
International Standard



5690/2

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**Equipment for distributing fertilizers — Test methods —
Part 2 : Fertilizer distributors in lines**

Matériels de distribution des fertilisants — Méthodes d'essai — Partie 2 : Distributeurs d'engrais en ligne

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Foreword

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It has been approved by the member bodies of the following countries:

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Equipment for distributing fertilizers — Test methods — Part 2 : Fertilizer distributors in lines

0 Introduction

The aim of this part of ISO 5690 is to harmonize testing of fertilizer distributors in lines by means of a standardized test method which is reproducible, allowing comparable results in figures and graph form to determine their performance to be obtained.

The test method takes into account the effects of the type of fertilizer, the level of fertilizer in the hopper, the application rate adjustment, the forward speed, the slope of the ground and the condition of the soil surface (bumps).

Optional tests (see annex C) may supplement the test by taking into account the distribution on the ground and the ease of use.

NOTE — These tests may be combined with tests on the basic machine with which the distributor in lines is twinned.

1 Scope and field of application

This part of ISO 5690 specifies a test method for fertilizer distributors in lines, including fertilizer distributors attached to a basic machine.

NOTE — Equipment designed for distributing microgranular pesticides or herbicides is excluded. ISO 5690/1 deals with full width fertilizer distributors. (See ISO 3339/0 for the classification.)

2 References

ISO 565, *Test sieves — Woven metal wire cloth, perforated plate and electroformed sheet — Nominal sizes of openings.*

ISO 3339/0, *Tractors and machinery for agriculture and forestry — Classification and terminology — Part 0 : Classification system and classification.*

ISO 3534, *Statistics — Vocabulary and symbols.*

ISO 3944, *Fertilizers — Determination of bulk density (loose).*

ISO 5698, *Agricultural machinery — Hoppers — Manual loading height.*

ISO 5699, *Agricultural machines, implements and equipment — Dimensions for mechanical loading with bulk goods.*

ISO 7424, *Agricultural equipment — Matching of wheeled tractors and rear mounted implements — Code numbering systems.*

3 Definitions

For the purpose of this part of ISO 5690, the following definitions apply.

3.1 fertilizer distributor in lines: [A definition is in preparation for the purpose of a future International Standard, ISO 3339/5.]

3.1.1 fertilizer distributor in lines twinned to a basic machine: An accessory which, from a hopper fitted to the chassis of a basic machine, lays down on the soil, in a band or in the soil, in one or several parallel lines with adjustable spacing, fertilizer at a given depth and application rate. For such purpose, for instance, the coulter of the basic machine to which they are attached may be used or separate coulters may be employed.

3.2 feed mechanism (for fertilizer): A mechanism which takes fertilizer from a hopper and transfers it at a constant determined flow rate on to the ground, in a band or in the soil, into a furrow via a feed pipe and possibly a coulter.

3.3 flow rate (of fertilizer): The quantity, expressed as mass or volume, of fertilizer distributed per unit time.

3.4 application rate (of fertilizer): The quantity, expressed as mass or volume, of fertilizer distributed per unit length or unit area.

3.5 hopper height: The internal height of the hopper, H , shall be the vertical distance between the lower edge of the outlets and the lower edge of the top of the hopper.

4 General test conditions

NOTE — The manufacturer or his representative shall be entitled to be present at the tests.

4.1 Fertilizer distributor

4.1.1 Selection

The distributor to undergo testing may be selected by the representative of the test office in agreement with the manufacturer.

The distributor shall, in all respects, conform strictly to the specifications which the manufacturer is required to send to the test office in writing.

The test report (see annex D) shall specify how the fertilizer distributor for test was chosen.

If the test on the distributor is associated with a test on a basic machine, the distributor chosen shall be that attached to the basic machine to be tested.

4.1.2 Manufacturer's instructions¹⁾

Use the distributor in accordance with the manufacturer's instructions, which shall specify, among other things

- a) the maximum working speed, expressed in kilometres per hour or metres per second;
- b) the types of fertilizer which the distributor can distribute;
- c) in the case where the device includes several interchangeable mechanisms, the type of feed mechanism and types of fertilizer which can be distributed by each model;
- d) any accessories which may be required for distributing certain types of fertilizer;
- e) the inflation pressure, if the distributor or the basic equipment is fitted with pneumatic tyres;
- f) the maximum and minimum application rates for the feed mechanisms with each type of fertilizer.

4.1.3 Checking of specifications

The technical characteristics supplied by the manufacturer shall be checked and shall be noted in the test report. When comparing laboratory test results with application rate and flow rate data supplied by the manufacturer, it shall be noted that manufacturer's data may have been adjusted for wheel slippage.

4.2 Fertilizer

4.2.1 Type of fertilizer used for the tests

Unless indicated otherwise by the manufacturer of the distributor (comment in the test report), carry out each of the performance tests with the following types of fertilizer :

— type a : a granular fertilizer;

— type b : a prilled fertilizer;

— type c : optionally, any other fertilizer which the test office considers of sufficient importance and whose physical properties differ from those of the fertilizers mentioned above.

4.2.2 Physical properties of the fertilizer

Determine the physical properties of the fertilizer used in the tests: particle size, bulk density (loose) (see ISO 3944), water content, and angle of repose (see annex B). These values shall be noted in the test report.

4.3 Ambient conditions

The degree of atmospheric humidity shall be noted in the test report.

5 Primary tests²⁾

5.1 Nature of tests (see annex A)

The essential aim of these tests is to determine the evenness of the flow rate and the accuracy of metering.

These tests shall be carried out according to two methods

- static tests;
- mobile tests;

to give the appropriate results.

5.1.1 Static tests

With the distributor stationary, the drive wheel shall rest on a drive mechanism. It shall be driven at a speed equal to that which it would have in actual operation, that is at the theoretic forward speed of the distributor travelling without slipping.

5.1.2 Mobile tests

The distributor shall be driven at a constant speed over a hard and uniform surface.

5.2 Distance between the feed mechanism and the surface

Care shall be taken that the mechanism is placed, in relation to the surface (collecting containers), at an average distance corresponding to that in actual operation.

5.3 Types of tests

5.3.1 Evenness of flow rate

The test shall be carried out with the machine stationary. The fertilizer shall be collected in containers placed under the feed mechanism or the coulters.

1) These instructions shall be attached to the test report.

2) For the optional tests, see annex C.

5.3.2 Accuracy of metering

5.3.2.1 Over a uniform surface

The test shall be carried out with the machine mobile. The fertilizer shall be collected in a series of containers placed on the ground. The collecting containers shall have external dimensions of 500 mm × 500 mm and shall have a minimum depth of 150 mm.

Preventive measures shall be taken to avoid spillage by ricochet out of the containers, for example by the use of

- interlocking inserts for dividing the container into cells of dimensions 50 mm × 50 mm, with a height not exceeding half the height of the container (see figure 1);
- unstretched net draped over the containers (see figure 2).

Each coulter corresponding to the feed mechanism to be tested shall be fitted with a sliding plate along the collecting containers at an adequate distance (between 20 and 30 mm), so as to avoid catching them during the run. If the coulter gets in the way, it shall be removed and the fertilizer collected from the end of the feed pipe.

The distributor shall be arranged so that only the feed mechanisms under test deliver their output into the container, the output of other feed mechanisms being deflected but not stopped up, which would influence the discharge.

The distance covered at constant speed (after starting acceleration) shall be not less than 15 m.

5.3.2.2 Over a bumpy surface

To simulate bumps, place, along the path of each land wheel of the equipment, a series of obstacles of height 50 mm and length 200 mm, preceded by a 150 mm ramp and placed in such a way that the obstacles are contacted at the same time by the two wheels. Each course shall include at least three pairs of obstacles distributed over its length in such a way that the distance between two obstacles is not less than 4 m.

5.4 Adjustments and measurements

5.4.1 Selection of feed mechanisms

5.4.1.1 Flow tests

Each test shall be carried out simultaneously on all the feed mechanisms of the distributor.

5.4.1.2 Metering tests

Each test shall be carried out simultaneously or successively on three feed mechanisms, one at the centre and one at each end of the fertilizer distributor.¹⁾

1) In the case of multirow equipment.

5.4.2 Filling the hopper

Put the fertilizer, in accordance with the specifications of the manufacturer, into the hopper immediately prior to testing so that there is no time for settling or consolidation.

5.4.3 Forward speed

The speeds of the distributor relative to the ground, corresponding to normal working speeds, shall be 1,50 m/s, 2,50 m/s and the maximum admissible speed. If one or several of these speeds is considered unacceptable by the manufacturer, it shall be replaced by that recommended by the manufacturer and mention of it shall be made in the test report.

For static tests, if the driving wheel is mounted on tyres, the rotary speed, ω , is given by the equation

$$\omega = \frac{v}{2\pi R}$$

where

v is the speed of travel;

R is the radius of the tyre under average load.

5.4.4 Adjustment of application rates

The tests shall be carried out at three application rates :

- a) minimum : the minimum application rate shown by the manufacturer;
- b) maximum : the maximum application rate shown by the manufacturer;
- c) mean : arithmetic mean of the minimum and maximum application rates.

If a mean rate cannot be obtained within the range of adjustments of the distributor, take the nearest rate which this range of adjustments allows, and note this in the test report.

5.4.5 Slope tests

The slope tests shall be carried out as follows :

- a) ascending a slope : incline the distributor 11° towards the rear (corresponding to a 20 % slope);
- b) descending a slope : incline the distributor 11° towards the front;
- c) slope to the right : incline the distributor 11° to the right;
- d) slope to the left : incline the distributor 11° to the left.

5.4.6 Duration of metering tests

The number of tests may vary according to the length of the test rig, which shall provide an overall effective length of 30 m. Before each reading a sufficient time shall be allowed for cancelling out the unevennesses due to starting up accelerations and to allow the establishment of flow of the fertilizer within the chamber of the feed mechanism.

5.4.7 Taking measurements

5.4.7.1 Flow rate test

The quantity of fertilizer collected in the container shall be weighed. Five readings lasting 30 s shall be made for each test.

5.4.7.2 Metering test

The quantity of fertilizer collected in each container shall be weighed.

6 Test procedure

The programming of the primary (mandatory) tests shall comply with annex A.

6.1 Effect of the fertilizer level in the hopper (test 1)

Determine whether the level of fertilizer in the hopper (consolidation or blocking) has an influence on the evenness of the flow rate.

6.2 Effect of the flow rate (test 2)

Determine the combined effect of the application rate adjustment and the forward speed. Determine whether the flow rate has an influence upon

- a) the evenness of flow (test 21);
- b) the accuracy of metering (test 22).

NOTE — A flow rate test shall be repeated to check the reliability of the adjustment mechanism of the feed mechanisms.

6.3 Effect of slope (test 3)

Determine whether the position of the equipment working on sloping ground has an influence on the evenness of flow.

6.4 Effect of bumps (test 4)

Determine whether bumps due to the unevenness of the ground (stony or lumpy ground) have an influence on the accuracy of metering.

7 Results

NOTE — The statistical terms used in this clause are defined in ISO 3534.

7.1 Flow rate test

7.1.1 Calculate the mean of five readings for each test to obtain a single flow figure, D .

7.1.2 Calculate the deviation with respect to the mean in the readings according to the formula

$$\frac{D_{\max} - D_{\min}}{D} \times 100$$

7.2 Metering test (longitudinal and transverse distribution)

The degree of unevenness shall be shown by the coefficient of variation, a , given by the equation

$$a = \frac{s}{\bar{x}}$$

where

s the standard deviation, is given by the equation

$$s = \sqrt{\frac{1}{n-1} \sum (x_i - \bar{x})^2}$$

in which

n is the number of containers;

x_i is the amount collected in each container;

\bar{x} the absolute mean, is given by the equation

$$\bar{x} = \frac{1}{n} \sum x_i$$

8 Test report

An example of a test report is given in annex D.

Dimensions in millimetres

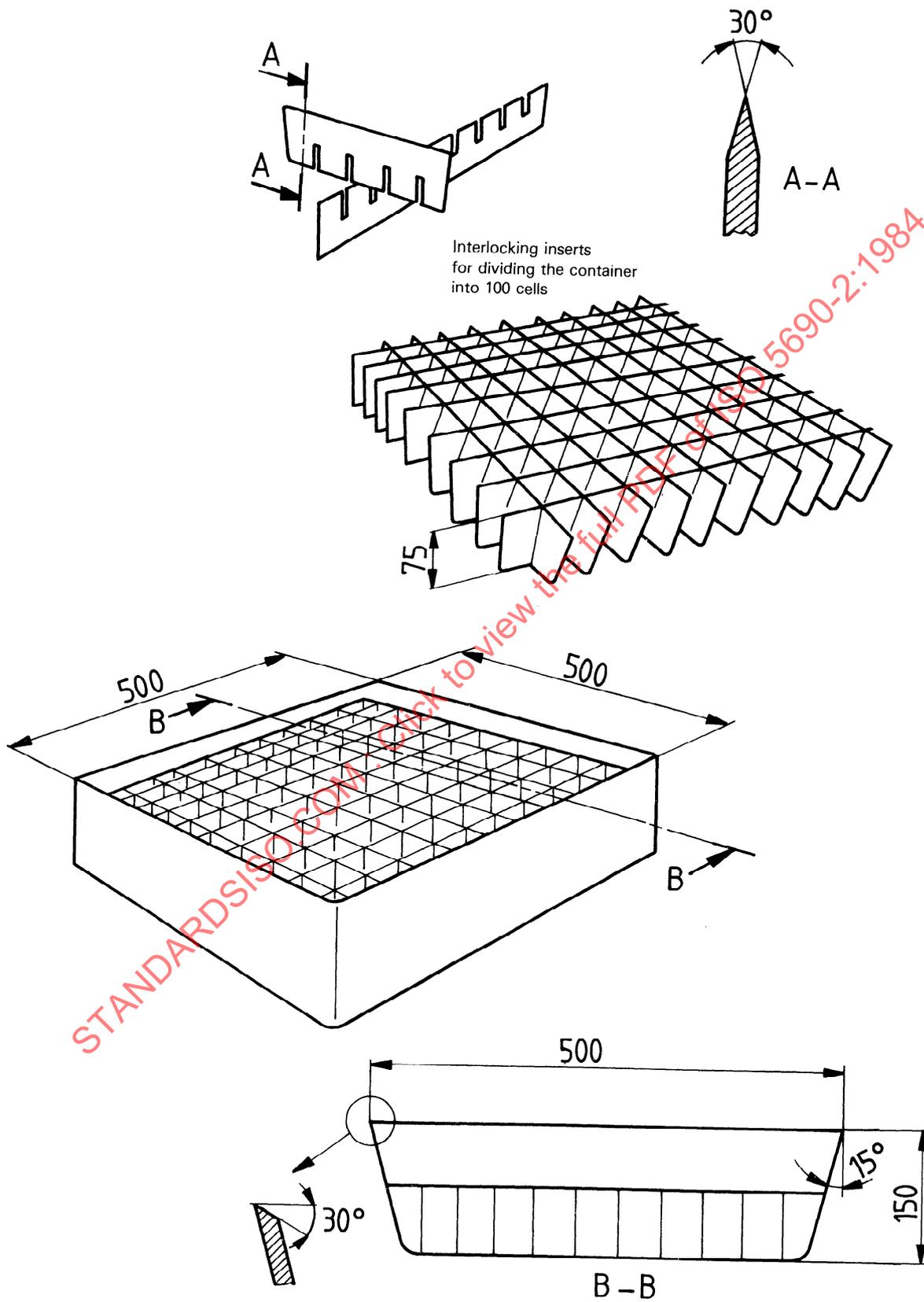


Figure 1 — Example of a fertilizer-collecting container for fertilizer distributor tests

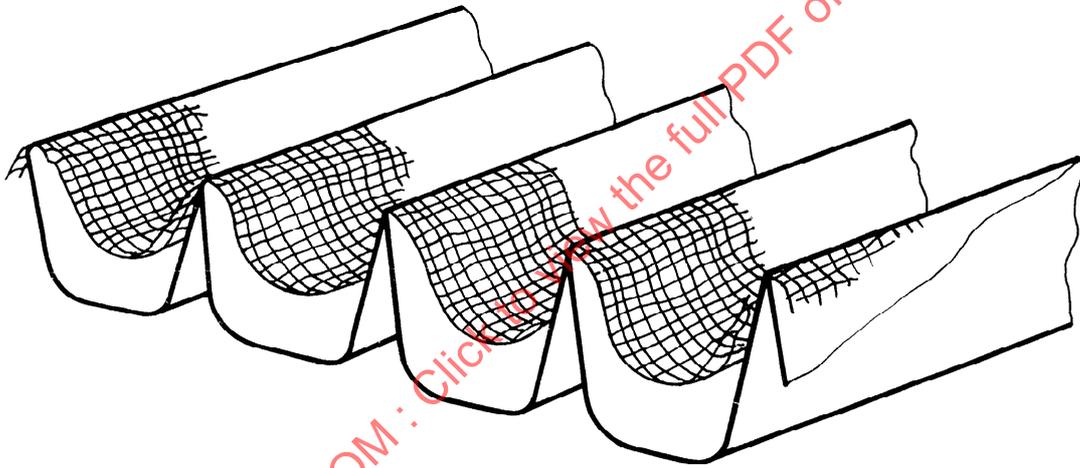


Figure 2 — Example of arrangement of a protective net over the containers to protect against ricochet

Annex A

Programming of primary (mandatory) tests

Table 1

Designation of test	Type of test	No. of test	Conditions of test					
			Slope	Fertilizer level in hopper ¹⁾	Forward speed m/s	Application rate adjustment	Type of fertilizer (see 4.2.1)	
1 Effect of fertilizer level in the hopper	static	100	none	—	1,50	min.	a	
		101		1/8	max.	a		
		102		—	1,50	min.	b	
		103		1/8	max.	b		
		104		—	1,50	min.	c	
105	1/8	max.	c					
2 Effect of flow rate	static	210	none	1/2	1,50	min.	a	
		211		—	2,50	mean	a	
		212		—	max.	max.	a	
		213		—	1,50	min.	a ²⁾	
		214		—	1,50	min.	b	
		215		—	max.	max.	b	
		216		—	1,50	min.	c	
	217	—	max.	max.	c			
	22 Accuracy of metering	mobile	220	none	1/2	1,50	min.	a
			221		—	2,50	mean	a
222			—		max.	max.	a	
223	—	1,50	min.	b				
224	—	max.	max.	b				
225	—	1,50	min.	c				
226	—	max.	max.	c				
3 Effect of slope	static	310 } 311 } 312 } 313 } 314 }	20 % upwards	1/2	max.	max. ³⁾	a	
				—	2,50	mean	a	
				—	max.	max. ³⁾	b	
				—	2,50	mean	b	
				—	2,50	mean	c	
		315 } 316 } 317 } 318 } 319 }	20 % downwards	—	1,50	min. ³⁾	a	
				—	2,50	mean	a	
				—	1,50	min. ³⁾	b	
				—	2,50	mean	b	
				—	2,50	mean	c	
	32 Lateral	static	320 } 321 }	20 % to the right	1/2	2,50	mean	a
					—	2,50	mean	b
			322 } 323 } 324 } 325 }	20 % to the left	—	2,50	mean	c
					—	2,50	mean	a
					—	2,50	mean	b
—	2,50	mean	c					
4 Effect of bumps	mobile	400	none	1/2	1,50	min.	a	
		401		—	max.	max.	a	
		402		—	1,50	min.	b	
		403		—	max.	max.	b	
		404		—	1,50	min.	c	
		405		—	max.	max.	c	

1) The hopper shall be full, unless indicated otherwise.

2) Repeat the test to examine the reliability of the adjustment.

3) When the fertilizer outlet is situated at the rear of the feed mechanism. If the outlet is situated at the front, the adjustments are changed as follows :

No. of test	Forward speed m/s	Application rate adjustment
310	1,50	min.
312	1,50	min.
315	max.	max.
317	max.	max.

Annex B

Determination of physical properties of fertilizers

B.1 Granulometric analysis

Carry out the granulometric analysis on a sample of 1 000 g of fertilizer, selected from the body of the fertilizer prior to its passing through the distributor. Do not dry the sample before sieving, which shall be effected using an approved type of mechanical sieve shaker vibrator.

Use square mesh sieves as specified in ISO 565, with the following mesh openings, in millimetres:

0,125; 0,250; 0,500; 0,710; 1,000; 2,000; 2,800; 4,000

The sieving period shall correspond to the instructions given by the sieve manufacturer. In the absence of such recommendations, it is 5 min.

Show the results of the granulometric analysis in accordance with ISO 565.

B.2 Bulk density (loose)

See ISO 3944.

B.3 Water content

Under study.

B.4 Angle of repose

Under study.

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Annex C

Optional tests

C.0 Introduction

These tests are left to the discretion of test offices. They shall allow visible operating faults to be noted. Under no circumstances do they concern robustness testing.

C.1 Ease of use

The loading facility (whose dimensions shall comply with ISO 5698 and ISO 5699), adjustment and cleaning shall be demonstrated as well as the possible effect of the presence of the distributor upon the ease of use of the basic machine.

C.2 Evenness of distribution on the application site

C.2.1 Distributors scattering on the ground

The quality of longitudinal and transverse metering shall be demonstrated.

C.2.2 Distributors which bury the fertilizer

The quality of longitudinal metering shall be demonstrated as well as the depth and evenness of placing the fertilizer.

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Annex D

Example of a test report on a fertilizer distributor in lines

Name and address of manufacturer :

Tests carried out on fertilizer distributor in lines by :

The specimen subjected to tests was selected by the manufacturer with the agreement of the testing office.

1 Specifications of the fertilizer distributor in lines

Characteristics

Make :

Type :

Serial No. :

Trailed, semi-mounted, mounted equipment :

Distributor and type of drive :

Type of selection and gear ratio :

Maximum and minimum working speed : km/h

Maximum and minimum rotary frequency of the distributing mechanism : min⁻¹

Types of fertilizers distributed :

Overall dimensions

Width

— in working position : m

— when positioned for road travel : m

Height when positioned for road travel : m

Length when positioned for road travel : m

Miscellaneous specifications

Load height : m

Hopper(s) capacity : dm³

Unladen mass : kg

Loaded mass (state the type of fertilizer) : kg

Tyre dimensions :

Radius of the tyres at half load : mm

Tyre pressure : N/m²

Numerical codes of instruments (as specified in ISO 7424) :

2 Features of fertilizers

Table 2

Dimensions of square mesh sieves mm	Types of fertilizer		
	a : Granular	b : Prill	c : Other type
	Percentage passing through the sieve		
0,125			
0,250			
0,500			
0,710			
1,000			
2,000			
2,800			
4,000			
Bulk density (loose), kg/m ³			
Water content, % (m/m)			
Natural angle of repose, °			

3 Test conditions

Date and place :

Kind and type of fertilizer :

Adjustment of the distributor

Level of fertilizer in the hopper :mm

Forward speed :m/s

Adjustment of the flow :kg/h or dm³/h

Rotary frequency of the distributing mechanism :min⁻¹

Atmospheric conditions

Humidity :%

4 Test results

4.1 Primary (mandatory) tests

4.1.1 Evenness of flow rate

4.1.1.1 Effect of the level of fertilizer in the hopper

4.1.1.2 Effect of flow rate adjustment (table 3)

4.1.1.3 Effect of slope (table 3)

Table 3

No. of test and conditions of test	No. of coulters	Type a : Granulated fertilizer		Type b : Prilled fertilizer		Type c : Other (....) fertilizer	
		Mean flow rate	Deviation with respect to the mean	Mean flow rate	Deviation with respect to the mean	Mean flow rate	Deviation with respect to the mean
No. Height of fertilizer in the hopper : - 1/1 - 1/2 - 1/8 Forward speed, m/s : - 1,5 - 2,5 - max. Adjustment of application rate : - min. - mean - max. Slope and direction of slope : - horizontal - towards rear - towards front - to right - to left							

4.1.2 Accuracy of metering

4.1.2.1 Effect of flow rate adjustment

4.1.2.2 Effect of bumps (table 4)

Table 4

No. of test and conditions of test	Location of the checked metering device	Type a : Granulated fertilizer			Type b : Prilled fertilizer			Type c : Other (....) fertilizer		
		Mean	Standard deviation	Coefficient of variation	Mean	Standard deviation	Coefficient of variation	Mean	Standard deviation	Coefficient of variation
No. ... Height of fertilizer in the hopper : - 1/1 - 1/2 Forward speed, m/s : - 1,5 - 2,5 - max. Adjustment of application rate : - min. - mean - max.										