

Formula 1

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Formula 2

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Detailed Explanation

ASTM D5334 specifies a field-deployable, transient line-source method where a thermally insulated needle probe containing a heater and temperature sensor is inserted vertically into undisturbed soil. A constant electrical current heats the probe for a defined duration (typically 10–30 minutes), and the temperature response is recorded at high resolution. The thermal resistivity is derived from the slope of the temperature-versus-log-time plot during the linear transient phase—exploiting the analytical solution to the infinite line-source heat conduction equation in homogeneous, isotropic media. While the standard assumes ideal conditions, experienced practitioners apply corrections for probe-soil contact resistance, ambient temperature drift, soil heterogeneity, and anisotropy through repeat testing, multi-depth profiling, and statistical validation. This test directly supports IEEE Std 835 and IEC 60287 ampacity calculations by replacing generic 'default' soil resistivity values (e.g., 90 K·m/W) with empirically validated, location-specific inputs—thereby enabling optimized cable sizing, reduced conductor oversizing, improved load capacity, and enhanced system reliability. It is especially critical for projects involving high-capacity circuits, congested urban corridors, or thermally challenging soils (e.g., dry sand, rocky fill, or compacted backfill).

Key Components

#	Component
1	Transient line-source probe
2	Data acquisition system with high-resolution temperature logging

#	Component
3	Calibrated power supply and timing controller

Applications

#	Application
1	Underground power cable ampacity validation and optimization
2	Pre-construction geotechnical-thermal site characterization
3	Thermal performance verification after cable installation or backfill modification

Related Concepts

#	Concept
1	Cable ampacity
2	Thermal conductivity
3	Transient heat conduction

Tags

soil testing, thermal resistivity, cable engineering, ASTM, ampacity, power transmission
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Soil Thermal Resistivity Field Testing SOP (ASTM D5334)
