

EVALUATION REPORT

408



Westfield TR100 x 51 Grain Auger

A Co-operative Program Between



WESTFIELD TR100 x 51

MANUFACTURER AND DISTRIBUTOR:

Westfield Ind. Ltd.
Box 39
Rosenort, Manitoba
ROG 1W0

RETAIL PRICE:

\$4,108.00, less tires (February 1985, f.o.b. Portage la Prairie, Manitoba).

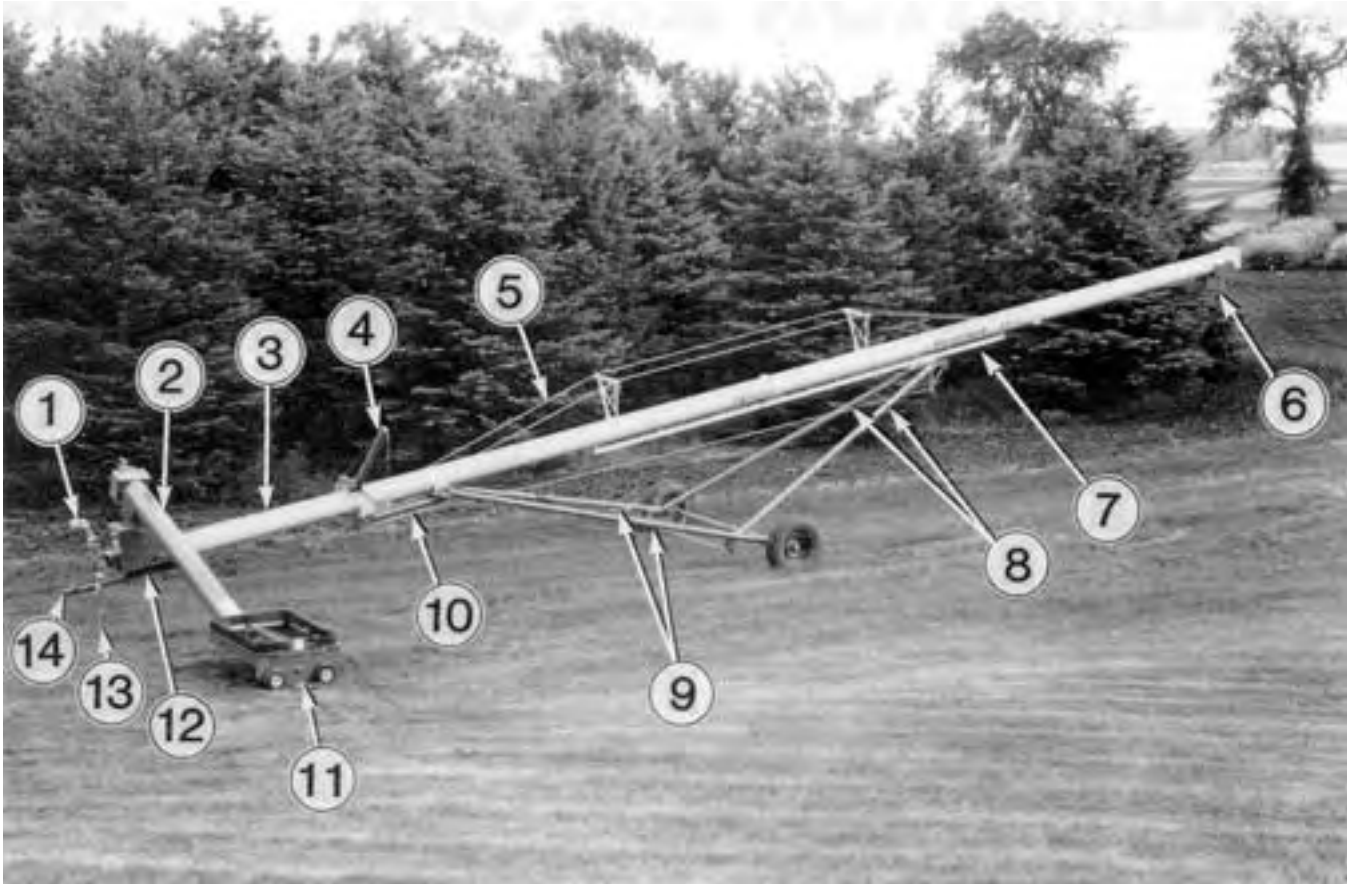


FIGURE 1. Westfield TR100 x 51 Grain Auger: (1) Power Take-off Driveline (2) Intake Auger, (3) Main Auger Tube, (4) Intake Auger Lift Boom, (5) Truss Cables, (6) Discharge Spout, (7) Elevating Track, (8) Lift Arms, (9) Lower Arms, (10) Hydraulic Cylinder, (11) Intake Hopper, (12) Auger Boot, (13) Jack, (14) Tow Hitch.

SUMMARY

Ease of Operation: The Westfield TR100 x 51 was very easy to position and operate since raising the main tube and engaging the flighting was performed from the tractor seat. Maneuverability was good and transportability was very good.

Rate of Work: At the 30° elevation angle, corresponding to a discharge height of 27 ft (8.3 m), maximum capacities were 4600, 7050, 5500 and 4900 bu/h (125, 103, 135 and 111 t/h) in wheat, oats, corn and rapeseed respectively. Maximum capacities were usually obtained at flighting speeds between 470 and 570 rpm.

Power Requirements: Combined power requirements for the main auger and the swing auger ranged from 10 to 53 hp (7.5 to 40 kW) in dry grain.

In damp grain, combined power requirements ranged from 11 to 64 hp (8.5 to 48 kW).

Quality of Work: In dry wheat, damage was less than 0.2% for each pass through the auger.

Safety: All nip points, rotating drive shafts, and inlet flighting were guarded in accordance with safety standards.¹

Operator's Manual: The manual was very well written and clearly illustrated.

Mechanical History: Several shear pins broke due to overloading the main auger flighting.

RECOMMENDATIONS

It is recommended that the manufacturer consider modifications to the boot and hopper to allow for more thorough cleaning and inspection of the flighting.

Station Manager -- G. M. Omichinski

Project Engineer -- D.J. May

THE MANUFACTURER STATES THAT

With regard to the recommendation:

When we designed the clean-out openings in the 'TR' boot and hopper, we were concerned that larger openings would reduce the level of safety and the structural strength of these components. We do feel that our present design is adequate for the majority of farmers. Should we be able to improve on this feature without reducing safety or strength levels, we will do so.

GENERAL DESCRIPTION

The Westfield TR100 x 51 Grain Auger (FIGURE 1) is a 10 in (250 mm) diameter, 51 ft (15.5 m) long portable screw conveyor with a hopper section at the bottom which swings to either side of the main auger.

The main auger tube is mounted on a tubular steel under carriage and supporting truss cables, and is raised or lowered hydraulically. The swing auger is raised or lowered with a hand-operated cable winch.

¹American Society of Agricultural Engineers Tentative Standard ASAE S361.2T, "Safety for Agricultural Auger Conveying Equipment," December 1983.

The test machine utilized a direct drive 540 rpm, PTO drive shaft to the main auger and a hydraulic drive on the swing auger.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Westfield TR100 x 51 was operated for about 20 hours while conveying a total of 1000 tons (910 t) of dry and damp wheat, oats, corn and rapeseed. A standard test material (APPENDIX II) was also used. The machine was transported over gravel and paved highways for a distance of 50 miles (80 km). It was evaluated for ease of operation and adjustment, rate of work, power requirements, quality of work, operator safety and suitability of the operator's manual.

RESULTS AND DISCUSSION

EASE OF OPERATION AND ADJUSTMENT

Discharge Heights: The discharge height (FIGURE 2) could be varied from 9.4 to 33.9 ft (2.9 to 10.3 m) with the hydraulic lift mechanism. Corresponding elevation angles varied from 9° to 39°. See TABLE 1.

The auger discharge height could be easily adjusted from the tractor seat. The hydraulic lift required a pressure of 1500 psi (10.3 MPa) to raise the auger.

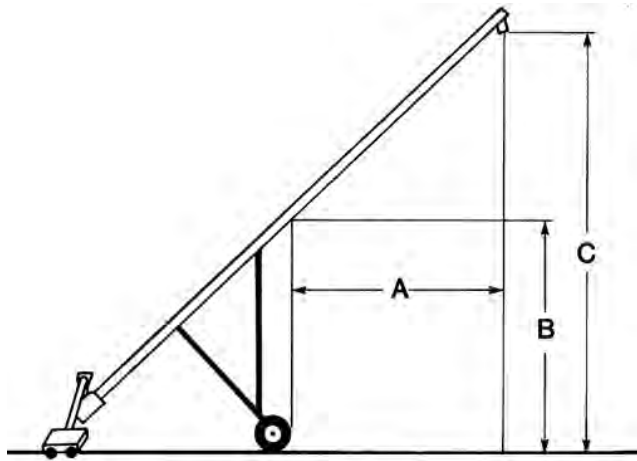


FIGURE 2. Dimensions: (A) Horizontal Reach, (B) Bin Eave Clearance, (C) Discharge Heights.

TABLE 1. Reach, Clearance and Discharge Height at Various Elevations

Angle Degrees	A Horizontal Reach		B Bin Eave Clearance		C Discharge Height	
	ft	m	ft	m	ft	m
9 (min)	14.8	4.5	7.2	2.2	9.5	2.9
20	17.4	5.3	12.8	3.9	18.7	5.7
30	20.3	6.2	15.8	4.8	27.2	8.3
39 (max)	19.7	6.0	18.4	5.6	33.8	10.3

Auger Reach: The bin eave clearance and horizontal reach (FIGURE 2) of the Westfield TR100 x 51 are shown in TABLE 1. Bin eave clearance, measured from the ground to the auger tube at the foremost part of the undercarriage, varied from 7.3 ft (2.2 m) at 9° to 18.3 ft (5.6 m) at 39° elevation. The reach, measured from the foremost part of the undercarriage to the centre of the discharge, varied from 14.6 ft (4.5 m) at 9° to 19.8 ft (6.2 m) at 39°.

Maneuverability: The Westfield TR100 was designed as a tractor implement. It could be transported, raised, positioned, and operated from the tractor seat. The large hitch weight of 494 lb (224 kg) made moving the auger by hand impractical. Despite the considerable length of the auger and the added length of the tractor, the maneuverability was good. However, it was difficult to judge the distances between the auger outlet and obstructions, due to its length.

The auger transported very well and was stable at speeds up to 50 mph (80 km/h) on paved highways and up to 30 mph (50 km/h) on gravel roads, although the manufacturer cautions against towing faster than 15 mph (23 km/h). The auger was supplied with a rigid reliable hitch. The operator should use a suitable hitch pin and safety chain to prevent accidental unhitching when transporting on public roads. A transport brace was supplied to secure the swing auger. Clearance under power lines was ample when fully lowered.

The transport height was 11.2 ft (3.4 m). See cover photo.

Swing Auger: The swing auger was easily moved to and from the transport position. It was easily positioned and operated very well with most grain trucks. The swing auger and winch could be moved from one side to the other in ten minutes. The fighting speed of the swing auger varied with the engine and hydraulic pump speed of the tractor. It did not have a flow control valve to vary the fighting speed in relation to the fighting of the main auger. There were clean out holes along the bottom of the hopper and auger boot however, it was difficult to completely clean out all of the grain. It is recommended that the manufacturer consider modifications to the boot and hopper to allow for more thorough cleaning and inspection of the fighting.

RATE OF WORK

Capacity: FIGURE 3 shows the capacities of the Westfield TR100 x 51 in various dry grains at a 30° elevation angle. Maximum capacities at this angle were 4600, 7050, 5500 and 4900 bu/h (125, 103, 135 and 110 t/h) in dry wheat, oats, corn and rapeseed respectively. As fighting speeds are increased, the capacity of screw conveyors increases to a peak, then levels off or decreases. Maximum or peak capacities for the Westfield TR100 x 51 occurred at fighting speeds (PTO speeds) ranging from 470 to 570 rpm.

The effect of elevation angle on capacity is illustrated in TABLE 2. Peak capacities in wheat dropped 9% from 4800 bu/h (131 t/h) at 20° elevation to 4350 bu/h (118 t/h) at maximum elevation.

TABLE 2. Peak Capacity, Specific Capacity and Power Requirements Vs Elevation Angle (Dry Wheat)

Elev. Angle Deg.	Discharge Height		Peak Capacity		Specific Capacity		Power Input	
	ft	m	bu/h	t/h	ton/hp-h	t/kW-h	hp	kW
20	19	5.7	4800	131	5.2	6.2	28	21
30	27	8.3	4600	125	3.6	4.5	38	28
39	34	10.3	4350	118	3.2	3.8	41	31

Specific Capacity: Specific capacity is the amount of grain moved per unit of power in a specific time. A high specific capacity indicates efficient use of energy. In general, specific capacity decreases (less grain is moved per horsepower-hour) with increasing fighting speed and elevation angle. Specific capacity at 30° ranged from 4.3 to 2.8 ton/hp-h (9.6 to 3.4 t/kW-h) in dry wheat, oats, corn and rapeseed. TABLE 2 indicates the effect of elevation angle on peak and specific capacities for the Westfield TR100 x 51.

Critical Speeds: At certain critical fighting speeds auger vibration may become excessive. This phenomenon, known as resonance, is common to all augers (although the critical speed may be outside of the operating range of any particular auger) and varies with grain type and operating conditions. Care should be taken not to operate at these critical speeds. On the Westfield TR100 x 51 a drop in capacity due to resonance was occasionally noticed at a PTO speed of about 520 rpm.

Power Requirements: FIGURE 3 gives power requirements for the Westfield TR100 x 51 in dry wheat, oats, corn and rapeseed at a 30° elevation angle. Power requirements ranged from 10 to 53 hp (7.5 to 40 kW). It should be noted that the swing auger uses 25 to 40% of the total power input in TABLE 2 and 3 and FIGURE 3.

TABLE 3. Peak Capacity, Specific Capacity and Power Requirements in Damp Grain at 30° Elevation

Grain (moisture content)	Peak Capacity		Specific Capacity		Power Input		Power Input (dry grain)	
	bu/h	t/h	ton/hp-h	t/kW-h	hp	kW	hp	kW
Wheat (20% MC)	3000	82	1.7	2.1	54	40	38	28
Corn (30% MC)	3350	85	2.1	2.6	58	43	48	36
Rapeseed (15% MC)	4100	93	2.1	2.6	48	36	40	30

The intake feed hopper motor required a hydraulic fluid flow rate of at least 10 (imp) gpm (45.5 L/m) at 1500 psi (10.3 MPa) for proper operation. The hydraulic lift mechanism had a pressure requirement of 1500 psi (10.3 MPa).

Damp Grain: TABLE 3 shows the effect of damp grain on peak capacity, specific capacity and power requirements for the Westfield TR100 x 51.

Generally, as grain moisture contents rise, power requirements

increase while capacities decrease. If augers are used to move damp grain the power source should be sized accordingly.

The power requirement for augers without side delivery will increase by approximately 5 %, 33% and 50% when moving damp rapeseed, corn and wheat respectively.

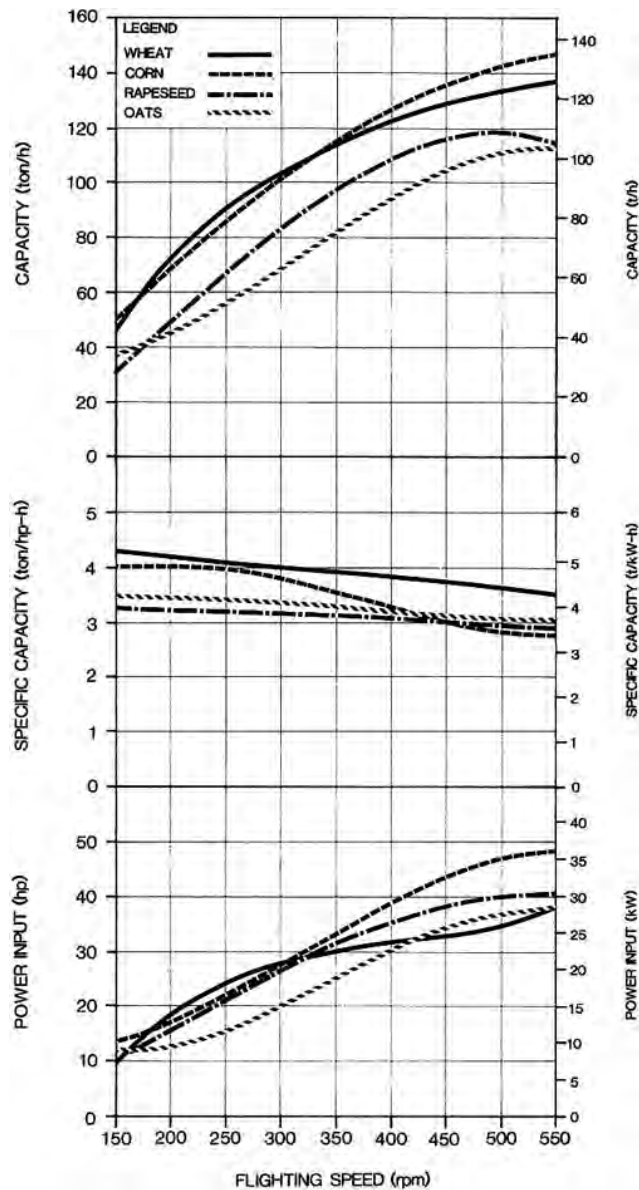


FIGURE 3. Capacity, Specific Capacity and Power Requirements for Various Speeds at 30° Elevation Angle (Dry Grain).

QUALITY OF WORK

Grain Damage: Damage in dry wheat was less than 0.2% for each pass through the auger. This was insignificant as long as the same grain was not augered many times. Crockage would be lower at higher moisture contents.

OPERATOR SAFETY

The Westfield TR100 x 51 met current safety standards for grain augers. It was safe to operate if normal precautions were observed. Safety signs were appropriately displayed alerting the operator of potentially hazardous areas.

Shielding was provided for all rotating shafts and pinch points. An adequate inlet safety guard (FIGURE 4) was provided. All capacities were determined with this inlet safety guard in place. The Institute strongly recommends that grain augers be operated with all safety equipment in place.

OPERATOR'S MANUAL

The operator's manual included instruction on set-up, operation, adjustment, maintenance, storage, warranty and safety.

It was generally very well written and clearly illustrated.



FIGURE 4. Inlet hopper and safety guard.

MECHANICAL HISTORY

The Westfield TR100 x 51 was operated for about 20 hours. Several shear pins broke when attempting to start up a full auger too rapidly or at too steep an angle.

**APPENDIX I
SPECIFICATIONS:**

MAKE: Westfield
MODEL: TR100 x 51
SERIAL NUMBER: E4713

OVERALL DIMENSIONS:
 -- transport length along ground 53.8 ft (16.4 m)
 -- field width 13.2 ft (4.0 m)
 -- transport width 9.4 ft (2.9 m)
 -- transport height 11.2 ft (3.4 m)

DRIVE:
 -- 540 rpm tractor power take-off
 -- direct drive
 -- power take-off to flying speed ratio 1:1

Intake Feed Auger
 -- hydraulic motor
 -- displacement 6.2 in³ (102 cm³)
 -- motor to flying speed ratio 1:1

LUBRICATION:
 -- pressure grease fittings 4
 -- sealed bearing 3
 -- packed wheel bearings 2

AUGER TUBE:
 -- inside diameter 9.9 in (250 mm)
 -- material thickness 0.1 in (3.0 mm)
 -- discharge spout 10.0 in (255 mm)

FLIGHTING:
 -- diameter 9.4 in (240 mm)
 -- pitch 9.2 in (230 mm)
 -- double at bottom of main auger
 -- exposed length 36.0 in (910 mm)
 -- thickness
 -inner 0.16 in (5 mm)
 -outer 0.13 in (3 mm)

INLET SAFETY GUARD:
 -- material dimensions 0.20 in dia. (5 mm)
 -- overall size 39 x 33 in (990 x 830 mm)
 -- grill openings
 -maximum open area 8.4 in² (54 cm²)
 -maximum open dimensions 4.1 in (100 mm)

LIFT MECHANISM:
 -- type hydraulic cylinder & cable
 -- cylinder size 4 x 30 in (100 x 760 mm)
 -- minimum pressure 1500 psi (10.3 MPa)

WEIGHT:	<u>Maximum Elevation</u>	<u>Minimum Elevation</u>
-- right wheel	789 lb (358 kg)	754 lb (342 kg)
-- left wheel	818 lb (371 kg)	851 lb (386 kg)
-- hitch	492 lb (223 kg)	494 lb (224 kg)
TOTAL	2099 lb (952 kg)	2099 lb (952 kg)

**APPENDIX II
Performance with Standard Test Material**

The standard test material is a high density granular polyethylene. The material is consistent and not subject to damage or changes in physical properties as are grains. FIGURE 5 gives the capacity, specific capacity and power requirements for the Westfield TR100 x 51 in a standard test material. This data may be used for comparison of different grain augers.

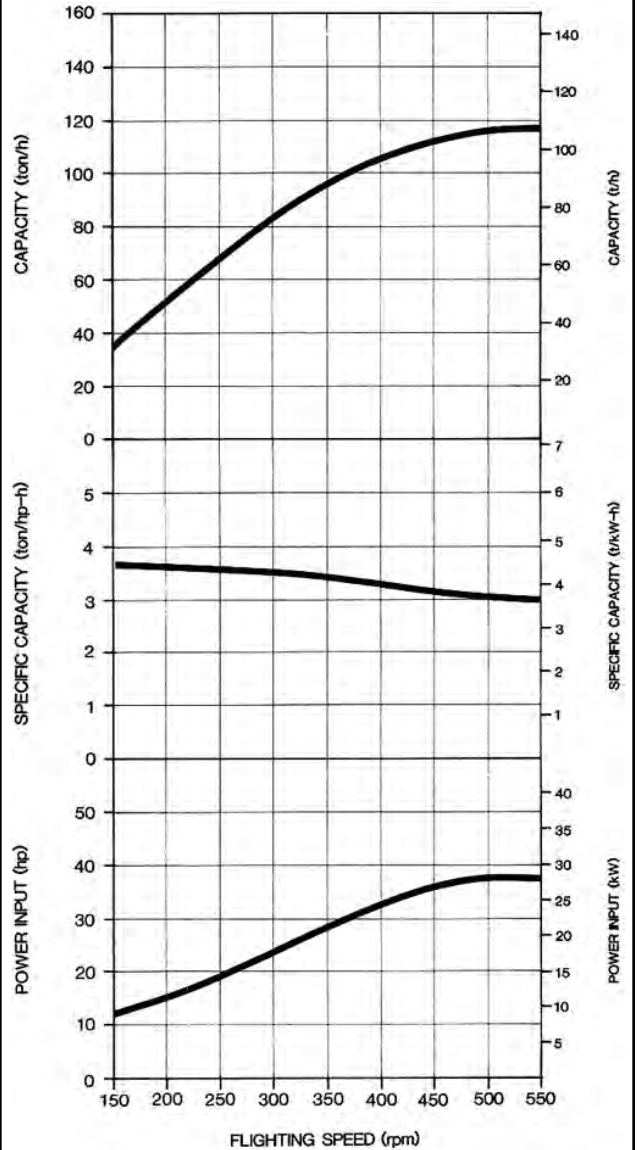


FIGURE 5. Capacity, specific capacity and power requirements with standard test material at 30° elevation angle.

**APPENDIX III
MACHINE RATINGS**

The following rating scale is used in Machinery Institute Evaluation Reports:

Excellent	Fair
Very Good	Poor
Good	Unsatisfactory

SUMMARY CHART

WESTFIELD TR100 x 51 GRAIN AUGER

RETAIL PRICE:	\$4,108.00 (February 1985, f.o.b. Portage la Prairie)
EASE OF OPERATION:	
Maneuverability	Good
Transportability	Very good
RATE OF WORK:	
Capacity at 30°:	
Wheat (dry)	4600 bu/h (125 t/h)
Standard material	118 ton/h (107 t/h)
POWER REQUIREMENTS:	
Dry grain	10 to 53 hp (7.5 to 40 kW)
QUALITY OF WORK:	
Dry wheat	less than 0.2% damage per pass.
OPERATOR SAFETY	guarded in accordance with safety standards.
OPERATOR'S MANUAL	very well written and clearly illustrated.
MECHANICAL HISTORY	several shear pins broke.



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