



BOOKLET TWO

Spreadmark Code of Practice:

Technical Specifications for the Testing and Certification of Solid Nutrient Application Units

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Introduction

This booklet is one of four booklets containing information that supports the Spreadmark Code of Practice for the Application of Nutrients in New Zealand.

The Spreadmark Code of Practice can be found [here](#).

This booklet forms part of the Code and all information related to copyright, document control, acknowledgements and glossary contained in the main Code apply equally to the information in this booklet.

Other booklets containing support information for the Spreadmark Code of Practice are:

- **Booklet 1:** Spreadmark Procedures, Protocols and Policies.
- **Booklet 3:** Technical Specifications for the Testing and Certification of Liquid Nutrient from Nozzles and for Nutrient Spread as a Slurry.

- **Booklet 4:** Spread Pattern Testing and Certification for Fixed Wing Aerial Application of Solid Nutrients.

These booklets are supported by two technical documents listed below and found here: <https://fertqual.co.nz/spreadmark/>

- Nutrient Application Specifications; and
- Nutrient Physical Properties - General Information.

Note this booklet deals with solid nutrient spread by ground spreaders, helicopters and UAVs. For solid nutrient spreading using fixed wing aircraft, refer booklet four.

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1. PERFORMANCE

Testing

Scope

In order to ensure that products are spread according to the requirements of the Spreadmark programme the following principles shall be followed with regard to the testing of nutrient applicator units.

1.1 Principles

- a. The spreader test procedure allows each spreader to be characterised so it can be set to accommodate variable product characteristics. The test procedure has been linked to international methods and practice, adapted to New Zealand conditions.
- b. Both indoor and outdoor testing is permitted for ground spreading units and UAVs. For outdoor testing, requirements for wind speed and direction, angle of slope and nature of surface shall be set. For groundspread, UAV and helicopters, outdoor testing shall be carried out in a way that does not cause environmental contamination by overloading the test site. For indoor testing the test facility shall be of such a size as to not interfere with the test result.
- c. The evenness of product spreading shall be expressed as a Coefficient of Variation (CV). The evenness of spread both across and along the direction of spreader travel is important. Application rate at the time of test and application rate calibration settings shall be recorded.
- d. To be Spreadmark Registered, application units must satisfy the performance standard for transverse CV% of 15% for nitrogenous nutrients and 25% for all other products.
- e. The spreadability of product depends on its physical characteristics, usually described by their bulk density (BD); uniformity index (UI); and size guide number (SGN). Spreading units shall be tested on a sufficiently wide range of products to provide a guide to the maximum safe bout width for the range of products the spreader distributes.

- f. Spreader certification testing shall be done at frequencies described in the Spreadmark Code of Practice Section 3.4 Approved Spreading Unit Testers.
- g. Spreader operators should use simple field tools (sieve box and bulk density measure) to estimate these parameters in the field and adjust the spreading units accordingly.
- c. The nutrient flow rate has two components; the average flow, which determines the application rate, and the momentary flow, which determines the longitudinal variation. The average flow rate is measured either directly when calibrating the spreader computer or can be determined by experience – the amount of product spread per unit area. Variations in momentary flow can be measured directly or indirectly by measuring the evenness of the longitudinal distribution.

1.2 Testing

- a. There are two primary factors that determine whether nutrient is applied evenly and at the correct rate: the performance of the spreading unit; and the nutrient flow rate to that spreading unit.
- b. The performance of the spreading unit is determined by measuring the evenness of transverse and longitudinal distribution.
- d. The interaction of these factors is complex and momentary changes in flow may affect transverse as well as longitudinal distribution.
- e. These two primary factors also interact with the operational conditions under which they are measured. It is necessary therefore to define the conditions under which they are measured. These are defined in the facilities section.



2. FACILITIES

2.1 For ground spreaders certification tests may be conducted either indoors or outdoors providing all the following specifications are met:

	INDOOR	OUTDOOR
Size	Width sufficient to allow the swath to reach the collectors without hindrance and length sufficient to allow the unit to stabilise prior to passing the collectors. ⁴	Width sufficient to allow the swath to reach the collectors without hindrance and sufficient run-up to allow the unit to stabilise prior to passing the collectors ⁴
Slope	Flat	< 5° (the plane of the collectors must be the same as the spreader)
Wind	Nil	< 15 km/hr and < +/-15° in the direction of travel ^{1,2,3,4}
Surface	Flat and hard	Firm and smooth
Anti-bounce	Lime or similar inert material at 20-25mm depth	Short grass or other vegetation
Site usage	Unlimited	Not to exceed local environmental requirements

2.2 It should also be noted that because of the vagaries of wind speed and direction, outdoor testing can only define the performance achieved under those specific conditions. That performance may be less than the optimum performance the unit is capable of under ideal conditions.

[1] In winds speeds between 10 and 15 km/hr, both the test entrant and the Tester have the right to call a halt to testing if either considers the unit will be unduly advantaged or disadvantaged by the conditions.

[2] Where the spreader performance appears to be unduly advantaged by a crosswind component, the Tester may set aside the result and request a repeat test.

[3] With the agreement of the Tester, the direction of travel may be either “into wind” or “down wind”.

[4] This windspeed is Beaufort wind scale 3, gentle breeze – i.e. ‘leaves and small twigs move and flags flap’.



3. TEST PRODUCTS

3.1 To obtain a meaningful measure of a nutrient spreader's performance, certification requires testing over a range of products chosen to represent the physical range of nutrient characteristics. The spreader must be tested with three products selected to represent the physical range of characteristics that are normally spread by the company, unless a lesser number of products are spread in which case one or both must be tested. Where

three representative products are tested one of them must be urea or treated urea.

3.2 Dedicated spreaders which are only used on one type of nutrient (typically, chicken litter or lime) need only be certified on that type of nutrient.

3.3 For the guidance of applicators, the following table describes the characteristics of typical nutrient products.

	SGN ¹	UI ²	PRODUCT EXAMPLE
1	20 – 60	4 – 10	Lime or RPR
2	120	20	Standard Ammonium Sulphate
3	250 – 350	30	Superphosphate
4	320	55	DAP or Granulated Ammonium Sulphate
5	320	60	Urea

[1] The Size Guide Number (SGN) is the Mean Particle Size (MPS) in millimetres multiplied by 100.

[2] UI = Uniformity Index which indicates the range of particle sizes within the sample. A low number indicates a wide range of particle sizes.

While the SGN's of superphosphate, DAP and urea are not greatly different, their spreading performance can be. Super may spread differently from DAP because of the different UI. Urea may spread differently from DAP because the bulk density is significantly less.

It is noted that the physical properties of generic nutrients, such as superphosphate, urea and lime vary over time and between suppliers.

The following measurements shall be carried out on each test product:

- size guide number
- uniformity index
- bulk density



4. TEST CONDITIONS

The following conditions must be met for measuring transverse and longitudinal distribution.

Applicaton unit	<p>Application units must be clean and in sound working condition. For ground spreading, spinning disc units must have a display of disc speed that can be observed by the operator while spreading. This cannot be done for helicopters so spinner speed during pattern testing is usually recorded by the tester.</p> <p>Evidence of the use of an auditable GPS tracking device is mandatory for spreaders that are to have Spreadmark Test Certificates. It is expected that the positioning accuracy of the GPS is to within one metre. The tracking system must be able to verify that the placement of product (mapping) is within the target area and in accordance with the Spreadmark test protocols so that nutrient is not spread into environmentally sensitive areas.</p>
Hopper loading	Sufficient to completely cover the feed mechanism and the hopper outlet throughout the duration of the test.
Application rate	Application rates used during test are to be the typical rates for that product by the operator. ¹
Speed over the collectors	As near as possible to the typical operating speed as is consistent with safety considerations
Distance prior to passing the collectors	20 metres minimum ²
Number of passes over collectors	Between one and three ³

[1] Otherwise, the default nominated test rates shall be:

- Urea 70 kg/ha
- Single super 300 kg/ha
- DAP and mixes 200 kg/ha
- Lime 2500 kg/ha

[2] Mechanically driven metering units require significantly less than 20m to achieve normal flow. For units with computer-controlled metering, the run-up distance may depend on the sensitivity of the software controlling the flow rate. All spreaders should be able to achieve stabilised flow within 20 metres of travel if they are to give acceptable performance in the field.

[3] The number of passes of the spreader over the trays will be between one and three. Where the nominal application rate is above 80 kg/ha a single pass will be used. Where more than one run is made, the runs will be in the same direction and with no alteration to the settings of the units, there will be one weight for the three runs and the number of runs will be recorded on the test sheet.

5. COLLECTORS and Collector Layout

Collectors and collector inserts used for Spreadmark testing must be of a type approved by the Fertiliser Quality Council for that purpose. Refer to the register of approved collector types for details.

5.1 Collectors used for transverse and longitudinal measurement shall either comply with the following specifications:

- a. Collector size shall be nominally 500 x 500 with a minimum collector depth of 95 mm.
- b. Collectors shall have suitable anti-ricochet inserts to ensure that as much product as practicable is collected.
- c. Only trays of exactly the same dimensions shall be used for Spreadmark certification tests.

Or as otherwise approved by the Fertiliser Quality Council.

5.2 For transverse distribution measurement, a single line of collectors at right angles to the direction of travel will be used. The length of the line will be sufficient to ensure the significant single pass pattern is measured.

5.3 Tray spacing will be at the discretion of the Tester but will not be greater than 1.0 meters.

5.4 For border spreading measurement the collector layout shall be as for transverse

distribution measurement except that there must be sufficient trays laid out that no product is collected in the last trays, i.e., there is a clear end to the swath.

5.5 The product caught in each collector shall be weighed and used to produce a Spreader Performance Certificate.

5.6 When measuring transverse distribution patterns using ground spreaders there is a need to remove collectors to allow the spreader to pass. The weight of product collected in these places shall be deemed to be the interpolated weight from the boxes on either side of the gaps.

5.7 The centre trays shall be three boxes parallel to the direction of vehicle travel. The weight entered into the testing software to be the average of the weights collected in the three trays.

5.8 For helicopters and UAVs the centre-line shall be entered into the GPS unit or marked on the ground by cones, taking into account any effects on distribution pattern resulting from propellor wash.



6. MEASUREMENT Standards

The following measurements shall be made and recorded for each certification test:

FACTOR	MEASUREMENT	STANDARD
Weight of product	gm/collector	Scales accurate to +/- 0.1 gm
Application rate¹	kg/ha	Generally within 30% of set rate
Transverse distribution	Coefficient of Variation	< 15% for N nutrients and 25% for all others
Longitudinal distribution	Coefficient of Variation	To be advised in future when limits are applied
Border spreading	Distance from spreader to pattern edge and shape of pattern	N/A

[1] Where the measured application rate varies from the set application rate by more than 30% then the collected information should be reassessed.



7. SCHEDULE of Tests

The following tests shall be conducted:

- Transverse distribution tests - all nutrient products certified;
- Product description - SGN, UI and BD measurements shall be carried out on samples of all products used.

8. FIELD REPORT

The following records shall be kept for each test:

Identification	Date:				
	Operator:				
	Spreading Unit Unique Identifier:				
	Technician:				
	Location:				
Facilities	Indoor/outdoor:				
	Size of venue:				
	Slope:				
	Wind speed:				
	Direction in relation to wind:				
Test Products		Rate	SGN	UI	DB
	Product 1				
	Product 2				
	Product 3				
	Product 4				
	Product 5				
Test Conditions	Speed over collectors:		Transverse:	Longitudinal:	
	Spreader condition:				
	Hopper loading:				
	Distance/time of run-up:		Transverse:	Longitudinal:	
Collectors	Number per pass:		Transverse:	Longitudinal:	
	Distribution: udinal:		Transverse:	Longitudinal:	
Certification	Certified Bout Width Product 1 = Product 2 = Product 3 = Product 4= Product 5= Shape of CV v Bout Width graph=				



9. CERTIFIED BOUT and Maximum Swath Widths

9.1 The tester shall generate a CV versus bout width graph from the test information obtained for each nutrient tested and will determine the Certified Bout Widths from these graphs. Testers will establish and record the maximum swath width for each test if required. Software to assist this analysis can be found [here](#).

9.2 The Certified Bout Width of a spreader shall be the bout width where the test result is 15% or less for nitrogenous nutrients and 25% or less for non-nitrogenous nutrients. Refer to the Glossary of Terms in the Code for a definition of nitrogenous nutrient.

9.3 Spreaders shall have both their 'Round and Round' and their 'To and Fro' bout widths determined for each nutrient tested.

9.4 If the CV versus bout width graph is 'S shaped' and intersects the appropriate CV limit at more than one bout width then this shall be recorded as, for example, "Up to 16 m and 22 to 29 metres".

9.5 Spreadmark Spreader Performance Certificates will not be issued for spreaders where the Certified Bout Width, when tested on urea, is less than 12 metres for either 'To and Fro' or 'Round and Round' spread patterns. An exception to this rule is made for units with single spinners which only travel 'Round and Round'. These units can be issued with Spreadmark Spreader Performance Certificates if they can achieve 12 metres on a 'Round and Round' spread pattern.

9.6 Dedicated orchard spreaders do not need to be evaluated for evenness of spread pattern but do need to be fit for purpose on rate and band width in order to be certified.

9.7 For border spread certification the certified border width shall be the tray beyond the one where the last granule of product was collected (both sides to be tested).



10. REPORTING

Approved Spreading Unit Testers shall, at the conclusion of the test, produce a Spreadmark Spreader Performance Certificate.

10.1 The Spreadmark Spreader Performance Certificate must show, at least:

- The spreading company name and a vehicle/helicopter/UAV identification number and the bin unique identification number.
- The tray weights collected.
- The Certified Bout Width (or Bout Width Range) for each nutrient tested for both 'Round and Round' and 'To and Fro' patterns.
- The Maximum Swath Width for each nutrient tested.

- A description of the physical characteristics of each nutrient tested. The description to include: product name, bulk density (BD), uniformity index (UI), size guide number (SGN) and a graph of the particle size distribution.
- The date of the test and the expiry date of the certificate. The expiry date shall be two years after the date of the test.
- The certified application rate range for each product. This rate range shall be $\pm 30\%$ of the set application rate.

10.2 On completion the Spreader Performance Certificate shall be sent to the company with a copy to the Auditor.



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