

Failure Analysis System Procedure

Submersible Vertical Pumps SVI



1) Electric pump applications

- Pumping of cooling liquids, lubricating and condensate
- Machine tool, welding machine, motor test-bed
- Cooling systems
- Washing systems
- Booster
- Fire fighting systems

2) Critical items of application

2.1) Electrical supply

- In running condition, max variation of supply voltage: $\pm 10\%$.
 - a too high voltage generates overheating and overload;
 - a too low voltage generates starting problems.
- Max frequency of start:
 - 20 start/h for power until 5.5 kW;
 - 15 start/h for power until 15 kW;
 - 12 start/h for power greater than 15 kW
 - an excessive number of starting generates overheating and overload of motor.

2.2) Liquid

• Pumps made in standard configuration (ceramic/coal/FPM) must pump clean liquids with the following limits of temperature:

- SVI pump, "S" and "N" versions: -10 °C, +90 °C,
- SVI pump, "E" version: -10 °C, +60 °C.

• In case of particular applications and range of temperature more extended, pumps must be configured with attention. Main configurations realized, based on the type of application, are wrote in the following table:

Application	Advised seal (*)	Note
Tools lubrication	Standard seal Ceramics/Coal/FPM	In presence of chips Widia/Widia/FPM or Silicon carbide/Silicon carbide/FPM
Filtration of liquid of machine tool	Widia/Widia/FPM	Liquid witch contain chips
Deionized water	Silicon carbide/Special coal/EPDM oFPM	Suitable for waters witch have just undergone by process of direct or reverse osmosis
Demineralized water	Silicon carbide/Special coal/EPDM o FPM	
Swimming pools	Widia/Special coal/EPDM	Waters witch contain chlorides with variable concentrations
Washing of systems for the food industry	Widia/Special coal/EPDM	Mixture of water and hard caustic: max conc. 20%, Tmax 80 °C.
Generics washing systems	Widia/Special coal/EPDM	Products to alkaline base with Ph between 8 and 10. For greater Ph it is advised Widia/Silicon carbide/EPDM
Refrigeration systems	Widia/Special coel/EPDM or Widia/Silicon carbide/EPDM	Mixture of water and glycol with concentration from 10% to 100% and temperature from -55 °C to +40 °C
Transfer/pumping of generic chemical products	It is advised contact the sale net	Large tipology of acids

(*) Rotating part/fixed part/O-Ring

- Pumping of diesel oil or others inflammable liquids is concurred only with use of special version pumps and equipped with ATEX motor.
- Pumping of abrasive liquids is forbidden because of rapid wear of hydraulic part.
- Pumping of liquid containing filaments is forbidden because if obstruction of filter.
- If it is pumped a liquid with a viscosity greater than water viscosity, it is necessary performe a oversizing of the motor to avoid its overheating.
- Pumping of sea water, brackishwater or with a great concentration of chlorine is not advised because of priming of corrosive phenomena in hydraulic part.

2.3) Installation

- Max environment temperature: 40 °C.
 - Min level of liquid in suction:
25 mm for SVI 2-4-8-16 versions;
100 mm for SVI 30-60 versions;
 - if the level is lower than fixed values, pump work in dry conditions and it generates a rapid wear of hydraulic part;
 - it is advised to check periodically the liquid level and keeping it in the fixed limits.
 - Pumping of liquid containing solid parts, generates a rapid obstruction of filter, moreover the solid particles can insert between shaft and bush, witch can break off itself; for this reasons, it is advised installation of prefilter.
 - Installation of pump in environment with a great humidity causes damaging of motor bearings.
 - After pump installation, it is advised to wait some minutes before the start to get time to water to penetrate in the pump body.
-
- In starting condition, it is necessary take the delivery outlet open to let out the air from the pump:
 - if there is air in the pump, it can be priming problems and it can damage the hydraulic part.
 - Pump must not work with the delivery outlet closed for a time longer than 4-5 min. Otherwise, it generates overheating of liquid and damages of mechanical seal.
 - Pump must never operates without water to avoid damages of mechanical seal and hydraulic part.
 - If the pump is installed in a tank, the reinstatement of pumped liquid must be performed avoiding that the air boubbles goes near the suction inlet and they be pumped. Pumping of liquid containing gas generates wear of hydraulic part and increasing of pump noise.
-
- It is necessary guarantee a correct air flow for motor cooling. It is necessary the ventilation grid is not partially or totally obstructed; otherwise it generates overheating and overload of motor.
 - It is necessary insert a non return valve inside of delivery for protect the pump from water hammer and reverse rotation.
 - Normally, the pump is installed with vertical axis; it can be also installed with horizontal axis, except for SVI 30-60 versions with more than 5 stages at 50 Hz and SVI 30-60 versions with more than 4 stages at 60 Hz.
 - In case of installation with horizontal axis, it is advised the presence of hole on the pump body near the upper impeller to let out the air boubbles from pump body.
 - If it should remove an impeller to reduces a pump head, it is advised to remove the upper impeller to guarantee a respect of minimum level of liquid.
 - If it is pumped a slimy liquids, it is advised to rinse the pump after its use to avoid the damaging of bushes.
-
- 1~ motors have an internal motor protection but they cannot operate without a operator supervision or insertion of additional protections inside of control board.
 - 3~ motors must be protected with a circuit breaker installed by a Customer (it is adviced use of Lowara control board).
 - It is recommended installation of high sensibility differential switch ($I\Delta n \leq 0.03$ A) inside of control board, to protect the people from possible electric contact with live parts.

2.4) Operation with inverter

- Operation with inverter positioned inside of the control board not present particular limits (see the inverter handbook).

3) Equipments and tools required and tools required

- Megaohmeter 500 - 1000 Vdc;

4) Inspection of defected product

4.1) Preliminary information

On receiving of defective product, requirements from Customer:

- purchase date (if possible, confirmed by bill or sale slip);
- installation date;
- conditions of installation.

4.2) External visual inspection

- Check the external condition of product, in a particular manner check on the surface of pump body the presence of weld or fusion defects and integrity of aluminum motor casing.

4.3) Preliminary inspections

- Data in plate:
 - type of product and code;
 - series number;
 - manufacturing date;
- Based on type of application witch is subject the pump, check if the configuration is right or wrong (see the table in 2.2).
- Condition of capacitor (1~ motor).

4.4) Electrical resistance of windings

- Measure electrical resistance of windings to find possible damages (interruptions/burnings).

4.5) Measure of insulation resistance

Performed in accordance with european standard EN 602 04-1 (500 Vdc between conductors and ground).
Test is passed if insulation resistance is $\geq 10 \text{ M}\Omega$.

5) Disassembly and analysis

N.W. The pictures refers to the pump SVI 2 (with join).

- Remove the protection grid of coupling joint and check the two elements of join are installed correctly (in balanced manner).
- Check with a thickness gauge the position of hydraulic pack: a wrong position generates a sliding of impellers on the diffusers.
- Remove the coupling joint.



- Remove the fixing screws which connects the delivery outlet to the motor, so separate the motor to the pump.



- Extract the screws and remove the filter:
 - check the presence of foreign matters.
- Unscrew the nuts and remove the suction bottom.



- Extract the sleeve and the first hydraulic box, so unscrew the fixing nut.



- Extract one by one all stages compounded of diffuser, impeller and spacer:
 - check wear of impeller and presence of defects in the welds.



- Extract the pump shaft and check:
 - integrity;
 - condition of surface of the mobile part of mechanical seal.

- Extract from the adaptor the fixed part of mechanical seal and check the condition of its surface.



- Remove the protection grid and the fan of motor.
- Remove the motor cover, separate the rotor to motor casing and check the condition of bearings.

- Performe an heads visual analysis for finding possible problems with following cases:
 - a) all motors:
 - one or more winding coils burnt ----> shorted coil;
 - b) 1~ motor:
 - run winding OK and start winding KO ----> capacitor defected;
 - run winding KO and start winding OK ----> motor could not start;
 - both windings faulty ----> overload;
 - c) 3~ motor:
 - 1 phase fine and 2 phases burnt ----> powered with only 2 phases;
 - all phases burnt ----> overload.





6) Check list

Type of problem

- Does not delivery water
- Low performance
- Does not starts
- Noisy
- Grounded motor
- Excessive power input
- Runs slowly
- Further:

Pump data

- Type:**
- Code:**
- Series number:**
- Installation date:**
- Manufacturing date:**
- Liquid pumped:**
- Temperature:**
- Remarks:**

SVI pumps failure causes required for claim opening

Where	What	Why
100 Electric motor	100 Flooded/full of water	106 Uncorrect assembly/testing of components
		110 holes of drain condensate, obstructed/closed
		111 Pinched gasket screws
		112 Not complying components tooling
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
		120 Excessive wear
		101 Further:
		101 Further:
100 Electric motor	101 Excessive power input / overheating / burnt	102 Motor shaft locket
		104 Wrong internal electrical connections
		106 Uncorrect assembly/testing of components
		107 Bursted / unconnected capacitor
		108 Short circuit for contact with mobile parts
		109 Short circuit between coils/windings
		114 Hydraulic rotating part locked
		115 Presence of external matters between windings
		100 Further (supply detailed description of failure)
		121 Inadequate power supply
		103 Not complying/unsuitable applications
		113 Inadequate size of motor
		116 Inadequate cooling
		119 Normal wear
		120 Excessive wear
101 Further:		
100 Electric motor	102 Runs slowly / does not starts	106 Uncorrect assembly/testing of components
		107 Bursted / unconnected capacitor
		117 Defected/wrong rotor
		118 Not operating level sensors
		119 Water full level sensors
		100 Further (supply detailed description of failure)
		121 Inadequate power supply
		103 Not complying/unsuitable applications
		113 Inadequate size of motor
		101 Further:
100 Electric motor	103 Does not stops	105 Defected/not operating electrical/electronic components
		118 Not operating level sensors
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		101 Further:
101 Motor shaft	104 Noisy / locked / vibrate (ok windings)	102 Locked motor shaft
		106 Uncorrect assembly/testing of components
		112 Not complying components tooling
		114 Hydraulic rotating part locked
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
		120 Excessive wear
101 Further:		

101 Motor shaft	102 Shaft / tothing jut	112 Not complying components tooling
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
		120 Excessive wear
101 Motor shaft	401 Broken/cracked	101 Further:
		112 Not complying components tooling
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
200 Control device	200 Not operate	120 Excessive wear
		101 Further:
		105 Defected/not operating electrical/electronic components
		200 Lack of technical / commercial information
		118 Not operating level sensors
		119 Water full level sensors
		100 Further (supply detailed description of failure)
		121 Inadequate power supply
		103 Not complying/unsuitable applications
		119 Normal wear
300 Total hydraulic	300 Low performance	120 Excessive wear
		101 Further:
		106 Uncorrect assembly/testing of components
		112 Not complying components tooling
		300 Wrong rating plate/packing
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
300 Total hydraulic	104 Noisy / locked / vibrate	119 Normal wear
		120 Excessive wear
		101 Further:
		106 Uncorrect assembly/testing of components
		112 Not complying components tooling
		114 Hydraulic rotating part locked
		100 Further (supply detailed description of failure)
403 Pump sleeve	400 Leak	103 Not complying/unsuitable applications
		119 Normal wear
		120 Excessive wear
		101 Further:
		106 Uncorrect assembly/testing of components
		112 Not complying components tooling
404 OR/Mechanical seal	400 Leak	100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
		120 Excessive wear
		101 Further:
		106 Uncorrect assembly/testing of components
408 Pump shaft/joint	401 Broken/cracked	112 Not complying components tooling
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
		120 Excessive wear
		101 Further:
600 Product	600 Wrong rating plate packing	106 Uncorrect assembly/testing of components
	601 Wrong product document	200 Lack of technical / commercial information
	602 Not acknowledgment of warranty	600 Out of legal warranty period
		601 Product tampering



Lowara

8) Faq

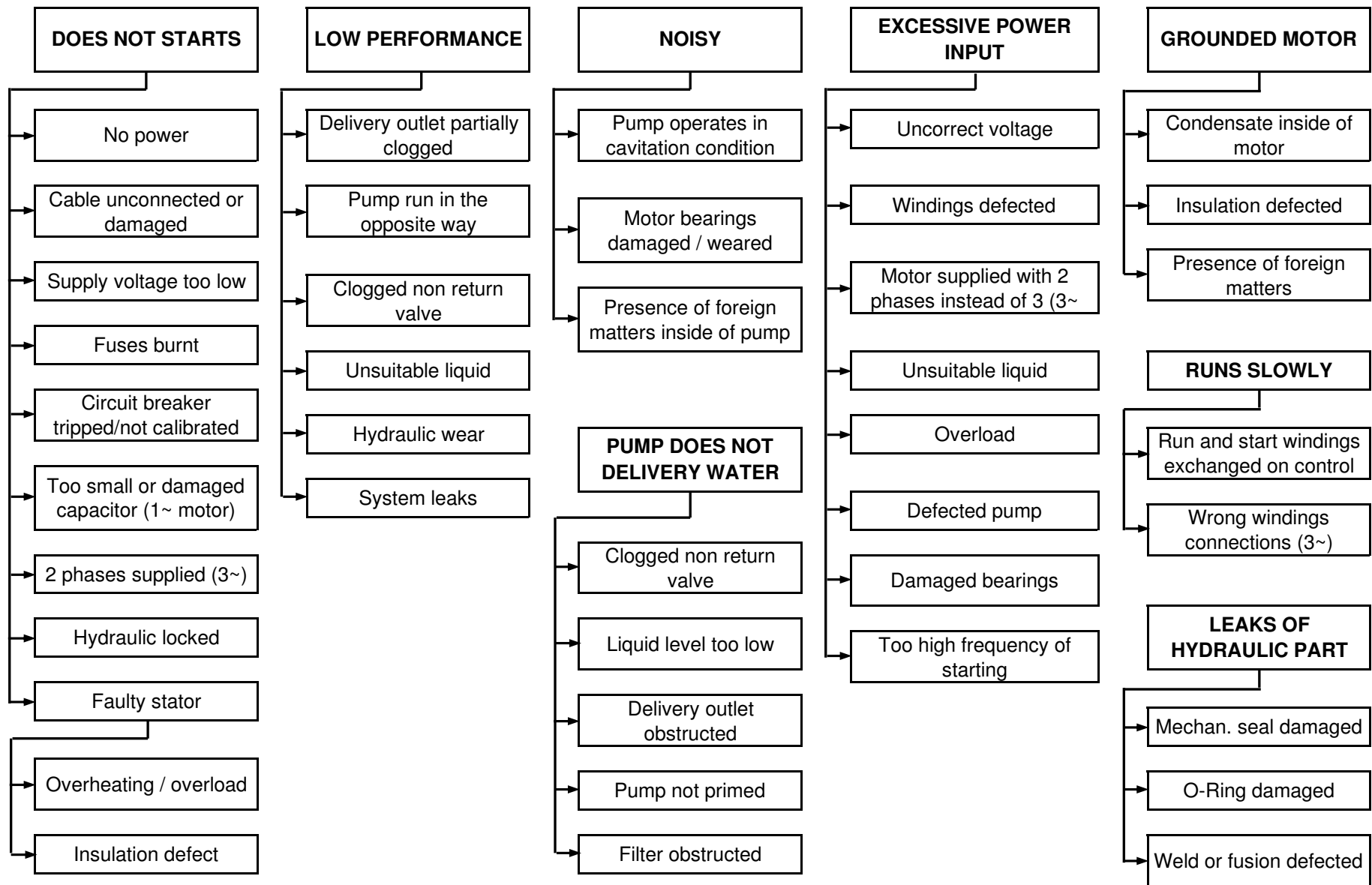
Problem founded	Possible causes of the problem
Pump does not start	Power supply problems: <ul style="list-style-type: none"> • no power; • unconnected or damaged cable; • supply voltage too low; Hydraulic locked. Fuses burnt. Circuit breaker tripped or not calibrated. Capacitor too small or damaged (1~ motor). 2 phases powered (3~ motor). Motor is burnt because of insulation defected, overheating or overload (unsuitable liquid)
Pump does not delivery water	Non return valve clogged Filter obstructed. Water level too low Pump run in the opposite way Pump operates in cavitation
Low performance	Filter partially obstructed Pump run in the opposite way Clogged non return valve Unsuitable liquid (density or specific weight >1) Wear of hydraulic part System leaks
Noisy	Pump operates in cavitation condition Motor bearings damaged cause by condensate Presence of foreign matters
Runs slowly	Run and start windings exchanged on control panel (1~ motor) Wrong windings connections inside the motor (3~ motor)
Grounded motor	Generation of condensate inside the motor Insulation defected
Excessive power input	Uncorrect voltage Windings defected Motor supplied with 2 phases (3~ motor) Unsuitable liquid Defected pump Defected bearings Too high frequency of startings

Hydraulic locked	Unsuitable liquid Presence of foreign matters inside of pump Tolerance of tooling beyond the limits O-ring out of seat
Overheating/overload	Too high liquid temperature Too high frequency of startings Wrong supply voltage Defected pump Thrust bearings damaged/seized Lack of adequate protection inside of control board (for motors without internal protection, see 2,3) Lack of ventilation of the motor Too high environment temperature



ITT

7) Failure tree (SVI pumps)



Lowara