PHILIPPINE NATIONAL STANDARD

PNS/BAFS 348:2022
ICS 65.060.10

Walking-Type Agricultural Tractor — Methods of Test

BUREAU OF AGRICULTURE AND FISHERIES STANDARDS
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Foreword

Since 2000, the local agricultural industry has observed technological innovations and advancements on the design, fabrication, and operation of walking-type agricultural tractors available in the market. Thus, it was necessary to revise the existing national standards on the walking-type agricultural tractor. In response, the Agricultural Machinery Testing and Evaluation Center (AMTEC)-University of the Philippines Los Baños (UPLB) initiated the development of the standards on walking-type agricultural tractor — Specifications — Part 1 (Pull-type), Part 2 (Rotary-tilling type) and Part 3 (Float-assisted tiller) and Methods of Test. The development of these standards was made in collaboration with the Bureau of Agriculture and Fisheries Standards (BAFS)-Department of Agriculture (DA) as the mandated agency to develop Philippine National Standards (PNS) for agriculture and fisheries machinery and infrastructures.

The Technical Working Group (TWG) tasked to develop the PNS was created through Special Order (SO) No. 617, series of 2022 (Amendment to Special Order No. 487, series of 2022 [Addendum to Special Order 103, series of 2022 entitled, “Creation of TWG for the Development of PNS for Agriculture and Fishery Products, Machineries, and Infrastructures”]). The TWG was composed of representatives from the relevant government agencies, academe, and research institutions. The draft PNS underwent a series of TWG meetings and stakeholder consultations via online platforms before their endorsement to the DA Secretary for approval.

This PNS/BAFS edition includes the following significant changes compared to PAES 111:2000 (Agricultural machinery – Walking-type agricultural tractor – Methods of test):

a) Modification of “Field performance test”;
b) Inclusion of provisions for “Principle of the Test”, “General”, “Presentation of Results”, and “Formula”; and
c) Adoption of the methods of test for “Turning ability test” and “Drawbar power test” from ANTAM 001-2021 (ANTAM standard code for testing of power tillers).

This Standard cancels and replaces PAES 111:2000. This PNS was drafted in accordance with the BAFS-Standards Development Division (SDD) Standardization Guide No. 1: Writing the Philippine National Standards.

Table of Contents

1 Scope

This Standard specifies the methods of test and inspection for the field performance of Walking-Type Agricultural Tractor (WTAT). Specifically, it shall be used to:

a) Verify the mechanism, main dimensions, materials of the WTAT, and the list of specifications submitted by the manufacturer;
b) Determine the field performance of the machine;
c) Evaluate the ease of handling and safety features; and
d) Prepare a report on the results of the tests.

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 all references, the latest edition of the referenced document (including any amendments) applies.

Agricultural Machinery Testing and Evaluation Center (AMTEC)-University of the Philippines (UPLB). (2000). Agricultural machinery — Method of sampling (PAES 103:2000). https://amtec.ceat.uplb.edu.ph/wp-content/uploads/2019/07/PAES-103-2000-Agricultural-Machinery-Method-of-Sampling.pdf

AMTEC-UPLB. (2015). Agricultural machinery – Disc plow for walking type agricultural tractor – Specifications (PNS/PAES 167:2015). https://amtec.ceat.uplb.edu.ph/wp-content/uploads/2019/07/PNS-PAES-167-2015-Agricultural-Machinery-Disk-Plow-for-Walking-Type-Agricultural-Tractor-S.pdf

Bureau of Agriculture and Fisheries Standards (BAFS)-Department of Agriculture (DA). (2022). Walking-type agricultural tractor — Specifications — Part 1: Pull-type (PNS/BAFS 345:2022).

BAFS-DA. (2022). Walking-type agricultural tractor — Specifications — Part 2: Rotary-tilling type (PNS/BAFS 346:2022).

BAFS-DA. (2022). Walking-type agricultural tractor — Specifications — Part 3: Float-assisted tiller (PNS/BAFS 347:2022).

3 Terms and Definitions

For the purpose of this Standard, the terms and definitions given in PNS/BAFS 345:2022 (Walking-type agricultural tractor — Specifications — Part 1: Pull-type), PNS/BAFS 346:2022 (Walking-type agricultural tractor —

Specifications — Part 2: Rotary tilling-type), PNS/BAFS 347:2022 (Walking-type agricultural tractor — Specifications — Part 3: Float-assisted tiller), and the following apply:

3.1
ground clearance
distance between the supporting surface and the lowest point of the WTAT

3.2
operating width
horizontal distance perpendicular to the direction of travel within which an implement or attachment performs its intended function, expressed in m

3.3
overall height
distance between the horizontal supporting surface and the horizontal plane touching the uppermost part of the WTAT including fixed components projecting upward

3.4
overall length
distance between two vertical planes at right angles to the median plane of the WTAT and touching its front and rear extremities

3.5
overall width
distance between two vertical planes parallel to the median plane of the WTAT, each plane touching the outer-most point of the WTAT on its respective side and with wheels set for minimum track

3.6
slip
ratio of the difference between the speed of pulley or belt and wheels or track with load, to the speed without load

3.7
WTAT weight
total weight of the machine excluding ballast and implements with the fuel tank filled to 80% capacity and with normal amount of cooling water and lubricating oil (if engine is integrated with the WTAT) and with specified wheels

4 Principle of the Test

The test shall be carried out to verify the actual specification of the WTAT. Its specifications shall be validated with any of the following Standards, as applicable:

a) PNS/BAFS 345:2022 (Walking-type agricultural tractor — Specifications — Part 1: Pull-type);
b) PNS/BAFS 346:2022 (Walking-type agricultural tractor — Specifications — Part 2: Rotary-tilling type); or
c) PNS/BAFS 347:2022 (Walking-type agricultural tractor — Specifications — Part 3: Float-assisted tiller)

5 Test Instruments and Materials

The suggested list of minimum field performance test equipment and materials needed to carry out the WTAT test is shown in Annex A (Minimum list of field performance test equipment and materials). These instruments shall be calibrated regularly. Before and after each test, these instruments shall be physically checked for operation and shall be cleaned, respectively. A checklist of instruments and materials to be used shall be prepared and will be validated before and after the test.

6 General

6.1 Conditions for the test

6.1.1 Test site conditions

The WTAT shall be assembled and tested for normal operation. The site should have ample provisions for workspace and suitable for normal working condition.

6.1.2 Selection of WTAT to be tested

WTAT submitted for testing shall be sampled in accordance with PAES 103:2000 (Agricultural machinery – Methods of sampling) or any suitable method of selection.

6.1.3 Repairs during test

All repairs made during the tests shall be noted together with comments on any practical defect.

6.1.4 Suspension/termination of test

During the test run, if the WTAT stops due to breakdown or malfunction affecting its performance, the test shall be suspended. If the WTAT will not be able to continue the operation, the test shall be terminated.

6.2 Pre-test activities

6.2.1 Running-in and preliminary adjustments

The WTAT shall have undergone a running-in period before starting the test. During the running-in period, the various adjustments of the WTAT shall be made according to the recommendation of the manufacturer.

6.2.2 Verification of specifications

The specifications claimed by the manufacturer and the physical details given in Annex B (Specifications of walking-type agricultural tractor) shall be verified by the testing agency. A stable and level surface shall be used as reference plane for verification of dimensional machine specifications when fully assembled and ready for use. All specifications of available attachments used for land preparation shall be verified.

6.2.3 Preparation of the WTAT for testing

The WTAT shall be checked so as to ensure that the machine has been assembled and installed in accordance with the instruction of the manufacturer. It shall be test according to the manufacturer's specifications.

7 Performance Test

7.1 Field performance test

7.1.1 Size and field condition of test plot

For upland field, the test plot shall be unplowed. For lowland field, the test plot shall be unplowed and soaked for at least 24 h with water level of 3 cm to 5 cm. Furthermore, the test plot shall be rectangular with sides in the ratio of 2:1 as much as possible. Its size shall not be less than 500 m^2. The total size of the prepared test plots shall be sufficient for the required number of test trials and running-in. If the test plots are not conforming to the recommended characteristics, the test shall be suspended.

7.1.2 Machine setting

The machine's depth of cut shall be set between 90 mm to 110 mm for plowing and rotary tilling. For plowing, the specifications of the disc plow to be used shall conform with PNS/PAES 167:2015 (Agricultural machinery – Disc plow

for walking type agricultural tractor – Specifications) and shall have an operating width of at least 150 mm.

7.1.3 Operation of the WTAT

The WTAT shall be operated with load at the test site until the operation is finished. It shall be operated by the official representative of the test applicant using the recommended settings. Pull-type WTAT shall be operated for plowing, while both rotary-tilling type and float-assisted type shall be operated for rotary tilling. As part of the test, the testing agency shall make all measurements. No other adjustments shall be permitted during the test.

7.1.4 Test trials

A minimum of two test trials shall be conducted.

7.1.5 Data collection

7.1.5.1 Duration of test

The duration of each trial shall last until the plowing or rotary tilling operation in the required area is finished.

7.1.5.2 Soil resistance before plowing/rotary tilling

Soil resistance shall be measured using cone penetrometer for lowland/wetland field. There shall be at least 10 trials conducted.

7.1.5.3 Traveling speed

a) Outside the longer side of the test plot, place two poles (A, B) approximately in the middle of the test plot as shown in Figure 1 to mark the traveling distance. These two poles should be 15 m apart. On the opposite side, place another two poles (C, D) in similar position and distance so that all four poles form corners of a rectangle, parallel to at least one long side of the test plot.

b) Calculate speed from the time required for the machine to travel the distance between the assumed line connecting two poles on opposite sides AC and BD. The reference point (e.g., pneumatic wheels) of the machine should be selected for measuring the time.

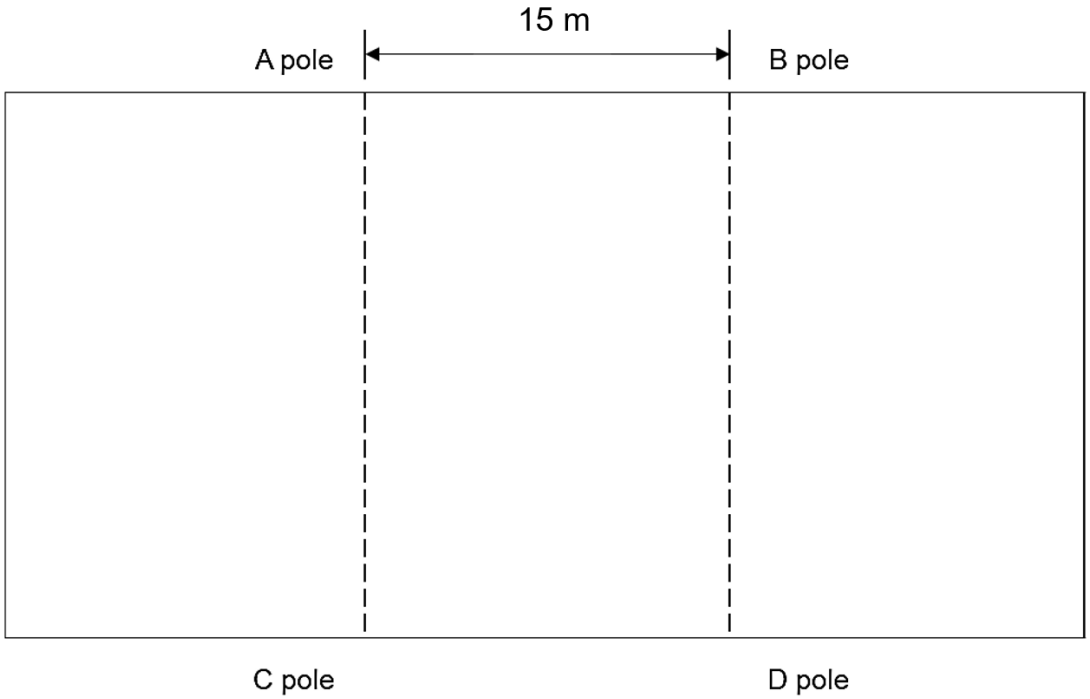

Figure 1. Measurement of operating/traveling speed

7.1.5.4 Average width and depth of plowing/rotary tilling

a) A depth and width meter, as shown in Figure 2, shall be used in measuring the width and depth of plowing/rotary tilling simultaneously.

b) Measure the depth and width by placing the tip of graduated depth scale to the rototilled/plowed surface (point B) and putting a pin at point A of width scale. This procedure shall be repeated for the succeeding passes. The distance between two pins adjacent to each other is the width of plowing/rotary tilling and the distance between point B and baseline for reading depth is the depth of rotary tilling/plowing. However, rototilled/plowed surface is not always level depending on the feature of the rotary tiller. Therefore, the tip of the depth scale shall be placed at relatively same point in each pass.

c) Determine the mean of the measured width and depth for the average width and depth of plowing/rotary tilling.

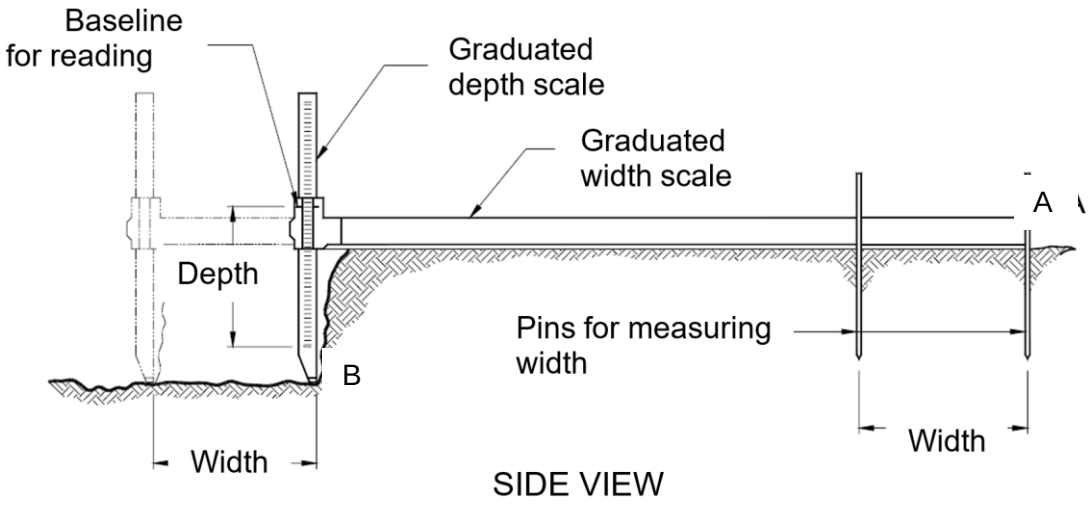

Figure 2. Measurement of width and depth of rotary tilling

7.1.5.5 Effective field capacity and percent overlapped/untilled

a) Operating width of implement or attachment, test plot's length, width and area, and number of rounds during operation shall be recorded for each trial. Actual width of swath, total distance traveled, effective area, and effective field capacity shall be calculated using the formulas in Annex C (Formulas used during calculations and testing).

b) Percent overlapped or untilled shall be calculated using the formula in Annex C (Formulas used during calculations and testing). If actual width of swath is less than the actual width of implement, the operator has passed over part of the area twice to secure better coverage. If the actual width of swath is greater than the actual width of implement, the operator has left part of the area untilled.

7.1.5.6 Theoretical field capacity

With the operating width of implement or attachment recorded and operating speed computed, the theoretical field capacity shall be obtained using the formula in Annex C (Formulas used during calculations and testing).

7.1.5.7 Fuel consumption

a) Total operating time of the WTAT's engine from the time it started until the time it stopped shall be recorded.

b) To get the amount of fuel consumed, refill method shall be used. The fuel tank shall be filled to full capacity or to a certain known level before the test. After the test, the tank shall be refilled up to the same level before the test. The amount of fuel used to refill the tank shall be recorded. While filling up

the fuel tank, it shall be kept horizontal and shall have no empty space left inside.

c) Fuel consumption per unit time shall be calculated using the formulas in Annex C (Formulas used during calculations and testing).

7.1.5.8 Noise level

a) The sound emitted by the WTAT during plowing or rotary tilling operation shall be measured using a sound level meter at the location of the operator. The noise level, expressed in dB (A), shall be measured 50 mm away from the ear level of the operator/s.

b) For each data to be taken, there shall be a minimum of five observations. Before taking data, it should be ensured that the operations and other functional characteristics have stabilized. The time of recording shall be properly spaced during the whole duration of the test trial. There shall be at least 10 data or readings obtained.

7.2 Turning ability test

7.2.1 Condition of test area (Centre for Sustainable Agricultural Mechanization [CSAM]-United Nations Economic and Social Commission for Asia and the Pacific [ESCAP], 2018)

The test area shall be a horizontal compact or paved surface having good tire adhesion and capable of displaying legible marking.

7.2.2 Machine setting (CSAM-ESCAP, 2018)

7.2.2.2 The WTAT shall be tested with all liquid reservoirs filled to the specified level but without ballast, mounted implements and any other specified components.

7.2.2.3 The height of the tire tread bars shall not be less than 65% of their height when new. The inflation pressure in the tires shall be maintained as recommended for by the manufacturer.

7.2.2.4 The test shall be conducted with the WTAT without tail wheel at the minimum attainable speed.

7.2.3 Data collection (CSAM-ESCAP, 2018)

7.2.3.1 The measurement of radius of turning circle and turning space are referred in Figure 3.

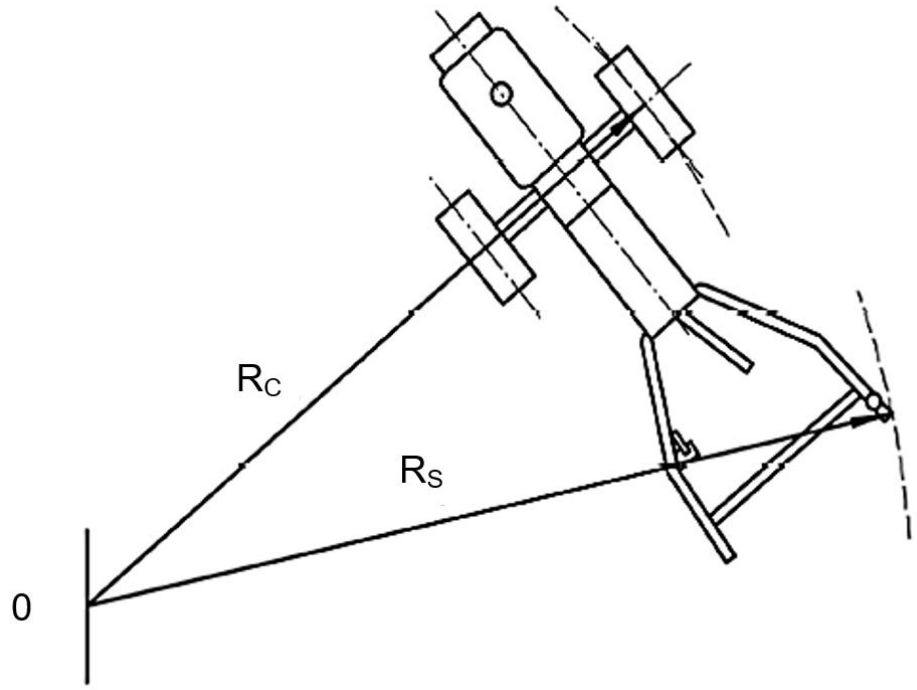

Figure 3. Measurement of radius of turning circle (R_C) and turning space (R_S) (adapted from CSAM-ESCAP, 2018)

7.2.3.2 The test shall be carried out at minimum travel speed of the WTAT by turning it to the right and the left sides using steering clutch until a 360-degree turn is completed. During the test, the diameter of the minimum turning circle and diameter of the minimum turning space required shall be measured.

7.3 Laboratory performance test

7.3.1 Transmission efficiency test

7.3.1.1 This test is carried out to determine the efficiency of the transmission system of the WTAT, using an electric motor or engine that is coupled with a torque transducer or load cell. The WTAT on test, without its wheels, shall be fixed on the test frame. Load is applied on the wheel axle or rotary tilling shaft through a dynamometer

7.3.1.2 Power is transmitted from the motor output shaft to the input shaft (first shaft) of transmission box in the same manner as those from engine to that of WTAT, for instance, V-belt. The diameter of the pulley on the output shaft of the electric motor is computed so that speed of input shaft at rated speed of electric motor is the same as that of rated engine speed. This test will not be applied to a WTAT in which the engine and transmission box are directly coupled.

7.3.1.3 Brake load shall be applied until the computed axle power or tilling shaft power reaches the maximum value.

7.3.1.4 Items to be measured and recorded are given in Annex D (Transmission efficiency test data sheet).

7.3.2 Varying load performance test

7.3.2.1 This test is carried out to determine the performance of the WTAT under different loads applied to the wheel axle or rotary tilling shaft. The WTAT on test, with its engine but without its wheels, shall be fixed on the test frame.

7.3.2.2 The engine shall be set at its rated speed and brake load shall be applied on the wheel axle or rotary tilling shaft by a dynamometer at an increment of 5-kg load until the engine's speed decreases.

7.3.2.3 The load, speed of engine output shaft, transmission input shaft and axle revolution per minute, fuel consumption, temperature of exhaust gas and transmission oil, and ambient dry bulb and wet bulb temperatures shall be measured simultaneously every three minutes at each applied brake load.

7.3.2.4 Items to be measured and recorded are given in Annex E (Varying load performance test).

7.3.3 Continuous-running test

7.3.3.1 This test is carried out to evaluate the operating performance and to find out any abnormality or trouble under the continuous running condition of the WTAT.

7.3.3.2 The WTAT on test, with its engine but without its wheels, shall be fixed on the test frame. Brake load is applied on the wheel axle or rotary tilling shaft by a dynamometer.

7.3.3.3 The engine shall be set at its rated speed and a brake load equivalent to the maximum axle/rotary tilling shaft power taken during the varying load performance test shall be applied on the wheel axle/rotary tilling shaft.

7.3.3.4 The load, speed of engine, transmission input shaft and axle/rotary tilling shaft revolution per minute, fuel consumption, and temperature of exhaust gas and transmission oil shall be measured simultaneously every thirty minutes.

7.3.3.5 Items to be measured and recorded are given in Annex F (Continuous running test data sheet).

7.3.3.6 The testing methods for each type of WTAT shall be as follows:

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a) Pull type

A brake load shall be applied on the wheel axle. The change-gear position shall be at the largest-ratio-reduction within the plowing speed range mentioned in the specifications. The continuous running test shall be conducted for 5 h.

b) Rotary-tilling type

A brake load shall be applied on the rotary tilling shaft. The change-gear position shall be at the largest-ratio-reduction within the tilling speed range mentioned in the specifications. The wheel axle shall be driven with no load. The continuous running test shall be conducted for 5 h.

c) Dual purpose type

There shall be two kinds of tests under dual-purpose type: wheel axle loading and tilling shaft loading tests. The method of loading on wheel axles and rotary tilling shaft shall be the same as in pull type and tilling type, respectively. However, the continuous running test shall be conducted for 2.5 h in either case. The laboratory performance test for dual purpose type will depend on the type of field performance test. If tested as pull type, the continuous running test shall follow 7.3.3.6a If tested as rotary tilling type, the continuous running test shall follow 7.3.3.6b.

7.3.4 Drawbar power test

7.3.4.1 Condition of test area and machine setting

a) The WTAT shall be fitted with pneumatic wheels, if applicable, and the test shall be conducted on a clean, horizontal, and dry concrete test track containing a minimum number of joints under natural ambient condition. The test shall be conducted in running state corresponding to the manufacturer's recommendations.

b) At the beginning of the test, the height of the tread bars of tires shall not be less than 65% of their height when new. The measurement shall be made at the center line of the standard tires (CSAM-ESCAP, 2018).

c) During the drawbar performance test, the speed control lever shall be set at maximum power.

d) The test shall not be conducted in the gear for which the forward speed exceeds the safety limit of the WTAT.

e) The test shall be made at the speed setting wherein the maximum power is developed, at the speed setting faster than in the setting in which the

greatest maximum power is developed, and at the speed setting slower than the speed setting at maximum power (CSAM-ESCAP, 2018)

f) During the test, the line of pull shall be maintained horizontal. The height of the drawbar shall remain fixed in relation to the WTAT.

g) The measurement of drawbar pull, speed, and slip shall be started only after the operational conditions are stabilized.

h) The test shall be conducted for at least 20 m run continuously without varying atmospheric or track conditions significantly (CSAM-ESCAP, 2018).

7.3.4.2 Test for maximum power and pull

a) The test shall be conducted until the maximum power and pull are found in different forward speed settings. Measurement of engine speed, drawbar pull, fuel consumption, forward speed and wheel slip shall be recorded (CSAM-ESCAP, 2018). The maximum drawbar pull and drawbar power shall be recorded at tractor wheel slippage only up to 15%.

b) If the manufacturer or test applicant recommends ballasting of the WTAT, the test shall be conducted both at ballasted and unballasted condition of the WTAT and the results shall be reported separately.

7.4 Data recording and observations

Record sheet for all data and information during the test is given in Annexes D (Transmission efficiency test data sheet) to I (Field performance test data sheet). Necessary observations and other parameters to be taken during the performance test should be recorded in this sheet.

8 Presentation of Results

Machine specifications and the results of the test shall be presented in tabular form in which data shall be taken from Annex B (Specifications of walking-type agricultural tractor) and Annex H (Turning ability test data sheet).

9 Formula

The formulas to be used during calculation and testing are given in Annex C (Formulas used during calculations and testing).

10 Test Report

The test report shall include the following information in the order given:

a) Name of testing agency;
b) Test report number;
c) Title;
d) Summary of results;
e) Observations;
f) Purpose and scope of test;
g) Methods of test;
h) Description of the machine;
i) Specifications;
j) Results;
k) Observations (include pictures); and
l) Names, signatures, and designation of test engineers.

Annex A
(Informative)

Minimum list of field performance test equipment and materials

A.1	Equipment	Quantity
A.1.1	Field performance test	
A.1.1.1	Timers Maximum resolution: 0.1 s	2
A.1.1.2	Sound level meter Range: 30 dB(A) to 130 dB(A)	1
A.1.1.3	Cone penetrometer	1
A.1.1.4	Measuring tape (at least 50 m)	1
A.1.1.5	Steel tape (at least 5 m)	1
A.1.1.6	Graduated cylinder Capacity: 500 mL (minimum)	1
A.1.1.7	Width and depth gauge	1
A.1.1.8	Camera	1
A.1.1.9	Caliper Accuracy: 0.025 mm	1
A.2	Materials for field performance test	
A.2.1	Pegs	10
A.2.2	Aluminum can	1
A.2.3	Labeling tags	10
A.3.1	Laboratory performance test	1
A.3.1.1	Load cells, capacity: 500 kg	2
A.3.1.2	Strain amplifier	1
A.3.1.3	Dynamometer	1
A.3.1.4	Electric motor	1
A.3.1.5	Multi-testers	2
A.3.1.6	Tachometer	2
A.3.1.7	Power meter Maximum voltage and current: V_{rms} and 20_{Arms}	1
A.3.1.8	Torque transducers	1
A.3.1.9	Hygrometer	1
A.3.1.10	Fuel consumption meter	1
A.3.1.11	Steel tape (at least 5 m)	1

Annex B
(Informative)

Specifications of walking- type agricultural tractor

Name of Applicant : _____
Address : _____
Tel. No. : _____

Name of Manufacturer : _____
Address : _____
Tel. No. : _____

GENERAL INFORMATION

Brand and model : _____ Make :_____
Type. : _____ Date of manufacture:_____
Serial no. : _____
Testing Agency : _____ Test Engineer : _____
Location of Test : _____ Date of Test : _____

No.	Item[1]	Manufacturer's specification	Verification by the testing agency
1	Main structure		
1.1	Overall dimensions, mm		
1.1.1	Length		
1.1.2	Width		
1.1.3	Height		
1.1.4	Ground clearance, mm		
1.2	Weight, kg (if applicable)		
2	Prime mover		
2.1	Engine		
2.1.1	Brand		
2.1.2	Model		
2.1.3	Make or manufacturer		
2.1.4	Type		
2.1.5	Serial number		
2.1.6	Rated power, kW		
2.1.7	Rated speed, rpm		
2.1.8	Displacement, cm^3		
2.1.9	Cooling system		
2.1.10	Starting system		
2.1.11	Power transmission system		

No.	Item[1]	Manufacturer's specification	Verification by the testing agency
2	Type of clutch		
3	Power transmission system		
3.1	Type		
3.2	Lubrication system		
4	Engine pulley (outside diameter x no. of grooves x inside diameter, mm)		
5	Input shaft pulley (outside diameter x no. of grooves x inside diameter, mm)		
6	Axle, L x W, mm		
7	Hexagonal hub		
7.1	Thickness, mm		
7.2	Length, mm		
8	Type of hitch point		
9	Tractive wheels		
9.1	Pneumatic tire size		
9.2	Cage wheel size, LxD, mm		
10	Attachments		
10.1	Plow		
10.1.1	Type		
10.1.2	Number of bottoms		
10.1.3	Thickness, mm		
10.1.4	Diameter, mm		
10.1.5	Width of cut, mm		
10.1.6	Material		
10.2	Harrow		
10.2.1	Type		
10.2.2	Number of tines		
10.2.3	Tine diameter, mm		
10.2.4	Tine length, mm		
10.2.5	Operating width, mm		
10.2.6	Material		
10.3	Rotary tiller		
10.3.1	Type		
10.3.2	Number of blades		
10.3.3	Number of flanges		
10.3.4	Blade thickness, mm		
10.3.5	Blade type		
10.3.6	Operating width, mm		

[1] The parameter will be checked upon availability

Annex C
(Informative)

Formulas used during calculations and testing

C.1 Determination of effective field capacity

C.1.1 Average swath or width of cut

$$S = \frac{W}{2n}$$

where:

S is the average swath
W is the width of plot, m
n is the number of rounds
2 is the number of trips per round

C.1.2 Total distance traveled

$$D = \frac{A}{S} = 2nL$$

$$A = L \times W$$

where:

D is the total distance travelled, m
A is the area of plot, m^2
L is the length of the plot, m

C.1.3 Effective area accomplished

$$A_e = wD = 2nLw$$

where:

A_e is the effective area accomplished, m^2
w is the operating width of implement or attachment, m

C.1.3.1 If the average width of tillage is less than the operating width of the implement or attachment, the operator has passed over part of the area twice to secure better coverage, therefore:

$$A_o = A_e - A$$

where:

A_o is the overlap (area which is plowed or rototilled twice), m^2

C.1.3.2 If the average width of tillage is greater than the operating width of the implement or attachment, the operator has left part of the area untilled, therefore:

$$A_u = A - A_e$$

where:

A_u is the untilled area (area missed), m^2

C.1.4 Effective field capacity

$$C_E = \frac{60A_e}{t}$$

where:

C_E is the effective field capacity, m^2/h
t is the time used during the operation, min

C.2 Theoretical field capacity

$$C_T = w_e \, x \, v$$

where:

C_T is the theoretical field capacity, m^2/h
w_e is the operating width of implement or attachment, m
v is the operating speed, m/h

C.3 Field efficiency

$$F_{eff} = \frac{efc}{tfc} \, x \, 100$$

where:

F_{eff} is the field efficiency, %

C.4 Fuel consumption

$$FC = \frac{V}{t}$$

where:

FC is the fuel consumption, L/h
V is the volume of fuel consumed, L
t is the total fuel consuming time, h

C.5 Axle/rotary shaft torque

$$T = F\ x\ L$$

where:

T is the shaft torque, kg-m
F is the axle or rotary shaft load, kg
L is the length of prony brake arm, m

C.6 Axle/rotary shaft power

$$P = \frac{T\ x\ N}{974}$$

where:

P is the shaft power, kW
T is the shaft torque, kg-m
N is the speed of axle or rotary shaft, rpm

C.7 Specific fuel consumption

$$SFC = \frac{F_c\ x\ \rho_f}{P}$$

where:

SFC is the specific fuel consumption, g/kW-H
F_c is the fuel consumption, L/h
ρ_f is the density of fuel, g/L
P is the axle or rotary shaft power, kW

C.8 Drawbar power

$$DBP = \frac{D\ x\ v}{367}$$

where:

DBP is the drawbar power, kW
D is the draft, kg
v is the operating speed, km/h

C.9 Transmission efficiency

$$T_{eff} = \frac{P_a}{P_{in}}\ x\ 100$$

where:

T_{eff} is the transmission efficiency, %
P_a is the power developed at the axle, kW
P_{in} is the power at the input transmission shaft, kW

Annex D
(Informative)

Transmission efficiency test data sheet

Test trial no. : _____
Test engineers : _____
Assistants : _____
Test applicant : _____

Date : _____
Location : _____
Machine : _____
Manufacturer : _____

Prime mover: _____

Test conditions

1. Air temperature

	1	2	3	4	5	6	7	8	9	10
Dry bulb,°C:	___	___	___	___	___	___	___	___	___	___
Wet bulb, °C:	___	___	___	___	___	___	___	___	___	___
2. Relative humidity, %:	___	___	___	___	___	___	___	___	___	___

	Motor	Input	Axle
3. No load speed, rpm:	____	____	____
4. Speed reduction ratio :	____		

Time, min	Axle load, kg			Speed, rpm		Belt slippage, %	Axle torque, kg-m	Axle shaft power, kW	Input			Efficiency, %
	Left	Right	Total	Drive shaft	Axle shaft				Torque, kg-m	Speed, rpm	Power, kW	

Annex E
(Informative)

Varying load performance test

Test trial no. : _____
Test engineers : _____
Assistants : _____
Test applicant : _____

Date : _____
Location : _____
Machine : _____
Manufacturer : _____

E.1 Wheel axle

Prime mover: _____

Test conditions

1. Air temperature 1 2 3 4 5 6 7 8 9 10
   Dry bulb,°C: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
   Wet bulb, °C: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
2. Relative humidity, %: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Motor Input Axle

3. No load speed, rpm: ____ ____ ____
4. Speed reduction ratio : ____

Time, min	Axle load, kg			Speed, rpm			Belt slip-page, %	Axle torque, kg-m	Axle shaft power, kW	Temperature, °C		Fuel consump-tion, L-h	Specific fuel consump-tion, g/kW-h
	Left	Right	Total	Drive shaft	Axle shaft	En-gine shaft				Ex-haust gas	Trans-mission oil		

E.2 Rotary tilling shaft

Prime mover: _____

Test conditions

1. Air temperature 1 2 3 4 5 6 7 8 9 10
   Dry bulb,°C: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
   Wet bulb, °C: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
2. Relative humidity, %: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Motor Input Axle

3. No load speed, rpm: ____ ____ ____
4. Speed reduction ratio : ____

Time,min	Rotary shaft load, kg	Speed, rpm			Belt slippage, %	Rotary shaft torque, kg-m	Rotary shaft power, kW	Temperature, °C		Fuel Consump-tion, L-h	Specific fuel consump-tion, g/kW-h
		Drive shaft	Rotary shaft	Engine shaft				Exhaust gas	Trans-mission oil		

Annex F
(Informative)

Continuous running test data sheet

F.1 Wheel axle

Prime mover: _____

Test conditions

1. Air temperature 1 2 3 4 5 6 7 8 9 10
   Dry bulb,°C: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
   Wet bulb, °C: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
2. Relative humidity, %: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Motor Input Axle

3. No load speed, rpm: ____ ____ ____
4. Speed reduction ratio : ____

Time, h	Rotary shaft load, kg	Speed, rpm			Belt slippage, %	Rotary shaft torque, kg-m	Rotary shaft power, kW	Temperature, °C		Fuel Consump-tion, L-h	Specific fuel consump-tion, g/kW-h
		Drive shaft	Rotary shaft	Engine shaft				Exhaust gas	Trans-mission oil		

Annex G
(informative)

Drawbar power test data sheet

Test trial no. : _____ Date : _____
Test engineers : _____ Location : _____
Assistants : _____ Machine : _____
Test applicant : _____ Manufacturer : _____

Prime mover: _____
Test conditions

1. Air temperature 1 2 3 4 5 6 7 8 9 10
   Dry bulb,°C: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
   Wet bulb, °C: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
2. Relative humidity, %: ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
3. Size of tires' tread bars: _____
4. Speed control lever setting: _____

Trial no.	Forward speed, km/h	Wheel slip, %	Engine speed, rpm	Fuel consumption, L/h	Draft, kg
1					
2					
3					
Average					

Annex H
(Informative)

Turning ability test data sheet

Test trial no. : _____ Date : _____
Test engineers : _____ Location : _____
Assistants : _____ Machine : _____
Test applicant : _____ Manufacturer : _____

No.	Item	Trial 1	Trial 2	Trial 3	Average
1	Test conditions				
1.1	Wheel track, mm				
1.2	Size of tire, mm				
1.3	Pressure of tire, kPa				
2	Turning ability				
2.1	Minimum turning circle diameter				
2.1.1	Right hand side, m				
2.1.2	Left hand side, m				
2.2	Minimum turning space diameter				
2.2.1	Right hand side, m				
2.2.2	Left hand side, m				

Annex I
(Informative)

Field performance test data sheet

Test trial no. : _____ Date : _____
Test engineers : _____ Location : _____
Assistants : _____ Machine : _____
Test applicant : _____ Manufacturer : _____

No.	Item	Trial 1	Trial 2	Trial 3	Average
1	Test conditions				
1.1	Condition of field				
1.1.1	Type				
1.2.1	Location (coordinates)				
1.2.3	Soil type				
1.2.4	Dimensions of field				
1.2.4.1	Length, m				
1.2.4.2	Width, m				
1.2.5	Area, m^2				
1.2.6	Depth of water, mm (for wet preparation)				
1.2.7	Moisture content, % (for dry preparation)				
1.2.8	No. of hours soaked (for wet preparation)				
1.2.9	Soil resistance, kg/cm^2				
1.2.10	Spacing of stubbles (rows x hills), mm (if applicable)				
1.2.11	Height of stubbles, mm (if applicable)				
1.2.12	Weed density				
1.2	Weather conditions				
1.2.1	Temperature, °C				
1.2.1.1	Wet bulb				
1.2.1.2	Dry bulb				
1.2.2	Relative humidity, %				
1.2.3	Weather (sunny, cloudy, rainy)				
1.3	Condition of WTAT				
1.3.1	Tractive device				

No.	Item	Trial 1	Trial 2	Trial 3	Average
1.3.1.1	Type				
1.3.1.2	Size, mm				
1.3.2	Implement				
1.3.2.1	Type				
1.3.2.2	Size, mm				
1.3.3	Wheel track, mm				
1.3.4	Additional weight, kg				
1.3.4.1	Front end				
1.3.4.2	Wheel				
1.3.5	Gross weight, kg				
1.3.6	Speed-gear positions				
1.3.6.1	Main transmission				
1.3.6.2	Auxiliary transmission				
1.3.6.3	Belt speed change				
1.3.6.4	Rotary speed change				
1.3.7	Others				
2	Field performance				
2.1	Date of test				
2.2	Type of field operation				
2.3	Operating time, min				
2.4	Time lost				
2.4.1	Turning, min				
2.4.2	Others (specify), min				
2.5	Field operational pattern				
2.6	Depth of cut, mm				
2.7	Traveling speed, km/h				
2.8	Operating width of implement/attachment, mm				
2.9	Average width of tillage, mm				
2.10	Theoretical field capacity, ha/h				
2.11	Effective field capacity, ha/h				
2.12	Field efficiency, %				
2.13	Fuel consumed, L				
2.14	Fuel time, min				
2.15	Fuel consumption, L/h				
2.16	Others (specify)				

3	Observations
3.1	Ease of handling and stability of the WTAT
3.2	Ease of manipulating of the operating levers
3.3	Ease of replacing and adjusting the parts
3.4	Safety features
3.5	Failure or abnormalities that may be observed on the WTAT or its component parts
3.6	Others

Observations

Ease of handling and stability of the WTAT

_____
_____

Ease of manipulating of the operating levers

_____
_____

Ease of replacing and adjusting the parts

_____
_____

Safety features

_____
_____

Failure or abnormalities that may be observed on the WTAT or its component parts

_____
_____

Others

_____
_____

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