International Standard 7256/1

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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.

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Sowing equipment — Test methods — Part 1: Single seed drills (precision drills)

0 Introduction

The aim of this part of ISO 7256 is to make available to test offices and other interested organizations a standardized test method permitting reproducibility of tests when they are carried out in geographically remote areas and/or in different climatic conditions; the main objective being comparability for any one model of equipment.

This condition of reproducibility limits the number of mandatory tests which can be used and eliminates mandatory tests in the field. However, these tests may be carried out optionally at the instigation of the test office or at the request of the manufacturer.

1 Scope and field of application

This part of ISO 7256 specifies test methods for single seed drills (precision drills).

2 Reference

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

NOTE — A future International Standard will deal with classification and terminology of equipment for sowing and planting.

3 Definitions

For the purpose of this part of ISO 7256 the following definitions apply.

3.1 single seed drills (precision drills): Drills whose metering mechanism distributes seeds singly by means of a burying device at predetermined intervals to form a sowing line.

NOTE — As the great majority of sowing equipment has equidistant spacings, the tests refer only to this type of equipment.

3.2 sowing unit (for seed): Unit generally comprising the metering mechanism and the burying device.

3.3 metering mechanism (for seed): Mechanism which takes seeds from a batch leaving the hopper individually or in groups and deposits them in a line (or row).

3.4 burying device: Device generally comprising a coulter, a device to regulate the ground penetration depth of the coulter and a unit that covers the seed.

3.5 coulter: Device for opening a furrow in the ground in which the seeds leaving the metering mechanism are placed.

3.6 flow rate: Amount of seed distributed, expressed as a number, mass or volume of seed per unit of time.[1)]

3.7 application rate: Amount of seed distributed, expressed as a number, mass or volume of seed per unit of length or surface.[1)]

3.8 spacing: The distance between two successive seeds in the row.

theoretical spacing: Spacing set on the control mechanism and stated by the manufacturer.

3.9 miss: For a single seed drill, the absence of a seed where there should be one theoretically. In practice, by analogy with statistical evaluation of results, all spaces larger than 1,5 times the theoretical seed spacing are considered to be misses (see 6.1.1).

3.10 multiples: For a single seed drill, the presence of two seeds or more where there should only be one. In practice, by analogy with statistical evaluation of results, all spacings less than 0,5 times the theoretical seed spacing are considered to be multiples (see 6.1.1).

1) For precision drills, only the number is to be taken into consideration for flow rate and application rate measurements.

4 General test conditions

4.1 Seed drill

4.1.1 Selection

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

The seed drill 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 F) shall specify how the drill to be tested was chosen.

4.1.2 Manufacturer's instructions

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

a) the maximum forward speed and, if appropriate, the minimum forward speed, expressed in metres per second;

b) the maximum, and if appropriate, the minimum number of revolutions, expressed in minutes to the power of minus one (min^{-1}), and/or peripheral speed, expressed in metres per second, of the metering mechanism;

c) the species and types of seed which may be sown;

d) the metering mechanisms suited to each seed species.

4.1.3 Checking of specifications

The technical characteristics supplied by the manufacturer shall be indicated in the test report and shall be checked.

4.2 Seed

4.2.1 Types

The tests shall be carried out taking into account the manufacturer's specifications.

4.2.1.1 Single-purpose drill

If the seed drill is stated to be specifically for one or more types of seed and/or distribution methods, the test shall be carried out exclusively with the seeds indicated by the manufacturer, and, as appropriate, of the size specified.

4.2.1.2 Multipurpose drill

If the drill is stated to be multipurpose, the tests shall be carried out with the following four types of seed:

— type a: a medium size round seed 3 ± 0,75 mm in diameter (for example, pea or a coated seed the coating of which shall be smooth and of a regular shape);

— type b: a small seed of regular shape (for example, cabbage) of diameter less than 3 mm;

— type c: a large irregular seed (for example, bean or flat maize seeds) of diameter greater than 6 mm;

— type d: the most difficult seed permitted by the manufacturer (for example unpelleted genetically monogerm beet seed, carrot, etc.).

NOTE — The seeds shall not have been subjected to any treatment which could change their physical properties, except that incorporated in the coatings.

4.2.2 Characteristics

The dimensional characteristics (scale and granulometric profile), purity (percentage of foreign bodies, bad seeds and broken seeds) and water content of the batch of seeds used shall be noted in the test report.

4.3 Ambient conditions

The hygrometric levels shall be observed and noted in the test report.

5 Mandatory tests[1)]

5.1 Nature of test (see annex A)

The mandatory tests deal essentially with the precision of seed planting and the efficiency of metering.

Each test shall be carried out with three different units, either three units on one multirow drill or three independent sowing units if each one has a metering mechanism.

Tests 1, 2, 3 and 6 (see annex A) shall be carried out with the sowing unit either static or mobile.

Test 4 (see annex A) shall be carried out with the sowing unit mobile.

Test 5 (see annex A) shall be carried out with the sowing unit moving over a bed of sand.

5.1.1 Static tests

With the sowing unit stationary, the metering mechanism shall be driven at a rotary speed equal to that which it would have for actual work, i.e. taking into account the theoretical forward speed and the adjustment of the ratio between the metering mechanism and the driving wheel speeds. In order to simulate the relative movement of the drill above the ground, an

1) For optional tests see annex E.

adhesive strip moving at the relative forward speed of the drill when travelling without slipping may be run underneath the seed drill.

NOTE — This recording on to an adhesive strip may be replaced by any other recording method, such as an acoustic or optical method. The method used shall be noted in the test report.

5.1.2 Mobile test

The sowing unit shall be fixed to a mobile trolley moving at a constant speed and without jolting over a stationary adhesive strip.

NOTE — Recording by means of an adhesive strip may be replaced by any other recording method, such as an acoustic or optical method. The method used shall be noted in the test report.

5.1.3 Test on a bed of sand

The sowing unit shall move over a bed of sand of specified characteristics (see the note) at a constant speed and without jolting.

The coulter shall penetrate this sand to a depth at least equal to the minimum working depth.

For this test, the coulter may be equipped with deflectors which, without interfering with the placing of the seeds, prevent the sand from falling back. It shall be maintained at a constant depth.

The forward speed shall be equal to the actual speed of the seed drill at work.

NOTE — Characteristics of the sand may be as follows:

a) foundry sand:
   - granulometry of 85 to 120 µm,
   - clay content intended to provide a binding agent (20 to 25 %),
   - water content between 4 and 6 %;

b) a pure sand (such as Fontainebleau sand to which a low-viscosity oil is added in the proportion of 1 %).

5.2 Adjustments and procedure

5.2.1 Position of the coulters (see annex A)

Tests 1, 2 and 6 (see annex A) may be carried out with the coulters raised, on the recommendation of the manufacturer. The distance between the metering mechanism seed outlet and the impact surface shall be as close as possible to that in actual practice between the seed outlet and the bottom of the furrow.

Test 3 (see annex A) shall be carried out partially with the coulter in position so as to check whether there is any seed rebound against the coulter wings. If so, the distance between the metering mechanism outlet and the impact surface shall be slightly greater, but still as close as possible to the actual distance so as not to extend the seed fall distance unduly. This distance shall be noted in the test report.

Tests 4 and 5 (see annex A) shall be carried out with the coulter in position.

5.2.2 Filling the hoppers

The hoppers shall be filled at the time of the test, avoiding any abnormal compaction of the seed.

For the tests with the hopper full, half full and one eighth full, these volumes correspond to 100, 50 and 12,5 % of the total volume of the hopper plus the usable volume of the metering mechanism feed chamber.

5.2.3 Forward speed

Three relative drill/ground speeds shall be chosen corresponding to the forward speeds from the range 1; 1,50; 2; 2,50 and 3 m/s in accordance with the manufacturer's instructions.

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 relative forward speed;

R is the radius of the tyre under average load.

5.2.4 Adjustment of the metering

The tests shall be carried out with the average spacings currently used in agriculture for these types of seeds. These metering amounts shall be recorded in the test report.

5.2.5 Speed adjustment of the metering mechanism

As the seed spacing control is obtained by a combination of the number of the holes or cells of the metering mechanism and its rotary (or linear) speed, the tests shall be carried out at maximum and minimum speeds and at the intermediate speed closest to the mean arithmetical speed between the maximum and minimum speeds specified by the manufacturer for the type of seed to be tested, adjusting the metering member (drum, disc or belt) on the sowing unit for the particular spacings.

If there is only one means of adjusting the spacing, the test shall only be carried out with this one setting.

5.2.6 Slope test

The slope tests shall be as follows:

a) ascending a slope: incline the sowing unit 11° towards the rear (corresponding to a 20 % slope);

b) descending a slope: incline the sowing unit 11° towards the front;

c) slope to the right: incline the sowing unit 11° to the right;

d) slope to the left: incline the sowing unit 11° to the left.

5.2.7 Duration of the tests

The number of runs may vary according to the length of the test bench. They shall cover a total workable distance corresponding to a minimum of 250 seeds *in situ*.

For each run on the test bench (mobile test) or each run on a mobile strip (static test), disregard an appropriate length to cancel out irregularities resulting from initial acceleration.

Before each test for which the hopper is filled, rotate the metering mechanism sufficiently to allow the seed flow to fill the feed chamber of the distributing mechanism.

5.2.8 Measuring procedure

The measurements relate solely to the distance between the seeds, both in the static and mobile tests. The unit of measurement shall be the millimetre, the spacing between two seeds being measured from the geometric centres of two consecutive seeds.

5.3 Test procedure (see annex A)

5.3.1 Effect of the level of seeds in the hopper (test 1)

Determine whether the level of seeds in the hopper has an effect on the feeding of the metering mechanism.

5.3.2 Effect of the adjustment of the speed of the metering mechanism (test 2)

Determine whether this speed has an effect on the feeding of the metering mechanism.

5.3.3 Effect of the position of the apparatus working on slopes (test 3)

5.3.3.1 Ascending and descending slopes

Determine whether these slopes have an effect on the feeding of the metering mechanism.

5.3.3.2 Lateral slopes

Determine whether these slopes have an effect on the feeding of the metering mechanism and the spacing precision (rebounds from the wings of the coulter).

5.3.4 Effect of the forward speed of the seed drill (test 4)

Determine whether this speed has an effect on the feeding of the metering mechanism and on the spacing precision.

5.3.5 Effect of the unwanted movements of seeds (test 5)

Check whether such movements exist (rotation of the seed) and whether they have an effect on planting accuracy.

5.3.6 Effect of the separation of the seeds (test 6)

Check if there is any seed separation in the hopper and whether it has an effect on the feeding.

NOTE — Before the test the metering mechanism should be rotated for 30 min feeding it constantly with new seeds from the batch to be tested and never letting the level in the hopper fall to below 1/8 of its capacity. The test is then carried out with the seeds remaining in the bottom of the hopper (filled to 1/8 capacity).

6 Test results

6.1 Results of mandatory tests

Add the figures for each run to obtain one result per test; thus tests on three sowing elements shall give three results for each test (one per unit).

6.1.1 Processing of data

6.1.1.1 The adjustment of the seed drill in accordance with the manufacturer's instructions gives the theoretical seed spacing x_{ref}. This theoretical spacing shall be verified by the testing office.

6.1.1.2 The measurement check gives the different values x for the spacing between successive seeds during the test.

6.1.1.3 These different values of x are divided up into segments equal to 0,1 x_{ref} distributed on either side of x_{ref}. Thus the intervals obtained around x_{ref} are as follows:

$[0{,}9\ x_{ref},\ x_{ref}]$; $[x_{ref},\ 1{,}1\ x_{ref}]$ etc.

6.1.1.4 Each segment is allocated the variable

$$X_i = \frac{x_i}{x_{ref}}$$

where x_i is the median of the segment.

6.1.1.5 The following are then drawn up:

a) a frequency table (see annex C) showing the different values of X_i and the number of times, n_i, that each value of X_i has been plotted.

b) a frequency histogram (see annex D) with the abscissa giving the values of X_i and the ordinate values of $F_i = \frac{n_i}{N}$, where N is the number of seeds recorded during the test.

6.1.1.6 The frequency table shall be divided up in accordance with the following intervals:

$\{0 \text{ to } \leqslant 0{,}5\}$
$\{> 0{,}5 \text{ to } \leqslant 1{,}5\}$
$\{> 1{,}5 \text{ to } \leqslant 2{,}5\}$
$\{> 2{,}5 \text{ to } \leqslant 3{,}5\}$
$\{> 3{,}5 \text{ to } +\infty\}$

if:

$n'_1 = \Sigma n_i \, (X_i \in \{0 \text{ to } 0{,}5\})$
$n'_2 = \Sigma n_i \, (X_i \in \{> 0{,}5 \text{ to } \leqslant 1{,}5\})$
$n'_3 = \Sigma n_i \, (X_i \in \{> 1{,}5 \text{ to } \leqslant 2{,}5\})$
$n'_4 = \Sigma n_i \, (X_i \in \{> 2{,}5 \text{ to } \leqslant 3{,}5\})$
$n'_5 = \Sigma n_i \, (X_i \in \{> 3{,}5 \text{ to } +\infty\})$

then:

$$N = n'_1 + n'_2 + n'_3 + n'_4 + n'_5$$

6.1.1.7 The following are established:

— number of multiples: $n_2 = n'_1$

— number of seeds normally sown: $n_1 = N - 2n_2$

— number of misses: $n_0 = n'_3 + 2n'_4 + 3n'_5$

— number of intervals: $N' = n'_2 + 2n'_3 + 3n'_4 + 4n'_5$

— average spacing of normally sown seeds:

$$\bar{X} = \frac{\Sigma n_i X_i}{n'_2} \text{ with } X_i \in \{> 0{,}5 \text{ to } \leqslant 1{,}5\}$$

6.1.2 Evaluating the results

6.1.2.1 Feed

Quality of feed index: $A = \frac{n_1}{N'} \times 100$

Multiples index: $D = \frac{n_2}{N'} \times 100$

Miss index: $M = \frac{n_0}{N'} \times 100$

6.1.2.2 Precision

Standard deviation: $\sigma = \sqrt{\frac{\Sigma n_i X_i^2}{n'_2} - \bar{X}^2}$

with $X_i \in \{> 0{,}5 \text{ to } \leqslant 1{,}5\}$

Coefficient of variation: $C = \sigma \times 100$

6.2 Results of optional tests

See annex E, clause E.4.

7 Test report

See details in annex F.

Annex A

Performance of bench tests

Table 1

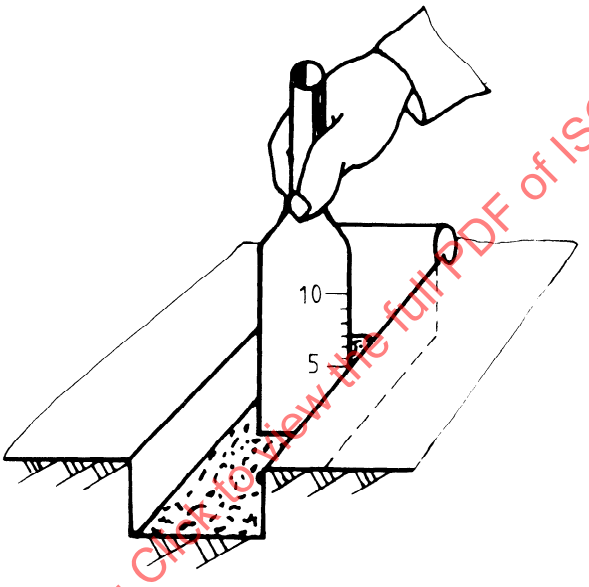
Description of test	Type of test	No. of test	Slope	Hopper level	Theoretical forward speed	Metering mechanism spead	Type of seed
A Mandatory tests							
1 Effect of the level of seeds in the hopper	Static or mobile Without coulter if appropriate	101 102 103 104	none	1/1 1/8 1/1 1/8	high low high low	average average average average	c c d d
2 Effect of the speed of the metering mechanism	Static or mobile Without coulter if appropriate	201 202 203 204 205 206	none	1/2	low high low high low high	minimum maximum minimum maximum minimum maximum	b b c c d d
3 Effect of the slope	Static or mobile						
	Without coulter if appropriate	301 302 303 304	20 % when descending 20 % when ascending				a c c a
	With coulter	305 306 307 308 309 310	20 % slope to right 20 % slope to left none	1/2	average	average	a c c a a c
4 Effect of the forward speed	Mobile or static With coulter	401 402 403 404 405 406 407 408 409 410 411 412	none	1/2	low average high low average high low average high low average high	maximum average minimum maximum average minimum maximum average minimum maximum average minimum	a a a b b b c c c d d d
5 Effect of unwanted movements of the seed	Mobile on bed of sand With coulter	501 502 503	none	1/2	average average average	maximum maximum maximum	a b c
6 Effect of separation	Fixed or mobile Without coulter if appropriate	601 602 603	none	1/8	average average average	average average average	a c d
B Optional tests							
7 Effect of seed dressings	Fixed or mobile Without coulter if appropriate	701 702 703	none	1/2	average average average	average average average	optio-nal

Annex B

Device for measuring the depth of sowing

The depth of sowing measuring device is pushed into the soil across the seed row so that the upper edge of the box is at the same level as the soil surface.

The earth is removed in layers by a flat scraper graduated in millimetres so that the seed is visible. The depth of sowing is measured with the flat scraper against the side of the box (see the figure).



Figure

Annex C

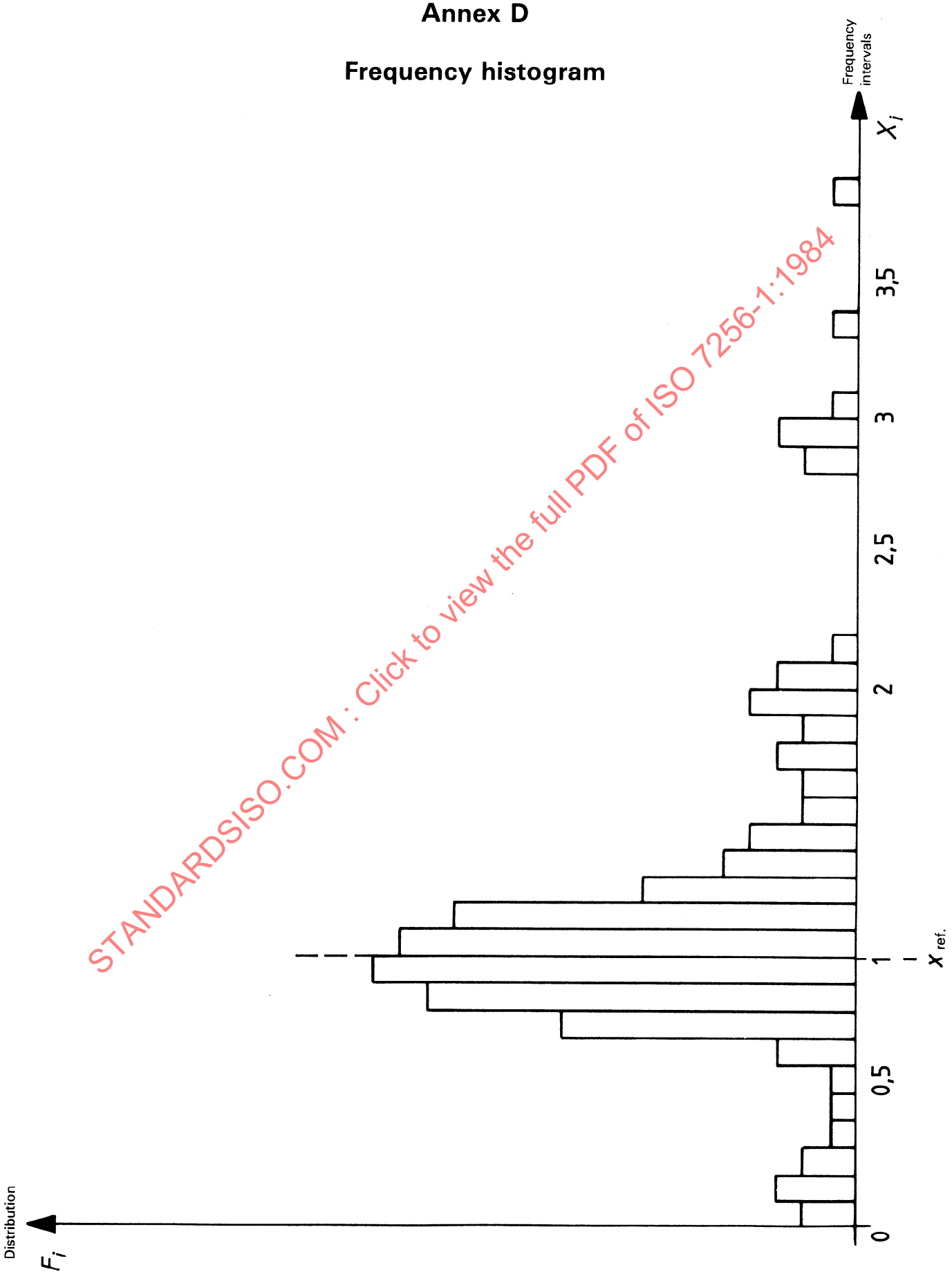
Frequency — Test No. ...

Table 2

	X_i	n_i	F_i		
0,1	0,05			$n'_1 = n_2 = \Sigma n_i$	$N = n'_1 + n'_2 + n'_3 + n'_4 + n'_5$ $N' = n'_2 + 2n'_3 + 3n'_4 + 4n'_5$ $n_2 = n'_1$ $n_1 = N - 2n_2$ $n_0 = n'_3 + 2n'_4 + 3n'_5$
0,2	0,15				
0,3	0,25				
0,4	0,35				
0,5	0,45				
0,6	0,55			$n'_2 = \Sigma n_i$ $\bar{X} = \frac{\Sigma n_i X_i}{n'_2}$ $\sigma^2 = \frac{\Sigma n_i X_i^2}{n'_2} - \bar{X}^2$	$A = \frac{n_1}{N'} \times 100$ $D = \frac{n_2}{N'} \times 100$ $M = \frac{n_0}{N'} \times 100$ $C = 100\,\sigma$
0,7	0,65				
0,8	0,75				
0,9	0,85				
1,0	0,95				
1,1	1,05				
1,2	1,15				
1,3	1,25				
1,4	1,35				
1,5	1,45				
1,6	1,55			$n'_3 = \Sigma n_i$	
1,7	1,65				
1,8	1,75				
1,9	1,85				
2,0	1,95				
2,1	2,05				
2,2	2,15				
2,3	2,25				
2,4	2,35				
2,5	2,45				
2,6	2,55			$n'_4 = \Sigma n_i$	
2,7	2,65				
2,8	2,75				
2,9	2,85				
3,0	2,95				
3,1	3,05				
3,2	3,15				
3,3	3,25				
3,4	3,35				
3,5	3,45				
3,6				$n'_5 = \Sigma n_i$ $(X_i > 3,5)$	

Annex D

Frequency histogram



Annex E

Optional tests

E.1 Bench tests (see annex A)

E.1.1 Nature of the test

Effect of seed dressings on the feed.

E.1.2 Test conditions

The test shall be carried out using a type of seed selected by the test office (preferably with a rough surface to retain a maximum amount of the dressing product); the impregnation shall be carried out with the dressing most used at the time for this type of seed.

E.1.3 Test procedure (Static test or mobile bench test)

Rotate the metering mechanism at maximum speed for approximately 30 min, constantly filling the hopper with new dressed seed.

During this period carry out three tests:

— one at the beginning of the period (test No. 701);

— one in the middle of the period (test No. 702);

— one at the end of the period (test No. 703).

E.2 Field tests

E.2.1 Nature of the tests

They shall cover:

a) the actual spacing of the seed on cultivated land;

b) the uniformity of the furrow depth;

c) the uniformity of the depth of the seed in the ground.

E.2.2 Test conditions

The test site shall be relatively level cultivated land of uniform nature and structure.

The depth of the previous crop, the nature of the ground, its structure (size and position of the clods of earth as they appear in a vertical cut) and its water content shall be noted in the test report.

The structure of the plot may be shown in a sketch attached to the test report.

If possible use a soil penetrometer to measure the hardness of the soil for the first 30 cm.

The duration of the test shall be sufficient to obtain meaningful results.

The machine shall operate under normal working conditions, from start-up until the end of the test, i.e. it shall not stop except for the half turns normally made at the ends of the plot.

The checks shall be made on at least five rows of a length giving at least 250 seeds sown.

The first check shall commence 20 m after the start, the last shall end 20 m before the end.

The test office shall determine the seed to use in accordance with the manufacturer's instructions.

If only one test is carried out, it shall be performed at a forward speed of 2 m/s, or at the average rotary speed of the metering mechanism as defined for the mandatory tests (see 5.1).

The theoretical quantity shall be that deemed to be normal for the type of crop.

The depth of sowing shall be that which is most suitable to the type of crop and shall be noted in the test report.

NOTE — This test should include a uniformity test after the seedlings emerge.

E.3 Measuring conditions

For each row checked, the following shall be measured:

a) the space between successive seeds or plants taken from centre to centre;

b) the average depth of the furrow obtained by several sections through the plot;

c) the depth of the seed in relation to the level of the ground. This depth may be determined for example in accordance with annex B.

E.4 Results of optional tests

E.4.1 Results of the test of the effect of seed dressings

The presentation shall be identical to that adopted for the mandatory tests (see 6.1).

The types of seed and the characteristics of the seed dressings (make, nature and, if possible, physical characteristics) shall be noted in the test report.

E.4.2 Results of tests in the field

For the spacing, the presentation shall be as defined in 6.1 for the mandatory tests.

E.5 Test report

See annex F.

Annex F

Example of test report on precision drills

Name and address of seed drill manufacturer : .....

Tests carried out on seed drill by : .....

The specimen undergoing the tests was selected by the manufacturer with the agreement of the test office.

A Specifications of the seed drill

Characteristics

Brand name : .....

Type : .....

Serial No. : .....

Towed, semi-mounted or mounted equipment : .....

Distributor and type of drive : .....

Number of gear ratios (speeds) and type of selection : .....

Maximum and minimum forward speeds : ..... km/h

Maximum and minimum rotary speeds of the metering mechanism : ..... min^{-1}

Species and types of seeds sown : .....

Overall dimensions

Width

— when ready to operate : ..... m

— when travelling on the road : ..... m

Height when travelling on the road : ..... m

Length when travelling on the road : ..... m

Other specifications

Load height : .....mm

Hopper(s) capacity : l

No-load mass : ..... kg

Loaded mass (state the type of seed) : ..... kg

Tyre dimensions : .....

Radius of the tyres at half-load : ..... m

Tyre pressure : ..... kPa

Instrument numerical code (in accordance with ISO 7424) : .....