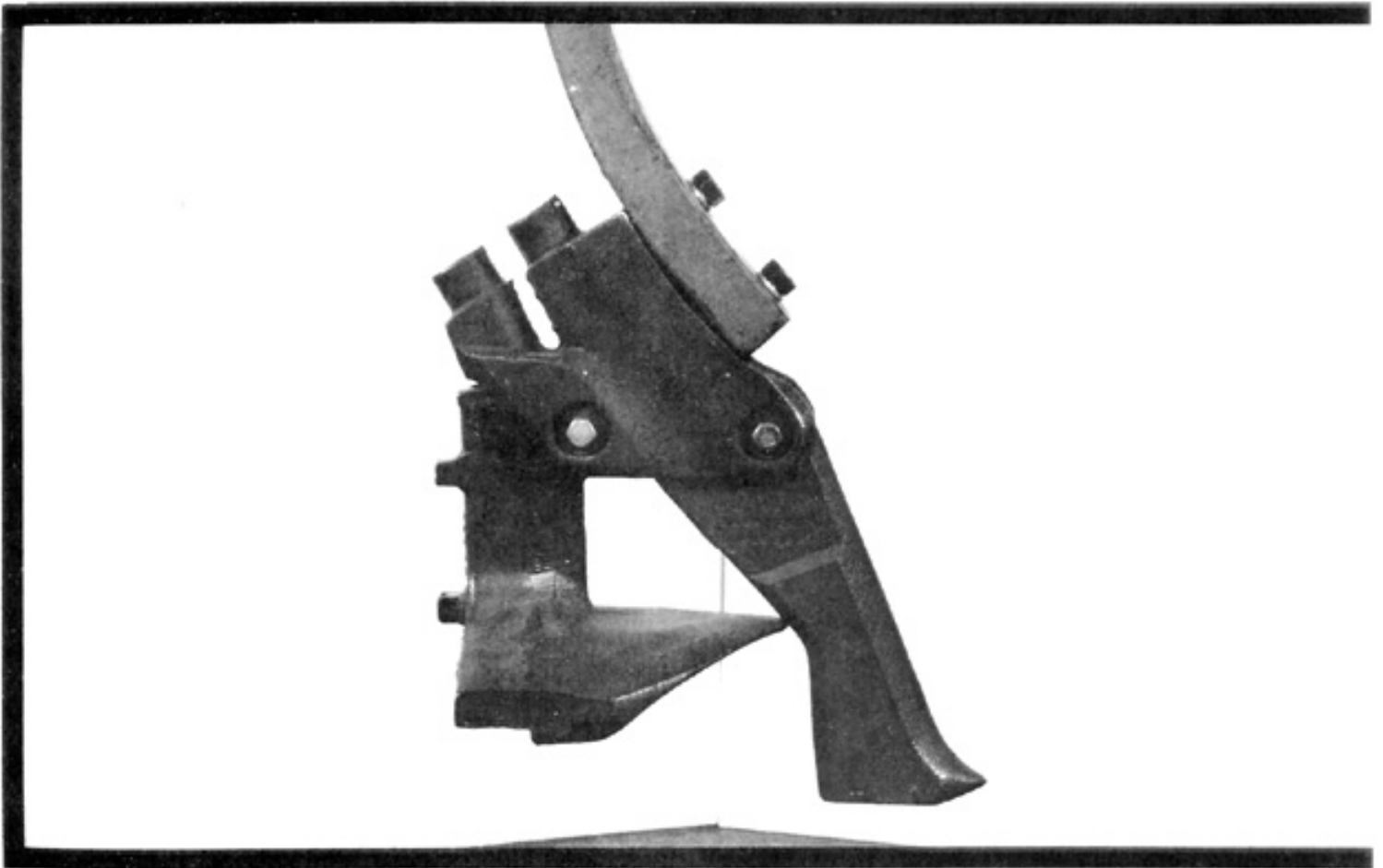


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Group 3(b)

Evaluation Report

570



Clarke Dual Delivery System

A Co-operative Program Between



ALBERTA
FARM
MACHINERY
RESEARCH
CENTRE



PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

CLARKE DUAL DELIVERY SYSTEM

MANUFACTURER AND DISTRIBUTOR:

Sutherland Steel Foundry
139 -105 St. E.
Saskatoon, Saskatchewan
S7N 1Z2

RETAIL PRICE: \$73.00 (March, 1986) F.O.B. - Lethbridge, AB.

Replacement Deep Banding Knife-\$14.60.
Replacement Paired Seeding Knife - \$26.45.

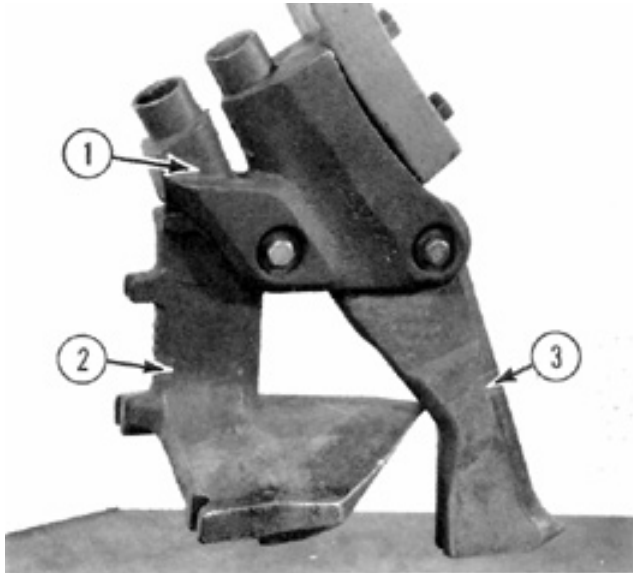


FIGURE 1. Clarke Dual Delivery System: (1) Double Tube T Slot Adaptor, (2) Paired Seeding Blade, (3) Deep Banding Blade.

SUMMARY AND CONCLUSIONS

QUALITY OF WORK

Penetration of the Clarke Dual Delivery System was good. Penetration depended entirely on the shank trip characteristics. A shank with a trip force of at least 750 lb (3340 N) is recommended.

Seed placement of the Dual Delivery System was very good. The seeding blade split the seed evenly into two rows 6 in (152 mm) apart. Bandwidth of the rows was slightly wider than that of a hoe drill. Use of the seed blades left ridges. This required the use of a harrow packer drawbar as a post seeding operation.

Fertilizer placement of the Dual Delivery System was very good. The fertilizer was placed directly between, and 2 in (51 mm) below the paired rows of seed.

Trash clearance was good. The use of the Clarke system increased the trash clearance capability of the test cultivator in normal conditions. Performance, though, was reduced in adverse wet or heavy trash conditions.

Operation of the Clarke system in stony conditions was very good. No major damage occurred to the deep banding blade or seed blade.

EASE OF OPERATION AND ADJUSTMENT

Ease of transporting the test cultivator with the Clarke Dual Delivery Systems mounted was poor. The deep banding blades had to be removed or secured up to allow for ground clearance while transporting.

The openings on the seeding blades did not plug during the test. The openings on the deep banding blades started to plug at the end of the test because of blade wear and operation in wet soils.

POWER REQUIREMENTS

Draft (drawbar pull) requirements depended on depth, field preparation, ground speed, soil type and moisture content. The draft on the Clarke system was 50 to 79% greater than a 16 in (406 mm) chisel sweep at the same seeding depth. Maximum tractor power requirements in primary conditions for one Clarke Dual Delivery System ranged from 7.1 to 9.4 hp (5.3 to 7.1 kW).

EASE OF INSTALLATION

Ease of installing the Clarke Dual Delivery System was good. Two major modifications had to be made to the test cultivator to accommodate the Clarke Dual Delivery System.

OPERATOR SAFETY

The Clarke Dual Delivery System presented no safety hazard if normal safety precautions were observed.

OPERATOR'S MANUAL

No operator's manual was provided.

MECHANICAL HISTORY

The deep banding knives were still useable after 25 acres (10 ha) per blade.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the double T slot adaptor to prevent trash from being trapped at the end of the cultivator shank.
2. Increasing the size of the opening on the rear of the blade to reduce plugging in wet soils as the deep banding blade wear.
3. Modifying the double T slot adaptor to prevent twisting on the shank.
4. Improving the quality of the double T slot adaptors to prevent faulty castings.
5. Providing an operator's manual with information on installation and operation.

Station Manager: R. P. Atkins

Project Engineer: L. W. Papworth

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Current production of the T-Slot Adapter has been modified so that the front or nose of the adapter is faired up to meet the end of a 1" thick shank. On a 1 ¼" thick shank, 1/4" will protrude above the fairing which should not catch trash.
2. The length of the slot in the fertilizer knife is designed to place the fertilizer at the bottom of the knife. As wear takes place from the bottom up, eventually the opening will plug. This is normally the time to replace the knife, however, the user can lengthen the slot by grinding the back side of the knife which will allow continued use without plugging. Extending the slot in this manner will also reduce the depth of the fertilizer band.
3. The extended nose of the T-Slot Adapter (see Item #1) butted against the shank end eliminates all possibility of twisting the adapter on the shank. As well, the T-Slot and Square Washer are designed to utilize 1/2" Plow Bolts to minimize play in the assembly. 7/16" Plow Bolts should only be used when the shank mounting holes demand it.
Future product packaging will include the users choice of either 1/2" or 7/16" hardware.

4. Changes have already been made in current production products to ensure bushing assemblies "float" and washers to not bind on the casting.
5. Company plans to supply complete installation instructions with a list of operating Dos and Don'ts and exploded parts diagrams included.

GENERAL DESCRIPTION

The Clarke Dual Delivery System is a combination banding knife and seeding boot attachment designed to mount on a conventional cultivator shank. The system divides the seed and places the seed in two rows. A banding knife places the fertilizer below and between the paired seed rows. The distance between the paired seed rows and the fertilizer is not adjustable.

The system includes a double tube T slot adaptor, a deep banding knife, a paired seeding blade, assembly and attachment hardware. The adaptor fits onto the back of the shank and the replaceable blades or knives attach to the adaptor with 3/4 in (19 mm) bushing assemblies. Fertilizer travels through the front knife and seed travels through the rear blade. The deep banding knife can be used alone but the seeding blade must be used with the knife.

FIGURE 1 shows the components of the system while detailed specifications are given in Appendix I.

SCOPE OF TEST

Each Clarke Dual Delivery opener was operated in the conditions shown in TABLE 1 for 78.5 hours while seeding 25.3 acres (10.1 ha). Soil conditions during the test varied from dry to moist. The openers were evaluated for quality of work, ease of operation and adjustment, power requirements, ease of installation and operator safety. The openers were mounted on a Flexi-coil Model 600 chisel plow throughout the test.

TABLE 1. Operating Conditions.

MATERIAL	SOIL TYPE AND CONDITION	STONE CONDITIONS	FIELD AREA ± (ha)	HOURS
Fertilizer	Silt Loam Secondary	Occasional Stones	128 (5.1)	44
Wheat	Silt Loam to Clay Loam Secondary	Moderately Stone	81 (3.3)	185
Winter Wheat	Silt Loam Secondary	Occasional Stones	11 (0.4)	4
	Silt Loam Primary	Occasional Stones	11 (0.4)	5
	Heavy Loam to Clay Primary	Occasional stones	22 (0.9)	7
TOTAL			253 (10.1)	78.5

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration of the Clark Dual Delivery System was good. Penetration was limited by the trip characteristics of the shank. The shank with the Clarke System mounted, tended to trip out in adverse primary conditions. No problems occurred under secondary conditions. FIGURE 2 shows the sweep pitch curve of the test shank equipped with the Clarke system and a conventional sweep. The test shank tripped at a force of 470 lb (2090 N) with the Dual Delivery System compared to 600 lb (2670 N) with a conventional sweep. The decrease in trip force was caused by the additional frame to tip clearance with the Clarke system compared to a conventional sweep. The Clarke Dual Delivery System should be used on a shank with a trip force of at least 750 lb (3340 N).

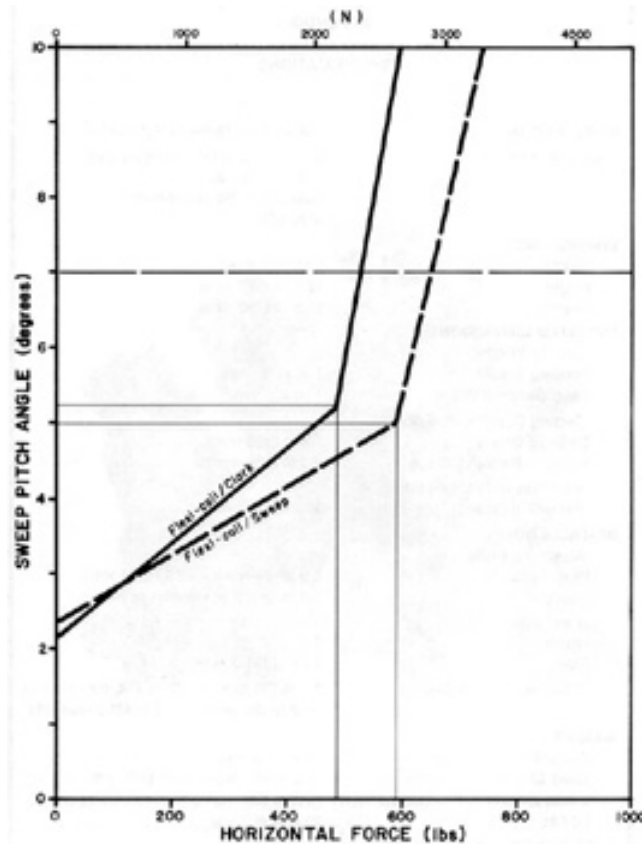


FIGURE 2. Sweep Pitch Over a Draft Range.

Seed Placement: Seed placement of the Clarke Dual Delivery System was very good. The seeding blade split the seed evenly into two rows 6 in (152 mm) apart. The rows were distinct with the band width slightly wider than that of a hoe drill, as shown in FIGURE 3. The actual row spacing varied because the seedlings tended to take the shortest route to the surface, as shown in FIGURE 4.

Variation in seed depth was small. At an average seeding depth of 2.4 in (61 mm) most of the seeds were placed within 0.5 in (13 mm) of the average seed depth.



FIGURE 3. Wheat Stubble of Crop Seeded With Clarke Dual Delivery System.

With the Clarke System, soil disturbance was greater than with a conventional sweep. The most ridging occurred in moist primary conditions as shown by the barley stubble in FIGURE 5. Throughout the test a harrow packer drawbar was used to level and pack the surface after seeding.

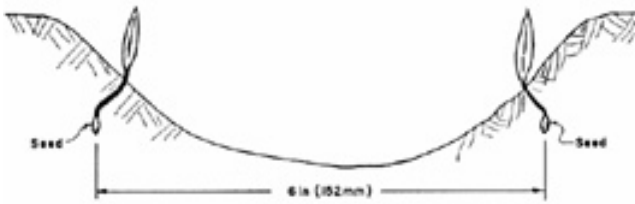


FIGURE 4. Seedlings Take Shortest Route to Surface.



FIGURE 5. Soil Surface After Seeding into Moist Barley Stubble.

Fertilizer Placement: Fertilizer placement of the Clarke Dual Delivery System was very good. The fertilizer was placed directly between the paired rows of seed. Average depth below the seed varied from 2 in (51 mm) when the deep banding blades were new to 1.5 in (38 mm) when the blades were worn at the end of the test. The average bandwidth was 1 in (25 mm).

Variation in the depth of the fertilizer was similar to that of the seed. Soil disturbance was minimal, when operating just the deep banding knives.

Trash Clearance: Trash clearance of the Clarke Dual Delivery openers was good. The use of the Clarke system increased the trash clearance capability of the test cultivator in normal conditions because of the increase in the frame to tip clearance. Performance, though, was reduced in adverse wet or heavy trash conditions. This was due to the method in which the system was attached to the shank. As shown in FIGURE 1, the cultivator shank was located in front of the T slot adaptor. This left an area in which trash was easily trapped. This resulted in a large furrow and more soil disturbance. It is recommended that the manufacturer consider modifying the T slot adaptor to prevent trash from being trapped at the end of the cultivator shank.

Stoney Conditions: Operation of the Dual Delivery System in stony conditions was very good. The unit was operated through several rock patches and the only damage to occur was a broken tip off a seed blade. This was caused by a faulty casting.

EASE OF OPERATION AND ADJUSTMENT

Maintenance: Ease of maintenance of the Clarke Dual Delivery System was very good. The only maintenance required was to coat the blades with oil or grease to inhibit rusting, when they were stored outside for extended periods.

Transporting: Ease of transporting the test cultivator with the Clarke Dual Delivery openers mounted was poor. Due to the large frame to tip clearance the deep banding blades had to either be removed or secured up to allow for sufficient ground clearance while transporting. This was time consuming. The Clarke Dual Delivery openers should be used on cultivators capable of at least 15 in (381 mm) ground clearance.

Plugging: The openings on the seeding blades did not plug during the test. Due to wear, the openings on the deep banding blades started to plug at the end of the test. The blades also

tended to plug in wet soil. Increasing the size of opening on the back of the banding blade would reduce plugging as the blade wore. It is recommended that the manufacturer consider increasing the size of the opening at the rear of the banding blade to prevent plugging in wet soils as the blade wears. The openings on the blades also tended to plug if the cultivator was stopped in the field without raising the unit.

POWER REQUIREMENTS

Draft: Draft (drawbar pull) requirements depended on depth, field preparation, ground speed, soil type and moisture content. Draft measurements were done with a single opener in primary silt loam soil at 5 mph (8 km/h). FIGURE 6 shows the draft of a 16 in (406 mm) chisel sweep (reference) and the Clarke system when new and worn. The draft on the Clarke system was 50 to 79% greater than the chisel sweep at the same seeding depth. The draft on the Clarke system with a worn banding blade was 9 to 15% less than with a new one. The draft for the banding blade alone was essentially the same as seeding and banding together.

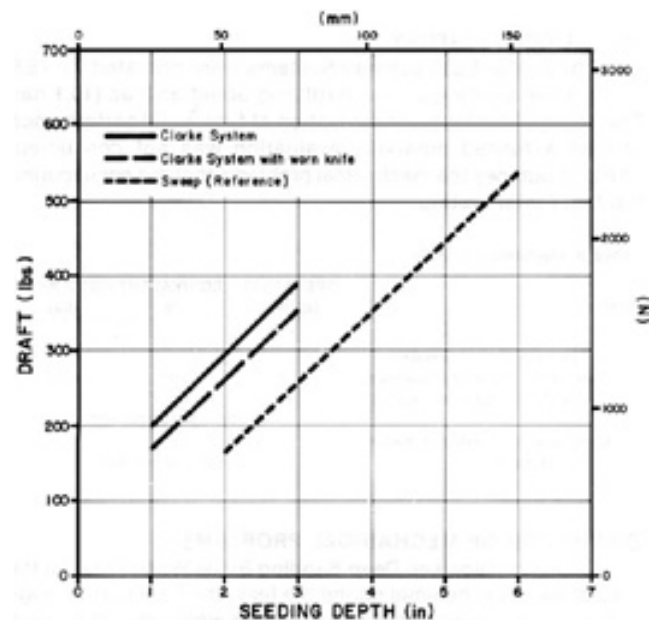


FIGURE 6. Average Drawbar Pull at 5 mph (8 km/h) of a Single Opener.

Tractor Size: Maximum tractor power requirements in primary conditions for one Clarke Dual Delivery System ranged from 7.1 to 9.4 hp (5.3 to 7.1 kW) in the seeding depth range of 2 to 3 in (51 to 76 mm). This compares to 4.0 to 6.1 hp (3 to 4.6 kW) for the chisel sweep seeding in the same depth range in primary conditions. These tractor sizes have been adjusted to include tractive efficiency and represent a tractor operating at 80% of maximum power take-off ratings as determined by Nebraska tests or as represented by the tractor manufacturer. The tractor sizes given will have ample power reserve to operate in the stated conditions.

EASE OF INSTALLATION

Installation: Ease of installing the Clarke Dual Delivery System was good. The double tube T slot adaptor was held on the back of the shank with two 2.5 in (64 mm) by 7/16 in (11 mm) plow bolts. The plow bolt heads were held in the adaptor with square T slot washers. The bolt spacing could vary from 1.9 in (48 mm) to 2.5 in (64 mm), making it adaptable to any cultivator shank. The test cultivator had 0.5 in (13 mm) shank holes at a spacing of 2.25 in (57 mm).

The blades were connected to the adaptor by a 0.75 in (19 mm) bushing. The bushing was held in place by flat washers and a 3/8 in (9.5 mm) bolt.

The double tube T slot adaptor had feed tubes which required 1.25 in (32 mm) diameter hoses. The distributor system used came with 1 in (25 mm) diameter hoses. To connect the two together, 6 in (152 mm) lengths of 1.25 in (32 mm) diameter hose were mounted as adaptors between the feed tubes and the distribution hoses.

Cultivator Modifications: Two major modifications were made to the test cultivator to accommodate the Clarke Dual Delivery System. To compensate for the additional frame tip clearance, the stabilizer wheels required 3 in (76 mm) extensions so the cultivator could be levelled from front to back. The lateral levelling adjustments were adjusted to the maximum height to raise the cultivator as high as possible.

OPERATOR SAFETY

The Clarke Dual Delivery System presented no safety hazards if normal safety precautions were observed.

OPERATOR'S MANUAL

No operator's manual was provided. It is recommended that the manufacturer consider providing an operator's manual with information on installation and operation.

MECHANICAL HISTORY

The Clarke Dual Delivery Systems were operated for 78.5 hours while seeding and/or fertilizing about 25.3 ac (10.1 ha). The intent of the test was evaluation of functional performance and an extended durability evaluation was not conducted. TABLE 2 outlines the mechanical problems that did occur during the functional testing.

TABLE 2. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA ac	(ha)
- one bolt holding on fertilizer knife broke and was replaced at	5	1.5	(0.6)
- double T slot adaptors twisted on shank			
- some seed and fertilizer blades came off during		throughout the test	
		last part of test	

DISCUSSION OF MECHANICAL PROBLEMS

Seeding Blade and Deep Banding Blade Wear: Wear on the seed blades was minimal during the test. The front bottom edge of the furrow openers on the seed blades were wore an average of 0.25 in (6.4 mm) at the end of the test.

FIGURE 7 shows the wear on the deep banding blades after 13 ac (5.2 ha) per blade, 20 ac (8 ha) per blade and at the end of the test. It should be noted that the deep banding blades provided adequate performance at the end of the test.



FIGURE 7. Wear on the Banding Blades After 13 ac (5.2 ha) per Blade, 20 ac (8 ha) per Blade and at the End of the Test.

Double T Slot Adaptors Twisting on Shank: The double T slot adaptor twisted on the shank during field operation. The reason was that the T slot adaptor only made contact with the shank at the top and bottom of the adaptor, as shown in FIGURE 8. It is recommended that the manufacturer consider modifying the double T slot adaptor to prevent twisting on the shank.

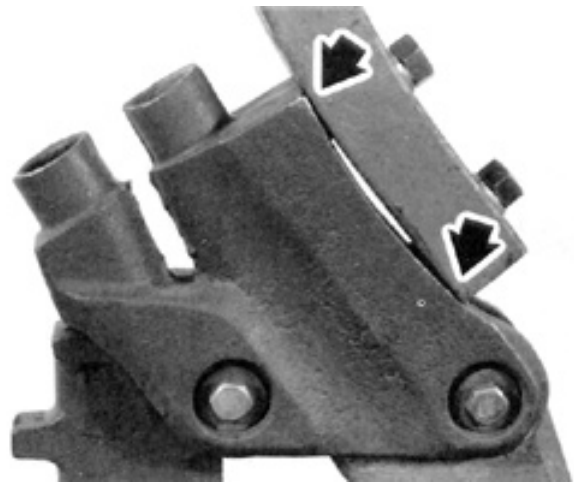


FIGURE 8. Double T Slot Adaptor Made Contact with Shank Only on Top and Bottom.

Seeding Blades and Deep Banding Blades Falling Off: It was found during field operation that several of the washers had tightened against the casting of the double T slot adaptor instead of the 0.75 in (19 mm) bushing. This caused the 3/8 in (9.5 mm) bolt and nut to loosen, during field operation allowing the bushing to fall out. FIGURE 9 shows an example of the faulty casting that the washers would tighten against. It is recommended that the manufacturer consider improving the quality of the double T slot adaptors, to prevent faulty castings.



FIGURE 9. Example of Faulty Casting of Double T Slot Adaptor.

SUMMARY CHART CLARKE DUAL DELIVERY SYSTEM

APPENDIX I SPECIFICATIONS

MAKE AND MODEL:	Clarke Dual Delivery System
MANUFACTURER:	Sutherland Steel Foundry Ltd. 139 - 105 St. E. Saskatoon, Saskatchewan S7N 1Z2
DIMENSIONS:	
- width	7 in (178 mm)
- height	12.8 in (325 mm)
- length	11.5 in (292 mm)
MOUNTED DIMENSIONS:	
Cutting Width	
- Seeding Blade	7 in (178 mm)
- Deep Banding Blade	1 in (25 mm)
Cutting Depth Below Shank	
- To Seed Blade	7.3 in (185 mm)
- To Deep Banding Blade	9.3 in (236 mm)
Knife Tip to Frame Bottom (Flexi-Coil Shank)	37.3 in (947 mm)
INSTALLATION:	
Attaching Bolts	
- Plow Bolts	2.5 in (64 mm) x 7/16 in (11 mm)
- Spacing	1.9 in to 2.5 in (48 mm to 64 mm)
Feed Tubes	
- Number	2
- Size	1.25 in (31.8 mm)
T-Slot Adaptor Bushings	1.5 in (38 mm) x 0.75 in (19 mm) held in by 2 in (51 mm) x 7/16 in (11 mm) bolts
WEIGHT:	
- Deep Banding Blade	4.4 lb (2.0 kg)
- Seed Blade	8.2 lb (3.7 kg)
- T-Slot Adaptor	<u>7.8 lb (3.5 kg)</u>
TOTAL	20.4 lb (9.2 kg)
DEEP BANDING BLADE POINT HARDNESS:	68 Rockwell "C"

RETAIL PRICE:	\$73.00 (March, 1988, f.o.b. Lethbridge)
QUALITY OF WORK:	
Penetration:	good ; requires a shank trip force of 750 lb (3340 N) to maintain penetration
Seed Placement:	very good ; split evenly into two rows 6 in (152 mm) apart
Fertilizer Placement:	very good ; 2 in (51 mm) below paired rows
Trash Clearance:	good ; as long as trash was not too wet or heavy
Stony Conditions:	very good ; no damage
EASE OF OPERATION AND ADJUSTMENT:	
Maintenance:	very good ; easily maintained
Transporting:	poor ; limited ground clearance
Plugging:	seed blades did not plug; deep banding blades plugged at end of test
POWER REQUIREMENTS:	7.1 to 9.4 hp (5.3 to 7.1 kW) per opener at seeding depths
EASE OF INSTALLATION:	good ; system easily attached to shank
OPERATOR SAFETY:	safe ; presented no safety hazard provided normal safety precautions were observed
OPERATOR'S MANUAL:	none provided
MECHANICAL HISTORY:	banding blades still useable after 25 ac (10 ha) per blade

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

- Excellent
- Very Good
- Good
- Fair
- Poor
- Unsatisfactory



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