

State-Of-The-Art

ACT-Gideon Ultra Low NOx Burner

By Dr. Shyh-ching Yang, President, Advanced Combustion Technology Co.,Ltd.

Worldwide concerns regarding the environment are presenting new challenge for power and energy industries and research. The emphasis on the combating of these challenges will highly escalate in this decade. (1-4)

There are five global environmental problems exist: (a.) climate change, (b.) acidification, (c.) eutrophication (atmospheric deposition), (d.) urban air quality, and (e.) tropospheric ozone.

NOx is one of the important pollutants in the above environmental problems, which is one of the main roles in formation of tropospheric ozone, acidification, and responsible for 70% of the global chemical destruction of stratospheric ozone.

The provisional emission reduction target for NOx, as given in the EU acidification strategy, is six (6) millions tones by 2010, which means a reduction of 55% as compared to 1990. (1)

On March 10, 2005 , US EPA issued the clean Air Interstate Rule (CAIR), a rule that will achieve the largest reduction in air pollution in more than a decade. CAIR will permanently cap emissions of nitrogen oxides (NOx) in the eastern United States. CAIR achieves large reductions of NOx emissions across 28 eastern states and the District of Columbia. When fully implemented, CAIR will reduce NOx by over 60 percent emissions in these states from 2003 levels. (4).

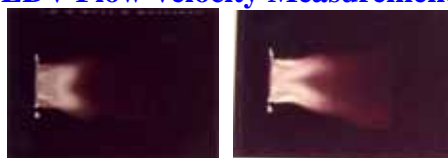
Fossil fuel combustion is one of the main sources for the global production of NOx. Low NOx combustion and burner technologies are presenting new challenge for power & energy industries

and research in this decade. We need to know how to burn today's fuels " Better-With Greater Efficiency and Less Pollution".

ACT-Gideon Ultra Low NOx Burner, which is presented by Advanced Combustion Technology Co., Ltd, is the state-of-the-art equipment for such needs.



2-D LDV Flow Velocity Measurement



Gideon Burner Swirling Flow Visualization

ACT-GIDEON ULTRA LOW NOx BURNER

ACT-Gideon Ultra Low NOx Burners have been developing by Dr. Shyh-ching Yang in more than a decade to reach its' state-of-the-art performances. (5-10). Dr. Y ang is the pioneer of developing the single digit NOx emissions Ultra Low NOx Commercial Burners in the world since 1991.

The key to successful burner design

lies in controlling the near-field burner aerodynamics of the combustion air to produce a match between the flame reaction rates and the imposed velocities. The application of swirl to the combustion air stream to create a re-circulation zone in front of the burner is an effective means for flame stabilization and allows an increase in the range of burner loads without reducing flame stability. The re-circulating fluid generates regions of high turbulence in the shear layer between the forward and the reverse flow, which resulting in faster mixing of combustion air with the injected fuel. The flow patterns and turbulence characteristics, which developed by swirling flow can be affected by the swirl profile, swirl level, diameter, and burner dimensions.

The ACT Gideon Ultra Low NOx Burner is the state-of-the-art equipment to meet the requirements and to compliance with emission standards for operators of all boilers. The burner is a highly precision made ultra low NOx burner, which is designed to meet all current and future NOx emission requirements. The design and operation of the burner is protected by 18 worldwide patents. Field tests of the ACT Gideon Ultra Low NOx Natural Gas Burner have demonstrated that the burner can achieve: $\text{NO}_x \leq 6$ ppm (d,3% O₂); $\text{CO} \leq 10$ ppm (d, 3% O₂); excess oxygen ≤ 1 % without the use of catalyst, re-burning, ammonia or urea injection.

NEW INSTALLATION AND RETROFIT APPLICATION

The burner can be installed on any new or retrofitted to any existing boiler, which uses a forced draft fan. The versatility of the burner is achieved by its simple design and custom manufacture of the connection to the boiler. The burner has been installed on fire tube boilers, and water tube boilers

without restricting access to the boiler. The custom fit of the burner to the boiler will maintain the original boiler design, allow access to the boiler and minimize the installation cost of the burner.

The burner achieves its state-of-the-art performance by a patented swirler design, which produces short, strongly stable flames when using flue gas re-circulation, FGR. FGR is provided to the burner through the air fan. The air, FGR, and fuel are linked proportionally to maintain proper combustion and the desired levels of O₂, NO_x, and CO. The burner has been demonstrated to operate over a turn down ratio of 10 to 1 for natural gas and 8 to 1 for oil.

The ACT Gideon Ultra Low NOx Burner is designed for the convenience of the operators of industrial and utility boilers. There are no moving parts in this burner. This simple design reduced maintenance to a minimum.



The ACT Gideon Ultra Low NOx Burner provides the end user with the operating characteristics other manufacturers still struggle to attain.

PERFORMANCE AND BENEFITS

The ACT Gideon Ultra Low NOx Burner operates with the lowest

emissions and highest performance of available burners. The burner has the following performance characteristics and offers a number of benefits over other available burners.

- The burner is very cost effective
- The burner can be operated at single digit (say ≤ 9 ppm; at d, 3% O₂) NO_x and CO emissions using FGR.
- The burner is high turndown, 10 to 1 for NG and 8 to 1 for oil.
- The burner is rapid load swing capabilities. From 10 to 1 for NG flame load swing requires less than 60 seconds.
- The burner can be operated at very low excess oxygen (say $\leq 1\%$ O₂), high efficiency operation.
- The burner even operated in air-preheat or high temperature air environment (say 590 F), can still remains the single digit NO_x and CO emissions.
- The burner exceeds all current and will meet all likely future air pollution regulations.
- The reduction of emissions below those required would generate emission credits, which can be used to expand capacity or to be sold.
- The burner can be easily installed on new or retrofitted to existing furnaces, water tube, fire tube boilers, heaters, and utility power plants.
- The burner has no moving parts and requires very low maintenance.
- The installation uses a single, low temperature fan.
- The burner is simplistic design, construction, installation and operation.



The ACT Gideon Ultra Low NO_x Natural Gas Burner is cost effective, has single digit NO_x and CO emissions, high turndown 10:1, and rapid load swing capability.



**Capacity: 19.9 MMBtu/hr;
Fuel: N.G.;
NO_x(d,3%O₂):< 9 ppm;
CO (d,3% O₂):<10 ppm ;
Excess Oxygen:< 3% O₂;
Sites: Central Valley, CA, USA**



**Capacity: 5 MMBtu/hr;
Fuel: N.G.;
NO_x(d,3%O₂):< 6 ppm;
CO (d,3% O₂):<10 ppm ;
Excess Oxygen:< 1% O₂;
Sites: USA**

BURNER FOR INDUSTRIAL AND UTILITY BOILERS

The ACT Gideon Ultra Low NO_x Burner is available for industrial furnaces, heaters, industrial and utility boilers in sizes from 1 MMBtu/hr to greater than 250 MMBtu/hr.

The ACT Gideon Ultra Low NO_x Burner is manufactured with the highest standards component. Performance and standards of manufacturing are guaranteed.



Capacity: 100 MMBtu/hr;
Fuel: N.G.;
NO_x(d,3% O₂):< 9 ppm;
CO (d,3% O₂):<10 ppm ;
Excess Oxygen:< 3% O₂;
Test Sites: USA

The burner is guaranteed to be free of material and manufacturing defects for two years after installation. Field tests of the ACT Gideon Ultra Low NO_x Natural Gas Burner have demonstrated that the burner can achieve: NO_x≤ 6 ppm (d,3% O₂); CO≤10 ppm (d, 3% O₂); excess oxygen ≤1 % without the use of catalyst, reburning, ammonia or urea injection.

References

- (1). “ Air Pollution in Europe 1997 Executive Summary EEA Environmental Monograph No. 4”, <http://report.eea.eu.int/92-9167-059-6-sum/en/page001.html>
- (2). Amburg, Bill Van “ Current actions, future trends”, PEI Power Engineering International pp.83-87, Nov. 2000.
- (3). Duckett, E.J. “ NO_x Control for Steel Industry Sources”, <http://www.aise.org/magazine/02apr4352.html>
- (4). “Clean Air Interstate Rule”, <http://www.epa.gov/cair/>
- (5). Yang, Shyh-ching, et. al., “ Velocity Measurement and Energy Distribution

on Isothermal Sudden Expanding Swirling Flow in an Industrial Burner with Bluff-body,” *ENERGY*; 15, No.11, pp. 1015-1021, 1990. U.S.A.

(6). Yang, Shyh-ching, et. al., “ Development of Low NO_x Gas Burners”, March, 1991, EPRI Joint Symposium on Stationary Combustion NO_x Control, Washington DC, U.S.A.

(7). Yang, Shyh-ching, et. al., “Performance of Low NO_x Gas Burners”, November, 1991, AIChE Symposium of Fundamental Chemical and Physical Processes in Combustion and Incineration, Los Angeles, U.S.A.

(8). Yang, Shyh-ching, et. al., “ Commercial Demonstration of A Gas-Fired Burner At 10 ppm”, March, 1992, Western States Section of the Combustion Institute, Corvallis, Oregon, U.S.A.

(9). Yang, Shyh-ching, et.al., “ Commercial Demonstration of A Gas-Fired Burner at 10 ppm”, July 1992, 24th International Symposium on Combustion, Sydney, Australia.

(10). Yang, Shyh-ching, et. al., “ Commercial Development of a 90 MMBtu/hr Low NO_x Gas Burner at 10 ppm”, May, 1993, EPRI/EPA, Joint Symposium on Stationary Combustion NO_x Control, Miami, Florida, U.S.A.

*** LOCAL REPRESENTATIVES WANTED***

For more information, please contact Advanced Combustion Technology Co.,Ltd.
Tel: +886-3-5788508
Fax:+886-3-5788510
Email: Shyh1215@ms37.hinet.net
Or visit our web site at:
www.act-gideon.com