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Failure Analysis System Procedure

4" 6" Oil Submersible Motors

1) Motor applications

• drinking water feeding;
• wells;
• irrigation systems;
• industrial systems;
• fountains;
• water level control;

2) Critical items of application

2.1) Electrical supply
• In running condition, supply voltage must be into tolerance values.
A too high voltage can generate overheatings and overloads.
• In starting operation, drop voltage must be into limits declared by constructor to avoid damage on the motor windings.
• 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).

2.2) Liquid

• Max liquid temperature and corresponding min liquid speed around the motor external sleeve, must respect limits indicates on the installation book.
- If temperature is too high or speed is too low, it can generate overheating.
  To guarantee a correct water speed, it have to installe an external sleeve, if necessary.
- If liquid temperature is greater than critical value, the motor must be derated according to coefficients supply by constructor.

• It must be guarantee a minimum distance of 1 m between pump and bottom of well in order to guarantee the correct cooling of the motor and to avoid the pump can suck deposited solid parts, witch obstruct the filter and damages the hydraulic part.
• Liquid must not be brackishwater, seawater or corrosive (for water witch contain chloride, see the attached diagram):
 - 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) Pump coupling

• Nominal motor power must be greater or equal than pump motor; otherwise, it can generate overheating or overload.
• Axial thrust value must be into tolerance values both in vertical and horizontal condition. Motor and pump cupling made by Lowara, assures respect of this requirement:
  - axial thrust too high can generate frictions witch can damage thrust bearing;
  - axial thrust too low can damage upper thrust washer.

2.4) Control of motor by inverter

• There are not scheduled particularly limitations except for informations wrote in inverter handbook.

3) Equipments and tools required

• Megohmmeter with applicable voltage of 500 - 1000 V.

4) Inspection of defected product

4.1) Preliminary information

To receiving of defected product, require of Customer:
• purchase date (if possible, confirmed by bill or sale slip);
• installation date;
• conditions of installation.

4.2) External visual inspection
• External aspect 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 ÷ 2.4) and exclude an acknowledgment of technical warrant.
Product analyse stop and repair (if required) is made 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;
  - stator number;
  - manufacturing date;
• Presence and condition of:
  - whole supply cable;
• Welds and dents in the jacket;
• Check with hand if rotor rotate or is locked (bearings damaged).
• Condition of connector and its seat
• Diaphragm position respect to normal condition

4.4) Electrical resistence of windings
• Measure electrical resistance of windings to check the presence of damages (interruptions or burning).

4.5) Measure of insulation resistance
Performed in accordance with european standard EN 602 04-1 (500 Vdc between conductors and ground) on following singular parts:
• supply cable unconnected (3 wires in short circuit and each wire separately):
  - insulation resistence must be > 20 MΩ
• motor (on connector pins)
  - insulation resistence must be > 20MΩ.

6) Disassembly phase and analysis

Review and check:
• diaphragm
  - persence of holes, cuts or deposit of sand or earth.

.

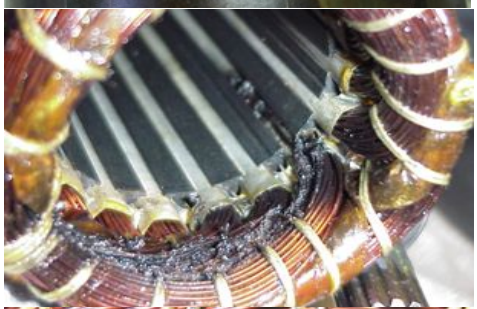
• sandslinger:
  - integrity;
  - wear;

• thrust bearings and mechanical seal:
  - damages/breakings;
  - slidings.

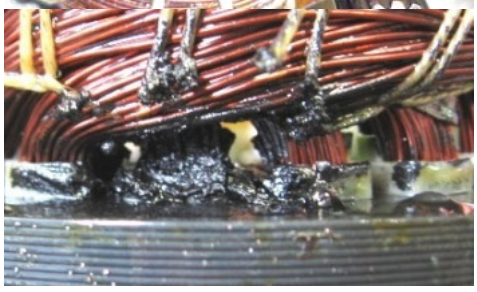
• rotor:
  - ground areas;
  - toothing;
  - excessive plays.

• Check sleeve/spacer ring condition:
  - holes / damages caused by rotor sliding;
  - swellings / change of colour caused by overheating.

• Heads visual analysis for 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;

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6) Check list

Type of problem

- ☐ Does not starts
- ☐ Does not stops
- ☐ Starts and stops too frequently
- ☐ Grounded motor
- ☐ Excessive power input
- ☐ Runs slowly
- ☐ Further:

Motor data

Type:
Code:
Series number:
Stator number:
Installation date:
Manufacturing date:
Remarks:

Submersible motors' failure causes required for claim opening

Where	What	Why	
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:	

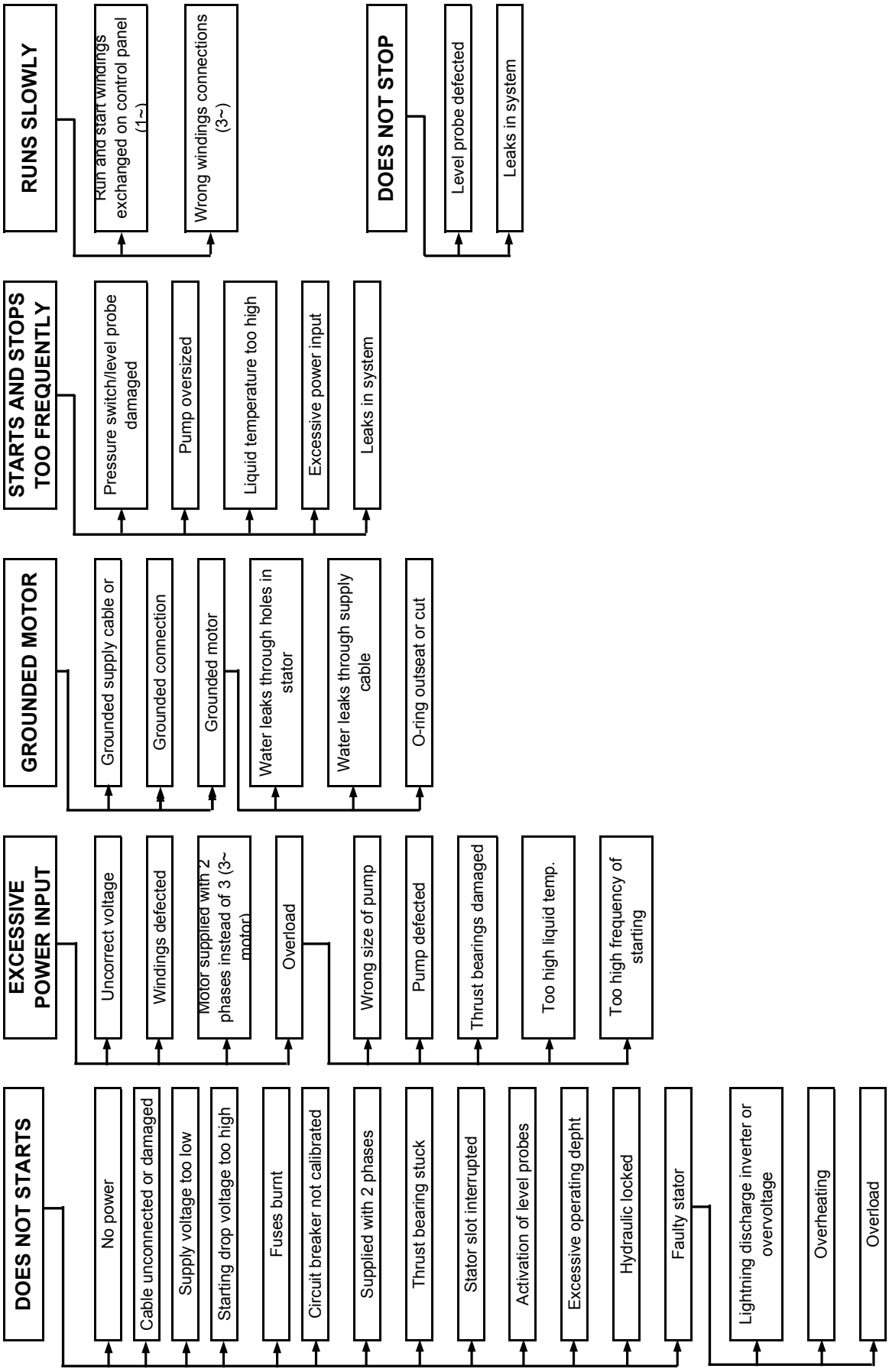
200 Control device	200 Not operate	105 Defected/not operating electrical/electronic components	
		200 Lack of technical / commercial information	
		118 Not operating level sensors	
		119 Water full level sensors	
		100 Further (supply detailed description of failure)	
		121 Inadequate power supply	
		103 Not complying/unsuitable applications	
		119 Normal wear	
		120 Excessive wear	
		101 Further:	
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:	
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	

8) FAQ

Problem	Possible causes of the problem
Motor does not start	Supply problems: • no power; • unconnected cable; • too low supply voltage; • excessive starting voltage drop; Burnt fuses Circuit breaker not calibrated Small capacitor or bursted (1~) 2 phases powered (3~) Thrust bearing stuck Stator slot interrupted Activation of level probes Hydraulic locked Excessive operating depht Faulty stator
Motor does not stops	Level probe defected Leaks in system
Motor rotates slowly	Run and start windings exchanged on the control panel (1~) Wrong wire connections inside of the motor Wrong voltage or frequency
Starts and stops too frequently	Pump oversized Pressure switch Liquid temperature too high Excessive power input Leaks in system
Excessive power current input	Overload Defected winding Motor supplied with 2 phases instead of 3 (3~ motor) Wrong pump (excessive load) Defected pump Mechanical motor problems (thrust bearing, sleve bearings)
Grounded motor	Grounded cable/jack Grounded connection Water leaks through holes in stator Water leaks through supply cable. O-Ring is out of seat or cut
Inflated sleeve	Inside short circuit

Change of sleeve colour	Overheating
Rotor locked	Degreased or seized bearing Bearing stuck caused by a long inactivity period Broken bearing Material deposit Inflated sleeve
Windings damaged	Overheating / overload Motor supplied with 2 phases Inadequate size of fuses Circuit breaker not calibrated Overvoltage caused by lightning discharge Rupture / defect of insulation
Bearings damaged	Excessive axial thrust Pumping of unsuitable liquid (sandy) Infiltration of sand caused by rupture of diaphragm or sandslinger Vibrations originated by pump
Overheating / overload	Motor operated outside of water Too high frequency of startings Too high liquid temperature Too low liquid flow around the sleeve. Too low quantity of cooling liquid in the motor Wrong supply voltage. Wrong pump Pump defected Thrust bearings damaged/seized Pump sanding

7) Failure tree (oil submersible motors)



Usefulness Range of Steel in Chlorinated Liquids