



European Network for Testing
Agricultural Machinery

ENTAM - TEST REPORT



Trailed Field Crop Sprayer John Deere 840 Design 840-27-002

Manufacturer:
John Deere Fabriek Horst B.V.
Energistraat 16
NL - 5961 PT HORST

Test report: D - 1671

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%)	O
4.1.1.3	residual (0.5% nominal capacity + 2 l/m working width, here: 72.7 l)	O
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 %)	++
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)	++
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)	+
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 (++,+,O)

Assessment:

- 4.1.1.1 (> 70 - 100 µm = O; 30 - 70 µm = +; < 30 µm = ++)
- 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 (> 10% - 15% = O; 5% - 10% = +; < 5% = ++)
- 4.1.1.5 (> 4.5m - 6m = O; > 3m - 4.5m = +; 3m or less = ++)
- 4.1.3.1 (1m - 1.5m = O; > 1.5m - 2.0m = +; > 2.0m = ++)
- 4.1.3.2 (> 0,1 bar - 0,2 bar = O; > 0,05 bar - 0,1 bar = +; 0,0 bar - 0,05 bar = ++)
- 4.1.6 (a) (> 4% - 5% = O; > 2% - 4% = +; 0% - 2,0% = ++)
- 4.1.6 (b) (> 4% - 6% = O; 2% - 4% = +; < 2% = ++)
- 4.2 (> 7% - 10% = O; > 3% - 7% = +; 0% bis 3% = ++)
- 4.2.2 (a) (> 2% - 3% = O; 1% - 2% = +; < 1% = ++)
- 4.2.2 (b) (> 7% - 10% = O; > 3% - 7% = +; 0% bis 3% = ++)
- 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_k 7 - 9 = O; V_k 4 - 7 = +; V_k < 4 = ++)

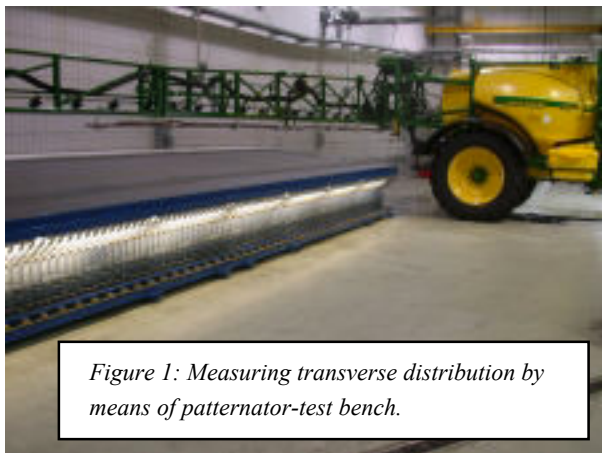


Figure 1: Measuring transverse distribution by means of patternator-test bench.

Technical data of sprayer

Assembly	Equipment
Frame / body / chassis	Steering drawbar with automatic tracking
Length: 6250 mm	system, eye diameter 40 mm for trailer
Height: 3920 mm	coupling; dual circuit air brakes with integrated
Width : 2550 mm	parking brake (spring-loaded brake); tyres 520/
Track: 1.8 – 2.0 m	70 R 38. Adjustable axle with track width from
Minimum ground clearance: 630 mm (for a trailer coupling height of 1130 mm)	1.8 to 2.0 m, with tyre change also from 1.5 to 1.75 m (only with row crop tyres).
Unloaded weight: 3966 kg	
Upper speed limit: 40km/h	
Tank	
Volume 4000 l	Spray tank contents indicator: indirect (cable with float) at the front wall of the spray tank on the left; filling: by tank filling device and by pump , scale of contents divided into: 100 l; pressure and return flow agitation system which can be switched off; internal cleaning of spray tank by 2 rotating nozzles, foot valve (shut-off valve); rinse water tank holding a volume of 400 l.
Spray boom	
Working width 27 m	Hydraulically folded boom consisting of 5 segments (7 segments incl. spacers to prevent nozzles ground contact); boom winch: hydraulic and continuously adjustable from 645 to 2550 mm (depending on tyres); boom damping system with parallelogram frame lift; nozzles attached to quintuple frames with bayonet caps.
Fitting/valves	
Regulator EL-4 with hydraulic-system EHB-2	Inlet pressure regulator (locked) for system pressure (agitation, rinsing, diluting); pressure regulator valve: membrane pressure regulator with electric adjustment at the front of the sprayer, nozzle bar sections and flow meter at the boom, remote control „EL-4“ to be fitted inside the tractor cab; damped remote manometer with a diameter of 100 mm at the front of the sprayer.
Pump	
Volume flux: 250.4 l/min at a nominal pressure of 20 bar	Six-chamber diaphragm pump AR 280 bp (piston membrane pump) integrated in univer- sal drawbar.

Diagram of the liquid system

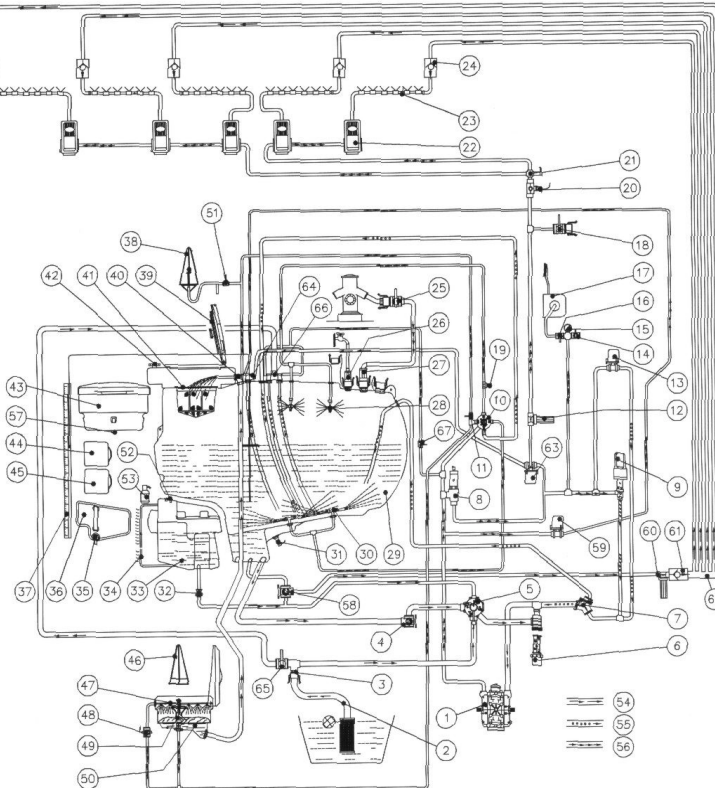


Figure 2: Liquid system.

1- diaphragm pump, 4-drain cock, 5-suction selector valve, 6-suction strainer, 8- inlet pressure regulator, 9-electrical spray pressure regulator; 12-pressure filter, 13-main valve, 20-flow gauge, 22-nozzle bar sections, 23-spray pipe, 24-non-return valve, 30-pressure agitation system, 40-injector-washing in device, 58-suction cock for recirculating system, 59-shut-off valve for VRS-system, 61-main non-return valve for VRS-system, 64-injector for VRS-system

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 sprayer. Statements on the behaviour of the sprayer with different appurtenances cannot be derived from these results.

Additional description of the sprayer



Figure 3: Right side view with steering drawbar.

The chassis of the sprayer is adjustable with springborn axle (polyurethane shock absorber). The adjustability of tracks depends on the type of tyres: 1.72m up to 2.25m with wide tyres and 1.5m up to 2.0m with row crop tyres. The chassis is designed for a maximum speed of 40 km/h (with full tank). The universal drawbar includes the six-chamber diaphragm pump (two pumps also possible). The height and distance of the coupling point (drawbar eye) can be varied by means of spacer blocks. The cardan shaft is coupled either above or below the trailer coupling, depending on the type of coupling. The design of the tank is such that it has no wash plates and has due to its round shape only

a few flat areas on the floor of the spray tank. In this way, depositions are reduced and the effect of the agitation system and the cleaning device are improved. The pressure agitation system (four injector nozzles) can be switched off just like the return flow agitation system, in order to keep the residual volumes in the spray tank as low as possible. By the VRS-system (vacuum-recirculation system), the entire remaining residual volume in the sprayer can be diluted. Furthermore, it ensures an immediate concentration build up in front of the nozzles before spraying starts. Moreover, rinsing of the pipes using freshwater without spraying (e.g. when interrupting work) is possible.



Figure 4: Left side with introduction bowl.

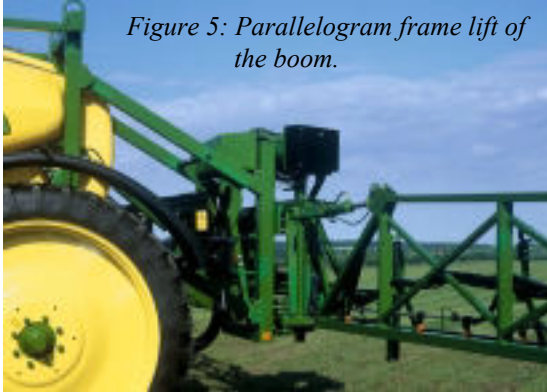


Figure 5: Parallelogram frame lift of the boom.

The VRS returns the direction of flow so that when the nozzle bar sections are open, the liquid is sucked out of the nozzle tubes by an injector and the rinsing liquid can flow into the nozzle bars via non-return valves. Either the flow gauge or the pressure sensor are fitted directly to the spray boom. Together with the nozzle bar sections (motorised control valves) which are mounted directly in front of the nozzle bars, a uniform pressure build-up in the spray boom is created with a very low pressure drop. By means of a hydraulic system the boom winch is continuously adjustable via a parallelogram lifting device with boom damping system and slope compensator (hydraulic). The inspected 27m spray boom can also be moved around half folded as a 15m spray boom. Slope compensation works electro-hydraulically by means of a pot located at the operator

control panel EL-4. The regulator EL-4 with 9 nozzle bar sections can either be operated by measuring the pressure (regulation by pressure) or by measuring the flow (regulation by flow) or by a combination of measurements of pressure and flow. The liquid system has a

primary pressure regulator which has been locked by the producer and provides a uniform admission pressure for the sprayer operations „cleaning“, „filling“ and „agitating“. The secondary pressure regulator for spray pressure is a diaphragm regulator powered by a servomotor. The main switch is operated via a main relay valve with a simultaneous activation of the VRS-system (vacuum back absorption). The electric power supply is established by bunched cables which are directly connected to the tractor battery, an ignition switch and two connector plugs

Figure 6: Operator control panel EL - 4.





Figure 7: VRS-return flow pipes with collective breeching and filter at the spray boom.

for spray computers and hydraulic functions. The regulator is designed in modular system and consists of the spray computer EL-4 with a liquid crystal display field, control keys (membrane keyboard) and switches for nozzle bar sections (toggle switches) and the hydraulic operating element EHB-2 (all hydraulic functions via toggle switches). Both operating elements are mounted on a support - which is also supplied by the manufacturer- in the working area and visual range of the driver. All hydraulic functions are controlled electrically, so the tractor merely needs a double-action control valve or a pressure connection with free return flow. In order to fill or clean the sprayer all necessary valves and connections are put together on the left side of the sprayer. The suction and pressure side is switched on and off by a preselector tap respectively. Next to this tap are connections for filling and emptying. Emptying is also possible by pump (e.g. for pumping back liquid fertiliser). The introduction bowl which is fitted as standard has a washing-in closed circular pipeline and a bundle rinsing nozzle (spraying nozzle) equipped with an ungeared valve.

Equipment alternatives

Besides the inspected model, tank sizes of 2400 l and 3200 l are on offer, as well as control via CAN BUS or GreenStar technology. Furthermore, the manufacturer offers this sprayer also with working

widths of 15, 18, 20, 21, 24, 27, 28, 30, 32, 33, 36 and 39 m and with “Twin Fluid” binary nozzle technique. Spray booms can also be equipped with “variable geometry” to choose where the left or right boom can be lifted or lowered individually (-6.5° up to +12.5°). Alternative to the 40 km/h axle (with full tank), a bigger axle with 50 km/h is possible also track width up to 2,25 m are possible. The sprayer’s “universal”- drawbar let the choice between a rigid or a steering drawbar – optional obtainable- with an automatic tracking system. Additionally, the customer may also order a special drawbar for low coupling with different diameters of the trailer coupling ring.

Test result tables

tested structural component		result (measured value)	
spray tank	over volume	6,1	
	tank scale	100	
	deviation	* min. 5 %	
	accuracy	-5,80%	* max. 100 l
		0,88%	* max. 7,5 % up to 800 l contents
			* max. 5 % between 800 and 4000 l
	surface roughness	0,015	
		* max 0,1 mm	
rinse water tank	volume	400 l corresponding to 10 % of the nominal contents	
	are rinsing and diluting possible	yes	
cleaning device for crop protection product cans	cleaning effect	0,00043	
		* max. 0,01 % of bundle contents	
pressure gauge	graduation of the scale	0,2 bar	
	accuracy	0,05 bar	
		* max. 0,2 bar	
agitation systems	deviation from required concentration after 15 h rest and 10 min. agitation	-14,70%	
		*max. 15 %	
technical residual volumes in l	dilutable	72,7	
	undilutable	0	
		* max. 74 l	
spray boom	regulating range from-to	645 mm - 2550 mm	
	nozzles protected from ground contact	yes	
	pressure drop between manometer and nozzles using 3 bar spray	1,70%	
		* max. 10 %	
	anti-drip device	0	
		* max. 2 ml	
	single nozzle output		
	nozzle type XR 110 03 VS		
	spraying pressure (bar)	application rate	max. deviation from table in % *(max. 10%)
			max. deviation from mean value in % *(max. 5 %)
	1,0	0,680	-2,50
	2,0	0,970	2,94
	3,0	1,181	-2,10
	4,0	1,370	2,71
	5,0	1,536	3,63
	nozzle type XR 110 05 VK		
	1,0	1,151	4,76
	3,0	1,927	-5,05
	5,0	2,499	-4,44
	3,71		
	3,16		
	3,31		
	transverse distribution measuring		
	nozzle type XR 110 03 VS		
	spraying pressure (bar)	spraying height (cm)	coefficient of variation Vk (%) *(general max. 9%; for main working condition max. 7%)
	1,0	50	6,20
main working condition	3,0	50	5,32
	5,0	50	5,81
	3,0	75	5,33
	nozzle type XR 110 03 VS		
	1,0	50	7,57
main working condition	3,0	50	5,01
	5,0	50	4,63
	3,0	75	6,63

Test result tables			
flowmeter (accuracy)			
	reading (l/min)	measured value (l/min)	deviation from measured value in % *(max 5%)
	10,8	11,1	-2,70
	21,6	21,8	-0,69
	32,4	32,1	0,93
	43,2	42,9	0,70
	54,0	53,8	0,37
	67,5	66,0	2,27
consistency of setting			
	application rate in l/ha	deviation from required value in % *(max. 6 %)	coefficient of variation *(3 %)
	210	-1,43	0,3
	300	-2,33	0,25
	390	-2,31	0,22
	regulating times for different operating states	regulating time (s) with a deviation of >10% from the required value	
	switching on and off	3,9	* max. 7 s
	switching of nozzle bar sections	1,5	* max. 7 s
speed variation by gear shifting			
	1,5 m/s to 2,0 m/s	2,7	* max. 7 s
	2,0 m/s to 2,5 m/s	2,1	* max. 7 s
	2,5 m/s to 2,0 m/s	2,4	* max. 7 s
	2,0 m/s to 1,5 m/s	2,7	* max. 7 s

Table 2: Test result tables.

Assessment

The test showed that all ENTAM-test requirements were met. The used coupling device ("universal" drawbar with automatic tracking system and rigid axle) makes follow-up track trailing possible. The filling opening can be reached easily from the ascent with attached working platform which is fitted at the front of the chassis. For filling 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 a washing-in pipe and a cleaning nozzle (ball headed nozzle) which permits bundle cleaning after filling. In order to make a hydraulic connection possible the tractor only needs to be equipped with a delivery connection and a return flow connection. Tank

The filling opening and the riddle are sufficiently big. By using the filling

connection, the tank can be easily filled by pump. A run-back of the fluid is thus effectively prevented. The lid of the tank seals sufficiently. the height of the tank is clearly perceivable by means of the scale of contents. The volume scale is sufficiently accurate. The tank with an outsize of 6% has got sufficient reserve space for possible foam formation. The effect of the agitation system is sufficient. The agitation systems (pressure and agitation system) can be turned off to reduce technical residual volumes. From the clean water tank containing 400 l which is integrated in the front of the frame area and by means of a valve, water can be taken via the VRS-system for diluting technical residual volumes, for internal tank cleaning and for rinsing parts of the sprayer which carry liquid.

The sprayer is equipped with two rotating tank cleaning nozzles for interior cleaning. They allow pre-cleaning of the tank and simultaneous dilution of residual volumes.

The easily accessible filling connection and the introduction bowl are also fitted on the left side of the sprayer.

Fittings

The control platform on the left side of the sprayer facilitates filling, spraying and cleaning. The adjustments of the suction and pressure system are easily understood by pictograms.

The regulator EL-4 offers several other advantages to the operator besides the automatic speed adjusted regulation of application. During operation of the flow gauge the imagined spraying pressure is calculated and indicated. Great differences between the pressure shown by the manometer and the calculated pressure indicate problems, like e.g. blocked filters, very early.

Spray boom

The parallelogram jack-up platform has a big setting range. The boom height can be adjusted easily by hydraulics. The used tyres of this inspected model, however, do not permit a nozzle height lower than 64 cm. Due to their arrangement the quintuple nozzle frames at the stainless steel nozzle tube are protected very well against damage, e.g. occurring through ground contact. Additionally, keep-off bars and spacers are installed. The march of pressure in the spray boom is very regular thanks to wide cross-sections and short hoses with little pressure drop. The hoses are laid on the spray boom without kinks. All joints/hinges and bearings of the

spray boom are made of stainless material. Wings avoid soiling of the nozzles and the control platform when the boom is folded up.

Safety examination

The sprayer is equipped with safety pictograms in the form of adhesive labels on the sprayer and an operating manual in the language of the country which contains additional safety instructions. The sprayer is provided with a 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 procedures provided for obtaining 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-regulation 98/37/EEC and that the standard EN 907 is met.

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: 007 / 03



CRA - Agricultural Research Centre

(Belgium)

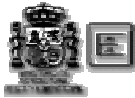
APPROVAL NUMBER: D - 1671



D.I.A.S. - Danish Institute of Agricultural Sciences

(Denmark)

APPROVAL NUMBER: 939-5A-27



EMA - Estacion de Meccanica Agricola (Spain)

APPROVAL NUMBER: ENT / 06 / 03 / 2



ENAMA - Ente Nazionale per la Meccanizzazione Agricola

(Italy)

APPROVAL NUMBER: D - 05.107



FAT - Eidgenössische Forschungsanstalt für Agrarwirtschaft und Landtechnik (Switzerland)

APPROVAL NUMBER: D - 02.03



MGI Gödöllő - Hungarian Institute of Agricultural Engineering (Hungary)

APPROVAL NUMBER: D - 2 / 2003



N.AG.RE.F - National Agricultural Research Foundation

(Greece)

APPROVAL NUMBER: AE/19/01/ZZ