

Accelerating Recovery with Bipolar Ionization

The background of the slide features several wireframe models of a virus, likely representing the COVID-19 virus, scattered across the blue gradient background. The models are composed of light blue lines forming a spherical shape with protruding spikes, resembling a crown. They vary in size and orientation, with some appearing larger and more detailed than others.

BPI Summary

July 15, 2020

The Enginuity logo consists of a red lowercase 'e' inside a white circle, followed by the word 'enginuity' in a bold, red, sans-serif font.

A majestic mountain range with snow-capped peaks and a winding river in the foreground. The mountains are rugged and rocky, with patches of snow and glaciers. The sky is overcast with grey clouds. In the foreground, there are rolling green hills and a blue river that winds through the valley.

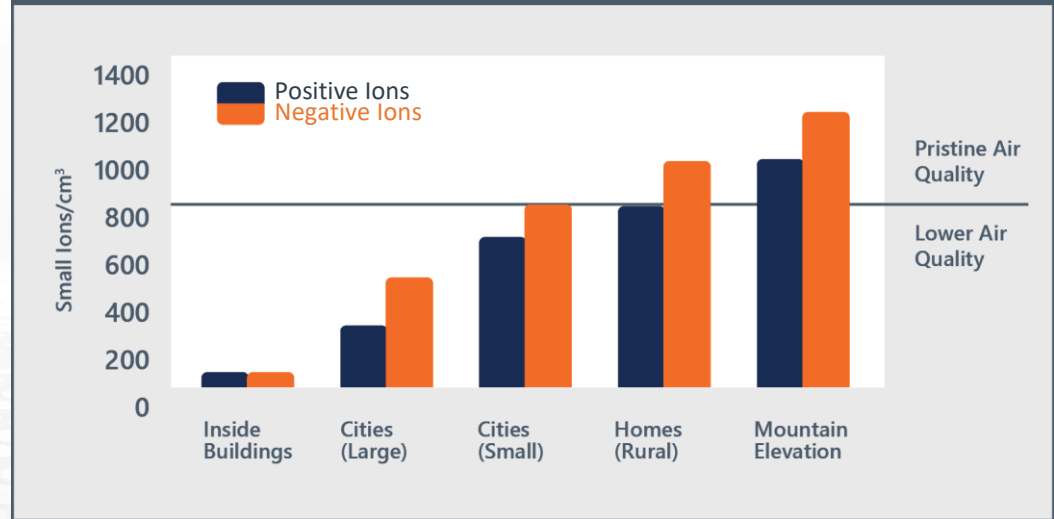
What is BPI?

Bipolar Ionization (BPI) is nature's cleansing process! Oxygen ions are charged through a high energy exchange of UV solar radiation and soil radioactivity which makes our mountain air fresh and enriched. Other sources of this high energy exchange include waterfalls, lightning storms and ocean waves.

Dielectric Barrier Discharge Bipolar Ionization (DBD BPI)

In the most pristine environments there are naturally higher ion levels. These levels fall as we enter more populated and polluted environments.

Small Ion Count at Various Locations



What's special about Oxygen ions?

Oxygen (O₂) in its natural state is relatively non-reactive but it can be made reactive by the actions described on the previous slide. These reactive states are:

- O₂⁺ dioxygen cation
- O₂²⁻ peroxide dianion
- O₂⁻ superoxide

“Only **superoxide** O₂⁻ is the most stable and the least reactive oxygen species. When reacting with water it produces hydrated clusters of hydroxyl radicals [OH⁻] which are formed on the surface of microbes, are short lived (half-life 2 seconds) and remove H from microbial cell walls thereby inactivating microbes. This fact makes hydroxyl radicals one of the safest processes for *disinfection*. The point here is that superoxide is least reactive and most stable and it forms hydroxyl radicals on surface of microbes removing H from proteins on surface of microbes. **Hydroxyls ... do not remain in the airstream as they are produced de novo on surfaces of microbes.**”

*Dr. Philip M. Tierno Jr., Professor of Microbiology
and Pathology*

New York University School of Medicine

How can we create superoxide ions?

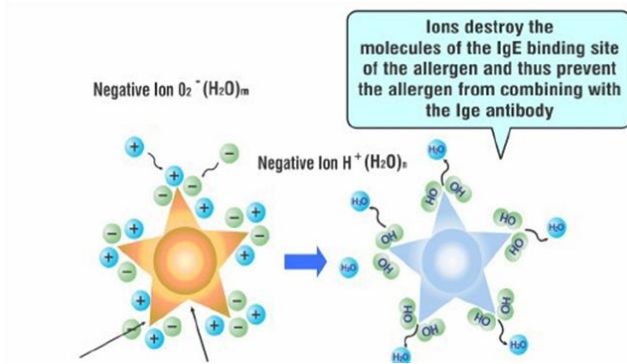
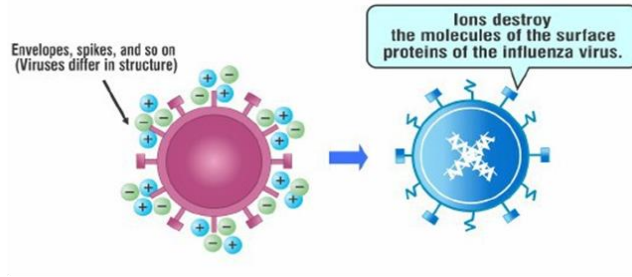
Dielectric Barrier Discharge (DBD) systems, such as those made by AtmosAir, create significant quantities of superoxide ions.

AtmosAir (formerly Bentex) has been making DBD systems for 50 years.



How can DBD BPI help: Continuous disinfection in air and on surfaces

Fungus - Bacteria - Virus



Mechanism for Inactivating Airborne Pathogen

- Superoxide ions surround the airborne pathogen
- Ions pull hydrogen molecules off of the virus to combine and into highly reactive hydroxyl radicals.
- The hydroxyl radical oxidizes the shell, forming water and rendering the virus inactive.
- The virus is no longer potent and cannot infect even if it enters the body.

Mechanism for Inactivating Airborne Allergens

- Superoxide ions surround the airborne allergen and change into highly reactive hydroxyl radicals.
- The hydroxyls then deactivate the molecules of the IgE antibody binding site of the allergen.
- No allergic symptoms occur even if allergens enter the body.

How can DBD BPI help with COVID-19?

Microorganism	Time	Percent Reduction vs. Normalized Numbers Control
S.saprophyticus	15 minutes	99.32%
ATCC 35552	45 minutes	99.9995%
E.coli	15 minutes	>99.94%
K12	45 minutes	>99.986%
MS2 Bacteriophage	15 minutes	98.13%
ATCC 15597-B1	45 minutes	99.99993%



According to Dr. Tierno, “Coronaviruses are enveloped viruses, they are easier to kill compared to naked viruses like Noroviruses.”

A June 4, 2020 study indicates a 99.9% effectiveness of BPI (DBD) on a human coronavirus 229E in 30 minutes.

“Coronavirus is a 1 on the scale from 1-10 in terms of ease to kill.”

- Dr. Tierno

Why Superoxide Kills Bacteria and is Safe for Humans



Dr. Philip M. Tierno Jr.
Professor of Microbiology & Pathology
New York University School of Medicine

Testing BPI against Coronavirus 229E vs SARS-Cov2 (Covid-19)

If you were to look under an electron microscope, morphologically they look identical. They have a lipid outer coat with protein spikes.

On a scale of 1 to, 10 referring to difficulty to kill, 1 is easiest and 10 is most difficult. Coronavirus is in category 1 as easiest to kill. Simple soap and water kills it quickly, as do mostly all disinfectants. Same as for BPI which destroys the outer protein spikes as well as other proteins on their outer surface.

There is no difference in kill for the different strains.....but CoV 229E is a lot safer to test.

The kill of CoV 229E is identical to the kill of Covid-19 virus: It destroys the proteins so it can't attach to human cells.

To make it more understandable: The 229E strain is similar to Covid-19 just like the similarity of one human to another human.

Different "strains" but containing the "same" parts.

- Bacteria are simple single celled organisms whereas humans are complex multicellular beings.
- Bacteria have a totally different outer cell envelope compared to humans— bacteria have a cell wall whereas humans have NO cell wall
- Bacteria are very primitive Prokaryotic cells whereas humans are comprised of advanced Eucaryotic cells.

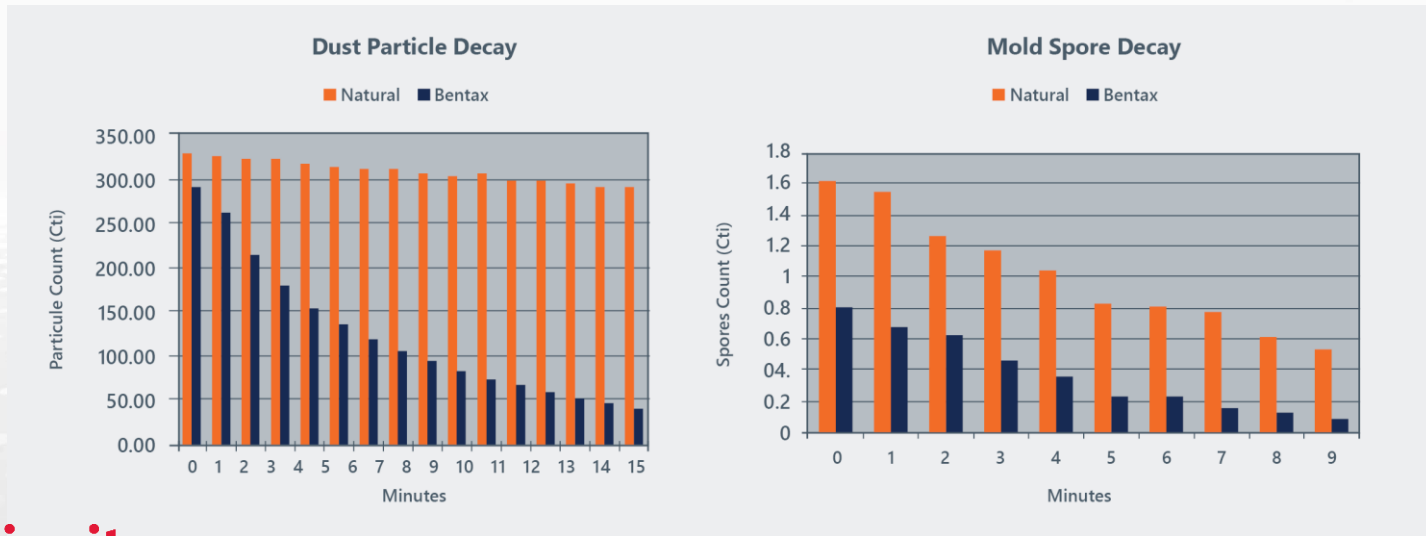
In fact, these differences are the very reason that antibiotics kill bacterial cells without killing humans.

-Dr. Phillip M. Tierno

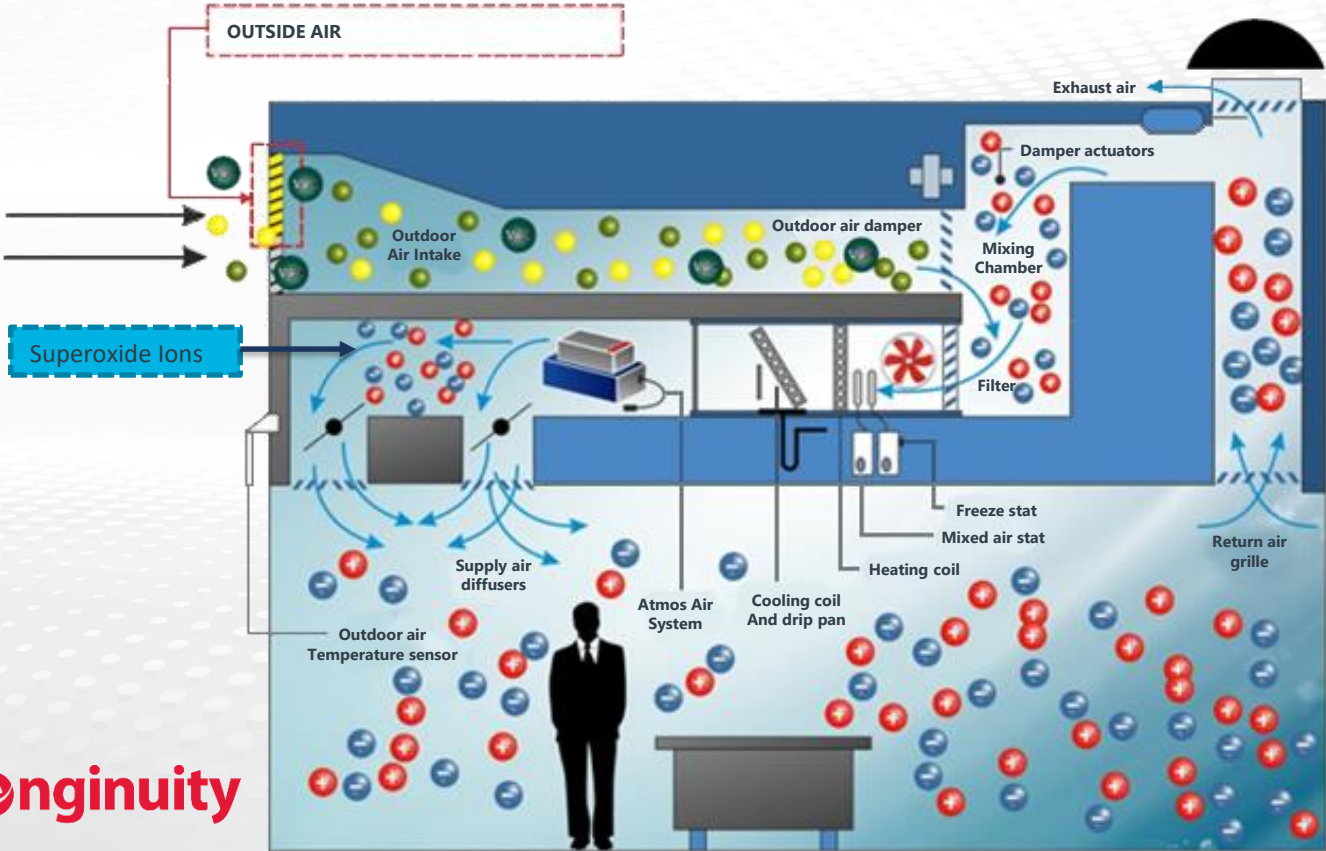
BPI removes particles from the breathing zone

By agglomerating particulates, BPI effectively removes them from the breathing zone. So in addition to neutralizing pathogens, they reduce their chances for inhalation. This agglomeration also makes filtration more effective.

Ultraline Particulate & Mold Spore Reduction Testing



Incorporating DBD BPI into an HVAC System



Mounting BPI into large HVAC systems

Supply Duct Mount

Rack or Wall Mounted in Discharge of Large HVAC Systems



Mounting BPI into smaller HVAC Systems

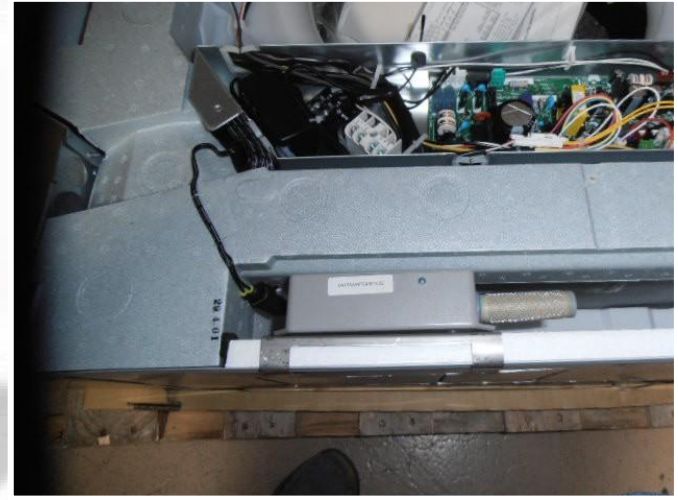
Mounted in Supply or Return of Small HVAC Units



AtmosAir FC400 in FCU

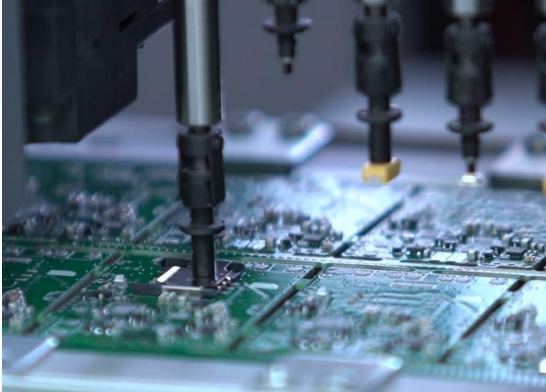


AtmosAir FC100 in FCU



AtmosAir FC400 in Cassette/VRF

What about other BPI systems?



BPI has been used for years as a mechanism to:

- Remove particulate matter from the air in:
 - Dusty factories
 - Cleanrooms
- Reduce static charges in
 - Sensitive manufacturing like electronics
 - Airplanes

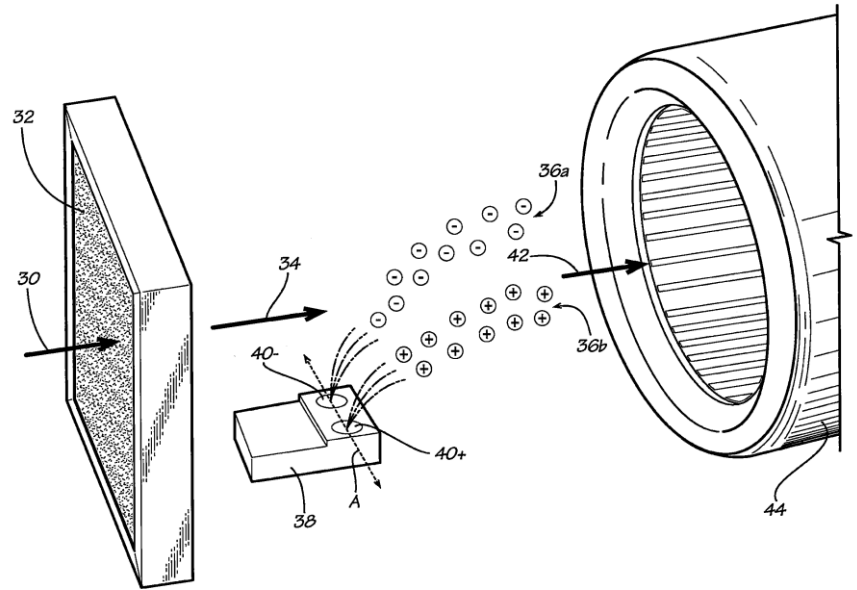
Just because other systems make air ions, doesn't make them effective at fighting pathogens.

What about other BPI systems

BPI can also be accomplished with a process called Needlepoint Ionization (NPI). NPI is marketed by a number of companies, but it has a fatal flaw...

According to the largest NPI manufacturer, NPI **does not** create O_2^- superoxide

The ions created by NPI systems do not linger in the air as long as the superoxide making NPI less suitable for ducted HVAC systems and less effective at killing pathogens.



What about other air cleaning systems?



There are lots of other air sanitizing options:

- Photocatalytic Oxidation (PCO)
 - Forms O_2 -- peroxide dianion
 - 60% less effective oxidation capacity compared to superoxide
 - Less effective at air particulate removal

UV

- “The average bacterium will be killed in ten seconds at a distance of six inches from the lamp in an American Ultraviolet Germicidal Fixture.”
(<https://www.americanultraviolet.com/uv-germicidal-solutions/faq-germicidal.cfml>)
- The average duct system moves air at 25 feet per second. To allow the UV light 10 seconds needed to kill the bacterium, the light would need to be **250 feet long** (10 seconds x 25 feet/second = 250 feet) before getting to the first diffuser!
- Also one duct side would need to be a maximum of 6” in length, thus making the duct extremely wide.



Bottom line, UV is great for killing stuff on things that are stationary.

HEPA

- In order to install HEPA filters in a typical office, a filter closet would have to be created (taking up floor space) and the ducts rerouted to it.
- The fan and its motor would have to be increased in size or a secondary fan added to overcome the pressure drop of the filter



Bipolar Ionization (DBD) vs. Competing IAQ Technologies

BIPOLAR IONIZATION (DBD) VS. COMPETING IAQ TECHNOLOGIES							
	BPI (DBD)*****	Media Filtration	UV****	PCO	Needlepoint Ionization	Carbon Filters	Electronic Air Cleaners
Affects Contaminants "In the Space"	Yes	No	No	Yes	Yes	No	No
Reduces Odors	Yes	No	No	Yes ***	Yes	Yes	No
Reduces VOCs	Yes	No	No	Yes	Yes	Yes	No
Reduces Particles (PM)	Yes	Yes	No	No	Yes	Yes	Yes
Effective on Bacteria and Virus and Germs	Yes	No	Yes	Yes	Yes	No	No
Significant Ozone Production	No	No	Yes ****	Yes ****	No	No	Yes****
Low Pressure Drop	Yes	No	Yes	Yes	Yes	No	Yes
Maintenance	Every 2 Years	Quarterly	Yearly	Yearly	7-10 Years **	Bi-annually	Monthly
Reengineering of HVAC system Needed	No*	Yes	No *	No *	No*	Yes	Yes
New Design and Retrofit Applications	Yes	No	Yes	Yes	Yes	No	No
Reduces Energy Cost	Yes	No	Yes	Yes	Yes	No	No
No Chemicals or Byproducts	Yes	Yes	No	No	Yes	Yes	Yes
Tested Contaminant Reductions in Occupied Space	Yes	No	No	No	No	No	No
Published and Peer Reviewed Research	Yes	Yes	Yes	Yes	Yes	Yes	Yes
"Smart" System (Integrated with Sensors and Monitors)	Yes	No	No	No	Yes	No	No



* Device can be installed directly into existing equipment or as a portable unit

** Devices last this long, on average. For self-cleaning models, yearly cleaning is still recommended.

***Select manufacturers only reduce organic odors

**** UV and systems using UV convert oxygen to ozone

***** UV proven ineffective on moving air streams for disinfectant purposes.

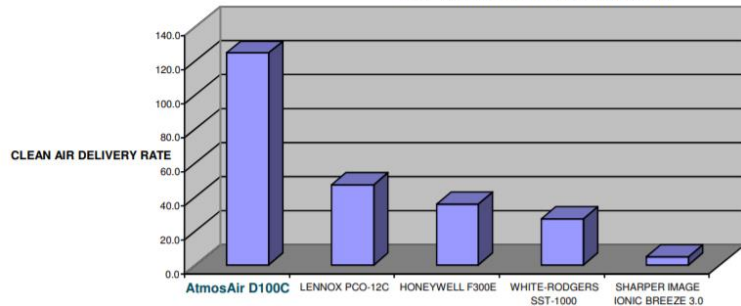
***** Validation: We believe that BPI DBD is the most effective and largely outperforms the other technologies based on independent lab studies

Air Quality - Product Comparison

Clean Air Delivery Rate (CADR)

Comparison of Popular Devices

AIR CLEANER TEST RESULTS (CADR)



Product	CADR Rating	Variance from Bi-Polar
ATMOSAIR D100	125	N/A
Lennox Healthy Climate PCO-12C	47.4	264%
Honeywell Enviro-Care F300E	35.8	349%
White-Rodgers SST 1000	27.2	460%
Sharper Image Ionic Breeze 3.0	4.8	2604%



REPORT
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Technology	CADR Rate
AtmosAir B-Polar Ionization	125
Lennox Photo Catalytic Oxidation	47.4
Honeywell Electronic Air Cleaner	35.8
Emerson Polarized Media Filter	27.2
Sharper Image Ionic Breeze	4.8
GPS Needlepoint Ionizer	1.3
Activetek PCO	-3.9

CADR output directly corresponds to the product's effectiveness in purifying the air of VOCs and PM2.5.

Independent Testing Source: Intertek ETL

Testing was performed to standard ANSI/AHAM AC-1-2002. Testing rated relative performance on .3 micron particles in a standard 10"x10'x10' chamber.

AtmosAir and Enginuity

We at Enginuity are “equipment agnostic” mechanical contractors and engineers. We install systems that we have thoroughly investigated and are certain are the best possible solution for our clients. We did not take our vendor’s word for the efficacy of their product, we had discussions with product inventors, CEOs, and CTOs, but, most importantly, the researchers who have independently investigated the products. This is why we recommend AtmosAir as the best available solution for:

- Pathogen mitigation
- Particulate removal
- Allergen mitigation

And unlike filtration and UV, DBD BPI actively cleans the breathing space.

Finally, AtmosAir does not emit ozone into the breathing space.

AtmosAir installations



About Us

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Enginuity is a design build mechanical contractor with years of experience designing, installing and servicing systems for specialty environments.

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