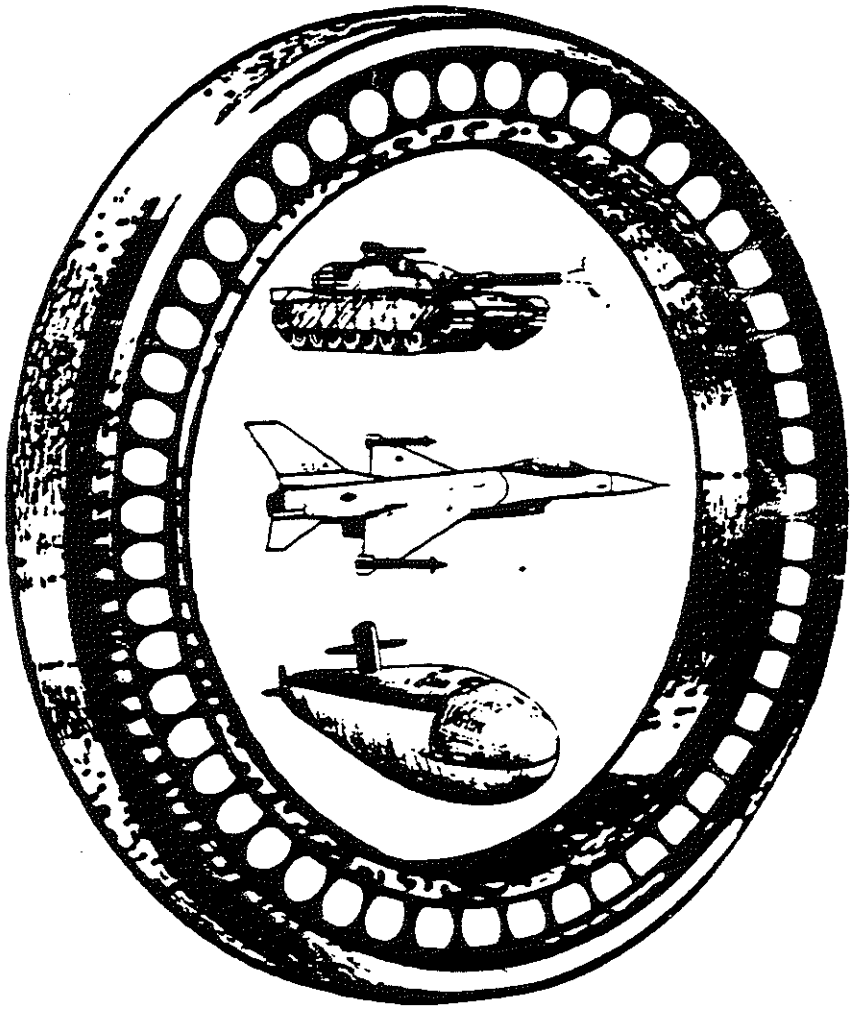
JOINT LOGISTICS COMMANDERS BEARING STUDY

18 JUNE 1986



PREPARED BY

THE JOINT BEARING WORKING GROUP

OF

THE JOINT GROUP ON THE INDUSTRIAL BASE

Joint Logistics Commanders Bearing Study - Conducted by the Joint Group on the Industrial Base chartered under the DOD Joint Logistics Commanders, this report assesses the bearing industry based on surveys of U.S. producers. Particular emphasis was placed on 30mm and larger bearings. This report analyzed defense and commercial bearing requirements, industry capacity, impact of bearing imports on national security in surge and mobilization environments and other competitive factors affecting the bearing industry. The study concludes that the U.S. bearing industry, having been subjected to increasing import penetration of the domestic market and lost market share, is in danger of being unable to support national defense needs. The report further states that the U.S. Government must take decisive and immediate actions (regulatory, legislative, and policy) if domestic production capability is to be maintained.

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JLC

BEARING INDUSTRY STUDY

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EXECUTIVE SUMMARY

The Deputy Secretary of Defense, William Howard Taft IV, in response to Congressional concern over government policies for procurement of ball bearings and how they affect the domestic industry, requested the Joint Logistic Commanders (JLC) conduct a study of the criticality of the bearing industry to the defense posture. Particular emphasis was to be placed on 30mm and larger bearings. As part of this review a determination was to be made of DOD and commercial bearing requirements, industry capacities, impact of bearing imports on national security in surge and mobilization environments and other factors affecting the bearing industry.

In response to Secretary Taft's request, the JLC tasked the Joint Group for the Industrial Base (JGIB) to establish a study team to address these issues. The team, the Joint Bearing Working Group (JBWG), included personnel from each of the services and the Defense Logistics Agency. The Department of Commerce and the International Trade Commission were asked to become members because of their expertise in trade and economic issues.

The JBWG developed questionnaires designed to gather data for analysis that would answer several taskings. Separate surveys were designed for the bearing industry, engine manufacturers, bearing component suppliers, specialty steel producers and tool manufacturers, all impacting or being impacted by conditions relating to the health of the bearing industry. Major companies in these industries were surveyed and plant visits were conducted at selected facilities to emphasize the criticality of the study and to discuss trade and economic related issues.

After analysis of data collected, discussions with company officials, and review of previous related government studies, the JBWG concluded that the US bearing industry, having been subjected to foreign penetration of the domestic market for an extended period of time, and having suffered the natural consequences of this lost market share, is in imminent danger of being unable to support national defense needs.

Findings

The JBWG concluded that imports of bearings over 30mm in diameter began to impact the position of domestic bearing companies in 1978. Since then, steady erosion of the commercial bearing sector has taken place.

This trend is continuing, and as foreign producers capture an ever increasing share of the US market, it becomes more difficult for domestic firms to remain competitive. The foreign share of the ball bearing market is currently 39% while 36% of the roller bearing market is held by foreign firms. Smaller bearing sizes, for which a FAR has been in effect since 1971, were first affected by imports in the mid 1960's. However, imports of these smaller sizes also increased since 1978, along with the larger sizes.

The commercial sector of the bearing market has traditionally provided the economic base over which production costs are spread. The Department of Defense portion of the total bearing market is approximately 17% (the superprecision segment is approximately one-fifth of DOD consumption). However, DOD demands alone are not large enough to sustain the overall health of the industry, or to provide incentives for firms to invest in new equipment or train new workers. Further, as the commercial sector has deteriorated, domestic producers have been forced into the production of specialty bearings or niches, to remain in business. These niches are characterized by low profit, low volume, high cost production runs. As the outlook for the commecial sector of the bearing industry continues to worsen, maintenance of adequate defense capability cannot be guaranteed.

Defense production has become a more important market for many domestic producers as they have given way to competition from foreign manufacturers in the commercial/commodity bearing sector. Until recently defense markets remained within the pervue of domestic producers and served as a refuge against foreign incursion. Some original equipment manufacturers have begun bearing qualification procedures with foreign producers and indicate that upon qualification of these sources, procurement of most of bearings used for new production of military engines will use those sources. Reasons cited for the decision to use foreign bearings is based on lower price, leadtime and better quality than offered by US firms.

Finding their traditional markets eroded, domestic producers have become reluctant to invest in modern capital equipment. This will further diminish their ability to compete in the world market. Conversely, as foreign producers capture a larger share of the domestic market, increasing profits provides them with the willingness to upgrade equipment and further widen the competitive gap between themselves and domestic producers.

If this trend is permitted to continue, qualified domestic producers will be forced to shut down production lines and some close their doors permanently. Once this production capability is lost it is difficult to regain within a reasonable time. Company officials estimate it would take at least four years to rebuild capability to produce superprecision bearings. Long leadtimes are caused by the design, order and in-place qualification of machine tools, redesign of plant layout, steel supply, and manpower training.

Production capacity within the industry is currently capable of meeting peacetime defense needs. There is however, little capability to expand capacity. While equipment remains idle that previously was used to produce commercial/commodity grade bearings, it is not, in most cases, readily convertible to the production of high precision bearings necessary for DOD weapon systems production. Additionally, peacetime demands upon domestic bearing producers have driven leadtimes beyond 40 weeks for several bearings, forcing OEMs to look elsewhere for sources which can meet their production schedules.

Superprecision bearing production require special equipment and highly skilled labor. This makes interchangeability among bearing lines or companies unlikely. The work force in the bearing industry is ageing; and, because of reduced overall production, fewer opportunities are available to train new and younger employees. These conditions will continue to restrict surge and mobilization capabilities. Survey data indicated the four mainshaft bearing manufacturers for gas turbine engines could reach only 39% of the surge target (doubling production) after 12 months and fall short of the mobilization target (quadrupling production) by 50% after two years. This situation is expected to worsen in the next few years.

As the OEM's increase their use of foreign bearings, additional limits are placed on domestic firms' ability to respond to surge and mobilization. OEMs increased dependence on foreign sources can lead to interruption of supply during an emergency, placing our nations' defense posture in jeopardy.

Recommendations

The JBWG determined a two-pronged approach is necessary to improve the competitiveness of the domestic industry, ensure its long-term survival as well as ensuring

the continued maintenance of defense capacility. The following recommendations include viable alternatives that are needed to address the problems facing this industry. They include DOD actions as well as other governmental agency initiatives beyond the purview of the Department of Defense. They are presented as a package to provide an effective competitive strategy. It is important to note that DOD actions alone will not resolve the problems facing the industry.

In order for the following recommendations to be effective, the group recommends Secretary Weinberger urge congressional level direction which will result in national policies designed to assist the industry in becoming competitive in the world market. An interagency group chaired by the Secretary of Commerce should investigate the following six issues:

1. Analyze the imposition of limiting bearing imports temporarily, combined with domestic producer plans for facility modernization and workforce training programs. This would allow a limited time period for the industry to expand market share and increase profits. Concurrently, through government/industry agreements, a minimum portion of these profits would be dedicated for plant and equipment modernization.

2. Analyze temporarily exempting the industry from anti-trust laws to provide an opportunity to consolidate and rationalize production. Major foreign markets have already permitted this process to occur and have realized production and competitive efficiencies.

3. Analyze tariffs, quotas and other US and foreign trade restrictions on bearing parts, components and steel. Numerous trade restrictions in foreign markets and the United States inhibit the ability of domestic bearing firms to compete with foreign competitors.

4. Restrain the transfer of bearing technology offshore through production agreements by limiting the number of these types of agreements. Each agreement contributes to industry decline by moving bearing technology offshore as well as causing lost production opportunities.

5. Review industry concerns regarding anti-dumping laws to determine if they are effective in discouraging dumping and unfair marketing practices.

6. Study the impact of imports on US producers of bearing parts, components and steel. During the investigation the group noted the US infrastructure supporting the bearing industry was eroding and being replaced by imports.

The four actions for the Department of Defense are:

1. Initiate a time limited FAR for the procurement of domestic bearings for all DOD uses, providing exceptions and waivers which are within the Government's best interest. This will initially ensure domestic bearings for DOD applications.

2. Consolidate, coordinate, and increase funding for joint service/industry modernization programs for domestic bearing manufacturers.

3. Investigate DOD capabilities and industry needs for a projection of bearings requirements.

4. Examine refurbishment capacity within the commercial industry and determine the appropriate split between commercial and DOD refurbishment work loads.

The bearing industry is critical to national security. However, the industry is at risk and will experience a dramatic contraction if nothing is done. The US government must take decisive and immediate actions, including regulatory changes, legislative enactments, and clear administrative policy directions if a domestic production capability is to be maintained.

BACKGROUND

Mission

On November 29, 1985, Deputy Secretary of Defense William H. Taft, IV, tasked the Joint Logistics Commanders to undertake a study on the criticality of the domestic bearing industry (30 millimeter and larger) and to determine the impact of the industry on national security. The study was initiated in response to Congressional concerns over the availability of bearings in an emergency and the use of foreign manufactured bearings in US weapon systems.

The following tasks were to be addressed by the study effort:

Task 1. Assess the criticality of the domestic bearing industry to national defense.

Task 2. Assess the current strength and long term economic viability of the US bearing industry.

Task 3. Determine DOD and essential commercial requirements.

Task 4. Analyze the extent to which bearings of foreign manufacture are used in weapon systems and components procured by DOD.

Task 5. Assess the implications for readiness and sustainability of using bearings of foreign manufacture.

Task 6. Analyze the feasibility of restricting DOD to the use of bearings of US manufacture only.

In response to Deputy Secretary Taft's request, the Joint Logistics Commanders directed the Joint Group on the Industrial Base (JGIB) to conduct a national security assessment of the bearing industry. The JGIB, which includes representatives from the Army Materiel Command, the Air Force Systems and Logistics Commands, and the Chief of Naval Operations (Logistics), was originally established to provide guidance and direction and

input to the JLC's on industrial base issues. The JGIB identifies and implements, or recommends for implementation, opportunities to improve the responsiveness of the peacetime defense industrial base to effectively meet surge and mobilization demands as specified in the Defense Guidance.

The JGIB, on December 24, 1985, organized the Joint Bearing Working Group, known hereafter as the Working Group, to conduct an assessment of the domestic bearing industry. The Working Group consists of members from the Army, Navy, Air Force and the Defense Logistics Agency. The Department of Commerce and the US International Trade Commission were also invited to participate in the Working Group due to their expertise with regard to the bearing industry. A listing of Working Group members is contained in Appendix A.

The primary emphasis of the study was on "superprecision" bearings larger than 30 mm outer diameter and a precision classification of ABEC/RBEC 5/7/9. However, the precision bearings of ABEC/RBEC 1/3 classification and aircraft control bearings were also included due to their military applications. The study tasking was to determine bearing requirements for DOD and essential commercial use. The impact of bearing imports on national security and in surge and mobilization environments, and other factors affecting this industry were to be addressed. After initial research by the Working Group, it became clear that the superprecision bearing segment could not be assessed in isolation from the bearing industry as a whole. This assessment develops a competitive picture (domestic and international) of the entire bearing industry, its relationship to the superprecision segment, and the importance of the entire bearing industry to national security.

Methodology

In developing the information needed to pursue this assessment of the bearing industry, the Working Group established four separate but related tasks:

1. Evaluation of Previous Bearing Industry Studies - Documents were provided to the Working Group for review, including two major Competitive Assessments of the US Ball

and Roller Bearing Industry, authored by the Department of Commerce and the US International Trade Commission, respectively.

2. Data Requests for Service Requirements - The three Services and the Defense Logistics Agency tasked their appropriate field agencies to provide total bearing demand and requirement data (by weapon system where possible), part numbers, names of suppliers, etc., for the years 1983-1987.

3. Data Requests from Industry - Nine Major bearing manufacturers were surveyed by the Department of Commerce under authority of the Defense Production Act. The Working Group developed a questionnaire requesting information concerning shipments, production capacity, investment, foreign relationships, etc., to gain a better perspective of the bearing industry. The Working Group decided not only to survey bearing manufacturers but also end users (gas turbine engine, gearbox and machine tool manufacturers), and support industries such as steel producers, forging companies and ball manufacturers. A specific questionnaire was developed and sent to companies in each industry. Extracted tabular data for these industries and sample questionnaires are attached in Appendix D and E.

4. Industry Plant Visits - Members of the Working Group formed teams to visit selected companies in each industry. The industry site visits were made to reinforce the importance of the written survey, to expand on issues of importance, and to have personal exchanges with industry executives on the economic, financial, trade, and political issues facing the industry today and in the future.

ANALYSIS AND FINDINGS

This Section contains an analysis of the data and information collected from targeted sources, and the findings developed from that analysis. Each task is individually discussed as described in the Mission statement.

Task 1. Assess the criticality of the bearing industry to national defense.

Ball and roller bearings are used throughout the commercial sector in diverse applications such as commercial aircraft, machine tools, farming equipment, mining equipment, computers, ground transportation vehicles, nuclear power plants, and steel mills. The importance of the maintenance of our national defense through strong industry cannot be over emphasized. The security of the US would be diminished if the domestic bearing market was unable to supply the bearings needed to keep equipment and industry operating during a national emergency. Many commercial bearings are components of machinery that are used to manufacture parts and equipment for the military. These bearings must be considered just as critical as the final military product. A viable domestic commercial bearing industry supports a strong defense bearing capability and is essential to our overall defense posture.

The Department of Defense consumes on the average slightly over 17 percent in dollar value of all bearings delivered to the US market. Bearings are essential components in nearly every weapon system. Some bearings, such as the "noise quiet" type used on submarines, give the United States an added strategic advantage over the Soviet Union.

Superprecision bearings are essential components of all major systems, and without them, the military capabilities of the United States would be substantially reduced. Their production requires specialized manufacturing equipment, specialty materials, and a highly skilled workforce. These domestic capabilities would take several years and a large capital investment to reestablish if they were lost. It is of the utmost importance that the US have and maintain a domestic source for each category of superprecision bearing, including sources for the specialty steels and other component parts used in production.

Superprecision bearings account for five to seven percent of the domestic bearing market,

but represent approximately 20 percent of total military consumption. The military consumes 60 to 70 percent of the dollar value of the total production of superprecision bearings and between 40 and 45 percent of the superprecision units. The remaining 80 percent of military bearing consumption is composed of precision and commercial/commodity grade bearings. The materials, equipment, and labor needed to produce commercial/commodity grade bearings do not present the same engineering problems associated with superprecision bearing grades. However, many of the precision bearings used in helicopters, tanks, ships, fixed winged aircraft, and accessory applications do present some of the same engineering and manufacturing problems encountered in producing the higher precision, or superprecision bearings.

Bearings are critical components in military weapon systems vital to a nation's ability to conduct modern warfare. The Industrial College of the Armed Forces report titled "Aircraft Engine Main Bearings", noted that during World War II, ball bearings became a bottleneck in Germany's efforts to increase armaments production because Allied bombing efforts were directed specifically at the destruction of German ball-bearing facilities. Therefore, dependence of DOD weapon systems on foreign produced bearings will cause a further weakening of the US industrial base and an erosion of our ability to provide the bearings used by the military and in essential commercial applications necessary for our national defense.

Task 2. Assess the current strength and long term economic viability of the US bearing industry.

The overall strength and competitiveness of the US bearing industry has been declining over the past few years. Major changes have taken place that are having a dramatic long term affect on the industry. Numerous takeovers and consolidations are symptomatic of these changes. Recent mergers and takeovers include: (1) Minebea (Japan) buyout of New Hampshire Ball Bearings, Inc.; (2) Ingersoll-Rand purchase of the Fafnir Bearing Company from Textron and for merger with its Torrington Bearing Company subsidiary; and (3) SKF Industries' (Sweden) offer to buy the MRC Bearings Division from TRW for merger with US operations. The Torrington-Fafnir consolidation will give Ingersoll-Rand (US corporation) 17 percent of the US market. The SKF-MRC consolidation will give SKF (foreign corporation) 32 percent (value; 11 percent of units) of the superprecision market in the US.

Another change is the increasing but steady erosion of the US market to imports. From 1978 to 1984 imports increased their share of the market from 23.8 percent to 38.2 percent. Although 1985 data is not complete, it is suspected import penetration now exceeds 40 percent. This projection is based on the growth of absolute imports by 14 percent from 1984 to 1985.

Most firms predict further decline in competitiveness and continued erosion of domestic markets by imports from countries such as Japan, Singapore, Thailand, China, and South Korea. All of the firms noted the Japanese price their bearings as low as is necessary to "buy" a US market share. These tactics are considered unfair trade practices. Surveyed firms pointed out that the Japanese, with strong financial backing, are able to sustain low prices for "years", or until the market is theirs. In this way they maintain employment and high production levels at home. No similar concern was expressed about Western European producers; however, it should be noted that the European Economic Community (EEC) producers are able to supply bearings to the US market at costs lower than US produced bearings. For this reason, US original equipment manufacturers are considering the use of bearings produced by European companies. In addition, Romania, Hungary, and Poland are willing to sell bearings at distress prices to get needed hard currency.

Analysis of the data collected from the bearing companies indicates a dramatic decline in the commodity (non-superprecision) segment of their business due mainly to an increasing foreign presence in the US market. Unit and dollar shipments (Tables 1-4 in Appendix D) bear this out. Between 1981 and 1985 unit shipments fell 32 percent in the size range 0-30 mm commodity ball bearings and 20 percent for sizes over 30 mm. In dollar terms, the smaller size range increased four percent over the period. This small dollar increase may be related to the substantial number of superprecision miniature and instrument bearings protected under the Federal Acquisition Regultation (FAR) mandating US bearing procurement of all ball bearings under 30mm for defense applications. Meanwhile, the dollar value for the over 30mm size range faced with increasing foreign competition, declined by 24 percent.

The roller bearing segment experienced extremely intense foreign competition. US firms cut prices (by 40 percent in the case of over 2 inch roller bearings) between 1981 and 1985 in a failing effort to maintain market share. (See Tables 6 and 7 in Appendix D). The

result was that dollar sales declined 19 percent in the over 2 inch roller bearing market despite an increase of over 30 percent in unit sales. In the smaller 0-2 inch size range both unit and dollar shipments increased by nine percent. This increase is due in large part to expanding sales of needle bearings which benefited from the import restraints on Japanese motor vehicles. Needle bearings are not currently affected by foreign competition. However, this could change if foreign firms turn their attention to this market.

The stability of the commodity sector of the bearing industry has deteriorated to the point where it now sits upon a precipice ready to collapse. If nothing is done by the Federal Government to reduce or eliminate the growing import share of the domestic market, the industry will almost certainly withdraw from more and more markets and jeopardize the maintenance of a defense capability.

Tables 14, 15 and 16 in Appendix D display measures of financial performance and employment in the commodity sector and compare it to the superprecision sector. The Tables underscore the severity of the bearing industry's inability to compete and paint a bleak picture for the future. Before tax, profits in the commodity sector fell from 7.2 percent in 1981 to a five year low of 1.4 percent in 1983, and then recovered partially to 5.1 percent in 1984, before declining again in 1985 to 3.4 percent. Because of increased foreign penetration into the US market, the bearing industry did not participate in the economic recovery that began in 1983.

Investment by the commodity sector declined as a percent of sales in each year from 1981 through 1985. The industry did not generate sufficient internal funds needed for new equipment and modernization. Investment per employee as well as per production worker also fell each year despite a 22 percent drop in employment between 1981 and 1985.

The 22 percent drop in employment amounted to over 10 thousand employees; from 46 to 35.7 thousand. Almost 97 percent of this decline involves production workers. Although the companies offered early retirement incentives to help reduce employment, they also released a substantial numbers of non-tenured, younger workers and failed to hire new workers during the period. This increased the average age of their work force. The companies also stepped up their foreign sourcing of parts and components which tended to lower their employment requirements.

With declines in employment came increases in labor productivity. However, with the additional outsourcing of bearing parts and components just alluded to, some of this productivity increase is imaginary; and not value added in the US. Sales per employee in the commodity sector increased 23 percent from $67 thousand to $83 thousand. (See Table 16a-b, Appendix D) Sales per production worker increased more dramatically from $77 to $98 thousand between 1981 and 1985. Nevertheless, a measure of labor productivity is sales per employee or sales per production worker.

The profitability of the superprecision bearing manufacturers deteriorated dramatically over the same period, with net profits (before taxes) falling steadily from 12.0 percent of sales in 1981 to only 1.7 percent in 1985. (See Table 14, Appendix D). The cost of goods sold rose steadily from 76 percent of sales in 1981 to 85 percent in 1985. Several factors contributed to the increase in costs experienced by the superprecision bearing manufacturers. One of these factors is the relative increase in defense business. The lot sizes typically ordered by defense customers are less than optimal and result in an inefficient use of equipment and personnel. The specifications and quality requirements for precision bearings grew tighter causing increased scrap rates as well as reject rates. This was aggravated by aging equipment. Further, the workforce is aging and many are probably drawing near peak career wages.

Another factor which would affect both the super precision and the commodity sectors is the rising cost of steel due to the Trade Restraint Agreements constricting access to foreign steels. These Agreements are bilateral marketing arrangements which establish market share quotas. They were negotiated with most major steel producing nations and will be in effect from 1983 to 1987. The targeted commodities include AISI 52100 and 440C bearing grade steels. These restraints effectively raise the price bearing firms must pay for steel.

The equipment in the superprecision bearing industry is old and getting older as shown on Tables 12a and 12b. The US bearing manufacturers have failed to keep pace with machine tool technology necessary to maintain a competitive position in the domestic and world markets. Manufacturing superprecision bearings requires expensive and specialized metal working equipment.

Currently it is becoming more difficult to maintain tolerances required for efficient runs. Setup times increase and this contributes to a rise in overhead costs which are difficult to recoup over short production runs. Superprecision bearing companies have been reinvesting profits into their plants and equipment but not at a rate sufficient to upgrade their facilities to the levels necessary to keep up with improvements in technology. Profit margins are too low for them to make the required investment.

Computer numerically controlled (CNC) equipment has dominated new machine purchases for the last decade. Forty five percent of the new CNC turning and grinding machines are under five years of age and another 36 percent is under ten years of age. However, the total superprecision industry has only 121 of these machines and it is distributed among 10 companies.

The reluctance of bearing manufacturers to invest in capital equipment necessary for the production of all bearings has resulted in changes in company philisophy regarding future profitability. Major changes are expected to take place in the near future, including possible reduced plant operations and plant closures. As an example, New Departure Hyatt Bearings Division of General Motors announced on 24 April 1986 that it's non-automotive bearing division will be sold. The primary reasons for most of the management decisions to consolidate operations or close unprofitable plants are: a diminishing share of the domestic bearing market, and, a dim view of future prospects for the US bearing industry. It remains to be seen whether the more recent changes involving company mergers will be beneficial to the domestic bearing industry as a whole.

Two recent reports have been published that discuss the current strength and long term viability of the domestic bearing industry. The International Trade Commission report, USITC Publication 1797 of January 1986, entitled Competitive Assessment of the US Ball and Roller Bearing Industry contained a statement concerning the outlook for the domestic bearing industry that is pertinent to this study. It stated "...the maintenance of capacity however, may pose potential problems for current and future competitiveness. Investment has not only fallen considerably but must be used, at least to some degree, to maintain assets generating low rates of return. Costs imposed by the maintenance of capacity in lines of bearings that are increasingly uncompetitive in US and world markets, impede efforts of firms seeking to upgrade facilities that produce lines of bearings that

are competitive. Uncertainty over the future course of competitiveness in low-value-added bearing markets could have a significant impact on the ability of US producers to compete in the so-called higher end of the market. Even if the value of the dollar falls, as many economists expect, several years of minimal investment may diminish the competitiveness of US producers."

The Department of Commerce published a report entitled, A Competitive Assessment of the US Ball and Roller Bearings Industry in February 1985. The final statement in the executive summary said "Issues concerning national defense and the maintenance of bearings industry capacity are of significant importance to the United States government. Bearing products are important components of both direct defense and essential civilian machinery and equipment. The US capacity to produce bearings is dwindling as foreign-made products continue to displace sales of US bearings at home and abroad." Unless current trends are reversed, the US bearing industrial base will continue to diminish and become less responsive to the needs of both the military and commercial markets. The long term outlook for the bearing industry will depend on the concerted actions of both the U.S. government and individual bearing companies. Exhibit I illustrates the declining industry trend. This graph was provided to the Working Group by the Torrington-Fafnir Bearing Company.

Task 3. Determine DOD and essential commercial requirements

In mid-February 1986 the Working Group tasked its Service field agencies to supply bearing demand and requirements information for 1983-1987 from which a consolidated DOD Requirments forecast could be built. The request for information included the following categories: National Stock Number; replacement cost; quantity of stock numbers per system; foreign/domestic supplier name; and number of bearings used per year. Additionally, field agencies were to provide bearing requirements for future years (1986 and 1987).

Difficulties surfaced in obtaining useful data from which to forecast requirements. Agencies responsible for purchasing replacement parts maintain only historic data which reflected demands on assets within the supply system and were not conducive to accurate forecasting beyond one year. Agencies which are responsible for new system procurement

do not gather specific data on bearings contained in those systems. The only method available to gather this information was through direct queries to prime contractors and subcontractors.

Further complicating the task were differences in the Service's information systems on historic data. Each system contains a different type of demand rate, cost information or number of bearings which would be required to build a forecast. Also, there was no consistent capability to forecast beyond one year with any accuracy. Information containing parts on order and on contract was not compatible for consolidation since there was no method to determine when the parts would be received. As a consequence of these difficulties the Working Group discontinued its attempt to build a requirements forecast. Since there had previously been a study done on refurbishment of the same type of bearings by the Joint Depot Maintenance Analysis Group (JDMAG), the Working Group used this data as a representative Service requirements forecast.

The JDMAG conducted a data call in 1985 as a part of a JLC Joint Bearing Repair Group study. This data call was issued to determine past bearing usage in order to forecast the quantity of bearings that would be potential candidates for Level II Refurbishment/(See section on Government Programs under refurbishment). This method of determining future Level II workload requirements on bearing usage was utilized since an accurate forecasting vehicle did not exist. The information that was collected by the JDMAG data call is useful to this study since it does provide an estimate of the Services' bearing usage and could be used to project the Services' future requirements. The JDMAG data identified bearings costing $150 or more. This criteria was chosen because it approximated the cost of manpower and equipment needed to rework a bearing. This cost criteria would exclude many lower cost precision and superprecision bearings and concentrate on the larger superprecision bearings that are of interest to this study. The table below reflects the data that was collected by JDMAG using the $150 threshold criteria. It provides the total of, number of national stock numbers (NSN) involved, the quantity of bearings procured by the Services, and the replacement costs if bought new. It should be noted that the JDMAG data reflects the Army's aviation applications and does not include their ground support equipment.

U.S. BALL & ROLLER BEARING INDUSTRY
MILLIONS OF 1967 $ — 12 MONTH MOVING TOTALS
from JAN 1966 to DEC 1985

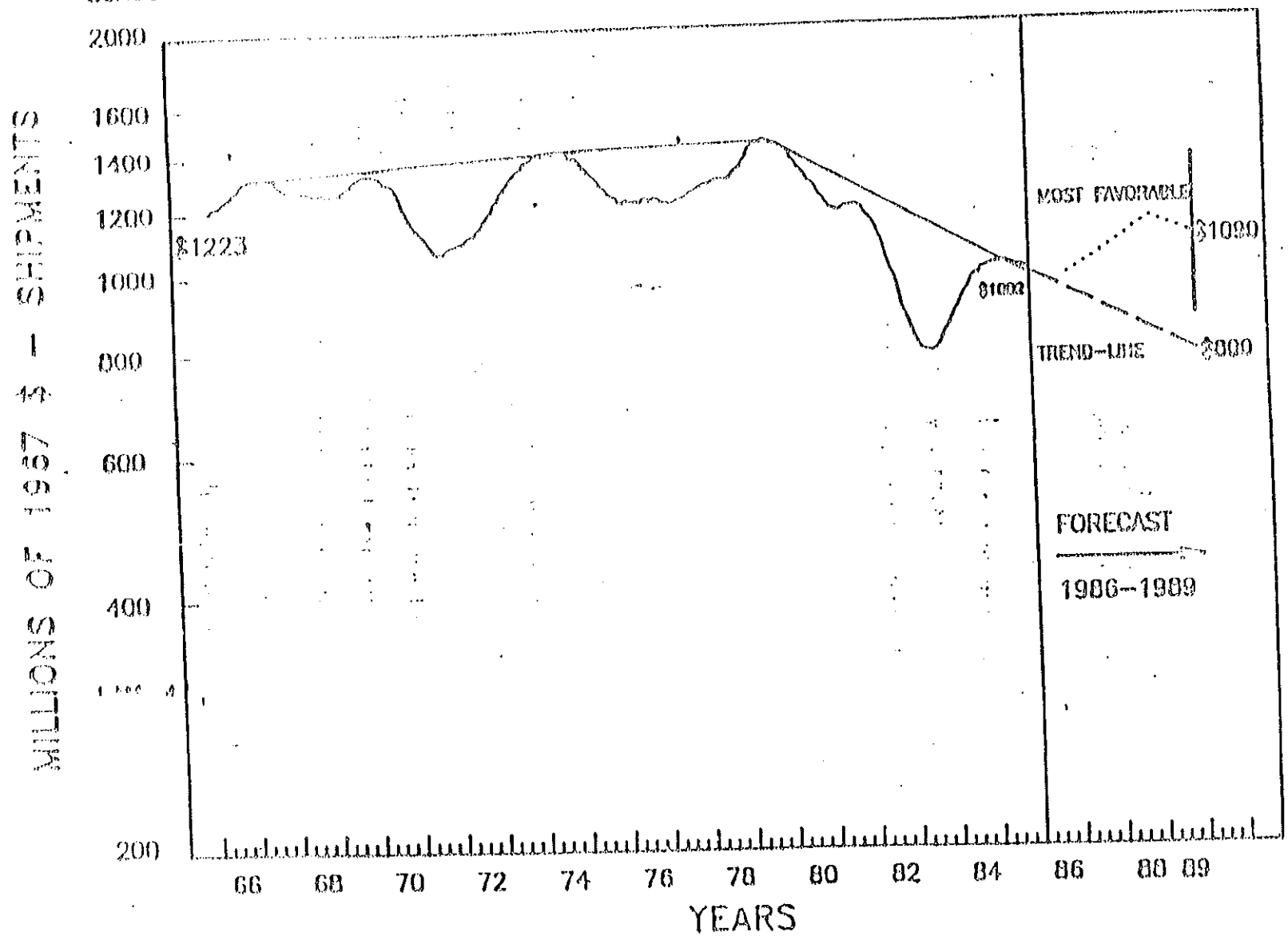

EXHIBIT 1

BEARING QUANTITIES, COSTS, AND NSNS

SERVICE	NSN	QUANTITY	DOLLAR VALUE
Army (AVSCOM)	443	4,397	5,487,333
Navy (ASO)	500	25,318	16,230,094
Navy (SPCC)	211	26,777	32,053,294
Air Force	150	38,146	15,402,470
DLA	205	50,235	25,408,138
Totals	1509	144,873	$94,581,329

As an additional estimate of DOD requirements, the DOC provided a forecast of defense demand for bearings using the DOD Defense Economic Impact Modeling System (DEIMS) and other available information. The total demand for bearings generated by US defense spending is estimated to average just over 17 percent of the total US bearing market for the period reviewed (1983-1987). In addition to bearing demands generated by domestic defense spending, foreign military sales (FMS) also create a demand for bearings. FMS demands are estimated to be an average of 1.5 percent of the total US market for bearings during the 1983-1987 period. With FMS, total defense related demand for ball and roller bearings averages just under 19 percent of the total market. This estimate includes:

1) direct purchases of bearings by the Department of Defense, primarily for use as spares or replacements;

2) indirect requirements which are bearing demands generated by prime contractors or their subcontractors, primarily for installation in new military equipment ordered by DOD;

3) military induced demands or the bearings required in the capital equipment needed to produce military items; and

4) demands for bearings created by foreign military sales (FMS).

A breakdown of estimated defense generated bearing requirements for the three major categories and the foreign military sales category is as follows:

Estimated Defense Demand for Bearings

	(millions of 1984$)					five year
	1983	1984	1985	1986	1987	average %
1) Direct	$152	$161	$163	$180	$194	4.7
2) Indirect	304	322	325	359	388	9.5
3) Induced	103	109	110	122	131	3.2
Total	$559	$592	$598	$661	$713	
% US Market	19.6%	16.5%	16.3%	17.4%	17.6%	17.4%
4) FMS	$ 45	$ 47	$ 48	$ 53	$ 57	
Total	$604	$639	$646	$714	$770	
% US Market	21.2%	17.8%	17.6%	18.8%	19.0%	18.8%

The DOD Defense Economic Impact Modeling System (DEIMS) provides distribution estimates of bearing requirements (direct and indirect) by defense service. The estimates given by DEIMS for the cumulative period 1983-1987 are as shown below.

Army	26%
Navy	34%
Air Force	40%

Superprecision bearings with an ABEC or RBEC rating of 5 and over are a special category for which defense consumption (direct and indirect) constitutes the major share of total demand. While these bearings are a minor portion (5-6 percent) of total bearing production, they are extremely critical in aerospace applications such as "noise quiet" equipment on submarines; high precision instrumentation; and a variety of other essential military equipment. The quality and effectiveness of US military capability would be substantially reduced without them.

Military consumption (direct and indirect) of super precision bearings is estimated to be between 60 and 70 percent of total production. Non-military markets include commercial aircraft and aircraft accessories, machine tools, computer peripherals and disc drives, high speed electric motors, and space hardware.

The table below includes estimates of defense generated requirements for superprecision bearings for the period 1983-1987. The estimates are based on the survey questionnaire sent to bearing manufacturers for this assessment.

Estimated Defense Demand for Superprecision Bearings
ABEC or RBEC 5 and over
(millions of 1984$)

Size	1983	1984	1985	1986	1987
Ball Bearings					
Over 30-52 mm OD	13.0	14.5	14.2	15.7	17.0
Over 52-100 mm OD	23.4	28.2	28.1	30.1	32.5
Over 100 MM OD	18.3	19.5	19.3	21.5	23.2
	54.7	62.1	61.6	67.3	72.7
Roller Bearings					
Over 2-4" OD	16.9	16.1	18.8	19.6	21.1
Over 4-6" OD	14.0	12.6	13.6	15.2	16.4
Over 6" OD	14.5	12.8	15.6	16.2	17.5
	45.5	41.5	48.0	51.0	55.0
TOTAL	100.2	103.6	109.6	118.3	127.7

Projected Percent Superprecision Bearings of
Total Defense Market

17.9	17.5	18.3	17.9	17.9

Methodology for Determining Defense Demands

The estimates of defense generated demands for bearings were made by consolidating information from:

1) Department of Commerce Input/Output Model.
2) Department of Defense "Defense Economic Impact Modeling System" (DEIMS)
3) DOD Security Assistance Agency factbook on Foreign Military Sales.
4) various Department of Commerce statistical publications

Direct Defense purchases of bearings were estimated by using the DOC I/O model which is published every five years. Direct defense purchase estimates for 1967, 1972 and 1977 (the latest data available) were translated to constant 1984 dollars. The estimates of direct defense purchases as shown in the I/O model averaged just under five percent of the total bearing market.

Indirect purchases of bearings for defense were developed from the DEIMS model. DEIMS is an I/O model used to forecast demands generated by defense spending for 429 industries, one of which is ball and roller bearings. A close examination of the indirect demands indicated double counting occurs in the ball, and roller bearing industry. The double counting involves the balls, rollers and other components counted with bearing shipments once and then a second time with finished bearings. To compensate, the DEIMS estimate of indirect defense demands were reduced by 15 percent. These adjusted figures were then projected from 1983 to 1987. Direct demands were estimated at half the value of indirect demands. By estimating direct demands in this way, they roughly equaled just under five percent of the total bearing market which made them comparable to the DOC I/O model estimates.

Induced demand was developed using the DOC I/O model and other DOC and DOD statistical publications. It was estimated that approximately 40 percent of total bearing consumption is used as subcomponents in capital equipment (investment goods). It was then assumed that aggregate defense spending in the general economy generates a portion of investment outlays on capital equipment. The portion of investment outlays generated by aggregate defense spending was determined (conservatively) at eight percent. Thus, eight percent of the 40 percent capital equipment market (3.2 percent) is induced by military spending. The 3.2 percent average was adjusted somewhat from year to year for business cycle swings and changes in defense spending. Foreign military sales from 1980 through 1984 averaged about eight percent of total defense spending for bearings. Eight percent of total defense demands for bearings (direct, indirect and induced) were, therefore, used as the estimate of bearings included in FMS sales.

Estimates of defense demands for superprecision bearings were taken from survey responses for 1983, 1984 and 1985 (See Table 2 in Appendix D, Defense Shipments). The average percent relationship between company reported defense shipments of

superprecision bearings and total defense demands was then computed for each superprecision size range and projected for 1986 and 1987.

Task 4. Analyze the extent to which bearings of foreign manufacture are used in weapon systems and components procured by the DOD.

Foreign bearings and components are increasingly being used in DOD weapon systems. This trend has come about because of increasing leadtimes and higher prices for domestic bearings. Foreign bearings can be purchased that are sometimes one half the price of a comparable US manufactured bearing. The gas turbine engine manufacturers reported that their use of imported bearings for 1985 was not a significant factor. Two of the companies visited are now importing bearings for use in defense applications. The imported bearings represent 1.2% of total units and 2.3% of dollar receipt for bearings in 1983, and 2.2% of total units and 2.4% of dollar receipts for bearings in 1985. Only two of the companies reported data for 1981. One of the companies reported it was purchasing imported bearings for qualification purposes only, but it intends to use the source(s) for its requirements for these bearings in 1986 and beyond.

From 1981 to 1984 the Navy was 100% dependent on a Japanese source (NTN), for noise quiet superprecision bearings. In 1981, after capturing the entire noise quiet bearing market, NTN notified the Navy that, as a result of new internal company management policies, NTN was changing its NT-3 (noise quiet)bearing programs. As a result, leadtime for delivery of bearings would change from 180-210 days to 300-400 days effective immediately, and cost per bearing would be increased. Subsequently, NTN stated it was committed to continue as a supplier of Navy NT-3 bearings but would no longer maintain an inventory of NT-3 bearings. The price of NT-3 bearings would continue to increase and NTN would no longer provide price quotes or supply NT-3 bearings in small quantities. The Navy exerted significant effort to develop a domestic bearing manufacturing source to overcome this unsatisfactory dependency.

Under Title III of the Defense Production Act, the Navy, in 1984, guaranteed the purchase of $1 million of noise quiet bearings for one year. This was in addition to the cost of the product. The Navy was then able to contract with a domestic bearing company for the manufacture of noise quiet ball bearings. Two years of efforts have resulted in only one

fully qualified domestic producer and one domestic company which is undergoing qualification procedures. The qualified producer is still "debugging" its manufacturing process.

The decline of the commercial bearing producers as a result of foreign competition has already been noted. Inroads are now being made into other superprecision bearing markets (other than noise quiet). The domestic sources in this area of critical manufacture are now in danger of being lost completely. Reasons being cited for this shift in procurement strategy are, state-of-the-art bearings availability, better quality materials, shorter leadtimes, and lower initial costs. This move could have serious impact on domestic bearing companies since additional foreign bearings are being considered for other weapon systems. In spite of the possible benefits of using foreign sources, OEMs identified several problem areas which could create difficulties in their operations. Reasons they cited for not wanting to deal with foreign bearing companies are: time differences; language differences; changing currency exchange rates after the signing of a contract; lack of influence on foreign governments; manufacturers' inability to enforce defense priorities and allocations system (DD or DX) ratings on foreign bearings; and expense for travel to meet with foreign manufacturers.

Foreign bearing companies are continuing to make inroads into the low value, high volume market, which has weakened the overall domestic bearing industry. This segment of the bearing market is where the major portion of company profits are centered. Without it, companies are unable to make the required capital investments in modernization and product research to remain competitive.

In recent years the domestic bearing industry has been hurt by the strong dollar, worldwide bearing production overcapacity, and low labor and steel costs in the Far-East and communist block countries. US manufacturers' share of the domestic market has been significantly reduced by imports of assembled products containing bearings such as automobiles, machine tools, electric motors, construction equipment and many other assemblies. This dictates a loss of market share for new and replacement bearings for these products. The effect on the US bearing industry has been inadequate capital accumulation, aging plants and equipment, lower profitability, sale or retirement of production capability, reduced exports, declining employment, and lost market shares.

Cheaper imports have been capturing the large volume, low technology/low cost larger order lots, forcing domestic producers into high cost smaller lots. The bearing companies all confirmed this trend, reporting that they are being driven to what they refer to as niches in the bearing market. The industry is very capital intensive, which makes it sensitive to low volume production. Smaller production runs reduce efficiency and lengthen investment paybacks, raising the cost of bearings produced. Historically, the US bearing industry has been based on long production runs and high volume production. Since they have lost most of their share of the high volume market the remaining low volume, small lot/niche type market is not suitable for most of their equipment and plant facilities. Using equipment that is more suitable for high volume manufacture on batch production runs is inefficient and costly, making the industry less competitive against foreign companies. As an indicator of how much the imports are penetrating the larger lot orders, one company representative noted that 65 percent of unit imports comprise 20 percent of the part numbers.

It is apparent that the US share of the commercial bearing market will continue to decline as foreign bearings increasingly penetrate the domestic market. The current trend is for an increasing use of foreign bearings in DOD weapon systems for cost, leadtime and performance reasons. The OEMs indicate they will continue to qualify and use more foreign bearings in their newly designed systems. This includes superprecision bearings for critical military applications. Therefore, the increasing dependence of DOD weapon systems on foreign produced bearings will cause an erosion of the US bearing industry resulting in an overall weakening of the US industrial base.

Task 5. Assess the implications on readiness and sustainability of using bearings of foreign manufacture.

The use of foreign bearings in weapon systems can have serious implications when determing readiness and sustainability for surge and mobilization. During these scenarios, any disruption in supplies of imported bearings would result in long procurement leadtimes and create shortages that could shut down production lines and/or limit the operation of critical weapon systems. Recent bearing shortages have caused grounding of our first line aircraft and line stoppage of M-1 tank production.

When foreign sources are cut off, the domestic bearing companies would be called upon to produce bearings at an accelerated rate to replace those no longer available from foreign sources. US bearing companies may not be able to support the sudden increase in requirements due to a lack of capacity/capability that has deteriorated because of increased reliance on foreign bearings. If this trend continues, the domestic bearing companies may have to close some of their facilities and disassemble their production lines as it is an added overhead expense to maintain idle capacity. This lost capacity/capability cannot be quickly regained and could take years to reestablish, especially for the superprecision bearings.

Producers not located within the United States are not subject to Federal Acquisition Regulations or the Defense Priorities and Allocation System. There is no mechanism to accomplish Industrial Preparedness Planning with Foreign companies for our surge or mobilization needs. As a result, estimates of their expandable capacity cannot be made. Domestic manufacturers, under mobilization conditions can be required to produce specific required goods. Similarly, leverage cannot be placed on foreign producers to influence their product mix or delivery schedule. They are under no legal or moral obligation to supply US defense needs, especially under circumstances where their own nation's security is also being threatened.

The erosion of our domestic bearing industry, if allowed to continue unabated, will preclude any effective efforts to plan, prepare and meet surge and mobilization requirements. The time required to replace lost capability would place the United States in jeopardy since critical weapon systems could not be adequately supported by domestic production. Dependence on foreign manufacturers for bearings for weapon systems and essential civilian applications will place the US defense posture at risk. The ability to domestically produce bearings is essential, and reliance on foreign bearing sources is a serious threat to our national security.

Surge and Mobilization Capabilities

Surge and mobilization production capabilities for superprecision bearings were reported by the bearing firms in their survey responses. Average 1985 monthly defense production was used as a proxy for base period defense requirements. Under surge conditions, the

firms were told to maintain commercial shipments while increasing defense production to the maximum extent possible. Increases were reported at intervals of three, six and 12 months. The companies were told to surge within existing facilities and target a twofold increase in defense production in one year.

Under mobilization conditions, commercial shipments are dropped to 25 percent of their 1985 average. Companies were told to invest in new plant and equipment and target a fourfold increase in base line defense production in two years. Mobilization increases were reported at intervals of six, 12 and 24 months.

Overall, 40 percent of the firms surveyed were not able to meet surge targets and 50 percent were not able to meet mobilization targets. Table 11 in Appendix D shows the current surge and mobilization production capabilities for the superprecision bearing sector as a whole. Surge production increased by 16 percent after three months, 49 percent in six months and by 96 after one year. Superprecision ball bearings increased 18 percent, 50 percent and 93 percent in the time intervals, and superprecision roller bearings increased two percent, 40 percent and 117 percent after three, six and 12 months, respectively.

All four major engine main shaft bearing producers failed to meet surge, reaching only 39 percent of target. These same four also failed to meet mobilization, reaching only 50 percent of the target of four times production. The major bottlenecks to surge were grinding equipment, gauging equipment, equipment parts, rolling elements, material lead times and skilled labor. Floor space, defense order quantities and tight specifications were also mentioned.

Mobilization capabilities exceeded the target for the superprecision industry as a whole, increasing to 4.2 times baseline production after 24 months. The increase in mobilization production was 91 percent after six months and 203 percent after 12 months. Superprecision ball bearings missed targeted capabilities by 68 percent, with only a 232 percent increase after two years. The ball sector increased 82 percent in six months and 163 percent after one year. Superprecision roller bearings increased 148 percent after six months, 462 percent after 12 months and 898 percent after 24 months. Four of nine firms were able to reach mobilization target levels. Skilled labor, and machine tools are bottlenecks to mobilization.

A major consideration in meeting mobilization is the convertibility of commercial capacity to defense production. Convertibility is extensive for bearings going to similar end-markets, such as main shaft bearings in commercial engines and military engines. Other conversions, such as from machine tools to main shafts would be more difficult, as different materials, heat treatment, tolerances and tests would be required.

In the event of an actual surge, commercial production could be displaced by defense priority orders. Imports of superprecision bearings, however, are penetrating the commercial sector, and these are not subject to defense priorities and allocation system (DPAS) regulations. One engine company said it is no longer even considering domestic sources for its commercial engines. Imports of superprecision bearings will soon be used more extensively in defense applications. This will cause surge and mobilization capabilities to decline as there will be no domestic suppliers left to produce these bearings.

Task 6. Analyze the feasibility of restricting DOD to the use of bearings of US manufacture.

The use of a government procurement regulation to require the use of domestic bearings has a precedent. In 1971, ASPR 1-2207 was issued to protect the DOD segment of the miniature and instrument bearing industry from low-priced Japanese imports in the 0-30mm size range. Japanese imports began to penetrate the small bearing segment of the US market in the early 1960's and by 1970 had captured 39 percent of the US market. Today, imported miniature and instrument bearings account for approximately 70% of the US market. The number of US producers has dwindled from six companies in 1960 to three at the present. The companies are currently able to support DOD requirements critical to national defense. The ASPR 1-2207, restricting the use of foreign bearings, helped the US bearing industry survive. However, it should be noted that the procurement regulation was only marginally effective since it did not address some of the fundamental problems facing the bearing industry and it could not provide protection for the vital commercial sector. The same problems of foreign bearings that the small bearings market faced in the 1970's are now confronting the larger bearing market today.

The use of a government procurement regulation for over 30mm ball and roller bearings would help the domestic bearing industry recover by protecting the military segment of the domestic market. Meetings with bearing industry management provided solid support for this type of action. They believe this is the absolute minimum action that should be taken to help give the domestic bearing industry sufficient time to recover and become viable. If this regulation were to be imposed, it should also include the requirement to purchase all bearing components and parts which are domestically manufactured.

It should be noted that it will be necessary to issue a procurement regulation that will cover all bearings procured for military applications to ensure domestic production capability. To be effective, the regulation must apply to superprecision bearings, precision bearings, airframe and aircraft control bearings, and wheel bearings. The protection of only the superprecision bearings will not ensure the survival of the industry, since it represents only a small segment of the total bearing market. The Working Group has determined that the total military bearing usage, including all types of bearings, is only 17 percent of the total US bearing production. Therefore, to effectively assist the bearing industry, the total military segment must be addressed.

The gas turbine engine manufacturers that were visited also endorsed the issuance of a procurement regulation to require purchases of domestic bearings for weapon system application. Engine manufacturers voiced certain reservations concerning its potential effect on the OEMs. Prices for domestic bearings could rise in the short term, and there may be long term technological disadvantages due to exclusion of foreign suppliers. They concur that the bearing industry must modernize and become more efficient and competitive. The bearing industry must institute improved manufacturing techniques, modern CNC equipment, and improved management controls to become more responsive to the requirements of the OEMs.

Unless a government procurement regulation requires the purchase of domestically manufactured bearings for all military applications, the incursion of foreign bearings will eventually lead to the destruction of the domestic bearing industry, including the military segment. The subtier supply levels of the industry will also face severe contraction. The military segment, including the superprecision bearings, is dependent upon the survival of the larger commercial/commodity bearing market and could not survive on its own. If

this were to occur, major price increases for military bearings would result and the industrial base for bearings necessary to support national defense will disappear as a domestic source.

In addition to a procurement policy requiring domestic bearing purchases by DOD, other actions are required that will address the primary economic and trade issues that are confronting the US bearing industry. The additional actions that are proposed by the Working Group are discussed in the Recommendations section.

PREVIOUS GOVERNMENT STUDIES SUMMARY

The bearing industry has been the subject of many studies in the past few years. Prior to this effort an investigation was made of available data on file with various government agencies. Several recent studies were reviewed by the Working Group and the following summary of information was extracted for inclusion in this report. This data supports and confirms our findings.

SPONSOR: Industrial College of the Armed Forces
TITLE: Aircraft Engine Main Bearings Study
DATE: May 1982

This study analyzed the availability of jet engine main bearings to support peacetime operations as well as future surge or mobilization requirements. The lack of these precision components will greatly impact the nation's ability to deploy, conduct, or sustain military operations.

Key issues such as technology, materials, requirements, manpower and quality control were examined as they related to the bearing industry in general, and to the Department of Defense (DOD) in particular. Pertinent facts and observations related to each area were highlighted and explained. The findings represented the culmination of extensive visits, briefings, tours, and discussions with engine and bearing manufacturers, engine overhaul facilities, engine/bearing management organizations, material suppliers, and forging facilities.

The study confirmed that engine bearings are critical assets which directly affect aircraft readiness rates and that the strategic airlift and tanker fleets face a far more serious problem than do other aircraft. The requirement for bearings to support these types of aircraft will rise as much as 500 percent during an intense conflict.

Although most bearings that are required for peacetime operating stocks are on hand, isolated shortages of one or more bearing types exist for several of our most modern and critical airlift and fighter aircraft. All services are experiencing similar problems with

peacetime stocks and have significant shortages in wartime requirements. This problem is compounded by the bearing industry's lack of awareness of surge/mobilization requirements. Companies in the industry have no discernable industrial preparedness plans and may have insufficient capacity to support a major protracted conflict.

SPONSOR: US Dept of Commerce
International Trade Administration
TITLE: A Competitive Assessment of the US Ball & Roller Bearing Industry
DATE: Feb 1985

Ball and roller bearings are essential components of most machinery and equipment containing rotary parts. Ball bearings account for about 36 percent of the total value of the bearing industries shipments; roller bearings, 45 percent, and the remaining 19 percent consists of parts and mounted bearings. The industry is mature, with a history of slow or no real growth during the last decade. The top four US companies manufacture 56 percent of the total value of domestic shipments. There are about 79 additional companies producing bearings at various degrees of specialization.

Steel is the major material in bearings and it's price will be a major influence on the future competitiveness of the US bearing industry in the world market. Quotas or other similar measures limiting steel imports could result in increasing prices of steel to some US bearing manufacturers. Currently US bearing producers purchase most of the steel used for the manufacture of balls from abroad.

The industry, with a payroll of $889 million, provides employment for almost 43,000 workers. Leading states in employment, jointly accounting for 55 percent of total employment in the industry are Ohio, Connecticut, South Carolina, and Indiana. The domestic industry is subject to cyclical economic activity, particularly those of major bearing markets such as automotive and industrial equipment. Annual capital expenditures in the US industry increased from $51 million in 1972 to $245 million in 1980. Capital expenditures remained relatively high at $186 million in 1981 and $164 million in 1982, suggesting that a number of firms are taking the long view and endeavoring to improve their competitive position. The primary motivator in this investment posture is the dramatic increase in shipments related to a general upturn in business conditions between 1973 and 1979.

The conclusion is that when market conditions dictate a necessity to invest in capital improvements to react to an expanding market, the companies in the bearing industry are not reluctant to act.

In foreign trade, exports have fluctuated between 8 and 10 percent of total US bearing manufacturers' shipments. Imports of bearings have grown steadily over the past fifteen years and they extensively and materially affect the ball bearings segment of the US market and are becoming a major factor in the roller bearings sector. Dominant overseas suppliers include Japan, Canada, and West Germany. Also, Singapore is rapidly expanding its influence in the US bearings import market. Free world trade in bearings by leading manufacturing countries tripled during the last 15 years. However, the US share of the world export market has dropped during the same period; Sweden and the United Kingdom have also lost market shares. West Germany's share increased as did those of Japan and France. Exports from Singapore, a new-to-market country, have also grown and significantly penetrated the US market for radial ball bearings in the under 30 millimeter size group. Soviet Bloc countries are expanding their presence in the world market. Romania, in particular has penetrated the US tapered roller bearing market.

Although US industry has some energy cost advantage and is comparable or superior in product technology, it continues to lose world market share because of higher labor and material costs. In addition, major foreign competitors concentrate their output on long-run, standard, and most profitable items, and are extremely price competitive in the US and Third World markets. US manufacturers have devoted a larger portion of their facilities to the production of short run, special purpose, and limited application bearings. Although some US firms are increasing their investments in advanced machinery and equipment, they may continue to lose their competitive position in the world market unless wages and material prices improve in relation to overseas competitors, and the exchange rate in the world market improves.

Revolutionary future technological developments which would give the US industry a greater competitive edge are not anticiapted. However, the United States is equal to or slightly ahead of world competitors in bearing technology. Generally, with bearings produced to international standards, the vast majority are interchangeable in world markets.

Issues facing the bearing industry are complex. The steel product manufacturing industry is in the middle of the production chain. Government policies that may aid the steel industry may not necessarily work to the best interests of the bearings industry, which relies heavily on steel in manufacturing bearings, or its customer industries. Tariffs continue as an important issue to the bearings industry. In the Tokyo round, the US reduced its duties on roller bearings, whereas some major overseas competitors did not. Further liberalization, either through multilateral or bilateral negotiations, now assumes great significance. Also, with imports of bearings an extremely sensitive issue, United States manufacturers strongly recommend continued exclusion of bearings from duty-free treatment under the General System of Preferences.

Issues concerning national defense and the maintenance of the bearing industry's capacity are of significant importance to the United States government. Bearing products are important components of both the direct defense and essential civilian machinery and equipment. The US capacity to produce bearings is dwindling as foreign-made products continue to displace sales of US bearings at home and abroad. Affecting the economic health of the bearings industry are other issues, including tax incentives for investment in research and development, machinery and equiment investment tax policies, corporate tax rates, and anti-trust policies.

SPONSOR: Joint Depot Maintenance Analysis Group (JDMAG)
TITLE: Bearing Study Report
DATE: March 1986

The JDMAG, located at Gentile Air Force Station, Dayton, Ohio, was tasked by the Joint Policy Coordination Group for Depot Maintenance Interservicing (JPCG-DMI) to assess the Services' total bearing repair workload potential, including aviation, marine, vehicles, and the equipment, facility and personnel requirements to accomplish this workload. To accomplish the tasking, JDMAG identified a potential workload baseline to determine the total number of bearings currently required by the Services and how that requirement is met. The sources of information were the materiel managers of bearings as well as the users of bearings. Information considered in JDMAG's assessment related to purchase quantities, personnel skills, numbers of personnel, support equipment used, and quantities of bearing processed by approved bearing shops utilizing approved techniques. To obtain

this information, JDMAG issued a data call to the Services. The Services' bearing materiel managers were requested to provide data for bearings costing $150.00 or more. The $150.00 was chosen because it approximated the cost of manpower and equipment needed to rework a bearing.

The Services identifed three bearing rework facilities in their reply. They are the Corpus Christi Army Depot, the Naval Air Rework Facility, North Island, and the Oklahoma City Air Logistics Center. These three facilities reworked 4,525 bearings with a cost of $150.00 or more. The bearings were disassembled, components inspected, parts replaced, or repaired as necessary, reassembled and returned to service. This effort saved the Services $1,273,542. The 4,525 bearings represent 30 percent of those bearings which were inducted for possible rework. The Services indicated that with better tooling and sufficient personnel the recovery rate would increase from 30 to 50 percent.

The Services detailed a number of reasons why more bearing rework is not accomplished. Their reply also identifed steps which are underway to eliminate these problems. Most bearings are identified in the DOD supply system as throw-away if they cannot be inspected and reused. Steps are underway to change the coding in the supply system for bearings to be returned to a depot facility for potential rework.

The Services reported a problem with the availabiltiy of the spare parts necessary to rework bearings. The original bearing manufacturers are reluctant to provide parts for the DOD rework effort; they prefer to sell new bearings. The Services are working through the Joint Bearing Repair Group to resolve this problem by obtaining the components necessary to refurbish bearings.

The Services reported that when the bearing refurbishment program is fully implemented at the three facilities, they will be able to rework and return to service approximately 30 percent of the 144,000 used bearings costing over $150 that are currently being replaced annually for cause by the DOD. This would mean 43,000 fewer new, high cost, replacement bearings would be purchased by the DOD from the domestic bearing industry.

SPONSOR: United States International Trade Commission
TITLE: Competitive Assessment of the US Ball and Roller Bearing Industry
DATE: Jan 1986

This study analyzes the conditions of competition between US and foreign industries, assesses relevant major country markets, and examines future trends and markets for industry products. In 1984, the United States was by far the world's largest producer (47 percent), consumer (57 percent), and importer (28 percent) of ball and roller bearings. Currently it is the third largest exporter after West Germany and Japan.

From January 1980 to June 1985, the industry has experienced many changes. World production declined 20 percent in the face of a slump in demand caused by the 1982-83 world recession. By 1984 and up to the January-June 1985 time frame, US industry sales were still about 6 percent below the 1981 peak of $3.4 billion. For 1984, exports were off 13 percent, and imports were up 28 percent from 1981 levels. Between 1980 and 1984 import penetration in the United States increased from 14.5 to 16.0 percent of domestic consumption, but its impact was heavily concentrated in low value, high volume products.

The domestic industry generally limited erosion of its US market share by lowering prices to those of imports, which were benefiting from the effects of the strong dollar. From 1981 to 1983, profits fell 19 percent to a low of 2.2 percent of net sales, recovered to 7.6 percent in 1984, but slumped again in January-June 1985 to 5.6 percent. These declines reduced the industry's ability to finance investment, which fell 45 percent. Even so, the industry remained profitable, with all but 8 of 38 firms reporting operating profits. Modernized specialized product producers maintained the highest level profits before taxes, of nearly 7 percent of net sales from 1982 to 83, recovering to around 10 percent in the 1984-85 timeframe.

The industry responded to competitive pressures mainly by cutting labor and costs, concentrating its limited investments in new manufacturing technology, selling off certain production facilities (some to foreign producers) and increasing its 1980-84 R&D investment by 50 percent, to about 2 percent of sales. After the strong recovery in 1984, the first half of 1985 produced a sharp increase in import competition. The recent decline in dollar strength may improve prospects somewhat, but concerns linger that erosion of

profits, investment cutbacks, and loss of sales to increased imports of products containing bearings all weaken the domestic industry's long-term competitive strength. The US bearing industry, despite intense import competition, has maintained capacity, but utilization of capacity and investment has fallen drastically (See Table 8 and 9). US producers have been more affected by imports of low-value-added, mass-produced bearings than by imports of higher value-added superprecision bearings. US exports to most major world markets as well as overall industry employment declined during the January 1980-1985 time frame.

Major world markets were dominated by a small number of firms with Swedish, US, West German, and Japanese firms most prominent. West Germany's ball bearing industry is dominated by three large firms. This high degree of industrial concentration has not necessarily protected the industry, however, because West German production of bearings has declined in the past four years. By contrast, Japan's ball and roller bearing industry increased total production from 1980 to 1984, albeit modestly. Between 80 and 90 percent of its production in ball and roller bearings was accounted for by five producers. Exports to the US market have grown considerably. Japanese exports to the US increased from 28 percent in 1980 to 33 percent in 1983. Japanese firms have also augmented direct exports with the acquisitions of bearing plants in the United States. They also, accounted for the majority of bearings installed in products imported by the United States.

Severe import competition recognition occurred initially in the high-volume OEM market, but now it is increasing at the distributor level. Japan, the principal supplier of US imported bearings, increased its share of US imports from 28 percent in 1980 to 46 percent in 1984 and to 49 percent during January-June 1985. West Germany was the second leading supplier but its share of the US import market declined from 17 percent in 1982 to 16 percent in 1984. Other significant suppliers included Canada and Singapore. During this period, Canada's share of the US import market ranged from a low of 9 percent during January-June 1985 to a high of 12 percent in 1983.

Data obtained by respondents to the commission's questionaires indicated that 12 US ball bearing producers and 7 US roller bearing producers have started to import bearings, in response to the increased competition in the US market from other imported ball and

roller bearings and parts manufacturers. Imports by domestic producers accounted for 56 percent, by dollar value, of total bearing imports in 1984. Increased imports can also be attributed to the rise of joint ventures between US and foreign bearing producers. This has led to increased imports of certain types of bearings that are produced in large volume overseas and, in some cases, marketed through channels of distribution in the United States that were established by the US producers.

The high cost of steel has become a major concern for the US bearing industry because this material accounts for such a significant part of the cost of producing bearings. US bearing producers import most of their steel because domestic steel is higher priced and/or not available in sufficient quantities at the quality grades needed for bearings. Japanese and European bearing producers benefit from lower priced, locally procured steel. US producers state that they have improved the quality of their bearings in response to import competition, but the Japanese and West German bearing producers were reported to have an overall competitive advantage over US bearing producers, in international as well as domestic markets.

The outlook for the US industry is dominated by the general level of US economic activity and by prospects for the auto industry in particular. High levels of R&D investment and a variety of promising technological research and development efforts enhance the outlook for continuing significant changes in products and production techniques. Whether US producers are even or ahead in developing and applying present technology unclear. The recent decline in the dollar's strength appears to be the most favorable feature now visible on the horizon.

-INDUSTRY SURVEY SUMMARY AND COMMENTS

This section contains a summary of the information gathered from the industry surveys and visits. Each contains a synopsis of comments to the survey questionnaires and discussions during the plant visits. Recommendations are strictly the views of the companies visited and are not to be considered as opinions of the Working Group.

BEARING COMPANIES

Nine bearing companies responded to the Department of Commerce mandatory survey. In addition, three other firms submitted completed surveys voluntarily. These firms represent a substantial portion of the industry. The overall market share (compared with Bureau of the Census data) attributable to the eleven reporting firms ranged from a high (in dollars) of 62 percent in 1981 and 1982 to a low of 56 percent in 1984 (the latest year available). The unit share ranged from a high of 41 percent in 1981 to a low of 35 percent in 1984. All of the superprecision sector was represented by the survey.

Nine of the responding firms produce superprecision bearings. They were requested to report their superprecision bearing capacity (in units) by size range. Tables 8 and 9 in Appendix D show a tabulation of capacity and capacity utilization by size range and firm. Almost 89 percent of the capacity to produce superprecision bearings is represented by ball bearing capacity. The dominance of ball bearing capacity in the superprecision sector is related to the predominance of high speed applications, especially in the small end of the size ranges. Over 50 percent of the ball bearing unit capacity is comprised of bearings in the smallest size range, 30-52 mm. If capacity were translated to dollar value, superprecision ball bearing capacity would be slightly over 60 percent, as roller bearings are on the average considerably more expensive.

Table 9 in Appendix D includes information on unused capacity and rev-up time. Unused capacity totals 1.5 million units or nearly half of total superprecision capability. This low utilization is in part due to foreign penetration into the commercial applications of superprecision bearings as well as a slump in commercial end markets such as aerospace and machine tools. The decline in units delivered to commercial markets between 1981 and 1985 amounted to 10 percent in the superprecision ball market and 47 percent in the superprecision roller bearing market (see Table 3, Appendix D).

Rev-up time is the time required to bring unused capacity into use. The superprecision sector reported an average rev-up time of 40 weeks with a low of only 12 weeks reported by two firms representing 749 thousand units or about 24 percent of capacity; and a high of 88 weeks reported by one firm with 235 thousand units or eight percent of capacity. Rev-up times vary because of local market conditions, firm integration, financial health and other factors. Skill levels required to produce superprecision bearings complicates the hiring and training of additional workers needed to man additional shifts. Also, much of the equipment in the industry is old, requiring extensive reconditioning. Additional time is needed to order and receive materials and components which are increasingly being foreign sourced.

Table 10 in Appendix D contains 1985 manufacturer's market shares for superprecision bearings in unit and dollar terms. Four firms produce majority of mainshaft bearings for gas turbine engines. A fifth firm participates in this market to a much lesser extent. End markets for superprecision bearings as follows:

INDUSTRIAL APPLICATION	NUMBER OF BEARING COMPANIES
1. Aircraft Engine and Gearbox	10
2. Machine Tools	7
3. Aircraft Accessories	6
4. Computers	3
5. Satellites/Space	2
6. Oil Field Machinery	2
7. Textile	1
8. Helicopter	1
9. X-Ray Tubes	1
10. Office Automation	1
11. Motor Vehicles	2
12. Farming	1
13. Steel Mills	1
14. Mining Equipment	1
15. Compressors	1
16. Dental Tools	1
17. Nuclear	1

The bearing plant visits included interviews with the top management of each of the bearing companies, and walk-throughs of their manufacturing facilities. The visits were intended to support the assessment objectives by determining: (1) the importance of a domestic bearing production capability to US defense requirements; (2) the connection, if any, between a viable commercial/commodity bearing production base and the maintenance of the defense related bearing production base capabilities; (3) the key problems confronting the bearing industry including the effects of foreign competition; (4) the future outlook for the bearing industry; and (5) the company recommendations for assuring the continued existence of a US bearing industry.

The following analysis of the information obtained during the bearing industry visits represents a composite bearing industry position as viewed by the study team members and is not necessarily the position of any specific bearing company. There is a wide divergency of opinion within the bearing industry as to the problems facing the industry and possible solutions which can be applied to specific situations. The bearing industry is often divided by differing goals and objectives. The domestic bearing companies that are foreign owned and operated have different views than the companies that are US owned and operated.

1. BEARING INDUSTRY OUTLOOK: The need for a strong bearing industry was constantly emphasized in all of the meetings with company executives. They referred to World War II and the concerted efforts that the Allied forces expended to try to destroy the German bearing manufacturing plants. It was also pointed out that a major bearing plant had to be built in this country in 1942 to manufacture superprecision bearings for use in the Norden bombsight. In the event of similar emergency bearing requirements in the future, there would not be sufficient time to build the bearing plants and develop the needed manufacturing capability to produce the necessary bearings to meet all military requirements. The companies believe the US bearing industry is an extremely important part of this country's industrial and military strength.

Comments of company officials concerning the International Trade Commission report of January 1986 indicated they felt the report did not fully describe the general state of the US bearing industry. They believe the problems facing the domestic companies were not adequately addressed, nor the gravity of the situation regarding foreign competition emphasized.

All of the bearing companies indicated there was a need to maintain a strong, multi-product domestic bearing industry in order to meet the requirements of the military not only during peacetime, but especially during surge and mobilization. Many of the companies indicated their manufacturing capabilities were being diminished by the effects of foreign bearing penetration in the US market(See Table 11, Appendix D). As their market share gets smaller or is lost, they must reduce or close down some of their operations, and this capacity is lost. This reduces their ability to meet future military requirements.

All of the companies reported a significant drop in replacement market sales, which can be attributed to increased sales of foreign products containing foreign bearings. The replacement bearing usually is of the same manufacture as was originally used by the OEM. The replacement market has historically been the US bearing manufacturers' primary source of profits resulting from normal markups. As this source of profit decreases, the cost of doing business must be spread over fewer bearing lines. This drives up bearing industry costs, making US bearings even less competitive.

Another primary area of concern is the commercial bearing production base requirements versus the military bearing production base requirements. It was emphasized by all the companies that they could not stay in business if they had to depend on the military business alone, which amounts to between 1 and 30 percent of their sales volume. The commercial/commodity market sales are necessary in order for the bearing companies to remain viable. The sale of commercial/commodity bearings provides the large production base over which costs can be spread, and is the source of profits needed to maintain a healthy industry. If the commercial market segment is allowed to continue to erode, the military segment is threatened with extinction or faced with exorbitant price increases.

2. TRADE AND COMPETITIVE FACTORS: The bearing companies consider their products to be competitive in the US and world markets, if allowed to compete by the same rules on a "level field" (See Table 13, Appendix D). They believe in "fair trade" not "free trade". The US seems to be the only country that is conforming to an "open/free" market philosophy.

Most of the companies expressed a concern over competition with foreign bearing companies in the world market. In the Japanese domestic market, even if US prices were competitive, Japanese trade restrictions preclude US firms from competition. The Japanese companies will not buy from US bearing companies regardless of price, as long as there is a Japanese product available. They will buy from the US only those bearings that they are unwilling/unable to manufacture. With respect to the European Economic Community, it is difficult to sell US manufactured bearings. This is due to a rising spirit of nationalism which encourages buying products from companies located in their own countries. Again, sales are made by some companies to the EEC of special kinds of bearings that are not currently made in Europe.

Competition with foreign bearing companies in the US market has it's own set of problems. Many of the foreign bearing companies are located in geographic areas that pay very low wages. The result is companies located in these low labor cost areas have a significant advantage over bearings that are manufactured in the US. US companies provide extensive technical sales and after-sales services that foreign manufacturers only marginally provide (See Table 13, Appendix D). These overhead costs must be added to the cost of the bearings by domestic firms. In response to foreign competition's reluctance to provide such services, some domestic manufacturers have eliminated these overhead costs completely to remain competitive. This then impacts the OEMs ability to acquire cost-free technical assistance when required and ultimately drives cost to the end user up..

The bearing companies expressed a concern that the US trade laws and regulations are either not adequately enforced, or when enforced, do not carry with them sufficient penalties to deter unfair trade practices. They all expressed the need for the government to vigorously enforce the existing trade laws regarding dumping on the part of foreign companies and to do so in a timely manner. They felt the US government has not been responsive to the degree necessary to prevent or reduce the practice of dumping bearings in the US market. The bearing companies also had reservations concerning licensing agreements that allowed foreign manufacturers access to specialized US bearing technology. This has hurt the US bearing industry by transferring important technology to a foreign base, where it can then be used to compete with domestic bearing manufacturers.

3. COST REDUCTION EFFORTS: The bearing industry is going through a period of belt tightening in an effort to reduce costs and become more competitive with foreign imports. US companies concede they have high overhead/administrative costs that must be added to the sale price of the bearings. Some of the primary cost cutting measures that many of the companies have taken are as follows:

a. All bearing companies are instituting quality improvements in their plants to reduce costs and become more efficient. One company indicated it has mandated a plan to reduce costs by 30 percent over the next three years in order to become competitive and ensure its survival.

b. Many companies are purchasing or planning to purchase new CNC metal working equipment that will enable them to reduce their machine tool setup times. Typically, setup times can be reduced from an average of 10-12 hours to 2-3 hours. This is especially important when working with the small production lots that are characteristic of a niche or specialty bearing market, into which the US bearing companies are being forced.

c. Plant expansions are being implemented or planned by some of the bearing companies. One company has already expanded its plant by 27,000 square feet and is planning to modernize it's quality control and inspection facilities. Another company has started an expansion program that will increase its capacity by 30 percent and improve the efficiency of its operations. Other companies are planning new plants or expansions but are holding them in abeyance pending positive changes in market outlook which would be favorable to the US bearing industry. All of these changes are intended to lower the cost of bearing manufacture through an improvement in production efficiency.

d. Several companies have negotiated wage and fringe benefit reductions with their unions. Reductions range between 15 and 20 percent. Labor costs for US bearing manufacturers are higher than the Japanese and Western European bearing manufacturers by as much as 40 percent, making them less competitive (See Table 13, Appendix D).

e. Companies are reducing other overhead costs by reducing field service, engineering and administrative staff, and research and development programs.

NOTE

These actions will have a negative impact on the companies by reducing their ability to respond to customer needs, and impair their future competitiveness through fewer new product developments.

f. Companies are moving many of their manufacturing operations to the Southern States where there are lower labor costs and the labor forces are nonunion.

g. Many of the bearing companies are implementing statistical process control programs (SPC) in their plants to improve bearing quality and reduce scrap rates. The extent of SPC in the bearing industry varies from a hand entry tracking method, to a fully computerized tracking system that is part of a totally integrated management control system.

h. A few companies are developing and implementing a fully integrated computerized management control system that will bring together all of their manufacturing operations and management functions.

i. Some bearing companies are currently importing foreign produced soft-turned bearings rings (unfinished) and semi-finished retainers in order to reduce costs and allow them to remain competitive against low cost foreign bearings.

The following list shows some of the parts that are currently being imported from overseas sources:

BEARING PART	PERCENTAGE IMPORTED	SOURCE
Ball/Rollers	1	Japan
Ball/Rollers	1	Germany
Ball/Rollers	5	Japan
Retainers	2	Japan
Retainers	2	Norway
Retainrs	60	Japan/Sweden
Forgings	1	France
Forgings	23	Japan/Sweden Germany/England

4. MATERIALS: The material costs confronting the US bearing manufacturers are higher than that of the Japanese and European bearing companies. One company reported that its material costs were 20 percent higher than the cost of Japanese material. Many US companies import foreign steel in order to remain competitive with foreign bearing companies. Their primary reasons for using foreign steel are availability, quality, and price.

AISI 52100 steel is the principal bearing material imported by the US bearing industry from overseas. Companies reported there were no domestic sources for vacuum degassed AISI 52100 steel used in the manufacture of bearing rings and balls. Vacuum degassed steel is used because of it's improved metallurgical qualities, and the resulting improvement in bearing life and performance. Vacuum degassed and specially drawn AISI 52100 ball wire is used in the manufacture of all bearing balls in the US. Domestic sources for this type of steel have disappeared due to the diminishing US bearing industry's reduced requirements.

Some bearing companies indicated a great amount of interest in refurbishing ball and roller bearings for the military.

Company officials felt any restriction or action by the US government which would increase the cost of foreign steel, the primary ingredient in bearings, would cause a

corresponding increase in the cost of domestically manufactured bearings, making them less competitive. Most of the companies indicated they would favor a national policy that would develop domestic sources for all materials used in the manufacture of ball and roller bearings. These companies are currently importing foreign steel to meet specific requirements of quality and/or price. The following table shows the current use of foreign steel by domestic bearing companies:

STEEL TYPE	PERCENTAGE OF USE
AISI 52100	6
AISI 52100	48
AISI 52100	3
AISI 52100	50
AISI 52100	26
AISI 440C	25
AISI 3310	95

5. GOVERNMENT PROGRAMS: Most of the companies were not familiar with government financial assistance programs such as IMIP (formally known as Tech Mod) that are intended to provide incentives for industrial modernization and product improvement and lower costs. Two companies are currently participating in this program and are enthusiastic about the results. The IMIP program is being used to develop a domestic source for noise quite bearings and eliminate US dependence on foreign bearings for a critical application. Four companies said that the IMIP (Tech Mod) program would help them modernize so they could effectively compete against foreign producers.

Some of the companies indicated they would be reluctant to participate in the IMIP program if they had to share all the technology they had gained during the development of the project with other US bearing companies. They did not feel that this kind of program would have any significant effect on their ability to regain competitiveness with foreign bearing companies.

The bearing companies were interested in acquiring new technology that would impact their manufacturing capabilities. Many of these technologies require extensive

development before they can be effectively utilized. The IMIP (Tech Mod) program would be an excellent vehicle to develop and implement these major improvements. Companies indicated an interest in the development of new technology involving the following processes:

TECHNOLOGY	NUMBER OF COMPANIES
CNC Grinders	9
Gaging:	7
Laser	
Non contact	
Eddy current	
In-process	
Hard Turning	6
Improved Inspection	4
Ceramic Fabrication	3
Ion Implementation	2
Powder Metallurgy	1
Heat Treatment	1
Raceway Honing	1
Robotic:	2
Deburring/polishing	
Assemply	
Flexible Manufacturing	2

6. REFURBISHMENT OF MILITARY BEARINGS: Many of the bearing companies indicated a considerable interest in refurbishing ball and roller bearings for the military. They indicated bearing refurbishment could easily be accomplished because of their extensive bearing manufacturing knowledge and experience. One company official said they could start immediately on refurbishing roller bearings since the company had unused capacity that could be utilized for this effort. Several companies indicated they would like to be involved in bearing refurbishment but would require one to one and a half years to get ready. Most bearing companies indicated they would establish separate facilities away from the new bearing manufacturing lines to perform the task.

Two companies indicated they would perform the work in the same manner the government rework facilities do. They would perform both the more limited, lower cost, Level II "Refurbishment", and the in-depth, Level IV "Remanufacture" procedure. Some companies would be willing to rework another manufactuer's bearings, while others expressed reluctance to try to rework bearings other than their own, due to different designs and internal configurations.

7. RATIONALIZATION: Some of the bearing companies suggested the US bearing industry should rationalize production in a manner similar to the Japanese. The effect of rationalization among US companies would be to maximize production runs, lowering production costs, and ultimately would result in US bearings becoming more competitive with foreign bearings. US bearing companies realize this cannot be attempted without major revisions to existing anti-trust laws. Other company officials took the position that rationalization might work if anti-trust laws were changed, and an umbrella organization was established to oversee its implementation.

8. RECOMMENDED GOVERNMENT ACTIONS: Not all of the bearing companies had the same view of what it would take to preserve or protect the US bearing industry, and make it more competitive, however, there was a concensus on many actions. This section contains recommendations made by the companies. The following recommendations were endorsed by all of the companies visited:

a. The government should implement a procurement regulation that would require the purchase of domestically manufactured bearings for all military applications.

NOTE

They indicated the regulation must apply to all bearings and not just to superprecision bearings.

b. The federal government should vigorously pursue improving timely enforcement of its existing trade regulations and laws, including anti-dumping actions. New regulations should be enacted to provide more deterents and to prevent violations.

c. The government should improve it's procurement practices by:

(1) providing the bearing industry with accurate forecasts of military bearing requirements,

(2) allowing scheduled deliveries during the life of the contract,

(3) ordering economic lot sizes.

d. The government should restrain/restrict the transfer of bearing related technology overseas through offset and licensing agreements.

The following recommended government actions were endorsed by many of the bearing companies. The government should:

a. Provide the bearing industry with low interest loans for capital investments in new equipment and plant modernization.

b. Provide the bearing industry with tax credits with accelerated write-offs to be used for capital investments in plant modernization and new equipment.

c. Establish and enforce quotas on imported bearings from Japan, other Far East countries, and Eastern Block countries to prevent unfair market control and further erosion of the US bearing industry.

d. Place tariffs on imported bearings similar to that enacted by the European Economic Community in June of 1985 against Japanese bearing companies, to prevent loss of the US bearing markets and eventual destruction of the US bearing industry.

e. Exclude bearing quality specialty steel from any new restrictions (tariffs and quotas) on imported steels to preclude higher costs that would be reflected in higher US bearing prices.

The following recommendations were endorsed by some of the bearing companies. The government should:

a. Change the anti-trust laws to allow the US bearing industry to rationalize product lines.

b. Establish and implement a national plan to develop domestic production sources for all materials used in the manufacture of ball and roller bearings.

c. Increase the use of IMIP to help the domestic bearing industry modernize and become more efficient and cost effective.

d. Reduce the number of plant audits that are conducted by the different OEMs and government agencies, by consolidating the audits under the jurisdiction of a common agency.

ORIGINAL EQUIPMENT MANUFACTURERS

One Canadian and eight US based Original Equipment Manufacturers (OEMs) responsed to a DOD/DOC questionnaire on shipments of defense and civilian superprecision bearings. In addition, responses included information on leadtimes for domestic and foreign produced bearings for defense, sole and single sourcing for bearings, foreign sourcing, and the companies' view of the domestic bearing industry. A list of respondents and a sample of the survey are included in Appendix B. The companies primarily produce gas turbine engines and gearboxes for use in airplanes, helicopters, tanks, and ships.

The superprecision bearings used by the OEMs range in size from 30mm to over ten inches in outside diameter. These bearings require special design characteristics and manufacturing techniques to enable the end product, into which they are incorporated, to operate in extreme environments, i.e. continous high speed and temperature. Because of the complexities involved in the manufacture of these bearings, production can take from 2½ to 48 weeks under normal circumstances.

The OEM's reported defense superprecision bearing receipts for 1983 and 1985 to be $40.7 and $46.1 million, respectively. This represents a 63.3 and 71.8 percent share of all precision bearings purchased by the eight US based companies surveyed (See Tables 17a-17d Appendix D). Stated in units for the same two years, superprecision bearings account for 48 and 51.7 percent of total bearings purchased by eight domestic OEMs. Of the total precision bearing shipments reported by bearing companies for defense purposes, these figures represent a 40.6 and 42.1 percent dollar share respectively. In units, these figures represent a 15.7 percent share for 1983 and a 22 percent share for 1985.

Eight companies responded to the survey and four of those firms were visited by teams from the Working Group. In every case, top management agreed that a viable domestic source of bearings is essential to the maintenance of our industrial base. A strong domestic source of supply assures that the necessary parts and components for production and maintenance capabilities are available during an emergency. The nation's defense industry depends on the domestic bearing industry for supply, since through 1985 use of foreign bearings by OEMs has been very limited. One company reported a substantial

delay in deliveries of a critical component from the United Kingdom during the Falklands crises, pointing out the high probability of interruption in supply from a foreign source.

In concert with this philosophy, the OEMs feel that maintaining the technology base of the domestic bearing industry is also important as they continue to utilize domestic sources for bearings. A domestic manufacturing capability is necessary to the continued technological advancement and product development of bearings. Company product engineers expressed their belief that engines of the future will operate at even faster speeds and higher temperatures. To keep pace with these trends, domestic bearing manufacturers must continue to devote resources to product research and development. One company official stated that most of the major product advances in the past ten years have been initiated by domestic producers. Foreign firms now appear to be devoting more resources to product development to the extent that the past ten years may not be indicative of the future. In spite of this, a strong domestic bearing industry is crucial to product development because of the ever increasing sophistication of engines.

The firms were asked if requirements for bearings could be reduced without sacrificing the performance of defense engine systems. In every case, firms responded that substitution of parts or reduction of specifications is not possible, especially for safety of flight. Additionally, as engines become more sophisticated, specifications will become even more stringent. All said tolerances and requirements are already relaxed as much as possible, and there are no requirements that could be relaxed for mobilization/surge conditions.

Interviews with engine company executives respecting the problems facing the US precision bearing manufacturers, showed a generally pessimistic outlook. The major problem areas which surfaced during discussions included increasing lead times, escalating prices, aging equipment, declining quality, qualification procedures, and stagnant product research and development. Some company executives mentioned the difficulties experienced by bearing companies which are part of a multi-layered conglomerate. As part of a conglomerate, a bearing company is only a small contributor to overall corporate revenues and as such is considered a relatively unimportant business segment. Since profits in bearing companies have been low, they have been unable to finance reinvestment as well as maintain research operations.

Although the OEMs are expanding their planned use of foreign produced bearings, they have noted several problem areas which have arisen as a result of doing business with foreign companies. These appear to be of minor significance but can lead to difficulties in execution of contracts. Differences in language can result in misinterpretation of some aspects of the contract or design specification. Because monetary settlements are made in one nation's currency, exchange rate fluctations can cause a loss of revenue to either party.

Leadtimes are becoming a significant problem in the precision bearing industry, especially when considering the sophistication of the product (See Table 9, Appendix D). OEMs reported that leadtimes by domestic precision bearing producers run from 28 to 74 weeks, while those of foreign producers are generally shorter, on the average of 46 weeks. The longest leadtime reported for a domestic supplier was 90 weeks, as compared to 48 weeks from a foreign supplier. Leadtimes reported by bearing companies ranged from 26 to 75 weeks, with the longest leadtime being 120 weeks. Four companies reported they experienced the longest leadtimes for the 52-100 mm bearings, while three companies reported the 30-52 mm size caused the longest leadtime. Two companies reported they had foreign sources supplying bearings, for which the leadtimes averaged 15 weeks less than equivalent bearing from domestic suppliers. Foreign bearing sources appear to be more responsive to the OEMs' needs. This fosters the trend to procure bearings from foreign sources.

Information was supplied by the gas turbine engine companies visited, indicating which foreign superprecision bearings will be used in the engines they produce. The information is displayed in the table below. The list is not all inclusive since it does not include all engine manufacturers. In addition, it does not include other manufacturers which use foreign bearings.

COMPANY	ENGINE	POSITION
RHP	PW400	#1 and 2 Mainshaft
FAG	PW2037	#3,4,5 Mainshaft
	PW4000	#2,3 Mainshaft
	9D	#2,4 Mainshaft; 7 Gearbox

	F100	#2.4 Mainshaft; 4 Gearbox
	TF30	#1 Mainshaft; 7 Gearbox
	TF33	#5 Mainshaft; 1 Gearbox
	F404	4 Mainstaft
	F110	2 Mainshaft; 13 Gearbox
SNFA	F409	1 Mainshaft
NTN	LM1600	Gearbox
	T700/CT700	50% of Mainshaft bearings
SNECMA	F108	4 Mainshaft; 13 Gearbox

Company officials reported that the price of super precision bearings in support of defense programs is increasing. This is another factor causing OEMs to seek alternate sources for bearings. Respondents who indicated they are in the process of qualifying foreign sources cited price as a primary factor. Other reasons included superior quality, shorter leadtime, and more sensitivity to the needs of the manufacturer. A foreign firm, FAG Kugelfisher Georg Schafer KG, has been approved as a source by six OEMs; a French firm, SNFA-SA, has been approved as a source by three OEM's

Most companies have a policy of retaining a domestic source of supply for precision bearings even if foreign sources are utilized, to ensure continuity, particularly in time of surge or mobilitzation. As noted above, a major trend to develop mulitiple sources, including foreign firms, is becoming widespread in the industry. Competition with other prime engine contractors to lower prices is also a driving force. Though the present policy is to maintain both a domestic source for precision bearings as well as a foreign supplier, some companies indicated that while a domestic source will be qualified, production orders may go only to a foreign supplier. They stated that the volume of business is not large enough to warrant having more than one active producer. Survey data reveals that the number of foreign sources has risen six-fold from two firms in 1980 to twelve firms by the end of 1985. Another 150 percent increase in foreign sourcing to a total of thirty firms is planned by 1990. The table below illustrates the increasing trend toward use of foreign sources.

CURRENT AND PROJECTED FOREIGN SOURCES FOR SUPERPRECISION BEARINGS AS REPORTED BY NINE SURVEYED ENGINE/TRANSMISSION FIRMS (FROM 1980 to 1990)

(number of qualified Foreign sources)

1980	1985	1986	1987	1990
2	12	18	23	30

NAMES OF FOREIGN COMPANIES CURRENTLY QUALIFIED AND THE NUMBER OF US FIRMS (OF THE NINE SURVEYED) THAT HAVE QUALIFIED THEM.

Name of Foreign Firm	Country	Number of US Firms Qualifying Them
F.A.G.	West Germany	6
S.N.F.A.	France	3
RHP	United Kingdom	2
NTN	Japan	2
Fafnir (UK)	United Kingdom	1
SNR	France	1

The OEMs felt that aging equipment in domestic bearing plants is a major factor contributing to declining quality and in the increasing reliance on foreign sources (See Table 12, Appendix D). Many foreign bearing companies have recently upgraded their equipment to embody the latest available technology. Aircraft engine company officials felt that an improvement in bearing production could be realized by implementing CNC machinery. This equipment could reduce the amount of matching and sorting of bearing parts necessary for a complete assembly. As equipment wears with age, more sorting and matching is required because it is more difficult to maintain tolerances. CNC machinery can be programmed to produce parts to tolerence consistently, reducing scrap, setup time, and overhead costs, leading to an improved competitive position.

As an indicator of OEM involvement with foreign businesses, the survey requested information on participation in joint ventures or other arrangements with foreign firms. Two companies reported agreements with foreign firms which impact the domestic industry. One company is part of a joint venture with a European producer of gearboxes which will have European bearings. Another has entered into a European co-production agreement for newly developed commercial engines. European sources will also provide specific precision engine bearings as well as gearbox bearings.

Of the recommendations mentioned below by the OEMs the major emphasis was directed toward issues protecting the bearing industry from foreign competition. During discussions with company executives, they all agreed trade restrictions could lead to increased prices for their products because of the use of more domestically produced bearings, which are currently much higher in price than foreign bearings. A FAR which would require that only domestic parts and components be used in defense products would cause their product price to rise. This would also affect foreign military sales as well as DOD prices. If the OEM's were allowed to purchase foreign produced superprecision bearings, prices for bearings would decrease. Some superprecision bearing prices charged by foreign producers were quoted to be $1500 less than the same bearing being produced by a domestic firm. One company executive estimated that on the average bearings represent approximately $20,000 for a $1,000,000 engine. A $1500 reduction in price can lead to a savings of $150,000 on sales of 100 engines.

Some of the OEM's believed that protecting the bearing industry could have a negative effect on modernization. Protectionism would benefit the bearing industry but perhaps create an atmosphere of complacency and foster less initiative to invest in state of the art equipment and improvements in production processes to stay competitive with their foreign counterparts. The OEM's felt any plan of this sort must include an incentive for self investment. There would have to be some consideration given to revision of the Competition in Contracting Act, since the price of domestically produced bearings would be less competitive.

The survey asked the OEM's to provide recommendations to help the bearing industry and the responses were many and varied. The following is a list of their recommendations.

1. Bearing manufacturers should make sizeable investments in state-of-the-art technology and capital equipment to keep up with foreign competitors. The government should allow more favorable investment tax credits to encourage and assist investment in modern equipment. This should include processing equipment which will improve productivity by automatic in-process inspection and sorting of parts. Other equipment should include computer controlled process machinery to assure parts are produced correctly during the production run. This would reduce scrap as well as improve matching and sorting. The bearing companies should implement the use of statistical process control to enhance productivity, reduce leadtimes and lower cost.

2. The bearing industry must increase expenditures for product research, development and quality improvement. The DOD could assist this effort by providing ancial incentives for all domestic research and development programs, which are expressly intended to retain or resume the lead in bearing technology. Cooperative product development would involve teams compromised of OEMs, bearing manufacturers, bearing material producers, grinding and inspection equipment manufacturers, surface treatment firms, and lubricant producers of aircraft turbine engines, gearboxes/transmissions, and auxiliary power units (APU). Consideration should be given to assigning security classifications to such programs and limiting dissemination of information and reports as deemed appropriate.

3. Review current NATO co-production contracts which require that a US weapons producers buy a percentage of materials and parts from member nations to maintain a viable domestic production base.

4. If anti-trust laws were relaxed with regard to bearing manufacturers, an industry produciton arrangement similar to what has occurred in the military jet engine industry could result. Rationalization of the bearing producers would result in a more stable industry, since the more viable producers would benefit from the effeciencies of larger production runs.

5. Instead of destroying bearings that are removed during routine maintenance, the government should maintain a stockpile of used bearings for use in an emergency. The refurbishment program would need to be expanded to include all bearings. Current

engines in the DOD inventory will need a supply of bearings for many years considering the current decisions for budget trimming and the DOD history of using weapon systems at least 10 years. These used bearings would be subject to limited use and be scheduled for removal after a certain period of time.

6. Stockpile bearings for mature weapon systems with the major portion of these bearings being stockpiled for weapon systems projected to remain in use for the longest period of time.

7. The federal government could enter into agreements with bearing producers to allow them to buy machine tools for the production of commercial high volume bearings but capable of producing superprecision bearing part. This would enhance surge capability and both the company and the government would benefit in the long run.

8. Encourage machine tool companies to develop machinery that will reduce setup time. Machinery centers capable of being computer programmed to machine different processes for different parts will enhance productivity, reduce inventory, reduce leadtimes and cut costs.

9. Undertake a more aggressive campaign to encourage the use of IMIP. This program could be used to encourage machine tool development for the industry. Also, increase funding in the program to allow broader use of the program. Other areas which would be beneficial to the bearing producers through IMIP are inspection, inspection automation, manufacturing process equipment, and manufacturing equipment improvement.

10. Urge the machine tool industry to be more sensistive to the needs of the bearing industry. Perhaps machines could be produced that would require less modification at the bearing producers plants. If machine tool companies and bearing producers are closely involved in development, better tool control, which would reduce the extent to which on-site tool modification would be necessary, would lead to improved productivity.

11. DOD should develop a forecast of requirements to enable the services as well as bearing producers to plan production operations for more efficient use of personnel and equipment.

STEEL MANUFACTURING AND FORGING COMPANIES

Production of bearing grade steel is generally a batch process. Steel manufacturers, in order to recognize the economies of facility utilization, will accumulate orders to schedule a minimum melt. This lends itself to producing for inventory against orders currently on the order book or, in some cases, an accepted history of customer requirements. A limiting factor in the production of bearing grade steel might include the availability of a raw material such as chrome. Current steel capacity exists in the industry to react favorably to increased requirements for bearing quality steel.

Some steel producers export bearing quality steel to offshore customers causing them concern over DOD plans requiring all bearings to be domestically produced. They feel some of their overseas customer deliveries might be suspended. Increased steel production in the early 1980's spurred capital investment in the industry, especially in the aircraft bearing grades. Steel production in some companies, especially the Carpenter Technology Corporation, undertook a $400M expansion based on increased volume. Currently, production of specialty steels peculiar to the precision and superprecision bearing industry is adequate and they have the ability to increase that capability. The grades necessary for the production of commercial bearings (not precision) have eroded to no domestic source due to foreign competition (aisi 52100VD). Some of the steel producers feel any protectionist measures taken to help the bearing industry would cause foreign competitors to simply turn capacity to non-protected areas and would cause more harm than good. Protectionist measures should be directed at encouraging development of new technology and maintaining that technology in the US. Steel producers feel that current laws against dumping are not enforced in the US.

While only one forging company was visited and three surveyed, it was felt the company visited was representative of the industry. The company has realized a 30 percent loss in sales over the past few years due to the effects of foreign competition. There was no observable recent capital investment in the plant. The company would prefer to not have to compete for defense related business. The plant is currently working at approximately 65 percent capacity, company officials estimate their surge or mobilization capability at 40 percent more than current production.

They maintain only a two month supply of steel in inventory, which would be a limiting factor in surge or mobilization.

MACHINE TOOL COMPANIES

Questionnaires were sent to selected machine tool manufacturers concerning the use of domestic and foreign bearings in domestically produced machine tool equipment. Two companies responded to the survey and a summary of their combined replies are provided.

The combined annual usage of precision bearings by the two companies surveyed amounted to $1,175,000. Most of these bearings were supplied by seven domestic bearing manufacturers.

Foreign bearings amount to between 4.2 and 15 percent of the total bearing requirements for machine tools and their use is increasing due to lower prices and shorter leadtimes as compared to domestic bearings. Most foreign bearings used for machine tools are supplied by the domestic bearing manufacturers acting as the middleman. Often foreign bearings are used instead of domestic bearings because of superior state-of-the-art technology, although the manufacturers want to maintain domestic sources in the event foreign supplies are interrupted.

The machine tool manufacturers believed the primary reason that US bearing companies are not competitive is their higher cost. Less productive manufacturing equipment as well as higher labor and inventory costs all contribute to this higher cost. Most foreign bearing companies are government subsidized which is another reason for lower prices.

Machine tool manufacturers provided recommendations on how the government could help the domestic bearing industry. These include:

1. Provide an economic stimulus in the form of investment capital for new plants, equipment, and more research and development.

2. Ensure that foreign bearing sources do not dump their products in the US market.

3. The government should provide the bearing companies adequate protection against unfair foreign competition through establishment of quotas and other import restrictions.

4. Issue a government procurement regulation requiring the purchase of domestic bearings for military applications. They realize this would increase the cost of the bearings they purchase and these added costs would be passed on by them in the form of higher prices for their machine tools.

Recommended actions be taken to make the US bearing manufacturers more competitive and responsive to the machine tool manufacturers needs include:

1. The bearing companies should modernize their plants and equipment.

2. The bearing companies should improve the productivity of their labor force through training and installation of modern machine tools.

3. The bearing companies should maintain an adequate inventory of precision bearings for sale to customers.

4. The bearing companies should increase their research and development programs, and possibly develop joint research programs with the machine tool industry.

5. The machine tool builders could attempt to standardize ball, screw, spindle, and other applications for bearings. This would reduce the number of bearing variations used in machine tools, resulting in larger bearing lot sizes which would increase the efficiency of bearing production.

GOVERNMENT PROGRAMS

Department of Defense programs are available to aid manufacturers in maintaining production capabilities. These include Title III of the Defense Production Act (DPA) of 1950, the Industrial Modernization Incentives Program (IMIP), Bearing Refurbishment (Rework) by manufacturers or contractors, and the Competition in Contracting Act (CICA) which offers opportunities for domestic competition.

TITLE III DEFENSE PRODUCTION ACT

One of the specific goals of the Defense Production Act is to provide financial assistance for expansion of productive capability to facilitate the production of goods and services necessary for national security. Title III of the Defense Production Act of 1950 contains provisions for assistance programs. One provision, purchase commitments, is already in use; others should be evaluated for their effectiveness in upgrading the bearing industry to capacity production in the event of surge or mobilization. Title III of the Act addresses expansion and supply, allowing the President to make provisions for loans to private business for the expansion of capacity, the development of processes or the production of essential material for defense. The Act states in SEC 303. (a) "...the President may make provisions for purchases of or commitment to purchase ...materials, for government use..." and in SEC 303 (e) "When in his judgment it will aid the national defense the President is authorized to install Government owned equipment in plants, factories, and other industrial facilities owned by private persons."

As indicated above the act makes funding possible for a variety of applications. Congress has limited DOD to only allow purchase commitments, however purchase commitments yield the most obvious return on investment, as hard goods are received for monies expended. Investments made through the other sections of the act are not as easy to justify by this criteria. It is precisely in the other areas that the greatest help to the bearing industry could be rendered.

Utilization of these alternate Title III provisions would help ensure the maintenance of a viable domestic industrial base for bearings. Purchase commitments are not enough of an investment to cure the problems of this industry in the long run. Loans for plant

modernization and capacity expansion would allow domestic bearing manufacturers to compete with foreign producers on a more equal footing. If the government were to furnish the means to acquire state-of-the-art equipment to manufacturers as well, it would provide the impetus for the industry to turn around its downward trend and begin to rebuild itself on a solid footing.

The Defense Production Act is due to expire at the end of this fiscal year. It has been extended before, but only as a temporary measure. As the bill is over thirty years old it is recommended that a complete examination of the existing provisions be undertaken. A strong commitment must be affirmed to the preservation of a healthy and strong domestic industrial base and full support must be given to it.

INDUSTRIAL MODERNIZATION INCENTIVES PROGRAM

Another government program that has direct application to the US bearing industry is the Industrial Modernization Incentives Program (IMIP), formerly called Tech Mod. This program was developed to provide financial assistance to specific companies that have been selected by the DOD to improve efficiencies of operation and reduce costs, thereby providing the DOD with an improved product at a lower price. Typical technologies to be included are: improved materials and materials processing; innovative machining and manufacturing techniques; and innovative inspection techniques.

The objective of the aircraft IMIP program is to "establish integrated, efficient, modernized production facilities capable of producing components for military systems at substantial validated cost savings". The IMIP program consists of three separate Phases:

Phase I: Factory Analyses and Conceptual Solutions: Focus on advanced manufacturing technologies, contemporary equipment, quality assurance, management information systems, and advanced materials.

Phase II: Technology Demonstration: This phase will establish detailed work center designs; establish and validate necessary enabling technology; develop and demonstrate the cost-reducing improvements to systems, equipment

or processes; and result in detailed implementation plans and cost-benefit analyses. Development of the required technology will be performed as required to obtain the necessary expertise.

Phase III: Implementation: The lead contractor and the team member bearing companies will integrate the results of Phase II into production.

There are currently two bearing companies participating in IMIP.

1. The San Antonio Air Logistics Center at Kelly Air Force Base currently has an IMIP project with the Fafnir Bearing Division of Torrington Bearing Company. This two year project involved the expenditure of $2,000,000 of Air Force funds that were matched by Fafnir funds. This project is directed at improving the manufacturing operations at Fafnir's New Britain, CT plant by developing the cellular concept of manufacture. Fafnir is currently in Phase II of the project.

2. TRW Bearings has completed a Phase I tasking at a cost of $500,000 to review their overall manufacturing operations. This has led to a Phase II contract.

The Aeronautical Systems Division of Air Force Systems Command (AFSC) at Wright-Patterson Air Force Base is currently developing a larger IMIP project with the aircraft engine bearing industry. This project is intended to address a large segment of the bearing industry and will also include some of the prime engine manufacturers to keep them actively involved in the program. It is anticipated that Phase I of the AFSC bearing industry IMIP will be contracted by early summer 1986.

Some of the bearing companies that were visited were unaware of IMIP but showed interest in participating in the program. Some of the companies indicated a reluctance to participate if the developed technology, including what they considered proprietary, had to be shared with other bearing companies. One company felt that the two year experience gained during the conduct of the project gave them a sufficient advantage to offset the data exchange.

The IMIP is a good example of a way the government can assist the bearing industry to help itself. The government funds are small compared to the matching bearing company

funds that would be required to complete and implement the technology developed during the program. It is the conclusion of this study group that additional funds should be allocated for this type of program for use in helping the US bearing industry modernize and become more competitive with foreign bearings.

BEARING REFURBISHMENT

Manufacturer or contractor refurbishment of bearings has been considered as a method to utilize available industry capacity. However, as discussed below, rework of used bearings means fewer purchases of new bearings. The military services are actively involved in Level II refurbishment (Refurbishment levels are defined in Exhibit 2) of aviation bearings. This program was initiated as a result of a Joint Technical Coordinating Group report dated 29 August 1984. The study showed the dollar value of refurbishing used bearings that had been rejected for cause, and returning them to an RFI (ready for issue) condition.

EXHIBIT 2
DEFINITIONS OF LEVELS OF BEARING REWORK

The following standardized definitions have been adopted by the military services to describe the various levels of bearing rework performed by/for the DOD.

Level I: Processing: Cleaning, minor metal cleanup of nonactive surfaces, visual and dimensional inspection, and lubrication.

Level II: Refurbishment: All of the Level I operations and the following additional operations:

1. Interchange of components of the same part number and manufacturer
2. Replace rolling elements
3. Repair/replace retainer
4. Grind and replate oversize/undersize mounting surfaces
5. Hone raceways of the inner/outer rings

Level III: Regrind: All of the Level I operations and the following additional operations:

1. Grind the raceways of the inner and outer rings
2. Design and manufacture a new retainer
3. Manufacture new oversize rolling elements

Level IV: Remanufacture: All of Levels I and II operations and the following additional operations:

1. Save the most expensive ring and hone the raceways as necessary
2. Manufacture new rolling elements, retainer, and inner ring

NOTE

Level IV maintains all of the original internal and external dimensions and operating parameters of the manufacturer.

The Services are currently establishing this bearing rework capability at three separate sites: 1. Navy: Naval Rework Facility North Island; 2. Army: Corpus Christi Army Depot; and 3. Air Force: Tinker Air Force Base.

The primary purposes of the bearing rework program is to save money and to provide an alternate source for critical bearings used in aeronautical applications. The monetary savings accrue as a result of rework costs that are significantly less than the replacement cost for new bearings.

The Services are currently involved in a JLC Joint Bearing Repair Group effort to increase the reuse of precision bearings by refurbishing them on a large scale at the three Service facilities. This potentially includes up to 43,000 bearings annually over $150 for 1500 different stock numbers. The number of bearings being removed from the new procurement requirements being bought by the Services from the bearing companies, would take a significant percentage of their already diminishing business.

Since the US bearing companies have already been affected by reduced sales due to loss of market share, the additional loss of sales due to increased reuse of high cost precision bearings by the military would also negatively impact the industry. If the military fully implements a bearing refurbishment program, it is anticipated that a total of 43,000 used bearings could be reworked and returned to service. This means that 43,000 bearings would not be procured from US companies at an estimated loss in sales to the industry of $28,374,000.

Many of the bearing companies that were visited showed considerable interest in reworking bearings for the military. In general, the companies were prepared to either begin reworking bearings at once, or were willing to establish special facilities to begin operations within 1 to 1½ years. As bearing manufacturers, the general feeling was that they were in the best position to rework bearings since they could manufacture replacement parts when required. Some of the companies had unused capacity that the rework program could use. Most of the companies said they would want to separate the rework and the new manufacturing functions. This would be done by separating their existing facilities, or by building new facilities.

The following policies/procedures were presented by most of the companies interested in reworking bearings for the military:

1. Use/save the most expensive ring, usually the outer ring. (This is a Level IV Remanufacturing bearing rework procedure per service definition)
2. Manufacture new inner ring, retainer and rolling elements.
3. Maintain all the original external and internal dimensions and parameters.
4. Guarantee the reworked bearing same as new.
*5. Rework any manufacturer's bearings.

*NOTE

Some companies would not rework another manufacturer's bearings due to widely differing internal configurations and the need to do reverse engineering.

There would have to be an assurance of an adequate market before many of the companies would become interested in expending their own funds, to develop the capability. However, there was one company that was willing to begin reworking bearings immediately to fill its unused capacity.

Most of the bearing companies were only interested in performing Level IV Remanufacturing, which is the highest cost approved bearing rework procedure. The service's bearing refurbishment program involves Level II, which is a lower cost, limited rework procedure, involving honing of the raceways, replacement of the rolling elements, and the repair/replacement of the retainer. Two bearing companies were very interested in performing Level II refurbishment in conjunction with Level IV Remanufacture.

The military's plan to fully implement its bearing refurbishing program would be detrimental to an already threatened bearing industry. If the bearing industry is willing and able to accomplish the necessary bearing rework functions, the services should utilize bearing company facilities. The military's bearing rework program was established to save a significant amount of money, and to develop an organic capability to be able to rework bearings in emergency situations. The service's capability could be maintained by limiting their bearing rework to emergency and/or extreme shortage situations, while utilizing the bearing manufacturers for the normal/high volume rework function.

COMPETITION IN CONTRACTING ACT

The Competition in Contracting Act (CICA) requires full and open competitive bidding and award to the lowest bidder. The Act has often been cited as a detriment to the preservation of our domestic industrial base. The emphasis on the lowest cost component or system has often allowed foreign vendors to gain the upper hand in defense procurements. This does not have to be the case. Competition can be encouraged but limited to domestic manufacturers. The act allows for seven exemptions to full and open competition and Exception 3, limits production to the industrial base to ensure its maintenance. Once the exception is invoked all subcontracts and vendors are also limited to domestic sources. This requires time and energy as well as money to be accomplished but is a workable and existing solution to maintaining domestic sources and capabilities.

CONCLUSIONS

Task 1

- A strong US bearing industry is needed to support a strong industrial base.
- A strong US bearing industry is critical to our national defense.
- Precision and superprecision bearings are used in many critical weapon systems.
- A strong commercial/commodity production base is needed to support the DOD bearing segment of the market.
- DOD bearing requirements alone are insufficient to support the bearing industry and ensure its survival.

Task 2

- The US bearing manufacturers are losing their commercial market share to foreign bearing suppliers.
- The US bearing industry is losing production capacity and capability.

Task 3

- The DOD does not currently have the capability to readily forecast bearing requirements, and needs to investigate the development of a capability for internal use and to provide a consolidated forecast of bearing requirements to the bearing industry for investment planning purposes.

Task 4

- There is an increasing use of foreign bearings in military applications.
- There is an increasing use of foreign superpresicion bearings by the OEMs for military and commercial applications.

Task 5

- Dependence on foreign bearings in DOD weapon systems leads to difficulties in planning for surge and mobilization.
- Dependence on foreign bearing may lead to major disruptions in supply during periods of conflict or other unplanned emergencies.
- Shortages of domestic bearings that could be used to replace the foreign bearings used in critical weapon systems will occur if supplies of foreign bearings are interrupted.

- Replacement of lost or diminished manufacturing capability would require leadtimes of several years.
- Foreign bearing sources cannot be regulated or controlled by the US government to meet urgent requirements.

Task 6

- A government procurement regulation requiring the use of domestic bearings for military applications will:

1. Have to be applied to all bearings used in military applications.
2. Help ensure domestic sources for military applications.
3. Contribute to the survival of the US bearing industry.
4. Not ensure the survival of the bearing industry as a whole.
5. Possibly contribute to complacency on the part of the bearing industry.
6. Not address all of the problems facing the US bearing industry.
7. Not prevent foreign manufacturers from dominating the commercial market.

Summary of Conclusions

1. The bearing industry needs to invest more capital in new plants and equipment to become more competitive with foreign manufacturers. The bearing industry must invest more money in research and development projects to stay competitive with foreign manufacturers.
2. Government assistance programs such as IMIP and Title III, if adequately funded could help the bearing industry modernize and become more competitive.
3. There are trade related problems facing the bearing industry that can only be addressed through enforcement and/or changes in US trade laws and regulations.
4. There is a need for a national policy to develop and maintain a domestic capability to produce all materials and parts necessary for the manufacture of bearings.
5. There is a need to establish an interagency group to address trade and economic issues such as: dumping, tariffs, quotas; and tax incentives and low interest loans for plant and equipment modernization. This panel should consist of experts in the areas of trade and economic policy, federal procurement policy, and international relations.

Options and Expected Results

Option 1. Do nothing.

The US bearing industry will continue to deteriorate and become less competitive, leading to more plant closures and lost capabilities. Survival of the industry would be in question and its ability to support military requirements in jeopardy.

Option 2. Issue a FAR to restrict military procurements to domestic bearings.

The US bearing industry will decline as a whole, while the military segment remains relatively stable. The military segment will be threatened when the commercial market is sufficiently eroded to destroy a viable production base.

Option 3. Issue a FAR as above, and implement additional economic and trade related solutions.

The US bearing industry would be given the time and the resources to regain it's production viability and competitiveness. This would ensure the continued presence of a strong domestic industrial manufacturing base that could supply all of the critical military requirements and essential commercial requirements for any eventuality.

RECOMMENDATIONS

The following recommendations have been developed by the Working Group to address the problems and issues that are now facing the US bearing industry. They are intended to: (1) provide solutions that can be immediately applied to the problems that must be solved to prevent the further erosion of the bearing industry: and (2) propose solutions to resolve the long term issues that must be resolved to ensure the survival and the continued viability of the bearing industry.

SHORT TERM These recommendations can be initiated by the DOD and will provide immediate relief to the bearing industry.

1. Supplement existing FAR to require for new designs for all defense applications, purchase of only domestically manufactured bearings (should not apply to existing design applications not currently available from domestic producers). Exceptions and waivers will be provided based on existing agreements (foreign government) within the best interest of the Federal Government. However, the intent is to provide domestic manufacturers the opportunity to develop capability to produce all defense bearings.

a. The regulation would apply to all DOD direct and indirect (contractor, OEMs, etc.) purchases of all types of ball (including spherical monoball), roller bearings, airframe and aircraft control bearings.

b. All of these bearing and bearing parts shall be manufactured in the US (within the definition of domestic end product as specified by FAR).

c. No unfinished or semi-finished foreign parts will be used in the manufacture of bearings for the DOD.

d. The FAR should be in effect for a limited period of time, at least five years. This would allow the bearing industry time to dedicate a portion of profits gained during this period toward modernization of facilities and equipment, and work force training programs.

2. The DOD should adequately fund industry modernization programs above current program levels as a means to provide incentive for the bearing industry to modernize equipment and facilities. DOD should also encourage development of new technology and processing equipment, that will improve the quality and ultimately the competitiveness of US bearings. OSD should consolidate its efforts in this area to establish a continued effort toward modernizing production capabilities.

3. The DOD should explore utilizing Title III of the Defense Production Act to assist the bearing industry to expand bearing capacity where inadequate.

4. The DOD should investigate industry needs for projecting bearing requirements, and the Services/Agencies develop the capability to provide this forecast.

5. The DOD should work with industry to determine the extent of bearing refurbishment. It should decide both DOD and commercial shares of bearing rework. The DOD's capacity should be directed toward urgent requirements and surge conditions.

6. The DOD should restrain the transfer of important bearing related technology that occurs through licensing agreements, by limiting the number of these agreements. Each agreement causes a loss of US technology as well as lost production opportunity.

LONG TERM

There is an urgent need to address the underlying issues that are causing the deterioration and erosion of the US bearing industry. These fundamental problems should be addressed by the establishment of a panel chaired by the Department of Commerce that can focus on trade and economic issues, and will help develop a fully coordinated national policy. This panel should consist of experts in trade and economic policies, federal procurement policies, and international relations. The panel would address areas such as:

Trade Issues:

1. Consider limiting bearing imports temporarily, combined with domestic producer plans for facility modernization and workforce training programs. This would allow a limited time period for the industry to expand market share and increase profits. Concurrently, through Government/Industry agreements, a minimum portion of these profits would be dedicated for plant and equipment modernization.

2. Evaluate industry concerns regarding existing anti-dumping regulations and evaluate their ability to discourage dumping and unfair trade practices. Consideration should be given to implementing actions that would control the "unfair" trade penetration (predatory pricing and cartels) of foreign bearings in the US bearing market.

3. Review industry concerns regarding existing anti-trust laws as they affect the bearing industry. Investigate a temporary exemption from anti-trust laws to allow industry the opportunity to consolidate bearing lines and rationalize production. Major foreign markets have already allowed this process to occur and have realized production and competitive efficiencies.

4. Analyze current US and foreign tariffs and quotas on bearing parts, components, and steel. This will encourage domestic subtier suppliers to reestablish manufacturing capacity to support the increased demand for bearing parts, components and specialty steels.

Economic Issues:

1. Evaluate the need and benefit of low interest loans to the bearing industry that would help obtain the necessary capital to build new plants and purchase new equipment. There is an urgent need for the aging bearing industry to modernize and become more competitive in the domestic and world markets, and to improve the quality of the product.

2. Evaluate the need and benefit of establishing an investment tax credit program for the domestic bearing industry that would help modernize plants and purchase new CNC equipment that is needed to become more efficient and improve the quality of bearings.

If approved, the tax credits, should be invested in new equipment and plant modernization and provisions should be provided to monitor this activity.

3. Evaluate the benefits of reducing the inventory tax on bearings and bearing parts and the positive effect this could have on the bearing industry.

Materials:

Evaluate the benefit of developing a national plan that would establish domestic production capability for all materials and parts used in the manufacture of bearings. This includes the currently imported specialty steel that is used in the manufacture of bearing and bearing balls and includes retainer materials sourced from foreign suppliers.

APPENDIX B

COMPANIES SURVEYED

OEM's

*GE - Lynn, MA

*GE - Evandale, OH

*PW - Hartford, CT

*Sikorsky - Stratford, CT

Allison - Indianapolis, IN

Allied Bendix - Utica, NY

*Avco Lycoming - Stratford, CT

Aircraft Gear - Chicago, IL

*Sunstrand Turbo Mach, San Diego, CA

PW, Canada

BEARINGS

*SBB- Lebanon, NH

MPB - Keene, NH

*Fafnir - New Britain, CT

*TRW/MRC - Jamestown, NY

*Kaydon - Muskegon, MI

*NHBB - Peteborough, NY

*Timken - Canton, OH

*SKF - Phila, PA

*New Departure, Sandusky, OH

Rollway - Syracuse, NY

Barden - Danbury, CT

STEEL

*Timken - Canton, OH

*Carpenter Tech, Reading, PA

*Latrobe - Latrobe, PA

MACHINE TOOL

Cincinnati Milacron, Cincinnati, OH

FORGINGS

*Specialty Ring, Ben Salem, PA

*Companies Visited

APPENDIX A

JBWG MEMBERS

LT COL J. MELVIN GILLESPIE II	HQ AFLC/XRPD US AIR FORCE
MAJOR TERRY GOWER	HQ AFLC/XRPD US AIR FORCE
MR MARTIN J. GARSHAK	HQ AFLC/XRPD US AIR FORCE
MS JOICE SCHERER	HQ AFLC/XRPA US AIR FORCE
MR GREGORY B. MCGATH	AFSC/PLMM US AIR FORCE
MR CALVIN W. MCDONALD	JDMAG/MAW US AIR FORCE
MR AUGUST PRITZLAFF	AMXIB-IA US ARMY
MR DAVID STANLEY	NAVAL AIR REWORK FACILITY NORTH ISLAND 34100 US NAVY
MR MICHAEL D. MEAD	NAVAIRSYSCOM 536A1 US NAVY
MR EDWARD PURCELL	NAVAIR 51411 US NAVY
MR MICHAEL A. WHITMORE	NAVSEA 907 US NAVY
MR EDWARD GRAHAM	DISC-PRI DEFENSE LOGISTICS AGENCY
MR BRAD BOTWIN	ITA/OIRA US DEPARTMENT OF COMMERCE
MR JOHN TUCKER	ITA/OIRA US DEPARTMENT OF COMMERCE
MR WILLIAM E. FLETCHER	ITA/CAPITAL GOODS AND INTERNATIONAL CONSTRUCTION US DEPARTMENT OF COMMERCE
MS CARLA SPRINGER	OFFICE OF INDUSTRY/MACHINERY AND EQUIPMENT US INTERNATIONAL TRADE COMMISSION

APPENDIX C

LETTERS AND CONGRESSIONAL RECORD EXCERPT

THE DEPUTY SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

29 NOV 1985

MEMORANDUM FOR JOINT LOGISTICS COMMANDERS

SUBJECT: Criticality of the Ball Bearing Industry

I am concerned about maintaining a domestic industrial base to supply critical bearings for our weapon systems. The bearing industry has been identified by the Air Force as a critical component technology that is necessary to ensure continued strength of the U.S. aerospace industrial base. There has been congressional concern expressed over government policies for procurement of ball bearings and how they affect the domestic industry. Specific questions have addressed the Department of Defense (DoD) procurements of bearings for the T700 and F404 aircraft engines.

I have been advised by my staff that the Joint Logistics Commanders have under charter a policy coordinating group entitled Joint Bearings Repair Group (JBRG), which has already done work with aviation bearings. My staff has approached the JBRG about the feasibility of a further assessment of the bearing industry for a better understanding of defense-wide requirements. Favorable interest was expressed in doing such a study.

I would like for you to undertake a study of this industry, with particular emphasis on 30mm and larger bearings to assess fully its importance to the defense posture. As part of this review, please determine bearing requirements for DoD and commercial use, industry capacities, impact of bearing imports on national security in surge and mobilization environments, and other factors affecting this industry. I hope that your assessment will show viable alternatives for keeping the domestic bearing industry competitive so that we can maintain this critical portion of our industrial base. I would like for you to complete this effort by June 1986.

William H. Taft, IV

FROM: House of Representatives Report 99-332, 24 Oct 85

SOURCES OF BALL BEARINGS

High precision ball bearings are a necessity in the manufacture of jet engines and other high technology devices. The Committee is concerned over availability of ball bearings, and over the possible use of ball bearings of foreign manufacture in critical weapons systems and components. The Committee directs the Department to study and report not later than June 30, 1986 on this subject. The report is to include: an assessment of the criticality of the ball bearing industry to national defense; an assessment of the current strength and long term economic viablity of the U.S. ball bearing industry; an analysis of the extent to which ball bearings of foreign manufacture are used in weapons systems and components procured by DOD; an assessment of the implications for readiness and sustainability of using ball bearings of foreign manufacture; and,

Atch 2

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY MATERIEL COMMAND
5001 EISENHOWER AVE., ALEXANDRIA, VA 22333-0001

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE LOGISTICS COMMAND
WRIGHT-PATTERSON AFB, OHIO 45433-5001

DEPARTMENT OF THE NAVY
DEPUTY CHIEF OF NAVAL OPERATIONS (LOGISTICS)
WASHINGTON, DC 20350-2000

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE SYSTEMS COMMAND
ANDREWS AFB, WASHINGTON, DC 20334-5000

SUBJECT: Criticality of the Ball Bearing Industry

Honorable William H. Taft, IV
Deputy Secretary of Defense
Department of Defense
Washington, DC 20301

The JLC are in receipt of your letter of 29 November 1985 in regards to the domestic ball bearing industry. We share your concern and will proceed with the study effort.

RICHARD H. THOMPSON
General, USA
Commander
U.S. Army Materiel Command

T. J. HUGHES
Vice Admiral, USN
Deputy Chief of Naval Operations
(Logistics)

EARL T. O'LOUGHLIN
General, USAF
Commander
Air Force Logistics Command

LAWRENCE A. SKANTZE
General, USAF
Commander
Air Force Systems Command

DATE: 12 December 1985

Atch 3

APPENDIX D

STATISTICAL DATA

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Table 1. Unit Shipments of Ball and Roller Bearings by Size and Grade for Non-Defense and Defense Applications as Reported by Eleven Firms

	Non-Defense Shipments, Units (000s)				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm(1+)	13920.6	10290.6	9512.4	10689.5	9494.1
30mm+(1 & 3)	76488.3	56985.7	64048.3	73704.9	61120.1
Super Precision					
30-52mm(5+)	414.9	438.9	368.2	410.0	469.1
52-100mm(5+)	398.0	303.3	258.4	286.5	270.2
100mm+(5+)	76.3	54.3	49.7	58.1	57.6
Tot.SuperPrec.	889.2	796.5	676.3	754.6	796.9
Total Ball	91298.1	68072.8	74237.0	85149.0	71411.1
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	177623.0	144078.6	178876.4	210244.2	194049.8
2" (1 & 3)	117865.5	92882.4	109443.3	128775.3	157311.8
Super Precision					
2-4" (5+)	62.8	43.7	31.1	35.6	29.7
4-6" (5+)	16.9	13.2	9.7	11.2	9.5
over 6" (5+)	6.9	7.8	5.9	5.0	6.9
Tot.SuperPrec.	86.6	64.7	46.7	51.8	46.1
Total Roller	295575.1	237025.7	288366.5	339071.3	351407.7
TOTAL	386873.2	305098.5	362603.4	424220.3	422818.8

	Defense Shipments, Units (000s)				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm(1+)	6639.3	5845.0	5029.6	5203.7	4219.9
30mm(1 & 3)	3115.8	2408.7	2215.7	2242.6	1957.2
Super Precision					
30-52mm(5+)	263.6	375.9	337.6	351.1	368.3
52-100mm(5+)	251.0	203.6	166.2	178.6	176.8
100mm+(5+)	85.6	43.6	39.6	39.2	42.4
Tot.SuperPrec.	600.2	623.1	543.4	568.9	587.5
Total Ball	10355.3	8876.8	7788.7	8015.2	6764.6
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	2140.2	1780.3	1875.7	1895.1	2185.4
2" (1 & 3)	7297.9	5396.4	5338.2	6606.2	6344.1
Super Precision					
2-4" (5+)	92.4	89.0	75.2	66.3	87.4
4-6" (5+)	33.2	33.5	29.1	23.7	26.1
over 6" (5+)	13.5	12.5	12.1	9.9	13.2
Tot.SuperPrec.	139.1	135.0	116.4	99.9	126.7
Total Roller	9577.2	7311.7	7330.3	8601.2	8656.2
TOTAL	19932.5	16188.5	15119.0	16616.4	15420.8

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Table 2. Dollar Shipments of Ball and Roller Bearings by Size and Grade for Non-Defense and Defense Applications as Reported by Eleven Firms

	Non-Defense Shipments, Dollars (000s)				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm(1+)	52771.0	48700.0	48508.0	55099.0	54650.0
30mm+(1 & 3)	455527.0	368494.0	365533.0	409835.0	345646.0
Super Precision					
30-52mm(5+)	13695.0	15443.0	14091.0	16386.0	17277.0
52-100mm(5+)	22999.0	18994.0	18513.0	19573.0	18313.0
100mm+(5+)	19359.0	14874.0	14761.0	17264.0	15821.0
Tot.SuperPrec.	$56,053.0	$49,311.0	$47,365.0	$53,223.0	$51,411.0
Total Ball	$564,351.0	$466,505.0	$461,406.0	$518,157.0	$451,707.0
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	163752.0	126181.0	147024.0	175447.0	177715.0
2" (1 & 3)	828930.0	611000.0	547113.0	687386.0	668118.0
Super Precision					
2-4" (5+)	9942.0	8320.0	7285.0	8203.0	7817.0
4-6" (5+)	6226.0	5957.0	5113.0	5964.0	5262.0
over 6"(5+)	5453.0	6177.0	6967.0	6423.0	7890.0
Tot.SuperPrec.	$21,621.0	$20,454.0	$19,365.0	$20,590.0	$20,969.0
Tot.Roller	$1,014,303.0	$757,635.0	$713,502.0	$883,423.0	$866,802.0
TOTAL	$1,578,654.0	$1,224,140.0	$1,174,908.0	$1,401,580.0	$1,318,509.0

	Defense Shipments, Dollars (000s)				
	1981	1982	1983	1984	1985
BALL BEARINGS					
0-30mm(1+)	35262.0	36203.0	35916.0	35291.0	30451.0
30mm(1 & 3)	26497.0	24546.0	25122.0	25465.0	22806.0
Super Precision					
30-52mm(5+)	10430.0	14007.0	12967.0	14461.0	14179.0
52-100mm(5+)	20511.0	22260.0	23449.0	28180.0	28106.0
100mm+(5+)	24399.0	19552.0	18275.0	19479.0	19308.0
Tot.SuperPrec.	$55,340.0	$55,819.0	$54,691.0	$62,120.0	$61,593.0
Total Ball	$117,099.0	$116,568.0	$115,729.0	$122,876.0	$114,850.0
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	15061.0	14985.0	13351.0	11293.0	13972.0
2" (1 & 3)	75769.0	57070.0	48429.0	75610.0	73355.0
Super Precision					
2-4" (5+)	13985.0	15759.0	16938.0	16082.0	18768.0
4-6" (5+)	12286.0	14389.0	13988.0	12629.0	13613.0
over 6" (5+)	9648.0	11780.0	14535.0	12828.0	15615.0
Tot.SuperPrec.	$35,919.0	$41,928.0	$45,461.0	$41,539.0	$47,996.0
Total Roller	$126,749.0	$113,983.0	$107,241.0	$128,442.0	$135,323.0
TOTAL	$243,848.0	$230,551.0	$222,970.0	$251,318.0	$250,173.0

Table 3. Unit Ratios Showing Changes in Non-Defense and Defense Shipments (1981=1)

	Non-Defense Shipments				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm (1+)	1.00	0.74	0.68	0.77	0.68
30mm+ (1 & 3)	1.00	0.75	0.84	0.96	0.80
Super Precision					
30-52mm (5+)	1.00	1.06	0.89	0.99	1.13
52-100mm (5+)	1.00	0.76	0.65	0.72	0.68
100mm+ (5+)	1.00	0.71	0.65	0.76	0.75
Tot. SuperPrec.	1.00	0.90	0.76	0.85	0.90
Total Ball	1.00	0.75	0.81	0.93	0.78
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	1.00	0.81	1.01	1.18	1.09
2" (1 & 3)	1.00	0.79	0.93	1.09	1.33
Super Precision					
2-4" (5+)	1.00	0.70	0.50	0.57	0.47
4-6" (5+)	1.00	0.78	0.57	0.66	0.56
over 6" (5+)	1.00	1.13	0.85	0.72	0.99
Tot. SuperPrec.	1.00	0.75	0.54	0.60	0.53
Total Roller	1.00	0.80	0.98	1.15	1.19
TOTAL	1.00	0.79	0.94	1.10	1.09

	Defense Shipments				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm (1+)	1.00	0.88	0.76	0.78	0.64
30mm (1 & 3)	1.00	0.77	0.71	0.72	0.63
Super Precision					
30-52mm (5+)	1.00	1.43	1.28	1.33	1.40
52-100mm (5+)	1.00	0.81	0.66	0.71	0.70
100mm+ (5+)	1.00	0.51	0.46	0.46	0.50
Tot. SuperPrec.	1.00	1.04	0.91	0.95	0.98
Total Ball	1.00	0.86	0.75	0.77	0.65
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	1.00	0.83	0.88	0.89	1.02
2" (1 & 3)	1.00	0.74	0.73	0.91	0.87
Super Precision					
2-4" (5+)	1.00	0.96	0.81	0.72	0.95
4-6" (5+)	1.00	1.01	0.88	0.71	0.79
over 6" (5+)	1.00	0.93	0.90	0.74	0.98
Tot. SuperPrec.	1.00	0.97	0.84	0.72	0.91
Total Roller	1.00	0.76	0.77	0.90	0.90
TOTAL	1.00	0.81	0.76	0.83	0.77

Table 4. Dollar Ratios Showing Changes in Non-Defense and Defense Shipments (1981=1)

	Non-Defense Shipments				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm (1+)	1.00	0.92	0.92	1.04	1.04
30mm+ (1 & 3)	1.00	0.81	0.80	0.90	0.76
Super Precision					
30-52mm (5+)	1.00	1.13	1.03	1.20	1.26
52-100mm (5+)	1.00	0.83	0.80	0.85	0.80
100mm+ (5+)	1.00	0.77	0.76	0.89	0.82
Tot.SuperPrec.	1.00	0.88	0.85	0.95	0.92
Total Ball	1.00	0.83	0.82	0.92	0.80
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	1.00	0.77	0.90	1.07	1.09
2" (1 & 3)	1.00	0.74	0.66	0.83	0.81
Super Precision					
2-4" (5+)	1.00	0.84	0.73	0.83	0.79
4-6" (5+)	1.00	0.96	0.82	0.96	0.85
over 6" (5+)	1.00	1.13	1.28	1.18	1.45
Tot.SuperPrec.	1.00	0.95	0.90	0.95	0.97
Tot.Roller	1.00	0.75	0.70	0.87	0.85
TOTAL	1.00	0.78	0.74	0.89	0.84

	Defense Shipments				
	1981	1982	1983	1984	1985
BALL BEARINGS					
0-30mm (1+)	1.00	1.03	1.02	1.00	0.86
30mm (1 & 3)	1.00	0.93	0.95	0.96	0.86
Super Precision					
30-52mm (5+)	1.00	1.34	1.24	1.39	1.36
52-100mm (5+)	1.00	1.09	1.14	1.37	1.37
100mm+ (5+)	1.00	0.80	0.75	0.80	0.79
Tot.SuperPrec.	1.00	1.01	0.99	1.12	1.11
Total Ball	1.00	1.00	0.99	1.05	0.98
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	1.00	0.99	0.89	0.75	0.93
2" (1 & 3)	1.00	0.75	0.64	1.00	0.97
Super Precision					
2-4" (5+)	1.00	1.13	1.21	1.15	1.34
4-6" (5+)	1.00	1.17	1.14	1.03	1.11
over 6" (5+)	1.00	1.22	1.51	1.33	1.62
Tot.SuperPrec.	1.00	1.17	1.27	1.16	1.34
Total Roller	1.00	0.90	0.85	1.01	1.07
TOTAL	1.00	0.95	0.91	1.03	1.03
Total Industry	1.00	0.80	0.77	0.91	0.86

Table 5. Unit and Dollar Defense Market Shares of Ball and Roller Bearings from 1981 to 1985, Reported by Eleven Firms (as percent of total shipments)

	(percent unit shares)				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm (1+)	32.29	36.22	34.59	32.74	30.77
30mm+ (1 & 3)	3.91	4.06	3.34	2.95	3.10
Super Precision					
30-52mm (5+)	38.85	46.13	47.83	46.13	43.98
52-100mm (5+)	38.67	40.17	39.14	38.40	39.55
100mm+ (5+)	52.87	44.55	44.37	40.25	42.40
Tot.SuperPrec.	40.30	43.89	44.55	42.98	42.44
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	1.19	1.22	1.04	0.89	1.11
2" (1 & 3)	5.83	5.49	4.65	4.88	3.88
Super Precision					
2-4" (5+)	59.54	67.07	70.74	65.06	74.64
4-6" (5+)	66.27	71.73	75.00	67.93	73.31
over 6" (5+)	65.98	61.43	67.06	66.44	65.84
Tot.SuperPrec.	61.97	67.02	70.92	65.91	72.56
Tot.Industry	4.90	5.04	4.00	3.77	3.52

	(percent dollar share)				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm (1+)	40.06	42.64	42.54	39.04	35.78
30mm+ (1 & 3)	5.50	6.25	6.43	5.85	6.19
Super Precision					
30-52mm (5+)	43.23	47.56	47.92	46.88	45.08
52-100mm (5+)	47.14	53.96	55.88	59.01	60.55
100mm+ (5+)	55.76	56.79	55.32	53.01	54.96
Tot.SuperPrec.	49.68	53.10	53.59	53.86	54.51
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	24.26	28.75	25.93	24.30	24.80
2" (1 & 3)	8.38	8.54	8.13	9.91	9.89
Super Precision					
2-4" (5+)	58.45	65.45	69.93	66.22	70.60
4-6" (5+)	66.37	70.72	73.23	67.92	72.12
over 6" (5+)	65.25	68.32	70.25	67.27	68.97
Tot.SuperPrec.	63.47	67.63	70.17	67.01	69.36
Tot.Industry	13.38	15.85	15.95	15.20	15.95

Table 6. Average Prices of Non-Defense and Defense Bearings by Size and Grade

(Non-Defense Average Prices)

	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm(1+)	3.79	4.73	5.10	5.15	5.76
30mm+(1 & 3)	5.96	6.47	5.71	5.56	5.66
Super Precision					
30-52mm(5+)	33.01	35.19	38.27	39.97	36.83
52-100mm(5+)	57.79	62.62	71.64	68.32	67.78
100mm+(5+)	253.69	273.97	297.12	296.94	274.67
Tot.SuperPrec.	63.04	61.91	70.04	70.53	64.51
Total Ball	6.18	6.85	6.22	6.09	6.33
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	0.92	0.88	0.82	0.83	0.92
2" (1 & 3)	7.03	6.58	5.00	5.34	4.25
Super Precision					
2-4" (5+)	158.31	190.39	234.24	230.42	263.20
4-6" (5+)	368.40	451.29	527.11	532.98	553.89
over 6"(5+)	785.73	788.89	1174.87	1284.34	1148.14
Total Roller	249.55	315.99	414.40	397.56	455.14
Total Roller	3.43	3.20	2.47	2.61	2.47
Tot. Non-Def.	4.08	4.01	3.24	3.30	3.12

(Defense Average Prices)

	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm(1+)	5.31	6.19	7.14	6.78	7.22
30mm(1 & 3)	8.50	10.19	11.34	11.36	11.65
Super Precision					
30-52mm(5+)	39.57	37.26	38.41	41.19	38.50
52-100mm(5+)	81.72	109.33	141.09	157.78	158.97
100mm+(5+)	285.07	448.34	461.26	497.42	455.38
Tot.SuperPrec.	92.20	89.58	100.64	109.20	104.84
Total Ball	11.31	13.13	14.86	15.33	16.98
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	7.04	8.42	7.12	5.96	6.39
2" (1 & 3)	10.38	10.58	9.07	11.45	11.56
Super Precision					
2-4" (5+)	151.35	177.07	225.24	242.56	214.74
4-6" (5+)	370.06	429.52	480.69	532.87	521.57
over 6" (5+)	716.79	944.67	1204.23	1295.89	1178.67
Tot.SuperPrec.	258.30	310.65	390.66	415.81	378.67
Total Roller	13.23	15.59	14.63	14.93	15.63
Total Defense	12.23	14.24	14.75	15.12	16.22

Table 7. Average Price Ratios Showing Changes in Non-Defense and Defense Prices (1981=1)

	Non-Defense Average Price Ratios				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm (1+)	1.00	1.25	1.35	1.36	1.52
30mm+ (1 & 3)	1.00	1.09	0.96	0.93	0.95
Super Precision					
30-52mm (5+)	1.00	1.07	1.16	1.21	1.12
52-100mm (5+)	1.00	1.08	1.24	1.18	1.17
100mm+ (5+)	1.00	1.08	1.17	1.17	1.08
Tot. SuperPrec.	1.00	0.98	1.11	1.12	1.02
Total Ball	1.00	1.11	1.01	0.98	1.02
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	1.00	0.95	0.89	0.91	0.99
2" (1 & 3)	1.00	0.94	0.71	0.76	0.60
Super Precision					
2-4" (5+)	1.00	1.20	1.48	1.46	1.66
4-6" (5+)	1.00	1.22	1.43	1.45	1.50
over 6" (5+)	1.00	1.00	1.50	1.63	1.46
Tot. SuperPrec.	1.00	1.27	1.66	1.59	1.82
Total Roller	1.00	0.93	0.72	0.76	0.72
Tot. Non-Def.	1.00	0.98	0.79	0.81	0.76

	Defense Average Price Ratios				
	1981	1982	1983	1984	1985
BALL BEARINGS					
Commodity Grade					
0-30mm (1+)	1.00	1.17	1.34	1.28	1.36
30mm (1 & 3)	1.00	1.20	1.33	1.34	1.37
Super Precision					
30-52mm (5+)	1.00	0.94	0.97	1.04	0.97
52-100mm (5+)	1.00	1.34	1.73	1.93	1.95
100mm+ (5+)	1.00	1.57	1.62	1.74	1.60
Tot. SuperPrec.	1.00	0.97	1.09	1.18	1.14
Total Ball	1.00	1.16	1.31	1.36	1.50
ROLLER BEARINGS					
Commodity Grade					
0-2" (1+)	1.00	1.20	1.01	0.85	0.91
2" (1 & 3)	1.00	1.02	0.87	1.10	1.11
Super Precision					
2-4" (5+)	1.00	1.17	1.49	1.60	1.42
4-6" (5+)	1.00	1.16	1.30	1.44	1.41
over 6" (5+)	1.00	1.32	1.68	1.81	1.64
Tot. SuperPrec.	1.00	1.20	1.51	1.61	1.47
Total Roller	1.00	1.18	1.11	1.13	1.18
Total Defense	1.00	1.16	1.21	1.24	1.33

Table 8. 1985 Reported Annual Capacity, Shipments and Capacity Utilization by Product Size for Super Precision Bearings (000s of Units)

Size	Capacity	Unit Shipments (in 000s) Non-Defense	Defense	Total	Percent Utilization
Ball Bearings (ABEC 5 and over)					
over 30-52mm	1,375.10	469.10	368.30	837.40	60.90
over 52-100mm	1,139.20	270.20	176.80	447.00	39.24
over 100mm	206.00	57.60	42.40	100.00	48.54
Total Ball	2,720.30	796.90	587.50	1,384.40	50.89
Roller Bearings (RBEC 5 and over)					
over 2-4 inch	164.70	29.70	87.40	117.10	71.10
over 4-6 inch	100.90	9.50	26.10	35.60	35.28
over 6 inch	82.20	6.87	13.25	20.12	24.48
Total Roller	347.80	46.07	126.75	172.82	49.69
Total ALL	3,068.10	842.97	714.25	1,557.22	50.76

Table 9. Super Precision Bearing Capacity by Firm, Capacity Utilization Rates, Unused Capacity and Leadtimes

	(000s of Units)					Leadtimes		
Firm	Unit Capacity	1985 Shipmts.	Percent Util.	Unused Capacity	Rev-up Time	Non-Defense	Defense	Longest Leadtime
a.	207	131	63	76	26	43	43	56
b.	42	23	55	19	52	18	28	39
c.	413	273	66	140	52	36	44	50
d.	810	478	59	332	56	26	26	36
e.	453	274	60	179	26	75	75	120
f.	723	219	30	504	12	30	30	40
g.	235	102	43	133	88	44	44	48
h.	26	13	50	13	12	40	60	120
i.	159	45	28	114	52	52	52	52
Totals	3068	1557	51	1511	40	39	41	55

Note: Rev-up time is weeks needed to reach practical capacity from 1985 utilization rate. Leadtimes are in weeks. In the Totals row, the rev-up time and the respective leadtimes are weighted averages.

Table 10. 1985 Market Shares in Units and Dollars for Super Precision Bearings

Firm	(000s) Unit Shipments	Percent of Market	Dollar Shipments	Percent of Market	(000s) Average Price
a.	274	18	25,410	14	93
b.	23	1	2,940	2	129
c.	273	18	28,681	16	105
d.	131	8	40,308	22	308
e.	478	31	26,676	15	56
f.	13	1	13,027	7	1,002
g.	219	14	6,351	3	29
h.	102	7	21,003	12	206
i.	45	3	17,573	10	395
Totals	**1,557**	**100**	**181,969**	**100**	**117**

Table 11. Surge and Mobilization Capabilities

		(factor increase—base times x)					
		Surge			Mobilization		
Size Range	base	3 mo	6 mo	12 mo	6 mo	12 mo	24 mo
Ball Bearings (ABEC 5 and over)							
over 30-52 mm O.D.	35.95	1.18	1.51	1.94	1.91	2.76	3.42
over 52-100 mm O.D.	34.65	1.21	1.53	1.95	1.77	2.55	3.29
over 100 mm O.D.	5.20	1.07	1.27	1.65	1.58	2.24	2.86
Total Ball	75.80	1.18	1.50	1.93	1.82	2.63	3.32
Roller Bearings (RBEC 5 and over)							
over 2-4 inch O.D.	7.94	1.01	1.33	1.78	2.11	4.55	7.80
over 4-6 inch O.D.	2.21	1.02	1.26	1.97	2.47	5.52	9.51
over 6 inch O.D.	1.70	1.07	1.90	4.28	4.22	10.78	20.72
Total Roller	11.85	1.02	1.40	2.17	2.48	5.62	9.98
Total Ball and Roller	87.65	1.16	1.49	1.96	1.91	3.03	4.22

Note: Base is average monthly defense production in 1985.

Table 12a. Age of Capital Equipment Used for Making Super Precision Bearings

Type of Machinery	Total	Number of Machines by Age Interval 0-4yr	5-9yr	10-19yr	20yr+
Hor.NC Turning <9	67	36	22	8	1
Hor.NC Turning >9	52	8	29	15	0
NC Grinding Mach.s	29	23	3	3	0
Internal Honers	101	22	13	32	34
External Honers	78	15	13	21	29
Mechanical Presses	42	3	0	10	29
Hydraulic Presses	9	2	0	4	3
Forging Presses	16	4	2	2	8
Batch Furnaces	82	5	4	23	50
Continuous Furnaces	37	0	8	10	19
Assembly Equipment	61	4	0	20	37
Totals	574	122	94	158	210

Table 12b. Age of Capital Equipment Used for Making Super Precision Bearings

Type of Machinery	Total	Percent of Machines Contained within Each Age Interval 0-4yr	5-9yr	10-19yr	20yr+
Hor.NC Turning <9	67	54	33	12	1
Hor.NC Turning >9	52	15	56	29	0
NC Grinding Mach.s	29	79	10	10	0
Internal Honers	101	22	13	32	34
External Honers	78	19	17	27	37
External Honers	42	7	0	24	69
Hydraulic Presses	9	22	0	44	33
Forging Presses	16	25	13	13	50
Batch Furnaces	82	6	5	28	61
Continuous Furnaces	37	0	22	27	51
Assembly Equipment	61	7	0	33	61
Totals	574	21	16	28	37

Note: The tables do not include conventional type (non-computer controlled) turning machines or conventional type grinding machines, which could have easily doubled the number of machines reported by the companies. Based on a single company's report that included these kinds of machines and conversations with industry representatives, the age of these non-NC turning and grinding machines is comparable to that of the honers and presses shown above. About 65 percent of the honers and 84 percent of the presses are over ten years of age.

Table 13. Comparison of Competitive Factors between the United States and Selected Other Countries based on U.S. Bearing Company reports

Competitive Factor	Competitive Viability U.S.	Japan	W.Germany	France
Price	4.3	1.4	2.9	3.4
Quality	2.3	1.8	1.9	3.6
Labor Costs	4.2	1.3	2.8	3.0
Capital Costs	3.2	1.2	2.5	3.7
Steel Costs	3.8	1.2	2.8	3.1
Delivery	2.0	2.2	2.3	3.7
Follow up service	1.2	3.1	2.4	4.2
Design capability	1.3	2.5	2.3	3.8
Engineering	1.2	2.8	2.0	4.2
Customer satisfaction	1.5	2.5	2.4	3.7
Trade barriers	4.8	1.1	2.8	2.7
Government supports	4.8	1.3	3.1	2.4

Competitive factor	U.K.	Sweden	Italy	Singapore/ Thailand
Price	3.8	3.0	3.0	1.0
Quality	2.0	3.0	4.5	2.0
Labor Costs	2.0	3.0	2.0	1.0
Capital Costs	3.6	3.3	2.5	1.0
Steel Costs	2.7	4.0	1.5	2.0
Delivery	3.3	4.0	3.5	2.0
Follow up service	3.0	3.0	4.5	4.0
Design capability	2.3	3.0	4.5	5.0
Engineering	3.3	3.0	4.0	5.0
Customer satisfaction	2.7	3.0	4.5	4.0
Trade barriers	3.0	3.3	3.5	2.0
Government supports	2.7	2.3	3.5	3.0

Note: 1 equals most competitive and 5 equals least competitive.

Financial Performance

Table 14. Profitability of the Commodity/Commercial Bearing Sector Compared with the Super Precision Bearing Sector

Commodity Sector
(in $000,000s)

Line Item	1981	1982	1983	1984	1985
Net Sales(1)	$3,355	$2,676	$2,668	$3,273	$3,226
Cost of Goods Sold(1)	2,697	2,228	2,246	2,622	2,628
Gross Profit (Loss)(3)	658	448	423	651	600
Net Inc. Before Taxes(4)	243	70	36	168	108
Percent Net Inc./Net Sales:	7.24	2.62	1.35	5.13	3.35

Super Precision Sector
(in $000,000s)

	1981	1982	1983	1984	1985
Net Sales(1)	$261.5	$252.7	$238.6	$255.6	$262.2
Cost of Goods Sold(1)	198.9	194.3	189.1	205.1	222.5
Gross Profit (Loss)(3)	59.5	58.5	49.5	50.8	39.7
Net Inc. Before Taxes(4)	31.4	27.8	20.2	19.9	4.5
Percent Net Inc./Net Sales:	12.00	11.00	8.47	7.78	1.73

(1) Net Sales include inter and intracompany tranfers.
(2) The Cost of Goods Sold includes raw materials, direct labor and other factory costs such as depreciation and inventory costs.
(3) Gross Profit is the difference between Net Sales and the Cost of Goods Sold.
(4) Net Income Before Taxes is Gross Profit less general, selling and administrative expenses, interest expenses and other expenses, plus other income.

Note: The Commodity Sector is based on the line item figures reported by the International Trade Commision in its "Competitive Assessment of the U.S. Ball and Roller Bearing Industry", USITC Publication 1797, January 1986. To obtain a purer picture of the commodity sector, the ITC figures were adjusted by subtracting the figures reported by the nine super precision bearing manufacturers shown above.

Table 15. Investment by the Commodity/Commercial Bearing Sector Compared with the Super Precision Bearing Sector

Commodity Sector
(in $000s)

Line Item	1981	1982	1983	1984	1985
Plant	$17,903	$19,982	$3,342	$10,504	$13,444
Mach. and Equipment	196,447	141,902	100,461	102,633	84,774
Total	$213,350	$161,884	$103,830	$113,137	$98,218
percent inv/net sales:	6.93	6.68	4.27	3.74	3.31
Inv./Employee	$4,664	$4,322	$3,102	$2,947	$2,755
Inv./Prod. Wker.	$5,348	$5,125	$3,652	$3,438	$3,261

Super Precision Sector
(in $000s)

Line Item	1981	1982	1983	1984	1985
Plant	$ 802	$ 454	$ 491	$ 433	$ 2,622
Mach. and Equipment	10,288	6,012	5,418	10,862	12,128
Total	$11,090	$6,466	$5,909	$11,295	$14,750
percent inv/net sales:	4.24	2.56	2.48	4.42	5.63
Inv./Employee	$1,949	$1,313	$1,350	$2,327	$3,067
Inv./Prod. Wker.	$2,547	$1,710	$1,640	$3,134	$4,029

Table 16a. Employment in the Commodity/Commercial Bearing Sector Compared with the Super Precision Bearing Sector

Commodity Sector

Employment	1981	1982	1983	1984	1985
Production Workers	40,084	31,585	28,433	32,911	30,122
Other Employees	5,879	5,868	5,044	5,477	5,534
All Employees	45,963	37,453	33,477	38,388	35,656
			(in $000s)		
Sales/Employee	$67.3	$64.7	$72.6	$78.6	$83.1
Sales/Prod. Wker.	$77.2	$76.7	$85.4	$91.7	$98.4

Super Precision Sector

Employment	1981	1982	1983	1984	1985
Scientists & Engineers	257	275	260	274	264
Production Workers	4,354	3,782	3,288	3,604	3,661
Other Employees	1,079	867	830	976	884
All Employees	5,690	4,924	4,378	4,854	4,809
			(in $000s)		
Sales/Employee	$46.0	$51.3	$54.5	$52.7	$54.5
Sales/Prod. Wker.	$60.1	$66.8	$72.6	$70.9	$71.6

Table 16b. Employment Ratios for the Commodity/Commercial Bearing Sector Compared with the Super Precision Bearing Sector (1981=1)

Commodity Sector

Employment	1981	1982	1983	1984	1985
Production Workers	1.00	.79	.71	.82	.75
Other Employees	1.00	1.00	.86	.93	.94
All Employees	1.00	.81	.73	.84	.78
		(in $000s)			
Sales/Employee	1.00	.96	1.08	1.17	1.23
Sales/Prod. Wker.	1.00	.99	1.11	1.19	1.27

Super Precision Sector

Employment	1981	1982	1983	1984	1985
Scientists & Engineers	1.00	1.07	1.01	1.07	1.03
Production Workers	1.00	.87	.76	.83	.84
Other Employees	1.00	.80	.77	.90	.82
All Employees	1.00	.87	.77	.85	.85
		(in $000s)			
Sales/Employee	1.00	1.12	1.18	1.15	1.18
Sales/Prod. Wker.	1.00	1.11	1.21	1.18	1.19

TABLE 17a TOTAL DEFENSES BEARING RECEIPTS AS REPORTED BY 9 OEMs

	1981		1983		1985	
RADIAL BALL BEARINGS	UNITS	DOLLARS	UNITS	DOLLARS	UNITS	DOLLARS
ABEC 5 and over						
Over 30-52 MM OD	12,529	2,519,836	21,228	3,435,288	15,404	2,535,736
Over 52-100MMOD	14,760	4,067,858	19,686	4,835,782	12,457	3,332,691
Over 100-170MM OD	210	184,840	1,174	707,030	1,140	842,000
Over 170 OD	948	1,451,000	2,261	3,733,000	2,376	3,937,092
TOTAL	28,447	8,223,534	44,349	12,711,100	31,377	10,637,519
ROLLER BEARINGS						
RBEC 5 and Over						
Over 2-4" OD	12,107	3,133,632	19,294	4,671,200	13,228	3,770,631
Over 4-6" OD	640	765,272	2,318	2,046,448	1,579	1,560,780
Over 6 OD	2,305	3,543,442	2,633	4,161,256	1,556	2,152,000
TOTAL	15,052	7,442,346	24,245	10,878,904	16,363	7,483,411
TOTAL	43,499	15,665,880	68,594	23,590,004	47,740	18,120,930

TABLE 17b DEFENSE PRECISION BEARING RECEIPTS AS REPORTED BY 9 OEMS

	1981		1983		1985	
RADIAL BALL BEARINGS	UNITS	DOLLARS	UNITS	DOLLARS	UNITS	DOLLARS
ABEC 5 and Over						
OVER 30-52 MM OD	14,850	1,396,300	23,875	3,219,375	25,848	4,015,812
OVER 41-100MM OD	8,235	1,450,283	20,425	4,772,439	24,622	5,984,345
Over 100-170MM OD	2,059	1,278,414	5,940	4,493,000	4,345	3,447,902
Over 170MM OD	674	737,900	1,927	3,376,897	2,131	3,297,143
TOTAL	36,462	6,008,771	56,192	18,272,260	72,996	22,558,198
ROLLER BEARINGS						
RBEC 5 and Over						
OVER 2-4" OD	7,087	2,984,544	15,519	3,515,502	21,352	5,101,330
OVER 4-6" OD	5,947	6,419,679	11,062	11,895,662	10,285	9,914,560
OVER 6" OD	912	1,025,531	2,328	3,174,058	2,401	3,390,700
TOTAL	42,682	12,929,325	47,729	22,423,138	83,814	23,515,931
TOTAL	79,144	18,938,096	103,921	40,695,398	156,810	46,074,129

TABLE 17c TOTAL DEFENSE/NONDEFENSE PRECISION BEARINGS RECEIPTS
AS REPORTED BY 9 OEMs

	1981		1983		1985	
RADIAL BALL BEARING	UNITS	DOLLARS	UNITS	DOLLARS	UNITS	DOLLARS
ABEC 5 and OVER						
OVER 30-52 MM OD	27,379	3,916,136	45,103	6,654,663	41,252	6,551,548
OVER 52-100MM OD	22,995	5,518,141	40,111	9,608,221	37,079	9,307,036
OVER 100-170MM OD	2,269	1,463,254	7,114	5,200,030	5,485	4,289,902
OVER 170MM OD	1,622	2,188,900	48,356	7,109,897	4,507	7,234,235
TOTAL	64,909	14,232,305	144,709	30,983,360	104,373	33,195,717
ROLLER BEARINGS						
RBEC 5 and OVER						
OVER 2-4" OD	19,194	6,118,165	34,813	8,186,702	34,580	8,871,961
OVER 4-6" OD	6,587	7,184,951	13,380	13,942,110	11,864	11,475,340
OVER 4-6" OD	3,247	4,568,973	3,961	7,335,314	102,423	5,542,700
OVER 6" OD	57,764	20,371,671	71,974	33,302,042	198,643	30,000,342
TOTAL	122,673	34,603,976	216,683	64,285,402	303,016	64,195,059

TABLE 17d DEFENSE PERCENT OF TOTAL PRECISION BEARINGS PURCHASED BY OEM's SURVEYED AS REPORTED BY 9 EOMs

	1981		1983		1985	
RADIAL BALL BEARINGS	UNITS	DOLLARS	UNITS	DOLLARS	UNITS	DOLLARS
ABEC 5 and Over						
OVER 30-52 MM OD	54.24	35.66	52.93	48.38	62.66	61.30
OVER 52-100MM OD	35.81	26.28	50.92	49.67	66.40	64.30
OVER 100-170MM OD	90.74	87.37	83.50	86.40	79.22	80.37
OVER 170MM OD	41.55	33.71	3.99	47.50	47.28	45.58
TOTALS PERCENT	56.17	42.22	38.83	58.97	69.94	67.96
ROLLER BEARINGS						
RBEC 5 and Over						
OVER 2-4" OD	36.92	48.78	44.58	42.94	61.75	57.50
OVER 4-6" OD	90.28	89.35	82.68	85.32	86.69	86.40
OVER 6" OD	28.09	22.45	46.93	43.27	2.34	61.17
TOTAL PERCENT	73.89	63.47	66.31	67.33	42.19	75.86
TOTAL	64.52	54.73	47.96	63.30	51.75	71.77

APPENDIX E

QUESTIONAIRES

Form ITA-9053
(2-86)

U.S. Department of Commerce
International Trade Administration

OMB Approval Not Required: less than ten respondents

NATIONAL SECURITY ASSESSMENT OF THE PRECISION BEARINGS INDUSTRY

Ball and Roller Bearings 30 mm and Larger and ABEC or RBEC 5 and Over

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THIS REPORT IS REQUIRED BY LAW

This report is required by law (50 U.S.C. App. Sec. 2155). Failure to report can result in a maximum fine of $1,000 or imprisonment up to one year, or both. Information furnished herewith is deemed confidential and will not be published or disclosed except in accordance with Section 705 of the Defense Production Act of 1950, as amended (50 U.S.C. App. Sec. 2155).

General Instructions

1. 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 indicate.
2. Report calendar year data, unless otherwise specified in a particular question. Please complete Parts II and III separately for each of your establishments that produce precision bearings in the United States. Please make photocopies of forms if additional copies are needed. For Parts I, IV and V, firms operating more than one establishment may combine the data for all establishments into a single report.
3. In addition to the original report form to be returned to us, there is enclosed a file copy for your records. You are not legally required to fill out or retain this file copy. While it would be a convenience to the Government for a file copy to be made and retained for reference purposes, no assurances can be provided that file copies are exempt from compulsory examination pursuant to legal process.
4. Questions related to the questionnaire should be directed to Mr. Dave Stanley, Supervisor Materials Engineer (619) 437-6711, Department of the Navy, Major Terry Gower, Senior Program Analyst (513) 257-2622, Department of the Air Force, or Mr. Bill Fletcher, Industry Specialist (202) 377-0309, Department of Commerce.
5. Before returning your completed questionnaire be sure to sign the certification and identify the person and phone number to contact your firm.
6. Return completed questionnaire by March 18, 1986 to:

U.S. Department of Commerce
International Trade Administration
Office of Industrial Resource Administration
Attn: Brad Botwin, Program Manager for
Industrial Capabilities, Room H3876
Washington, D.C. 20230

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DEFINITIONS

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

CRITICAL OCCUPATIONS—Includes occupations for which you anticipate a potential shortage of qualified personnel during surge or mobilization. In general, this would include skilled occupations that require an extended training period.

ESTABLISHMENT—All facilities in which precision bearings are produced. Includes auxiliary facilities operated in conjunction with (whether or not physically separate from) such production facilities. Does not include wholly owned distribution facilities.

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

MOBILIZATION PRODUCTION CAPABILITY—The maximum realistic increase of sustainable defense production capability a manufacturing establishment can achieve in the 24 month period following a declared national emergency. Report achievable increase in defense production at the end of 6 months, 12 months and 24 months in the mobilization capability section of Part II of the questionnaire. Non-Defense production limited to 25 percent or less of 1986 peacetime levels. Government financial assistance and prioritization of construction materials and outfitting equipment is available. Your existing manufacturing buildings may be enlarged, new buildings constructed or existing buildings currently used by you for non-manufacturing purposes may be converted into manufacturing facilities, and plant equipment acquired. Consider critical labor skills to operate at maximum sustained production levels. Minimum defense requirement is 4X your average monthly defense production in 1985.

OFFSET AGREEMENTS—A range of industrial and commercial compensation practices which include co-production, licensed production, subcontractor production, overseas investment, technology transfer, and countertrade.

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

1. Under most circumstances assume your 1985 product mix. If no production took place in 1985 of a particular size group which you have, or will have the capability to produce and can anticipate receiving orders for in the future, include a reasonable quantity as part of your 1985 product mix.

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 before they can be made operative.

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. Do not consider overtime pay, added costs for materials, or other costs to be limiting factors in setting capacity.

5. Although it may be possible to expand plant output by using productive facilities outside of the plant, such as by contracting out subcontractible work, do not assume the use of such outside facilities in greater proportion than has been characteristic of your operations.

PRECISION BEARINGS—Ball and roller bearings 30 mm and over with an ABEC or RBEC standard of 5 and over.

PRODUCTION WORKERS—Persons, up through the line supervisor level, engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, or shipping precision bearings. In addition, persons engaged in supporting activities such as maintenance, repair, product development, auxiliary production for your firm's own use, record keeping, and other services closely associated with production operations at your firm. Employees above the working supervisor level are excluded from this item.

SCIENTISTS AND ENGINEERS—Persons engaged in research and development work or production operations that have at least a four-year college education in the physical sciences or engineering.

SHIPMENTS—Report unit and dollar values of domestically produced precision bearings shipped from your plant during the reporting period for each category for questions Part 1 -A, B, C, and D. Such shipments should include inter-plant or intra-plant transfers, but should exclude shipments of products produced by other manufacturers for resale under your brand name. Report shipments for defense consumption separate from non-defense. Such shipments should exclude shipments of products produced by other manufacturers for resale under your brand name. Do not adjust for returned shipments. The defense portion of your business may be identified by those purchase orders bearing a DO or DX rating and/or a contract number from the Department of Defense, NRC, CIA, FAA, or NASA, as well as the orders of your customers whom you could identify as producing products for defense purposes, and items tested and certified to military specifications shipped to qualified distributors.

SINGLE SOURCE—An item currently being purchased from one source; other sources may be available, however, they may not be qualified or were not considered.

SOLE SOURCE—An item being purchased from one source, and no other production capability exists.

SURGE PRODUCTION CAPABILITY—The maximum sustainable level of defense production that can be achieved within an existing establishment by the end of the 12 month period immediately following surge day while maintaining non-defense deliveries. Report achievable defense production quantities of precision bearings at the end of 3 months, 6 months and 12 months in the surge capability section of Part II of the questionnaire. Procurement actions for additional materials to sustain surge production levels will be initiated on surge day. Existing idle equipment may be activated as is, repaired, or upgraded and brought into service, or used equipment may be purchased and installed if possible within the 12 month time frame. Labor may be hired and trained in numbers sufficient to operate around the clock and week-ends allowing for necessary equipment maintenance and downtime. Minimum defense requirement is 2X your average monthly defense production in 1985.

UNITED STATES—The term "United States" includes the fifty States, Puerto Rico, the District of Columbia, and the Virgin Islands.

FIRM IDENTIFICATION

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

_____

_____

_____

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

_____

_____

_____

2. Identify the location of your precision bearing manufacturing establishment(s) in the United States. (See definition of precision bearing.)

	Locality	State	Zip Code
(a)	_____	_____	_____
(b)	_____	_____	_____
(c)	_____	_____	_____
(d)	_____	_____	_____
(e)	_____	_____	_____

3. Identify U.S. manufacturing establishments in which you ceased precision bearing production since 1980 and the reason production was stopped.

_____

_____

_____

_____

_____

_____

PART I - A. NON-DEFENSE SHIPMENTS (UNITS)

Enter total Non-Defense unit shipments of precision bearings as indicated below (all manufacturing establishments). See definition of shipments.

(in thousands of units)

	1981	1982	1983	1984	1985
Radial Ball Bearings (including self-aligning)					
Below 9-30 mm O.D. (ABEC 1 and over))	___	___	___	___	___
Over 30 mm O.D. (ABEC 1 and 3)	___	___	___	___	___
ABEC 5 and Over					
Over 30-52 mm O.D.	___	___	___	___	___
Over 52-100 mm O.D.	___	___	___	___	___
Over 100-170 mm O.D.	___	___	___	___	___
Over 170-240 mm O.D.	___	___	___	___	___
Over 240-580 mm O.D.	___	___	___	___	___
Over 580 mm O.D.	___	___	___	___	___
Roller Bearings					
0-2" O.D. (RBEC 1 and over)	___	___	___	___	___
Over 2" O.D. (RBEC 1 and 3)	___	___	___	___	___
RBEC 5 and Over					
Over 2-4" O.D.	___	___	___	___	___
Over 4-6" O.D.	___	___	___	___	___
Over 6-8" O.D.	___	___	___	___	___
Over 8-10" O.D.	___	___	___	___	___
Over 10" O.D.	___	___	___	___	___

PART I - B. NON-DEFENSE SHIPMENTS (DOLLARS)

Enter total Non-Defense dollar shipments of precision bearings as indicated below (all manufacturing establishments). See definition of shipments.

	(in thousands of dollars)				
	1981	1982	1983	1984	1985
Radial Ball Bearings (including self-aligning)					
Below 9-30 mm O.D. (ABEC 1 and over))	___	___	___	___	___
Over 30 mm O.D. (ABEC 1 and 3)	___	___	___	___	___
ABEC 5 and Over					
Over 30-52 mm O.D.	___	___	___	___	___
Over 52-100 mm O.D.	___	___	___	___	___
Over 100-170 mm O.D.	___	___	___	___	___
Over 170-240 mm O.D.	___	___	___	___	___
Over 240-580 mm O.D.	___	___	___	___	___
Over 580 mm O.D.	___	___	___	___	___
Roller Bearings					
0-2" O.D. (RBEC 1 and over)	___	___	___	___	___
Over 2" O.D. (RBEC 1 and 3)	___	___	___	___	___
RBEC 5 and Over					
Over 2-4" O.D.	___	___	___	___	___
Over 4-6" O.D.	___	___	___	___	___
Over 6-8" O.D.	___	___	___	___	___
Over 8-10" O.D.	___	___	___	___	___
Over 10" O.D.	___	___	___	___	___

PART I - C. DEFENSE SHIPMENTS (UNITS)

Enter total Defense unit shipments of precision bearings as indicated below (all manufacturing establishments). See definition of shipments.

(in thousands of units)

	1981	1982	1983	1984	1985
Radial Ball Bearings (including self-aligning)					
Below 9-30 mm O.D. (ABEC 1 and over))	___	___	___	___	___
Over 30 mm O.D. (ABEC 1 and 3)	___	___	___	___	___
ABEC 5 and Over					
Over 30-52 mm O.D.	___	___	___	___	___
Over 52-100 mm O.D.	___	___	___	___	___
Over 100-170 mm O.D.	___	___	___	___	___
Over 170-240 mm O.D.	___	___	___	___	___
Over 240-580 mm O.D.	___	___	___	___	___
Over 580 mm O.D.	___	___	___	___	___
Roller Bearings					
0-2" O.D. (RBEC 1 and over)	___	___	___	___	___
Over 2" O.D. (RBEC 1 and 3)	___	___	___	___	___
RBEC 5 and Over					
Over 2-4" O.D.	___	___	___	___	___
Over 4-6" O.D.	___	___	___	___	___
Over 6-8" O.D.	___	___	___	___	___
Over 8-10" O.D.	___	___	___	___	___
Over 10" O.D.	___	___	___	___	___

PART I - D. DEFENSE SHIPMENTS (DOLLARS)

Enter total Defense dollar shipments of precision bearings as indicated below (all manufacturing establishments). See definition of shipments.

	(in thousands of dollars)				
	1981	1982	1983	1984	1985
Radial Ball Bearings (including self-aligning)					
Below 9-30 mm O.D. (ABEC 1 and over))	___	___	___	___	___
Over 30 mm O.D. (ABEC 1 and 3)	___	___	___	___	___
ABEC 5 and Over					
Over 30-52 mm O.D.	___	___	___	___	___
Over 52-100 mm O.D.	___	___	___	___	___
Over 100-170 mm O.D.	___	___	___	___	___
Over 170-240 mm O.D.	___	___	___	___	___
Over 240-580 mm O.D.	___	___	___	___	___
Over 580 mm O.D.	___	___	___	___	___
Roller Bearings					
0-2" O.D. (RBEC 1 and over)	___	___	___	___	___
Over 2" O.D. (RBEC 1 and 3)	___	___	___	___	___
RBEC 5 and Over					
Over 2-4" O.D.	___	___	___	___	___
Over 4-6" O.D.	___	___	___	___	___
Over 6-8" O.D.	___	___	___	___	___
Over 8-10" O.D.	___	___	___	___	___
Over 10" O.D.	___	___	___	___	___

PART II - A. PEACETIME CAPACITY
B. SURGE
C. MOBILIZATION CAPABILITIES

INSTRUCTIONS

- Complete Part II for each establishment that manufactures precision bearings.
- Report calendar year data, unless otherwise specified.
- If information is not readily available from your records in exactly the form requested, furnish estimates and designate by the letter "E".
- Do not leave questions unanswered. Enter "none" where appropriate.

ESTABLISHMENT IDENTIFICATION

(Locality) _____ (State) _____ (Zip Code) _____

A. PEACETIME CAPACITY

1. What is your annual practical capacity in units for producing ball and roller bearings in the following size and quality ranges?. (See definition of practical capacity.)

(in thousands of units)

Radial Ball Bearings (including self-aligning)

Below 9-30 mm O.D. (ABEC 1 and over) _____

Over 30 mm O.D. (ABEC 1 and 3) _____

ABEC 5 and Over

Over 30-52 mm O.D. _____

Over 52-100 mm O.D. _____

Over 100-170 mm O.D. _____

Over 170-240 mm O.D. _____

Over 240-580 mm O.D. _____

Over 580 mm O.D. _____

Roller Bearings

0-2" O.D. (RBEC 1 and over) _____

Over 2" O.D. (RBEC 1 and 3) _____

RBEC 5 and Over

Over 2-4" O.D. _____

Over 4-6" O.D. _____

Over 6-8" O.D. _____

Over 8-10" O.D. _____

Over 10" O.D. _____

2. Enter below factors which would increase/decrease figures given above. (e.g. material, length of production run, etc.)

_____

_____

_____

3. What was this establishment's practical capacity utilization rate in percent during 1985?

Practical Capacity Utilization: Precision Bearings ____%

Other Bearings ____%

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

Precision Bearings ____weeks

Other Bearings ____weeks

4. Enter workforce shift information below.

Operation	Average shifts during 1985 # shifts	man hours/ shift	days/wk	Number shifts if at practical capacity # shifts	man hours/ shift	days/wk
Boring, Grinding and Turning						
Heat Treating						
Polishing/Lapping						
Calibration and/ Inspection						
Assembly						
Testing						
Other						

5. Briefly discuss the convertibility of your non-defense production operations to defense production and the problems that might arise in the conversion.

_____

_____

_____

6. a. During 1985, what was your average leadtime (i.e., from receipt of order to delivery to customer) for:

Non-Defense Orders _____ weeks Defense Orders _____ weeks

b. Are leadtimes increasing

For Non-Defense Orders? yes ____, no ____

For Defense Orders? yes ____, no ____

c. If leadtimes are increasing, what are the reasons?

_____

_____

_____

d. Regarding your longest leadtime defense items, list the size group of precision bearings, the defense system supported, the average leadtime during 1985, and describe how that leadtime could be significantly shortened.

Precision Bearing Size Group	Defense System	Average Leadtime	How to Shorten Leadtime

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B. SURGE CAPABILITY

1. What is your precision bearing surge capability? (Use 1985's defense production and product mix for the precision bearing size ranges shown on the table below as your base production rate. In estimating your precision bearing surge capability, assume any other bearing production in this establishment for defense is also surged. Maintain non-defense production at 1985 levels. See definitions of surge capability and shipments.)

(monthly rates in thousands of units)

Size Range	1985's average monthly defense production rate	Surge rate at 3 months	Surge rate at 6 months	Surge rate at 12 months
Ball Bearings				
ABEC 5 and Over				
Over 30-52 mm O.D.				
Over 52-100 mm O.D.				
Over 100-170 mm O.D.				
Over 170-240 mm O.D.				
Over 240-580 mm O.D.				
Over 580 mm O.D.				
Roller Bearings				
RBEC 5 and Over				
Over 2-4" O.D.				
Over 4-6" O.D.				
Over 6-8" O.D.				
Over 8-10" O.D.				
Over 10" O.D.				

2. List and rank the bottlenecks you envision would be encountered during a surge and the time and cost to correct. Refer to definition of BOTTLENECKS. Rank bottlenecks in order of occurrence. If the answer is "none", please indicate.

Operation	Bottlenecks	Rank	Time and Cost to Correct
Boring, Grinding and Turning			
Heat Treating			
Polishing/Lapping			
Calibration and/ Inspection			
Assembly			
Testing			
Other			
Other areas			
Inventory			
Materials			
Parts/Components			
Government Regulations			
Other (specify)			

3. What can the government do to help reduce or eliminate bottlenecks?

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MOBILIZATION CAPABILITY

1. What is your mobilization capability for precision bearings? (Use 1985's defense production and product mix for the precision bearing size groups shown on the table below as your base production rate. In estimating your precision bearing mobilization capability, assume any other bearing production in this establishment for defense is also mobilized. Non-defense production falls to 25 percent of 1985 levels. See definitions of mobilization capability and shipments.)

Size Range	(monthly rates in thousands of units) 1985's average monthly defense production rate	Mobilization rate at 6 months	Mobilization rate at 12 months	Mobilization rate at 24 months
Ball Bearings				
ABEC 5 and Over				
Over 30-52 mm O.D.	_____	_____	_____	_____
Over 52-100 mm O.D.	_____	_____	_____	_____
Over 100-170 mm O.D.	_____	_____	_____	_____
Over 170-240 mm O.D.	_____	_____	_____	_____
Over 240-580 mm O.D.	_____	_____	_____	_____
Over 580 mm O.D.	_____	_____	_____	_____
Roller Bearings				
RBEC 5 and Over				
Over 2-4" O.D.	_____	_____	_____	_____
Over 4-6" O.D.	_____	_____	_____	_____
Over 6-8" O.D.	_____	_____	_____	_____
Over 8-10" O.D.	_____	_____	_____	_____
Over 10" O.D.	_____	_____	_____	_____

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2. List and rank the bottlenecks you envision would be encountered in a mobilization and the time and cost to correct. Refer to definition of BOTTLENECKS. Rank bottlenecks in order of occurrence. If the answer is "none", please indicate.

Operation	Bottlenecks	Rank	Time and Cost to Correct
Boring, Grinding and Turning			
Heat Treating			
Polishing/Lapping			
Calibration and/ Inspection			
Assembly			
Testing			
Other			
Other areas			
Inventory			
Materials			
Parts/Components			
Government Regulations			
Other (specify)			

3. What can the government do to help reduce or eliminate bottlenecks?

PART III - INVESTMENT, TECHNOLOGY, RESEARCH AND DEVELOPMENT, EMPLOYMENT AND SUPPLIERS.

INSTRUCTIONS

- o Complete Part III for each establishment that manufactures precision bearings.
- o If information is not readily available from your records in exactly the form requested, furnish estimates and designate by the letter "E".
- o Enter "none" where appropriate.

ESTABLISHMENT IDENTIFICATION

_____	_____	_____
(Locality)	(State)	(Zip Code)

---

1. Investment: Enter expenditures for new plant, machinery, and equipment from 1981 through 1985 as requested below. Enter any government investment expenditures at your establishment separately.

Private Investment Expenditures
(in thousands of dollars)

	1981	1982	1983	1984	1985
Plant	____	____	____	____	____
Machinery and Equipment	____	____	____	____	____
Total:					

Government Investment Expenditures
(in thousands of dollars)

	1981	1982	1983	1984	1985
Plant	____	____	____	____	____
Machinery and Equipment	____	____	____	____	____
Total:					

2. Planned expansion: Enter percentage increase(+)/decrease(-) in practical production capacity planned for in the time frames indicated.

	Change in Capacity	Cost of Change	Description and Reason for Change
In one year	____	____	_____
In two-three years	____	____	_____
In over three years	____	____	_____

3. Enter the number of machines you have in each age interval on the tables below (pages 14-16) for machines used for caging, raceway and rolling element production operations.

Capital Equipment Used For Making Caging

	Age of Capital Equipment			
	0-4 yr.	5-9 yr.	10-19 yr.	20yr & up
Metal Cutting				
Numerical Control Turning Machines				
a) Horizontal, Under 9"	____	____	____	____
b) Horizontal, Over 9"	____	____	____	____
Numerical Control Grinding Machines	____	____	____	____
Internal Honing (inc. comb. bore-hone)	____	____	____	____
External Honing	____	____	____	____
Metal Forming				
Numerical Control Punching Machines	____	____	____	____
Non-Numerical Control Punching Machines (inc. comb. punch-shear)	____	____	____	____
Mechanical Presses (except Forges)	____	____	____	____
Hydraulic Presses (except Forges)	____	____	____	____
Forging Presses	____	____	____	____
Other Equipment				
Heat Treating Furnaces- batch	____	____	____	____
continuous	____	____	____	____
Assembly Equipment	____	____	____	____

Capital Equipment Used For Making Raceways

	Age of Capital Equipment			
	0-4 yr.	5-9 yr.	10-19 yr.	20yr & up
Metal Cutting				
Numerical Control Turning Machines				
a) Horizontal, Under 9"	____	____	____	____
b) Horizontal, Over 9"	____	____	____	____
Numerical Control Grinding Machines	____	____	____	____
Internal Honing (inc. comb. bore-hone)	____	____	____	____
External Honing	____	____	____	____
Metal Forming				
Numerical Control Punching Machines	____	____	____	____
Non-Numerical Control Punching Machines (inc. comb. punch-shear)	____	____	____	____
Mechanical Presses (except Forges)	____	____	____	____
Hydraulic Presses (except Forges)	____	____	____	____
Forging Presses	____	____	____	____
Other Equipment				
Heat Treating Furnaces- batch	____	____	____	____
continuous	____	____	____	____
Assembly Equipment	____	____	____	____

Capital Equipment Used For Making Rolling Elements

	Age of Capital Equipment			
	0-4 yr.	5-9 yr.	10-19 yr.	20yr & up
Metal Cutting				
Numerical Control Turning Machines				
a) Horizontal, Under 9"	____	____	____	____
b) Horizontal, Over 9"	____	____	____	____
Numerical Control Grinding Machines	____	____	____	____
Internal Honing (inc. comb. bore-hone)	____	____	____	____
External Honing	____	____	____	____
Metal Forming				
Numerical Control Punching Machines	____	____	____	____
Non-Numerical Control Punching Machines (inc. comb. punch-shear)	____	____	____	____
Mechanical Presses (except Forges)	____	____	____	____
Hydraulic Presses (except Forges)	____	____	____	____
Forging Presses	____	____	____	____
Other Equipment				
Heat Treating Furnaces- batch	____	____	____	____
continuous	____	____	____	____
Assembly Equipment	____	____	____	____

4. Government sponsored programs:

a. Are you currently involved in a Government sponsored modernization program respecting your precision bearing manufacturing operations? yes _____, no _____

b. How beneficial do you feel Government sponsored modernization programs are?

_____

_____

c. Will they result in reduced lead times? _____
Will they lower production costs? _____
Will they lower precision bearing prices to DOD? _____
Will they help you compete on the world market? _____

d. What problems still exist that these programs do not address? _____

_____

_____

5. In which of the following areas do you consider the application of new technologies to be most critical? Number from one (the most critical) to seven (the least critical).

Boring, Grinding and Turning	_____	Assembly	_____
Heat Treating	_____	Testing	_____
Polishing/Lapping	_____	Other(specify)	_____
Calibration and/ Inspection	_____		

List and rank specific new technologies you would be most interested in acquiring.

_____

_____

6. Employment: Enter the number of employees from 1981 through 1985 as requested below. (See definition of Scientists and Engineers, and Production Workers)

	1981	1982	1983	1984	1985
Scientists and Engineers	___	___	___	___	___
Production Workers	___	___	___	___	___
Administration and Others	___	___	___	___	___
Total:					

Critical Occupations: List below. (See definition of Critical Occupations)

Job Title	Number Employed	Training Period (in months)

7. Research and Development: Enter research and development expenditures from 1981 through 1985 as requested below. Enter any Government funded expenditures separately..

Private Funded Research and Development Expenditures
(in thousands of dollars)

	1981	1982	1983	1984	1985
On Materials					
On Processes					
Other					
Total:					

Government Funded Research and Development Expenditures
(in thousands of dollars)

	1981	1982	1983	1984	1985
On Materials					
On Processes					
Other					
Total:					

8. For the following steels, how much of an inventory do you normally maintain? (in days supply)

AISI 52100 _____ AISI 440C _____ M50 _____ Other (specify) _____

What factors influence your inventory policy for these steels (e.g., availability, tax policies, minimum purchase quantities, etc.)?

9. For the following parts/components used in the manufacture of precision bearings name and give the location of your top five domestically produced sources of supply and th percentage of the total parts/components purchased from each. (See page 19 for foreign suppliers.)

	Balls/Rollers	Retainers/Cages	Forgings
a.			
b.			
c.			
d.			
e.			

10. What percent of your work did you subcontract out (rather than make yourself) in the past five years?

	1981	1982	1983	1984	1985
a. Balls/Rollers	____	____	____	____	____
b. Retainers/Cages	____	____	____	____	____
c. Forgings	____	____	____	____	____

Specify the manufacturing operations most frequently subcontracted.

_____

_____

11. Have you in the past five years experienced shortages or extended leadtimes in obtaining any material or supply, machinery, equipment, or additional labor that forced you to modify or curtail your operations?

yes _____, no _____

If yes, list below. Identify the nature and duration of the problem on your operatio and the action you took to resolve the situation.

_____

_____

_____

12. Identify all military systems for which you partially or fully supply precision bearings. (e.g., FD0 gas turbine engine, M1 tank)

_____

_____

13. List your top five Non-Defense end product uses for precision bearings.

_____

_____

14. a.) Are you considered a sole source or single source producer for any defense related precision bearings?

yes _____, no _____

If yes, specify the size range, name the defense contractor, the defense system supported, and provide the basis for such a position. (See definitions of sole and single source.)

_____

_____

_____

b.) Do you have any sole source or single source suppliers for manufacturing equipment, parts, components, or materials?

_____yes _____no

If yes, specify the equipment, part, component, or material, the name of the supplier, and how the loss of that supplier would effect your operations.

_____

_____

_____

_____

_____

PART IV - FOREIGN RELATIONSHIPS / FOREIGN SOURCING
(Part IV may be completed for your firm as a whole)

1. Enter the location and primary activity of any establishment outside the United States your firm wholly or partly owns or controls or is affiliated with or has license agreements with that manufactures precision bearings or bearing parts/components.

Name	Country	Primary Activity

2. If any of the foreign establishments you listed above are integrated with your U.S. operations on a normal basis, please briefly specify the nature of that integration in the space provided below.

3. If the foreign establishments that you interact with suddenly ceased operations for an indefinite period, what adjustments would you need to make in your U.S. operations to counteract this interruption, how long would it take to establish a new source, and how would the interruption effect your surge and mobilization capabilities?

4. For the following parts/components used in the manufacture of precision bearing identify your top five foreign suppliers, the percentage of the total parts/ components purchased from each, and country of origin.

	Balls/Rollers	Retainers/Cages	Forgings
a.			
b.			
c.			
d.			
e.			

5. For the following steels, indicate the percentage of imported steel to the total steel you use in the manufacture of precision bearings.

AISI 52100 _____ AISI 440C _____ M50 _____

Other (specify) _____

If steel is imported, why (e.g., price, lead time, availability, quality)?

_____

_____

_____

_____

6. Complete the following table addressing which foreign made critical manufacturing equipment, parts, components, or materials (except steel) you use in your manufacturing operations. Use the following coded reasons why a foreign source is used in completing the table:

A. No known domestic source
B. Domestic source not available or inadequate
C. Offset Agreement
D. Lower cost
E. Quicker delivery
F. Better quality
G. Other (specify)

Item	Country of Origin	For equipment Are spare parts/maintenance available only from a foreign source?	Reason why foreign source

6. (continued)

A. No known domestic source
B. Domestic source not available or inadequate
C. Offset Agreement
D. Lower cost
E. Quicker delivery
F. Better quality
G. Other (specify)

Item	Country of Origin	For equipment Are spare parts/maintenance available only from a foreign source?	Reason why foreign source

7. If the foreign sourced items identified in question 6 are lost, what is your contingency plan (i.e. qualified domestic source, alternate material) and does this impact your ability to surge or mobilize?

8. In recent years, have offset agreements affected your firm?

_____yes _____no

If yes, how (cite examples)?_____

PART V - COMPETITIVE VIABILITY

1. On the table below, rank from one (the most competitive) to five (the least competitive) each competitive factor as it applies to firms producing precision bearings in the United States, Japan, West Germany, France and (other of your choice).

Competitve Factor	United States	Japan	West Germany	France	Other (specify)
Price	____	____	____	____	____
Quality	____	____	____	____	____
Input costs:					
labor	____	____	____	____	____
capital	____	____	____	____	____
steel	____	____	____	____	____
other (specify)	____	____	____	____	____
Delivery	____	____	____	____	____
Follow up service	____	____	____	____	____
Design capability	____	____	____	____	____
Engineering capability	____	____	____	____	____
Customer satisfaction	____	____	____	____	____
Trade barriers	____	____	____	____	____
Government supports	____	____	____	____	____

2. What, if anything, can the Government do to help mitigate the competitive disadvantages of U.S. firms you indicated above?

_____

_____

_____

3. What cost reduction actions have you taken in recent years to increase your international competitiveness?

_____

_____

_____

4. How do you view the competitive prospects for your firm's U.S. precision bearings operations over the next five years?

They should:
- improve greatly _____
- improve somewhat _____
- stay the same _____
- decline somewhat _____
- decline greatly _____

Please discuss the basis for your answer. _____

_____

_____

_____

5. Discuss how the continued viability of a U.S. located commercial production base for bearings can contribute to the maintenance of a defense precision bearings production base.

_____

_____

_____

_____

6. Profitability: Enter the profitability of your U.S. precision bearing operations for the years indicated.

	1981	1982	1983	1984	1985
Net Sales (1)	____	____	____	____	____
Cost of Goods Sold (2)	____	____	____	____	____
Gross Profit or (Loss) (3)	____	____	____	____	____
Net income before taxes (4)	____	____	____	____	____

(1) Trade, including inter- and intracompany transfers
(2) Includes raw materials direct labor and other factory costs such as depreciation and inventory carrying costs.
(3) Difference between Net Sales and Cost of Goods Sold
(4) Gross Profit or (Loss) less general, selling and administrative expenses, interest expenses and other expenses, plus other income

Special Question:

Are you interested in refurbishing precision bearings?

yes _____, no _____

If yes, What would you need to do to establish this capability (facilities, equipment, personnel)?

_____

_____

Are you willing to refurbish other manufacturer's bearings?

yes _____, no _____

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 Untied States as to any matter within its jurisdiction.

_____ (Date)

_____ (Signature of Authorized Official)

_____ Area Code and Telephone Number

_____ (Type or Print Name and Title of Authorized Official)

_____ Area Code and Telephone Number

_____ (Type or Print Name and Title of Person to Contact Regarding this Report)

Comments: If you wish to add anything not covered in the questionnaire that, in your judgment might be useful to, or that should be brought to the attention of this assessment, please use the space below. Topics of special interest include international competition, government regulations, technology advancement in machinery and equipment and/or material formulations, and possibilities for improving defense productivity and costs.

_____

_____

_____

_____

NOTE

Under separate cover letter, the same questionnaire on page 102 was sent to additional bearing companies and ball and roller producers.

U.S. DEPARTMENT OF DEFENSE
JOINT LOGISTICS COMMANDERS
HEADQUARTERS AIR FORCE LOGISTICS COMMAND

NATIONAL SECURITY ASSESSMENT OF THE PRECISION BEARINGS INDUSTRY BALL AND ROLLER BEARINGS 30 MM AND LARGER AND ABEC OR RBEC 5 AND OVER

GENERAL INSTRUCTIONS

1. 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 indicate.

2. Report calendar year data, unless otherwise specified in a particular question. Please complete Parts II and III separately for each of your establishments that produce precision bearings in the United States. Please make photocopies of forms if additional copies are needed. For Parts I, IV and V, firms operating more than one establishment may combine the data for all establishments into a single report.

3. A file copy of the questionnaire is enclosed for your records. While it would be a convenience to the Government for a file copy to be made and retained for reference purposes, no assurances can be provided that file copies are exempt from compulsory examination pursuant to some future legal process.

4. Questions related to the questionnaire should be directed to Mr. Dave Stanley, Supervisor Materials Engineer (619) 437-6711, Department of the Navy, or Major Terry Gower, Senior Program Analyst (513) 257-2622, HQ, Air Force Logistics Command.

Return completed questionnaire by March 18, 1986 to:

Department of the Air Force
HQ, AFLC/XRPD
Gilmore Hall, Post 211Q
Attn: Major Terry Gower
Wright-Patterson AFB
Dayton, OH 45433-5001

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U.S. DEPARTMENT OF DEFENSE
JOINT LOGISTICS COMMANDERS
HEADQUARTERS AIR FORCE LOGISTICS COMMAND

NATIONAL SECURITY ASSESSMENT OF GAS TURBINE ENGINE/TRANSMISSION MANUFACTURERS USAGE AND FOREIGN SOURCING OF PRECISION BEARINGS: Ball and Roller Bearings 30 mm and larger and ABEC or RBEC 5 and over

GENERAL INSTRUCTIONS

1. The questionnaire is targeted to the usage of precision bearings as sub-components in yo gas turbine engine/transmission manufacturing operations and is not concerned with t other activities of your firm. Complete the questionnaire separately for ea establishment that produces gas turbine engines/transmissions in the United State (Please photocopy the questionnaire as necessary.) The questionnaire is organized ir five Parts as follows:

Part I	Receipt and Usage of Bearings
Part II	Leadtimes
Part III	Sole and Single Sourcing
Part IV	Foreign Sourcing
Part V	Importance of a Domestic Bearing Industry

Note: BEARINGS USED IN, OR IN SUPPORT OF, FOREIGN MILITARY SALES, DEFENSE RELATED LICENSE AGREEMENTS, OR OFFSET AGREEMENTS ARE TO BE INCLUDED AS DEFENSE BEARINGS.

2. It is not our desire to impose an unreasonable burden on any respondent. IF INFORMATION NOT READILY AVAILABLE FROM YOUR RECORDS IN EXACTLY THE FORM REQUESTED, FURNISH ESTIMA AND DESIGNATE BY THE LETTER "E". Comments or explanations should be supplied in the spa provided or on separate sheets attached to this questionnaire. Ensure that you referer the proper question if you use extra sheets. If any answer is "none", please indicat Before completing the questionnaire, please read the definitions on the next page.

3. A file copy of the questionnaire is enclosed for your records. While it would be convenience to the Government for a file copy to be made and retained for referer purposes, no assurances can be provided that file copies are exempt from compulsc examination pursuant to some future legal process.

4. Questions related to the questionnaire should be directed to Mr. Ed Graham, Chie Industrial Preparedness Branch, (215) 697-2725, Defense Industrial Supply Center, Defer Logistics Agency, Mr. Mike Mead, Propulsion Engineering Manager (202) 692-2613, Departme of the Navy, or Major Terry Gower, Senior Program Analyst (513) 257-2622, Headquarters, A Force Logistics Command.

5. Information furnished in response to this questionnaire will be treated as proprietary and will not be published or otherwise divulged to reveal the operations of individual firms.

Return completed questionnaire by March 21, 1986 to:

Department of the Air Force
HQ, AFLC/XRPD
Gilmore Hall, Post 211Q
Attn: Major Terry Gower
Wright-Patterson AFB
Dayton, OH 45433-5001

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PART I - A. TOTAL NON-DEFENSE BEARING RECEIPTS

For the size and quality standards indicated below, enter the total (i.e., domestic and foreign origin) units and dollar value of non-defense bearings delivered for use in your engine/transmission manufacturing activities in 1981, 1983 and 1985.

(in thousands of units and thousands of dollars)

	1981		1983		1985	
	(units)	($000s)	(units)	($000s)	(units)	($000s)
Radial Ball Bearings (including self-aligning)						
Below 9-30 mm O.D. (ABEC 1 and over)	____	____	____	____	____	____
Over 30 mm O.D. (ABEC 1 and 3)	____	____	____	____	____	____
ABEC 5 and Over						
Over 30-52 mm O.D.	____	____	____	____	____	____
Over 52-100 mm O.D.	____	____	____	____	____	____
Over 100-170 mm O.D.	____	____	____	____	____	____
Over 170-240 mm O.D.	____	____	____	____	____	____
Over 240-580 mm O.D.	____	____	____	____	____	____
Over 580 mm O.D.	____	____	____	____	____	____
Roller Bearings						
0-2" O.D. (RBEC 1 and over)	____	____	____	____	____	____
Over 2" O.D. (RBEC 1 and 3)	____	____	____	____	____	____
RBEC 5 and Over						
Over 2-4" O.D.	____	____	____	____	____	____
Over 4-6" O.D.	____	____	____	____	____	____
Over 6-8" O.D.	____	____	____	____	____	____
Over 8-10" O.D.	____	____	____	____	____	____
Over 10" O.D.	____	____	____	____	____	____

PART I - B. IMPORTED NON-DEFENSE BEARING RECEIPTS

For the size and quality standards indicated below, enter the imported units and dollar value of non-defense bearings delivered for use in your engine/transmission manufacturing activities in 1981, 1983 and 1985.

(in thousands of units and thousands of dollars)

	1981		1983		1985	
	(units)	($000s)	(units)	($000s)	(units)	($000s)
Radial Ball Bearings (including self-aligning)						
Below 9-30 mm O.D. (ABEC 1 and over)	____	____	____	____	____	____
Over 30 mm O.D. (ABEC 1 and 3)	____	____	____	____	____	____
ABEC 5 and Over						
Over 30-52 mm O.D.	____	____	____	____	____	____
Over 52-100 mm O.D.	____	____	____	____	____	____
Over 100-170 mm O.D.	____	____	____	____	____	____
Over 170-240 mm O.D.	____	____	____	____	____	____
Over 240-580 mm O.D.	____	____	____	____	____	____
Over 580 mm O.D.	____	____	____	____	____	____
Roller Bearings						
0-2" O.D. (RBEC 1 and over)	____	____	____	____	____	____
Over 2" O.D. (RBEC 1 and 3)	____	____	____	____	____	____
RBEC 5 and Over						
Over 2-4" O.D.	____	____	____	____	____	____
Over 4-6" O.D.	____	____	____	____	____	____
Over 6-8" O.D.	____	____	____	____	____	____
Over 8-10" O.D.	____	____	____	____	____	____
Over 10" O.D.	____	____	____	____	____	____

PART I - C. TOTAL DEFENSE BEARING RECEIPTS

For the size and quality standards indicated below, enter the total (i.e., domestic and foreign origin) units and dollar value of defense bearings delivered for use in your engine/transmission manufacturing activities in 1981, 1983 and 1985.

(in thousands of units and thousands of dollars)

	1981		1983		1985	
	(units)	($000s)	(units)	($000s)	(units)	($000s)
Radial Ball Bearings (including self-aligning)						
Below 9-30 mm O.D. (ABEC 1 and over)	____	____	____	____	____	____
Over 30 mm O.D. (ABEC 1 and 3)	____	____	____	____	____	____
ABEC 5 and Over						
Over 30-52 mm O.D.	____	____	____	____	____	____
Over 52-100 mm O.D.	____	____	____	____	____	____
Over 100-170 mm O.D.	____	____	____	____	____	____
Over 170-240 mm O.D.	____	____	____	____	____	____
Over 240-580 mm O.D.	____	____	____	____	____	____
Over 580 mm O.D.	____	____	____	____	____	____
Roller Bearings						
0-2" O.D. (RBEC 1 and over)	____	____	____	____	____	____
Over 2" O.D. (RBEC 1 and 3)	____	____	____	____	____	____
RBEC 5 and Over						
Over 2-4" O.D.	____	____	____	____	____	____
Over 4-6" O.D.	____	____	____	____	____	____
Over 6-8" O.D.	____	____	____	____	____	____
Over 8-10" O.D.	____	____	____	____	____	____
Over 10" O.D.	____	____	____	____	____	____

PART I - D. IMPORTED DEFENSE BEARING RECEIPTS

For the size and quality standards indicated below, enter the imported units and dollar value of defense bearings delivered for use in your engine/transmission manufacturing activities in 1981, 1983 and 1985.

(in thousands of units and thousands of dollars)

	1981		1983		1985	
	(units)	($000s)	(units)	($000s)	(units)	($000s)
Radial Ball Bearings (including self-aligning)						
Below 9-30 mm O.D. (ABEC 1 and over)	____	____	____	____	____	____
Over 30 mm O.D. (ABEC 1 and 3)	____	____	____	____	____	____
ABEC 5 and Over						
Over 30-52 mm O.D.	____	____	____	____	____	____
Over 52-100 mm O.D.	____	____	____	____	____	____
Over 100-170 mm O.D.	____	____	____	____	____	____
Over 170-240 mm O.D.	____	____	____	____	____	____
Over 240-580 mm O.D.	____	____	____	____	____	____
Over 580 mm O.D.	____	____	____	____	____	____
Roller Bearings						
0-2" O.D. (RBEC 1 and over)	____	____	____	____	____	____
Over 2" O.D. (RBEC 1 and 3)	____	____	____	____	____	____
RBEC 5 and Over						
Over 2-4" O.D.	____	____	____	____	____	____
Over 4-6" O.D.	____	____	____	____	____	____
Over 6-8" O.D.	____	____	____	____	____	____
Over 8-10" O.D.	____	____	____	____	____	____
Over 10" O.D.	____	____	____	____	____	____

PART II - LEADTIMES

1. Have you in the past five years experienced extended leadtimes or shortages in obtaining any precision bearing that forced you to modify or curtail your operations?

yes _____, no _____

If yes identify the nature and duration of the problem on your operation and the action you took to resolve the situation.

_____

_____

_____

_____

_____

2. For non-defense bearings received during 1985, what was your average leadtime (i.e., from placement of new order to initial delivery from supplier) for:

	Domestically Produced	Foreign Produced
Precision Bearings:	_____weeks	_____weeks
Other Bearings:	_____weeks	_____weeks

3. In your experience, how do the following influence leadtimes:

		Increases Leadtimes	Decreases Leadtimes
a.	Larger order quantities	_____	_____
b.	Orders at regular intervals	_____	_____
c.	Greater complexity of the bearing	_____	_____
d.	Longer term contractual arrangements	_____	_____
e.	Historic relationship with supplier	_____	_____
f.	Other (specify)	_____	_____

4. **LEADTIMES - DOMESTICALLY PRODUCED BEARINGS FOR DEFENSE:** Enter below by size and quality group the average leadtimes (in weeks) you experienced in 1985 for domestically produced bearings used in defense systems. In the last three columns, enter the bearing part number within each group with the longest average leadtime, its leadtime, and the quantity of that bearing received in 1985.

Size and Quality Group	Average Leadtime in 1985 (weeks)	Bearing Within Size Group with Longest Average Leadtime in 1985 (part number)	Longest Average Leadtime in 1985 (weeks)	Quantity of Longest Leadtime Bearing Received in 1985 (units)	($000)
Radial Ball Bearings (including self-aligning)					
Below 9-30 mm O.D. (ABEC 1 and over)					
Over 30 mm O.D. (ABEC 1 and 3)					
ABEC 5 and Over					
Over 30-52 mm O.D.					
Over 52-100 mm O.D.					
Over 100-170 mm O.D.					
Over 170-240 mm O.D.					
Over 240-580 mm O.D.					
Over 580 mm O.D.					
Roller Bearings					
0-2" O.D. (RBEC 1 and over)					
Over 2" O.D. (RBEC 1 and 3)					
RBEC 5 and Over					
Over 2-4" O.D.					
Over 4-6" O.D.					
Over 6-8" O.D.					
Over 8-10" O.D.					
Over 10" O.D.					

3. LEADTIMES - FOREIGN PRODUCED BEARINGS FOR DEFENSE: Enter below by size and quality group the average leadtimes (in weeks) you experienced in 1985 for foreign produced bearings used in defense systems. In the last three columns, enter the bearing part number within each group with the longest average leadtime, its leadtime, and the quantity of that bearing received in 1985.

Size and Quality Group	Average Leadtime in 1985 (weeks)	Bearing Within Size Group with Longest Average Leadtime in 1985 (part number)	Longest Average Leadtime in 1985 (weeks)	Quantity of Longest Leadtime Bearing Received in 1985 (units)	($000)
Radial Ball Bearings (including self-aligning)					
Below 9-30 mm O.D. (ABEC 1 and over)					
Over 30 mm O.D. (ABEC 1 and 3)					
ABEC 5 and Over					
Over 30-52 mm O.D.					
Over 52-100 mm O.D.					
Over 100-170 mm O.D.					
Over 170-240 mm O.D.					
Over 240-580 mm O.D.					
Over 580 mm O.D.					
Roller Bearings					
0-2" O.D. (RBEC 1 and over)					
Over 2" O.D. (RBEC 1 and 3)					
RBEC 5 and Over					
Over 2-4" O.D.					
Over 4-6" O.D.					
Over 6-8" O.D.					
Over 8-10" O.D.					
Over 10" O.D.					

PART III - SOLE AND SINGLE SOURING

1. Identify domestically produced sole source or single source precision bearings by size group used in your defense production operations and name the firm supplying the bearings. Give the reason(s) for sole or single sourcing (e.g., small volumes, technical complexity, only one source available, etc.). State how much time would be needed to qualify an alternative supplier.

2. Identify foreign produced sole source or single source precision bearings by size group used in your defense production operations and name the firm supplying the bearings. Identify the supplier and give the reason(s) for sole or single sourcing (e.g., small volumes, technical complexity, offset agreements, etc.). State how much time would be needed to qualify an alternative supplier.

PART IV - FOREIGN SOURCING

1. How many qualified foreign sources for precision bearings did you have at the end of:

   1980?_____ 1985?_____

   How many additional foreign sources do you estimate will be qualified by the end of:

   1986?_____ 1987?_____ 1990?_____

2. How has foreign sourcing effected your inventory policies for precision bearings?

3. In recent years, how have offset agreements affected your purchase and/or use of bearings (cite examples)?

4. Are you engaged in any joint ventures or other arrangements (excluding offsets) with foreign firms that impact either directly or indirectly on the U.S. Bearings Industry.

   yes_____, no_____

   If yes, please explain:_____

FOREIGN SOURCES - Please provide the name and compl[illegible] the table below for each foreign source from which you obtain bearings for defense or non-defense applications, or both. For the column headings "Reason(s) Foreign Sources Used" and "Competitive Advantage(s) Over U.S. Based Production", please use the letter codes given below. Use as many of the codes for the named foreign source as applicable. Any qualifying comments can be made on the next page.

Reasons Foreign Source Used

a. Competitive advantages over U.S. firms
b. We were approached by foreign firm with an attractive offer
c. Part of an offset/countertrade agreement
d. Domestic source not available
e. Tied to a joint venture
f. Other (specify)

Competitive Advantages Over U.S. Based Production

a. Lower prices
b. Superior quality
c. Better performance
d. Better reliability
e. Shorter leadtime
f. More responsive
g. Spare parts availiability
h. Superior design and engineering capabilities
i. Government supports
j. Other (specify)

Name of Foreign Source	Country of Origin	Year First Used	Name of Qualified Domestic Source	Reason(s) Foreign Sources Used (see codes)	Competitive Advantage(s) Over U.S. Based Production (see codes)	1985 Dollar Value Received Defense ($000)	Non-Defense ($000)

Qualifying comments about information on the table:

5. Have you engaged in any bearings research or bearing product development for neww applications with a foreign firm?

yes_____, no_____

If yes, please describe the nature of the arrangement and the reason why the arrangement was undertaken?

6. How would were firm be effected if the Government required you to use domestically produced bearings: a) for defense applications; b) for non-defense applications?

PART V - IMPORTANCE OF A DOMESTIC BEARING INDUSTRY

1. SECURITY OF SUPPLY - How important do you think a domestic capability to produce bearings is during a) peacetime b) a surge, and c) a mobilization? (see definitions of surge and mobilization)

2. TECHNOLOGY BASE - In your opinion, how important to the technological advancement and product development of bearings is a domestic bearing manufacturing capability?

3. SUBSTITUTION - In what ways, if any, can your requirements for bearings be reduced without sacrificing the performance of your defense engine systems (e.g., new designs, simpler products, fewer moving parts, etc.)?

4. What recommendations could you offer that would help the U.S. Bearing Industry be more competitive with foreign manufactured bearings, and also be more responsive to your requirements?

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 Telephone Number	(Type or Print Name and Title of Authorized Official)
Area Code and Telephone Number	(Type or Print Name and Title of Person to Contact Regarding this Report)

Comments: Please use the space below to provide any additional comments or information you may wish regarding the U.S. Bearings Industry, foreign sourcing, international relationships, or other related issues that impact your firm.

QUESTIONNARIE

FOR THE BEARING AND ENGINE MANUFACTURERS VISITS

1. What are your perceptions of the problems confronting the U.S. domestic bearing industry?

2. Do you feel that we have addressed the major problems that face the U.S. Bearing Industry in our questionnaire?

3. What additional concerns should we be addressing?

4. Can the U.S Bearing Industry compete with foreign bearing producers in the U.S. and/or foreign markets?

5. What steps should be taken by the U.S. government to strengthen the domestic bearing industry? e.g. Economic Recovery Tax Act of 1981. Accelerated Cost Recovery System; Investment Tax Credit; R&D Tax Credit; Effective Corporate Tax Rate; Small Business Innovation Development Act of '82; Federal Sales Corporation Act.

6. Is some type of protectionist legislation/regulation the answer, eg: domestic purchase requirements; increased tariffs on foreign imports; reduced import allowances; change in tax laws; etc?

7. What will be the economic impact of imposing trade restrictions/tariffs on the importation of foreign steel on the domestic bearing industry?

8. What is/has been the effect of foreign takeovers of U.S. Bearing Companies? What in your opinion will happen if the current trend continues without government intervention?

9. In your opinion what role should the U.S. Government assume in efforts to preserve a domestic bearing industry?

10. Can/will the U.S Bearing Industry continue to produce the required precision bearings for military applications without a strong commercial base for high production run commercial bearings?

11. Should a national plan be established and implemented that would ensure domestic sources for all raw materials and component parts used in the manufacture and protection of precision ball/roller bearings?

12. Should the DOD continue to help industry fund projects under such programs as "Tech Mod", Title III", or "IMIP"? Will programs of this type significantly help the bearing industry survive, and/or compete with foreign bearing producers?

13. Do multi-national bearing companies that operate manufacturing plants in the U.S. and in foreign countries present "unfair" cost/manufacturing advantages over bearing companies that operate only in the U.S.? If so, what?

14. What about bearing refurbishment? Do you see this as a viable alternative to supply problems?

15. What about future decisions to qualify & procure foreign bearings for military use?

BEARING STEEL SURVEY

1. What is your current annual manfacturing capacity of steel used in ball/roller bearings?

Classify by steel type:
- AISI 52100 Bearing steel
- AISI 440C Corrosion resident steel
- M50 Tool steel
- M50 NIL Tool steel mod with nickel
- Case Hardened steels
- Other

NOTE: Differentiate VIMVAR double vacuum melted steel from AIRMELT steel

2. What is your current production utilization (percentage) of your capacity by type?

3. What is the estimated percentage of current steel producation/annual business that is in support of military application, by type?

4. What is your surage capacity to meet military requirements in a national emergency? (3,6,12 months)

5. Do you plan to increase your capacity to produce bearing quality steel? If so, how much? and what type?

6. What is the dollar value and quanity of the bearing quality steel produced by your company?

7. What is your current production processing time for bearing quality steel? What are the current leadtimes for producing bearing quality steel after receipt of order? Are they increasing/descreasing? If they are increasing what are the reasons/causes?

8. How would reduced production of U.S Bearings affect your company in continued productions of bearing quality steel? Short term/long term?

9. If enacted, how would requiring domestic procurement of bearings for the military affect your company?

10. What steps/actions do you feel need to be taken to ensure the continuance of a strong and viable domestic bearing manufacturing base that will/can meet the needs of the military and commercial bearing markets for precision ball and roller bearings?

11. Do you import foreign produced steel for resale to supplement domestic steel productions? If yes, explain.

Bearing Forgings Survey

1. What is your current annual manufacturing capacity of forgings used in the manufacture of ball/roller bearings?

Classify by steel type: M50 tool steel
M50 NIL tool steel mod. with nickel
Other?

2. What is your current production utilization (percentage) of your capacity by size?

3. What is the estimated percentage of current forging production/annual business that is in support of military applications, by size?

4. What is your surge capacity to meet military requirements in a national emergency? (3, 6, 12 months)

5. Do you plan to increase/decrease your capacity to produce bearing quality forgings? If so, how much?

6. What is the dollar value and quantity of the bearing quality forgings produced by your company?

7. What is the manufacturing process time for producing bearing quality forgings? What are the current leadtimes for producing forgings after receipt of order? Are they increasing/decreasing? If they are increasing what are the reasons/causes?

8. How would reduced production of U.S. domestically produced bearings affect your company in the continued production of bearing quality forgings? Short term/long term?

9. Who are your sources of supply (domestic/imported), for the steel used in the manufacture of bearing quality forgings?

a. If the steel is imported, why? (price, availability, quality)
What is the percentage of imported steel vs domestic steel?

b. How much of an inventory of M50, M50 NIL or other bearing steel do you maintain?

c. How long could you maintain bearing forging production if supplies were cut off?

d. What can be done to improve the availability of the proper type and quality steel used by your company in the production of bearing quality forgings?

e. What would happen if foreign sources of steel were cut off?

10. If enacted, how would requiring the domestic procurement of bearings for the military affect your company?

11. If enacted, how would requiring domestic procurement of steel affect your company?

12. If enacted, how would increased tariffs and/or reduced import allowances on foreign produced steel affect your company?

13. What steps/actions do you feel need to taken to ensure the continuance of a strong and viable domestic bearing manufacturing base that will/can meet the needs of the military and commercial bearing markets for precision ball/roller bearings?

QUESTIONS FOR THE MACHINE TOOL INDUSTRY
CONCERNING BEARINGS USED IN PRODUCTION

SCOPE/APPLICATION OF THE QUESTIONNAIRE:

Precision Ball and Roller Bearings Over 30mm Outer Diameter.
(ABEC 5/7/9 and RBEC 5/7)

1. What is the annual dollar value of precision bearings purchased for use by your company?

2. Who are the domestic sources for precision bearings used by your company?

3. Are you using foreign manufactured precision bearings in machines manufactured by your company?

If yes, a. What is the quantity/percentage used?
b. Is the use of foreign bearings increasing/decreasing?
c. What are the sources/manufacturers?
d. Identify any domestic sources for foreign bearing purchases.
e. What will you do in the event your foreign sources are cutoff?

4. What are your reasons for buying foreign bearings in lieu of domestically manufactured bearings?

a. Cost less?
b. Shorter leadtimes? How much?
c. Longer life? How much?
d. Trade agreements?
e. Offset agreements?
f. Other?

5. What new applications are you planning to qualify/utilize foreign bearings in the future? Why?

6. Do you believe the U.S. Bearing Industry is competitive with the foreign manufacturers? If not, what do you believe are the reasons for the U.S. Bearing Industry not being competitive with foreign sources?

7. How can the U.S. Government help to make the U.S. Bearing Industry more competitive?

   a. If the Government places a requirement on procurements for military applications to require domestic purcheses, how would it affect your company?

   b. Other?

7. What actions can the U.S. Machine Tool Manufacturers take to help the U.S. Precision Bearing Industry better meet your requirements?

8. What actions could the U.S. Government take that would help the manufacturers meet military requirements that would also aide the U.S. Bearing Industry?

9. What recommendations could you offer that would help the U.S. Bearing Industry be more competitive with foreign manufactured bearings, and also be more responsive to your requirements?

10. Do your have a contingency plan in the case of foreign bearing source cutoff?

Retainer Manufactures Survey

1. What is your current total annual manufacturing capacity of bearing retainers?

2. What is your current annual manufacturing capacity of retainers devoted to precision bearings over 30mm outer diameter?

3. What is your current production utilization (percentage) of your capacity, by size?

4. What is your current bearing retainer production/annual business that is in support of military applications, by size?

5. What is your surge capacity to meet military requirements in a national emergency? (3, 6, 12 months)

   a. Can your raw material suppliers surge to meet your requirements in a surge situation?

   b. Do you have any foreign suppliers/sole source suppliers that limit your ability to surge?

6. Do you have any plans to increase/decrease your capacity for producing bearing retainers?

   a. What are those plans, and how much of an increase in production capacity will be realized?

7. What is the dollar value and quantity of bearing retainers produced by your company?

8. Who do you currently supply bearing retainers to in the U.S./foreign countries?

9. What is the manufacturing process time for producing bearing retainers? What are the current leadtimes for producing bearing retainers after receipt of order? Are they increasing/decreasing? If they are increasing/decreasing what are the reasons/causes?

10. Identify current production problems that may be contributing to the long leadtimes. Is there any current action/planned action to correct these problem areas?

BALL MANUFACTURING SURVEY

1. What is your current total annual manufacturing capacity of balls?

2. What is your current annual manufacturing capacity of balls devoted to precision bearings over 30mm outer diameter? Precision: Grade 25 and Grade 10. Size: 7/32 nds and larger.

3. What is your current production utilization (percentage) of your capacity, by size?

4. What is the percentage of current ball production/annual business that is in support of military applications, by size?

5. What is your surge capacity to meet military requirements in a national emergency? (3,6,12 months).

   a. Can your raw material suppliers surge to meet your requirements in a surge situation?

   b. Do you have any foreign suppliers/sole source suppliers that limit your ability to surge?

6. Do you plan to increase/decrease your capacity for producing balls?

   a. What are those plans, and how much of an increase in production capacity will be realized?

7. What is the dollar value and quanity of balls produced by your company?

8. What is the manufacturing process time for producing balls? What are the current leadtimes for producing balls after receipt of order? Are they increasing/decreasing? If they are increasing what are the reasons/causes?

9. Identify current production problems that may be contributing to the long leadtimes. Is there any current action/planned action to correct these problem areas?

10. Are you currently involved in a government sponsored modernization program? Are you planning to participate in one?

11. Who is your source of supply (domestic or imported), for the following steel types?

    AISI 52100 AISI 440C M50

   a. If steel is imported, why? (Price, availability, quality) What is the percentage of imported steel vs domestic steel?

   b. How much of an inventory of M50/440c/52100 steel do you maintain?

   c. How long could you maintain ball production if supplies were cut off?

   d. What can be done to improve availability of the proper type and quality steel used by your company?

   e. What would happen if foreign sources of steel were cut off?

13. If enacted, how would requiring domestic procurement of steel affect your company?

14. If enacted, how would increased tariffs and/or reduced import allowances on foreign produced steel affect your company?

15. How would reduced production quantities of bearings by the U.S. domestic ball bearing industry affect your company?

16. What steps/actions do you feel need to be taken to ensure the continuance of a strong and viable domestic manfacturing base that will/can meet the needs of the military and commercial bearing markets for precision ball bearings?

APPENDIX F

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