Safety first
Quality always

Reduction

Grupo THERMOJET®

Grupo THERMOJET®

Thermojet began in the **year 2000**, when the engineer and entrepreneur Ricardo Leite Passos gathered a group of colleagues to acquire the **Special Heating and Cooling Division** of the company **Brasimet**, where they worked. The colleagues became partners. They brought with them a remote history, from the **Lindberg** company, which in **1977** had introduced convective heating in South America, and had been incorporated by Brasimet.

By the time of its foundation, Thermojet primarily served glass and steel industries, offering thermal input at the start-up and shutdown, with a heating characterized by the **equalization of temperatures** over long stretches and **high thermal uniformity**, far superior to that provided by the then known methods.

CERTIFIED ISO 9001:2008 COMPANY

Born with the excellence of the companies from which it originated, Thermojet grew at a rapid pace, **doubling annually in size** in each of its first 10 years. Meanwhile, it began to carry out major works in plants with a capacity of **tens of millions of tons per year**, which it attends in an agile way with its **more than 250 combustion sets.**

Simultaneously, Thermojet extended its portfolio to offer a variety of **solutions in Thermal Engineering**, such as the preservation of refractories, mobile system for monitored oxyfuel combustion and computer simulation, among others.

In 2005, Thermojet filed its first **patent** application. It thus formalized the innovative vocation that continues to this day, materialized in **a division specially dedicated to the development of technology**, **Æstus**, which has among its products the development of the **software COBRA** for the management of refractory preservation in coking plants, efficient heating and cooling stations, and the consistent patent registration of burners and auxiliary devices, as a result of R&I investments amounting to 2% of revenue.

In 2014, through the incorporation of Brazilian national leader **4Pipe**, Thermojet Group's portfolio integrated products and services for **cleaning and inspection of pipelines**.

At present Thermojet features a vast history of services for industries in various segments throughout **South America, Central America and the Caribbean**, as well as operations in China and the **partnership with Glass Service**, based in the **Czech Republic**, which has developed and used since 1990 a **computational fluid dynamics software**, CFD, refined in the simulation of refractory lined equipment.

24h Emergency response

Services

Thermojet has specialized teams in several applications of Thermal Engineering, as well as consultants and **innovation** partners for the development of **tailor-made solutions:**

- Controlled drying and heating
- Accelerated or controlled cooling
- Mobile system for monitored oxyfuel combustion
- Monitored hot-hold
- Expansion and contraction control
- Monitored draining and filling of glass ovens
- Monitored thermal comfort
- Generation of hot gas at specific flow and temperature
- Refractory diagnosis
- COBRA: Management of refractory preservation
- *Jetwelding*® ceramic welding
- Heat treatment
- Computational simulation of heat exchange
- Tailor-made special services

Global presence

Having units in Brazil, Colombia and Argentina, Thermojet serves the whole **South America, Central America and the Caribbean.** It is also based in **China** and represents Glass Service and Flammatec companies based in the **Czech Republic** and global reference in burners, accessories and advanced solutions for the glass industry.

THERMOJET

Reduction

ESTUS Industrial Solutions

Complete solutions in Thermal Engineering.

The **drying** and **heating** of **steel refractories** are in our bedrock. Since our foundation, we have served industries that sowed the industrial activity in Brazil. Over the years, we have innovated and expanded our portfolio, which today has countless solutions for **starting, partial stop and general refurbishment** in the most diverse equipment in the reduction area of steel mills:

- Blast furnaces, with bustle pipes and hot blast mains
- Hot stoves
- Troughs and runners
- Torpedo cars
- Ignition furnaces

Operation with mobile system for monitored oxyfuel combustion

Thermojet performed the **removal by fusion of the pig iron solidified in the hearth**.

Blast furnace
2.8 million tons of pig iron per year

Hot blast stoves

Thermojet performed the **drying and initial heating**.

- World record of productivity
- 10,367 days of uninterrupted operation
- 94,557 tonnes accumulated in that period
- The largest hot stoves in Brazil

Blast furnace
3.5 million tons of pig iron per year

Hot blast stoves

Thermojet performed the drying and **initial heating**.

Blast furnace
2.8 million tons of pig iron per year

In the demands for thermal transfer at higher temperature, we apply equipment and personnel specialized in **mobile system for monitored oxyfuel combustion**:

- Bringing obstructed blast furnaces back into operation
- Thermal support to the start-up of blast furnaces
- Removal by fusion of the pig iron solidified in the hearth
- Cleaning of torpedo cars

Our burners are designed to operate on both LPG and NG

Contact us to check the feasibility of using other fuels in tailor-made projects.

Services

- Controlled drying and heating
- Accelerated or controlled cooling
- Heating and cooling stations
- Mobile system for monitored oxyfuel combustion
- Monitored hot-hold
- Controlled thermal comfort
- *Jetwelding*® ceramic welding
- Heat treatment
- Computational simulation of heat exchange
- Tailor-made special services

THERMOJET

Heating and cooling stations

Retrofit or custom manufacturing.

We have a technical and managerial team specifically dedicated to the development of cooling and heating stations, with a focus on providing the **maximum performance and durability of refractories**. **Technical Assistance available 24 hours a day**.

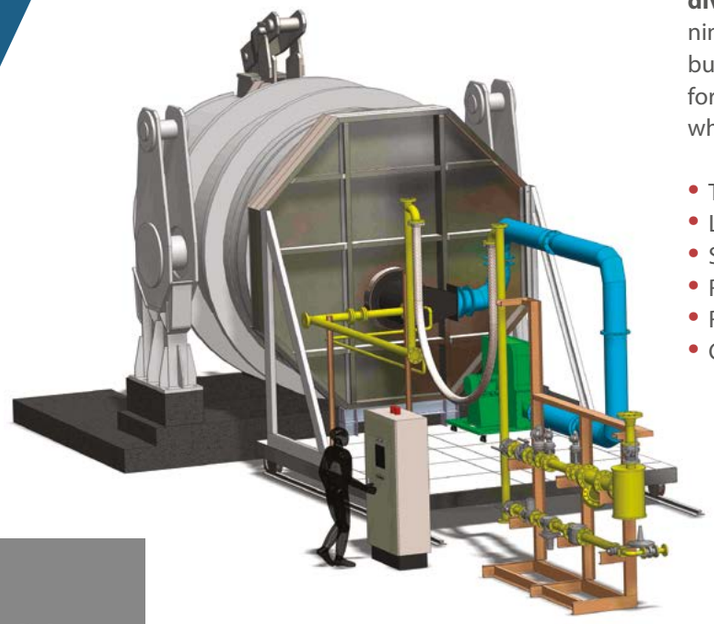
We retrofit and manufacture stations for the most diverse equipment:

Steel and pig iron ladles

Torpedo cars

Blast furnace runners

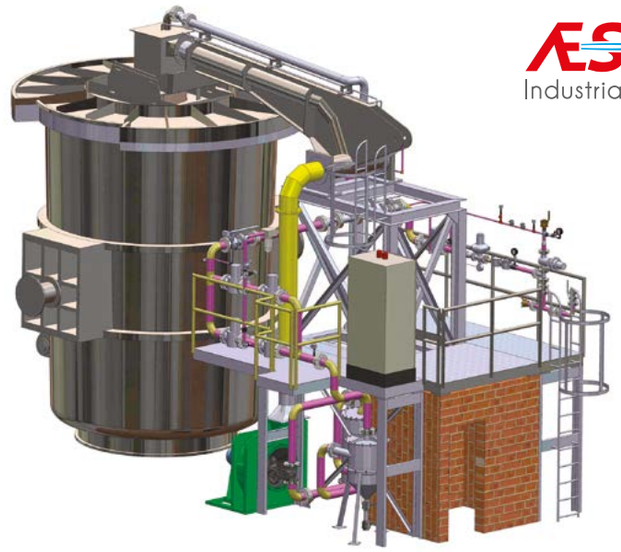
Tundishes



In tailor-made projects, and using the resources of our **Æstus technology division**, we **finely adjust operational variables** such as burner positioning and inclination, combustion products injection speed, path of the combustion products inside the equipment, positioning and exhaust diameter, for **maximum efficiency of heating or cooling**, in the various activities in which the stations are applied:

- Total relining
- Localized repairs
- Slag line replacement
- Replacement of plugs
- Reheating due to losses in the operational cycle
- Controlled or accelerated cooling

ÆSTUS Industrial Solutions



We elaborate practical and theoretical studies as well as computational simulations so that our stations can **efficiently** solve the main problems related to refractories and their heat exchange in the production units:

- Cut in heating and reheating **times**
- Cut in cooling **times**
- Abatement of **fuel** consumption
- Increase in the refractory **campaign**
- Thermal **uniformity**
- Thermal **soak**
- Reduction of thermal shock, with **preservation of the refractory**

Cut in heating, reheating and cooling times

Practical and theoretical studies as well as computational simulations

24h Technical assistance

Our technical assistance is swift, acting with agility in any emergencies. We maintain backup burners as an **interim system that is readily operative**, aiming at **high availability** and **thermal stability** of the equipment to the operation.

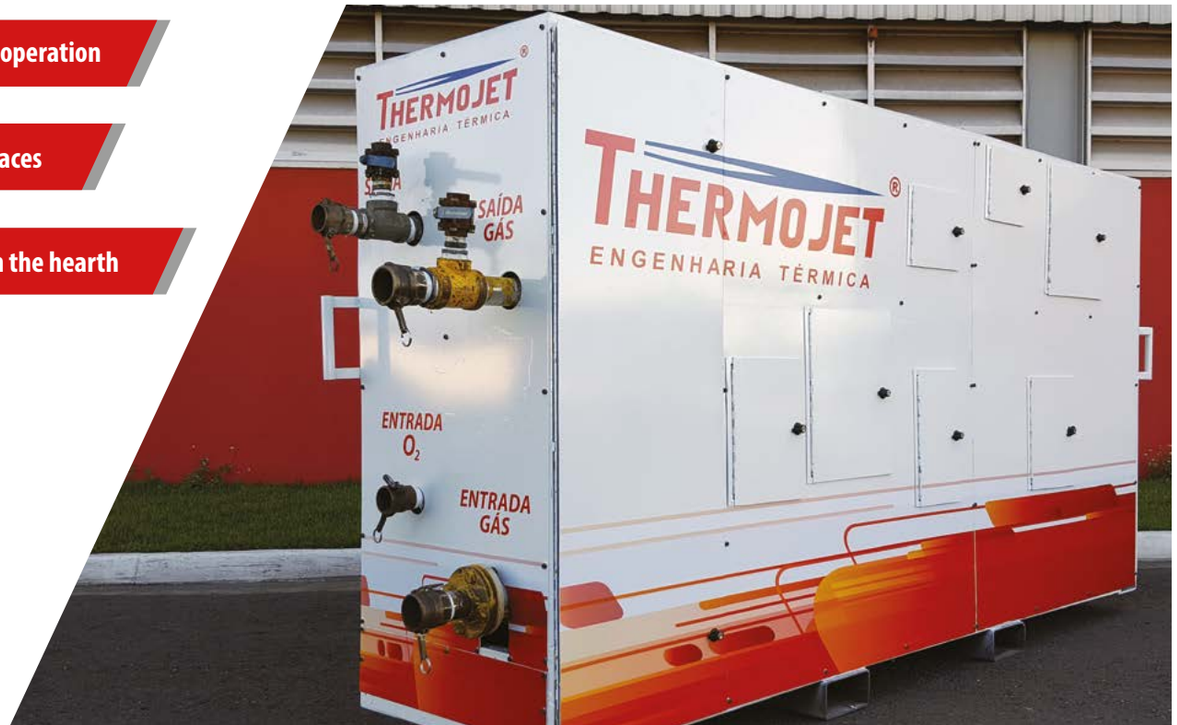
THERMOJET

Mobile system for monitored oxyfuel combustion

Experience. Safety.

We have specialized equipment and personnel to carry out operations with **Mobile System for Monitored Oxyfuel Combustion** to meet the demands for **high temperature portable thermal supply**, such as:

- **Bringing obstructed blast furnaces back into operation**
- **Thermal support to the start-up of blast furnaces**
- **Removal by fusion of the pig iron solidified in the hearth**
- **Cleaning of torpedo cars**
- **Cleaning of ladles**



Operation with mobile system for monitored oxyfuel combustion

Thermojet performed the **removal by fusion of the pig iron solidified in the hearth**.

Blast furnace

2,8 million tons of pig iron per year

Dedicated software

During these activities, we perform the **operation, monitoring and recording of data**, as well as controlling parameters such as temperature, oxygen flow and fuel gas. Processed in **dedicated software**, the data is made available for **real-time consultation**.

THERMOJET

Thermal comfort

ÆSTUS
Industrial Solutions

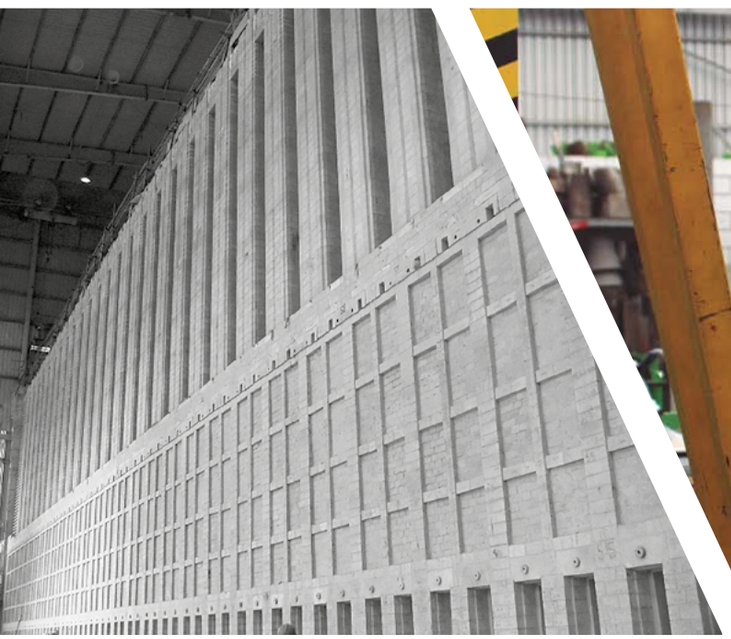
Regulatory compliance and productivity

To meet strict regulation of working conditions, our technology division, Æstus, developed **Mobile Units for Thermal Comfort (MUTCs)** with high capacity of directed cooling.

Our equipment is presented in portable modules, directing high flows of fresh and cooled air to the work fronts, with streams that reach **long distances**, deepening in closed environments.

As a result, we provide adequate **health, safety and productivity** conditions to operational teams.

Fresh and cooled air at long distances



As a result, we provide adequate **health, safety and productivity** conditions to operational teams.

- **Health**
- **Safety**
- **Productivity**

Reheating furnaces

We performed **thermal comfort services at the Rolling Hot Strip**, passing to the modality of contract given the success of the operations

Rolling Hot Strip with capacity of **4 million** **tons** of hot rolled coils per **year**

THERMOJET

Jetwelding® ceramic welding

Postponement of stops, prolongation of life.

- Developed by professionals with around 30 years of experience
- Synergy with our research department in Thermal Engineering
- Partnership with the best universities in Brazil
- Experienced operators with a history of repairing more than 1,200 ovens
- The best ceramic welding technology

Physical-chemical process

- **Exothermic oxidation reactions** produce heat and melt the welding and substrate materials using pure or dilute oxygen.
- The metal **oxides** produced in the reaction are **compatible** with those of the substrate, avoiding contamination.

Extensive repair welding

- **Large surfaces** can be welded, gaining time compared to the **time-consuming** replacements of bricks on walls.
- Pure welding can be carried out or **in conjunction with zero expansion bricks**.

Technical features

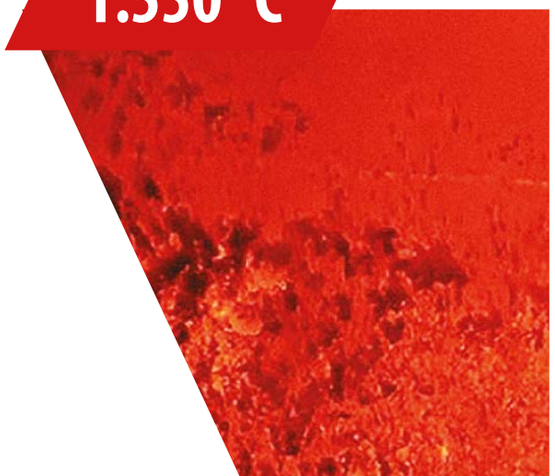
- Application **without aqueous vehicles**, normally harmful to refractories
- Type of maintenance with the **longest service life** for refractories
- **Durability** of the repair, in conditions of operation free of accidents and chemical contaminations, possibly superior, in time, to the very life of the refractory of the substrate
- **Composition of welding material almost identical** to that of the substrate

There are no practical limits to welding in terms of:

- **Temperature**: repairs under up to 1,550°C
- **Types of refractory**: SiO_2, silica-alumina, high alumina, zirconite, electro-fused
- **Application reach**: up to 12 m between operator and region to be repaired
  - Today, more than **80% of coke ovens** in Europe and the Americas are routinely repaired with ceramic welding.
  - The repair method was extended to aluminium furnaces, ceramic blast furnace burners (Brazil) and reheating fu.
  - One of the great advantages of ceramic welding is to **run hot**, with the **oven in normal operation**, without cooling.

Repairs under up to

1.550° C



Bottom repair

Main recovery method with many advantages:

- Repair **speed**
- **Little labour** involved
- **Safety** (reduced risk of accidents or incidents)
- **Hot repair**: no need for cold rooms or oven cooling
- **Routine** repair, no preparation time needed

Extensive bottom repair (through hole)

- There is no history of repairs on large extensions with ceramic welding that have collapsed.
- **Speed** about **70% greater** than that of a **parts replacement repair**.
- In no time the furnace cooling is required.
- There is a recorded case of **repair intact for over 25 years** (ACME Steel, Chicago USA, 1975-2000).
- There are **no reported incidents and / or accidents**.

Case of repair intact for over

25 years

ACME Steel, Chicago EUA, 1975-2000

THERMOJET

Computational simulation of heat exchange

ÆSTUS Industrial Solutions

CFD simulation of heating up a float furnace

We developed a study to determine the most efficient **burner configuration** resulting in **uniformity of temperatures** in the melting zone, with **reduced fuel consumption**.

Furnace capacity **900** tons/day

Refinement of processes and equipment

We offer the **detailed assessment of** thermal processes by modelling and simulation of industrial equipment.

Using a computational fluid dynamics (CFD) software developed and implemented since **1990** by our partners of Glass Service, based in the **Czech Republic**, we carry out scenario studies for heating or hot-hold activities, in search of the **optimal operational parameters** that result in the desired outputs for each process, whether contributing to the **reduction in fuel consumption** or to obtaining a **high level of thermal soak**, for example.

Computational Fluid Dynamics

CFD

Using computational fluid dynamics software, **CFD**, developed and implemented since **1990** by our partners of Glass Service, based in the **Czech Republic**, we carry out scenario studies for heating or hot-hold activities, in search of the **optimal operational parameters** that result in the desired outputs for each process, whether contributing to the **reduction in fuel consumption** or to obtaining a **high level of thermal soak**, for example.

The studies also allow the evaluation of the **design of furnaces and regenerators** to **select the most efficient scenario**.

Detailed assessment / **Reduction in fuel consumption**

THERMOJET

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www.thermojet.com

+55 12 2126 9800

Headquarters: Pindamonhangaba SP | BRAZIL
+55 12 2126 9800
solutions@thermojet.com
Avenida Felix Galvão Cruz Simões, 375
Industrial Feital CEP: 12441-275 Caixa Postal n° 521

Thermojet Argentina | Buenos Aires
+54 03407 42 5346 | +54 03407 42 1218
consultas@thermojet.com.ar
Av. Central Acero Argentino Este, 610
Parque Industrial Comirsa, San Nicolás de Los Arroyos,
Buenos Aires | Argentina.

Thermojet Colombia | Sogamoso
+57 317 665 1515 / +57 098 772 4848
ingenieria@thermojetcolombia.com.co
Calle 54 N° 10E - 65
Sogamoso, Boyacá | Colombia. Postcode: 152210

Thermojet International | Cartagena de Indias
+57 315 297 8935
comercial.tecnico@thermojetcolombia.com.co
Km 6 Vía Momonal | Edif. Comfenalco | Ofc. 308
Cartagena, Bolívar | Colombia. Postcode: 130013

Thermojet China | Shanghai
+86 158 2168 23 65
2366 Jin Qiao Lu | Bld. 1, 527
Pudong Xinqu, Shanghai Shi, China. Postcode: 201203

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