

THERMAL INTEGRITY PROFILE TESTING OF DRILLED SHAFTS

Effective: April 20, 2016

Revised: March 24, 2023

Description. This work shall consist of furnishing and installing materials and equipment necessary to perform Thermal Integrity Profile (TIP) testing of drilled shafts according to Illinois Modified ASTM D7949. Data collection using embedded thermal sensors shall be performed on all drilled shafts identified on the plans. Analysis and reports shall be performed only on selected drilled shafts where specified and as directed by the Engineer. This work includes collection, analysis, and storage of the TIP data, preparation of reports summarizing the TIP data, and investigating anomalies identified in the TIP data.

Qualifications. A consulting firm experienced in TIP testing shall direct this work. The TIP consulting firm shall be a company independent from the Contractor with a minimum of 3 years of experience performing TIP testing of drilled shafts. The individual evaluating the TIP data and preparing the report shall be an Illinois Licensed Professional Engineer and have experience on a minimum of 5 TIP testing projects.

The name, contact information, and qualifications of the TIP consulting firm, including the names and experience of the individual employees performing and analyzing the test results and preparing the report, shall be submitted to the Engineer at least 30 days prior to drilled shaft construction.

Training. The TIP Consultant shall provide on-site instruction to the Contractor on the installation of the embedded thermal sensors and data recording devices, use of the data recording apparatus, use of the processing and display apparatus, and methods of transferring data to the TIP Consultant.

Construction. Embedded thermal sensors shall be installed on all drilled shafts identified on the plans according to the Illinois Modified ASTM D7949. Embedded thermal sensors shall be checked for functionality after the reinforcing cage has been placed in the shaft excavation. Any embedded thermal sensors that are not functioning correctly shall be removed and replaced.

In wet installations, embedded thermal sensors shall have enough lead in wire to allow for connection of the recording apparatus above the water.

The TIP data shall be recorded and stored for each shaft where embedded thermal sensors are installed. Analysis and reports shall be performed only on selected drilled shafts where specified and as directed by the Engineer. The Engineer may direct additional analysis and reports, if necessary, due to problems encountered or observed during drilled shaft construction. The Engineer will determine which shaft(s) shall have an analysis and report prepared. All drilled shafts that do not require an analysis and report shall have the raw data submitted according to Illinois Modified ASTM D7949.

Superimposed loads, either dead or live, shall not be applied to a drilled shaft until TIP testing is completed, TIP reports have been submitted, any necessary testing and repairs have been completed, and permission has been granted by the Engineer.

Reports. Reports shall be according to Illinois Modified ASTM D7949. Reports shall identify, label, and discuss anomalies, potential flaws, or defects. If none are identified, that shall be stated in the report. Reports shall discuss recommendations for additional investigation or testing of anomalies, flaws, or defects identified. Reports shall give an overall assessment of the constructed shaft quality based on the data and information analyzed. Reports shall be submitted to the Bureau of Bridges and Structures, or local agency owner, for review and acceptance.

Anomalies. If anomalies are identified, they shall be investigated by coring or other methods approved by the Engineer. If coring is to be performed, the Engineer will determine the location of the core(s).

Remediation of Drilled Shaft Defects. When the Engineer determines that a defect is present, the Engineer will direct the Contractor to repair the defect. The Contractor shall submit a plan to repair the defect to the Engineer for approval. No compensation will be made for remedial work, or losses, or damage, due to remedial work of drilled shafts found defective or not in accordance with the drilled shaft specifications or plans. Modifications to the structure shall be designed, detailed, and sealed by an Illinois Licensed Structural Engineer.

Method of Measurement. TIP testing materials, equipment, and data collection will be measured for payment by the linear foot of drilled shafts instrumented. Each individual embedded thermal sensor wire will not be measured for payment.

TIP test analysis and reporting will be measured for payment for each drilled shaft where analysis and reporting is specified or directed by the Engineer.

Investigation of anomalies will not be measured for payment.

Basis of Payment. TIP materials, equipment, and data collection will be paid for at the contract unit price per foot for THERMAL INTEGRITY PROFILE DATA COLLECTION. TIP test analysis and reporting will be paid for at the contract unit price per each for THERMAL INTEGRITY PROFILE TESTING.

ILLINOIS MODIFIED ASTM D7949, Method B
Effective Date: April 20, 2016
Revised Date: August 4, 2023

Standard Test Method for
Thermal Integrity Profiling of Concrete Deep Foundations, Method B
Reference ASTM D7949-14

The testing shall be per ASTM D7949-14, Method B, except as modified herein. All references to the Method A procedure shall be disregarded.

ASTM SECTION	Illinois Modification														
1.6	Revise this section as follows: Units—The values stated in either English units or SI units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard. Reporting of test results in units other than English units shall not be regarded as nonconformance with this standard.														
3.2	Add the following to this section: 3.2.12 anomaly, n – irregularity or series of irregularities observed in a thermal profile indicating a possible flaw.														
6.1, 6.2, 6.2.1, 6.3.1, 6.3.2, 6.3.3, & 6.3.4	Delete these sections.														
6.4.1	Revise the first sentence of this section as follows: The recording apparatus shall record depth and temperature data from each group of embedded thermal sensors at a depth interval of no greater than 300 mm.														
7.1	<div>Revise this section as follows: The embedded thermal sensors shall be installed during construction of the foundation element. The location plan shall provide access locations for embedded thermal sensors according to the following table.</div> <table><tr><th>Reinforcing Cage Diameter (feet)</th><th>Number of access locations for embedded thermal sensors</th></tr><tr><td>≤ 5.0</td><td>4</td></tr><tr><td>5.1 to 7.0</td><td>6</td></tr><tr><td>7.1 to 9.0</td><td>8</td></tr><tr><td>9.1 to 11.0</td><td>10</td></tr><tr><td>11.1 to 13.0</td><td>12</td></tr><tr><td>> 13.0</td><td>14</td></tr></table> <div>Access locations for embedded thermal sensors shall be spread equally around the perimeter and spaced at an equal distance from the axis, and the sensor levels shall be the same for all of the access locations with a maximum depth interval between levels of 300 mm. Fig 3 illustrates several plan layout configurations for the access locations.</div>	Reinforcing Cage Diameter (feet)	Number of access locations for embedded thermal sensors	≤ 5.0	4	5.1 to 7.0	6	7.1 to 9.0	8	9.1 to 11.0	10	11.1 to 13.0	12	> 13.0	14
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ASTM SECTION	Illinois Modification
7.1.2	Revise this section as follows: Temperature measurements shall be performed starting at the beginning of concrete placement in the element and terminating a minimum of 12 hours after the peak temperature of the concrete has been reached. The tests should be performed, analyzed, and reported on the selected shaft(s) at the time of ½ peak temperature, and at the time of peak temperature of the concrete.
7.2, 7.2.1, 7.2.2, 7.2.3, & 7.2.4	Delete these sections.
7.3.1	Revise the third sentence of this section as follows: Embedded thermal sensors shall extend to the bottom of the foundation element.
7.4, 7.4.1, 7.4.2, 7.4.3, 7.4.4, 7.4.5, 7.4.6, 7.4.7, 7.4.8, & 7.4.9	Delete these sections.
7.5.3	Revise this section as follows: Connect each embedded thermal sensor to the Recording Apparatus. Start recording temperature data to the nearest 0.1°C prior to concrete placement. Record temperatures periodically at intervals not to exceed 15 minutes. Testing shall be terminated only after a minimum of 12 hours has elapsed after the peak temperature of the concrete has been reached.
7.6.1	Delete this section.
8.1.1 (New Section)	Add as follows: Test data and results shall be reported in US Customary units.
8.5 (New Section)	<i>Raw Data Submittal</i> – The raw temperature data for the peak temperature time and ½ the peak temperature time shall be provided to the Engineer for each drilled shaft where data was collected. The data shall be clearly labeled and organized in a standard computer spreadsheet format. The data shall be provided in a table and in a graph.