

# International Standard



# 8524

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## Equipment for distributing granulated pesticides or herbicides — Test method

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## Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8524 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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# Equipment for distributing granulated pesticides or herbicides — Test method

## 0 Introduction

The aim of this International Standard is to harmonize testing of equipment for distributing granulated pesticides or herbicides, by means of standardized tests which are reproducible, allowing comparable results in figures and graph form to be obtained.

The tests assess the effects of the type of granulated pesticides or herbicides, the level of granules in the hopper, the application rate setting and the forward speed, on flow rate, evenness of flow rate and evenness of distribution.

Optional tests (see annex B) can complete the assessment.

NOTE — These tests may be combined with tests on the basic machine to which the distributor is linked. In such cases, the test refers to this combination.

## 1 Scope and field of application

This International Standard specifies a laboratory test method for granulated pesticide or herbicide distributors, including distributors for attachment to a basic machine.

## 2 Reference

ISO 3534, *Statistics — Vocabulary and symbols*.

## 3 Definitions

For the purposes of this International Standard, the following definitions apply.

**3.1 granule pesticides or herbicides (granules):** Plant protection product in granule form, for example made up of an active and a carrying material, with particle size of between 0,15 and 2,00 mm.

**3.2 granule distributors:** Equipment for distributing the granulated product defined under 3.1, over a wide area, in rows, bands or at individual spots.

**3.3 basic machine:** Implement (e.g. single seed drill) to which additional accessories (e.g. granule distributor) are fitted.

**3.4 feed mechanism (of granules):** Mechanism which takes the granules from a hopper to transfer them at a constant predetermined flow rate onto the ground (e.g. broadcast or in a band) or into the soil (e.g. into a drill via a feed pipe).

**3.5 flow rate (of granules):** Quantity of granules distributed, expressed in mass or volume, per unit of time.

**3.6 application rate (of granules):** Quantity of granules distributed, expressed in mass or volume, per unit of length or surface, or per spot.

**3.7 hopper capacity:** Total of granules which the hopper is designed to contain.

The top surface of the material shall be horizontal. If there is no full mark or statement in the manufacturer's instructions, the hopper shall be filled to a level 2 cm below the lowest top edge.

## 4 General test conditions

### 4.1 Granule 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. It shall be either a complete multi-row unit or three individual units with all accessories.

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

The test report (see annex C) shall specify how the distributor for testing was chosen. Should the test on the distributor be combined with a basic machine, the distributor chosen will be that attached to the basic machine.

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

#### 4.1.2 Manufacturer's instructions<sup>1)</sup>

The distributor shall be used in accordance with the manufacturer's instructions which shall include, among other things:

- a) range of working speeds, in kilometres per hour;
- b) type of feed mechanism and types of granules (if the device includes several interchangeable mechanisms) which can be distributed by each model;
- c) types of granules which the distributor can distribute;
- d) accessories required for distributing certain types of granules;
- e) minimum and maximum flow rates of the emptying device of each feed mechanism for each granule;
- f) if the basic machine is fitted with pneumatic tyres, the inflation pressure, in bars.<sup>2)</sup>

#### 4.1.3 Checking of specifications

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

### 4.2 Granules

#### 4.2.1 Types

Tests shall be carried out with up to three different granular materials indicated by the manufacturer of the distributor. If, for safety reasons, the test has to be carried out with simulated granulated products, not more than three of the following types should be used:

- a) Pumice stone (common quality):
  - poor flow qualities, rough, coarse, hard;
  - bulk density: approximately 0,4 g/cm<sup>3</sup>;
  - granule size: 1,0 to 1,6 mm for more than 85 % of the mass.
- b) Quartz:
  - good flow qualities, round, fine grained, hard, heavy;
  - bulk density: approximately 1,4 g/cm<sup>3</sup>;
  - granule size: 0,5 to 1,0 mm for more than 85 % of the mass.

#### c) Calcite:

- wide distribution of granule size, heavy, soft;
- bulk density: approximately 1,4 g/cm<sup>3</sup>;
- granule size: 0,4 to 1,0 mm for more than 85 % of the mass.

#### d) Gypsum:

- good flow qualities, round, soft;
- bulk density: approximately 0,9 g/cm<sup>3</sup>;
- granule size: 0,4 to 0,9 mm for more than 85 % of the mass.

e) Any other granulated product which the test office and manufacturer considers of sufficient importance and the physical properties of which differ from the products indicated above.

The granulated products used shall be listed in the test report.

#### 4.2.2 Physical characteristics

The following physical characteristics of the granules used in the test shall be determined: particle size distribution, bulk density, water content, slope angle. The type of simulated product, if appropriate, shall also be stated.

### 4.3 Ambient conditions

Atmospheric humidity and temperature at the time of the test shall be noted in the test report.

## 5 Mandatory tests<sup>3)</sup>

### 5.1 Nature of tests (see annex A)

These tests shall allow determination of the evenness of the flow rate and of distribution and will include both static and mobile measurements.

#### 5.1.1 Static tests

With the distributor stationary, the drive wheel, if it exists, shall rest on the drive mechanism. The drive wheel or any other power input shall be driven at a speed equal to that which it would have for actual work, i.e. at the theoretical 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, uniform surface.

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

2) 1 bar = 10<sup>5</sup> Pa = 100 kPa (exactly).

3) For the optional tests, see annex B.

## 5.2 Distance between the feed mechanism and the surface

Care shall be taken that the outlet of the mechanism is placed at the same average distance from the surface (collecting boxes) as in actual working conditions.

## 5.3 Types of tests

### 5.3.1 Evenness of flow rate

The test shall be carried out with the machine stationary, with at least three feed mechanisms to compare their flow rates. The granules shall be collected in boxes placed under the feed mechanism or, for example, under the pipes or fishtails, where fitted.

NOTE — Air-assisted distributors need not have three feed mechanisms.

### 5.3.2 Evenness of distribution

#### 5.3.2.1 Test conditions

The test shall be carried out on a moving machine with at least three feed mechanisms. The granules shall be collected in boxes placed on the ground.

The collecting boxes shall have external dimensions of approximately 100 mm × 100 mm and a depth of approximately 30 mm.

The boxes shall be of anti-static material and provision shall be made to avoid loss through rebounding. Sloping walls allow the granules to empty into a weighing bowl, while preventing foreign bodies from falling into the bowl. Cardboard boxes covered in plastic have proved satisfactory.

Ensure that only the feed mechanisms under test direct their flow into the boxes, flow from the other feed mechanisms being deflected but not stopped, which could influence the discharge.

NOTE — Air-assisted distributors need not have three feed mechanisms.

#### 5.3.2.2 Arrangement of boxes

##### 5.3.2.2.1 Arrangement of boxes for spot distribution

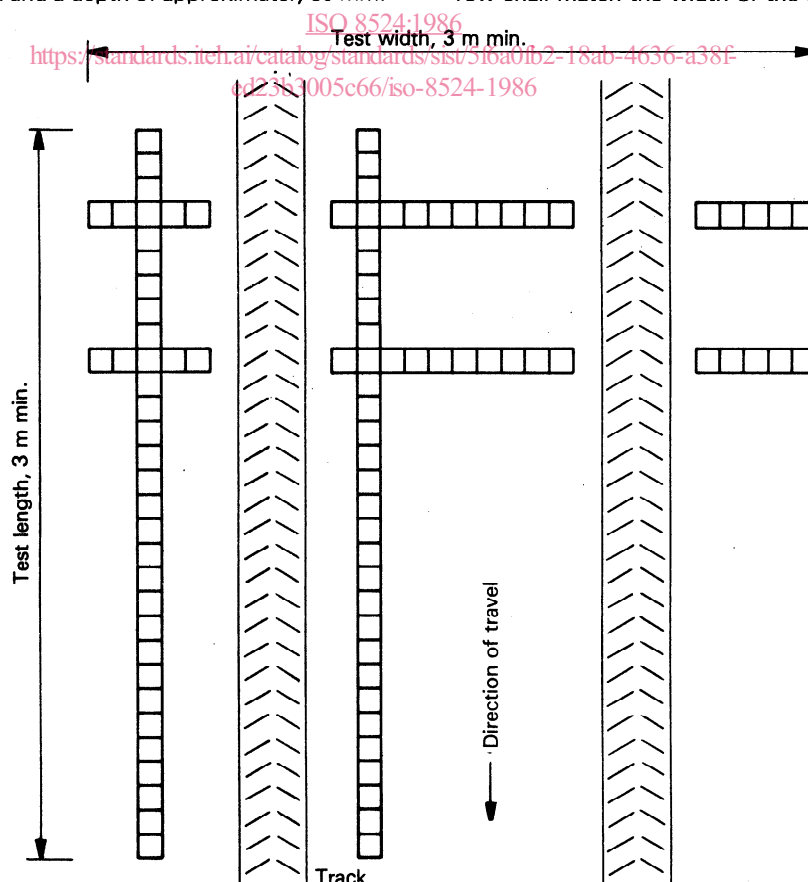
Thirty collecting boxes shall be placed at each spot where the granules are to be dropped in the direction of travel. The number of boxes (or arrangement of boxes) per spot shall be chosen in accordance with the area of a spot.

##### 5.3.2.2.2 Arrangement of boxes for row application

Fifty collecting boxes shall be placed successively in a row in the direction of travel.

##### 5.3.2.2.3 Arrangement of boxes for band application

Fifty collecting boxes (or a set of boxes) shall be placed successively in a row in the direction of travel. The width of the row shall match the width of the band.



NOTE — To calculate  $n$  (see 7.2.1), boxes at crossings shall be counted twice.

Figure 1 — Box arrangement for broadcast application

#### 5.3.2.2.4 Arrangement of boxes for broadcast application

The collecting boxes shall be set as shown in figure 1. The test width and length shall be at least 3 m.

The test office shall report the arrangement of the boxes.

### 5.4 Adjustment and measurement

#### 5.4.1 Selection of feed mechanisms

The flow and distribution tests shall be carried out simultaneously or successively.

#### 5.4.2 Filling the hopper

The granules shall be loaded 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 speeds

In the case of land-wheel-driven machines, the relative distributor/ground speeds shall be minimum, maximum and arithmetical mean speeds, recommended by the manufacturer.

For static tests the rotational frequency,  $\omega$ , of the land-wheel is given by

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

where

$v$  is the forward speed, in metres per second;

$R$  is the radius of the tyre under average load.

In the case of PTO-driven machines, the PTO speed or any other power input speed shall be chosen in accordance with the manufacturer, and noted in the test report.

#### 5.4.4 Adjustment of application rate

For each type of granule, the tests shall be carried out at the minimum and maximum application rate settings recommended by the manufacturer and the arithmetical mean between minimum and maximum.

If a mean rate setting or the mean speed cannot be obtained within the range of adjustments of the distributor, take the nearest rate setting or speed which this range of adjustment allows. Note this in the test report.

#### 5.4.5 Duration of tests

Before the start of each recording, sufficient time shall be allowed to avoid any unevenness of flow due to starting up and to allow free flow of the granules from the hopper to the feed mechanism.

#### 5.4.5.1 Flow rate test

Two recordings lasting at least 15 s shall be made for each test.

#### 5.4.5.2 Distribution test

The distributor shall complete a single pass over the collection boxes at the set forward speed and application rate.

#### 5.4.6 Taking measurements

The granules collected in each box (or set of boxes) shall be weighed.

### 6 Test procedure

The test procedure and programming shall be in accordance with annex A.

#### 6.1 Effect of forward speed, adjustment of application rate and type of granules (test No. 1)

Determine whether there are any effects of forward speed, adjustment of application rate or type of granules on flow rate and distribution.

#### 6.2 Effect of the granule level in the hopper (test No. 2)

Determine whether the level of granules in the hopper influences the flow rate or its evenness due to settling or bridging.

### 7 Test results

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

The individual test results shall be reported, as appropriate, together with the results of the calculations according to 7.1 and 7.2.

#### 7.1 Flow rate tests

7.1.1 Calculate the average of the two recordings for each test so as to obtain a single flow rate value  $D_i$  for each feed mechanism.

7.1.2 Calculate the percentage deviation for each feed mechanism, given by

$$\frac{D_i - \bar{D}}{\bar{D}} \times 100$$

where

$$\bar{D} = \frac{1}{n} \sum D_i$$



**7.1.3** Calculate the relative differences of  $D_i$  for all feed mechanisms in the recordings in relation to the average:

$$\text{Relative difference} = \frac{D_{i, \max} - D_{i, \min}}{\bar{D}} \times 100$$

**7.1.4** The degree of unevenness shall be demonstrated by the coefficient of variation CV:

$$CV = \frac{s}{\bar{D}}$$

where

$s$  is the standard deviation given by the equation

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

in which  $n$  is the number of feed mechanisms, or number of tests for effect of granule level in the hopper.

## 7.2 Distribution tests

**7.2.1** Calculate the average mass,  $\bar{M}_n$ , of each longitudinal row of collecting boxes or arrangement of boxes, where  $n$  is the number of collecting boxes or arrangement of boxes per row.

**7.2.2** Calculate the coefficient of variation,  $CV_n$ , of each row of collecting boxes

$$CV_n = \frac{s}{\bar{M}_n}$$

where

$s$  is the standard deviation given by the equation

$$s = \sqrt{\frac{1}{n-1} \sum (M_i - \bar{M}_n)^2}$$

in which

$M_i$  is the mass collected in individual boxes or collection of boxes;

$\bar{M}_n$  is given by the equation

$$\bar{M}_n = \frac{1}{n} \sum M_i$$

**7.2.3** Calculate the relative difference per row, Rel. diff.  $_n$ , by the equation

$$\text{Rel. diff. } _n = \frac{M_{i, \max} - M_{i, \min}}{\bar{M}_n} \times 100$$

**7.2.4** Calculate the mass collected,  $M_i$ , in each collecting box or arrangement of boxes, expressed as a percentage of  $\bar{M}_n$  for spot, strip, or band application or as percentage of  $\bar{M}_N$  for broadcast application, where  $n$  (or  $N$ ) is the total number of boxes.

**7.2.5** For broadcast application the following shall also be calculated and reported:

$$a) \bar{M}_N = \frac{1}{N} \sum M_i$$

$$b) CV_N = \frac{s}{\bar{M}_N}$$

where

$$s = \sqrt{\frac{1}{N-1} \sum (M_i - \bar{M}_N)^2}$$

in which  $N$  is the number of all collecting boxes.

$$c) \text{ Rel. diff. } _N = \frac{M_{i, \max} - M_{i, \min}}{\bar{M}_N} \times 100 \text{ for all collecting boxes.}$$

## 8 Test report

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

## Annex A

## Programming of mandatory tests

Table 1 — Mandatory tests

Description of test	Type of test	No. of test	Test procedure			
			Degree of fill	Theoretical forward speed	Adjustment of application rate	Type of granule
<b>1 Effect of forward speed, adjustment of application rate and types of granules</b>  <b>10</b> on flow rate on evenness of flow rate  <b>11</b> on evenness of distribution	static          mobile	100 101 102 103 104 105 106 107 108  110 111 112 113 114 115 116 117 118	1/2          1/2	min. min. min. mean mean mean max. max. max.  min. min. min. mean mean mean max. max. max.	min. mean max. min. mean max. min. mean max.  min. mean max. min. mean max. min. mean max.	Maximum of three types of granules according to 4.2.1.
<b>2 Effect of level in the hopper<sup>1)</sup></b>  <b>20</b> on flow rate on evenness of flow rate	static	201 202 <sup>2)</sup> 203 204	1/1 1/2 1/4 min. <sup>3)</sup>	mean mean mean mean	mean mean mean mean	

1) In the case of several hoppers, one shall be chosen for the test.

2) This test corresponds to test No. 104.

3) Minimum level recommended by the manufacturer (state in the test report).

## Annex B

### Optional tests

#### B.0 Introduction

These tests are left to the discretion of the test office. They should allow the observation of visible operating faults. Under no circumstances do these concern testing of robustness.

#### B.1 Ease of use

##### B.1.1 Loading, coupling

Ease of loading, coupling, uncoupling and adjustment shall be assessed as well as the possible effect of the presence of the distributor upon the ease of use of the basic machine.

##### B.1.2 Adjustment

Pay special attention to the facility with which the operator can obtain a set application rate and determine the optimum adjustment for all the controls or adjustment devices exercising an influence on the evenness of distribution and accuracy of application rate after adjustment. Indicate also the extent to which the service manual eases the operator's task in this area and the language in which it is printed.

#### B.1.3 Maintenance, cleaning

Estimate the ease with which daily and periodic maintenance can be undertaken. Similarly, note the ease of daily and periodic cleaning, and special features such as access to the working parts, facilities for emptying, resistance to corrosion.

#### B.2 Change of granule

Assess whether granules are changed by being passed through the distributor.

#### B.3 Effect of slope

Ascertain whether the position of the equipment working on sloping ground influences the evenness of flow and the distribution for broadcast application.

The test schedule and programming shall be in accordance with table 2.

#### B.4 Practical use of feed mechanism

Check the practical use of the feed mechanism for certain other types of granulated products.

Table 2 — Slope test

Description of test	Type of test	No. of test	Test procedure				
			Slope	Degree of fill	Theoretical forward speed	Adjustment of application rate	Type of granule
<b>31</b> on flow rate on evenness of flow rate	static	310	20 % ascending	1/2	mean	max.	Maximum of three types of granules according to 4.2.1.
		311	20 % <sup>1)</sup> descending	1/2	mean	max.	
		312	20 % to right	1/2	mean	max.	
		313	20 % <sup>1)</sup> to left	1/2	mean	max.	
<b>32</b> on evenness of distribution for broadcast application	mobile	320	20 % ascending	1/2	mean	max.	
		321	20 % <sup>1)</sup> descending	1/2	mean	max.	
		322	20 % to right	1/2	mean	max.	
		323	20 % <sup>1)</sup> to left	1/2	mean	max.	

1) Depending on the type of feed mechanism, and left to the discretion of the test office.