

S-xx (2111) Digital Test Rolling

REVISED 07/22/14 ◀DO NOT REMOVE THIS. IT NEEDS TO STAY IN FOR THE CONTRACTORS.
SP2014-54.2

The Veda Software and Digital Test Rolling forms are available on the MnDOT Advanced Materials and Technology (AMT) Website:

<http://www.dot.state.mn.us/materials/advancedmaterialsandtechnology.html>.

S-1.1 DESCRIPTION

This work consists of providing and operating equipment to test roll roadway embankments.

S-1.2 DEFINITIONS

- (A) *Deflection*—is the average deflection, with the Standoff Height removed, measured from a Single, Point Laser.
- (B) *Digital Test Rolling*— evaluates the adequacy of the roadbed construction relative to subgrade strength, stiffness and moisture content using a single-point laser attached to the tire hubs of the steer axle of a heavily loaded truck. The laser measures the sinkage of the truck (i.e., deflection measurements) along the testing Strip. A GPS antenna is mounted to the cab of the truck to allow for collection of coordinates for each laser measurement. The deflection and coordinate data is collected with a data acquisition system which sends this data directly to a laptop for storage and analysis.

The Digital Test Roller will detect weak-unstable embankment areas to depths typically up to 18 in (450 mm). This equipment is loaded to masses of about 9,000 lb (4,100 kg) on each tire.
- (C) *Granular Materials*— are defined in MnDOT 3149.2B.
- (D) *Standard Test Rolling (Test Roller 1)*—evaluates the adequacy of the roadbed construction relative to subgrade strength, stiffness and moisture content using a rod attached to a heavily loaded trailer system. The Standard Test Roller will detect weak-unstable embankment areas to depths typically up to 1.5 m (5 ft). This equipment is loaded to masses of 14 metric tons (15 tons) on each tire.
- (E) *Standoff Height*—is the sensor reading when no deflection is present beneath the wheel. This measurement is collected when the truck is in a static position on an asphalt or concrete surface. The Standoff Height must be collected prior to data collection to accommodate variances in host vehicles.
- (F) *Strip*—is the area covered by the rolling tire.
- (G) *Veda*—is a standardized intelligent construction data management (ICDM) software that stores, maps and analyzes digital test rolling data and associated geospatial data (e.g., thermal profiler data, intelligent compaction data, spot test data). This software can perform standardized data processing, analysis and reporting to provide Project summary results quickly in the field. In particular, the software can provide statistics, histograms, correlations for the digital test rolling measurements, document deflection measurements, testing Strips and evaluate the uniformity of compaction as part of the Project quality control operations.

S-1.3 EQUIPMENT REQUIREMENTS

- (A) Test Roller

Provide test rolling equipment meeting the requirements of Table **S-xx.1**.

Table S-xx.1	
Digital Test Roller Requirements	
Requirement	Test Roller for Use with Digital System
Tire Spacing	At least 6 ft (1.8 m) apart, center to center
Tire Size	15 in × 22.5 in (385 mm × 575 mm)
Tire Pressure	Maximum Load Rated Pressure
Load Per Tire	Steer Axle Tires 5,800 to 6,200 lb (2,630 to 2,800 kg) 7,300 to 7,700 lb (3,300 to 3,500 kg) 8,800 to 9,200 lb (4,000 to 4,200 kg) (Notes 1 and 2)
Tire Pressure	Maximum Allowable Tire Pressure
Vehicle Type	Three (3)-Axle Truck Allowing Maximum Legal Load is: Single, Steer Axle: 18,000 to 20,000 lb Tandem Axle Group: at least 34,000 lb (Note 3)
Bolt Configuration	10 × 11"
Hub Elevation	20 in (500 mm) to center of Hub
Layer Thickness	≥ 12 in (300 mm) ≤ 18 in (500 mm)

- NOTE 1: Load truck to **maximum allowable load**. Ensure the loading on the steer, axle tires are within one of the load ranges provided in Table 2111-1.
- NOTE 2: Keep individual tire loads within 200 lb (90 kg) of each other.
- NOTE 3: In the future, different axle configurations maybe allowed.

(B) Digital Measurement System

(1) Data Acquisition System

Provide the Department with data acquisition components per Table S-xx.2.

Table S-xx.2		
Data Acquisition Requirements		
System	Accuracy	Range
Global Positioning System	± 300 mm (12 in) in the X and Y Direction	
Single, Point Laser Vertical Requirements	21 in (500 mm) Midpoint	± 8 in (200 mm)
Single, Point Laser	Granular Materials ± 0.5 mm (20 mils) at a nominal distance of 250 mm (10 in) from the testing surface.	0 to 3 in (0 to 76 mm)
	FDR / SFDR ± 0.1 mm (4 mils) at a nominal distance of 250 mm (10 in) from the testing surface.	
Data Collection Unit Rate	≥ 3.5 Hz	

(2) Digital Test Rolling Data

- (a) Digital Test Rolling data must be exportable:
 - (i) as dbase ASCII or text format; or
 - (ii) directly into Veda.
- (b) The Digital Test Rolling data must be the requirements of Tables S-xx.3 and S-xx.4. (Data Format examples to be established to allow for import into Veda. Required format not currently available.)

Table S-xx.3	
Required Fields in Header of Each File, Section or with each Data Point	
Data Field Name	Data Format Examples
Project ID	SPXXXX-XX
Trunk Highway	TH XX
Material Type	Select Granular
Location Description	N/A
Starting Station	1400+50
Operator	John Doe
Front Axle Weight (lb)	20,000
Total Truck Weight (lb)	N/A
Right Tire Pressure (psi)	N/A
Left Tire Pressure (psi)	N/A
Right Tire Size	N/A
Left Tire Size	N/A
Left Sensor Standoff Height	N/A
Right Sensor Standoff Height	N/A
GPS Offset X (ft) from Passenger-Side Sensor	N/A
GPS Offset Y (ft) from Passenger-Side Sensor	N/A
Target Deflection Value (in)	N/A

Table S-xx.4	
Required Fields for Each Data Point	
Data Field Name	Data Format Examples
Date Stamp (YYYYMMDD)	20080701
Time Stamp (HHMMSS.SS –military format)	214622.962 (21 hr 46min. 22.962 s.)
Latitude	N/A
Longitude	N/A
Test Roller Speed (mph)	5.5
Right Sensor Deflection (in) (Note 1)	0.33
Left Sensor Deflection (in) (Note 1)	0.34
Trigger / Event Marker	N/A

Note 1: Deflection measurement with the Standoff Height removed.

- (3) Mount Single-Point Laser Sensor directly to the tire hubs of the front, steer axle of the truck. The laser mounting configuration must meet the following:

- (a) The laser (elevation/deflection) measurements are about 13 in (330 mm) from the face of the hub.
- (b) The laser should be approximately 20 in (500 mm) from the testing surface.
- (4) The Single-Point Laser must collect elevation (deflection) measurements, with the Standoff Height removed, in the longitudinal direction. The average change in elevation (deflection), over a 6 in (15 cm) length, must be recorded and stored by the data acquisition unit.
- (4) Mount GPS unit near the center of the instrumented axle when possible.
- (C) Deflection Analysis Software

Use Veda to conduct Deflection analysis and mapping to determine areas requiring corrective action.

S-1.4 **CONSTRUCTION REQUIREMENTS**

- (A) Surface Preparation

Meet the requirements of 2111.3A.2(1).
- (B) Testing Requirements - General
 - (1) Meet the requirements of 2111.3A.1.
 - (2) Weigh test roller using a certified scale. Obtain weights for the front axle weight and total truck weight. Provide weight printout to the Department.
 - (3) Perform testing within 12 hours of completion of the embankment.
 - (4) Perform Digital Test Rolling immediately prior to Standard Test Rolling.
 - (5) Operate the test roller at a speed from 3 mph to 5 mph (5 kph to 8 kph). Keep truck in gear that causes the least amount of vibration on the chassis.
 - (6) Test roll the entire length and width of embankment from shoulder point of intersection to shoulder point of intersection, or over the width of the subcut.
 - (7) Make each pass continuously, regardless of length, and end the digital data collection at the end of the test Strip, prior to slowing down and turning the truck around for return/subsequent passes.
 - (8) Roll subsequent passes centered between the wheel paths of the previous pass.
- (C) Corrective Action
 - (1) Correct areas exceeding allowable deflections per table **S-xx.4**.

Table S-xx.4				
Maximum Allowable Deflections				
Roller Type	Load Per Tire	Allowable Deflection (Note 1)		
		Granular & Non-Granular	Full-Depth Reclamation (2215)	Stabilized Full Depth

		Materials (2105, 2106)	Aggregate Base (2211) Shoulder Base Aggregate (2221) Aggregate Surfacing (2118)	Reclamation; Cold In Place Recycling (2331)
Digital (Notes 2 and 3)	5,800 to 6,200 lb (2,630 to 2,800 kg)	0.4 in (10 mm)	0.4 in (10 mm)	0.3 in (8 mm)
	7,300 to 7,700 lb (3,300 to 3,500 kg)	0.5 in (13 mm)		
	8,800 to 9,200 lb (4,000 to 4,200 kg)	0.6 in (15 mm)		

Note 1: Deflection is measured while rolling.

POSITIVE DEFLECTIONS reflect bumps or dips.

NEGATIVE DEFLECTIONS reflect sinkage of tires (rutting).

Note 2: Choose load rating closest to actual tire load.

Note 3: Redo surface preparation and repeat testing when 10 percent or more of the positive Deflections exceed 0.4 in (10 mm) as documented using Veda. Positive Deflections generally result from poor surface preparation.

(2) Coordinates

(a) Ensure coordinate point identifications are included on the appropriate sample or testing forms.

(b) Use a Rover, with an accuracy of ± 12 in (300 mm) in the horizontal direction, to determine the coordinates for boundaries of areas requiring corrective action, as determined by the Standard Test Rolling and/or through visual observation.

Record coordinates (and average and range of Deflection values measured during Standard Test Rolling) per form IC-105.

(3) Test Rolling Corrected Areas

(1) Repeat test rolling over repaired areas.

(2) The Department may waive repeat testing on corrected areas less than 50 ft (9 m) for the Digital Test Roller.

(D) Submittals

Submit electronic files representing the raw data from each rolling pass, in CSV and ICP format, on the same day of the Test Rolling.

S-1.5 **METHOD OF MEASUREMENT**

(A) The Department will measure test rolling by length for the entire width, when it is listed as a contract item in the contract.

(B) The Department will separately measure test rolling on each roadbed for divided highways.

(C) The Department will combine all test rolling (regardless of the vehicle or measuring device) into one quantity.

S-1.6

BASIS OF PAYMENT

- (A) Test rolling on embankment constructed under this contract is incidental to the embankment contract item, unless it is listed as a separate contract item.
- (B) The Department will pay for all repairs to failing sections constructed under a previous contract in accordance with 1402, "Contract Revisions."
- (C) The Department will pay for test rolling embankment based on the following schedule:

Item No.:	Item:	Unit:
2111.501	Test Rolling	road station [meter]

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