Clean Air Filter // *Quality Tested. Performance Proven.*

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NA - Cab Pressure Is Not An Indication Of Cab Protection Levels

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About CLEAN AIR FILTER
Clean Air Filter (CAF) has been testing cabs since 1990. In 1995, the California-EPA[1] approved our "chamber test" for vapor testing cabs and filters to meet ASAE S525. We have also collaborated with NIOSH[3] and MSHA[7].

CAF is in a unique position to completely characterize environmental enclosures with accepted particulate and vapor methodologies. (In addition, CAF utilizes a patented CO_2 Cab Integrity Test that measures integrity, to 0.00038μm^2). To our knowledge, we do more cab integrity testing than anyone in the world. This is the basis of our Protection Level Claims.

As ASAE committee members, we voted against S525 because it endorsed an unnecessary high cab pressure minimum of 62.5 Pascals. This led to a NIOSH investigation at CAF's facility which eventually led to S525 being rescinded. The collaboration continued with NIOSH testing our FPS unit in their Silicosis Research Project. When Ernest S. Moyer retired from NIOSH he became a consultant/employee for CAF. His credentials/experience/integrity gives recognized credibility to our test data.

The EN15695-1 Requirements[5]
"5.2.2 The air delivery system shall cause a positive differential pressure within the cab of:
-- 50 Pa minimum; or
-- 20 Pa minimum, if a pressure indicator is provided;"

Myths of high cab pressure.
The myth and promotion of high cab pressure as the method for measuring protection levels started in the USA in the 1990's and is still misleading OEM's and the general public today. You cannot measure Protection Level with a Differential Pressure Gage just because it is easy to use.

Why is cab pressure necessary?
Cab pressure reduces outside contaminants, blown by wind velocities, from entering the cab by forcing conditioned air out the cracks and leaks.

We need to pressurize, but how much?

Society for Mining, Metallurgy, and Exploration publication from February 2013 annual meeting states "*Although minimum pressurization has been shown to have positive results from field studies, a good rule of thumb is to have at least 12.5 to 9.9 pascals (0.05 – 0.08 inches wg) of positive pressure in enclosed cabs. A reasonable range of enclosure pressure is between 19.9 and 62.3 pascals (0.08 and 0.25 inches wg).*

NIOSH Publication RI 9677[3] states *"Wind had the least impact on cab Pen between the calm and 10mph wind velocities tested and was only found to be significant as an interaction with intake filter loading without the intake pressurizer fan."* (Pen references Penetration)

*note that pressure had the least impact and was only significant when the pressurizer fan was shut off.

Technical papers written by NIOSH[4] reflect low cab pressures and excellent protection levels.

*Cab pressure of **0.20 to 0.40 (50-100 Pascals)** yields a protection factor of 56.0*
*Cab pressure of **0.07 to 0.12 (17.43-30.00 Pascals)** yields a protection factor of 89.3*
*note that the cab with **lower** pressure had a **greater** protection factor.

Can high cab pressure be a problem? Yes
High cab pressures create undue stress on gaskets and seals[1]. There is a higher failure rate because of unnecessary stress created by increased pressures.

Please note this excerpt from the Society for Mine Metallurgy and Exploration (SME) Preprint 16-017[6]. *"Higher pressure differentials create lower airflows and encourage greater system leakage, as the air follows the path of least resistance from by-passing the filter."*

There are two ways to increase cab pressure.
Each has certain cautionary factors to consider.

1. High cab pressure achieved by increasing intake air flow may:
   - -Reduce Protection Levels due to increased face velocity
   - -Reduce particulate and vapor filter life
   - -Exceed HVAC capacity to maintain climate control and remove moisture
2. High cab pressure achieved by a very tight cab may reduce the amount of fresh air intake
   - -Below EN15695 minimum of 30M^3/H (17.66cfm)
   - -To the point of respiratory acidosis (excessive CO_2 build up in the body), and/or
   - -Hypoxia (lack of sufficient oxygen)

CAF has encountered this in cabs with excessive cab pressure

This is a balance between air flows (cfm), HVAC capacities, absorption & adsorption rates, filter life, etc.

What is the significance of the Differential Pressure Gage measurement?
Once a cab is qualified to EN15695, the Differential Pressure Gage (DPG) measurement is recorded. Any change in the DPG measurement indicates a change in cab performance such as filter loading, cab seal degradation, electrical changes, improper filter installation, etc.

Summary
Cab pressure is not an indication of the Protection Level
You cannot measure Protection Level with a Differential Pressure Gage!

NIOSH states "Cab pressurization is not always a true indication of cab efficiency and worker protection because the location of the leak is the critical factor."[9]

CAF's position is that pressure is necessary, but only a small part of the equation.
Protection Level is 100% of the equation.

Engineering controls that demand **undocumented high minimum pressure are a great disservice to workers' health and safety,** and are in contradiction to CAF, NIOSH[3], MSHA[7], Cal-EPA, and even **EN15695[5], which is the only governing Standard in effect!**

References

*1 Cal-EPA, Dennis Gibbons, ASAE S525, 28 Feb 1995, Sr. Industrial Hygienist, Worker Health and Safety Branch

*2 William Heitbrink, Consultant

*3 Key Design Factors of Enclosed Cab Dust Filtration Systems, NIOSH Publication RI 9677, Dept of Health and Humans Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, November 2008, John A. Organiscak and Andrew B. Cecala. Page 21.
http://www.cdc.gov/niosh/mining/works/coversheet1616.html

*4 Maximizing Air Quality Inside Enclosed Cabs With Uni-Directional Filtration And Pressurization System, A.B. Cecala, NIOSH, J.A. Organiscak, NIOSH, J.A. Zimmer, NIOSH, M.S. Hillis, Vulcan Materials Co., D. Moredock, Sy-Klone International, Page 2
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*5 EN15695-1 Standard

*6 Comparing The Air Quality Inside Enclosed Cabs Of Underground Mining Equipment With MERV 16 And HEPA Filters, SME Annual Meeting, Feb 21-24, 2016, Phoenix, AZ, Preprint 16-017, A.B. Cecala, NIOSH, J.A. Organiscak, NIOSH, J. Noll, NIOSH, J.A. Zimmer, NIOSH, Page 6

*7 Effectiveness of Cabs for Dust and Silica Control On Mobile Mining Equipment, Joseph J. Garcia and Ronald E Gresh, Coal Mine Safety and Health, District 2, Hunker, PA-USA-15639, Mary Beth Gareis and Robert A. Haney, Pittsburgh Safety and Health Technology Center, Pittsburgh, PA—15236
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*9 Test for the Integrity of Environmental Tractor Cab Filtration Systems, Ernest S. Moyer, William A. Hietbrink & Paul Jensen, Journal of Occupational and Environmental Hygiene, 2:10, 516-523, DOI 10.1080/15459620500297519
http://www.ncbi.nlm.nih.gov/pubmed/16183625