Low NOx Burners
Stork Thermeq
Stork Thermeq is an unrivalled specialist in the area of combustion systems. Our customers are refineries, power plants, industrial energy units and boiler manufacturers. Stork has over 60 years of experience in designing and supplying combustion installations for boilers with capacities between 10 and 2000 tonnes of steam per hour. Stork, as a designer of complete boiler installations for power stations and industrial boilers, ensures a thorough insight in the requirements of the combustion installation for each situation. Our engineers fit patented and proven concepts to your specific demands. For many decades Stork Thermeq has a successful track record as Original Equipment Manufacturer for combustion systems.

Why Stork Thermeq?
General

Stringent environmental standards for emission of nitrogen oxides (NOx) have led to the development of the Double Register Burner. Based on thorough knowledge of NOx formation and experiments at test plants, Stork Thermeq developed a burner that enables a substantial cut back in NOx emissions, linked with a high combustion efficiency.

A typical feature of this burner type is the staged supply of combustion air. Part of the air is fed to the centre of the burner throat while being in strong rotation, while the rest of the air is skirting the flame like a peel. This type of air supply has the effect of falling flame temperature and oxygen concentration, which decreases the formation of thermal and fuel NOx.

Low calorific gasses and waste streams

Besides the application of fuel oil and high calorific gasses, the Double Register concept can also be applied for all kind of Low Calorific Gasses and Waste streams, like for instance blast furnace gas, tail gas, coke oven gas and animal fat. The optimum results are obtained by a customer made design for each specific fuel or waste stream. Based on long term experience, Stork ensures a reliable burner for all kind of fuels and various applications.

Application

- Power station boilers
- Industrial boilers
- Waste heat recovery boilers
- Retrofit to low NOx

Emissions

Application of the Double Register Burner leads to considerable reduction of NOx emission at combustion with low excess air. Unburned losses and CO remain at a minimum.

<table>
<thead>
<tr>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gas:</strong> natural gas</td>
</tr>
<tr>
<td>refinery gas</td>
</tr>
<tr>
<td>hydrogen gas</td>
</tr>
<tr>
<td>process gas</td>
</tr>
<tr>
<td>blast furnace gas</td>
</tr>
<tr>
<td>tail gas</td>
</tr>
<tr>
<td>vent gas</td>
</tr>
<tr>
<td><strong>Oil:</strong> light oil</td>
</tr>
<tr>
<td>heavy oil</td>
</tr>
<tr>
<td>residual oil</td>
</tr>
<tr>
<td>bitumen, pitch</td>
</tr>
<tr>
<td>animal fat</td>
</tr>
<tr>
<td>bio oil</td>
</tr>
<tr>
<td><strong>Heat input range:</strong> 5 - 100 MWth</td>
</tr>
<tr>
<td><strong>Guaranteed turn down ratio</strong></td>
</tr>
<tr>
<td><strong>Gas:</strong> 1 : 5</td>
</tr>
<tr>
<td><strong>Oil:</strong> 1 : 4</td>
</tr>
</tbody>
</table>
Impulse Ultra Low NOx Gas Burner

General
To meet the most stringent NOx requirements, the Impulse Gas Burner has been developed. Based on the experience with the Stork Double Register Burner and our thorough knowledge of the burning process and formation of NOx, we have developed our third generation gas burner, the Impuls Gas Burner. Single digit NOx values are possible.

Combustion principle
The basic principle of the burner is the separated injection of air (1) and fuel (2) in the furnace. By means of this injection method flue gasses from the furnace (4) are aspirated into the air and gas flow prior to mixing the flows into a combustable mixture. The aspiration of flue gasses lowers the oxygen concentration and increases the mass flow in the flame, both limiting the formation of NOx. An impeller is installed in the centre of the air supply. In order to create a stable ignition of the flame (zone A), part of the fuel gas is injected after this impeller (3). The completion of combustion takes place in zone B at low excess air and low flame temperature conditions.

By using this unique technique Stork has achieved maximum NOx reduction with highly efficient combustion, complying with the most stringent requirements.

Application
• Power Station boilers
• Industrial boilers
• Waste heat recovery boilers
• Retrofit to low NOx

Emissions
The Impulse burner is able to meet the most stringent local and international NOx emission demands.

Low NOx systems
Besides Low NOx burners, Stork Thermeq can offer Low NOx systems for new and retrofit installations like,
• two stage combustion
• flue gas re-circulation
• re-burning

The following emission levels can be achieved:

<table>
<thead>
<tr>
<th>Fuel</th>
<th>NOx level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>10 mg/m³</td>
</tr>
<tr>
<td>Heavy Fuel Oil</td>
<td>150 mg/m³</td>
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</tbody>
</table>

Technical data
<table>
<thead>
<tr>
<th>Fuel: Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat input range: 5 - 100 MWth</td>
</tr>
<tr>
<td>Guaranteed turn down ratio: 1 : 5</td>
</tr>
</tbody>
</table>
Our process control and instrumentation group consists of skilled and experienced personnel who are specialized in measurement, instrumentation, control, safe guarding and automation for a variety of burner and energy systems.

**Wide range of activities**

- **Turnkey projects**
  Ranging from instrumentation to complete automation. From project management, engineering, delivery, erection, start up and training Stork Thermeq can do the job.

- **Renovation and updating**
  Stork Thermeq can offer you a complete renovation and updating of the process and control equipment. The degree of automation can also be improved by the use of intelligent systems and modern field equipment, tailored to your specific requirements.

- **Energy audits / Consultancy**
  Our specialists and facilities can execute energy audits to investigate and review processes in existing energy systems and advise you on further improvements.

A practical project oriented approach

Projects and orders are carried out using a proven project approach. Unique is the combination of activities of the process and control & instrumentation group.

- Energy Audits
- Consultancy / Studies
- Basic and detail engineering
- BMS, DCS and & PLC /Scada systems
- Instrumentation and Emergency
  Shut Down (ESD) systems
- System verification / Factory
  Acceptance Test (FAT)
- Commissioning / Site acceptance Test (SAT)
- Training

A strong service group

Stork Thermeq has a strong service group at its disposal, which aims at maintaining the reliability of installations with a minimum possible operating cost. Five important factors contribute to this:

- Planned preventive maintenance and regular inspections
- Reconditioning and supply of spare parts
- Trouble shooting
- Training
- Emission and energy measurements
Qualifications

Stork Thermeq BV is certified according to:

- European Pressure Equipment Directive
- ASME certificates and Code Stamps S, U and R
- VCA**
- TÜV, AD-Merkblätter HP 0 and TRD 201

Furthermore, Stork Thermeq is qualified for designing, manufacturing, servicing and testing boiler components and pressure vessels to the internationally recognised rules and requirements of:

- Dutch Rules for Pressure Vessels
- UDT Office of Technical inspection, Poland
- Other Codes and standards as PD 5500, EN 13445, SVTI/ ASIT, IBR, CODAP, etc

Welders and welding procedures are available for any possible steel type and procedure combinations, such as prescribed by Euronorm and ASME.
HTNR Burner

General

The HTNR Burner ('High Temperature NOx Reduction) belongs to the so called second generation Low NOx burners. The main feature by which these burners can be distinguished from the first generation is the use of chemical NOx reduction in the flame. The HTNR Burner could also be called 'In Flame NOx Reduction' burners. The Stork Thermeq HTNR Burner is a proven design for the combustion of pulverised coal. In Poland for example the first time the new 170 g/GJ NOx emission standard was attained with the Stork Thermeq HTNR Burner (single stage combustion).

Combustion principle

The aim in the development of this second generation burner was to reduce NOx in the flame, in zone A, close to the burner, very high temperatures prevail which promote fast devolatisation and initial combustion. In zone B, with a low O₂ concentration, reducing species are produced. These species create a reducing zone C in which almost all the NOx produced in zone A is reduced to N₂. After mixing with an outside air layer (tertiary air), in zone D, the combustion, of mainly the char, is completed at relatively low temperatures.

Application

- Power station boilers
- Industrial boilers
- Retrofit to low NOx

Technical data

<table>
<thead>
<tr>
<th>Fuel main: Coal:</th>
<th>auxiliary: Gas:</th>
<th>auxiliary: Oil:</th>
</tr>
</thead>
<tbody>
<tr>
<td>hardcoal, lignite natural gas, refinery gas hydrogen gas process gas light oil, heavy oil residual oil bitumen, pitch</td>
<td></td>
<td></td>
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</tbody>
</table>

Heat input range

<table>
<thead>
<tr>
<th>Coal:</th>
<th>Gas:</th>
<th>Oil:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 - 60 MWth</td>
<td>1 : 2</td>
<td>1 : 4</td>
</tr>
</tbody>
</table>

Guaranteed turn down ratio

<table>
<thead>
<tr>
<th>Coal:</th>
<th>Gas:</th>
<th>Oil:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 : 2</td>
<td>1 : 4</td>
<td>1 : 4</td>
</tr>
</tbody>
</table>

Emissions

In general it can be stated that the HTNR Burner reduces the NOx emission with about 40 - 50% compared with conventional burners, with the same CO and UBC levels. This burner type is in operation in retrofits and new power plants up to 600 MWe. In new boilers, in combination with two-stage combustion, NOx emissions of lower than 300 mg/Nm³ (110 mg/MJ) can be achieved.

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Supplementary Firing Burners
Stork Thermeq
Inline Circular Duct Burner

General
The Inline Circular Duct Burner is designed for supplementary firing oil and gas based on the long term experience in windbox applications. This burner is appropriate for a wide range of fuel compositions, both liquid and gaseous fuels. The flame shape is adjustable by means of a cone, which also creates an optimal mixing of fuel and TEG/combustion air.

Combustion principle
The fuel is supplied to the flame by the fuel nozzle in the centre of the burner. The TEG/combustion air is divided into a primary and secondary flow. The ratio of these flows will be set by the primary inlet cone in order to obtain the optimal flame shape and combustion performance. The swirler in the centre of the burner provides a stable ignition and combustion. The Inline Circular Duct Burner ensures a uniform heat distribution and low pressure drop.

Application
- Supplementary firing in ducts or plug in units
- Waste heat recovery boilers
- Supplementary firing of both gas and oil
- TEG and Fresh Air back up

<table>
<thead>
<tr>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel: Liquid / Gases</td>
</tr>
<tr>
<td>Heat input range 5 - 35 MWth</td>
</tr>
<tr>
<td>Guaranteed turn down ratio</td>
</tr>
<tr>
<td>Gas: 15/10 : 1</td>
</tr>
<tr>
<td>Oil: 4/6 : 1</td>
</tr>
<tr>
<td>Naptha 5 : 1</td>
</tr>
</tbody>
</table>

① SIGHT PORT  ② FLAME SCANNER  ③ IGNITION BURNER  ④ GAS SUPPLY  ⑤ OIL BURNER
Inline Grid Burner

General

After many years of experience with applying supplementary firing burners and experiments at the own test facilities, Stork Thermeq developed the Inline Grid Burner. This burner is appropriate for supplementary firing in ducts with large velocity TEG flows. The shape and the applied materials ensure a very robust construction and long lifetime. The Inline Grid Burner achieves a good flame stabilisation at both TEG and Fresh Air combustion maintaining a large turn down ratio and remarkably short flames.

Combustion principle

The fuel gas is injected via the supply pipe by means of a nozzle into the flame. This means an optimum gas injection pattern and flexibility of the system for firing different gaseous fuels because of the changeability of the nozzles. Stabilising Vanes ensure a fixed ignition zone and a stable combustion.

The Inline Grid Burner ensures a uniform heat distribution and a low pressure drop.

Application

- Supplementary firing in ducts or plug in units
- Waste heat recovery boilers
- High fresh air/TEG velocities
- TEG and Fresh Air back up

Technical data

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Fuel: Gas</td>
<td></td>
</tr>
<tr>
<td>Guaranteed turn down ratio (minimum)</td>
<td>15/10 : 1</td>
</tr>
<tr>
<td>Gas pressure before burner</td>
<td>1 - 2 bar(g)</td>
</tr>
</tbody>
</table>

Diagram:

- IGNITION BURNER
- GAS SUPPLY
- DUCT SECTION
- FLAME SCANNER
- SIGHT GLASS
- ELEMENT
- LINE
Qualifications

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- ASME certificates and Code Stamps S, U and R
- VCA**
- TÜV, AD-Merkblätter HP 0 and TRD 201

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- Other Codes and standards as PD 5500, EN 13445, SVTI/ ASIT, IBR, CODAP, etc

Welders and welding procedures are available for any possible steel type and procedure combinations, such as prescribed by Euronorm and ASME.

The Stork Network

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