**Designation: D7208 – 14**

# Standard Test Method for Determination of Temporary Ditch Check Performance in Protecting Earthen Channels from Stormwater-Induced Erosion[1]

This standard is issued under the fixed designation D7208; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the guidelines, requirements, and procedures for evaluating the ability of temporary ditch check systems to protect earthen channels from stormwater-induced erosion. Critical elements of this protection are the ability of the temporary ditch check to:

1.1.1 Slow or pond runoff, or both, to encourage sedimentation, thereby reducing soil particle transport downstream;

1.1.2 Trap soil particles up stream of structure; and

1.1.3 Decrease soil erosion.

1.2 This test method utilizes full-scale testing procedures, rather than reduced-scale (bench-scale) simulation, and is patterned after conditions typically found on construction sites at the conclusion of earthwork operations, but prior to the start of revegetation work. Therefore this test method considers only unvegetated conditions.

1.3 This test method provides a comparative evaluation of a temporary ditch check to baseline bare soil conditions under controlled and documented conditions.

1.4 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026 unless superseded by this standard.

1.4.1 The procedures used to specify how data are collected/recorded and calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that should generally be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analysis methods for engineering design.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units, which are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Also, the user must comply with prevalent regulatory codes, such as OSHA (Occupational Health and Safety Administration) guidelines, while using the test method.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft$^3$ (600 kN-m/m$^3$))

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D6026 Practice for Using Significant Digits in Geotechnical Data

D6460 Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, see Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *temporary ditch check (in erosion control), n*—a non-permanent barrier consisting of rocks, straw bales, excelsior logs, wattles, lumber, rock bags, interlocking pre-cast

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.25 on Erosion and Sediment Control Technology.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

concrete blocks, or other materials installed or constructed across a drainage way, swale, or other ephemeral waterway to reduce flow velocity, decrease erosion, and promote soil retention.

3.2.2 *trapezoidal test channel, n*—an earthen channel used to test erosion control products shaped such that the bottom is flat with sides greater than 90° angle in relation to the bottom of the channel.

## 4. Summary of Test Method

4.1 The performance of a temporary ditch check in reducing stormwater-induced erosion is determined by subjecting the material to simulated stormwater flow in a controlled and documented environment.

4.2 Key elements of the testing process include:

4.2.1 Calibration of the stormwater simulation equipment;

4.2.2 Preparation of the test channel;

4.2.3 Documentation of the temporary ditch check(s) to be tested;

4.2.4 Installation of the temporary ditch check(s);

4.2.5 Performance of the test;

4.2.6 Collection of hydraulic, topographical, and associated data;

4.2.7 Analysis of the resultant data; and

4.2.8 Reporting.

## 5. Significance and Use

5.1 This test method evaluates a system of temporary ditch checks and their means of installation to:

5.1.1 Reduce soil loss and sediment concentrations in stormwater runoff under conditions of varying channel conditions and soil type; and

5.1.2 Improve water quality exiting the area disturbed by earthwork activity by reducing suspended solids.

5.2 This test method models and examines conditions typically found on construction sites involving earthwork activities, including: highways and roads; airports; residential, commercial and industrial developments; pipelines, mines, and landfills; golf courses; etc.

5.3 This test method is a performance test. It is a comparative tool for evaluating the erosion control characteristics of different temporary ditch checks and can be used for quality control to determine product conformance to project specifications. Take caution when comparing results from different laboratories because information about between-laboratory precision is incomplete and slight differences in soil and other environmental and geotechnical conditions may affect temporary ditch check performance. Unique project-specific conditions should be taken into consideration.

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

## 6. Apparatus

6.1 *Test Channel*—The earthen trapezoidal test channel shall be a minimum of 18 m (59 ft) in length. The channel shall be constructed to approximately a 5 % slope. The channel shall be constructed to a 0.6 m (2.0 ft) bottom width with 2H:1V side slopes prior to testing. The test channel shall have a way of measuring water discharging in to the channel. A weir is suitable this purpose.

6.2 *Water Delivery System*—The water delivery system shall include pump(s), piping, channels, and water control structures, as necessary, to achieve the desired hydraulic conditions. The water control structures shall regulate the flow and to direct it into the desired test channel. The water delivery system shall be constructed such that turbulence at the entrance to the test channel is minimized. Use of flow straighteners (for example, tube racks or vanes) will reduce turbulence and achieve uniform flow conditions. For this purpose, use a direct flow system (that is, controlled flow diverted from a natural waterway). The water delivery system in Fig. 1 shows an example of a closed-loop water delivery system.

6.3 *Total Station System*—The total station system is a standard surveying instrument that is capable of measuring vertical and horizontal angles, and distance, simultaneously to determine measurement point coordinates (that is, *X*, *Y* and *Z* axis) and that uses an internal data logger to store this information for future use. Instead of a total station system, manual surveying equipment may be used providing it supplies equivalent accuracy. Periodic calibration and certification of this equipment shall be performed.

6.4 *Velocity Probe*—A velocity probe capable of measuring point velocities to an accuracy of ±0.03 m/s (±0.10 ft/s) shall be used to identify flow conditions during test operation. Acceptable types of probes include electromagnetic, spinning cup, propeller, and static tube devices. Periodic calibration and certification of this equipment shall be performed.

6.5 *Miscellaneous*—Other miscellaneous equipment includes: meteorological equipment (wind speed, temperature, precipitation), and cameras or video recorders.

## 7. Reagents

7.1 *Water Source*—Any water source shall be suitable for testing provided that it is not sediment laden or contains deleterious materials that could impair the operation of the pumps.

## 8. Calibrations

8.1 Perform determination of the water delivery system discharge (Q). Begin calibration of the water delivery system when a steady-state flow is achieved.

8.2 For open-channel water delivery systems, measure the depth of water flowing into the test channel. Measure the velocity in the supply channel using a velocity probe in the measurement location shown in Fig. 2.

## 9. Procedure

9.1 *Trapezoidal Test Channel Preparation:*

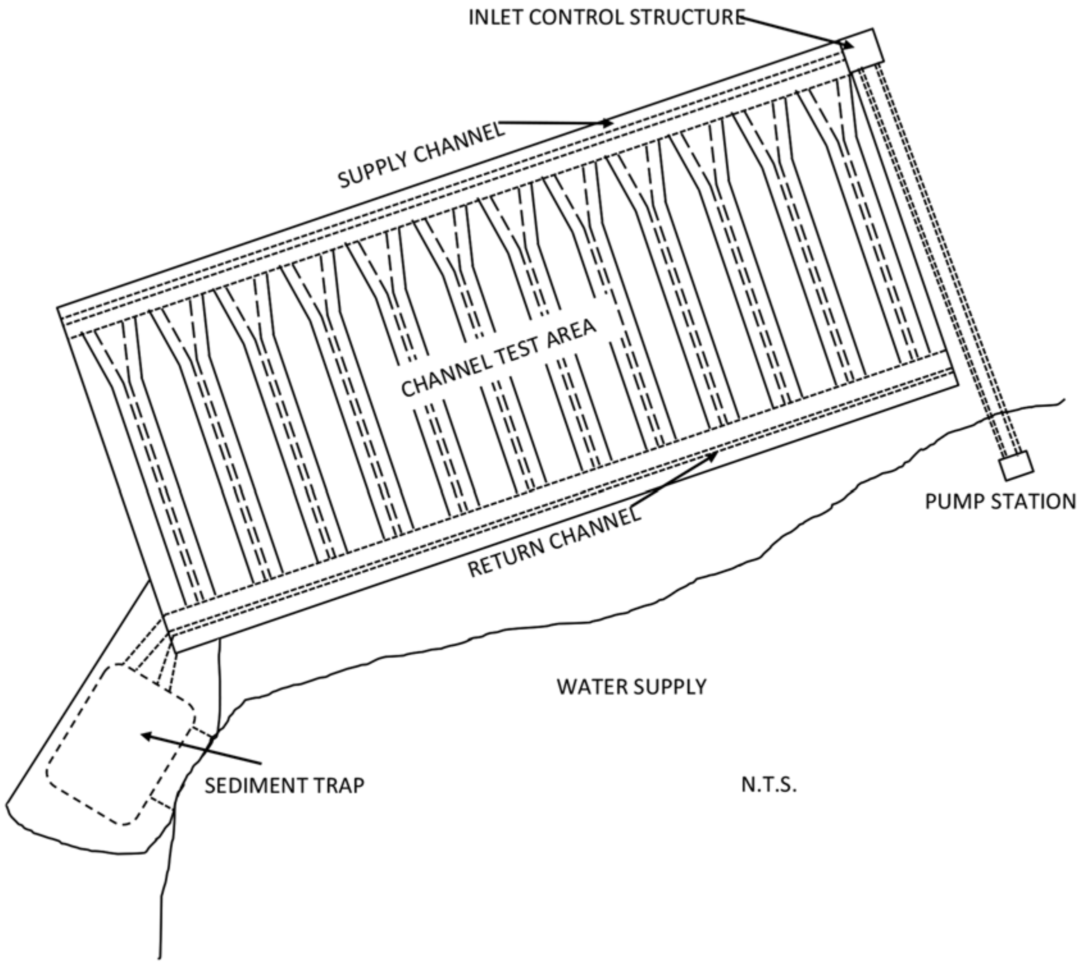



**FIG. 1 Typical Water Delivery System**

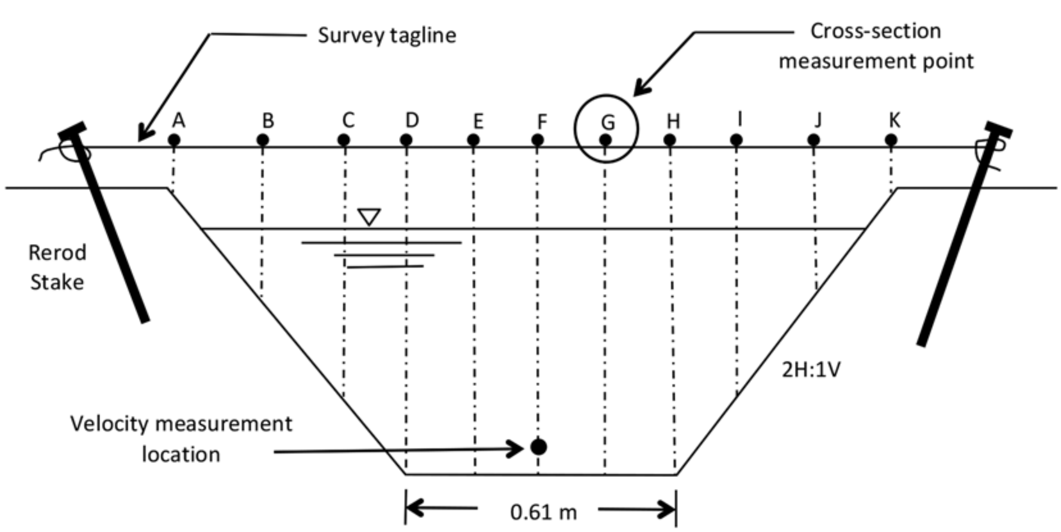



**FIG. 2 Typical Channel Cross-Section**

9.1.1 Construct earthen test channels using conventional earthwork placement techniques similar to procedures outlined in Test Method D6460 for trapezoidal channels. Perform compaction of channel bed material to create a stable subgrade.

9.1.2 Plate the channel surface with a minimum 45 cm (18 in.) thick veneer of soil. General soil types to be used for testing shall be loam, clay, and sand. Target grain sizes and plasticity indices are included in Table 1. Place the veneer in 15

**TABLE 1 Target Grain Sizes and Plasticity Indices**

| | Sand | Loam | Clay |
|---|---|---|---|
| $D_{100}$ (mm) | $D_{100}$ < 40 | $D_{100}$ < 25 | $D_{100}$ < 10 |
| $D_{85}$ (mm) | 1.0 < $D_{85}$ < 10.0 | 0.5 < $D_{85}$ < 5.0 | 0.01 < $D_{85}$ < 1.0 |
| $D_{50}$ (mm) | 0.08 < $D_{50}$ < 2.0 | 0.01 < $D_{50}$ < 1.0 | 0.001 < $D_{50}$ < 0.1 |
| $D_{15}$ (mm) | 0.001 < $D_{15}$ | 0.0005 < $D_{15}$ | $D_{15}$ < 0.0005 |
| Plasticity Index | nonplastic | 1 < PI < 8 | 14 < PI |

cm (6 in.) lifts and compact to 90 ± 3 % of standard Proctor density in accordance with Test Method D698.

9.1.3 Excavate the channels to a trapezoidal cross-section with a 61 ± 2 cm (2.0 ± 0.07 ft) bottom width and 2H:1V side slopes. The test channels shall be a minimum of 18.3 m (60.0 ft) in length to allow sufficient distance between temporary ditch check structures during testing. Bed slope shall be approximately 5 %. Fig. 3 shows a typical channel profile and Fig. 2 shows a typical channel cross-section.

9.1.4 Begin the test reach far enough below the inlet to the channel to ensure flow is uniform and extend 12 ± 0.3 m to (39 ± 1 ft) downstream from that point. Establish benchmarks on either side of the channel at each end of the test reach and at 1.5 ± 0.1 m (5.0 ± 0.3 ft) intermediate intervals (nine cross-sections total).

9.1.5 Loosen the soil veneer in the test reach and 1.5 ± 0.1 m (5.0 ± 0.3 ft) upstream and downstream of the test reach to a depth of approximately 10 ± 2 cm (4.0 ± 0.8 in.) using a tiller or other appropriate tools. Rake the tilled channel smooth with a steel hand rake and compact. Repair depressions, voids, soft or uncompacted areas before testing can commence. Also, free the channel from obstruction or protrusions, such as roots, large stones or other foreign material.

9.1.6 If the channel has been used previously for a test series, discard the soil carried out of the channel, and obliterate any rills and gullies. Spread new soil of the same type across the channel and blend (rake or tilled) into the surface.

9.2 *Pre-Test Documentation:*

9.2.1 Maintain a test folder for each test cycle, including information on:

9.2.1.1 Site conditions;

9.2.1.2 Geotechnical and soil conditions;

9.2.1.3 Meteorological data;

9.2.1.4 Temporary ditch check product type, description, and installation procedure; and

9.2.1.5 Photo documentation.

9.2.2 Include the following subjective site information: general visual conditions of the channel to be tested; general meteorological information; channel treatment; photographs or videotape, or both, and any supplemental information that is not included in the following sections, but is thought to be of significance to the test.

9.2.3 Include the following geotechnical and soils information: soil classification [Unified Soil Classification System (USCS) or USDA classification system, or both]; Standard Proctor moisture-density relationship; "K" factor; and gradation (including hydrometer test for the $P_{200}$ fraction).

9.2.4 Include the following meteorological information: all data from the on-site weather station at the time of the test (that is, ambient air temperature, wind speed and precipitation).

9.2.5 Include the following product type and description information: manufacturer name; product name; description; specifications; size, and; a sample of the material, if practical.

9.3 *Test Set-Up:*

9.3.1 Install the maximum number of temporary ditch check(s) in the 12.2 ± 0.1 m (40.0 ± 0.3 ft) test channel after calibration has been completed and the test channel has been prepared. Document the installation methodology for the temporary ditch check(s) including: orientation on the bed and side slopes (longitudinal or lateral); placement (which side faces up); termination details; joint details; spacing between temporary ditch checks if more than one is to be tested, and; anchor type and installation pattern. Place the temporary ditch check(s) across the channel bottom perpendicular to the flow direction and extend it up the side slopes far enough so ponded water cannot erode around the temporary ditch check. If more than one temporary ditch check is to be tested, spacing shall follow manufacturer recommendations or ditch check spacing equation (see Section 10).

9.3.2 Measure the elevation of the channel surface with the total station equipment using the reference benchmarks and a stringline between opposing benchmarks. Take elevation measurements for each test cross-section (nine total) at the locations shown in Fig. 2. Elevation measurements for additional cross-sections directly in front and behind each temporary ditch check shall also be taken to measure deposition and/or scour directly adjacent to ditch check structure. To allow measurement of the channel surface, a steel tip extension ("stinger") may need to be attached to the base of the

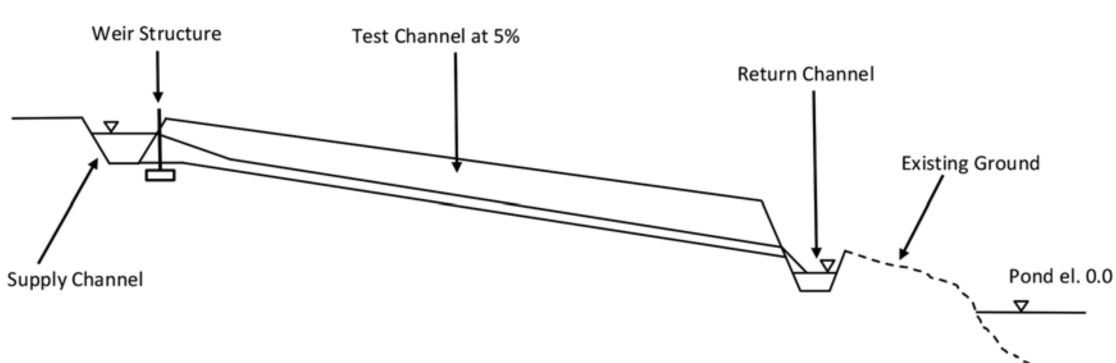



**FIG. 3 Typical Channel Profile**

surveyor's rod. Perform rod placement from an above channel platform, so that the rodman does not walk on the test channel. The rodman must use care in positioning the rod so measurements are indicative of the channel surface.

9.3.3 Take photographs or videotape, or both, of the test channel prior to testing.

9.4 *Test Operation and Data Collection:*

9.4.1 Include the following test data: operator name and title; time flow began; time flow stopped; time runoff stopped; flow depths, and; measured velocities.

9.4.2 Take water surface elevation measurements at the centerline point of each test cross-section and directly in front and behind each temporary ditch check using the total station equipment as soon as the flow reaches a steady-state, uniform condition. Take velocity measurements at the centerline point of each test cross-section using the velocity probe (see Fig. 2). If the depth of flow is less than 20 cm (8.0 in.), take only the six-tenths depth reading. Take photographs or videotape, or both, during the test.

9.4.3 Perform testing at a minimum target flow of 0.014 ± 0.005 $m^3/s$ (0.49 ± 0.18 cfs).

9.4.4 Test duration shall be 30 minutes or until a temporary ditch check becomes dislodged.

9.4.5 At the conclusion of the test, take channel surface elevation measurements again at the same locations as the pre-test measurements. As with the previous test data collection, take the rod elevation measurements from above and do not walk on the test channel surface.

9.4.6 Record general observations regarding the condition of the tested temporary ditch check(s) at the conclusion of the data collection.

9.4.7 Carefully remove the temporary ditch check(s) from the channel, with as little disturbance of the soil as possible. Note general observations regarding the condition and scour patterns. Take photographs and or videotape to record the condition of the test channel. Markers may be used to identify any scour patterns for the pictorial documentation.

9.4.8 Include a minimum of one test at a specific flow rate for each type of temporary ditch check to be evaluated.

9.4.9 Include a minimum of one bare soil test for each type of temporary ditch check to be evaluated. Use data from a new bare soil channel test or achieved testing that meets the same test parameters/criteria that the temporary ditch check was evaluated under.

## 10. Calculation

10.1 *Calibration Data:*

10.1.1 Report all significant digits as referred to in Practice D6026.

10.1.2 *Discharge*—Calculate discharge for each flow and report measurement method and the associated accuracy.

10.2 *Temporary Ditch Check Spacing:*

10.2.1 *Ditch Check Spacing Equation*—The necessary spacing required between temporary ditch checks that place the bottom of the upstream temporary ditch check and the top of the downstream temporary ditch check at the same elevation is computed as:

$$D = (H/S) \times 100 \quad (1)$$

where:

$D$ = spacing distance, m (ft),
$H$ = distance between channel bed and top of installed temporary ditch check, m (ft), and
$S$ = slope of channel bed, %,

10.2.2 See also Fig. 4.

10.3 *Test Data:*

10.3.1 Analysis of the test data involves the following variables: total discharge, velocity, flow depth, and energy slope.

10.3.2 Determine total discharge by the calibration activity and also compute at each of the nine measurement cross-sections by the continuity equation, as follows:

$$Q = V_{avg} A \quad (2)$$

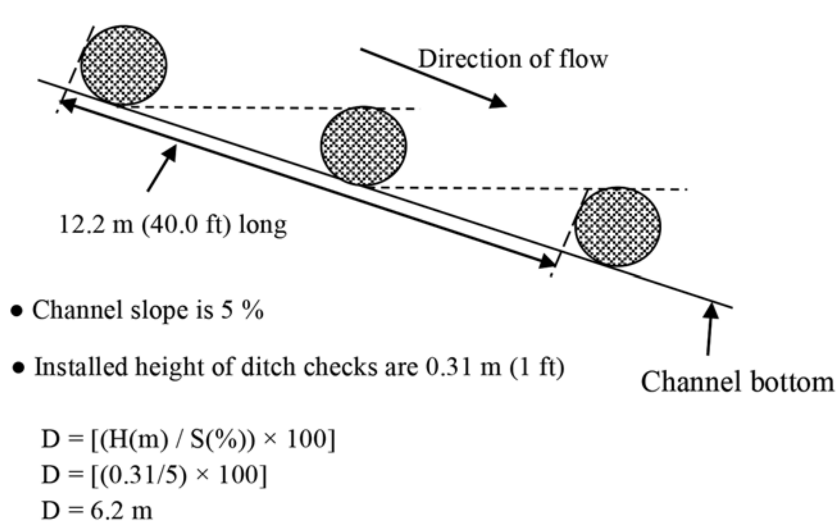



**FIG. 4 Example Calculation of Ditch Check Spacing**

where:

$Q$ = discharge, $m^3/s$,
$V_{avg}$ = average of the three centerline velocity measurements, m/s, and
$A$ = cross-sectional area of flow, $m^2$.

10.3.3 Determine the energy slope, $S_f$, by fitting a regression line through the energy grade line elevation determined at each of the nine measurement cross-sections, as follows:

$$S_f = WSE + V_{avg}^2/2\ g \quad (3)$$

where:

$S_f$ = energy slope,
$WSE$ = water surface elevation,
$V_{avg}$ = average velocity, m/s, and
$g$ = gravitational constant, 9.8 $m/s^2$.

10.3.4 Calculate the Clopper Soil Loss Index (CSLI) from the topographic data gathered before and after test flows using the total station equipment. Use the change in channel topography to define the performance of the temporary ditch check. Quantify areas of degradation (soil loss) as "cut" and quantify areas of aggradation (sediment deposition) as "fill." Use commercially-available earthworks software to evaluate the channel topographies and determine areas of cut and fill. Calculate the CSLI as follows:

$$CSLI = (C_T/A_T) \times 100 \quad (4)$$

where:

$CSLI$ = Clopper Soil Loss Index, cm,
$C_T$ = total cut, $m^3$, and
$A_T$ = wetted channel area, $m^2$.

10.3.5 Calculate the Soil Aggradation Index (SAI) from the topographic data gathered before and after test flows using the total station equipment. Use the change in channel topography to define the performance of the temporary ditch check. Quantify areas of aggradation (sediment deposition) as "fill" and quantify areas of degradation (soil loss) as "cut". Use commercially-available earthworks software to evaluate the channel topographies and determine areas of cut and fill. Calculate the SAI as follows:

$$SAI = (F_T/A_T) \times 100 \quad (5)$$

where:

$SAI$ = Soil Aggradation Index, cm,
$F_T$ = total fill, $m^3$, and
$A_T$ = wetted channel area, $m^2$.

## 11. Report: Records

11.1 Report at a minimum the following information:

11.1.1 General information, including test facility location, date, time and operator(s),

11.1.2 Test channel preparation,

11.1.3 Calibration data and analysis,

11.1.4 Materials documentation including temporary ditch check material and other pertinent physical properties, and anchor description,

11.1.5 Test set-up activities including trenching (if applicable), anchor pattern, and average anchor density (anchor per unit area),

11.1.6 Test operation and data collection (including "raw" data such as measured discharge for each test flow), record of overtopping if it occurred, and

11.1.7 Analysis (including hydraulic conditions, CSLI, and SAI compared to a bare soil data set containing a minimum of three replications).

11.2 *Reporting of Significant Digits:*

11.2.1 Report all significant digits as referred to in Practice D6026.

## 12. Precision and Bias

12.1 *Precision*—Test data on precision is not presented due to the nature of the materials tested by this test method. It is either not feasible or too costly at this time to have ten or more laboratories participate in a round-robin testing program. Also, it is either not feasible or too costly to produce multiple specimens that have uniform physical properties. Any variation observed in the data is just as likely to be due to specimen variation as to operator or laboratory testing variation.

12.1.1 The Subcommittee D18.25.08 is seeking any data from the users of this test method that might be used to make a limited statement on precision.

12.2 *Bias*—There is no accepted reference value for this test method, therefore, bias cannot be determined.

## 13. Keywords

13.1 erosion control; scour; sediment; soil loss; temporary ditch check

# APPENDIX

## (Nonmandatory Information)

## X1. DATA COLLECTION SHEET

X1.1 See Fig. X1.1.

NOTE X1.1—The data collection sheet shown in the appendix is representative of a data collection sheet for testing a product that is 1.7 m (20 in.) in height on a 5 % channel.

| | | | |
|---|---|---|---|
| Date: | ____ | Slope Gradient: | ____ % |
| Time: | ____ | Side Slope Gradient: | ____ H:1V |
| Test Name: | ____ | Bottom Width: | ____ |
| Channel #: | ____ | Soil Type: | ____ |
| Product: | ____ | Personnel: | ____ |
| Product: | ____ | | |

**Water Depths Measurements in Test Reach**

| Cross-Section | Water Depth (cm) |
|---|---|
| A | |
| A1 | |
| B | |
| C | |
| D | |
| E | |

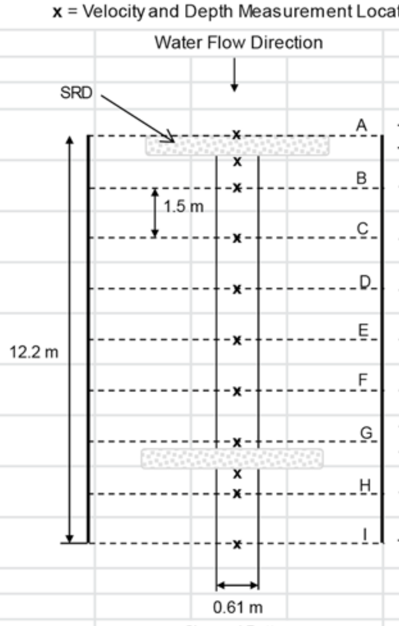
| Cross-Section | Water Depth (cm) |
|---|---|
| F | |
| G | |
| G1 | |
| H | |
| I | |
| J | |

**Note:** A1 and G1 are depth readings taken directly behind the SRD.

**Velocity Measurements in Test Reach**

Test Channel Configuration

**x** = Velocity and Depth Measurement Location




| Cross-section | Measurement Depths .2d m/s | .6d m/s | .8d m/s |
|---|---|---|---|
| A | | | |
| A1 | | | |
| B | | | |
| C | | | |
| D | | | |
| E | | | |
| F | | | |
| G | | | |
| G1 | | | |
| H | | | |
| I | | | |

**Note:** A1 and G1 are velocity readings taken directly behind the SRD.

NOTES: ____

FIG. X1.1 Data Collection Sheet

## ADDITIONAL REFERENCES


**(1)** Ayres Associates. "A Quantitative Assessment of Erosion and Sediment Control Best Management Practices—Channel Erodibility Studies: Straw Bale Check Structures," Ayres Associates, Fort Collins, CO, 2001.

**(2)** Cabalka, D. A., Clopper, P. E., and Johnson, A., "Research, Development and Implementation of Test Protocols for Channel Erosion Research Facilities (CERFs)," *Proceedings of the International Erosion Control Association*, Vol 29, 1998, pp. 237–248.

**(3)** Linsley, Kohler and Paulhus, *Hydrology for Engineers*, McGraw-Hill Book Company, 1972 .

**(4)** McWhorter, J. C., Carpenter, T. G., and Clark, R. N., "Erosion Control Criteria for Drainage Channels," Conducted for the Mississippi State Highway Department in cooperation with the U.S. Federal Highway Administration by the Agricultural and Biological Engineering Department, Mississippi State University, State College, Mississippi, 1968.