

Failure Analysis System Procedure

CEA-CA, HM-HMS Electric Pumps



1) Electric pump applications

CA-CEA made with AISI 304 and HM

- Pumping of water and liquids chemically and mechanically not aggressive.
- Water storing;
- Irrigations;
- Water circulation (cold, hot, chilled)

CA-CEA made with AISI 316 and HMS

- Reverse osmosis
- Industrial washings
- Swimming pool
- Gold industry
- Wine production

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;
 - frequents start and stop of pump can generate a rupture of the motor tie rods.

2.2 Liquid

- Pumps made in standard configuration must pump clean water or condensate.

Temperature limits and standard configurations:

- CEA-CA pumps: -10°C, +85°C,
with mechanical seal ceramics/coal/NBR;
- CEA(N)-CA(N) pumps: -10°C, +85°C,
with mechanical seal ceramics/coal/EPDM;
- HM pumps: -10°C, +60°C,
with mechanical seal ceramics/coal/EPDM;
- HMS pumps: -10°C, +110°C,
with mechanical seal ceramics/coal/EPDM.

- In case of applications with bigger range of temperature and pumping of other liquids, pumps must be configured with attention.

Main configurations realized, based on the type of application, are wrote in the following table:

Application	Advised seal (*)	Note
Deionized water	Silicon carbide/Special coal/EPDM oFPM	Suitable for waters witch have just undergone by process of direct or reverse osmosis
Demineralized water	Silicon carbide/Special coal/EPDM oFPM	
Pasteurizing systems	Ceramica/Coal/NBR or FPM or EPDM	Pumping of water with Tmax ≤ 100°C
Washing of systems for the food industry	Widia/Special coal/EPDM	Mixture of water and hard caustic: max conc. 20%, Tmax 80°C.
Generics washing systems	Widia/Special coal/EPDM	Products to alkaline base with Ph between 8 and 10. For greater Ph it is advised Widia/Silicon carbide/EPDM
Refrigeration systems	Widia/Special coel/EPDM or Widia/Silicon carbide/EPDM	Mixture of water and glycol with concentration from 10% to 100% and temperature from -55°C to +40°C
Transfer/pumping of generic chemical products	It is advised to contact the sale net	Large tipology of acids

(*) Rotating part/fixed part/O-Ring

- If is pumped an abrasive liquid with CEA pump, it is advised to use the pump with the seal holding disc without the 3 indents.
- Pumping of diesel oil or others inflammable liquids is concurred only with use of special version pumps and equipped with Atex motor.
- Pumping of sea water, brackishwater or with a great concentration of chlorine is not advised because of priming of corrosive phenomena in hydraulic part.

2.3) Installation:

- Max environment temperature: 40 °C.
- Max operating pressure: 8 bar.
- Installation of pump inside of environments with a great humidity causes damaging of motor bearings.
- If the pump is used in refrigeration systems, it is advised to remove the condensate evacuation plugs of the motor for facilitate her evacuation.
- In case of pump with negative water head, or in case of pumping of hot liquids it is necessary check the difference in height between the axis pump and the level of water can guarantee the correct working of pump without cavitation (check NPSH value).
- Pump must never operates without water to avoid damages of mechanical seal and hydraulic part.
- The pump mustn't operates when the delivery outlet is closed (overheating of pumped liquid and motor).

- 1~ motors with power until 1.5 kW of CEA-CA pumps and 1~ motors of HM-HMS pumps have an internal motor protection but they cannot operate without a operator supervision or insertion of additional protections inside of control board.
- For 1~ motor with power >1,5 kW of CEA-CA pumps and all 3~ motor, must be protect with a circuit breaker installed by a Customer (it is advised use of Lowara control board).
- 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.
- Pump must be positioned correctly so that permit the disassembly of the motor and the hydraulic part without remove the pump body from pipe so that performe ease an inspection.

- Pump must be positioned and anchored to a plane surface. Moreover, suction and delivery pipes must be anchored to a wall and they mustn't charge to pump body; otherwise, suction and delivery pump cupling can break.
- It is necessary insert a non return valve inside of delivery for protect the pump from water hammer and reverse rotation.
- 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 performance will be low and will generates damages of hydraulic part.
- If the performances of pump are greater than witch previewed, or if it pumps a dense, viscous liquids, is possible change their by turning of impeller.
- Normally the pump is installed with horizontal axis; it can be installed with vertical axis too, but the motor must be positioned over the hydraulic part to avoid the contact with water (in case ok leaks) or condensate witch can be on the pump body.

2.4) Operation with inverter

- Operation with inverter positioned inside of the control board not present particular limits (see the inverter handbook).
- Installation of our equipment TKS directly is possible only for 3~ pump with power until 1.1kW.

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 the presence of weld defects, and integrity of aluminum motor casing.

4.3) Preliminary inspections

- Data in plate:
 - type of product and code;
 - series number;
 - manufacturing date;
- Based on type of application witch is subject the pump, check if the configuration is right or wrong (see the table in 2.2).
- Condition of capacitor (if present) and connections on terminal board.

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 refer to HM pump.

- Remove the protection grid, depending on the motor type, extract the fan with 2 screwdriver or unsrew the screws on the hub and check:

- the condition of fan;
- the free rotation of the shaft with screwdriver.

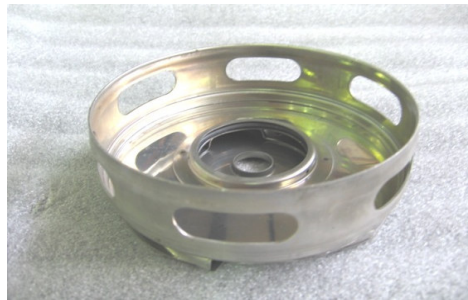


- Unscrews the screws, remove the pump body (HM-HMS-CEA) or suction flange (CA) and check:

- conditions of his internal surface (presence of wear, defects of welds);
- the presence of initial disc inserted for interference (this disc is necessary to keep close the stages in the HM-HMS pumps);
- conditions of O-Ring positioned between pump body and suction flange (CA);
- the presence of foreign matters.



- Unscrew the lock nut and extract one by one the stages (diffuser + impeller) and check:
 - the presence of wear or defects of welds (stainless steel impellers);
 - presence of wear in the bush of plastic impeller (HM).



- Remove O-Ring from his seat (on seal holding disc):
 - check the presence of wear or cuts.
- Extract the mechanical seal from shaft, taking care of not damage it, and remove the seal housing:
 - check condition of her 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);
 - if inside of CEA pumps there are the three indents on the seal holding disc, check their wear condition (possible wear indicates the pumping of abrasive liquid).



- Extract the rotor and check the conditions of bearings.



- 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

<input type="checkbox"/>	Does not delivery water
<input type="checkbox"/>	Low performance
<input type="checkbox"/>	Does not starts
<input type="checkbox"/>	Noisy
<input type="checkbox"/>	Grounded motor
<input type="checkbox"/>	Excessive power input
<input type="checkbox"/>	Runs slowly
<input type="checkbox"/>	Further:

Pump data

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

CEA-CA-HM-HMS 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
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 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

8) Faq

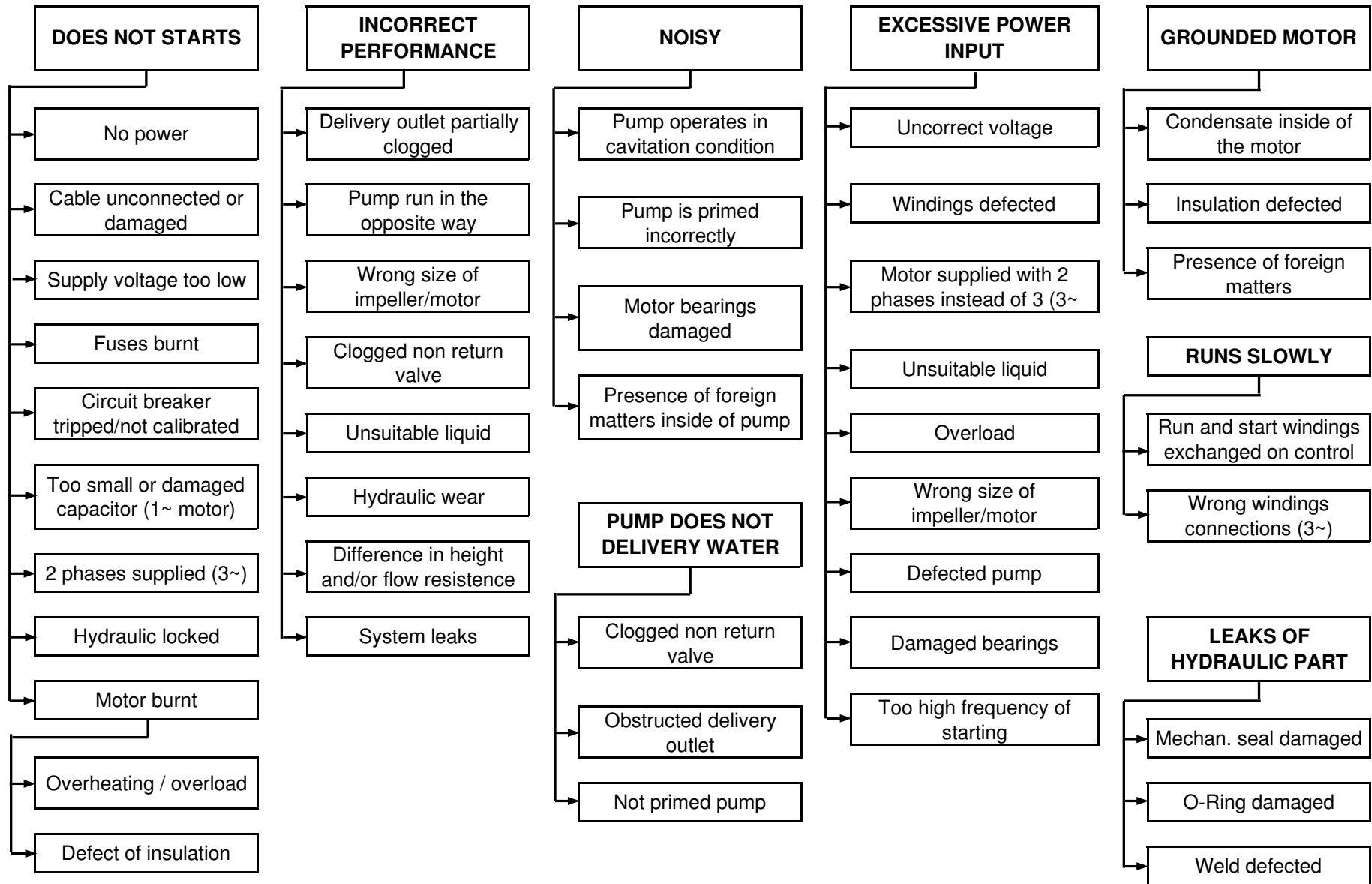
Problem founded	Possible causes of the problem
Pump does not start	Power supply problems: <ul style="list-style-type: none"> • no power; • unconnected or damaged cable; • supply voltage too low; Hydraulic locked. Fuses burnt. Circuit breaker tripped/not calibrated. Capacitor too small or damaged (1~ 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 clogged Pump run in the opposite way Pump is undersized Wrong size of the motor Wrong diameter of pump impeller Clogged non return valve Unsuitable liquid (density or specific weight) Wear of hydraulic part Difference in height and/or flow resistance too highs 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	<ul style="list-style-type: none"> Uncorrect voltage Windings defected Motor supplied with 2 phases instead of 3 (3~ motor) Unsuitable liquid Wrong size of impeller/motor Defected pump Defected bearings Too high frequency of startings
Hydraulic locked	<ul style="list-style-type: none"> Unsuitable liquid Presence of foreign matters inside of the pump Tolerance of tooling beyond the limits O-ring out of seat
Overheating/overload	<ul style="list-style-type: none"> Too high pumped liquid temperature Too high frequency of startings Wrong supply voltage Wrong size of pump/motor 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



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7) Failure tree (CEA-CA-HM-HMS pumps)



Lowara