



LINCOLN[®]
ELECTRIC

CHEMICAL PROCESSING

WELDING & CUTTING SOLUTIONS



The Lincoln Electric Company

Founded in 1895 by John C. Lincoln, The Lincoln Electric Company is the world leader in the design, development and manufacture of arc welding products, robotic arc welding systems, plasma and oxyfuel cutting equipment and has a leading global position in the brazing and soldering alloys market. Headquartered in Cleveland, Ohio, Lincoln Electric has a global network of manufacturing, distribution, sales and technical support covering more than 160 countries.

INNOVATION

With a long history of innovation in arc welding equipment and consumables, Lincoln Electric has been providing cutting-edge products and comprehensive welding process solutions to our customers for nearly 120 years. We operate the industry's most comprehensive research and product development program, supported by our R&D centers around the world.

CUSTOMER COMMITMENT & SUPPORT

High-quality products and great customer service are important aspects of the Lincoln Electric story, but it's our unmatched welding expertise that truly sets us apart. If there's a better way for you to weld, we'll help you find it. If automation can improve your bottom line, we'll guide you through the decision-making process. If there's a method that can help you reduce costs, we'll show you how – and why.



We are driven by customer satisfaction and known as the supplier of choice in the many industries we serve. We continuously strive to exceed customer expectations and are not simply known as a provider of equipment and consumables, but as a provider of complete welding solutions.



THE CHEMICAL PROCESSING INDUSTRY

Welding Solutions to Meet the Most Demanding Requirements – Yours.

INDUSTRY CHALLENGES

Whether it's a large petroleum refinery or a small specialty chemical plant, the chemical processing industry poses some of the greatest and most critical challenges to welding. The industry handles a large variety of materials, many of them corrosive, volatile or toxic. When dealing with such materials, quality welding is of critical importance. Pipelines, valves, distillation columns and pressure vessels must operate reliably in highly-corrosive environments and withstand extreme temperatures and pressures.

Lincoln Electric understands the critical nature of welding requirements in the chemical processing industry. We know the requirements of temperature, pressure and corrosion extremes. Whether welding on standard-grade materials or with X-Factor requirements, Lincoln Electric provides a complete range of consumables, equipment and processes to meet the industry's exacting standards for quality and productivity.

LINCOLN ELECTRIC PROVIDES SOLUTIONS

Our industry specialists are knowledgeable in virtually every joining, cutting and cladding process used in the industry. We offer a full matrix of matching equipment and consumable solutions engineered to meet the welding requirements for all types of base materials, including the exotic steels and corrosion-resistant alloys common to the chemical processing industry.

Lincoln Electric partners with MRO contractors and subcontractors, so we understand how critical it is to complete turnaround projects on time and under budget. And we remain committed to advancing the science and technology of welding for customers in the chemical processing industry. That's why we invest in the largest application engineering, automation and R&D support centers in the welding industry. Highly trained and experienced technologists, engineers and applications experts are available to customers to troubleshoot problems in the field and develop new process or consumable solutions on actual customer parts. This industry-leading technical support team has one focus – providing you with the best welding solutions for your specific needs.





OIL & GAS DOWNSTREAM

OIL REFINING

Refineries are very complex chemical plants with five process operations that must perform over a wide range of temperatures, pressure levels, and corrosive environments to convert crude oil into fuels and feedstocks for other chemical manufacturing processes.

- **Fractionating** the various constituent molecules, such as crude oil distillation.
- **Cracking**, such as fluid catalytic cracking (FCC) or hydrocracking, where larger molecules are converted to smaller ones.
- **Hydrotreating** to improve the performance of fuels by reducing sulfur, aromatics, nitrogen, oxygen, and metals.
- **Reforming** the molecules using a catalytic reformer.
- **Conversion** of small-chain hydrocarbons into larger molecules, such as the alkylation units.

While significant amounts of mild steel is used in a refinery, a wide range of welding consumables are used for joining and overlay. Mild steel, creep resistant CrMo alloys, 300 series stainless steel, and nickel alloys are used in the various operations of a refinery that include distillation columns, reactors, steam boilers, heat exchangers, storage tanks and spheres, direct fired furnaces, pressure vessels and piping.

Best-Fit Solutions

Consumables

- » Mild Steel – Excalibur®, SuperArc®, SuperGlide®, Hyrod, Baso®, Conarc
- » Creep-Resistant CrMo B2 and B3 Alloys – Chromet® Series, Cormet®, Ultramet®, Tufmet, SL Series
- » Stainless Steel 300 and 400 Series – Lincolnweld®, Excalibur, Ultramet, LNT Series, LNM Series
- » Nickel Alloys – Techalloy®, Nimrod

Equipment

- » SAW: Power Wave® AC/DC 1000® SD
- » SMAW & GMAW: Power Wave S350/S500 with Advanced Process Module

GAS PROCESSING

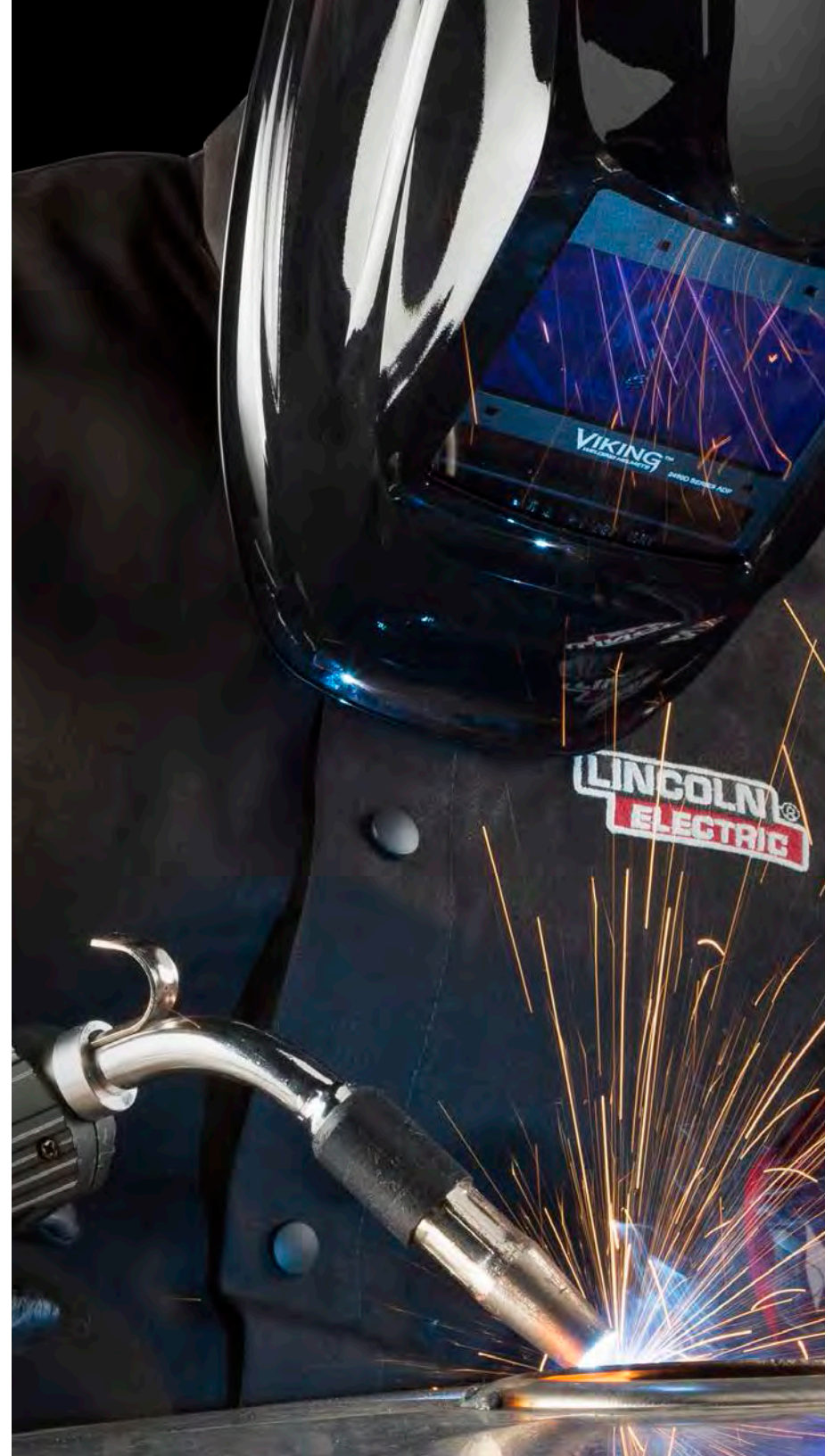
In order to be used as a fuel or a feedstock for such chemical operations as ammonia, methanol and ethylene, natural gas must be treated in gas processing plants to clean up the gas and to separate the constituent components, primarily methane, ethane, propane and butane. This is true for plants constructed at a gas field or at a refinery to process refinery gases. With increasing amounts of sour gas (high sulfur) gases being processed, corrosion-resistant alloys are required. A processing plant may need different metals either as base material or weld overlay depending on the nature of the sour gas. Alloys such as 308LCF/316LCF, 316, 347, Alloy 825 or Alloy 625 weld overlay is required. Use of carbon steel as well as low alloy and chrome-moly alloys are also used for non-corrosive structural applications. Lincoln Electric provides a full spectrum of consumable products to meet these needs via our Lincolnweld®, Metrode®, Techalloy® and Weartech® portfolios.

OLEFINS AND AROMATICS

Olefins (such as ethylene and propylene) and aromatics (benzene, toluene and xylene) are the key building blocks for the petrochemical industry. Naphtha from oil refining has been the primary process to produce olefins and aromatics. The recent exploitation of shale natural gas has led to a paradigm shift toward ethane cracking to produce ethylene.

In both processes, a cracking furnace is used for steam/catalytic reforming. In the case of naphtha, it is cracked in the furnace by being heated to 1,150 °C. With ethane, the cracking temperature is 900 °C. In both cases the cracked hydrocarbons are then quenched in oil/water columns, compressed and then cryogenically separated. From naphtha, olefins and aromatics are produced. With ethane the primary product is ethylene. The liquefied materials range from -120 °C to -150 °C.

Joining alloys for these processes are 35.45 for the cracking furnace, C-Mn and 316L for the fractionators, and 1-, 2.5- or 3-percent Ni for storage tanks. For weld overlays, alloys 308L 316L and 625 are most often used.





CHEMICAL INDUSTRY

The chemical industry is made up of two sectors, the inorganic sector and the organic sector. The inorganic sector is the largest, including all of the chemical processes using inorganic raw materials. Some of the major products are chlor-alkali plants producing chlorine and sodium hydroxide (caustic soda); nitric acid, a key feedstock for fertilizer; ammonia, a feedstock for nitric acid and ammonium nitrate derived from natural gas; sulfuric acid; phosphoric acid; hydrochloric acid (muriatic); and urea.

The organic sector consists of those chemicals derived from oil, natural gas, coal, plants and animals that are processed to olefins, aromatics, organic acids and biofuels. Further processing leads to consumer products such as plastics, paints, fibers, adhesives, fertilizers, pesticides and many other products. Some common organic chemicals are acetic acid, vinyl chloride, cellulose esters, ethanol, and fatty acids.

Stainless steels, such as 304L and 316L are used extensively, as is carbon steel. Duplex, super duplex and nickel/nickel alloys are also used in corrosive environments.

FOOD & BEVERAGE

This industry covers a wide range of products produced in distilleries, breweries, food processing plants and storage facilities. Due to the consumption of the products, there are very stringent requirements to avoid contamination. Equipment used in this includes: storage tanks, pressure vessels, process vessels, piping, mixers and distillation systems.

The most commonly used material group is 300 series stainless, chosen for its corrosion resistance and sanitary properties. This includes 304L, austenitic steels and Mo alloyed 316L. Other alloys are increasingly used in more severe environments such as duplex, lean duplex, and super duplex.

PHARMACEUTICALS

The production of pharmaceutical products utilizes equipment very similar to other sectors. As with Food & Beverage, avoiding contamination is critical. For this reason, 304L and 316L are used for most applications.

DESALINATION

The removal of salts from seawater to create fresh water for industrial, agricultural, potable supply is critical in many parts of the world. There are two main processes for desalination- distillation and reverse osmosis (RO). For large-scale operations distillation is used. Due to the use of seawater, corrosion is a major issue. Base materials used are 316L, duplex, CuNi, and NiCu (Alloy 400).



The Six Stages of Paper Production:

- » **Digesters** - cooking of the wood chips at around 175 °C in the alkaline solution. Duplex provides very good results in this environment.
- » **Washing and Screening** - 304L and 316L have been replacing mild steel. Duplex is finding increasing use.
- » **Bleaching** - In this stage, the pulp is treated to whiten it. Concerns about organo-chlorine into the environment have led to the development of TCF (Total Chlorine Free) bleaching, ECF (Elemental Chlorine Free) bleaching. Typical base materials include alloys 904L, C276 and S31254.
- » **Evaporators** - multi-stage boiler to recover the black liquors. Duplex and lean duplex are being used in preference to 304L that has replaced carbon steel.
- » **Towers and Tanks** - 304L is suitable but lean duplex and duplex are becoming more common.
- » **Paper Mill** - 316L, 317 as well as duplex grades due to reduced water usage resulting more corrosive environments.

PULP & PAPER

Pulp & Paper mills require quite a varied number of materials due to the specific chemical environments in each stage of processing. The kraft process is used for the conversion of wood chips into wood pulp consisting of almost pure cellulose fiber. It involves the treatment of the wood chips with sodium hydroxide and sodium sulfide that breaks the bonds that link the lignin to the cellulose.

Lincoln Electric provides filler metals to match the full spectrum of base materials used in the construction of pulp & paper mills, including complete solutions for mild steel, stainless, duplex/lean duplex and nickel alloys.



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CUSTOMER ASSISTANCE POLICY

The business of The Lincoln Electric Company® is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for information or advice about their use of our products. Our employees respond to inquiries to the best of their ability based on information provided to them by the customers and the knowledge they may have concerning the application. Our employees, however, are not in a position to verify the information provided or to evaluate the engineering requirements for the particular weldment. Accordingly, Lincoln Electric does not warrant or guarantee or assume any liability with respect to such information or advice. Moreover, the provision of such information or advice does not create, expand, or alter any warranty on our products. Any express or implied warranty that might arise from the information or advice, including any implied warranty of merchantability or any warranty of fitness for any customers' particular purpose is specifically disclaimed.

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

Subject to Change – This information is accurate to the best of our knowledge at the time of printing. Please refer to www.lincolnelectric.com for any updated information.



MC13-164