



**SPECIAL PROVISIONS
FOR
INSTRUMENTATION, MONITORING AND SETTLEMENT CONTROL**

**Woodbury County
IM-NHS-029-6(257)147--03-97**

**Effective Date
March 18, 2014**

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

120146.01 DESCRIPTION.

- A. Surface settlement / movement survey requirements.
- B. Maximum allowable settlements, movement, and deflections.

120146.02 MATERIALS.

- A. Surface Settlement Measurement Points shall consist of survey markers such as PK nails, wooden hubs with nails, or other markers appropriate for the ground, pavement or top-of-rail in or on which they are installed. Surface settlement monitoring shall not be done directly on ground.
- B. Utility monitoring points shall consist of a No. 6 rebar settlement rod installed within and isolated from a PVC cased borehole.
- C. Maintenance Vault: 8 inch minimum diameter by 12 inch minimum long maintenance hole with gasket and bolt-down lid. The following are approved products:
 - Global Drilling Suppliers Model SMI 8x12
 - Morrison Bros. Co. 418XA and 418XAW.
 - Royer's Aluminum Watertight Manhole with 4 inch open and 6 inch skirt.
 - Approved equal.

120146.03 CONSTRUCTION.

A. Submittals.

1. Submit the following:
2. Product literature and installation methods for extensometers and surface settlement points.

3. Monitoring procedures for extensometers and surface settlement points.
4. Qualifications of persons installing, monitoring, and abandoning the instruments specified in this Special Provision.
5. Submit reports daily of all readings and measurements made as required by this Special Provision.
6. If settlements / movements greater than those specified in this Special Provision are observed, submit descriptions of tunneling or horizontal directional drilling (HDD) modifications and remedial actions.

B. Definitions.

1. **Surface Settlement Measurement Point:** A surface settlement measurement point is a reference point established at the surface or on a building or structure above ground to permit monitoring of vertical movements at established locations.
2. **Utility Markers:** An instrument installed over an existing utilities by potholing, vacuum excavating, or similar methods to allow monitoring of settlements.

C. Quality Assurance.

1. Reading of instrumentation and surveying described in this Special Provision shall be taken by a surveyor familiar with this type of work.
2. Installation of surface settlement points shall be done by a surveyor familiar to this type of work.

D. General.

The Engineer will adjust instrumentation locations after submittal of work plans for tunneling and HDD.

E. Surface Settlement Measurement Points.

1. Install surface settlement measurement points for tunneling at locations approved by the Engineer.
2. Install railroad rail settlement/deflection points at locations shown on the plans

F. Utility Monitoring Points.

1. Install utility monitoring points at locations shown on the plans or as approved by the Engineer.
2. Do not use drilling techniques to install the monitoring points. Vacuum excavation of the hole is acceptable provided over excavation is avoided.
3. Do not damage the existing utility. The settlement rod shall be located at the crown of the utility to be monitored. The casing shall be flush with the ground surface in unimproved areas or recessed, capped, and protected with a maintenance vault, if installed within traffic lanes, shoulders, parking lots, sidewalks, or bike lanes.

G. Instrumentation Readings.

1. Take a baseline survey and a follow up survey on a different day to establish the elevations of all surface settlement measurement points and utility markers at least 2 weeks before the start of subsurface work in the area. Baseline surveys shall be conducted when there is no frost in the ground. Use at least two frost-free benchmarks at least 100 feet away from the tunnel centerline as established reference points. Start the survey at one benchmark and close the survey at the second benchmark. If results of baseline survey vary by more than 0.05 feet at any location, complete a third survey and reevaluate.
2. During shaft excavation or tunnel face advancement, take readings on surface settlement measurement points and utility markers every 4 hours (minimum twice a day) on all points within 40 feet of a shaft or the tunnel face. When the tunnel face is not being advanced, take daily readings on all points within 40 feet of the tunnel face. Submit readings daily to the Engineer.
3. During pilot hole drilling, pre-reaming and back reaming/pipe pullback beneath a railroad rail spur for a distance of 50 feet on either side of the centerline of the track, take readings on surface settlement/deflection measurement points every 2 hours (minimum four times per day) on all top-of-rail points.
4. At a minimum, take weekly readings, except as noted for the excavation period, on all surface settlement measurement points and utility markers from the start of subsurface work to 30 days after completion of the subsurface work, including grouting and shaft backfilling, at each tunnel.
5. If there is frost in the ground at the completion of the work, take two sets of readings after the frost is out of the ground.
6. All elevation survey measurements shall be to an accuracy of 0.01 foot.
7. Maintain clear and orderly records of these measurements and submit to the Engineer within 24 hours after readings are taken.

H. Response to Instrumentation Reading.

1. Notify the Engineer immediately and take the necessary remedial measures when the results of instrument measurements indicate that settlements equal to that of those specified in this Special Provision as Alert Limits or if a potentially damaging or hazardous situation is arising. Do everything necessary, including grouting specified in Special Provisions for Tunnel Grouting, to correct such deflections and modify working methods so as to prevent further deflection or damage. All corrective measures, damage repair and necessary changes in construction methods shall be undertaken by the Contractor at his own expense.
2. Stop tunneling, modify tunneling methods, and conduct grouting or other remedial actions if settlements exceed those limits specified below. Provide descriptions of modifications and remedial actions. Obtain approval from the Engineer before resuming tunneling:
 - a. Surface settlement over tunnel:
 - 1) Alert Limit = 0.125 inches
 - 2) Action Limit = 0.25 inches
 - b. Surface settlement at roadways, underground utilities, and structures:
 - 1) Alert Limit = 0.50 inches
 - 2) Action Limit = 0.75 inches
 - c. Subsurface settlement as identified by utility monitoring point over tunnel:
 - 1) Alert Limit = 0.125 inches

- 2) Action Limit = 0.25 inches
3. Stop pilot hole drilling, pre-reaming, back reaming and/or pipe pullback, conduct grouting or other remedial actions if top-of-rail horizontal and/or vertical settlement and/or deflection exceed those limits specified below. Provide descriptions of modifications and remedial actions. Obtain approval from the Engineer before resuming HDD operation.
 - a. **Top-of-Rail surface settlement:**
 - 1) Alert Limit = 0.125 inches
 - 2) Action Limit = 0.25 inches
 - b. **Top-of-rail horizontal deflection:**
 - 1) Alert Limit = 0.125 inches
 - 2) Action Limit = 0.25 inches

J. Protection and Maintenance of Instrumentation.

Exercise care to avoid damage to instrumentation. Flag and protect all instruments.

Instrumentation that is damaged shall be replaced at the Contractor's own expense. A damaged instrument within 50 feet of the work shall be replaced before the work is permitted to continue.

120146.04 METHOD OF MEASUREMENT.

Instrumentation, Monitoring And Settlement Control: Incidental to bid items for Sanitary Sewer Gravity Main with Casing Pipe, Trenchless, Reinforced Concrete Pipe (RCP), 370D (Class V), 54 inch and Cased Dual-Siphon System (24 inch and 30 inch Carrier Pipe).

120146.05 BASIS OF PAYMENT.

Instrumentation, Monitoring And Settlement Control: Incidental to bid items Sanitary Sewer Gravity Main with Casing Pipe, Trenchless, Reinforced Concrete Pipe (RCP), 370D (Class V), 54 inch and Cased Dual-Siphon System (24 inch and 30 inch Carrier Pipe). Will not be paid for separately.