Ente Nazionale
Meccanizzazione Agricola

AGRICULTURAL MACHINES FUNCTIONAL AND SAFETY TESTING SERVICE

TEST REPORT No. 03 - 037a

ROTARY TILLER: PANTERA 520

(extensions: 03-037b – PANTERA 420;

03-037c – PANTERA 470; 03-037d – PANTERA 570)

MANUFACTURER: MASCHIO S.p.A.
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TESTS CARRIED OUT IN COMPLIANCE WITH ENAMA SPECIFICATIONS NO. 03 BY THE EXPERIMENTAL INSTITUTE FOR AGRICULTURAL MECHANISATION, MONTEROTONDO - ROME:

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TO FACILITATE INTERPRETATION OF THE RESULTS, IT SHOULD BE REMEMBERED THAT:

- **1 MPa = 1000 kPa = 10 bar (10 kg_{force}/cm^2**
- **1 daN ≈ 1.02 kg_{force}**
- **1 kW = 1.36 CV**
- **1 m/s = 3.6 km/h.**

DESCRIPTION OF MACHINE

The rotary tiller model PANTERA 520, is a mounted implement designed to improve soil and prepare the seed bed, supplementing the work of the plough. The tiller in question, having a maximum working width of 5.20 , belongs to the "PANTERA" series, which consists of 4 models of varying widths, from 4.2 to 5.7 m. The soil is cultivated by 120 bevelled hoe blades, which rotate on a horizontal axis and are fixed with 6 bolts to supporting flanges. The soil is broken down further and levelled via a rear unit, which is regulated using mechanical spring rams and an interchangeable roller.

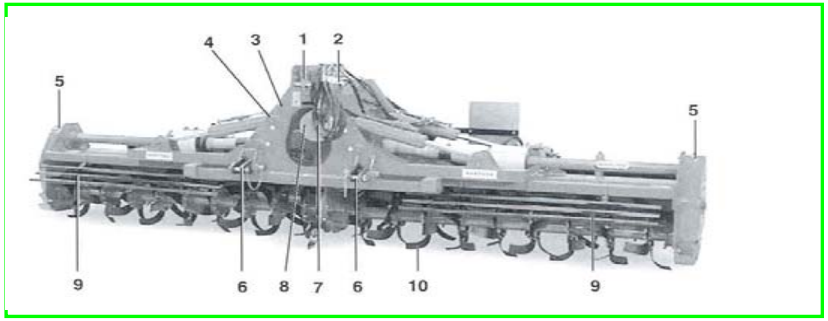

Figure 1 – Front view of the tested machine and its parts: 1) coupling 3rd hitch; 2) cardan shaft support when uncoupled to the tractor; 3) three-point coupling support; 4) position of gear unit; 5) side transmission unit; 6) hitches to lower arms of tractor lift; 7) connection to cardan shaft; 8) cardan shaft guard; 9) safety guards; 10) rotor with hoe blade implements.

ACCESSORIES

The machine may be fitted with:

- *front plough shares on left and right: mounted laterally on the front beam, with a view to facilitating machine penetration on unploughed soil;*
- *pair of hydraulic jacks (2+2): to lift folding parts during transportation; they are standard for the "Pantera 570";*
- *central gear unit: endowed with external selector so that two different speeds of rotation of the tool rotors are possible with the tractor's PTO at 1000 rpm;*
- *lubricating oil cooling unit: endowed with heat exchanger, recommended when the central gear unit is used.*

TECHNICAL DATA

SERIAL NUMBER OF TESTED MACHINE 029720004

DIMENSIONS	working position	folded position
total width (mm)	5580	2480
total length (mm)	1920	1920
total height (mm)	1453	(on the basis of hitch points)
FRAME		
type	steel plate box	
coupling to tractor	three-point hitch cat. ISO III	
DRIVE TRANSMISSION		
from PTO	cardan shaft with cam overload clutch;	
from central reduction unit	box with oil-bath spur gear in constant mesh;	

transmission to implements	for each of the tiller's sections, the cross-drive shaft, leaving the reduction box, is connected to the blade-holder rotor via side transmission and gear cascade, with further step-downs and tool rotation speed of 258 rpm;
PTO speed	1000 rpm
STANDARD IMPLEMENTS	
type	bevelled steel blades rotating on horizontal axis and bolted to circular steel flanges;
total number	120
no. per flange	6
width at base (mm)	97
standard thickness (mm)	10
flanges (no.)	20
axle base (mm)	250
diameter (mm)	154
tool rotors	
number	2
length (mm)	2458
diameter of shaft (mm)	101
diameter including tools (mm)	550
NOMINAL SIZE OF CULTIVATED BED	
maximum width (mm)	5280
maximum depth (mm)	290
SPEED OF ROTATION OF TOOLS	(PTO 1000 rpm)
standard gear pair	258 rpm
optional gear position A	279 rpm
optional gear position B	241 rpm
MEAN POWER AT PTO (KW)	175.8 – 91.2

ROLLERS

1 peg-tooth packer (∅ 525 mm): levelling and improvement of soil surface, control of depth on all soil types providing they are not too humid and sticky;

2. spiropackers (∅ 500 mm): settling/consolidation of deep strata, also suitable for sticky soil;

3. cage-type with helical booms (∅ 460 mm): levelling and improvement of soil surface, control of depth on all soil types providing they are not too humid and sticky;

4. paddy field (∅ 490 mm): check tilling depth in paddy fields; endowed with larger drum (∅ 220 mm) and shorter spikes than traditional spike roller;

5. spike (∅ 600 mm): levelling and improvement of soil surface, control of depth on all soil types; especially useful in very rainy environments to facilitate water percolation.

TOTAL MASS (KG) with cardan shaft and spike roller 3140

TEST CONDITIONS

TRACTOR USED

The rotary tiller was coupled to a 4-wheel drive tractor having the following characteristics:

- nominal power 205 kW
- total mass 11,000 kg
- hitch device ISO cat.3

The PTO speed of rotation to operate the rotors was adjusted to 1000 rpm, in

combination with the 1,974 rpm of the drive shaft.

TEST GROUND

Tests were performed on a previously ploughed level ground to a depth of approximately 0.40 m, with a swaft of approximately 0.11 m, and the soil basically free of left-over crops.
Prior to hoeing operations the following values were determined: relative humidity (from 0 to 0.2 m and from 0.2 to 0.4 m in depth), the apparent mean density and mean resistance to soil penetration (from 0 to 0.4 m in depth) (tab. 1).

skeleton (%)	**0**
sand (%)	**2.3**
silt (%)	**43.4**
clay (%)	**54.3**
liquid limit (%)	**62.2**
plastic limit (%)	**40.3**
plasticity index	**21.9**
humidity 0 m ÷ 0.2 m (%)	**22.2**
humidity 0 m ÷ 0.2 m (%)	**23.0**
mean density apparent (g/cm^3)	**1.38**
mean resistance to penetration (MPa)	**0.76**

Table 1 – Physical-mechanical properties of test ground.

RESULTS OF TESTS

After having established the most appropriate gear for the tractor (1st), in keeping with the properties of the test ground, inserted double traction and the differential locking mechanism and moved the accelerator lever to the top, the functional and operational characteristics (referring to one hectare) given in Table 2 were determined. Tests were conducted using the implement at two different hoeing depths and setting the gear in position A, corresponding to a tool rotor speed of 279 rpm.
The tiller was equipped with a completely closed levelling unit at the rear in order to prepare the seed bed with a single passage.
In the test at the maximum hoeing depth the mean specific power was 0.91 kW/m·cm (per metre of operating width and centimetre of working depth on cultivated soil), while the specific mean power was 0.98 daN/m·cm (per metre of effective width and centimetre of working depth on cultivated soil), operating at a forward speed in keeping with cultivability conditions. In the test at medium depth, the specific mean power was 0.77 kW/m·cm and the specific mean force 5,74 daN/m·cm.
In both tests tractor slippage performance was positive, in both cases modest or negligible, despite the thrust exerted by the tiller rotor, meaning a better exploitation of power, reduction in consumption and less wear and tear on tyres.
Table 2 shows that the maximum working width in both tests was used to the extent of 99.0%, while the thickness of the cultivated bed was 0.25 m, with a settlement of 0.13 m, for the maximum depth test, and 0.14 m, with a soil settlement of 0.11 m, for the medium depth test.
Fig. 2 shows that the tiller made a good job of breaking up the soil of the ploughed soil. The relative improvement index went from 0.50 for the ploughed soil to 0.83 (for the maximum depth test) and 0.85 (for the medium-depth test), with a reduction of clod level of 39.1% and 40.4% respectively; it was thus possible to eliminate upper size classes and to bring the clod classes below 10 mm to 47.7% and 49.8% respectively of the total volume of pulverised soil. The consequent “seed bed quality index” (ratio: mass of clods having a diameter

≤ 10 mm / mass of clods having diameter > 10 mm) was calculated at 0.91 in the maximum depth test and 0.99 in the medium-depth test, thus ensuring an adequate substratum for sowing and subsequent germination.

The combined effect of rotating tools and the rear plate produced a successful levelling of soil, considerably reducing surface roughness and leading to a levelling percentage of 82.6% for the maximum depth test and 81.4% for the medium depth test.

Elements	***Performance***	
	Maximum depth	***Medium depth***
mean engine speed (rpm)	1849	2026
mean PTO speed (rpm)	937	1026
mean rotor speed (rpm)	262	287
max. working width (m)	5.00	5.00
effective working width (m)	5.17	5.17
operating working width (m)	5.12	5.12
use of working width (%)	99.0	99.0
working depth on cultivated soil (m)	0.38	0.25
depth of cultivated bed	0.25	0.14
settlement (m)	0.13	0.11
cultivated section (m²)	1.96	1.29
effective working time (h/ha)	0.62	0.57
operating working time (h/ha)	0.71	0.66
operating performance (%)	87.7	86.8
effective mean speed (km/h)	3.16	3.43
operating capacity (ha/h)	1.42	1.52
hourly fuel consumption (kg/h)	46.1	28.8
unit fuel consumption (kg/ha)	32.5	18.9
mean traction force (daN)	193	742
mean PTO torque (daNm)	179.3	84.9
mean PTO power (kW)	175.9	91.2
mean traction power required for hoeing* (kW)	1.7	7.1
total mean power required (kW)	177.6	98.3
specific mean power (kW/m.cm)	0.91	0.77
power supplied to tractor motor (kW)	199.4	107.1
tractor wheel slip (%)	1.4	2.3

Table 2 – Mean results obtained using rotary tiller.
(*) Global power expended for machine traction, excluding losses of transmission due to idle feed, wheel slippage and the power required for the tractor's hydraulic functions.

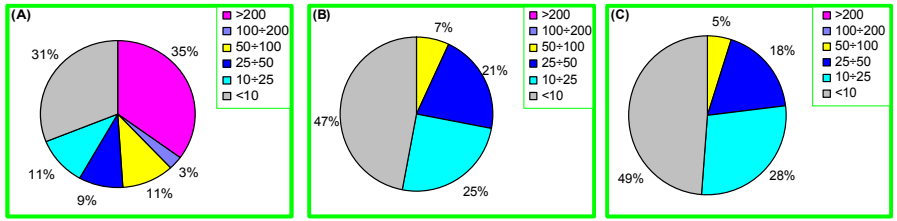

Figure 2 – Clod level of soil before (A) and after passage of tiller at maximum (B) and medium (C) working depth; the legend shows, in mm, clod size classes.

Model Maschio "PANTERA" series	Working width (m)	Operating capacity (ha/h)	Mean PTO power (kW)	Flanges (no.)	Mass with spike roller (kg)
420	4.20	1.15	140.8	16	2580
470	4.70	1.28	158.4	18	2780
570	5.70	1.56	193.6	22	3680

Table 3 – Evaluation of operating capacity and PTO power of other rotary tiller models in "PANTERA" series manufactured by the firm Maschio. Values are theoretical, and are to be considered as valid for conditions of use identical to those chosen for the model "PANTERA 520" during tests performed at the maximum depth.

NOTES ON FUNCTIONALITY

The rotary tiller Maschio PANTERA 520 showed itself capable of adequately hoeing soil, in a single passage, working on a rugged silt-clay base characterised by surface clod level. The implement achieved good results for the soil improvement and levelling indices despite working in soil conditions deemed to be difficult.
Use of a 205 kW tractor appeared correct for the difficult test conditions, considering the need for power to the tractor's PTO and the low power needed for the implement's traction in view of the rotor's thrust. When soil conditions are easier, it may be preferable to use a less powerful tractor, as recommended by the manufacturer.

REMARKS AND INSTRUCTIONS

The implement is endowed with instruction and maintenance handbook in compliance with existing law provisions.

ROAD CIRCULATION

For the purposes of the Highway Code the machine is classified as a mounted agricultural machine, and therefore forms an integral part of the tractor (pursuant to art. 57, Legislative Decree 285 of 30/04/1992). It does not require type approval and may circulate on the road providing it complies with tractor mass and jolt ratios with and existing law provisions.

SAFETY CHECKS

The machine is endowed with CE marking, an identification plate, safety pictograms, a user and maintenance handbook and an EC manufacturer's declaration of conformity.
The EC manufacturer's declaration of conformity certifies that the machine conforms to the following harmonised standards and technical specifications: UNI EN 708:2002; UNI EN 1553:2001; ISO 11684:1995.
Checks carried out with reference to documentation sent by the manufacturer did not show up inconsistencies with the contents of the aforementioned standards.
The relative documentation has been filed.

MODELS IN THE SAME SERIES

From tests performed on the rotary tiller Maschio PANTERA 520 and the results of table 2, it may be supposed that under the same test conditions and for a different number of flanges the values given in table 3 may be obtained.
Table 4 shows the other tiller models to which the present certificate has been extended.

Cert. No.	Model	Serial No.
03-037b	PANTERA 420	029720015
03-037c	PANTERA 470	029720009
03-037d	PANTERA 570	029720005

Table 4 - Other tiller models to which the present certificate has been extended.

THE PRESENT REPORT IS VALID FOR A PERIOD OF FIVE YEARS OR UNTIL REFERENCE REGULATIONS FOR THE ROTARY TILLER PANTERA 520 AND RELATIVE EXTENSIONS ARE ALTERED, AND IS OFFICIALLY RECOGNISED BY ENAMA MEMBERS:

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(National Union of Farm Machine Manufacturers)
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(National Union of Farm Mechanisation Enterprises)

AND BY MEMBERS OF THE EXECUTIVE COUNCIL OF THE ENAMA, IN WHICH THE FOLLOWING ARE ALSO REPRESENTED:

MIPAF (Ministry for Agricultural and Forestry Policies)
Regions and Autonomous Provinces
ISMA (Istituto Sperimentale per la Meccanizzazione Agricola)
(Experimental Institute for Agricultural Mechanisation)

ENAMA CERTIFICATA

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