Fans for Tunnel Ventilation

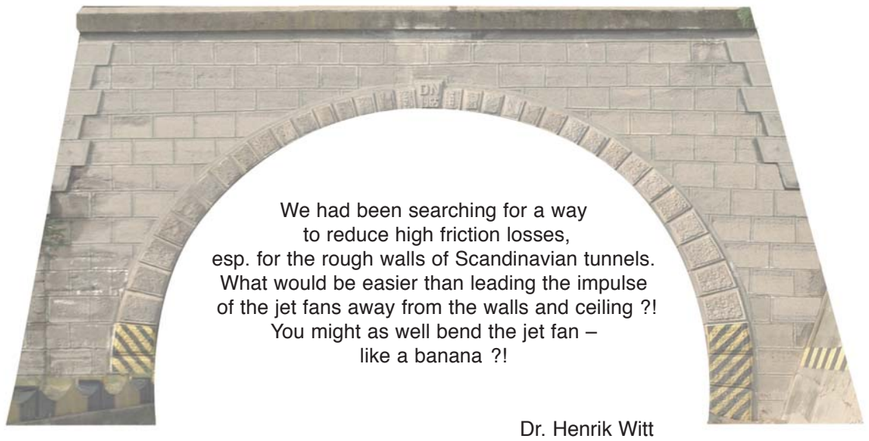
Axial

Quality made in Germany

Banana Jet®
by WITT & SOHN

WITT&SOHN
IGW Ventilatoren

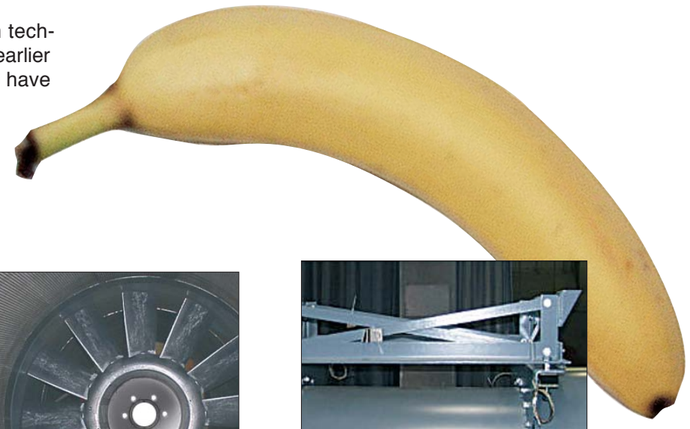
BEND IT LIKE A BANANA !



We had been searching for a way
to reduce high friction losses,
esp. for the rough walls of Scandinavian tunnels.
What would be easier than leading the impulse
of the jet fans away from the walls and ceiling ?!
You might as well bend the jet fan –
like a banana ?!

Dr. Henrik Witt
Inventor

The **Banana Jet**® combines reliable jet fan technology with new ideas. Components which earlier limited the transformation of the fan's thrust have been improved markedly.



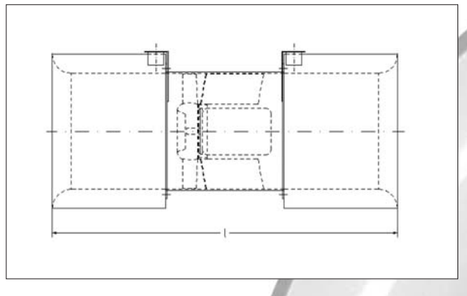
Some examples:

Silencer: The air is blown directly to the relevant zones of the tunnel and not towards the wall, ceiling or other components installed in the tunnel.

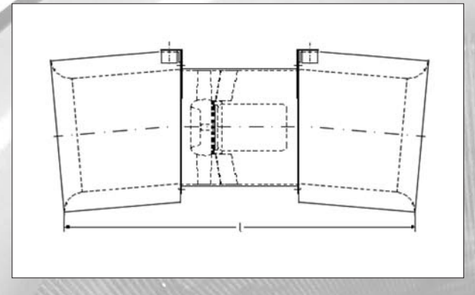
Reliable design: The robust construction of the Banana Jet® can deal with the most stringent requirements, e.g. corrosion, heat or smoke.

Support structure: The Banana Jet® can be mounted very close to the ceiling with no additional losses and increased mechanical stability.

Traditional technology with innovative design – this is the essential difference:



Traditional jet fans – horizontal design with fan outlet in fan axis. The silencers are in alignment.



Banana Jet® - curved design with fan outlet bent away from the friction areas (ceiling/walls) of the tunnel. The silencers are directed downwards/sideways.

The **Banana Jet**® with its dynamic design can be custom-fitted to the tunnel layout especially for niches and corners – like its natural prototype the banana to the banana tree.

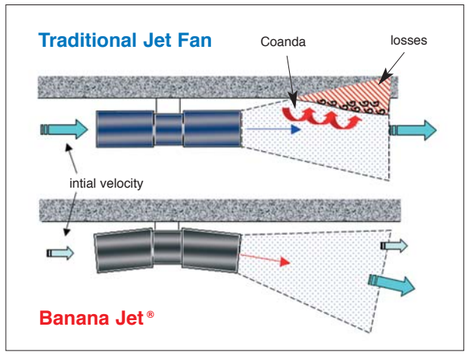
BANANAS DO IT BETTER !

As simple as it is effective – simply better:

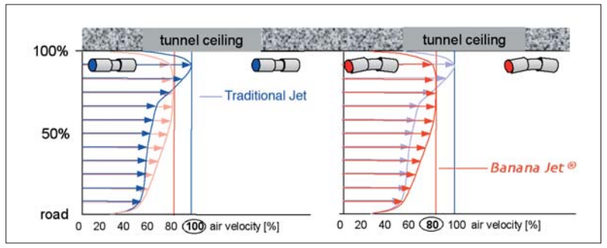
The Banana Jet® achieves a significantly increased air velocity in the tunnel with the same nominal thrust and motor power due to:

~ Reduction of the impulse losses at the walls and ceiling
~ Reduction of the background velocity (initial velocity) at the air inlet.
~ Reduction of the friction losses due to decreased Coanda Effect.

With similar installation height the Banana Jet® transfers the thrust to the tunnel more effectively.



It's the flow that counts:



The Banana Jet® improves the flow and the air velocity profile in the tunnel by its unique design. It distributes the flow more uniformly by focusing the impulse towards the middle of the tunnel and reduces the losses in critical friction areas.

Particularly for critical areas:

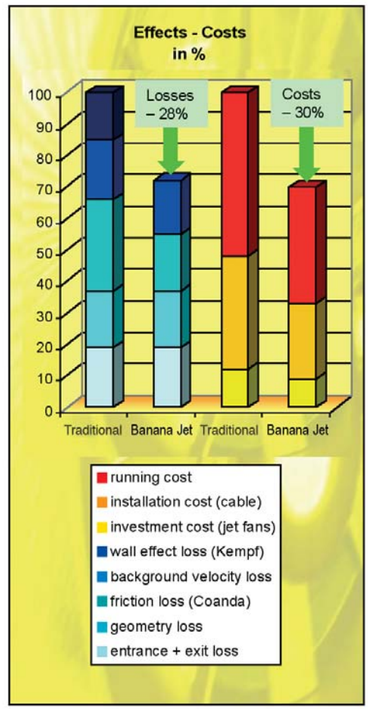
	$\approx 1-\frac{1}{K}$	$\approx 1-\left(\frac{1}{K}\right)^2$	$\approx 1-\left(\frac{1}{K}\right)^3$
Losses acc. to Kempf*	– 5 - 15%	– 10 - 25%	– 15 - 35%
Banana Jet®-Effect**	+ 20 - 30%	+ 25 - 40%	+ 30 - 50%

* Only impulse losses acc. to Kempf, Schweizer Bauzeitung, Jan. 1968
** In combination with friction loss and reduced background velocity acc. to a W&S analysis and CFD simulation

The Banana Jet® shows its strengths especially in cases of installation in the corners of the tunnel ceiling or in niches. This is where the Banana Jet's® advantages are most evident.

More efficiency means more savings !

Savings via a Banana Jet® compared to a traditional jet fan:



Source: Witt & Sohn, analysis: Project Kirchenwald-Tunnel data base: 0.1 kW/hour, 1.000 hours/year, EUR 2.000 installation cost per fan.

The specific outcome of this is:

1. Reduction of the required number of jet fans and the total energy consumption

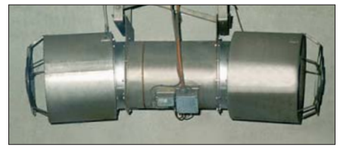
   But alternatively:

2. Reduction of the jet fan size, power and energy consumption while maintaining the same number of fans.

Benefits:

1. Reduced investment costs by reduced number of fans
2. Reduced installation and cabling costs
3. Reduced maintenance costs
4. Lower sound levels
5. Lower overall power consumption
6. Improved environmental record (e.g. CO_2)

Higher profits for all parties !



Reduction in size:
The size of the Banana Jet® can be adjusted to project specific requirements.

BREATH DEEPLY - GUARANTEED !

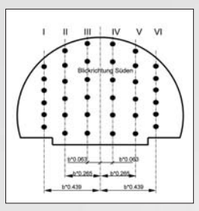
Numerous tests have been performed in various conditions to be sure:

We keep our promises …

and we can prove it !

The Banana Jet ® creates a more intelligent distribution of the air flow in the tunnel. Comparative measurements have been executed in real tunnels and show the impressive effects !

Beratende Ingenieure	
Tunnel:	Uznaberg West
Betrieb:	Hauptfahrtrichtung (A—>B)
Datum:	04.09.2003
Querschnitt:	UW1 (120m)
Richtung:	N—>S
Zeit Anfang/Ende:	02:37 / 02:56
Temp. t_a/t_i [°C]	14.5 / 14.5
pUmgeb A/E [mbar]	977 / 977
Grundstr. A/E [m/s]	2.17 / 1.72
max. Breite b [m]	10.12
Breite am Boden [m]	9.86
Mitte am Boden [m]	4.93



Beratende Ingenieure	
Tunnel:	Uznaberg West
Betrieb:	Hauptfahrtrichtung (A—>B)
Datum:	16.09.2003
Querschnitt:	UW4 (20 m)
Richtung:	N—>S
Zeit Anfang/Ende:	22:07 / 22:22
Temp. t_a/t_i [°C]	15.7 / 15.7
pUmgeb A/E [mbar]	977 / 977
Grundstr. A/E [m/s]	1.38 / 1.59
max. Breite b [m]	10.12
Breite am Boden [m]	9.86
Mitte am Boden [m]	4.93

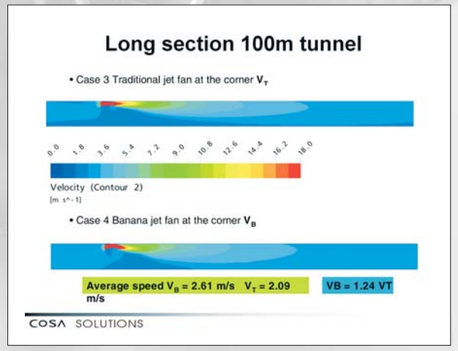
Renowned test institutes have determined the effective values and confirmed our results !

To compare the Banana Jet ® with a traditional jet fan, the Banana Jet ® was modified with adapters to straighten out the flow. Air flow grid measurements according to the “Log-Tchebycheff-Method” have shown the clear superiority of the Banana Jet ® principle !

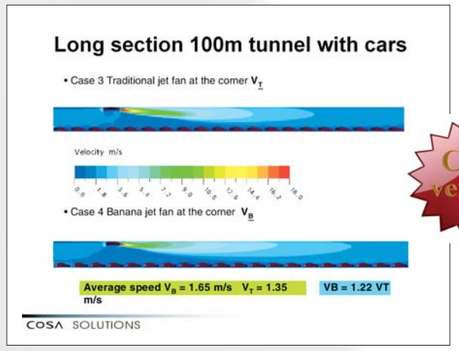
Air flow measurements in the tunnel have been conducted by external engineering companies and demonstrate the high efficiency of the Banana Jet ®.

The results have been verified with CFD simulations by independent specialists:

Compared to traditional jet fans the Banana Jet ® increases the average air velocity in the tunnel with the same motor power and directs the impulse away from off the friction areas (walls and ceiling). This means: higher air velocity with lower friction loss !

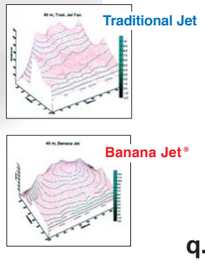


Source: COSA SOLUTIONS **Thrust + 53%**

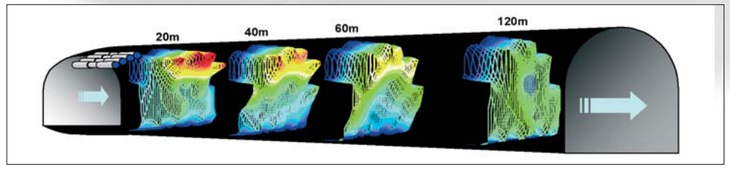


Source: COSA SOLUTIONS **Thrust + 48%**

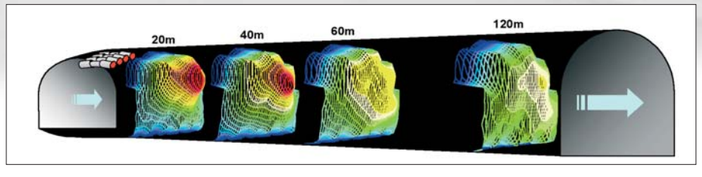
An established and independent engineering bureau calculated CFD simulations comparing the fluid mechanics of the Banana Jet® and a comparable traditional jet fan. Different scenarios in the tunnel have been considered.



q.e.d. !



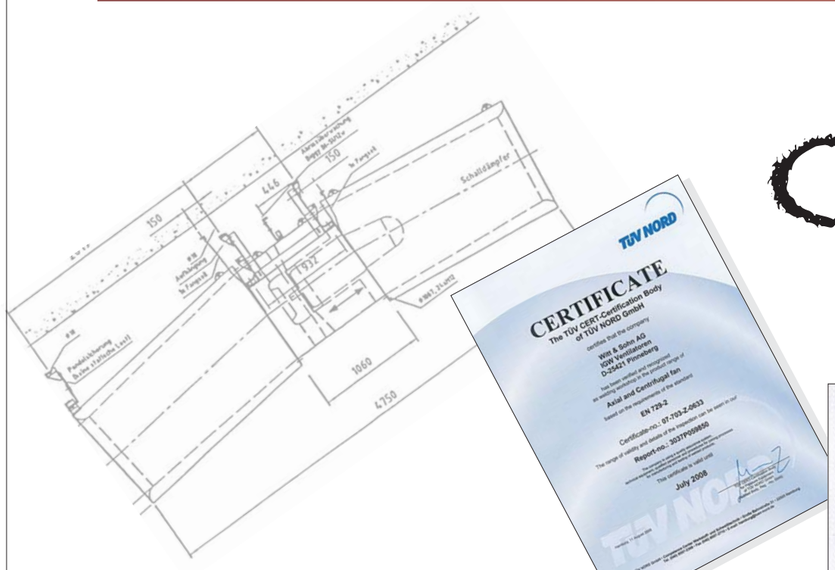
Air flow profile traditional jet fan: Air velocity peaks on the tunnel ceiling, even after 120 m low velocity in the middle of the tunnel cross section.



Source: Witt & Sohn

Air flow profile Banana Jet®: High air velocities in the upper half of the tunnel, also 120 m behind the Banana Jet ®.

Others have also noticed:



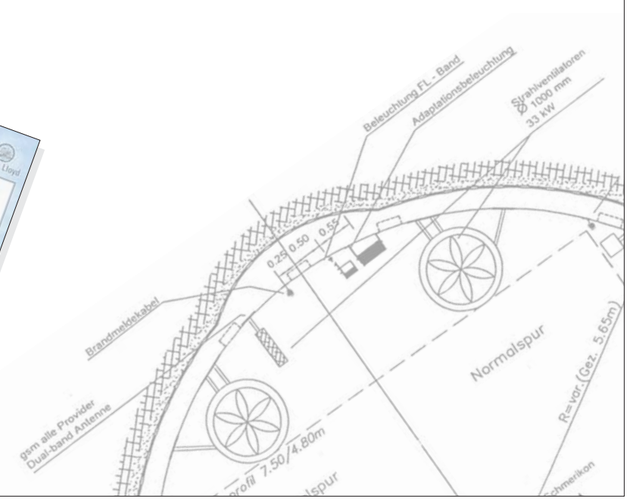
A good idea with a solid basis!

The Banana Jet® fulfils the same high quality standards that apply to the total product range of Witt & Sohn AG.
Strictly specified by international accredited institutes and regularly checked and audited by the TÜV.

Produced at the Witt & Sohn AG headquarters Pinneberg/Germany according to ISO 9001:2000 certified industrial processes.
The Banana Jet® is tested and certified according to EN 12101-3 as are all the other Witt & Sohn AG jet fans to withstand the stresses from heat and smoke extraction applications according to F200, F300 and F400 up to 400°C (752°F) for 2 hours.

A good idea needs good protection. For this reason the Banana Jet® principle has been patented!

All jet fans are tested prior to shipment. On request a complete FAT (factory acceptance test) according to international standards is performed and documented. This guarantees a 100% compliance of the jet fan with the specified performance values.



And now to conclude in figures:

ONE YOU CAN COUNT ON !

An example of the potential savings can be shown in a tunnel in Germany:

Tunnel Aubing in the Munich beltway, Germany.

Tunnel length: 2 x 1.950 m
Operation mode: unidirectional
Opening: 2006
Measurements: independent Swiss engineering bureau

	Originally scheduled	Realisation w. Banana Jet®
Number of jet fans:	60	48
Static thrust / fan:	516 N	516 N
Total thrust:	30.960 N	24.768 N
Electrical power / fan:	20,9 kW	20,9 kW
Total electrical power:	1.254 kW	1.003 kW
Air velocity:	2,92 m/s	3,5 m/s
Installed thrust:	**100 %**	**143 %**

The Banana Jet® benefits everyone. It is groundbreaking, cost efficient, proven and tested. We are proud to offer our clients this attractive product and hope we have been able to draw your attention to a new and bracing idea.

In order to be able to select the required Banana Jet® quickly we have established the following Quick-Selection table that enables our clients to chose an adequate Banana Jet®:

Banana Jet® - Quick Selection, 50Hz

Jet fan size	unidirectional			reversible		
	thrust	equivalent thrust (*)	volume flow	thrust	equivalent thrust (*)	volume flow
mm	N	N	m_/s	N	N	m_/s
560	325	425	8,4	330	430	8,4
630	545	710	12,2	545	710	12,2
710	730	950	15,9	715	930	15,8
800	420	545	13,6	345	450	12,3
900	680	885	19,5	550	715	17,5
1000	1060	1380	27,0	905	1175	25,0
1120	1360	1770	34,3	1305	1695	33,6
1250	1680	2185	42,5	965	1255	32,2
1400	1640	2130	47,1	1430	1860	43,9
1600	2000	2600	59,4	1840	2390	57,0

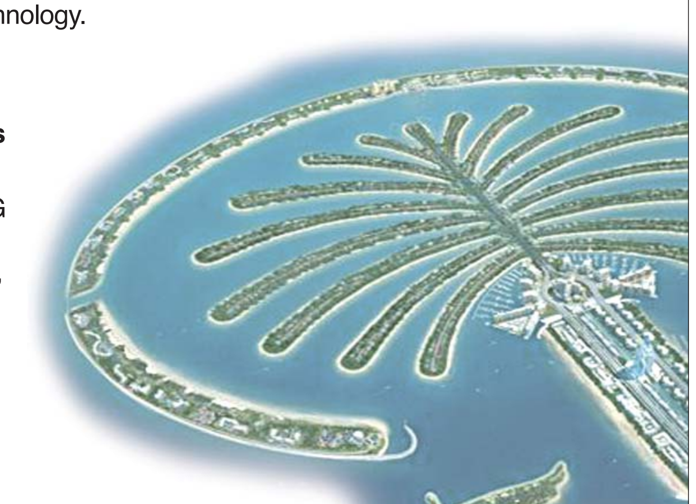
(*) assumption: 30% increased efficiency of thrust

This Quick-Selection table gives an overview of the effective thrust in the tunnel generally available with the Banana Jet®.

Depending on the length and design type of the tunnel, W&S carefully selects the number and size of the Banana Jets® required – including a comparison to traditional jet fan technology.

The large number of realised projects worldwide reflects the success of the Banana Jet® idea:

Since the market launch of the Banana Jet®, Witt & Sohn AG has integrated this unique technology in 50% of its tunnel projects e.g. in Austria, Australia, Dubai, France, Germany, Norway, Portugal, Russia, Spain, Switzerland, UK, Venezuela, etc. .



WITT&SOHN
IGW Ventilatoren

Witt & Sohn AG • Postfach 2262 • Wuppermanstr. 6-10 • 25421 Pinneberg • Germany
Tel: +49 - 4101 - 7007 - 0 • Fax: +49 - 4101 - 7007 - 30
e-mail: witt@wittfan.de • web: www.wittfan.de