

NCDOT SPT Hammer Energy Measurement Requirement

NCDOT Geotechnical Engineering Unit

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Energy Measurement Test Site Consideration:

- Do not conduct energy measurement tests on the following sites.
 - Weathered rock (possible presence of inflated transfer energy due to superimposed compressive down and up waves)
 - Very soft clay soils with a BPF < 8 (possible presence of reduced transfer energy due to superimposed compressive down and tension up waves)
- Ideally energy measurements should be acquired in materials with consistencies between 8 bpf and 50 bpf.
- Energy measurements conducted on non-NCDOT or out-of-state projects are acceptable.

SPT Hammer Energy Measurement Frequency:

- Measure SPT hammer energy annually
- Measure SPT hammer energy when SPT hammer has a major repair

Energy Measurement and Report Requirement:

- Report shall be sealed by a professional engineer registered in the State of North Carolina.
- Report should be submitted within one (1) month after the initial test was completed.
- Use the most current ASTM Standard D4633.
- Report an average transferred energy in percentage as compared to the theoretical energy of a 140-pound ram falling 30 inches (ASTM D1586).
- Energy evaluation of the hammer system is more reliable when the length L is 9 to 12 m (30 to 39 ft) or more (see Section 7.3 Note 8 of ASTM D4633). Energy measurement limited in a depth of less than 30 ft will be rejected unless a reasonable explanation is provided and accepted by Engineer.
- Perform measurements for at least 3 depths of quality data with 5 depths preferred (see Section 7.9 of ASTM D4633).
- Submit electronic file copy of the reports in portable document format (pdf).

Energy Measurement Report Content Information:

The following are general guidelines on what information should be presented in the report. Actual report can be varied depending upon a consultant's common practice.

1. General Information

- Consultant company name
- Project number
- Project description
- Boring name
- Report date
- Test date
- Test personnel (testing and report)
- Test location: county and state
- Client information (company name, contact, address)
- Geologist or engineer name
- General description of subsurface soils

2. Introduction

- Purpose and scope of work
- Test method and test standard

3. Test Equipment

- Main test unit maker and serial number (place in main report)
- SPT Rod maker, type (AW or AWJ), serial number, and dimensions – OD, ID, cross-sectional area, and typical length in main report (place in main report)
- Strain gauges and accelerometers maker, serial number, and certificate of calibration (place in appendix)

4. Drill Rig Information

- Owner information (name, contact, address, phone number)
- Manufacturer
- Model
- Type (Trailer, ATV, Track, Truck, ...)
- Serial number (manufacturer)
- Equipment number (NCDOT rigs)
- Rig operator

5. Hammer Information

- Type (automatic, manual, ...)
- Ram weight
- Drop height

6. Boring Information

- County and State
- TIP number or state project number, if applicable
- Station and offset, if applicable
- Bore log report or field bore log, if available

7. Energy Measurement Method, Results, and Rating

- Method – most current ASTM D4633
- Results – include the following information
 - LE: Length below gauges to pile bottom
 - LP: Length of penetration (at the end of driving)
 - BPF (or BLC): Blow count per foot (including blow count per each 6-inch increment)
 - BPM: Blow per minute
 - AET: Average transfer energy, in ft-lbs or kip-ft
 - ETR: Energy transfer ratio, in percentage
 - Soil sample description
- Rating – Report an energy measurement rating, in percentage

8. Attachments

- Overview of SPT hammer energy measurement method
- Plots show –
 - Average ETR versus rod length
 - ETR versus rod length
- Plots show –
 - FMX: Penetration vs. maximum force
 - EFV: Penetration vs. energy of FV
 - ETR: Penetration vs. energy transfer ratio
 - BPF (or BLC): Penetration vs. Blow count per foot
 - And any other additional information

- Table shows depth versus the following quantities –
 - BPF (or BLC): blow count per foot
 - BPM: blow count per minute
 - EFV: energy of FV
 - ETR: energy transfer ratio
 - FMX: maximum force
 - VMX: maximum velocity
 - DMX: maximum displacement
 - CSX: maximum compression stress
 - DFN: final displacement
 - And any other additional information (or quantities)
- Plot of typical wave forms showing the following information
 - force and velocity vs. time, and
 - project information
 - BN: blow count
 - All quantity results
 - Pile properties
 - Sensors information
- Boring log or field log, if available
- All information related to accelerometer and strain gauge serial numbers and calibration information