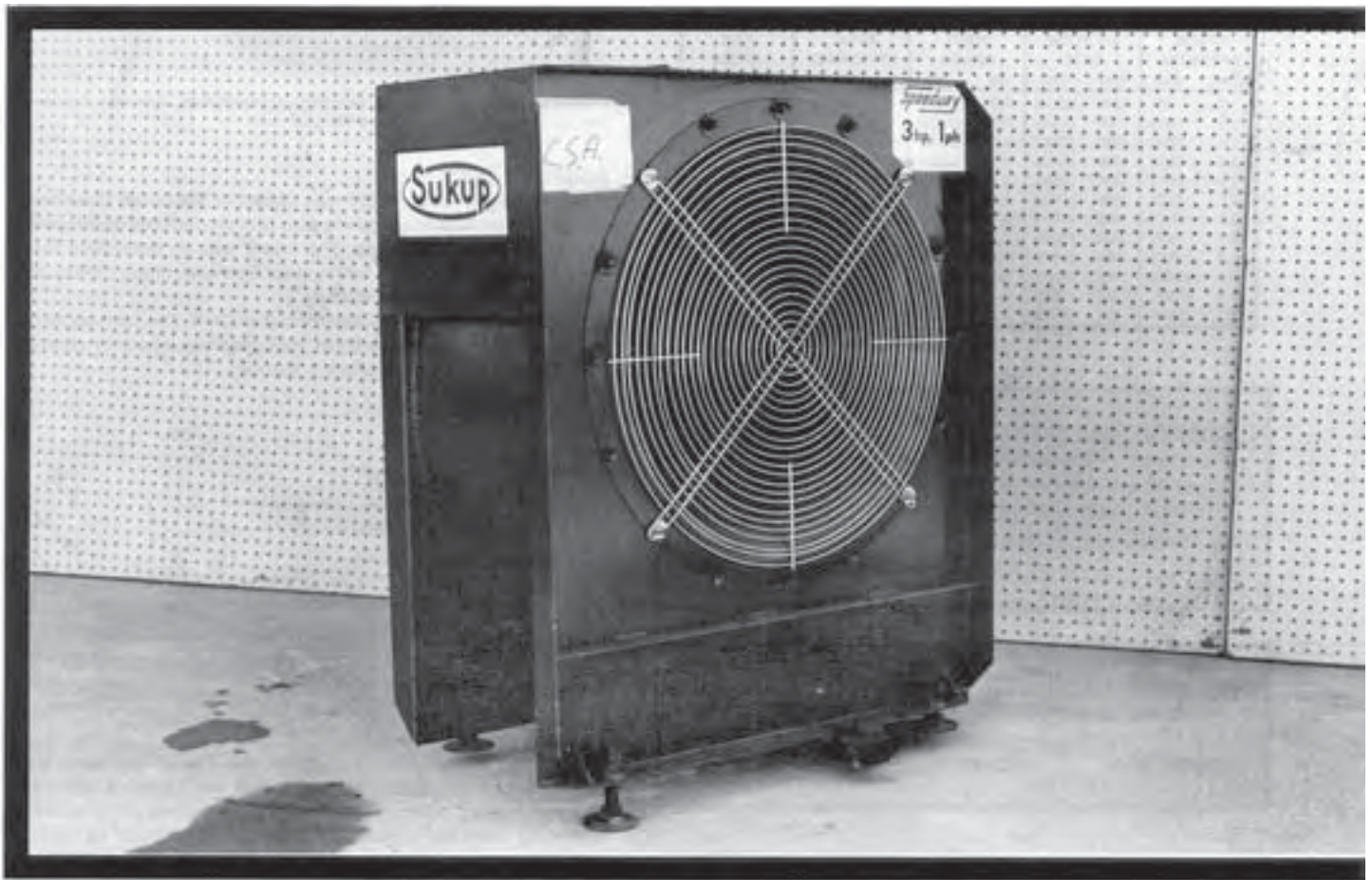


Evaluation Report

395



Sukup Model 3-221 Centrifugal Fan

A Co-operative Program Between



SUKUP MODEL 3-221 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:
\$1384.00 (November, 1984, f.o.b. Lethbridge, Alberta complete with optional control assembly).

SUMMARY OF RESULTS

TABLE 1. Sukup Model 3-221 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)	5310	(2510)	3.81	(2840)	12	1770
0.5	(125)	5130	(2420)	3.92	(2920)	20	1755
1.0	(249)	4920	(2320)	4.02	(3000)	27	1747
1.5	(374)	4680	(2210)	4.13	(3080)	33	1746
2.0	(497)	4430	(2090)	4.21	(3140)	37	1744
2.5	(623)	4160	(1960)	4.26	(3180)	39	1743
3.0	(747)	3870	(1830)	4.29	(3200)	41	1743
3.5	(872)	3460	(1630)	4.28	(3190)	43	1744
4.0	(996)	3090	(1460)	4.24	(3160)	43	1744
4.5	(1120)	2500	(1180)	4.06	(3030)	41	1746
5.0	(1240)	1350	(637)	3.38	(2520)	28	1756
5.5	(1370)	624	(295)	2.95	(2200)	15	1766

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 3-221 centrifugal fan is a 23 in (584 mm) diameter, single speed, direct drive, centrifugal flow fan. It is primarily used for grain aeration or grain drying systems.

The Sukup model 3-221 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 3 hp (2240 W), single phase, 115/208-230 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 3-221 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 230 V. The fan was also evaluated for ease of operation, maintenance, operator safety and suitability of the operator's manual.

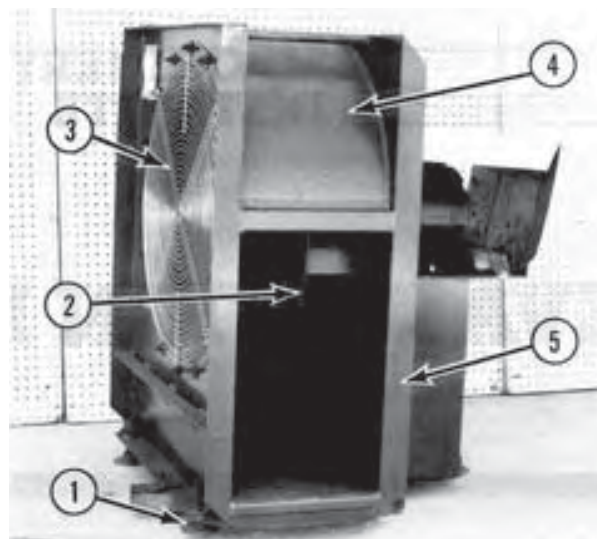


FIGURE 1. Sukup Model 3-221 Centrifugal Fan: (1) Levelling Lugs, (2) Impeller, (3) Guard Grill, (4) Fan Housing, (5) Mounting Flange.

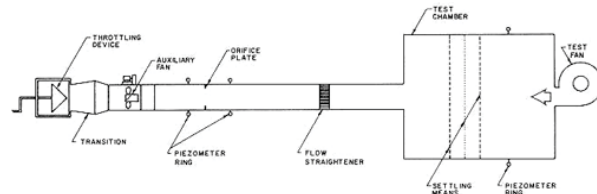


FIGURE 2. Schematic of Fan Test Apparatus - Outlet Chamber Setup.

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 at typical levels of operation (i.e. static pressure²) are given in TABLE 1. The air flow rate ranged from 624 cfm (295 L/s) at 5.5 in wg (1370 Pa) to 5310 cfm (2510 L/s) at 0 in wg (0 Pa). FIGURE 3 illustrates the fan performance curves for the Sukup model 3-221 fan. 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 2.95 hp (2200 W) at maximum static pressure and minimum air flow rate to 4.29 hp (3200 W) at 3 in wg (747 Pa) static pressure and an air flow rate of 3870 cfm (1830 L/s). The maximum amperage drawn by the motor was 15.3 amps, which was well below the rated motor amperage of 18.9 amps.

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 12 to 43%. The maximum total efficiency of 43% occurred at 3160 cfm (1490 L/s) at a static pressure of 3.9 in wg (980 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 wind milling of the motor. Every six weeks during the off season the motor required a 10-minute run to

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).

redistribute grease in the motor bearings and to expel condensation from the motor housing. The removable guard grill and inlet bell allowed easy access for maintenance.

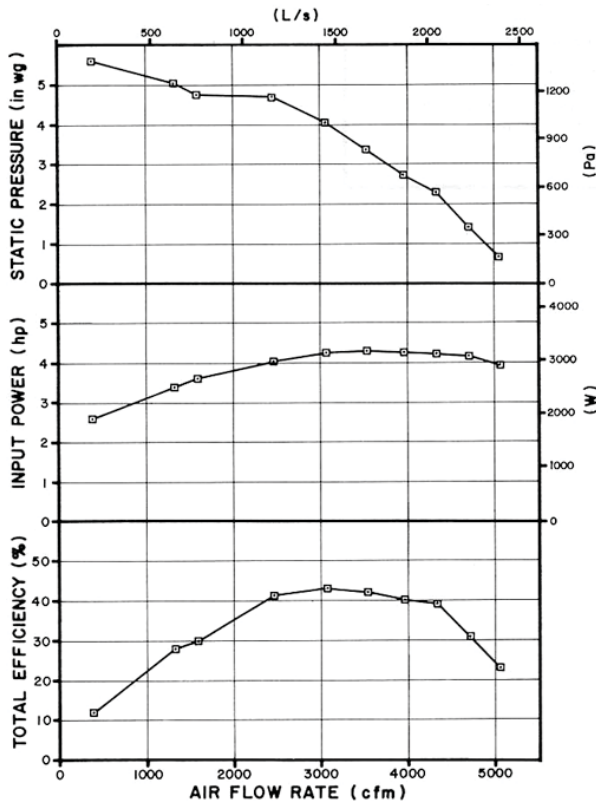


FIGURE 3. Sukup Model 3-221 Fan Performance Curves.

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 3-221 was CSA approved.

The noise level³ of the Sukup model 3-221, 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 79 dB(A). Higher noise levels could be expected if the fan was operated in the vicinity of other buildings. The Sukup model 3-221 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: 3-221
SERIAL NUMBER: 03682
MANUFACTURER: Sukup Manufacturing Company
 Sheffield, Iowa 50475

OVERALL DIMENSIONS:
 -- housing width 31.2 in (794 mm)
 -- housing depth 31.8 in (806 mm)
 -- housing height 37.4 to 39.1 in (949 to 994 mm)
 -- inlet bell diameter 14 in (356 mm)
 -- guard grill diameter 24.1 in (613 mm)
 -- grill opening 0.125 in (3 mm) diameter, spaced at 0.5 in (13 mm) in a circular pattern-discharge opening 11.5 x 19.9 in (292 x 505 mm)

IMPELLERS:
 -- diameter 23 in (584 mm)
 -- inside flange diameter 16 in (406 mm)
 -- number of blades 9
 -- blade angle 45°

WEIGHT: 342 lb (155 kg)

MOTOR NAMEPLATE DATA:
 -- make Leeson
 -- model N184C17DB1B
 -- frame G184T
 -- class B*
 -- code J
 -- design L
 -- duty continuous
 -- rpm 1740
 -- service factor 1.15
 -- ambient temperature rise 40°C
 -- volts 115/208-230 V
 -- amps 37.8/18.9 A
 -- phase 1
 -- cycles 60 Hz
 -- horsepower 3 hp (2240 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 3-221 CENTRIFUGAL FAN

RETAIL PRICE: \$1384.00 (November, 1984, f.o.b. Lethbridge)
FAN DESCRIPTION: 23 in (584 mm) single speed, direct drive, 3 hp (2240 W) electric motor.
FAN SPEED: 1743 to 1770 rpm
MAXIMUM EFFICIENCY: 43%
AIR FLOW RATE:
 -range 624 to 5310 cfm (295 to 2510 L/s)
 -at maximum efficiency 3160 cfm (1490 L/s) at a 3.9 in wg (980 Pa) static pressure
INPUT POWER: 2.95 to 4.29 hp (2200 to 3200 W)
OPERATOR SAFETY: Guard grill provided CSA approved Noise level = 79 dB(A) at 4.9 ft (1.5 m) from fan inlet
OPERATOR'S MANUAL: adequate



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