

(Formerly Series No. MA32C)

Information about the scope of the survey, methodology, explanation of terms and historical notes for this survey may be found in the introduction of the 1997 Manufacturing Profiles, issued August 1999.

Current data are released electronically on Internet for all individual surveys as they become available. Use: <http://www.census.gov/econ/www/manumenu.html>. Individual reports can be accessed by choosing "Current Industrial Reports (CIR's)," clicking on "Report Number Index;" from the "Industrial Products by Numeric Index," choose the survey of interest. Follow the menu to view the PDF file or to download the worksheet file (WK format) to your personal computer.

These data are also available through the U.S. Department of Commerce and STAT-USA Electronic Bulletin Board by subscription. To access, dial 202-482-3870 and follow the prompts to register. Also, you may call 202-482-1986 or 1-800-STAT-USA, for further information. The Internet address is: www.stat-usa.gov/.

NOTE. Data are now published on the new North American Industry Classification System (NAICS) basis and therefore are not always comparable to the old Standard Industrial Classification (SIC) code. For further information on NAICS, see www.census.gov/epcd/www/naics.html.

SUMMARY OF FINDINGS. In 1999, total manufacturers' shipments of refractories

amounted to \$2,243.1 million, a decrease of 6 percent, from \$2,380.5 million in 1998.

Shipments of clay refractories decreased 6 percent to \$965.4 million in 1999, from \$1,023.2 million in 1998. Clay refractories shipments accounted for 43 percent of total refractories shipments in 1999 and 43 percent in 1998.

Shipments of nonclay refractories decreased 6 percent to \$1,277.7 million in 1999, from \$1,357.3 million in 1998. Nonclay refractories shipments accounted for 57 percent of the total refractories shipments in 1999 and 57 percent in 1998.

Brick and shapes continue to be the dominate form of refractories. Brick and shapes from clay refractories showed a decrease of 10 percent to \$517.7 million in 1999, from \$572.2 million in 1998. Brick and shapes from nonclay refractories showed a decrease of 5 percent to \$689.8 million in 1999, from \$726.4 million in 1998. Unshaped clay refractories decreased 1 percent to \$393.4 million in 1999, from \$398.6 million in 1998. Mortars decreased 15 percent to \$22.9 million in 1999, from \$26.9 million in 1998. Plastic refractories and ramming mixes from nonclay refractories decreased 7 percent to \$169.5 million in 1999, from \$182.8 million in 1998. Ceramic refractory fibers decreased 13 percent to \$116.6 million in 1999, from \$134.6 million in 1998.

Current Industrial Reports

Address inquiries concerning these data to Primary Goods Industries Branch, Manufacturing and Construction Division (MCD), Washington, DC 20233-6900, or call John Linehan, 301-457-4742.

For mail or fax copies of this publication, please contact the Information Services Center, MCD, Washington, DC 20233-6900, or call 301-457-4673.

U S C E N S U S B U R E A U

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U.S. Census Bureau



Table 1. Value of Shipments of Refractories: 1989 to 1999
[Thousands of dollars]

Year	Total	Clay	Nonclay
1999.....	2,243,077	965,388	1,277,689
1998.....	2,380,480	1,023,210	1,357,270
1997.....	2,565,817	1,084,179	1,481,638
1996.....	2,340,757	930,006	1,410,751
1995.....	2,222,384	940,835	1,281,549
1994.....	2,046,979	906,165	1,140,814
1993.....	1,930,233	772,986	1,157,247
1992.....	1,956,083	786,078	1,170,005
1991.....	1,946,842	784,331	1,162,511
1990.....	2,002,833	771,315	1,231,518
1989.....	2,010,947	823,266	1,187,681

Table 2a. Quantity and Value of Shipments of Refractories by Type: 1999
 [Value in thousands of dollars]

Product code	Product description	No. of cos.	Quantity shipped (unit of measure)		M bricks (1,000 9-inch equivalent)	Value of shipments
			Short tons	Metric tons		
	Clay and nonclay refractories.....	(X)	(X)	(X)	(X)	2,243,077
327124	Clay refractories.....	(X)	(X)	(X)	(X)	965,388
	Brick and shapes.....	(X)	949,427	860,767	292,049	517,685
3271240111	Fireclay, including semisilica, bloating and superduty fireclay brick and shapes, fireclay and high alumina pouring pit refractories; clay kiln furniture; radiant heater elements; and other miscellaneous clay refractory shapes.....	27	423,997	384,403	117,580	160,209
3271240211	High alumina brick and shapes containing 50 percent alumina and over, including glass-house pots, tank blocks, feeder parts, and upper structure shapes, made predominantly of calcined bauxite, kyanite, andalusite, and similar raw materials 1/.....	31	479,353	434,590	138,514	300,885
3271240411	Insulating brick and shapes.....	12	46,077	41,774	35,955	56,591
	Unshaped clay refractories.....	(X)	836,459	758,348	(X)	393,403
3271240421	Refractory bonding mortars, wet and dry, including clay and high alumina.....	35	133,964	121,454	(X)	60,564
3271240431	Plastic refractories and ramming mixes, less than 50 percent alumina; high alumina plastic refractories and ramming mixes, 50 percent alumina and over; and high alumina phosphate bonded plastic refractories and ramming mixes, 50 percent alumina and over 2/.....	28	158,378	143,588	(X)	79,051
3271240311	Castable refractories less than 50 percent alumina; high alumina castables 50 percent and over; and insulating castables (hydraulic setting), density up to 105 pounds/cubic foot 3/.....	32	358,185	324,737	(X)	189,586
3271240441	Fireclay gunning mixes, including hydraulic setting gunning mixes, less than 50 percent alumina; high alumina gunning mixes, 50 percent alumina and over; and insulating gunning mixes (hydraulic setting).....	28	185,932	168,569	(X)	64,202
	Other refractory raw materials and refractory materials sold in lump or ground form, either for direct use by customer as a finished refractory product or as exported material.....	(X)	164,983	149,577	(X)	29,386
3271240451	Clay and high alumina refractory raw materials 4/.....	16	152,646	138,392	(X)	26,126
3271240461	Clay and high alumina refractory materials 5/.....	10	12,337	11,185	(X)	3,260
3271240000	Clay refractories, n.s.k. 6/.....	(X)	(X)	(X)	(X)	24,914
327125	Nonclay refractories.....	(X)	(X)	(X)	(X)	1,277,689
	Brick and shapes.....	(X)	459,123	416,249	110,337	689,788
3271250111	All silica brick and shapes, excluding semisilica.....	12	28,328	25,683	13,478	53,892
3271250121	Magnesite-carbon brick and shapes, both less than 7 percent carbon, 7 percent carbon and over, predominantly pitch and resin bonded, and carbon magnesite brick.....	7	107,300	97,280	20,532	109,750
3271250131	Magnesite brick and shapes, burned and unburned.....	9	32,821	29,756	(D)	33,428

Continued

Table 2a. Quantity and Value of Shipments of Refractories by Type: 1999
 [Value in thousands of dollars]

Product code	Product description	No. of cos.	Quantity shipped (unit of measure)		M bricks (1,000 9-inch equivalent)	Value of shipments
			Short tons	Metric tons		
3271250141	Magnesite-chrome, chrome-magnesite, including high fires, burned and unburned brick, and chrome brick.....	4	53,423	48,434	11,278	53,332
3271250151	Silicon-carbide brick and shapes (made predominantly of silicon carbide), including kiln furniture.....	12	13,760	12,475	(D)	70,251
3271250161	Extra-high alumina brick and shapes containing 87.5 percent alumina and higher, and extra-high alumina pouring pit refractories, including sleeves, nozzles, runners, tuyeres, ladle gate parts, and mullite brick and shapes.....	24	39,171	35,513	11,913	115,741
3271250171	Zircon and zirconia brick and shapes (made predominantly of either of these materials, including electrocast).....	14	7,242	6,566	4,146	63,575
3271250181	All other brick and shapes, including dolomite, dolomite-magnesite, forsterite, pyrophyllite-zircon, carbon and graphite crucibles, retorts, stopper heads, natural graphite refractories, and molten cast.....	17	177,078	160,542	38,769	189,819
	Mortars.....	(X)	70,304	63,739	(X)	22,919
3271250211	Unshaped nonclay refractories basic bonding mortars made predominately of magnesite or chrome ore, dolomite, and other nonclay mortars (made predominantly of forsterite, zircon, and silica).....	8	(D)	(D)	(X)	(D)
3271250216	Extra-high alumina refractory mortars (made predominantly of fused or synthetic alumina and mullite).....	17	(D)	(D)	(X)	(D)
	Plastic refractories and ramming mixes.....	(X)	195,877	177,586	(X)	169,536
3271250221	Basic castable mixes, including chrome, chrome-magnesia, magnesia-chrome, magnesia, and dolomite.....	12	87,213	79,069	(X)	62,664
3271250226	Extra-high alumina plastic refractories and ramming mixes, 87.5 percent alumina and higher (made predominately of fused or synthetic aluminas and mullites), and extra-high alumina phosphate bonded plastic refractories and ramming mixes.....	20	60,022	54,417	(X)	66,013
3271250241	Extra-high alumina castables and gunning mixes.....	11	8,269	7,497	(X)	9,818
3271250236	Other nonclay plastic refractories and ramming mixes.....	11	(D)	(D)	(X)	(D)
3271250231	Other nonclay refractory castables and plastic refractories.....	14	(D)	(D)	(X)	(D)
	Gunning mixes:					
3271250246	Basic nonclay gunning mixes, including chrome, chrome-magnesia, magnesia-chrome, magnesia, and dolomite and other nonclay gunning mixes.....	14	239,657	217,277	(X)	92,236
3271250251	Ceramic refractory fibers, 1,500 degrees F and higher.....	10	33,060	29,973	14,440	116,610
	Other nonclay refractory materials sold in lump or ground form, including ground silica.....	(X)	395,960	358,985	(X)	152,806
3271250256	Domestic shipments for direct use by customers as a finished refractory and all exported material 5/.....	19	176,613	160,121	(X)	88,791

Table 2a. Quantity and Value of Shipments of Refractories by Type: 1999
 [Value in thousands of dollars]

Product code	Product description	No. of cos.	Quantity shipped (unit of measure)		M bricks (1,000 9-inch equivalent)	Value of shipments
			Short tons	Metric tons		
3271250261	All other domestic shipments of nonclay refractory materials sold in lump or ground form as a refractory raw material 4/.....	8	219,347	198,864	(X)	64,015
3271250000	Nonclay refractories, n.s.k. 6/.....	(X)	(X)	(X)	(X)	33,794
327992	Dead-burned magnesia or magnesite.....	(X)	(D)	(D)	(X)	(D)
3279920331	Domestic shipments for direct use as finished refractory products and all exported material 5/.....	6	(D)	(D)	(X)	(D)
3279920336	All other domestic shipments predominantly for use as a refractory raw material.....	8	(D)	(D)	(X)	(D)
3274100311	Dead-burned dolomite.....	2	(D)	(D)	(X)	(D)

D Withheld to avoid disclosing data for individual companies. n.s.k. Not specified by kind. X Not applicable.

1/Includes high alumina pouring pit refractories (containing 50 percent alumina and over), sleeves, nozzles, runners, and ladle gate parts. Excludes data for mullite and extra-high alumina refractories. These products are included in nonclay refractories section.

2/Includes products referred to as plastic firebrick and less plastic materials intended for ramming into place after addition of water (when shipped in dry form).

3/Includes hydraulic setting castables designed for low thermal conductivity and having bulk densities as defined in ASTM classification C-401, not greater than 105 pounds/cubic foot.

4/Includes shipments to refractory producers for reprocessing in manufacture of brick and other refractories.

5/Includes shipments for direct use as finished refractory products by establishments classified in manufacturing industries and excludes shipments to refractory producers for reprocessing in manufacture of brick and other refractories. Includes all exports.

6/Not specified by kind (n.s.k.) represents value of shipments for establishments that did not report detailed information and establishments, typically with less than five employees that were not included on MA327C mailing panel.

Table 2b. Quantity and Value of Shipments of Refractories by Type: 1998
 [Value in thousands of dollars]

Product code	Product description	No. of cos.	Quantity shipped (unit of measure)		M bricks (1,000 9-inch equivalent)	Value of shipments
			Short tons	Metric tons		
327124	Clay and nonclay refractories.....	(X)	(X)	(X)	(X)	2,380,480
	Clay refractories.....	(X)	(X)	(X)	(X)	1,023,210
	Brick and shapes.....	(X)	1,062,538	963,316	341,650	572,248
3271240111	Fireclay, including semisilica, bloating and superduty fireclay brick and shapes, fireclay and high alumina pouring pit refractories; clay kiln furniture; radiant heater elements; and other miscellaneous clay refractory shapes.....	31	547,637	496,498	155,036	211,580
3271240211	High alumina brick and shapes containing 50 percent alumina and over, including glass-house pots, tank blocks, feeder parts, and upper structure shapes, made predominantly of calcined bauxite, kyanite, andalusite, and similar raw materials 1/.....	31	r/ 463,880	r/ 420,562	145,585	301,615
3271240411	Insulating brick and shapes.....	13	51,020	46,256	r/ 41,029	59,053
3271240421	Unshaped clay refractories.....	(X)	837,945	759,696	(X)	398,560
3271240421	Refractory bonding mortars, wet and dry, including clay and high alumina.....	35	133,630	121,151	(X)	60,462
3271240431	Plastic refractories and ramming mixes, less than 50 percent alumina; high alumina plastic refractories and ramming mixes, 50 percent alumina and over; and high alumina phosphate bonded plastic refractories and ramming mixes, 50 percent alumina and over 2/.....	29	170,460	154,542	(X)	80,037
3271240311	Castable refractories less than 50 percent alumina; high alumina castables 50 percent and over; and insulating castables (hydraulic setting), density up to 105 pounds/cubic foot 3/.....	35	364,053	330,057	(X)	193,270
3271240441	Fireclay gunning mixes, including hydraulic setting gunning mixes, less than 50 percent alumina; high alumina gunning mixes, 50 percent alumina and over; and insulating gunning mixes (hydraulic setting).....	30	169,802	153,946	(X)	64,791
3271240451	Other refractory raw materials and refractory materials sold in lump or ground form, either for direct use by customer as a finished refractory product or as exported material.....	(X)	174,258	157,986	(X)	25,993
3271240461	Clay and high alumina refractory raw materials 4/.....	16	165,569	150,108	(X)	23,705
3271240461	Clay and high alumina refractory materials 5/.....	10	8,689	7,878	(X)	2,288
3271240000	Clay refractories, n.s.k. 6/.....	(X)	(X)	(X)	(X)	26,409
327125	Nonclay refractories.....	(X)	(X)	(X)	(X)	1,357,270
3271250111	Brick and shapes.....	(X)	481,813	436,820	108,730	726,399
3271250111	All silica bricks and shapes, excluding semisilica.....	15	r/ 30,393	r/ 27,555	r/ 13,278	r/ 58,967
3271250121	Magnesite-carbon brick and shapes, both less than 7 percent carbon, 7 percent carbon and over, predominantly pitch and resin bonded, and carbon magnesite brick.....	8	109,232	99,032	20,392	110,660
3271250131	Magnesite brick and shapes, burned and unburned.....	10	37,328	33,842	6,887	33,404
3271250141	Magnesite-chrome, chrome-magnesite, including high fires, burned and unburned brick, and chrome brick.....	5	53,798	48,774	11,312	53,423

Continued

Table 2b. Quantity and Value of Shipments of Refractories by Type: 1998
 [Value in thousands of dollars]

Product code	Product description	No. of cos.	Quantity shipped (unit of measure)		M bricks (1,000 9-inch equivalent)	Value of shipments
			Short tons	Metric tons		
3271250151	Silicon carbide brick and shapes (made predominantly of silicon carbide), including kiln furniture.....	14	16,210	14,696	4,289	80,730
3271250161	Extra-high alumina brick and shapes containing 87.5 percent alumina and higher, and extra-high alumina pouring pit refractories, including sleeves, nozzles, runners, tuyeres, ladle gate parts, and mullite brick and shapes.....	28	41,879	37,968	r/ 10,516	117,210
3271250171	Zircon and zirconia brick and shapes (made predominantly of either of these materials, including electrocast).....	15	8,828	8,004	4,437	62,758
3271250181	All other brick and shapes, including dolomite, dolomite-magnesite, forsterite, pyrophyllite-zircon, carbon and graphite crucibles, retorts, stopper heads, natural graphite, refractories, and molten cast.....	18	184,145	166,949	37,619	209,247
3271250211	Mortars..... Unshaped nonclay refractories basic bonding mortars made predominantly of magnesite or chrome ore, dolomite, and other nonclay mortars (made predominantly of forsterite, zircon, and silica).....	(X) 11	75,238 (D)	68,212 (D)	(X)	26,893 (D)
3271250216	Extra-high alumina refractory mortars (made predominantly of fused or synthetic alumina and mullite).....	19	(D)	(D)	(X)	(D)
3271250221	Plastic refractories and ramming mixes.....	(X)	r/ 203,383	r/ 184,391	(X)	182,764
3271250226	Basic castable mixes, including chrome, chrome-magnesia, magnesia-chrome, magnesia, and dolomite.....	13	89,388	81,041	(X)	64,834
3271250241	Extra-high alumina plastic refractories and ramming mixes, 87.5 percent alumina and higher (made predominantly of fused or synthetic aluminas and mullites), and extra-high alumina phosphate bonded plastic refractories and ramming mixes.....	20	62,106	56,306	(X)	72,566
3271250246	Extra-high alumina castables and gunning mixes.....	11	11,504	10,430	(X)	14,589
3271250236	Other nonclay plastic refractories and ramming mixes.....	11	(D)	(D)	(X)	(D)
3271250231	Other nonclay refractory castables and plastic refractories.....	13	(D)	(D)	(X)	(D)
3271250246	Gunning mixes: Basic nonclay gunning mixes, including chrome, chrome-magnesia, magnesia-chrome, magnesia, and dolomite and other nonclay gunning mixes.....	16	248,184	225,008	(X)	96,436
3271250251	Ceramic refractory fibers, 1,500 degrees F and higher.....	12	39,569	35,874	20,265	134,597
3271250256	Other nonclay refractory materials sold in lump or ground form, including ground silica.....	(X)	415,039	376,282	(X)	154,280
3271250261	Domestic shipments for direct use by customers as a finished refractory and all exported material 5/.....	21	207,061	187,725	(X)	93,630
3271250000	All other domestic shipments of nonclay refractory materials sold in lump or ground form as refractory raw material 4/.....	9	207,978	188,557	(X)	60,650
327992	Nonclay refractories, n.s.k. 6/.....	(X)	(X)	(X)	(X)	35,901
	Dead-burned magnesia or magnesite.....	(X)	(D)	(D)	(X)	(D)

Table 2b. Quantity and Value of Shipments of Refractories by Type: 1998
 [Value in thousands of dollars]

Product code	Product description	No. of cos.	Quantity shipped (unit of measure)		M bricks (1,000 9-inch equivalent)	Value of shipments
			Short tons	Metric tons		
3279920331	Domestic shipments for direct use as finished refractory products and all exported material 5/.....	4	(D)	(D)	(X)	(D)
3279920336	All other domestic shipments predominantly for use as a refractory raw material.....	8	(D)	(D)	(X)	(D)
3274100311	Dead-burned dolomite.....	2	(D)	(D)	(X)	(D)

D Withheld to avoid disclosing data for individual companies. n.s.k. Not specified by kind. r/Revised by 5 percent or more from previously published data. X Not applicable.

1/Includes high alumina pouring pit refractories (containing 50 percent alumina and over), sleeves, nozzles, runners, and ladle gate parts. Excludes data for mullite and extra-high alumina refractories. These products are included in nonclay refractories section.

2/Includes products referred to as plastic firebrick and less plastic materials intended for ramming into place after addition of water (when shipped in dry form).

3/Includes hydraulic setting castables designed for low thermal conductivity and having bulk densities as defined in ASTM classification C-401, not greater than 105 pounds/cubic foot.

4/Includes shipments to refractory producers for reprocessing in manufacture of brick and other refractories.

5/Includes shipments for direct use as finished refractory products by establishments classified in manufacturing industries and excludes shipments to refractory producers for reprocessing in manufacture of brick and other refractories. Includes all exports.

6/Not specified by kind (n.s.k.) represents value of shipments for establishments that did not report detailed information and establishments, typically with less than five employees, that were not included on MA327C mailing panel.

Table 3. Value of Shipments, Exports, Imports, and Apparent Consumption of Refractories by Type: 1999 and 1998
 [Value in thousands of dollars]

Product code 1/	Product description	Manufacturers' shipments	Exports of domestic merchandise 1/ 2/ (value at port)	Percent exports to manufacturers' shipments	Imports for consumption 1/ 3/ (value at port) 4/	Apparent consumption 5/	Percent imports to apparent consumption
1999							
	Clay and nonclay refractories 6/.....	2,002,177	351,372	17.5	333,394	1,984,199	16.8
	Clay refractories.....	911,088	54,881	6.0	107,812	964,019	11.2
3271240111, 211, 411	Brick and shapes.....	517,685	45,003	8.7	106,280	578,962	18.4
3271240311, 421, 431, 441	Unshaped refractories and gunning mixes.....	393,403	9,878	2.5	1,532	385,057	0.4
	Nonclay refractories.....	1,091,089	296,491	27.2	225,582	1,020,180	22.1
3271250121, 131, 141	Nonclay magnesite and magnesite-chrome brick and shapes and chrome brick.....	196,510	58,267	29.7	92,031	230,274	40.0
3271250111, 151, 161, 171, 181	All other brick and shapes.....	493,278	133,400	27.0	107,320	467,198	23.0
3271250211, 216, 221, 226, 231, 236, 241, 246, 251	Unshaped nonclay refractories and gunning mixes.....	401,301	104,824	26.1	26,231	322,708	8.1
1998							
	Clay and nonclay refractories 6/.....	2,137,897	338,639	15.8	256,023	2,055,281	12.5
	Clay refractories.....	970,808	59,712	6.2	30,929	942,025	3.3
3271240111, 211, 411	Brick and shapes.....	572,248	46,600	8.1	29,296	554,944	5.3
3271240311, 421, 431, 441	Unshaped refractories and gunning mixes.....	398,560	13,112	3.3	1,633	387,081	0.4
	Nonclay refractories.....	1,167,089	278,927	23.9	225,094	1,113,256	20.2
3271250121, 131, 141	Nonclay magnesite and magnesite-chrome brick and shapes and chrome brick.....	197,487	59,055	29.9	92,088	230,520	39.9
3271250111, 151, 161, 171, 181	All other brick and shapes.....	528,912	112,125	21.2	106,936	523,723	20.4
3271250211, 216, 221, 226, 231, 236, 241, 246, 251	Unshaped nonclay refractories and gunning mixes.....	440,690	107,747	24.4	26,070	359,013	7.3

1/For comparison of North American Industry Classification System-Based product codes with Schedule B export numbers and HTSUSA import numbers, see Table 4.

2/Source: Census Bureau report EM 545, U.S. Exports.

3/Source: Census Bureau report IM 146, U.S. Imports for Consumption and General Imports.

4/"Value at port" includes both import value and duty value.

5/Apparent consumption is derived by subtracting exports from total of shipments plus imports (including duty).

6/"Clay and nonclay refractories" total shown here excludes product codes 3271240451, 3271240461, 3271240000, 3271250256, 3271250261, 3271250000, 3279920331, 3279920336, and 3274100311; therefore, they differ from the totals shown in Tables 1 and 2a.

Table 4. Comparison of North American Industry Classification System-Based Product Codes with Schedule B Export Numbers, and HTSUSA Import Numbers: 1999

Product code	Product description	Export number 1/	Import number 2/
3271240111, 211, 411	Clay brick and shapes.....	6902.20.1010	6902.20.1010
		6902.20.5010	6902.20.5010
		6902.90.1010	6902.90.1010
		6902.90.5010	6902.90.5010
		6903.90.0010	6903.90.0010
3271240311, 421, 431, 441	Unshaped clay refractories and gunning mixes.....	3816.00.0010	3816.00.0010
3271250121, 131, 141	Nonclay magnesite and magnesite-chrome brick and shapes, and chrome brick	6902.10.1000	6902.10.1000
		6902.10.5000	6902.10.5000
3271250111, 151, 161, 171, 181	All other nonclay brick and shapes.....	6902.20.5020	6902.20.5020
		6902.90.1020	6902.90.1020
		6902.90.5020	6902.90.5020
		6903.90.0050	6903.90.0050
3271250211, 216, 221, 226, 231, 236, 241, 246, 251	Unshaped nonclay refractories and gunning mixes.....	3816.00.0050	3816.00.0050

1/Source: 1999 edition, Harmonized System-Based Schedule B, Statistical Classification of Domestic and Foreign Commodities Exported from the United States.

2/Source: Harmonized Tariff Schedule of the United States, Annotated (1999).