Introduction

Aerodyne Environmental supplies equipment to the food industry. Our GPC dust collection cyclone's compact size and unique horizontal design lends itself to food applications, especially when the easy-clean door is added to the design.

The SplitStream™ cyclone allows material to be collected from an airstream while heating / cooling both the airstream and the collected material. The secondary airflow in the SplitStream also allows the collection of friable material with minimal damage.

The Aerodyne Vacu-Valve® is an economical alternative to rotary valves. For fine, free flowing material that doesn't bridge, the Vacu-Valve is a low maintenance airlock in non-explosive applications. The Aerodyne Double Dump Valve provides low leakage airlocking and the StopTight Knife Gate provides hopper control.

Aerodyne's experience in the food industry started in the 1960s providing SplitStream cyclones for agricultural facilities. The SplitStream provided high dust removal that wasn't achievable in most cyclone dust collectors in that day. When baghouses and cartridge collectors were introduced, the SplitStreams were often replaced to provide higher dust removal. One problem with the filter collectors is that many food applications have unique conditions that often cause operational issues, such as high heat and/or humidity causing filter damage. The other issue is that material collects on the filters and spoilage can become an issue, thereby regulating all material collected to the waste stream.

Pre-filter cyclones like the Aerodyne SplitStream and GPC cyclone do not retain material in filters and often can be designed to allow regular cleaning. This prevents any spoilage from contaminating the collected material, thereby allowing re-integration of the material back to the production line, minimizing the waste. In some instances, that material could be sold or used as an ingredient for a different product. Now, with the recent design of the easy cleaning access door on the GPC cyclone, cleaning is very easy with minimal down time or dismantling of the process equipment.

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Aerodyne Cyclones


Vertical GPC with removable hopper

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. Filters retain particles even after cleaning, which can lead to contamination with prior batches or spoiled materials. The cyclone's 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. Most of the useful food particles in the airstream will be captured by a cyclone pre-filter while the very fine particles (too small for use) would be captured by the filters afterwards.


Portable GPC in packaging

Besides allowing the reuse/recycling of the captured particles, a cyclone pre-filter also significantly lowers the loading on the filters. This 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 savings can be seen if the compressor loading can be downsized for a facility.

GPC Cyclones

GPC Cyclones 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 much shorter and the internal ground plate provides an integral vortex breaker. The unique features 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, allowing the material to be collected in an area where it can be re-entrained into the process. The horizontal configuration 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 with minimal downtime.

SplitStream Cyclone


Horizontal SplitStream in cereal production

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 particulate 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.


Horizontal SplitStream in cereal production

The SplitStream cyclone get a very high removal efficiency when compared to traditional cyclone designs. 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, the SplitStream has a long process life for abrasive applications. The secondary airstream also allows it to collect friable material without damaging it, since it keeps the material from colliding with the cyclone walls.

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

1) Hot or cold secondary airstream used to heat or cool both 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 provides overall airflow (usually located after the cyclone outlet) and a secondary fan to push the secondary airflow into the cyclone.

Aerodyne Airlocks


Vacu-Valve

Vacu-Valve

The Aerodyne Vacu-Valve is an economical alternative to rotary valves. It's simple design and easy maintenance makes it a no-brainer when the application is right. The Vacu-Valve uses the vacuum in the hopper above it to seal 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 to cause movement 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 the 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 and rat holes. Rather, the Vacu-Valve is ideal for applications that are fine free flowing.


Double Dump valve awaiting packaging

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 takes a single person less than 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 perfect for large and chucky material. 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 it's 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 in bakery

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.

Food Applications

Aerodyne Environmental has provided equipment in multiple applications in the food processing industry. This can range from collecting material during grinding and particle reduction to spray drying. Here are a few examples of the processes Aerodyne equipment has been used on.

Grinding & Particle Size Reduction

Aerodyne GPC cyclones have been used to capture material after they have been fed through particle size reduction equipment such as grinders. The GPC cyclone can be used as a single cyclone or in series (two or more) to capture the material for further processing. A baghouse or cartridge collector will be required after the GPC cyclone to prevent very fine material from escaping.

Pneumatic Conveying

Aerodyne GPC cyclones can be used to separate material being pneumatically conveyed from one part of the process to another. The horizontal design allows the cyclone to be mounted in areas with limited headspace. However, due to the compact design of the GPC, the volumetric flowrate of the material will affect the size of the cyclone.

Pre-filters and Material Reclamation

Aerodyne GPC cyclones are ideal as pre-filters for baghouses and cartridge collectors. The GPC's high dust removal (often times over 90%, see sample case studies on following pages) collects most of the material in the cyclone before it gets to the filters. This extends the life of the filters, decreases utility usage (compressed air or water for wet scrubbers), and increases removal efficiency of the system. However, it also allows the reclamation of material before it reaches the filters and gets contaminated. This can mean additional product in bagging applications or putting ingredients back into the process.


SplitStream in spray drying application

Spray Drying

The Aerodyne SplitStream cyclone uses a secondary airflow to capture dust particles in the airstream(s). Since spray dryers often have partially dried product being collected, a SplitStream cyclone would allow a heated recycle airflow to be used to help capture the product and further dry it. While a baghouse or cartridge collector would be required afterwards to capture the very fine particles, the SplitStream's high removal efficiency will minimize material loss in the filters. The SplitStream can get very high removal efficiencies, often over 90% and around 99% of 7 micron material.

Applications by Product

The following are just some of the food products that Aerodyne cyclones and equipment have been used on. Aerodyne SplitStreams and GPC cyclones have been used in the food industry for over 40 years.


Vertical GPC in bakery application


Splitstream in Wet Oats collection

1. **Almond** – dust collection
2. **Bakery (flour and cornmeal)** – dust collection from cleaning a pre-coating
3. **Cereal** – dust collection from production and ingredient preparation
4. **Cocoa** – dust collection
5. **Coffee bean roasting** – chaff collector before IWS or thermal oxidizer
6. **Corn** – dust collection from oven dryer
7. **Dog Food (wet)** – reclamation dust collector
8. **Carmel Flavoring Syrups** – pre-filter for wet scrubber on reactors
9. **Fruits and Vegetable** – collection off grinder
10. **Grain Dust** – dust collection on aspirators
11. **Hops** – dust collection
12. **Pea** – dust collection from dryer
13. **Salt** – dust collection
14. **Soybeans** – dust collection
15. **Seed Processing** – dust collection
16. **Sugar** – dust collection
17. **Tobacco and similar agricultural products** – dust collection from processing
18. **Wet Oats** – dust collector after drying oven

Pilot Test Case Studies

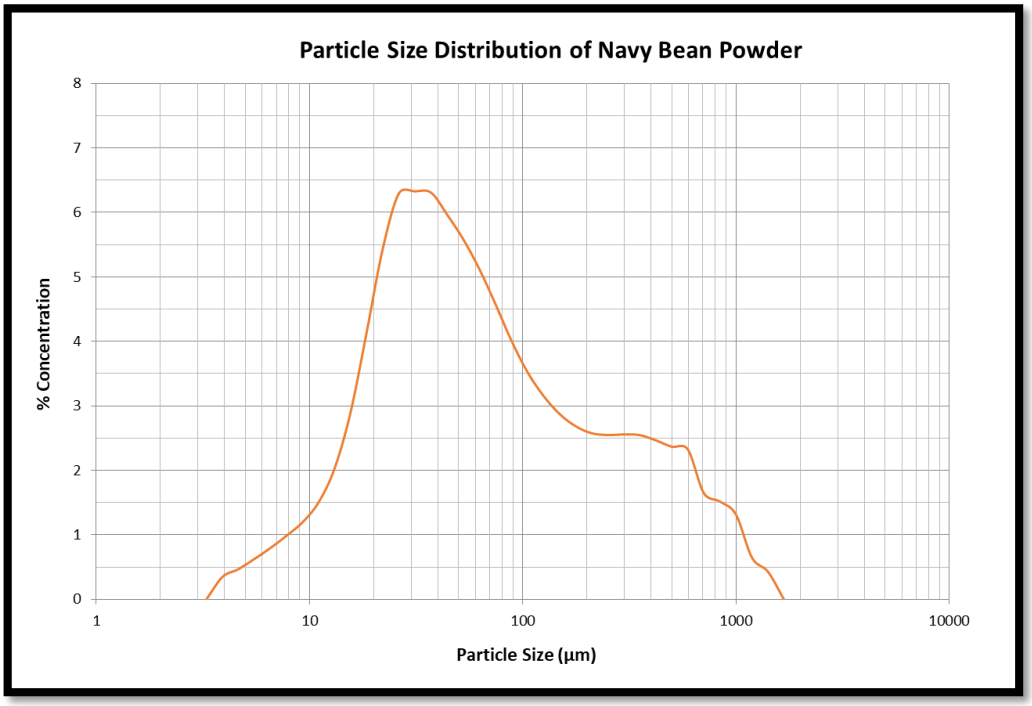
Aerodyne Environmental's pilot lab has various pieces of equipment that are available for pilot testing. Some can be sent to a customer's facility while others have to be run at our lab. Both the GPC cyclone and SplitStream cyclone are available for testing both in our facility and at the customer's site.

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

GPC Cyclone Dust Removal Case Study
Navy Bean Powder Removal

Aerodyne Environmental tested navy bean powder from food processing in our GPC-08 test lab. The test was done at room temperature and with a pressure drop of 7" W.C. through the cyclone. The dust loading was 28 grains/ft^3. The navy bean powder sample tested had a particle size distribution as shown in the graph below. Its mean particle size was 50 micron and had a bulk density of 45 lbs/ft^3.

The GPC-08 cyclone got 95%* removal of the material.

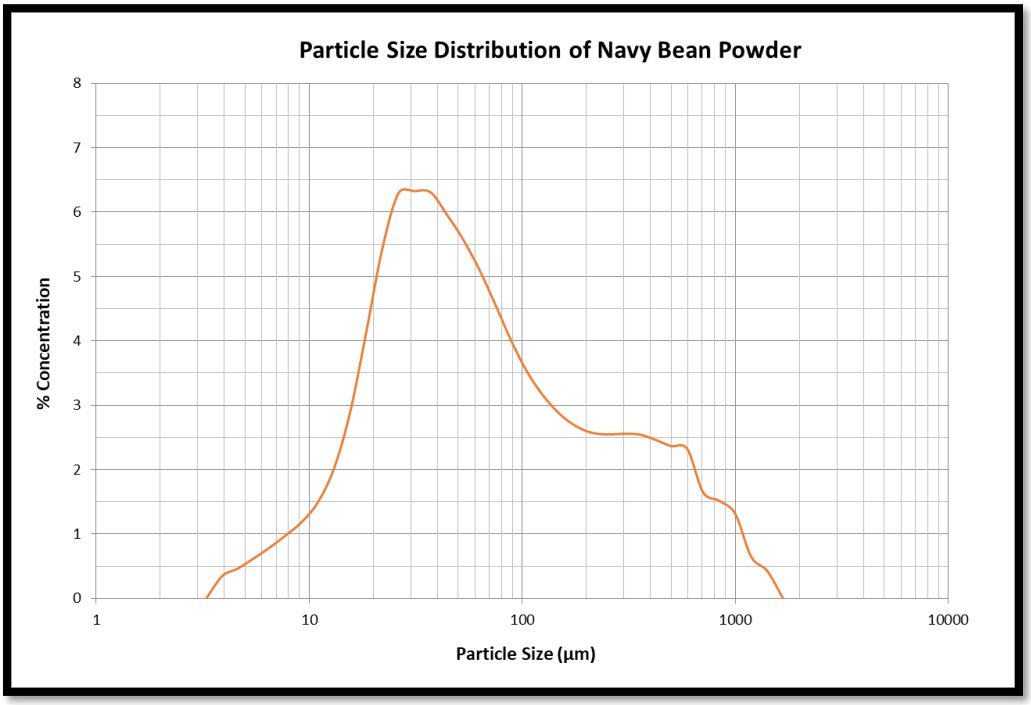


** Please note that particle removal efficiency is based on multiple factors in the process, including but not limited to cyclone size, pressure drop through the cyclone, particle size distribution, particle geometry, and material density. This test is a representative test, and results for your application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

SplitStream Cyclone Dust Removal Case Study
Navy Bean Powder Removal

Aerodyne Environmental tested navy bean powder from food processing in our S400 SplitStream test lab. The test was done at room temperature and with a pressure drop of 4.5" W.C. through the primary airstream of the cyclone and 8.0" W.C. through the secondary airstream. The dust loading was 19 grains/ft^3. The navy bean powder sample tested had a particle size distribution as shown in the graph below. Its mean particle size was 50 micron and had a bulk density of 45 lbs/ft^3.

The S400 SplitStream cyclone got 99%* removal of the material.

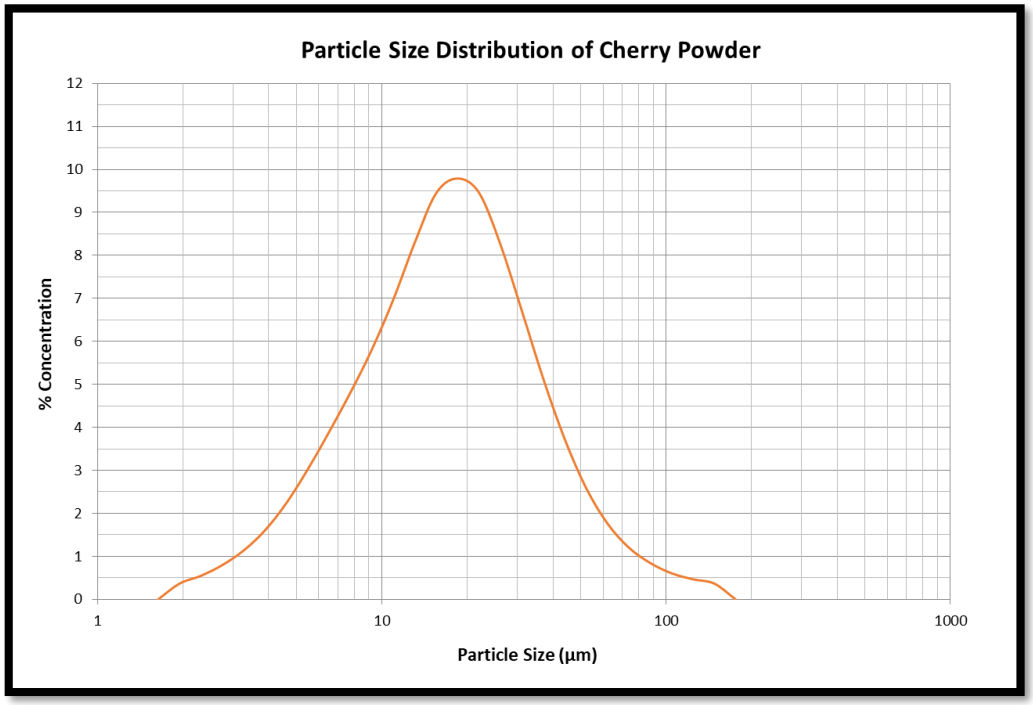


** Please note that particle removal efficiency is based on multiple factors in the process, including but not limited to cyclone size, pressure drop through the cyclone, particle size distribution, particle geometry, and material density. This test is a representative test, and results for your application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

SplitStream Cyclone Dust Removal Case Study
Cherry Powder Removal

Aerodyne Environmental tested cherry powder from food processing in our S400 SplitStream test lab. The test was done at room temperature and with a pressure drop of 5.0" W.C. through the primary airstream of the cyclone and 9" W.C. through the secondary airstream. The dust loading was 20 grains/ft^3. The cherry powder sample tested had a particle size distribution as shown in the graph below. Its mean particle size was 16 micron and had a bulk density of 37 lbs/ft^3.

The S400 SplitStream cyclone got 98%* removal of the material.

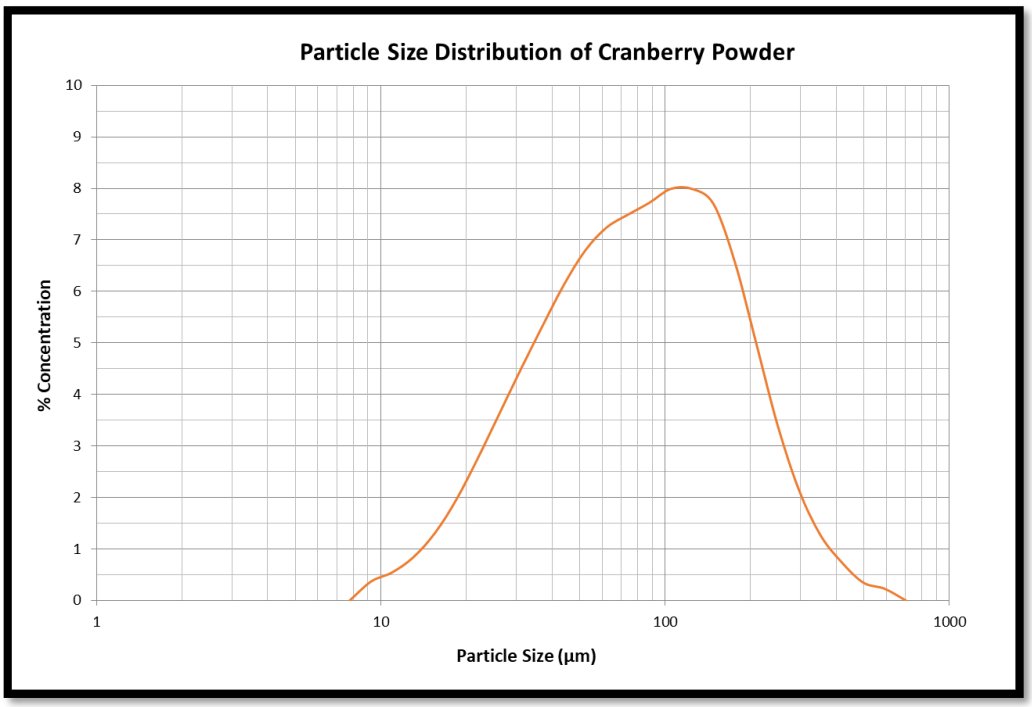


** Please note that particle removal efficiency is based on multiple factors in the process, including but not limited to cyclone size, pressure drop through the cyclone, particle size distribution, particle geometry, and material density. This test is a representative test, and results for your application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

GPC Cyclone Dust Removal Case Study
Cranberry Powder Removal

Aerodyne Environmental tested cranberry powder from food processing in our GPC-18 test lab. The test was done at room temperature and with a pressure drop of 4.5" W.C. through the cyclone. The dust loading was 30 grains/ft^3. The cranberry powder sample tested had a particle size distribution as shown in the graph below. Its mean particle size was 75 micron.

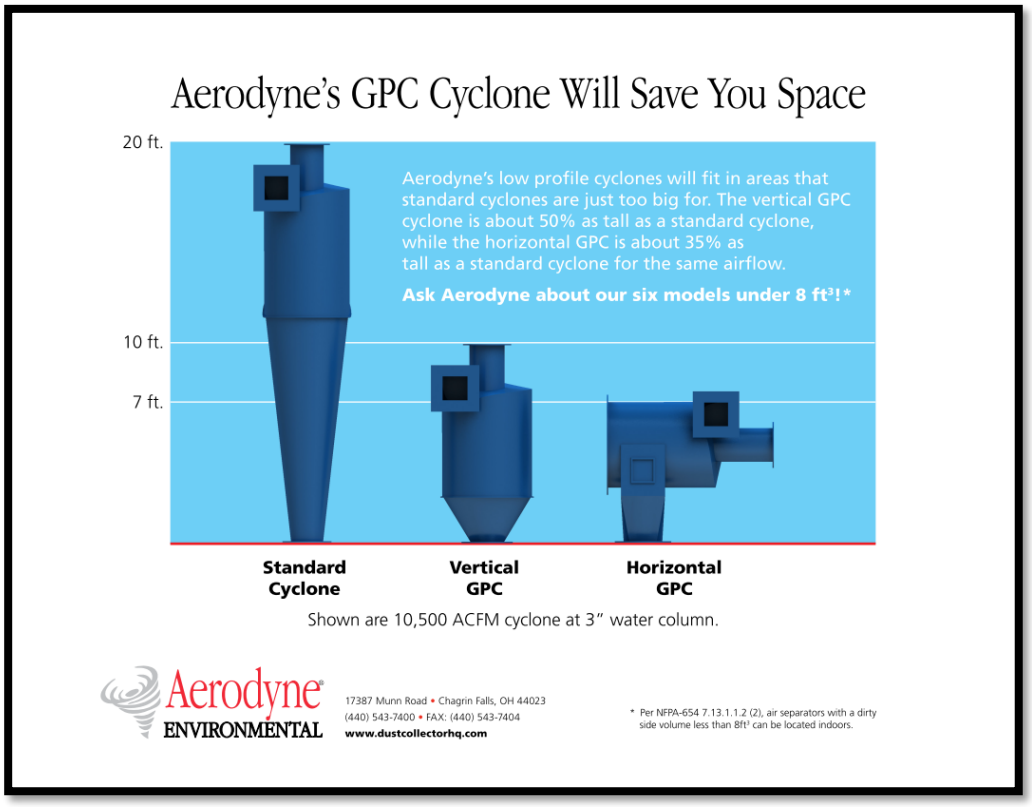
The GPC-18 cyclone got 97%* removal of the material.



** 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.*

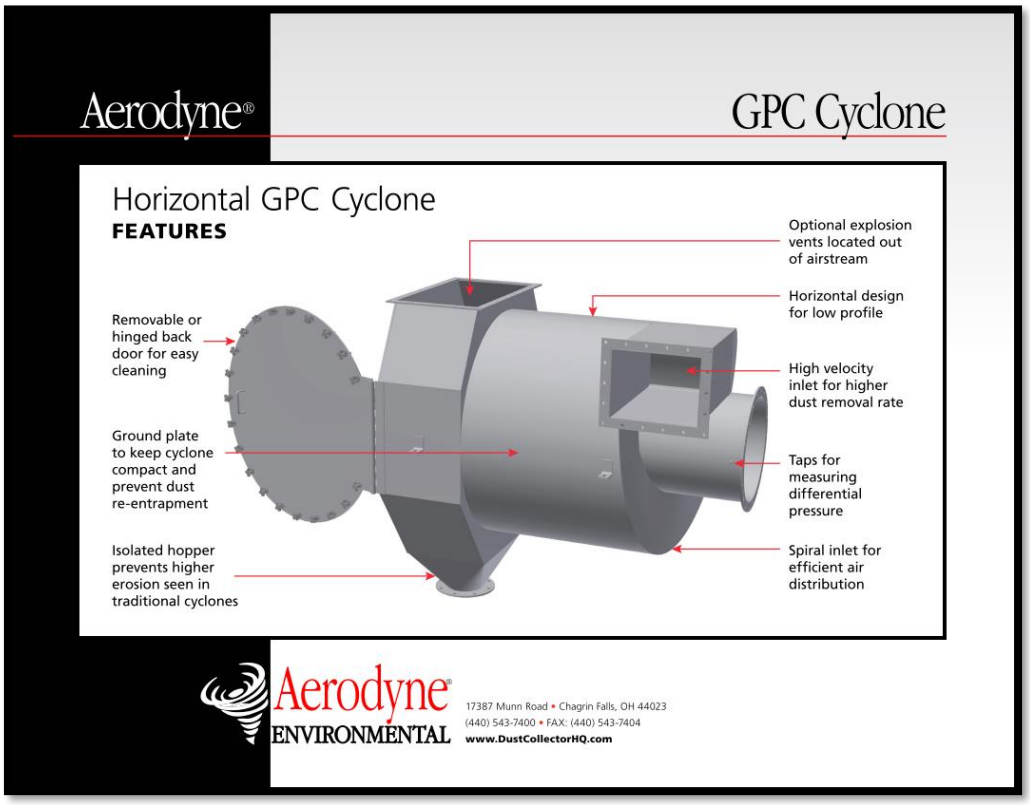
Aerodyne's Food Equipment Benefits

1) Horizontal Cyclone Design



The Aerodyne horizontal cyclone design allows cyclones to fit into areas where traditional cyclones won't fit. This allows cyclones to be retrofitted into existing systems that are having operational issues without making the major changes to the area typically necessary to fit a tall traditional cyclone. The horizontal design of 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) Easy-Clean Door Design for GPC Cyclone



The horizontal GPC has a back plate that is often removable in the smaller sizes as described above. This allows the back plate to be installed with a hinged design, thereby allowing the back plate to swing open instead of removed. This provides easier access to the cyclone interior for cleaning. The hinged door design can have knobs, swing bolts, or clamps* to keep it closed.

** - Depending on the application, ex. Explosive application, clamped design may not be available.*

3) Special Material of Construction

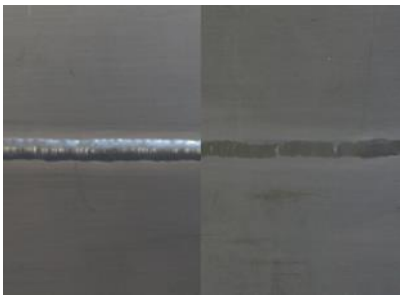
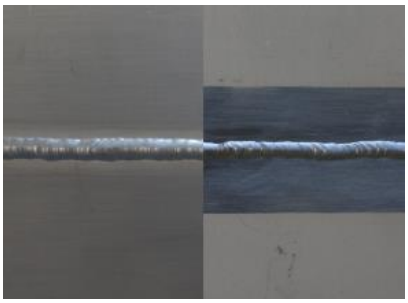
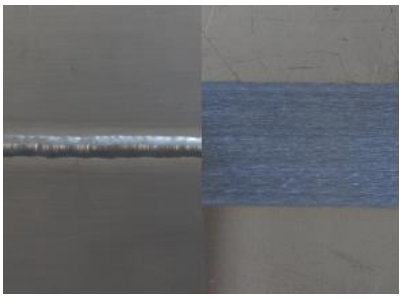
Aerodyne can provide equipment in various materials of construction. For food applications, we have provided 304 SS or 316 SS for the majority of the applications, but other materials of construction such as duplex stainless, Hastelloy, etc. can be provided. If an internal or external coating is required for your process, we can design the equipment for the coating and, if desired, have it applied before shipping. Please provide us with the specifications of the coating, or we may be able to suggest one for your approval. Aerodyne can provide gaskets of FDA approved material such as Silicone, EPDM, Nitrile, Neoprene, Urethane, Viton, etc.

4) Welding and Material Finish

Aerodyne can provide the level of welding and finishing that your facility requires. Our standard welding specs are provided in the next section, however if you have a specification that you need for the equipment, both welding and finishing, please don't hesitate to send us a copy of the spec.

Stainless Steel Weld Spec

The following are Aerodyne's normal welding specifications. If you have a specific weld and/or polishing specification, please advise us so we can provide a quote.

Class A  Exterior Interior	Continuous full penetration shall be achieved by TIG welding the external sides using filler and fusing the internal sides. The weld will not have inclusions, cracks, holes or crevices. All slag and spatter is removed and there will not be any internal projections. All welds are passivated with acid treatment.
Class B  Exterior Interior	Continuous full penetration shall be achieved by TIG welding the external and internal sides using filler. The weld will not have inclusions, cracks, holes or crevices. All slag and spatter is removed and there will not be any internal projections. All welds are passivated with acid treatment. Internal welds are polished to 80 grit finish.
Class C  Exterior Interior	Continuous full penetration shall be achieved by TIG welding the external and internal with filler. The weld will not have inclusions, cracks, holes or crevices. All slag and spatter is removed and there will not be any internal projections. All welds are passivated with acid treatment. Internal welds are ground flush to 120 grit.