

ENTAM - Test Report



Sprayer type:

Trailed field crop sprayer

Trade mark:

Hardi

Model:

Commander Delta 4400

Manufacturer:

Hardi International A / S

Helges Hoj Allé 38

DK - TAASTRUP

Test report: D - 1742

October 2005

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| Assessment table |
|------------------|

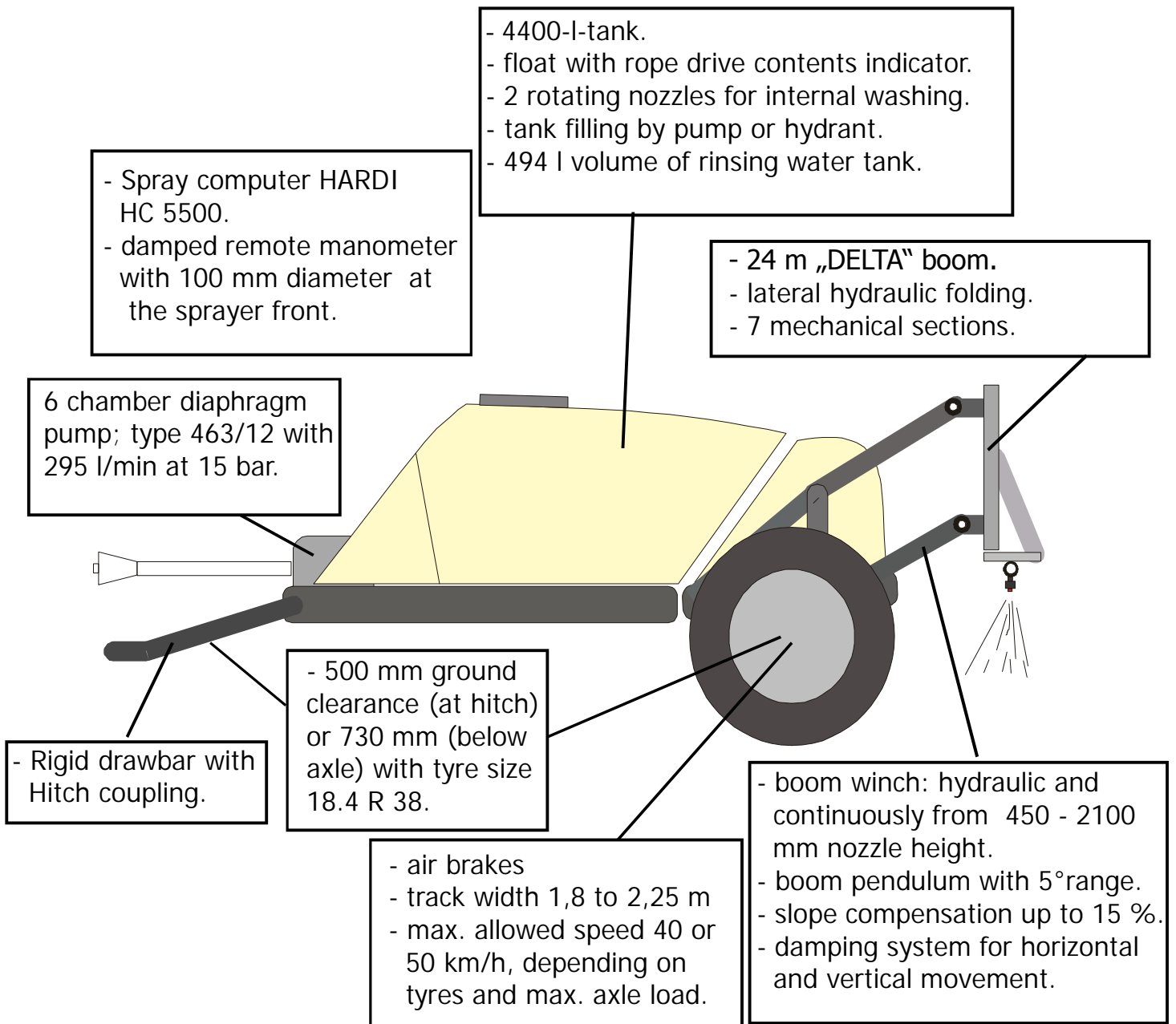
| No. | Contents | Assessment |
|-----|---|------------|
| 1 | Spray tank surface roughness | + |
| 2 | Spray tank over volume | +++ |
| 3 | Volume of total residual (here max. allowed 72,7 l) | ++ |
| 4 | Spray tank contents gauge up to 20% Filling | +++ |
| 5 | Spray tank contents gauge from 20% Filling | ++ |
| 6 | Agitation system (deviation of even solution) | + |
| 7 | Width of nozzle bar section | ++ |
| 8 | Boom height adjustment range | ++ |
| 9 | Deviation of pressure gauge | ++ |
| 10 | Deviation of flow meter | ++ |
| 11 | Regulation speed | ++ |
| 12 | Transverse distribution | ++ |
| 13 | Rinsing water tank | + |
| 14 | Deviation of volume/hectare adjustment device (spray computer) from desired value | ++ |
| 15 | Repeatability of volume/hectare adjustment device (spray computer) | ++ |
| 16 | Pressure drop between manometer and nozzle | +++ |
| 17 | Deviation of single nozzle output from table | ++ |

Note: The assessment keys are listed below. All detailed results are in the following test report.

| No. | unit | + | ++ | +++ | No. | unit | + | ++ | +++ |
|-----|----------------|------------|------------|-----------|-----|----------------|-------|--------|------|
| 1 | µm | >70-100 | 30-70 | <30 | 10 | % | 4-5 | 2-4 | 0-<2 |
| 2 | % | 5-8 | >8-12 | >12 | 11 | % | >7-10 | >3-7 | 0-3 |
| 3 | of allow.value | >2/3-3/3 | 1/3-2/3 | <1/3 | 12 | CV | >7-9 | 4-7 | <4 |
| 4 | % | 7.5-5.0 | 5.0-2.5 | <2.5 | 13 | % of tank vol. | 10-12 | >12-14 | >14 |
| 5 | % | 5.0-4.0 | <4.0-2.0 | <2.0 | 14 | % | >4-6 | 2-4 | <2 |
| 6 | % | >10-15 | 5-10 | <5 | 15 | % | >2-3 | 1-2 | <1 |
| 7 | m | 4.5-6 | >3-4.5 | 3 or less | 16 | % | >7-10 | 3-7 | <3 |
| 8 | m | 1-1.5 | >1.5-2.0 | >2.0 | 17 | % | >7-10 | 3-7 | <3 |
| 9 | bar | >0.10-0.20 | >0.05-0.10 | 0.00-0.05 | | | | | |

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| Free download of the test under: www.ENTAM.com or www.BBA.de |
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Technical data of sprayer



Dimensions and weights:

| | |
|-----------------------|---|
| total length: | 7900 mm |
| height: | 3200 mm |
| transportation width: | 2550 mm (manufacturer statement for 24 m serial DELTA boom) |
| unloaded weight: | 3594 kg |

Description of sprayer



Fig. 4: rigid drawbar with trailer coupling ring for hitching, tank scale and operating controls.

The sprayer consists of a chassis with an adjustable axle. The track width of the sprayer can be varied by adjusting the rear axle shafts from 1.8 m to 2.25 m. The chassis is designed for a maximum speed of 40 km/h. The rigid drawbar can either be equipped with a hitch eye, hitch ball or a drawbar eye which complies with DIN 11026. The optional articulated steering, „Safe Track“, assures follow-up track trailing. The pivot point is between tank and axle;

Fig. 5: operating controls on the left of the sprayer with control fittings for suction and pressure sides and easily accessible induction bowl.



the front of the sprayer with the drawbar and spray tank, and the axle with clean water tank and boom form separate units. The coupling point to the tractor (drawbar eye) cannot be varied in spacing and height. The propeller shaft is coupled above, or if the drawbar eye is used according to the DIN standard, also below.

The spray tank is not designed with splash walls and only a small part of its base is flat due to its slim shape and sloping sides. This all helps to reduce deposits and improve the efficiency of the agitation system and the cleaning device. The pressurised agitation system (agitation rod and injector nozzles) can be switched off to keep the residues in the tank to a minimum. The speed of the agitation system can also be infinitely adjusted by a valve.



Fig. 6: boom suspension with section valve control unit

The open induction bowl lid also acts as a work surface on which to place the plant protection product before it is put into the bowl.

The boom is a framework construction whose height can be infinitely adjusted using hydraulics (HARDI PARALIFT). It has a centrally pivoted suspension system with a suspension range up to 5° and hydraulic incline adjustment up to 15 %. The section valves (motorised valves) and the flow meter are positioned on the boom support. Because the hose diameters are correspondingly generous, the pressure is evenly distributed in the boom with negligible pressure loss. The tested 24 m boom can also be partly folded to measure 12 m.

Incline adjustment is electro-hydraulic and activated by a rocker switch on the hydraulics operating terminal.

The standard EFC control panel comprises 7 section valves (motorised valves), a main valve, control valve and electrical control panel, „Spray II“. The main switching mechanism is operated via a separate main valve and simultaneous opening / closing of the section valves with a pressure equaliser system. The control system, Hardi HC 5500, is for speed-dependent spray control and for controlling the entire sprayer with the additional components, „Spray II“ and „Hydraulics“.

Additional control panel functions: Manual pressure adjustment, end nozzle control, foam marking (left/off/right) and intermittent foam marking.



Fig. 7: control system, HC 5500



Fig. 8: „EasyClean Filter“ is easy to remove

The modular control system, „HC 5500“, consists of a generous liquid crystal display and the necessary control keys, a spray switch panel, „Spray II“, and a hydraulics panel, „Hydraulics“. In operation, the respective application rate is displayed in l/ha, and also the vehicle speed and the active spray sections. Information on the current flow rate, tank contents, treated area, total of spray liquid applied and the remaining section and area to be treated can be called up. The electrical connection is via a cable with a three-pole socket. The three control elements are assembled with the provided bracket within reach and sight of the driver. All hydraulic functions are controlled electrically so that only a double-action control valve or a pressure connection with free reflux is necessary.

All the necessary valves and connections are situated on the left side of the sprayer for filling and cleaning. The suction and pressure sides are each regulated by a control fitting. The connections for filling and emptying are next to this. The pump can also be used for emptying (e.g. for pumping the liquid fertiliser back, optional accessory). The standard induction bowl comprises an induction nozzle, „Vortex nozzle“ and a container rinsing nozzle (rotating nozzle) with a spring-loaded valve. The large „EasyClean Filter“ (suction filter) on the left of the sprayer is easily removed. Any filter blockages are shown on a separate pressure gauge at the front of the sprayer. The central pressure filter is self-cleaning and situated on the right of the sprayer. Storage compartments on the left (personal protection gear) and the right (PPP container) as well as a device for cleaning the outside of the sprayer with a hose reel and spray gun round off the sprayer equipment.

Alternative equipment

In addition to the tested version, a 3200 l tank is also available. The manufacturer can also offer the working widths 27, 28, 30, 32, 33 and 36 m. Apart from the hitched version, the sprayer is also available with articulated steering („SafeTrack“) and a variety of other coupling systems (hitch socket, hitch eye or drawbar eye).

| Result table | | | | |
|----------------------------------|--|--|--|--|
| tested assembly | | result (measured) | | |
| spray tank | over volume | 11.4 | | * min. 5 % |
| | contents gauge graduation marks | 100 | | * max. 100 l |
| | deviation | -4.64% | | * max. 7.5 % up to 880 l filling |
| | | -4.00% | | * max. 5 % between 880 and 4400 l |
| surface roughness | 0.09 mm | | * max 0.1 mm | |
| rinsing tank | volume | 494 l entsprechend 11,2 % des Nenninhaltes | | * min. 10 % of nominal contents |
| | rinsing and dilution possible? | yes | | |
| can rinsing equipment | rinsing efficiency | 0.001 % residual | | * max. 0.01 % of can contents |
| manometer | graduation marks | 0.2 bar | | * max. 0.2 bar |
| | deviation | 0.1 bar | | * max. 0.2 bar |
| agitation system | deviation from even concentration | -12.75% | | *max. 15 % |
| residual in l | dilutable | 24.8 l | | * max. 70 l |
| | non delutable | 17.7 l | | |
| spray boom | height adjustment range from - to | 450 mm - 2100 mm | | |
| | nozzle ground contact protection | yes | | |
| | pressure loss between manometer and nozzle at 3 bar pressure | 3.30% | | * max. 10 % |
| | nozzle dripping after switch off | 0 ml | | * max. 2 ml |
| | single nozzle flow rate | | | |
| | type of nozzle: Hardi F-04-110 | | | |
| | pressure (bar) | flow rate (l/min) | max. deviation from table in % *(max. 10 %) | max. deviation from mean in % *(max. 5 %) |
| | 1.5 | 1.126 | -0.35 | -4.4 |
| | 3.0 | 1.588 | -0.75 | -3.7 |
| | 5.0 | 1.984 | -4.15 | -3.3 |
| transverse distribution | | | | |
| type of nozzle: Hardi F-04-110 | | | | |
| pressure (bar) | distance (cm) | coefficient of variation (%) *(max. 9 %) | | |
| 1.5 | 50 | 3.87 | | |
| 3.0 | 50 | 4.64 | | |
| 5.0 | 50 | 4.52 | | |
| volume/hectare adjustment device | | | | |
| | displayed (l/min) | real (l/min) | deviation in % from real *(max. 5 %) | |
| | 14.6 | 15.0 | -2.67 | |
| | 28.8 | 29.5 | -2.37 | |
| | 43.2 | 44.4 | -2.71 | |
| | 57.6 | 58.8 | -2.04 | |
| | 72.0 | 72.5 | -0.69 | |

Fig.9: test result table, part 1

| Result table | | |
|---|---|-----------------|
| volume/hectare adjustment device | | |
| repeatability of adjustment | | |
| adjusted flow rate in l/ha | deviation from adjusted value % *(max. 6 %) | CV *($< 3\%$) |
| 200 | 1.96 | 1.37 |
| 300 | 1.19 | 1.37 |
| 400 | 0.54 | 0.96 |
| procedure | regulation time (s) with deviation $> 10\%$ to adjusted value | |
| switching on / off | 3.3 | * max. 7 s |
| switching of single sections | 5.6 | * max. 7 s |
| change of driving speed by changing gears | | |
| 1.5 m/s to 2.0 m/s | 4.1 | * max. 7 s |
| 2.0 m/s to 2.5 m/s | 5.0 | * max. 7 s |
| 2.5 m/s to 2.0 m/s | 4.2 | * max. 7 s |
| 2.0 m/s to 1.5 m/s | 4.1 | * max. 7 s |

Fig.10: test result table, part 2

Assessment

The tests showed that all ENTAM inspection requirements were complied with. The type of hitching does not allow follow-up track trailing for the inspected version. The sprayer is also available with articulated steering, „SafeTrack“. The filling hole is easily accessible from the steps with platform at the front of the chassis. The induction bowl (which can be swivelled in and out) on the left of the sprayer can be used for filling the tank with the plant protection product. The induction bowl is equipped with an induction nozzle and a cleaning nozzle (rotating), which means that receptacles can be cleaned after the tank has been filled. Due to the tightly closing lid, the entire induction bowl can be rinsed after use with the cleaning nozzle.

Only a pressure and reflux connection on the tractor are required for hydraulic connection.

Tank

The filling hole and the filter insert are sufficient in size. Due to the use of the filling connection, the tank can be filled easily using the pump. This prevents the liquid from running back. The tank lid seals properly. The height of the tank contents can be read easily using the scale. The volume scale is sufficiently accurate. The tank has an oversize of 11 % and thus sufficient reserves for any resulting foam. The efficiency of the agitation system is satisfactory.

The speed of the agitation system can be adjusted infinitely and can also be switched off to reduce technical residues.

Thanks to the clean water tank integrated into the front frame area which holds 490 l, water can be drawn using a valve for diluting technical residues, cleaning the inside of the tank and rinsing the fluid conducting sprayer parts.

The sprayer is equipped with two rotating tank cleaning nozzles for cleaning the inside of the tank. They allow the tank to be pre-cleaned whilst at the same time diluting the residues.

The easy-to-access filling connection and the induction bowl are also situated on the left of the sprayer.

Control valves

The operator panel on the left of the sprayer makes filling, spraying and cleaning easier. The various adjustments for the suction and pressure system are easy to understand due to the use of pictograms.

The control system HC 5500 offers the operator automatic speed-controlled spray adjustment. This spray adjustment is quick to react and is precise. The central pressure filter is designed for self-cleaning. A pressure gauge shows how dirty the central suction filter is.

Boom

The parallelogram-shaped lifting frame has a large adjustment range. The boom height can be adjusted easily with the hydraulics. The tyres allow a minimum nozzle height of 45 cm for the tested model.

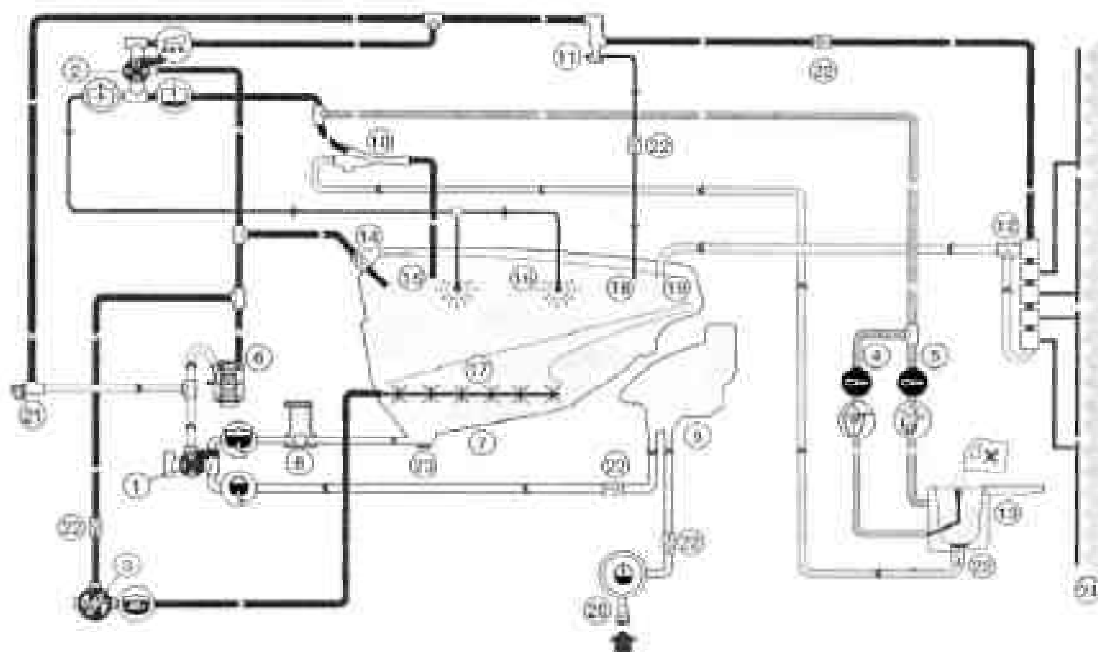
The triple nozzle bodies on the stainless steel nozzle tube are very practical for preventing damage, for example caused by ground contact, due to the arrangement of the nozzles. In addition, the sprayer has protection bars. The pressure in the boom is even due to the large cross sections and short hoses, and pressure loss is negligible. The hoses are laid on the boom without buckling. Mudguards prevent soiling of the nozzles and the operator panel when the boom is folded.

Safety Tests

The sprayer is equipped with safety pictograms (stickers) and operating instructions in the native language, which include further safety information. The sprayer carries a CE-mark and a vehicle identification plate.

The CE-mark shows that a product fulfils the requirements defined for the respective EC directives and that the supplier has carried out the appropriate procedures to achieve conformity. The CE-mark is placed on the equipment by the manufacturer. The manufacturer confirms by doing so that the sprayer was designed and built in accordance with harmonised EC Directive 98/37/EEC and that standard EN 907 has been complied with.

Diagram of the liquid system



1-Control fitting („SmartValve“) suction side, 2-Control fitting pressure side, 4-canister rinsing, 5-induction nozzle, 6-pump, 8-suction filter, 9-clean water tank, 10-injector filling, 11-pressure filter, 12-spray section valves, 15-injector filling, 16-tank cleaning nozzles, 17-agitation system, 20-clean water filling, 21-pressure regulation valve, 23-empty tank, 24-spray boom.

fig.11: diagram of the pipe / hose system.

Explanation on testing:

Testing takes place according to the Technical Instructions for ENTAM-Tests of Filled crop sprayers. This procedure was developed by the competent testing authorities of the European countries participating in ENTAM and 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 sprayer. Statements on the behaviour of the sprayer with different appurtenances cannot be derived from these results.

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

This test is recognized by the ENTAM members:



HIAE Hungarian Institute of Agricultural
 Engineering (Hungary)

D-5/2005



NAGREF National Agricultural Research
 Foundation (Greece)

LE/64/01/ZZ



ENAMA Ente Nazionale per la Meccanizzazione
 Agricola (Italy)

ENTAM „Rapporto di prova
 prestazionale“ 03/2005



CMA Generalitat de Catalunya
 Centre de Mecanització Agrària (CMA) (Spain)

EPH001/05



HBLuFA FRANCISCO JOSEPHINUM
 WIESELBURG (Austria)

BLT-Prot.-Nr. 029/05



PIMR - Przemyslowy Instytut Maszyn Rolniczych
 Industrial Institute of Agricultural Engineering
 (Poland)

PIMR - 7/ENTAM/05



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

DIAS recognition 956



CRA-W Centre de Recherches Agronomiques
 de Gembloux; Département de Génie rural
 (Belgium)

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