PHILIPPINE NATIONAL STANDARD

PNS/BAFS PABES 301:2020
ICS 65.060.10

Production Machinery – Four-Wheel Tractors – Specifications

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Foreword

The Philippine National Standard (PNS) for Agricultural Machinery – Four-Wheel Tractors – Specifications (PNS/BAFS PABES 301:2020) was developed by the Bureau of Agriculture and Fisheries Standards (BAFS) as per the request of Task-Force PAES of the Philippine Council for Agriculture and Fisheries (PCAF). It has been prepared by the Technical Working Group (TWG) for the revision of PAES for Four-Wheel Tractors and Walking Type Agricultural Tractors per approved Department of Agriculture Special Order No. 290 series of 2017.

In the development of the Standard, some provisions were adopted from the following documents:

- ISO 6489-3: 2004, *Agricultural Vehicles – Mechanical connections between towed and towing vehicles – Part 3: Tractor Drawbar*
- ISO 500-1:2014, *Agricultural Tractors – Rear-mounted power take-off types 1,2,3,4 – Part 1: General specifications, safety requirements, dimensions for master shield and clearance zone*
- ISO 730:2009, *Agricultural Wheeled Tractors- Rear-mounted three-point linkage – Categories 1N, 1, 2N, 2, 3N, 3, 4N and 4;* and
- IRRI Rice Production Manual.

This Standard includes the following significant changes compared to the previous edition:

- Deletion of the second paragraph in Clause 1- Scope
- Revision of the definition of the term “drawbar”
- Inclusion of the term “rated power” in Clause 3
- Revision of the definition for “roll- over protective structure”
- Adoption of the terms and definitions related to dimensions and components of three-point linkage from ISO reference
- Deletion of “lower hitch point tire clearance” and “lower hitch point tractor clearance” in Clause 3
- Revision of the definition for “linchpin”
- Deletion of “four-wheel drive” and “two-wheel drive” in Clause 3
- Inclusion of the discussions for “two- wheel drive” and “four-wheel drive” in Clause 4
- Modification of Figures for “four-wheel drive” and “two-wheel drive”
- Inclusion of classification based on transmission system
- Revision on the title of Clause 5 to “Four-wheel Tractor Parts and Components” and the provisions under it
- Deletion of provision for materials in Clause 5
- Revisions on the provisions under Clause 5.2 – Controls
- Revision of provisions for three-point linkage categories and its dimensions based on updated ISO references
- Inclusion of provision for dimensions and components of three-point linkage in Clause 5.3
- Modification of figure for “Clevis- type drawbar hole diameter, thickness, and width”
- Deletion of provision for transmission systems in Clause 5
- Revisions on the provisions for PTO shaft in Clause 5
- Addition of pneumatic brake/ air brake as a manner of transmitting the force from the control for brake system in Clause 5
- Deletion of the provision for allowable wheel slip for maximum efficiency in Clause 6
- Addition of minimum PTO power and maximum specific fuel consumption as part of the performance requirements in Clause 6

- Deletion of provision for tractor speed during field operation in Clause 6
- Revision on the title of Clause 7 to “Safety, Workmanship and Finish” and the provisions under it
- Revision on the title of Clause 8 to “Warranty for Fabrication and Services” and the provision under it
- Modification of the provisions under clauses for “Maintenance and Operation”, “Sampling”, “Testing”, and “Marking and Labelling”; and
- Harmonization of the provisions to the latest versions of ISO references

This Standard cancels and replaces the provisions recommended by PAES 118:2001 – Agricultural Machinery – Four-Wheel Tractors – Specifications.

This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2.

1 Scope

This standard specifies the requirements for the construction and operation of agricultural four-wheel tractors.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

PAES 101:2000, *Agricultural Machinery- Technical Means for Ensuring Safety- General.*

PAES 102:2000, *Agricultural Machinery – Operator's Manual – Content and Presentation*

PAES 103:2000, *Agricultural Machinery – Method of Sampling*

PAES 104:2000, *Agricultural Machinery – Location and Method of Operation of Operator's Controls – Control for Agricultural Tractors and Machinery*

PNS/BAFS PABES 302:2020, *Agricultural Machinery – Four-Wheel Tractor – Methods of Test*

ISO 730:2009, *Agricultural Wheeled Tractors- Rear-mounted three-point linkage – Categories 1N, 1, 2N, 2, 3N, 3, 4N and 4*

ISO 6489-3:2004, *Agricultural Vehicles – Mechanical Connections between Towed and Towing Vehicles – Part 3: Tractor Drawbar*

PNS/BAFS/PAES 192:2016, *Agricultural Machinery- Guidelines on After- Sales Service*

PAES 101:2000, *Agricultural Machinery- Technical Means for Ensuring Safety- General.*

PAES 139: 2004, *Agricultural Machinery- Roll-Over Protective Structures (ROPS)- Specifications*

PAES 140: 2004, *Agricultural Machinery- Roll-Over Protective Structures (ROPS)- Methods of Test*

3 Terms and Definition

For the purpose of this Standard, the following terms and definitions shall apply.

3.1
drawbar power
power available at the drawbar sustainable over a distance of at least 20 meters

3.2
four-wheel tractor
self-propelled, wheeled vehicle having two axles designed to carry, pull or propel agricultural implements and machines

3.3
power-take-off (PTO) shaft
external shaft usually located at the rear of the four-wheel tractor that provides rotational power to implements and machines

3.4
PTO output power
power measured at the PTO shaft

3.5
rated power
maximum engine power at rated engine speed

3.6
roll-over protective structures (ROPS)
cab or frame installed on agricultural tractors to protect the operator from accidental overturning during operations

3.7
three-point linkage
combination of one upper link and two lower links, each articulated to the four-wheel tractor and the implement at opposite ends, that connects the implement to the tractor

3.7.1
levelling adjustment
movement allowing inclination of the implement, measured vertically and with one lower link horizontal, so that either lower hitch point can be moved higher or lower than the other

3.7.2
lift rods
connections that transmit force to the lower links for raising and lowering

3.7.3
linchpin
pin, usually fitted with a spring- retaining device, by which an articulated connection is retained in position

3.7.4
linchpin hole distance
distance from the centerline of the linchpin hole to the shoulder of the hitch pin

3.7.5
lower hitch attachment
pin, or clevis and pin, usually attached to the implement, by which a lower link is secured

3.7.6
lower hitch point
articulated connection between a lower link and the implement

3.7.7
lower hitch point clearance
clearance, expressed as a radial dimension, from the lower hitch point axis to the outside diameter of the tire, mudguard or other part of the tractor, measured in a longitudinal vertical plane with the implement raised to transport height and all side-way prevented

3.7.8
lower hitch point height
height of the center of the lower hitch points above the ground level when they are fully lowered using the full extent of manual adjustment provided in the lift rods in conjunction with the movement range, and when the lower hitch point axis is maintained horizontal to the ground in a traverse plane

3.7.9
lower hitch point span
distance between the shoulders of the lower hitch pins, against which the sides of the lower link ball joints abut

3.7.10
lower link
lower linkage element, fitted with an articulated connection at both ends
3.7.11
lower link point
articulated connection between a lower link and the tractor

3.7.12
mast
component that provides the location of the upper hitch point on the implement

3.7.13
mast height
vertical distance between the upper hitch point and the common axis of the lower hitch points

3.7.14
movement range
vertical movement of the lower hitch points corresponding to the power travel of the lift, excluding any adjustments in the lift rod linkage

3.7.15
upper hitch attachment
pin, usually detachable and forming part of the upper link assembly, by which an upper link is secured

3.7.16
upper hitch point
articulated connection between the upper link and the implement

3.7.17
upper link
upper linkage element, fitted with an articulated connection at both ends

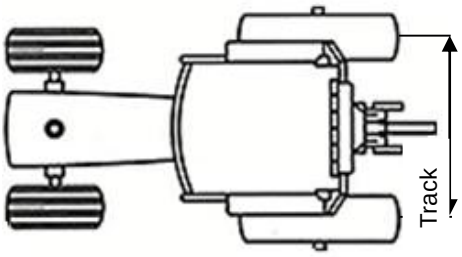
3.7.18
upper link attachment
pin by which the upper link is connected to the tractor

3.7.19
upper link point
articulated connection between the upper link and the tractor

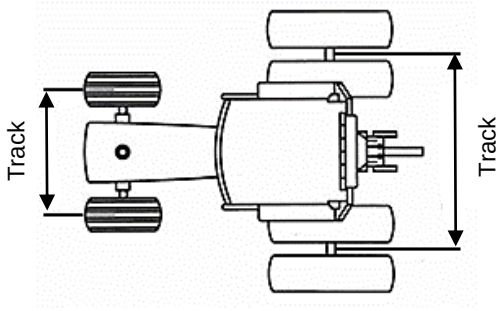
3.7.20
transport height
total height of the lower hitch points above the ground using the full extent of manual adjustment provided in the lift rods in conjunction with the movement range, with the lower hitch point axis maintained horizontal to the ground in transverse plane

3.8
tractor drawbar
drawbar
rigid bar at the rear of the four-wheel tractor to which trailed implements and equipment are hitched
NOTE A tractor drawbar can be regular non-adjustable or adjustable.

3.9
wheel track
wheel tread
center to center distance between two front or rear wheels as shown in Figure 1



a. single rear wheel



b. double rear wheel

Figure 1 – Four-wheel tractor wheel tread/track

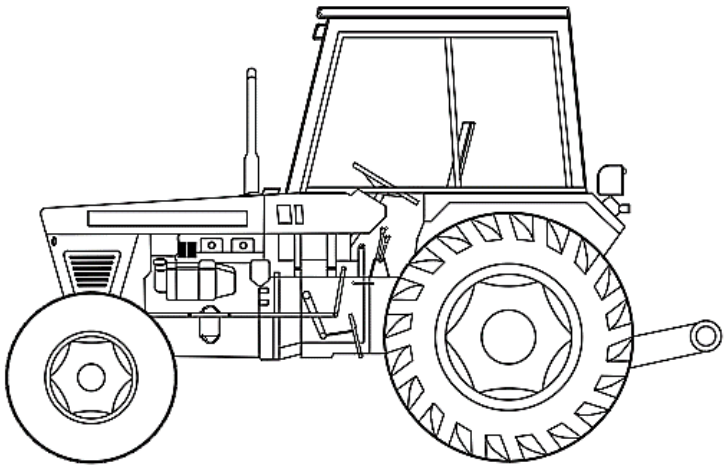
4 Classification

The classification of four-wheel tractors should be based but not limited to the following.

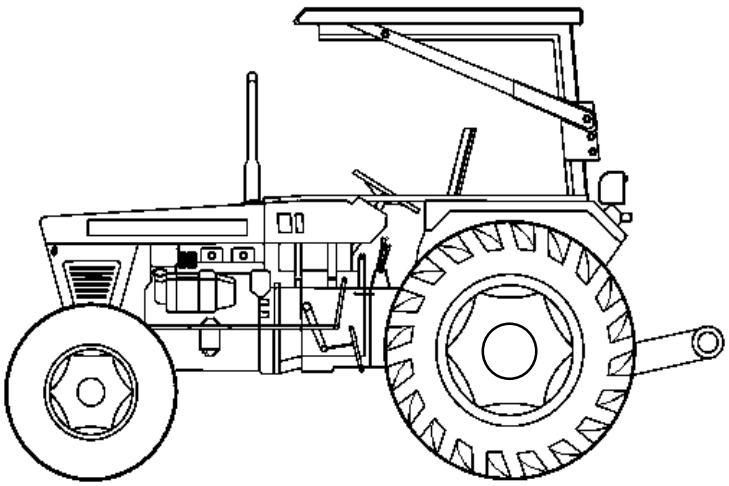
4.1 Drive system

4.1.1 Two-Wheel Drive (2WD)

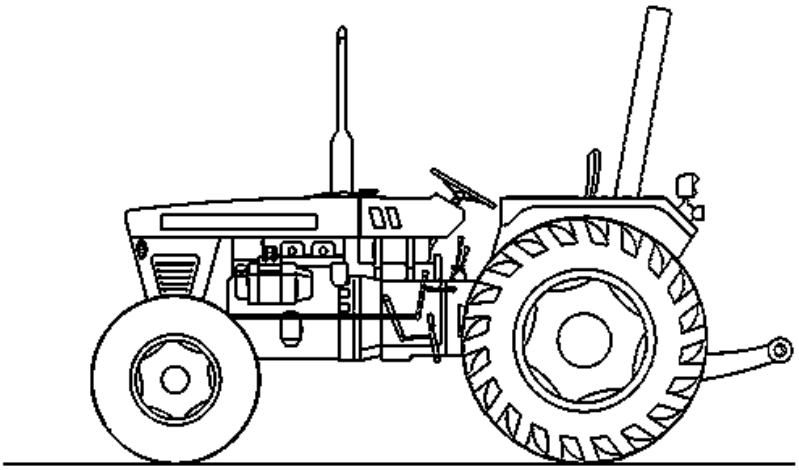
Four-wheel tractors that can receive tractive power from the rear axle only.



a. with cab



b. with retractable ROPS

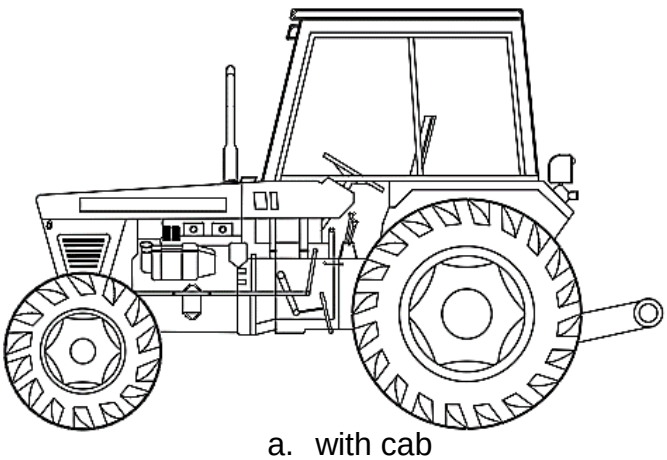


c. without cab

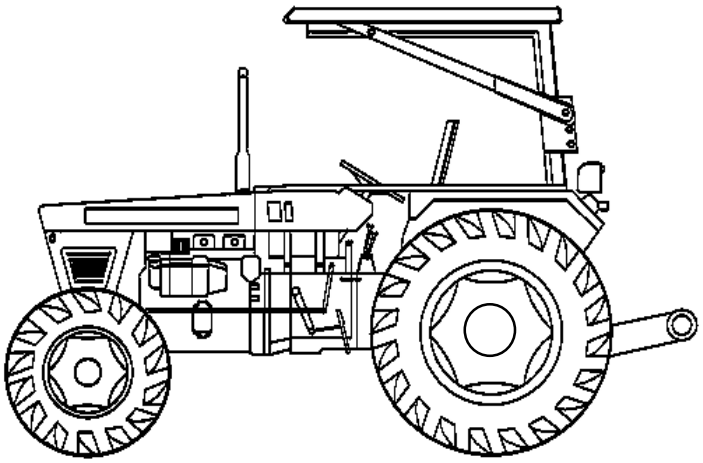
Figure 2 – Two-wheel drive four-wheel tractor

4.1.2 Four-Wheel Drive (4WD)

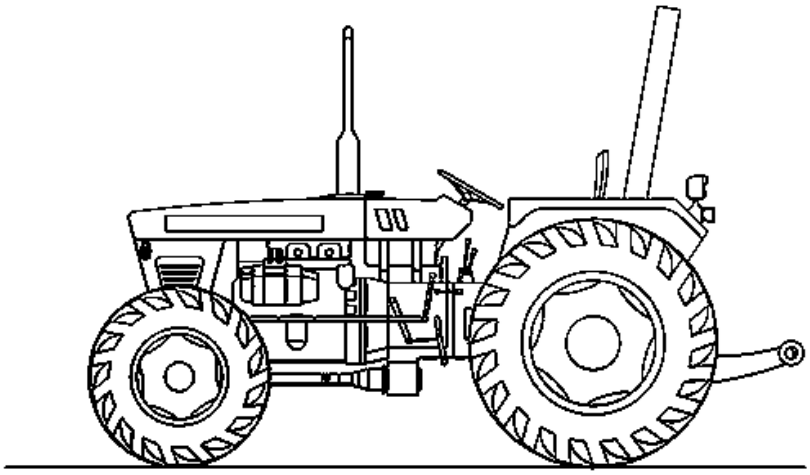
Four-wheel tractors that can receive tractive power from the rear wheels or from both rear and front wheels.



a. with cab



b. with retractable ROPS



c. without cab

Figure 3 – Four-wheel drive four-wheel tractor

4.2 Transmission system

This is an enclosed system of assembled gears that transmits and distributes power from the engine to the different parts of the transmission system. The power from the engine can be modified by changing the speed and direction of rotation of the output shaft.

4.2.1 Sliding gear

The gear ratio is selected by disengaging the traction clutch and sliding the gear on the shaft until it meshes with a mating gear.

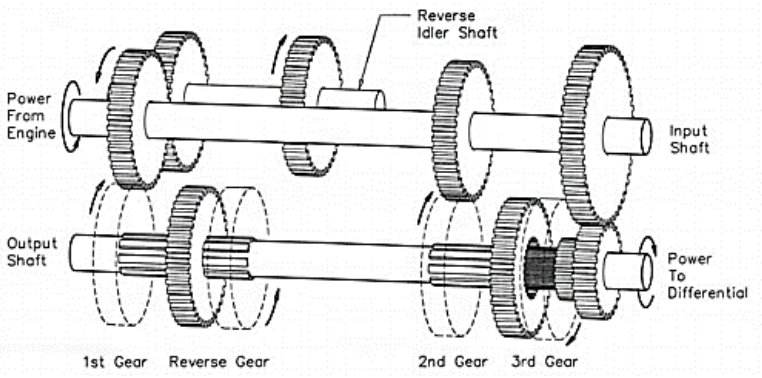


Figure 4 – Sliding mesh type transmission

4.2.2 Constant mesh

Gears are mounted so that they are always in mesh with at least one of the meshing gears free to rotate on the shaft.

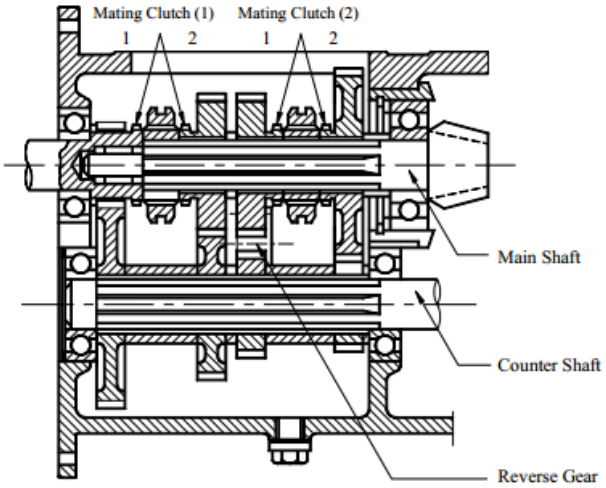


Figure 5 – Constant mesh type transmission

4.2.2.1 Synchronized or synchromesh

A type of constant mesh transmission wherein the synchronized or synchromesh gear has small friction clutches to disengage the transmission. The resulting frictional torque is used to prevent disengagement of the shifter collar until the rotational speed of the collar and gear are nearly similar or synchronized.

4.2.2.1.1 Constant load type

Cone clutches are formed between the inner part of the hub and the mating gears (1) and (2). Mating of the clutch is done by moving the sleeve axially which gives sliding motion to the hub via the steel balls along the main shaft. By mating of the friction clutch, the revolution of the gear and the main shaft becomes uniform. If the sleeve is pushed further after giving same revolution to the gear and the main shaft, the steel balls are displaced from the grooves causing the sleeve to slide on the hub. This

results to smooth meshing between the clutching gear and interval splines of the sleeve.

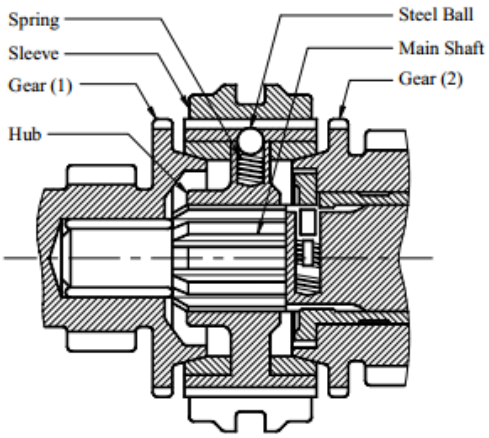


Figure 6 – Constant load type synchronous transmission gear

4.2.2.1.2 Inertia lock type

The clutch becomes engaged when the sliding ring is moved by the shift lever. The fixed collar moves together by spring force and its end face presses against the cone. Differential revolution speed, if any, between the gears (1) and (2) and the main shaft causes the cone to rotate towards a similar direction until it halts by the side face of the fixed collar. The more the sliding ring of the teeth of the cone are pressed, the more the cone is pressed by cam lift generating frictional torque in the cone clutch. This results to a synchronizing action. When the speed of the main shaft and the gears (1) or (2) is equalized, the torque given by the cone clutch to rotate the cone is lifted and the cone is returned by the sliding ring to its neutral position passing the teeth and meshes with the clutching teeth of gear (1) or (2).

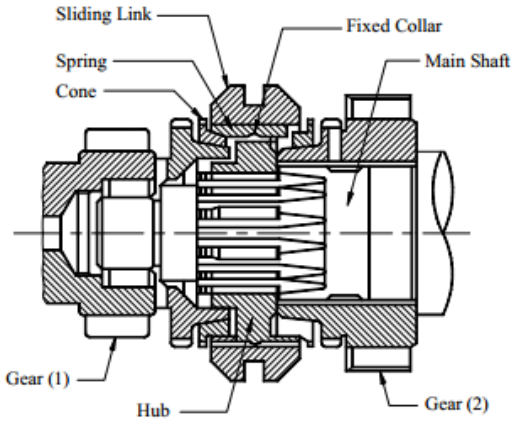


Figure 7 – Inertia lock type synchronous transmission gear

4.2.3 Automatic transmission

Automatic transmission is coupled to the engine with torque converter.

5 Four-Wheel Tractor Parts and Components

5.1 Engine

The engine serves as the immediate source of power for the operation of four-wheel tractors. It is a mechanism which uses air to extract the energy from the fuel and transforms it into mechanical (rotational) form. The engine's performance, which is represented in terms of the fundamental characteristics for the engine, largely determines and limits the performance of the tractor.

Engines used for agricultural tractors may be classified according but not limited to the following.

Table 1. Classification of engines

Number of cycle	Two- stroke cycle Four- stroke cycle
Fuel ignition	Spark ignition (gasoline/petrol, natural gas) Compression ignition (diesel)
Air induction	Naturally-aspirated Turbo-charged Turbo-charged and intercooled
Speed control	Governed (automatic) Ungoverned (manual)

5.2 Controls

Four-wheel tractor common controls, safety levers, and their functions are presented in Table 2.

Table 2 – Tractor controls and functions

Controls	Functions
Ignition switch/ button	The ignition key/ button is used to start or stop the four- wheel tractor.
Steering wheel	Steering wheel is located in front of the operator. Its clockwise rotation shall effect a right turn, and a counterclockwise rotation shall effect a left turn.
Brakes	Most tractors are fitted with two (2) independent brake pedals that can be locked together. When using the tractor in transport mode, the brake pedals must be locked together for safety purposes. During field operation, the lock of the brake pedal should be disengaged to enable the operator to step on either the left or right pedal. This aids in steering and improving the turning radius of the tractor.

Table 2 Continued

Clutch pedal	The clutch is used to disengage the drive train from the engine and change gears.
Throttle	The hand and foot throttle are used to control the engine speed. The hand throttle should always be upon operation of the tractor in the tractor in field. The foot throttle can be used when driving the four-wheel tractor on a roadway. However, it should not be used in the field.
Gear levers	Most tractors have (two) 2 gear levers to control ground speed. The first lever is a range gear shift lever with high and low range speeds. Sometimes, it includes medium speed and reverse speed settings. The second lever is the main gear shift lever which shifts the main gears. Some tractors may have a forward and reverse lever and one gear lever to control ground speed. Others may have a hydrostatic or automatic gear box.
Light switches and warning lights	Most tractors have head lights for working at night and indicators and stop lights for travelling on roadway. The indicator light may also be used as hazard lights, especially for road travel. Warning lights may also be displayed on the dashboard to warn the operator on cases of malfunctioning and overheating.
Power- take- off lever (PTO)	This lever activates the tractor's PTO shaft to provide rotational power for the equipment attached to the tractor like mowers, rotary tillers, and pumps. The PTO shaft is located behind the differential of the tractor and between the (two) 2 rear wheels.
Front wheel assist engagement lever or button	This is used to engage the front axle of the four-wheel tractor to improve traction. This may work in conjunction with an indicator light when engaged.
Draft control lever	This activates the rockshaft (lift arm) to lift and lower the implement automatically in response to the draft load.
Position control lever	This lever controls the depth of penetration of a soil engaging tool below ground level, or the height of the clearance above the ground of other types of implements such as three-point linkage carry all.
Auxiliary hydraulic control valve	This is used to activate the external hydraulic system to raise or lower drawbar attached implements such as plows, trailers and buckets mounted on the front of four-wheel tractors.

Table 2 Continued

Drop control valve knob	This controls the speed of drop of the implement attached to the four-wheel tractor. Excessive speed of the drop may cause damage or injury. The speed of drop should be adjusted slow enough for safe operation.
Differential lock	This locking device is a pedal normally located under or at the side of the driver seat. The “diff lock” is used to lock the differential when the tractor drive wheels begins to slip and the machine bogs down. It makes both rear wheels rotate at the same time and helps forward propulsion.

5.3 Hydraulic three-point linkage system

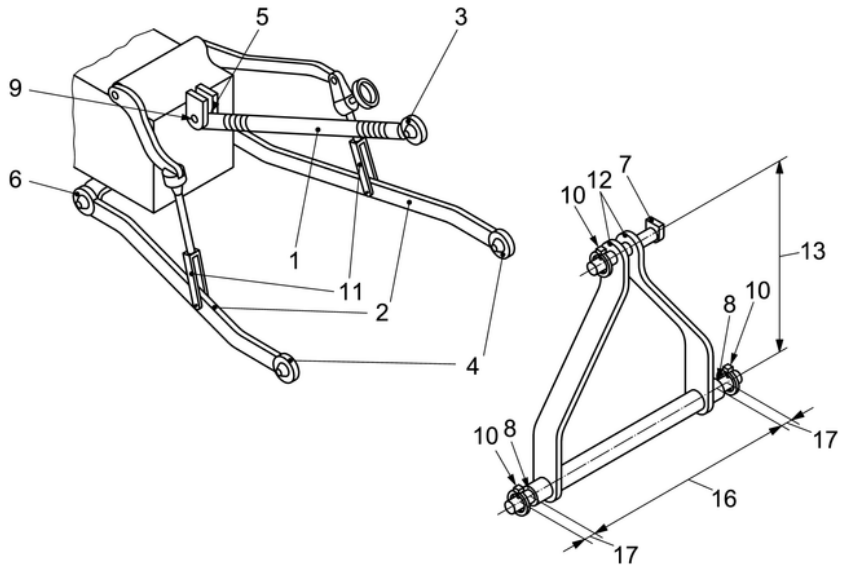
5.3.1 The four-wheel tractor shall be equipped with position and/or draft hydraulic control levers.

5.3.2 The dimensions of three-point linkage shall be based on the following categories. This is to enable implements that will be attached to all makes of four-wheel tractors. Each category covers tractor power ranges as shown in Table 3.

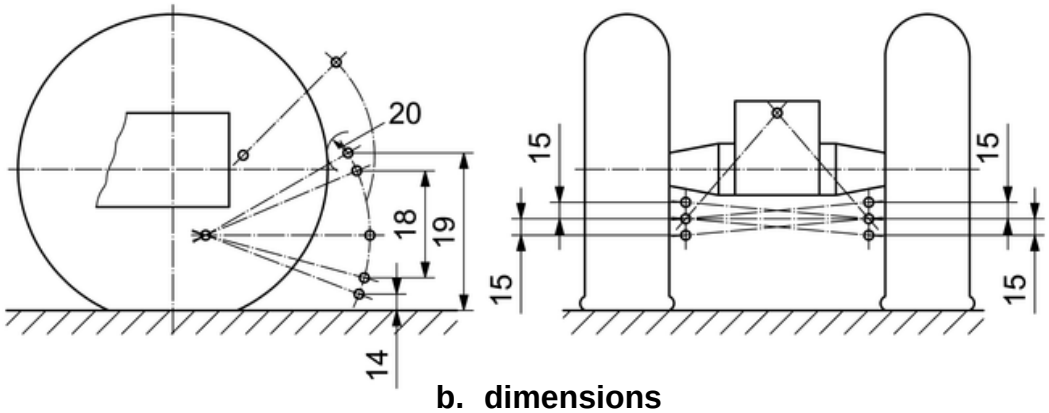
Table 3– Categories of rear- mounted three- point linkage

Category	**PTO power at rated rotational frequency of engine**[a], kW
1N	Up to 35
1	Up to 48
2N/2	30-92
3N/3	60-185
4N/4	110-350
[a] Determined in accordance with ISO 789-1.	

5.3.3 The dimensions associated with the three-point linkage of the four-wheel tractor is shown in Figure 8 while the dimensions related to the hitch points are shown in Figure 9 and Table 4.



a. Components



b. dimensions

1 upper link
2 lower link
3 upper hitch point
4 lower hitch point
5 upper link point
6 lower link point
7 upper hitch attachment
8 lower hitch attachment
9 upper link attachment
10 linchpin
11 lift rods
12 mast
13 mast height
14 lower hitch point height
15 levelling adjustment
16 lower hitch point span
17 linchpin hole distance
18 movement range
19 transport height
20 lower hitch point clearance

Figure 8 – Components and dimensions of three-point linkage

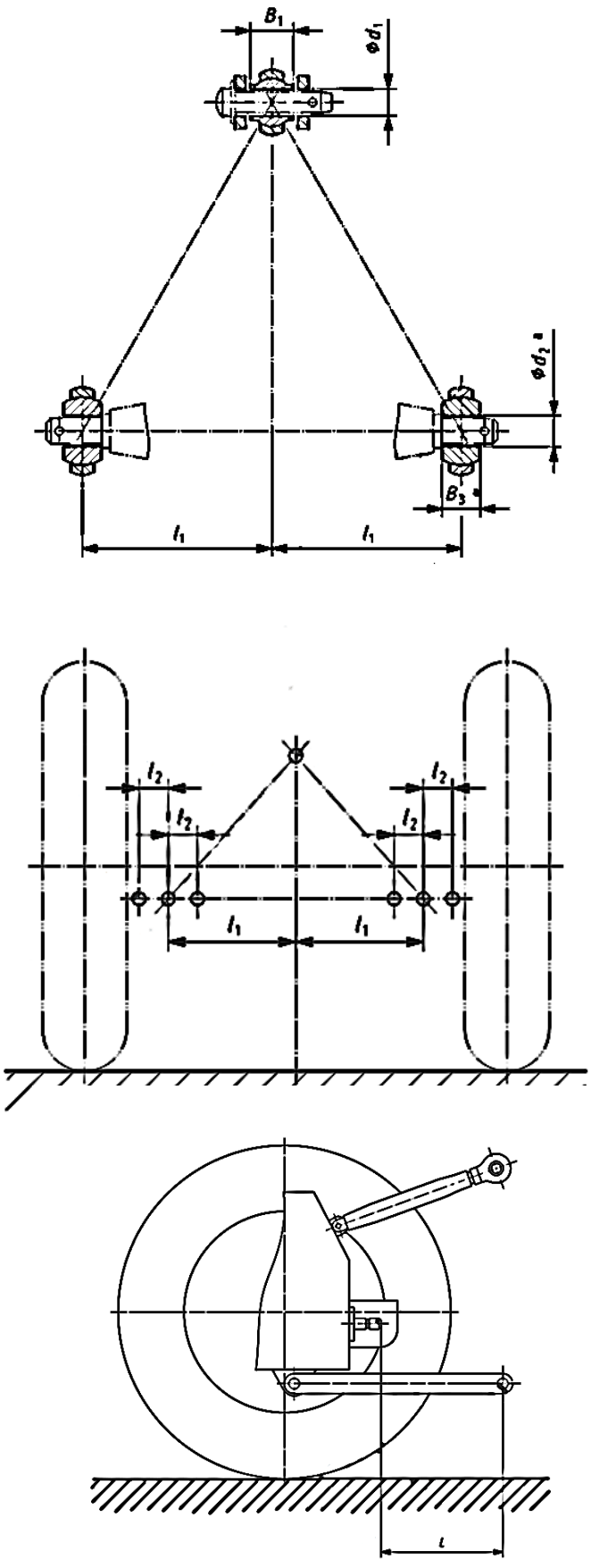


Figure 9 – Dimensions related to tractor hitch points

Table 4 – Dimensions related to tractor linkage points

Dimensions in millimeter

Dimension	Description	Category							
		1N	1	2N	2	3N	3	4N	4
Upper hitch point									
d_1	Diameter of hitch pin hole	$19,3\ ^{+0.2}_{0}$	$19,3\ ^{+0.2}_{0}$	$25,7\ ^{+0.2}_{0}$	$25,7\ ^{+0.2}_{0}$	$32\ ^{+0.25}_{0}$	$32\ ^{+0.25}_{0}$	$45,2\ ^{+0.3}_{0}$	$45,2\ ^{+0.3}_{0}$
B_1	Width of ball	$44\ ^{0}_{-0.5}$	$44\ ^{0}_{-0.5}$	$51\ ^{0}_{-0.5}$	$51\ ^{0}_{-0.5}$	$51\ ^{0}_{-0.5}$	$51\ ^{0}_{-0.5}$	$64\ ^{0}_{-0.5}$	$64\ ^{0}_{-0.5}$
Lower hitch point									
d_2	Diameter of hitch pin holes	$22,4\ ^{+0.25}_{0}$	$22,4\ ^{+0.25}_{0}$	$28,7\ ^{+0.3}_{0}$	$28,7\ ^{+0.3}_{0}$	$37,4\ ^{+0.35}_{0}$	$37,4\ ^{+0.35}_{0}$	$51\ ^{+0.5}_{0}$	$51\ ^{+0.5}_{0}$
B_3	Width of ball	$35\ ^{0}_{-0.5}$	$35\ ^{0}_{-0.5}$	$45\ ^{0}_{-0.5}$	$45\ ^{0}_{-0.5}$	$45\ ^{0}_{-0.5}$	$45\ ^{0}_{-0.5}$	$57,5\ ^{0}_{-0.5}$	$57,5\ ^{0}_{-0.5}$
l_1	Lateral distance from lower hitch point to centerline of tractor[a]	21 8	359	364	435	435	505	505[b]	612
l_2	Lateral movement of lower hitch point[c], minimum	50	100 [d]	100 [d]	125	125	125	125	125
L	Distance from end of power take- off to centre of lower hitch point, with the lower link horizontal [e,f]	300 to 375	500 to 575	550 to 625	550 to 625	550 to 625	575 to 675	575 to 675	575 to 675

[a] It could be necessary to vary these dimensions in case of specialized implements.

[b] If U-frame couplers according to ISO 11001-1 are used, dimension l_1 should be 489 mm.

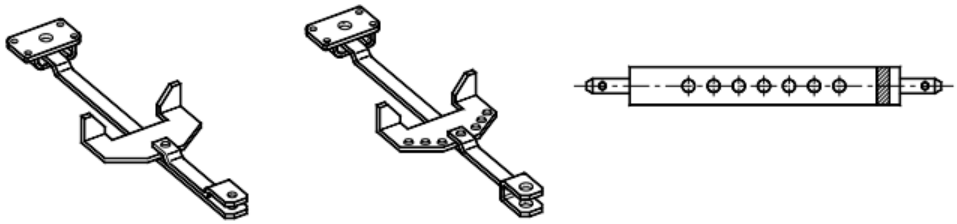
[c] Values may be reduced to a maximum of 35 mm in certain applications.

[d] If the tractor has a track width ≤ 1 150 mm, this value may be reduced to 50 mm min.

[e] If a U-frame coupler according to ISO 11001-1 is expected to be used on the tractor, the lower links should be designed to the minimum *l* dimension.
[f] Dimensions shall be applied only to nominal diameter 35 mm PTO-shaft and shall be increased by 100 mm if a nominal diameter 45 mm PTO-shaft is used.

5.4 Drawbar

5.4.1 Types of drawbar



a) fixed drawbar b) swinging drawbar c) link drawbar

Figure 10 – Drawbar types

5.4.2 Drawbar location

The drawbar shall be situated in the longitudinal mid-plane of the tractor.

5.4.3 Drawbar categories

The drawbar categories are shown in Table 5.

Table 5 – Drawbar categories

Drawbar category	PTO power (kW) [a] at rated engine speed
0	≤ 28
1	≤ 48
2	≤ 115
3	≤ 185
4	≤ 200
5	≤ 500

[a] Determined in accordance with ISO 789-1 or OECD code 1 or 2. If PTO power is not available, use 86% of engine power as determined in ISO 14396:2002- Reciprocating internal combustion engines – Determination and method for the measurement of engine power – Additional requirements for exhaust emission test.

5.4.4 Drawbar dimensions

The drawbar dimensions shall conform to Figure 11 and Table 6.

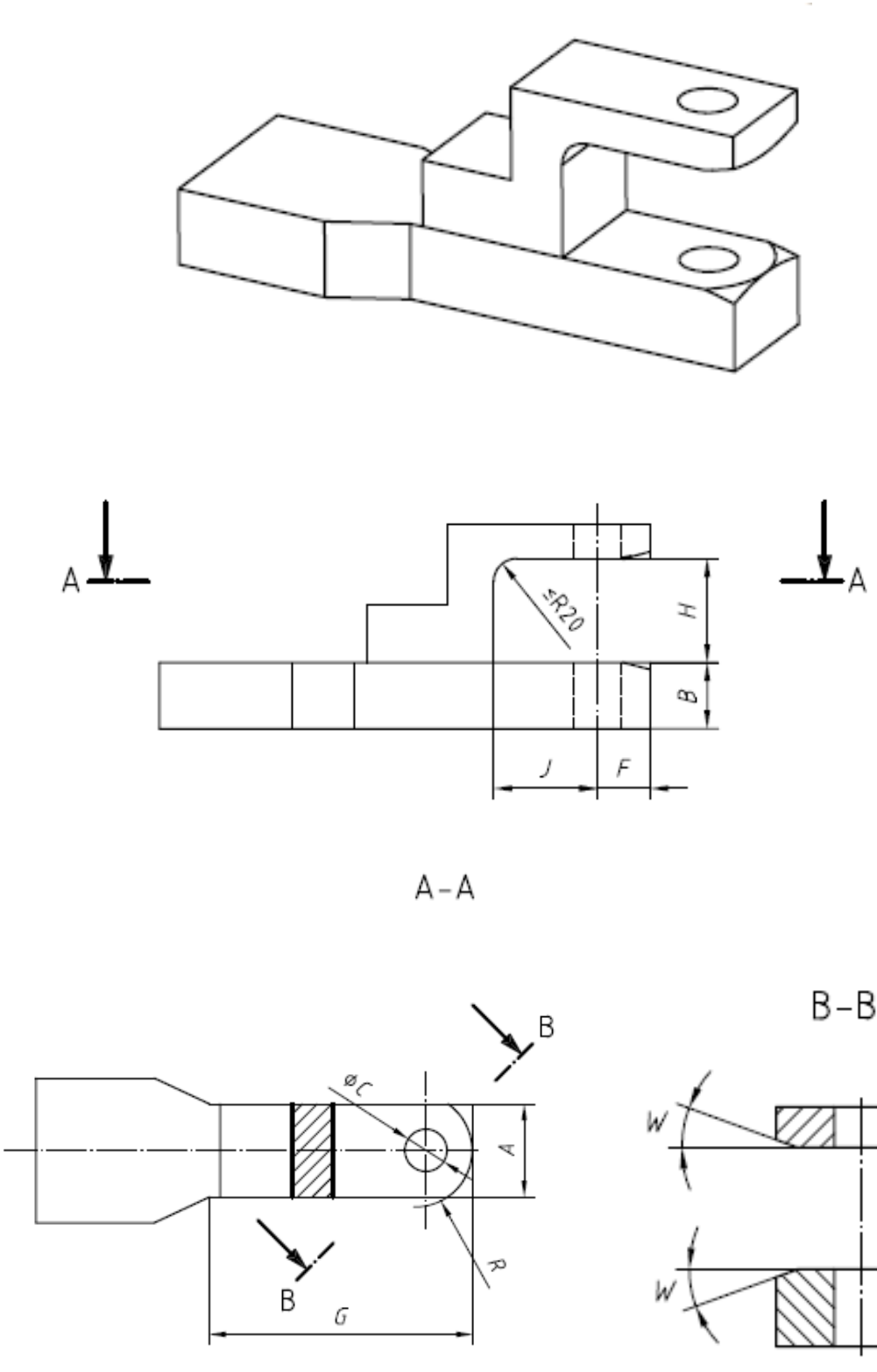


Figure 11 – Tractor drawbar and clevis

Table 6 – Tractor drawbar and clevis – Dimension values

Dimensions in millimeters

Dimension	Drawbar Category					
	0	1	2	3	4	5
Drawbar width, *A*[a] max	60	67	90	90	130	160
Drawbar thickness, *B*	20	36	52	57	64	80
Pin hole dimeter, *C*	20	33	33	41	52,5	72,5
Pin diameter, *C1*	18	30	30	38	50	70
F	30	40	45	45	65	80
G[b]	140	210	210	210	210	210
Height, *H*	50	70	70	90	90	100
Throat depth, *J*	50	70	80	80	90	110
End radius of drawbar and clevis, *R*[c]	35	40	55	55	80	95
W[c]	20°	20°	20°	20°	15°	15°

[a] The drawbar pin handle, retention devices, or clevis may extend beyond width but shall not interfere with the implement articulation angles specified in Clause 6 of ISO 6489-3:2004.

[b] *G* is the distance over which the specified dimensions A and B shall be maintained.

[c] The profile shown in Figure 2 represents the maximum envelope for the drawbar and clevis. The radius and angle may differ from the values given so long as the maximum envelope is not exceeded.

Mechanism for drawbar height adjustment should be provided as this can be useful for setting up the implement for the most efficient output.

NOTE For more detailed specification of drawbar, refer to ISO 6489-3:2004.

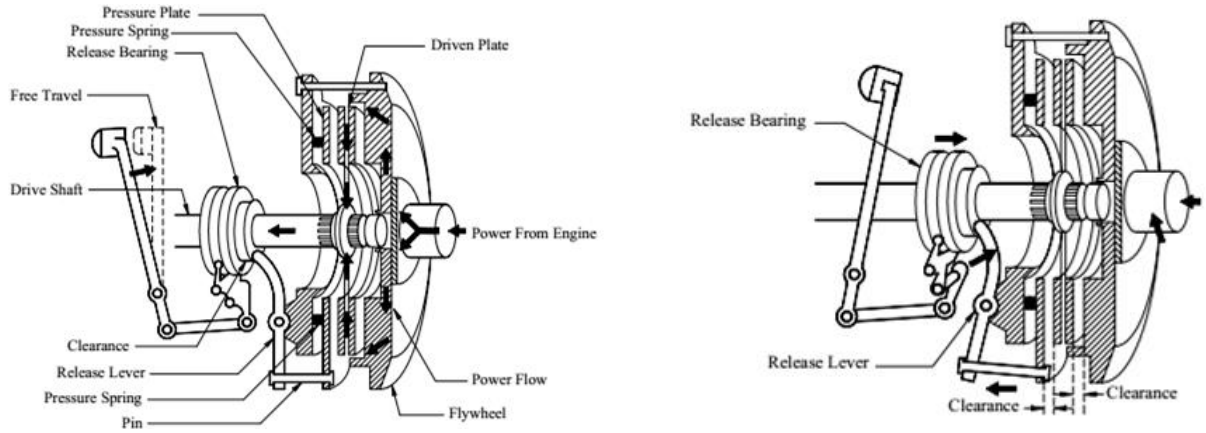
5.5 Power transmission system

5.5.1 Main clutch and PTO clutch

5.5.1.1 Dry type single-plate clutch

The clutch is engaged when the driven plate is gripped firmly between the flywheel and pressure plate by the force of the pressure spring. This causes the rotary motion of the flywheel to be transmitted through driven plate to main drive shaft as shown in Figure 12a.

Applying a stepping force on the clutch pedal causes the rod to move in the direction of the arrow accompanying the leftward movement of the release bearing so that the lower end of the release lever is pushed in the same direction. The pressure plate is shifted toward the right against the force of the pressure spring, removing the pressure from the driven plate so that transmission of the revolution of the flywheel to the driven plate is cut bringing the main shaft to a halt as shown in Figure 12b.



a) clutch engaged b) clutch disengaged

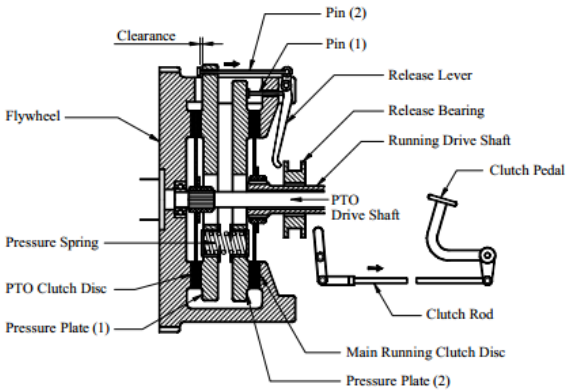
Figure 12 – Dry type single-plate clutch

5.5.1.2 Dual clutch

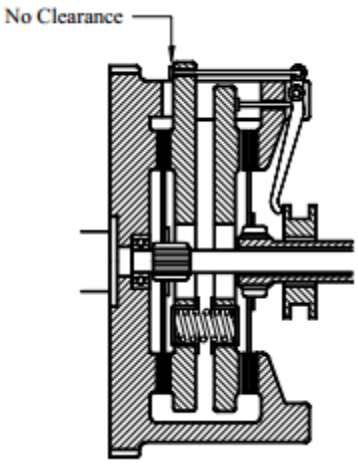
When the main clutch and dual clutch parts are both engaged, the main clutch disc and PTO clutch disc are transmitting power to the main driving shaft and PTO driving shaft, respectively as shown in Figure 13a.

The first stage of stepping on the clutch pedal causes the pin to move in the direction of the arrow, but the original space between the pin (2) and the pressure plate (1) is wide enough to prevent the pin (2) from pulling the pressure plate. However, the pin (1) pushes the pressure plate towards the flywheel side until it becomes apart from the main clutch disc. Thus, the first stage recession of the clutch pedal disengages the main clutch part while the PTO clutch is still engaged as shown in Figure 13b.

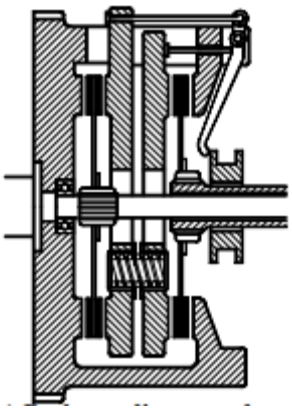
The second stage of stepping on the clutch pedal further down causes the pin (2) to pull the pressure plate (1) away from the PTO clutch disc. This makes both the PTO clutch and main clutch disengaged as shown in Figure 13c.



a) both are engaged



b) Main clutch is disengaged but PTO clutch is engaged

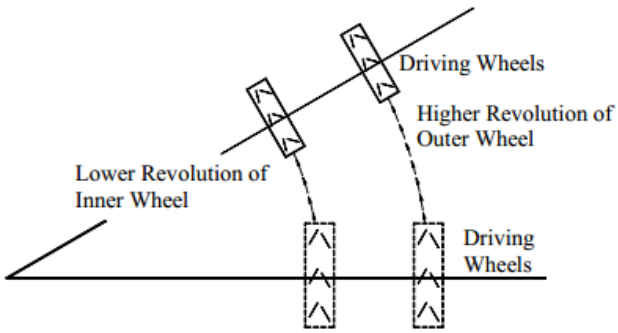


c) both are disengaged

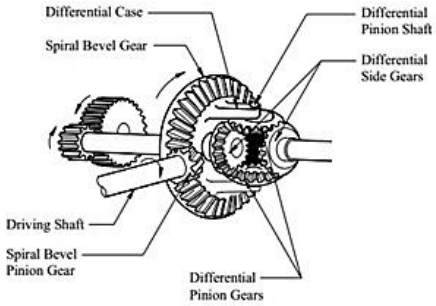
Figure 13 – Construction and function of dual clutch

5.5.2 Differential gear

It is an arrangement of gears constructed and located in the transmission system that permits one driving wheel to rotate slower or faster than the other and at the same time propels its share of the load.



a) function

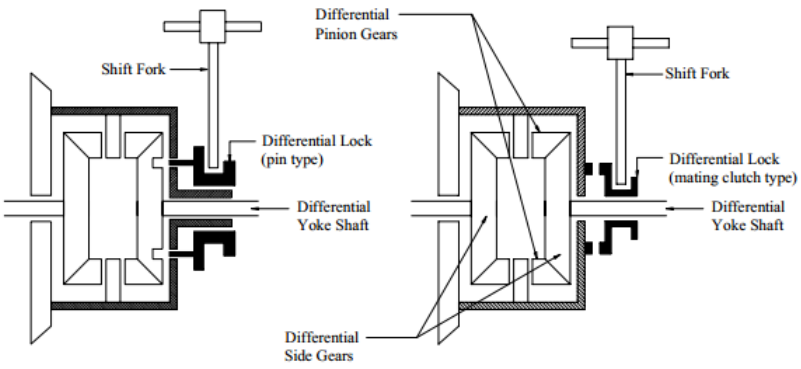


b) construction

Figure 14 – Function and construction of differential gears

5.5.3 Differential lock

The differential lock is a device by which a restraining force is applied to the differential gears in case one of the wheels goes into a spin. This permits the differential yoke shafts to rotate together as one unit.



a) pin type b) mating clutch type

Figure 15 – Types of differential locks

5.5.4 Final drive

Final drive permits the drive wheel to run at much slower speed and with a much higher torque than the earlier part of the drive train.

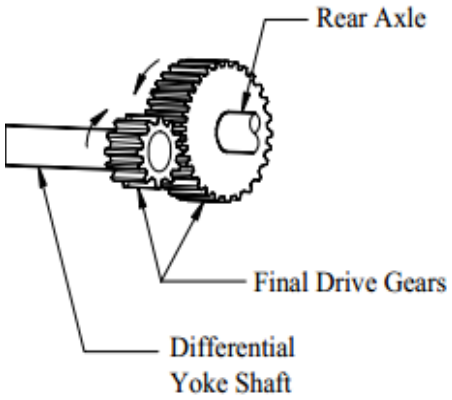


Figure 16 – Final drive

5.5.5 PTO shaft

Power take-off shaft is located at the tractor's rear, commonly used to drive rotary implements. The direction of PTO rotation shall be clockwise when viewed from behind the tractor except when a ground driven PTO is operated with the tractor in reverse direction.

The nominal PTO rated shaft speed can be realized by one or more engine speed ranges.

The main characteristics of the four types of PTO shafts shall be as specified in Table 7.

Table 7 – Characteristics of PTO types

PTO Type	Nominal Diameter, mm	Number and Type of Splines	Nominal PTO rated rotational frequency, rpm	Recommended PTO power at rated engine speed[a], kW
1	35	6 straight splines	540	<65
			1000	<110
2	35	21 involute splines	1000	<130
3	45	20 involute splines	1000	<300
4	57.5	21 involute splines	1300	<450
a Determined in accordance with ISO 789-1 or OECD code 2				

NOTE For more detailed specifications of PTO, refer to ISO 500- 1 and 3:2014 and ISO 500-2:2004.

5.6 Wheel tread adjustment

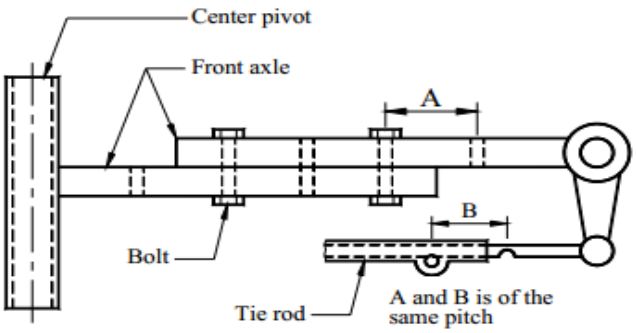
Mechanism for wheel tread adjustment shall be provided, as this can be useful for allowing the wheel tread to match with the implements.

5.6.1 Front tread

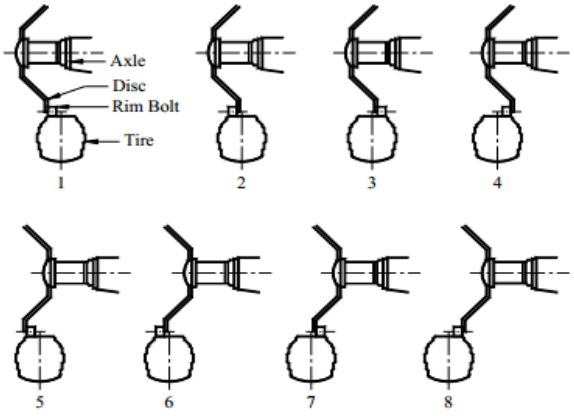
The length of the front axle itself may be adjustable by changing set bolt positions as shown in Figure 20a. The length of the tie-rod shall be adjusted accordingly. For four-wheel drive tractors, the front tread may be adjusted by inverting the disc or changing the position of the disc or rim along the shaft.

5.6.2 Rear tread

For two-wheel and four-wheel drive tractors, the rear tread may be adjusted by inverting the disc or rim, since the shaft length is not changeable. It may be adjusted by changing the position of the disc along the shaft as shown in Figure 17a and 17b.



a) Tread adjustment of front wheel for 2WD



b) Tread adjustment of front or rear wheels for 4WD

Figure 17 – Wheel tread adjustment

5.7 Brake system

The classification of the brake system should be based but not limited to the following.

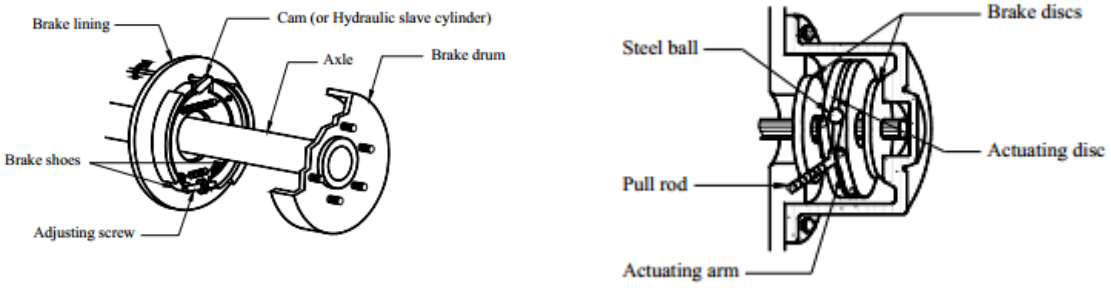
5.7.1 Manner of applying braking force

5.7.1.1 Internal expansion type

The motion of the brake cam in the direction of the arrow makes the brake shoes open outward until the brake linings are pressed hard against the brake drum for braking as shown in Figure 18a.

5.7.1.2 Disc type

The steel balls between the two actuating discs push them outward until they are pressed hard against the brake discs for braking as shown in Figure 18b.



a) internal expansion type

b) disc type

Figure 18 – Types of brake based on brake force application

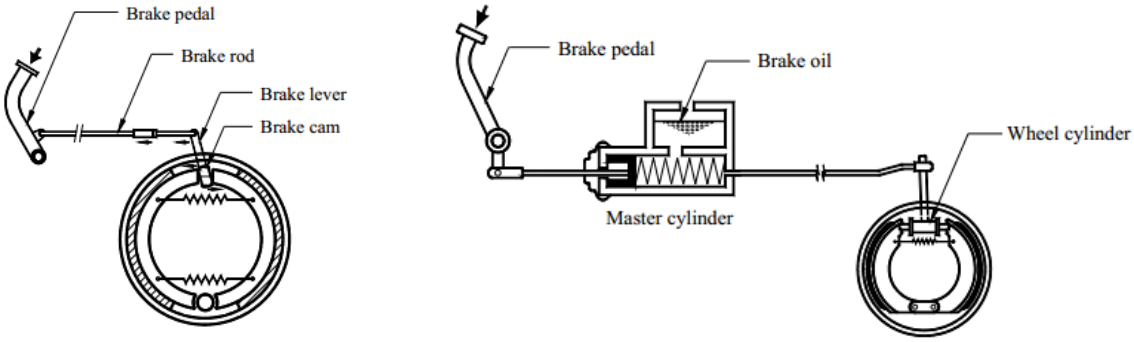
5.7.2 Manner of transmitting the force from the control

5.7.2.1 Mechanical brake

The motion of the brake rod in the direction of the arrow is transmitted through the brake lever to rotate the brake cam for braking as shown in Figure 19a.

5.7.2.2 Hydraulic brake

The stepping force on the brake pedal is converted to hydraulic forces by the master cylinder and then transmitted through the pipe to the wheel cylinder as shown in Figure 19b.



a) mechanical brake b) hydraulic brake

Figure 19 – Types of brake based on brake force transmission

5.7.2.3 Pneumatic brake/ air brake

Pneumatic brakes or air brakes, use compressed air generated by the compressor and stored in a tank. The compressed air applies pressure to the master cylinder's piston which brakes or decelerate the four-wheel tractor

6 Performance and Other Requirements

6.1 The drawbar power shall be tested in accordance with PNS/BAFS PABES 302:2020.

6.2 The four-wheel tractor equipped with three-point linkage shall have the minimum hydraulic lift force capacity available throughout the power range, at a distance of 610 mm beyond the lower hitch points (without external assist hydraulic cylinders) as shown in Table 8.

Table 8 – Hydraulic lift force capacity

Maximum drawbar power (kW)	Lift force per drawbar power (kN/kW)
65 and below	0.31
Above 65	20.15 plus 0.155 kN/kW for the succeeding drawbar power

6.3 The performance requirements of four-wheel tractor shall conform with the values specified in Table 9.

Table 9– Performance criteria for four-wheel tractors

Criteria	Performance Data
PTO Power, minimum, percent of the rated power	85
Specific Fuel Consumption, maximum, g/kW-h	350

7 Safety, Workmanship and Finish

7.1 The maximum allowable noise level shall be 90 dB (A). There shall be provision for ear protection.

7.2 For operator's safety, the following shall be provided:

7.2.1 All tractors shall be equipped with Roll- Over Protective Structures (ROPS) and seat belts.

NOTE For a more detailed specification of seat belt, refer to ISO 3776-1: 2006 and ISO 3776- 2:2013.

7.2.2 Seat shall be provided which will adequately support the operator in all working and operating conditions. Adequate and comfortable support and protection for the feet shall also be provided. Seats and ROPS shall conform to the requirements specified in PAES 139 and 140: 2004.

7.2.3 When the PTO is in use, a cover or casing that protects the sides of the PTO shaft shall be fitted. An additional non-rotating casing shall also be provided when the PTO is not in use. This casing shall enclose the PTO shaft completely and be fixed to the tractor body.

7.3 The engine of the four-wheel tractor shall be equipped with cooling system suitable for tropical operations.

7.4 Mechanism that minimizes/reduces vibration shall be provided.

7.5 The four-wheel tractor shall be free from manufacturing defects that may be detrimental to its operation.

7.6 Any uncoated metallic surface shall be free from rust and shall be painted properly.

7.7 Appropriate labels, safety symbols, and warnings shall be provided appropriately.

7.8 All hot surfaces that may come in contact with the operator shall be provided with heat shield or protective cover.

7.9 Attachment of ballast or other weights shall be provided, as necessary.

7.10 The four-wheel tractor shall be free from sharp edges and surfaces that may injure the operator. Warning notices shall be provided in accordance with PAES 101:2000.

8 Warranty for Fabrication and Services

Warranty shall be provided for parts and services except for normal wear and tear of expendable or consumable maintenance parts for at least one (1) year upon the acceptance of the procuring entity. General requirements of warranty and after-sales service shall conform to PNS/BAFS/PAES 192:2016.

9 Maintenance and Operation

9.1 Each four-wheel tractor unit shall be provided with the following minimum quantity of basic hand tools applicable to tractors: three (3) pieces open wrenches, one (1) piece each of Philips and flat screw driver, one (1) pair of mechanical pliers, one (1) piece adjustable wrench, one (1) piece grease gun, one (1) piece of tire wrench and one (1) piece of lifting jack.

9.2 Operator's manual based on PAES 102:2000, maintenance schedule, list of warrantable parts of the tractor, and applicable Personal Protective Equipment (PPE) shall be provided.

9.3 Four-wheel tractor parts that need regular cleaning should be easily accessible.

10 Sampling

The four-wheel tractor shall be sampled for testing in accordance with PAES 103:2000 or any other suitable method of selection.

11 Testing

Sampled tractors shall be tested in accordance with PNS/BAFS PABES 302:2020.

12 Marking and Labeling

12.1 Each unit of four-wheel tractor shall be marked at noticeable place with the following information:

12.1.1 Registered trademark of the manufacturer

12.1.2 Brand

12.1.3 Model

12.1.4 Year of manufacture

12.1.5 Serial number of engine and unit

12.1.6 Name, address and contact details of the manufacturer/importer/distributor

12.1.7 Country of manufacture/origin (if imported) / “Made in the Philippines” (if manufactured in the country)

12.1.8 Rated power, kW

12.2 Safety/precautionary markings shall be provided. It shall be stated in English and/or Filipino and printed in red font color with a white background.

12.3 The markings shall be durably bonded to the base surface material. The markings shall be all weather resistant and shall be under normal cleaning procedures. It shall not fade, discolor, peel, crack, or blister at all cost. It shall remain legible.

Bibliography

American Society of Agricultural Engineers (ASAE) S217.12 DEC01 (ISO+ 730-1:1994) *Three- Point Free- Link Attachment for Hitching Implements to Agricultural Wheel Tractors*

American Society of Agricultural Engineers (ASAE) S203.10:1982 *Rear Power Take-off for Agricultural Tractors*

American Society of Agricultural Engineers (ASAE) S217.10:1984 *Three-point Free-link Attachment for Hitching Implements to Agricultural Wheel Tractors*

Hunt, Donnel. *Farm Power and Machinery Management*. 7th Edition. Iowa State University Press, Ames, Iowa.1977.

Implementing Rules and Regulations of Republic Act No. 8749, also known as Philippine Clean Air Act of 1999.

IRRI Rice Production Manual

ISO 4253:1993, *Agricultural Tractors – Operator's seating accommodation – Dimensions*

ISO 3776-1:2004, *Tractors and Machinery for Agriculture – Seat Belt- Anchorage Location Requirements*

ISO 3776-2:2013, *Tractors and Machinery for Agriculture – Seat Belt- Anchorage Strength Requirements*

ISO 500-2:2004, *Agricultural Tractors – Rear-mounted power-take-off types 1, 2, 3 and 4- Part 2- Narrow Track Tractors, Dimensions for Master Shield and Clearance Zone.*

ISO 14396:2002- *Reciprocating Internal Combustion Engines – Determination and Method for the Measurement of Engine Power – Additional Requirements for Exhaust Emission Test.*

ISO 789- 3:2015- *Agricultural Tractors- Test Procedures- Part 3- Turning and Clearance Diameters*

Mcmillan, R.H. *The Mechanics of Tractor – Implement Performance*. Agricultural Engineering International Development Technologies Centre, University of Melbourne.2002

OECD 2011, Standard Codes for the Official Testing of Agricultural and Forestry Tractors

Philippine Agricultural Engineering Standard (PAES) 118:2001, *Agricultural Machinery- Four- Wheel Tractor- Specifications*

Philippine Agricultural Engineering Standard (PAES) 119:2001, *Agricultural Machinery- Four- Wheel Tractor- Methods of Test*

Regional Network for Agricultural Machinery (RNAM) Test Codes and Procedures for Farm Machinery. Technical Series No. 12 :1983.

Republic Act No. 7394 otherwise known as “The Consumer Act of the Philippines”

Department of Agriculture
Bureau of Agriculture and Fisheries Standards
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