

Mineral Industry Surveys

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NICKEL IN JULY 2004

Reported domestic consumption in July, on a daily average basis, was 9% less than that of June, according to the U.S. Geological Survey. Average daily nickel consumption of cathode, pellets, briquets, powder, and ferronickel for stainless steel was 66.5 metric tons per day (t/d)—8% less than the 72.5 t/d for June 2004 and 2% greater than the 65.1 t/d (revised) for July 2003. Consumption of >99.8% nickel metal to make superalloys (such as INCONEL 718 and WASPALOY) decreased 13% from revised June levels, on a daily average basis. Consumption to make corrosion-resistant, less stress-resistant nickel-base alloys (such as INCONEL 600 and Nickel 200) decreased by 7%. Sales to plating companies averaged 24.6 t/d, about 20% less than the June sales figure of 30.7 t/d.

On July 31, U.S. consumer stocks of cathode, pellets, briquets, and powder totaled 1,220 metric tons (t)—16% less than the 1,450 t on June 30 and 12% less than the 1,390 t reported for yearend 2003. Stocks in London Metal Exchange (LME) warehouses worldwide totaled 9,978 t on July 31—19% greater than the 8,394 t on May 31.

The United States imported 67,300 t of primary nickel in the first half of 2004, 2% less than the 68,700 t for the corresponding period of 2003. Trade data for July will appear in a subsequent report.

Scramjets—A future aerospace market for nickel

On November 16, the National Aeronautics and Space Administration (NASA) successfully flew the last of its three X-43A hypersonic aircraft. According to preliminary calculations, the unmanned X-43A reached a speed of Mach 9.8, or about 7,000 miles per hour. The research flight set a new speed record for an aircraft powered by an air-breathing engine (Gugliotta, 2004a, b). The engine, called a scramjet, is constructed primarily from nickel-based superalloys.

Developing structures and materials that can withstand future hypersonic flight is a major challenge. If the engine is not cooled, temperatures in the combustor will exceed 5,000 °F, which is higher than the melting temperature of most metals. The use of nickel-based superalloys combined with good structural design and active cooling allows the engine to survive

these very high temperatures (Andreadis, 2004).

The engine fired for only 10 seconds, but gave NASA critical information that will help the aerospace industry design propulsion systems for future space vehicles and hypersonic aircraft. The scramjet—a supersonic combustion ramjet—has the potential to integrate air and space travel, drastically reducing flight times between distant cities and making travel into space much more affordable. The scramjet uses no rotating parts and is mechanically simpler, but more aerodynamically complex than a conventional jet engine. Most of today's experimental scramjets are powered and cooled by JP10 or JP7 jet fuel. However, the X-43A burns liquid hydrogen. Hydrogen is more difficult to handle than hydrocarbon fuels, but appears to be more effective in this particular application.

The scramjet cannot operate from a standing start. The X-43A was mated with a Pegasus rocket booster and launched from the underside of a B-52 aircraft. The rocket booster accelerated the scramjet until it reached the speed at which the engine could ignite. The scramjet then decoupled from the rocket and flew on its own.

Engineers designed and built three scramjet aircraft as part of NASA's Hyper-X program. Each aircraft was 3.7 meters (12.3 feet) in length and weighed about 1.3 metric tons. Controllers aborted the test flight of the first aircraft in 2001 after the rocket booster malfunctioned. On March 27, 2004, the second aircraft reached Mach 6.83 (5,200 miles per hour), shattering the world speed record for air-breathing, non-rocket aircraft and making hypersonic flight a reality (Dornheim, 2004). The flight of the third X-43A took place over the U.S. Navy's test range off the coast of southern California. The flight ended with the pilotless aircraft plunging into the Pacific Ocean about 1,400 kilometers (850 miles) from the coast. NASA had no plans to recover the aircraft (Gugliotta, 2004a, b).

The U.S. Air Force also has a scramjet demonstration program and is exploring the feasibility of developing a hypersonic cruise missile for national defense. The Boeing Company and the Pratt & Whitney business unit of United Technologies Corp. are collaborating with the Air Force on the project. The first tests of the Air Force scramjet are scheduled

for late 2008, again off the coast of southern California.

References Cited

Andreadis, Dean, 2004, Scramjets integrate air and space: *The Industrial Physicist*, v. 10, no. 4, August/September, p. 24-27.

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Gugliotta, Guy, 2004a, With 'Scramjet,' NASA shoots for Mach 10: *Washington Post*, November 10, p. A01.

Gugliotta, Guy, 2004b, NASA 'Scramjet' beats air speed record again: *Washington Post*, November 17, p. A08.

TABLE 1
CONSUMPTION OF NICKEL (EXCLUSIVE OF SCRAP), BY FORM AND USE¹

(Metric tons, nickel content)

Period	Cathodes, pellets, briquets, and powder	Ferronickel	Oxide-sinter, salts, and other forms	Total	Total year to date
2003:					
July	4,240	900	25	5,170	35,600
August	4,320	873	28	5,220	40,800
September	4,320	844	28	5,190	46,000
October	4,840	911	32	5,780	51,800
November	4,420	1,190	30	5,640	57,400
December	4,130	902	30	5,060	62,500
January-December	53,400	8,620	412	62,500	XX
2004:					
January	4,290	595	34	4,920	4,920
February	4,940	455	26	5,420	10,300
March	5,010	529	34	5,580	15,900
April	4,660	458	52	5,170	21,100
May	5,250	528	27	5,810	26,900
June	5,210	556	39	5,800	32,700
July:					
Steel:					
Stainless and heat resisting	1,530	536	W	2,060	14,200
Alloy (excludes stainless)	W	--	--	W	W
Superalloys	988	--	W	988	6,810
Copper-nickel alloys	W	--	--	W	W
Electric, magnetic, and expansion alloys	39	--	--	39	105
Other nickel & nickel alloys	W	--	W	W	W
Cast iron	W	--	--	W	W
Electroplating (sales to platers)	763	--	--	763	6,250
Chemical and chemical uses	W	--	--	W	W
Other uses	1,580	--	43	1,620	10,800
Total reported	4,890 ²	536	43	5,470	38,200
Total all companies (calc) ³	XX	XX	XX	9,610	67,100
2004: January-July	34,300	3,660	257	38,200	XX
2003: January-July	31,400	3,890	266	35,600	XX

W Withheld to avoid disclosing company proprietary data; included in "Other uses" category. XX Not applicable.
-- Zero.

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

²Of consumption, 3,910 metric tons were consumed as cathodes and pellets, the remainder as briquets and powder.

³Figures represent calculated apparent consumption; based on the revised proportion of reported primary consumption (56.93%) to apparent primary consumption for 2002.

TABLE 2
ENDING STOCKS OF NICKEL (EXCLUSIVE OF SCRAP) HELD BY CONSUMERS,
BY FORM AND USE^{1,2}

(Metric tons, nickel content)

Period	Cathodes, pellets, briquets, and powder		Ferronickel	Oxide-sinter, salts, and other forms	Total
2003:					
July	1,480	91	57	1,630	
August	1,670	140	51	1,860	
September	1,280	99	52	1,430	
October	1,360	109	60	1,530	
November	1,410	227	59	1,690	
December	1,390	260	46	1,700	
2004:					
January	1,390	186	55	1,630	
February	1,660	111	44	1,810	
March	1,630	108	40	1,780	
April	1,760	227	34	2,020	
May	1,360	158	42	1,560	
June	1,450	185	45 [†]	1,680	
July:					
Steel (stainless, heat resisting and alloy)	346	127	(3)	473	
Nonferrous alloys ⁴	861	(3)	(3)	861	
Foundry (cast irons)	(3)	(3)	--	(3)	
Chemical (catalysts, ceramics, plating salt, etc.) and unspecified uses	15	20	30	65	
Total	1,220	147	30	1,400	

[†]Revised. -- Zero.

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

²Stocks held by companies that consume nickel in more than one end-use category are credited to the major category. Stocks are subject to revisions owing to inventory adjustments.

³Included in the "Chemical and unspecified uses" category.

⁴Includes superalloys, nickel-copper and copper-nickel alloys, permanent magnet alloys, and other nickel alloys.

TABLE 3
CONSUMPTION AND ENDING STOCKS OF PURCHASED SECONDARY NICKEL, BY USE¹

(Metric tons, nickel content)

Period	Consumption			Stocks		
	Ferrous scrap ²	Nonferrous scrap ³	Total scrap	Ferrous scrap ²	Nonferrous scrap ³	Total scrap
2003:						
July	4,340	676	5,010	3,370	105	3,480
August	4,770	749	5,520	3,310	115	3,430
September	3,810	732	4,540	3,290	108	3,400
October	5,350	756	6,110	3,110	101	3,210
November	4,960	668	5,620	2,950	97	3,050
December	4,930	647	5,580	2,810	85	2,900
January-December	57,600	8,330	65,900	XX	XX	XX
2004:						
January	5,050	684	5,740	2,700	73	2,770
February	4,780	694	5,480	2,710	79	2,790
March	5,520	923	6,440	3,270	80	3,350
April	5,280	851	6,130	2,950	82	3,030
May	5,210	787	6,000	2,730	63	2,790
June	5,090	790	5,880	2,750	85	2,830
July	4,850	664	5,510	2,640	76	2,720
January-July	35,800	5,390	41,200	XX	XX	XX

XX Not applicable.

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

²Nickel content is calculated from an average nickel content and the reported gross weight of scrap.

³Combined consumption and stocks of aluminum-base, copper-base, and nickel-base scrap.

TABLE 4
U.S. IMPORTS FOR CONSUMPTION OF NICKEL, BY COUNTRY¹

(Metric tons, nickel content)²

Period and country of origin	Cathodes pellets, and briquets	Powder and flakes	Ferro-nickel	Metal-lurgical-grade oxide	Waste and scrap	Stainless steel scrap	Chemicals	Total ³	Total year to date ⁴	Wrought nickel
2003:										
June	10,800	368	692	(5)	226	408	327	12,800	73,600	41
July	6,240	294	1,840	11	352	420	312	9,470	83,000	49
August	7,420	762	913	(5)	477	475	544	10,600	93,600	62
September	9,990	1,030	1,180	(5)	570	744	248	13,800	107,000	48
October	7,270	565	1,010	20	326	715	255	10,200	118,000	34
November	7,030	625	932	--	318	889	324	10,100	128,000	28
December	6,230	860	471	(5)	530	821	284	9,190	137,000	34
January-December	99,300	9,130	13,100	90	4,790	6,690	3,790	137,000	XX	660
2004:										
January	7,360	829	1,040	40	489	933	435	11,100	11,100	77
February	7,200	834	1,070	161	667	1,020	485	11,400	22,600	49
March	10,700	812	806	134	1,430	1,660	376	15,900	38,400	72
April	10,700	720	1,680	23	574	908	296	14,900	53,400	53
May	8,530	564	941	--	698	680	381	11,800	65,200	55
June:										
Australia	820	60	--	--	10	--	--	890	5,540	--
Brazil	216	--	--	--	5	--	--	221	1,420	--
Canada	4,640	421	--	--	122	524	--	5,700	35,200	--
Colombia	--	--	381	--	--	--	--	381	1,570	--
Dominican Republic	--	--	452	--	--	--	--	452	3,890	--
Finland	120	40	--	--	--	--	49	209	3,530	--
France	102	--	--	--	23	--	11	136	1,080	6
Germany	3	1	--	--	56	--	42	102	1,200	44
Japan	--	2	--	--	68	--	42	112	497	7
Mexico	--	--	--	--	13	87	1	101	1,260	--
New Caledonia	--	--	100	--	--	--	--	100	550	--
Norway	1,980	--	--	--	--	--	--	1,980	7,080	--
Russia	1,160	131	45	--	--	--	--	1,330	9,530	--
South Africa	--	40	--	--	--	--	--	40	479	--
Sweden	--	7	--	--	--	--	--	7	36	--
United Kingdom	13	17	--	--	139	--	21	190	1,860	(5)
Venezuela	--	--	--	--	--	11	--	11	328	--
Zimbabwe	100	--	--	--	--	--	--	100	521	--
Other	40 ⁶	13	--	--	117	58	158	386	2,070	29
Total	9,190	732	978	--	553	680	324	12,500	77,600	86
2004: January-June	53,700	4,490	6,510	357	4,410	5,880	2,300	77,600	XX	392
2003: January-June	55,100	5,000	6,750	60	2,220	2,620	1,830	73,600	XX	403

XX Not applicable. -- Zero.

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

²The nickel contents are assumed to be as follows: metallurgical-grade oxide (77%), waste and scrap (50%), and stainless steel scrap (7.5%). The chemicals category includes chlorides (25%); sulfates (22%); other salts (22%); supported catalysts (22%); and oxide, sesquioxide, and hydroxide (65%).

³Excludes wrought nickel.

⁴May include revisions for prior months.

⁵Less than 1/2 unit.

⁶All or part of these data have been referred to the Census Bureau for verification.

Source: U.S. Census Bureau.

TABLE 5
U.S. EXPORTS OF NICKEL, BY COUNTRY¹

(Metric tons, nickel content)²

Period and country of destination	Cathodes pellets, and briquets	Powder and flakes	Ferro-nickel	Metal-lurgical-grade oxide	Waste and scrap	Stainless steel scrap	Chemicals	Total ³	Total year to date	Wrought nickel
2003:										
June	90	47	29	33	516	2,310	276	3,300	28,500	143
July	87	95	27	2	510	3,570	393	4,690	33,200	148
August	56	77	37	1	792	3,040	301	4,300	37,500	162
September	107	106	18	51	707	2,350	223	3,560	41,100	148
October	133	153	12	4	1,010	3,270	276	4,850	45,900	141
November	210	127	1	5	819	1,600	371	3,130	49,000	102
December	44	92	10	4	809	3,190	441	4,590	53,600	72
January-December	996	1,100	181	161	9,460	37,800	3,900	53,600	XX	2,890
2004:										
January	52	129	15	5	657	2,370	399	3,630	3,630	153
February	85	166	--	17	540	2,550	396	3,750	7,380	54
March	116	150	(4)	8	1,000	3,800	497	5,570	12,900	59
April	144	132	3	8	1,070	2,660	563	4,570	17,500	227
May	54	127	23	4	1,290 ^r	3,100	323	4,920	22,400	120
June:										
Australia	--	(4)	--	--	--	--	(4)	(4)	6	--
Belgium	--	6	--	--	--	--	25	31	186	--
Canada	4	15	2	--	1,020	173	157	1,370	7,290	10
China	--	(4)	1	--	--	935	16	952	4,300	(4)
Finland	--	--	--	--	52	992	--	1,040	3,100	--
Germany	(4)	9	--	(4)	45	4	--	58	438	2
India	--	(4)	--	--	--	412	(4)	412	1,040	--
Italy	--	(4)	--	--	--	2	4	6	36	--
Japan	--	16	--	2	51	42	21	132	566	2
Korea, Republic of	--	7	--	--	--	843	10	860	5,360	2
Mexico	119	5	--	--	--	1	9	134	603	14
Netherlands	--	14	--	--	10	308	(4)	332	922	(4)
South Africa	--	(4)	--	1	--	--	1	2	27	--
Spain	--	(4)	--	--	--	313	--	313	313	--
Sweden	--	25	--	--	--	--	11	36	170	--
Taiwan	--	2	--	--	--	320	8	330	1,990	(4)
United Kingdom	--	2	--	(4)	133	158	9	302	635	11
Other	64	37	--	1	--	218	296	616	2,410	24
Total	187	138	3	4	1,310	4,720	567	6,930	29,400	65
2004:January-June	640	842	43	45	5,860	19,200	2,750	29,400	XX	678
2003:January-June	360	446	76	93	4,820	20,800	1,890	28,500	XX	2,120

^rRevised. XX Not applicable. -- Zero.

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

²The nickel contents are assumed to be as follows: metallurgical-grade oxide (77%), waste and scrap (50%), and stainless steel scrap (7.5%). The chemicals category includes chlorides (25%); sulfates (22%); other salts (22%); supported catalysts (22%); and oxide, sesquioxide, and hydroxide (65%).

³Excludes wrought nickel.

⁴Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF NICKEL ALLOYS, BY COUNTRY¹

(Metric tons, gross weight)

Period and country of origin	Unwrought alloyed ingot	Bars, rods and profiles	Wire	Plates and sheets	Foil	Tubes and pipes	Other alloyed articles	Total	Total year to date
2003:									
June	150	156	579	244	35	292	102	1,560	9,140
July	130	266	554	277	30	305	168	1,730	10,900
August	151	78	469	319	32	322	154	1,530	12,400
September	48	239	406	211	10	115	95	1,120	13,500
October	204	307	443	305	15	162	95	1,530	15,000
November	195	239	331	210	23	89	156	1,240	16,300
December	314	169	388	215	45	704	147	1,980	18,300
January-December	1,910	2,520	5,750	3,330	214	2,770	1,770	18,300	XX
2004:									
January	102	278	286	193	14	134	133	1,140	1,140
February	165	214	362	251	8	374	238	1,610	2,750
March	102	167	446	213	18	363	459	1,770	4,520
April	345	255	504	164	44	773	172	2,260	6,770
May	124	270	494	131	14	231	115	1,380	8,150
June:									
Australia	63	--	--	--	--	--	--	63	345
Belgium	--	--	(2)	2	--	--	--	2	65
Canada	--	(2)	2	--	--	3	8	13	114
China	--	--	7	(2)	--	--	34	41	197
France	--	--	91	30	--	10	10	141	784
Germany	31	202	196	258	40	70	2	799	3,800
Italy	--	98	1	--	--	--	(2)	99	882
Japan	--	--	8	3	--	4	(2)	15	550
Mexico	--	--	(2)	--	(2)	--	22	22	278
Netherlands	--	--	1	--	--	2	3	6	95
South Africa	39	--	--	--	--	--	--	39	183
Sweden	--	22	201	8	--	35	--	266	1,580
United Kingdom	51	22	6	(2)	--	9	2	90	620
Other	43	--	4	--	--	3	19	69	321
Total	227	344	517	301	40	136	100	1,670	9,820
2004: January-June	1,060	1,530	2,610	1,250	138	2,010	1,220	9,820	XX
2003: January-June	865	1,220	3,160	1,790	60	1,080	956	9,140	XX

XX Not applicable. -- Zero.

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

²Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 7
U.S. EXPORTS OF NICKEL ALLOYS, BY COUNTRY¹

(Metric tons, gross weight)

Period and country of destination	Unwrought alloyed ingot	Bars, rods and profiles	Wire	Plates and sheets	Foil	Tubes and pipes	Other alloyed articles	Total	Total year to date
2003:									
June	180	980	94	521	21	163	280	2,240	13,600
July	750	553	72	223	25	263	216	2,100	15,700
August	708	707	112	344	30	228	201	2,330	18,000
September	597	623	80	281	52	140	271	2,040	20,100
October	206	802	55	396	55	255	253	2,020	22,100
November	274	621	121	382	49	254	208	1,910	24,000
December	379	571	69	350	107	203	199	1,880	25,900
January-December	6,660	7,960	1,190	3,960	661	2,420	3,050	25,900	XX
2004:									
January	522	731	155	366	9	118	231	2,130	2,130
February	543	777	155	343	15	172	299	2,300	4,440
March	980	640	92	491	30	184	333	2,750	7,190
April	283	649	99	472	22	144	303	1,970	9,160
May	457	976	168	334	46	119	543	2,640	11,800
June:									
Australia	--	(2)	1	1	--	2	5	9	116
Belgium	90	146	13	1	--	1	1	252	1,050
Canada	42	44	13	28	14	60	25	226	1,380
China	--	11	2	28	(2)	8	21	70	565
France	148	130	(2)	17	(2)	(2)	2	297	1,780
Germany	7	36	1	82	8	5	2	141	573
India	1	2	1	(2)	--	--	(2)	4	45
Ireland	--	--	(2)	(2)	--	--	(2)	(2)	11
Italy	47	4	1	25	--	(2)	2	79	602
Japan	133	54	3	7	(2)	2	(2)	199	1,750
Korea, Republic of	--	5	1	59	--	28	1	94	616
Mexico	(2)	12	66	58	2	30	141	309	1,490
Netherlands	--	2	(2)	2	--	2	(2)	6	171
Singapore	(2)	3	5	1	(2)	(2)	1	10	61
Spain	1	--	1	--	--	1	1	4	43
Sweden	--	(2)	--	--	--	--	(2)	(2)	74
Switzerland	16	(2)	4	8	(2)	1	--	29	126
Taiwan	--	1	(2)	27	4	3	(2)	35	232
United Kingdom	22	204	10	30	(2)	8	9	283	2,000
Other	4	68	8	53	5	19	61	218	1,380
Total	511	722	130	427	33	170	272	2,270	14,100
2004: January-June	3,300	4,490	798	2,430	155	907	1,980	14,100	XX
2003: January-June	3,750	4,080	678	1,980	343	1,080	1,700	13,600	XX

XX Not applicable. -- Zero.

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

²Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 8
NICKEL CONSUMPTION IN CAST AND WROUGHT PRODUCTS

	Percent	
	Wrought	Cast
July 2004:		
Stainless and heat resisting steels	70	30
Alloy steels	99	1
Superalloys	89	11
Copper-nickel alloys	93	7
Other nickel-base alloys	100	(1)

¹Less than 1/2 unit.

TABLE 9
NICKEL PRICES

Date	Platts Metals Week				American Metal Market, 18/8 Stainless steel scrap Pittsburgh
	Cathode NY Dealer \$/lb.	LME Cash mean ¹ \$/t	LME Cash mean ¹ \$/lb.	18/8 Stainless steel scrap Free market \$/long ton (gw)	18/8 Stainless steel scrap Pittsburgh \$/long ton (gw)
2003:					
Average for month of:					
August	4.418	9,351.375	4.242	918	935
September	4.668	9,965.341	4.520	978	985
October	5.066	11,047.174	5.011	1,041	1,013
November	5.568	12,086.500	5.482	1,153	1,160
December	6.390	14,162.500	6.424	1,262	1,222
Yearly average	4.446	9,629.469	4.368	961	942
2004:					
Average for week ending:					
July 2	7.01-7.10	14,945.500	6.779	1,350-1,400	1,200-1,215 ^r
July 9	7.18-7.52	15,768.000	7.152	1,375-1,425	1,440-1,460
July 16	7.17-7.45	15,209.000	6.899	1,450-1,465	1,440-1,460
July 23	7.02-7.18	14,867.000	6.744	1,450-1,465	1,440-1,460
July 30	6.57-6.87	14,231.000	6.455	1,450-1,465	1,440-1,460
August 6	6.44-6.67	13,780.500	6.251	1,450-1,465	1,550-1,570
August 13	6.26-6.52	13,522.000	6.133	1,530-1,600	1,550-1,570
August 20	6.27-6.70	14,071.000	6.382	1,425-1,475	1,550-1,570
August 27	6.31-6.74	13,491.000	6.119	1,425-1,475	1,550-1,570
September 3	6.01-6.31	12,738.125	5.778	1,425-1,475	1,460-1,480
September 10	5.74-5.94	12,285.000	5.572	1,425-1,475	1,460-1,480
Average for month of:					
January	6.900	15,326.548	6.952	1,517	1,463
February	6.968	15,145.125	6.870	1,537	1,585
March	6.203	13,715.000	6.221	1,458	1,556
April	6.056	12,848.125	5.828	1,361	1,503
May	5.185	11,118.289	5.043	1,281	1,367
June	6.063	13,533.523	6.139	1,241	1,208
July	6.990	15,023.295	6.814	1,430	1,402
August	6.320	13,679.524	6.205	1,481	1,560

^rRevised.

¹Mean of the cash buyer price and the cash seller and settlement price.

