

This presentation is company confidential and can not be shared with any third party without proper authorization.

Fan Performance Tests Air Velocity Measurements Coverage Area Determination

Falco eMotors Engineering Team

Aug 27, 2019

Testing Procedures for Air Flow and Coverage Area

- Four Ways to determine CFM and Area Coverage
 - Method 1: Use CFM (Computation Fluid Mechanics);
 - Method 2: Use CFD (Computational Fluid Dynamics);
 - Method 3: Use AMCA 230-15;
 - Method 4: Use Falco's Test Procedure 102018;

**Highly
Confidential**



Method 1: CFM Calculations

Analytical Methods

**Highly
Confidential**

Critical Factors to be Considered for Air Flow Coverage

1. Diameter of the fan;
2. Coverage area;
3. Optimum distance from the ceiling (X);
4. Optimum distance from the floor (Y);
5. Optimum distance from the wall (Z).

**Highly
Confidential**

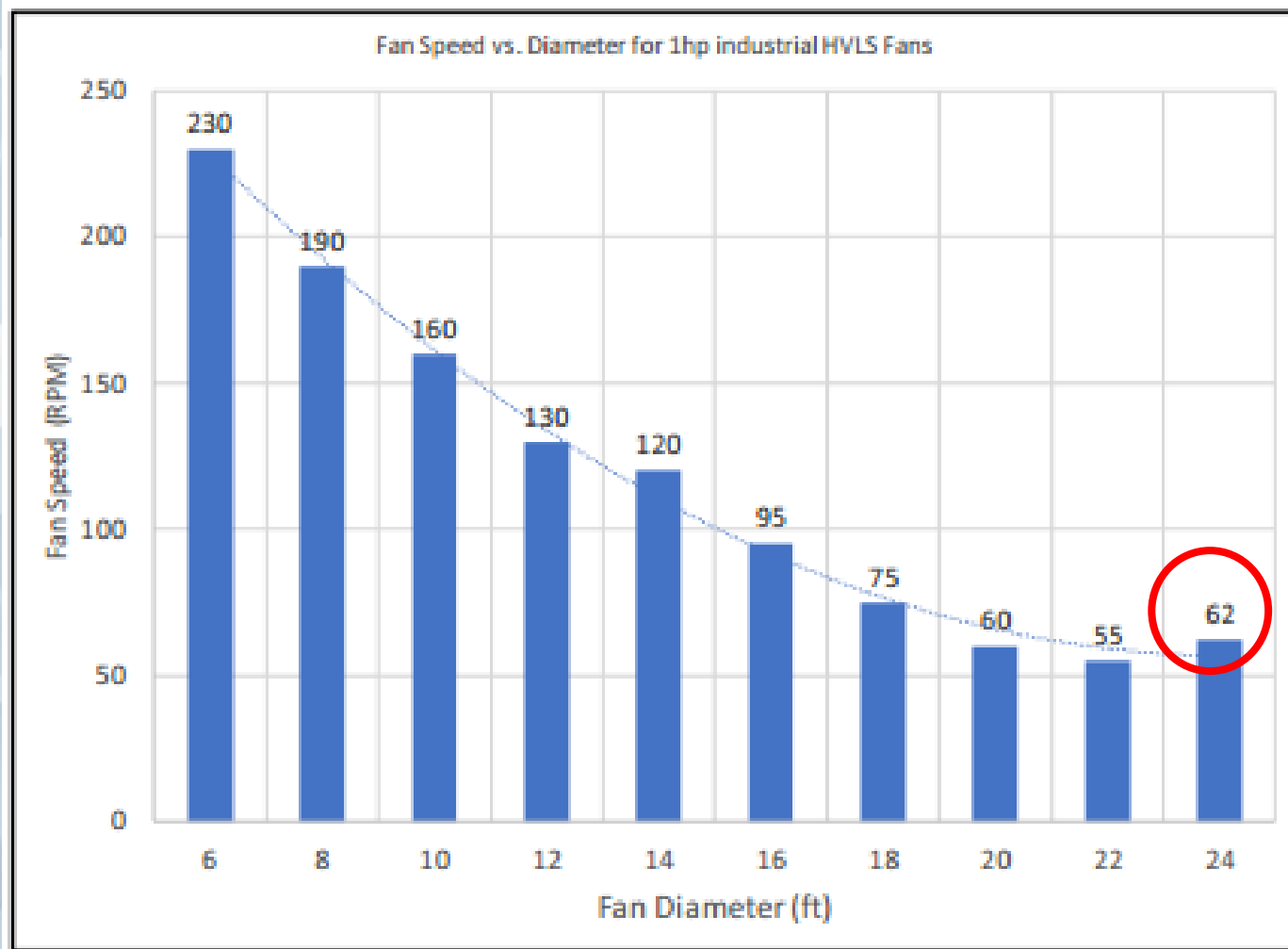
Fan Performance Comparison for All Fans (6 to 24-ft)

Diameter of the Fan (ft)	Speed (RPM)	Power (W)	Max Coverage Area (Sq. Ft.) A	Optimum Distance from the Ceiling (ft) X	Optimum Distance from the Floor (ft) Y	Optimum Distance from the Wall to the fan center (ft) Z
6	230	650	4000	2	9	9
8	190	860	5000	2	12	12
10	160	1000	6000	2	15	15
12	130	700	7000	3	18	18
14	120	1150	8000	3	21	21
16	95	1060	12000	4	24	24
18	75	900	15000	4	27	27
20	60	720	18000	5	30	30
22	55	680	23000	5	33	33
24	62	1200	30000	5	36	36

24-ft Fan

Fan Diameter (ft)	24
Speed (RPM)	62
Power Consumption (W)	1120
Max Coverage Area (Sq. Ft.)	30,000
Optimum Distance from the Ceiling (ft) - X	5
Optimum Distance from the Floor (ft) - Y	36
Optimum Distance from the wall to the fan center (ft)	36

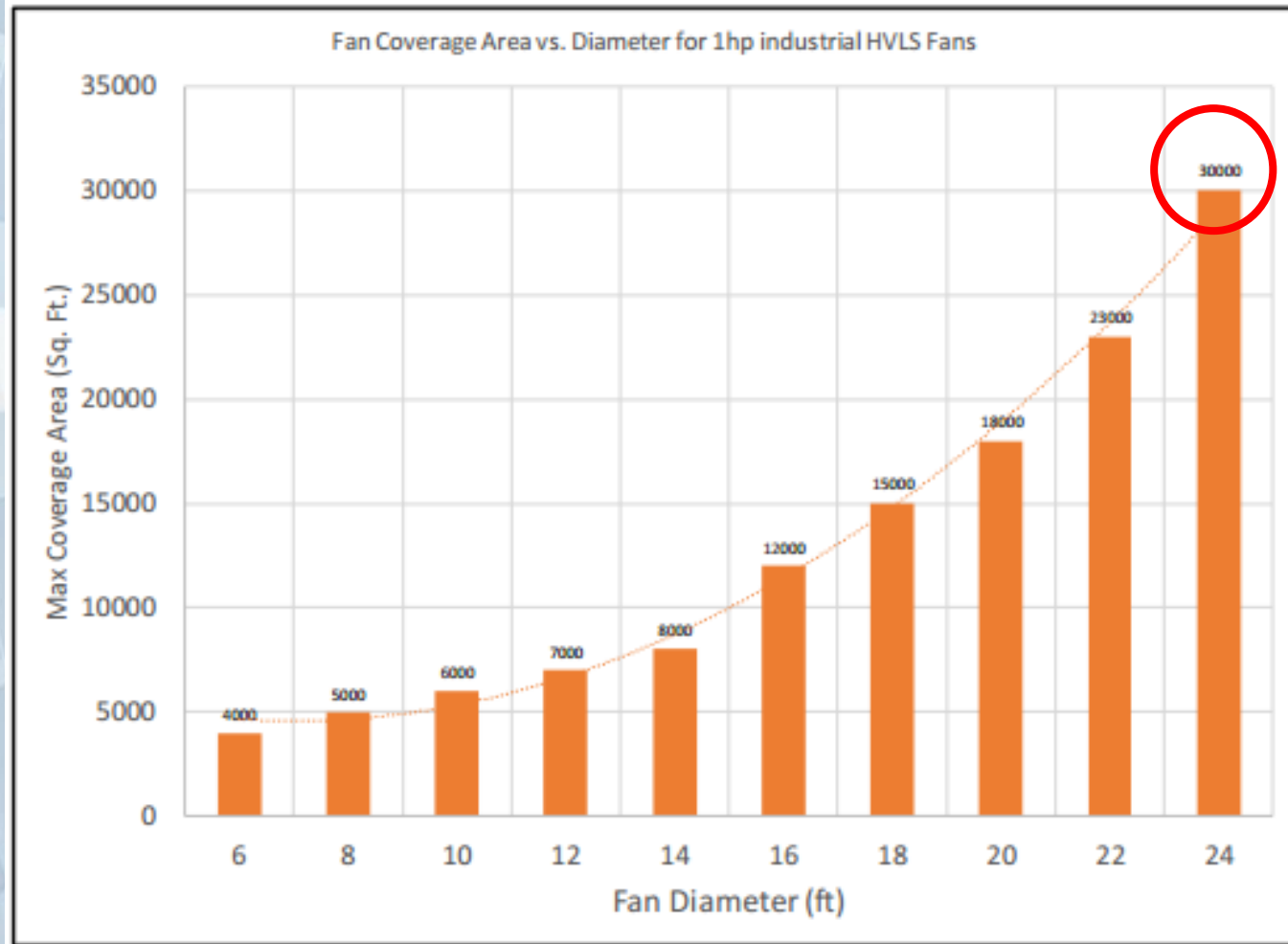
Fan Speed Vs. Diameter For HVLS Fan



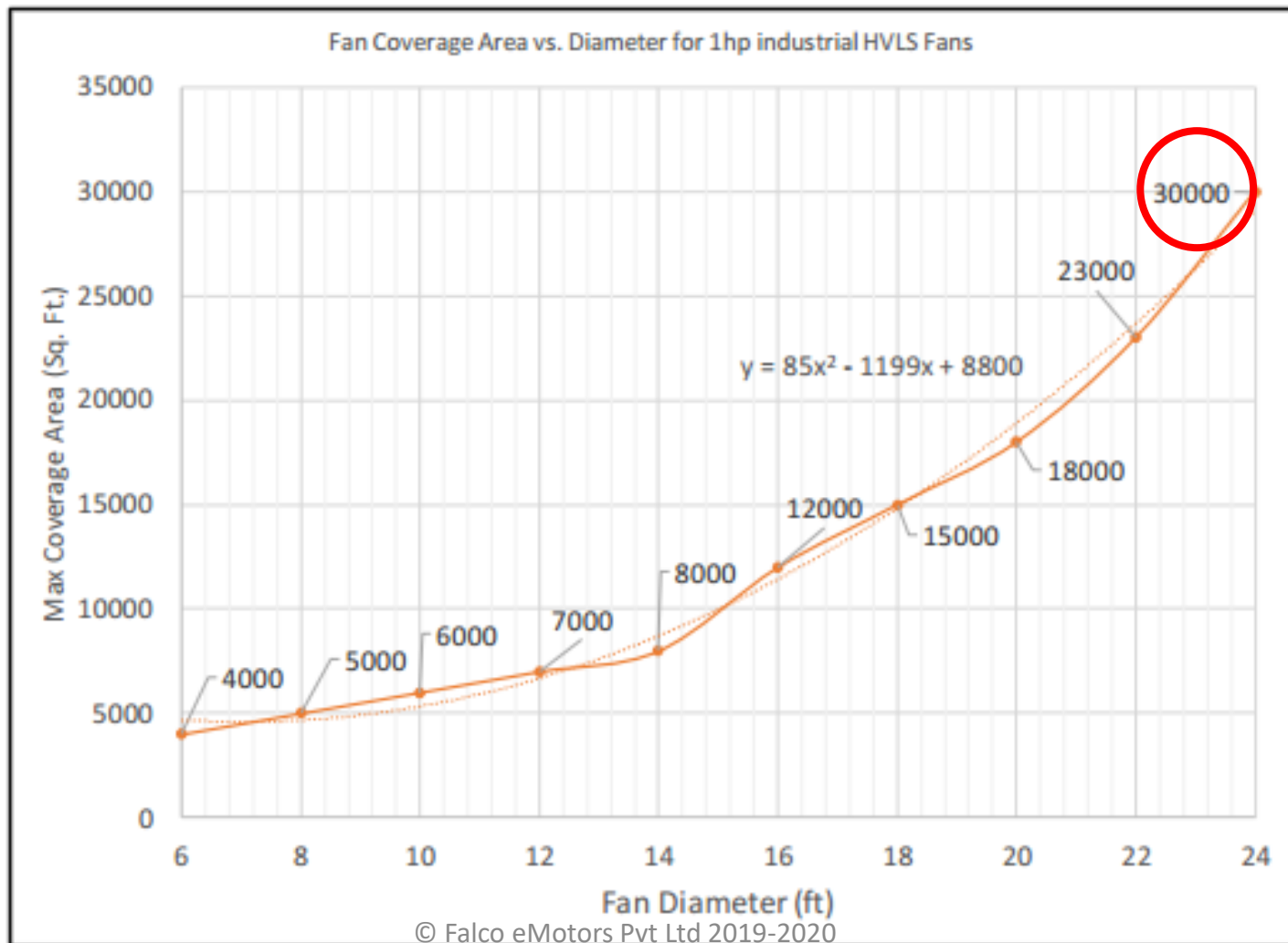
Note: Higher Fan Speed is not an indication of higher air flow.

© Falcon Motors Pvt Ltd 2019-2020

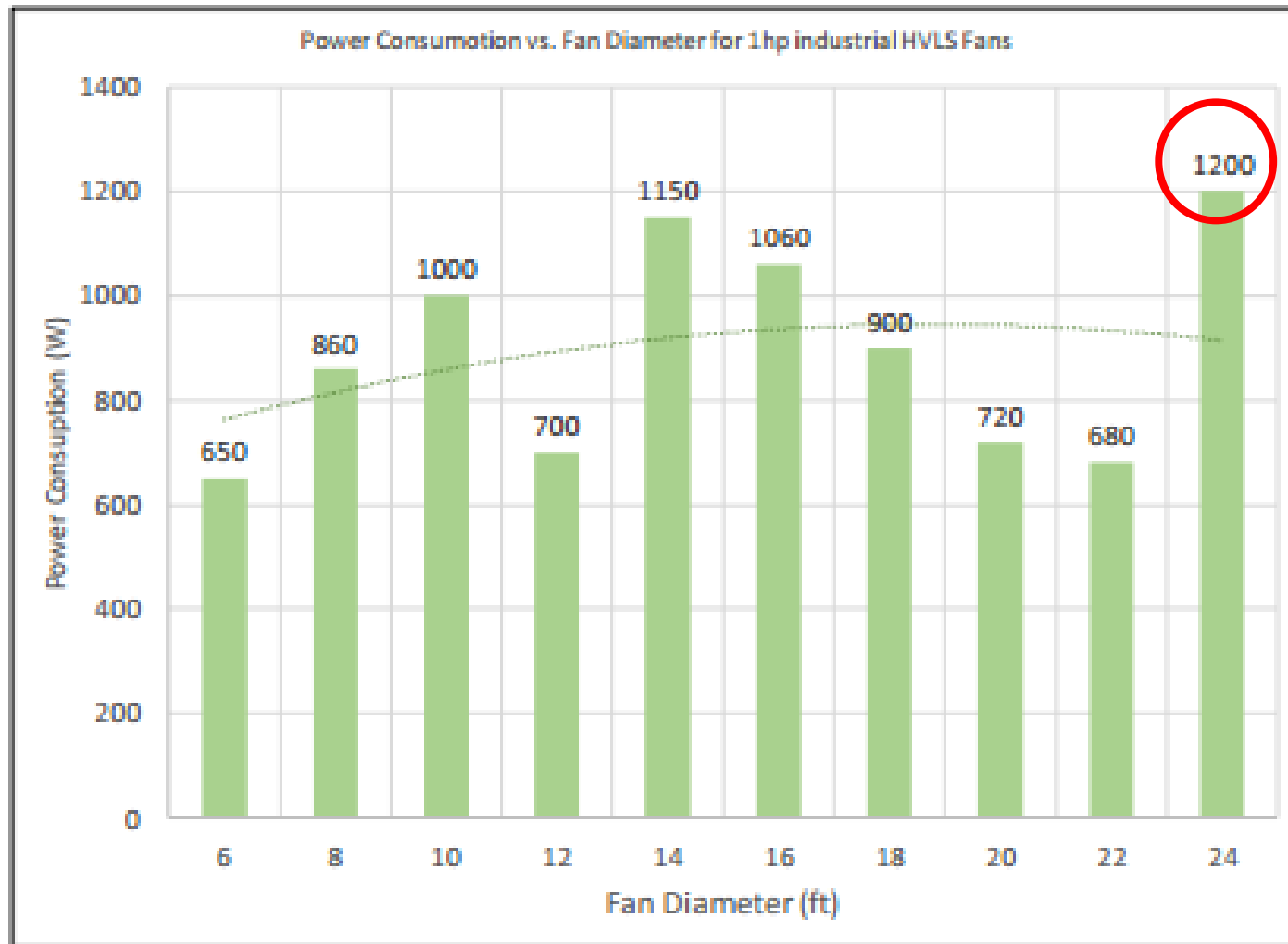
Max Coverage Vs. Fan Diameter



Fan Coverage Vs. Fan Diameter

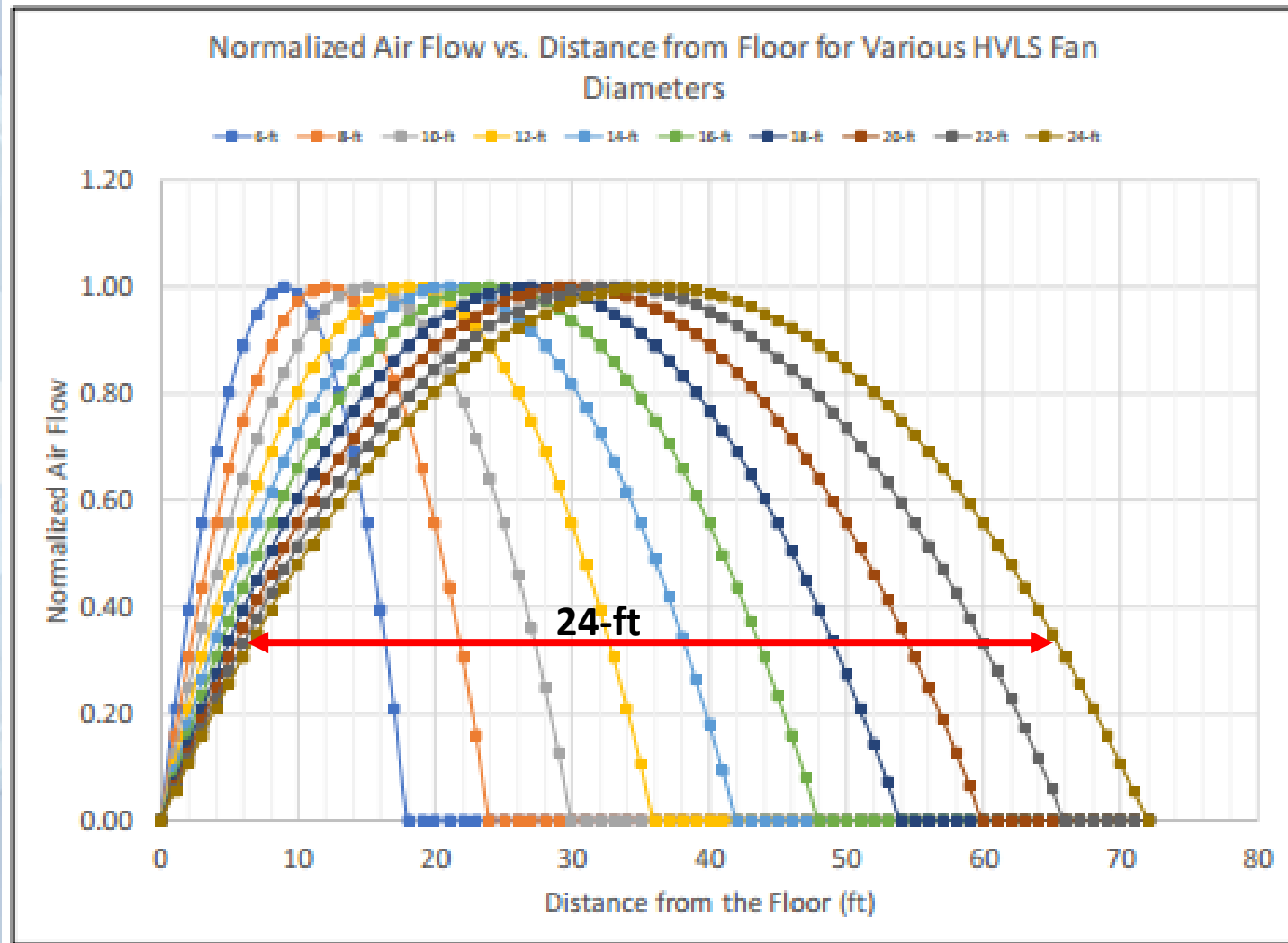


Power Consumption Vs. Fan Diameter



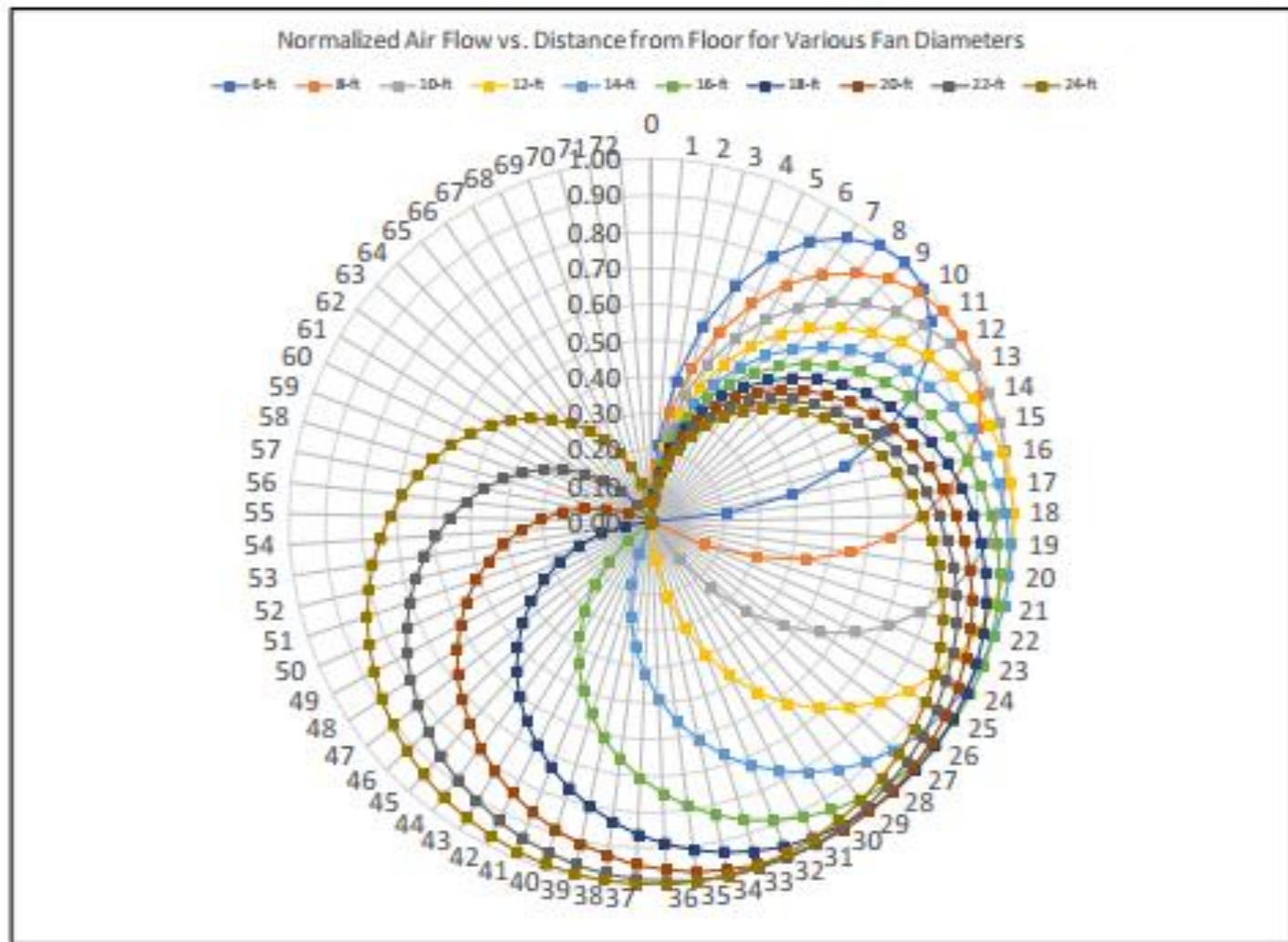
Note: Coverage area increases with increase in fan diameter but at reduced air flow speed at the boundaries if power consumption is kept the same.

Air Flow Vs. Distance from floor



Note: Real input power consumption is a critical indicator of air flow.

Air Flow Vs. Distance from floor



Note: Air flow is most optimum at 1.5 times the fan diameter.

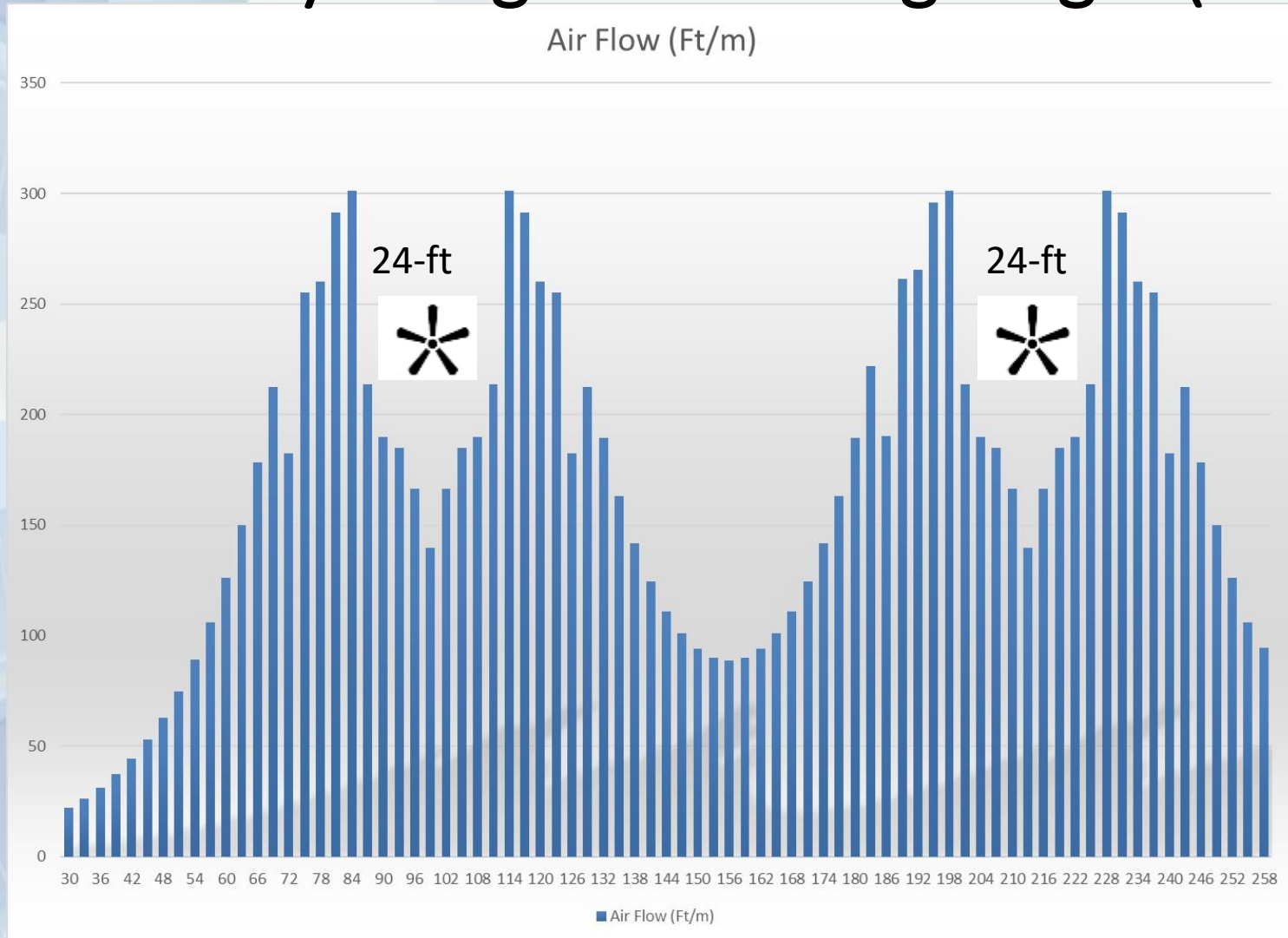


CFM Results

24 ft vs. 18 ft

**Highly
Confidential**

Air Velocity along the building length (Bay 2)

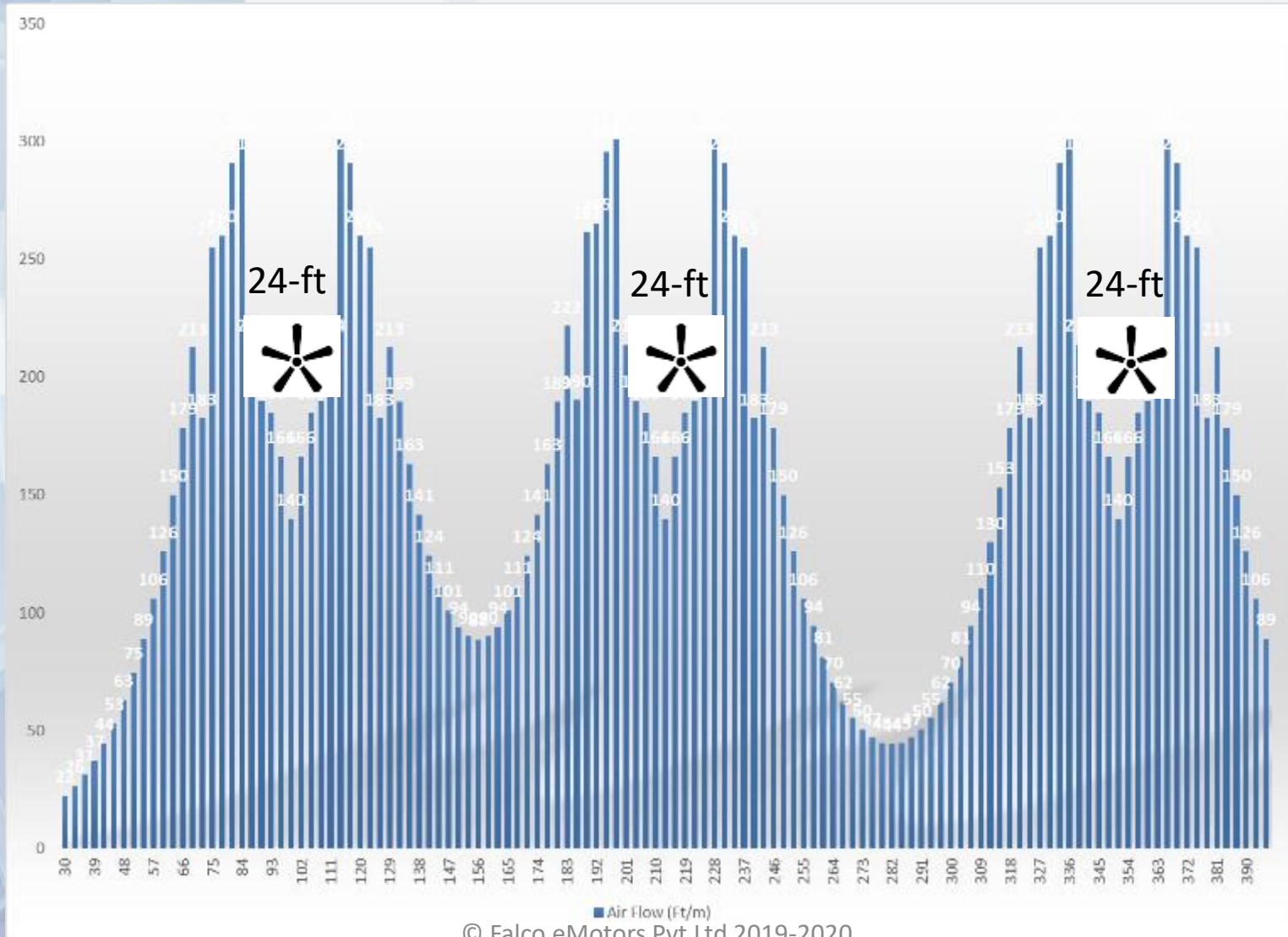


Average CFM for 24 ft(2 Fans)

- Average Air Velocity = 171 f/m
- Average Fan Sweep Area = 3617 Sq. Ft.
- Average CFM = 651,060

**Highly
Confidential**

Air Velocity along the building length (3 Fans)



© Falco eMotors Pvt Ltd 2019-2020

Estimated Air Flow based on Experiments – Data Captured at 3ft from Ground

Average CFM for 24-ft (3 Fans)

- Average Air Velocity = 162 f/m
- Average Fan Sweep Area = 3617 Sq. Ft.
- Average CFM = 585,954

**Highly
Confidential**



Method 2:CFD

Computational Fluid Dynamics

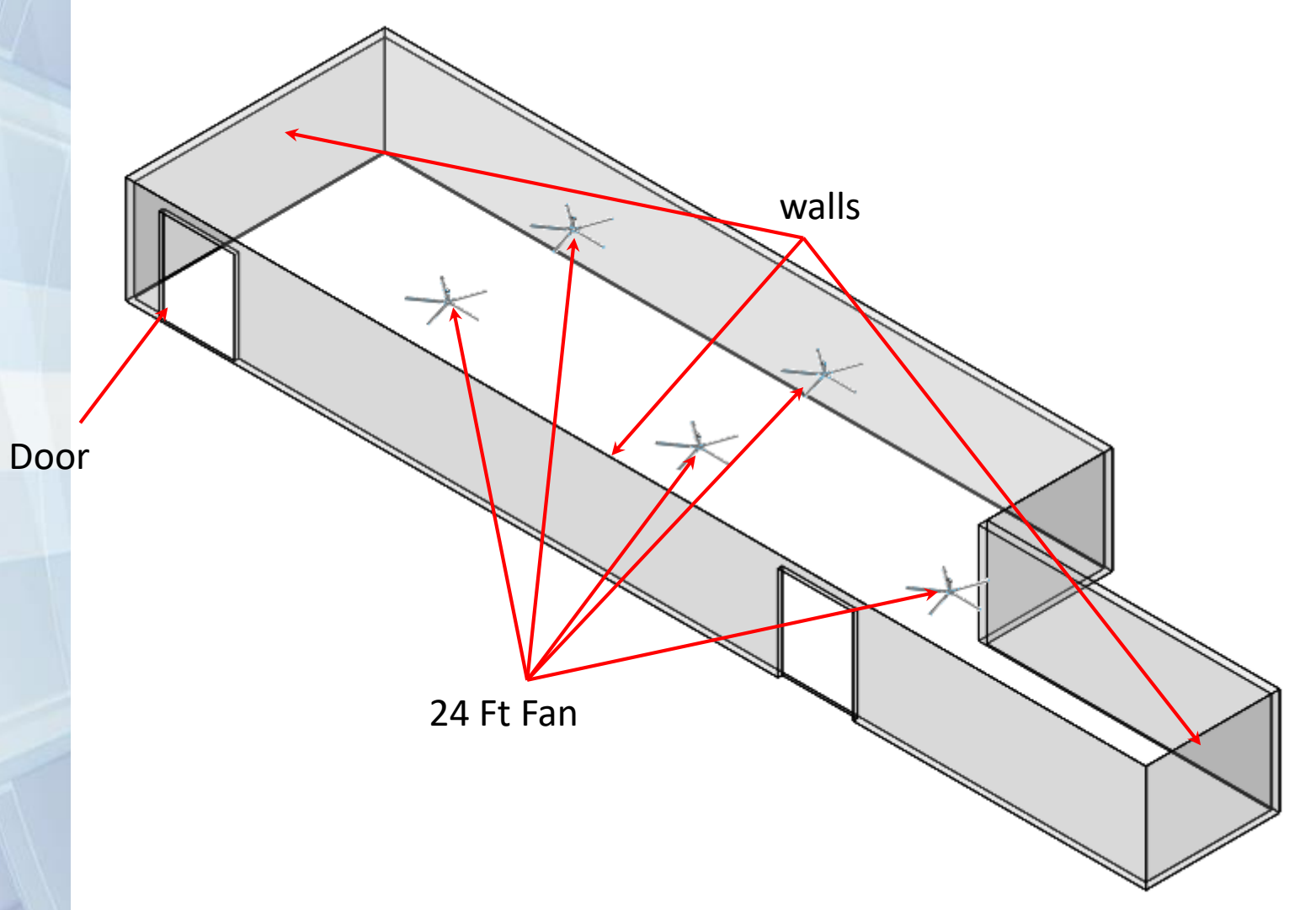
**Highly
Confidential**



Study with 24 Feet

**Highly
Confidential**

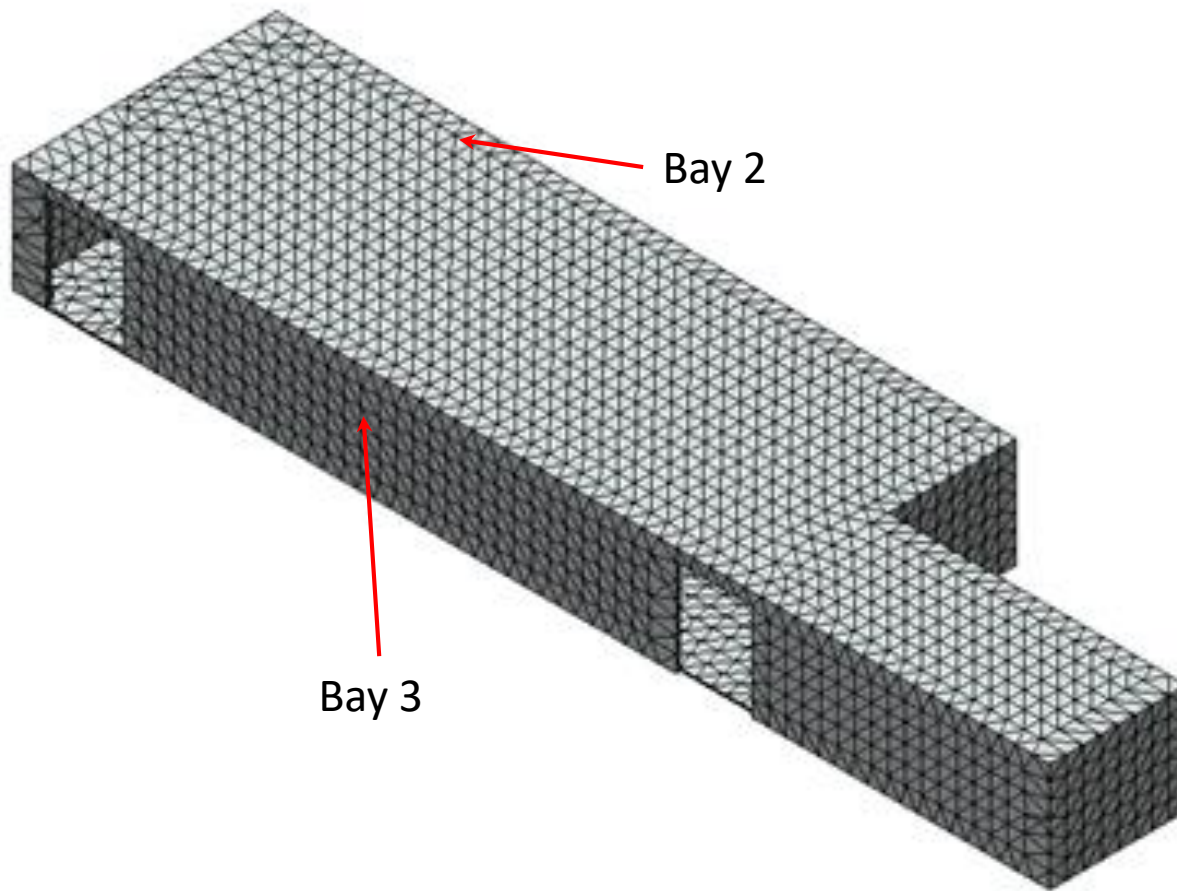
Geometry with 24 Feet



Bay 2 & 3 Site Dimensions: - 121 X 30 X 12 meter

© Falco eMotors Pvt Ltd 2019-2020

Meshing



Fan Data



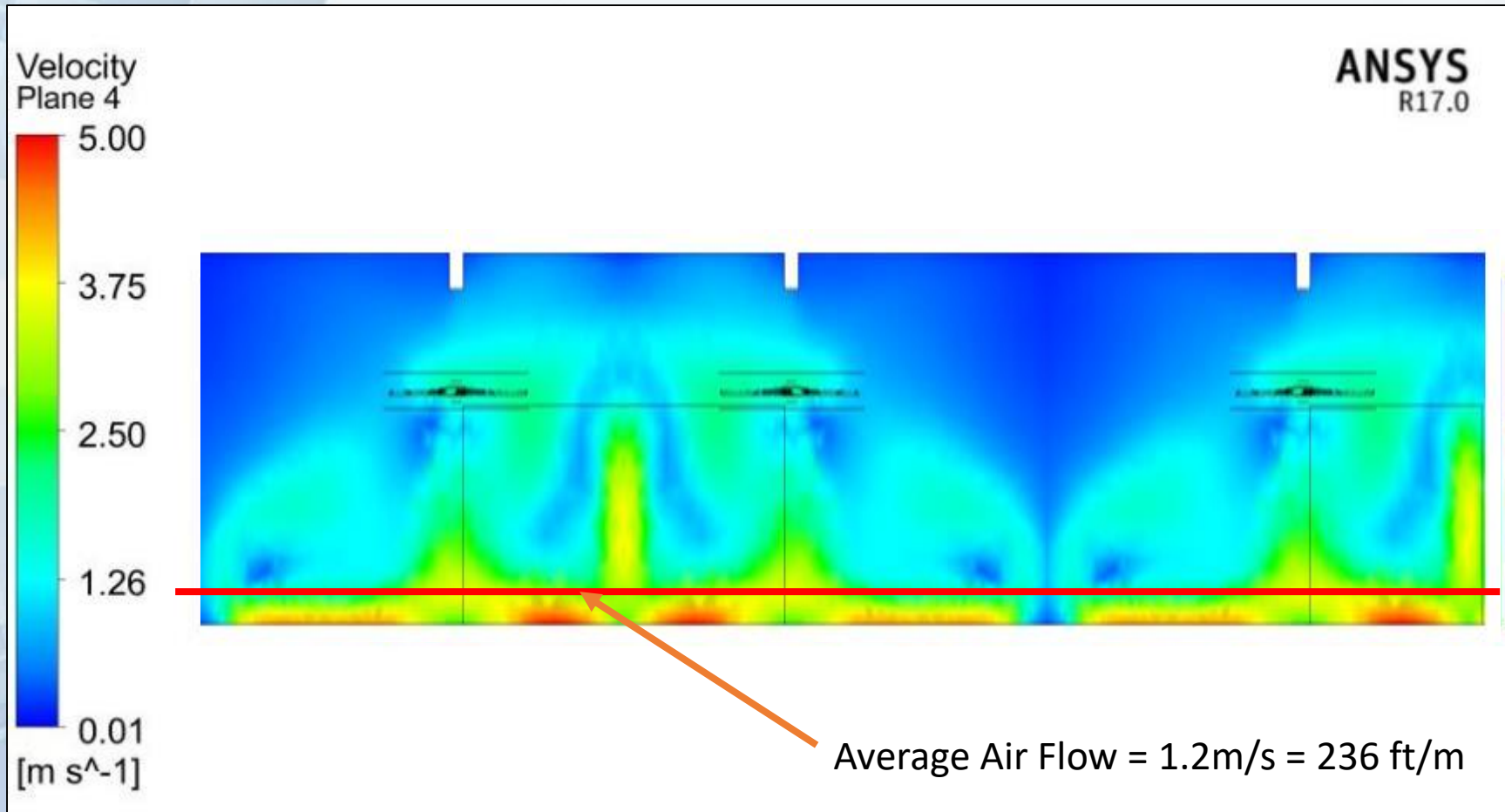
Working fluid	Air
Angular velocity of fan	62 rpm
Technology	UPF / PMSM
Motor Power (Kw)	1.2 Kw
Minimum Space from wall in feet	36 feet
Torque	0 to 170 Nm
Voltage	200-265VAC, 1 Phase, 50/60 Hz

METHODOLOGY

□ Numerical Models

1. Solver : This study utilized industry standard Computational Fluid Dynamics (CFD) software package ANSYS CFX with double precision to carry out flow simulations.
2. Turbulence Model : The k- epsilon turbulence model is a two-equation model that is used for many fluid dynamics applications. k-epsilon model in the free stream. For general purpose simulations, the k- epsilon offers a good compromise in terms of accuracy.
3. Method : Higher order differencing schemes are used for all advections.

Side View



ANSI/AMCA Standard 230-15

Laboratory Methods of Testing
Air Circulating Fans for Rating
and Certification

An American National Standard
Approved by ANSI on October 16, 2015

Method 3: AMCA 230-15

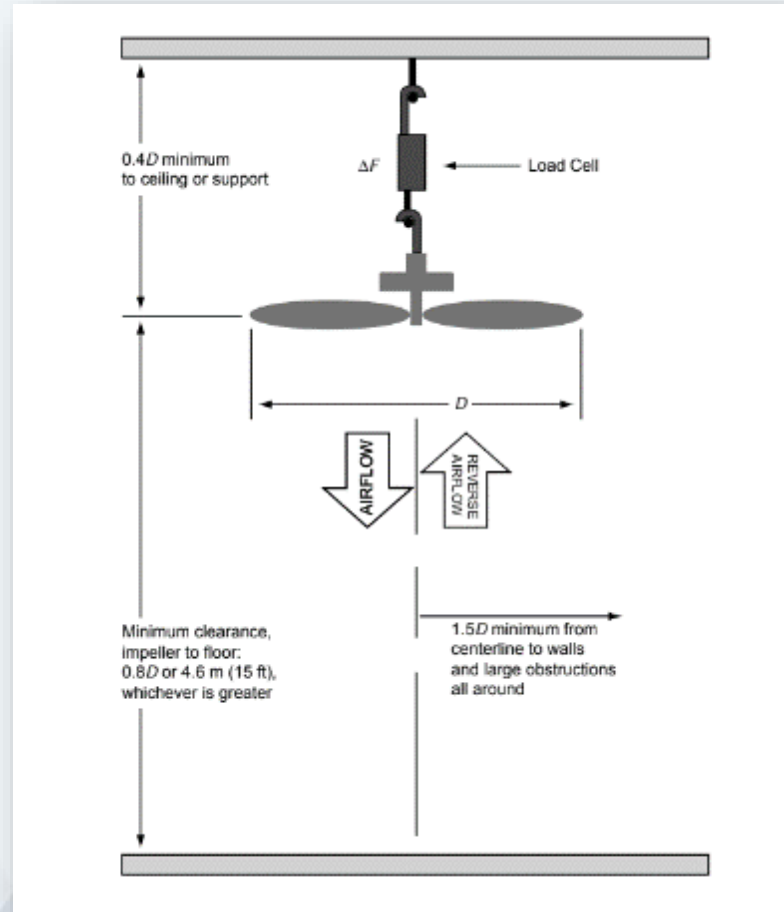
AMCA is air movement and Control Association (USA)



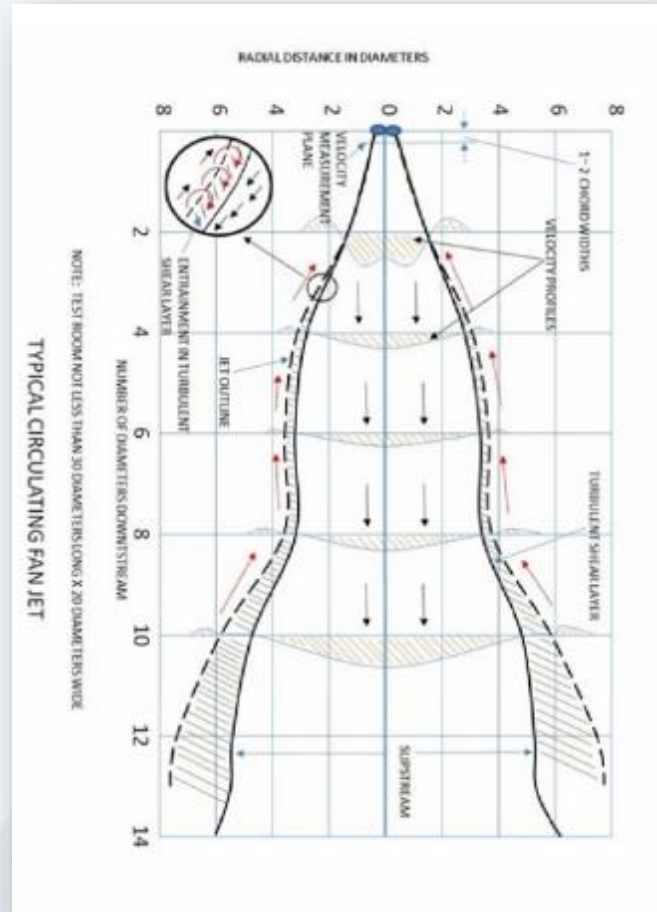
**AIR MOVEMENT AND CONTROL
ASSOCIATION INTERNATIONAL INC.**

The International Authority on Air System Components

AMCA Test Set Up



Air Flow Measurement



The Data

- The following data was collected by the Lucas TVS

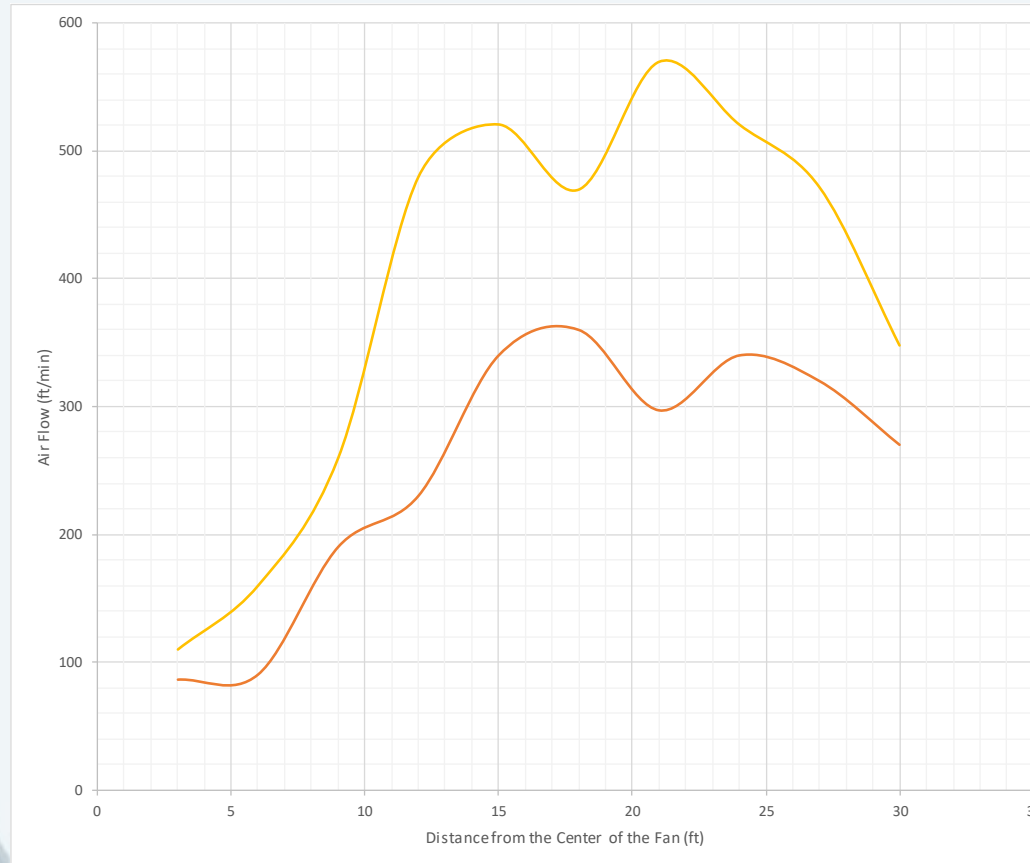
	Epoch
Voltage	240.7
Current	4.43
Power Factor	0.958
Watts	1023
Volta-Ampere	1066

Data Collected on Air Flow (ft/min)

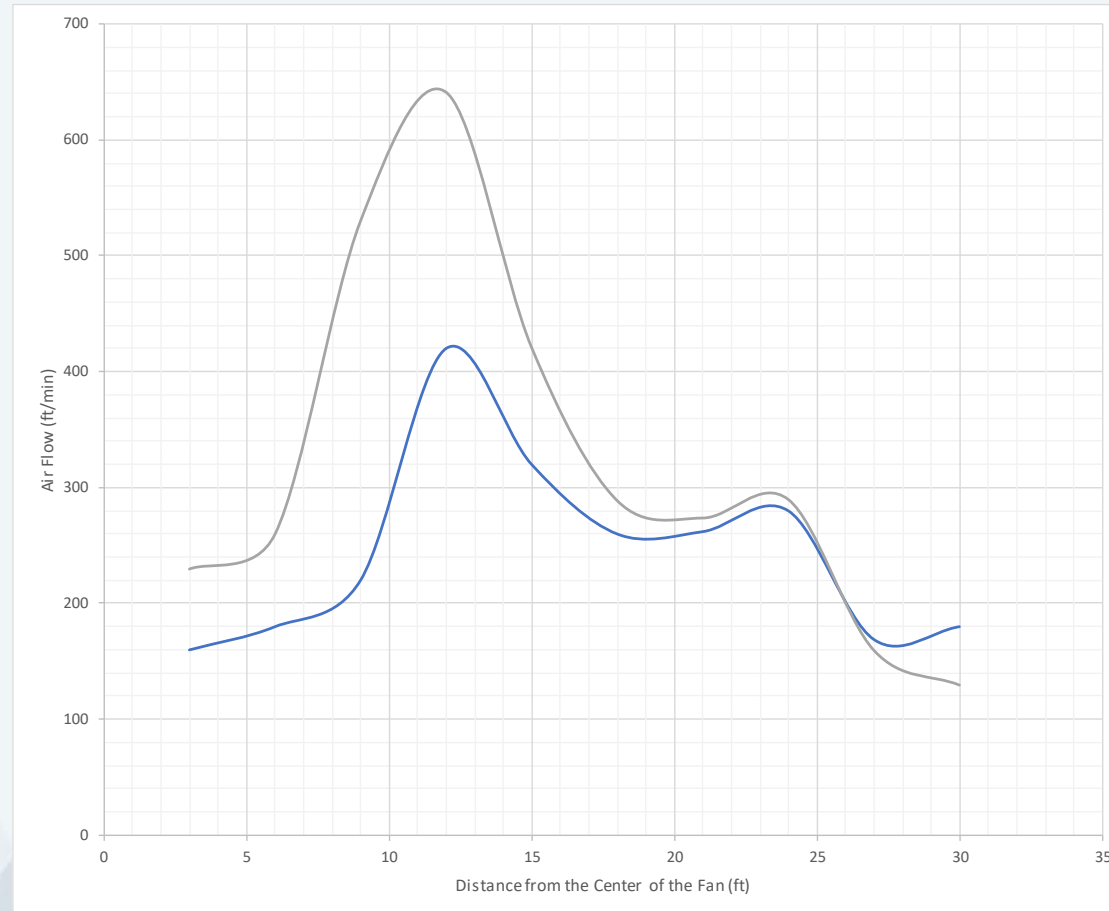
(July 26, 2019 – AMCA 230-15)

Distance	Up (Epoch)	Low (Epoch)
3	230	110
6	260	160
9	530	260
12	641	480
15	421	521
18	289	470
21	274	570
24	290	521
27	160	472
30	130	348

Data Collected on Air Flow on the Floor



Data Collected on Air Flow at 3-ft from the Floor



Fan Performance AMCA 230-15

Data to be entered		Units
Ambient wet bulb temperature t_{w0}	28	Celsius
Ambient dry bulb temperature t_{d0}	37	Celsius
Barometric pressure in pascal	101200	Pa
Gas constant- R	287	J/Kg.K
Standard air density	1.2	Kg/m ³
Dia of the fan	24	ft
Electrical input power	1217	W
Output current	3.75	Arms
Preliminary calculations		
P_e	3760.8	
P_p	3153.6	
Area	42.02448161	m ²
Output Power	976.8143555	W
Torque	148.125	Nm
Load measured by Load cell	814.6345488	N
Fan performance data		
Ambient air density	1.123519969	Kg/m ³
Thrust Ft	870.0881918	N
Air flow rate	893546.4747	CFM
Efficiency	80.26412124	%
Efficacy	1555727.556	m ³ /s/W

Method 4: 102018

**Highly
Confidential**

Testing Procedure for Air Flow and Coverage Area (Procedure 102018)

- Install Fan on Location as per Required Height;
 - For 3-Blade Fans Optimum Height is 1.1 to 1.2 times fan diameter, 5 or 6 blade fans, optimum height is 1.5 times the fan diameter.
- Run Fan at Maximum Speed;
- Take Air Velocity Measurements by using Digital Pencil Probe Anemometer.
- Air Velocity measured at Several locations at distance of every 10 Feet from the Fan Center.
- Measure Power Consumption of Fan by using Digital Power Guard Meter.

INDEX

Sr. No.	Titles	Page No.
1	Testing procedure for Coverage Area	02
2	Testing Instruments	04
3	Instruments Calibration Certificate	05
4	Epoch 16 & 20 Feet Fan Specifications	07
5	Test Report for 20 Feet Fan	12
6	Test Report for 16 Feet Fan	16

Testing Instruments

- Digital Pencil Probe Anemometer
- Digital Power Guard meter



Digital Pencil Probe Anemometer



Digital Power Guard meter

Digital Pencil Probe Anemometer Calibration Certificate

N. P. K. FOUNDERS (Test & Calibration Lab. Division) Calibration And Testing of Test & Measuring Instruments for ISO 9001 & TS.	
LAB & OFFICE AT : A-92, 93 'H' BLOCK, M.I.D.C. PIMPRI, PUNE - 411 018. • TEL : (020) 27473429, 27478865 • FAX : (020) 27472631 • SERVICE CELL NO. 98 819 78 834 LAB 2 AT : W-18, M.I.D.C., Wai, Dist. Satara - 412 903. • E-mail : marketing@npkcalibration.com • www.npkcalibration.com	
Doc No. GATFOR.5.10.02 REV.02	
Calibration Certificate No.:	INT/18/411/ FLOW Page : 1 of 2,
Date Of Issue :	04/01/2019
Name Of Customer :	N.P.K FOUNDERS, (TEST & CALLAB. DIVN)
Address of Customer :	PLOT NO. A-92 & 93, H BLOCK, MDC, PIMPRI, PUNE.
Date of Receipt :	04/01/2019 Condition : P.O.K. OP. UNKNOWN.
Date of Calibration :	04/01/2019
Identification Of Instrument :	DIGITAL HOT WIRE ANEMOMETER.
Customer's Id.No. :	INLU111/FLOWM Lab Id.No. : INT/18/411
Make :	LUTRON Model : AM4204 Sr.No. : 5023844
L.C. :	REF PAGE 2 OF 2 Accuracy : REF MFRS SPECS.
Range :	0.2 TO 20 m/s, 0.7 TO 72.0 km/h, 49 TO 3940 f/min, 0.4 TO 88 knots, 0.5 TO 44.7 ml/sft, TEMPERATURE
Input :	AIR FLOW. Output : INDICATION.
Calibration Standards Used:	
Parameter	ID No. Certificate No. Valid Up to
Barometric pressure	IML243PREM WP18/478 17/04/2020
Wind Tunnel Off Pressure	IML375PREM 18090174 24/09/2019
Temperature & Humidity	IML231TMPM FCR1ETU15-18C/9H 04/05/2019
Calibration Standards Traceable to NPL through Unbroken chain. REF.MFRS.SPECS. REF.STD.MIL.	
Calibration Method Used : W.G.NO.NNP-12	
Location of Calibration : OUR LAB.	
Environmental Conditions : 1. Temperature in Degree C. : 23 ± 1.5	
2. Relative Humidity in % Rh : 40 TO 60%	
Calibrated By :	K.M GHATNEKAR Certified By : B.P.KARANDIKAR (By HEAD OF LAB)
Signature :	<i>Ghatnekar</i> Signature : <i>Karandikar</i>
Notes: This certificate refers only to the particular item submitted for Calibration. This certificate shall not be reproduced, except in full, unless written permission is obtained from Authorised Signatory for N.P.K. Founders, (Test & Cal. Lab. Div.). Calibration results reported in the Certificate are valid at the time of & under the stated conditions of measurement.	
Retention Period : 3 Years (Soft Copy)	

TRUE COPY
Ghatnekar
FOR N.P.K FOUNDERS
(T & C LAB DIV.)





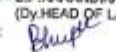
N. P. K. FOUNDERS (Test & Calibration Lab. Division) Calibration And Testing of Test & Measuring Instruments for ISO 9001 & TS.																																	
LAB & OFFICE AT : A-92, 93 'H' BLOCK, M.I.D.C. PIMPRI, PUNE - 411 018. • TEL : (020) 27473429, 27478865 • FAX : (020) 27472631 • SERVICE CELL NO. 98 819 78 834 LAB 2 AT : W-18, M.I.D.C., Wai, Dist. Satara - 412 903. • E-mail : marketing@npkcalibration.com • www.npkcalibration.com																																	
Doc No. GATFOR.5.10.02 REV.02																																	
Calibration Certificate No.:	INT/18/411/ FLOW Page : 2 of 2,																																
Date Of Calibration :	04/01/2019																																
CALIBRATION RESULTS																																	
<table border="1"> <thead> <tr> <th>Unit Under Calibration</th> <th>Range</th> <th>Reading</th> <th>Call. Standard Reading</th> <th>Error in m/s</th> <th>*Exp. Uncertainty (±) % of Reading</th> </tr> </thead> <tbody> <tr> <td rowspan="5">0.2 TO 20 m/s. L.C.: 0.1 m/s.</td> <td>0.2</td> <td>0.2</td> <td>0.2056</td> <td>-0.0050</td> <td>2.12</td> </tr> <tr> <td>1.0</td> <td>1.0</td> <td>1.0069</td> <td>-0.0069</td> <td>1.52</td> </tr> <tr> <td>4.0</td> <td>4.0</td> <td>4.0144</td> <td>-0.0144</td> <td>0.38</td> </tr> <tr> <td>8.0</td> <td>8.0</td> <td>8.0220</td> <td>-0.0220</td> <td>0.82</td> </tr> <tr> <td>18.0</td> <td>18.0</td> <td>18.0387</td> <td>-0.0387</td> <td>0.82</td> </tr> </tbody> </table>		Unit Under Calibration	Range	Reading	Call. Standard Reading	Error in m/s	*Exp. Uncertainty (±) % of Reading	0.2 TO 20 m/s. L.C.: 0.1 m/s.	0.2	0.2	0.2056	-0.0050	2.12	1.0	1.0	1.0069	-0.0069	1.52	4.0	4.0	4.0144	-0.0144	0.38	8.0	8.0	8.0220	-0.0220	0.82	18.0	18.0	18.0387	-0.0387	0.82
Unit Under Calibration	Range	Reading	Call. Standard Reading	Error in m/s	*Exp. Uncertainty (±) % of Reading																												
0.2 TO 20 m/s. L.C.: 0.1 m/s.	0.2	0.2	0.2056	-0.0050	2.12																												
	1.0	1.0	1.0069	-0.0069	1.52																												
	4.0	4.0	4.0144	-0.0144	0.38																												
	8.0	8.0	8.0220	-0.0220	0.82																												
	18.0	18.0	18.0387	-0.0387	0.82																												
<table border="1"> <thead> <tr> <th>Unit Under Calibration</th> <th>Range</th> <th>Reading</th> <th>Call. Standard Reading</th> <th>Error in °C</th> <th>*Exp. Uncertainty (±) in °C</th> </tr> </thead> <tbody> <tr> <td rowspan="3">TEMPERATURE L.C.: 0.1 °C.</td> <td>18.1</td> <td>18.1</td> <td>18.067</td> <td>0.033</td> <td>0.65</td> </tr> <tr> <td>25.6</td> <td>25.6</td> <td>25.545</td> <td>0.055</td> <td>0.85</td> </tr> <tr> <td>30.7</td> <td>30.7</td> <td>30.689</td> <td>0.011</td> <td>0.35</td> </tr> <tr> <td></td> <td>36.5</td> <td>36.5</td> <td>36.428</td> <td>0.072</td> <td>0.65</td> </tr> </tbody> </table>		Unit Under Calibration	Range	Reading	Call. Standard Reading	Error in °C	*Exp. Uncertainty (±) in °C	TEMPERATURE L.C.: 0.1 °C.	18.1	18.1	18.067	0.033	0.65	25.6	25.6	25.545	0.055	0.85	30.7	30.7	30.689	0.011	0.35		36.5	36.5	36.428	0.072	0.65				
Unit Under Calibration	Range	Reading	Call. Standard Reading	Error in °C	*Exp. Uncertainty (±) in °C																												
TEMPERATURE L.C.: 0.1 °C.	18.1	18.1	18.067	0.033	0.65																												
	25.6	25.6	25.545	0.055	0.85																												
	30.7	30.7	30.689	0.011	0.35																												
	36.5	36.5	36.428	0.072	0.65																												
Brief Results : Observed values are reported. Refer calibration certificate before use.																																	
General Remarks : 1. A Sticker indicating 'Calibration Status' has been affixed on the instrument. As Requested, Next Calibration Due Date: 03/01/2020 2. No Error adjustment was done Before Calibration. 3. *Expanded Uncertainty reported is estimated at confidence level of approx. 95% with k=1.90. 4. Readings reported above are average of 5 readings. 5. Results reported do not convey any long term stability data since noted for short duration.																																	
Abbreviations Used: P.O.K.: Physically O.K. OP. Unknown : Operational condition Unknown. P.D.: Physically Damaged. LUC : Unit Under Calibration																																	
Calibrated By :	K.M GHATNEKAR Certified By : B.P.KARANDIKAR (By HEAD OF LAB)																																
Signature :	<i>Ghatnekar</i> Signature : <i>Karandikar</i>																																
END OF CERTIFICATE																																	





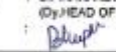
TRUE COPY
Ghatnekar
FOR N.P.K FOUNDERS
(T & C LAB DIV.)

NPK FOUNDERS (T & C LAB DIV.)
TRACEABILITY COPY
for C C No./s 201904/021VAL

NPK FOUNDERS (T & C LAB DIV.)
TRACEABILITY COPY
for C C No./s 201904/021VAL

Digital Power Guard meter Calibration Certificate

		N. P. K. FOUNDERS (Test & Calibration Lab. Division) Accredited laboratory as per ISO/IEC:17025:2005 by NABL Calibration And Testing of Test & Measuring Instruments for ISO 9001 & TS.			
Accredited Calibration fields: ● Electro-Technical ● Mechanical ● Thermal					
ULR No. CC21891900001155F					
CERTIFICATE OF CALIBRATION Doc No. QATFOR.5.19.02-REV-02					
Calibration Certificate No. : 190314/06 /POW Date Of Issue : 16/03/2019		Page : 1 of 2.			
Name Of Customer : FALCO EMOTORS PVT. LTD. (IACSR NO.1619/1228)					
Address of Customer : A-105, H- BLOCK, NEAR MORIWADI COURT, PIMPRI MIDC, PUNE.					
Date of Receipt : 14/03/2019		Condition * : P.O.K., OP, UNKNOWN.			
Date of Calibration: 15/03/2019					
Identification Of Instrument : OIG, POWERGUARD (POWER METER)					
Customer's Id.No. : 004		Lab.Id.No. : 190314/06			
Make : MECCO	Model : PG-09	Sr.No. : NIL			
L.C. : REF. PAGE 2 OF 2		Accuracy: REF. MFRS. SPECS.			
Range : AC:250V, 10A, AC POWER: 2 KVA, POWER FACTOR.					
Input : VOLTAGE, CURRENT, POWER		Output : INDICATION.			
Calibration Standards Used:					
Parameter	ID No.	Certificate No.	Valid Upto		
VOLTAGE, CURRENT,	IML/394/ML/US	0437012	25/03/2019		
POWER, POWER FACTOR	IML/394/ML/US	18050006	31/08/2019		
Calibration Method Used : WG. NO. JAMP-21 & COMPARISON,					
Location of Calibration : OUR LAB, PIMPRI, PUNE-411 018.					
Environmental Conditions : 1. Temperature in Degree C. : 25 ± 2.					
2. Relative Humidity in % Rh : 45 - 75 %					
Calibrated By : N.V.RAO		Certified By : B.P.KARANDIKAR (Dy.HEAD OF LAB)			
Signature : 		Signature : 			
Notes: This certificate refers only to the particular item submitted for Calibration. This certificate shall not be reproduced, except in full, unless written permission is obtained from Authorised Signatory for N.P.K. Founders, (Test & Cal. Lab. Div.). Calibration results reported in the Certificate are valid at the time of & under the stated conditions of measurement.					
Retention Period : 3 Years (Soft copy)					




		N. P. K. FOUNDERS (Test & Calibration Lab. Division) Accredited laboratory as per ISO/IEC:17025:2005 by NABL Calibration And Testing of Test & Measuring Instruments for ISO 9001 & TS.																																	
Accredited Calibration fields: ● Electro-Technical ● Mechanical ● Thermal																																			
ULR No. CC21891900001155F																																			
CALIBRATION RESULTS																																			
Calibration Certificate No. : 190314/06 /POW Date Of Calibration: 15/03/2019		Doc No. QATFOR.5.19.02-REV-02 Page : 2 of 2.																																	
<table border="1"> <thead> <tr> <th colspan="2">Unit Under Calibration</th> <th>Cal. Standard Reading</th> <th>Error in VAC</th> <th>*Exp. Uncertainty (±) in % of reading</th> </tr> </thead> <tbody> <tr> <td>Range</td> <td>Reading</td> <td></td> <td></td> <td></td> </tr> <tr> <td>250 VAC</td> <td>149.50</td> <td>149.54</td> <td>-0.04</td> <td>0.214</td> </tr> <tr> <td>L.C.: 0.1</td> <td>199.54</td> <td>199.40</td> <td>0.24</td> <td>0.204</td> </tr> <tr> <td></td> <td>249.42</td> <td>249.69</td> <td>-0.27</td> <td>0.130</td> </tr> </tbody> </table>						Unit Under Calibration		Cal. Standard Reading	Error in VAC	*Exp. Uncertainty (±) in % of reading	Range	Reading				250 VAC	149.50	149.54	-0.04	0.214	L.C.: 0.1	199.54	199.40	0.24	0.204		249.42	249.69	-0.27	0.130					
Unit Under Calibration		Cal. Standard Reading	Error in VAC	*Exp. Uncertainty (±) in % of reading																															
Range	Reading																																		
250 VAC	149.50	149.54	-0.04	0.214																															
L.C.: 0.1	199.54	199.40	0.24	0.204																															
	249.42	249.69	-0.27	0.130																															
<table border="1"> <thead> <tr> <th colspan="2">Unit Under Calibration</th> <th>Cal. Standard Reading</th> <th>Error in AAC</th> <th>*Exp. Uncertainty (±) in % of reading</th> </tr> </thead> <tbody> <tr> <td>Range</td> <td>Reading</td> <td></td> <td></td> <td></td> </tr> <tr> <td>10 AAC</td> <td>1.3990</td> <td>1.4562</td> <td>-0.2006</td> <td>0.310</td> </tr> <tr> <td>L.C.: 0.001</td> <td>2.0010</td> <td>2.1288</td> <td>-0.1280</td> <td>0.345</td> </tr> <tr> <td></td> <td>4.6934</td> <td>5.0424</td> <td>-0.1490</td> <td>0.192</td> </tr> <tr> <td></td> <td>8.9534</td> <td>9.0006</td> <td>-0.1472</td> <td>0.158</td> </tr> </tbody> </table>						Unit Under Calibration		Cal. Standard Reading	Error in AAC	*Exp. Uncertainty (±) in % of reading	Range	Reading				10 AAC	1.3990	1.4562	-0.2006	0.310	L.C.: 0.001	2.0010	2.1288	-0.1280	0.345		4.6934	5.0424	-0.1490	0.192		8.9534	9.0006	-0.1472	0.158
Unit Under Calibration		Cal. Standard Reading	Error in AAC	*Exp. Uncertainty (±) in % of reading																															
Range	Reading																																		
10 AAC	1.3990	1.4562	-0.2006	0.310																															
L.C.: 0.001	2.0010	2.1288	-0.1280	0.345																															
	4.6934	5.0424	-0.1490	0.192																															
	8.9534	9.0006	-0.1472	0.158																															
<table border="1"> <thead> <tr> <th colspan="2">Unit Under Calibration</th> <th>Cal. Standard Reading</th> <th>Error in kVA</th> <th>*Exp. Uncertainty (±) in % of reading</th> </tr> </thead> <tbody> <tr> <td>Range</td> <td>Reading</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2 kVA</td> <td>0.0634</td> <td>0.0624</td> <td>0.0010</td> <td>1.637</td> </tr> <tr> <td>L.C.: 0.001</td> <td>0.7534</td> <td>0.7785</td> <td>-0.0251</td> <td>0.497</td> </tr> <tr> <td></td> <td>1.1434</td> <td>1.1657</td> <td>-0.0253</td> <td>0.490</td> </tr> <tr> <td></td> <td>1.8924</td> <td>1.9259</td> <td>-0.0335</td> <td>0.478</td> </tr> </tbody> </table>						Unit Under Calibration		Cal. Standard Reading	Error in kVA	*Exp. Uncertainty (±) in % of reading	Range	Reading				2 kVA	0.0634	0.0624	0.0010	1.637	L.C.: 0.001	0.7534	0.7785	-0.0251	0.497		1.1434	1.1657	-0.0253	0.490		1.8924	1.9259	-0.0335	0.478
Unit Under Calibration		Cal. Standard Reading	Error in kVA	*Exp. Uncertainty (±) in % of reading																															
Range	Reading																																		
2 kVA	0.0634	0.0624	0.0010	1.637																															
L.C.: 0.001	0.7534	0.7785	-0.0251	0.497																															
	1.1434	1.1657	-0.0253	0.490																															
	1.8924	1.9259	-0.0335	0.478																															
<table border="1"> <thead> <tr> <th colspan="2">Unit Under Calibration</th> <th>Cal. Standard Reading</th> <th>Error in PF</th> <th>*Exp. Uncertainty (±) in PF</th> </tr> </thead> <tbody> <tr> <td>Range</td> <td>Reading</td> <td></td> <td></td> <td></td> </tr> <tr> <td>1 PF</td> <td>0.999</td> <td>-1.000</td> <td>-0.001</td> <td>0.010</td> </tr> <tr> <td>L.C.: 0.001</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>						Unit Under Calibration		Cal. Standard Reading	Error in PF	*Exp. Uncertainty (±) in PF	Range	Reading				1 PF	0.999	-1.000	-0.001	0.010	L.C.: 0.001														
Unit Under Calibration		Cal. Standard Reading	Error in PF	*Exp. Uncertainty (±) in PF																															
Range	Reading																																		
1 PF	0.999	-1.000	-0.001	0.010																															
L.C.: 0.001																																			
POWER FACTOR @ 230 V / 1 A, @ 60 Hz:																																			
Brief Results : Observed values are reported. Refer calibration certificate before use.																																			
General Remarks: <ol style="list-style-type: none"> A Sticker indicating 'Calibration Status' has been affixed on the instrument. As Requested, Next Calibration Due Date: 14/03/2020 No Error adjustment was done Before Calibration. *Expanded uncertainties are estimated at confidence level of 95% with k=1.96. Readings reported above are average of 5 readings. Ranges marked with "*" are not covered under our scope of Accreditation. Results reported do not convey any long term stability data since noted for short duration. 																																			
Abbreviations Used: P.O.K.: Physically O.K. OP: Unknown; Operational condition Unknown. P.D.: Physically Damaged. UUC: Unit Under Calibration																																			
Calibrated By : N.V.RAO		Certified By : B.P.KARANDIKAR (Dy.HEAD OF LAB)																																	
Signature : 		Signature : 																																	
END OF CERTIFICATE																																			
LAB AT : A-92, 33 TH BLOCK, MIDC, PIMPRI, PUNE - 411 018. ● TEL : (020) 27473409, 27473895 ● FAX : (020) 27472031 ● SERVICE CALL NO. 98 810 76 854 ● E-mail : market@nptcalibration.com ● www.npkcalibration.com																																			

Testing procedure for coverage area.



Actual Pictures of Fan Installation

Test Measurements for 20 Feet Fan.

 N. P. K. FOUNDERS (Test & Calibration Lab. Division) Calibration And Testing of Test & Measuring Instruments for ISO 9001 & TS.						
LAB & OFFICE AT : A-82, 93 'H' BLOCK, M.I.D.C. PIMPRI, PUNE - 411 018. ● TEL : (020) 27473429, 27478895 ● FAX : (020) 27472631 ● SERVICE CELL NO. 98 810 78 834 LAB 2 AT : W-18, M.I.D.C., Wal, Dist. Solara - 412 803. ● E-mail : marketing@npkcalibration.com ● www.npkcalibration.com						
Test report No. 201904/02 /VAL		Date: 04/04/2019 Page 2 of 2				
10. TEST SPECIFICATIONS / TEST RESULTS: SAMPLE ID No.201904/02 Operating conditions as offered by client on site. The fan was mounted on ceiling 30 feet above floor level with 20 feet diameter 3 blades in a factory shed. Air velocity is measured at specified distance from fan. Speed of the fan was of 80-81 RPM during measurement as on client's application. Average values are reported in results.						
Sr. No.	Name of Test or Parameter	Details of specifications / Standard applicable	Test Requirement	Observations		
				Unit: m/s	Max. Value	Min. value
10.1	Air Velocity Measurement	not specified	Air velocity measurement carried out at 7 locations at distance of every 10 feet from motor upto 70 feet in total. Refer location Map Annex Page 1 of 2	Location 1:	0.3	0.2
				Location 2:	0.8	0.3
				Location 3:	1.6	0.2
				Location 4:	0.2	0.1
				Location 5:	0.7	0.2
				Location 6:	0.4	0.2
				Location 7:	0.2	0.1
10.2	Power consumption	not specified	To measure maximum power drawn by the fan at 80-81 RPM Speed. Refer Annex Page 2 of 2 for photo	---	0.785 kW	---
Test Carried out at Environmental conditions 32 to 36 °C . 25 to 36% RH.						
Remarks: 1. Observed values are reported. 2. Results reported do not convey any long term stability data since tested for short duration.						
Tested By : K.M.GHATNEKAR		Certified By: P.P.KARANDIKAR (HEAD OF LAB.) Signature : 				
Notes: This Certificate refers only to the particular item submitted for Test / calibration. This certificate shall not be reproduced except in full unless written permission is obtained from Authorised Signatory for N.P.K. Founders, (Test & Cal.Lab.). Test / Calibration results reported in the certificate are valid at the time of and under the stated conditions of measurement and/or test.						
END OF TEST REPORT						

**Ground level to Fan
Distance : 24 Feet**



N. P. K. FOUNDERS

(Test & Calibration Lab. Division)

Calibration And Testing of Test & Measuring Instruments for ISO 9001 & TS.

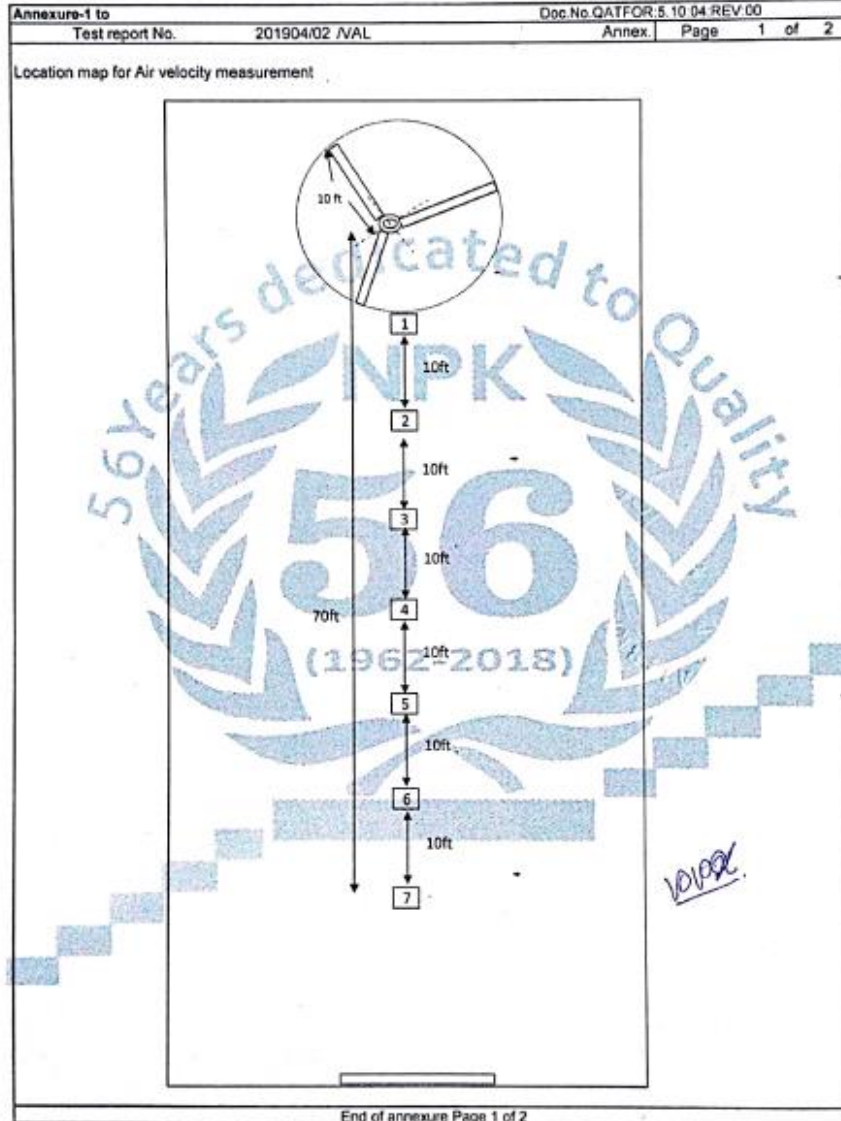


LAB & OFFICE AT : A-92, 93 'H' BLOCK, M.I.D.C. PIMPRI, PUNE - 411 018.

● TEL. : (020) 27473429, 27478895 ● FAX : (020) 27472631 ● SERVICE CELL NO. 98 810 78 834

LAB 2 AT : W-18, M.I.D.C., Wal, Dist. Satara - 412 803.

● E-mail : marketing@npkcalibration.com ● www.npkcalibration.com





N. P. K. FOUNDERS

(Test & Calibration Lab. Division)

Calibration And Testing of Test & Measuring Instruments for ISO 9001 & TS.



LAB & OFFICE AT : A-92, 93 'H' BLOCK, M.I.D.C. PIMPRI, PUNE - 411 018.

● TEL. : (020) 27473429, 27478895 ● FAX : (020) 27472631 ● SERVICE CELL NO. 98 810 78 834

LAB 2 AT : W-18, M.I.D.C., Wai, Dist. Satara - 412 803.

● E-mail : marketing@npkcalibration.com ● www.npkcalibration.com

Annexure-1 to

Doc.No.QATFOR.5.10.04.REV.00

Test report No. 201904/02 /VAL

Annex. Page 2 of 2

Photographs:

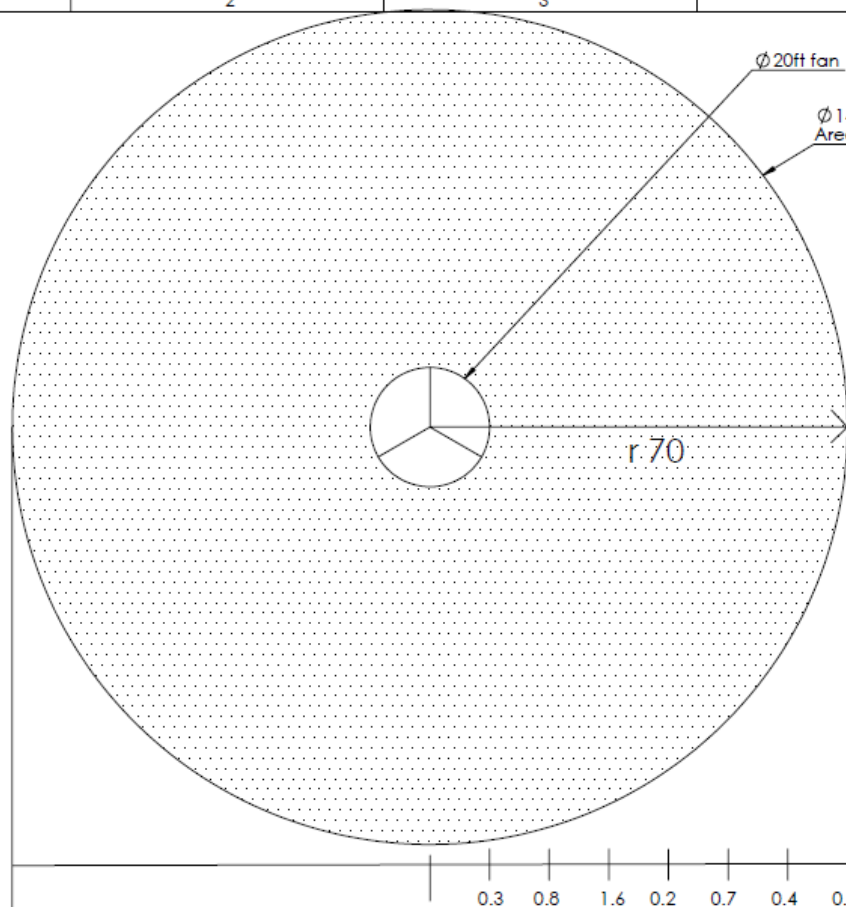
3 blade fan mounted :



Power consumption measured on power meter:



End of annexure Page 2 of 2



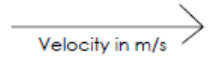
Calculation for Area of coverage

Area for circle is given by;
 $A = \pi \times r^2$

Note: It is observed that upto 70ft radially or 140 ft diametrically, we found a good airflow with cooling effect

From reading at 80 rpm we found airflow upto radius 70ft

Hence
 $r = 70 \text{ ft}$
 $A = 3.142 \times (70)^2$
 $A = 15,396 \text{ sq-ft}$



- NOTES: (Unless otherwise specified)
1. Remove all sharpe Edges with 0.5X45° chamfer.
 2. Fillet R1.0 mm
 3. Critical Dimensions:

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF FALCO eMOTORS PVT LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF FALCO eMOTORS PVT LTD IS PROHIBITED.

MATERIAL:	Qty/unit:	
ALT.MATERIAL:		
MATERIAL CALL OUT:		
PROCESS:		
Unless otherwise specified		
-X	-XX	-XXX
±0.1	±0.05	±0.03
Angular	±1°	

DRAWN BY	VDS 4.4.19
CHECKED BY	DAK
ENGG-APP BY	
MFG-APP BY	



Falco eMotors Pvt. Ltd
 PROJECT: Epoch system

TITLE: Area of coverage for ϕ 20ft fan	
SIZE DWG. NO.	A3 503543
REV	0
SCALE: 1:1 WT:	SHEET 1 OF 1

DO NOT SCALE DRAWING

Test Measurements for 16 Feet Fan.

**CALIBRATION LABORATORY FOR
ELECTRO-TECHNICAL, TEMPERATURE,
MECHANICAL-DIMENSIONAL & PRESSURE
INSTRUMENTS, TORQUE, MASS & VOLUME
VIBRATION & ACCELEROMETER**

Ph. No. : (020) 67115100, 27660325, 27660326
E-MAIL : calibration@universalinstruments.co.in
Web : www.universalinstruments.co.in

UNIVERSAL
CALIBRATION SERVICES PVT. LIMITED

PLOT NO. G-43/1 & 2, G-44/1 & 2, G-BLOCK,
AJANTA NAGAR, BEHIND KASTURI MARKET,
MIDC, CHINCHWAD, PUNE - 411019.

CALIBRATION CERTIFICATE

Calibrated For:	FALCO EMOTORS PVT.LTD. A-105, H-BLOCK, NEAR MARWADI COURT, MIDC PIMPRI, PUNE-18	Certificate No. :	UI/190523/511/001
		Date of calibration :	23/05/2019
		Calibration due date :	22/05/2020
		Received date/Condition :	23/05/2019 /GOOD
		Calibration at :	Universal Instruments Lab
		Page no. :	1 of 3

DETAILS OF UNIT UNDER CALIBRATION

Nomenclature :	DIGITAL HOT WIRE ANEMOMETER	Id. No. :	IML/411/FLOW/M
Make :	LUTRON		
Sr. No. :	S023844		

Environmental Conditions:- Temperature : 26.38 °C Relative Humidity : 64.38 %

STANDARD USED FOR CALIBRATION

Sr.No.	Instrument Name	Instrument sr.no	Certificate No	Calibrated By	Valid upto
1	THERMAL ANEMOMETER	01925020	CAW 2350 1901 216	FCRI, PALAKKAD, KERALA	15/01/2021

RESULT OF CALIBRATION

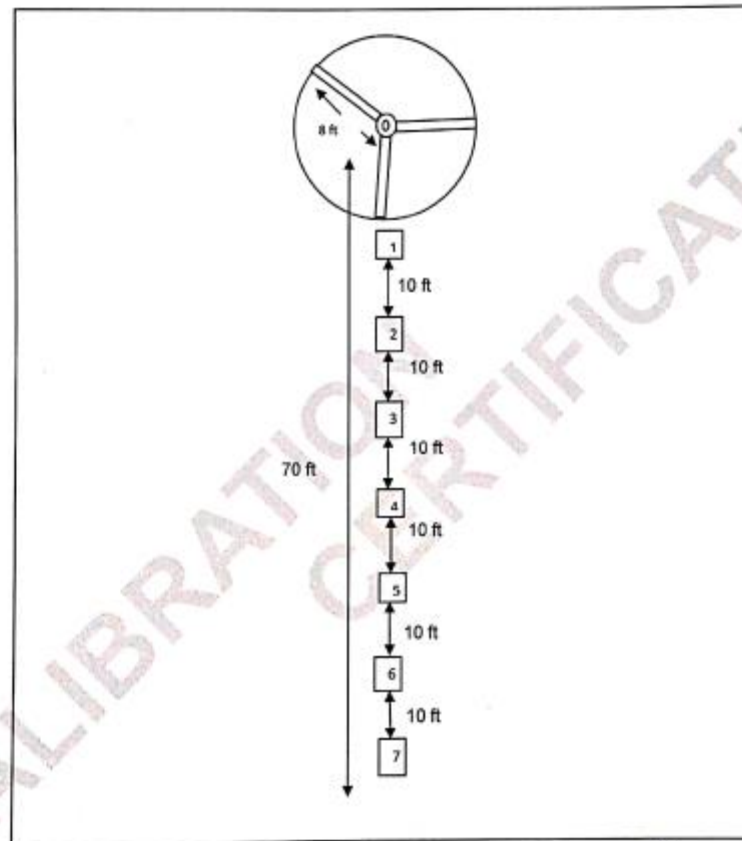
Sr. No	Name of Test or Parameter	Details of specifications /Standard applicable	Test Requirement	Observation		
				Unit :m/s	Max Value	Min Value
1	Air Velocity Measurement	Not Specified	Air velocity measurement Carried out at 7 locations at Distance of every 10 feet from motor upto 60 feet in total Refer location Map Page 2 of 3	Location 1	4.12	1.72
				Location 2	1.97	0.14
				Location 3	1.17	0.15
				Location 4	1.05	0.11
				Location 5	1.26	0.11
				Location 6	0.86	0.13
2	Power consumption	Not specified	Reading of maximum power drawn by the fan at 90-91 RPM speed Refer Annex. Page 3 of 3 for photo	--	0.529 kW	--

Ground level to Fan
Distance : 18 Feet



CALIBRATION CERTIFICATE

Certificate No: UI/190523/511/001 Date Of Calibration: 23/04/2019 Page No.: 2 of 3



Authorized by :

K. M. Bhosale
(Technical Manager)



CALIBRATION CERTIFICATE

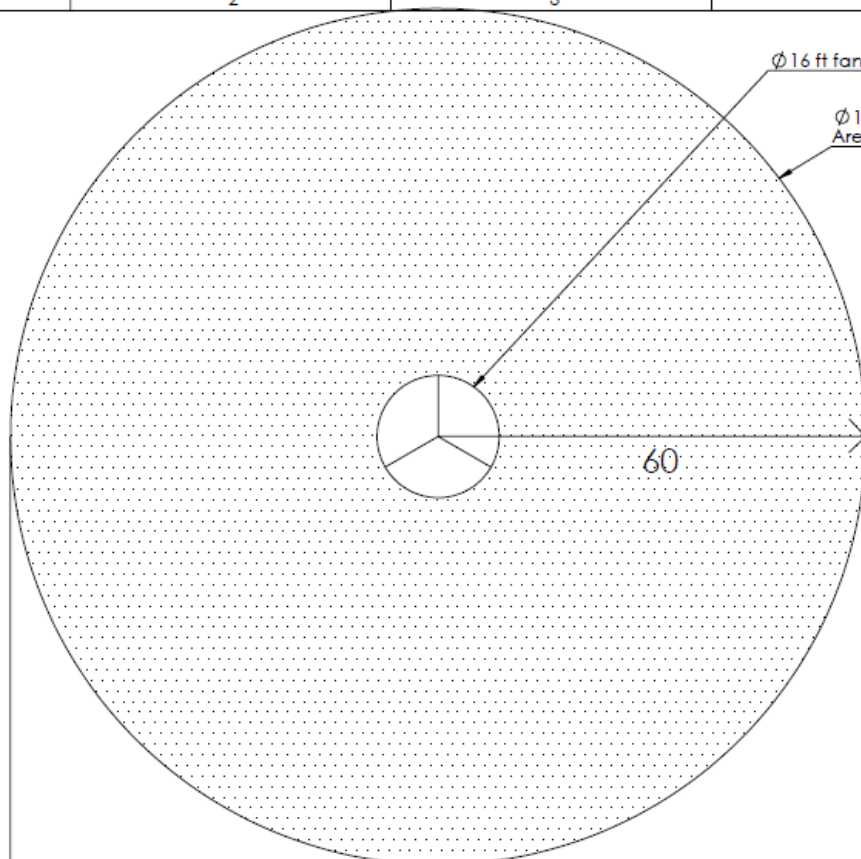
Certificate No: UI/190523/511/001 Date Of Calibration: 23/04/2019 Page No.: 3 of 3



Authorized by :

K. M. Bhosale
(Technical Manager)





Calculation for Area of coverage

Area for circle is given by;

$$A = \pi \times r^2$$

Note: It is observed that upto 60 ft radially or 120 ft diametrically, we found a good airflow with cooling effect

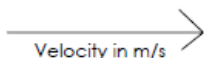
From reading at 91 rpm we found airflow upto radius 60 ft

Hence

$$r = 60 \text{ ft}$$

$$A = 3.142 \times (60)^2$$

$$A = 11311 \text{ sq-ft}$$



NOTES: (Unless otherwise specified)

1. Remove all sharp Edges with 0.5X45° chamfer.
2. Fillet R1.0 mm
3. Critical Dimensions

THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF FALCO eMOTORS PVT LTD. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF FALCO eMOTORS PVT LTD IS PROHIBITED.

MATERIAL:		
ALT.MATERIAL:		
MATERIAL CALL OUT:		
PROCESS:		
Unless otherwise specified		
.X	.XX	.XXX
±0.1	±0.05	±0.03
Angular		±1°

Qty/unit:	
DRAWN BY	VDS 4.4.19
CHECKED BY	DAK
ENGS-APP BY	
MFG-APP BY	

Falco eMotors Pvt. Ltd	
PROJECT: Epoch system	
TITLE: Area of coverage for ϕ 16ft fan	
SIZE DWG. NO.	503723
A3	REV 0
SCALE: 1:1	WT:
SHEET 1 OF 1	



Questions

- USA
 - +1 877 278 6323
- India
 - +91 9028332255/66
- Email:
 - Epochfans@falcoemotors.com