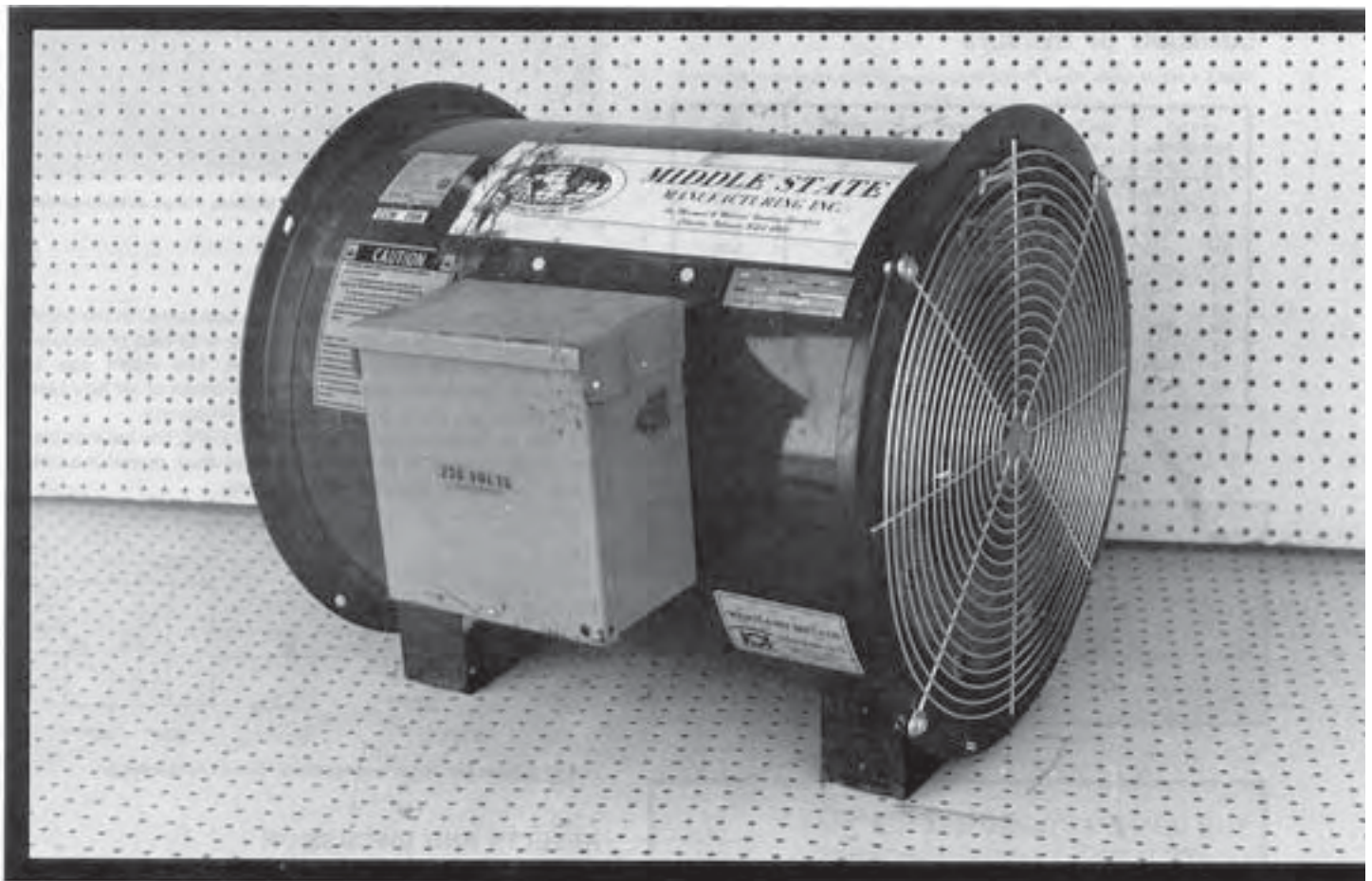


# Evaluation Report

# 374



## Middle State Model IC-18-3 3 hp In-Line Centrifugal Fan

A Co-operative Program Between



# MIDDLE STATE MODEL IC-18-3 3 HP IN-LINE CENTRIFUGAL FAN

## MANUFACTURER:

Middle State Manufacturing Inc.  
 Box 788  
 Columbus, Nebraska  
 68601

## DISTRIBUTOR:

Westland Metals  
 Box 3041  
 Saskatoon, Sask.  
 S7K 3S9

## RETAIL PRICE:

\$1100.00 (September, 1984, f.o.b. Lethbridge, Alberta complete with motor control).

## SUMMARY OF RESULTS

TABLE 1. Middle State Model IC-18-3 Performance at Typical Levels of Operation

Static Pressure		Airflow Rate		Input Power		Total Efficiency	Fan Speed
in wg	Pa	cfm	L/s	hp	W	%	rpm
0.5	125	2890	1360	2.98	2220	7	3500
1.0	249	2710	1280	3.18	2370	15	3489
1.5	374	2620	1240	3.26	2430	18	3484
2.0	497	2520	1190	3.35	2500	21	3480
2.5	623	2380	1120	3.45	2570	25	3475
3.0	747	2120	1000	3.56	2660	29	3469
3.5	872	2070	975	3.57	2660	29	3468
4.0	996	1920	906	3.57	2660	30	3467
4.5	1120	1700	803	3.50	2610	30	3469
5.0	1240	1230	581	3.05	2280	28	3489
5.5	1370	178	84	1.75	1310	8	3545

## RECOMMENDATIONS

It is recommended that the manufacturer consider:

- Updating the operator's manual to include the model IC-18-3.

Senior Engineer: E. H. Wiens

Project Engineer: R. P. Atkins

## THE MANUFACTURER STATES THAT

With regard to recommendation number:

- An operator's manual is now available for in-line centrifugal fans.

## GENERAL DESCRIPTION

The Middle State model IC-18-3 fan is a 12.5 in (318 mm) diameter, single speed, direct drive, in-line centrifugal flow fan. It is primarily used for grain aeration or grain drying systems.

The Middle State model IC-18-3 is equipped with a chromed guard grill, an inlet bell, a duct mounting flange, straightening vanes, and an optional motor control. The welded steel impeller consists of a hub-backplate, 9 backward inclined blades and a flange. The impeller is directly mounted on the 3 hp (2240 W), single phase, 115/208/230 V electric motor. The fan housing, motor mounts, straightening vanes, inlet bell, flanges and mounting legs are 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 Middle State model IC-18-3 fan was tested in the outlet 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.

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 air<sup>1</sup> 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.

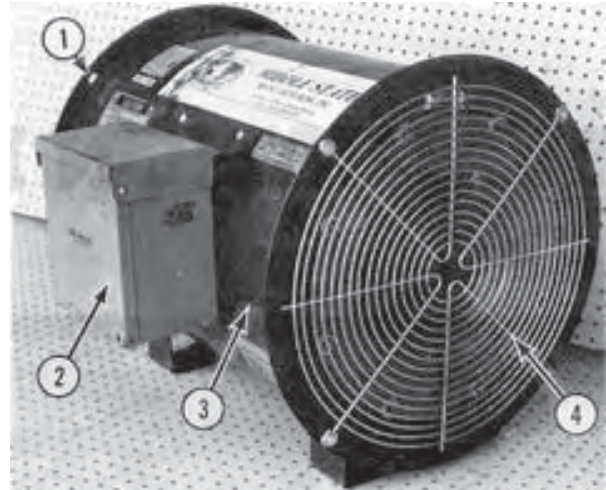


FIGURE 1. Middle State Model IC-18-3 Fan: (1) Mounting Flange, (2) Motor Control, (3) Fan Housing, (4) Guard Grill.

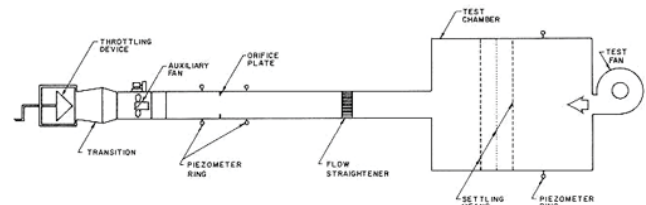


FIGURE 2. Schematic of Fan Test Apparatus - Outlet Chamber Setup.

**Air Flow Rate:** Fan output at typical levels of operation (i.e. static pressure<sup>2</sup>) are given in TABLE 1. The air flow rate ranged from 178 cfm (84 L/s) at 5.5 in wg (1370 Pa) to 3000 cfm (1420 L/s) at 0 in wg (0 Pa). FIGURE 3 illustrates the fan performance curves for the Middle State model IC-18-3 fan and a comparison to the manufacturer's rated performance. The manufacturer's literature provided fan performance information over a range of static pressures from 2 to 5 in wg (497 to 1240 Pa) in increments of 1 in wg (249 Pa). The difference in output between the manufacturer's and PAMI's results varied depending upon the level of operation. At static pressures greater than 4 in wg (996 Pa) the air flow rates were similar. Below 4 in wg (996 Pa) the PAMI results were lower than the manufacturer's. For example, at a static pressure of 3 in wg (747 Pa), PAMI's measured flow rate of 2120 cfm (1000 L/s) was 19% lower than the manufacturer's rated output of 2610 cfm (1232 L/s).

**Power Requirements:** The power required to run the fan depended upon the point of operation of the fan. The minimum input power of 1.75 hp (1310 W) occurred at maximum static pressure and minimum air flow rate. The peak power input of 3.57 hp (2660 W) occurred at 4 in wg (996 Pa) static pressure and an air flow rate of 1920 cfm (906 L/s). The maximum amperage drawn by the motor was 12.1 amps, which was well below the rated motor amperage of 14 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 7 to 30%. The maximum total efficiency of 30% occurred at 1720 cfm (812 L/s) at a static pressure of 4.4 in wg (1100 Pa).

## EASE OF OPERATION

**Maintenance:** Motor bearings required lubrication seasonally or twice a year under continuous use. During the off season the

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

<sup>2</sup>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).

fan should be operated for 30 minutes every 3 weeks to ensure even distribution of lubricant within the bearing cavity and to prevent condensation in the motor.

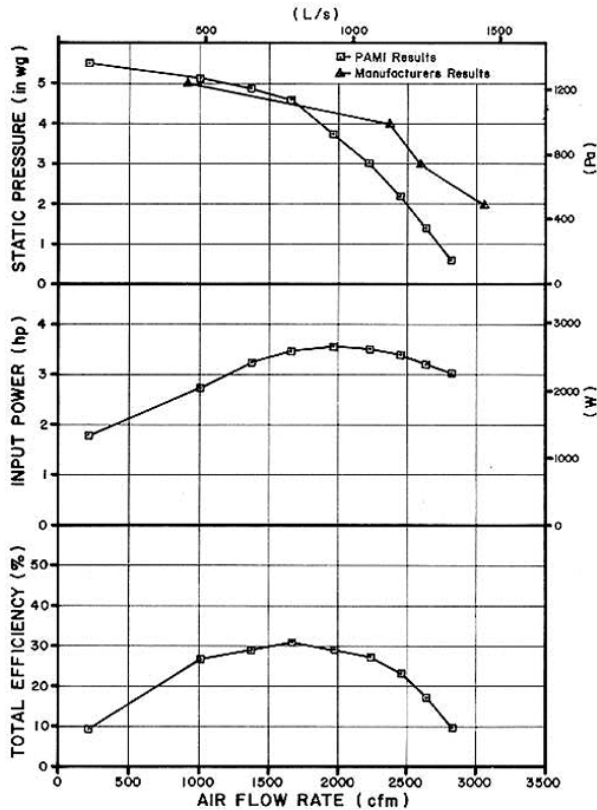


FIGURE 3. Middle State Model IC-18-3 Fan Performance Curves.

### 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 Middle State model IC-18-3 was CSA approved.

The noise level<sup>3</sup> of the Middle State model IC-18-3, 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 Middle State model IC-18-3 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 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 contained information on operation, installation, maintenance and safety for axial fans. The model IC-18-3 in-line centrifugal fan was not specifically included in the manual. It is recommended that the manufacturer consider updating the operator's manual to include the model IC-18-3 in-line centrifugal fan.

<sup>3</sup>PAMI Test Procedure for Determining Fan Noise Level.

### APPENDIX I SPECIFICATIONS

**MAKE:** Middle State  
**MODEL:** IC-18-3  
**SERIAL NUMBER:** 167000619043001  
**MANUFACTURER:** Middle State Manufacturing Inc.  
 Box 788  
 Columbus, Nebraska 68601

#### OVERALL DIMENSIONS:

- housing width 25 in (636 mm)
- housing height 21.4 in (543 mm)
- housing length 23.5 in (597 mm)
- inside tube diameter 18.2 in (464 mm)
- inlet bell diameter 7.5 in (190 mm)
- guard grill diameter 18 in (457 mm)
- grill opening 0.125 in (3mm) diameter, spaced at 0.5 in (13 mm) in a circular pattern.

#### PROPELLER:

- diameter 12.5 in (318 mm)
- inside flange diameter 8.7 in (220 mm)
- number of blades 9
- blade angle 42 degrees

#### WEIGHT:

144 lb (65 kg)

#### MOTOR NAMEPLATE DATA:

- make Baldor
- model L 1406T
- frame 182T
- class 13
- code G
- duty continuous
- rpm 3450
- service factor 1.15
- ambient temperature rise 40° C
- volts 115/208/230V
- amps 28/14.7/14A
- 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

**MIDDLE STATE MODEL IC-18-3 3 HP IN-LINE CENTRIFUGAL FAN**  
**RETAIL PRICE:** \$1100.00 (September, 1984, f.o.b. Lethbridge)  
**FAN DESCRIPTION:** 12.5 in (318 mm) single speed, direct drive, 3 hp (2240 W) electric motor  
**FAN SPEED:** 3467 to 3545 rpm  
**MAXIMUM EFFICIENCY:** 30%  
**AIR FLOW RATE:**  
 - range 178 to 2880 cfm (82 to 1360 L/s)  
 - at maximum efficiency 1720 cfm (812 L/s) at a 4.4 in wg (1100 Pa) static pressure  
**INPUT POWER:** 1.75 to 3.57 hp (1310 to 2660 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:** complete for axial fans but requires updating to include in-line centrifugal fans



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