

Ws+

CENTRIFUGAL PUMP

FORM NO.: 381497 USA  
REVISION: 10/2014

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.





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**Contents:**
**USA**


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## Introduction

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Congratulations, you are the owner of a quality built item from SPX Flow Technology. This pump was manufactured by the skilled personnel of a company which has served the needs of the dairy, food and process industries for more than 100 years.

The purpose of this manual is to provide instructions for the safe installation, operation and maintenance of your SPX Flow Technology equipment.

Read and understand the entire manual before removing from the crate and installing the equipment.

SPX Flow Technology is committed to providing quality equipment and customer satisfaction. We have a unique network of sales and service support throughout the world, which are listed in this manual. Please note the office located nearest to you. Should you have any questions concerning any information contained in this manual, contact the nearest office for assistance.

## Standard Warranty

### Obligations of Seller

During the warranty period, the Seller shall repair, or at Seller's option, replace parts determined by the seller to be defective in material or workmanship. The warranty period is one (1) year from the date of delivery to Buyer F.O.B. point of manufacture. The foregoing shall be the sole obligation of the seller under this warranty with respect to the equipment and the other property included in this agreement. With respect to the equipment, materials, parts and accessories manufactured by others, seller's sole obligation shall be to use reasonable efforts to obtain for the Buyer the full benefit of the manufacturer's warranties

### Warranty Exclusions

Repair or replacement of parts required because of misuse, improper care or storage, negligence, alterations, accident, use of incompatible supplies or lack of specified maintenance are excluded from the Seller's warranty obligations.

### Disclaimer of Warranties

*The foregoing warranty expressions are in lieu of all other warranties, expressed or implied, including implied warranties of merchantability and fitness for a particular purpose, and existence of any such other warranty is hereby denied.*

### Limitation of Liability and Remedies

The liability of the Seller for breach of any warranty obligation hereunder is limited to:

1. The repair or replacement of the equipment on which the liability is based or,
2. At the Seller's option, the refund to the Buyer of the amount paid by the Buyer to the Seller for said equipment.



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## Introduction

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All other liability of the Seller with respect to this agreement, or from the manufacture, installation, maintenance, repair or use of any equipment covered by or furnished under this agreement, whether in contract or in tort, or otherwise, is limited to the amount paid by the Buyer to the Seller pursuant to the terms herein:

*Seller shall not be liable for incidental or consequential damages of any kind whatsoever. The remedies set forth herein are exclusive.*

### **Breach**

Any breach by the Seller with respect to any items or unit of equipment shall be deemed a breach with respect to that item or unit only.

### **Infringement**

The Seller will not be liable for the infringement of any patent by the Buyer's use of any equipment or materials delivered hereunder.

### **A word about SPX Flow Technology Service Parts**

We want to raise your awareness to the problem associated with the purchase of parts not manufactured to the high quality specifications of SPX Flow Technology.

In addition to our high quality, SPX Flow Technology parts are manufactured to meet regulatory agency authorization, approvals and certification (3A Sanitary standards, USDA, ASME, BISSC, and OSHA). Where applicable, materials used in construction of SPX Flow Technology parts conform to FDA regulations.

Types of equipment include, but are not limited to, rotary pumps, centrifugal pumps, homogenizers, ice cream freezers, scrape surface heat exchangers, plate heat exchangers, ingredient feeders, process tanks and contact plate freezers.

We bring this potentially serious problem to your attention in order to safeguard your best interest and those of your employees.

If you have any questions, please feel free to call your local SPX Flow Technology contact.

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## Warnings

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*Parts not manufactured to our specifications may cause damage to your SPX Flow Technology equipment and void all warranties. Use of parts that do not meet SPX Flow Technology specifications may cause property damages and serious bodily injury.*

### **Policy regarding availability of service parts**

SPX Flow Technology will attempt to remain in a position to supply replaceable parts during the normal life of any item of SPX Flow Technology equipment. This is contingent upon availability of tools, material and facilities of our own as well as of our suppliers.

After the expiration of this period, the supply of service parts will be limited to available stock of completed parts. If unable to supply the service part, drawings will be furnished when available to permit local manufacturing, if desired.

SPX Flow Technology reserves the right to improve, change or modify the construction of its equipment or any parts thereof without incurring any obligation to provide like changes to equipment previously sold.

## **Safety Information**

### **Electrical Hazard**

A pump is normally powered by an electric motor. This creates a hazard of electrical shock which could cause severe injury or even loss of life.

#### **To minimize the risk of this hazard:**

All electric/electronic installation, maintenance, and service must be performed by trained and authorized electricians only.

All electric/electronic installation must comply with all applicable codes and standards including those established by OSHA (Occupational Safety and Health Administration).

Do Not perform any maintenance or service on the motor or any other electrical devices unless the electric power source has been turned off and Locked Out using a locking device for which only the person involved in the maintenance procedure has possession of the key.

#### **Make installation suitable for a wet environment, including:**

1. A power disconnect which can be locked in a power Off position and the key removed. This will allow maintenance or service to be performed without possibility of power being accidentally turned on.
2. Protection of all electric connections within a sealed junction box.
3. Proper grounding of the motor.
4. Protection from flooding. Do not install in an area which could fill with water to a level which contacts the motor.



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## Warnings

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### Rotating Parts Hazard

Routine cleaning and maintenance procedures require pump disassembly. The pump contains close fitting parts which rotate during operation. Should the pump start unexpectedly while disassembled, severe injury could result.



#### To minimize the risk of this hazard:

1. Do Not assemble or disassemble the pump
2. Do Not remove the guard from the adapter
3. Do Not perform any maintenance or service on the motor or pump unless the power source has been turned off and Locked Out, where only the person involved in the maintenance procedure has possession of the key.

### High Temperature Hazard

Some pump applications may require processing of high temperature liquids and/or the use of high temperature cleaning/ sanitizing solutions. Pumping high temperature liquids is considered to be hazardous and extreme care should be taken when handling such liquids.

#### To minimize the risk of this hazard:

1. All installation, maintenance, and service of piping, valves, and other controls must be performed by trained and authorized plumbers only. This applies to process piping and cleaning/sanitizing piping.
2. All plumbing installation must comply with all applicable codes and standards including those established by OSHA.
3. Do Not perform any maintenance or service on the motor or pump unless the power source has been turned off and Locked Out, where only the person involved in the maintenance procedure has possession of the key.
4. Never disconnect any lines or fittings (whether process or cleaning/ sanitizing) or disassemble the pump until the line is no longer under pressure and the fluid inside is not hot or harmful.
5. Operating personnel must be authorized and trained.



## Warnings

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### High Pressure Hazard

Fluids processed by a pump are under pressure. This creates a hazard to personnel working in the area should a leak occur. Leaking high pressure fluid may cause injury by startling personnel or from actual contact with the leaking fluid.

#### To minimize the risk of this hazard:

1. All installation, maintenance, and service of piping, valves and other controls must be performed by trained and authorized plumbers only. This applies to process piping and cleaning/sanitizing piping.
2. All plumbing installation must comply with all applicable codes and standards including those established by OSHA.
3. Never disconnect any lines or fittings (whether process or cleaning/sanitizing) or disassemble the pump when lines are under pressure.
4. Should a leak occur, immediately find the cause and stop the leak.

Never operate the pump with both the inlet valve and the outlet valve in closed positions. If the pump runs with liquid in it, while the valves controlling the suction and discharge lines are both closed, the liquid in the pump will heat up and turn into vapor, causing a risk of explosion.

To eliminate the risk of explosion, it is strongly recommended that the following be included in the system:

1. A pressure relief device which relieves pressure and contains any discharge, or
2. A thermal/pressure overload device to isolate the pump motor in the event of excessive temperature/pressure.

### Leaking Fluid Hazard

Fluid leaks or spills may occur in any pumping system. This creates a hazard to personnel due to slippery floor conditions or contact with possibly hazardous fluids.

#### To minimize the risk of this hazard:

1. Always clean up leaks and spills immediately.
2. Find and correct the cause of the leak immediately.



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## Important Warnings

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The following important cautions describe ways to avoid incorrect operating procedures which will cause serious damage to the pump.

### **Cavitation**

Cavitation is a condition within the pump which results in extreme hydraulic forces which can create a risk of severe damage to pump components. Cavitation makes a characteristic "rattling" noise. It is caused by operation with low fluid pressure at the pump inlet.

#### **To minimize this risk:**

Install and operate the pump so that NPSH (net positive suction head) available to the pump equals or exceeds the "NPSH required" as shown on the pump performance curve. To increase NPSH available:

1. Decrease the temperature of the liquid being pumped.
2. Increase the height of liquid supply level.
3. Decrease the suction line length and remove restrictions to flow such as elbows, valves, etc.
4. Increase the suction line size (diameter).
5. Reduce the pump flow rate (throttle discharge).

### **Corrosion Pitting**

Stainless steel is subject to a risk of corrosion when improperly cleaned or sanitized.

#### **To minimize this risk:**

1. Never use steel wool or a wire brush to clean stainless steel surfaces.
2. Iron particles will embed and cause corrosion pits. Use a non-metallic brush or scrub pad for cleaning when required.
3. Never allow prolonged contact of sanitizing solutions or other corrosive cleaning chemicals with stainless steel. Only use sanitizing solutions immediately prior to processing.

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## Important Warnings

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### Motor Overload

Depending on the impeller diameter and motor horsepower, there is a risk the pump motor will overload if operated with a fully opened, unrestricted discharge.

#### To minimize this risk:

1. Before operating the pump, review performance curve and application giving consideration to motor horsepower and impeller diameter versus expected discharge flow rate and pressure. If the pump is operated with less than expected discharge pressure, the flow rate will increase and the load on the motor will increase.
2. Install a throttling type valve in the discharge piping to allow control of pump discharge flow rate during initial operation. The valve may be removed later when the system is proven to supply adequate discharge pressure to prevent overload.

### Impeller Shaft Location

The location of the impeller shaft on the motor shaft is critical for correct pump operation and to obtain maximum operating efficiency.

APV Centrifugal Pumps are designed to achieve excellent operating efficiency. This efficiency is possible, in part, because of precision manufacturing of the pump components. The impeller must be precisely located between the casing and backplate to take full advantage of the pump's operating efficiency.

Incorrect location of the impeller shaft may cause the impeller to contact the casing or the backplate during operation and cause extensive damage to the pump.

The procedures for correctly locating the impeller shaft are described in the Maintenance section. This should be referred to whenever:

1. A new pump is installed onto a motor or pedestal.
2. The impeller shaft is loosened or removed from the motor or pedestal shaft.
3. A replacement casing or backplate is installed.



## Sectional Drawing

**Ws+**

### Shaft size ø25 and ø35



### Shaft size ø25 and ø35



## Sectional Drawing

Ws+

- 1: Pump housing
- 2: Air screw
- 3: O-ring
- 4: Impeller
- 6: O-ring
- 7: Back plate
- 8: Locating pin
- 9: Clamp ring
  
- 11: Shaft
- 12: Screw
- 13: Shaft guard
- 14: Extension frame
- 15: Bracket (screw)
- 16: Screw
- 17: Spacer flange
  
- 25: Clamp ring
- 26: O-ring
- 27: Front cover
- 28: Clamp ring
- 29: Gasket
- 30: Recirculation pipe

**Section 1:** Single seal for shaft size  $\varnothing 25$  and  $\varnothing 35$

**Section 2:** Double seal with liquid flushing for shaft size  $\varnothing 25$  and  $\varnothing 35$

- 5.1: Seal housing
- 5.3: Pressure ring
- 5.4: Drain pipe
- 5.5: O-rings
- 5.6: Stationary seal face
- 5.7: Rotary seal face
- 5.8: Pin
- 5.9: Seal housing
- 5.10: O-ring
- 5.11: Pressure ring



## 1. Introduction to the Ws+ program

### 1.1 The Ws+ range

This manual covers the standard version of the Ws+ pump, which is supplied pre-fitted with recirculation connection, and a simplified version, which has no recirculation.

Units are designed and constructed to meet the requirements of 3-A sanitary standards for cleanability of processing equipment.

### 1.2 Selection of the standard or simplified pump

1. The standard Ws+ pump should be installed as a normal liquid ring pump, i.e. with a "swan neck" (two x 90° bends) on the inlet and a length of vertical pipe on the outlet. (See length H in Fig. 2).
2. However, in many CIP pump applications, it is possible to simplify the pipe layout and bring the inlet pipe directly (horizontally) to the Ws+ pump inlet and eliminate the recirculation connection. For the pump to function in this manner, there the inlet pipework must meet the specifications detailed in Section 2.2. If in doubt, the standard Ws+ with swan neck and recirculation connection must be used.

### 1.3 The Ws+ pump, options and extras

Standard Options are available in the Ws+ range:

- with frame and feet
- with shaft seal in carbon/SiC or SiC/SiC
- with o-rings in EPDM or FPM (Viton)
- with single mechanical shaft seal or double mechanical shaft seal prepared for water-flushed shaft seal.

Additional Options:

- drain valve
- pump trolley
- Ws+ pumps can be supplied with all standard welded ferrules (Tri-clamp, bevel seat, ISO etc.).

### 1.4 Identifying the pump model

A nameplate as is fitted on the extension frame (Fig. 1).

#### Example:

Type: Indicates pump model, such as Ws+ 20/15, Ws+ 30/30, etc.

Serial No.: Use the serial number whenever requesting information on service parts.

Order No.: SPX's order number.

Year: Indicates the year of manufacture.

Fig. 1: Nameplate

The nameplate is a rectangular label with a grey background. It features the SPX logo in green on the left and the APV logo in green on the right. The label contains several input fields: a large field for ORDER NO. at the top, a field for TYPE below it, a field for SERIAL NO. below that, and a field for YEAR at the bottom left. There are also two small circular icons on the right side of the label, one of which is a Euro symbol (€).

## 2. Installation of the pump

### 2.1 Reminder

The Ws+ pump, like all self priming pumps of its type, requires an initial volume of liquid in order to form the liquid ring within the pump which is essential for the self priming function. See below.

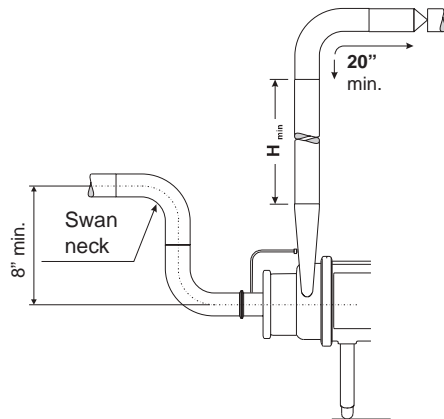
Pump Ws+	20/15	30/30	44/50
Priming volume gallons	0.45	0.53	0.98

### 2.2 Installation of pump

In the standard Ws+ pump, the priming volume of liquid must be retained either within the body of the pump or where it can circulate back to the inlet. To this end the pump must be installed with outlet vertically upwards and with a length of vertical pipe coupled to it.

A swan neck coupled directly to the pump's inlet prevents loss of that priming volume down the inlet pipe. To provide space for discharged air, any non-return valve must be mounted at least 20" downstream of the specified length of vertical pipe. See table and Fig. 2.

Fig. 2: Pump installation



Pump Ws+	20/15	30/30	44/50
H min (Fig. 2)	40" (2" diam.)	60" (2" diam.)	60" (3" diam.) or 80" (2" diam.)

Shorter pipe lengths will adversely affect the time taken for the pump to self-prime.

Note that the pump should not be left running too long without pumping (typically 15 minutes, but less if the pumped liquid is hot) as it gets warm and loses priming liquid by evaporation.

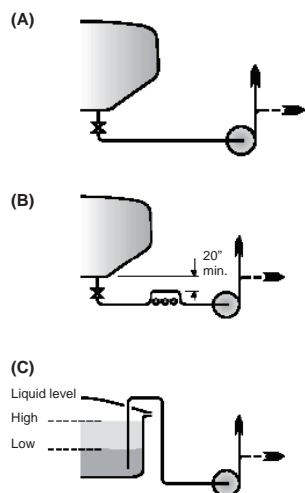
Keep the number of valves, bends and T-pieces on the suction side to an absolute minimum.

There must be sufficient space around the pump for piping and access for maintenance.



## 2. Installation of the pump

Fig. 3: Typical applications



### 2.3 Installation of pump without recirculation.

In this application, where the simplified pipe layout is to be used, one important requirement must be met:

As the suction tank starts to refill, some liquid will be able to flow from the tank into the pump to replenish any priming liquid lost when the tank was previously pumped dry. Typical applications can be seen in Fig. 3.

**Note:** The pump body must always be mounted with outlet vertically upwards and all the other conditions apply.

**Note:** Any eccentric reducer should be mounted such that the pump center line is lower than the inlet pipe's center line.

### 2.4 Lining up the pipe system

Line up the pipes carefully to the pump suction and discharge ports. Make sure that the pipe system is adequately supported by pipe supports, so that the pump body is not subject to strains and weight from the pipe system.

**Note:** During priming the pump may tend to vibrate. A pipe support should be placed close to the pump suction to prevent pipework vibration creating excessive noise.

### 2.5 Power supply

All electrical installation must comply with all applicable codes and standards including those established by the Occupational Safety and Health Administration (OSHA).

Install a main power disconnect on-off switch that can be locked in the power off position and have the key removed when service is performed.

Thoroughly read the motor manufacturer's instructions before making installation.

The motor should be connected such that the rotating direction of the motor (and thus of the impeller) is counterclockwise when viewed from the front towards the suction nozzle of the pump body (Fig. 4).

Fig. 4: Direction of rotation

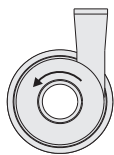
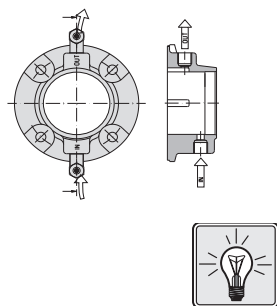


Fig. 5: Water flush hose connections



### 2.6 Water supply for water-flushed shaft seal

Pumps with a water-flushed shaft seal have two hose connectors on the seal flange (Fig. 5). The hose connectors are 1/8 inch NPT and fit a 1/4 inch plastic tubing. A flush flow of 4-8 gallons/h is required.

Maximum pressure is 100 PSIG.

The hose connection in the seal flange should always be positioned vertically with the fluid inlet underneath and the outlet on top.

Water consumption can be limited by installing a solenoid valve for the flushing water on the supply side. The open/close function of the solenoid valve can be controlled by the pump's start/stop sequence.

Before starting the pump, dismantle and clean the suction pipe. Any foreign material in the pump must be removed.



### 3. Before start-up

**Note:** for numbered items, see assembly drawing on page 8.

#### 3.1 Checking the pump for foreign material

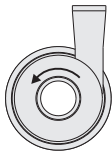
Remove the front cover, air screw and its housing as described below. Refer to the assembly drawing on page 8.

1. Lock Out power and disconnect from the power supply.
2. Remove the front cover by unscrewing the clamp ring (item 25), after disconnecting the re-circulation connection (item 30, if fitted)
3. Unscrew the air screw (item 2) (use a pipe C-spanner or a round bar in the balance hole in the shaft muff to secure the shaft)
4. Remove similarly the housing clamp ring (item 9) and carefully pull off the pump/screw housing
5. Turn the impeller (item 4) to ensure that there is no foreign material behind it.
6. If there is any foreign material in the pump, remove it.
7. When the pump is clean and free of foreign material, reassemble the pump.
8. When mounting the pump/screw housing check that the location pin (item 8, where fitted) in the top of the back plate (item 7), mates with the detent in the pump body and press the pump/screw housing in over the o-ring (item 6). Re-fit the clamp ring.
9. Screw the air screw on to the shaft. Remember the correct tightening torque - see section 5.2.18.
10. Press the front cover into place and fit the clamp ring. Re-assemble the re-circulation connection (if fitted).
11. Install suction and discharge pipes. Check that the pipe unions have been tightened properly and that pipe supports have been fitted.

To make the front cover and the pump/screw housing easier to fit, we recommend that you give the o-ring a thin layer of food-approved, acid-free grease or soap.



Fig. 6: Direction of rotation



#### 3.2 Testing the pump

To check that the pump is working properly, pour water into the pump and start it for a moment. Check the direction of rotation (Fig. 6). Listen for any unusual noises.

In pumps with water-flushed shaft seals, the seal chamber must be filled with water.

Never allow the pump to run without liquid, as this will ruin the shaft seal.



## 4. Putting the pump into service

Check the following before starting the pump:

- that the shaft guard has been fitted properly
- that there is free access for liquid and the pump is primed
- that the valve on the discharge side (if fitted) is closed

The valve on the discharge side is closed during start-up to prevent the motor from overloading, but should be opened again as soon as the pump has been started.

**Note:** The Ws+ pump should not be left running too long without pumping (typically 15 minutes, if the pumped liquid is not hot), as it gets warm and loses priming liquid by evaporation.

### 4.1 Flushing water.

In pumps with a flushed shaft seal, check that the supply of flushing medium is open and that the flow of the medium is adequate (approx. 4-8 gallons/hour).

## 5. Maintenance

### 5.1 Checking the shaft seal

Check the pump's shaft seal for leaks on a regular basis. If the shaft seal is leaking, replace it as described below.

### 5.2 Replacing the shaft seal

The sectional drawing (page 8) shows the pump and position and construction of the shaft seal - both ordinary seals and seals with water flushing.

To replace the shaft seal, it is necessary to dismantle the pump as described below. The sectional drawing is to be used for reference.

1. Disconnect the power supply in the motor isolator by removing the fuses and disconnecting the cables.
2. Turn off the flushing water supply.
3. Close the inlet and discharge of the pump, and drain the pump/screw housing, and make sure that there is no liquid in the pump body.



If the pump is used for hot and/or aggressive liquids, special precautions must be taken. In such cases, observe the local regulations for personal protection when working with these products.

4. Once the inlet and outlet pipes have been properly isolated and the re-circulation connection (if supplied) removed, remove the clamp ring (item 25) and front cover (item 27).
5. Unscrew the air screw (item 2) (use a pipe C-spanner or a round bar in the balance hole in the shaft muff to secure the shaft). Then open the clamp ring (item 9), take off the pump/screw housing (item 1) and remove the impeller (item 4).

*Note: for numbered items, see assembly drawing on page 8.*

### Dismantling the pump

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## 5. Maintenance

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### Dismantling the shaft seal

**Note:** for numbered items, see assembly drawing on page 8.

6. With your fingers, remove the stationary seal face (item 5.6), mounted in the back plate (item 7).
7. Remove the o-ring (item 5.5) from the stationary seal face.
8. Use your fingers to remove the rotary seal face (item 5.7) mounted in the impeller (item 4).
9. Remove the o-ring (item 5.5) from the rotary seal face.
10. Clean the stator and rotary seal face locations, if necessary with air or water.

In the case of water-flushed shaft seals, the back plate must be removed to dismantle the rear shaft seal. The rear stationary seal face (item 5.6) is mounted in the pressure ring (item 5.11) and the rotary seal face (item 5.7) is mounted on the shaft (item 11). These are removed in the same way as the front seal components.

### Checking parts for wear



11. Check o-rings (item 5.5) for signs of cracks, lack of elasticity, brittleness and/or chemical attack. Replace worn or defective parts.
12. Check the stationary and rotary seal faces for signs of wear too. The wearing surfaces must be completely free of scratches/cracks. If not, the rings must both be replaced.

In the case of water-flushed shaft seals, check the rear seal rings (item 5.6, 5.7) for wear, and replace if necessary.

13. Fit new o-rings on the stationary seal face and rotary seal face.

**Note:** Remember to moisten these with water.

### Fitting



14. Fit the rotary seal face (item 5.7) on the impeller without using tools.

**Note:** The notch in the rotary seal face must be fitted so that it mates with the driving pin (item 5.8) in the impeller hub.

In the case of water-flushed seals, also fit a rotary seal face (item 5.7) with its o-ring (item 5.5) in the location on the shaft - again without using tools.

15. Fit the stationary seal face (item 5.6) in the back plate without using tools.

**Note:** The notches in the stationary seal face must mate with the driving dogs on the carrier in the back plate. Check that the stationary seal face is positioned so that it slides back and forth easily within the back plate.

When fitting new water-flushed seals, remove the drain pipe (item 5.4) from the stationary seal faces for both the front and rear seal before fitting them in the pressure ring (item 5.11) and back plate respectively.

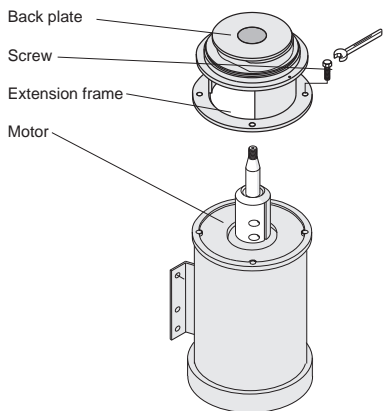


## 5. Maintenance

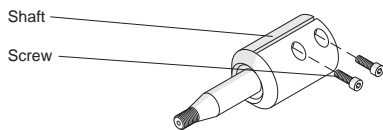
**Note: for numbered items, see assembly drawing on page 8.**

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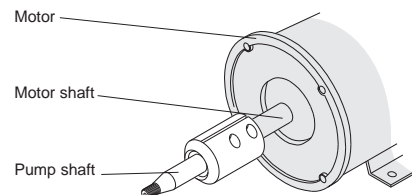
**Fig. 8: Unscrew motor flange bolts**



**Fig. 9: Loosen screws**



**Fig. 7: Mount pump shaft**



16. After fitting, clean the wearing surfaces.  
For liquid-flushed, re-mount the back plate.
17. Fit the impeller. Check that the location pin (item 8, where fitted) in the top of the back plate, mates with the detent in the pump body and carefully, to avoid damaging the o-ring, press the pump/screw housing (item 1) in over the o-ring (item 6). Fasten with the clamp ring (item 9). See "Required torques for housing clamp" table on page 18.
18. Re-mount the air screw. Remember to use the proper tightening torque:  
M14: 52 lb·ft (70 Nm)  
M20: 148 lb·ft (200 Nm)
19. Press the front cover into place and fit the clamp ring.  
Re-assemble the re-circulation connection (if fitted).

### 5.3 Replacement of motor

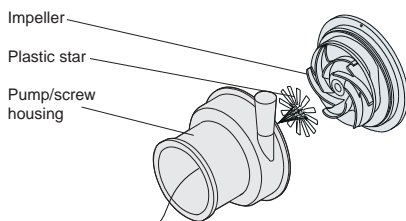
The standard motor for the Ws+ pump has a locked front bearing. If the motor is replaced, the new motor must also have a locked front bearing. The motor bearing is enclosed and permanently lubricated.

Follow the instructions below when replacing the motor. For replacement of bearings, see the motor supplier's service instructions.

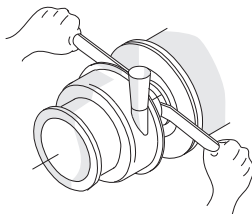
1. Lock Out power supply then disconnect the pump and motor from system.
2. Remove of the front cover, air screw, pump/screw housing and impeller (items 27, 2, 1 and 4) described as in para. 5.2, points 1-5 on page 14.
3. If possible, stand the pump on end. See Fig. 8.
4. Undo the four motor flange bolts and remove them. See Fig. 8.
5. Lift the backplate (item 7) and extension frame (item 14), which are still bolted together, up and off the shaft. See Fig. 8. Remove the washer (item 17), if supplied.
6. See Fig. 9. Loosen the screws in the shaft muff, pull the shaft off and replace the motor.
7. See Fig. 8. Before re-mounting the pump shaft, remove any dirt and grease from the motor shaft and the muff's internal clamping surfaces. Mount the pump shaft loosely. Position the balance hole over the keyway.
8. Fit the back plate and extension frame over the shaft.
9. Tighten the bolts.
10. Stand the pump back on its legs/bracket.
11. Fit the impeller and secure it temporarily with the nut (M14 or M20) which is supplied as a tool with the pump.

## 5. Maintenance

**Fig. 10: Place plastic star against impeller**



**Fig. 11: Push shaft forward**



12. Place the plastic star (item 31) against the impeller (Fig. 10).
13. Fit the pump/screw housing and fasten with the clamp ring. See "Required torques for housing clamp" table on page 18.
14. Push the shaft forward until the impeller is touching the plastic star. See Fig. 10.
15. Apply "Never-Seez" or equivalent to the screw threads. Tighten the shaft screws. Remember to use the proper tightening torque for the screws:
  - M8: 22 lb-ft (30 Nm) (uses 6mm Allen wrench)
  - M10: 41 lb-ft (55 Nm) (uses 8mm Allen wrench)
16. Remove the star by pulling it out through the inlet.
17. Replace the temporary nut with the air screw. Remember to use the proper tightening torque:
  - M14: 52 lb-ft (70 Nm)
  - M20: 148 lb-ft (200 Nm)
18. Press the front cover in and fasten the clamp ring. Reassemble the re-circulation connection, if fitted.

### 5.4 Recommended inventory of spare parts

#### Seal sets

We recommend that you keep both seal kits and service kits for the Ws+pumps in stock. The seal kit for the Ws+ pump consists of the wearing parts of the pump, as specified on page 27.

#### Service kit

The service kit is made up of a number of the main components of the pump which are not wearing parts, but which you still may have to replace: shaft, impeller, cap nut and fixing kit.

The table below shows the recommended inventory of spare parts for normal operation and for specific operating conditions such as:

- 24-hour operation
- Operation with abrasive media
- Processes sensitive to production down time.

Wearing parts (seal kit, see page 27)

	No. of pumps in service		
	0-5	5-20	> 20
	Sets	Sets	Sets/ 10 pumps
Normal operation	2	3	1
Special needs	3	6	2

Service parts (shaft, impeller, air screw page 23; fixing kit page 25)

	No. of pumps in service		
	0-5	5-20	> 20
	Sets	Sets	Sets/ 10 pumps
Normal operation	0	1	1
Special needs	1	2	1



## 6. Technical data

### 6.1 Maximum permissible outlet pressure for Ws+ pumps

Do not exceed the maximum pump outlet pressures specified below (applies to water at 68°F/20°C):

Pump	Ws+20/15	Ws+30/30	Ws+44/50
Maximum permissible pressure	87 psig (6 bar)	116 psig (8 bar)	189 psig (13 bar)

Subject to change.

### 6.2 Required Torque, Ws+ pumps

Pump Model	Motor Frame	Shaft size	Screw Size	Screw Torque	
				(N-m)	lb-ft
Ws+20/15, Ws+30/30	143-145TC	25	M8x30	30	22
Ws+20/15, Ws+30/30	182-184TC				
Ws+20/15, Ws+30/30	213-215TC				
Ws+30/30	254-256TC				
Ws+40/15	254-256TC	35	M10x30	55	41
Ws+40/15	284-286TC				
Ws+40/15	324-326TC				

Torque the stub shaft bolts according to the size of the screws listed:

M8: 22 lb-ft (30 Nm) (uses 6mm Allen wrench)

M10: 41 lb-ft (55 Nm) (uses 8mm Allen wrench)

Required torques for housing clamp				
Pump type	mounting	Size	required torques	
Ws+20/15	Clamp	M10	55 Nm	41 lb-ft
Ws+30/30				
Ws+44/50				

Required torques for cap nuts				
Pump type	Shaft Ø	Cap Nut	required torques	
Ws+20/15	Ø25	M14	70 Nm	52 lb-ft
Ws+30/30				
Ws+44/50	Ø35	M20	200 Nm	148 lb-ft



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## 6. Technical data

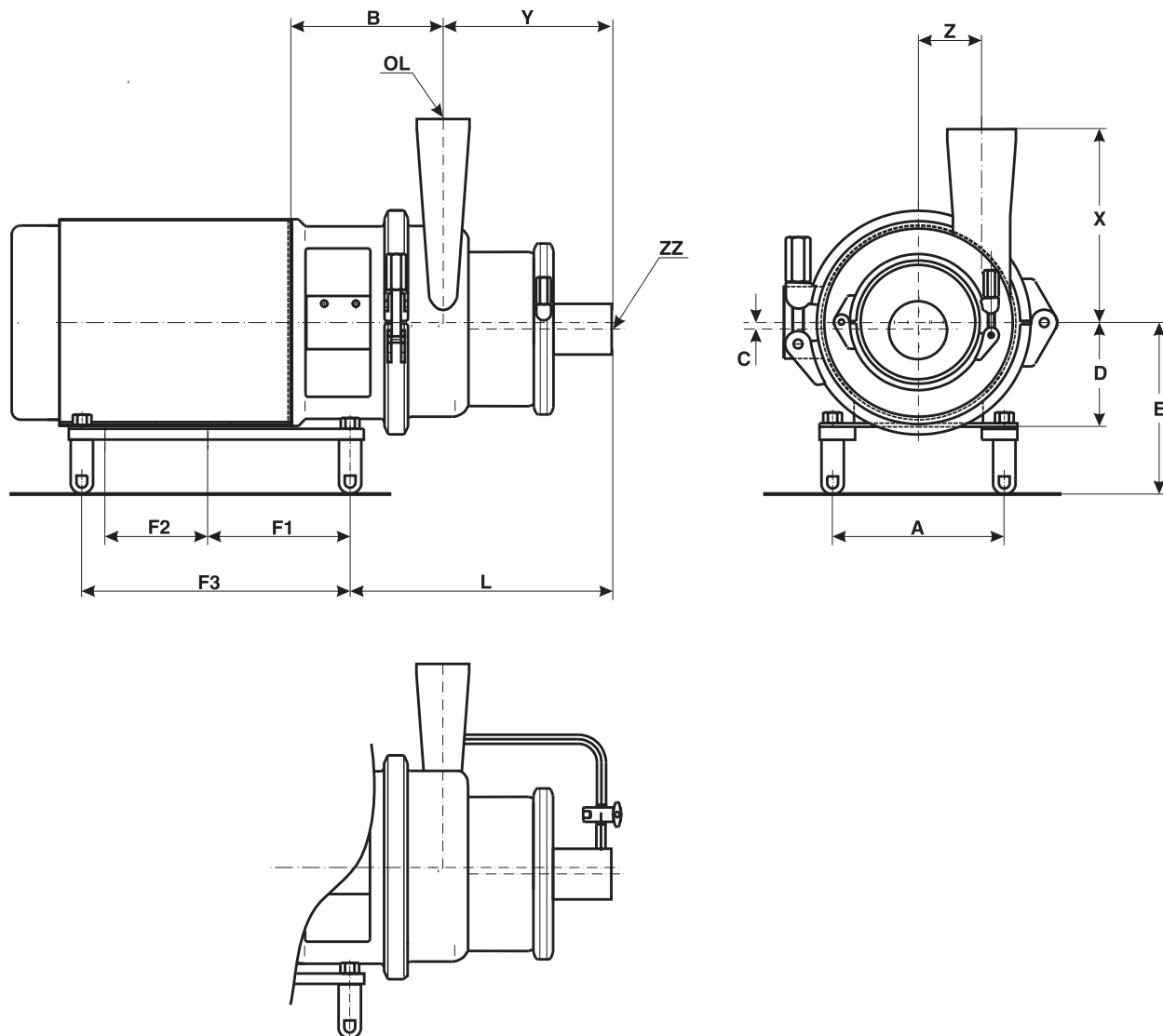
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## 7. Ws+ Spare Parts, Dimensions

### 7.1 Pump Dimensions



Inlet/Outlet Size	Bevel Seat	Threaded PV	TRI Clamp	APC Clamp	ISS	Male Pipe Thread	150#Flange
2.0" (51 mm)	0.750" (19 mm)	0.750" (19 mm)	1.125" (29 mm)	0.750" (19 mm)	1.125" (29 mm)	1.687" (43 mm)	1.187" (30 mm)
2.5" (63 mm)	0.844" (21 mm)	0.844" (21 mm)	1.125" (29 mm)	0.844" (21 mm)	1.125" (29 mm)	2.187" (55 mm)	1.187" (30 mm)
3.0" (76 mm)	0.906" (23 mm)	0.906" (23 mm)	1.125" (29 mm)	0.906" (23 mm)	1.125" (29 mm)	2.250" (57 mm)	1.500" (38 mm)



## 7. Ws+ Spare Parts, Dimensions

### 7.1 Pump Dimensions

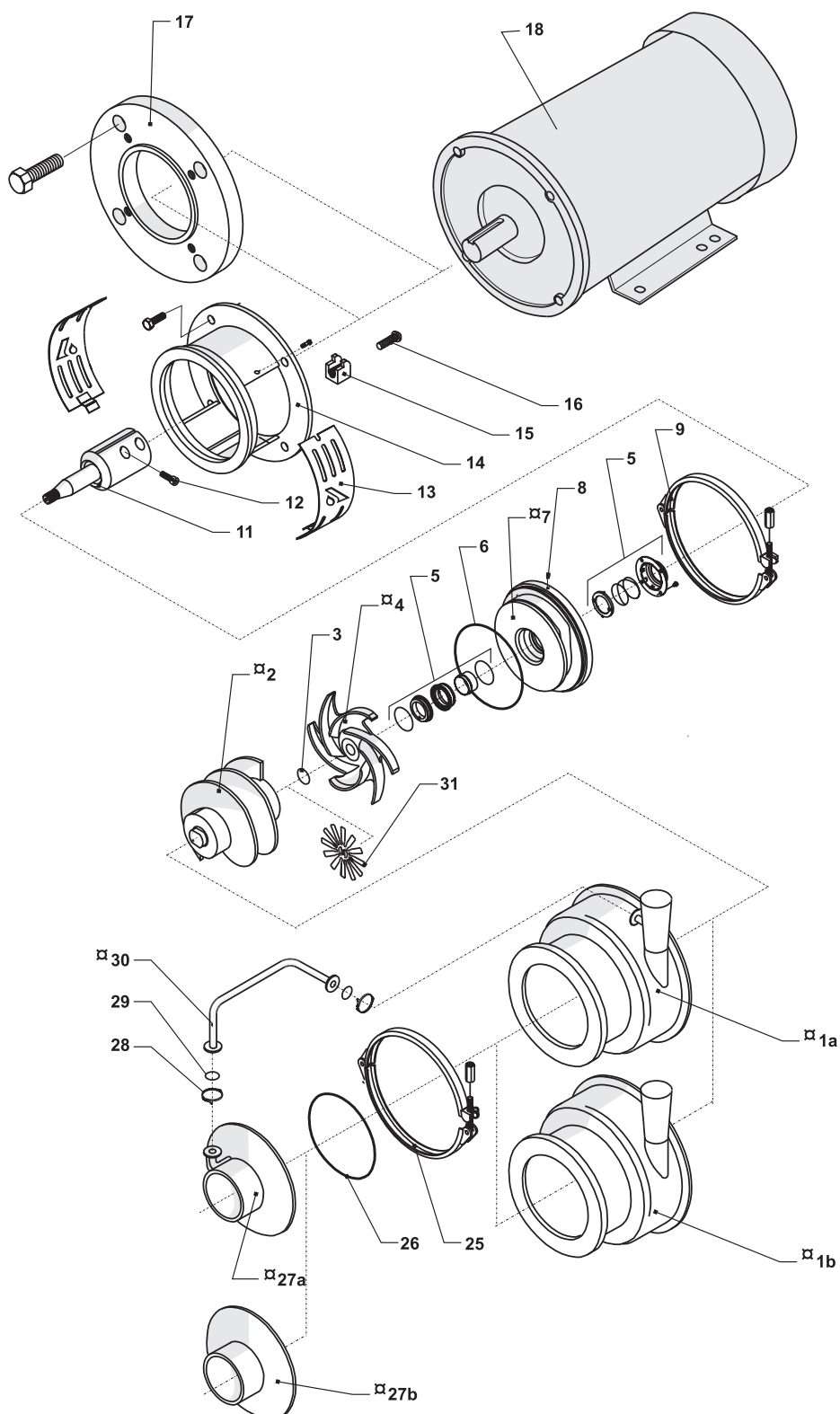
Pump Type	Motor Size	F1	F2	F3	D	A	E	L	C	B	ZZ	OL	Z	X (Butt weld)	Y (Butt weld)
Ws+20/15	145TC	3.75 (93.5)	5.00 (127)	10.25 (260.4)	3.50 (88.9)	5.50 (139.7)	7.00 (177.8)	9.46 (240)	0.315 (8)	5.98 (152)	2.5 (63.5)	2.0 (51.6)	2.60 (66)	8.47 (215)	4.48 (190)
	182TC	4.37 (111)	4.50 (114.3)	11.37 (288.8)	4.50 (114.3)	7.50 (190.5)	8.00 (203.2)	9.87 (250)		7.01 (178)					
	184TC		5.50 (139.7)												
Ws+30/30	184TC	4.37 (111)	5.50 (139.7)	11.37 (288.8)	4.50 (114.3)	7.50 (190.5)	8.00 (203.2)	12.12 (308)	0.39 (10)	6.14 (156)	2.5 (63.5)	2.0 (51.6)	3.27 (83)	9.06 (230)	7.60 (193)
	213TC		5.50 (139.7)												
	215TC	5.38 (136.7)	7.0 (177.8)	13.88 (352.6)	5.25 (133.4)	8.50 (215.9)	8.75 (222.3)	11.86 (301)							
	254TC	6.50 (165.1)	8.25 (209.6)	18.00 (457.2)	6.25 (158.8)	10.00 (254)	9.75 (267.7)	12.12 (308)		6.77 (172)					
Ws+44/50	254TC	6.50 (165.1)	8.25 (209.6)	18.00 (457.2)	6.25 (158.8)	10.00 (254)	9.75 (267.7)	14.81 (376)	0.51 (13)	7.28 (185)	3.0 (76.1)	2.0 (51.6)	3.94 (100)	8.66 (220)	9.78 (248)
	256TC		10.00 (254)												
	284TSC		9.50 (241.3)	19.00 (482.6)	7.00 (177.8)	11.00 (279.4)	10.50 (266.7)	14.64 (372)		6.61 (168)					
	286TSC		11.00 (279.4)												
	324TSC		7.00 (177.8)	10.50 (266.7)	20.50 (520.7)	8.00 (203.2)	12.50 (317.5)	11.50 (292.1)		7.68 (195)					

Tolerances:	Y:	+0mm -5mm	X:	+5mm -0mm	OL,ZZ:	nominal	B:	±5mm	L:	±5mm	Others:	±2mm
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## 7. Ws+ Spare Parts, Dimensions

### 7.2 Pump Parts



## 7. Ws+ Spare Parts, Dimensions

### 7.2 Pump Parts

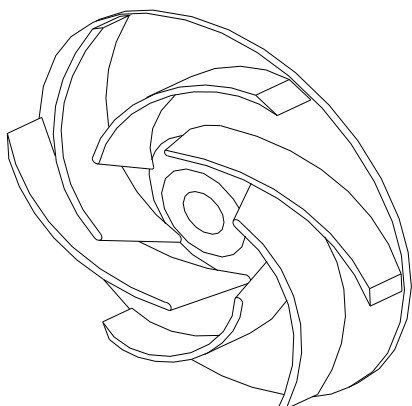
			Pump Type		
			Ws+20/15	Ws+30/30	Ws+44/50
Pos	Qty	Description	Part No.		
1a	1	Pump casing	L804669	L804670	L804671
1b	1	Pump casing	L182857	L182858	L182859
2	1	Air screw	L804675	L804676	L804677
3	1	O-ring	see page 27		
4	1	Impeller	see page 24		
5	1	Shaft seal	see page 25/26		
6	1	O-ring	see page 27		
7	1	Back Flange	L260948*	L260950	L260954
8	1	Pin	-----	L772493	L772493
9	1	Clamp ring	L188430	L188436	L188432
11	1	Shaft	see page 28		
12	2	Screw	see page 28		
13	2	Shaft guard	see page 29		
14	1	Extension frame	see page 29		
15	2	Bracket	-----	L268499	L268499
16	2	Screw	-----	L701942	L701942
17	1	Flange Adapter	see page 29		
18	1	Motor	See order		
25	1	Clamp ring	L169050	L188430	L804665
26	1	O-ring	see page 27		
27a	1	Front cover	L804672	L804673	L804674
27b	1	Front cover	L808296	L808297	L808298
28	2	Clamp ring	L771837	L771837	L771837
29	2	Gasket	see page 27		
30	1	Recirculation pipe	L808288	L808289	L808290
31	1	Spacer/Plastic star	L259776	L259776	L260406
--	--	Frame	see page 30		

\* integrated in extension frame, pos. 14



## 7. Ws+ Spare Parts, Dimensions

### 7.3 Impeller



Ws+20/15, Ws+30/30



Ws+44/50

Impeller Ø	Pump type		
	Ws+20/15	Ws+30/30	Ws+44/50
	Part No.		
8.7" / Ø220			L253777
8.5" / Ø215			L253778
8.3" / Ø210			L253779
8.1" / Ø205			L253780
7.9" / Ø200			L253781
7.7" / Ø195			L253782
7.5" / Ø190			L253783
7.3" / Ø185			L253784
7.1" / Ø180			L253785
6.9" / Ø175		L267000	L253786
6.7" / Ø170		L267001	L253787
6.5" / Ø165		L267002	L253788
6.3" / Ø160		L267003	L253789
6.1" / Ø155		L267004	
5.9" / Ø150		L267005	
5.7" / Ø145		L267006	
5.5" / Ø140	L253767*	L267007	
5.3" / Ø135	L253768	L267008	
5.1" / Ø130	L253769	L267009	
4.9" / Ø125	L253770	L267010	
4.7" / Ø120	L253771	L267011	
4.5" / Ø115	L253772		
4.3" / Ø110	L253773		
4.1" / Ø105	L253774		
3.9" / Ø100	L253775		
3.7" / Ø95	L253776		

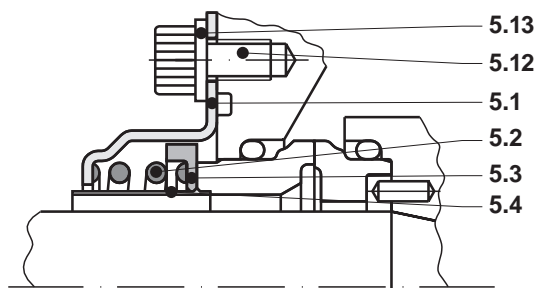
\*5.5" / Ø142

## 7. Ws+ Spare Parts, Dimensions

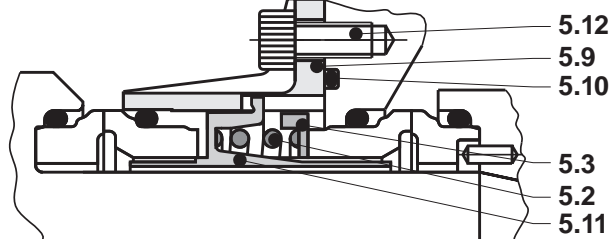
### 7.4 Shaft Seal

#### 7.4.1 Fixing Kit

A. Single Seal Ø25+Ø35



B. Double Seal Ø25+Ø35



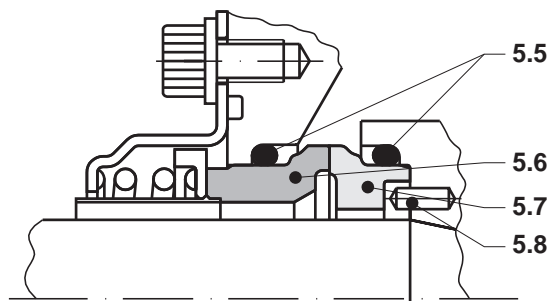
Fixing Kit				Shaft Size		
				Ø25	Ø35	
Pos	Description	Items	Material	Part No.		
A	Single Seal	Complete	-----	L772460	L772465	
		Pos 5.1 Seal housing	AISI 316			
		Pos 5.2 Spring	AISI 316			
		Pos 5.3 Pressure ring	AISI 316			
		Pos 5.4 Drain pipe	PTFE	(L773100)	(L773101)	
B	Double Seal	Complete	-----	L194448	L194449	
		Pos 5.2 Spring	AISI 316			
		Pos 5.3 Pressure ring	AISI 316			
		Pos 5.9 Seal housing	AISI 316			
		Pos 5.11 Pressure ring	AISI 316			
5.10		O-ring	EPDM	L772470	L771362	
5.12		4 Screws M6x10	AISI 316	L770496	L770496	



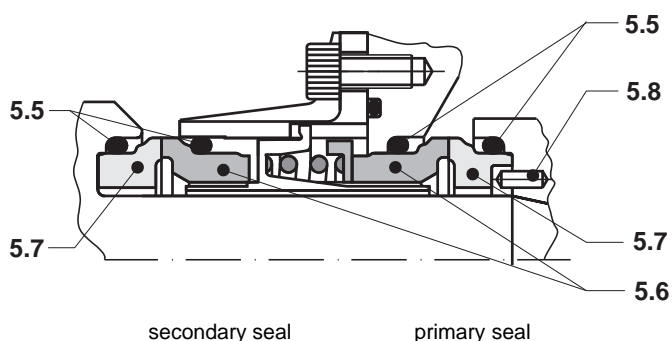
## 7. Ws+ Spare Parts, Dimensions

### 7.4.2 Face Kit

A. Single Seal Ø25+Ø35



B. Double Seal Ø25+Ø35



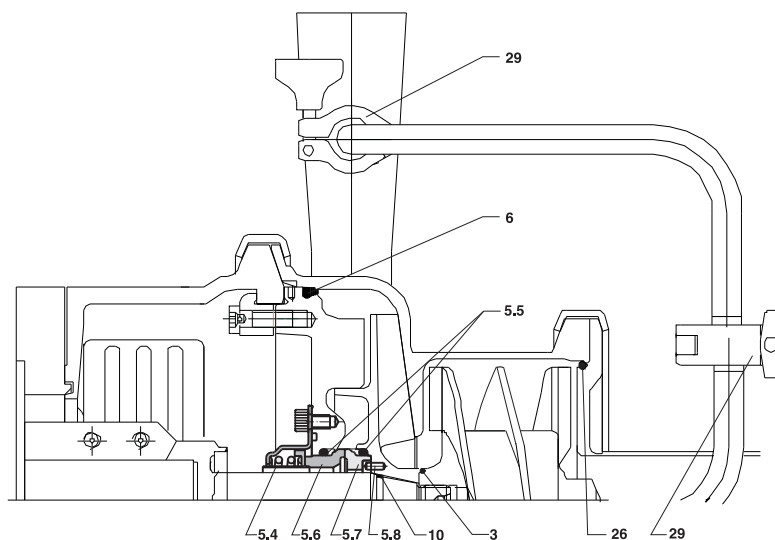
Shaft Seal				Shaft Size		
				Ø25	Ø35	
Pos	Description	Items	Material	Part No.		
A	Face Kit	Complete	EPDM	L772461	L772466	
B	SiC/Car EPDM	Pos 5.5 2 off O-rings Pos 5.6 Stationary seal Pos 5.7 Rotary seal Pos 5.8 Pin	Car SiC AISI316L			
A	Face Kit	Complete	FPM (Viton)	L772462	L772467	
B	SiC/Car FPM (Viton)	Pos 5.5 2 off O-rings Pos 5.6 Stationary seal Pos 5.7 Rotary seal Pos 5.8 Pin	Car SiC AISI316L			
A	Face Kit	Complete	EPDM	L772463	L772468	
B	SiC/SiC EPDM	Pos 5.5 2 off O-rings Pos 5.6 Stationary seal Pos 5.7 Rotary seal Pos 5.8 Pin	SiC SiC AISI316L			
A	Face Kit	Complete	FPM (Viton)	L772464	L772469	
B	SiC/SiC FPM (Viton)	Pos 5.5 2 off O-rings Pos 5.6 Stationary seal Pos 5.7 Rotary seal Pos 5.8 pin	SiC SiC AISI316L			

B All combination of material are available – APV recommend the use of SiC/Car as secondary seal

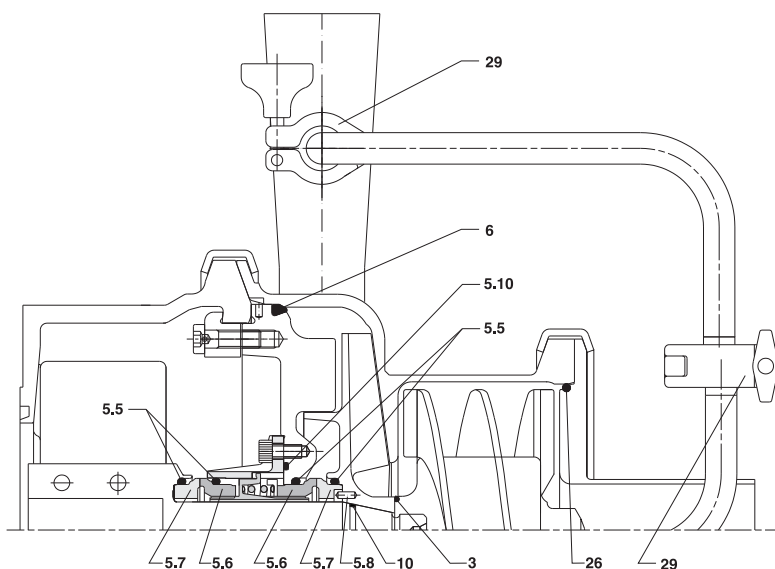
## 7. Ws+ Spare Parts, Dimensions

### 7.5 Seal Kit

A. Single Seat



B. Double Seat

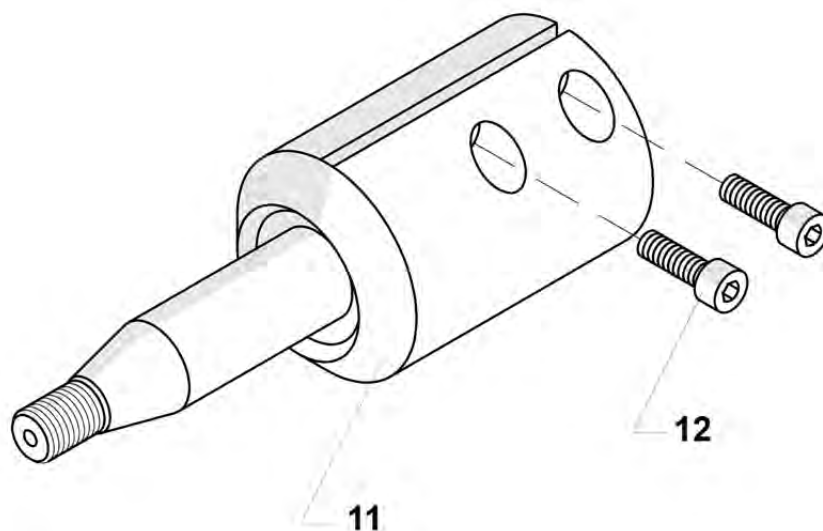


Pos.	Material	Pump Type		
		W+10/8	W+22/20	W+30/80
<b>Seal Kit , Single</b> 3, 6, 10, 26,29x2, 5.4, 5.5x2, 5.6, 5.7, 5.8	SiC/SiC - EPDM	L808325	L808326	L808327
	SiC/Car - EPDM	L808328	L808329	L808330
	SiC/SiC - FPM	L808331	L808332	L808333
	SiC/Car - FPM	L808334	L808335	L808336
<b>Seal Kit , Double</b> 3, 6, 10, 26,29x2, 5.5x2, 5.6x2, 5.7x2, 5.8, 5.10	SiC/SiC - EPDM	L808551	L808555	L808559
	SiC/Car - EPDM	L808552	L808556	L808534
	SiC/SiC - FPM	L808553	L808557	L808535
	SiC/Car - FPM	L808554	L808558	L808536
<b>O-Ring Kit</b> 3, 6, 10, 26,29x2, 5.5x2, 5.6x2, 5.7x2, 5.8, 5.10	EPDM	L808551	L808555	L808559
	SiC/Car - EPDM	L808552	L808556	L808534



## 7. Ws+ Spare Parts, Dimensions

### 7.6 Shaft



Pump Type	Motor						
	145TC	182-184TC	213-215TC	254TC	254-256TC	284-286TSC	324TSC
	Pos. 11 Shaft Ø25				Pos. 11 Shaft Ø35		
Ws+20/15	L267333	L267334	-----	-----	-----	-----	-----
Ws+30/30	L267333	L267334	L267335	L267336	-----	-----	-----
Ws+40/15	-----	-----	-----	-----	L267341	L267342	L267343
	Pos. 12						
Qty.	2	2	2	2	2	2	2
Screw	L771199	L771199	135664+	135664+	135664+	135664+	135664+

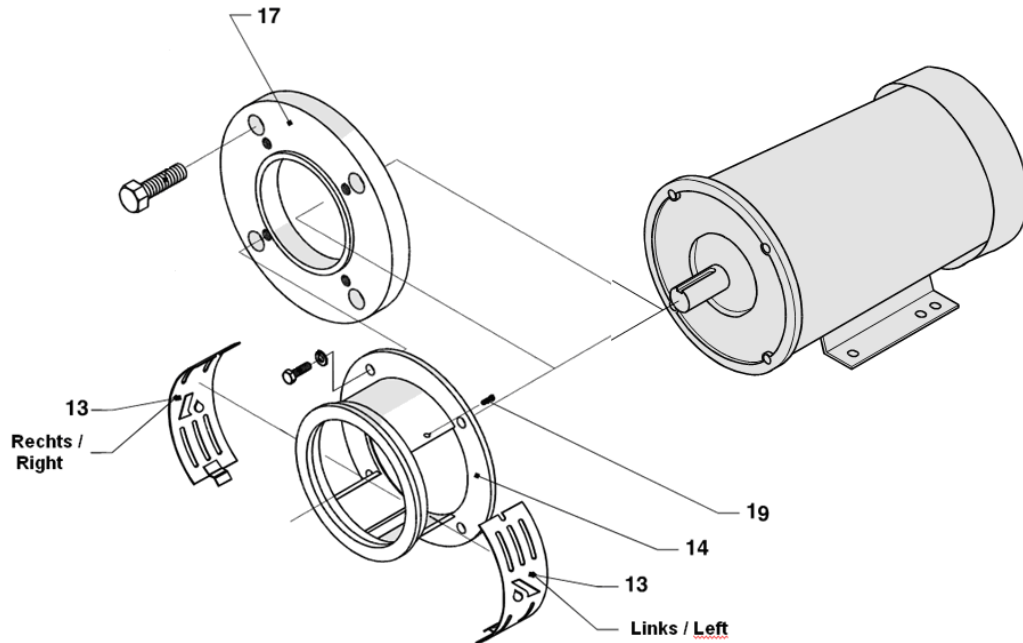
**Note:**

- As of April 2014, the screws used on stub shafts L267335, L267336, L267341, L267342, and L267343 changed from M8 (22 lb-ft torque) to M10 (41 lb-ft torque).



## 7. Ws+ Spare Parts, Dimensions

### 7.7 Extension Frame and Shaft Guard



Pump Type	Qty	Motor							
		145TC	182TC	184TC	213-215TC	254TC	256TSC	284-286TSC	324TSC
		Pos. 13 Shaft Guard							
Ws+20/15	2 R / L	L188334	L188334	L188334					
Ws+30/30	2 R / L			L188653	L188653	L188653			
Ws+44/50	2 R / L					L188653	L188653	L188811	L188811

Pump Type	Motor							
	145TC	182TC	184TC	213-215TC	254TC**	256TC	284-286TSC	324TSC***
	Pos. 14 Extension Frame							
Ws+20/15	L260973#	L260973#*	L260973#*	-----	-----	-----	-----	-----
Ws+30/30	-----	-----	L260975	L260975	L260975	-----	-----	-----
Ws+44/50	-----	-----	-----	-----	L260977	L260977	L260978	L260978

# integrated in back plate pos. 7b

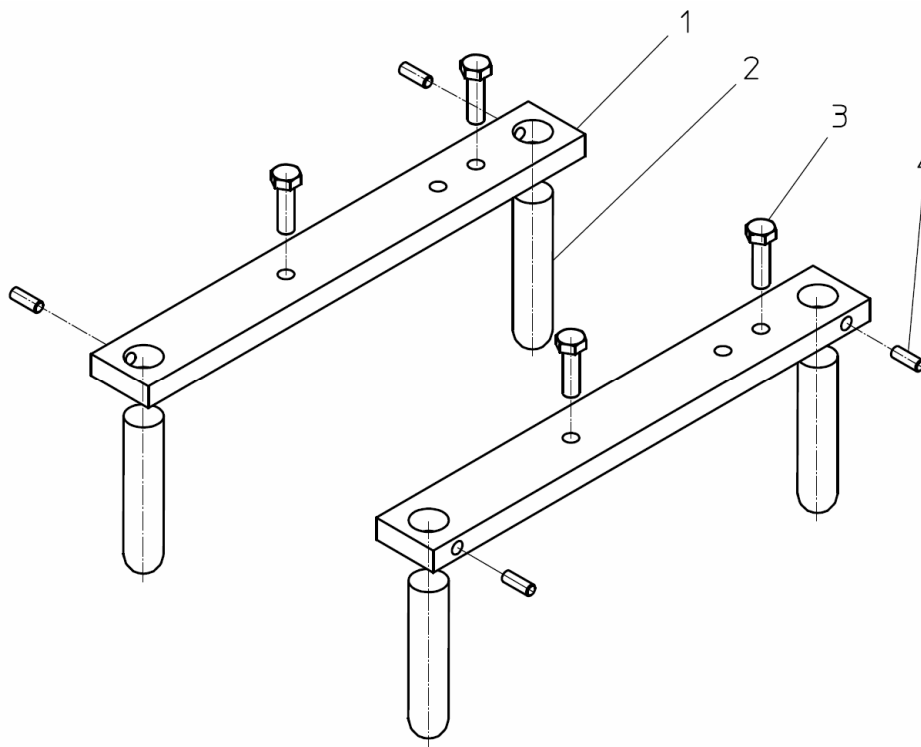
Pos. 17 Flange Adapter St 37 / (AISI 304SS)								
*	-----	*L267095	*L267095	-----	-----	-----	-----	-----
**	-----	-----	-----	-----	**L267096	-----	-----	-----
***	-----	-----	-----	-----	-----	-----	-----	***L267097

Pos	Qty.	Motor							
		56C	143-145TC	182-184TC	213-215TC	254-256TC	284-286TSC	324-326TSC	364-365TSC
		Part No.							
19	2	L700420	L700420	L700420	L700420	L700420	L700420	L700420	L700420



## 7. Ws+ Spare Parts, Dimensions

### 7.8 Frame



			Motor					
			145TC	182-184TC	213-215TC	254-256TC	284-286TSC	324TSC
Pos	Qty	Description	Part No.					
--	--	Frame cpl.	L110256	L110255	L110254	L110253	L110252	L110251
1	2	Side bar	L110262	L110261	L110260	L110259	L110258	L110257
2	4	Leg ¾"	L110264			----		
2	4	Leg 1"	----			L110263		
3	4	Screw	5/16-18 x 3/4	3/8-16 x 1		1/2-13 x 1 1/8		5/5-11 x 1 1/4
4	2	Screw	1/4-20 x 1/2 SQ.HD			1/4-20 x 5/8 SQ.HD		



WS+

CENTRIFUGAL PUMP



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