

Evaluation Report

396



Sukup Model 5-221 Centrifugal Fan

A Co-operative Program Between



SUKUP MODEL 5-221 CENTRIFUGAL FAN

MANUFACTURER:

Sukup Manufacturing Company
Sheffield, Iowa
50475

DISTRIBUTOR:

United Farmers of Alberta Co-operative Limited 1016 - 68 Avenue
S.W. Calgary, Alberta T2V 4J2

RETAIL PRICE:

\$1741.00 (November, 1984, f.o.b. Lethbridge, Alberta, complete with optional control assembly).

SUMMARY OF RESULTS

TABLE 1. Sukup Model 5-221 Performance at Typical Levels of Operation

| Static Pressure | | Air Flow Rate | | Input Power | | Total Efficiency | Fan Speed |
|-----------------|--------|---------------|--------|-------------|--------|------------------|-----------|
| in wg | (Pa) | cfm | (L/s) | hp | (W) | % | rpm |
| 0 | (0) | 8060 | (3800) | 6.09 | (4540) | 26 | 1763 |
| 0.5 | (125) | 7580 | (3580) | 6.23 | (4650) | 32 | 1761 |
| 1.0 | (249) | 7250 | (3420) | 6.38 | (4760) | 36 | 1758 |
| 1.5 | (374) | 6850 | (3230) | 6.67 | (4980) | 41 | 1754 |
| 2.0 | (497) | 6490 | (3060) | 6.96 | (5190) | 44 | 1751 |
| 2.5 | (623) | 6180 | (2820) | 7.18 | (5360) | 46 | 1749 |
| 3.0 | (747) | 5880 | (2770) | 7.34 | (5470) | 47 | 1747 |
| 3.5 | (872) | 5490 | (2590) | 7.45 | (5560) | 48 | 1746 |
| 4.0 | (996) | 4940 | (2280) | 7.38 | (5500) | 48 | 1746 |
| 4.5 | (1120) | 4400 | (2080) | 7.17 | (5350) | 46 | 1748 |
| 5.0 | (1240) | 1560 | (736) | 4.88 | (3640) | 23 | 1768 |
| 5.5 | (1370) | 600 | (283) | 4.10 | (3060) | 11 | 1774 |

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying a table or curve of air flow rates over a complete range of static pressures,

Senior Engineer: E. H. Wiens

Project Engineer: R. P. Atkins

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Air flow information is available and will be supplied with each fan in the future.

GENERAL DESCRIPTION

The Sukup model 5-221 centrifugal fan is a 22.8 in (578 mm) diameter, single speed, direct drive, centrifugal flow fan. It is primarily used for grain aeration or grain drying systems.

The Sukup model 5-221 is equipped with a wire mesh guard grill, an inlet bell, duct mounting flange and levelling lugs. A control assembly consisting of a magnetic motor starter, motor overload protection and a start-stop switch is available as an option, but was not supplied with the fan. The impeller consists of a steel and cast iron hub-backplate, 9 sheet metal, backward inclined airfoil blades and a steel flange. The impeller is directly mounted on the 5 hp (3730 W), single phase, 230 V electric motor. The fan housing is of steel construction with an enamel coating for corrosion protection.

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

SCOPE OF TEST

The Sukup model 5-221 was tested in the outlet chamber set up (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.

Fan performance was determined at 230V. The fan was also evaluated for ease of operation, maintenance, operator safety and suitability of the operator's manual.

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.

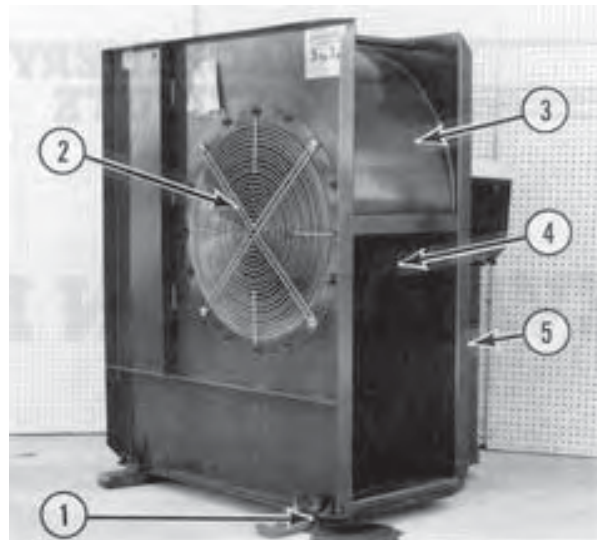


FIGURE 1. Sukup Model 5-221 Centrifugal Fan: (1) Levelling Lugs, (2) Guard Grill, (3) Fan Housing (4) Impeller, (5) Mounting Flange.

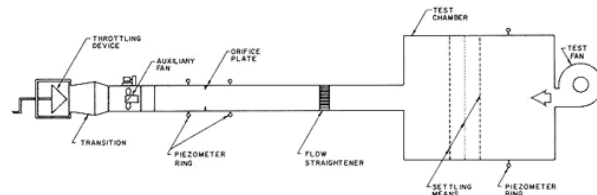


FIGURE 2. Schematic of Fan Test Apparatus - Outlet Chamber Setup.

Air Flow Rate: Fan output at typical levels of operation (i.e. static pressure²) are given in TABLE 1. The air flow rate ranged from 600 cfm (283 L/s) at 5.3 in wg (1320 Pa) to 8060 cfm (3800 L/s) at 1.0 in wg (249 Pa). FIGURE 3 illustrates the fan performance curves for the Sukup model 5-221 fan. The performance (i.e. air flow rate) dropped off sharply at static pressures above 5 in wg (1240 Pa). There was no manufacturer's performance information provided. It is recommended that for fan selection purposes, the manufacturer provide a table or curve of air flow rates over a complete range of static pressures.

Power Requirements: The power required to run the fan depended upon the point of operation of the fan. The input power required varied from 4.10 hp (3060 W) at a static pressure of 5.3 in wg (1320 Pa) and an air flow rate of 600 cfm (283 L/s) to 7.45 hp (5560 W) at 4.5 in wg (1120 Pa) static pressure and an air flow rate of 5490 cfm (2590 L/s). The maximum amperage drawn by the motor was 25 amps, which was slightly less than the rated motor amperage of 23 amps with a service factor of 1.15. Prolonged operation in excess of rated amperage could reduce motor life.

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) ranged from 11 to 48%. The maximum total efficiency of 48% occurred at 5290 cfm (2500 L/s) at a static pressure of 4.7 in wg (1160 Pa).

EASE OF OPERATION

Maintenance: Seasonal inspection of the control assembly, fan blades, housing and mounts was required. Covering of the fan inlet during the off season was recommended to keep out weather and pests and to prevent windmilling of the motor. Every six weeks during the off season the motor required a 10-minute run to redistribute grease in the motor bearings and to expel condensation from the motor housing. The removable guard grill and inlet bell

¹Standard air is air with a density of 0.075 lb/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).

allowed easy access for maintenance.

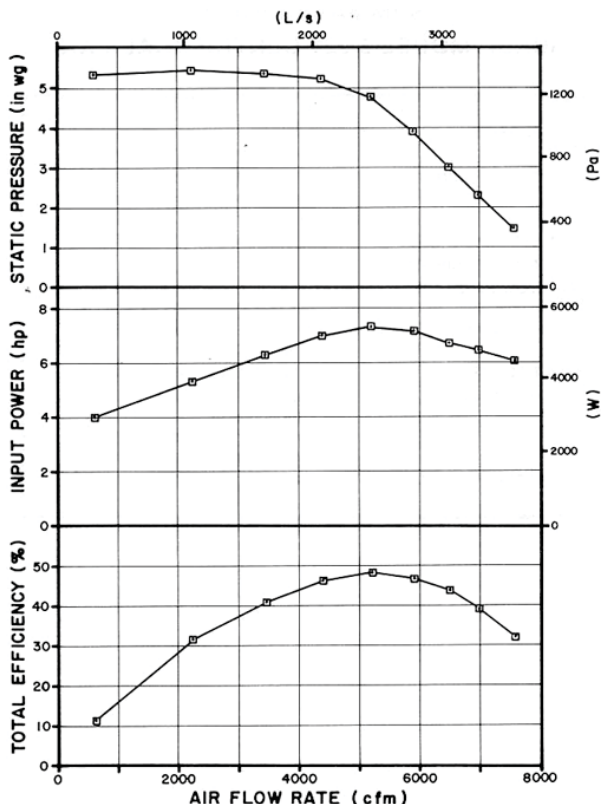


FIGURE 3. Sukup Model 5-221 Fan Performance Curves.

OPERATOR SAFETY

The guard grill provided adequate protection from the fan blades. The motor was a totally enclosed unit and presented no safety hazards. The Sukup model 5-221 was CSA approved.

The noise level³ of the Sukup model 5-221, at a distance of 4.9 ft (1.5 m) from the centre of the fan inlet, while operating at a 1 in wg (249 Pa) static pressure, was 83 dB(A). Higher noise levels could be expected if the fan was operated in the vicinity of other buildings. The Sukup model 5-221 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 blower for prolonged periods.

OPERATOR'S MANUAL

The operating instructions contained information on preparation, installation, wiring, safety, maintenance, service and trouble shooting.

³PAMI Test Procedure for Determining Fan Noise Level.

APPENDIX I SPECIFICATIONS

| | |
|------------------------------|---|
| MAKE: | Sukup |
| MODEL: | 5-221 |
| SERIAL NUMBER: | 04045 |
| MANUFACTURER: | Sukup Manufacturing Company Sheffield, Iowa 50475 |
| OVERALL DIMENSIONS: | |
| -- housing width | 36 in (914 mm) |
| -- housing depth | 42 in (1070 mm) |
| -- housing height | 51.7 to 53.4 in (1310 to 1360 mm) |
| -- inlet bell diameter | 14 in (356 mm) |
| -- guard grill diameter | 23 in (584 mm) |
| -- grill opening | 0.125 in (3 mm) diameter, spaced at 0.5 in (13 mm) in a circular pattern |
| -- discharge opening | 15.7 x 27.2 in (398 x 692 mm) |
| IMPELLERS: | |
| -- diameter | 22.8 in (578 mm) |
| -- inside flange diameter | 16 in (406 mm) |
| -- number of blades | 9 |
| -- blade angle | 45° |
| WEIGHT: | 515 lb (234 kg) |
| MOTOR NAMEPLATE DATA: | |
| -- make | Leeson |
| -- model | C184K17DB1B |
| -- frame | J184T |
| -- class | B* |
| -- code | H |
| -- design | L |
| -- duty | continuous |
| -- rpm | 1740 |
| -- service factor | 1.15 |
| -- ambient temperature rise | 40°C |
| -- volts | 230 V |
| -- amps | 23 A |
| -- phase | 1 |
| -- cycles | 60 Hz |
| -- horsepower | 5 hp (3730 W) |

APPENDIX II NOISE LEVEL RANGES

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

SUMMARY CHART SUKUP MODEL 5-221 CENTRIFUGAL FAN

| | |
|----------------------------|---|
| RETAIL PRICE: | \$1741.00 (November, 1984, f.o.b. Lethbridge) |
| FAN DESCRIPTION: | 22.8 in (578 mm) single speed, direct drive, 5 hp (3730 W) electric motor. |
| FAN SPEED: | 1746 to 1774 rpm |
| MAXIMUM EFFICIENCY: | 48% |
| AIR FLOW RATE: | |
| -range | 600 to 8060 cfm (283 to 3800 L/s) |
| -at maximum efficiency | 5290 cfm (2500 L/s) at a 4.7 in wg (1160 Pa) static pressure |
| INPUT POWER: | 4.10 to 7.45 hp (3060 to 5560 W) |
| OPERATOR SAFETY: | Guard grill provided CSA approved Noise level = 83 dB(A) at 4.9 ft (1.5 m) from fan inlet |
| OPERATOR'S MANUAL: | adequate |



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