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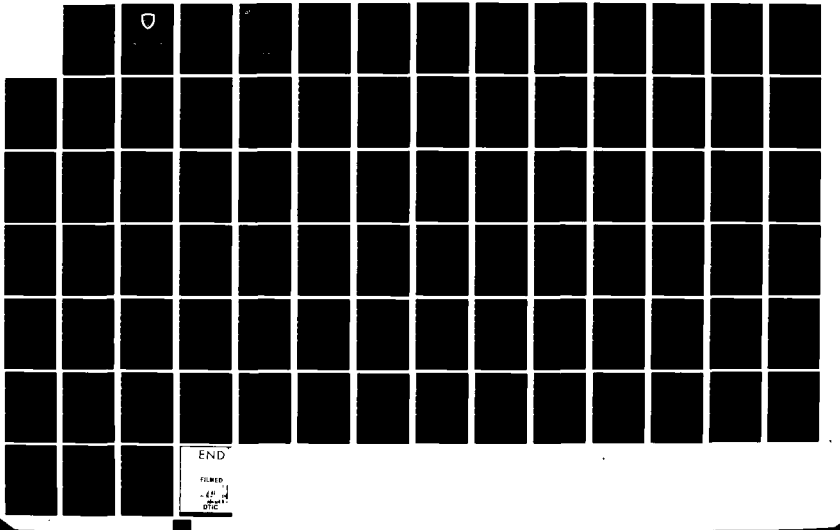

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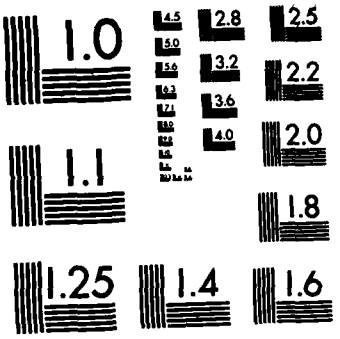

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DARCOM METAL REMOVAL WORKING GROUP

1982 ANNUAL REPORT

PREPARED FOR

DARCOM DIRECTORATE FOR MANUFACTURING TECHNOLOGY
ALEXANDRIA, VIRGINIA 22333

BY

USA INDUSTRIAL BASE ENGINEERING ACTIVITY
MANUFACTURING TECHNOLOGY DIVISION
ROCK ISLAND, ILLINOIS 61299

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)* This document summarizes the activities of the DARCOM Metal Removal Working Group for 1982. It contains an analysis of the metal removal Manufacturing Methods and Technology (MMT) program and outlines recommendations for technology areas which should be addressed in future metal removal MMT projects. Also included are summaries for all metal removal projects planned or funded from FY 70 through FY 84.		

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DEPARTMENT OF THE ARMY
US ARMY INDUSTRIAL BASE ENGINEERING ACTIVITY
ROCK ISLAND, ILLINOIS 61299

REPLY TO
ATTENTION OF:

DRXIB-M

14 MAR 1983

SUBJECT: DARCOM Metal Removal Working Group 1982 Annual Report

SEE DISTRIBUTION

1. Reference DARCOM-R 15-21, DARCOM Metal Removal Working Group, dated 3 September 1976.

2. The Metal Removal Working Group (MRWG) Annual Report summarizes the activities of the MRWG for 1982 and presents their recommendations for metal removal technologies to be pursued in future Manufacturing Methods and Technology (MMT) projects. The Report also contains a summary of all metal removal MMT projects initiated since 1970, with each project categorized according to a technology thrust area. Funding data is summarized for each major thrust area and for completed, active, and planned projects. The funding shown in Figure 2, however, does not reflect recent changes in FY83 and FY84 MMT Budgets.

3. Comments on this Report are welcomed and should be sent to the Chairman of the MRWG, Mr. Alan Peltz, US Army Industrial Base Engineering Activity, DRXIB-MM, Rock Island, IL 61299.

4. Until a limited supply is exhausted, additional copies of the report may be obtained by contacting Mr. Peltz. Copies may also be obtained by sending a written request to the Defense Technical Information Center, ATTN: TSR-I, Cameron Station, Alexandria, VA 22314.

FOR THE DIRECTOR:

JAMES W. CARSTENS
Chief, Manufacturing Technology Division

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INTRODUCTION AND BACKGROUND

The Metal Removal Working Group was formally established by DARCOM in 1976. At that time, several observations could be made concerning the Army's Manufacturing Technology Program. During the 1960's the Army had pursued proportionately more work in the area of metal removal and sponsored considerable work in establishing applications for numerically controlled machine tools. In the 1970's this work expanded to include the application of numerical control to processes other than metal removal, computer-aided manufacturing became the technology of interest, and there was a corresponding reduction in the funding of efforts undertaken to improve metal removal operations. At the same time, net and near net shape processes were being emphasized, thereby contributing further to the downward pressure on metal removal funding levels.

By 1977, only three percent of the total Manufacturing Technology Program was being directed toward metal removal technology and it had become clear that a forum was needed to focus attention upon the low level of Manufacturing Technology associated with metal removal processes and to coordinate the DARCOM Metal Removal Program. The Metal Removal Working Group was therefore established to coordinate metalcutting activities at the operational level and serve as a means of exchanging information among Army activities relative to metalcutting efforts, to identify significant metalcutting problems, to recommend metalcutting efforts with high potential payoff, and to provide long range plans for the development of metalcutting technology.

1982 ACCOMPLISHMENTS AND 1983 GOALS

Activities of the DARCOM Metal Removal Working Group for 1982 may be summarized as follows:

- MEMBERSHIP ROSTER UPDATED.
- DRAFT REVISION TO DARCOM-R 15-21, DARCOM METAL REMOVAL WORKING GROUP, DEVELOPED.
- PLANS FOR END-OF-PROJECT DEMONSTRATION DEVELOPED.
- AGENDA FOR 1982 MRWG ANNUAL MEETING DEVELOPED.
- END-OF-PROJECT DEMONSTRATION FOR MMT PROJECT 5 80 6738 ATTENDED BY MRWG MEMBERSHIP.
- METAL REMOVAL THRUST AREA SCHEME DEVELOPED TO SUPPORT REVIEW AND DISCUSSION OF METAL REMOVAL MMT PROJECTS.
- 1982 ANNUAL MEETING HELD 3-4 NOVEMBER 1982 AT SPRINGFIELD, VERMONT.
- RECOMMENDATIONS FOR FUTURE METAL REMOVAL PROJECTS DEVELOPED.
- PLANS DEVELOPED FOR 1983 ANNUAL MEETING.

The membership roster, proposed revision to DARCOM-R 15-21, 1982 Metal Removal Working Group meeting agenda, summaries for the end-of-project demonstration and annual meeting, and metal removal project summaries are contained in the appendixes to this report. It is noted that DARCOM-R 15-21 was revised in order to reflect organizational changes which have occurred since it was originally published in 1976 and to modify the functional requirements of the Metal Removal Working Group in view of the experience gained during its first five years of operation.

For 1983 the following actions have been targeted for the Metal Removal Working Group:

- EVALUATION OF WORK GENERAL ELECTRIC COMPANY WISHES TO PURSUE IN THE AREA OF TOOL CONDITION MONITORING AND DIAGNOSTICS.
- REVIEW AND EVALUATION OF KENNAMETAL'S TOOL MANAGEMENT PROGRAM (STANDARDIZATION).
- SPONSOR BRIEFING BY METCUT RELATIVE TO THEIR UNSOLICITED PROPOSAL --CENTRALIZED MACHINING TECHNOLOGY DATA BASE. COMPLETE ANALYSIS OF PROPOSAL AND FORMALIZE AN ARMY POSITION.
- ARRANGE FOR TOUR OF M1 TANK PRODUCTION FACILITIES AT LIMA, OH OR WARREN, MI.

- DEVELOP PLANS FOR AN END-OF-PROJECT DEMONSTRATION FOR TACOM MMT PROJECT 4 83 5090--IMPROVED AND COST EFFECTIVE MACHINING TECHNOLOGY.

- CONDUCT A METAL REMOVAL WORKING GROUP MEETING IN THE FALL OF 1983 TO REVIEW THE STATUS OF PROJECTS DEVELOPED IN SUPPORT OF RECOMMENDATIONS OF THE 1982 MEETING AND TO EVALUATE THE PROGRESS MADE TOWARD COMPLETING 1983 ACTION ITEMS.

ANALYSIS OF METAL REMOVAL MMT PROGRAM

In order to facilitate review and analysis of the metal removal program, projects were categorized using a thrust area scheme developed by the Metals Subcommittee of the Manufacturing Technology Advisory Group, shown in Figure 1. As can be seen from Figure 1, this thrust area scheme represents a pictorial overview of the technologies associated with the metal removal program. It was used to provide a basis for discussions of the metal removal program and for the development of recommendations for future technologies to be pursued in the metal removal MMT program.

Figure 2, "Overview of Total Army and Metal Removal MMT Program," shows funding for the total MMT program and for metal removal related projects from FY70 through FY84. For each of these years, the metal removal program is also depicted as a percentage of the total Army MMT program. As can be seen from Figure 2, the funding for metal removal projects was maintained at a fairly low level from FY70 to FY78, averaging approximately $750,000 per year - slightly over one percent of total Army MMT program for those years. Since FY79, funding for metal removal related projects has averaged approximately seven million dollars - slightly over six percent of the total Army MMT program for those years. Expressed as a percentage of the total MMT program, metal removal related project funding peaked at 9.8 percent in FY80. It has been trending downward since that time and is projected to be 3.2% of the FY84 MMT program.

Figure 3, "Metal Removal Thrust Area Summary," shows the funding levels for the major thrust areas associated with the metal removal program. It has been divided into three sections in order to show data for completed, active, and planned projects.

As can be seen in Figure 3, 58 percent of all metal removal projects planned or funded since FY70 are currently active, on the basis of dollars, with 14 percent of the total program since FY70 completed and 28 percent being planned for FY83 and FY84.

Two major thrust areas, "Improved Metal Removal Rates" and "Improvement of Current Process Technology," account for 70 percent of the total metal removal program. These major thrust areas include both traditional and non-traditional machining processes applied to a wide variety of manufacturing operations employed in the production of Army materiel, and a wide range of projects designed to improve the overall efficiency of various manufacturing operations.

The third largest metal removal thrust area is "Computer Integrated Manufacturing Systems." Projects included in this area which were reviewed by the Metal Removal Working Group are those computer related projects which contain elements of an integrated or flexible manufacturing system and emphasize the development or improvement of machining operations related to a specific end item category. As can be seen from Figure 3, this thrust area has grown significantly since FY70 and now

Metal Removal Thrust Areas

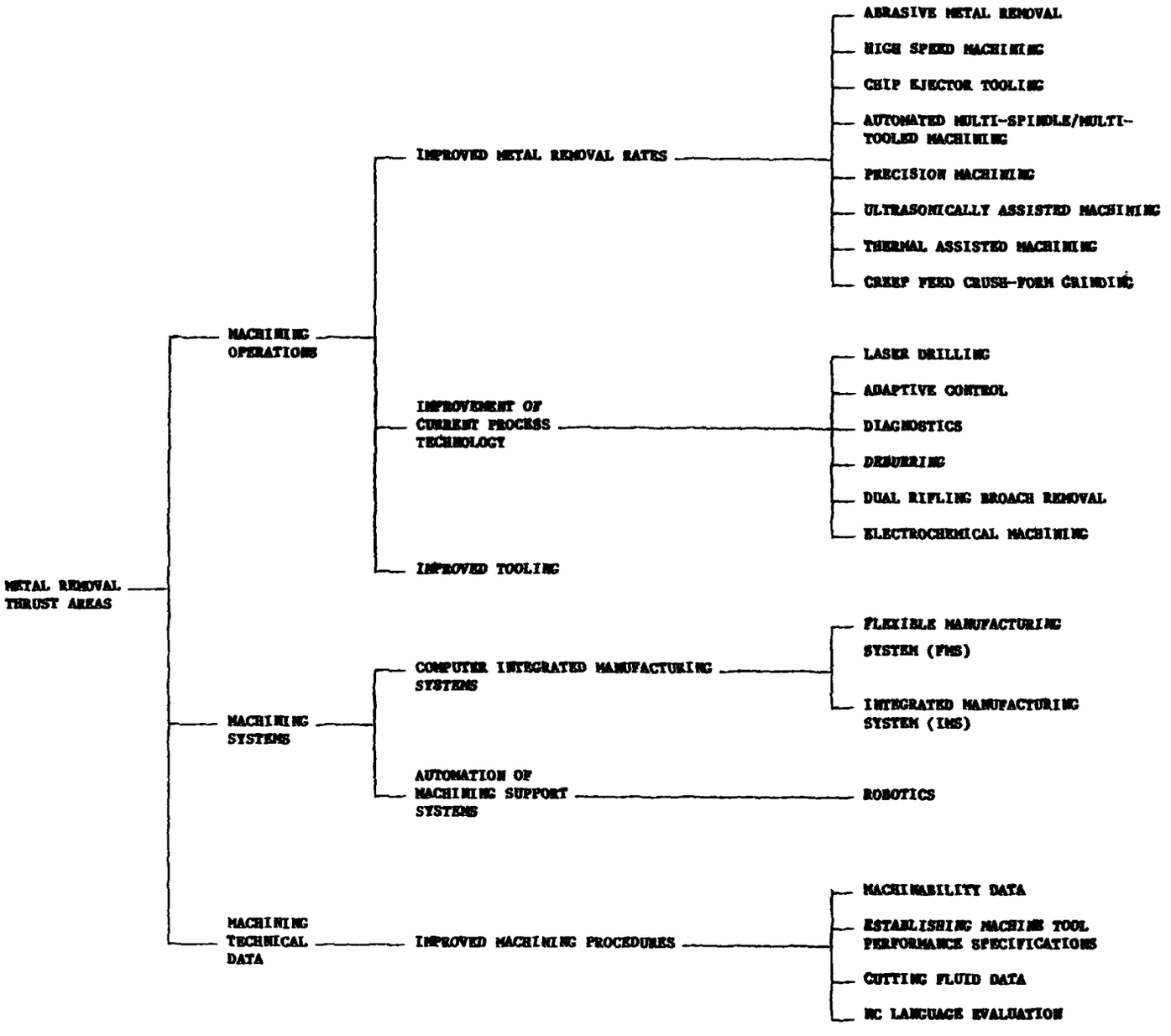

FIGURE 1. METAL REMOVAL THRUST AREAS.

OVERVIEW

TOTAL ARMY AND METAL REMOVAL MMT PROGRAM

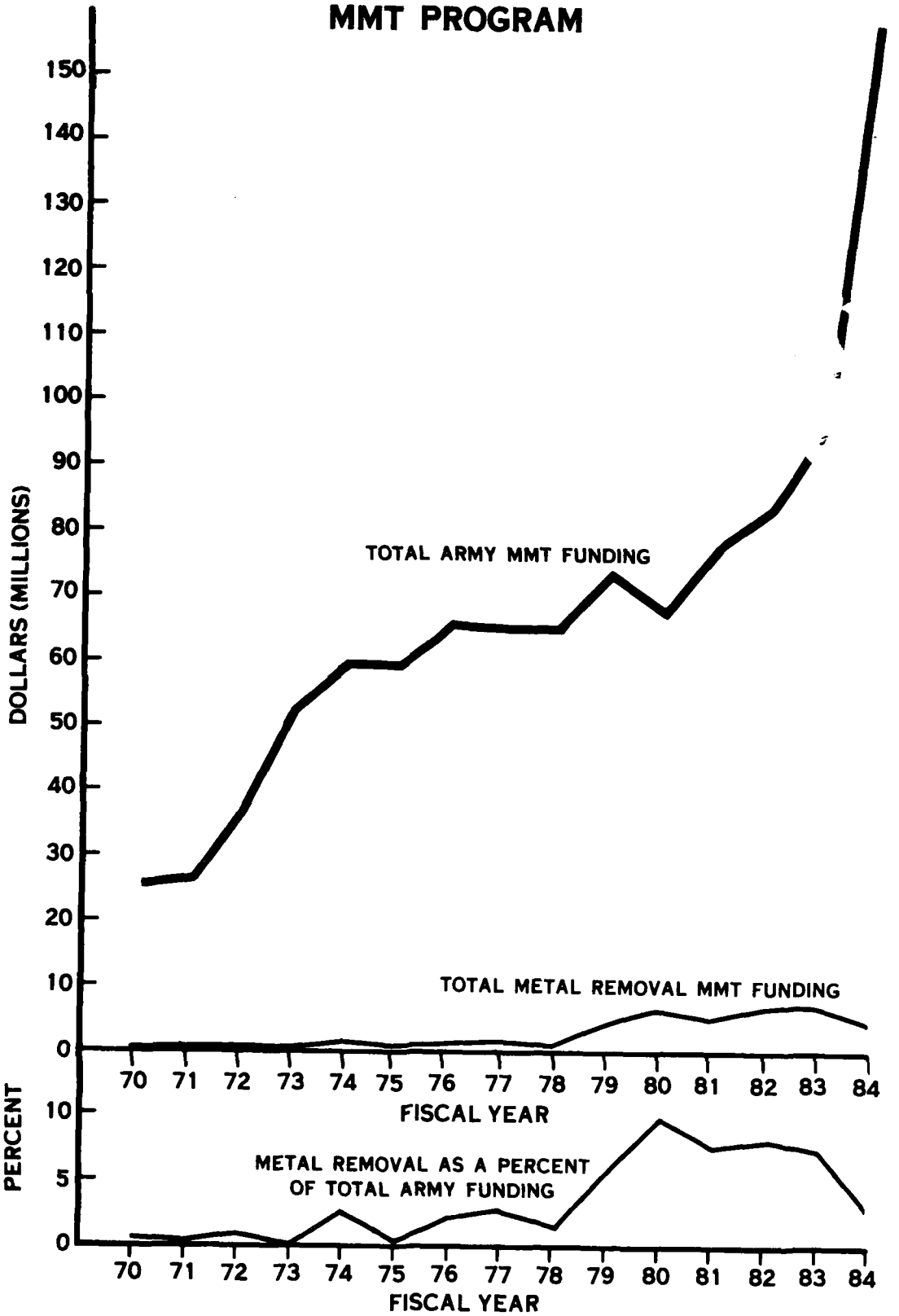

FIGURE 2. OVERVIEW OF TOTAL ARMY AND METAL REMOVAL MMT PROGRAM.

comprises approximately one-sixth of the total active or planned metal removal program. It is expected that it will continue to grow as the MMT program supports the introduction and application of metal removal projects utilizing the concepts of flexible and integrated manufacturing systems.

"Improved Machining Procedures" is the fourth largest metal removal thrust area. It includes projects for the development of data related to machining feeds and speeds, cutting fluids, NC programming languages, tolerances and surface finishes, and machine tool performance specifications. As can be seen from Figure 3, the amount of dollars programmed for this thrust area has been decreasing at a fairly consistent rate.

"Improved Tooling" and "Automation of Machine Support Systems" are the two smallest metal removal thrust areas and together account for only five percent of the total metal removal program since 1970. The Metal Removal Working Group membership recognizes the importance of these two thrust areas and has addressed them in their recommendations relative to future metal removal projects which should be pursued in the Army's MMT program.

METAL REMOVAL THRUST AREAS

	COMPLETED SINCE FY70		ACTIVE		PLANNED FOR FY83 AND FY84		TOTAL METAL REMOVAL PROGRAM	
	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent
Improved Metal Removal Rates	2168	36	5016	20	3736	31	10920	25
Improvment of Current Process Technology	2540	43	11484	46	5245	43	19269	45
Improved Tooling	244	4	888	3	790	6	1922	4
Computer Integrated Manufacturing Systems	40	1	4800	19	1849	15	6689	16
Automation of Machining Support Systems	0	0	400	2	0	0	400	1
Improved Machining Procedures	925	16	2402	10	625	5	3952	9
TOTAL METAL REMOVAL PROGRAM	5917	14	24990	58	12245	28	43152	100

Figure 3 - Funding for Metal Removal Thrust Areas

RECOMMENDATIONS

In the development of recommendations for future work which should be pursued in the Army's Metal Removal MMT Program, the membership felt that the MMT program should continue to support efforts for the development of machining data in order to identify and document optimum combinations of tool material, tool geometry, and feeds and speeds, with particular attention to O.D. turning, I.D. turning, drilling and milling operations. In this general regard, the membership felt the Army should establish and maintain a strong program for continuing evaluation of new tooling materials and geometries for their potential application to high speed machining.

Recommendations for other technologies which should be supported by the MMT program are listed below:

* Develop tooling support sytems

* Integrate automated load and unload system

* Establish techniques for machining brittle high strength wear resistant materials, (i.e., ceramics)

* Identify and demonstrate specific applications for multiple operation tooling

* Optimize multi-spindle machining for large caliber weapons component production

* Investigate skiving, flo-peeling, and form turning for high metal removal rate potential

* Apply an active magnetic electrospindle to the high speed machining of large caliber weapons components.

* Identify and demonstrate a specific application for the ultrasonically assisted machining of tactical combat vehicle components.

* Apply emerging composite and ceramic tooling to the machining of superalloys employed in the production of aircraft components.

APPENDIXES

APPENDIX A

PROPOSED REVISION TO DARCOM-R 15-21

DARCOM METAL REMOVAL WORKING GROUP

DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 Eisenhower Ave, Alexandria, VA 22333

DARCOM REGULATION
No. 15-21

Boards, Commissions, and Committees

DARCOM METAL REMOVAL WORKING GROUP

1. Purpose. This regulation establishes and prescribes the mission, functions, and responsibilities of the US Army Materiel Development and Readiness Command (DARCOM) Metal Removal Working Group.

2. Scope. This regulation applies to Headquarters, DARCOM, DARCOM major subordinate commands, Army Materials and Mechanics Research Center, and the US Army Industrial Base Engineering Activity.

3. Definitions. Metal removal processes are defined as those processes used for the shaping or finishing of parts from work pieces produced by primary fabrication, and are otherwise known as conventional and nonconventional machining.

4. Mission. To provide recommendations to the Manufacturing Technology Directorate, HQ, DARCOM, for effecting the economic and technical benefits to be obtained by exploiting improvements in metal removal processes.

5. Functions. a. Coordinate efforts for improvement of metal removal technology at the project officer level.

b. Exchanges information among DARCOM activities for metal removal efforts.

c. Identifies and recommends significant efforts for the improvement of metal removal technology.

d. Provides long range plans for the development of metal removal technology.

6. Responsibilities. a. The Director for Manufacturing Technology (DMT), will designate a DARCOM representative to act as the chairman.

b. Commanders of DARCOM major subordinate commands/activities will, through their MMT Representatives, designate at least one individual as a member and will furnish the chairman with his name, office symbol, phone number, and changes thereto as they occur.

c. The Chairman of the Working Group will:

(1) Call and conduct an annual meeting.

(2) Publish minutes of the meeting.

(3) Assign tasks to the members of the group in order to accomplish the stated mission and functions.

(4) Arrange for presentations by industry, university, or other Government agency representatives, as required, to carry out the stated mission and functions.

(5) Furnish an annual report to the Director for Manufacturing Technology detailing the accomplishments, technology trends, and future plans for metal removal technology.

(6) Maintain appropriate records of the group activities.

d. Each member of the Working Group will:

(1) Provide the plans and status of their command's/installation's metal removal program.

(2) Attend and participate in meetings called by the Chairman.

(3) Perform tasks assigned by the Chairman.

(4) Coordinate working group recommendations within their activity.

(DRCMT)

FOR THE COMMANDER:

OFFICIAL:

W. H. SCHNEIDER
Major General, USA
Chief of Staff

G. J. HAROLD
LTC, GS
Adjutant General

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APPENDIX B

MEMBERSHIP ROSTER

DARCOM METAL REMOVAL WORKING GROUP

DARCOM METAL REMOVAL WORKING GROUP

MEMBER	ORGANIZATION	TELEPHONE NUMBER	MT REPRESENTATIVE	TELEPHONE NUMBER
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Gary Conlon	BENET WEAPONS LAB DRDAR-LCB-SE	AV 974-5737 (518) 266-5737	Donald J. Fischer	AV 880-2708 (201) 328-2708
William H. Deaver	TECOM DRSTE-AD-M	AV 283-2375 (301) 278-2375	John Gehrig	AV 283-3677 (301) 278-3677
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Gerald Gorline	AVRADCOM DRDAV-EGX	AV 693-1625 (314) 263-1625	Dan Haugan	AV 693-1625 (314) 263-1625

DARCOM METAL REMOVAL WORKING GROUP

MEMBER	ORGANIZATION	TELEPHONE NUMBER	MT REPRESENTATIVE	TELEPHONE NUMBER
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Jim Shindle	DESCOM DRSDS-RM-EIE	AV 242-6321 (717) 263-6321	Jim Shindle	AV 242-6321 (717) 263-6321

APPENDIX C

AGENDA

DARCOM METAL REMOVAL WORKING GROUP MEETING

3-4 NOVEMBER 1982

METAL REMOVAL WORKING GROUP MEETING AGENDA

* Introduction
* Agenda Overview
* Discussion of Metcut Unsolicited Proposal No. 382-84-2
* Discussion of Kennametal's "Standardization" Program
* Discussion of DARPA's Advanced Machining Research Program (AMRP) and AFWAL's Advanced Metal Removal Initiatives Program (AMRIP)
* Discussion of General Electric's work relative to in-process inspection, tool condition monitoring and diagnostics
* Discussion of Army metal removal MMT projects
* Development of recommendations relative to metal removal technology that should be exploited by the MMT program
* Development of plans for 1983 MRWG activities

APPENDIX D

SUMMARY OF DISCUSSIONS

DARCOM METAL REMOVAL WORKING GROUP MEETING

3-4 NOVEMBER 1982

SUMMARY OF DISCUSSION TOPICS FOR
METAL REMOVAL WORKING GROUP MEETING

Metcut Unsolicited Proposal - The general reaction from the membership was that the proposal is extremely ambitious. It outlines a very large undertaking and raises many questions. Mr. Cargo, TACOM; Mr. Conlon, Benet Weapons Laboratory; and Mr. Kirschbaum, RIA, each expressed interest in the proposal and have retained a copy of it for further evaluation. In conjunction with the Metcut Proposal Review, an article in the August 1982 issue of American Machinist titled, "Computerized Machining-Data Systems Compared," was made available to all attendees. Mr. Gary Conlon indicated Watervliet Arsenal has a $2 million effort which began in FY82 that is somewhat related to the Metcut proposal. He will review that effort to determine if it can or should be modified to support part of the Metcut proposal.

Mr. David Fuller, Kennametal Inc., had forwarded information to the Manufacturing Branch relative to their "Standardization" Program. All attendees were provided a copy of that literature. Several members expressed a desire to view the two-hour slide program Kennametal uses to introduce their Standardization Program to manufacturing facilities, possibly in conjunction with a future MRWG meeting. Mr. Jerry Gorline, AVRADCOM, stated that the Standardization Program, at least through the recommendation phase, might be helpful to the various IPI Programs being considered.

Copies of the latest reports for DARPA's Advanced Machining Reseearch Program (AMRP) and AFWAL's (Air Force Wright Aeronautical Laboratories) Advanced Metal Removal Initiations Program (AMRIP) were made available to all attendees and the status of the programs were briefly discussed. Several attendees expressed a desire to be included on the distribution list for all future reports associated with these two Air Force managed programs. I agreed to forward a request to the Air Force and urged all members to attend the next annual review of the AMRP/AMRIP Programs.

Dr. Donald G. Flom, General Electric Company, had forwarded an article from Metalworking News concerning work they are doing for the Air Force in the area of in-process inspection. He also indicated General Electric is very concerned about efforts needed in the area of tool condition monitoring and diagnostics. They had done some work in the area of relating vigration spectra to tool breakage and are looking for contractual support in an effort to develop sensors that would be required for automated machining processes. Mr. Don Cargo, TACOM, expressed interest in the work GE is doing and was given Dr. Flom's name as a point of contact.

Army metal removal projects were reviewed within the context of a thrust area spider chart previously developed by the Metals Subcommittee of the Manufacturing Technology Advisory Group. Prior to the meeting, the spider chart was revised slightly to better fit the needs of the Metal Removal Working Group, and projects were tentatively slotted into the thrust areas identified on the spider chart. During the project

discussions, several changes to the spider chart and to the specific classification of individual projects were made by working group members. These recommendations were noted and will be reflected in the 1983 Annual Report of the Metal Removal Working Group.

The project discussions provided a useful forum for the exchange of technical information among the various Major Subordinate Commands and Arsenals in attendance. It also served to develop necessary background for the generation of recommendations to the Manufacturing Technology Directorate of DARCOM concerning metal removal technology that should be exploited by the MMT Program.

A discussion was held concerning the format for future MRWG meetings and specific plans for next year's meeting. The concensus of opinion was that a two or three day meeting, held in conjunction with an end-of-project demonstration, is optimum. That format provides an opportunity to review current metal removal projects, discuss metal removal technologies, develop points of contact relative to projects of specific interest to individual members, and to become familiar with the findings of a recently completed MMT effort.

After some discussion, it was agreed that the theme of next year's meeting will be centered around TACOM's MMT Program. Mr. Don Cargo volunteered to arrange for a tour of the M1 tank production facilities at Lima and for a briefing of the metal removal MMT work being conducted there. He will also attempt to coordinate an end-of-project demonstration for a TACOM project at Battelle, Columbus, OH, as that facility is within easy driving distance of Lima, OH. Mr. George O'Brien, MPBMA, stated there is an ARRADCOM project with Battelle that will be completed next year and agreed to investigate the possibility of having an end-of-project demonstration for it, also in conjunction with next year's meeting.

APPENDIX E

SUMMARY OF END-OF-PROJECT DEMONSTRATION

FOR MMT PROJECT 5 80 6738

ULTRAHIGH SPEED METAL REMOVAL-ARTILLERY SHELL

SUMMARY OF END-OF-PROJECT DEMONSTRATION FOR MMT PROJECT 5 80 6738 ULTRAHIGH SPEED METAL REMOVAL-ARTILLERY SHELL

Mr. Al Tessier opened the demonstration by reviewing J&L's involvement in the production of industrial equipment, from Fay automatics, tracer lathes, optical comparators, and form grinders to computer numerical controlled equipment. Mr. Raymond Pohl, ARRADCOM, then introduced MMT project 5 80 6738 by briefly describing the objectives of the project as the development of machining data relative to newer non-tungsten based tooling materials - data that would provide a starting point for machining projectile steel without difficulty.

Mr. Dick Pugh, J&L, conducted an in-depth review of the technical aspects of MMT 5 80 6738. He began by describing the experimental procedure used in the investigations. All tests were conducted on projectile bodies in the as-forged and heat treated condition. The projectile bodies were checked in a dynamometer lathe with the end supported by a live center mounted in a hexagon turret. Turning cuts were taken on the dynamometer lathe, using dynamometer output as a guide to tool wear rate. Surface speed in feet per minute was adjusted using a hand held tachometer referenced to the uncut diameter. Depths of cut of 0.100 inches for roughing cuts and 0.050 inches for finishing cuts were taken, for a predetermined length. After completion of the cut, the wear-land of the insert was measured and recorded. The diameter of the turned portions and the length of cuts were then measured. The circumference was calculated and multiplied by the length of turn in inches in order to obtain value for the square inches of machine surface. This value, along with the wear-land of a particular cut, provided a point to plot on a curve of wear-land in inches versus machined surface in square inches.

Cuts were repeated and their values were used to plot a curve, until such time as the data showed imminent tool failure or until the wear-land had reached a predetermined value for tool life comparison. The curves of wear-land in inches versus square inches of machine surface yielded values for a life-line chart showing surface speed versus square inches of machined surface. Points on the curve were determined from the number of square inches of machined surface for a specified speed at a predetermined wear-land. Data was plotted for various surface speeds in order to obtain the tool life line for a given material.

Tool wear was the only factor considered in determining the tool life from these tests. Whenever tool breakage occurred, the machining parameters were adjusted to avoid breakage under the test conditions. The machining parameters established in this program should therefore produce equal or better results in a production environment.

Hot pressed and cold pressed ceramic tooling was tested in this program. Results obtainable with ceramic coated tungsten carbide cutting tools were used as reference data.

Conclusions reached and recommendations made as a result of this study are as follows:

CONCLUSIONS:

1. Significant increases in metal removal rates for heat treated steels can be obtained using ceramic tools.

2. Ceramic tools and ceramic coated tungsten carbide tools show equivalent tool life when machining steels in the "as-forged" condition.

3. Optimum cutting tool life requires infinite spindle speed control through the usable range.

4. Higher cutting speeds require higher horsepower machines.

RECOMMENDATIONS:

1. The use of ceramic cutting tools should be considered for all machining operations.

2. When ceramic cutting tools are used, the tool holders should be designed to accept thicker inserts, have a stable insert pocket, and have a low profile, rugged clamping device.

3. Variable spindle control is important for optimum tool life when machining "as-forged" steel and is of paramount importance when machining heat treated steels.

4. Feed control, so a consistent tool load can be maintained throughout all tool paths, is required when applying ceramic cutting tools and will result in better tool life when using tungsten carbide tools.

5. The results on heat treated 4340 material were inconclusive when ceramic cutting tools were tested and further effort is needed in this area.

Upon completion of the technical presentation of the machining parameters developed as a result of MMT 5 80 6738, a cutting demonstration was conducted on an HF-1 steel shell. It was well received by attendees from the munitions production base and one attendee expressed surprise at the ease with which the HF-1 steel was being machined.

After a tour of the Jones & Lamson Technical Center, the end-of-project demonstration was concluded with a panel discussion conducted by Mr. Pohl, Mr. Pugh, and Mr. Tessier. A general conclusion drawn by the panelists was that, for the materials tested, ceramic tooling will work and will generate higher productivity rates. Mr. Pugh discussed the fact that HF-1 steel machines a lot like 52-100. He further stated that HF-1 is slightly more abrasive then 52-100, and that, in the higher speed ranges, it machines a lot like cast iron.

A member of the audience acknowledged the need for higher productivity and also stressed the need for flexibility. Other topics discussed included the use of concrete beds for machining equipment, single platen equipment, and the interchangeability of various NC software programs.

APPENDIX F

METAL REMOVAL

PROJECT SUMMARIES

APPENDIX F-1

COMPLETED PROJECTS

ABRASIVE METAL REMOVAL

6 7408

ABRASIVE MACHINING OF MAJOR COMPONENTS

PROBLEM

EXCESSIVE MACHINING TIME IS REQUIRED FOR EFFECTIVE METAL REMOVAL.

SOLUTION

INVESTIGATE THE APPLICATION OF ABRASIVE MACHINING TO MAJOR CANNON, HOWITZER AND MORTAR COMPONENTS.

FY74 $100K
COMPLETED
METALS

ACTION OFFICER: RODD J

ABRASIVE METAL REMOVAL

6 7583

APPLICATION OF ELECTROMECHANICAL MACHINING TO WEAPON COMPONENTS

PROBLEM

CUTTING FORCES AND TOOL WEAR LIMIT MACHINE TOOL EFFICIENCY AND MACHINING RATES. MACHINING TIME AND COSTS ARE UNNECESSARILY HIGH BECAUSE OF NORMALLY INHERENT WORK MATERIAL STRENGTH AND TOOL WEAR.

SOLUTION

ADAPT ELECTROMECHANICAL MACHINING TO REDUCE MAJOR FORCE OF CHIP FORMATION IN CUTTING AND TOOL WEAR. CONVERT REDUCED CUTTING FORCES AND TOOL WEAR TO FASTER CUTTING FOR HIGHER PRODUCTIVITY.

FY75 $90K
COMPLETED
METALS

ACTION OFFICER: WILKINS

HIGH SPEED MACHINING

3 3230

HIGH SPEED MACHINING OF ALUMINUM

PROBLEM

MACHINING OPERATIONS FOR ALUMINUM STRUCTURES AND ASSEMBLIES FOR MISSILE SYSTEMS ARE MAJOR COST ITEMS. TECHNOLOGY ADVANCES IN MACHINE TOOL DESIGN SHOULD BE TAKEN ADVANTAGE OF TO REDUCE COSTS.

SOLUTION

SCALE-UP, EXTEND, AND OPTIMIZE ALUMINUM MACHINING PROCESSES DEVELOPED BY INDUSTRY RESEARCH.

FY76 $242K
COMPLETED
METALS

ACTION OFFICER: MELONAS J

HIGH SPEED MACHINING

5 6738

ULTRA-HIGH SPEED METAL REMOVAL, ARTILLERY SHELL

PROBLEM

DUE TO THE LOW METAL REMOVAL RATES OF THE CURRENT CONVENTIONAL MACHINING OPERATIONS, A GREATER NUMBER OF MACHINES ARE REQUIRED TO PRODUCE ARTILLERY PROJECTILES.

SOLUTION

ACHIEVE INCREASED METAL REMOVAL RATES THEREBY REDUCING THE NUMBER OF MACHINES CURRENTLY USED TO PRODUCE PROJECTILES.

FY79 $181K
COMPLETED
METALS, MUNITIONS

FY80 $297K
COMPLETED
METALS

ACTION OFFICER: POHL R

CHIP EJECTOR TOOLING

5 6576

APPLICATION OF HIGH SPEED BORING FOR LARGE CALIBER SHELL

PROBLEM

THE STANDARD METHOD OF DEEP BORING LARGE CALIBER SHELLS IS BY USING A CONVENTIONAL BORING BAR ARRANGEMENT ON A HOLLOW SPINDLE BORING LATHE.

SOLUTION

THIS PROJECT WILL INVESTIGATE A HIGH PRESSURE COOLANT SYSTEM FOR DEEP BORING LARGE CALIBER ARTILLERY ITEMS.

FY74 $133K
COMPLETED
MUNITIONS, METALS
ACTION OFFICER: GUSTAD D

FY75 $30K
COMPLETED
MUNITIONS, METALS
ACTION OFFICER: LANGMAN

CHIP EJECTOR TOOLING

6 7122

FABRICATION AND REPAIR OF RECOIL CYLINDERS WITH NEW PROCESS

PROBLEM

THERE ARE NEW REQUIREMENTS FOR INTERCHANGEABILITY. THE LIFE OF RECOIL CYCLINDERS NEEDS TO BE LENGTHENED.

SOLUTION

APPLY HYDROSTATIC, PRESSURIZED, COOLANT CHIP EJECTOR BORING HEADS AND APPLY FORM GRINDING.

FY72 $50K
COMPLETED
METALS

ACTION OFFICER: LIUZZI L

CHIP EJECTOR TOOLING

6 7652

COOLANT CHIP EJECTOR, MULTI-OPERATION TOOLING

PROBLEM

DRILLING AND SIZING OF RECOIL CYLINDER BORES IS SLOW AND SOMETIMES INACCURATE.

SOLUTION

APPLY NEW COOLANT CHIP EJECTOR TOOLS FOR DRILLING AND SIZING PROCESSES.

FY77 $65K
COMPLETED
METALS

ACTION OFFICER: KIRSCHBAUM R

AUTOMATED MULTI-SPINDLE/MULTI-TOOLED MACHINING

1 7103

IMPROVED MANUFACTURING FOR BLISK AND IMPELLER TURBINE ENGINE COMPRESSOR PARTS

PROBLEM

IMPELLERS AND INTEGRAL BLADE/DISKS, WHEN MANUFACTURED BY SINGLE SPINDLE TRACING EQUIPMENT, ARE EXPENSIVE.

SOLUTION

DEVELOP THE PROCESS TO MANUFACTURE THESE COMPONENTS BY ONE OF SEVERAL ROUGHING METHODS, FINISH MILLING BY NUMERICALLY CONTROLLED MULTI-SPINDLE MACHINES AND ABRASIVE FLOW FINISHING.

FY76 $435K
COMPLETED
CADAM, METALS

FY77 $305K
COMPLETED
CADAM, METALS

ACTION OFFICER: REED F

AUTOMATED MULTI-SPINDLE/MULTI-TOOLED MACHINING

6 8043

IMPROVED MACHINING PROCEDURES FOR DOVETAILS

PROBLEM

CLOSE TOLERANCE DOVETAILS ARE REQUIRED TO ASSEMBLE RECOIL RAILS ON LARGE CALIBER WEAPONS. EXTREME CARE IS REQUIRED WHEN MILLING TO AVOID OVERSIZE CUTTING.

SOLUTION

DEVELOP MACHINING AND TOOLING FOR BROACHING DOVETAILS, THEREBY ELIMINATING THE NEED FOR MULTIPLE MILLING PRESENTLY USED IN ORDER TO ACHIEVE CLOSE TOLERANCES. BROACHING, ONCE DEVELOPED, WILL IMPROVE QUALITY OUTPUT AND REDUCE TIME. SIZE CONTROL WILL BE BUILT INTO THE TOOLING.

FY78 $100K
COMPLETED
METALS

ACTION OFFICER: CONLON G

PRECISION MACHINING

6 7532

SINGLE POINT CUTTING FOR METAL AND PLASTIC OPTICS

PROBLEM

FABRICATE A LASER SURFACE MIRROR TO PRECISION TOLERANCES WITHOUT BURNISHING OR CRUSHING THE SURFACE.

SOLUTION

DEVELOP SINGLE POINT DIAMOND TOOL CUTTING.

FY75 $140K
COMPLETED
NON-METALS

ACTION OFFICER: SELKIN J

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

H 9423

IMPROVED CLOSED CYCLE CRYOGENIC COOLER

PROBLEM

THERE IS NO INDUSTRIAL PRODUCTION CAPABILITY FOR THE COOLERS REQUIRED BY THE NIGHT OBSERVATION THERMAL IMAGING DEVICE.

SOLUTION

DISSEMINATE PRODUCTION ENGINEERING INFORMATION TO INDUSTRY TO HELP CREATE A COMPETITIVE INDUSTRY CAPABILITY.

FY74 $708K
COMPLETED
ELECTRONICS, METALS

ACTION OFFICER: SANDERS J

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

1 7104

T700 TURBINE ENGINE NOZZLE MANUFACTURING PROCESS

PROBLEM

ALTHOUGH CURRENT SMALL GAS TURBINE ENGINES HAVE TURBINE INLET TEMPERATURES COMPARABLE TO OTHER MODERN TURBINE ENGINES, THE MANUFACTURING AND QUALITY PROBLEMS DO NOT SCALE DOWN DIRECTLY.

SOLUTION

DEVELOP MANUFACTURING TECHNIQUES FOR SMALL, AIR COOLED TURBINE NOZZLES REQUIRED FOR CURRENT DESIGNS.

FY77 $36K
COMPLETED
METALS

FY78 $32K
COMPLETED
METALS

ACTION OFFICER: ROLSTON P

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

5 6561

DEVELOP NEW TECHNIQUE FOR PIERCING SMALL HOLES IN FUZE/TIMER COMPONENT

PROBLEM

FUZE AND TIMER PARTS NEED TO BE PRECISE AND INTERCHANGEABLE. HOLES ARE REQUIRED TO BE DRILLED TO CLOSE TOLERANCES WITH ACCURATE LOCATIONS.

SOLUTION

ESTABLISH A TECHNOLOGY FOR MASS PRODUCTION OF SMALL, DEEP PRECISION HOLES BY A NEW PIERCING TECHNIQUE.

FY74 $125K
COMPLETED
MUNITIONS, METALS

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 6771

DESIGN AND CONSTRUCT REFINED STEP THREAD MACHINE

PROBLEM

THE CONVENTIONAL METHOD OF MACHINING STEP THREADS IN RINGS AND BLOCKS IS BY USE OF AN ENGINE LATHE. THIS IS A VERY SLOW PROCESS.

SOLUTION

DEVELOP THE SPECIFICATION REQUIREMENTS OF A STEP THREADING MACHINE FOR THE 175MM AND 8 INCH BREECHBLOCKS, TEST, AND DEVELOP OPERATING PARAMETERS.

FY70 $122K
COMPLETED
METALS

FY71 $125K
COMPLETED
METALS

FY74 $195K
COMPLETED
METALS

ACTION OFFICER: ROSE C

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 7246

BREECH RING MANUFACTURE BY AUTOMATION

PROBLEM

A PRIOR YEAR STUDY HAS IDENTIFIED MANY AREAS WHERE COST REDUCTIONS ARE POSSIBLE IN THE MANUFACTURING OF THE 105MM M68 BREECH RING.

SOLUTION

SELECTED OPERATIONS WILL BE COMBINED. EQUIPMENT WILL BE MODIFIED IN ORDER TO REDUCE TIME AND COST.

FY73 $75K
COMPLETED
CADAM, METALS

ACTION OFFICER: RODD

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 7647

PROCESS FOR MANUFACTURING SWAGING MANDRELS FOR GUN BARRELS

PROBLEM

BARREL SWAGING MANDREL AVAILABILITY IS LIMITED.

SOLUTION

DEVELOP GRINDING AND FINISHING PROCESSES AND TOOLING FOR FAST, ACCURATE MACHINING OF GUN BARREL SWAGING MANDRELS.

FY76 $100K
COMPLETED
METALS

ACTION OFFICER: KIRSCHBAUM R

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 7825

ELIMINATION OF FACILITATING HONING OPERATIONS

PROBLEM

HONING OPERATIONS REQUIRE EXCESSIVE TIME AND COST.

SOLUTION

IMPROVED BORING TECHNIQUES AND AN IMPROVED BORING HEAD WILL ELIMINATE OPERATIONS.

FY78 $133K
COMPLETED
METALS

ACTION OFFICER: GOODHEIM H

ADAPTIVE CONTROL

6 7715

APPLICATION OF CONTROLLED-FORCE MACHINING

PROBLEM

UNSTEADY FORCES IN MACHINING ADVERSELY EFFECT ACCURACY, QUALITY, AND COSTS OF COMPONENTS.

SOLUTION

APPLY THE CONCEPT OF CONTROLLED-FORCE MACHINING.

FY77 $64K
COMPLETED
METALS

ACTION OFFICER: KIRSCHBAUM R

DUAL RIFLING BROACH REMOVAL

6 7402

DEVELOPMENT OF IMPROVED RIFLING PROCEDURES AND EQUIPMENT

PROBLEM

EXCESSIVE TIME IS REQUIRED TO RIFLE GUN TUBES.

SOLUTION

MODIFY THE RIFLER TO ACCEPT TWO TUBES SIDE BY SIDE TO PRODUCE TWO TUBES IN THE SAME TIME AS IS CURRENTLY REQUIRED FOR ONE TUBE.

FY74 $120K
COMPLETED
METALS

FY76 $46K
COMPLETED
METALS

ACTION OFFICER: LAROSS C

ELECTROCHEMICAL MACHINING

6 7460

ELECTROCHEMICAL MACHINING APPLIED TO DEBURRING AND SHAPING

PROBLEM

PRESENT MANUFACTURING METHOD FOR HOWITZER RECOIL CYLINDER INVOLVES THE MULTIPLE TOOL, STEPPED MACHINING OPERATIONS OF DRILLING, REAMING, AND BORING. THESE OPERATIONS ARE TIME CONSUMING, COSTLY, AND PRESENT PROBLEMS IN THE NEW DIFFICULT TO MACHINE MATERIALS AND SHAPES.

SOLUTION

APPLY ELECTROCHEMICAL MACHINING TO THE FABRICATION OF HOWITZER RECOIL MECHANISM COMPONENTS BY COMBINING TEST PROVEN TOOLING WITH A SUITABLE ECM MACHINE.

FY74 $175K
COMPLETED
METALS

FY75 $100K
COMPLETED
METALS

ACTION OFFICER: KIRSCHBAUM R

ELECTROCHEMICAL MACHINING

6 7485

APPLICATION OF CHEMICAL PROCESSES TO IMPROVE SURFACE FINISH

PROBLEM

COST OF HONING AND GRINDING IS HIGH. TENSILE AND RESIDUAL STRESSES CAUSE REDUCED FATIGUE LIFE.

SOLUTION

USE ELECTROPOLISHING TO REDUCE COSTS AND RESIDUAL STRESSES.

FY77 $309K
COMPLETED
METALS

ACTION OFFICER: POCHILY T

ELECTROCHEMICAL MACHINING

6 7711

ELECTROPOLISHING PROCESS MODELS FOR SMALL BORE WEAPONS

PROBLEM

ELECTROPOLISHING PROCESSES HAVE DIFFICULTY OBTAINING REPRODUCIBLE SMOOTH SURFACE FINISHES.

SOLUTION

EVALUATE AND PROVIDE DESCRIPTION DETAILING PROCESS PARAMETERS NECESSARY TO PRODUCE QUALITY SURFACES.

FY77 $75K
COMPLETED
METALS

ACTION OFFICER: LAKSHMINARAYANA

IMPROVED TOOLING

5 4480

HIGH SPEED HEAD TURN TOOL MODULE FOR SMALL CALIBER AMMUNITION PRODUCTION

PROBLEM

THE SCAMP CASE SUBMODULE HAS CONTINUOUSLY EXPERIENCED EXCESSIVELY HIGH USAGE RATE OF HEAD TURN TOOL MODULES. THIS IS DUE MORE TO THE TOOL MODULE GOING OUT OF ADJUSTMENT THAN TO BREAKAGE OF TOOLING.

SOLUTION

EVALUATE TWO DESIGNS TO IMPROVE THE HEAD TURN TOOLING. THE FIRST DESIGN USES A SELF-OPENING HOLLOW MILL TO REPLACE THE CUTTER AND ROLLER GUIDE PRESENTLY USED. THE SECOND DESIGN INCLUDES NEW METHODS OF HOLDING THE PIECE FOR HEAD TURNING.

FY80 $184K
COMPLETED
METALS

ACTION OFFICER: LENG M

IMPROVED TOOLING

6 7119

FABRICATION OF GUN BARRELS AND RECOIL CYLINDER THROUGH OPTIMIZED TOOL

PROBLEM

CURRENT TOOLING IS FOUND TO BE GROSSLY INEFFICIENT WHEN COMPARED TO TOOLS WHICH HAVE BEEN SCIENTICALLY OPTIMIZED AND FOUND TO YIELD 700 TO 800 PERCENT GREATER TOOL LIFE.

SOLUTION

IMPROVE TOOL LIFE AND ACCELERATE METAL REMOVAL RATES THROUGH SCIENTIFICALLY ENGINEERED OPTIMIZATION OF TOOL GEOMETRY.

FY72 $60K
COMPLETED
METALS

ACTION OFFICER: CASEY P

FLEXIBLE MANUFACTURING SYSTEM

6 8104

IMPROVED BREACH BLOCK MANUFACTURING

PROBLEM

THE WIDE VARIETY OF MACHINE TABLE STANDARDS INVOLVES EXPENSIVE AND SPACE WASTING ALTERNATIVES TO SPECIFICALLY DESIGNED MANUFACTURING PROCESSES.

SOLUTION

A SPECIFICALLY DESIGNED MANUFACTURING FACILITY USING A PALLETIZED SYSTEM OF FIXTURING, MAXIMUM TOOL EFFICIENCY, AND REDUCED MATERIAL HANDLING WILL BE DEVELOPED.

FY79 $40K
COMPLETED
METALS, CADAM

ACTION OFFICER: WAKULENKO A

IMPROVED MACHINING PROCEDURES

6 7203

APPLICATION OF LEAST COST TOLERANCES AND FINISHES TO PRODUCTION OF GUN BARRELS

PROBLEM

SURFACE FINISH AND DIMENSIONAL TOLERANCE REQUIREMENTS DICTATE THE MANUFACTURING PROCESS AND MACHINING OPERATIONS WHICH WILL BE USED TO PRODUCE A COMPONENT. THEY ALSO DIRECTLY AFFECT THE OVERALL PRODUCTION COSTS.

SOLUTION

RELATE THE DIMENSIONAL AND SURFACE FINISH TOLERANCE TO SIMPLIFY THE MANUFACTURE OF CANNON COMPONENTS.

FY76 $52K
COMPLETED
METALS

ACTION OFFICER: RODD J

MACHINABILITY DATA

1 7240

MACHINING METHODS FOR ESR 4340 STEEL FOR HELICOPTER APPLICATIONS

PROBLEM

MANY CRITICAL HELICOPTER PARTS REQUIRE HIGH BALLISTIC TOLERANCE CHARACTERISTICS. THESE COMPONENTS ARE BEING FABRICATED FROM ESR 4340 STEEL. HOWEVER, THE MACHINING OF THIS NEW MATERIAL IS NOT CLEARLY DEFINED AND, THEREFORE, IS OVERLY EXPENSIVE.

SOLUTION

MACHINING METHODS WILL BE INVESTIGATED TO ESTABLISH THE TECHNIQUES NECESSARY TO EFFICIENTLY FABRICATE COMPONENTS FROM ESR 4340. BOTH CONVENTIONAL AND UNCONVENTIONAL APPROACHES WILL BE PURSUED.

FY78 $117K
COMPLETED
METALS

FY80 $94K
COMPLETED
METALS

ACTION OFFICER: AYVAZIAN A

MACHINABILITY DATA

6 7461

TOOL AND PROCESS MACHINING FOR SINTERED POWDER METAL COMPONENTS

PROBLEM

MACHINING DATA FOR POWDER METAL PARTS IS SCARSE OR NON-EXISTENT.

SOLUTION

DEVELOP MACHINING DATA AND GUIDELINES FOR MACHINING FORGED POWDER METAL PARTS.

FY74 $34K
COMPLETED
METALS

ACTION OFFICER: KIRSCHBAUM

NC LANGUAGE EVALUATION

M 9000

IMPROVED PARTS PROGRAMMING FOR NUMERICALLY CONTROLLED MACHINES

PROBLEM

PARTS PROGRAMMING FOR NUMERICALLY CONTROLLED MACHINES IS CONSTRAINED BY A LACK OF STANDARDIZATION IN NC PROGRAM LANGUAGE.

SOLUTION

INVESTIGATE AND SUMMARIZE THE FIELD OF PARTS PROGRAMMING.

FY75 $8K
COMPLETED
METALS, CADAM

ACTION OFFICER: HOWIE

NC LANGUAGE EVALUATION

2 9679

NUMERICAL CONTROL LATHE LANGUAGE EVALUATION

PROBLEM

THERE ARE APPROXIMATELY SEVENTEEN MAJOR NUMERICAL CONTROL LATHE LANGUAGES CURRENTLY IN POPULAR USE.

SOLUTION

EVALUATE EACH LANGUAGE AND ITS ADVANTAGES AND DISADVANTAGES FOR SPECIFIC LATHE OPERATIONS.

FY72 $225K
COMPLETED
CADAM, METALS

FY76 $395K
COMPLETED
CADAM, METALS

ACTION OFFICER: RUPPE D

APPENDIX F-2

ACTIVE PROJECTS

ABRASIVE METAL REMOVAL

1 7376

AUTOMATIC INSPECTION AND PRECISION GRINDING OF SPIRAL BEVEL GEARS

PROBLEM

CURRENT MANUFACTURING METHOD FOR SPIRAL BEVEL GEARS IS LABOR INTENSIVE REQUIRING CONTACT PATTERN CHECKS WITH EXPENSIVE MASTER MATING GEARS. THE PATTERN SHIFTS WITH A CHANGE IN TORQUE AND TEMPERATURE. AS A RESULT, THE TOOTH FORM EXPERIENCES GREAT STRESS.

SOLUTION

DEVELOP AN AUTOMATED PRODUCTION PROCESS OF GRINDING SPIRAL BEVEL GEARS BY TAPE CONTROLLED MACHINES, BASED ON A COORDINATE SYSTEM MADE POSSIBLE BY A PARTIAL NON-INVOLUTE TOOTH FORM.

FY81 $215K
APPROVED
METALS

FY82 $1012K
APPROVED
TEST AND INSPECTION

FY83 $345
APPORTIONMENT
METALS, TEST AND INSPECTION

ACTION OFFICER: REED F

ABRASIVE METAL REMOVAL

6 8024

HIGH SPEED ABRASIVE BELT GRINDING

PROBLEM

SLIDE SURFACE DIAMETER AND FINISH ARE PRESENTLY PRODUCED ON CYLINDRICAL GRINDING MACHINES USING ABRASIVE WHEELS. THE TIME IT TAKES FOR THIS OPERATION CAN BE SIGNIFICANTLY REDUCED.

SOLUTION

ABRASIVE BELT GRINDING, DEPENDING ON ITS APPLICATION, HAS METAL REMOVAL RATES WHICH CAN EXCEED MILLING OR GRINDING WHILE AT THE SAME TIME PRODUCING CLOSE TOLERANCES AND EXCELLENT SURFACE FINISH.

FY80 $324K
APPROVED
METAL

FY82 $142K
APPROVED
METAL

ACTION OFFICER: BAK J

HIGH SPEED MACHINING

6 8103

HIGH VELOCITY MACHINING

PROBLEM

SPEED OF MACHINING CANNON TUBES IS LIMITED WITH CURRENT EQUIPMENT.

SOLUTION

EVALUATE HIGH SPEED METAL REMOVAL METHODS AND AVAILABLE EQUIPMENT. FUTURE YEAR FUNDING WILL PROVIDE FOR ACQUISITION AND TESTING OF NEW MACHINE AND PROCESS.

FY82 $37K
APPROVED
METALS

FY83 $285K
APPORTIONMENT
METALS

FY84 $160K
BUDGET
METALS

ACTION OFFICER: WONDISFORD W

HIGH SPEED MACHINING

6 8106

LARGE CALIBER POWDER CHAMBER BORING

PROBLEM

POWDER CHAMBER PRODUCTION ON LARGE BORE CANNON, 8 INCH M201, CURRENTLY REQUIRES 14 HOURS FOR BOTH ROUGH AND FINISH OPERATIONS.

SOLUTION

PERFORM THE FINISHING OPERATION IN THE SAME SETUP AS THE ROUGHING OPERATION BUT USING AS A CUTTING MEDIA DIAMOND FINISHING TOOLS WHICH AT VERY HIGH SPEEDS PRODUCE EXCELLENT SURFACE FINISH. THIS PROCESS WILL ELIMINATE ONE GRINDING OPERATION.

FY80 $59K
COMPLETED
METALS

FY81 $159K
APPROVED
METALS

FY82 $72K
APPROVED
METALS

ACTION OFFICER: WAKULENKO A

CHIP EJECTOR TOOLING

6 8238

BORING BREECH RING LUGS

PROBLEM

PRESENT METHODS OF PRODUCING THE VARIOUS HOLES ON BREECH RINGS ARE TREPANNING, TWIST DRILLING, GUN DRILLING, AND FINISH BORING. PRODUCTION OF THESE HOLES IS A TIME CONSUMING AND COSTLY OPERATION.

SOLUTION

THE JOINT PROCESS OF EJECTOR DRILLING AND INDEXABLE CARBIDE INSERT HOLE DRILLING PROMISES TO REDUCE THE SEQUENCE STEPS NOW REQUIRED AND TO PROVIDE A FAR MORE COST EFFECTIVE MEANS OF PRODUCING AN ACCEPTABLE HOLE.

FY82 $203K
APPROVED
METALS

ACTION OFFICER: DINOVO N

PRECISION MACHINING

3 3445

PRECISION MACHINING OF OPTICAL COMPONENT

PROBLEM

EXISTING PRECISION MACHINING FACILITIES CANNOT KEEP UP WITH THE DEMAND, MEET OPTICAL DESIGN REQUIREMENTS, MEET PRODUCTION SCHEDULES, AND STAY WITHIN REASONABLE COST BOUNDARIES.

SOLUTION

INTEGRATE BOTH THE WELL PROVEN ERDA DEVELOPED SINGLE POINT DIAMOND MACHINING CAPABILITIES AND THE DEVELOPING INTERFEROMETRIC AIDED AND COMPUTER CONTROLLED TECHNOLOGY INTO A MANUFACTURING METHOD.

FY79 $300K
COMPLETED
CADAM, METALS, NON-METALS

FY80 $400K
COMPLETED
CADAM, METALS, ELECTRONICS

FY81 $625K
APPROVED
ELECTRONICS, CADAM

ACTION OFFICER: FRIDAY W

PRECISION MACHINING

6 8080

HIGH SPEED FABRICATION OF ASPHERIC OPTICAL SURFACES

PROBLEM

THE BULK OF THE COST OF OPTICS FOR FIRE CONTROL SYSTEMS LIES IN THE FIGURING AND POLISHING STAGE.

SOLUTION

USE THE TUBULAR TOOL GRINDING PROCESS TO PRODUCE ASPHERIC SURFACES DIRECTLY DURING THE GRINDING PROCESS.

FY81 $204K
APPROVED
ELECTRONICS

FY82 $170K
APPROVED
ELECTRONICS

ACTION OFFICER: ASSADOURIAN L

ULTRASONICALLY ASSISTED MACHINING

1 7156

ULTRSONICALLY ASSISTED MACHINING FOR SUPERALLOYS

PROBLEM

MANY HELICOPTER PARTS ARE EXPENSIVE TO MACHINE.

SOLUTION

EMPLOY ULTRASONICS TO ASSIST MACHINING OPERATIONS FOR HARD TO MACHINE COMPONENTS.

FY76 $300K
COMPLETED
METALS

ACTION OFFICER: AYVAZIAN A

FY80 $60K
APPROVED
METALS

ACTION OFFICER: PARK B

6 8107

CREEP FEED CRUSH FORM GRINDING

PROBLEM

THE BRACKET SLOT ON THE 105MM M68 BREECH RING IS A HIGH COST OPERATION. IT IS CURRENTLY MILLED WITH FORM TOOLS IN TWO OPERATIONS-ROUGH AND FINISH.

SOLUTION

A NEW PROCESS IS BEING DEVELOPED THAT RESEMBLES THE CRUSH FORM ABRASIVE MACHINE FOR CYLINDRICAL PARTS EXCEPT THAT THE PROCESS IS USED TO PRODUCE FLAT CONTOURED SURFACES. THIS PROCESS WILL BE ADAPTED TO PRODUCTION OF THE BRACKET SLOT.

FY79 $82K
COMPLETED
METALS

FY80 $579K
APPROVED
METALS

FY81 $73K
APPROVED
METALS

ACTION OFFICER: RODD J

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

E 3717

HIGH TEMPERATURE TURBINE NOZZLE FOR 10 KW POWER UNIT

PROBLEM

SUPERALLOY METALS USED IN HOT COMPONENTS OF GAS TURBINES ARE LIMITED IN OPERATING TEMPERATURE AND ARE SUBJECT TO PREMATURE FAILURE IN DUSTY OR CORROSIVE ATMOSPHERE. ALLOY METALS ARE STRATEGIC MATERIALS AND ARE COSTLY TO MANUFACTURE.

SOLUTION

DETERMINE METHODS AND TECHNIQUES TO REDUCE THE COST OF MANUFACTURING HIGH TEMPERATURE CERAMIC MATERIALS WHICH HAVE BEEN FOUND TO POSSESS HIGH TEMPERATURE RESISTANCE TO DUST ABRASION AND SALT CORROSION. MATERIALS WILL CONTAIN NO STRATEGIC ELEMENTS.

FY78 $339K
COMPLETED
NON-METALS

FY80 $436K
APPROVED
NON-METALS

FY81 $422K
APPROVED
NON-METALS

ACTION OFFICER: ARNOLD J

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

1 7366

SPIRAL SELF-ACTING SEALS

PROBLEM

LABYRINTH SEALS HAVE HIGH LEAKAGE RATES AND CAUSE SIGNIFICANT POWER LOSS. T700 DATA SHOW ENGINE POWER LOSSES OF 2-17 PERCENT DUE TO THE SEAL LEAKAGE. ACCURACY OF GROOVES AND PARALLELISM OF FACES NEED TO BE DEVELOPED.

SOLUTION

DEVELOP MANUFACTURING TECHNOLOGY NECESSARY FOR FABRICATION OF SPIRAL GROOVE SELF-ACTING SEALS. R&D HAS DEMONSTRATED THE HIGH-SPEED, LOW-WEAR, AND LOW-LEAKAGE CAPABILITY OF THE SPIRAL SEAL.

FY82 $370K
APPROVED
METALS

ACTION OFFICER: BRAND W

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

4 3749

HYDRAULIC ROTARY ACTUATORS

PROBLEM

ROTARY ACTUATOR MODELS HAVE NEVER BEEN PRODUCED ON A QUANTITY BASIS.

SOLUTION

REDUCE DIFFICULTIES THAT ARE ANTICIPATED IN OBTAINING THE REQUIRED CLOSE TOLERANCES AND MICRO-FINISHES WITH STANDARD PRODUCTION TOOLS.

FY77 $750K
APPROVED
METALS

FY80 $145K
APPROVED
METALS

FY81 $106K
APPROVED
METALS

ACTION OFFICER: NETTE R

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

5 4189

HIGH FRAGMENTATION STEEL PRODUCTION PROCESS

PROBLEM

THE CURRENT PRODUCTION PROCESS FOR MANUFACTURING HF1 PROJECTILES IS EXTREMELY EXPENSIVE. PROPRIETARY PRODUCTION PROCESSES DEVELOPED BY PRIVATE INDUSTRY ARE NOT AVAILABLE.

SOLUTION

EXAMINE NEW AND IMPROVED PRODUCTION PROCESSES FOR REDUCTION OF STARTING MULT WEIGHT, MACHINING TECHNIQUES, ANNEALING FORGINGS, ONE-HIT HOT NOSING, HEAT TREATING AND FRACTURE TOUGHNESS, AND COMPLETE A TDP FOR COMPETITIVE PROCUREMENT.

FY79 $747K
COMPLETED
METALS

FY80 $1048K
APPROVED
METALS

FY82 $554K
APPROVED
METALS

ACTION OFFICER: SHARPE W

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 7482

MODIFIED RIBBON RIFLING GENERATING MACHINE

PROBLEM

RIFLING OF GUN TUBES REQUIRES AN EXCESSIVELY LONG HONING TIME.

SOLUTION

MODIFY THE RIFLER TO ACCEPT TWO TUBES SIDE BY SIDE TO PRODUCE TWO TUBES IN THE TIME NOW NEEDED FOR ONE.

FY79 $76K
APPROVED
METALS

ACTION OFFICER: WAKULENKO A

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 7730

MANUFACTURE OF SPLIT RING BREECH SEALS

PROBLEM

SPLIT RINGS REQUIRE PRECISE MANUFACTURING. PRESENT METHODS ARE OUTDATED AND COSTLY, REQUIRING MUCH HAND FINISHING BY HIGHLY SKILLED WORKERS. A HIGH REJECTION RATE IS EXPERIENCED AND MUCH REWORK IS REQUIRED.

SOLUTION

AUTOMATED AND IMPROVED PROCEDURES WILL BE ADOPTED FOR A NEW METHOD OF SLITTING THE RING WHICH REQUIRES LESS STOCK REMOVAL. SPECIAL EQUIPMENT WILL BE DESIGNED AND PURCHASED TO MINIMIZE HAND FINISHING BY HIGH SKILL OPERATORS.

FY79 $137K
COMPLETED
METALS

FY80 $363K
APPROVED
METALS

FY82 $108K
APPROVED
METALS

ACTION OFFICER: DEMEO R

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 7925

BORE EVACUATOR BORING

PROBLEM

BOTH ENDS OF THE BORE EVACUATOR HAVE SIMILAR DIAMETER BORES AND REQUIRE ALMOST EQUAL MACHINING TIME. REDUCTION OF MACHINING TIME IS IMPERATIVE.

SOLUTION

A SPECIAL PURPOSE MACHINE AND TOOLING PACKAGE PROVIDING A HEAD FOR EACH END OF THE EVACUATOR CHAMBER CAN BE DEVELOPED TO PRODUCE BOTH BORES SIMULTANEOUSLY. IF BOTH SURFACES ARE PRODUCED FROM THE SAME SET UP, ORIENTATION OF CENTERLINES CAN BE ASSURED.

FY80 $111K
APPROVED
METALS

FY81 $248K
APPROVED
METALS

ACTION OFFICER: LAROSS C

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 7927

GENERATION OF BASE MACHINING SURFACES

PROBLEM

TO OBTAIN A DISTRIBUTION OF STOCK ON A ROUGH CAST COMPONENT, IT IS CURRENTLY NECESSARY TO "DRAW" THE FINISHED COMPONENT ON THE MATERIAL USING HEIGHT GAGES AND LAYOUT TEMPLATES. THIS IS DONE ON A TABLE FROM WHICH THE PART MOVES TO A MACHINE FOR SIMILAR SET-UP.

SOLUTION

USING PRESENT LAYOUT TECHNIQUES SUCH AS OPTICAL SHADOW LAYOUT TEMPLATES, THE COMPONENT CAN BE POSITIONED DIRECTLY ON THE MACHINE TO ESTABLISH THE FIRST CUT, ELIMINATING THE INITIAL LAYOUT OPERATION.

FY80 $86K
APPROVED
METALS

FY81 $422K
APPROVED
METALS

ACTION OFFICER: ROSE B

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 7985

SMALL ARMS WEAPONS NEW PROCESSES PRODUCTION TECHNOLOGY

PROBLEM

GUN BARREL MANUFACTURING PROCEDURES REFLECT ANTIQUATED TECHNOLOGY AND RELY ON MASS REMOVAL OF MATERIAL BY CONVENTIONAL MACHINING METHODS. CURRENT EQUIPMENT REPRESENTS 1940-50 TECHNOLOGY. NEW MATERIALS COMPOUND THE PROBLEM.

SOLUTION

REDUCE TO PRACTICE NEW TECHNIQUES FOR CAL 50 TO 40MM BARRELS BY ESTABLISHING THE TECHNOLOGY AND PROCESS EQUIPMENT REQUIRED TO BRIDGE GAP BETWEEN CAPABILITIES AND REQUIREMENTS.

FY80 $382K
APPROVED
METALS

FY81 $436K
APPROVED
METALS

FY82 $620K
APPROVED
METALS

FY83 $813K
SUBTASK NO: B
TITLE: BARREL BROACHING
APPORTIONMENT
METALS

FY84 $728K
BUDGET
METALS

ACTION OFFICER: PIZZOLA R

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 8047

PASS THRU STEADY RESTS FOR TUBE TURNING

PROBLEM

ROLLER RESTS PROVIDE NECESSARY SUPPORT FOR GUN TUBE TURNING BUT WILL NOT ALLOW TURNING FULL LENGTH IN ONE SET UP. PRESENT METHOD IS TO USE TWO LATHES WITH TWO SET UPS OR LATHE MUST HAVE TWO CARRIAGES.

SOLUTION

A PASS THRU REST WILL ALLOW THE CARRIAGE TO MOVE FROM ONE SUPPORTED AREA OF THE TUBE TO THE OTHER WITHOUT DISTURBING THE SETUP. THE DESIGN WILL BE APPLICABLE TO CURRENTLY AVAILABLE EQUIPMENT BUT WILL HAVE EVEN GREATER IMPACT ON NEW EQUIPMENT ACQUISITIONS.

FY78 $139K
COMPLETED
MUNITIONS

FY80 $369K
APPROVED
METALS

ACTION OFFICER: RODD J

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 8105

ESTABLISH ROUGH THREAD BLANKS, 8-INCH M201 BUSHING

PROBLEM

A SINGLE POINT TOOL IS NOW USED TO PRODUCE THE ROUGH FORMED BLANK FOR STEP THREADS ON STEP BLOCKS. CURRENT TIME VALUE IS 13.9 HOURS.

SOLUTION

POSSIBLE APPLICATIONS OF MULTIPLE SLOTTING TOOLS AND MILLING OFFER A FAR MORE EFFICIENT METAL REMOVAL PROCESS AIMED AT TIME AND COST REDUCTION.

FY80 $88K
COMPLETED
METALS

FY81 $292K
APPROVED
METALS

ACTION OFFICER: BAK J

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 8246

GAS CHECK SEAT FINISHING

PROBLEM

MACHINING OF GAS CHECK SEATS IS A PRECISION PROCESS INVOLVING GRINDING AND LAPPING OF A CRITICAL AREA OF THE CANNON WHICH RESULTS IN 30 TO 50 PERCENT REWORK TO PASS CONTACT GAGE REQUIREMENTS.

SOLUTION

APPLY MORE PRECISE ALIGNMENT OF FINISHING EQUIPMENT AND ELIMINATE THE MACHINING FACILITY WHICH TENDS TO INDUCE ECCENTRICITY. THE GAUGING SYSTEM WILL ALSO BE REVIEWED.

FY81 $60K
COMPLETED
METALS

FY82 $153K
APPROVED
METALS

ACTION OFFICER: LAROSS C

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 8341

HOLLOW CYLINDER CUT OFF MACHINE

PROBLEM

ESTABLISHING CYLINDER LENGTH IS DONE IN ONE OF TWO WAYS; PARTED OFF IN A LATHE AND FACED TO LENGTH, OR SAWED OFF AND THEN SET UP IN A LATHE FOR FACING TO FINAL LENGTH DIMENSIONS. IN EITHER CASE, THE OPERATION REQUIRES DOUBLE HANDLING OR SLOW OPERATING PROCEDURES.

SOLUTION

NEW TECHNOLOGY IS BEING DEVELOPED WHEREBY A SET OF ROTATING CUTTERS MILLS THE CYLINDER TO LENGTH PRODUCING A FACE SURFACE TO SATISFY OUR TUBE LENGTH REQUIREMENTS. CURRENT MACHINE DESIGN WILL NOT PERFORM THIS FUNCTION BUT THE TECHNOLOGY IS APPLICABLE.

FY81 $84K
APPROVED
METALS

FY82 $655K
APPROVED
METALS
ACTION OFFICER: DEMEO R

ADAPTIVE CONTROL

6 8120

ADAPTIVE CONTROL TECHNOLOGY (CAM)

PROBLEM

CURRENT GRINDING PROCESSES DO NOT TAKE ADVANTAGE OF THE GRINDING WHEEL CUTTING EFFICIENCY. PRECISION TOLERANCES ARE DIFFICULT TO HOLD DUE TO PART HEATING. WHEEL WEAR RATES INCREASE EXPONENTIALLY WITH FEED RATES AND LIMIT PRODUCTIVITY.

SOLUTION

USE A PROCESS CALLED ENERGY GRINDING, EMPLOYING ADAPTIVE CONTROL WITH A CYLINDRICAL GRINDER. WHEEL SPEED, THE PRIMARY DETERMINANT OF WHEEL SHARPNESS, WILL BE PRECISELY CONTROLLED, RESULTING IN INCREASED GRINDING EFFICIENCY AND IMPROVED METAL REMOVAL RATE.

FY81 $60K
APPROVED
CADAM, METALS

FY83 $495K
APPORTIONMENT
CADAM, METALS

ACTION OFFICER: WONDISFORD W

ADAPTIVE CONTROL

6 8135

IN-PROCESS CONTROL OF MACHINING

PROBLEM

DURING MANUFACTURING OF RECOIL CONTROL ORIFICES, ERRORS ARE INTRODUCED WHICH REQUIRE REWORK. CORRECTIVE ACTIONS INVOLVE COSTLY DETAILED INSPECTION AND REANALYSIS WITH COMPUTERIZED DESIGN PROGRAMS TO DEFINE POSSIBLE REWORK ALTERNATIVES.

SOLUTION

AN IMPROVED MANUFACTURING METHOD UTILIZING ADAPTIVE CONTROLS AND AUTOMATED INSPECTION EQUIPMENT WILL BE ESTABLISHED. MACHINE TOOLS WILL BE RETROFITTED.

FY81 $613K
APPROVED
METALS, CADAM

FY82 $841K
APPROVED
METALS, CADAM

ACTION OFFICER: KIRSCHBAUM R

DEBURRING

6 8346

DEBURRING OF BORE EVACUATOR HOLES

PROBLEM

AN INABILITY TO SUCCESSFULLY AND CONSISTENTLY PRODUCE A SMOOTH RADIUS ON THE INTERNAL OPENING OF THE BORE EVACUATOR HOLES OF THE 120MM HAS LED TO EARLY CHROMIUM FAILURE.

SOLUTION

AN INTERNAL FIXTURE, ACTING AS A CARRIER FOR THE ANODE AND SOLUTION, WILL BE DESIGNED AND FABRICATED. THE UNIT WILL BE CAPABLE OF DEBURRING THE INTERNAL AREA OF THE EVACUATOR HOLES BY USE OF ELECTROCHEMICAL POLISHING.

FY82 $224K
APPROVED
METALS

IMPROVED TOOLING

6 7317

OPTIMIZATION OF STEP THREAD TOOLING

PROBLEM

MUCH OF THE TOOL IS LOST DUE TO LIMITATIONS OF SHARPENING. THE CUTTER BLADES SHOULD BE EVALUATED IN AN ATTEMPT TO OBTAIN MORE DURABLE AND READILY GRINDABLE STEEL.

SOLUTION

REDESIGN CUTTER BLADE AND/OR ITS HOLDER TO PROVIDE MORE RESHARPENING CAPABILITY. NEWER CUTTING STEELS OFFER BETTER FORMABILITY AND CAN PROVIDE CAPABILITY OF FASTER SPEED AND FEED.

FY79 $75K
APPROVED
METALS

ACTION OFFICER: LAROSS C

IMPROVED TOOLING

6 8248

APPLICATION OF HIGH-RATE CUTTING TOOLS

PROBLEM

APPLICATION OF NEW HIGH-RATE CUTTING TOOLS LAG DUE TO LACK OF TESTING, ANALYSIS, AND ENGINEERED APPLICATIONS. MANUFACTURERS PROVIDE INSUFFICIENT DATA FOR EFFICIENT APPLICATIONS OF CERAMICS, OXIDES, NITRIDES, BORIDES, AND DIAMONDS.

SOLUTION

HIGH-RATE CUTTING TOOLS WILL BE TESTED, ANALYSED, AND APPLIED WITH BOTH NEW AND EXISTING MACHINING TOOLS. ENGINEERING GUIDELINES WILL BE ESTABLISHED FOR BOTH PHYSICAL AND ECONOMIC MACHINING PARAMETERS AND LIMITS.

FY82 $102K
APPROVED
METALS

ACTION OFFICER: KIRSCHBAUM R

IMPROVED TOOLING

7 8190

MMT IMPROVED BLISK-IMPELLER CUTTER LIFE

PROBLEM

MILLING CUTTER COST ASSOCIATED WITH THE BLISK AND IMPELLER FOR THE T-700 ENGINE IS AVERAGING $2540 PER ENGINE AND IS CONSIDERED EXCESSIVELY HIGH.

SOLUTION

INVESTIGATE CUTTER PARAMETERS WHICH AFFECT CUTTER LIFE, SUCH AS FEEDS, SPEEDS, GEOMETRY, AND CUTTING FLUIDS AND THEREBY DEVELOP A MANUFACTURING TECHNOLOGY TO REDUCE CUTTER COSTS BY 50 PERCENT.

FY81 $225K
APPROVED
METALS

FY82 $486K
APPROVED
METALS

ACTION OFFICER: GOLDBERGER A

FLEXIBLE MANUFACTURING SYSTEM

4 5082

FLEXIBLE MACHINING SYSTEM, PILOT LINE FOR TCV COMPONENTS

PROBLEM

PARTS FOR TRACKED COMBAT VEHICLES ARE TYPICALLY NOT MANUFACTURED IN LARGE QUANTITIES. BECAUSE OF THIS, MASS PRODUCTION TECHNOLOGIES THAT RESULT IN LOWER PRODUCTION COSTS ARE NOT USED.

SOLUTION

THE ADVANTAGES OF MASS PRODUCTION CAN BE REALIZED IN PRODUCING MEDIUM QUANTITY SIZE LOTS BY A CONCEPT KNOWN AS FLEXIBLE MACHINING SYSTEMS. THIS PROJECT WILL ADVANCE THE FMS TECHNOLOGY MAKING IT FEASIBLE TO UTILIZE FMS FOR THE MANUFACTURE OF ARMY MATERIEL.

FY79 $904K
COMPLETED
METALS, CADAM

FY80 $857K
APPROVED
METALS, CADAM

FY81 $779K
APPROVED
METALS, CADAM

FY82 $750K
APPROVED
CADAM, METALS

FY83 $350K
APPORTIONMENT
CADAM, METALS

ACTION OFFICER: PYRCE D

FLEXIBLE MANUFACTURING SYSTEM

5 4124

FABRICATION OF CONTROL ACTUATION SYSTEM HOUSINGS

PROBLEM

THE HOUSINGS USED IN TACTICAL WEAPONS CONTROL SYSTEMS ARE THE SINGLE HIGH COST ITEM IN THESE SYSTEMS. THESE HOUSINGS ARE EXPENSIVE BECAUSE MID VOLUME PRODUCTION CAPABILITIES HAVE NOT BEEN ESTABLISHED.

SOLUTION

PROVIDE A COMPUTER NUMERICAL CONTROL (CNC) MULTIMISSION CENTER CAPABILITY FOR THE PRODUCTION OF THESE HOUSINGS AT AN ANNUAL RATE OF 12,000 TO 50,000.

FY79 $930K
APPROVED
CADAM, METALS

ACTION OFFICER: PELLEN R

FLEXIBLE MANUFACTURING SYSTEM

6 8416

FLEXIBLE MACHINING SYSTEM - RIA (CAM)

PROBLEM

FLEXIBLE MACHINING SYSTEM (FMS) TECHNOLOGY OFFERS MANY ADVANTAGES TO PLANTS THAT MANUFACTURE PARTS IN LOW TO MID VOLUME QUANTITIES. HOWEVER, ESTABLISHING FEASIBILITY, PURCHASING, AND IMPLEMENTING FMS IS WIDE IN SCOPE AND VERY COMPLEX.

SOLUTION

FEASIBILITY WILL BE ESTABLISHED VIA AN FY82 PROJECT. THE FY84 PROJECT WILL PERFORM THE ANALYSIS NEEDED TO DEVELOP A REQUEST FOR PROPOSAL (RFP) AND AN RFP WILL BE PREPARED.

FY82 $138K
APPROVED
CADAM, METALS

FY84 $399K
BUDGET
CADAM, METALS

INTEGRATED MANUFACTURING SYSTEM

6 8154

COMPUTER INTEGRATED MANUFACTURING (CIM) FOR CANNON

PROBLEM

NUMERICAL CONTROL MACHINE TOOLS OFFER MANY ADVANTAGES OVER CONVENTIONAL MACHINE TOOLS BUT HAVE CERTAIN DISADVANTAGES. ONE PROBLEM AREA IS GETTING MACHINE INSTRUCTIONS TO THE MACHINE TOOL AND COLLECTING MANAGEMENT INFORMATION.

SOLUTION

INTERFACE IN-HOUSE COMPUTER FACILITIES WITH CURRENT AND FUTURE NUMERICALLY CONTROLLED MACHINE TOOLS TO FORM AN ADVANCED COMPUTER INTEGRATED MANUFACTURING SYSTEM. UTILIZE DNC TECHNOLOGY.

FY81 $442K
APPROVED
CADAM

FY83 $650K
APPORTIONMENT
CADAM

FY84 $450
BUDGET
CADAM

ROBOTICS

6 7928

ROBOTIZED BENCHING OPERATIONS

PROBLEM

BENCHING OPERATIONS ON BREECHBLOCKS AND RINGS ARE UNSAFE AND TIME CONSUMING.

SOLUTION

DEVELOP AN INDUSTRIAL ROBOT TO PERFORM THESE OPERATIONS.

FY80 $113K
APPROVED
METALS, CADAM

FY81 $287K
APPROVED
CADAM, METALS

ACTION OFFICER: MONTOURI V

MACHINABILITY DATA

4 5090

IMPROVED AND COST EFFECTIVE MACHINING TECHNOLOGY

PROBLEM

MACHINING DATA FOR FASTER REMOVAL RATES ON NEWER MATERIALS HAS NOT BEEN ESTABLISHED.

SOLUTION

ESTABLISH DATA WHEREAS THE NEW MACHINING EQUIPMENT MAY BE UTILIZED WITH MAXIMUM EFFICIENCY.

FY79 $455
COMPLETED
METALS

FY80 $229K
APPROVED
METALS

FY81 $30K
APPROVED
METALS

FY82 $250K
APPROVED
METALS

FY83 $350K
APPORTIONMENT
METALS

FY84 $275K
BUDGET
METALS

ACTION OFFICER: SHARMA S

MACHINABILITY DATA

6 7707

AUTOMATED PROCESS CONTROL FOR MACHINING (CAM)

PROBLEM

MACHINING OPERATIONS ARE SELECTED, PARAMETERS ARE SET, AND STANDARDS ARE ESTABLISHED EMPIRICALLY WITH LITTLE OR NO ENGINEERING ANALYSES, CONTROL OR FEEDBACK.

SOLUTION

APPLY COMPUTERIZED CONTROLS FOR OVERALL SELECTION OF PROCESSES, OPERATIONS, PARAMETERS, FEEDBACK AND OPTIMATION, WITH AUTOMATED ESTIMATING AND DETERMINATION OF REAL TIME AND COSTS.

FY77 $105K
COMPLETED
CADAM

FY82 $135K
APPROVED
METALS, CADAM

ACTION OFFICER: KIRSCHBAUM R

ESTABLISH MACHINE TOOL PERFORMANCE SPECIFICATIONS

6 7802

ESTABLISH MACHINE TOOL PERFORMANCE SPECIFICATIONS

PROBLEM

PROCUREMENT, ACQUISITION, AND APPLICATION OF NEW AND USED MACHINE TOOLS ARE BOTH PHYSICALLY AND ECONOMICALLY INEFFICIENT.

SOLUTION

TESTS WILL BE DESIGNED AND PROCEDURES ESTABLISHED FOR TESTING MACHINE TOOLS AND DETERMINING OVERALL PERFORMANCE EFFICIENCY. GUIDELINES WILL BE WRITTEN FOR PROCUREMENT OF MACHINE TOOLS ACCORDING TO SPECIFIC PERFORMANCE REQUIREMENTS AND EFFICIENCIES.

FY78 $195K
COMPLETED
CADAM, TEST AND INSPECTION

FY79 $322K
APPROVED
METALS, CADAM

ACTION OFFICER: KIRSCHBAUM R

ESTABLISH MACHINE TOOL PERFORMANCE SPECIFICATIONS

6 8051

APPLICATION AND CONTROL OF MACHINE TOOLS (CAM)

PROBLEM

CURRENT PROCEDURES FOR THE JUSTIFICATION, SELECTION, APPLICATION, AND MAINTENANCE OF MACHINE TOOLS ARE INADEQUATE, ALLOWING THE PROCUREMENT OF INEFFICIENT AND UNRELIABLE MACHINE TOOLS.

SOLUTION

ESTABLISH AN ACCURATE DEFINITION OF MACHINE TOOL REQUIREMENTS IN RELATION TO COMPONENT MACHINING REQUIREMENTS. DEVELOP PERFORMANCE ANALYSES AND COMPETITIVE PERFORMANCE EVALUATION CRITERIA.

FY80 $209K
APPROVED
CADAM, METALS

ACTION OFFICER: KIRSCHBAUM R

CUTTING FLUID DATA

6 7948

ESTABLISH CUTTING FLUID CONTROL SYSTEM

PROBLEM

THE LACK OF A CONTROLLED PROGRAM FOR THE USE OF CUTTING FLUIDS RESULTS IN HIGH COSTS DUE TO THE USE AND INVENTORYING OF MANY DIFFERENT FLUID TYPES.

SOLUTION

ESTABLISH A PROGRAM TO CONTROL SHOP FLOOR TESTING AND DEFINE METHODS TO CONTROL USE OF CUTTING FLUIDS DURING MANUFACTURING OPERATIONS.

FY79 $150
COMPLETED
METALS

FY80 $158K
APPROVED
METALS

FY81 $164K
APPROVED
METALS

ACTION OFFICER: JOHNSON R

APPENDIX F-3

PLANNED PROJECTS

IMPROVED METAL REMOVAL RATES

6 8352

SKIVING (METAL SHAVING) GUN TUBE BORES

PROBLEM

INTERMEDIATE TUBE BORE HONING OPERATIONS FOR SURFACE FINISH AND SIZE CONTROL ARE A TIME CONSUMING, COSTLY METAL REMOVAL PROCESS. COUNTERBORING OPERATIONS PRIOR TO SWAGE AUTOFRETTAGE ARE ALSO SLOW, TIME CONSUMING, AND HIGH IN TOOLING COSTS.

SOLUTION

THE APPLICATION OF RECENTLY DEVELOPED SKIVING TECHNOLOGY AND EQUIPMENT WILL ELIMINATE COSTLY ROUGH HONING COUNTERBORING OPERATIONS.

FY83 $120K
APPORTIONMENT
METALS

ABRASIVE METAL REMOVAL

5 4380

ABRASIVE MACHINING IN PROJECTILE MANUFACTURE

PROBLEM

NEW GENERATION OF PROJECTILES HAVE HIGH HARDNESS AND ARE MADE FROM ALLOY AND HIGH FRAGMENTATION STEELS. CONVENTIONAL MACHINING OF THESE ALLOYS REQUIRE SURFACE SPEEDS LOWER THAN NORMALLY EXPECTED WITH CARBON STEELS AND IS CONSEQUENTLY HIGHER IN COST.

SOLUTION

ABRASIVE MACHINING TECHNIQUES CAN BE USED TO INCREASE METAL REMOVAL RATES WHEN MACHINING NEW GENERATION PROJECTILES MADE WITH HARD STEEL ALLOYS. THIS PROGRAM WILL INVESTIGATE BOTH RIGID AND FLEXIBLE SURFACE ABRASIVE MACHINING TECHNIQUES.

FY83 $176K
APPORTIONMENT
METALS

FY84 $412K
BUDGET
METALS

HIGH SPEED MACHINING

4 5093

MANUFACTURING METHODS FOR HIGH SPEED MACHINING OF FERROUS ALLOYS

PROBLEM

FAST CHIP REMOVAL HAS NOT BEEN ESTABLISHED FOR PRODUCTION OF FERROUS ALLOYS.

SOLUTION

ESTABLISH FAST CHIP REMOVAL FOR PRODUCTION CONDITIONS.

FY83 $550K
APPORTIONMENT
METALS

FY84 $550K
BUDGET
METALS

HIGH SPEED MACHINING

6 7985-C

HIGH SPEED MACHINING

PROBLEM

GUN BARREL MANUFACTURING PROCEDURES REFLECT ANTIQUATED TECHNOLOGY AND RELY ON MASS REMOVAL OF MATERIAL BY CONVENTIONAL MACHINING METHODS. CURRENT EQUIPMENT REPRESENTS 1940-50 TECHNOLOGY. NEW MATERIALS COMPOUND THE PROBLEM.

SOLUTION

REDUCE TO PRACTICE NEW TECHNIQUES FOR CAL 50 TO 40MM BARRELS BY ESTABLISHING THE TECHNOLOGY AND PROCESS EQUIPMENT REQUIRED TO BRIDGE THE GAP BETWEEN CAPABILITIES AND REQUIREMENTS.

FY83 $813K
APPORTIONMENT
METALS

THERMAL ASSISTED MACHINING

4 6057-11

THERMAL ASSISTED MACHINING

PROBLEM

MATERIALS AND MANUFACTURING PROCESSES EMPLOYED IN THE MANUFACTURING OF THE XM1 CAN BE IMPROVED BY INCORPORATING NEW TECHNOLOGIES. THIS WILL ENABLE THE XM1 TO BE MANUFACTURED MORE ECONOMICALLY.

SOLUTION

IMPROVE PROCESSES FOR XM1 MANUFACTURING. THESE INCLUDE THERMAL CUTTING, AUTOMATED METALLIZING, BI-CAST HP TURBINE NOZZLES, RSR NICKEL BASE SUPER-ALLOYS, MONOCRYSTAL ALLOYS, CERAMIC COMBUSTORS, THERMALLY ASSISTED MACHINING, ETC.

FY84 $325K
BUDGET
METALS

ACTION OFFICER: MACALLISTER G

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

E 3718

AIR CYCLE AIR CONDITIONER COMPRESSOR EXPANDER

PROBLEM

TO REDUCE COST OF COMPRESSOR/EXPANDER PARTS FOR THE ENVIRONMENTAL CONTROL UNIT (ECU) AND TO MEET THE REQUIRED SCHEDULE, A MASS PRODUCTION CAPABILITY MUST BE ESTABLISHED. THIS WORK SUPPORTS AIR CYCLE DEVELOPMENT EFFORTS.

SOLUTION

ESTABLISH AN AUTOMATED PROCESS TO REDUCE COMPLEXITY OF THE SEGMENTED COMPRESSOR AND EXPANDER ROTORS. DEVELOP A TECHNIQUE TO CONTROL THE CONCENTRICITY OF THE COMPRESSOR/EXPANDER STATOR AND THE CAM TRACKS IN THE END PLATES.

FY83 $315K
APPORTIONMENT
METALS

FY84 $315K
BUDGET
METALS

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 8250

IMPROVED FABRICATION OF RECOIL WEAR SURFACES

PROBLEM

GRINDING AND HONING OPERATIONS ON WEAK SURFACES RESULT IN PARTICLE INCLUSIONS WHICH COME IN CONTACT WITH HYDRAULIC SYSTEMS AND PRODUCE HIGH WEAR RATES.

SOLUTION

USING ADVANCED METHODS, REMOVE FOREIGN PARTICLES PRIOR TO THE FINAL GRINDING OR HONING OPERATION OR, IF MORE EFFECTIVE, AFTER FINAL GRINDING OR HONING.

FY84 $28K
BUDGET
METALS

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 8351

IMPROVED MANUFACTURING OF QUADRANT FLATS AND MUZZLE BRAKE KEYWAY

PROBLEM

THE PRESENT METHOD OF MACHINING FLATS AND KEYWAYS REQUIRES TWO SET-UPS ON TWO SEPARATE MACHINE TOOLS WITH ATTENDANT MATERIEL HANDLING REQUIREMENTS.

SOLUTION

DESIGN A DUAL MACHINING SYSTEM CAPABLE OF MANUFACTURING BOTH THE KEYWAY AND THE LEVELING FLATS IN A SINGLE SET-UP, FABRICATE, AND RETROFIT TO CURRENT EQUIPMENT.

FY83 $88K
APPORTIONMENT
METALS

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 8442

IMPROVED CUTTING OF CHARPY AND TENSILE BLANKS

PROBLEM

CANNON TUBE TEST SPECIMEN BLANKS ARE SAWED MANUALLY. THIS METHOD IS TIME CONSUMING AND OFTEN RESULTS IN BLANKS THAT ARE OVERSIZED AND REQUIRE ADDITIONAL MACHINING OPERATIONS.

SOLUTION

ADAPT HIGH SPEED CUTTING PROCEDURES AND AUTOMATED HANDLING TECHNIQUES IN ORDER TO DECREASE MACHINING TIME AND ELIMINATE SUBSEQUENT MACHINING OPERATIONS.

FY84 $80K
BUDGET
METALS

IMPROVEMENT OF CURRENT PROCESS TECHNOLOGY

6 8444

MACHINING INTERNAL SURFACES OF MUZZLE BRAKES

PROBLEM

MACHINING OF THREADS AND INTERNAL SURFACES ON MUZZLE BRAKE FORGINGS IS PRESENTLY ACCOMPLISHED ON FOUR SEPARATE MACHINES. THIS METHOD IS TIME CONSUMING AND PRONE TO ALIGNMENT ERROR.

SOLUTION

UTILIZE NEWLY DEVELOPED MATERIAL HANDLING TECHNIQUES AND MACHINE CONTROL DEVICES THAT WILL PERMIT MACHINING OF THREADS AND INTERNAL SURFACES IN A SINGLE SET UP.

FY84 $80K
BUDGET
METALS

ADAPTIVE CONTROL

4 6041

INTEGRATED APPLICATION OF ADAPTIVE CONTROL FOR MACHINE TOOLS AND ROBOTS

PROBLEM

SENSORS WHICH RECOGNIZE AND SIGNAL PHENOMENAL CHANGES HAVE BEEN DEVELOPED AND DEMONSTRATED. APPLICATION OF THESE TO ADAPTIVE CONTROL CAN ADVANCE AUTOMATION TO THE LEVEL OF "PUSH BUTTON" FACTORIES, BUT LITTLE OR NOTHING HAS BEEN DONE IN THIS AREA.

SOLUTION

STATE-OF-THE-ART SENSORS WILL BE ADAPTED TO A CNC MACHINING CENTER TO ADVANCE ITS PERFORMANCE BEYOND PRESENT LEVELS OF EFFICIENCY. THIS WILL PROVIDE A PROVEN CAPABILITY WHICH CAN BE EMPLOYED ON OTHER MACHINES.

FY83 $500K
APPORTIONMENT
METALS, CADAM

DIAGNOSTICS

4 6057-05

MACHINE DIAGNOSTICS

PROBLEM

MATERIALS AND MANUFACTURING PROCESSES EMPLOYED IN THE MANUFACTURE OF THE XM1 CAN BE IMPROVED BY INCORPORATING NEW TECHNOLOGIES INTO THE CURRENT SYSTEM. THIS WILL ENABLE THE XM1 TO BE MANUFACTURED MORE ECONOMICALLY.

SOLUTION

IMPROVE PROCESSES FOR XM1 MANUFACTURE. THESE INCLUDE THERMAL CUTTING, AUTOMATED METALLIZING, BI-CAST HIGH PRESSURE TURBINE NOZZLES, RSR NICKEL BASE SUPERALLOYS, MONOCRYSTAL ALLOYS, CERAMIC COMBUSTORS, THERMALLY ASSISTED MACHINING, ETC.

FY83 $1028K
APPORTIONMENT
METALS

FY84 $420K
BUDGET
METALS

ACTION OFFICER: MACALLISTER G

ELECTROCHEMICAL MACHINING

6 7985-F

TRAVELING ELECTRODE ECM RIFLING

PROBLEM

GUN BARREL MANUFACTURING PROCEDURES REFLECT ANTIQUATED TECHNOLOGY AND RELY ON MASS REMOVAL OF MATERIAL BY CONVENTIONAL MACHINING METHODS. CURRENT EQUIPMENT REPRESENTS 1940-50 TECHNOLOGY. NEW MATERIALS COMPOUND THE PROBLEM.

SOLUTION

REDUCE TO PRACTICE NEW TECHNIQUES FOR CAL 50 TO 40MM BARRELS BY ESTABLISHING THE TECHNOLOGY AND PROCESS EQUIPMENT REQUIRED TO BRIDGE THE GAP BETWEEN CAPABILITIES AND REQUIREMENTS.

FY84 $225K
BUDGET
METALS

ELECTROCHEMICAL MACHINING

6 8225

ELECTROCHEMICAL GRINDING OF WEAPON COMPONENTS

PROBLEM

SIZING AND FINISHING OF LARGE, LONG WEAPON COMPONENTS BY CONVENTIONAL GRINDING IS SLOW AND COSTLY, OFTEN REQUIRING MULTIPLE OPERATIONS, SET-UPS, WHEEL CHANGES, AND REPETITIVE MULTIPLE PASSES. PLANNING AND GRINDING FOR THE HOWITZER MOUNT RAIL ARE EXAMPLES OF SUCH OPERATIONS.

SOLUTION

RETROFIT AN EXISTING LONG BED HORIZONTAL SURFACE GRINDER WITH AN ELECTROLYTIC SYSTEM TO PROVIDE FAST SINGLE PASS ROUGH FINISHING OF LARGE COMPONENTS, AND ELIMINATE THE NEED FOR ROUGHING BY PLANNING OR MILLING BEFORE ELECTROLYTIC GRINDING.

FY83 $130K
APPORTIONMENT
METALS

IMPROVED TOOLING

1 7302

PRODUCTION OF BORIDE COATED LONG LIFE TOOLS

PROBLEM

AIRFRAME COMPOSITE COMPONENTS REQUIRE EXTENSIVE MACHINING WHICH IS EXPENSIVE IN TERMS OF LABOR HOURS REQUIRED AND TOOL COSTS.

SOLUTION

MANUFACTURE OF TITANIUM BORIDE COATED TOOLS WILL BE SCALED UP FROM LBORATORY SIZED ELECTROLYTIC CELLS (15 LBS) TO PRODUCTION SIZE (ABOUT 300 LBS) WITH THE CAPABILITY TO PLATE VARIOUS TOOL TYPES AND SHAPES. TOTAL TOOLING COST WILL BE REDUCED BY APPROXIMATELY 80 PERCENT.

FY83 $225K
APPORTIONMENT
NON-METALS

FY84 $265K
BUDGET
NON-METALS

IMPROVED TOOLING

5 4535

PRECISION TOOLING FOR SMALL CALIBER AMMUNITION

PROBLEM

TOOL ADJUSTMENT TIME AND TOOL COSTS ARE SIGNIFICANT FACTORS IN THE COST OF AMMUNITION. WORK IN THE CAN INDUSTRY SHOWS THAT SIGNIFICANT IMPROVEMENTS CAN BE ACHIEVED IN TERMS OF CLOSER TOLERANCES, IMPROVED GRINDING METHODS, AND TOOL LIFE.

SOLUTION

INDUSTRY TECHNIQUES WILL BE EVALUATED. SAMPLES WILL BE PRODUCED AND EVALUATED IN ACTUAL PRODUCTION ENVIRONMENT. COST AND TOOL LIFE WILL BE OPTIMIZED.

FY84 $220K
BUDGET
METALS

IMPROVED TOOLING

6 8439

IMPROVED RIFLING PROCEDURES

PROBLEM

RIFLING HEADS USED TO HOLD BROACH CUTTERS IN THE RIFLING OPERATION ARE SUBJECT TO EXCESSIVE WEAR, NECESSITATING SIGNIFICANT MAINTENANCE AND REPAIR EXPENDITURE.

SOLUTION

DESIGN A NEW RIFLING HEAD THAT IS NOT SUBJECT TO WEAR, THEREBY ELIMINATING MAINTENANCE AND REPAIR EXPENDITURE ASSOCIATED WITH WORN RIFLING HEADS.

FY84 $80K
BUDGET
METALS

APPENDIX G

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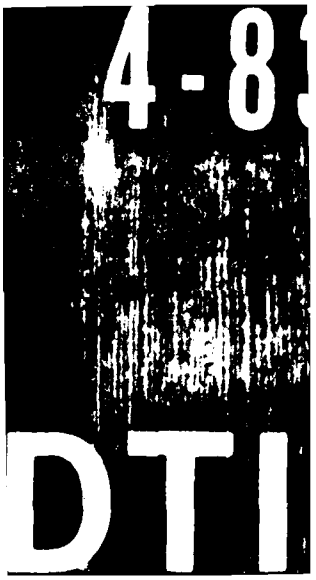
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