

Winding Damages

Single-Phase Motors



The correct specification of the motor (voltage, frequency, polarity, degree of protection, among others) for its application is the first basic requirement for a long useful life of the motor. However, this is not all that will ensure proper operation. The correct installation, maintenance and operation are essential. In the event of the burnout of an electric motor, the first measure to be taken is to identify the cause (or possible causes) for the burnout by analyzing the damaged winding. It is essential that the cause of the burnout be identified and eliminated so as to prevent any new damages to the motor. In order to help in the analysis, the pictures and the table below present the characteristics of some types of winding burnouts and their possible causes.

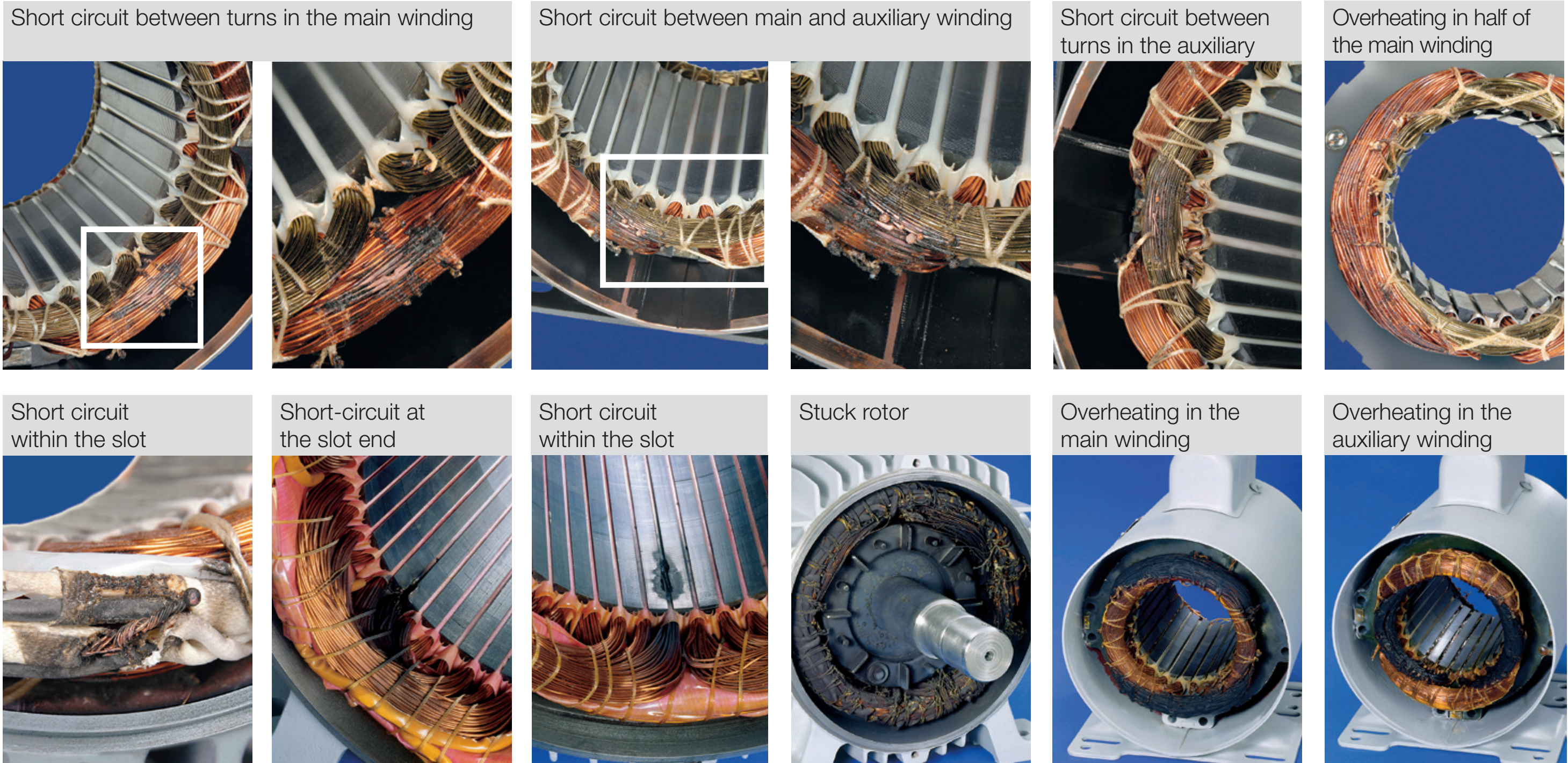


Table of burnout characteristics and possible causes

Burnout characteristics		Possible causes
Short circuit between turns in the main winding		<ul style="list-style-type: none">Internal contamination of the motor;Fault in the wire insulating enamel;Fault in the impregnation varnish;Fast oscillations in the power supply.
Short circuit between turns in the auxiliary winding		<ul style="list-style-type: none">Internal contamination of the motor;Fault in the wire insulation enamel;Fault in the impregnation varnish.
Overheating in half of the main winding		<ul style="list-style-type: none">Fault in the voltage selector switch when set to lower voltage supply;Overload peaks that cause the centrifugal closing of the stationary switch with the motor supplied with the higher voltage. The half of the winding that burns out is the one which is not in parallel with the auxiliary winding.
Short circuit between main and auxiliary winding	Motors with start capacitor or split-phase (no capacitor)	<ul style="list-style-type: none">Internal contamination of the motor;Fault in the wire insulation enamel;Fault in the impregnation varnish.
	Motors with permanent capacitor	<ul style="list-style-type: none">Internal contamination of the motor;Degradation of the insulating material by drying out caused by high temperatures;Fault of the insulating material between main and auxiliary.
Short circuit in the connection		<ul style="list-style-type: none">Internal contamination of the motor;Fault in the insulating material;Overheating of the connection due to poor contact.
Short circuit at the end of the slot our short circuit within the slot		<ul style="list-style-type: none">Internal contamination of the motor;Degradation of the insulating material by drying out caused by high temperatures;Fault in the wire insulation enamel;Fault in the insulating material;Fault in the impregnation varnish;Fast oscillations in the power supply.
Stuck rotor		<ul style="list-style-type: none">Excessive difficulty to start the motor (significant voltage drop, inertia and load torque too high);Load shaft is stuck.
Overheating in the main winding	Motors IP21 and IP55	<ul style="list-style-type: none">Too long and/or very thin supply cables;Incorrect wiring of the motor connecting cables;Load excess on the shaft end (permanent or occasional/periodic);Overvoltage or undervoltage in the power supply (permanent or occasional/periodic);Poor ventilation (high ambient temperature, motor operating in confined place, obstruction of the motor air inlets, dirt on the frame, fan cover [IP55] damaged or obstructed).
	Motors IP21	<ul style="list-style-type: none">Auxiliary circuit open: <ul style="list-style-type: none">Motor with start capacitor: problem on the capacitor, stationary switch or centrifugal;Permanent capacitor motors: problem on the capacitor;Motor split-phase: problem on the stationary switch or centrifugal.
	Motors IP55	<ul style="list-style-type: none">Auxiliary circuit open: problem on the capacitor, stationary switch or centrifugal.
Overheating in the auxiliary winding	Motors with start capacitor or split-phase (no capacitor)	<ul style="list-style-type: none">Incorrect wiring of the motor connecting cables;Difficulty to start the motor (significant voltage drop, inertia or load torque too high), not allowing the quick opening of the centrifugal/stationary switch set, leaving the auxiliary coil energized too long;Excessive number of starts in a short time;Penetration of foreign objects in the motor may cause the not opening of the centrifugal/stationary switch.
	Motors with permanent capacitor	<ul style="list-style-type: none">Incorrect wiring of the motor connecting cables;Excessive difficulty to start the motor (significant voltage drop, inertia and/or load torque too high);Excessive number of starts in a short time;Motor operating with no load or with load too low.





Three-Phase Motors

The correct specification of the motor (voltage, frequency, polarity, degree of protection, among others) for its application is the first basic requirement for a long useful life of the motor. However, this is not all that will ensure proper operation. The correct installation, maintenance and operation are essential. In the event of the burnout of an electric motor, the first measure to be taken is to identify the cause (or possible causes) for the burnout by analyzing the damaged winding. It is essential that the cause of the burnout be identified and eliminated so as to prevent any new damages to the motor. In order to help in the analysis, the pictures and the table below present the characteristics of some types of winding burnouts and their possible causes.

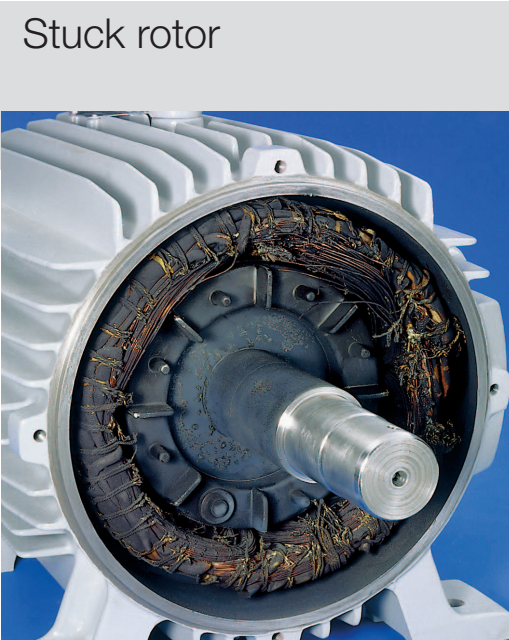
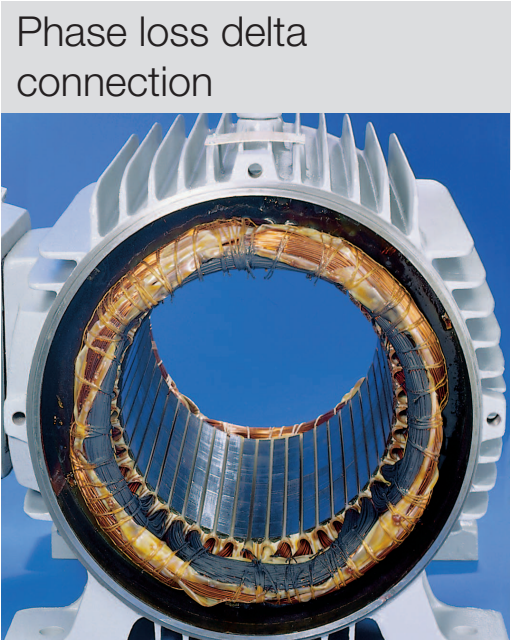
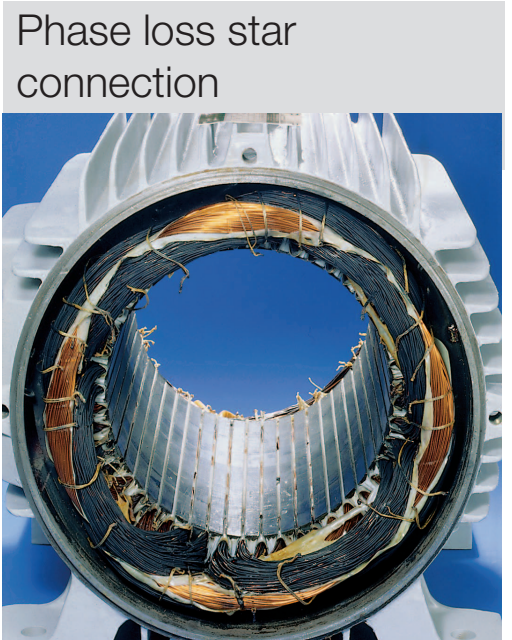
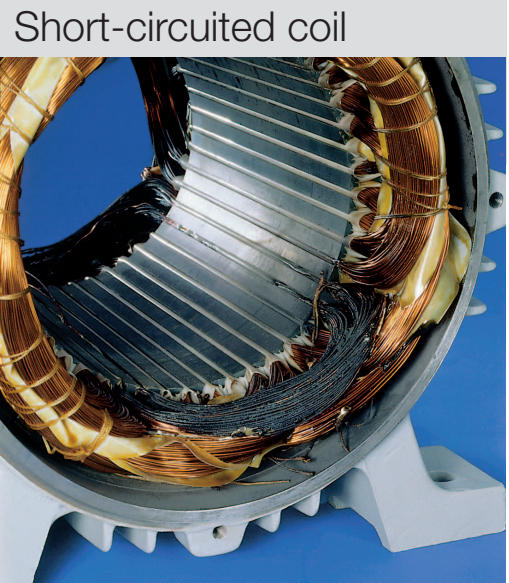
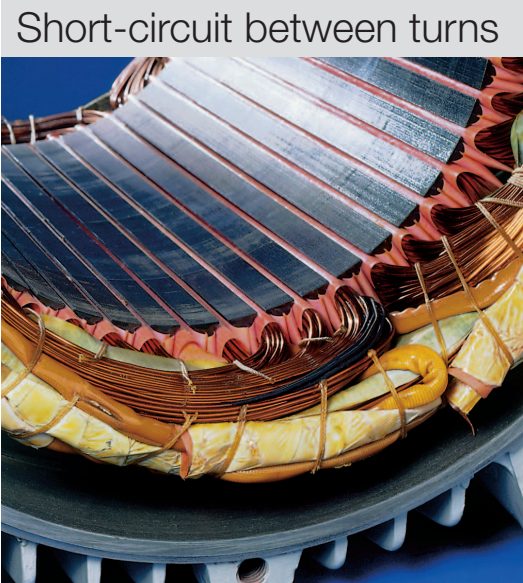
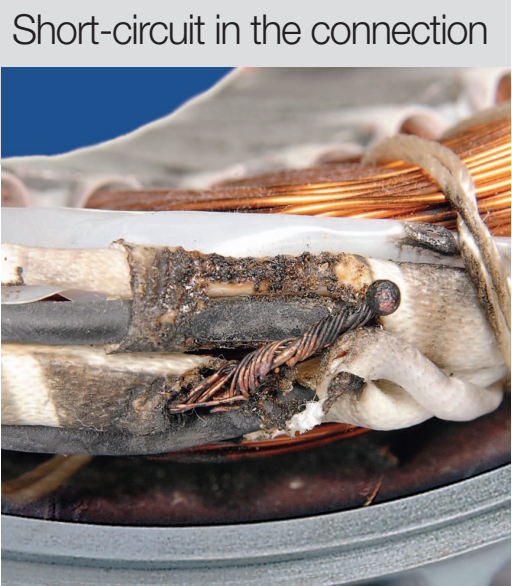
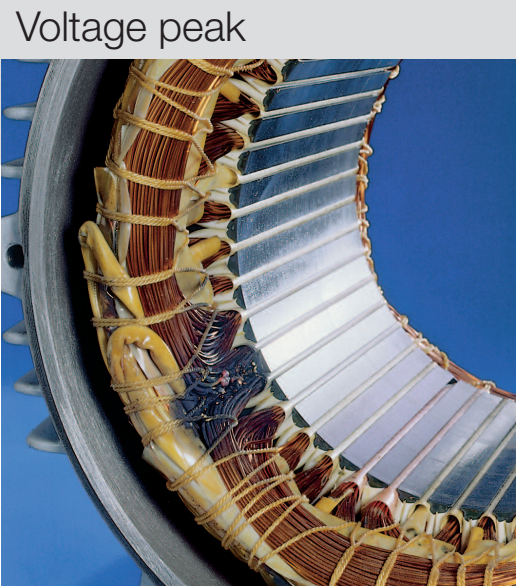
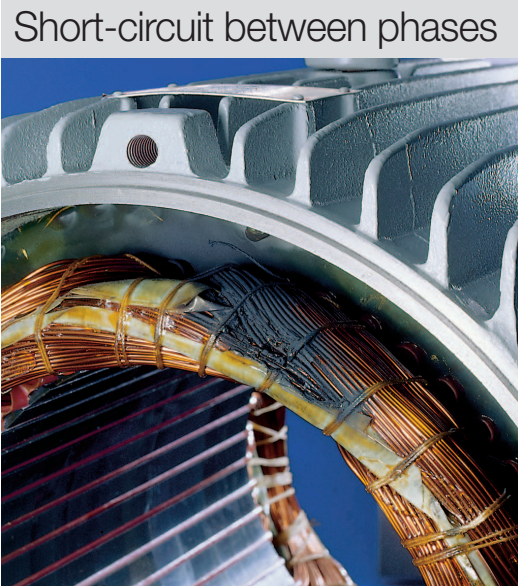


Table of burnout characteristics and possible causes

Burnout characteristics	Possible causes
Short circuit between turns or Short circuited coil	<ul style="list-style-type: none">■ Internal contamination of the motor;■ Fault on the wire insulating enamel;■ Fault in the impregnation varnish;■ Fast oscillations in the power supply.
Short circuit between phases	<ul style="list-style-type: none">■ Internal contamination of the motor;■ Degradation of the insulating material by drying out caused by high temperatures;■ Fault in the insulating material.
Short circuit in the connection	<ul style="list-style-type: none">■ Internal contamination of the motor;■ Fault in the insulating material;■ Overheating of the connection due to poor contact.
Short circuit at the slot end or Short circuit within the slot	<ul style="list-style-type: none">■ Internal contamination of the motor;■ Degradation of the insulating material by drying caused by high temperatures;■ Fault in the wire insulating enamel;■ Fault in the impregnation varnish;■ Fault in the insulating material;■ Fast oscillations in the power supply.
Voltage peak	<ul style="list-style-type: none">■ Motor driven by frequency inverter with some incorrect parameters (amplitude of the voltage pulse, rise time, dv/dt , distance between pulses, switching frequency);■ Great oscillation in the power supply, for example, lightning discharges;■ Switching surges of capacitor bank.
Voltage unbalance	<ul style="list-style-type: none">■ Voltage and/or current unbalance between phases;■ Fault in capacitor bank;■ Poor contact in connections, switches, contactors, circuit breakers, etc.;■ Voltage oscillations in the three phases.
Stuck rotor	<ul style="list-style-type: none">■ Excessive difficulty to start the motor due to significant voltage drop, very high inertia and load torque;■ Load shaft is stuck.
Overheating	<ul style="list-style-type: none">■ Too long and/or very thin supply cables;■ Incorrect wiring of the motor connecting cables;■ Excessive number of starts in a short time;■ Load excess on the shaft end (permanent or occasional/periodic);■ Overvoltage or undervoltage in the power supply (permanent or occasional/periodic);■ Poor ventilation (damaged or obstructed fan cover, dirt on the frame, high ambient temperature, etc.).
Phase loss: ■ Star (Y): Burnout of two phases ■ Delta (Δ): Burnout of one phase	<ul style="list-style-type: none">■ Poor contact in switch, contactor or circuit breaker;■ Poor contact in connections;■ Poor contact in the terminal of one phase of the transformer;■ Burnout of a phase of the supply transformer;■ Burnout of a fuse;■ Disruption of a feeder cable.

