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FIFTEENTH REPORT OF THE MECHANICAL PROPERTIES DATA CENTER

MARCH 1979

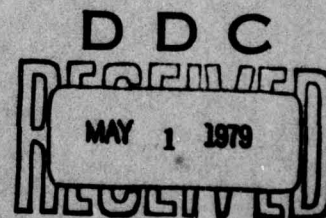
MECHANICAL PROPERTIES DATA CENTER
Traverse City, Michigan 49684

ANNUAL REPORT - CONTRACT DSA900-78-C-0447

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Prepared for

ARMY MATERIALS AND MECHANICS RESEARCH CENTER
Watertown, Massachusetts 02172



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ABSTRACT

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FOREWORD

This report was prepared by the Mechanical Properties Data Center operated by Belfour Stulen Div., 13919 West Bay Shore Drive, Traverse City, Michigan 49684, under DSA Contract DSA900-78-C-0447. The work described herein was accomplished under Project No. 8975, Materials Information Analysis Centers, Task No. 897504, Mechanical Properties Data Center.

This effort has been administered under the direction of the Defense Logistics Agency with Technical Supervision by the Army Materials & Mechanics Research Center, Watertown, MA, Mr. S. Valencia, Contracting Officer's Technical Representative.

This report covers the period from September 16, 1977 to February 16, 1979.

The report was released by the author February 1979.

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ABSTRACT

This report reviews and discusses the continuing operation and development of the Mechanical Properties Data Center. Activity and growth of the Center are discussed in terms of the six major work areas: Input, File Maintenance, Output, Systems Development, Management and Marketing-Sales.

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INTRODUCTION

This report summarizes seventeen months of continuous operation of the Mechanical Properties Data Center by Belfour Stulen Div. During the reporting period covered herein, the Defense Logistics Agency has had the administrative responsibilities and the technical monitor has been the Army Materials and Mechanics Research Center, Watertown, Massachusetts.

Under Defense Logistics Agency management, the Mechanical Properties Data Center had as its objectives the acquisition, review, analysis and dissemination of available well-defined mechanical properties data on structural metals and alloys. Additionally, the Center was charged with the responsibility of maintaining a marketing-sales program for the products and services of the Center, to "achieve a rate of reimbursement equal to at least 100% of the initial DoD funding." This report presents the essential details of operation, data acquisition through marketing, which produced receipts and supplemental support of nearly 90% of target.

DATA AND INFORMATION INPUT

Acquisition - The basis of all the products and services of the Mechanical Properties Data Center is the computerized data-information storage file. This file consists of two elements - test data and non-numeric information related to processing, fabrication, test procedures, composition and the myriad of other variables that affect the mechanical properties of metals and alloys. To assure that the file represents current information, a continuous acquisition effort must be maintained. During the contract period this effort produced 635 documents. Table I identifies the document sources and the quantity received from each. Note that those received DIRECT account for over 58% of the total. DIRECT indicates that the documents were acquired directly from the generating organizations or sponsors. Principal sources of direct acquisition are government agencies, contractors, materials producers and technical societies or associations.

The acquisition effort of this contract period produced about 40% of the total quantity of documents acquired during the previous contract. The decline reflects the reduced materials R & D effort in government and industry as well as the rather arbitrary distribution limitations imposed by some government agencies and contractors.

TABLE I
TECHNICAL DOCUMENTS ACQUIRED

<u>MONTH/YEAR</u>	<u>DDC</u>	<u>DIRECT</u>	<u>TOTAL</u>
October 1977	5	20	25
November 1977	12	17	29
December 1977	10	20	30
January 1978	41	15	56
February 1978	31	11	42
March 1978	42	12	54
April 1978	23	16	39
May 1978	10	22	32
June 1978	19	58	77
July 1978	7	14	21
August 1978	22	26	48
September 1978	21	11	32
October 1978	8	85	93
November 1978	8	35	43
December 1978	10	4	14
	<u>269</u>	<u>366</u>	<u>635</u>

Control - All documents acquired by the Center were screened for pertinence and "preliminary indexed". The screening process eliminates duplications and the handling of data not properly within the scope of the Center's activities. Preliminary indexing provides an input control and the first step toward retrievability of data and information. Briefly, the indexing, based on materials, properties, processing practices, environments, etc., provides for computer identification and bibliographic printout of documents containing specific information or data on one or more of the index topics. These printouts are an end product in themselves as a subject reference list or a supplement to a data printout. Further, a selective reference search and resulting printout is an efficient tool for controlling input to the data file.

Not all reports of materials evaluation programs contain original well-defined test data which is suitable for storage; however, most do contain discussions and/or conclusions regarding the behavior of materials, effect of variables, etc., that are valuable additions to our technical knowledge. The indexing procedures of this Center afford an efficient method of conserving and recycling this segment of knowledge. A total of 454 pertinent documents were indexed under this contract.

Data Extraction and Storage - Previous reports have described in detail the codes, formats and practices employed in the encoding and storage procedure. That information will not be repeated here.

The data input effort produced approximately 15,574 units of computer retrievable data and information. The encoded test data includes the following:

<u>Card Type</u> <u>(unit)</u>	<u>Data Description</u>	<u>Quantity</u>
A	Material, specimen, test conditions and measured properties	5,226
A _n	Supplementary detail and properties	863
B	Material composition and processing	1,360
B ₁	Heat treatment details	1,273
		<u>8,722</u>

The encoded data is entered into punch cards, identified above as A, A_n, B and B₁, which are in turn committed to magnetic disk for storage, retrieval and manipulation. The punched cards are retained for back-up. Each card type, A through B₁, has a fixed format except for the test result portions of the "A" cards which are formatted to accomodate the test results of each of more than 30 standardized or commonly used mechanical property test procedures.

The data storage file now contains over 1,210,000 units of information. Table II presents a recent summary inventory of the file in a material type-test type matrix.

Data File Code Maintenance - Each time data is committed to disk or tape through the computer, a program function provides an up-to-date and detailed data inventory. This inventory is used as a guide to future input effort and also serves the output (search) effort as a preliminary search tool.

To interpret encoded data and information the computer must also be fed new code descriptions. These must be added to the computer master code disk packs immediately after the addition of any encoded information which incorporates new codes.

Data and code additions were incorporated in the data file four times during this contract period.

DATA CENTER OUTPUT PRODUCTS & SERVICES

To satisfy the need for mechanical properties data and information, MPDC offers a variety of products and services including data displays, data inventories, handbook chapters, selective reference lists, an alloy cross-index and materials-processes information.

Data Searches and Inquiries - The Center responded to 247 technical inquiries, excluding specific and general requests for information on the products and services of the Center.

TABLE II
GENERAL INVENTORY
DATA AND INFORMATION STORAGE FILE

- - - - - QUANTITY OF RETRIEVABLE TEST RESULTS BY TEST TYPE - - - - -

<u>MATERIAL TYPE OR BASE</u>	<u>TENSION</u>	<u>COMP- RESSION</u>	<u>SHEAR</u>	<u>BEARING</u>	<u>VESSEL BURST</u>	<u>CREEP</u>	<u>STRESS CORROSION</u>	<u>FATIGUE</u>	<u>IMPACT</u>	<u>FRACTURE TOUGHNESS</u>	<u>CRACK PROPAGATION</u>
Low Alloy Steel	45,432	1,603	1,418	1,079	145	4,638	1,760	18,669	55,186	4,983	155
Stainless Steel	43,034	2,664	5,036	1,349	-	4,996	4,113	9,431	3,448	2,228	103
Tool Steel	15,773	329	406	256	17	1,057	474	2,080	1,554	880	-
Super Alloys/ Maraging Steels	33,263	1,142	1,451	886	13	4,079	2,045	4,828	12,126	4,104	-
Cast Iron	584	-	-	-	-	189	-	-	106	-	-
Nickel or Chromium Base	47,667	2,107	4,952	1,227	-	21,252	856	10,560	1,031	924	32
Aluminum	57,478	5,469	5,903	4,475	-	2,590	29,298	26,785	1,997	4,833	971
Titanium	98,979	7,066	10,147	9,469	-	8,062	2,050	27,361	15,797	3,575	138
Magnesium	9,377	3,024	845	586	-	842	-	1,735	282	2	27
Cobalt	7,909	558	523	472	-	3,884	73	1,582	101	10	-
Copper	3,376	49	68	-	-	440	325	537	450	-	-
Silver	93	-	-	-	-	-	-	28	29	-	-
Zinc	40	-	-	-	-	-	-	-	130	-	-
Tungsten	4,239	74	12	7	-	1,187	-	11	-	-	-
Plutonium/ Uranium Base	416	322	-	-	-	-	-	-	238	-	-
Lead/Tin Base	449	-	152	-	-	-	-	500	574	-	-
Tantalum	4,910	77	211	-	-	1,238	-	182	-	-	-
Columbium	9,214	58	529	21	-	2,356	-	691	20	40	-
Molybdenum	10,707	170	228	48	-	2,192	-	489	630	48	-
Beryllium	9,634	531	246	120	-	448	-	549	562	80	-
Zirconium	455	6	-	-	21	185	-	-	11	-	-
Hafnium	7	-	-	-	-	-	-	-	-	-	-
Paladium	25	-	-	-	-	-	-	-	-	-	-
Carbon	184	-	-	-	-	12	-	-	-	-	-
Vanadium	510	8	6	-	-	5	-	-	-	-	-
Dissimilar Metal (joints)	1,767	-	408	-	-	87	-	-	-	-	-

SUPPLEMENTARY DESCRIPTIVE INFORMATION AND RESULTS

Alloy Composition - 127,793

Supplementary Test Results - 171,399

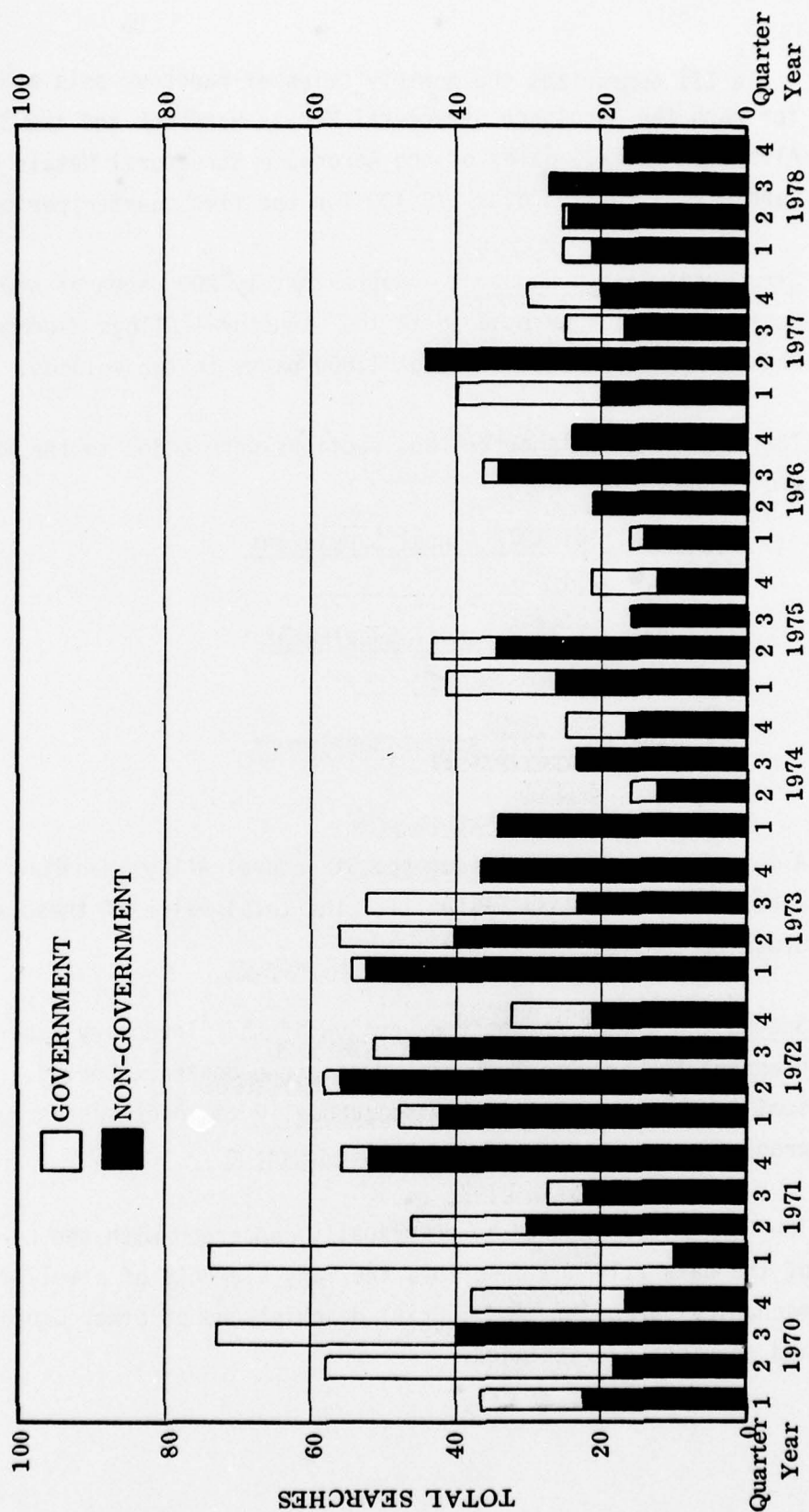
Heat Treat Details - 94,348

Three hundred and forty-five data or reference searches were accomplished. Appendix I presents a two-part summary of 1) search activity by months, and 2) frequency of use by individual organizations. A graphic recap of search activity, Figure 1, shows government and non-government Data Center use on a quarterly basis since 1966. Total search activity for the last five quarters equals activity for the previous eight quarters. Service to non-government organizations remained near the level experienced during the previous year.

Aerospace Structural Metals Handbook - Five new or revised chapters/sections were published and added to the Aerospace Structural Metals Handbook during this contract period. In addition to the chapters, several pages consisting of revised appendices, covers, insertion-maintenance instructions, acknowledgements and notices were published to supplement the Handbook. Over 260 pages of new and revised data/information were generated.

In the five quarterly distributions of this contract the following chapters were added to the Handbook. The schedule of distribution is shown below:

<u>First Quarter 10/1/77 - 12/31/77</u>		
<u>Alloy</u>	<u>Chapter Code</u>	<u>New/Revised</u>
Types 347 & 348 Steel	1309	Revised
<u>Second Quarter 1/1/78 - 3/31/78</u>		
Type 17-4PH SS	1501	Revised
<u>Third Quarter 4/1/78 - 6/30/78</u>		
Titanium 6-2-4	3718	Revised
<u>Fourth Quarter 7/1/78 - 9/30/78</u>		
Steel	1208	New
<u>Fifth Quarter 10/1/78 - 12/31/78</u>		
IN-100	4212	Revised



SEARCH ACTIVITY BY CALENDAR QUARTERS

Figure 1

Table III summarizes the monthly sales of Handbook sets and Supplements for both the Aerospace Structural Metals Handbook and the Structural Alloys Handbook. Sales of the Aerospace Structural Metals Handbook and Supplements totaled over \$73,400 for the five quarter period.

Structural Alloys Handbook - Approximately 200 pages of new and revised data/information were added to the Structural Alloys Handbook. The Handbook now consists of about 1,800 pages in two volumes.

The following new chapters and sections were added to the Handbook during the reporting period:

Second half of 1977 Annual Supplement

316 SS

First half of 1978 Annual Supplement

Ferritic, 400 SS

Second half of 1978 Annual Supplement

A-36 Steel

A monthly record of sales of the Structural Alloys Handbook and Supplements is presented in Table III. The total value of these sales was close to \$38,400.

Special Reports - An updated version of the "Inventory Report" was prepared for free distribution during the contract period. This special semi-technical report is revised annually to inform users regarding products and services of the Center.

The "Inventory Report" is principally concerned with the current content of the data file and describes the many elements of a well-defined mechanical property test. Brief descriptions of other Center products and services are included.

TABLE III
SALES OF HANDBOOKS AND SUPPLEMENTS
IN CONTRACT PERIOD

<u>MONTH/YEAR</u>	<u>AEROSPACE STRUCTURAL METALS HANDBOOK</u>		<u>STRUCTURAL ALLOYS HANDBOOK</u>	
	<u>Handbooks</u>	<u>Supplements</u>	<u>Handbooks</u>	<u>Supplements</u>
October 1977	10	55	9	45
November 1977	4	17	4	24
December 1977	25	56	22	39
January 1978	9	500	2	215
February 1978	6	79	7	31
March 1978	13	18	7	10
April 1978	7	56	5	17
May 1978	9	55	3	63
June 1978	-	24	3	8
July 1978	8	139	5	159
August 1978	7	13	2	3
September 1978	5	12	7	9
October 1978	9	9	4	3
November 1978	4	31	4	10
December 1978	<u>2</u>	<u>17</u>	<u>1</u>	<u>2</u>
Totals	118	1081	85	638

The "User Guide" provides guidelines for the phrasing of inquiries to produce data or bibliographic information from the MPDC files. Also included are check lists citing minimum descriptions of material and testing required to produce an efficient search and limit the output to that which is most pertinent to the inquiry.

A new product/service brochure was also generated to serve as a promotional mailing piece. Approximately three thousand copies were distributed to a core mailing list, a screened DDC/DAL listing and in response to other direct inquiries.

SYSTEM DEVELOPMENT

Improvements and additions to the computer hardware/software available to the Center for data storage, retrieval and output functions were accomplished. The upgrading reflects the continuing effort of the Belfour Stulen Division to provide computer facilities and capabilities that offer greater efficiency and anticipate future needs.

Hardware - The addition of an IBM 3742 Data Entry Station and an IBM 3540 Diskette Reader offers the economies of diskette (floppy disk) data input and eliminates the storage/handling associated with punched card input procedures. Equipment changes also include two IBM 3203-4 Printers to replace an IBM 1403; an IBM 3135 Processing Unit was replaced by a 3138 and six IBM 2314 Disk Storage Units were replaced by five 3340 Units. IBM 3210 Console Keyboard has been replaced by an IBM 3277 Display Console.

The present computer system available to the Center for data processing functions is identified below:

IBM 370 Model 138 System -

- 1287 Optical Character Reader
- 3203-4 Printers (2)
- 3340-A2 Disk Storage Unit
- 3340-B2 Disk Storage Unit (2)
- 3344-B2 Disk Storage Unit (2)
- 2540 Card Read Punch
- 3138 Processing Unit
- 3277 Display Operator Console
- 3420 Magnetic Tape Drives (4)
- 3540 Diskette Reader/Writer
- 3741 Data Entry Station, Single
- 3742 Data Entry Station, Dual

Figure 2 presents schematically the data flow and equipment array of the Mechanical Properties Data Center system from Information Acquisition through Output.

MANAGEMENT

Management objectives during the contract period were:

- Increase marketing/sales effort
- Improve software/hardware efficiency
- Expand properties coverage
- Develop new data products/applications

These objectives were all satisfied to some extent within the limitations imposed by budgeting considerations. The favorable income/funding ratio previously noted attests to the success of the total effort.

Marketing and Sales - The marketing effort has been directed toward increasing the awareness of potential users, particularly those in government agencies, to the availability and advantages of IAC products/services. A promotional program included participation in two major material trade shows, news releases and ads in trade papers, and direct mailing of brochures to an expanded mailing list. Of these, the most effective were trade show participation and direct mailings; however, the influence of news releases and trade paper insertions are admittedly difficult to measure or evaluate. In any case, the key to successful promotion lies in the ability to sustain a program(s) and this ability seems to be beyond the reach of the IACs.

Table IV presents the sales figures for the various income producing products or services generated by the Mechanical Properties Data Center during the reporting period.

Software/Hardware - No significant modifications to existing software were accomplished during the reporting period.

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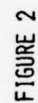


TABLE IV

MPDC INCOME STATEMENT AND OPERATING COSTS

FUNDING SOURCES

DSA Contract #900-78-C-0447 & Modifications	\$245,000
Sales	
Data file and search	1,295
Aerospace Structural Metals Handbook	73,440
Structural Alloys Handbook	38,385
Alloy Cross Index	6,125
	\$364,245

OPERATING COSTS

Data acquisition and input	\$ 69,803
Output	
Technical inquiries and data file	19,720
Aerospace Structural Metals Handbook	139,166
Structural Alloys Handbook	77,457
Alloy Cross Index	17,438
Current awareness and promotion	3,133
Management, support & R/D	21,543
Fee	15,965
	\$364,245

Other Applications and Products - The MPDC data base appears to be unique in the field of materials information. Although some organizations, societies and other groups are establishing data bases, no fully operational materials data bases presently exist. This position has encouraged the Center to promote the sale of the data base, or segments of it, to organizations interested in establishing computer assisted materials selection systems. Since 1966 four organizations have purchased significant portions of the data file (with software). The applications within each of the purchasing organizations are: Curtis Wright, the first of these, used the data to develop in-house materials specifications; the University of Michigan Engineering School studied the effect of material and test variables on the fatigue life (endurance limit) of ferrous and non-ferrous materials; the Naval Ship Engineering Center utilized the data base to establish specific applications ratings; and the Army Materials and Mechanics Research Center is incorporating data in a comprehensive computer assisted materials selection system (pilot program). The Center continues to seek additional applications for a file.

The MPDC Alloy Cross Index has become an increasingly popular product since its introduction three years ago. Originally the Index served only the in-house data encoding effort, but is now finding usage wherever "equivalent" metal alloys must be identified. Purchasing agents, material specifiers, librarians and others purchased nearly 120 copies of the two volume Index during the contract period.

The Center has completed negotiations with the NBS Cryogenic Laboratory to produce a handbook in support of the ERDA (DOE) sponsored magnetic fusion energy program. This effort will produce three completed chapters (stainless steels 316, 21-6-69 and 304) during 1979. Properties coverage includes over twenty electrical, mechanical and physical properties at temperatures from 4.2K to room temperature.

Distribution of Effort - Table V presents the distribution of man-hours associated with areas of contractual effort.

CONCLUSIONS AND RECOMMENDATIONS

The DoD Information Analysis Centers continue to provide vital services and products to an important audience within the United States defense/industrial complex; however, the audience apparently represents relatively few of the total potential users. Although most IACs have reached or are near the goal established for cost recovery, recent surveys confirm the fact that the majority of potential users are not aware of the Centers or the services that they provide. Limitations on promotional mailings and advertising preclude the correction of this situation by the Centers on an individual basis. A concerted effort by the Centers and sponsors must be mounted.

In support of such a program each Center should review and update products, services and information handling concepts.

Within the MPDC, the following tasks are cited as needing special emphasis and extra effort if we are to maintain an effective and progressive Information Analysis Center:

Remote Terminals and Data Networks - A study of hardware/software requirements associated with remote access to data files and compatible with networks which interconnect several data bases should be initiated.

Metrication of Data Base and Publications - A course of action, funding and scheduling should be established for the conversion of English units of measure to metric (SI).

Software for Computerized Handbook Production - The development of software to increase the utilization of computers in the production of printer-ready text, graphs and tables for handbooks should be undertaken.

TABLE V

DISTRIBUTION OF EFFORT

<u>Work Areas</u>	<u>Man Hours Expended</u>		<u>Total</u>
	<u>Professional</u>	<u>Non-Professional</u>	
Data acquisition, input and file maintenance	391.5	3,108.5	3,500.0
Technical inquiries and data transfer	140.0	650.4	790.4
Handbook generation and revisions	2,403.4	6,048.4	8,451.3
Current awareness and promotion	59.5	20.8	80.3
Management, Support & R/D	198.5	61.3	259.8
	<u>3,192.9</u>	<u>9,889.4</u>	<u>13,082.3</u>

Aerospace Structural Metals Handbook Format Update - The ASMH format has remained basically unchanged since its inception. Some redundancy does exist and if users do not find it helpful it should be eliminated. Some consideration should also be given to a title change; the Handbook serves a broader audience than the title indicates.

Alloy Equivalency - The increasing emphasis on efficient materials utilization and the importance of equivalency of materials in international trade increases the need for an international cross index of alloys. The MPDC Alloy Cross Index presently includes many equivalent foreign materials; however, considerable effort would be required to produce an index of international importance.

Other areas of program activity common to most DLA IACs that would benefit from continued attention and action from DoD Program Managers and Technical Monitor are:

- Improve the flow of information/data from government agencies and contractors to the IACs.

- Promote interaction between IACs and foreign counterparts.

- Utilize existing federal publications and organizations in a continuing program to increase user awareness of IACs within government laboratories and research centers.

APPENDIX I
A Summary of Inquiry
and
Search Responses

APPENDIX I
A Summary of Inquiry
and
Search Responses

Part I

	<u>SEARCH INQUIRIES</u>	<u>SEARCHES ACCOMPLISHED</u>	<u>OTHER INQUIRIES</u>
1975			
Fourth Quarter	14	21	27
1976			
First Quarter	15	16	32
Second Quarter	13	14	21
Third Quarter	13	34	38
Fourth Quarter	14	24	55
1977			
First Quarter	14	40	31
Second Quarter	24	45	20
Third Quarter	16	27	33
Fourth Quarter	10	30	114
1978			
First Quarter	13	25	67
Second Quarter	12	25	26
Third Quarter	10	27	22
Fourth Quarter	<u>10</u>	<u>17</u>	<u>29</u>
	178	345	515

APPENDIX I
A Summary of Inquiry
and
Search Responses

PART II

<u>Organization</u>	<u>Inquiries</u>	<u>Searches</u>
Babcock & Wilcox	2	4
Beech Aircraft	1	2
Bendix Corporation	2	3
Boeing Wichita	1	2
Canadian GE	1	1
CE/KSB Pump Company	1	1
Creare	1	3
Cummins Engine Company	1	4
Curtis Wright	2	5
Dept. Tech. Energy Research Foundation (Netherlands)	2	3
Ehrentries, David	1	1
F.M.C.	1	1
Finnish Embassy	1	1
General Electric	1	1
Grumann Aerospace	1	1
Honeywell Avionics Div.	1	1
Hughes Aircraft	1	1
Hughes Helicopters	1	1
INCO, Toronto	1	1
Independent Living	1	1
Ingersoll Rand	2	12
Klauder & Assoc.	1	1
Knolls Atomic Power Lab.	1	9
Lambert Kay	1	1
LOM Corp.	1	1
Neutrino	1	1

PART II (continued)

<u>Organization</u>	<u>Inquiries</u>	<u>Searches</u>
O'Donnell Associates	1	1
Piasecki Aircraft	1	1
Pratt & Whitney	1	1
Raytheon Company	1	1
Rockwell International	1	1
Rohr Industries	2	3
Southwest Research Institute	1	4
Stainless Foundary & Engineering, Inc.	1	1
Sundstrand Aviation	3	5
Teledyne CAE	2	7
Vought Corporation	1	2

DISTRIBUTION LIST

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Army Materials and Mechanics Research Center Watertown, Massachusetts 02172 FIFTEENTH ANNUAL REPORT OF THE MECHANICAL PROPERTIES DATA CENTER Robert C. Braden, Mechanical Properties Data Center, Belfour Stulen Div. Traverse City, Michigan 49684 Technical Report AMMRC Contract DSA900-78-C-0447 Final Report, September 16, 1977 thru February 15, 1979 This report reviews and discusses the continuing operation and development of the Mechanical Properties Data Center. Activity and growth of the Center are discussed in terms of the six major work areas: Input, File Maintenance, Output, Systems Development, Management and Marketing-Sales.	AD UNCLASSIFIED UNLIMITED DISTRIBUTION Key Words Technical Information Center Metals Alloys Information retrieval Data Processing Systems	Army Materials and Mechanics Research Center Watertown, Massachusetts 02172 FIFTEENTH ANNUAL REPORT OF THE MECHANICAL PROPERTIES DATA CENTER Robert C. Braden, Mechanical Properties Data Center, Belfour Stulen Div. Traverse City, Michigan 49684 Technical Report AMMRC Contract DSA900-78-C-0447 Final Report, September 16, 1977 thru February 15, 1979 This report reviews and discusses the continuing operation and development of the Mechanical Properties Data Center. Activity and growth of the Center are discussed in terms of the six major work areas: Input, File Maintenance, Output, Systems Development, Management and Marketing-Sales.	AD UNCLASSIFIED UNLIMITED DISTRIBUTION Key Words Technical Information Center Metals Alloys Information retrieval Data Processing Systems
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