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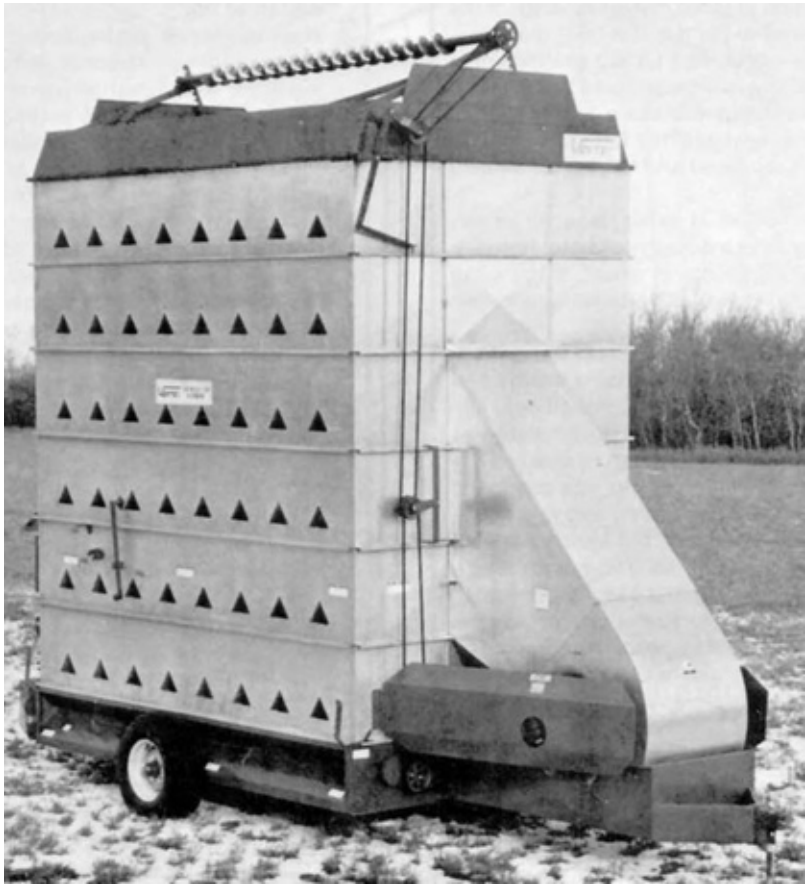
Evaluation Report 289



Vertec VT 5600 R Grain Dryer

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

VERTEC VT 5600 R (1979 MODEL) GRAIN DRYER

MANUFACTURER AND DISTRIBUTOR:

Vertec Industries Limited
P.O. Box 840
Vermilion, Alberta
T0B 4M0

RETAIL PRICE:

$23,000.00 (August, 1982, f.o.b. Humboldt, complete with electric motor drive and grain pressure switch.)

SUMMARY AND CONCLUSIONS

Functional performance of the Vertec VT 5600 R (1979 model) continuous flow grain dryer was very good in wheat, barley, rapeseed and Hybrid 3996 corn.

The rated drying capacity of the Vertec VT 5600 R was 9.1 t/h (334 bu/h) in wheat, 8.1 t/h (372 bu/h) in barley, 3.7 t/h (163 bu/h) in rapeseed and 5.3 t/h (209 bu/h) in corn. No grain damage occurred when operating at the manufacturer's recommended settings.

Specific fuel consumption at rated drying capacity or the amount of propane required to dry a quantity of grain was 12.3 L/t (7.4 gal/100 bu) in wheat, 13.2 L/t (6.3 gal/100 bu) in barley, 10.0 L/t (5.0 gal/100 bu) in rapeseed and 24.7 L/t (13.8 gal/100 bu) in corn. This corresponded to a fuel consumption of 112 L/h (24.6 gal/h) in wheat, 107 L/h (23.5 gal/h) in barley, 37 L/h (8.1 gal/h) in rapeseed and 131 L/h (28.8 gal/h) in corn.

Specific energy consumption at rated capacity or the total energy required to remove a quantity of water from the grain, was 4700 kJ/kg (2000 Btu/lb) in wheat, 5100 kJ/kg (2200 Btu/lb) in barley, 4600 kJ/kg (2000 Btu/lb) in rapeseed and 4400 kJ/kg (1900 Btu/lb) in corn.

The Vertec VT 5600 R was easy to transport and set up. Burner performance was good and provided a steady and uniform grain drying temperature in most conditions. Optional equipment was required to dry corn at temperatures below 0° C (32° F). The grain drying temperature was easy to set, but had to be set slowly. Grain cooling was good, and easy to adjust. Ease of filling and unloading was very good. Grain flow was uniform and adequate, but sensitive to adjust. Ease of cleaning the Vertec VT 5600 R was excellent. Lubrication points were accessible and easy to service.

The Vertec VT 5600 R was safe to operate as long as the manufacturer's safety instructions were followed. The sound level at the operator's station was 69 dBA.

The operator's manual was well illustrated, clearly written and contained much useful information.

The rear cross auger drive belt broke once during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Increasing the hitch clevis gap to accommodate large tractor drawbars.
2. Revising the high limit temperature settings recommended in the operator's manual.
3. Modifications to Improve ease of setting the metering roll speed.
4. Equipping the dryer with tires that comply with the Tire and Rim Association load rating.
5. Shielding the belt and chain on the metering roll drive.
6. Providing a more noticeable warning of safety shut. down.
7. Including recommended grain flow settings in the operator's manual.

Senior Engineer- G.E. Frehlich

Project Engineer- J.D. Wassermann

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The celvis gap has been adequate for most medium size tractors or trucks used to move the dryer. A wider gap could allow excessive bouncing, but will be considered.
2. Machines after 1979 have high limit temperature switches that permit higher temperature settings. Modifications have also been made to reduce the occasional temperature variations in the dryer that caused the limit switch to trip.
3. New machines are equipped with a chain reduction drive, and an optional screw type adjustment is available to reduce the sensitivity of setting metering roll speed and to make settings easy to reproduce. An electronic moisture controller that automatically adjusts metering roll speed to accurately maintain a uniform moisture content is now available.
4. New dryers are equipped with tires that have higher load ratings and can be operated at higher speeds.
5. Shielding of the metering roll drive is being reviewed. The metering roll drive is shielded on dryers equipped with the automatic moisture controller.
6. Increasing the size of the warning light will be considered. The system is presently designed to accept additional warning devices such as a horn.
7. Recommended grain flow settings will be included in the operator's manual.

MANUFACTURER'S ADDITIONAL COMMENTS

1. Grain drying temperatures higher than those indicated in the operator's manual have been commonly used by Vertec owners to obtain greater drying capacities and efficiencies. The grain drying temperatures in the operator's manual will be revised.
2. Machines after 1979 have improved burners and air mixing, that reduce temperature variations within the dryer, improve fuel efficiency, increase drying capacity and eliminate erratic burner performance at low flame set. tings. These Improvements can be purchased and installed on older dryers.
3. Higher garner sides, which are now standard equipment, have eliminated air escaping from the upper corners of the dryer.

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

GENERAL DESCRIPTION

The Vertec VT 5600 R (1979 model) is a continuous multi-flow grain dryer with a centrifugal fan, propane burner, wet holding section and two vertical grain chambers enclosing the hot and cool air plenums. Grain is loaded into the top of the dryer and flows down the six layers of the vertical grain chambers past the hot and cool air plenums. Ambient air (outside air), forced by the fan either past the burner into the hot air plenum or directly into the cool air plenum, passes through the grain chamber ducts to dry and cool the grain. Dry grain is discharg. ed at the bottom of the dryer.

Grain flow is controlled by variable speed metering rolls and the grain drying temperature is controlled by a modulating valve and monitored near the control panel. Grain cooling is controlled by varying the cool air plenum size and the air flow into the plenum.

The fan, conveying and metering equipment on the test machine were driven by an optional 11.2 kW (15 hp) 230 V AC, three phase electric motor. The standard power take-off drive was also used during the tests.

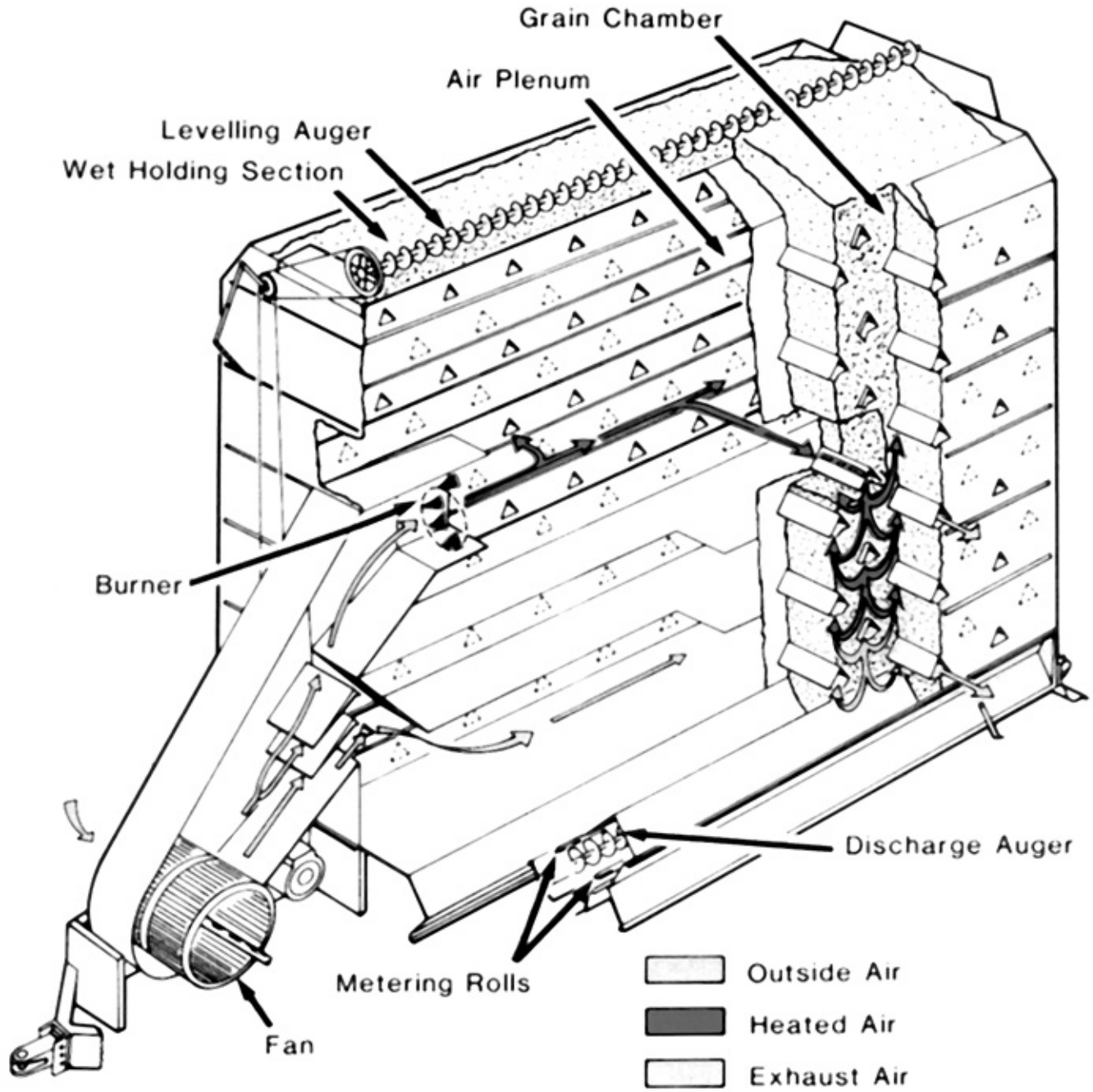


FIGURE 1. Vertec VT 5600 R Grain Dryer.

A control circuit shuts off fuel to the burner if the burner flame is extinguished, the fan shuts down or if the grain drying temperature exceeds the high limit setting.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Vertec VT 5600 R was operated with artificially wetted grains shown in TABLE 1 for 120 hours while drying about 733 tonnes (30000 bu) of grain. It was evaluated[1] for ease of operation and adjustment, rate of work, power requirements, fuel and energy consumption, quality of work, operator safety and suitability of the operator's manual.

TABLE 1. Operating Conditions.

GRAIN	GRADE	DOCKAGE (%)	MOISTURE CONTENT (%)	HOURS	GRAIN DRIED (t)
Wheat	3CW RS		15.9 to 21.4	42	306
Barley	1 FEED		16.1 to 21.4	21	94
Rapeseed	2CW	14	12.3 to 16.6	31	170
Corn (Hybrid 3996)	3CW	4	20.8 to 31.6	26	163
			TOTAL	120	733

[1] *Tests were conducted as outlined in the Machinery Institute Detailed Test Procedures for Grain Dryers.*

RESULTS AND DISCUSSION

EASE OF OPERATION AND ADJUSTMENT

Transporting: The hitch jack and adjustable hitch clevis made hitching to the Vettec VT 5600 R easy. The hitch clevis could be adjusted vertically in three positions. The clevis gap was too narrow for most tractor drawbars and it is recommended that the clevis gap be increased to accommodate these drawbars.

Transport width of the test machine was 3.1 m (10.2 ft) while transport height was 4.8 m (15.7 ft). Care was needed when transporting over bridges and beneath power and telephone lines.

The Vertec VT 5600 R towed well at speeds up to 40 km/h (25 mph). Care had to be taken to use a towing vehicle with adequate weight and brakes to permit safe stopping in emergency situations.

Rear visibility when transporting was restricted. Extended rear view mirrors on the towing vehicle were required for adequate rear vision.

Setup: The Vertec VT 5600 R was set up by two men in about one hour. The machine had to be blocked up higher than recommended by the manufacturer, to obtain adequate clearance for the unloading auger. The power take-off drive was easily attached to the tractor, and the propane supply and electrical services were easily connected to the control panel.

Fan: The fan was operated at 600 rpm with the power take-off drive and 560 rpm with the electric motor drive (FIGURE 2). A tractor with a 1000 rpm power take-off is recommended to permit operating the tractor at a low engine speed.

Sound level at the operator's station was about 69 dBA.

Burner: The spark-ignited burner (FIGURE 3) was started with a switch at the control panel (FIGURE 4). Fuel pressure was monitored on gauges below the control panel. The flame burned erratically and occasionally went out when drying corn at low ambient temperatures. The burner performed well in all other conditions encountered.

Grain Drying Temperature: Grain drying temperature was set by adjusting a screw on the modulating valve. The maximum drying temperature limit was adjusted on the high limit temperature switch at the control panel. If this setting was exceeded, the fuel to the burner was automatically shut off.

The modulating valve had to be adjusted slowly to prevent tripping of the high limit temperature switch. The switch frequently tripped when drying at the manufacturer's recommended settings for most drying conditions. It is recommended that the high limit temperature settings in the operator's manual be revised.

The range of the drying temperature could be varied by changing the orifice located ahead of the firing valve. Drying temperature was monitored at the control panel and was adequate except when drying corn at temperatures below 0°C (32°F). Optional equipment is available for operating in these conditions.

Grain Cooling: Grain cooling was controlled by adjusting the size of the cool air plenum and the air flow through the plenum. Two wind boards at the fan outlet were easily adjusted (FIGURE 5) to vary the air flow and a divider door was easily set (FIGURE 6) to change the size of the cool air plenum to obtain one, two or no layers of cooling. The wind boards were usually set for maximum air flow and two layers provided adequate cooling for all the conditions encountered. All capacity tests were conducted with one layer of cooling.

Grain Filling: A loading auger with a discharge height of 5.3 m (17.4 ft) was required to fill the Vertec VT 5600 R. The optional grain pressure switch was very useful for stopping and starting an electrically powered grain auger to maintain the grain level in the wet grain holding section. The sensitivity of the grain pressure switch had to be increased when drying rapeseed by removing the rear cover plate(FIGURE 7) and adjusting the sensitivity screw.

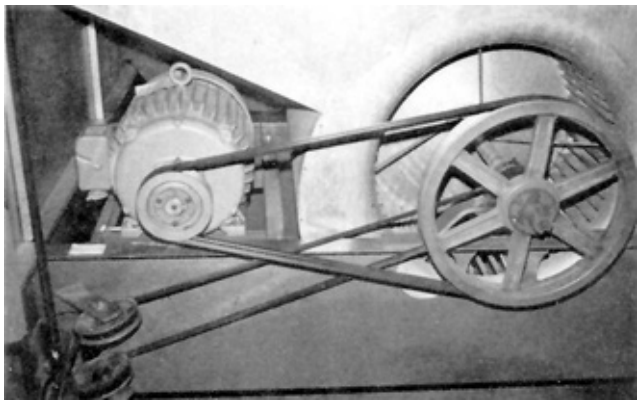


FIGURE 2. Electric Motor Drive.

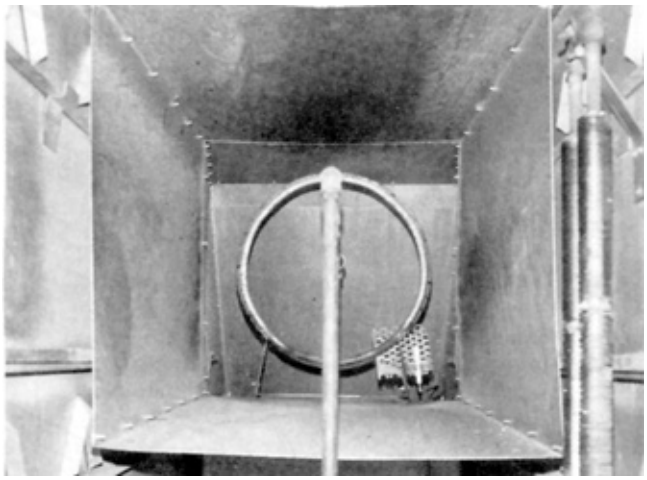


FIGURE 3. Burner.

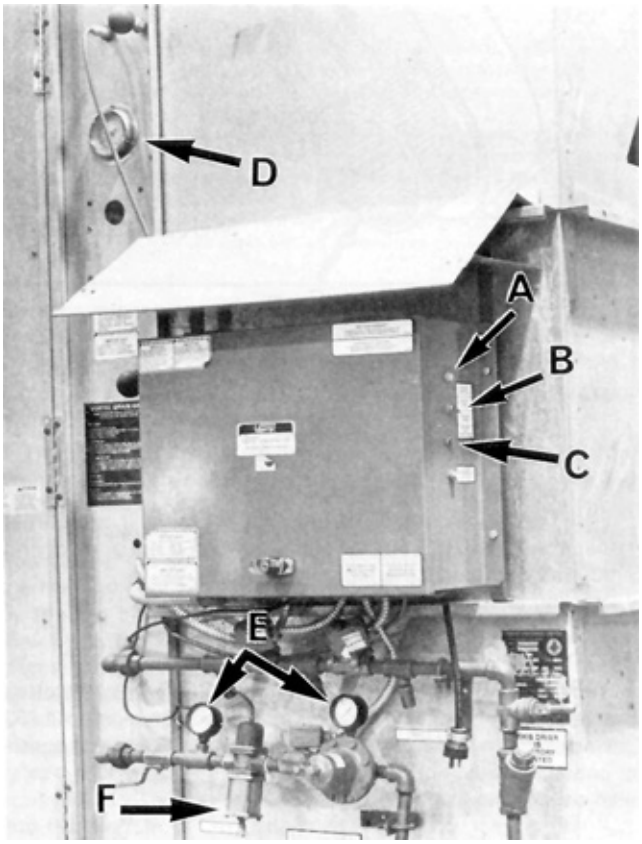


FIGURE 4. Controls and Instruments: (A) Power Indicator, (B) Power Switch, (C) Shutdown Indicator, (D) Grain Drying Temperature Gauge, (E) Fuel Pressure Gauges, (F) Modulating Valve.

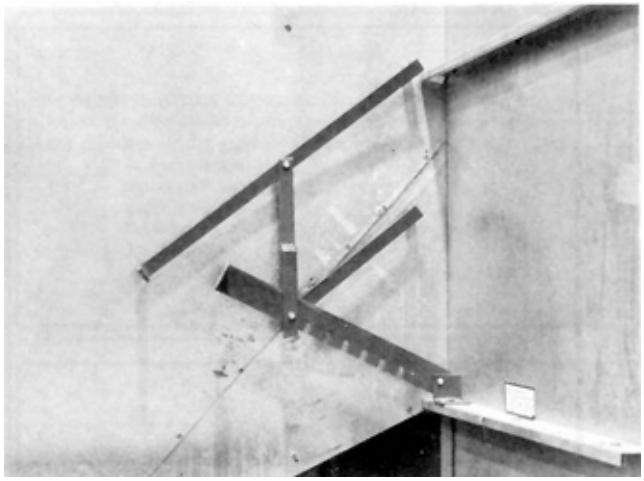


FIGURE 5. Wind Board Adjustment.

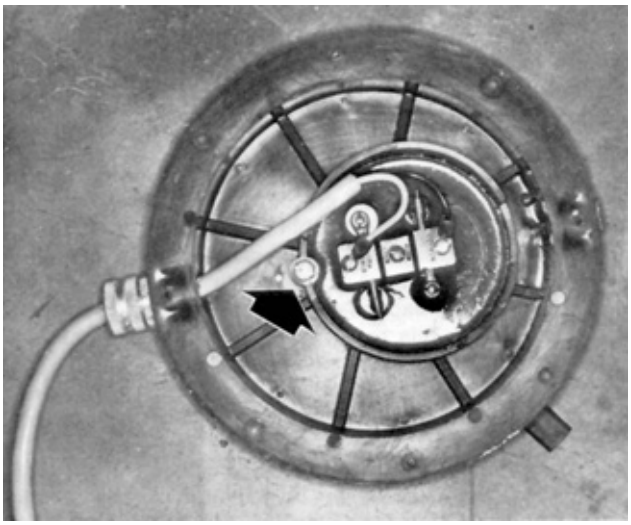


FIGURE 7. Grain Pressure Switch Sensitivity Adjustment.

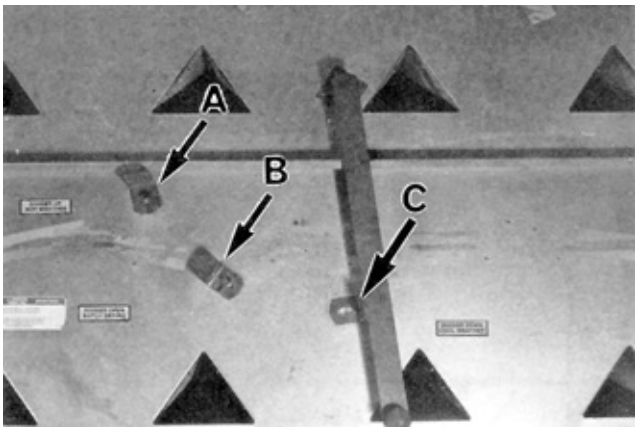


FIGURE 6. Divider Door Adjustment:
(A) Two Layers, (B) No Layers, (C) One Layer.

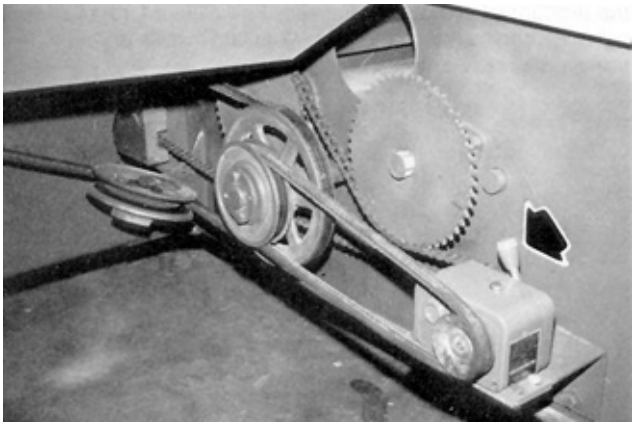


FIGURE 8. Metering Roll Speed Adjustment.

The levelling auger did not maintain a uniform grain level at the ends of the grain chambers, allowing air to escape from the hot air plenum. The levelling auger position had to be adjusted for different grain moisture contents, and the grain pressure switch had to be repositioned when the levelling auger was adjusted. The levelling auger was easily reversed to permit filling from either end.

The holding capacity of the Vertec VT 5600 R was about 19.1 m^3 (525 bu).

Grain Discharge: Grain flow was controlled by two metering rolls at the bottom of each grain chamber. Metering roll speed was varied by adjusting the lever on the variable speed metering roll drive (FIGURE 8). Small movements of the lever produced large changes in metering roll speed, making it very difficult to adjust grain flow. Also, grain flow could be stopped only by setting the lever to zero. It is recommended that the manufacturer consider modifications to improve the ease of setting metering roll speed.

Grain flow was adequate and steady except when grain chunks occasionally caught in the bottom of the grain chambers and had to be removed by hand. Maximum grain flow through the metering rolls was 30 m^3/h (825 bu/h). Grain was discharged from the left or the right corner at the rear of the dryer (FIGURE 9).

Wet Grain Startup and Shutdown: The manufacturer recommended using the duct shutoff slides to control air flow into the grain chamber for drying the first and last fill of grain. This was easily conducted and dried the grain uniformly.

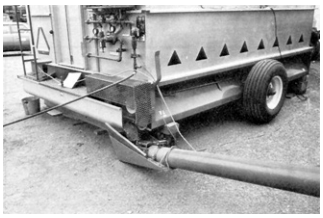


FIGURE 9. Grain Discharge.

Batch Drying: The Vertec VT 5600 R could be operated as a batch dryer with the grain stationary or being recirculated if conveying equipment was available. Batches smaller than the holding capacity could be dried, but this was difficult and time consuming.

Cleaning: Ease of cleaning the Vertec VT 5600 R was excellent as it had no screens. The troughs under the grain chamber augers and rear cross auger could be swung down for cleaning (FIGURE 10). Fines accumulated within the plenums and were easily removed. Fines accumulating around the dryer had to be cleaned up weekly to prevent excessive buildup.

Lubrication: The Vertec VT 5600 R had 8 pressure grease fittings. Two required greasing every 15 hours and six required greasing every 100 hours. The oil level in the metering roll drive required checking seasonally and 13 bearings required seasonal oiling.

RATE OF WORK

Standard Conditions: To provide a meaningful comparison of grain dryer performance, the capacity, and fuel and energy consumption of the dryers should be determined for identical drying conditions. Because it is impossible to obtain the same air and grain conditions in the field when testing each machine, the dryer capacities and fuel and energy consumptions included in this report have been mathematically adjusted to standard drying conditions[2]. These adjusted results can be compared to the adjusted results of other dryers, even though they were tested under different conditions or in different years.

Drying Capacity: The drying capacity[3] of a dryer is the rate at which grain can be dried to the dry moisture content specified by the Canadian Grain Commission, while operating the dryer at standard conditions and the settings recommended by the manufacturer. Drying capacity varies with the grain type and the amount of moisture removed. FIGURES 11 to 14 present capacity curves for the Vertec VT 5600 R while drying wheat, barley, rapeseed and Hybrid 3996 corn.

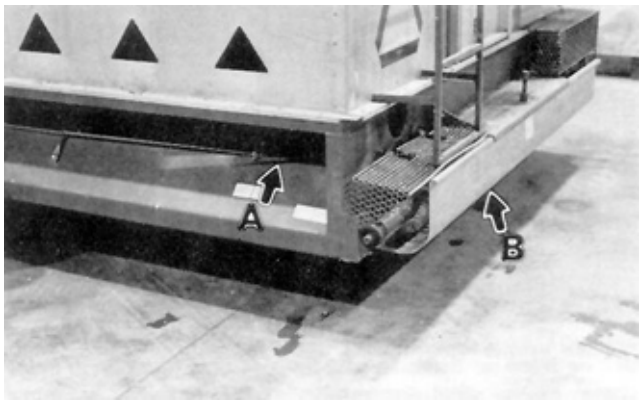


FIGURE 10. Grain Cleanout: (A) Grain Chamber Cleanout Lever, (B) Rear Cross Auger Trough.

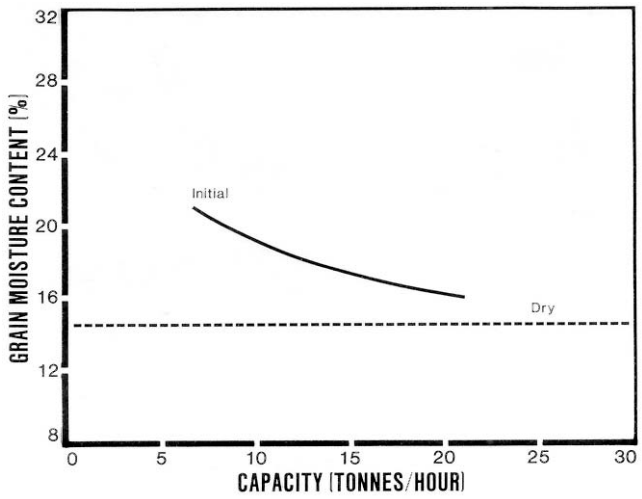


FIGURE 11. Drying Capacity in Wheat.

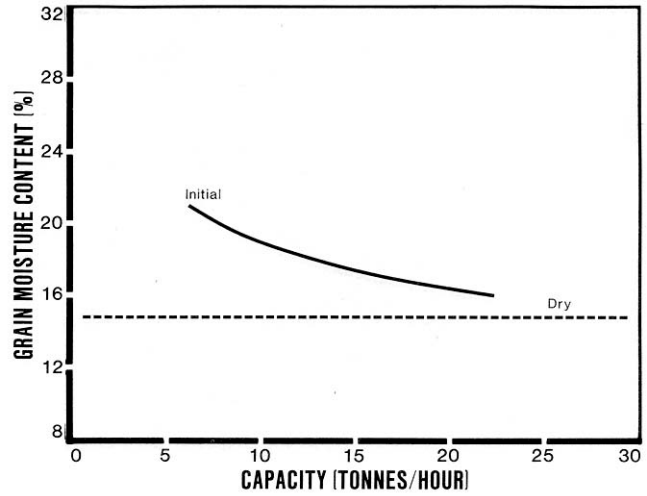


FIGURE 12. Drying Capacity in Barley.

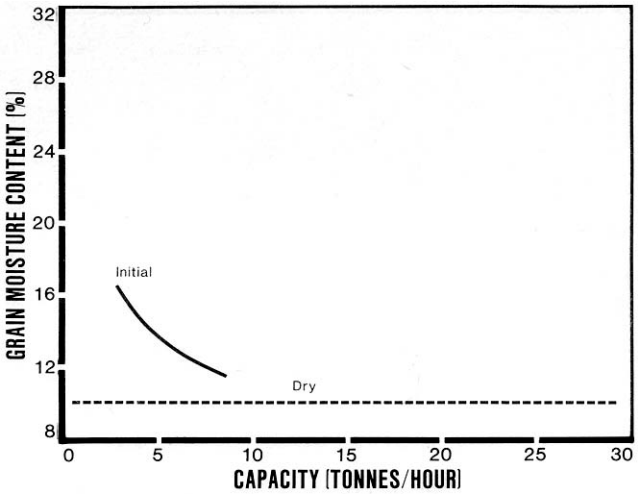


FIGURE 13. Drying Capacity in Rapeseed.

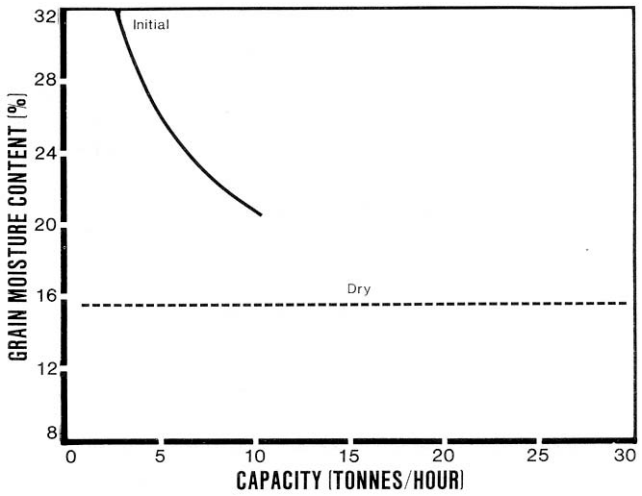


FIGURE 14. Drying Capacity in Corn (Hybrid 3996).

[2]The standard drying conditions used by the Machinery Institute for the presentation of grain dryer results are given in APPENDIX II.

[3]The Machinery Institute determines the drying capacity using the weight of the dried grain discharged from the dryer. Some manufacturers state their drying capacities using the weight of the wet grain entering the dryer. See APPENDIX VI for the wet grain to dry grain conversion.

Rated Drying Capacity: The Machinery Institute has designated the rated drying capacity as the capacity of the dryer while removing 5% moisture in wheat, barley and rapeseed, and 10% moisture in corn. The rated drying capacity of the Vertec VT 5600 R (TABLE 2) varied from 3.7 t/h (163 bu/h) in rapeseed to 9.1 t/h (334 bu/h) in wheat.

TABLE 2. Vertec VT 5600 R Rated Drying Capacities.

GRAIN	INITIAL MOISTURE CONTENT (%)	MOISTURE REMOVED (%)	GRAIN DRYING TEMPERATURE SETTING (°C)	RATED DRYING CAPACITY (t/h)	FIGURE NO.
Wheat	19.5	5	90	9.1	11
Barley	19.8	5	93	8.1	12
Rapeseed	15.0	5	72	3.7	13
Corn (Hybrid 3996)	25.5	10	110	5.3	14

QUALITY OF WORK

Grain Quality: Grain can be damaged in the dryer, if it is dried too long at excessively high temperatures. The grain damage that can occur before there is a loss in the grade and a corresponding reduction in the grain price, depends on whether the grain is seed, commercial or feed. Feed grain is permitted the greatest damage and seed grain the least damage before a grade loss occurs. It is very important for the operator to occasionally have the grain tested for damage especially when drying unfamiliar grains or operating at new dryer settings.

No grade losses occurred when drying commercial wheat and rapeseed, or feed barley and corn with the Vertec VT 5600 R grain dryer.

Grain Drying Temperature: A uniform grain drying temperature minimizes grain damage and provides uniform and efficient grain drying. The uniformity of the grain drying temperature for the Vertec VT 5600 R was very good. See APPENDIX IV for further details.

POWER REQUIREMENTS

The 11.2 kW (15 hp) electric motor on the Vertec VT 5600 R had a rated full load current of 42 amps when operating on 230 V AC, three phase power. A separate 15 amp, 115 V AC outlet was required to operate the control circuit. Power requirements varied from 7.6 kW (10.2 hp) in rapeseed to 12.2 kW (16.4 hp)in barley. Optional equipment is available for operating with single phase power only.

A 15 kW (20 hp) tractor should have sufficient power to operate the Vertec VT 5600 R equipped with the power take-off drive.

FUEL AND ENERGY CONSUMPTION

Specific Fuel Consumption: Fuel consumption of a grain dryer varies considerably with the temperature and moisture content of the grain and ambient air, the grain drying temperature, air flow and burner efficiency. To permit comparison of fuel used in different dryers, fuel consumption must be adjusted to standard conditions and must be related to the quantity of grain dried. Specific fuel consumption is a measure of the fuel used to dry a quantity of grain and is expressed in litres (L) of propane per tonne (t) of grain dried (gallons (gal) of propane per 100 bushels (bu) of grain dried). A low specific fuel consumption indicates efficient fuel use.

The specific fuel consumption for the Vertec VT 5600 R at rated drying capacity (TABLE 3) varied from 10.0 Lit (5.0 gal/100 bu) in rapeseed to 24.7 L/t (13.8 gal/100 bu) in corn. This corresponds to a fuel consumption of 37 L/h (8.1 gal/h) in rapeseed to 131 L/h (28.8 gal/h) in corn.

Specific Energy Consumption: Energy consumption of a dryer also varies with drying conditions and grain dryer design. To permit comparison of the energy used in different dryers, energy consumption must be adjusted to standard conditions and related to the quantity of water removed from the grain. Specific energy consumption is a measure of overall dryer efficiency. It is the total energy, including electrical, mechanical and fuel, required to remove a quantity of water and is expressed in kilojoules (kJ) of energy per kilogram (kg) of water removed (British thermal units (Btu) of energy per pound (lb) of water removed). A low specific energy consumption indicates efficient grain drying.

The specific energy consumption for the Vertec VT 5600 R (TABLE 3) at rated drying capacity varied from 4400 kJ/kg (1900 Btu/lb) in corn to 5100 kJ/kg (2200 Btu/lb) in barley.

TABLE 3. Fuel and Energy Consumption.

CROP	MOISTURE REMOVED (%)	FUEL CONSUMPTION (L/h)	RATED DRYING CAPACITY (t/h)	SPECIFIC FUEL CONSUMPTION (L/t)	SPECIFIC ENERGY CONSUMPTION (kJ/kg)
Wheat	5	112	9.1	12.3	4700
Barley	5	107	8.1	13.2	5100
Rapeseed	5	37	3.7	10.0	4600
Corn (Hybrid 3996)	10	131	5.3	24.7	4400

OPERATOR SAFETY

The Vertec VT 5600 R operator's manual emphasized operator safety, and warning decals adequately indicated dangerous areas.

Care was needed when transporting over bridges and beneath power and telephone lines. Since the Vertec VT 5600 R is not equipped with brakes, the towing vehicle must be heavy enough and have adequate brakes to be able to safely stop in emergency situations. The manufacturer recommended using at least a three-quarter ton truck for towing. A hitch safety chain for transporting was not provided.

The Vertec VT 5600 R towedwell at speeds up to 40 km/h (25 mph). Tire loads exceeded the Tire and Rim Association Maximum rating for 11L x 15SL, 6 ply tires by 45%. The tire overload was considered unsafe and hazardous, especially at high transport speeds. It is recommended that the dryer be equipped with tires having suitable load ratings.

Since rear visibility and the rear lights of a towing truck are obscured by the dryer, the operator should ensure that adequate signal devices are installed before transporting on public roads. A slow moving vehicle sign was provided.

The metering roll speed adjustment was located near the unshielded drive belt and chain. It is recommended that the manufacturer consider shielding this area. Other drives were well shielded providing safe machine adjustments.

The Vertec VT 5600 R is CGA (Canadian Gas Association) certified as meeting the requirements of Gas Fired Equipment for Drying Farm Crops. Safety controls were effective in automatically shutting off the fuel to the burner if the burner flame went out, the fan shut down or if the temperature in the hot air plenum exceeded the set maximum. The warning light that indicated a safety shutdown was very difficult to see in daylight and it is recommended that the manufactuer provide a more noticeable warning of safety shutdown.

A ULC approved multi-purpose fire extinguisher with a 2A 10BC rating should be kept with the dryer at all times.

OPERATOR'S MANUAL

The operator's manual was clearly written and well illustrated. It contained useful information on safe operation, adjustments, service and lubrication.

Initial grain flow settings were not included in the operator's manual. It is recommended that these settings be included in the operator's manual.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Vertec VT 5600 R during 120 hours of operation while drying 733 tonnes (30,000 bu) of grain. The intent of the test was to evaluate the functional performance of the machine. An extended durability test was not conducted.

TABLE 4. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT GRAIN DRIED (t)
The rear cross auger belt broke and was replaced at	43	324

APPENDIX I

SPECIFICATIONS

MAKE:	Vertec
MODEL (1979):	VT 5600 R
SERIAL NUMBER:	5597151
MANUFACTURER:	Vertec Industries Ltd. Vermilion, Alberta, Canada
GRAIN LOADING:	
- height	variable, 4906 to 5123 mm
- levelling auger	
- diameter	152 mm
- speed	261 rpm
- drive	belt
WET HOLDING SECTION:	
- length	3664 mm
- height	variable, 152 to 381 mm
- width	2035 mm
GRAIN CHAMBERS:	
- type	2 vertical columns
- length	3664 mm
- height	
- drying	3048 or 2439 mm
- cooling	609 or 1218 mm
- width	762 mm
- effective grain depth	303 mm
- area	
- drying	11.2 or 8.9 m^2
- cooling	2.2 or 4.5 m^2
GRAIN DISCHARGE:	
- metering device	
- type	metering rolls
- number	4
- diameter	66 mm
- drive	chain from variable speed gearbox
- adjustment	vary metering roll speed
- speed	0 to 18 rpm
- discharge augers	
number	2 grain chamber augers 1 cross auger
- diameter	151 mm
- length	grain chamber augers - 3665 mm cross auger- 2500 mm
- drive	belt
- speed	265 rpm
- discharge height	level with machine base
- discharge position	right or left rear corners
HOT AIR PLENUM:	
- shape	rectangular with triangular top
- air transfer to grain	duct
- number of ducts	170 or 138
- duct shape	triangular
- duct size	180 x 180 x 220 mm
- temperature adjustment	modulating valve
COOL AIR PLENUM:	
. shape	rectangular
- air transfer to grain	duct
- number of ducts	34 or 66
- duct shape	triangular
- duct size	180 x 180 x 220 mm
FAN:	
- type	forward-curved centrifugal
- outer diameter	700 mm
- effective length	704 mm
- number of blades	56
- speed	550 to 600 rpm
- drive	belt from electric motor
BURNER:	
- maximum rating	3.9 GJ/h
- type	22 mm diameter pipe in 520 mm diameter circle
- fuel	propane
- ignition	spark
ELECTRICAL SYSTEM:	
- control circuit	115 V AC, single phase
- electric motors	
- number	1
- size	
- fan	11.2 kW, 230 V AC, three phase
NO. OF CHAIN DRIVES:	1
NO. OF BELT DRIVES:	8
NO. OF PRELUBRICATED BEARINGS:	20
LUBRICATION POINTS:	
- 15h	2
- 100 h	6
- seasonal	14
TIRES:	2, 11L x 15SL, 6 ply
0VERALL DIMENSIONS:	
- wheel tread	2858 mm
- transport height	4816 mm
- transport length	6461 mm
- transport width	3126 mm
- field height	5294 mm
- field length	6461 mm
- field width	3126 mm
- body metal thickness	1.2 mm
- ground clearance	170 mm
- hitch height	306 to 410 mm
WEIGHT: (Dryer Empty)	
- hitch	336 kg
- wheels	3275 kg
TOTAL	3611 kg
SOUND LEVEL: (At Control Panel)	69 dBA
HOLDING CAPACITY:	19.1 m^3
INSTRUMENTS:	fuel pressure gauges, grain drying temperature gauge, safety shutdown warning light
OPTIONS:	electric motor drive, grain pressure switch

APPENDIX II

MACHINERY INSTITUTE STANDARD DRYING CONDITIONS

The Machinery Institute has chosen to state the performance of grain dryers at the following air and grain conditions

Ambient temperature	10°C	
Initial grain temperature	10°C	
Barometric pressure	95 kPa	
Final grain moisture content	- wheat	14.5%
(Canadian Grain Commission)	- barley	14.8%
	- rapeseed	10.0%
	- corn	15.5%

APPENDIX III

REGRESSION EQUATIONS FOR DRYING CAPACITY RESULTS

Regression equations for the drying capacity results shown in FIGURES 11 to 14 are presented in TABLE 5. In the regressions, C = drying capacity in t/h and M = initial grain moisture content in percent of total weight, while ℓ_n is the natural logarithm. Sample size refers to the number of tests conducted. Limits of the regression may be obtained from FIGURES 11 to 14 while the grain conditions are presented in TABLE 1.

TABLE 5. Regression Equations.

GRAIN	FIG. NO.	REGRESSION EQUATION	SIMPLE CORRELATION COEFFICIENT	VARIANCE RATIO	SAMPLE SIZE
Wheat	11	$\ell_n C = 14.72 - 4.21 \ell_n M$	.97	76[1]	8
Barley	12	$\ell_n C = 16.25 - 4.74 \ell_n M$	.95	68[1]	8
Rapeseed	13	$\ell_n C = 9.78 - 3.13 \ell_n M$	.92	40[1]	8
Corn (Hybrid 3996)	14	$\ell_n C = 11.54 - 3.05 \ell_n M$	.97	43[1]	6

[1]Significant at $P \leq .01$

APPENDIX IV

GRAIN DRYING TEMPERATURE VARIATION

The coefficient of variation[4] (CV) is used to describe the variation in the temperature within the hot air plenum. This temperature variation is representative of the variation in the grain drying temperature. The lower the CV, the more uniform is the grain drying temperature.

TABLE 6 presents the coefficients of variation for the Vertec VT 5600 R when drying wheat, barley, rapeseed and corn.

TABLE 6. Hot Air Plenum Temperatures.

GRAIN	GAUGE SETTING (°C)	AVERAGE PLENUM TEMPERATURE (°C)	CV (%)
Rapeseed	73	67	4
Wheat	90	77	5
Barley	93	80	6
Corn	110	97	10

[4]The coefficient of variation is the standard deviation of the measured hot air plenum temperatures expressed as a percent of the mean plenum temperature.

APPENDIX V

MACHINE RATINGS

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

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

APPENDIX VI

CONVERSION TABLE

1 millimetre (mm)	= 0.04 inches (in)
1 kilogram (kg)	= 2.2 pounds (lb)
1 litre (L)	= 0.22 Imperial gallons (gal)
1 cubic metre (m^3)	= 28 bushels (bu)
1 kilojoule/kilogram (kJ/kg)	= 0.43 British thermal units/pound (Btu/lb)
1 tonne (t)	= 37 bushels (bu) wheat
	= 46 bushels (bu) barley
	= 44 bushels (bu) rapeseed
	= 39 bushels (bu) corn

$$\text{dry grain weight (t)} = \text{wet grain weight (t)} \times \frac{(100 - \text{wet moisture content (\%)})}{(100 - \text{dry moisture content (\%)})}$$

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