



## Compressor Health Starts with Inlet Air Quality

Gas Turbine Air Filtration  
for the Energy & Electric Utility Industry



## CLARCOR Industrial Air

CLARCOR has nearly 50 years of experience delivering innovative solutions for gas turbine inlet filtration. Founded in 1966, **altair**® became a specialist in off-shore filtration while skillfully branching into other areas of filtration. Acquired by GE in 2006 and re-named GE Air Filtration, we developed the **clearcurrent**® brand for energy & electric utility applications while utilizing the GE expertise in gas turbine design to further refine the right criteria for proper inlet filtration. The **clearcurrent** name and history is now a key product and system brand for CLARCOR Industrial Air.

Through our **altair** and **clearcurrent** brands, we have real world knowledge that will help you get more output and more reliability from your machine.

## Gas Turbine Inlet Filtration

Compressor health starts with inlet air quality. Gradual performance degradation can be offset by compressor washing, but the frequency and effectiveness of this washing can be linked to the performance of the combustion air filter. Inlet filtration systems play the key role in the quality of the air entering the gas turbine, and the wrong choice of filters can have disastrous consequences. New filtration technologies from CLARCOR have been proven to reduce compressor degradation and improve turbine output, availability and reliability – in effect gaining power from the turbine for no extra cost.



**CLARCOR Industrial Air supplies a full range of inlet systems and filters designed to meet your operating goals, including:**

- Higher power output
- Lower operating costs
- Proven performance utilizing advanced filter technology
- Maximum protection against corrosion and fouling
- Extended gas turbine availability
- Easy maintenance and change out
- Lower heat rate
- Longer filter life

Visit [www.clearcurrentpro.com](http://www.clearcurrentpro.com) to see our media experiment, estimate your savings with **clearcurrent** PRO and learn more about the Predictable, Reliable Output achievable from your gas turbine with PRO technology.

## World-Class Technical Facilities and Capabilities

Fully equipped laboratories enable the CLARCOR Industrial Air engineers to perform sophisticated product development and thoroughly challenge the filter system before it is released to our customers. We consider all likely airborne hazards such as water, sand, dust, hydrocarbons, snow and ice to help extend time between compressor water washes. This is a critical part in reducing operating costs, especially on rotating machinery tasked with delivering to your customer.

These are some of the tests we perform in our laboratories:

- Pressure loss
- Dust holding capacity with ASHRAE and ISO A2 fine
- EN779 Performance
- Combined (prefilter and final filter) dust holding capacity with ASHRAE and ISO A2 fine
- Wet saturation test
- Fog/Mist testing
- 72 hour wet loss of efficiency and burst
- Humidity testing
- Media hydrostatic head testing, flat sheet and pleated
- Heat aging evaluation
- Adhesive pull testing
- Filter “bucket” testing
- We can test hot to 135° C (275° F)
- We can test cold to -70° C (-94° F)
- Dry salt testing
- Wet salt testing
- Gasket hydrostatic head testing
- ARAMCO testing
- Transportation/Rough Handling
- Acoustic testing

Of course, we get our filters externally verified so that we have an independently validated test certificate.

- External EN779 2002 on discharged filter
- External EN779 2012
- External EN1822 2009 where applicable, on discharged filter
- External ASHRAE 52.2 initial efficiency on discharged filter
- External GE 10 day hydrophobic test
- External Shaker table Transportation load testing



Our Mobile Test Rig helps customers evaluate environment and filter technology, on-site, in any condition.



Our outside test rigs used for long term evaluation of filters.



A test rig we use for wet test evaluations.

## Industry Leading Filter Portfolio

CLARCOR is the world's most diversified filter company, and we know how to develop and produce high quality gas turbine air inlet filters. Whether you are in need of a cartridge, vCell, pocket or panel filter, our portfolio is robust. With extensive knowledge built up with nearly 50 years of making inlet filters and gas turbine inlet filtration solutions, and a vast library of medias, we can deliver filters that answer the most demanding performance questions.

When it comes to selecting the right filter for your power plant, our clearcurrent filter portfolio offers extremely high levels of turbine protection for a wide range of environments. Our filter elements are designed to fit a range of new and retrofit systems and are available in various sizes and materials of construction.

## Key Characteristics of Cartridges



## A Unique Solution for Power Plants



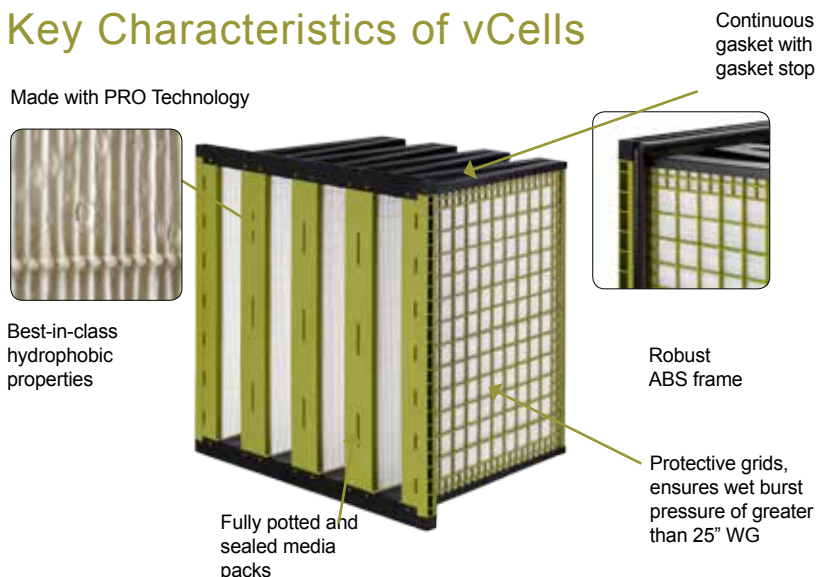
### The clearcurrent TS1000 coalescer

Excellent coalescing ability, low maintenance, and extended final filter life — all are benefits of the clearcurrent TS1000 coalescer, which represents an upgrade over traditional coalescing options.

Unlike current coalescers, the TS1000 uses a 100% synthetic high performance mesh that helps it stay optimized in wet or dry conditions. And because it is washable, the coalescer lasts longer than traditional options.

It coalesces 99% of water droplets down to 10 microns and pressure drop remains steady and not affected by dust deposits. Which makes it a perfect choice for those operating in challenging mist/fog conditions.

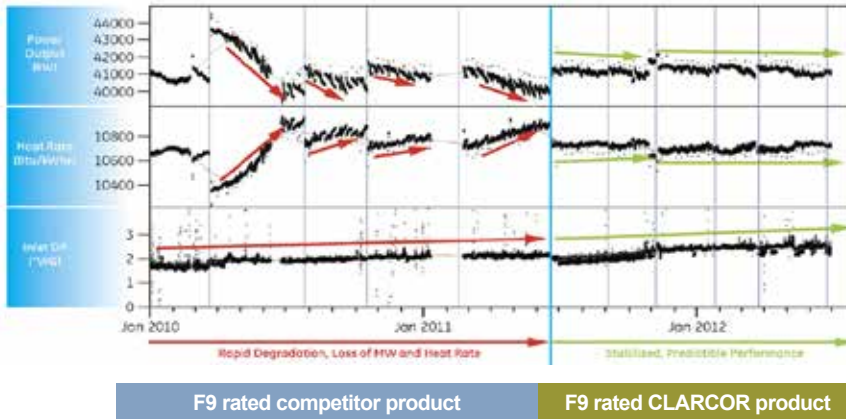
## Key Characteristics of vCells



Visit [www.clearcurrentfilters.com](http://www.clearcurrentfilters.com) for more information.

## Reduced Degradation—Improved Gas Turbine Performance

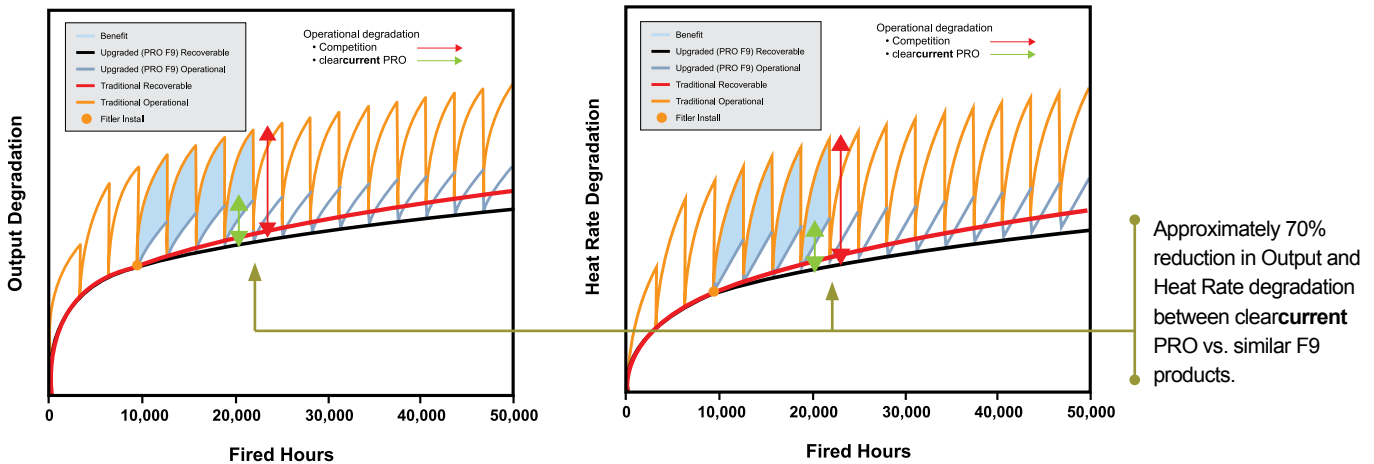
Only filters using PRO technology from clear**current** deliver fleet-tested compressor protection and enhanced turbine performance



We analyzed more than 50 sites globally to determine what factors play a role in compressor health. Using our unique position as a gas turbine filter supplier who also was part of a major gas turbine OEM, we were able to not only monitor performance, but also gain access to a wide variety of gas turbines.

## Measuring the Difference in Performance

The diagrams below show the realized difference in performance between clear**current** PRO and traditional F9 (EN779) filters. These field-validated models are representative of F-class gas turbines with an offline water wash performed every 3000 fired hours.



Output degradation (left) and heat rate degradation (right) are significantly reduced with the installation of clear**current** PRO filter cartridges. The shaded blue area represents the before/after performance improvement gained from clear**current** PRO.

### What does reduced degradation mean to an operator?

Average MW Cost = \$50 / MWhr

An operator could save approx. \$500k over two years by switching to clear**current** PRO.

These calculations are indicative of a 250 MW base load unit operating ~8,000 hours, ~16,000 hours in a two-year period, with a 2.5% reduction in degradation. They show assumed operating characteristics and financial values, to give an indication of potential savings that could be seen.

### What does a 10BTU/kWhr heat rate saving mean to a 250MW gas turbine?

Average Fuel Cost = \$9 / MMBTU

A saving of 10BTU/kWhr = 10000 BTU/MWhr

An operator can save approx. \$360k over two years by switching to clear**current** PRO.

## PRO Technology

PRO (Predictable, Reliable, Output)

- Gas Turbine Power Output Improvement
- Heat Rate Improvement
- No Change in Pressure Loss
- No Change in Cost

**300+ Gas Turbine installations today.**

## Filter Systems Engineered for Your Plant and Environment

The clearcurrent systems range are specifically designed for the Energy and Electric utility market. Engineered to provide consistent performance to gain the best output from your plant, the range is tailored to the industry. All clearcurrent systems are designed aerodynamically to ensure clean and uniform airflow entering the gas turbine.

The clearcurrent systems include:

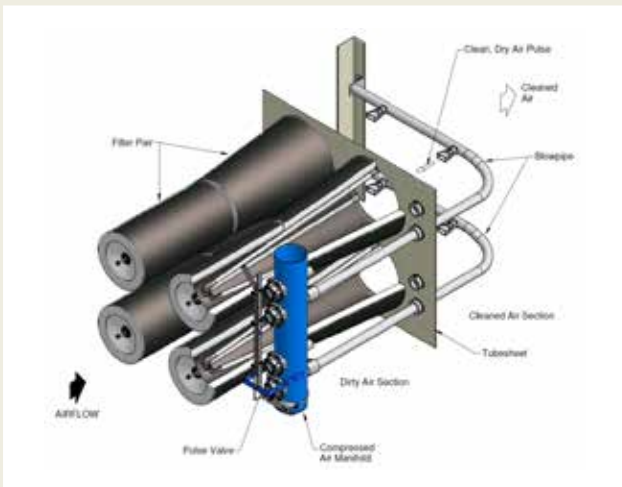
- Pulse—designed for dusty, desert, arctic and challenging environments.
- Static—designed for coastal and moderate inland environments.
- Hybrid—designed for dusty and coastal environment, which offers protection from both high dust and moisture. Utilizes multiple static and pulse filtration stages.



The clearcurrent systems work with all turbine types. Examples of installed projects include a GE 7FA turbine (above), as well as an GE LMS100 aeroderivative solution (above).

### Smart Pulsing Systems - Extending filter life

Did you know you can get more from your filter when you pulse it correctly? We ensure our clearcurrent systems pulse the filter evenly and effectively, gaining a longer life.



3D rendering of how our smart pulsing system operates to ensure filter life is extended

## Massive Scale; Max Protection

The clearcurrent systems offer many benefits:

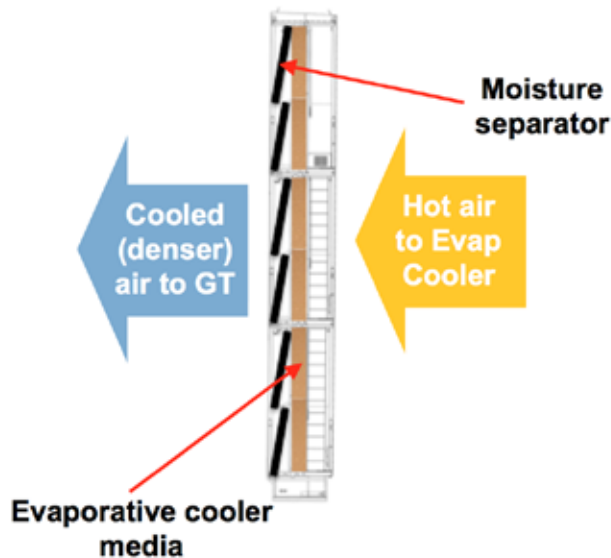
- Flexible and cost effective modularized designs
- Quick installation/minimal site work
- Low maintenance requirements
- Low pressure loss, all designs are aerodynamically optimized
- Customer and/or site specific solutions
- Full gas turbine solution, covering combustion and ventilation
- Designs which meet all international building codes and certification requirements including PED, ASME, CE, IEC, IBC and UBC
- OEM approved designs

Technical Performance:

- Material options to customer requirements
- Size Range: 25 MW to 400 MW simple cycle
- Filter Efficiency options from G4 (EN779) to H13 (EN1822)

Visit [www.clearcurrentsystems.com](http://www.clearcurrentsystems.com) for more information.

## A Cooler Option for Upgrading Your MW Output



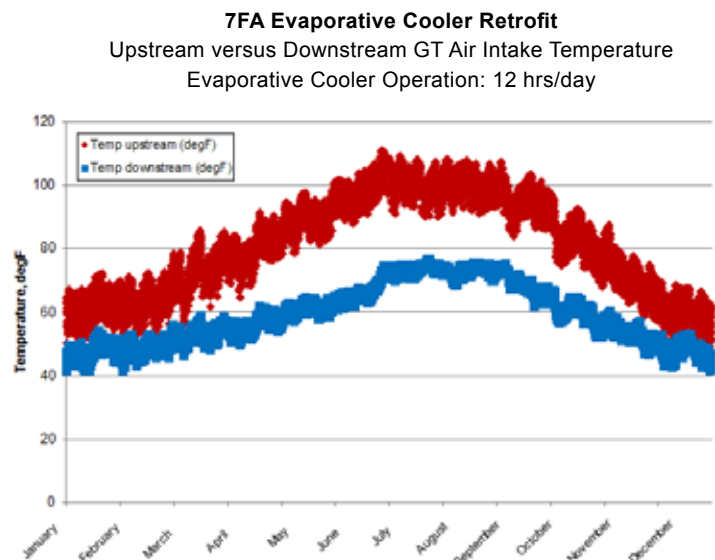
Every evaporative cooler is run through a first-piece qualification performance test before it is delivered to the customer. Above, an evaporative cooler for a GE 9FA turbine is put to the test.

Gas turbines work best when the air passing through the compressor is cooler and more dense. When ambient air temperature increases, density decreases, resulting in loss of output and requiring more fuel to generate the same amount of power. Evaporative coolers (above, right) work by passing air through wetted media before it continues on to the gas turbine (above, left), significantly reducing the ambient temperature and increasing density for easier firing capability and reduced fuel usage. This has been repeatedly validated on operational gas turbines.

- Increased power output
- Reduced capital cost (\$/kW) per unit of power plant output capacity
- Increased fuel efficiency
- Increased steam output in cogeneration systems
- Increased power output of steam turbines in combined-cycle systems
- Improved predictability of power output by reducing the reliance on ambient air conditions.

### Payback

Evaporative coolers can have an immediate impact on turbine performance, especially during hot summer months. As shown in the example at right, an inlet system retrofitted with an evaporative cooler helped decrease temperatures by 39°F during peak operating conditions. This particular turbine, a GE 7FA, operates in base load conditions in the Arizona desert, so it requires cooler, denser air to satisfy power demands during the months of June-September.



CLARCOR Industrial Air has developed a payback calculator that determines whether an evaporative cooler makes sense for your site. Using a variety of conditions and criteria, we can help you decide what upgrades and retrofits can generate more MW output from your currently operating turbines. Contact us today and let's talk about your site needs.



For more information, contact your clearcurrent representative at **CLARCOR Industrial Air**:

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