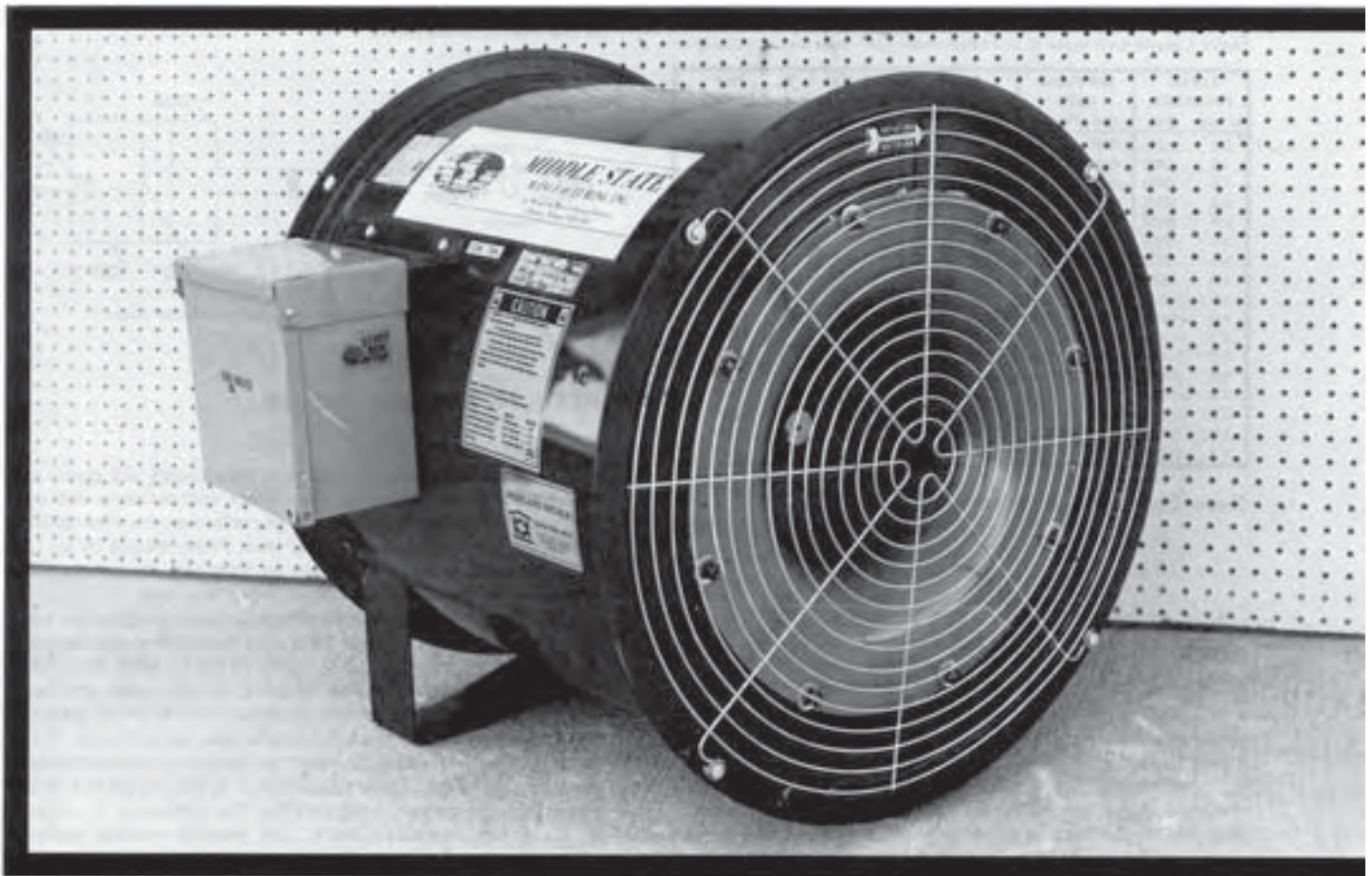


# Evaluation Report

# 394



## Middle State Model IC-24-7.5 7.5 hp In-Line Centrifugal Fan

A Co-operative Program Between



# MIDDLE STATE MODEL IC-24-7.5 7.5 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:

\$1550.00 (November, 1984, f.o.b. Lethbridge, Alberta, complete with motor control).

## SUMMARY OF RESULTS

TABLE 1. Middle State Model IC-24-7.5 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
0.5	(125)	4940	(2330)	8.30	(6190)	4	3529
1.0	(249)	4620	(2180)	8.85	(6600)	12	3521
1.5	(374)	4500	(2120)	9.06	(6760)	14	3518
2.0	(497)	4450	(2100)	9.15	(6820)	15	3517
2.5	(623)	4400	(2080)	9.24	(6890)	16	3515
3.0	(747)	4300	(2030)	9.40	(7010)	18	3513
3.5	(872)	4150	(1960)	9.61	(7170)	20	3510
4.0	(996)	3970	(1870)	9.84	(7340)	23	3506
4.5	(1120)	3770	(1780)	10.0	(7460)	25	3503
5.0	(1240)	3600	(1700)	10.1	(7540)	27	3500
5.5	(1370)	3460	(1630)	10.1	(7570)	28	3499
6.0	(1490)	3350	(1580)	10.2	(7570)	28	3499
6.5	(1620)	3260	(1540)	10.1	(7570)	29	3498
7.0	(1740)	3100	(1460)	10.1	(7530)	29	3497
7.5	(1870)	2760	(1300)	9.88	(7370)	29	3498
8.0	(1990)	2180	(1030)	9.18	(6840)	27	3504
8.5	(2120)	194	(92)	5.24	(3900)	4	3555

Senior Engineer: E. H. Wiens  
Project Engineer: R. P. Atkins

## GENERAL DESCRIPTION

The Middle State model IC-24-7.5 in-line centrifugal fan is a 15.25 in (387 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-24-7.5 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 7.5 hp (5590 W), three phase, 208-230/460 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.



FIGURE 1. Middle State Model IC-24-7.5 Fan: (1) Mounting Flange, (2) Motor Control, (3) Fan Housing, (4) Guard Grill.  
Page 2

## SCOPE OF TEST

The Middle State model IC-24-7.5 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.

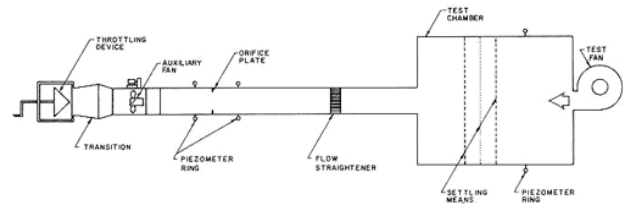


FIGURE 2. Schematic of Fan Test Apparatus - Outlet Chamber Setup.

## RESULTS AND DISCUSSION

### FAN PERFORMANCE

All fan performance results in this report are given at standard 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.

**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 194 cfm (92 L/s) at 8.5 in wg (2120 Pa) to 4940 cfm (2330 L/s) at 0.5 in wg (125 Pa). FIGURE 3 illustrates the fan performance curves for the Middle State model IC-24-7.5 fan and a comparison to the manufacturer's rate performance. The manufacturer's literature provided fan performance information over a range of static pressures from 3 to 8 in wg (747 to 1990 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 7 in wg (1740 Pa) the air flow rates were similar. Below 7 in wg (1740 Pa) the PAMI results were lower than the manufacturer's results. For example, at 4 in wg (996 Pa) PAMI's measured air flow rate was 3970 cfm (1870 L/s). This was 10% lower than the manufacturer's rated output of 4430 cfm (2090 L/s) at the same static pressure.

**Power Requirements:** The power required to run the fan depended upon the point of operation of the fan. The minimum input power of 5.24 hp (3900 W) occurred at maximum static pressure and minimum air flow rate. The peak power input of 10.2 hp (7570 W) occurred at 6 in wg (1490 Pa) static pressure and an air flow rate of 3350 cfm (1580 L/s). The maximum amperage drawn by the motor was 15.3 amps which was well below the rated motor amperage of 18.8 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 4 to 29%. The maximum total efficiency of 29% occurred at 2910 cfm (1370 L/s) at a static pressure of 7.1 in wg (1770 Pa).

### EASE OF OPERATION

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

### OPERATOR SAFETY

The guard grills provided adequate protection from the fan blades. The motor was a totally enclosed unit and presented no safety hazards. The Middle State model IC-24-7.5 was CSA

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

approved.

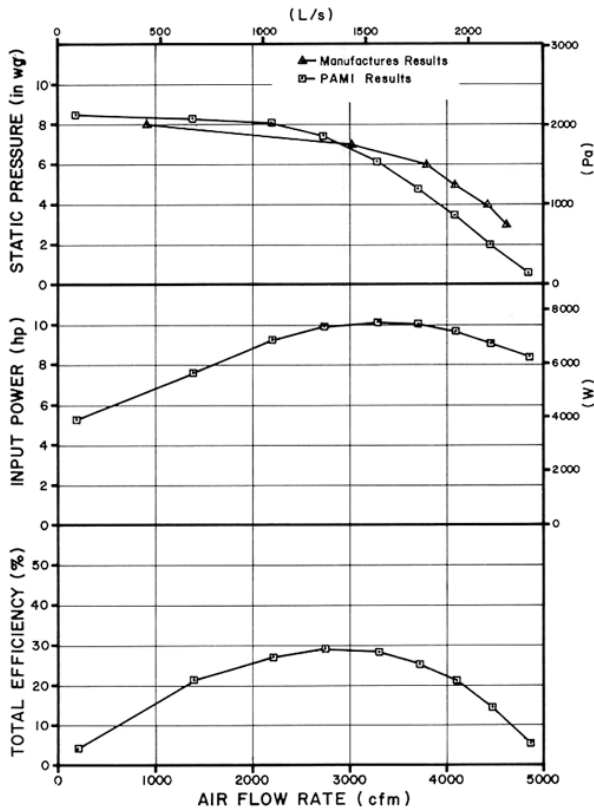


FIGURE 3. Middle State Model IC-24-7.5 Fan Performance Curves.

The noise level<sup>3</sup> of the Middle State model IC-24-7.5, 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 86 dB(A). Higher noise levels could be expected if the fan was operated in the vicinity of other buildings. The Middle State model IC-24-7.5 falls within range 4 of the PAMI noise level range classification (APPENDIX II). The noise level produced by this fan could damage hearing depending on exposure time. Ear protection is definitely recommended.

### OPERATOR'S MANUAL

The operator's manual contained information on operation, installation, maintenance and safety.

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

#### OVERALL DIMENSIONS:

- housing width 30.5 in (775 mm)
- housing height 27.5 in (699 mm)
- housing length 24 in (610 mm)
- inside tube diameter 24 in (610 mm)
- inlet bell diameter 9.2 in (235 mm)
- guard grill diameter 24.5 in (622 mm)
- grill opening 0.125 in (3 mm) diameter, spaced at 0.75 in (19 mm) in a circular pattern.

#### PROPELLER:

- diameter 15.25 in (387 mm)
- inside flange diameter 10.4 in (265 mm)
- number of blades 9
- blade angle 42 degrees

#### WEIGHT:

227 lb (103 kg)

#### MOTOR NAMEPLATE DATA:

- make Baldor
- model M37091
- frame 215T
- class B
- code J
- design B
- duty continuous
- rpm 3450
- service factor 1.15
- ambient temperature rise 40°C
- volts 208-230/460V
- amps 21 - 18.8/9
- phase 3
- cycles 60 Hz
- horsepower 7.5 hp (5590 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 10-24-7.5 7.5 HP INLINE CENTRIFUGAL FAN

<b>RETAIL PRICE:</b>	\$1550.00 (November, 1984, f.o.b. Lethbridge)
<b>FAN DESCRIPTION:</b>	15.25 in (387 mm) single speed, direct drive, 7.5 hp (5590 W) electric motor
<b>FAN SPEED:</b>	3497 to 3555 rpm
<b>MAXIMUM EFFICIENCY:</b>	29%
<b>AIR FLOW RATE:</b>	-range 194 to 4940 cfm (92 to 2330 L/s)
	-at maximum efficiency 2910 cfm (1370 L/s) at a 7.1 in wg (1770 Pa) static pressure
<b>INPUT POWER:</b>	5.24 to 10.2 hp (3900 to 7570 W)
<b>OPERATOR SAFETY:</b>	Guard grill provided CSA approved Noise level = 86 dB(A) at 4.9 ft (1.5 m) from fan inlet
<b>OPERATOR'S MANUAL:</b>	complete

#### APPENDIX I SPECIFICATIONS

<b>MAKE:</b>	Middle State
<b>MODEL:</b>	IC-24-7.5
<b>MANUFACTURER:</b>	Middle State Manufacturing Inc. Box 788 Columbus, Nebraska 68601



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