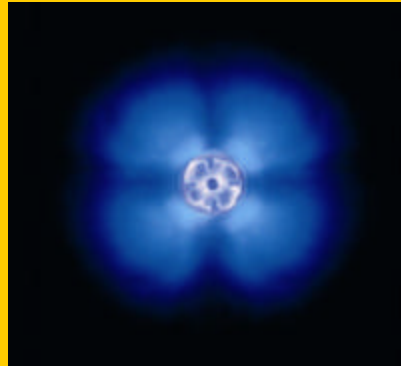


## **Weishaupt – Low NOx Solutions for Boiler Applications**



Presentation by Greg Meyer

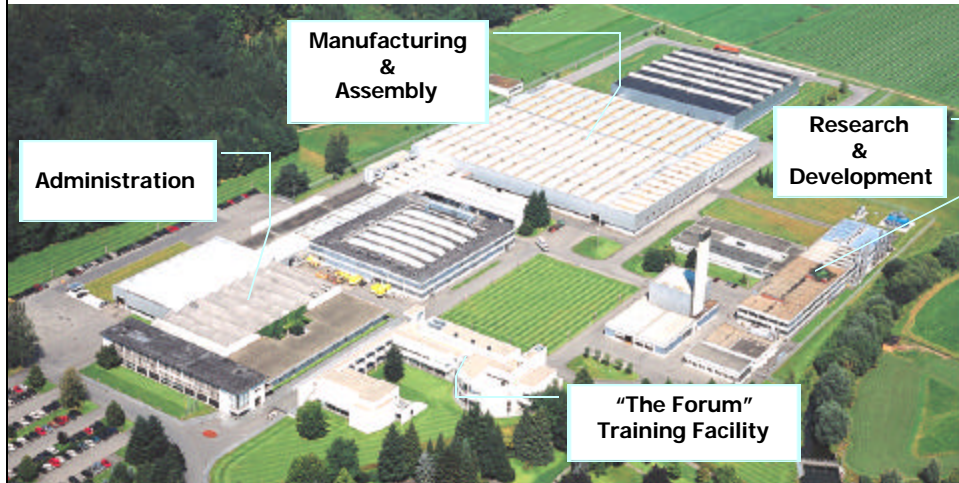
Ottawa, 2003

### **Content**

- **Weishaupt Company and Products**
- Weishaupt Low NOx Solutions
- Applications

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## Max Weishaupt GmbH



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## Max Weishaupt GmbH

- 150,000 burners / year sold in more than 60 countries
- 3,000 employees
- Service and support worldwide
- Burners are engineered to meet approvals and emission requirements for each country
- > 4 million burners



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## Research and Development

- Established in 1962
- One of the largest privately owned research facilities
- 100 full time engineers plus support staff keeps Weishaupt burners at the leading edge of technology
- Several sizes of units to match the capacity requirements



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## Research and Development

- All products are developed internally
- Custom Fuels are blended to match site specifications
- Combustion fan testing in a pressurized chamber to determine fan curve characteristics



## Quality

- Priority No.1
- Checks for quality and consistency
- Latest equipment



## Product Line



- W Series
- max 2,000 MBH



- Monarch Series
- max 37,000 MBH



- WK Series
- max 60,000 MBH

## Content

- Weishaupt Company and Products
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  - Efficiency throughout the Capacity Range
  - NOx reducing Design Features
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## Content

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### Efficiency throughout the Firing Range

- What is the most effective method of reducing emissions?

➡ By burning less fuel.

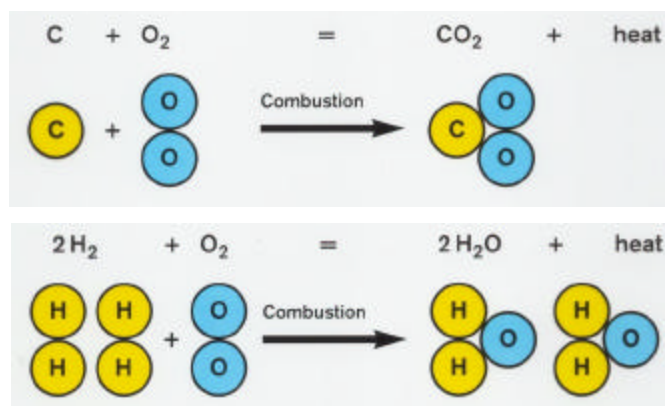
- How does Weishaupt reduce fuel consumption?

➡ By manufacturing high efficiency burners.

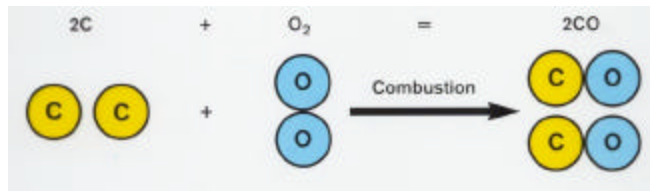
- How has Weishaupt accomplished this?

➡ By investing heavily in R&D and employing high quality manufacturing methods

### Complete (Stoichiometric) Combustion



## Incomplete Combustion



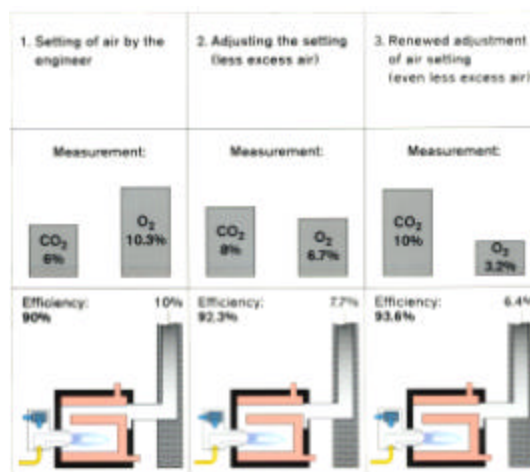
Single carbon atoms combine with single oxygen atoms to produce carbon monoxide (CO):

Insufficient air results in:

- Explosion Danger
- Toxic Carbon Monoxide
- Fuel Wastage

## Combustion Efficiency

- Low O<sub>2</sub> in flue gas means high energy gain & high efficiency.



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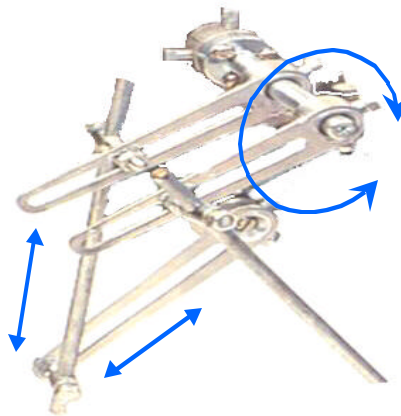
### Efficiency vs. Operation without CO

	CO <sub>2</sub> 6%	O <sub>2</sub> 10.3%	CO <sub>2</sub> 10%	O <sub>2</sub> 3.2%	CO <sub>2</sub> 11%	O <sub>2</sub> 1.4%	CO <sub>2</sub> 11.5%	O <sub>2</sub> 0.5%
CO content	CO- ca 0.005 %		CO- 0%		CO- 0%		CO- ca 0.3%	
Efficiency	90% 10%		93.6% 6.4%		94% 6%		94.2% 5.8%	
Remarks	Poor efficiency		Best setting high efficiency no CO		Insufficient excess air		Too much CO	

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### Control linkages

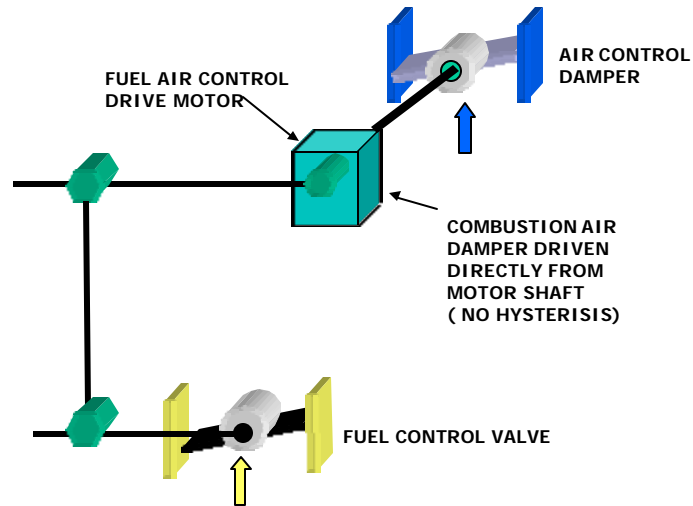
- The control linkages on a burner are critically important since their function is to control the fuel to air ratio throughout the firing capacity of the burner.
- In order to maximize efficiency and ensure repeatability, control linkages must be well designed with a minimum of hysteresis.
- Excessive “play” has a detrimental effect on how well a burner can be tuned and therefore directly affects the burner and boiler efficiency.



Typical Linkage Arrangement

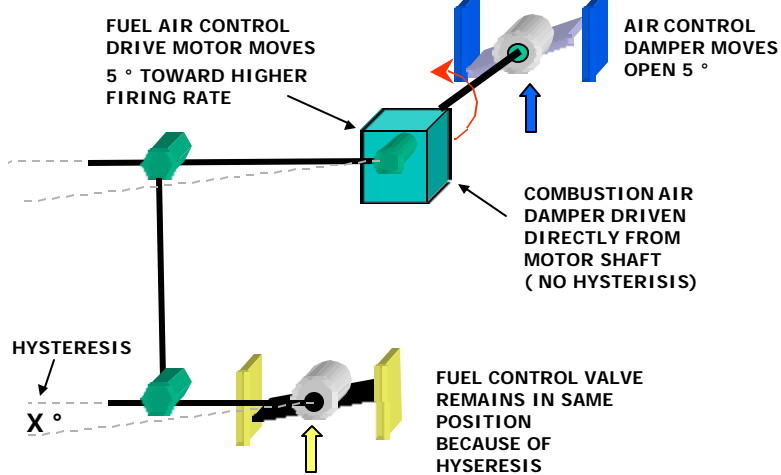


## Control linkages



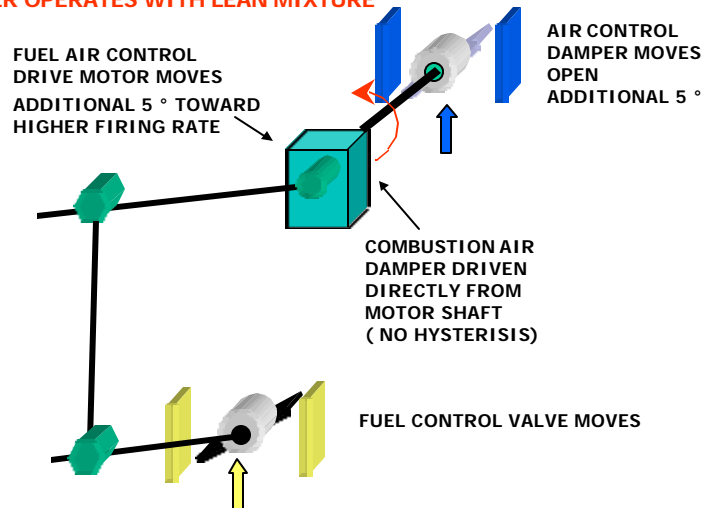
## Control linkages

**BURNER OPERATES WITH LEAN MIXTURE**



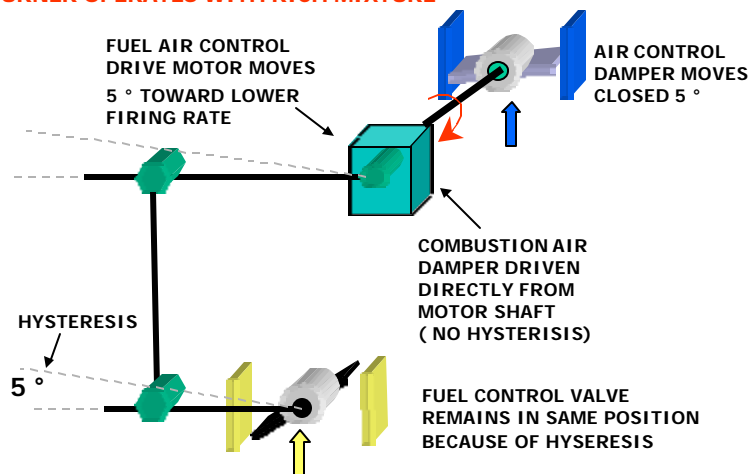
## Control linkages

### BURNER OPERATES WITH LEAN MIXTURE



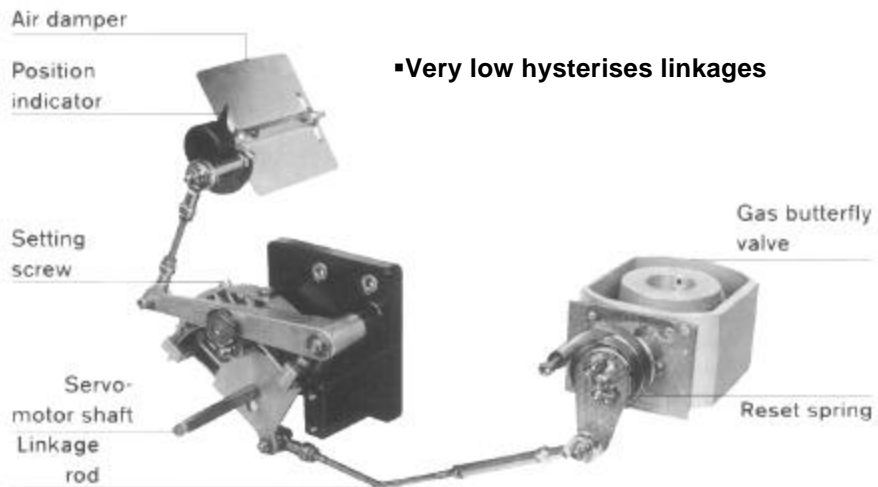
## Control linkages

### BURNER OPERATES WITH RICH MIXTURE



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### Control linkages

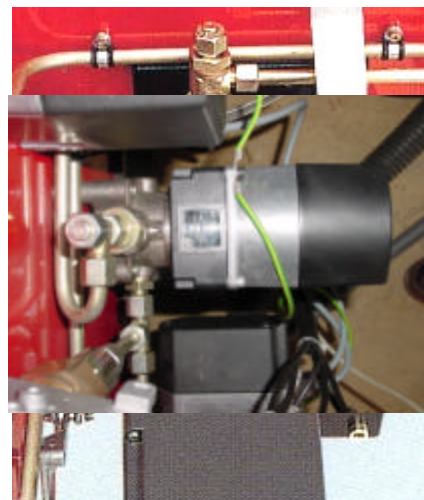


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### Control linkages

▪Cast aluminum cam with needle roller bearing cam followers

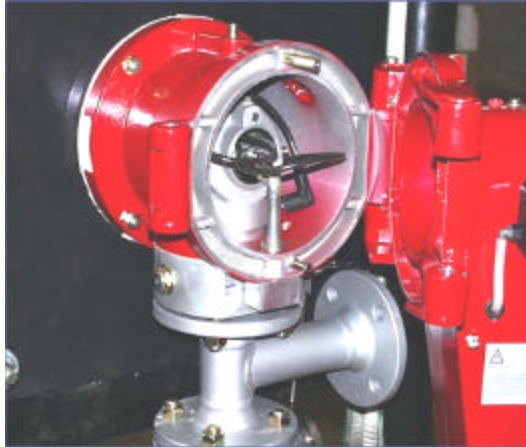
▪Linkage – less system with individual servodrives for each function accurate to 0.1 deg



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### Quality Features for high Efficiency

- High temperature stainless steel flame tube
- Precisely manufactured combustion head components
- Very simple service

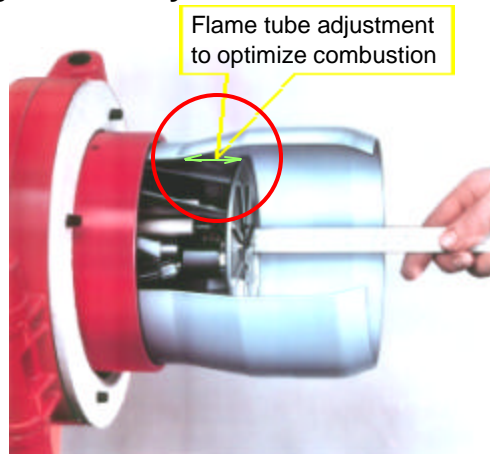


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### Design Features for High Efficiency

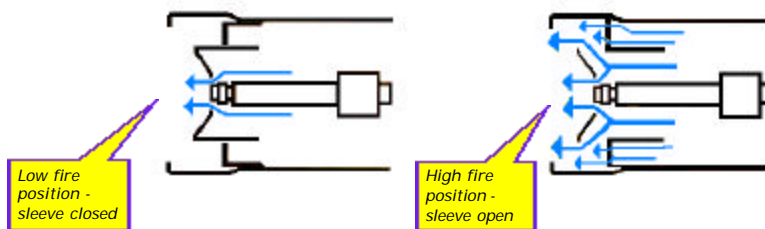
Adjustable flame tubes allows burners to be optimized for the specific application and allows higher turndown ratio for increased efficiency

? P through the flame tube should be maximized



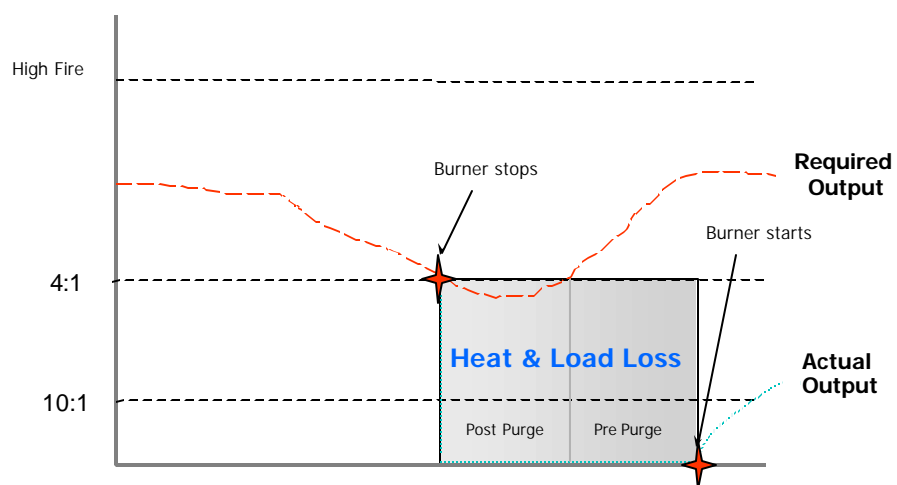
## Design Features for High Efficiency

**Variable head geometry** - maintains pressure drop throughout entire firing range



- **Major Benefits:**
  - Increased efficiency with higher turndown ratio

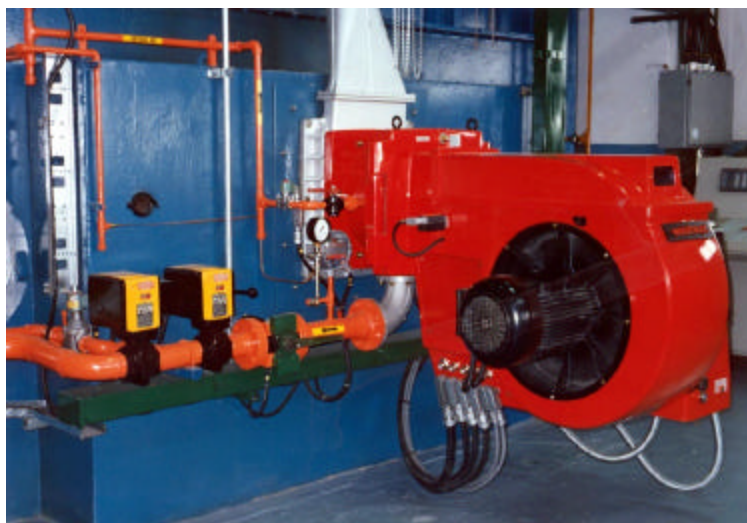
## Turndown Ratio



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## Forced Flue Gas Recirculation



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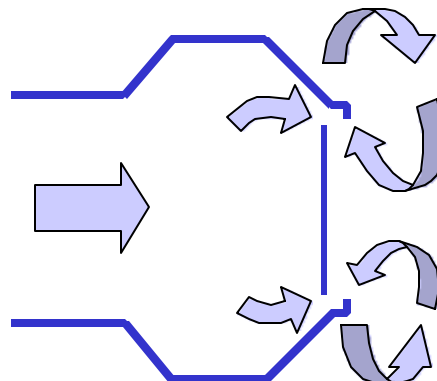
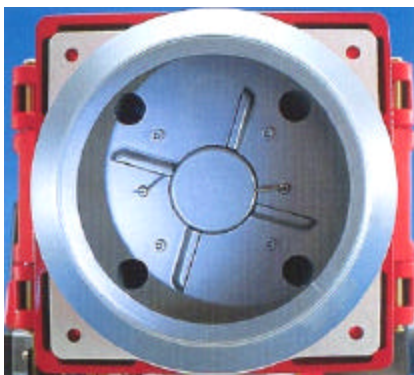
### Fuel Staging

- Mixing heads designed to meet various NOx requirements



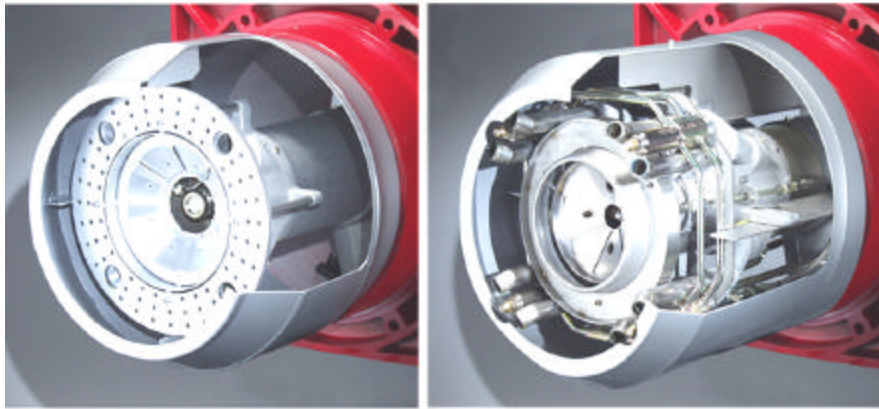
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### Internal Recirculation



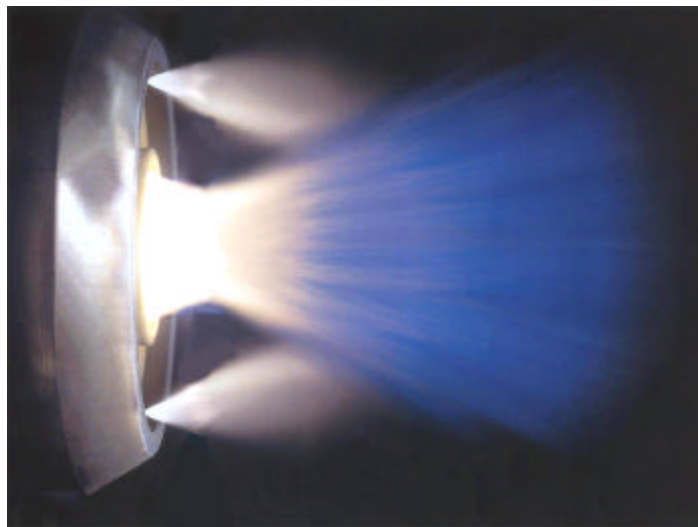
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### Combined Technologies



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### multiflam® Oil Flame





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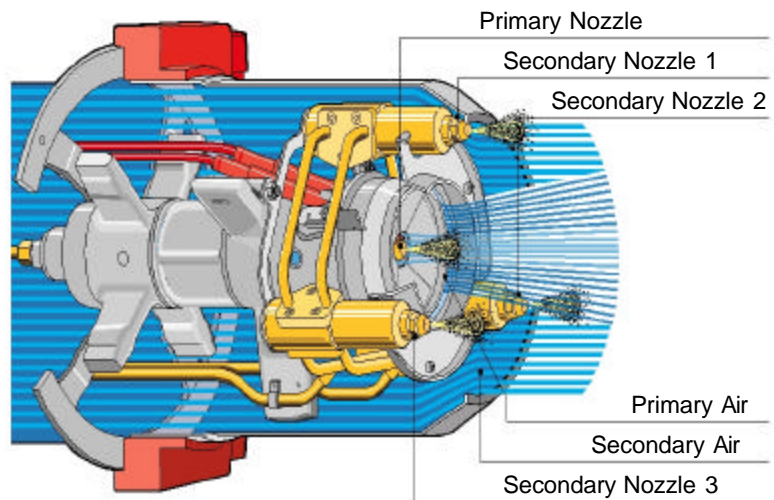
### multiflam®

- Low emissions on gas and on oil
- No induced flue gas recirculation
- 1,000 – 40,800 MBH



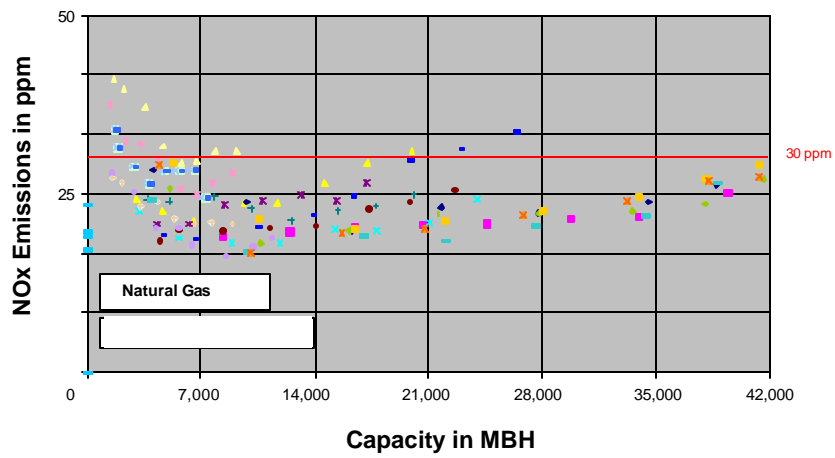
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### multiflam®



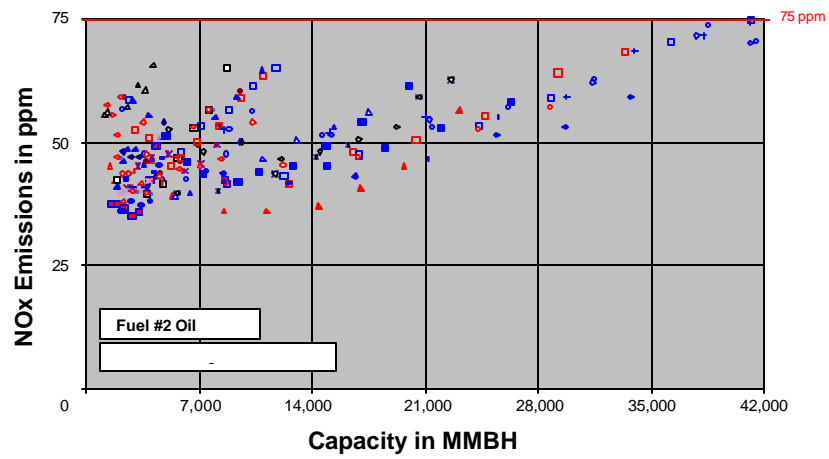
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### multiflam® Gas



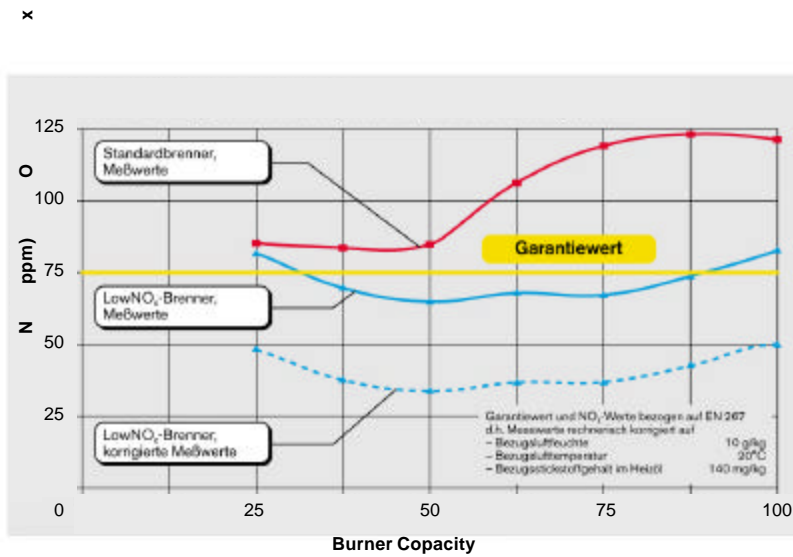
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### multiflam® Oil



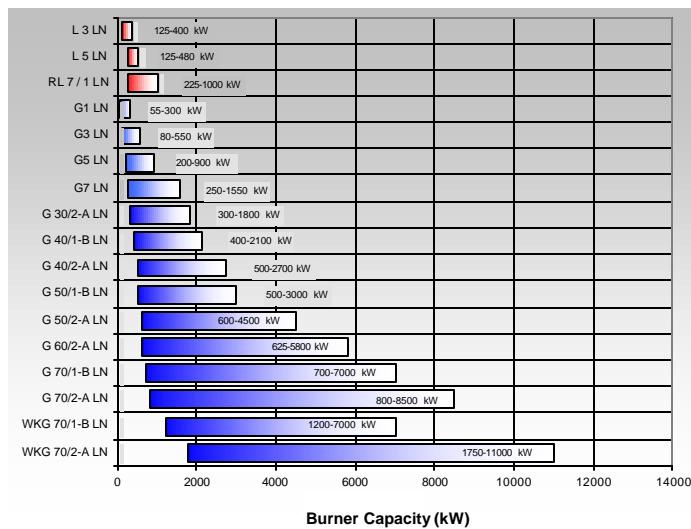
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## Low NOx Oil Burner vs. Standard Burner

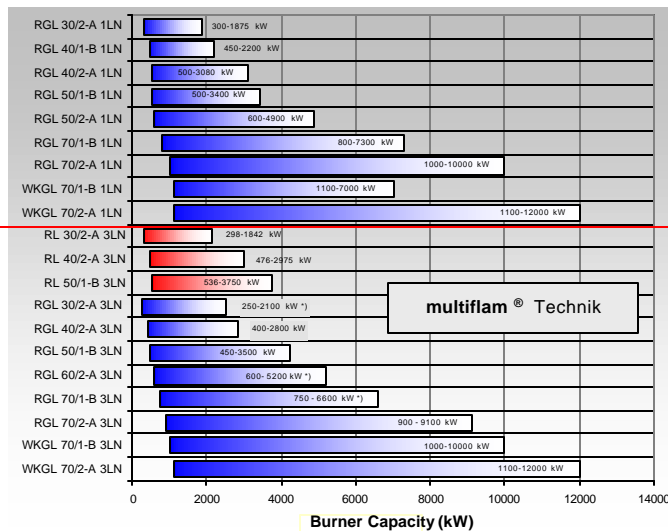


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## Low NOx Burner Models



## Low NOx Burner Models



## No Compromise Low NOx Technologies

Weishaupt Low NOx Burners provide:

- Reduced Operating & Maintenance
- Increase in Boiler Efficiency
- No Reduction in Turn-Down
- No Reduction in Output Capacity
- No Reduced Boiler Life
- NOx reduction with Gas, Oil and Dual Fuel-Burners

## Content

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## Case Study

- Process Steam Boiler
- Texas NOx Requirements < 30 PPM
- High maintenance costs
- NOx Levels > 35 PPM

### BEFORE:

- Efficiency (Average) 76.5%
- NOx 38 PPM
- CO > 100 PPM

### AFTER:

- Efficiency (Average) 82.5%
- NOx <25 PPM
- CO < 10 PPM
- Increased Turndown Ratio
- Reduced Electrical Consumption



## Boiler Efficiency

### Abstract:

A boiler operates for 8,000 hrs per year and consumes 500,000 MMBtu of natural gas while producing 45,000 lb/hr of 150 psig steam. Stack gas measurements indicate an excess air level of 44.9% with a net flue gas temperature of 400°F. From the table, the boiler combustion efficiency is 78.2% (E1) . Tuning the boiler reduces the excess air to 9.5% with a net flue gas temperature of 300°F. The boiler combustion efficiency increases to 83.1% (E2) Assuming a steam value of \$4.50/MMBtu, the annual cost savings are:

***Cost Savings = Fuel Consumption X (1 – E1/E2) X steam cost =  
29,482 MMBtu/yr X \$4.50/ MMBtu = \$132,671.00 US annually.***

Source: U.S. Department of Energy

## Unilux



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### Boilersmith



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### Dominion Bridge Retrofit





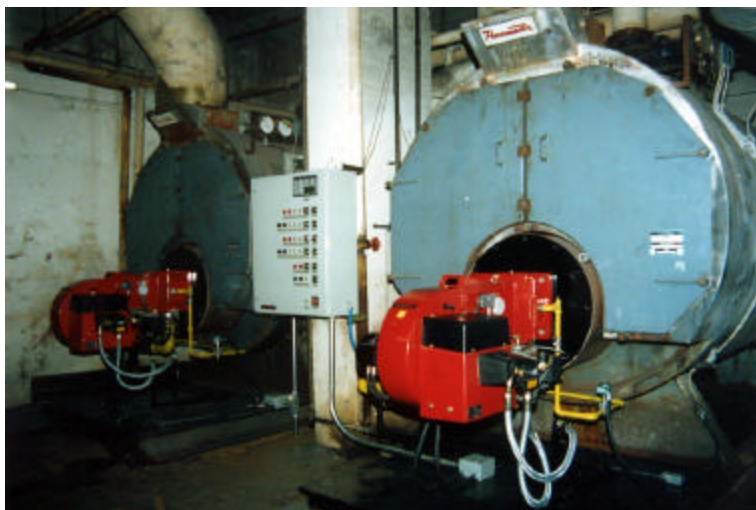
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### Rimouski – Before and After



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### Powermaster Retrofit





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### Cleaver Brooks Retrofit



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### Weishaupt Canada

#### Weishaupt Corp.

6280 Danville Road

Mississauga, On L5T 2H7

Phone: (905) 564 0946

[sales@weishaupt-corp.com](mailto:sales@weishaupt-corp.com)



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