

SUBMERSIBLE MOTOR ENGINEERING



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Water in Drop Cables or Motor Leads for a Submersible Motor.

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General

Water can enter the supply cables to a Submersible Motor if there is damage to the cable insulation or if the spliced joints have not been made completely watertight. If the protection circuit does not trip there will probably be catastrophic damage to the windings due to high currents flowing through the windings.

Likely Causes

1. Spliced joints between Drop Cables and Motor Leads not terminated correctly and not properly sealed against water entry. Spliced joints not "watertight".
2. Insulation damage to Drop Cables or Motor leads which allows water access. Great care must be taken to protect the cables and prevent damage during installation of the motor and pump.

Effect and Results of Water in Leads.

Water in Leads	Fault in 1 lead	Fault in 2 leads	Fault in 3 leads
Winding Currents (Most motors are internally connected in Delta).	Unbalanced currents. High Insulation Resistance to Earth 1 to 2 x FLC Light Load on motor 2 to 3 x FLC Stalled motor 4 to 6 x FLC.	Unbalanced currents. High Insulation Resistance to Earth 1 to 2 x FLC Light Load on motor 2 to 3 x FLC Stalled motor 4 to 6 x FLC.	Unbalanced currents. High Insulation Resistance to Earth 1 to 2 x FLC Light Load on motor 2 to 3 x FLC Stalled motor - probably no current in motor winding.
Current in Dry leads	1 to 6 x FLC	1 to 6 x FLC	N/A
Current in Wet leads	Current flow to Earth = 20 x FLC	Current flow to Earth = 20 x FLC	Current flow to Earth = 20 x FLC
Failure	Over heated Winding. Over heated Motor lead.	Over heated Winding. Over heated Motor lead.	Over heated Winding. Over heated Motor lead.
Recommended Protection	Fast Acting Earth Leakage Relay. Fast Acting Overload Relay or Circuit Breaker.	Fast Acting Earth Leakage Relay. Fast Acting Overload Relay or Circuit Breaker.	Fast Acting Earth Leakage Relay. Fast Acting Overload Relay or Circuit Breaker.

On a correct installation the motor frame is earthed. Water is a good conductor of electricity. As soon as a circuit is established between the water in the bore and the power supply cables, current will flow through this fault causing unbalanced currents in excess of normal Full Load Current (FLC). If the motor is not disconnected from the supply immediately, catastrophic damage will be caused to the windings, due to over heating because of high currents.

The magnitude of the current flows will depend on the level of insulation to earth. Sometimes these faults are not solid connections to the water or to earth, i.e. there is still a high insulation level to earth, which restricts the current flow to earth. In this case the Earth leakage and/or overload protection may not trip immediately and the motor windings will overheat due to the unbalanced currents.

Evidence of Water in the leads.

If water drains out when the motor leads, or drop cables are cut, and the leads are held up in the air, and the recently cut ends are left hanging down. This will confirm that there is a damaged cable or the spliced joint was not properly sealed.

If water is found in the drop cables we can also expect to find that the stator winding have overheated which usually causes multiple earth faults in the windings.

SME cannot accept warranty if water is found in the drop cables/leads.

Typical Circuit.

