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AFMDC 70-5

SIXTH ANNUAL REPORT OF THE  
AIR FORCE MACHINABILITY DATA CENTER

1969 - 1970

ROBERT E. SNIDER  
Metcut Research Associates Inc.

TECHNICAL REPORT AFML-TR-70-313

MARCH 1971

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AIR FORCE MATERIALS LABORATORY  
AIR FORCE SYSTEMS COMMAND  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

## FOREWORD

The Sixth Annual Report of the Air Force Machinability Data Center (AFMDC) covers work performed under Contract F33615-69-C-1112 from October 1, 1969, through September 30, 1970. The work described in this report covers that accomplished under project No. 8975, Materials Information Analysis Centers, Task No. 897506, Air Force Machinability Data Center. It also cites some statistics covering the 5-3/4 years that AFMDC has been in operation. This Center is operated for the Air Force Materials Laboratory, by Metcut Research Associates Inc., 3980 Rosslyn Drive, Cincinnati, Ohio 45209. The manuscript was released by the author, Robert E. Snider, Director of AFMDC, in October 1970 for publication as an AFMDC Report.

This effort is being administered under the direction of the Air Force Materials Laboratory, Wright-Patterson Air Force Base, with Mr. E. L. Horne (LAM) as project engineer.

Your comments are solicited on the potential utilization of the Air Force Machinability Data Center as applied to your present or future production programs.

For a complete analysis of the progress made by the Center from its early inception to the present, the following six references should be reviewed:

“Final Report on the Design of a System for Collecting, Evaluating and Disseminating Machinability Data for Aerospace Materials”, Technical Documentary Report Nr. ASD-TDR-63-572, July 1963, AD-416743.

“First Annual Report of the Air Force Machinability Data Center”, AFMDC 65-2, February 1966, AD-482278.

“Second Annual Report of the Air Force Machinability Data Center”, AFMDC 66-4, February 1967, AD-813037.

“Third Annual Report of the Air Force Machinability Data Center”, AFMDC 67-8, February 1968, AD-829879.

“Fourth Annual Report of the Air Force Machinability Data Center”, AFMDC 68-6, October 1968, AD-844920.

“Fifth Annual Report of the Air Force Machinability Data Center”, AFMDC 69-6, October 1969, AD-697794.

This report has been reviewed and is approved.



Edward Dugger  
Chief, Materials Information Branch  
Materials Support Division  
Air Force Materials Laboratory

### ABSTRACT

This report covers the sixth year of operation of the Air Force Machinability Data Center from October 1, 1969 through September 30, 1970 (Contract F33615-69-C-1112). During this contracting period 5,141 documents were processed from which 19,654 cards were keypunched. Currently, there are 110,143 supporting records on punched cards which permit computer searches to be conducted for citation to 40,966 specific machining situations coded on AFMDC's documents.

During this reporting period, 1,038 specific inquiries were answered for 512 different organizations representing 761 individuals in 101 different SIC categories. Since the Center's operation began in October 1964 a total of 5,739 specific inquiries have been processed. The average number of inquiries was 86 per month at an average processing cost of \$43.77 per inquiry.

Statistics are presented for estimated cost savings of AFMDC users. Through September 30, 1970, it has been very conservatively estimated that these savings amounted to more than \$50,000,000.

Also in this report are tables and information reflecting AFMDC activity in other areas related to data publications, Government activity, types of inquiries, etc.

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## INTRODUCTION

This Sixth Annual Report of the Air Force Machinability Data Center covers a one year operational period from October 1, 1969, through September 30, 1970.

The Air Force Machinability Data Center began operation on October 1, 1964, on a contract operated by Metcut Research Associates Inc. for the Manufacturing Technology Division of the Air Force Materials Laboratory. On October 1, 1968, the Center then continued operation under a change of administration to the Materials Information Branch of the Air Force Materials Laboratory.

This report is concerned primarily with activities and progress made during this past contract year of operation. Contained herein are charts reflecting the scope of services in answering technical inquiries and the dissemination of information through the sale of data publications. The other charts, along with presenting activities, serve as a guideline on the trends in material removal and materials being used in today's industry and the area of industry in which they are being used.

During this reporting period several new computer programs were developed. One enables AFMDC to more effectively and at less cost obtain data on all center activity. The data reported in this Sixth Annual Report was primarily collected by utilization of this new computer program. Other new computer processing capabilities are also reported.

AFMDC COMPUTER PROCESSING AREA



## DESCRIPTION OF AFMDC

AIR FORCE MACHINABILITY DATA CENTER, 3980 Rosslyn Drive, Cincinnati, Ohio 45209.  
Operated for the Air Force Materials Laboratory, Materials Support Division, under  
Contract F33615-69-C-1112, by Metcut Research Associates Inc.

### SCOPE

The Air Force Machinability Data Center (AFMDC) collects, evaluates, stores, and disseminates material removal information including specific and detailed machining data for the benefit of industry and government. Strong emphasis is given to engineering evaluation for the purpose of developing optimized material removal parameters, such as speeds, feeds, depths of cut, tool material and geometry, cutting fluids and other significant variables. Data are being processed for all types of materials and for all kinds of material removal operations such as turning, milling, drilling, tapping, grinding, electrical discharge machining, electrochemical machining, etc.

### COLLECTION

AFMDC has a data file of over twenty-seven thousand selected documents pertaining to all phases of material removal technology. This data file is supported by an automated retrieval system which is controlled by an IBM 1130 computer installation. Information retrieval is based upon the specific material (with definite chemical, physical, and mechanical properties) and the specific material removal operation being used. Sophisticated computerized search techniques are employed utilizing a combination of search parameters to produce source data. Information retrieval can be refined to the extent necessary to satisfy the requirements of a specific inquiry by controlling the input search parameters.

### INFORMATION SERVICES PROVIDED BY AFMDC

The Air Force Machinability Data Center maintains an intensive effort to serve as a communication link for both Government and industry by providing the following services related to the field of material removal. Strong emphasis is placed on providing analyzed data in answer to technical inquiries. Services are available to the aerospace industry, all DoD agencies and their contractors and other Government agencies, technical institutions and nonmilitary industries in a position to assist the defense effort. At the present time inquiry service is available without charge, however, AFMDC is conducting studies into a possible future means of collecting output costs related to this service. AFMDC also maintains a selected mailing list (User File) for the dissemination of new information or services available from the Center.

### TO REQUEST MACHINING INFORMATION.....

Telephone: 513-271-9510  
TWX: 810-461-2840 or  
Write: Air Force Machinability Data Center  
3980 Rosslyn Drive  
Cincinnati, Ohio 45209

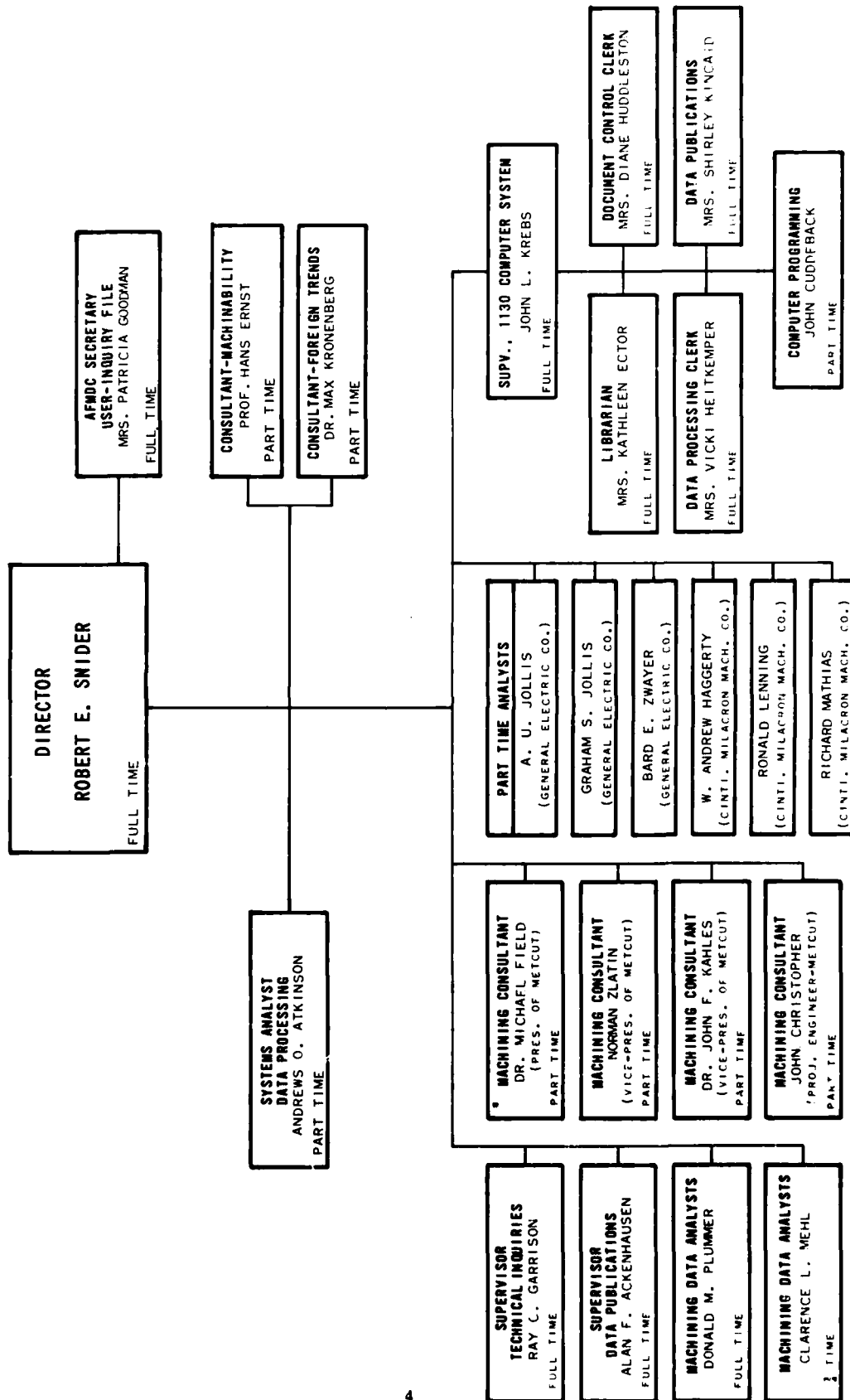
### TO HELP US ANSWER YOUR INQUIRY, IF POSSIBLE PLEASE:

1. Identify the material being machined (specification or tradename); condition, (as cast, hot rolled, cold drawn, annealed, quenched and tempered, etc.); microstructure and hardness.
2. Identify the material removal operation in question (turning, milling, drilling, tapping, surface grinding, electrical discharge machining (EDM), electrochemical machining (ECM), etc.).
3. Specify reasons for requiring data unless your needs are proprietary. This enables AFMDC to broaden the scope of its technical advice.
4. Specify delivery requirements.
5. Indicate to whom the inquiry reply should be sent.
6. Transmit all details concerning present practices, including feeds, speeds, cutting tool material and geometry, cutting fluids, etc., in the event your inquiry pertains to improvement of an existing machining situation.

\*\*\*\*\*

NOTE: Association of the names of companies and individuals with specific requests is kept confidential. However, data developed remain the property of AFMDC for dissemination as required for answering similar inquiries and for developing data publications.

# AFMDC ORGANIZATION CHART



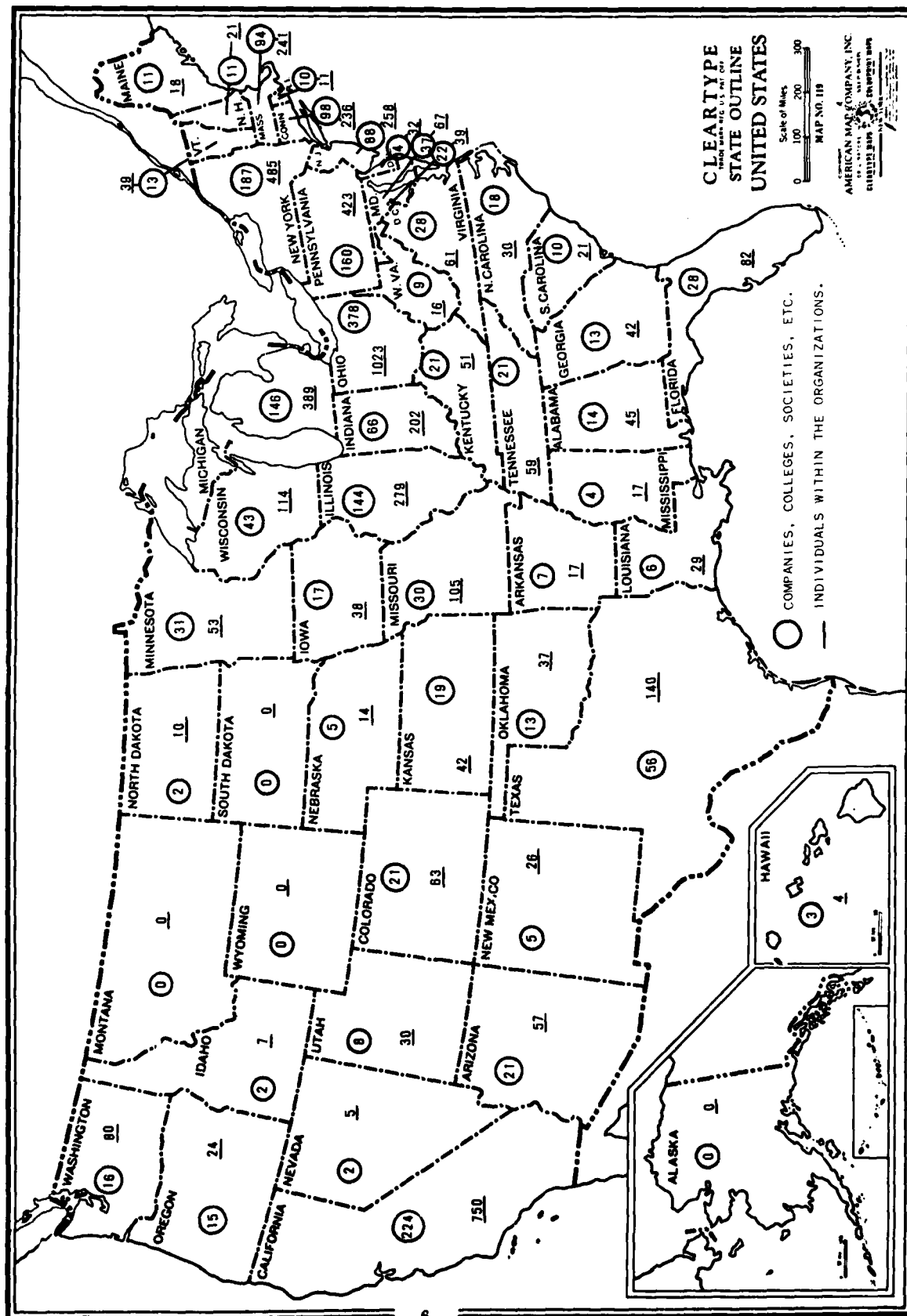


### AFMDC OPERATIONAL AREAS

At AFMDC, personnel shown on page 4, work in ten functional areas of operation. These are indicated below along with the numbers used for time coding purposes:

1	Administration	Administration of technical and general activities of AFMDC
2	Engineering Supervision	Technical activities including all mechanized handling of data and processing of inquiries
3	Systems Analysis	Design of the machinability data system, particularly processing
4	Machining Data Analysis	Technical evaluation of machinability data and information including Preliminary Screening
5	Data Processing	Operation of a mechanized system including a computer
6	Data Control	Superimposition and use of controls to guarantee proper operation of data processing system
7	Document Acquisition and Document Storage	Acquisition of all types of data and information for processing. Storage of documents including those which have received Final Technical Evaluation and those in process
8	Data Dissemination	Dissemination including duplication and printing
9	Machining Data Verification - Experimental Machining	Laboratory and shop work necessary for resolving highly significant and controversial data situations
0	Secretarial and Clerical	Development and execution of all procedures relating to typing and filing

# AFMDC USER FILE MAP



## DISTRIBUTION OF AFMDC USER FILE

Names are added to the User File as a result of: 1) inquirers, 2) visitors, 3) additional names submitted by current Users, 4) requests resulting from dissemination of data publications, and 5) technical articles published in periodicals and announcements pertaining to the Center.

### GENERAL CONCENTRATION OF USERS BY NUMBERS

STATES	ORGANIZATIONS	TOTAL NO. ORGANIZATIONS	STATES*	INDIVIDUAL	TOTAL INDIVIDUAL USERS
4	0	0	4	0	0
14	1-10	77	13	1-25	185
16	11-25	266	12	26-50	429
6	26-50	197	11	51-125	792
5	51-100	402	6	126-300	1,356
6	OVER-100	<u>1,239</u>	5	OVER-300	<u>3,070</u>
		TOTAL 2,181			TOTAL 5,832

### AREA CONCENTRATION OF ORGANIZATIONS

West Coast (3 states)-	255 companies
Midwest (5 states) -	777 companies
North Central (3 states) -	435 companies
New England (6 states)-	237 companies

The total User File (5,832), can be broken down as follows:

Company Users (Individuals)	4,979
Companies	1,938
College Users (Individuals)	729
Colleges	202
Societies, Centers, etc. (Individuals)	124
Societies, Centers, etc.	41

\* Includes Washington, D.C.

# SUMMARY OF SPECIFIC INQUIRIES BY TYPE OF INQUIRY

October 1, 1969 - September 30, 1970

NO. OF  
INQUIRIES  
10/1/69-9/30/70

1. RECOMMENDATIONS FOR A SPECIFIC MACHINING SITUATION. <i>Typical Example:</i> Requested recommendations for turning Waspaloy in the solution treated and aged condition.	148
2. STARTING RECOMMENDATIONS FOR AN EXTENSIVE GROUP OF MACHINING SITUATIONS. <i>Typical Example:</i> Requested machinability data on AN-350, S-816, HS-31, Inconel X-750, Unitemp M-252 and Hastelloy N-235.	359
3. INFORMATION PERTAINING TO NEW MACHINING PROCESSES, EQUIPMENT AND TOOLS. <i>Typical Example:</i> Requested information on the manufacturer of equipment called "Liquid Lathe".	38
4. COORDINATION AND POTENTIAL USE OF AFMDC. <i>Typical Example:</i> Requested detailed information on services available from AFMDC.	63
5. VISITS TO THE CENTER. <i>Typical Example:</i> Visited to coordinate with AFMDC to determine services available and to review System details.	6
6. REQUESTS FOR SPECIFIC DOCUMENTS, REPORTS, BOOKS, PAPERS, ETC. <i>Typical Example:</i> Requested a list of reports available for machining of titanium. Also wanted cost of each report.	110
7. GENERAL INFORMATION SUCH AS SAFETY PRACTICES, NAMES OF FIRMS HAVING CERTAIN MACHINING CAPABILITIES, TOOL MATERIAL PROPERTIES, ETC. <i>Typical Example:</i> Requested the names of people to contact in the fields of metal removal such as EDM, ECM, ECG, EDG, USM, CHM, EDM, LBM, Abrasive Machining and Hot Machining.	69
8. REQUESTS FOR BIBLIOGRAPHIES AND ABSTRACTS. <i>Typical Example:</i> Request for bibliographies with abstracts covering use of ceramic tools and abrasives in machining various materials.	11
9. STATE-OF-THE-ART INFORMATION AND REPORTS. <i>Typical Example:</i> Suggestions for important manufacturing programs for the next five years in the field of material removal. Supply problem, approach and approximate funds.	31

# SUMMARY OF SPECIFIC INQUIRIES BY TYPE OF INQUIRY (cont.)

October 1, 1969 - September 30, 1970

NO. OF  
INQUIRIES  
10/1/69-9/30/70

10. SPECIAL INQUIRIES AND REPORTS FOR U.S. AIR FORCE, MANUFACTURING TECHNOLOGY DIVISION. <i>Typical Example:</i> Requested a report on the progress during the last five years in machining of titanium and hard to machine materials - state of the art.	5
11. EVALUATION, TRANSLATION AND REVIEW OF REPORTS, BOOKS, PAPERS. <i>Typical Example:</i> Requested an evaluation of a report published in Electro-Technology, October 1964, concerning adaptive control possibilities.	4
12. REQUESTS FOR INFORMATION ON METAL REMOVAL RATES. <i>Typical Example:</i> Requested information on maximum metal removal rates in turning and drilling of leaded steels.	5
13. COMPARISON OF ONE PROCESS OR MATERIAL WITH ANOTHER. <i>Typical Example:</i> Requested a comparison of the machining of Inconel W with Inconel X in both solution treated and solution treated and aged conditions, primarily in turning but also drilling and milling if possible.	27
14. INFORMATION PERTAINING TO CUTTING FLUIDS. <i>Typical Example:</i> Requested cutting fluid recommendations for titanium and a wide variety of high temperature alloys and stainless steels.	29
15. INFORMATION ON MACHINABILITY RESEARCH. <i>Typical Example:</i> Requested machining information on the effect of work diameter on tool life, mathematical correlations of the various machining processes and the means of predicting the surface quality in milling.	104
16. INFORMATION PERTAINING TO ESTIMATING COST, SETTING TIME STANDARDS, AND PRODUCTION RATES IN MACHINING. <i>Typical Example:</i> Requested information including formulas that could be used to predict production rates and costs.	29
<b>TOTAL</b>	<b>1,038</b>

\*This total does not include requests for published data publications such as AFMDC reports.

# ANALYSIS OF INQUIRIES BY STATE

October 1, 1969 - September 30, 1970

10 STATES LEADING INQUIRIES			
STATES	COMPANIES	INDIVIDUALS	NO. OF INQUIRIES
CALIFORNIA	43	84	103
CONNECTICUT	18	35	38
ILLINOIS	30	37	40
MICHIGAN	32	47	61
MISSOURI	6	14	27
NEW JERSEY	20	32	42
NEW YORK	37	55	64
OHIO	95	216	308
PENNSYLVANIA	37	54	65
TEXAS	10	20	31
<b>TOTAL</b>	<b>328</b>	<b>584</b>	<b>779</b>
OTHER STATES SUBMITTING INQUIRIES			
ALABAMA	2	2	5
ARIZONA	7	11	23
COLORADO	4	4	6
DISTRICT OF COLUMBIA	5	5	7
DELAWARE	1	5	6
FLORIDA	4	4	6
GEORGIA	4	5	6
INDIANA	7	15	20
IOWA	6	6	6
KANSAS	1	1	1
KENTUCKY	6	10	14
LOUISIANA	1	1	2
MAINE	1	1	1
MARYLAND	5	5	5
MASSACHUSETTS	17	17	19
MINNESOTA	6	8	8
MISSISSIPPI	1	1	2
NEBRASKA	1	1	1
NEW HAMPSHIRE	2	2	2
NEW MEXICO	2	5	7
NORTH CAROLINA	6	6	7
OKLAHOMA	5	9	17
OREGON	1	2	4
RHODE ISLAND	5	6	8
SOUTH CAROLINA	2	2	4
TENNESSEE	6	6	15
VERMONT	7	9	19
VIRGINIA	6	7	9
WEST VIRGINIA	2	2	2
WASHINGTON	6	12	13
WISCONSIN	10	11	14
<b>TOTAL</b>	<b>139</b>	<b>181</b>	<b>259</b>
<b>TOTAL FOR ALL STATES</b>	<b>467</b>	<b>775</b>	<b>1038</b>

# ANALYSIS OF INQUIRIES BY MATERIAL GROUP

October 1, 1969 - September 30, 1970

MATERIAL GROUP	INQUIRIES
PLAIN CARBON & LOW ALLOY STEELS	125
ULTRA HIGH STRENGTH & TOOL STEELS	55
CARBIDES	12
CAST IRON	60
CAST STEELS	11
STAINLESS STEELS	59
NICKEL ALLOYS	22
MARAGING STEELS	12
HIGH TEMPERATURE ALLOYS	200
TITANIUM ALLOYS	108
REFRACTORY ALLOYS	58
BERYLLIUM ALLOYS	9
ZIRCONIUM ALLOYS	9
ALUMINIUM, MAGNESIUM, ZINC, LEAD, COPPER & TIN ALLOYS	84
PRECIOUS & RARE METALS	11
POWDER METALS	11
FOAMY METALS	2
NONMETALLICS INCLUDING CERAMICS, PLASTICS, GRAPHITE & COMPOSITES	81
MULTIPLE GROUP	185
UNITERM TYPE (NO GROUP)	401
TOTAL	<u>1,495</u>

# **ANALYSIS OF INQUIRIES BY TYPE OF MACHINING OPERATION**

October 1, 1969 - September 30, 1970

OPERATION	INQUIRIES
<b><u>CONVENTIONAL CHIP REMOVAL</u></b>	
TURNING	129
BORING	30
MILLING (GENERAL)	32
FACE MILLING	18
END MILL SLOTTING	15
PERIPHERAL END MILLING	17
SLAB MILLING	3
ALL OTHER TYPES OF MILLING	15
DRILLING	125
GUN DRILLING	7
REAMING	14
TAPPING	29
GEAR CUTTING	6
BROACHING	12
ROUTING	4
BANDSAWING	4
<b>TOTAL</b>	<b>460</b>
<b><u>CONVENTIONAL GRINDING</u></b>	
GENERAL GRINDING	55
SURFACE GRINDING	28
CYLINDRICAL GRINDING	12
INTERNAL GRINDING	6
CENTERLESS GRINDING	8
ABRASIVE MACHINING	5
ABRASIVE BELT GRINDING	3
ABRASIVE CUTOFF	5
HONING	10
<b>TOTAL</b>	<b>132</b>
<b><u>ALTERNATE MACHINING METHODS</u></b>	
ELECTRICAL DISCHARGE MACHINING	31
ELECTROCHEMICAL MACHINING	37
ELECTROCHEMICAL GRINDING	6
CHEMICAL MACHINING	14
PHOTOCHEMICAL MACHINING	2
ULTRASONIC MACHINING	11
LASER MACHINING	6
ABRASIVE JET MACHINING	2
SUB-ZERO MACHINING	8
HOT MACHINING	12
THREAD ROLLING	2
<b>TOTAL</b>	<b>120</b>
<b><u>MISCELLANEOUS</u></b>	
BURNISHING	12
POLISHING	1
UNITERM DESCRIPTIVE OPERATIONS	379
MULTIPLE OPERATIONS	336
MISCELLANEOUS CONVENTIONAL OPERATIONS	44
<b>TOTAL</b>	<b>772</b>
<b>TOTAL</b>	<b>1464</b>



SUMMARY OF INQUIRIES PROCESSED BY AFMDC FOR STSP\* & SBA\*\*

October 1, 1969 - September 30, 1970

NUMBER OF INQUIRIES FOR STSP*	
<u>STATE</u>	<u>NO. OF INQUIRIES</u>
ARIZONA	5
IOWA	1
MICHIGAN	2
MINNESOTA	1
NEW JERSEY	1
NEW YORK	1
OHIO	1
VERMONT	11
VIRGINIA	1
TOTAL	24

NUMBER OF INQUIRIES FOR SBA**	
<u>STATE</u>	<u>NO. OF INQUIRIES</u>
CALIFORNIA	1
COLORADO	2
ILLINOIS	2
MASSACHUSETTS	1
MICHIGAN	1
MINNESOTA	1
NEW YORK	2
OHIO	2
PENNSYLVANIA	4
TOTAL	16

STSP\* - STATE TECHNICAL SERVICES, PROGRAMS

SBA\*\* - SMALL BUSINESS ADMINISTRATION TECHNOLOGY  
UTILIZATION PROGRAMS

# AIR FORCE MACHINABILITY DATA CENTER

## SUMMARY OF SPECIFIC INQUIRIES BY SIC\* NUMBER

OCTOBER 1, 1969 - SEPTEMBER 30, 1970

SIC MAJOR GROUP NO.	SIC INDUSTRY NO.		NUMBER OF INQUIRIES		
			BY SIC INDUSTRY NO.	BY SIC MAJOR GROUP NO.	% OF TOTAL
91		FEDERAL GOVERNMENT		88	8.5
	9100	DEFENSE RESEARCH LAB - SANTA BARBARA, CALIF.	1		
	9100	USAF - WRIGHT FIELD	28		
	9100	USAF - ANDREWS AIR FORCE BASE	2		
	9100	USAF - ROBINS AIR FORCE BASE	1		
	9100	USAF - KELLY AIR FORCE BASE	2		
	9100	U.S. ARMY	12		
	9100	ARNOLD AIR FORCE STATION, TN.	1		
	9100	NATIONAL AERONAUTICS & SPACE ADMINISTRATION	3		
	**9191	STATE TECHNICAL SERVICE PROGRAMS	24		
	9192	SMALL BUSINESS ADMINISTRATION	14		
19		ORDNANCE AND ACCESSORIES		5	.5
27		PRINTING, PUBLISHING, AND ALLIED INDUSTRIES		10	1.0
28		CHEMICALS AND ALLIED PRODUCTS		17	1.6
29		PETROLEUM REFINING AND RELATED INDUSTRIES		15	1.4
32		STONE, CLAY, GLASS, AND CONCRETE PRODUCTS		18	1.7
33		PRIMARY METAL INDUSTRIES		58	5.6
34		FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY, AND TRANSPORTATION EQUIPMENT		50	4.8
35		MACHINERY, EXCEPT ELECTRICAL		255	24.5
36		ELECTRICAL MACHINERY, EQUIPMENT AND SUPPLIES		64	6.2

# SUMMARY OF SPECIFIC INQUIRIES BY SIC\* NUMBER (cont.)

SIC MAJOR GROUP NO.	SIC INDUSTRY NO.		NUMBER OF INQUIRIES		
			BY SIC INDUSTRY NO.	BY SIC MAJOR GROUP NO.	% OF TOTAL
37		TRANSPORTATION EQUIPMENT		311	29.9
	3721	AIRCRAFT AND MISSILES	144		
	3722	AIRCRAFT ENGINES & ENGINES PARTS - MISSILE ENGINES	88		
	3729	AIRCRAFT PARTS & AUXILIARY EQUIPMENT - MISSILE PARTS OTHERS	37 42		
38		PROFESSIONAL, SCIENTIFIC, AND CONTROLLING INSTRUMENTS: PHOTOGRAPHIC AND OPTICAL GOODS: WATCHES AND CLOCKS		8	.8
39		JEWELRY, PRECIOUS METALS		1	.1
40		RAILROADS, LINE-HAUL OPERATING		1	.1
50		WHOLESALE TRADE		6	.6
73		MISCELLANEOUS BUSINESS SERVICES		56	5.4
82		EDUCATIONAL SERVICES		46	4.4
86		NONPROFIT MEMBERSHIP ORGANIZATIONS		7	.7
89		MISCELLANEOUS SERVICES		23	2.2
TOTALS				1038	100.0%

\* Standard Industrial Classification Manual (SIC). Executive Office of the President,  
Bureau of the Budget, 1967

\*\* This SIC Number Was Assigned Because of the Special Significance of the State Technical Service Program

COMPANIES AND AGENCIES SUBMITTING INQUIRIES TO AFMDC

OCTOBER 1, 1969 - SEPTEMBER 30, 1970

\* INDICATES NEW INQUIRERS

\* A+B DICK CO. CHICAGO, IL.  
 \* ABBOTT LABORATORIES CHICAGO, IL.  
 \* ABEX CORP. COLUMBUS, OH.  
 \* ABEX CORP. MANHATTAN, NJ.  
 \* ACCRA TRONICS SEALS CORP. BURBANK, CA.  
 \* ACCURATE BUSHING CO. GARWOOD, NJ.  
 \* ACCURATE DIAMOND TOOL CORP. HACKENSACK, NJ.  
 \* ACME ELECTRIC WELDER CO. LOS ANGELES, CA.  
 \* ACRALOC CORP. OAK RIDGE, TN.  
 \* ADAPTATRONICS, INC. MC LEAN, VA.  
 \* AEROFJET GENERAL CORP. SACRAMENTO, CA.  
 \* AEROFJET-GENERAL CORP. AZUSA, CA.  
 \* AERONCA MANUFACTURING CO. MIDDLETOWN, OH.  
 \* AIR FORCE, DEPT. OF THE ANDREWS AFB, DC.  
 \* AIR FORCE, DEPT. OF THE KELLY AFB, TX.  
 \* AIR FORCE, DEPT. OF THE ROBINS AFB, GA.  
 \* ALJO TOOL CO. STERLING, NJ.  
 \* ALLEGHENY-LUDLUM CO. DUNKIRK, NY.  
 \* ALLIED CHEMICAL CORP. MORRISTOWN, NJ.  
 \* ALLIED SCREW PRODUCTS, INC. MISHAWAKA, IN.  
 \* ALLIS-CHAMBERS MANUFACTURING CO. MILWAUKEE, WI.  
 \* ALLOY STEELS, INC. CINCINNATI, OH.  
 \* ALUMINUM CO. OF AMERICA DAVENPORT, IA.  
 \* ALUMINUM CO. OF AMERICA PITTSBURGH, PA.  
 \* AMERACE ESNA CORP. UNION, NJ.  
 \* AMERICAN COMPUTER SERVICE CINCINNATI, OH.  
 \* AMERICAN HELLER CORP. DETROIT, MI.  
 \* AMERICAN OPTICAL CO. SOUTHBRIDGE, MA.  
 \* AMERICAN STANDARD INC. FALLS CHURCH, VA.  
 \* AMERICAN TOOL CO. KALAMAZOO, MI.  
 \* AMERICAN TOOL WORKS CINCINNATI, OH.  
 \* AMERICAN TRADERS INC. ANAHEIM, CA.  
 \* AMERICAN WELDING & MANUFACTURING CO. WARREN, MI.  
 \* APEX CORP. HUDSON, OH.  
 \* API MIAMI, FL.  
 \* APOLLO WELDING CO. INC. ROYAL OAK, MI.  
 \* ARIZONA STATE UNIVERSITY TEMPE, AZ.  
 \* ARMY, DEPT. OF THE NEW YORK, NY.  
 \* ARMY, DEPT. OF THE PHILADELPHIA, PA.  
 \* ARMY, DEPT. OF THE ROCK ISLAND, IL.  
 \* ARMY, DEPT. OF THE TEXAS, TX.  
 \* ARMY, DEPT. OF THE SACRAMENTO, CA.  
 \* ARMY, DEPT. OF THE ST. LOUIS, MO.  
 \* ARMY, DEPT. OF THE CHAMPAIGN, IL.  
 \* ARNOLD AIR FORCE STATION, TN.  
 \* ASC CORP. OWING, MD.  
 \* ASHLAND CIL INC. ASHLAND, KY.  
 \* ASTRO MET ASSOCIATES INC. CINCINNATI, OH.  
 \* ATLANTIC RICHFIELD CO. HARVEY, IL.  
 \* AUTO SPECIALTIES MANUFACTURING CO. HARTFORD, MI.  
 \* AUTOMATION INDUSTRIES INC. ABILENE, TX.  
 \* AVCO CORP. CINCINNATI, OH.  
 \* AVCO CORP. LOWELL, MA.  
 \* AVCO CORP. STRATFORD, CT.  
 \* AVEY MACHINE TOOL CO. COVINGTON, KY.  
 \* AVIATION TOOLS AND MACHINES, INC. NEW YORK, NY.  
 \* BABCOCK & WILCOX LYNCHBURG, VA.  
 \* BANCROFT CO., INC. FRANK, COLUMBUS, OH.  
 \* BATTLEFIELD MEMORIAL INSTITUTE COLUMBUS, OH.  
 \* BAUER BROS. CO. SPRINGFIELD, OH.  
 \* BELL HELICOPTER CO. FORT WORTH, TX.  
 \* BEVIS & CALL CO. SPRINGFIELD, MA.  
 \* BENDIX CORP. DAVENPORT, IA.  
 \* BENDIX CORP. DAYTON, OH.  
 \* BENDIX CORP. KANSAS CITY, MO.  
 \* BENDIX CORP. SOUTHFIELD, MI.  
 \* BERG ELECTRONICS, INC. NEW CUMBERLAND, PA.  
 \* BERLIN SUPPLY CO. PHILADELPHIA, PA.  
 \* BOEING CO. (THE) NEW ORLEANS, LA.  
 \* BOEING CO. (THE) PHILADELPHIA, PA.  
 \* BOEING CO. (THE) SEATTLE, WA.  
 \* BRADEN INDUSTRIES, INC. BROKEN ARROW, OK.  
 \* BRADLEY UNIVERSITY PEORIA, IL.  
 \* BRANSON INSTRUMENTS INC. COOKVILLE, TN.  
 \* BRANSON INSTRUMENTS INC. DANBURY, CT.  
 \* BROWN & SHARPE MFG CO. DAYTON, OH.  
 \* BRUBAKER TOOL CORP. MILLERSBURG, PA.  
 \* BRUSH BERYLLIUM CO. (THE) CLEVELAND, OH.  
 \* BRYANT GRINDER CORP. SPRINGFIELD, VT.  
 \* BULLARD CO. (THE) BRIDGEPORT, CT.  
 \* BUNKER-RAND CORP. HIGHLAND HEIGHTS, OH.  
 \* BURGESS BROTHERS, INC. NORWOOD, MA.  
 \* CADILLAC GAGE CO. COSTA MESA, CA.  
 \* CALIFORNIA UNIVERSITY OF LIVERMORE, CA.  
 \* CAMERON IRON WORKS HOUSTON, TX.  
 \* CANFIELD MACHINE CO. KINGSTON, NY.  
 \* CARBORUNDUM CO. NIAGARA FALLS, NY.  
 \* CARLTON MACHINE TOOL CO. CINCINNATI, OH.  
 \* CARPET CORP. MADISON HEIGHTS, MI.  
 \* CATERPILLAR TRACTOR CO. PEORIA, IL.  
 \* CAVITRON ULTRASONICS INC. LEO CITY, NY.  
 \* CCS ENGINEERING, INC. SANTA CLARA, CA.  
 \* CENTRAL MICHIGAN UNIV. MT. PLEASANT, MI.  
 \* CESSNA AIRCRAFT CO. WICHITA, KS.  
 \* CHAMBERLAIN MANUFACTURING CORP. WATERLOO, IA.  
 \* CHAR-LYNN CO. EDEN PRAIRIE, MN.  
 \* CHEM FORM POMPAHO BEACH, FL.  
 \* CHEM PROJECTS ASSOC. NEW YORK, NY.  
 \* CHERRY-BURRELL CORP. CEDAR RAPIDS, IA.  
 \* CHRYSLER CORP. DAYTON, OH.  
 \* CHRYSLER CORP. HARTFORD, CT.  
 \* CHRYSLER CORP. STERLING HEIGHTS, MI.  
 \* CINCINNATI MILLACRON CINCINNATI, OH.  
 \* CINCINNATI MILLACRON WILMINGTON, OH.  
 \* CINCINNATI, INC. WHITEWATER, OH.  
 \* CINCINNATI, UNIVERSITY OF CINCINNATI, OH.  
 \* CITIES SERVICE OIL CO. TULSA, OK.  
 \* CLARKSON COLLEGE OF TECHNOLOGY, POTSDAM, NY.  
 \* CLEVELAND AUTOMATIC MACHINE TOOL CO. CINCINNATI, OH.  
 \* CLEVELAND PNEUMATIC TOOL CO. (THE) CLEVELAND, OH.  
 \* CLEVELAND STATE UNIVERSITY CLEVELAND, OH.  
 \* CLIMAX POLYMERUM CO. NEW YORK, NY.  
 \* CLIMCO PRODUCTS INC. CINCINNATI, OH.  
 \* CO-I INDUSTRIES HARTFORD, CT.  
 \* CONNECTICUT UNIVERSITY OF STORRS, CT.  
 \* CONSOLIDATED AERO STRUCTURES CORP. TORRANCE, CA.

\* CONTINENTAL MACHINES, INC. SAVAGE, MN.  
 \* COPPER RANGE CO. LEETSDALE, PA.  
 \* CORNELL UNIVERSITY ITHACA, NY.  
 \* COULTER STEEL & FORGE CO. EMERYVILLE, CA.  
 \* CREMISO, DR. R. & CLINTON, NJ.  
 \* CRESCENT PRECISION PRODUCTS TULSA, OK.  
 \* CTL-DIXIE CINCINNATI, OH.  
 \* CUMMINS ENGINE CO., INC. COLUMBUS, IN.  
 \* CURTISS-WRIGHT CORP. BUFFALO, NY.  
 \* CURTISS-WRIGHT CORP. CALDWELL, NJ.  
 \* CURTISS-WRIGHT CORP. EAST PATERSON, NJ.  
 \* CURTISS-WRIGHT CORP. WOOD-RIDGE, NJ.  
 \* CYCLOPS CORP. PITTSBURGH, PA.  
 \* DANA CORP. IVORYTON, CT.  
 \* DAWSON TOOL & ABRASIVE, INC. SEATTLE, WA.  
 \* DAYTON STEEL FOUNDRY CO. DAYTON, OH.  
 \* DENVER UNIVERSITY DENVER, CO.  
 \* DESIGN AND DEVELOPMENT INC. INDEPENDENCE, OH.  
 \* DICK, COL. J. NICHOLAS WASHINGTON, DC.  
 \* DILLON MANUFACTURING CINCINNATI, OH.  
 \* DO ALL CO. DES PLAINES, IL.  
 \* DOVER CORP. CINCINNATI, OH.  
 \* DOV CHEMICAL CO. MIDLAND, TX.  
 \* DR. MAX KRONENBERG CINCINNATI, OH.  
 \* DUNCAN MFG. CO. CINCINNATI, OH.  
 \* E-I DU PONT WESTERN SPRINGS, IL.  
 \* E-I DU PONT WILMINGTON, DE.  
 \* EAGLE PITCHER INDUSTRIES, INC. JOPLIN, MO.  
 \* EAGLE TOOL & MACHINE CO. PRINCETON, OH.  
 \* EASTERN CAROLINA STEEL CO. FLORENCE, SC.  
 \* ENERGY SERVICE CORP. WASHINGTON, DC.  
 \* ENOIS EQUIPMENT CO. MORTON GROVE, IL.  
 \* ENVIRONMENT-ONE CORP. LATHAM, NY.  
 \* ETICO TOOL & MACHINE CO. YORK, PA.  
 \* EX-CELL-O CORP. LIMA, OH.  
 \* FAIRBANKS-MORSE BELLOIT, WI.  
 \* FALK CORP. (THE) MILWAUKEE, WI.  
 \* FEDERAL MOGUL CORP. DETROIT, MI.  
 \* FEDERAL MOGUL CORP. NORTH TONAWANDA, NY.  
 \* FELLOWS GEAR SHAPER CO. (THE) SPRINGFIELD, VT.  
 \* FERRIS STATE COLLEGE BIG RAPIDS, MI.  
 \* FIRESTONE TIRE & RUBBER CO. (THE) AKRON, OH.  
 \* FIRTH STERLING MC KEESPORT, PA.  
 \* FLORIDA UNIVERSITY OF GAINESVILLE, FL.  
 \* FORD MOTOR CO. CINCINNATI, OH.  
 \* FORD MOTOR CO. DEARBORN, MI.  
 \* FORD MOTOR CO. DETROIT, MI.  
 \* FRANKLIN INSTITUTE RESEARCH LAB. PHILADELPHIA, PA.  
 \* G & M TECHNOLOGY INC. SANTA MONICA, CA.  
 \* G.A. GRAY CO. CINCINNATI, OH.  
 \* GARRETT CORP. LOS ANGELES, CA.  
 \* GARRETT CORP. PHOENIX, AZ.  
 \* GARRETT CORP. TORRANCE, CA.  
 \* GARSON LAB INC. JACKSON, MS.  
 \* GARVIN CORP. (THE) CINCINNATI, OH.  
 \* GENERAL DYNAMICS CORP. FORT WORTH, TX.  
 \* GENERAL DYNAMICS CORP. POMONA, CA.  
 \* GENERAL DYNAMICS CORP. SAN DIEGO, CA.  
 \* GENERAL ELECTRIC ERIE, PA.  
 \* GENERAL ELECTRIC CO. ALBUQUERQUE, NM.  
 \* GENERAL ELECTRIC CO. BURLINGTON, VT.  
 \* GENERAL ELECTRIC CO. CINCINNATI, OH.  
 \* GENERAL ELECTRIC CO. CLEVELAND, OH.  
 \* GENERAL ELECTRIC CO. DETROIT, MI.  
 \* GENERAL ELECTRIC CO. LOUISVILLE, KY.  
 \* GENERAL ELECTRIC CO. PHILADELPHIA, PA.  
 \* GENERAL ELECTRIC CO. SAN JOSE, CA.  
 \* GENERAL ELECTRIC CO. SCHENECTADY, NY.  
 \* GENERAL ELECTRIC CO. SYRACUSE, NY.  
 \* GENERAL ELECTRIC CO. WARREN, MI.  
 \* GENERAL ELECTRIC CO. WEST LYNN, MA.  
 \* GENERAL ELECTRIC CO. WILMINGTON, NC.  
 \* GENERAL ELECTRIC CO. WORTHINGTON, OH.  
 \* GENERAL MOTORS CORP. BUFFALO, NY.  
 \* GENERAL MOTORS CORP. FLINT, MI.  
 \* GENERAL MOTORS CORP. INDIANAPOLIS, IN.  
 \* GENERAL MOTORS CORP. LA GRANGE, IL.  
 \* GENERAL MOTORS CORP. SAGINAW, MI.  
 \* GENERAL MOTORS CORP. SANDUSKY, OH.  
 \* GENERAL MOTORS CORP. SANTA BARBARA, CA.  
 \* GENERAL MOTORS CORP. WARREN, MI.  
 \* GEOMETRIC TOOL CO. NEW HAVEN, CT.  
 \* GEORGETOWN TOOL & MANUFACTURING CO. GEORGETOWN, KY.  
 \* GILFORD INSTRUMENT LABORATORIES INC. OBERLIN, OH.  
 \* GLEASON WORKS ROCHESTER, NY.  
 \* GLOBE INDUSTRIES DAYTON, OH.  
 \* GOULD INC. MC CONNELSVILLE, OH.  
 \* GRACE CO., W. R. CLARKSVILLE, MO.  
 \* GRINDING WHEEL INSTITUTE CLEVELAND, OH.  
 \* GRUMMAN AIRCRAFT BETHPAGE, NY.  
 \* GULF GENERAL ATOMIC INC. SAN DIEGO, CA.  
 \* H & M INDUSTRIES DAYTON, OH.  
 \* HARPER CO., H. M. MORTON GROVE, IL.  
 \* HENRY WALKER CO. (THE) NORFOLK, VA.  
 \* HEWLETT PACKARD PALO ALTO, CA.  
 \* HITTMAN ASSOC. INC. COLUMBIA, MO.  
 \* HOGANES CORP. RIVERTON, NJ.  
 \* HONEYWELL, INC. NEW BRIGHTON, MN.  
 \* HOUDAILLE INDUSTRIES, INC. LOS ANGELES, CA.  
 \* HOUGHTON CO., E. F. CINCINNATI, OH.  
 \* HOUGHTON CO., E. F. PHILADELPHIA, PA.  
 \* HOWE RICHARDSON SCALE CO. RUTLAND, VT.  
 \* HUNNET CORP. POMONA, CA.  
 \* HUGHES AIRCRAFT CO. CULVER CITY, CA.  
 \* HUGHES AIRCRAFT CO. TUCSON, AZ.  
 \* ICI AMERICA INC. STAMFORD, CT.  
 \* IIT RESEARCH INSTITUTE CHICAGO, IL.  
 \* INDUSTRIAL TOOL & MACHINE CO. GEORGETOWN, KY.  
 \* INGERSOLL MILLING MACHINE CO. (THE) ROCKFORD, IL.  
 \* INGERSOLL RAND CO. PRINCETON, NJ.  
 \* INGERSOLL RAND CO. ROCKFORD, IL.  
 \* INTERNATIONAL BUSINESS MACHINES CORP. OREGON, NY.  
 \* INTERNATIONAL BUSINESS MACHINES CORP. SAN JOSE, CA.  
 \* INTERNATIONAL BUSINESS MACHINES CORP. BOULDER, CO.  
 \* INTERNATIONAL NICKEL CO. INC. (THE) OAK BROOK, IL.  
 \* INTERNATIONAL NICKEL CO. INC. (THE) NEW YORK, NY.  
 \* INTERNATIONAL NICKEL CO. INC. (THE) HARTINGTON, NV.  
 \* IOWA STATE UNIVERSITY OF SCIENCE & TECHNOLOGY AMES, IA.  
 \* IRON AGE CO. CINCINNATI, OH.  
 \* ITT MARLOW MIDLAND PARK, NJ.  
 \* J-TEC CEDAR RAPIDS, IA.  
 \* JOHNSON & SON, INC., S. C. RACINE, WI.

JOHNSON SUPPLY CO., BILL PHOENIX, AZ.  
 JONES & LAMSON, SPRINGFIELD, VT.  
 JOSTEN'S INC., QUATONNA, MN.  
 KAISER ALUMINUM & CHEMICAL CORP., OAKLAND, CA.  
 KAHAN CORP., BLOOMFIELD, CT.  
 KANAR CORP., KINGSTON, PA.  
 KEENE STATE COLLEGE, KEENE, NH.  
 KELSEY HAYES, SPRINGFIELD, OH.  
 KENNAMETAL, INC., CINCINNATI, OH.  
 KENNAMETAL, INC., LATROBE, PA.  
 KINSEY CO., E. & S., CINCINNATI, OH.  
 KIRKOP MANUFACTURING CORP., GRAND RAPIDS, MI.  
 KRUECK, ROBERT T., DAYTON, OH.  
 LADISH CO., CUDAHY, MI.  
 LASER SYSTEMS CORP., ANN ARBOR, MI.  
 LATROBE STEEL CO., LATROBE, PA.  
 LE BLOND TOOL CO., R. K., CINCINNATI, OH.  
 LEAR SIEGLER CO., DETROIT, MI.  
 LIESCHADDER, CLEVELAND, OH.  
 LEHIGH UNIVERSITY, BETHLEHEM, PA.  
 LIBRARY OF CONGRESS, WASHINGTON, DC.  
 LIMITORQUE, LYNCHBURG, VA.  
 LINCOLN MANUFACTURING CO., CHICAGO, IL.  
 LING-TEMCO-VOUGHT, INC., WARREN, MI.  
 LING-TEMCO-VOUGHT, INC., DALLAS, TX.  
 LITTON INDUSTRIES, COLLEGE PARK, MD.  
 LOCKHEED AIRCRAFT CORP., BURBANK, CA.  
 LOCKHEED AIRCRAFT CORP., MARIETTA, GA.  
 LOCKHEED AIRCRAFT CORP., PALO ALTO, CA.  
 LOCKHEED AIRCRAFT CORP., REDLANDS, CA.  
 LODGE & SHIPLEY CO. (THE), CINCINNATI, OH.  
 LOWELL TECH. INSTITUTE RESEARCH FOUNDATION, LOWELL, MA.  
 MACHINERY, WHEATON, IL.  
 MACOMB COUNTY COMMUNITY COLLEGE, WARREN, MI.  
 MALLEABLE FOUNDERS SOCIETY, CLEVELAND, OH.  
 WALLORY METALLURGICAL CO., P.O., INDIANAPOLIS, IN.  
 MANLEY MANAGEMENT CORP., GREENWICH, CT.  
 MARANCHIK AND ASSOCIATES, JOHN, CINCINNATI, OH.  
 MARATHON CORP., LITTLETON, CO.  
 MARBON CHEMICAL CO., WASHINGTON, WV.  
 MARCUM CO., SACS, ME.  
 MARINE IRON WORKS, INC., TACOMA, WA.  
 MARKETING INTERNATIONAL INC., IRWIN, PA.  
 MARQUARDT CORP. (THE), VAN NUYS, CA.  
 MARTIN CO., ORLANDO, FL.  
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MA.  
 WATERALL RESEARCH LAB., GLENWOOD, IL.  
 MATHET CORP., PHOENIX, AZ.  
 MC CROSKY TOOL CORP., MEADVILLE, PA.  
 MC DANF. REFRACTORY PORCELAIN CO., BEAVER FALLS, PA.  
 MC DONELL DOUGLAS CORP., LONG BEACH, CA.  
 MC DONELL DOUGLAS CORP., ST. LOUIS, MO.  
 MC DONELL DOUGLAS CORP., SANTA MONICA, CA.  
 MENASCO MANUFACTURING CO., BURBANK, CA.  
 METAL IMPROVEMENT INC., HACKENSACK, NJ.  
 METALWORKING ECONOMICS, BOSTON, MA.  
 METHODS AND EQUIPMENT CO., DETROIT, MI.  
 MICHIGAN TECHNOLOGY UNIVERSITY, MOUNTAIN, MI.  
 MICRO-SWISS, INC., CHERRY HILL, NJ.  
 MIDWEST CENTERLESS GRINDING CO., CINCINNATI, OH.  
 MINNESOTA UNIVERSITY OF MINNEAPOLIS, MN.  
 MODERN MACHINE SHOP, CINCINNATI, OH.  
 MORGAN DIE & ENGINEERING CO., DAYTON, OH.  
 MONSANTO RESEARCH CORP., MIAMI, FL.  
 MONTE-COPIER INC., SEATTLE, WA.  
 MONTVALE CUSTOM TOOLS, MONTVALE, NJ.  
 MOORE INC., BLOOMFIELD, VT.  
 MOORE INC., EAST AURORA, NY.  
 MORRIS & CO., E. K., CINCINNATI, OH.  
 MOTOR STATE OIL & GREASE CO., JACKSON, MI.  
 MULLEN CO., E. C., CHICAGO, IL.  
 NATIONAL AERONAUTICS & SPACE ADMINISTRATION, CLEVELAND, OH.  
 NATIONAL AERONAUTICS & SPACE ADMINISTRATION, MONTVILLE, AL.  
 NATIONAL CASH REGISTER CO., DAYTON, OH.  
 NATIONAL LEAD CO., ALBANY, NY.  
 NATIONAL LEAD CO., FERNDALE, OH.  
 NATIONAL TOOL DIE & PRECISION MACH. ASSOC., WASHINGTON, DC.  
 NEW BRITAIN MACHINE CO. (THE), NEW BRITAIN, CT.  
 NEW BRITAIN MACHINE CO. (THE), CLEVELAND, OH.  
 NICHOLS CO., W. H., WALTHAM, MA.  
 NORTH AMERICAN AVIATION, INC., LOS ANGELES, CA.  
 NORTH AMERICAN AVIATION, INC., COLUMBUS, OH.  
 NORTH AMERICAN AVIATION, INC., TULSA, OK.  
 NORTH AMERICAN AVIATION, INC., BETHANY, OK.  
 NORTH CAROLINA SCI. & TECH. RES. CTR., TRIANGLE PARK, NC.  
 NORTH CAROLINA STATE UNIVERSITY, RALEIGH, NC.  
 NORTON CO., WORCESTER, MA.  
 NUMERICAL CONTROL ASSOCIATES, SYOSSET, NY.  
 OAKLEY DIE AND MANUFACTURING CO., CINCINNATI, OH.  
 OHIO STATE UNIVERSITY, THE, COLUMBUS, OH.  
 OLIN CORP., EAST ALTON, IL.  
 ORENS-CORNING FIBERGLAS, GRANVILLE, OH.  
 PACIFIC SCIENTIFIC CO., ANAHEIM, CA.  
 PENN. CENTRAL CO., ALTOONA, PA.  
 PENNSYLVANIA STATE UNIVERSITY (THE), UNIVERSITY PARK, PA.  
 PERMAC PACIFIC CORP., LOS ANGELES, CA.  
 PRAUDLAR CO., ROCHESTER, NY.  
 PITTSBURGH PLATE GLASS CO., BARBERTON, OH.  
 PITTSBURGH UNIVERSITY OF PITTSBURGH, PA.  
 PNC DESIGNING, CINCINNATI, OH.  
 PNEUMO PRECISION PRODUCTS, INC., KEENE, NH.  
 PRATT & WHITNEY AIRCRAFT, EAST HARTFORD, CT.  
 PRATT & WHITNEY CORP., CUDAHY, MI.  
 PRECISION CASTPARTS CORP., PORTLAND, OR.  
 PRECISION FORGINGS INC., VALLEY PARK, MO.  
 PROCTER & GAMBLE CO., CINCINNATI, OH.  
 PRODUCT PLANNING INC., WELLESLEY, MA.  
 PRODUCTION BLOOMFIELD HILLS, MI.  
 PRODUCTION FLUIDS INC., CHAMBLEE, GA.  
 PURDUE UNIVERSITY, WEST LAFAYETTE, IN.  
 PURE CARBON CO., INC., ST. MARYS, PA.  
 RADIC CORP., OF AMERICA, LANCASTER, PA.  
 RAYCHEM CORP., MENLO PARK, CA.  
 RAYTHEON CO., LOWELL, MA.  
 REMINGTON ARMS CO., INC., BRIDGEPORT, CT.  
 RESISTOPLEX CORP., ROSELAND, NJ.  
 RER CHAINBELT INC., DOWNERS GROVE, IL.  
 REYNOLDS METALS CO., CORPUS CHRISTI, TX.  
 RHODE ISLAND UNIVERSITY OF KINGSTON, RI.  
 RICHARDSON CO. (THE), MELROSE PARK, IL.

RICHMOND MANUFACTURING CO., HOUSTON, TX.  
 ROBERT A. KEYES ASSOC., GARDEN CITY, NY.  
 ROCHESTER INSTITUTE OF TECHNOLOGY, ROCHESTER, NY.  
 ROCKWELL MANUFACTURING CO., REARNEY, NB.  
 ROCKWELL MANUFACTURING CO., SYRACUSE, NY.  
 ROGERS CO., F. P., SEATTLE, WA.  
 ROHR CORP., CHULA VISTA, CA.  
 RYAN AER NAUTICAL CO., SAN DIEGO, CA.  
 SAGINAW JAMESON CORP., SAGINAW, MI.  
 SANDIA CORP., ALBUQUERQUE, NM.  
 SCHRAEDER AUTOMOTIVE PRODUCTS, DICKSON, IN.  
 SEALMASTER BEARING, AURORA, IL.  
 SEALOL INC., PROVIDENCE, RI.  
 SHERWIN-WILLIAMS CHEMICALS, CINCINNATI, OH.  
 SHORELINE COMMUNITY COLLEGE, SEATTLE, WA.  
 SIGNODE CORP., FLORENCE, KY.  
 SIMMONS PRECISION, VERGENNES, VT.  
 SIMOND SAW & STEEL, FITCHBURG, MA.  
 SINGER CO. (THE), CHICAGO, IL.  
 SINGER CO. (THE), ELIZABETH, NJ.  
 SINGERS GENERAL PRECISION, LITTLE FALLS, NJ.  
 SMALL BUSINESS ADMINISTRATION, CLEVELAND, OH.  
 SMALL BUSINESS ADMINISTRATION, MINNEAPOLIS, MN.  
 SMALL BUSINESS ADMINISTRATION, DENVER, CO.  
 SMALL BUSINESS ADMINISTRATION, DALLAS, TX.  
 SMALL BUSINESS ADMINISTRATION, DETROIT, MI.  
 SMALL BUSINESS ADMINISTRATION, NEW YORK, NY.  
 SOCIETY OF AUTOMOTIVE ENGINEERS, NEW YORK, NY.  
 SOCIETY OF MANUFACTURING ENGINEERS, DEARBORN, MI.  
 SOUTHCO, INC., LESTER, PA.  
 SOUTHERN AUTOMATICS INC., MADEIRA, OH.  
 SOUTHERN RESEARCH INSTITUTE, BIRMINGHAM, AL.  
 SPERRY RAND CORP., LEBANON, OH.  
 SPERRY RAND CORP., PHOENIX, AZ.  
 SPERRY RAND CORP., TROY, MI.  
 SPRINGFIELD WORKS, SPRINGFIELD, OH.  
 ST. PETERS COLLEGE, JERSEY CITY, NJ.  
 STACAPOL CARBON CO., ST. MARYS, PA.  
 STANDARD PRESSE STEEL CO., NEWINGTON, PA.  
 STANFORD LINEAR ACCELERATOR CO., STANFORD, CA.  
 STANFORD RESEARCH INSTITUTE, MENLO PARK, CA.  
 STAR TOOL AND DIE WORKS, DETROIT, MI.  
 STRICKLAND CO., W. J., MARIETTA, GA.  
 STRUCTURAL DYNAMICS RESEARCH CORP., CINCINNATI, OH.  
 SUMMEN PRODUCTS CO., ST. LOUIS, MO.  
 SUPERIOR TUBE CO., NORRISTOWN, PA.  
 SWISSCO INC., CINCINNATI, OH.  
 SYLVESTER SCREW MACHINE CO., PROVIDENCE, RI.  
 SYSTEMS, SCIENCE AND SOFTWARE, LA JOLLA, CA.  
 TALLY CORP. (THE), NEWARK, CA.  
 TEC MAGNETICS, SANTA FE SPRINGS, CA.  
 TECHNICAL EQUIPMENT SALES CO., CINCINNATI, OH.  
 TECHNOLOGIC RESEARCH ASSOC., CHICAGO, IL.  
 TELE-PRESS ASSOC., NEW YORK, NY.  
 TELEDYNE CO., MONROE, NC.  
 TEXTRON CO. (A), BUFFALO, NY.  
 THERM INC., ITHACA, NY.  
 THOROL CORP., ROCKAWAY, NJ.  
 THUL MACHINE WORKS, INC., PLAINFIELD, NJ.  
 TITANIUM METALS CORP., OF AMERICA, TORONTO, ON.  
 TOOL STEEL GEAR & PINION CO. (THE), CINCINNATI, OH.  
 TORRINGTON CO. (THE), UNION, SC.  
 TRANE CO. (THE), LA CROSSE, WI.  
 TRW INC., CLEVELAND, OH.  
 TRW INC., DANVILLE, PA.  
 TRW INC., NEW YORK, NY.  
 TRIGG INDUSTRIES, INC., HARTMANVILLE, IN.  
 U. S. & STEEL CORP., PITTSBURGH, PA.  
 U. S. & STEEL CORP., CINCINNATI, OH.  
 U. S. & STEEL CORP., GARLAND, TX.  
 UNION CARBIDE CORP., OAK RIDGE, TN.  
 UNION CARBIDE CORP., PARMA, OH.  
 UNION CARBIDE CORP., PITTSBURGH, PA.  
 UNION CARBIDE CORP., TARRYTOWN, NY.  
 UNITED AIR LINES, SAN FRANCISCO, CA.  
 UNITED AIRCRAFT CORPORATE SYSTEMS CENTER, WINDSOR LOCKS, CT.  
 UNITED AIRCRAFT CORPORATE SYSTEMS CENTER, EAST HARTFORD, CT.  
 UNITED CARBIDE CORP., REDONDO BEACH, CA.  
 UNITED NUCLEAR CORP., UNCASVILLE, CT.  
 UTD CORP., ATHOL, MA.  
 VALERON CORP. (THE), DAYTON, OH.  
 VALERON CORP. (THE), EAST BROWSTER, MA.  
 VALERON CORP. (THE), OAK PARK, MI.  
 VALERON CORP. (THE), TROY, MI.  
 VAPOR CORP., CHICAGO, IL.  
 VARIAN ASSOCIATES, SAN CARLOS, CA.  
 VASCO CINCINNATI, OH.  
 VBP PRODUCTS, INC., TULSA, OK.  
 VERMONT AMERICAN CORP., LOUISVILLE, KY.  
 VERMONT UNIVERSITY OF BURLINGTON, VT.  
 VIRGINIA MILITARY INSTITUTE, LEXINGTON, VA.  
 VIKRESON CO., WAUKEGAN, IL.  
 WALLACE-MURRAY CORP., CHICAGO, IL.  
 WATERBURY FARREL, CHESHIRE, CT.  
 WAUKESHA CUTTING TOOLS, WAUKESHA, WI.  
 WEATHERHEAD CO. (THE), DAYTON, OH.  
 WELLES SUPPLY CO., INC. (THE), ELNORA HEIGHTS, NY.  
 WESTERN ELECTRIC CO., INC., REARNEY, NJ.  
 WESTERN ELECTRIC CO., INC., PRINCETON, NJ.  
 WESTINGHOUSE AIR BRAKE CO., PITTSBURGH, PA.  
 WESTINGHOUSE ELECTRIC CORP., ANNAPOLIS, MD.  
 WESTINGHOUSE ELECTRIC CORP., BLAIRSVILLE, PA.  
 WESTINGHOUSE ELECTRIC CORP., CHESWICK, PA.  
 WESTINGHOUSE ELECTRIC CORP., CHARLOTTE, NC.  
 WESTINGHOUSE ELECTRIC CORP., COLUMBIA, SC.  
 WESTINGHOUSE ELECTRIC CORP., CINCINNATI, OH.  
 WESTINGHOUSE ELECTRIC CORP., EAST PITTSBURGH, PA.  
 WESTINGHOUSE ELECTRIC CORP., ELMIRA, NY.  
 WESTINGHOUSE ELECTRIC CORP., PHILADELPHIA, PA.  
 WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.  
 WESTINGHOUSE ELECTRIC CORP., SUNNYSVALE, CA.  
 WESTINGHOUSE ELECTRIC CORP., WRIGHT-PATTERSON AFB, OH.  
 WHITTAKER CORP., LOS ANGELES, CA.  
 WHITTAKER CORP., SANTA MONICA, CA.  
 WINCHESTER WESTERN, LA PORTE, IN.  
 WISCONSIN CENTRIFUGAL INC., WAUKESHA, WI.  
 WISCONSIN UNIVERSITY OF MADISON, WI.  
 WORCESTER POLYTECHNIC INSTITUTE, WORCESTER, MA.  
 WRIGHT-PATTERSON AIR FORCE BASE, DAYTON, OH.  
 XEROX CORP., WEBSTER, NY.  
 ZERO CHECK INC., THOMASTON, CT.

POTENTIAL FOR AFMDC SERVICES TO INDUSTRY

STATISTICAL SUMMARY OF METALWORKING PLANTS PARTIAL LIST FROM DUN & BRADSTREET METALWORKING, DIRECTORY 1970-71				AFMDC SUMMARY OF INQUIRIES FOR 8 SIC GROUPS OCTOBER 1, 1969 - SEPTEMBER 30, 1970	
STANDARD INDUSTRIAL CLASSIFICATION (SIC) NUMBER & INDUSTRY CLASSIFICATION	MAJOR PRODUCT MANUFACTURED NO. OF COMPANIES*	NO. OF INDIVIDUALS	MINOR PRODUCT MANUFACTURED NO. OF COMPANIES	INQUIRERS	NO. OF AFMDC COMPANIES
MAJOR GROUP 37 - TRANSPORTATION EQUIPMENT SIC INDUSTRY NO.					
3721 - AIRCRAFT & MISSILES	96	328,120	28	138	26
3722 - AIRCRAFT ENGINES & PARTS	141	159,937	124	60	9
3723 - AIRCRAFT PROPELLERS & PROPELLER PARTS	10	2,208	15	—	—
3729 - AIRCRAFT PARTS & AUXILIARY EQUIPMENT	566	160,910	578	31	22
MAJOR GROUP 33 - PRIMARY METAL INDUSTRIES	4,135	1,272,832	3,022	48	31
MAJOR GROUP 34 - FABRICATED METAL PRODUCTS, EXCEPT ORDNANCE, MACHINERY & TRANSPORTATION EQUIPMENT	11,392	1,402,617	8,237	38	30
MAJOR GROUP 35 - MACHINERY, EXCEPT ELECTRICAL	11,726	2,043,293	9,340	175	117
MAJOR GROUP 36 - ELECTRICAL MACHINERY, EQUIPMENT & SUPPLIES	5,659	1,903,685	4,118	43	29
	33,725	7,273,602	25,462	533	264

\* 20 or more employees

# DESCRIPTION OF AFMDC DATA PUBLICATIONS

October 1, 1969 - September 30, 1970

DESCRIPTION & CONTENT	NO. OF COPIES DISSEMINATED
AFMDC 65-1, MACHINING DATA FOR TITANIUM ALLOYS, AUGUST 1965 Turning, Face Milling, End Mill Slotting, Peripheral End Milling, Drilling, Reaming, Tapping, Broaching, and Surface Grinding for Commercially Pure Titanium, Alpha & Alpha-Beta, and Beta Alloys.	276
AFMDC 66-1, MACHINING DATA FOR NUMERICAL CONTROL, DECEMBER 1966 Contains all the data originally printed in the 7 individual reports, AFMDC 66-1.1 through 66-1.7	335
AFMDC 66-2, GRINDING RATIOS FOR AEROSPACE ALLOYS, JUNE 1966 Surface Grinding of Alloy Steels, Ultra-High Strength Steels, Tool Steels, Stainless Steels, Titanium Alloys, High Temperature Alloys, Refractory Alloys, and Nonmetallics.	157
AFMDC 66-3, MACHINING DATA FOR BERYLLIUM METAL, JUNE 1966 This booklet covers problems involved in machining beryllium, in addition to specific data for 10 conventional operations and 4 alternate machining methods.	130
AFMDC 68-1, DETERMINATION AND ANALYSIS OF MACHINING COSTS AND PRODUCTION RATES USING COMPUTER TECHNIQUES, AUGUST 1968 This data publication describes a practical approach to the problem of obtaining machining costs and production rates. It includes equations, numerous computer calculations, and computer source program listings.	322
AFMDC 68-2, 1968 SUPPLEMENT TO MACHINING DATA FOR NUMERICAL CONTROL, AUGUST 1968 This supplement is a companion volume to Machining Data for Numerical Control (AFMDC 66-1). Machining data are presented for the newer aerospace materials.	292
AFMDC 70-1, MACHINING OF HIGH STRENGTH STEELS WITH EMPHASIS ON SURFACE INTEGRITY, JUNE 1970 This book was prepared from data collected on various high temperature alloys and both conventional and nonconventional machining operations. The emphasis in the presentation of machining data and information is on providing guidelines for maintenance of high surface quality and in particular high surface integrity.	385
TOTAL	1,897

# AFMDC OPERATING COSTS

OCTOBER 1, 1969 - SEPTEMBER 30, 1970

INPUT COSTS		
TECHNICAL EVALUATION		\$ 59,972.02
DATA PROCESSING		37,399.82
DOCUMENT ACQUISITION & REPRODUCTION		<u>8,813.02</u>
		106,184.86
EQUIPMENT, SUPPLIES & SERVICES		<u>13,091.37</u>
	TOTAL	119,276.23
OUTPUT COSTS		
<u>INQUIRIES</u>		
TECHNICAL EVALUATION		\$ 36,997.06
DATA PROCESSING & RETRIEVAL		5,262.32
DATA ACQUISITION & REPRODUCTION		<u>3,219.03</u>
GOVERNMENT AGENCIES	3,093.91	45,478.41
(NOT INCLUDING SBA & STSP)		
ALL OTHER ORGANIZATIONS	<u>42,384.50</u>	
	SUBTOTAL	\$ 45,478.41
<u>DATA PUBLICATIONS</u>		
DATA PUBLICATIONS COMPLETED & IN PROCESS		\$ 25,867.88
EQUIPMENT, SUPPLIES & SERVICES		<u>7,735.81</u>
		33,603.69
	TOTAL	79,082.10
GENERAL DISSEMINATION		
GENERAL DISSEMINATION OF MACHINABILITY DATA & CENTER INFORMATION		\$ 22,352.16
EQUIPMENT, SUPPLIES & SERVICES		<u>1,684.19</u>
	TOTAL	24,036.35
REPORTS		
<u>AFMDC SYSTEMS REPORTS</u>		
AFMDC, MSD AND INFORMATION BRANCH MEETINGS AND SPECIAL MSD REPORTS		\$ 10,210.75
EQUIPMENT, SUPPLIES & SERVICES		<u>5,355.56</u>
	TOTAL	15,566.31
SYSTEMS ANALYSIS, MODIFICATION & CONTROL		
TECHNICAL EVALUATION		\$ 4,304.48
DATA PROCESSING - IBM 1130		
TECHNICAL & SYSTEMS ASPECTS		37,144.49
OPERATIONS MANUAL & CODE BOOK REVISIONS & ADDITIONS		<u>356.74</u>
		41,805.71
EQUIPMENT, SUPPLIES & SERVICES		<u>1,886.19</u>
	TOTAL	43,691.90
TOTAL ACTUAL COSTS NOT INCLUDING FIXED FEE		\$ 281,852.89



ESTIMATED COST SAVINGS RESULTING FROM AFMDC'S OPERATION

OCTOBER 1, 1964 - SEPTEMBER 30, 1970

COST SAVINGS RESULTING FROM AFMDC'S

RESPONSE TO SPECIFIC INQUIRIES

Total Number of Specific Inquiries 5,739

Estimated Total Number of Machining Situations Included in the 5,739  
Inquiries - 28,537

Estimated Savings per Machining Situation Response - \$800.00

Estimated Total Savings Resulting from Specific Inquiries - 28,537  
Machining Situations x \$800.00 - \$22,829,600.00

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COST SAVINGS RESULTING FROM AFMDC'S 14 DATA PUBLICATIONS

Total Number of Data Publication Copies Distributed - 18,669

Estimated Number of Machining Situations Utilized per Data Publications  
Copy - 5

Estimated Total Number of Machining Situations - 18,669 Data Publication  
Copies x 5 - 93,345

Estimated Savings per Machining Situation - \$300.00

Estimated Total Savings Resulting from Data Publications - 93,345 Machining  
Situations x \$300.00 - \$28,003,500

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TOTAL ESTIMATED COST SAVINGS RESULTING FROM AFMDC'S OPERATION

\$50,833,100.00

ECONOMIC ENVIRONMENT FOR AFMDC OPERATIONS  
(ANNUAL COSTS)

Labor and Overhead Costs for Operating Metal Cutting Machine Tools  
in the United States

Total number of metal cutting machine tools in the metal-working industries	=	2,500,000*
Average labor cost + overhead	=	\$8.00 per hour
Average working day	=	8 hours
Number of working days per year	=	250
Average number of direct labor personnel per machine	=	1
Total cost of Labor + Overhead: 2,500,000 x \$8.00 x 8 x 250 x 1	=	\$40,000,000,000

\$40,000,000,000

\* Based on American Machinist Tenth Inventory

Total Shipments Including Exports of Metal Cutting Type  
Metalworking Machinery

\$1,080,766,000 (1968)

Source: National Machine Tool Builders Association

Machine Tool Accessories Industry

Small cutting tools for machine tools and metalworking machinery in the amount of \$739,000,000, includes \$45,500,000 for tool holders.

Source: 1968 U.S. Department of Commerce

## AFMDC INPUT & OUTPUT SUMMARY

### **SYSTEM INPUT**

October 1, 1964 - September 30, 1970

#### Document and Card Totals

##### Documents Entered into the System (including Specific Inquiries)

Oct. 1, 1964 - Jan. 31, 1967	17,576
Feb. 1, 1967 - Jan. 31, 1968	3,695
Feb. 1, 1968 - Sept. 30, 1968	2,341
Oct. 1, 1968 - July 31, 1969	3,316
Aug. 1, 1969 - Sept. 30, 1970	5,638
Total	32,566

##### Evaluated Documents (including Specific Inquiries)

Oct. 1, 1964 - Jan. 31, 1967	9,367
Feb. 1, 1967 - Jan. 31, 1968	3,734
Feb. 1, 1968 - Sept. 30, 1968	2,840
Oct. 1, 1968 - July 31, 1969	3,780
Aug. 1, 1969 - Sept. 30, 1970	7,522
Total	27,243

##### Total Cards Punched

Oct. 1, 1964 - Jan. 31, 1967	75,173
Feb. 1, 1967 - Jan. 31, 1968	27,077
Feb. 1, 1968 - Sept. 30, 1968	13,833
Oct. 1, 1968 - July 31, 1969	33,868
Aug. 1, 1969 - Sept. 30, 1970	27,054
Total	177,005

### **SYSTEM OUTPUT**

#### Data Publications

	<u>Copies Distributed</u>
AFMDC 65-1, Machining Data for Titanium Alloys	6,201
AFMDC 66-1, Machining Data for Numerical Control	1,245
AFMDC 66-2, Grinding Ratios for Aerospace Alloys	1,084
AFMDC 66-3, Machining Data for Beryllium Metal	1,378
AFMDC 68-1, Determination & Analysis of Machining Cost & Production Rates Using Computer Techniques	1,009
AFMDC 68-2, 1968 Supplement to Machining Data for Numerical Control	789
AFMDC 70-1, Machining of High Strength Steels with Emphasis on Surface Integrity	385

#### Unit Costs

Average Cost Per Inquiry (1,038) - Oct. 1, 1969 - Sept. 30, 1970	\$ 43.77
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AFMDC VISITS FOR ACQUISITION AND DISSEMINATION  
OF MACHINABILITY INFORMATION

October 1, 1969 - September 30, 1970

CONFERENCE ON PROFITABLE METALWORKING (Presentation on use of Machinability Data)  
Small Business Administration, Denver, Colorado  
October 14, 1969

SOUTHERN ARIZONA GOVERNMENT-INDUSTRY PROCUREMENT CONFERENCE (Participated)  
Sponsored by Senators Paul J. Fannin & Barry M. Goldwater,  
Congressmen John J. Rhodes and Sam Steiger in cooperation with the Chamber of Commerce of Arizona  
Tucson/Phoenix, Arizona  
October 29-31, 1969

SOCIETY OF MANUFACTURING ENGINEERS (Presentation on AFMDC)  
Portland, Maine  
January 8, 1970

SOCIETY OF MANUFACTURING ENGINEERS' SEMINAR ON ECONOMICS OF MATERIAL REMOVAL (Presented Paper)  
Cincinnati, Ohio  
February 23-25, 1970

SEMINAR SPONSORED BY THE CINCINNATI CHAPTER OF THE AMERICAN SOCIETY FOR METALS ENTITLED  
"MACHINING" (Presentation on "Analysis of Cost and Production in Machining")  
March 4, 1970

CONFERENCE ON NEW TECHNOLOGY (Participated)  
Sponsored by NASA, SBA, North Carolina Science and Technology Research Center, North Carolina  
Department of Conservation and Development and Industrial Extension Service, North Carolina  
State University  
March 25-28, 1970

INFORMATION INDUSTRY ASSOCIATION NATIONAL MEETING (Attended)  
Washington, D. C.  
March 23-24, 1970

AMERICAN ORDNANCE ASSOCIATION SPRING MEETING OF THE METALWORKING TOOLING, FLUIDS AND  
LUBRICANTS SECTION (Attended)  
Sponsored by American Ordnance Association  
Dearborn, Michigan (Ford Motor Company)  
May 6-7, 1970

CONFERENCE ON ULTRA-HARD TOOL MATERIALS (Attended)  
Carnegie-Mellon University  
Sponsored by National Science Foundation  
May 28, 1970

SBA CONFERENCE, DELTA COLLEGE (Presentation on AFMDC)  
Delta College, Bay City, Michigan  
May 28, 1970

AIR FORCE MATERIALS SYMPOSIUM '70 (Participated)  
Miami Beach, Florida  
May 18-22, 1970

CONFERENCE ON C-141 LANDING GEAR SYSTEMS (Participated)  
Hill Air Force Base, Ogden, Utah  
July 14-16, 1970

NATIONAL MACHINE TOOL BUILDER'S EXPOSITION (Attended)  
Chicago, Illinois  
September 20, 1970

## NEW COMPUTER SEARCH PROGRAMS

AFMDC's data file is organized for quick retrieval of information on any phase of the broad spectrum of machinability. Input documents are coded by source (for identification and physical filing) and by subject matter (for retrieval and use involving a specific machining situation). All documents are coded in accordance with the metallurgical properties of the material, the material group and material description, as well as the applicable machining operations and tool data. Descriptive uniterms are used to define machining situations of a general nature which do not lend themselves to numerical coding. Finally, each document is identified by date of entry into the computer files.

In the past, computer programs used for searching the files had certain limitations that required in some instances many searches to be conducted to obtain citation of the machining information being sought. For example, if documents were required for several machining operations on one material group, individual searches had to be conducted for each specific machining operation required. Also it was sometimes necessary to conduct many searches to find data for one machining operation on a variety of material groups.

Throughout the summer of 1970, new computer programs were written and tested. The control programs and data were then loaded on AFMDC's three primary data files, namely: the Index, Inquiry and Uniterm files.

The new computer programs permit broader searches to be conducted on AFMDC's three primary files. Each of these files can be interrogated separately utilizing the new computer search techniques to the degree necessary for obtaining the required documents. Three new forms were generated for better communication between the machining analyst requiring the search and the computer processing department. These new forms are shown on pages 26, 27, and 28. Each form is different and is designed to match the structure of the individual file. Where applicable, both descriptive uniterms and numerical data can be specified as search parameters. The new programs also permit a range of numerical coding for machining operations and/or material groups, or they will also permit a combination of uniterms, up to a maximum of six, to be utilized in the search strategy.

As may be noted in reviewing the three search forms, the data for interrogating the files are punched directly from the forms which denote the card columns for the data input.

### Inquiry Files

The Data Center engineers initiate requests for searches of the computer files. The type of search is determined by the nature of the inquiry or the subject being reviewed. The object of the search is to provide document source numbers so that the documents can be physically retrieved from the data files.

One of AFMDC's important files contains all of the formerly answered inquiries which are coded in the same format used for other documents. This file is searched quite frequently and saves time if the same inquiry was recently answered; then, it is not necessary to search the Index File and re-evaluate many documents to find the pertinent ones required for the new inquiry.

INDEX FILE	R6	00859	10/29/70
SEARCH REQUEST FORM	NAME	INQUIRY IDENTIFICATION	DATE

1 - 3	4 - 5	6 - 8	9 - 10	11 - 12	13 - 15	16	17 - 20
OPERATION	TOOL MATERIAL	HARDNESS CODE	CONDITION	HEAT TREATMENT	MATERIAL GROUP	FOREIGN *	
070	H5	---	---	---	321		
072		---	---	---	321		

\* FOREIGN DOCUMENT SEARCH SPECIFICATION CODES:

F = RETRIEVE FOREIGN DOCUMENTS ONLY

D = RETRIEVE DOMESTIC DOCUMENTS ONLY

b = RETRIEVE ALL DOCUMENTS

\*\* DOCUMENT NO. FIELD

FOR NUMERICAL PARAMETERS, PLACE LOW LIMIT OF RANGE IN FIRST ROW AND HIGH LIMIT IN SECOND ROW.

81 - 84	85 - 88	87 - 88	89 - 70	71 - 74	75 - 76	77 - 78	79
SOURCE CODE **	SOURCE INDEX **		YEAR PUBL. **	INDEX NO. **	MONTH ENTERED		YEAR ENTERED
			65				
			70				

MATERIAL DESCRIPTION (21 - 30)									
T	I	G	A	L	A	V			

1 - 3	4 - 5	6 - 8	9 - 10	11 - 12	13 - 15	16	17 - 20
OPERATION	TOOL MATERIAL	HARDNESS CODE	CONDITION	HEAT TREATMENT	MATERIAL GROUP	FOREIGN *	

\* FOREIGN DOCUMENT SEARCH SPECIFICATION CODES:

F = RETRIEVE FOREIGN DOCUMENTS ONLY

D = RETRIEVE DOMESTIC DOCUMENTS ONLY

b = RETRIEVE ALL DOCUMENTS

\*\* DOCUMENT NO. FIELD

FOR NUMERICAL PARAMETERS, PLACE LOW LIMIT OF RANGE IN FIRST ROW AND HIGH LIMIT IN SECOND ROW.

81 - 84	85 - 88	87 - 88	89 - 70	71 - 74	75 - 76	77 - 78	79
SOURCE CODE **	SOURCE INDEX **		YEAR PUBL. **	INDEX NO. **	MONTH ENTERED		YEAR ENTERED

MATERIAL DESCRIPTION (21 - 30)									

UNITERM FILE	Q Q	00874	10/30/70
SEARCH REQUEST FORM	NAME	INQUIRY IDENTIFICATION	DATE

OPERATION	/	0	2	0	THRU	/	0	2	8
MATERIAL GRP	/	3	0	1	THRU	/	3	0	1
SOURCE CODE					THRU				
SOURCE INDEX	/				THRU	/			
YEAR PUBL.	/				THRU	/			
INDEX NO.					THRU				
		MONTH		YEAR			MONTH		YEAR
DATE ENTERED					THRU				

XXXX XX XX XXXX  
IOC. NO. FIELD KEY

UNITERM 1 (1-30)									
T	O	O	L		L	I	F	E	-
E	F	F	E	C	T				-
T	O	O	L		G	E	O	M	
UNITERM 2 (31-60)									
C	H	A	T	T	E	R			

OPERATION	/				THRU	/			
MATERIAL GRP	/				THRU	/			
SOURCE CODE					THRU				
SOURCE INDEX	/				THRU	/			
YEAR PUBL.	/				THRU	/			
INDEX NO.					THRU				
		MONTH		YEAR			MONTH		YEAR
DATE ENTERED					THRU				

XXXX XX XX XXXX  
IOC. NO. FIELD KEY

UNITERM 1 (1-30)									
UNITERM 2 (31-60)									

OPERATION	/				THRU	/			
MATERIAL GRP	/				THRU	/			
SOURCE CODE					THRU				
SOURCE INDEX	/				THRU	/			
YEAR PUBL.	/				THRU	/			
INDEX NO.					THRU				
		MONTH		YEAR			MONTH		YEAR
DATE ENTERED					THRU				

XXXX XX XX XXXX  
IOC. NO. FIELD KEY

UNITERM 1 (1-30)									
UNITERM 2 (31-60)									

INQUIRY FILE	<i>RES</i>	00863	10-28-70
SEARCH REQUEST FORM	NAME	INQUIRY IDENTIFICATION	DATE

1 - 3	4 - 5	6 - 8	9 - 10	11 - 12	13 - 15	16	17 - 18	19	20
OPERATION	TOOL MATERIAL	HARDNESS CODE	CONDITION	HEAT TREATMENT	MATERIAL GROUP		INQUIRY TYPE	ANALYST	
085					281				
085					281				

UNITERM 1 (31 - 60)									
C	U	T		F	L	U	I	D	-
R	E	C	O	M	N	D	T	N	S
UNITERM 2 (31 - 60)									

61 - 64	65 - 68	69 - 70	71 - 74	75 - 76	77 - 78	79
S.I.C. CODE	COMPANY CODE	DIVISION CODE	INQUIRY SEQUENCE NUMBER	INDIVIDUAL CODE	MONTH	YEAR

MATERIAL DESCRIPTION (21 - 30)									
I	7	-	4	P	H				

FOR NUMERICAL PARAMETERS, PLACE LOW LIMIT OF RANGE IN FIRST ROW AND HIGH LIMIT IN SECOND ROW.

1 - 3	4 - 5	6 - 8	9 - 10	11 - 12	13 - 15	16	17 - 18	19	20
OPERATION	TOOL MATERIAL	HARDNESS CODE	CONDITION	HEAT TREATMENT	MATERIAL GROUP		INQUIRY TYPE	ANALYST	

UNITERM 1 (31 - 60)									
UNITERM 2 (31 - 60)									

61 - 64	65 - 68	69 - 70	71 - 74	75 - 76	77 - 78	79
S.I.C. CODE	COMPANY CODE	DIVISION CODE	INQUIRY SEQUENCE NUMBER	INDIVIDUAL CODE	MONTH	YEAR

MATERIAL DESCRIPTION (21 - 30)									

FOR NUMERICAL PARAMETERS, PLACE LOW LIMIT OF RANGE IN FIRST ROW AND HIGH LIMIT IN SECOND ROW.



## FUTURE PLANNING

AFMDC will continue to serve as a communication link for both Government and industry by providing support to the defense effort. Continuing efforts include:

1. Answering technical inquiries.
2. Study of better acquisition techniques for new important input to AFMDC's data bank.
3. Close liaison with organizations such as the Small Business Administration, the State Technical Services Technology Utilization Programs and other information centers.

## MAJOR GOALS

1. Completion of work started on a new computerized User-Inquirer file. When completed it will eliminate two previously used card files and the metal plate Addressograph mailing system.
2. Implimentation of a new computerized SIC system that, when completed, will provide AFMDC with the following capabilities:
  - a) Provide a User File profile on individuals and their field of expertise.
  - b) Permit quick access to companies having capabilities either in certain machining operations and/or materials. This will be an important tool for both selective dissemination or acquisition of data.
  - c) Provide an easier, more accurate and cheaper method of obtaining data on AFMDC activities for evaluation of effectiveness and reporting.
3. Completion of final engineering effort on the Machining Data Handbook preparatory to printing.
4. Preparation of an updated version of the AFMDC publication 'Machining Data for Titanium Alloys', AFMDC 65-1.
5. Preparation of an AFMDC data publication on Metal Removal Rates and Unit Horsepower.
6. Continuation of studies on a computerized data bank of machining recommendations that can be used for future preparation of data publications, updating of data and provide latest information for response to inquiries.

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D		
(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)		
1. ORIGINATING ACTIVITY (Corporate author) Metcut Research Associates Inc. Cincinnati, Ohio 45209		2a. REPORT SECURITY CLASSIFICATION Unclassified
		2b. GROUP N/A
3. REPORT TITLE  SIXTH ANNUAL REPORT OF THE AIR FORCE MACHINABILITY DATA CENTER		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Annual Report covering the period of October 1, 1969 thru September 30, 1970		
5. AUTHOR(S) (First name, middle initial, last name)  Robert E. Snider		
6. REPORT DATE March, 1971	7a. TOTAL NO. OF PAGES 29	7b. NO. OF REFS 6
8a. CONTRACT OR GRANT NO. Contract F33615-69-C-1112	9a. ORIGINATOR'S REPORT NUMBER(S)  AFMDC 70-5	
b. PROJECT NO.  9M 810/8975	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)  AFML-TR-70-313	
c.		
d.		
10. DISTRIBUTION STATEMENT  This document has been approved for public release and sale; its distribution is unlimited.		
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Air Force Materials Laboratory Materials Support Division Wright-Patterson Air Force Base, Ohio
13. ABSTRACT <p>This report covers the sixth year of operation of the Air Force Machinability Data Center from October 1, 1969 through September 30, 1970 (Contract F33615-69-C1112). During this contracting period 5,141 documents were processed from which 19,654 cards were keypunched. Currently, there are 110,143 supporting records on punched cards which permit computer searches to be conducted for citation to 40,966 specific machining situations coded on AFMDC's documents.</p> <p>During this reporting period, 1,038 specific inquiries were answered for 512 different organizations representing 761 individuals in 101 different SIC categories. Since the Center's operation began in October 1964, a total of 5,739 specific inquiries have been processed. The average number of inquiries was 86 per month at an average processing cost of \$43.77 per inquiry.</p> <p>Statistics are presented for estimated cost savings of AFMDC users. Through September 30, 1970, it has been very conservatively estimated that these savings amounted to more than \$50,000,000.</p> <p>Also in this report are tables and information reflecting AFMDC activity in other areas related to data publications, Government activity, types of inquiries, etc.</p>		

DD FORM 1 NOV 65 1473

Unclassified

Security Classification

