Why Oxy/Fuel?

A Superior Method of Firing

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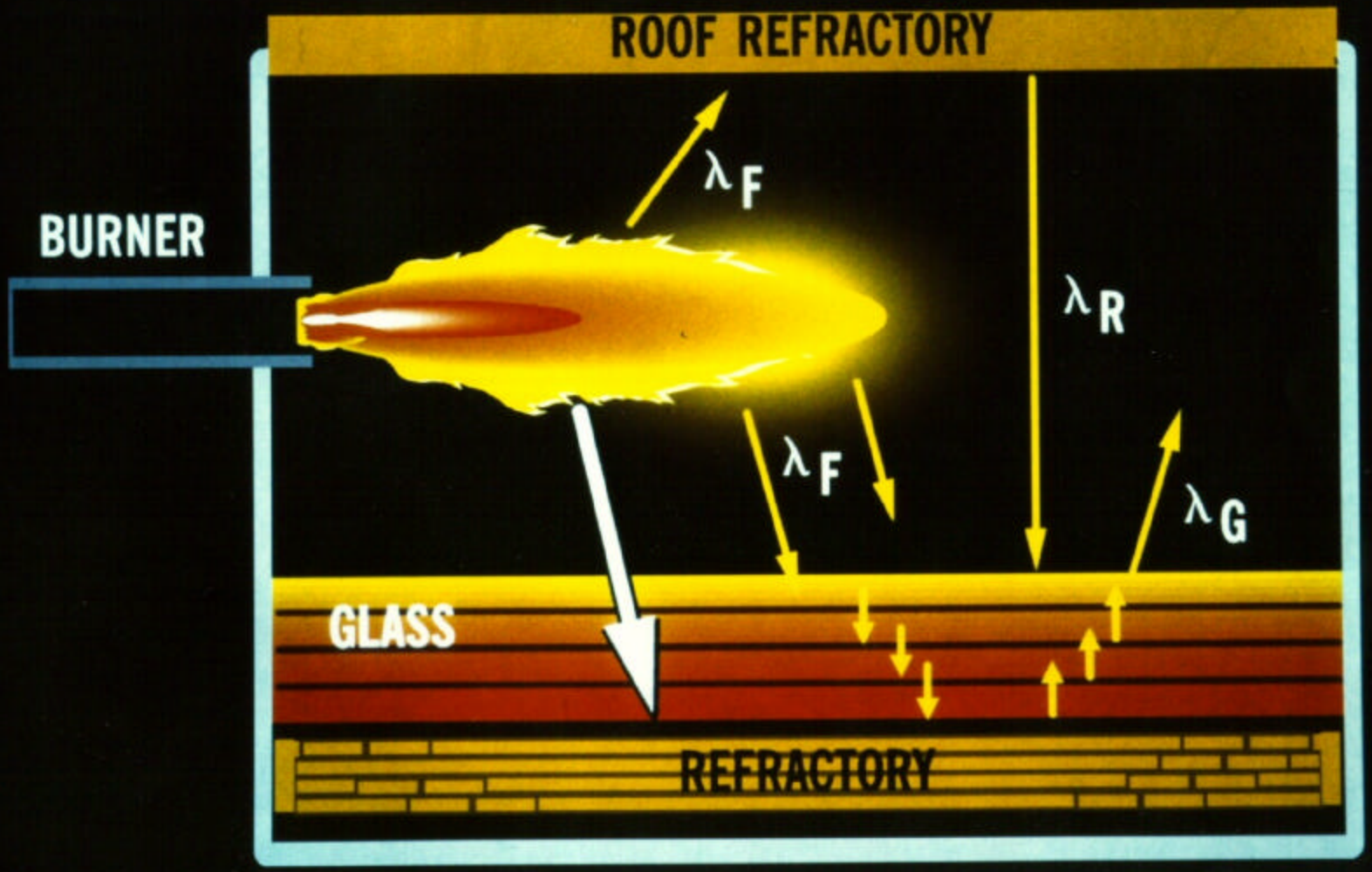
O_2/Methane Reaction

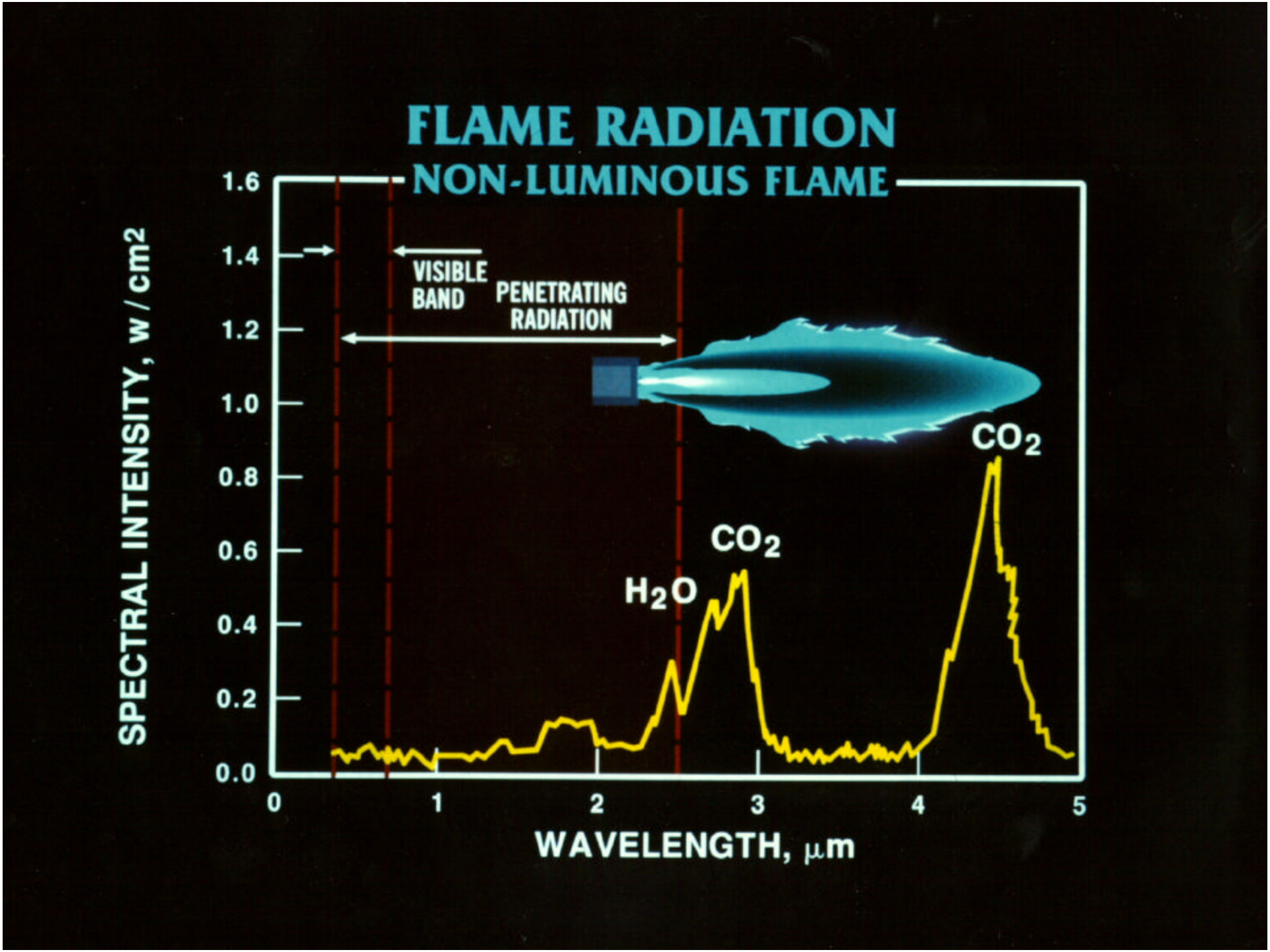
$$CH_4 + 2O_2 = CO_2 + 2H_2O + Heat$$

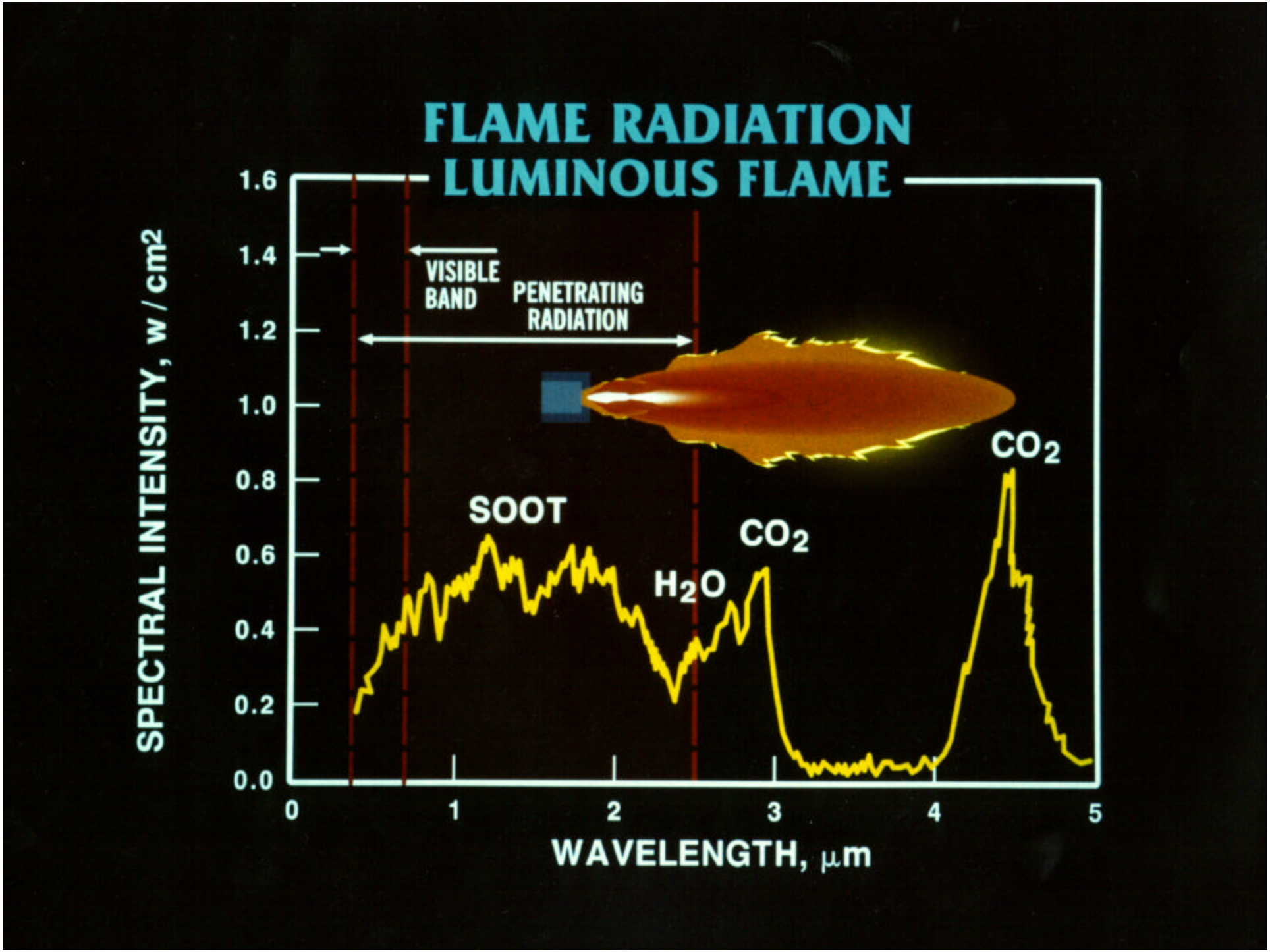
Air/Methane Reaction

$$CH_4 + 2O_2 + 8N_2 =$$
$$CO_2 + 2H_2O + 8N_2 + (1000\ BTU)$$

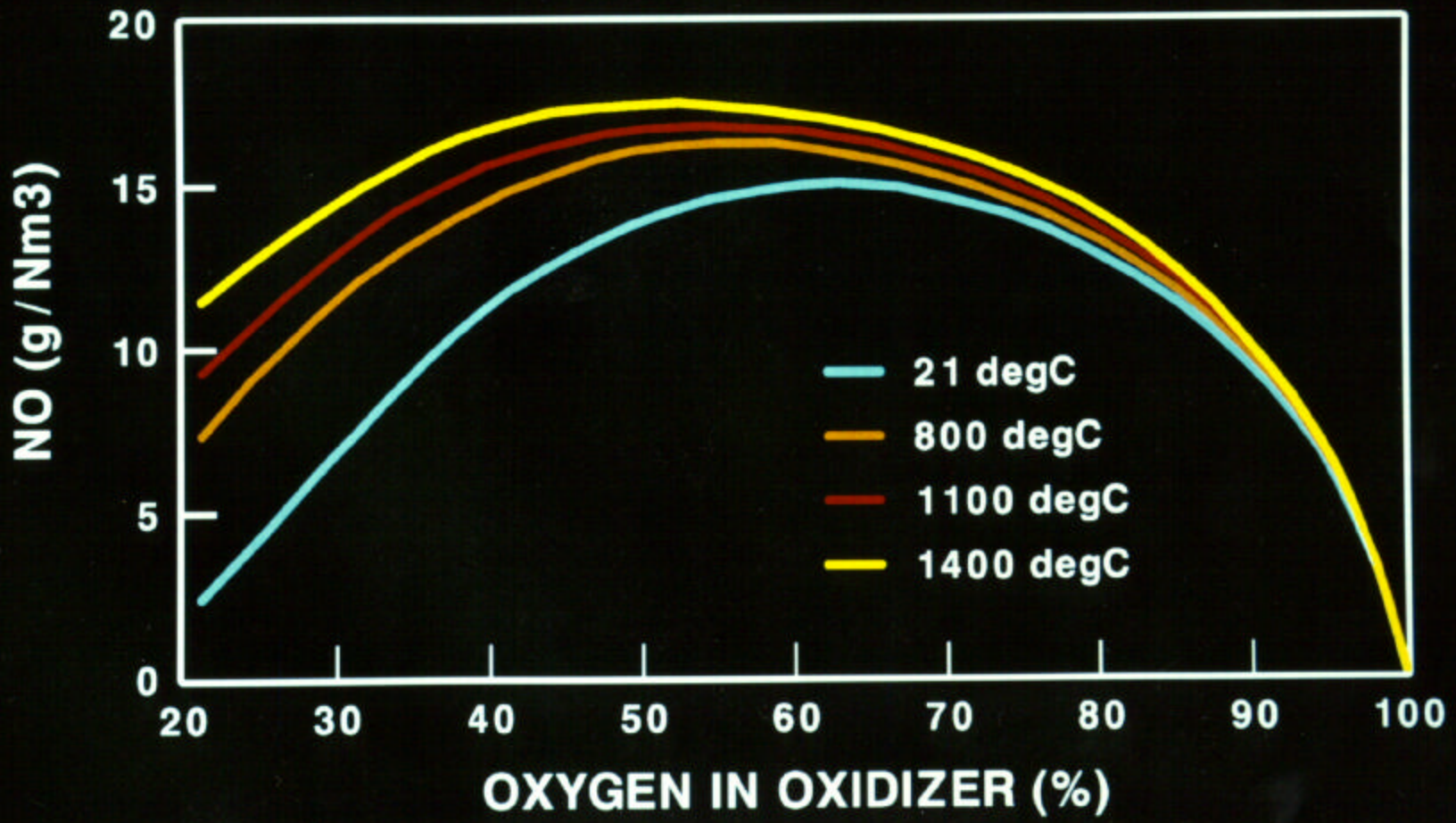
HEAT TRANSFER IN A TYPICAL FURNACE




FLAME RADIATION
NON-LUMINOUS FLAME
SPECTRAL INTENSITY, w / cm2
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
VISIBLE BAND
PENETRATING RADIATION
CO2
CO2
H2O
0
1
2
3
4
5
WAVELENGTH, μm


FLAME RADIATION
LUMINOUS FLAME
SPECTRAL INTENSITY, w / cm2
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
VISIBLE BAND
PENETRATING RADIATION
SOOT
H2O
CO2
CO2
0
1
2
3
4
5
WAVELENGTH, μm

ADIABATIC EQUILIBRIUM NO
CH4 W/AIR PREHEAT



FUEL CONSUMPTION VS. OXYGEN

Unit Melter and Air Heat Recovery Cases

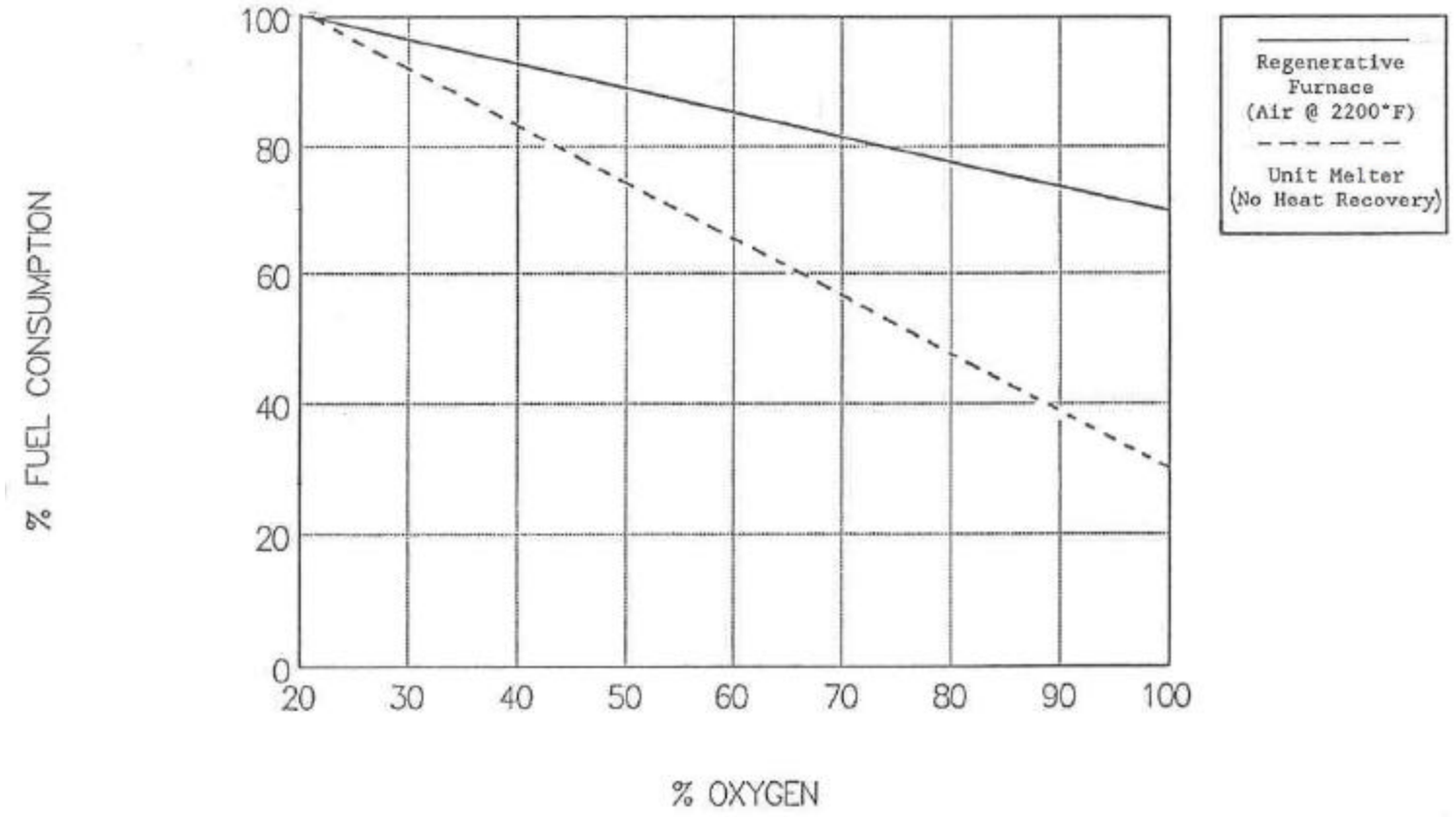
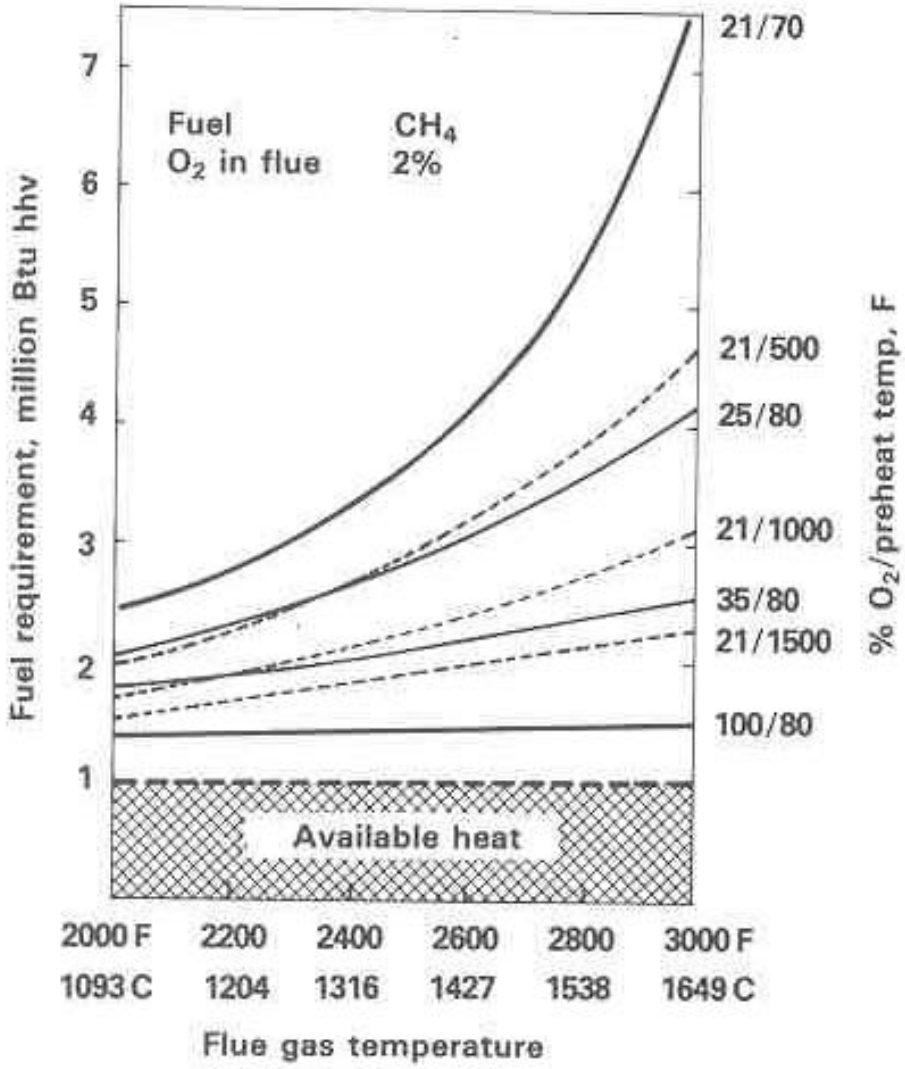


Figure 13.15. Fuel requirement to provide 1 000 000 Btu of available heat.



Tri-Atomic Atmosphere Transfers Heat Better Than Di-Atomic

Environmental Concerns Facing Industry

- Emissions
- Permitting
- Repeatability of Reporting

Air-Fired Environmental Results

- High NO_x
- High Firing Rates
- High Fuel Consumption
- Problems with Repeatability

Oxy-Fired Environmental Results

- Low NO_x
- Lower Firing Rates
- Lower Fuel Consumption
- Stable Repeatability

Exhaust Differences

Oxy/Fuel Produces Less Volume

Examples

Exhaust Volumes @ 1 Million BTU/HR

Air/Gas - - 11,000 CU.FT. Produced

Examples

Exhaust Volumes @ 1 Million BTU/HR

Oxy/Gas - - 3000 CU.FT. Produced

Exhaust Breakdown

Air/Gas

CO_2 - - - 8% - - - 880 CU. FT. Produced

H_2O - - - 16% - - 1760 CU. FT. Produced

NO_x - - - 75% - - 8250 CU. FT. Produced

Exhaust Breakdown

Oxy/Gas

CO_2 - - - 30% - - - 900 CU. FT. Produced

H_2O - - - 66% - - - 1980 CU. FT. Produced

NO_x - - 3% - - - 90 CU. FT. Produced

99% LESS !

Advantages of Less Exhaust

- Smaller Exhaust System
- Less Capital
- Less Cost in Post Cleaning (if Necessary)

Why Oxy/Fuel Summary

- Faster Heat Up
- High Luminosity Generated from Flame
- Tri-Atomic Atmosphere
- Higher Heat Transfer
- Highest Level of Radiation Available
- Low NO_x
- Reduced Exhaust Volumes

Primefire® Series
Oxy-Fuel Burners

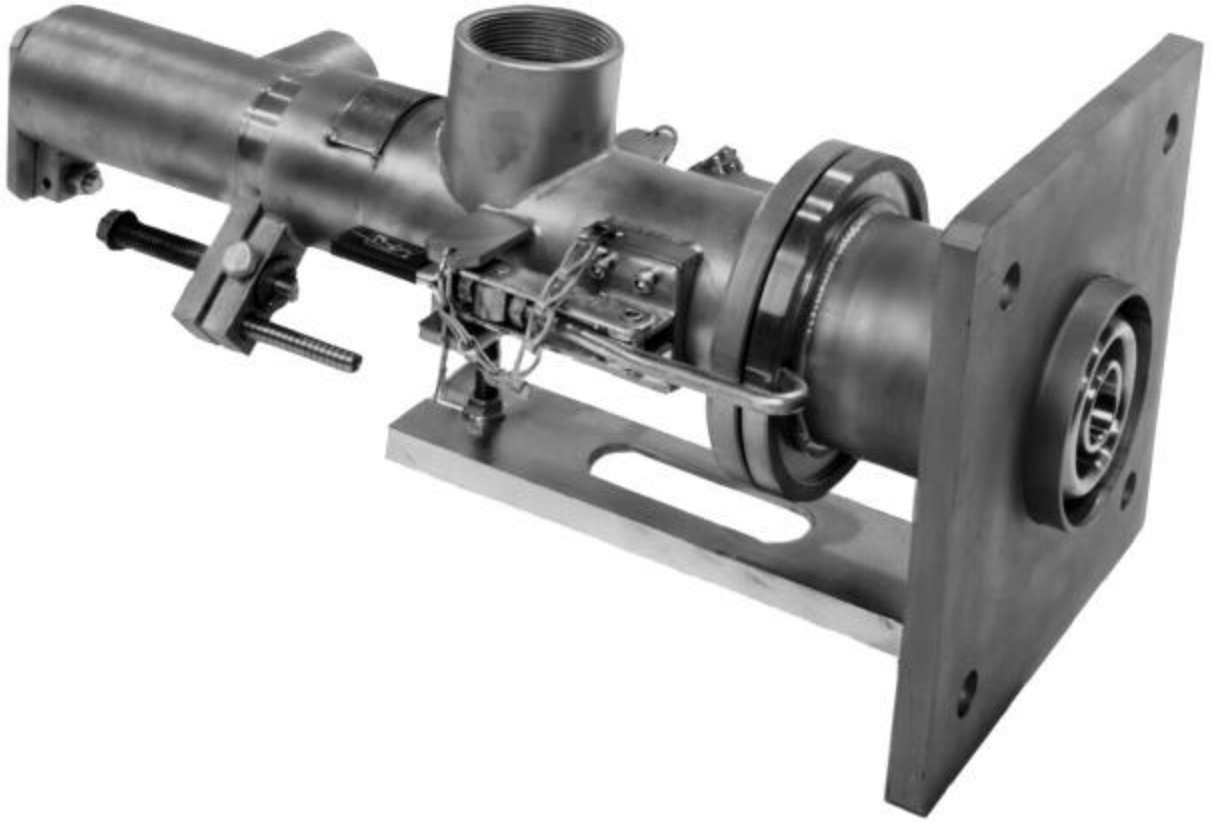
Primefire® 100 Series Burners

- Produces a conventional shape flame
- Currently in use in 50 furnaces worldwide

Primefire® 100 Series Burners

- Design Features
  - High flame luminosity
  - Adjustable flame shape
  - Adjustable flame momentum
  - Low emissions (NO_x and particulate)
  - Multi-fuel capabilities (natural gas and fuel oils)
  - No maintenance design

Primefire® 100 Series
Oxygen-Gas Burner



Primefire® 100 Series Oxygen-Gas Burner

2-8 MM Btu/hr Capacity Burner

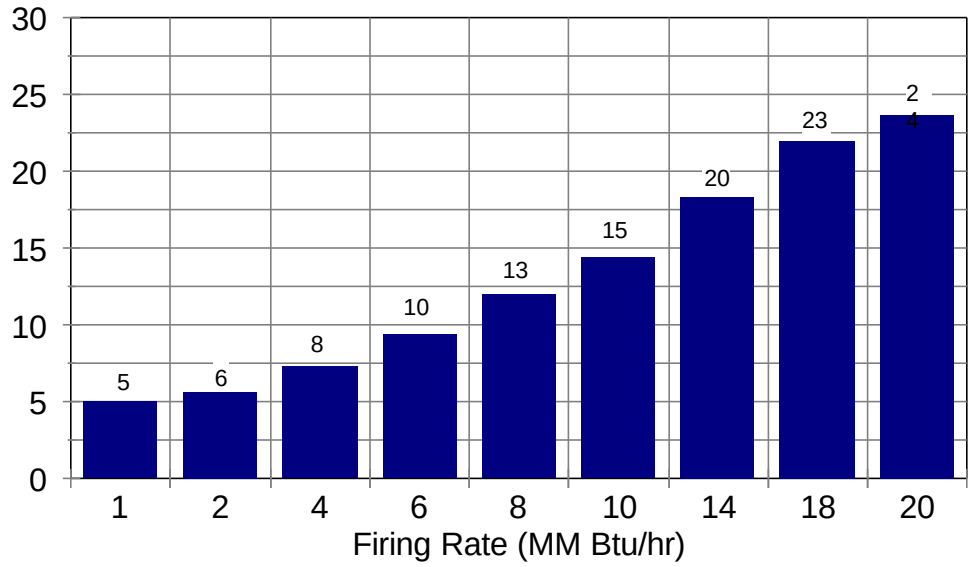
Primefire® 100 Series Burner Combustion Tec Lab Firing

Oxygen-Gas Firing at 3.5 MM Btu/hr

Primefire® 100 Oxy-Gas Burners

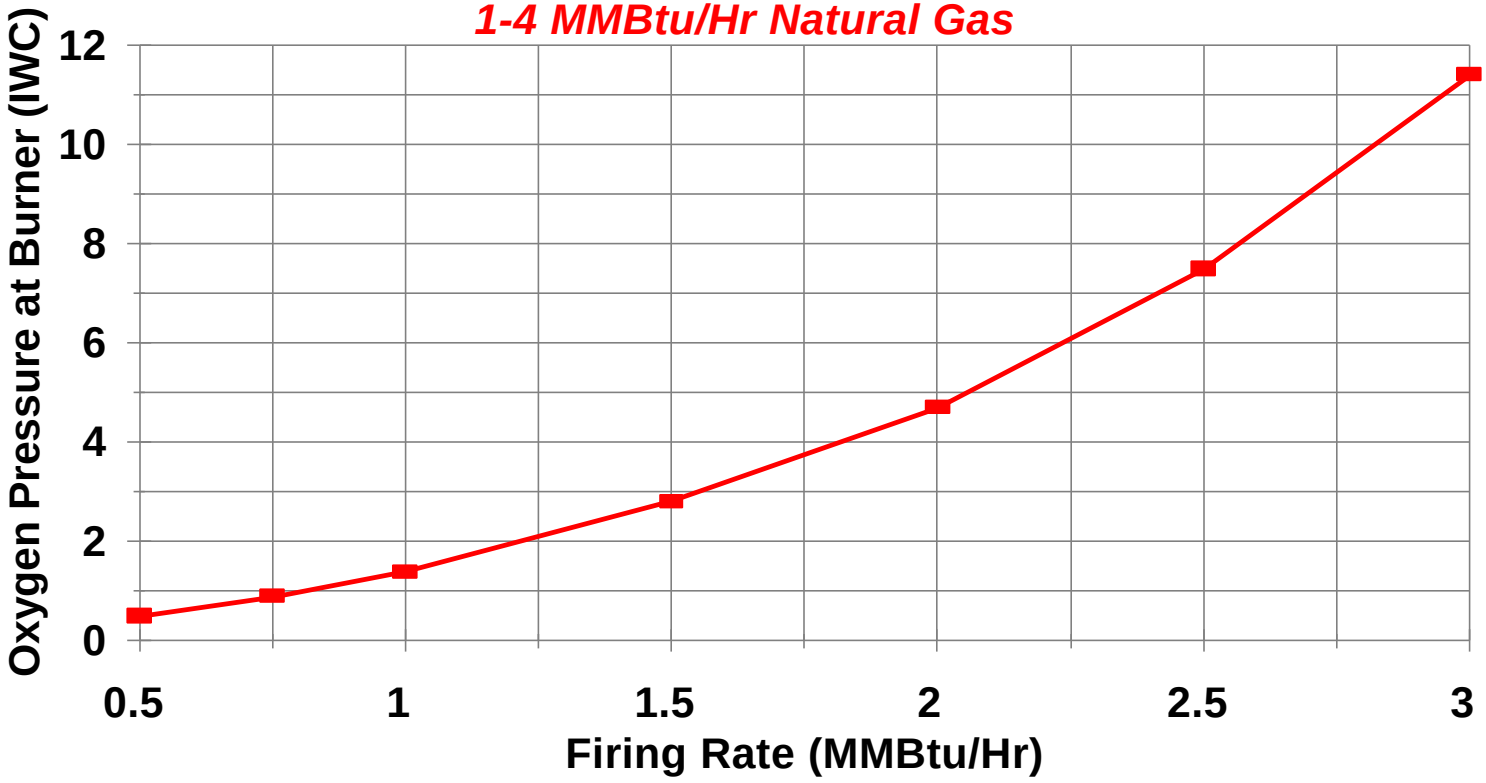
Visible Flame Length (feet)

Combustion Tec and Field Oxygen-Gas Firing Data
Various Burner Sizes and Tips



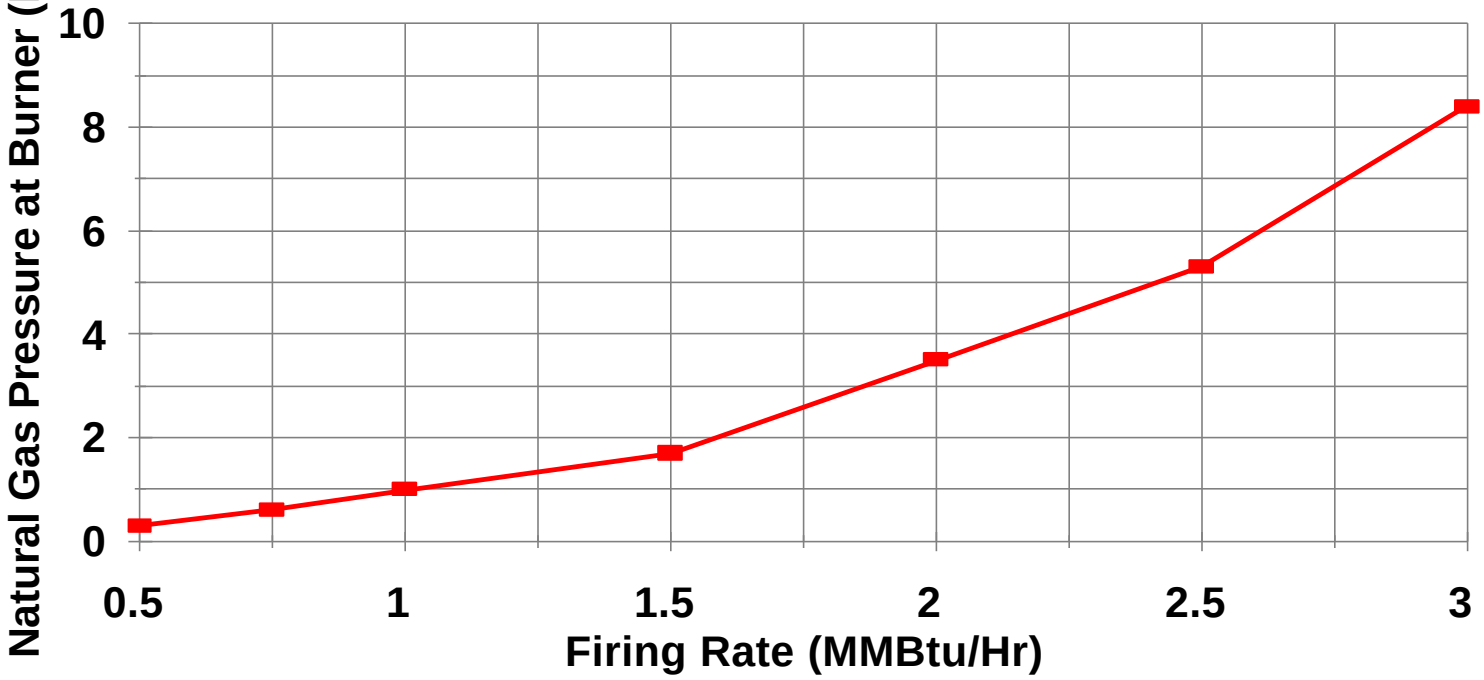
Oxy-Gas Primefire® 100 Burner

1-4 MMBtu/Hr Natural Gas



Oxy-Gas Primefire® 100 Burner

1-4 MMBtu/Hr Natural Gas

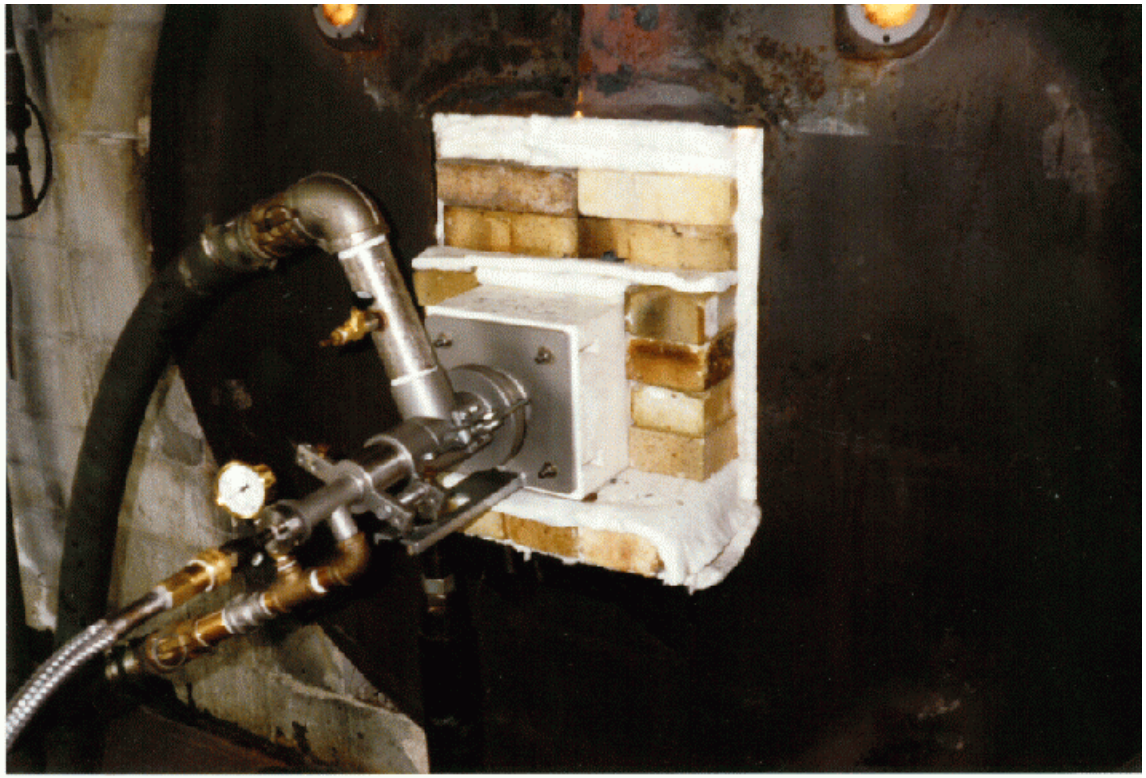


Primefire® 100 Series Oxygen-Oil Burners

- Dual fuel design
- Variable momentum
- Variable flame
- Better heat distribution than higher velocity burners

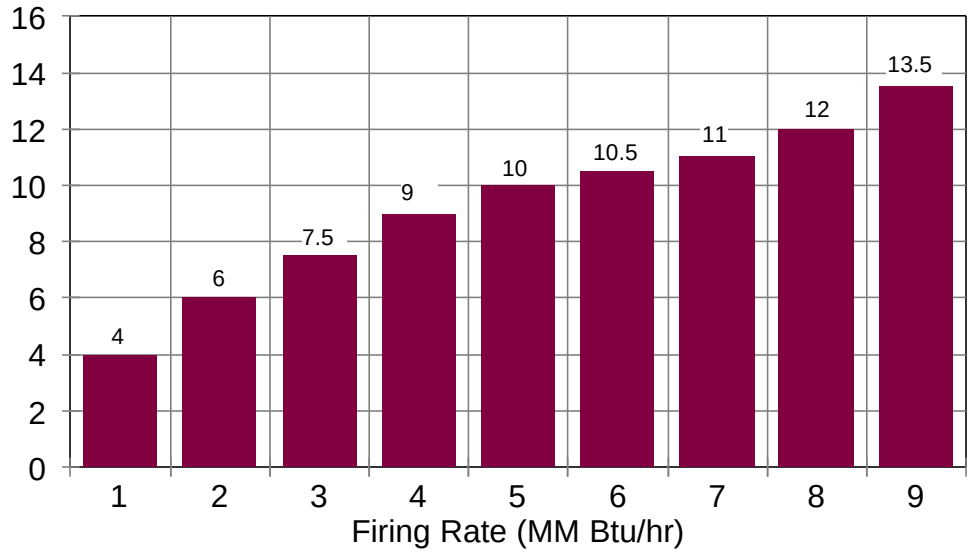
Primefire® 100 Series Oxygen-Oil Burners

2-8 MM Btu/hr capacity burner



Primefire® 100 Series Oxygen-Oil Burners

Visible Flame Length (feet)
Combustion Tec and Field Oxygen-Oil Firing Data
Various Burner Sizes and Tips



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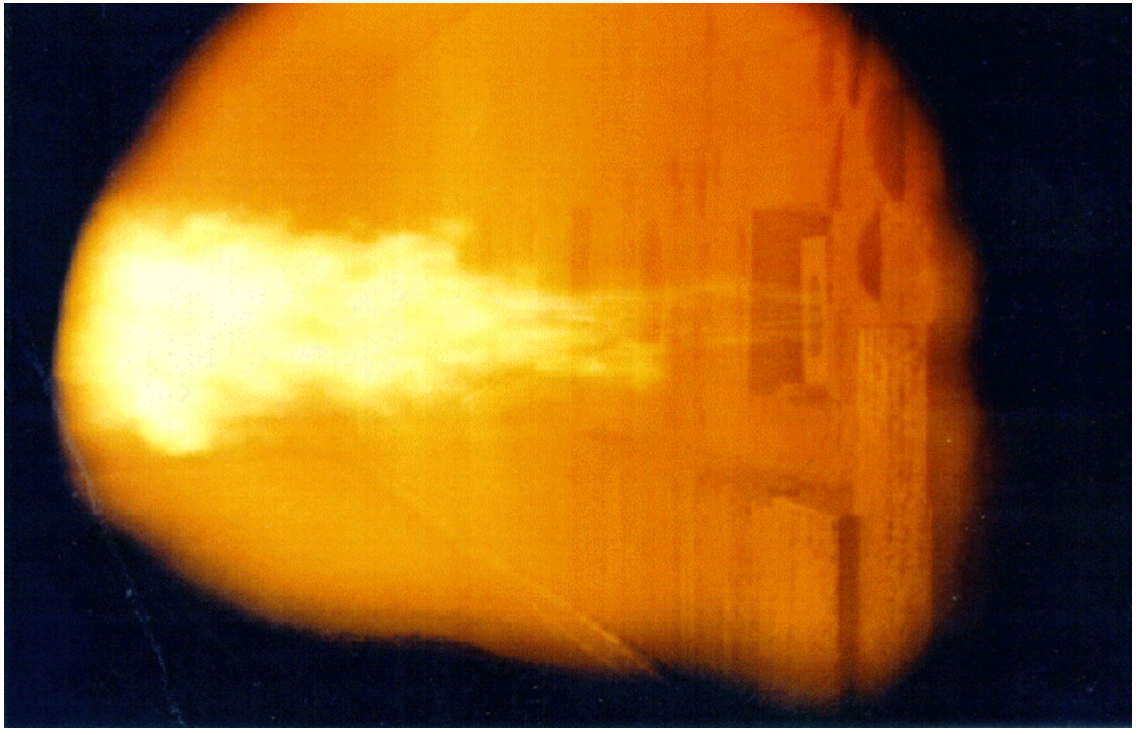
Primefire® 100 Series Oxygen-Oil Burner

Oxygen-Oil Firing at 3 MM Btu/hr

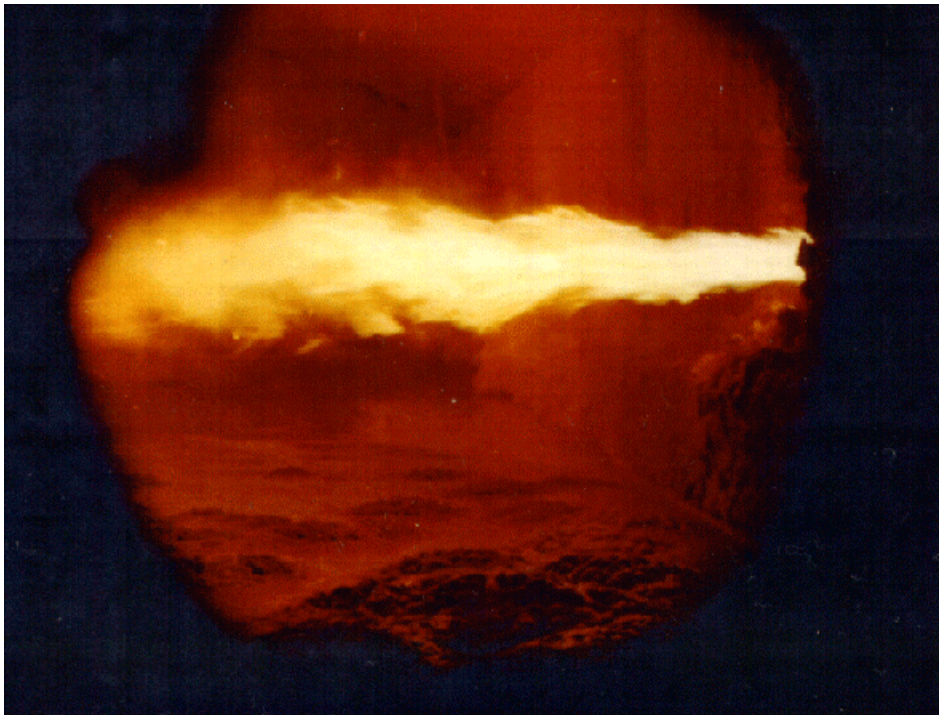
Primefire® 100 Series Oxygen-Gas Burner

Firing in a Fiberglass Furnace



Primefire® 100 Series Oxygen-Oil Burner

Firing in a Fiberglass Furnace



Primefire® 300 Series Burners

- New generation oxy-fuel burners
- Produce fish-tail or fan-shaped flame
- Flat flame by momentum shaping
- Higher luminosity than round-flame oxygen-fuel burners

Primefire® 300 Series Burners

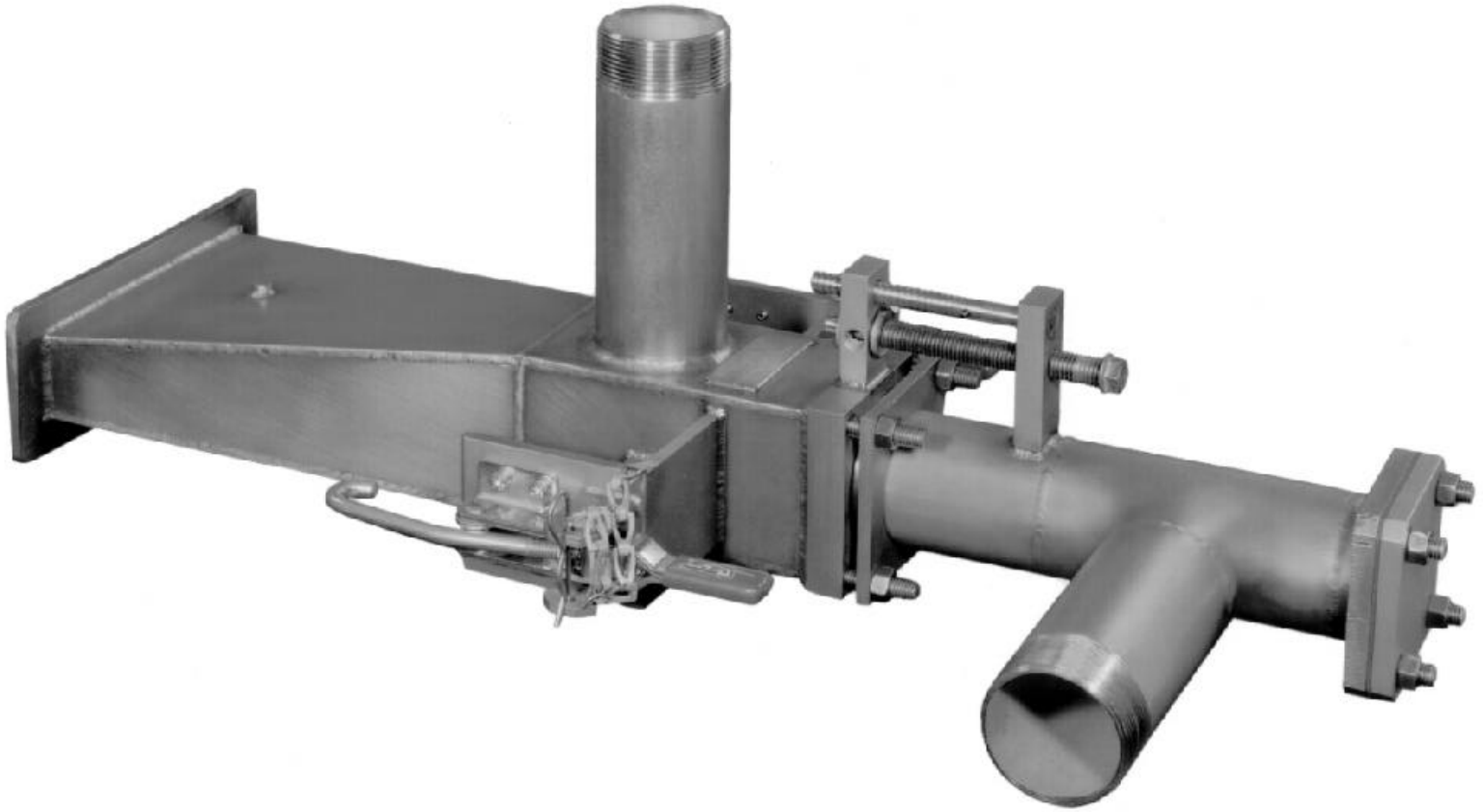
- Wider and longer flame than round-flame oxygen burners
- Increased flame radiation
- Adjustable flame shape

Primefire® 300 Series Burner Design

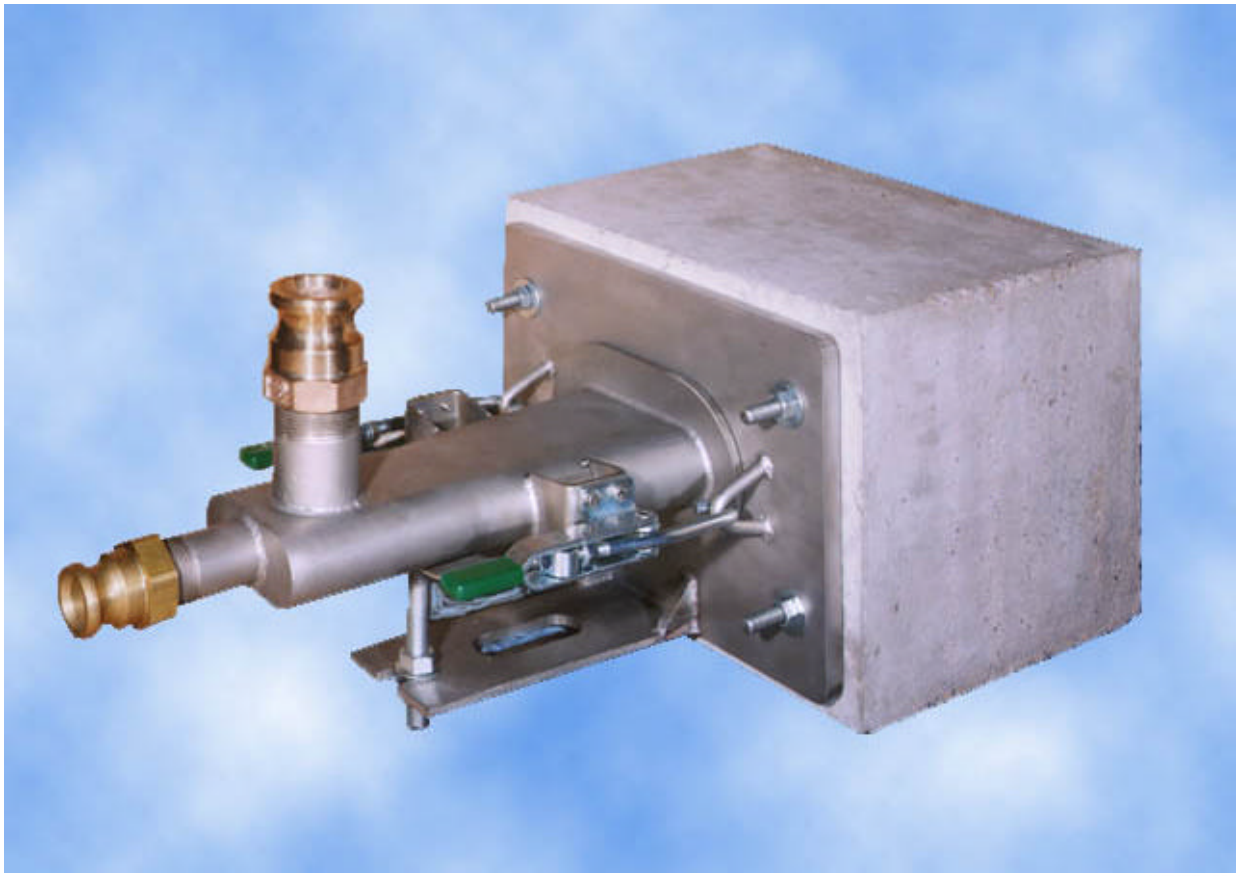
Flat Flame by Momentum Shaping

- Flat flame is generated by streamwise conditioning of both fuel and oxygen in a converging and diverging burner body
- Patented precombustor creates a very luminous and low momentum flame

Primefire® 300 Series Burners



Primefire® 300 Series Oxygen-Gas Burner

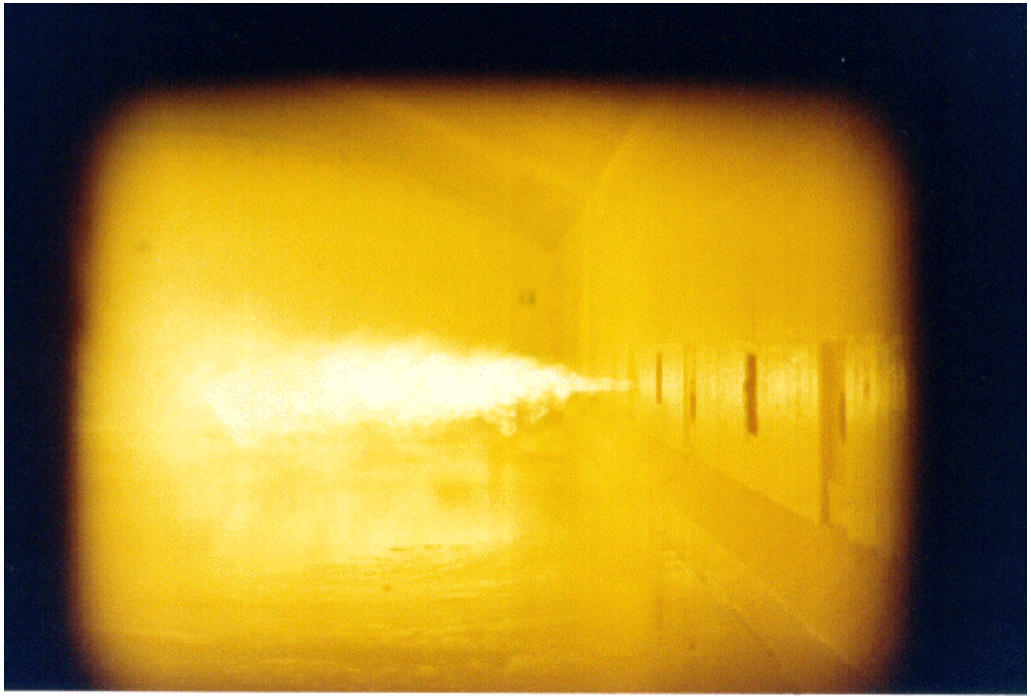


Primefire® 300 Series Oxygen-Gas Burner

Oxygen-Gas Firing at 3.5 MM Btu/hr

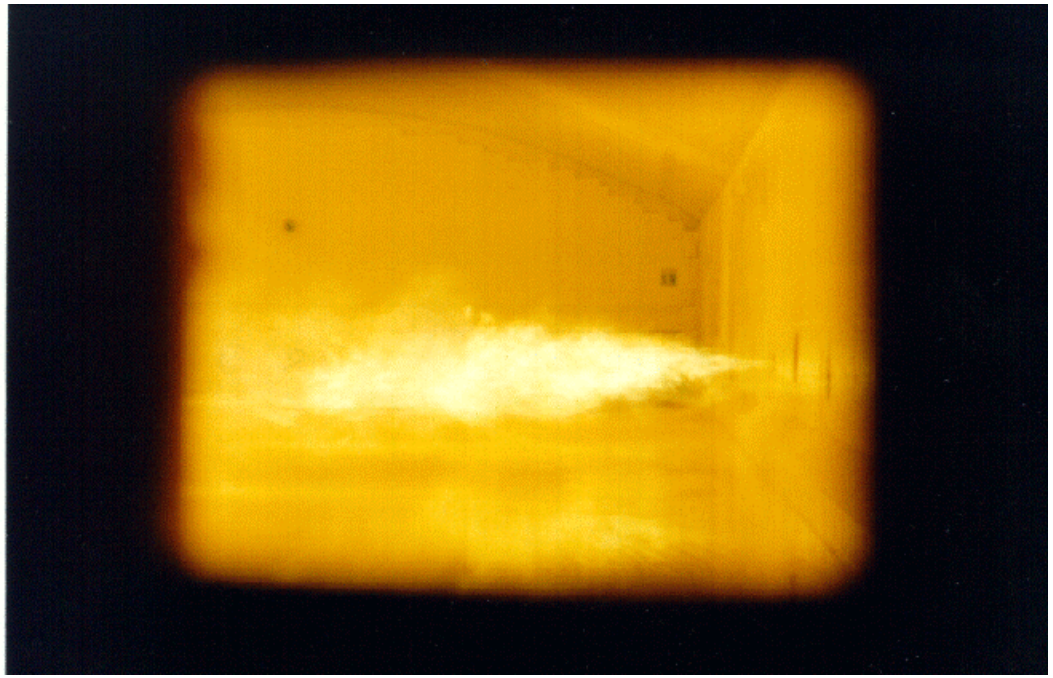
Primefire® 300 Series Oxygen-Gas Burner

Oxygen-Gas Firing at 3.6 MM Btu/hr



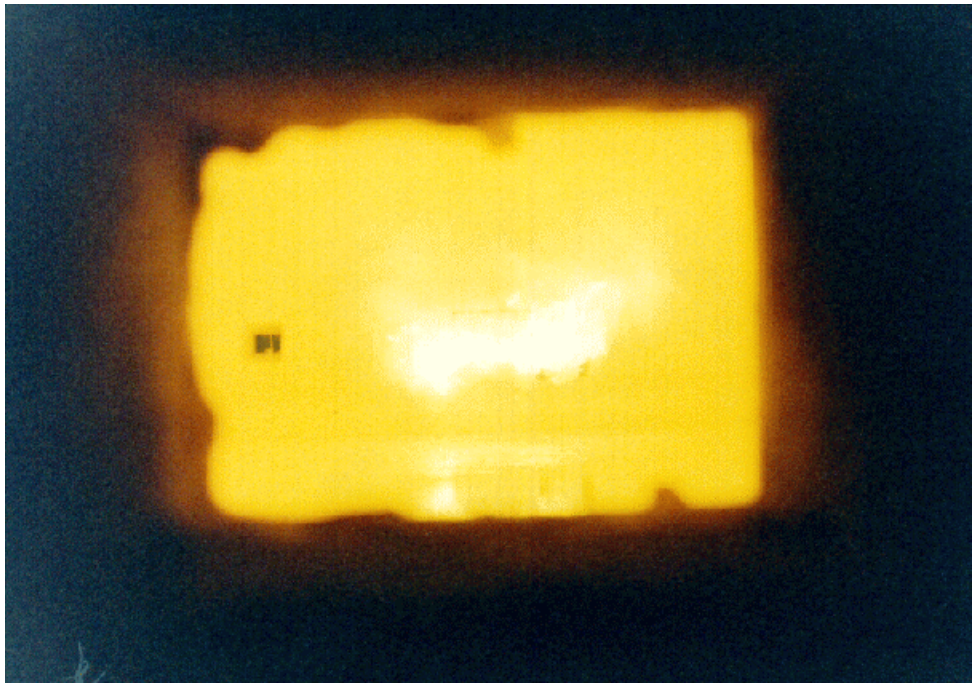
Primefire® 300 Series Oxygen-Gas Burner

Oxygen-Gas Firing at 4.6 MM Btu/hr



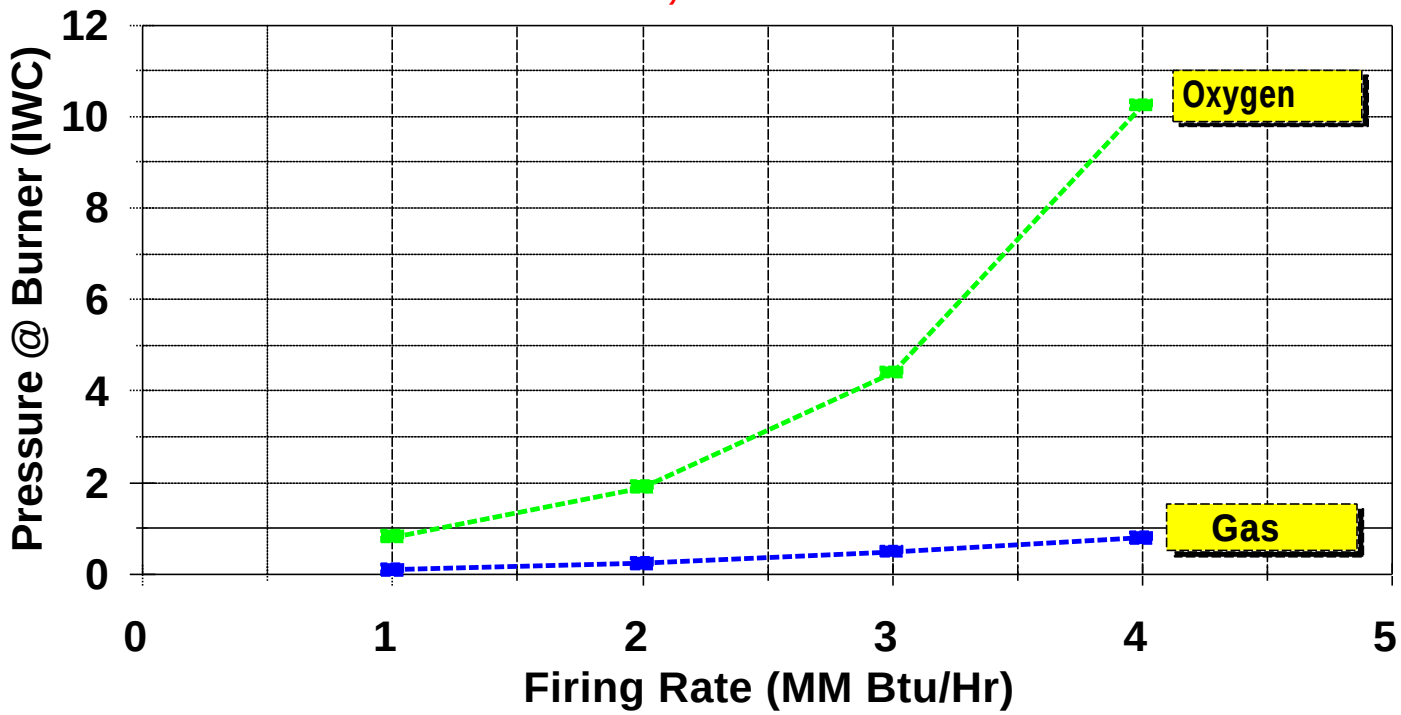
Primefire® 300 Series Oxygen-Gas Burner Field Trial

Oxygen-Gas Firing at 8.0 MM Btu/hr



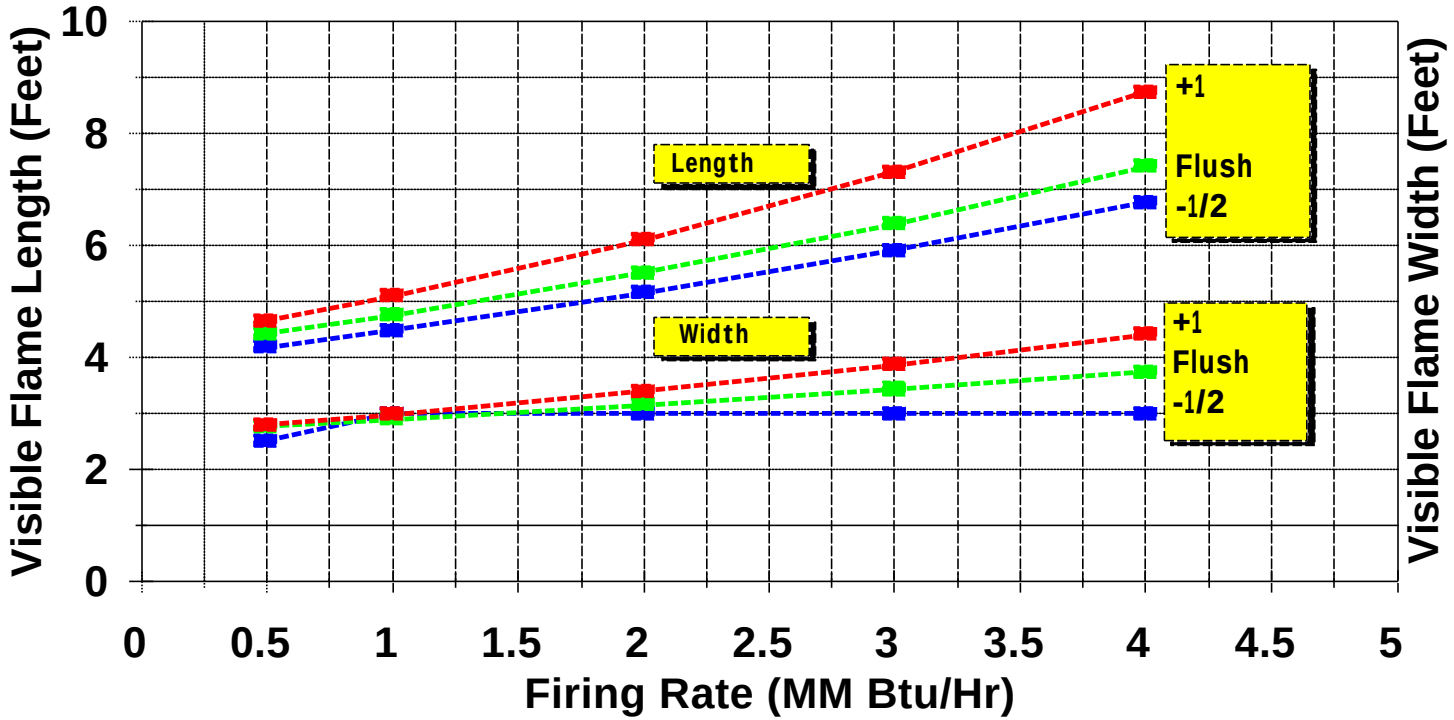
Primefire® 300 Series Oxygen-Gas

0.75 to 3.00 MM; 2" O2 & 2" Gas Inlets



Primefire® 300 Oxygen-Gas

0.75-3.00 MM; Unsealed Lab Firing



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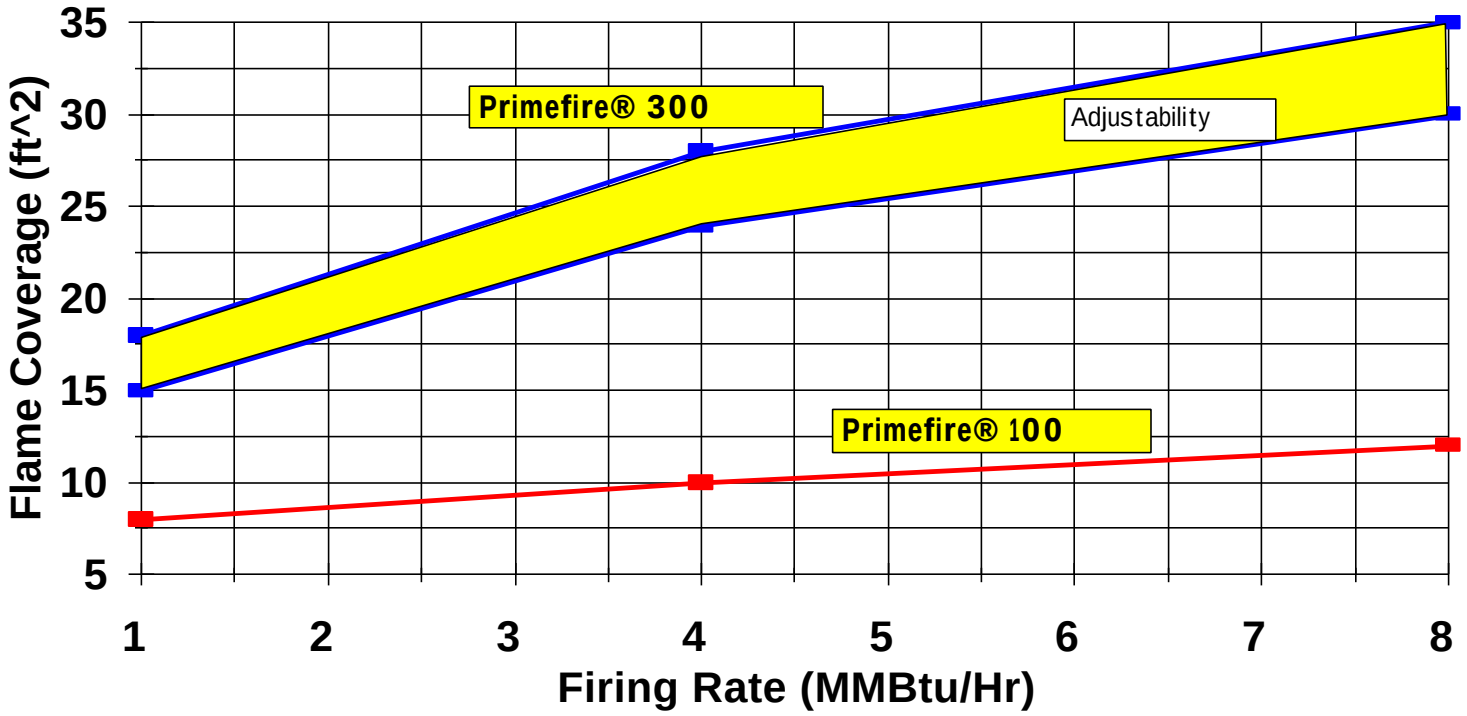
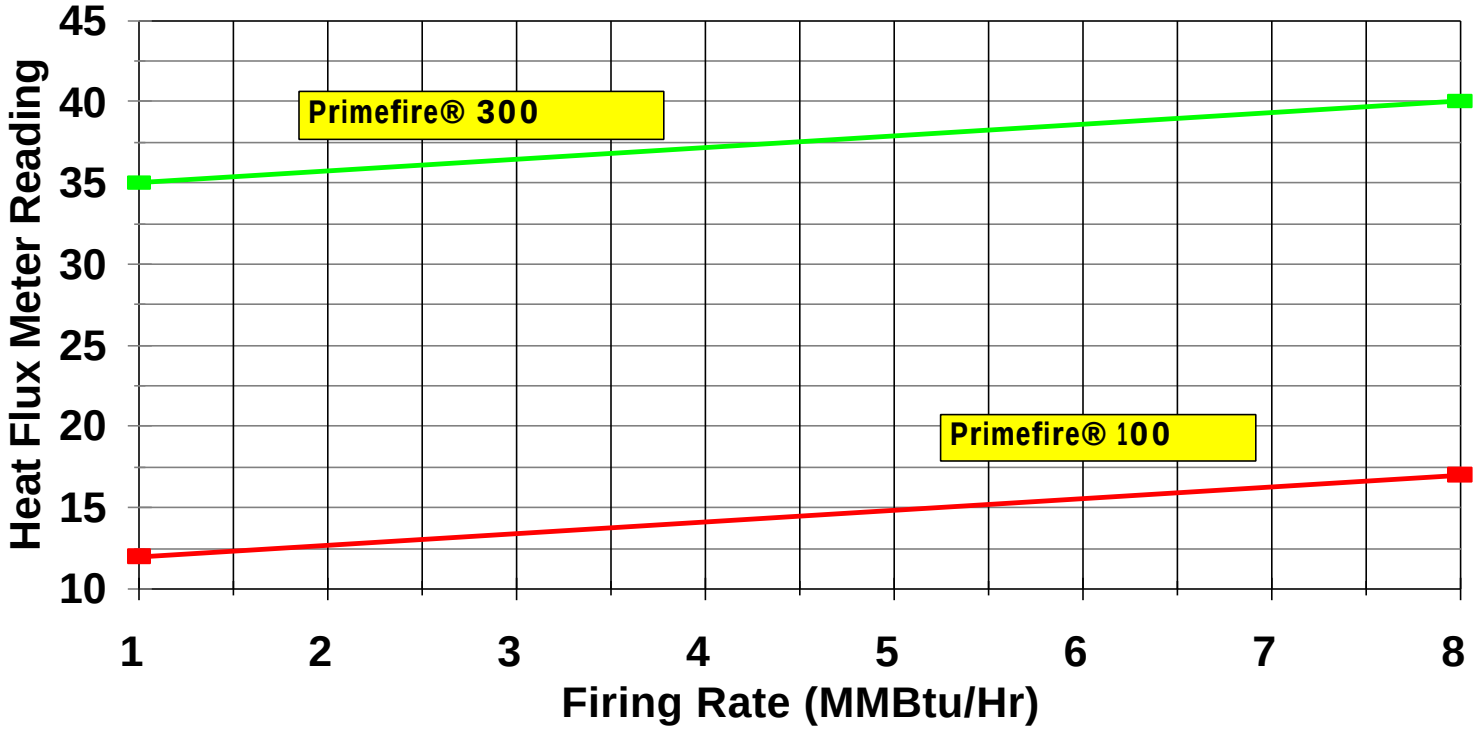
2-8 MMBtu/Hr Primefire® 300 Oxy-Gas

Flame Coverage



2-8 MMBtu/Hr Primefire® 300 Oxy-Gas

Radiation Measurements



Primefire® 300 Series Burner Summary

- Gas and oil firing capabilities
- Lower flame momentum
- Adjustable flame shape
- Lower peak flame temperatures
- Higher flame radiation
- Lower fuel and oxygen pressures
- Enhanced flame coverage
- Minimum maintenance

Primefire® 300 Series Burner Advantages

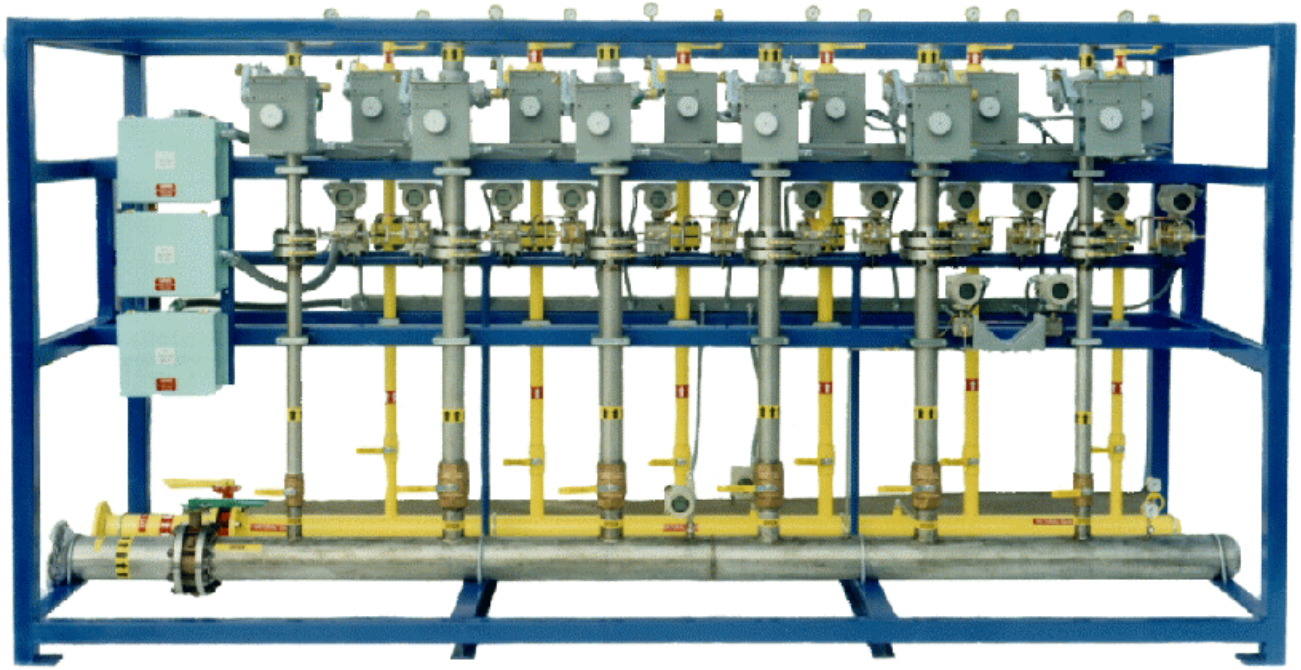
- Fuel savings due to increased radiation
- Lower oxygen consumption
- Higher flame radiation
- Lower crown temperatures
- Improved control
- Improved productivity

Oxygen and Gas Control Equipment

Oxygen Concerns

- Safety
- Supply
- Metering
- Control
- Training

Gas and Oxygen Metering and Flow Control Train

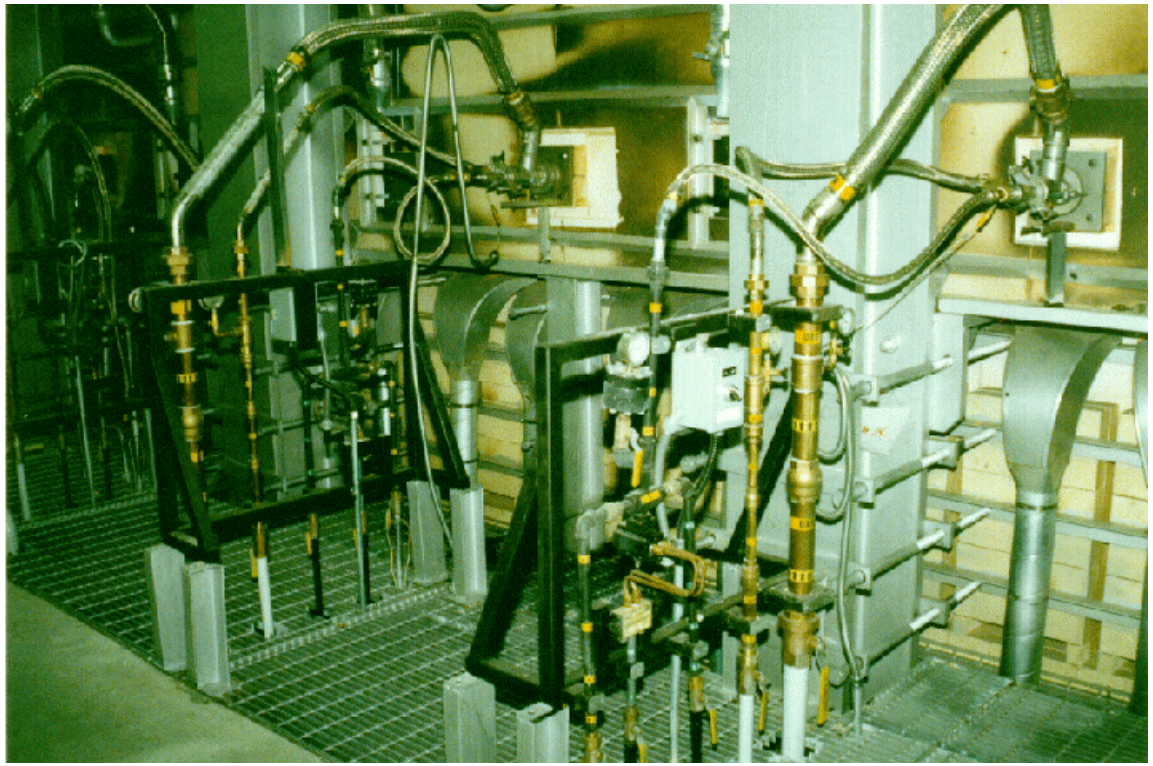


Main Gas Train

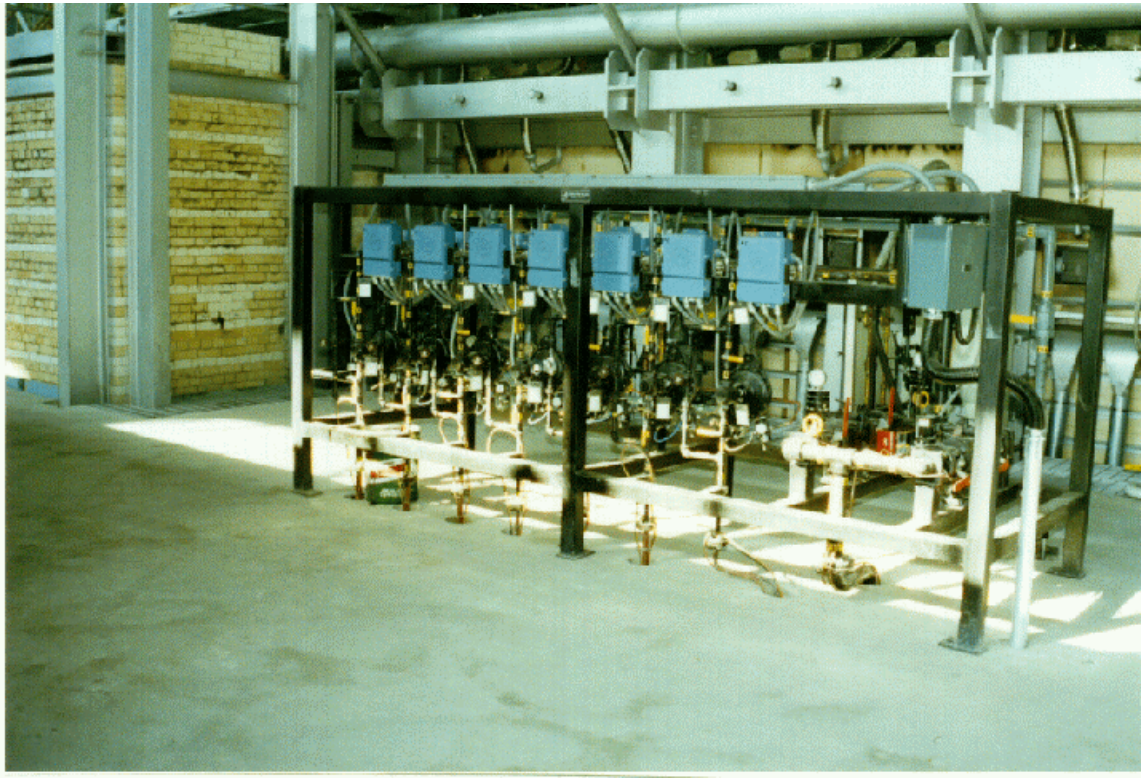
Main Oxygen and Natural Gas Safety Trains

Oxygen-Gas Boosting Train

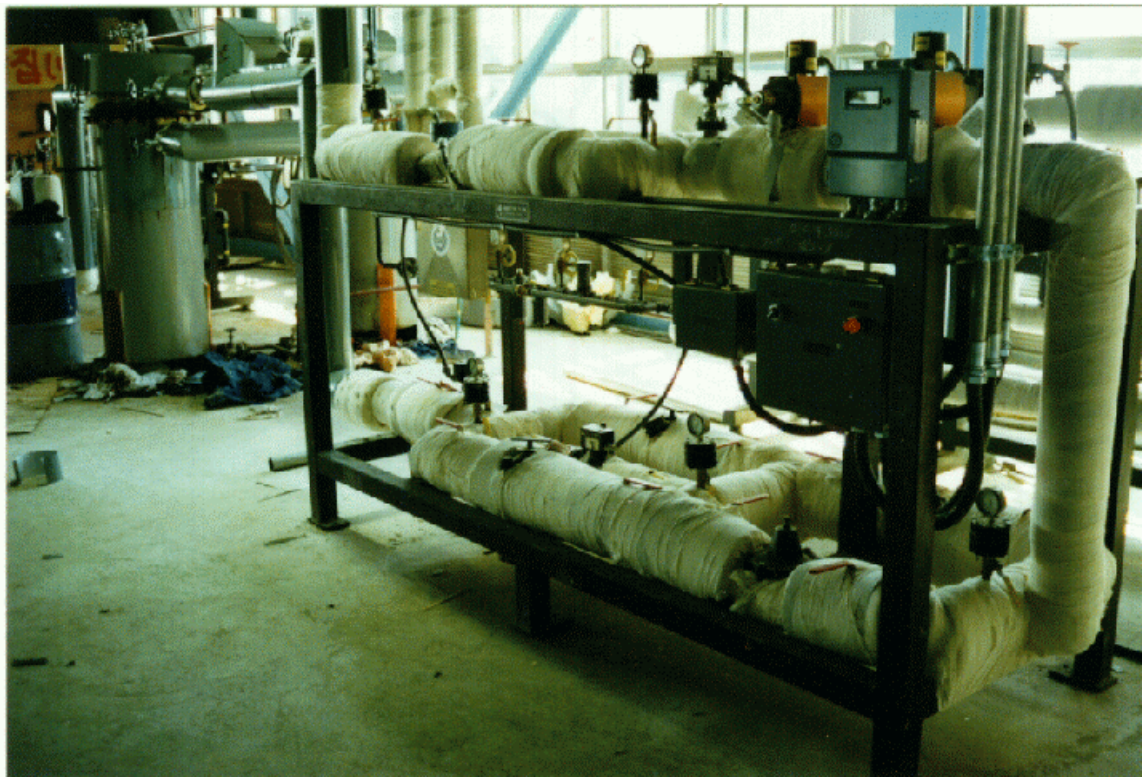
Primefire® 100 Series Oxygen-Oil Burners and Burner Accessory Panels



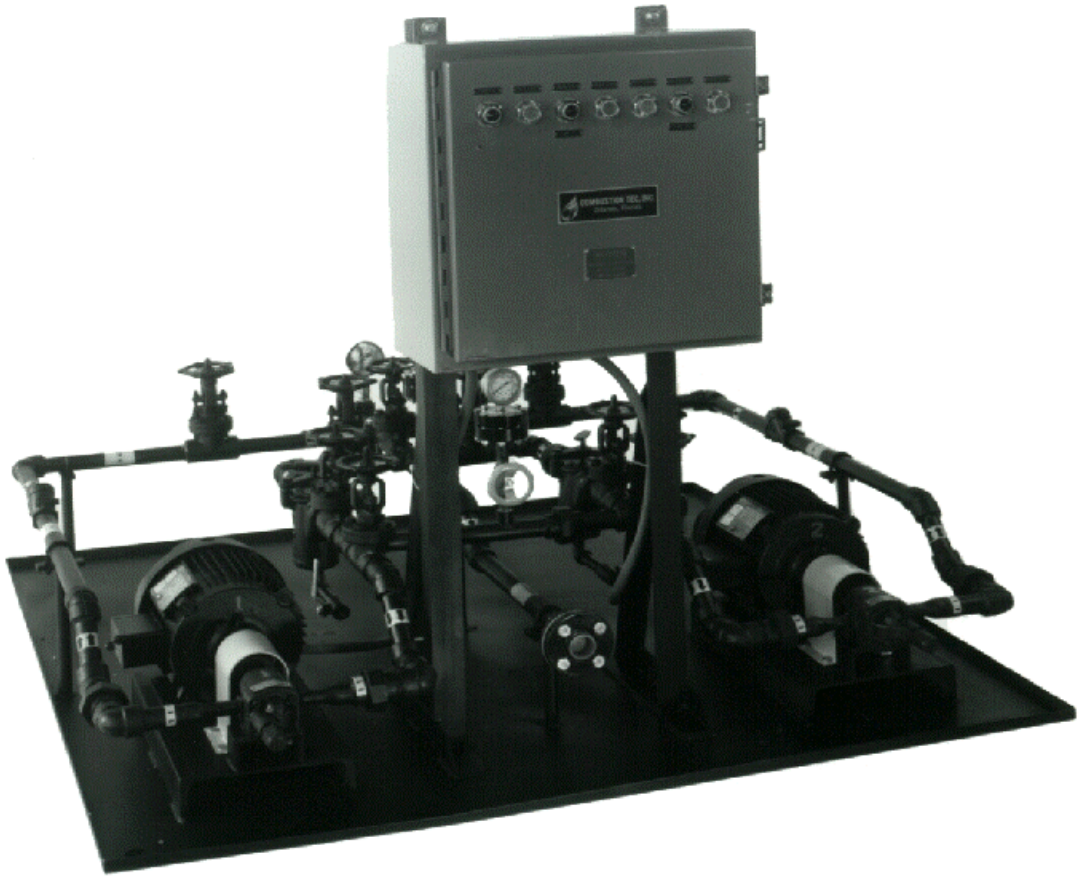
Metering Flow Controls Installation - Heavy Fuel Oil



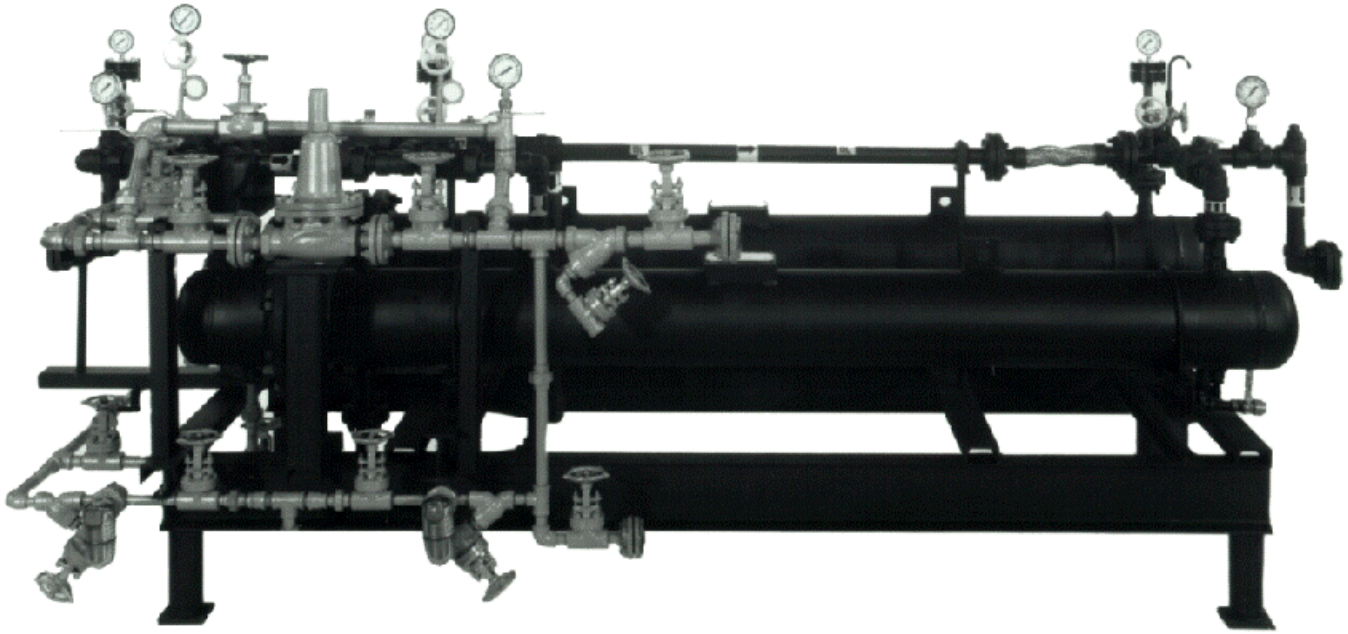
Heavy Fuel Oil Pipe Train



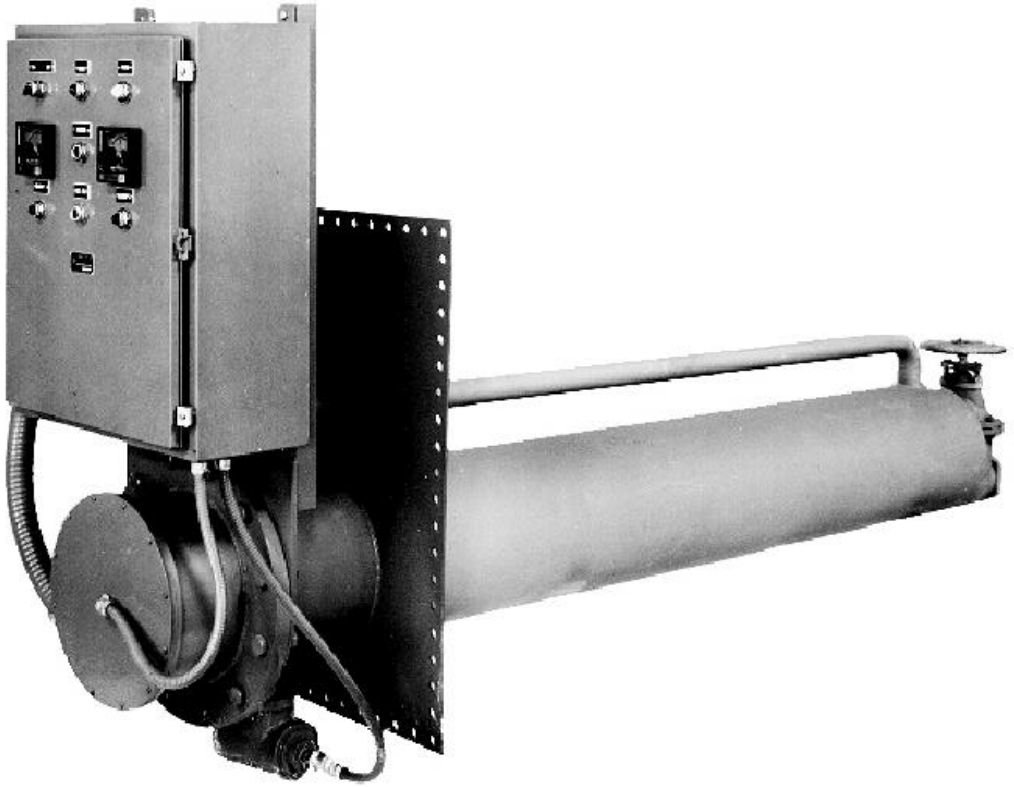
Circulating Pump Skid



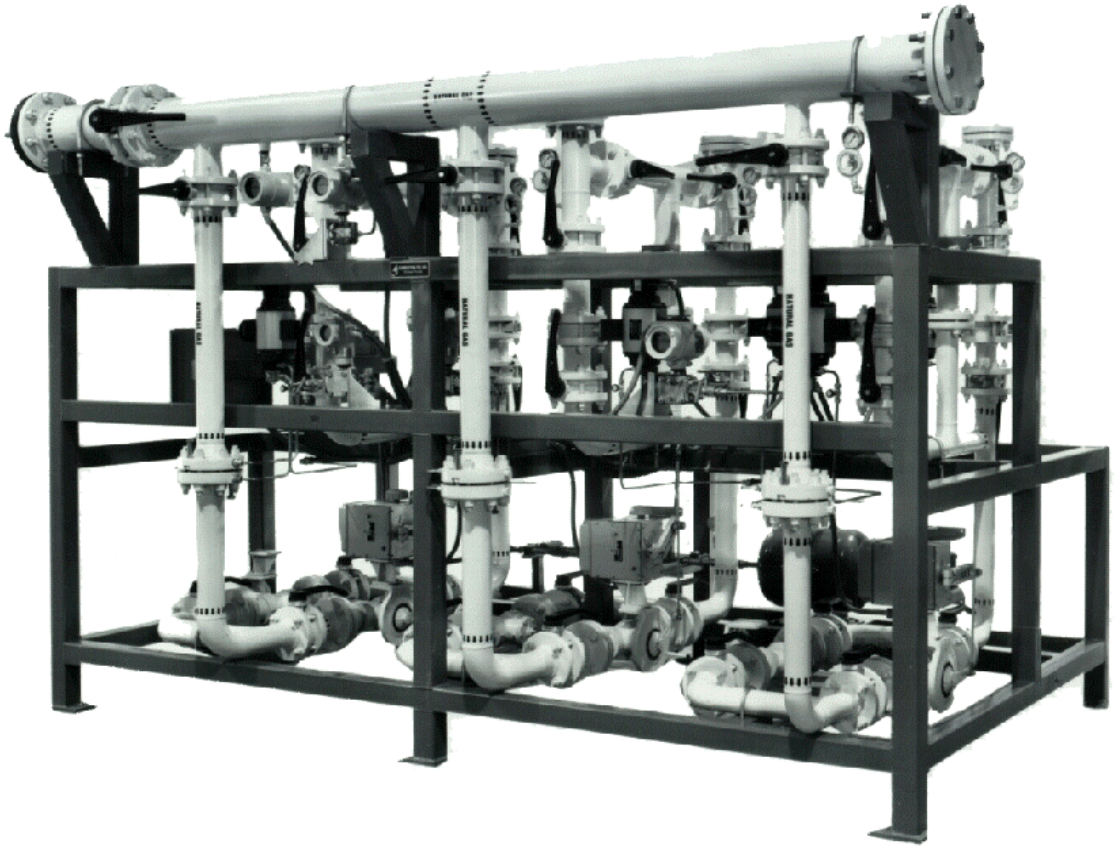
Steam Booster Heater



Oil Suction Heater - Heavy Oil Preheat System



Mixing Station



Main Instrumentation Control Station