NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

SURFACE ROUGHENING

(Ac.)

CODE 609

DEFINITION

Performing tillage operations that create random roughness of the soil surface

PURPOSE

This practice is applied to support one or more of the following:

- Reduce soil erosion from wind and wind-borne sediment deposition.
- Improve plant health by protecting the growing crops from damage by wind-borne soil particles.
- Improve air quality by reducing the generation of airborne particulate matter.

CONDITIONS WHERE PRACTICE APPLIES

This is for emergency tillage on soils that have a surface layer suitable for clod formation and have a high potential for wind erosion due to lack of surface cover. This practice should not be used as a primary erosion control practice.

CRITERIA

General Criteria Applicable To All Purposes

Tillage operations will produce random roughness (RR) values (inches) large enough to achieve a 25% reduction in the potential erosion rate (soil "I" value), OR reduce wind erosion during the management period by 25% as determined by the most current wind erosion technology.

The random roughness (K_{rr}) value used to estimate wind erosion shall be determined from Table 1. Random roughness (K_{rr}) shall be equal to or less than 0.75. The shaded area shows the RR – "I" factor combinations that meet the 25% reduction criterion.

Table 1. K_{rr} from Random Roughness (RR) and "I" Factor Values[1]

RR (in)	I = 104	I = 86	I ≤ 56
0.2"	1.0	1.0	1.0
0.4"	0.95	0.86	0.70
0.6"	0.88	0.76	0.51
0.8"	0.82	0.68	0.40
1.0"	0.78	0.62	0.34
1.2"	0.74	0.57	0.30
1.4"	0.72	0.54	0.27
1.6"	0.69	0.51	0.24

[1]Note -"I" factor values ≥134 have a K_{rr} > .75, therefore the "I" of 134 soil will not reach a 25% reduction at any RR.

Estimate Random Roughness (RR) from the field operations table for random roughness in the National Agronomy Manual, Part 502, Table 502-7, Random Roughness (standard deviation) Core Values, or estimate using the random roughness pictures in Agriculture Handbook 703, Appendix C, pages 339 to 347.

Additional Criteria to Protect Plants from Abrasion by Wind Blown Soil Particles

Tillage operations for this purpose will produce random roughness sufficient to reduce erosion to the planned soil loss objective to protect the growing crop. See National Agronomy Manual Table 502-1 for crop tolerances for wind erosion.

CONSIDERATIONS

This practice should be used when a well-planned and properly applied wind erosion control system fails for reasons beyond the control of the producer. These situations may exist when a low residue-producing crop is planted too late in a growing season to produce sufficient residue cover, or when the planned erosion control system fails to control erosion during a high wind event.

Timing of a surface roughening tillage operation shall coincide with the potential of the target field to erode due to a combination of inadequate protection from crop residue coupled with the expected percent of erosive wind energy (see Table 3 for county specific erosive wind energy, by month).

Wide spacing of chisel points or skip chiseling (alternate chiseled/non-chiseled strips) for the first operation may permit salvaging part of a growing crop of small grain and leave undisturbed soil for later operations, if needed.

Spacing and depth of chisel operation are important to obtain uniform distribution of clods on the surface. Close spacing at shallow depths generally pulverizes the soil, and does not produce enough random roughness to decrease the soil-blowing potential.

Proper tillage equipment matched to the crop being grown and soil is important. In general, chisels or narrow sweeps may reduce potential soil blowing on loamy or fine textured soils. Roughening the soil surface with a lister/bedder or wide shovels on chisel shanks is more effective on soils whose surface layer has a wind erodibility factor (I) value of 104 and 86.

Emergency tillage (surface roughening) can be done on soil that has an “I” factor greater than 104 using deep tillage, when soil moisture is adequate to create a stable aggregate (clod) and when finer soil material can be brought to the surface.

Perform the initial tillage operation as soon as erosion starts, or as soon as it is evident that the existing cover or surface roughness is inadequate to control erosion below an acceptable level.

Begin surface roughening operations on the windward (up wind) edge of the field.

Ridging associated with the tillage is very important to controlling wind erosion. Tillage that creates ridging is done perpendicular to the direction of damaging wind. Refer to the Oklahoma NRCS Cross Wind Ridges (588) standard for criteria to use ridging.

Surface crusts generally reduce soil erodibility. However, certain smooth, crusted soils with loose grains (sand size particles) on the soil surface may cause crusts to abrade rapidly. These soils include loamy fine sands and sandy loams that have significant portions of sand on the surface when crusted. They also include certain calcareous loams, silt loams, and silty clay loams that tend to form sand sized aggregates in the surface when crusted.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the criteria and Operation and Maintenance requirements.

Specifications shall describe the application requirements to achieve the intended purpose including:

- WEPS erosion calculations
- Tillage Implement requirements
- Tillage depth requirements
- Timing of tillage (soil moisture)

Record practice specifications in an approved Surface Roughening, 609, Implementation Requirements document.

OPERATION AND MAINTENANCE

This practice will be performed as soon as possible when there is inadequate cover to protect the soil from potential wind erosion events or when a crusted soil condition occurs as sensitive crop is emerging and inadequate crop residues are present.

REFERENCES

USDA, Natural Resources Conservation Service, National Agronomy Manual, 4th Edition, Feb. 2011. Website: http://directives.sc.egov.usda.gov/ Under Manuals and Title 190.

NRCS, OK

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Table 2 [1/]

ESTIMATED RANDOM ROUGHNESS FOR TILLAGE OPERATIONS

Operation	Random Roughness (RR) (inches)
Aerator, field surface, ground driven	**0.60**
Bedder/Hipper, disk hiller	**0.60**
Chisel, straight points	**1.50**
Chisel, sweep shovel	**1.20**
Chisel, twisted shovel	**1.90**
Coulter caddy, w/fluted coulters	**0.30**
Cultivator, field w/spike points	**0.80**
Cultivator, row – 1st pass ridge till	**0.70**
Cultivator, row 1 in. ridge	**0.30**
Disk, offset, heavy	**1.50**
Disk, tandem, heavy, primary op.	**1.50**
Disk, tandem, light finishing	**0.60**
Drill or Air seeder, hoe opener in heavy residue	**0.50**
Drill or Air seeder, double disk	**0.30**
Drill, deep furrow 7 to 10 in. spacing	**0.50**
Fertilizer applicator, deep placement hvy. shank	**1.50**
Fertilizer applicator, anhyd., knife 30 in.	**0.60**
Cultivator, rowcrop, ridge till	**0.50**
Furrow diker	**0.50**
Harrow, coiled tine	**0.40**
Harrow, rotary	**0.40**
Harrow, spike tooth	**0.40**
Harrow, tine, on beds	**0.30**
Harvest, dig root crops residue on surface	**0.40**
Manure Injector, liquid high disturbance 30 in.	**1.50**
Mulch treader	**0.40**
Para-plow or Para-till	**1.90**
Planter, DD opener	**0.40**
Planter, DD opener, w/fluted coulters	**0.40**
Planter, ridge-till	**0.40**
Plow, disk	**1.90**
Plow, moldboard	**1.90**
Rodweeder	**0.40**
Rotary Hoe	**0.40**
Rototiller, field	**0.40**
Sand fighter	**0.40**
Subsoiler-bedder, (ripper/hipper)	**1.20**
Sweep plow, 20-40 in. wide	**0.40**
Sweep plow wider than 40 in. w/mulch treader	**0.35**
Sweep plow, wider than 40 in.	**0.40**

[1/] Data in Table 2 extracted from RUSLE2 database.

Table 3 [1/]
Percent (%) of erosive wind energy

Counties	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Altus Climate Station Caddo, Comanche, Cotton, Jackson, Kiowa, Tillman	7.8	10.5	21.9	17.3	8.2	7.3	1.9	1.9	3.7	5.7	6.3	7.5
Clinton Climate Station Beckham, Custer, Dewey, Greer, Harmon, Washita	10.1	9.7	19.9	16.4	10.3	6.4	1.7	1.6	3.4	5.0	6.2	9.3
Gage Climate Station Ellis, Harper, Roger Mills, Woods, Woodward	7.2	7.6	14.0	13.8	9.8	9.7	5.1	3.7	6.7	7.6	6.9	7.9
Oklahoma City Climate Station Canadian, Carter, Cleveland, Garvin, Grady, Jefferson, Lincoln, Logan, Love, McClain, Murray, Oklahoma, Payne, Stephens	8.9	12.6	22.1	18.6	2.9	3.9	1.4	1.1	2.6	6.0	8.9	11.0
Ponca City Climate Station Kay, Noble, Osage, Pawnee	13.0	11.0	23.4	12.3	5.2	6.3	2.8	2.0	3.1	6.0	7.4	7.5
Tulsa Climate Station Adair, Cherokee, Craig, Creek, Delaware, Haskell, Mayes, McIntosh, Muskogee, Nowata, Okfuskee, Okmulgee, Ottawa, Rogers, Sequoyah, Tulsa, Wagoner, Washington	6.6	8.2	24.0	23.6	6.7	4.9	1.7	1.4	2.5	5.9	6.7	7.8
Garden City KS Climate Station Beaver, Cimarron, Texas	5.3	8.4	12.2	12.9	11.5	13.9	6.7	6.3	7.6	5.6	5.4	4.2
Wichita KS Climate Station Alfalfa, Blaine, Garfield, Grant, Kingfisher, Major	9.3	9.4	15.8	17.5	10.0	5.4	2.4	3.7	5.2	5.8	8.0	7.5
Sherman TX Climate Station Atoka, Bryan, Choctaw, Coal, Hughes, Johnston, Latimer, Leflore, Marshall, McCurtain, Pittsburg, Pontotoc, Pottawatomie, Pushmataha, Seminole	11.5	8.8	24.9	17.2	5.2	4.3	1.0	0.6	1.7	4.6	11.5	8.7

[1/] Data in Table 4 extracted from Wind Erosion Equation (WEQ) table. Wind Erosion Prediction System (WEPS) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/