

Foreword

This standard is a revision of the Philippine Standard Administrative Order (SAO) 397:1980-“Terminology for Tillage Equipment”. The revision was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled "Enhancing the Implementation of AFMA Through Improved Agricultural Engineering Standards" which was funded by the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA).

This revised standard was reviewed by the Technical Committee for Study 1- Development of Standards for Agricultural Production Machinery and was circulated to various private and government agencies/organizations concerned for their comments and reactions. This standard was presented to the Philippine Society of Agricultural Engineers (PSAE) and subjected to a public hearing organized by the National Agriculture and Fisheries Council (NAFC). The comments and reactions received during the presentation and public hearing were taken into consideration in the finalization of this standard.

This standard has been technically revised in accordance with PNS 01:Part 4:1998 - Rules for the Structure and Drafting of Philippine National Standards. The main changes are listed below:

- title of the standard has been modified in conformity to the format of International Standard; and
- modification of tillage terminologies to make it comprehensible.

In the preparation of this standard, the following documents/publications were considered:

American Society of Agricultural Engineers (ASAE) EP291.2:1993 Terminology and Definitions for Soil Tillage and Soil-Tool Relationships

American Society of Agricultural Engineers (ASAE) S414.1:1997 Terminology and Definitions for Agricultural Tillage Implements.

Agricultural Machinery – Soil Tillage and Equipment – Terminology

1 Scope

This standard includes the definitions used in the general classification, design, construction, operation and performance of tillage equipment and soil-tool relationships.

2 Definitions**2.1 Basic tillage goals****2.1.1****tillage action**

action of a tillage tool in executing a specific form of soil manipulation

EXAMPLE soil cutting, shattering and/or inversion

2.1.2**tillage objective**

desired soil condition produced by one or more tillage operations

2.1.3**tillage requirement**

soil physical conditions which can be produced by tillage and is necessary based on utilitarian and/or economic considerations

2.2 General tillage terms and kind of tillage**2.2.1****broadcast tillage**

overall tillage

tillage of an entire area as contrasted to a partial tillage as in bands or strips

2.2.2**deep tillage**

primary tillage operation which manipulates soil to a greater depth than 300 mm

NOTE It may be accomplished with a very heavy-duty moldboard or disc plow which inverts the soil, or with a chisel plow or subsoiler which shatters the soil.

2.2.3**earthmoving**

tillage action and transport operations utilized to loosen, load, carry, and unload soil

2.2.4

land forming

tillage operation which move soil to create desired soil configurations

NOTE Forming may be done on a large scale such as contouring or terracing, or on a small scale such as ridging or pitting.

2.2.4.1

land grading

tillage operation which move soil to establish a desired soil elevation and slope

EXAMPLE leveling, contouring, cutting, and filling.

2.2.4.2

land planing

tillage operation that cuts and moves small layers of soil to provide smooth, refined surface condition

2.2.5

oriented tillage

tillage operation which are oriented in specific paths or directions with respect to the sun, prevailing winds, previous tillage actions, or field base lines

2.2.6

rotary tillage

tillage operation employing power-driven rotary action to cut, break up, and mix soil

2.2.7

soil cultivation

shallow tillage operation performed to promote growth of crop plants by creating a soil condition conducive to aeration, infiltration, and moisture conservation or to pest control

2.2.8

tillage

mechanical manipulation of soil for any desired purpose

NOTE In agriculture the term is usually restricted to the changing of soil conditions for the enhancement of crop production.

2.2.8.1

primary tillage

tillage, which constitutes the initial major soil-working operation, normally designed to reduce soil strength, cover plant materials, and rearrange aggregates

2.2.8.2

secondary tillage

tillage, following primary tillage, which are designed to control weed growth and to create specific soil surface configurations before seeding

2.2.9**tillage depth**

tool depth

vertical distance from the initial soil surface to a specified point of penetration of the tool

2.3 Tillage systems**2.3.1****conservation tillage**

system that maintains a minimum of 30% residue cover on the soil surface after planting or maintains at least 1,100 kg/ha of flat small grain residue equivalent on the soil surface during the critical erosion period (see also item 2.3.4)

2.3.2**conventional tillage**

system traditionally performed in preparing a seedbed for a given crop and grown in a given geographical area

2.3.3**minimum tillage**

system wherein least soil manipulation is performed

2.3.4**mulch tillage**

system in which tillage of the total soil surface is performed in such a way that plant residue is specifically left on or near the soil surface (see also item 2.3.1)

2.3.5**optimum tillage**

idealized system which permits a maximized net return for a given crop under given conditions

2.3.6**precision tillage**

subsoiling under the plant row prior to planting usually intended for subsurface drainage

2.3.7**reduced tillage**

system in which the primary tillage operation is performed in conjunction with special planting procedures in order to reduce or eliminate secondary tillage operations

2.3.8**reservoir tillage**

system in which a large number of depressions or small reservoirs are formed to hold rain or sprinkler applied water

2.3.9

ridge tillage

system in which the ridges are formed during cultivation or after harvest and maintained from year to year in the same location

NOTE Seeding is done on the ridge top.

2.3.10

strip tillage

system in which only isolated bands of soil is tilled

2.4 Specific tillage operation

2.4.1

anchoring

tillage to partially bury and thereby prevent movement of materials such as plant residues or artificial mulches

2.4.2

bedding

ridging

listing

tillage which forms a ridge and furrow soil configuration

2.4.3

bulldozing

pushing or rolling of soil by a steeply inclined blade

2.4.4

chisel plowing

tillage in which a narrow curved shank is used

NOTE Chisel plowing at depths greater than 350 mm is termed *subsoiling* (see item 2.4.12).

2.4.5

combined tillage operations

operations simultaneously utilizing two or more different types of tillage tools or implements (subsoil-lister, lister-planter, or plow-planter combinations) to simplify, control, or reduce the number of trips over a field

2.4.6

harrowing

operation which pulverizes, smoothens, and makes the soil ready for planting

NOTE It is commonly used before seeding.

2.4.7

incorporating

mixing

operation which mix or disperse foreign materials, such as pesticides, fertilizers or plant residues into the soil

2.4.8

middlebreaking

hilling-up

operation wherein a lister is used in a manner that forms a furrow midway between two previous rows of plants

2.4.9

off barring

operation that cuts and throws the soil away from the base of plants

NOTE This is the reverse of middlebreaking or hilling-up.

2.4.10

moldboard plowing

operation which is performed to cut the soil with partial or complete soil inversion

2.4.11

residue processing

operation that cut, crush, anchor or otherwise handle residues in conjunction with soil manipulation

2.4.12

subsoiling

deep tillage, below 350 mm for the purpose of loosening soil for root growth and/or water movement (see item 2.4.4)

2.4.13

vertical mulching

operation in which a vertical band of mulching material is injected into the slit immediately behind a tillage tool shank

2.5 Tillage equipment

2.5.1

general-purpose tillage implement

implement performing functions simultaneously that of initial cutting, breaking and pulverizing the soil

2.5.1.1

plow-harrow

implement which works under the combined principles of the regular disc plow and harrow

NOTE It has a frame, wheel arrangement and depth adjustment of the disc plow but the disc are assembled on a single shaft and turn as a unit similar to a gang of disc harrow.

2.5.1.2

rotary tiller

implement used for broadcast or strip tillage and is also used as chemical incorporator and as row crop cultivator

NOTE It consists of power-driven shaft, transverse to the direction of travel, equipped with curved knives that slice through the soil, chop surface residue and mix all materials in the disturbed layer.

2.5.1.3

spiral plow

rotary plow

implement which consists of two horizontal power driven spiral flanged shafts which rotate vertically

NOTE The two shafts are placed end-to-end and oriented to throw the soil outward.

2.5.2

primary tillage implement

implement used for cutting, displacing and/or shattering the soil to reduce soil strength and to bury or mix plant materials, pesticides, and fertilizers in the tillage layer

2.5.2.1

chisel plow

implement which shatters the soil without complete burial or mixing of surface materials

NOTE Multiple rows of staggered curved shanks are mounted either rigidly, with spring-cushions, spike, or shovel tools are attached to each shank.

2.5.2.2

disc plow

implement with individually mounted concave disc blades which cut, partially or completely invert a layer of soil to bury surface material, and pulverize the soil

NOTE Blades are attached to the frame in a tilted position relative to the frame and to the direction of travel for proper penetration and soil displacement.

2.5.2.3

moldboard plow

implement which cuts, partially or completely inverts a layer of soil to bury surface materials, and pulverizes the soil

NOTE It consists of cutting edge, stabilizer and curved surface.

2.5.2.3.1

right-hand plow

turns the furrow slice to the right of the plow

2.5.2.3.2

left-hand plow

turns the furrow slice to the left of the plow

2.5.2.3.3

two-way plow

eliminates back and dead furrows and is used for surface irrigation

NOTE It consists of both the right-hand and left-hand plows, with one type being used at a time.

2.5.2.4

subsoiler

implement for intermittent tillage at depths sufficient to shatter compacted subsurface layers

NOTE It is equipped with widely spaced shanks either in-line or staggered on a V-shaped frame.

2.5.3

secondary tillage implement

implement used for tilling the soil to a shallower depth than primary tillage implements, provide additional pulverization, mix pesticides and fertilizers into the soil, level and firm the soil, close air pockets, and eradicate weeds

2.5.3.1

comb-tooth harrow

implement used for breaking clods after initial plowing, for subsequent operations prior to transplanting and for puddling and leveling

NOTE It consists of a row of teeth that works like a rake.

2.5.3.2

disc harrow

implement used to pulverize the soil to attain a better soil tilth for the seed germination and growth

NOTE It consists of two or four gangs of concave steel disc.

2.5.3.2.1

single-action disc harrow

consists of two gangs of discs, placed end-to-end at an angle, which throw the soil in opposite directions

2.5.3.2.2

double-action disc harrow

tandem disc harrow

consists of two or more gangs, in which a set of two gangs follows behind the front gangs and is arranged in such a way that the discs on the front gangs throw the soil in one direction (usually outward) and the discs on the rear gangs throw the soil in the opposite directions

2.5.3.2.3

offset disc harrow

consists of two gangs wherein one gang is located behind the other at an angle and the harrow is operated in an offset position in relation to the tractor

2.5.3.3

field cultivator

implement for seedbed preparation, weed eradication, or fallow cultivation subsequent to some form of primary tillage

NOTE It is equipped with spring steel shanks or teeth (generally spaced 150-230 mm in a staggered pattern) which has an integral forged point or mounting holes for replaceable shovel or sweep tools.

2.5.3.4

packer

implement for crushing soil clods and compacting the soil

NOTE It consists of one or two in-line gangs of rollers such as lugged wheels or any one of various shaped ridged wheels.

2.5.3.5

roller-harrow

implement used for seedbed preparation which crushes soil clods and smooths and firms the soil surface

NOTE It consists of an in-line gang of ridged rollers, followed by one or more rows of staggered spring cultivator teeth, followed by a second in-line gang of ridged rollers.

2.5.3.6

rotary hoe

implement for dislodging small weeds and grasses and for breaking soil crust and is used for fast, shallow cultivation before or soon after crop plants emerge

NOTE Rigid curved teeth mounted on wheels roll over the soil, penetrating almost straight down and lifting soil as they rotate. Hoe wheels may be mounted in multiple gangs or as short gangs on spring loaded arms suspended from the main frame.

2.5.3.7

row crop cultivator

implement wherein the frame and cultivating tools are designed to adequately pass through standing crop rows without crop damage

NOTE Gangs of shanks are often independently suspended on parallel linkages with depth-controlling wheels to provide floatation with the soil surface.

2.5.3.8

spike-tooth harrow

implement consisting of long spikes attached rigidly to cross bars and staggered to attain maximum stirring and raking of soil

2.5.3.9

spring-tooth harrow

implement consisting of long, flat and curved teeth made of spring steel

NOTE The teeth are fastened to cross bars with the other end pointed to give good soil penetration.

2.5.4

cultivating tillage implement

implement performing shallow post-plant tillage to aid the crop by loosening the soil and/or by mechanical eradication of undesired vegetation

2.5.4.1

continuous-tool bar cultivator

implement consisting of tool bars that extend across the top of the rows, which allow lateral adjustments of the tools for different row spacing

2.5.4.2

separated gang cultivator

implement consisting of tool bars that drop down between the rows to provide maximum vertical clearance for the plants

2.6 Nomenclature for tillage tools and implements

2.6.1

bed shaper

soil-handling implement which forms uniform ridges of soil to predetermined shapes

2.6.2

blade

soil-working tool, consisting of an edge and a surface, which is primarily designed to cut through the soil

EXAMPLE rotary tiller blades, anhydrous ammonia blades

2.6.3

coulter

circular, flat tool used to cut plant material and soil

2.6.4

draft

force to propel an implement in the direction of travel which is equal and opposite to drawbar pull

2.6.5

effective operating width

operating width excluding overlap (see 2.6.18 and 2.6.19)

2.6.6

edge clearance angle

effective angle which is included between the line of travel and a line drawn through the back or nonsoil-working surface of the tool at its immediate edge

2.6.7

ground clearance

minimum vertical distance between the soil surface and a potentially obstructing machine element

2.6.8

hitch

portion of an implement designed to connect the implement to a power source

2.6.9

implement width

horizontal distance perpendicular to the direction of travel between the outermost edges of the implement

2.6.10

injector

implement used to insert materials into the soil

2.6.11

jointer

miniature plow attachment whose purpose is to turn over a small furrow slice directly ahead of the main moldboard plow bottom, to aid in covering trash

2.6.12

lateral tool spacing

horizontal distance between corresponding reference points on adjacent tools when projected upon a vertical plane perpendicular to the direction of travel

2.6.13**line of travel**

line and direction along which the tillage implement travels

2.6.14**lister-planter**

combined tillage implement which is composed of a lister and a planting attachment to permit a single listing-seeding operation with the planter normally being operated in the furrow

2.6.15**longitudinal tool spacing**

horizontal distance between corresponding reference points of two tools when projected upon a vertical plane parallel to the direction of travel

2.6.16**mechanical tillage implement**

single or groups of soil-working tools together with power transmission structure, control, and protection systems present as an integral part of the machine

2.6.17 Moldboard plow clearances**2.6.17.1****horizontal clearance**

distance measured between specified points on adjacent plow bottoms

EXAMPLE diagonal (rake), tip of share to tip of share; fore and aft, width of cut or furrow slice; throat width, minimum distance from face of moldboard to projecting member of preceding bottom

2.6.17.2**vertical clearance**

distance measured from cutting edge of share to nearest potentially obstructing member such as main truss (backbone), frame, beam, release mechanism, etc

2.6.18**operating overlap**

distance perpendicular to the direction of travel that an implement reworks soil previously tilled

2.6.19**operating width**

horizontal distance perpendicular to the direction of travel within which an implement performs its intended function

2.6.20**protected zone**

soil and/or plant zone purposely protected by virtue of tool design, tool spacing or evasive tool movement

2.6.21

scouring

shedding

soil-tool reaction in which soil slides over the surface of the tillage tool without significant adhesion

2.6.22

shank

structural member primarily used for attaching a tillage tool to a beam or a standard

2.6.23

shovel

spade-shaped, V-pointed soil working tool, which is used for various plowstocks, cultivators, grain drills, and soil scarifiers

2.6.24

side force

side draft

horizontal component of pull, perpendicular to the line of motion

2.6.25

soil-additive applicator

machine used to apply, or to apply and incorporate soil additives by means of tillage

EXAMPLES Granular herbicide applicator, lime or manure spreader, fumigation and fertilizer distributor, or chemical incorporator are examples of soil-additive applicator.

2.6.26

soil-additive incorporator

machine used to mechanically incorporate or mix material into the soil

2.6.27

soil opener

tillage tool used to slice through soil and create an opening for the insertion of material such as seeds, pesticides, fertilizers

EXAMPLE disc, knife, and runner

2.6.28

soil roller

rotating implement which pulverizes, firms or smooths soil by crushing or compacting

2.6.29

soil-sliding path

path along which one element of soil slides across a tillage tool

2.6.30

soil-sliding path length

length of the path along tillage tool upon which soil slides

2.6.30.1

soil-ascending angle

angle between the sliding path and the horizontal at any point along the sliding path

2.6.30.2

soil-sliding angle

angle at any point on the surface of a tool between the soil sliding path and a horizontal contour line constructed through the surface of the tool

2.6.31

soil-tool geometry

configuration of the soil-tool boundary wherein the overall shape is usually oriented with the direction of travel of the tool and the soil surface

2.6.32

soil-working surface

portions of tillage tools which are designed to be in contact with the soil

2.6.33

specific draft

unit draft

draft force of an implement per unit area of tilled cross-section

2.6.34

standard

beam

upright support which connects the shank to tillage implement frame

2.6.35

sweep

type of cultivator shovel which is wing-shaped

2.6.36

teeth

projections on tillage tools which serve to penetrate, grip, cut, or tear soil

2.6.37

tillage tool

individual soil-working element

2.6.37.1

complex tillage tools

tillage tools which rotate or move so that they present a varying boundary and contact area to the soil

EXAMPLE clod breakers, notched discs, rotary hoes

2.6.37.2

dynamic tillage tools

tillage tools which are powered so that some of their movements are in direction other than along the line of travel

2.6.37.3

multi-powered tillage tools

tillage tools powered by more than one form of power, such as draft and rotating power, or draft and electrical power

2.6.37.4

simple tillage tools

tillage tools which present a reasonable constant boundary area to the soil

2.6.38

tool clearance

minimum distance in a specified direction between a point on the tool and the nearest potentially obstructing implement element

2.6.39

tool-operating width

maximum horizontal distance perpendicular to the line of motion over which a tool performs its intended function

2.6.40

orientation, tool

position of the tool in a framework of cartesian coordinates which is usually oriented with the soil surface and the direction of travel

NOTE Orientation is specified in side, tilt, and lift angles as a minimum.

2.6.40.1

lift angle

rake angle

angle, in a vertical plane parallel to the direction of travel, between a tool axis and the soil surface

2.6.40.2

side angle

angle, in the soil surface plane, between a tool axis and a line, which is perpendicular to the direction of travel

2.6.40.3

tilt angle

angle, in a vertical plane perpendicular to the direction of travel, between a tool axis and the soil surface

2.6.41

tool overlap

distance perpendicular to the direction of travel in which a tool operating width coincides with the operating width of another tool

2.6.42

tool-skip area

area of soil surface left undisturbed during passage of a tool

2.6.43

tool width

maximum horizontal projection of a tool in the soil perpendicular to the line of motion

2.6.44

vertical tool spacing

vertical distance between corresponding points on adjacent tools when projected upon a vertical plane parallel to the direction of travel

2.6.45

wings

projections attached to the sides of tillage tools to increase the volume of soil which can be disturbed, or to control the nature and distance of soil movement. Wings usually have lift, tilt, and side angles which are different from those found in the orientation of the main tool and standard

2.7 Soil reaction nomenclature

2.7.1

soil abrasion

scratching, cutting, or abrading of materials caused by the action of soil

2.7.2

soil adhesion

sticking of soil to objects such as tillage tools or wheels

2.7.3

soil compaction

act of reducing the specific volume of soil

2.7.4

soil cutting

separation of a soil mass by a slicing action

2.7.5

soil failure

alteration or destruction of a soil structural condition by mechanical forces such as in shearing, compression, or tearing

2.7.6

soil heaving

lifting or swelling of soil resulting from natural forces such as freezing

2.7.7

soil reaction

soil response to the application of mechanical forces

2.7.8

soil shatter

pulverization

general fragmentation of a soil mass resulting from the action of tillage forces

2.7.9

soil sliding

sliding of soil across a surface

2.7.10

throw

movement of soil in any direction as a result of kinetic energy imparted to the soil by the tillage tool

2.8 Soil nomenclature

2.8.1

additive, soil

foreign

materials, other than seeds, which are added to and/or incorporated in soil for directly influencing the soil condition or environment

EXAMPLE pesticides, fertilizers, mulches, or conditioners, but not foreign bodies such as drain tiles, which have an indirect influence

2.8.2

adhered soil bodies

masses of soil (may be stationary or in a relatively slow motion) which adheres on soil-working surfaces and act as a part of the tool

EXAMPLE soil cone, an adhered soil body which resembles a cone; soil sheet, an adhered soil body which covers a large area of tool like a sheet; soil wedge, an adhered soil body which resembles a narrow wedge

2.8.3

compacted layer

hard pan
 plow pan
 plow soil
 dense layer of soil immediately below tillage depth created by mechanical pressure and/or soil-shearing forces

2.8.4**concretions**

soil structural units which are irreversibly cemented together

2.8.5**covering depth**

thickness of soil with which materials are covered by an implement

2.8.6**foreign materials**

all materials added to or mixed into soil, including residues, soil additives, and foreign bodies that have not originated in the soil's development

2.8.7**mechanical impedance**

resistance to the movement of plant parts or tillage tools through soil that is caused by the mechanical strength of the soil

2.8.8**mechanical stability**

mechanical strength

degree of resistance of soil to deformation

2.8.9**shear blocks**

clods

blocks of soil which are sheared loose from the main soil mass by tillage tool action

2.8.10**shear surface**

failure surfaces occurring where the soil has sheared

2.8.10.1**primary shear surfaces**

initial and distinct surfaces appearing during failure which are caused mainly by shear

2.8.10.2**secondary shear surfaces**

shear surfaces which result from the twisting, pushing, or tumbling of the soil after or during the initial displacement

NOTE Secondary shear surfaces are often perpendicular to the primary shear surfaces.

2.8.11

soil aggregates

soil peds

agglomerations of primary soil particles which are produced by natural processes

2.8.12

tillability

degree of ease with which a soil may be manipulated for a specific purpose

2.9 Soil and surface characteristics

2.9.1

back furrow

raised ridge left at the center of the strip of land, when plowing is started from center to side

NOTE It is formed when a furrow slice is lapped over another slice.

2.9.2

dead furrow

open trench (about twice the width of one plow bottom) left in between the adjacent strips of land after finishing of plowing

NOTE It is formed when two adjacent furrow slices are thrown opposite each other.

2.9.3

furrow

trench left when the plow bottom cuts and turns the furrow slice

2.9.4

furrow crown

peak of the turned furrow slice

2.9.5

furrow depth

ditch depth

pit depth

trench depth

depth of depression below a specified (initial or subsequent) soil surface

2.9.6

furrow slice

soil mass cut, lifted, pulverized, inverted and thrown to one side of the plow bottom

2.9.7

furrow wall

undisturbed or unbroken side of the furrow

2.9.8

head land

unplowed soil at the end of the furrow strip

2.9.9

land

unplowed soil

2.9.10

ridge height

bed height

hill height

windrow height

height of soil above a specified (initial or subsequent) soil surface

2.9.11

root bed

soil profile modified by tillage or amendments for use by plant roots

2.9.12

root zone

part of the soil profile exploited by the roots of plants

2.9.13

seedbed

soil zone which affects germination and emergence of seeds

2.9.14

soil density

weight of a unit volume of soil expressed on either a wet basis (including soil and water) or on a dry basis (soil only, most common)