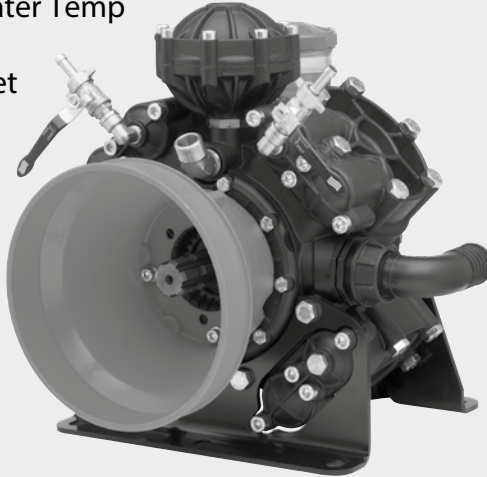




**ANNOVI<sup>®</sup>  
REVERBERI**  
The Power of Experience

**AR 1604  
AR 1604NI**

140° F - Max Water Temp  
1 1/2" - Suction  
3/4" NPT - Outlet



**INSTRUCTION MANUAL**

**AR1604 - 550 RPM - SEMI-HYDRAULIC FOUR DIAPHRAGM PUMP**

MODEL	MAX GPM	MAX L/MIN	MAX PSI	MAX BAR	HP POWER	WEIGHT LBS.
AR1604-C/C	40.4	153	725	50	18.6	88.2

DIAPHRAGM KITS		VALVE KITS		O-RING KITS		OIL	
MODEL	DESCRIPTION	MODEL	DESCRIPTION	MODEL	DESCRIPTION	MODEL	DESCRIPTION
AR43313	BlueFlex	AR42941	Valves	AR42942	O-Rings	AR64532D	Oil
AR43311	Desmopan					AR64532D-C	Case (6)Oil
AR43310	NBR						
AR43312	Viton						

**Purpose of the manual**

The manufacturer has provided this manual to provide the operating instructions and the criteria to be complied with when installing, using and maintaining the pump identified by designation on the cover. The manufacturer supplies the original instructions in Italian.

The manufacturer may supply the original instructions in other languages in response to statutory or commercial requirements.

If the pump is sold, the seller must pass on this manual to the new owner along with the appliance.

The instructions are intended for the skilled, suitably trained operators who carry out the installation and routine maintenance procedures.

Refer to the table of contents for rapid access to the topics covered.

The manufacturer reserves the right to amend the manual without notice, unless the amendments refer to the pump's level of safety.

The purchaser must ensure that the installation is designed in accordance with the instructions in this manual, statutory requirements, and the relevant national and local regulations.

The technical instructions in this "Use and Installation Manual" are the property of the manufacturer and must be treated as confidential.

The symbols shown and described below are used to identify safety risks or important information.



**Danger - Warning**

**Identifies information or procedures the failure to comply with which may constitute a serious threat to health and safety.**



**Caution - Take Care**

**Identifies information or procedures the failure to comply with which may constitute a threat to health and safety or cause damage.**



**Information**

**Identifies useful and important information or procedures which should be borne in mind.**

**Pump and manufacturer identification**

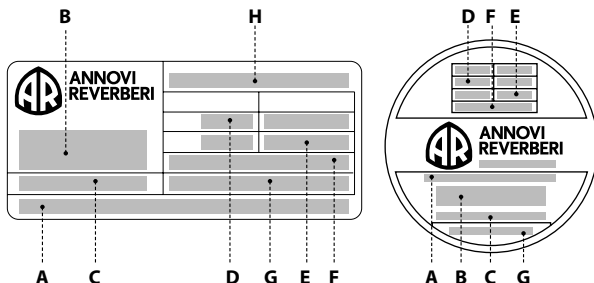
**Data plate**

The data plate shown here, containing essential information for safe operation, is affixed to every pump.

- A) Manufacturer's name and address
- B) Model
- C) Serial number
- D) Maximum delivery rate (l/min)
- E) Maximum operating pressure (bar)
- F) Maximum rpm
- G) Lubricant specifications
- H) Pump code:

**Manufacturer's name and address**

Annovi Reverberi Spa  
Via Martin Luther King, 3  
41122 Modena (MO) - Italy





## Intended uses

The pump is designed and constructed for incorporation in plants and machinery (spraying machines for the protective treatment of agricultural crops and garden plants). **All other uses constitute misuse unless approved by the manufacturer's technical service**

The pump must be used in a manner appropriate to its technical data (see "Technical Data"), and must not be modified or improperly used.

## Misuses

**Do not** put the pump into service until the plant or machinery in which it is incorporated has been declared compliant with the relevant national and local legal requirements.

**Do not** use the pump in a potentially explosive atmosphere.

**Do not** use the pump for **flammable**, toxic or corrosive liquids or liquids with unsuitable density, especially **seawater, adhesives, bitumens, asphalt sealers, two-step curing compounds, concrete sealers, liquefied gases or solvents** of any kind, paints of any kind or liquids containing solids in suspension, and in all cases **do not** use with any liquid unless certain that it is compatible with the materials used in the pump circuit.

**Do not** draw in liquids at temperatures above 50°C or below 5°C.

**Do not** use the pump in drinking water supply systems.

**Do not** use the pump on products for human consumption.

**Do not** use the pump on pharmaceutical products.

**Do not** use the pump without first checking that the intake and delivery circuit pipelines are correctly secured and free from leaks.

**Do not** use the pump without the safety devices provided: guards for shafts and drive couplings and suitably rated relief valve on the delivery circuit.

**Do not** use the pump to wash or spray: people, animals or delicate items, live electrical equipment or chemicals whose characteristics are not known.

## Safety devices



### Danger - Warning

**Never tamper with or by-pass the safety devices. Maintain all safety devices regularly to ensure they all work efficiently.**

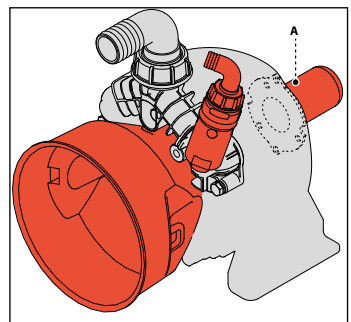
The drawing shows the position of the safety devices mounted on the machine.

Additional safety devices must be added as necessary during the design phase (see "Installation information").

**A) Fixed guard:** provides protection against accidental contacts with the drive shaft when in operation.

## Residual risks

Even if the safety regulations and information provided in the manual are complied with, the residual risks described in the declaration of incorporation still apply when the pump is in operation.



### General description

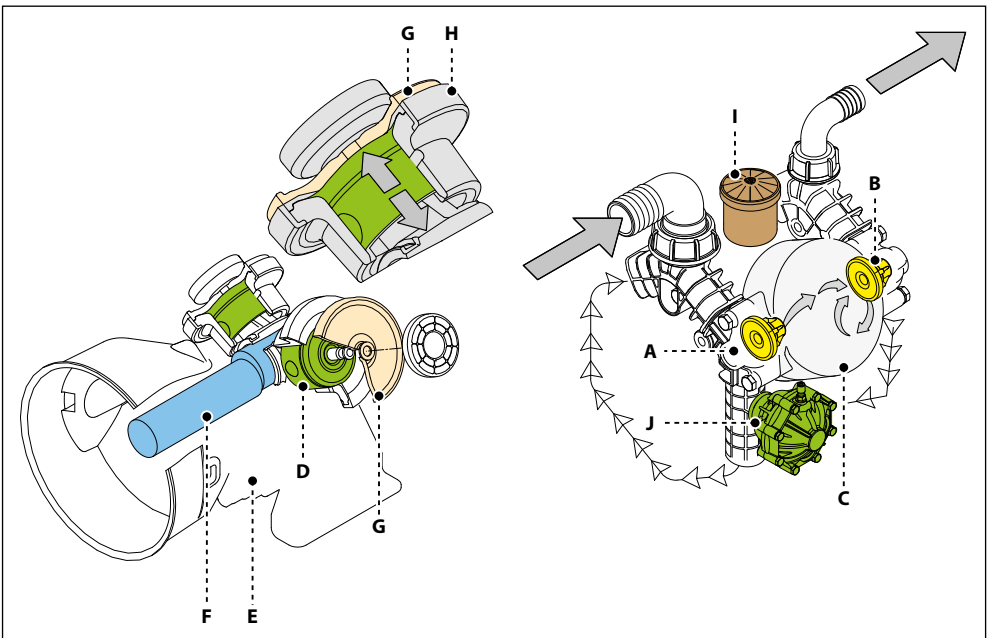
The pump is designed and constructed to pump and compress liquids on spraying machines for the protective treatment of agricultural crops and garden plants.

The pump incorporates radial pistons which actuate the diaphragms by means of an oil cushion. The diaphragms are connected to the pistons in their middles by means of plates and secured at the edges between the cylinder liner and head.

The motion of the piston draws the diaphragm inward (intake) and then outward (delivery). The flow of liquid is regulated by the intake and delivery valves.

Oil between the pump body and diaphragm serves not only as a lubricant but also as a pressure compensation medium.

### Main components



- A) Intake valve
- B) Delivery valve
- C) Head
- D) Piston
- E) Pump body
- F) Crankshaft
- G) Diaphragm
- H) Cylinder liner
- I) Oil tank
- J) Pressure accumulator



### General safety rules

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Most workplace accidents and injuries are caused by carelessness and failure to comply with common sense and safety rules.

In most cases, accidents can be avoided by predicting their possible causes and proceeding with the necessary care and attention.

A careful operator who follows the rules is the best guarantee against accidents.

Before installing and using the pump, the operators and other staff must read and understand the instructions in the manual provided and the details of the installation design.

Do not tamper with, disarm or bypass the safety devices as this may cause serious threats to health and safety.

Do not release pollutants into the environment.

Dispose of waste in accordance with statutory requirements.

Before performing any procedure, adopt appropriate safety measures in accordance with the relevant statutory occupational safety requirements and comply with the safety regulations in the manual.



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### **Safety recommendations for handling and lifting**

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**Before starting the operations, organise the intended working area so that the materials can be lifted and handled in safety.**

**Unloading, loading, handling and lifting operations must be carried out by skilled, authorised, specifically trained staff.**

**During lifting and handling operations, the people not involved in the operations must remain at a safe distance.**

**For lifting, use hooks and ropes which are free from damage and appropriate for the load to be lifted.**

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### **Packaging description and unpacking**

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The packaging normally consists of a cardboard box for easy, safe transport.

Depending on the quantity of goods to be shipped and the place of destination, packages may be fixed on a pallet for easier lifting and handling.

Check the weight of the item on the transport documents to allow the use of suitable lifting equipment.

When unpacking, check that all components are present and intact. If items are missing or damaged, contact the dealer or manufacturer to agree the procedures to be followed.

The packaging material must be disposed of appropriately in accordance with the relevant statutory requirements.

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### **Transport**

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The pump may be shipped by a variety of means of transport (road, rail, sea or air) depending on its destination. Secure the packaging firmly to the vehicle during transport, to prevent random movement.

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### **Storage**

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In the event of a lengthy period out of use, place the pump (in its packaging if possible, or otherwise protected) under cover, protected from the weather.

Do not store in places where the ambient conditions might impair the pump's operating condition over time.

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### **Safety recommendations for installation**

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Take all possible precautions to allow the pump to be installed in a safe, risk-free manner.

All installation phases must be taken into consideration when designing the machinery or plant in which the pump is to be installed.

The design must consider all mounting points, the means of transmission of the energy sources, and the protective and safety devices required by the relevant regulations to prevent the risk of injury.

## Installation

The mechanical connection between the pump and the motive power source may be made by means of a pulley and belt, with a drive shaft, or through a direct flanged connection to the motive power source.

The crankshaft may turn in either direction.

The water connection between the pump and the machine circuit must be made using hoses of suitable diameter, in all case no less than that of the pump fittings, securing them to the fittings using good quality clamps.

The intake hose must be coil-reinforced to prevent restrictions.

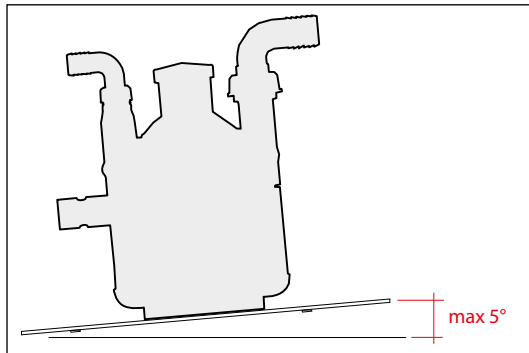
The machine intake circuit must be fitted with a filter having suitable capacity for the pump delivery rate and must be designed to generate a vacuum of no more than -0.25 bar. This value can be measured by connecting a vacuum gauge to the pump intake fitting.

The rated pressure of the delivery hose, fittings and clamps must be no less than the maximum rated pressure of the pump. Replacing the intake and delivery fittings provided on the pump by the manufacturer with small-diameter alternatives may reduce the pump's performance and annul the warranty.

## Mounting the pump

The pump must be installed on a horizontal surface with no flexible components between it and the mounting surface.

The illustration shows the maximum permitted pump installation angle beyond which proper lubrication of the crank mechanism is not ensured.



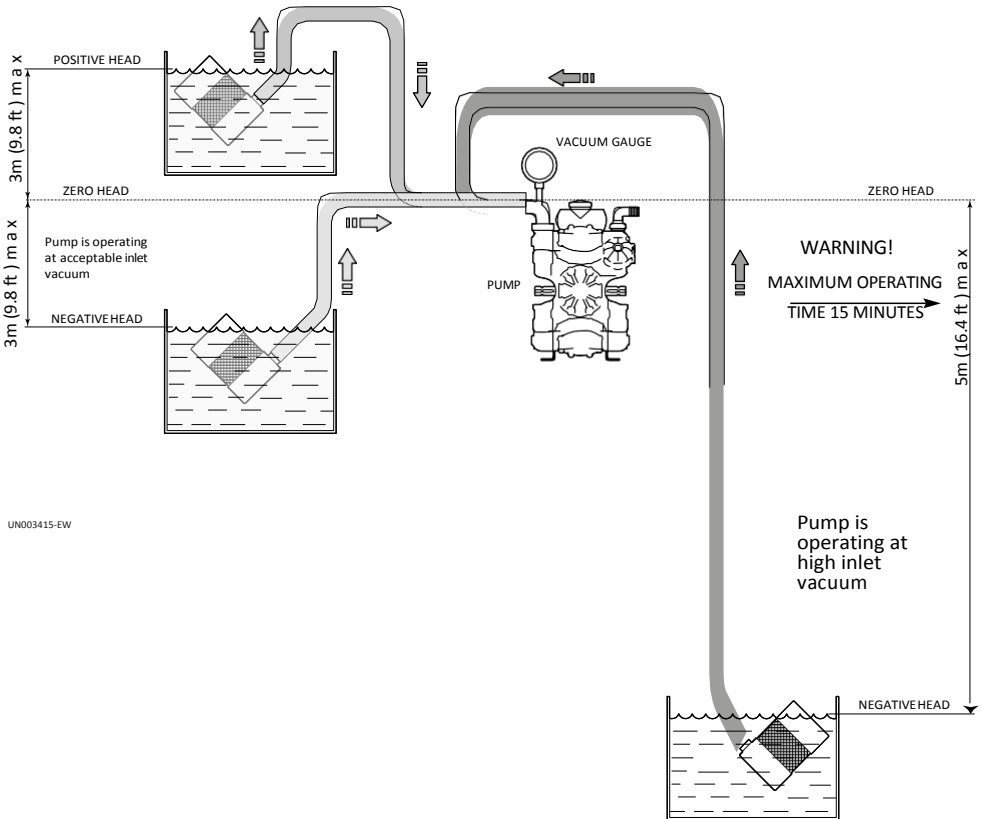
**Fix the pump** by screwing the pump support onto the base of the machine with suitable screws, tightening appropriately.

## General guidelines on water supply connection

To operate correctly, the diaphragm pump must draw in liquids from containers at atmospheric pressure.

**Do not supply the pump with pressurised liquids.**

For continuous duty, the pump should not draw in water by gravity from containers with liquid level at heights above 3 m.



UN003415-EW

For continuous duty, the pump should not draw in liquids by vacuum from containers with the liquid level more than 3 m below the pump intake fitting and the circuit must consist of hoses of length and diameter appropriate to the pump intake fitting (see "Technical Data"), free from restrictions and elbows, and with a filter of suitable capacity (see "Installation").

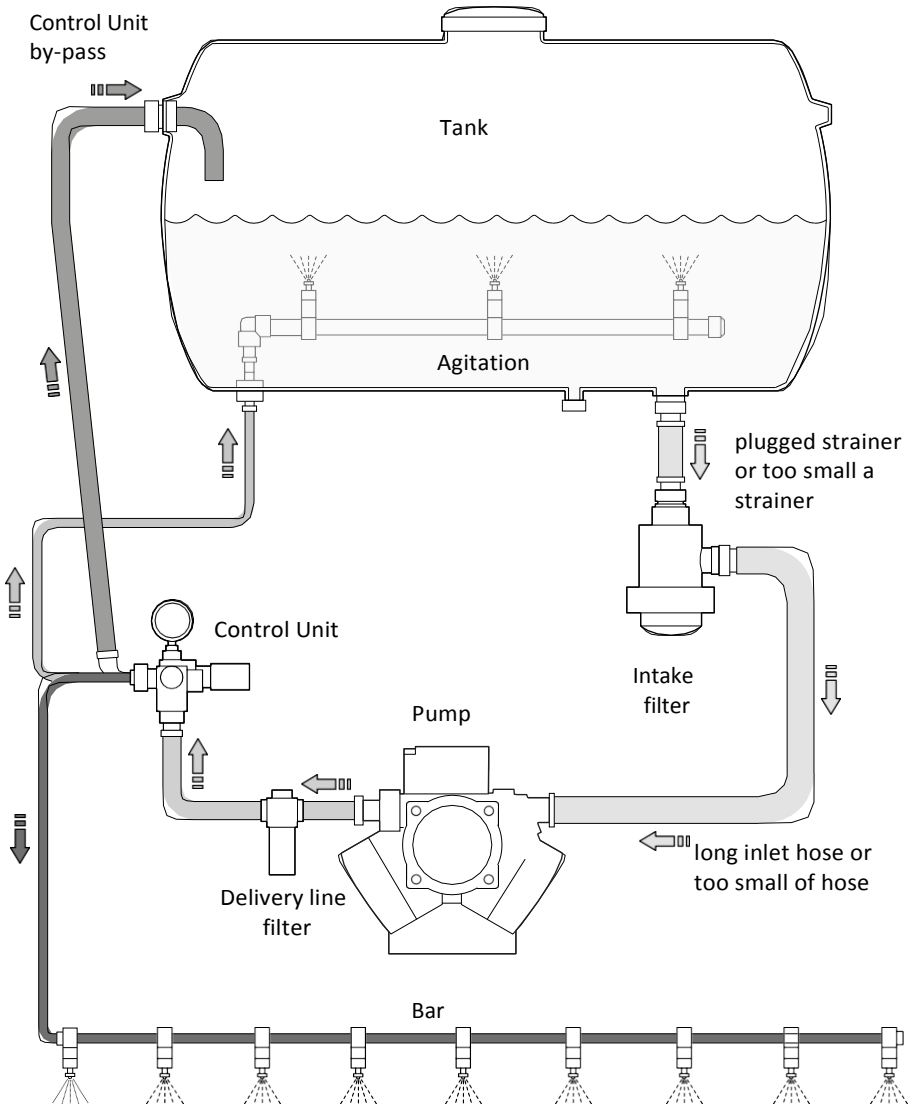
For occasional duty, such as filling water supply tanks, the pump can be operated at a vacuum drawing in liquids from reservoirs having the surface of the liquid up to 5 m below the pump intake fitting, for periods of no more than 15 minutes.

**Drawing in liquids from lower levels or for longer times causes cavitation in the pump circuit and reduces the lifetime of the diaphragms, valves and mechanical parts.**



## Installation diagram (guideline)

The following is a simplified illustration of the typical installation layout and is purely guideline.





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### Safety recommendations for use

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**Before start-up, the operator must perform the necessary safety checks.**

**In the event of leaks from the pressurised pipes, stop the pump at once and remove the cause of the leak.**

**Do not operate the pump above the limits set by the manufacturer to increase its performance.**

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### Preliminary checks

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If the pump has a pressure accumulator, check its level of inflation, see “Checking the inflation pressure”.

Check the fittings of the hoses and the pump's intake and delivery circuits to prevent restrictions, the intake of air and leaks of liquid.

Check that any ball valves on the pump or distributor are closed.

Check the pump tank oil level as described in the “Checking the oil level” section.

Before putting the pump into operation, check that the pressure regulator knob is turned fully anticlockwise and the pressure distributor switching lever is in the by-pass position.

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### Starting and stopping the pump

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To start the pump, proceed as described below.

1. When starting the pump, keep the pressure lever in the by-pass position until the pump has primed.
2. Move the lever into the pressure regulation position.
3. Turn the distributor knob clockwise to increase the pressure or anticlockwise to decrease it.
4. During the first few hours of operation, check that the oil level in the tank remains between the minimum and maximum limits. If top-ups are required, use AR Premium Diaphragm Pump Oil.

To stop the pump, proceed as described below.

1. Reduce the pressure by turning the distributor knob anticlockwise
2. Open the by-pass valve to discharge the pressure.
3. Stop the pump.

**Safety recommendations for maintenance**

**Caution - Take Care**

**Before doing any maintenance work, depressurise the water system and isolate the pump from all energy sources.**

**When the jobs are done, before restarting the pump, check that no tools, rags or other materials have been left close to moving parts or in hazardous zones.**

**Replace any excessively worn components with original parts and use the lubricants recommended by the manufacturer.**

**Scheduled maintenance table**

<b>Frequency</b>	<b>Component</b>	<b>Procedure</b>	<b>Reference</b>
Every working day	Filter	Inspect filter cartridge	See "Inspecting the filter"
	Pump	Checking the oil level	See "Checking the oil level"
	Connection of pump to power source (pulley, belt, coupling)	Inspection	-
	Pump	Inspect mounting	See "Inspecting the pump mounting"
	Pipes and connections	Inspection	See "Inspecting the connections and pipes"
Every 100 working hours	Pressure accumulator (if installed)	Check inflation pressure	See "Checking the inflation pressure"
	Reduction gear (if installed)	Check oil	See "Checking the oil level"

**Dispose of the worn-out components and lubricants in accordance with the relevant statutory requirements.**

**Carry out the routine maintenance procedures specified by the manufacturer to keep the pump safe and performing well.**

**Table of lubricants**

The pump is delivered complete with high-performance synthetic multigrade oil suitable for the intended ambient conditions (see "Environmental operating limits").

**Inspecting the pump mounting**

Check that the pump's fixing screws have not become loose.

If necessary, tighten them with the driving torque stated in the installation design.

**Inspecting the connections and pipes**
**- Inspect the connections for leaks.**

Leaks can normally be dealt with by tightening the connections properly.

If leaks from the intake pipeline connections are noticed, the seals must be repaired.

**- Inspect the hoses.**

If the pipes show signs of aging, breakage, swelling, rubbing, etc., they must be replaced.

**Inspecting the Filter**
**- Inspect the filter cartridge.**

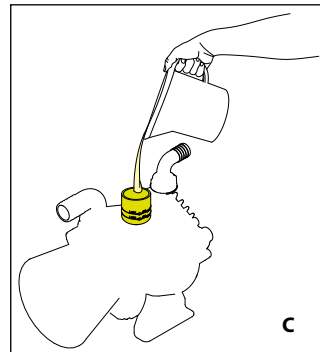
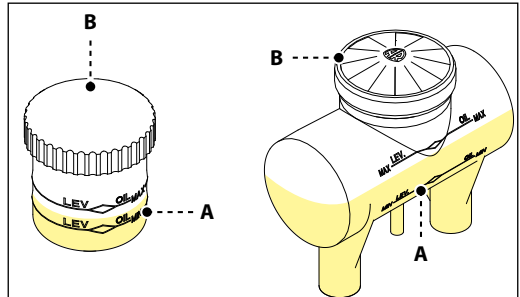
If the cartridge is fouled, wash it thoroughly to remove the dirt.

If the cartridge is torn or cracked, it must be replaced.

**Checking the oil level**

- Check the oil with the pump level, ensuring that it has been running for at least 5 minutes in normal working conditions.
  - If the oil level is not between the MIN and MAX marks on the tank, add or remove oil to restore this level and check, still with the pump running, that the oil level does not vary so much that it leaks from or is no longer visible in the tank.
  - If necessary, top up with oil with the characteristics specified in the "Lubricants table".
  - Check the oil level regularly, as it may vary significantly with the operating conditions.
- To top up with oil proceed as described below.

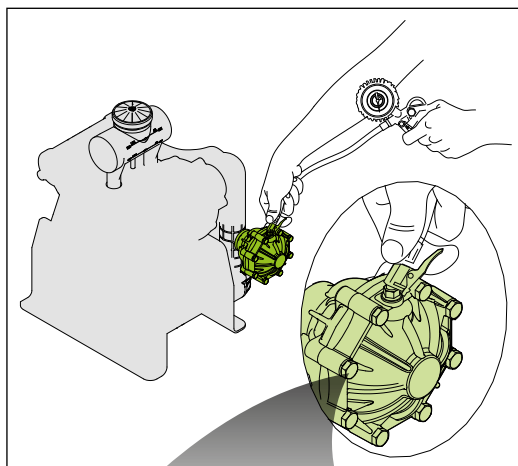
- 1) Unscrew the plug (B) and pour in oil (C).
- 2) Screw the plug (B) back into place.

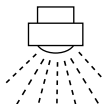
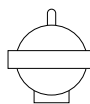


Diaphragm Pump Oil  
Part No. AR64532D

**Checking the inflation pressure**

If the pump has a pressure accumulator, check its level of inflation, with the pump at a standstill, using an air gun fitted with a pressure gauge. The accumulator is inflated by the manufacturer for use of the pump at its maximum pressure. For adaptation of the accumulator pressure to the working pressure, refer to the table below.



			
bar	psi	bar	psi
1-3	15-44	1	15
3-12	44-174	1-3	15-44
12-20	174-290	3-5	44-73
20-50	290-725	5-7	73-102

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### Lengthy pump lay-offs

It is important to comply with the recommendations for lay-offs in the operator's manual of the machine into which the pump is incorporated.

For the pump itself, at the end of pumping operations it is essential to flush out the internal circuit by pumping clean water. After this, open the intake circuit to the air and leave the pump in operation until the internal circuit is completely empty. Following this simple procedure at the end of every operating session will prevent the retention inside the pump of products which are often corrosive and may damage its hydraulic circuit in the long-term.

If the pump is laid off during the winter in locations with severe weather conditions, it is very important to flush out the internal circuit as described above and then draw diluted automotive anti-freeze into the pump. Then take care to discharge the liquid from the system and the pump in particular; it usually has a specific drain plug.

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### Putting the pump back into service

Before putting the pump back into service after a long period out of use, check the oil level and the tightness of the mounting screws.

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### Scrapping the pump

Used units must be disposed of in compliance with local legislation.



A/R Pump Saver  
P/N 64511  
Protects Pumps from Freezing Conditions

The information provided is intended to provide guidance how to deal with malfunctions which may occur during use.

Some of these procedures may be carried out by skilled staff, while others have to be performed at specialised service centres since they require the use of specific equipment as well as detailed knowledge of repair operations.

<b>Problem</b>	<b>Cause</b>	<b>Remedy</b>
The pump does not prime properly.	Intake circuit not airtight.	Tighten, repair or replace hoses and fittings as necessary.
	Distributor switching lever on "Pressure" setting.	Move distributor switching lever to "By-pass" setting.
The pump does not require the required pressure.	Seat and plate of intake and delivery valves worn.	Replace the worn valves.(1)
	Nozzles worn or too large in diameter.	Replace the worn nozzles. Use nozzles of suitable diameter.
	Restriction in intake circuit.	Remove the restriction from the circuit.
	Intake filter fouled.	Clean the filter cartridge.
Pressure gauge needle wobbles, pressure throbbing.	Intake circuit not airtight.	Clean or replace the intake and delivery valves. (1)
	Residual air left inside pump.	Discharge the air by opening a ball valve/central unit connected to the delivery side with the pump in operation.
	Valve plate stuck to its seat.	Tighten, repair or replace hoses and fittings as necessary.
	Pressure accumulator deflated	Inflate accumulator to the correct pressure.
Uneven flow of liquid to nozzles.	Pressure accumulator deflated	Inflate accumulator to the correct pressure.
Increase in noise and simultaneous drop in oil level (pump cavitation).	Restriction in intake circuit.	Remove the restriction from the circuit.
	Intake filter fouled.	Clean the filter cartridge.
	Pump drawing in liquid from too low a level.	See "Pump Intake Conditions" section.

(1) Operations which must be carried out at an authorised service centre



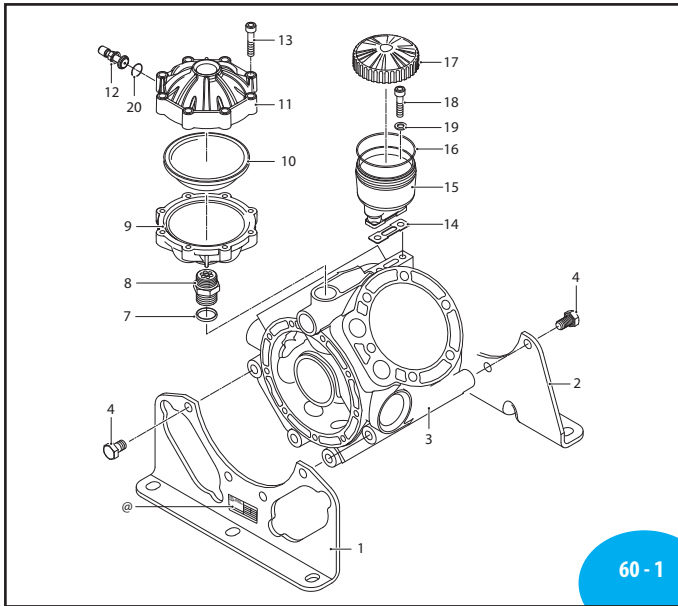
Problem	Cause	Remedy
Oil on pump body or base.	Oil seal on pump shaft worn.	Replace the worn oil seal. (1)
	Oil pressure inside pump too high.	Restore correct oil level in tank.
Pump using too much oil (oil flowing from delivery port) or oil whitish in colour (water/oil emulsion in tank).	One or more diaphragms ruptured.	<b>Stop the pump at once.</b> Replace the diaphragms (1)

(1) Operations which must be carried out at an authorised service centre

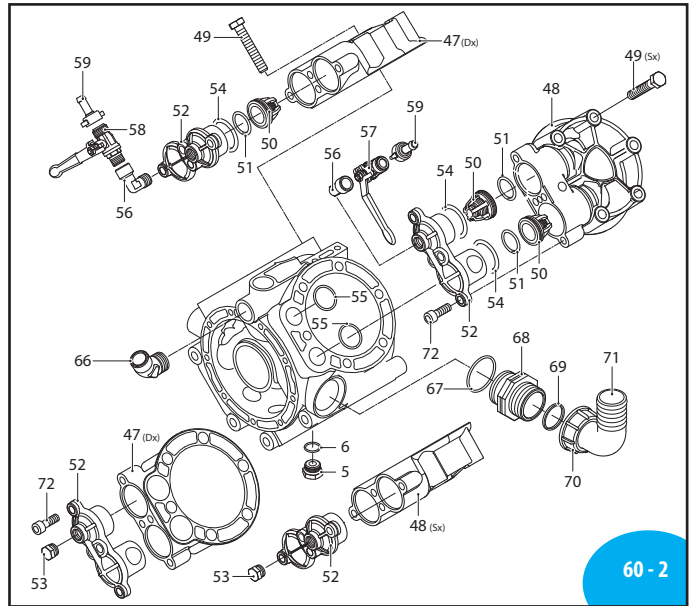


# A.R. NORTH AMERICA

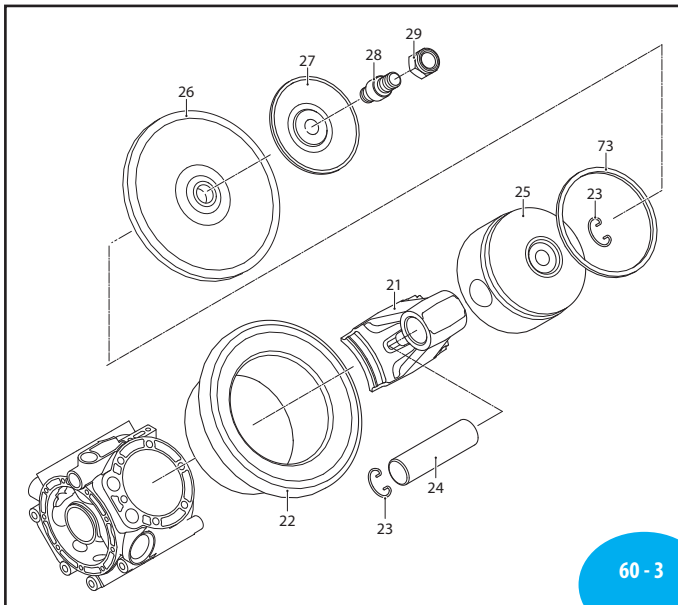
## AR 1604



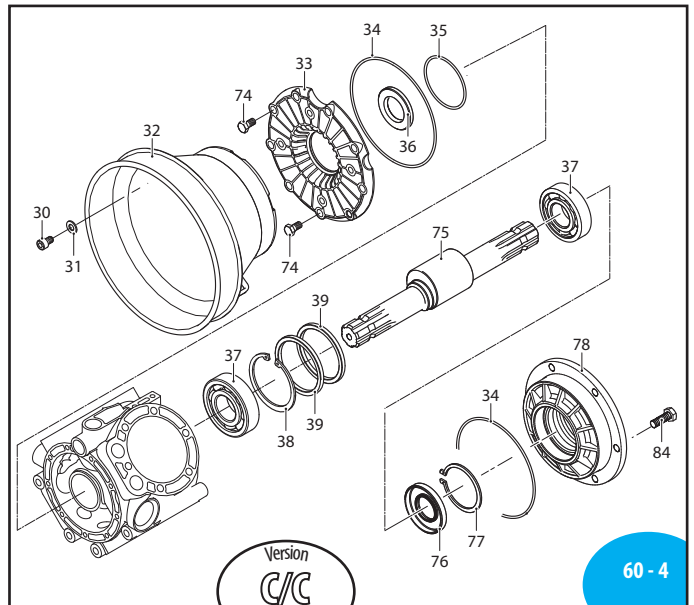
60 - 1



60 - 2



60 - 3



60 - 4



# AR 1604

	C/C
AR1604	31759

Pos	Code	Description	Qty	Note
1	3920030	Base front	1	
2	3920040	Base back	1	
3	3920010	Pump body	1	
4	1520861	Bolt TE M12x20	8	T445* (a)
	540210	Bolt TE M12x25	8	T445* (b)
5	820361	Plug 1/2" G brass	1	T180*
6	180101	O-ring Ø17.5x2	1	
7	720030	O-ring Ø22.22x2.62	1	
8	2240490	Fitting	1	T180*
9	2240481	Semi air chamber lower	1	T180*
10	550190	Diaphragm air chamber	1	NBR
	550194	Diaphragm air chamber	1	BlueFlex™
11	620234	Semi air chamber upper	1	Anodized
12	180020	Air valve	1	T310*
13	380410	Bolt TCEI M8x40	8	T180*
14	750040	Gasket	1	
15	750030	Oil sight glass	1	
16	1040060	O-ring Ø72.69x2.62	1	
17	750050	Plug red	1	
18	680350	Bolt TCEI M8x35	2	T90*
19	380241	Washer	2	
20	650542	Gasket	1	
21	3920020	Connecting-rod bronze	4	
22	2680080	Sleeve	4	
23	160691	Ring circlip Øi 18	8	
24	260700	Pin	4	
25	2240060	Piston Ø72	4	
26	550080	Diaphragm	4	NBR
	550081	Diaphragm	4	BlueFlex™
	550085	Diaphragm	4	DESMOPAN
	550086	Diaphragm	4	HPDS
27	580090	Retaining washer	4	
28	2240100	Hub pin	4	(c) T310*
29	2240110	Nut M10	4	SS T265*
30	850250	Bolt TCEI M8x12	4	T90*
31	390311	Washer	4	
32	1500470	Shield	1	
33	2680050	Manifold suction	1	
34	1400120	O-ring Ø145.72x2.62	2	
35	2240270	O-ring Ø 67.95x2.62	1	
36	2680110	Ring seal	1	
37	751280	Bearing	2	
38	230340	Ring circlip Øi 80	1	
39	2240540	Ring connecting rod	2	
41	2680340	Bearing	1	
42	2680290	Ring circlip Øe 65	1	
43	2680240	Flange	1	
44	1400150	Ring seal	1	

Pos	Code	Description	Qty	Note
45	1400140	Flange	1	
46	1400110	Ring	1	
47	2680030	Head marked DX	2	
48	2680031	Head marked SX	2	
49	750070	Bolt TE M12x70	24	T445*
50	2689050	Valve	8	
51	180240	O-ring Ø31.34x3.53	8	
52	2680040	Cover	4	
53	130171	Plug 3/8" G	3	T180*
54	2680150	O-ring Ø42.52x2.62	8	
55	1520650	O-ring Ø29.82x2.62	8	
56	900210	Fitting 3/8" G M-F	2	
57	130491	Ball valve 3/8" G - 1/2" GM-M DX	1	
58	130492	Ball valve 3/8" G - 1/2" GM-M SX	1	
59	110131	Ring nut 1/2"	2	
65	880831	O-ring Ø15.54x2.62	1	Viton
66	851650	Elbow manifold	1	
67	751140	O-ring Ø47.22x3.53	1	
68	751130	Fitting 1" 1/2 G M-M	1	
69	390290	O-ring Ø29x3	1	
70	750670	Ring nut 1 1/2" G	1	
71	50267	Elbow 1 1/2"	1	
72	540300	Bolt TCEI M10x30	16	T310*
73	260230	Piston ring	4	
74	180370	Bolt TE M8x25	9	T180*
75	2680190	Shaft C/C m-CM	1	
76	2680120	Ring seal	1	
77	161050	Ring circlip Øi 72	1	
78	2680020	Flange	1	
80	750920	Bearing	1	
81	2680021	Flange	1	
82	2680130	Ring seal	1	
83	2420250	Ring center	1	
84	160670	Bolt TE M10x25	6	T355*

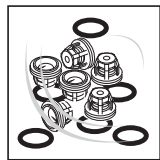
@ Pump and manufacturer identification.  
(a) From serial number N° 39249140001.  
(b) Up to serial number N° 39248149999.  
(c) Bolt with Loctite 242 pin side piston.

\* Torque: in-lbs +/- 10%

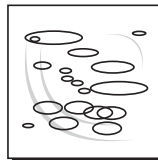
High pressure



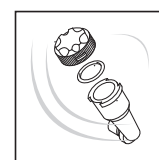
<b>AR 43313</b> BlueFlex™ diaphragms	
<b>AR 43310</b> Buna diaphragms	
<b>AR 43312</b> Viton diaphragms	
<b>AR 43311</b> Desmopan diaphragms	
Pos.	Qty
10	1
26	4
55	8



<b>AR 42941</b> Valves	
Pos.	Qty
50	8
51	8



<b>AR 42942</b> O-Rings			
Pos.	Qty	Pos.	Qty
6	1	69	1
7	2		
16	1		
34	2		
35	1		
51	8		
54	8		
55	8		
65	1		
67	1		



<b>Suggested Oil</b>	
Type	Oz
AR64532D	32
Crankcase Oil Capacity 78 oz	