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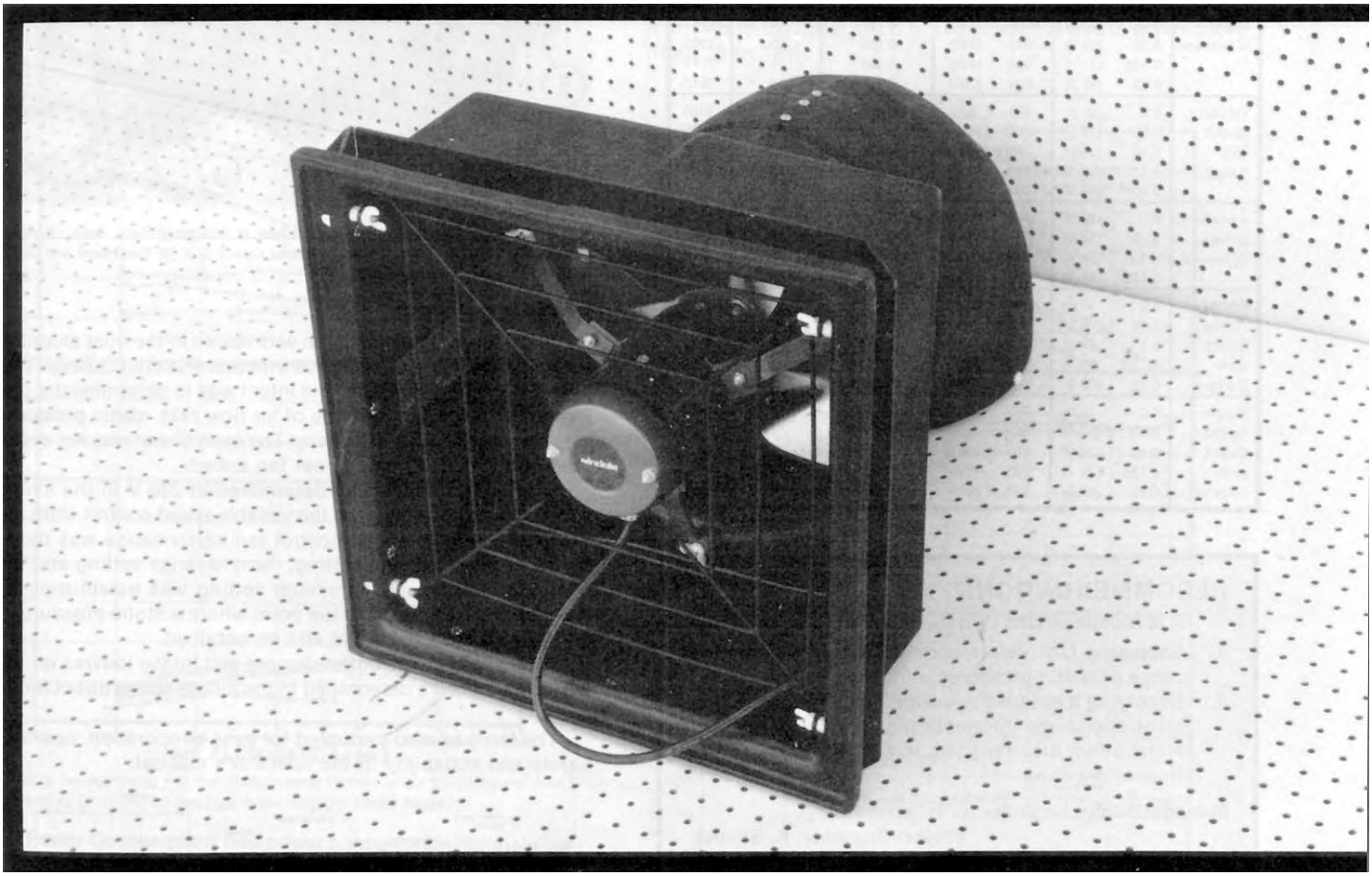
Evaluation Report 482



Del-Air Model F12 Ventilation Fan

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

DEL-AIR MODEL F12 VENTILATION FAN

MANUFACTURER AND DISTRIBUTOR:

Del-Air Systems Limited
P.O. Box 2500
Humboldt, Saskatchewan S0K 2A0

RETAIL PRICE:

$400.00 (June, 1986, f.o.b. Lethbridge, Alberta).

SUMMARY OF RESULTS

TABLE 1. Del-Air Model F12 Fan Performance at Typical Levels of Operation.

SETTING	STATIC PRESSURE in wg	(Pa)	AIR FLOW RATE cfm	(L/s)	POWER CONSUMPTION kW	TOTAL EFFICIENCY %	FAN SPEED rpm
Single Speed Direct	0.0	(0.0)	1150	(543)	0.142	14	1616
	0.05	(12.5)	1060	(500)	0.139	16	1612
	0.10	(24.9)	991	(468)	0.140	17	1605
	0.125	(31.1)	949	(448)	0.142	18	1599
	0.25	(62.3)	595	(281)	0.136	14	1636
Variable Speed Maximum	0.0	(0.0)	1130	(533)	0.154	12	1603
	0.05	(12.5)	1050	(496)	0.152	14	1587
	0.10	(24.9)	975	(460)	0.152	15	1581
	0.125	(31.1)	942	(445)	0.155	16	1577
	0.25	(62.3)	624	(295)	0.155	14	1615
Variable Speed Mid Range	0.0	(0.0)	991	(468)	0.121	10	1386
	0.05	(12.5)	905	(427)	0.122	12	1356
	0.10	(24.9)	785	(371)	0.120	13	1353
	0.125	(31.1)	749	(354)	0.120	14	1355
	0.25	(62.3)	397	(187)	0.126	10	1386
Variable Speed Minimum	0.0	(0.0)	746	(352)	0.088	6	987
	0.05	(12.5)	571	(270)	0.086	7	961
	0.10	(24.9)	416	(196)	0.086	7	1058
	0.125	(31.1)	293	(138)	0.088	5	995
Single Speed Direct with Damper	0.0	(0.0)	1070	(605)	0.140	11	1585
	0.05	(12.5)	992	(468)	0.139	13	1580
	0.10	(24.9)	926	(437)	0.144	15	1581
	0.125	(31.1)	884	(417)	0.144	15	1584
	0.25	(62.3)	568	(268)	0.141	13	1615
Single Speed Direct with Louvres	0.0	(0.0)	972	(459)	0.135	9	1609
	0.05	(12.5)	886	(418)	0.136	10	1605
	0.10	(24.9)	808	(381)	0.136	12	1616
	0.125	(31.1)	753	(355)	0.134	12	1627
	0.25	(62.3)	521	(246)	0.141	12	1593

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying fan performance data over a complete range of static pressures.
2. Supplying a detailed operator's manual containing illustrations and information on general operation, installation, maintenance, rated performance, and trouble shooting.

Manager/Senior Engineer: E. H. Wiens

Project Engineer: K. Shimek

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The manufacturer is considering the revision of all printed material containing fan performance data to include performance of the 5 sizes of Del-Air fans at varying static pressures.
2. The manufacturer, at PAMI's suggestion, is preparing a detailed Operator's Manual to be included with each fan.

GENERAL DESCRIPTION

The Del-Air Model F12 ventilation fan is a 11.5 in (292 mm) diameter, single or 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.

The Del-Air Model F12 is a flush mounted unit equipped with an inlet guard grill, mounting face plate, fan hood, optional PVC intake louvres, outlet butterfly damper, variable speed control and insulated door. The fan hood is an integral part of the fan housing. The 4 blade aluminum propeller and plastic hub are mounted directly on a 0.19 hp (140 W), single phase, 240 V electric motor. The motor mount consists of three flat iron braces bolted to the motor casing and molded PVC fan housing. The steel guard grill is plastic coated for corrosion protection.

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

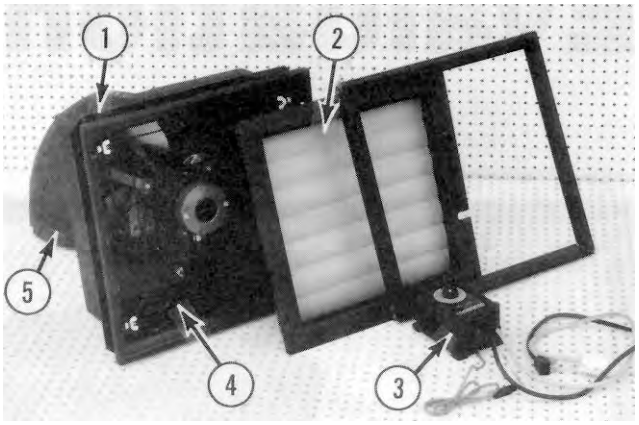


FIGURE 1. Del-Air Model F12 Ventilation Fan: (1) Mounting Face Plate, (2) Intake Louvres, (3) Variable Speed Control, (4) Inlet Guard Grill, (5) Fan Hood and Outlet Butterfly Damper.

SCOPE OF TEST

The Del-Air Model F12 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, input power and total efficiency. The control unit was not evaluated and was used only to set fan speed.

Fan performance was determined at 230V n the single speed direct mode and with the variable speed control. With the SCR type variable speed control fan performance was determined at the maximum setting, the mid-range setting and the minimum setting. The minimum setting was established by reducing the fan speed to the point where a static pressure of 0.125 in wg (31.1 Pa) could still be obtained.

The effect of the outlet damper and intake louvres on fan performance were 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.

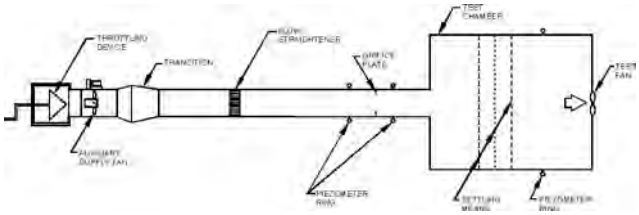


FIGURE 2. Schematic of Fan Test Apparatus -- Inlet Chamber Setup.

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 both the single speed direct

[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).

mode and at the maximum setting on the variable 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 from maximum to mid range to minimum setting, reduced the air flow rate from 942 cfm (445 L/s) to 749 cfm (354 L/s) to 416 cfm (196 L/s) respectively.

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). PAMI's measured flow rate in the single speed direct mode at this condition was 949 cfm (448 L/s). There was no manufacturer's performance information provided. Since building ventilation design is possible over a range of static pressures, it is recommended that, for fan selection purposes, the manufacturer include a table or curve of air flow rates over a complete range of static pressures.

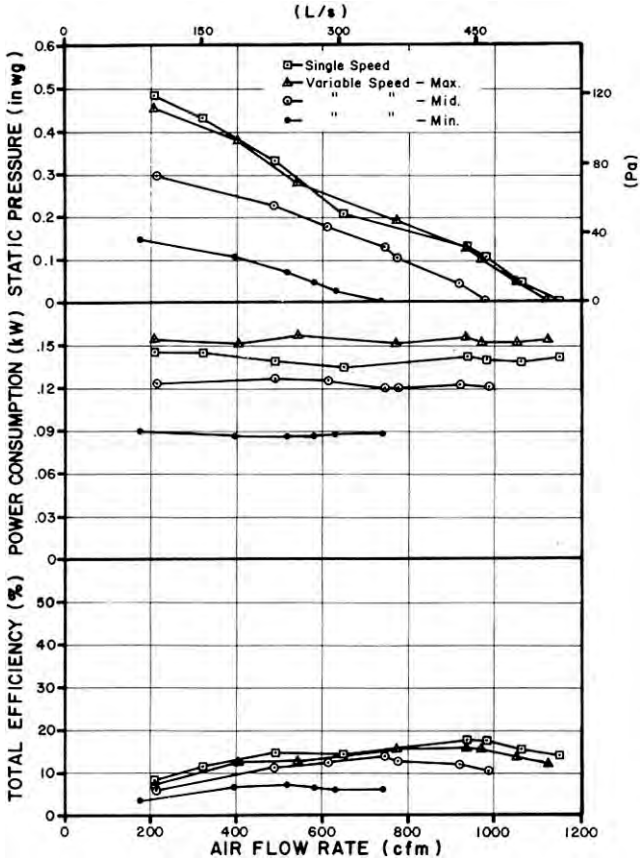


FIGURE 3. Del-Air Model F12 Fan Performance Curves in the Single Speed Direct Mode and at Three Speed Settings in the Variable Speed Mode.

Power Consumption: The power consumption numbers given in TABLE 1 can be used to calculate the cost of operating the fan. To calculate the cost of fan operation, multiply the power consumption (kW) by the number of hours of fan operation times the cost per kilowatt hour.

For typical levels of static pressure (TABLE 1), the power consumption varied from 0.136 to 0.142 kW in the single speed direct mode, from 0.152 to 0.155 kW at maximum speed, from 0.120 to 0.126 kW at mid range and from 0.086 to 0.088 kW at minimum speed. The maximum amperage drawn by the motor was 0.5 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, the total efficiency (TABLE 1), using the variable speed control, ranged from 12 to 16% at maximum speed, 10 to 14% at mid range and 5 to 7% at minimum speed. The total efficiency in the single speed direct mode at a static pressure of 0.125 in wg (31.1 Pa) was 18%.

Effect of Outlet Butterfly Damper: The optional outlet butterfly damper was installed within the fan hood on the outlet side of the fan to determine its effect on fan output. The fan was tested under these conditions in the single speed direct mode only. Using the butterfly damper reduced the air flow rate by 5 to 7% (FIGURE 4) over the typical range of operation. For example, at a static pressure of 0.125 in wg (31.1 Pa), the damper reduced the air flow rate by 7%, from 949 to 884 cfm (448 to 419 L/s) (TABLE 1). The efficiency was in turn reduced from 18 to 15%.

Effect of Louvres: The optional intake louvres were installed on the intake 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 12 to 21% (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 11%, from 949 to 753 cfm (448 to 355 L/s) (TABLE 1). The efficiency was in turn reduced from 18 to 12%.

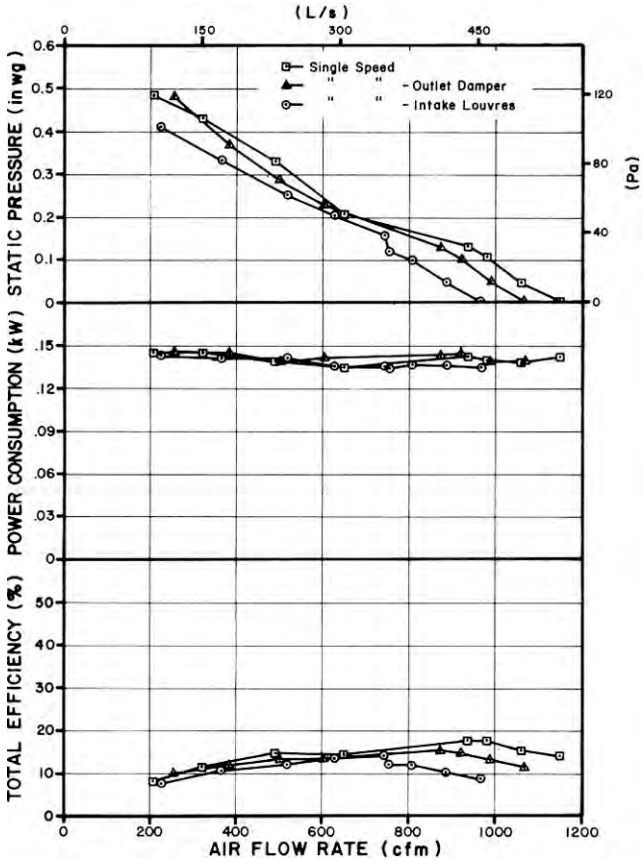


FIGURE 4. Effect of Butterfly Damper and Louvres on Fan Performance.

EASE OF OPERATION

Maintenance: The inlet guard grill, motor mount and motor could all be easily removed for cleaning. 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 F12 was CSA approved.

The noise level of the Model F12, 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 71 dB(A). Higher noise levels could be expected if the fan was operated in the vicinity of other buildings. The Model F12 falls within range 3 of the PAMI noise level range classification (APPENDIX II). The noise level

[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).

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 instruction sheet contained information on installation of the fan. It is recommended that the manufacturer supply a detailed manual containing illustrations and information on general operation, installation, maintenance, rated performance, safety aspects and trouble shooting.

APPENDIX I

SPECIFICATIONS

MAKE:	Del-Air
MODEL:	F12
SERIAL NUMBER:	FE12-115
MANUFACTURER:	Del-Air Systems Limited P.O. Box 2500 Humboldt, Saskatchewan S0K 2A0
OVERALL DIMENSIONS:	
housing width	19.0 in (483 mm)
housing height	19.0 in (483 mm)
housing length	29.4 in (746 mm)
housing diameter	11.8 in (298 mm)
guard grill size	14 in by 14 in (356 mm by 356 mm)
grill opening	0.1 in (3mm) diameter wire spaced at 1.6 in (41 mm)
IMPELLERS:	
diameter	11.5 in (292 mm)
hub diameter	4.8 in (121 mm)
number of blades	4
blade angle	variable - 30° at tip, 39° at hub
WEIGHT:	28 lb (13 kg)
MOTOR NAMEPLATE DATA:	
make	Indola
type	V50/1
rpm	1600
volts	240 V
amps	0.65 A
cycles	60 Hz
horsepower	0.19 hp (140 W)

APPENDIX II

NOISE LEVELS

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 l ong-terr 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 I I

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	= millimeters (mm)
inches water gauge (in wg) x 249.1	= pascals (Pa)
pounds (lb) x 0.45	= kilograms (kg)

SUMMARY CHART
DEL-AIR MODEL F12
VENTILATION FAN

RETAIL PRICE:	$400.00 (June, 1986, f.o.b. Lethbridge)
FAN DESCRIPTION:	11.5 in (292 mm) propeller fan, single or variable speed, direct drive, 0.19 hp (140 W) 240 V electric motor
FAN SPEED:	
- single speed direct	1599 to 1636 rpm
- variable speed	961 to 1615 rpm
EFFICIENCY RANGE:	
- without dampers or louvres	14 to 18%
- with dampers	11 to 15%
- with louvres	9 to 12%
EFFICIENCY AT 0.125 in wg (31.1 Pa):	
- without damper or louvres	18%
- with damper	15%
- with louvres	12%
AIR FLOW RATE:	
- range	293 to 1150 cfm (138 to 543 L/s)
- at 0.125 in wg (31.1 Pa)	949 cfm (448 L/s) without dampers or louvres 884 cfm (417 L/s) with damper 753 cfm (355 L/s) with louvres
POWER CONSUMPTION:	0.086 to 0.155 kW
OPERATOR SAFETY:	inlet guard provided CSA approved noise level = 71 dB(A) at 4.9 ft (1.5 m) from fan discharge
OPERATOR'S MANUAL:	installation instructions only.

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