ITT

Lowara

Failure Analysis System Procedure

DOC Submersible Electric Pumps

1) Electric pump applications

- Emptying of residential sump pits or rainwater tanks
- Emergency draining of flooded basements and garages.
- Transfer of water from tanks, cistems and swimming pools.
- Garden and lawn irrigation.

2) Critical items of application

2.1) Electrical supply

- In running condition, supply voltage must be into tolerance values ± 5%:
  - a too high voltage generates overheating and overload;
  - a too low voltage, generates starting problems.
- In starting operation, max drop voltage 5%:
  - a too high drop voltage generates starting problems.
- Max starting frequency 40 start/h:
  - if starting frequency is greater than limits, it generate overheating or overload problems.

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2.2) Liquid

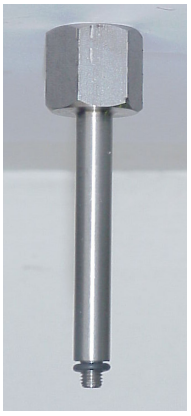
• Max liquid temperature with pump partially submersed 40°C:
  - if temperature is greater than max value, it generate overheating in motor.
• Max diameter of solids in suspension:
  - DOC 3, DOC 7 pump: 10 mm;
  - DOC 7VX pumps: 20 mm;
- solid parts with diameters greater than limits, damages hydraulic part (stoppages) and motor (overload/overtemperature).
• DOC 7VX (with VORTEX impeller) can pump water with suspended solid and filaments.
• Pumping of abrasive liquid generate a rapid wear of impeller.
• Pump must not pump hydrocarbons or danger liquids.
• Liquid must not be brackishwater, seawater or corrosive:
  - corrosions 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 depht of immersion: 5 m.
• Pump must not operate 24h/24h; otherwise it generates overheating of the motor.
• Pump must not handled with the supply cable, but only with the handle; otherwise the cable can disjoin.
• If the pump is installed inside of a sump pit, his dimensions must be so that to avoid continous start and stop of the pump; otherwise, the motor is subjected to overheating.
• If the pump is installed in a fixed installation, it is advised a positioning with a min high of 10 cm from the floor to avail the water decantation. Otherwise it generate a rapid wear of impeller.
• If the pump is not installed in a fixed installation and it is used to drain a little room, it can positioned on the foor.
• The pump must never work in dry condition.

• Lenght of float cable must not be modified and it necessary check the fixing of the cable. Changing of cable lenght generates continous start and stop or dry working of pump.
• The pump must be positioned so that to let the float to move without obstacles (see the draw in the installation handbook).
• GT version (fixed float) must pump only clean water and not stagnant to guarantee its correct working.
• 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.

3) Equipments and tools required



• Megaohmeter 500 - 1000 Vdc;
• Threaded clutch (code 160600400) for test of pneumatic seal (see picture).

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;
• installation handbook;
• conditions of installation.

4.2) External visual inspection
• External condition of product
Corrosion on metal surface or on welds (with little holing) or overtemperature (motor sleeve with brown/blue colour) are an indication of incorrect or unsuitable use (see 2.1, 2.2, and 2.3) and exclude an acknowledgment of technical warranty.
Product analysis stop and repair (if required) is done for a fee.
If there are not elements of objection, go on with inspections in 4.3.

4.3) Preliminary inspections
• Data in plate:
  - type of product and code;
  - series number;
  - manufacturing date;
NOTE WELL: if rating plate on the pump is illegible or lost, it can found in one copy in installation booklet or, if installed, on control board door.
• Presence and condition of:
  - whole supply cable;
  - float;
  - test screw of pneumatic seal on head and his O-Ring;
• Welds and possible dents in the jacket.

4.4) Electrical resistence of windings
• Measure electrical resistance of windings to check the possible presence of interruption or burning.

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 MΩ.
Lower values of 10 MΩ are indicative of insulation breakdown (with probable water infiltration), therefore is necessary pneumatic seal test (see 4.6).

NOTE WELL: if pneumatic seal test does not indicate leaks, is necessary unconnect all electrical parts (supply cable, wound stator and float if presente), and repeat the measure of insulation resistance on singular components.

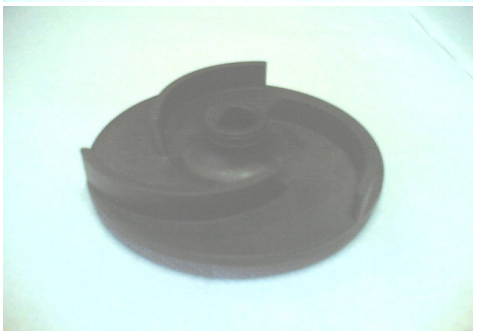
4.6) Pneumatic seal test

• Blow in compressed air 0.6 bar in test hole on higher head with help of threaed clutch.
NOTE WELL: pressures greater than 0.6 bar can generate damage to components and people.
• With pump immersed in water check absence of air balls from: delivery side, presscable plaques, bottom and welds.
• If pneumatic seal test not indicate leaks, see NOTE WELL in 4.5.

5) Disassembly and analysis

N.W. The pictures refers to a DOC 3 pump
• Remove the lower cover and the suction grid (DOC 3, DOC 7) or remove the fixing screw and the lower support (DOC 7VX) and check:
- presence or not of solid parts can have obstructed the pump.

• Remove the stop ring and exctract the impeller:
- check the conditions of the impeller and condition of V-Ring inserted on the hub.



• Unscrew the tie-rods and remove the external sleeve checking:
- its integrity;
- condition of welds;
- condition of O-Ring.

• Detach the upper head from the stator and check:
  - condition of O-Ring;
  - condition of capacitor;
  - connection in the terminal board;
  - check the possible presence of water or deposit witch indicates a infiltration of water through O-Ring or presscable.

• Detach the pump body and the rotor from the stator and examine:
  - the condition of intenal surface of pump body;
  - the condition of rotor bearings;
  - the possible corrosion of lower part of the shaft.

• Performe a heads visual analysis of stator to find 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) Checl list

Type of problem

- ☐ Does not delivery water
- ☐ Low performance
- ☐ Does not starts
- ☐ Does not stops
- ☐ Starts and stops too frequently
- ☐ Noisy
- ☐ Grounded motor
- ☐ Excessive power input
- ☐ Runs slowly
- ☐ Further:

Pump data

Type:
Code:
Series number:
Installation date:
Manufacturing date:
Liquid pumped:
Temperature:
Note:

DOC 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	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 st	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:	

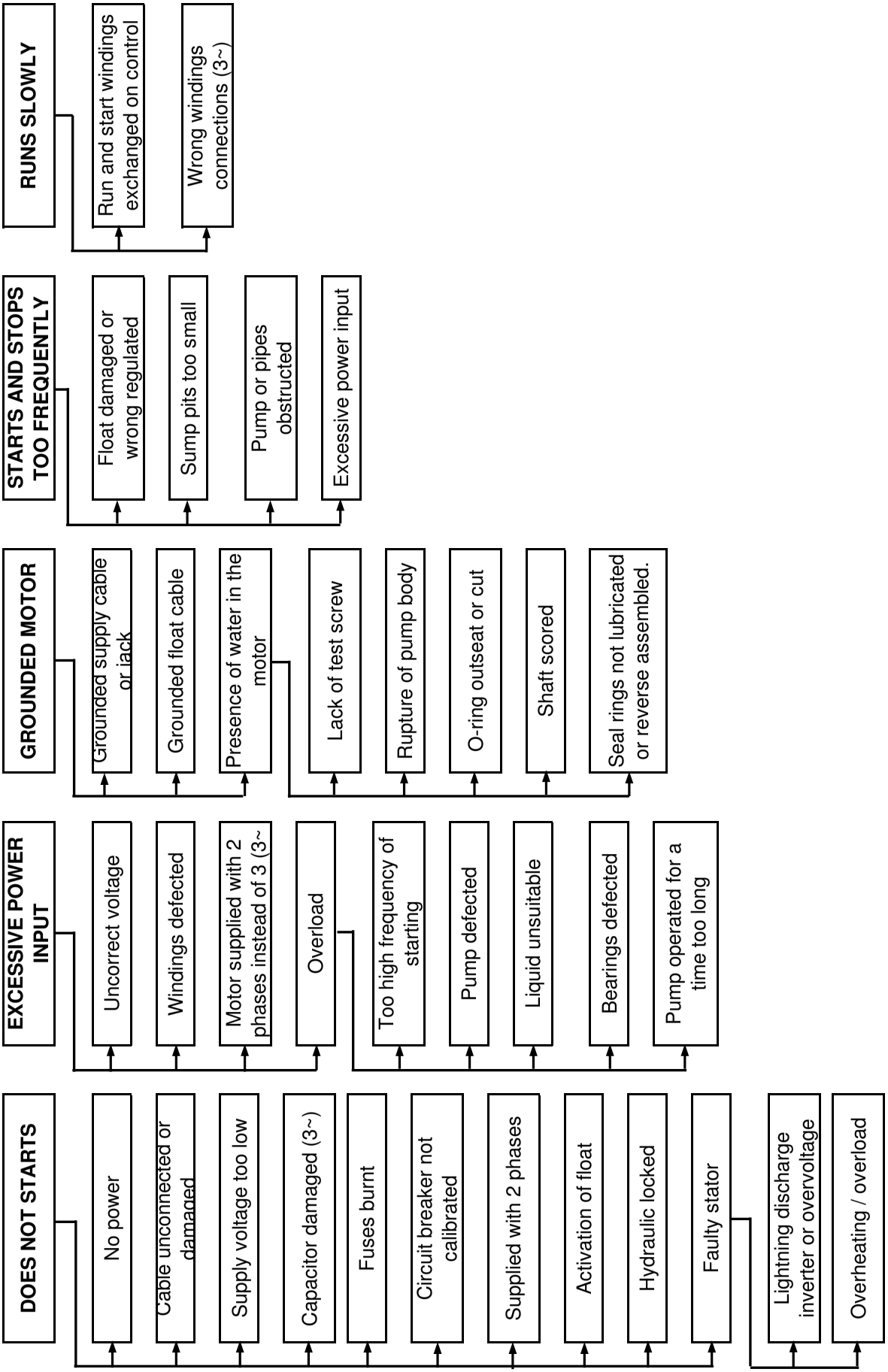
101 Motor shaft	Shaft / toothing jut	112 Not complying components tooling	
		100 Further (supply detailed description of failure)	
		103 Not complying/unsuitable applications	
		119 Normal wear	
		120 Excessive wear	
		101 Further:	
101 Motor shaft	401 Broken/cracked	112 Not complying components tooling	
		100 Further (supply detailed description of failure)	
		103 Not complying/unsuitable applications	
		119 Normal wear	
		120 Excessive wear	
		101 Further:	
200 Control device	200 Not operate	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	
		120 Excessive wear	
		101 Further:	
300 Total hydraulic	300 Low performance	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	
		119 Normal wear	
		120 Excessive wear	
		101 Further:	
300 Total hydraulic	104 Noisy / locked / vibrate	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:	
403 Pump sleeve	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	
		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	
		120 Excessive wear	
		101 Further:	
408 Pump shaft/joint	401 Broken/cracked	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	
		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	

9) Faq

Problem founded	Possible causes of the problem
Pump does not start	Power supply problems: • no power; • unconnected cable or damaged; • supply voltage too low; • starting drop voltage too high; Fuses burnt. Circuit breaker not calibrated. Capacitor too small or damaged (1~). 2 phases powered (3~). Activation of float. Hydraulic locked (solid parts between the impeller and the suction flange) Faulty stator.
Pump does not delivery water	Delivery outlet obstructed Water level too low Filter obstructed
Low performance	Delivery outlet obstructed Water level too low System leaks Dirty filter Wear of hydraulic part Pump run in the opposite way Wrong pump, undersized O-Ring damaged
Noisy	Motor bearings damaged Unbalanced hydraulic
Starts and stops too frequently	Float damaged or wrong regulated Sump pit too small Pump or pipes obstructed Excessive power input Leaks in system
Runs slowly	Run and start windings exchanged on control panel (1~) Wrong windings connections inside the motor (3~)
Grounded motor	Grounded supply cable or jack Grounded float cable Water infiltration: • through test holes; • rupture of pump body; • shaft scored; • O-ring pinched or cut; • seal rings not lubricated or reverse assembling.

Excessive power input	Uncorrect voltage Windings defected Motor supplied with 2 phases instead of 3 (3~ motor) Overload
Faulty stator	Lightning discharge inverter or overvoltage Overheating Overload
LEAKS OF HYDRAULIC PART	O-Ring pinched or cut External sleeve broken
Presence of water in the motor	Test screw lacking Rupture of pump body O-ring out of seat or cut Shaft scored Seal rings not lubricated or reverse assembled
Hydraulic locked	Liquid unsuitable Presence of foreign matters between the impeller and the suction flange.
Overheating/overload	Liquid unsuitable. Motor thrust bearings damaged Too high frequency of startings Supply voltage uncorrect Defected pump Pump operated for a time too long

7) Failure tree: motor (DOC pumps)



8) Failure tree: hydraulic part (DOC pumps)