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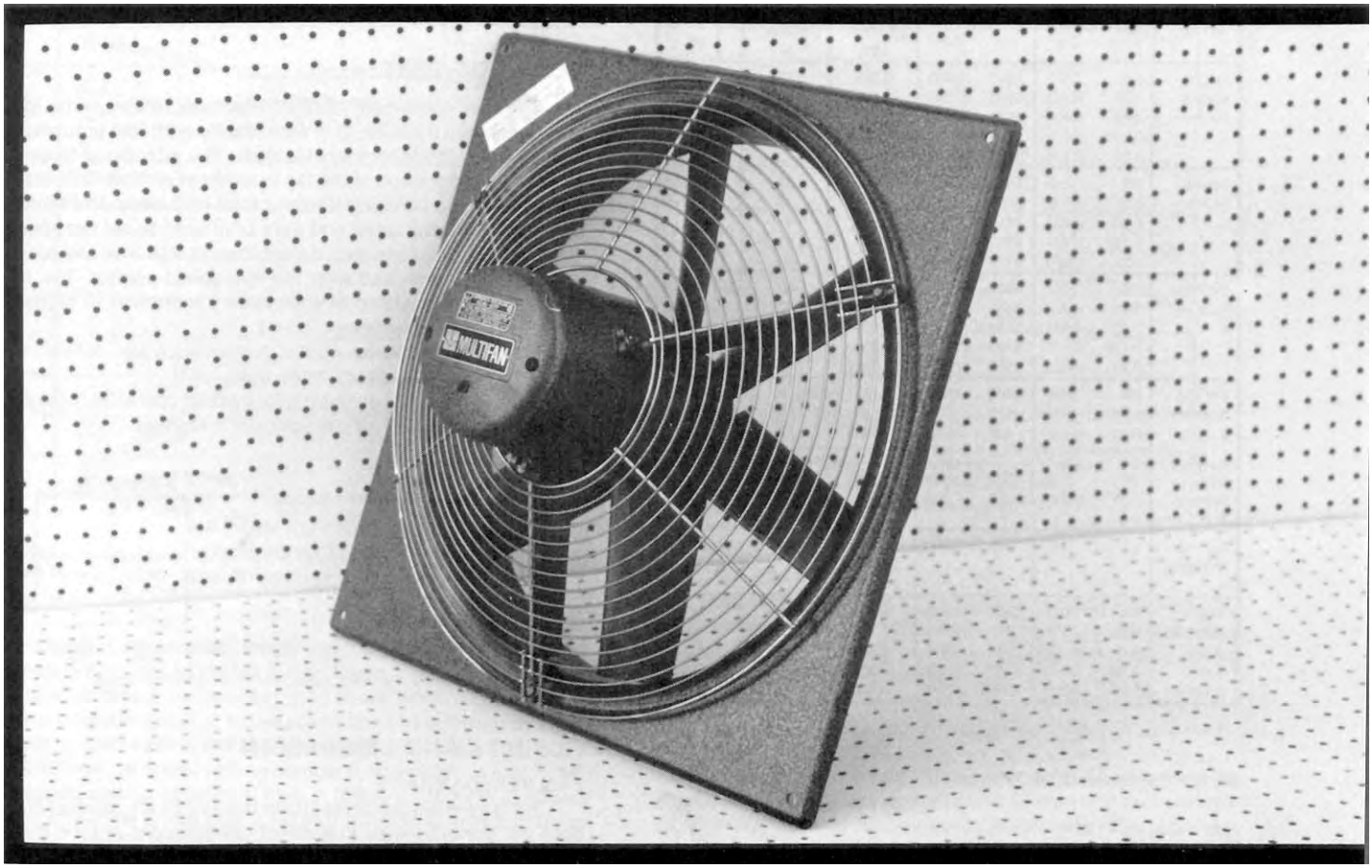
Evaluation Report 460



Multifan Model 4E45-6PP Ventilation Fan

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

MULTIFAN MODEL 4E45-6PP VENTILATION FAN

MANUFACTURER:

A. Vostermans BV
P.O. Box 366-5900 AJ
Venlo, Holland

DISTRIBUTOR:

Godro Equipment Inc.
P.O. Box 280
Roxton Pond, Quebec
J0E 1Z0

RETAIL PRICE:

$250.00 (November, 1985, f.o.b. Roxton Pond, Quebec).

SUMMARY OF RESULTS

TABLE 1. Multifan Model 4E45-6PP Fan Performance at Typical Levels of Operation.

SETTING	STATIC PRESSURE in wg	(Pa)	AIR FLOW RATE cfm	(L/s)	POWER CONSUMPTION kWh	TOTAL EFFICIENCY %	FAN SPEED rpm
Single Speed Direct	0.0	(0.0)	3820	(1800)	0.355	37	1646
	0.05	(12.5)	3720	(1760)	0.366	39	1636
	0.10	(24.9)	3580	(1690)	0.372	40	1630
	0.125	(31.1)	3520	(1660)	0.376	41	1625
	0.25	(62.3)	3170	(1500)	0.386	43	1601
Setting Number 5	0.0	(0.0)	3810	(1800)	0.366	35	1650
	0.05	(12.5)	3730	(1760)	0.370	39	1640
	0.10	(24.9)	3610	(1710)	0.376	41	1632
	0.125	(31.1)	3550	(1670)	0.384	41	1623
	0.25	(62.3)	3210	(1510)	0.401	43	1606
Setting Number 4	0.0	(0.0)	3050	(1440)	0.330	20	1313
	0.05	(12.5)	2850	(1340)	0.325	22	1269
	0.10	(24.9)	2550	(1200)	0.329	21	1212
	0.125	(31.1)	2480	(1170)	0.332	22	1211
	0.25	(62.3)	1980	(933)	0.335	23	1209
Setting Number 3	0.0	(0.0)	1460	(688)	0.175	4	632
	0.05	(12.5)	1120	(528)	0.169	6	601
	0.10	(24.9)	438	(207)	0.168	3	622
	0.125	(31.1)	101	(48)	0.178	1	538
Setting Number 2	0.0	(0.0)	982	(464)	0.104	2	441
	0.05	(12.5)	207	(98)	0.107	1	394
Setting Number 1	0.0	(0.0)	836	(394)	0.102	1	378
Single Speed Direct with Louvres	0.0	(0.0)	3580	(1690)	0.381	28	1626
	0.05	(12.5)	3410	(1610)	0.385	29	1615
	0.10	(24.9)	3240	(1530)	0.391	30	1605
	0.125	(31.1)	3160	(1490)	0.393	31	1598
	0.25	(62.3)	2730	(1290)	0.403	32	1583

Senior Engineer: E. H. Wiens

Project Engineer: R. P. Atkins

GENERAL DESCRIPTION

The Multifan Model 4E45-6PP ventilation fan is a 17.9 in (454 mm) diameter variable speed, direct drive, propeller type axial flow fan. It is primarily used in livestock and poultry barns as an exhaust fan located in the wall or ceiling.

The Multifan Model 4E45-6PP is a flush mounted unit equipped with an inlet guard grill and a mounting face plate. Optional features include PVC louvres, a five speed control, a two speed control, a single speed control and a thermostatic control. The six polypropylene blades are attached to a nylon reinforced hub. The propeller is directly mo.unted to a 0.46 hp (340 W), single phase, 220 V, electric motor. The motor is suspended by three tapered supports bolted directly to the motor casing and fan housing. The cast aluminum housing, motor casing and motor supports are coated with a lacquer finish for corrosion protection.

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

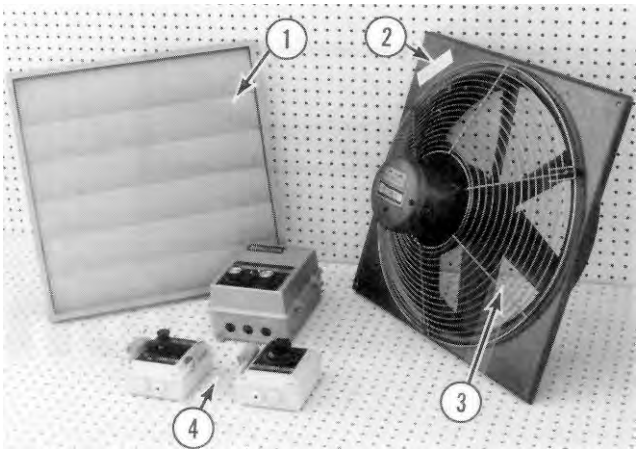


FIGURE 1. Multifan Model 4E45-6PP Ventilation Fan: (1) Optional Louvres, (2) Mounting Face Plate, (3) Inlet Guard Grill, (4) Motor Controls.

SCOPE OF TEST

The Multifan Model 4E45-6PP fan was tested in the inlet chamber setup (FIGURE 2) in accordance with test procedures developed by the Machinery Institute. The intent was to determine the performance of the fan in terms of air flow rate, static pressure, power consumption and total efficiency. The control units were not evaluated and were only used to set fan speed.

Fan performance was determined at 230 V in the single speed direct mode and with the five speed control. The five speed control consisted of a stepped transformer to regulate the speed at predetermined levels.

The effect of louvres on fan performance was determined in the single speed direct mode only.

The fan was also evaluated for ease of operation, operator safety and suitability of the operator's manual.

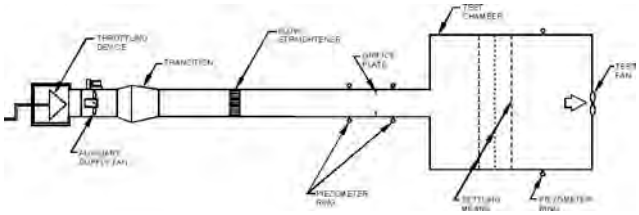


FIGURE 2. Schematic of Fan Test Apparatus - Inlet Chamber Setup.

RESULTS AND DISCUSSION

FAN PERFORMANCE

All fan performance results in this report are given at standard air[1] conditions so that direct comparisons can be made with other fan test reports. Fan performance under actual operating conditions could differ from these results by up to 10%, depending on such things as temperature, barometric pressure, humidity and elevation above sea level.

Air Flow Rate: Fan output in the single speed direct mode and at the number 5 setting on the five speed control were similar (FIGURE 3). Reducing the fan speed, greatly reduced the air flow rate for a given static pressure[2]. For example, at a static pressure of 0.125 in wg (31.1 Pa), reducing the speed controi setting from number 5 to number 4 and number 3 reduced the air flow rate from 3550 cfm (1670 L/s) to 2480 cfm (1170 L/s) to 438 cfm (207 L/s) respectively. Settings number 2 and number 1 were unable to achieve static pressures of 0.125 in wg (31.1 Pa).

[1]Standard air is air with a density of 0.075 lbm/ft^3 (1.2 kg/m^3) which occurs at 68°F (20°C), 50% relative humidity and a barometric pressure of 29.92 in Hg (101.325 kPa).

[2]Static pressure is a measure of the pressure difference between the pressure inside the building and the pressure on the outside of the building. Static pressure is usually expressed in inches of water gauge (in wg) or Pascals (Pa).

Air flow rates at typical levels of operation (i.e. static pressure) are given in TABLE 1. Ventilation fans are often rated on their output at a static pressure of 0.125 in wg (31.1 Pa). The manufacturer's rated air flow rate at 0.125 in wg (31.1 Pa), in the single speed direct mode, was 4129 cfm (1950 L/s). PAMI's measured flow rate at the same conditions was 3520 cfm (1660 L/s) or 15% lower than the manufacturer's rating.

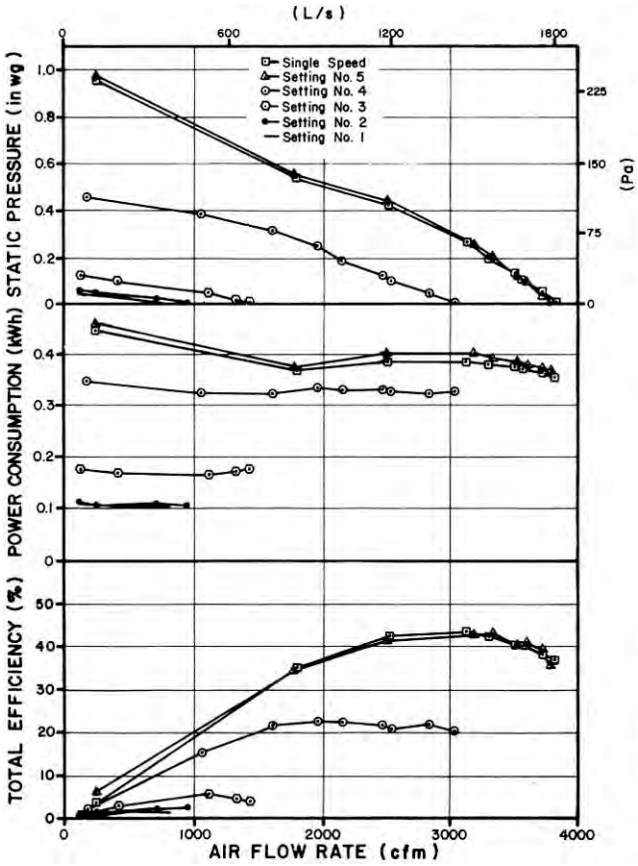


FIGURE 3. Multifan Model 4E45-6PP Fan Performance Curves in the Single Speed Direct Mode and at Five Speed Settings.

Power Consumption: Power consumption is the amount of energy (kWh) used by the fan motor. These numbers can be used directly to determine fan operating costs. For typical levels of static pressure (TABLE 1), the power consumption varied from 0.355 to 0.386 kWh in, the single speed direct mode, from 0.366 to 0.401 kWh at speed setting number 5, from 0.325 to 0.335 kWh at speed setting number 4, from 0.168 to 0.178 kWh at speed setting number 3, and from 0.102 to 0.107 kWh at speed settings number 2 and number 1. The maximum amperage drawn by the motor was 1.9 amps, which was the same as the rated motor amperage.

Total Efficiency: Total efficiency is the ratio of air horsepower over the input power. Air horsepower is dependent upon the air flow rate and corresponding total pressure. For typical levels of operation, when using the five speed control, the total efficiency (TABLE 1) ranged from 35 to 43% at speed setting number 5, 20 to 23% at speed setting number 4, 1 to 6% at speed setting number 3, and 1 to 2% at speed settings number 2 and number 1. The total efficiency in the single speed direct mode at a static pressure of 0.125 in wg (31.1 Pa) was 41%.

Effect of Louvres: The optional louvres were installed on the outlet side of the fan to determine their effect on fan output. The fan was tested under these conditions in the single speed direct mode only. Using the louvres reduced the air flow rate by 6 to 14% (FIGURE 4) over the typical range of operation. For example, at a static pressure of 0.125 in wg (31.1 Pa), the louvres reduced the air flow rate by 10%, from 3520 cfm (1660 L/s) to 3160 cfm (1490 L/s) (TABLE 1). The efficiency was in turn reduced from 41 to 31%. The use of other control devices such as shutters, dampers, screens, and hoods would also reduce air flow rates by varying amounts. The use of such control devices have to be taken into consideration when designing a ventilation system.

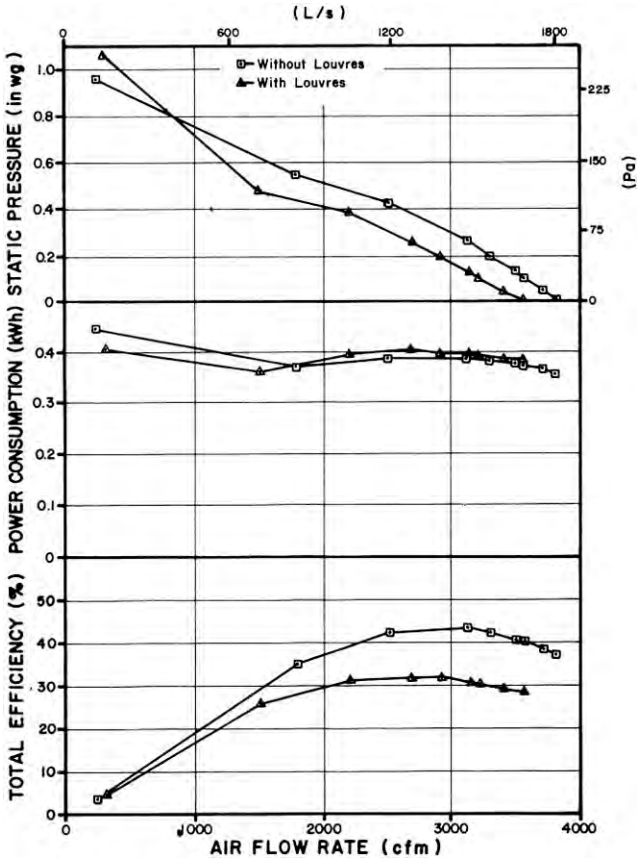


FIGURE 4. Effect of Louvres on Fan Performance.

EASE OF OPERATION

Maintenance: The inlet guard grill was easily removed. This made for easy access to clean the housing and fan blades. Regularly scheduled cleaning and maintenance will ensure longer motor life and optimum performance.

OPERATOR SAFETY

The inlet guard grill provided adequate protection from the fan blades. The motor was a totally enclosed unit and presented no safety hazards. The model 4E45-6PP was CSA approved.

The noise level of the model 4E45-6PP, at a distance of 4.9 ft (1.5 m) from the centre of the fan discharge, while operating at a 0.125 in wg (31.1 Pa) static pressure, was 67 dB(A). Higher noise levels could be expected if the fan was operated, in the vicinity of other buildings. The model 4E45-6PP falls within range 3 of the PAMI noise level range classification (APPENDIX II). The noise level produced by this fan can be considered annoying and be detrimental to hearing and operator performance under continuous exposure. Ear protection should be considered if working near the fan for prolonged periods.

OPERATOR'S MANUAL

The operator's manual consisted of a series of booklets and information sheets on the general operation, installation, maintenance, specifications, rated performance and trouble shooting of the Multifan and its controls.

APPENDIX I

SPECIFICATIONS

MAKE:	Multifan
MODEL:	4E45-6PP
MANUFACTURER:	A. Vostermans BV P.O. Box 366-5900 AJ Venlo, Holland
OVERALL DIMENSIONS:	
. housing width	21.6 in (548 mm)
- housing height	21.6 in (548 mm)
- housing depth (motor included)	11.4 in (289 mm)
- housing diameter	18.0 in (457 mm)
- guard grill diameter	20.4 in (518 mm)
- grill opening	0.13 in (3 mm) diameter wire spaced at 0.6 in (14 mm) in a circular pattern
PROPELLER:	
- diameter	17.9 in (454 mm)
- number of blades	6
- blade angle	variable - 28° at the tip, 36° at the hub
WEIGHT:	19 lb (9 kg)
MOTOR NAMEPLATE DATA:	
make	Multifan
model	I P55
class	E
type	TP
rpm	1650
ambient temperature rise	40°C
volts	220 V
amps	1.9 A
phase	single
cycles	60 Hz
horsepower	0.46 hp (340 W)

APPENDIX II

NOISE LEVEL RANGES

RANGE	SOUND LEVEL (dBA)	COMMENTS
1	up to 45	Tolerable, low level background noise.
2	45 to 60	Dominating background noise that would interfere with normal conversation.
3	60 to 85	Could be annoying and be detrimental to hearing and operator performance under long-term continuous exposure. Ear protection should be considered.
4	over 85	Could damage hearing, depending on level and exposure time. Ear protection is definitely recommended.

APPENDIX III

CONVERSION TABLE

cubic feet/minute (cfm) x 0.472	= litres/second (L/s)
horsepower (hp) x 745.7	= watts (W)
inches (in) x 25.4	= millimetres (mm)
inches water gauge (in wg) x 249.1	= pascals (Pa)
pounds (lb) x 0.45	= kilograms (kg)

SUMMARY CHART
MULTIFAN MODEL 4E45-6PP
VENTILATION FAN

RETAIL PRICE:	$250.00 (November, 1985, f.o.b. Roxton Pond)
FAN DESCRIPTION:	17.9 in (454 mm) propeller fan, variable speed, direct drive, 0.46 hp (340 W) 220 V electric motor.
FAN SPEED:	
- single speed direct	1601 to 1646 rpm
- 5 speed setting	378 to 1650 rpm
EFFICIENCY RANGE:	
- without louvres	37 to 43%
- with louvres	28 to 32%
EFFICIENCY AT 0.125 in wg (31.1 Pa):	
- without louvres	41%
- with louvres	31%
AIR FLOW RATE:	
- range	101 to 3820 cfm (48 to 1800 L/s)
- at 0.125 in wg (31.1 Pa)	3520 cfm (1660 L/s) without louvres and 3160 cfm (1490 L/s) with louvres
POWER CONSUMPTION:	0.102 to 0.403 kWh
OPERATOR SAFETY:	inlet guard provided CSA approved noise level = 67 dB(A) at 4.9 ft (1.5) from fan discharge
OPERATOR'S MANUAL:	adequate

ALBERTA FARM MACHINERY RESEARCH CENTRE

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute
Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:
P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080