



**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**RESIDUE AND TILLAGE MANAGEMENT, REDUCED TILL**

**CODE 345  
(AC.)**

**DEFINITION**

Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year round while limiting the soil-disturbing activities used to grow and harvest crops in systems where the entire field surface is tilled prior to planting.

**PURPOSE**

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

1. Reduce sheet, rill, and wind erosion - Resource Concern (SOIL EROSION - Sheet, rill, and wind erosion).
2. Reduce tillage-induced particulate emissions - Resource Concern (AIR QUALITY IMPACTS - Emissions of Particulate Matter - PM - and PM Precursors).
3. Maintain or increase soil quality and organic matter content - Resource Concern (SOIL QUALITY DEGRADATION - Organic matter depletion).
4. Reduce energy use - Resource Concern (INEFFICIENT ENERGY USE - Farming/ranching practices and field operations).
5. Increase plant-available moisture - Resource Concern (INSUFFICIENT WATER - Inefficient moisture management).

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to all cropland.

This practice includes tillage methods commonly referred to as reduced (conservation/mulch) tillage where the entire soil surface is disturbed by tillage operations such as chisel plowing, field cultivating, tandem disking, or vertical tillage. It also includes tillage/planting systems with few tillage operations such as ridge till, hoe drills, air seeders, and certain "no till" drills that do not meet the STIR criteria for WI NRCS Conservation Practice Standard (WI NRCS CPS) 329, Residue and Tillage Management, No Till.

## **CRITERIA**

### **General Criteria Applicable to All Purposes**

Residue shall not be burned.

The water and wind erosion prediction model inputs shall reflect any removal of crop residue from the soil surface.

Residues shall be uniformly distributed over the entire field.

Minimum planned residue levels will be maintained from harvest until after planting of the next crop. Removing residue from the row area prior to or as part of the planting operation is acceptable.

The [Soil Tillage Intensity Rating \(STIR\)](#) value shall include all field operations that are performed during the crop interval between harvest of the previous crop and harvest or termination of the current crop (includes fallow periods).

The annual STIR value rating shall be no greater than 80, and no primary inversion tillage implements such as a moldboard plow shall be used.

### **Additional Criteria to Reduce Sheet/Rill and Wind Erosion**

Soil loss estimates shall be calculated for the dominate critical soil map units using the current erosion prediction technology; [Revised Universal Soil Loss Equation \(RUSLE2\)](#), for sheet and rill erosion, or the [Wind Erosion Prediction System \(WEPS\)](#).

Use the current erosion prediction model to determine:

- Minimum amount of randomly distributed surface residue required,
- Time of year the residue needs to be present on the field,
- The amount of surface soil disturbance allowed to reduce erosion to the desired level. All practices on the management system will be reflected, and
- For ridge-till systems, plan ridge height and ridge orientation to manage runoff and to minimize erosion, ridges shall have a maximum row grade of 4 percent.

### **Additional Criteria to Reduce Tillage Induced Particulate Emissions**

Reduce or modify tillage operations that create dust, especially during critical air quality periods.

Avoid tillage activities during periods when the soil is most vulnerable to wind erosion.

Adopt tillage practices that reduce particulate emissions.

### **Additional Criteria to Maintain or Increase Soil Quality and Organic Matter Content**

An evaluation of the cropping system using the current approved [Soil Conditioning Index \(SCI\)](#) procedure shall result in a output value of zero or higher.

### **Additional Criteria to Increase Plant Available Moisture**

A minimum of 60 percent residue shall cover the soil surface throughout the year to reduce evaporation from the soil surface.

Fall tillage operations shall leave the crop stubble in an upright position to trap snow, as outlined below. Maintain the planned crop stubble height during the time when significant snowfall is expected to occur:

- At least 10 inches for crops with a row spacing of less than 15 inches,
- At least 15 inches for crops with a row spacing of 15 inches or greater, and
- Maintain these heights over at least 50 percent of the field.

Fall tillage operations shall be conducted perpendicular to the direction of prevailing winds, during the time that significant snowfall is expected to occur.

### **Additional Criteria to Reduce Energy Use**

Reduce the total energy consumption associated with field operations by at least 25 percent compared to the benchmark condition. Use the current approved NRCS tool for determining energy use to document energy use reductions.

## **CONSIDERATIONS**

### **General Considerations**

Removal of crop residue, such as baling or grazing, can have a negative impact. These activities should not be performed without full evaluation of impacts on soil, water, animal, plant, and air resources.

Reduced till may be practiced continuously throughout the crop sequence, or may be managed as part of a residue management system that includes other tillage methods such as no till. Soil Tillage Intensity Rating (STIR) should be used to define acceptable tillage methods for specific sites.

Production of adequate amounts of crop residue necessary for the proper functioning of this practice can be enhanced by selection of high residue producing crops and crop varieties in the rotation, use of cover crops and adjustment of plant populations and row spacing.

When providing technical assistance to organic producers, residue management, and tillage activities should be consistent with the USDA - Agricultural Marketing Service National Organic Program Standard.

### **Considerations for Improving Soil Organic Matter Content**

Carbon loss is directly related to the volume of soil disturbed, intensity of soil disturbance, soil moisture content, and soil temperature at the time the disturbance occurs. The following guidelines can make this practice more effective:

- Shallow soil disturbance (1-3 inches) tillage practices.
- When deep soil disturbance is performed, such as by sub-soiling or fertilizer injection, make sure the vertical tillage slot created by these implements is closed at the surface.
- Minimize soil disturbance by planting with a single-disk opener, planter or no-till drill.
- Soil disturbance that occurs when soil temperatures are below 50° F release less CO<sub>2</sub> than operations done on warmer soils, thus reducing organic matter losses.

### **Considerations for Improving Soil Health/Quality**

Producers can achieve major improvements in soil health by using the following activities/practices:

- Use a diverse crop rotation, incorporating multiple crop types (cool-season grass, cool-season legume/forb, warm-season grass, warm-season legume/forb) into the crop rotation.

- Plant a cover crop after every annually tilled crop in the rotation to increase the time the roots are actively growing in the soil. Multi-species cover crop mixes provide greater benefits than single-specie cover crops.
- Implement management strategies to increase soil organic matter levels.
- Use undercutting tillage tools rather than burying tillage tools to enhance accumulation of organic material in the surface layer.
- Conduct soil-disturbing field operation when soil moisture is optimal, in order to maintain soil tilth, and reduce the need for additional tillage in the future.

### **Considerations for Increasing Plant Available Soil Moisture**

Leave stubble taller than the minimum required height to increase the soil humidity close to the soil surface and reduce the rate of evaporative loss from the soil.

Leave stubble taller to trap more snow.

Variable height stubble patterns may be created to further increase snow trapping and storage.

Perform all field operations on the contour to slow overland flow and increase infiltration, which increases water storage in the root zone.

### **Considerations to Reduce Energy Use**

The Soil Tillage Intensity Rating (STIR) for each crop interval between establishment and harvest should be less than or equal to 80.

### **Considerations for Wildlife Food and Cover**

Avoid tillage and other soil and residue/stubble disturbing operations during the nesting season and brood-rearing period for ground-nesting species.

Leave crop residues undisturbed after harvest (do no shred, bale, or till) to maximize the cover and food source benefits to wildlife during critical winter months.

Leaving rows of un-harvested crops standing at intervals across the field or adjacent to permanent cover will enhance the value of residues for wildlife food and cover. Leaving un-harvested crop rows for two growing seasons will further enhance the value of these areas for wildlife.

## **PLANS AND SPECIFICATIONS**

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit. The specifications shall identify, as appropriate:

1. Resource concern to be treated or the purpose for applying the practice.
2. Location map with planned crops identified.
3. Summary of all field operations or activities that affect:
  - Amount of residue produced for each crop
  - Amount of residue cover with all field operations reflected
  - Residue orientation
  - Disturbance of the soil surface including all disturbances
4. The amount of residue (pounds/acre or percent surface cover) required to accomplish the planned purpose, and the time of year it must be present.

5. The maximum STIR value allowed to accomplish the planned purpose, and the time of year soil disturbance is allowed.
6. The minimum Soil Conditioning Index (SCI) value required to accomplish the purpose.

Record specifications in the client's case for each field on the Wisconsin Job Sheet 345, Residue and Tillage Management, Reduced Till.

## **OPERATION AND MAINTENANCE**

Evaluate/measure the crop residues cover and orientation for each crop to ensure the planned amounts and orientation are being achieved. Adjust management as needed to achieve planned residue amount and orientation.

If there are areas of heavy residue accumulation as a result of harvest equipment or movement by water or wind in the field, spread the residue prior to planting so it does not interfere with planter operation.

## **FEDERAL, TRIBAL, STATE AND LOCAL LAWS**

Users of this standard shall be aware of potentially applicable federal, tribal, state and local laws, rules, regulations or permit requirements governing residue management. This standard does not contain the text of federal, tribal, state, or local laws.

## **REFERENCES**

Job Sheet 345 Residue and Tillage Management, Reduced Till

Soil Conditioning Index Fact Sheet located in the Conservation Planning section of Wisconsin's NRCS web page.

Soil Tillage Intensity Rating Fact Sheet located in the Conservation Planning section of Wisconsin's NRCS web page.

USDA, Natural Resources Conservation Service, Wisconsin electronic Field Office Technical Guide, Section I, Soil Erosion Prediction Models.

USDA, Natural Resources Conservation Service, Wisconsin electronic Field Office Technical Guide, Section IV, Standards and Specifications.

USDA, Natural Resources Conservation Service, Tillage Equipment Pocket Identification Guide, 2005.

USDA, Natural Resources Conservation Service, Wisconsin Agronomy Technical Note WI-4, Estimates of Residue Cover Remaining After Single Operation of Selected Machines.

USDA, Natural Resources Conservation Service, Tillage Practice Guide, 2006.

Kuepper, George, 2001. Pursuing conservation tillage systems for organic crop production-ATTRA. <http://attra.ncat.org/attra-pub/organicmatters/conservationtillage.html>

Reicosky, D.C., M.J. Lindstrom, T.E. Schumacher, D.E. Lobb and D.D. Malo. 2005. Tillage-induced CO<sub>2</sub> loss across an eroded landscape. Soil Tillage Res. 81:183-194.

Reicosky, D.C. 2004. Tillage-induced soil properties and chamber mixing effects on gas exchange. Proc. 16th Triennial Conf., Int. Soil Till. Org. (ISTRO).

RUSLE2 Users Reference Guide: [http://fargo.nserl.purdue.edu/rusle2\\_dataweb/RUSLE2\\_Index.htm](http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm)

Shaffer, M.J., and W.E. Larson (ed.). 1987. Tillage and surface-residue sensitive potential evaporation submodel. In NTRM, a soil-crop simulation model for nitrogen, tillage and crop residue management. USDA Conserv. Res. Rep. 34-1. USDA-ARS.

USDA, Natural Resources Conservation Service, National Agronomy Manual, 190-V. 4th Ed.

Wind Erosion Prediction System Users Reference Guide: <http://www.weru.ksu.edu/>

## DEFINITIONS

**Revised Universal Soil Loss Equation (RUSLE2)** - Revised Universal Soil Loss Equation Version 2 is a soil erosion prediction tool. RUSLE2 calculates on a daily basis the effects of erosivity factor rainfall (R), erodibility factor (Soil K value), slope length (L), slope steepness (S), cover management which includes crop rotation and all associated tillage (C), and supporting conservation practices (P).

**Soil Conditioning Index (SCI)** – A relative measurement that estimates the consequences of cropping systems and tillage practices on the soils condition as it relates to CO<sub>2</sub> losses. The SCI is calculated using the RUSLE2 programs and WEPS. A SCI value greater than zero indicates a net improvement in soil organic matter.

**Soil Tillage Intensity Rating (STIR)** – A relative measurement that compares the effect of various tillage operations throughout the growing season and rotation. The STIR value takes into consideration the number of tillage operations, the degree of soil disturbance such as depth, speed, type of equipment, along with the overall amount of soil surface disturbed. The STIR value is calculated using the RUSLE2 program. A smaller STIR value indicates a decreasing amount of soil disturbance which relates to soil health concepts.

**Wind Erosion Prediction System (WEPS)** - A process-based, daily time-step, computer model that predicts soil erosion via simulation of the fundamental processes controlling wind erosion.

*In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident. Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English. To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [How to File a Program Discrimination Complaint](#) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: [program.intake@usda.gov](mailto:program.intake@usda.gov). USDA is an equal opportunity provider, employer, and lender.*