

Failure Analysis System Procedure

P-PAB-PSA-SP Centrifugal Electric Pumps



1) Electric pump applications

- Pumping of clean waters for domestic use
- Little irrigation
- Pressurization
- Washings
- Supply of underpressure (it is advised the PSA series)
- Pumping of hot water (it is advised the PAB, PABLB series)
- Application with difficult maintenance of priming (SP)

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 40 start/h:
 - an excessive number of starting generates overheating and overload of motor.

2.2 Liquid

• Pump with standard configuration (ceramic/coal/FPM) is available to pump clean water and diathermic oil. Max and min temperature of pumped liquid are:

- P, PS pumps: -10°C, +40°C.

For temperature greater than 40°C, the following advised pumps are made with EPDM ---- :

- PAB, PSA, PABLB pumps: -10°C, +80°C.

• For pumps, used in chiller systems, it is advised the ceramic/coal/EPDM and it must respect the following conditions:

- pumped liquid must have a low concentration of glycol;
- the temperature of liquid must be $\geq -15^\circ\text{C}$.

Installation of pump inside of environments with a great humidity causes damaging of motor bearings.

- To pumping liquids with high temperature ($>40^\circ\text{C}$) it is advised to use a bronze version of pump.
- SP pump can pump water witch contains the gas.
- Pumping of abrasive liquids is forbidden because of rapid wear of impeller and pump body.
- Liquid must not be brackishwater, seawater or corrosive:
 - corrossions are caused by incorrect applications (inadequate ground system, leakage current, stray current, unsuitable pumped liquid...) and they cannot be inputed to product or constructive materials.

2.3) Installation

• Max environnement temperature: 40°C.

• Max operating pressure:

- P-PAB-PS pumps: 8 bar;
- PSA pumps: 10 bar.

• Installation of pump inside of environments with a great humidity causes damaging of motor bearings.

• After installation of the pump it is advised to turn manually the rotor and check the free rotation. A long period of storage can causes the lock of impeller.

• To get a correct priming of pump, in starting condition, it is necessary to fill the pump body and the delivery pipe with water; otherwise, the pump operates in dry conditions and it generates damages of mechanical seal and hydraulic part.

• To avoid the empty of pump, when it is not used, it is necessary insert a standing valve in the suction side. If the pump is for a long time without water it can generate the lock of the pump caused by the generation of oxide on the surface.

- SP pumps not requires a total filling of pump body to priming. They can also primes if the impeller is partially out of water but in this case the starting time can last some minutes.
- 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 advised use of Lowara control board).
- The pump mustn't operates when the delivery outlet is closed (overheating of pumped liquid and motor).
- It is necessary guarantee a correct air flow to cool the motor. It is necessary the ventilation grid is not partially or totally obstructed; otherwise it generates overheating and overload of motor.
- The possible substitution of mechanical seal must be performed using an adequate tool, witch allows the correct insertion of mechanical seal in the shaft without damage it.

3) Equipments 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 and operating.

4.2) External visual inspection

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

4.3) Preliminary inspections

- Data in plate:
 - type of product and code;
 - series number;
 - manufacturing date;
- Condition of capacitor and connections on terminal board (1~ motor).

4.4) Electrical resistance of windings

Check electrical continuity of windings and find possible interruptions or 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 P pump.

- Check with the screwdriver the free rotation of shaft.
- Unscrews the fixing screws, remove the pump body and check:
 - conditions of his internal surface (presence of wear, defects of fusion);
 - conditions of O-Ring (pinching, cuts).
- In case of PSA-PAB-SP pumps, remove the cover of pump body.



- Remove the impeller with two screwdrivers and check its condition of wear.
- Extract the mechanical seal from shaft, taking care of not damage it and check:
 - the conditions of its surface and condition of wear;
 - positioning of fixed part of mechanical seal on the seal holding disc (if the mechanical seal is not positioned correctly, it reduces her operating life and her efficiency).



- Remove the protection grid, depending on the motor type, extract the fan with 2 screwdriver and check its condition.



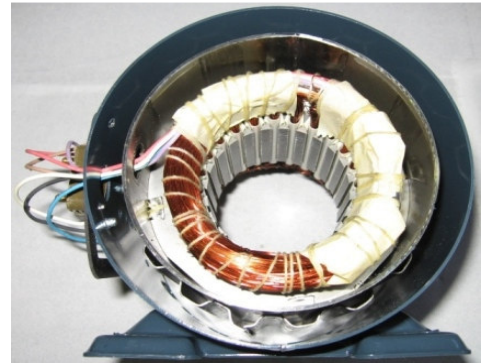
- Unscrew the tie rods to separate the pump bracket and the motor cover from the motor.
(In case of PSA-PAB-SP pumps, it is removed the motor cover and the pump body).
Check the condition of pump bracket (defects of fusion) and the condition of motor cover (possible deformations or dents).



- Extract the rotor and check the conditions of bearings.



- Unconnect the conductors from terminal board and extract the stator from external sleeve (only for pump with internal ventilation).
- 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:**

P-PSA-PBA-SP 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
300 Total hydraulic	300 Low performance	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	104 Noisy / locked / vibrate	120 Excessive wear
		101 Further:
		106 Uncorrect assembly/testing of components
		112 Not complying components tooling
		300 Wrong rating plate/packing
403 Pump sleeve	400 Leak	100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
		120 Excessive wear
		101 Further:
404 OR/Mechanical seal	400 Leak	106 Uncorrect assembly/testing of components
		112 Not complying components tooling
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
408 Pump shaft/joint	401 Broken/cracked	120 Excessive wear
		101 Further:
		106 Uncorrect assembly/testing of components
		112 Not complying components tooling
		100 Further (supply detailed description of failure)
600 Product	600 Wrong rating plate packing	103 Not complying/unsuitable applications
	601 Wrong product document	119 Normal wear
	602 Not acknowledgment of warranty	120 Excessive wear
		101 Further:
		106 Uncorrect assembly/testing of components
		200 Lack of technical / commercial information
		600 Out of legal warranty period
		601 Product tampering



Lowara



8) Faq

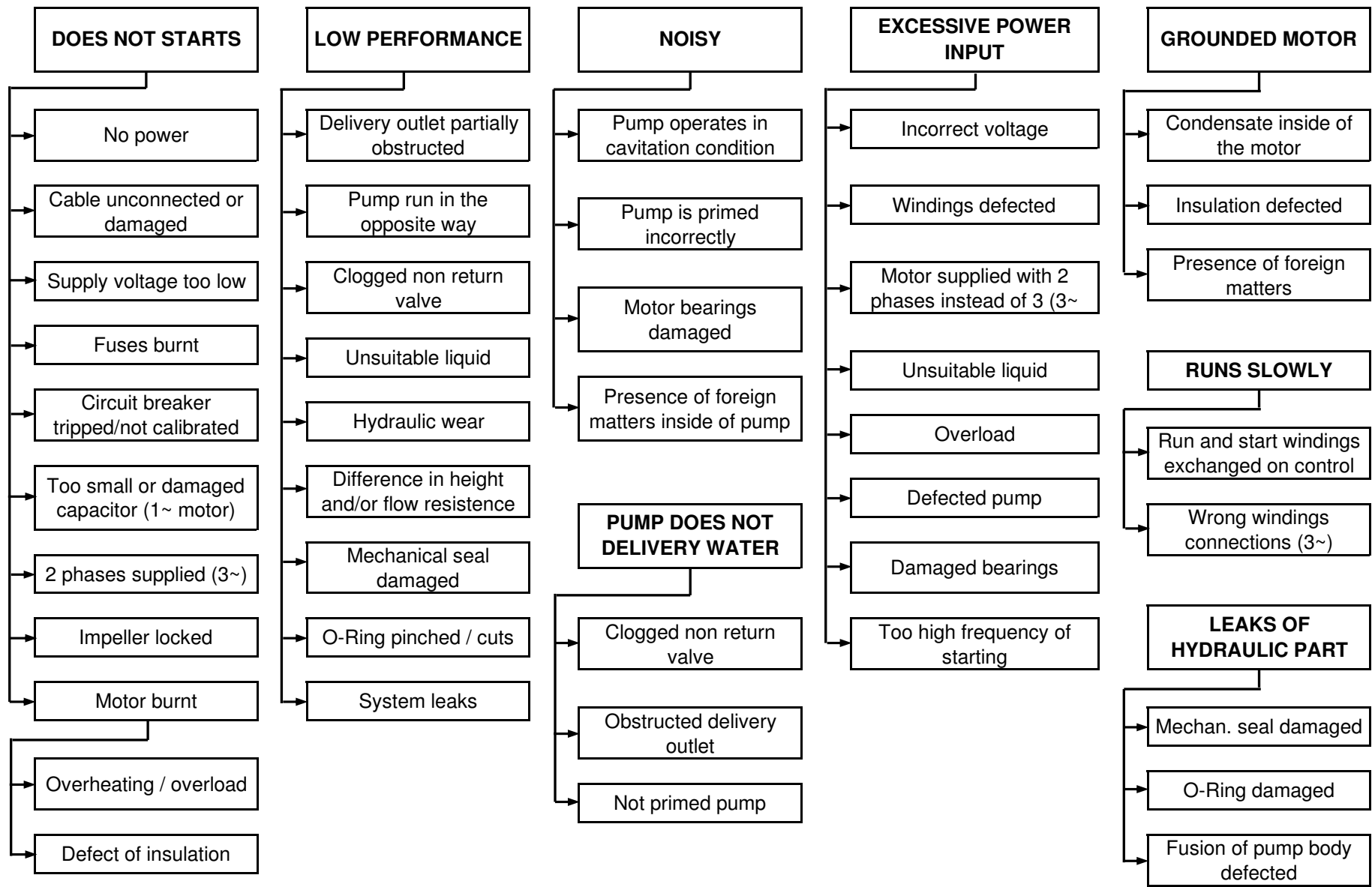
Problem founded	Possible causes of the problem
Pump does not start	Power supply problems: <ul style="list-style-type: none">• no power;• unconnected or damaged cable;• supply voltage too low. Impeller locked because of presence of oxide on the surface Fuses burnt. Circuit breaker tripped/not calibrated. 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. Delivery outlet obstructed because of foreign matters. Not primed pump. Pump operates in cavitation.
Incorrect performance	Delivery outlet partially obstructed Pump run in the opposite way Pump is undersized Clogged non return valve Unsuitable liquid Wear of hydraulic part Difference in height and/or flow resistance too highs Mechanical seal damaged O-Rings pinched or cuts System leaks
Noisy	Pump operates in cavitation condition Pump is primed incorrectly 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 of the motor Insulation defected Presence of foreign matters (swarfs or bolts and screws)

Excessive power input	Uncorrect voltage Windings defected Motor supplied with 2 phases instead of 3 (3~ motor) Unsuitable liquid Defected pump Defected bearings Too high frequency of startings
Hydraulic locked	Dry working Unsuitable liquid Presence of foreign matters inside of the pump Tolerance of tooling beyond the limits O-ring out of seat
Overheating/overload	Too high pumped 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 (P-PSA-PBA-SP pumps)



Lowara