Certified Ultra-Low Emissions Burner (CEB®)

AEREON

CREATING A CLEANER PLANET:
GAS AND VAPOR TECHNOLOGY & SERVICES

FLARE INDUSTRIES
An Aereon Company

JORDAN TECHNOLOGIES
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CREATING *a cleaner* PLANET

AEREON, headquartered in Austin, Texas, is a global leader in the supply of high-quality technologies and services for gas and vapor handling, combustion and recovery for the oil and gas industries. AEREON was formed in 2012 when Flare Industries, LLC acquired Jordan Technologies.

Under the two brands, AEREON offers the broadest product line of engineered flare systems, enclosed combustion systems, ignition systems and vapor recovery units, and is the largest field service company for vapor recovery and combustion equipment in the world. AEREON operates in more than 45 countries around the world. For more information, visit www.aereon.com.

Advantages of AEREON:

- High quality, customer focused global leader that is still small enough to care
- Most advanced and intuitive VRU control system available for ease of operations
- Can exceed the world's most stringent emission requirements through application of a variety of technologies
- Broad portfolio of cost-effective quality gas and vapor handling, combustion and recovery technologies and services
- Turnkey engineering and project management which mitigates risk for the site owners
- One of the largest field service organizations in the world for VRU's / VCU's providing 24/7 coverage when required, to keep you running efficiently and compliant

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Flare Systems • Enclosed Combustion Systems • Vapor Recovery Systems • Service

CERTIFIED
ultra-low emissions
BURNER (CEB®)

AEREON's CEB® technology is an elegant solution to a common question, how to maximize destruction efficiency of the Volatile Organic Compounds (VOCs) while minimizing the NO_x and CO emissions.

The CEB® utilizes pre-mixed, metal fiber surface combustion technology in order to achieve VOC destruction efficiencies of up to 99.99%, while generating less than 15 ppmv of NO_x and less than 10 ppmv of CO.*

The combustion reaction in the CEB® is so efficient that it generates short, non-luminous, blue flames. It is the extremely high combustion efficiency that gives the CEB® its high destruction efficiency and ultra-low CO emissions. It is also what allows the CEB® to have such a short stack, relative to conventional enclosed flares of similar capacity.

The predominate mechanism for NO_x formation in enclosed flares and thermal oxidizers is thermal NO_x, which is primarily the result of temperature and residence time. The longer the products of combustion are held at elevated temperatures, the greater the amount of NO_x that is formed. Because of the unique surface combustion technology, and CEB's® very short stack height, the residence time for the products of combustion in the stack is limited. This is why the CEB® is able to achieve NO_x emissions of $\leq$15 ppmv at 3% oxygen.

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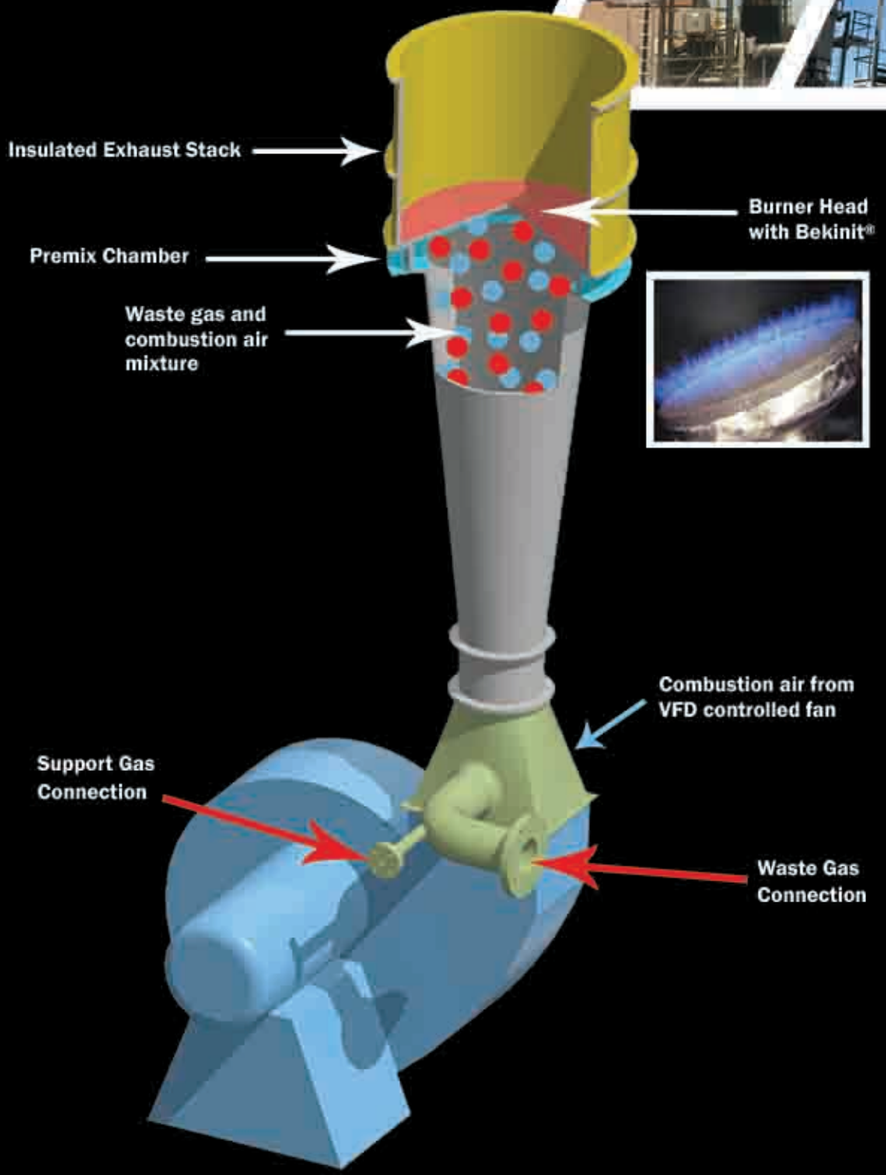
HOW *it* WORKS

The waste gas (and/or support gas) enters the CEB® through the waste gas inlet and immediately passes through a static mixer, where the entering gases and combustion air streams are brought into intimate contact. Exiting as a near homogenous mixture, the gases pass into the head of the burner. The mixture is then forced through the knitted metal fiber media (Bekinit®), where the flow is separated into countless small streams, and combusted to form millions of small, surface resident mini-flames.

In order to further enhance the efficiency of the thermal oxidation reaction, the CEB® operates with an air-to-fuel ratio of roughly 15:1. The high excess air ensures an exceptionally efficient reaction, which means an extremely high VOC destruction efficiency and ultra-low CO emissions (≤10 ppmv at 3% oxygen).

The efficiency of the combustion reaction also results in very short, non-luminous, blue flames, which allows the CEB® to utilize a very short exhaust stack. This means a very short stack residence time for the combustion products, which results in ultra-low NO_x emissions (≤15 ppmv at 3% oxygen).



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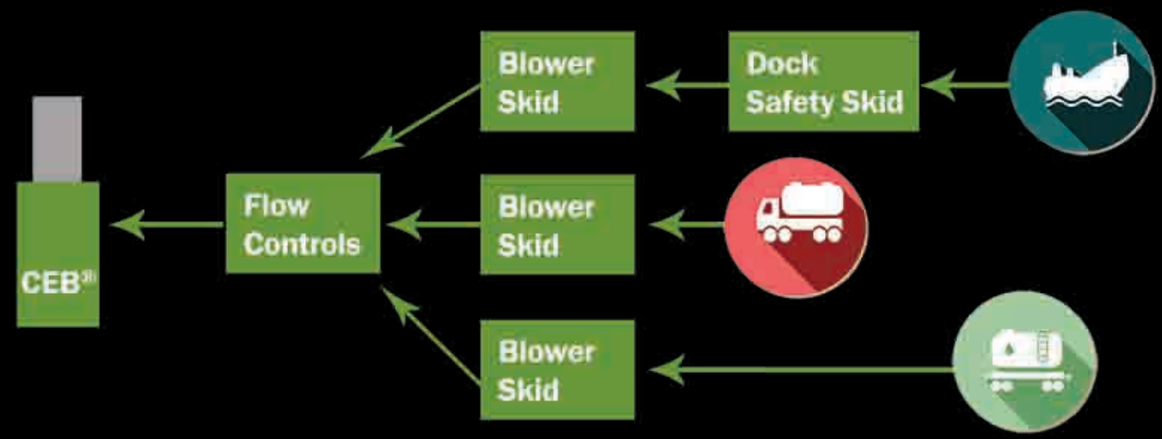
THE *terminal market* CEB®

When liquid hydrocarbons are loaded into trucks, railcars, barges, ships or fixed roof tanks, the transfer process will displace vapors already present in the vessel. As more liquid is loaded, some will vaporize and will be carried out with the displaced vapors. Because of this, these vapors must either be thermally oxidized or recovered (see AEREON's Vapor Control Solutions for more details on our recovery options).

Should you choose to thermally oxidize the vapors, the CEB® has some unique advantages:

- Fast start-up – reaches process temperatures within a few minutes
- Able to operate on very lean waste gas streams, as little as 160 BTU/SCF or 6.3 MJ/Nm³ without the need of support gas
- High flexibility in acceptance of vapor composition and vapor flow changes
- High turn-down ratio
- Modular approach means greater operational flexibility
- AEREON has over 30 years of experience engineering, manufacturing and servicing Vapor Recovery and Vapor Combustion Units in the terminal market
- AEREON's Marine Vapor Combustion Units are built to 33 CFR Part 154 Subpart P
- The CEB® technology is utilized in U.S. Coast Guard certified Marine Vapor Combustion Units.
- Ultra-Low Emissions:
  - NO_x emissions of $\leq$ 15 ppmv at 3% oxygen
  - CO emissions of $\leq$ 10 ppmv at 3% oxygen
  - VOC destruction efficiency of $\geq$ 99.9%



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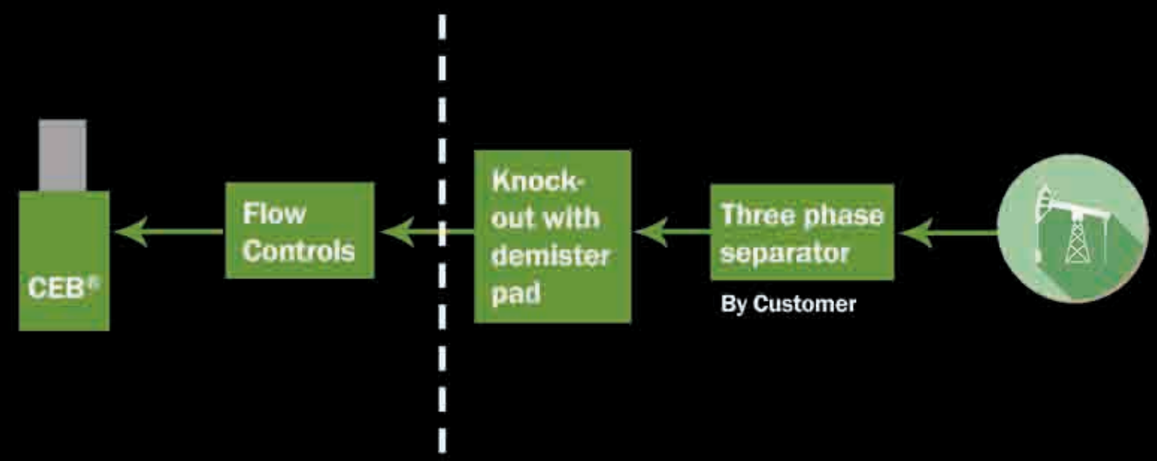
THE UPSTREAM
oil exploration
CEB®

When oil is pumped out of the ground, it typically contains water and various mixtures of naturally occurring hydrocarbon gases such as methane, ethane and propane. Before the crude oil can be shipped to the refinery, oil must be separated from the water and gases. Once separated, the gas can be purified and sold, or used on-site to generate power, fire a boiler, or heat a three phase separator. The CEB® typically serves as a back-up to these devices and burns any excess gas that is produced (peak shaving) or in case the normal gas consumer is down. If the site doesn't have a use for the gas or the gas is trapped, the CEB® is an environmentally acceptable combustion alternative.

For Early Production Units (EPU's), a CEB® can be a highly effective alternative to conventional enclosed flares. The small visual footprint, smokeless operation and non-luminous flame make it ideal for sensitive exploration activities, such as in the shale gas & oil fields. The CEB® has a light and compact design, and can be the ideal solution for a mobile unit for temporary installations.

The CEB® has some unique advantages:

- Non-luminous flame
- Smokeless operation
- High turn-down ratio
- Small visual footprint
- Short stack height
- Quiet operation
- Ultra-low VOC, NO_x and CO emissions



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THE *chemical industry* CEB®

The oil refining and petrochemical industries have a wide variety of processes that continuously generate waste streams containing Hazardous Air Pollutants (HAPs) and Volatile Organic Compounds (VOCs). A common practice is to route these waste streams to the plant's emergency flare header.

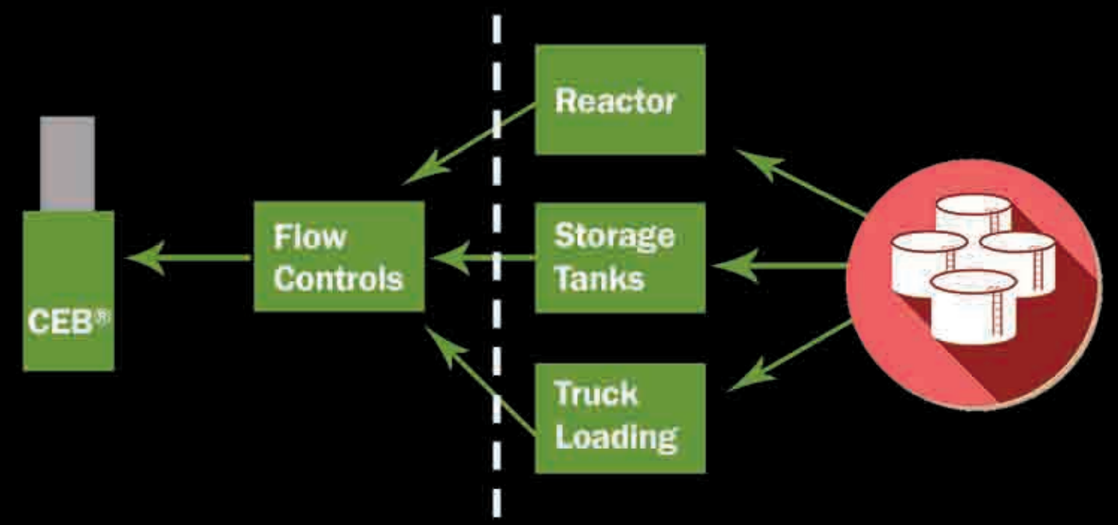
Emergency flares are designed for rarely occurring emergency cases and in the majority of applications are allowed a maximum VOC destruction efficiency of 98%. In addition, per United States EPA Regulation 40 CFR 60.18, waste streams sent to a flare must have a lower heating value (LHV) of at least 200 BTU/SCF for unassisted flares or 300 BTU/SCF for steam or air assisted flare systems. Streams below these thresholds require enrichment gas (to boost the LHV to the required level). Typical enrichment fuel gases include natural gas or propane. Operators often use these flares for small, non-emergency, process waste gas streams.

By re-routing these non-emergency, process waste gases to a CEB®, a facility can take credit for up to a 95% reduction in VOC emissions from these streams thanks to the higher destruction efficiency of the CEB® technology. This coupled with the CEB's® ultra-low NO_x emissions, could result in sufficient reductions in a site's overall emissions to allow for expansion in other areas of the plant or to provide the operator with emissions credits.

Furthermore, operating costs can be reduced as the CEB® requires no fuel gas enrichment for waste streams with LHVs above 160 BTU/SCF (6.3 MJ/Nm^3). The CEB® also offers the option of heat recovery to further boost plant efficiency.

State of the art automated control systems and modular design allows the CEB® the flexibility to handle increased flowrates and changing process conditions without operator involvement.

All this, along with the small footprint and enclosed flame make the Certified Ultra-Low Emissions Burner an ideal technology to incorporate into the design of a new facility, or to retrofit into an existing facility for improved operation.



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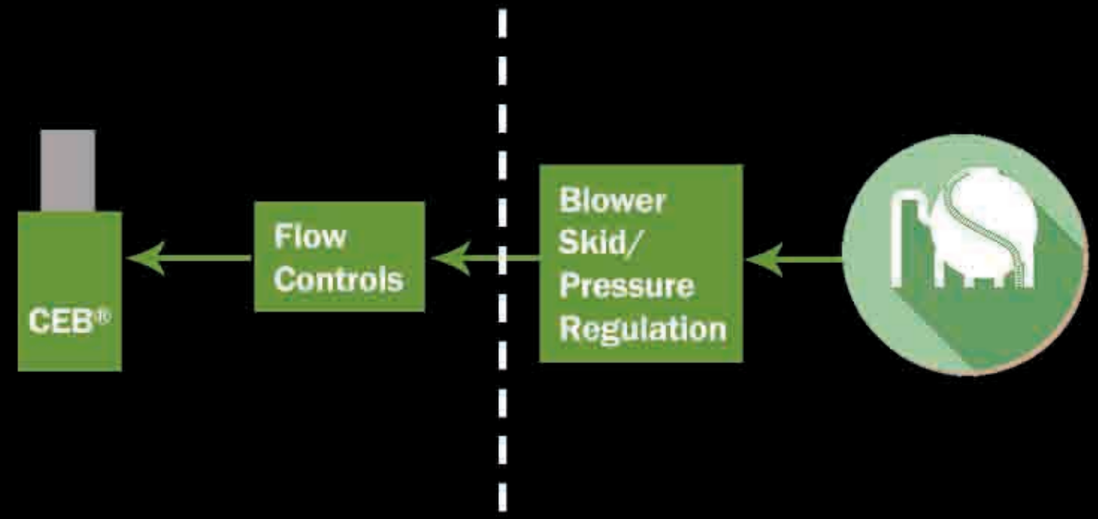
THE BIOGAS
and syngas industries
CEB®

Biogas is generated by the anaerobic digestion of organic waste in a wastewater treatment plant or by the decay of materials in landfills. Biogas is typically 50 to 60% methane with the balance being carbon dioxide. Biogas can be used in internal combustion engines, fuel cells or boilers as fuel or it can be purified to pipeline quality and sold as recycled methane, which gives the user renewable energy credits in some geographies. In the event that the primary use point of the biogas goes down, for any reason, there needs to be a back-up way to dispose of the biogas, as well as processing biogas peaks (peak shaving). The CEB® is an excellent choice for this service in areas where limitations on VOC and NO_x emissions are very tight.

Also, when the landfill is closed and the methane content drops below 30% normal gas engines and standard enclosed flares won't operate anymore. In order to comply with local air permit requirements effective destruction if the biogas is still required. Unlike conventional enclosed flares, the CEB® is capable of operating on as little as 15% methane, without the need of support gas.

The CEB® has some unique advantages:

- Modular approach allows you to tailor your system to back up each piece of equipment
- Non-luminous flame
- Small visual footprint
- Short stack height
- Quiet operation
- Lean gas processing
- Ultra-low emissions



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THE SYNTHESIS
(syn) gas
PRODUCTION CEB®

During the gasification of bio material (wood, straw, etc.), a low caloric value gas, syngas, is produced. This syngas is normally used to fire an internal combustion engine (ICE) that generates electricity or the syngas is purified to pipeline quality and sold into the natural gas grid.

Because the raw feed is a natural product, the syngas production and composition will vary. During start-up the caloric value is typically too low and unstable to feed to the ICE genset.

Because of the rapid response to changes in gas composition and flow rates, combined with lean gas processing capabilities, the CEB® is the perfect unit for start-up, production peak shaving and emergency back-up in case the ICE genset is down or power take-off is not possible.

Ultra-low emissions levels, very high destruction efficiency, non-luminous and smokeless thermal oxidation and low visual profile makes the CEB® ideal to use within renewable energy applications.

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OPTIONS *for the* CEB®

Hybrid combination of our carbon-based vapor recovery unit with the CEB®

AEREON's carbon bed vapor recovery systems can be used to capture the hydrocarbon laden vapors that are generated with a truck, railcar, fixed roof tank or marine vessel is loaded with a liquid hydrocarbon. The carbon beds adsorb C3+ hydrocarbons while letting the air, C1 and C2 pass through. A concentrated stream of C3+ hydrocarbon vapors is then pulled off the carbon beds and are sent to an absorber column where the vapors are reabsorbed by the liquid hydrocarbon and then returned to the storage tank. If the liquid hydrocarbon stream contains C1 and C2 then a control device must be added to the vent line of the carbon beds in order to control these hydrocarbons.

In addition, new VOC emissions limits set by German TA-Luft and Dutch NeR, 50 mg/Nm³, will require additional processing of the VRU tail gas in order to comply with the VOC, as well as with the CO and NO_x emissions levels.

The CEB® is an excellent choice for this service in areas where both VOC and NO_x emissions are stringently enforced.

For new built hybrid VRU-CEB® systems in gasoline applications, the design does not require the use of additional support gas.

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Waste heat recovery

The CEB® operates at roughly 2200°F/1200°C. With this in mind, the exhaust gases from the CEB® contains a significant amount of energy that could be put to good use.

- A special heat exchanger can be added to new and existing CEB® systems, resulting in a recuperation efficiency up to 85%.
- The combustion gases of the CEB® can also be fed into a waste heat boiler.
- In both cases, the waste heat of the CEB® can be converted into:
  - steam
  - hot water
  - hot oil, etc.

Dilution Stack

Need an ultra-low emissions control device but the area you want to put it in requires exhaust gas temperatures as low as 380°F/195°C and/or the stack exit must be above 50 feet/15 meters?

No problem. The optional dilution stack can be added to the CEB® to give you the best of both worlds, ultra-low emissions and extremely low exhaust gas temperatures.

The dilution stack sits above the CEB's® standard stack on its own sub-frame. The integrated ambient air blower, which is driven by a VFD, is controlled by the CEB® system based on stack exhaust temperature. The blower injects air into the CEB's® exhaust gases, reducing the temperature to the desired set point and diluting the components (see photo on left above). The dilution stack can be retrofitted to existing CEB® installations.

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