

**SECTION 02317 - EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES****PART 1 GENERAL****1.1 REFERENCES**

1. General: The work shall comply with the most recent standards or tentative standards as published at the date of the contract and as listed in this specification using the abbreviation shown.
2. American Society for Testing and Materials Publications (ASTM):
  - 1) D 448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction
  - 2) D 698 Test Method for Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>)
  - 3) D 1556 Standard Test Method for Density and Unit Weight of Soil In Place by the Sand-Cone Method
  - 4) D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>)(2,700kN-m<sup>3</sup>)
  - 5) D 2167 Standard Test Method for Density and Unit Weight of Soil In Place by the Rubber Balloon Method
  - 6) D 2487 Standard Classification of Soils for Engineering Purposes (unified Soil Classification System)

**1.2 DEFINITIONS**

1. Controlled Fill and Compacted Backfill: Controlled fill and compacted backfill are satisfactory materials compacted according to these Standards. Controlled fill is required beneath all areas on which final grade is not placed on original excavated soil.
2. Satisfactory Materials: Materials classified by ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, and CL are satisfactory as fill for overlot grading and are satisfactory in-situ.
3. Unsatisfactory Materials: Materials classified by ASTM D 2487 as OL, OH, MH, CH, and PT are unsatisfactory in-situ and as fill. Unsatisfactory materials also include those materials containing roots and other organic matter, trash, debris, frozen materials, mud, and stones larger than 6 inches. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.
4. Cohesionless and Cohesive Materials: Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have plasticity index of zero.
5. Degree of Compaction: Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 698 or ASTM D 1557 as specified, abbreviated above as a percent of laboratory maximum density.
6. Topsoil: Material obtained from excavations, suitable for topsoils, shall consist of friable clay loam, free from roots, stones, other undesirable material and shall be capable of supporting a good growth of grass.

7. **Rock:** Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume.
8. **Unyielding Material:** Unyielding material shall consist of rock and gravelly soils with stones greater than 18 inches in any dimension.
9. **Unstable Material:** Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.
10. **Select Granular Material:** Select granular material shall consist of well-graded sand, gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall not contain more than 10 percent by weight of material passing a No. 200 mesh sieve. The maximum allowable aggregate size shall be 1 inch, or the maximum size recommended by the pipe manufacturer, whichever is smaller.
11. **Select Initial Backfill Material:** Initial backfill material shall consist of select granular material or satisfactory materials free from rocks 1 inch or larger in any dimension.

### 1.3 QUALITY ASSURANCE

1. **Testing Results:** Copies of all laboratory and field test reports shall be submitted to the Authority's Representative within 72 hours of the completion of the test.

## **PART 2 PRODUCTS**

N/A

## **PART 3 EXECUTION**

### 3.1 EXCAVATION AND PREPARATION OF TRENCH

1. **General:** Excavation within the VDOT right-of-way shall be in accordance with VDOT requirements.
2. **Depth:** Depth of trenches shall be as shown on plans and Standard Details except that the trench shall be excavated to allow for a depth of 1/4 of the pipe's outside diameter or a minimum of 6 inches of ASTM D 448 #68 aggregate bedding for gravity sewer. For force main and water main, excavation for bell holes in firm subgrade shall be sufficient except in rock where 6 inches of bedding, ASTM D 448 #68 stone, will be required. Where the trench is inadvertently excavated to a depth below grade, it shall be backfilled with ASTM D 448 #68 stone, compacted to provide sound and uniform support for the pipe at the proper level as shown on the plans. Minimum cover over any pipe shall be 42 inches. Maximum cover over any pipe shall be 18 feet, unless otherwise approved by the Authority.
3. **Width:** Width shall be sufficient to allow pipe installation without walking or standing on pipe. The trench width at a point 12 inches above the top of the pipe shall be 8 inches on each side of the pipe unless otherwise directed by the Authority's Representative. Excavation at manholes and similar structures shall be sufficient to leave at least 12 inches clearance between their outer surface and the embankment or sheeting. See Standard Detail W-1 and S-1 regarding pipe installation.
4. **Excess and Unsuitable Material:** Wet or otherwise unsuitable soil at the subgrade shall be removed to a minimum depth of 12 inches below the bottom of the pipe or to a depth required by the Authority's Representative and replaced with compacted ASTM D 448 #68 stone to the bottom of the normal trench bedding, See Standard Details W-1 and S-1.

When the bottom of the trench or subgrade is found to consist of material that is unstable to such a degree that it cannot be removed, the Developer's Engineer shall submit plans to the Authority's Engineer for review showing the proposed foundation for the pipe and/or appurtenances, using concrete or other material. Concrete encasement may be required where the amount of cover material would be two feet in depth (or less) over the top of the pipe.

5. **Rock Excavation:** Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe, manholes, valves or other appurtenances and overdepth shall be backfilled with satisfactory material and compacted in conformance with BACKFILLING subsection. These clearances shall also be observed for pieces of concrete or masonry and other debris or subterranean structures, such as masonry walls, piers, or foundations that may be encountered during excavation. See Standard Details W-1 and S-1.
6. **Trench Protection:** Protection shall be the sole responsibility of the Contractor.
7. **Pumping, Bailing, and Draining:** The Contractor shall remove any water which may accumulate or be found in the trenches or other excavations and shall keep the excavations clear of water while work is being installed, unless approval to the contrary is granted by the Authority's Representative.
8. **Blasting:** Blasting shall be in accordance with local ordinances and shall be the sole responsibility of the Contractor.

### 3.2 BACKFILLING

1. **Materials:** All backfill materials shall be free from mud, refuse, construction debris, organic material, boulders, frozen or otherwise unsuitable material. Select initial backfill shall be as defined in Part 1 of this section. Remaining backfill may contain stones up to 5 inches in their greatest dimension, unless otherwise specified. The Contractor may backfill with the excavated material, provided it meets the conditions as stated above.
2. **Gravity Sewer Bedding:** Bedding shall be required on all gravity sewer lines, and shall be in accordance with Standard Detail S-1. Bedding material shall extend from the excavated trench bottom to the pipe springline (midpoint) except on PVC pipe where it shall extend to 6 inches above the top of the pipe. Bedding material shall be compacted to 95 percent of maximum density as measured by ASTM D 698.
3. **Pressure Pipe Bedding:** Bedding for pressure pipe shall consist of firm subgrade with excavation for bell holes. When trench is in rock or non-select material bedding shall consist of a gravel base, unless shown otherwise on plans, and shall be in accordance with Standard Detail W-1. Gravel bedding material shall extend from the excavated trench bottom to the pipe springline (midpoint). Bedding material shall be compacted to 95 percent of maximum density as measured by ASTM D 698.
4. **Backfilling to Grade:** Initial backfill shall be with select material to a depth of at least two feet over the pipe and compacted prior to placement of remaining backfill. Initial backfill shall be placed in lifts not to exceed 6 inches (prior to compaction). Remaining backfilling shall be carried up evenly in lifts not to exceed 2 feet.
5. **Backfilling in Controlled Areas:** Backfill under pavement, proposed pavement, or in areas within rights-of-way shall be in layers of selected earth not more than 6 inches in thickness, and each layer shall be compacted to a minimum of 95 percent of maximum density at optimum moisture when tested in accordance with ASTM D 698. Compaction shall be in accordance with instructions in this Section as modified herein. The top course of backfill directly under pavement shall consist of aggregate base material meeting the requirements of VDOT #21A stone. The depth of this course shall be at least 1-1/2 times greater than the existing base course, but in no case shall be less than 6 inches. Moisture content shall be within 20 percent of optimum.

6. **Backfill Compaction Testing:** The Contractor shall demonstrate the adequacy of backfill compaction by performing density testing of the completed trench at no cost to the Authority. Testing shall be performed by an independent testing laboratory qualified to perform such tests and approved by Authority's Representative. Density testing shall be performed at three depths for each test location: surface, mid-depth, and near maximum trench depth. The character of the backfill material will be observed during the excavation for density testing to determine conformance with the specifications. Density testing shall be performed using nuclear field density equipment or conventional weight-volume methods. If the weight-volume method is used, volume shall be determined by using the sand replacement test (ASTM D 1556) or liquid displacement methods (ASTM D 2167). If nuclear methods are used, the trench correction effect shall be accounted for by recalibrating the nuclear gauge on its calibration block at the location of each test prior to taking the density measurement. The Contractor shall furnish all equipment, tools, and labor to prepare the test site for testing. Testing shall be performed by an independent testing laboratory qualified to perform such tests and approved by the Authority's Representative. All testing shall be witnessed by the Resident Project Representative. The test shall be repeated until satisfactory results are obtained. The Contractor shall be charged for all retests at the normal rates for inspection services.
  - 1) **Normal Testing Frequency:** One test shall be performed within the first 500 feet of pipe installed by each crew. This test will be used as an initial evaluation of the compaction methods being used. Beyond the initial 500 feet, one test shall be performed in each 1,000 foot section of pipe installed or fraction thereof. Testing shall progress as each 1,000 foot section is completed. The location of the test within each section shall be selected by the Resident Project Representative. Testing which indicated that unacceptable material has been incorporated into the backfill, or that insufficient compaction is being obtained shall be followed by expanded testing to determine the limits of the unacceptable backfill.
  - 2) **Expanded Testing Requirements:** If normal testing within a test section indicated unacceptable backfill, the Authority's Representative may require additional testing within the same test section to determine the limits of unacceptable backfill. Unacceptable backfill within the limits established by the testing shall be removed and replaced by the Contractor at no cost to the Authority. Additional testing beyond that required may be performed by the Contractor at his expense to further delineate limits of unacceptable backfill.
  - 3) **Additional Testing:** Testing beyond the normal frequency or expanded testing required which is requested by the Authority's Representative, and approved by the Authority, shall be at the Authority's expense.
7. **Finished Surfaces:** Uniformly smooth grading of disturbed areas shall be required after backfill and compaction. Road shoulders shall have a minimum depth of 6 inches of VDOT #25 or #26 crusher run aggregate, compacted to a minimum 95 percent of maximum density as measured by ASTM D 698. Ditches and gutters shall be finished to drain readily. In grass or lawn areas, the last 4 inches of compacted fill will consist of topsoil or an approved soil which will support a turf growth after fertilizing and seeding. Settlement or other damage that occurs prior to acceptance of this work shall be repaired and grades satisfactorily re-established.
8. **Quality Assurance:** The Developer will be responsible for and shall repair any settlement in the backfill or pavement for a period of one year after acceptance of the work.

END OF SECTION