

Making our world more productive



Selas-Linde

The furnace experts



Decades of experience

Our company.

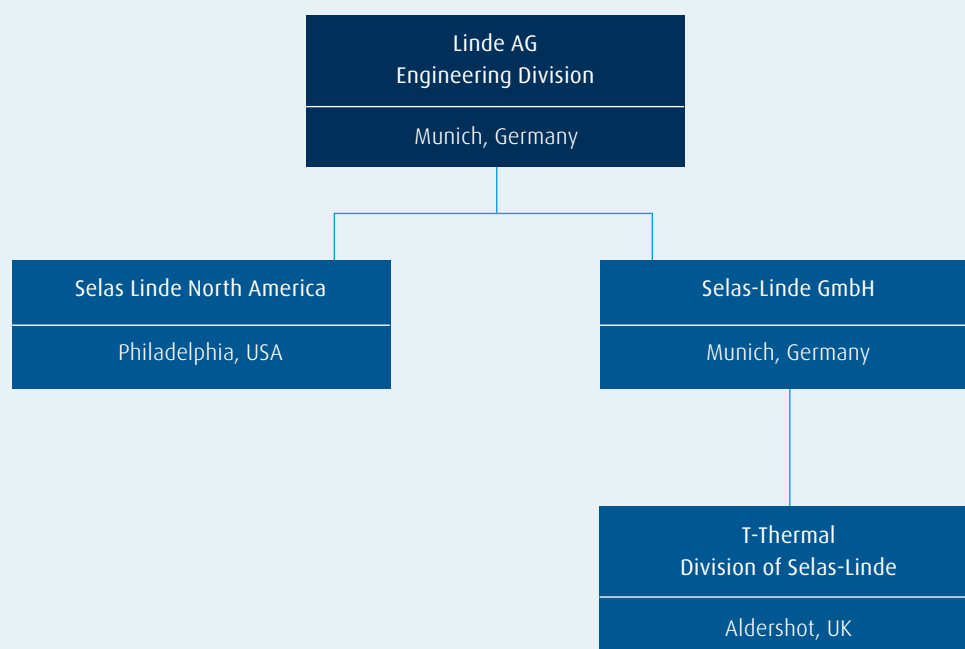
Selas-Linde has a long tradition in furnace design, dating back to the early 1930s in the United States. The original company, Selas Corporation of America, was involved in the technology of fired process furnaces at an early stage. Over the years, the company worked continuously on developing this technology.

In 1948, the Ernst Kirchner company in Hamburg started developing its product line for fired industrial furnaces. After the death of the company's founder in 1970, the fired industrial furnaces product line was spun off and sold to Selas Corporation of America. This acquisition was then renamed Selas-Kirchner GmbH. In 1973, Selas Corporation of America and the Linde AG Process Engineering and Contracting Division signed a license agreement for the planning, manufacturing and erection of pyrolysis furnaces to produce olefins. This move also combined Selas, Kirchner and Linde technologies in the field of fired process-furnace plants for the chemical and refinery industries. Over the following years, Linde's Process Engineering and Contracting gradually acquired ever-larger shares of Selas-Kirchner and of the fired process-furnace plant division of Selas Corporation of America.

In 1985, Linde AG became the sole owner of Selas-Kirchner, Germany and of the process furnaces division of Selas Corporation. This division now operates under the name Selas Linde North America based in Blue Bell, Pennsylvania, USA. On 1 January 1999, Selas-Kirchner GmbH was renamed Selas-Linde GmbH. Selas-Linde GmbH and Selas Fluid Processing Corporation now market the entire, bundled know-how of Selas, Kirchner and Linde furnace technology know-how exclusively throughout the world under the Selas trademark. Since its acquisition of T-Thermal in 1992, Selas-Linde now complements its environmental engineering technology with extensive know-how and leading technology in the thermal oxidation of gaseous and liquid waste. Furthermore, Selas-Linde designs, supplies and constructs plants for the vaporisation of cryogenic liquids. Today, Selas-Linde is one of the leading global contractors in all of the above-mentioned fields.



Cracking furnace for ethylene production, Rafnes Norway, Noretyl AS.



Our experience.

Selas-Linde has extensive experience in the conceptual and detailed design and construction of turnkey plants. It also offers a wide range of industrial services. Close ties between Selas-Linde in Munich and Selas Linde North America, backed by the global network and proven capabilities of the Linde Engineering Division, ensure state-of-the-art technologies and project execution.

Efficient engineering work by experienced specialists and the use of the most modern 3D CAD systems (PDS) result in optimal design and reliable, long-term operation of all Selas-Linde plants. Materials and equipment are procured worldwide in close cooperation with approved suppliers and partners.

Selas-Linde has decades of experience as a general contractor, managing the complex logistics of plant procurement and construction. Proven project management and control systems guarantee strict adherence to cost, schedule and quality requirements.

Contracts are executed in compliance with all relevant international standards and rules and accompanied by continuous quality-assurance activities. Selas-Linde has been certified under ISO 9001 since February 2000. After a contract has been completed, Selas-Linde remains a reliable partner for its customers through flexible and efficient after-sales service. Proof of Selas-Linde's capability and know-how lies in the successful completion and commissioning of more than 2,000 plants since the company's foundation.

+2,000
plants constructed
worldwide



Cracking furnace, Rafnes Norway, Noretyl AS.

**Extensive
know-how
and leading
technology**

Our portfolio.

Process furnaces for the chemical and petrochemical industry

- Cracking furnaces for ethylene production
- EDC cracking furnaces
- Cracking furnaces for special chemicals, such as acetic acid and freon

Reformers

- Steam reformer for hydrogen and synthesis gas production

Fired heater units for refineries

- Crude oil heaters
- Vacuum oil heaters
- Visbreakers
- Platformers
- HDS heaters
- Reboilers
- Superheaters

Special-purpose furnace equipment

- Furnaces for iron direct-reduction processes
- Steam superheaters
- Waste heat recovery units for gas turbines

Environmental technology

In addition to these fields, Selas-Linde is also a leader in the design and construction of plants for oxidising gaseous and liquid waste, including waste heat recovery, flue gas

treatment and by-product recovery in the handling of

- Halogenated hydrocarbons
- PCBs – polychlorinated biphenyls
- Pesticides
- Dioxins
- Pharmaceutical waste
- Aqueous salt-laden waste
- Nitrogen-bound organics

Vaporisation of cryogenic fluids

Submerged combustion vaporiser systems (Sub-X®) for

- LNG
- LPG
- Nitrogen
- Ethylene
- Others

Range of services

Selas-Linde offers a wide range of services tailored to customer needs

- Studies
- Project management
- Basic and detail engineering
- Procurement of services and materials
- Construction, revamps and commissioning
- Supervision of fabrication and construction
- Start-up supervision
- After-sales service
- Project financing

Cracking furnaces for ethylene production.

In ethylene plants, pyrolysis or ethylene cracking furnaces are key building blocks in the production of basic chemicals such as ethylene, propylene, butadiene, etc. for the plastics industry.

In designing such cracking furnaces based on Linde's PYROCRACK® technology, Sels-Linde can draw on its experience in the construction of more than 450 cracking furnaces.

Depending on available feedstocks and product distribution plans, Sels-Linde recommends an appropriate PYROCRACK cracking coil system. Highlights of these furnaces include vertically arranged coils for high product output, long furnace runtimes and robust mechanical design.

Firing is via a pure bottom/sidewall or combined bottom/sidewall burner arrangement. Integrated flue-gas heat recovery allows furnace efficiency rates of over 92%.

Over 92%
furnace efficiency rates
achieved



Furnace group in Gofer, Germany.



EDC cracking furnace DOW-BSL, Schkopau, Germany.



Working on site.

EDC cracking furnaces.

Vinyl chloride (VCM) is one of the most important monomers for producing a wide range of polymers today.

The vinyl chloride monomer is produced by thermal cracking ethylene dichloride (EDC) in a box-type furnace at temperatures of around 500°C and pressures of up to 30 bar.

Selas-Linde has designed and built EDC cracking furnaces for various processes. Worldwide customers include Goodrich, Stauffer, DOW, EVC, PPG, Hoechst and Atochem.

The coils and the fire box are designed by means of a special computer model for reaction kinetics. This allows the furnace design to be optimised with respect to the temperature/heat flux profile, residence time and pressure loss. Both main and secondary reactions are taken into account.

EDC furnaces are fired by natural-draft or forced-draft sidewall burners.

The residual heat of the flue gases is utilised for generating steam or preheating the air so that efficiency rates of over 90% can be achieved.

Steam reformers.

Many processes in the chemical industry are based on the use of hydrogen or synthesis gas. The most important industrial method of generating hydrogen and synthesis gas is by steam reforming hydrocarbons. This is carried out in top-fired primary reformers.

Selas-Linde's experience in designing and building reforming furnaces dates back to 1957.

Selas-Linde has developed a special reaction model of the reforming process to support the design of reformers. This computer program calculates the composition of the reformed gas, and the firebox is dimensioned for a wide feedstock envelope.

The design of the waste-heat recovery system for the flue and process gases takes into account the customers's specific requirements and allows furnace efficiency rates of over 92%.

Designing
and building
steam reformers
since 1957



Steam reformer, Linde AG, Leuna, Germany.

Refinery heaters.

All major processes in refineries require the heating and sometimes vaporisation of the hydrocarbons in direct fired heaters.

Selas-Linde has more than sixty years of experience in designing and building refinery heaters, and the company has constructed more than 450 heaters around the world.

Refinery heaters are designed according to the requirements of the process with pressures ranging from 0.05 to 150 bar and temperatures from 200°C to 900°C. Selas-Linde heaters cover fired duties from 3 MW to more than 100 MW.

These heaters come in single-cell, double-cell box or cylindrical designs. They are fired by natural-draft or forced-draft bottom or sidewall burners. Efficiency rates of over 90% are achieved through preheated air, hot oil and steam generation.





Reduction gas heater and reformer plant (HYL, Danieli), Abu Dhabi, UAE.

Furnaces for direct-reduction steel plants.

The demand for sponge iron (DRI = direct-reduced iron) as the feedstock for steel production in electric melting furnaces is growing. Selas-Linde supplies DRI gas heaters tailored to the specific process for the newly developed methods of direct reduction (Finmet, Circored, Midrex plant using COREX gas, Danarex, Hylsamex).

Circored

DRI is produced in a circulating and a stationary fluidised bed using almost pure hydrogen. Selas-Linde supplied the three reducing-gas heaters for the first industrial-scale plant using this technology.

Finmet

DRI is produced in four stationary fluidised-bed reactors using a mixture of hydrogen and carbon monoxide. The reducing gas is heated from a minimum of 50°C to a maximum of 935°C.

HYL, Danieli

The DRI will be produced in a reactor. The reduction gas consists of a mixture of hydrogen and carbon monoxide, which is heated up to 930°C in a reduction process gas heater.

To generate reduction gas, a syngas reformer including the waste heat recovery section is used; Selas-Linde also supplies the complete reformer and waste heat recovery unit.

Midrex plant using COREX gas

DRI is produced in a conventional Midrex shaft but using purified COREX gas as the reducing gas, which is a mixture of hydrogen and carbon monoxide heated up with a 2-stage heater. Tail gas from another part of the plant with an extremely low heat value, which would otherwise have to be flared off, can be used to preheat the reducing gas. This provides a considerable increase in the overall efficiency of the process.





Cracking furnaces, Dahej, India.

Other furnaces.

Steam superheaters for styrene plants

When dehydrogenating ethylbenzene to styrene, process steam is superheated to about 800°C in a furnace before being fed into the dehydrogenation reactor together with the ethylbenzene.

The furnace is based on a double-cell design with a common convection section to utilise the waste heat.

The tube system is gas fired from both sides by means of natural-draft or forced-draft floor burners.

Gas-turbine waste-heat recovery unit (WHRU)

This method combines gas-turbine operation with that of a conventional refinery furnace. Combinations such as this provide an alternative use for the exhaust from the gas turbine. Depending on process requirements, this type of plant can also be built with auxiliary firing equipment to increase steam production, for instance.

The exhaust gases from a gas turbine are used in the horizontal waste-heat train to heat and partially vaporise crude oil in several tube bundles connected in series. The exhaust gases can also be used to heat process water.

Environmental technology.

The Selas-Linde/T-Thermal environmental technology disposes of almost all kinds of gaseous and liquid pollutants, particularly halogenated hydrocarbons and salt-laden aqueous waste.

Selas-Linde/T-Thermal has many years of experience in designing and building incinerators for treating waste materials from the following industries:

- Pharmaceutical
- Chemical
- Refinery
- Pesticides
- Plastics

Typical plants consist of vertically or horizontally arranged combustion sections with own proprietary burner technology and Sub-X quench systems, plus sections for heat recovery, flue-gas treatment and by-product recovery, depending on the application. Selas-Linde/T-Thermal has more than sixty years of experience in building plants and over 500 references all over the world.

+60 Years
of experience
all over the
world.



Thermal oxidation unit for aqueous waste, pharmaceutical industry, Portugal.

99.99%
destruction efficiency
guaranteed



Thermal oxidation unit for organic and aqueous waste liquid, Böhlen, Germany.

Thermal oxidation.

A pollution-free environment

Selas-Linde is committed to provide the equipment, service and technical support required to resolve complex disposal problems. Using tailor-made combustion technology, Selas-Linde can safely destroy nearly any kind of liquid and gaseous waste encountered in industry.

Since building our first thermal waste oxidation system in 1949, we have supplied over 1000 installations worldwide to many of the leading process and manufacturing

companies. In a technology where experience and expertise are critical, Selas-Linde is an acknowledged world leader.

Guaranteed destruction efficiencies

Thermal oxidation is the most direct, efficient, complete and final method for the disposal of particularly hazardous liquid and gaseous industrial waste. For some forms of waste, it is the only practicable solution.

Destruction efficiencies enabled by Selas-Linde waste oxidation systems are guaranteed

to meet European legislation and exceed the most demanding requirements anywhere in the world. We have successfully dealt with virtually every kind of hazardous and toxic waste. One example of many: A specially designed thermal system was selected for the US Army's program to destroy the nation's stockpile of obsolete chemical weapons, including nerve agents. A destruction efficiency of 99.999999% was achieved.

Submerged combustion vaporiser systems.

T-Thermal invented the submerged combustion vaporiser (Sub-X), filed it for patent protection and installed the first design unit at Alabama Gas in 1965. Since the acquisition of T-Thermal in 1992, Selas-Linde has continued to develop and supply a range of specialised units for heating and vaporising cryogenic fluids such as LNG, LPG, liquid nitrogen, oxygen, ammonia and ethylene. The technology has been applied in LNG terminals worldwide, for both base-load and peak-shaving duties.

Selas-Linde is the global market leader in the supply of submerged combustion vaporiser systems.

The Sub-X vaporiser is an assembly with the following major components:

- Vaporiser tank constructed in epoxy-coated carbon steel, stainless steel or concrete
- Sub-X burner complete with distribution duct and sparging system
- Heat exchanger coil
- Weir assembly
- Combustion air fan, motor, inlet and outlet silencer and acoustic housing as required
- Control panel and instrumentation package for hazardous area classification
- Optional cogeneration hot water distribution system



LNG vaporisers, Belgium.

High gross thermal efficiency rates approaching **100%** can be achieved.

Main advantages of the submerged combustion Sub-X vaporiser system.

Operational safety

The process tubes are submerged in a water bath and the tube wall temperature therefore does not exceed 55°C. There is no risk of flame impingement with LNG contact.

High thermal efficiency

With high heat flux and narrow temperature approach, high gross thermal efficiency rates approaching 100% can be achieved.

Fast response

Rapid start-up and shut-down without process disruptions.

Heat transfer rate

The bubble formation by direct contact heating and the use of a patented weir arrangement provides a high level of turbulence and excellent recirculation over tubes containing the cryogenic fluid, thus maintaining temperature uniformity. Observations of unit operations have indicated no ice build-up, even when operating with low bath temperatures.

High operational reliability

With the exception of facilities that have closed, all Sub-X LNG vaporisers installed since 1965 are still in operation.

Environmental impact

These units are designed to meet the new regulatory standards with very low NOx emission values.



Petrochemical Plant, Rafnes, Norway.

Dedicated to ease of business.

At Selas-Linde, we offer a lot more than the design and delivery of state-of-the-art plant components and process technologies. Our ultimate aim is to make doing business with us as easy and pleasant as possible.

As a world-leading engineering contractor for steam reformers, cracking furnaces, fired heaters, LNG vaporisers and incinerators, we offer our customers a streamlined, single interface for all technology, engineering, procurement and construction (T-EPC) services. We also work collaboratively with our clients to fulfil their project needs and agreed timelines – always taking operability, maintenance and regulatory requirements into account.

Whether revamp or greenfield projects, customers can thus rely on us for a one-stop, hassle-free project management service that covers every step in the solution lifecycle – from initial feasibility studies through basic and detail engineering to procurement and supervision of assembly, construction and start-up.



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Your partner for the production and processing of gases

Delivering reliable process plants for maximum capital efficiency

Linde has been optimizing gas processing technologies for 140 years, successfully delivering more than 4,000 plant engineering projects around the globe. Favoring trusted, lasting business relationships, the company collaborates closely with customers to enhance plant lifecycle productivity and innovate process flows. The company's proven gas processing expertise plays an indispensable role in the success of customers across multiple industries – from natural gas and oil refining through petrochemicals and fertilizers to electronics and metal processing.

Operational excellence along the entire plant lifecycle

We work closely with our customers to gain an in-depth understanding of individual needs. Building on the unique synergies of Linde as an integrated plant operator and engineering company, Linde offers innovative process technologies and services to exceed our customers' reliability and profitability expectations. This commitment to innovation extends along the entire plant lifecycle. The LINDE PLANTSERV® service team supports customers every step of the way – from maintenance and repairs to full revamps. Leveraging the latest digital technologies to offer on-site and remote operational and support services, we consistently take asset performance to the next level.

Making the impossible possible

From the desert to the Arctic, from small- to world-scale, from standardized to customized designs, Linde's engineering specialists develop solutions that operate under all conditions. The company covers every step in the design, project management and construction of gas processing plants and components. Customers can always rely on Linde to deliver the plants, components and services that fit their needs best – anywhere in the world.

Discover how we can contribute to your success at www.linde-engineering.com

Get in touch with our furnace and heater team:

Phone +49 89 7445-0, inquiry: www.linde-engineering.com/contact

Core competencies at a glance

Plant engineering

- Air separation plants
- LNG and natural gas processing plants
- Petrochemical plants
- Hydrogen and synthesis gas plants
- Adsorption plants
- Cryogenic plants
- Carbon capture and utilization plants
- Furnaces, fired heaters, incinerators

Component manufacturing

- Coldboxes and modules
- Coil-wound heat exchangers
- Plate-fin heat exchangers
- Cryogenic columns
- Cryogenic storage tanks
- Liquefied helium tanks and containers
- Air-heated vaporizers
- Water bath vaporizers
- Spiral-welded aluminum pipes

Services

- Revamps and plant modifications
- Plant relocations
- Spare parts
- Operational support, troubleshooting and immediate repairs
- Long-term service contracts
- Expert reviews for plants, operations and spare part inventory
- Operator training

