MATCHING LOW NO_x BURNER AND HEAT GENERATOR

INTRODUCTION

To choose any burner, the following data are mandatory:
- Boiler type
- Burner input
- Backpressure in the combustion chamber
- Dimensions of the combustion chamber included the reverse smoke chamber
- NO_x emissions requested, 80, 50, 30 mg/kWh

The procedure is divided into three steps:
- choosing the burner;
- to obtain the correct emissions
- choosing the blast tube length.

CHOOSING THE BURNER

Introduction

To clearly explain the procedure please follow the example.

Example:	
Boiler type	3 pass
Furnace input	7.300 kW
Backpressure in combustion chamber	12 mbar
Dimensions of combustion chamber	Length L = 4.450 mm (4,45 m)
Smoke reverse chamber	Length L = 400 mm (0,4 m)
Total length of combustion chamber	Length TL = 4.850 mm (4,85 m)
Diameter	D = 1.250 mm (1,25 m)
Combustion chamber volume	D x D x 0,78 x TL 1,25 m x 1,25 m x 0,78 x 4,85 m = 5,91 m^3
Thermal load MW/m^3	Furnace input kW/Combustion chamber volume /1000 7.300/5,91/1.000 = 1,23 MW/m^3
Gas type	Natural gas

Next step, identify the burners whose requested outputs are included within their performance curves.

BURNER SELECTION FOR NO_x < 80 mg/kWh

COMBUSTION CHAMBER BACKPRESSURE

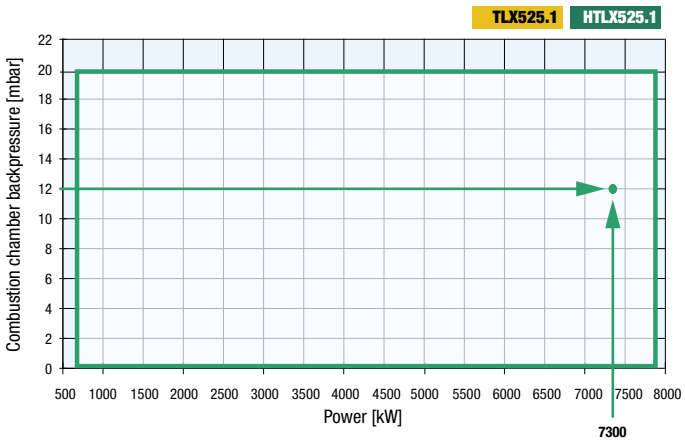


Fig. 1

NO_x DIAGRAM IN REFERENCE TO THE THERMAL LOAD

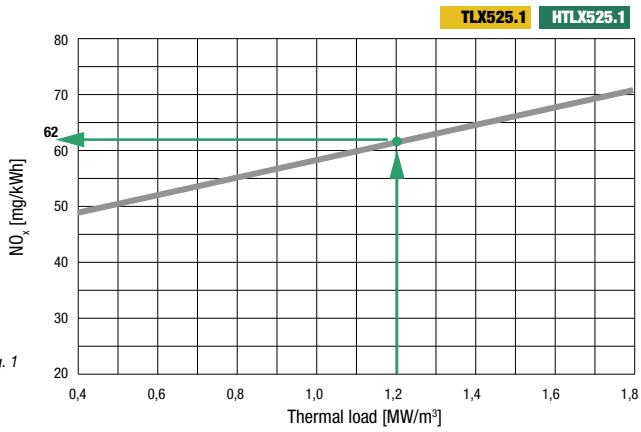
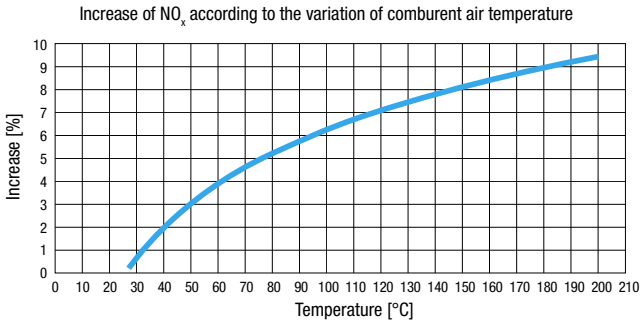


Fig. 2

Consider the operating range of the burner chosen in the above diagram: draw a vertical line matching the furnace input value (7.300 kW) and a horizontal line matching the backpressure value (12 mbar) (Fig. 1).
The burner is suitable if the intersection is inside the performance curve (these curves are correct for the NO_x < 80 mg/kWh).
In this case we have 62 mg/kWh at 3 % O_2 (Fig. 2).



Reference conditions

- Measurement tolerances according to EN 676 standard
- Temperature: 20 °C
- Dried flue gases
- Barometric pressure: 1013 millibars
- Relative humidity: 70 % (equivalent to 10 g H_2O/kg of air)
- Boiler temperature: 110 °C
- Fuel: G20 (natural gas, 100 % CH_4)
- Three-smoke pass boiler

The final step is to check blast tube dimensions, in relation to combustion chamber, because they are a critical parameter to obtain the expected emissions.
Two conditions should be met:

1) It is recommended that the diameter of the chamber is 2,5 to 3 times larger than the diameter of the burner blast tube.
2) The low NO_x blast tube must penetrate 150÷200 mm into the combustion chamber.

In the cited example, the boiler chamber diameter was 1.250 mm, so the optimal blast tube diameter lies in the range between 400 mm and 500 mm.
The dimensional table on page 83 shows that TLX525.1 blast tube diameter is equal to 419 mm, thus the first condition is met.
Regarding the blast tube length, suppose the boiler door is 350 mm thick, refractory included. The blast tube must penetrate at least 150 mm as said above, thus the long blast tube variant is selected (530 mm). The short blast tube (430 mm) is insufficient as it only penetrates by 80 mm into the combustion chamber.
In this case we have 180 mm.
To properly install the burner, please refer to Fig. 3 to the side.
Of course, it is possible to carry out the reverse procedure as well: given an emission limit that cannot be exceeded by design, the NO_x diagram provides the admissible thermal load for a given heat generator. This way, designer can select a suitable boiler based on project specifications and required power. In any case, burner blast tube dimensions must be checked to complete the matching procedure.

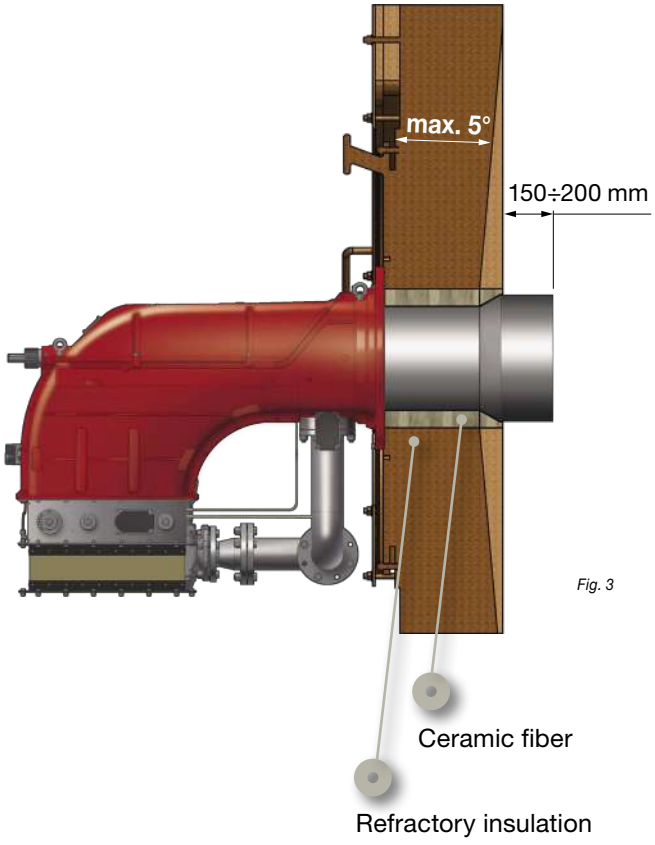
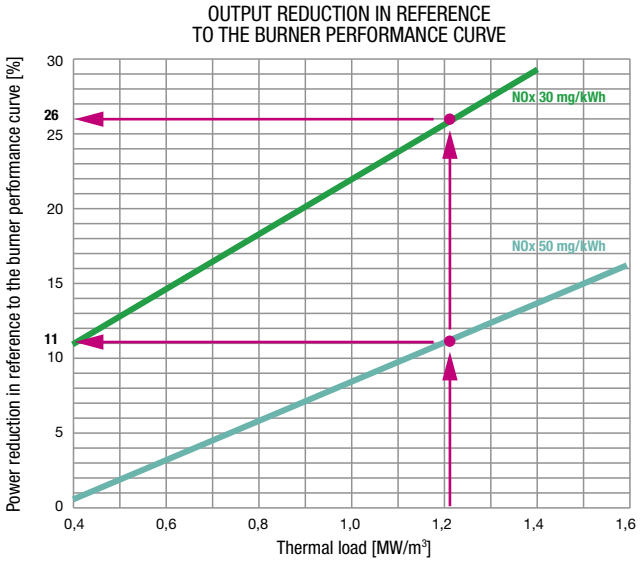


Fig. 3

BURNER SELECTION FOR NO_x < 50 mg/kWh and < 30 mg/kWh

With NO_x < 50 mg/kWh and < 30 mg/kWh we need to have a smoke recirculation (FGR).
The smoke recirculation decreases a percentage of the performance curves and increases the backpressure in the combustion chamber. This percentage depend also of the thermal load of the combustion chamber.
In order to select the correct burner we can calculate the depowering percentage needed.

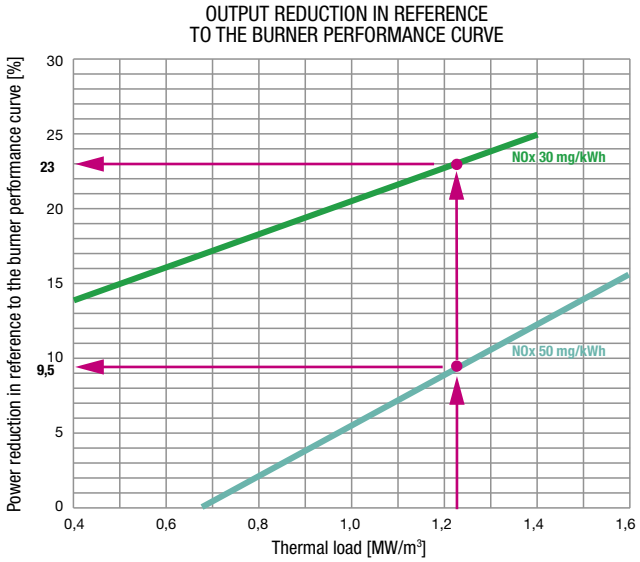
SELECTION 1: TLX525.1...FGR



< 50 mg/kWh
In the selection 1 with the thermal load 1,22 MW/m³ the percentage of the depowering of the burner is **11 %**.

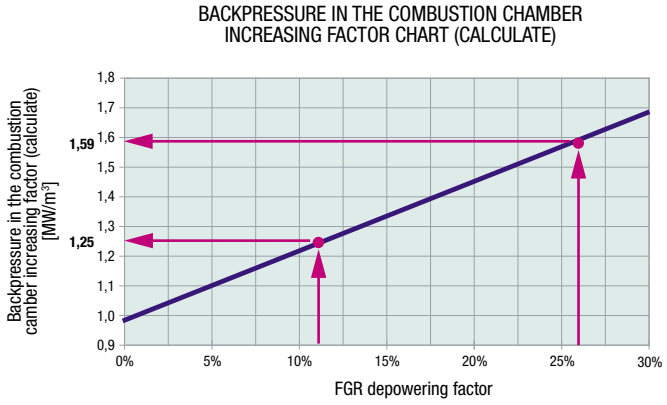
< 30 mg/kWh
In the selection 1 with the thermal load 1,22 MW/m³ the percentage of the depowering of the burner is **26 %**.

SELECTION 2: TLX1030.1...FGR



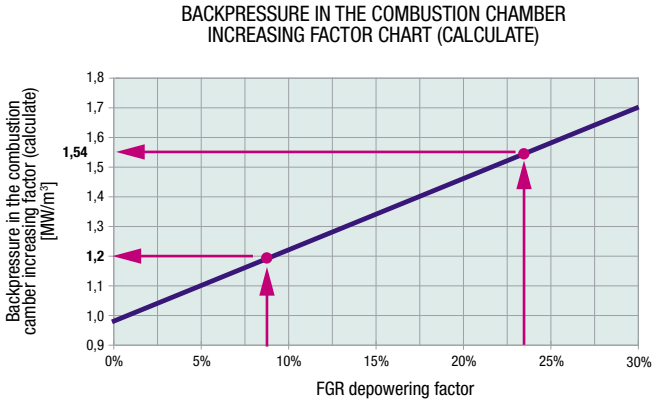
< 50 mg/kWh
In the selection 2 with the thermal load 1,22 MW/m³ the percentage of the depowering of the burner is **9,5 %**.

< 30 mg/kWh
In the selection 2 with the thermal load 1,22 MW/m³ the percentage of the depowering of the burner is **23 %**.



< 50 mg/kWh
In the selection 1 with the thermal load 1,22 MW/m³ the percentage of the depowering of the burner is **11 %** and the backpressure in the combustion chamber increases
12 x 1,25 = **15 mbar**

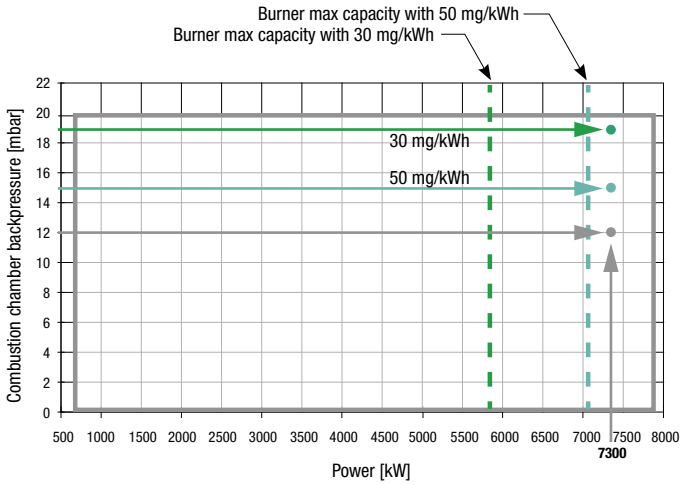
< 30 mg/kWh
In the selection 1 with the thermal load 1,22 MW/m³ the percentage of the depowering of the burner is **26 %** and the backpressure in the combustion chamber increases
12 x 1,6 = **19,2 mbar**



< 50 mg/kWh
In the selection 2 with the thermal load 1,22 MW/m³ the percentage of the depowering of the burner is **9,5 %** and the backpressure in the combustion chamber increases
12 x 1,2 = **14,4 mbar**

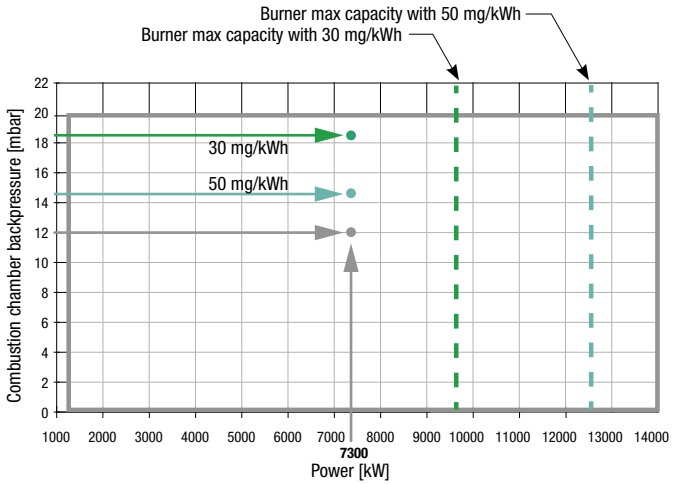
< 30 mg/kWh
In the selection 2 with the thermal load 1,22 MW/m³ the percentage of the depowering of the burner is **23 %** and the backpressure in the combustion chamber increases
12 x 1,54 = **18,48 mbar**

SELECTION 1: TLX525.1...FGR



The burner TLX525.1 in the **selection 1 is outside** of the performance curve, for this reason we can not choose this burner.

SELECTION 2: TLX1030.1...FGR



The burner TLX1030.1 in the **selection 2 is correct** because is inside of the performance curve with emissions 50 and 30 mg/kWh.

The final step is to check blast tube dimensions with a new burber selected, in relation to combustion chamber, because they are a critical parameter to obtain the expected emissions.

SELECTION 1
It is recommended that the diameter of the chamber is 2,5 to 3 times larger than the diameter of the burner blast tube.
SELECTION 2
The low NO_x blast tube must penetrate 150÷200 mm into the combustion chamber.
In the cited example, the boiler chamber diameter was 1.250 mm, so the optimal blast tube diameter lies in the range between 400 mm and 500 mm.
The dimensional table on page 84 shows that TLX1030.1 blast tube diameter is equal to 491 mm, thus the first condition is met.
Regarding the blast tube length, suppose the boiler door is 350 mm thick, refractory included. The blast tube must penetrate at least 150 mm as said above, thus the long blast tube variant is selected (545 mm). The short blast tube (445 mm) is insufficient as it only penetrates by 95 mm into the combustion chamber.
In this case we have 195 mm.
To properly install the burner, please refer to Fig. 4 to the side.
Of course, it is possible to carry out the reverse procedure as well: given an emission limit that cannot be exceeded by design, the NO_x diagram provides the admissible thermal load for a given heat generator. This way, designer can select a suitable boiler based on project specifications and required power. In any case, burner blast tube dimensions must be checked to complete the matching procedure.

If design specifications are very demanding, for example if the boiler thermal load is extremely high, CIB Unigas offers a proven low NO_x solution for your needs: the FGR (flue gas recirculation) system.
Please contact our Technical Dept for further details.

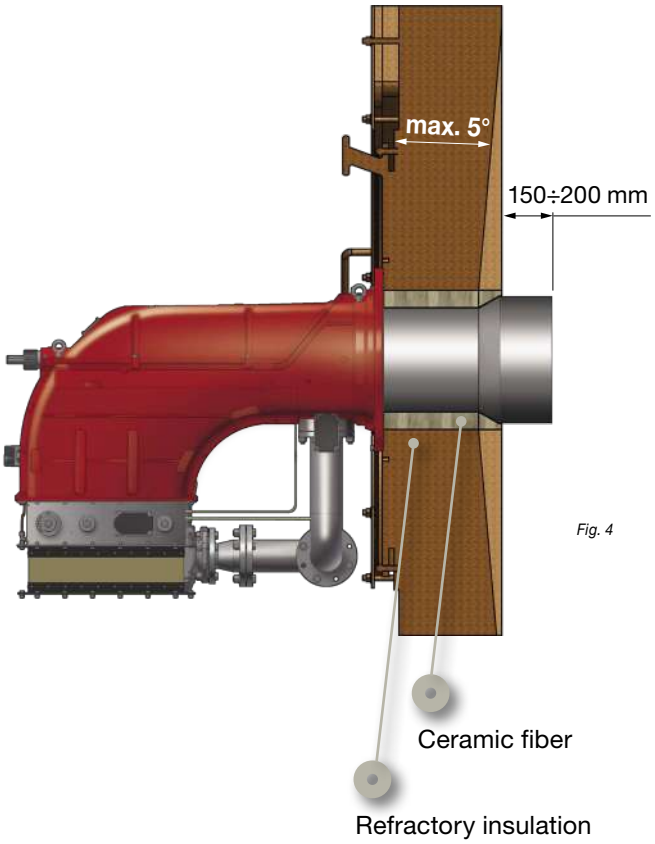
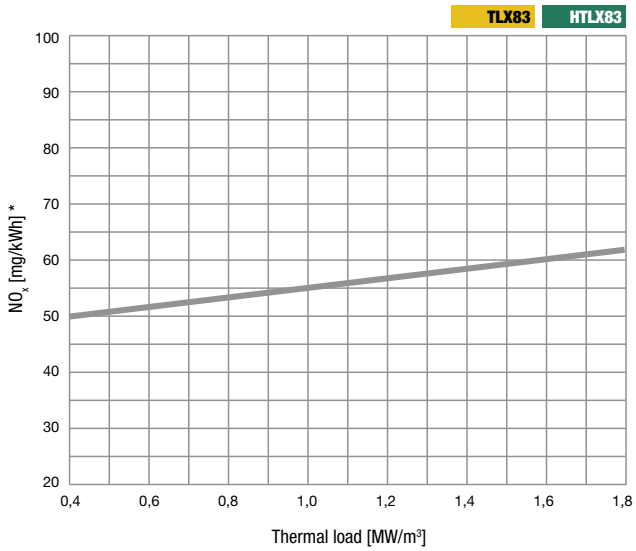


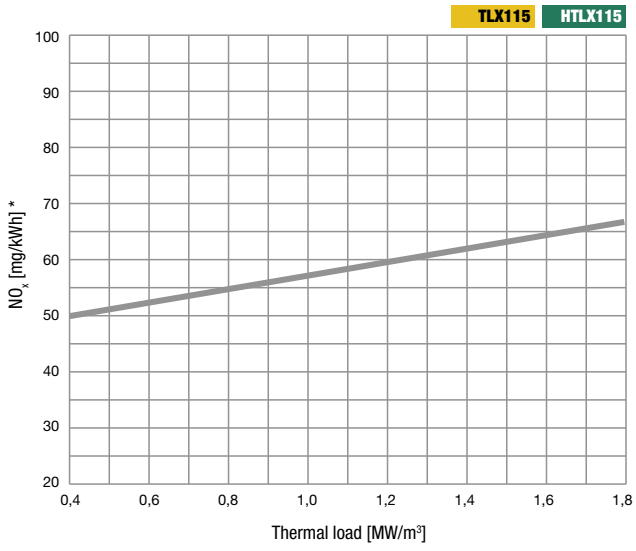
Fig. 4

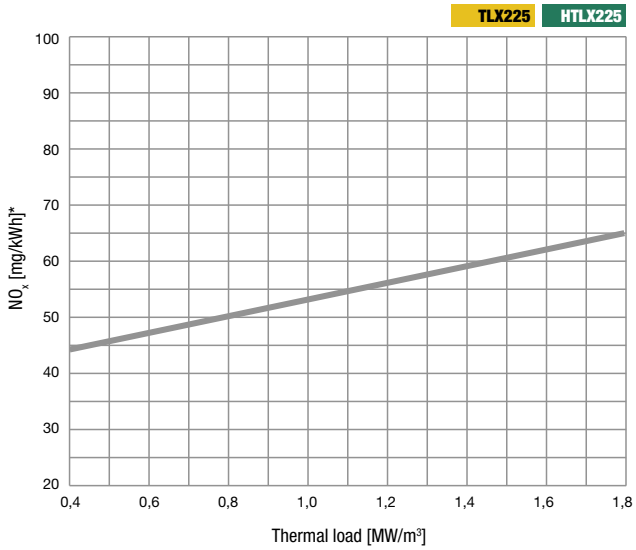
Reverse flame boilers: contact our Technical Department.

MATCHING LOW NO_x BURNER AND HEAT GENERATOR

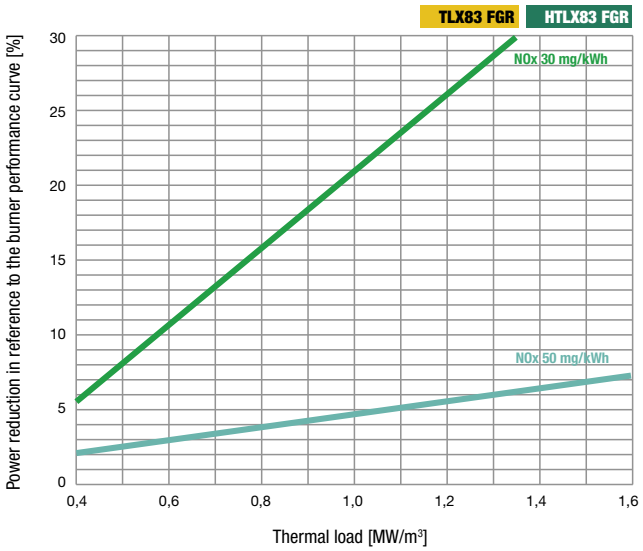
NO_x DIAGRAM IN REFERENCE TO THE THERMAL LOAD

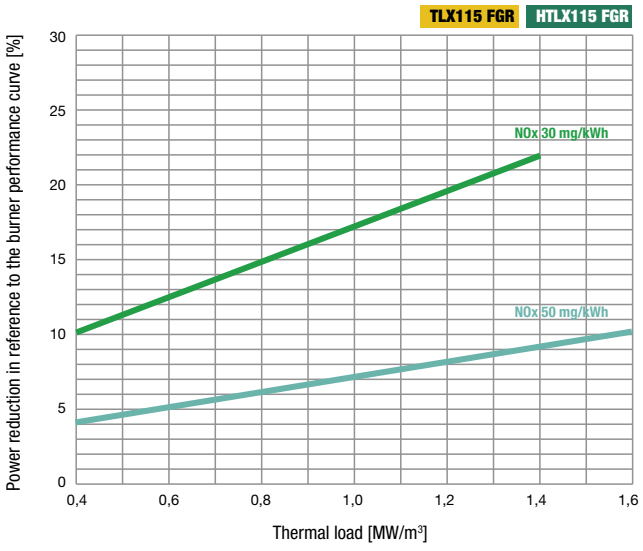


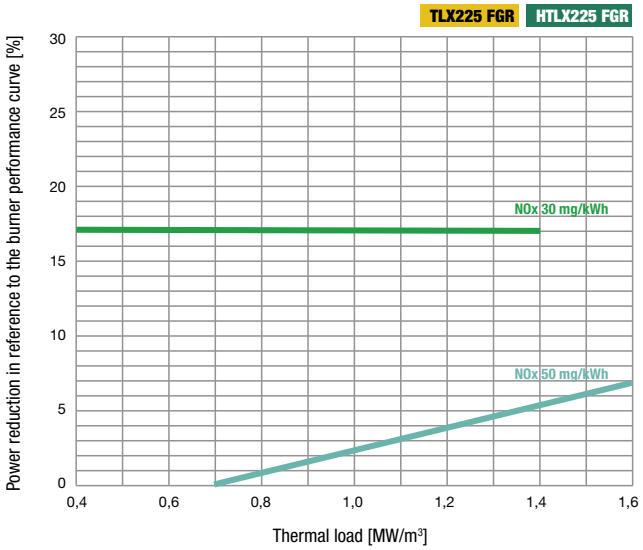




OUTPUT REDUCTION IN REFERENCE TO THE BURNER PERFORMANCE CURVE





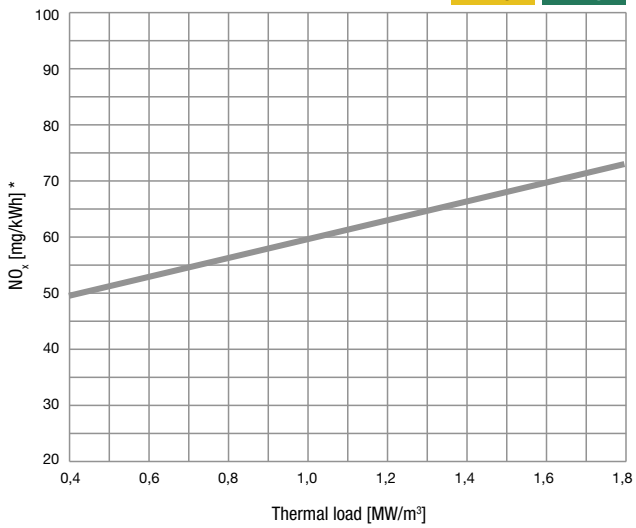


* According to UNI EN 676 correction method; p amb 1013 mbar; t amb 20 °C; h 10 g/kg.

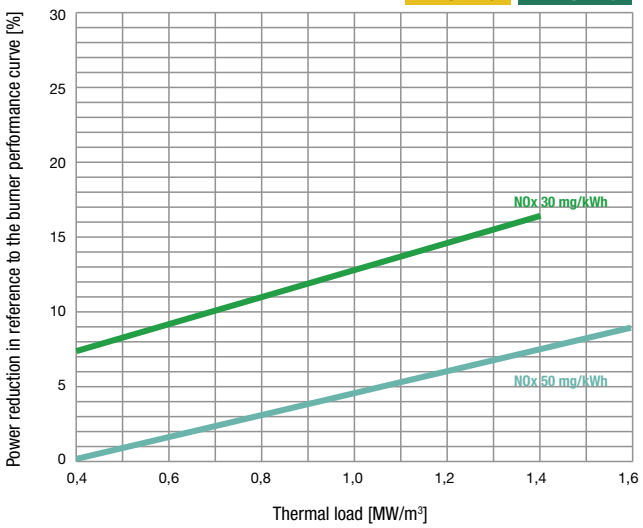
NO_x DIAGRAM IN REFERENCE TO THE THERMAL LOAD

OUTPUT REDUCTION IN REFERENCE TO THE BURNER PERFORMANCE CURVE

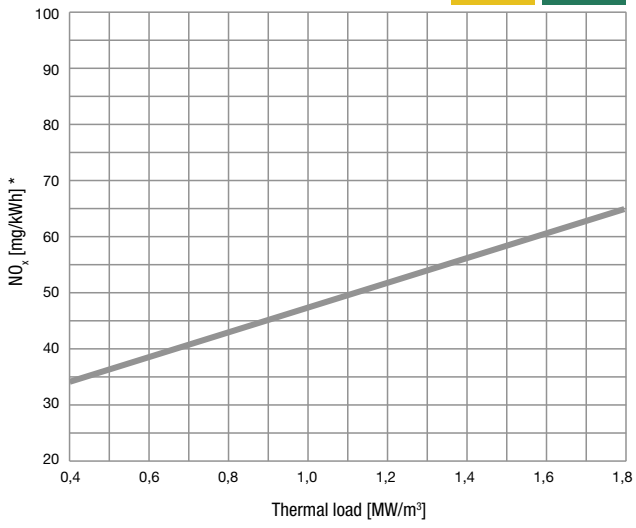
TLX92R **HTLX92R**



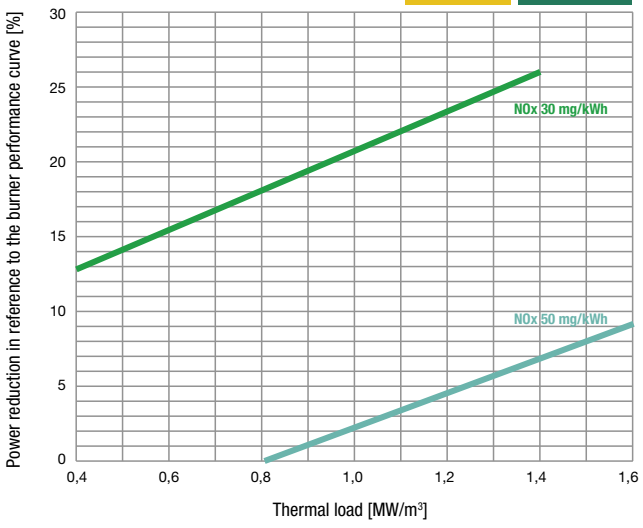
TLX92R FGR **HTLX92R FGR**



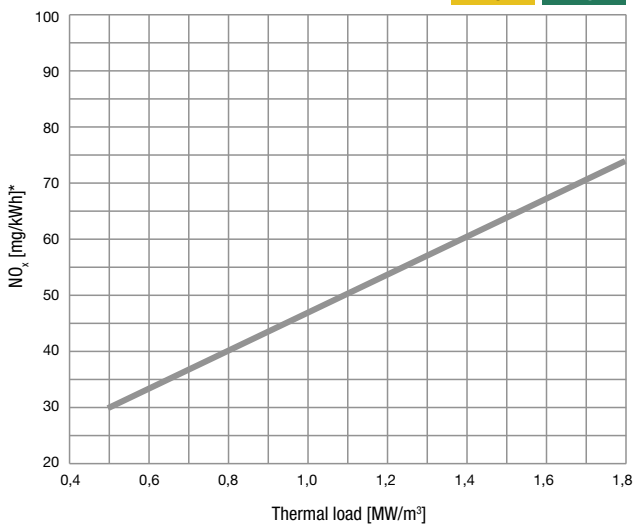
TLX92.1 **HTLX92.1**



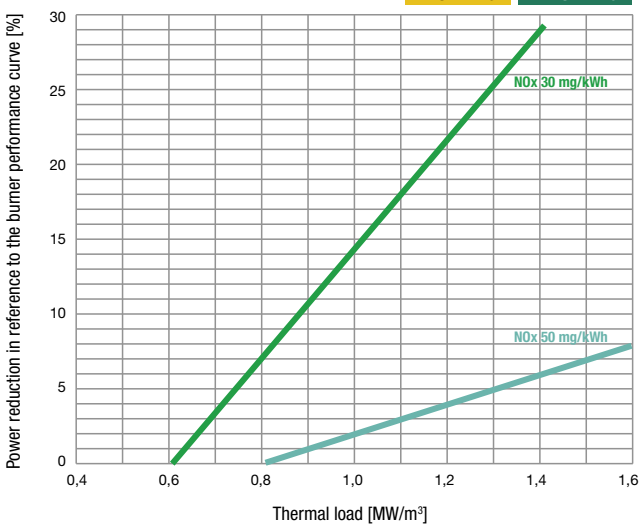
TLX92.1 FGR **HTLX92.1 FGR**



TLX512R **HTLX512R**



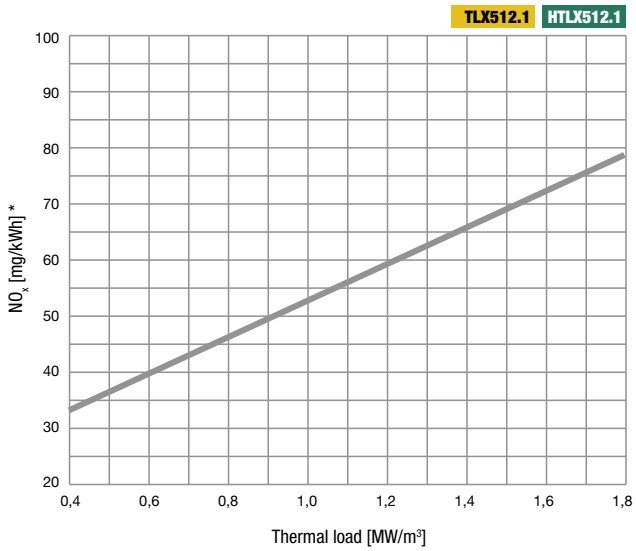
TLX512R FGR **HTLX512R FGR**

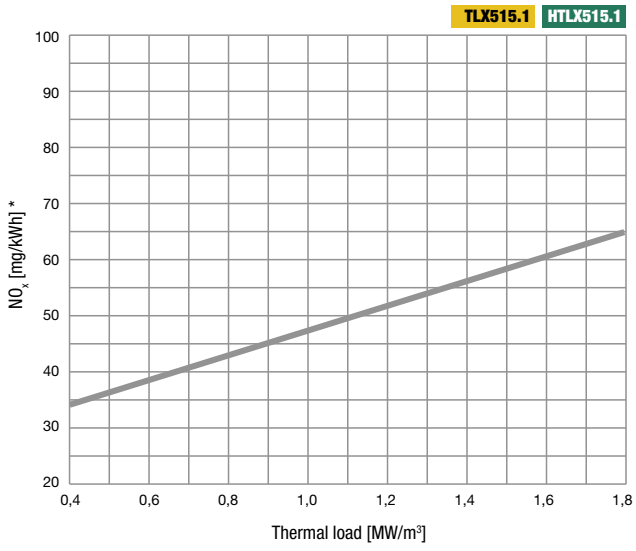


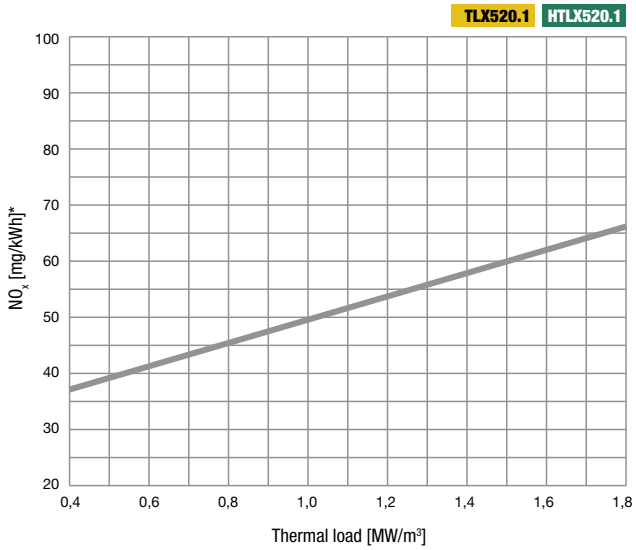
* According to UNI EN 676 correction method; p amb 1013 mbar; t amb 20 °C; h 10 g/kg.

MATCHING LOW NO_x BURNER AND HEAT GENERATOR

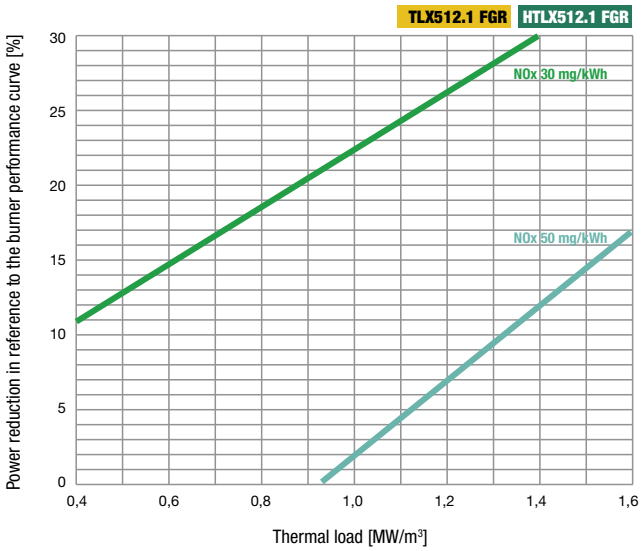
NO_x DIAGRAM IN REFERENCE TO THE THERMAL LOAD

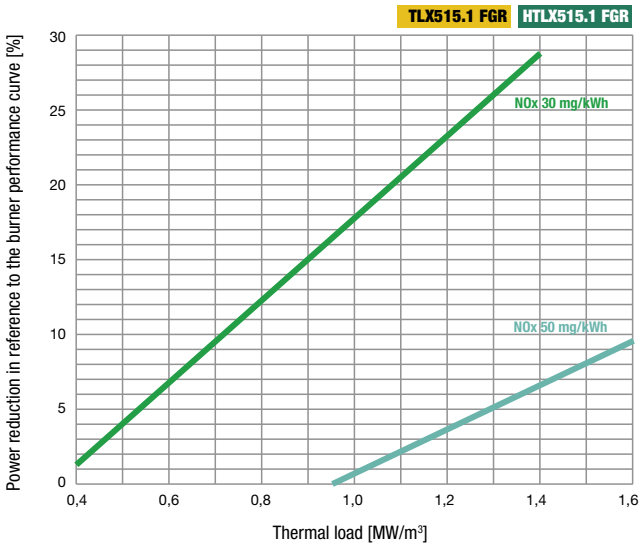


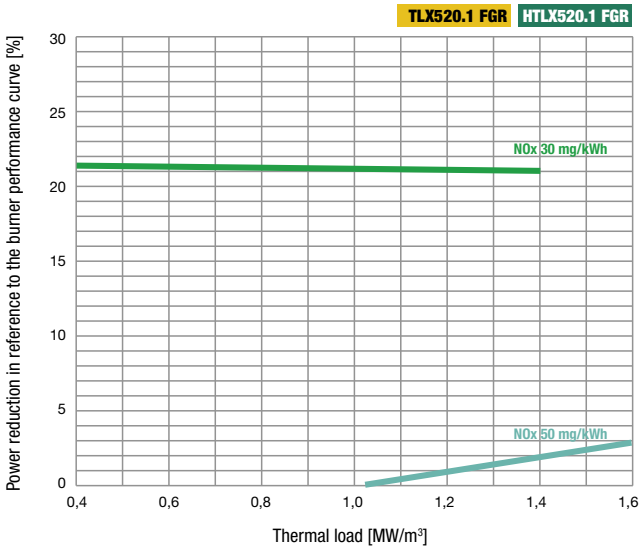




OUTPUT REDUCTION IN REFERENCE TO THE BURNER PERFORMANCE CURVE



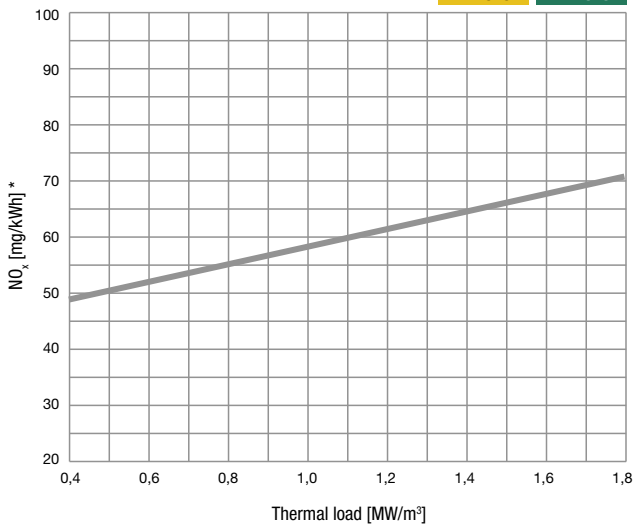




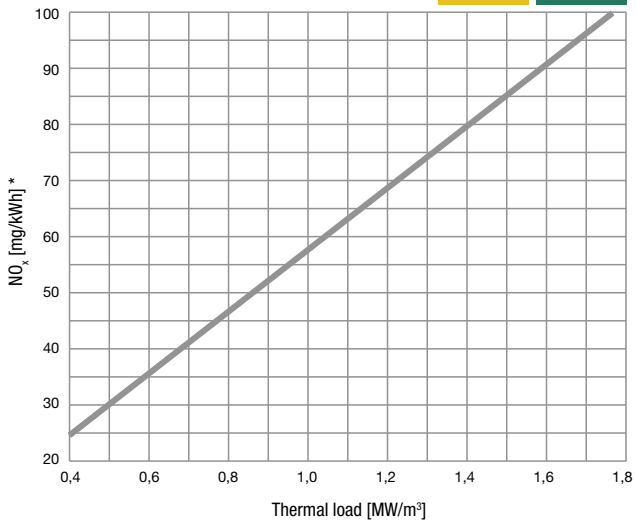
* According to UNI EN 676 correction method; p amb 1013 mbar; t amb 20 °C; h 10 g/kg.

NO_x DIAGRAM IN REFERENCE TO THE THERMAL LOAD

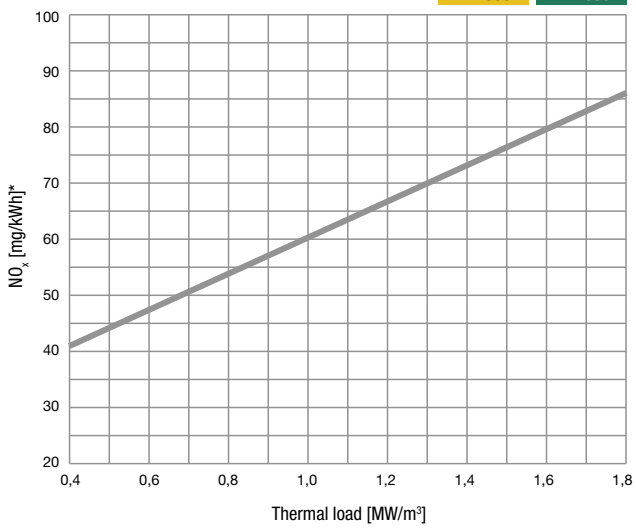
TLX525.1 **HTLX525.1**



TLX1030R **HTLX1030R**

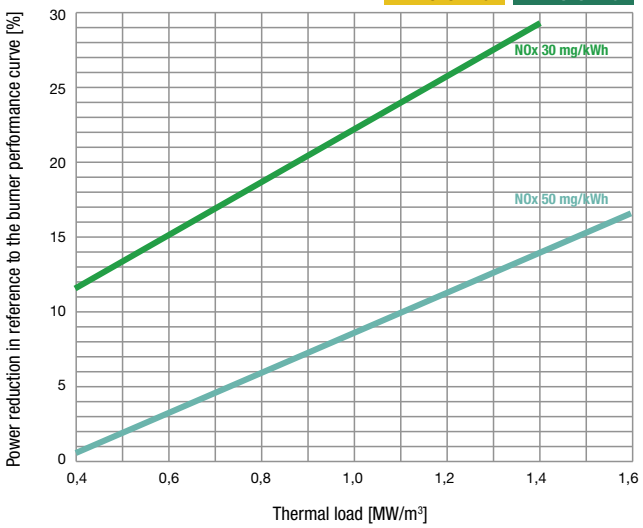


TLX1030.1 **HTLX1030.1**

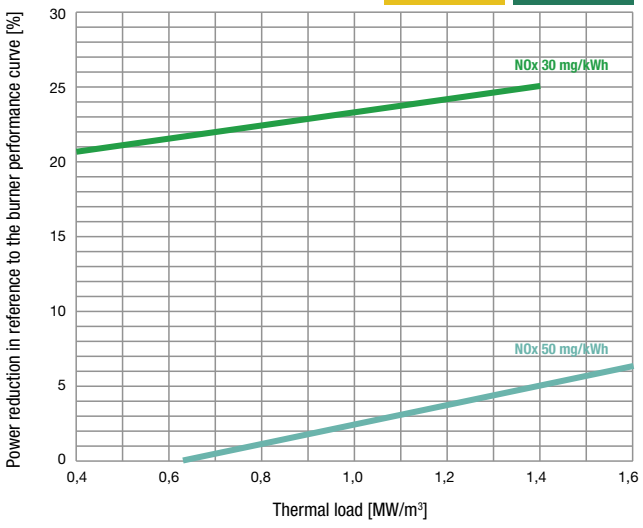


OUTPUT REDUCTION IN REFERENCE TO THE BURNER PERFORMANCE CURVE

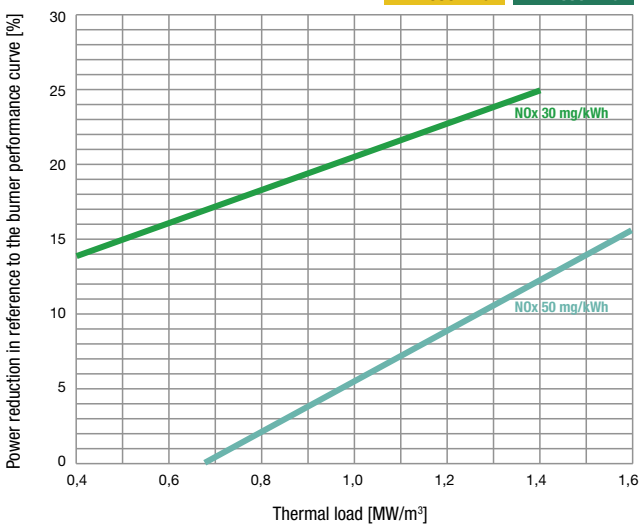
TLX525.1 FGR **HTLX525.1 FGR**



TLX1030R FGR **HTLX1030R FGR**



TLX1030.1 FGR **HTLX1030.1 FGR**



* According to UNI EN 676 correction method; p amb 1013 mbar; t amb 20 °C; h 10 g/kg.

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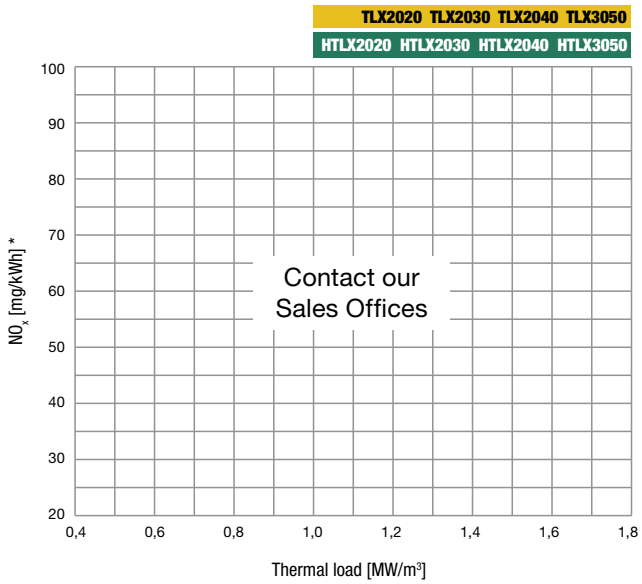
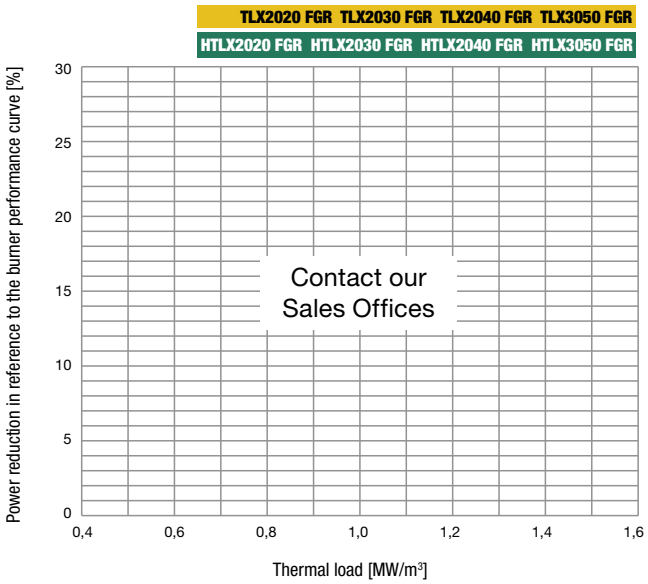
NO_x DIAGRAM IN REFERENCE TO THE THERMAL LOAD



OUTPUT REDUCTION IN REFERENCE TO THE BURNER PERFORMANCE CURVE



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