ITT

Lowara

Failure Analysis System Procedure

DN DL Submersible Electric Pumps for Dirty Waters

1) Electric pump applications

DN pumps
• Draining of flooded excavations and marshy ground.
• Irrigation from rainwater reservoirs, ditches, ponds and watercourses.

DL pumps
• Pumping of sewage with suspended solids and filaments.
• Emptying of sumps, septic tanks and wastewater discharge tanks.
• Draining of flooded excavations and marshy ground.
• Water display, fountains.

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 20 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:
  - pump totally submersed: 50°C;
  - pump partially submersed: 25°C;
  - if temperature is greater than max value, it generate overheating in motor.
• Max diameter of solids in suspension:
  - DN pump: 5 mm;
  - DL 80, 90, 105, minivortex, vortex pumps: 45 mm;
  - DL 180, 200 pumps: 50 mm;
  - DL 180, 200 pumps: 60 mm;
  - DLV 120, 140, 160 pumps: 65 mm.
- solid parts with diameters greater than limits, damages hydraulic part (stoppages) and motor (overload/overheating);
  - if the liquid contains filaments on suspension, it is advised to use the pump with VORTEX impeller.
• 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.
• If the pump is installed inside of a sump pit, its dimensions must be so that to avoid continous start and stop of the pump; otherwise, the motor is subjected to overheating.
• Immersion of the pumps, must be performed so that avoid a generation of air bell inside of it; it is advised immersion with oblique or horizontal axis.
• These pumps have motor filled with oil, so they must not installed with horizontal axis. Otherwise, it generates a overheating of the motor caused by movement of air bouble contained in the motor.
• The topping up of the oil in the motor is forbidden because there is an explosion danger.
• These pumps must be handled only with the handle on the head or the chains but never with the supply cable to avoid the damages.
• Lenght of float cable must not be modified and it necessary check the fixing of the cable. Changing of cable length 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).
• The pump must never work in dry condition.
• It is necessary insert a ball valve in the delivery outlet at min distance of 50 cm from pump (and with vertical axis) to protect it from water hammer and reverse rotation.
• These pumps can not rotate in the opposite way; in particular manner, in DL pumps, the reverse rotation generate a rupture of the impeller (just next to the spot welding).
• 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;
  - capacitor (if present);
  - support feet in DL pump (they can be detached because of vibrations caused by operating with null flow rate or unbalanced hydraulic or presence of foreign matters between impeller and pump body).
• Welds and possible dents in the jacket.

4.4) Electrical resistence of windings
• Measure electrical resistance of windings to check the possible presence of 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 ≥ 20 MΩ.
Lower values of 20 MΩ are indicative of insulation breakdown (with probable water infiltration and/or leak of oil), therefore is necessary pneumatic seal test (see disassembly).

5) Disassembly and analysis

NOTE WELL The pictures refers to DN pump.
• Check the free rotation of the shaft. If the shaft is locked or rotate with difficult, the mechanical seal can be stuck or (for DL pumps with singlechannel impeller), the foreign matters can interpose oneself between the impeller and the suction flange
• Remove the filter and the suction flange (DN) or remove the support feet and the suction flange (DL) and check:
- presence or not of a great quantity of solid material witch can have obstructed the pump;
- condition of wear of suction flange. The wear is caused by normal working of pump and possible replacement can not be considered under warranty.

• Remove the fixing screw and exctract the impeller:
- check the conditions of impeller welds and its wear.

• Unscrew the presscable and remove the Supply cable, and float cable (if present).
• Remove the plug of oil filling and empty the motor.
• Performe a pneumatic seal test using a test hole on the head:
- blow in compressed air 0.6 bar in filling oil hole on higher head with help of threaded 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.

• Unscrew the fixing screw of motor casing to the pump body and remove the pump body hiting it with the hammer:
- check the condition of internal surface of pump body;
- check the condition of O-Ring.

• Extract the rotor (for DL 109-125 e DLV 100-115 pumps, first of all, it is necessary remove the two lock bearings plaques) and check:
- the condition of motor bearings;
- possible rupture of shaft near the key seat (defect of production)
• Remove the mechanical seal from the shaft and check the condition of its surface.

• Extract from the pump body, the segger and extract one by one the seal shoulder washer, the fixed part of mechanical seal and the seal specer:
- check the correct assembling of the mechanical seal;
- check the possible wear of the parts.

• Performe a heads visual analysis of stator 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
- ☐ 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:
Remarks:

DN-DL 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 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:

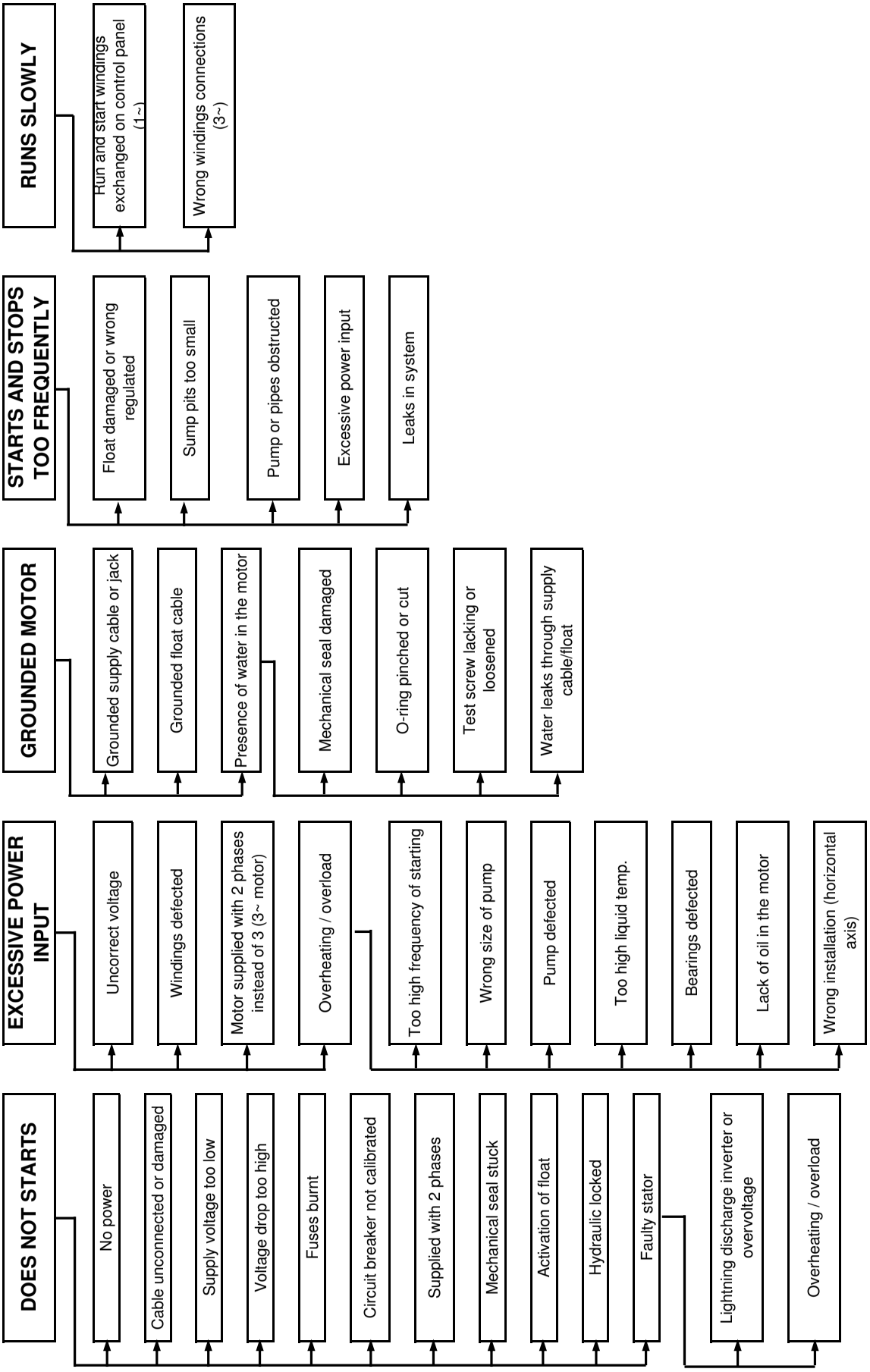
101 Motor shaft	102 Shaft / toothing jut	112 Not complying components tooling
		100 Further (supply detailed description of failure)
		103 Not complying/unsuitable applications
		119 Normal wear
		120 Excessive wear
		101 Further:
101 Motor shaft	401 Broken/cracked	112 Not complying components tooling
		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~). Mechanical seal stuck 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 Non return valve clogged
Low performance	Delivery outlet obstructed Dirty filter Clogged non return valve Non return valve installed with horizontal axis Water level too low System leaks 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 leaks through holes in stator Water leaks through supply cable or float cable Water leaks through mechanical seal Water leaks through test hole O-ring pinched or cut
Excessive power input	Uncorrect voltage Windings defected Motor supplied with 2 phases (3~ motor) Overload
Faulty stator	Lightning discharge inverter or overvoltage Overheating Overload
Presence of water in motor	Mechanical seal damaged O-Ring pinched or cut Test screw loosened or lacking Water leaks through supply cable/float Motor sleeve damaged
Leaks of hydraulic part	O-Ring pinched or cut Mechanical seal damanged Defect of fusion
Hydraulic locked	Liquid unsuitable Presence of foreign matters between the impeller and the suction flange (DL pump with singlechannel impeller)
Overheating/overload	Too high frequency of startings Too high liquid temperature. Wrong supply voltage. Wrong size of pump Defected pump Motor thrust bearings damaged/seized Lack of oil in the motor Wrong pump installation (horizontal axis)

7)Failure tree: motor (DN-DL pumps)



8) Failure tree: hydraulic part (DN-DL pumps)