

## **THERMAL INTEGRITY PROFILE TESTING OF DRILLED SHAFTS**

Effective: April 20, 2016

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, Method B. Data collection using embedded thermal sensors shall be performed on all drilled shafts of structures identified on the plans. Analysis and reports shall be performed on selected drilled shafts. This work includes collection and analysis 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 experience in 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 3 TIP projects performing TIP testing of drilled shafts.

The name, contact information, and qualifications of the TIP consulting firm, including the names and experience of the individual employees directing the work, analyzing the test data, 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, use of the data recording apparatus, use of the processing and display apparatus, and methods of transferring data to the TIP Consultant.

The TIP Consultant shall provide on-site instruction to the Engineer on how to perform a preliminary analysis of the data to determine if an analysis and report is necessary.

Construction. Embedded thermal sensors shall be attached to the reinforcement cage in vertical arrays, situated symmetrically around the diameter of the shaft according to the Illinois Modified ASTM D7949, Method B. 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 provided to the Engineer so the Engineer can perform a preliminary evaluation of the data to determine which drilled shafts shall have a TIP analysis and report completed. The Engineer may direct additional analysis and reports, if necessary, due to problems encountered or observed during drilled shaft construction.

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 repairs have been completed, and permission has been granted by the Engineer.

Reports. Reports shall be according to Illinois Modified ASTM D7949.

Anomalies. If anomalies are identified, they shall be investigated by coring or other methods approved by the Engineer.

Correction of Drilled Shaft Defects. When testing determines that a defect is present, the Engineer will direct the Contractor to submit remedial measures 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 drilled shaft design, or any load transfer mechanisms required by the remedial action, must be designed, detailed, and sealed by an Illinois Licensed Structural Engineer, and submitted for approval.

Method of Measurement. TIP testing materials and equipment will be measured for payment per shaft by the linear foot of drilled shaft(s) instrumented.

TIP test analysis and reporting will be measured for payment for each drilled shaft analysis and report prepared.

Investigation of anomalies will not be measured for payment.

Basis of Payment. TIP materials and equipment will be paid for at the contract unit price per foot for THERMAL INTEGRITY PROFILE DATA COLLECTION. TIP 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

Standard Test Method for

**Thermal Integrity Profiling of Concrete Deep Foundations, Method B**

Reference ASTM D7949-14

**IMPORTANT:** The Department will specify Method B only. All references to the Method A procedure shall be disregarded, including but not limited to references to thermal probes, access ducts, depth-measuring device, and so on.

ASTM SECTION	Illinois Modification														
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, 6.2.2, 6.3, 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	<p>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.</p> <table border="1"> <thead> <tr> <th>Reinforcing Cage Diameter (feet)</th> <th>Number of access locations for embedded thermal sensors</th> </tr> </thead> <tbody> <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>&gt; 13.0</td> <td>14</td> </tr> </tbody> </table> <p>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.</p>	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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**Thermal Integrity Profiling of Concrete Deep Foundations, Method B**

Reference ASTM D7949-14

ASTM SECTION	Illinois Modification
7.2, 7.2.1, 7.2.2, 7.2.3, & 7.2.4	Delete these sections.
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.
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.