SINGLE STAGE DOUBLE SUCTION
SPLIT CASING CENTRIFUGAL PUMP

TYPE: CSCM
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0 General
This pump/unit has been developed in accordance with state-of-the-art technology; it is manufactured with utmost care and subject to continuous quality control.

These operating instructions are intended to facilitate familiarization with the pump and its designated use. The manual contains important information for reliable, proper and efficient operation. Compliance with the operating instructions is of vital importance to ensure reliability and a long service life of the pump. These operating instructions do not take into account local regulations; the operator must ensure that such regulations are strictly observed by all, including the personnel called in for installation.

This pump/unit must not be operated beyond the limit values specified in the technical documentation for the medium handled, capacity, speed, density, pressure, temperature and motor rating. Make sure that operation is in accordance with the instructions laid down in this manual or in the contract documentation.

The name plate indicates the model, size, main operating data and serial number; please quote this information in all correspondence, particularly when ordering spare parts. If you need any additional information or instructions exceeding the scope of this manual or in case of damage please contact Crane’s nearest customer service center.

0.0 Safety
These operating instructions contain important information which must be complied with during installation, operation and maintenance. Therefore this operating manual must be read and understood both by the installing personnel and the responsible trained personnel/operators prior to installation and commissioning, and it must always be kept close to the location of operation of the machine/unit far easy access. Not only must the general safety instructions in this chapter on "Safety" be complied with, but also the safety instructions outlined under specific headings.

0.1 Marking of Instructions in the Manual
The safety instructions contained in this manual whose non-observance might cause hazards to persons are specially marked with the general hazard sign.

The electrical danger warning sign is safety sign.

The word “Caution” is used to introduce safety instructions whose non-observance may lead to damage to the machine and its functions.

Instructions attached directly to the machine, e. g.
- arrows indicating the direction of rotation
- markings for fluid connections must always be complied with and be kept in perfectly legible condition at all times.

0.2 Personnel Qualification and Training
All personnel involved in the operation, maintenance, inspection and installation of the machine must be fully qualified to carry out the work involved.

Personnel responsibilities, competence and supervision must be clearly defined by the operator. If the personnel in question is not already in possession of the requisite know-how, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer/supplier to take care of such training.

In addition, the operator is responsible for ensuring that the contents of the operating instructions are fully understood by the responsible personnel.

0.3 Non-compliance with Safety Instructions
Non-compliance with safety instructions can jeopardize the safety of personnel, the environment and the machine itself. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages.

In particular, noncompliance can, for example, result in:
- failure of important machine/unit functions
- failure of prescribed maintenance and servicing practices
- hazard to persons by electrical, mechanical and chemical effects
- hazard to the environment due to leakage of hazardous substances.

0.4 Safety Awareness
It is imperative to comply with the safety instructions contained in this manual, the relevant national health and safety regulations and the operator’s own internal work, operation and safety regulations.

0.5 Safety Instructions for the Operator/User
- Any hot or cold components that could pose a hazard must be equipped with a guard by the operator.
- Guards which are fitted to prevent accidental contact with moving parts (e. g. coupling) must not be removed whilst the machine is operating.
- Leaks (e. g. at the shaft seal) of hazardous media handled (e.g. explosive, toxic, hot) must be contained so as to avoid any danger to persons and the environment. Pertinent legal provisions must be adhered to.
- Electrical hazards must be eliminated. (in this respect refer to the relevant safety regulation applicable to different countries and/or the local energy supply companies.)

0.6 Safety Instructions for Maintenance, Inspection and Installation work
The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.
Work on the machine must be carried out only when the pump is not in operation. The shutdown procedure described in the manual for taking the machine out of service must be adhered to. Pumps handling media hazardous to health must be decontaminated. Immediately following completion of the work, all safety-relevant and protective devices must be reinstalled and/or re-activated. Please observe all instructions set out in the chapter on “Commissioning” before returning the machine to service.

0.7 Unauthorized Modification and Manufacture of Spare Parts
Modifications or alterations of the machine are only permitted after consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer ensure safety.

0.8 Unauthorized Modes of Operation
The warranty relating to the operating reliability and safety of the pump/unit supplied is only valid if the machine is used in accordance with its designated use and if all operating instructions described in chapter 1 have been followed. The limits stated in the data sheet must not be exceeded under any circumstances.

1.0 Transport and Interim Storage

1.1 Safety Instructions
Transport of the unit requires proper preparation and handling. Observe the following explanations and safety instructions.

1.2 Transport
Transport in horizontal position is recommended in all cases, since this ensures stable positioning the unit without any risk of accident, whatever method of transport is used, e.g., road, rail or, ship etc. For transport purpose the unit should be secured on suitable pallets or sleds. All loose and movable parts must be secured.

1.2.1 Lifting the Pump Unit by Crane
The motor lifting lugs must only be used for lifting the motor alone and never for lifting the complete unit.

When lifting the unit by crane, observe the directions of pull. Angles greater than 90° are forbidden. Use separate belts on each side!

The drawings below show the correct lifting method by a crane.
2.0 Description of the Product and Accessories

2.1 Technical specification
The pump is a horizontally installed, single-stage, axially split case pump with double-entry radial impeller. Connection flanges are manufactured according to DIN, ISO, BS or ANSI, as preferred.

Pumps are used in waterworks, irrigation and drainage pumping plants, power stations, industrial water supply, air conditioning systems, dock installations, fire extinguishing systems and many other areas.

2.2 Designation

<table>
<thead>
<tr>
<th>Series</th>
<th>CSCM xxx - xxx - xxx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction nozzle in mm</td>
<td></td>
</tr>
<tr>
<td>Discharge nozzle in mm</td>
<td></td>
</tr>
<tr>
<td>Nominal impeller dia. in mm</td>
<td></td>
</tr>
</tbody>
</table>

2.3 Design Details

2.3.1 Pump Casing
Axially split volute casing with replaceable wear rings. Suction and discharge nozzles in lower half of casing are at the same level (inline).

2.3.2 Impeller
The double-entry radial impeller is manufactured for the operating data provided in each case. Impeller wear rings are available on request. In double-entry radial impellers the axial thrust is largely balanced.

2.3.3 Pump Shaft
The shaft is fully sealed against the liquid being pumped. Shaft-protecting sleeves are fitted in the seal area.

2.3.4 Shaft Seal
The shaft seal at the drive end of internal bearing end is designed as described in the “Shaft Seal” operating instructions.

2.3.5 Bearings and Lubrication
The pump is fitted with the bearing and lubrication system stated in the design and operating data. The fixed bearing at the internal bearing end is located on a sleeve to permit rapid changing without removing the rotor or upper half.

2.4 Type of Installation
The pump is installed in horizontal position. See “Installation” operating instructions.

2.5 Attachment
The accessories supplied with the pump are specified in the relevant individual operating instructions.

2.6 Dimensions and Weights
For dimensions and weights please refer to the pump installation drawing.

3.0 Installation at Site

3.1 Safety Regulations

Electrical equipment operated in hazardous locations must comply with the explosion protection regulations. This is indicated on the motor rating plate.

If the equipment is installed in hazardous locations, the applicable local explosion protection regulations and the regulations of the test certificate supplied with the equipment and issued by the responsible approval authorities must be observed and complied with. The test certificate must be kept close to the location of operation for easy access (e.g. foreman’s office).

3.2 Checks to be carried out prior to installation
All structural work required must have been prepared in accordance with the dimensions stated in the dimension table/installation plan. The concrete foundations shall have sufficient strength (min. BN 150) to ensure safe and functional installation in accordance with DIN 1045 or equivalent standards. Make sure that the concrete foundation has set firmly before placing the unit on it. Its surface should be truly horizontal and even.

3.3 Installing the Pump/Unit
See Operating Instructions” Installation”.

CAUTION
Before setting up the pump, check the operating data. Ensure that the data on the name plate agrees with the data in the order and the system data, e.g. operating voltage, frequency, pumped liquid temperature, etc.

3.3.1 Aligning the Pump/Drive
To align the unit, refer to the sections, “Coupling” and “Installation”.

CAUTION
Improper alignment of the unit can cause damage to both the coupling and the unit itself!

3.4 Connecting the Piping

CAUTION
Never use the pump itself as an anchorage point for the piping. Suction lift lines should be laid with a rising slope towards the pump and suction head lines with a downward slope towards the pump. The pipelines should be anchored in close proximity to the pump and should be connected without transmitting any stresses or strains to the pump. Their weight must not exert any load on the pump. With short pipelines, the nominal diameters should be at least equal to the nominal diameters of the pump Nozzles. For long pipelines the most economical nominal diameter has to be determined from job to job.

Any additional loads on the discharge and suction nozzles, e.g. caused by:
Weight of the water-filled pipes, changes in the length of pipes owing to temperature fluctuations, reactive forces due to unbraced compensators must not exceed the stated values.

CAUTION
An excessive, impermissible increase in the pipeline forces may cause leaks on the pump where the medium handled can escape into the atmosphere.
The flange covers on the pump suction and discharge nozzles must be removed prior to connection to the piping.

3.4.1 Auxiliary Connections
The dimensions and locations of the auxiliary connections (cooling, heating, sealing liquid, flushing liquid, etc.) are indicated on the installation plan or piping layout. More detailed installation instructions are given in the respective operating instructions.

**CAUTION** These connections are required for proper functioning of the pump and are therefore of vital importance!

3.4.2 Coupling Guard

*In compliance with the accident prevention regulations the pump must not be operated without a coupling guard. If the customer specifically requests not to include a coupling guard in our delivery, then the operator must supply one.*

3.5 Final Check

Re-check the alignment as described in section 3.3.2. It must be easy to rotate the shaft by hand at the coupling.

**CAUTION** Check the integrity and proper functioning of all connections.

4.0 Commissioning, Start-up / Shutdown

Compliance with the following requirements is of paramount importance. Damage resulting from non-compliance will void the warranty.

4.1 Commissioning

Before starting up the pump make sure that the following requirements have been checked and fulfilled:

- Has the pump been firmly bolted to the base/ foundation?
- Have the coupling and pump unit been aligned as specified?
- Are the pipes properly fitted?
- Has the motor been installed according to its operating instructions?
- Can the unit be easily rotated by hand at the coupling? (Carry out at least one full rotation).
- Has the coupling guard been fitted?
- Have the staff been informed about sources of danger and measures taken to comply with the accident prevention regulations?
- Is the unit protected against overload (appropriate safety valve)?
- Have the seals been fitted according to their operating instructions?
- Have - any additional devices been prepared and fitted according to their operating instructions?
- Has lubrication been provided for oil-lubricated bearings?
- Has the pump been vented as specified in section 4.3?

4.2 Shaft Seal

If the pump has been out of operation for a prolonged period, the measures specified in section 4.6 must be carried out.

4.3 Venting

Before the pump is started up, the pump and the pipes must be vented and filled with the liquid to be pumped. In the case of both gravity feed and suction operation, venting must be carried out via the hole on the upper suction elbow. In the case of suction operation the pump must additionally be evacuated (a vacuum must be created).

4.4 Commissioning

4.4.1 Checking the Direction of Rotation

**CAUTION** For trouble-free operation of the pump, the correct direction of rotation of the impeller is of paramount importance. If running in the wrong direction of rotation, the pump cannot reach its duty point; this will also result in vibration and overheating. The pump or the shaft seal might be damaged.

Correct direction of rotation:
The direction of rotation must correspond to the direction indicated by the arrow on the pump. This can be verified by switching the pump on and then off again immediately.

*Before checking the direction of rotation make sure that there is no foreign matter in the pump casing. Never put your hands or any other objects into the pump!*

4.4.2 Start-Up

**CAUTION** Dry - running will result in increased wear and must be avoided.

If a non-return valve is not fitted at the discharge end, close the delivery gate valve. If a shut-off valve is fitted at the suction end, open it fully. All additional connections for cooling, heating, lubrication, irrigation or sealing liquid etc, if fitted, must be opened fully or switched on and the flow must be checked. Switch on the motor. As soon as the pump starts, slowly open the delivery gate valve until the desired pressure is reached.

**CAUTION** The pump may operate against the closed gate valve only during start-up and shutdown, or else inadmissible temperature rise occurs resulting in damage. Never operate the pump for prolonged period of time at shut-off.

4.4.3 Pump Operating Range

The flow rate “Q” adjusts itself automatically to the delivery head according to the Q - H characteristic. The pumps permitted operating range is restricted to a certain range.

1. Partial load operating limit with low flow rate. This limit is indicated in the Q - H characteristic by Q min or by the continuation of the characteristic which is not depicted.

**CAUTION** It is not permissible to operate the pump in the range from Q = 0 to Q min, prolonged operation as this causes greatly increased mechanical loads which components cannot withstand. Brief passage through the critical range is permissible, e. g. during start-up.

2. NPSH - related limits in the partial load and overload ranges.
These two limits are determined by the ratio of NPSHr to NPSHa. They are calculated as follows:

The intersections of NPSHr and NPSHa are projected onto the Q - H characteristic, where they give the operating limits (refer to the diagram below). Checking of the NPSHr operating limit is not necessary for operating the pump under design conditions. If system-related changes occur, an NPSH check must be carried out. If necessary, consult the nearest Crane representative.

4.4.4 Shutdown

Close the shut-off valve in the discharge line. If the discharge line is equipped with a check valve, the shut-off valve may remain open, provided there is back pressure in the line.

The shut-off valve in the suction line must not be closed when switching off the pump. Switch off the motor, making sure that the unit runs smoothly down to a standstill. Depending on the system, the pump should have an adequate after run period with the heat source switched off to allow the medium handled to cool down sufficiently to avoid any heat build-up within the pump.

In the case of prolonged shutdown, the shut-off valve in the suction line has to be closed. Close the auxiliary connections. The shaft seal in pumps where the liquid is fed in under vacuum must also be lubricated with sealing liquid during standstill. In the event of frost and/or prolonged shutdowns, the pump and if applicable the cooling chambers must be drained or otherwise protected against freezing.

4.5 Shutdown/ Storage /Preservation

Each Crane pump leaves the factory carefully assembled. If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump storage.

4. 5. 1 Storage of New Pumps

New pumps are supplied by our factory duly prepared for storage. Maximum protection for up to 12 months, if the pump is properly stored indoors. Store the pump in a dry location.

4. 5. 2 Measures to be taken for prolonged shutdown

1. The pump remains installed; periodic check of operation: In order to make sure that the pump is always ready for instant start-up and to prevent the formation of deposits within the pump and the pump intake area, start up the pump set regularly once a month or once every 3 months for a short time (approx. 5 minutes) during prolonged shutdown periods. Prior to an operation check run ensure that there is sufficient liquid available for operating the pump.

2. The pump is removed from the pipe and stored: Before putting the pump into storage carry out all checks specified in sections 5.1 to 5.4: Spray-coat the, inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative. Spray the preservative through the suction and discharge nozzles. It is advisable to close the nozzles (for ex. with plastic caps).

4.6 Returning to service after storage

Before returning the pump to service carry out all checks and maintenance work specified in sections 5.1 and 5.2.

In addition, the instructions laid down in section 4.1 “Commissioning” and section 4. 4. 3 Operating limits must be observed.

Upon completion of the work, all safety-related and protective equipment must be properly refitted and/or reactivated before starting the pump set.

5.0 Maintenance/ Repair

5.1 General Instructions

The operator is responsible for ensuring that maintenance, inspection and installation work is carried out by authorized, duly qualified person who is thoroughly familiar with these operating instructions.

A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free reliable operation of the pump with a minimum of maintenance expenditure and work.

Work on the unit must only be carried out after the power has been switched off. Make sure that the pump set cannot be switched on accidentally.

Pumps handling liquids posing health hazards must be decontaminated. When draining the medium see to it that there is no risk to persons or the environment. All relevant laws must be adhered to.

5.2 Maintenance/ Inspection

5.2.1 Supervision of Operation

The pump should run quietly and free from vibrations at all times. The pump must never be allowed to run dry.
5.3.2 Preparations for Dismantling

Please observe the "Coupling" Operating Instructions. The pump is designed so that the complete rotor can be removed in the sequence described below without removing the suction or discharge pipe or disturbing the alignment of the pump unit:

Close the suction and delivery gate valves and drain the pump by opening the drain plug and vent plug.
Remove any pipes between additional equipment and the pump.
Remove coupling guard.
Detach the pump-side coupling half as described in the Operating Instructions “Coupling”.
Loosen and push back the seal cover.
Undo flange screws and release the upper casing half from the lower casing half with the aid of the forcing screws.
Remove with lifting gear and store in a safe place. The interior of the pump is then free (impeller with casing wear rings, shaft seals) for inspection and further disassembly.
In case of oil-lubricated pumps, drain off the oil. Remove the screw connection between bearing housing and bearing brackets. Also undo the nuts and bolts which secure the bearing cover.

Press the bearing housing out of the recesses and lift the rotor upwards out of the lower casing half. For further disassembly, place securely in horizontal position. Pull off the bearing housing of the fixed bearing (opposite the drive end). Undo and twist off the grooved nut. Remove the deep groove ball bearing with bushing from the shaft. Remove bearing cover. Remove V-Ring from shaft protecting sleeve. Remove shaft seal housing. Pull off shaft protecting sleeve.

The impeller is located with sliding fit on the shaft and can normally be removed easily. In case of difficulty, it can be loosened by gently tapping with a plastic hammer.
Remove second shaft protection sleeve complete with the shaft seal housing, if fitted. Remove coupling half. Pull off bearing housing. Remove circlip and pull off deep groove ball bearing.

5.4 Reassembly

Reassembly should be carried out in reverse order to dismantling. For all work on the pump unit the general diagram, in conjunction with the individual parts list, serves as a guide.

The customary rules of mechanical engineering and also the installation instructions for removal and installation of shaft seal, bearing, impeller wear rings and casing wear rings sections must be observed. In the case of oil lubricated bearings, the Operating Instructions “Oil lubricated bearings” must be observed.

For the required tightening torques please refer to works standard ZN 192 unless otherwise specified. It is essential to use the correct tightening torques and the required screw locking devices. The relevant parts are specially indicated in the general drawing.

The symbols for screw locking devices and sealing elements are explained in BN 433.
O-rings and V-rings must be replaced and their seats on the shaft must be cleaned. In addition, all the sealing elements must be fitted into the components provided for this purpose before installation.
For assembling the rotor, position the pump shaft securely. All fits, threads and sliding fits of the shaft must be cleaned and coated with assembly sealant. Insert the keys required for assembly into the pump shaft. Mount the impeller, which has a sliding fit. When fitting the impeller, observe the direction of rotation (see diagram below).

For assembling the casing wear rings, observe item 7.4.2 “Changing the casing wear rings”. Put the casing wear rings onto the running surfaces of the rotor. Ensure that the bevels of the rings are on the outside (towards the bearing). Insert the pins required for fixing the casing wear rings.

The remaining components are fitted first on the movable bearing side (i.e. the drive motor side) of the pump shaft. Push the shaft protecting sleeve onto the pump shaft. Ensure that the groove provided engages in the key of the impeller. Push the complete housing shaft seal see Operating Instructions “Shaft seals”, V-Ring over the pump shaft. Push the bearing cover over the shaft. Heat the deep grooved ball bearing and fit it onto the pump shaft. It is essential to avoid one sided pressure, e.g. hammer blows, on the outer rings. The bearing is secured by the disc and the securing ring.

To fit the shaft protecting sleeve, shaft seal housing, V-Ring and bearing cover at the interior bearing end, proceed as described above for the drive motor side. Heat the deep groove ball bearing and fit it onto the sleeve. Push the sleeve with deep groove ball bearing onto the pump shaft with key inserted.

Tension the rotor parts elastically with groove nut and disc spring. For this purpose tension the disc spring to blocking point and then undo the grooved nut again by half a turn.

⚠️ CAUTION This measure is essential to compensate for differences in thermal expansion between pump shaft and the components fitted on it.

Fitting of the rotor is then complete. Insert the rotor into the pump casing. Apply liquid sealant (refer to the appended list) to the surfaces of the casing wear rings and the sealing faces of the casing.
5.6 Spare Parts

5.6.1 Purchasing of Spares
The following information is required for ordering (see manufacturer’s nameplate or refer to the information given in the design and operating data sheets):
Model; serial number of pump; year of manufacture.
The required parts should be specified as follows (see general drawing and spares list).

Example:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Material</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bearing</td>
<td>ST</td>
<td>121</td>
</tr>
</tbody>
</table>

5.6.2 Proposal for Spares

5.6.2.1 Recommended Spare Parts
Recommended spare parts stock for 2 years operation to VDMA24296
(also for continuous operation)

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Part Description</th>
<th>Number of pumps (included stand by pumps)</th>
<th>Number of spare parts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>117</td>
<td>Impeller</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>118</td>
<td>Casing wear ring</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>117.1</td>
<td>Impeller wear ring</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Shaft with keys and shaft nuts</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>121</td>
<td>Anti-friction bearing</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>119</td>
<td>Shaft protecting sleeve</td>
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<td>4</td>
</tr>
<tr>
<td>128A</td>
<td>Packing ring</td>
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<td>Set of seals</td>
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<td>128B</td>
<td>Mechanical Rotating seal ring</td>
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<td></td>
<td>seal:</td>
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<td>Stationary seal ring</td>
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<td></td>
<td>O-rings</td>
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<td>6</td>
</tr>
<tr>
<td></td>
<td>Seals on stationary rings</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Set of springs</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
### 6.0 Trouble Shooting

#### 6.1 General

The diagram is to facilitate understanding the causes of faults and their remedies.

The cause of many operating faults on pumps is often hydraulic. The hydraulic behavior of a pump is illustrated by its characteristic curves $H$, $P$, $\eta$ and NPSH in combination with the plant characteristic curves $H_A$ and the point of intersection with pump curve $H$. The duty point $B$ is where the system curve $H_A$ and the pump curve $H$ intersect. If it is not possible to determine the cause of the trouble, contact a Crane representative.

#### 5.6.2.2 Interchangeability of Rotor Components

<table>
<thead>
<tr>
<th>Pump sizes</th>
<th>Pump Shaft Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td>125 - 80 - 210</td>
<td>*</td>
</tr>
<tr>
<td>125 - 80 - 270</td>
<td>*</td>
</tr>
<tr>
<td>125 - 80 - 370</td>
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</tr>
<tr>
<td>150 - 100 - 250</td>
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</tr>
<tr>
<td>150 - 100 - 310</td>
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</tr>
<tr>
<td>150 - 100 - 375</td>
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</tr>
<tr>
<td>200 - 125 - 230</td>
<td>*</td>
</tr>
<tr>
<td>200 - 125 - 290</td>
<td>*</td>
</tr>
<tr>
<td>200 - 125 - 365</td>
<td>*</td>
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<tr>
<td>200 - 125 - 500</td>
<td>*</td>
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<tr>
<td>200 - 150 - 200</td>
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</tr>
<tr>
<td>200 - 150 - 360</td>
<td>*</td>
</tr>
<tr>
<td>200 - 150 - 460</td>
<td>*</td>
</tr>
<tr>
<td>200 - 150 - 605</td>
<td>*</td>
</tr>
<tr>
<td>250 - 200 - 320</td>
<td>*</td>
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<td>250 - 200 - 420</td>
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<td>250 - 200 - 520</td>
<td>*</td>
</tr>
<tr>
<td>250 - 200 - 670</td>
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</tr>
<tr>
<td>300 - 250 - 370</td>
<td>*</td>
</tr>
<tr>
<td>300 - 250 - 480</td>
<td>*</td>
</tr>
<tr>
<td>300 - 250 - 600</td>
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<td>350 - 300 - 300</td>
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<tr>
<td>400 - 300 - 435</td>
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<tr>
<td>400 - 300 - 560</td>
<td>*</td>
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<tr>
<td>400 - 300 - 700</td>
<td>*</td>
</tr>
<tr>
<td>400 - 350 - 360</td>
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</tr>
<tr>
<td>450 - 350 - 430</td>
<td>*</td>
</tr>
<tr>
<td>400 - 350 - 510</td>
<td>*</td>
</tr>
</tbody>
</table>
### 6.2 Causes of faults and their remedies

#### Causes

- Pump pressure too low
- Pump pressure too high
- Flow capacity too high
- Flow capacity too low
- Power consumption too high
- Pump fails to pump liquid after being switched on
- Pump ceases to pump liquid
- Pump does not run smoothly (noise, vibrations)
- Inadmissible temperature increase at pump/seal casing
- Bearing temperature too high
- Excessive leakage at shaft seal
- Drive machine overloaded
- Leakage at pump

#### Remedies

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duty point does not lie at the calculated intersections of Q and H</td>
<td>Re-adjust duty point</td>
</tr>
<tr>
<td>Pump or piping incompletely vented or not primed</td>
<td>Vent</td>
</tr>
<tr>
<td>Suction pipe or impeller blocked</td>
<td>Clean impeller check, Check plant for impurities, Remove deposits in pump and / or piping, - Check strainer/suction aperture</td>
</tr>
<tr>
<td>Formation of air pockets in the piping</td>
<td>Correct suction conditions, Alter piping</td>
</tr>
<tr>
<td>Suction head too high (NPSHavailable too low) / water level too low</td>
<td>Clean sealing liquid line, possibly introduce sealing liquid from an external source or increase pressure, Check level of liquid in feed tank, Renew shaft seal, Renew shaft protecting sleeve</td>
</tr>
<tr>
<td>Air is drawn in at shaft seal</td>
<td>Renew worn components</td>
</tr>
<tr>
<td>Wrong direction of rotation</td>
<td>Change over two phases of the power feed, Check electrical connections, Check impeller position, correct if necessary</td>
</tr>
<tr>
<td>Speed too low</td>
<td>Increase speed, Check switchgear</td>
</tr>
<tr>
<td>Internals worn</td>
<td>Check duty point/selection, Increase back pressure by throttling, Check medium handled for contamination by chemicals and solid matter content, Renew worn components</td>
</tr>
<tr>
<td>Pump pressure is lower than specified in the order</td>
<td>Re-adjust duty point, Increase back pressure by throttling</td>
</tr>
<tr>
<td>Higher density or viscosity of medium handled than specified in the order</td>
<td>Reduce speed, If there is constant overloading possibly machine impeller (1.)</td>
</tr>
<tr>
<td>Speed too high</td>
<td>Reduce speed, If there is constant overloading possibly machine impeller (1.)</td>
</tr>
<tr>
<td>Tie bolts/seals</td>
<td>Tighten tie bolts, Renew gaskets, Check pipe connections and pump mounting, if necessary improve mounting of piping</td>
</tr>
<tr>
<td>Shaft seal worn</td>
<td>Check flushing/sealing liquid pressure, Check sealing liquid line, possibly introduce sealing liquid from an external source or increase pressure, Renew shaft seal, Renew worn components</td>
</tr>
<tr>
<td>Unfavorable flow to suction to suction nozzle of pump</td>
<td>After piping, If necessary, alter suction/intake pipe if resistance are too high, Check whether pipe route has a twisted or irregular flow profile (e.g. downstream of an elbow)</td>
</tr>
</tbody>
</table>

(1.) Consult Factory
## 6.2 Causes of faults and their remedies

<table>
<thead>
<tr>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gland follower, seal cover (mech. seal) wrongly fitted, incorrect packing material</td>
<td>- After&lt;br&gt; - Renew&lt;br&gt; - Correct&lt;br&gt; - Renew gland packing&lt;br&gt; - Renew worn components</td>
</tr>
<tr>
<td>Lack of cooling liquid or cooling liquid chamber contaminated</td>
<td>- Check flushing/sealing liquid pressure&lt;br&gt; - Clean sealing liquid line, possibly introduce sealing liquid from an external source or increase its pressure&lt;br&gt; - Increase flow cooling liquid&lt;br&gt; - Clean cooling liquid</td>
</tr>
<tr>
<td>Pump misaligned or there are resonance vibrations in the piping</td>
<td>- Re-align pump/drive machine&lt;br&gt; - Check piping connections and pump mounting, if necessary improve mounting of piping&lt;br&gt; - Apply vibration - damping measures</td>
</tr>
<tr>
<td>Excessive axial thrust</td>
<td>- Check duty point/layout&lt;br&gt; - Check mode of operation&lt;br&gt; - Check suction flow</td>
</tr>
<tr>
<td>Too little, too much or unsuitable lubricant</td>
<td>- Clean bearing&lt;br&gt; - Renew lubricant&lt;br&gt; - Top off, reduce or change lubricant</td>
</tr>
<tr>
<td>Running on two phases</td>
<td>- Renew defective fuses&lt;br&gt; - Check electrical connections&lt;br&gt; - Check switchgear</td>
</tr>
<tr>
<td>Rotor imbalance</td>
<td>- Clean rotor&lt;br&gt; - Check rotation realign necessary&lt;br&gt; - Re-balance rotor</td>
</tr>
<tr>
<td>Bearing damaged</td>
<td>- Renew / change</td>
</tr>
<tr>
<td>Flow capacity too low</td>
<td>- Re-adjust duty point&lt;br&gt; - Fully open shut-off valve in the suction/intake pipe&lt;br&gt; - Fully open shut-off valve in the discharge pipe&lt;br&gt; - Recalculate or measure the hydraulic losses Hv</td>
</tr>
<tr>
<td>In star/delta operation motor sticks at star stage</td>
<td>- Check electrical connections&lt;br&gt; - Check switchgear</td>
</tr>
<tr>
<td>Inadmissible air or gas content in liquid</td>
<td>- Vent&lt;br&gt; - Check integrity of suction pipe seal if necessary</td>
</tr>
<tr>
<td>Air drawn in at pump inlet</td>
<td>- Correct suction conditions&lt;br&gt; - Reduce flow velocity at suction pipe entry&lt;br&gt; - Increase suction head&lt;br&gt; - Check integrity of suction pipe and seal if necessary&lt;br&gt; - Renew defective pipes</td>
</tr>
<tr>
<td>Cavitation (ratting noise)</td>
<td>- Correct suction conditions&lt;br&gt; - Check mode of operation&lt;br&gt; - Increase suction head&lt;br&gt; - Install pump at a lower level</td>
</tr>
<tr>
<td>Foundation not rigid enough</td>
<td>- Check&lt;br&gt; - After</td>
</tr>
<tr>
<td>Inadmissible parallel operation</td>
<td>- Re-adjust duty point&lt;br&gt; - After pump characteristic H</td>
</tr>
<tr>
<td>Shaft is out of true</td>
<td>- Renew / change</td>
</tr>
<tr>
<td>Impeller fouls casing components</td>
<td>- Check rotor&lt;br&gt; - Check impeller position&lt;br&gt; - Check that the piping connected free of stress</td>
</tr>
</tbody>
</table>

(1.) Consult Factory
## 7.0 Routine Maintenance and Inspection Intervals

<table>
<thead>
<tr>
<th>Interval</th>
<th>Number of personnel required</th>
<th>Time (hours)</th>
<th>Maintenance job</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>1</td>
<td>1/10</td>
<td>- Check leakage on mechanical seal or leakage of packed gland (see operating instructions “Shaft seal”)</td>
</tr>
<tr>
<td>Weekly</td>
<td>1</td>
<td>1/4</td>
<td>- Check pump operation (positive suction pressure, total head, bearing temperature, noise and vibration)</td>
</tr>
<tr>
<td>Monthly</td>
<td>1 1/4</td>
<td>1/4</td>
<td>- Check twist play of coupling (see operating instructions “Coupling”)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- If available, switch to stand-by pump or carry out a test run (for 5 min.)</td>
</tr>
<tr>
<td>every 20,000 operating hours</td>
<td>2</td>
<td>3</td>
<td>- Replace deep groove ball bearings (see operating instructions)</td>
</tr>
<tr>
<td>every 4 years or if total head</td>
<td>2</td>
<td>6</td>
<td>- General inspection and overhaul of pump in accordance with the operating instructions Check and replace, if required - Wear parts such as: bearings, casing wear rings (Impeller wear rings, if provided), shaft sleeves - Impeller and shaft of pump drops</td>
</tr>
</tbody>
</table>
Limited 24 Month Warranty

Crane Pumps & Systems warrants that products of our manufacture will be free of defects in material and workmanship under normal use and service for twenty-four (24) months after manufacture date, when installed and maintained in accordance with our instructions. This warranty gives you specific legal rights, and there may also be other rights which vary from state to state. In the event the product is covered by the Federal Consumer Product Warranties Law (1) the duration of any implied warranties associated with the product by virtue of said law is limited to the same duration as stated herein, (2) this warranty is a LIMITED WARRANTY, and (3) no claims of any nature whatsoever shall be made against us, until the ultimate consumer, his successor, or assigns, notifies us in writing of the defect, and delivers the product and/or defective part(s) freight prepaid to our factory or nearest authorized service station. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply.

THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF ANY AND ALL WARRANTIES WITH RESPECT TO ANY PRODUCT SHALL BE TO REPLACE OR REPAIR AT OUR ELECTION, F.O.B. POINT OF MANUFACTURE OR AUTHORIZED REPAIR STATION, SUCH PRODUCTS AND/OR PARTS AS PROVEN DEFECTIVE. THERE SHALL BE NO FURTHER LIABILITY, WHETHER BASED ON WARRANTY, NEGLIGENCE OR OTHERWISE. Unless expressly stated otherwise, guarantees in the nature of performance specifications furnished in addition to the foregoing material and workmanship warranties on a product manufactured by us, if any, are subject to laboratory tests corrected for field performance. Any additional guarantees, in the nature of performance specifications must be in writing and such writing must be signed by our authorized representative. Due to inaccuracies in field testing if a conflict arises between the results of field testing conducted by or for user, and laboratory tests corrected for field performance, the latter shall control. RECOMMENDATIONS FOR SPECIAL APPLICATIONS OR THOSE RESULTING FROM SYSTEMS ANALYSES AND EVALUATIONS WE CONDUCT WILL BE BASED ON OUR BEST AVAILABLE EXPERIENCE AND PUBLISHED INDUSTRY INFORMATION. SUCH RECOMMENDATIONS DO NOT CONSTITUTE A WARRANTY OF SATISFACTORY PERFORMANCE AND NO SUCH WARRANTY IS GIVEN.

This warranty shall not apply when damage is caused by (a) improper installation, (b) improper voltage (c) lightning (d) excessive sand or other abrasive material (e) scale or corrosion build-up due to excessive chemical content. Any modification of the original equipment will also void the warranty. We will not be responsible for loss, damage or labor cost due to interruption of service caused by defective parts. Neither will we accept charges incurred by others without our prior written approval.

This warranty is void if our inspection reveals the product was used in a manner inconsistent with normal industry practice and/or our specific recommendations. The purchaser is responsible for communication of all necessary information regarding the application and use of the product. UNDER NO CIRCUMSTANCES WILL WE BE RESPONSIBLE FOR ANY OTHER DIRECT OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO TRAVEL EXPENSES, RENTED EQUIPMENT, OUTSIDE CONTRACTOR FEES, UNAUTHORIZED REPAIR SHOP EXPENSES, LOST PROFITS, LOST INCOME, LABOR CHARGES, DELAYS IN PRODUCTION, IDLE PRODUCTION, WHICH DAMAGES ARE CAUSED BY ANY DEFECTS IN MATERIAL AND/OR WORKMANSHIP AND/OR DAMAGE OR DELAYS IN SHIPMENT. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER EXPRESS OR IMPLIED WARRANTY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

No rights extended under this warranty shall be assigned to any other person, whether by operation of law or otherwise, without our prior written approval.
IMPORTANT!
WARRANTY REGISTRATION

Your product is covered by the enclosed Warranty. To complete the Warranty Registration Form go to:

http://www.cranepumps.com/ProductRegistration/

If you have a claim under the provision of the warranty, contact your local Crane Pumps & Systems, Inc. Distributor.

RETURNED GOODS
RETURN OF MERCHANDISE REQUIRES A “RETURNED GOODS AUTHORIZATION”. CONTACT YOUR LOCAL CRANE PUMPS & SYSTEMS, INC. DISTRIBUTOR.

Products Returned Must Be Cleaned, Sanitized, Or Decontaminated As Necessary Prior To Shipment, To Insure That Employees Will Not Be Exposed To Health Hazards In Handling Said Material. All Applicable Laws And Regulations Shall Apply.