

Failure Analysis System Procedure

Centrifugal Vertical Pumps SV 33-46-66-92



1) Electric pump applications

- Water transfer and circulation in the civil, industrial and agricultural sectors;
- Pressure boosting and water supply systems;
- Irrigation systems for agriculture and sporting facilities;
- Washing systems;
- Boiler feed;
- Water treatment and reverse osmosis plants;
- Fountains;
- Handling of moderately aggressive liquids.

2) Critical items of application

2.1) Electrical supply

- In running condition, max variation of supply voltage:

f [Hz]	~	Un [V]	± %
50	1	220-240	6
50	3	230-400	10
50	3	400-690	10

f [Hz]	~	Un [V]	± %
60	1	220-240	6
60	3	230-400	5
60	3	400-690	5

- a too high voltage generates overheating and overload;
- a too low voltage generates starting problems.

- Max frequency of start:
60 start/h for power from 0.25 kW to 3 kW;
40 start/h for power from 4 kW to 7.5 kW;
30 start/h for power from 11 to 15 kW
24 start/h for power from 18.5 kW to 22 kW;
16 start/h for power from 30 kW to 37 kW;
8 start/h for power of 45 kW;
- if the pump starts too frequently, check the standing valve and check the possible presence of system leaks;
- an excessive number of starting generates overheating and overload of motor.

2.2) Liquid

- Pumps made in standard configuration (silicon carbide/coal/EPDM) must pump clean water with the following limits of temperature: -30°C, + 120°C.
- If the pump have the gasket with not standard material, the temperature limits are:
 - FPM: -10°C, + 120°C;
 - NBR: -20°C, + 85°C;
 - PTFE: 0°C, + 120°C;
- In case of particular applications and pumping of liquids witch are different to clean water, pumps must be configured with attention. Main configurations realized, based on the type of application, are wrote in the following table:

Application	Advised seal (*)	Remarks
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 of pumps SV ATEX.
- Pumping of abrasive liquids or with filaments in suspension is forbidden because of rapid wear of hydraulic part.
- 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.
- These pumps are suitables to pumping drinkable water.
- Pumping of sea water, brackishwater or with a great concentration of chlorine is not adviced because of priming of corrosive phenomena in hydraulic part.

2.3) Installation

- Limits of environment temperature: $0^{\circ}\text{C} \div 40^{\circ}\text{C}$:
 - if the temperature is greater than limits and/or if installation is made at altitude greater than 1000 m it is necessary performe a derating of motor using a coefficients inside of installation handbook. Otherwise it generates overheating of motor.
 - Relative humidity of environment must not greater than 50% at 40°C .
 - installation of pump in environment with a great humidity causes a damaging of motor bearings.
 - Max operating pressure of system:
 - SV 33, 46: 16-25-40 bar;
 - SV 66, 92: 16-25 bar.
 - Min pressure in suction with hot water must respect limits of installation handbook; otherwise it generates a cavitation and damaging of hydraulic part.
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- Pump must never operates without water; otherwise, it generates damages of mechanical seal and bushes.
 - The pump, before the starting, must be primed by filling the pump body and the suction pipe:
 - in case of positive suction head, it must close the downstream on-off valve, remove the priming plug, open the upstream on-off valve until the water let out to the plug and so replace the plug.
 - in case of suction lift, it must close the downstream on-off valve, open the upstream on-off valve, remove the priming plug and fill with water the pump with the appropriate glass or the funnel and so replace the plug;
 - possible residual air bubbles can be left out loosening the the priming plug.
 - In starting condition it must check the direction of rotation of pump:
 - a wrong direction of rotation causes a loosening of fixing nut of impellers.
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- In case of working in suction lift it is adviced to installation of standing valve to avoid the empty of pump and the consequent reverse rotation.
 - 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.
 - If it is necessary change the mechanical seal, it is not necessary separate the motor from the pump; it is sufficient remove the coupling joint and the seal holding disc: in riassembly phase, it must respect the driving torque of nuts and screws wrote in the installation handbook.
 - If it is pumped a slimy liquids, it is adviced to rinse the pump after her use to avoid the damaging of bushes.

- 1~ motors of power until 1.5 kW, have an internal motor protection but they cannot operate without a operator supervision or insertion of additional protections inside of control board.
- 1~ motors of power greater than 1.5 kW and 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.
- If during the operating there is an anomalous whistle, it can be caused by air infiltration; to avoid it is sufficient tighten the nuts of tie rods.

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 ≥ 10 M Ω .

5) Disassembly and analysis

- Remove the protection grid of coupling joint and check that its two elements are installed correctly (in balanced manner):
 - if assembly of joint is uncorrect, it generates an unbalancing of rotating part, witch can cause noise and damaging of pump.
- Check with a calibrated fork-shaped shim the position of hydraulic pack: a wrong position generates a sliding of impellers on the diffusers.
- Remove the coupling join taking care that you don't miss the coupling pin of pump shaft/join positioned on the pump shaft.



- Remove the fixing screws witch connects the motor flange to the adaptor, so separate the motor from the pump.

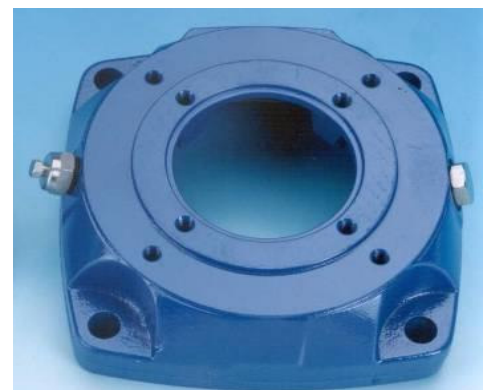
- Remove the seal holding disc, unscrewing the fixing screws and remove the fix part of mechanical seal:
 - check the condition of O-Ring;
 - check the condition of surface of mechanical seal.



- Now is possible remove the mobile part of mechanical seal and check the condition of its surface, or before of this, it can separate the adaptor from the upper head.



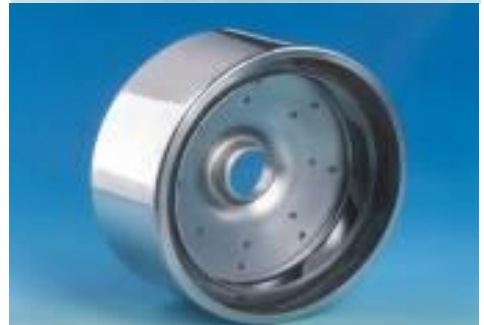
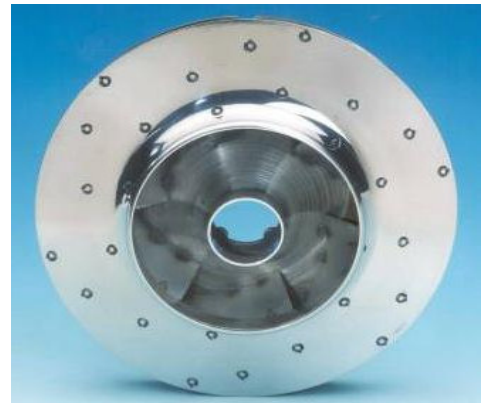
- Unscrew the nuts, remove the tie rods and the upper head:
 - check the presence of weld or fusion defects depending on version;
 - check the condition of O-Ring (pinching, cuts).



- Separate the pump body from the external sleeve:
 - check the presence of weld or fusion defects depending on version;
 - check the condition of O-Ring (pinching, cuts);
 - if present, check the condition of thrust balancing piston.



- Extract the full impellers/diffusers pack from external sleeve.
- Unscrew the fixing nut of hydraulic pack remove the lower support and extract one by one all stages (impellers, diffusers, impellers spacers):
 - check the wear of impellers and presence of defects in the welds;
 - check the presence of diffusers stack spring and its integrity.
- If the pump must be subsequently riassedbled, it must put the diffuser with bush in the same position to avoid dangerous oscillations of hydraulic pack during the operating.
- Examine the pump shaft and check its integrity.



- Remove the protection grid and the motor fan.
- Remove the motor cover, separate the rotor from the 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:

SV 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:
		100 Electric motor
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		
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 Motor shaft	104 Noisy / locked / vibrate (ok windings)	101 Further:
		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 / toothing 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



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8) Faq

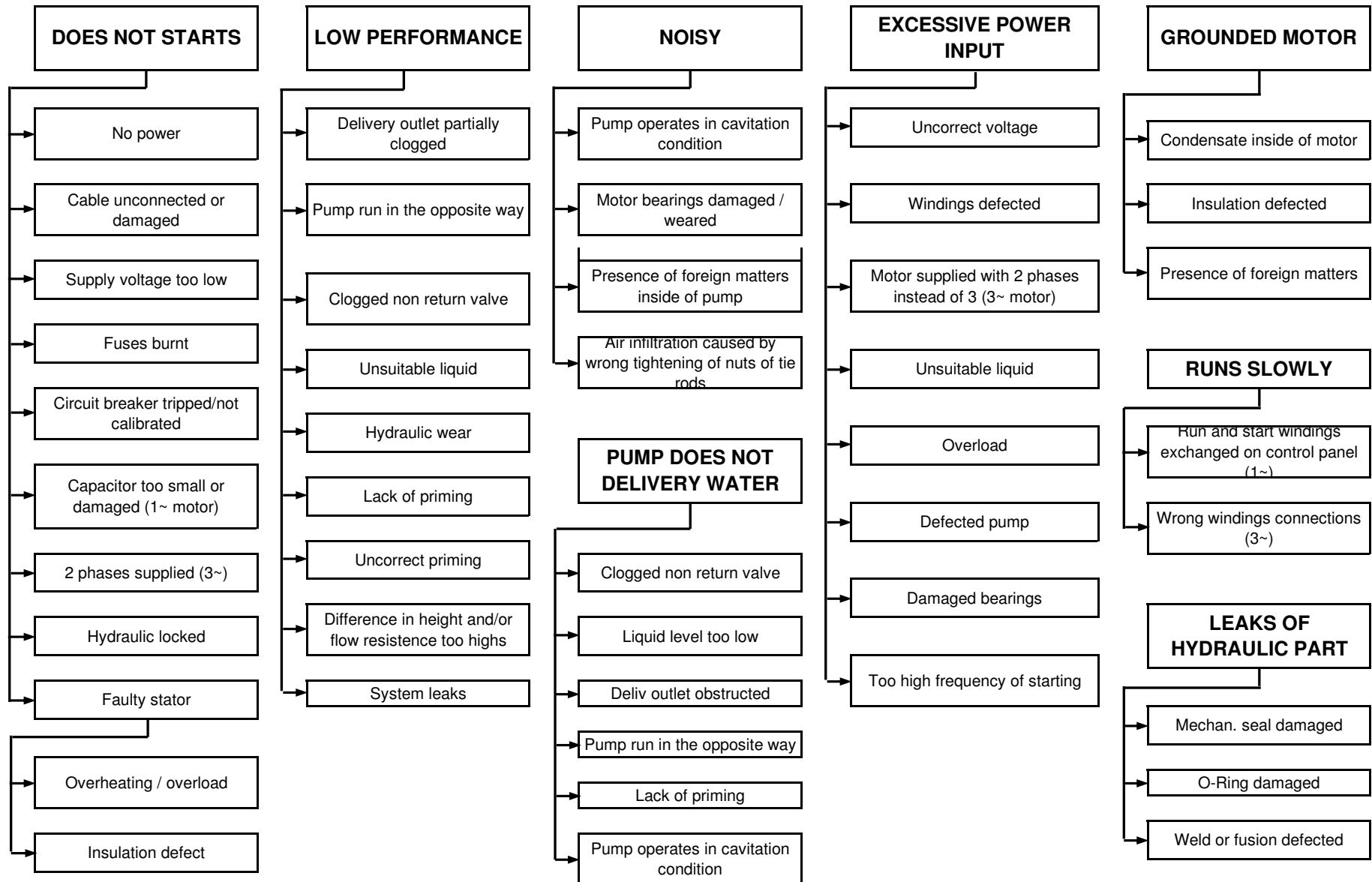
Problem founded	Possible causes of the problem
Pump does not start	Power supply problems: <ul style="list-style-type: none"> • no power; • unconnected or damaged cable; • supply voltage too low; Hydraulic locked. Fuses burnt. Circuit breaker tripped or not calibrated. Capacitor too small or damaged (1~ 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 Water level too low Delivery outlet obstructed Pump run in the opposite way Lack of priming Pump operates in cavitation
Low performance	Delivery outlet partially obstructed Pump run in the opposite way Clogged non return valve Unsuitable liquid (density or specific weight >1) Wear of hydraulic part Lack of priming Uncorrect priming Difference in height and/or flow resistance too highs System leaks
Leaks of hydraulic part	Mechanical seal damaged O-Ring damaged Welds or fusions defected
Noisy	Pump operates in cavitation condition Motor bearings damaged cause by condensate Presence of foreign matters Air infiltration caused by wrong tightening of nuts of tie rods
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 Presence of foreign matters

Excessive power input	Uncorrect voltage Windings defected Motor supplied with 2 phases (3~ motor) Unsuitable liquid Overload 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 Presence of foreign matters in the thrust balancing piston (metallic flash)
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

7) Failure tree (SV 33-46-66-92 pumps)



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