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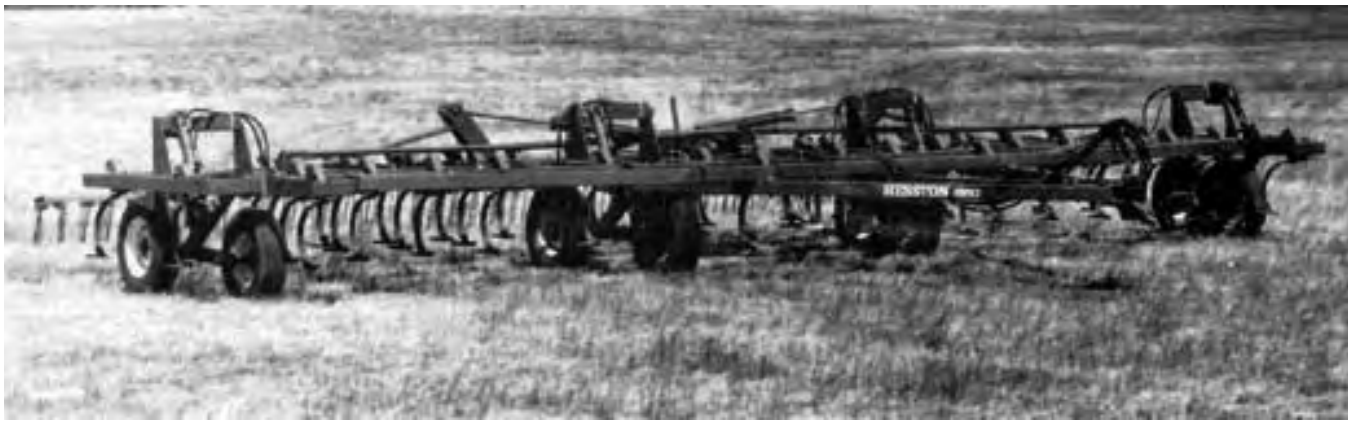
# Evaluation Report 61



## Hesston Model 2210 (10.1 m) Field Cultivator

A Co-operative Program Between
ALBERTA FARM MACHINERY RESEARCH CENTRE
PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

## HESSTON MODEL 2210 FIELD CULTIVATOR

**MANUFACTURER:**

Hesston Corporation
Hesston, Kansas 67062
U.S.A.

**DISTRIBUTOR:**

Hesston Industries Limited
920 - 26th Street North East
Calgary, Alberta
T2A 2M4

**RETAIL PRICE:**

$10,756.00 (April, 1979, f.o.b. Lethbridge, 10.1 m width, with optional finishing harrows and tandem wing wheels).

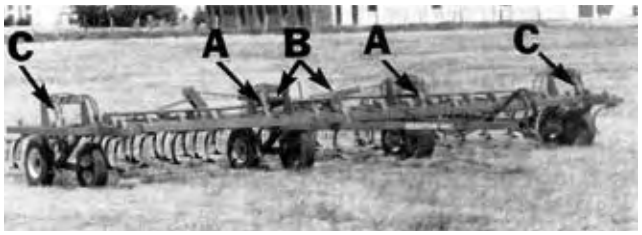



**FIGURE 1.** Hesston 2210: (A) Master Cylinders, (B) Wing Lift Cylinder, (C) Slave Cylinders.

**SUMMARY AND CONCLUSIONS**

Overall functional performance of the Hesston Model 2210 field cultivator was very good for seedbed preparation and herbicide incorporation, providing mounted finishing harrows were used. Its performance, for second operation summerfallow was good with good weed kill if 203 mm (8 in) sweeps, or larger, were used. As with most light duty field cultivators, the Hesston 2210 was unsuitable for first operation summerfallow or in heavy trash.

The spring cushioned shanks could lift 240 mm (9.5 in) to clear stones. As with most field cultivators, the shanks were very flexible. When equipped with recommended sweeps, having a 47 degree sweep angle, sweep pitch varied from 3 to 21 degrees over the range of normal secondary tillage draft, resulting in furrow bottom ridging in firm soils. With 178 mm (7 in) shank spacing, shank cushioning spring preload was exceeded at drafts greater than 2.1 kN/m (147 lb/ft), occurring midway within the secondary draft range. Penetration was adequate in previously tilled soil, but inadequate in harder soils. Plugging was not a problem in most trash conditions. Plugging occurred around the wing wheels in heavy trash. The Hesston 2210 buried less trash than most heavy duty cultivators and left a smooth, unridged soil surface, particularly if mounted finishing harrows were used. The sweep pattern was symmetrical and sideways skewing was not a problem, however, sideways movement of the shanks in the shank holders caused some heavy stalked weeds to be missed. Weed kill in second operation summerfallow generally was good as long as sweeps with adequate overlap were used.

The Hesston 2210 could be conveniently placed into transport position in less than five minutes. The 255 mm (10 in) sweep-to-ground clearance, in transport position, was adequate. Due to its large transport width and height, transporting on public roads had to be with extreme caution and the manufacturer's maximum recommended transport speed of 16 km/h (10 mph) should not be exceeded. The 10.1 m (33.3 ft) wide test machine has a transport height of 4.5 m (14.9 ft) permitting safe transport under power lines in the three prairie provinces. Transport height of the 14 m (46 ft) wide model of the Hesston 2210 is 5.4 m (17.7 ft) which is higher than minimum power line height in all three provinces.

When equipped with optional finishing harrows, hitch weight was negative, making hitching inconvenient. Adequate adjustment was provided for both lateral and fore-and-aft levelling. Tillage depth was uniform across the width of the cultivator as long as the centre frame and wing section hydraulic cylinders were kept synchronized.

Average draft for the 10.1 m (33.3 ft) wide test machine, in light secondary tillage, at 8 km/h (5 mph), varied from 8 kN (1760 lb) at 40 mm (1.5 in) depth to 20 kN (4400 lb) at 100 mm (4 in) depth. In heavy secondary tillage, at 8 km/h (5 mph), average draft varied from 14 kN (3080 lb) at 40 mm {1.5 in) to 30 kN (6600 lb) at 100 mm (4 in).

In light secondary tillage, at 10 km/h (6.2 mph) and 75 mm (3 in) depth, a tractor with 84 kW (113 hp) maximum power take-off rating will have sufficient power reserve to operate a 10.1 m (33.3 ft) wide Hesston 2210. In heavy secondary tillage at the same depth and speed, a 122 kW ( 163 hp) tractor is needed.

The Hesston 2210 was equipped with wing transport locks to aid in transport safety. A slow moving vehicle sign and mounting bracket were provided. The operator's manual was clear, concise and well illustrated.

Some mechanical problems occurred during the 188 hours of field operation: Four shank holders bent requiring replacement, while many other holders loosened. A number of harrow tine bar compression springs broke and attaching bolts loosened. Two tire valve stems sheared in trash. The left outer frame member broke.

**RECOMMENDATIONS**

It is recommended that the manufacturer consider:

1. Modifying the shank holders to eliminate holder bending.
2. Modifying the method of attaching the tine bars to the mounted finishing harrows to reduce compression spring failure and loosening of the attaching bolts.
3. Supplying a mechanical transport lock for the centre frame depth control cylinders as standard equipment.
4. Providing an alternate location for the hitch jack for use at the rear of the cultivator to facilitate hitching when equipped with mounted harrows.
5. Working with the agricultural equipment industry to standardize hydraulic quick couplers and hydraulic hose fitting threads..
6. 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-E. H. Wiens*

**THE MANUFACTURER STATES THAT**

With regard to recommendation number:

1. The 1979-80 production will have a redesigned shank holder which has greater side load capacity.
2. The compression spring was redesigned in mid 1978.
3. No action is planned on this recommendation. Depth collars are provided to act as transport locks. It has been our experience that when machines are towed behind farm tractors, transport locks are seldom used.
4. Hesston provides, as optional equipment, rear stands to be used with the smoothing harrow attachment. When the stands are set in place the hitch jack can be used to adjust hitch height.

5 & 6. We design our products in accordance with the ASAE standards and recommendations whenever possible.

**GENERAL DESCRIPTION**

The Hesston 2210 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 16 widths ranging from 7.6 to 14 m. The test machine was a 10.1 m model, with a 3.7 m centre frame and two 3.2 m wings. It was equipped with 57 spring cushioned shanks, laterally spaced at 178 mm, arranged in three rows on the wings and in four rows on the centre section.

The centre frame is carried on two tandem wheel sets. The test machine was also equipped with optional tandem wheel sets for each wing. Four hydraulic cylinders control the tillage depth. Two master cylinders connected in parallel, control the centre frame wheels while each set of wing wheels is controlled with a slave cylinder connected in series to the master cylinder on its side. The wings fold into upright transport position with two hydraulic cylinders connected in parallel. A tractor with dual remote hydraulic controls is

needed to operate the Hesston 2210.

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

### SCOPE OF TEST

The Hesston 2210 was operated in the field conditions shown in TABLE 1, for 188 hours, while cultivating about 1700 ha. 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 most of the test.

**TABLE 1.** Operating Conditions

| FIELD CONDITIONS | HOURS | FIELD AREA (ha) |
|---|---|---|
| Soil Type | | |
| - loam | 74 | 669 |
| - clay loam | 59 | 533 |
| - clay | 55 | 498 |
| TOTAL | 188 | 1700 |
| Stoney Phase | | |
| - stone free | 103 | 931 |
| - occasional stones | 45 | 407 |
| - moderately stony | 40 | 362 |
| - vey stony | 0 | 0 |
| TOTAL | 188 | 1700 |

## 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 in normal tillage, on some cultivators. A slightly positive sweep pitch results in uniform tillage depth and a smooth furrow bottom while excessive sweep pitch causes furrow bottom ridging and rapid sweep tip wear. Shanks which maintain a relatively constant sweep pitch, over the normal range of tillage forces, are desirable.

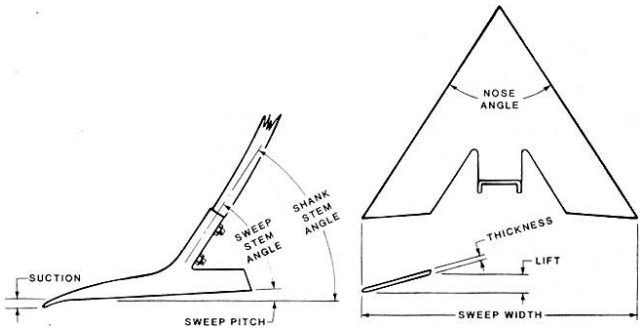



**FIGURE 2.** Shank and Sweep Terminology.

The Hesston 2210 was equipped with adjustable, spring cushioned shank holders. The shank holders Could be set in two positions to suit soil conditions. The normal position was recommended for mellow soils in typical secondary tillage, while the alternate position was intended to aid penetration in harder soils. During the test, the Hesston 2210 was used with both 203 and 228 mm wide Hesston sweeps with a 47 degree stem angle, giving a no load sweep pitch of 3 degrees.

FIGURE 3 shows pitch characteristics of the Hesston 2210 shank assembly. 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. Sweep pitch varied about 18 degrees over the full range of draft normally occurring in secondary tillage. When equipped with 47 degree sweeps, as used during the test, sweep pitch varied from 3 to 21 degrees over this draft range. Cushioning spring preload was exceeded at drafts greater than 2.1 kN/m, occurring midway in the range of normal secondary tillage draft. This shows that the Hesston 2210 is suitable only for light, secondary tillage and is unsuitable for heavier tillage operations. Setting the shank holder in the alternate position, as recommended for harder soils, was of little benefit since it did not appreciably increase the force to overcome cushioning spring preload.

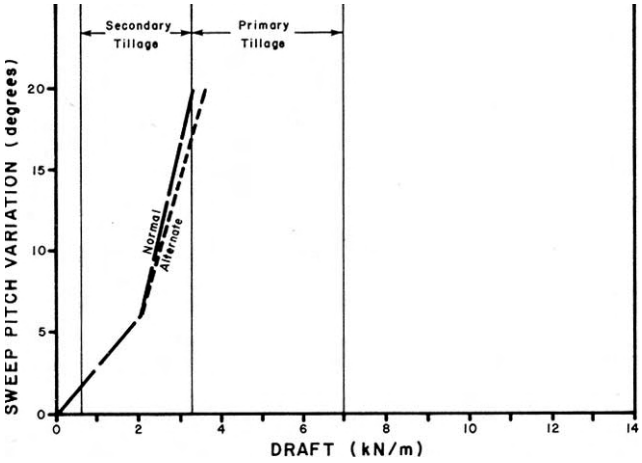



**FIGURE 3.** Sweep Pitch Variation over a Natural Range of Draft (178 mm shank spacing).

FIGURE 4 shows the lifting pattern when shanks encounter stones or field obstructions. Maximum lift height was 240 mm with the spring clamp in normal position and 200 mm with the clamp in the alternate position. Four shank holders bent, requiring replacement during the 188 hour test period.

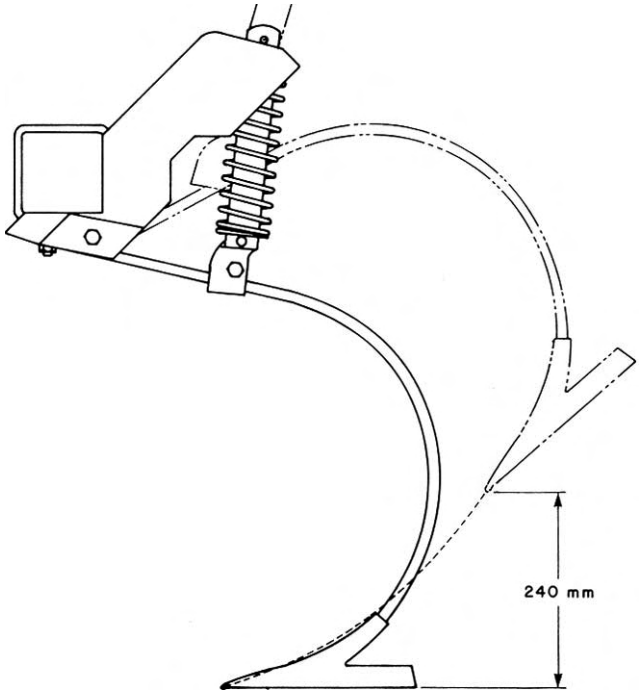



**FIGURE 4.** Shank Lifting Pattern (Shank Holder in Normal Position).

**Penetration:** Penetration was good in light tillage such as seedbed preparation, herbicide incorporation and secondary summerfallow. Penetration was inadequate in most primary tillage operations. As with most field cultivators, the Hesston 2210 was not intended for primary tillage.

Penetration was uniform across the cultivator width. Tires were adequately sized to provide good flotation in most soil conditions. The wheels were positioned so that each centre section wheel supported about 17% of the cultivator weight while each wing wheel supported about 8%. In addition, each centre section wheel supported about 15% of the total tillage suction force while each wing wheel supported about 10%. For good flotation, it is desirable to have wheels sized

and positioned so that each supports equivalent weight and a similar tillage suction force.

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

The Hesston 2210 followed gently rolling field contours very well, maintaining quite uniform depth across its width. All sections were about the same width. As with most wing cultivators, large variations in tillage, depth occurred in fields with abrupt contour changes.

**Plugging:** The Hesston 2210 cleared trash well in medium to heavy straw and weed conditions. Plugging occurred occasionally in heavy trash, starting around the wing wheels. Plugging in heavy straw was sometimes initiated by the harrow mounting brackets, eventually building up around the rear row of shanks.

**Trash Burial and Field Surface:** The Hesston 2210 buried less trash than most heavy duty cultivators. In light, secondary tillage, the resulting soil surface was smooth, even and unridged. The optional mounted finishing harrows were solidly attached to the cultivator frame, creating enough downward force to break most soil lumps that were brought to the surface, resulting in very good seedbed preparation (FIGURE 5).

**FIGURE 5.** Typical Seedbed Preparation.

**Furrow Bottom Ridging:** In soft, previously tilled fields,, no furrow bottom ridging occurred. In fields with a hard subsoil layer, ridging was severe due to excessive sweep pitch (FIGURE 3) at high draft.

**Skewing and Stability:** The Hesston 2210 was very stable and did not skew sideways in normal field conditions. The shank 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 steep hillsides. Due to the 178 mm shank spacing, only very slight skewing would result in weeds being missed. When equipped with 203 mm sweeps, weeds would be missed if the cultivator skewed more than 0.5 degrees. With 228 mm sweeps the cultivator could skew 1 degree before weeds were missed.

Although skewing was not a problem, sideways movement of the shanks in the shank holder occurred in heavy stalked weeds. With worn sweeps, shank movement was sufficient to cause weed misses.

**Weed Kill:** In soft fields, weed kill was good with both 203 mm and 229 mm sweeps at the standard 178 mm shank spacing. New 203 mm sweeps had only 25 mm overlap. With worn 203 mm sweeps sideways movement of the shanks in the shank holders caused misses of large well rooted weeds, in harder soils. The use of 228 mm sweeps eliminated misses in these conditions.

## EASE OF OPERATION AND ADJUSTMENT

**Transporting:** The Hesston 2210 was easily placed in transport position using the hydraulic wing lift system supplied as standard equipment. Two safety straps, which had to be attached by hand, were provided to lock the wings during transport. Raising and lowering, which depended on the tractor hydraulic system, took one man less than five minutes. To lock the master depth control cylinders in transport position, six depth control stops had to be placed on each cylinder (FIGURE 7). This was inconvenient and it is recommended a suitable mechanical lock be provided.

Since the wings folded in beyond the upright position (FIGURE 8. Care was needed when transporting on public roads, through-gates, over ridges and beneath power or telephone lines.

Hitch weight, without finishing harrows, was about 160 kg, while with attached finishing harrows, the hitch weight was minus 18 kg. In spite of the negative hitch weight, the Hesston 2210 towed well at speeds up to 40 km/h, however the manufacturer recommends a maximum transport speed of 16 km/h. If a farm truck is used to transport the cultivator, sufficient weight should be added to the truck to compensate for the negative hitch weight.

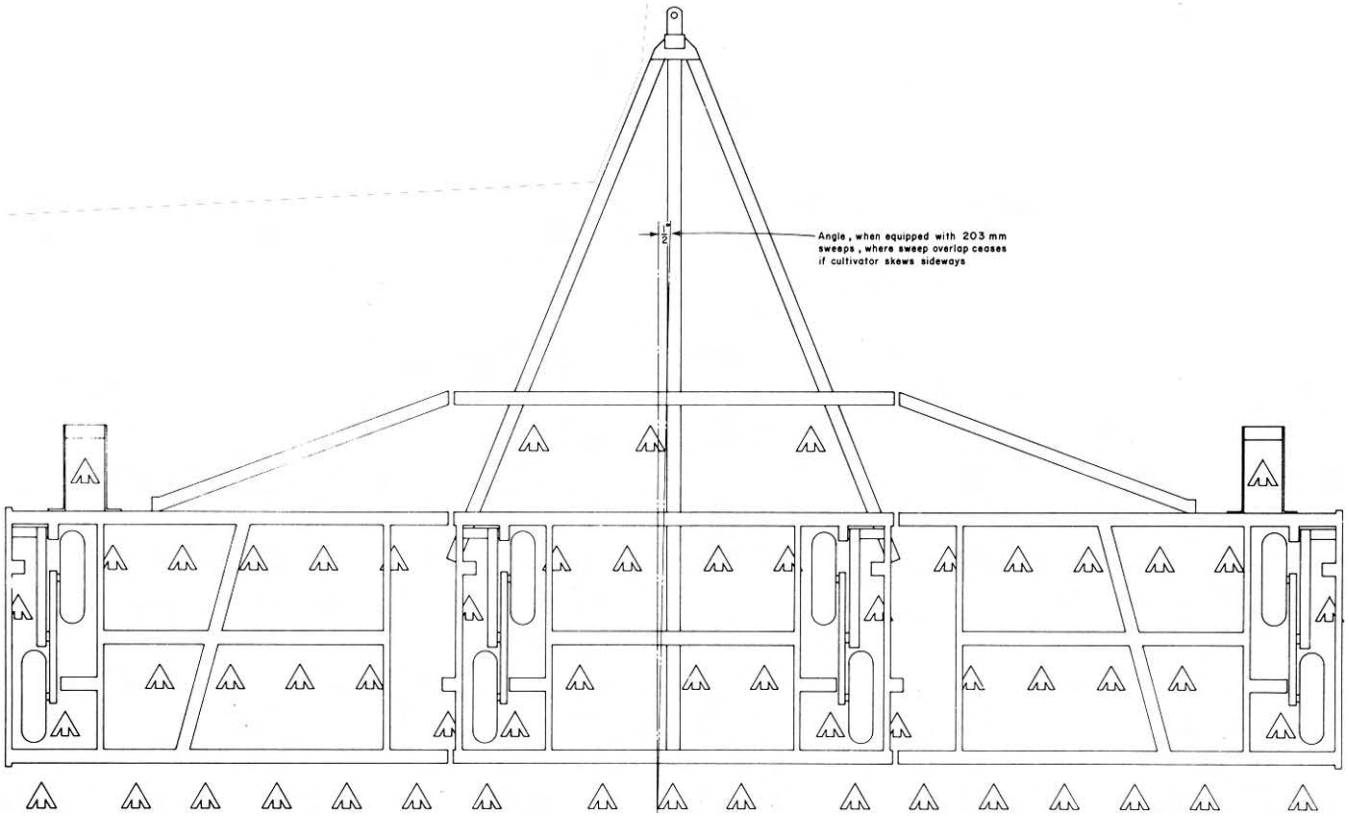



**FIGURE 6.** Sweep Pattern (178 mm shank spacing).

**FIGURE 7.** Depth Control Stops Used as Master Cylinder Transport Locks.

Sweep to ground clearance during transport was 255 mm, while transport wheel tread was 2.6 m. This provided ample ground clearance.

**FIGURE 8.** Transport Position.

**Hitching:** The Hesston 2210 was equipped with a suitable hitch jack. The jack permitted easy hitching, only if the cultivator was not equipped with finishing, harrows. When finishing harrows were attached, the resulting negative hitch weight made it difficult for one man to hitch the cultivator to a tractor. Optional support stands were available for the rear of the cultivator to limit backward tipping. However, since these were not adjustable, they did not necessarily set the hitch at a suitable hitching height. It is recommended that an alternate location for the adjustable hitch jack be provided at the rear of the cultivator to facilitate hitching when equipped with finishing harrows.

Hitching to a tractor could be accomplished by one man since the hitch clevis contained a stop to hold it in a horizontal position (FIGURE 9).

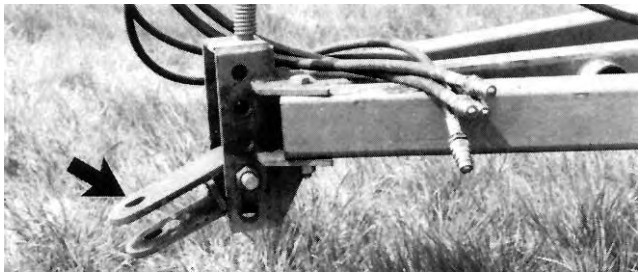


**FIGURE 9.** Hitch Clevis Held in Horizontal Position for Easy Hitching.

Hitch height could be adjusted 230 mm in five increments by removing one bolt. This range was adequate to allow fore-and-aft cultivator frame levelling with all tractors used during testing.

A hydraulic check valve assembly, mounted on the hitch and supplied as standard equipment, made it easy to connect the depth control hydraulics to the tractor, under pressure.

**Frame Levelling:** There was no provision for levelling the centre frame section other than by placing the same number of depth control stops (FIGURE 7) on each master cylinder. The centre frame remained level throughout the test. Initial levelling of the wings, in relation to the centre frame, was accomplished, during set-up, by placing the required number of shims (FIGURE 10) under each wing cylinder assembly.

**Depth of Tillage:** Tillage depth is controlled by four hydraulic cylinders. Two master cylinders, connected in parallel, control the centre frame wheels, while each set of wing wheels is controlled with a slave cylinder connected in series with the master, cylinder on its side. An appropriate number of depth control stops (FIGURE 7) had to be used on each master cylinder to set the desired tillage depth. As is common with series hydraulic systems, to maintain the centre and wing frames at the same height, periodic synchronization of the cylinders, by completely extending them to fully raised position, was necessary.

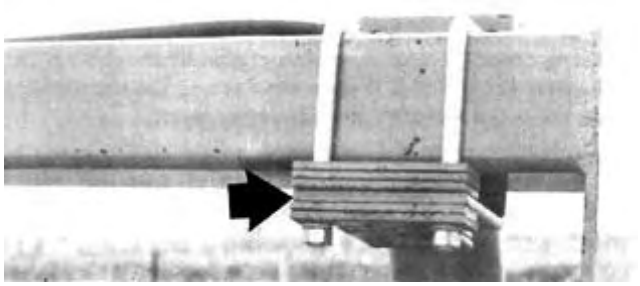


**FIGURE 10.** Shims for Leveling Wings in Relation to Centre Frame.

**Sweep Installation:** It took one man about three hours to remove and replace the 57 sweeps on the Hesston 2210. The sweep bolts were short enough to have their ends completely covered by the retaining nuts, preventing thread damage to the sweep bolts during tillage.

**Shank Installation:** Shanks could be easily replaced by removing two bolts. A shank could be replaced in less than five minutes.

## POWER REQUIREMENTS

**Draft Characteristics:** FIGURE 11 shows draft requirements for field cultivators in typical secondary tillage, at a speed of 8 km/h. 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.

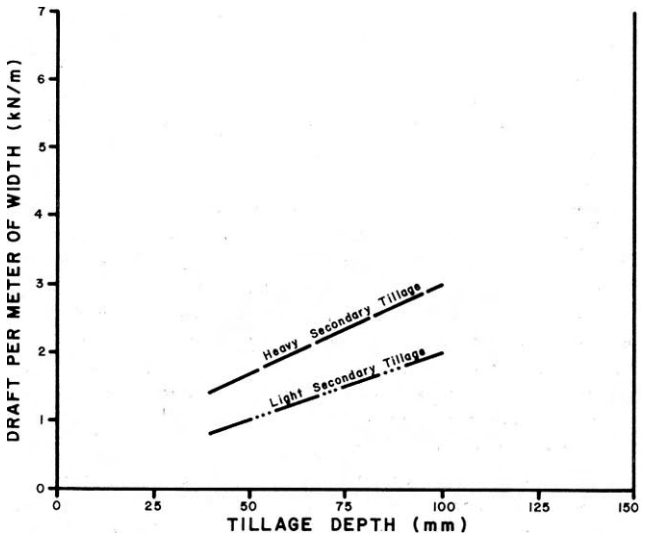



**FIGURE 11.** Average Draft Requirements for Field Cultivators at 8 km/h.

In light secondary tillage, such as herbicide incorporation or seedbed preparation, average draft per metre of width, at 8 km/h, varied from 0.8 kN at 40 mm depth to 2 kN at 100 mm depth. For the 10.1 m wide test machine, this corresponds to a total draft ranging from about 8 kN to 20 kN.

In heavy secondary tillage, such as firm summerfallow, average draft per metre of width, at 8 km/h, varied from 1.4 kN at 40 mm depth to 3 kN at 100 mm depth, corresponding to a total variation from about 14 to 30 kN for the 10.1 m test machine.

Increasing speed by 1 km/h, increased draft by about 90 N per metre of width. For the 10.1 m wide test machine this represents a draft increase of 0.9 kN for a 1 km/h speed increase.

**Tractor Size:** TABLES 2 and 3 show tractor Sizes needed to operate the 10.1 m wide Hesston 2210 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 Hesston 2210 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 depth and 10 km/h, an 84 kW tractor is needed to operate the Hesston 2210. In heavy secondary tillage at the same depth and speed, a 122 kW tractor is needed.

**TABLE 2.** Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 10.1 m Wide Hesston 2210 in Light Secondary Tillage.

| DEPTH mm | SPEED km/h | | | | | |
|---|---|---|---|---|---|---|
| | 7 | 8 | 9 | 10 | 11 | 12 |
| 40 | 24 | 31 | 38 | 47 | 56 | 66 |
| 50 | 32 | 39 | 48 | 57 | 67 | 79 |
| 75 | 50 | 61 | 72 | 84 | 97 | 111 |
| 100 | 69 | 62 | 96 | 111 | 126 | 143 |

**TABLE 3.** Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 10.1 m Wide Hesston 2210 in Heavy Secondary Tillage.

| DEPTH mm | SPEED km/h | | | | | |
|---|---|---|---|---|---|---|
| | 7 | 8 | 9 | 10 | 11 | 12 |
| 40 | 44 | 53 | 64 | 76 | 89 | 102 |
| 50 | 53 | 64 | 76 | 89 | 108 | 118 |
| 75 | 76 | 90 | 106 | 122 | 139 | 157 |
| 100 | 99 | 116 | 135 | 155 | 175 | 197 |

## OPERATOR SAFETY

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

Transport height of the 10.1 m wide test machine was 4.5 m, permitting safe transport under prairie power lines. On the other hand, transport heights of the 14 m wide model of the Hesston 2210 is 5.4 m, which is high enough for contact with many 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 public roads. If height limits are exceeded, the operator must contact power and telephone utilities before moving.

The Hesston 2210 was 4.5 m wide in transport position. This necessitated some. caution when towing on public roads, over bridges and through gates. A slow moving vehicle sign and mounting bracket were provided. The manufacturer recommends that transport speed should not exceed 16 km/h.

Safety straps were provided to lock the wings in transport position. Depth control stops, installed on the master depth control cylinders, acted as transport stops in the event of hydraulic hose failure.

The four tires supporting the main frame were adequately sized for transporting the cultivator. Individual tire loads did not exceed the Tire and Rim Association maximum rating for 7.60 x 15, 6-ply tires. The operator's manual clearly outlined all safety precautions.

## 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 was very good, containing useful information on safety, operation, maintenance and assembly. It was clear, concise and well illustrated.

## DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Hesston 2210 during 188 hours of field operation while tilling about 1700 ha. 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

| ITEMS | OPERATING HOURS | EQUIVALENT FIELD AREA ha |
|---|---|---|
| Sweeps and Shanks | | |
| - Many shank holder attaching bolts had loosened, necessitating tightening at | 14, 102, 139 | 127, 922, 1257 |
| - Four shank holders were bent and replaced between | 34 & 125 | 307 & 1130 |
| - Worn sets of 203 mm sweeps were replaced at | 70, 172 | 633, 1555 |
| Mounted Harrows | | |
| - Many harrow line bar attaching bolt compression springs broke and were replaced | During the Test | |
| - Many tine bar attaching bolts loosened, were lost and replaced | During the Test | |
| Wheels | | |
| - A tire valve stem sheared due to trash build up at | 80, 125 | 723, 1130 |
| Frame | | |
| - The left frame member failed and was rewelded at | End of Test | |

## DISCUSSION OF MECHANICAL PROBLEMS

**Shank Holders:** Four shank holders bent, requiring replacing during the test. Many other shank holders bent slightly near the frame attaching bolt, causing the shank holders to loosen on the frame. It is recommended that shank holders be modified to overcome this problem.

**Mounted Harrows:** Many of the compression springs on the tine bar attaching bolts (FIGURE 12) broke due to fatigue. The tine bar attaching bolts also loosened frequently and many were lost. It is recommended a modified method of attaching the tine bars to the harrow frame be investigated.

**Frame:** The left end frame member broke (FIGURE 13), requiring welding, at the end of the test. The reason for the failure was not apparent.

## APPENDIX I

**SPECIFICATIONS**
**MAKE:** Hesston Field Cultivator
**MODEL:** 2210 (10.1 m size)
**SERIAL NUMBER:** FC22-0429
**MANUFACTURER:** Hesston Corporation
Hesston, Kansas 67062
U.S.A.

| **DIMENSIONS** | **FIELD POSITION** | **TRANSPORT POSITION** |
|---|---|---|
| - width | 10,146 mm | 4500 mm |
| | 6050 mm | 6050 mm |
| - height | 1400 mm | 4540 mm |
| - maximum ground clearance | 255 mm | 255 mm |
| -wheel tread | | 2590 mm |

| | |
|---|---|
| **Shanks:** | |
| - number | 57 |
| - lateral spacing | 178 mm |
| - trash clearance (frame to sweep tip) | 400 mm |
| - number of shank rows: | |
| - centre section | 4 |
| | 3 |
| - distance between rows | 915 mm |
| - shank cross section | 13 x 44 mm |
| - shank stem angle | 50° |
| - sweep hole spacing | 44 mm |
| - sweep bolt size | 11 mm |
| **Hitch:** | |
| - vertical adjustment range | 230 mm |
| **Depth Control:** | hydraulic |
| **Frame:** | 102 mm square tubing |
| **Tires:** | |
| - centre section | 4, 7.60 x 15, 6 ply |
| - wings | 4, 7.60 x 15, 6 ply |
| **Number of Lubrication Points:** | 16 grease fittings, 10 hour service<br>8 wheel bearings, annual service |
| **Hydraulic Cylinders:** | |
| - main frame, depth control masters | 2, 89 x 203 mm |
| - wings, depth control slaves | 2, 83 x 203 mm |
| | 2, 102 x 813 mm |

| **WEIGHTS:** (Without Harrows) | **FIELD POSITION** | **TRANSPORT POSITION** |
|---|---|---|
| - right wheels | 363 kg | |
| - right centre wheels | 799 kg | 1142 kg |
| - left centre wheels | 799 kg | 1142 kg |
| - left wheels | 363 kg | |
| - hitch | 118 kg | 158 kg |
| TOTAL | 2442 kg | 2442 kg |
| **Weights:** (With Mounted Harrows) | | |
| - right wheels | 413 kg | |
| - right centre wheels | 851 kg | 1280 kg |
| - left centre wheels | 851 kg | 1280 kg |
| - left wheels | 413 kg | |
| - hitch | -22 kg | -18 kg |
| TOTAL | 2542 kg | 2542 kg |

**Optional Equipment**
- 16 width options from 7.6 to 14 m
- rear support stands
- mounted finishing harrows*
- tandem wing wheels*

* supplied on test machine

## APPENDIX II

**MACHINE RATINGS**
The following rating scale is used in PAMI Evaluation Reports:

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

## APPENDIX III

**METRIC UNITS**
In keeping with the Canadian Metric Conversion program, this report has been prepared in SI units. For comparative purposes, the following conversions may be used:

| | |
|---|---|
| 1 hectare (ha) | = 2.47 acres (ac) |
| 1 kilometre/hour (km/h) | = 0.62 mile/hour (mph) |
| 1000 millimetres (mm) = 1 meter (m) | = 39.37 inches (in) |
| 1 kilowatt (kW) | = 1.34 horsepower (hp) |
| 1 kilogram (kg) | = 2.20 pounds mass (lb) |
| 1 newton (N) | = 0.22 pounds force (lb) |
| 1 kilonewton (kN) | = 220 pounds force (lb) |
| 1 kilonewton/metre (kN/m) | = 70 pounds force/foot (lb/ft) |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