



European Network for Testing  
Agricultural Machinery

# *ENTAM - TEST REPORT*



## ***Trailed Field Crop Sprayer HARDI CM plus TWIN FORCE Design 66***

Manufacturer:  
Hardi International  
Helgeshoi Alle 38  
DK-2630 TAASTRUP

Test report: D - 1544

Assessment of sprayer		
Test point acc. to EN 12761/2	Contents	Assessment
4.1.1.1	spray tank surface roughness (max. 0.1 mm)	++
4.1.1.2	spray tank outvolume (min. 5%)	+
4.1.1.3	residual (0.5% nominal capacity + 2 l/m working width, here:63 l)	+
4.1.1.4	spray tank contents gauge up to 20% filling contents (max. 7.5 %)	O
	spray tank contents gauge from 20% filling contents (max. 5 %)	O
4.1.1.5	agitation systems test, fortification deviation max. 15 %	O
4.1.3.1	width of nozzle bar sections	++
4.1.3.2	boom winch, regulating range (min. 1m)	+
4.1.6 (a)	accuracy of pressure gauge (max. 0.2 bar inaccuracy)	O
4.1.6 (b)	accuracy of flow gauge (max. 5 % error)	+
4.2	accuracy of regulator, deviation from desired value (max. 6 %)	+
4.2.2 (a)	regulation speed (max. 10% deviation after 7s)	+
4.2.2 (b)	deviation from consistency (VK max. 3%)	++
4.2.3	pressure drop between manometer and nozzles (max. 10%)	++
4.3.1 (a)	accuracy of single nozzle air volume flux (max. 5% deviation from mean value)	+
4.3.1 (b)	deviation of nozzle volume flux from table	+
4.3.1 (c)	uniformity of transverse distribution ( VK max. 7 or max. 9 respectively )	O
4.4	volume of clean water dispenser (min. 10% of main tank)	O

Table 1: Assessment table.

Note: The assessment takes place in 3 steps linearly according to the permissible variation (++,

Assessment:

- 4.1.1.1 (> 70 - 100  $\mu\text{m}$  = O; 30 - 70  $\mu\text{m}$  = +; < 30  $\mu\text{m}$  = ++)
- 4.1.1.2 (5% - 8% = O; > 8% - 12% = +; > 12% = ++)
- 4.1.1.3 (> 2/3 - 3/3 of the permissible value = O; 1/3 - 2/3 of the permissible value = +; < 1/3 of the permissible value = ++)
- a. 4.1.1.4 (permissible value = +; < 1/3 of the permissible value = ++)
- 4.1.1.5 (> 10% - 15% = O; 5% - 10% = +; < 5% = ++)
- 4.1.3.1 (> 4,5m - 6m = O; > 3m - 4,5m = +; 3m or less = ++)
- 4.1.3.2 (1m - 1,5m = O; > 1,5m - 2,0m = +; > 2,0m = ++)
- 4.1.6 (a) (> 0,1 bar - 0,2 bar = O; > 0,05 bar - 0,1 bar = +; 0,0 bar - 0,05 bar = ++)
- 4.1.6 (b) (> 4% - 5% = O; > 2% - 4% = +; 0% - 2,0% = ++)
- 4.2 (> 4% - 6% = O; 2% - 4% = +; < 2% = ++)
- 4.2.2 (a) (> 7% - 10 % = O; > 3% - 7% = +; 0% bis 3% = ++)
- 4.2.2 (b) (> 2% - 3% = O; 1% - 2 % = +; <1% = ++)
- 4.2.3 (> 7% - 10 % = O; > 3% - 7% = +; 0% bis 3% = ++)
- 4.3.1 (a) (> 4% - 5% = O; > 2% - 4% = +; 0% - 2,0% = ++)
- 4.3.1 (b) (> 7% - 10 % = O; > 3% - 7% = +; 0% bis 3% = ++)
- 4.3.1 (c) (> V<sub>k</sub> 7 - 9 = O; V<sub>k</sub> 4 - 7 = +; V<sub>k</sub> < 4 = ++)

## Diagram of liquid system

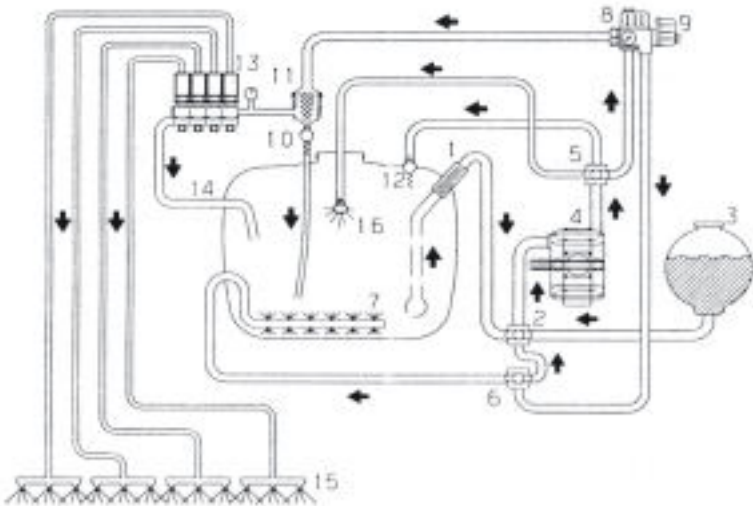


Figure 1: Liquid system.

Diagram of the liquid system, with 1- suction strainer; 2- 4 directional control tap ; 3- rinse water tank; 4- pump; 5- 4 directional control tap; 6- agitation system switch off; 7- agitation system; 8-regulator; 9- central relay valve ; 10- ; 11- ; 12- ; 13- switchboard for nozzle bar sections (group of valves); 14-return pipe; 15- control of nozzle bar sections (valve group); 16-cleaning nozzle

### Explanations on testing:

Testing takes place according to a procedure which was developed by the competent testing authorities of the European countries participating in ENTAM. This procedure is based on the CEN standard EN 12761 "Agricultural and forestry machinery – Plant protection equipment for the application of plant protection products and liquid fertilisers". This test is only a technical performance test which takes place without an accompanying field test. The test results apply only to the tested appurtenances of the implement. Statements on the behaviour of the implement with different appurtenances cannot be derived from these results.

## Technical data of sprayer

<p>Frame / body / chassis</p> <p>Length:                7500 mm</p> <p>Height:                3660 mm</p> <p>Width :                 3240 mm</p> <p>Track:                 1.8 – 2.0 m</p> <p>Minimum ground clearance:                               430 mm</p> <p>Unloaded weight:    4338 kg</p> <p>Upper speed limit:   40km/h</p>	<p>Equipment</p> <p>Rigid drawbar with eye diameter 40 mm trailer coupling; dual circuit air brakes with mechanical parking brake; tyres 18.4 R 38</p>
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<p>Tank</p> <p>Volume</p>	<p>4200 l Tank contents indicator: indirect (float with rope drive) at the front left side of the spray tank; filling: by pump or hydrant, scale of contents divided into: 100 l; return flow agitation system which can be switched off; internal cleaning of spray tank by 2 rotating nozzles, foot valve with rope control; rinse water tank holding a volume of 450 l.</p>
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<p>Spray boom</p> <p>Working width</p>	<p>21 m Hydraulically folded boom consisting of 7 segments; boom winch: hydraulic and continuously adjustable from 400 to 2250 mm (depending on tyres); boom damping system „Hardi Paralift“; nozzles attached to triple frames with bajonet caps.</p>
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<p>Fitting / valves</p>	<p>Pressure adjusting valve: volume current dividing coil with adjustable cross-section and electrical spindle alteration at the front of the sprayer, nozzle bar sections and flow meters at the boom, remote control „NOVA 4500“ to be fitted inside the tractor cab; damped remote manometer with a diameter of 100 mm at the front of the sprayer.</p>
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**Additional description of the sprayer**

As a check the hydraulic pressure in the front area of the sprayer is indicated.

To facilitate handling of the manometer,

its scale is divided in colour (blue: 40 - 75 bar, green 75 - 145 bar, orange: 145 - 195 bar, red: over 195 bar).

The sprayer is air-assisted to improve deposition and reduce drift. For this purpose, hydraulically driven axial flow fans ( oil cooled) are fixed to the boom frame. The air flow generated by the blowers is carried to the nozzles via pipes made out of synthetic fabric. From there the air flows through perforated outlets into the direction of the nozzle compartments.

Fitting Standard EVC-armature with 7 section valves (motor control valves), main switch by simultaneous opening/closing of the section valves with pressure equaliser. Control valve and regulator with the



agricultural bus system (LBS) "HARDI NOVA 4500" to regulate application depending on speed and to control the entire sprayer. Additional functions of the operating unit:

Via the "Nova Grip" switch grip, the nozzle bar sections, the main switch, lifting and lowering of the boom, bending (lifting) of both boom parts, and

*Figure 2: Spray boom with air conduction via synthetic fabric hoses and outlets which are adjustable as to direction.*

The air is directed in an acute angle to the spray jets of the nozzles. The direction of spray and air can be continuously varied 30° forward and backward via little hydraulic cylinders by the control unit. Thus, application can be adjusted to crop stands and to environmental conditions, like wind for instance. Air speed can be continuously adjusted by regulating the speed of the axial flow fan.

control of the slope compensator can be operated.

The switching console "NOVA 4500" consists of a display and the corresponding input-terminal ("NOVA Set") and, depending on equipment, the following additionally adaptable individual components:



Figure 3: Switch grip „Nova Grip“.

”NOVA Hydraulik” (control of hydraulic functions), ”NOVA TWIN” (control of air-assistance) and ”NOVA Track” (control of the drawbar).

#### Arrangement:

Independent controller with pressure regulating valve in the front part of the sprayer (covered) and the section valves on the boom, Switchboard ”NOVA 4500” for putting up in the reaching area of hands and the visual range of the tractor driver; switch grip ”NOVA Grip” to be fitted to the armrest of the tractor seat by using corresponding angle steel.

Furthermore, the NOVA-Job Computer functioning as a link between sprayer and controlling computer.

Pressure regulating valve: Volume flux divisor with permanently adjustable cross-section; progressively adjustable via electric motor (volume flux division to boom section valves and the return flow). Pressure relief and closing of the boom section valves is controlled by a central push button.



Figure 4: Nova 4500 with its components (from top to bottom): -display, -set, -hydraulic, -twin, -track.

#### Equipment alternatives

Beside the tested model, tank sizes of 2200 l, 2800 l and 3200 l are also obtainable. Moreover, the manufacturer will supply the sprayer with working widths of 18, 20, 24, 27, 28 or 30m. Regarding coupling (hitch) devices, apart from the integrated rigid drawbar in this case, various steering drawbar systems are available.

Alternatively the steering drawbar ”STEER TRACK” to be operated via the control panel, the mechanical steering drawbar ”SELF TRACK” with absorption (only available for the 2200 l and 2800 l models) or a combination of ”STEER TRACK” and the control system ”NOVA TRACK” (see pict. above) can be installed.

Increasing the upper speed limit to 50 km/h is possible by installing a suspension axle.

## Test result tables

tested structural component	result (measured value)	
over volume	10.8 % (requirement: min. 5 %)	
contents indicator (deviation)	up to 800 l: 4,1 % - 7.5 % (requirement: max. 7.5%)	
	over 800 l: 0.96% - 4.1% (requirement: max. 5.0%)	
volume rinse water tank	449.4 l (min. 10% of the nominal spray volume)	
rinsing and diluting possible	yes	
tank surface roughness	<0.02 mm (0.1 mm)	
agitation systems test: deviation in %	13.5 (< 15%)	
spray pump performance during nominal pressure and nominal speed	220 l/m in at 15 bar, 540 min <sup>-1</sup> 243 l/m in at 10 bar, 540 min <sup>-1</sup>	
technical residual volumes in l (requirement: max. 0.5% of the nominal volume + 2l per meter working width)	33.6 l without agitation system	
	46.2 l with agitation system at: 3 bar, 80 l/m in (max. residual volumes here: 63 l)	
flow meter (accuracy)		
reading in l/m in	measured value in l/m in	deviation in % requirement: max 5%)
28.8	29.4	2.0
43.2	42.0	-2.9
57.6	55.7	-3.4
73.2	72.5	-1.0
single nozzle output, type of nozzle: 4110-12		
spraying pressure in bar	deviation in % of flowrate table value * (max. 10%)	max. deviation in % of mean value * (max. 5%)
1.5	0.95	2.7
3.0	-1.35	3.0
4.0	-1.18	2.9
nozzle type: 4110-20		
1.5	-1.77	2.0
2.0	-0.77	2.5
3.0	-2.50	2.6
4.0	6.48	3.6

Table 2: Measured values.

\* requirements in brackets

measured values of transverse distribution test: spraying height 50 cm using nozzle type: 4110-12		
spraying pressure in bar	coefficient of variation **	air assistance
1,5	5,66	without
2,0	4,89	without
3,0	6,52	without
2,0	7,68	medium
measured values of transverse distribution test: spraying height 50 cm using nozzle type: 4110-20		
spraying pressure in bar	coefficient of variation **	air assistance
1,5	8,25	without
2,0	5,52	without
3,0	4,81	without
4,0	4,56	without
2,0	7,72	medium
4,0	7,23	medium
consistency of adjustability		
application rate in l/ha	deviation from desired value in % *(max. 6%)	coefficient of variation *( $\leq 3$ )
200	2,19	0,82
300	1,25	0,55
400	1,80	0,28
test results of regulator		
test	desired time (s) including a deviation of > 10% *	
switching on/off	2,7 (7 s)	
operating nozzle bar section	2,5 (7 s)	
speed variation by change of gears	desired time (s) including a deviation of > 10% *	
1.5 m/s to 2.0 m/s	3,3 (7 s)	
2,0 m/s to 2,5 m/s	3,7 (7 s)	
2,5 m/s to 2,0 m/s	2,7 (7 s)	
2,0 m/s to 1,5 m/s	2,7 (7 s)	

Table 3: Measured values.

\* requirements in brackets

\*\* requirement: general max. 9%; for main working condition (3 bar, 50 cm high) max. 7%.



## Assessment

The test result showed that all ENTAM-tester requirements were met. The used trailer coupling (by means of a rigid drawbar connected with the tractor's yoke) of this model does not make follow-up track trailing possible. The filling hole can be reached easily from the ascent with attached working platform which is fitted to the front of the chassis. For the filling of plant protection products the (swing-out) introduction bowl may be used which is fitted to the side of the sprayer. The introduction bowl is provided with ring pipe and a cleaning nozzle (ball headed nozzle), enabling the cleaning of crop protection product cans. In order to make a hydraulic connection possible, the tractor only needs to have a delivery line connection and a return line connection.

From the rinsing water tank containing 450 l which is integrated in the front of the frame area and by means of a valve,



Figure 5: Control platform on the left side of the sprayer.

Tank water can be taken for diluting the residual in the tank, for internal tank cleaning sufficiently big. By using the filling and for rinsing of liquid carrying parts of connection, the tank can be easily filled the sprayer. The sprayer is equipped with two thus effectively prevented. Furthermore, rotating tank cleaning nozzles for internal the tank can be filled by hydrant. For cleaning. They allow pre-cleaning of the this purpose, a connection including a tank and simultaneous dilution of residu-Storz-clutch can be found on the left side al. The easily accessible filling of the sprayer. The opening lid of the connections and the introduction bowl are tank is sealed sufficiently. The contents also fitted on the left side of the sprayer. of the tank is always clearly visible by the contents indicator. The contents Fittings indicator is sufficiently accurate. The The control platform on the left side of tank with an over volume of nearly 11% the sprayer facilitates operation during has got sufficient reserve space for filling, spraying and cleaning. The possible foam formation. The effect of adjustments of the suction and pressure the agitation system is good. system can be easily understood because The agitation system can be turned off they are coloured. to reduce the residual in the tank.

## Safety Tests

The sprayer is equipped with safety pictograms in the form of adhesive labels on the sprayer and an operating manual in German which contains additional safety instructions. The sprayer is provided with an CE-symbol and a vehicle identification plate.

The CE-symbol indicates that a product meets the requirements defined by the respective EC-regulations and that the supplier has carried through the envisaged procedures to obtain conformity. The CE-symbol is put on the sprayer by the manufacturer. The manufacturer confirms that this sprayer was designed and constructed according to the harmonised EC-regulations 89/368/EEC; 91/368/EEC and 93/368/EEC.

## Responsibility and recognition



### Performing competent authority:

Federal Biological Research Centre for Agriculture and Forestry (BBA) (Germany)  
Application Techniques Division; Messeweg 11-12;  
D-38104 Braunschweig



### Associated Member of ENTAM through:

**DLG** - Deutsche Landwirtschafts-Gesellschaft  
(Germany)

**This test is recognized by the ENTAM Members:**



**BLT Wieselburg** -Bundesanstalt fuer Landtechnik (Austria)

*APPROVAL NUMBER: 006 / 03*



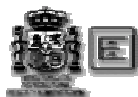
**CRA** - Agricultural Research Centre  
(Belgium)

*APPROVAL NUMBER: D - 1544*



**D.I.A.S.** - Danish Institute of Agricultural Sciences  
(Denmark)

*APPROVAL NUMBER: 940-5A-28*



**EMA** - Estacion de Meccanica Agricola (Spain)

*APPROVAL NUMBER: ENT / 06 / 03 / 1*



**ENAMA** - Ente Nazionale per la Meccanizzazione Agricola  
(Italy)

*APPROVAL NUMBER: D - 05.106*



**FAT** - Eidgenössische Forschungsanstalt für Agrarwirtschaft und Landtechnik (Switzerland)

*APPROVAL NUMBER: D - 03.03*



**MGI Gödöllő** - Hungarian Institute of Agricultural Engineering (Hungary)

*APPROVAL NUMBER: D - 1 / 2003*



**N.AG.RE.F** - National Agricultural Research Foundation  
(Greece)

*APPROVAL NUMBER: AE/20/01/ZZ*