



INNOVEK

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COFIMCO
AXIAL FANS FOR THE WORLD

TANDEM FAN

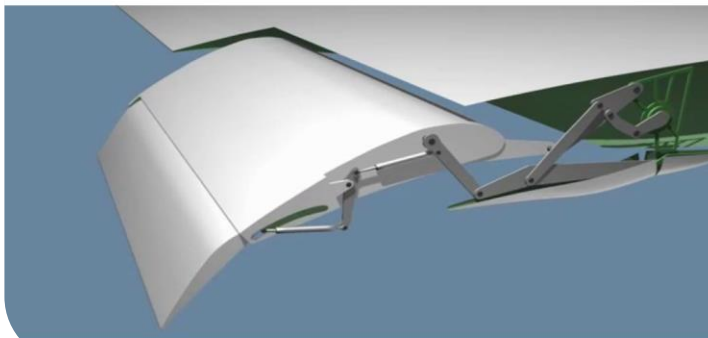
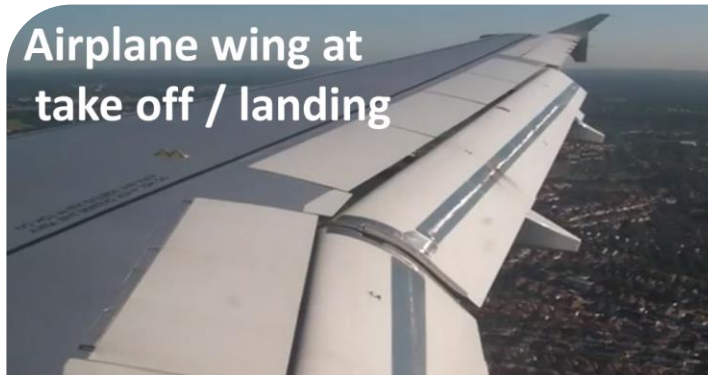
THE GAME CHANGER

BACK TO YEAR 2019



LAUNCHED TANDEM FAN

DUPLICATE AIR PLANE WING BUT **LIMIT DIAMETER 5.486 m (MAX)**



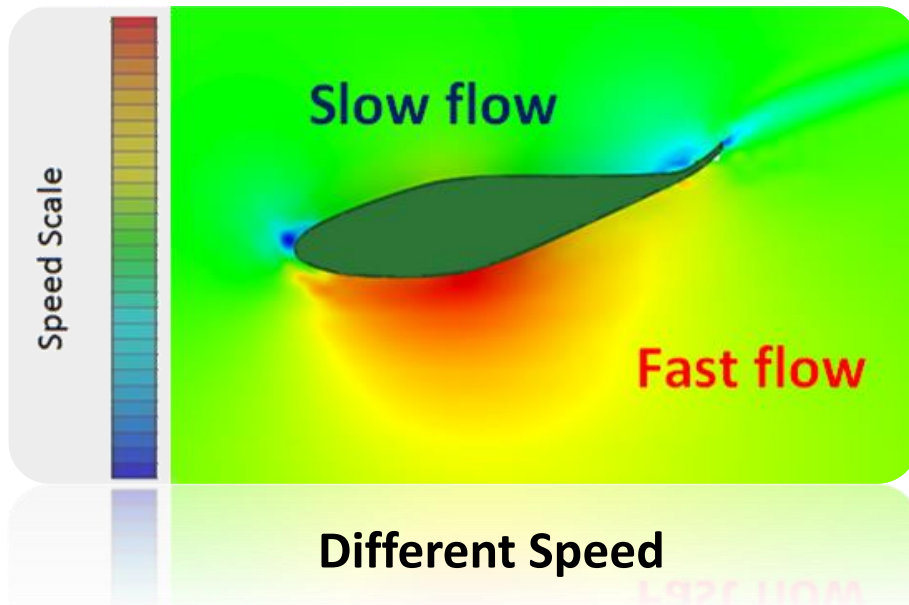


REVIEW

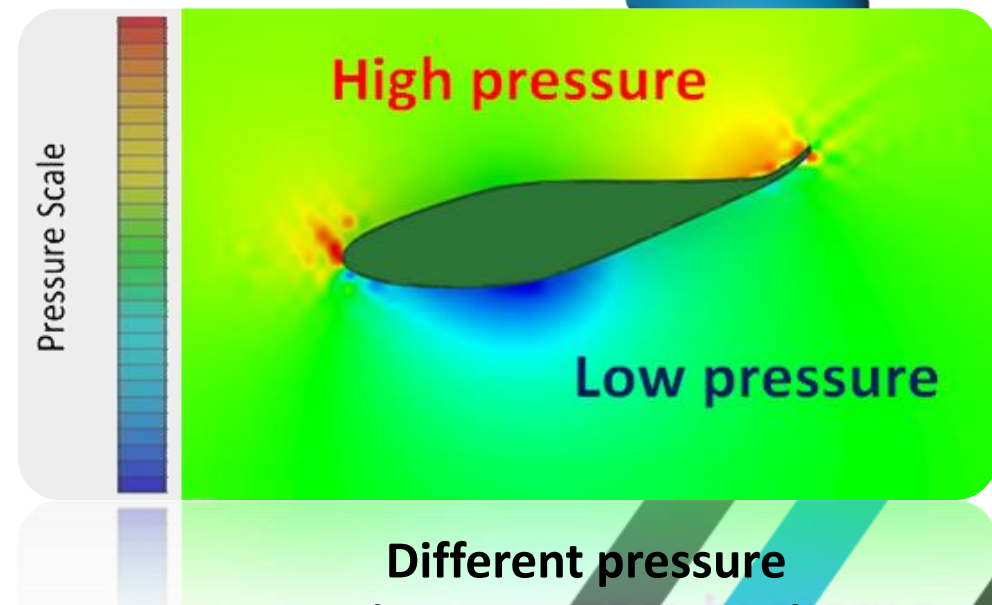
AERODYNAMIC

BASIS

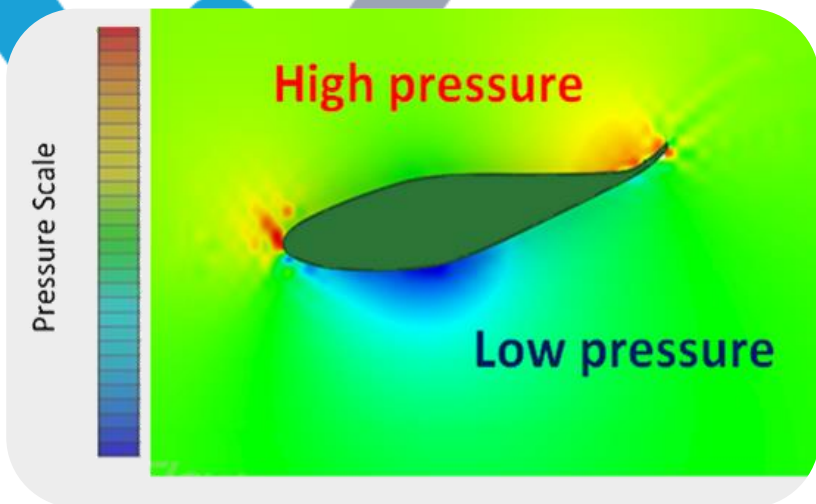
Fan blades are made using aerodynamic airfoils. When in rotation, the airflow approaching the leading edge, divided into an upper and lower flow with two different speeds.



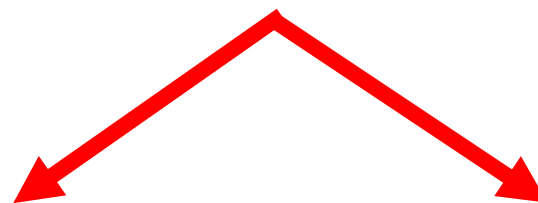
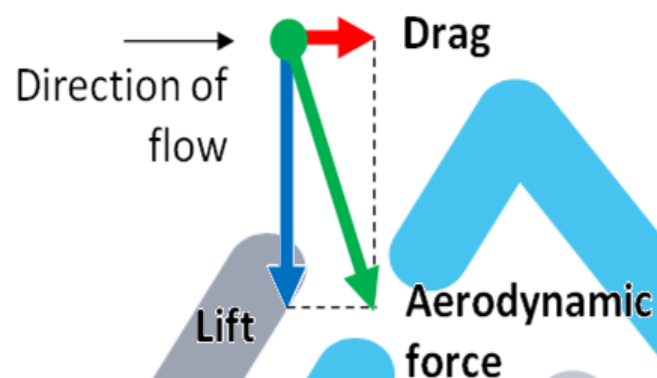
Different Speed



Different pressure
(Bernoulli Principle)



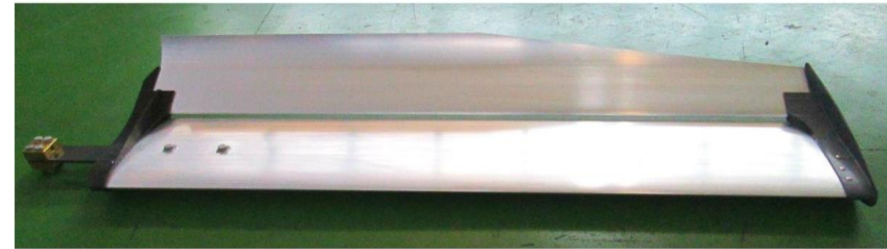
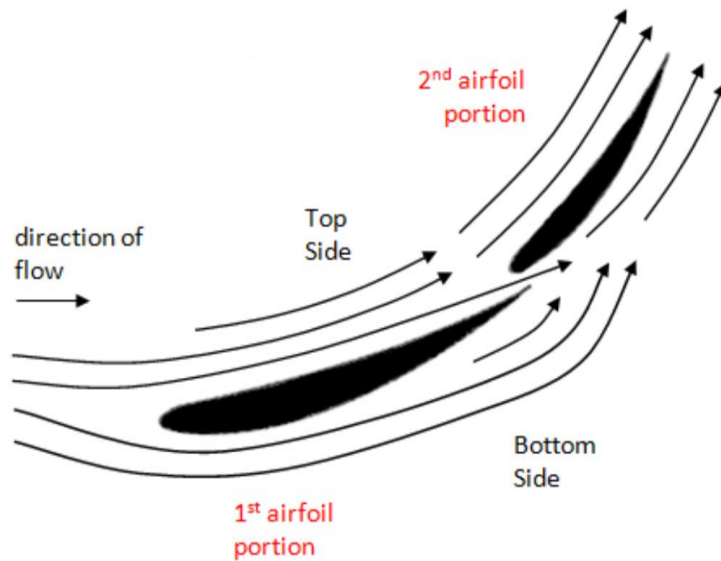
Different pressure on the airfoil top and bottom results in an aerodynamic force which can be divided into 2 components.



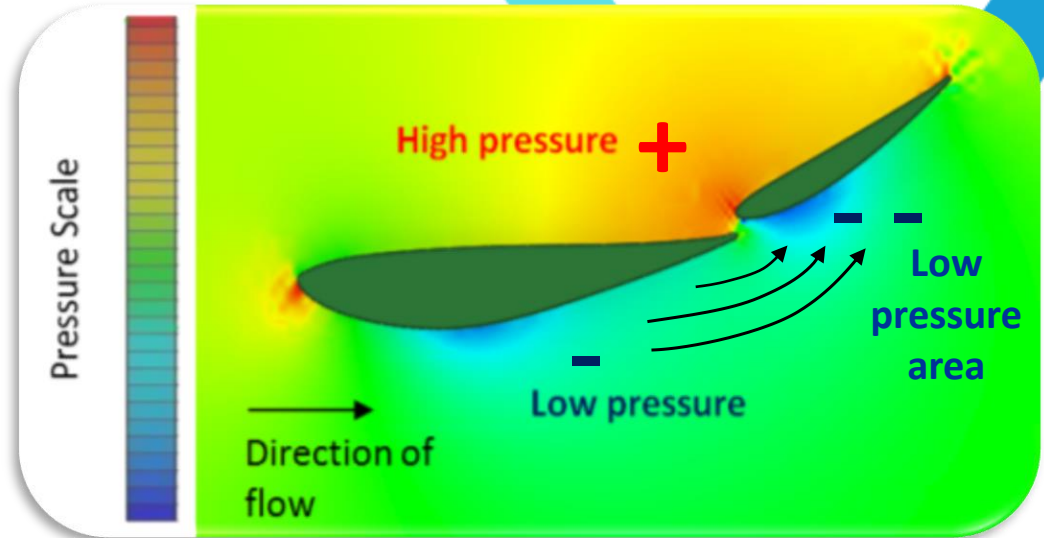
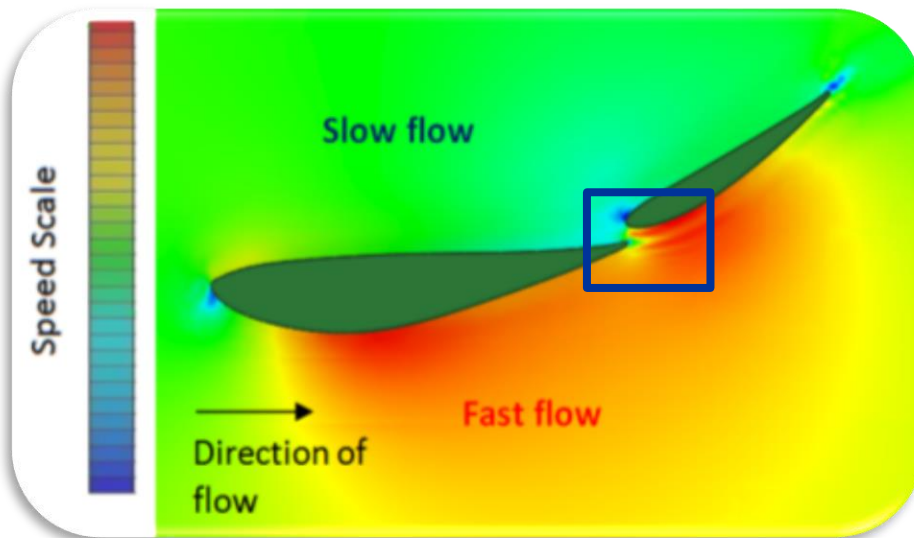
Air Volume
(on fan application)

Power Absorption
(on fan application)

The ultimate evolution in axial fan performance is represented by innovative TANDEM® BLADE where aeronautic concept of slotted airfoil has been applied.



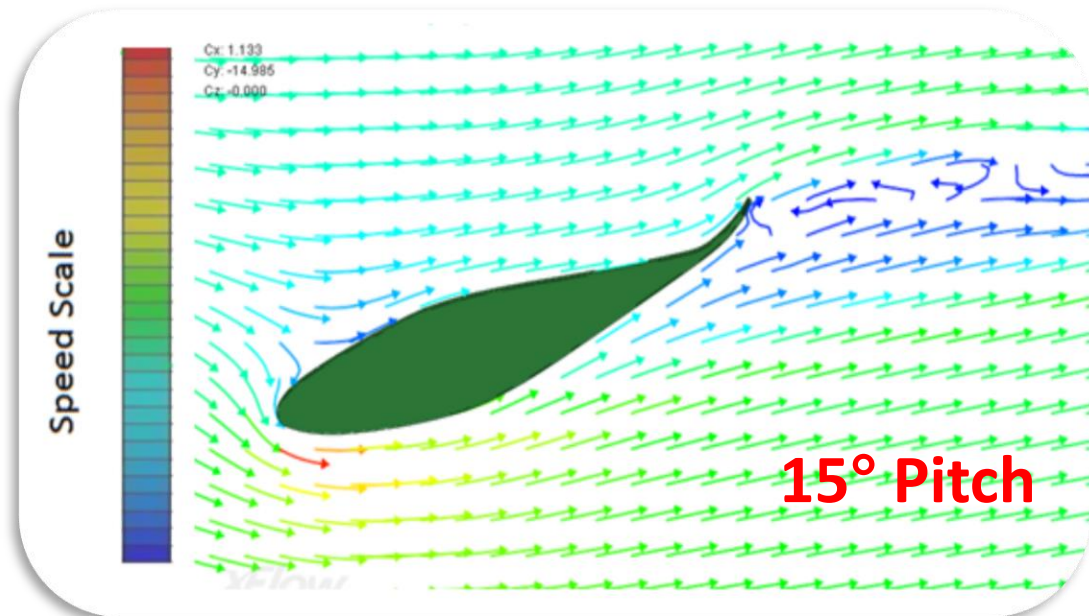
| TANDEM BLADE SOLUTION



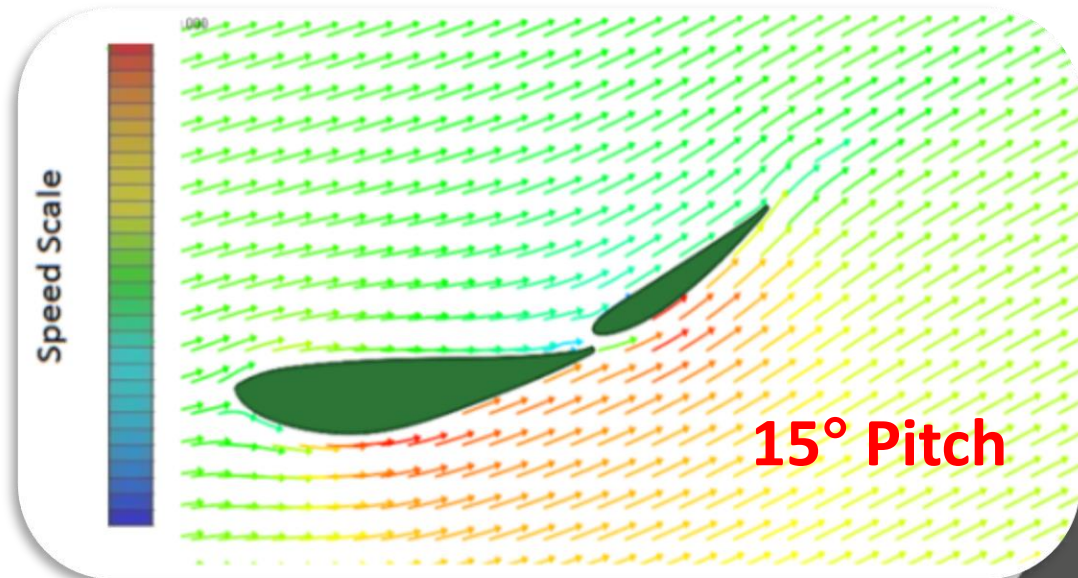
In aerodynamics, the application of a slotted airfoil has the scope of increasing performance.

The air speed in correspondence to the slot is very high and a **local low pressure area** is generated: the turbulent airflow on the bottom of the airfoil is sucked and reattached to the surface.

As a result, the lift of slotted airfoil is noticeably increased compared to traditional airfoils.



Simultaneously, a vortex reduction at the trailing edge is realized.



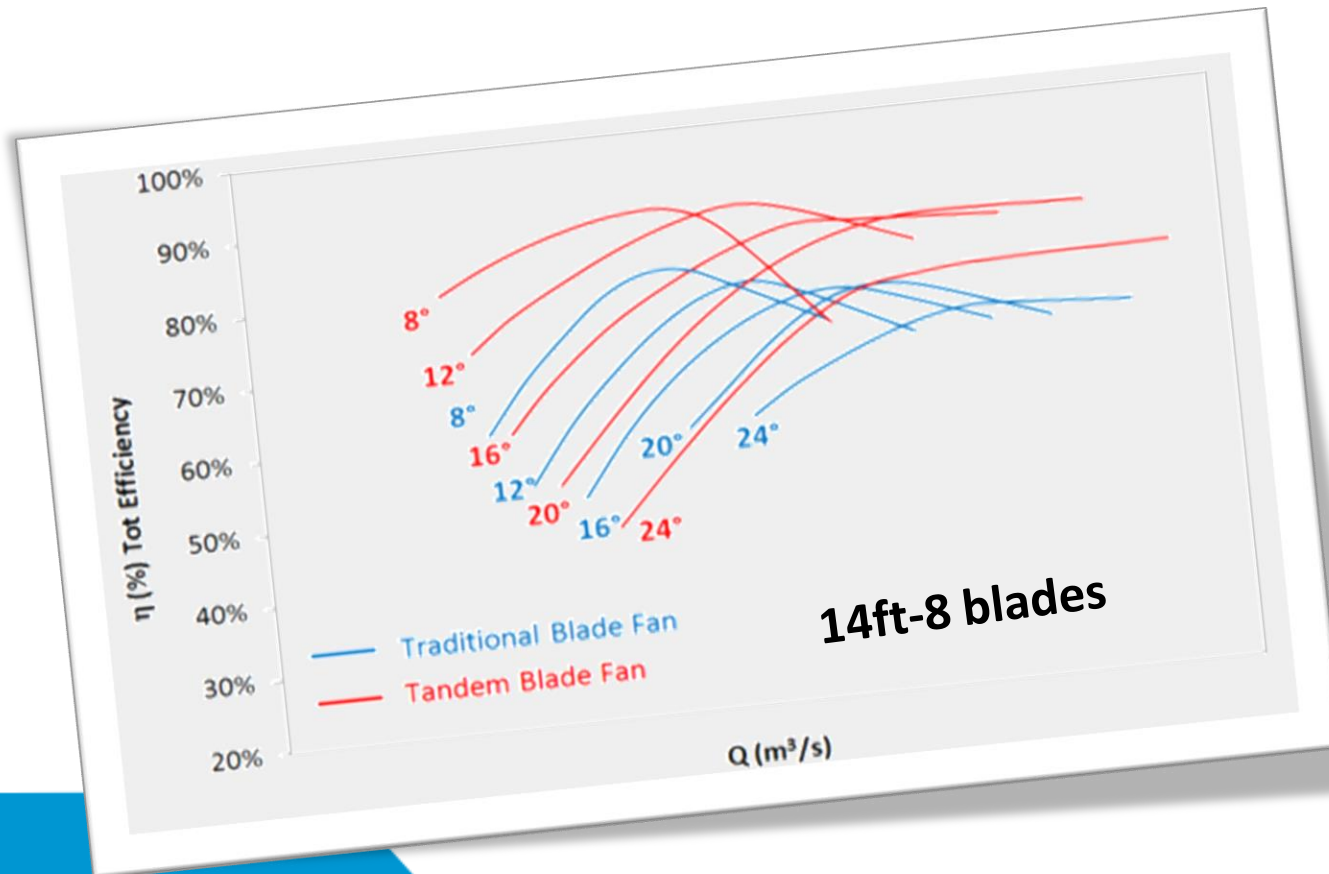
In fan applications, assigned a duty point, using tandem blade airfoils means:

- **The air volume can be provided with smaller or less #blades than usual.**
- **The fan efficiency is noticeably increase and power consumption correspondingly reduced.**
- **The fan noise can be reduced thanks to the vortex reduction and the lower speed the fan can be operated.**

The resulting Tandem Blade is the combination of 2 airfoils in extruded aluminum held together by special root and tip caps, available in the diameter range 10 – 18 ft (3.048-5.476m) with Cofimco flexi technology (strong reduction of vibration and load transmitted to drive system: life extension).



Fan total efficiency results noticeably increased compared to traditional airfoil (up to +25%) while power absorption is reduced for comparable operating curves.

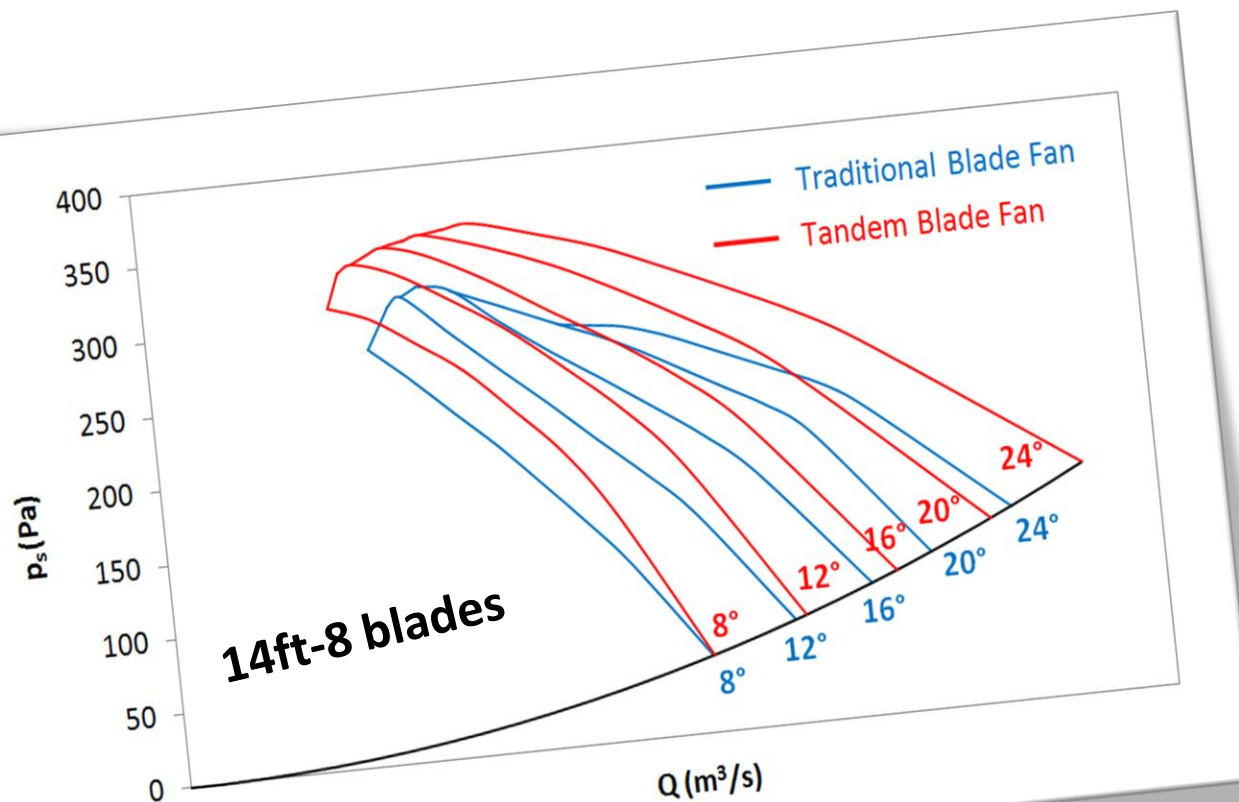


Tandem blade airfoil



Traditional blade airfoil

Fans equipped with Tandem Blades show higher performance than traditional blades of the same size at the same speed.



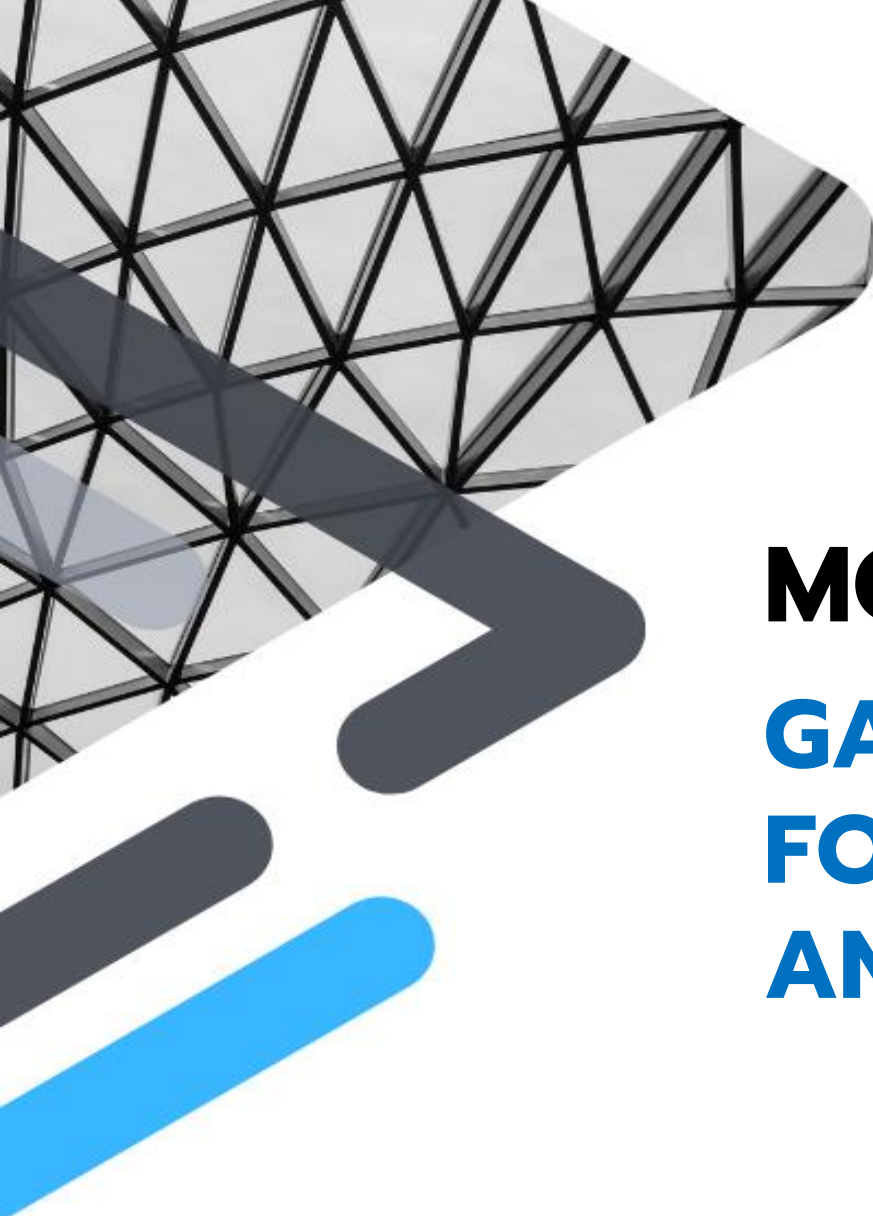
Tandem blade airfoil



Traditional blade airfoil



Total Efficiency
= ACFM * Total pressure
6356 * Fan Horse Power

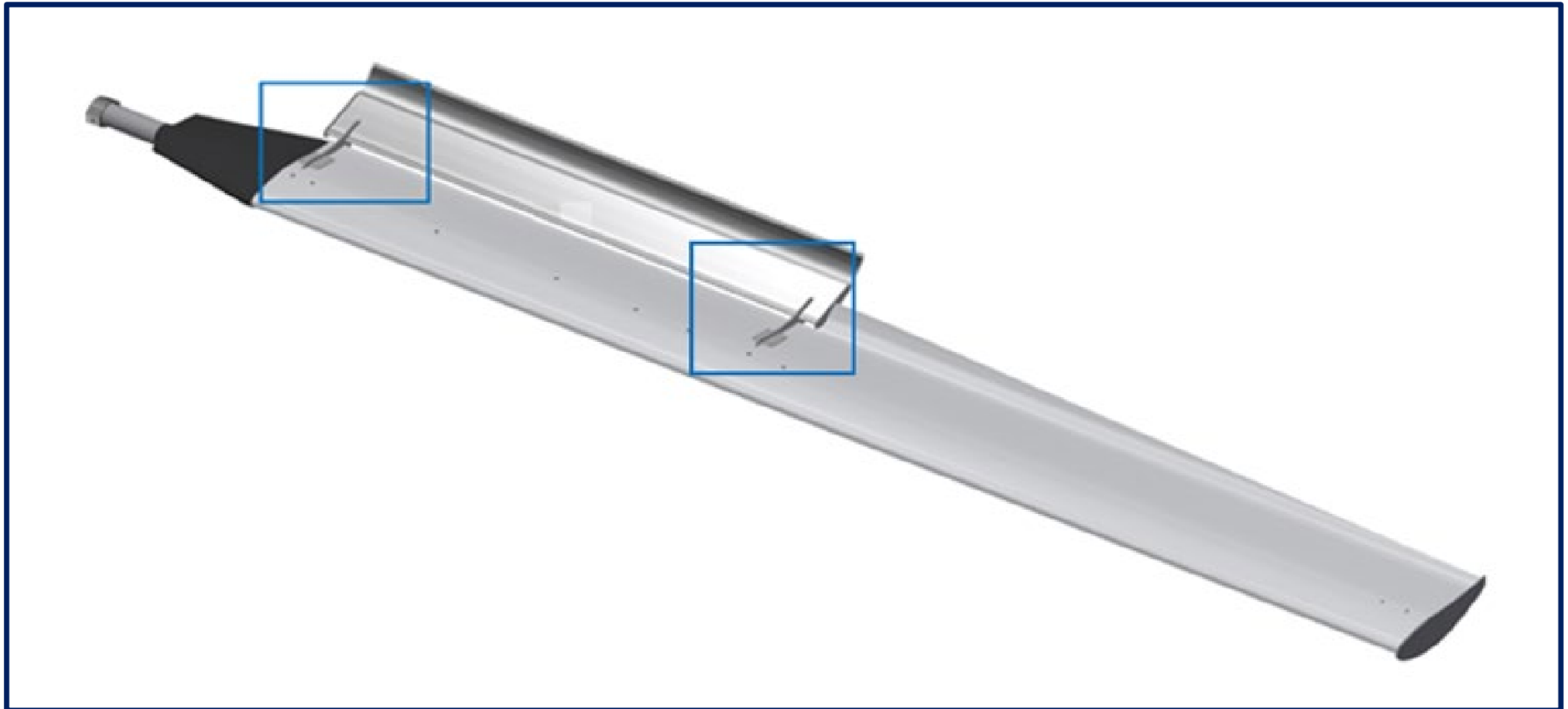


MODEL LAUNCHED 40TD

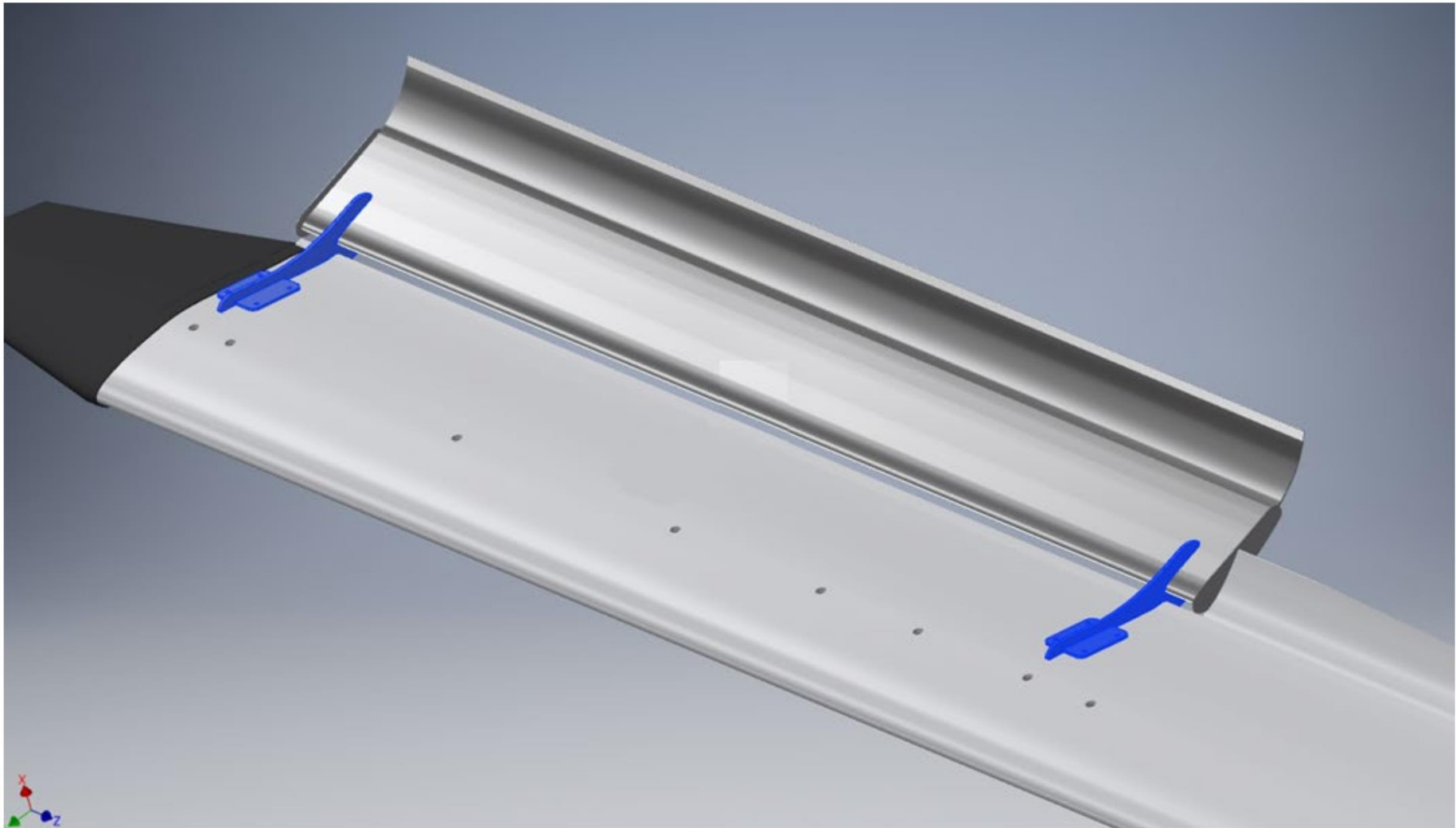
GAME CHANGER FOR COOLING TOWER AND ACC APPLICATION

40TD represents the ultimate application of TANDEM® technology for fan diameters up to 34ft.

The Tandem blade is obtained thanks to the application of stainless steel support directly rived in the root area of the main airfoil.



40TD represents the ultimate application of TANDEM ® technology for fan diameters up to 34ft.



40TD TANDEM ® BLADES have been extensively tested in the 38ft Megafan in Cofimco facility for different configurations and duty point combinations.



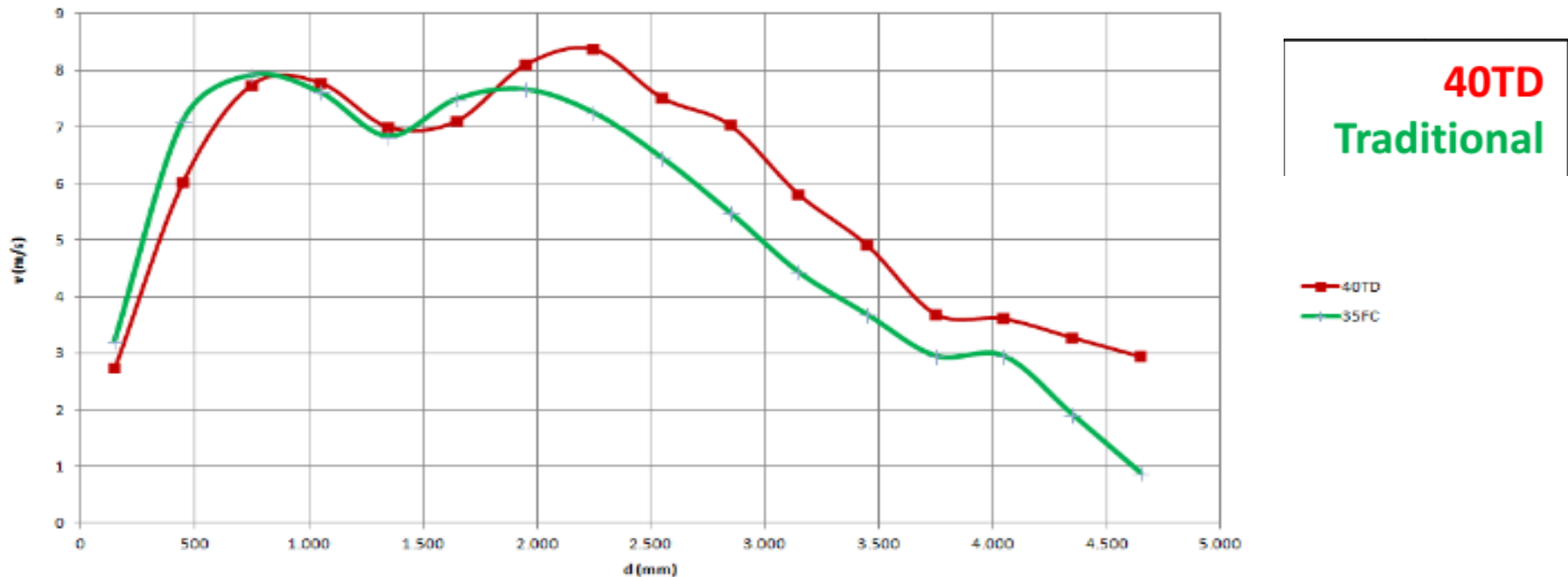
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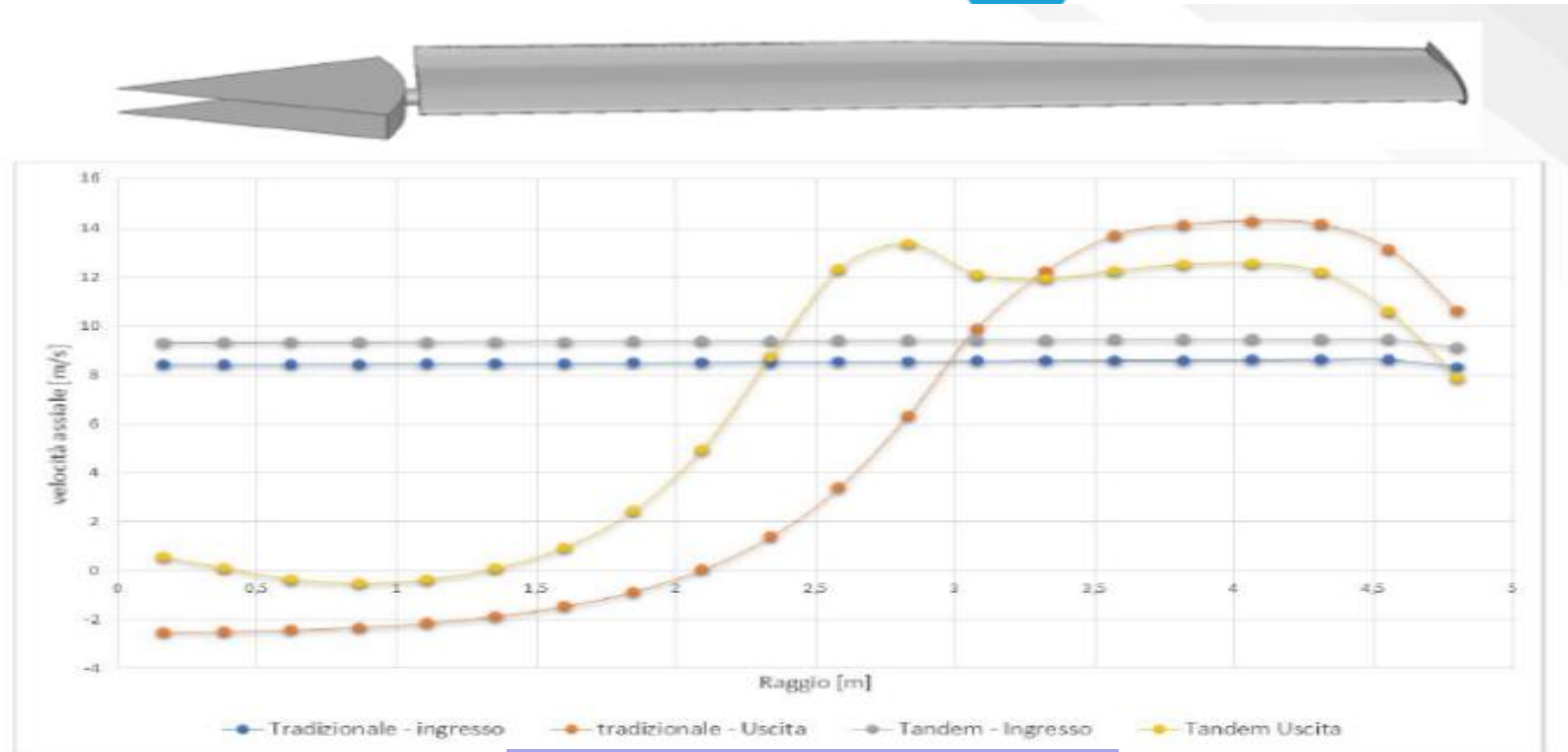
The speed distribution along blade length showed an improvement of the sucked flow toward the fan center and a reduction toward tip as expected



Fan diameter (mm)

The speed distribution along blade length showed an improvement of the sucked flow toward the fan center and a reduction toward tip as expected

Air
speed
(m/s)



Fan radius (mm)

The fan working areas can be set on Cofimco Megafan by changing the inclination of a louver system located in the test rig suction side.

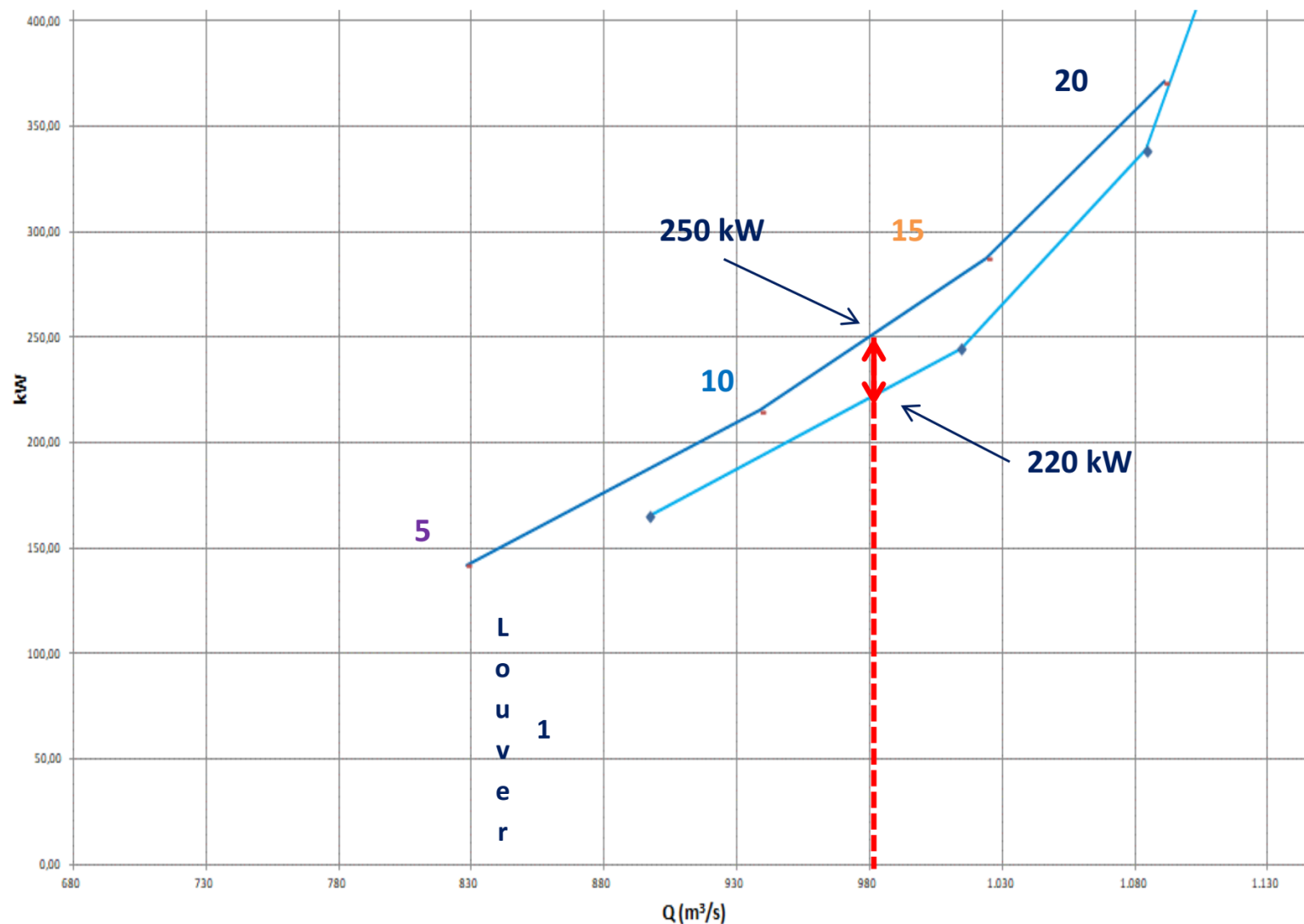


Each louver position stands for a different heat exchanger with its own curve.



In detail, for each louver position, it is possible to determine a corresponding fan curve that put in relation kW-Airflow.

For each louver configuration, the kW-Airflow relation of a traditional airfoil is compared to 40TD to determine possible benefit given by efficiency increase.



**kW-Airflow
38ft-12bl
Traditional**

**kW-Airflow
38ft-12bl
40TD**

40TD blade design features FRP components to withstand severe operating conditions for the ACC and CT markets.



40TD blade design features FRP components to withstand severe operating conditions for the ACC and CT markets.

Airfoil and **shaft** are obtained by **pultrusion process** → it means the blades are not obtained by mould and/or glued components but by an industrial, continuous process which has the scope of offering a monolithic section profile and shaft free of structural defects.

The introduction of **Carbon rovings** improve the shaft strength and limit the blade deflection above all large fans.

The proper mix of glass and carbon rovings result in the right combination of flexibility, strength and blade deflection.

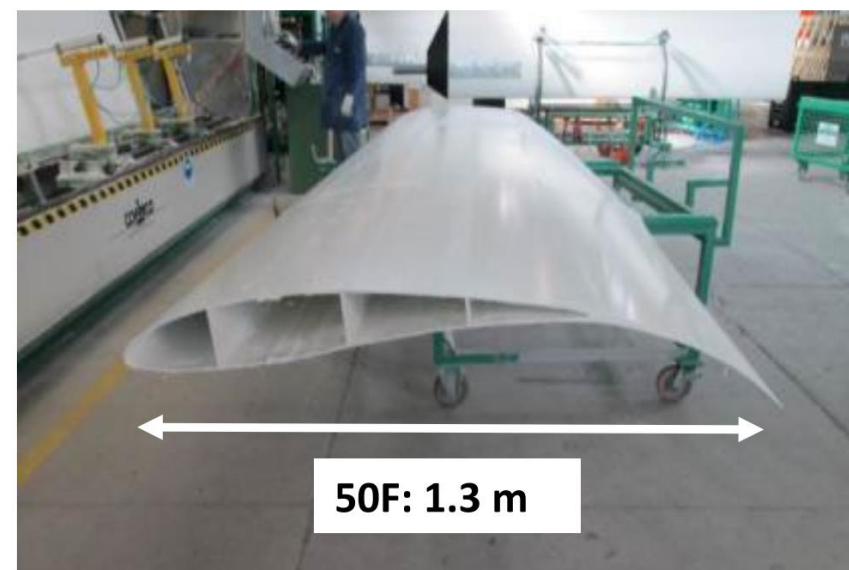


40TD blade design features FRP components to withstand severe operating conditions for the ACC and CT markets.

As for the pultrusion process, a monolithic FRP bar is obtained.

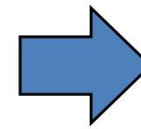


As a result, the typical issues/defect of hand laminated blades usually glued are avoided

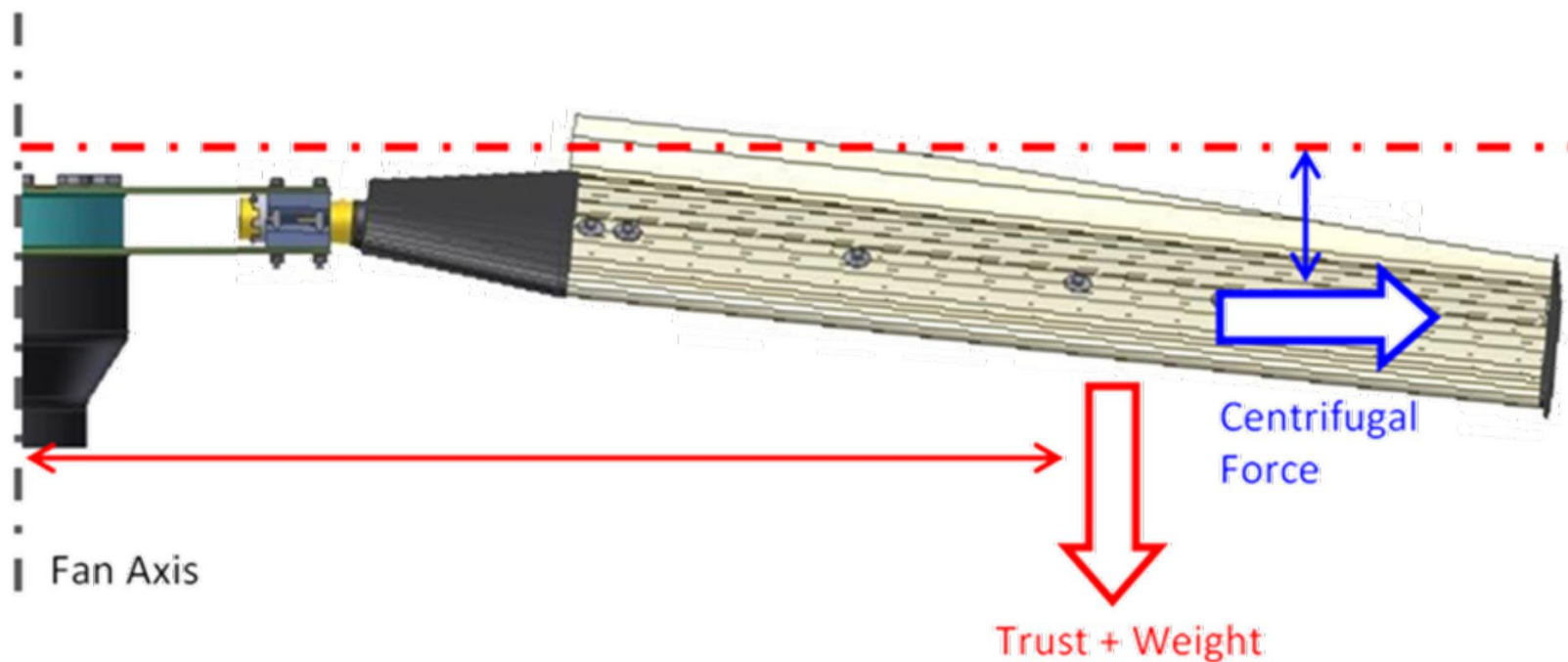


40TD blade design features FRP components to withstand severe operating conditions for the ACC and CT markets.

Thanks to blade Flexibility, the resulting Bending Moment is reduced thanks to Centrifugal Force Moment



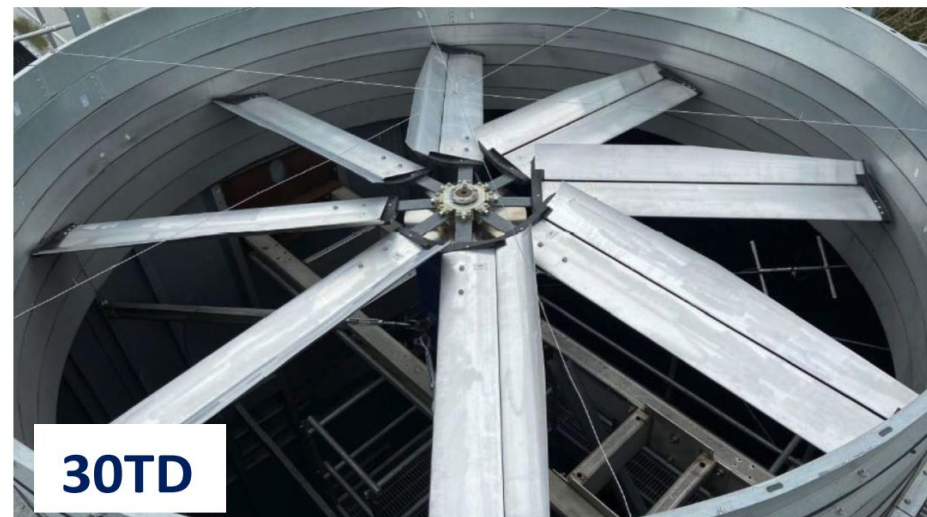
Reduction of the loads transmitted to drive system: Life extension



BENEFIT FOR 35F PROFILE CUSTOMER JUST PURCHASE 40TD KIT TO MOUNT ON EXISTING 35F BLADE PROFILE



High efficiency fan series foreseeing TANDEM® concepts ranges from 7ft up to 34ft thanks to 3 different blade sizes: 20TD, 30TD and 40TD





Axial fans for the world



corimco

- **COFIMCO S.r.l. was established in 1975**
- **COFIMCO is a global leader in the design, manufacture, sale and service of highly engineered aluminum and fiberglass axial fans**
 - **Products used in demanding cooling tower, air fin cooler, air cooled condenser and evaporative condenser applications**
- **Recognized as a technological leader in the industry holding numerous patents**
- **Leader in high efficiency fan blade and energy saving of fan blade**
- **Patented Flexy design for low vibration applications**
- **Recently introduced “CX Super Low Noise Profile” and the new 50F profile.**

COFIMCO

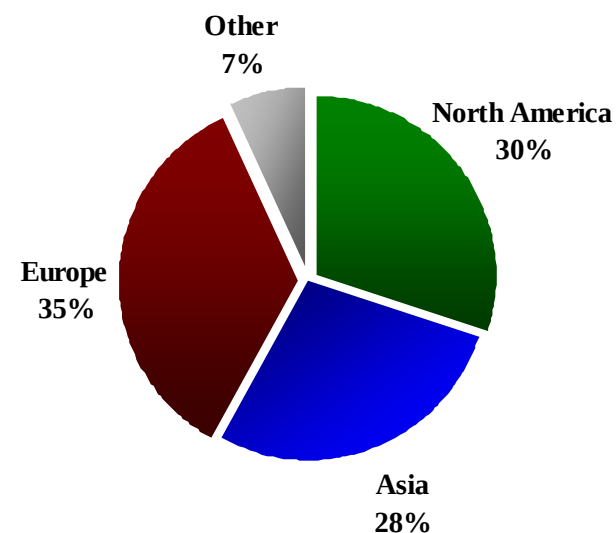
CONSISTS OF THE COMBINED INTERNATIONAL STRENGTHS AND TALENTS OF :

Cofimco Srl Italy	-	Founded in 1975
Cofimco USA	-	Founded in 1985
Cofimco International Shanghai	-	Founded in 2006
Cofimco Changshu	-	Founded in 2008

HIGHLY DEVELOPED GLOBAL PRESENCE

- Historical and continued commitment to international resources and infrastructure positions
- Over 35 years of international experience
 - Facilities in Europe, USA, China and India
 - 65% of sales outside Europe and in 14 foreign countries
 - 8 international sales engineers; 11 international sales representatives; and sales offices in USA, Brazil and China
 - Outsourcing and international manufacturing initiatives

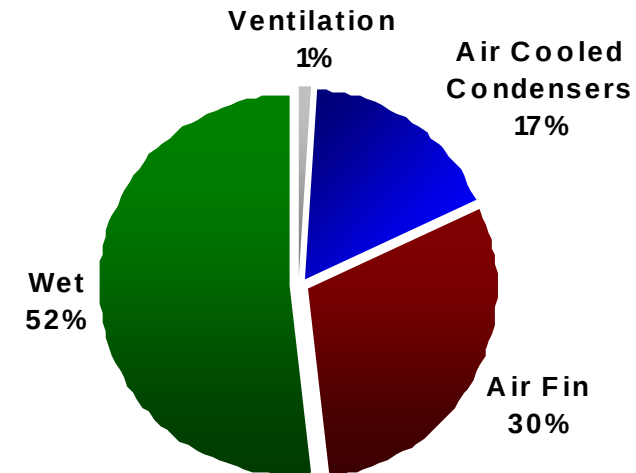
International Sales - 2006



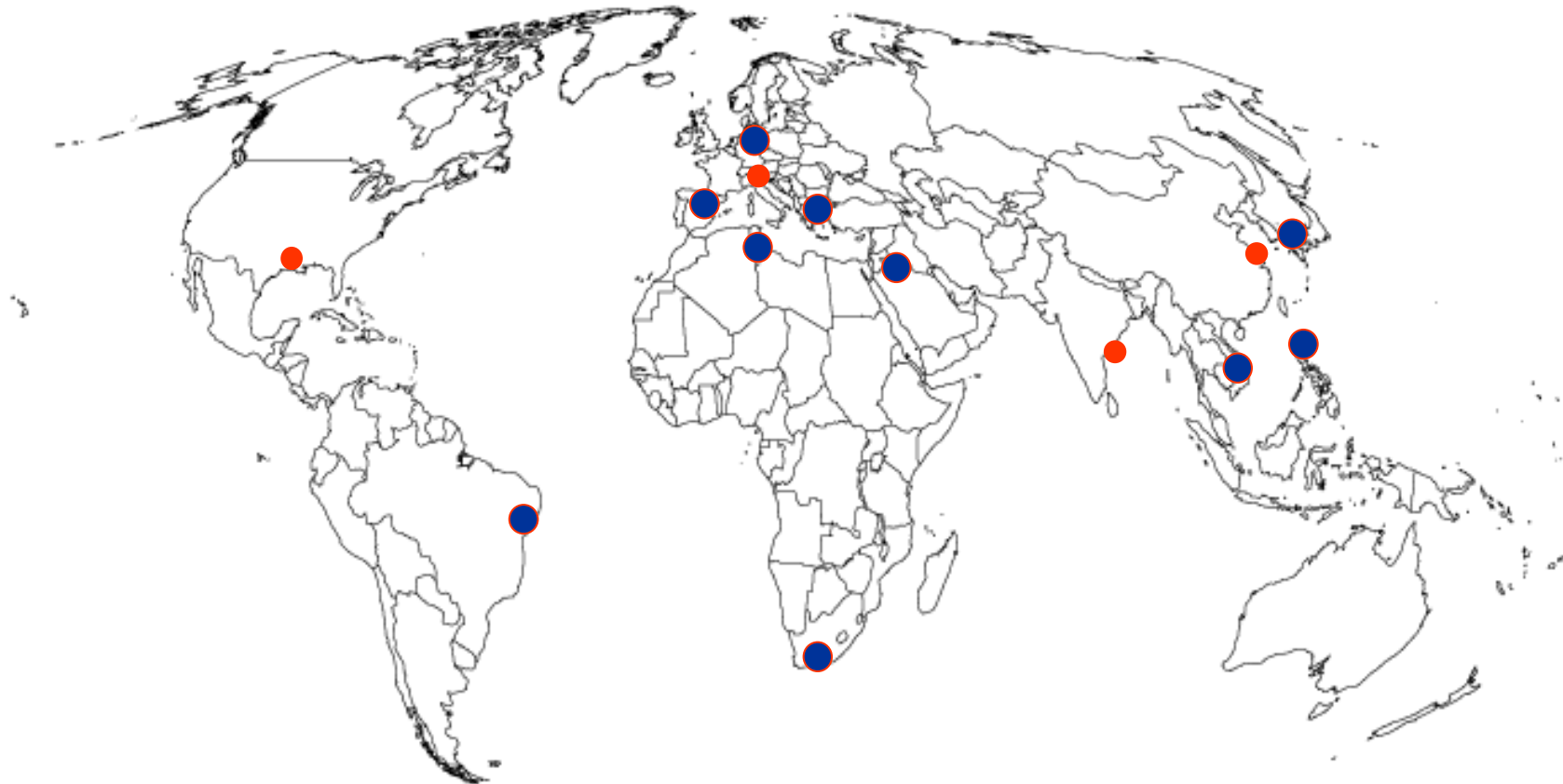
BROAD RANGE OF APPLICATIONS

- Broadest range of axial fan products for cooling applications
 - Wet cooling towers
 - Air cooled condensers
 - Air fin coolers

Sales by Application - 2006



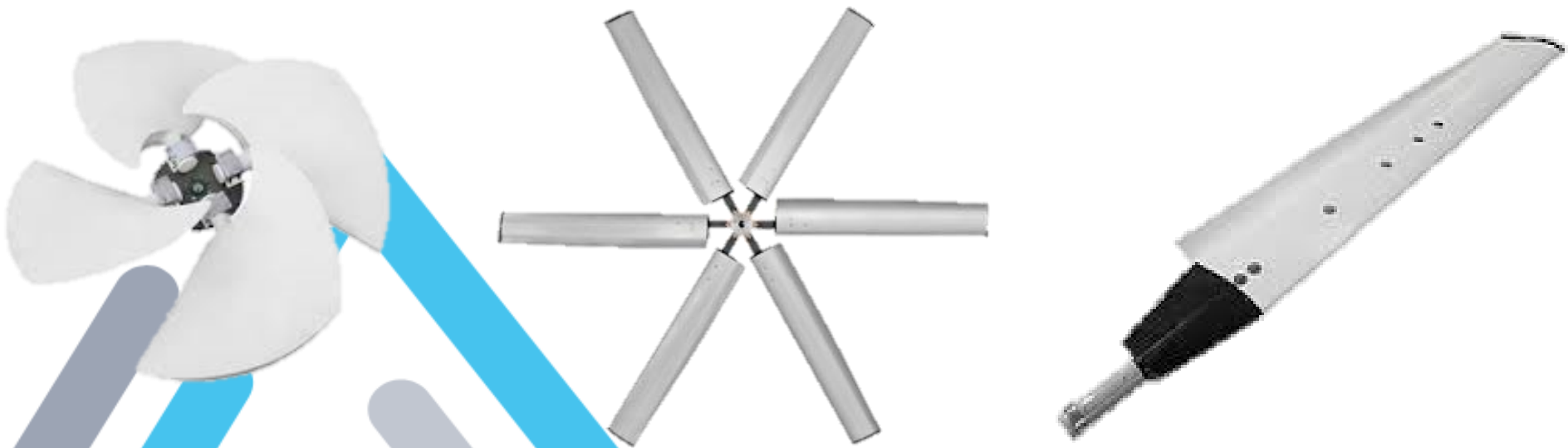
COFIMCO - WORLDWIDE COVERAGE



● Own Manufacturing & Sales ● Representatives

STRONG HISTORY OF PRODUCT AND PROCESS ENGINEERING

- Recognized as a leader in product innovation with 35 patents
- Development high efficiency and energy saving of fan blade
- Release of flexi fan technology that significantly reduces vibration & noise
- Development of Low Noise and Super Low Noise Profiles



WORLD-CLASS CUSTOMER BASE

Longstanding relationships with all the major cooling tower, air cooled condenser and air fin cooler manufacturers



Korea Heat Exchanger Co., Ltd.



COFIMCO'S OPERATION AND FACILITIES

COFIMCO'S EMPLOYEES AND FACILITIES



HEADQUARTERS

66,000 SQUARE FT. FACILITY;

105 EMPLOYEES

SALES, SERVICE, ENGINEERING,
MANUFACTURING & ASSEMBLY OPERATIONS



USA

22,000 SQUARE FT FACILITY:

25 EMPLOYEES

SALES, MANUFACTURING OF CX FANS,
CONSIGNMENT STOCK FOR USA
CUSTOMERS

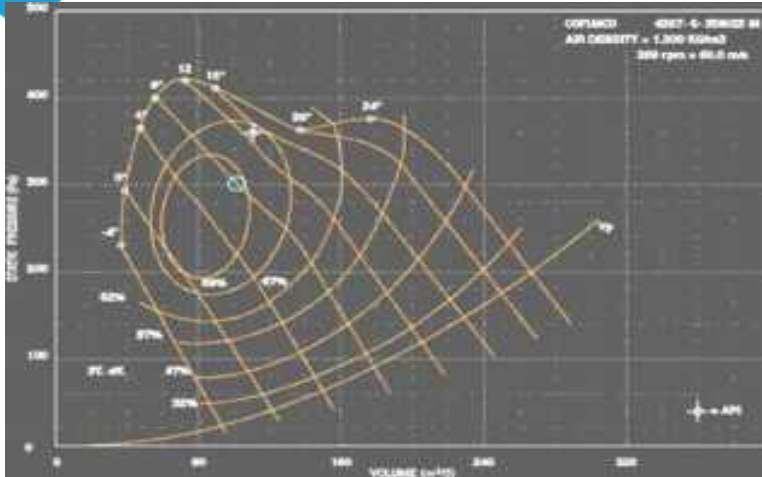
COFIMCO'S MANUFACTURING CAPABILITIES

- Welding – aluminum profiles
- Painting
- Automated machining
- Assembly
- Balancing



COFIMCO'S ENGINEERING AND PRODUCT DEVELOPMENT

COFIMCO'S EXTENSIVE ENGINEERING EXPERIENCE

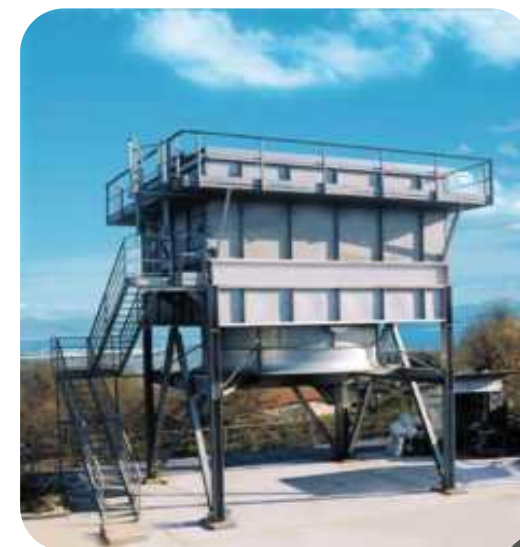


- Experience areas include:
 - Aerodynamics
 - Materials
 - Mechanical engineering
 - Sound attenuation
- Computerized fan selection program to identify optimal fan selection
- Fan selection program embedded in selected customer tower selection programs
- Extensive application experience

COFIMCO'S INVESTMENT IN RESEARCH & DEVELOPMENT

- Full and scaled model testing in two wind tunnels
 - 48in and 78in to BS848
 - Test data creates fan performance curves

- Two test rigs simulating actual air coolers verify the curves and determine the influence of tip clearance, aerodynamic disturbances and inlet shape.
 - Sound tests are also performed in accordance with DIN 45635.
 - Air resistance is available by the use of remotely operated vanes.

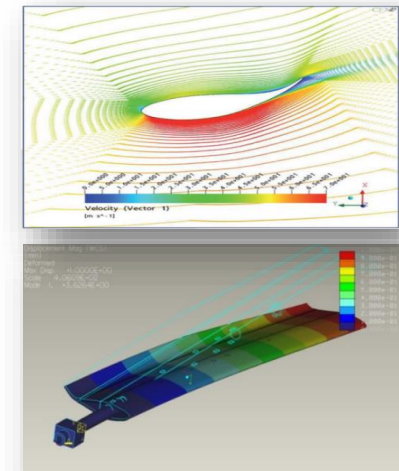
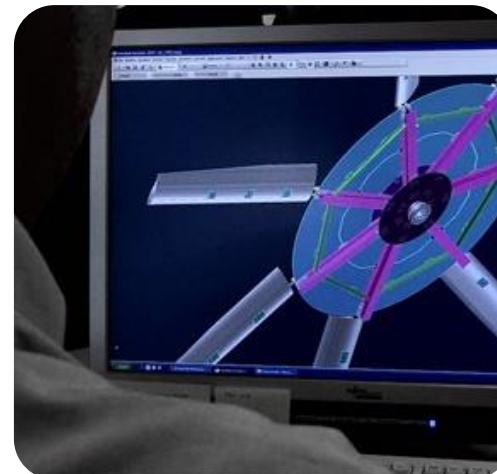


COFIMCO'S INVESTMENT IN RESEARCH & DEVELOPMENT

- 36' diameter test ring for full scale testing activities



- Mechanical and Fluid dynamic analysis with FEM to optimize blade airfoils performances and noise



COFIMCO'S MECHANICAL TESTING ACTIVITIES

- Testing equipment includes
- Vibration analyzer
- Sound level meters
- Electronic portable balancing
- Multi-channel strain gauges with data collection system
- Fatigue test bench



PRODUCT OVERVIEW

AIR COOLED CONDENSERS



WET COOLING TOWER



AIR FIN COOLERS



AIR FLOW TEST

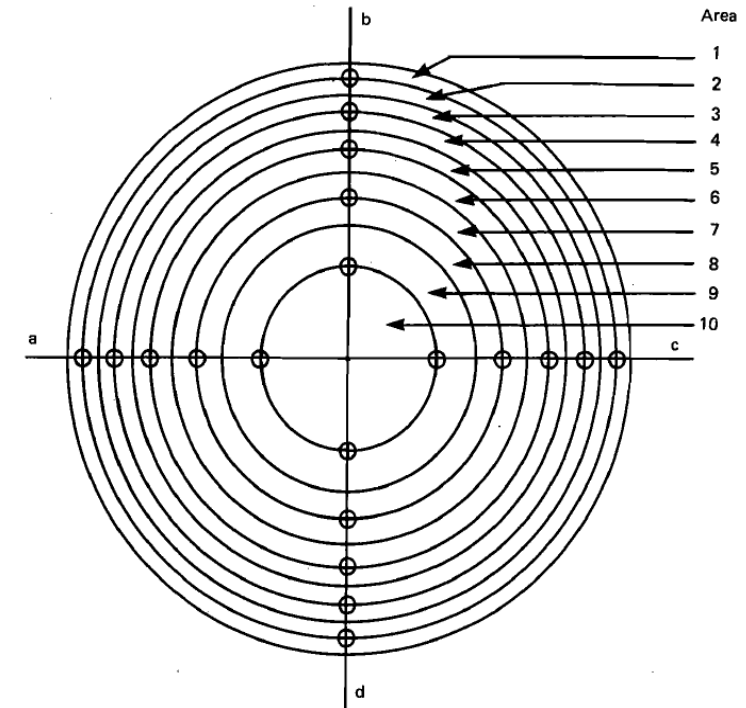
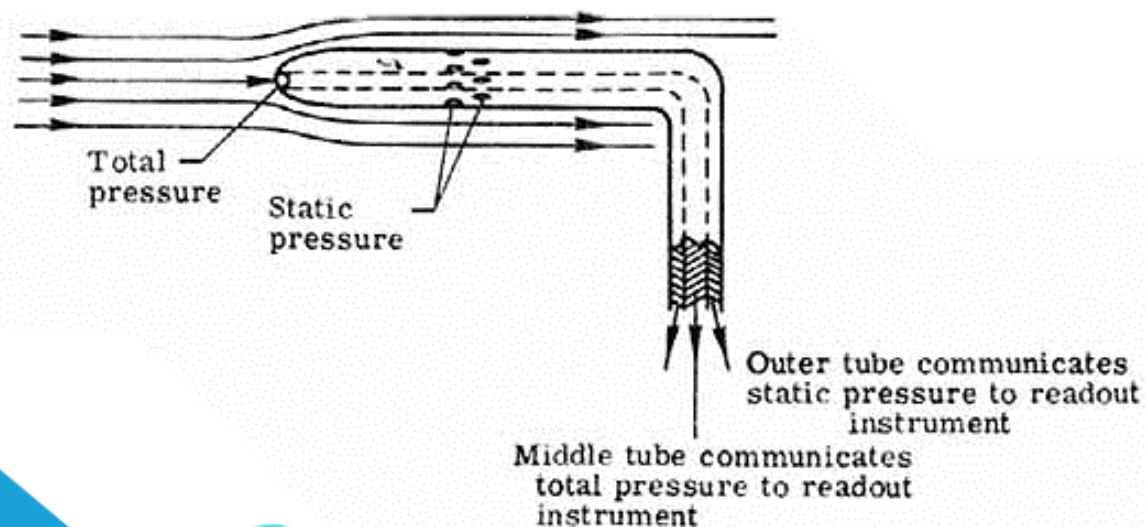
AIR FLOW TEST

This air flow test comply to ASME PTC30

- 1) Pitot tube with vinyl tubing
- 2) 20 FT section $\frac{3}{4}$ " Pipe or conduit
- 3) K Type digital thermometer
- 4) Power meter model 3910
- 5) Model8702 DP-Calc Micromanometer
- 6) 4" Hole saw blade



Measure static pressure and total pressure by insert pitot tube through cooling tower in each transverse totally 4 transverses and 10 point per transverse then totally require measure 40 points





PREPARING FOR FIELD TEST : MEASURING FOR AIR PROPERTIES



ANEMOMETER METER

- Measuring for surrounding air velocity, by using Anemometer
- As per PFM143, recommend air velocity should not exceed 10 mile/h (4.5m/s)



PREPARING FOR FIELD TEST : MEASURING FOR AIR PROPERTIES



Measuring for wet bulk temperature and humidity by using humidity meter



PREPARING FOR FIELD TEST : INSTALLING MEASUREMENT TOOLS

- Record for static and total pressure (in InH2O) and air temperature (in °F)
- Repeat for 1-10 measuring points and 4 transverses



READING STATIC PRESSURE TOTAL PRESSURE AND TEMPERATURE

➤ From equation
 $P_t = P_s + P_v$ -----(1)

P_t = Total pressure

P_s = Static pressure

P_v = Velocity pressure

➤ $Velocity = 1096.2 \sqrt{P_v / D}$ -----(2)
 D = Air density in lbs/cu. Ft.

➤ $Q = V * NFA$ -----(3)

Q = Air flow

V = Air velocity from (2)

NFA = Net free air

REFERENCE LIST

BANGKOK COGENERATION CO.,LTD



Fan Dia (mm)	Old Fan		Cofimco Fan		After Replace Fan Blade	
	Flow (m3/s)	Rotor Shaft Power (KW)	Flow (m3/s)	Rotor Shaft Power (KW)	Flow Increase %	Energy Saving %
3 Cell						
10,058	636.76	168.57	657.76	125.62	+ 3.3	+ 25.48

BANGKOK SYNTHETIC CO.,LTD



Fan Dia (mm)	Old Fan		Cofimco Fan		After Replace Fan Blade	
	Flow (m3/s)	Rotor Shaft Power (KW)	Flow (m3/s)	Rotor Shaft Power (KW)	Flow Increase %	Energy Saving %
5 Cell						
8,534	489.16	131.77	571.10	113.03	+ 14.35	+ 14.22

PTTGC BPE PLANT 1



Fan Dia (mm)	Old Fan		Cofimco Fan		After Replace Fan Blade	
	Flow (m3/s)	Rotor Shaft Power (KW)	Flow (m3/s)	Rotor Shaft Power (KW)	Flow Increase %	Energy Saving %
2 Cell						
7,925	358.87	78.32	363.11	58.46	+ 1.17	+ 25.36

SIAM UNITED STEEL



Fan Dia (mm)	Old Fan		Cofimco Fan		After Replace Fan Blade	
	Flow (m3/s)	Rotor Shaft Power (KW)	Flow (m3/s)	Rotor Shaft Power (KW)	Flow Increase %	Energy Saving %
3 Cell						
5,486	195.57	48.94	197.23	38.64	+ 0.84	+ 21.05

NONG KHAE COGEN (GULF ELECTRIC)



Fan Dia (mm) 3 Cell	Old Fan		Cofimco Fan		After Replace Fan Blade	
	Flow (m3/s)	Rotor Shaft Power (KW)	Flow (m3/s)	Rotor Shaft Power (KW)	Flow Increase %	Energy Saving %
7,320	332.36	93.85	337.82	73.18	+ 1.62	+ 22.02

AGC PRAPRADEANG



Fan Dia (mm) 2 Cell	Old Fan		Cofimco Fan		After Replace Fan Blade	
	Flow (m3/s)	Rotor Shaft Power (KW)	Flow (m3/s)	Rotor Shaft Power (KW)	Flow Increase %	Energy Saving %
3,048	81.37	25.04	82.60	17.67	+ 1.49	+ 29.41

Company	Q'ty	Fan Dia (mm)	After Replace Blade Air Flow Increase (%)	After Replace Blade Energy Saving (%)
Thai Kraft (SCG)	2	4,500	AVG +3.16 %	AVG 20.775 %
TPE LD	2	4,270	AVG +2.70 %	AVG 45.30 %
TPE PP#1	2	6,100	AVG + 0.82 %	AVG 19.66 %
TPE PP#2	3	6,100	AVG +1.79 %	AVG 21.58 %
SCG Kangkoi Power #2	2	8530	AVG + 4.75 %	AVG 17.40 %
SCG Kangkoi Power #1	2	7,700	AVG + 2.11 %	AVG 28.84 %
PTTGC4 (ATC1)	3	5,486	Wait for installation	Warranty 20 %
AGC Rayong	1	7,315	+1.61 %	23.45 %
SCG Thaluang Power	4	6,980	AVG + 2.84 %	AVG 16.8 %
BRIDGESTONE Carbon	2	5,400	AVG +2.25 %	AVG 18.54 %
SCG Khaowong Power	1	8,000	+5.62 %	16.71 %
Thai Nitrate	2	4,877	AVG +1.17 %	AVG 21.2 %
SCG Lampang Power	3	6,100	AVG +3.43 %	AVG 15.2 %

Company	Q'ty	Fan Dia (mm)	After Replace Blade Air Flow Increase (%)	After Replace Blade Energy Saving (%)
PTTGC BPE2	2	10,363	AVG + 2.43 %	AVG 17.54 %
PTTEP	24	3,658	AVG + 13.29 %	AVG 8.92 %
PTTGSP#3	8	4,267	AVG + 1.24 %	AVG 14.6 %
PTT KHAO BO YA	3	3,658	Wait Installation	Warranty 15 %
UBE	1	8,534	Wait Installation	Warranty 15 %
MOC (SCG)	4	10,363	Wait Installation	Warranty 11 %
GRAN SIAM COM (SCG)	6	2,100	Wait Installation	Warranty 15 %
IRPC (H21.1)	4	3,962	Wait Installation	Warranty 20 %
VINA KRAFT PAPER	1	6,096	AVG + 4.16 %	AVG 48.62 %
TPC VINA 1	2	7,315	Wait Installation	Warranty 20 %
TPC VINA 2	2	6,706	Wait Installation	Warranty 20 %
ASM	1	7,315	AVG + 4.64 %	AVG 18.50 %
PTTGC5 (ATC2)	4	7,315	Wait Installation	Warranty 15 %

Company	Q'ty	Fan Dia (mm)	After Replace Blade Air Flow Increase (%)	After Replace Blade Energy Saving (%)
PTTGC BPE	3	3,658	Wait Installation	Warranty 18 %
AGC Rayong	1	7,315	Wait Installation	Warranty 20 %
AJINOMOTO	1	3,900	Wait Installation	Warranty 20 %
EGAT South	8	9,145	Wait Installation	Warranty 20 %
HMC PDH	5	7,925	Wait Installation	Warranty 12 %

Q&A

Thank you for your time and attention

