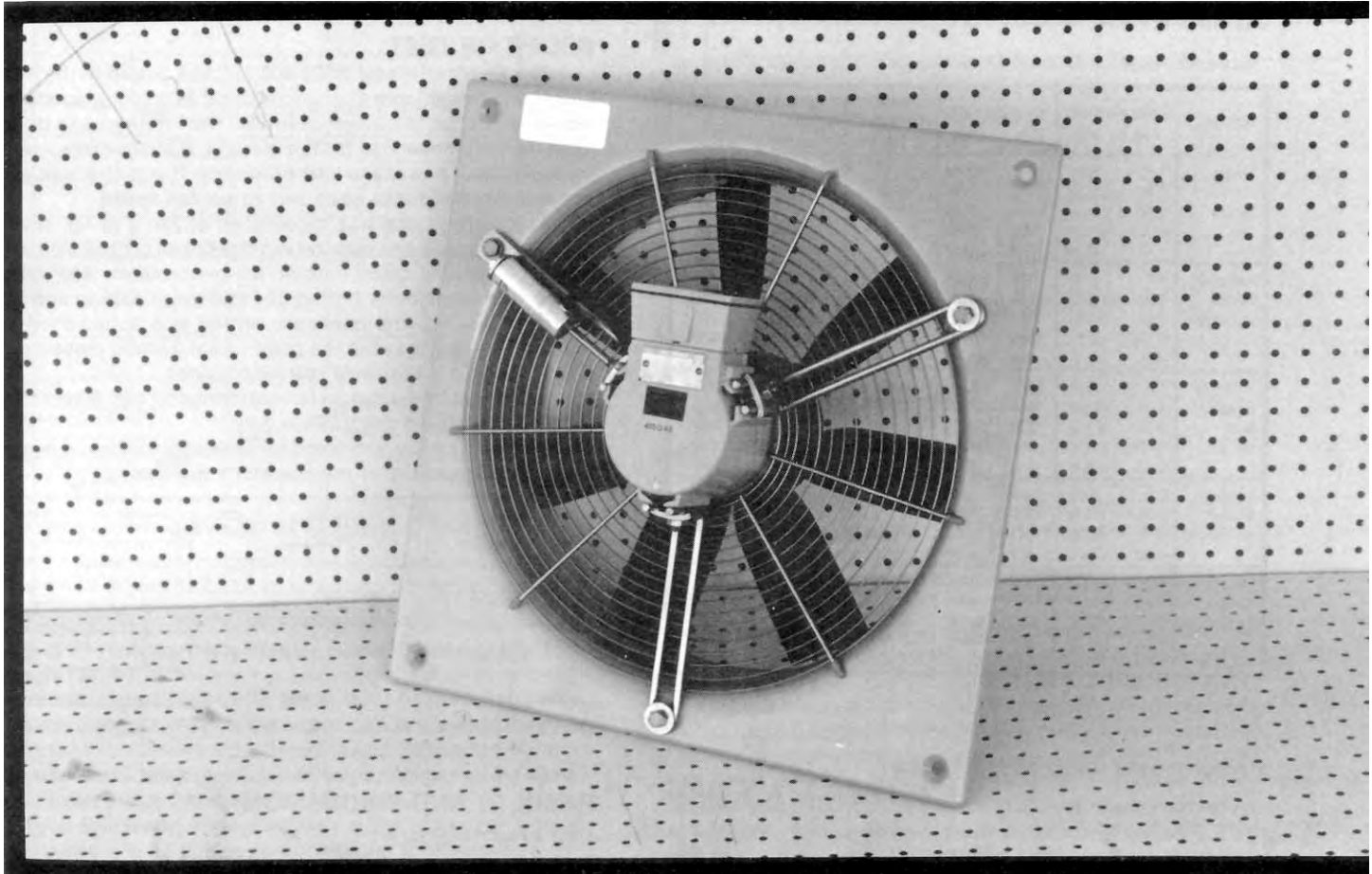


Evaluation Report

467



Siemens Model 2CC2-406 Ventilation Fan

A Co-operative Program Between



SIEMENS MODEL 2CC2-406 VENTILATION FAN

MANUFACTURER:

Siemens Electric Limited
9829, 45 Avenue
Edmonton, Alberta
T6E 5C8

DISTRIBUTOR:

Ziehl Ventilating Equipment
803 - 30 Street North
Lethbridge, Alberta
T1H 5G5

RETAIL PRICE:

\$246.00 (January, 1986, f.o.b. Lethbridge, Alberta.)

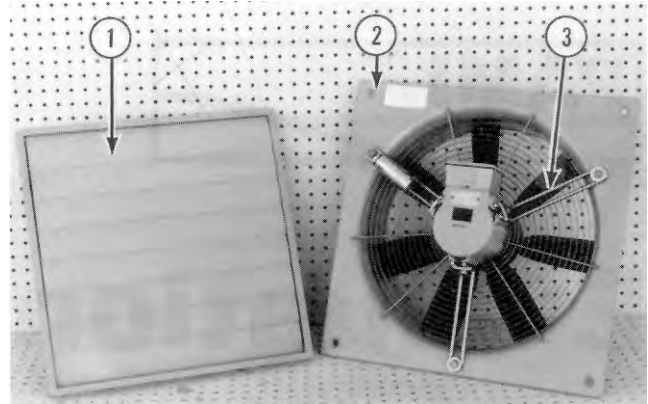


FIGURE 1. Siemens Model 2CC2-406 Ventilation Fan: (1) Optional Louvres, (2) Mounting Face Plate, (3) Inlet Guard Grill.

SUMMARY OF RESULTS

TABLE 1. Siemens Model 2CC2-406 Fan Performance at Typical Levels of Operation.

| SETTING | STATIC PRESSURE | | AIR FLOW RATE | | POWER CONSUMPTION | TOTAL EFFICIENCY | FAN SPEED |
|--------------------------|----------------------------------|--------|---------------|--------|-------------------|------------------|-----------|
| | in wg | (Pa) | cfm | (L/s) | kWh | % | rpm |
| Single Speed Direct | 0.0 | (0.0) | 2120 | (1000) | 0.192 | 20 | 1077 |
| | 0.05 | (12.5) | 2070 | (977) | 0.187 | 26 | 1077 |
| | 0.10 | (24.9) | 1770 | (835) | 0.186 | 24 | 1080 |
| | 0.125 | (31.1) | 1630 | (769) | 0.185 | 22 | 1082 |
| | 0.25 | (62.3) | 250 | (118) | 0.185 | 4 | 1077 |
| Variable Speed Maximum | 0.0 | (0.0) | 2120 | (1000) | 0.184 | 22 | 1075 |
| | 0.05 | (12.5) | 1950 | (920) | 0.183 | 22 | 1075 |
| | 0.10 | (24.9) | 1780 | (840) | 0.186 | 24 | 1075 |
| | 0.125 | (31.1) | 1640 | (774) | 0.183 | 23 | 1078 |
| | 0.25 | (62.3) | 308 | (146) | 0.184 | 5 | 1067 |
| Variable Speed Mid Range | 0.0 | (0.0) | 1800 | (850) | 0.150 | 16 | 901 |
| | 0.05 | (12.5) | 1590 | (750) | 0.149 | 17 | 905 |
| | 0.10 | (24.9) | 1420 | (670) | 0.147 | 20 | 938 |
| | 0.125 | (31.1) | 996 | (472) | 0.145 | 13 | 976 |
| | 0.25 | (62.3) | 662 | (312) | 0.146 | 9 | 984 |
| Variable Speed Minimum | 0.0 | (0.0) | 1590 | (750) | 0.139 | 12 | 810 |
| | 0.05 | (12.5) | 1330 | (628) | 0.137 | 13 | 808 |
| | 0.10 | (24.9) | 941 | (444) | 0.123 | 12 | 935 |
| | 0.125 | (31.1) | 397 | (189) | 0.135 | 5 | 818 |
| | Single Speed Direct with Louvres | 0.0 | (0.0) | 1750 | (826) | 0.186 | 12 |
| 0.05 | | (12.5) | 1470 | (694) | 0.183 | 12 | 1084 |
| 0.10 | | (24.9) | 860 | (406) | 0.174 | 7 | 1096 |
| 0.125 | | (31.1) | 801 | (378) | 0.176 | 8 | 1091 |
| 0.25 | | (62.3) | 470 | (222) | 0.185 | 7 | 1076 |

SCOPE OF TEST

The Siemens Model 2CC2-406 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 230 V in 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 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.

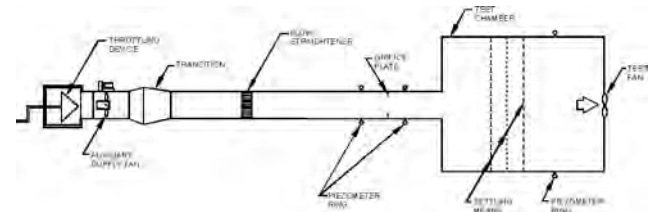


FIGURE 2. Schematic of Fan Test Apparatus -- Inlet Chamber Setup.

Manager/Senior Engineer: E. H. Wiens

Project Engineer: R. P. Atkins

GENERAL DESCRIPTION

The Siemens Model 2CC2-406 ventilation fan is a 15.4 in (391 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 Siemens Model 2CC2-406 is a flush mounted unit equipped with an inlet guard grill, a mounting face plate, optional PVC louvres, and variable speed control. The 7 blade propeller and hub are made of plastic and are mounted directly on a 0.11 hp (80 W), single phase, 240 V electric motor. The motor mount consists of three steel formed double rod brackets bolted to the motor casing and face plate. The steel face plate and cast motor housing are coated with a heavy enamel for corrosion protection.

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

RESULTS AND DISCUSSION

FAN PERFORMANCE

All fan performance results in this report are given at standard air¹ 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 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 pressure². 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 1640 cfm (774 L/s) to 996 cfm (472 L/s) to 397 cfm (189 L/s) respectively.

¹Standard air is air with a density of 0.075 lbm/ft³ (1.2 kg/m³) which occurs at 68°F (20°C), 50% relative humidity and a barometric pressure of 29.92 in Hg (101.325 kPa).

²Static 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 1782 cfm (841 L/s). PAMI's measured flow rate at the same conditions was 1630 cfm (769 L/s) or 8% less than the manufacturer's rating.

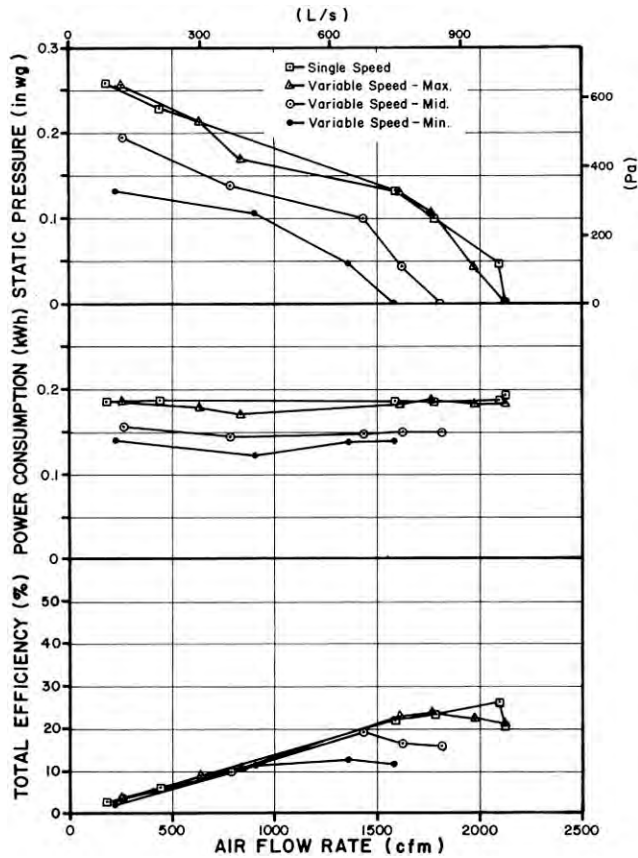


FIGURE 3. Siemens Model 2CC2-406 Fan Performance Curves in the Single Speed Mode and at Three Speed Settings in the Variable Speed Mode.

Power Consumption: Power consumption is the amount of energy (kWh) used by the fan motor. For typical levels of static pressure (TABLE 1), the input power varied from 0.185 to 0.192 kWh in the single speed direct mode, from 0.183 to 0.186 kWh at maximum speed, from 0.145 to 0.150 kWh at mid range and from 0.123 to 0.139 kWh at minimum speed. The maximum amperage drawn by the motor was 0.95 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 5 to 24% at maximum speed, 9 to 20% at mid range and 5 to 13% 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 22%.

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 18 to 51% (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 51%, from 1630 cfm (769 L/s) to 801 cfm (378 L/s) (TABLE 1). The efficiency was in turn reduced from 22 to 8%. 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.

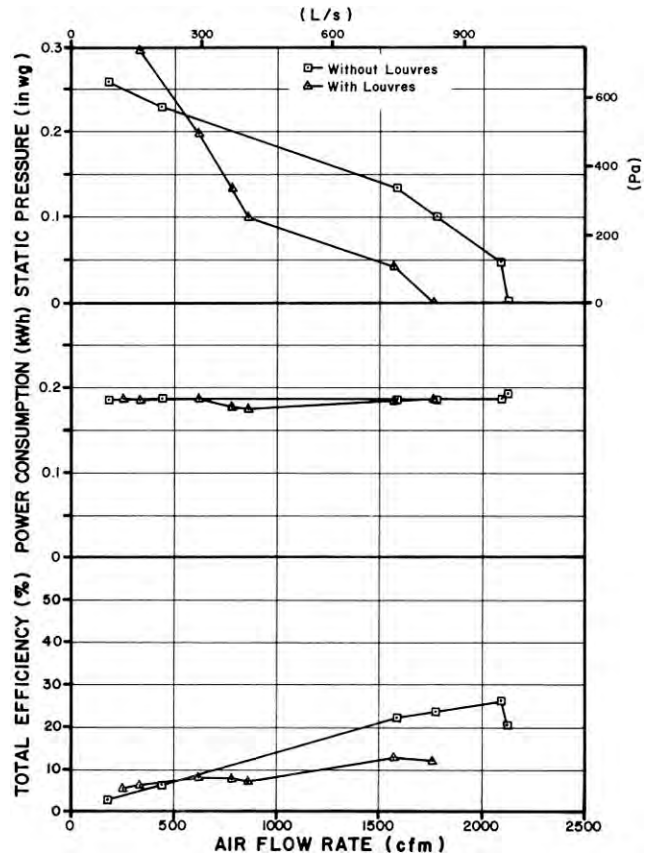


FIGURE 4. Effect of Louvres on Fan Performance.

EASE OF OPERATION

Maintenance: The inlet guard grill, 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 2CC2-406 was CSA approved.

The noise level of the Model 2CC2-406, 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 73 dB(A). Higher noise levels could be expected if the fan was operated in the vicinity of other buildings. The Model 2CC2-406 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 operating instructions contained information on general operation, installation, maintenance, and safety. Fan performance data was given in a separate brochure.

**APPENDIX I
SPECIFICATIONS**

MAKE: Siemens
MODEL: 2CC2-406
MANUFACTURER: Siemens Electric Limited
 9829, 45 Avenue
 Edmonton, Alberta
 T6E 5C8

OVERALL DIMENSIONS:
 - housing width 19.75 in (501 mm)
 - housing height 19.75 in (501 mm)
 - housing depth (motor included) 7 in (178 mm)
 - housing diameter 15.60 in (397 mm)
 - guard grill diameter 16 in (406 mm)
 - grill opening 0.062 in (2 mm) diameter wire spaced at 0.375 in (10 mm) in a circular pattern

IMPELLERS:
 - diameter 15.40 in (391 mm)
 - hub diameter 4.88 in (124 mm)
 - number of blades 7
 - blade angle variable - 27° at the tip, 67° at the hub

WEIGHT: 42 lb (19 kg)

MOTOR NAMEPLATE DATA:
 - make Siemens
 - model 2CC2-406
 - rpm 1070
 - volts 240 V
 - amps 0.95 A
 - phase 1
 - cycles 60 Hz
 - horsepower 0.11 hp (80 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
SIEMENS MODEL 2CC2.406
VENTILATION FAN**

RETAIL PRICE: \$246.00
 (January, 1986, f.o.b. Lethbridge)

FAN DESCRIPTION: 15.4 in (391 mm) propeller fan, variable speed, direct drive, 0.11 hp (80 W) 240 V electric motor.

FAN SPEED:
 - single speed direct 1077 to 1082 rpm
 - variable speed 808 to 1078 rpm

EFFICIENCY RANGE:
 - without louvres 5 to 26%
 - with louvres 7 to 12%

EFFICIENCY AT 0.125 in wg (31.1 Pa):
 - without louvres 22%
 - with louvres 8%

AIR FLOW RATE:
 - range 250 to 2120 cfm (118 to 1000 L/s)
 - at 0.125 in wg (31.1 Pa) 1630 cfm (769 L/s) single speed without louvres and 801 cfm (378 L/s) with louvres

POWER CONSUMPTION: 0.123 to 0.192 kWh

OPERATOR SAFETY: inlet guard provided
 CSA approved
 noise level = 73 dB(A) at 4.9 ft (1.5 m) from fan discharge

OPERATOR'S MANUAL: adequate



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