AN ECONOMIC ASSESSMENT

OF THE

UNITED STATES

INDUSTRIAL FASTENER INDUSTRY

(1979 to 1986)

U.S. Department of Commerce
International Trade Administration
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OVERVIEW

In February 1983, the U.S. Department of Commerce determined that imports of nuts, bolts and large screws were not entering the United States in such quantities or in such a manner that threatened the national security. This determination followed a one year investigation that found imports of these fasteners to be reliable and domestic production capacity adequate to meet defense requirements. The assessment that follows reviews the macroeconomic variables that affect the entire metal fastener industry including the categories covered in the 1983 investigation.

Over the past several years, the U.S. fastener industry has experienced a mixed set of economic trends. Shipments by the industry peaked in 1979, but were generally depressed in the early 1980's, largely due to poor performances in the end-user markets such as automobiles. The most recent years have shown modest improvement as the general economy rebounded. Employment fell sharply in the early 1980's but since then has recovered somewhat and expanded by over 15 percent. Investment in new plant and equipment in the fastener industry has been highly variable but increasing in recent years.

Overall import penetration in this industry has increased from 14.5 percent (in value) in 1979 to a high of 19.4 percent in 1984, but with the declining value of the dollar, imports appear to have stabilized at around 19 percent of the market. With regard to the specific product lines investigated in the 1983 Section 232 case, we estimate that import penetration (in value) increased from about 27 percent in 1981 to about 34 percent in 1986.

Imports come mainly from the Pacific Rim Countries. Japan,

although still the largest supplier of imports, has lost market share to Taiwan and South Korea, which have lower labor costs and more favorable exchange rates relative to the dollar. Further increases in import penetration are expected to be more gradual since gains would have to be in specialty fastener markets where price is less important than quality, delivery time, customer specific requirements, and in some cases advanced production capabilities. U.S. firms remain highly competitive in these specialty markets and have the advantage of proximity to end-users.

One important trend over the 1979 to 1986 period is the fact that the number of fastener producing plants in the United States has increased. This increase, however, is due to a large crop of new small (under 100 employees) plants which counterbalanced decreases in the number of large facilities. This trend demonstrates the effect imports have had on the industry. U.S. producers have been pushed into specialty niches with relatively small volume production requirements. Recent technical innovations and declines in the value of the dollar have made the competitive outlook for the domestic industry more promising. The first U.S. plant in 25 years to produce standard fasteners (which are 90 percent dominated by imports) opened in 1986.

With the erosion of key elements of the manufacturing sector in the U.S. (such as automobiles, oil field machinery, farm equipment, and construction machinery), and the rise of imported finished products into the domestic marketplace, lower tier industries such as fasteners are confronted with a declining customer base. This may be a greater threat to the long-term viability of the domestic fastener industry than further incursions of imported fasteners.

1983 Fastener National Security Investigation

The Department of Commerce initiated an investigation to determine the effect on the national security of imports of nuts, bolts and large screws of iron and steel (excluding mine roof bolts, but including lag screws and bolts) under the authority of Section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. 1862), in response to a February 11, 1982 request from the Secretary of Defense. The Section 232 investigation was completed in February, 1983.

This investigation concerned imports of the following industrial fastener categories as defined by the Tariff Schedules of the United States (TSUS):

Item Number	
646.4920	Lag Screws or bolts (of iron and steel)
646.5400	Bolts and bolts and their nuts imported in the same shipment (of iron and steel)
646.5600	Nuts (of iron and steel)
646.6320	Cap screws having shanks or threads over 0.24 inch in diameter (of iron and steel)
646.6340	Other screws with shanks or threads over 0.24 inch in diameter (of iron and steel)

These five categories were investigated primarily because imports had made significant in-roads into the U.S. domestic market. Moreover, the generally larger sizes (e.g., over .24 inches in diameter) that these categories included were used in large quantities in the assembly of military ships, vehicles, ordnance, and other heavy equipment.

After assessing relevant data as required by the statute, it was concluded that nuts, bolts and large screws of iron and steel are

not being imported into the U.S. in such quantities or under such circumstances as to threaten or impair our national security. It further concluded that imports of fasteners would be reliable, would comprise an important part of our required supply of industrial fasteners and would supplement our domestic production. In addition, the investigation found that defense needs could be met with domestic production and that domestic production could be expanded (as it had been during World War II) to meet the increasing fastener requirements in the out years of the mobilization scenario. Further, the decline in production capacity of the investigated categories was found not to pose a threat to our national security. The industry's difficulties were due not only to import penetration, but also to general economic conditions, and a general economic recovery was expected to help the sector significantly. Imports, therefore, were determined not to be a threat to the national security.

This report reviews the condition of the overall industrial fastener industry which includes all product categories reviewed in the Section 232 investigation. Furthermore, specific attention is given to the change in the import levels for the five categories previously investigated (see Note below).

Note: Because U.S. shipments of the fasteners investigated under Section 232 are not reported separately by the Bureau of the Census statistical publications, they could not be segregated from the larger industrial fastener industry. The separation of these fastener categories would have required a comprehensive survey of the industry similar to the one conducted for the 232 investigation. The larger industry includes non-ferrous fasteners, certain other threaded fasteners (such as small screws, studs and turnbuckles), non-threaded fasteners and the bulk of aerospace fasteners.

Limitations of Fastener Statistics

Quantitative statistics on fasteners can be measured in terms of value, weight, or pieces. Measurement by each method will give different results with respect to import penetration levels, market sector consumption rates, and industry concentration ratios. For example, measurement of import penetration in terms of value (approaching 20 percent) greatly understates import levels measured in terms of weight (which industry sources report is near 50 percent) and in terms of pieces (which may be 65 percent). These differences arise because fasteners are highly differentiated products. The differences can be very great such as between small screws and mine roof bolts. There may be over 200 small screws per pound, while a single mine roof bolt can weigh 50 pounds or more. Comparisons, therefore, can be distorting.

Value is probably the superior measurement because it embodies many of these differences (i.e., size, material composition, quality, etc.) as well as variations in production complexities and production volumes. However, distortions will also arise with value because many countries have lower factor costs than the United States. But this distortion would not be as great as distortions could be using weight or piece measurements.

Value is used in this report to measure economic variables because it is reported for U.S. shipments, imports and exports while weight and pieces are not. Weight is reported for imports and exports only and is shown where appropriate for comparative purposes. Usable statistics are not available for "pieces".

MARKET PROFILE

The metal fastener industry is identified by Standard Industrial Classification number (SIC) 3452. Included are nuts, bolts, screws, studs, rivets, washers, and other non-threaded fasteners such as cotter pins. The classification does not include metal brads, nails, pins, staples, tacks or rail spikes. Fasteners are made predominantly of iron and steel. Ten to 15 percent are made of non-ferrous materials. The industry is commonly called the industrial fastener industry.

Metal fasteners are vital to the national security of the United States. They are used in great numbers to hold together automobiles, trucks, aircraft, ships, buildings, production machinery and countless other items underlying our high standard of living. They are also used in virtually every weapon system used by the military.

Metal fasteners are used in most manufacturing industries, the agricultural sector, mining, construction, utilities, and consumer hardware markets. Nearly 200 billion fasteners are sold annually, and of these, manufacturing accounts for about 70 to 75 percent of consumption. The largest markets (see Appendix 1) are the automotive, 25 to 30 percent of consumption; aerospace, 15 percent; off-road and farm equipment, 5 to 7 percent; home appliances, 3 to 5 percent; and construction, 5 to 10 percent. In addition, the broadly defined electronics sector (computers, telecommunications, etc.) has been a rapidly expanding market for fasteners and presently this sector may account for over 10 percent of sales. Mining is a special category requiring very large fasteners called

mine roof bolts. Mining accounts for about 5 percent of the fastener market.

Direct and indirect military fastener purchases (standards and specials) claim between 10 and 15 percent of the value of the U.S. fastener market. The military accounts for more than half of aerospace fastener sales, but only about 5 percent of all other fastener consumption.

"Standard" fasteners are manufactured to recognized standards, published by the Society of Automotive Engineers and many other standardizing organizations. All other fasteners are "specials". These include modified standards, proprietary fasteners and specially engineered parts. A modified standard has at least one of its features altered to meet a customer's specific need. A proprietary fastener has one or more features that are patented. An engineered part is unique and designed to reduce assembly time. It is often proprietary as well.

Many specials are designed and produced for a single customer who has unique requirements. Over the years, the trend has been increasingly toward specials as manufacturers seek ways to reduce high assembly costs. In many industries, final assembly represents over 50 percent of the costs of production.

Specials are usually produced in relatively small volumes, especially the engineered specials. However, larger volumes are used in mass produced items such as automobiles, lawnmowers, and refrigerators.

Standards on the other hand, are normally produced without any particular customer in mind. They are made for inventory in anticipation of future orders and compete on a price basis. The

most common standard fasteners may be made in quantities of several hundred million. Others, such as many larger standard fasteners (that may be hot worked and take longer to process) are made in much smaller quantities.

Imported fasteners, which are commonly sold through distributors, are used in large numbers in most U.S. markets (except mining). Most of the imports are standard fasteners which account for about 90 percent of total imported fasteners (in pieces). Imports of specials, while lower in volume than standards, have increased in recent years in some high-volume sectors and account for the remaining 10 percent of industrial fastener imports. Durable equipment producers use large quantities of both standards and specials, probably in about equal amounts taken in the aggregate. Imported fasteners dominate the construction and home hardware markets.

Over two million varieties of fasteners are produced, the most extensive range of products made by any U.S. industry. About 75 percent of fastener varieties are specials. However, standard fasteners are shipped in much greater quantities, and may represent two of every three fasteners consumed in the United States. Approximately 50 thousand fastener types account for over 90 percent of total unit shipments.

Various trade publications report that about 90 percent (in pieces) of the U.S. standard market is now controlled by imports. Using this information the following table can be assembled showing foreign and domestic shares of standard and special fasteners.

Estimated Foreign and Domestic Market Shares
for Standard and Special Fasteners

(in billions of pieces)

	Foreign	Domestic	Total
Standards	117.0	13.0	130.0
Specials	13.0	57.0	70.0
Total	130.0	70.0	200.0

On a piece basis imported fasteners are estimated to be about 65 percent of the overall U.S. market, but only 18.6 percent of the specials market. If these numbers were converted from pieces to weight the import penetration levels would decline because of less import competition in the larger sized fastener markets such as mine roof bolts. On a weight basis, import penetration may be in the range of 50 percent overall and about 10 percent in specials.

Recent Trends in End-Markets

Most significant among these is a declining customer base reflecting the erosion of key elements of the manufacturing sector in the U.S. and the rise of imported finished products into the domestic marketplace. Lower tier industries such as fasteners, bearings and forgings are consequently confronted by declining domestic demand. The automotive sector, which has lost market share to imports, is a notable example of this trend, as are the off-road and farm equipment, electronics and home appliance sectors. The declines in these end-use markets may be a greater threat to the long-term viability of the domestic fastener industry than further incursions of imported fasteners.

Other developments in the marketplace are further reducing the

need for fasteners but at a slower rate than described above. The use of adhesives as a substitute for fasteners has expanded with the greater use of plastics, composites, and other non-metal materials. Also, growth in the use of robots has led to more spot welding to fasten joints at the expense of metal fasteners. Another trend is for fasteners to be made of higher grade materials. These materials are stronger and permit a reduction in the size of fasteners, or in the number of fasteners needed for particular applications. Additionally, efforts have been underway to downsize autos and other equipment to conserve energy, materials, or space. This has also reduced fastener requirements.

With the increased specialization in the fastener industry and its confinement to and dependence on the cyclically volatile durable goods manufacturing sector, the fastener industry's long term outlook is mixed. Actions by the industry to become more competitive can be negated by lost domestic manufacturing capability for automobiles and other end users of fasteners.

INDUSTRY PERFORMANCE, 1979 to 1986

Shipment and Import Trends

Metal Fastener Shipments, Imports, Exports and the U.S. Market (Apparent Consumption), 1979-1986

(in millions of dollars)

	(A)	(B)	+ (C)	- (D)	= (E)	(C/E)
	Shipments				U.S.	Percent
Year	Constant ($)	Current ($)	Imports	Exports	Market	Imports
1979	$4422.6	$3763.6	$605.0	$183.0	$4185.6	14.5
1980	4189.5	3829.2	550.0	202.3	4177.1	13.5
1981	4087.9	3973.4	577.4	221.7	4329.1	13.3
1982	3071.1	3071.1	550.0	191.0	3430.1	16.0
1983	3315.1	3278.6	556.2	180.9	3653.9	15.2
1984	3747.1	3814.5	867.1	209.8	4472.1	19.4
1985	3757.8	3863.0	837.3	181.2	4519.1	18.5
1986	3757.8	3874.3	877.0	185.8	4565.5	19.2

Bolstered by expanding sales of aircraft, motor vehicles, and capital equipment, metal fastener shipments reached their all time high in 1979, at $4.4 billion (1982$). Imports captured 14.5 percent of the market that year, or $605 million. In early 1979, the President levied a three-year 15 percent special tariff on nuts, bolts, and large screws of iron and steel (the Section 232 items) at the recommendation of the U.S. International Trade Commission. The special tariff helped reduce import penetration in 1980, and again in 1981, to 13.3 percent of the market. The drop was also precipitated by extraordinary increases in aerospace fastener sales, which are only slightly affected by imports, and declines in various construction markets, which are heavy users of imported fasteners. Aerospace fastener shipments rose from $488.8 million in 1979 to $780.3 million in 1981. This increase occurred primarily because material costs, chiefly aluminum and titanium, rose sharply during this time, raising the unit cost of each fastener. However, aircraft sales expanded to both commercial (up 3.2 percent) and military (up 26.9 percent) customers.

Shipments of domestically produced fasteners grew slightly in nominal dollars in 1980 and 1981. However, in constant dollars, shipments fell 5.3 percent in 1980, due to poor performances in the automotive, construction and capital goods markets. The downward trend continued in 1981, with shipments falling 2.4 percent because of continued weakness in major markets and a drastic drop in farm equipment sales.

In 1982, shipments of metal fasteners reached their lowest levels in over twenty years. Less than $3.1 billion were shipped, almost 25 percent below 1981 levels, and 31 percent below peak year

1979 shipments. Virtually every fastener market contracted in 1982. Auto sales plummeted to under six million vehicles; aircraft production fell sharply; construction was down, and off-road and farm equipment sales slumped badly.

Imports also declined, in absolute terms, to $550 million in 1982. The import share of the U.S. market, however, climbed to 16 percent. Imported fasteners, which are predominantly standards, gained relative market share because they have a broader customer base and are less reactive than domestic producers to the volatile business cycles of durable goods industries - such as autos, aircraft and heavy machinery. Only about 50 percent of imports are consumed in the manufacturing durables sector versus 80 to 90 percent of domestic fasteners. The following year (1983), durable goods markets picked up and import penetration actually declined slightly to 15.3 percent.

Fastener shipments expanded 7.9 percent in 1983, and a healthy 13 percent in 1984, following in the path of a surging economy. Rapid expansion occurred in auto shipments, capital equipment and home appliance sales. Aerospace fastener sales declined slightly in 1983, before resuming an upward expansion again in 1984. Imports rose only slightly in 1983, but then rose dramatically by almost 56 percent in 1984, to 19.4 percent of U.S. consumption. This rapid increase in imports was greatly facilitated by the strong dollar. Strong performances in commercial and industrial construction markets, as well as durables and consumer hardware markets, were contributing factors.

In 1985, shipments expanded by only 0.3 percent, trailing small increases in auto sales and aircraft. Imports declined in 1985,

losing market share in the process. The decline can be attributed to the weakened dollar, especially relative to the Japanese yen. However, non-residential construction fell steeply by about 10 percent in 1985, a slump which persisted into 1986. In 1986, fastener shipments are estimated to show no growth. Auto shipments and farm machinery were down slightly, but aerospace again showed a strong increase. Imports fell to 18.5 percent of the market in 1985 and are expected to increase slightly to 19.2 percent in 1986.

Import Analysis

Metal fastener import data are collected under 29 tariff schedule numbers that include nuts, bolts, screws, rivets, washers, and other threaded and non-threaded fasteners (see Appendix 2). Ferrous and non-ferrous fasteners are reported separately. Non-ferrous fasteners, however, represent only about three percent of the value, and one percent of the tonnage imported. In 1985, the top five imported categories represented 69.8 percent of the total imported value, and 78.3 percent of the tonnage.

1985 Top Five Imported Fastener Products

(in millions of dollars and millions of pounds)

TSUS#	Description	Value	Percent	Pounds	Percent
646.5600	Nuts*	$167.0	19.9%	271.0	19.9%
646.6040	Small Screws	138.6	16.6	202.8	14.6
646.5400	Bolts and Nuts* (in same shipment)	127.9	15.3	290.6	20.9
646.6320	Large Cap Screws*	116.4	13.9	256.8	18.5
646.5800	Machine Screws	34.6	4.1	66.1	4.8
		$584.5	69.8%	1,087.3	78.3%

* Analyzed in 1983 Fastener 232 Investigation

The United States imported metal fasteners from 75 countries in 1985. Most of the imports originated in the Far East, which accounted for 68.5 percent of the dollar value and 76.8 percent of the tonnage. Canada and Western Europe accounted for most of the remainder. The top five countries of origin represented 86.4 percent of the value and 90 percent of the tonnage in 1985.

1985 Fastener Imports By Region

(in millions of dollars and millions of pounds)

Region	Value	Percent	Pounds	Percent
Far East	$573.4	68.5%	1,066.3	76.8%
Canada	135.5	16.2	198.5	14.3
Western Europe	113.8	13.6	92.1	6.6
	$822.8	98.3%	1,356.9	97.7%

1985 Top Five Countries of Origin

(in millions of dollars and millions of pounds)

Country	Value	Percent	Pounds	Percent
Japan	$387.2	46.2%	605.3	43.6%
Taiwan	148.8	17.7	353.5	25.5
Canada	135.5	16.2	198.5	14.3
W. Germany	27.8	3.3	n/a	n/a
S. Korea	n/a	n/a	63.1	4.5
Italy	24.4	2.9	29.0	2.1
	$723.7	86.4%	1,249.3	90.0%

Imports have increased by over 50 percent in terms of value and by almost 45 percent in terms of weight since 1981. However, imports appear to have stabilized since 1984, when imports attained their highest penetration level of 19.4 percent. This stabilization can be attributed to the declining value of the dollar, increased specialization and competitiveness of domestic producers, and

fewer opportunities for imports to penetrate the already import dominated standard fastener markets.

The table below shows total imports from the world for the years 1981 through 1986. The better than 50 percent rise in imports that took place in 1984 was in response to a surging U.S. economy. While the general economy expanded by 6.8 percent that year, durable goods shipments rose by more than 15 percent. Furthermore, the dollar was gaining value relative to most foreign currencies and distributors accelerated their purchases of imported fasteners in anticipation of rising demands and to replenish dwindling inventories. Declines in imports since 1984 mirrored the deterioration in end-markets following the 1984 boom, overbought distributor inventories, and a weakening dollar.

Perhaps of most importance in the apparent stabilization of imports has been the near exhaustion of new export opportunities into the U.S. standard fastener markets. By 1984, these standard fastener markets were reportedly 90 percent dominated by imports. Future increases in import levels will consequently have to come at the expense of specials, an area where U.S. fastener firms are highly competitive in terms of price, quality and delivery schedules.

Imports of Metal Fasteners, 1981 to 1986

(in millions of dollars and millions of pounds)

Year	dollars	(1981=1)	pounds	(1981=1)
1981	577.4	1.000	984.4	1.000
1982	550.0	.952	929.1	.944
1983	556.2	.963	986.9	1.003
1984	867.1	1.502	1,481.4	1.505
1985	837.3	1.450	1,388.0	1.410
1986	877.0	1.519	1,423.0	1.446

Shifts_in_Far_East_Trade_Patterns

The major but declining source of metal fastener imports has been Japan. Imports from Japan as a share of total imports peaked at over 50 percent in 1982, but since then have declined rather steeply. By 1986, Japan's share of imports had dropped to 41.2 percent of the dollar value and only 36.3 by weight. Taiwan and South Korea have both increased their relative shares, primarily at the expense of Japan.

Underlying the shift in import shares is the fact that Japan is gradually being displaced from the lower grade type standard fasteners and forced to compete in the higher grade standards, and increasingly in the specials end of the U.S. market. This could increase competition for some U.S. firms. However, foreign penetration of the specials market will involve more than simple price competition. This will give U.S. firms an edge with respect to design capabilities, specialization and response time, all of which will be difficult for Japanese firms to duplicate from production facilities in Japan. Nevertheless, some inroads into the specials markets by Japanese firms will probably occur, perhaps mostly to Japanese owned U.S. assembly plants. Also, to compete effectively in specials markets, some Japanese fastener firms are likely to establish fastener production capabilities in the United States.

The lower grade fasteners from which Japan is being displaced are made from a softer steel which is more easily cold formed and commonly used to make standard fasteners. These are made more cheaply in low wage countries such as Taiwan and South Korea where a complimentary steel making capability also exists. Since these

fasteners are made in enormous quantities, their production is a natural extension of Taiwan's and South Korea's fairly new steel plants. Fastener production adds value to the raw steel and also provides an excellent export opportunity.

Taiwan and South Korea are expected to continue displacing Japan from the lower grade fastener markets, especially since the yen has appreciated dramatically against the dollar. Also, both Taiwan's and South Korea's currencies have remained pegged to the dollar. This should enable them to maintain lower prices in the forseeable future. These countries can also be expected to enter the higher volume specials markets in the future.

As evidence of Japan's shift to higher grade fasteners, the average price per pound of imported fasteners from Japan rose from 53 cents to 69 cents between 1983 and 1986, a 30 percent increase. Part of this rise is undoubtably attributable to appreciation of the yen relative to the dollar. However, imported commodities vital to steel production such as iron ore and coal are denominated in U.S. dollars on the international markets in which Japanese producers purchase. This would serve to moderate the ill effects of the rising yen with respect to its influence on fastener prices. Taiwanese average price per pound for imported fasteners remained around 40 cents for the last six years, while South Korean prices ranged from 34 to 39 cents over that period.

Changes in Imported Fastener Market Shares, in Percent

(percentage market shares in dollars)

Country	1981	1982	1983	1984	1985	1986
Japan	49.8%	50.5%	48.3%	46.7%	46.2%	41.2%
Taiwan	11.8	11.4	12.8	16.9	17.8	21.1
South Korea	2.2	2.4	2.3	2.3	2.7	3.9
Total	63.8%	64.3%	63.4%	65.9%	66.7%	66.2%

Changes in Imported Fastener Market Shares, in Percent

(percentage market shares in pounds)

Country	1981	1982	1983	1984	1985	1986
Japan	51.1%	53.1%	51.3%	45.0%	43.6%	36.3%
Taiwan	18.0	16.9	19.2	24.4	25.5	31.4
South Korea	3.4	3.6	3.9	3.7	4.5	6.6
Total	72.5%	73.6%	74.4%	73.1%	76.6%	74.3%

Average Prices Per Pound, 1981 to 1986

(in cents per pound)

Country	1981	1982	1983	1984	1985	1986
Japan	57	56	53	61	64	69
Taiwan	39	40	38	41	42	41
South Korea	39	39	34	36	35	36

note: Increases in per pound prices of fasteners do not necessarily reflect improvements in fastener quality. Such increases can also reflect shifts in fastener sizes and types.

Imports of Section 232 Fasteners

Imports of fasteners reviewed under the Section 232 investigation increased since 1981, but at a lower rate than overall metal fasteners. In terms of value Section 232 fasteners increased by 37.9 percent between 1981 and 1986, while in tonnage the increase was somewhat less at 30.6 percent. The maximum import levels in terms of value and tonnage were achieved in 1984. The major countries of origin of Section 232 fasteners are roughly equivalent to that for all imports, except that Taiwan's share on a tonnage

basis now exceeds that of Japan (36.8 percent versus 32.5 percent). As a share of total imported fasteners, the Section 232 fasteners have declined since 1981 from 58.1 percent to 54.8 of the value and from 67.8 percent to 63.4 in terms of tonnage. This drop may be explained by the earlier entry of foreign suppliers into the Section 232 type fastener markets which led to an earlier saturation of export opportunities. Also, the three year special tariff (1979 to 1981) on Section 232 fasteners may have encouraged some foreign suppliers to enter and establish a position in the non-232 sectors.

Imports of Section 232 Fasteners, 1981 to 1986

(in millions of dollars and millions of pounds)

Year	dollars	(1981=1)	pounds	(1981=1)
1981	335.5	1.000	677.4	1.000
1982	310.6	.926	620.9	.917
1983	297.4	.886	645.7	.953
1984	480.1	1.431	975.2	1.440
1985	451.7	1.346	879.3	1.298
1986	462.5	1.379	884.6	1.306

Section 232 Fastener Imports as a Share of Total Imports

	dollar percent	pound percent
1981	58.1%	67.8%
1982	56.5	66.8
1983	53.5	65.4
1984	55.4	65.8
1985	53.9	63.4
1986	54.8	63.4

We estimate that import penetration (in value) for the five Section 232 categories increased from about 27 percent in 1981 to about 34 percent in 1986. In terms of tonnage, import penetration increased from about 45 percent in 1981 to about 49 percent in 1986.

Estimates of Apparent Consumption and
Import Penetration for the Section 232 Fastener Categories

(in millions of dollars and millions of pounds)

Year	value	% imports	pounds	% imports
1981	1,253.0	26.8	1,495.2	45.3
1982	985.9	31.5	1,288.4	48.2
1983	1,036.0	28.7	1,373.3	47.0
1984	1,336.0	35.9	1,787.3	54.6
1985	1,343.1	33.6	1,752.7	50.2
1986	1,360.5	34.0	1,795.5	49.3

Employment Trends

Changes in employment in the metal fastener industry tracked shipments. Employment was at its highest in the fourth quarter of 1979, when it reached 62.4 thousand, but then dropped steadily until the fourth quarter 1982, when it had fallen by 28.4 percent to 44.7 thousand. In 1983 and 1984, employment increased moderately. By the first quarter 1985, employment reached 51.5 thousand, a 15.2 percent expansion over the fourth quarter 1982. Since then, employment has been stable, fluctuating in a narrow band between 50.8 thousand in the third quarter 1985 and 51.6 thousand in the second quarter of 1986.

Total Employment

(in thousands)

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Average
1979	61.0	62.0	61.8	62.4	61.8
1980	61.7	59.7	55.3	57.2	58.5
1981	58.4	58.1	56.8	55.5	57.2
1982	52.4	49.7	47.6	44.7	48.6
1983	45.1	46.0	45.7	47.9	46.2
1984	49.4	50.5	50.4	51.4	50.4
1985	51.5	51.4	50.8	50.9	51.2
1986	51.3	51.6	51.2		

The number of production workers also reached its peak in the fourth quarter 1979, at 46.6 thousand. By the fourth quarter 1982, production worker employment declined by 32.6 percent, standing at only 31.4 thousand. A slow improvement, punctuated by several small random declines ensued until reaching a plateau of about 37 thousand in the fourth quarter 1984 which was a 17.8 percent increase from the low in 1982. Employment of production workers has remained stable for the past two years.

Production Workers

(in thousands)

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Average
1979	45.7	46.6	46.2	46.6	46.3
1980	46.1	44.2	40.1	41.9	43.1
1981	43.0	42.4	41.5	40.6	41.9
1982	37.9	35.6	34.0	31.4	34.7
1983	31.9	32.5	32.3	34.3	32.7
1984	35.6	36.4	36.4	37.2	36.4
1985	37.3	37.3	36.7	36.6	37.0
1986	37.0	37.1	36.5		

Advances in the productivity of labor as well as economic downturns may reduce overall employment requirements. Productivity, measured as average dollar shipments per employee, rose slightly over the period. Had productivity remained constant at its 1979 level, total employment requirements in 1986 would have been 2 to 3 percent higher, or an additional 1,000 to 1,500 employees.

Investment

Investment in new plant and machinery by the fastener industry peaked in 1980 (in nominal dollars) at $168.5 million. About $141 million, or 83.6 percent of this total was in new machinery and

equipment. During this period (1979 to 1981), the industry's cash flow and profits increased, in part because of the 15 percent import surcharge placed on nuts, bolts and large screws of iron and steel, which constituted about 60 percent of the total value of imports. Also, the record shipments in 1979 improved balance sheets and provided incentives to accelerate investment in 1980.

Investment dropped to $148.4 million in 1981, reflecting deteriorating market conditions and rising interest rates. Investment then further dropped to $109.8 million in 1982. Many firms cancelled or pushed back discretionary investment expenditures as shipments fell sharply and capacity utilization rates fell below 60 percent. As often happens in economic downcycles, when firm liquidations increase, used equipment expenditures rose in 1982, to $32.5 million, up from $17.6 million in 1979, and $26.2 million in 1981.

Investment advanced after 1982, but not to levels experienced in prior years. By 1985 investment had risen to $138.2 million, or by 25.9 percent above 1982 levels. While balance sheets improved during these years, high interest rates and uncertainties about the future obviated some investment opportunities.

In the next few years, investment in the fastener industry could be negatively affected by a predicted downturn in the automotive market and continued slowness in the off-road and farm equipment markets (U.S. Department of Commerce, 1987 Industrial Outlook). However, improvement in most other markets should slightly more than offset these negative developments. The tax reform bill, by eliminating investment tax credits and lengthening depreciation schedules, may reduce investment below levels that would have

otherwise been attained. However, this negative effect, which will primarily be short run, could be overtaken by declines in interest rates, which are predicted to be a longer term effect of tax reform.

Investment by the Metal Fastener Industry
(in millions of dollars)

Year	Plant	Machinery & Equipment	Total	Used Plant & Equipment
1979	$23.5	$121.4	$144.9	$17.6
1980	27.7	140.8	168.5	22.2
1981	27.7	120.7	148.4	26.2
1982	14.0	95.8	109.8	32.5
1983	32.7	87.4	120.1	19.2
1984	n/a	n/a	124.1	n/a
1985	n/a	n/a	138.2	n/a

Trends in Fastener Facilities

The number of fastener production establishments in the United States in 1984 increased by 13 percent above 1980 figures, which are highlighted in the DOC, Bureau of the Census publication, "County Business Patterns". This increase however, was accompanied by a drop in the average number of employees per establishment which fell from 86 to 59 employees. This occurred because of the decline of large establishments caused by imports of standard fasteners, and an increase in the number of smaller facilities.

The greatest increase in establishments over the period was reported in the smallest size class of under 20 employees. This size class rose from 299 to 416 plants (39 percent). Small plants engage primarily in small volume production runs that larger concerns are not interested in or cannot handle efficiently. Although these small firms represent nearly half the number of establishments, they account for only five or six percent (value basis) of the industry's shipments.

Imported fasteners consisting mostly of standards made in ultra large volumes are just the opposite of these mini establishments. Therefore, imports pose little threat to smaller establishments. However, imports may be indirectly responsible for the large increase in the number of these small establishments, by creating a pool of unemployed skilled craftsmen let go by larger firms impacted by imports.

The establishment size class which ranges from 20 to 100 employees also increased in number from 304 to 326 facilities, or by 7.2 percent. These firms represent about 30 to 35 percent of fastener shipments, handling intermediate production volumes. This size class is also little affected by imports because of its small volumes and concentration on specials. Most of the firms in this class are "niche" producers. They specialize in a narrow range of fasteners, often for a few select customers.

The 100 to 250 size class includes establishments with characteristics of niche producers and large production volume firms. This size group decreased by over 20 percent, from 107 to 86 facilities between 1980 and 1984. The segment represents about 25 to 30 percent of total fastener shipments. Imports have affected this size class by forcing the survivors into specials. This group is highly specialized, very competitive and will be difficult to dislodge further by imports.

The over 250 size group shrank by over 29 percent and is the most adversely impacted by imports. The group declined from 62 establishments in 1980 to 44 by 1984. The group accounts for about 30 to 40 percent of industry shipments. Historically, these large firms made the ultra large volume standards and large volume

specials. Many large companies in this category, notably Lamson & Sessions, RB & W, Modulus, Armco and Bethlehem Steel, either closed their doors or dropped standard lines altogether.

The retrenchment of the industry has reduced historical concentration ratios. In 1967, the four largest fastener firms made 18 percent of the fastener shipments. In 1982, this level had fallen to 13 percent. Declines also occurred in the 8, 20 and 50 largest company categories. For the 8 largest, the market share fell from 27 percent in 1967 to 23 percent in 1982. The 20 largest dropped from 47 percent to 38 percent, and the 50 largest, from 68 percent to 58 percent. Similar declines were registered in the individual segments of the metal fastener industry.

In 1984, when imports increased dramatically, the largest size class establishments actually increased their numbers by 5, from 39 to 44. This is a clear indication that an adjustment has been made. For the most part, these firms are no longer competing directly against imports. Instead, many large firms have reoriented themselves into the larger volume specials markets, where their financial health and survival is tied to conditions prevailing in the various durable goods end-markets.

Establishment Count

(number of establishments)

Employment Range	1980	1981	1982	1983	1984
1 to 19	299	323	356	453	416
20 to 99	304	297	317	310	326
100 to 249	107	97	98	76	86
250 and greater	62	59	49	39	44
Total	772	776	820	878	872

A harbinger of the possible re-entry of U.S. firms into the standards markets is the opening by Nucor Corporation of the first standard fastener plant in the United States in over 25 years. The new facility, located in St. Joe, Indiana was built in 1986 at a cost of $25 million and took less than a year from breaking ground to producing its initial fastener. Nucor is also investing $10 million in its Norfolk, Nebraska steel mill to furnish cold header quality wire rod used to make fasteners. Nucor intends to compete in grade 2, grade 5, and grade 8 hex cap screws, and A325 and A490 structural bolts in sizes ranging from 1/4" to 1-1/4".

The capacity of the plant will be 40 to 45 thousand tons with expansion potential to 80 thousand, which is equivalent to 5 to 10 percent of recent imported tonnages. The plant will employ between 130 and 140 people, a significant drop from the 300 to 500 people once needed to run a similar size bolt plant. The employees received three months of in-depth training on primary boltmaking machines, with extensive cross training in tool making, maintenance, plating and furnace operations. Each employee understands the total process and is able to fill a variety of jobs in the plant. The future of this new facility looks promising and its progress will be closely monitored by the Commerce Department's Office of Industrial Resource Administration.

COMPETITIVE TRENDS

The competitiveness of U.S. fastener firms has improved in the last few years in terms of both technical efficiency and exchange rate sensitive labor costs. However, the costs of American producers remain higher than competitors despite these recent improvements.

During the last 15 years, stiff import competition has forced the domestic industry to become more specialized at the factory level. This has narrowed the focus of many firms, allowing them to excel in terms of product quality, shorter lead times, responsiveness to customers' specific requirements, and production efficiencies. Further, because specials are produced in smaller volumes and require closer collaboration with end users, they confer a degree of immunity from foreign competition. Although imports dominate the high volume standards markets which are price sensitive, additional import incursions will have to be in the specials markets where price is less important. Thus, further gains of imports will be gradual.

In the last four years, the speed of the machinery used by the fastener industry has increased by about 20 percent. In addition, the machinery is easier to reset or change over to new production parameters. However, with much of the industry confined to smaller volumes, production speed has become somewhat less important and resetting the equipment more important.

National Machinery Company in Tiffin, Ohio is the chief producer of fastener machines, including a full line of cold headers, thread rollers, nut formers and boltmakers. National has developed what it calls a "Change Over Assistance Package" (COAP) to quicken the reset time. The package includes computer controlled tool changes and push button settings and clampings. On larger, multi-station machines COAP can reduce set-up time by a factor of five or even six. The further computerization and automation of fastener process technology are now the central thrusts of National's research efforts.

Another rapidly evolving technology is in-process controls, which measure and monitor the forces exerted by the tooling on the fastener blanks at the various machine stations. The units can detect wear in the tooling, thereby reducing scrap rates and improving quality control. The devices also shut the machine down if tooling should break which decreases the severity or eliminates the downtime caused by "smash-ups". This not only saves many thousands of dollars in tooling costs but also enables the machine to come back on line faster because it reduces downtime clean-up, thereby increasing equipment utilization. It also allows the machine to run unattended, permitting an operator to handle several machines where only one could be handled before, thereby reducing labor requirements and costs. The number of in-process controls installed has increased from only a few hundred four years ago to well over a thousand today. Expectations are that their use will double or triple in number in the next two or three years.

The largest marketer of these devices in the world is Brankamp, which manufactures the units in Dusseldorf, West Germany. Helm Instruments, in Maumee, Ohio is the largest U.S. producer of the devices, followed by Impax, a subsidiary of the Brunswick Corporation, located in Downers Grove, Illinois.

The new Nucor plant in St. Joe, Indiana is equipped with 24 state-of-the-art boltmakers from National Machinery Company. Each of these has a Brankamp in-process control to measure forces and a Nematron computer to monitor machine functions and collect production statistics.

The cost of labor (including social payments) accounts for about one-third of the shipment value of fasteners in the United States.

The cost of labor in the manufacturing sector as a whole is much less at slightly over 20 percent. This implies fastener production is more labor intensive than most other manufacturing processes. Hourly compensation (without social payments included) of production workers in the fastener industry grew by 21.4 percent between 1981 and the third quarter 1986, from $8.24 to about $10.00.

A comparison of wage scales, adjusted for exchange rates, with our leading trading partners shows the United States becoming more competitive, especially since 1984, when the dollar began weakening. Since statistics for the foreign countries were not available for the fastener industry, the more aggregated industry, Fabricated Metal Products, which includes fasteners, was used to make the comparison.

The United States has the highest labor rates among our major fastener trading partners. However, our rates have declined relative to most of our trading partners with the weakening of the dollar, combined with the more rapid growth of labor rates (in national currencies) in most foreign countries than in the United States.

In 1984, Japan's wage rate was only 49.4 percent that of the U.S. However, by the third quarter 1986, because of the steep appreciation of the yen, Japan's rate had climbed to 73.1 percent of the U.S. rate. The growth of Japan's wage scale in terms of yen was only 14.1 percent between 1981 and 1986.

Taiwan pegs the Taiwanese dollar to the U.S. dollar. However, the wage scale measured in Taiwanese dollars increased by 39.2 percent from 1981 to 1986, which was more than that experienced in the U.S. This resulted in a small improvement in the U.S.

position. However, Taiwanese wage rates currently average only $1.63 per hour, or only 12 percent of the U.S. compensation of $13.56. It is difficult for U.S. (or Japanese) firms to compete on a price basis with labor rates this low.

South Korean wage rates grew by almost 83 percent, measured by the Korean won, between 1981 and 1986. This led to a slight improvement in the U.S. position. However, Korean compensation was only $1.65 in 1986. West German labor rates increased from 67.8 percent of U.S. rates in 1984, to 97.6 percent in the third quarter 1986. This was due primarily to a 29 percent rise in the DM relative to the dollar. Italian rates climbed from 57 percent of U.S. compensation in 1984, to 87.2 percent in 1986. Canadian rates, however, declined relative to the U.S., falling from 84.3 percent in 1984, to 77.8 percent by the third quarter 1986. Partly in response to this deteriorating position, exports of fasteners to Canada, the major customer of U.S. firms, fell by almost 38 percent over this period.

Changes in Comparative Labor Compensation Rates
(in U.S. dollars adjusted for exchange rates)

Year	U.S.	Canada	Japan	Taiwan	S. Korea	WGermany	Italy
1981	$11.08	$9.58	$6.16	$1.27	$1.17	$9.98	$7.45
1984	12.79	10.78	6.32	1.51	1.46	8.67	7.29
1985							
I	13.15	10.51	5.88	1.53	1.54	8.14	7.29
II	-	10.37	6.04	-	1.49	8.59	7.48
III	-	10.44	6.35	-	1.46	9.32	7.77
IV	-	10.29	7.33	-	1.46	10.29	8.42
1986							
I	13.56	10.48	8.22	1.63	1.64	11.77	10.61
II	-	10.63	9.09	-	1.64	12.30	11.82
III	-	10.55	9.91	-	1.65	13.24	11.82

Note: The above labor rates are for the broader industry (SIC 34) Fabricated Metal Products, which includes Industrial Fasteners as one of its component industries.

An adverse consequence of the weaker dollar may be a tightening and possible increase of steel prices. Steel represents about 30% of finished fastener cost. Over 50 percent of the steel wire rod used to make fasteners is imported from Japan. However, additional quantities have come from Korea and Taiwan in recent years. Since their currencies are pegged to the dollar, imports of their steels would be expected to increase somewhat at the expense of Japan and moderate upward pressures on Japanese prices.

Steel prices have fallen in the U.S. in the last several years as major over capacity problems in the steel industry have forced consolidations and bankruptcies. The prolonged shutdown of USX Corporation's steel division beginning August 1 last year halted the downward pressure on prices. With the strike now over and this firm's re-entry into the marketplace, prices are likely to resume their downward trend.

Imports of fastener grade steel should continue at high levels as many of the integrated mills have reduced or dropped the fastener grades altogether. Mini mills such as Georgetown, North Star, Rariton River, and now Nucor have moved quickly to fill this gap, and may, because of good quality at competitive prices, gain market shares at the expense of imports. With the yen hovering around 160 to the U.S. dollar, this appears all the more likely.

Conclusions

- Industrial fastener activity remains substantially below peak production experienced in 1979. However, with the expansion in the general economy shipments, employment, investment and the number of firms producing fasteners have increased since the completion of the Section 232 investigation in 1983.

- Imports of all fasteners increased from about 15 percent ($556 million) in 1983 to about 19 percent ($867 million) of U.S. apparent consumption in 1984, when they appear to have stabilized. The tonnage increase in absolute terms was from 987 to 1,481 million pounds. Further increases will be gradual and are likely to be in the specialty markets, in which U.S. firms have competitive advantages.

- Stagnation or declines in the U.S. customer base for fasteners may pose as significant a threat to the long-term viability of the fastener industry as the higher levels of imports.

- Japan is experiencing a loss in its U.S. market share due to increased competition with lower-wage countries such as Taiwan and South Korea. Because of this, Japan may be forced into the specials markets and may be in direct competition with U.S. firms in this area in the future.

- The competitiveness of U.S. firms showed some signs of improvement with continuing technical innovation. The improved exchange rate position with Japan should provide some future assistance in our trade position. But increasing U.S. market shares by Taiwan and Korea could have a moderating influence on the overall U.S. position.

- Although some large companies have gone out of business or dropped the standard fastener lines since 1979, a major firm re-entered the standard fastener market in 1986.

- Given the fact that the manufacture of standard industrial fasteners (which have the highest import penetration levels) is based on long-established technologies, we expect that U.S. production capacity could be expanded significantly under emergency conditions that would prevail under a general mobilization.

APPENDIX 1

Since the U.S. fastener industry today is so reliant on its end users, particularly the automotive and aerospace sector, a brief discussion of these two areas follows.

Automotive

In recent years the motor vehicle industry has consumed about a billion dollars in metal fasteners on an annual basis. This is by far the largest amount consumed by any single industry and accounts for between 25 and 30 percent of the value of total fastener consumption. Each newly constructed passenger car contains from 2,500 to 3,000 joints which require mechanical fastening. Assuming the various sized trucks use a similar number, the 12 million vehicles assembled in this country every year contain from 30 to 36 billion fasteners.

The great size of the auto market has influenced the design, material usage, technology, and fastener standards prevalent in the fastener industry. Almost every major fastener producer supplies the automotive market and some firms do so exclusively. While most original equipment manufacturers try with varying degrees of success to avoid the more costly specials, the auto makers, because of their large order quantities, can usually get a fastener maker to invest in the tooling and equipment needed to make specials, and provide them at a price little more than standard fastener costs.

The final assembly of motor vehicles accounts for most of the fastener use - considerably more than all previous operations combined. About 50 to 60 percent of the fastening is done mechanically with metal fasteners, 30 to 40 percent spot welded and

the remainder with adhesives and riveting. The assembly operation also accounts for more than 50 percent of the total manufactured cost of the finished vehicle. In the assembly operation, the actual installation of mechanical fasteners may be 5 to 10 times more costly than the fasteners themselves. This circumstance continues to stimulate new fastener designs (specials) which are more easily installed and serve to lower assembly costs.

Because so many specials are consumed by the domestic auto makers, these firms have historically favored domestic fastener manufacturers to supply their requirements and thereby provided somewhat of a captive market. Domestic fastener production afforded the auto maker closer engineering control over the fastener design and material composition, lower inventory carrying costs, and familiarity (cultural, language, etc.) with the supplier. Today the auto firm's preference for just-in-time inventories, lower installation costs, and traceability (to resolve potential liability claims) continues to favor the domestic producer. Nevertheless, auto firms are less concerned today about retaining domestic sources and more concerned about reducing costs.

The use of imported fasteners is increasing, especially where standard fasteners are used. The auto industry purchases about 25 to 35 percent of its fasteners through distributors and many of these are imported. Although distributors market the higher volume specials which may or may not be imported, they primarily offer imported standard type fasteners. However, since over 80 percent of the fasteners used in an automobile are not for critical or safety applications (i.e., not for wheels, brakes, transmissions, etc.), the traceability issue is of less significance in constraining

imports than the added installation costs standard fasteners may entail. Where the installation cost is not a factor, the imported fastener would be favored.

Honda, Nissan and Volkswagen have assembly plants in the United States which foreign source many of their fasteners. Nifco (Japan), which markets fasteners to all of the Japanese auto companies both in the United States and in Japan, is setting up a joint venture with Illinois Tool Works in Kentucky to provide a local fastener source to Honda and Nissan and in the near future to Mazda and Mitsubishi when they open U.S. assembly plants. In addition, General Motors is forming a joint venture to produce auto fasteners for its Saturn small car project in Tennessee with two Korean firms, Pohang Iron and Steel and Dongbu Industrial. The new facility could involve at least $15 million in investment during 1987.

The auto industry is confronted with the greatest competitive pressures of its history. Imported cars exceeded 3 million units (28.3 percent of U.S. consumption) in 1986, up from 2.3 million in 1981 and 2.8 million in 1985. By 1990 imported autos are expected to approach 4.2 million (nearly 37 percent of U.S. consumption). Sales of Japanese made imports, including "captive" imports of GM and Chrysler, remain strong, despite Japanese extensions of voluntary restraints and the dramatic rise in the value of the yen to the U.S. dollar. If anything, the restraints on Japanese car exports accelerated the move of Japan's automakers into the upscale market. Since 1980, sales of Japanese mini and subcompacts have declined relative to compacts and luxury models, which almost doubled. More new luxurious models were introduced during 1986 and sold very well. Further, strong demand for European built models

and new models from Korea helped bolster 1986 import sales.

In 1987, imports are projected to increase from 3.1 to 3.65 million units to capture a 34 percent share of the U.S. market. Domestic made car sales are anticipated to fall by over 10 percent from 7.85 million to less than 7.1 million units. Little improvement is expected through 1990. Japan will persistently move toward larger, more luxurious models. New vehicles will enter from Australia, Brazil, Romania and possibly Taiwan and will join those already coming from Korea and Yugoslavia. By 1990, between 1.5 and 2 million units will be assembled in foreign owned plants located in the United States.

Imports of smaller more fuel efficient vehicles were in large part a response to a shift in consumer preference for more fuel efficient cars coupled with the American companies' inability to supply that demand. The auto companies lost record levels of money in the early 1980s. This was aggravated by the deep recession of 1982. However, enormous sums are being invested by the auto makers in automation to improve their competitiveness and to meet the shift in consumer preference. These and other developments in the Auto Industry are having an adverse impact on the mechanical fastener industry.

The average car size is getting smaller each year, reducing the number of fasteners required. Lighter materials such as plastics, which lend themselves to adhesives rather than metal fasteners, are being substituted for metals. The installation of thousands of robots is increasing the use of spot welding at the expense of mechanical fasteners. Further, fasteners are increasingly being made stronger so that their size or number can be reduced.

Aerospace

The aerospace industry share of U.S. fastener consumption has ranged between 10 and 15 percent in terms of value in recent years, making it the second largest fastener user following the auto industry. Because of their high unit cost, the unit consumption of aerospace fasteners is a much smaller share of the market than their share in terms of value. However, as in autos, installation costs are a critical consideration in the design of these fasteners. For example, the assembly cost of a C-130 Cargo Transport, which has about 3.5 million fasteners, would be astronomically higher, and perhaps impossible to build, if careful attention were not paid to fastener design criteria.

The aerospace fastener business is highly specialized and unique in terms of material usage, production parameters, and quality control. Heavy dependence on military contracts has put emphasis on product quality and traceability and less on production efficiency. The special materials, limited production quantities, expensive tooling and extra quality control costs make aerospace fasteners from five to ten times more expensive than their non-aerospace counterparts. A non-aerospace producer would have great difficulty converting to aerospace fastener production. The entire production floor would have to be re-equipped. Additional equipment to work harder materials would be needed along with different heat treatment, inspection and testing capabilities. Further, extensive retraining of personnel would be required.

About 70 to 80 percent of the mechanical fastening is done with rivets, 10 to 20 percent with threaded fasteners, and the remainder spot welded. Approximately three-fourths of the fasteners

are rated at 160,000 psi tensil strength or better. Adhesives as well as composite materials are increasing in use, but this should not significantly affect the use of mechanical fasteners in the foreseeable future.

More than half the fasteners used in aerospace applications are made from aluminum. Titanium is increasing in use and is preferred in critical structural applications where great strength is needed such as rotor assemblies on helicopters. Other materials include stainless steels and brass. Driven by the need for better performance, ongoing efforts are underway to develop new mechanical fastener designs and material chemistry to improve fatigue resistance, corrosion resistance and fastener strength. This could lead to smaller fasteners of less weight which will increase fuel efficiency.

At the present time, imports of aerospace fasteners are nearly non-existent. A representative of the Defense Industrial Supply Center in Philadelphia reported that he knew of no imported fasteners used by defense in aerospace applications. An industry spokesman reported that small amounts of imports enter from Western Europe, chiefly the United Kingdom. Another source of imports would be those imported into the U.S. and contained in general aviation aircraft used for business transportation, regional airline service or recreation. These aircraft are imported from British Aerospace, de Havilland of Canada, Dassault-Breguet of France, and Saab-Scania of Sweden. However, contained aerospace fastener imports are more then offset by a large export surplus of large aircraft.

The aerospace sector is extremely cyclical, although it is currently in an upswing. This has improved the outlook for

aerospace fasteners, which will probably expand proportionately with the market through 1990. Military aerospace shipments have outdistanced civilian shipments since 1982. In 1986, military shipments accounted for approximately 65 percent of total aerospace shipments. However, U.S. budget constraints cast uncertainties on the future demand for military aircraft.

The U.S. dominates the world aerospace market, thanks to the dynamic and advancing nature of the domestic technology base. As offshore competition intensifies, U.S. aircraft and missile manufacturers must continue to pioneer new technologies to protect their lead. Further inroads will be made by foreign concerns in the established technologies.

APPENDIX 2

TARIFF SCHEDULES OF THE UNITED STATES: INDUSTRIAL FASTENERS

TSUS#	Product Description
646.1500	Unthreaded drive pins, studs and other fasteners
646.1700	Threaded drive pins, studs and other fasteners
646.4000	Rivets, not brightened, lathed, or machined of iron and steel
646.4100	Rivets, non-ferrous, n.e.s.
646.4200	Cotters, cotter pins, etc., non-ferrous
646.4920	Lag screws or bolts of iron and steel
646.4940	Wood screws of iron and steel, n.e.s.
646.5100	Wood screws having shanks or threads not over 0.12 inches, non-ferrous, n.e.s.
646.5300	Wood screws having shanks or threads over 0.12 inches, non-ferrous, n.e.s.
646.5400	Bolts and bolts and their nuts imported in the same shipment of iron and steel
646.5600	Nuts of iron and steel, n.e.s.
646.5700	Studs and studding of iron and steel
646.5800	Machine screws 0.375 inch or more in length and 0.125 inch or more in diameter of iron and steel
646.6020	Cap screws having shanks or threads, not over .24 inch diameter of iron and steel
646.6040	Screws not over 0.24 inch diameter of iron and steel, n.e.s.
646.6320	Cap screw, over 0.24 inch diameter of iron and steel
646.6340	Screws over 0.24 inch diameter of iron and steel, n.e.s.
646.6500	Spiral and other lock washers of iron and steel
646.7000	Washers of iron and steel, n.e.s.
646.7200	Assembled bolts or screws and washers; screw eyes, screw hooks and screw rings, etc.; turnbuckles of iron and steel
646.7400	Muntz or yellow metal bolts, non-ferrous, n.e.s.
646.7500	Bolts, having shanks, threads, or holes not over 0.24 inch diameter, non-ferrous
646.7600	Bolts, having shanks, threads, or holes over 0.24 inch diameter, non-ferrous
646.7700	Studs and studding, non-ferrous
646.7800	Assembled bolts or screws and washers; screw eyes, screw hooks and screw rings, etc.; turnbuckles, non-ferrous
646.7910	Bolts, if Canadian article and orig. motor vehicle equip.
646.7920	Nuts, if Canadian article and orig. motor vehicle equip.
646.7930	Screws, if Canadian article and orig. motor vehicle equip.
646.7940	Bolts, nuts, screws, etc., Canadian article and orig. motor vehicle equip., n.s.p.f.