



# 2009 Minerals Yearbook

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## CHROMIUM

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In 2009, the U.S. chromium supply (measured in contained chromium) was 141,000 metric tons (t) from recycled stainless steel scrap, 273,000 t from imports, and 162,000 t from Government and industry stocks. Supply distribution was 280,000 t to exports, 136,000 t to Government and industry stocks, and 160,000 t to apparent consumption. Chromium apparent consumption decreased by 63.0% compared with that of 2008. Historically, chromium ferroalloys have replaced chromite ore as the leading source of chromium to the U.S. economy. Stainless steel mill products have been accounting for an increasing share of chromium supply to the domestic economy, now rivaling that of ferrochromium. Because stainless steel mill products contribute a significant amount of chromium to the domestic economy, trade in these products has been incorporated into chromium trade statistics, and their contribution has been accounted for in chromium apparent consumption.

## Domestic Data Coverage

Domestic data for chromium materials were developed by the U.S. Geological Survey (USGS) by means of the monthly “Chromite Ores and Chromium Products” and “Consolidated Consumers” consumer surveys. Stainless and heat-resisting steel producers are the leading chromium consumers, and high-carbon ferrochromium is the leading chromium-containing material consumed.

## Legislation and Government Programs

The Defense National Stockpile Center (DNSC) disposed of chromium materials under its fiscal year 2009 (October 1, 2008, through September 30, 2009) Annual Materials Plan (AMP) and announced the fiscal year 2010 plan. The DNSC’s fiscal year 2010 AMP set maximum disposal goals for chromium materials at 90,700 t of chromium ferroalloys and 907 t of chromium metal (Defense National Stockpile Center, 2009).

## Production

The major marketplace chromium-containing materials are chromite ore and foundry sand; chromium chemicals, ferroalloys, and metal; and stainless steel. In 2009, the United States produced chromium chemicals, ferroalloys, and metal, and stainless steel. The United States is a major world producer of chromium chemicals, chromium metal, and stainless steel.

Industrial Minerals Corp. Ltd. (Australia) (IMC) conducted the Oregon Resources Project (ORP) to recover chromite from its paleo-beach placer (heavy-mineral sand) deposits in Coos County, OR. IMC reported proved chromite ore reserves of 7,876,847 t at an average grade of 7.50% Cr<sub>2</sub>O<sub>3</sub>. IMC planned to

start construction of the main processing facilities at Coos Bay (Industrial Minerals Corp. Ltd., 2010, p. 10–13).

Eramet Marietta produced chromium metal and ferrochromium at its Marietta, OH, plant. Eramet produced chromium metal via the electrolytic process, with a production capacity of about 3,000 metric tons per year (t/yr).

The U.S. stainless steel industry produces more than 2 million metric tons per year (Mt/yr) of stainless steel and imports and exports stainless steel mill products and scrap, which account for a significant amount of chromium in U.S. trade. The stainless steel industry is the leading consumer of chromium materials. AK Steel Corporation, Allegheny Technologies Incorporated (ATI), and North American Steel Co. were the leading U.S. stainless steel producers.

AK Steel produced stainless steel at Butler, PA, and Mansfield, OH. AK Steel reported shipments of 608,000 t stainless and electrical steel in 2009 compared with 868,300 t in 2008 (AK Steel Corporation, 2010, p. 9, 16). ATI produced stainless steel at Brackenridge, Midland, Natrona, and Latrobe, PA. ATI reported production of 381,991 t of high value and standard stainless steel products in 2009 compared with 492,041 t in 2008 (Allegheny Technologies Incorporated, 2010, p. F15, F28).

ThyssenKrupp Stainless USA [a subsidiary of ThyssenKrupp AG (Germany)] reported progress in the construction of a stainless steel plant at Calvert, AL. The new plant would have a stainless steel melt shop production capacity of 1 Mt/yr of slabs. Construction started in 2007, and the plant was to be completed in 2010 (ThyssenKrupp AG, 2009, p. 84).

North American Stainless (NAS) [a subsidiary of Acerinox, S.A. (Spain)] produced stainless steel in Ghent, KY. NAS reported melt shop production at 682,235 t in 2009 compared with 709,326 t in 2008. NAS completed startup of the No. 4 annealing and pickling line and began operation of the No. 5 cold rolling mill. NAS added new cutting lines at its service centers in Wrightsville, PA, and Monterrey, Mexico (Acerinox S.A., 2010, p. 177–179).

Didaleusky and others (2010) documented the 1987–2007 decline of bulk ferroalloy companies, plants, and production in North America, noting that a decrease of ferrochromium production was clearly observed as early as 1970.

## Environment

The U.S. Environmental Protection Agency (EPA) regulates chromium releases to the environment and reports on any such releases (U.S. Environmental Protection Agency, 2010). The Occupational Safety and Health Administration (OSHA) regulates workplace exposure to chromium (Occupational Safety and Health Administration, 2010).

OSHA (2009) published a booklet about hexavalent chromium [Cr(VI)] intended to provide information for general industry standards (29 CFR 1910.1026), shipyards (29 CFR 1915.1026), and construction (29 CFR 1926.1126). The booklet also discusses exposure, hygiene, housekeeping, regulations, and other related topics. OSHA reported that Cr(VI) is a toxic form of the element chromium. Cr(VI) is used in pigments, metal finishing (electroplating), wood preservatives and fungicides, and in chemical synthesis as an ingredient and catalyst; however, it is rarely found in nature and is generally synthetic. Cr(VI) may be present in fumes generated during the production or welding of chromium-containing alloys. Chromium metal is often alloyed with other metals or plated on metal and plastic substrates to improve corrosion resistance and provide protective coatings. The steel industry is a major consumer of chromium in the production of stainless steel.

### Prices

Chromium materials are not openly traded. Purchase contracts are confidential between buyer and seller; however, trade journals report composite prices based on interviews with buyers and sellers, and traders declare the value of materials they import or export. Thus, industry publications and U.S. trade statistics are sources of chromium material prices and values, respectively.

The average South African Rand exchange rate is a potentially significant factor in the price of chromite ore and ferrochromium because South Africa is a leading producer of these materials. The South African Rand exchange rate decreased to a time-weighted average of R8.43 per U.S. dollar in 2009 from R8.27 per U.S. dollar in 2008 (Pacific Exchange Rate Service, 2010). From 2001 through 2006, the change in U.S. dollar per Rand coincided with the change in U.S. import value of high-carbon ferrochromium; however, in 2007 and 2008 the Rand per U.S. dollar and the import value of high-carbon ferrochromium increased. Coincident change returned in 2009. Expansion of the Chinese economy and that of India were thought to have been the leading influences causing chromium prices to increase from 2007 through part of 2008 until the global financial crisis in late 2008 caused those prices to decline. The drop in mass-weighted average import value of high-carbon ferrochromium from 2008 to 2009 was thought to have resulted from the global economic crisis of 2008.

### Foreign Trade

Chromium-containing material exports from and imports to the United States included chromite ore; chromium chemicals, ferroalloys, metal, and pigments; and stainless steel. Based on foreign trade statistics collected by the U.S. Department of the Treasury and reported by the U.S. Department of Commerce for calendar year 2009, the value of foreign trade of these chromium materials excluding stainless steel mill products and scrap was \$87 million for exports and \$444 million for imports. A significant amount of chromium exits and enters the U.S. economy via stainless steel mill product and scrap trade. The value of foreign trade of chromium materials including stainless

steel mill products and scrap was \$2,320 million for exports and \$2,290 million for imports (table 1).

### World Industry Structure

The chromium industry comprises chromite ore, chromium chemicals and metal, ferrochromium, stainless steel, and chromite refractory producers. Several trends are simultaneously taking place in the chromium industry. The chromium chemical industry has eliminated excess production capacity, concentrating on production growth in surviving plants. Chromite refractory use has been declining; however, foundry use has been increasing slowly. Environmental concerns have reduced the use of chromite refractories and chromium chemicals. The fraction of chromite ore from independent producers is declining, while that from vertically integrated producers is increasing. In other words, chromite ore mines tend now to be owned and operated by chromite refractory, chromium chemical, or ferrochromium producers. This trend is associated with the migration of ferrochromium production capacity from stainless steel producing countries to chromite ore-producing countries, a trend that has been interrupted with the emergence of China as a significant ferrochromium and leading stainless steel producer. While ferrochromium production capacity was closed in historically producing countries, which usually have been stainless steel-producing countries, new furnaces or plants were constructed in chromite ore producing areas. The electrical power and submerged-arc electric-furnace production capacities used to produce ferrochromium have been increasing. Furnaces built recently have an electrical capacity in the tens of megavoltamperes (MVA), whereas when ferrochromium plants were first built, furnaces rated in the low kilovoltampere (kVA) range were common.

Production process improvements, such as agglomeration of chromite ore, preheating and prereduction of furnace feed, and closed-furnace technology, have been retrofitted at the plants of major producers and are being incorporated in newly constructed plants. Since the introduction of post-melting refining processes in the steel industry after 1960, there has been a shift in production to high-carbon ferrochromium from low-carbon ferrochromium. After years of ferrochromium production, slag stockpiles have grown. Recently developed processes have efficiently recovered ferrochromium from that slag, and processes have been or are being installed at existing plant sites. In South Africa, the leading chromite ore- and ferrochromium-producing country, three trends are emerging—ferrochromium plants are being developed in the western belt of the Bushveld Complex, ferrochromium plants are being built in association with chromite ore mines, and ferrochromium production processes have been developed to accommodate chromite ore byproduct recovered from platinum operations.

**Capacity.**—Rated capacity is defined as the maximum quantity of product that can be produced in a period of time at a normally sustainable long-term operating rate based on the physical equipment of the plant and given acceptable routine operating procedures involving labor, energy, materials, and maintenance. Capacity includes both operating plants and plants

temporarily closed that can be brought into production within a short period of time with minimum capital expenditure. Because not all countries or producers provide information about production capacity, historical chromium trade data also have been used to estimate national production capacities. Reported production capacity changes result from both facility changes and increased knowledge about facilities. New information about a facility may result in the reevaluation of production capacity for that facility. Production capacities have been rated for the chromite ore, chromium chemical, chromium metal, ferrochromium, and stainless steel industries (table 7).

**Production.**—In 2009, world chromite ore production was about 18.9 million metric tons (Mt) gross weight, of which 95.2% was produced for the metallurgical industry; 2.4%, for the foundry industry; 1.6%, for the chemical industry; and 0.8%, for the refractory industry (International Chromium Development Association, 2010, p. 1).

The chromium industry entered 2009 under the burden of a world economic recession resulting from the world financial crisis of 2008. Demand for chromium declined significantly along with demand for industrial and consumer products that contain chromium. Under conditions of reduced consumption, producers and consumers of chromium-containing materials used stocks as their primary source of supply, exacerbating falling demand. Prices of chromium materials fell, but began to recover before the end of the year. Consumption, however, did not return to 2008 levels.

**Chromium Chemicals.**—Major chromium chemical producers included China, Russia, South Africa, Kazakhstan, and the United States. Murthy (2009) reported that world sodium dichromate production was about 1.2 Mt produced by China (27%), United States (16%), Kazakhstan (12%), Russia (11%), South Africa (11%), Turkey (9%), and India (8%).

**Chromium Metal.**—Major chromium metal producers included Russia (by the electrolytic process), Japan (by the silicothermic process) and China, France, Kazakhstan, Russia, and the United Kingdom (by the aluminothermic process). Lofthouse (2009) reported that industrial-scale chromium metal production by the aluminothermic process started in Germany after the process was patented by Hans Goldschmidt in 1922 and by the electrolytic process in the United States after 1950. In 1990, there were 15 industrial scale chromium metal producers, 12 aluminothermic and 3 electrolytic; however, by 2010 there were 7 aluminothermic, 1 electrolytic, and 1 silicothermic chromium metal producers. During the same time period, production shifted from 70% aluminothermic/30% electrolytic in 1990 to 95% aluminothermic in 2010. Chromium metal produced by the aluminothermic process requires metal-grade chromic oxide, a chemical product, as a feed material. The two metal producers in China, Jinzou and Sing Horn, and two of the metal producers in Russia, Kluchevsky and Novotroitsk, are vertically integrated chromic oxide-chromium metal producers. The remaining two aluminothermic chromium metal producers, LSM in the United Kingdom and Delachaux in France, were supplied by Aktyubinsk in Kazakhstan and Elementis in the United Kingdom until it closed in 2009 and then by Elementis in the United States. World production of chromium metal peaked at 40,000 t in 2007, and then declined to 34,000 t

in 2008. Nickel- and cobalt-based alloys and superalloys used in aerospace (jet engine) and electrical power (turbine powerplants) were the leading end use for chromium metal.

**Stainless Steel.**—In 2009, world stainless steel production was 24.579 Mt, a decrease of 5.2% from that of 2008 (International Stainless Steel Forum, 2010). At 36% of world stainless steel production, China was the leading producer in 2009. Pariser (2010, p. 14) reported stainless steel production increased in 2009 from 2008 for Asia excluding China (7.9%) and for China (32.8%). The rest of the world showed mostly double digit declines.

**Ferrochromium.**—The price of coke, an essential reductant for ferrochromium production, has escalated owing to, in the Western world, stricter environmental regulations and less integrated steel production; in China, which accounted for one-half of world trade in 2009, by export taxes and the closure of bee hive furnaces; and in general by higher prices owing to port and rail investments to alleviate transportation bottlenecks. Jones estimated that coke accounted for 25% of ferrochromium price in 2004 at 25 cents per pound, and for 20% of that price in 2009, assuming 0.6 t of coke per ton of ferrochromium product (Jones, 2010).

**Stainless Steel Scrap.**—Stainless steel scrap is an important source of chromium to the stainless steel industry that consists of three components: internal (such as, scrap generated in the steelmaking plant), external (such as, scrap that originates outside the steel producing plant), and reclaimed (such as, post-consumer scrap). Stainless steel scrap recycling accounts for a significant, but undocumented, fraction of world stainless steel production. Kovarsky (2009) reported historical stainless steel melting production growth rate (from 1995 to 2008) to have been 5.3% and that of ferrochromium consumption to have been 5.2%. External stainless steel scrap growth during the same period was about 8.1%. China was expected to become the leading stainless steel producer and consumer of stainless raw materials, which would lead to chromium-material markets reflecting Chinese market dynamics. Merrills (2009) reported that historical stainless steel scrap availability increases to about the same rate as stainless steel melting production (5% to 7% per year). Internal stainless steel scrap is recycled within about 3 months; external scrap, within about 6 months; and reclaimed scrap, within about 15 to 20 years. Stainless steel scrap is less costly to consume in the production of stainless steel than primary raw materials and is more environmentally friendly because less carbon dioxide (CO<sub>2</sub>) is generated and less energy used when recycled raw materials are used in place of primary raw materials (such as iron and ferroalloy). Asia recently has accounted for most of the growth in stainless steel production and consumption driven mainly by China. As a result, Asia was expected to surpass Europe in stainless steel production and consumption by 2013 and to become a leading source of stainless steel scrap.

## World Review

**Albania.**—ACR (formerly Albanian Chrome) [a subsidiary of DCM (Austria)] produced chromite ore at Bulquiza Mine. DCM DECOMetal [a subsidiary of DCM (Austria)] produced high- and low-carbon ferrochromium at Elbasan (DCM, 2008).

DCM operated three furnaces at Elbasan, two for high-carbon ferrochromium and one for low-carbon ferrochromium. DCM's production capacity was 18,000 t/yr of low-carbon ferrochromium and 18,000 t/yr of high-carbon ferrochromium. DCM planned to increase low-carbon ferrochromium production capacity to 33,000 t/yr (Metal Bulletin Daily, 2009a, b; SBB Daily Briefing, 2009a).

Albanian Minerals & Bytyci Shpk explored for chromite ore in the Tropoje and Kukës areas of northern Albania and Kosovo (International Chromium Development Association Secretariat, 2009).

Empire Mining Corporation (Canada) explored for chromite ore in the Bulqiza chromite mining district near the town of Bulqiza (41°29'27" N, 20°13'4" E). Empire started a drilling program in the area (Empire Mining Corporation, 2009, 2010).

JAB Resources Limited (Australia) explored for chromite ore in the Bregu I Bibes, Kalimash, and Zogaj areas. JAB reported inferred mineral resources of 6.72 Mt grading 4.36% Cr<sub>2</sub>O<sub>3</sub> in the Kalimash area (JAB Resources Limited, 2010, p. 63).

**Australia.**—The Government of Western Australia reported chromite ore sales by calendar year in contained Cr<sub>2</sub>O<sub>3</sub>: 2008, 56,881 t-Cr<sub>2</sub>O<sub>3</sub>; 2009, 74,789 t-Cr<sub>2</sub>O<sub>3</sub> (Government of Western Australia, 2010, p. 20).

**Brazil.**—Brazil produced chromite ore, ferrochromium, and stainless steel. Brazil reported 2008 chromite ore production of 705,762 t (299,952 t Cr<sub>2</sub>O<sub>3</sub>-content), 54,273 t of chromite ore (24,422 t Cr<sub>2</sub>O<sub>3</sub>-content) exports, and 22,896 t (12,592 Cr<sub>2</sub>O<sub>3</sub>-content) imports. Brazil produced from a chromite ore reserve of 12.9 Mt containing about 4.469 Mt Cr<sub>2</sub>O<sub>3</sub>-content, mostly in Bahia State. In 2008, Brazil produced 199,354 t of chromium ferroalloys, exported 34,827 t and imported 11,648 t (Ramos, 2010). Based on production of chromite ore and trade of chromite ore and chromium ferroalloys, Brazilian chromium apparent consumption was 312,000 t in 2008.

**Canada.**—Canada reported chromium mineral imports of 60,301 kg in 2008, 50,599 kg in 2007; and 49,009 kg in 2006; exports of 1,921 kg in 2008, 1,759 kg in 2007; and 2,733 kg in 2006; 2,991 kg in 2005 (Natural Resources Canada, 2009).

Cliffs Natural Resources Inc. (United States) (2010, p. 5, 115) acquired Freewest Resources Canada Inc. and its chromite ore resources in Ontario, Canada. Cliffs planned to mine from 1 to 2 Mt/yr of chromite ore to produce from 400,000 to 800,000 t/yr of ferrochromium that would subsequently be used to produce alloy or stainless steel.

**China.**—China produced chromite ore, chromium chemicals and metal, ferrochromium, and stainless steel. China was the leading producer of stainless steel, which also made it the leading market for ferrochromium. China produced a small amount of chromite ore; a moderate amount of ferrochromium, mostly from imported chromite ore; and a large amount of stainless steel.

The Government encouraged power consumers to negotiate prices directly with powerplants without the interference of local authorities. Discounts in electricity prices were expected to be available, but at a smaller discount than before. As a result, electrical power prices were expected to rise for ferrochromium producers (Metal Bulletin Daily, 2009c, p. 1).

China's economy grew by 8.7% in 2009 and inflation was 1.9% year-on-year in December. China's government stimulus measures helped the economy to withstand the global recession. To avoid further inflation, China raised its reserve ratio requirement, which limits the amount banks can lend as a proportion of total reserves (Metal Bulletin Daily, 2010, p. 1).

The leading stainless steel producers in China were Baosteel Stainless, Lianzhong Stainless Steel Corporation, Shanghai Krupp Stainless, Shanxi Taigang Stainless (Taiyuan Iron & Steel), and Zhangjiang Pohang Stainless Steel.

**Finland.**—Finland produced chromite ore (Kemi Mine) (65°46'55.50" N, 24°42'18.58" E), ferrochromium (Tornio Works), and stainless steel (Tornio Works) (Baerchmann, undated). In 2009, Outokumpu produced 247,000 t of marketable chromite ore from 0.9 Mt of run-of-mine ore and 123,000 t of ferrochromium compared with 614,000 t of chromite ore from 1.3 Mt of run-of-mine ore and 234,000 t of ferrochromium in 2008. The company reported proven reserves of chromite ore at 37 Mt graded at 26% Cr<sub>2</sub>O<sub>3</sub>, and indicated resources of chromite ore at 13 Mt graded at 30% Cr<sub>2</sub>O<sub>3</sub>, and inferred resources of chromite ore at 73 Mt graded at 29% Cr<sub>2</sub>O<sub>3</sub>. Outokumpu produced stainless steel at meltshops in Tornio, Avesta (Sweden), and Sheffield (Britain). Outokumpu reported that its stainless steel comprised 90% recycled materials while the world average is 60%. Outokumpu idled its Kemi Mine, ferrochromium works, and a stainless steel melt shop from April to October owing to weak demand (Outokumpu Ojy, 2010).

**Germany.**—Germany produced low-carbon ferrochromium and stainless steel. Elektrowerke Weisweiler GmbH produced low-carbon ferrochromium and ThyssenKrupp AG produced stainless steel. Elektrowerke Weisweiler was owned by Kermas Group (United Kingdom). Kermas also owned Serov Ferroalloys Plant (Russia) and Samancor (South Africa), other low-carbon ferrochromium producers.

**India.**—India produced chromite ore, chromium chemicals, ferrochromium, and stainless steel. India exported lumpy and friable chromite ore and chromite ore concentrates. India reported that 21 mines collectively produced 4,798,515 t of chromite ore in fiscal year 2007–08 (April 1, 2007, through March 31, 2008) from a chromite ore reserves of 66.128 Mt compared with 5,295,551 t from 17 mines in fiscal year 2006–07. India reported chromite ore exports of 906,575 in fiscal year 2007–08, 1,203,060 in fiscal year 2006–07, and 692,673 t in fiscal year 2005–06 (Indian Bureau of Mines, 2009). Kapure and others (2010) estimated that 140 Mt of chromite overburden had been mobilized in India and that 5 Mt is generated each year. The chromite overburden contains 0.6% to 0.8% nickel in addition to chromium and iron. The authors recovered about 80% of chromium, iron, and nickel from chromite overburden in bench-scale tests by direct reduction using coal.

The leading Indian chromite ore producers were OMC Ltd. and Tata Iron and Steel Corp. (Metal Bulletin Daily, 2009e). Orissa Mining Corp. operated the Daitari and Kaliapani Mines (OMC Ltd., undated). Ferro Alloys and Minerals (FAMD), a division of Tata Iron and Steel Corp., produced chromite ore

in the Jajpur District of Orissa State. FAMD beneficiated its ore at its beneficiation plant in Sukinda and then exported the product or converted it to ferrochromium at its plants in Keonjar District and Cuttack, Orissa State. At Cuttack, FAMD operated two furnaces with electrical power rating of 16.5 MVA and ferrochromium production capacity of 50,000 t/yr. At Bannipal, FAMD operated one furnace with electrical power rating of 33.5 MVA and ferrochromium production capacity of 60,000 t/yr (Ferro Alloys and Minerals Division, undated).

Balasore Alloys Limited, formerly Ispat Alloys Limited, a part of the Ispat Group produced chromite ore and ferrochromium. Balasore operated chromite ore mines in Sukinda Valley, Jajpur, Orissa. Balasore planned to set up a captive electrical powerplant and to expand beneficiation, furnaces, and transportation (Balasore Alloys Limited, 2010, p. 10).

OMC suspended mining operations for about 2 weeks in September while it resolved a forest clearance with the State Forest Department, after which OMC was ordered by the State of Orissa to stop supplying chromium ore to ferrochromium producers outside the State of Orissa for the December quarter (Metal Bulletin Daily, 2009f, g).

Idcol Ferro Chrome & Alloys planned to build a chromite ore beneficiation plant. The company's ferrochromium plant in Jajpur, Orissa State, has a production capacity of 25,000 t/yr of high-carbon ferrochromium from a captive ore supply. The plant also produced low-carbon ferrochromium (Metal Bulletin Daily, 2009d).

JSL Limited (formerly Jindal Stainless) produced chromite ore, ferrochromium, and stainless steel. JSL operated a 40,000-t/yr ferrochromium plant at Vizag and a 150,000-t/yr ferrochromium plant in Orissa. JSL's chromite ore division produced 3,946 t of chromite ore and 22,833 t of chrome ore concentrate. JSL commissioned a chromite ore beneficiation plant in August. JSL's Vizag, Andhra Pradesh, plant produced 32,681 t of high-carbon ferrochromium in 2009 compared with 31,901 t in 2008. JSL continued construction of a 1-Mt/yr stainless steel plant in Jajpur, Orissa (JSL Limited, 2010, p. 11, 17, 35).

Ferro Alloys and Minerals Division of Tata Steel Limited produced ferrochromium at its Bannipal plant in fiscal year 2009–10 (April 1 through March 31) (Tata Steel Limited, 2010, p. 75, 137).

Facor Alloys Limited produced 63,350 t of ferrochromium in 2008–09 compared with 69,075 t in 2007–08 at its Garividi Plant, Andhra Pradesh (18°16'25" N, 83°32' E) (Facor Alloys Limited, 2009, unpaginated; Prakash, 2010).

Ferro Alloys Corporation Limited produced 177,760 t of chromite ore and 56,216 t of high-carbon ferrochromium in FY 2008–09 compared with 186,896 t of ore and 53,750 t of ferrochromium in 2007–08. Ferro Alloys Corporation produced ferrochromium at Charge Chrome Plant, Randia, Orissa, and mined chromite ore, also in Orissa (Ferro Alloys Corporation Limited, 2009, p. 20).

Indian Metals and Ferro Alloys Limited (IMFA) mined chromite ore in Orissa and produced ferrochromium at Choudwar and Therubali plants. IMFA mined 282,836 t of chromite ore and produced 130,758 t of ferrochromium (Indian Metals and Ferro Alloys Limited, 2009, p. 7, 8, 13). IMFA

planned to expand production of high-carbon ferrochromium at Choudwar plant with the addition of a 30 MVA furnace to the existing two furnaces by 2010. The expansion would increase IMFA's total production capacity to 275,000 t/yr. IMFA exported about 75% of its ferrochromium production, mainly to China, Japan, and Republic of Korea. The company also operated three chromite ore mines in Orissa and had a captive powerplant at the Choudwar works (SBB Daily Briefing, 2009c).

Rohit Ferro-Tech Limited produced ferrochromium at Jajpur, Orissa, and Dishnupur, West Bengal (Rohit Ferro-Tech Limited, 2009, p. 4, 18).

Jindal (2009) reported that more than three-fourths of India's stainless steel production is 200 series and that production capacity in 2009 was 2.910 Mt; production was 2.1 Mt. Ferrochromium production capacity was 1.3 Mt.

Murthy (2009) reported that sodium dichromate production capacity in India amounted to 88,000 t/yr of which Vishnu Chemicals Limited accounted for 70,000 t/yr.

**Kazakhstan.**—Eurasian Natural Resources Corporation PLC (ENRC) (United Kingdom) produced chromite ore and ferrochromium. ENRC produced chromite ore at Donskoy and Saranovskaya Mines. Production capacity at Donskoy was 3.5 Mt/yr from 184.2 Mt of reserves at an average grade of 41.5% Cr<sub>2</sub>O<sub>3</sub>; Saranovskaya production was 150,000 t/yr. ENRC produced ferrochromium at Aksu (800,000-t/yr ferrochromium production capacity), Aktobe (368,000-t/yr ferrochromium production capacity), and Serov (195,000-t/yr ferrochromium production capacity) plants. ENRC reported production with 1.161 Mt ferrochromium in 2009 compared with 1.196 Mt in 2008. ENRC constructed a second 700,000-t/yr pelletizing plant at a cost of \$40 million and worked on installation of a direct current furnace at Aktobe with production capacity of 440,000 t/yr that was to be completed in 2012 at a cost of \$590 million. The new production capacity was to displace a portion of the old production capacity, which was to be retired (Eurasian Natural Resources Corporation PLC, 2009, p. 10; 2010, p. 14–16, 45).

Chromite ore commercial reserves were 317.2 Mt at an average grade of 45.9% Cr<sub>2</sub>O<sub>3</sub> of which 24.8 Mt at 41.4% Cr<sub>2</sub>O<sub>3</sub> could be surface mined and the remaining 292.4 Mt at 50.7% Cr<sub>2</sub>O<sub>3</sub> could be mined by underground methods. In 2008, TNK Kazchrome (a subsidiary of ENRC in Aktobe) produced 1.07 Mt of chromium ferroalloys; 996,267 t of high-carbon ferrochromium; 45,496 t of medium-carbon ferrochromium; and 32,914 t of low-carbon ferrochromium (Tolymbekov and others, 2010).

**Russia.**—Russia produced chromite ore, chromium metal and chemicals, ferrochromium, and stainless steel. Mechel Open Joint-Stock Company produced chromite ore (Voskhod deposit in Aktyubinsk region of Kazakhstan), ferrochromium (Tikhvin Ferroalloy Smelting Plant Closed Joint-Stock Company, Leningradskaya region), and stainless steel. Mechel reported production of 58,000 t of ferrochromium in 2008 (Mechel Open Joint-Stock Company, 2009, p. 6, 10). Russia also produced ferrochromium at Serov and ferrochromium and chromium metal at Kluchevsky Ferroalloy Plant.

Russia increased ferrochromium production to 578,000 t in 2005 from 274,000 t in 2000 based mostly on chromite ore imported from Kazakhstan, Turkey, and other countries. Russia

mined chromite ore in the Urals (Saranovskoe, Alapaevskoe, and others) and in the Komi region; however, the ore was low grade. Saranovskoe chromite ore was used in Serov Ferroalloys Plant, JSC (Leontyev and Zhuchkov, 2010).

**South Africa.**—South Africa was a leading chromite ore and ferrochromium producing country and produced chromium chemicals and stainless steel.

AMCOL International Corporation (United States) purchased 53% interest in the Ruighoek Chrome Project from Pacific Niugini Limited [formerly Chrome Corporation Limited (Australia)] citing strong demand for specialized grade chromite within the heavy-casting industry (AMCOL International Corporation, 2010, p. 4). AMCOL took operational control of Ruighoek Chrome Project in the Western Lobe of the Bushveld Igneous Complex in North West Province of South Africa, where chromite has been mined for more than 50 years. AMCOL planned to mine chromite ore from the LG6 and LG6A seams first by surface and then by underground methods (Chrome Corporation Ltd., 2010, p. 6).

African Rainbow Minerals Ltd. (ARM) produced chromite ore and ferrochromium in joint-venture partnerships with Assmang Ltd. (Dwarsrivier Chrome Mine and Machadodorp Ferrochrome Works) and with Norilsk Nickel Africa (Nkomati Nickel and Chrome Mine). Nkomati Nickel Mine produced 528,000 t of chromite ore in fiscal year 2009 compared with 1,177,000 t in 2008 and 631,000 in 2007. Nkomati chromite ore proven and probable reserves reportedly were 2.9 Mt at 31.0% Cr<sub>2</sub>O<sub>3</sub>; measured and indicated resources were 1.8 Mt at 33.6% Cr<sub>2</sub>O<sub>3</sub>. Dwarsrivier Chrome Mine production was 684,000 t in fiscal year 2009 compared with 849,000 t in 2008, 710,000 Mt in 2007, and 526,000 t in 2006. Dwarsrivier proven and probable reserves were 39.6 Mt at 39.5% Cr<sub>2</sub>O<sub>3</sub>; measured and indicated resources were 53.2 Mt at 39.56% Cr<sub>2</sub>O<sub>3</sub>. Machadodorp ferrochromium production was 169,000 t in 2009 compared with 270,000 t in fiscal year 2008, 242,000 t in 2007, and 230,000 t in 2006 (African Rainbow Minerals Ltd., 2009, p. 35, 48).

Assore Ltd. produced chromite ore at Zeerust Chrome Mines Ltd. and chromite ore and ferrochromium in joint-venture partnership with ARM [Dwarsrivier Chrome Mine (30°05'00" E, 24°59'00" S), Machadodorp Ferrochrome Works] through its subsidiary company Rustenburg Minerals Development Company (Proprietary) Ltd. (RMDC). RMDC developed shafts to mine underground as surface reserves diminished. Zeerust chromite ore proven reserves were 0.8 Mt; measured and inferred resources were 0.9 Mt and 10.6 Mt, respectively (Assore Ltd., 2010, p. 7, 20, 29).

ASA Metals (Pty.) Ltd. (24°33' S, 30°08'35" E) (Pentz, undated a) [a joint venture between Sinosteel Corp. (China) and Limpopo Economic Development Enterprise] produced chromite ore and ferrochromium. ASA installed two 66-MVA furnaces and a beneficiation and pelletizing plant to process feed material for ASA's furnaces. ASA increased its ferrochromium production capacity to 400,000 t/yr (ASA Metals (Pty.) Ltd., undated). ASA operated four furnaces; two rated at 66 MVA, one at 45 MVA, and one at 33 MVA with a collective annual ferrochromium production capacity of 240,000 t/yr. The beneficiation and pelletizing plant production capacity was

600,000 t/yr of pellets comprised of chromite ore concentrate, UG2 chromite concentrate, smelter dust, fine coke, and bentonite. The pellets contained 41.4% Cr<sub>2</sub>O<sub>3</sub> and were smelted into ferrochromium product containing 50.5% chromium (Ives, 2009).

Chromex Mining plc (United Kingdom) operated the Stellite opencast mine in the western limb of the Bushveld Complex. A processing facility designed to take 40,000 metric tons per month of run-of-mine ore was completed in 2009, and production of chromite ore graded at 42% to 44% Cr<sub>2</sub>O<sub>3</sub> was started (Chromex Mining plc, 2010).

Hernic Ferrochrome (Pty.) Ltd. produced chromite ore and ferrochromium. Hernic produced chromite ore at its Maroelabult Mine and started development of Bokfontein Mine, which was planned to produce 1.5 Mt/yr of chromite ore. Hernic reported chromite ore reserves of 250 Mt and production capacity of 420,000 t/yr (Hernic Ferrochrome (Pty.) Ltd., 2007).

International Ferro Metals Ltd. (Australia) (IFM) produced chromite ore at Lesedi Mine and ferrochromium at its integrated works in the western limb of the Bushveld Complex. IFM developed the SkyChrome property in which it held 80% interest. IFM reported Lesedi plus SkyChrome proven and probable reserves of 55.359 Mt at 32% Cr<sub>2</sub>O<sub>3</sub> and measured and indicated resources of 102.553 Mt at 32.49% Cr<sub>2</sub>O<sub>3</sub>. In the fiscal year that ended in June, IFM reported ferrochromium production of 110,346 t from a production capacity of 267,000 t/yr (International Ferro Metals Ltd., 2009, p. 2, 7, 25).

Merafe Resources Ltd. produced chromite ore and ferrochromium via wholly owned subsidiary companies and in joint venture with Xstrata plc. In the eastern limb of the Bushveld Complex, Merafe mined chromite ore or produced byproduct chromite at Boshhoek, Horizon, Kanana UG2 plant, Kroondal, Marikana, and Waterval Mines and produced ferrochromium at Lydenburg and Lion plants. In the western limb of the Bushveld Complex, Merafe mined chromite ore or produced byproduct chromite at EPL UG2 plant, Helena, Magareng, Mototolo UG2 plant, and Thorncliffe and produced ferrochromium at Boshhoek, Rustenburg, and Wonderkop plants. Collectively, these plants had ferrochromium production capacity of 1.979 Mt/yr from 20 furnaces at 5 production sites. Merafe reported run-of-mine production of 3.33 Mt in 2009 from proven chromite ore reserves of 52.078 Mt at an estimated average grade of 33.93% Cr<sub>2</sub>O<sub>3</sub> (Merafe Resources Ltd., 2010, p. 3, 75, 78).

Samancor Chrome Ltd. [a subsidiary of the Kermas Group (Virgin Islands)] is the second leading chromite ore and ferrochromium producer in South Africa. Samancor operated two mining complexes (Eastern Chrome Mines, Lydenburg-Steelpoort area, Mpumalanga Province, and Western Chrome Mines, Rustenburg, North West Province) and four ferrochromium plants (Ferrometals, Emalahleni (formerly Witbank), Mpumalanga Province; Middelburg Ferrochrome, Middelburg, Mpumalanga Province; and Tubatse Ferrochrome (24°44'27.55" S, 30°11'45.09" E), Lydenburg-Steelpoort area, Mpumalanga Province (Pentz, undated b; Samancor Chrome Ltd., 2008).

Tata Steel reported production from two 75,000-t/yr furnaces at Richards Bay to have been 118,327 t in financial year

2009–10 (April 1 through March 31) compared with 63,479 t in financial year 2008–2009 (Tata Steel Limited, 2010, p. 80).

Xstrata plc (Switzerland) was the leading world ferrochromium producer. Xstrata produced chromite ore and ferrochromium in South Africa at vertically integrated operations. Xstrata produced 0.786 Mt in 2009 compared with 1.126 Mt of ferrochromium in 2008. Xstrata reported proven reserves of 52 Mt and probable reserves of 17 Mt (Xstrata plc, 2010, p. 53, 93, 173).

Columbus Stainless Pty. Ltd. produced 546,261 t of stainless steel in 2009 compared with 528,336 t in 2008, a 3.4% increase. Columbus worked to optimize its use of liquid ferrochromium to reduce its electrical power needs (Acerinox S.A., 2010, p. 180–181).

**Sweden.**—Sweden produced ferrochromium and stainless steel. Vargön Alloys AB (58°21'29.83" N, 12°22'54.04" E), Vargön, Västra Götalands Län, a Yildirim Group (Turkey) company, produced ferrochromium. Vargön operated with ferrochromium production capacity of about 230,000 t/yr from four furnaces (SBB Daily Briefing, 2009b). Outokumpu (Finland) produced stainless steel at its Avesta plant in Avesta, Dalarnas Län (Outokumpu Oyj, 2010).

**Turkey.**—Turkey produced chromite ore, chromium chemicals, and ferrochromium. Eti Krom A.S., a Yildirim Group company, produced chromite ore and high-carbon ferrochromium (38°39'10" N, 39°46'10" E). Eti Krom's ferrochromium production capacity was 150,000 t/yr (Eti Krom Inc., undated). Eti Elektrometalurji A.S. produced chromite ore and high- and low-carbon ferrochromium near Antalya (36°56'08" N, 30°39' E) from an annual production capacity of 12,000 t/yr low-carbon ferrochromium and 12,000 t/yr high-carbon ferrochromium (Eti Elektrometalurji A.Ş., undated).

**United Kingdom.**—The United Kingdom produced chromium metal and stainless steel. Outokumpu (Finland) produced stainless steel at its Sheffield plant (Outokumpu Oyj, 2008, p. 33). London & Scandinavian Metallurgical Co. Ltd. (53°24'57" N, 1°22' W) produced chromium metal by aluminothermic reduction at Rotherham, United Kingdom (London & Scandinavian Metallurgical Co Limited, undated). Elementis plc, a leading world chromium chemicals producer, manufactured sodium dichromate from chromite ore at Castle Haynes (North Carolina, United States) and Eaglescliffe (Stockton-on-Tees, United Kingdom). Elementis closed the Eaglescliffe plant (54°31'30" N, 1°22'50" W) in July (Elementis plc, 2010, p. 7, 9).

**Zimbabwe.**—Zimbabwe produced chromite ore and ferrochromium. Chromex Mining plc (United Kingdom) purchased Falvect Mining (Private) Limited, a company that owns chromite concessions in the Shurugwe and Ngezi areas (Chromex Mining plc, 2010).

Zimbabwe Alloys reprocessed chromite ore dumps, improved chromium recovery in the furnace, and recovered chromium from slag. Mining and smelting started in 1953 when fines were not suitable furnace feed and metal was not recovered from slag. As a result, the operation stockpiled these materials (Chirasha and Shoko, 2010). Use of briquetted recovered chromite ore fines resulted in improvement in production, power specific consumption, chromium recovery, and chrome ore specific consumption.

## Current Research and Technology

**Mineral Processing and Industrial Applications.**—South Africa's Council for Mineral Technology (Mintek) continued conducting Government- and commercial-sponsored research and development on chromite ore and ferrochromium. Mintek developed mine-specific processes for chromite ore beneficiation, developed platinum recovery process applied to chromite ore tailings, developed furnace controller technology for ferrochromium-producing furnaces, and developed stainless steel dust recycling technology. Mintek expected the first commercial use of an electrode monitor that reports the position of the electrode tip in a ferrochromium-producing electric arc furnace (Mintek, 2009, p. 43). Mintek recovered platinum from chromite ore tailings using its ConRoast process, which involves roasting followed by direct current arc smelting (Mintek, 2010, p. 23).

A concise international chemical assessment on inorganic chromium (III) compounds was published by the International Programme on Chemical Safety—a cooperative program of the World Health Organization, the International Labour Organization, and the United Nations Environment Programme (Santonen and others, 2009). Natural and anthropogenic sources, routes of exposure, and concentrations at which environmental or human impact could be expected were discussed.

Holappa (2010) reported energy (3,100 to 3,500 kilowatthours of electricity per metric ton of high-carbon ferrochromium produced from a closed submerge-arc furnace) and raw materials consumption data and the CO<sub>2</sub> emission factor for ferrochromium production (about 1.6 t of CO<sub>2</sub> per metric ton of ferrochromium). Reduction in CO<sub>2</sub> emissions by more energy-efficient production, higher recovery rates, and other ways were also discussed. A bioaccessibility study of ferrochromium, ferrochromium silicon, and a common grade of stainless steel found that very little chromium was released (less than 0.15% expressed as amount of metal released per amount of particles loaded) from ferrochromium and even less from ferrochromium silicon or stainless steel (Midlander and others, 2010).

## Outlook

The outlook for chromium consumption in the United States and the rest of the world is about the same as that for stainless steel, which is the major end use for chromium worldwide. In 2009, China and India were in the process of economic expansion that resulted in increasing need for chromium to produce stainless steel; however, chromium consumption did not recover to 2008 peak levels.

The practice of supplying chromium in the form of ferrochromium by countries that mine chromite ore was interrupted as China became a major producer of ferrochromium; however, that trend was not expected to continue as China closed small, inefficient, environmentally unfriendly ferroalloy production facilities. The rising cost of ferrochromium sustained independent ferrochromium producers; however, other factors being equal, ferrochromium production is most cost effective when the ferrochromium plant is close to the chromite mine. With new efficient and reliable ferrochromium production facilities in chromite ore-producing countries,



ferrochromium production capacity and production are expected to diminish in market-driven economies that produce ferrochromium without nearby chromite ore resources. Other factors of production, such as electrical energy or labor costs, can offset chromite ore transportation costs. Further vertical integration of the chromium industry is expected as countries that produce chromite ore expand ferrochromium or stainless steel production capacity.

**Chromite Ore.**—Chromite ore production capacity was expected to remain in balance with average consumption. To improve chromite ore availability and to stabilize feed material prices, ferrochromium producers invested in mines that produce chromite ore. Indeed, most chromite ore was produced under vertically integrated mine-smelter or mine-plant ownership. As platinum mining moves to chromite-bearing seams in South Africa, a greater portion of chromite is likely to be supplied as byproduct from such operations. In addition, platinum may become a byproduct of some chromite operations when efficient recovery of platinum from chromite tailings is developed.

**Chromium Chemicals.**—Leading chromium chemical-producing countries where large sodium dichromate plants (production capacity in excess of 100,000 t/yr) operate included Kazakhstan, Russia, and the United States. Moderate-sized production facilities were located in China, India, Japan, South Africa, Turkey, and the United Kingdom. Small-scale local producers operated in China and India.

**Ferrochromium.**—Ferrochromium production is electrical energy intensive. Charge-grade ferrochromium requires 2,900 to 4,100 kilowatt-hours of electrical energy per metric ton of product, with efficiency varying by ore grade, operating conditions, and production process. Thus, ferrochromium plant location will reflect a cost balance between raw materials and electrical energy supply.

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TABLE 1  
SALIENT CHROMIUM STATISTICS<sup>1</sup>

|  |                        | 2005                   | 2006                   | 2007                   | 2008                   | 2009                 |
|--|------------------------|------------------------|------------------------|------------------------|------------------------|----------------------|
| World, production, contained chromium:   |                        |                        |                        |                        |                        |                      |
| Chromite ore (mine) <sup>2</sup>   | metric tons            | 5,920,000 <sup>r</sup> | 6,080,000 <sup>r</sup> | 7,040,000 <sup>r</sup> | 7,410,000 <sup>r</sup> | 5,940,000            |
| Ferrocromium (smelter) <sup>3</sup>  | do.                    | 3,930,000 <sup>r</sup> | 4,190,000              | 4,770,000 <sup>r</sup> | 4,590,000 <sup>r</sup> | 3,990,000            |
| Stainless steel <sup>4</sup>   | do.                    | 4,130,000              | 4,820,000              | 4,730,000              | 4,410,000 <sup>r</sup> | 4,180,000            |
| U.S. supply:   |                        |                        |                        |                        |                        |                      |
| Components of U.S. supply, contained chromium:                                   |                        |                        |                        |                        |                        |                      |
| Domestic mines   | do.                    | --                     | --                     | --                     | --                     | --                   |
| Secondary <sup>5</sup>   | do.                    | 174,000                | 179,000                | 162,000                | 146,000                | 141,000              |
| Imports:   |                        |                        |                        |                        |                        |                      |
| Chromite ore <sup>2</sup>  | do.                    | 52,900                 | 53,800                 | 46,400                 | 64,300                 | 23,000               |
| Chromium chemicals   | do.                    | 11,400                 | 12,100                 | 10,600                 | 18,000                 | 10,600               |
| Chromium ferroalloys   | do.                    | 278,000                | 265,000                | 259,000                | 307,000                | 140,000              |
| Chromium metal   | do.                    | 11,000                 | 10,900                 | 11,700                 | 13,100                 | 7,570                |
| Stainless steel mill products and scrap  | do.                    | 150,000                | 179,000                | 158,000                | 157,000                | 91,800               |
| Stocks, January 1:   |                        |                        |                        |                        |                        |                      |
| Government   | do.                    | 466,000                | 375,000                | 253,000 <sup>6</sup>   | 115,000                | 155,000 <sup>7</sup> |
| Industry <sup>8</sup>  | do.                    | 7,900                  | 8,520 <sup>r</sup>     | 9,620 <sup>r</sup>     | 9,940 <sup>r</sup>     | 7,290                |
| Total  | do.                    | 1,150,000              | 1,080,000              | 910,000                | 831,000                | 576,000              |
| Distribution of U.S. supply, contained chromium:                                 |                        |                        |                        |                        |                        |                      |
| Exports:   |                        |                        |                        |                        |                        |                      |
| Chromite ore <sup>2</sup>  | do.                    | 13,700                 | 17,400                 | 12,000                 | 2,280                  | 743                  |
| Chromium chemicals   | do.                    | 18,900                 | 16,700                 | 21,000                 | 22,600                 | 13,500               |
| Chromium ferroalloys and metal   | do.                    | 24,700                 | 22,300                 | 27,000                 | 11,300                 | 2,900                |
| Stainless steel mill products and scrap  | do.                    | 162,000                | 156,000                | 231,000                | 250,000                | 263,000              |
| Stocks, December 31:   |                        |                        |                        |                        |                        |                      |
| Government   | do.                    | 375,000                | 272,000 <sup>6</sup>   | 115,000                | 105,000 <sup>9</sup>   | 129,000              |
| Industry <sup>8</sup>  | do.                    | 8,520 <sup>r</sup>     | 9,620 <sup>r</sup>     | 9,940 <sup>r</sup>     | 7,290 <sup>r</sup>     | 7,050                |
| Total  | do.                    | 603,000                | 493,000 <sup>r</sup>   | 416,000                | 399,000                | 416,000              |
| Production, reported, chromium ferroalloy and metal net production <sup>10</sup> |                        |                        |                        |                        |                        |                      |
|  |                        | W                      | W                      | W                      | W                      | W                    |
| Consumption:   |                        |                        |                        |                        |                        |                      |
| Apparent, contained chromium   | do.                    | 548,000                | 589,000 <sup>r</sup>   | 493,000                | 432,000                | 160,000              |
| Reported:  |                        |                        |                        |                        |                        |                      |
| Chromite ore and concentrates, gross weight                                      | do.                    | W                      | W                      | W                      | W                      | W                    |
| Chromium ferroalloys: <sup>11</sup>  |                        |                        |                        |                        |                        |                      |
| Gross weight   | do.                    | 424,000 <sup>r</sup>   | 422,000 <sup>r</sup>   | 462,000 <sup>r</sup>   | 427,000 <sup>r</sup>   | 394,000              |
| Contained chromium   | do.                    | 247,000 <sup>r</sup>   | 249,000 <sup>r</sup>   | 272,000 <sup>r</sup>   | 251,000 <sup>r</sup>   | 231,000              |
| Chromium metal, gross weight   | do.                    | 7,270                  | 6,160                  | 5,410                  | 4,740 <sup>r</sup>     | 4,240                |
| Stocks, December 31, gross weight:   |                        |                        |                        |                        |                        |                      |
| Government: <sup>6</sup>   |                        |                        |                        |                        |                        |                      |
| Chromite ore   | do.                    | 73,400                 | 1,160                  | --                     | --                     | --                   |
| Chromium ferroalloys   | do.                    | 492,000                | 373,000                | 155,000                | 140,000 <sup>9</sup>   | 175,000              |
| Chromium metal   | do.                    | 6,190                  | 5,280                  | 4,970                  | 4,820                  | 4,670                |
| Industry:  |                        |                        |                        |                        |                        |                      |
| Producer <sup>12</sup>   | do.                    | W                      | W                      | W                      | W                      | W                    |
| Consumer:  |                        |                        |                        |                        |                        |                      |
| Chromium ferroalloys <sup>13</sup>   | do.                    | 13,800 <sup>r</sup>    | 15,500 <sup>r</sup>    | 16,300 <sup>r</sup>    | 11,700 <sup>r</sup>    | 11,400               |
| Chromium metal   | do.                    | 229                    | 220                    | 221                    | 235 <sup>r</sup>       | 160                  |
| Other  | do.                    | 304                    | 231                    | 216                    | 271                    | 263                  |
| Prices, average annual:  |                        |                        |                        |                        |                        |                      |
| Chromite ore <sup>14</sup>   | dollars per metric ton | NA                     | 119                    | 244                    | 348                    | 158                  |
| Ferrocromium, chromium content <sup>15</sup>                                     | dollars per pound      | 0.684                  | 0.695                  | 1.048                  | 1.748                  | 0.806                |

See footnotes at end of table.

TABLE 1—Continued  
SALIENT CHROMIUM STATISTICS<sup>1</sup>

|   |             | 2005        | 2006         | 2007        | 2008                 | 2009        |
|---|-------------|-------------|--------------|-------------|----------------------|-------------|
| Prices, average annual—Continued:                         |             |             |              |             |                      |             |
| Electrolytic chromium metal, gross weight <sup>16</sup>   | do.         | 4.50        | 4.50         | NA          | NA                   | NA          |
| Aluminothermic chromium metal, gross weight <sup>17</sup> | do.         | 2.72        | 2.94         | 3.66        | 5.30                 | 4.08        |
| Value of trade: <sup>18</sup>                             |             |             |              |             |                      |             |
| Exports   | thousands   | \$116,000   | \$121,000    | \$150,000   | \$149,000            | \$86,600    |
| Imports   | do.         | \$583,000   | \$529,000    | \$699,000   | \$1,430,000          | \$444,000   |
| Net exports <sup>19</sup>                                 | do.         | -\$468,000  | -\$408,000   | -\$548,000  | -\$1,280,000         | -\$358,000  |
| Stainless Steel:  |             |             |              |             |                      |             |
| Production:   |             |             |              |             |                      |             |
| Gross weight <sup>20</sup>                                | metric tons | 2,240,000   | 2,460,000    | 2,170,000   | 1,930,000            | 1,620,000   |
| Contained chromium <sup>21</sup>                          | do.         | 373,000     | 419,000      | 360,000     | 324,000 <sup>r</sup> | 276,000     |
| Average grade, dimensionless <sup>22</sup>                |             | 0.1667      | 0.1705       | 0.1656      | 0.1684               | 0.1703      |
| Shipments, gross weight <sup>23</sup>                     | metric tons | 1,730,000   | 1,890,000    | 1,700,000   | 1,380,000            | 1,200,000   |
| Exports, gross weight                                     | do.         | 371,000     | 410,000      | 476,000     | 471,000              | 414,000     |
| Imports, gross weight                                     | do.         | 770,000     | 872,000      | 809,000     | 783,000              | 416,000     |
| Scrap, gross weight:                                      |             |             |              |             |                      |             |
| Receipts  | do.         | 1,030,000   | 1,050,000    | 953,000     | 858,000              | 832,000     |
| Consumption   | do.         | 1,480,000   | 1,500,000    | 1,430,000   | 1,330,000            | 1,260,000   |
| Exports   | do.         | 585,000     | 506,000      | 882,000     | 1,000,000            | 1,130,000   |
| Imports   | do.         | 111,000     | 180,000      | 118,000     | 140,000              | 124,000     |
| Value of trade:   |             |             |              |             |                      |             |
| Exports   | thousands   | \$1,340,000 | \$1,580,000  | \$2,110,000 | \$2,300,000          | \$1,450,000 |
| Imports   | do.         | \$2,630,000 | \$3,210,000  | \$4,300,000 | \$4,040,000          | \$1,710,000 |
| Scrap exports   | do.         | \$670,000   | \$716,000    | \$1,620,000 | \$1,190,000          | \$777,000   |
| Scrap imports   | do.         | \$124,000   | \$209,000    | \$198,000   | \$217,000            | \$138,000   |
| Net exports <sup>19, 24</sup>                             | do.         | -\$744,000  | -\$1,130,000 | -\$770,000  | -\$773,000           | \$384,000   |

<sup>1</sup>Revised. do. Ditto. NA Not available. W Withheld to avoid disclosing company proprietary data. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Calculated assuming chromite ore to average 44% Cr<sub>2</sub>O<sub>3</sub>, which is 68.42% chromium.

<sup>3</sup>Calculated assuming chromium content of ferrochromium to average 57% chromium.

<sup>4</sup>Calculated from American Iron and Steel Institute reported stainless steel production assuming chromium content of stainless steel to average 16.7% chromium.

<sup>5</sup>Calculated assuming chromium content of stainless steel to average 17% chromium.

<sup>6</sup>“Summary of Commodities” as reported by the Defense National Stockpile Center (DNSC) through 2006. “Inventory of Stockpile Material” as reported by DNSC starting in 2007 except where noted otherwise.

<sup>7</sup>From January 1, 2009 to December 31, 2009, the DNSC made an accounting adjustment to low-carbon ferrochromium stocks making them (the stocks for those months) incompatible for the purpose of computing stock change for that year. January stocks were estimated.

<sup>8</sup>Includes consumer stocks of chromium ferroalloys and metal and other chromium-containing materials.

<sup>9</sup>From January 1, 2008 to December 31, 2008, the DNSC changed its high-carbon and low-carbon ferrochromium stocks accounting method making them (the stocks for those months) incompatible for the purpose of computing stock change for that year. December stocks were estimated based on monthly stock changes excluding the accounting-change month.

<sup>10</sup>Includes chromium ferroalloys and metal and other chromium materials in the United States.

<sup>11</sup>Chromium ferroalloy, chromite ore, and other chromium-containing materials excluding chromium metal.

<sup>12</sup>Chromium ferroalloy and metal producer stocks of chromium ferroalloys and metal.

<sup>13</sup>Consumer stocks of high- and low-carbon ferrochromium and ferrochromium-silicon.

<sup>14</sup>Time-weighted average price of South African chromite ore that contains 44% Cr<sub>2</sub>O<sub>3</sub> f.o.b. South Africa as reported in Ryan’s Notes.

<sup>15</sup>Time-weighted average U.S. price of imported high-carbon chromium that contains 50% to 55% chromium as reported in Platts Metals Week.

<sup>16</sup>Time-weighted average U.S. price of domestically produced electrolytic chromium metal as reported by Ryan’s Notes.

<sup>17</sup>Time-weighted average U.S. price of imported aluminothermic chromium metal as reported by Ryan’s Notes.

<sup>18</sup>Includes chromite ore and chromium ferroalloys, metal, and chemicals.

<sup>19</sup>Negative data indicate that imports are greater than exports.

<sup>20</sup>Source: American Iron and Steel Institute annual report of stainless and heat-resisting raw steel production and shipments.

<sup>21</sup>Estimated mass-weighted average of the mean chromium content of stainless steel production by grade. Uncertainty is approximately ± 0.01, owing to the range of chromium chemical specification limits by stainless steel grade.

<sup>22</sup>Ratio of estimated mass-weighted average chromium content of stainless steel production by grade to production. Expressed as a fraction.

<sup>23</sup>Source: American Iron and Steel Institute annual report of stainless and heat-resisting raw steel shipments.

TABLE 1—Continued  
SALIENT CHROMIUM STATISTICS<sup>1</sup>

<sup>24</sup>Includes stainless steel and stainless steel scrap.

Source: American Iron and Steel Institute quarterly reports of stainless and heat-resisting raw steel production by grade.

TABLE 2  
U.S. REPORTED CONSUMPTION AND STOCKS OF CHROMIUM PRODUCTS<sup>1</sup>

(Metric tons)

|   | 2008                 |                      | 2009         |                  | Change <sup>2</sup> |            |
|---|----------------------|----------------------|--------------|------------------|---------------------|------------|
|   | Gross weight         | Chromium content     | Gross weight | Chromium content | Quantity            | Percentage |
| Consumption by end use:                         |                      |                      |              |                  |                     |            |
| Alloy uses:                                     |                      |                      |              |                  |                     |            |
| Steel:  |                      |                      |              |                  |                     |            |
| Carbon steel                                    | 6,200                | 3,740                | 5,760        | 3,500            | -432                | -7         |
| High-strength low-alloy steel                   | 3,690                | 2,490                | 5,810        | 2,330            | 2,110               | 57         |
| Stainless and heat-resisting steel              | 345,000              | 199,000              | 323,000      | 188,000          | -21,100             | -6         |
| Full alloy steel                                | 23,600               | 14,400               | 13,400       | 8,200            | -10,200             | -43        |
| Unspecified steel <sup>3</sup>                  | 27,600               | 17,200               | 26,900       | 16,000           | -651                | -2         |
| Superalloys                                     | 9,670 <sup>r</sup>   | 7,530 <sup>r</sup>   | 8,740        | 6,920            | -929                | -10        |
| Other alloys and uses <sup>4</sup>              | 16,100 <sup>r</sup>  | 10,800 <sup>r</sup>  | 14,300       | 9,660            | -1,820              | -11        |
| Total   | 431,000 <sup>r</sup> | 256,000 <sup>r</sup> | 398,000      | 235,000          | -33,000             | -8         |
| Consumption by material:                        |                      |                      |              |                  |                     |            |
| Low-carbon ferrochromium                        | 43,800 <sup>r</sup>  | 30,000 <sup>r</sup>  | 38,700       | 25,600           | -5,070              | -12        |
| High-carbon ferrochromium                       | 353,000              | 209,000              | 323,000      | 192,000          | -29,900             | -8         |
| Ferrochromium silicon                           | W                    | W                    | W            | W                | W                   | W          |
| Chromium metal                                  | 4,740 <sup>r</sup>   | 4,670 <sup>r</sup>   | 4,240        | 4,210            | -502                | -11        |
| Chromium ore                                    | 1,150                | 375                  | 5,070        | 1,660            | 3,920               | 340        |
| Chromium-aluminum alloy                         | 454                  | 293                  | 355          | 219              | -98                 | -22        |
| Other chromium materials                        | 28,000 <sup>r</sup>  | 11,000 <sup>r</sup>  | 26,600       | 11,200           | 1,340               | 5          |
| Total   | 431,000 <sup>r</sup> | 256,000 <sup>r</sup> | 398,000      | 235,000          | -33,000             | -8         |
| Consumer stocks:                                |                      |                      |              |                  |                     |            |
| Low-carbon ferrochromium                        | 1,960 <sup>r</sup>   | 1,340                | 2,040        | 1,350            | 81                  | 4          |
| High-carbon ferrochromium                       | 8,770                | 5,190                | 8,560        | 5,080            | -203                | -2         |
| Ferrochromium silicon                           | 964 <sup>r</sup>     | 379 <sup>r</sup>     | 764          | 321              | -200                | -21        |
| Chromium metal                                  | 235 <sup>r</sup>     | 231 <sup>r</sup>     | 160          | 159              | -75                 | -32        |
| Chromium-aluminum alloy                         | 126                  | 82                   | 119          | 73               | -7                  | -6         |
| Other chromium materials                        | 146                  | 61                   | 144          | 62               | 2                   | 1          |
| Total   | 12,200 <sup>r</sup>  | 7,290 <sup>r</sup>   | 11,800       | 7,050            | -405                | -3         |
| National Defense Stockpile stocks: <sup>6</sup> |                      |                      |              |                  |                     |            |
| Chromium ferroalloys: <sup>7</sup>              |                      |                      |              |                  |                     |            |
| High-carbon ferrochromium                       | 139,000 <sup>r</sup> | 99,200 <sup>r</sup>  | 113,000      | 80,800           | -25,800             | -19        |
| Low-carbon ferrochromium                        | 70,900 <sup>r</sup>  | 50,600 <sup>r</sup>  | 61,500       | 48,900           | -9,410              | -13        |
| Chromium metal <sup>8</sup>                     | 4,820                | 4,820                | 4,670        | 4,670            | -152                | -3         |

<sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data; included in "Other chromium materials."

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Change based on gross weight quantity of unrounded data of current year compared with that of previous year.

<sup>3</sup>Includes electrical, tool, and unspecified steel end uses.

<sup>4</sup>Includes cast irons, welding and alloy hard-facing rods and materials, wear- and corrosion-resistant alloys, and aluminum, copper, magnetic, nickel, and other alloys.

<sup>5</sup>The source for stockpile information is the Defense Logistics Agency, Defense National Stockpile Center (DNSC).

<sup>6</sup>The DNSC data is based on the "Total Uncommitted Inventory" of stockpile material D-1 report.

<sup>7</sup>Chromium content estimated using 71.4% chromium.

<sup>8</sup>Chromium content estimated using 100% chromium.

TABLE 3  
VALUE OF IMPORTS AND U.S. PRICE QUOTATIONS FOR CHROMIUM MATERIALS<sup>1</sup>

| Material                                      | 2008                   |              | 2009               |              |       |
|---|------------------------|--------------|--------------------|--------------|-------|
|   | Contained chromium     | Gross weight | Contained chromium | Gross weight |       |
| Value: <sup>2,3</sup>                         |                        |              |                    |              |       |
| Chromite ore:                                 |                        |              |                    |              |       |
| Not more than 40% chromic oxide               | dollars per metric ton | XX           | XX                 | 2,030        | 344   |
| More than 40% but less than 46% chromic oxide | do.                    | 788          | 247                | 1,980        | 621   |
| 46% or more chromic oxide                     | do.                    | 675          | 222                | 641          | 203   |
| Average                                       | do.                    | 696          | 227                | 762          | 227   |
| Ferrochromium:                                |                        |              |                    |              |       |
| Not more than 0.5% carbon                     | do.                    | 7,520        | 5,130              | 4,490        | 3,040 |
| More than 0.5% but not more than 3% carbon    | do.                    | 4,880        | 3,160              | 3,360        | 2,030 |
| More than 3% but not more than 4% carbon      | do.                    | 2,290        | 1,360              | 1,000        | 540   |
| Average (not more than 4%)                    | do.                    | 7,340        | 4,990              | 4,230        | 2,800 |
| More than 4% carbon                           | do.                    | 3,370        | 1,940              | 1,540        | 844   |
| Average (all grades)                          | do.                    | 3,730        | 2,180              | 2,090        | 1,190 |
| Chromium metal <sup>4</sup>                   | do.                    | XX           | 11,100             | XX           | 9,900 |
| Price: <sup>5</sup>                           |                        |              |                    |              |       |
| Chromite ore: <sup>6</sup>                    |                        |              |                    |              |       |
| Turkey <sup>7</sup>                           |                        |              |                    |              |       |
| 40% to 42% Cr <sub>2</sub> O <sub>3</sub>     | do.                    | XX           | 492                | XX           | 229   |
| 44% Cr <sub>2</sub> O <sub>3</sub>            | do.                    | 1,750        | 526                | 814          | 245   |
| South Africa                                  |                        |              |                    |              |       |
| 39% Cr <sub>2</sub> O <sub>3</sub>            | do.                    | 1,240        | 330                | 573          | 153   |
| 44% Cr <sub>2</sub> O <sub>3</sub>            | do.                    | 1,160        | 348                | 525          | 158   |
| High-carbon ferrochromium: <sup>8</sup>       |                        |              |                    |              |       |
| 50% to 55% chromium                           | cents per pound        | 174.80       | XX                 | 80.57        | XX    |
| 60% to 65% chromium                           | do.                    | 205.34       | XX                 | 82.45        | XX    |
| Low-carbon ferrochromium: <sup>8</sup>        |                        |              |                    |              |       |
| 0.05% carbon                                  | do.                    | 466          | XX                 | 236          | XX    |
| 0.10% carbon                                  | do.                    | 435          | XX                 | 210          | XX    |
| 0.15% carbon                                  | do.                    | 432          | XX                 | 209          | XX    |
| Chromium metal:                               |                        |              |                    |              |       |
| Imported, aluminothermic <sup>6</sup>         | do.                    | XX           | 530                | XX           | 408   |

do. Ditto. XX Not applicable.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Mass-weighted average based on customs value and weight of imported material.

<sup>3</sup>Reported by the U.S. Census Bureau.

<sup>4</sup>Average over all grades.

<sup>5</sup>Time-weighted average based on prices reported by material in trade journals.

<sup>6</sup>Source: Ryan's Notes.

<sup>7</sup>Price is cost and freight China.

<sup>8</sup>Source: Platts Metals Week.

TABLE 4  
U.S. EXPORTS OF CHROMIUM MATERIALS, BY TYPE<sup>1</sup>

| HTS <sup>2</sup> code | Type  | 2008                    |                      | 2009                    |                      | Principal destinations in 2009<br>(Quantity in metric tons, value in thousands)   |
|-----------------------|---|-------------------------|----------------------|-------------------------|----------------------|---|
|                       |   | Quantity<br>(kilograms) | Value<br>(thousands) | Quantity<br>(kilograms) | Value<br>(thousands) |   |
| 2610.00.0000          | Chromite ore and concentrate, gross weight                      | 7,000,000               | \$4,370              | 2,500,000               | \$1,610              | Canada (1,550, \$851); Mexico (671, \$447).   |
|                       | Metal and alloys, gross weight:                                 |                         |                      |                         |                      |   |
| 8112.21.0000          | Unwrought chromium powders                                      | 389,000                 | 7,030                | 213,000                 | 4,570                | Japan (82, \$1,360); Germany (25, \$886); Canada (21, \$367); Mexico (16, \$186); China (15, \$410); Brazil (13, \$287).  |
| 8112.22.0000          | Chromium metal waste and scrap                                  | 67,900                  | 1,410                | 19,600                  | 481                  | Japan (10, \$271); Germany (8, \$194); Republic of Korea (1, \$15).   |
| 8112.29.0000          | Chromium metal other than unwrought powders and waste and scrap | 541,000                 | 12,000               | 179,000                 | 8,250                | Japan (43, \$2,610); Hong Kong (33, \$1,160); Brazil (18, \$675); China (14, \$439); Belgium (10, \$713); Canada (9, \$90); United Kingdom (9, \$239); Mexico (7, \$256).   |
|                       | Total chromium metal  | 998,000                 | 20,400               | 411,000                 | 13,300               |   |
|                       | Chromium ferroalloys:   |                         |                      |                         |                      |   |
| 7202.41.0000          | High-carbon ferrochromium: <sup>3</sup>                         |                         |                      |                         |                      |   |
|                       | Gross weight  | 10,800,000              | 14,500               | 3,200,000               | 4,270                | Canada (1,690, \$2,100); Mexico (840, \$1,220); Brazil (145, \$266).  |
|                       | Contained weight  | 4,280,000               | XX                   | 1,770,000               | XX                   |   |
| 7202.49.0000          | Low-carbon ferrochromium: <sup>4</sup>                          |                         |                      |                         |                      |   |
|                       | Gross weight  | 13,400,000              | 27,500               | 1,560,000               | 2,440                | Canada (635, \$1,050); Japan (436, \$587); Mexico (205, \$333); Sweden (108, \$146); United Kingdom (87, \$117); Brazil (53, \$104); China (34, \$83).  |
|                       | Contained weight  | 5,990,000               | XX                   | 710,000                 | XX                   |   |
| 7202.50.0000          | Ferrochromium-silicon:  |                         |                      |                         |                      |   |
|                       | Gross weight  | 216,000                 | 1,140                | 18,500                  | 109                  | Hong Kong (all).  |
|                       | Contained weight  | 18,200                  | XX                   | 6,490                   | XX                   |   |
|                       | Total chromium ferroalloys:                                     |                         |                      |                         |                      |   |
|                       | Gross weight  | 24,500,000              | 43,100               | 4,780,000               | 6,820                |   |
|                       | Contained weight  | 10,300,000              | XX                   | 2,490,000               | XX                   |   |
|                       | Chemicals, gross weight:  |                         |                      |                         |                      |   |
|                       | Chromium oxides:  |                         |                      |                         |                      |   |
| 2819.10.0000          | Chromium trioxide   | 17,400,000              | 24,700               | 10,100,000              | 18,600               | China (1,820, \$3,950); Brazil (1,720, \$2,270); India (962, \$1,540); United Kingdom (921, \$1,770); Chile (507, \$792); Belgium (443, \$684); France (398, \$563); Indonesia (371, \$542); Republic of Korea (302, \$598); Canada (255, \$878); Mexico (255, \$800); Turkey (252, \$402). |
| 2819.90.0000          | Other   | 3,610,000               | 14,100               | 1,900,000               | 9,300                | Canada (526, \$2,230); Spain (351, \$800); Belgium (198, \$461); Chile (109, \$235); Brazil (91, \$466); France (69, \$1,070); United Kingdom (69, \$210); Mexico (68, \$333); Germany (60, \$863).   |
|                       | Total chromium oxides   | 21,000,000              | 38,900               | 12,000,000              | 27,900               |   |
| 2833.29.4000          | Chromium sulfates   | 52,400                  | 362                  | 16,100                  | 114                  | Mexico (8, \$41); Hong Kong (4, \$17); Guatemala (3, \$14); India (1, \$43).  |

See footnotes at end of table.



TABLE 4—Continued  
U.S. EXPORTS OF CHROMIUM MATERIALS, BY TYPE<sup>1</sup>

| HTS <sup>2</sup> code                         | Type                                    | 2008                    |                      | 2009                    |                      | Principal destinations in 2009<br>(Quantity in metric tons, value in thousands)   |
|---|---|-------------------------|----------------------|-------------------------|----------------------|---|
|   |   | Quantity<br>(kilograms) | Value<br>(thousands) | Quantity<br>(kilograms) | Value<br>(thousands) |   |
| Salts of oxometallic or peroxometallic acids: |   |                         |                      |                         |                      |   |
| 2841.90.4500                                  | Zinc and lead chromate                  | 17,100                  | \$157                | 56,200                  | \$293                | Mexico (18, \$54); Colombia (18, \$41); Trinidad and Tobago (11, \$62); Jamaica (5, \$28); Dominican Republic (3, \$24); South Africa (1, \$68); Taiwan (1, \$16).              |
| 2841.30.0000                                  | Sodium dichromate                       | 31,300,000              | 26,000               | 19,700,000              | 20,200               | Japan (14,800, \$14,100); Canada (2,080, \$3,240).  |
| 2841.50.1000                                  | Potassium dichromate                    | 77,000                  | 338                  | 52,700                  | 276                  | Hong Kong (26, \$206); Canada (25, \$62); Taiwan (1, \$8).  |
| 2841.50.9100                                  | Other                                   | 1,380,000               | 4,650                | 615,000                 | 2,330                | Indonesia (94, \$167); Republic of Korea (90, \$311); China (88, \$377); Canada (76, \$267); Vietnam (58, \$294); Hong Kong (38, \$160); Thailand (27, \$97); India (27, \$43). |
| Total salts                                   |   | 32,800,000              | 31,200               | 20,500,000              | 23,100               |   |
| 3206.20.0000                                  | Pigments and preparations, gross weight | 1,230,000               | 10,600               | 1,220,000               | 13,800               | Japan (583, \$7,352); Mexico (181, \$1,959); Canada (146, \$775); Colombia (46, \$525); Republic of Korea (34, \$233).  |

XX Not applicable.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States of America.

<sup>3</sup>More than 4% carbon.

<sup>4</sup>Not more than 4% carbon.

Source: U.S. Census Bureau.

TABLE 5  
U.S. IMPORTS FOR CONSUMPTION OF FERROCHROMIUM, BY COUNTRY<sup>1</sup>

| Country      | Not more than 0.5% carbon<br>(HTS <sup>2</sup> code 7202.49.5090) |                                   |                      | More than 0.5% carbon, but<br>not more than 3% carbon<br>(HTS <sup>2</sup> code 7202.49.5010) |                                   |                      | More than 3% carbon, but<br>not more than 4% carbon<br>(HTS <sup>2</sup> code 7202.49.1000) |                                   |                      | More than 4% carbon<br>(HTS <sup>2</sup> code 7202.41.0000) |                                   |                      | Total all grades                    |                                   |                      |
|--------------|---|-----------------------------------|----------------------|---|-----------------------------------|----------------------|---|-----------------------------------|----------------------|---|-----------------------------------|----------------------|-------------------------------------|-----------------------------------|----------------------|
|              | Gross<br>weight<br>(metric<br>tons)                               | Cr<br>content<br>(metric<br>tons) | Value<br>(thousands) | Gross<br>weight<br>(metric<br>tons)   | Cr<br>content<br>(metric<br>tons) | Value<br>(thousands) | Gross<br>weight<br>(metric<br>tons)   | Cr<br>content<br>(metric<br>tons) | Value<br>(thousands) | Gross<br>weight<br>(metric<br>tons)                         | Cr<br>content<br>(metric<br>tons) | Value<br>(thousands) | Gross<br>weight<br>(metric<br>tons) | Cr<br>content<br>(metric<br>tons) | Value<br>(thousands) |
|              |   |                                   |                      |   |                                   |                      |   |                                   |                      |   |                                   |                      |                                     |                                   |                      |
| 2008:        |   |                                   |                      |   |                                   |                      |   |                                   |                      |   |                                   |                      |                                     |                                   |                      |
| Brazil       | 37  | 25                                | \$116                | --  | --                                | --                   | --  | --                                | --                   | 2,000   | 1,040                             | \$3,820              | 2,030                               | 1,070                             | \$3,940              |
| China        | 4,550   | 2,920                             | 23,000               | 340   | 212                               | \$1,200              | --  | --                                | --                   | 632   | 400                               | 1,730                | 5,520                               | 3,530                             | 25,900               |
| Germany      | 5,200   | 3,580                             | 29,400               | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 5,200                               | 3,580                             | 29,400               |
| India        | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 58,000  | 35,800                            | 105,000              | 58,000                              | 35,800                            | 105,000              |
| Italy        | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 159   | 100                               | 260                  | 159                                 | 100                               | 260                  |
| Japan        | 4,220   | 2,750                             | 15,100               | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 4,220                               | 2,750                             | 15,100               |
| Kazakhstan   | 2,130   | 1,460                             | 6,880                | --  | --                                | --                   | --  | --                                | --                   | 114,000   | 79,300                            | 310,000              | 117,000                             | 80,700                            | 317,000              |
| Mexico       | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 38  | 28                                | 123                  | 38                                  | 28                                | 123                  |
| Russia       | 20,100  | 14,100                            | 113,000              | 1,490   | 1,010                             | 5,220                | 344   | 204                               | \$466                | 40,500  | 26,200                            | 89,900               | 62,500                              | 41,500                            | 209,000              |
| South Africa | 408   | 249                               | 769                  | 420   | 227                               | 666                  | --  | --                                | --                   | 220,000   | 107,000                           | 310,000              | 220,000                             | 108,000                           | 312,000              |
| Sweden       | 359   | 243                               | 1,550                | --  | --                                | --                   | --  | --                                | --                   | 718   | 448                               | 1,370                | 1,080                               | 691                               | 2,910                |
| Zimbabwe     | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 33,200  | 19,400                            | 87,200               | 33,200                              | 19,400                            | 87,200               |
| Total        | 37,000  | 25,300                            | 190,000              | 2,250   | 1,450                             | 7,090                | 344   | 204                               | 466                  | 469,000   | 270,000                           | 910,000              | 509,000                             | 297,000                           | 1,110,000            |
| 2009:        |   |                                   |                      |   |                                   |                      |   |                                   |                      |   |                                   |                      |                                     |                                   |                      |
| Albania      | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 558   | 360                               | 714                  | 558                                 | 360                               | 714                  |
| Austria      | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 466   | 301                               | 576                  | 466                                 | 301                               | 576                  |
| Belgium      | --  | --                                | --                   | --  | --                                | --                   | 17  | 12                                | 27                   | --  | --                                | --                   | 17                                  | 12                                | 27                   |
| China        | 1,850   | 1,180                             | 4,730                | 160   | 98                                | 368                  | --  | --                                | --                   | 40  | 32                                | 142                  | 2,050                               | 1,300                             | 5,240                |
| Germany      | 3,800   | 2,640                             | 15,700               | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 3,800                               | 2,640                             | 15,700               |
| India        | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 2,050   | 1,230                             | 1,870                | 2,050                               | 1,230                             | 1,870                |
| Japan        | 1,090   | 752                               | 4,810                | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 1,090                               | 752                               | 4,810                |
| Kazakhstan   | 2,030   | 1,400                             | 6,100                | 495   | 348                               | 1,580                | --  | --                                | --                   | 43,100  | 29,500                            | 51,200               | 45,600                              | 31,300                            | 58,900               |
| Netherlands  | 22  | 16                                | 92                   | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 22                                  | 16                                | 92                   |
| Russia       | 23,900  | 16,400                            | 71,100               | 249   | 175                               | 708                  | 3,160   | 1,700                             | 1,690                | 15,900  | 10,100                            | 15,900               | 43,200                              | 28,400                            | 89,400               |
| South Africa | 3,630   | 2,160                             | 7,840                | 1,210   | 657                               | 1,640                | --  | --                                | --                   | 136,000   | 67,000                            | 96,100               | 141,000                             | 69,800                            | 106,000              |
| Sweden       | 115   | 75                                | 574                  | --  | --                                | --                   | --  | --                                | --                   | 317   | 210                               | 791                  | 433                                 | 285                               | 1,370                |
| Turkey       | 180   | 126                               | 390                  | --  | --                                | --                   | --  | --                                | --                   | --  | --                                | --                   | 180                                 | 126                               | 390                  |
| Total        | 36,600  | 24,800                            | 111,000              | 2,110   | 1,280                             | 4,290                | 3,180   | 1,720                             | 1,720                | 198,000   | 109,000                           | 167,000              | 240,000                             | 137,000                           | 285,000              |

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States of America.

Source: U.S. Census Bureau.

TABLE 6  
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE<sup>1</sup>

| HTS <sup>2</sup> code       | Type  | 2008                    |                                   | 2009                    |                                   | Sources in 2009<br>(Quantity in metric tons, value in thousands)  |
|-----------------------------|---|-------------------------|-----------------------------------|-------------------------|-----------------------------------|---|
|                             |   | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) |   |
| Chromite ore:               |   |                         |                                   |                         |                                   |   |
| 2610.00.0020                | Not more than 40% Cr <sub>2</sub> O <sub>3</sub> :                |                         |                                   |                         |                                   |   |
|                             | Gross weight  | --                      | --                                | 10,300,000              | \$3,540                           | South Africa (all).   |
|                             | Cr <sub>2</sub> O <sub>3</sub> content                            | --                      | XX                                | 2,560,000               | XX                                |   |
| 2610.00.0040                | More than 40%, but less than 46% Cr <sub>2</sub> O <sub>3</sub> : |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 38,400,000              | \$9,470                           | 859,000                 | 533                               | South Africa (all).   |
|                             | Cr <sub>2</sub> O <sub>3</sub> content                            | 17,600,000              | XX                                | 394,000                 | XX                                |   |
| 2610.00.0060                | 46% or more Cr <sub>2</sub> O <sub>3</sub> :                      |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 159,000,000             | 35,300                            | 66,100,000              | 13,400                            | South Africa (all).   |
|                             | Cr <sub>2</sub> O <sub>3</sub> content                            | 76,400,000              | XX                                | 30,600,000              | XX                                |   |
| Total chromite ore:         |   |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 197,000,000             | 44,800                            | 77,200,000              | 17,500                            |   |
|                             | Cr <sub>2</sub> O <sub>3</sub> content                            | 94,000,000              | XX                                | 33,600,000              | XX                                |   |
| Chromium ferroalloys:       |   |                         |                                   |                         |                                   |   |
| 7202.49.5090                | Not more than 0.5% carbon:  |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 37,000,000              | 190,000                           | 36,600,000              | 111,000                           | Russia (23,900, \$71,100); Germany (3,800, \$15,700); South Africa (3,630, \$7,840); Kazakhstan (2,030, \$6,100); China (1,850, \$4,730);   |
|                             | Cr content  | 25,300,000              | XX                                | 24,800,000              | XX                                | Japan (1,090, \$4,810); Turkey (180, \$390); Sweden (115, \$574); Netherlands (22, \$92).   |
| 7202.49.5010                | More than 0.5%, but less than 3% carbon:                          |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 2,250,000               | 7,090                             | 2,110,000               | 4,290                             | South Africa (1,210, \$1,640); Kazakhstan (495, \$1,580); Russia (249, \$708); China (160, \$368).  |
|                             | Cr content  | 1,450,000               | XX                                | 1,280,000               | XX                                |   |
| 7202.49.1000                | More than 3%, but less than 4% carbon:                            |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 344,000                 | 466                               | 3,180,000               | 1,720                             | Russia (3,160, \$1,690); Belgium (17, \$27).  |
|                             | Cr content  | 204,000                 | XX                                | 1,720,000               | XX                                |   |
| 7202.41.0000                | More than 4% carbon:  |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 469,000,000             | 910,000                           | 198,000,000             | 167,000                           | South Africa (136,000, \$96,100); Kazakhstan (43,100, \$51,200); Russia (15,900, \$15,900); India (2,050, \$1,870); Albania (558, \$714); Austria (466, \$576); Sweden (317, \$791); China (40, \$142). |
|                             | Cr content  | 270,000,000             | XX                                | 109,000,000             | XX                                |   |
| 7202.50.0000                | Ferrochromium-silicon:  |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 24,200,000              | 57,900                            | 7,560,000               | 9,140                             | Kazakhstan (all).   |
|                             | Cr content  | 9,810,000               | XX                                | 3,120,000               | XX                                |   |
| Total chromium ferroalloys: |   |                         |                                   |                         |                                   |   |
|                             | Gross weight  | 533,000,000             | 1,170,000                         | 248,000,000             | 294,000                           |   |
|                             | Cr content  | 307,000,000             | XX                                | 140,000,000             | XX                                |   |

See footnotes at end of table.

TABLE 6—Continued  
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE<sup>1</sup>

| HTS <sup>2</sup> code | Type  | 2008                    |                                   |                         | 2009                              |                         |                                   | Sources in 2009<br>(Quantity in metric tons, value in thousands)  |
|-----------------------|---|-------------------------|-----------------------------------|-------------------------|-----------------------------------|-------------------------|-----------------------------------|---|
|                       |   | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) |   |
|                       | Chromium metal, gross weight:                 |                         |                                   |                         |                                   |                         |                                   |   |
| 8112.21.1000          | Unwrought chromium powders                    | 1,050,000               | \$11,700                          | 635,000                 | \$6,410                           |                         |                                   | Russia (360, \$2,540); China (156, \$2,020); United Kingdom (96, \$1,640); France (18, \$54); Germany (4, \$126); Japan (1, \$14).  |
| 8112.22.0000          | Waste and scrap                               | 523,000                 | 3,000                             | 107,000                 | 797                               |                         |                                   | Mexico (87, \$333); Singapore (15, \$393); Taiwan (2, \$32); United Kingdom (1, \$18); Germany (1, \$17); Japan (1, \$4).   |
| 8112.29.0000          | Other than waste and scrap                    | 11,500,000              | 131,000                           | 6,830,000               | 67,700                            |                         |                                   | United Kingdom (2,930, \$30,200); France (1,520, \$17,100); China (1,080, \$10,200); Russia (979, \$8,140); Kazakhstan (230, \$784); Germany (42, \$896); Italy (38, \$144); Netherlands (7, \$39); Japan (5, \$182).   |
|                       | Total chromium metal                          | 13,100,000              | 145,000                           | 7,570,000               | 74,900                            |                         |                                   |   |
|                       | Chemicals, gross weight:                      |                         |                                   |                         |                                   |                         |                                   |   |
|                       | Chromium oxides and hydroxides:               |                         |                                   |                         |                                   |                         |                                   |   |
| 2819.10.0000          | Chromium trioxide                             | 8,890,000               | 22,500                            | 6,240,000               | 18,400                            |                         |                                   | Turkey (3,820, \$11,400); Kazakhstan (1,670, \$3,940); China (293, \$1,480); South Africa (227, \$615); Canada (151, \$678); Colombia (37, \$124); Germany (20, \$138); Italy (16, \$68); France (2, \$6); Canada (1,250, \$1,460); China (817, \$3,810); United Kingdom (400, \$1,840); Germany (205, \$1,480); Colombia (49, \$313); Kazakhstan (39, \$165); France (38, \$160); Russia (18, \$74); Spain (17, \$109); Taiwan (12, \$108); Finland (7, \$38). |
| 2819.90.0000          | Other   | 2,550,000               | 9,850                             | 2,850,000               | 9,560                             |                         |                                   |   |
|                       | Total oxides                                  | 11,400,000              | 32,300                            | 9,100,000               | 28,000                            |                         |                                   |   |
| 2833.29.4000          | Sulfates of chromium                          | 56,400                  | 92                                | 70,600                  | 88                                |                         |                                   | Turkey (39, \$48); India (32, \$29).  |
|                       | Salts of oxometallic or peroxometallic acids: |                         |                                   |                         |                                   |                         |                                   |   |
| 2841.90.4500          | Chromates of lead and zinc                    | 298,000                 | 1,310                             | 32,200                  | 101                               |                         |                                   | Republic of Korea (20, \$47); Japan (8, \$30); France (4, \$25).  |
| 2841.30.0000          | Sodium dichromate                             | 33,000,000              | 28,600                            | 15,000,000              | 17,300                            |                         |                                   | United Kingdom (14,900, \$16,900); China (84, \$156); Colombia (42, \$187); Russia (20, \$29).  |
|                       | Other chromates and dichromates;              |                         |                                   |                         |                                   |                         |                                   |   |
|                       | Peroxochromates:                              |                         |                                   |                         |                                   |                         |                                   |   |
| 2841.50.1000          | Potassium dichromate                          | 4,810                   | 29                                | 3,200                   | 10                                |                         |                                   | Mexico (3, \$3); Japan (1, \$7).  |
| 2841.50.9100          | Other   | 320,000                 | 905                               | 239,000                 | 711                               |                         |                                   | Austria (111, \$325); Colombia (48, \$110); Canada (30, \$88); France (21, \$89); Germany (20, \$51); China (8, \$23); Taiwan (1, \$22).  |
|                       | Total salts                                   | 33,600,000              | 30,800                            | 15,300,000              | 18,100                            |                         |                                   |   |
| 2849.90.2000          | Chromium carbide                              | 129,000                 | 2,460                             | 165,000                 | 3,060                             |                         |                                   | Japan (49, \$638); United Kingdom (37, \$446); Canada (26, \$530); Austria (23, \$1,030); Germany (15, \$142); China (14, \$265).   |

See footnotes at end of table.

TABLE 6—Continued  
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE<sup>1</sup>

| HTS <sup>2</sup> code                         | Type                       | 2008                    |                                   | 2009                    |                                   | Sources in 2009<br>(Quantity in metric tons, value in thousands)  |
|---|----------------------------|-------------------------|-----------------------------------|-------------------------|-----------------------------------|---|
|   |                            | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) |   |
| Chromium metal, gross weight:                 |                            |                         |                                   |                         |                                   |   |
| 8112.21.1000                                  | Unwrought chromium powders | 1,050,000               | \$11,700                          | 635,000                 | \$6,410                           | Russia (360, \$2,540); China (156, \$2,020); United Kingdom (96, \$1,640); France (18, \$54); Germany (4, \$126); Japan (1, \$14).  |
| 8112.22.0000                                  | Waste and scrap            | 523,000                 | 3,000                             | 107,000                 | 797                               | Mexico (87, \$333); Singapore (15, \$393); Taiwan (2, \$32); United Kingdom (1, \$18); Germany (1, \$17); Japan (1, \$4).   |
| 8112.29.0000                                  | Other than waste and scrap | 11,500,000              | 131,000                           | 6,830,000               | 67,700                            | United Kingdom (2,930, \$30,200); France (1,520, \$17,100); China (1,080, \$10,200); Russia (979, \$8,140); Kazakhstan (230, \$784); Germany (42, \$896); Italy (38, \$144); Netherlands (7, \$39); Japan (5, \$182).   |
| Total chromium metal                          |                            | 13,100,000              | 145,000                           | 7,570,000               | 74,900                            |   |
| Chemicals, gross weight:                      |                            |                         |                                   |                         |                                   |   |
| Chromium oxides and hydroxides:               |                            |                         |                                   |                         |                                   |   |
| 2819.10.0000                                  | Chromium trioxide          | 8,890,000               | 22,500                            | 6,240,000               | 18,400                            | Turkey (3,820, \$11,400); Kazakhstan (1,670, \$3,940); China (293, \$1,480); South Africa (227, \$615); Canada (151, \$678); Colombia (37, \$124); Germany (20, \$138); Italy (16, \$68); France (2, \$6); Canada (1,250, \$1,460); China (817, \$3,810); United Kingdom (400, \$1,840); Germany (205, \$1,480); Colombia (49, \$313); Kazakhstan (39, \$165); France (38, \$160); Russia (18, \$74); Spain (17, \$109); Taiwan (12, \$108); Finland (7, \$38). |
| 2819.90.0000                                  | Other                      | 2,550,000               | 9,850                             | 2,850,000               | 9,560                             |   |
| Total oxides                                  |                            | 11,400,000              | 32,300                            | 9,100,000               | 28,000                            |   |
| Sulfates of chromium                          |                            |                         |                                   |                         |                                   |   |
| 2833.29.4000                                  | Sulfates of chromium       | 56,400                  | 92                                | 70,600                  | 88                                | Turkey (39, \$48); India (32, \$29).  |
| Salts of oxometallic or peroxometallic acids: |                            |                         |                                   |                         |                                   |   |
| Chromates of lead and zinc                    |                            |                         |                                   |                         |                                   |   |
| 2841.90.4500                                  | Chromates of lead and zinc | 298,000                 | 1,310                             | 32,200                  | 101                               | Republic of Korea (20, \$47); Japan (8, \$30); France (4, \$25).  |
| 2841.30.0000                                  | Sodium dichromate          | 33,000,000              | 28,600                            | 15,000,000              | 17,300                            | United Kingdom (14,900, \$16,900); China (84, \$156); Colombia (42, \$187); Russia (20, \$29).  |
| Other chromates and dichromates:              |                            |                         |                                   |                         |                                   |   |
| Peroxychromates:                              |                            |                         |                                   |                         |                                   |   |
| 2841.50.1000                                  | Potassium dichromate       | 4,810                   | 29                                | 3,200                   | 10                                | Mexico (3, \$3); Japan (1, \$7).  |
| 2841.50.9100                                  | Other                      | 320,000                 | 905                               | 239,000                 | 711                               | Austria (111, \$325); Colombia (48, \$110); Canada (30, \$88); France (21, \$89); Germany (20, \$51); China (8, \$23); Taiwan (1, \$22).  |
| Total salts                                   |                            | 33,600,000              | 30,800                            | 15,300,000              | 18,100                            |   |
| 2849.90.2000                                  | Chromium carbide           | 129,000                 | 2,460                             | 165,000                 | 3,060                             | Japan (49, \$638); United Kingdom (37, \$446); Canada (26, \$530); Austria (23, \$1,030); Germany (15, \$142); China (14, \$265).   |

See footnotes at end of table.

TABLE 6—Continued  
U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE<sup>1</sup>

| HTS <sup>2</sup> code   | Type              | 2008                    |                                   | 2009                    |                                   | Sources in 2009<br>(Quantity in metric tons, value in thousands)  |
|---|-------------------|-------------------------|-----------------------------------|-------------------------|-----------------------------------|---|
|   |                   | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) | Quantity<br>(kilograms) | Value <sup>3</sup><br>(thousands) |   |
| Pigments and preparations based on chromium,<br>gross weight: |                   |                         |                                   |                         |                                   |   |
| 3206.20.0010  | Chrome yellow     | 1,120,000               | \$5,590                           | 1,000,000               | \$4,670                           | Canada (536, \$3,140); China (222, \$599); Mexico (133, \$475);<br>Republic of Korea (64, \$223); Germany (22, \$139); Colombia<br>(19, \$65); Brazil (7, \$7); Netherlands (1, \$18).                                      |
| 3206.20.0020  | Molybdenum orange | 373,000                 | 3,110                             | 269,000                 | 2,170                             | Canada (227, \$1,960); Mexico (25, \$134); Colombia (12, \$64);<br>Netherlands (4, \$13); Japan (1, \$5).   |
| 3206.20.0030  | Zinc yellow       | 71,500                  | 192                               | 168,000                 | 464                               | China (158, \$425); Mexico (9, \$39).   |
| 3206.20.0050  | Other             | 531,000                 | 1,830                             | 254,000                 | 1,350                             | France (150, \$603); Poland (38, \$206); China (25, \$67); Germany<br>(15, \$130); India (11, \$73); United Kingdom (7, \$169); Brazil (3, \$50);<br>Japan (2, \$18); Colombia (2, \$7); Canada (1, \$15); Taiwan (1, \$8). |
| Total pigments  |                   | 2,100,000               | 10,700                            | 1,700,000               | 8,650                             |   |

XX Not applicable. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Harmonized Tariff Schedule of the United States of America.

<sup>3</sup>Customs import value generally represents a value in the foreign country and therefore excludes U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise into the United States.

TABLE 7  
 WORLD PRODUCTION CAPACITY OF CHROMITE ORE, FERROCHROMIUM, CHROMIUM METAL,  
 CHROMIUM CHEMICALS, AND STAINLESS STEEL, AND APPARENT CONSUMPTION IN 2009 and 2006<sup>1</sup>

(Thousand metric tons of contained chromium)

| Country              | Production capacity |               |       |           |                 | Apparent (consumption <sup>2</sup> ) |                    |
|----------------------|---------------------|---------------|-------|-----------|-----------------|--------------------------------------|--------------------|
|                      | Ore                 | Ferrochromium | Metal | Chemicals | Stainless steel | 2009                                 | 2006               |
| Afghanistan          | 2                   | --            | --    | --        | --              | --                                   | --                 |
| Albania              | 77                  | 22            | --    | --        | --              | 8                                    | 22 <sup>r</sup>    |
| Argentina            | --                  | --            | --    | 13        | --              | 9                                    | 20 <sup>r</sup>    |
| Australia            | 78                  | --            | --    | --        | --              | -33                                  | -43 <sup>r</sup>   |
| Austria              | --                  | --            | --    | --        | 11              | 52                                   | 102 <sup>r</sup>   |
| Belgium              | --                  | --            | --    | --        | 259             | 93                                   | 174 <sup>r</sup>   |
| Brazil               | 205                 | 125           | --    | --        | 95              | 203                                  | 164 <sup>r</sup>   |
| Canada               | --                  | --            | --    | --        | --              | 9                                    | 20 <sup>r</sup>    |
| China                | 60                  | 853           | 6     | 70        | 1,700           | 3,140                                | 1,520 <sup>r</sup> |
| Czech Republic       | --                  | --            | --    | --        | 3               | 7                                    | 11 <sup>r</sup>    |
| Finland              | 185                 | 134           | --    | --        | 222             | 52                                   | 158 <sup>r</sup>   |
| France               | --                  | --            | 7     | --        | 90              | 36                                   | 83 <sup>r</sup>    |
| Germany              | --                  | 18            | 1     | --        | 292             | 160                                  | 255 <sup>r</sup>   |
| Greece               | 1                   | --            | --    | --        | --              | (3)                                  | (3)                |
| India                | 1,200               | 451           | (3)   | 31        | 302             | 713                                  | 468 <sup>r</sup>   |
| Indonesia            | --                  | --            | --    | --        | --              | -2                                   | -2 <sup>r</sup>    |
| Iran                 | 77                  | 5             | --    | 2         | --              | (3)                                  | (3)                |
| Italy                | --                  | --            | --    | --        | 292             | 159                                  | 252 <sup>r</sup>   |
| Japan                | 1                   | 8             | 1     | 17        | 695             | 257                                  | 500 <sup>r</sup>   |
| Kazakhstan           | 1,110               | 720           | 2     | 37        | --              | 169                                  | 202 <sup>r</sup>   |
| Korea, Republic of   | --                  | --            | --    | --        | 387             | 205                                  | 222 <sup>r</sup>   |
| Kosovo               | 1                   | --            | --    | --        | --              | (3)                                  | --                 |
| Madagascar           | 42                  | --            | --    | --        | --              | 15                                   | 24 <sup>r</sup>    |
| Oman                 | 258                 | --            | --    | --        | --              | (3)                                  | -2 <sup>r</sup>    |
| Pakistan             | 97                  | --            | --    | 3         | --              | -8                                   | -1 <sup>r</sup>    |
| Philippines          | 11                  | --            | --    | --        | --              | (3)                                  | -6 <sup>r</sup>    |
| Poland               | --                  | --            | --    | --        | 1               | 7                                    | 11 <sup>r</sup>    |
| Russia               | 291                 | 372           | 16    | 31        | 19              | 241                                  | 376 <sup>r</sup>   |
| Slovakia             | --                  | 1             | --    | --        | --              | (3)                                  | 3 <sup>r</sup>     |
| Slovenia             | --                  | --            | --    | --        | 15              | 7                                    | 14 <sup>r</sup>    |
| South Africa         | 2,920               | 1,900         | --    | 23        | 117             | -532                                 | 216 <sup>r</sup>   |
| Spain                | --                  | --            | --    | --        | 214             | 60                                   | 128 <sup>r</sup>   |
| Sudan                | 10                  | --            | --    | --        | --              | --                                   | (3)                |
| Sweden               | --                  | 86            | --    | --        | 116             | 47                                   | 94 <sup>r</sup>    |
| Taiwan               | --                  | --            | --    | --        | 279             | 201                                  | 268 <sup>r</sup>   |
| Turkey               | 568                 | 48            | --    | 17        | --              | 64                                   | 29 <sup>r</sup>    |
| Ukraine              | --                  | --            | --    | --        | 21              | --                                   | (3)                |
| United Arab Emirates | 10                  | --            | --    | --        | --              | -1                                   | (3)                |
| United Kingdom       | --                  | --            | 7     | --        | 64              | 24                                   | 56 <sup>r</sup>    |
| United States        | --                  | --            | 3     | 38        | 419             | 150                                  | 233 <sup>r</sup>   |
| Vietnam              | 31                  | --            | --    | --        | --              | --                                   | --                 |
| Zimbabwe             | 247                 | 135           | --    | --        | --              | 26                                   | 75 <sup>r</sup>    |
| Total                | 7,480               | 4,880         | 43    | 282       | 5,610           | XX                                   | XX                 |

<sup>r</sup>Revised. XX Not applicable. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Apparent consumption is chromite ore production plus chromite ore, ferrochromium, and chromium metal net imports. Net imports are imports minus exports. Based on data reported by the International Chromium Development Association. A negative apparent consumption indicates that exports are greater than production plus imports.

<sup>3</sup>Less than ½ unit.

TABLE 8  
CHROMITE: WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons, gross weight)

| Country <sup>3</sup>     | 2005                 | 2006                 | 2007                    | 2008                    | 2009                   |
|--------------------------|----------------------|----------------------|-------------------------|-------------------------|------------------------|
| Afghanistan <sup>4</sup> | 6,818 <sup>r</sup>   | 7,273 <sup>r</sup>   | 6,491 <sup>r</sup>      | 6,491 <sup>r</sup>      | 6,000 <sup>e</sup>     |
| Albania <sup>5</sup>     | 182,772 <sup>r</sup> | 212,581 <sup>r</sup> | 199,771 <sup>r</sup>    | 207,104 <sup>r</sup>    | 256,000 <sup>e</sup>   |
| Australia                | 241,865              | 258,087              | 253,400                 | 224,809                 | 119,314                |
| Brazil <sup>6</sup>      | 616,534              | 562,739              | 627,772                 | 705,726 <sup>r</sup>    | 700,000 <sup>e</sup>   |
| Burma <sup>4</sup>       | 410                  | --                   | --                      | --                      | --                     |
| China <sup>e</sup>       | 200,000              | 200,000              | 200,000                 | 200,000                 | 200,000                |
| Cuba                     | 34,000               | 27,900               | 25,000                  | 25,000 <sup>e</sup>     | 25,000 <sup>e</sup>    |
| Finland                  | 571,103              | 548,713              | 556,100                 | 613,543                 | 246,817                |
| Greece <sup>4</sup>      | 1,500                | 1,500                | 1,400                   | 1,400 <sup>e</sup>      | 1,400 <sup>e</sup>     |
| India                    | 3,255,162            | 3,600,400            | 3,320,000               | 3,900,000               | 3,760,000 <sup>e</sup> |
| Iran                     | 223,563              | 244,603              | 185,760                 | 188,000                 | 255,129                |
| Kazakhstan               | 3,581,242            | 3,366,078            | 3,687,200               | 3,629,000               | 3,333,197              |
| Madagascar               | 140,847              | 132,335              | 122,260                 | 84,000                  | 60,000 <sup>e</sup>    |
| Oman                     | 50,400               | 70,500               | 407,822                 | 859,748 <sup>r</sup>    | 636,482                |
| Pakistan                 | 148,432              | 199,000              | 323,100                 | 320,000 <sup>e</sup>    | 275,000 <sup>e</sup>   |
| Philippines              | 38,081               | 46,728               | 31,592                  | 15,268                  | 14,000 <sup>e</sup>    |
| Russia                   | 772,000              | 966,065              | 776,681                 | 913,000 <sup>r</sup>    | 416,194                |
| South Africa             | 7,552,000            | 7,418,326            | 9,646,958               | 9,682,640               | 6,865,540              |
| Sudan                    | 21,654               | 28,772               | 15,476                  | 31,890                  | 19,000 <sup>e</sup>    |
| Turkey                   | 688,377              | 1,059,901            | 1,678,932               | 1,885,712               | 1,770,029              |
| United Arab Emirates     | --                   | --                   | 19,000                  | 34,350                  | 23,770                 |
| Vietnam                  | 78,915               | 73,037               | 103,830                 | 55,880                  | 37,105                 |
| Zimbabwe                 | 819,903              | 712,908              | 663,593                 | 484,482                 | 279,360                |
| Total                    | 19,200,000           | 19,700,000           | 22,900,000 <sup>r</sup> | 24,100,000 <sup>r</sup> | 19,300,000             |

<sup>e</sup>Estimated. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Table includes data available through August 20, 2010.

<sup>3</sup>Figures for all countries represent marketable output unless otherwise noted.

<sup>4</sup>Gross weight estimated assuming an average grade of 44% chromic oxide (Cr<sub>2</sub>O<sub>3</sub>).

<sup>5</sup>Ore grade was 18% to 42% Cr<sub>2</sub>O<sub>3</sub>.

<sup>6</sup>Average chromic oxide (Cr<sub>2</sub>O<sub>3</sub>) content was as follows: 2005—41.0% (revised); 2006—40.6%; 2007—40.3%; 2008—42.5% (revised); and 2009—40.0%.



TABLE 9  
FERROCHROMIUM: WORLD PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons, gross weight)

| Country                    | 2005                   | 2006                   | 2007                   | 2008                   | 2009                   |
|----------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Albania                    | 34,400                 | 17,040                 | --                     | 11,916                 | 7,556                  |
| Brazil <sup>3</sup>        | 197,653                | 166,577                | 195,890                | 194,323 <sup>r</sup>   | 194,500 <sup>p</sup>   |
| China <sup>e</sup>         | 850,000                | 1,000,000              | 1,300,000              | 1,500,000 <sup>r</sup> | 1,550,000              |
| Finland                    | 234,881                | 243,350                | 241,760                | 233,550                | 123,310                |
| Germany                    | 22,672                 | 26,710                 | 22,030                 | 26,960                 | 13,667                 |
| India <sup>e,4</sup>       | 611,373 <sup>s</sup>   | 634,200 <sup>s</sup>   | 820,000                | 750,000                | 670,000                |
| Iran <sup>e</sup>          | 8,000                  | 7,000                  | 8,000                  | 8,000                  | 8,000                  |
| Japan <sup>3</sup>         | 12,367                 | 13,056                 | 12,016                 | 13,888                 | 7,700 <sup>e</sup>     |
| Kazakhstan                 | 1,156,168              | 1,200,000              | 1,307,536              | 1,220,315              | 1,100,000 <sup>e</sup> |
| Russia <sup>e</sup>        | 578,000 <sup>s</sup>   | 600,000                | 570,000                | 490,000                | 378,000 <sup>s</sup>   |
| Slovakia                   | 867                    | 19                     | --                     | --                     | --                     |
| South Africa <sup>6</sup>  | 2,812,000              | 3,030,000              | 3,552,000 <sup>r</sup> | 3,269,000 <sup>r</sup> | 2,800,000 <sup>e</sup> |
| Sweden                     | 127,451                | 136,374                | 124,403                | 117,053                | 31,345                 |
| Turkey                     | 26,043                 | 67,975                 | 69,730                 | 75,840 <sup>r</sup>    | 41,028                 |
| United States <sup>7</sup> | W                      | W                      | W                      | W                      | W                      |
| Zimbabwe <sup>e</sup>      | 218,143 <sup>r,5</sup> | 200,673 <sup>r,5</sup> | 150,000                | 150,000                | 73,600                 |
| Total                      | 6,890,000 <sup>r</sup> | 7,340,000              | 8,370,000 <sup>r</sup> | 8,060,000 <sup>r</sup> | 7,000,000              |

<sup>e</sup>Estimated. <sup>p</sup>Preliminary. <sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

<sup>1</sup>World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Table includes data available through August 20, 2010.

<sup>3</sup>Includes high- and low-carbon ferrochromium.

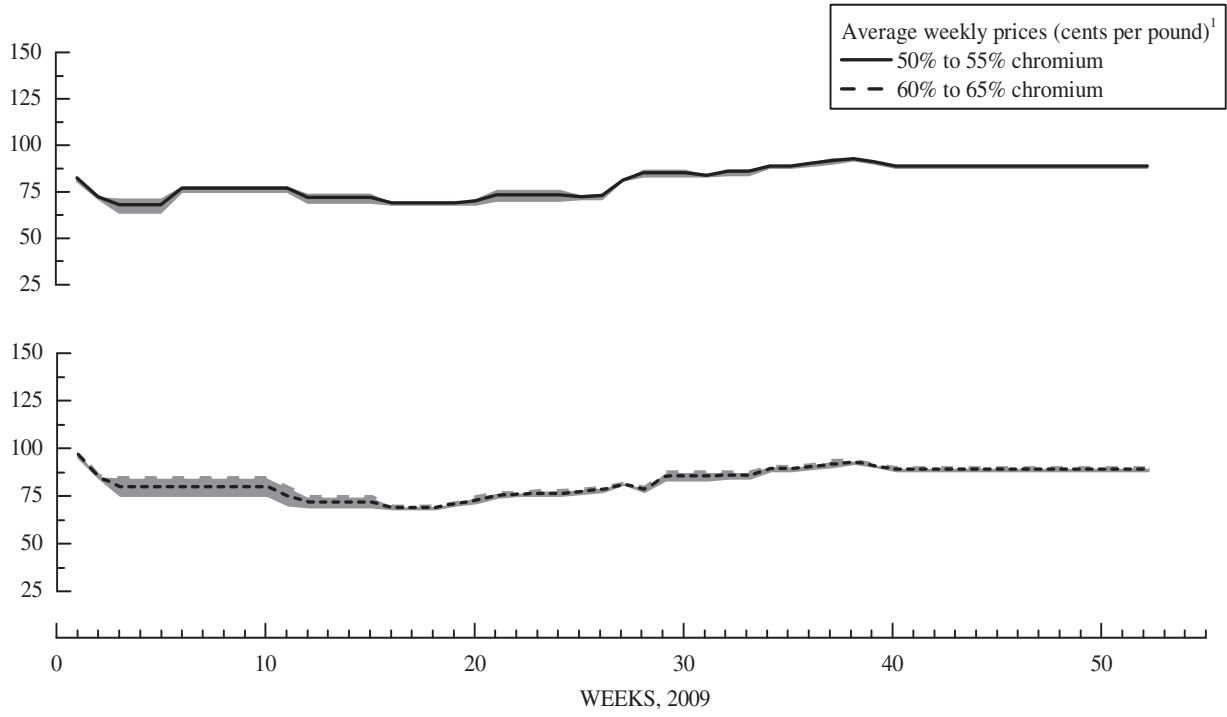
<sup>4</sup>Includes ferrochrome and charge chrome.

<sup>5</sup>Reported figure.

<sup>6</sup>Includes high- and low-carbon ferrochromium and ferrochromium-silicon.

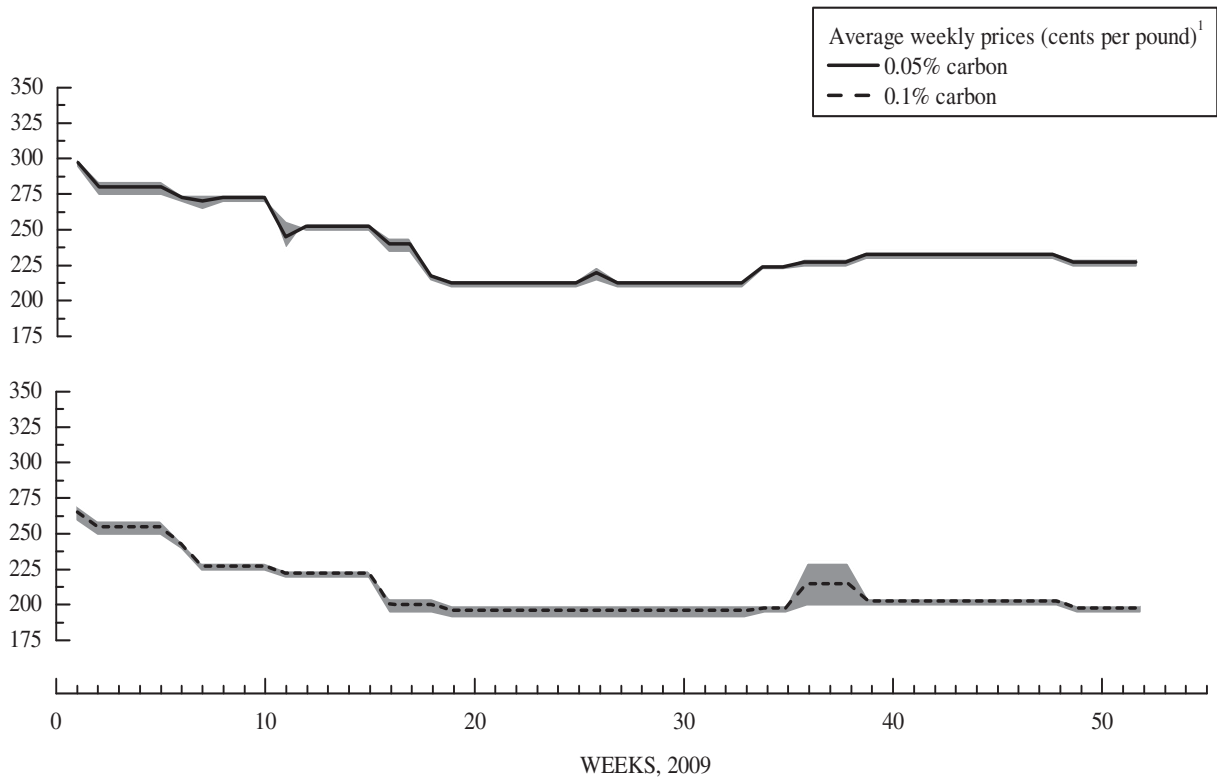
<sup>7</sup>Includes chromium metal, high- and low-carbon ferrochromium, ferrochromium-silicon, and other chromium materials.

FIGURE 1  
 U.S. IMPORTED HIGH-CARBON FERROCHROMIUM IN 2009



<sup>1</sup>Average weekly price shown against price range background.  
 Source: Platts Metals Week

FIGURE 2  
 U.S. IMPORTED LOW-CARBON FERROCHROMIUM IN 2009



<sup>1</sup>Average weekly price shown against price range background.

Source: Platts Metals Week