

TECHNICAL BULLETIN NO. 1

SERIES OF 2021

GENERAL GUIDELINES ON
THE SELECTION OF
TRACTOR SIZE,
IMPLEMENTS, AND
OTHER SPECIFICATIONS





Republic of the Philippines
OFFICE OF THE SECRETARY
Elliptical Road, Diliman
1100 Quezon City

September 22, 2021

MEMORANDUM ORDER

No. 62
Series of 2021

TO : ALL HEADS OF DA BUREAUS, ATTACHED AGENCIES/
CORPORATIONS, AND REGIONAL EXECUTIVE DIRECTORS

SUBJECT : ADOPTION OF TECHNICAL BULLETIN NO. 1
GENERAL GUIDELINES ON THE SELECTION OF TRACTOR SIZE,
IMPLEMENTS, AND OTHER SPECIFICATIONS

Agricultural mechanization plays an integral role for faster and effective crop production. For land preparation, tractors are essential for expanding the aggregate area cultivated and the reduction of the amount of labor required. Notwithstanding the use of tractors during land preparation, several other uses may still be considered.

In line with the implementation of the planning and validation provisions on the DA Memorandum Order No. 50, Series of 2020 or the "Revised Guidelines in the Provision of Agricultural Production, Postharvest and Processing Machinery, Equipment, and Facilities" and to ensure maximized use of tractors to be distributed starting FY 2022, the DA Implementing Offices (IOs) are hereby directed to adopt and implement the *Technical Bulletin No. 1, Series of 2021 or the General Guidelines on the Selection of Tractor Size, Implements, and Other Specifications*.

In consonance with the implementation of the above-mentioned technical bulletin, the IOs are further directed on the following:

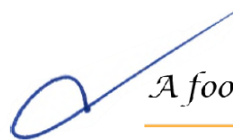
1. *Tractor Size*

With the peculiarity of production areas across the regions, it is necessary for the IOs to gather site-specific information on the proposed project area prior to the identification of tractor specifications, most specially the tractor capacity.

The IOs are hereby directed to include during the validation, the information on the soil type, service area and condition of the proposed production area, the types of implements necessary for the area, and the cultivation practices of the crops identified in the area.

2. *Selection of Implements*

To maximize the use of tractors to be distributed, attachments should not be limited to tillage implements since there are a variety of other purposes that can be done with a



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with empowered and prosperous farmers and fisherfolk



tractor as heavy equipment. As guidance, each tractor to be distributed shall be coupled with at least three (3) implements, with the following composition:

- a. At least one (1) unit of tillage implement (Primary, Secondary, or General-Purpose Implements);
- b. At least one (1) unit of other implements (Earth-moving implements, hauling implements, PTO-driven implements); and
- c. The third implement could be any type of implement as deemed necessary in the validated project site.

To ensure the compatibility of various implements to be attached to the tractors, the following shall be considered:

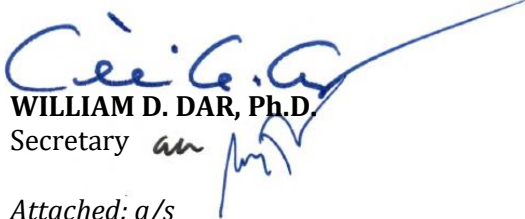
- a. Selected implements should have compatible linkage/connection with the tractor.
- b. The tractor shall be equipped with hydraulic control valve/s for all hydraulic functions on both front and/or rear implements.
- c. For tractors not equipped with hydraulic control valves, an auxiliary hydraulic control valve shall be required to allow additional functions.
- d. To allow simultaneous functions on both the rear and front of the tractor, a separate auxiliary hydraulic control valve shall be additionally installed and assigned to the front implements.

With the above-stated general considerations, detailed specifications suitable to IOs' requirement should be identified through the conduct of site-specific assessment of the target project sites and beneficiaries, availability of tractors and implements that comply with the identified technical specifications, and the availability of suppliers in the area, among others.

The IOs shall adopt and implement the guidelines starting FY 2022. Pending the issuance of the General Appropriations Act for FY 2022, identified specifications based on the guidelines shall be used for the early procurement of tractors for FY 2022 and the succeeding funding years. Revalidation of proposed project sites for FY 2022 may be conducted if necessary, and any adjustments on the physical targets should be supported with justifications.

This Memorandum Order shall take effect immediately upon approval.

For compliance.


WILLIAM D. DAR, Ph.D.
Secretary

Attached: a/s





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TECHNICAL BULLETIN

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SUBJECT : GENERAL GUIDELINES ON THE SELECTION OF TRACTOR SIZE, IMPLEMENTS, AND OTHER SPECIFICATIONS

SECTION I. RATIONALE

The Department of Agriculture (DA) has been implementing mechanization projects for the production, postharvest, processing, storage, and transportation of various agricultural commodities. Noting the importance of land preparation for crop production, tractors are widely promoted for improving soil physical condition through tillage.

Tractor is specifically designed to deliver high tractive power or torque at slow speeds for various operations. Tractors can be considered as multi/general-purpose machines since different types of implements may be attached to perform a wide range of operations. For on-farm activities, tractors can be used for tillage, planting, weeding, and harvesting. On the other hand, off-farm activities may include heavy operations like hauling, loading, dozing and other earth and sand moving operations. Equipped with a Power Take-Off (PTO) device, tractors can also serve as prime mover of other agricultural machines such as dryers, pumps, planters, and seeders.

In line with the implementation of the planning and validation provisions on the DA Memorandum Order No. 50, Series of 2020 or the "Revised Guidelines in the Provision of Agricultural Production, Postharvest and Processing Machinery, Equipment, and Facilities", this Technical Bulletin is issued to provide guidance in the proper tractor sizing and ensure the maximized used of tractor through selection of implements and other specifications.

SECTION II. DEFINITION OF TERMS

The following terms shall apply to this Memorandum Order:

Draft - the resistance of the soil to tillage operation.

Drawbar Power - power available and measured at the drawbar or at the point where implements were attached.

Engine - serves as the immediate source of power for the operation of four-wheel tractors and may be classified according to the number of cylinders, number of cycles, cooling system, speed control, fuel injection system, air induction or aspiration method, and fuel/fuel ignition.



Four-Wheel Tractor - self-propelled, wheeled vehicle having two axles designed to carry, pull or propel agricultural implements and machines

Four Wheel Tractor - Two Wheel Drive (2WD) are four-wheel tractors that can receive tractive power from the rear axle only and can deliver up to 50% of their rated engine power at the drawbar.

Four Wheel Tractor - Four Wheel Drive (4WD) are four-wheel tractors that can receive tractive power from both rear and front wheels and can deliver up to 60% of power at the drawbar.

Hydraulic Control Valve - an auxiliary function valve installed on the tractor to add an additional hydraulic function to activate and control front or rear implements. A separate auxiliary hydraulic control valve may be installed assigned to front implements only to allow simultaneous functions.

Hydraulic Kit - composed of tools to be installed to add functionality to the tractor, particularly on the adjustments of implements attached to the rear or front of the tractor. The kit mostly consisted of control valve, joystick handle, harness assembly, valve mounting bracket, mounting bracket, socket head screws and coupler sets.

Implementing Offices (IOs) - refer to any of the units of the DA that provides agricultural machinery, equipment, and facilities such as the national banner programs, regional field offices, DA bureaus, attached agencies and corporations.

Implements - refer to tools that are attached to an agricultural tractor for performing various tasks on farmlands

Power Take-Off (PTO) - refers to a device located at the end of the tractor that provides rotational power to implements and machines

Rated Power - maximum engine power at rated engine speed

Roll-Over Protective Structures (ROPS) - cab or frame installed on agricultural tractors to protect the operator from accidental overturning during operations

Specific Fuel Consumption - refers to the amount of fuel consumed by the tractor for each unit of power output.

Steering System - converts the rotation of the steering wheel into a swiveling movement of the road wheels in such a way that the steering-wheel rim turns to move the road wheels and may be classified as full-hydrostatic, power-assisted, and mechanical steering.

Tillage - refers to any soil manipulation which develops desirable soil structure for a seedbed and destroys weeds and rearranges dead plant materials.

Transmission System - an enclosed system of assembled gears that transmits and distributes power from the engine to the different parts of the transmission system and may be classified as sliding gear, constant mesh, and automatic transmission.



SECTION III. SCOPE AND COVERAGE

This Technical Bulletin covers all four-wheel tractors (2WD or 4WD) to be implemented by the bureaus, regional field offices, attached agencies and corporations, and other implementing offices (IOs) of the Department of Agriculture.

SECTION IV. OBJECTIVES

This Technical Bulletin aims to guide DA IOs on the selection of tractor size, necessary implements, and other specifications during planning and validation. Specifically, it aims to:

1. Guide the IOs on the preparation of specifications particularly the size of the tractor, the implements, and other specifications;
2. Provide a minimum list of information to be identified during planning and validation; and
3. Provide guidance in the cost estimate of tractors and implements.

SECTION V. TRACTOR SIZING

Tractor size may be estimated based on the validated conditions in the field characterized by the soil type and its specific draft, the estimated working speed, and the type of implement to be used and the corresponding working width and depth, expressed in the following equation.¹

$$\text{Draft Horsepower Requirement (hp)} = \frac{D(a) \times S}{274}$$

Where $Draft(a) = D(s) \times W \times D \times \% \text{Increase in Draft due to speed}$

D(a) = Adjusted Draft, Kg

Speed = Speed, Kph

D(s) = Specific Draft, kg/cm² (see Table 1 of Annex A)

W = width of cut, cm

D = depth of cut, cm

% Increase in draft due to speed (see Table 2 of Annex A)

Power Factor² = 50% of rated power for two-wheel drive tractors

= 60% of rated power for four-wheel drive tractors

1. Draft - is determined by the resistance of the soil to tillage or the implements being pulled by tractors in the field. The various types of soil suitable for crop production have their specific draft as defined by literature. Crops such as rice may require clay loam, corn may be planted from silt to clay type of soil, and cassava, fruits and vegetables may require sandy loam type of soil.

Since the specific draft of soil is defined as the force required to cut a cross-sectional area of soil, the higher the resistance of the soil, the higher the power requirement will be, as shown in Table 1.

¹ Tillage Machinery, Institute of Agricultural Engineering, CEAT-UPLB, 2006

² Engine Powered Tractors, Rice Production Manual, International Rice Research Institute (IRRI)

Table 1. Specific Draft of Different Soils³

SOIL TYPE	SPECIFIC DRAFT	
	kg/cm ²	lbs/in ²
Sandy soil	0.21	3
Sandy loam	0.21-0.42	3-6
Silty loam	0.35-0.49	5-7
Clay loam	0.42-0.56	6-8
Heavy Clay	0.70-0.77	10-11
Virgin Soil, clay	0.85-1.06	12-15
Gumbo, moist	1.13-1.27	16-18
Dry adobe	1.27-1.41	18-20

2. Speed –The forward speed of tractors, as influenced by the type of soil and the working width and depth of implements, may affect the requirement or the utilization of tractor power during operations. For tractor sizing purposes, tractor speed may be characterized as slow (2 kph), medium (5 kph), and fast (7 kph).

Considering the assumed speed of operation, a corresponding increase in draft due to speed should be accounted for during tractor size estimation for the additional resistance during turning and pulverizing furrow slice, as shown in Table 2.

Table 2. Increase in Draft due to Speed⁴

Speed, kph	Draft, %	Speed, kph	Draft, %
1.6	100	6.0	138
2.0	104	6.5	143
2.5	108	7.0	147
3.0	112	7.5	152
3.5	117	8.0	156
4.0	121	8.5	160
4.5	125	9.0	165
5.0	130	9.5	169
5.5	134		

3. Width – The rated width of implement may be determined based on the desired working capacity in the field or the duration of passing the implement in the entire field to be cultivated. Using the formula⁵ below, the working width may be computed:

$$\text{Field Capacity (FC)} = \frac{S \times W \times \text{Efficiency}}{10}$$

Field Capacity (FC) = ha/h

Speed (S) = kph

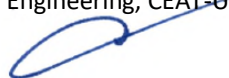
Width (W) = m

Efficiency = 80% field efficiency is recommended

³ Tillage Machinery, Institute of Agricultural Engineering, CEAT-UPLB, 2006.

⁴ Ibid.

⁵ Tillage Machinery, Institute of Agricultural Engineering, CEAT-UPLB, 2006.



Since the available service area is one of the priorities during validation of project sites, the desired field capacity may be determined first, and the determination of the required working width will follow, as expressed in the following equation:

$$Width = \frac{FC \times 10}{S \times Efficiency}$$

Using the formula for width, the existing implements in the market with width closest to the computed shall then be used as assumption in tractor sizing.

4. Depth – is the vertical distance from the initial soil surface to a specified point of penetration of the tool. Different crops have different depth requirements for tillage.

In view of the above considerations, it is necessary for the IOs to gather site-specific information on the proposed project area prior to the identification of tractor specifications. Attached in **Annex A** is the sample computation on the recommended tractor power based on the identified field parameters as assumptions.

SECTION VI. IMPLEMENTS

The selection of appropriate implements to be attached to tractors is important to maximize its use. However, tractor attachments should not be limited to tillage implements since there are a variety of other purposes that can be done with a tractor as heavy equipment.

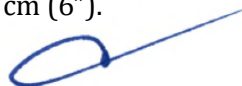
Detailed as follows are the possible set of implements to be attached to the tractor.

1. *Primary Tillage Implements* covers the initial soil-working operations such as cutting, breaking and inversion of the soil designed to reduce soil strength, cover plant materials, and rearrange aggregates. Common implements used are disc, moldboard, chisel plows and subsoilers cutting the soil to a depth of 15 cm to 90 cm (6" to 36").

For tractor sizing, the type of primary tillage equipment should be first identified since the power requirement for primary tillage will require the most power and since primary tillage is the priority operation for land preparation. Depending on the result of tractor sizing, specifications of other implements should match the identified tractor power.

In some cases, subsoilers are being used as diggers of root crops during harvesting. In the same manner, diggers and other similar implements may be identified as implements of the tractor and be used as subject of assumptions in tractor sizing.

2. *Secondary Tillage Implements* covers the subsequent breaking, pulverization and leveling of the soil designed to control weed growth and to create specific soil surface configurations before seeding. Common implements used are disc, spike-tooth and spring-tooth harrows preparing the soil to a depth of 7 cm to 15 cm (3" to 6").
3. *General Purpose Tillage Implements* combines both the primary and secondary tillage in one operation. Common implements used are the rotary tillers, and disc harrow cutting the soil to a depth of up to 15 cm (6").



4. *Earth-moving Implements* include tractor equipment designed for heavy operations such as scooping, transporting, and flattening of earth and sand. Such includes loaders, dozers, tractor trailers, among others. For earth-moving implements attached to the front of the tractor, four-wheel drive tractors will be necessary.
5. *Hauling Implements* allows the transport of products, materials, or other equipment to and/or from the field which includes tractor trailers with capacity ranging from 1 to 1.5 times the weight of the pulling tractor.
6. *Other Implements* include those PTO-driven implements other than the tillage implements. This includes planters, seeders, dryers, pumps, among others.

Attached in **Annex B** are some of the identified implements grouped by tractor power, which may be used as a reference but is recommended to be further verified by the IOs. It shall be noted that selected implements should have compatible linkage/connection with the tractor.

SECTION VII. MINIMUM LIST OF SPECIFICATIONS

Considering the site-specific requirements of each IO for tractors and its implements, uniform specifications across all areas may not be determined. In view of such, the IO is hereby directed to at least identify the following minimum list of specifications to ensure uniformity of identified parameters and allow comparison for monitoring purposes:

- A. Prime Mover
 1. Type of Prime Mover
(No. of Cylinder, No. of Cycle, Cooling System, Fuel Injection System, Fuel)
 2. Rated Power
 3. PTO Power
 4. Specific Fuel Consumption (g/kWh)
- B. Performance/Classification
 1. Engine Type/Aspiration Method
 2. Steering System
 3. Transmission System
- C. Mandatory Accessories:
 1. Roll-Over Protective Structure (ROPS), Seatbelt, and Canopy*
 2. Set of Standard Tools for Maintenance*
 3. Original Equipment Manufacturer (OEM) Manual*
 4. Hydraulic Control Valve for front and rear implements**
 5. Other accessories as may be required by implementing offices

*As per PAES 301:2020

**For tractors not equipped with hydraulic control valve, an auxiliary hydraulic control valve may be required to allow additional functions.



D. Mandatory Attachments*:

At least three (3) implements including:

1. At least one (1) unit of tillage implement (Primary, Secondary, or General-Purpose Implements);
2. At least one (1) unit of other implements (Earth-moving implements, hauling implements, PTO-driven implements); and
3. The third implement could be any type of implement as deemed necessary in the validated project site.

*It shall also be noted that selected implements should have compatible linkage/connection with the tractor. Technical description of implements should also be specified.

E. After-sales Service

1. Warranty against defective materials and workmanship for parts and services, for at least one (1) year upon the acceptance of the procuring entity of the machinery.
2. The manufacturer / distributor / dealer shall be capable of:
 - a. supplying the services of mechanic/ technical personnel free of charge for replacing parts under warranty to put the unit in running condition during the warranty period
 - b. providing services on repairs after warranty period at reasonable cost
 - c. providing illustrated parts catalogue and repair or workshop manual
 - d. maintaining spare parts of at least 10% of their average past three-year sales per product to ensure adequate inventory of fast- moving spare parts; and
 - e. repair of defective units and provision of other after sales services shall be undertaken within 72 hours upon the receipt of complaints.

F. Other Optional Features

1. Smart technology features for the precision of operations in the field such as but not limited to the following:
 - GPS or other sensors to check location and work areas, and allow more precise operations, among others; and
 - Display option to visualize work logs and performance through connection to computer monitors (built-in or separate), mobile phones, and other devices.

SECTION VIII. DETERMINATION OF COSTS

With the number of market players, varying options/classifications of tractors, and the different preferences on the types of implements to be used, uniform costing across IOs may not be possible. It is therefore recommended for IOs to conduct thorough market survey/canvassing based on the identified tractor power, implements, and other specifications prior to the annual budget proposal.



SECTION IX. IMPLEMENTATION PROCEDURES

For the implementation procedures, the IOs may refer to the issued Memorandum Order No. 50, Series of 2020 dated September 28, 2020 - "Revised Guidelines in the Provision of Agricultural Production, Postharvest and Processing Machinery, Equipment, and Facilities".

SECTION X. INSPECTION, TESTING, AND ACCEPTANCE

For inspection, testing, and acceptance, the IOs may refer to the issued Department Circular No. 5, series of 2017 dated May 16, 2017 - "National Guidelines on Testing and Evaluation of Agricultural and Fisheries Machinery".

For reference and guidance.



ENGR. ARIODEAR C. RICO

Director IV

Attached: a/s

Annex A

Sample Estimates based on the identified field parameters as assumptions

Table 1. Sample Computation of Field Capacity and Implement Width

Operating Conditions	Unit of Measure	Value
Service Area	ha	200
Working hours per day	hours	8
Working days per month	days	30
Working months per season	months	2
FIELD CAPACITY	ha/h	0.42
Speed	kph	5
Efficiency	%	0.80
WIDTH OF IMPLEMENT	m	1.04

Table 2. Sample of Tractor Power Estimate

Operating Conditions	Recommended 2WD Tractor Size (Hp)	Recommended 4WD Tractor Size (Hp)
Primary Tillage Equipment DISC PLOW @ 4 discs, 22-in diameter, 150-200-mm depth) Working Width: 90 cm Working Speed: 5 kph @ 130% increase in draft Soil Type: Silty Loam @ 0.77 kg/cm ² resistance Power Factor: 50% (2WD), 60% (4WD)	66	55
Primary Tillage Equipment SUBSOILER @ 30 cm depth Working Width: 100 cm Working Speed: 5 kph @ 130% increase in draft Soil Type: Clay @ 0.77 kg/cm ² resistance Power Factor: 50% (2WD), 60% (4WD)	110	92
Secondary Tillage Equipment DISC HARROW @ 5 discs, 24-in diameter, 100-150-mm depth) Working Width: 110 cm Working Speed: 5 kph @ 130% increase in draft Soil Type: Silty Loam @ 0.77 kg/cm ² resistance Power Factor: 50% (2WD), 60% (4WD)	61	51

Annex B

Sample List of Implements by Tractor Size based on Market Survey

Tractor Power*	Implement**	Description
35-45	Disc Plow	4 discs, 22 in diameter, 150-200 mm depth, 750 mm width
		3 discs, 22 in diameter, 200 mm depth, 810 mm width
	Disc Harrow	5 discs, 22 in diameter, 100-150 mm depth, 850 mm width
		6 discs, 22 in diameter, 100-150 mm depth, 1000 mm width
	Rotary Tiller	32 blades, 1500 mm width
		32 blades, 1600 mm width
	Dozer	100-150 mm depth, 1800 mm blade length
	Loader	400 kg lift, 1500 mm width
	Trailer***	1500 kg capacity for 1000 kg (36 hp) tractor weight 1800 kg capacity for 1200 kg (40 hp) tractor weight
Subsoiler	3 shanks, 30 mm thickness, 350 mm depth, 1920 mm	
46-50	Disc Plow	4 discs, 22 in diameter, 150-200 mm depth, 800 mm width
		3 discs, 22 in diameter, 200 mm depth, 810 mm width
	Disc Harrow	6 discs, 24 in diameter, 150-200 mm depth, 1100 width
	Rotary Tiller	36 blades, 1800 mm width
		54 blades, 1800 mm width
		48 blades, 1600 width
	Dozer	100-150 mm depth, 1800 mm length
	Loader	450 kg lift, 1800 mm width
	Trailer***	2250 kg capacity for 1500 kg tractor weight (50 hp)
65, min	Disc Plow	3 discs, 26-inch diameter, 250 mm depth, 800 mm width
	Disc Harrow	6 discs, 26-inch diameter, 180 mm depth, 1550 mm width
	Rotary Tiller	54 blades, 2200 mm length
	Dozer	150 mm depth, 2000 mm blade length
	Trailer***	3000 kg capacity for 2000 kg tractor weight (70 hp)
	Subsoiler	5 shanks, 30 mm thickness, 365 mm depth, 2050 mm
90, min	Disc Plow	4 discs, 26-inch diameter, 300 mm depth, 800 mm width
	Rotary Tiller	54 blades, 2200 mm length
	Trailer	4050-5400 kg capacity for 2700 kg (95 hp) to 3600 kg (100 hp) tractor weight
	Subsoiler	5 shanks, 450 mm depth, 1500 mm

*Tractor Power identified from the FY 2022 Recommended NEP for National Rice and Corn Programs

**Tractor Implements and Description identified from market survey.

Front implements like dozer and trailer can only be attached to four-wheel drive tractors.

***Trailer Capacity: Maximum weight of 1.5 times the weight of the tractor

Annex C

Sample List of Attachments and Implements

A. Tillage Implements

- ❖ Bed Former
- ❖ Disc/Moldboard Plow
- ❖ Disc/Power Harrow
- ❖ Field Cultivator
- ❖ Leveler
- ❖ Levee Former
- ❖ Mulcher
- ❖ Rotary Tiller
- ❖ Rake
- ❖ Rotary Ditcher
- ❖ Soil Puddler
- ❖ Soil Pulverizer
- ❖ Subsoiler

B. Earth-Moving Implements

- ❖ Backhoe
- ❖ Front Dozer
- ❖ Front Loader
- ❖ Drilling Rig
- ❖ Soil Auger/ Post-hole Digger

C. Hauling Implements

- ❖ Trailer
- ❖ Pallet Fork
- ❖ Baler Bale Wrapper

D. PTO-driven Implements

- ❖ Mobile Dryers
- ❖ Mobile Sprinkler Irrigation System
- ❖ Planters
- ❖ Seeder
- ❖ Baler
- ❖ Bale Wrapper
- ❖ Broadcast Spreader
- ❖ Crop Care Implement
- ❖ Sprayer
- ❖ Weeder
- ❖ Granule Applicator
- ❖ Rotary Cutter
- ❖ Grooming Mower
- ❖ Harvesting Implement
- ❖ Harvester
- ❖ Digger



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