

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**DEEP TILLAGE**

(Ac.)

**CODE 324**

**DEFINITION**

Performing tillage operations below the normal tillage depth to modify adverse physical or chemical properties of a soil.

the normal tillage operations or at an altered depth.

**PURPOSE**

This practice supports one or more of the following purposes:

- Bury or mix soil deposits from wind or water erosion or flood overwash – Resource concern (DEGRADED PLANT CONDITION – Undesirable plant productivity and health).
- Fracture restrictive soil layers – Resource concern (SOIL QUALITY DEGRADATION – Compaction).

**CRITERIA**

**General Criteria Applicable to All Purposes**

Deep tillage operations shall be performed when soil moisture is less than 30-50 percent of field capacity, according to the “feel test” or other acceptable method, at the maximum depth to which the tillage will be done.

**Additional Criteria to Fracture Restrictive Soil Layers**

Deep tillage operation to fracture restrictive layers shall be operated, at a minimum, to a depth of 1" below the bottom of the restrictive layer. Tillage depth should be set carefully and periodically checked to maintain this working depth.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to land having adverse soil conditions which inhibit plant growth, such as compacted layers formed by field operations (plow pans), restrictive layers such as cemented hardpans (duripan) in the root zone, overwash or deposits from wind and water erosion or flooding. It will have minimal effect and high cost when used on certain soils. These soils have dense layers found just above bedrock in subglacial (basal) till soils.

This practice does not apply to normal field operations and tillage methods for planned crop production, i.e. tillage practices to prepare a seedbed.

This standard includes tillage operations commonly referred to as deep plowing, in-row subsoiling, strip-tillage, paratilling, subsoiling, ripping, or row-till, performed not as a part of

The horizontal extent of the fractured layer, at a minimum, shall be sufficient to permit root penetration below the restrictive soil layer.

Complete fracturing of the restrictive layer is not required. The fractured zone, as a minimum, shall be sufficient to permit root penetration below the restrictive soil layer. The fractured zone does not need to extend to the row middles and should be limited to the area near the rows [in the case of crops broadcast-planted or drilled in narrow rows (less than 15 inches), the fractured zone may be disrupted completely].

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service Connecticut State Office (<http://www.ct.nrcs.usda.gov>), or download it from the Connecticut electronic Field Office Technical Guide (eFOTG) <http://www.nrcs.usda.gov/technical/efotg/>.

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**Additional Criteria to Bury or Mix Soil Deposits from Wind and Water Erosion or Flood Overwash**

Deep tillage operation to invert and mix soil deposits shall be operated to a the depth needed to meet planning objectives

Soil deposits shall be inverted and mixed a minimum of 2 times (2X) the depth of the deposited material

**CONSIDERATIONS**

Where restrictive layers are a concern, the effects of this practice can be enhanced by including deep rooted crops in the rotation that are able to extend to and penetrate the restrictive layer. This can also be achieved through the use of diverse cover crops (CT Conservation Practice Standard 340 – Cover Crop), which include deep rooted crops such as radishes and sunflowers.

Reduce or control equipment traffic during periods when soils are prone to compaction and formation of tillage pans. Caution should also be exercised when excessively heavy equipment is used to ensure that soils are not prone to compaction. Loads greater than 6 tons/axle have been found to cause compaction to depths of approximately 16 inches which is below normal depths of tillage and may cause yield reductions for several years.

Reducing contact pressure between the load and the soil may also be helpful to reduce recompaction. Complete field operations with appropriate tires selected for soils and site conditions which are inflated at the correct pressure per manufacturer's specifications to reduce compaction on the field. Other methods that can be used to further spread the load and potentially reduce soil recompaction include using dual tires or tracks beneath tractors, grain wagons, slurry tanks, etc.

Research on numerous crops has shown that tillage conducted excessively deeper than the compacted layer does not promote increased yields, requires excessive amounts of tillage energy, and promotes future compaction from nearby vehicle traffic.

Reduce or control equipment traffic during periods when soils are prone to compaction and formation of tillage pans.

To maximize effectiveness and minimize compaction, deep tillage should be performed at an appropriate soil moisture content. Percent available water capacity can be estimated in the field (see Estimating Soil Moisture by Feel and Appearance <http://nmp.tamu.edu/content/tools/estimatingsoilmoisture.pdf> ). Soils closer to field capacity (100% awc), will be more likely to compact during field operations.

To help reduce development of compacted restrictive layers, conduct normal tillage operations when soil moisture is less than 50 percent of field capacity. When possible, harvest operations should be avoided when soil moisture is greater than 50 percent of field capacity. Field harvest haul traffic should be limited to end rows or haul roads. Compacted regions between crop rows that are not fractured can assist in supporting vehicle traffic, limiting rutting and soil compaction beneath the row.

When infertile flood overwash is mixed with the pre-flood soil profile, the soil rebuilding process can be enhanced by additions of organic matter, such as manure or cover crops utilized as green manure. Crop rotations, tillage and planting systems, which maintain high levels of crop residues, such as no-till, can also accelerate this process.

Where the flood overwash layer is too thick to effectively mix with the pre-flood soil profile, redistribution of the overwash layer by smoothing or removal may be necessary. Generally, no more than about 6 inches of overwash can be uniformly mixed into the soil profile using commonly available equipment. Specialized equipment may be necessary where greater depths of overwash are to be incorporated.

Where unfavorable soil materials such as high sodium, calcium, gypsum or other undesirable materials, are within anticipated deep tillage depth and would be brought to the surface by deep tillage operations, this practice should not be applied.

Transport of sediment-borne pollutant(s) offsite can be reduced when this practice is used in a conservation management system, by reducing

the concentration of pollutants in the surface layer.

In rocky soils, deep tillage often brings up many large stones from below the historic plow level. Use spring resets on the subsoiler shanks and adjust the tension per manufacturer's recommendations for optimal performance. Moldboard plows and large tandem disks, when used to bury and mix soil deposits have a destructive effect on soil physical characteristics. These implements create conditions ideal for soil compaction to occur. Chisels with twisted points have a slightly less destructive impact.

Disruption of the soil surface is not desired and should be minimized where possible through proper selection of shanks. Excessive disturbance of the soil surface can cover plant residues which should be maintained on the soil surface to intercept rainfall and impede surface runoff.

#### **PLANS AND SPECIFICATIONS**

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit according to the selected conservation practice purposes, criteria and conditions, and considerations in this conservation practice standard.

Record practice design using approved Implementation Requirements document.

#### **OPERATION AND MAINTENANCE**

Evaluate effectiveness of deep tillage field operations applied for fracturing restrictive layers or mixing soil deposits and adjust plan if needed and reapply deep tillage when these field conditions reoccur.

#### **REFERENCES**

Baumhardt, R.L., O.R. Jones, and R.C. Schwartz. 2008. Long-term effects of profile modifying deep plowing on soil properties and crop yield. *Soil Sci. Soc. Am. J.* 72:677-682.

Reeder, R. and D. Westermann. 2006. Soil management practices. p. 63. In M. Schnepf and C. Cox (ed.) *Environmental benefits of conservation on cropland: The status of our*

*knowledge.* Soil and Water Conservation Society, Ankeny, IA.

USDA, NRCS. 1996. *Soil Quality Information Sheet: Sediment deposition on cropland.*