

Spark Arrestors & Coolers (A comparison of different methods)

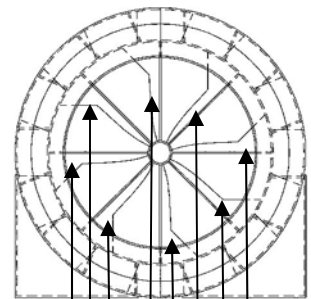
There are several approaches to the issue of extinguishing sparks in a gas stream.

Important Factors in Spark Arrestor Selection

- (1) There is no such thing as an efficiency rating for spark arrestors. They either work or they don't. **Remember, it takes only one spark/ember getting through the device to cause a fire or explosion.**
- (2) Maximum turbulence is the key to effective spark arresting and in the selection of a spark arresting device. Some devices do not impart enough turbulence (and/or pressure drop) to be 100% effective. **The recommended pressure drop for an in-line device (one that is installed in a section of the ductwork) is between 0.75 and 1.5 inches WC. Anything less is highly risky. This is a basic law of physics.**
- (3) Pressure drop across a QUENCHER™ style of spark arrestor is a function of the Reynolds number which is proportional to the density for air. This means that a unit can be sized smaller if operating at a higher temperature. For instance a spark arrestor operating at 440 degrees F is 2/3 the size of the typical unit applied at 70 degrees F and the pressure drop will be designed the same. This lowers the cost of the spark arrestor and ensures its effectiveness. The density is also affected by the water vapor in the gas stream. It has little effect at temperatures below 125°F but can be a major factor when operating at higher temperatures.
- (4) If the gas stream has dust that might drop out in the duct at the velocities in the blender style or QUENCHER™ spark arrestor, a booster must be provided to periodically remove this accumulation. If this unit is not kept clean, it might pose a threat by putting an extra load on the ductwork. Without an automatic cell cleaner / booster system, the spark arrestor would require periodic manual cleaning.
- (5) The cell cleaner / booster design is also temperature sensitive and must be altered to accommodate changing gas stream conditions.
- (6) **Most suppliers do not have the capability to modify the designs as referred to in item (3), (4) & (5) above.**

Blender Type Air Mixers

A number of these air blender/mixers have been applied with varied success as in-line spark coolers, arrestors and suppressors. Over the last several years standard air mixers have been adapted and applied between the spark generating process and dust collector. They were applied in processes where fires in the dust collectors had previously occurred. One supplier hired a consultant to develop a market for these air blender/mixers as a spark arrestor/cooler. This air blending or mixer style design was an outgrowth of mixing two gas streams of different temperatures to insure a uniform temperature after the static mixer. It was deduced that the gas stream produced turbulent flow as it passed through the blades and this was the reason it could be adapted to spark cooling. However, **these are air mixers first and spark arrestors second.** They are marketed as having low pressure drop (maximum 0.5 inch WC) through them. There are **performance limitations** because **not enough turbulence (and related pressure drop) is imparted to the spark/ember.** To achieve spark suppression, we need to go from laminar to highly turbulent flow in the duct which strips away the hot air envelope around the spark/ember thereby cooling it and starving it of fuel (oxygen). For air blending this is not a requirement. Also, these devices have **large gaps between the mixing blades**, when looking through the inlet and downstream of the device. These gaps can **allow a percentage of sparks/embers to slip through** and cause a fire or even an explosion in the dust collector.



Large gaps where sparks can slip through and cause a fire or explosion.

"In the past 18 months, we have had 4 fires. One fire destroyed the exterior dust collector... We have a Blender Products Spark Cooler... We believe we either have an issue with the Blender spark arrestor... I am looking to possibly replace an existing "Blender" style spark arrestor to improve the effectiveness of spark capture." Jim Jones

Improved In-Line Spark Arrestors

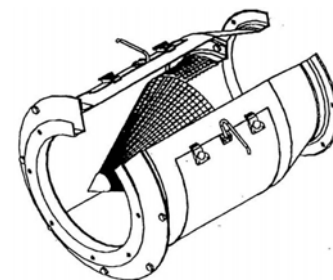
QAM developed the **QUENCHER™** in-line spark arrestor, which is a variation of the blender/mixer design. Employing a 60 year old spin vane mist eliminator technology developed by Hosakawa Ltd of Japan and Sly Manufacturing in the early 1960's, led QAM to vary the blade designs to have **the most effective performance, inducing maximum turbulence to the gas stream, and lowering the cost.** Maximum turbulence (and the pressure drop that results from it) is the key to spark arresting. After several tests it was found that the air blending/mixer design did not impart enough turbulence and some sparks got through, especially at low gas stream velocities. Eventually, **there was a specific design which imparted the most effective swirling and turbulence thereby extinguishing the sparks quickly and most effectively.** In fact, during testing of the QUENCHER™, the arrestor cell would light up as a ball of fire, however, one inch past the cell nothing was left in the gas stream. These designs were incorporated into the QUENCHER™. QAM has developed special application data in which the blade angles are adjusted to produce minimum effective pressure drop for different temperatures and gas densities. To our knowledge, no one else accounts for the gas density effects on spark arrestors. In truth, due to the advanced design, even applying the incorrect parameters to a QUENCHER™ may not result in a failure to put out sparks. Since the pressure drop across the device is a function of the velocity through it, the development of **a pneumatically operated cell cleaner / booster was introduced to prevent dust dropout** accumulating in the static arresting cell. It also blows out accumulations on the blades.



“...and tested it last night. It was quite amazing. We put through a large continuous stream of sparks from a grinder and viewed it...” Grant Stevens, Porex Ltd.

OEM Spark Trap

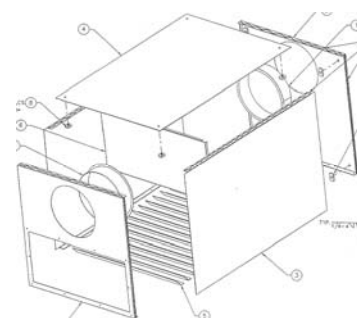
This is a recent type of spark arrestor developed by dust collection OEMs (such as Donaldson-Torit, Farr, ACT etc). It is an attempt to copy the in-line spark arrestors, referenced above, to offer an in-house equivalent. It is a simplification of those models, in fact an over simplification. **It doesn't work!** The problem is that it is only a perforated screen cone in the air stream. It acts as a filter and deviates the air but does not produce enough turbulence to effectively extinguish and cool sparks and/or embers. Actually, the mesh filter, referenced below, creates more turbulence. The larger particles hit the screen and drop down inside the device but the smaller sparks get through the screen and travel to the dust collector. It also is a high maintenance item and must be cleaned out regularly.



“We purchased the spark trap with our Torit cartridge dust collector for our laser-cutting. We have had two fires in the dust collector in the past month and determined that this device doesn't work and replaced it with a Quencher. The only thing it seems to do is accumulate dirt in the device and we have to open the access ports to clean it out twice a day.” Jim Stanko

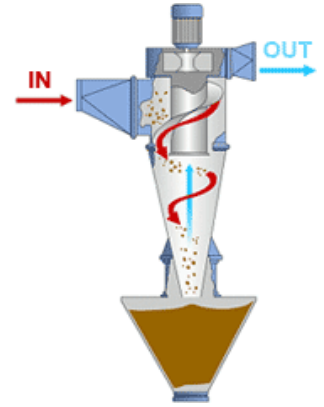
Static Baffle-Box Spark Arrestor (drop-out box)

Many dust collector suppliers offer this type of device as a spark arrestor. It consists of air entering at one end of a baffle box running over a baffle plate which drops out the sparks and much of the dust collected. The air exits at the other end, and then travels to the dust collector. The big drawback is that a hopper and flexible or solid hose connection to a collection barrel is required. Also, these devices do not eliminate all of the sparks. There is not enough turbulence generated to ensure 100% spark arresting. Sparks may also ignite the contents of the collection bin under it.



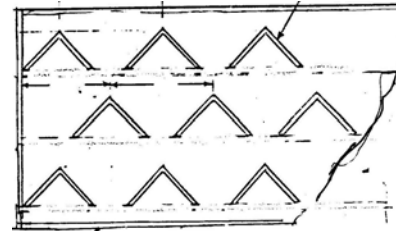
Cyclone Dust Collectors

Contrary to common belief cyclones are not effective spark arrestors. For a spark arrestor/cooler to work there must be high turbulence in the air stream. If you have turbulence in a cyclone the pressure drop is very high. Cyclones are designed to avoid turbulence. Many bag house fires occur in systems with cyclone pre-cleaners. Amazingly the inlet baffles on the baghouse are more effective as spark arrestors, however they are not foolproof.



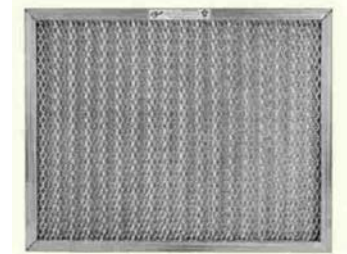
Static Blade Spark Suppressor (Tri Pass)

These were developed in Japan to replace multiple cyclones in coal fired boilers. They found that the multiple cyclones did not stop sparks from entering the dust collectors. The first ones were installed in the early 1970's. They ran at 1.5 inches of pressure drop and were fabricated from structural angles to resist the wear of the abrasive ashes in the coal that they fired. There are several of these applications installed in the USA and Canada designed by one of our colleagues. They have since given way to the "in-line" spark arrestors, referenced above, which are simpler, easier to maintain and operate at lower pressure drop.



Mesh Filters

This is a common stop-gap measure where the filter is placed at the exhaust duct of hoods or installed in the ductwork. When clean, the mesh filter will stop at best 80% of sparks. These filters do not produce enough pressure drop to be fully effective. It only takes one spark to ignite dust in the duct or set a dust collector on fire. The only thing these filters do is clog up and add to your maintenance.



Liquid Spray Systems

For many years these systems were the only method to prevent fires caused by sparks. The system consists of electronic detectors that detect sparks and react to their presence. When a spark is detected liquid sprays are actuated and water sprayed into the duct. The sprays actually cool the gas stream below the dew point. However, in dust collection systems, the water then wets the filter bags or cartridges. This prevents fires but the gas flow is interrupted and the bags must be either replaced or dried out before the process can resume. It takes a whole day or two to dry out the bags or even to prevent blinding and replacement. The detector sensitivity can be lowered to prevent excessive actuations, but, this reduces the reliability of the systems. The detector missing a spark is an ever present danger and a fire may occur. Bag or cartridge replacement is definitely required.

We trust that the above information will enable you to evaluate and select the most suitable method and supplier for your application. **Buying our QUENCHER / BOOSTER combination will give you a risk free unit, fine tuned for each application.**