

SECTION NINE

SPRING MANUFACTURING AND METAL STAMPING

9.1 PROFILE

Copper beryllium alloys are used to make light gauge springs, electronic connectors, and other stamped metal products.

Spring Manufacturing: Beryllium-copper wire is commonly used to produce coil springs for electronic applications in the automobile, aerospace, telecommunications, computers, and other sectors. Industry contacts and literature suggest that beryllium copper is used almost exclusively in the manufacture of light gauge springs (NAICS 332611) and has little application in the manufacture of heavy-gauge springs (NAICS 332612).

The 2002 Economic Census reports 358 establishments with 16,815 total employees and 13,411 production employees for the light spring manufacturing industry (see Table 9-1). Of these establishments, most (87%) employ fewer than 100 employees. According to industry contacts and a review of spring manufacturer Internet sites, most spring manufacturers potentially use beryllium-copper alloys, though beryllium-copper springs typically account for only a small percentage of their overall business. Of the six coil spring manufacturers contacted, all use beryllium copper (Bollinger, 2001; Briere, 2001; Germain, 2001; Leahy, 2001; Victorian, 2001; Witham, 2001). However, three of the manufacturers indicated that beryllium-copper springs accounted for 3 percent or less of their business while a fourth indicated that beryllium-copper springs accounted for a very small percentage (Bollinger, 2001; Germain, 2001; Leahy, 2001; Witham, 2001). The remaining two contacts did not supply this information.

A representative of the Spring Manufacturers Institute (SMI) also indicated that beryllium-copper springs account for only a small part of the overall coil spring market. However, any spring manufacturer could produce them because no special equipment is required. According to the SMI representative, the spring business is based almost entirely on custom orders, with manufacturers producing springs to customer specifications (Wood, 2001).

Therefore, virtually any spring manufacturer could receive an order for beryllium-copper springs. Based on information from manufacturers, the SMI, and spring manufacturer web sites, ERG estimates that all light gauge spring manufacturers are manufacturing beryllium-copper springs, at least an occasional basis.

Stampings and Connectors: Stamped beryllium copper is used to make a variety of parts, especially for electronic applications. These applications include connectors, terminals, switches, spring contacts, and EMI shielding gaskets (Battey, 2002; Page, 2002; Tech-Etch, 2002). Stamped beryllium copper is also used to make a wide range of clips and card guides used to secure parts in electronic assemblies. Beryllium-copper clips are used to secure components such as resistors, capacitors, fuses, relays, transistors and other small cylindrical parts in electronic assemblies (Atlee, 2002a). Beryllium-copper card guides are used to hold printed circuit boards in place (Atlee, 2002b). Manufacturers also stamp beryllium copper to produce parts for mechanical applications, including washer springs and retaining rings (Small Parts, 2002; Rotor Clip, 2002).

A connector is a device for mating and de-mating electrical power connections or communications media. Beryllium copper, however, finds little or no use in heavy duty electrical power connectors. Beryllium-copper alloys are used in the manufacture of a variety of electronic connector components, including flat and leaf springs, pins, jacks, and bus bars. These find use in computers, telecommunication equipment, audio and video components, medical monitors, and a range other electronic equipment.

Establishments producing connector components are classified in NAICS 334417, Electronic Connector Manufacturing. Other establishments in the NAICS classification, NAICS 332116, Metal Stamping, might produce stamped and formed products for use in the connector and electronics industries. Manufacturers producing automotive parts might also directly use beryllium-copper alloys directly in the production of electronic equipment. These producers are contained in the NAICS classification 336322, Other Motor Vehicle Electrical and Electronic Equipment Manufacturing.

According to the 2002 Economic Census, the metal stamping and electronic connector industries comprise 321 and 1,775 establishments, respectively (U.S. Census Bureau, 2004). As shown in Table 9-1, 49,971 production workers are employed in the metal stamping industry, while 17,533 production workers are employed in the manufacture of electronic connectors. Both industries are dominated by small establishments, with facilities with fewer than 20 employees accounting for about one-half of the total. While data from the 2002 Census is not yet available, the 1997 Economic Census reported 1,021 establishments with 95,617 total and 75,419 production employees for producers of automotive electrical and electronic equipment. This industry is also dominated by small to mid-sized establishments.

Table 9-1. Spring and Electronic Connector Manufacturing and Metal Stamping - 2002							
NAICS	No. of Firms	No. of Establishments	Total Employees	Production Workers	Estabs. with <20 Employees	Estabs. with 20 - 99 Employees	Estabs. with >99 Employees
332612 Light Gauge Springs Manufacturing	283	358	16,815	13,411	177 (49%)	134 (37%)	47 (13%)
332116 Metal Stamping	1,703	1,795	66,307	49,971	958 (53%)	813 (45%)	24 (1%)
334417 Electronic Connector Manufacturing	281	321	24,639	17,533	151 (47%)	145 (45%)	25 (8%)
336322 Other Motor Vehicle Electronic and Electronic Equipment	950	1,021	95,617	75,419	566 (57%)	376 (37%)	79 (8%)
Source: U. S. Census Bureau, 2004.							

Stamping Manufacturers Using Copper-Beryllium: Based on information from industry representatives, beryllium copper is used, at least occasionally, by most of stampers that supply the electronics industry (Page, 2002; Tschool, 2002). Many stampers produce parts to order and will use beryllium-copper alloys if called for in the customer’s specifications (Battey, 2002; Becker, 2002; Tschool, 2002).

Beryllium-copper stampings are, however, believed to account for only a small percentage of the industry's total output. Though two stampers contacted said that beryllium-copper alloy stampings account for a substantial portion of their business (Laird, 2001; Yarborough, 2002), most industry sources stated that the alloy represented only a small percent of their overall output (Battey, 2002; Becker, 2002; Tschool, 2002; Volkert, 2001). One source estimated that no more than 5 percent of stamped parts intended for the electronics market are beryllium-copper (Page, 2002).

Of the 17,795 reported establishments in the stamping industry, however, most do not produce products for the electronics industry. Based on data from the Economic Census Product Summary, it is possible to identify a subset of companies that are likely to be stamping parts for the electronics industry. Table 9-2 shows the number of companies in the stamping industry with shipments greater than \$100,000 for each of four product areas comprising the electronics applications. Since some companies probably produce for more one or more of these product classes, the Census statistics likely over count the number of unique entities. Thus, at most, 169 companies produce products for the four identified electronics product areas. ERG estimated the associated number of establishments (179) operated by these companies by multiplying the number of companies for each of the four product classes by the average number of establishments per company for the stamping industry as a whole. The numbers of employees and production employees were similarly derived by multiplying the estimated number of establishments by the average number of employees and by the average number of production employees per establishment for the industry as a whole.

Based on information from industry representatives, ERG also estimates that approximately 75 percent of stampers producing parts for the electronics industry work with beryllium-copper alloys. Table 9-3 shows the resultant estimate of number establishments and associated production employees in the stamping industry that use beryllium copper. Thus, ERG estimates that 134 establishments in the stamping industry with 3,719 production employees use beryllium-copper alloys.

Table 9-2. Estimated Number of Firms, Establishments, Employees and Production Employees in the Stamping Industry Involved in the Production of Parts for the Electronics Industry				
Product & NAICS Product Code	No. of Firms	No. of Establishments	No. of Employees	No. of Production Employees
Radio and phonographs (NAICS 3321161352)	11	12	428	323
Televisions (NAICS 3321161354)	26	27	1,012	763
Computers (NAICS 3321161421)	102	108	3,971	2,993
Office Machines (excluding computers) (NAICS 3321161441)	30	32	1,168	880
Total [a]	169	179	6,580	4,959

Sources: Derived from 2002 Economic Census. See text for details.
[a] Companies and establishments may be double counted if they produce for more than one product category.

Electronic Connector Manufacturers Using Copper Beryllium: None of the industry sources contacted could estimate the share of electronic connector manufacturers that use beryllium copper. However, because of its cost, most sources believe that the number of manufacturing users is limited. This is supported by review of information on connector manufacturers and in Thomas Register and on the Web (Thomas, 2002). Based on these sources, ERG estimates that 20 percent or less of electronic connector manufacturers use beryllium-copper alloys. Based on this percentage, an estimated 64 establishments and 3,511 production employees use beryllium alloys in this industry.

Automotive Parts Manufacturers Using Copper-Beryllium: Data describing the number of automotive parts manufacturers using beryllium alloys are not available. The BWI customer database, however, shows that an estimated 527 Brush customers perform stamping operations (Kolanz, 2001) Using this figure as the total number of establishments that perform stamping of beryllium alloys, primarily for electronic applications, the residual of 329 is obtained after subtracting the estimates for the stamping and electronic connector industries. In lieu of any better information, ERG assigned this residual to the automotive parts industry,

NAICS 336322. Table 9-3 summarizes the estimates of the establishments using beryllium alloys for spring manufacturing, electronic applications, and other stamped and formed productions.

Table 9-3. Spring, Stamping, Connector, and Other Electronic Equipment Manufacturers Using Beryllium Alloys					
NAICS Industry	Establishments	Production Employees	Using Beryllium Alloys		
			%	Establishments	Production Employees
332612 Light Gauge Springs Manufacturing	358	13,411	100%	358	13,411
332116 Metal Stamping	1,795	49,971			
Electronic Applications	179	1,959	75%	134	3,719
334417 Electronic Connector Manufacturing	321	17,533	20%	64	3,511
336322 Other Motor Vehicle Electronic and Electronic Equipment	1,021	75,419	32%	329	24,302
Totals	3,495	156,354		885	44,943

Source: ERG estimates. See text.

9.2 COSTS OF CONTROLS

Engineering Controls: Based the technological feasibility analysis, estimated median exposure levels for all of the affected job categories were less than the lowest PEL option of 0.1 $\mu\text{g}/\text{m}^3$, and, therefore, no engineering controls are required to comply with the draft standard. Establishments using beryllium alloys would, however, be subject to certain program requirements.

Program Requirements: Table 9-4 shows the compliance costs for the program requirements for each of the four NAICS industries included in the spring manufacturing and

stamping sector. A complete explanation of the program cost estimation methodology and underlying assumptions is presented in Section 2.

Costs for the exposure assessment reflect the initial assessment only (as no workers are exposed above the action level at any of the option levels) and vary with the number of production workers in each industry. These costs range from \$23,333 to \$161,501 over the four industries comprising this sector and are invariate with the PEL option level. No costs are incurred for providing regulated areas, protective clothing, hygiene areas, or for medical surveillance as all at-risk worker initially have exposures well below the lowest PEL option level.

Costs for housekeeping are based on the number of affected workers in beryllium establishments in each industry and range from \$98,740 to \$1.9 million for all PEL option levels. Similarly, training costs, based on total employment, range from \$98,740 to \$1.8 million. Much lower costs are incurred for the written hazard control plan and for respiratory protection.

Over all four industries in this sector, program costs were estimated at \$5.1 million at the 1.0 $\mu\text{g}/\text{m}^3$ PEL level and rising to \$7.3 million at the 0.1 $\mu\text{g}/\text{m}^3$ PEL level.

Table 9-4
Program Costs
Spring Manufacturing and Stamping

NAICS	Item	PEL Options (micrograms per cubic meter)			
		1.0	0.5	0.2	0.1
NAICS 332612, Light Gauge Spring Manufacturing					
	Exposure Assessment	\$89,124	\$89,124	\$89,124	\$89,124
	Regulated Areas	\$0	\$0	\$0	\$0
	Written Plan	\$32,268	\$32,268	\$32,268	\$32,268
	Respiratory Protection	\$202,771	\$202,771	\$202,771	\$202,771
	Protective Clothing (reusable)	\$0	\$0	\$0	\$0
	Hygiene Areas	\$0	\$0	\$0	\$0
	Housekeeping	\$1,855,590	\$1,855,590	\$1,855,590	\$1,855,590
	Medical Surveillance	\$0	\$0	\$0	\$0
	Communication of Hazards	\$799,888	\$799,888	\$1,570,305	\$1,570,305
	Total for NAICS 332612	\$2,979,641	\$2,979,641	\$3,750,058	\$3,750,058
NAICS 332116, Metal Stamping					
	Exposure Assessment	\$24,715	\$24,715	\$24,715	\$24,715
	Regulated Areas	\$0	\$0	\$0	\$0
	Written Plan	\$2,464	\$2,464	\$2,464	\$2,464
	Respiratory Protection	\$15,482	\$15,482	\$15,482	\$15,482
	Protective Clothing (reusable)	\$0	\$0	\$0	\$0
	Hygiene Areas	\$0	\$0	\$0	\$0
	Housekeeping	\$141,678	\$141,678	\$141,678	\$141,678
	Medical Surveillance	\$0	\$0	\$0	\$0
	Communication of Hazards	\$192,640	\$192,640	\$376,604	\$376,604
	Total for NAICS 332116	\$376,978	\$376,978	\$560,943	\$560,943
NAICS 334417, Electronic Connector Manufacturing					
	Exposure Assessment	\$23,333	\$23,333	\$23,333	\$23,333
	Regulated Areas	\$0	\$0	\$0	\$0
	Written Plan	\$1,717	\$1,717	\$1,717	\$1,717
	Respiratory Protection	\$10,790	\$10,790	\$10,790	\$10,790
	Protective Clothing (reusable)	\$0	\$0	\$0	\$0
	Hygiene Areas	\$0	\$0	\$0	\$0
	Housekeeping	\$98,740	\$98,740	\$98,740	\$98,740
	Medical Surveillance	\$0	\$0	\$0	\$0
	Communication of Hazards	\$183,103	\$183,103	\$357,598	\$357,598
	Total for NAICS 334417	\$317,682	\$317,682	\$492,177	\$492,177
NAICS 336322, Other Motor Vehicle Electrical & Electronic Equipment					
	Exposure Assessment	\$161,501	\$161,501	\$161,501	\$161,501
	Regulated Areas	\$0	\$0	\$0	\$0
	Written Plan	\$1,343	\$1,343	\$1,343	\$1,343
	Respiratory Protection	\$8,441	\$8,441	\$8,441	\$8,441
	Protective Clothing (reusable)	\$0	\$0	\$0	\$0
	Hygiene Areas	\$0	\$0	\$0	\$0
	Housekeeping	\$77,241	\$77,241	\$77,241	\$77,241
	Medical Surveillance	\$0	\$0	\$0	\$0
	Communication of Hazards	\$1,151,351	\$1,151,351	\$2,248,701	\$2,248,701
	Total for NAICS 336322	\$1,399,876	\$1,399,876	\$2,497,227	\$2,497,227
Total program costs		\$5,074,178	\$5,074,178	\$7,300,404	\$7,300,404

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