

Pressure Booster System

# DeltaSolo D

From Series 2021w39

## Installation/Operating Manual



CE



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Installation/Operating Manual DeltaSolo D

Original operating manual

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## Glossary

### Accumulator

Pressure losses may occur in the piping downstream of the pressure booster system as a result of losses due to leakage. The accumulator serves to compensate for pressure losses and minimises the frequency of starts of the pressure booster system.

### Certificate of decontamination

A certificate of decontamination is enclosed by the customer when returning the product to the manufacturer to certify that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

### Dry running protection

Dry running protection devices prevent the pump from being operated without the fluid to be handled, which would result in pump damage.

### IE3

Efficiency class to IEC 60034-30: 3 = Premium Efficiency (IE = International Efficiency)

### Manual mode

Direct operation on the power supply network, independently of the control unit.

### Switchgear and controlgear assembly

Control cabinet with one or several control units / switchgears and electrical equipment.

## 1 General

### 1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover.

The operating manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series, the main operating data and the serial number. The serial number uniquely describes the product and is used as identification in all further business processes.

In the event of damage, immediately contact your nearest KSB service facility to maintain the right to claim under warranty.

### 1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance.

### 1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇒ Section 2.3, Page 8)


### 1.4 Other applicable documents

**Table 1:** Overview of other applicable documents

Document	Contents
Sub-supplier product literature	Operating manuals, circuit diagram and other product literature describing accessories and integrated machinery components








### 1.5 Symbols

**Table 2:** Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇒	Result of an action
⇔	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

### 1.6 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

Symbol	Description
	<b>DANGER</b> This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
	<b>WARNING</b> This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
	<b>CAUTION</b> This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	<b>Explosion protection</b> This symbol identifies information about avoiding explosions in potentially explosive atmospheres in accordance with EU Directive 2014/34/EU (ATEX).
	<b>General hazard</b> In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	<b>Electrical hazard</b> In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	<b>Machine damage</b> In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.



## 2 Safety

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

### 2.1 General

- This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.
- Comply with all the safety instructions given in the individual sections of this operating manual.
- The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.
- The contents of this operating manual must be available to the specialist personnel at the site at all times.
- Information and markings attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:
  - Flow direction arrow
  - Markings for connections
  - Name plate
- The operator is responsible for ensuring compliance with all local regulations not taken into account.

### 2.2 Intended use

- The pressure booster system must only be operated within the operating limits described in the other applicable documents.
- Only operate pressure booster systems which are in perfect technical condition.
- Do not operate partially assembled pressure booster systems.
- The pressure booster system must only handle the fluids described in the product literature of the respective design variant.
- Never operate the pressure booster system without the fluid to be handled.
- Observe the information on minimum flow rates specified in the product literature (to prevent overheating, bearing damage, etc).
- Observe the maximum flow rates indicated in the data sheet or product literature (to prevent overheating, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the pressure booster system (to prevent cavitation damage).
- Consult the manufacturer about any other modes of operation not described in the product literature.

### 2.3 Personnel qualification and personnel training

- All personnel involved must be fully qualified to install, operate, maintain and inspect the product this manual refers to.
- The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.
- Deficits in knowledge must be rectified by means of training and instruction provided by sufficiently trained specialist personnel. If required, the operator can commission the manufacturer/supplier to train the personnel.
- Training on the pressure booster system must always be supervised by specialist technical personnel.



### 2.4 Consequences and risks caused by non-compliance with this manual

- Non-compliance with these operating instructions will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices
  - Hazard to the environment due to leakage of hazardous substances

### 2.5 Safety awareness

In addition to the safety information contained in this operating manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

### 2.6 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If stopping the pump does not increase potential risk, fit an emergency-stop control device in the immediate vicinity of the pump (set) during pump set installation.

### 2.7 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pressure booster system are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorised by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Carry out work on the pressure booster system during standstill only.
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pressure booster system out of service always adhere to the procedure described in the manual.
- Decontaminate pressure booster systems which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and/or re-activate any safety-relevant and protective devices. Before returning the product to service, observe all instructions on commissioning.
- Make sure the pressure booster system cannot be accessed by unauthorised persons (e.g. children).
- Prior to opening the device, pull the mains plug and wait for at least 10 minutes.

### **2.8 Unauthorised modes of operation**

Always observe the limits stated in the product literature.

The warranty relating to the operating reliability and safety of the pressure booster system supplied is only valid if the equipment is used in accordance with its intended use. (⇒ Section 2.2, Page 8)

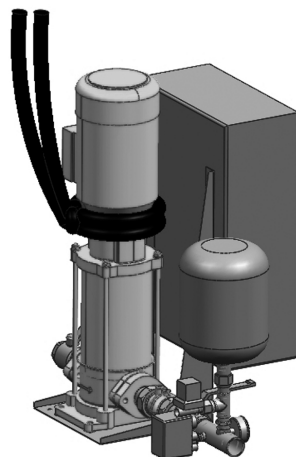
### 3 Transport/Storage/Disposal

#### 3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the supplying dealer and the insurer about the damage in writing immediately.

#### 3.2 Transport



	<b>DANGER</b>
	<p><b>Pressure booster system tipping over</b> Risk of injury by falling pressure booster system!</p> <ul style="list-style-type: none"> <li>▷ Never suspend the pressure booster system by its cable.</li> <li>▷ Observe the applicable local accident prevention regulations.</li> <li>▷ Observe the information on weights, centre of gravity and fastening points.</li> <li>▷ Use suitable and permitted transport equipment, e.g. crane, forklift or pallet truck.</li> <li>▷ To transport the pressure booster system, suspend it from the lifting tackle as illustrated.</li> <li>▷ Attach the pressure booster system to crane lifting tackle as shown, or use a forklift or pallet truck to move the pallet.</li> </ul>



**Fig. 1:** Transporting the pressure booster system

- ✓ Transport equipment/lifting equipment suitable for the corresponding weight has been selected and is available.
1. Remove the packaging. Remove the caps from the connection openings.
  2. Check for any in-transit damage.
  3. Transport the pressure booster system to the place of installation.
  4. Detach the pressure booster system from the pallet using a suitable tool.
  5. Attach the pressure booster system to the lifting equipment as illustrated.
  6. Separate the pressure booster system from the wooden skids with a suitable tool. Lift the pressure booster system off. Dispose of the wooden skids.
  7. Carefully place down the pressure booster system at the place of installation.

### 3.3 Storage/preservation

	<p style="background-color: #FFD700; margin: 0;"><b>CAUTION</b></p> <p><b>Damage during storage due to frost, moisture, dirt, UV radiation or vermin</b> Corrosion/contamination of pressure booster system!</p> <p>▸ Store the pressure booster system in a frost-proof room. Do not store outdoors.</p>
	<p style="background-color: #FFD700; margin: 0;"><b>CAUTION</b></p> <p><b>Wet, contaminated or damaged openings and connections</b> Leakage or damage of the pressure booster system!</p> <p>▸ Only open the openings of the pressure booster system at the time of installation.</p>

If commissioning is to take place some time after delivery, we recommend that the following measures be taken:

Store the pressure booster system in a dry, protected room where the atmospheric humidity is as constant as possible.

**Table 4:** Ambient conditions for storage

Ambient condition	Value
Relative humidity	50 % maximum
Ambient temperature	0 °C to +40 °C



- Frost-free
- Well-ventilated

### 3.4 Return to supplier

1. Drain the pressure booster system as per operating instructions.
2. Always flush and clean the pressure booster system, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pressure booster system has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pressure booster system must also be neutralised and treated with anhydrous inert gas to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pressure booster system. (⇒ Section 12, Page 39)  
Always indicate any safety and decontamination measures taken.

	<p style="background-color: #0070C0; color: white; margin: 0;"><b>NOTE</b></p> <p>If required, a blank certificate of decontamination can be downloaded from the following web site: <a href="http://www.ksb.com/certificate_of_decontamination">www.ksb.com/certificate_of_decontamination</a></p>
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### 3.5 Disposal

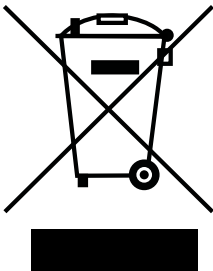
	 <b>WARNING</b>
	<p><b>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</b></p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▸ Collect and properly dispose of flushing fluid and any fluid residues.</li> <li>▸ Wear safety clothing and a protective mask if required.</li> <li>▸ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>

1. Dismantle the pressure booster system.  
Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
  - Metals
  - Plastics
  - Electronic waste
  - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

Electrical or electronic equipment marked with the adjacent symbol must not be disposed of in household waste at the end of its service life.

Contact your local waste disposal partner for returns.

If the used electrical or electronic equipment contains personal data, the operator is responsible for deleting it before the equipment is returned.



## 4 Description

### 4.1 General description

- Pressure booster system

### 4.2 Product information as per Regulation No. 1907/2006 (REACH)

For information as per European chemicals regulation (EC) No. 1907/2006 (REACH) see <https://www.ksb.com/en-global/company/corporate-responsibility/reach>.

### 4.3 Designation

Example: DeltaSolo D 1 / 0405 / 2 B

Table 5: Designation key

Code	Description
DeltaSolo	Type series
D	Three-phase current
1	Number of pumps
04	Pump size
05	Number of stages
2	Inlet pressure [bar]
B	Design status

### 4.4 Name plate

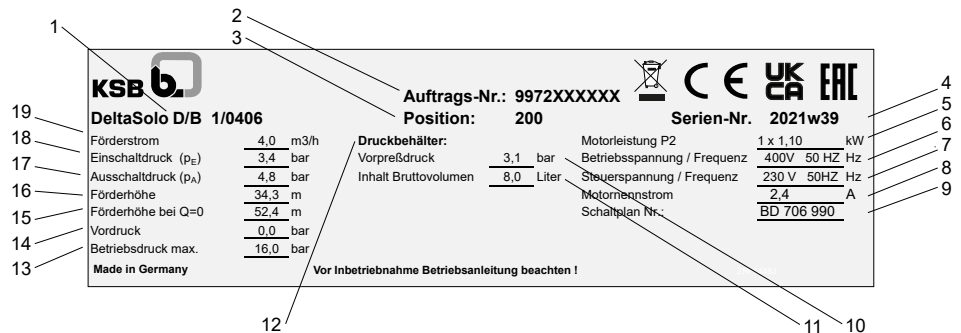


Fig. 2: Name plate (example)

1	Type series, size	11	Gross vol. content
2	Order number	12	Accumulator
3	Order item number	13	Maximum operating pressure
4	Year / calender week of construction	14	Inlet pressure
5	Motor power P2	15	Head at Q = 0
6	Operating voltage, frequency	16	Maximum head
7	Control voltage, frequency	17	Stop pressure
8	Nominal motor current	18	Start-up pressure
9	Wiring diagram number	19	Maximum flow rate
10	Pre-charge pressure		

## 4.5 Design details

### Design

- Fully automatic pressure booster package system
- Discharge-side, direct-flow membrane-type accumulator, approved for drinking water
- Pressure gauge

### Installation

- Stationary dry installation

### Drive

- Three-phase asynchronous squirrel-cage motor
- Efficiency class IE3 to IEC 60034-30
- 220 – 240 V / 380 – 420 V, 380 – 420 V / 660 – 720 V
- Enclosure IP55
- Thermal class F
- DOL starting up to and including 4 kW
- Star-delta starting  $\geq 5.5$  kW

### Automation

- Control unit for pressure-controlled starting and stopping
- Control unit (IP54 enclosure)
- LEDs indicate faults and lack of water
- Motor protection switch
- Manual-0-automatic selector switch
- Timer for 24-hour functional check run
- Terminal strip with markings for all connections
- Volt-free contacts for operation, fault, lack of water
- Lockable master switch (repair switch)

### 4.6 Configuration and function



**Fig. 3:** Illustration of the pressure booster system

1	Pump	4	Pressure gauge
2	Accumulator	5	Control unit
3	Check valve	6	Shut-off valve

**Design** The fully automatic pressure booster system is equipped with a non-self-priming vertical high-pressure pump (1) for pumping the fluid handled to the consumer installations in the set pressure range.

**Function** The pump set is started and stopped as a function of pressure via the electro-mechanical control system. If the pressure drops below the set start-up pressure  $p_E$ , the pump is started up via the pressure switch. When consumption decreases again, the pump set is stopped as a function of pressure after the set after-run period (up to 3 minutes). The integrated dry running protection is enabled in manual mode and automatic mode. In the event of dry running the pressure booster system stops after approx. 10 seconds (factory setting).



#### 4.7 Noise characteristics

For the noise characteristics refer to the operating manual of the pump (set).

#### 4.8 Scope of supply

Depending on the model, the following items are included in the scope of supply:




- Pressure booster system
  - 1 vertical Movitec high-pressure centrifugal pump
  - Discharge-side piping
  - Check valve
  - Shut-off valves
  - Discharge-side, direct-flow membrane-type accumulator
  - Pressure switch on the discharge side
  - Pressure gauge
  - Vibration damping
- Control unit
  - Power supply connection
  - Motor protection switch
  - Manual-0-automatic selector switch
  - Terminal strip with markings for all connections
  - Volt-free contacts for operation, fault, lack of water
  - Colour LED indicating lack of water (red)
  - Colour LED indicating a fault (amber)

#### 4.9 Dimensions and weights

For dimensions and weights refer to the outline drawing.

## 5 Installation at Site



### 5.1 Checks to be carried out prior to installation

	<p style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></p> <p><b>Installation on a mounting surface which is unsecured and cannot support the load</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class X0 to EN 206 .</li> <li>▷ The mounting surface must be set, even, and level.</li> <li>▷ Observe the weights indicated.</li> </ul>
	<p style="background-color: #0070c0; color: white; padding: 5px;"><b>NOTE</b></p> <p>The anti-vibration mounts provide adequate insulation against solid-borne noise.</p>
	<p style="background-color: #0070c0; color: white; padding: 5px;"><b>NOTE</b></p> <p>Do not operate the pressure booster system near living quarters and/or sleeping quarters.</p>

Before beginning with the installation check the following:

- All structural work required has been checked and prepared in accordance with the dimensions in the outline drawing.
- The data on the name plate of the pressure booster system has been checked. The pressure booster system must be suitable for operation on the available power supply network.
- The place of installation is frost-free.
- The place of installation can be locked.
- The place of installation is well-ventilated.
- A suitably dimensioned drain connection (e.g. leading to a sewer) is available.
- If expansion joints are used, take note of their creep resistance. Expansion joints must be easily replaceable.

### 5.2 Installing the pressure booster system

	<p style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></p> <p><b>Top-heavy pressure booster system</b> Risk of personal injury by pressure booster system tipping over!</p> <ul style="list-style-type: none"> <li>▷ Pressure booster systems awaiting final installation must be secured against tipping over.</li> <li>▷ Firmly anchor the pressure booster system.</li> </ul>
	<p style="background-color: #0070c0; color: white; padding: 5px;"><b>NOTE</b></p> <p>To prevent the transmission of piping forces and solid-borne noise, installing expansion joints with length-limiters is recommended.</p>

- ✓ The pressure booster system's packaging has been removed.
- ✓ A suitable installation site has been selected that meets the requirements.
- ✓ Sufficient clearance in all directions is provided for servicing work.
  1. Mark out the anchoring holes on the floor as shown in the outline drawing.
  2. Drill the holes (max. diameter: 12 mm).
  3. Insert plug fixings of appropriate size.
  4. Place the pressure booster system in its correct installation position.
  5. Use suitable bolts to firmly anchor the pressure booster system.

### 5.3 Mounting the accumulator

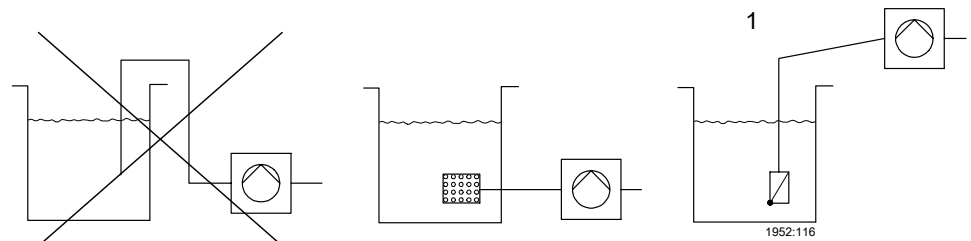
	<b>CAUTION</b>
	<p><b>Dirt in the pressure booster system</b>          Damage to the pump sets!</p> <p>▷ Clean the accumulator before filling it.</p>

✓ The original operating manual of the pressure booster system is on hand.

1. Mechanically and electrically connect the accumulator in accordance with the original operating manual supplied.

### 5.4 Connecting the piping

	<b>CAUTION</b>
	<p><b>Air pockets in suction line</b>          Pressure booster system cannot prime!</p> <p>▷ Lay the pipe with a continuously rising slope.</p>





**Fig. 4:** Correct piping connection

1	Suction lift operation
---	------------------------



1. Mechanically support the suction head line on site to provide for absorption of mechanical forces.
2. Install the piping without transmitting any stresses and strains.
3. Connect the piping to the distribution lines on the inlet side and discharge side.

5.4.1 Fitting an expansion joint (optional)

	<p><b>⚠ DANGER</b></p>
	<p><b>Sparks and radiant heat</b> Fire hazard!</p> <ul style="list-style-type: none"> <li>▷ Take suitable precautions to protect the expansion joint if any welding work is carried out.</li> </ul>
	<p><b>CAUTION</b></p>
	<p><b>Leaking expansion joint</b> Flooding of installation room!</p> <ul style="list-style-type: none"> <li>▷ Never use the expansion joint to compensate for misalignment or mismatch of the piping.</li> <li>▷ Do not apply any paint to the expansion joint.</li> <li>▷ Keep the expansion joint clean.</li> <li>▷ Regularly check for cracks or blisters, exposed fabric or other defects.</li> </ul>

- ✓ Sufficient clearance in all directions is provided for checking the expansion joint.
- ✓ The expansion joint is not insulated along with the pipeline insulation.
  1. Sufficient clearance in all directions is provided for checking the expansion joint.
  2. Install the expansion joint in the piping free of twist or distortion.
  3. Evenly tighten the bolts crosswise. The ends of the bolts must not protrude from the flange.

5.4.2 Fitting the pressure reducer (optional)

	<p><b>NOTE</b></p>
	<p>A pipe length of approximately 600 mm must be provided on the inlet side to accommodate a pressure reducer, if necessary.</p>
	<p><b>NOTE</b></p>
	<p>A pressure reducer must be installed if the inlet pressure fluctuation is too high for the pressure booster system to operate as intended or if the total pressure (inlet pressure and shut-off head) exceeds the design pressure.</p>

The inlet pressure ( $p_{inl}$ ) varies between 4 and 8 bar. A minimum pressure gradient of 5 m is required for the pressure reducer to function properly. This means that the pressure reducer must be mounted 5 m higher than the pressure booster system. The pressure drops by about 0.1 bar per metre of height difference. Alternatively, the pressure reducer can be subjected to a pressure of 0.5 bar.




**Example**  $p_{inl} = 4$  bar

Minimum pressure gradient = 5 m  $\pm$  0.5 bar

Downstream pressure: 4 bar - 0.5 bar = 3.5 bar.

- ✓ A minimum pressure gradient of 5 m is available.
  1. Install the pressure reducer in the pipe on the inlet side.

### 5.5 Electrical connection

	<p style="background-color: #e67e22; color: white; padding: 5px;"><b>⚠ DANGER</b></p> <p><b>Electrical connection work by unqualified personnel</b>            Danger of death from electric shock!</p> <ul style="list-style-type: none"> <li>▷ Always have the electrical connections installed by a trained and qualified electrician.</li> <li>▷ Observe regulations IEC 60364 .</li> </ul>
	<p style="background-color: #f1c40f; color: white; padding: 5px;"><b>⚠ WARNING</b></p> <p><b>Incorrect connection to the mains</b>            Damage to the power supply network, short circuit!</p> <ul style="list-style-type: none"> <li>▷ Observe the technical specifications of the local energy supply companies.</li> </ul>
	<p style="background-color: #2980b9; color: white; padding: 5px;"><b>NOTE</b></p> <p>Installing a motor protection device is recommended.</p>

#### Lightning protection

- Electrical installations must be protected against overvoltage (compulsory since 14 December 2018) (see DIN VDE 0100-443 (IEC60364-4-44:2007/A1:2015, modified) and DIN VDE 0100-534 (IEC 60364-5-53:2001/A2:2015, modified). Whenever modifications are made to existing installations, retrofitting a surge protective device (SPD) in accordance with VDE is mandatory.
- A maximum cable length of 10 metres should not be exceeded between the surge protective device (usually type 1, internal lightning protection) installed at the service entrance and the equipment to be protected. For longer cables, additional surge protective devices (type 2) must be provided in the sub-distribution board upstream of the equipment to be protected or directly in the equipment itself.
- The associated lightning protection concept must be provided by the operator or by a suitable provider commissioned by the operator. Surge protective devices can be offered for the control units on request.

#### Wiring diagram

The wiring diagrams are located in the control cabinet, which is where they must be stored.

The product literature of the switchgear and controlgear assembly supplied with the system includes a list of the electrical components installed. When ordering spare parts for electrical components, always indicate the number of the wiring diagram.

#### Terminal assignment

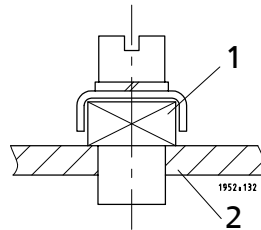
For the terminal assignment refer to the wiring diagram.

### 5.5.1 Sizing the power cable

Determine the cross-section of the power cable based on the total rated power required.

### 5.5.2 Connecting the pressure booster system

- ✓ The data on the name plate has been checked. The pressure booster system must be suitable for operation on the available power supply network.  
(⇒ Section 4.4, Page 14)
- ✓ The wiring diagram is available.
  1. Connect terminals L1, L2, L3, PE and N in accordance with the wiring diagram.
  2. Connect the potential equalisation conductor to the terminal on the baseplate marked with the earthing symbol.



**Fig. 5:** Connecting the potential equalisation conductor

1	Earthing terminal	2	Baseplate
---	-------------------	---	-----------

3. Connect the dry running protection device. (⇒ Section 5.5.3, Page 23)

### 5.5.3 Connecting the dry running protection device

- ✓ The original operating manual of the dry running protection device is on hand.
  1. Fit the dry running protection device in accordance with the supplied original operating manual. Connect it in the control unit in accordance with the supplied original operating manual.

## 6 Commissioning/Start-up/Shutdown

### 6.1 Commissioning/Start-up

#### 6.1.1 Prerequisites for commissioning/start-up

	<b>CAUTION</b>
	<p><b>Pump set running dry</b>            Damage to the pump set/pressure booster system!</p> <ul style="list-style-type: none"> <li>▷ Use dry running protection. If the dry running protection terminal is disabled by means of a bridge, the operator shall assume responsibility for any dry running that might occur.</li> </ul>

Ensure that the following requirements are met prior to commissioning/start-up:

- The pressure booster system has been properly connected to the electric power supply and is equipped with all protection devices.
- All relevant VDE standards and/or regulations applicable in the country of use are complied with.
- The dry running protection device has been installed. (⇒ Section 5.5.3, Page 23)

#### 6.1.2 Priming and venting the pressure booster system

	<b>CAUTION</b>
	<p><b>Foreign matter in the piping</b>            Damage to the pump / pressure booster system!</p> <ul style="list-style-type: none"> <li>▷ Before commissioning/starting up or functional check running the pressure booster system, make sure that there is no foreign matter in the pressure booster system or piping.</li> </ul>

	<b>CAUTION</b>
	<p><b>Operation without the fluid to be handled</b>            Damage to the pump sets!</p> <ul style="list-style-type: none"> <li>▷ Prime the pressure booster system with the fluid to be handled.</li> </ul>

	<b>NOTE</b>
	<p>Prior to its delivery, the pressure booster system will be tested hydraulically with water and then drained again. For technical reasons the presence of some residual water is unavoidable.</p> <p>Prior to commissioning/start-up observe EN 806. After prolonged standstill periods, flushing or professional disinfection is recommended. For extensive or branched piping systems, flushing the pressure booster system can be restricted to a limited area.</p>

	<b>NOTE</b>
	<p>Minor leakage of the mechanical seals during commissioning is normal and will cease after a short period of operation.</p>

Have commissioning carried out by specialist KSB staff.

- ✓ The original operating manual of the pump set is on hand.
- ✓ The pipe unions between the pump set and the piping have been re-tightened.
- ✓ Flange connections have been firmly tightened.



- ✓ The cooling air inlet openings and cooling air outlet openings at the motor are unobstructed.
- ✓ All shut-off valves are open.
- ✓ The pre-charge pressure of the accumulator has been checked.  
(⇒ Section 8.4, Page 33)
- ✓ The minimum flow rate has been observed. (⇒ Section 6.2.5, Page 28)
  1. Set the master switch to 0; unlock all motor protection switches (if applicable).
  2. Provide connection to power supply.
  3. Open the vent plugs at the pump set in accordance with the supplied original operating manual of the pump set.
  4. Slowly open the inlet-side shut-off valve and prime the pressure booster system until the fluid to be handled escapes through the vent holes.
  5. Close and slightly tighten the pump vent plugs.
  6. Switch on all motor protection switches.
  7. If fitted, set the manual-0-automatic selector switches to "automatic".
  8. Switch on the master switch.
  9. Open the discharge-side valve.
  10. When all pump sets have been run once, loosen the vent plugs again to let any remaining air escape while the pump is switched off.
  11. Close the vent plug.
  12. Check that the pump sets are running smoothly.
  13. Close the discharge-side valve in order to verify whether the pump sets reach the maximum shut-off head.
  14. Open the discharge-side valve.
  15. Set the dry running protection device.

**6.1.3 Setting the dry running protection device**

Dry running protection is provided in the form of a pressure switch. The dry running protection device is set to the values specified in the purchase order. If the settings do not match the site data, adjust the settings for dry running protection.


**Pressure switch**

- ✓ The original operating manual of the pressure switch is on hand.
  1. Undertake settings in accordance with the operating manual of the pressure switch.

**Table 6:** Recommended settings for pressure switches

Stop pressure	Start-up pressure
0.5 bar below $p_{inl}$	0.2 bar below $p_{inl}$

6.1.4 Start-up

	<b>NOTE</b>
	The pressure booster system is factory-set to the data indicated on the name plate.

**Standard design**

- ✓ The pressure booster system has been primed and vented.  
(⇒ Section 6.1.2, Page 24)
- 1. Switch on the master switch.
- ⇒ The green LED lights up and signals the system's readiness for operation.

**Additional instruments**

- ✓ The pressure booster system has been primed and vented.  
(⇒ Section 6.1.2, Page 24)
- 1. Set the manual-0-automatic selector switch to automatic.
- ⇒ The green LED lights up and signals the system's readiness for operation.

6.1.5 Checklist for commissioning/start-up

Table 7: Checklist

Steps to be carried out	Action	Done
1	Read the operating manual.	
2	Compare the power supply data against the name plate data.	
3	Check the earthing system/take measurements.	
4	Check the mechanical connection to the water mains. Re-tighten the flange and pipe unions.	
5	Prime and vent the pressure booster system from the inlet side.	
6	Check the inlet pressure.	
7	Check whether all cables are firmly connected to the terminals inside the control unit.	
8	Compare the settings of the motor protection switches with the name plate data and re-adjust if necessary.	
9	Check the start-up pressure and the stop pressure; re-adjust if necessary.	
10	Test the proper function of the dry running protection equipment. If not fitted, make a relevant note in the commissioning report.	
11	After the pump sets have been running for 5 to 10 minutes, vent them again.	
12	Set all switches to automatic.	
13	Check the pre-charge pressure.	
14	Enter any deviations from the name plate or order documentation in the commissioning report.	
15	Complete the commissioning report together with the operator/user and instruct the operator/user as to the function of the unit.	

### 6.2 Operating limits

	<b>⚠ DANGER</b>
	<p><b>Non-compliance with operating limits</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Comply with the operating data indicated in the data sheet.</li> <li>▷ Avoid operation against a closed shut-off element.</li> <li>▷ Never operate the pump set outside the limits specified below.</li> </ul>

	<b>⚠ DANGER</b>
	<p><b>Non-compliance with operating limits for the fluid handled</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Never use the pump to handle different fluids which might react chemically with each other.</li> <li>▷ Never use the pump to handle a flammable fluid with a fluid temperature above the ignition temperature.</li> </ul>

#### 6.2.1 Frequency of starts

To prevent high temperature increases in the motor and excessive loads on the pump, motor, seals and bearings, the frequency of starts shall not exceed the following number of starts per hour.

**Table 8:** Frequency of starts

Motor rating [kW]	Maximum frequency of starts [Starts/hour]
≤ 7,5	20
11 - 22	10
≥ 30	6

#### 6.2.2 Ambient conditions

Observe the following parameters and values during operation:

**Table 9:** Permissible ambient conditions

Ambient condition	Value
Ambient temperature	0 °C to +40 °C
Relative humidity	50 % maximum

#### 6.2.3 Maximum operating pressure

	<b>CAUTION</b>
	<p><b>Permissible operating pressure exceeded</b> Damage to connections and seals!</p> <ul style="list-style-type: none"> <li>▷ Never exceed the operating pressure specified in the data sheet.</li> </ul>

The maximum operating pressure equals 16, 25 or 40 bar, depending on the design variant.

### 6.2.4 Fluid handled

#### 6.2.4.1 Permissible fluids to be handled

- Clean fluids not chemically or mechanically aggressive to the pump materials
- Drinking water
- Service water
- Cooling water

#### 6.2.4.2 Fluid temperature

**Table 10:** Temperature limits of the fluid handled

Permissible fluid temperature	Value
Maximum	+70 °C
Minimum	0 °C

### 6.2.5 Minimum flow rate

**Table 11:** Minimum flow rate per pump in manual mode

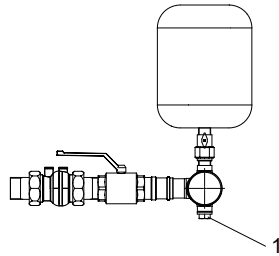
Size	Minimum flow rate per pump
	[l/h]
Movitec 2B	200
Movitec 4B	400
Movitec 6B	600
Movitec 10B	1100
Movitec 15C	1900
Movitec 25B	2800
Movitec 40B	4600
Movitec 60B	6100
Movitec 90B	8500
Movitec 125B	12500

### 6.3 Shutdown

#### 6.3.1 Shutdown

1. Set the manual-0-automatic selector switch to 0.

#### 6.3.2 Measures to be taken for shutdown




**Fig. 6:** Venting and draining the accumulator

1	Vent plug
---	-----------

- ✓ The pressure booster system has been switched off.
  1. Open vent plug 1 at the accumulator.
    - ⇒ The pressure booster system is being vented and drained.
  2. Close vent plug 1 at the accumulator.

## 7 Operation

	<b>CAUTION</b>
	<p><b>Incorrect operation</b> Damage to the pump system!</p> <ul style="list-style-type: none"> <li>▷ Make sure to comply with all local regulations, particularly the EC Machinery Directive and the EC Directive on Low-Voltage Equipment.</li> <li>▷ Check all electric cables prior to commissioning/start-up.</li> </ul>

### 7.1 LED display

The LED provides information on the operating status.

**Table 12:** LED description

LED	Description
Yellow	Fault
Red	Lack of water

### 7.2 Operating modes

#### 7.2.1 Manual mode

Manual mode is reserved for emergencies. Continuous manual operation would lead to waste of energy and water and cause the fluid handled and/or the pump set to overheat. A manual-automatic selector switch is provided at the switchgear and controlgear assembly. When the switch is set to **manual** the pump set is operated on the power supply network, independently of the automatic system (pressure switch).

#### 7.2.2 Functional check run

The switchgear and controlgear assembly contains a timer. During the functional check run the pump set is operated directly on the power supply network, independently of the automatic system (pressure switch). The functional check run parameters can be set via the timer (see supplied original operating manual).





### 7.3 Functions

#### 7.3.1 Dry running protection

A digital input is provided for connecting dry running protection equipment. When the input is open, the control unit detects dry running and stops the pressure booster system after approx. 10 seconds (factory setting).

## 8 Servicing/Maintenance

### 8.1 General information/safety regulations

	<p><b>⚠ DANGER</b></p> <p><b>Unintentional start-up of pressure booster system</b>            Danger to life!</p> <ul style="list-style-type: none"> <li>▷ De-energise the pressure booster system for any repair work or servicing work.</li> <li>▷ Ensure that the pressure booster system cannot be re-energised unintentionally.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Improper lifting/moving of heavy assemblies or components</b>            Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Unqualified personnel performing work on the pressure booster system</b>            Risk of personal injury!</p> <ul style="list-style-type: none"> <li>▷ Always have repair and maintenance work performed by specially trained, qualified personnel.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Incorrectly serviced pressure booster system</b>            Function of pressure booster system not guaranteed!</p> <ul style="list-style-type: none"> <li>▷ Regularly service the pressure booster system.</li> <li>▷ Prepare a maintenance schedule for the pressure booster system, with special emphasis on lubricants, shaft seals and pump couplings.</li> </ul>

The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.



- Observe the safety instructions and information.
- For any work on the pump (set) observe the operating manual of the pump (set).
- In the event of damage you can always contact KSB Service.
- A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation with a minimum of maintenance expenditure and work.
- Never use force when dismantling and reassembling the equipment.

### 8.2 Inspection contract

For inspection work and servicing work we recommend the KSB inspection contract. Contact your service partner for details.

### 8.3 Servicing/inspection

#### 8.3.1 Supervision of operation

	<b>CAUTION</b>
	<p><b>Increased wear due to dry running</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without liquid fill.</li> <li>▷ Never close the shut-off element in the suction line and/or supply line during pump operation.</li> </ul>
	<b>CAUTION</b>
	<p><b>Impermissibly high temperature of fluid handled</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).</li> <li>▷ Observe the temperature limits in the data sheet and in the section on operating limits.</li> </ul>

While the pump is in operation, observe and check the following:

- If activated, check the functional check run.
- Measure the actual start-up pressure and stop pressure of the pump sets with a pressure gauge. Compare the values with the specifications on the name plate.
- Compare the pre-charge pressure of the accumulator with the recommended data. (⇒ Section 8.4, Page 33)
- Check the rolling element bearings for running noises.  
Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Monitor the functions of auxiliary connections, if any.



#### 8.3.2 Maintenance schedule

**Table 13:** Overview of maintenance work

Maintenance interval	Servicing/maintenance work
At least once a year	Check the pump sets for smooth running and the mechanical seal for integrity.
	Check the shut-off elements, drain valves and check valves for proper functioning and tightness.
	If fitted, clean the strainer in the pressure reducer.
	If fitted, check the expansion joints for any wear.
	Verify the pre-charge pressure. Check the accumulator for integrity. (⇒ Section 8.4, Page 33)
	Check the automatic switching functionality.
	Check the cut-in levels and cut-out levels.
Check the inflow, inlet pressure, dry running protection, flow monitoring and pressure reducer.	



### 8.4 Setting the pre-charge pressure

	<b>⚠ WARNING</b>
	<b>Wrong gas</b> Danger of poisoning! ▷ Use only nitrogen as cushion gas of the membrane-type accumulator.
	<b>CAUTION</b>
	<b>Pre-charge pressure too high</b> Damage to the accumulator! ▷ Observe the manufacturer's product literature (see name plate or operating manual of the accumulator).

The accumulator's pre-charge pressure ( $p$ ) must be lower than the set start-up pressure ( $p_E$ ) of the pressure booster system.

The best storage volumes are achieved with the following settings (mean value):

- Value 0.9 at start-up pressure > 3 bar
- Value 0.8 at start-up pressure < 3 bar

**Example 1**  $p_E = 5$  bar

$$5 \text{ bar} \times 0.9 = 4.5 \text{ bar}$$

With a start-up pressure of 5 bar the pre-charge pressure of the accumulator must be 4.5 bar.

**Example 2**  $p_E = 2$  bar

$$2 \text{ bar} \times 0.8 = 1.6 \text{ bar}$$

With a start-up pressure of 2 bar the pre-charge pressure of the accumulator must be 1.6 bar.

#### Checking the pre-charge pressure

1. Close the shut-off elements fitted underneath the membrane-type accumulator.
2. Drain the membrane-type accumulator via the drain valve.
3. Remove and store the protective cap of the membrane-type accumulator valve.
4. Check the pre-charge pressure using suitable equipment (e.g. tyre pressure gauge).
5. Fit the protective cap of the membrane-type accumulator valve.

#### Filling the membrane-type accumulator

1. Remove and store the protective cap of the membrane-type accumulator valve.
2. Add nitrogen through the valve.
3. Fit the protective cap of the membrane-type accumulator valve.

## 9 Trouble-shooting

	<p><b>⚠ WARNING</b></p>
	<p><b>Improper work to remedy faults</b> Risk of injury!</p> <p>▷ For any work performed to remedy faults, observe the relevant information given in this operating manual and/or in the product literature provided by the accessories manufacturer.</p>
	<p><b>NOTE</b></p>
	<p>Please contact KSB Service before carrying out any work on the pump's internal parts during the warranty period. Non-compliance will lead to forfeiture of warranty cover and of any and all rights to claims for damages.</p>

If problems occur that are not described in the following table, consultation with the KSB service is required.

- A Pump cuts out shortly after start-up in manual mode. Red indicator lamp signals lack of water.
- B Pressure booster system does not start up.
- C Pump running but not delivering water.
- D Insufficient delivery of pressure booster system.
- E Discharge-side pressure too low.
- F Discharge-side pressure too high.
- G Leakage at mechanical seal.
- H Motor/pump overheated.
- I Motor protection switch triggered. Yellow indicator lamp is on.
- J Pump does not stop.
- K Pump starts too often (more than 30 starts per hour).

**Table 14: Trouble-shooting**

A	B	C	D	E	F	G	H	I	J	K	Possible cause	Remedy <sup>1)</sup>
-	-	X	X	-	-	-	X	-	X	-	Pump and/or piping are not completely vented or primed.	Vent and/or prime.
X	X	X	X	X	-	-	X	-	-	-	Shut-off valves fully or partially closed	Check, open as necessary.
X	-	-	X	X	-	-	-	-	X	-	Strainer is clogged.	Clean.
-	-	X	X	X	X	-	-	-	-	-	Suction-side shut-off valve closed	Check, open as necessary.
-	-	-	-	-	-	-	X	-	X	-	Discharge-side shut-off valve closed or defective	Check, open as necessary.
X	-	-	X	X	-	-	X	-	X	-	Inlet pressure lower than specified in purchase order	Contact the manufacturer.
-	X	-	-	-	X	-	-	-	-	-	Inlet pressure higher than specified in purchase order	Contact the manufacturer.
-	-	-	-	-	-	-	-	-	X	-	Start-up pressure set too high	Check setting.
-	-	-	-	-	-	-	X	-	-	X	Pre-charge pressure of accumulator too low	Restore nitrogen cushion.
-	-	-	-	-	-	-	X	-	-	X	Defective accumulator	Check integrity. Replace if necessary.
-	-	-	-	-	-	X	-	-	-	-	Defective mechanical seal	Replace the mechanical seal.
X	-	-	-	-	-	-	-	-	-	-	Suction-side pressure switch set incorrectly or defective	Check setting.

<sup>1)</sup> Before any work on pressure-retaining components, release the pump set pressure and de-energise the pump set.

A	B	C	D	E	F	G	H	I	J	K	Possible cause	Remedy <sup>1)</sup>
-	-	X	X	X	-	-	X	X	X	-	Defective check valve in the pressure booster system	Check. Replace sealing element if necessary.
-	-	-	-	X	-	-	-	X	X	X	Water extraction higher than specified in purchase order	Contact the manufacturer.
-	-	-	-	-	-	-	-	X	-	-	Motor protection switch has tripped, is set incorrectly and/or pump is blocked.	Compare setting against name plate data.
-	-	-	-	-	-	-	-	-	-	X	Set delay too short	Check setting.
-	X	-	-	-	-	-	-	-	-	-	Power supply interrupted	Check power cable. Remedy defect. Check fuse.
-	X	-	-	-	-	-	-	X	-	-	Main fuse on (owner-supplied) distribution board loose or blown; fuses possibly too small or too fast	Check fuses. Replace them if required. Check motor current.
-	X	-	-	-	-	-	-	-	-	-	Phase failure	Check phases. Replace fuse if necessary.
X	-	-	-	-	-	-	-	-	-	-	Inlet tank empty / Float switch defective or not connected	Check. Remedy defect as applicable.

## 10 Related Documents

### 10.1 General arrangement drawings with list of components

#### 10.1.1 DeltaSolo D with Movitec 2, 4, 6, 10, 15

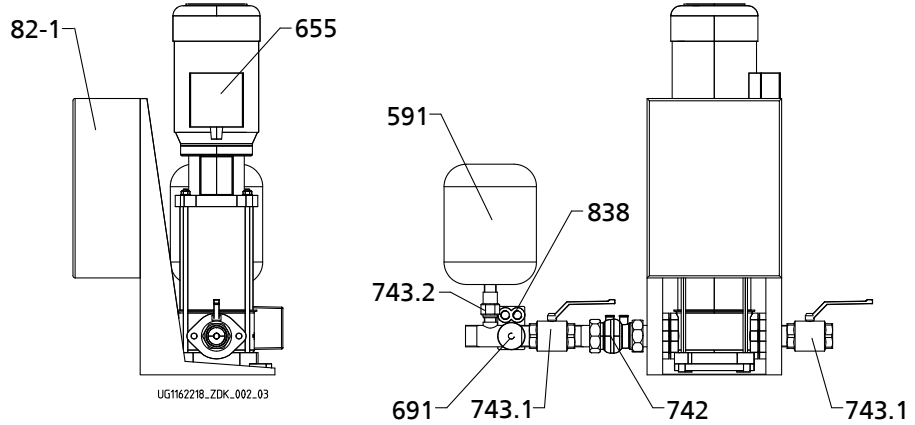


Fig. 7: General assembly drawing of DeltaSolo D with Movitec 2, 4, 6, 10

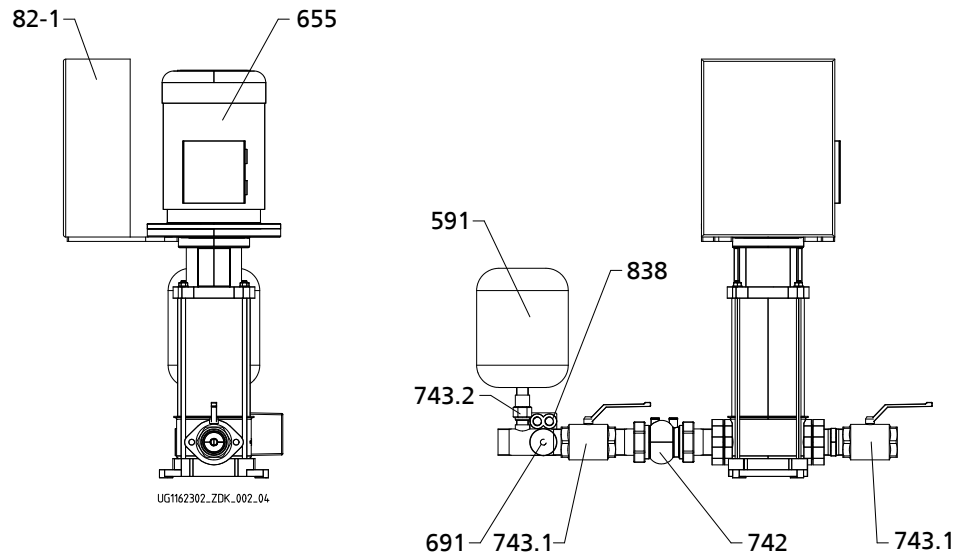



Fig. 8: General assembly drawing of DeltaSolo D with Movitec 15

Table 15: Spare parts for DeltaSolo D with Movitec 2, 4, 6, 10, 15

Part No.	Description	Ident. No.
591	Accumulator	01 079 764
655	Pump	
691	Pressure gauge, discharge side	00 401 413
742	Lift check valve 1 (Movitec 2, 4)	01 149 253
742	Lift check valve 1 1/4 (Movitec 6)	01 149 254
742	Lift check valve 1 1/2 (Movitec 10)	01 149 255
742	Lift check valve 2 (Movitec 15)	01 149 256
743.1	Ball valve 1 (Movitec 2, 4)	01 057 427
743.1	Ball valve 1 1/4 (Movitec 6)	01 057 428
743.1	Ball valve 1 1/2 (Movitec 10)	01 057 429
743.1	Ball valve 2 (Movitec 15)	01 057 430
743.2	Ball valve (make Reflex)	01 079 765
82-1	Control unit	On request
838	Pressure switch MCS 22	01 049 356

For electric parts refer to the circuit diagram in the Annex.

	<b>NOTE</b>
	Pump spare parts correspond to Movitec in standard design (with oval flange).

10.1.2 DeltaSolo D with Movitec 25, 40, 60, 90

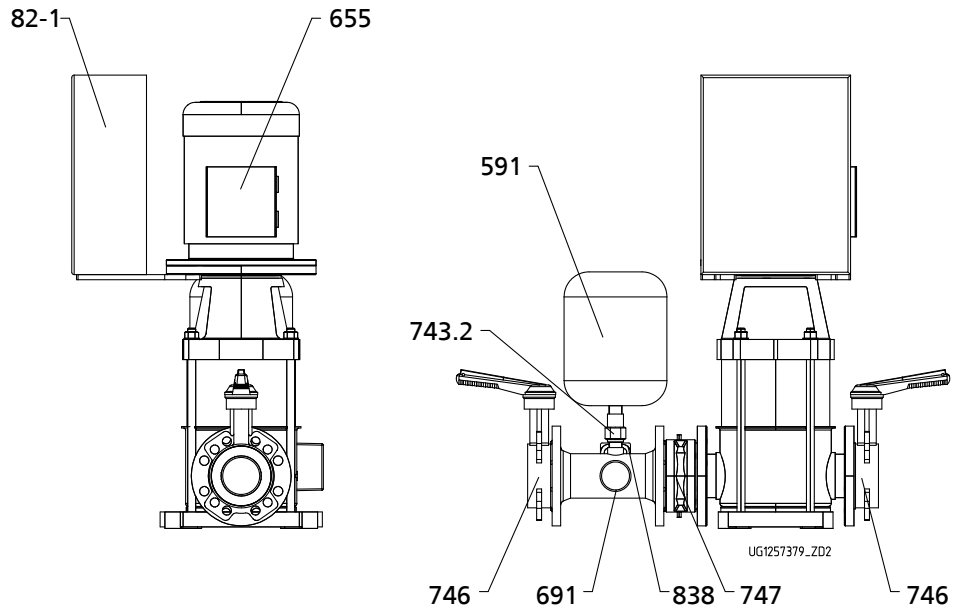



Fig. 9: General assembly drawing of DeltaSolo D with Movitec 25, 40, 60, 90

Table 16: Spare parts for DeltaSolo D with Movitec 25, 40, 60, 90

Part No.	Description	Ident. No.
591	Accumulator	01 079 764
655	Pump	
691	Pressure gauge, discharge side	00 401 413
743.2	Ball valve (make Reflex)	01 079 765
746	Butterfly valve DN 65 (Movitec 25)	40 982 350
746	Butterfly valve DN 80 (Movitec 40)	40 982 351
746	Butterfly valve DN 100 (Movitec 60, 90)	40 982 352
747	Swing check valve DN 65 (Movitec 25)	01 086 243
747	Swing check valve DN 80 (Movitec 40)	01 056 931
747	Swing check valve DN 100 (Movitec 60, 90)	01 087 142
82-1	Control unit (not shown)	On request
838	Pressure switch MCS 22	01 049 356

For electric parts refer to the circuit diagram in the Annex.

Non-documented parts on request (please indicate serial No. or order No.)

	<b>NOTE</b>
	Pump spare parts correspond to Movitec in standard design (with round flange).

## 11 EU Declaration of Conformity

Manufacturer: **KSB SE & Co. KGaA**  
**Johann-Klein-Straße 9**  
**67227 Frankenthal (Germany)**

The manufacturer herewith declares that the product:

### DeltaSolo D

KSB order number: .....

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
  - Pump set: 2006/42/EC Machinery Directive
  - 2011/65/EU: Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

The manufacturer also declares that

- the following harmonised international standards<sup>2)</sup> have been applied:
  - ISO 12100
  - EN 809
- Applied national technical standards and specifications, in particular:
  - DIN 1988-500

Person authorised to compile the technical file:

Name  
Function  
Address (company)  
Address (street, No.)  
Address (post or ZIP code, city) (country)

The EU Declaration of Conformity was issued in/on:

Place, date

.....<sup>3)</sup>.....

Name  
Function  
Company  
Address

---

<sup>2</sup> Apart from the standards listed here referring to the Machinery Directive, further standards are observed for explosion-proof versions (ATEX Directive) as applicable and are listed in the legally binding EU Declaration of Conformity.

<sup>3</sup> A signed, legally binding EU Declaration of Conformity is supplied with the product.

---

### 12 Certificate of Decontamination

Type: .....

Order number /  
Order item number<sup>4)</sup>: .....

Delivery date: .....

Application: .....

Fluid handled<sup>4)</sup>: .....

Please tick where applicable<sup>4)</sup>:



Corrosive



Oxidising



Flammable



Explosive



Hazardous to health



Seriously hazardous to health



Toxic



Radioactive



Bio-hazardous



Safe

Reason for return<sup>4)</sup>: .....

Comments: .....

The product / accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch / placing at your disposal.

We herewith declare that this product is free from hazardous chemicals and biological and radioactive substances.

For mag-drive pumps, the inner rotor unit (impeller, casing cover, bearing ring carrier, plain bearing, inner rotor) has been removed from the pump and cleaned. In cases of containment shroud leakage, the outer rotor, bearing bracket lantern, leakage barrier and bearing bracket or intermediate piece have also been cleaned.

For canned motor pumps, the rotor and plain bearing have been removed from the pump for cleaning. In cases of leakage at the stator can, the stator space has been examined for fluid leakage; if fluid handled has penetrated the stator space, it has been removed.

- No special safety precautions are required for further handling.
- The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....  
.....

We confirm that the above data and information are correct and complete and that dispatch is effected in accordance with the relevant legal provisions.

.....  
Place, date and signature

.....  
Address

.....  
Company stamp

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<sup>4</sup> Required field

### 13 Commissioning Report

The pressure booster system specified below has been commissioned today by the undersigned, authorised KSB Service who created this report.

**Pressure booster system details**

Type series .....  
 Size .....  
 Serial number .....  
 Order No. ....

**Purchaser/place of installation**

<b>Purchaser</b>	<b>Place of installation</b>
Name .....	.....
Address .....	.....
.....	.....

**Operating data** For further data refer to the wiring diagram.

Start-up pressure  $p_E$  bar .....

Inlet pressure monitoring  $p_{inl} - x$  .....  
 (setting of inlet pressure switch)

Stop pressure  $p_A$  bar .....

Inlet pressure  $p_{inl}$  [bar] .....

Pre-charge pressure of accumulator  $p_{pre-charge}$  [bar] .....

The operator or operator’s representative herewith confirms to have received instructions on how to operate and service the pressure booster system. The relevant circuit diagrams and operating instructions have been handed over.

<b>Non-conformities found during commissioning</b>	<b>Deadline for remedial action</b>
Non-conformity 1.....	.....
.....	.....
.....	.....
.....	.....
Name of KSB representative .....	Name of purchaser or representative .....
Place .....	Date .....
.....	.....



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