

# ENGINEERING REPORT

## TOPIC: Airfoil Blade Design Advantages

Report No. 8190:1

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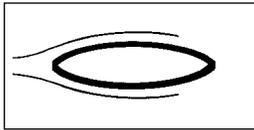
There are several pieces of information out there stating airfoil blades on dampers are unnecessary. To help your engineers make up their own minds as to the correct blade to specify, here are five reasons to specify an airfoil blade over a triple-V-groove or modified flat blade:

1. BLADE STRENGTH
2. STATIC PRESSURE LOSS
3. SEALING ABILITY
4. FIRE PROTECTION ABILITY
5. NOISE PRODUCED

Now, let's look at these five reasons in detail.

### 1. BLADE STRENGTH

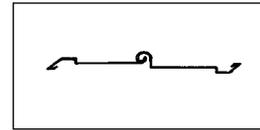
The strength of a blade comes primarily from its shape. There are three basic blade shapes available in the market:



**AIRFOIL**



**TRIPLE-V-GROOVE**



**MODIFIED SINGLE SKIN  
(Prefco)**

Single skin blades are difficult to keep flat and true when compared to a hollow, airfoil shaped blade like the Ruskin 60 blade. When side linkage is used to keep the linkage out of the airstream, a hollow blade does not twist from side to side. A single skin design will twist.

The following chart compares blade length and maximum static pressure. The maximum static pressure is based on 1/360 of the span deflection, which is required to maintain good leakage characteristics.

*(Continued on next page)*

**RUSKIN**

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**MAXIMUM INSTANTANEOUS STATIC PRESSURE\***

Blade Length	Maximum Instantaneous Static Pressure – in. w.g.*		
	60 Blade Airfoil	35 Blade Triple-V-Groove 16 Gage	Modified Single Skin Prefco 20 gage
36"	17	8.5	2.1
32"	25	12.5	2.9
30"	30	15.0	3.6

\*Instantaneous static pressures shown are not normal operational design static pressures, but sudden and momentary static pressures that may be encountered.

Your engineer may say he doesn't need the high static pressure design. But if the dampers are designed to close rapidly – such as fire dampers with fusible links or bimetal links – the instantaneous static pressure will far exceed the design static pressure due to the mass of air flowing through the duct downstream of the damper at closure. The negative static pressure can collapse duct as shown in Figure 1.1 or destroy the damper as shown in Figure 1.2.

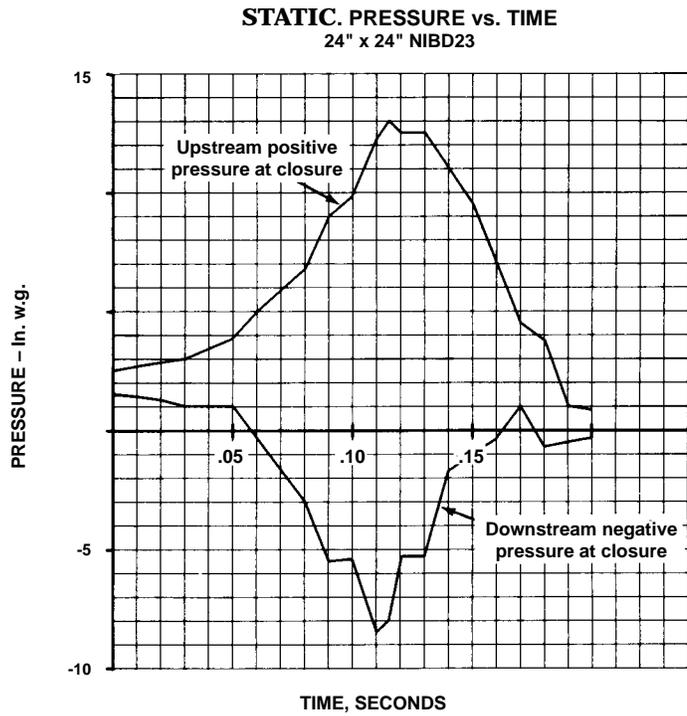


**FIGURE 1.1**



**FIGURE 1.2**

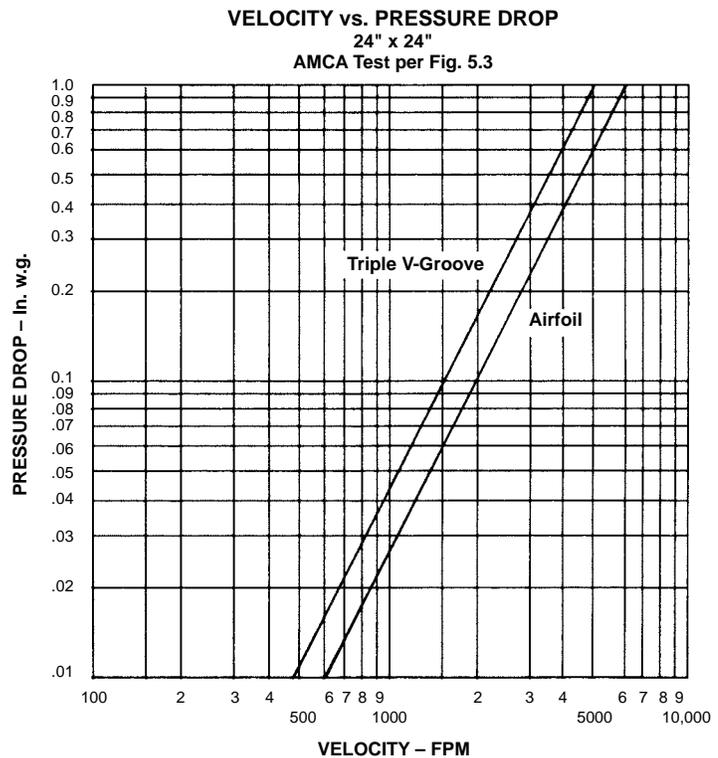
The negative static pressure can build as depicted in Figure 1.3, which is based on 4000 fpm duct velocity and only 21' downstream ductwork. As you can see, blade design is important in handling the static pressure that can build in your everyday HVAC system.



## 2. STATIC PRESSURE LOSS

The static pressure drop on a 60 airfoil blade is less than single skin type blades. Figure 2.1 shows static pressure vs. airflow comparison for 24" x 24" dampers. Testing was performed to AMCA Standard 500.

Because many systems have multiple dampers in series, static pressure drop becomes important when velocity is above 1500 fpm.



### 3. SEALING ABILITY

The 60 hollow shape, airfoil blade does not twist when force is exerted from one edge. Single skin blades depend on offsets or bends in the blade to make it strong; these bends do not give support to the blade in a twisting action. Try twisting a piece of paper and see how one edge bends and the other edge does not. A hollow shape blade moves throughout its length when twisted on one end, giving excellent blade-to-blade sealing action.

### 4. FIRE PROTECTION ABILITY

The hollow airfoil blade of the 60 has proven to withstand the most rigorous fire endurance testing. The hollow double skin airfoil blade shape actually provided heat resistance not found in a single skin blade design. Figure 4.1 shows a four hour British Fire Test of the FSD60 and FSD35. The temperature on the exposed side of the FSD60 was 212°F cooler throughout the fire test due to the insulating effect of the hollow blade. The British Fire Test shown was performed under positive pressure which gives a much hotter test than an Underwriters Laboratories fire testing.



FIGURE 4.1

### 5. NOISE PRODUCED

The airfoil blade produces less turbulence to the airstream than a triple-v-groove or modified single skin blade. The following chart shows the noise produced by all three blade shapes at various velocities flowing through the damper.

#### NOISE CRITERIA

Velocity	Airfoil	Triple-V-Groove	Prefco Single Skin
1000 FPM	19 NC	30 NC	29 NC
2000 FPM	35 NC	46 NC	46 NC
3000 FPM	45 NC	55 NC	58 NC
4000 FPM	51 NC	60 NC	63 NC

1. NC based on noise generated in third octave band with 10 db room attenuation.
2. Test conducted in accordance with ASTM Standard E477-80.

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