



## Proof of concept.

One of our container glass customers reported the following operational benefits with COROX LowNO<sub>x</sub>, based on a low up-front investment (EUR 140,000 – EUR 150,000) and annual operating expenses between EUR 70,000 and EUR 75,000.

Parameter	Standard air/fuel furnace	COROX® LowNO <sub>x</sub> furnace
Fuel, natural gas	1000 Nm <sup>3</sup> /h	965 Nm <sup>3</sup> /h
Additional oxygen	–	100 Nm <sup>3</sup> /h
NO <sub>x</sub> level	1200–1400 mg/m <sup>3</sup>	600–700 Nm <sup>3</sup> /h
Pull rate	260 t/d	260 t/d

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→ COROX® LowNO<sub>x</sub> technology for endport furnaces

THE LINDE GROUP

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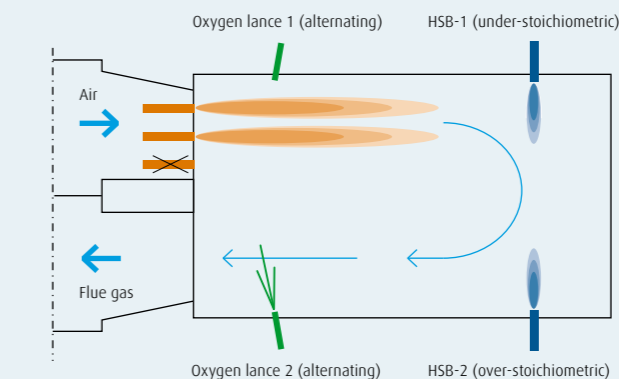
# COROX® LowNO<sub>x</sub>

Lowest NO<sub>x</sub> at lowest energy consumption.

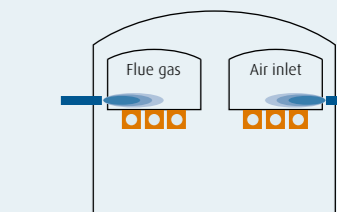




Top view



Front view



## Growing pressure on glass manufacturers.

## Time to act.

Increasingly strict EU legislation is placing growing pressure on glass furnace operators to limit emissions, with attention focusing on nitrogen oxides in particular. Nitrogen oxides (mainly NO and NO<sub>2</sub>) – known as NO<sub>x</sub> – react with oxygen in the air to produce ground-level ozone. The amount of NO<sub>x</sub> present in furnace flue gases must be measured for the purposes of compliance. These values are reported in milligrams per normal cubic metre (mg/Nm<sup>3</sup>) in dry flue gas, based on 8% residual oxygen. In glass furnaces, NO<sub>x</sub> is mainly caused by thermal NO<sub>x</sub> and – to a lesser extent – fuel NO<sub>x</sub>.

Because of the health and environmental risks associated with NO<sub>x</sub>, new European legislation, for instance, limits NO<sub>x</sub> emissions to 800 mg/Nm<sup>3</sup> – which is a significant reduction compared with current emission levels in many furnaces. These new threshold values are due to come into effect at the end of 2013, which means that glass manufacturers need to take action now.

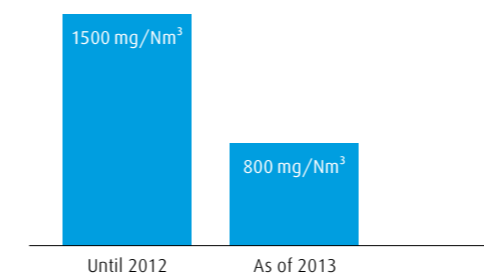
Our new COROX<sup>®</sup> LowNO<sub>x</sub> solution can help you meet ever stricter compliance requirements, keeping your NO<sub>x</sub> emissions within a 500–800 mg/Nm<sup>3</sup> corridor.

## Best fit for today's glass production challenges. Put our expertise to work for you.

COROX LowNO<sub>x</sub> is a unique patent-pending fuel dilution and gas conditioning technology suited to both regenerative and recuperative endport glass furnaces. It employs special horizontal oxygen lances, which can be combined with oxyfuel burners, to create atmospheric conditions that result in substantially reduced NO<sub>x</sub> emissions. It can be fitted to new furnaces or easily added to existing facilities with minimal space requirements.

We combine this innovative technology with the vast process know-how and experience we have gained serving glass customers over the years to analyse your individual requirements and engineer a package tailored to your specific furnace and productivity needs. Our offering extends from this initial consultation through installation of oxygen lance technology and oxyfuel burners to fine-tuning the control equipment.

**NO<sub>x</sub> limit**  
(EU Directive 2012/75/EU – BATC 03/2012)



## So how does it work?

Additional oxygen is injected through high-pressure lances to create a more intense, directional flue gas recirculation effect within the furnace. As a result, the main air/gas burner system produces a diluted, staged combustion process. Fuel dilution leads to a more homogeneous flame and a reduced flame temperature. As the flame temperature has a direct impact on NO<sub>x</sub> levels, this lowers emissions significantly. A lower flame temperature also reduces the concentration of hydrocarbon radicals in the furnace, thereby limiting NO<sub>x</sub> formation. In addition, an improved heat transfer rate shortens the window during which NO<sub>x</sub> can form.

You can combine oxygen lances with oxyfuel burners to reduce NO<sub>x</sub> emissions even further or increase your melting capacity by 5–15% while still complying with upcoming EU legislation.

## Highlights at a glance

- NO<sub>x</sub> emissions down by as much as 65% to 500 mg/Nm<sup>3</sup>
- Energy consumption down by between 3 and 5%
- Consistently high glass quality (e.g. no shift in T-profile, stable CO concentration)
- Furnace capacity increase by 5–15%
- Low up-front investment and operating costs

