silent.eco.wing
International Patent Pending

Noise Reduction and Energy Efficiency

Convincing. Simple. Better.

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From the Vision to the Patent

Noise in air traffic with helicopters: Not only experts know this problem. Though engines and rotors have been optimized again and again over the past decades, in the end – as anywhere else – only consistent pursuing of an idea and maybe also a vision leads to a result.

In 1995, Walter Enthammer laid the foundation for a project, which was inspired by nature, more exactly by the physical lift characteristics at the ends of bird's wings. This bionics development was presented under

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and today is an innovation, the advantages of which are unique:

- Simple technical implementation
- Clear noise reduction
- Significant savings in driving power and thus energy

Emphasis may also be placed on the two main issues:
Less noise and significantly better energy efficiency in the operation of not only helicopters.

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From 1995 on	Intensive dealing with the subject of noise development at wing profiles.
1998	Initiation of a development project with FACC. Construction of an own testbed for basic testing with rotor blades. Tests with various wing ends and wing shapes.
1999	Initiation of a development project with AVL List GmbH and MT Propeller Straubing. Tests with various wing ends in cooperation with Carbo Tech Composite GmbH.
2001	Tests with various surface structures, including 3M aerodynamic drag reduction tape.
2002-2005	Further tests with various surface structures as well as blade and blade tip geometries, without achieving substantial improvements. First tests with bionics derivations of bird's wing ends. Construction of various fin prototypes. Tests show significant improvements.
2005-2008	Optimization of shape and arrangement for the current silent.eco.wing solution.
2008	**Austrian patent application**
2009	Wind tunnel tests at Technical University Munich. Confirmation of higher lift coefficients and of the reduction of drag coefficients with the use of silent.eco.wing-modified blade tips.
2009	**International patent application**

Persons

Those with more than 30 years of flying experience are also familiar with the laws of nature. Walter Enthammer is a professional helicopter pilot with an eye for the "competitor". The observation of birds was the fundamental and essential idea, which then over many years lead to a fascinating result.

Walter Enthammer
Inventor and Developer of the silent.eco.wing

Aaron Barth
Project Support and Prototype Manufacturing

PD Dr.-Ing. habil. Christian Breitsamter
Chair in Aerodynamics
Technical University Munich

Dipl. Phys. Roman Reß
Test Management Wind Tunnel
Technical University Munich

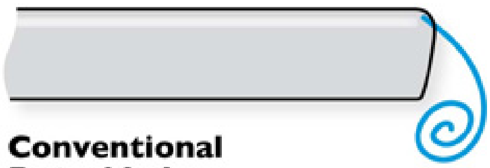
The System – Design and Effect

The induced drag: It develops at the wing's end – exactly like a big, compensating boundary vortex. The cause for that are the pressure differences at the wing's upper and lower side. This vortex is particularly strong in rotors – the main reason for noise development and flow resistance.

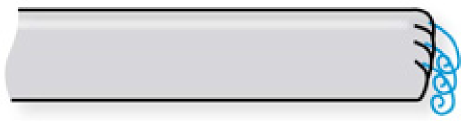
The **silent.eco.wing system** optimizes the boundary vortexes. Simply by changing the flow ratios at the wing end or the rotor blade tip. There is a "split-up" into many small vortexes and thus a reduction of the induced drag. Thus, in the end results a lower sound pressure.

Less drag always also means savings in energy. The required driving power can be reduced, because power losses simply do not result to the extent anymore as with conventional rotors and propellers.

One *large* boundary vortex = high power loss = high noise development
Several *small* boundary vortexes = lower power loss = more efficiency



Conventional Rotorblade
Airflow (simplified)



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Airflow (simplified)

silent.eco.wing – Mode of functioning (simplified representation)

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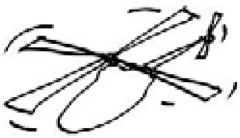
Areas of Application

One of the specifications for the project team was: The **silent.eco.wing system** must be equally applicable to all aerodynamic components like wings, blades, propellers, rotors and tail units. The adaptation to any specific use is thus perceivably simple, if the fundamental parameters like speed or profile are considered. Existing systems do not necessarily have to be changed. Re-equipment and concentration on the end piece are sufficient in order to achieve significant improvements.

silent.eco.wing. Stunningly simple in its installation. But with clear results in practice and air traffic:

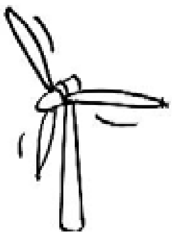
- Reduction of the vortex formation
- Minimization of the noise emission
- Improvement of the efficiency

The **silent.eco.wing system** – useful in many ways:



Helicopters
Rotors, tail rotors,
parts of the aerofoil

Planes
Propellers, aerofoils, tail units



Wind power plants
Rotors, aerodynamic components

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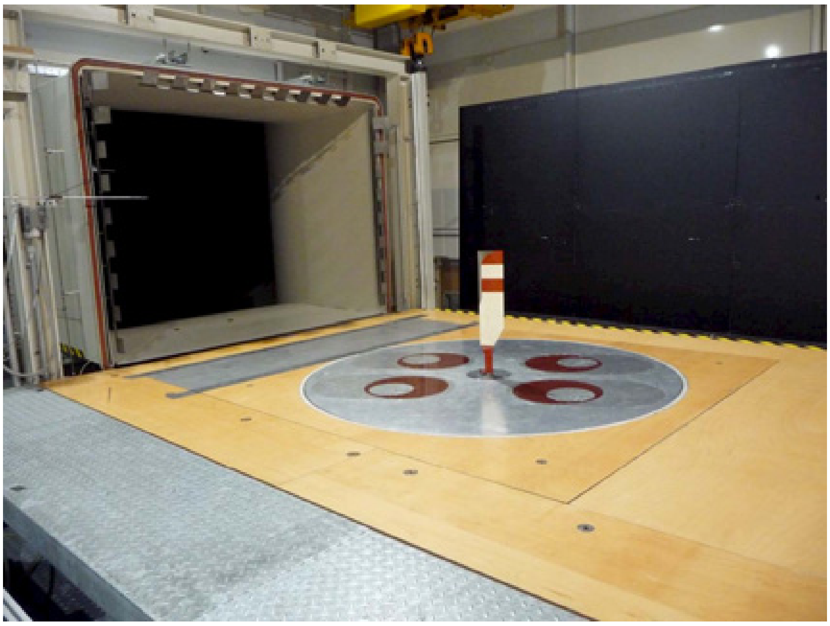
The Proof – Wind Tunnel Tests at Technical University Munich

Under the management of PD Dr.-Ing. habil. Christian Breitsamter and Dipl.-Phys. Roman Reß, the silent.eco.wing system was put “to the acid test”, so to say, in the wind tunnel of Technical University Munich, and its efficiency measured on the in-house rotor testbed.

In that, all prognoses were confirmed. The test series at the example of a tail rotor blade of a MD Hughes 500 all were more than positive. For the basic essentials resulted an increase of the lift coefficient (ca) as well as a reduction of the drag coefficient (cw).

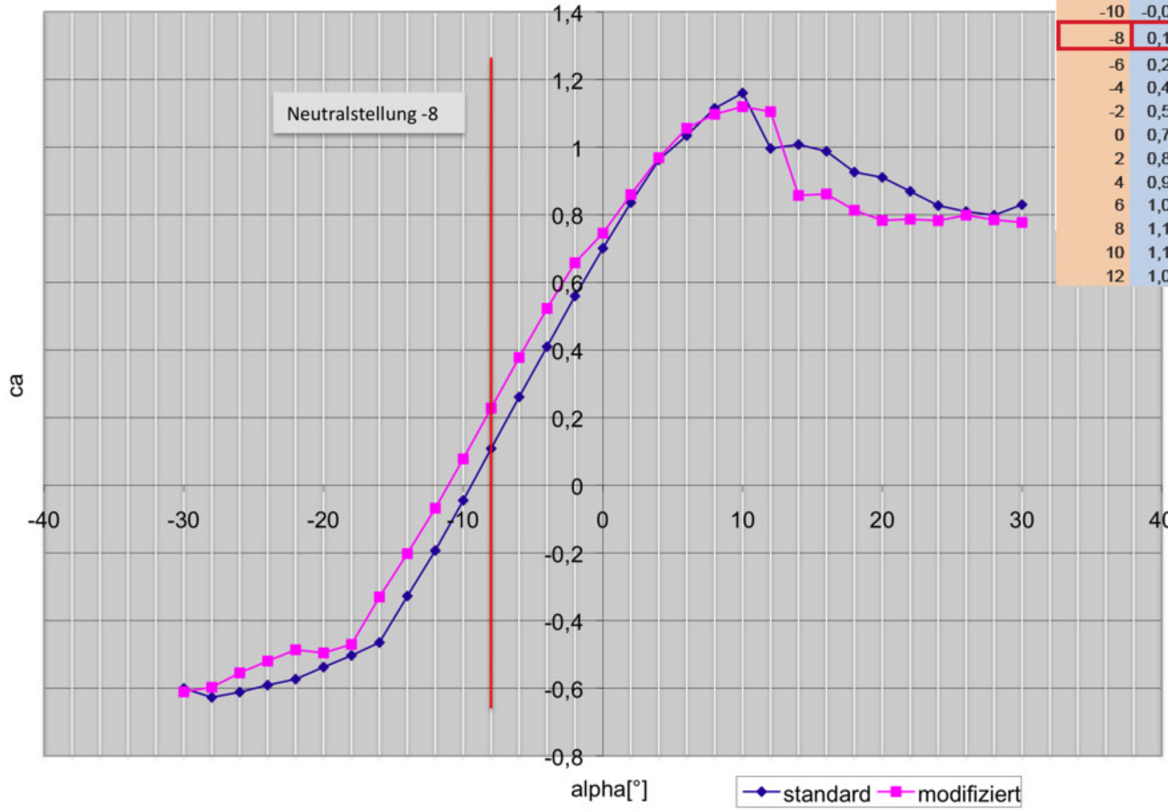


Measurement of the Lift Coefficient

The wind tunnel and the rotor testbed clearly show: The **silent.eco.wing system** increases the lift coefficient.
Value at a neutral position of the blade (table value -8) 0.12:

Std.	*Hrs*
Veränderung	*Change*
Neutralstellung -8	*Neutral position -8*
modifiziert	*modified*

alpha[°]	Std. ca	Mod. silent.eco.wing ca	Veränderung ca
-28	-0,63	-0,60	+0,03
-26	-0,61	-0,55	+0,06
-24	-0,59	-0,52	+0,07
-22	-0,57	-0,49	+0,08
-20	-0,54	-0,50	+0,04
-18	-0,50	-0,47	+0,03
-16	-0,46	-0,33	+0,13
-14	-0,33	-0,20	+0,13
-12	-0,19	-0,07	+0,12
-10	-0,04	0,08	+0,12
-8	0,11	0,23	+0,12
-6	0,26	0,38	+0,12
-4	0,41	0,52	+0,11
-2	0,56	0,66	+0,10
0	0,70	0,75	+0,05
2	0,84	0,86	+0,02
4	0,96	0,97	+0,01
6	1,03	1,06	+0,03
8	1,11	1,10	-0,01
10	1,16	1,12	-0,04
12	1,00	1,10	+0,10



Lift coefficient ca for the pitch angle alpha

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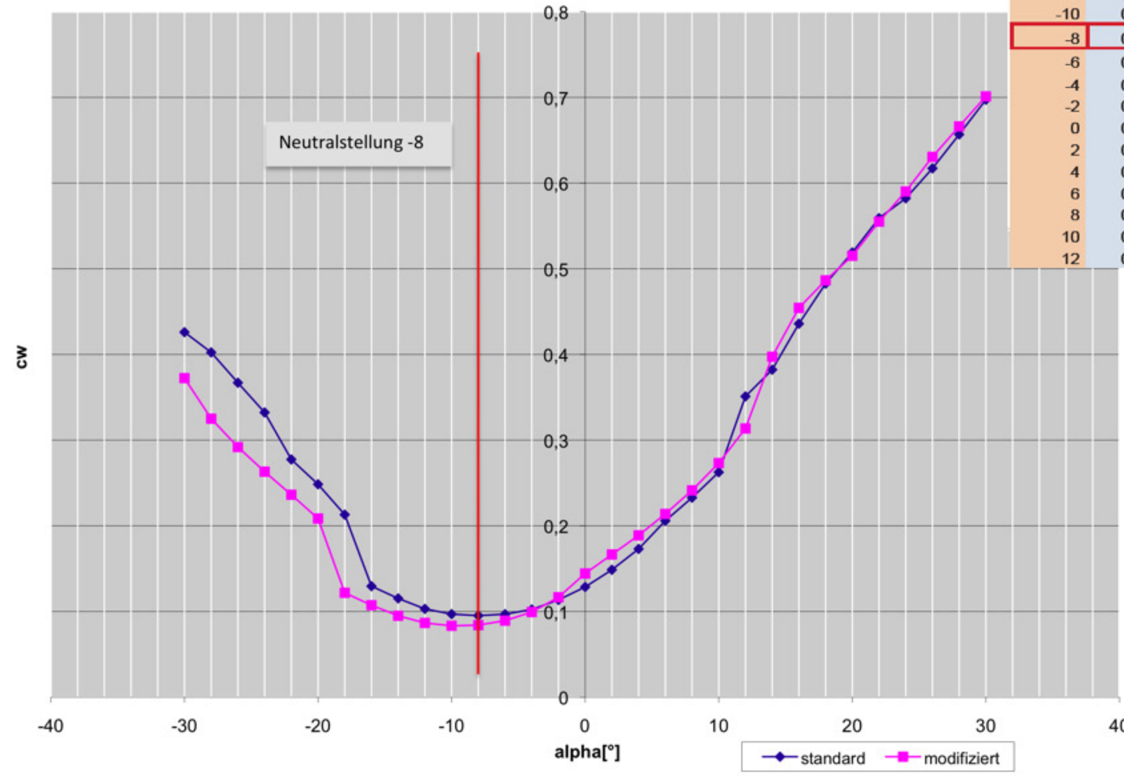
Measurement of the Drag Coefficient

The high potential of the **silent.eco.wing system** is clearly indicated by the results from the wind tunnel. Considering the values in the example of the MD Hughes 500 already shows: The reduction of the drag coefficient is a clear step towards less noise and more power.

Std.	*Hrs*
Veränderung	*Change*
Neutralstellung -8	*Neutral position -8*
modifiziert	*modified*

	Std.	Mod. silent.eco.wing	Veränd erung
alpha[°]	cw	cw	cw
-28	0,40	0,33	-0,07
-26	0,37	0,29	-0,08
-24	0,33	0,26	-0,07
-22	0,28	0,24	-0,04
-20	0,25	0,21	-0,04
-18	0,21	0,12	-0,09
-16	0,13	0,11	-0,02
-14	0,12	0,09	-0,03
-12	0,10	0,09	-0,01
-10	0,10	0,08	-0,02
-8	0,10	0,08	-0,02
-6	0,10	0,09	-0,01
-4	0,10	0,10	±0
-2	0,11	0,12	+0,01
0	0,13	0,14	+0,01
2	0,15	0,17	+0,02
4	0,17	0,19	+0,02
6	0,21	0,21	±0
8	0,23	0,24	+0,01
10	0,26	0,27	+0,01
12	0,35	0,31	-0,04



Drag coefficient cw for the pitch angle alpha

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Comparative Figures Speak For Themselves

Empirical data in respect of noise reduction and performance data from the comparative tests at Technical University Munich with a tail rotor blade of the MD 500 Hughes demonstrate very impressively: With the **silent.eco.wing system** integrated, all parameters are improved.

	Speed [n^{-1}]	Noise level [dbA]		Power [A]	Moment [%]	Temperature [°C]
		Distance [m] approx. 1	Distance [m] approx. 5			
Original blade	2825	109.7	105.7	13.1	189	22
silent.eco.wing	**2838**	**105.8**	**100.5**	**11.0**	**160**	**22**

Blade tip speed: approx. 206 m/sec.

On average, noise development is reduced by 5 dbA in the near-field region (1-5 meters). From that results a perceived **noise reduction** of **approx. 25 percent**.*

The **power input** is reduced by 2.1 A, and thus by **24 percent**. In practice, this means higher efficiency with the same wing profile.

** On the basis of the general determination, that a reduction by 10 dbA corresponds to halving the perceived noises.*

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The improvement of the entire profile efficiency was impressively confirmed by the measuring results and test runs. The predominant wish for noise reduction from 1995 has meanwhile not only been fulfilled, but even exceeded with the resulting increase in performance.

The **silent.eco.wing system** stands out from the previous solutions for reduction of the boundary vortexes in decisive aspects. This technology now brings really countable and considerable advantages:

- Relatively simple implementation of the design features.
- Clear improvements in the boundary vortex area, especially for rotors and the flow angles and speeds, which here are continuously different.
- No additional parts, which have a drag potential themselves.
- Significant noise reduction by approx. 25 percent.*
- Lower required driving power by approx. 20 to 30 percent.*
- Permanent reduction of the fuel consumption, i.e. the operating costs.
- Longer ranges.

** Referring to the measuring results at the MD Hughes 500 tail rotor blade.*

silent.eco.wing: Simple adaptation to the respectively existing system and an optimum of efficiency.

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