

**Booklet Two**

**of the**

**Spreadmark Code of Practice**

**Technical Specifications for the Testing and Certification of Solid Nutrient Spreading Units**

**Technical specifications for the testing and certification of solid Nutrient SPREADING UNITS**

**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 <https://fertqual.co.nz/resources/>

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 supporting information for the Spreadmark Code of Practice are:

Booklet 1: Spreadmark Procedures, Protocols, Policies and Codes.

Booklet 3: Technical Specification for the Testing and Certification of Conventional Boom Sprayers Applying Liquid Nutrient.

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 fertiliser spread by ground spreaders, helicopters and UAVs. For solid fertiliser spreading using fixed wing aircraft, refer booklet four.**

1. **PERFORMANCE TESTING**

**Principles**

Section 5.1 of the Spreadmark Code of Practice lists a series of principles for spreader certification. These include:

* The spreader test procedure allows each spreader unit to be characterised so it can be set to accommodate variable nutrient characteristics;
* The test procedure has been linked to international methods and practice, adapted to New Zealand conditions;
* Both indoor and outdoor testing is permitted for ground spreading units;
* For outdoor testing, requirements for wind speed and direction, angle of slope and nature of surface shall be set;
* Outdoor testing shall be carried out in a way that does not cause environmental contamination by overloading the test site;
* The evenness of nutrient spreading both across and along the direction of spreader travel is important and shall be expressed as a Coefficient of Variation;
* 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;
* Spreading units shall be tested on a sufficiently wide range of nutrients to provide a guide to the maximum safe bout width for the range of products the spreader distributes;
* Spreader certification testing shall be done at regular intervals as prescribed in the Spreadmark Code of Practice;
* Every certified spreader shall have, a unique identification number;
* For groundspread vehicles spreader certification lapses if the bin changes to another vehicle;
* When spreaders are sold from a Spreadmark registered company to another Spreadmark registered company, the current Spreadmark Test Certificates can be transferred to the new owner. If the sale is to a non-Spreadmark registered company then the certificates lapse.

**Testing**

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.

The performance of the spreading unit is determined by measuring the evenness of transverse and longitudinal distribution.

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.

The interaction of these factors is complex and momentary changes in flow may affect transverse as well as longitudinal distribution.

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 below.

1. **FACILITIES**

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 (see 4 below) | 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 (see 4 below) |
| Slope | Flat | < 5o (the plane of the collectors must be the same as the spreader) |
| Wind | Nil | < about 15 km/hr and < +/- 15o 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 |

**Notes**

1In 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.

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

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

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

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 and, that performance may be less than the optimum performance the unit is capable of under ideal conditions.

1. **TEST PRODUCTS**

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.

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.

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

|  |  |  |  |
| --- | --- | --- | --- |
|  | SGN1 | **UI2** | **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 |

**Notes**

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

2UI = 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 will be carried out on each test product:

* size guide number
* uniformity index
* bulk density

1. **TEST CONDITIONS**

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

|  |  |
| --- | --- |
| **Spreader unit** | Spreaders 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.  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 fertiliser (mapping) is within the target area and in accordance with the Spreadmark test protocols so that fertiliser is not spread into environmentally sensitive areas. |
| **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 operator1 |
| **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 three3 |

**Notes**

1Otherwise, 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

2Mechanically 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.

3The 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.

1. **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.

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

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

Or as otherwise approved by the Fertiliser Quality Council.

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.

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

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 nutrient is collected in the last trays, i.e., there is a clear end to the swath.

The nutrient caught in each collector will be weighed and used to produce a Spreader Performance Certificate.  (See item 10, Reporting, below).

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

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.

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.

1. **MEASUREMENT STANDARDS**

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

|  |  |  |
| --- | --- | --- |
| **Factor** | **Measurement** | **Standard** |
| Weight of nutrient | gm/collector | Scales accurate to +/- 0.1 gm |
| Application rate 1 | 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 |

**Notes**

1Where the measured application rate varies from the set 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 will 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: 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**

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 <https://fertqual.co.nz/spreadmark/>

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.

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

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 meters”.

Spreadmark Spreader Performance Certificates will not be issued for spreaders where the Certified Bout Width, when tested on urea, is less than 12 meters 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 meters on a ‘Round and Round’ spread pattern.

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.

For border spread certification the certified border width will be the tray beyond the one where the last granule of nutrient 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.

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 (see item 9 for details) 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 will be two years after the date of the test.
* The certified application rate range for each product. This rate range is to be ± 30% of the set application rate.

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