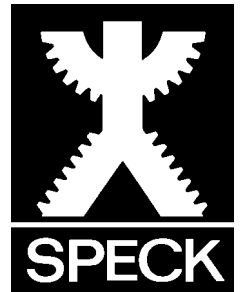


Operating Instructions, Spare Parts List



SPECK *BÜFFEL* Pumps S75, S100, S150, S450, S456 (S200, S300)

1. In General

Every individual pump undergoes a lengthy test-run before leaving our factory.

1.1 Areas of Applications

SPECK piston pumps are for pumping drinking water and waste water and find their use in:

- Agriculture • Ships • Industry • Horticulture


Should the pumps be used for pumping other media than water, written consent must be given by the manufacturer. Special versions are built by us for pumping other fluids.

1.2 Economical Features

SPECK piston pumps save energy. The comparatively high price of a piston pump is rewarded in time by its low power consumption and long working life.

1.3 Accessories

A belt guard is available for V-belt drive. The law on technical appliances obligates the manufacturer to supply a belt guard, even for pumps without motors. Please note this when ordering.

Declaration of Conformity	Declaration by the Manufacturer
We herewith declare on our own liability	
that the following pump units: Pumps with Motor: S75 S100 S150 S450 S456	that the following Pumps without Motor: S75 S100 S150 S450 S456
Comply with the following relevant stipulations: EU Machinery Guidelines 98/37/EU	
Applied harmonized standards: EN 809 EN 292 T1 EN 292 T2	
Electromagnetic Compatibility: 89/336/EWG	
Applied harmonized standards: EN50 081-1 EN50 082-2	
Use of Electrical Equipment within specified Voltage Limits: 73/23/EU	
Applied harmonized standards: EN60 335-1 EN60 335-2-51	
p.p.  (Technical Director)	

Country of Origin: Federal Republic of Germany

SPECK - KOLBENPUMPENFABRIK

Otto Speck GmbH & Co. KG · P.O. Box 1240 · D-82523 Geretsried
 Tel. (08171) 62930 · Fax (08171) 629399

2. Safety

The Operating instructions give basic information which must be observed during installation, operation and maintenance of the pump. It is therefore imperative that the operating instructions be read by the fitter and personnel/operator prior to assembly and operation. This manual must always be on hand at the site of the pump unit. It is not only the general safety instructions contained under this main heading 'Safety' that are to be observed, but also the specific information provided under the other main headings.

2.1 Identification of Symbols shown in the operating instructions

The safety directions given in these operating instructions, which when not observed can cause danger to persons, are identified by the following symbol:



safety sign as per DIN 4844-W9



safety sign as per DIN 4844-W8

Safety measures whose non-observance can cause damage to the machine are marked:

Important!

It is imperative that signs affixed to the machine such as:

- the arrow indicating the directions of rotation
- symbols indicating fluid connections

be observed and are kept legible.

2.2 Qualification and Training of the Operating Personnel

The personnel responsible for operation, maintenance, inspection and assembly must be adequately qualified. Scope of responsibility and supervision of the personnel must be exactly defined by the plant operator. If the staff does not have the necessary knowledge, they must be trained and instructed, which may be carried out by the machine manufacturer or supplier on behalf of the plant operator. Furthermore, the plant operator is to make sure that the contents of the operating instructions are fully understood by the personnel.

2.3 Hazards in the Event of Non-Compliance with the Safety Instructions

Non-observance of the safety instructions may cause a risk to the personnel as well as to the environment and the machine, and may result in a loss of any right to claim damages.

For example, non-compliance can involve the following dangers:

- Failure of important functions of the machine/pump unit
- Failure of specified procedures for maintenance and repair
- Exposure of people to electrical, mechanical and chemical hazards
- Endangering the environment owing to hazardous substances being released

2.4 Safety at Work

The safety instructions contained in this manual, the relevant national accident prevention regulations and any other service and safety instructions given by the plant operator are to be observed.

2.5 Safety Instructions relating to Operation

- If hot or cold machine components involve hazards, they must be guarded against accidental contact
- Guards for moving parts (e.g. coupling) must not be removed from the machine while in operation
- Any leakage of hazardous (e.g. explosive, toxic, hot) fluids (e.g. from the shaft seal) must be drained away to prevent any risk to persons or the environment. Statutory regulations are to be complied with.
- Electrical danger must be prevented (details can be obtained from the German Electrical Engineering Association and from local power stations, for example)

2.6 Safety Instructions for Maintenance, Inspection and Assembly Work

It shall be the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is carried out by authorized and qualified personnel who have adequately familiarized themselves with the subject matter by studying this manual in detail.

Any work on the machine must only be carried out when it is at a standstill.

Pumps and pump units that convey hazardous media must be decontaminated.

On completion of work, all safety and protective devices must be put back and made operative again.

Prior to restarting the machine, the instructions listed under 'Operation' are to be observed.

2.7 Unauthorized Alterations and Spare Parts

Any modification to the machine may only be made after consultation with the manufacturer. Using original spare parts and accessories authorized by the manufacturer is in the interest of safety. Use of other parts may exempt the manufacturer from any liability.

2.8 Unauthorized Modes of Operation

The reliability of the machine delivered will only be guaranteed if it is used in the manner intended which is described under the heading 'In General' of this manual. The limit values specified in the data sheet must under no circumstances be exceeded.

Norms and Other Data

DIN 4844 Part 1	Safety descriptions and safety signs W8 - supplement sheet 13
DIN 4844 Part 1	Safety descriptions and safety signs W9 - supplement sheet 14

3. Transport and Storage

Storage in a humid environment or where temperatures are below zero is to be avoided. The storage room should be airy as moisture can damage the motor and thus void the warranty.

Pumps are packed for transportation in cardboard boxes or on pallets. When unpacking, check for any damage.

4. Description

4.1 Büffel Pumps

SPECK piston pumps of the *Büffel* series have a thoroughly proven double-helical precision gear of unsurpassed working quietness and service life.

When turned in the correct direction, the gear is lubricated by an oil-dip with bath flooded crosshead. Suction and discharge connections are on the valve casing and are interchangeable.

The valve casing, air chamber, stuffing box casing and cylinder cover are of grey cast iron (GG20).

The brass suction and discharge valves (2 of each) are made easily accessible by removing the air chamber. The suction/discharge line does not have to be removed.

The conrod is of solid bronze (G-CuAl10Ni).

The brass cylinder sleeve can be removed via set-screws.

The duo piston is of NBR rubber.

Teflon-impregnated packing rings are used to seal the piston rod in the stuffing box.

4.2 Büffel Pump with Vertical Tank (Pump Unit)

Pump units with vertical tanks are set up by a fitter at the site of installation (see section 5.3). The air volume control unit installed in the pressure tank of the unit automatically ensures the correct ratio between the water amount and the necessary air cushion. When the tank is approx. 2/3 full, the valve of the air volume control unit, activated by the float, opens and the pump begins conveying both air and water into the tank.

A suction head of approx. 4-6 m is necessary so that the pump can draw in air in the proper manner. This rule applies for pressure tanks with a maximum volume of 750 l or less. Larger tanks should be fed air via a separate source (e.g. through a compressor, see section 5.3).

When water leaves the tank, the pressure in the tank drops. Eventually the pressure sinks to the automatic switch-on point which then activates the pressure switch to turn on the motor/pump. The tank is then refilled until the switch-off level is attained. This procedure repeats itself every time the minimum water amount is reached.

4.3 Adjusted Values of the Pressure Switch

Pump Unit, 4 bar: Switch-On Pressure: 2 bar
Switch-Off Pressure: 3,5 bar

Pump Unit, 6 bar: Switch-On Pressure: 3 bar
Switch-Off Pressure: 5,5 bar

4.4 Safety Valve

The *Büffel* pump series S75, S100, S150, S450, S456 (S200, S300) do not have a built-in safety valve. Therefore a safety valve has to be installed into the discharge line as per the below table or as per the stipulations of the plant operator. The valve manufacturer can also be consulted with regard to the correct size of the safety valve.

Safety Valve Table:

Pump Model:	S75	S100	S150	S200	S300	S450/S456
Minimum Size :	G1 1/2	G2	G2 1/2	G2 ½ - 3	G3-4	G4

5. Set-Up and Installation (to be done by qualified persons only)

5.1 Location of Pump

Important! The room must be free of frost and dry. It should also be well aired to prevent undesirable moisture forming on the unit. Moisture damages the motor.



To protect against accidents, each pump must be equipped with a belt-guard which conforms to trade union and/or general safety rules.

5.2 Büffel Pump

Single *Büffel* pumps are screwed onto a small brick or concrete base and secured with foundation bolts. Do not, however, connect the base directly to the wall.

No particular foundation is required for vertical tanks. Particularly quiet operation is achieved by mounting the piston pump onto anti-vibration material and inserting rubber joints into the suction and discharge lines. The pump must be accessible from all sides so that maintenance can be carried out properly.

5.3 Büffel Pump with Vertical Tank (Pump Unit)

Pump units with vertical tanks are set up at the site of installation by a fitter. Do not forget that an air volume control unit for tanks with a max. volume of 750 l or less can also be fitted when setting up units with vertical tanks. We recommend that tanks over 1,000 in volume litres be fed air via a separate air source (such as a small compressor, for example).

5.4 Suction Line for *Büffel* Pumps and Pump Units

Important! Perfect functioning of the pump depends largely on a correctly chosen and well laid-out suction line. In order to prevent air pockets, the suction line should rise gradually from the well to the pump, or should at least be laid horizontally. It must be absolutely leakproof and its inner diameter has to be at least as large as the connection on the pump. Only bows are to be used, no elbows. It is advisable to install a foot valve – or in the case of a closed filter well, an intermediate valve. If suction lines are longer than 30 m, a suction air chamber is to be installed directly in front of the pump.

Suction Air Chamber Table:

Pump Output	Litre/h	5000	10000	20000	30000	40000	45000
Suction Air Chamber Volume	Litre	20	50	100	200	300	300

5.5 Suction Head

Important! The total measured suction head which is the height between the water level and the pump plus loss of friction in the pipe and possible filter resistance, is not to exceed 7.5 m, not forgetting that in dry seasons the water level in the well may be lower than usual.

In the case of short suction lines or a suction head of below 2 m, or if booster input pressure is present, a shut-off valve must be installed (not a tilted seat valve) in suction line directly in front of the pump. This shut-off valve can be adjusted with greater accuracy to the required suction head, ensuring the avoidance of water hammer.

5.6 Intake Pressure – Pump Unit as Booster Set

Important! If the inlet pressure is more than 0.3 bar (3 m), it is advisable to install pressure-free feed tank with float valve. If this is not possible, a shut-off regulator valve must be installed in the feed line under all circumstances. A vacuum of between 4 – 6 m is required for the the automatic air volume control unit to function properly. If the pump hammers, install a suction air chamber into the feed line (section 5.4). A shut-off valve in the suction line is an absolute necessity so that the suction line can be closed for maintenance work to the pump.

5.7 Discharge Line – for *Büffel* Pumps and Pump Units

Important! If possible, the discharge line should rise gradually upwards from the pump to the tank or at least be horizontal. Use curved joints only; elbow fittings are admissible only after the tank. A shut-off valve must under all circumstances be installed between the pump and tank so that the discharge line can be closed for maintenance work to the pump. A kick-back valve is unnecessary - it only causes noise.

Correct Sequence of Installation:

Pump – Diaphragm Compensator – Safety Valve – Shut-Off Valve – Pressure Tank or Overhead Tank

- see installation plan on page 10

If discharge lines are longer than 30 m, an air chamber is to be installed to damp pulsation

Pump Output	Litre/h	5000	10000	20000	30000	40000	45000
Size of Air Chamber	Litre	20	100	150	300	500	500

5.8 Interchanging Suction and Discharge Connections

The suction and discharge sides of SPECK *Büffel* pumps can be interchanged by converting the suction and discharge valves which often simplifies installation of the suction and discharge line.

Interchanging the valves is quite simple:

Remove the air chamber (5). Screw off the two fixing screws (hexagon nuts 13a) and take out the valve bridges (14). The valves (11 and 12) are now exposed and can be interchanged. When fitting the valves, make sure that the valve seat seals (11x and 12x) sit correctly on the sealing surface.

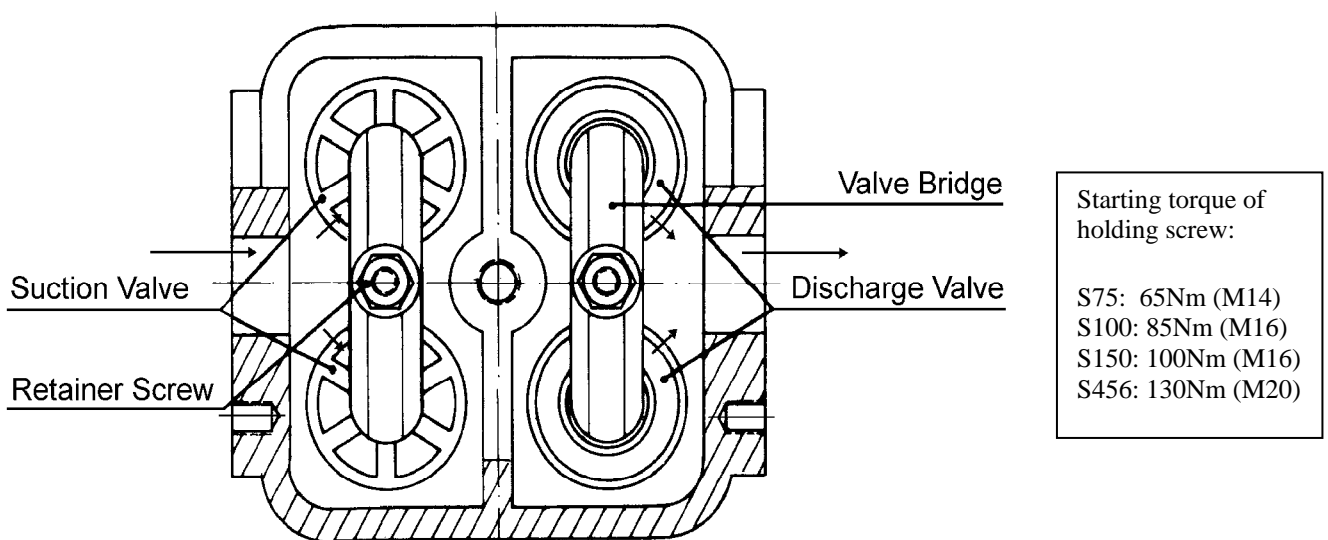


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6. Operation

6.1 To Fill Pump with Oil

Important! Fill the crankcase with an SAE30 quality oil by pouring it through the opening (28) and over the crosshead (23).

Oil Quantity:

S75	S100	S200	S150	S300	S450/S456
1.5 Ltr.	3.0 Ltr.	2x3.0 Ltr.	6.0 Ltr.	2x6.0 Ltr.	6.0 Ltr.

6.2 To Fill Pump with Water

Important! Fill up the pump head with water by pouring the water through the filler plug (33). At the same time, turn the pump V-belt pulley (18) manually in the direction of the arrow. In the case of long suction lines, fill right up to the foot valve/intermediate valve (see 5.4).

6.3 Motor Alignment and Electrical Connection

Using a ruler, make sure that the pump pulley and motor pulley (18 & 18b) are in line with each other. The motor could have been shifted during transport and if the pulleys do not align precisely, the belt will wear out quickly.



Electrical connection is to be carried out by qualified persons only

The electric motor must be connected as per the circuit diagram which can be found in the terminal box of the electric motor. Motors up to 1.5 kW in power can be started directly with the pressure switch. Motors above 1.5 kW in power must be started with a star-delta switch and a relay contactor. A centrifugal clutch pulley is absolutely necessary to ensure smooth starting and to prevent excessive current peaks.

The pump/motor must be guarded by a correctly adjusted protective motor switch.

6.4 Fittings

Open shut-off fittings and taps in the discharge line after the tank so that air in the pipe system can escape.

6.5 Switching On The Motor

Important! Check the direction of rotation (see arrows on the drive casing). The correct direction of rotation is achieved by exchanging any two lead wires. The shut-off fitting is to be closed again only when: 1. water has begun being pumped; 2. when the suction line and pump are vented and 3. when water exits the tap. Depending on the size of the tank, it takes between 5-15 minutes until the tank is full and the pressure switch switches off at either 3.5 bar or 5.5 bar.

6.6 To Let Water Out

Turn the tap on and let water out. The pressure drops eventually to 2 or 3 bar respectively and the pump switches on automatically again. Only a few air bubbles should now be in the discharge line, otherwise there is reason to believe that the suction line and/or pump are not correctly sealed. The mentioned slow decrease in pressure does not apply to units with an overhead tank or to bilge pumps on ships.

6.7 On and Off Switching Pressure

(for 4 and 6 bar units)

Important! The *Büffel* pump and pressure tank are approved for a maximum pressure of 4 or 6 bar. Consequently the pressure switch must only be adjusted to a maximum switch-off pressure of 3.5 bar / 5.5 bar, otherwise the safety valve will be activated.

To readjust the switch-on / switch-off pressure, see the included instructions for the pressure switch.

Switching Stages:

4 bar Pump Unit:	Switch-On Pressure	2 bar
	Switch-Off Pressure	3,5 bar
6 bar Pump Unit:	Switch-On Pressure	3 bar
	Switch-Off Pressure	5,5 bar

7. Service and Maintenance

7.1 Lubrication

Important!

The gear is lubricated automatically provided the pump revolves in the correct direction. The oil level should be checked every 3 months, and topped up if necessary until oil can be seen through the indicator glass (24). First oil change after 1 month of operation and then every year thereafter, or every 6 months if the pump is running continuously. This is done by unscrewing the oil indicator (24) or drain screw (16) and draining the old oil. Clean out the crankcase (by removing gear cover [2]) and refill with new oil as described under section 6.1.

7.2 Stuffing Box

Important!

The compact stuffing box is made up of Teflon-impregnated packing rings and a grooved seal ring and requires partially no maintenance at all. The stuffing box must not run dry. Single isolated drops serve to lubricate and cool it. Should the stuffing box continuously drip, tighten the stuffing box nut (6a) carefully by approx. $\frac{1}{4}$ to max. $\frac{1}{2}$ turn. If this does not help, all of the packing rings (6d) and the seal ring (6b) must be replaced. Pay careful attention when installing the seal ring: the lip ring seal must face the piston.

7.3 V-Belts

Important!

V-belts (34) should not be overtensioned. However, it is advisable to tighten belts up again after the first days of initial operation due to stretching. When replacing V-belts on multi-belt drive, the complete set must be replaced.

7.4 Gear

Important!

The original SPECK high-pressure *Büffel* pump has a double-herringbone (helical) precision gear with a bronze connecting rod. If the directions under section 7.1 for lubrication are followed, further maintenance is practically unnecessary. Only the connection rod (17) might need readjusting after approx. 1 year when it has been run in if a possible knocking sound can be heard. To do this, unscrew the locking nut (17c), screw out the hexagon tension screw (17a) and remove 0.1 – 0.5 mm of spacer shims (405) as required from the connecting rod joint. Screw the tension screw (17a) back on tightly and then the locking nut. After approx. 1 of operation, check whether the connecting rod has not been overadjusted and is running hot.

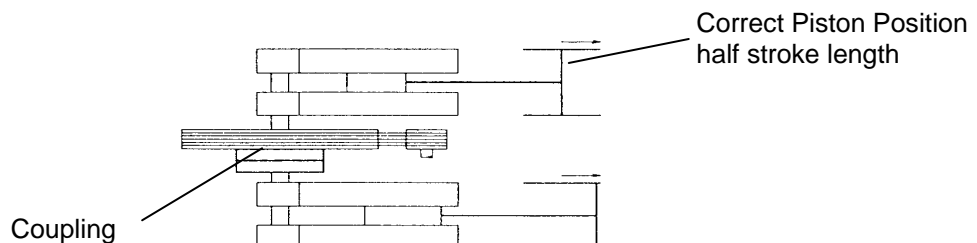
7.5 Air Replenishment

Important!

The pump will run smoothly and silently if there is air in the air chamber. This air cushion is regulated via the snifting valve. At the same time air is also pumped into the pressure tank. The more air there is in the pressure tank, the more water can be discharged before the pump switches on again (see section 4.2 and 5.3). If the automatic air volume control unit has to be repaired, kindly ask for our instruction sheet D10672. The unit itself is only available as a complete set.

Duplex S200, S300 und S900 *Büffel* Pumps

1. Duplex *Büffel* pumps always come with two suction lines but only one discharge line.
2. When coupling both drive shafts, pay careful attention that both piston rods do not run parallel together. One piston rod must not follow after the complete stroke length of the other. Both pumps must be coupled so that one piston rod follows the other by one half stroke (see drawing). This is important to ensure a harmonious flow and thus avoid a throbbing water supply. The pumps are correctly coupled at the factory. These directions are most important if the pumps must be dismantled for a certain purpose (due to narrow doorways, or changing V-belts etc).



8. Trouble-Shooting

If you have trouble with your pump, you may be able to help yourself by reading the tips we give you below. If you cannot find the reason for the problem, call a fitter or write to us, not forgetting to mention the pump model and its serial number.



Prior to doing any work on the pump, switch off the electricity and make sure that the pump is idle and that pressure is at zero.

8.1 Little or no water at all is being pumped

Possible Cause:	Remedy:
a) Pump is running but delivers no water even though it is filled properly.	Rubber valve discs have become stuck due to the pump being stored for a long period of time. Remove the air chamber (5) and loosen the rubber valve discs (113/123).
b) Pump is not sufficiently filled with water.	Refill the pump as explained in 6.2, at the same time turn the V-belt pulley (18) several times pouring in up to 5 litres of water little by little. Screw on the filler plug (33) again and seal it carefully. More water is necessary if the suction line is very long or the suction head very high.
c) The suction head is too high or the suction line too long.	Measure the difference between the water level and the pump flange connection. If the suction line is long, calculate the pipe friction loss using the herewith enclosed chart and add this loss to the overall suction height (section 5.5).
d) The suction line is not water-tight.	Check all connections and sealing areas on the suction pipe for water tightness. If necessary, carry out a hydro static test of the suction line by using a hand pump
e) The valves are soiled or worn.	Pebbles, hemp, shavings etc. often get sucked into the pump where new wells are concerned. To check the valves and to replace the rubber valve discs screw off the nut (13) above the valve bridge (14). Then take off the valve bridge and lever out the valves to the side using the handle of a hammer. The valve seat seal (11x and 12x) is situated below the valve. When reassembling, make sure that the valve seat seal sits correctly (section 5.8).
f) The stuffing box is not seal-proof	Tighten the stuffing box nut by ¼ to max. ½ turn. If this does not help, all the packing rings (6d) must be replaced. The seal ring (6b) should also be replaced (section 7.2)

8.2 Pump Knocks

Possible Reason:	Remedy:
a) There is no or too little air cushion in the air chamber (5).	Check whether the air volume control unit is working properly and if the snifting valve on the air chamber is open wide enough. The valve (large hexagon nut) of the air volume control unit and the snifting valve should be able to be clearly heard during pump operation. Air could also be possibly escaping through a sealed area. Cover all sealing points with a soap solution to determine whether air is escaping (section 5.4).
b) The pump is fed with booster pump.	Install a shut-off slide valve in the suction line (see section 5.5 and 5.6). Adjust the correct suction height by closing the slide valve. Monitor the adjusted value using a vacuum gauge. A vacuum of approx. 5 to 6 m is required to ensure the air volume control unit works correctly.
c) The pump suction head is very low.	The same applies here as explained under b).
d) A very high suction head and a long suction line are causing increased pipe friction resistance.	Install a suction air chamber and ensure sufficient air intake. Check whether the water level in the well has not sunk too much (due to a dry season, etc – see section 5.4 and 5.5).
e) The connecting rod bearing does not sit properly.	You cannot always determine the reason for knocking by ear. Therefore you have to turn the V-belt pulley (18) back and forth and listen for any clearance between the bearing and the conrod. Repairs to the gear are best done by a specialist.
f) The bore of the pump pulley is no longer symmetrical.	The same applies here as under e).
g) One of the ball bearings is defective.	The same also applies as explained under e).

8.3 The pump switches on when very little water is discharged and switches off immediately the tap is turned off.

Possible Reason:	Remedy:
a) The air cushion in the tank is too small. During initial operation, there may not have been enough air pumped into the tank or the air the pump has pumped into the tank is escaping somewhere (pressure switch, pressure gauge, air volume control unit, pump connections, transport damage etc).	If the snifting valve and air volume control unit are working correctly and there is still not enough air in the tank, coat all threaded connections on the tank with a soap solution to establish where air is escaping from. Air could also be escaping through the diaphragm on the inside of the pressure switch. The air volume control unit is not suitable for air input into pressure vessels which are larger than 750 ltrs in volume. We recommend that the air be drawn into the tank via an external channel connected to a compressor (section 8.2a).

8.4 The pump switches on automatically although the taps are turned off.

Possible Reason:	Remedy:
a) The following parts might not be water-tight: shut-off taps, pipe connections, flange connections etc.	Build up pressure in the unit, then turn it off. Now check whether any water is escaping from a sealed area.
b) The suction valves are sealing correctly. Water is flowing back into the suction line.	Open the pump and examine the suction valves. If necessary, fit new rubber valve discs (113).

8.5 Air escapes from tap when water is let out

Possible Reason:	Remedy:
a) There is too much air in the tank. The well water is probably very gassy and a lot of air separates in the tank. If the suction line is very long and the suction high, the pump might be sucking in too much air through the air volume control unit.	In this case we recommend that the hose of the air volume control unit be bent together/kinked for a short period or that a special rubber lip with a particularly small hole be inserted into the snifting valve (29).
b) The suction line is not seal-proof	The same applies here as under 8.1d.

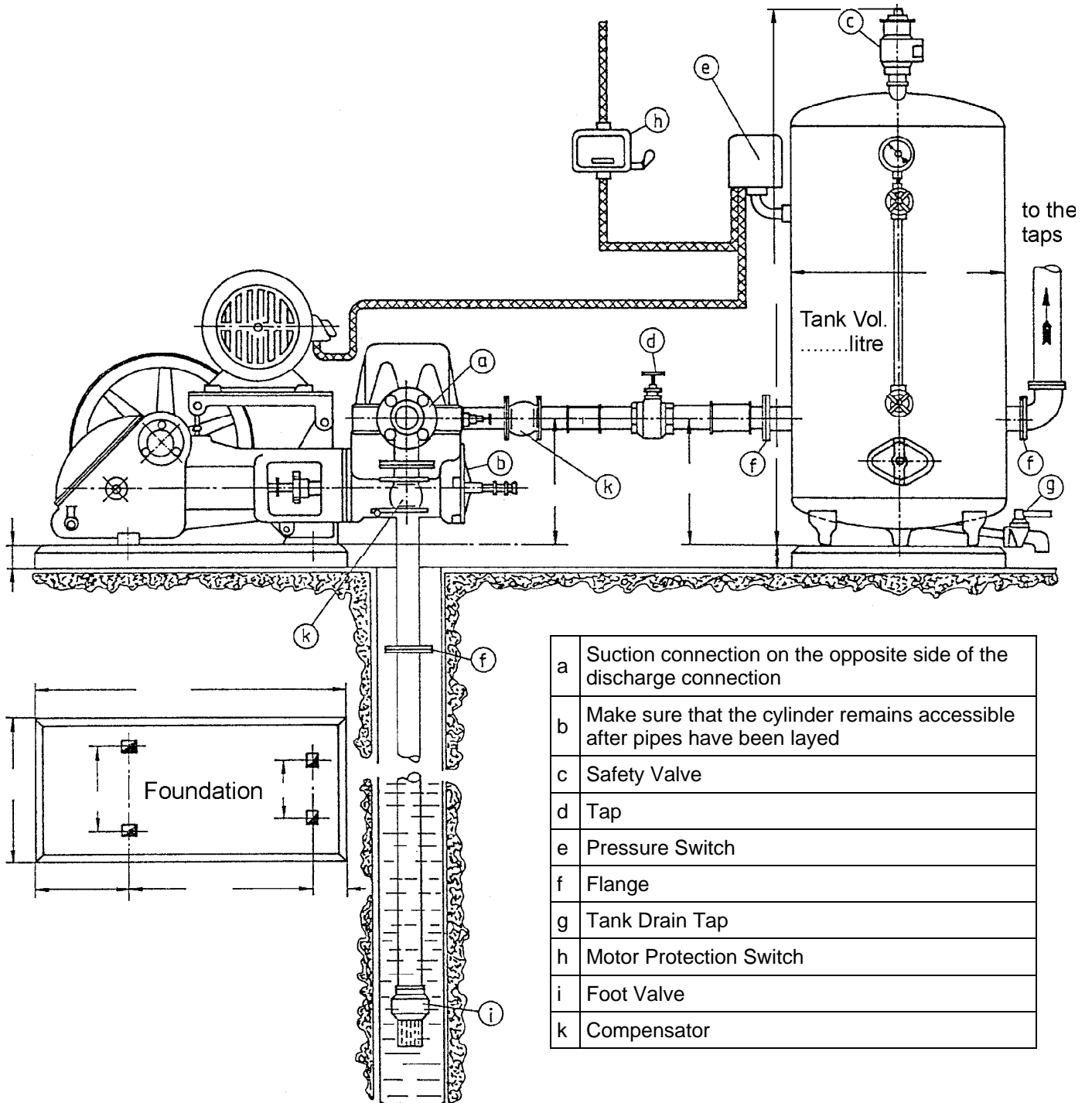
8.6 The pump conveys water easily till shortly before the switch-off pressure is reached - and then continues to run but without pumping water because the final pressure cannot be attained.

Possible Reason:	Remedy:
This can happen if too much air is sucked in through the air volume control unit when suction lines are very long and the suction head is very high. This also often occurs if the suction line is not absolutely air-tight which causes even more air to be drawn into the pump. The air cushion in the air chamber is too big and can no longer be decreased by the pump itself. The interrupted water supply can also be caused by worn rubber valve discs, a worn cylinder or piston.	See section 8.5a). Replace defective rubber valve discs (113/123) or duo piston (8) or brass cylinder (9).

8.7 Water leaks at the Air Volume Control

Possible Reason:	Remedy:
The rubber lip (29a) of the snifting valve (29) in the pump is missing or defective.	Take out the snifting valve (29) and replace the rubber lip (29a).

9. Büffel Pump Unit Installation Plan



10. Technical Data and Measurements (model series)

Model		S75	S100	S150	Duplex S200	Duplex S300	S456
Normal Flow Rate	m ³ /h	7.5	10	15	20	30	25
Maximum Flow Rate	m ³ /h	10	15	20	30	40	45
Normal Flow Pressure	bar	4					
Maximum Flow Pressure	bar	6					
Normal Suction Height	bar	-0.7					
Tested Suction Height	bar	-0.85					
Stroke Length	mm	95	115	122	2 x 115	2 x 122	122
Cylinder Diameter	mm	110	125	145	2 x 125	2 x 145	180
Normal Stroke Rate	per min	73	62	65	62	65	74
Maximum Stroke Rate	per min	98	93	87	93	87	132
Gear Ratio		91:18	91:19	86:19	91:19	86:19	86:19
Normal Revolutions of the Driven Shaft	per min	372	300	296	300	296	340
Max. Revolutions of the Driven Shaft	per min	498	451	399	451	399	580
Diameter of the Driven Shaft	mm	28 _{k6}	35 _{k6}	38 _{k6}	35 _{k6}	38 _{k6}	38 _{k6}
Effective Diameter of the Pump Pulley	mm	400	500	560	530	590	500
Normal Motor Revolutions (rpm)	1/min	1450					
Maximum Motor Revolutions (rpm)	1/min	1750					
Effective dia. of Motor Pulley at normal Flow Rate and 1450 rpm	mm	100	106	112	110	122	118
	mm	85	85	100	91	101	95
External dia. of Motor Pulley at normal Normal Flow Rate and 1450/min	mm	104	110	119	120	132	123.6
	mm	89	89	107	101	111	100.6
Effective dia. of Motor Pulley at max. Flow Rate and 1450/min	mm	140	160	150	165	162	200
	mm	112	132	125	137	135	170
External dia. of Motor Pulley at max. Flow Rate and 1450/min	mm	144	164	157	175	172	205.6
	mm	116	136	132	147	145	175.6
Volumetric Efficiency	%	97					
Mechanical Efficiency	%	59	62	63	65	65	60
Power Required for 4 bar Discharge Pressure at normal Flow Rate	kW	1.5	2.2	3.0	4.0	6.5	7.5
Power Required for 6 bar Discharge Pressure at normal Flow Rate	kW	2.2	3.0	5.5	7.5	11	7.5
Power Required for 4 bar Discharge Pressure at maximum Flow Rate	kW	2.2	3.0	4.0	6.5	7.5	11
Power Required for 6 bar Discharge Pressure at maximum Flow Rate	kW	3.0	5.5	7.5	11	15	15
Size of V-Belt	mm	XPZ x 1550Lw	XPZ x 1850Lw	XPB x 2240Lw	17 x 1900Li	17 x 2260Li	SPA x 2132Lw
No. of V-Belts		2	3	3	4	6	3
Suction Connection	G	2 ½	3	3	3 + 3	3 + 3	4
Discharge Connection	G	2	2 ½	3	3	4	4
Length of Pump	ca. mm	1050	1245	1400	1245	1450	1370
Width of Pump	ca. mm	460	490	573	1050	1250	515
Height of Pump	ca. mm	500	630	755	700	800	845
Net Weight without Motor	ca. kg	171	245	410	510	830	500

11. Spare Parts List

Teile-Nr. Part No.	Gegenstand Description	S75	S100	S150	S450	S456
1	Antriebsrahmen Crankcase	01.0093	01.0332	01.0277		
1a	Sechskantschraube (Wippenschraube) Hexagon Screw	21.0258				
1b	Stiftschraube (Stehbolzen) Stud Bolt	21.0199	21.0064			
1c	Sechskantmutter Hexagon Nut	07.3277	07.2306			
2	Getriebedeckel Gear Cover	03.0160	03.0161	03.0158		
2a	Sechskantschraube (Getriebedeckelschraube) Hexagon Screw	21.0258				
2b	Entlüftungsstopfen G1/2 mit Dichtung Vent and Filler Plug w/Gasket G1/2	00.2373				
2x	Getriebedeckeldichtung Gasket for Gear Cover	06.0444	06.0445	06.0446		
3	Ventilgehäuse kpl. mit Stiftschrauben und Muttern Valve Casing Assy with Stud Bolts and Nuts	00.2517	00.2518	00.2519	00.2527	00.5313
3a	Zwischenflansch Saug Intermediate Flange	20.0081	-	-	-	
3a	Zwischenflansch Saug / Druck Suction Intermediate Flange	-	20.0081	20.0029	-	
3ax	Dichtung für Zwischenflansch Gasket for Flange Branch	06.0626		06.0627	-	
3b	Flansch Saug Suction Flange	20.0067	20.0065	-	-	
3bx	Flanschdichtung, Saug Suction Flange Gasket	06.0423	06.0624	-	-	
3b	Flansch Saug / Druck Suction/Discharge Flange	-	-	20.0119	20.0063	
3x	Flanschdichtung, Saug / Druck Flange Gasket	-	-	06.0625	06.0631	
3c	Sechskantschraube (Flanschschraube) Hexagon Screw	21.0248		21.0249	21.0144	
3d	Stiftschraube (Stehbolzen) Stud Bolt	21.0048		21.0047	-	
3e	Flansch Druck Discharge Flange	20.0066	20.0067	-	-	
3x	Flanschdichtung, Druck Discharge Flange Gasket	06.0422	06.0623	-	-	
3f	Sechskantmutter Hexagon Nut	07.2306			-	
3g	Sechskantmutter Hexagon Nut	07.0988			-	
3h	Zwischenflansch Druck Discharge Intermediate Flange	20.0080	-	-	-	
400	Getriebe komplett Gear Assy	00.2016	00.2017	00.2018		
5	Windkessel kpl. m. Auffüllsto. u. Schüffelventil Air Chamber Assy	00.2521	00.2522	00.2523		
5	Windkessel Air Chamber	01.0250	01.0251	01.0105		
5x	Windkesseldichtung Air Chamber Gasket	06.0090	06.0091	06.0092		
6	Stopfbüchsengehäuse Stuffing Box Casing	01.0028	01.0029	01.0338	01.0833	
6a	Stopfbüchsenmutter Stuffing Box Nut	07.0118	07.1340	07.1847		
6b	Nutringmanschette Seal Ring	06.0424	06.0324	06.0325	06.0326	
6c	Stopfbüchseneneinsatz Stuffing Box Insert	07.1644	07.1341	07.1848	07.4021	
6d	Stopfbüchsenpackungs-Ring Packing-Ring bland	06.1137	06.1138	06.1140	06.1151	
6x	Stopfbüchsendichtung Stuffing Box Gasket	06.0426	06.0511	06.0512		
	Stopfbüchse komplett Stuffing Box complete	00.2259	00.2260	00.2261	00.5309	
	Kolbenstange kpl. m. Zahnscheibe und Muttern Piston Rod Assy	00.2524	00.2525	00.2526	00.5332	
7	Kolbenstange Piston Rod	11.0326	11.0323	11.0041	11.0737	
7a	Sechskantmutter Hexagon Nut	07.2306	07.1030	07.1031	07.2806	
8	DUO-Kolben DUO-Piston	06.0783	06.0767	06.0764	06.0765	06.1453

Teile-Nr. Part No.	Gegenstand Description	S75	S100	S150	S450	S456
8a	Sechskantmutter (Kolbenmutter) Hexagon Nut	07.2306	07.1845	07.1846		07.4019
8b	Federring Spring Ring	07.3199	07.3200	07.3201		07.4027
8c	Verstärkungsscheibe Support Disc	07.1525	07.1527	07.1529	07.0754	07.4020
9	Zylinder komplett Cylinder Assy	00.1920	00.1921	00.1922	22.0059	
9a	Sechskantschraube (Zylinderschraube) Hexagon Screw	21.0259		21.0260	21.0155	
9x	Zylinderdichtung Cylinder Gasket	06.0427	06.0614	06.0622	06.0549	
10	Zylinderdeckel Cylinder Cover	03.0181	03.0180	03.0179	03.0139	
10a	Sechskantschraube (Zylinderdeckelschr.) Hexagon Screw	21.0394		21.0155	21.0097	
10x	Zylinderdeckeldichtung Gasket for Cylinder Cover	06.0592	06.0593	06.0594	06.0550	
10b	Stopfen G1/2 Plug G1/2	07.0705			-	-
10bx	Kupfer-Dichtring Copper Gasket	06.0620			-	-
11	Saugventil komplett Suction Valve Assy	00.1042	00.1484	00.1486	00.1488	
111	Ventilbolzen Saug Suction Valve Stem	07.1323	07.1600	07.2428		
112	Ventilsitz Saug Suction Valve Seat	07.0079	07.1598	07.1503	07.0698	
113	Ventilgummiplatte Saug Suction Rubber Valve	06.0859	06.0861	06.0863		
114	Federspannscheibe groß Saug Suction Spring Tension Disc (large)	07.1622	07.1602	07.1504		
115	Ventilfeder Saug und Druck Suction and Discharge Valve Spring	07.3336	07.0018		07.0312	
116	Federspannscheibe klein Saug Suction Spring Tension Disc (small)	07.1623	07.1604	07.1505		
117	Splint Cotter Pin	07.1182			07.1180	
118	Ventilfeder Saug / Druck linksgewickelt Suction and Discharge Valve Spring	-	07.0019		-	-
12	Druckventil komplett Discharge Valve Assy	00.1043	00.1483	00.1485	00.1487	
121	Ventilbolzen Druck Discharge Valve Stem	07.1327	07.1599	07.2427		
122	Ventilsitz Druck Discharge Valve Seat	07.0078	07.1597	07.1502	07.0698	
123	Ventilgummiplatte Druck Discharge Rubber Valve Plate	06.0860	06.0862	06.0864		
124	Federspannscheibe, groß Druck Discharge Spring Tension Disc (large)	07.1381	07.1601	07.1506		
125	Ventilfeder Saug / Druck Suction and Discharge Valve Spring	07.3336	07.0018		07.0312	
126	Federspannscheibe, klein Druck Discharge Spring Tension Disc (small)	07.1382	07.1603	07.1507		
127	Splint Cotter Pin	07.1182			07.1180	
128	Ventilfeder Saug / Druck linksgewickelt Suction and Discharge Valve Spring	-	07.0019		-	-
11x/12x	Ventilsitzdichtung Gasket for Valve Seat	06.0428	06.0537	06.0513	06.0548	
13	Stiftschraube (Ventilbrückenbolzen) Valve Bridge Stud Bolt	21.0050	21.0244	21.0079		21.0595
13a	Sechskantmutter Hexagon Nut	07.3277	07.2306			07.4028
14	Ventilbrücke Valve Bridge	03.0041	03.0043	03.0045		03.0321
15	Stopfen G1/4 Plug G1/4	07.0751				
15x	Dichtung G1/4 Gasket G1/4	06.0312				
16	Stopfen (Ölablaß) Plug	07.2803				
16x	Dichtung Gasket	06.1020				
17	Pleuel kpl. Connecting Rod Assy	00.2008	00.2009	00.2010		
17a	Innensechskantschraube (Pleuelspannschr.) Inner Hexagon Screw	21.0344	21.0107	21.0108		
17b	Pleuelbüchse Sleeve for Connecting Rod	05.0070	05.0071	05.0072		

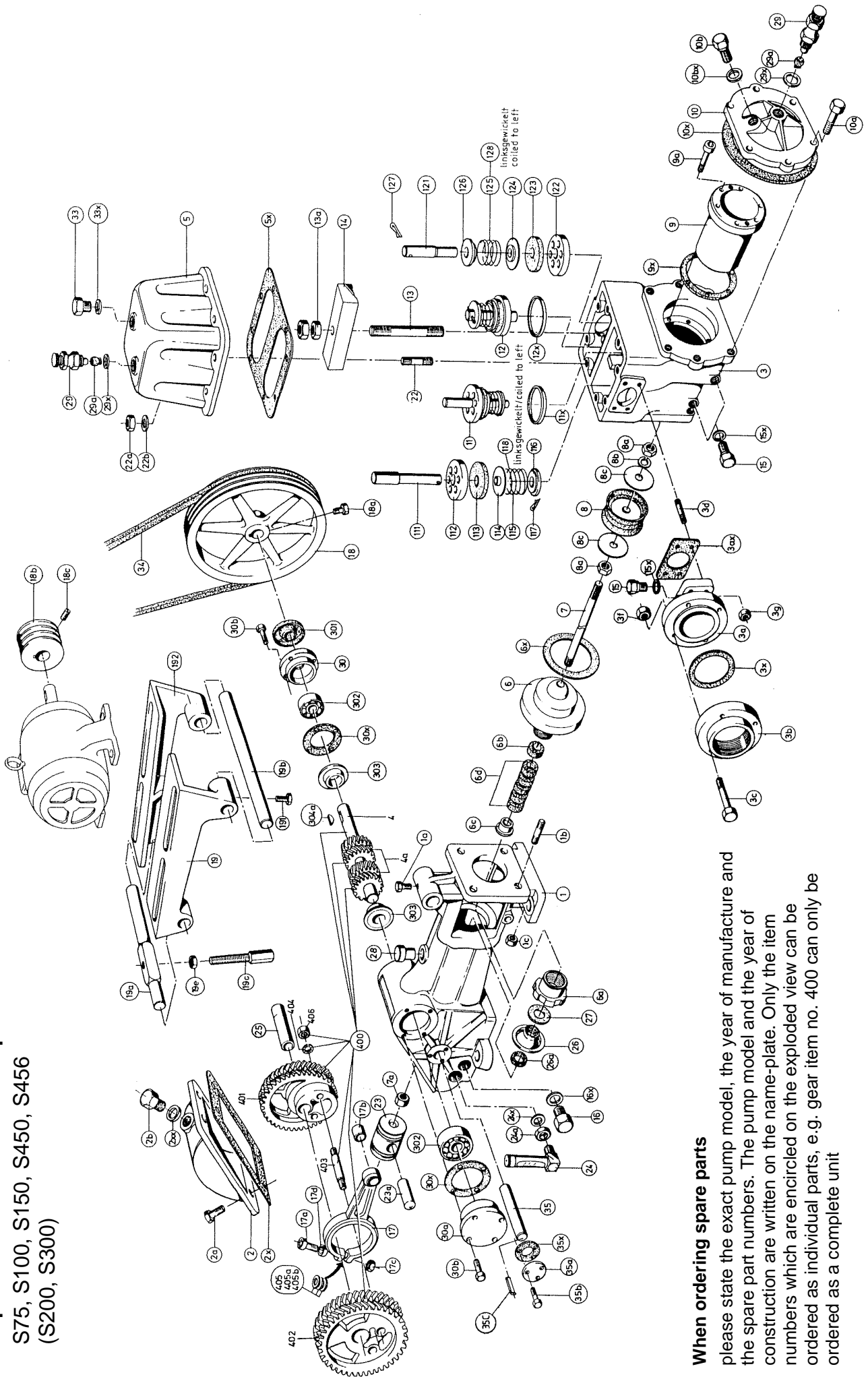
Teile-Nr. Part No.	Gegenstand Description	S75	S100	S150	S450	S456
17c	Sechskantmutter selbstsichernd Self-Locking Hexagon Nut	07.2791	07.2792	07.2793		
17d	Distanzring Spacer Ring	-	-	07.1321		
405	Paßscheibe 0,2mm f. Pleuel Fitting Disc 0,2mm	07.1336	07.1886	07.1788		
405a	Paßscheibe 0,5mm f. Pleuel Fitting Disc 0,5mm	07.2101	07.1887	07.1789		
405b	Paßscheibe 1,0mm f. Pleuel Fitting Disc 1,0mm	-	07.1888	07.1790		
18	Pumpenkeilriemenscheibe Pump V-Belt Pulley	00.3535	00.4285	00.4172	00.4225	
18a	Sechskantschraube (Stellschraube) Hexagon Screw	-	-	-	-	-
18b	Motorkeilriemenscheibe Motor V-Belt Pulley	00.3778	00.4275	00.4119	00.4216	00.4215
18c	Gewindestift mit Spitze (Madenschraube) Pointed Threaded Stud	-	-	-	-	-
	Motorspannwippe komplett Motor Rocker Assy	00.2513	00.2514	00.2515		
19	Motorspannschiene links Motor Mounting Rail left	23.0022	23.0023	23.0025		
192	Motorspannschiene rechts Motor Mounting Rail right	23.0121	23.0024	23.0026		
191	Sechskantschraube (Wippenwellenschraube) Hexagon Screw	21.0258				
19a	Wippenwelle mit Gewindeloch Hinge Pin with Thread	11.0327	11.0324	11.0319		
19b	Wippenwelle ohne Gewindeloch Hinge Pin w/o Thread	11.0328	11.0325	11.0318		
19c	Sechskantschraube (Spannschraube) Hexagon Screw	21.0120	21.0166	21.0167		
19e	Sechskantmutter Hexagon Nut	07.2398	07.3277	07.2306		
22	Stiftschraube (Windkesselstehbolzen) Air Chamber Stud Bolt	21.0048		21.0047		
22a	Sechskantmutter Hexagon Nut	07.0988				
22b	Unterlegscheibe Disc	07.1259				
23	Kreuzkopf Crosshead	17.0011	17.0012	17.0009		17.0022
23a	Kreuzkopfbolzen Crosshead Pin	11.0021	11.0022	11.0023		
24	Ölstandsanzeiger G1/4 Oil Level Gauge	00.1938				
24x	Dichtung G1/4 Gasket	06.0312				
25	Hauptlagerbüchse Main Bearing Sleeve	05.0035	05.0036	05.0040		
26	Ölspritzdeckel mit Dichtring Oil Splash Cap w/Gasket	00.2377	00.2378	00.2379	00.2049	
26a	Dichtring Gasket	06.0432	06.0265	06.0056		06.1276
27	Ölabstreifer Oil Scraper	06.0433	06.0471	06.0472		06.0473
28	Ölauffüllstopfen ohne Gewinde Oil Filler Plug w/o Thread	07.1320				
29	Schnüffelventil mit Rändelschraube Snifting Valve with Stop Screw	00.1939				
29a	Schnüffelventil-Lippe Snifting Valve Lip	06.0398				
29x	Dichtung Gasket	06.1020				
30	Lagerdeckel offen Bearing Cover open	03.0187	03.0186	03.0176		
30a	Lagerdeckel geschlossen Bearing Cover closed	03.0065	03.0066	03.0067		
30b	Sechskantschraube (Lagerdeckelschraube) Hexagon Screw	21.0258				
30x	Lagerdeckeldichtung Gasket for Bearing Cover	06.0450	06.0451	06.0452		
301	Radialwellendichtring (Simmerring) Radial Shaft Seal	06.0435	06.0712	06.0721		
302	Rollenlager Roller Bearing	05.0112	05.0113	05.0114		
303	Distanzscheibe Spacer Disc	07.1334	07.1347	07.1345		
304a	Scheibenfeder Woodruff Key	07.0671				

Teile-Nr. Part No.	Gegenstand Description	S75	S100	S150	S450	S456
33	Stopfen G3/8 (Auffüllstopfen) Plug	07.2803				
33x	Dichtung Gasket	06.1020				
34	Keilriemen V-Belt	07.2942	07.2943	07.3101	07.2131	
35	Hauptlagerwelle Main Bearing Shaft	11.0015	11.0016	11.0017		
35a	Deckel zur Hauptlagerwelle Cover for Main Bearing Shaft	03.0086	03.0087			
35b	Sechskantschraube Hexagon Screw	21.0256				
35c	Spannstift Tension Pin	07.4528				
35x	Dichtung Gasket	06.0436	06.0629			
xx	Satz Dichtungen komplett Complete Set of Gaskets	00.2505	00.2506	00.2507	00.2508	
	Antrieb komplett Crankcase Assy	00.2761	00.2762	00.2763	00.2826	00.5312
	Antrieb komplett vertauscht Crankcase Assy exchanged	00.2764	00.2765	00.2766	00.2827	00.5333
	Wasserteil kpl. Pump Head Assy	00.2621	00.2622	00.2623	00.2624	00.5325

11.1 Spare Parts List for Seawater Pumps

Teile-Nr. Part No.	Gegenstand Description	S75	S100	S150	S450	S456
5	Windkessel kpl. Seewasser Air Chamber Assy Seawater	00.3484	00.3485	00.3486		
	Kolbenstange kpl. Seewasser Piston Rod Assy Seawater	-	00.3489	00.3490	-	
8a	Sechskantmutter (Kolbenmutter) Seewasser Hexagon Nut Seawater	-	07.1849	07.1850		-
9	Zylinder komplett Seewasser Cylinder Assy Seawater	22.0145	22.0146	22.0147	-	-
10b	Stopfen G1/2 Seewasser Plug G1/2 Seawater	07.1427			-	-
11	Saugventil komplett Seewasser Suction Valve Assy Seawater	00.1515	00.1513	00.1491	00.1489	
112	Ventilsitz Saug Seewasser Suction Valve Seat Seawater	07.1383	07.1743	07.1509	07.1474	
114	Federspannscheibe groß Seewasser Spring Tension Disc (large) Seawater	07.1622	07.1745	07.1510		
116	Federspannscheibe klein Seewasser Spring Tension Disc (small) Seawater	07.1623	07.1747	07.1511		
12	Druckventil komplett Seewasser Discharge Valve Assy Seawater	00.1516	00.1514	00.1492	00.1490	
122	Ventilsitz Druck Seewasser Discharge Valve Seat Seawater	07.1384	07.1742	07.1508	07.1474	
124	Federspannscheibe groß Seewasser Spring Tension Disc (large) Seawater	07.1624	07.1744	07.1512		
126	Federspannscheibe klein Seewasser Spring Tension Disc (small) Seawater	07.1625	07.1746	07.1513		
15	Stopfen G1/4 Seewasser Plug Seawater	07.1422				
29	Schnüffelventil mit Rändelschraube Seewasser Sniffing Valve with Stop Screw Seawater	00.2355				
33	Stopfen G3/8 (Auffüllstopfen) Seewasser Plug Seawater	07.2666				
	Wasserteil kpl. Seewasser Pump Head Assy Seawater	00.2638	00.2639	00.2640	00.2641	00.5311

Exploded View of Büffel Pump
S75, S100, S150, S450, S456
(S200, S300)



When ordering spare parts

please state the exact pump model, the year of manufacture and the spare part numbers. The pump model and the year of construction are written on the name-plate. Only the item numbers which are encircled on the exploded view can be ordered as individual parts, e.g. gear item no. 400 can only be ordered as a complete unit

PIPELINE RESISTANCE

The following pipeline resistance (h) will be produced per 100m pipeline with the following hole widths (d) at an hourly discharge (Q) and speed (v).

v is speed in m/sec.	Q is m ³ /h h in m	Width of Bore in mm															
		20	25	30	40	50	60	70	80	90	100	125	150	175	200	225	250
0.10	Q	0,11	0,18	0,25	0,45	0,71	1,0	1,4	1,8	2,3	2,8	4,4	6,4	8,7	11,2	14,3	17,7
	h	0,15	0,12	0,091	0,062	0,047	0,036	0,030	0,026	0,022	0,019	0,015	0,012	0,0098	0,0083	0,0072	0,0064
0.15	Q	0,17	0,27	0,38	0,68	1,1	1,5	2,1	2,7	3,4	4,2	6,6	9,5	13,0	17,0	21,5	26,5
	h	0,30	0,23	0,18	0,12	0,094	0,075	0,062	0,052	0,046	0,040	0,030	0,025	0,020	0,017	0,015	0,013
0.20	Q	0,23	0,35	0,51	0,91	1,4	2,0	2,8	3,6	4,6	5,7	8,8	12,7	17,3	22,6	28,6	35,3
	h	0,49	0,37	0,30	0,20	0,16	0,12	0,10	0,087	0,075	0,067	0,051	0,041	0,035	0,030	0,026	0,023
0.25	Q	0,28	0,44	0,64	1,1	1,8	2,5	3,5	4,5	5,7	7,1	11,1	15,9	21,7	28,3	35,8	44,2
	h	0,72	0,53	0,44	0,30	0,23	0,18	0,15	0,13	0,11	0,10	0,077	0,062	0,052	0,045	0,039	0,035
0.30	Q	0,34	0,53	0,76	1,4	2,1	3,1	4,2	5,4	6,9	8,5	13,3	19,1	26,0	33,9	42,9	53,0
	h	0,99	0,75	0,60	0,42	0,32	0,26	0,21	0,18	0,16	0,14	0,11	0,087	0,073	0,063	0,055	0,049
0.40	Q	0,45	0,71	1,0	1,8	2,8	4,1	5,5	7,2	9,2	11,3	17,7	25,5	34,6	45,2	57,3	70,7
	h	1,6	1,2	0,99	0,69	0,53	0,43	0,36	0,31	0,27	0,24	0,18	0,15	0,12	0,11	0,094	0,084
0.50	Q	0,57	0,88	1,3	2,3	3,5	5,1	6,9	9,1	11,5	14,1	22,1	31,8	43,3	56,6	71,6	88,4
	h	2,4	1,9	1,5	1,0	0,80	0,65	0,54	0,46	0,40	0,36	0,28	0,23	0,19	0,16	0,14	0,13
0.60	Q	0,68	1,1	1,5	2,7	4,2	6,1	8,3	10,9	13,7	17,0	26,5	38,2	52,0	67,9	85,9	106
	h	3,3	2,6	2,1	1,5	1,12	0,90	0,75	0,65	0,57	0,50	0,39	0,32	0,27	0,23	0,21	0,18
0.70	Q	0,79	1,2	1,8	3,2	5,0	7,1	9,7	12,7	16,0	19,8	31,0	44,5	60,6	79,2	100	124
	h	4,4	3,4	2,7	1,9	1,5	1,2	1,0	0,86	0,75	0,67	0,52	0,43	0,36	0,31	0,27	0,24
0.80	Q	0,94	1,4	2,0	3,6	5,7	8,1	11,1	14,5	18,3	22,6	35,3	50,7	69,3	90,5	115	141
	h	5,6	4,3	3,4	2,5	1,9	1,5	1,3	1,1	0,98	0,86	0,67	0,55	0,46	0,40	0,35	0,31
0.85	Q	0,96	1,5	2,2	3,9	6,0	8,7	11,8	15,4	19,5	24,0	37,6	54,1	73,6	96,1	122	150
	h	6,3	4,8	3,9	2,7	2,1	1,7	1,5	1,2	1,1	0,97	0,75	0,62	0,52	0,45	0,40	0,35
0.90	Q	1,0	1,6	2,3	4,1	6,4	9,2	12,5	16,3	20,6	25,5	39,8	57,3	77,9	102	129	159
	h	6,9	5,3	4,3	3,0	2,4	1,9	1,6	1,4	1,2	1,1	0,84	0,69	0,58	0,50	0,44	0,39
0.95	Q	1,1	1,7	2,4	4,3	6,7	9,7	13,2	17,2	21,8	26,9	42,0	60,4	82,3	107	136	168
	h	7,7	5,9	4,8	3,4	2,6	2,1	1,8	1,5	1,3	1,2	0,93	0,77	0,65	0,56	0,50	0,44
1.00	Q	1,1	1,8	2,6	4,5	7,1	10,2	13,9	18,1	22,9	28,3	44,2	63,6	86,6	113	143	177
	h	8,3	6,4	5,1	3,7	2,9	2,3	2,0	1,7	1,5	1,3	1,0	0,84	0,71	0,61	0,54	0,48
1.05	Q	1,2	1,9	2,7	4,8	7,4	10,7	14,6	19,0	24,1	29,7	46,4	66,8	90,9	119	150	186
	h	9,2	7,1	5,7	4,1	3,1	2,5	2,2	1,8	1,6	1,4	1,1	0,92	0,78	0,67	0,60	0,53
1.10	Q	1,2	1,9	2,8	5,0	7,8	11,2	15,2	19,9	25,2	31,1	48,6	70,0	95,3	124	157	194
	h	9,9	7,6	6,2	4,4	3,4	2,8	2,3	2,0	1,8	1,6	1,2	1,0	0,85	0,74	0,65	0,58
1.15	Q	1,3	2,0	2,9	5,2	8,1	11,7	15,9	20,8	26,3	32,5	50,8	73,2	99,6	130	165	203
	h	10,8	8,3	6,7	4,8	3,8	3,0	2,6	2,2	2,0	1,7	1,3	1,1	0,93	0,81	0,71	0,63
1.20	Q	1,4	2,1	3,1	5,4	8,5	12,2	16,6	21,7	27,5	33,9	53,0	76,3	104	136	172	212
	h	11,7	9,0	7,2	5,2	4,0	3,3	2,8	2,4	2,1	1,9	1,5	1,1	1,0	0,87	0,77	0,69
1.25	Q	1,4	2,2	3,2	5,7	8,8	12,8	17,3	22,6	28,6	35,4	55,2	79,5	108	141	179	221
	h	12,5	9,7	7,8	5,6	4,3	3,5	3,0	2,6	2,3	2,0	1,6	1,3	1,1	0,94	0,83	0,74
1.50	Q	1,7	2,7	3,8	6,8	10,6	15,3	20,8	27,1	34,4	42,4	66,3	95,4	130	170	215	265
	h	17,4	13,5	10,1	7,8	6,1	5,0	4,2	3,6	3,2	2,8	2,2	1,8	1,5	1,3	1,2	1,1
1.75	Q	2,0	3,1	4,5	7,9	12,4	17,8	24,3	31,7	40,1	49,5	77,3	111	152	198	250	309
	h	23,1	18,0	14,6	10,5	8,1	6,6	5,7	4,8	4,3	3,8	3,0	2,4	2,1	1,8	1,6	1,4
2.00	Q	2,3	3,5	5,0	9,1	14,1	20,4	27,7	36,2	45,8	56,6	88,4	127	173	226	286	353
	h	29,6	23,0	18,6	13,4	10,5	8,6	7,2	6,2	5,5	4,9	3,8	3,2	2,7	2,3	2,1	1,8
2.50	Q	2,8	4,4	6,4	11,3	17,7	25,5	34,6	45,2	57,3	70,7	110	159	216	283	358	422
	h	45,0	34,7	28,3	20,5	16,0	13,1	11,1	9,6	8,4	7,5	5,9	4,9	4,1	3,2	3,2	2,9
3.00	Q	3,4	5,3	7,6	13,6	21,2	30,5	41,6	54,3	68,7	84,8	133	191	260	339	429	530
	h	62,9	47,9	39,6	28,8	24,7	18,6	15,8	13,6	11,8	10,7	8,4	6,9	5,9	5,1	4,5	4,1

5m pipe lengths should be allowed for suction strainers, taps, non-return valves and bends. The total length of pipe resulting from this should be used to determine the resistance losses stated above, which are necessary to obtain the effective (geodetic) delivery head. The above figures do not apply to encrusted pipelines and the resistance losses will increase in proportion with the degree of incrustation for which an appropriate allowance should be made.