The **GreenBurn®** range of fired heater burners

*GreenBurn®* is the trademark name for the burner range of Greens Combustion Limited, UK.

The team of engineers at Greens Combustion boasts over 200 years of combustion experience dedicated to all aspects of burner development, design and supply. The basis of the burner range relies on our strong background in proven technology, enhanced by modern techniques as required to meet the stringent demands of global legislation for lower and lower emissions.

Our philosophy is also to ensure that operational flexibility is not forgotten in the challenge for ever decreasing emissions and this is clearly inherent in our designs. Economic challenges are not ignored either, whilst ensuring that sacrifices have not been made in the through life cost of the product. A clear characteristic of the product is the robust and high quality materials used.

The *GreenBurn®* SA and *GreenBurn®* ULN are primarily designed for a range of process fired heater applications and can be configured to suit most services and conform to international standards such as API535.

Certain principles are applied to the full range of burners which are highlighted below.

The burner wind box is designed in such a way to ensure:

- Optimum air flow distribution to the combustion head; the better the air flow distribution the better the burner and furnace efficiency.
- The inlet of the wind box for the ND version is angled upwards to the furnace floor, this is done for 2 specific reasons:
  1) To lower the noise emissions of the burner, angling the inlet up like this can reduce the under floor noise by half.
  2) As a safety measure in the fact that if a furnace malfunctions or upset occurs and the furnace pressurises, hot furnace gases can potentially back flow out of the burner. If the inlet is horizontal then this poses a threat to any operators working under the heater in the vicinity of the burner, angling the inlet upwards eliminates this hazard.
- Noise insulation panels are encased in perforated plate as opposed to simple clamping sprags. This ensures that lower noise levels are emitted and avoids erosion of the insulating material.
- Thicker plate 5 – 6 mm is used in the construction as opposed to 3 - 4 mm. This thicker plate reduces noise emissions further and provides for a more robust construction giving a longer life of the product.
- It is not unusual in low NOx burners to see the CO emission sacrificed along with burner stability and operability, solely to achieve an extremely low NOx number. All the *GreenBurn®* range of burners are designed to ensure low CO and low NOx emission capability and thus a lower carbon footprint.
- Many combustion issues are caused by failing burner tiles. Cracks and tile disintegration as a result of thermal shock or spalling can be avoided by selecting high quality raw materials for the refractory mix, a closely controlled manufacturing process as well as correct drying or pre-firing temperatures. Greens ensure a great amount of emphasis is put of the burner tile material selection and recommend the use of high quality (not quantity) of alumina and the avoidance of low grade phosphatically bonded materials.
The GreenBurn® SA burner uses air staging as a NOx reduction technique. It can be configured for flat or round flame patterns as well as gas, oil or dual fuel firing.

The staged air principle divides the combustion air into zones whilst the fuel remains as a single stream. The fuel is mixed into the primary air flow whilst the remaining combustion air is introduced in specific phases of the combustion process to reduce peak flame temperatures thus reducing NOx.

Air staging provides a number of advantages compared to staged fuel (splits the fuel and introduces the fuel into a single air stream) with regard to burner stability, turndown and firing heavy / dirty fuel gases. However misconceptions have been made that it cannot achieve the same NOx reduction as staged fuel. Whilst this may be true at the extremities of NOx reduction using enhanced air staging technology Greens have considerably advanced the technique such that it matches the NOx reduction characteristics of staged fuel.

The burner splits the air into 2 zones, one primary and one secondary with primary air approximately 40% of the total air requirement. This severe degree of staging is achieved by ensuring a very stable primary flame within the burner throat and leads to much lower Nox levels than commonly seen in other designs of staged air burners.

A novel principle in the GreenBurn® SA burner is that the secondary air mixes with entrained products of combustion. This reduces the oxygen concentration of the secondary air before it joins the combustion process, thus reducing the flame temperature and NOx formation accordingly.

In the primary combustion zone, air is mixed with the total quantity of fuel generating a fuel rich flame which is both cool and lacking in oxygen inhibiting NOx formation. The remaining air is introduced latterly in the flame where combustion is completed, again in an environment which is cool and thus limiting NOx production.

The air splitting is facilitated within the wind box and burner tile assemblies.
The GreenBurn® Ultra is designed for those applications where environmental legisla-
tion has driven combustion emissions down to extremely low levels whilst still providing
the end user with a large degree of operational flexibility. The burner is gas only and
supplied for natural or forced draught operation.

This burner design uses a NOx reduction
technique that is generically called “Internal flue
gas recirculation (IFGR)”. This IFGR is
accommodated by having dedicated mixing
chambers incorporated within the burner tile
where fuel, combustion air and flue gases can be
mixed in accurate quantities thus ensuring
optimum NOx reduction whilst still retaining a
high level of stability. A dedicated lance injects a
specific amount of fuel into each of the mixing
chambers where a hole in the tile close to the
furnace floor allows the firebox gases to be
drawn into the chamber mixing with the fuel gas.

The carefully designed chambers ensure the
firebox gas and fuel are mixed in the correct
proportion to change the characteristics of the
fuel gas as it exits the chambers before mixing
with combustion air. The fuel gas characteristics
have been changed to such a degree that it
resembles a very low calorific fuel which naturally
generates a very low NOx producing flame. As
the fuel is also preheated by the hot flue gases
this increases the generic stability of the fuel and
associated resultant combustion.

Flame stability is ensured by using a small
amount of fuel as a highly stable conventional
raw gas burner with flame paths within the tile to
each of the external mixing chambers to ensure
the combustion process has a high degree of
integrity.
Refineries and Petrochemical plants have a variety of fired heater types. The most common burner found is the round flame gas nozzle mix burner that uses either natural draft or forced draft air supply. From our years of experience in the Industry Greens Combustion has developed the GreenBurn range to cover the majority of these applications.

**Natural Draught Gas Only Low NOx**

The Greenburn ND uses the principle of staged air to achieve low NOx emissions whilst in turn providing stability for a wide range of fuel gases due to its central fuel gun with large holes.

**Features**
- Staged Air Design
- Single Inlet Gas Gun
- Single Damper
- Silenced Windbox
- 10:1 Turn Down
- Up Fired or Side Fired
- NOx < 100mg/Nm$^3$
- CO < 10 mg/Nm$^3$
- Capacity 0.75 to 6 MW

**Natural Draught Gas Only Ultra Low NOx**

The Greenburn Ultra combines all current NOx reduction methods; staged air, staged fuel and flue gas recirculation to achieve sub 50 mg/Nm$^3$ NOx emissions. By having an asymmetric poker design it has a small footprint meaning its ideal for retrofit in old furnace with tight dimensions.

**Features**
- Asymmetric pokers
- Single Inlet Gas Gun
- Single Damper
- Silenced Windbox
- 10:1 Turn Down
- Up Fired or Side Fired
- NOx < 50mg/Nm$^3$
- CO < 10 mg/Nm$^3$
- Capacity 1 to 8 MW
Forced Draught Gas Only Low NOx

The Greenburn FD being from the same family as the ND burner uses the principle of staged air to achieve low NOx emissions whilst in turn providing stability for a wide range of fuel gases due to its central fuel gun with large holes.

Features

- Staged Air Design
- Single Inlet Gas Gun
- Single Damper
- Silenced Windbox

- 10:1 Turn Down
- Up Fired or Side Fired
- NOx < 100mg/Nm³
- CO < 10 mg/Nm³
- Capacity 1 to 19 MW

After Market & On-site services

Heaters and furnaces are the heart of the refineries and petrochemical plants, and it follows that the burners installed on them are a critical item. It is therefore essential that the burners are well maintained and are operated correctly within their design operating envelope. Greens Combustion have highly experienced staff who can assist with optimizing furnaces, offer maintenance training, carry out health checks, give turn around advice, and if so desired supply component parts.

Testing Capabilities

To ensure that we can develop the burners and cope with the demands specified by the Industry Greens Combustion utilize a number of test furnaces throughout Europe. Site fuels are simulated by blending gases such as Natural Gas, Hydrogen, Propane, Carbon Dioxide, Nitrogen, HFO or Diesel. Other specific fuels may be fired upon request.

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