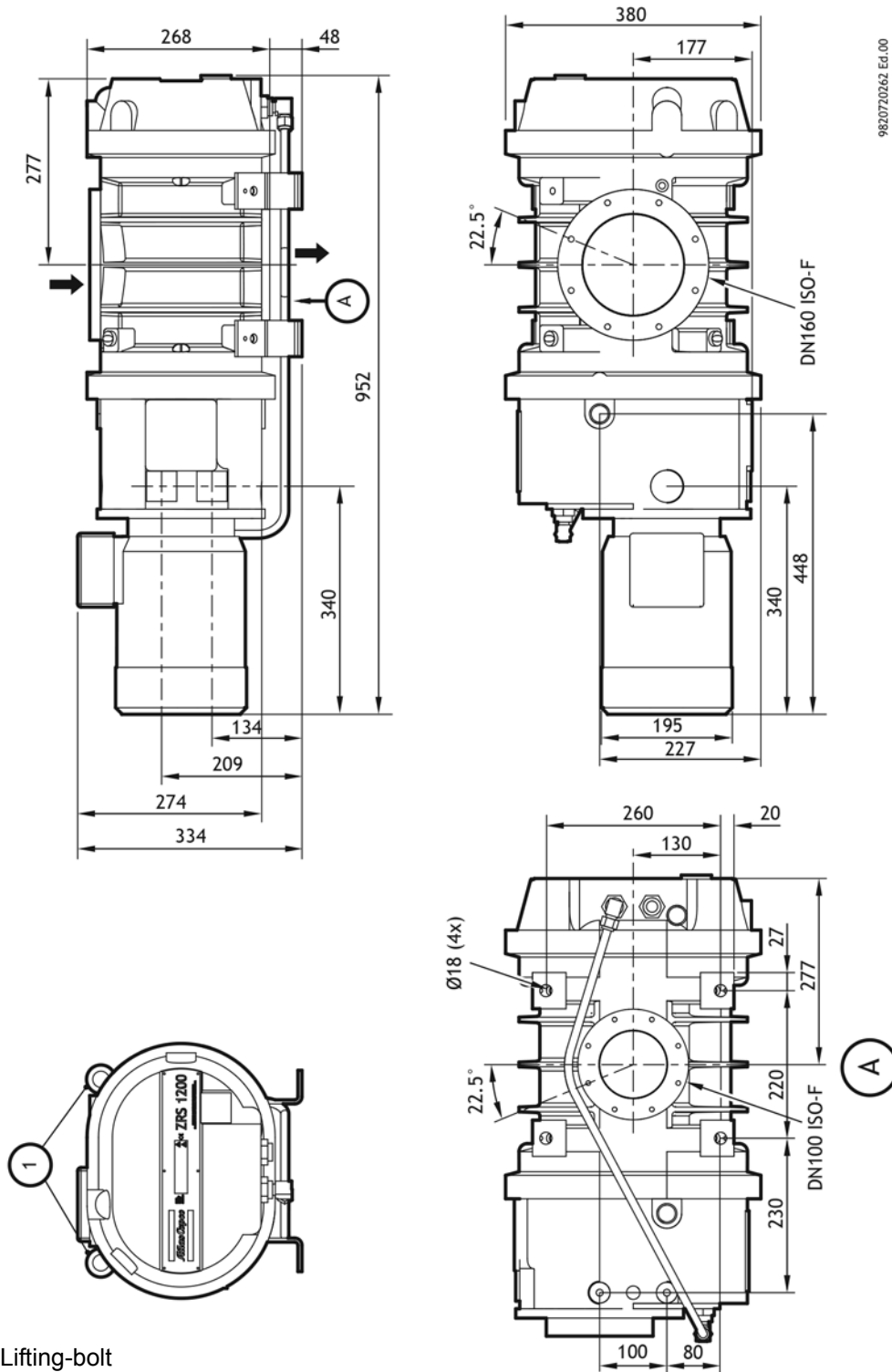
Figure 3 – ZRS 250 dimensions (mm)

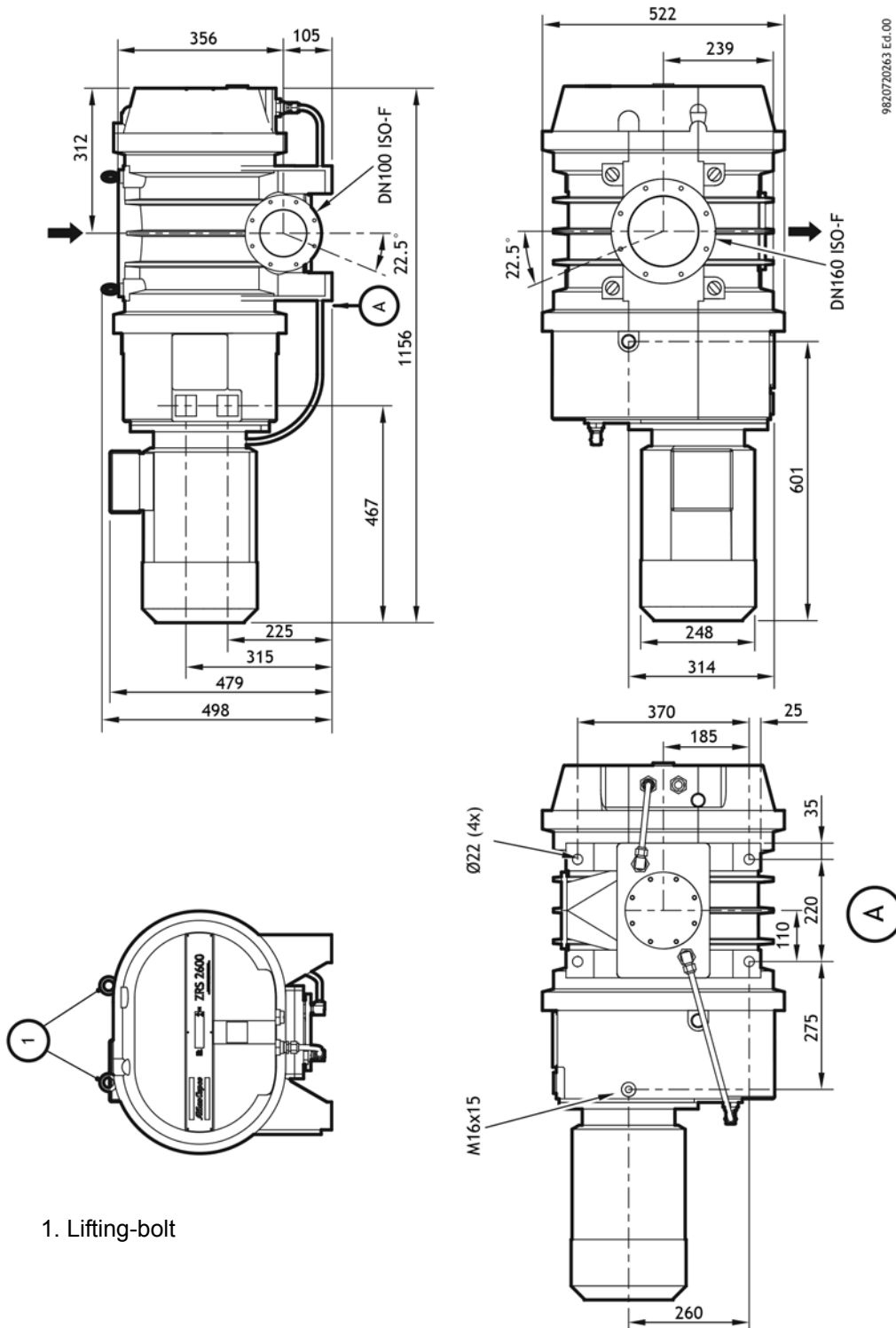


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- 1. Lifting-bolt
- 2. External evacuation port

Figure 4 – ZRS 500 dimensions (mm)





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Figure 6 – ZRS 2600 dimensions (mm)

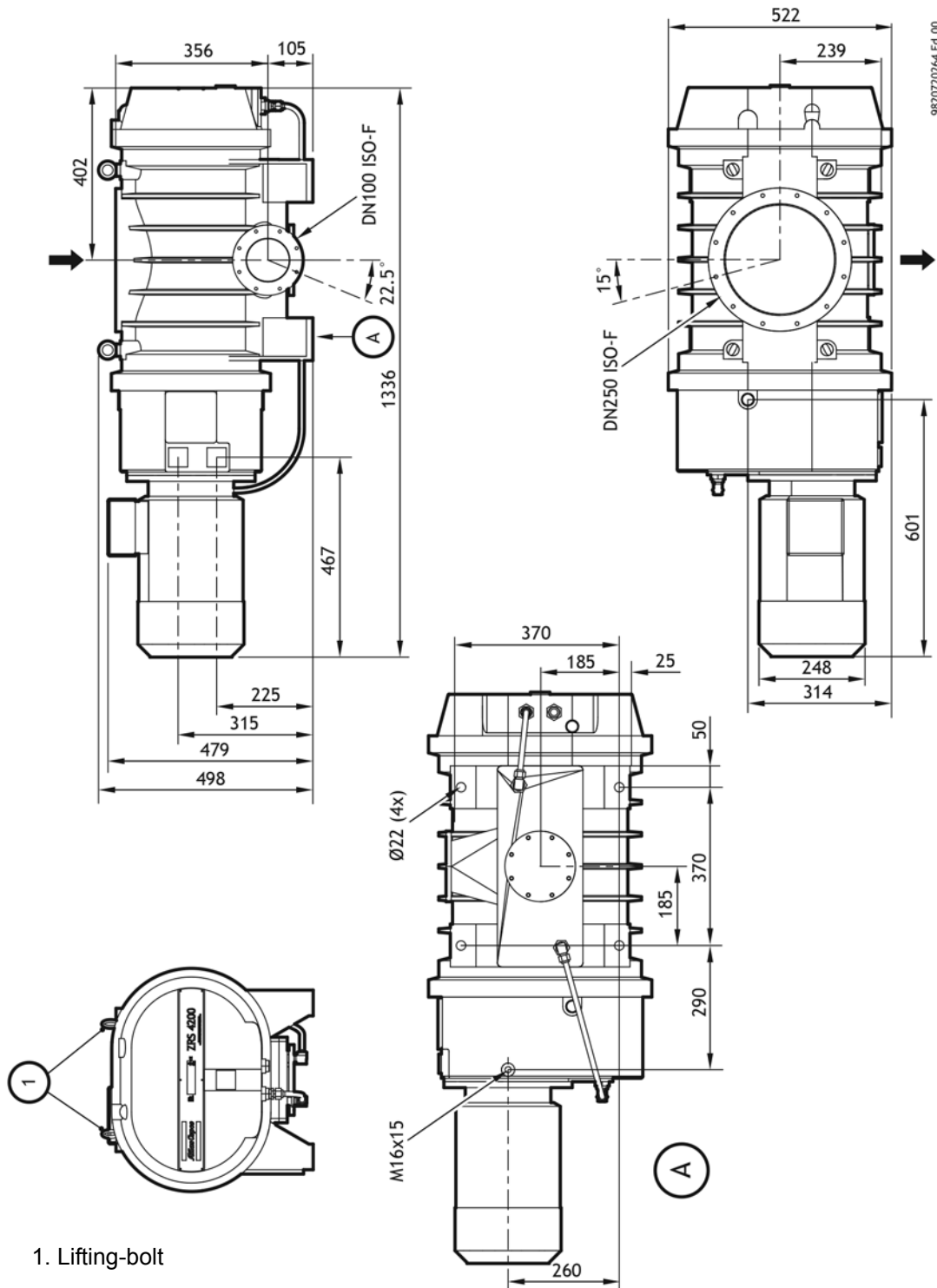



Figure 7 – ZRS 4200 dimensions (mm)

## 3 Installation

### 3.1 Safety

	<p><b>WARNING</b></p> <p><b>Obey the safety instructions listed below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.</b></p>
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- A suitably trained and supervised technician must install your ZRS pump.
- Ensure that the installation technician is familiar with the safety procedures which relate to the products pumped. Wear the appropriate safety-clothing when you come into contact with contaminated components. Dismantle and clean contaminated components inside a fume-cupboard.
- Vent and purge the pumping system before you start installation work.
- Check that all the required components are available and of the correct type before you start work.
- Ensure that debris does not get into the ZRS pump when you install it.
- Disconnect the other components in the pumping system from the electrical supply so that they cannot be operated accidentally.
- Do not reuse O-rings and Co-Seals.
- Ensure that the cooling-air flow through the pump-motor cooling-fan cannot be obstructed.
- Ensure that all electrical cables, nitrogen pipelines and cooling-water pipelines are safely positioned, secured and routed, so that they do not present a trip hazard.
- Provide adequate access to all pump servicing points and oil-level sight-glasses.
- Leak-test the system after installation work is complete and seal any leaks found to prevent leakage of hazardous substances out of the system and leakage of air into the system.



## 3.2 System requirements

Consider the following points when you design your pumping system:


- You must use a suitable backing pump.
- The ZRS pump must be mounted on a firm, level surface.
- Vacuum pipelines must be adequately supported to stop the transmission of stress to pipeline joints.
- If necessary, incorporate flexible pipelines in your system pipelines to reduce the transmission of vibration and to prevent loading of the coupling joints. If you use flexible pipelines, you must ensure that you use flexible pipelines which have a maximum pressure rating which is greater than the highest pressure that can be generated in your system.

If the ZRS pump is to be fitted in a new system, ensure that all preliminary pipelines have been installed and that a suitable base for the ZRS pump has been prepared before you start installation.

Check that the following services and facilities are available for connection to the ZRS pump:

- Cooling-water supply and return.
- Electrical supply.
- Exhaust-extraction system.

## 3.3 Unpack and inspect

	<p><b>WARNING</b></p> <p>Use suitable lifting equipment to move the ZRS pump, in accordance with the method described below. If you do not, you can injure yourself or damage the ZRS pump. Refer to <a href="#">Section 2.3</a> for the mass of the ZRS pump.</p>
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Use the following procedure to unpack and inspect the ZRS pump:


1. Place the pallet in a convenient position with a fork lift truck or a pallet truck.
2. Remove all packing materials.
3. Use suitable lifting-gear to remove the ZRS pump from its pallet:
  - On all pumps, attach the lifting-gear to the centre pair of lifting-bolts on the ZRS pump.
  - ZRS 2600 model pumps have centres of mass which are offset towards the motor. On these pumps, you must fit an additional support strap to the motor (behind the lifting-bolt) to support the pump, and prevent it from tilting when you lift it. Do not try to lift

the ZRS pump by hand (see [Section 2.3](#) for the mass of your ZRS pump).

4. Remove all protective covers and inspect the ZRS pump. If the ZRS pump is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the ZRS pump together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the ZRS pump if it is damaged.
5. If the ZRS pump is not to be used immediately, refit the protective covers. Store the ZRS pump in suitable conditions as described in [Section 6.1](#).

## 3.4 Fill the pump with oil

	<p><b>WARNING</b></p> <p>Changing the oil in a ZRS pump from hydrocarbon to another oil could potentially cause a safety hazard.</p> <p>You must contact your local Atlas Copco Customer Centre.</p>
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	<p><b>WARNING</b></p> <p>Ensure that the correct grade of oil is used and that the oil-levels in the ZRS pump are correct. If an incorrect oil is used or if an oil-level is incorrect, ZRS pump performance may be affected and the ZRS pump may be damaged, which will compromise its constructional safety.</p>
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### 3.4.1 Hydrokinetic drive/gearbox

We recommend that the hydrokinetic drive/gearbox oil-level is maintained at the recommended oil-level shown in [Figure 8](#), item 5; if the oil-level is above or below the recommended oil-level, the performance of the ZRS pump may be affected.

Do not allow the oil-level to fall below the bottom of the reflector plate ([Figure 8](#), item 4) or the ZRS pump may be damaged.

1. Remove the hydrokinetic drive/gearbox oil filler-plug ([Figure 1](#), item 3 or [Figure 2](#), item 4).
2. Refer to [Figure 8](#). Fill the hydrokinetic drive/gearbox with the recommended type of oil until the oil-level reaches the recommended oil-level (5) at the top of the reflector plate (4) in the oil-level sight-glass (3).
3. Refit the hydrokinetic drive/gearbox oil filler-plug.

### 3.4.2 Shaft-seal reservoir

	<p><b>WARNING</b></p> <p><b>Ensure that the correct vented filler-plug is refitted in the shaft-seal reservoir. If you use a non-vented plug, the reservoir will be pressurised and the oil sight-glass may fracture.</b></p>
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We recommend that you fill the shaft-seal reservoir so that the oil-level is at the recommended oil-level, shown in [Figure 8](#), item 2.

You can operate the ZRS pump as long as the oil-level is above the bottom of the reflector plate. Do not allow the shaft-seal oil-level to fall below the bottom of the reflector plate or the ZRS pump may be damaged. You must use the same oil you used to fill the hydrokinetic drive/gearbox.

1. Remove the shaft-seal reservoir vented oil filler-plug ([Figure 1](#) and [2](#), item 2).
2. Refer to [Figure 8](#). Fill the shaft-seal reservoir with oil until the oil-level is at the recommended oil-level (2) at the top of the reflector plate (6).
3. Refit the vented oil filler-plug.

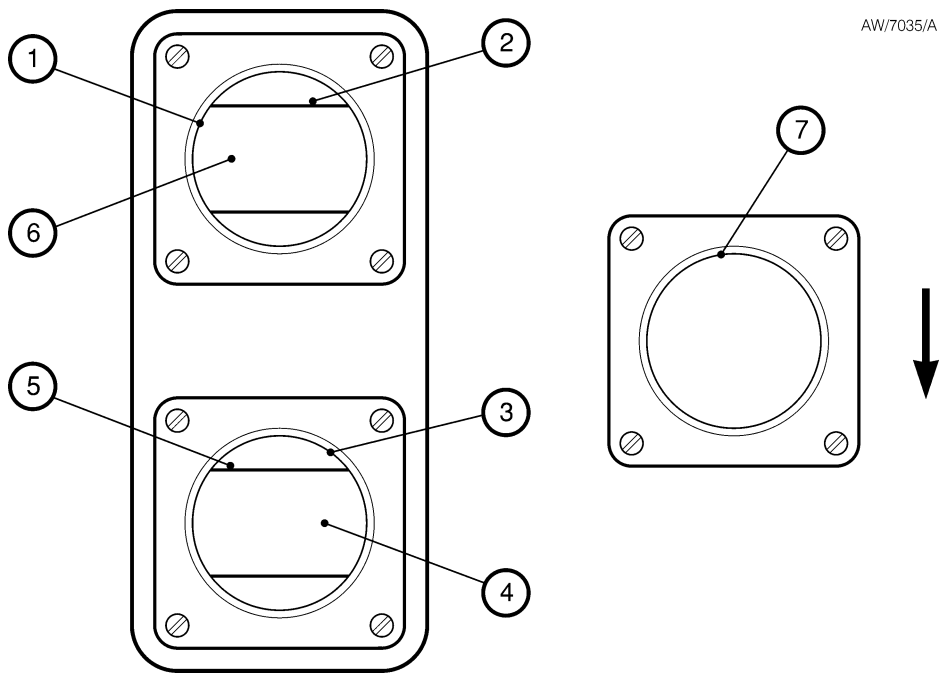


Figure 8 – Sight glasses

Reference	Designation	Reference	Designation
(1)	Shaft-seal reservoir sight-glass	(5)	Hydrokinetic drive/gearbox recommended oil-level
(2)	Shaft seal reservoir recommended oil-level	(6)	Shaft-seal reflector plate
(3)	Hydrokinetic drive/gearbox sight-glass	(7)	Direction of rotation sight-glass* (the arrow shows the correct direction)
(4)	Hydrokinetic drive/gearbox reflector plate		

\* Not fitted to ZRS 2600 and ZRS 4200

### 3.4.3 Gear-cover (ZRS 1200, ZRS 2600 and ZRS 4200 model pumps only)

Use the following procedure to fill the gear-cover on ZRS 1200, ZRS 2600 and ZRS 4200 pumps.

You must fill the gear-cover with the same oil you used to fill the hydrokinetic drive/gearbox and shaft-seal reservoir.


1. Remove the oil filler-plug on the top of the gear-cover (Figure 2, item 7).
2. Fill the gear-cover with oil until the oil-level is at the middle of the reflector plate in the gear-cover oil-level sight-glass (Figure 2, item 9).
3. Refit the oil filler-plug.

### 3.5 Cooling-water connections (ZRS 1200, ZRS 2600 and ZRS 4200 model pumps only)

Connect the cooling-water supply and return lines to the G3/8 connectors. One connector is on the rear of the hydrokinetic drive/gearbox, the other connector is on the underside of the gear-cover. You can connect the supply and return lines to either of the connectors; the direction of cooling-water flow is not important.

Refer to [Section 2.6](#) for the minimum cooling-water flow rate required. If the danger of the condensation of gases in the booster is not process critical, always connect the supply line to the gearbox cover first.


### 3.6 Electrical connections


	<p><b>WARNING</b></p> <p>Ensure that the electrical installation of the ZRS pump conforms with your local and national safety requirements. It must be connected to a suitably rated (refer to motor rating plate for electrical information) fused and protected electrical supply and a suitable earth (ground) point.</p>
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#### 3.6.1 Electrical supply configuration


Refer to the wiring instructions provided with the pump motor. Configure your electrical connections according to the manufacturers instructions.

#### 3.6.2 Motor connections

	<p><b>WARNING</b></p> <p>You must provide suitable strain relief on the electrical supply cable. If you do not, the cable (or wires in the cable) may become disconnected from the pump and there may be a risk of injury or death by electric shock.</p>
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	<p><b>WARNING</b></p> <p>Connect the electrical supply to the motor through a contactor which has a manual reset control.</p>
---	---

	<p><b>WARNING</b></p> <p>Connect the electrical supply to the motor so that it is automatically switched off if the backing pump stops. If you do not, the ZRS pump may overheat if it continues to operate when the backing pump is stopped.</p>
---	---

	<p><b>WARNING</b></p> <p><b>You must be able to isolate and lock out the electrical supply from the ZRS pump.</b></p>
---	---

<p><b>CAUTION</b></p> <p><b>The motor must be correctly configured and you must make the correct electrical connections for your electrical supply. If you do not, you can damage the motor.</b></p>
--

Connect the supply through a contactor which has overload-protection or use a controller which incorporates a contactor.

You must use a contactor which has a manual reset control. If you do not, the ZRS pump could automatically restart after an electrical overload or an electrical supply failure.

You must use a suitable multi-wire cable and a suitable cable-gland (see Step 4 below) to connect your electrical supply to the pump motor.

Connect the motor to the electrical supply as described in the following procedure.


1. Remove the motor terminal-box cover (Figure 1 and 2, item 1).
2. Check your electrical supply voltage and frequency. If necessary, configure the motor (that is, the terminal wires and any links) to operate with your supply voltage: refer to the wiring instructions supplied with the pump motor.
3. Remove the plug from the cable-entry hole that you will use for the electrical supply cable. Choose the most suitable hole for your application.
4. Fit a suitable cable-gland to the cable-entry hole. The cable-gland (and adaptor, if fitted) must provide a protective seal to IP44 (or higher), as defined by IEC 529. Refer to Table 10 for the cable-gland hole sizes.
5. Pass the electrical supply cable through the cable-gland.
6. Connect the wires of the cable to the appropriate terminals, as shown in the wiring instructions supplied with the pump motor.
7. Tighten the cable-gland.

*Table 10 – Motor cable-gland hole sizes*

Motor frame size*	Electrical supply cable-gland hole size (ISO)
90, 100	20
132	25
160	32

\* As shown on the motor label.

## 3.7 Check the direction of pump rotation

	<p><b>WARNING</b></p> <p><b>Blank the inlet or connect the ZRS pump to the vacuum system before you check the direction of pump rotation. If you do not, there is danger of objects being trapped in the rotating rotors.</b></p>
---	---


It is possible for the three-phase electrical supply to the motor to be phased incorrectly. If the supply is phased incorrectly, the rotors will rotate in the reverse direction or remain stationary. Check the direction of rotation as described below.


1. Check that the ZRS pump is connected to the vacuum system or that the inlet is blanked off.
2. Connect the backing pump and switch the backing pump on.
3. On ZRS 2600 and ZRS 4200 model pumps, the correct direction of rotation is indicated by an arrow on the motor fan cover (Figure 2, item 17). To determine the direction of rotation: watch the motor fan inside the fan cover, switch on the ZRS pump for two or three seconds, then switch the ZRS pump off.

On ZRS 250, ZRS 500 and ZRS 1200 model pumps, you can use the method above to determine the direction of rotation. Alternatively, the direction of rotation is also indicated by an arrow next to the direction of rotation sight-glass (Figure 1, item 10 and Figure 2, item 14): watch the motor-coupling in the sight-glass (Figure 8, item 7), switch on the ZRS pump for two or three seconds, then switch the ZRS pump off.

4. Check that the direction of rotation of the coupling noted in Step 3 was the same as that indicated by the rotation arrow on the motor or on the direction of rotation sight-glass. If the direction of rotation was correct, continue at Section 3.8.
5. If the direction of rotation of the coupling was incorrect:
  - Switch off the backing pump and vent the system; isolate the ZRS pump from the electrical supply; reverse any two of the phase-wires in the motor terminal-box.
  - Repeat the check from Step 2 to ensure that the direction of rotation is now correct.

## 3.8 Connect the pump-inlet and outlet

	<p><b>WARNING</b></p> <p>Do not exceed the load limits on the pump-inlet and outlet flanges as specified in <a href="#">Figure 9</a>. If you do, there will be a risk of leakage of process gases from the ZRS pump, or of damage to the ZRS pump.</p>
---	--

	<p><b>WARNING</b></p> <p>If particles, debris or loose components could enter the ZRS pump during commissioning or running, you must fit a suitable inlet filter which you can remove before operating the ZRS pump on process duties.</p>
---	--

You must connect the inlet of the ZRS pump to your vacuum system, and connect the outlet of the ZRS pump to your backing pump and exhaust-extraction/abatement systems, as required.

Pump-inlet and outlet connections are made with standard ISO-F flanges, trapped O-rings and (on the ZRS 250 pumps only) a Co-Seal.

ZRS 2600 and ZRS 4200 model pumps have two alternative outlet positions: on the underside of the ZRS pump, and at the side of the ZRS pump.

As supplied, these ZRS pumps are configured to use the outlet at the side of the ZRS pump and the flange on the underside of the ZRS pump is blanked off. If you do not wish to use the side outlet, remove the blanking-plate and O-ring from the outlet on the underside of the ZRS pump and refit the blanking-plate with a new O-ring over the side outlet-flange.

Take note of the following when you connect your ZRS pump to the vacuum system.

- Move the ZRS pump to the required location and ensure that it is level and secure.
- For optimum pumping speeds, ensure that the pipeline connected to the pump-inlet is as short as possible and has a bore size not less than the inlet port diameter.
- Use a flexible connection in the pipeline from the vacuum system to the ZRS pump to reduce vibration and stress in the system pipelines (see [Section 3.2](#)).
- On very dusty applications, use a low-impedance inlet-filter to minimise abrasion in the ZRS pump.

## 3.9 External evacuation of hydrokinetic drive/gearbox (optional)

The hydrokinetic drive/gearbox may be evacuated using an external pump. A description of the connections required is beyond the scope of this manual.

Contact your supplier or your nearest Atlas Copco Customer Centre company for advice if you wish to use this facility.



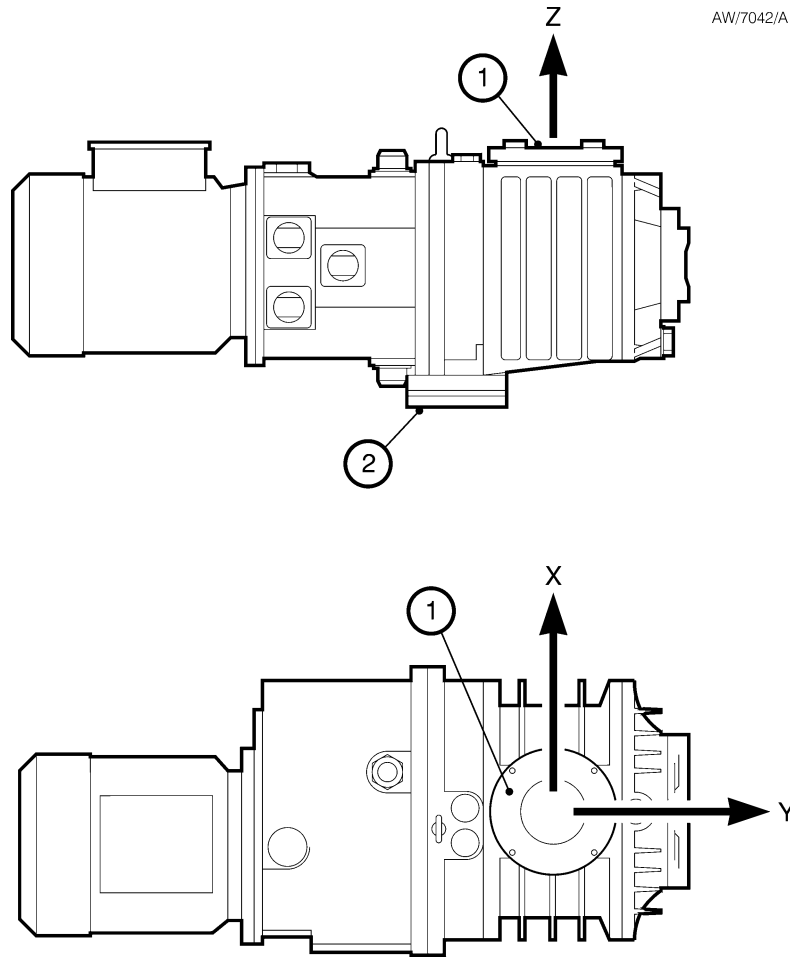


Figure 9 – Flange loading limits


**NOTE**

ZRS 250 pump shown. The flange loading limits apply to all ZRS pumps.


		Maximum force		Pump-inlet		Pump-outlet	
1. Pump-inlet	FX	±1000 N	±224 lbf	±750 N	±168 lbf		
2. Pump-outlet	FY	±1000 N	±224 lbf	±750 N	±168 lbf		
	FZ	±2000 N	±449 lbf	±1500 N	±337 lbf		
F Force	FR	±2400 N	±539 lbf	±1800 N	±404 lbf		
		Maximum moment		Pump-inlet		Pump-outlet	
M Moment	MX	±500 N m	±112 lbf ft	±300 N m	± 67 lbf ft		
R Resultant	MY	±500 N m	±112 lbf ft	±300 N m	± 67 lbf ft		
X Load orientation	MZ	±500 N m	±112 lbf ft	±300 N m	± 67 lbf ft		
Y Load orientation	MR	±870 N m	±195 lbf ft	±520 N m	±116 lbf ft		
Z Load orientation							

## 4 Operation

### 4.1 Operational safety

	<p><b>WARNING</b></p> <p>Ensure that the cooling-air flow around the ZRS pump and pump motor is not restricted. If the air flow is restricted, the pump and/or motor will get hotter than normal during pump operation. This may result in reduced reliability or the risk of an explosion.</p>
---	---

	<p><b>WARNING</b></p> <p>During operation, parts of the ZRS pump can become very hot. Ensure that you do not touch the ZRS pump.</p>
---	--

	<p><b>WARNING</b></p> <p>Do not operate the ZRS pump with the inlet or outlet open to atmosphere. If you do, your fingers or other parts of your body may get trapped and you may be injured by the rotating pump mechanism.</p>
---	--

Ensure that the cooling-air flow around the ZRS pump and pump-motor is not restricted. (Refer to the ambient temperature specification in [Section 2.1](#)). Take all necessary precautions to avoid accidental contact with the ZRS pump.

### 4.2 Start-up procedure

#### 4.2.1 Pre-start checks

1. Check that the ZRS pump oil-levels are correct (see [Section 3.4](#)).
2. Check that the ZRS pump is correctly installed, especially after initial installation and maintenance.

### 4.2.2 Start-up

Start-up the ZRS pump as described in the procedure below. This procedure assumes that the ZRS pump and the vacuum system are at atmospheric pressure.

1. ZRS 1200, ZRS 2600 and ZRS 4200 model pumps only:
  - Switch on the cooling-water supply and check that there is an adequate flow of cooling-water at the correct pressure (see [Section 2.6](#)).
  - Check the water connections for leaks.

Refer to [Section 2.6](#) for the cooling-water requirements.

2. Close all valves to atmospheric pressure and ensure that all other openings are closed.
3. Switch on the backing pump and open the backing valve (if fitted).
4. Switch on the ZRS pump.
5. Allow the ZRS pump to run for approximately fifteen minutes to achieve normal operating temperature.
6. Slowly open the pump-inlet isolation-valve (if fitted).

## 4.3 Shut-down


### CAUTION

**If the pump is to be shut down for a long period or is due to be shipped on, refer to [Section 6.1](#) for the storage instructions.**

1. Close the pump-inlet isolation-valve (if fitted).
2. Leave the pump operating for sufficient time such that the pump is thoroughly purged of any hazardous substances.
3. Switch off the ZRS pump.
4. Open the backing pump air-admittance valve (if fitted) and switch off the backing pump.
5. ZRS 1200, ZRS 2600 and ZRS 4200 model pumps only: turn off the cooling-water supply.

## 5 Maintenance

### 5.1 Safety information

	<p><b>WARNING</b></p> <p><b>Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.</b></p>
---	---

- A suitably trained and supervised technician must maintain the ZRS pump.
- Dismantle the ZRS pump in a clean workshop environment, with the correct tools and safety facilities available.
- Ensure that the maintenance technician is familiar with the safety procedures which relate to the products pumped. Wear the appropriate safety-clothing when you come into contact with contaminated components. Dismantle and clean contaminated components inside a fume-cupboard.
- Allow the ZRS pump to cool for at least three hours before you start maintenance work.
- Vent and purge the pumping system with nitrogen before you start maintenance work.
- Check that all the required parts are available and of the correct type before starting work.
- Isolate the ZRS pump and other components from the electrical supply so that they cannot be operated accidentally.
- Re-check the ZRS pump rotation direction if the electrical supply has been disconnected.
- Do not reuse O-rings and Co-Seals.
- Dispose of components and waste oil safely (see [Section 6.2](#)).
- Take care to protect sealing-faces from damage.
- Do not touch or inhale the thermal breakdown products of fluorinated materials which may be present if the ZRS pump has been overheated to 260 °C and above. These breakdown products are very dangerous. Fluorinated materials in the ZRS pump may include oils, greases and seals. The ZRS pump may have overheated if it was misused, if it malfunctioned or if it was in a fire.
- Leak-test your system after installation and maintenance to prevent leakage of dangerous substances out of the system and leakage of air into the system.

The ZRS pump will be contaminated with the process chemicals that have been pumped. Ensure that you take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred.

Table 11 – Maintenance plan


Operation	Frequency	Refer to Section
Check the oil-levels	Weekly	5.3
Inspect the pump connections	Monthly	5.4
Change the pump oil	12 monthly	5.5
Lubricate the rear bearing	12 monthly	5.6
Overhaul the pump	6 yearly	5.7

## 5.2 Maintenance plan

Table 11 details the maintenance operations necessary to maintain ZRS pumps in normal use. Instructions for each operation are given in the section shown.

More frequent maintenance may be required if the ZRS pump is used to pump corrosive or abrasive gases and vapours. If necessary, adjust the maintenance plan according to your experience.

## 5.3 Check the oil-levels

	<p><b>WARNING</b></p> <p>Ensure that the correct grade of oil is used and that the oil-levels in the pump are correct. If an incorrect oil is used or if an oil-level is incorrect, ZRS pump performance may be affected and the ZRS pump may be damaged, which will compromise its constructional safety.</p>
---	--

<p><b>NOTE</b></p> <p><i>If there is a loss of oil from the shaft-seal reservoir, the shaft-seal may have failed. Contact your supplier or a Atlas Copco Customer Centre for advice.</i></p>
--

Use the following procedure to check the oil-levels in the sight-glasses. Refer to Figure 1 and 2 for the location of the filler-plugs and sight-glasses. During normal operation, the hydrokinetic drive/gearbox sight-glass (Figure 8, item 3) may appear empty or show a froth because the oil is in circulation around the coupling.


1. Shut down the ZRS pump, vent it to atmospheric pressure and allow it to cool.
2. Refer to Figure 8. Check the shaft-seal oil-level. If the oil-level is below the bottom of the reflector plate (6), refer to Section 3.4 and refill the shaft-seal reservoir.
3. Check the hydrokinetic drive/gearbox oil-level. If the oil-level is below the top of the reflector plate, refer to Section 3.4 and refill the hydrokinetic drive/gearbox oil reservoir.


4. ZRS 1200, ZRS 2600 and ZRS 4200 model pumps only, check the gear-cover oil-level. If the oil-level is below the middle of the reflector plate, refer to [Section 3.4](#) and refill the gear-cover.

## 5.4 Inspect the pump connections

1. Check that the cooling-water connections are secure.
2. Inspect the cooling-water pipelines and connections for corrosion, leaks and damage.
3. Check that the electrical connections are secure.
4. Check the electrical supply cables for damage.
5. Inspect all the vacuum pipelines for corrosion and damage. Check that all the vacuum connections are secure.

## 5.5 Change the pump oil

	<p><b>WARNING</b></p> <p>Changing the oil in a ZRS pump from hydrocarbon to another oil could potentially cause a safety hazard.</p> <p>You must contact your local Atlas Copco Customer Centre.</p>
--	--


	<p><b>WARNING</b></p> <p>Ensure that the correct grade of oil is used and that the oil-levels in the pump are correct. If an incorrect oil is used or if an oil-level is incorrect, ZRS pump performance may be affected and the ZRS pump may be damaged, which will compromise its constructional safety.</p>
---	--

Replace the pump oil as described below. Refer to [Figure 1](#) and [2](#) for the location of the oil-filler and drain-plugs.

1. Switch off the ZRS pump, vent it to atmospheric pressure and allow it to cool.
2. Remove the hydrokinetic drive/gearbox oil filler-plug.
3. Remove the hydrokinetic drive/gearbox oil drain-plug from the underside of the hydrokinetic drive/gearbox and allow the oil to drain into a suitable container.
4. Remove the shaft-seal vented oil filler-plug. Use a suitable pump to suck the oil out of the shaft-seal reservoir.
5. Refit the hydrokinetic drive/gearbox oil drain-plug.

6. Refer to [Section 3.4](#) and fill the hydrokinetic drive/gearbox and shaft-seal reservoir with oil.
7. Refit the hydrokinetic drive/gearbox oil filler-plug and the shaft-seal reservoir oil filler-plug.
8. ZRS 1200, ZRS 2600 and ZRS 4200 model pumps only:
  - Remove the oil filler-plug on the gear-cover.
  - Remove the oil drain-plug from the underside of the gear-cover and allow the oil to drain into a suitable container.
  - Refit the oil drain-plug and refer to [Section 3.4](#) to refill the gear-cover with oil.
  - Refit the oil filler-plug.

## 5.6 Lubricate the rear-bearing (ZRS 250 and ZRS 500 model pumps only)

	<p><b>WARNING</b></p> <p>When you remove the end-cover, take note of the exact locations of the spacers and shims (<a href="#">Figure 10</a>, items 3 and 4) inside the end-cover. You must refit these items correctly in order to ensure that the rotor clearance settings remain correct. Altering the rotor clearance settings may compromise the constructional safety of the pump.</p>
--	--

Use the following procedure to replace the grease in the rear-bearing. Refer to [Section 2.5](#) for the correct type/grade of grease.

1. Switch off the ZRS pump and isolate it from the electrical supply. Vent the ZRS pump to atmospheric pressure.
2. Refer to [Figure 10](#). Remove the four plastic cover-caps (8) from the bearing end-cover (6).
3. Undo and remove the socket-head screws (7) located under the four plastic cover-caps.
4. Remove the end-cover (6) and O-ring (5). Dispose of the O-ring safely.
5. Note the exact location of the shims (4) and spacers (3) inside the end-cover (6). Clean off all visible grease from the end-cover taking care not to misplace or damage the shims and spacers.
6. Use a soft, clean, lint free cloth or a plastic or wooden spatula to remove all visible grease from both bearings (2).
7. Fill the visible side of each bearing (2) with clean grease, then lightly force the grease into the bearing.
8. Refill the visible side of each bearing (2) with clean grease.

9. Apply a light wipe of high-vacuum grease to the new O-ring (5) and fit into the groove in the end cover (6).
10. Check that the shims (4) and spacers (3) are correctly located in the end-cover (6).
11. Refit the end-cover (6) and secure it with the four socket-head screws (7). Tighten the screws evenly and refit the plastic cover-caps (8).
12. Leak test the system and seal any leaks found.

## 5.7 Overhaul the pump

Contact your local Atlas Copco Customer Centre for advice.

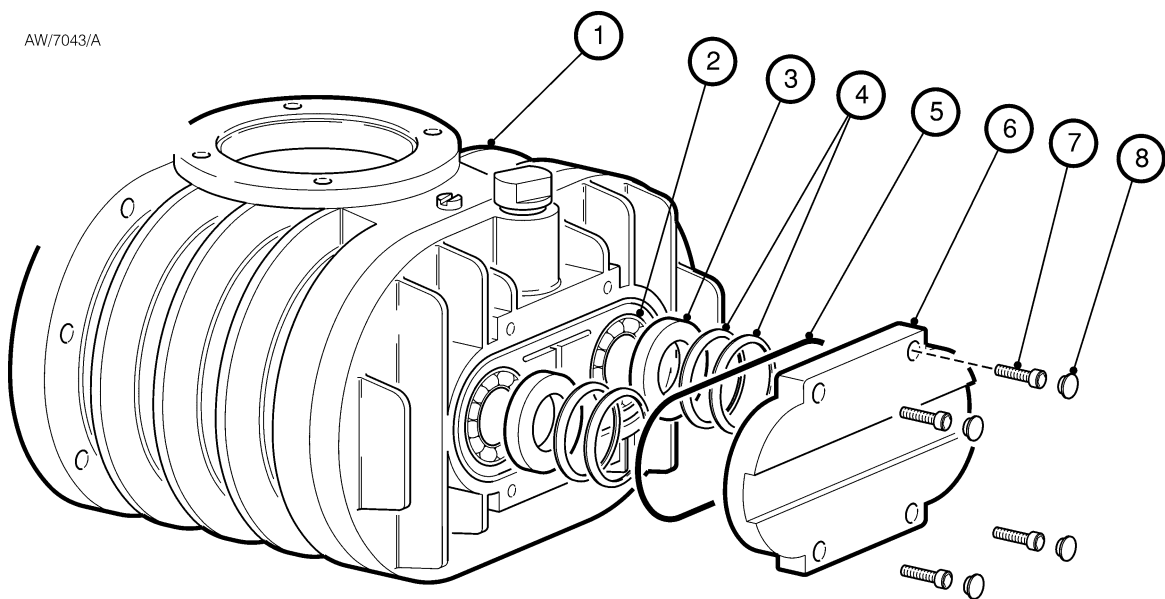


Figure 10 – Lubricate the rear bearing (ZRS 250 and ZRS 500 pumps only)

Reference	Designation	Reference	Designation
(1)	Pump-body	(5)	O-ring
(2)	Bearing	(6)	End-cover
(3)	Spacer	(7)	Socket-head screw
(4)	Shims	(8)	Cover-cap



## 6 Storage and Disposal

### 6.1 Storage

**CAUTION**

Observe the storage temperature limits stated in [Section 2.1](#). Storage below -30 °C will permanently damage the ZRS pump seals and lubricants.

**CAUTION**

Ensure that the water lines are emptied if the pump will be stored below 0 °C. If you do not, the water in the lines will freeze and may cause the pipes to burst. If the pump is to be shipped by air, the temperature in the hold can drop to -50 °C. In such cases it is important that the lines are completely emptied of water.

Use the procedure below to store the ZRS pump.

1. Shut-down the ZRS pump as described in [Section 4.3](#).
2. Isolate the ZRS pump from the electrical supply and disconnect it from the vacuum system.
3. Clean the ZRS pump and change the oil as described in [Section 5.5](#).
4. Place protective covers over the inlet and outlet-flanges.
5. Store the ZRS pump in cool, dry conditions until required for use. When required, prepare and install the ZRS pump as described in [Section 3](#).

### 6.2 Disposal

Dispose of the ZRS pump and any components safely in accordance with all local and national safety and environmental requirements.

Take particular care with components and waste oil which have been contaminated with dangerous process substances.

## **7 Service and Spares**

### **7.1 Introduction**

Atlas Copco products, spares and accessories are available from Atlas Copco Customer Centres and a world-wide network of distributors.

Order spare parts and accessories from the nearest Atlas Copco Customer Centre or distributor. When ordering, state for each part required:

- Model and Item Number of the equipment
- Serial number
- Item Number and description of part.

### **7.2 Service**

Atlas Copco products are supported by a world-wide network of Atlas Copco Customer Centres.

For more information about service options, contact your local Atlas Copco Customer Centre.

### **7.3 Spares**

Refer to the corresponding Atlas Copco parts list.

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# *Sustainable Productivity*

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towards the environment and the people around us.  
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