XIX. DISC BRAKE PADS (LIGHT/MEDIUM VEHICLES)

A. Product Description

Disc brakes are used on the front wheels of virtually all (95 percent) light and medium vehicles (cars and light trucks) (GM 1986a). Approximately 5 percent of light/medium vehicles, certain luxury and high-performance cars (e.g., Cadillac Seville and El Dorado, Corvette, Pontiac STE and Fiero, high-performance Camaro and Firebird), have disc brakes on all four wheels (GM 1986a). A disc brake consists of a caliper to which are attached two steel plates, each lined with a molded friction material called a disc brake pad. The two disc brake pads straddle the rotor, or disc, that is in the center of a vehicle's wheel. Friction between the disc and the brake pad stops the vehicle when the brakes are applied (ICF 1985, Krusell and Cogley 1982).

Asbestos-based disc brake pads, like drum brake linings, are molded products containing asbestos fiber, fillers, additives, and resins. A dry-mix process is usually used in their manufacture; the basic steps in this process are as follows:

- Mixing of fibers, dry resins, and property modifiers;
- Molding and curing using heat and pressure; and
- Finishing by grinding and drilling.

The degree of automation of these steps may vary considerably among manufacturers, but once the finishing is completed, the pads are either bonded (glued) or riveted to the steel plates (ICF 1985, Krusell and Cogley 1982, Allied Automotive 1986).[1] The approximate asbestos fiber content per pad is 0.22 lbs. (ICF 1986a).[2]

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[1] While bonded brake pads have greater frictional surface, riveted pads are quieter (Allied Automotive 1986).

[2] See Attachment, Item 1.

Secondary processing of disc brake pads includes installation of pads into new brake assemblies, repackaging for sale to the aftermarket, and retrofitting worn brake pads with new pads for resale (ICF 1985, Krusell and Cogley 1982).

In addition to asbestos-based disc brake pads, there are semi-metallics. Semi-metallics pads have been in the domestic market for the last 15 years (Abex 1986). These pads are molded products containing chopped steel wool, sponge iron, graphite powder, fillers, and resins (Allied Automotive 1986, Ford 1986a). Some semi-metallic pads contain a very thin asbestos-containing backing, or underlayer, between the plate and pad. Other semi-metallic pads have no underlayer or have one made of a non-asbestos material. The underlayer acts as a thermal barrier between the pad and plate, and helps to bond the pad to the plate (Allied Automotive 1986). Producers generally do not consider semi-metallic pads with the asbestos underlayer to be asbestos pads since the lining itself contains no asbestos and the underlayer is only a very small percentage of the total content of the pad (Allied Automotive 1986).

Disc brake pads are used in the front of light/medium vehicles, whether rear-wheel or front-wheel drive, because of the heavier brake load or brake force in the front of vehicles (GM 1986a).[3] Disc brakes have higher performance than drum brakes, which are usually used in the rear, because they have longer service life and are generally more efficient at dissipating (GM 1986a). Front-wheel drive vehicles, which have greater brake load in the front (and, thus, generate more brake heat in the front) than rear-wheel drive vehicles, use semi-metallic disc brakes in the front, exclusively (Allied

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[3] In front-wheel drive cars the brake load is 85 percent in the front and in rear-wheel drive cars, about 70 percent of the load is in the front (Ford 1986a, Design News 1984).

Automotive 1986, Chilton's Motor Age 1986). Semi-metallic disc brakes perform better at higher temperatures than asbestos-based disc brakes and have a longer service life (Allied Automotive 1986, GM 1986a). Rear-wheel drive vehicles generally use asbestos-based disc brake pads in the front, though some also use semi-metallic front disc brakes (e.g., Ford Mustang) (Ford 1986b, GM 1986a). In general, at lower temperatures, asbestos-based disc brakes perform better than semi-metallics, and are quieter (GM 1986a, Allied Automotive 1986).

B. Producers and Importers of Disc Brake Pads (Light/Medium Vehicles)

Table 1 lists the fourteen 1985 primary processors of disc brake pads (asbestos and non-asbestos) for light/medium vehicles. Thirteen of the processors produced asbestos-based pads in 1985 and, currently, twelve are still producing. Twelve of the producers also produced a non-asbestos pad (Brake Systems 1986, ICF 1986a). Friction Division Products only produces non-asbestos pads (ICF 1986a).

Changes in primary processors from 1981 to 1985 include Friction Division Product's purchase of Thiokol's Trenton, NJ, plant and Brake Systems Inc.'s purchase of one of Raymark's Stratford, CT, plants (ICF 1986a, Brake Systems 1986). Brassbestos of Paterson, NJ, went out of business in August, 1985 (ICF 1986a). H.K. Porter of Huntington, IN (not listed in Table 1), stopped producing disc brake pads altogether prior to 1985 (ICF 1986a).

Table 2 lists the 1985 secondary processors of disc brake pads. The Standard Motor Products plant, formerly owned by the EIS Division of Parker-Hannifin, no longer is involved in secondary processing of asbestos-based pads

Table 1. 1985 Primary Processors of Disc Brake Pads
(Light and Medium Vehicles)

Company	Plant Location(s)	Product		References
		Asbestos	Non-Asbestos	
Brake Systems Inc. (Division of Echlin) (plant formerly owned by Raymark)	Stratford, CT	X	X	Brake Systems 1986, TSCA 1982a
Delco Moraine Division, General Motors	Dayton, OH	X	X	GM 1986a, TSCA 1982a
Abex	Winchester, VA	X	X	Abex 1986, TSCA 1982a
Allied Automotive	Green Island, NY Cleveland, TN	X X	X X	Allied Automotive 1986, TSCA 1982a
Nuturn	Smithville, TN	X	X	ICF 1986a, TSCA 1982a
Auto Specialties Manufacturing Company	St. Joseph, MI	X	X	ICF 1986a, TSCA 1982a
LSI-Certified Brakes (Division of Lear-Siegler)	Danville, KY	X	X	ICF 1986a, TSCA 1982a
Brassbestos	Paterson, NJ	X[a]		ICF 1986a, TSCA 1982a
Friction Division Products (plant formerly owned by Thiokol)	Trenton, NJ		X	ICF 1986a, TSCA 1982a
U.S. Automotive Manufacturing	Tappahannock, VA	X		ICF 1986a, TSCA 1982a
Virginia Friction Products	Walkerton, VA	X	X	ICF 1986a, TSCA 1982a
H. Krasne Manufacturing	Los Angeles, CA	X	X	ICF 1986a, TSCA 1982a
Chrysler	Wayne, MI	X	X	ICF 1986a, TSCA 1982a
Auto Friction Corp.	Lawrence, MA	X	X	ICF 1986a, TSCA 1982a

[a]Brassbestos went out of business in August 1985. However, it is assumed that they produced asbestos-based disc brake pads in 1985.

Table 2. 1985 Secondary Processors of Disc Brakes Pads
(Light and Medium Vehicles)

Company	Plant Location	Product		References
		Asbestos	Non-Asbestos	
Standard Motor Products (plants formerly owned by EIS Division of Parker-Hannifin)	West Bend, WI		N/A	ICF 1986b, TSCA 1982b
Wagner	Parsippany, NJ	X	N/A	ICF 1986b, ICF 1985
Cali-Blok (EIS Division of Parker-Hannifin)	Gardena, CA	X	X	ICF 1986b, TSCA 1982b

N/A: Information not available.

Table 4. Production and Fiber Consumption for Asbestos-Based Disc Brake Pads (Light and Medium Vehicles)

	1981	1985	Percent Change (%)	References
Production (pieces)	94,409,007	65,869,172[a]	-30.2	ICF 1986a, TSCA 1982a
Asbestos Fiber Consumption (tons)	9,525.9	7,119.2[b]	-25.3	ICF 1986a, TSCA 1982a

[a]Allied Automotive, Abex, Brassbestos, and Brake Systems Inc. did not provide 1985 asbestos disc brake pad production data. Their production was estimated using a method described in the Appendix A of this RIA.

[b]Abex, Brassbestos, and Brake Systems Inc. did not provide 1985 fiber consumption data. Their fiber consumption was estimated using a method described in the Appendix A of this RIA.

completely replaced in the OEM.[6] Although asbestos is still contained in the underlayer of some semi-metallic pads, the trend is, also, towards complete replacement.[7]

D. Substitutes

Semi-metallics are the only major substitute for asbestos-based disc brake pads (light/medium vehicles). GM, Ford, and Chrysler indicated that essentially all of their non-asbestos disc brake pads were semi-metallic (GM 1986a, Ford 1986b, Chrysler 1986). Nine of the fourteen producers of disc brake pads make a semi-metallic product: Allied Automotive, Nuturn, Friction Division Products, GM, Virginia Friction Products, H. Krasne Manufacturing Co., Chrysler, Abex, and LSI-Certified Brakes (ICF 1986a, Allied Automotive 1986, Abex 1986). Nuturn and Virginia Friction Products stated that Kevlar was also contained in their semi-metallic pads (ICF 1986a). A representative from GM stated that non-semi-metallic non-asbestos pads had a very small share of the OEM (GM 1986a). The other class of non-semi-metallic substitute pads are the non-asbestos organic (NAO) pads. Two producers, Brake Systems Inc. and Auto Friction Corp., were found to make these pads, but neither indicated whether they produced them in sizeable quantities (ICF 1986a).

As indicated earlier, asbestos holds only 15 percent of OEM disc brake pads (light/medium vehicles). Thus, the balance of 85 percent is nearly all semi-metallics (Allied Automotive 1986). Given the trend towards 100 percent front-wheel drive light/medium vehicles, it is clear that semi-metallics will replace most if not all asbestos pads in the near future (Chilton's Motor Age 1986, Allied Automotive 1986).

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[6] See Attachment, Item 2, for the current trends of GM, Ford, and Chrysler.

[7] See Attachment, Item 3.

Substitutes for the thin asbestos underlayer in some semi-metallic pads include either no underlayer or a chopped fiberglass or Kevlar(R) underlayer, depending upon the application (Allied Automotive 1986). Allied Automotive stated that the substitutes for the asbestos underlayer performed just as well (Allied Automotive 1986).

Replacement of asbestos pads with substitutes in the aftermarket, however, is much more difficult. Most producers and users agreed that brake systems designed for asbestos pads should continue to use asbestos. Semi-metallic pads which were designed for the OEM, when used to replace worn asbestos pads, do not perform as well as asbestos, and could jeopardize brake safety (Allied Automotive 1986, GM 1986b, Wagner 1986b, Ford 1986c). A much higher percentage of vehicles in the aftermarket, furthermore, are rear-wheel drive, most of which were designed to have asbestos front disc brakes (Chilton's Motor Age 1986).

In general, there are three important reasons for little or no development of substitutes engineered for aftermarket brake systems that were designed for asbestos:

- Considerable technical difficulties with developing adequate substitutes for a system designed specifically for asbestos;
- No federal safety and performance standards for brakes for the aftermarket;[8] and,
- High cost of producing and testing substitute formulations (Allied Automotive 1986, GM 1986c, Ford 1986a, Ford 1986b, Wagner 1986b, Abex 1986).

Aftermarket producers, except for those who also produce for the OEM, are generally small and almost totally lacking in testing equipment (Ford 1986a). If any of these firms devoted substantial resources to testing

[8] By contrast, OEM brakes must meet certain regulatory standards, Federal Motor Vehicle Safety Standards (FMVSS) 105 and 121 (and, in the future, the proposed 135) (Ford 1986a, Abex 1986).

and research and development, they would be out of business (Ford 1986a, Abex 1986). As long as there are asbestos disc brakes sold in the aftermarket, there will be little, if any, economic incentive to develop retrofit substitutes (LBJ Space Center 1986). However, even with a ban on asbestos pads for the aftermarket, the cost of substitutes designed for the aftermarket are likely to be prohibitive, given the technical difficulties (LBJ Space Center 1986).

Table 5 provides the data for the regulatory cost model. The substitute is the semi-metallic disc brake pad. Price and performance data were not available for NAO pads either because companies would not provide information or production was in very limited quantities (ICF 1986a). It is assumed, however, that NAO pads would account for a negligible share of the market. Note that the equivalent price of the semi-metallic pad is slightly less than the asbestos pad price because of the significantly longer service life.

E. Summary

Disc brakes are used on the front wheels of virtually all (95 percent) light and medium vehicles (cars and light trucks). Approximately 5 percent of all light/medium vehicles have disc brakes on all four wheels (GM 1986a). Thirteen companies consumed 7,119.2 tons of asbestos to produce 65,869,172 asbestos disc brake pads in 1985. Twelve companies are still producing. Between 1981 and 1985, production of asbestos disc brake pads declined approximately 30 percent (ICF 1986a, TSCA 1982a). Currently, asbestos only comprises 15 percent of the OEM for disc brake pads; the balance of 85 percent is held by semi-metallics (Allied Automotive 1986). If asbestos were no longer available it is predicted that semi-metallics would take 100 percent of the asbestos market. The

Table 5. Data Inputs on Disc Brake Pads (LMV) for Asbestos Regulatory Cost Model[a]

Product	Output	Product Asbestos Coefficient	Consumption Production Ratio	Price	Useful Life	Equivalent Price	Market Share	Reference
Asbestos Mixture	65,869,172 pieces[b]	0.00011 tons/piece	1.19	$0.42/piece	4 years	$0.42/piece	N/A	ICF 1986a, ICF 1985
Semi-Metallic	N/A	N/A	N/A	$0.67/piece	7.4 years	$0.40/piece	100%	ICF 1986a, H. Krasne 1986, Cali-Blok 1986

N/A: Not Applicable.

[a] See Attachment, Items 4-6.

[b] The output for disc brake pads (light and medium motor vehicles) is split into OEM brakes (10,077,464 pieces) and aftermarket brakes (55,791,708 pieces) based on the ratio of OEM and replacement sales shown in Appendix A.

equivalent price of semi-metallic disc brake pads is slightly less than the price of asbestos disc brake pads (ICF 1986a).

<u>ATTACHMENT</u>

1. The asbestos fiber content per pad was calculated by dividing the 1985 asbestos fiber consumption for disc brake pads by the 1985 production for producers for which both fiber consumption and production were available: 7,119.2 tons (14,238,400 lbs.) divided by 65,869,172 pieces, or 0.22 lbs. per piece.

2. GM, Ford, and Chrysler, the three largest U.S. automakers, and thus, probably the three largest consumers of OEM disc brake pads for light/ medium vehicles, were asked for the share asbestos held in their OEM pads. One company stated that currently only 5 percent of the OEM pads it consumes were asbestos-based. The second company stated in its 1986 model year the share was 6.9 percent, and projected it to be 3.9 percent in the 1987 model year. The third company stated asbestos held 40 percent of its OEM pads in the 1986 model year, but projected the share to be 10 percent in the 1987 model year (Ford 1986b). An editor from <u>Chilton's Motor Age</u>, an important trade publication, stated that currently 75 percent of domestic OEM light/medium vehicles were front-wheel drive (Chilton's Motor Age 1986). Because front-wheel drive vehicles use semi-metallic pads, the asbestos share of OEM pads could not be more than 25 percent, and probably somewhat less, given the fact that some rear-wheel drive cars use semi-metallic pads (e.g., Ford Mustang) (Chilton's Motor Age 1986). A large producer of asbestos-based pads in 1981 and a major supplier of materials for friction products both agree that the asbestos share of OEM pads for light/medium vehicles is 15 percent. Therefore, 15 percent would be a good estimate for the current share.

3. A large producer of semi-metallic pads, stated that in the 1986 vehicle model year, 50 percent of both its OEM and aftermarket semi-metallic pads contained an asbestos underlayer, but by January 1987, 90 percent of both its OEM and aftermarket pads would use either no underlayer or one made of a non-asbestos material. An automobile manufacturer stated that in its 1986 model year, 12.7 percent of its semi-metallic pads contained an asbestos underlayer, all of which were purchased from a single source. The rest of its pads contained no underlayer at all. The second automobile manufacturer estimated the OEM share that contained an asbestos underlayer to be currently 10 percent. The third automobile manufacturer stated that in the 1986 model year, 99.65 percent of its semi-metallic pads had an asbestos underlayer, and the share would be 91.75 percent in the 1987 model year. Nonetheless, the overall trend is towards complete replacement.

4. The product asbestos coefficient is the same value calculated in Item 1 above, converted into tons per piece.

5. The consumption production ratio was calculated using 12,589,555 pieces as the value for the 1985 U.S. imports. (Total 1985 production is 65,898,172 pieces.) This value, however, only includes imports for the firms who provided information (see Table 4).

6. The asbestos product price is a weighted average (by production) of prices for producers who provided information. The useful life of the asbestos product was assumed to be the same as that reported in 1984 in Appendix H (ICF 1985). The price of the semi-metallic pad was computed by increasing the weighted average asbestos product price by what GM stated was the percentage price increase of its semi-metallic product over its asbestos product (60.2 percent). The useful life of the semi-metallic pad was computed by taking the average of what two companies stated to be the percent increase in useful life of their semi-metallic pads over their asbestos pads (the straight average of 100 percent and 71 percent, or 85.5 percent), and then increasing the useful life of the asbestos product (given in Appendix H) by this value (85.5 percent) (ICF 1986a, 1986b). (Note: GM did not provide information on the useful life.)

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XX. DISC BRAKE PADS (HEAVY VEHICLES)

A. Product Description

Disc brake pads (both asbestos and non-asbestos) for heavy vehicles are a small and relatively new market (Allied Automotive 1986, Carlisle 1986). Although disc brake pads were small percentage of heavy vehicle brakes in the past, these systems are increasingly common for these vehicles. Except for the larger size, the pads are similar to those described for light and medium vehicles (Allied Automotive 1986). Disc brake pads for heavy vehicles, to date, are only used on the front wheels of certain intermediate-sized trucks (12,000-22,000 lbs. per axle) (Allied Automotive 1986). One producer, Allied Automotive, stated that disc brakes could never be used for the heaviest trucks, while another producer, Carlisle, indicated that, in perhaps five years, disc brakes will be developed for large trucks such as tractor trailers (Allied Automotive 1986, Carlisle 1986).

Although non-asbestos semi-metallic pads have nearly always been used for disc brakes for heavy vehicles in small proportions (Allied Automotive 1986, Carlisle 1986), in the past, asbestos-based pads were used to a greater extent. Asbestos disc brakes for heavy vehicles are now apparently only used to replace worn asbestos pads in the aftermarket (ICF 1986a, ICF 1985, Allied Automotive 1986, Carlisle 1986). The switch to semi-metallic pads from asbestos pads is due to the high braking temperatures generated in this vehicle application; semi-metallic pads, in general, have superior performance and service life at high temperatures (Allied Automotive 1986).

Semi-metallic pads are molded products containing chopped steel wool, sponge iron, graphite powder, fillers, and resins (Allied Automotive 1986, Ford 1986). Some semi-metallic pads for heavy vehicles may contain a very thin asbestos-containing backing, or underlayer, between the pad and the steel plate to which it is attached.[1] Other semi-metallic pads have no underlayer or have one made of chopped Kevlar or fiberglass (Allied Automotive 1986). The underlayer acts as a thermal barrier between the pad and plate and helps to bond the pad to the plate (Allied Automotive 1986). Producers generally do not consider semi-metallic pads with asbestos underlayers to be asbestos pads since the lining itself contains no asbestos and the underlayer accounts for only a very small percentage of the total content of the pad (Allied Automotive 1986).

Primary and secondary processing of asbestos-based pads is the same as that described for light and medium vehicles. According to Carlisle, the approximate asbestos fiber content per pad is 1.5 lbs. (ICF 1986a).

B. Producers and Importers of Disc Brake Pads (Heavy Vehicles)

Table 1 lists the four producers of (asbestos and non-asbestos) disc brake pads for heavy vehicles in 1985. Carlisle, and possibly Allied Automotive, produced asbestos-based pads in 1985. However, an Allied Automotive representative stated that the firm currently manufactures only semi-metallic pads (Allied Automotive 1986). Brake Systems and Raymark, only manufacture semi-metallic pads (Brake Systems 1986, ICF 1986a, Design News 1984).

Table 2 lists the sole secondary processor of disc brake pads for heavy vehicles in 1985. The firm, Hall Brake Supply, was also the only secondary processor in 1981 (TSCA 1982b). The pads produced by the firm are all asbestos-based (ICF 1986b).

There were no importers of asbestos disc brake pads for heavy vehicles in 1985 (ICF 1986a).

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[1] Information is not available on the percentage of semi-metallic pads that possibly contain an asbestos underlayer. Brake Systems, Inc. makes semi-metallic disc brake pads for heavy vehicles with an asbestos underlayer (Brake Systems 1986). Information was not available for the other producers.

Table 1. 1985 Primary Processors of Disc Brake Pads
(Heavy Vehicles)

Company	Plant Location	Product		References
		Asbestos	Non-Asbestos	
Carlisle, Motion Control Industries Division	Ridgway, PA	X	X	ICF 1986a, TSCA 1982a
Allied Automotive	Green Island, NY	N/A[a]	X	Allied Automotive 1986, TSCA 1982a
Brake Systems	Stratford, CT		X[b]	Brake Systems 1986
Raymark	N/A[c]		X	Design News 1984

N/A = Information not available.

[a] Allied Automotive refused to respond to our survey. It was assumed that they produced asbestos-based disc brake pads in 1985, however they currently only produce semi-metallic pads (Allied Automotive 1986).

[b] Brake Systems produces semi-metallic pads with a very small asbestos underlayer; this is not considered an asbestos disc brake pad (Brake Systems 1986).

[c] Raymark, itself, did not provide information on its disc brake pad production. They only produce semi-metallic pads (ICF 1986a, Design News 1984).

Table 2. 1985 Secondary Processors of Disc Brake Pads
(Heavy Vehicles)

Company	Plant Location	Product		References
		Asbestos	Non-Asbestos	
Hall Brake Supply	Phoenix, AZ	X		ICF 1986b, TSCA 1982b

C. Trends

Table 3 gives the production of asbestos-based disc brake pads for heavy vehicles and the corresponding consumption of asbestos fiber.

As previously mentioned, there were no importers of asbestos-based disc brake pads for heavy vehicles in 1985 (ICF 1986a). Hall Brake Supply was the sole importer in 1981. (ICF 1984).

According to Carlisle, the market for heavy-vehicle disc brakes is growing. The firm predicts that the switch to front disc brakes that occurred in cars and light trucks will also happen in intermediate- and large-sized trucks (Carlisle 1986).

D. Substitutes

According to Allied Automotive and Carlisle, 100 percent of the original equipment market (OEM) and most of the aftermarket is held by the semi-metallic pads (Allied Automotive 1986, Carlisle 1986). It is assumed that the 100 percent of the aftermarket will also become semi-metallic as aftermarket vehicles are scrapped and/or switch over to semi-metallic pads.[2]

Table 4 provides data inputs for the regulatory cost model.

E. Summary

Asbestos disc brake pads for heavy vehicles are used only on the front wheels of certain intermediate-sized trucks (12,000-22,000 lbs. per axle) (Allied Automotive 1986). Two producers, in 1985, consumed 117.6 tons of asbestos to produce 156,280 disc brake pads (heavy vehicles). Only one, Carlisle-Motion Control Industries, currently produces the asbestos disc brake pad for heavy vehicles (Allied Automotive 1986, Carlisle 1986, ICF 1986a).

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[2] Allied Automotive also reports that non-asbestos underlayers, which are made of either chopped fiberglass or Kevlar(R), perform just as well as asbestos underlayers (Allied Automotive 1986).

Table 3. Production and Fiber Consumption for Asbestos-Based Disc Brake Pads (Heavy Vehicles)

	1981		1985		
	Production (pieces)	Asbestos Fiber Consumption (tons)	Production (pieces)	Asbestos Fiber Consumption (tons)	References
Total	385,496	44.6	156,820[a]	117.6[a]	ICF 1986a, TSCA 1982a

[a]One company refused to provide production and fiber consumption data for their asbestos-based disc pads (heavy vehicles). Its production and fiber consumption have been estimated using a method described in Appendix A of this RIA.

Table 4. Data Inputs on Disc Brake Pads (HV) for Asbestos Regulatory Cost Model[a]

Product	Output	Product Asbestos Coefficient	Consumption Production Ratio	Price	Useful Life	Equivalent Price	Market Share	References
Asbestos Mixture	156,820 pieces	0.00075 tons/piece	1.0	$10.00/piece	0.5 years	$10.00/piece	N/A	ICF 1986a, ICF 1985, Carlisle 1986
Semi-Metallic	N/A	N/A	N/A	$12.50/piece	0.75 years	$8.40/piece	100%	Allied Automotive 1986, Carlisle 1986

N/A: Not Applicable.

[a]See Attachment, Items 1-2.

Asbestos-based pads are now only used to replace worn asbestos pads in the aftermarket. For OEM, semi-metallic pads are used rather than asbestos pads because of the high braking temperatures generated in this application. If asbestos were no longer available, it is estimated that 100 percent of the aftermarket would become semi-metallic. Semi-metallic disc brake pads (heavy vehicles) cost approximately 20 percent less than asbestos disc brake pads for heavy vehicles.

ATTACHMENT

1. The product asbestos coefficient, as well as the asbestos and semi-metallic pad prices were provided by Carlisle.

2. The useful life of the asbestos pad was assumed to be the same as that reported in 1984 in Appendix H (ICF 1985). Carlisle stated that semi-metallic pads have 50 percent longer service life than asbestos pads; thus, the useful life of the semi-metallic pad given in the table is 1.5 times the asbestos pad life.

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XXI. BRAKE BLOCKS

A. Product Description

Brake blocks are brake linings used on the drum brakes of heavy vehicles -- heavy trucks, buses, and heavy off-road vehicles.[1] The comparable components on light/medium vehicles (cars and light trucks) are drum brake linings, which are discussed in Section XVIII. The heavy-vehicle drum brake consists of two curved metal "shoes" to which brake blocks are attached. When the brakes are applied, the curved shoes are pressed out against a metal drum that is connected to the wheels of the vehicle.[2] The pressure of the shoes against the drum stops the turning of the wheels (ICF 1985).

Each shoe has two blocks, a longer one (the anchor) and a shorter one (the cam), resulting in a total of four blocks per wheel. Each block is at least three-quarters of an inch thick and covers 50° to 60° of the arc around the wheel (Allied Automotive 1986, ICF 1985).

Asbestos-based brake blocks contain approximately 1.16 lbs.[3] of asbestos fiber per block on average (ICF 1986a). Asbestos is used because of its thermal stability, reinforcing properties, flexibility, resistance to wear, and relatively low cost (Krusell and Cogley 1982).

Brake blocks are usually manufactured by a dry mix process in which asbestos fiber is combined with a powdered binder (usually an epoxy novolac resin) to form briquets under pressure of 1,500 to 2,500 psi and temperature

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[1] Heavy trucks range from moderately heavy, 12-22,000 lbs. per axle, to very heavy, i.e., tractor trailers and logging and mining trucks (Allied Automotive 1986). Examples of heavy off-road vehicles include agricultural tractors and earth-moving equipment.

[2] Drum brakes for heavy vehicles are either air- or hydraulic-activated, depending upon the application. Tractor trailers, for example, would always use air brakes, while medium-sized trucks would normally use hydraulic brakes (Allied Automotive 1986).

[3] See Attachment, Item 1.

of 1985°F.[4] The briquets are then formed into blocks at 265°F to 300°F under additional pressure (2,000 to 3,000 psi) for 10 to 30 minutes. The blocks are then cut and ground to shape. After curing, grinding, drilling, and chamfering (cutting grooves), the block is finished (ICF 1985). The finished block is then riveted to the brake shoe (Allied Automotive 1986).

Secondary processing of brake blocks is similar to that of drum brake linings. Some processors install new brake blocks into brake assemblies for new vehicles. Others may repackage blocks for sale as replacement parts in the aftermarket. None of these secondary processes involve any grinding, drilling, or other treatment of the brake block. Another distinct type of secondary processing is brake rebuilding. Rebuilders receive used, worn blocks attached to the shoes. The old blocks are removed from the shoes, the shoes are cleaned by abrasion, and new blocks are attached. The rebuilt shoes with blocks are then packaged and sold for the aftermarket (ICF 1985, Krusell and Cogley 1982).

B. <u>Producers and Importers of Brake Blocks</u>

Table 1 lists the twelve primary processors of brake blocks in 1985. At least eight of these firms produced an asbestos-based product; Raymark did not provide information. Allied Automotive is a relatively small manufacturer of brake blocks, producing only for the severe braking applications segment of the market (i.e., logging and mining trucks) (Allied Automotive 1986). At least eleven of the processors also currently produce substitute products (ICF 1986a, Design News 1984).

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[4] Brake blocks may also be woven from asbestos yarn; however, the woven block is an older and far less common technology (Carlisle 1986a). Raymark and Standco Industries are, apparently, the only two producers who still make woven brake blocks (ICF 1986a).

Table 1. 1985 Primary Processors of Brake Blocks

Company	Plant Location(s)	Product		References
		Asbestos	Non-Asbestos	
Carlisle, Motion Control Industries Division	Ridgway, PA	X	X	ICF 1986a, TSCA 1982a
Abex	Salisbury, NC Winchester, VA	X X	X X	Abex 1986, TSCA 1982a
Nuturn	New Castle, IN	X	X	ICF 1986a, TSCA 1982a
Allied Automotive	Cleveland, TN	X	X	Allied Automotive 1986, TSCA 1982a
Raymark	Crawfordsville, IN	N/A[a]	X	Design News 1984, TSCA 1982a
Standco Industries	Houston, TX	X		ICF 1986a, TSCA 1982a
H.K. Porter	Huntington, IN	X[b]	X	ICF 1986a, TSCA 1982a
Brake Systems Inc. (Division of Echlin) (plant formerly owned by Molded Industrial Friction Co.)	Prattville, AL		X	ICF 1986a, TSCA 1982a
Palmer Products Corp.	Louisville, KY	X	X	ICF 1986a, TSCA 1982a
Friction Products	Medina, OH		X	Friction Products 1986
Scan Pac	Menomonee Falls, WI		X	ICF 1986a, TSCA 1982a
Wheeling Brake Block	Bridgeport, CT	X[c]	X	ICF 1986a, ICF 1985

N/A = Information not available.

[a]Raymark refused to provide production information. However, it was assumed that they produced asbestos brake blocks in 1985.

[b]H.K. Porter stated that it would phase out its production of asbestos brake blocks by the end of 1986 (PEI Associates 1986).

[c]Wheeling Brake Block of Bridgeport, CT phased out its production of asbestos brake blocks in 1985 (Wheeling Brake Block 1986).

Changes in primary processors from 1981 to 1985 include Brake Systems Inc.'s purchase of Molded Industrial Friction Co.'s plant in Prattville, AL. The Brake Systems plant phased out asbestos-based blocks prior to 1985, and now produces only a non-asbestos product (ICF 1986a). Wheeling Brake Block of Bridgeport, CT, phased out its asbestos-based brake block operations in 1986. The firm currently manufactures a non-asbestos product (Wheeling Brake Block 1986). H.K. Porter stated it would phase out production of asbestos-based blocks by the end of 1986 (PEI Associates 1986).

Table 2 lists the three current secondary processors of brake blocks. Freightliner Corporation of Portland, OR, is essentially Mercedes-Benz's U.S. truck operations (Freightliner 1986). Information was not available on the type of secondary processing in which these firms were involved.

Table 3 lists the importers of asbestos-based brake blocks. There were four importers in 1981. Hall Brake Supply, one of the 1981 importers, did not import in 1985. Navistar International and Abex did not provide information on their imports, therefore the total 1985 imports could not be determined.

C. Trends

Table 4 gives the production of asbestos-based brake blocks and the corresponding consumption of asbestos fiber. Although, producers and purchasers of brake blocks did not provide current market shares, they indicated that the majority of the original equipment market (OEM) and aftermarket is probably still asbestos-based (Abex 1986, Ford 1986a, DuPont

Table 2. 1985 Secondary Processors of Brake Blocks

Company	Plant Location	Product		References
		Asbestos	Non-Asbestos	
Hall Brake Supply	Phoenix, AZ	X	N/A	ICF 1986b, TSCA 1982b
FMC Corporation	Cedar Rapids, IA	X		ICF 1986b, TSCA 1982b
Freightliner Corporation	Portland, OR	X	N/A	ICF 1986b, TSCA 1982b

N/A = Information not available.

Table 3. Imports of Asbestos-Based Brake Blocks

	1981 Quantity Imported (pieces)	1985 Quantity Imported (pieces)	References
Total	182,809	N/A	ICF 1984

N/A = Information not available.

Table 4. Production and Fiber Consumption for Asbestos-Based Brake Blocks

	1981	1985	References
Production (pieces)	18,457,840	4,570,266[a]	ICF 1986a, TSCA 1982a
Asbestos Fiber Consumption (tons)	12,992.5	2,643.6[b]	ICF 1986a, TSCA 1982a

[a]Allied Automotive, Abex, Raymark, and Wheeling Brake Block refused to provide production data for their asbestos-based brake blocks. Data on production for Allied Automotive, Abex and Raymark was estimated using a method described in the Appendix A to this RIA. Data for Wheeling Brake Block is not included. They did not make asbestos brake blocks in 1981 and they have stopped production of asbestos brake blocks in 1986. We, therefore, assume that their 1985 production is small.

[b]Abex, Raymark, and Wheeling Brake Block refused to provide fiber consumption data for their asbestos-based brake blocks. Data on fiber consumption for Abex and Raymark was estimated using a method described in the Appendix A to this RIA. Data for Wheeling Brake Block is not included. They did not make the asbestos product in 1981 and they have stopped production in 1986. Therefore, we assume their 1985 fiber consumption is small.

1986).[5] Representatives from Ford and Abex agreed that good substitutes have been developed for a range of brake block applications; however, some heavy truck and heavy vehicle applications (which they did not specify) do not yet have substitutes (Ford 1986a, Abex 1986). Ford also indicated that while substitutes have been developed, many may not be near the point of large-scale commercial production (Ford 1986a). DuPont, a major supplier of materials for friction products, e.g., Kevlar(R), estimated that currently 75 percent of OEM brake blocks are still asbestos-based (DuPont 1986). Thus, 75 percent is assumed to be the asbestos-based OEM share, as it is the only available figure and it is not out of line with the comments of Ford and Abex. All firms, however, agreed that substantial progress is being made towards the replacement of asbestos blocks in the OEM (Abex 1986, Ford 1986a, DuPont 1986).

D. Substitutes

For the vast majority of applications, i.e. heavy trucks and off-road vehicles, excluding the super-heavy applications (logging and mining trucks), the major group of substitutes are the non-asbestos organics (NAOs) (Carlisle 1986a, DuPont 1986, Allied Automotive 1986). In fact, 65 percent of Nuturn's brake block production is currently NAO blocks (ICF 1986a). The major substitute for the super-heavy braking applications (logging and mining trucks), which represent a very small share of the total market, is the full-metallic block (Carlisle 1986a, Allied Automotive 1986).

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[5] 100 percent of railroad car brake blocks are non-asbestos (Ford 1986a, Abex 1986); and probably 100 percent of aircraft brake blocks are also non-asbestos (Krusell and Cogley 1982). These types of brake blocks have been non-asbestos for the last several years, and it is likely that asbestos-based blocks were never used to any great extent (if at all) for these markets (Krusell and Cogley 1982). Therefore, for the purposes of defining the asbestos-based brake block market, railroad car and aircraft brake blocks will be excluded.

NAO formulations generally contain the following ingredients: Kevlar(R) and/or fiberglass and/or mineral fibers,[6] perhaps some steel wool and/or other fibers, and fillers and resins (ICF 1986a). Fiberglass and Kevlar(R) usually account for only a small percentage of the total formulation. For example, a representative from DuPont stated that the optimal level of Kevlar(R) in brake block formulations is usually only 5 percent by weight (DuPont 1986). Thus, labelling substitute brake blocks as Kevlar(R)-based or fiberglass-based (producers tend to do this for marketing reasons) is misleading (Carlisle 1986b, Abex 1986, Ford 1986a). Of the twelve primary processors of brake blocks in 1985, at least eight currently produce NAO blocks. These firms are: Carlisle, Abex, Nuturn, H.K. Porter, Brake Systems Inc., Palmer Products, Scan Pac, and Wheeling Brake Block (Abex 1986, Wheeling Brake Block 1986, ICF 1986a).[7]

Producers generally agree that NAO brake blocks have the same or better performance than asbestos-based blocks, as well as improved service life (ICF 1986a, Allied Automotive 1986, Carlisle 1986a). A representative from Carlisle, the largest producer of brake blocks in 1981 (with approximately 36.6 percent of the market), stated that, on average, NAO blocks had 30 percent greater service life than asbestos blocks. (Nuturn, another major producer, claimed its NAO blocks had 100 percent greater service life (ICF 1986a).) NAO blocks are priced 30-50 percent higher than asbestos blocks, according to Carlisle (Carlisle 1986a).

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[6] Mineral fibers commonly used by producers include: wollastonite, phosphate fiber, aluminum silicate fiber, Franklin fiber, mineral wool, and PMF (processed mineral fiber) (ICF 1986a).

[7] Raymark did not provide information; Allied Automotive is in the process of developing a non-asbestos, non-full-metallic block (Allied Automotive 1986).

Full-metallic blocks are molded from sintered steel wool and sponge iron, and contain no resin (Ford 1986a). Producers of full-metallic blocks include Allied Automotive and Wheeling Brake Block (Allied Automotive 1986, Wheeling Brake Block 1986).[8] Allied Automotive stated that these substitutes had improved performance over asbestos for extremely high temperature ranges (Allied Automotive 1986). By contrast, Wheeling Brake Block, which manufactures full-metallic blocks in only limited quantities, stated that in the past its product generally had poor performance compared to asbestos blocks, however they have been improving this product recently (Wheeling Brake Block 1986, 1987). Allied Automotive indicated that the full-metallic blocks have up to two times longer service life than asbestos blocks, while Wheeling Brake Block felt their product had the same life as asbestos blocks (Allied Automotive 1987, Wheeling Brake Block 1987). Carlisle, which used to make the full-metallic brake block, but no longer does so, also stated that full-metallics had about the same life as asbestos brake blocks (Carlisle 1987). For the purposes of the asbestos regulatory cost model the useful life of the full metallic brake block has been assumed to be the same as for the asbestos block.[9]

Full-metallic brake blocks on average are 20 percent more expensive per component than asbestos brake blocks, assuming the useful lives are the same. The computation for the price of the full metallic brake block price does include an adjustment for the longer life of Allied Automotive's product.[10]

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[8] S.K. Wellman of Toronto, Ontario, Canada also produces a full-metallic brake block. They are specialty items, however, and are not carried in stock (S.K. Wellman 1987).

[9] See Attachment, Item 4.

[10] See Attachment, Item 4.

A potential substitute for brake blocks in the future may be carbon fiber and carbon/carbon fiber composite brake blocks (Ashland Petroleum 1986). Up to the present time, carbon fiber and carbon/carbon fiber composite blocks have been so expensive that they have only been used in very demanding applications such as high-performance military aircraft and large commercial airline applications (Ashland Petroleum 1986). These carbon-based blocks are used because of their high thermal stability and low weight (Krusell and Cogley 1982). The Ashland Carbon Fibers Division of Ashland Petroleum, however, has recently developed a low cost carbon fiber and carbon pitch product (which is used in combination with the carbon fiber for the carbon/carbon fiber composite) for use in carbon-based brake blocks. The firm believes that carbon blocks will now be manufactured more widely for the commercial and industrial brake block markets (Ashland Petroleum 1986).

Given the current OEM market shares, however, it is clear that in the near-term NAO brake blocks will capture the majority of the asbestos-based OEM in the event of a ban (Carlisle 1986a, Allied Automotive 1986). A representative from Carlisle stated that 75-80 percent of the OEM would likely be NAO blocks, with only 0.5 percent being full-metallic; the balance being substitutes not yet developed (Carlisle 1986a).[11]

Choice of replacement of asbestos-based brake blocks in the aftermarket, however, is more difficult to estimate. Many producers and users agreed that brake systems designed for asbestos brake blocks should continue to use asbestos. Substitute linings which were designed for the OEM, when used to replace worn blocks, do not perform as well as asbestos, and could jeopardize brake safety (Allied Automotive 1986, Ford 1986b). Abex, however, indicated

[11] Until other replacements can be found for the remaining 19.5-24.5 percent of asbestos-based applications, it is assumed for the present that the NAO substitute will replace 99.5 percent of the asbestos market if asbestos were no longer available. See Attachment, Item 5.

that it is selling its OEM non-asbestos-organic blocks for the aftermarket, and reports that they are performing well (Abex 1986). Given this evidence, we have concluded that the aftermarket shares would be identical to the OEM shares.

Table 5 provides data for the regulatory cost model. The substitutes are the NAO and full-metallic blocks. Note that the equivalent price of the NAO block given in the table is close to the asbestos block price because of the longer service life.

E. Summary

Brake blocks are brake linings used in drum brakes of heavy vehicles such as heavy trucks, buses, and heavy off-road vehicles (ICF 1985). There were nine producers of asbestos-based brake blocks in 1985. These companies consumed 2,643.6 tons of asbestos and produced 4,570,266 pieces of brake blocks. Since 1985, H.K. Porter and Wheeling Brake Block have stopped processing asbestos. This leaves seven current producers of asbestos brake blocks (ICF 1986a).

A majority of the OEM (about 75 percent) and the aftermarket is still asbestos-based (Abex 1986, Ford 1986a, DuPont 1986). The major group of substitutes for most applications are the non-asbestos organics (NAOs). It is projected that they would capture 99.5 percent of the asbestos brake block market if asbestos were not available. Full metallic brakes are a major substitute in super-heavy braking applications and they are projected to capture the remaining 0.5 percent of the asbestos market.

Table 5. Data Inputs on Brake Blocks for Asbestos Regulatory Cost Model[a]

Product	Output	Product Asbestos Coefficient	Consumption Production Ratio	Price	Useful Life	Equivalent Price	Market Share	References
Asbestos Mixture	4,570,266 pieces	0.00058 tons/piece	1.01	$5.74/piece	0.5 years	$5.74/piece	N/A	ICF 1986a, ICF 1985,
NAO	N/A	N/A	N/A	$8.04/piece	0.65 years	$6.22/piece	99.5%	Carlisle 1986a
Full-Metallic	N/A	N/A	N/A	$6.89/piece	0.5 years	$6.89/piece	0.5%	Allied Automotive 1986, Wheeling Brake Block 1986, Carlisle 1986a

N/A: Not Applicable.

[a]See Attachment, Items 2-5.

ATTACHMENT

1. The asbestos fiber content per block was calculated by dividing the 1985 asbestos fiber consumption for brake blocks by the 1985 asbestos brake block production: 2,643.6 tons (5,287,200 lbs.) divided by 4,570,266 pieces, or 1.16 lbs. per piece.

2. The product asbestos coefficient is the same value calculated in Item 1 above, converted into tons per piece.

3. The consumption production ratio was calculated using 41,808 pieces as the value for 1985 U.S. imports. (Total 1985 production is 4,570,266 pieces.) This value, however, only includes imports for the firms who provided information (see Table 4).

4. The asbestos product price is a weighted average (by production) of prices for producers who provided both price and production information for 1985. The useful life of the asbestos product was assumed to be the same as that reported in 1984 in Appendix H (ICF 1985).

   The price and useful life of the NAO block was calculated by multiplying what Carlisle reported as the average percent increase in price and useful life, respectively, of an NAO block over an average asbestos block by the (weighted average) asbestos product price and useful life, respectively. As mentioned in the text, Carlisle stated that NAO blocks are 30-50 percent higher in price (thus, 40 percent is used as the price increase) and have 30 percent longer useful life.

   The price and useful life of full-metallic brake blocks was computed based on information from three firms. Wheeling Brake Block claims their full-metallic brake block has the same useful life as asbestos brake blocks, but is 10-15 percent (12.5 percent average) more expensive (Wheeling Brake Block 1987). Carlisle, which no longer makes the full-metallic product but is familiar with the market, stated that full-metallic brake blocks have the same life as asbestos brake blocks, but are approximately 25 percent more expensive (Carlisle 1987). A third firm, Allied Automotive, claims their full metallic brake block have up to double the useful life (we assumed 50 percent on average), but is 83 percent more expensive than their premium asbestos product (Allied Automotive 1987). In order to average the estimates for these three firms, an equivalent price for the Allied Product had to be computed. (The equivalent price is a present value calculation that determines the price a product would have if it had the same useful life as asbestos.) This calculation showed Allied Automotive's full-metallic product to be 22.65 percent more expensive than asbestos blocks. The average cost of the full-metallic brake block is therefore 20.05 percent more expensive than asbestos brake blocks.

5. The market shares for the substitutes are provided by Carlisle. Carlisle stated the super-heavy applications (logging and mining trucks), for which full-metallic blocks would be used, represent only 0.5 percent of the market. Seventy-five to 80 percent of the market, stated Carlisle, would be captured by NAO blocks and the rest of the market would be taken by substitutes not yet developed. However, until other replacements can be found for the remaining 19.5-24.5 percent of asbestos-based applications, it is assumed that for the present that NAO blocks will replace 99.5 percent of the asbestos market if asbestos were no longer available.

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XXII. CLUTCH FACINGS

A. Product Description

Clutch facings are friction materials attached to both sides of the steel disc in the clutch mechanism of manual-transmission vehicles. Two metal pressure plates flanking the disc are pressed against the clutch facings by springs when the clutch is engaged. This pressure keeps the gears of the vehicle in position by means of a metal component that extends between the disc and the gears. When the driver steps on the clutch pedal to change gears, the springs pressing the plates against the clutch facings are pulled back, releasing the pressure that holds the gears in position (ICF 1985).

Clutch facings are made of molded or woven friction materials. Molded facings are used more widely than the woven (H.K. Porter 1986, ICF 1985). Woven clutch facings are a premium product. They have longer service life and engage gears better than molded facings; however, they cost substantially more (H.K. Porter 1986, ICF 1985). Woven clutch facings are, therefore, used in luxury automobiles (e.g., Mercedes-Benz) and high-performance vehicles. They may also be used in off-road vehicles, such as agricultural tractors and earth-moving equipment, where improved service life is important (H.K. Porter 1986, Deere and Co. 1986).[1]

Molded and woven clutch facings for the automotive markets are usually made of asbestos or fiberglass (ICF 1985).[2] The molded products are usually

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[1] The service life of these off-road vehicles ranges from 20 to 35 years, or roughly five times the life of an automobile. Clutch facings for these vehicles must last the lifetime of the vehicle, as the typical cost of opening up the transmission to replace a worn facing is on the order of $10,000 (Deere and Co. 1986).

[2] In heavy trucks and heavy earth-moving equipment, the clutch facings are replaced by buttons which can withstand greater pressure but are heavier, noisier, and cost more than materials used in automobiles. The buttons are made of sintered metal (bonded metal particles). Asbestos has almost never been used for these clutch applications (S.K. Wellman 1986). Thus, for the purpose of defining the asbestos-based clutch facing market, heavy vehicle clutch components will be excluded.

made by a dry mix process, as described for disc brake pads. Asbestos fiber or fiberglass is combined with binders in the molding process, during which wires are run through the component to give it shape. The final product is then pressed, cured, and ground to its final shape. Woven clutch facings are made by running asbestos or fiberglass yarn or cord through a wet mix to pick up the wet mixture. The yarn or cord is then woven after drying. The woven product is then hot-pressed, cured, and ground, as other wet-mix friction products (e.g., drum brake linings for light/medium vehicles) (ICF 1985, Krusell and Cogley 1982).

Secondary processing of clutch facings is similar to the secondary processing of automotive friction products previously discussed. Woven clutch facings may be rebuilt, as described for other automotive products (ICF 1985, Krusell and Cogley 1982). Repair of clutches is similar to repair of drum and disc brakes, as described earlier (ICF 1985, Krusell and Cogley 1982).

Asbestos-based molded clutch facings currently produced contain approximately 0.26 lbs. of asbestos fiber per piece (ICF 1986a).[3] (Data was not available on the asbestos fiber content per piece for woven facings.) Asbestos fiber is used to impart stability under friction, good wear up to 480°F, quietness, and very high tensile strength of 10,000 psi (ICF 1985).

B. Producers and Importers of Clutch Facings

Table 1 lists the three primary processors of clutch facings in 1985.[4] All three produce for the automobile, truck, and off-road vehicle markets; and, all firms make asbestos as well as non-asbestos facings (ICF 1986a). Raymark manufactures woven and, probably, molded facings (ICF 1986a, H.K. Porter 1986). H.K. Porter manufactures only woven facings; the firm stated

[3] See Attachment, Item 1.

[4] Producers of clutch buttons (which are non-asbestos) for heavy trucks and off-road vehicles are not included.

Table 1. 1985 Primary Processors of Clutch Facings

Company	Plant Location(s)	Product		References
		Asbestos	Non-Asbestos	
Raymark	Manheim, PA	X	X	ICF 1986a, TSCA 1982a
	Stratford, CT[a]	N/A	N/A	TSCA 1982a
	Crawfordsville, IN[a]	N/A	N/A	PEI Associates 1986
H.K. Porter	Huntington, IN	X	X	ICF 1986a, TSCA 1982a
Nuturn	Smithville, TN	X	X	ICF 1986a, TSCA 1982

N/A = Information not available.

[a]This plant refused to respond to our survey. It is assumed that they are still producing asbestos clutch facings.

that it and Raymark are probably the only two current producers of woven facings (H.K. Porter 1986). H.K. Porter stated, however, that it would completely replace production of asbestos-based clutch facings with non-asbestos substitutes by the end of 1986 (PEI Associates 1986). Standco Industries of Houston, TX, (not listed in Table 1) ceased production of asbestos clutch facings prior to 1985; information was not available on whether it produced a non-asbestos product (ICF 1986a).

Table 2 lists the six current secondary processors of clutch facings. Freightliner Corporation of Portland, OR, is essentially Mercedes-Benz's U.S. truck operations (Freightliner 1986). Information was not available on the type of secondary processing in which these firms were involved (ICF 1986b).

Table 3 lists the 27 current importers of asbestos-based clutch facings. According to DuPont, non-asbestos clutch facings are used extensively in European cars; most new German cars, in fact, are equipped with non-asbestos facings (DuPont 1986). Nuturn of Smithville, TN, (not listed in Table 3) stopped importing asbestos-based clutch facings prior to 1985 (Nuturn 1986). Saab-Scania of America (Orange, CT; not listed in Table 3) reported that Saab cars are equipped with non-asbestos clutch facings; the firm stopped importing asbestos facings prior to 1985 (Saab-Scania of America 1986). New Mercedes-Benz automobiles are also equipped with non-asbestos clutch facings (DuPont 1986b).

C. Trends

Table 4 gives the production of asbestos-based clutch facings and the corresponding consumption of asbestos fiber. The 1985 values for production and fiber consumption do not include Raymark's Crawfordsville, IN, plant. Information on the size of the clutch facings production at the Crawfordsville plant was not available (ICF 1986a).

Table 2. 1985 Secondary Processors of Clutch Facings

Company	Plant Location(s)	Product		References
		Asbestos	Non-Asbestos	
Stanhope	Brookville, OH	X	N/A	ICF 1986b, TSCA 1982b
Comdaco	Kansas City, MO	X	N/A	ICF 1986b, TSCA 1982b
Freightliner Corp.	Portland, OR	X	N/A	ICF 1986b, TSCA 1982b
Hall Brake Supply	Phoenix, AZ	X	N/A	ICF 1986b, TSCA 1982b
Borg and Beck Clutch	Chicago, IL	N/A	N/A	TSCA 1982b
Dana Corp.	Wichita Falls, TX	N/A	N/A	TSCA 1982b

N/A = Information not available.

Table 3. Importers of Asbestos-Based Clutch Facings

Company	Location	References
U.S. Suzuki Motor Corp.	Brea, CA	ICF 1986a, ICF 1984
Toyota Motor Sales, USA	Torrence, CA	ICF 1986a, ICF 1984
Western Automotive Warehouse Distributors	Los Angeles, CA	ICF 1984
Kawasaki Motors Corp.	Santa Ana, CA	ICF 1986a, ICF 1984
J.I. Case	Racine, WI	ICF 1984
General Motors	Dayton, OH	ICF 1984
BMW of North America	Montvale, NJ	ICF 1984
Mercedes-Benz of North America	Montvale, NJ	ICF 1984
Volkswagen of America	Troy, MI	ICF 1986a, ICF 1984
Peugeot Motors of America	Lyndhurst, NJ	ICF 1984
Freightliner Corp.	Portland, OR	ICF 1986a, ICF 1984
Original Quality Inc.	Jacksonville, FL	Original Quality 1986
Alfa Romeo	Englewood Cliffs, NJ	Automobile Importers of America 1986
Fiat	Dearborn, MI	Automobile Importers of America 1986
American Honda Motor Company	Gardena, CA	Automobile Importers of America 1986
American Isuzu Motor, Inc.	Whittier, CA	Automobile Importers of America 1986
Jaguar	Leonia, NJ	Automobile Importers of America 1986
Lotus Performance Cars	Norwood, NJ	Automobile Importers of America 1986
Mazda (North America) Inc.	Irvine, CA	Automobile Importers of America 1986
Mitsubishi Motors Corp. Services, Inc.	Southfield, MA	Automobile Importers of America 1986
Nissan Motor Corp.	Gardena, CA	Automobile Importers of America 1986
Porsche Cars North America	Reno, NV	Automobile Importers of America 1986
Renault USA, Inc.	New York, NY	Automobile Importers of America 1986

Table 3 (Continued)

Company	Location	References
Rolls-Royce Motors, Inc.	Lyndhurst, NJ	Automobile Importers of America 1986
Subaru of America, Inc.	Pennsauken, NJ	Automobile Importers of America 1986
Volvo Cars of North America	Rockleigh, NJ	Automobile Importers of America 1986
Hyundai Motor America	Garden Grove, CA	Automobile Importers of America 1986

Table 4. Production and Fiber Consumption for Asbestos-Based Clutch Facings

	1981	1985	References
Production (pieces)	7,478,934	7,237,112[a]	ICF 1986a, TSCA 1982a
Asbestos Fiber Consumption (tons)	1,120.5	993.5[b]	ICF 1986a, TSCA 1982a

[a]Raymark's Crawfordsville, IN and Stratford, CT plant refused to provide production data. Raymark's Stratford, CT production was estimated using a method described in the Appendix A of this RIA. The Crawfordsville, IN plant's production could not be estimated because they did respond to the 1981 TSCA Section 8(a) data request regarding this product and thus no previous production data were available to use for an estimate of 1985 production. Therefore, the number for total production does not include the production volume of Raymark's Crawfordsville, IN plant.

[b]Raymark's Crawfordsville, IN and Stratford, CT plant refused to provide fiber consumption data. Raymark's Stratford, CT plant fiber consumption was estimated using a method described in the Appendix A of this RIA. The Crawfordsville, IN plant's fiber consumption data could not be estimated because they did not respond to the 1981 TSCA Section 8(a) data request regarding this product and thus no previous fiber consumption data were available to use for an estimate of 1985 consumption. Therefore, the total fiber consumption number does not include asbestos fiber consumption of Raymark's Crawfordsville, IN plant.

The production of asbestos-based facings remained fairly level from 1981 to 1985. While the overall size of the clutch facings market (asbestos and non-asbestos substitutes) is not known, the asbestos-based share of the market may have declined somewhat. The vast majority of the clutch facings market is for light/medium vehicles, i.e., cars and light trucks (Ford 1986, Abex 1986). Currently, 15 percent of light/medium vehicles have manual transmissions (and, thus, use clutch facings), but this percentage has been steadily increasing (Ford 1986). Therefore, since the asbestos-based production remained fairly constant from 1981 to 1985, the non-asbestos-based share of the overall market may have increased.

D. Substitutes

All three primary processors of clutch facings produce a non-asbestos product; however, none of the producers would give estimates for the current shares the substitutes hold in the original equipment market (OEM) or aftermarket (ICF 1986a). U.S. automakers frequently import non-asbestos clutch facings from Europe, where they are used extensively. According to DuPont, the European woven clutch facings contain fiberglass, acrylic, and other fibers and are made primarily by Valeo, a French manufacturer (DuPont 1986 and 1987). Price and performance data for the European woven clutches were not available.

Raymark and H.K. Porter also produce non-asbestos fiberglass-based woven clutch facings (H.K. Porter 1986, DuPont 1987). While Raymark would not provide information, H.K. Porter stated that its fiberglass[5] woven facing has the same or improved performance and service life over asbestos-based woven facings, and that it is priced the same as its asbestos product. While the fiberglass product is more difficult to process, the same processing equipment can be used. Because woven clutch facings cost substantially more than molded

[5] The product also contains a smaller proportion of other fibers, which H.K. Porter did not specify (ICF 1986a).

products, however, H.K. Porter did not believe that woven fiberglass facings could capture the majority of the asbestos-based market in the event of a ban (ICF 1986a, H.K. Porter 1986).

Raymark and Nuturn manufacture non-asbestos molded clutch facings (ICF 1986a). Raymark's facing is fiberglass-based; the firm, however, would not provide price or performance information, nor would it estimate the expected market share in the event of a ban (ICF 1986a). Nuturn's facing contains aramid fiber, cellulose fiber, fiberglass, and ceramic fiber (ICF 1986a). Nuturn indicated that its non-asbestos product was priced 49 percent higher than its asbestos-based facing, but it had the same or up to 50 percent longer service life. This non-asbestos facing, however, would not be structurally stable in higher-temperature applications. Nuturn could not estimate the expected share of the market in the event of a ban (ICF 1986a).

Table 5 provides the data for the regulatory cost model. The substitute clutch facings included in the table are the European woven fiberglass facing, the molded fiberglass facing, Nuturn's molded product, and the woven fiberglass facing made by U.S. producers. Because price and useful life were not available for the European woven fiberglass clutch facing or Raymark's molded fiberglass facings, for the asbestos regulatory cost model it was assumed that the European product had the same price and longevity as the woven fiberglass facings produced by the U.S. firms Raymark and H.K. Porter, and that Raymark's molded fiberglass facing had the same life and price as Nuturn's aramid and fiberglass molded facing.

It should be noted that the asbestos substitute clutch facing market has been changing rapidly as substitutes improve. The market shares and prices shown in Table 5 are 1986 estimates; as of July, 1987 some of this information is already outdated and the market is still changing. This change is primarily due to U.S. firms improving their woven substitute facings (DuPont 1987).

Table 5. Data Inputs on Clutch Facings for Asbestos Regulatory Cost Model[a]

Product	Output	Product Asbestos Coefficient	Consumption Production Ratio	Price	Useful Life	Equivalent Price	Market Share	References
Asbestos mixture	7,237,112 pieces	0.00014 tons/piece	1.12	$1.71/piece	5 years	$1.71/piece	N/A	ICF 1986a, ICF 1985, b
Woven fiberglass (European product)	N/A	N/A	N/A	$2.92/piece	7.5 years	$2.11/piece	50%	DuPont 1986
Woven figerglass (U.S. Product)	N/A	N/A	N/A	$2.92/piece	7.5 years	$2.11/piece	30%	ICF 1986a
Molded aramid fiber, fiberglass, cellulose and ceramic fiber (Nuturn's product)	N/A	N/A	N/A	$2.55/piece	6.25 years	$2.12/piece	10%	ICF 1986a
Molded fiberglass	N/A	N/A	N/A	$2.55/piece	6.25 years	$2.12/piece	10%	ICF 1986a

N/A: Not Applicable.

[a]See Attachment, Items 2-7.

E. Summary

Clutch facings are friction materials attached to both sides of the steel disk in the clutch mechanism of manual transmission vehicles. Clutch facings are made of molded or woven friction materials; molded facings are used more widely than woven facings (ICF 1985, H.K. Porter 1986). In 1985, three producers consumed 993.5 tons of asbestos to produce 7,237,112 asbestos clutch facings. All three firms also make non-asbestos facings (ICF 1986a). The production of asbestos-based clutch facings remained fairly level from 1981 to 1985. The four major substitutes for the asbestos clutch facings are: European facings which contain fiberglass and other fibers; molded fiberglass-based facings produced by Raymark; a Nuturn molded facing containing aramid fiber, cellulose fiber, fiberglass and ceramic fiber; and fiberglass-based woven facing made by both Raymark and H.K. Porter (DuPont 1986 1987). Equivalents costs for the substitutes were 20-25 percent higher than for the asbestos product. If asbestos were not available it is estimated that the European substitute will take 50 percent, woven fiberglass 30 percent, molded fiberglass 10 percent and Nuturn's product 10 percent of the asbestos-based clutch facing market.

ATTACHMENT

1. The asbestos fiber content per piece was calculated by dividing the 1985 asbestos fiber consumption for molded asbestos clutch facings 993.5 tons or 1,987,000 lbs. by the 1985 production of molded asbestos clutch facings (7,237,112 pieces).

2. The product asbestos coefficient is the same value calculated in Item 1 above, converted into tons per piece.

3. The consumption production ratio was calculated using 885,947 pieces as the value for 1985 U.S. imports. (Total 1985 production of asbestos clutch facings is 7,237,112 pieces.) This value, however, only includes imports for the firms who provided information (see Table 4).

4. The asbestos mixture price is the price given by Nuturn for its molded asbestos product. The woven fiberglass mixture price is the price given by H.K. Porter for its woven fiberglass product.

5. The useful life of the asbestos mixture is assumed to be the same as that reported in 1984 in Appendix H (ICF 1985). The useful life of the woven fiberglass facing produced by U.S. firms is assumed to be 50 percent greater than the molded asbestos product, or 7.5 years. H.K. Porter stated the woven facing is a "premium" product with significantly longer service life than molded products (H.K. Porter 1986). Nuturn stated its substitute had the same or up to 50 percent increased service life (ICF 1986a). Thus, a 25 percent service life increase is assumed, which gives the Nuturn product a life of 6.25 years. Because price and useful life were not available for the European woven fiberglass clutch facing or Raymark's molded fiberglass facings, for the asbestos regulatory cost model it was assumed that the European product had the same price and longevity as the woven fiberglass facings produced by the U.S. firms Raymark and H.K. Porter, and that Raymark's molded fiberglass facing had the same life and price as Nuturn's aramid and fiberglass molded facing.

6. Based upon DuPont's statement that the European clutch facings are frequently used by U.S. automakers, a 50 percent share is assumed for the European facings. H.K. Porter stated that 30 percent of the market would be captured by the fiberglass woven facings. The remaining share is split equally between the molded fiberglass facings and Nuturn's product.

7. It should be noted that the asbestos substitute clutch facing market has been changing rapidly as substitutes improve. The market shares and prices shown in Table 5 are 1986 estimates; as of July, 1987 some of this information is already outdated and the market is still changing. This change is primarily due to U.S. firms improving their woven substitute facings (DuPont 1987).

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