Special Specification XXXX
Thermal Integrity Profiler (TIP) Testing of Drilled Shafts

1. DESCRIPTION

Perform the nondestructive testing (NDT) method, termed Thermal Integrity Profiler (TIP) testing, by obtaining records of the heat generated by curing cement (hydration energy) to assess the quality of drilled shafts. TIP measurements, that are colder than normal, indicate necks, inclusions, or poor-quality concrete, while warmer than normal measurements are indicative of bulges. Variations of temperatures between tubes reveal cage eccentricity. Furnish all materials, equipment, and labor necessary to conduct TIP testing on production drilled shafts. The TIP testing will meet the requirements of ASTM D 7949, except as noted below.

2. EQUIPMENT

Supply all materials and equipment required to perform TIP tests. Equipment to perform the test shall have the following minimum requirements:

2.1. **Probe or wire option**. A computer-based TIP data acquisition system for (a) display of signals during data acquisition (probe option only,) or (b) to monitor temperature versus time after casting (wire option only.) The primary option for TIP tests shall be the wire only option. Probe only option shall only be used as a back-up system for use in the event of failures with the wire only option system. Drilled shafts with TIP testing shall have the number of wires or tubes equal to the greater of 4 or the nearest whole integer value, rounded up, of the diameter of the drilled shaft measured in feet.

2.2. **Probe only option.** Thermal probe with 4 infrared sensors equally spaced at 90° around the perimeter that read temperatures of the tube wall to within 1°F accuracy. The probes shall be less than 1.25 in. in diameter and shall freely descend through the full depth of properly installed access tubes in the drilled shafts; one depth encoder sensor to determine probe depths; ability to collect data at user specified depth increment.

2.3. **Wire only option**. Ability to collect data at user defined time intervals (typically 15 to 60 min.)

3. TESTING PROCEDURE

Conform to testing procedures in ASTM D 7949 specification.

4. TEST RESULT REPORTING

Submit a written report within 5 working days of completion of testing. The report shall present results of TIP tests by including:

4.1. **Graphical Displays**. Provide graphical displays of all temperature measurements (probes or wires) versus depth.

4.2. **Significant Temperature Deviations**. Report indication of unusual temperatures, particularly significantly cooler local deviations of the average at any depth from the overall average over the entire length, in either probe or thermal wire measurements.

4.3. **Overall Average Temperature.** This temperature is proportional to the average radius computed from the actual total concrete volume installed (assuming a consistent concrete mix throughout). Radius at any point can then be determined from the temperature at that point compared to the overall average temperature.

4.4. Temperature Variation. Report variations in temperature between tubes (at each depth) which in turn correspond to variations in cage alignment. Where concrete volume is known, report the cage alignment or offset from center.

4.5. Shaft Specific Information. Report shaft specific construction information (e.g. elevations of the top of shaft, bottom of casing, bottom of shaft, etc.) when available. These values should be noted on all pertinent graphical displays.

A zone with an anomaly shall be identified as either of the two criteria:

(a.) Temperature fluctuation > 5°F or,

(b.) Radius reduction > 6%

5. MEASUREMENT

This item will be measured by each drill shaft with successful tests approved by the Engineer. Quantities of TIP testing will be shown on the plans.

6. PAYMENT

The work performed and materials furnished, in accordance with this Item and measured as provided under "Measurement," will be paid for at the unit price bid for each "Thermal Integrity Profiler (TIP) Testing of Drilled Shaft." This price is full compensation for material, equipment, labor, work, tools, and incidentals.