

# FLEXISEEDER CELL WHEEL AND DISTRIBUTOR MODULE: AN OVERVIEW INCLUDING TECHNICAL SPECIFICATIONS

## *Flexi Technical Note - 005*

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### SUMMARY (ABSTRACT)

Hundreds of Oyjord and “Oyjord-like” cell wheels and mechanical distributors remain in use globally, some more than 40 years old. Spare parts, new units and upgrades are included. These include cell wheels of different sizes and lamellae spacing cast with different numbers, as well as deeper than normal lamellae, (suited to metering larger than normal seeds / fertilizer and other particles / sizes of samples) and distributor impellers of clockwise and counter-clockwise rotation. Such specialized units have been fabricated at additional cost rather than being cast routinely, for want of improved pattern making and casting ideas and procedures as developed recently under the Flexiseeder Project<sup>7</sup> by S&N International Ltd in association with SLU<sup>8</sup>, BACD<sup>9</sup>, The Casting Shop, Collins Patterns and Geoff Gray Ltd. These improved Flexiseeder technologies including an improved cell wheel / portion feeder assembly are introduced and described in this technical note together with details of two modern hard-wearing, low-friction materials that are being used in combination with traditional materials to improve efficiency and to reduce costs. These technologies have been put into the public domain.

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<sup>7</sup> [www.flexiseeder.com](http://www.flexiseeder.com). A voluntary user-group project of the Seed and Seed Drilling Technology Help Group: International Association for the Mechanization of Field Experiments / Global Institute and Agricultural University Internet Hub (IAU Trust).

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## INTRODUCTION

There is a continuing need for Oyjord cell wheel and distributor technology<sup>10</sup> both as spare parts and for new machines up-dated to include modern technologies. Besides standard units, cell wheels with varying numbers and spacing of lamella are required, including deep lamella designed for dispense larger-than-normal amounts of seed and / or fertilizer (750 to 1500 gms for example) which cannot be dispensed easily using belted cones. Affordable, standard distributor heads (impellers) are needed cast in aluminium or bronze, both of clockwise and counter-clockwise rotation which can be machined to fit a range of products.

Historically it has not been possible to cast and mass-produce Oyjord cell wheels with lamella (partition walls) more than 4 to 5mm high, instead they have had to be fabricated, usually from sheet material (Plate 1). As the height of the lamella was raised, the base also had to be made



*Plate 1. Oyjord cell wheel fitted with extended lamellae fabricated from sheet metal using modified design of Hallerström, 1974..*

wider to enable the molten bronze / aluminium to fully penetrate the mould. Consequently, the area of the cell it contained was reduced while the increase in the angle of repose of the lamella made the cell more likely to block, particularly where large samples are being dispensed (700 to 1.5 kg of fertilizer, for example).

Distributor efficiency declines as impellers become corroded and worn with use especially where fertilizer is used. They need to be replaced / up-graded as a matter of routine. This needs to be made simple and affordable by using mass produced standard castings / components of a design able to be machined down to fit various makes and models, because the design has remained in the public domain. These products

should be available in the open market as standard products for all to use, OEM and end users included.

To proceed further in affordable and economically sustainable ways, new casting / fabrication techniques (modules) are required combined with additional networking to facilitate the mass production and distribution of these products to a high standard, in uniform ways, using modern technologies. At the same time, relevant standards need to be developed for these multi-purpose modules to help refine and bring them into common use, along the lines used more than 30 years ago under IAMFE, for defining standards for arable plot drills (*Hallerström, 1992; Oyjord, 1996*).

This technical note which introduces and describes several new approaches to manufacturing / fabricating Oyjord-type cell wheels and distributor components / spares is one of six listed in the attachments providing additional technical background to Leuchovius et.al., (2008) and Stevens et al., (2008)<sup>11</sup>.

## BACKGROUND

During 2006, Norway ordered a S&N Flexi Plot Seeder from the New Zealand arm of the Flexiseeder Project, fitted with Kincaid cones (imported from the United States of America, [www.kincaidequipment.com](http://www.kincaidequipment.com)). Although recognised and used world-wide as an excellent product, these cones did not meet the specific requirements of the Norwegian programme for sowing large samples including fertilizer. Namely:

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<sup>10</sup> Now more than 40 years old.

<sup>11</sup> Covering the evolution and development of modular components of the Flexiseeder project, under the IAMFE / IAU Seed and Seed Drilling Help Group formed at IAMFE 2004 in St Petersburg.



Plate 2. S&N Flexi Plot Seeder fitted with Kincaid cones.

- Kincaid cell wheel assembly did not lift Perspex loading tube high enough and then emptied too slowly for effectively dispensing more than 500g of fertilizer.
- Solenoid was not strong enough to lift “large after-market” funnel needed for handling large samples of fertilizer (750 to 1500 gms).
- Outlet hole in the cell wheel base plate was too small for the large amounts of fertilizer to be dispensed and some seed types (e.g. beans and peas).
- Oat and meadow seed did not work very well, cone was not steep enough and not well enough polished to be self-cleaning.
- Tolerances between the base plate and cell wheel were not as fine as with traditional Oyjord cell wheel design, and were considered likely to cause trouble with small seeds.
- Drive gear ratio / bevel gears used on the final drive did not match well with gear ratio used on the Zero Max Y2 gear box. The input to output ratio needed to be increased (input speed increased while the output speed reduced) to allow the cone to rotate more smoothly.

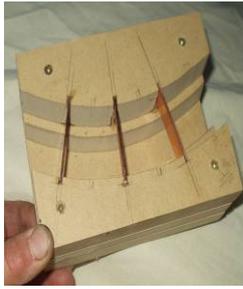
Both 320mm diameter cones assemblies were returned together with the request that a modified Oyjord cell wheel assembly / module was designed and manufactured as described in this paper, which overcame the stated limitations. At the same time (a) Sweden and the New Zealand Crop and Food Research Institute expressed interest in receiving 400mm diameter cell wheels with deep lamellae and (b) a Farmall mid-mounted plot seeder was being up-graded in New Zealand to take the Flexiseeder tyne system. As part of the Farmall contract, the owner (Plant Research New Zealand Ltd, [www.plantresearchnz.co.nz](http://www.plantresearchnz.co.nz)) requested that the Oyjord - type distributor already mounted on it, be re-powered with a heavier direct-coupled motor.

During 2007, a core working group was formed in New Zealand under the Flexiseeder Project to resolve these issues, comprising an agronomist / plant breeder, an engineer, a pattern maker and a foundry owner and operator, guided by colleagues in Sweden and Norway. Out of this, through necessity, the Flexiseeder cell wheel and distributor module was born, financed by S&N International Ltd.

## MODULE COMPONENTS

### Cell Wheel

New casting technologies were identified and developed allowing a range of lamella numbers and dimensions to be cast using a common “base” pattern depending on the dimensions of brass bar used to form the lamella, about which the remainder of the cell wheel is poured. This base pattern also can be further modified to cast “fertilizer / additional product rings” to be used as spacers (Plate 3).



Brass inserts used as lamella - every second lamella may be left out at time of casting<sup>12</sup>



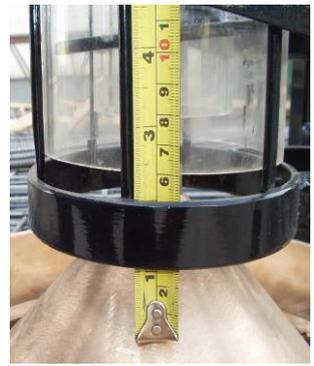
Corner mount – gives any of four positions for product outlet



320 mm cone – 1kg fert.  
Tube 110 mm ID x 250mm



Heavy-duty solenoid



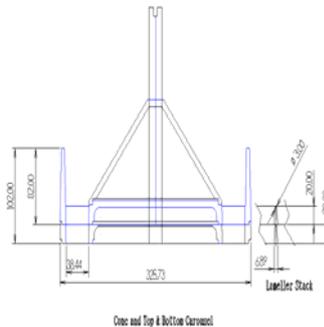
60 mm clearance for product release inside holder



16 different sized options for inner Pexiglass tube



320 cell wheel loaded with 1kg fert. Note uhmwpe-BR base plate



Product extension ring



Brooks right-angle drive 7.5:1 and 15:1 ratio plus torque arm



S&N Deep walled (23mm) cell wheel and cone retro-fitted to original Oyjord-Shou planter base plate  
*Plate 3. Cell wheel module which is either manual drive or digital (see Fraser et.al. 2008).*

Main advantages:

- ✓ Repeatable, affordable and suited to mass production.
- ✓ Retro-fits to earlier Oyjord / Oyjord-type machines.
- ✓ Product clearly visible within product tubes. Extra height to prevent spillage.
- ✓ Manual trip easily swapped from left to right-handed operation.
- ✓ Heavy-duty solenoid an optional extra with manual over-ride retained in form of original manual trip.

<sup>12</sup> Alternatively, separate core boxes can be made for other spacing / lamella heights. Once set up, multiple runs can be made using same pattern.

- ✓ Torque arm mount allows 360 degree rotational option for positioning input to right angle drive / motor mount
- ✓ A total of 16 Pexiglass product cores / tubes available, ranging in size from 110 ID down to 20mm. Quick to swap between sizes. Affordable to replace as required. Replacement material easily obtained on international market. Simple to machine and fit.
- ✓ Extended guides above tube cage provide ideal support for loading funnels, positioned so that funnels remain stationary while the tube lifts. Funnel weight is therefore removed from handle / solenoid.
- ✓ Traditional Oyjord continuous sowing devices may be fitted after making simple adjustment to main spigot shaft.
- ✓ Heavy-duty spigot bearing held in place with four bolts is self aligning and easily centred under the delivery tube for perfect seal of Pexiglass tube.
- ✓ Product tube / cage assembly easily aligned with centre of cone to provide perfect seal.
- ✓ Any of four outlet positions (increments of 90 degrees) available for positioning product release outlet from cell wheel. Note: traditional Oyjord outlet hole has been modified to improve clean out while using high volume samples.
- ✓ Ultra high molecular weight (density) plastic extrusion plastic<sup>13</sup> base plate provided standard (6 mm thick) ... UV resistant, excellent abrasion resistance, low friction, self bedding, long-lasting, self cleaning. Easily replaced as required and / or interchanged with different sized outlet holes.
- ✓ Automatic levelling attachment available.
- ✓ Simple PVC extension ring available for outer cell wheel rim as wind shield or alternatively a Perspex dome may be provided as optional extras.
- ✓ Packs down well for shipping.
- ✓ Low maintenance – all parts other than castings and formed Perspex dome are available as standard items from the international market.
- ✓

### Distributor Impellor



*Plate 3. Direct coupled dynamo fitted with inverse impellor (left) and standard distributor impellor blocks (right) cast in bronze and aluminium with raised centre. High performance Brooks – S & N 12v drive plus in-line mechanical variator in background.*

On the Farmall conversion, a vehicle dynamo was used which rotated clockwise, whereas the original impellor was designed to rotate counter clockwise. An inverse image was fabricated in steel, tested, used and made available for casting a pattern. During testing, a dead area for seed was noted within the centre of the impellor, which meant that it was not fully self cleaning. This was corrected by raising the centre of the impellor, a modification also used while casting the counter-clockwise image for with refined Brooks – S&N power pack (see Fraser et. al.

<sup>13</sup> "uhmwpe-BR", [www.ludoplas.com](http://www.ludoplas.com).

2008) developed subsequently. Basic blocks as they leave the foundry may then be machined and balanced to fit most Oyjord and Oyjord-type distributors.

## CONCLUSIONS

Through necessity, a series of new technologies have been developed for manufacturing / repairing / replacing cell wheels and distributor impellers. These technologies have been released to the public as standard items and are being manufactured in New Zealand and sold globally. They are available commercially under the Flexiseeder Project through S&N International Ltd to original equipment manufacturers as well as all other end-users, both as spare parts and as components for new machines.

Trading surpluses will initially be used to recover research and development costs, which have been considerable, funded by S&N International Ltd. After that, a portion will be given to help maintain IAMFE and to further develop and improve the initiative.

## Where Next?

We are open to suggestions.

## REFERENCES

**Hallerström, B 1974.** The Oyjord experimental seed drill as a fertilizer distributor. Proceedings of IAMFE USA 1976, Iowa State University, Ames, USA, pp 101-107

**Hallerström, B 1992.** The IAMFE Plot size investigation. Department of Agricultural Engineering, SLU, Uppsala, Sweden.

**Leuchovius, T., E.J. Stevens, D.S. Fraser, C.D. Roberts, T. Gaardlos, M. Bakkegard. 2008.** Plot machine modules: More flexibility and lower costs. The Flexiseeder Approach. Proceedings of IAMFE Congress 2008, AgroTech, Århus, Denmark.

**Oyjord, E. 1964-2008.** Papers and presentations at the IAMFE International conferences/exhibitions.

**Oyjord, E. 1996.** National and international strategies for mechanization of field experiments. Proceedings of IAMFE FRANCE '96. International IAMFE Centre, SLU, Uppsala, pp. 19-26.

**Stevens, E.J., T. Leuchovius, T. Gaardlos, A. Russell, R. Zuerrer, M. Bakkegard. 2008.** "Flexiseeder": A new modular approach to help improve correlation / cross-over of results between plot and field research and commercial agriculture, horticulture and viticulture. Proceedings of IAMFE Denmark 2008. AgroTech, Århus, Denmark.

**Fraser, D.S., E.J. Stevens, T. Leuchovius, L.P. Brooks, T. Gaardlos, M. Bakkegard. 2008.** Flexiseeder drive modules: An overview including technical specifications. *Flexi Technical Note - 001*. Proceedings of IAMFE Denmark 2008. AgroTech, Århus, Denmark.

**Thian, L.P., E.J. Stevens, T. Leuchovius, T. Gaardlos, K.I. Thian, M. Bakkegard. 2008.** Flexiseeder "continuous-run" seed and fertilizer modules for small-scale users: An overview including technical specifications. *Flexi Technical Note - 002*. Proceedings of IAMFE Denmark 2008. AgroTech, Århus, Denmark.

**Small, G.T., N.B. (Jock) Baker, E.J. Stevens, T. Leuchovius, T. Gaardlos, M. Bakkegard. 2008.** Flexiseeder air assisted delivery and distribution module: An overview including technical specifications. *Flexi Technical Note - 003*. Proceedings of IAMFE Denmark 2008. AgroTech, Århus, Denmark.

**Stevens, E.J., T. Leuchovius, T. Gaardlos, I. Close, N.D. Collins, G. Gray. 2008.** Flexiseeder seed and fertilizer coulter module: An overview including technical specifications. *Flexi Technical Note - 004*. Proceedings of IAMFE Denmark 2008. AgroTech, Århus, Denmark.

**Stevens, E.J., T. Leuchovius, T. Gaardlos, C.D. Roberts, G. M. Gray, L.P Thian. 2008.** Flexiseeder frame module: An overview including technical specifications. *Flexi Technical Note - 006*. Proceedings of IAMFE Denmark 2008. AgroTech, Århus, Denmark.