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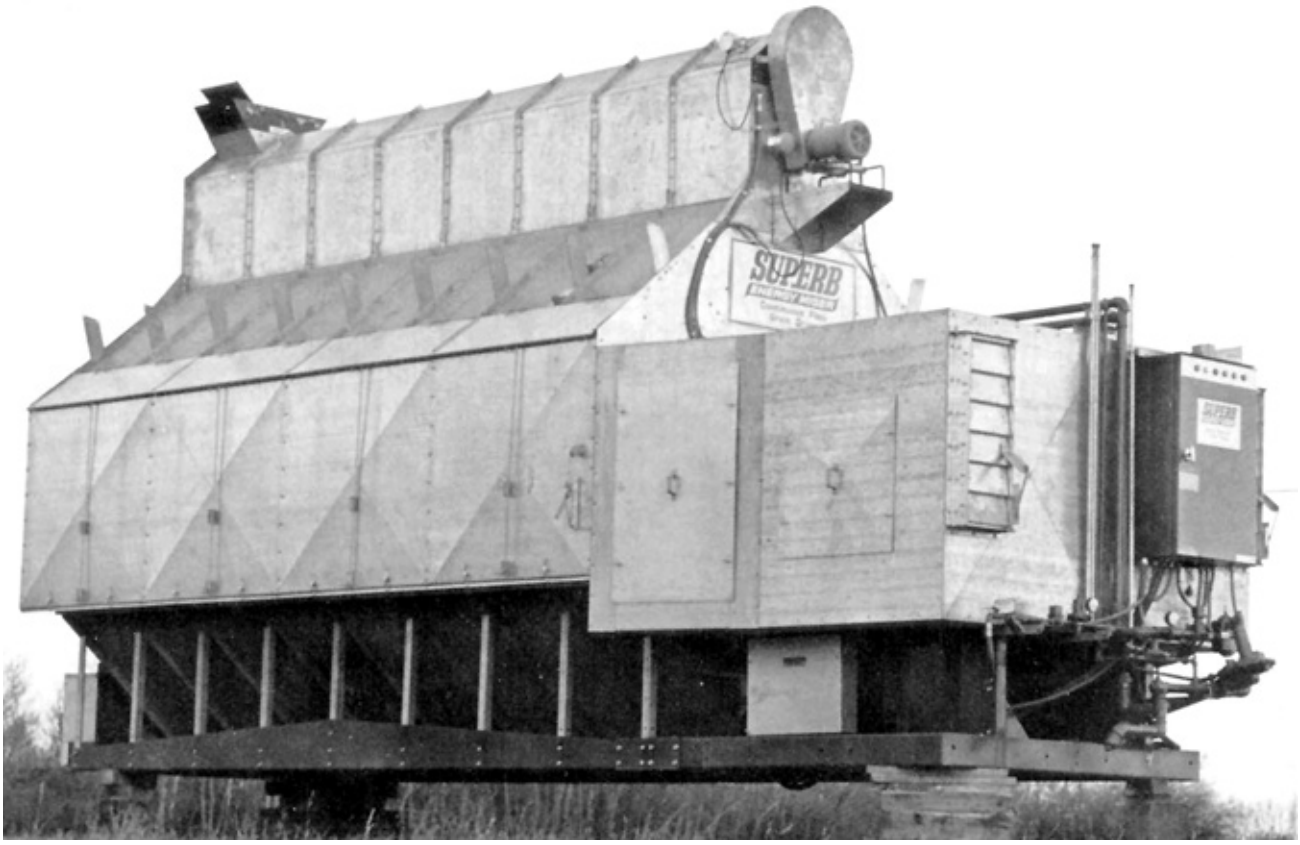

Superb S500C Grain Dryer

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

SUPERB S500C (1980 MODEL) GRAIN DRYER

MANUFACTURER AND DISTRIBUTOR:

Beard Industries Inc.
R.R. No. 6, Box 19
Frankfort, Indiana
46041

RETAIL PRICE:

S47,500.00 (August, 1982, f.o.b. Humboldt, complete with 1.8 mm screens).

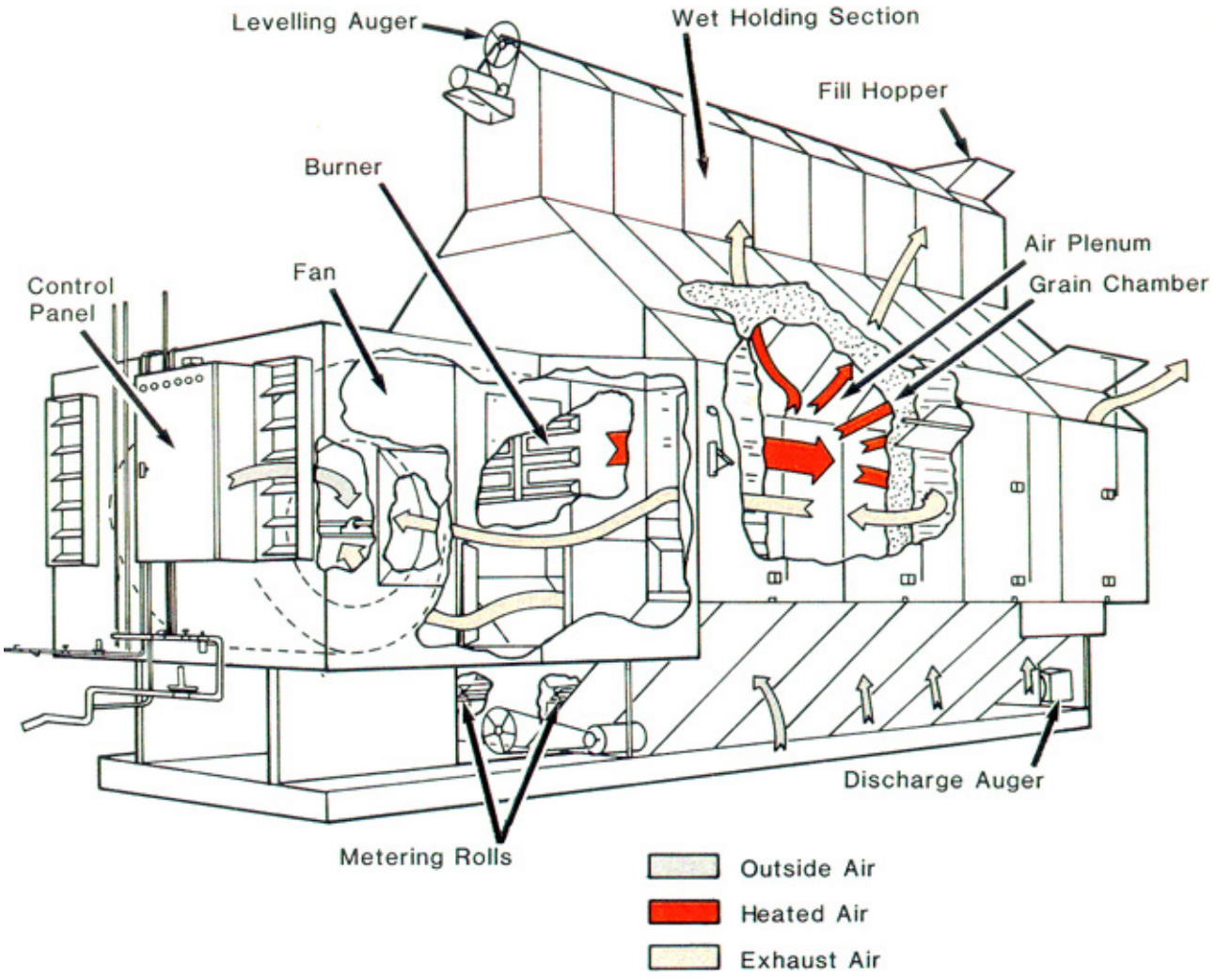

FIGURE 1. Superb S500C Grain Dryer.

SUMMARY AND CONCLUSIONS

Functional performance of the Superb S500C (1980 model) continuous flow grain dryer was *very good* in wheat, barley, rapeseed and Hybrid 3996 corn.

The rated drying capacity of the Superb S500C was 9.4 t/h (345 bu/h) in wheat, 7.0 t/h (332 bu/h) in barley, 4.8 t/h (212 bu/h) in rapeseed and 4.8 t/h (189 bu/h) in corn. Grain damage occurred in wheat when operating at the manufac. turer's setting.

Specific fuel consumption at rated capacity, or the amount of propane required to dry a quantity of grain, was 8.2 L/t (4.9 gal/100 bu) in wheat, 8.4 L/t (4.0 gal/100 bu) in barley, 7.9 L/t (3.9 gal/100 bu) in rapeseed and 18.9 L/t (10.5 gal/100 bu) in corn. This corresponded to a fuel consumption of 77 L/h (16.9 gal/h) in wheat, 59 L/h (12.9 gal/h) in barley, 38 L/h (8.3 gal/h) in rapeseed and 91 L/h (19.9 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 3300 kJ/kg (1400 Btu/lb) In wheat, 3400 kJ/kg (1500 Btu/lb) in barley, 3800 kJ/kg (1600 Btu/lb) in rapeseed and 3500 kJ/kg (1500 Btu/lb) in corn.

The Superb S500C was easy to install, but was not equipped for transporting. Burner performance was very good and provided a steady and uniform grain drying temperature in all conditions. Grain drying temperature was easy to set and was adequate for all conditions. Grain cooling was very good and easy to adjust. Ease of filling and unloading was good. Grain flow was uniform, adequate and easy to adjust. Ease of cleaning the Superb S500C was good. Small grains and fines partially plugged the grain chamber screens, and had to be cleaned out regularly. Lubrication points were accessible and easy to service.

The Superb S500C was safe to operate as long as the manufacturer's safety instructions were followed. The sound level at the operator's station was 85 dBA.

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

Three minor durability problems occurred during the tests.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Reducing the high limit temperature settings recommended in the operator's manual.
2. Providing locks for all positions of the recirculation butterfly valve.
3. Revising the recommended dryer temperature settings for wheat to reduce grain damage.
4. Including metric units and initial settings for rapeseed in the operator's manual.
5. Modifications to prevent dust from entering the metering roll speed and grain drying temperature gauges.

Senior Engineer- G.E. Frehlich
Project Engineer- J.D. Wassermann

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The recommended high limit temperature settings are intended to prevent damage to the dryer without causing unnecesarry shutdowns. We will review the settings in the operator's manual or note that these are maximum settings and that lower high limit settings may be used.
2. Latches for the air recirculation butterfly adjustment have been added to all 1981 and 1982 models.
3. We have received no complaints from 1980 to 1982 of damage when drying commercial grade, direct combined wheat at the recommended drying temperature of 87°C (190°F). We will revise the recommended drying temperature to 82°C (180°F) for windrowed wheat.
4. Initial dryer settings for rapeseed, and English and metric units will be reviewed for inclusion in future editions of the operator's manual.
5. We have not noted an unusual in-field failure rate of metering roll speed and grain drying temperature gauges; however, we will review the meter construction for means of additional sealing.

MANUFACTURER'S ADDITIONAL COMMENTS

1. The reported drying capacity for yellow corn was determined while drying at 98°C (208°F). The operator's manual recommends drying at 110°C (230°F) which would significantly increase drying capacity and decrease specific fuel consumption.
2. The capacities reported in our operator's manual are greater than those indicated in this report. Our capacities were calculated using wet grain entering the dryer whereas capacities indicated in this report were calculated using dry grain discharged from the dryer.
3. The standard grain column screen has 2.4 mm (0.09 in) diameter perforations and is less susceptible to plugging than the 1.8 mm (0.07 in) diameter perforations used to dry rapeseed and similar crops.
4. The following improvements have been made to the Superb S500C since 1980:
   a) perforated material has been added to the base of the garner bin side walls to improve drying performance.
   b) the metering roll feed gate can be adjusted from outside the dryer during operation.
   c) a fill hopper cover plate and an automatic moisture controller are now standard equipment.
   d) the seals on the auger cover doors have been improved to eliminate fines being drawn into the cool air plenum from the auger and metering roll area.
   e) the thickness of the upper slope of the grain columns has been decreased from 305 mm (12 in) to 254 mm (10 in) to improve drying performance.
   f) troughs have been added below the levelling auger to evenly distribute fines along the grain columns.

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

GENERAL DESCRIPTION

The Superb S500C (1980 model) is a continuous cross-flow grain dryer with a centrifugal fan, propane burner, wet holding section, and two grain chambers enclosing the hot and cool air plenums. Grain is loaded into the top of the dryer and flows down the grain chambers around the hot and cool air plenums. Ambient air (outside air) is drawn by the fan through the lower grain chamber screens into the cool air plenum to cool the grain, and is forced past the burner into the hot air plenum and through the upper grain chamber screens to dry the grain. Air exhausted from the grain drying chamber can be recirculated to the fan. Dry grain is discharged at the bottom of the dryer.

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

The fan on the test machine was driven by an 18.7 kW (25 hp), 230 V AC, three phase electric motor and the conveying and metering equipment was driven by three auxiliary electric motors. An optional power take-off drive was available.

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. Controls also provided protection for other component and operating failures.

Detailed specifications are given in APPENDIX 1.

SCOPE OF TEST

The Superb S500C was operated with artificially wetted grains shown in TABLE 1 for 101 hours while drying about 571 tonnes (24,000 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	3	16.0 to 22.0	24	192
Barley	1FEED	1	16.2 to 21.7	22	160
Rapeseed	3CW	20	11.4 to 17.8	37	143
Corn (Hybrid 3996)	3CW	5	20.2 to 32.0	18	76
			TOTAL	101	571

RESULTS AND DISCUSSION

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Superb S500C was not equipped for transporting. A hitch and wheels were available as optional equipment.

Installation: The Superb S500C was installed by 2 men in about 3 hours. The manufacturer's recommended installation height provided adequate clearance for the unloading auger. The propane supply and electrical services were easily connected to the dryer.

Fan: The fan was belt driven by an 18.7 kW (25 hp) electric motor at a speed of about 1410 rpm. The motor was started and stopped with a switch at the control panel (FIGURE 2). A warning light and audible alarm indicated motor overload.

Sound level at the operator's station was about 85 dBA.

Burner: The pilot-ignited burner (FIGURE 3) was started with a switch at the control panel. Fuel pressure was monitored on gauges at the control panel and a warning light and audible alarm indicated a flame outage. The burner performed well for all the conditions encountered.

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

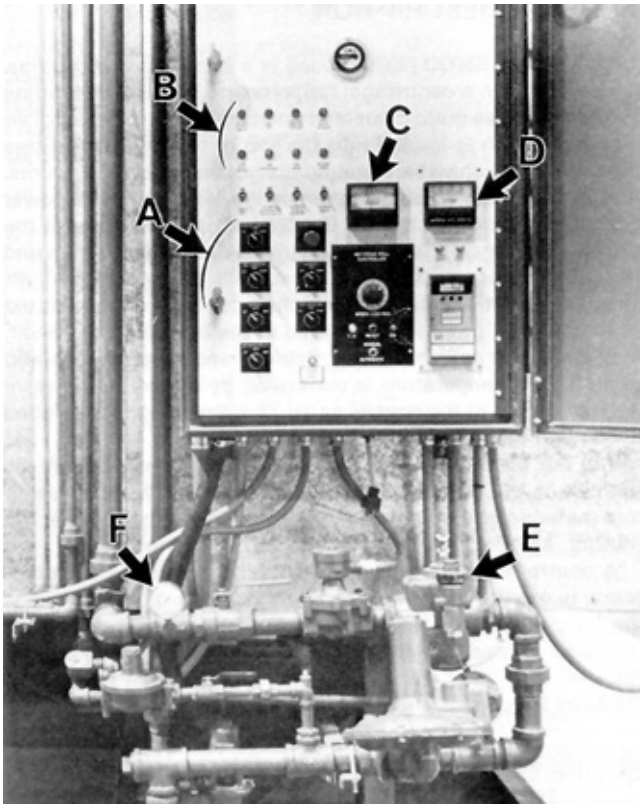

FIGURE 2. Controls and Instruments: (A) Motor and Burner Controls, (B) Indicator Lights, (C) Grain Drying Temperature Gauge, (D) Metering Roll Speed Gauge, (E) Modulating Valve, (F) Burner Pressure Gauge.

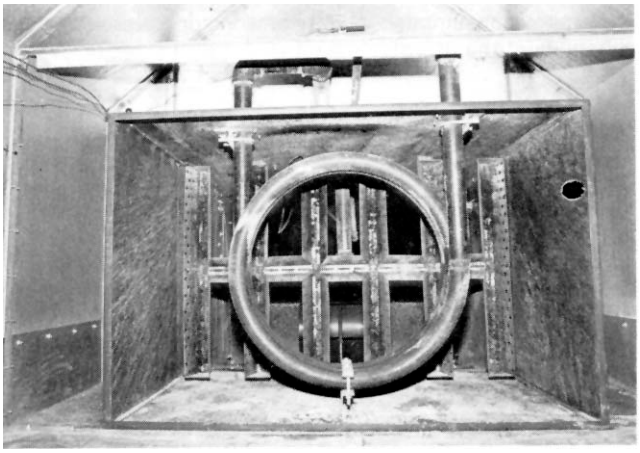

FIGURE 3. Burner.

Grain Drying Temperature: The grain drying temperature was set by adjusting a dial at the control panel. The maximum and minimum drying temperature limits were adjusted on switches at a panel above the fan housing. If these settings were exceeded, the fuel to the burner was automatically shut off.

The high limit temperature switch failed to shut off the fuel when a faulty grain drying temperature gauge caused overheating in corn. It is suspected that the manufacturer's recommended high limit temperature setting of 42 to 47°C (75 to 85°F) above the grain drying temperature was too high. It is, therefore, recommended that the manufacturer consider reducing the recommended high limit temperature settings.

The grain drying temperature was monitored at the control panel and was adequate for all the conditions encountered.

Air Recirculation: The size of the grain chamber from which the exhaust air was collected for recirculating was adjusted for different initial grain moisture contents, and the amount of exhaust air recirculated was adjusted to obtain the desired grain discharge temperature. The size of the grain chamber

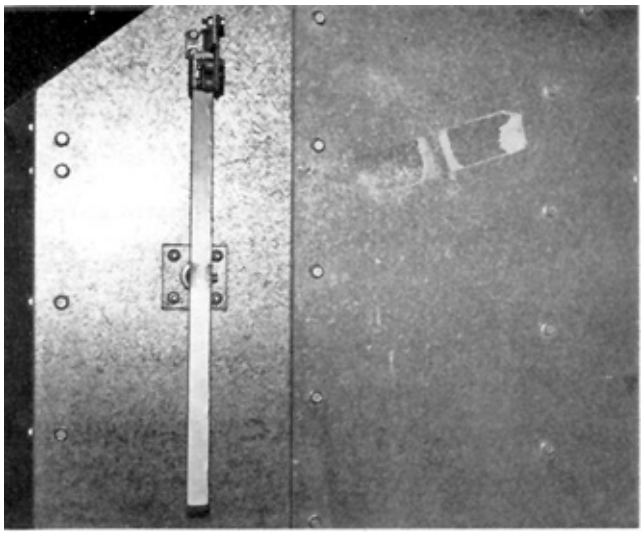

FIGURE 4. Butterfly Valve Adjustment.

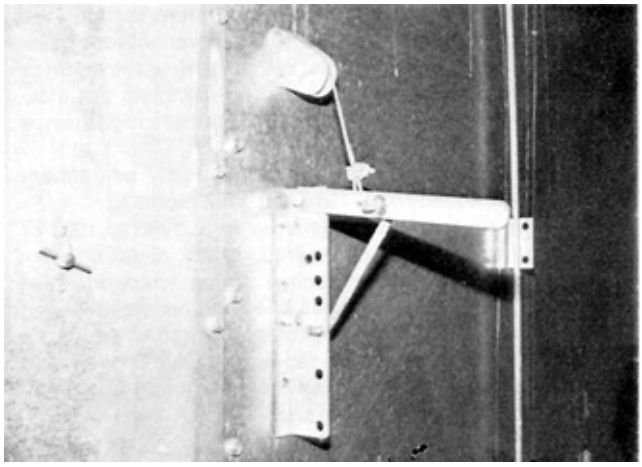

FIGURE 5. Recirculation Door Adjustment.

recirculated was easily varied by adjusting the butterfly valve (FIGURE 4) for each grain chamber. The amount of air recirculated was easily varied by adjusting recirculation doors on both sides of the dryer (FIGURE 5). The butterfly valve could only be locked in the vertical position and slipped when placed in other positions. It is recommended that locks be provided for all positions.

Grain Cooling: Grain cooling was controlled by adjusting the amount of ambient air drawn through the grain cooling chamber, and the amount of ambient and recirculated air drawn directly into the fan. The ambient air drawn through the grain cooling chamber was varied by adjusting the inlet air shutter (FIGURE 6) and the recirculation doors, and the amount drawn directly into the fan was easily varied by adjusting the inlet air shutter. Cooling was adequate for all the conditions encountered.

Grain Filling: A loading auger with a discharge height of 4.6 m (15.1 ft) was required to fill through the hopper at the rear of the Superb S500C. A cover had to be fabricated for the hopper to prevent grain and fines from blowing away when loading. The grain level switch was very useful in stopping and starting an electrically powered grain auger to maintain the desired grain level. A warning light and audible alarm indicated low grain level.

The holding capacity of the Superb S500C was about 11.6 m^3 (320 bu).

Grain Discharge: Grain flow was controlled by a feed gate and metering roll at the bottom of each grain chamber. Metering roll spee.d was easily adjusted with a dial and monitored on a gauge at the control panel (FIGURE 2). The feed gate was easily adjusted for coarse and fine grains and

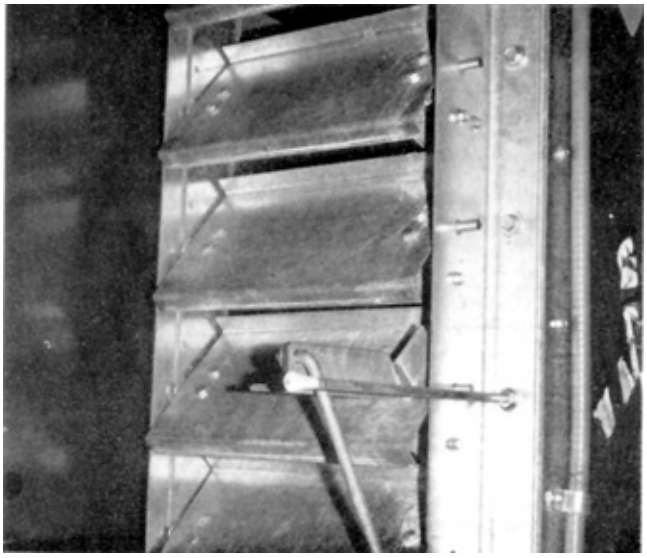

FIGURE 6. Inlet Air Shutter Adjustment.

was normally set between 38 and 64 mm (1.5 and 2.5 in). The feed gate required 30 minutes to adjust (FIGURE 7) and had to be adjusted with the dryer empty to obtain the best accuracy.

Grain flow was adequate and uniform. Grain chunks occasionally caught in the feed gates 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 centre at the rear of the dryer (FIGURE 8). A warning light and audible alarm indicated discharge auger failure or a reduction in metering roll speed.

Wet Grain Startup and Shutdown: The first and last fill of grain was dried uniformly using the procedure recommended by the manufacturer. The procedure was difficult and time consuming to conduct.

Batch Drying: The Superb S500C could be operated as a batch dryer with the grain stationary or being recirculated if conveying equipment was available.

Cleaning: Ease of cleaning the Superb S500C was good. The screens, especially those in the lower grain chamber, partially plugged during operation. Sweeping as recommended by the manufacturer, did not adequately clean the screens. The screens could be adequately cleaned with a high pressure washer, but this was laborious and time consuming.

Fines in the hot air plenum were automatically collected and fed into the discharge auger. The discharge auger trough could be swung down for easy cleaning (FIGURE 9). Fines accumulated at the rear of the cool air plenum (FIGURE 10) and had to be cleaned out regularly. Fines accumulating in the recirculation ducts were accessible through cleanout doors and fines that accumulated around the dryer had to be cleaned up weekly to prevent excessive buildup.

Lubrication: The Superb S500C had 13 pressure grease fittings that required greasing twice a month. The oil level in the metering roll drive had to be checked twice a month. Checking the oil level was difficult.

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 ad-

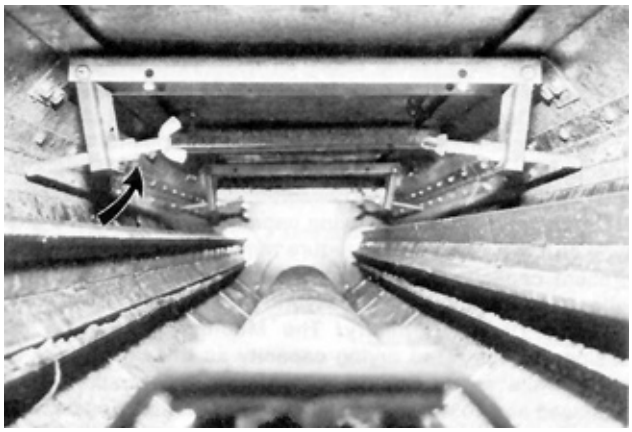

FIGURE 7. Feed Gate Adjustment.

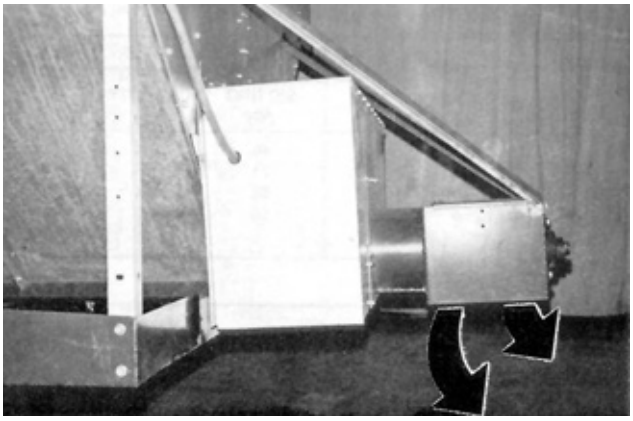

FIGURE 8. Grain Discharge Location.

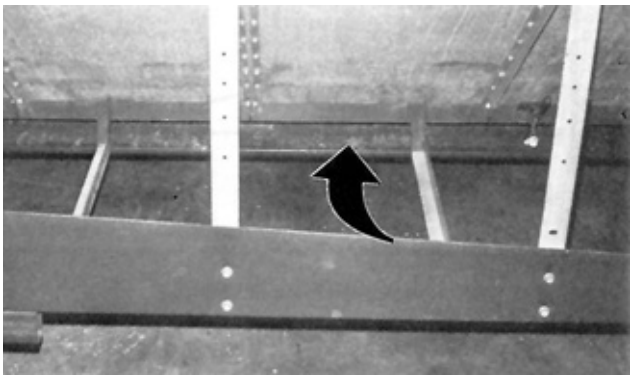

FIGURE 9. Discharge Auger Trough.

FIGURE 10. Accumulation of Fines in the Cool Air Plenum.

justed 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 Superb S500C while drying wheat, barley, rapeseed and Hybrid 3996 corn.

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 Superb S500C varied from 4.8 t/h (189 bu/h) in corn to 9.4 t/h (345 bu/h) in wheat.

TABLE 2. Superb S500C 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	88	9.4	11
Barley	19.8	5	71	7.0	12
Rapeseed	15.0	5	52	4.8	13
Corn (Hybrid 3996)	25.5	10	98	4.8	14

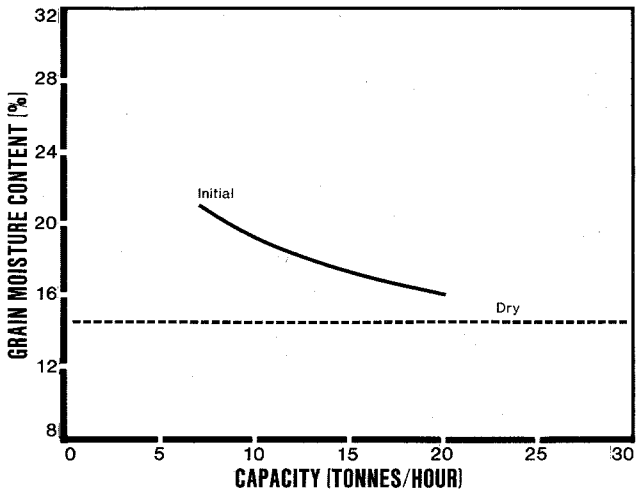

FIGURE 11. Drying Capacity in Wheat.

QUALITY OF WORK

Grain Quality: Grain can be damaged in a 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.

A grade loss occurred when drying commercial wheat at the recommended temperature settings. A grade loss did not occur when drying commercial rapeseed or feed barley and corn.

[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 capacity using the weight of the wet grain entering the dryer. See APPENDIX VI for the wet grain to dry grain conversion.

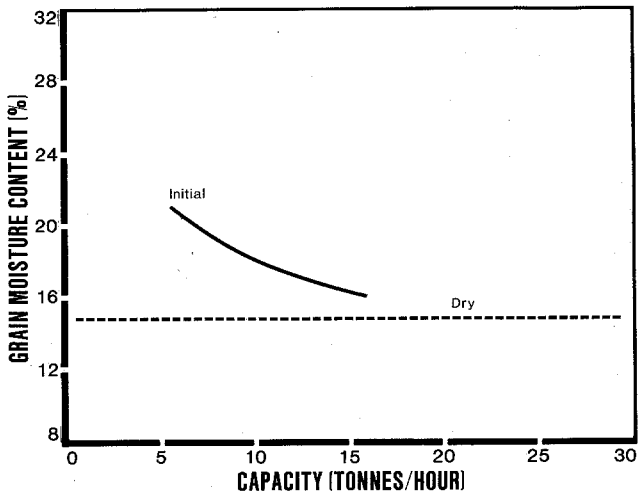

FIGURE 12. Drying Capacity in Barley.

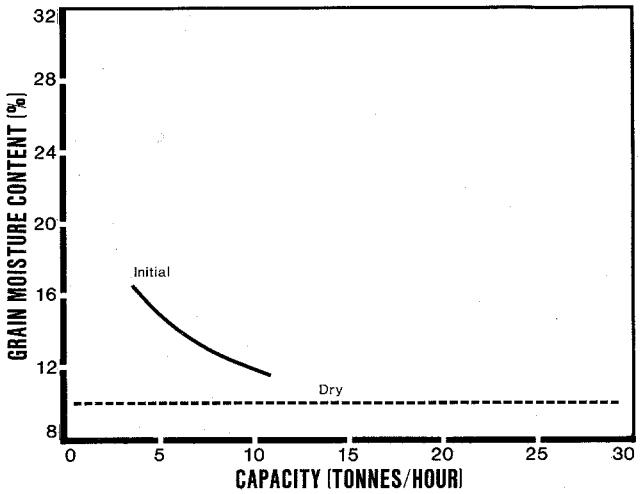

FIGURE 13. Drying Capacity in Rapeseed.

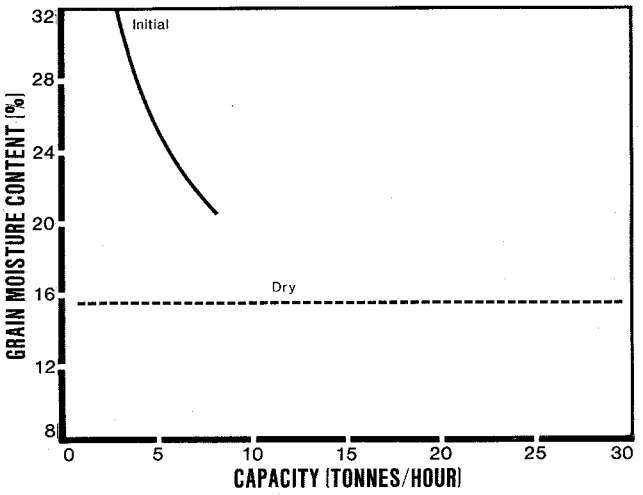

FIGURE 14. Drying Capacity in Corn (Hybrid 3996).

It is recommended that the manufacturer revise his recommended dryer temperature settings for wheat to reduce grain damage. Changing the drying temperature in wheat, will affect the drying capacity.

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 Superb S500C was very good. See APPENDIX IV for further details.

POWER REQUIREMENTS

The Superb S500C had a rated full load current of 85 amperes when operating on 230 V AC, three phase power. Power requirements varied from 20.5 kW (27.5 hp) in rapeseed to 22.3 kW (29.9 hp) in corn. An optional power take-off drive was available.

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 Superb S500C at rated drying capacity (TABLE 3) varied from 7.9 L/t (3.9 gal/100 bu) in rapeseed to 18.9 L/t (10.5 gall100 bu) in corn. This corresponds to a fuel consumption of 38 L/h (8.3 gal/h) in rapeseed to 91 L/h (19.9 gal/h) in corn.

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	77	9.4	8.2	3 300
Barley	5	59	7.0	8.4	3 400
Rapeseed	5	38	4.8	7.9	3 800
Corn (Hybrid 3996)	10	91	4.8	18.9	3 500

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 water from the grain, 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 Superb S500C (TABLE 3) at rated drying capacity varied from 3300 kJ/kg (1400 Btu/lb) in wheat to 3800 kJ/kg (1600 Btu/lb) in rapeseed.

Air Recirculation: The Superb S500C was equipped for recirculating exhaust air and the results presented in this report have been obtained with recirculation settings indicated in the operator's manual. Slightly greater drying capacities could be obtained with the Superb S500C by reducing the amount of exhaust air recirculated. However, this would increase the specific fuel and energy consumption and reduce the benefits obtained from air recirculation.

OPERATOR SAFETY

The Superb S500C operator's manual emphasized operator safety and warning decals adequately indicated dangerous areas. Drives were well shielded and machine adjustments could be safely made.

The Superb S500C 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. Warning lights and an audible alarm indicated safety shutdown. The automatic hot air plenum cleanout greatly reduced any fire hazard from fines collecting in the plenum.

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, well illustrated and very detailed. It contained useful information on safe operation, adjustments, service and lubrication.

Initial settings for drying rapeseed and metric units were not included in the operator's manual and it is recommended that they be included.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Superb S500C during 101 hours of operation while drying 571 tonnes (24000 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)
Conveying:		
- An unloading auger bolt broke and was replaced at	41	156
Controls:		
- The metering roll speed gauge failed and was replaced at	43	164
The grain drying temperature gauge stuck once at	83	396

DISCUSSION OF MECHANICAL PROBLEMS

Controls: The sticking of the metering roll speed and grain drying temperature gauges was attributed to dust collecting within the gauges. It is recommended that the manufacturer consider modifications to prevent dust from entering the gauges.

APPENDIX I

SPECIFICATIONS

MAKE:	Superb
MODEL (1980):	S500C
SERIAL NUMBER:	S500C 321048013A
MANUFACTURER:	Beard Industries Inc. Frankfort, Indiana, U.S.A.
GRAIN LOADING:	
- height	4590 mm
- levelling auger	
- diameter	174 mm
- speed	420 rpm
drive	belt from electric motor
WET HOLDING CHAMBER:	
- length	4980 mm
- height	1200 mm
- width	618 mm
GRAIN CHAMBERS:	
- type	2 vertical and sloped grain columns
- length	4980 mm
- height	
- drying	1674 mm
- cooling	1013 mm
- width	
- drying	305 mm
- cooling	254 mm
- area	
- drying	8.3 m^2
- cooling	5.0 m^2
GRAIN DISCHARGE:	
- metering device	
- type	metering rolls fed by adjustable feed gate
- number	2
- diameter	101 mm
- drive	chain from variable speed DC motor
- adjustment	vary metering roll speed and feed gate opening
- speed	0 to 8.5 rpm
- discharge augers	
- number	1
- diameter	174 mm
- length	5983 mm
- drive	belt from electric motor
- speed	253 rpm
- discharge height	72 mm above machine base
- discharge position	rear centre
HOT AIR PLENUM:	
- shape	rectangular with triangular top
- air transfer to grain	screen
- screen porosity	22 holes/cm^2
- screen hole size	1.8 mm dia.
- temperature adjustment	modulating valve
COOL AIR PLENUM:	
- shape	rectangular with triangular bottom
- air transfer to grain	screen
- screen porosity	22 holes/cm^2
- screen hole size	1.8 mm dia.
FAN:	
- type	backward-inclined airfoil centrifugal
- outer diameter	759 mm
- effective length	430 mm
- number of blades	9
- speed	1410 rpm
- drive	belt from electric motor
BURNER:	
- maximum rating	7.6 GJ/h
- type	32 x 70 x 970 mm main tube with six 32 x 32 x 646 mm lateral tubes
- fuel	propane
- ignition	pilot
ELECTRICAL SYSTEM:	
- main circuit	85 amp, 230 V AC, three phase
- electric motors	
- number	4
- size	
- fan	18.7 kW, 230 V AC, three phase
- levelling auger	2.2 kW, 230 V AC, three phase
- discharge auger	1.5 kW, 230 V AC, three phase
- metering roll	0.5 kW, variable V DC
NO. OF CHAIN DRIVES:	1
NO. OF BELT DRIVES:	3
NO. OF PRELUBRICATED BEARINGS:	4
LUBRICATION POINTS:	
- twice monthly	13
- 5 times yearly	6
OVERALL DIMENSIONS:	
- field height	4450 mm
- field length	8743 mm
- field width	3378 mm
- body metal thickness	1.5 mm
WEIGHT: (Dryer Empty)	5070 kg
SOUND LEVEL: (At Control Panel)	85 dBA
HOLDING CAPACITY:	11.6 m^3
INSTRUMENTS:	fuel pressure gauges, grain drying temperature gauge, safety shutdown warning lights and audible alarm, metering roll speed gauge, burner pressure gauge and hourmeter.
OPTIONS:	liquid propane, propane vapour or natural gas fuel systems
	230 V AC, single phase; 208, 230, 460 or 575 V AC, three phase; 60 or 50 Hz electrical systems; reduced voltage starters; reduced current starters; auxiliary conveying equipment starter package; rotary phase converter
	transport axles and hitch; power take-off driven blower; dryeration package; reversed fill and unload augers; centre or intermediate point discharge; extended load hopper position; extended unload discharge tube

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 ℓn 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	$\ell nC = 13.70 - 3.86 \ell nM$	.98	141[1]	8
Barley	12	$\ell nC = 13.48 - 3.87 \ell nM$	.97	80[1]	8
Rapeseed	13	$\ell nC = 9.93 - 3.09 \ell nM$	.99	453[1]	8
Corn (Hybrid 3996)	14	$\ell nC = 9.38 - 2.41 \ell nM$	.99	137[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 Superb S500C when drying rapeseed, wheat, barley and corn.

TABLE 6. Hot Air Plenum Temperature Variation.

GRAIN	GAUGE SETTING (°C)	AVERAGE PLENUM TEMPERATURE (°C)	CV (%)
Wheat	88	96	4
Barley	71	80	5
Rapeseed	52	59	4
Corn	98	111	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
b) very good
c) good
d) fair
e) poor
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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