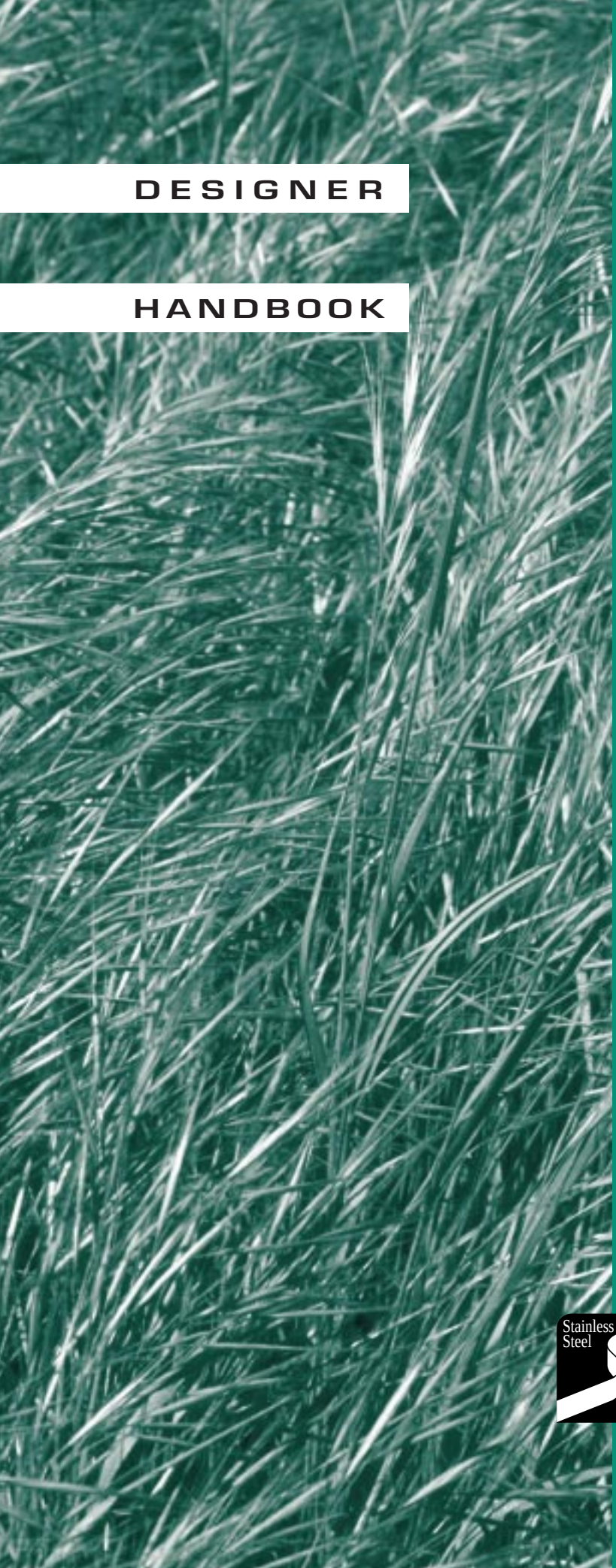

DESIGNER

HANDBOOK

STAINLESS STEEL THE GREEN MATERIAL

Stainless Steel
The Value Option®

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SOCIETY HAS BECOME INCREASINGLY CONCERNED WITH THE HEALTH OF THE NATURAL ENVIRONMENT AND THE ROLE OF MATERIALS IN IMPACTING THE ECOSYSTEM.

The recognition of and response to environmental concerns is often called "greening." The "greenness" or quality of environmental performance is leading some to consider this in materials selection.

This designer handbook will attempt to outline the numerous environmental considerations associated with the production, use and **recyclability** of stainless steel. Environmental evaluation criteria are identified and the performance of stainless steel against these criteria is noted in order to assess the "greenness" of stainless steel. In order to understand and evaluate stainless steel as a material, a brief description of the production process is outlined below:

Exhibit 1 (see page 5) illustrates the typical process for making a variety of stainless steel products. The first step is the selection of "raw material." This consists of **recycled** stainless steel scrap (usually 75 to 85% of the furnace charge) plus alloying elements such as chromium, nickel, molybdenum and others that will make up the composition of the particular type of stainless steel being produced. This material is then charged into an electric furnace where it is melted. Once liquefied, this charge is then transferred to an AOD (Argon Oxygen Decarburization) vessel, where the carbon content is reduced and the final chemistry is obtained. The gaseous releases from both of these operations are collected and the dust **recycled** to reclaim the metallic compounds. The liquid stainless is then poured into a continuous casting machine (or possibly into individual ingot molds) where it solidifies into slabs or ingots. The slabs (or ingots) are then reheated and rolled or forged into hot bands (for sheet & strip products) or billets (for bar & wire products) or plates or structural shapes. Hot rolled sheet can then be further processed by cold rolling into cold rolled sheets and strips. Billets can be either hot rolled further into hot rolled bars or rods. Bars can be cold finished by turning or machining. Rods can be further processed by drawing into wire.

Table 1 shows the classifications of various stainless steel product forms.

Further information can be found in the Designer Handbooks available from the Specialty Steel Industry of North America (SSINA).

WHAT IS STAINLESS STEEL?

Stainless steel is not a single alloy but rather the name applies to a group of iron based alloys containing a minimum of 10.5% chromium. Other elements such as nickel and molybdenum are added and the chromium content increased to improve corrosion resistance, improve heat-resisting properties, and/or to improve fabricating characteristics. There are over 60 stainless steel grades that were originally recognized by the American Iron and Steel Institute (AISI). It is the presence of chromium that creates the invisible surface layer that prevents the rusting of the iron base by forming a complex chrome oxide that will not let oxygen attack the surface.

Three general classifications are used to identify stainless steel. They are:

1. Metallurgical structure.
2. The AISI numbering system (200, 300, 400 series).
3. The Unified Numbering System, which was developed by the American Society for Testing Materials (ASTM) and the Society of Automotive Engineers (SAE) to apply to all commercial metals and alloys.

The various types of stainless steel are detailed in a designer handbook, *Design Guidelines for the Selection and Use of Stainless Steel*, available from the SSINA.

STAINLESS STEEL INDUSTRY

The stainless steel industry is a group of companies that produce or process stainless steel products. Most belong to the Specialty Steel Industry of North America (SSINA), a trade association based in Washington, DC. A listing of member companies is contained on the back cover of this handbook.

Table 1 CLASSIFICATION OF STAINLESS STEEL PRODUCT FORMS*

ITEM	DESCRIPTION	DIMENSIONS		
		Thickness	Width	Diameter or Size
Sheet	Coil and cut lengths: Hot Rolled No. 1	under 0.1875" (4.76mm)	24.000" (609.6mm) and over	—
	Cold Rolled No. 2D, 2B, Bright Annealed, TR	under 0.1875" (4.76mm)	24.000" (609.6mm) and over	
	Polished No. 3, 4, 6, 7 & 8	under 0.1875" (4.76mm)	24.000" (609.6mm) and over	
Strip	Coils and cut lengths: Hot Rolled No. 1	under 0.1875" (4.76mm)	under 24.000" (609.6mm)	—
	Cold Rolled No. 2D, 2B, Bright Annealed, TR	under 0.1875" (4.76mm)	under 24.000" (609.6mm)	
	Polished No. 3, 4, 6, 7 & 8	under 0.1875" (4.76mm)	under 24.000" (609.6mm)	
Plate	Coils and cut lengths: Hot Rolled, annealed & pickled	0.1875" (4.76mm) and over	over 10.000" (254mm)	—
	Polished available for special applications	0.1875" (4.76mm) and over	over 10.000" (254mm)	
Bar	Straight lengths: Hot finished rounds, squares, octagons and hexagons	—	—	0.250" (6.35mm) and over
	Hot finished flats	0.125" (3.18mm) and over	0.250" (6.35mm) to 10.000" (254mm)	—
	Cold finished rounds, squares, octagons and hexagons	—	—	0.062" (1.59mm) and over
	Cold finished flats	—	0.375" (9.53mm) and over	—
Rod	Hot Rolled coils may be annealed and/or descaled	—	—	0.200" (5.54mm) and over
Wire	Cold finishes only: Rounds, squares, octagons and hexagons	—	—	0.500" (12.7mm) and under
	Flat wire (coils only)	0.010" (0.254mm) to under 0.185" (4.76mm)	0.062" (1.59mm) to under 0.375" (9.53mm)	
Pipe & Tube	Several different classifications with differing specifications are available. For information on standard sizes, consult your local Steel Service Center or the SSINA.			
Extrusions	Not considered "standard" shapes, but available. Currently limited in size to approximately 6.50" (165.1mm) diameter circle, or structural to 5.00" (127mm) diameter.			

** Ingots, Slabs, Hot Bands, Angles and Rolled Shapes are also available*

CRITERIA FOR EVALUATING THE "GREENNESS" OF STAINLESS STEEL

A wide variety of criteria exists that can be used to evaluate the environmental performance of stainless steel, as shown below.

Criteria for Evaluating the Greenness of Stainless Steel

1. Environmental Principles
2. Environmental Management Systems
3. Materials, Energy, Water Usage
4. Pollution Prevention
5. Waste Minimization
6. Recycling
7. Environmental Compliance Evaluations
8. Participation in Cooperative Environmental Councils and Partnerships
9. Communication of Environmental Activity
10. Environmental Releases and Sustainable Relationship with the Natural Environment

1 ENVIRONMENTAL PRINCIPLES

It is necessary to guide many corporate environmental actions. Therefore, developing an environmental policy is one of the most important components of environment management. Many of the producers of stainless steel in North America have such a policy. Additionally, the SSINA has a statement of environmental principles. These principles are consistent and similar to the environmental policy of individual companies.

SSINA member companies are committed to operating their facilities in compliance with applicable federal, state and local environmental laws and regulations, the promotion of environmentally and scientifically-sound and cost-effective corporate and public policies, while simultaneously fostering continued economic growth. To fulfill this long-standing commitment, SSINA has adopted the following guiding principles:

- Develop and integrate environmental programs into corporate policies and procedures.
- Manage raw materials, byproducts, co-products, and wastes in compliance with applicable federal, state, and local environmental laws and regulations.
- Consider environmental impacts when evaluating new projects, technologies, and manufacturing processes.
- Promote the conservation of natural resources, pollution prevention and minimization, and the legitimate **recycling** and reuse of materials in manufacturing processes.
- Encourage the research and development of improved manufacturing and environmental technologies and the wider use of long-lasting, **recyclable** specialty steel products.
- Foster employee awareness of their environmental responsibilities within corporate policies.
- Respond appropriately to community and customer information requests.

2 ENVIRONMENTAL MANAGEMENT SYSTEMS

Commitment from top management is critical for the success of environmental management efforts. SSINA member companies have established an Environmental Affairs Department analogous to the marketing and finance departments, or designated individuals, which address environmental issues and interact with business units in the corporation and regulatory agencies to assure compliance with environmental regulations.

3 MATERIALS, ENERGY, WATER USAGE

The environmental impact of the use of raw materials, energy, and water in the production of stainless steel is outlined below:

RAW MATERIAL: **Recycled** stainless steel or other alloy scrap containing the basic elements that will form stainless steel after melting in the electric furnace. Scrap is inspected for quality, content, and radiation as it enters the facilities. NOTE: Stainless steel is 100% **recyclable** and all available stainless steel scrap is collected for **recycling** both from within the plant itself and from customers and fabricators after a useful life in the marketplace. **Stainless steel does not require a surface coating that can deteriorate to possibly pollute the environment.**

ALLOYING ELEMENTS: Generally consist of ferro-chrome and ferro-nickel that are mined and refined before being delivered to the plant site. Environmental considerations for these products can be obtained from the International Chromium Development Association and the Nickel Development Institute.

SLAG: A byproduct of the electric furnace melting operation. It is collected, metals reclaimed, and the aggregate produced for reuse or supply to other industries for use, such as road bed material.

ENERGY: The electric furnaces that are used to melt the raw materials are state-of-the-art with computer controls to ensure the efficient use of electric power. Many companies contract with the utility companies to use off-peak power and/or to level power usage in high demand periods.

WATER USAGE: Water is used mainly as a cooling medium. Applications include use of a heat exchange medium for non-contact cooling process during hot rolling and in the "pickling" (acid wash) treatment after rolling. Many companies **recycle** most of their cooling waters up to 100 times prior to discharge.

4 POLLUTION PREVENTION

AIR EMISSIONS: The air emissions from the electric furnaces and AOD vessel are collected via a series of ductwork and hoods, then routed to a high efficiency fabric filter (bag house) where the solid particles are collected and processed for metals recovery. The air emissions from acid pickling are collected and routed to a fume scrubber to remove the acid mists. Many acid pickling operations include chemical fume scrubbers for a greater level of removal.

WATER TREATMENT: All plant water is collected and passed through a treatment facility. Wastewater is generated from many different sources. Waters are treated and re-used to the maximum extent feasible through the use of clarification and filtration equipment that meets best available technology standards. Acid metering equipment and acid recovery equipment are utilized in the pickling process to minimize waste and recover used acid.

5 WASTE MINIMIZATION

Wherever possible, minimization of waste is a major objective in the stainless steel industry. All discarded pieces of product (such as the tail ends and edge trims) are collected and segregated by type and returned to the electric furnace as **recycled** in-house scrap. Packaging usually consists of wrapping paper, steel bands, and wooden cradles, all of which can and are **recycled** to reduce solid waste generation.

6 RECYCLING

As mentioned in the section on waste minimization all stainless steel products are 100% **recyclable** and have value even after a very long life as capital goods or consumer products. Products like fast food equipment, automotive exhaust systems, kitchen sinks, boat shafting, aircraft parts, building roofs, etc., can all be fully **recycled** after a useful life. In fact the long life of stainless steel products contributes to resource minimization, since new resources are not needed as often to replace corroded or failed products. Stainless steel is collected by metal scrap dealers all around the world and sent back to the melt shop for use in producing new stainless steel. The stainless steel that is processed in the electric furnace is of the same quality as the original and is not "downgraded" as is the case with some other so-called **recycled** materials.

7 ENVIRONMENTAL COMPLIANCE EVALUATIONS

Environmental compliance evaluations involve examining the procedures and practices to see if they meet legal and internal requirements for good environmental practice. The member companies of the SSINA use such practices.

8 PARTICIPATION IN COOPERATIVE ENVIRONMENTAL COUNCILS AND PARTNERSHIPS

The stainless steel industry is involved with various governmental and environmental councils and partnerships. The industry and one member company was a participating member in a task force named the *Common Sense Initiative*. The mission of the task force, chaired by the Administrator of the U.S. Environmental Protection Agency, was to streamline regulations. Also, most member companies were participants in the federal 33/50 Program. This voluntary program reduced the release and transfer of 17 targeted chemicals nationally by 50% based on 1994 TRI data. Member companies also participate at the local levels by involvement in programs such as River Sweep, various watershed associations, pollution prevention roundtables, Boy Scouts, regional air quality partnerships, county picnics, leadership rolls in LEPC (Local Emergency Planning Commission), Wild Turkey Federation, Ducks Unlimited, private game reserves, wetlands recovery projects, and partners in spill response activities. They provide technical assistance upon request. Member companies in Pennsylvania have collectively been awarded the "Pennsylvania Governor Award for Environmental Excellence," receiving five awards in the past ten years.

9 COMMUNICATION OF ENVIRONMENTAL ACTIVITY

A measure of an organization's commitment to the environment is its level of communications. Member companies have various levels of mechanisms to communicate environmental information to others. Typical examples include: employee newspapers, environmental training for employees, web pages, press releases, disclosure statements in 10K forms, annual reports, environmental reports, SSINA publications, presentations to schools, chambers of commerce, Rotary clubs, etc.

10 ENVIRONMENTAL RELEASES AND SUSTAINABLE RELATIONSHIP WITH THE NATURAL ENVIRONMENT

One of the most commonly used indicators of environmental performance is the amount of hazardous and waste material released. The specialty steel industry generates hazardous electric furnace dust and waste pickle liquor. One hundred percent of the industry's electric furnace dust is **recycled** for metals recovery purposes and therefore not discharged into the environment. Most companies operate acid recovery units to minimize generation of waste pickle liquor. All companies either **recycle** or treat waste pickle liquor, rendering it non-hazardous prior to disposal.

HEALTH

A study by EUROFER (European Confederation of Iron and Steel Industries) published in January 1999 entitled *"Manufacture, Processing and Use of Stainless Steel: A Review of the Health Effects"* **CONCLUDED:**

1. Stainless steels themselves do not cause adverse effects on health and so do not need to be classified as hazardous to health.
2. There is no indication from the available data that the manufacture of stainless steel adversely affects the health of workers.
3. The grinding and cutting of stainless steel do not appear to cause any adverse health effects.
4. The welding of stainless steel does not cause any stainless-steel-specific increase in the risk of lung cancer over and above the increased risk from any steel welding.

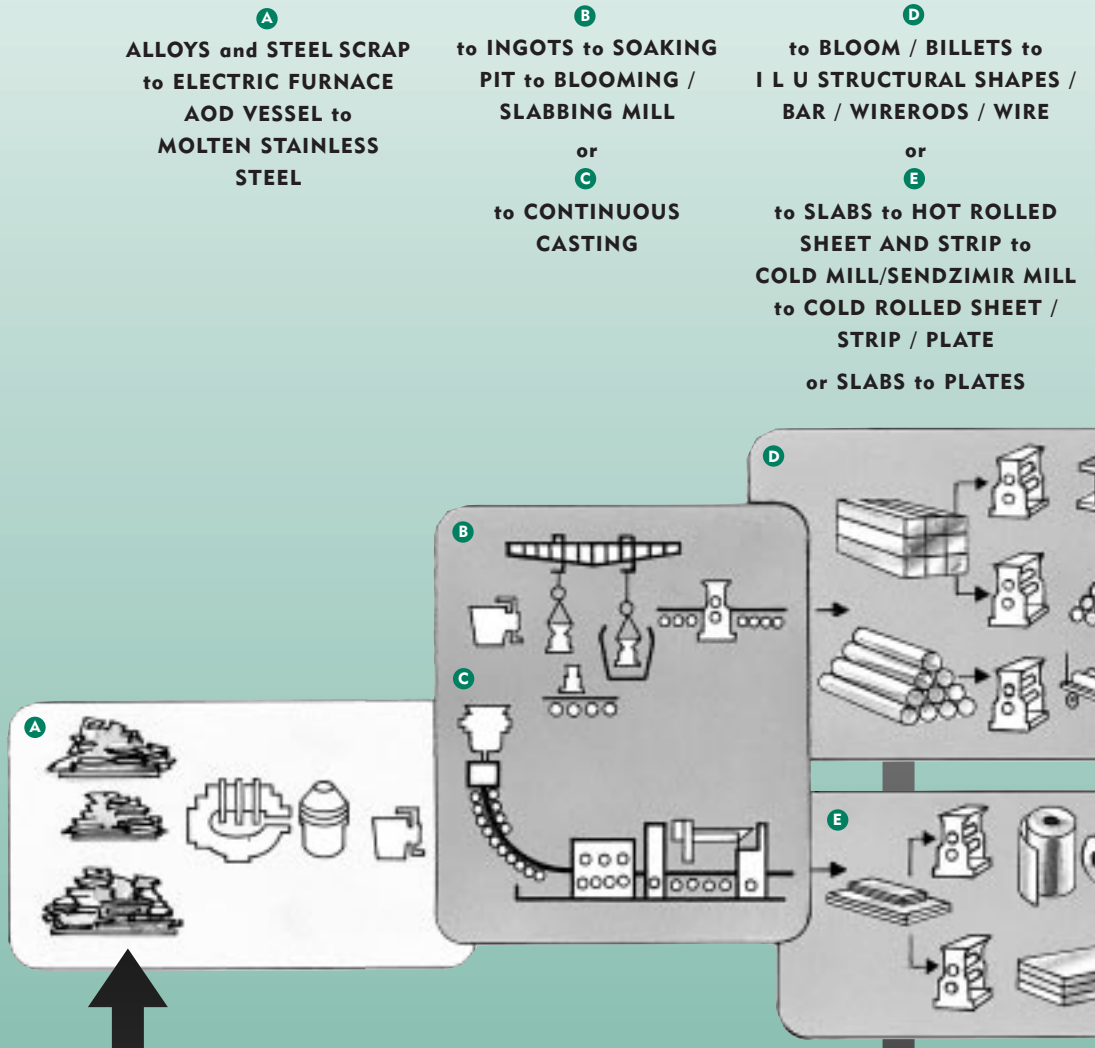
PUBLICATIONS AVAILABLE

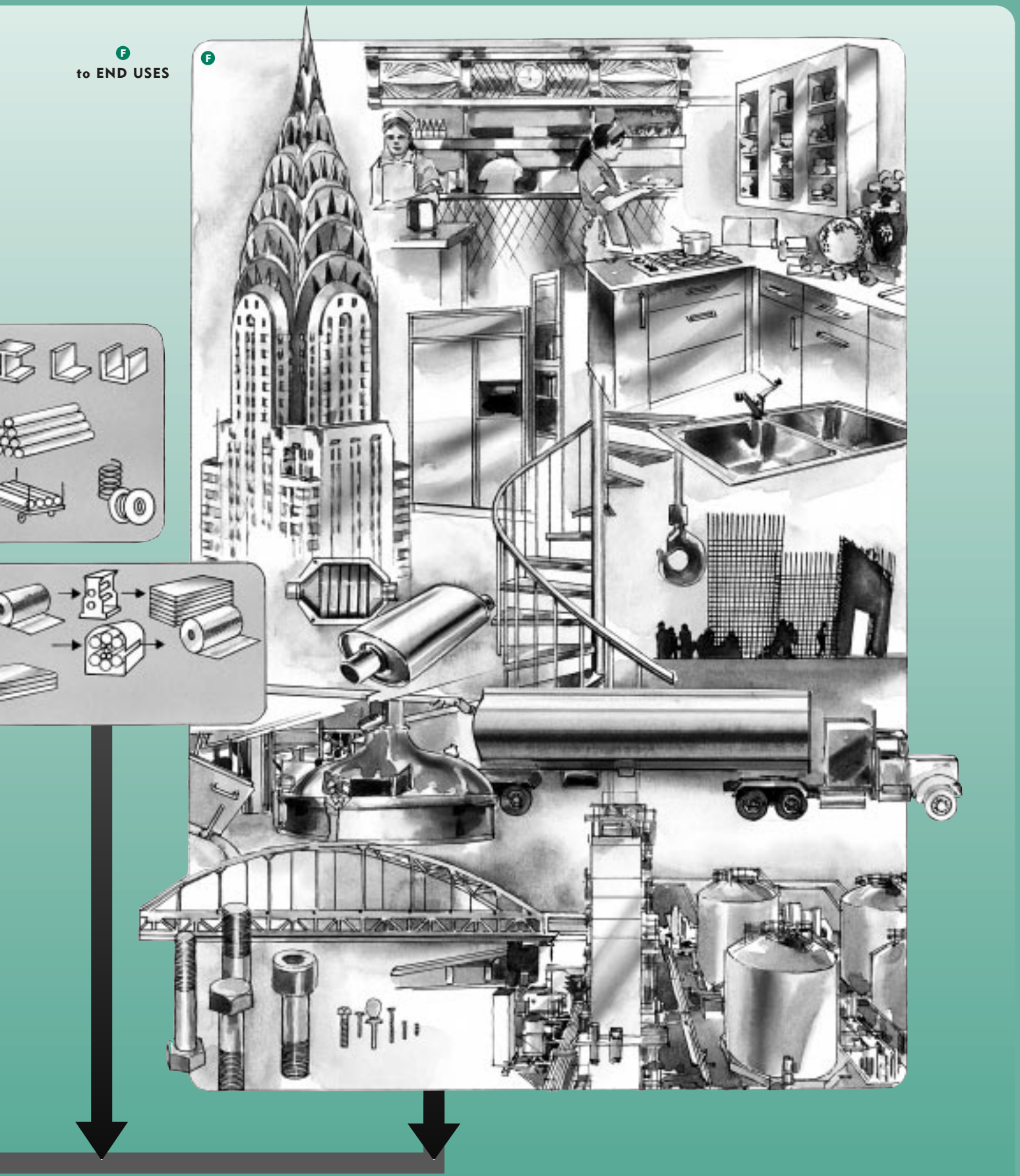
"Full Life Cycle of Stainless Steel – The Right Material for our Environment"

Published by the SSINA

"Manufacture, Processing, and Use of Stainless Steel: A Review of the Health Effects"

Published by EUROFER (January 1999)

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