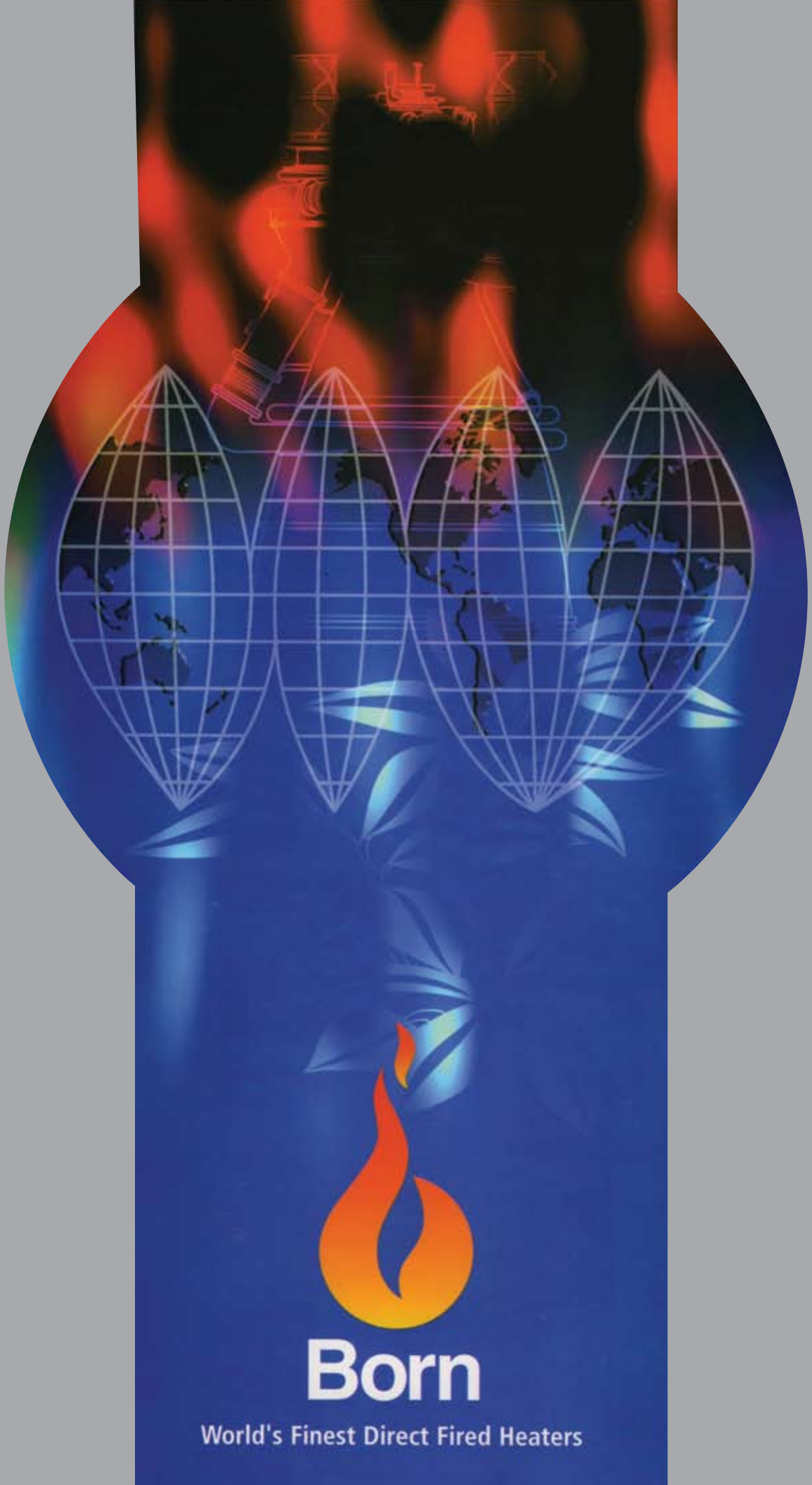

Born
World's Finest Direct Fired Heaters

B - BEST

O - ORIGINAL

R - RENOWN

N - NAME

-In Heaters-

# Comprehensive, Cost-Effective and Super-Efficient — The Born Range of Products and Services

## Specialist Furnaces

- Hydrocracking
- Steam Reforming
- Sulfur Recovery Units
- EDC Cracking Furnaces
- Platformer Heaters
- High Temperature Pyrolysis
- Ethylene Cracking Furnaces
- Waste Heat Recovery Units for Turbine Exhaust
- Steam Superheaters
- Vacuum Units
- MTBE Feedstock Reformers
- Ammonia Reformers
- Hydrogen Reformers

## Cylindrical Heaters

- Helical Coil Radiant & Convection
- Twin Vertical Coil Radiant
- Vertical Tube Radiant & Convection
- Segmented Vertical Tube Radiant & Convection
- Helical Coil Radiant
- Vertical Tube Radiant
- Segmented Vertical Tube Radiant

## Box Type Heaters

- Horizontal Tube-Hipframe-Radiant Convection
- Vertical Tube Multi-Cell
- Twin Cell Horizontal Tube-Radiant Convection
- Horizontal Tube-Flat Roof-Radiant Convection
- Centre Tube Double Fired
- Multi-cell Vertical & Horizontal Tube

## Ancillary Equipment & Service

- Erecting & Commissioning Supervision
- Procurement & Inspection Services
- Consulting Services for Increased Efficiency
- Supply of Spare Parts
- Fuel Saving, De-Bottlenecking & Revamping Existing Furnaces
- Sootblower Selection & Economizer Section Cleaning
- Engineering Studies
- Air Preheat Systems
- Burner Management Systems
- Burner Selection & Control Systems
- Noise Attenuation Plenum Chambers
- NOx and SOX Reduction Services and Equipment
- Piping and Control Valves with Tie-ins Around The Heaters
- Computerized Piping Stress Analysis
- Computerized Structural Mechanical Analysis

**The best heaters are Born**

# Versatile! .... The Popular Born "Prefab" ...

The Born "Prefab" heater is a tough, versatile unit that is shipped in completely assembled modules. It is available either with horizontal tubes or vertical tubes.

The prefabricated and preassembled heater was developed in response to a demand for a process heater which could be shipped as a single entity or in modules or sections ready for field assembly.

Units are available in sizes ranging from 200,000 BTU/hr to 500,000,000 BTU/hr.

The unique feature of the Born "Prefab" heater is that it arrives at the job-site as completely preassembled units. This feature reduces field construction costs to the absolute minimum while at the same time giving quality process heater operation and efficiency.

This unit has a true radiant tube section, thus assuring controlled radiant heat absorption, while the convection section insures high thermal efficiency.

Design of the Born "Prefab" heater enables the natural flow of combustion gases upward from the burners with no obstructions, resulting in very low pressure drops so that adequate draft can be obtained with very short stack lengths. This Born design is based on over 90 years experience in designing and constructing heaters for the petroleum industry.

Maximum efficiencies are obtainable with the Born "Prefab" heater. Flow of oil through the convection section of the heater is counter-current to the hot flue gas, the coldest oil entering at the top of the heater and the hot oil passing out of the section at the bottom. With this type of process, the coldest oil absorbs the last available heat from the stack gas, which results in higher efficiencies.

The special design and construction of the Born "Prefab" heater keeps the oil or other fluid being heated in the maximum temperature zone for a relatively short period of time.

This construction feature also allows an extremely accurate and sensitive control of the temperature of the outgoing fluid. Actual recorder charts of many furnaces now in operation show that the outlet temperature can be maintained within ½ of 1 degree Fahrenheit.

The heater structure is a steel frame and will support the entire weight of the refractory walls, tubes, headers, breeching and stack. The stack is a self-supporting steel stack superimposed on the heater structure.

All shielded walls are lined with insulating refractories tied to the steel-work. These are either ceramic fiber refractories or insulating castables.

The elevated air-cooled floor is insulate and reinforced for ample beam strength. The interior area of the breaching , including explosion doors, is insulated.

Access doors are provided for the combustion chamber, the breeching and stack.

The famous Born "Prefab" heater eliminates field construction and offers top efficiency—any time, any place, any size.

**Heaters are not made they are Born**

# Useful Table and Charts

## Method of Estimating Temperatures

| | Deg. C | Deg. F |
|---|---|---|
| Dark Blood or Black Red | 532 | 990 |
| Dark Red | 566 | 1050 |
| Dark Cherry | 677 | 1250 |
| Bright Cherry | 745 | 1375 |
| Light Red | 816 | 1550 |
| Orange | 899 | 1650 |
| Light Orange | 940 | 1725 |
| Yellow | 997 | 1825 |
| Light Yellow | 1080 | 1975 |
| White | 1204 | 2200 |
| Dazzling White | 1500 | 2732 |

## Gross and Net Heating Values of Simple Fuels

| | | Gross Heating Value | | Net Heating Value | |
|---|---|---|---|---|---|
| Fuel | Symbol | BTU/ft$^2$ | BTU/lb | BTU/ft$^2$ | BTU/lb |
| Carbon | C | | 14,093 | | 14,093 |
| Hydrogen | $H_2$ | 325.0 | 61,100 | 275.0 | 51,623 |
| Carbon Monoxide | CO | 321.8 | 4,347 | 321.8 | 4,347 |
| Sulfur | S | | 3,982 | | 3,892 |
| Methane | $CH_4$ | 1013.2 | 23,879 | 913.1 | 21,520 |
| Ethane | $C_2H_6$ | 1792.0 | 22,320 | 1641.0 | 20,442 |
| Propane | $C_3H_8$ | 2590.0 | 21,661 | 2385.0 | 19,944 |
| Normal Butane | n-$C_4H_{10}$ | 3370.0 | 21,308 | 3113.0 | 19,680 |
| Acetylene | $C_2H_2$ | 1503.0 | 21,572 | 1453.0 | 20,840 |
| Hydrogen Sulfide | $H_2S$ | 672.0 | 7,479 | 633.0 | 6,930 |

# Determination of Furnace Efficiency with Born Nomograph

## DATA REQUIRED:

By Orsat analysis determine percentage of $CO_2$ and $O_2$ in stack gases and stack temperature °F

## DIRECTIONS:

Connect $CO_2$ and $O_2$ with a straight edge. The straight edge will fall over reference points on lines 2,3,4,5 and 6. Line 2 indicates the latent heat loss due to burning of $H_2$ in fuel and also shows Hydrogen/Carbon ratio by weight of fuel. The straight edge must fall on the proper H/C point on line 2 for the particular fuel being burned. Line 5 shows the sensible heat loss to the stack in terms of percent/100°F of stack temperature. Line 6 indicates the percent excess air in the sample tested.

Example: 0.6 sp.gr. Natural Gas H/C = 0.31 ($N_2$ and $CO_2$ free)

Orsat Data: $CO_2$ = 9.2%

$O_2$ = 5.2%

Stack Temp.: 810°F - 60°F Ambient Temp. = 750° Rise
Stack Loss: Latent Heat 8.75%
Sensible Heat 2.39 x 7.5 = 17.95%
Total Loss:
(Gross Heat Basis) 17.95 + 8.75 = 26.70%
Total Loss:
(Net Heat Basis) = $\frac{17.95}{(100-8.75)} \times 100 = 19.65\%$
Radiation Loss: to be added
Furnace efficiency on either the gross or net heat basis is determined by subtracting the above losses from 100%.

Note: The nomograph may also be utilized in the same manner if only the percentage of $O_2$ in the stack gas is known, provided the H/C ratio is known, or calculated.
Average HIC rations are as follows:

Natural Gas 0.31 - 0.33
Refinery Gas 0.25 - 0.28
12 API Fuel Oil 0.117
Coal 0.05 - 0.07

## Vertical Cylindrical Heaters

These heaters can have either helical coils or serpentine coils depending on your specific requirements and most suitable design solution to meet them. The type of heater offered is carefully selected to feature low capital cost, high efficiency, close control and trouble free operation.

## Reformers

Born manufactures steam reformers utilizing technology supplied by companies such as Haldor Topsoe, etc. They can be down fired or side fired depending on your requirements and the technology to be used. The tubes are spun cast alloys. Refractory linings are suitable for high temperatures and include ceramic fiber modules.

## UOP Platform Heaters

This platform heater was fully modularized and delivered to the site by barge. The four radiant cells are complete with 'U' tube assemblies, manifolds, burners and refractories and the convection section and stack were fully modularized. To reduce the expense of these high cost capital items, Born source the materials worldwide.

The barge took the platformer to the quayside local to the refinery. It was then transported to the foundations prepared for it and was lifted straight into position.

## Heaters With Air Pre-Heat System

This air preheat system preheats the combustion air to increase overall efficiency by means of an air heater which utilizes the hot flue gases. The cool flue gases are then passed through an induced draft fan and exhausted to a stack and the combustion air is supplied via a forced draft fan.

These units can be either recuperative or regenerative type.

**More and more heaters are Born everyday**

# Unequaled Service Facilities.... plus Quality Control

Complete service facilities supplied by Born for over 90 years assures our Clients of experienced personnel when service issues arise.

## Quality control

The Born organization comprises of a design department, engineering department, drafting department, consulting engineers, project management teams, procurement staff, Quality Assurance staff, Quality Control department as well as a full marketing and sales team. All our personnel are fully trained to ensure that every heater is designed, supplied and delivered in accordance with our high-quality standards and the contract requirements.

## Fabricating

Born Inc. has its own fabrication facility in Tulsa, OK. Born Inc. can also fabricate heaters in qualified approved fabrication shops that are selected on a contract by contract basis considering final destination, contract size and any particular Client requirements. Wherever Born heaters are fabricated all work is undertaken under the direct supervision of Born engineers and Quality Control personnel.

## Engineering

A full staff of highly-trained mechanical, structural, and process engineers are available to serve you in any heater issues that may arise.

## Research

Continuous research in the field, laboratory and engineering departments of the company keep the Born heater a leader in the heater field.

## Heaters are not made they are Born

**Born** is the world's leading authority in fired heater technology. It has been so for over 90 years since the inspirational pioneering work of the founder of the company, Dr. Sidney Born. He was born in 1889, received his Ph.D. in 1913, and went on to develop a new thermal oil cracking process which launched his reputation into the petro-chemical industry.

Born Inc. is a family run business through three generations of the Born family. The current CEO is Dr. Sidney L. Born the grandson of the founder.

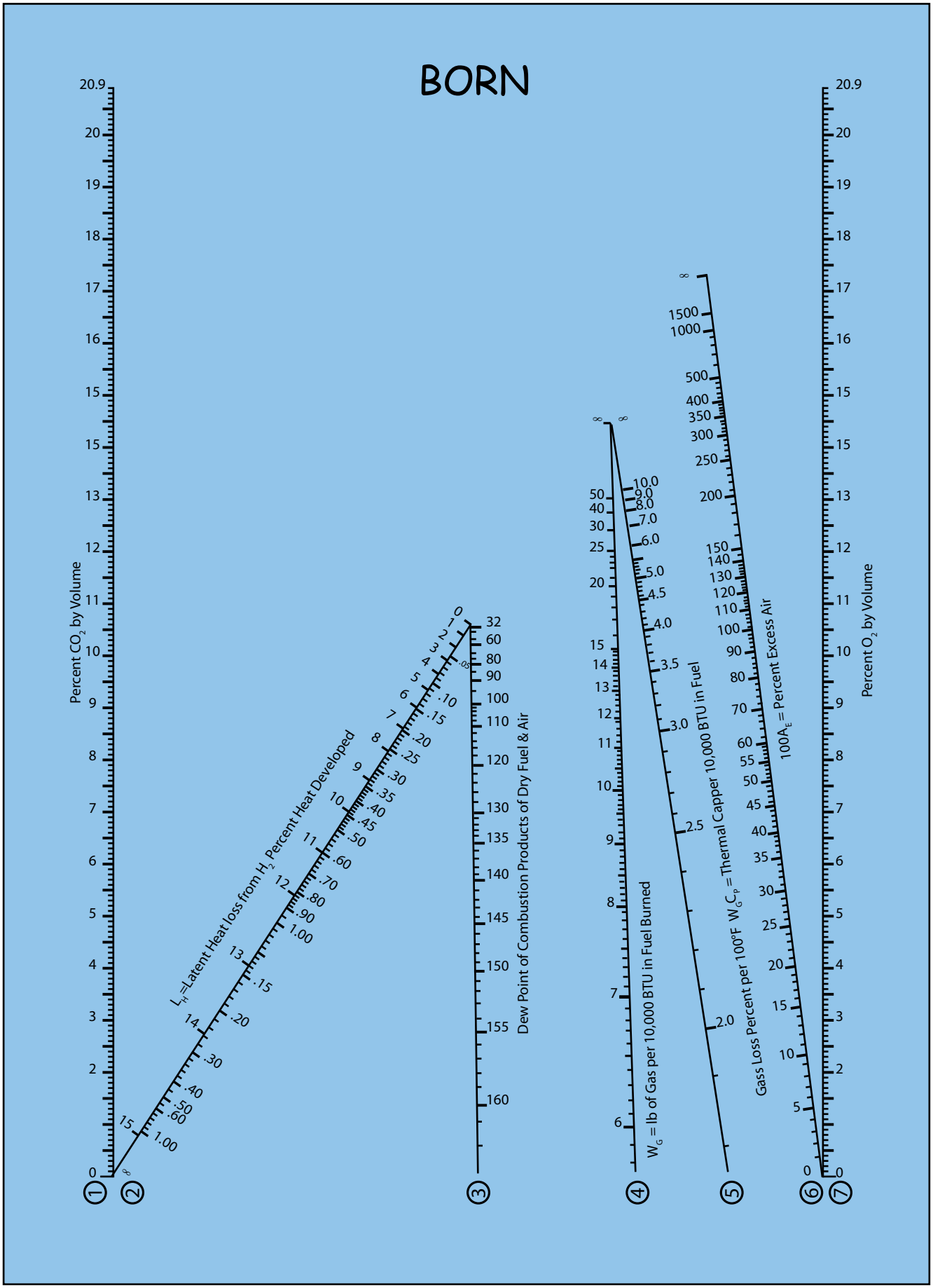
Born's continued concentration on process heaters and furnaces for a petro-chemical industry is the real strength of the company. It engineers, manufactures, inspects, installs, commissions and provides ongoing advice and maintenance.

Our reputation is second to none.

# The Benefits of Born

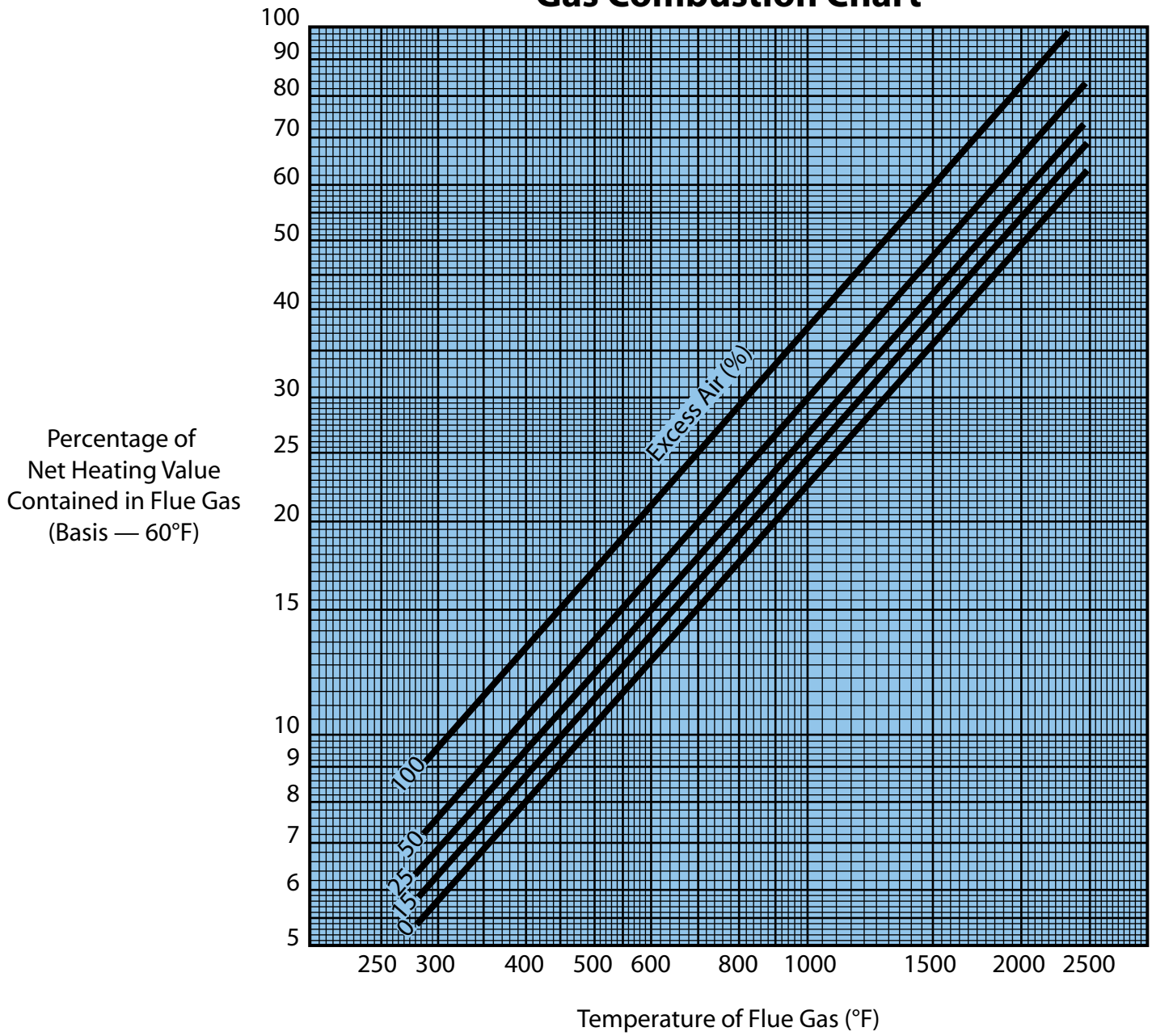
- **Low Initial Cost.** You will benefit from over 90 years of experience during which we have become the market leaders in designing the most economical heaters to your specifications. Our designs coupled with our worldwide procurement result in our being able to provide efficient competitive heaters without sacrificing quality.
- **High Efficiency.** Born heaters are designed to fit your specific requirements and achieve the very highest efficiencies obtainable. Where inlet temperatures are low enough, these high efficiencies can be achieved by the proper design of the convection section. In other cases, heaters are designed which recover heat from gas turbine exhaust or other available high temperature gases. Born has designed many heaters utilizing air preheat and have one of the only installations in the world with a single air preheater servicing two different heater services. Born has been the leader in designing heaters to save on the rising fuel costs long before the "energy crisis" became a common phrase.
- **Low Operating Cost.** The counter-current flow of a Born heater reduce fuel costs while providing high efficiencies. Careful design and construction details keep operating costs low in a Born heater. Heat recovery units are installed in all types of services, including recovery heat, process preheat and air preheat.
- **Lower Maintenance Cost.** Born heaters offer the lowest maintenance and upkeep costs in the heater due to their proven efficient design and material selection.
- **Use Less Space: Easily Serviced.** The compact design of Born Heaters, especially the vertical tube heater, offers high efficiency units where space is critical. Construction design of the heaters allows easy, quick servicing. The highly-trained Born technicians are available for any on-site services you may require.
- **Maximum Utilization of Fuel for Combustion.** Born engineers are specialists in selecting the proper number, size and arrangements of burners for the very best combustion efficiency. This can be accomplished by floor firing, end firing, or side firing depending on the type of fuel to be burned.
- **Environmentally Sensitive.** Born can supply heaters conforming to the most stringent environmental control standards, including noise, NOx and SOx, etc.

## The impossible is achievable with a Born heater



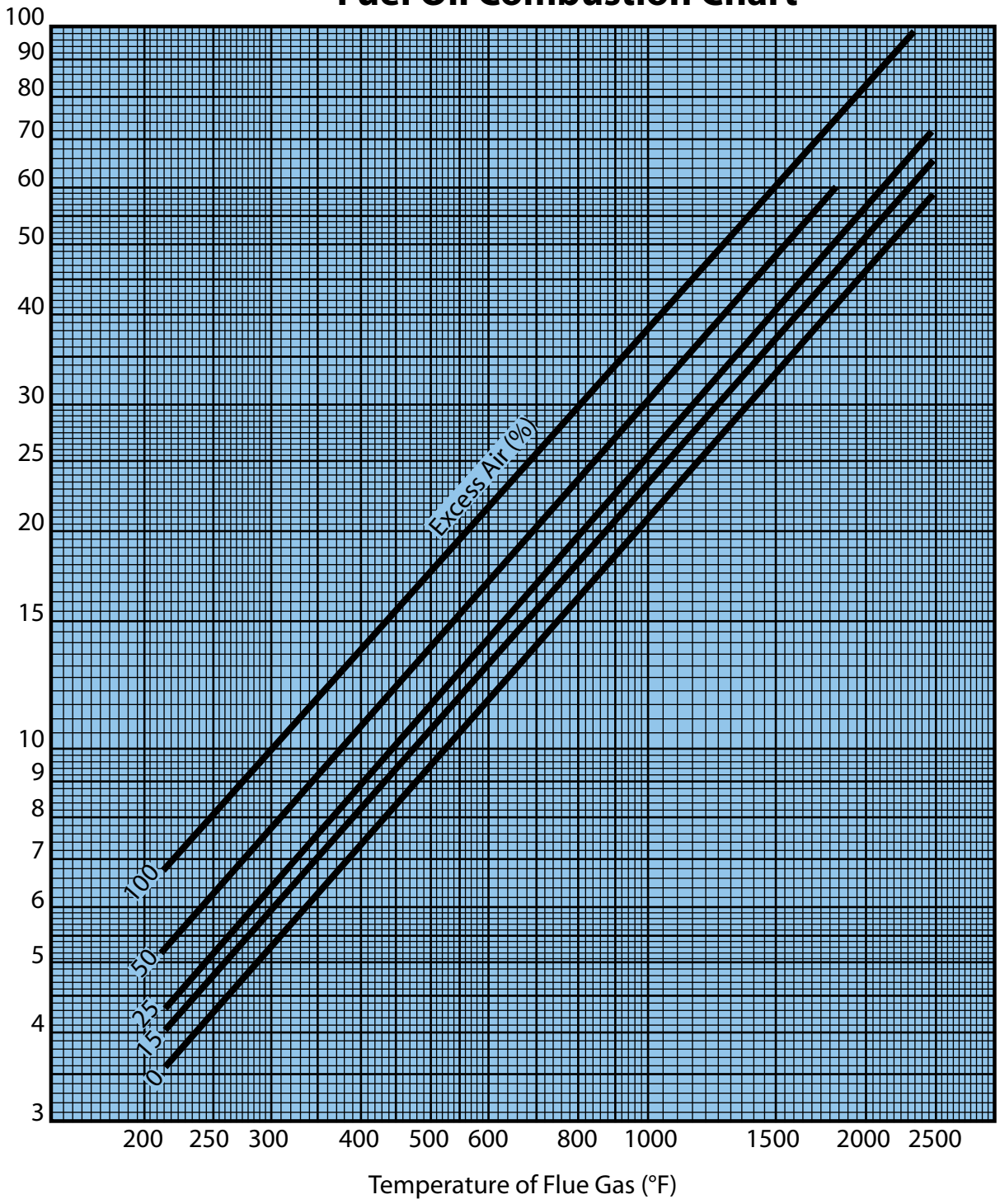

**The Impossible is achievable with a Born heater**

# Gas Combustion Chart




**Heaters are not made they are Born**

# Fuel Oil Combustion Chart



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