ITT

Lowara

Failure Analysis System Procedure

5" Submersible Electric Pump SCUBA

1) Electric pump applications

• Water procurement from tanks, wells, ponds and watercourse;
• rain irrigation;
• rainwater recovery;
• industrial washings;
• pressurisation.

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:
  - 25 from 0,75 kW to 0,9 kW
  - 20 for 1,1 kW

If starting frequency is greater than limits, it generate overheating or overload problems.

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2.2) Liquid

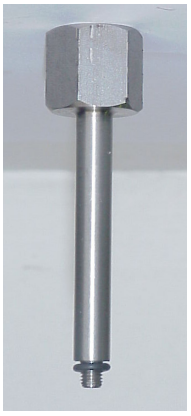
• Max liquid temperature less than 40°C
  - if temperature is greater than 40°C, it generate overheating in motor.
• Max diameter of solids in suspension: 2,5 mm
  - solid with diameters greater than limit, damage hydraulic part (stoppages) and motor (overload, overtemperature).
• Max amount of sand in water: 25 g/m^3.
  - excessive presence of sand damage impellers and mechanical seal.
• Liquid must not be brackishwater, seawater or corrosive.
  - for brackishwater, using a sleeve passivated it can extend pump operating life;
  - 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: 20 m.
  - an excessive depth damage float working (if present) and over heating of motor.
• Min depth of immersion: 0,5 m
  - a fluid level too low, generates problems of priming, pumping of pump, lubrication of mechanical seal and cooling of motor.
• 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).

2,4) Operation with inverter

There are no particular limitations except for information wrote in inverter handbook.



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 receveing 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

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;
  - plaque screws of cablepress and their gaskets;
  - filter;
• welds and dents in the jacket.

4.4) Electrical resistence of windings

Measure electrical resistance of windings and match values with those provided by Lowara.
If values are much different, it is possible there are damages of windings (interrupted/burnt).

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 penetration), 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.

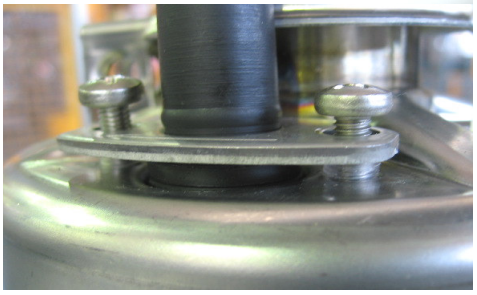
4.6) Pneumatic seal test

• 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

5.1) Hydraulic part analysis

• Remove the filter, screws, the supply cable and float cable (if present); check gasket of presscable screws (witch cause penetration of water in motor).



• Extract external sleeve.
• Extract the bush support and check conditions of bush (only for pumps with number of stages ≥ 5) and conditions of O-Ring.
• Turn with hand the pump shaft to check integrity and smoothness and see if:
  - shaft is broken;
  - external mechanical seal is stuck (excessive rotation resistance);
  - motor shaft bearings are damaged.

• Disassemble hydraulic part checking:
  - presence of possible damages, wear or slides of impeller hub;
  - condition of O-Ring in diffuser box;
  - presence of foreign matters (sand, gravel, filament,...) in impellers and diffusers;
  - condition of external mechanical seal surface and O-Ring;
• Unscrew the screw on the lower head and empty the oil chamber checking quantity and presence of water in emulsion (indicate penetration of water through mechanical seal).
• Check condition of internal mechanical seal (surface and O-Ring).

• Check upper head to find possible cracks of fault in O-Ring.

5.2) Electrical part analysis

• Condition of capacitor (if present);
• Condition of stator sleeve (internal) particularly in welded area (welding seam continuity), absence of steps
• Extract wound stator , check O-Ring on lower bearing rest (integrity, squashing, cutting,...);
• Check motor shaft and presence of compensation ring.

• Heads visual analysis for finding of 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
- ☐ 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:

Scuba pump 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 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	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. 2 phases powered (3~). Mechanical seal stuck. Stator slot interrupted. Pump shaft broken. Activation of float and level probes. Excessive operating depht. Hydraulic locked. Faulty stator
Pump does not delivery water	Water level has dropped Delivery outlet clogged Pump shaft broken Clogged filter
Low performance	Water level has dropped Delivery outlet clogged Clogged check valve Pump shaft broken Wrong connections in the motor System leaks Dirty filter Wear of hydraulic part Pump run in the opposite way Wrong pump, undersized O-Ring damaged
Does not stops	Float defected Level probe defected Leaks in system
Noisy	Motor bearings damaged Unbalanced hydraulic Impellers slide on diffusers
Starts and stops too frequently	Pump oversized Pressure switch not calibrated, float damaged Liquid temperature too high Excessive power input Leaks in system

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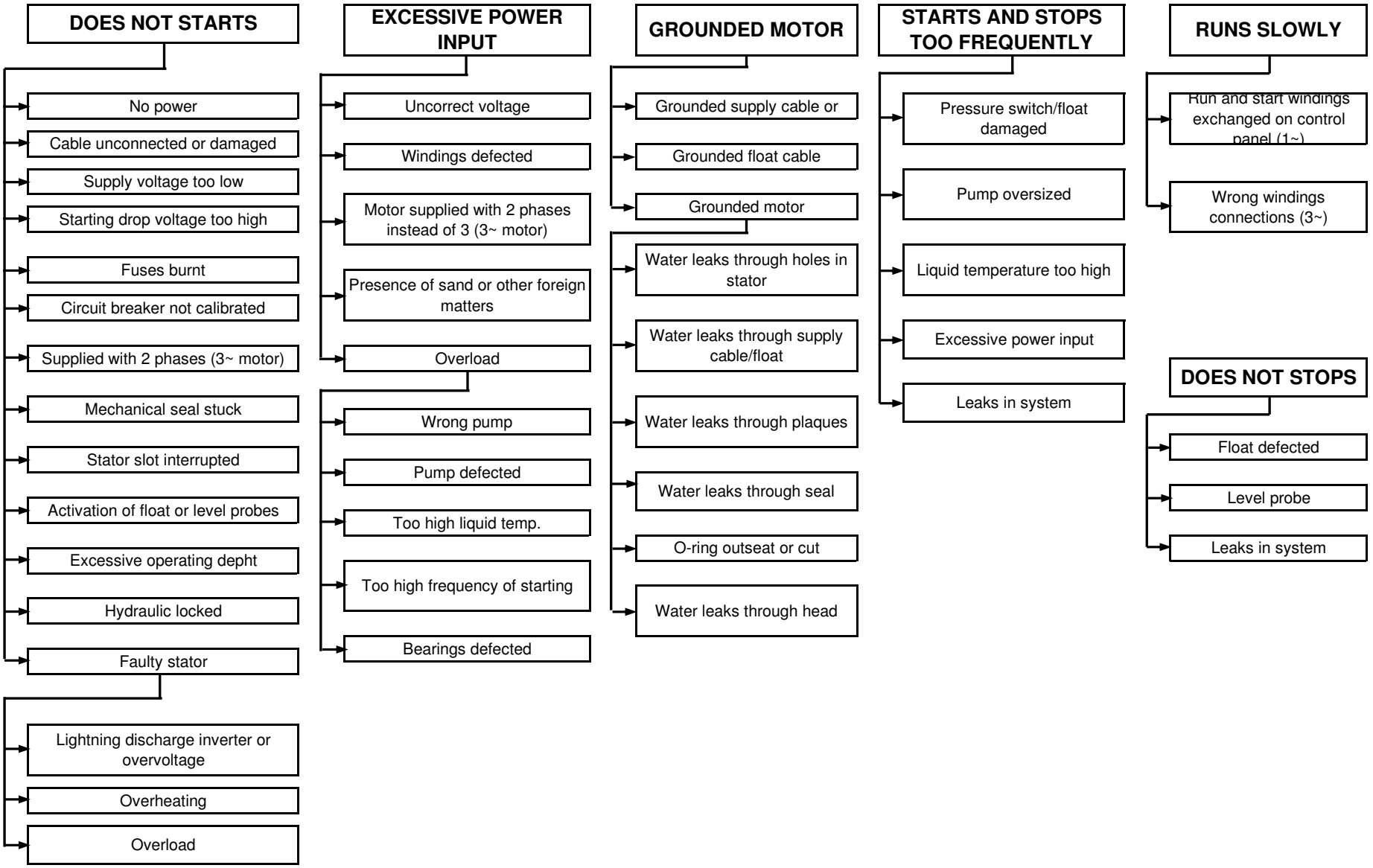
Runs slowly	Run and start windings exchanged on control panel (1~) Wrong windings connections inside the motor (3~)
Grounded motor	Grounded supply cable or jack Grounded float cable Water leaks through holes in stator Water leaks through supply cable or float cable Water leaks through plaques Water leaks through seal O-ring outseat or cut Water leaks through head
Execessive power input	Uncorrect voltage Windings defected Motor supplied with 2 phases instead of 3 (3~ motor) Presence of sand or other foreign matters inside of pump Wrong pump Pump defected Bearings defected
Faulty stator	Lightning discharge inverter or overvoltage Overheating Overload
Presence of water in motor	Double mechanical seal broken O-Ring outseat or cut Plastic upper head broken Stator sleeve damaged
Hydraulic locked	O-Ring outseat Liquid unsuitable Presence of foreign matters in pump Mechanical seal stuck
Overheating/overload	Too high frequency of startings Too high liquid temperature. Wrong supply voltage. Wrong pump Defected pump Thrust bearings damaged/seized Pump sanding

7) Failure tree: motor (SCUBA)



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8) Failure tree: hydraulic part (SCUBA)