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2007 Minerals Yearbook

DIAMOND, INDUSTRIAL [ADVANCE RELEASE]

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Diamond, Industrial

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In 2007, U.S. synthetic diamond production was estimated to be 260 million carats with an estimated value of $261 million. U.S. imports of all forms of industrial diamond totaled about 414 million carats valued at almost $112 million, while exports totaled more than 107 million carats valued at almost $56.4 million. The estimated U.S. apparent consumption of all forms of industrial diamond was 603 million carats with an estimated value of $335 million.

Diamond is best known as a gemstone, but some of its unique properties make it ideal for many industrial and research applications as well. Current information on gem-grade diamond can be found in the U.S. Geological Survey (USGS) Minerals Yearbook, volume I, Metals and Minerals chapter on gemstones. Diamond that does not meet gem-quality standards for clarity, color, shape, or size is used as industrial-grade diamond. Production and consumption quantities and values reported are estimated to avoid disclosing company proprietary data and still provide useful data on the overall market. Trade data in this report are from the U.S. Census Bureau. All percentages in the report were computed using unrounded data. The USGS does not conduct surveys of either domestic polycrystalline diamond (PCD) producers or domestic chemical vapor deposition (CVD) diamond producers for quantity or value of annual production. Also, trade and consumption quantity or value data are not available for PCD or for CVD diamond.

Diamond is the hardest known material and has the highest thermal conductivity of any material at room temperature. Diamond is more than twice as hard as its nearest competitors, cubic boron nitride and silicon nitride. Because it is the hardest substance known, diamond has been used for centuries as an abrasive in cutting, drilling, grinding, and polishing. Industrial-grade diamond continues to be used as an abrasive for many applications. Even though it has a higher unit cost, diamond has proven to be more cost-effective in many industrial processes because it cuts faster and lasts longer than alternative abrasive materials (Boucher, 1997, p. 26.6). Diamond also has chemical, electrical, optical, and thermal characteristics that make it the best material available to industry for wear- and corrosion-resistant coatings, special lenses, heat sinks in electrical circuits, wire drawing, computing, and other advanced technologies.

Both synthetic and natural diamonds have industrial uses. Synthetic industrial diamond is superior to its natural diamond counterpart because its properties can be tailored to specific applications, and it can be produced in large quantities (Boucher, 1996). These are the reasons that synthetic diamond accounts for about 94% of the industrial diamond used in the United States and about 88% of the industrial diamond used in the world.

Legislation and Government Programs

Congress has authorized the sale of all diamond in the National Defense Stockpile (NDS), which is managed by the Defense National Stockpile Center (DNSC). The entire remaining inventory of the stockpiled diamond stones was authorized for sale in the NDS's fiscal year 2007 annual plan. One sale was held in April in which 41,000 carats of diamond were sold for $173,000 (Lough, 2007). At yearend 2007, the DNSC reported an NDS remaining inventory of about 437,000 carats of industrial diamond stone with a market value of $3.15 million (Stead, 2007). The DNSC planned to conduct additional sales until all NDS diamond stone stocks are sold.

Production

The USGS conducts an annual survey of domestic industrial diamond producers and U.S. firms that recover diamond wastes. Although most of these companies responded to the 2007 survey, one of the two U.S. primary producers of industrial diamond and one of the four industrial diamond recycling firms refrained from reporting data that they deemed to be proprietary. To protect the proprietary data of other producers, only estimates of U.S. primary and secondary output are provided in this review.

As one of the world's leading producers of synthetic industrial diamond, the United States accounted for an estimated output of 260 million carats valued at more than $261 million in 2007. Only two U.S. companies produced synthetic industrial diamond during the year—Diamond Innovations, Inc., Worthington, OH, and Mypodiamond, Inc., Smithfield, PA.

In 2007, at least nine U.S. companies also manufactured polycrystalline diamond (PCD) from synthetic diamond grit and powder. These companies were Dennis Tool Co., Houston, TX; Diamond Innovations, Inc., Worthington, OH; Novatek LLC, Provo, UT; Precorp Inc., Provo; Sii MegaDiamond Inc., Provo; Tempo Technology Corp., Somerset, NJ; US Synthetic Corp., Orem, UT; and Western Diamond Products LLC, Salt Lake City, UT.

During 2007, an estimated 34.7 million carats of used industrial diamond worth about $18.2 million were recycled in the United States. Recycling firms recovered most of this material from used diamond drill bits, diamond tools, and other diamond-containing wastes. Additional diamond was recovered during the year from residues generated in the manufacture of PCD; most of this material was recovered from within the production operations of the PCD-producing companies.

The recovery and sale of industrial diamond was the principal business of four U.S. companies in 2007—Industrial Diamond Laboratory Inc., Bronx, NY; Industrial Diamond Powders Co., Pittsburgh, PA; International Diamond Services Inc., Houston, TX; and National Research Co., Fraser, MI. In addition to these companies, other domestic firms may have recovered industrial diamond in smaller secondary operations.

There were no commercially operated diamond mines in the United States during 2007. The last commercially operated diamond mine in the United States was the Kelsey Lake diamond mine, located near Fort Collins, CO, which closed in 2002 and is now fully reclaimed.

Canadian diamond production continued increasing in 2007 to about 18 million carats. Diamond exploration continued in many parts of Canada, and many new deposits have been found and are being developed. In 2007, Canada produced about 11% of the world's combined natural gemstone and industrial diamonds. The success of the Canadian diamond industry has stimulated interest in exploration for commercially feasible diamond deposits in the United States in Alaska, Colorado, Minnesota, Montana, and Wyoming. Microscopic and larger diamonds and some diamond indicator minerals have been found in all of these States. Parts of Alaska have similar geologic terrain to the diamond producing areas of Canada's Northwest Territories, and there are similarities between the geology in other Canadian areas where diamond deposits have been found in Minnesota (Diamond Registry Bulletin, 2005). A diamond-bearing kimberlite was found in a 32.4-hectare site known as the Homestead property near Lewistown, MT; and diamonds have been found in the stream beds and glacial valleys of Montana for years (Associated Press, 2004). Studies by the Wyoming Geological Survey have shown that Wyoming has the potential for a large diamond mining business. Wyoming has many of the same geologic conditions that are found in the Canadian diamond-producing areas, and there is good evidence of hundreds of kimberlite pipes in the State. More than 20 diamondiferous kimberlite pipes and 1 diamondiferous mafic breccia pipe have been identified in southern Wyoming. The State Line and the Iron Mountain kimberlite fields of Wyoming are two of the largest kimberlite fields in the United States, and the Leucite Hills lamproite field in Wyoming is the largest lamproite field in the United States (Associated Press, 2002).

Consumption

The United States remained the world's leading market for industrial diamond in 2007. Based on production estimates, trade data, and adjustments for Government stockpile sales, apparent U.S. consumption of industrial diamond during the year increased by about 7% to an estimated 603 million carats valued at $335 million. This apparent consumption was the combination of 599 million carats of diamond bort, grit, dust, and powder valued at $299 million and 3.48 million carats of diamond stone valued at $36.3 million.

The major consuming industries of industrial diamond in the United States during 2007 were construction, machinery manufacturing, mining services (exploration drilling for minerals, natural gas, and oil), stone cutting/polishing, and transportation systems (infrastructure and vehicles). Within these sectors, stone cutting and highway building/repair together made up the largest demand for industrial diamond. Research and high-technology uses included close-tolerance machining of ceramic parts for the aerospace industry, heat sinks in electronic circuits, lenses for laser radiation equipment, polishing of silicon wafers and disk drives, and other applications in the computer industry.

Diamond tools have numerous industrial functions. Diamond drilling bits and reaming shells are used principally for minerals, natural gas, and oil. Other applications of diamond bits and reaming shells include foundation testing, masonry drilling, and inspecting concrete. The primary uses of point diamond tools are for dressing and truing grinding wheels and for boring, cutting, finishing, and machining applications. Beveling glass for automobile windows is another application. Cutting dimension stone and cutting/grooving concrete in highway reconditioning are the main uses of diamond saws; other applications include cutting composites and forming refractory shapes for furnace linings. Very fine diamond saws are used to slice brittle metals and crystals into thin wafers for electronic and electrical devices. Diamond wire dies are essential for high-speed drawing of fine wire, especially from hard, high-strength metals and alloys. The primary uses of diamond grinding wheels include edging plate glass, grinding dies, grinding parts for optical instruments, and sharpening and shaping carbide machine tool tips.

Two types of natural diamond are used by industry—diamond stone (generally larger than 60 mesh/250 micrometers) and diamond bort (smaller, fragmented material). Diamond stone is used mainly in drilling bits and reaming shells used by mining companies; it also is incorporated in single- or multiple-point diamond tools, diamond saws, diamond wheels, and diamond wire dies. Diamond bort is used for drilling bits and as a loose grain abrasive for polishing. Other tools that incorporate natural diamond include bearings, engraving points, glass cutters, and surgical instruments.

Synthetic diamond grit and powder are used in diamond grinding wheels, saws, impregnated bits and tools, and as a loose abrasive for polishing. Diamond grinding wheels can be as much as 1 meter in diameter.

Loose powders made with synthetic diamond for polishing are used primarily to finish cutting tools, gemstones, jewel bearings, optical surfaces, silicon wafers, and wire-drawing dies for computer chips. Hundreds of other products made from ceramics, glass, metals, and plastics also are finished with diamond powders.

Two types of PCDs used by industry are polycrystalline diamond compacts (PDCs) and polycrystalline diamond shapes (PDSs). The use of PDCs and PDSs continues to increase for many of the applications cited above, including some of those that employ natural diamond. The use of PDCs, PDSs, and matrix-set synthetic diamond grit for drilling bits and reaming shells has increased in recent years. PDCs and PDSs are used in the manufacture of single- and multiple-point tools, and PDCs are used in a majority of the diamond wire-drawing dies.

Apollo Diamond, Inc., near Boston, MA, developed and patented a method for growing extremely pure, gem-quality diamond with flawless crystal structure by chemical vapor deposition (CVD). The CVD technique transforms carbon into plasma, which then is precipitated onto a substrate as diamond. CVD has been used for more than a decade to cover large surfaces with microscopic diamond crystals, but until this process was developed, no one had discovered the combination of temperature, gas composition, and pressure that resulted in the growth of a single diamond crystal. CVD diamond precipitates as nearly 100% pure, almost flawless diamond, and therefore may not be distinguishable from natural diamond by some tests (Davis, 2003). CVD diamond's highest value besides its use as gemstones is as a material for high-tech uses. CVD diamond could be used to make extremely powerful lasers; to create cellular telephones that fit into a watch and storage devices for MP3 players that could store 10,000 movies, not just 10,000 songs; to create frictionless medical replacement joints; or to coat cars that would not scratch or wear out. The greatest potential use for CVD diamond is in computer technology (Maney, 2005). For diamond to be a practical material for use as a semiconductor, it must be affordably grown in large wafers. After this process and technology are fully developed, CVD diamond could possibly be grown for relatively inexpensive prices. Growth of CVD diamond is limited only by the size of the seed placed in the diamond growing chamber. Apollo predicts it will be producing 100-millimeter wafers in the near future. Scientists have said that diamond computer chips are more durable because they can work at temperatures up to 1,000° C, while silicon computer chips stop working at about 150° C. This means that diamond computer chips will probably work at a much higher frequency or faster speed and could be placed in a high-temperature environment (Diamond Registry Bulletin, 2003).

In 2004, scientists at the Carnegie Institution of Washington's Geophysical Laboratory published a study showing that researchers grew diamond crystals by a special CVD process at very high growth rates. They were able to grow gem-sized crystals in a day—a growth rate 100 times faster than other methods used before. This is a new way of producing diamond crystals for such new applications as diamond-based electronic devices and next generation cutting tools (Willis, 2004). By early 2005, the Carnegie Institution's Geophysical Laboratory and the University of Alabama jointly had developed and patented the CVD process and apparatus to produce 10-carat, ½-inch thick single diamond crystals at very rapid growth rates (100 micrometers per hour). This faster CVD method uses microwave plasma technology and allows multiple crystals to be grown simultaneously. This size is about five times that of commercially available lab-created diamonds produced by high pressures and high temperatures (HPHT) methods and other CVD techniques (Willis, 2004; Carnegie Institution of Washington, 2005; Science Blog, 2005).

Both Apollo Diamond and the Carnegie Institution have noted that their diamonds produced by the CVD method are harder than natural diamonds and diamonds produced by HPHT methods.

Prices

Natural and synthetic industrial diamonds differ significantly in price. Natural industrial diamond normally has a more limited range of values. The price varies from an average of $1.01 per carat for bort size material to about $1.86 to $10 per carat for most stones, with some larger stones selling for up to $200 per carat.

Synthetic industrial diamond has a much larger price range than natural diamond. Prices of synthetic diamond vary according to particle strength, size, shape, crystallinity, and the absence or presence of metal coatings. In general, synthetic diamond prices for grinding and polishing range from as low as $0.37 to $1.67 per carat. Strong and blocky material for sawing and drilling sells for $1.50 to $3.50 per carat. Large synthetic crystals with excellent structure for specific applications sell for many hundreds of dollars per carat (Law-West, 2002, p. 23.8).

Foreign Trade

The United States continued to lead the world in industrial diamond trade in 2007; imports were received from 39 countries, exports were sent to 37 countries, and reexports were sent to 28 countries (tables 1-4). Although the United States has been a major producer of synthetic diamond for decades, growing domestic markets have become more reliant on foreign sources of industrial diamond in recent years. U.S. markets for natural industrial diamond always have been dependent on imports and secondary recovery operations because there has been no domestic production of natural diamond.

During 2007, U.S. imports of industrial-quality diamond stones (natural and synthetic) increased by 41% from those of 2006 to about 3.06 million carats valued at more than $35.3 million (table 1). Imports of diamond dust, grit, and powder (natural and synthetic) increased by 11% from those of 2006 to 411 million carats valued at almost $76.4 million (table 2).

Reexports may account for a significant portion of total exports/reexports; therefore, exports and reexports are listed separately in tables 3 and 4 so that U.S. trade and consumption can be calculated more accurately. During 2007, the United States did not export any industrial diamond stones, while U.S. reexports of industrial diamond stone increased by 37% from those of 2006 to 2.12 million carats valued at $32.4 million (table 3). U.S. exports of industrial diamond dust, grit, and powder (natural and synthetic) increased by 18% from those of 2006 to 107 million carats valued at $56.4 million, and reexports of industrial diamond dust, grit, and powder (natural and synthetic) decreased by 36% from those of 2006 to 5.99 million carats valued at $6.15 million (table 4).

World Industry Structure

In 2007, industrial diamond was produced in 31 countries (tables 5-6). Total industrial diamond output worldwide was estimated by the USGS to be about 645 million carats valued between $646 million and $1 billion. Natural industrial diamond production worldwide was estimated to be more than 76.7 million carats, a 4% decrease compared with that of 2006. Congo (Kinshasa) was the leading producing country, followed by Australia and Russia, in descending order of quantity. These three countries produced more than 73% of the world's natural industrial diamond (table 5). Synthetic industrial diamond production worldwide was estimated to be more than 568 million carats, a slight increase compared with that of the previous year. The United States was the leading producing country, followed by Russia, Ireland, and South Africa, in descending order of quantity. These four countries produced about 81% of the world's synthetic industrial diamond (table 6).

In addition to the countries listed in table 6, Germany and the Republic of Korea produced synthetic diamond, but specific data on their output could not be confirmed. China's industrial diamond output is much higher than listed in the table (Terry Kane, executive director, Industrial Diamond Association of America, Inc., written commun., January 7, 2009). This under reporting is owing to a poor information dissemination and gathering within China. In 2007, 81% of the total global natural and synthetic industrial diamond output was produced in Ireland, Japan, Russia, South Africa, and the United States. Synthetic diamond accounted for more than 88% of global diamond production and consumption.

World Review

Canada.—The Ekati Diamond Mine, Canada's first operating commercial diamond mine, completed its ninth full year of production in 2007. Ekati produced 3.67 million carats of diamond from 4.33 million metric tons (Mt) of ore (BHP Billiton Ltd., 2008, p. 10). BHP Billiton Ltd. has an 80% controlling ownership in Ekati, which is in the Northwest Territories in Canada. Ekati has estimated reserves of 60.3 Mt of ore in kimberlite pipes that contain 54.3 million carats of diamond, and BHP Billiton projected the mine life to be 25 years. Approximately one-third of the Ekati diamond production is industrial-grade material (Darren Dyck, senior project geologist, BHP Diamonds, Inc., oral commun., May 27, 2001).

The Diavik Diamond Mine, also in the Northwest Territories, completed its fifth full year of production. In 2007, Diavik produced 11.9 million carats of diamond (Diavik Diamond Mines Inc., 2008). At yearend 2006, Diavik estimated the mine's remaining proven and probable reserves to be 24.5 Mt of ore in kimberlite pipes, containing 81.7 million carats of diamond, and projected the mine life to be 16 to 22 years (Diavik Diamond Mine Dialogue, 2007). The mine is an unincorporated joint venture between Diavik Diamond Mines Inc. (60%) and Harry Winston Diamond Mines Ltd. (40%). In November, Diavik announced approval of its investment in the underground mining phase of the Diavik Diamond Mine. Underground diamond production will begin in 2009 and continue beyond 2020. Open pit mining is expected to cease in 2012, at which time Diavik will become an all-underground mine (Diavik Diamond Mine Dialogue, 2008). The mine is expected to produce a total of about 110 million carats of diamond at a rate of 8 million carats per year (Diavik Diamond Mines Inc., 2000, p. 10-12; Diavik Diamond Mine Dialogue, 2007).

Canada's third diamond mine, the Jericho Diamond Mine wholly owned by Tahera Diamond Corp., completed its first full year of production. The Jericho mine is located in Nunavut. In 2007, Jericho produced 375,000 carats (Abazias Diamonds, 2008). Tahera estimated the Jericho Diamond Mine's reserves at 2.6 Mt of ore and 3.11 million carats of diamond (Tahera Diamond Corp., 2007).

Diamond exploration continued in Canada, with several other commercial diamond projects and additional discoveries located in Alberta, British Columbia, the Northwest Territories, the Nunavut Territory, Ontario, and Quebec. Canada produced about 11% of the world's combined natural gemstone and industrial diamond production in 2007.

Outlook

The United States will most likely continue to be the world's leading market for industrial diamond well into the next decade. The United States also is expected to remain a significant producer and exporter of industrial diamond. The strength of U.S. diamond demand will depend on how well the diamond life cycle cost-effectiveness compares with competing materials that initially are less expensive. Diamond offers many advantages for precision machining and longer tool life. In fact, even the use of wear-resistant diamond coatings to increase the life of materials that compete with diamond is a rapidly growing application. Increased tool life not only leads to lower costs per unit of output but also means fewer tool changes and longer production runs (Advanced Materials & Processes, 1998). In view of the many advantages that come from increased tool life and reports that diamond film surfaces can increase durability by a factor of 50, much wider use of diamond as an engineering material is expected.

The most dramatic increase in domestic use of industrial diamond is likely to be in the construction sector as the Nation builds and repairs the U.S. highway system. Demand for saw-grade diamond alone is expected to continue increasing if national goals for repair and replacement of roads, bridges, and other components in the transportation infrastructure of the country are fulfilled.

PCD for abrasive tools and wear parts will continue to replace competing materials in many industrial applications by providing closer tolerances as well as extending tool life. For example, PDCs and PDSs will continue to displace natural diamond stone and tungsten carbide products used in the drilling and tooling industries.

Truing and dressing applications will remain a major domestic end use for natural industrial diamond stone. Stones for these applications have not yet been manufactured economically. No shortage of the stone is anticipated, however, because new mines and more producers selling in the rough diamond market will maintain ample supplies. More competition introduced by the additional sources also may temper price increases.

World demand for industrial diamond will continue to increase. Constant dollar prices of synthetic diamond products, including CVD diamond films, will decline as production technologies become more cost effective and as competition increases from low-cost producers in China and Russia.

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TABLE 1
U.S. IMPORTS FOR CONSUMPTION OF INDUSTRIAL DIAMOND STONES, BY COUNTRY[1]

(Thousand carats and thousand dollars)

	Natural industrial diamond stones[2]				Miners' diamond, natural and synthetic[3]			
	2006		2007		2006		2007	
Country	Quantity	Value[4]	Quantity	Value[4]	Quantity	Value[4]	Quantity	Value[4]
Australia	36	366	13	398	1	56	2	139
Belgium	158	193	30	311	28	178	19	1,150
Botswana	797	14,700	1,140	19,900	32	761	4	158
Congo (Kinshasa)	113	530	18	239	2	86	3	13
Ghana	121	221	13	56	1	53	1	7
India	138	62	223	135	89	64	24	43
Namibia	297	1,630	273	1,480	1	16	5	25
Russia	115	3,020	145	3,320	--	--	--	--
South Africa	216	4,850	1,090	6,950	10	140	32	306
Other	11	241	15	456	6	263	5	174
Total	2,000	25,800	2,960	33,300	171	1,620	95	2,010

-- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes glazers' and engravers' diamond unset, Harmonized Tariff Schedule of the United States (HTS) codes 7102.21.3000 and 7102.21.4000.
[3]HTS codes 7102.21.1010 and 7102.21.1020.
[4]Customs value.

Source: U.S. Census Bureau.

TABLE 2

U.S. IMPORTS FOR CONSUMPTION OF DIAMOND DUST, GRIT, AND POWDER, BY COUNTRY[1]

(Thousand carats and thousand dollars)

	Synthetic[2]				Natural[2]			
	2006		2007		2006		2007	
Country	Quantity	Value[3]	Quantity	Value[3]	Quantity	Value[3]	Quantity	Value[3]
Belgium	4,400	1,660	3,370	967	1,130	574	440	262
China	210,000	19,400	241,000	19,100	867	458	1,890	411
Germany	256	117	4	6	--	--	--	--
Hong Kong	2,280	1,460	2,170	545	--	--	20	4
India	1,220	534	2,040	613	448	203	1,970	1,180
Ireland	89,000	38,500	91,800	36,100	1,970	1,230	1,740	1,030
Israel	167	37	119	50	29	21	13	3
Italy	513	216	75	32	112	46	52	131
Japan	5,270	3,870	4,960	3,230	10	5	10	20
Korea, Republic of	16,400	4,660	23,100	4,350	41	34	2	3
Macau	110	46	8	5	--	--	--	--
Mexico	111	50	140	24	139	70	55	22
Romania	786	204	976	114	--	--	--	--
Russia	24,100	2,280	24,300	2,680	443	247	268	236
Switzerland	746	1,040	974	1,400	232	279	178	230
Taiwan	180	31	246	56	--	--	19	3
Ukraine	4,410	367	643	81	10	5	--	--
United Arab Emirates	478	214	284	164	--	--	192	92
United Kingdom	3,700	1,440	5,950	1,940	1,160	584	1,240	727
Other	367	236	379	286	227	293	219	435
Total	364,000	76,400	403,000	71,700	6,810	4,050	8,320	4,790

-- Zero.

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

[2]Harmonized Tariff Schedule of the United States codes 7105.10.0020, 7105.10.0030, and 7105.10.0050 for synthetic and 7105.10.0011 and 7105.10.0015 for natural.

[3]Customs value.

Source: U.S. Census Bureau.

TABLE 3

U.S. EXPORTS AND REEXPORTS OF INDUSTRIAL DIAMOND STONES, BY COUNTRY[1]

(Thousand carats and thousand dollars)

Country	Industrial unworked diamonds[2]			
	2006		2007	
	Quantity	Value[3]	Quantity	Value[3]
Exports, Canada	7	16	--	--
Reexports:				
Belgium	380	8,500	672	11,300
Brazil	14	164	7	137
Canada	108	924	182	1,180
Germany	15	579	23	663
Hong Kong	651	2,510	872	3,490
Israel	61	97	3	60
Japan	145	8,160	164	9,260
Korea, Republic of	22	1,470	23	1,340
South Africa	17	41	46	66
United Arab Emirates	13	1,590	7	1,210
United Kingdom	117	2,320	83	2,260
Other	14	490	37	1,480
Total	1,560	26,800	2,120	32,400
Grand total	1,560	26,900	2,120	32,400

-- Zero.

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

[2]Harmonized Tariff Schedule of the United States code 7102.21.0000.

[3]Customs value.

Source: U.S. Census Bureau.

TABLE 4

U.S. EXPORTS AND REEXPORTS OF INDUSTRIAL DIAMOND DUST, GRIT, AND POWDER, BY COUNTRY[1]

(Thousand carats and thousand dollars)

	Synthetic[2]				Natural[2]			
	2006		2007		2006		2007	
Country	Quantity	Value[3]	Quantity	Value[3]	Quantity	Value[3]	Quantity	Value[3]
Exports:								
Austria	113	57	497	197	121	31	839	219
Belgium	402	169	137	49	1	3	--	--
Brazil	3,330	1,470	7,520	2,530	291	48	--	--
Canada	5,020	3,760	5,300	4,200	270	580	217	511
Germany	1,120	441	1,610	631	208	98	88	78
Greece	611	144	493	100	--	--	--	--
Hong Kong	125	66	74	72	14	34	114	138
India	2,340	854	2,110	876	55	14	40	14
Ireland	21,300	11,200	30,500	16,200	296	406	713	622
Israel	135	66	29	26	--	--	6	14
Italy	4,050	1,640	4,580	1,670	20	14	88	12
Japan	23,300	13,000	19,500	9,670	119	79	184	261
Korea, Republic of	8,210	4,140	9,640	5,110	219	63	432	143
Mexico	166	59	801	288	80	54	38	28
Singapore	552	1,050	219	271	53	61	6	15
Spain	276	73	186	53	21	10	15	4
Switzerland	5,330	4,540	6,030	5,220	285	166	426	229
Taiwan	4,220	1,860	4,620	2,270	7	3	57	41
Thailand	4,060	1,210	4,880	1,650	22	13	64	39
United Kingdom	589	228	487	260	57	76	674	402
Other	2,770	1,540	2,740	1,080	169	343	553	1,260
Total	88,000	47,600	102,000	52,400	2,310	2,090	4,560	4,030
Reexports:								
Austria	139	45	--	--	106	28	--	--
Belgium	248	195	254	142	195	307	265	440
Brazil	99	32	11	21	--	--	--	--
Canada	1,290	1,410	2,780	2,880	153	137	77	157
Germany	596	210	235	113	294	189	140	289
India	68	24	56	10	7	14	13	10
Ireland	310	315	370	265	18	15	22	15
Italy	142	64	22	28	39	15	--	--
Japan	1,580	594	301	135	--	--	371	453
Korea, Republic of	1,260	861	667	824	18	4	--	--
Macau	431	131	--	--	--	--	--	--
Mexico	114	47	14	25	2	10	14	32
United Arab Emirates	--	--	11	14	1,590	3,970	--	--
United Kingdom	79	70	21	26	79	86	49	50
Other	232	200	189	130	327	121	105	102
Total	6,590	4,200	4,930	4,610	2,820	4,890	1,060	1,550
Grand total	94,600	51,800	107,000	57,000	5,130	6,990	5,610	5,580

-- Zero.

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

[2]Harmonized Tariff Schedule of the United States codes 7105.10.0025 for synthetic and 7105.10.0010 for natural.

[3]Customs value.

Source: U.S. Census Bureau.

TABLE 5

NATURAL DIAMOND: WORLD PRODUCTION, BY COUNTRY AND TYPE[1, 2, 3]

(Thousand carats)

Country and type[4]	2003	2004	2005	2006	2007
Gemstones:					
Angola[e]	5,130	5,490	6,400 r	8,300 r	8,700
Australia	13,981	6,058	8,577	7,305	231
Botswana[e]	22,800	23,300	23,900	24,000	25,000
Brazil[e]	400	300 [5]	300	300	300
Canada	10,756	12,618	12,314 r	13,278 r	17,998
Central African Republic[e]	250	263	300 r	340 r	370
China[e]	100	100	100	100	100
Congo (Kinshasa)	5,400 r	5,900 r	7,000 r	5,700 e	5,400
Côte d'Ivoire[e]	154 [5]	201	210 r	210 r	210
Ghana	724	725	810 r	780	720
Guinea	500	555	440 r	380 r	815 e
Guyana	413	445	357 e	341 e	350
Liberia[e]	26	7	7	7	13
Namibia	1,481	2,004	1,902	2,400 e	2,200
Russia[e]	20,000	23,700 r	23,000	23,400	23,300
Sierra Leone[e]	233	318	395	360 e	360
South Africa[e]	5,144 [5]	5,800	6,400	6,100 r	6,100
Tanzania[e]	201 [5]	258	185	230 r	230
Venezuela[e]	11 [5]	40	46	45	45
Other[6]	145	335 r	262 r	223 r	152
Total	87,800	88,400 r	92,900 r	93,800 r	92,600
Industrial:					
Angola[e]	570	610	680 r	880 r	970
Australia	17,087	18,172	25,730	21,915	18,960
Botswana[e]	7,600	7,800	8,000	8,000	8,000
Brazil[e]	600	600	600	600	600
Central African Republic[e]	83	88	80 r	85 r	47
China[e]	955	960	960	965	970
Congo (Kinshasa)	21,600	23,600 r	28,200 r	22,800 r	21,800
Côte d'Ivoire[e]	76 [5]	99	90 r	90 r	90
Ghana[e]	180	180	200 r	190	180
Guinea	167	185	100 r	95 r	200 e
Liberia[e]	14	4	4	4	9
Russia[e]	13,000	15,200 r	15,000	15,000	15,000
Sierra Leone	274 e	374 e	274	252	240
South Africa[e]	7,540 [5]	8,500	9,400	9,100 r	9,100
Tanzania[e]	36	46	35	42 r	40
Venezuela[e]	24 [5]	60	69	70	70
Other[7]	112 r	191 r	990 r	163 r	463
Total	69,900	76,700	90,400 r	80,300 r	76,700
Grand total	158,000	165,000 r	183,000 r	174,000 r	169,000

[e]Estimated. [r]Revised.

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through May 22, 2008.

[3]In addition to the countries listed, Nigeria and the Republic of Korea produce natural diamond and synthetic diamond, respectively, but information is inadequate to formulate reliable estimates of output levels.

[4]Includes near-gem and cheap-gem qualities.

[5]Reported figure.

[6]Includes Cameroon, Congo (Brazzaville), Gabon (unspecified), India, Indonesia, Togo (unspecified), and Zimbabwe.

[7]Includes Congo (Brazzaville), India, Indonesia, and Zimbabwe.

TABLE 6

SYNTHETIC DIAMOND: ESTIMATED WORLD PRODUCTION, BY COUNTRY[1, 2, 3]

(Thousand carats)

Country	2003	2004	2005	2006	2007
Belarus	25,000	25,000	25,000	25,000	25,000
China	17,000	17,000	17,000	18,000	18,000
Czech Republic	5	5	5	5	5
France	3,000	3,000	3,000	3,000	3,000
Ireland	60,000	60,000	60,000	60,000	60,000
Japan	34,000	34,000	34,000	34,000	34,000
Russia	80,000	80,000	80,000	80,000	80,000
South Africa	60,000	60,000	60,000	60,000	60,000
Sweden	20,000	20,000	20,000	20,000	20,000
Ukraine	8,000	8,000	8,000	8,000	8,000
United States	236,000	252,000	256,000	258,000	260,000
Zimbabwe	5	5	5	5	5
Total	543,000	559,000	563,000	566,000	568,000

[1]World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through May 22, 2008.

[3]In addition to the countries listed, Germany and the Republic of Korea also produces significant amounts of synthetic diamond, but output is not officially reported, and available information is inadequate to formulate reliable estimates of output levels.