

# Incremental Differential Flow (IDF)

Venturi Solutions

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# DOMAIN

## ① USAGE

For use in dust collectors for filter bag flanged supports to **increase performance** of any jet pulse cleaning operation.



## ⚙️ FUNCTIONING

In jet pulse cleaning, compressed air is injected into the cages from a pipeline connected to a tank and operated by pulse valves. The scope of the shooting operation is to provoke the periodic fall of the dust cake into the hopper to renew the filter efficiency.

# ADVANTAGES

UP TO:

+50% PEAK  
PRESSURE

+25% WAVE  
VELOCITY

+50% AIR  
INTAKE

= LOWER  $\Delta P$

= LOWER ENERGY CONSUMPTION

Ecoturbo is a reusable, detachable device in recyclable aluminium able to **lower energy consumption** during its life cycle. It has purposefully been **designed to increase sustainability in dust collectors** using jet pulse technology.





# CONSTRUCTION

\* Suitable for use with:

- 01. EcoSmart digital tag for EAM of cage and bags.
- 02. Antistatic copper strip band to fasten the earthed cell plate.

## MAIN PARTS

The special combination design of Venturi-Collar enables the perfect cage fit by:

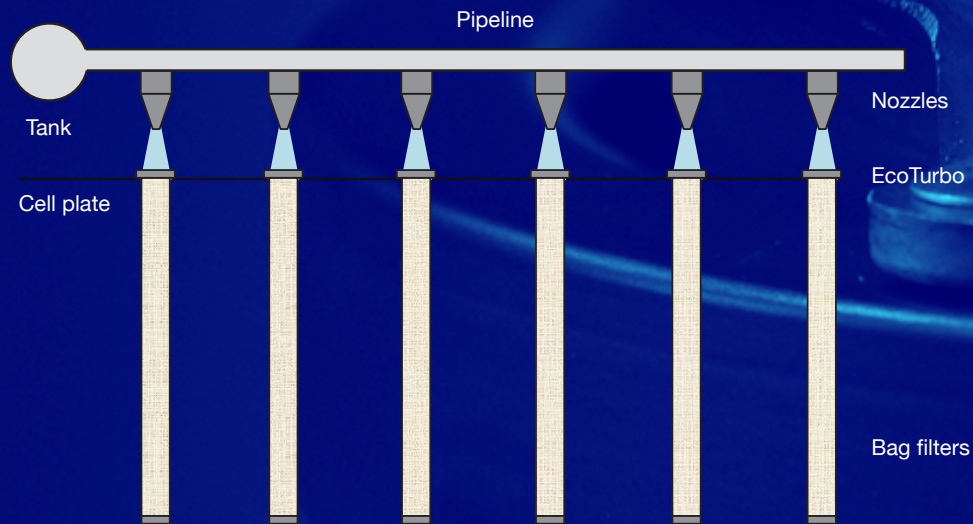
- 01 **Increasing the air inflow** for a more powerful pressure wave;
- 02 **Not obstaculating any flows** coming from the processing area saving fan's energy.



# CONCEPT

EcoTurbo is a device able to increase the intensity of the peak pressure wave with **significant improvement of the dust release process** and consequent **reduction of the cleaning frequency**. The need to introduce energy savings in dust collectors whose filter cleaning is operated by jet pulse technology could insist on a research towards two axis:

01. **A wider surface filtration** operating by increasing the filtering area (Waveline®);
02. **A better mechanism** relating the dust release process during cleaning.

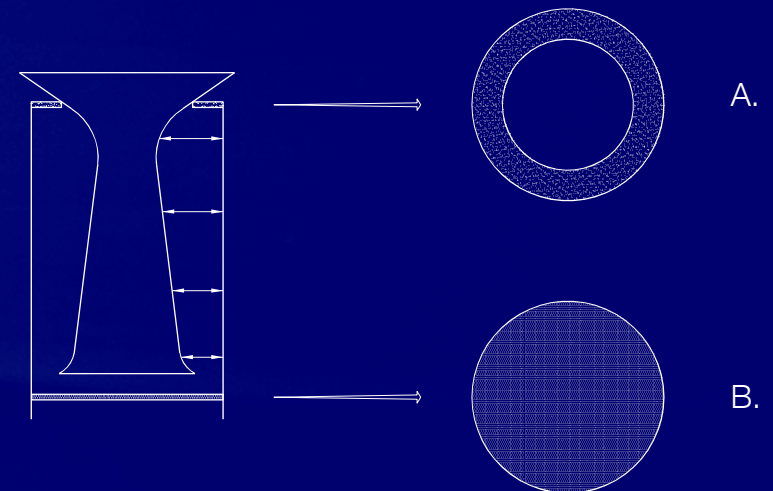


## TESTING

Due to the complexity of the study, CleanAir Europe - after having identified the variable affecting the efficient cleaning as appears in academic studies - has appointed **Politecnico di Milano** for one series of analysis and simulation both in **CFD** (Computational Fluid Dynamics) **and instrumental validation** of a more efficient product.

## PATENT

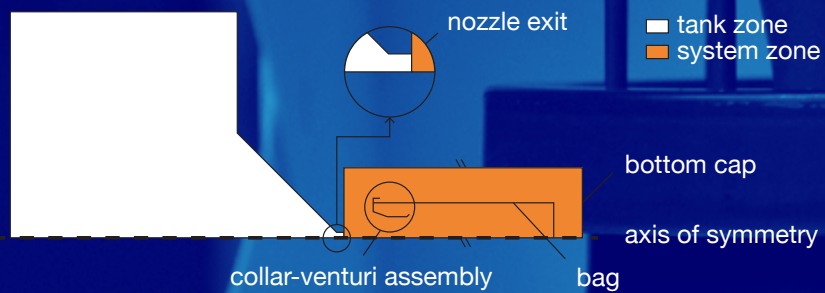
The possibility to increase by design peak pressure and air inlet introduces in EcoTurbo the relevancy of the ratio among some of the Venturi dimensions on respect to collar and cage diameters. This ratio has been object of an **European patent**. In EcoTurbo, an extra open space in between collar and Venturi is obtained to favour an **additional air inflow during cleaning**.



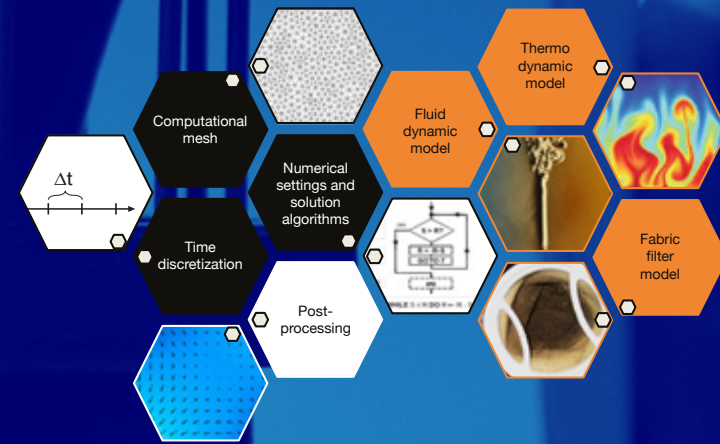
# PROCESS

## A CFD APPROACH: DESIGNING THE BACKGROUND CONDITIONS

Axysymmetric 2D domain with a 10m long sleeve.



01. Our domain simulation

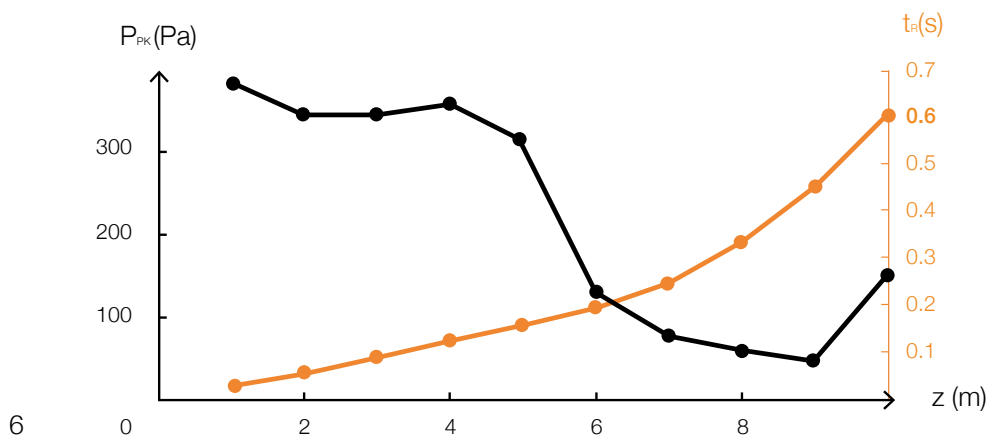


02. Time mesh/equation

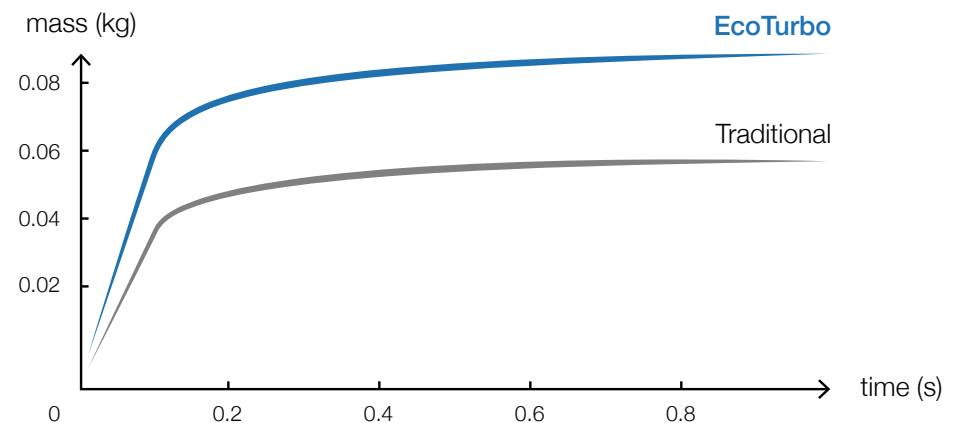
The main parameters to investigate in our own simulation were (1) Air Flow; (2) Peak Pressure; (3) Peak Pressure Arrival Time\*.

*In order to do so, a specific environment of simulation had been set, taking into account: (1) Flow Equation; (2) Thermodynamic Model; (3) Fabric Model; (4) State Gas Equation.*

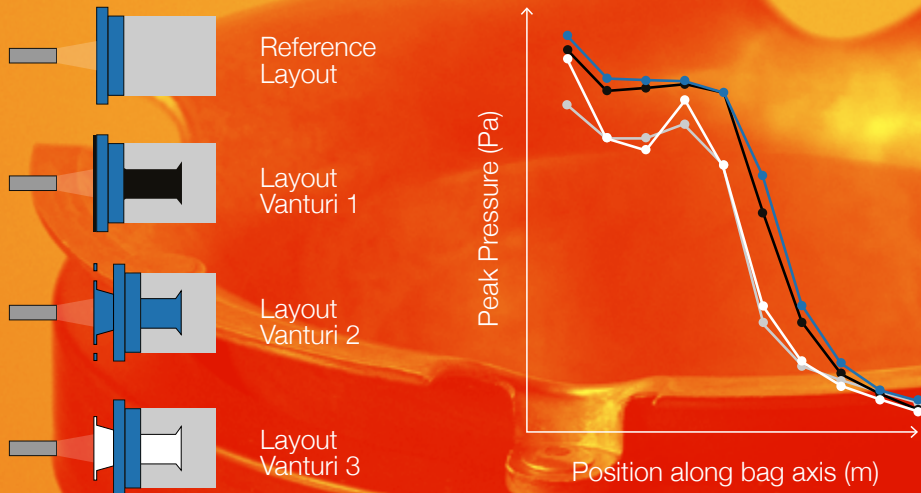
\*Peak Pressure & Arrival Time:



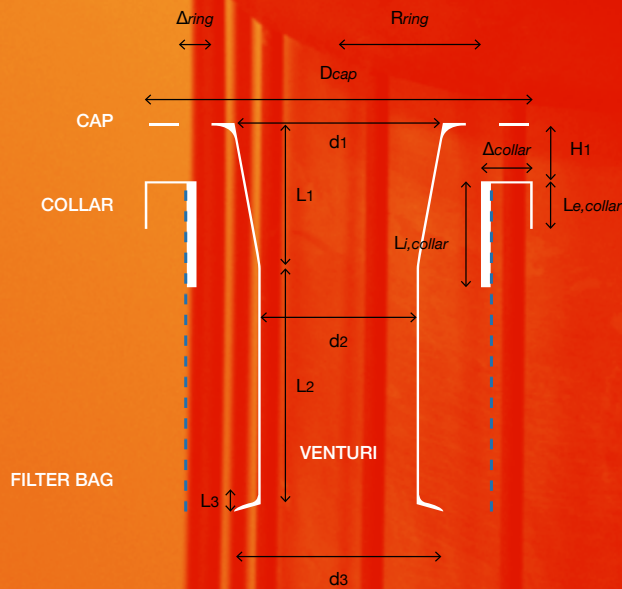
\*Air Flow:







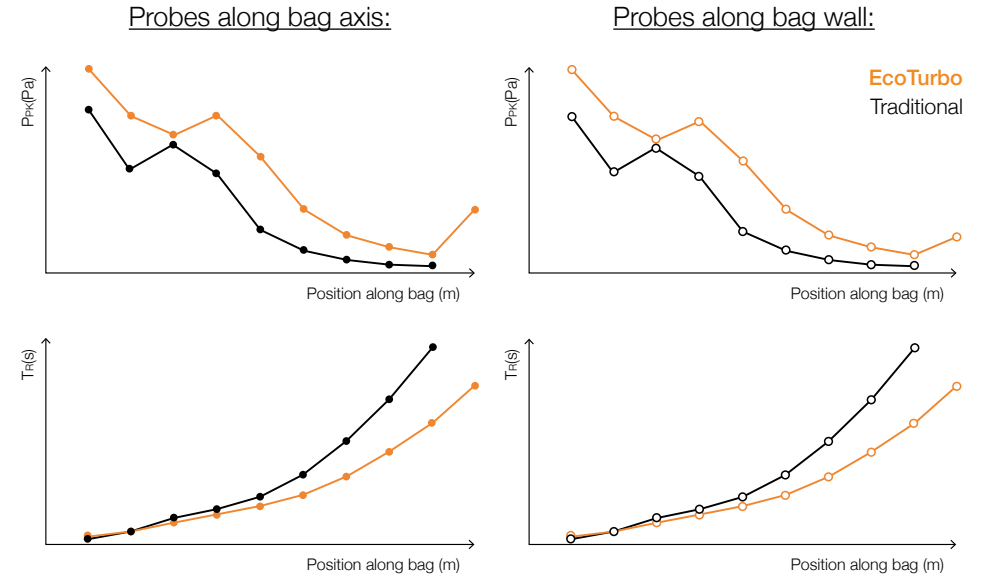
↗ A first set of findings in different Venturi configurations introduces the need to vary its geometry to increase performances.



The analysis made by comparison and variation of the geometric variables highlights those impacting the peak pressure and peak pressure's arrival time.

## A CFD APPROACH: DESIGNING THE PRODUCT

By choosing a specific set of parameters and confronting the new designated solutions with the traditional assembly used for Venturi, it was possible to define the best possible performances of EcoTurbo.



$$0,90 < d/D < 1,25$$

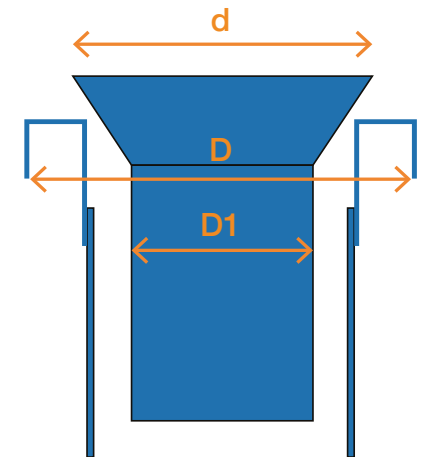
$$1,40 < d/D1 < 1,90$$



**EcoTurbo final shape and dimensions' ratio\***

(d, D, D1)

\*Specific dimensional range ratios of the EcoTurbo venturi assembly versus the top collar are patent pending.



# INSTRUMENTAL VALIDATION



## SETTING A TEST ENVIRONMENT - SCOPE:

The scope of the tests was to evaluate the different performances of EcoTurbo against a traditional solution along peak pressure.

### Pressure sensor & holder

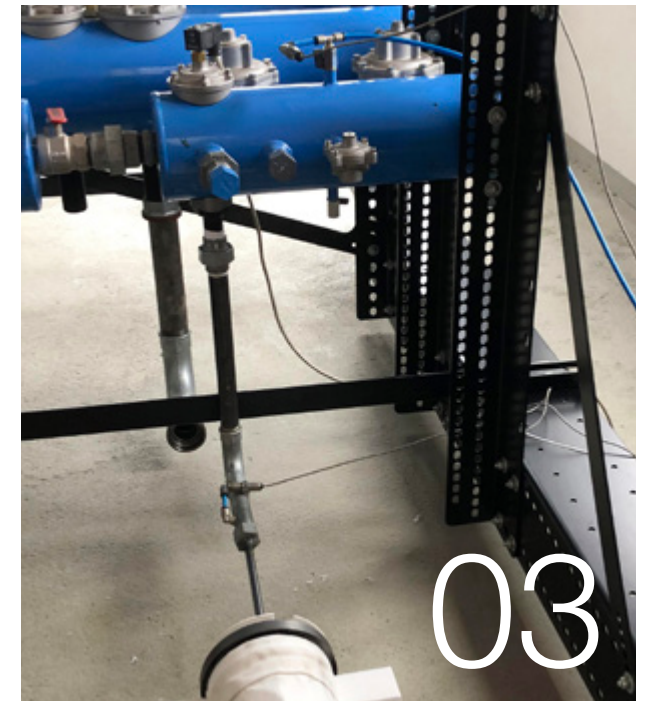
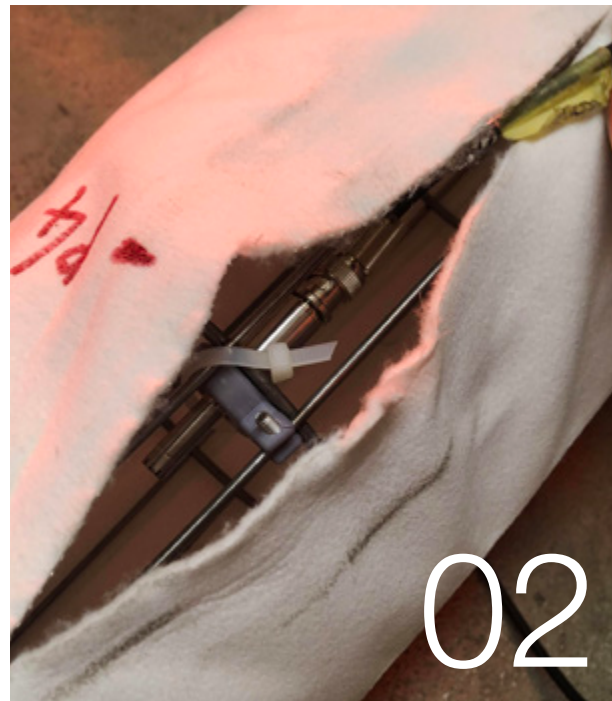
Two classes of pressure sensors have been placed in the cage to measure wave thanks to tailor-made sensor holders\*.

### Polyester filter bag

A polyester filter bag has been then wrapped around a 10 meters long cage and put to the test.

### Tank and injectors

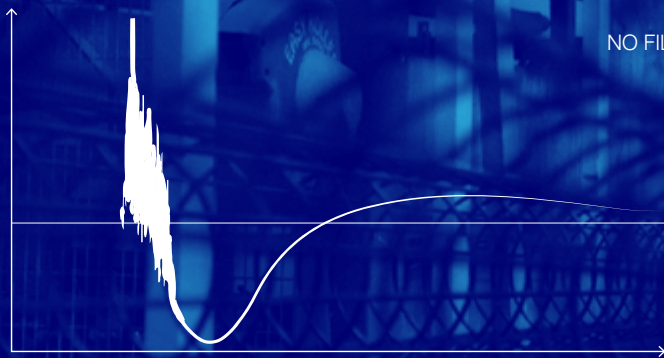
A specific tank was used to create the cleaning pulse and evaluate the effect on the peak pressure at different values.



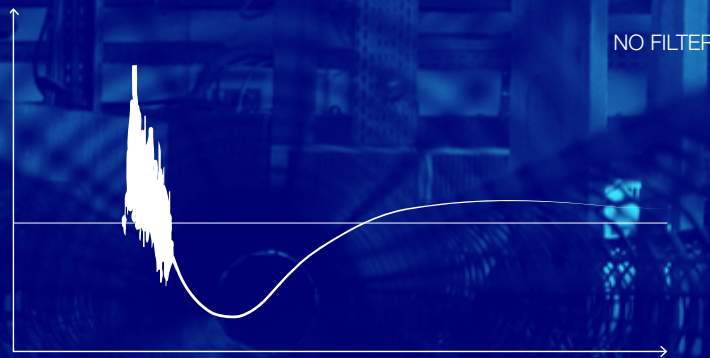


# MEASURING PERFORMANCES

\*Tests were performed by Politecnico di Milano's Mechanical Engineering Department

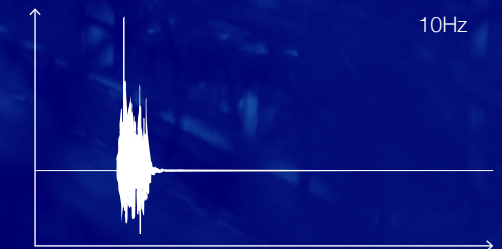
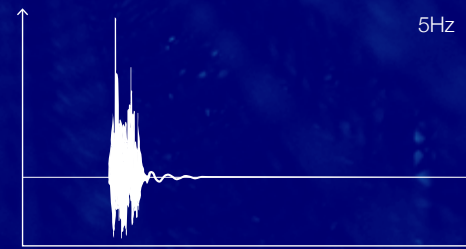
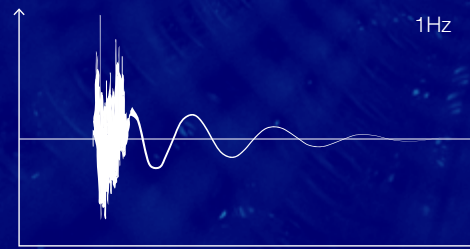
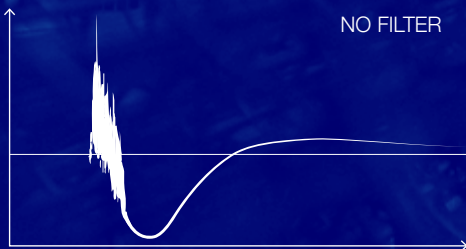


EcoTurbo wave with higher peak pressure



Traditional wave

By reproducing the simulation parameters in real the performances of EcoTurbo have been analyzed and confronted with a traditional Venturi solution. The results validate **peak pressure increase up to 50%** in certain areas of the filter bass as underlined in the table.\*



\* Ratio minimum and maximum pressure value, filtered data, 5 meters length, distance nozzle 10 cm, 4 and 5 bars tank pressure.

	Pressure	$p1_{new}/p1_{old}$	$p2_{new}/p2_{old}$	$p3_{new}/p3_{old}$
Maximum value	4	1.38	1.35	0.91
	5	1.20	1.53	1.24
Minimum value	4	1.13	1.37	1.54
	5	1.04	1.45	0.89



A solid analysis of the signal has been done to **exclude any bias** due to the measuring system.



# ENERGY SAVINGS

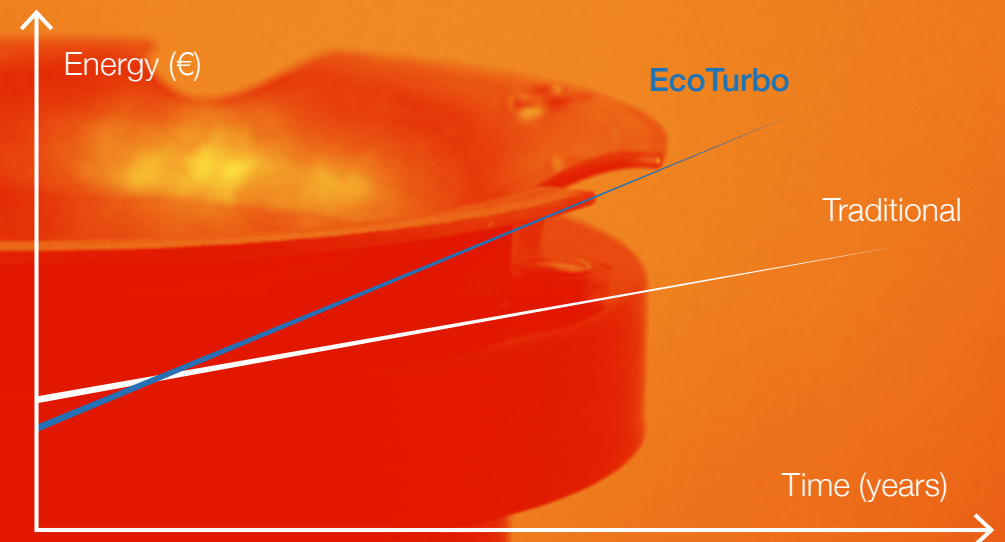
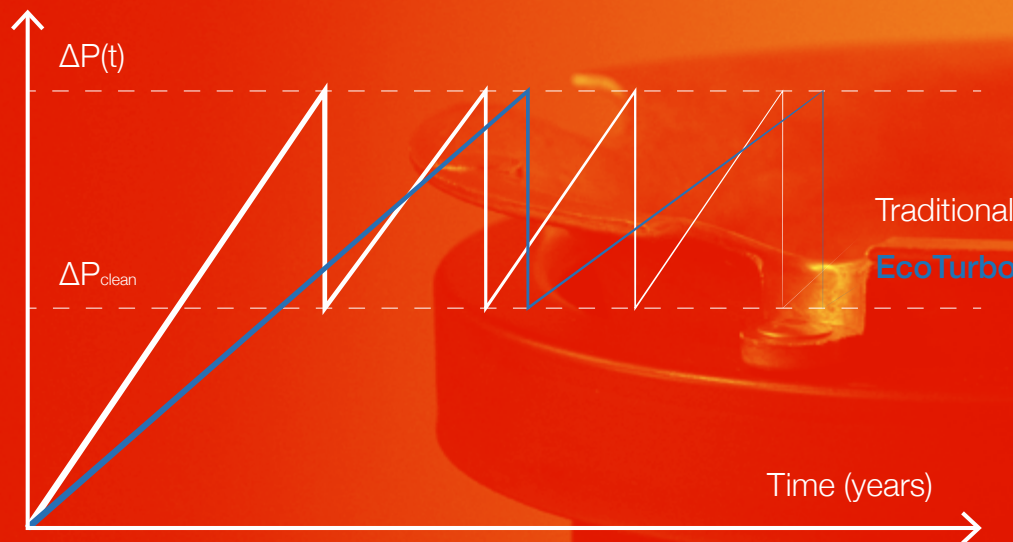
\*in working and cleaning

Decreasing cleaning frequency by releasing a superior quantity of dust contributes to save:

01 AIR COMPRESSION ENERGY

02 COMPRESSED AIR

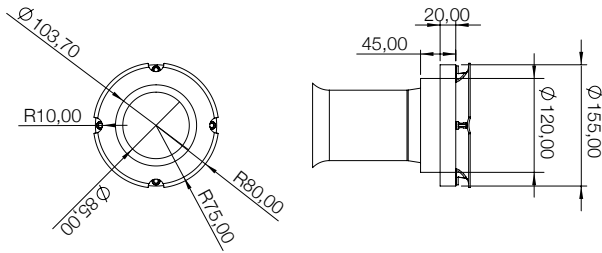
By reducing the cleaning frequency we obtain an average lower differential pressure in the dust collector, requiring **less power to the fan** in working conditions. As an overall effect the pay back time of EcoTurbo cage can faster return the investment made over the time in cage and filter bags along the whole life cycle. Thanks to its detachable fixing, EcoTurbo can also be reused with renewed cages.



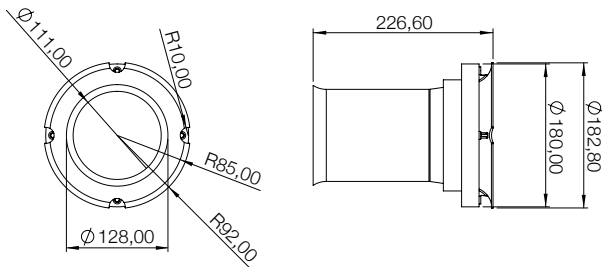


# RANGE

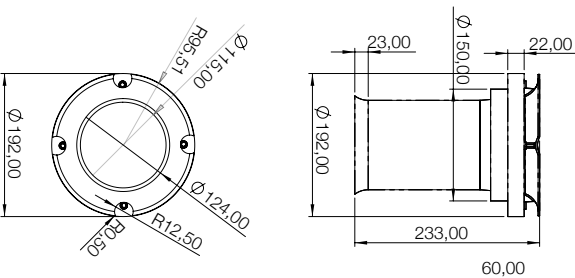
## Small:



## Medium:



## Big:



EcoTurbo could be used for **all round and star shaped cages**, as well as the new Waveline® filter.



The cleaning process of the wider filtration area of waveline could benefit from a **stronger shaking effect** at the EcoTurbo potential pressure wave.

## ACCESSORIES



Rivets



Riveting hand tool



EcoSmart Tag



Antistatic strip





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