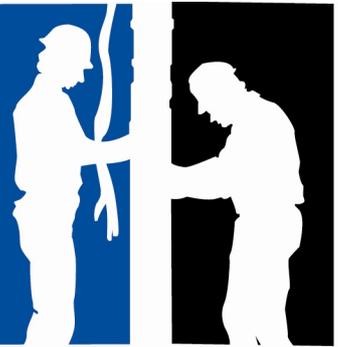


# FRANKLIN AID



Franklin Electric



Franklin Application/ Installation Data Europe

AID 4/2005

## Lightning/Voltage surges and their effects on submersible installations

Short duration voltage spikes are commonly generated by switching large inductive appliances under load or lightning that strikes overhead power lines. The two characteristic properties of such a spike are its very short duration (tiny part of a second) and very high magnitude (tenthousands of volts).

These transient voltage spikes travel along the power lines looking for a path to earth (to ground themselves). By nature, the best electrical ground is supplied by the underground water strata (aquifer), and this is exactly where the submersible motors are situated. For this reason, the submersible borehole motor is more susceptible to be damaged by overvoltage than other, above ground mounted appliances.

### **How lightning/voltage surges do its damage.**

Arriving through the motor supply cables (drop cables), the surge will leave the power lines at the motor, jump across the motor winding insulation to motor frame, and dissipate itself to ground (water). The surge will no longer exist on the power lines, except that a very small hole has been punctured through the motor winding insulation. If the motor is running at the time, the current of the normal voltage supply will follow through this hole in the motor winding insulation. It is this power follow current which causes the damage. This current will be high (in the nature of a short circuit) and severe burning of windings and insulation will result that will ruin the motor windings. Remember: This whole procedure takes only a tiny part of a second.

### **How to protect ?**

The industry offers a large variety of surge protectors (commonly referred to as lightning arrestors) to the consumers. Basically, these arrestors create a lower insulation resistance point in the way of the transient overvoltage. When the voltage surge arrives at these devices, it will encounter them as a convenient, low resistance way to earth and will tend to ground itself through this device, thus protecting the downstream mounted electrical appliances. By construction, these lightning arrestors are capable of withstanding the very high transient discharge current as well as break the power follow current. The correct grounding of the surge arrester is of paramount importance for its capability to provide protection. For efficient protection of submersible motors, the arrester must be low resistance grounded to the same water strata the motor is installed.

### 4" Motors

The best way to do that would be to put a lightning/surge arrester right into the motor itself, one arrester for each wire coming in. The arrestors are in contact with the casing of the motor, which is in contact with the underground water. When the power surge comes down the lead wires, the arrestors divert it to the casing, and then on into the water. And the arrestors keep on diverting all parts of the surge into the water so there's no double-power reflected voltage to damage a motor.

Franklin Electric offers optional built-in lightning arrestors for its 4" SS motors. (Exclusion: 2-wire BIAC motors are as a standard factory equipped with lightning arrestors)

### 6" and larger Motors

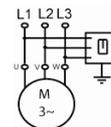
For the lightning protection of 6" motors and larger Franklin Electric recommends the use of commercially available 3-phase surge arrestors. To provide best protection for the submersible motor, above ground arrestors must be installed as close to the well head as possible. As described before, the suitability of the ground connection is all important: if the grounding of the arrester is better than the ground afforded by the submersible motor, most of the high voltage surge will go through the lightning arrester to ground and protection will be provided to the motor.



Single phase lightning arrester  
(in the motor installed)



Three phase lightning arrester  
(external)



Connection

### **Seminars:**

To check out our latest seminar schedule, please visit our website [www.franklin-electric.de](http://www.franklin-electric.de) or contact us at: [field-service@franklin-electric.de](mailto:field-service@franklin-electric.de)



Franklin Electric Europa GmbH

Rudolf Diesel Straße 20  
D-54516 Wittlich/Germany  
e-mail: [field-service@franklin-electric.de](mailto:field-service@franklin-electric.de)  
[www.franklin-electric.de](http://www.franklin-electric.de)

Tel.: +49 (0)65 71 10 54 20  
Fax: +49 (0)65 71 10 55 13