Cold-Rolling Laboratory

This laboratory includes a four-high single stand cold reduction mill, which processes 12-inch-wide strip at a maximum speed of 500 fpm. The mill is fully instrumented to obtain all engineering information relevant to the cold-rolling process. The unit is used to refine the rolling operations in U. S. Steel and to develop practices for processing new sheet and tin-mill products. A small, two-high cold mill is also available for temper rolling studies on smaller steel specimens.

Formability and Heat Treating Laboratory

This laboratory includes box and tube furnaces for heat-treating studies including quench and temper studies and Jominy tests. A heat-treating simulator is available that reproduces the batch annealing process for sheet and tin-mill products. The simulator is capable of using various atmospheric gases and annealing temperature cycles.

Electroplating Laboratory

This laboratory consists of extensive bench scale and circulation flow-cell facilities to simulate continuous strip electroplating processes. Flow cells can produce plated panels 2.5 inches by 8 inches and 8 inches by 12 inches, which are large enough for formability studies. The equipment is used to develop new coatings for sheet and tin-mill applications.

Electrical Steels Laboratory
This laboratory houses various processing and testing facilities for evaluating cold-rolled magnetic lamination steels used in the manufacture of motors, transformers, ballasts and other electrical devices. The laboratory facilities include QDA furnaces, AC and DC magnetic testers and an interlaminar resistance tester.

**Canmaking Line**

This laboratory is used to determine optimum tooling for lighter, stronger, lower-cost steel cans. Both drawn and ironed draw-redraw canmaking equipment is available.

**Paint Laboratory**

This laboratory is used to duplicate the preparation and painting operations used in the appliance and automotive industries. The equipment is capable of cleaning, phosphating and electrocoating steel panels for subsequent paint and corrosion evaluation.

**Corrosion Laboratories**

These laboratories are used to evaluate product performance for various markets. Accelerated environmental exposure cabinets, including humidity and salt fog, are used to evaluate a range of product performance attributes for automotive, appliance and metal building applications. Sulfide stress cracking and hydrogen sulfide testing are used for tubular products.

**Enameling Laboratory**
This laboratory is capable of applying the one-coat and two-coat powder techniques and of firing under controlled furnace conditions. This equipment is used to determine optimum processing for Vitrenamel® steels and to aid in evaluating the use of our steel by customers.

Processing Facilities

These facilities include the following: (1) 500-lb. air and vacuum induction melting furnaces with a new solid-state power supply and accompanying ingot casting equipment; (2) a one-million-pound separating force two-high, single-stand, reversing hot-rolling mill with two accompanying reheate furnaces, computer-controlled pass schedules, and a state-of-the-art, computer-controlled water spray, direct quenching and accelerated cooling facility. These facilities are used to prepare experimental steels for new product development and to conduct thermomechanical processing studies to improve the properties of existing hot-rolled and tubular steels.

Tin Mill Product Laboratory

This laboratory includes test equipment for measuring oil film thickness and tin coating weights. The laboratory is also used for lacquer application and the evaluation of lacquered tin-mill products.

Mechanical Testing Facilities

These facilities include automated tension test and hardness equipment with computer data storage and plotting, and numerous pieces of conventional hardness and tension test equipment used to support product development and customer application projects for the section.

Metallographic Facilities
These facilities are used to support plant, development and customer service projects for the entire U. S. Steel Research and Technology Center. The equipment in this facility includes:

- LEO SUPRA 25 Field-Emission Scanning Electron Microscope (SEM) with EDAX integrated Electron Backscattered Diffraction (EBSD) and Energy Dispersive Spectroscopy (EDS) System
- JEOL JSM-6400 SEM with EDS
- Spectra-Tech Irµs microscope Fourier-Transform Infrared Spectrometer (FTIR)
- Physical Electronics PHI-560 Auger Electron Spectrometer/Electron Spectroscopy for Chemical Analysis (AES/ESCA)
- Rigaku RU200B X-Ray Diffractometer with Rotating Anode
- Metallographic optical microscopes with digital cameras and image analysis software
- Auxiliary support equipment for preparation of metallographic specimens

**Welding Facilities**

**Fracture and Mechanical Testing Facilities**

These facilities include: (1) a Vibrofore fatigue testing/CTOD precracking machine; (2) various smaller capacity MTS hydraulic machines for fatigue testing and precracking specimens; (3) a 440-kip MTS hydraulic machine for CTOD fracture toughness testing of large specimens; (4) a 10,000 ft.-lb. capacity dynamic tear testing facility; and (5) numerous pieces of conventional hardness and tension test equipment located throughout the Research and Technology Center. The fracture toughness testing equipment is used for special heavy product development projects, and
the conventional test equipment is used to support plant, development and customer application projects for the entire U. S. Steel Research and Technology Center.

These facilities include: (1) AC and DC spot welding units for sheet product studies; (2) various tungsten, metal inert gas and flux core welding equipment for studies of all product lines and plant equipment repair; and (3) single and multiple wire submerged-arc welding equipment for heavy product projects.

**Iwatani-Rhesca Hot Dip Process Simulator (HDPS)**

This is a state-of-the-art unit that provides a realistic simulation of annealing and hot dip coating processes on a laboratory scale. It is the first simulator with air or nitrogen wiping, induction heating, gas humidifying and two pots fully integrated into the control system. It provides the capability to develop and evaluate product and process improvements, metallurgical and coating properties for new steels, such as automotive high-strength formable steels, exposed galvanneal and galvanize, and GALVALUME®, galvanize and new coatings for construction and appliances. It allows ongoing facility process problem solving for the U. S. Steel and joint venture hot dip and continuous annealing lines. The HDPS eliminates part of the expense of using production units to conduct trials and allows experiments that could not be conducted at current facilities.

**Gleeble 3500 Thermomechanical Test System**

This equipment couples the ability to apply thermal cycles and mechanical deformation to materials specimens. Direct resistance heating is applied to the test specimen according to a prescribed time-temperature cycle input with the system’s workstation computer. The ability to program a desired thermal cycle allows users to simulate such processes as welding and continuous annealing. Also, dilatation measurements can be made during the thermal program, which forms the basis for determining phase
transformation temperatures. Concurrent to the thermal processing, specimens can be deformed in tension or compression. An example application of this type of testing is using high temperature tensile tests to determine hot ductility for specific steel chemistries. This hot ductility data can then be applied to cooling patterns during continuous casting to help prevent cracking.