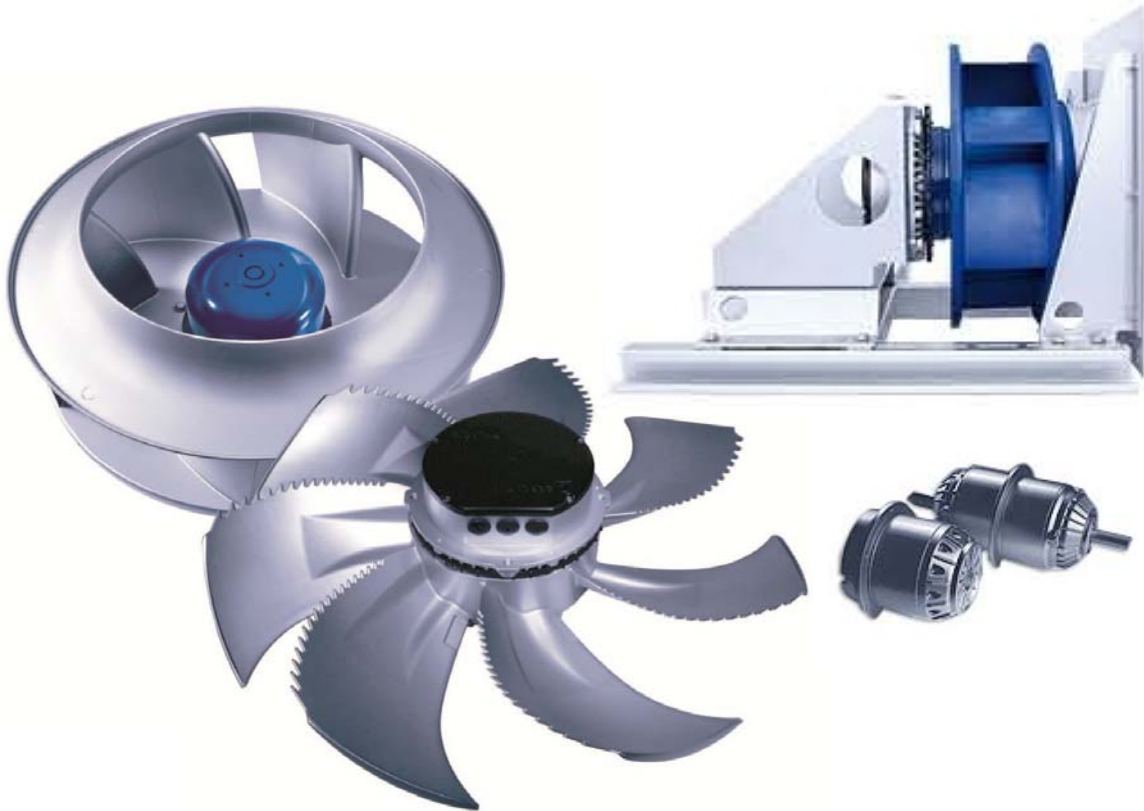


# Benefits of EC Motor Technology for Automotive Air Handling



*Zeke Carlyon 10.30.12*

# Benefits of EC Motor Technology for Automotive Air Handling

## Lower Initial Cost

With the simple open design fans units with this style of fan will have a lower first cost compared to large housed fans.

## Energy Savings

Using the high efficient DC motors fans will use significantly less energy than conventional fans even when compared at full volume operation. With the ability to control the flow by varying the fan speed without the need for a separate variable frequency drive, fans can be turned down for significant additional energy savings.

## Redundancy

Fans are supplied in an a TMI fan array™ consisting of a bank of multiple fans, so that if there is ever a problem with one of the fans the unit can maintain airflow with other fans speeding up to compensate.

## Reduced Maintenance

Since fans are direct drive there are no belts to change out & no fan bearings that need to be lubricated & the motors include maintenance free "lifetime lubrication"

## Interchangeability

Since the fans are in a multiple fan array, a single fan size can be used to cover a wide range of different units allowing the facility to stock only one fan & motor assembly. Fan assemblies are extremely light weight such that the entire assembly weighs less than a standard 15 horse power motor.

## Space Savings

The use of this array of fans can drastically reduce the housing required for the units while improving the air velocity profile at the same time.

## Reduced Noise

Fans are mounted in acoustically lined modules & the total assembly will be much more quiet than a conventional fan, typically at least 10% less noise is generated by the entire Fan Array™ than even the noise from just the bare housed fan without even considering the added sound from the motor & drives.

# Fan Energy Case Study - Side by Side Comparison



## Fan Comparison

Fan Type:	EC Fan Array	AC Fan Array	AC AFDW Fan	AC AFDW Fan
Speed Control:	Integral Speed Control	Variable Frequency Drive	Variable Frequency Drive	Standard Starter
Motor Description:	Brushless EC Motor	Premium Efficient AC Motor	Premium Efficient AC Motor	Premium Efficient AC Motor
Total Airflow Rate:	65,000 c.f.m.	65,000 c.f.m.	65,000 c.f.m.	65,000 c.f.m.
Airflow Rate Per Fan:	7,222 c.f.m.	7,222 c.f.m.	65,000 c.f.m.	65,000 c.f.m.
Total Static Pressure:	3.50"w.c.	3.50"w.c.	3.50"w.c.	3.50"w.c.
Total Static Pressure with System Effect:	3.50"w.c.	3.50"w.c.	3.65"w.c.	3.65"w.c.
Fan Quantity:	9	9	1	1
VFD Efficiency:	100.0%	98.0%	98.0%	100.0%
Power Factor: (with Incoming Power Factor Correction)	100.0%	96.0%	96.0%	96.0%
Power Usage:	40.84 k.W.	43.25 k.W.	44.92 k.W.	44.02 k.W.
Relative Initial Cost: (Fans, Drives, Housing, etc.)	83.1%	84.2%	90.4%	85.7%
Sound at supply air opening:	79.5 dBA @ 5ft.	82.0 dBA @ 5ft.	84.0 dBA @ 5ft.	84.0 dBA @ 5ft.
Maintenance Requirements:	Yearly Inspection	Yearly Inspection Grease Motor Bearings Every Two Years	Yearly Inspection	Yearly Inspection Grease Motor Bearings Every Year Grease Fan Bearings Every 4 Months Yearly Check/Tension Belts Change Belts Every 2-3 Years

## Energy Data: (24/7/365 Full Speed Operation)

Total hours per day:	24	24	24	24
Total days per year:	365	365	365	365
Total Fan Yearly kWh:	357,775.96 kWh	378,852.39 kWh	393,506.93 kWh	385,636.79 kWh
Electricity Cost:	\$0.08 /kWh	\$0.08 /kWh	\$0.08 /kWh	\$0.08 /kWh
<b>Total Electricity Cost:</b>	<b>\$28,622.08</b>	<b>\$30,308.19</b>	<b>\$31,480.55</b>	<b>\$30,850.94</b>

## Energy Data: (24/7/365 Partial Speed Operation)

Total hours per day: (100%/75%/50%)	18/3/3	18/3/3	18/3/3	24
Total days per year:	365	365	365	365
Total Fan Yearly kWh:	309,249.93 kWh	317,995.40 kWh	336,352.54 kWh	385,636.79 kWh
Electricity Cost:	\$0.08 /kWh	\$0.08 /kWh	\$0.08 /kWh	\$0.08 /kWh
<b>Total Electricity Cost:</b>	<b>\$24,739.99</b>	<b>\$25,439.63</b>	<b>\$26,908.20</b>	<b>\$30,850.94</b>
			(1)	(1)



TMI Recommended

## Notes:

(1) Belt losses based on AMCA 203-90 data

# TMI EC Fan Array Performance Data

Project Name: **Energy Study**  
 Project Number: **12-616**  
 Unit Tag: **EC Fan Array**  
 TMI Serial Number: **12-616-001**  
 Fan Tag: **Supply Fan Array**



## 100% Capacity Performance Data

Total Airflow Rate: **65,000 c.f.m.**  
 Airflow Rate Per Fan: **7,222 c.f.m.**  
 Total Static Pressure: **3.50" w.c.**  
 Fan Quantity: **9**  
 Fan Speed: **1,711 r.p.m.**  
 Fan Speed Setting: **97.8%**  
 Static Efficiency: **65.5%**  
 Individual Fan Power: **5.72 b.h.p.**  
 Total Fan Power: **51.48 b.h.p.**  
 Motor Efficiency @ Load: **94.0%**  
 Power Usage @ Load: **40.84 k.W.**

## 75% Capacity Performance Data

Total Airflow Rate: **48,750 c.f.m.**  
 Airflow Rate Per Fan: **5,417 c.f.m.**  
 Total Static Pressure: **2.97" w.c.**  
 Fan Quantity: **9**  
 Fan Speed: **1,465 r.p.m.**  
 Fan Speed Setting: **83.7%**  
 Static Efficiency: **65.5%**  
 Individual Fan Power: **3.64 b.h.p.**  
 Total Fan Power: **32.74 b.h.p.**  
 Motor Efficiency @ Load: **94.0%**  
 Power Usage @ Load: **25.97 k.W.**

## 50% Capacity Performance Data

Total Airflow Rate: **32,500 c.f.m.**  
 Airflow Rate Per Fan: **3,611 c.f.m.**  
 Total Static Pressure: **1.88" w.c.**  
 Fan Quantity: **9**  
 Fan Speed: **1,112 r.p.m.**  
 Fan Speed Setting: **63.5%**  
 Static Efficiency: **63.1%**  
 Individual Fan Power: **1.60 b.h.p.**  
 Total Fan Power: **14.36 b.h.p.**  
 Motor Efficiency @ Load: **94.0%**  
 Power Usage @ Load: **11.39 k.W.**

## Fan Sound Data

<u>Band</u>	<u>Inlet</u>	<u>Outlet</u>
63 Hz	54 dB	57 dB
125 Hz	72 dB	73 dB
250 Hz	83 dB	86 dB
500 Hz	84 dB	89 dB
1,000 Hz	84 dB	86 dB
2,000 Hz	83 dB	82 dB
4,000 Hz	81 dB	80 dB
8,000 Hz	78 dB	76 dB
Sound at supply:	83.5 dBA @ 3ft.	78.5 dBA @ 5ft.
Sound at outside unit:	59.5 dBA @ 3ft.	54.5 dBA @ 5ft.

## Fan Information:

Fan Type: **Plenum**  
 Fan Model Number: **GR56C-ZID.GL.CR**  
 Drive Type: **Direct**  
 Airstream Temperature: **70°F**  
 Elevation: **0' A.S.L.**  
 Maximum Fan Speed: **1,750 r.p.m.**

## Motor Information:

Selected Motor Size: **6.5 h.p.**  
 Motor Enclosure: **EC**  
 Motor Speed: **1,750 r.p.m.**

## Fan Accessories:

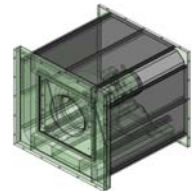
Fans to include integral airflow measuring ports

## Motor Accessories:



## Fan Sizing:

Module Width: **44.0"**  
 Module Height: **41.3"**  
 Module Depth: **30.0"**  
 Modules Wide: **3**  
 Modules High: **3**  
 Assembly Width: **132.0"**  
 Assembly Height: **123.9"**



# TMI Fan Array Performance Data

Project Name: [Energy Study](#)  
 Project Number: [12-616](#)  
 Unit Tag: [AC Fan Array](#)  
 TMI Serial Number: [12-616-001](#)  
 Fan Tag: [Supply Fan Array](#)



## 100% Capacity Performance Data

Total Airflow Rate: [65,000 c.f.m.](#)  
 Airflow Rate Per Fan: [7,222 c.f.m.](#)  
 Total Static Pressure: [3.50" w.c.](#)  
 Fan Quantity: [9](#)  
 Fan Speed: [1,738 r.p.m.](#)  
 VFD Setting: [59.1 Hertz](#)  
 Static Efficiency: [71.0%](#)  
 Individual Fan Power: [5.62 b.h.p.](#)  
 Total Fan Power: [50.58 b.h.p.](#)  
 Motor Efficiency @ Load: [92.7%](#)  
 Power Usage @ Load: \* [43.25 k.W.](#)

## 75% Capacity Performance Data

Total Airflow Rate: [48,750 c.f.m.](#)  
 Airflow Rate Per Fan: [5,417 c.f.m.](#)  
 Total Static Pressure: [1.97" w.c.](#)  
 Fan Quantity: [9](#)  
 Fan Speed: [1,304 r.p.m.](#)  
 VFD Setting: [44.3 Hertz](#)  
 Static Efficiency: [71.0%](#)  
 Individual Fan Power: [2.37 b.h.p.](#)  
 Total Fan Power: [21.33 b.h.p.](#)  
 Motor Efficiency @ Load: [90.0%](#)  
 Power Usage @ Load: \* [18.79 k.W.](#)

## 50% Capacity Performance Data

Total Airflow Rate: [32,500 c.f.m.](#)  
 Airflow Rate Per Fan: [3,611 c.f.m.](#)  
 Total Static Pressure: [1.88" w.c.](#)  
 Fan Quantity: [9](#)  
 Fan Speed: [1,112 r.p.m.](#)  
 VFD Setting: [37.8 Hertz](#)  
 Static Efficiency: [72.0%](#)  
 Individual Fan Power: [1.49 b.h.p.](#)  
 Total Fan Power: [13.41 b.h.p.](#)  
 Motor Efficiency @ Load: [87.6%](#)  
 Power Usage @ Load: \* [12.13 k.W.](#)

## Fan Sound Data

<u>Band</u>	<u>Inlet</u>	<u>Outlet</u>
63 Hz	62 dB	62 dB
125 Hz	73 dB	73 dB
250 Hz	87 dB	90 dB
500 Hz	90 dB	93 dB
1,000 Hz	90 dB	96 dB
2,000 Hz	89 dB	87 dB
4,000 Hz	86 dB	85 dB
8,000 Hz	84 dB	81 dB

## Fan Information:

Fan Type: [Plenum](#)  
 Fan Model Number: [ER50C-4DM.H7.1R](#)  
 Drive Type: [Direct](#)  
 Airstream Temperature: [70°F](#)  
 Elevation: [0' A.S.L.](#)  
 Maximum Fan Speed: [2,640 r.p.m.](#)

## Motor Information:

Selected Motor Size: [7.5 h.p.](#)  
 Motor Enclosure: [TEFC](#)  
 Motor Speed: [1,765 r.p.m.](#)  
 Motor FLA: [12.5 Amps](#)  
 NEMA Efficiency: [91.8%](#)

## Fan Accessories:

Fan performance to be AMCA certified  
 Fans to be rated as AMCA Class 3  
 Fans to include integral airflow measuring ports

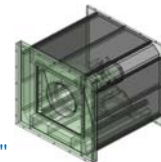
## Motor Accessories:

Motor to be Premium Efficiency rated for VFD use  
 Aegis shaft grounding rings



## Fan Sizing:

Module Width: [44.0"](#)  
 Module Height: [44.0"](#)  
 Module Depth: [30.0"](#)  
 Modules Wide: [3](#)  
 Modules High: [3](#)  
 Assembly Width: [132.0"](#)  
 Assembly Height: [132.0"](#)



# Conventional Housed Fan, Variable Frequency Drive

Project Name: [Energy Study](#)  
 Project Number: [12-616](#)  
 Unit Tag: [AFDW Fan with VFD](#)  
 TMI Serial Number: [12-616-001](#)  
 Fan Tag: [Supply Fan](#)



## 100% Capacity Performance Data

Total Airflow Rate: [65,000 c.f.m.](#)  
 Airflow Rate Per Fan: [65,000 c.f.m.](#)  
 Total Static Pressure: [3.65" w.c.](#)  
 Fan Quantity: [1](#)  
 Fan Speed: [761 r.p.m.](#)  
 VFD Setting: [60.0 Hertz](#)  
 Static Efficiency: [72.0%](#)  
 Individual Fan Power: [53.84 b.h.p.](#)  
 Total Fan Power: [53.84 b.h.p.](#)  
 Motor Efficiency @ Load: [95.0%](#)  
 Power Usage @ Load: \* [44.92 k.W.](#)

## 75% Capacity Performance Data

Total Airflow Rate: [48,750 c.f.m.](#)  
 Airflow Rate Per Fan: [48,750 c.f.m.](#)  
 Total Static Pressure: [3.05" w.c.](#)  
 Fan Quantity: [1](#)  
 Fan Speed: [646 r.p.m.](#)  
 VFD Setting: [50.9 Hertz](#)  
 Static Efficiency: [77.0%](#)  
 Individual Fan Power: [31.79 b.h.p.](#)  
 Total Fan Power: [31.79 b.h.p.](#)  
 Motor Efficiency @ Load: [95.0%](#)  
 Power Usage @ Load: \* [26.52 k.W.](#)

## 50% Capacity Performance Data

Total Airflow Rate: [32,500 c.f.m.](#)  
 Airflow Rate Per Fan: [32,500 c.f.m.](#)  
 Total Static Pressure: [1.91" w.c.](#)  
 Fan Quantity: [1](#)  
 Fan Speed: [486 r.p.m.](#)  
 VFD Setting: [38.3 Hertz](#)  
 Static Efficiency: [78.0%](#)  
 Individual Fan Power: [13.05 b.h.p.](#)  
 Total Fan Power: [13.05 b.h.p.](#)  
 Motor Efficiency @ Load: [93.0%](#)  
 Power Usage @ Load: \* [11.12 k.W.](#)

## Fan Sound Data

<u>Band</u>	<u>Inlet</u>	<u>Outlet</u>
63 Hz	<a href="#">98 dB</a>	<a href="#">103 dB</a>
125 Hz	<a href="#">104 dB</a>	<a href="#">104 dB</a>
250 Hz	<a href="#">95 dB</a>	<a href="#">93 dB</a>
500 Hz	<a href="#">90 dB</a>	<a href="#">91 dB</a>
1,000 Hz	<a href="#">90 dB</a>	<a href="#">88 dB</a>
2,000 Hz	<a href="#">84 dB</a>	<a href="#">82 dB</a>
4,000 Hz	<a href="#">81 dB</a>	<a href="#">79 dB</a>
8,000 Hz	<a href="#">78 dB</a>	<a href="#">75 dB</a>
Sound at supply:	<a href="#">87.0 dBA @ 3ft.</a>	<a href="#">82.0 dBA @ 5ft.</a>
Sound at outside unit:	<a href="#">66.0 dBA @ 3ft.</a>	<a href="#">61.0 dBA @ 5ft.</a>

## Fan Information:

Fan Type: [AFDW](#)  
 Fan Model Number: [49"](#)  
 Drive Type: [Belt](#)  
 Airstream Temperature: [70°F](#)  
 Elevation: [0' A.S.L.](#)  
 Maximum Fan Speed: [818 r.p.m.](#)

## Motor Information:

Selected Motor Size: [60.0 h.p.](#)  
 Motor Enclosure: [TEFC](#)  
 Motor Speed: [1,775 r.p.m.](#)

## Fan Accessories:

[Inlet screens](#)  
[Belt Guard](#)  
[Open type spring isolation](#)

## Motor Accessories:

[Motor to be Premium Efficiency rated for VFD use](#)  
[Aegis shaft grounding rings](#)



# Conventional Housed Fan, Across the Line Starter

Project Name: **Energy Study**  
 Project Number: **12-616**  
 Unit Tag: **AFDW Fan with Starter**  
 TMI Serial Number: **12-616-001**  
 Fan Tag: **Supply Fan**



## 100% Capacity Performance Data

Total Airflow Rate: **65,000 c.f.m.**  
 Airflow Rate Per Fan: **65,000 c.f.m.**  
 Total Static Pressure: **3.50" w.c.**  
 Fan Quantity: **1**  
 Fan Speed: **761 r.p.m.**  
 VFD Setting: **60.0 Hertz**  
 Static Efficiency: **72.0%**  
 Individual Fan Power: **53.84 b.h.p.**  
 Total Fan Power: **53.84 b.h.p.**  
 Motor Efficiency @ Load: **95.0%**  
 Power Usage @ Load: \* **44.02 k.W.**

## Fan Information:

Fan Type: **AFDW**  
 Fan Model Number: **49"**  
 Drive Type: **Belt**  
 Airstream Temperature: **70°F**  
 Elevation: **0' A.S.L.**  
 Maximum Fan Speed: **901 r.p.m.**

## Motor Information:

Selected Motor Size: **60.0 h.p.**  
 Motor Enclosure: **TEFC**  
 Motor Speed: **1,765 r.p.m.**

## Fan Accessories:

Inlet screens  
 Belt Guard  
 Open type spring isolation

## Motor Accessories:

Motor to be Premium Efficiency



## Fan Sound Data

<u>Band</u>	<u>Inlet</u>	<u>Outlet</u>
63 Hz	98 dB	103 dB
125 Hz	104 dB	104 dB
250 Hz	95 dB	93 dB
500 Hz	90 dB	91 dB
1,000 Hz	90 dB	88 dB
2,000 Hz	84 dB	82 dB
4,000 Hz	81 dB	79 dB
8,000 Hz	78 dB	75 dB
Sound at supply:	87.0 dBA @ 3ft.	82.0 dBA @ 5ft.
Sound at outside unit:	66.0 dBA @ 3ft.	61.0 dBA @ 5ft.