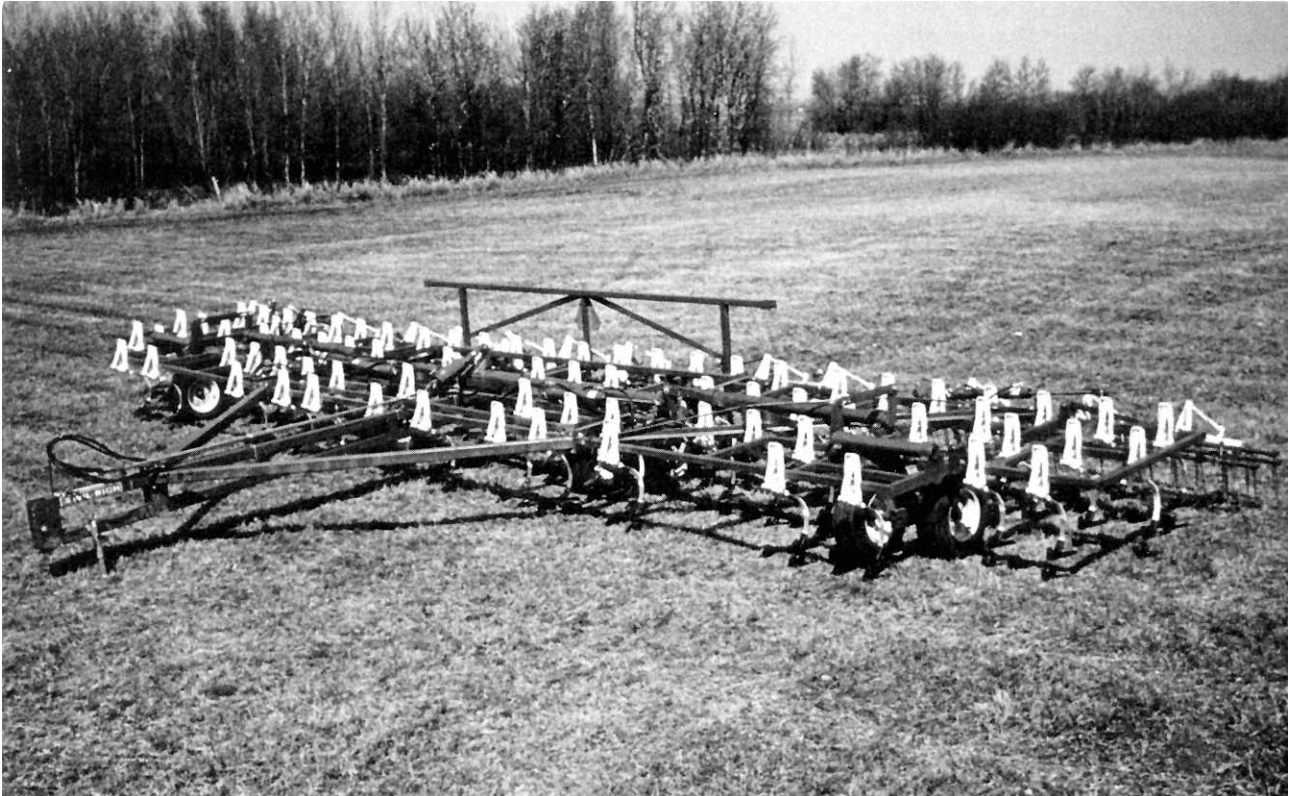


Evaluation Report 197



Wil-Rich 17FCW (13.7 m) Field Cultivator

A Co-operative Program Between



ALBERTA
FARM
MACHINERY
RESEARCH
CENTRE



PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

WIL-RICH 17FCW FIELD CULTIVATOR

MANUFACTURER AND DISTRIBUTOR:

Wil-Rich Inc.
Box 1013
Wahpeton, North Dakota 58075

RETAIL PRICE:

\$16,222.93 (June, 1980, f.o.b. Humboldt, 13.7 m width, with optional mounted harrows, jack stand and 9.5L x 15 tires)

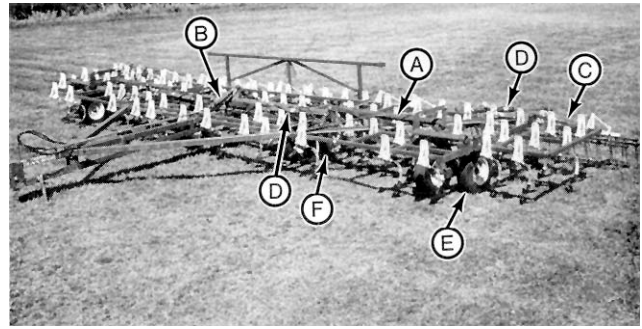


FIGURE 1. Wil-Rich 17FCW: (A) Depth Control Rockshaft, (B) Depth Control Cylinder, (C) Wing Extensions, (D) Wing Lift Cylinders, (E) Wing Wheels, (F) Centre Wheels.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Wil-Rich 17FCW field cultivator was good for seedbed preparation, second operation summerfallow and herbicide incorporation, providing mounted finishing harrows were used. Its performance in second operation summerfallow was reduced slightly by limited weed kill. As with most light duty field cultivators, the Wil-Rich 17FCW was unsuitable for first operation summerfallow or in moderate or heavy trash.

The spring-cushioned shanks could lift 330 mm (13.0 in) to clear stones. As with most field cultivators, the shanks were quite flexible. When the shank assemblies were set at the manufacturer's recommended setting, with sweeps having a 48° stem angle, sweep pitch varied from 1 to 13 degrees, over the normal tillage draft range. At maximum spring setting, pitch varied from 1 to 9 degrees over this range. With the 180 mm (7 in) shank spacing, shank cushioning spring preload was exceeded and tripping occurred at drafts greater than 1.8 kN/m (123 lb/ft) at the manufacturer's setting and at 2.6 kN/m (178 lb/ft) at maximum setting. Tripping, at both normal and maximum settings, occurred within the normal secondary tillage draft range, indicating that the Wil-Rich 17FCW shanks are suited for light, secondary tillage operations and are not intended for primary tillage.

Plugging was a problem in moderately heavy trash in second operation summerfallow. The Wil-Rich 17FCW buried less trash than most heavy duty cultivators. Slight skewing occurred on hillsides or in uneven field conditions, causing weed misses between trimmed sweeps. Weed kill was also reduced by transplanting effects of the wheels. Mounted harrows helped to uproot and expose loosened weeds.

The Wil-Rich 17FCW could be conveniently placed into transport position in less than five minutes. The 180 mm (7 in) sweep-to-ground clearance was adequate for normal transport. Because of its large transport width and height, transporting on public roads had to be done with extreme caution. The Wil-Rich 17FCW was stable and towed well at normal transport speeds. The tires of the centre section were adequate to support the cultivator with mounted harrows, in transport, up to a speed of 28 km/h (15 mph). The 13.7 m (45 ft) wide machine was 4.5 m (14.8 ft) high in transport, permitting fairly safe passage under power lines in the three prairie provinces. Wider models of the Wil-Rich 17FCW are high enough to contact power lines.

When equipped with finishing harrows, hitch weight was negative, making hitching inconvenient without use of tractor hydraulics. Adequate adjustment was provided for both fore-and-aft, and lateral levelling. Tillage depth was normally level across the cultivator width. The hitch pole was narrow, permitting normal turns. The tandem wheels skidded slightly in normal turns.

Average draft for the 13.7 m (45 ft) wide test machine, in light secondary tillage, at 8 km/h (5 mph), varied from 11.0 kN (2470 lb) at 40 mm (1.5 in) depth to 28.8 kN (6470 lb) at 100

mm (4 in) depth. In heavy secondary tillage, at 8 km/h (5 mph), average draft varied from 19.2 kN (4310 lb) to 41.1 kN (9320 lb) over the same depth range.

In light secondary tillage, at 10 km/h (6.2 mph) and 75 mm (3 in) depth, a tractor with 114 kW (153 hp) maximum power take-off rating will have sufficient power reserve to operate the 13.7 m (45 ft) wide Wil-Rich 17FCW. In heavy secondary tillage at the same depth and speed, a 166 kW (223 hp) tractor is needed.

The Wil-Rich 17FCW was equipped with wing and depth control transport locks. No slow moving vehicle sign was provided. The operator's manual was clear, concise and well illustrated, but lacked safety information.

A few mechanical problems occurred during the 140 hours of field operation none of which seriously affected cultivator performance.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Arranging the shanks to avoid use of trimmed sweeps, and to avoid tilling soil directly ahead of the wheels.
2. Providing an alternate location for the hitch jack at the rear of the cultivator for use when equipped with mounted harrows.
3. Supplying a device to hold the hitch link in the horizontal position to facilitate one-man hitching.
4. Modifying the lateral frame levelling linkage to allow easier and more precise adjustment.
5. Routing the hydraulic hoses to avoid interference with moving components.
6. Supplying a slow moving vehicle sign.
7. Modifications to reduce yoke pin retainer clip failures on the depth control hydraulic cylinder.
8. Including adequate safety information in the operator's manual.
9. Working with the agricultural equipment industry to standardize hydraulic quick couplers and hydraulic hose fitting threads.
10. Working with the agricultural equipment industry to standardize shank and sweep stem angles, and sweep fastener spacings and sizes.

Chief Engineer -- E. O. Nyborg

Senior Engineer -- J. D. MacAulay

Project Engineer -- D. E. Gullacher

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The test machine was operated with 254 mm (10 in) sweeps, which are wider than the 227 mm (9 in) sweeps provided by the manufacturer. There should be no need to trim sweeps when using those supplied by the manufacturer, however if 254 mm (10 in) sweeps are used, it is necessary to trim two sweeps to provide tire clearance. The manufacturer agrees that ideally it would be best practice if no wheels had to track on tilled soil. In practice, when designing equipment, the engineer must balance cost and demand against the ideal. The Wil-Rich FCW 45 is designed so that no tire is tracking directly behind a sweep.
2. An optional rear jack stand assembly is available for use with mounted harrows.
3. An optional, two-bolt, heavy duty hitch link is available and facilitates one-man hitching. There has not been adequate demand for a device on the one-bolt hitch link to justify the added cost.
4. The manufacturer is considering a more accessible wing frame levelling adjustment on future designs. The manufacturer feels that the present adjustment that permits 13 mm (0.5 in) steps of correction on the outside of the wing frames is not too coarse.
5. Correct dealer set-up of the hydraulic hoses would have eliminated hose interference and subsequent failure.
6. Consideration will be given to providing slow moving vehicle sign brackets.
7. Redesigned hydraulic cylinder yoke pins, which prevent damage to the retainer clips, are in production.
8. A new operator's manual will contain adequate safety information.
9. Hydraulic hoses furnished with the cultivator utilize standard J.I.C. 0.375 in ends to fit adapters for male couplers. The customer fits couplers to match tractor specifications.
10. We support updating the current ASAE 255.1 Standard, and in any future design, we would seriously consider following the standard.

Note: This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX III.

GENERAL DISCRIPTION

The Wil-Rich 17FCW is a trailing, flexible, three section field cultivator suitable for light tillage such as seedbed preparation, herbicide incorporation and secondary summerfallow. It is available in widths ranging from 5.2 to 15.8 m (17 to 52 ft). The test machine was a 13.7 m (45 ft) model with a 5.1 m (16.8 ft) centre frame, and two 3.1 m (10.2 ft) wings with 1.2 m (4 ft) fold-out, extensions. It was equipped with 77 spring cushioned shanks, laterally spaced at 180 mm (7 in) arranged in four rows on the centre and wings, and in three rows on the wing extensions.

The frame is supported by four tandem wheel sets, one on each wing and two on the centre frame. Tillage depth is set with a hydraulic cylinder controlling a common rockshaft for the centre and wing wheels. Four hydraulic cylinders fold the wings and extensions into transport position. A tractor with dual remote hydraulic controls with a minimum pressure capability of 13,600 kPa (1970 psi) was needed to operate the test machine.

Detailed specifications are given in APPENDIX I while FIGURE 1 shows the location of major components.

SCOPE OF TEST

The Wil-Rich 17 FCW was operated in the field conditions shown in TABLE 1, for 140 hours, while cultivating about 1206 ha (3015 ac). It was evaluated for quality of work, ease of operation and adjustment, power requirements, safety and suitability of the operator's manual.

Optional attached finishing harrows were used during the test.

RESULTS AND DISCUSSION

QUALITY OF WORK

Shank Characteristics: There is a large variation in shank and sweep stem angles (FIGURE 2) on cultivators from different manufacturers. Sweeps and shanks must be matched to obtain sufficient sweep pitch to achieve and maintain penetration. Usually manufacturers recommend sweeps with a stem angle from 0 to 5 degrees less than the shank stem angle to result in a slightly positive no-load sweep pitch.

Sweep pitch increases in proportion to draft due to shank flexing, and, depending on shank stiffness and cushioning-spring preload, may become excessive on some cultivators in normal tillage. A slightly positive sweep pitch results in uniform tillage depth and a smooth furrow bottom while excessive sweep pitch causes furrow bottom ridging, rapid sweep tip wear, and increased draft. Shanks which maintain a low, relatively constant sweep pitch, over the normal range of tillage forces, are desirable.

The Wil-Rich 17FCW was equipped with spring cushioned shank holders. Spring tension was adjustable. The Wil-Rich 17FCW was used with 254 mm (10 in) Nicols sweeps with a 48° stem angle, giving a no load sweep pitch of 1 degree.

FIGURE 3 shows pitch characteristics of the shank assemblies on the Wil-Rich 17FCW. The low end of the pitch curve results from shank flexing, while the steeper upper part of the curve occurs when draft is large enough to overcome cushioning spring preload. Increasing cushion spring pretension increases the shank force required for tripping as shown by the dashed line on the curve.

TABLE 1. Operating Conditions

FIELD CONDITION	HOURS	FIELD AREA (ha)
Soil Type		
— light loam	50	431
— loam	36	310
— clay	54	465
Total	140	1 206
Stony Phase		
— stone free	41	353
— occasional stones	27	233
— moderately stony	60	517
— very stony	12	103
Total	140	1 206

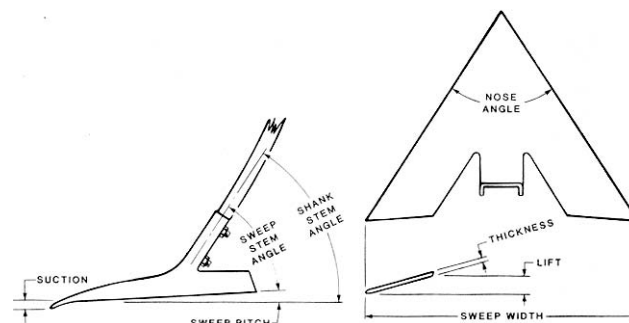


FIGURE 2. Shank and Sweep Terminology.

With the shank spring pretensioned at the manufacturer's recommended setting, sweep pitch varied from 1 to 13 degrees, over the normal secondary tillage draft range. At maximum spring pretension, sweep pitch varied from 1 to 9 degrees, over the same draft range. At the manufacturer's recommended setting, cushioning spring preload was exceeded at drafts greater than 1.8 kN/m (125 lb/ft). At the maximum setting, tripping occurred at drafts greater than 2.6 kN/m (180 lb/ft). Tripping, at both settings, occurred within the normal secondary tillage draft range, indicating that the Wil-Rich 17FCW shanks are suited only for light, secondary tillage operations and are not intended for primary tillage.

FIGURE 4 shows the lifting pattern when shanks encountered stones or field obstructions. Maximum lift height was 330 mm (13 in). One shank bent during the 140 hour test period. The cushioning springs gave good shank and sweep protection and this failure does not represent a serious problem.

Penetration: Penetration was good in light tillage. Penetration was inadequate in heavy secondary tillage and in primary tillage. As with most field cultivators, the Wil-Rich 17FCW was not intended for primary tillage.

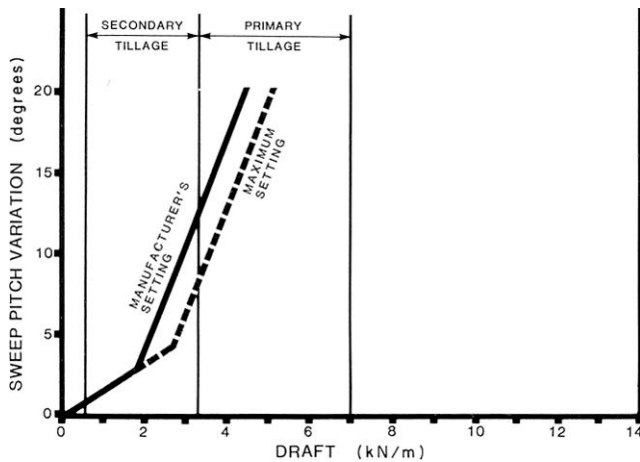


FIGURE 3. Sweep Pitch Variation over a Normal Range of Draft (180 mm Shank Spacing).

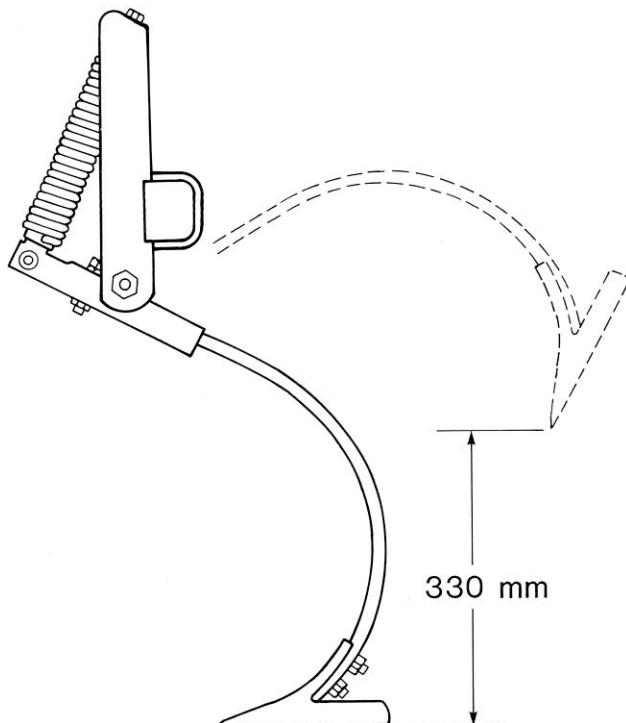


FIGURE 4. Shank Lifting Pattern.

In most conditions, penetration was uniform across the cultivator width. In rough, uneven fields, torsion in the rockshaft allowed the cultivator wings to bounce causing undulations in tillage depth of about 25 mm (1 in), at the wing ends. Tires were adequately sized and positioned to provide uniform flotation in most conditions. The wheels were positioned so that each centre section wheel supported about 15% of the cultivator weight while each wing wheel supported about 10%. During operation, tillage forces redistributed the load on the cultivator wheels so that each centre wheel supported about 14% of the total weight while each wing wheel supported about 11%. For good flotation and uniform penetration across the cultivator width, it is desirable to have wheels sized and positioned so that each supports equivalent weight.

Depth differences between the front and rear rows of shanks were slight, once the frame had been properly levelled. The frame remained relatively level, in normal secondary tillage, with little twisting of the wing frames.

The Wil-Rich 17FCW followed gently rolling field contours well, maintaining uniform depth across its width. As with most wing cultivators, large variations in tillage depth occurred in fields with abrupt contour changes.

Plugging: The 180 mm (7 in) lateral shank spacing and 540 mm (21 in) sweep-to-frame clearance was suitable only for light trash conditions. Plugging occurred in most areas of the cultivator in fields with moderate buried or surface trash. Plugging seldom occurred in light secondary tillage operations for which the cultivator was intended.

Trash Burial and Field Surface: As with most field cultivators, the Wil-Rich 17FCW buried less trash than most heavy duty cultivators. In secondary tillage, the Wil-Rich 17FCW left a slightly ridged field surface. The mounted harrows levelled ridges and smoothed the soil surface resulting in a uniform seedbed (FIGURE 5).

Furrow Bottom Ridging: Shank and spring-cushion stiffness was sufficient to hold the sweeps fairly level. In normal secondary tillage, furrow bottom ridging did not exceed 16 mm (0.6 in). Furrow bottom ridging was severe in hard soils due to excessive sweep pitch at high draft.

Skewing and Stability: The Wil-Rich 17FCW was stable and did not skew sideways in normal field conditions. The sweep pattern (FIGURE 6) was symmetrical and did not impose any side forces on the cultivator during normal tillage. As with most field cultivators, slight skewing occurred on hillsides or where soil hardness varied across the machine width. With the 254 mm (10 in) sweeps, the cultivator had to skew more than 2 degrees for weed misses to consistently occur across the cultivator width. Two trimmed sweeps, adjacent to the centre depth control wheels, however, gave very little overlap. Weed misses occurred at these sweeps with only minimal sideways skewing.



FIGURE 5. Typical Seedbed Preparation.

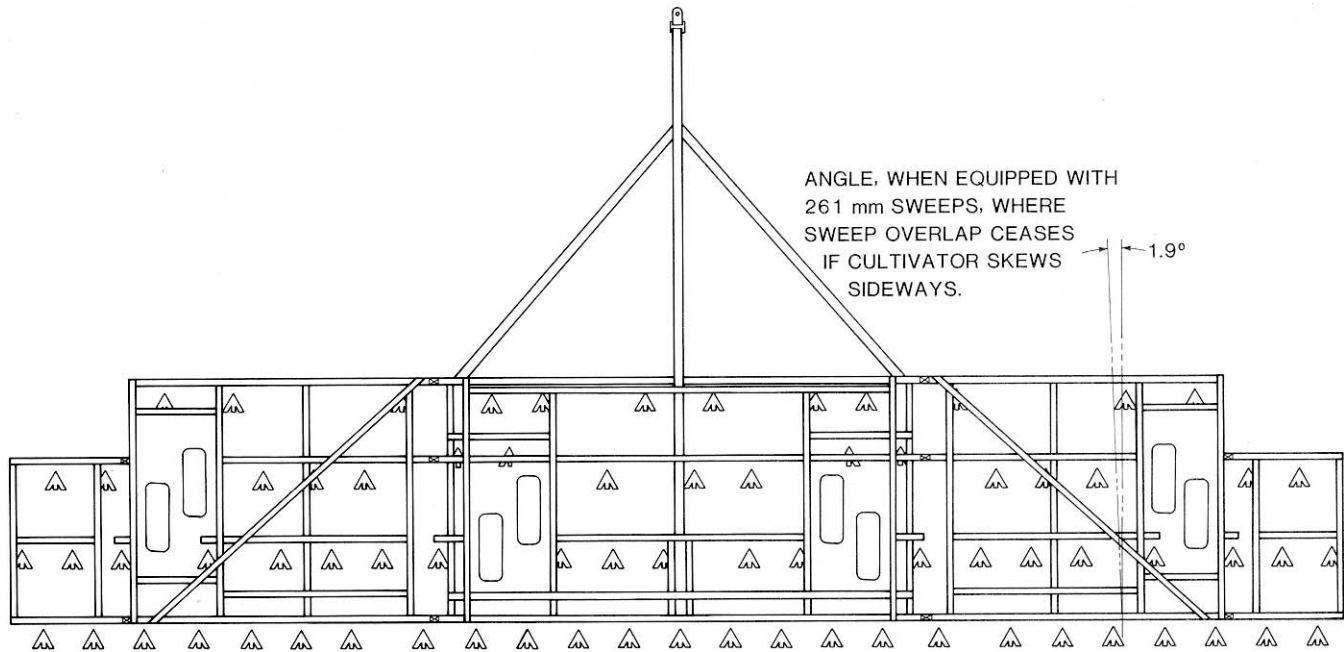


FIGURE 6. Sweep Pattern (180 mm Shank Spacing).

Weed Kill: Weed kill was good on most areas of the cultivator when using 254 mm (10 in) sweeps on 180 mm (7 in) spacing. At four locations, sweeps were positioned directly ahead of the depth control wheels. The wheels repacked the soil behind these sweeps, transplanting weeds in the wheel tracks. Weed kill was also reduced adjacent to the centre depth control wheels, where sweeps were trimmed to avoid tire interference. It is recommended that shanks be rearranged to avoid the use of trimmed sweeps adjacent to wheels, and to avoid tilling soil directly ahead of the wheels. The mounted harrows improved weed kill by uprooting and exposing loosened weeds.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Wil-Rich 17FCW was easily placed into transport position (FIGURE 7) by one man in less than five minutes using the hydraulic wing lift system. Transport locks for the wings and depth control wheels were provided. Care must be taken to avoid danger areas when installing the locks.

Transport width of the test machine was 6.8 m (22.5 ft) while transport height was 4.5 m (14.8 ft). Extreme care was needed when transporting on public roads, through gates, over bridges, and beneath power and telephone lines.

The Wil-Rich 17FCW towed well without sway at normal transport speeds. Sweep-to-ground clearance of 180 mm (7 in) and a wheel tread of 3.6 m (11.9 ft) gave good transport ground clearance on slopes and rough terrain.

Hitching: The Wil-Rich 17FCW was equipped with an optional hitch jack. The jack permitted easy hitching, only if the cultivator was not fitted with mounted harrows. When mounted harrows were attached, the resulting negative hitch weight made it difficult for one man to hitch the cultivator without use of the tractor hydraulics. It is recommended that an alternate location for the hitch jack be provided at the rear of the cultivator, to facilitate hitching when equipped with mounted harrows.

The hitch link swivelled downward when not hitched to a tractor (FIGURE 8), making one man hitching very difficult. It is recommended that a device be supplied to hold the hitch link in the horizontal position.

The hitch height could be adjusted 250 mm (10 in) in ten increments by removing one pin. This range was adequate to allow fore-and-aft frame levelling with all tractors used during testing.

Maneuverability: The hitch pole was narrow, with braces positioned to permit normal turns without tractor wheel interference. The tandem wheels skidded slightly in normal turns. There was sufficient overhang beyond the wing wheels to allow moderate

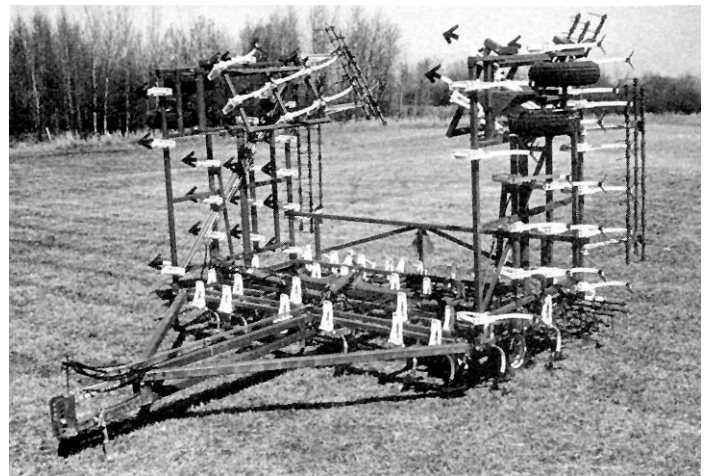


FIGURE 7. Transport Position.



FIGURE 8. Hitch Link in Vertical Position.

overlap without running a wheel on cultivated ground. Running all wheels on similar soil conditions maintains proper flotation and aids in uniform penetration.

Frame Levelling: Turnbuckle linkages were provided between the wing and centre frame rockshafts for lateral levelling (FIGURE 9). The turnbuckles were not easily accessible because of their position on the cultivator frame. The adjustment also was very coarse, making precise levelling difficult. It is recommended that the lateral frame levelling linkage be modified to allow easier and more precise adjustment.

Tillage Depth: Tillage depth was set with a single hydraulic cylinder controlling a common rockshaft linked to all depth control wheels. Depth was set by positioning a threaded collar on the cylinder shaft. Range of adjustment was increased by using spacers on the shaft.

Sweep Installation: It took one man about four hours to remove and replace the 77 sweeps on the Wil-Rich 17FCW. The sweep bolts were short enough to have their ends completely covered by the retaining nuts, preventing thread damage during tillage. Two sweeps had to be trimmed for installation adjacent to the centre-frame wheels to prevent tire damage. Sweep-to-ground clearance of 180 mm (7 in) was adequate for easy sweep removal.

Shank Installation: Shanks could easily be replaced by removing one shank fastener bolt. A shank could be replaced in less than five minutes.

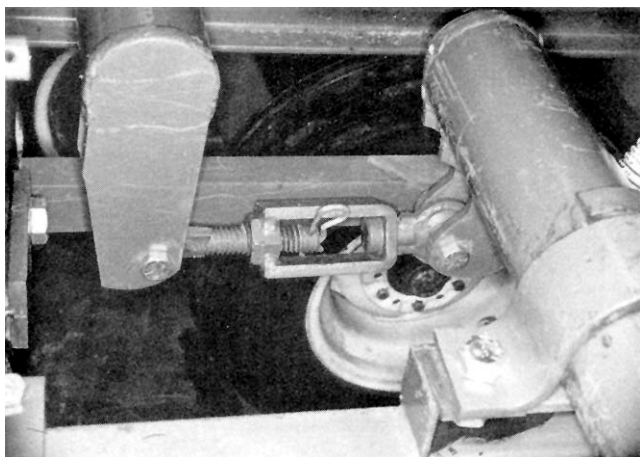


FIGURE 9. Frame Levelling Turn Buckle.

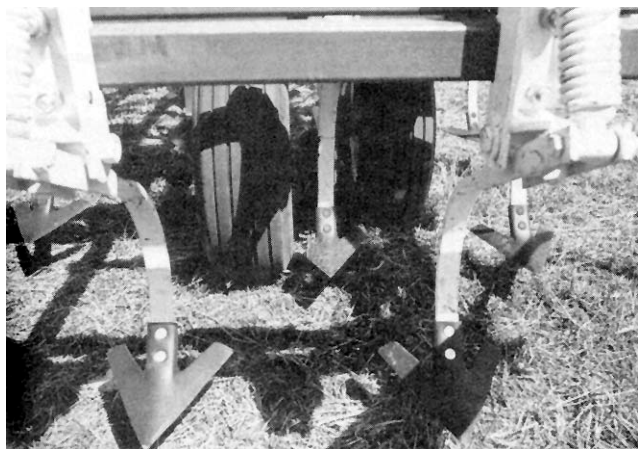


FIGURE 10. Trimmed Sweeps Adjacent to Centre Section Wheels.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 11 shows draft requirements for field cultivators in typical secondary tillage, at a speed of 8 km/h (5 mph). This figure gives average requirements based on tests of six makes of field cultivators in two seasons and 12 different field conditions. Attempting to compare draft requirements of different makes of field cultivators usually is unrealistic. Draft requirements for the same cultivator, in the same field, may vary by as much as 30% in two different years, due to changes in soil conditions. Variation in soil conditions affect draft much more than variation in machine make, usually making it impossible to measure any significant draft differences between different makes of field cultivators.

In light secondary tillage, such as herbicide incorporation or seedbed preparation, average draft per metre of width, at 8 km/h (5 mph), varied from 0.8 kN/m (55 lb/ft) at 40 mm (1.5 in) depth to 2.1 kN/m (144 lb/ft) at 100 mm (4 in) depth. For the 13.7 m (45.3 ft) wide test machine, this corresponds to a total draft ranging from about 11.0 to 28.8 kN (2420 to 6336 lb).

In heavy secondary tillage, such as firm summerfallow, average draft per metre of width, at 8 km/h (5 mph), varied from 1.4 kN/m (96 lb/ft) at 40 mm (1.5 in) depth to 3.0 kN/m (206 lb/ft) at 100 mm (4 in) depth, corresponding to a total variation from about 19.2 to 41.1 kN (4224 to 9042 lb) for the 13.7 m (45.3 ft) test machine.

Increasing speed by 1 km/h (0.6 mph), increased draft by about 90 N/m (6 lb/ft). For the 13.7 m (43.5 ft) wide test machine, this represents a draft increase of about 1.2 kN (260 lb) for a 1 km/h (0.6 mph) speed increase.

Tractor Size: TABLES 2 and 3 show tractor sizes needed to operate the 13.7 m (43.5 ft) wide Wil-Rich 17FCW in light and heavy secondary tillage. Tractor sizes have been adjusted to include tractive efficiency in loose soils and represent a tractor operating at 80% of maximum power on a level field. The sizes presented in the tables are the maximum power take-off rating, as determined by Nebraska tests or as presented by the tractor manufacturer. Selected tractor sizes will have ample power reserve to operate the Wil-Rich 17FCW in the stated conditions.

Tractor size may be determined by selecting the desired tillage depth and speed from the appropriate table. For example, in light secondary tillage at 75 mm (3 in) depth and 10 km/h (6 mph), a 114 kW (148 hp) tractor is needed to operate the Wil-Rich 17FCW. In heavy secondary tillage at the same depth and speed, a 166 kW (216 hp) tractor is needed.

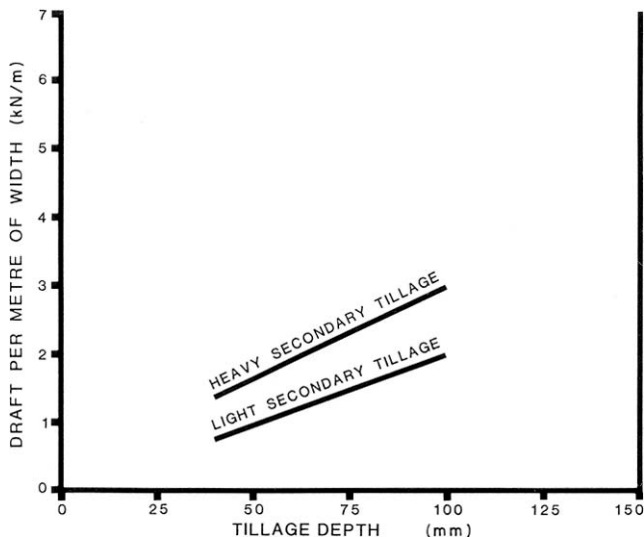


FIGURE 11. Average Draft Requirements for Field Cultivators at 8 km/h.

TABLE 2. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 13.7 m Wide Wil-Rich 17FCW in Light Secondary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
40	33	42	52	63	76	89
50	43	53	65	78	92	107
75	68	82	98	114	132	150
100	94	112	131	151	172	194

TABLE 3. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 13.7 m Wide Wil-Rich 17FCW in Heavy Secondary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
40	59	73	87	103	121	139
50	72	87	104	121	140	160
75	103	123	144	166	189	214
100	134	158	185	210	238	268

OPERATOR SAFETY

Extreme caution is needed in transporting most folding cultivators, to avoid contacting power lines. Minimum power line heights vary in the three prairie provinces. In Saskatchewan, the energized line may be as low as 5.2 m (17 ft) over farm land or over secondary roads. In Alberta and Manitoba, the neutral ground wire may be as low as 4.8 m (16 ft) over farm land. In all three provinces, power lines in farmyards may be as low as 4.6 m (15 ft).

Transport height of the 13.7 m (45 ft) wide test machine was 4.5 m (14.8 ft) permitting fairly safe transport under prairie power lines. On the other hand, wider models of the Wil-Rich 17FCW are high enough to contact some prairie power lines. The legal responsibility for safe passage under utility lines rests with the machinery operator and not with the power utility or the machinery manufacturer. All provinces have regulations governing maximum permissible equipment heights on various types of public roads. If height limits are exceeded, the operator must contact power and telephone utilities before moving.

The test machine was 6.8 m (22.5 ft) wide in transport position, necessitating caution when transporting.

No slow moving vehicle sign or mounting bracket was provided. It is recommended that a slow moving vehicle sign be supplied as standard equipment.

Locks for the wings and depth control were provided for safe transport. Two pins were used to lock the wings in transport position, and were easily accessible at the rear of the cultivator frame. The depth control was locked in raised position with a spacer on the depth control cylinder shaft. Care must be taken to avoid danger areas of the machine when installing these locks.

A safety hazard exists when a person holds the hitch link in horizontal position while the operator moves the tractor into position for hitching. It is recommended that a device be supplied to hold the hitch link in horizontal position to avoid this hazard.

The four tires supporting the main frame were adequately sized for transporting the cultivator, with mounted harrows, at speeds up to 32 km/h (20 mph).

STANDARDIZATION

Hydraulics: During the test, considerable difficulty was encountered due to differences in hydraulic couplers on various tractors. The difficulty was in the lack of standardization both in couplers and in hose threads. More standardization is needed in this area.

Sweep Bolt Holes: The bolt hole size and spacing on cultivator sweeps and shanks, as well as stem angles, should similarly be standardized to provide some degree of interchangeability of sweeps.

OPERATOR'S MANUAL

The operator's manual contained useful information on operation and maintenance. It was clear, concise and well illustrated. Very little safety information was included in the operator's manual. It is recommended that information regarding the safe operation of the cultivator be included in the operator's manual.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Wil-Rich 17FCW during 140 hours of field operation while tilling about 1206 ha (3015 ac). The intent of the test was evaluation of functional performance. The following mechanical problems represent those which occurred during the functional testing. An extended durability evaluation was not conducted.

TABLE 4. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA (ha)
Hydraulic System		
several hydraulic cylinder pin retainer clips sheared and were replaced		during the test
one hydraulic hose was damaged		during the test
Shank and Holder		
one shank bent and was replaced	102	879

DISCUSSION OF MECHANICAL HISTORY

Hydraulic System: Retainer clips on the hydraulic depth control cylinder pins (FIGURE 12), sheared off by forced rotation of the pins, during operation. It is recommended that modifications be considered to reduce retainer clip failure.

One hydraulic hose was slightly damaged by moving components of the cultivator (FIGURE 13). It is recommended that hoses be routed away from moving components to reduce the possibility of damage.

Shank and Holder: One shank bent while operating in very stony conditions. This failure does not represent a serious problem.

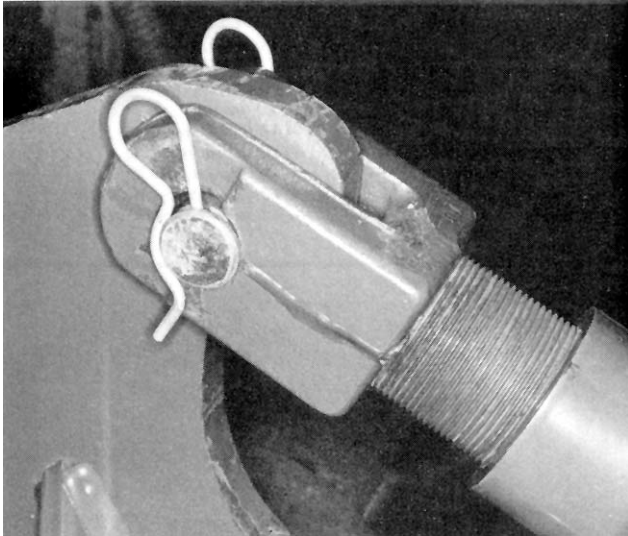


FIGURE 12. Damaged Retainer Clip on Depth Control Cylinder Yoke Pin.

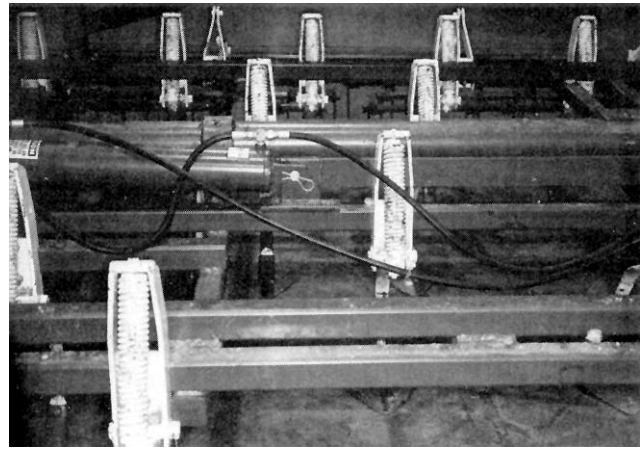


FIGURE 13. Hydraulic Hose Installation.

APPENDIX I

SPECIFICATIONS

MAKE: Wil-Rich Field Cultivator

MODEL: 17CFW

SERIAL NUMBER: 1589

MANUFACTURER: Wil-Rich Inc.

Box 1013

Wahpeton, North Dakota 58075

U.S.A.

DIMENSIONS:	FIELD POSITION	TRANSPORT POSITION
width	14,200 mm	6800 mm
length - with mounted harrows	7500 mm	7500 mm
height	1700 mm	4500 mm
maximum ground clearance	180 mm	180 mm
wheel tread	10,280 mm	3540 mm

SHANKS:

number	77
lateral spacing	180 mm
trash clearance (frame to sweep tip)	540 mm
number of shank rows	
centre section	4
wings	4
distance between rows	
first - second	860 mm
second - third	815 mm
third - fourth	810 mm
shank cross section	10 x 45 mm
shank stem angle	49°
sweep hole spacing	40 mm
sweep bolt size	5/16 x 1-3/8 in

HITCH:

vertical adjustment range	250 mm
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DEPTH CONTROL:

hydraulic

FRAME:

cross section	65 mm, square tubing, 6.4 and 4.8 mm thick
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TIRES:

centre section	4, 9.5L x 15, 6 ply
wings	4, 9.5L x 15, 6 ply
NUMBER OF LUBRICATION POINTS:	12 grease fittings, daily service
	8 grease fittings, weekly service
	8 wheel bearings, yearly service
	4 tandem bearings, yearly service

HYDRAULIC CYLINDERS:

depth control	1, 127 x 203 mm
wing lift	2, 102 x 610 mm
	2, 76 x 610 mm

WEIGHTS:

(Without Harrows)

	FIELD POSITION	TRANSPORT POSITION
right wheel	756 kg	
right centre wheels	1016kg	1742 kg
left centre wheels	1020 kg	1758 kg
left wheel	720 kg	
hitch	196 kg	208 kg
TOTAL	3708 kg	3708 kg

WEIGHTS:

(With Mounted Harrows)

	FIELD POSITION	TRANSPORT POSITION
right wheel	838 kg	
right centre wheels	1288 kg	2040 kg
left centre wheels	1320 kg	2036 kg
left wheel	908 kg	
hitch	-136 kg	142 kg
TOTAL	4218kg	4218kg

OPTIONAL EQUIPMENT:

15 width options from 5.2 to 15.8 m
hitch jack
mounted finishing harrows

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

(a) excellent	(d) fair
(b) very good	(e) poor
(c) good	(f) unsatisfactory

APPENDIX III

CONVERSION TABLE

1 hectare (ha)	= 2.5 acre (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 millimetre (mm)	= 0.04 inches (in)
1 metre (m)	= 3.3 feet (ft)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 kilonewton (kN)	= 220 pounds force (lb)
1 kilonewton/metre (kN/m)	= 70 pounds force/foot (lb/ft)
1 kilopascal (kPa)	= 0.2 pounds force/square inch (psi)



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