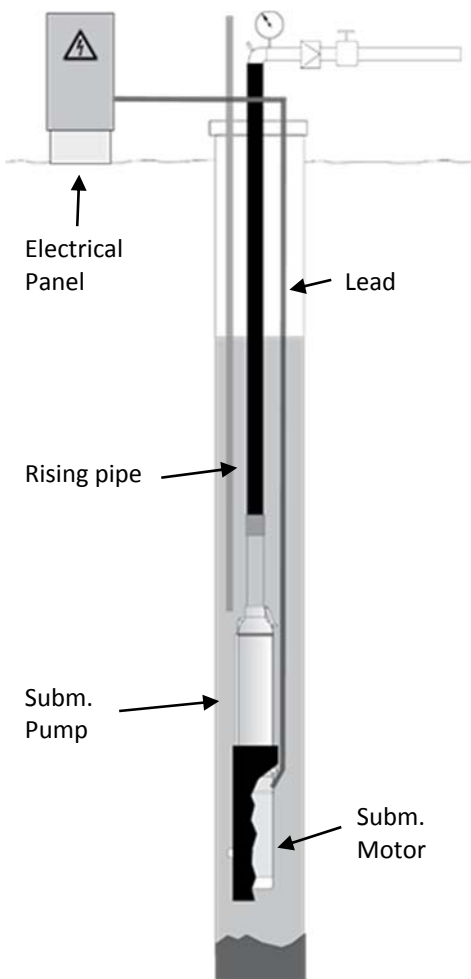




Submersible motor cable selection

Special needs...

Submersible motors, specially designed for a life underwater, require supply cables equally special in form and function.



On the left, you will find a simple schematic of a typical borehole installation. From this, it is easy to deduct the challenges in selecting/sizing the right cable. Ideally, a cable that feeds a submersible borehole pump must:

- be sized to deliver adequate voltage to the motor
- work without overheating or burnout – both in the well/water and aboveground in air/conduct
- satisfy any local safety and/or drinking water/hygienic approvals
- mechanically withstand installation conditions and provide reliable life.

Because of the complexity of the subject, we will dedicate this and the next edition of our AID Bulletin to discuss above mentioned requirements and possible technical solutions in detail.

Voltage

When power flows through electrical cable, some input voltage is lost in the cable due to its electrical resistance/reactance. Essentially, it can be thought of as an electrical resistor that creates voltage and power loss. The longer the cable and the smaller its cross-sectional area, the larger these losses will be and the less voltage will arrive at the motor terminals. So, in order to maintain an efficient and reliable motor operation, the drop cable cross section should be matched to the expected motor amperage.

Temperature

Cables consist of the active part – in today's world almost always copper which conducts the electrical field and the current. The copper wire is insulated against neighboring conductors and the environment by different layers of electrically insulating materials, usually XLPE and/or rubber compounds (see figure 2).

When conducting electrical current, heat built up in the copper is transferred to and through these insulating compounds and dissipated to the environment (water or air).

Cable manufacturers specify the maximum temperature these insulating/sheathing materials can withstand, in function of the ambient conditions (water or air and temperature), the cable construction (single conductor or multicore) and the method of installation (laying on surface/free in air etc.).

Having understood the above, it now becomes clear why factory-fitted motor short leads can be much smaller than the ones they will be spliced to: these motor leads always operate under water (so their current carrying capability is high) and because of their shortness, the voltage drop across them is insignificant.



Safety and drinking water/hygienic requirements

The vast majority of submersible motors are used for extracting water from aquifers and so, are subjected to governmental, state or community laws/regulations concerning contamination. In Europe, there are several national agencies that are testing and approving cable materials for safe use in drinking water: ACS, KTW, WRAS are some of the acronyms encountered.

Also, the majority of national electrical codes require a jacketed construction for any cable intended to be permanently installed under water. In the absence of a dedicated cable standard for borehole applications, most manufacturers use the more generic cable standards to prove compliance to safety regulations.

Mechanical construction

Cables can be built using either stranded or solid conductors, and copper or aluminum as active material. For our application, it is the stranded copper variant that will be best suited to bear mechanical and electrical stresses typically encountered.



Special conditions

- Hydrocarbon resistance

Not all installations are for drinking water supply or irrigation; sometimes, borehole pumps are used for mine dewatering, process water pumping or desalination. In such cases, yet again special chemical or mechanical properties must be taken into consideration, which are not within the scope of this article. It should be considered, though, that factory supplied motor short leads are built for drinking water usage and their suitability for special applications must be checked prior to commissioning.

- VFD

Today, many submersible pumps are controlled by variable speed drives. The PWM voltage generated by these devices poses some very unique challenges to the motor/cable system that can lead to premature failure if not addressed: High electrical field generated by reflected voltage as well as high dV/dt rates shorten useful life of insulation material. The best way to diminish the negative effects of voltage overshoots and high dV/dt rates is using passive filtering at the drive output.

In EMC-sensitive applications, it may be desirable to use shielded motor cables with symmetrically disposed earth conductors. In the vast majority of cases, however, experience shows it is more practical and economical to shield adjacent low-power cables.

Conclusion

Submersible motor cables are different, and most large cable manufacturer's catalogues list a selection of drinking water approved leads for your convenience.

In the next edition of our AID bulletin, we will be taking you through the cable sizing process and explain how to use cable charts supplied by submersible motor manufacturers.

SAVE THE DATES

Keep yourself and your colleagues up-to-date with the latest developments in submersible borehole technology and trends. We're offering conveniently-timed, off season technical seminars for industry professionals at our Wittlich, Germany training facility.

Check into our website for the latest dates at: <http://www.franklin-electric.de/training.aspx?lang=en>