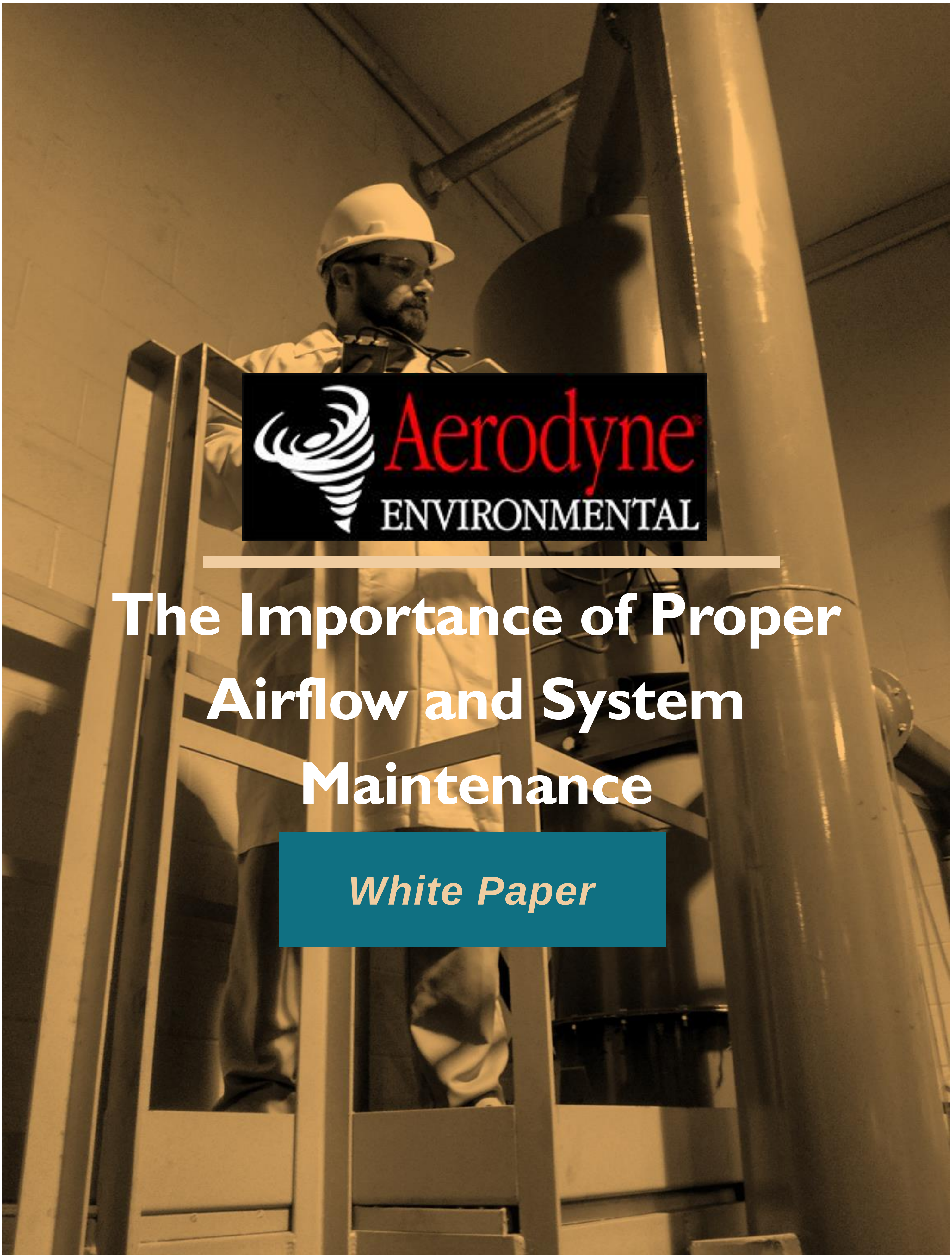


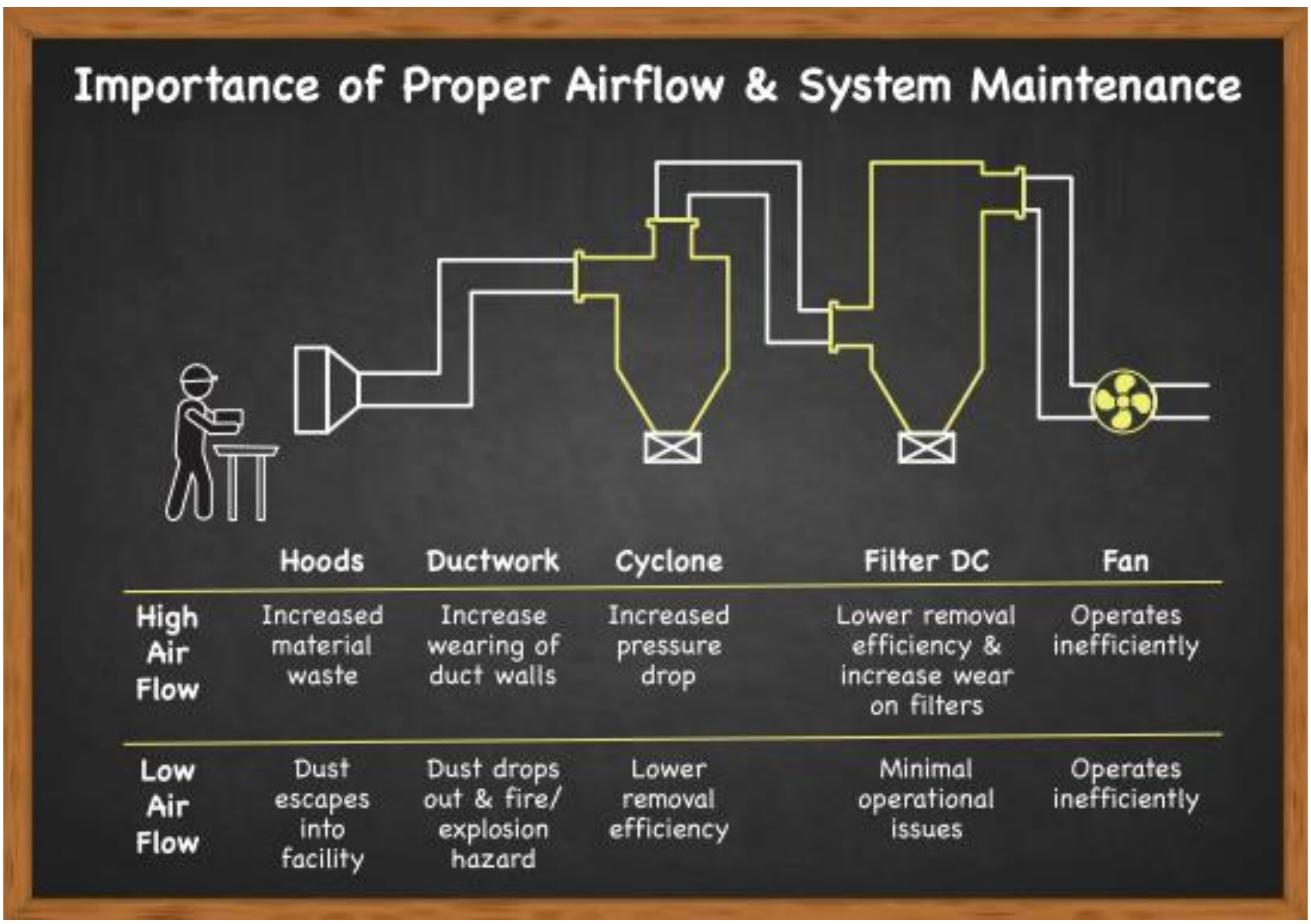
Aerodyne ENVIRONMENTAL

The Importance of Proper Airflow and System Maintenance

White Paper

OVERVIEW

Dust collection systems pick up dust generated by process equipment and move it away for disposal or to be recycled. They use hoods to gather the air around the dust generation equipment. The dusty air is then sent to the dust collection equipment through ductwork. The dust collection equipment often consists of a pre-filter to help collect the dust followed by the main dust collector. An exhaust fan is often at the end and it powers the system by pulling the air through each of these components.



HOODS

Ductwork

The first stage of the dust collection system are the collection hoods. Well-designed hoods are engineered so the dust generated by the equipment can be collected with the least amount of airflow possible. The amount of airflow required by a hood is dependent on a variety of factors including, how the dust is generated, distance of the hood to the equipment, and the size and shape of the hood. How the dust is being generated and the distance of the hood from the equipment both affect the minimum velocity the air needs in the hood. While the size and shape of the hood affects the total airflow that hood requires for proper dust collection (velocity x area= airflow).

A properly designed dust collection system will have enough velocity in the hood to collect the dust being generated. The exhaust fan will have enough static pressure to keep this velocity after all the pressure drops in the system (ductwork, pre-filter and dust collector). Now, if for some reason the airflow is not at the design velocity at the hood, then the dust collection from the process will be affected.

A typical hood installed at a 55-gallon drum filling station

HOODS

Airflow Too High

If there is too high of an airflow in the system, the airflow through the hood will also be too high. This means that the velocity through the hood is also higher than designed. The greater airflow (velocity) will mean the hood will have greater suction around the equipment. While the hood will pick up the nuisance dust that you want collected, it could also collect material that you want to stay on a conveyor, table, etc. This will cause higher dust loading in the system. It will also mean that the dust collector is collecting valuable material that should be used in the process or is product. This will increase the waste of the system, thereby increasing costs. The greater dust loading in the system will also cause more maintenance in the ductwork and dust collector.

Airflow Too Low

If there is too low of an airflow in the system, then the airflow through the hood will also be too low. This means that the velocity through the hood is lower. This will allow dust that is being generated by the process equipment to escape the dust collection system by not being collected in the first place. The dust that escapes the dust collection system will settle on the surrounding equipment. This will cause increased housekeeping in the plant to prevent dust buildup. Dust buildup could become a fire and explosion hazard and/or cause increased maintenance on plant equipment.

Monitoring the airflow in the dust collection system will allow you to make sure the airflow at the pickup hoods is correct which will prevent dust from escaping from the system which would cause additional issues or too much material being collected which would cause loss of profits.

DUCTWORK

Ductwork

Once the dust leaves the pickup hoods, it travels through ductwork until it reaches the dust collector(s). In a well-designed dust collector system, the ductwork will be sized so that the airflow has enough velocity to keep the dust from falling out in the ductwork. Usually, the airflow needs to be between 4000 and 5500 FPM to keep dust from falling out. So, if the airflow in the system changes from its designed conditions the velocity in the ductwork will also change.

Airflow Too High

A technician taking velocity pressure measurements in ductwork to calculate the

With too high of an airflow, the air velocity in the ductwork will increase. This will cause increased pressure drop in the system but it will also increase the erosion of the ductwork walls by particles making contact with the walls. Increased erosion of the duct walls will cause holes to develop, which will further affect the airflow in the system

Airflow Too Low

With too low of an airflow, the air velocity in the ductwork will decrease and could allow dust to begin dropping out and building up within the ductwork. This can cause the ductwork to become heavy and fall. If the dust is explosive, this dust can cause or feed an explosion and is a safety risk. If enough dust piles up, it could end up plugging the ductwork, thereby cutting off airflow through the ductwork.

CYCLONES

Cyclones

Cyclone dust collectors are very dependent on the airflow that is going through them. Cyclone pressure drops are based on many factors, but the two most important are the geometry of the cyclone and the volumetric airflow through the cyclone. The pressure drop formula of a cyclone has the square of the volumetric airflow through the cyclone. So, doubling the airflow will quadruple the pressure drop (2x ACFM leads to 4x dp). If your airflow changes through the system, the pressure drop through your cyclone can fluctuate.

Aerodyne's Digital Airflow Meter will provide pressure drop and airflow measurements through their GPC cyclone

Since dust collection system static requirements are all related, the exhaust fan will find its operating condition naturally. However, if the airflow decreases, then the removal efficiency of cyclone will decrease too. This means the cyclone will remove less of the finer dust particles, thereby sending them on to the filters. That will cause greater dust loading for the filters, which could increase the frequency of cleaning (more plant air usage, greater filter wear, etc.) and decrease the lifespan of the filters.

Filter Collectors

Filter collectors would actually benefit from lower airflow. The lower airflow would decrease the air to cloth ratio, which can extend the life of the filters. However, as described in the rest of this paper, the overall performance of the dust collector system will decrease. And if the system has a cyclone dust collector, the benefits gained by a lower a/c ratio could be counteracted by higher dust loading coming through the cyclone.

Higher airflow will increase the air to cloth ratio and could put more strain on the filters. The velocity of the air going through the filter could increase enough that holes in the filters could develop, thereby causing dust to bypass the filters.

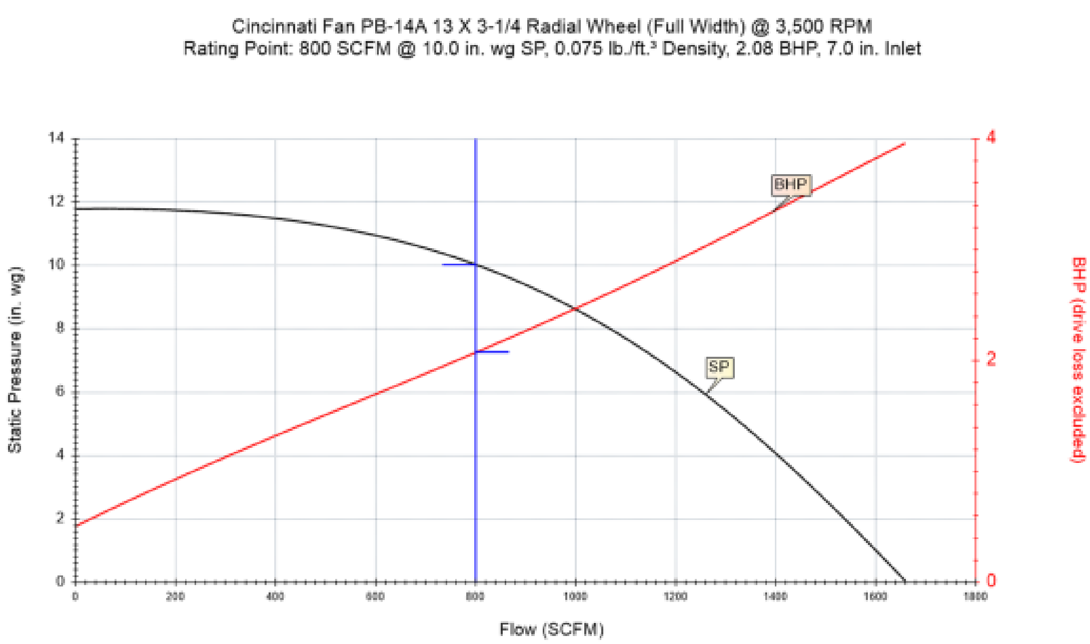
However, filter collectors have a pretty good range of airflows they can handle without significant effect on the system. Unlike cyclones, the pressure drop in a filter is based less on airflow and more on the filter pack on them.

FANS

Fans

The exhaust fan provides the motive force for the dust collection system. The exhaust fan has a performance curve that defines how much airflow it will pull at a certain static pressure. When you turn on a fan, it will ramp up and increase the airflow until reaching the maximum static pressure it can provide. As most exhaust fans are centrifugal fans, the curves show that the lower the airflow, the higher the static pressure. This means that as the airflow increases the static pressure decreases. When the airflow in a system changes, this means the static pressure required in the system has changed, so the system performance has changed per the exhaust fan curve.

With higher airflow, the operating point will move further right on the fan curve. Generally, this won't affect the fan much. The efficiency of the fan could change, but the overall affect would be minimal. If this change takes the fan off its curve, then you could develop operational issues with the fan. However, this isn't a common occurrence.



A typical centrifugal fan curve

FANS

A much greater issue is when the airflow drops. This moves the operational point to the left of the curve. Most centrifugal curves have the static pressure of the fan level out as the airflow decreases. If you get to this flat part of the curve, the fan could provide unstable performance, where the airflow jumps around. For example, the fan curve can show that between 0 ACFM and 800 ACFM the fan provides 12" W.C. This means when you get into this area your airflow can fluctuate anywhere from 0 to 800 ACFM. This can cause issues throughout your system and isn't a good place on the curve for the fan to operate.

When you are operating a dust collection system it is imperative that you maintain the airflow in the system within design criteria. If it increases too much it can cause added expenses, maintenance, and product loss. If it decreases too much it will let dust escape, lower removal efficiency, and possibly create dangerous environments. So, we highly recommend regular, if not continuous, monitoring of your process airflows to be sure you're operating within design parameter.