PUBLIC

THE EFFECT OF IMPORTS OF PLASTIC INJECTION MOLDING MACHINES ON THE NATIONAL SECURITY

An Investigation Under Section 232
of the Trade Expansion Act of 1962, as amended
(19 U.S.C. 1862)

U.S. Department of Commerce
Bureau of Export Administration
Export Administration
Office of Industrial Resource Administration
Strategic Analysis Division

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EXECUTIVE SUMMARY

Background

On January 11, 1988, the Domestic Injection Molding Machinery Trade Group of the Society of the Plastics Industry (SPI), of Washington, D.C. petitioned the Department of Commerce (DOC) to conduct an investigation under Section 232 of the Trade Expansion Act of 1962, as amended, to determine the effect of imports of thermoplastic injection molding machines (PIMMs) on the national security.

Under the statute, the President has authority to "adjust imports" based on recommendations from the Secretary of Commerce. Under then-existing law, the DOC had one year in which to complete its investigation and forward its report to the President. (Congress has recently amended the statute to require that future investigations be completed within 270 days.)

In its petition, the SPI asserted that "import penetration has drastically endangered the health of the injection molding machinery industry ... (and the) continued and uncontrolled importation (of injection molding machines) is a threat to the national security."

The Significance of PIMMs to National Security

Plastic injection molding machines are used to manufacture a wide range of parts used pervasively in defense applications, ranging from knobs and handles to missile nose cones. Some of these parts are essential to the effective operation of critical military systems, while others have more mundane applications and can be substituted by the use of other materials. Based on available information, DOC estimates that the Department of Defense consumes about four percent of products manufactured on injection molding machines. About 30 percent of this is specialty plastic, versus only three percent of total commercial consumption. In the event of a national security crisis involving a major mobilization of U.S. Armed Forces, it is expected that DOD usage of injection molded plastic would increase substantially.

Investigation Methodology

The methodology for this investigation is based on a two-step process.

Step I

In order to determine whether the United States can meet current and prospective national security requirements for PIMMs, the Department developed the following supply/demand analysis.

Available supply of PIMMs was determined by considering:

- o the ability of the domestic industry to expand production during emergency conditions based on a DOC survey of the manufacturing capabilities of nine leading domestic PIMM producers;

- the ability to convert the existing stock of PIMMs from civilian to defense use;
- imports available from reliable sources; and
- an evaluation of industry economic trends to determine whether it can be anticipated that the domestic production base will shrink, expand, or remain constant in the years ahead.

Unlike previous Section 232 investigations (machine tools, bearings) requirements (demand) for PIMMs are not directly obtainable from the 1984 NSC Stockpile Study. In order to estimate national security requirements in a one year mobilization period followed by one year of a major conventional conflict, the Department pursued the following approaches as the best means available to analyze demand for parts manufactured by PIMMs:

- deriving PIMM requirements from Stockpile Study required outputs for the more aggregate Special Industry Machinery category, and from the Plastic Materials category which includes PIMM feedstocks;
- estimating national security PIMM requirements by extrapolating from data on annual consumption of plastic resins;
- conducting a series of focused interviews with PIMM users; and
- consulting with the Department of Defense to estimate future trends in PIMM requirements expected to result from research and development and from projected weapon systems procurements.

Step II

If a supply shortfall is found, the Department then determines whether imports have been a significant cause of the industry's inability to meet national security requirements.

Significant Industry Trends

In order to determine the prospective production and technological capabilities of the domestic industry in the coming years, the Department evaluated recent trends that affect the industry's overall industrial competitiveness.

Domestic shipments have varied significantly from year to year. Shipments peaked in 1984, fell sharply in 1985 and have been static through 1987.

Employment has declined 11 percent since 1984. Employment of production workers has fallen 16 percent over the period, while the number of engineers increased by 8 percent.

Exports have been volatile, increasing since 1984 after bottoming out in 1983 and 1984. The largest markets for U.S. exports have continued to be our neighbors in Canada and Mexico.

Imports have increased dramatically since 1982, growing 700% by value and 350% by units. Import penetration appears to have stabilized, however, thus far in 1988. Japan currently supplies over 55 percent of imports in both unit and value terms, and has been responsible for the overwhelming majority of increased import penetration in recent years.

Competitiveness

The domestic industry's competitiveness has deteriorated in recent years, particularly relative to Japanese manufacturers. There are encouraging signs, however, that this trend has begun to reverse.

Although quality and technical capabilities are believed to be the most important factors considered by PIMM purchasers, recent devaluation of the dollar should allow U.S. builders to increase their price competitiveness. The petitioner alleges that dumping by foreign suppliers has limited U.S. producers' ability to benefit from exchange rate fluctuations.

Recent introductions of new PIMM product lines by U.S. manufacturers have successfully sought to replicate Japanese success with building "standard" machines in large production runs. While the competitiveness of larger U.S. producers is expected to improve in the near to mid-term, smaller firms are likely to either remain successful in niche markets or see continuing deterioration.

Supply Shortfall Analysis

Using all the methods described above for determining defense requirements for PIMMs in a national emergency, no shortfalls in the availability of PIMMs were found. U.S. producers have the ability to expand production by about 100 percent within the one year of mobilization and one year of war, nearly meeting estimated defense requirements for PIMMs. When the approximately 80,000 existing machines currently used to produce non-critical items and reliable imports are included in the available supply, estimated defense requirements for PIMMs are easily met.

Finding

Therefore, we have determined that available supplies of plastic injection molding machines will be sufficient to meet anticipated requirements during a national security emergency. The Department, therefore finds that plastic injection molding machines are not being imported into the United States in such quantities or under such circumstances as to represent a threat to the national security.

Recommendation

The Department recommends that the President take no action to adjust imports under authority of Section 232 of the Trade Expansion Act of 1962, as amended.

I. INTRODUCTION

On January 11, 1988 the Domestic Injection Molding Machinery Trade Group of the Society of the Plastics Industry (SPI) of Washington, D.C., petitioned the Secretary of Commerce to conduct an investigation under Section 232 of the Trade Expansion Act of 1962, as amended, to determine the effect of imports of thermoplastic injection molding machines on the national security. The Act states that:

> The Secretary shall report the findings of his investigation ... with respect to the effect of the importation of such article.... The President shall take such action, and for such time, as he deems necessary to adjust the imports of such article ... so that such imports will not threaten to impair the national security....

In its petition, the SPI asserted that "import penetration has drastically endangered the health of the injection molding machinery industry" and the "continued and uncontrolled importation [of injection molding machines] is a threat to the national security." A summary of the allegations set forth in the petition and in supplemental submissions by the petitioner is attached at Tab A.

The Department of Commerce (DOC) reviewed and accepted the SPI petition, and announced its initiation of this investigation in the Federal Register on March 4, 1988 (copy attached at Tab B). The articles under investigation are covered by Tariff Schedule of the United States (TSUS) numbers 678.3517 and 678.3570, and in Standard Industrial Classification (SIC) numbers 3559.353, 3559.354 and 3559.355. Under then-existing law, the Secretary of Commerce had one year from the date of receipt of the SPI petition in which to conduct an investigation and forward a report to the President.

The Department conducted this investigation with assistance from the interagency community, including the Departments of Defense and Labor. In order to obtain data regarding the industry's ability to supply sufficient machines during a national security crisis, the Department conducted a survey of nine major producers of this equipment (copy attached at Tab C). Additional information was gathered from public comments received in response to our Federal Register notice (summary attached at Tab D), from other Government and private studies of the plastics industry, and from independent research and consultation with industry experts - including telephone conversations with approximately 75 firms involved in the injection molding industry.

Investigation Methodology

A Section 232 investigation is conducted to determine the effect of imported articles on the national security. An investigation includes examination of the effect of imports on all phases of U.S. productive capacity necessary to meet requirements for the article based on a selected emergency scenario.

The Department's Section 232 regulations (found at 15 CFR 359) provide the following factors for consideration in determining the effect of imports on the national security:

a) domestic production needed for projected national defense requirements;

b) the capacity of domestic industries to meet projected national defense requirements;

c) the existing and anticipated availabilities of human resources, products, raw materials, production equipment and facilities, and other supplies and services essential to the national defense;

d) the growth requirements of domestic industries to meet national defense requirements and the supplies and services including investment, exploration and development necessary to assure such growth; and

e) other relevant factors.

Supply

In determining the total available supply of injection molding machines, the following elements were considered: a) the ability of the domestic injection molding machinery manufacturing industry to expand production under emergency conditions; b) the existing stock of injection molding machines in this country and their ability to be converted from civilian to defense use; and c) imports available from reliable sources.

Requirements

Recent Section 232 investigations have derived national security requirements from the 1984 National Security Council Stockpile Study. The NSC Stockpile Study does not, however, directly provide requirements for plastic injection molding machines (PIMM). Requirements for these machines are presented as a constituent element of the larger category of special industrial machinery. Our first approach to estimating requirements was, therefore, to estimate PIMM requirements based on Stockpile Study data. We also utilized Stockpile Study data on plastic resin requirements, and extrapolated from this information the number of PIMMs needed to process this resin. Due to the inexact nature of these approaches, we chose to supplement them with three other approaches.

Next, we employed a methodology proposed in the public comments of the Japan Society of Industrial Machinery Manufacturers. This approach led us to estimate the total number of PIMMs used in defense-related activities by extrapolating from data on the annual domestic consumption of plastic resin.

Third, a series of structured interviews were conducted with PIMM users to determine the extent of their defense-related business, and the fungibility of equipment currently used in non-defense applications.

Finally, Commerce asked the Department of Defense to estimate future trends in requirements for injection molded defense products expected to result from research and development (including secret programs) and projected procurements of new and modified weapons systems.

Report Outline

This investigation report begins in Chapter II with an overview of the plastics industry. Chapter III provides specific information about the product under investigation, and the industry that manufactures this product. Chapter IV discusses present and future defense applications of plastic, and the role that injection molding machines play in this usage. This is followed in Chapter V by a description and analysis of the industry's recent economic performance, including shipments, exports and imports. In Chapter VI, the international competitiveness of the industry is assessed. Chapters VII and VIII estimate anticipated supply and demand of PIMMs in a national security emergency. Finally, Chapter IX presents the investigation's finding and recommendation.

II. OVERVIEW OF THE PLASTICS INDUSTRY

A. Plastic Raw Materials

Plastic has been used to replace traditional materials such as wood, rubber, metal, and glass for over one hundred years. Cellulose nitrate, a type of plastic material, was used as a substitute for ivory in billiard balls as early as the 1860's. However, rapid growth in the plastics industry did not begin until World War II. During the war, traditional materials were often in short supply, and plastic materials were introduced as substitutes into many markets at a rapid rate.

Since that time, plastics have continued to expand in applications, and now have penetrated virtually all markets because of their adaptability (i.e., their ability to be formed into any shape), ease of processing, and relative low price. Plastics have grown in use because they are able to be processed into complex shapes much more readily and with less labor than traditional materials. Metals, for example, require expensive and time consuming machining. Moreover, with plastics, there is no waste -- no scrap or trimmings, and rejected parts can simply be remelted and used again.

There are numerous types of plastic materials, each with unique characteristics. New varieties of plastic material and blends/alloys of materials with new and improved qualities (e.g., heat resistance, antistatic qualities, improved conduction, and processibility) continue to be introduced at a rapid rate. In the past year, for example, over 950 new types or grades of thermoplastics were introduced.[1]

In general, a plastic is a polymer, a long chain molecule containing thousands of repeating small molecular units (monomers). Most polymers are amorphous (i.e., have no fixed crystalline form), and thus are capable of being modified into an endless variety of shapes. In addition, most polymers in use today are originally derived from crude oil and natural gas feedstocks, chiefly ethylene, polyethylene, and benzene.

There are two main types of plastic materials: thermoplastics and thermosets. These categories differ mainly in their ability to be reprocessed. Thermoplastics can be repeatedly softened and hardened by temperature and so can be processed repeatedly. In thermosets, on the other hand, a chemical reaction known as crosslinking occurs during solidification, and a three dimensional network among the molecules is formed. Reheating of thermosets does not fully break down this structure, and so

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[1] Plastics Technology, June, 1988, page 104.

reprocessing is not possible. Thus, thermoplastics are much more economical to use than thermosets, because waste and scrap can be salvaged and reused. Thermoplastics account for over 95 percent of total resins processed by injection molding, and almost 80 percent of resins used by all plastics processing methods.

Polymers are synthesized by chemical companies (there are over 250 suppliers in the United States) and are distributed to plastics processors in a variety of usable forms called resins. Resins can take the form of pellets, powders, granules, or liquids and often contain additional functional ingredients such as colorants and stabilizers. Moreover, two or more different polymers are often alloyed or blended to form a resin, resulting in a combination or improvement of the characteristics of the individual polymers. In some cases, fillers or reinforcements such as glass or carbon fibers or minerals are added to the polymer to form a composite, which may have superior performance qualities than possible with a polymer alone. Advanced composite is a term used to describe a composite which has performance characteristics which equal or exceed metals, generally with a polymer content of 30-40 percent, and a reinforcement content (carbon fiber, aramid, glass) of 60-70 percent. This combination often results in a material that is stronger than metal, but with a much lower weight. This quality makes advanced composites excellent materials for military and aerospace applications, as well as some specialized consumer applications such as golf clubs and tennis rackets.

Plastic resins can generally be divided into three broad categories or tiers: commodity, engineering, and performance. Commodity resins are relatively easy to process, are commonly used in most commercial applications, are inexpensive, and are sold in large volumes to processors. Engineering resins exhibit higher performance characteristics, such as heat resistance, are sold in much lower volumes and are relatively expensive. Performance (also known as advanced) resins possess even better qualities, but are expensive and often difficult to process. Table II-1 provides estimated annual sales volumes, prices and typical applications for common resins in each of the three categories.

According to SPI, commodity-grade resins accounted for nearly 97 percent of the nearly 48 billion pounds of resins sold in the United States in 1985.[2] Polyethylenes alone (LDPE, HDPE, LLDPE) accounted for about 30 percent of volume resin sales. Engineering and performance resins, on the other hand, made up only three percent of resin volume in that year.

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[2] SPI, Plastics A.D. 2000, Appendix, Table A-3.

TABLE II-1

Thermoplastic Resins Sales and Uses

	1987 SALES VOLUME (Million Lbs)	PRICE/POUND* ($)	TYPICAL APPLICATIONS
COMMODITY RESINS			
Polyethylene	9,499	.45	Packaging, Bags
Polyvinylchloride	8,055	.41	Pipes, Construction
Polystyrene	4,857	.58	Toys, Cups, Cassettes
ENGINEERING RESINS			
PET	1,667	.60	Bottles, Film
Nylon	471	1.50	Transportation, Electronics
Polycarbonate	387	1.60	Glazing, Electronics, Batteries
PERFORMANCE RESINS			
Polysulfone**	NA	4.25	Pumps, Medical, Electrical
Polyetherimide**	NA	4.46	Circuit Boards, Electronics
Polyamideimide**	NA	5.40	Valves, Mechanical
PEEK	.5	23.00	Wire, Aerospace, Bearings

* As of March, 1988. Plastics Technology, April, 1988.

** Sales volumes not available, but all are less than 20 million pounds each.

SOURCE: SPI Plastics A.D. 2000; Plastics Technology, April, 1988.

The most critical plastics for military application are in the engineering and performance categories, although a great deal of commodity grade plastics are used in defense items as pervasively as they are used throughout the rest of the economy. (See Chapter IV for a further discussion.)

B. Plastic Processing

Plastics processing constitutes the next phase of the overall plastics industry. This sub-industry consists of fabricators of plastic parts and shapes who purchase their raw materials from resin suppliers and their capital equipment, from machinery suppliers, such as PIMM manufacturers that are the subject of this investigation.

There are a variety of ways in which plastic materials can be processed, depending on the desired part or shape and the type of resin. The following is a brief description of the three most commonly used methods in which plastic raw materials are transformed into a vast array of products and shapes.[3]

Extrusion is a continuous process used to produce semi-finished goods such as pipe, wire, film, cable, sheet, raincoats, and packaging materials. Extrusion accounts for 35 percent of the volume of all resins processed, more than any other processing method. There are approximately 3,000 extrusion plants in the United States, and over 17,000 extrusion machines in operation. Resin throughput per machine is very high in the extrusion process.

Blow Molding is the plastic processing method used to produce hollow thermoplastic items, such as bottles, containers and suitcases. In most cases, a plastic preform is heated and air is blown in, forcing the material against a mold in the desired shape. Approximately 1,200 plants are involved in blow molding operations, with a total of 6,500 blow molding machines. Blow molding accounts for only 9 percent of resin consumption.

Injection Molders, the purchasers and users of the injection molding machines that are the subject of this investigation, employ the third primary method of processing plastics. This method is used to produce more kinds of plastic parts and products than any other method, and is generally used for thermoplastics, although thermosets can also be processed in this way with slight alterations in machine design. Three-dimensional injection molded plastic products can be found in virtually every sector of the economy, including toys, automotive parts, appliances, electronic components, and medical devices.

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[3]Statistical information in this section is taken from Plastic Technology's "Plastics Manufacturing Census, 1986."

Injection molding is by far the largest sector of the plastics processing industry, with over 7,000 facilities and nearly 80,000 machines in operation. This sector accounts for only 20 percent of resin consumption. However, over one fifth was engineering or performance resins because the parts produced can be very complex and are used in demanding applications.

Among the 7000 injection molding facilities, about 70 percent are "custom" molders, who produce plastic parts as subcontractors to other manufacturers. The remaining 30 percent are "captive" molders, divisions of larger manufacturing companies devoted to producing needed plastic parts for internal consumption.

These three methods -- extrusion, blow molding, and injection molding -- account for the bulk (about two-thirds) of plastics processed in the United States. In addition to these primary methods for processing plastics, there are a number of other means to fabricate specific types of plastic parts. Thermoforming begins with extruded thermoplastic sheet, onto which heat and vacuum are applied in order to form shapes such as refrigerator door liners, bathtubs, trays and packaging materials. Rotomolding is used to form large hollow objects, and involves turning a sealed mold on which heat is being applied in order to distribute the resin evenly over the mold surface. Compression Molding and Transfer Molding are most often utilized to process thermoset resins. In these processes, resin is preheated to close to cure temperature and then is introduced into a mold. It is forced into all parts of the mold by pressure, and then is allowed to cure in the mold. Another relatively new type of specialized processing is Reaction Injection Molding (RIM), considered a separate sector from injection molding. RIM is a thermoset process involving a chemical reaction of two material components. It is used extensively in the automotive industry for formation of large, rigid structures such as bumpers, and is desirable because of its low energy usage. Hand Layup and Sprayup are methods of processing plastic composites. Hand layup entails laying a fibrous mat or cloth on an open mold, impregnating it with resin using rollers, and then curing. Sprayup is similar, but the resin and fibrous substance are sprayed onto the mold simultaneously. Filament Winding is another method used to process thermosets and composites, using a continuous fiber-reinforced thread to form a desired shape by winding it over some predetermined path. Pultrusion is a method commonly used to process reinforced plastics and composites into rod and tube-shaped articles such as fishing rods and construction beams. In this process, resin is applied to a rod or tube pulled through a molding machine, resulting in high strength along the length of the finished product.

C. Related Sectors

In addition to resin and primary plastics working machinery (including injection molding machines), there is a wide variety of other equipment used by plastic processors in the course of fabricating plastic forms. For example, robots and conveyors are employed for automatic part removal, and hopper-loaders automatically feed resin into the machines. Heaters, driers and chillers are needed to regulate the temperature of molds. Granulators, blenders and mixers allow custom resin combinations. Molds of all types (injection, compression, blow, etc.) are provided to processors by the separate mold-making industry, although some processors make their own molds and many operate mold repair and maintenance facilities. The remainder of this report will focus on injection molding machines, and will cite other sectors of the plastic industry only as they pertain to injection molding.

III. PLASTIC INJECTION MOLDING MACHINERY INDUSTRY

A. Product Description[1]

As noted above, injection molding is the most widely used process for fabrication of complex plastic parts. Injection molding machines first came into use in the 1920's, as new resins were introduced. Today, manufacturers of injection molding machines work closely with both resin producers and plastic processors in order to design and build equipment capable of forming three dimensional and often complex shapes to close tolerances. Injection molding machines can be used to shape virtually all types of thermoplastic materials. Many thermoset materials can be injection molded as well, but some modifications to the injection molding machine are necessary.

In injection molding, plastic raw material, usually in pellet or granule form, is fed from a hopper into a heated barrel containing a screw which acts as a plunger. In the barrel, the resin is melted, the rotation of the screw ensuring a homogenous mixture. The shape and length to diameter ratio of the screw varies according to the specific resin to be injected, but there are "general purpose" screws that are used in 70-75 percent of machines.

After the resin is melted, it is injected under high pressure into a closed, chilled mold cavity. The mold, which has two parts, is attached to a platen on the machine. The two parts are held closed by clamp pressure, measured in tons. After sufficient cooling time, the mold opens and releases the finished plastic part, perhaps with the aid of robots. The molding cycle then begins again. The cycle time depends upon a number of factors, including the type of thermoplastic and size and design of the plastic part, but typically lasts from several seconds for small parts to several minutes for larger ones. Much of the cycle time for larger parts is needed for cooling in the mold.

Injection molding machines are made in a vast array of sizes and types. Machine size can be measured by "shot capacity" -- the number of ounces of resin that can be injected at one time. Machines are also commonly sized according to their "clamp force," the number of tons available to hold the two parts of the mold closed during the injection and molding stages. In general, there is a proportional relationship between clamp force and the size of the finished plastic part. Injection molding machines are offered for sale in this country in clamp forces from two

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[1] This section draws heavily from the Modern Plastics Encyclopedia 1988.

tons up to 6,100 tons and from .2 ounce shot capacity to 2977 ounce shot capacity.

Injection molding machines are also available in "horizontal" and "vertical" types, referring to the axis of orientation of the injection unit containing the screw. Vertical machines are primarily used for small, close tolerance parts and for insert molding, in which plastic is molded onto or around non-plastic parts, such as a screwdriver with a plastic handle or various electronic components. In addition, the clamp unit (which opens and closes the mold) can be either mechanically (called "toggle") or hydraulically operated. Toggle clamps are comparatively less expensive and easy to use, and are used mostly on smaller machines. Hydraulic clamps offer more flexibility in machine set-up and operation, and are used extensively on mid- to large-size machines. Hydromechanical clamps, a combination of the two types, are often used on very large machines.

Injection molding machines are also sometimes classified according to the type of material they can process (thermoplastic or thermoset). The U.S. Government classifies machines in this way to monitor imports via the Tariff Schedule of the United States (TSUSA). Although the petition that initiated this investigation only specified thermoplastic injection molding machines, this report generally addresses both types of machines. This was done because it was not analytically possible to make a distinction between the two classes of machines in many cases. Many U.S. producers for example, could not provide specific data broken down by type of machine. Moreover, neither SPI nor SIC-based data make such a distinction.

In addition, for the purposes of this investigation, a differentiation between thermoplastic and thermoset machines is irrelevant as well as impractical. Both types of machines are manufactured by the same producers in the same facilities. The differences between the two types are relatively minor. Lastly, thermoset injection machines account for only three to five percent of total injection machine sales and usage. Hence, the inclusion of thermoset machine data along with thermoplastic machine data does not significantly alter apparent industry trends.

There are up to 200 variables that must be controlled during a single injection process. Thus, injection molding machines incorporate controls to monitor and govern essential machine functions, such as temperatures, times, speeds and pressures. If any of these variables go out of tolerance during the molding process, a poor quality plastic part can result.

Early machines used relay controls, then solid state circuit boards came into use. Today, many machines utilize microprocessors and microcomputers, operated from a CRT. These controls are capable of controlling all operations of the machine as well as auxiliary devices, such as hoppers, chillers, and robots. Moreover, these advanced controls are capable of automatically recording set-up and processing parameters for production of a given plastic part, greatly improving the repeatability of quality part production. With advanced controls, the injection molding machine has become an integral part of a computerized manufacturing system. Thus, in the last decade injection molding has become much less of a "black art" and more of a science with the assistance of microprocessor-based controls.

B. Molds

Injection molds are supplied to plastics processors independently of injection molding machines. The mold, however, is the essential component for production of a specific plastic part. Different molds can be and are used on a single injection molding machine, as long as the part size is compatible with the machine's basic features and dimensions (i.e., shot size and clamp force). The process of changing a mold on a machine can take anywhere from four to 15 hours in unproductive downtime, involving electric and hydraulic disconnections and hookups, movement of heavy components, and attachment to the machine platen. The introduction of quick mold change (QMC) systems in the late 1970's reduced mold changing time to under one-half hour by use of standardized machine/mold interfaces, mold preheat stations and robotic movement of molds. However, QMC systems are very expensive, making them cost-effective only among processors who must change molds frequently.

Molds, which are usually made of special alloy or stainless steel, are very complicated devices. In addition to a cavity in the precise shape of the desired part, each two-part mold contains other components needed to successfully mold plastic materials, including runners (to control the flow of molten thermoplastic), cooling channels (to control mold temperature), and ejection systems (to remove the part after molding is completed). Mold making is a very skilled operation, both in the design and machining phases. Each mold must be engineered so as to ensure the best possible flow of thermoplastic into all sections of the mold, and systems for controlling the temperature (and minimizing cooling time) must be built into the mold. Mold design and manufacturing can exceed nine months for complex parts, and requires close collaboration between mold makers and processors. The development and commercialization of CAD/CAM systems in recent years, however, has simplified mold-making and has led to increased mold imports from distant offshore sources.

C. U.S. Injection Molding Machine Industry

The most recent Census of Manufactures[2] for SIC 355, Special Industry Machines (1982) identified a total of 138 establishments and 12,000 employees involved in the manufacture of plastics-working machinery in the United States. This broad category includes manufacturers of all types of plastics-processing equipment, including injection molding machines as well as extrusion machines, blow molding machines, and less common types. Shipments of all equipment totalled $614.4 million in 1986, of which $315.0 million (51 percent) was injection molding equipment.[3] Plastics machinery production in the United States is concentrated in Ohio, with over one quarter of all shipments originating in that state.

The injection molding machinery industry is even more concentrated in that region, with the three biggest producers and many of the smaller ones located in and around the Ohio valley. In fact, five of the seven petitioners are based in Ohio. According to the Census of Manufactures, there were 22 firms in 1982 which shipped at least $100,000 of injection molding machines with 500 tons of clamping force or less; and 11 firms meeting this level of shipments of larger size injection molding machines. Since there is an overlap between the two groups, the total number of U.S. firms producing injection molding machines cannot be determined through publicly-available data. While most firms that produce large size machines (over 500 tons clamp force) also manufacture smaller machines, there are a number of companies that exclusively produce small machines.

Published indices and directories of plastics machinery manufacturers[4] were consulted in an attempt to identify all current U.S. producers of injection molding equipment (see Table III-1). The group that filed the petition initiating this investigation includes the country's largest injection molding machine producers among its seven members. In fact, the three biggest producers (Cincinnati Milacron, Van Dorn, and HPM, all members of the petitioning group) together account for over 60 percent of U.S. production. The other petitioners (Natco, Newbury, Reed Div., and Klockner Ferromatik[5]) bring to over 80

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[2]Conducted every five years by the Dept. of Commerce, Bureau of the Census.

[3] SPI Facts and Figures, p. 108.

[4]Such as Plastics World Magazine's "1988 Plastics Directory" and Modern Plastics Encyclopedia 1988.

[5] Klockner later dropped its support for the petition.

percent the volume of U.S. production represented. Many of the other companies involved in the production of injection molding machines produce very small quantities (less than 25 machines per year). Some of these firms, however, (Mar-Tech, Morgan, Jaco, Gluco, Illinois Precision) produce significant volumes of machines (50-200 per year).

TABLE III-1

U.S. Manufacturers of Injection Molding Machines

Autojectors, Inc. (Albion, IN)
Cincinnati Milacron (Batavia, OH)*
Gluco, Inc., (Pittsburgh, PA)
HPM Corp. (Mt. Gilead, OH)*
Hettinga Equipment (Des Moines, IA)
Hull Corp., (Hatboro, PA)
Jaco Manufacturing Co. (Berea, OH)
Klockner Ferromatik Desma (Erlanger, KY)*
Lester Engineering (Stow, OH)
Illinois Precision Corp. (Wheaton, IL)
Mar-Tech Machinery (Fort Wayne, IN)
Morgan Industries (Long Beach, CA)
NATCO Inc. (Richmond, IN)*
Newbury Industries (Newbury, OH)*
Package Machinery Co., Reed Div. (Stafford Springs, CT)*
Van Dorn Plastic Machinery (Strongsville, OH)*
Simplomatic Mfg. Co. (Chicago, IL)
Trueblood, Inc. (Tipp City, OH)
Vimm Machine (Worcester, MA)

* Full Range Producer

However, these companies, unlike the leading PIMM producers manufacture only a limited selection of generally small clamp force (less than 100 tons), vertical, insert molding, and/or rotary or shuttle press injection machines, which they sell in specialty niche markets. These machines tend to be lower priced than those manufactured by the major producers, and often are on the lower end of the technological scale. Many of the smaller producers have primary businesses that are complementary to production of injection machines, such as the manufacture of rubber and die casting equipment, mold making, and other types of plastics working machinery.

In addition, there are some additional firms in the United States, such as the Epco Division of John Brown Machinery Co., that specialize in the remanufacture of injection molding machines. (Some injection machine producers also offer this service.) These firms purchase used machines and replace worn parts and update technology within the confines of the machine design, and then resell the machine. A remanufactured machine costs approximately half the price of a comparable new machine. Epco, the largest rebuilder, reconstructs about 200 machines per year.[6]

Several firms have discontinued production of injection molding machines in recent years. The most significant of these companies was Farrell Corp., which had been the fourth largest U.S. producer. Farrell left the injection machine business in mid 1982. In 1983, Cincinnati Milacron acquired Farrell's line of large injection machines (over 1000 tons), and Conlon Corp. purchased its smaller machine lines. Later, the Improved Co. purchased Farrell's small machine operations from Conlon, and was itself purchased by Newbury in 1986. Another fairly large producer, the New Britain Co. of Connecticut, was bought by HPM in 1985 and consolidated into HPM's manufacturing operations, only to be closed in 1987.

Other establishments that have ceased production of injection molding machines include Kent, Stokes, McNeil Akron, and Micromatic. However, none of these firms was ever a major player in the general injection molding marketplace. Most of these firms exited the injection machine business before imports became a major presence in the U.S. marketplace, which has occurred only over the past four or five years.

In addition, some U.S. injection machinery producers have closed plants and/or consolidated operations in smaller facilities. These include HPM as noted above as well as Package Machinery Corp. (Reed Division) which closed its East Meadow, Massachusetts plant in 1986, consolidating operations in a new, efficient, but smaller plant in Stafford Springs, Connecticut. Natco also downsized its operations in Richmond, Indiana, dismissing half of its workforce and reducing its production capacity by 200 units per year.

D. International Injection Molding Machinery Industry

In addition to the United States, several other countries are major players in injection molding machinery manufacture, supplying equipment to a wide variety of users throughout the world. Japan, West Germany, Canada, Switzerland, and Italy are among the largest injection molding machine manufacturers. Table III-2 below lists major producers in these countries.

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[6] Plastics Technology, January, 1988, p. 76.

Limited official statistical information is available on the injection molding machinery manufacturing operations in any of these countries. Generally, this industry is not broken out from other sectors of the plastic-working machinery industry in official publications, and in some cases it is combined with rubber-working equipment.

TABLE III-2

Major Foreign Manufacturers of Injection Machines

Company	Home Country
Arburg	W. Germany
Battenfeld	W. Germany
Boy Machine	W. Germany
Bucher	W. Germany
Engel	Austria/Canada
Husky	Canada
Italtech	Italy
Japan Steel Works	Japan
Klockner Ferromatik	W. Germany
Krauss Maffei	W. Germany
Mannesmann Demag	W. Germany
Mir	Italy
Netstal	Switzerland
Niigata	Japan
Nissei	Japan
Sandretto	Italy
Toshiba Machine	Japan
Ube	Japan

Industry experts estimate that about 32,000 injection molding machines are manufactured worldwide per year.[7] U.S. production accounts for less than 10 percent of this total, down from a significantly higher world market share in the 1970's. While specific figures are unavailable, at that time, U.S. production surpassed 4,000 units while total world production was less than it is today.

Japan's Institute of the Polymer Industry states that in 1986, Japan produced over 11,000 injection machines (about one-third of world production and three times U.S. production).[8] Japan

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[7] For example, in a statement by Raymond Ross, Vice President of Cincinnati Milacron, Plastics Machinery Division, to Commerce Department representatives on September 28, 1988.

[8] Plastics Industry News, Vol. 33, No. 4 (April, 1987), p. 51.

appears to specialize in production of smaller size machines: almost 50 percent were under 100 tons clamping force versus 35 percent of U.S. production. Japan exported about one-third of its production in 1986 (30 percent of which went to the United States), while imports totalled only 173 units (about two percent of domestic consumption).

European countries, led by West Germany and Italy, produce approximately 16,000 machines per year, fully one-half of world production. However, production information on either a company or a country basis is spotty. West Germany is recognized as a leader in injection molding technology, specializing in very high quality, sophisticated equipment for advanced applications such as two-tone automobile taillight molding and manufacture of compact disks. Like Japan, West Germany exports significant numbers of injection machines. Half of its exports go to other European nations, and about one-quarter go to North America.

Italy has several major producers of injection molding equipment, and apparently specializes in production of very large size machines. One Italian firm, Italtech, manufacturers the largest injection machine available in the United States, at 10,000 tons of clamping force. Sandretto and Mir, also of Italy, account for production of over 1,500 machines per year (combined), in all size ranges from 90 to 4,500 tons.[9]

Canada is home to Husky Injection Molding Systems, which produces high quality machines used extensively in packaging applications. Husky also produces injection molds. Also manufacturing in Canada is Engel, an injection molding machinery manufacturer based in Austria, as well as several specialized smaller producers. Canada exports a large percentage of its PIMM production, mostly to the United States.

In addition to these long-time players, there are some relatively new entrants into the world injection molding machine market, including Taiwan and South Korea. One source indicated that there are about 100 injection molding machinery producers in Taiwan alone, albeit minor producers with a considerably different product than machines used here.[10] These countries have been producing injection machines for domestic consumption for a number of years, but are now beginning to focus more attention on export markets, especially the United States. Firms in these countries have begun to Americanize their products: adding features that U.S. processors demand but are not needed in

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9 Plastics Machinery & Equipment, November 1987, p. 64.

10 Plastics World, February, 1988, p. 17.

Pacific Rim countries. These countries will undoubtedly have a growing presence in the U.S. market in the next several years. Some U.S. and other developed country producers are establishing production facilities in these countries for the cost savings they can reap from lower wage rates. Van Dorn has had an operation in the Far East for several years; and Cincinnati Milacron has a licensing agreement with Daewoo of South Korea and Fanuc of Japan to manufacture Cincinnati machines for consumption in the Far East, where U.S.-origin machines have not been competitive. Swiss producer Netstal is in the process of opening a production facility in Singapore, after cancelling similar plans to start production in the United States due to costs. Finally, Sharp Industries of Japan has just begun to market in the United States Taiwan-built injection machines from 85-2,800 tons.

IV. DEFENSE USES OF PLASTICS

Quantifying defense uses of plastic is extremely difficult. Plastics are used in virtually every industrial sector, from toys and housewares to the most advanced tactical aircraft, and much of these plastics are fabricated on injection molding machines. According to Plastic Technology's injection molding census,[1] the top five industries utilizing captive injection molding machines are electrical/electronic equipment (36 percent); medical, optical and other instruments (16 percent); transportation, including automotive and aerospace (12 percent); miscellaneous manufacturing, including toys, housewares, and sporting goods (12 percent); and non-electrical machinery (10 percent). Many of these types of industrial products have military as well as commercial application, although military use may be minor relative to total peacetime consumption.

One recent study[2] found that the Department of Defense is the largest single consumer of plastic parts (as it is for many industrial products), accounting for approximately four percent of the value of all plastic parts sold in the U.S. between 1980 and 1985. According to this report, over one-third of DOD's consumption was "specialty" plastics -- either engineering or performance thermoplastics, reinforced plastics, or polymer-based advanced composites. (Specialty plastics account for only about three percent of overall plastics consumption by volume in the general market.) The most sophisticated and critical of these specialty plastics used by the Defense Department are the composite materials.

A. Polymer Matrix Composites

There are several different types of composite materials, including ceramic matrix composites, metal matrix composites, and those most relevant to this study, polymer matrix composites (PMCs). Polymer composites are broken into two categories: reinforced plastics and advanced composites. Reinforced plastics include such relatively inexpensive and widely used materials as fiberglass, which has been in use for over 30 years in such applications as boat hulls, sporting goods, and automobiles. This type of composite accounts for about 98 percent of the volume of composites consumed in this country. The remaining two percent of composites are referred to as "advanced," meaning that the material exhibits properties (e.g., high temperature resistance and stiffness) superior to conventional materials such

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[1] Plastics Technology, August 8, 1986, pages 62-65.

[2] "Specialty Plastics in Military Applications," prepared by Business Communications Co., Stamford, Connecticut, 1986; as reported in Modern Plastics, October, 1986, p. 168.

as steel and aluminum. These are generally "tailored" materials: designed and manufactured to have specific properties required for a particular application. In fact, the primary use for polymer-based advanced composites is in aerospace and military applications, with these applications accounting for over two-thirds of advanced composite consumption. Due to their expense, few advanced composites are currently used in the commercial sector outside of commercial aerospace applications.

PMCs are desirable for such advanced operations due to their light weight, high stiffness and strength, and resistance to corrosion and fatigue in comparison with most metals. Currently, a major limitation on the increased use of PMCs is their low temperature resistance relative to some metals and other advanced materials, notably ceramic composites. At present, the maximum operating temperature for PMCs is about 600° F, but with additional research and development, operating temperatures near 800° F are projected.

Advanced PMCs were first used about 15 years ago in the horizontal stabilizer of the F-14 fighter plane, and have become standard and essential features of all sophisticated fighter and attack aircraft. Major uses include wing skins, fuselages, horizontal and vertical stabilizers, helicopter blades, meteorite shrouds on satellites, and trusses and struts on space vehicles.

Currently, PMCs are under full-scale development for use in the Navy's V-22 Osprey aircraft and are under consideration for use in the Army's LHX helicopter and the Air Force's Advanced Tactical Fighter. The Defense Department has devoted at least $119 million in research and development funds to the PMC field from 1985-1987.[3]

Most PMCs utilize thermosetting resins as a binder for fiber reinforcements because of their superior temperature resistance (see Table IV-1). Recently, advanced thermoplastic materials, such as polyetheretherketone (PEEK), have been developed and offer great promise for future use as a base for composites. Thus, the next generation of fighter aircraft may contain thermoplastic composites, which are preferable because of their relative ease of fabrication.

PMC's are currently fabricated into the desired shapes in a variety of ways, but most of these are very time consuming, labor intensive and expensive. The most common method is lay up,

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[3] Advanced Materials By Design: New Structural Materials Technologies, Office of Technology Assessment, June 1988, p. 26.

TABLE IV-1

Common Resins and Fibers Used to Form Advanced Polymer Matrix Composites

RESINS	FIBERS
Polyethersulfone (PES)	Aramid
PEEK	Boron
Polyimide	Carbon
Polyphenylene sulfide	Glass
Polyamide imide	
Epoxy	
Phenolic	
Polyester	
Bismaleimide	

either manually or automated with robotics. Other methods include filament winding, compression molding, and transfer molding, which are all suited to formation of thermosetting materials. One of the most critical areas of research and development in the polymer composite area is aimed toward progress in the fabrication process. This is all the more important because other types of materials including new aluminum alloys, metal-matrix and carbon-carbon composites, and advanced ceramics compete with plastics and plastic-matrix composites for sophisticated military applications. The future use of plastics in military and other advanced applications is thus to some extent dependent on the development of economical methods of fabrication (such as injection molding), as well as on the development of new types of materials with superior performance characteristics.

In October 1987, the National Bureau of Standards held an industry workshop[4] on the potential of various processing methods as commercially viable means to fabricate polymer composites. The workshop was attended by advanced composites users, suppliers, and fabricators and focused on technical barriers to commercialization. The industry experts present were asked to project which generic processing methods are or will be important for economical processing of polymer composites in the next five to 15 years. Injection molding was included on the list of possible processing methods, but failed to rank in the top nine as an efficient technique for use in automating and commercializing production of polymer composites. Processes which appear to have greater potential for composite processing

[4]Polymer Composite Processing: An Industry Workshop. U.S. Department of Commerce, National Bureau of Standards, Institute for Materials Science Engineering, October 7, 1987.

include: compression molding, transfer molding, filament winding, thermoforming, and pultrusion.[5] Injection molding is currently used to form certain types of composite parts, such as small gears and electronic components, which are made from thermoplastic composite materials which contain short fiber reinforcements. For the future, injection molding was considered to be a possible composite processing method by some of the electronics producers present at the workshop, particularly for use on equipment housings.

With improvements both in processing technology and the properties of the materials, polymer composite usage is predicted to expand at a rate of 15 percent per year throughout the remainder of this century. Defense use is expected to grow at an even faster rate (up to 22 percent per year) over this period.[6]

In conclusion, although advanced polymer composites are indisputably significant for the national defense, and their continued expansion and commercialization is certainly necessary for both defense and economic reasons, it does not appear that injection molding has had or will have in the foreseeable future a large role to play in this expansion.

In addition, the injection molding process is currently being explored as a method of forming advanced ceramics, which are expected to be extremely critical in future defense applications because of their temperature resistance. However, development of this technology is presently in its infancy. In fact, ceramic injection molding machines are not yet manufactured for sale. Although the petitioners allege that PIMM technology is important for the future development of ceramic injection molding techniques, there is no conclusive evidence that this is the case. Firms that are involved in ceramics research are primarily ceramic companies, research institutions, and the major aerospace gas turbine engine producers. Injection molding machinery producers are not directly involved in the research at this time, although perhaps they could have a role to play.

B. Other Specialty Plastics

Some types of plastic are considered "advanced materials" even though they are not composites. Polyetheretherketone (PEEK), polysulfone, and polyamideimides are among plastic advanced materials. Defense accounts for a significant, but indeterminate amount of consumption of these materials. They are included,

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[5] A brief discussion of each of these processing methods, is included in Chapter II.

[6] Office of Technology Assessment, op.cit., p. 12.

along with advanced composites, in the "specialty plastics" category that makes up an estimated one-third of defense use of plastics. Not all of DOD usage of these materials is injection molded; much is formed in other ways, such as transfer and compression molding and reaction injection molding. Nevertheless, certainly some of these specialty engineering and performance polymers are injection molded, and are used in a wide variety of defense-related products. Non-composite materials are used extensively on aircraft fuel tanks, ship hulls, tank turrets, and satellite dishes. Specialty thermoplastics with high heat resistance, mechanical strength, and low dielectric (non-conducting) properties will become increasingly important for military electronics applications. This sector is expected by industry experts to grow at between 5.0 and 7.5 percent per annum. Specific examples of military utilization of engineering/ performance polymers include reinforced phenolic rocket nozzles, polycarbonate cockpit enclosures, polyester travelling wave tubes, and electronic enclosures used in missile guidance of polyamideimide and glass-filled PPS.

C. Commercial Grade Plastics

Given that only one-third of Defense polymer consumption is of "specialty" plastics and advanced composites, there remains a significant amount of consumption in the "commercial" grades of plastics, including polyethylene, PVC, and polypropylene. Defense use for these plastics include: pipes, knobs, handles, and other component parts of ammunition, guns, missiles, and aircraft. Although detailed information is not available, the use of plastics in these types of applications is dictated (as in the commercial sector) largely by the low price and easy processibility of plastic. Use of plastic for more important applications is restricted because of low pressure and heat resistance.

It is reasonable to assume that the plastic parts used by DOD are fabricated by processes similar to the proportion that they are fabricated in the commercial arena. Thus, a great deal of these plastic parts (including pipe and sheet) are likely formed by extrusion, while injection molding is probably used to form the majority of complex, three dimensional plastic shapes. Injection molding machines, therefore, contribute significantly to the smooth routine operation of the military based on the volume and pervasiveness of the plastic parts fabricated by them, even if these plastic parts are not of the highest level of sophistication.

In order to gain a better understanding of defense uses of injection molded plastic parts (as well as mobilization capabilities and competitiveness information), the Department of Commerce conducted informal telephone interviews with more than 50 plastics processors involved in production of defense and medical items. The firms contacted manufacture a wide variety of defense-related items, including projectile supports, parts for jet engines, ignition caps for M-8 smoke grenades, missile fins, electrical parts for thermoinsulators and Trident Submarines, sealing bands that seal pressure in barrels, parts for artillery rounds; ordnance items such as ammunition parts, cartridges, magazine clips, and shell casings, computer parts, visors, switches, O-rings for missiles, canteen lids, and battery casings. Medical parts produced include eye droppers, syringes, pill closures, I-V pumps and blood testing equipment.

According to these processors, critical defense components are manufactured using a wide range of plastics resins. The most common resins, as in the commercial sector, were polypropylene, polyethylene, and polycarbons. A significant number of processors, however, cited usage of sophisticated engineering and performance resins, including nylon, PEEK, and PES.

Injection molding machines used to form these items ranged from as small as 28 tons up to 1,500 tons of clamping force, in much the same ratio as the machines are used in the commercial sector. Medical items, which are generally small, tend to be produced on smaller machines (as small as 15 tons clamp force).

Most of the processors polled manufactured other items in addition to defense-related production, and few sold their product directly to the Defense Department. For this reason, the processors had only an incomplete understanding of the amount of their output ultimately to be used for defense purposes. To the extent they knew, their products were supplied to such important defense contractors as General Dynamics, Lockheed, Boeing, Northrop, Honeywell, Hughes, Grumman, McDonnell Douglas, and TRW.

The informal conversations held with these processing operations generally confirmed the information regarding defense use of injection molded plastics.

V. U.S. INDUSTRIAL PERFORMANCE

A. Domestic Shipments

There are no comprehensive figures available for U.S. shipments of injection molding machines. Although SPI gathers and assembles shipment data from its membership, these data are not exhaustive of the industry. Despite the fact that SPI has among its members the majority of injection molding machinery producers, there are a number of firms that do not participate in the association, and statistics from these firms are not included in SPI data. The table below presents SPI's calculations of domestic machinery shipments for the years 1978-1987. Participants in SPI's survey changed over time as companies merged, ceased production of PIMMs, or simply withdrew from the SPI. The most recent years (1986-1987) have had ten members reporting.[1]

TABLE V-1

Shipments of Injection Molding Machines According to SPI

Year	Units	Value (Millions)
1978	3081	$286.6
1979	3024	$285.9
1980	2175	$220.7
1981	2124	$232.4
1982	1469	$150.5
1983	1922	$191.7
1984	2705	$305.5
1985	2332	$337.7
1986	1709	$281.8
1987	1748	$242.6E

Source: SPI Petition

Shipments data from the DOC producers' survey very closely track SPI statistics for the last six years. This is not surprising as seven of the DOC's nine survey recipients also participated in the most recent SPI poll. The results of the DOC survey are shown below, broken down by clamp force.

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[1] Van Dorn, HPM, Cincinnati Milacron, Reed Division of Package Machinery Corp., Jaco Manufacturing Co., Lester Engineering Co., Natco, Newbury, Klockner, and Epco Div., John Brown Machinery. The last is largely symbolic, since Epco no longer builds new machines.

TABLE V-2a
U.S. Shipments of Injection Molding Machines
In Units

Clamp Force	1982	1983	1984	1985	1986	1987	1988*
0-99 Tons	337	492	747	646	448	425	484
100-299	529	704	1048	781	592	663	606
300-499	260	397	571	504	405	475	464
500-699	76	118	169	180	130	144	194
700-999	51	69	101	161	142	105	128
1000-1499	13	24	24	54	59	56	58
1500+	16	9	12	43	57	26	38
Total	1282	1813	2672	2375	1839	1899	1974
(SPI Total)	(1469)	(1922)	(2705)	(2332)	(1709)	(1748)	(NA)

Source: Section 232 Industry Survey

TABLE V-2b
U.S. Shipments of Injection Molding Machines
(Millions of Dollars)

Clamp Force	1982	1983	1984	1985	1986	1987	1988*
0-99 Tons	$12.8	$20.2	$34.0	$29.2	$22.6	$22.2	$24.6
100-299	41.0	57.4	87.3	79.2	60.9	62.3	54.4
300-499	32.8	50.8	69.7	78.9	65.9	76.2	72.0
500-699	14.1	21.9	32.3	40.8	29.8	32.3	46.8
700-999	11.8	16.4	21.7	51.2	45.9	34.1	20.4
1000-1499	4.3	7.7	9.5	23.3	27.5	25.9	27.2
1500+	11.2	6.3	5.3	32.6	43.0	19.4	26.6
TOTAL	$128.0	$180.7	$259.8	$335.2	$295.3	$272.4	$292.8
(SPI Total)	($150.5)	($191.7)	($305.5)	(337.7)	($281.8)	($242.6)	(NA)

Source: Section 232 Industry Survey

* 1988 figures are annualized based on six months of actual data.

These data display a number of interesting trends. First of all, shipments show significant variation from year to year. This is due to the effect of large individual orders which have had a tangible effect on the overall total. However, it is apparent that 1984 was a particularly good year, when nearly 2,700 units were shipped, a 47 percent increase over the previous year. This is the most since 1978, when industry shipments (according to SPI figures) exceeded 3,000 units. The next two years showed a decrease in domestic shipments, while in 1987 and 1988, shipments are again on the rise, even though the levels of the earlier years have not been attained.

In value terms, shipments follow a similar path over the 1982-1988 period. One exception is that value shipments continue to decline in 1987 despite the increase in unit shipments, indicating a decline in the average value of each machine, perhaps in response to import competition.

The DOC survey recipients reported their shipment levels in two ways in addition to size: machines with microprocessor controls and those with simpler controls (e.g., solid state). Machines with microprocessor-based controls increased dramatically over the 1982-1987 period, from 15 percent to 69 percent of the overall total. In general, larger size machines are more likely to have microprocessor controls than smaller size machines. In 1987, only 47 percent of the smallest size category of machines had these advanced controls, contrasted with 90 percent of machines in the 1,000 to 1,499 ton range.

The years 1982-1988 also show small but significant shifts in the relative importance of machines in various size ranges to domestic manufacturers' sales. In particular, shipments in the two smallest size categories (under 300 tons clamp force) accounted for 67 percent of unit shipments and 42 percent of value shipments in 1982; by 1987 their share had dropped to 57 percent of units and 31 percent of value. This may be in response to increasing imports over the period, particularly from Japan, whose exports are concentrated in the smaller categories. Meanwhile, all of the remaining larger machine categories show increases in share of shipments over the period, although the percentage increase for each individual category is small. The 100 to 299 ton size range of machine has remained the most common size in terms of unit sales among the major U.S. producers (accounting for 35 percent in 1987) while the next-size range (300-499 tons) captures the largest portion of value sales (28 percent).

As noted above, neither the DOC survey nor the SPI data covered all domestic manufacturers of plastic injection molding machines. Although a great deal of information and apparent trends can be derived from the shipment data above, for some analyses and for comparisons with foreign countries, it is essential to estimate the size of the total U.S. plastic injection molding machinery industry. Thus, in order to supplement the DOC questionnaire, telephone interviews were conducted with senior level representatives of all other identified U.S. injection molding machinery producers. These firms were queried as to their current average annual production of injection molding machines, as well as the sizes and types of machines produced. The results of this informal survey are provided below.

If these smaller firms, generally involved in producing small and/or specialized equipment, are included in the U.S. shipment figure, 1987 shipments would increase by about 500 units (approximately 25 percent) to about 2,400 units. Using this as an approximation for total U.S. production of plastic injection molding machines in 1987, the top three producers account for about 60 percent of industry shipments. The SPI shipment data capture about 70 percent of the total, while the DOC survey data capture over 75 percent for 1987.

TABLE V-3

Other U.S. Producers of Injection Molding Machines

Name of Firm	Approx. Annual Production (1987)	Size Range	Notes
Gluco, Inc. Pittsburgh, PA			
Hull Corp. Hatboro, PA			Peak: /yr
Illinois Precision Wheaton, IL			Insert Molding
Jaco Manuf. Co. Berea, OH			
Krauss-Maffei Florence, KY	********************** * DELETED TO PROTECT *		Plans for /yr
Lester Co. Stow, OH	* COMPANY PROPRIETARY* * INFORMATION * **********************		Major player, 1950's & 60's
Mar-Tech Mach. Fort Wayne, IN			
Morgan Indust. Long Beach, CA			Insert Molding
Trueblood Tipp City, OH			Vertical, Shuttle Press
Vimm Machine Worcester, MA			Peak: /yr.
TOTAL	423-581	Most Under 100 tons	

Source: DOC Telephone Interviews

Extrapolating from this information, estimates can be made of the U.S. industry's total production for the years 1982 to 1988. To do this, SPI shipment data for the years 1982 to 1984 were used as a baseline, since for this time period the SPI survey is superior to the DOC data (because it covers former SPI members now out of business). For the more recent years (1985-1988), the DOC survey is more comprehensive, as evidenced by the greater levels of shipments captured by it in comparison to the SPI data. To these baseline data for each year, 25 percent was added to the unit shipments in order to account for the shipments of the smaller firms that are not parties to the SPI or the DOC surveys. To derive estimates of the comparable value of shipments over this time period, the SPI or DOC actual dollar shipments were increased by the average value of non-computer controlled machines in the under 100 ton clamp force category times the estimated additional production in units (25 percent). This is justified by the fact that, for the most part, the firms that are not captured by the SPI or DOC data produce small, less sophisticated equipment.

These computations are set forth below:

TABLE V-4

Estimates of Total Shipments

	Baseline*		Additional		Total	
	Units	Value (Millions)	Units	Avg. Value	Units	Value (Millions)
1982	1469	$150.5	367	$37,900	1836	$164.4
1983	1922	$191.7	480	$40,800	2402	$211.3
1984	2705	$305.5	676	$43,200	3381	$334.7
1985	2375	$335.2	594	$42,300	2969	$360.1
1986	1839	$295.3	460	$43,600	2299	$315.4
1987	1899	$272.4	475	$45,300	2374	$294.0
1988E	1974	$292.8	493	$49,900	2467	$317.4

* Baseline figures: for 1982-1984, SPI data. For 1985-1988, Section 232 Industry Survey.

Source: DOC and SPI

B. Employment Trends

For the nine firms surveyed by the DOC, employment within the injection molding machinery manufacturing operations totalled 3,547 in 1987, down 422 workers (11 percent) since 1984. Employment levels increased two percent from 1984 to 1985, but declined thereafter. (See Table V-5).

TABLE V-5

Employment by Surveyed Firms

	1984	1985	1986	1987
Engineers & Computer Specialists	225	235	228	242
Designers & Drafters	171	182	160	160
Production Workers	1801	1861	1754	1540
Other (incl. Admin.)	1772	1761	1425	1605
TOTAL	3969	4039	3567	3547

Source: Section 232 Industry Survey

In comparison, according to the Bureau of Labor Statistics, employment within the broader industry (SIC 355 - special industry machinery) was down only 3.8 percent during this period. For all manufacturing, employment fell just 1.6 percent between 1984 and 1987.[2] Within the state of Ohio (where the three largest producers are located) employment in SIC 355 fell 9.7 percent from 1984 to 1987.[3]

Manufacturing workers (e.g., machinists, assemblers, painters, and engineers) represented 54.8 percent of total employment in 1987. This percentage was slightly lower than the 1984 figure of 55.4 percent. Firms have reduced their manufacturing staffs by 225 workers or 11.6 percent since 1984, indicating that a slight majority of the employment reductions taken fell upon this group.

The mix of workers in the industry has also shifted since 1984. The expanded use of numerically controlled machines and robotics during the production process, and the constant development of more sophisticated, computer driven injection molding machines have increased industry demand for computer specialists and electrical engineers, and have reduced the need for machinists, welders, and assemblers. While overall employment has dropped by more than 10 percent since 1984, the number of assemblers, machinists, and

2 Bureau of Labor Statistics, LABSTAT database, July 1988.

3 Labor Market Statistics, Ohio Employment Service, October 1988.

welders fell 15.8 percent, while the number of engineers and similar professions increased by eight percent. This trend is likely to continue as firms pursue the manufacture of more sophisticated machines and adopt production processes (such as Flexible Manufacturing Systems) requiring fewer machinists.

C. U.S. Exports and Imports of Injection Molding Machines

1. U.S. Exports

Export performance has been volatile over the 1982 to 1988 period. Exports did, however, begin to increase in 1985 after low levels in 1983 and 1984. This favorable trend was likely due to the devaluation of the dollar at that time as well as other factors which increased competitiveness. Exports account for a relatively small percentage of U.S. shipments of injection molding machines, varying between four and 16 percent on both a unit and value basis, but have increased since 1984.

The traditional markets for U.S. machines, as for many U.S. manufactured products, are our neighbors in Mexico and Canada. Other major markets are in South America, South Korea, and Western Europe, but these areas show much more variability from year to year, reflecting the impact of large single orders.

TABLE V-6a

U.S. Exports of Plastic Injection Molding Machines 1982-1988 (Units)

	1982	1983	1984	1985	1986	1987
Mexico	60	42	33	77	162	138
Canada	30	31	26	43	40	36
S. Korea	0	0	0	2	12	75
Venezuela	11	2	4	7	19	16
Japan	1	1	3	7	10	8
Italy	1	0	0	18	0	4
U.K.	8	0	11	8	6	24
France	2	1	1	3	6	0
Colombia	15	22	9	2	22	11
Australia	3	3	0	1	1	1
OTHERS	30	51	62	67	88	66
TOTAL	161	153	149	235	366	379
% of Shipments	8.8%	6.4%	4.4%	7.9%	15.9%	16.0%

Source: U.S. Bureau of the Census

TABLE V-6b

U.S. Exports of Plastic
Injection Molding Machines
1982-1988

(Millions of Dollars)

	1982	1983	1984	1985	1986	1987
Mexico	$9.9	$2.7	$3.1	$5.8	$15.0	$7.7
Canada	4.7	3.0	3.4	8.9	4.2	4.9
S. Korea	0.0	0.0	0.0	0.4	1.5	9.6
Venezuela	1.3	0.2	0.6	0.7	5.0	2.2
Japan	0.4	0.0	0.3	0.5	1.4	2.9
Italy	0.0	0.0	0.0	1.3	0.0	2.0
U.K.	0.3	0.0	0.5	1.4	0.3	1.3
France	0.1	0.1	0.1	0.7	0.2	1.1
Colombia	2.5	0.8	1.1	0.3	1.1	1.4
Australia	0.6	0.5	0.0	0.1	0.0	1.5
OTHERS	$2.9	$1.9	$6.0	$7.3	$6.6	$5.3
TOTAL	$22.8	$9.3	$15.1	$27.4	$35.4	$39.9
% of Shipments	13.9%	4.4%	4.5%	7.6%	11.2%	13.6%

Source: U.S. Bureau of the Census

2. U.S. Imports

Prior to 1982, U.S. imports of thermoplastic injection molding machines were aggregated in a general category that also included thermoset injection molding machines and rubber injection molding machines. Thus, figures before 1982 are not comparable with statistics after that date, and import levels before 1982 are unavailable. However, in the years 1982 to 1988, a clear trend in imports of thermoplastic injection molding machines is evident.

Imports have increased dramatically over the period, from 671 units valued at $27.5 million in 1982, to over 3,000 units valued at $230.5 million in 1987. This is a phenomenal 700 percent growth in value (350 percent in units) in just six years. Data for the first 10 months of 1988 show unit imports running about 11 percent lower than last year, but the value of imports is slightly higher, possibly due to fluctuations in currency, as well as price increases due to technological advances.

The U.S. trade balance in injection molding machines has worsened progressively, although it has been a deficit throughout the entire 1982 through 1987 time frame. The 1982 PIMM trade deficit of $4.7 million and 510 units, worsened to $195 million and 2700 units in 1987.

The top six injection molding supplying nations (Japan, Canada, West Germany, Switzerland, Italy, and Taiwan) consistently account for nearly 95 percent of total U.S. imports. However, as can be seen in Table V-7 below, there have been shifts among these countries over the 1982 to 1988 time frame. In 1982, West Germany was by far the leading supplier of imported injection machines on unit basis, while Canada provided the greatest value of machines. Since that time, both Germany and Canada have lost market share to Japan. Germany's share of unit imports has fallen from a high of 55 percent in 1983 to a low of 13 percent for the first 10 months of 1988.[4] Canada's share has similarly plummeted from 32 percent of total imports (18 percent unit basis) to 17 percent (12 percent unit basis). Meanwhile, Japan has increased its share from roughly 25 percent to over 55 percent, in both unit and value terms.

TABLE V-7a

U.S. Imports of
Thermoplastic Injection Molding Machines
(Units)

	1982	1983	1984	1985	1986	1987	1988*
Japan	151	332	708	867	1,197	1,571	1,390
W. Germany	322	859	814	791	654	623	313
Canada	122	216	303	219	250	349	292
Switzerland	8	11	22	52	139	71	134
Taiwan	2	7	4	19	73	122	106
Italy	28	47	65	54	206	52	68
Others	38	74	186	296	386	288	201
TOTAL	671	1,546	2,102	2,298	2,905	3,076	2,504
TRADE BALANCE	**(510)**	**(1,393)**	**(1,953)**	**(2,063)**	**(2,539)**	**(2,697)**	**(NA)**

Source: U.S. Bureau of the Census
* Annualized from 10 months of actual data.

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[4] The decline in imports from Germany, especially precipitous in the first 10 months of 1988, can be partially explained by an increase in assembly and/or manufacture of machines in the United States. Krauss-Maffei and Klockner Ferromatik Desma have both begun to manufacture domestically.

TABLE V-7b
U.S. Imports of
Thermoplastic Injection Molding Machines
(Millions of Dollars)

	1982	1983	1984	1985	1986	1987	1988*
Japan	$ 7.3	$ 13.2	$ 33.3	$ 48.2	$ 94.8	$132.2	$132.8
Canada	8.9	15.7	33.6	22.9	34.0	36.4	40.5
W. Germany	8.0	18.1	24.6	31.3	37.9	31.7	26.2
Switzer.	0.3	0.6	1.8	6.0	7.2	8.2	13.0
Italy	1.3	2.3	3.7	2.0	6.2	6.1	8.5
Taiwan	0.1	0.1	0.1	0.3	2.2	5.1	4.6
Others	$ 1.6	$ 4.0	$ 7.3	$ 10.3	$ 10.4	$ 10.9	$ 14.2
TOTAL	$ 27.5	$ 54.1	$104.4	$120.9	$192.7	$230.5	$239.8
TRADE BALANCE ($ Millions)	(4.7)	(44.8)	(89.3)	(93.5)	(165.3)	(195.1)	(NA)

* Figures for 1988 are estimated based on 10 months of actual import data.

Source: U.S. Bureau of the Census

Of the other major suppliers, Switzerland and Italy show growth in unit import levels and market share until 1987, when imports fell significantly. Data for early 1988 display a stabilization for these countries' share of the import market. Imports from Taiwan, though still relatively minor, have shown tremendous growth over the period, from just two units in 1982 to 122 in 1987. This has enabled Taiwan to increase its share from less than one percent to 4 percent, and overtake Italy and Switzerland to become the fourth biggest supplier, on a unit basis.

In addition to complete injection molding machines, the United States also imports parts of injection molding machines from other countries. Analysis of statistics for these imports, presented in Table V-8 below, reveals some interesting trends.

First, imports of injection machine parts have increased markedly over the 1982 to 1987 period, in tandem with imports of complete machines. Again, the leading sources of imports are Japan, Canada, and West Germany, followed by Italy, Switzerland, and Taiwan. Austria also provides significant levels of injection machine parts, most likely because of the presence of Engel machines in the United States. However, Japan's share of the import market for parts, while increasing, has not approached the share that Japan has of the complete machine market (28 percent versus 55 percent). West Germany and Canada are equal players with Japan in this market, at least at present.

TABLE V-8

U.S. Imports of Parts of Injection Molding Machines

(Millions of Dollars)

	1982	1983	1984	1985	1986	1987	1988*
Japan	$ 2.9	$ 3.4	$ 8.4	$ 8.2	$19.0	$25.9	$18.9
W. Germany	5.4	6.2	8.8	11.8	17.3	24.8	20.7
Canada	11.1	15.2	18.3	18.7	18.5	23.4	28.6
Italy	0.9	1.3	1.2	1.0	1.5	3.1	4.9
Austria	0.5	0.5	1.1	1.1	1.8	2.6	1.4
Switzerland	0.3	0.3	1.3	0.9	1.6	2.0	2.6
Taiwan	0.0	0.1	0.1	0.5	0.4	1.4	1.4
Others	3.1	3.0	3.4	5.2	7.5	6.5	6.7
TOTAL	$24.2	$30.0	$42.6	$47.4	$67.6	$89.7	$85.2

* Extrapolated from 10 months actual data

Source: U.S. Bureau of the Census

There are several reasons underlying this fact. Parts of injection machines are used to repair and maintain existing machines in this country. Thus, to a certain degree, levels of part imports are dependent on the number of machines from a particular country in use. Since Japanese machines have only relatively recently begun to have a commanding presence in the U.S. processing market, parts imports are still low. They will likely increase significantly over the next few years as Japanese-origin machines in this country begin to age.

Conversely, West Germany and Canada have had a presence in the U.S. processing market for longer periods of time; hence, imports of machine parts from these countries are fairly and consistently high. Moreover, imports of parts from Germany and to some extent Canada and Austria, are used in the manufacture or assembly of injection machines in this country. German firms, in particular, have begun to invest in manufacturing facilities in the United States (e.g., Krauss Maffei, Klockner Ferromatik). Imports of parts of injection machines from Germany will thus likely increase in the near future.

D. U.S. Consumption and Import Penetration

As measured by apparent consumption (domestic shipments plus imports, less exports), U.S. annual demand for injection molding machines has been static over the past several years, but has stabilized at a significantly higher level than in the recessionary years of the early 1980's. Consumption was particularly high in 1984, with both U.S. shipments and imports increasing to satisfy the demand. One explanation for the surge in consumption in that year is that processors had delayed purchasing new equipment during the economic downturn of the earlier 1980's, and in 1984, after recovery, made purchases that otherwise would have been made earlier. Since 1984, the U.S. plastics processing industry has consumed about 5,000 injection molding machines each year, either to add to their capacity or to replace worn out or obsolete equipment.

TABLE V-9a

U.S. Apparent Consumption and Import Penetration (Unit Basis)

	Domestic Shipments	- U.S. Exports	+ U.S. Imports	= Apparent Consumption	Import Penetration
1982	1,836	161	671	2,346	28.6%
1983	2,402	153	1,546	3,795	40.7%
1984	3,381	149	2,102	5,334	39.4%
1985	2,969	235	2,298	5,032	45.7%
1986	2,299	366	2,905	4,838	60.0%
1987	2,374	379	3,076	5,071	60.7%
1988E	2,467	274	2,504	4,697	53.3%

Source: U.S. Bureau of the Census and Section 232 Industry Survey

TABLE V-9b

U.S. Apparent Consumption and Import Penetration (Value Basis)

	Domestic Shipments	- U.S. Exports	+ U.S. Imports	= Apparent Consumption	Import Penetration
1982	$164.4	$22.8	$ 27.5	$169.1	16.3%
1983	211.3	9.3	54.1	256.1	21.1%
1984	334.7	15.1	104.4	424.0	24.6%
1985	360.1	27.4	120.9	453.6	26.7%
1986	315.4	35.4	192.7	472.7	40.8%
1987	294.0	39.9	230.5	484.6	47.6%
1988E	317.4		239.8		

Source: U.S. Bureau of the Census and Section 232 Industry Survey

Although U.S. demand for injection machines has been consistent for the past several years, there have been marked shifts among the suppliers of this demand. Specifically, imports have now captured 60 percent of the U.S. market, up from under 30 percent just five years ago. On a value basis, import penetration is slightly lower, rising from 16.2 percent in 1982 to 47.6 percent in 1987. This difference between unit- and value-based import penetration indicates imported machines have a lower cost per unit than domestic machines. Although no one factor likely explains this phenomenon, imports have made the greatest inroads in smaller, less technically advanced models. In addition, the SPI petition alleges that imports have been dumped (i.e., sold at unfairly low prices) in order to gain market share.

Imports first began to penetrate significantly the U.S. market in the early 1980's, spurred by the high value of the dollar at that time. Since that time, imports have continued to gain market share even after the dollar had declined relative to other currencies. Data from the first part of 1988 indicate that imports may be decreasing slightly, at least on a unit basis. This figure is preliminary, however, and may change significantly depending on sales in the latter part of 1988.

Import levels as a percentage of total U.S. consumption of injection molding machines are broken down below by country of origin for analytical purposes. These data reveal that Japan alone accounted for almost one third of U.S. consumption of new machines in 1987. Moreover, Japan is responsible for most (about 75 percent) of the increase in import penetration that occurred between 1982 and 1987: total import penetration rose 32.1 percentage points during this time frame, 24.6 percentage points of which can be traced to increases in Japanese imports.

TABLE V-10

Imports as a Percent of Total U.S. Consumption
(Unit Basis)

	1982	1987	Change
Japan	6.4%	31.0%	+24.6
Canada	13.7%	6.4%	- 7.3
W. Germany	5.2%	12.3%	+ 7.1
Others	3.3%	11.0%	+ 7.7
TOTAL	28.6%	60.7%	+32.1

Source: U.S. Census Bureau and Section 232 Industry Survey

E. Outlook

Statistics for U.S. imports, exports and import penetration for January to October, 1988 show some promising changes from the consistently negative trade patterns of the early and mid 1980's. Preliminary data on domestic shipments, too, indicate some improvement over recent years. It remains to be seen, however, whether early 1988 statistics represent a reversal of earlier trends or just a temporary halt to continuing deterioration in the industry's competitive position.

One trend that has recently begun and will most likely continue over the next several years is an increase in foreign investment in injection molding machinery manufacturing operations in the United States. This trend was begun by German firms, including Klockner Ferromatik and Krauss Maffei. Now, other foreign producers are announcing plans or intentions to start up U.S. manufacture of injection machines. Billion SA (Spain), Mannesmann Demag and Battenfeld (both of W. Germany) are among those considering investment in this country. If foreign investment does increase, this may lead to a decline in imports from the home countries, since the U.S. market will be supplied locally. However, plans for investment in this country frequently fall through (as was the case for Netstal of Switzerland, which first announced plans to manufacture here, then decided on Singapore instead). Moreover, many of these "manufacturing" operations are actually mostly assembly operations, with major machine parts sourced abroad.

SPI itself predicts slight improvements in conditions in the injection molding machinery market in the next several years. SPI predicts that imports will taper off, domestic shipments will increase, U.S. demand for injection machines will remain strong, and more foreign manufacturers will set up manufacturing facilities in the United States.[5]

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[5] SPI, Plastics A.D. 2000.

VI. COMPETITIVENESS

As the import penetration and other statistics in the preceding chapter clearly indicate, the U.S. injection molding machinery manufacturing industry has suffered a substantial loss in competitiveness in recent years, particularly relative to Japanese manufacturers. This chapter will address factors underlying this change in position. In addition, it will discuss the competitive prospects for the U.S. industry for the next several years.

A. Elements of Competitiveness

In order to evaluate U.S. competitiveness relative to foreign suppliers of injection molding equipment, it is first necessary to understand the elements which influence a customer's decision to purchase one machine over another. As part of its industry survey, the Department of Commerce asked nine domestic manufacturers to rank factors that affect sales of their equipment. Their aggregate responses are presented in Table VI-1 below.

TABLE VI-I

Relative Importance of Factors in Sales of Injection Molding Machines
(1=Most Important, 5=Least Important)

Quality & Durability of Product	1.7
Technical Features of Product	2.6
Price of Product	2.8
Reliability of Manufacturer	3.0
Follow-up Service	3.1
Historical Business Relationship	3.3
Warranties on Product	3.7
Design Assistance	3.9
Financing Package	4.2

Source: Section 232 Industry Survey

It is interesting to note that the price of the machine is not thought to be the most important factor influencing purchases of injection molding machines. Rather, the overall quality and technical features of a machine are its major selling points. Price remains an important consideration, however.

This information is supported by a recent survey of approximately 40 U.S. injection molders (i.e., users of the machines) conducted by Plastics Technology in March, 1988, as well as Department of Commerce telephone interviews with about 55 defense and medical molders. Molders which utilized foreign machines indicated that many factors influenced their decision to buy an imported machine, but quality, molding performance, and control features of the machine were most important. The Plastics Technology survey also showed that foreign machines are perceived by molders to be of lower price than comparable U.S. machines, however.

B. Price

Statistics on the actual sales prices of imported machines and U.S.-origin machines are not available. Although list prices are available in some cases, significant discounts are often made available to purchasers. However, a rough indicator of price is the average unit value of machines (total value/total units). Such calculations for imports from selected countries and for U.S. shipments are provided in Table VI-2.

These data must be interpreted with caution, since they do not differentiate price by size or sophistication of machine. However, they do provide a general sense of relative costs of machines.

TABLE VI-2

Average Unit Values*

	Total Value ($000's)	Total Units	Average Unit Value
Japan	$132,211	1571	$ 84,157
Canada	36,931	349	104,272
W. Germany	31,651	623	50,804
Switzerland	8,154	71	114,845
Italy	6,078	52	116,846
Taiwan	5,093	122	41,746
U.S.	272,432	1899	143,461

* Figures for foreign countries are 1987 total imports in units and dollars; for the U.S. they are shipments in units and values.

Source: U.S. Census Bureau and DOC Survey.

These data show that the U.S. has by far the greatest average unit value per machine at $143,000, far above Japan's $84,000 average. As expected, Taiwan, with its low production costs, has the lowest average value at $42,000, while machines from Canada and Switzerland have relatively high values. West Germany's low $50,800 figure is counter-intuitive, since German machines are perceived as being highly sophisticated and generally more expensive than U.S. machines. This apparent contradiction is explained by the fact that many of the imported German machines are of small size, and hence, lower price, while larger German-designed machines have in recent years increasingly been built and/or assembled in this country and do not appear in import figures. These skewed unit values are also apparent for imports from Japan, which also tend to be of small size, and from Italy, which specializes in large-size machines.

The major factor which influences the selling price of a machine is its production cost, including labor costs, raw material costs, part/subcomponent costs, energy costs, and others. Table VI-3 provides the percentage of each of these costs of total production costs for U.S. injection molding machinery manufacturers.

TABLE VI-3

Production Cost Factors

	Average	Range
Labor	19%	7% - 43%
Raw Materials	20%	9% - 35%
Subcomponents	41%	25% - 54%
Energy	2%	0% - 5%
Other	19%	2% - 41%

Source: Section 232 Industry Survey

The purchase of finished or semifinished parts and subcomponents from outside vendors is by far the greatest single component of production cost. Injection molding machines are comprised of many distinct parts (e.g., hydraulics, manifolds, motors, electronics, and forgings), which explains the high percentage of total costs accounted for by subcomponents. Labor and raw material costs involved in production and assembly of injection machines are also substantial (at about 20 percent of total cost each), and so can have a major impact on total production costs.

Labor costs (wage rates) vary significantly from country to country, giving certain regions of the world price advantages over others. Although there are no specific data available for the injection molding machinery industry, hourly compensation costs for the broader industry (non-electrical machinery, SIC 35) are presented below. (Actual hourly wage rates for the U.S. industry ranged from $9.67 for a painter to $16.65 for an engineer). Table VI-4 shows that there has been significant improvement in the relative position of the United States in terms of labor costs since 1982, due mostly to the depreciation of the dollar relative to most other currencies since that time. In fact, 1987 marks the first time since 1980 that U.S. workers were not the highest compensated in the world. However, during much of last few years, relatively high U.S. wage rates put domestic manufacturers at a significant disadvantage. A continuation of the trend in wage rates apparent from 1982 to 1987 would further strengthen the competitive position of the U.S. industry.

TABLE VI-4

Hourly Compensation Costs for Machinery Industry
U.S. Dollars
(Index Numbers, U.S. = 100)

	1982	1987
U.S.	$12.72 (100)	$14.55 (100)
Canada	11.22 (88)	12.47 (86)
France	8.32 (65)	12.99 (89)
W. Germany	10.75 (85)	17.60 (121)
Italy	7.61 (60)	10.57 (73)*
Japan	6.74 (53)	12.69 (87)
Korea	1.44 (11)	2.05 (14)
Taiwan	1.39 (11)	2.47 (17)

* 1986 figure

Source: Bureau of Labor Statistics, Office of Productivity and Technology, August, 1988.

C. Exchange Rates

Exchange rates are a major factor in the relative labor costs described above; they also affect the overall cost of production and pricing of machines. As with wage rates, since the early 1980's there has been marked improvement in the terms of trade faced by U.S. industry. Yet imports of injection molding machines have continued to rise both absolutely and relative to U.S. consumption despite the depreciation of the dollar. The petitioners claim that some foreign manufacturers have chosen to dump their products (i.e., sell at less than fair value) in order to retain market share. A Section 232 study reviews these claims only as they affect the industry's ability to meet national security requirements. Dumping allegations would be addressed in an antidumping investigation. However, as a rough measure of foreign machine price relative to U.S. price, Table VI-5 presents the average unit value of imported machines relative to the average unit value of domestic machines over time.[1] These data clearly show an increase since 1982, especially in the first part of 1988.

[1] The average values are presented in relative terms rather than actual dollars because machines have increased in value significantly since 1982 due to inflation as well as increasing sophistication of the machines. These data are subject to the same limitations as those in Table VI-2, and should be interpreted with caution.

Japan, West Germany, and Canada have all shown increases in the relative average value since 1982 and particulary in the first half of 1988. The average unit value of imports from Taiwan, on the other hand, has decreased relative to U.S.-built PIMMs. This may be due to the fact that much of the increase in machine value during these years is accounted for by increasing sophistication of machines (especially computer controls). Since Taiwan primarily competes in the low-end sector of the U.S. injection machinery market, value increases may be less for them.

TABLE VI-5

Average Value of Imported Machines as a Percentage of Average Domestic Machine Value

(Selected Years)

	1982	1984	1987	1988 (6 Mos.)
Japan	48	48	59	61
Canada	73	114	73	98
W. Germany	25	31	35	63
Taiwan	33	35	29	27

Source: U.S. Census Bureau and Section 232 Industry Survey.

D. Investment

The surveyed producers all consider investment in structures and equipment to be essential to their competitive viability. Investment has helped the firms to lower their production costs as well as to improve the quality of their product. Examples of such beneficial investments include installation of flexible manufacturing systems, purchase and use of Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) systems and other computerized systems for order entry, parts handling, and inventory control. Purchase of new state-of-the-art machine tools has increased the firms' ability to produce close-tolerance parts which improve the performance of their injection molding machines.

Table VI-6 presents aggregate investment spending by the nine surveyed domestic producers. The 1982 to 1988 period shows no clear trend in investment spending. Investment in buildings and structures has varied greatly from year to year, reflecting large but intermittent investments by single firms in some years. Investment in machinery and equipment is more consistent, although both types of investment were at very low levels in 1983, likely due to the general economic downturn at that time.

TABLE VI-6

Investment Expenditures
1982-1988E
($000's)

	1982	1983	1984	1985	1986	1987	1988E
Buildings & Structures	2030	123	5808	768	3882	2410	1761
Machinery & Equipment	6848	2965	7106	9280	7427	3622	6420
TOTAL	$8878	$3088	$12914	$10048	$11309	$6037	$8181

Source: Section 232 Industry Survey

On average, the nine surveyed firms invested about four percent of their total sales into structures and equipment. Some firms, generally the smaller producers, acknowledged that while adequate investment is necessary to competitive success, they have been unable to dedicate sufficient funds for this purpose due to lagging sales in recent years. Lagging investment will likely further exacerbate their competitive position.

E. Research and Development

Like investment, research and development in new products and new processes is viewed by the nine firms as vital to the future of the U.S. injection molding machinery industry. Their aggregated R&D expenditures are provided in Table VI-7.

TABLE VI-7

R&D Expenditures
($000's)

	R&D	Sales	R&D as % of Sales
1982	$3930	$128,000	3.1%
1983	$3863	$180,700	2.1
1984	$4640	$259,500	1.8
1985	$7507	$335,200	2.2
1986	$8683	$295,300	2.9
1987	$8718	$272,400	3.2

Source: Section 232 Industry Survey

These figures show a trend of continually increasing R&D expenditures, from less than $4 million in 1982 to $8.7 million in 1987. This indicates that U.S. firms have increased their R&D spending sharply to a higher level, perhaps reflecting a change in attitude and policy toward the importance of R&D to their competitiveness. R&D expenditures as a percentage of value of shipments have been more variable. In particular, the years 1983 through 1985 show a lower percentage of R&D (about two percent), with a slight increase since that time. Similarly, the number of engineers employed by the nine firms rose 16 percent between 1984 and 1987.

Major R&D investments over this period include work to improve control and hydraulic technology to improve machine performance; processing of new resins and composite materials; and new applications for injection molding of such items as compact disks and large automotive body panels. Moreover, some firms carry out process R&D in addition to product R&D. This type of R&D, devoted to development and application of new production processes, can lead to both reduced production costs and improved production quality. Particular areas of interest included new and/or expanded application of flexible manufacturing systems, robotics, and CAD/CAM to injection molding machine manufacture.

In fact, three of the nine surveyed firms were already using some type of FMS; all utilize CAD/CAM; three have some type of statistical process control in place; and one firm uses robotics in the production of injection machines.

F. Profitability

Profitability within the industry is highly variable from firm to firm (see Table VI-8). The two largest manufacturers (Van Dorn, Cincinnati Milacron) have consistently been profitable in their plastics machinery operations, of which injection molding machines are the major product. Both firms have achieved profit margins far above the average for the broader special industry machinery industry (SIC 3559), although the years 1985-1987 show a slight downward trend. In the case of Cincinnati Milacron, the division's 1987 operating earnings were held back by new product development and start-up costs (many associated with the new Vista line of injection molding machines) according to the Company's 1987 Annual Report. Nevertheless, CM's plastics machinery division accounted for a disproportionate share of total firm profits -- although these products represented only 28 percent of sales in 1987, they were responsible for nearly 58 percent of operating earnings, due to mostly to lagging machine tool operations.

Other injection molding firms, notably HPM and Package Machinery Corp. (Reed Division) registered losses. (PMC does not publish profitability information broken down by division, so the relative performance of the injection molding operations themselves are not available. However, injection molding machines represent a significant portion of their business.) HPM has apparently improved its profitability position in the past year through a consolidation and modernization of operations

(HPM's Eastern Division, in Connecticut, was permanently shut down in 1987). PMC's financial position on the other hand has worsened since 1985, with losses of $287,000 and $398,000 in 1986 and 1987. PMC closed its Long Meadow, Massachusetts plant in 1986 and opened a new facility in Connecticut in order to consolidate, modernize and improve efficiency of its injection molding machinery operations. It remains to be seen if this consolidation will prove successful for PMC. Profitability information for the smaller (privately held) injection molding machinery producers is not available.

TABLE VI-8

Operating Profit
(Percent of Net Sales)

	1985	1986	1987
Cincinnati Milacron (Plastics Machinery Division)	13.1%	12.9%	11.0%
Van Dorn Corp. (Plastics Machinery Company)	16.3%	13.5%	13.8%
HPM Corp.	NA	(-0.1%)	4.8%
Package Machinery Corp.	4.6%	(-0.1%)	(-0.1%)
Industry Average SIC 3559, Special Industry Machinery	5.0%	5.4%	NA

Source: Company Annual Reports; SIC 3559 information from Robert Morris Associates.

G. Industry Structure

As described above, U.S. injection molding machine users have turned to Japanese and other imported machines because they perceive these products to provide greater value (quality and features as well as low price) in comparison to many U.S.-made machines.

The key to Japanese success in constructing and selling a high-quality machine at a low price is directly related to the structure of the industry in Japan, in contrast to the U.S. industry structure. Japan is estimated to produce more than 10,000 machines per year, in comparison to about 3,000 in this country. Similarly, individual Japanese injection molding equipment manufacturers, such as Toshiba and Ube, have larger operations than the largest U.S. producers. Japanese companies have taken advantage of economies of scale in production by producing large quantities of standard machines, targeted for the vast commodity injection molding industry here and abroad. Moreover, the mass-produced machines are not low-technology; rather, they are full-featured machines which are used in a wide range of applications. During the early 1980's, these machines have received great acceptance in the U.S. market. At the same time, exchange rates were very favorable to Japanese exporters. The combination of low costs obtained through economies of scale and the exchange rate situation enabled the Japanese to increase their share of the U.S. injection molding machinery market from 6 percent in 1982 to 31 percent last year. Moreover, Japanese machines generally have shorter lead times than U.S.-origin machines, because they are held in inventories ready for delivery.

The U.S. industry, on the other hand, was not structured to mass produce injection molding machines. In fact, no two machines were built alike -- each was equipped with customized features to suit a particular customer's needs. This custom-tailoring process, although yielding a high quality machine, is an expensive and time-consuming process. The result was that in many cases, a Japanese-made machine with numerous features was available at a lower price than a similarly equipped U.S. machine. The U.S. manufacturers, along with West Germany and Switzerland, remained competitive in the smaller specialty machine market.

Since the early 1980's, U.S. firms have begun to restructure their product design and manufacture to better compete with imports and be more in tune with the broad commodity market for injection machines in which the Japanese firms had achieved such success. In the past two years, the two largest U.S. producers both introduced new, redesigned lines of injection molding equipment -- Van Dorn's HT (High Technology) series and Cincinnati Milacron's Vista series.

Van Dorn's HT line of injection molding machines, introduced in early 1988, is "high value/low cost" and includes as standard more than 50 features that were formerly options added at the request of a specific customer. These features, including self-lubricating bushings, unexposed motors and pumps, proportional directional valves and a more efficient and compact overall construction provide tangible benefits to molders through easier maintenance, lower energy costs, and increased productivity. Despite all of the new machine's features, economies of scale allow Van Dorn to price the HT line 20 percent below a Van Dorn custom-built machine of the same size and similar features.[2]

Similarly, in late 1986 Cincinnati Milacron's new Vista line was introduced. Vista is designed for both quality and manufacturing efficiency, and competes in both the U.S. and world markets. Raymond Ross of Cincinnati Milacron claims that "when a customer buys our Vista, it comes with all the bells and whistles and beepers -- all the major performance options -- as standard equipment. If he doesn't need them - fine, but he's got them because I'm putting them on every machine, exactly the same. It's like a molder placing an order for 500 machines - he gets a hell of a quantity break."[3]

Both the HT and the Vista lines have been selling well according to Cincinnati Milacron and Van Dorn. Thus, it appears that the U.S. industry (or at least the two biggest producers) has taken important steps toward restructuring operations to better compete with the strengths of Japanese imports. Smaller U.S. injection molding machinery producers are again less able to do so: they have neither the funds available to redesign their machines and manufacturing operations nor the volume of sales needed to achieve the economies of scale. But they too have taken a number of steps to increase the efficiency of their operations, the quality of their product, and their competitiveness.

D. Competitive Outlook

Of the nine surveyed injection molding manufacturers, five foresee improving competitive conditions in the next few years, albeit with caveats about the state of the economy and exchange rate fluctuations. Three additional producers were unsure of their future, and only one firm predicted a downturn.

In general, conditions faced by the U.S. industry have improved since the mid 1980's. Sales appear to have bottomed out in 1986. Imports have continued to rise, but the 1988 figures indicate that this trend may be ending. Moreover, the perceptions of the U.S. molding industry have shifted in favor of the U.S. producer since the early 1980's. A survey of molders showed that 54 percent believed that imported machines represented a higher level of technology than U.S. machines in the early and mid 1980's; only 42 percent of molders hold that view in 1988.[4]

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[2] Van Dorn 1987 Annual Report and Plastic Technology, March 1988, pp. 15-16.

[3] Statement of Raymond Ross of Cincinnati Milacron, Plastic Technology, April 1987, p. 84.

[4] Plastic Technology, March, 1988.

An additional factor which should improve the U.S. industry's competitive position is Congress' decision to ban imports from Toshiba Machine of Japan for a three year period. This action was taken in response to the company's violation of COCOM prohibitions on the export of advanced machine tools to the Soviet Union. Toshiba Machine has been one of the leading sources of imported PIMMs in recent years, and the temporary prohibition on imports of their machines will increase market opportunities for both other Japanese and domestic PIMM manufacturers.

Furthermore, U.S. firms have undertaken many efforts to improve their position, from restructuring their entire operations to consolidation and rationalization of production to acquisition of improved machine tools. Preliminary indications are that they have been successful in these endeavors.

The competitive outlook for smaller producers, however, is not as favorable. Some smaller firms will remain successful as niche producers (such as insert molding machines), while others will be faced with continued deterioration of their competitive position. Also posing competitive challenges in the future will be additional imports from such low production cost countries as South Korea and Taiwan.

VII. CAPACITY

An assessment of the ability of U.S. PIMM producers to meet national security requirements requires measurement of the industry's maximum production capacity in an emergency situation, an assessment of the ability to meet needs from existing machines not currently producing critical items. Derivation of this capacity involves several elements, including the ability of U.S. injection molding machinery manufacturers to increase production in a crisis, the ability of plastics processors currently producing defense parts to expand production of these parts, the conversion potential of machines currently producing non-essential commercial items to produce needed defense parts, as well as the extent to which new imported machines would be available in a crisis. Other relevant factors include trends in foreign investment in machinery manufacturing facilities, raw material, subcomponent, and labor availability, and possible substitute materials and processes.

A. Mobilization Capacity of the Domestic Manufacturing Sector

As part of the Section 232 industry survey, nine injection molding machinery manufacturers were asked to estimate their ability to expand production under emergency conditions. The firms were instructed to use the following criteria to gauge their mobilization capacity: existing facilities are operated at the maximum rate possible; no new facilities may be constructed, but new equipment may be purchased; labor and equipment availability reflects normal market conditions; and material and energy requirements are fully met. Furthermore, survey participants were asked to assume their present product mix. Respondents reported their production capacity at six month intervals, aggregated in the following table.

This table indicates that U.S. machinery producers could increase their production rate by about one third in the first six months of a mobilization. After a year, this rate would increase 63 percent over peacetime levels of production. After two years, injection molding machinery manufacturers could approximately double current production rates, producing 2,057 units in six months, or an annual rate of about 4,100 units.

In individual size ranges of machines, those with 1500 tons of clamp force or more have the greatest capacity for expansion, albeit from a very small base of 19 units produced in the first half of 1988. Also showing above average ability for expanded production are machines in the 300-499 ton range, which can be produced at 120% of their peacetime rate after 2 years. Machines in this size range are some of the most commonly used, for both defense and civilian applications. There exists flexibility between production in varying size ranges, within the confines of manufacturing equipment (machine tools, cranes).

TABLE VII-1

Mobilization Capacity
Number of Units at 6 Month Intervals

Clamp Force	Actual* Ship. 1/88-6/88	First 6 Months Mob.	Second 6 Months Mob.	Third 6 Months Mob.	Fourth 6 Months Mob.	Percent Increase 24 Mos.
<100	248	353	443	488	499	101%
100-299	304	386	467	574	628	107%
300-499	227	299	374	448	500	120%
500-699	101	136	152	173	196	94%
700-999	66	92	103	118	135	105%
1000-1499	28	42	44	49	55	96%
1500+	19	19	34	38	44	132%
TOTAL	993	1,327	1,617	1,888	2,057	107%

* Provided as a baseline

Source: Section 232 Industry Survey

Production of machines 500-699 tons and 1,000-1,499 tons, on the other hand, are slightly less able to be increased than average, with increases of 94 percent and 96 percent, respectively, after two years. The remaining three size categories (less than 100 tons, 100-299, 700-999) also show production increases of about average, ranging from 101 percent to 107 percent after two years.

As explained in Chapter V, the Section 232 Industry Survey (used to generate both mobilization capacity and shipment statistics) did not include the entire domestic injection molding machinery manufacturing base. Thus, there is additional potential to expand production of injection equipment over the levels indicated in the above Table.

In order to estimate this additional mobilization capability, the 1987 shipments of the un-surveyed firms were used as a baseline. Since the vast majority of these manufacturers were found to produce injection machines only in the smallest size category (less than 100 tons), additional production potential only in this range was estimated. In the first six months of 1987, these firms produced approximately 250 units. Assuming these firms are able to mobilize similarly to the surveyed firms for machines in this size category (101 percent after two years), yields production capability (by six month intervals) for an additional 355 machines after six months, an additional 444 machines after another six months, 488 additional machines after 18 months, and 500 additional after two years. This raises total estimated PIMM mobilization production capacity to 4,600 units per year (from 4,100).

Under the guidelines of the mobilization given and used to derive the estimates above, firms were not allowed to build new structures (facilities) in order to increase production capacity. This assumption was introduced to offset the highly optimistic assumptions about material, labor, equipment and energy availability. However, in order to determine the net effect of this assumption, firms were asked to estimate by how much their mobilization production capacity would increase if the new facilities constraint were lifted. Their responses indicated that no manufacturer could construct a functioning facility in the first six months after mobilization begins. After one year, most firms indicated that they could expand production by an additional 10 percent. After 18 months, manufacture of injection machines could be increased by an additional 15 to 25 percent, and after two years, increases of about 30 to 40 percent are possible. The average number of months needed to construct and equip an injection molding machinery manufacturing facility was 14, with an additional five months required to become fully operational.

In addition, all the companies surveyed indicated that they generally hold no completed PIMMs in inventory, aside from a small number of units needed for testing and demonstration purposes. Inventories would not, therefore, be available to supplement companies' mobilization production capacity.

B. Factors Limiting Expansion of Production

There are several factors which would limit the ability of domestic injection molding machinery manufacturers to expand their production. The most important of these are the availability of skilled labor, raw materials, needed equipment, and subcomponents.

1. Labor

The availability of additional skilled laborers, including machinists, engineers, and computer specialists necessary to support expanded production of injection machines was a primary concern of all surveyed producers. The nine companies were asked to estimate the additional labor they would need to reach the mobilization production levels presented in the previous section. Table VII-2 provides their aggregated responses, presented as additional workers needed in each 6 month period following the onset of mobilization as well as the total number of workers required in any given interval. This data indicates that firms would need to increase their manufacturing workforce by 24 percent over peacetime levels in the first six months after mobilization (from 1,942 to 2,409 employees) in order to expand their production. Similarly, employment increases of 45 percent, 57 percent and 70 percent over peacetime levels in the next three

6 month intervals would be necessary. (Note that the number of employees increases only by 70 percent to generate an increase in output of about 100 percent).

TABLE VII-2

Mobilization Labor Requirements

	Baseline*	6 Months	12 Months	18 Months	24 Months
Additional Production Workers		413	377	201	223
Cumulative Total	1540	1953	2330	2531	2754
Additional Engineers		54	35	25	27
Cumulative Total	402	456	491	516	543
Additional All Workers		467	412	226	250
Cumulative Total	1942	2409	2821	3047	3297

* 1987 actual employment

Source: Section 232 Industry Survey

There are a number of jobs in the injection molding machinery manufacturing industry which are considered "critical" for mobilization. (A critical job is defined, for the purposes of this study, as one that is essential to maintaining production that requires a minimum of one year's training before a worker can effectively perform the duties and responsibilities of the specific position). Among the critical jobs, five are professional and include several types of engineers and computer specialists. Each of these jobs require four years of college plus two to five years on-the-job training. An additional 27 jobs considered critical in the production area. These include a variety of machinists, assemblers, machine builders, welders, and electronics mechanics. All of these production worker jobs require a high school education and generally from two to five years work experience.

While many injection molding machinery manufacturing jobs are considered critical, few are unique. With the possible exception of specialized assembly jobs, counterparts can be found in other related industries, including Special Industry Machinery (SIC 355) and General Industry Machinery (SIC 356). Broadly speaking, these skills involve metal fabrication and finishing, welding, and electrical wiring. For engineers and computer specialists, some of the general, more transferable skills relate to electrical, hydraulic, and mechanical system design, and computer programming and software development. In a national security emergency, however, related industries currently employing such workers would also be expected to surge their production. This would make the industry's ability to obtain additional skilled workers somewhat problematic.

2. Equipment and Subcomponents

Injection molding machine manufacturers rely on a wide variety of suppliers, both foreign and domestic, to furnish needed material and component inputs. Several machinery producers anticipate problems in receiving sufficient quantities of these needed items under emergency conditions.

Of particular concern were machine tools necessary to expand production, including precision, grinding, polishing, and milling machines. Many of these machine tools are sourced abroad, especially from Japan and West Germany, and are subject to long lead times, even during peacetime.

Injection molding machinery producers also anticipate production bottlenecks to arise due to shortages in supplies of other critical production inputs. Thick steel plate, tie bars, and large castings are essential to PIMM production, but are generally outsourced by manufacturers. Items such as valves, pumps, motors, and computer controls are also of concern, especially in cases where foreign sourcing is involved.

B. Reliable Imports

In addition to domestic capability to produce injection molding machines in a national security emergency, a certain number of machines could be imported to supplement domestic production. This import level depends directly on the scenario of the conflict: Is there a warning period before sea lanes are interrupted in which to import machines? During the conflict, how much attrition of sea lanes would there be? Would the injection machinery supplying nations have capacity to contribute to our requirements in addition to their own needs? Are they politically reliable suppliers?

Most likely in any of these cases, imports of machines would be possible from Canada. Canada, being adjacent to the United States, would be able to ship injection machines regardless of sea lane interference. Moreover, Canada is largely integrated with the United States in the defense arena, and is considered a part of the North American industrial base in defense planning. Imports of injection machines from Canada amounted to 349 units in 1987. A conservative approach is to assume that Canada could provide at least this number of machines in an emergency. While

Canadian production would increase, Canadian demands would increase as well.

C. Existing Injection Molding Machines

The greatest potential for producing essential defense and medical plastic items, however, lies in the PIMMs currently used to produce non-critical items.

Plastic defense parts are being made on some of these machines during peacetime. The plastic processors currently making these defense parts would be called upon in an emergency to increase production of these items. In the numerous interviews DOC representatives held with these defense and medical-related molders, most indicated that they could easily increase production by three or four times by adding shifts, increasing the utilization rates of their machines, and lengthening production runs.

Moreover, injection molding machines are used extensively throughout the civilian economy in such nonessential applications as production of housewares, toys, automotive parts, and non-defense electronic components. In fact, there are very few processors exclusively devoted to defense work; most defense molders fabricated commercial items as their primary products. According to processors, there is a great deal of fungibility of injection machines. Basically, all that is needed to convert an injection machine from producing a noncrucial item to producing a critical defense item is to change the mold on the machine. According to the processors DOC contacted, there would be no significant technical problems in achieving this conversion, which would take only several hours in most cases.

There are factors, however, which would limit convertibility of existing machines. For example, the defense mold and the civilian mold must be of generally the same size (i.e., requiring a compatible machine platen and shot force). Age of machine is also of some concern; newer machines are better able to handle the higher temperatures and pressures needed to process advanced materials often used in defense applications. Newer machines are also more flexible in converting production due to their advanced computer controls and QMC systems.

Information on the number of injection molding machines in operation today is collected and published by PLASPEC, the database marketing service offered by Plastics Technology. These data, collected through surveys of nearly all plastic processors in this country, is the best information available on the plastic processing industry. According to this census, there were over 7,000 injection molding processing plants operating about 80,000 injection machines in 1986. Geographically, these processors are located throughout the U.S., but with heaviest concentration in the Midwest (Ohio, Illinois, Indiana, Michigan, Minnesota), the Northeast (Pennsylvania, New Jersey, New York, Massachusetts), California, and Texas. There is a wide variety of sizes of machine in operation, as described in the table below:

TABLE VII-2

Injection Molding Machines in Operation

Clamp Tonnage	Number of Machines	Percentage
<50 tons	12,320	17%
50-99 tons	12,579	17%
100-199 tons	13,318	18%
200-299 tons	12,031	16%
300-399 tons	10,790	15%
400-499 tons	3,470	5%
500-749 tons	4,868	7%
750-1199 tons	1,543	2%
1200-1999 tons	695	1%
2000+ tons	288	<1%
Size Unknown	5,938	NA
TOTAL	79,383	100%

Source: PLASPEC, Plastics Manufacturing Census

According to the same source, approximately one-third of the existing machines are less than five years old; one-third are between five and ten years old; and the remaining third are over ten years old.

As established earlier, defense uses of injection-molded plastic are similar to civilian uses. The size ranges of machines commonly used in defense correspond to those most commonly used in the commercial arena. Moreover, most defense-related consumption is in the commercial grades of plastic resins, which are easily processed and do not require sophisticated equipment. Some defense applications do require engineering or performance resins; however, these substances are used in the commercial sector as well, in such items as electronic components and automotive goods. Sophisticated injection molding machines are currently in operation in these and similar applications.

In conclusion, there are over 80,000 injection molding machines in operation, 26,000 of which are less than five years old. Only a very small percentage of these machines are used for defense-related production during peacetime. Many of these machines are used for nonessential civilian consumer production and could be relied upon in wartime to produce plastic parts needed for defense or medical purposes, assuming all the other production needs were met.

One area of concern in utilization of these machines in a national emergency is repair and maintenance. Many defense-related molders contacted by DOC indicated some concern about the availability of spare and repair parts for these machines, especially if the machines are manufactured overseas. Spare parts for imported machines are generally also imported, and thus may not be readily available in times of conflict. However, in a mobilization situation, domestic manufacturers would duplicate parts or adapt similar parts or components to fit foreign machines.

D. Other Factors Affecting Capacity

1. Molds

In order to produce the needed defense parts in an emergency, injection molds in the correct shapes would be essential in addition to the injection equipment. This investigation did not concentrate on injection mold building capacity, and so no conclusions can be reached regarding their sufficient availability in a national security emergency. However, some general issues and concerns regarding molds became apparent in the course of our analysis.

Imports do not appear to be a problem in the moldmaking industry at this time, although they are increasing. In 1987, 30,090 molds for injection of rubber or plastics (TSUS 680.1210) were imported, mainly from Canada, Portugal and Taiwan. However, it is estimated that the U.S. consumes over $2.7 billion molds per year, only about eight percent of which are imported. There are no firm data on the number of firms engaged in moldmaking; in general, the industry is made up of a large number of small operations or "job shops" that also produce molds and dies for other applications. Some plastics processors have in-house moldmaking capabilities; many more have mold maintenance and repair facilities.

The moldmaking process is very complex and time-consuming. Lead times of up to six months or more are not uncommon according to plastics processors. Moreover, the labor skills required to design and construct molds are very sophisticated and take several years to perfect. Even in peacetime, there have been shortages of such skilled moldmakers. None of the processors contacted indicated that they carried spare molds of defense-related items for use in an emergency.

Thus, although imports of injection molds are not currently at a level that threatens the national security, other factors suggest that the availability of molds may be limited in a national emergency. Moldmakers are very skilled and in short supply; molds take several months to design and manufacture, and plastics processors do not routinely hold spare molds for critical defense items for use in an emergency.

2. Resins

Also essential to the production of defense critical plastic parts is the continued availability of the necessary plastics resins. As with molds, imports of resins are not currently at high levels, although imports come in from many countries including Saudi Arabia and the Soviet Union. However, acquisition of enough resins by plastics processors has been a problem for many processors, even without a mobilization. This availability situation is primarily caused by excess demand for resins in comparison to capacity. Plastics products have continued to increase in use in recent years, driving up the demand for resins. On the other hand, resins are ultimately derived from petroleum and natural gas. The falling petroleum and petroleum feedstock prices in recent years created a situation in which it was not profitable for chemical companies to invest in additional capacity for such items as ethylene and propylene, the building blocks of plastic resins. Thus, resins were often in short supply.

In recent months, these supply conditions have eased somewhat, and processors are more easily obtaining needed materials. As a result, additional capacity has been created and prices have stabilized. On the other hand, in a national emergency, availability of resins would pose problems for plastics processors if the supply of petroleum and petroleum products from the Middle East were cut off from the United States.

VIII. NATIONAL SECURITY REQUIREMENTS

Recent Section 232 investigations estimated national security requirements for the product in question by relying upon industrial output requirements in the 1984 National Security Council Stockpile Study. For plastic injection molding machines, however, Stockpile Study requirements are presented only within the more aggregate category of special industrial machinery. While an attempt was made to estimate national security requirements for PIMM's from this source; in consultation with DOD, we pursued several other methods of estimating emergency requirements for PIMM's.

In addition to the above, we examined a methodology proposed in the public comments of the Japan Society of Industrial Machinery Manufacturers (JSIM). This approach estimated the total number of plastic injection molding machines used in defense-related activities by extrapolating from data on the annual domestic consumption of plastic resin and estimates of the amount of resin currently used for defense production.

Further, a series of structured telephone interviews were conducted with plastic injection molders to determine the extent of their defense-related business and the fungibility of their equipment used to produce non-defense items.

Finally, Commerce asked DOD to develop estimates of future defense requirements for plastic injection molded products in view of ongoing research and development (including secret programs) and projected procurements of new or revised weapon systems.

A. The War Scenario

Consistent with Stockpile Study guidance, Scenario 3A was used to estimate emergency PIMM requirements. This scenario consists of a three year war, preceded by a one year mobilization effort. Consistent with the methodology employed in the 1988 Section 232 investigation of antifriction bearings, we chose to examine only the one year mobilization period followed by the first year of a war of indefinite length. This scenario was considered to be more realistic in today's environment than the gradual increases in the three-year war depicted in Scenario 3A. DOD agreed that this was the most appropriate scenario to be employed in the current investigation.

In addition, we tracked the bearing study's methodology by using Stockpile Study requirements for the mobilization year as mobilization year requirements and requirements for the third war year as requirements for the first year of the war of indefinite length. This was done because the level of defense spending was highest in the third year of scenario 3A, more nearly approximating the anticipated first year of an all-out war.

As established earlier, projected available supplies of PIMM's are displayed in Table VIII-1. Note that both Cincinnati Milacron and JSIM agree with the PLASPEC estimate that about 80,000 PIMM's were in the domestic inventory at the beginning of 1988.

In addition, although Stockpile Study requirements already take into account supplies available from reliable imports, an estimate of available imports is presented for use in the other proposed methods.

Table VIII-1

Projected Available PIMM Supplies

79,383	Existing Domestic Inventory (from PLASPEC)
3,743	Estimated Production During The Warning Year (from Section 232 Industry Survey)
4,933	Estimated Production During First War Year (from Section 232 Industry Survey)
349	Annual Imports From Canada (from DOC statistics)

C. NSC Study Requirements for Special Industrial Machinery

As noted above, Stockpile Study requirements for PIMM's are contained within the more aggregate total of requirements for special industrial machinery. The following methodology was used to estimate disaggregated Stockpile Study requirements for PIMM's:

- First, dollar shipments of injection molding machines from the 1982 Census of Manufacturers were compared to Census figures for dollar shipments of all Special Industrial Machinery.

- Next, the ratio of injection molding machines shipments in the Census to total Special Industrial Machinery shipments was calculated in percentage terms.

- Finally, mobilization requirements in the Special Industrial Machinery category of the NSC Study were multiplied by the previously calculated percentage to obtain an estimate of mobilization requirements for injection molding machines.

Specifics of the Methodology

The NSC Study contains industrial output requirements expressed in 1972 dollars for some 257 sectors of the economy. These requirements represent the new production that would be required to meet direct defense, industrial and essential civilian requirements during a warning year and three years of a conventional global war. The outputs were calculated at the 4-digit SIC level based on economic and mobilization assumptions concerning GNP and related matters.

The industrial outputs from the NSC Study for Special Industrial Machinery for all four years of the mobilization are displayed in Table VIII-2 below:

Table VIII-2

Stockpile Study Requirements for Special Industrial Machinery
(Millions Of 1972 Dollars)

Warning Year	1st Mob Year	2nd Mob Year	3rd Mob Year
$2,510	$1,356	$1,473	$1,605

An examination of 1982 Census of Manufacturers shipments data reveals that 3.329 percent of Special Industrial Machinery is attributable to injection molding machines (see Table VIII-3). The results of multiplying the Stockpile Study requirements for Special Industrial Machinery by the 3.329 percentage and inflating the result to current (August, 1988) dollars are displayed in Table VIII-4.

Table VIII-3

PIMM Shipments as a percentage of all Special Industrial Machinery
(Millions Of 1982 Dollars)

SIC No.	Description	Dollar Value
355935	PIMM Total	$178.2
3559	Special Industrial Machinery (SIM)	$5,353.7

$$\text{PIMM AS PERCENTAGE OF SIM} = \frac{178.2}{5353.7} = 3.329 \text{ percent}$$

TABLE VIII-4

Derived Stockpile Study Requirements for Additional PIMM's
(Millions Of 1988 Dollars)

Warning Year		1st Mob Year		2nd Mob Year		3rd Mob Year	
1972$	1988$	1972$	1988$	1972$	1988$	1972$	1988$
81.6	341.7	45.1	184.6	49.0	200.5	53.4	218.5

Requirements Compared to Supplies

Before analyzing the results, the dollar figures in Table VIII-4 were converted to units. This was done to be consistent with other requirements and supply data presented in this chapter. The results for the warning year and first war year are displayed in Table VIII-5.

Table VIII-5

Unit Mobilization Requirements for additional PIMM's

WARNING YEAR

PIMM Size In Tonnage:	<100	100-299	300-499	500-699	700-999	1000-1499	1500+	Total
Number of PIMM Units:	533.5	831.2	595.4	181.0	133.4	73.8	33.3	2,381.
Percent of Total PIMM:	22.4	34.9	25.0	7.6	5.6	3.1	1.4	100.0

FIRST YEAR OF WAR OF INDEFINITE LENGTH

PIMM Size In Tonnage:	<100	100-299	300-499	500-699	700-999	1000-1499	1500+	Total
Number of PIMM Units:	341.1	531.5	380.7	115.7	85.3	47.2	21.3	1,522.
Percent of Total PIMM:	22.4	34.9	25.0	7.6	5.6	3.1	1.4	100.0

The results of the calculations converting injection molding machine requirements from dollar values to units indicate that:

- o the total number of additional injection molding machines needed for the war is 2,382 for the warning year and 1,523 for the first war year;
- o the 2,382 additional injection molding machines required in the mobilization year is only 64 percent of the 3,743 that would be manufactured during that year;
- o the 1,523 required in the first war year is only 24 percent of the 6,294 additional machines that would be available during that year. This includes 4,933 machines manufactured during that year plus the 1,361 excess machines that could be produced during the warning year.

As noted above, due to the uncertainty of this approach, we chose to examine several other methods of estimating the relationship between supply and demand of PIMM's in a mobilization emergency.

D. Requirements Extrapolated From Resin Consumption Data

The second methodology for calculating requirements is based on assumptions and data suggested by the JSIM in its public comments on the petition. JSIM suggests that requirements can be extrapolated from data on the annual domestic consumption of the resin feedstock from which plastic products are made. Using JSIM assumptions and data, the following methodology was developed:

- o First, the 55 billion pounds of resin used to make all plastic products in 1987 was multiplied by 4 percent (the percentage of resin devoted to defense-related production of plastic parts) yielding an estimated 2.2 billion pounds of resin devoted to defense production in 1987. (Note: the Department of Defense is unable to provide its own estimate of the amount or character of its plastics consumption.)
- o Next, the 2.2 billion pounds of defense-related resin was multiplied by 19.6 percent which is the percentage of all resin processed by injection molding machines. The result was 431.2 million pounds of defense-related resin that was injection molded.
- o Third, the 431.2 million pounds of injection molded resin used for defense-related products was divided by 135,000 pounds, the amount of resin processed annually by the average injection molding machine. This established a requirement of 3,194 machines to process annually the peacetime military

consumption of injection molded resin.* (Note: the figure for the amount of resin processed annually by the average injection molding machine was derived by first establishing the figure for the amount of resin annually processed through injection molding (55 billion pounds x 19.6 percent) which is 10.8 billion pounds. This number in turn was divided by the number of injection molding machines in the domestic inventory which is roughly 80,000. The result was 135,000 pounds per machine.)

- to determine wartime requirements for injection molding machines for a "worst case" scenario, JSIM suggests increasing the peacetime requirement by a factor of five. The result was a military requirement of 15,970 machines.

- the peacetime number of injection molding machines devoted to production of medical equipment is 6,583. JSIM suggested that this number would triple in wartime. Following this assumption, a mobilization requirement of 19,749 machines was determined to be necessary to meet wartime medical requirements.

- adding the military-related projection of 15,970 machines to the medical estimate of 19,749 machines, the total annual mobilization requirements for injection molding machines would be 35,719 machines. (See Table VIII-6.)

Requirements Compared to Supplies

This requirement of 35,719 machines is less than half of the roughly 80,000 injection molding machines in the current domestic inventory, leaving ample surplus capacity for other essential civilian and industrial requirements. Projected available machines would be even greater because of reliable imports (at a minimum of 349 machines per year from Canada) and expanded domestic production of injection molding machines (a total of 8,676 new machines during the warning year and first war year).

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*The JSIM Submission arrives at the same number using a somewhat different method of calculation. See JSIM Submission, pp. 96-97.

Table VIII-6

PIMM Mobilization Requirements
(annual resin consumption methodology)

Annual Domestic Resin Consumption	55 billion pounds
Peacetime Military Resin Consumption	4 percent
DOD Peacetime Resin Consumption	2.2 billion pounds
Percent of Domestic Resin Consumption Injection Molded	19.6 percent
Annual Peacetime Military Consumption of Injection Molded Resin	431,200 pounds
Total U.S. Injection Molded Resin Consumption (1988)	10.8 billion pounds
Total Domestic PIMM Inventory	80,000 machines
Resin Processed By Average Domestic PIMM	135,000 pounds
PIMM Required to Process All Resin Used By Peacetime Defense Sector	3,194 machines
Estimated Wartime Defense Sector Requirement For PIMM	15,970 machines
Wartime PIMM Requirements for Medical Equipment	19,749 machines
Total PIMM Mobilization Requirements	35,719 machines

Key Assumptions Evaluated

The key assumptions in the approach suggested by the JSIM are that:

- Peacetime military-related consumption of plastic is four percent of total consumption - Arrived at by JSIM through surveys of the percentage of plastic in over 15 diverse weapons systems and other defense goods; and through phone calls to 14 large defense contractors and six resin suppliers to obtain estimates of defense plastics use based on their own acquisition patterns.

JSIM reports that estimates ranged from three to five percent. In addition, JSIM cites an October, 1986 Modern Plastics report that Business Communications Company (BCC), an independent consulting firm, arrived at the same four percent figure in an independent marketing study. (Note: The petitioners also cite other work from the same BCC study.)

The Department of Commerce considers this assumption to be reasonable because although the absolute amount of plastic used in defense-related products is large (2.2 billion pounds), the uses of plastic in the civilian economy are vast. While DOD reportedly is the single largest domestic purchaser of plastic parts, the overwhelming majority of plastic resin is devoted to non-essential civilian uses. In addition, the independent confirmation of the four percent estimate by the BCC study lends added credence to this estimate.

- The percentage of plastic resin which is injection molded (19.6 percent) is the same for the peacetime defense sector as for the economy as a whole. - Derived from JSIM's telephone survey of defense contractors and from analysis of data from the Plastics Manufacturing Census. JSIM examined the percentage of plastic processed by each industrial process (e.g. blow molding, extrusion and injection molding) for 14 large defense contractors, as well as for a series of product end markets such as transportation, computers, and electronics, from which DOD purchases each year. JSIM found that although the percentage of plastic processed by injection molding varied from 15 to 25 percent for the product end markets (and even more at the firm level), the overall percentage was approximately the same as for the economy as a whole.

Again, Commerce considers this assumption to be reasonable as our independent analysis found that the diversity of plastic parts purchased by DOD and its prime contractors roughly parallels the diversity of parts in the civilian sector. In addition, as we noted in Chapter III, despite the relatively greater use of engineering plastics in some defense parts, two-thirds of the plastic consumed by DOD is of the same commercial grades used in the civilian sector. While the SPI notes in its Supplemental Submission that, in dollar terms, 50 percent of plastic products are injection molded; unit volume is a more important measure of the capacity of available machines to meet security requirements. Although in its Supplemental Submission, SPI argues that 31 percent of plastic materials are processed by injection molding, it does not cite a source or methodology for deriving this figure.

o Military-related demand would increase by a factor of five and total medical demand would increase threefold during wartime. - This assumption is based on the fivefold increase in the size of the military forces from current levels that would be necessary to reach the troop levels of World War II. For medical demand in wartime, the increase was reduced to threefold on the assumptions that the increase was based on the entire economy's consumption level, not just the defense sector, and that large U.S. export markets for medical equipment might be somewhat reduced in wartime.

The Commerce Department accepts these assumptions as reasonable because although the demand for some defense systems would be expected to increase in demand by more than a factor of five during a global war, troop levels would increase only by a factor of two or two and a half. In fact, if needed, substitution of other materials or plastic processing methods for injection molded plastic might reduce PIMM requirements as many military applications are non-critical components with readily-available substitutes.

o Injection molding machines that are more than five years old which lack sophisticated computer controls could be used to meet essential civilian requirements and some military-related requirements during a war. The SPI has strongly objected to this assumption, arguing that many plastic parts in current weapons systems are produced with computer controlled injection molding machines that have been available only within the last five years. Only about 26,000 machines out of the 80,000 PIMM's in the domestic inventory were produced during the last five years.

The Commerce Department has determined that JSIM is correct in assuming that older PIMM's can be used to meet some defense and many civilian and industrial requirements. We believe this is true because a significant percentage of the injection molded plastic consumed by the military is not for critical parts of weapons systems, but for relatively low technology purposes. The same is true in the industrial and essential civilian sector. The Department believes older injection molding machines can be used to produce most of these parts. In addition, our telephone interviews with defense molders confirmed that a significant majority did not believe that the age or technology of the machines in their possession would limit significantly their ability to meet expanded defense orders in a national emergency.

E. NSC Study Requirements for Plastic Feedstock

The third methodology for estimating the relationship of mobilization requirements and projected supplies involves the requirement figures for Plastics Materials (including resins) from the Stockpile Study. (Note: the data is for SIC Code 2821 which contains 51 items including plastics materials, synthetic resins, and nonvulcanizable elastomers. Because many of these materials would not be processed through injection molding machines, the requirements generated from this data somewhat overstate the needs for injection molding machines in a mobilization.) The NSC mobilization requirements for Plastics Materials are displayed in Table VIII-7.

Table VIII-7

Stockpile Study Requirements for Plastics Materials
(Millions of Dollars)*

Warning Year 1983		1st Mob Year 1984		2nd Mob Year 1985		3rd Mob Year 1986	
1972$	1986$	1972$	1986$	1972$	1986$	1972$	1986$
5,500	18,084.0	4,304	14,151.6	4,701	15,456.9	5,045	16,588.0

*The requirements are inflated to 1986 dollars rather than 1988 dollars because the conversion formula that will be used to generate injection molding machine requirements is based on 1986 data.

The methodology used for converting these requirements to PIMM requirements is as follows:

- The relationship of volume to value in resins was determined to be 2.3 pounds to $1 since the value of domestic resins shipped in 1986 was $21.9 billion and the volume shipped that year was 50.8 billion pounds (50.8 billion pounds divided by $21.9 billion).

- The total dollar figures for each year of resin requirements in Table VIII-7 were multiplied by 2.3 to generate resin requirements in pounds for each year of Scenario 3A. These requirements are displayed below in Table VIII-8.

Table VIII-8

Stockpile Study Requirements for Plastics Materials
(Millions Of Pounds)

Warning Year	1st War Year	2nd War Year	3rd War Year
41,593.2	32,548.7	35,550.9	38,152.4

- o Resin requirements for the mobilization year and first war year (third year of Scenario 3A) were multiplied by 19.6 percent to obtain the mobilization requirements for injection molded resin of 8.15 billion and 7.48 billion pounds respectively.
- o these figures were divided by the number of pounds of resin processed annually by the average injection molding machine (135,000 pounds) generating mobilization requirements displayed in Table VIII-9 of 60,370 injection molding machines for the warning year and 55,407 for the first war year. (Note: these requirements include injection molding machines used for medical purposes because the total NSC feedstock requirements from Table VIII-7 on which they are based include the essential civilian sector as well as the industrial and direct defense sectors.)

Table VIII-9

PIMM Mobilization Requirements
(Plastic Materials Data Method)

	Warning Year	1st War Year
Total Mobilization Requirement For Resin	41.6 bil. lbs.	38.2 bil.lbs.
Percent of Domestic Resin Consumption Injection Molded	19.6%	19.6%
Mobilization Requirement For Injection Molded Resin	8.15 bil. lbs.	7.48 bil. lbs.
Resin Processed By Average Domestic PIMM	135,000 lbs.	135,000 lbs.
Mobilization Requirements For PIMM	60,370	55,407

The total requirements generated are not large enough to create shortfalls when compared to projected available supplies of 83,126 machines during the warning year and 88,059 at the end of the first war year. Exports were subtracted as they have already been factored into the NSC requirements.

F. Interviews with Plastic Processors

The Department of Commerce conducted structured telephone interviews with representatives of 57 firms that use plastic injection molding machines to manufacture plastic parts. The names of these molders with defense-related and medical business were supplied by several of the Petitioners in their initial Submission and in subsequent communications with the Commerce Department. Of these firms, thirty-seven are involved in production of parts that are eventually sold to defense contractors or DOD. Twenty others are firms producing plastic parts for medical equipment.

The interviews covered many aspects of the injection molding industry including:

- o the extent of defense-related business conducted by each molder;
- o the extent to which each firm could convert injection molding machines from civilian production to production of defense-related parts (i.e fungibility of equipment); and
- o whether injection molding machines that are more than five years old can be used to make defense-related and medical parts.

Background on Molders

The defense-related plastic products produced by the molders varied widely including projectile supports, jet engine parts, ignition caps for smoke grenades, missile fins, electrical parts for a variety of weapon systems, parts for artillery rounds, magazine clips, shell casings, terminal boards and covers for computers, O rings for missiles, helmet visors, switches, canteen lids and casings for batteries. The size of the machines used to produce defense and medical products also varied widely from 24 tons to 1,500 tons clamp force.

The extent of defense-related business by dollar volume conducted by the defense molders ranged from 1 percent to 100 percent with the average being 33 percent. Several companies noted that the level of their defense-related business varied significantly from year to year depending on the extent of their defense contracts.

The medically-related plastic parts produced by the medical molders included pill closures and screw-on caps, eye droppers, pumps for intravenous fluids, eye glass lenses, blood testing equipment, stethoscopes, and syringes. The medical molders reported an average of 60 percent medically-related business.

Interview Results

On the crucial question of how much they could increase defense production using idle capacity or converting machines from nondefense production, a majority of the defense molders (18 of 30 answering) stated they could increase defense production by 100 percent if necessary. The lowest percentage increase projected was 25 percent, while several cited figures of up to four times current production. Medical molders also estimated significant production increases in a national emergency, although to a lesser extent. The average increase projected was 75 percent.

When queried about technical factors such as the availability of machines of the appropriate size and age, extra molds for these machines and resin feedstock; 24 of the 35 defense molders who answered the question stated that there would be no significant technical problems that would prevent them from enhancing defense production through conversion of machines currently used for nondefense production or that were idle.

Only three of the defense molders stated that the age of machines would be a factor in handling the greater temperatures and pressures associated with processing of advanced plastic materials used in some defense articles. Of the medical molders, 15 of 20 anticipated that no technical problems would prevent in converting machines to medical production.

In summary, our interviews with molders supported the view that production of mobilization-related plastic products could be expanded dramatically from current peacetime levels; even though the production of some defense products would be restricted to newer, computer controlled machines.

G. <u>Future Military Requirements</u>

In determining whether PIMM imports threaten to impair the national security, it is also necessary to evaluate anticipated future increases in defense and essential civilian demand for injection molded plastic products. To accomplish this, Commerce asked DOD to examine trends in R & D and projected acquisitions of new or revised weapons systems. We formally requested that the Office of the Secretary of Defense (OSD) evaluate increased usage of injection molded plastic in direct defense applications such as aerospace systems, ships and submarines, land warfare vehicles and other military systems. In addition, Commerce requested DOD to provide available information on the magnitude of any projected increase in defense usage of injected molded plastic and the types of military equipment likely to be affected.

DOD Response

After checking R & D activity related to weapons systems, including highly secret or "dark" projects and the DOD Plastics Technical Evaluation Center, OSD concluded that military consumption of injected molded plastic in the next few years would increase at about the same rate as usage in the general economy. DOD noted that there is research and development activity related to plastic injection molding applications as there is with other materials technologies needed for state-of-the-art weapons systems. However, DOD also noted that the use of substitute materials in defense equipment and supplies often lags behind the commercial sectior because of the lead times needed to revise specifications and/or perform qualification tests.

Public Comments

In its September 13, 1988 Supplemental Submission, SPI pointed out that some potential military applications are already being adopted commercially. SPI also argued that defense usage of injection molded plastic will increase at a dramatic rate in the future, especially in aerospace applications, because of the potential use of injection molding machines to process polymer matrix materials (i.e., advanced composites and reinforced plastics) and ceramic and powdered metal-based materials.

However, much of the information cited by the Petitioner applies to increased usage of plastics in general or plastic composites regardless of whether they are injection molded. Moreover, with regard to injection molding of ceramic, metal and cemented carbide powders, the Petitioners acknowledges that such techniques are "embryonic" and in their "infancy."

Furthermore, the development of a plastic part that can substitute for a metal part as a component in a critical defense system does not guarantee that it is cost-effective to make the substitution. The public comments of the German Machinery and Plant Manufacturers Association (VDMA) on the Petition point out that "...the U.S. government has for several years considered making critical, high performance parts by plastics injection molding process for critical military equipment, and although the technology is in place, there are few such high performance applications."

In summary, we believe that available evidence confirms the OSD view that military consumption of plastic injection molded parts in the near and intermediate future will grow at a rate comparable to that of the general economy. Therefore, we do not anticipate that such growth will lead to an otherwise unforeseen shortfall between wartime requirements and available supplies of injection molding machines.

Conclusion

The Department has determined that available supplies of plastic injection molding machines will be sufficient to meet anticipated requirements during a national security emergency under each of the methods undertaken above. Since no shortfalls were identified, the Department did not undertake an analysis of the link between imports and any identified supply shortfalls.

IX. FINDING AND RECOMMENDATION

Finding

We have determined that available supplies of plastic injection molding machines will be sufficient to meet anticipated requirements during a national security emergency. The Department, therefore, finds that plastic injection molding machines are not being imported into the United States in such quantities or under such circumstances as to represent a threat to the national security.

Recommendation

We, therefore, recommend that the President take no action to adjust imports under authority of Section 232 of the Trade Expansion Act of 1962, as amended.

TAB A

SUMMARY OF THE PETITION

Background

On January 11, 1988, the Society of the Plastics Industry, Inc. (SPI), on behalf of the Domestic Injection Molding Machinery Trade Group, petitioned the Department of Commerce to initiate an investigation under Section 232 of the Trade Expansion Act of 1962, as amended, to determine the effect of plastic injection molding machine imports on national security. The Society seeks relief from growing levels of injection molding machinery imports. They specifically request the Department to identify problems in the industry and to recommend remedial actions to be taken by the President.

The SPI is a trade association including domestic producers of plastic injection molding machinery (PIMM). Its Domestic Injection Molding Machinery Trade Group is comprised of seven major U.S. PIMM manufacturers.

The petition focuses on the preservation of domestic capacity adequate to supply the nation's economic and military needs in time of crisis. The Society contends that excessive dependence on imports of injection molding machinery substantially jeopardizes the domestic industry and further undermines U.S. security in the event of a national emergency.

Industry Overview

The petitioner describes the U.S. plastics industry as a thriving industry that is developing at an extraordinary pace, in advance of the domestic economy. Plastic injection molding machines, a key sector of this industry, are a commonly used type of equipment designed to process plastic feedstocks to create civilian and defense-related products.

The petitioner alleges that U.S. manufacturers of injection molding machines are at a competitive disadvantage due to the surge of foreign imports at extremely low prices, particularly from Japan. The SPI reports that the U.S. market share has dropped significantly and continues to decline.

Imports

SPI states that U.S. injection molding machine imports increased significantly, as U.S. production has decreased. Imports accounted for almost two-thirds of the machines purchased in the U.S. during 1986. The petitioner estimates that import penetration will increase through 1987 and 1988.

Imports of low value, standard machines are those most commonly purchased and used by the U.S. industry. The intense import competition is disproportionately placed in this end of the market in which cost advantages and other factors have led offshore producers to undersell U.S. producers by the highest margins. This competition is derived mainly from Japan, Canada and Germany, with Japan dominating the market. Japan's share of the import market has increased from 32 percent in 1984 to 56 percent in 1987.

Rising import penetration has forced many domestic producers out of business. The Society alleges that the loss of key, high-volume markets to imports is the main cause of this industry's declining profitability and loss of efficiency. They further contend that future investments cannot be made without the assurance of a reasonable level of profits.

The petitioner alleges that increased Japanese import penetration has been accomplished through use of trade practices such as: allowing no down payment and requiring no payment for six months thereafter; providing low interest or discount financing with extended payment periods; free trial programs for 6-12 months; free trips to Japan for extensive travel and entertainment, and the like.

Competitiveness

The world market is in a state of growing excess capacity, and exports are naturally being targeted toward the United States. In responding to the growing challenge of import penetration, the United States faces the critical disadvantage of the relative openness of its injection molding market. Conversely, trade restrictions, high tariff and non-tariff barriers preclude U.S. producers from entering many foreign markets. Since 1986, U.S. exports have decreased significantly and exports to Japan have remained stagnant.

The plastics industry has a long history of actively exporting, however, the difficulties associated with noncompetitive financing and unfair foreign trade practices, have limited U.S. manufacturers competing abroad. Consequently, injection molding machinery exports have experienced only a slight increase in the past three years.

According to the petitioner, the loss of sales of standard machines, that provide an economic base to support specialty, high-tech machinery, has resulted in plant closings, employment decreases, and the demise of manufacturing skills that take years to acquire. In addition, relatively high U.S. labor costs contribute to the decrease in this industry's competitiveness.

Technology

In order to maintain technological competitiveness, PIMM producers must have a continuous volume of business that allows production economies of scale. Domestic producers have retreated, however, to high-value low-volume market niches where their technological expertise permits them to effectively compete. Although these products are important for military and specialized uses, they are manufactured and sold in comparatively low volumes, and overall production levels have decreased significantly.

Defense Uses

According to the Society, PIMM producers are an integral part of our U.S. defense base producing a wide range of defense-related and medical products. Defense products include: submarine and jet engine parts, suspension pins for fuel rockets, stealth technology and radar sights. Medical products include: pediatric suprapubic Catheters, cytology brushes and single puncture prostatic biopsy needles.

If an emergency were to occur, however, this country would lose access to most, if not all sources of imported machinery and parts. The U.S. must, therefore, rely on domestic sources of supply for defense technology and machinery.

Employment

The Society contends that PIMM industry employment has experienced a substantial reduction. This employment drop is the result of recessions, layoffs and plant closings. The petitioner believes that if the overall employment decline continues, domestic production capability will be severely hampered during an emergency. In addition, the aging work force coupled with the inability to attract young workers has lessened this industry's ability to regain its lost capacity.

New technological advances using the rare qualities of plastic's strength and lighter weight will replace many items currently not produced with plastic products. These new technologies will require the development of new processing methodology and machinery. Machinists, technicians and engineers will be required to produce the necessary equipment.

Outlook

The petitioner contends that imports are entering this country at an alarming rate and that the future outlook for the injection molding machine industry is grim. They report that as "the value of the Japanese yen has risen dramatically against the U.S. dollar, Japanese producers have not raised their prices proportionately and in some instances have lowered them." They believe that "this practice negates the argument that a fall in the value of the U.S. dollar will in itself adjust the trade imbalance and suggests predatory pricing policies intended to capture the market."

During an armed conflict, the United States will not be able to meet critical defense production needs without a strong PIMM industry and a lead in technology. Losing valuable market shares to imports has been critically damaging and has threatened the existence of the domestic industry. "Accordingly, the petitioner urges a thorough investigation and swift remedial action."

SUPPLEMENTAL SUBMISSIONS

SPI submitted several supplements to their petition. Among the points raised were the following:

- The Japanese share of the import market escalated from 25 percent in 1982 to 56 percent during 1987.
- Since 1986, the unit price of Japanese machines have increased dramatically as the unit price of U.S. machines dropped. This increase is viewed as a common practice used by the Japanese after they have cornered the market by undercutting U.S. sales. The Japanese have now moved to the specialty machine market where prices are undercut by as much as 40 percent. Aided by unlimited government financing, the Japanese can sustain operation losses while eliminating competition.
- Foreign governments and foreign industrial conglomerates subsidize their industry by investing in research and the development of new technology.
- Fifty percent of all plastics products are produced by the injection molding process. This method is used to manufacture dependable and inexpensive plastic parts of all shapes, sizes and materials that can be adapted to a variety of applications.
- New developments in material technology include the advanced composites area where polymer, metal and ceramic matrix composites are being produced. In addition to their strength, their higher temperature capability and their corrosion resistance make them beneficial for defense uses.
- Materials such as PEEK and liquid crystal polymers are being used in composites to injection mold products that can substitute for metal. This advance in materials technology is creating many defense uses for injection-molded items. As a result, numerous opportunities for injection molders and extruders currently exist.
- Polymers have an advantage over metal products since they can be shaped into their final form without additional machining. Existing multiple metal parts can be replaced by a single injection molded component. Replacing these existing metal parts with the lightweight component part will save on material, inventory and tooling costs.
- Over 67 percent of the injection molding machines of five or more years are American made. The majority of the older machines cannot be retrofitted, rebuilt, or remanufactured effectively to satisfy military requirements. Conversion to high-tech parts for electronics, automotive, aerospace and defense applications is difficult.

- It is difficult to convert between peacetime and defense production. Defense production is more specialized and therefore conversion could take weeks or months. In addition to mold changing, the machine tonnage, distance between the tie bars, and injection unit size must fit with the specific end use.

The Society questions the validity of the information contained in the PLASPEC presentation. They raise the following major concerns and allegations:

- Imports are expected to continue at the same high level for the second half of 1988, unlike the low levels projected by PLASPEC.

- The market growth estimates of 24 percent in 1988 and five percent in 1989 made by PLASPEC are questionable. Recent trends in this industry show an increase of two percent in 1987 and a decrease of about 27 to 41 percent during 1985 and 1986 respectively.

- None of the U.S. companies identified by PLASPEC have plans to expand their injection molding facilities. Future expansions in this industry are expected to take place in systems and non-injection molding sales.

- Foreign producers are not relocating their injection molding operations to the United States to recover lost market shares. In fact some of the companies mentioned by PLASPEC for possible relocation do not produce injection molding machines.

- Cincinnati Milacron's corporate officers never provide machine sales amounts to the public as suggested by PLASPEC. However, total dollar sales are available by division.

In addition, an increasing number of injection molding machines are being trans-shipped by the Japanese to this country through Canada. This sudden increase in shipments occurred after the imposition of Congressional sanctions on Toshiba.

SPI asserts that JSIM's October 14 submission misstates the importance of the injection molding process within the composites industry.

ARCTIC RESEARCH COMMISSION

Meeting of Commission

Notice is hereby given that the Arctic Research Commission will meet with the Governor, State of Alaska, and with Members of the Alaska State Legislature in Juneau, Alaska, on 10–11 March 1988.

At 8:30 a.m. on 10 March the Commission will meet in Executive Session at the Westmark Juneau Hotel, Juneau, Alaska. Agenda topics will include: Commission budgetary matters; consideration of new members and staff; and the internal operations of the Commission. In addition the Commission will discuss future plans and activities.

At 1:45 p.m. the Commission will hold an open session at the Westmark Juneau Hotel. Topics to be discussed will include: international cooperation in Arctic research; Arctic logistics; and Arctic information and data.

At 4:30 p.m. the Commission will meet with the Governor, State of Alaska, at the Governor's Mansion, Juneau, Alaska.

At 9:00 a.m. on 11 March the Commission will hold a public meeting at the Juneau Borough council chambers, 155 Seward Street, Juneau, Alaska. Public comments is requested on U.S. Arctic research needs and policy issues.

The Commission will meet in the afternoon with the House and Senate Health, Education and Social Services Committees and the Senate International Trade Committee, Capital Building, Juneau, Alaska.

FOR FURTHER INFORMATION CONTACT: Mr. W. Timothy Hushen, (213) 743–0970.

W. Timothy Hushen,

Executive Director, Arctic Research Commission.

[FR Doc. 88–4624 Filed 3–2–88; 8:45 am]

BILLING CODE 7555–01–M

DEPARTMENT OF COMMERCE

International Trade Administration

Initiation of National Security Investigation of Imports of Plastic Injection Molding Machines

AGENCY: International Trade Administration, Office of Industrial Resource Administration, Commerce.

ACTION: Notice of an investigation under section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. 1862), and request for comments.

SUMMARY: This notice is to advise the public that an investigation is being initiated under section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. 1862), to determine the effects on the national security of imports of plastic injection molding machines. Interested parties are invited to submit written comments, opinions, data, information or advice relative to the investigation to the Strategic Analysis Division, Office of Industrial Resource Administration, U.S. Department of Commerce.

EFFECTIVE DATE: Comments must be received not later than April 4, 1988. Written comments should be addressed to: Steven C. Goldman, Director, Strategic Analysis Division, Office of Industrial Resource Administration, International Trade Administration, U.S. Department of Commerce, Room H3878, Washington, DC 20230.

FOR FURTHER INFORMATION CONTACT: Steven C. Goldman, Director, Strategic Analysis Division, Office of Industrial Resource Administration, International Trade Administration, U.S. Department of Commerce, Room H3878, Washington, Dc 20230; telephone number: (202) 377–4060.

SUPPLEMENTARY INFORMATION: In an application submitted January 11, 1988 by the Society of the Plastics Industry, Inc. on behalf of the Domestic Injection Molding Machinery Trade Group, the Department of Commerce was requested to initiate an investigation under section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. 1862), to determine the effect on the national security of imports of plastic injection molding machines.

On February 29, 1988 the Department of Commerce confirmed receipt of and accepted the application requesting an investigation. The findings and recommendations of the investigation will be reported by the Secretary of Commerce to the President no later than January 11, 1989.

The articles to be investigated include both horizontal and vertical plastic injection molding machines. These items are currently described by Standard Industrial Classification Code 355935, and are currently classifiable in the Tariff Schedules of the United States Annotated (TSUSA) at items 678.3517 and 678.3570.

This investigation is being undertaken in accordance with Part 359 of Title 15 of the Code of Federal Regulations (15 CFR Part 359) ("Regulations"). Interested parties are invited to submit written comments, opinions, data, information or advice relevant to this investigation to the Office of Industrial Resource Administration, U.S. Department of Commerce, no later than April 4, 1988.

All materials should be submitted with 10 copies. Public information will be made available at the Department of Commerce for public inspection and copying. Material that is national security classified information or business confidential information is subject to the provisions of § 359.6 of the regulations (15 CFR 359.6) Anyone submitting business confidential information should clearly identify the business confidential portion of the submission and also provide a non-confidential submission which can be placed in the public file.

The public record concerning this investigation will be maintained in the Central Records Unit, Import Administration, International Trade Administration, Room B-099, U.S. Department of Commerce, 14th and Pennsylvania Avenue, NW., Washington, DC 20230. The records in this facility may be inspected and, for a fee, copied in accordance with regulations published in Part 4 of Title 15 of the Code of Federal Regulations.

Information about the inspection and copying of records at the facility may be obtained from the Central Records Unit, Import Administration, at (202) 377–1248.

If deemed appropriate by the Department, public hearings may be held to elicit further information as provided in § 359.8 (15 CFR 359.8) of the Regulations. Notice will be published in the **Federal Register**, giving the time, place, and matters to be considered at such hearing(s) so that interested parties will have an opportunity to participate.

Dated: February 29, 1988.

Gilbert B. Kaplan,

Acting Assistant Secretary for Import Administration.

[FR Doc. 88–4638 Filed 3–2–88; 8:45 am]

BILLING CODE 3510–DT–M

National Oceanic and Atmospheric Administration

Deep Seabed Mining; Approval of Exploration License Revision for Kennecott Consortium

AGENCY: National Oceanic and Atmospheric Administration, Commerce.

ACTION: Notice of approval of deep seabed hard mineral resources exploration license revision for Kennecott Consortium.

SUMMARY: On October 29, 1987, at 52 FR 41611, the National Oceanic and Atmospheric Administration (NOAA), noticed receipt of a proposal from Kennecott Consortium (KCON), 1515 Mineral Square, Salt Lake City, Utah 84112, to modify the exploration plan

UNITED STATES DEPARTMENT OF COMMERCE
International Trade Administration
Washington, D.C. 20230

TO: PRODUCERS OF PLASTIC INJECTION MOLDING MACHINES

The enclosed questionnaire, Form ITA-9059, is being sent to your firm as part of the Department of Commerce's investigation, under Section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. 1862), of the impact of imports of thermoplastic injection molding machines on the national security. This equipment is covered under classification numbers 678.3517 and 678.3570 of the Tariff Schedules of the United States. This investigation is being undertaken in accordance with the enclosed Department of Commerce regulations found in 15 CFR 359. To make its determination, the Department must receive your response to the enclosed questionnaire not later than DATE, 1988.

The information requested is needed to supplement data available to the Department from other sources. Failure to respond to this questionnaire could result in a maximum fine of $1,000 or imprisonment of up to one year, or both under the authority of the Defense Production Act of 1950, as amended (50 U.S.C. App. 2155).

Where appropriate, it is essential that information and material submitted be designated "BUSINESS CONFIDENTIAL" as provided in Section 359.6 of the attached Department of Commerce regulations. Submissions not so designated may be subject to release under provisions of the Freedom of Information Act.

If you have any questions concerning this questionnaire, please contact Karen Swasey on (202) 377-3634 or Edward Levy on (202) 377-3795.

Sincerely,

John A. Richards
Director
Office of Industrial Resource Administration

Enclosures

Form ITA-9059
(6-88)

OMB Approval Not Required

U.S. DEPARTMENT OF COMMERCE
INTERNATIONAL TRADE ADMINISTRATION

INVESTIGATION OF THE IMPACT OF IMPORTS OF THERMOPLASTIC INJECTION MOLDING MACHINES ON THE NATIONAL SECURITY

PRODUCER'S QUESTIONNAIRE

THIS QUESTIONNAIRE IS REQUIRED BY LAW

PLEASE RETURN BY AUGUST 5, 1988

Failure to respond to this questionnaire could result in a maximum fine of $1,000 or imprisonment of up to one year under section 705 of the Defense Production Act of 1950, as amended (50 U.S.C. App. 2155).

UNCLASSIFIED

GENERAL INSTRUCTIONS

1. Where appropriate, information and material submitted should be designated "BUSINESS CONFIDENTIAL" as provided for in section 359.6 of the enclosed U.S. Department of Commerce Regulations, 15 C.F.R. 359.

2. It is not our desire to impose an unreasonable burden on any respondent. IF INFORMATION IS NOT READILY AVAILABLE FROM YOUR RECORDS IN EXACTLY THE FORM REQUESTED, FURNISH ESTIMATES AND DESIGNATE BY THE LETTER "E". Any necessary comments or explanations should be supplied in the space provided or on separate sheets attached to this questionnaire. Ensure that you reference the proper question if you use extra sheets. If any answer is "none", please so indicate.

3. Report calendar year data, unless otherwise specified in a particular question. Parts I, and IV - VI, apply to your entire firm and its total domestic operations. PLEASE NOTE HOWEVER THAT PARTS II AND III SHOULD BE REPORTED SEPARATELY FOR EACH ESTABLISHMENT THAT PRODUCES PLASTIC INJECTION MOLDING MACHINES IN THE UNITED STATES. Please make photocopies of forms if additional copies are needed.

4. While it would be convenient to the Government for a file copy of the completed survey be retained by your firm for reference purposes, no assurances can be provided that file copies are exempt from compulsory examination pursuant to legal process.

5. Please read the list of Definitions carefully before completing the questionnaire. These terms are used throughout the document.

6. Before returning your completed questionnaire be sure to sign the certification and identify the person and phone number to contact within your firm.

7. Return the completed questionnaire by August 5, 1988 to:

   INTERNATIONAL TRADE ADMINISTRATION
   U.S DEPARTMENT OF COMMERCE
   WASHINGTON, DC 20230
   ATTN: Edward Levy, Room H3878

8. Any questions you may have concerning this questionnaire should be directed to Karen Swasey, Trade & Industry Analyst at (202) 377-3634, or Edward Levy, Program Manager at (202) 377-3795.

DEFINITIONS

BOTTLENECK - During a production expansion, the production process, operation, procedure, or labor requirement within your manufacturing establishment that would delay or prevent increased production.

ESTABLISHMENT - Facility(ies) at a single location where manufacturing or production of plastic injection molding machines takes place. Includes auxiliary facilities operated in conjunction with such production facilities (whether or not in the same building).

FIRM - An individual proprietorship, partnership, joint-venture, association, corporation (including any subsidiary corporation in which more than 50 percent of the outstanding stock is owned), business trust, cooperative, trustee in bankruptcy, or receivers under decree of any court, owning or controlling one or more establishments as defined above.

FOREIGN SOURCE - A source located outside of the United States from which you purchase a component, part, machine, or assembly.

LEAD TIME - The time interval, expressed in weeks, between the placement of an order for a plastic injection molding machine, and its delivery to the end-user.

PRACTICAL CAPACITY - Sometimes referred to as engineering or design capacity, this is the greatest level of output a given plant can achieve within the framework of an economically realistic work pattern. In estimating practical capacity, please take into account the following considerations:

1. Assume your current product mix (size and type of machine).
2. Consider only the machinery and equipment in place and ready to operate. Do not consider facilities which have been inoperative for a long period of time and, therefore, require extensive reconditioning.
3. Take into account the additional downtime for maintenance, repair, or clean-up which would be required as you move from current operations to full capacity.
4. Assume the use of productive facilities outside of the plant, such as contracting out and subassembly work, to be in the same proportion as has been characteristic of your operations.

SHIPMENTS - Report unit and dollar values of domestically produced plastic injection molding machines shipped by your firm during the reporting period for each category for the questions in Part I. Such shipments should include inter-plant and intra-plant transfers, but should exclude shipments of products produced by other manufacturers for resale under your brand name. Do not adjust for returned shipments.

UNITED STATES - The United States is defined as the fifty states, Puerto Rico, the District of Columbia, and the Virgin Islands.

PART I.
FIRM IDENTIFICATION

(TO BE FILLED OUT IN AGGREGATE FOR ENTIRE FIRM)

1. Name and address of your firm or corporate division.

____

____

____

2. If your firm is wholly or partly owned by another firm, indicate the name and address of the parent firm and the extent and nature of ownership.

____

____

____

Percentage ownership: ______________________________ %

3. Identify the location of your plastic injection molding machinery manufacturing establishment(s) in the United States and abroad, as well as affiliates, including licensees and joint venture partners, etc.

	Locality	State/ Country	Zip	Relationship
(a)				
(b)				
(c)				
(d)				
(e)				
(f)				
(g)				

4. a. Identify U.S. plastic injection molding machinery manufacturing establishments and/or major product lines in which you ceased production since January 1, 1980 and the reason production was stopped. (Use letter codes provided below.) Include facilities closed after mergers/acquisitions.

Reasons:
a. Loss of market share to imports.
b. Loss of market share to domestic competition.
c. Declining demand.
d. Low profitability.
e. Firm restructuring.
f. Other (Specify:________________).

Date	Location (City/State)	Reasons (Codes)	Annual Practical Capacity Lost in Units*

b. Please explain any entries in the above section:________________

5. Are there any plans for a) plant closings/contractions, or b) plant expansion/new construction over the next three years? If so, indicate the volume of productive capacity that will be lost (added) Also provide explanatory comments in the space allocated.

a. CLOSINGS/CONTRACTIONS

Date	Location (City/State)	Annual Practical Capacity Lost in Units

(continued)

(Question 5 continued)

b. EXPANSIONS/NEW CONSTRUCTION

Date*	Location (City/State)	Annual Practical Capacity Gained in Units (Planned)

*Date at which plant is expected to be be fully operable.

EXPLANATION (e.g., rationale for planned expansion/contraction):

6. The following two tables request information relating to your firm's shipments of domestically-produced injection molding machinery from January, 1982 through June, 1988. Shipments are requested, in both unit and dollar terms, for a) thermoplastic injection machines in 7 size ranges, and b) thermoset injection machines.

(continued)

(Question 6 continued)

a. SHIPMENTS OF INJECTION MOLDING MACHINES
(UNITS)

I. THERMOPLASTIC MACHINES

SIZE OF MACHINE	1982	1983	1984	1985	1986	1987	First 6 Mos. 1988(E)
Clamp Force < 100 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 100-299 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 300-499 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 500-699 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 700-999 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 1,000-1,499 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 1,500 tons and over							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
TOTAL, Theromplastic Machines	____	____	____	____	____	____	____

(continued)

(Question 6a continued)

a. SHIPMENTS OF INJECTION MOLDING MACHINES
(UNITS)

II. THERMOSET MACHINES OF ALL SIZES

	1982	1983	1984	1985	1986	1987	First 6 Mos. 1988(E)
Thermoset Machines	____	____	____	____	____	____	____
GRAND TOTAL, all types	____	____	____	____	____	____	____

(continued)

(Question 6 continued)

b. SHIPMENTS OF THERMOPLASTIC INJECTION MOLDING MACHINES
(THOUSANDS OF DOLLARS)

I. THERMOPLASTIC MACHINES

SIZE OF MACHINE	1982	1983	1984	1985	1986	1987	First 6 Mos. 1988(E)
Clamp Force < 100 tons							
Microprocessor	$____	$____	$____	$____	$____	$____	$____
Other Controls	____	____	____	____	____	____	____
Clamp Force 100-299 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 300-499 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 500-699 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 700-999 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 1,000-1,499 tons							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
Clamp Force 1,500 tons and over							
Microprocessor	____	____	____	____	____	____	____
Other Controls	____	____	____	____	____	____	____
TOTAL, Therompiastic Machines	$____	$____	$____	$____	$____	$____	$____

(continued)

(Question 6b continued)

b. SHIPMENTS OF THERMOPLASTIC INJECTION MOLDING MACHINES
(THOUSANDS OF DOLLARS)

II. THERMOSET MACHINES OF ALL SIZES

	1982	1983	1984	1985	1986	1987	First 6 Mos. 1988(E)
Thermoset Machines	$_____	$_____	$_____	$_____	$_____	$_____	$_____
GRAND TOTAL, all types	$_____	$_____	$_____	$_____	$_____	$_____	$_____

(continued)

7. What is your firm's inventory policy regarding injection molding machines? If you maintain an inventory of finished or nearly finished machines, what was the stock of these machines on May 31, 1988?

____

____

____

____

____

____

8. What are the most common applications for your plastic injection molding machines?

Containers/Packaging	______	%
Medical	______	%
Housewares/Toys	______	%
Automotive	______	%
Audio/Video/Electronics	______	%
Construction	______	%
Appliances	______	%
Others (specify)		
______________	______	%
______________	______	%
______________	______	%
All Other	______	%
	=======	
	100	%

PART II.
MOBILIZATION CAPACITY ESTIMATES

(TO BE FILLED OUT FOR EACH DOMESTIC MANUFACTURING ESTABLISHMENT)

READ DIRECTIONS CAREFULLY BEFORE COMPLETING

Directions:

The following table has been developed to provide the Department of Commerce with an accurate unit measure of your firm's domestic production capacity for plastic injection molding machines, by production facility. These capacity estimates are to be used in turn in an assessment of the ability of the domestic industry to meet national security requirements during a global conventional war. For purposes of completing this survey assume mobilization begins July 1, 1988.

Mobilization capacity is defined as the maximum realistic level of production that a manufacturing establishment can achieve during a designated 6 month period given the set of predetermined operational parameters listed below. Capacity (in units) is requested for four six month intervals (6, 12, 18, and 24 months after mobilization begins). In the space provided at the top of the chart, identify the establishment to which the data apply.

In calculating production capacity during mobilization assume the following parameters:

- Facilities operate at the maximum rate possible given technological and floor space constraints; economic constraints are no longer binding;
- Existing production facilities are to be raised to full productive capacity, including the acquisition of equipment needed to accomplish this;
- Labor and equipment availability reflects normal local market conditions;
- Material and energy requirements are fully met;
- Assume your current product mix.

Since mobilization begins on July 1, 1988, your shipments for the first six months of 1988 can be used as a baseline from which to increase production.

ESTABLISHMENT: ______________________

1.

a. WARTIME PRODUCTION CAPACITY
QUANTITY IN UNITS

	BASELINE	MOBILIZATION			
	First 6 Mos. 1988 Shipments (Units)	Production During 1st 6 Months	Production During 2nd 6 Months	Production During 3rd 6 Months	Production During 4th 6 Months
Time Elapsed From Mob. (Mos):	0	6	12	18	24
Clamp Force (tons)					
Less than 100	____	____	____	____	____
100-299	____	____	____	____	____
300-499	____	____	____	____	____
500-699	____	____	____	____	____
700-999	____	____	____	____	____
1,000-1,499	____	____	____	____	____
1,500 and over	____	____	____	____	____

b. By what additional percentage would these quantities increase if the constraint regarding construction of new facilities were lifted?

After 6 Months ________ %

After 12 Months ________ %

After 18 Months ________ %

After 24 Months ________ %

(Question 1 continued)

c. Please explain the top three factors which would effect these numbers, such as size of machine ordered, type and complexity of machine (i.e., toggle vs. hydraulic, computer controlled or not, etc.).

____

____

____

____

____

____

2. a. According to the assumptions given, what is the approximate size of the additional labor force which would be required to support the increase in production given in question 1?

	AFTER 6 Mos.	AFTER 12 Mos.	AFTER 18 Mos.	AFTER 24 Mos.
Additional Production Workers Needed:	____	____	____	____
Additional Engineers/ Scientists Needed:	____	____	____	____

PART III.
BOTTLENECKS, LEAD TIMES, AND EXPANSION CAPABILITIES

(TO BE FILLED OUT FOR EACH ESTABLISHMENT)

ESTABLISHMENT: ____________________

1. PRODUCTION BOTTLENECKS:

   a. In which of the following areas would you encounter bottlenecks in this facility during the surge in production outlined in the preceding war scenario? Also indicate the time and cost it would take to remove such bottlenecks. (Refer to the definition provided for bottlenecks in the definition section of this survey.) Rank entries from 1 to 5 in order of severity (1 = most severe, 5 = least severe).

Operation	Rank	Bottlenecks	Time and Cost to Correct
Machining:			
Metal Cutting	____	____________	____________
Metal Forming	____	____________	____________
Assembly	____	____________	____________
Testing	____	____________	____________
Parts/Components	____	____________	____________
Others (Specify)	____	____________	____________
	____	____________	____________

   b. Please provide a detailed description of the nature of the two most significant bottlenecks indicated above (e.g., specific machine, long lead time, training time, etc.): ____________________

____

____

____

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____

____

2. MAKE/BUY RATIOS

What is the average anticipated make/buy ratio corresponding to your firm's production in 1988? ("Make/buy" is defined as the dollar value measure of components used in the production of plastic injection molding machines which are made "in-house" by your firm compared with the total value of components used in the production of plastic injection molding machines at your firm.)

Make/buy Ratio ____________%

*Please photocopy section as necessary to cover all products and establishments.

3. REPLACEMENT COST:

a. Please estimate the replacement cost of this facility, the time it would require to construct and equip, and the time required to become fully operational. Assume financing is available and the availability of labor and materials reflects normal market conditions.

Replacement Cost: $ ____________________

Time required to construct and equip: ____________ months.

Time required to become fully operational: ___________ months.

b. What factors would effect the time and/or cost of replacement outlined above?

____

____

____

____

____

____

____

4. LEAD TIMES:

a. Provide the following lead time (i.e., time from receipt of order to delivery to customer) information for domestically produced plastic injection molding machines:

Minimum lead time item ____________ # of weeks ____________

Maximum lead time item ____________ # of weeks ____________

Average lead time # of weeks __________

b. Please explain the three leading factors which affect lead time (e.g., size, complexity, customization) and provide information on how lead times could be shortened:

____

____

____

____

____

____

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____

5. EQUIPMENT REQUIREMENTS: What kind of equipment would be most critical to the ability of your firm to expand production capacity at this facility? Is any of this equipment foreign sourced or prone to extensive purchasing lead times or short supply?

Machine Tools: ______________________________

____

____

Other Equipment: ______________________________

____

____

____

PART IV.
LABOR

(TO BE FILLED OUT IN AGGREGATE FOR ENTIRE FIRM)

1. Provide the number of employees at your domestic plastic injection molding machinery manufacturing facilities in each of the following occupations for the years 1984 to 1987.

	1984	1985	1986	1987
Engineer	____	____	____	____
Designer	____	____	____	____
Drafter	____	____	____	____
Computer Specialist	____	____	____	____
Machinist	____	____	____	____
Welder	____	____	____	____
Inspector	____	____	____	____
Painter	____	____	____	____
Assembler	____	____	____	____
Tester	____	____	____	____
Others (including Admin./Managemt.)	____	____	____	____
TOTAL EMPLOYMENT	____	____	____	____

2. What are the educational and work experience requirements for each of the following occupations (e.g., high school, 4 years college, etc.)? Please indicate with an "X" those jobs you consider to be critical (i.e., those that are essential to maintain production and that require a minimum of one year of training).

	EDUCATION	EXPERIENCE	CRITICAL
Engineer	______	______	______
Designer	______	______	______
Drafter	______	______	______
Computer Spec.	______	______	______
Machinist	______	______	______
Welder	______	______	______
Inspector	______	______	______
Painter	______	______	______
Assembler	______	______	______
Tester	______	______	______

3. What is the average age of your work force at present? What do you estimate the average age to be 5 years from now?

Average age of work force today: ______ years.
Average age 5 years from now: ______ years.

4. On average, at any one point in time, how many job vacancies to you have?

Number of Vacancies ________.

5. On average, for each of the following occupations, how many days does it take to fill a job vacancy?

Engineer	________	days
Designer	________	days
Drafter	________	days
Computer Spec.	________	days
Machinist	________	days
Welder	________	days
Inspector	________	days
Painter	________	days
Assembler	________	days
Tester	________	days

6. What is the average wage for each of the following occupations?

	Hourly Wage	or	Annual Salary
Engineer	$________		$________________
Designer	________		________________
Drafter	________		________________
Computer Spec.	________		________________
Machinist	________		________________
Welder	________		________________
Inspector	________		________________
Painter	________		________________
Assembler	________		________________
Tester	________		________________

7. During 1987, how many employee separations and accessions did you experience in each of the following occupations?

	SEPARATIONS	ACCESSIONS
Engineer	________	________
Designer	________	________
Drafter	________	________
Computer Spec.	________	________
Machinist	________	________
Welder	________	________
Inspector	________	________
Painter	________	________
Assembler	________	________
Tester	________	________

PART V.
CONVERSION, RESEARCH & DEVELOPMENT, TECHNOLOGY, AND INVESTMENT

(TO BE FILLED OUT IN AGGREGATE FOR ENTIRE FIRM)

1. DEFENSE APPLICABILITY:

   a. Which types of plastic injection molding machines do you consider most important to the national defense (i.e., which types of machines are currently used in most defense applications)? Comment on the convertibility of machines currently used in civilian applications to be converted to defense use.

      i) Most defense critical: ____________________

      ii) Ability to convert civilian to defense: ____________________

   b. Can equipment currently used to produce a particular type and size of plastic injection molding machine be converted to production of another type, or is equipment dedicated? Please explain factors that limit conversion of production, including machinery and labor constraints.

2. RESEARCH & DEVELOPMENT

a. Please provide your annual Research & Development expenditures for plastic injection molding machines for the years 1982-1987.

1982	$________	Thousand
1983	$________	Thousand
1984	$________	Thousand
1985	$________	Thousand
1986	$________	Thousand
1987	$________	Thousand

b. How important do you view research and development to your firm's competitive viability as it affects a) product development, and b) the production process (including factors such as cost, quality control, etc.):

____

____

____

____

____

(continued)

(Question 2 continued)

c. Please enter the letter code listed below which best describes your firm's current usage of the following technologies in the production of plastic injection molding machines.

Type of Involvement:

a.) Technology not suited for my operations.
b.) Technology too expensive at this time.
c.) Technology requires additional innovation.
d.) Plan to introduce within the next three years.
e.) Currently using, and plan to increase use.
f.) Currently conducting R&D in this area.
g.) Other (Specify: ______________________________.)

Technologies:

CAD/CAM	_____
FMS	_____
Robotics	_____
SPC	_____
Others (Specify):	
____________________	_____
____________________	_____

3. INVESTMENT

a. Please provide your annual investment expenditures for plastic injection molding machine operations (in thousands of dollars) for the following years:

	Machinery & Equipment	Buildings & Structures
1982	$__________	$__________
1983	__________	__________
1984	__________	__________
1985	__________	__________
1986	__________	__________
1987	__________	__________
1988(E)	__________	__________

(Question 3 continued)

b. How important do you view investment to your firm's competitive viability as it affects the production process (including factors such as cost, quality control, etc.) and any other competitive factors:

____

____

____

____

____

____

PART VI.
TRADE IMPACTS, FOREIGN SOURCING

(TO BE FILLED OUT FOR ENTIRE FIRM)

1. a. What was your firm's practical capacity utilization rate for injection molding operations in percent for the following years?

Practical Capacity Utilization: ______ % 1982
______ 1983
______ 1984
______ 1985
______ 1986
______ 1987

b. How long would it take to reach practical capacity from the 1987 rate indicated? (in weeks)

______ Weeks

3. How have imports of plastic injection molding machines positively and negatively affected your domestic manufacturing operations? For example, has import competition altered the size range of your sales? Have more sales been concentrated in specialized/customized equipment?

____
____
____
____
____
____
____
____
____
____
____
____
____
____

2. a. Please complete the following table for major foreign sourced parts, subassemblies, components, machinery, materials, etc. you currently use to produce finished injection molding machines In the space provided enter the approximate percentage of the part imported relative to the total stock of that type you have used. Only supply information on items you import directly or know are imported. Also provide the reason(s) you foreign source these items. (Select as many responses from the letter coded list below as apply.)

Foreign-Sourced Item	%	Reason(s)
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______

REASONS:

a. Domestic Source unavailable.
b. Foreign source offers items at a lower price.
c. Foreign source produces higher quality items.
d. Foreign source provides quicker delivery.
e. Foreign source supplements domestic production.
f. Foreign source supplements other domestic sources.
g. Foreign sourcing is part of global marketing strategy.
h. Other (specify: ______________________________.)

(continued)

(Question 2 continued)

b. Please provide any comments you may have on the preceding question:

3. What actions have you taken in recent years to increase your competitiveness vis a vis foreign and domestic competitors (i.e., increase R&D efforts, target new export markets, develop new product lines, etc.)?

4. How do you view the competitive prospects for your firm's U.S. injection molding machinery operations over the next five years (i.e., improve or decline)? Explain.

5. Please rank the following competitive factors from 1 (most important) to 5 (least important) as they apply to sales of your injection molding machinery in the U.S. market.

- _______ Price
- _______ Quality and Durability
- _______ Reliability of Manufacturer
- _______ Technical Factors/Options
- _______ Design/Engineering Assistance
- _______ Follow Up Service
- _______ Financing
- _______ Warranties
- _______ Historical Manufacturer/Costumer Relationship
- _______ Foreign Marketing/Export Experience
- _______ Other (Specify: ____________________________)

6. What percentage of your production costs are accounted for by the following factors?

Labor Costs	_______ %
Raw Materials	_______ %
Subcomponents/ Parts	_______ %
Energy	_______ %
Other	_______ %
	======
	100 %

7. Please explain any cost-cutting programs that are planned or currently underway: ____________________________

____

____

____

____

____

8. Please estimate the percentage of your firm's annual sales of plastic injection molding machines that are sold through the following channels:

- _______ Direct Sale to U.S. End User
- _______ Domestic Sale through Affiliated Sales Agent
- _______ Domestic Sale through Independent Distributor
- _______ Exports
- _______ Other (Specify: ____________________________)

9. Please rank the following from 1 (most effective/important) to 5 (least effective/important) as they specifically relate to your firm's ability to locate new sales opportunities:

- ______ Advertising/Media
- ______ Historical Relationship with Purchaser
- ______ Trade Fairs/Conventions
- ______ Market Research
- ______ Other (Specify: ______________________)

COMMENTS: Please use the space below to provide any additional comments or information you may wish regarding your operations, or other related issues that have an impact on your firm.

CERTIFICATION

The undersigned certifies that the information herein supplied in response to this questionnaire is complete and correct. The U.S. Code, title 18 (Crimes and Criminal Procedure), Section 1001, makes it a criminal offense to willfully make a false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

(date)

(Signature of Authorized Official)

(Area Code and Number)

(Type or Print Name and Title above)

(Area Code and Number)

(Person of contact regarding this questionnaire)

15 C.F.R § 359 (1982)

PART 359—EFFECT OF IMPORTED ARTICLES ON THE NATIONAL SECURITY

AUTHORITY: Sec. 232 Trade Expansion Act of 1962, as amended (Pub. L. 93-618, 88 Stat. 1993, 19 U.S.C. 1862); Reorg. Plan No. 3 of 1979 (44 FR 69273, Dec. 3, 1979), Exec. Ord. 12188 of Jan. 2, 1980 (45 FR 989, Jan. 4, 1980); Dept. of Commerce Org. Ord. No. 10-3 (45 FR 6141, Jan. 25, 1980), and International Trade Admin. Organization and Function Order No. 41-1 (45 FR 11862, Feb. 22, 1980).

SOURCE: 47 FR 14692, April 6, 1982, unless otherwise noted.

§ 359.1 Definitions.

As used in this part:

"Department" means the United States Department of Commerce and includes the Secretary of Commerce and the Secretary's designees.

"Secretary" means the Secretary of Commerce or the Secretary's designees.

"Applicant" means the person or entity submitting a request or application for an investigation pursuant to this part.

§ 359.2 Purpose.

These regulations set forth the procedures by which the Department shall commence and conduct an investigation to determine the effect on the national security of the imports of any article. Based on this investigation, the Secretary shall make a report and recommendation to the President for action or inaction regarding an adjustment of the imports of the article.

§ 359.3 Commencing an investigation.

Upon request of the head of any government department or agency, upon application of an interested party, or upon motion of the Secretary, the Department shall immediately conduct an investigation to determine the effect on the national security of the imports of any article.

§ 359.4 Criteria for determining effect of imports on the national security.

(a) To determine the effect on the national security of the imports of the article under investigation, the Department shall consider the quantity of the article in question or other circumstances related to its import. With regard for the requirements of national security, the Department shall also consider the following:

(1) Domestic production needed for projected national defense requirements;

(2) The capacity of domestic industries to meet projected national defense requirements;

(3) The existing and anticipated availabilities of human resources, products, raw materials, production equipment and facilities, and other supplies and services essential to the national defense;

(4) The growth requirements of domestic industries to meet national defense requirements and the supplies and services including the investment, exploration and development necessary to assure such growth; and

(5) Any other relevant factors.

(b) In recognition of the close relation between the strength of our national economy and the capacity of the United States to meet national security requirements, the Department shall also, with regard for the quantity, availability, character and uses of the imported article under investigation, consider the following:

(1) The impact of foreign competition on the economic welfare of any domestic industry essential to our national security;

(2) The displacement of any domestic products causing substantial unemployment, decrease in the revenues of government, loss of investment or specialized skills and productive capacity, or other serious effects; and

(3) Any other relevant factors that are causing or will cause a weakening of our national economy.

§ 359.5 Request or application for an investigation.

(a) A request or application for an investigation shall be in writing. The original and 12 copies shall be filed with the Director, Office of Industrial Resource Administration, Room 3876, U.S. Department of Commerce, Washington, D.C. 20230

(b) When a request, application or motion is under investigation, or when an investigation has been completed pursuant to § 359.10 of this part, any subsequently filed request or application concerning imports of the same or related article that does not raise new or different issues may be either consolidated with the investigation in progress as provided in § 359.7(e) of this part, or rejected. In either event, an explanation for taking such action shall be promptly given to the applicant. If the request or application is rejected, it will not be returned unless requested by the applicant.

(c) Requests or applications shall describe how the quantity, availability, character, and uses of a particular imported article, or other circumstances related to its import, effect the national security, and shall contain the following information to the fullest extent possible:

(1) Identification of the applicant;

(2) A precise description of the article;

(3) Description of the domestic industry affected, including pertinent information regarding companies and their plants, locations, capacity and current output of the industry;

(4) Pertinent statistics on imports and domestic production showing the quantities and values of the article;

(5) Nature, sources, and degree of the competition created by imports of the article;

(6) The effect that imports of the article may have upon the restoration of domestic production capacity in the event of national emergency;

(7) Employment and special skills involved in the domestic production of the article;

(8) Extent to which the national economy, employment, investment, specialized skills, and productive capacity is or will be adversely affected;

(9) Revenues of Federal, State, or local Governments which are or may be adversely affected;

(10) National security supporting uses of the article including data on applicable contracts or sub-contracts, both past and current; and

(11) Any other information or advice relevant and material to the subject matter of the investigation.

(d) Statistical material presented should be, if possible, on a calendar-year basis for sufficient periods of time to indicate trends. Monthly or quarterly data for the latest complete years should be included as well as any other breakdowns which may be pertinent to show seasonal or short-term factors.

§ 359.6 Confidential information.

(a) Any information or material which the applicant or any other party desires to submit in confidence at any stage of the investigation that would disclose national security classified information or business confidential information (trade secrets, commercial or financial information, or

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any other information considered sensitive or privileged), shall be submitted on separate sheets with the clear legend "National Security Classified" or "Business Confidential," as appro~~priate. marked at the top of each~~ sheet. Any information or material submitted that is identified as national security classified must be accompanied at the time of filing by a statement indicating the degree of classification, the authority for the classification, and the identity of the classifying entity. By submitting information or material identified as business confidential, the applicant or other party represents that the information is exempted from public disclosure, either by the Freedom of Information Act (5 U.S.C. 552 et seq.) or by some other specific statutory exemption. Any request for business confidential treatment must be accompanied at the time of filing by a statement justifying non-disclosure and referring to the specific legal authority claimed.

(b) The Department may refuse to accept as business confidential any information or material it considers not intended to be protected under the legal authority claimed by the applicant, or under other applicable legal authority. Any such information or material so refused shall be promptly returned to the submitter and will not be considered. However, such information or material may be resubmitted as non-confidential in which case it will be made part of the public record.

§ 359.7 Conduct of an investigation.

(a) If the Department determines that it is appropriate to afford interested parties an opportunity to present information and advice relevant and material to an investigation, a public notice shall be published in the FEDERAL REGISTER soliciting from any interested party written comments, opinions, data, information or advice relative to the investigation. This material shall be submitted as directed within a reasonable time period to be specified in the notice. All material shall be submitted with 6 copies. In addition, public hearings may be held pursuant to § 359.8 of this part.

(b) All requests and applications filed and all materials submitted by interested parties, except information or material that is classified or determined to be confidential as provided in § 359.6 of this part, will be available for public inspection and copying in the International Trade Adminis~~tration Freedom of Information Records In~~spection Facility, Room 3102, U.S. Department of Commerce, Washington, D.C. 20230, in accordance with regulations published in Part 4 of Title 15, Code of Federal Regulations.

(c) Further information may be requested by the Department from other sources through the use of questionnaires, correspondence, or other appropriate means.

(d) The Department shall, as part of an investigation, seek information and advice from, and consult with, the Secretary of Defense and any other appropriate officers of the United States or their designees, as shall be determined. Communications received from agencies of the U.S. Government or foreign governments will not be made available for public inspection. The Department may also seek assistance in the conduct of an investigation from other agencies of the United States, as shall be necessary.

(e) Any request or application that is filed while an investigation is in progress, concerning imports of the same or related article and raising similar issues, may be consolidated with the request, application or motion that initiated the investigation.

§ 359.8 Public hearings.

(a) If it is deemed appropriate by the Department, public hearings may be held to elicit further information.

(1) A notice of hearing shall be published in the FEDERAL REGISTER describing the date, time, place, the subject matter of each hearing and any other information relevant to the conduct of the hearing. The name of a person to contact for additional information or to request time to speak at the hearing shall also be included. Public hearings may be held in more than one location.

(2) Hearings shall be open to the public unless national security classified information will be presented. In that event the presiding officer at the hearing shall close the hearing, as nec-

essary, to all persons not having appropriate security clearances or not otherwise authorized to have access to such information. If it is known in sufficient time prior to the hearing that national security classified information will be presented, the notice of hearing published in the FEDERAL REGISTER shall state that national security classified information will be presented and that the hearing will be open only to those persons having appropriate security clearances or otherwise specifically authorized to have access to such information.

(b) Hearings shall be conducted as follows:

(1) The Department shall appoint the presiding officer;

(2) The presiding officer shall determine all procedural matters during the hearing;

(3) Interested parties may appear, either in person or by representation, and produce oral or written information relevant and material to the subject matter of the investigation;

(4) Hearings will be fact-finding proceedings without formal pleadings or adverse parties. Formal rules of evidence will not apply;

(5) After a witness has testified, the presiding officer may question the witness. Questions submitted to the presiding officer in writing by any interested party may, at the discretion of the presiding officer, be posed to the witness. No cross examination of any witness by a party shall be allowed.

(6) Each hearing will be stenographically reported. Transcripts of the hearing, excluding any national security classified information, may be purchased from the Department at actual cost of duplication, and will be available for public inspection in the International Trade Administration, Freedom of Information Records Inspection Facility, Room 3102, U.S. Department of Commerce, Washington, D.C. 20230.

§ 359.9 Emergency action.

In emergency situations, or when in the judgment of the Department, national security interests require it, the Department may vary or dispense with any or all of the procedures set forth in § 359.7 of this part.

§ 359.10 Report of an investigation and recommendation.

(a) When an investigation conducted pursuant to this part is completed, a report of the investigation shall be promptly prepared. The report shall be organized in several sections, if necessary. One section shall contain all information and material that is not classified or confidential as provided in § 359.6 of this part. Another section shall contain all national security classified information and material. A third section shall contain all business confidential information and material.

(b) The Secretary shall report to the President the findings of the investigation and a recommendation for action or inaction within one year after receiving a request or application or otherwise beginning an investigation pursuant to this part.

(c) The report, excluding the sections containing national security classified and business confidential information and material, shall be published in the FEDERAL REGISTER upon the disposition of each request, application, or motion made pursuant to this part. Copies of the published report will then be available for public inspection and copying in the International Trade Administration, Freedom of Information Records Inspection Facility, Room 3102, U.S. Department of Commerce, Washington, D.C. 20230.

TAB D

SUMMARY OF PUBLIC COMMENTS

Comments were submitted in response to the PIMM petition by the Japan Society of Industrial Machinery Manufacturers (JSIM) and by the German-American Group of Injection Molding Machine Builders.

JSIM Comments

The JSIM is a trade association of Japanese producers of plastic injection molding machinery. JSIM contends that the petitioners' allegations concerning the threat of imports of plastic injection molding machines to U.S. security are unfounded. Any future import restrictions on this industry would damage rather than improve national security. A reduction of imports will ultimately increase the price of machines manufactured in this country, and will deplete the available supplies.

JSIM cites an SPI study entitled Plastics A.D. 2000 which predicts a growth in PIMM sales of five percent yearly through the year 2000. The SPI study predicts that imports from West Germany have reached their peak and that Canadian imports seem to be leveling off. It also reports that Japanese machine prices have escalated to $84,000 per machine from $47,000 in 1984. JSIM states that it agrees with the SPI study's assessment that future imports will fall and domestic production will rise.

JSIM argues that producers would be unable to supply all U.S. demands without imports. They contend that imports play a major role in meeting U.S. requirements for high quality machines. Between 1983 and 1985, U.S. requirements for injection molding machines produced an increase in imports that far exceeded other nations. Actual U.S. purchases expanded 41 percent (unit basis) from 1983 to 1987 and 92 percent on a value basis. The value of imports rose between 1983 and 1984 from $54,081,000 to $104,442,000. During the same period U.S. manufacturing increased to $337,691,000 in 1985 from a total value of $191,735,000 in 1983.

Competitiveness

The "Big Three" producers account for 70 percent or more of the domestic market. In addition, the 95 percent market share held by the seven petitioners has continued for more than ten years. JSIM believes that the Section 232 petition is a vehicle used by the petitioners to eliminate the competition brought on by imports, and to return to the virtual captive market once enjoyed for their machines.

JSIM contends that the domestic plastics industry has made the technological advances that have allowed it to be competitive as well as profitable. These advances allow the U.S. to compete with import sales in the high-volume low unit-value end of the domestic market.

The SPI study predicts that imports will decrease because of (1) exchange rate fluctuation; (2) slower overall growth in U.S. demand; (3) better U.S. technology; and (4) the new trend towards foreign direct investment in the U.S. by producers. However, JSIM believes that it is important to remember that foreign competition has offered important technological advances at a cost savings.

Technology

JSIM believes that the U.S. industry has increased its competitive edge by investing in new technology. Technological gains cited by JSIM include: incorporation of advanced electronic controls; replacement of electromagnetic controls with solid state sequence controls; advancements in hydraulics; improved precision in controlling the temperature of resins; and automated removal of parts by use of robotics.

Foreign Direct Investment

Offshore producers have contributed significantly to the technical innovations and improvements that this industry currently enjoys. However, the competitive edge formerly held by foreign competition has decreased significantly. Many foreign producers have relocated their operations to this country to recover some of the market share lost to U.S. competitors. In addition, they are using a significant amount of U.S. parts in their production.

The SPI study states that a decrease in imports will be forthcoming when foreign direct investment increases. Foreign direct investment will benefit the United States by adding state-of-the-art manufacturing facilities and will help keep prices low.

Available Suppliers

JSIM believes that the petition failed to address the importance of available materials needed to produce certain injection molded military, medical and essential civilian supplies. They maintain that the entire plastics industry must be reviewed (including suppliers) in order to fully evaluate the importance of injection machines to national security.

Injection molders rely on all of their suppliers in order to manufacture plastics products by the injection molding process. Suppliers for injection molding include resins and mold makers and other contributing industries. During a national security emergency, suppliers for injection molding will probably be unable to provide the needed materials to the manufacturing sector. However, many of these materials such as resins can be converted from civilian to military uses. Also, injection molding machines used in the civilian sector can be converted for defense and other emergency uses by changing the mold.

Convertibility

JSIM contends that this industry has a healthy commercial base that can be redirected to supply expanded military needs during a national emergency. The manufacturers and the equipment that they use can be converted for defense purposes. In addition, critical materials and mold building production can be redirected during a crisis.

In a matter of minutes, the mold producing a civilian product can be replaced with the appropriate mold to produce a needed military product. Molds can also be changed between different models of injection machines from other companies as long as the machine has the same clamp force and platen size. The foregoing indicates that this industry has the convertibility potential needed to adjust to an emergency.

Profitability

JSIM states that the Big Three are all "fundamentally strong companies financially that enjoy sufficient volumes so as to make money from the sales of injection machines." These companies have made the necessary investments and have a sufficient sales volume to keep up with foreign competition. Further, U.S. exports are increasing due to the manufacture of products that can compete in the foreign marketplace. While imports are soaring, these U.S. companies continue to compete and show substantial profits.

Defense Uses

Over 90 of the domestic injection molding machines are used for non-defense purposes. According to JSIM, the domestic injection molding sector is well able to meet present and future defense needs. Of the 80,000 or more injection machines identified, approximately 28,000 (35 percent) are less than five years old. In addition, about 24,000 (30 percent) are from five to ten years old and can accomplish high quality production jobs when retrofitted. JSIM estimates that approximately 3,200 machines would be required to satisfy high priority national defense needs. If for some unforeseen reason the existing stock of injection molding machines were not adequate to meet defense needs, they could be produced rapidly by domestic manufacturers.

If additional employees are needed for additional machine production, this requirement can be met by using those currently working in other machine manufacturing facilities. JSIM contends that the skills required to produce injection machinery are identical to those needed to produce other industrial machinery.

If injection molding were not available during an emergency, some defense-related injection molded products i.e. aircraft interior panels, fuel tanks etc. could be produced by compression molding and/or blow molding. JSIM concludes that there is more than enough domestic capacity to meet defense needs.

Available Alternate Remedies

JSIM outlines a variety of assistance programs that could be enacted to strengthen the U.S. defense industrial base. Increased government procurement through the Defense Industrial Reserve Act of 1973 authorizes a general reserve of industrial manufacturing equipment subject to Buy American Act regulations. Another form of assistance available under the Defense Production Act is loan guarantees that may be made to the private sector for expansion of capacity, development of new technology or production of essential materials. There are also a significant amount of research and development programs available to the private sector through DOD and other government agencies. JSIM believes that these alternatives would further enhance U.S. competitiveness and provide limited assistance without interfering with imports.

Conclusion

JSIM concludes that imports of injection machines do not adversely affect U.S. national security. JSIM urges the Department to "recommend to the President of the United States that The Society of the Plastics Industry's request for the imposition of import restrictions on injection machine imports be dismissed."

Supplemental Comments - JSIM

JSIM submitted several supplements to their initial comments. Among the points raised were the following:

PLASPEC Presentation Summary

- o The domestic injection molding machine market is recovering from losses incurred during the early 1980's. During this period imports from Europe peaked, as Japan, Taiwan and Korea increased their market presence.
- o Cincinnati Milacron, HPM, NATCO , Newbury Industries and Van Dorn have all announced plans to increase their injection molding machine production capacity.
- o Foreign suppliers who are making direct investments in the United States include Battenfeld of America, Inc., Mannesman-Demay, Billion S.A., Kloeckner-Ferromatik-Desma, and Krauss Maffei Corp.
- o The maximum manufacturing capacity during a six-month war effort is about 730 machines using existing domestic capacity (excluding Canada) or 1,050 machines including all imports.

Note: Subsequently, the Department of Commerce received a letter from Malcolm W. Riley, President, Plastics Division, Plastics Technology, disassociating his magazine from the above presentation and stating that "the report is subjective, factually selective, and in some cases, in my judgment quite erroneous. Further, it goes far beyond our charter as suppliers of basic engineering and marketing information."

Financial Analysis of Injection Molding Machine Manufacturers

- o The three major U.S. manufacturers of injection molding machines, Cincinnati Milacron, Van Dorn Company, and HPM Corporation have indicated in their filings with the Securities and Exchange Commission that sales are increasing and that they are operating at a profit.
- o Besides injection molding, there are at least five other principle methods used to manufacture composites. SPI failed to identify any examples of composite items manufactured by the injection molding process.

German-American Group Comments

The German-American Group of Injection Molding Machine Builders includes a number of American producers and associates of German companies and is established as a part of the German Machinery and Plant Manufacturers Association (VDMA). This group accounts for a large percentage of the injection molding machinery exports received from Germany.

Imports

VDMA reports that imports from the nine leading European countries declined by 40 percent during 1987. VDMA claims that German machines are distinctively different from the standard, high-volume low-priced U.S. machines identified by the petitioner. The Germans have advanced their technology to build specialty machines to conform to the various U.S. market needs that domestic machines do not address. These uniquely designed machines are used to produce multi-colored rear light lenses for motor vehicles; large-sized car body parts (made from a number of different component materials); automobile bumpers made from high-performance blends; compact discs; and wide neck containers for the food industry.

Technological Resurgence

VDMA contends that any problems faced by this industry are self-made and are not the result of import penetration. However, the United States is now regaining its technological competitiveness. VDMA cites Cincinnati Milacron as a leader in the revival of U.S. technology. Milacron's new Vista series is a high-tech, but economical machine capable of competing anywhere in the world.

The presence of European firms that produce specialized machines will help U.S. manufacturers to regain their competitiveness. A new American machine is evolving that combines European technology and Far Eastern value. This machine provides the ruggedness and reliability needed to meet the rigorous demands of the high-production-oriented uniquely American marketplace.

Convertibility

VDMA claims that most of the U.S. plastics injection machines can be converted from civilian uses to defense uses during an emergency in a short period of time--from possibly minutes or hours to days. A flexible production system would make it economically feasible for U.S. producers to convert between peacetime and defense production, if molds are accessible. Automatic mold changing systems have reduced the time needed to change molds on German machines to a few minutes. Some of these machines are exported to the U.S. and are built by associated companies located in this country.

Defense Uses

VDMA asserts that the PIMM industry does not produce high-performance, critical military equipment. Less than one percent of the injection molding machines sold in the U.S. have defense applications. The plastic injection molded parts used in defense applications are not essential elements and don't affect the crucial nature of the sensitive technology. Other materials or other means can be used as a substitute.

Non-SPI Production

Since there are at least 14 other U.S. producers (not affiliated with German companies) manufacturing plastic injection molding machines, VDMA believes that DOC should add at least 450 units to SPI's 1987 production estimate of 1,721. They believe that this figure is still modest and fails to include production by other U.S. manufacturers and Canadian exports to the United States. Commenter believes that this clearly refutes the petitioner's allegation that imports have escalated to two-thirds of the U.S. market.

Economic Outlook

VDMA believes that the domestic plastics industry is continuing to develop. Moreover, some of the products produced by this industry are used as a substitute for metal, wood, ceramics, natural textile fibers, and rubber. Commenter alleges that injection molded fasteners will soon supersede the U.S. metal fastener replacement industry, an estimated $4-billion per year industry.

The American injection molding industry will suffer if imports, the provocation for improvement, are eliminated. Increased U.S. dedication to long-term planning for research and development, for education and training, and for investments and assistance will ensure the future of this industry.

Conclusions

The German-American firms are operating at a profit in the U.S. thereby contributing employment, training, and advanced skills. Imposing import restraints will result in increased costs to the users, and will raise the cost of plastic products thereby jeopardizing free and open U.S. foreign trade. These restraints will threaten the free flow of technology needed to make the domestic industry competitive.

In addition, there is a risk of European retaliation under the GATT. VDMA and its German-American injection molding machinery builders, based on the forgoing, respectfully urge the Secretary of Commerce to recommend to the President that imports of plastics injection molding machinery do not threaten to impair the national security of the United States, and that the petition be dismissed.

German-American Group Supplemental Comments

VDMA submitted supplemental comments on April 4, 1988 and made the following points:

- A six month comparison (January - June 1987 and January - June 1988) shows a decline, both in units and value terms, in injection molding machine imports from West Germany.
- The 1986 Plastics Manufacturers Census reports that the U.S. has a total of 75,000 injection molding machines in about 7,000 plants. Two-thirds of those in place are less than 10 years old. Commenter reports that the average life span of an injection molding machine is between 12 to 15 years.
- Plastics used for defense items are primarily component parts. The low pressure sensitivity and restricted temperature resistance of the polymer materials limit the potential uses of plastics in weapon and armaments.
- Plastics products play a significant part in the non-strategic military equipment sector. These items range from toothbrushes and cups to medical supplies.