Bulletin 4213

Ultra Low NOx Magna-Flame™ LEx
System Overview

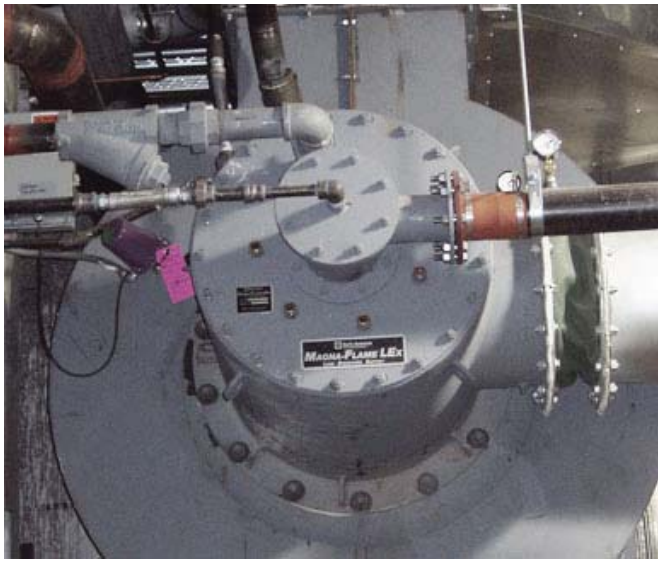
FEATURES

- **Ultra low NOx and CO without FGR**
- **Dual-fuel capability**
- **Natural gas, propane, low Btu waste and industrial fuel gas**
- **High intensity flame allows signifcant reductions in firing chamber size**
- **3 to 200 million Btu/hr**
- **Single UV monitoring**

APPLICATIONS

- **Air heaters**
- **Incinerators**
- **Process heaters**
- **Rotary dryers**
- **Recirculating Dryer**
- **Calcining**

Magna-Flame LEx systems greatly reduce the typical pollutants (NOx, CO) from gas combustion. Utilizing lean premix technology, the patented burner produces NOx emissions of less than 10 ppm in many applications. It is intended for lower temperature solutions where secondary air is normally employed to achieve process temperatures between 300-1600º F. Over 80 percent of the combustion is completed in the companion extended reaction chamber producing very compact flame geometry. This compact flame allows significant reductions in furnace size and overall installed cost. Some furnace configurations or applications will allow for a short standard reaction chamber.



OPERATION

The LEx's combustion air supply is split between main (primary) air and radial air connections. The fuel gas supply is divided between two gas connections: primary and radial.

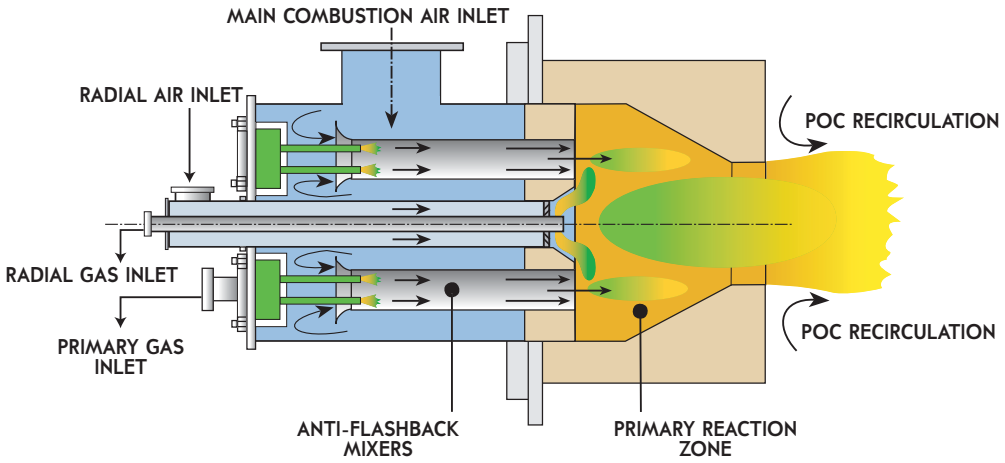
The radial gas is used at start-up and for stabilization of the primary (lean) core. The primary gas feeds internal mixers to create the lean primary zone, typically operated at 60-70% excess air. By completing most combustion in the reaction chamber, the low NOx characteristics of the burner are protected from process influences.

Main (Primary) combustion air can be heated up to 700º F for increased efficiency. Ambient air is required for the radial air supply.

The burner is designed to operate at 10-15" wc main air pressure and 8 psig gas pressure. The minimum primary air pressure required for continuous operation is 0.75" wc. The burner and control system are designed to hold to a preset ratio over a 4:1 turndown. Thermal turndowns of 10:1 or greater are also possible in most applications.

Simplified Burner Design — No Moving Parts — No FGR — Low Blower HP

Figure 1. The Magna-Flame LEx uses patented premix technology to establish a lean premix and then combusts the mixture in a controlled reaction zone without the use of FGR, complex staging devices or moving parts. The fuel and air are introduced separately into the burner where they are intimately mixed within anti-flashback mixers. This mixture is then directed into the reaction region where lean combustion takes place.



BURNER CONSTRUCTION

The burner is of rugged construction suitable for industrial applications. High temperature or corrosion resistant materials may be used as applications require. Precision cast silicon carbide/mullite mix primary mixer tube extensions are cast into the burner hot face, keeping the metal mixer parts remote and protected from flame radiation and heat soak. The burner face and reaction chamber lining are constructed of 3,000º F dense refractory which has been oven dried prior to assembly.

OTHER FUELS

The LEx burner can fire many gaseous fuels with similar low emission performance. The LEx reaction chamber makes it extremely effective for low Btu gases including high hydrogen, refinery fuels and biogas. Light fuel oils may be used as a back up fuel. Consult your Fives North American Combustion, Inc. Sales and Application Engineer for your specific needs.

VARIANTS

The 4211 LE burner is the 4213 LEx with secondary fuel injectors used for higher temperature applications. The primary core operates at excess air rates between 60-80%. Secondary gas injectors are incorporated into the reaction chamber and inject fuel into the oxygen rich primary combustion zone for operation at 10 – 15% excess air. Standard inputs range from 4 to 300 MM Btu/hr with larger sizes available. It is intended for applications where the process temperatures will be greater than 1400°F. LE burners include short reaction chambers producing flame lengths longer than those of comparable capacity LEx burners. See Bulletin 4211 for more information.

The 4231 GLE burner is a “pre-packaged LE” configured to fire oil field steam generators at 62.5, 85 or 100 MM Btu/hr. It is supplied with a pre-piped 4020 pilot, ignition cable, NEMA 4 ignition transformer; 3 pre-piped, pre-wired, pre-set, pressure switches (for purge, low combustion air, and low fire proving); and a junction box for wiring to the necessary control hardware, simplifying installation and field start-up.

Consult your Fives North American Combustion, Inc. Sales and Application Engineer for burner capacities higher or lower than those shown in the table below. Our experience includes a range 0.5 to > 400 mmBtu.

LEx Burner Capacity and Characteristics

LEx Designation	Input at 60% XSA (million Btu/hr)	Main Air Flow (scfh)	Pilot[1]	Flame Length (feet)[2]	Flame Diameter (feet)[2]
4213-3-5X1.5GG	2.9	43,000	4020-0-LP	2.0	1.0
4213-4-6X1.5GG	3.5	51,600	4020-0-LP	2.1	1.0
4213-5-8X1.5GG	4.7	68,800	4020-2-LP	2.2	1.0
4213-6-6X2GG	5.8	85,100	4020-2-LP	3.3	1.1
4213-7-7X2GG	6.8	99,300	4020-3-LP	3.4	1.1
4213-8-8X2GG	7.7	113,500	4020-3-LP	3.5	1.2
4213-10-5X3GG	10.6	156,300	4020-4-LP	4.8	1.5
4213-12-6X3GG	12.8	187,500	4020-4-LP	4.9	1.5
4213-14-7X3GG	14.9	218,000	4020-4-LP	5.1	1.7
4213-19-5X4GG	18.3	269,000	4020-5-LP	6.0	1.8
4213-22-6X4GG	22.0	322,900	4020-5-LP	6.2	2.0
4213-27-7X4GG	25.6	376,700	4020-5-LP	6.4	2.1
4213-29-8X4GG	29.3	430,500	4020-6-LP/5	6.5	2.2
4213-33-9X4GG	32.9	484,300	4020-6-LP/5	6.7	2.4
4213-38-10X4GG	36.6	538,200	4020-6-LP/5	6.8	2.6
4213-42-5X6GG	41.5	610,600	4020-6-LP/5	8.0	2.8
4213-51-6X6GG	49.9	732,800	4020-6-LP/5	8.2	3.0
4213-59-7X6GG	58.2	854,900	4020-7-LP/6	8.4	3.2
4213-67-8X6GG	66.5	977,000	4020-7-LP/6	8.6	3.5
4213-77-9X6GG	74.8	1,099,200	4020-7-LP/6	8.8	3.8
4213-85-10X6GG	83.1	1,221,300	4020-7-LP/6	8.9	4.0
4213-80-5X8WB	78.3	1,151,700	4020-7-LP/6	10.0	4.0
4213-96-6X8WB	94.0	1,382,000	4020-7-LP/6	10.4	4.3
4213-112-7X8WB	109.7	1,612,300	4020-7-LP/6	10.6	4.5
4213-125-5X10WB	122.6	1,802,400	4020-7-LP/6	11.5	4.8
4213-150-6X10WB	147.1	2,162,900	4020-7-LP/6	11.8	5.0
4213-176-7X10WB	171.7	2,523,400	4020-7-LP/6	12.0	5.3
4213-201-8X10WB	196.2	2,883,900	4020-7-LP/6	12.2	5.5

[1] Recommended pilot; not included. HEI may be used in place of pilot.
[2] Flame shapes are approximate and may vary based on reaction chamber length and internal profile. Extended reaction chambers contain most or all of the flame.

CONTROL

A characterizable mass flow ratio control device is recommended. This gives the operator the tools to tailor the burner ratio through the turndown for optimum emissions performance. Combustion air flow is measured with a North American 8631 Venturi Air Meter or other air flow determining device. Air flow control can be by control valve, blower IVD or VFD, as dictated by the air system design. A separate radial air blower is typically required when a VFD is used on the primary air blower or the primary air is preheated.

The critical primary air/fuel ratio is maintained by the electronic ratio controller. As input demand changes, the desired primary air/fuel ratio is maintained by cross-limiting the air and primary gas valves. To meet the lowest emissions requirements, fully modulated radial air and gas control valves are required, also allowing for thermal turndown as high as 20:1. Smaller burners may not require radial air or may allow for use of a manual radial air valve. Large capacity burners require modulated radial air regardless of emissions requirements.

PILOT and FLAME SUPERVISION

The 4020-LP nozzle mix pilot is recommended for use on the burner. Refer to Bulletin 4020 for specific information on the operation of this pilot. The pilot should be the interrupted type.

A 4058 High Energy Igniter system can be used in place of the pilot for lighting the burner in most applications. The integrated retraction mechanism protects the spark rod from contact with the flame after ignition.

A single UV scanner monitors both the main flame and the pilot. UV scanners should be installed using a 4-40412-1 (1" UV connection) or 4-40412-2 (3/4" UV connection) adapter which not only protects the scanner from contact with the POC but also allows for purging of the scanner port with air to maximize the flame signal. Clean, dry air is required for cooling and purging of scanner.

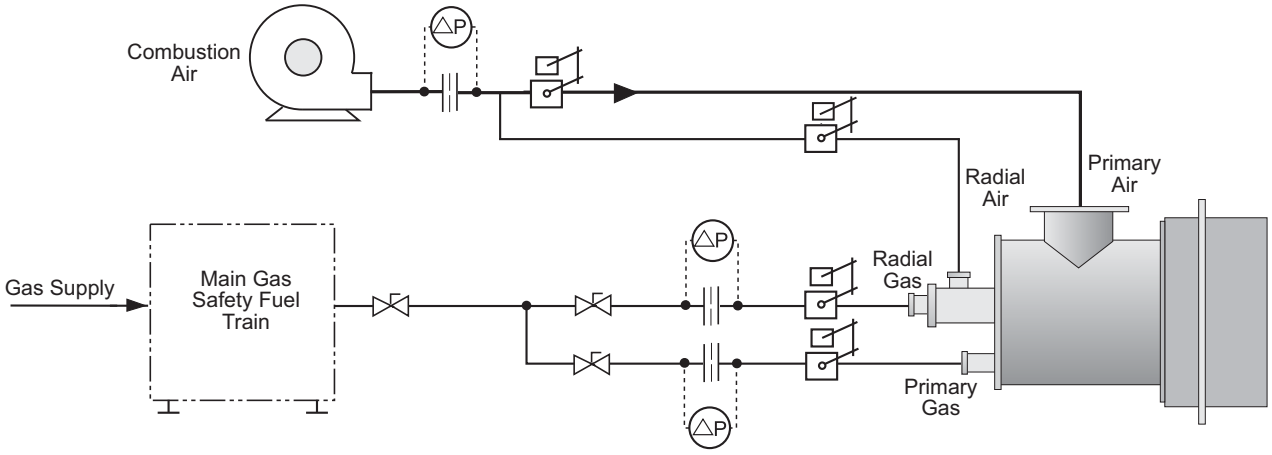
NOx and CO Emissions Comparison*
Example at 1200º F Process Temperature

	Typical Cold Air Burner	Magna-Flame LEx System
NOx	82	9
CO	20	5

Emissions ppm_V at 3% O_2
*Application dependent

Flow Control Concept

Figure 2. Typical Control Concept for Single Burner MAGNA-FLAME™ LEx Combustion System.
A characterizable mass flow ratio control device is recommended for tailoring burner ratio through turndown.



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