Introduction

Aerodyne Environmental supplies equipment to the mining industry. Our GPC cyclone's compact size and unique horizontal design lends itself to mining applications. While the SplitStream cyclone allows material to be collected from an airstream while minimizing the wear of the dust particles. The Aerodyne Vacu-Valve is an economical alternative to rotary valves. For fine, free flowing material that doesn't bridge, the Vacu-Valve can provide a low maintenance alternative to rotary valve in non-explosive applications. The Aerodyne Double Dump Valve provides low leakage air locking and the StopTight Knife Gate provides hopper control.

Aerodyne's experience in the mining industry started in the 1960s providing Vacu-Valve for mining dust collectors. The Vacu-Valve low cost and easy maintenance allows saves both time and money over rotary airlocks which are often used.

And Aerodyne cyclones, while not providing the dust removal efficiency of baghouse and cartridge collectors, provide high dust removal in a compact and low maintenance package. The compact design can easily fit into the confined space of an underground mine, or on mining equipment. Whereas a baghouse or cartridge collector would be much too bulky. Therefore, installing a cyclone is a great way to decrease the dust in an underground mine without having to find space for a baghouse or cartridge collector.

Aerodyne Cyclones

Why Install Cyclones?

Cyclones are one of the simplest dust collectors available on the market. Dirty air enters the cyclone which then causes the dirty air to swirl around the separation chamber. The centrifugal forces caused by the swirling air forces the particles out towards the walls. Once the air / dust mixture gets down near the hopper, the air changes direction (called vortex reversal) and leaves through the center of the cyclone separation chamber. The solid particles that were concentrated near the wall fall into the hopper and are then removed from the hopper via the airlock.

A cyclone dust collector will capture the solids without using filters. The cyclone high removal efficiency of larger particles means it usually captures most of the material (based on weight) while only the very fine particles pass by. So, most of the heaviest and largest particles in the airstream will be captured by a cyclone pre-filter while the very fine particles would have to be captured by the filters afterwards.

This significantly lowers the loading on the filters. Which reduces the cleaning that is required on the filters, thereby extending the life of the filters. Less cleaning also lowers the amount of compressed air required for cleaning (pulse jet type). Significant saving can be seen if the compressor loading can be downsized for a facility.

GPC Cyclones

GPC Cyclone are compact cyclones that remove around 99% of 20 micron dust. They compare in removal efficiency with traditional cyclone designs. The big difference being that the GPC cyclone is shorter and the internal ground plate provides an integral vortex breaker.

The unique design of the GPC cyclone allows it to be designed horizontally, thereby minimizing the height required for installation, allowing a cyclone pre-filter to be installed in applications where a traditional cyclone won't fit.

The compact size of the GPC means it can often be installed right by the location of dust generation, and allowing the material to be collected in area where it can be re-entered into the process. The horizontal design of the GPC means that it's backplate can be designed as an easy clean door access. This will allow easy access to the cyclone internals for cleaning.

SplitStream Cyclone

The SplitStream cyclone uses a secondary airflow to capture dust particles and convey them to the hopper. In a vertical unit, the primary (dirty) airstream enters the separation chamber just above the hopper, through a stationary spinner which cause the airflow to begin spinning, this forces the solid particles out towards the walls of the cyclone.

A secondary airflow enters the separation chamber just below the outlet of the cyclone. This airflow enters through nozzles or vanes and travels down the walls of the cyclone, spinning until it reaches the hopper. Particles traveling from the primary airflow are collected by the secondary air and conveyed into the hopper. At the hopper the secondary airflow joins the primary airflow, while the particles fall into the hopper.

The SplitStream cyclone get a high removal efficiency when compared to traditional cyclone design. The SplitStream often gets 99% of 7-micron dust particles. And since the secondary airflow keeps material from coming in contact with the cyclone walls, thereby minimizing erosion and damage to the cyclone walls, extending the cyclone operational life in abrasive applications. The secondary airstream also allows it to collect friable material without damaging it, since it keeps the material from contacting the cyclone walls.

The main benefit of the secondary airstream is that it allows a second airstream to enter the process while collecting particulate. The addition of a second airstream while collecting particulates can be very useful in certain systems, here a few examples

1) Hot / cold secondary airstream used to heat / cool the outlet stream and the particles being collected.
2) High nitrogen secondary (or low oxygen content) used to lower the oxygen level in the system so a fire/explosion cannot happen.
3) Recycled secondary airflow allows a second pass at the particulate to provide higher removal efficiency.

The SplitStream cyclone can be either vertical or horizontal in design. Since it requires a secondary airstream the SplitStream requires two (2) exhaust fans. The primary fan to provide overall airflow (usually located after the cyclone outlet) and a secondary fan to push the secondary airflow into the cyclone.

Aerodyne Airlocks

Vacu-Valve

The Aerodyne Vacu-Valve is an economical alternative to rotary valves. It's simple design and easy to maintain makes it a no-brainer when the application is right. The Vacu-Valve uses the vacuum in the hopper above it to shut the rubber sleeves. As material builds up above it, the material will slowly work its way through the sleeve and out of the system. The height of the head pushes material through the sleeve and the flowrate of the material is based on a variety of factors including, material density, flowability, particle size distribution, vacuum above and valve spring setting.

The Vacu-Valve is NOT suitable for an explosive application. The rubber sleeve will not isolate the hopper in the event of a deflagration. The Vacu-Valve will also not work well with applications that have large, irregular particles, or material that regularly bridge or pigeon holes. Rather the Vacu-Valve is ideal for applications that are fine free flowing dust.

One of the main benefits of the Vacu-Valve is that it can be easily maintained. The replacement of the sleeve can be done with the valve installed and only takes about 5 minutes. Sleeve life varies with the process conditions and material going through the application.

Double Dump Valve

The double dump valve is a low leakage valve that allows larger material through. It has a much smaller flow rate than a rotary valve (~10% of a rotary valve through put). The double dump valve is also about twice the height of a rotary valve, as its basically two (2) flap valves in series. The double dump valve can use gravity, be motorized or use pneumatic cylinders to operate the flaps.

Knife Gate

The knife gate is one of the most basic airlocks available. It is often used to manually control the movement of material from a hopper or used to isolate a rotary valve during maintenance. The knife gate is available in both manual and pneumatic actuation.

Mining Applications

Aerodyne Environmental has provided equipment in multiple applications in the mining industry.

GPC Cyclones

1) Underground Trona Mine – general area dust collection
2) Underground Potash Mine – general area dust collection

Vacu-Valve

1) Underground Trona Mine
2) Underground Potash Mine
3) Underground Salt Mine
4) Limestone Quarry
5) Sand Mining
6) Iron Ore Mining
7) Gold Mining
8) Kaolin Mining

Case Studies#1

Vacu-Valve Solves Limestone Quarry's Issues

A state-of-the-art limestone mining facility in Ohio was experiencing very costly problems with its rotary airlock valves. Due to the abrasive nature of limestone dust, the rotary airlock valve's performance was short lived. In addition, the difficult access to the drive assemblies made repairs a challenge.

The company decided to replace their expensive rotary airlocks with the much more cost-effective Vacu-Valve from Aerodyne. This trickle valve system improved overall process efficiency and saved an estimated $8,000 to $10,000 a year or more.

Aerodyne's Vacu-Valve Airlock Valve System is the most cost-effective way to manage dust discharged from bag filters or cyclones under negative pressure. The Vacu-Valve consists of an automatic non-powered valve and has a duckbill rubber sleeve which is held closed by the negative pressure. As material builds up, the sleeve is forced open and the material discharges from the hopper. The system's negative pressure then closes the sleeve automatically.

Case Studies#2

Salt Mine Operation Sees Improvement with Rotary Valve Replacement

A salt mine in the state of New York was finding issues in its dust collection system. The main particulate being filtered out, salt dust, was corroding the rotary valve meant to transport it to the dust collector. These problems required constant maintenance, necessitating a shut-down of the system and leading to losses in man-hours. While expanding their cyclone dust collector, the company decided to try Aerodyne's Vacu-Valve as a replacement.

The Vacu-Valve's neoprene sleeve reduces the impact of corrosive while improving ease of maintenance and part replacement. The Armadillo Vacu-Valve in particular fits the situation well, as the solid flange on the bottom of the device creates greater stability and the solid steel cage gives the valve better protection against the environmental factors associated with a salt mine.

Easy replacement of Vacu-Valve sleeves reduced the amount of downtime and man-hours needed for regular maintenance. The mine ultimately decided on installing an Armadillo Vacu-Valve on its dust collector after a few months of testing. Two more Armadillo Vacu-Valves were purchased for their other collectors.

Pilot Test Case Studies

Aerodyne Environmental's pilot lab has various pieces of equipment that are available for pilot testing.

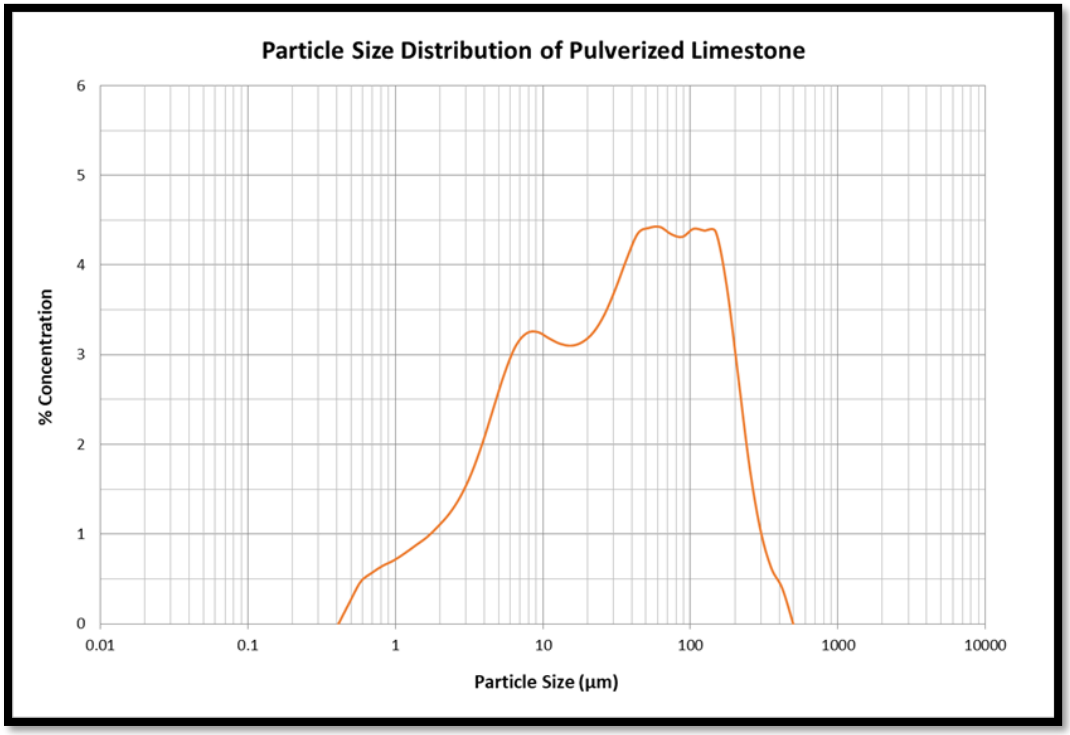
Some can be sent to a customer's facility while others have to be run at our lab. Both the GPC cyclone and SplitStream cyclone are available for testing both in our facility and at the customers site.

The following Case Studies are from lab testing of material on our GPC and SplitStream cyclones.

GPC Cyclone Dust Removal Case Study
Limestone Removal

Aerodyne Environmental tested pulverized extra fine agricultural limestone in our GPC-08 test lab. The test was done at room temperature and with a pressure drop of 6" W.C. through the cyclone. The dust loading was 35 grains/ft^3. The limestone sample tested had a particle size distribution as shown in the graph below. Its mean particle size was 30 micron and had a bulk density of 90 lbs/ft^3.

The GPC-08 cyclone got 90%* removal of the material.

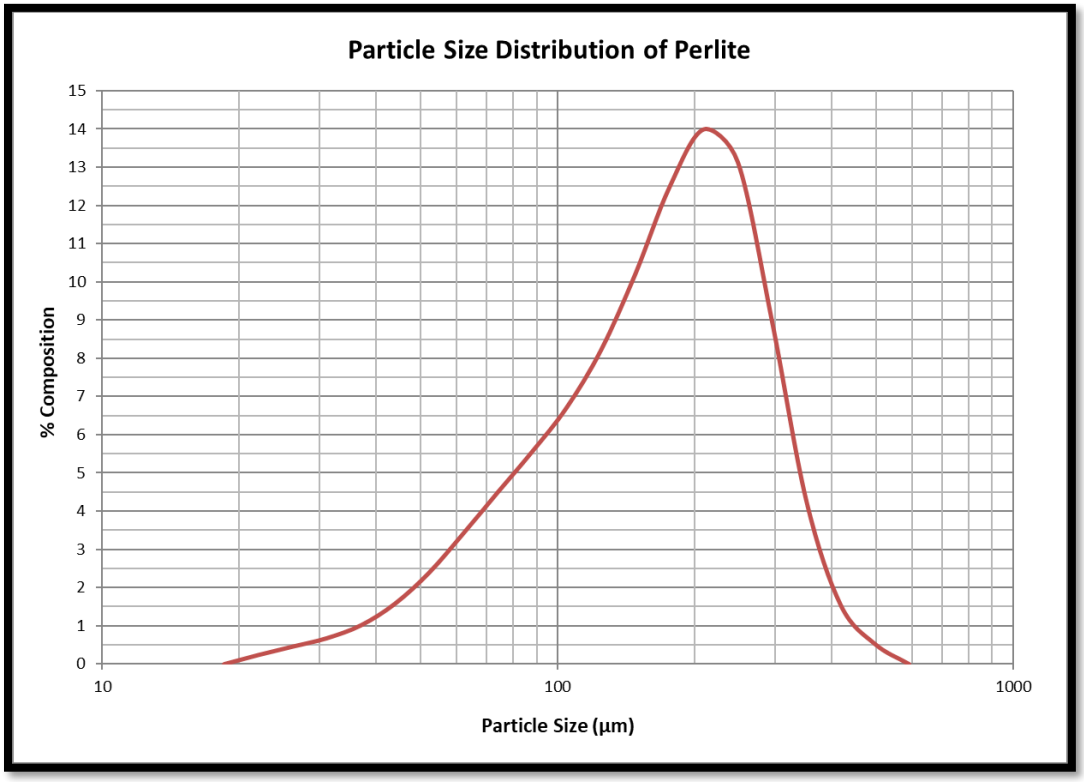


** Please note that particle removal efficiency is based on multiple factors in the process, including but not limited to cyclone size, pressure drop through the cyclone, particle size distribution, particle geometry, and material density. This test is a representative test, and results for your application may be different based on the above conditions.*

GPC Cyclone Dust Removal Case Study
Perlite Powder Removal

Aerodyne Environmental tested perlite powder in our GPC-24 test lab. The test was done at room temperature with a pressure drop of 1.5" W.C. through the cyclone. The dust loading was 2.8 grains/ft^3. The perlite sample had a particle size distribution as shown in the graph below. Its mean particle size was 159 micron with a loose bulk density of 4.4 lbs/ft^3.

The GPC-24 cyclone got 99%* removal of the material.



** Please note that particle removal efficiency is based on multiple factors in the process, including but not limited to cyclone size, pressure drop through the cyclone, particle size distribution, particle geometry, and material density. This test is a representative test, and results for your application may be different based on the above conditions.*

GPC and SplitStream Cyclone Dust Removal Case Study

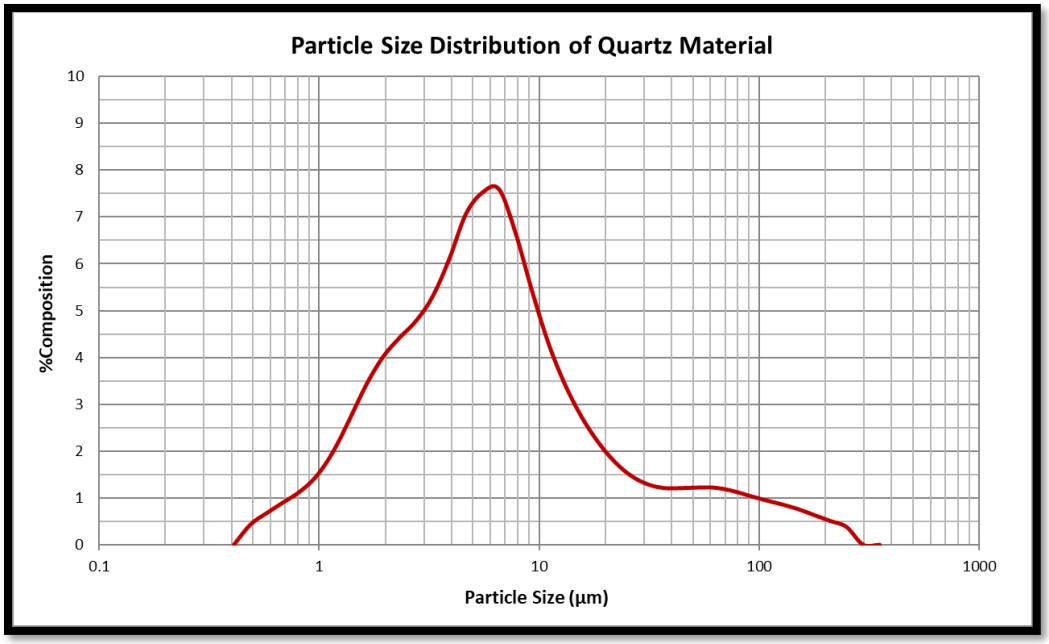
Quartz Dust Removal

Aerodyne Environmental tested quartz dust in our GPC-18 and S400 SplitStream test labs. All tests were done at room temperature with a dust loading of 16 grains/ft^3. The GPC-18 test had a pressure drop of 2.5" W.C. Two tests with the S400 were performed by varying the airflows of the primary and secondary airtreams: 3:2 ratio and 1:1 ratio. For the 3:2 ratio S400 test, there was a pressure drop of 6.5" W.C. through the primary airstream and 8.0" W.C. through the secondary aistream. For the 1:1 ratio S400 test, there was a pressure drop of 4.0" WC through the primary airstream and 18.0" through the secondary airstream. The quartz dust sample tested had a particle size distribution as shown in the graph below. Its mean particle size was 5 micron and had a bulk density of approximately 56 lbs/ft^3.

The GPC-18 cyclone got 56%* removal of the material.

The S400 SplitStream cyclone (3:2 ratio) got 85%* removal of the material.

The S400 SplitStream cyclone (1:1 ratio) got 90%* removal of the material.



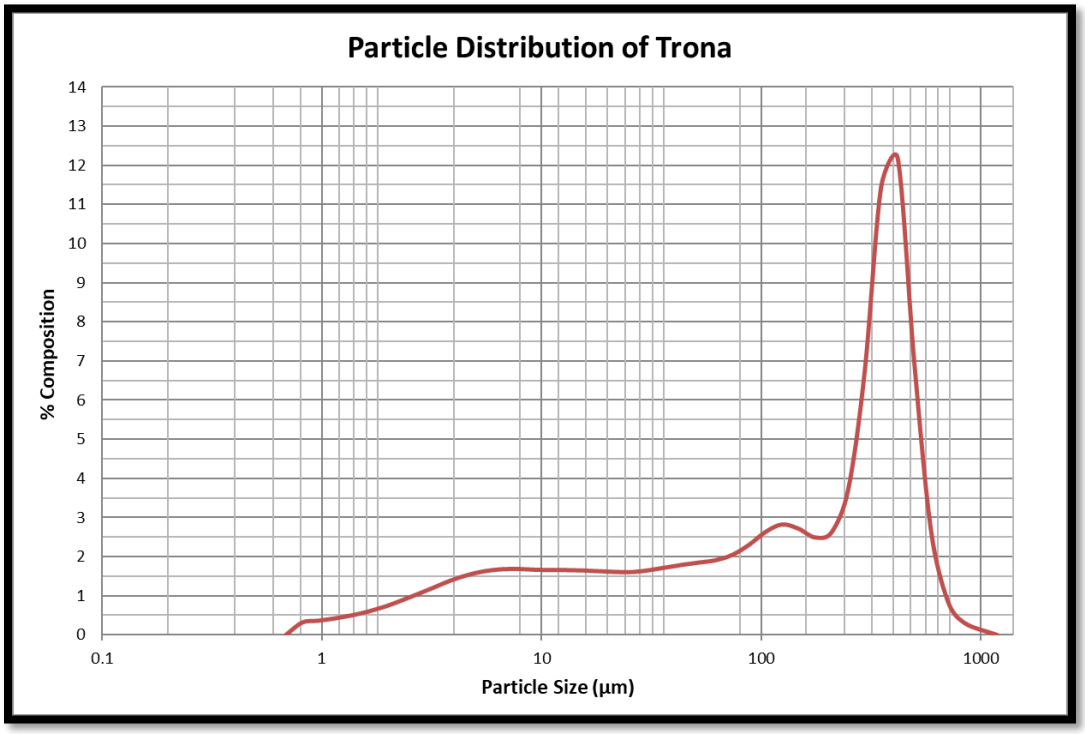
** Please note that particle removal efficiency is based on multiple factors in the process, including but not limited to cyclone size, pressure drop through the cyclone, particle size distribution, particle geometry, and material density. This test is a representative test, and results for your application may be different based on the above conditions.*

GPC Cyclone Dust Removal Case Study

Trona Removal

Aerodyne Environmental tested trona powder in our GPC-18 test lab. The test was done at room temperature with a pressure drop of 5" W.C. through the cyclone. The dust loading was 23 grains/ft^3. The trona sample had a particle size distribution as shown in the graph below. Its mean particle size was approximately 176 micron.

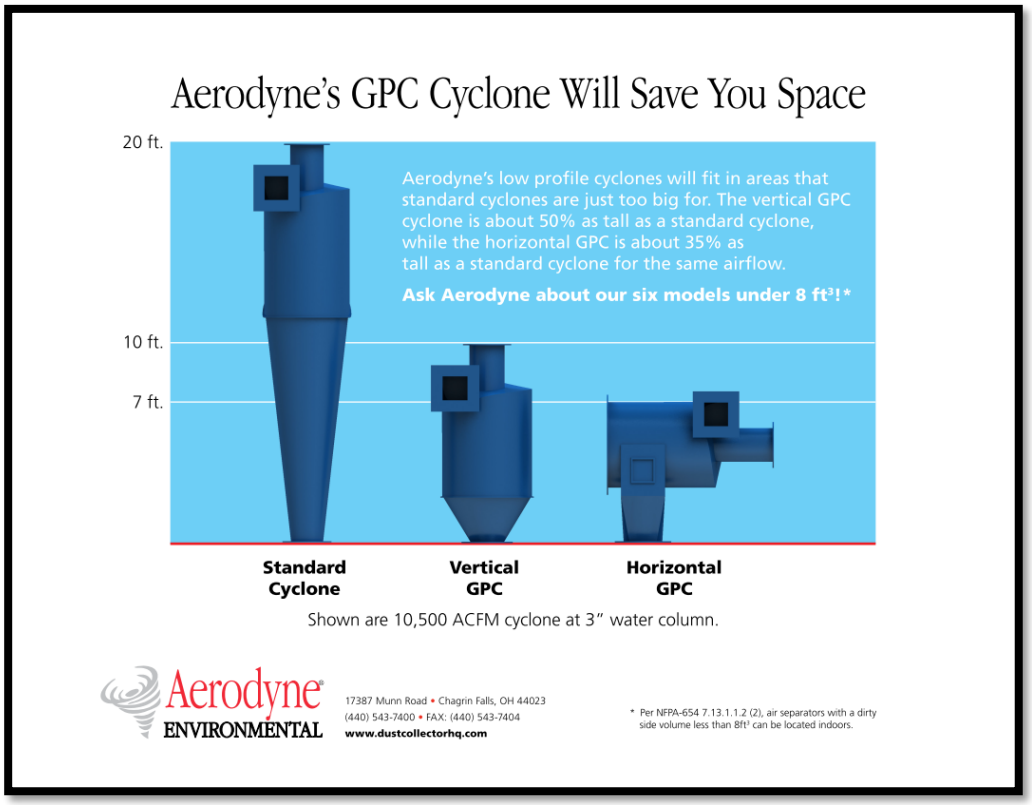
The GPC-18 cyclone got 98%* removal of the material.



**Please note that particle removal efficiency is based on multiple factors in the process, including but not limited to cyclone size, pressure drop through the cyclone, particle size distribution, particle geometry, and material density. This test is a representative test, and results for your application may be different based on the above conditions.*

Aerodyne's Mining Equipment Benefits

1) Horizontal Cyclone Design

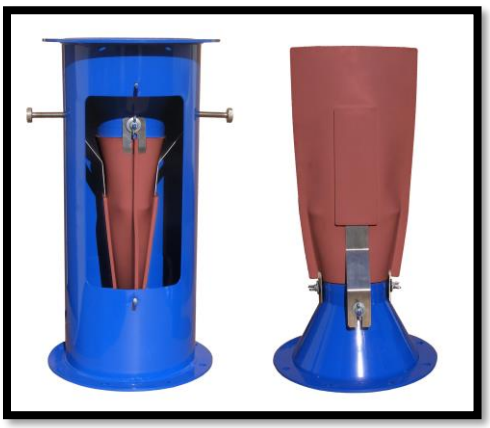


The Aerodyne horizontal cyclone design allows cyclones to fit into areas where traditional cyclones won't fit, such as underground mines, on mobile mining equipment, etc. This allows cyclones to be retrofitted on to existing systems that is having operational issues without making major changes to the area around to fit a tall traditional cyclone.

The horizontal design on the GPC cyclone also provides a back plate which on the smaller cyclone sizes is often removable, thereby providing access to the cyclone internals. Unlike other cyclones that are disassembled for cleaning, the GPC doesn't require disassembly or disconnecting from the ductwork for access.

2) Vacu-Valve

Since the Aerodyne Vacu-Valve doesn't require any electricity or other utility for operation, it greatly simplifies installation in the mining industry. Along with its low cost and easy maintenance, the Vacu-Valve is a much better solution for dust collector airlock than rotary valves in the mining industry. It is ideal for application that have rock dust and sand.



3) Abrasive resistance

Aerodyne has multiple options for abrasive application. Cyclones can be constructed out of AR steel, have abrasive resistant coatings or the SplitStream cyclone can be used to minimize wear.