Critical Airflow Control Design for the 21st Century

Evolution of Airflow Control Technology

ACCUTROL LLC

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Overview

Air flow control valve technology had not changed much over the past 30 years – until recently. The new century brought a new energy consciousness and the desire to reduce the operating cost of airflow control systems. Engineers and owners began looking beyond the status quo for more ways to reduce energy usage. One obvious place is in reducing pressure requirements of the air handling system by replacing mechanically pressure independent valves with lower pressure drop valves. In 2006, the AccuValve ushered in a new development in critical airflow technology.

Evolving Air Flow Technology

Beginning in the 1980s, air flow valve technology for critical environments were either pneumatically controlled utilizing bladder dampers, or mechanically pressure independent venturi valves. These products were applied for constant air volume and variable air volume control of supply, general room exhaust, fume hood exhaust and other specialized exhaust.

Mechanical devices had some advantages in the past. However, this technology has now become outdated when compared to the 21st century technological advances offered with the AccuValve. The demand for energy efficiency has made the use of high pressure drop mechanical devices undesirable. The innovative design of the AccuValve enables high speed, stable, closed loop control at very low pressure drop, eliminating the need for open loop mechanical technology.

Technology must improve for advances to take place.

Feedback from the engineering and owner community indicated that the biggest concern with mechanically pressure independent valves was that they required fan pressure to operate, thereby using more energy than necessary.

In the early 2000s, Accutrol went to work designing a new product from the ground up. Instead of taking technologies developed in the 1960s and attempting to modify them, Accutrol started with a clean sheet to develop a truly innovative product – the AccuValve.

LOW PRESSURE DROP – While designing the AccuValve the overriding concern was to develop a product that allowed reduction in duct operating pressure saving the building owner electrical costs 24/7/365. In addition to low pressure drop design, engineers and owners desired the following important features:

- True air flow measurement
- No straight run requirement
- Fast speed of response
- Linear flow characteristics
- Simple application layout
- Ability to be mounted in any position
- Meets ASHRAE 90.1 Demand Based Static Pressure Reset Standard

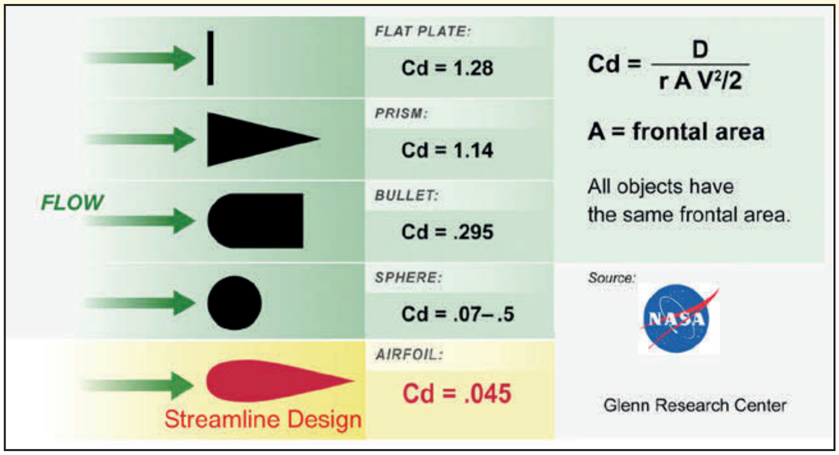


Figure 1
The streamlined airfoil design creates less drag and this translates into minimal pressure drop.

Meeting these demands meant that the solution needed a different approach.

True Airflow Measurement without Straight Runs

All air flow sensors require a uniform velocity profile. One way to achieve this is to provide lengths of straight duct into and out of the air flow sensor. Another is through air compression. The AccuValve incorporates a compression section into the inlet of the valve producing a uniform velocity profile for the airflow sensors without the need for straight duct into or out of the valve. Since two physical phenomenon take place in the compression section, less turbulent airflow and increased air velocity, this is an ideal place for air flow measurement. This eliminates the requirement for straight duct runs into and out of the valve and the increased velocity enables the sensor to read lower than if it was located in the duct section.

Reducing Pressure Drop Effectively

Providing a compression section in the inlet has definite advantages for air flow measurement. However, what about pressure drop? Taking inspiration from NASA (*Figure 1*), the AccuValve utilizes a streamline design, which takes advantage of the air compression and also incorporates a static regain section to "regain" most of the pressure loss associated with the compression section.

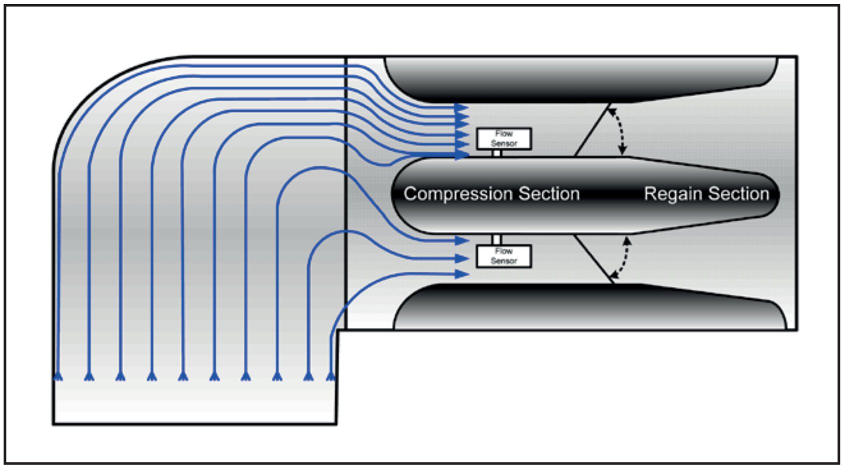


Figure 2
A compression section in the front of the valve compresses the air removing turbulence and increasing air velocity.

By reducing the area via an airfoil shaped compression section, the air is compressed and the velocity increased to make the airstream more laminar. This improves the turndown of the measuring system and eliminates the need for straight duct sections into the valve. Then by adding a static pressure regain section after the control blades, it further reduces the pressure drop of the valve. *(Figure 2)*

In addition, incorporating a streamlined design in the airstream provides a much lower drag coefficient. At maximum design air flow, a pressure drop under 0.3" should be the norm. This means reducing duct operating pressure between 0.5" and 1.0" lower than what would be required for a mechanical valve can easily be achieved. This lowers the brake horsepower of both the supply and exhaust fan systems.

Reducing the overall pressure drop in a ventilation system equates to less fan horsepower and a significant reduction in energy cost. This energy reduction not only saves money, but it also reduces the building's environmental impact and carbon footprint. In addition, noise levels are lowered in the duct, making the building environment more pleasant to work in.

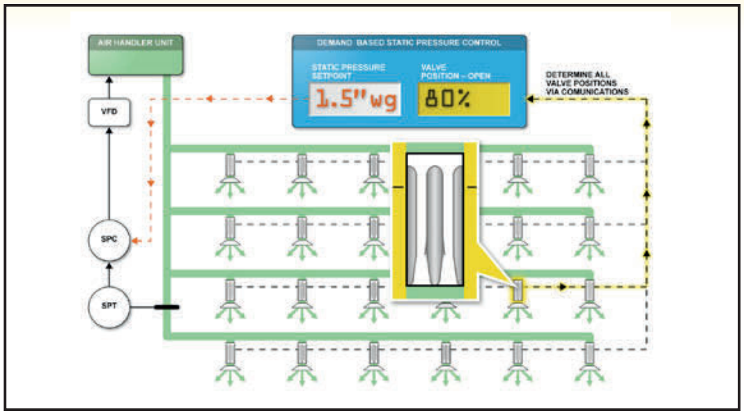


Figure 3
By using demand based static pressure reset control, the system is operating at the lowest possible static pressure.

Demand Based Static Pressure Reset Control

Whether in a pharmaceutical or university research facility, laboratories use much larger amounts of energy than other buildings. In continuing efforts to reduce energy costs, make buildings "greener" and more sustainable, Labs21 has recommended reducing the static pressure drop of the devices in the airstream for both supply and exhaust systems in labs.

ASHRAE Standard 90.1-6.5.3.2.3 provides: "For systems with direct digital control of individual zone boxes reporting to the central control panel, static pressure setpoint shall be reset based on the zone requiring the most pressure; i.e., the setpoint is reset lower until one zone damper is nearly wide open."

This standard simply states that through network communications the BMS should:

- Survey all of the valve positions for a given system
- Determine which valve is most open
- Adjust static pressure setpoint until the most open valve approaches wide open

These steps ensure that the fan is operating at the lowest possible static pressure while maintaining laboratory safety. This simple control scheme allows the fans to run at minimum electrical input at all times.

If the valve is not a mechanical device and actually measures air flow, the valve will modulate to whatever position is required for the air flow. If the static pressure in the system is high it will modulate to a more closed position and if the static pressure in the system is lower it will modulate to a more open position.

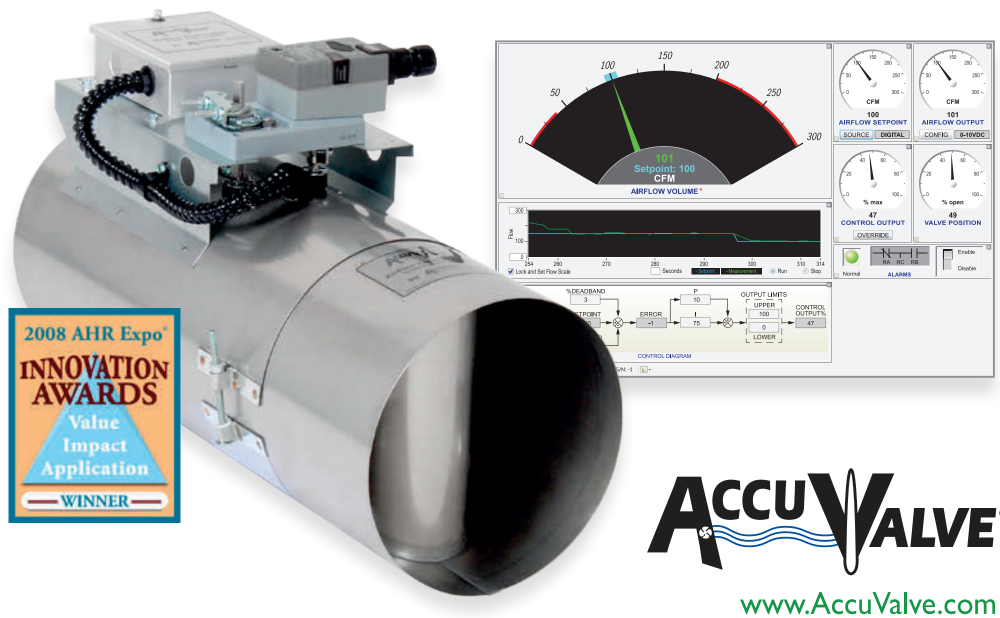
Separating the Air Flow Valve from its Controller

Today, there are many choices of controls for critical environments. However, no matter how good the controller is, if it does not receive an accurate air flow measurement signal over a wide range, it is limited in the accuracy it can maintain. The utilization of vortex shedding technology instead of differential pressure ensures highly accurate air flow measurement with high turndown ratio and is a proven technology within critical environments. In addition, the best controller cannot overcome the non-linear control action of a single blade damper in critical air flow control applications. By incorporating a dual offset linkage, the air flow is linearized with respect to the control input. These design features allow the AccuValve to be combined with controllers from many of the top BAS (building automation system) providers as chosen through the engineering and owner community. When combined with other features such as low pressure drop design, no straight run requirement, the ability to be mounted in any position and demand based static pressure reset capability, the advantages of the AccuValve for critical air flow technology becomes clear.

AccuValve® is the Choice for Critical Air Flow Control

At Accutrol we believe that innovation is our reason for being. In 2012, Accutrol introduced the AccuValve with Electronic Pressure Independence (ePI®). Now the AccuValve provides stand-alone control applications. The ePI includes all of the innovative benefits of the standard AccuValve and incorporates an airflow controller to make it electronically pressure independent. Native BACnet® is included as standard on the AccuValve with ePI. Applications include single/multi-position constant volume and tracking pair airflow control for operating room, isolation room, vivarium, and many others. The AccuValve with ePI also comes standard with an intuitive user interface dashboard. Using a PC you can communicate directly with the AccuValve to configure the controller parameters or locally monitor the AVC performance. All that's required is a PC with a USB Port, a USB Cable and the free AVC Insight Software.

That's why we say "It's all about the valve."



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