



Vortrag

Freitag, 2. Oktober 2026, 09:00 Uhr

Erdung innovativ gedacht: Grabenlose Installation mit HDD als Alternative zur offenen Bauweise

Vortragende: Philipp Schrage, TRACTO-TECHNIK GmbH & Co. KG
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Lecture

Friday, 2nd October 2026, 09:00 pm

A new approach to transforming trenches to trenchless: Innovative earth grounding system

Speakers: Philipp Schrage, TRACTO-TECHNIK GmbH & Co. KG
Tim McClure, Trenchless Grounding Infrastructure Design Solutions
Pty Ltd, Australia

“A NEW APPROACH TO TRANSFORMING TRENCHES TO TRENCHLESS: INNOVATIVE EARTH GROUNDING SYSTEM”

Philipp Schrage (TRACTO); Tim McClure (Trenchless Grounding Infrastructure Design Solutions)
Grounding systems

Grounding systems are essential to almost all electrical installations, including residential buildings, industrial plants, substations, distribution networks, wind farms, photovoltaic systems and many others. Although installed underground, they are vital for the safety and reliability of electrical systems. Their main function is to provide a controlled current path to earth in the event of a fault, allowing fault and lightning currents to be dissipated safely and protective devices to disconnect affected parts quickly.

Grounding protects people from electric shock as well as machinery, equipment and the wider electrical infrastructure. With Europe's energy transition and ongoing electrification, the importance of grounding is increasing. Electric vehicles, heat pumps, digital infrastructure and electrified industrial processes are driving higher electricity demand, while renewable energy expansion requires new grid connections. At the same time, much of Europe's existing infrastructure must be modernised.



Figure 1: Higher degree of electrification through heat pumps, electromobility, data centers and industrial applications

This creates two parallel tasks: installing new grounding systems and inspecting or renewing existing ones. In practice, this is often difficult due to limited space, restricted access, dense development, competing underground infrastructure and growing demands for resource efficiency and environmental sustainability.

Trenchless Grounding

This is where the patented trenchless grounding approach comes into play. The method installs grounding electrodes and conductors using a directional drilling process. With the aid of HDD technology, the total earth resistance of an electrode-conductor system can be reduced across different geological layers without using conventional vertically driven electrodes.

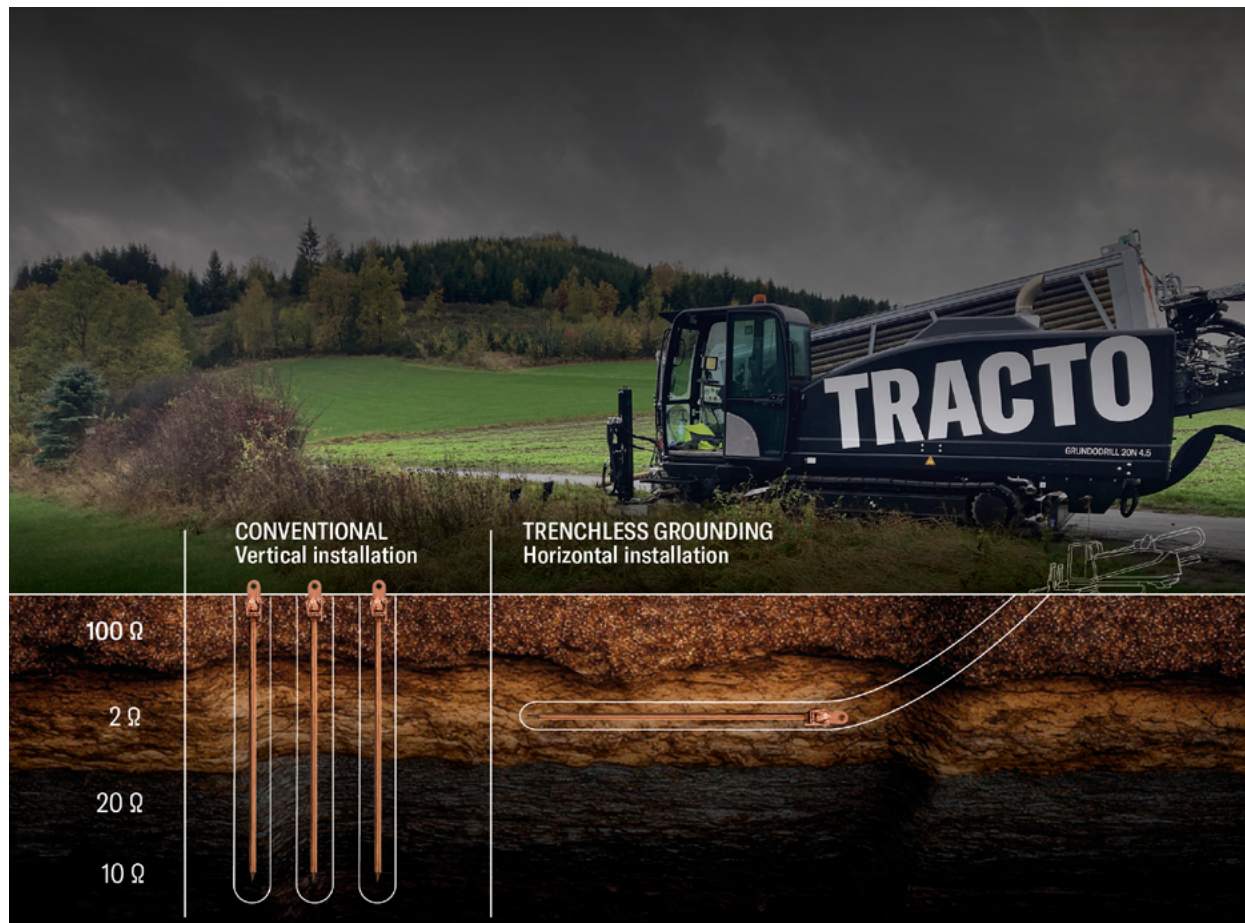


Figure 2: Comparison of vertical and horizontal installation of grounding systems

At the same time, electrode resistance can be measured during drilling. The method can be used for new installations and also for extending existing systems. It offers particular advantages in existing corridors, environmentally sensitive areas and sites with restricted access. Cost efficiencies may also result from reduced material usage and the targeted use of favourable horizontal soil layers.

Conventional grounding electrodes

Conventional grounding usually requires trenching and the installation of vertically driven electrodes. Their number and length depend on the specific soil resistivity. Local geology is therefore crucial, since soil consists of layers with varying resistivity such as clay, sand, gravel or rock. The aim is to position electrodes as far as possible in layers with high conductivity or low specific resistance so that fault currents can be dissipated effectively. However, a vertical electrode does not necessarily benefit from a favourable layer if it only partly penetrates it or misses it entirely. Other factors include altered surface layers, dry or frozen soil, fluctuating groundwater levels, extreme weather events and corrosive soil conditions. In hard ground, driving electrodes may lead to deformation or damage. If the measured resistance is too high, additional electrodes must be installed.

Principle of trenchless grounding

Trenchless grounding uses horizontal directional drilling to install grounding conductors in different soil layers while soil and electrode resistance are monitored in real time. Preliminary measurements define the drilling path, and measurement systems analyse total resistance to assess soil conditions. The method does not require open trenches and can be used in a wide range of geological conditions for new systems, extensions and hybrid solutions. In areas with earth potential rise (EPR) or electrical interference, insulated conductors can be used in selected sections. Horizontal drilling is nearly every geology. The drill head can be guided into layers with favourable electrical resistance so that the grounding

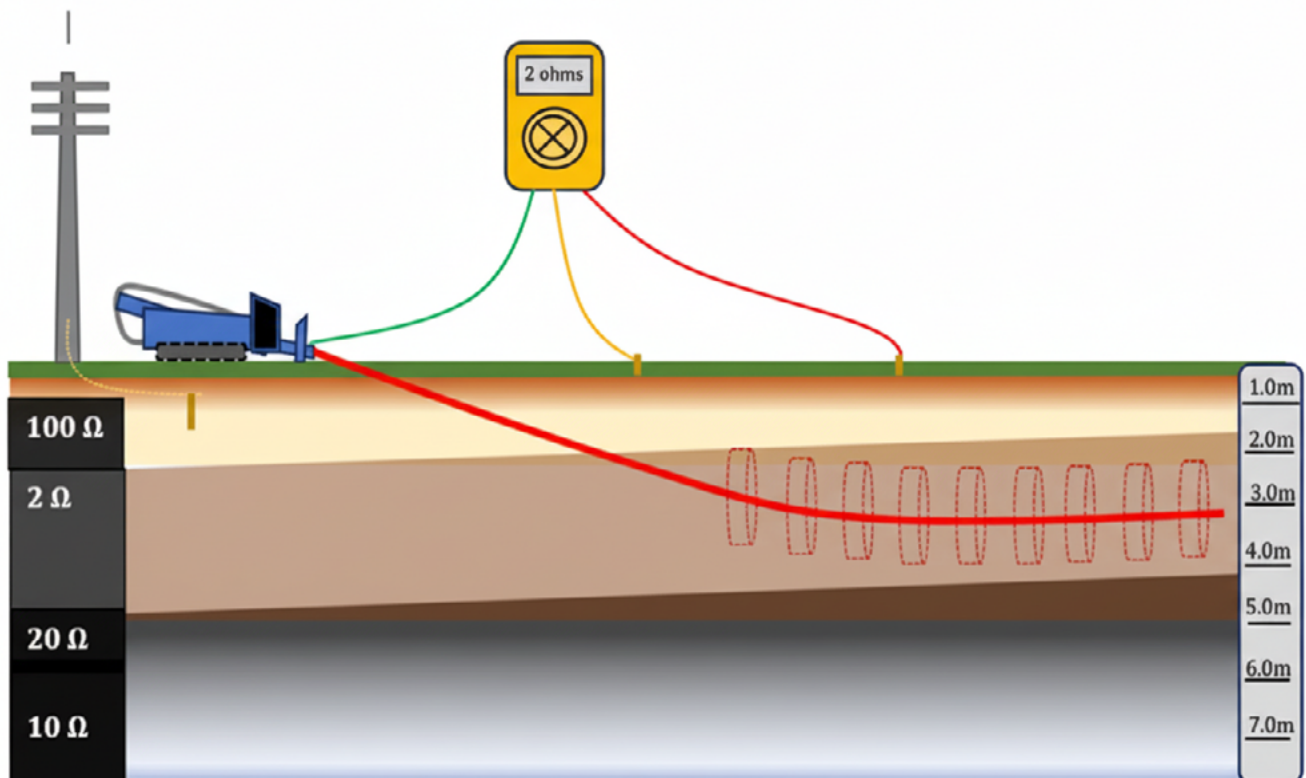


Figure 3: Trenchless earth grounding system installed substantially within the geological layers of the ground with lateral array pattern.

Once the target resistance is reached, the conductor is installed in the borehole, the annular space is usually filled with bentonite, and the system is measured and commissioned. Regular testing ensures long-term performance.

Targeted use of soil layers

The targeted use of horizontal soil layers with favourable resistivity is the key technical advantage of trenchless grounding. While a vertical electrode passes through different soil layers only at one point or along a limited line, a directionally drilled conductor can be installed over a longer distance within a favourable geological layer. This increases the effective volume of soil available for dissipating electrical current.

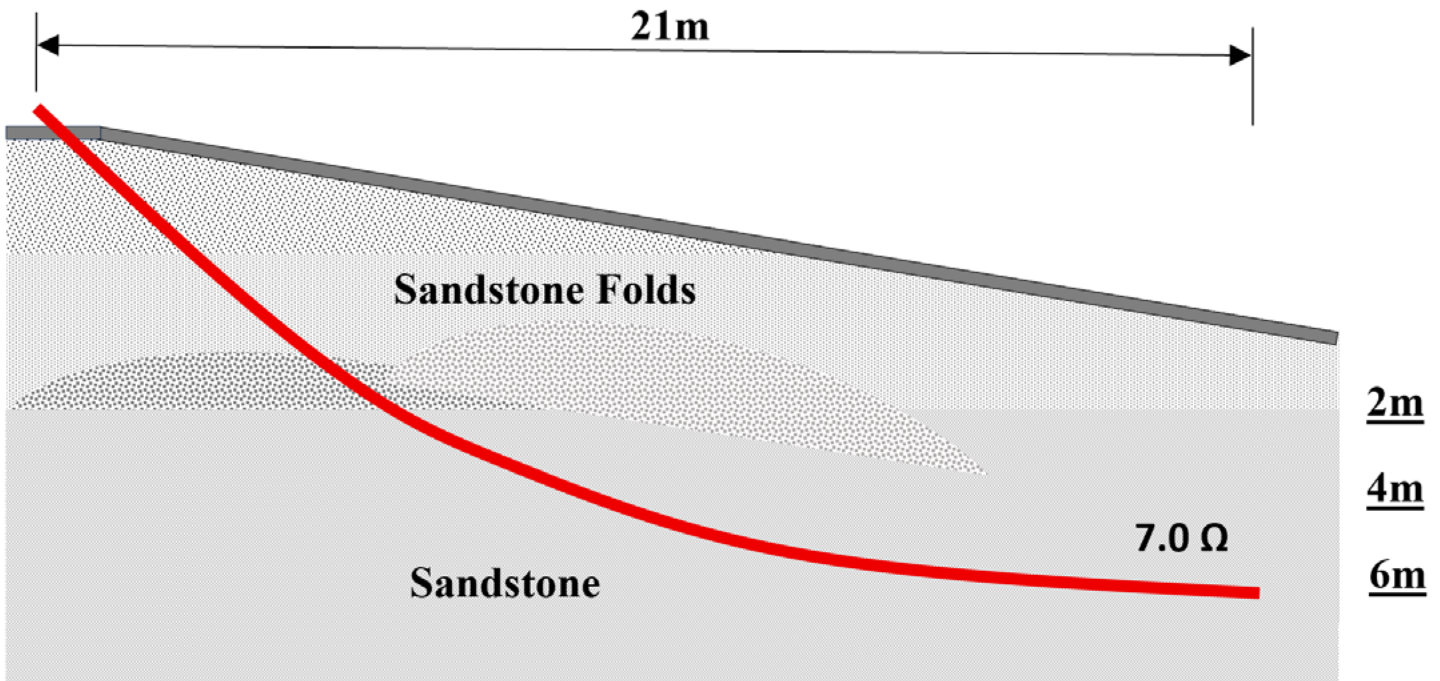


Figure 4: Directionally drilled grounding substantially installed within a horizontal layer of sandstone

This arrangement can improve the electrical performance of the grounding system and may also reduce conductor length and material requirements. At the same time, resistance measurements during drilling allow immediate evaluation of the achieved performance, making it possible to adjust the installation length and optimise the grounding system during the work.

Case Studies and Field Tests

Case studies from Australia, the USA and Germany demonstrate the practical performance of the method under different geological and climatic conditions.

In Central Victoria, a SWER (Single-Wire Earth Return) grounding system was brought down to the required target resistance by adding a directionally drilled section, despite very hard sandstone formations and environmental restrictions. In North Central Victoria, a resistance of 1 Ω was achieved at a transformer site by targeting favourable soil layers within a drilling length of only 30 metres. These examples show that effective solutions can also be achieved in difficult ground conditions and where construction space is limited. Tests in California confirmed that sandy soils can contain resistance layers at different depths. By installing the grounding conductor in the most suitable layer, stable and favourable resistance values were achieved, with measurements also indicating good long-term stability. A field test in Lennestadt, Germany, showed that changes in soil resistance can be measured during drilling and used to optimise installation. Further tests in Castlemaine confirmed the integrity of the borehole and the long-term electrical contact between conductor, bentonite and surrounding soil. Overall, these case studies show that trenchless grounding is not just a theoretical concept but can deliver reliable results under real-world conditions.

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Cost Efficiency, Sustainability and Safety

Compared with conventional methods, trenchless grounding can reduce costs by avoiding open trenches, minimising surface restoration and using conductor length more efficiently. It can also be installed within existing corridors or beneath overhead power lines with little disruption to ongoing operations. The method may also improve sustainability by reducing impacts on vegetation, waterways, agricultural land and sensitive cultural areas. At the same time, material use, including copper, as well as disturbance to soil and surface can potentially be reduced.

From a safety perspective, trenchless grounding can better protect people and equipment. Deeply installed conductors are less exposed to external damage, underground utilities can be avoided more precisely, and the risks associated with open trenches are eliminated. The system can also be designed to reduce step and touch voltages.

Conclusion

Trenchless grounding is an efficient method for installing low-resistance grounding systems. By placing the conductor in soil layers with favourable resistivity, conductor length may be reduced while still achieving the required target resistance. The method can be applied in different geological conditions and allows resistance to be monitored during installation. This creates new possibilities for grounding system design and installation, especially where conventional methods reach technical, spatial or environmental limits. As electrical infrastructure continues to expand, trenchless grounding could become an increasingly attractive solution combining safety, resource efficiency and practical performance.