WHITE PAPER | AIR-FOIL BLADE SHAPE

Definition & Comparison of Blade Types

TAMCO

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EXPERIENCE TRUE EXCELLENCE IN SERVICE, QUALITY, AND MAINTENANCE-FREE PERFORMANCE.

The Question

Engineers and specifications will often call for dampers with air-foil shaped blades, but what exactly is an air-foil shape? How does it differ from other designs used in the industry? Before selecting a damper, it is important to be familiar with the true definition of air-foil and how it pertains specifically to damper blades. This distinction will help educate our damper selection by giving us a clear understanding of how an air-foil blade is different from other common blade designs.

It is commonly believed that for a damper to be considered air-foil, the blades must be shaped like an airplane wing. This has brought TAMCO's design into question. How can TAMCO dampers be considered air-foil if the blades are not specifically shaped like an airplane wing? Once a common understanding of the air-foil shape is established, we can take a closer look at TAMCO's blade design, compare it to other common designs in the industry and determine how TAMCO's damper blade incorporates the air-foil shape.

Often, the air-foil blade requirement itself is questioned. We need to determine whether the specific shape of the damper blade is really important, or whether it is the effect of the blades shape on overall damper performance we should be concerned about. When air-foil dampers are specified, it is often pressure drop that is the true concern. In this white paper, we will tackle these questions and work to shed some light on this often misunderstood topic.

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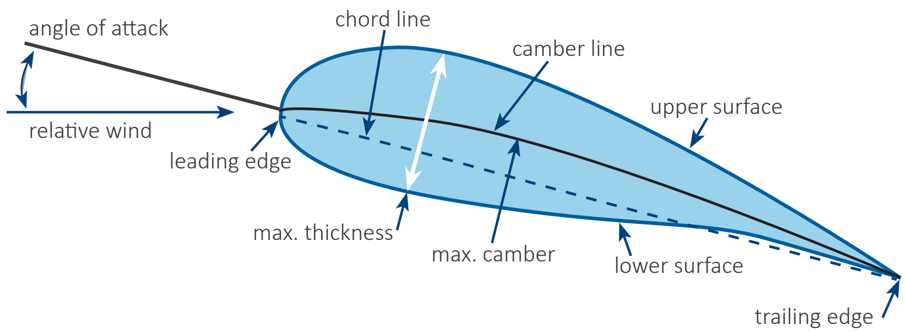
Air-foil shape detail

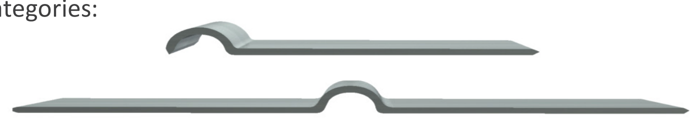


What is air-foil?

An air-foil, or aerofoil, is the cross-sectional shape of an object that, when moved through a fluid such as air, produces an aerodynamic force. The air-foil shape is employed on wings, fan blades, and sails to aid in lifting or controlling. The component of this force that is perpendicular to the direction of motion is called lift. Drag acts parallel to the direction of motion. A subsonic air-foil wing, shown on the previous page, is shaped with a rounded leading edge, a sharp trailing edge and symmetric curvature on the upper and lower surfaces.

What damper blade designs are used in the industry?

Three basic blade designs are used in the damper industry. While the nuances of each blade may vary among manufacturers, they will generally fall into one of these categories:



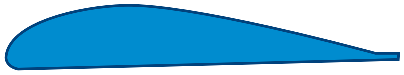
1. Flat: This is commonly used for single-blade dampers, both round and rectangular, that encounter low velocity and pressure. This is the weakest of the three designs.

2. Triple-V, 3V, or Crimped: Commonly made of steel or aluminum, these blades can have a slight variation in shape depending on the manufacturer. The blades are press-broken or roll-formed and incorporate various shapes at the ends and in the center. These shapes produce downstream voids known as eddies. Eddies are circular currents that create a whirlpool action that prevents the air from flowing smoothly across the blade, resulting in a higher loss of pressure.

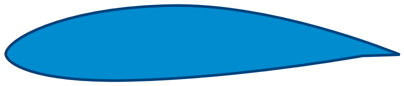
3. Air-Foil: Air-foil blades typically have smooth transitions along their surface, unlike the abrupt ones found on the 3V or crimped blades. It should be noted the term "air-foil" is something of a misnomer, as the damper blade is not a true air-foil shape as shown in the examples to the right. Rather, this type of damper blade could be more accurately described as having an aerodynamic shape.

   This design is specifically engineered to reduce or eliminate the eddy effect. Eddies cause turbulence and turbulence creates pressure loss. The smooth transition of the air-foil shape reduces turbulence and produces a more laminar airflow. Once more laminar airflow is achieved, there is less energy or pressure loss. This reduces the need to add additional power to the system to overcome that loss.

Examples of air-foils shapes

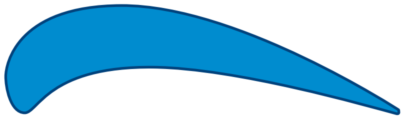


Low-speed ULM (1 m)



Propeller blade (15 cm)

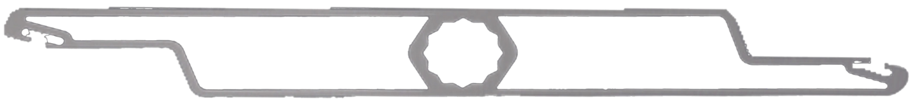
Turbofan fan blade (80 cm)



Turbine blade (8 cm)

How does TAMCO utilize the air-foil design?

TAMCO's blade profile does not have any shapes protruding from it, other than the blade seal. Its parabolic curve shape allows the TAMCO blade to fall within the air-foil or aerodynamic blade design.



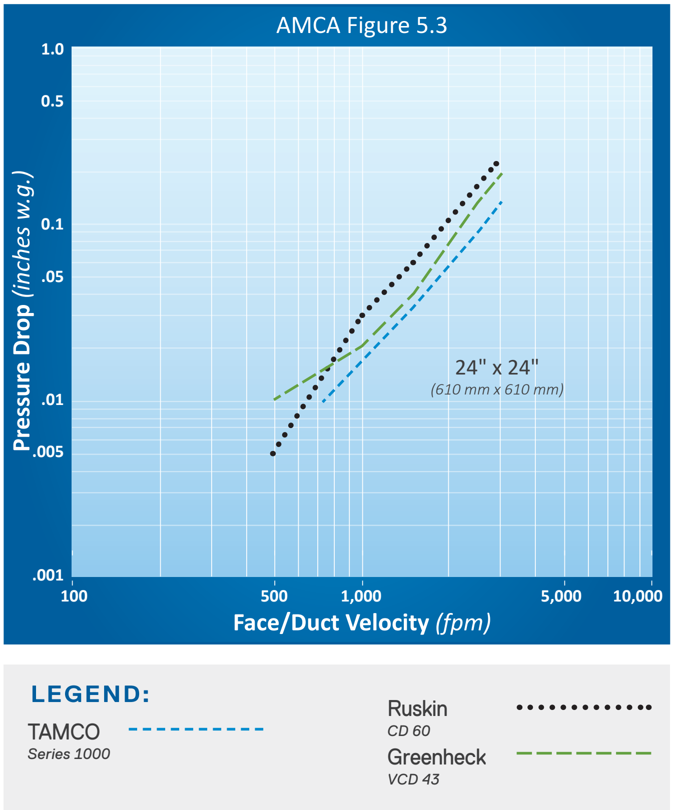
TAMCO Series 1000 blade profile

How does TAMCO's Series 1000 pressure drop compare with that of the leading competitors?

Below is a graph showing pressure drop data for the following dampers: TAMCO Series 1000, Ruskin CD-60, and Greenheck VCD 43.

These three models are generally considered to be equivalent products and are constructed with air-foil type damper blades.

VELOCITY VS. PRESSURE DROP



The data shown is based on the pressure drop values obtained from the AMCA certified catalog pages for each damper model. Pressure drop for the TAMCO Series 1000 is clearly the lowest of the three.

AMCA FIG. 5.3
PRESSURE DROP TEST DATA

	TAMCO Series 1000		
	Q *CFM*	V *FPM*	ΔP 24x24
1	2963	741	0.010
2	3988	997	0.017
3	5982	1496	0.034
4	7998	1999	0.058
5	9977	2494	0.092
6	12053	3014	0.134

	Ruskin CD 60		
	Q *CFM*	V *FPM*	ΔP 24x24
1	2024	506	0.005
2	3992	998	0.030
3	6056	1514	0.060
4	8048	2012	0.110
5	11468	2867	0.220

	Greenheck VCD-43		
	Q *CFM*	V *FPM*	ΔP 24x24
1	2000	500	0.010
2	4000	1000	0.020
3	6000	1500	0.040
4	8000	2000	0.080
5	10000	2500	0.130
6	12000	3000	0.190

Conclusion

A common misconception in the industry is that in order for a damper blade to be considered air-foil, it must be shaped like an airplane wing. As a result, the TAMCO blade design is often brought into question. It is important to keep in mind that air-foil design is not meant to resemble a specific shape. It is simply meant to be aerodynamic with smooth transitions that eliminate the eddy effect that causes turbulence and pressure loss. This is precisely how the TAMCO blade is designed. Specifications calling for air-foil blade dampers are common, but it is not necessarily because a particular blade shape is needed. Instead, it is the performance and pressure drop ratings of a damper that are the ultimate concerns. A precise pressure drop is sometimes required at a particular velocity, and as damper blades with an aerodynamic shape often provide the lowest pressure drop, air-foil blades are listed as a requirement.

TAMCO is dedicated to specializing in air control dampers. With unique blade design combined with intricate frame features, TAMCO dampers provide the lowest pressure drop in the industry today.

AIR-FOIL BLADE SHAPE

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