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ANNUAL REPORT (10th) OF THE MECHANICS
PROPERTIES DATA CENTER

Robert C. Braden

Mechanical Properties Data Center

Prepared for:

Army Materials and Mechanics Research Center

September 1972

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TENTH ANNUAL REPORT OF THE
MECHANICAL PROPERTIES DATA CENTER

September 1972

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Michigan 49684

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Watertown, Massachusetts 02172

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13. ABSTRACT This report describes the activities of the Mechanical Properties Data Center during the tenth year of operation. Under Contract DSA900-72-C-0787 the Center acquired 1,418 materials evaluation reports, encoded over 61,000 computer retrievable test results, responded to 182 technical inquiries and generated 15 new or revised chapters for the Aerospace Structural Metals Handbook. Emphasis on cost reimbursement through the sale of products and services by the Center necessitated a moderately aggressive marketing-sales program, a search for new users and the development of new products-services. The results of these efforts, including the attainment of nearly 60% of initial funding through sales, are discussed in detail. Hardware and data flow are described by means of a schematic flow chart. Distribution of effort, levels of activity and other statistical information are presented in graphic or tabular form.		

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Metals						
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Operation						
Data Processing systems						
Reviews						

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FOREWORD

This report was prepared by the Mechanical Properties Data Center operated by Belfour Stulen, Inc., 13919 West Bay Shore Drive, Traverse City, Michigan 49684, under U.S.A.F. Contract DSA900-72-C-0787. 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 Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, with E. L. Horne (MAAM) as project engineer. Commencing in FY 73, this effort will be administered by the Defense Supply Agency with Technical Supervision by the Army Material & Mechanics Research Center, Watertown, Mass., Dr. J. J. Burke, Contracting Officer's Technical Representative.

This report covers the period of work, August 1, 1971 to July 31, 1972.

The report was released by the author September 1972.

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 the tenth year of continuous operation of the Mechanical Properties Data Center by Belfour Stulen, Inc. During the reporting period covered herein, the Defense Supply Agency has had the administrative responsibilities and the technical monitor has been the Materials Information Branch of the Air Force Materials Laboratory.

Under Defense Supply 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 establishing and maintaining a marketing-sales program for the products and services of the Center, to "achieve a rate of reimbursement equal to at least 50% of the initial funding". This report presents the essential details of operation, data acquisition through marketing, which produced sales of nearly 60% of initial DoD funding. At contract closing receipts from sales amounted to 57% of initial funding.

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 effect 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 1,418 documents. Table I identifies the document sources and the quantity received from each. Note that those received DIRECT account for over 50% 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.

TABLE I

TECHNICAL DOCUMENTS ACQUIRED

<u>MONTH</u>	<u>DDC</u>	<u>NASA</u>	<u>NTIS</u>	<u>DIRECT</u>	<u>TOTAL</u>
August 1971	26	7	2	50	85
September 1971	23	4	5	75	107
October 1971	31	6	0	61	98
November 1971	68	6	2	52	128
December 1971	55	9	3	108	175
January 1972	27	14	1	54	96
February 1972	54	10	5	68	137
March 1972	76	9	6	57	148
April 1972	35	31	2	53	121
May 1972	41	9	4	79	133
June 1972	16	34	2	50	102
July 1972	<u>27</u>	<u>21</u>	<u>1</u>	<u>39</u>	<u>88</u>
Total	479	160	33	746	1418

For the third consecutive year the Mechanical Properties Data Center has experienced a decline in the available quantity of original well defined metals test data. This condition, of course, reflects the general decline in new aerospace and defense hardware and resulting cut-back in materials evaluation programs.

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. For example, if the data inventory indicates the file lacks coverage of data on "the elevated temperature fatigue properties of IN 100 in a corrosive environment", a search can be initiated to identify documents containing such information or data. The data along with associated material test variables can then be incorporated (encoded) in 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 1,548 pertinent documents were indexed under this contract.

Data Extraction and Storage - Previous reports¹ 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 62,000 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.	47,871
A _n	Supplementary detail and properties.	2,461
B	Material composition and processing.	6,326
B ₁	Heat treatment details.	<u>5,068</u>
		61,306

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,

¹ See Reference List.

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 accommodate the test results of each of more than 30 standardized or commonly used mechanical property test procedures.

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

Data File Code Maintenance - Each time data is committed to 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 accomplished four times in 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 and materials-processes information.

Data Searches and Inquiries - The Center responded to 182 technical inquiries, excluding specific requests for the Aerospace Structural Metals Handbook or related information.

One hundred eighty data or information searches were accomplished. A two-part summary of search activity and user frequency is included in

TABLE II

GENERAL INVENTORY

DATA AND INFORMATION STORAGE FILE

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

MATERIAL TYPE OR BASE	Tensile	Compression	Shear	Bearing	Vessel Burst	Creep & Corrosion	Fatigue	Impact	Fracture Toughness
Low Alloy Steel	39,301	1,506	1,248	1,079	145	4,987	20,083	50,757	2,688
Stainless Steel	40,611	2,449	4,954	,295	--	7,521	**	2,861	1,829
Tool Steels	15,699	303	406	256	18	1,272	*	1,476	755
Super Alloys & Maraging Steels	31,111	1,030	1,364	886	13	5,282	25,486	11,014	2,889
Cast Iron	366	--	--	--	--	189	*	--	--
Nickel or Chromium Base	41,927	2,047	4,593	1,227	--	17,226	**	977	747
Aluminum	48,176	4,187	4,084	3,515	--	21,295	22,262	2,199	2,420
Titanium	89,814	6,439	9,841	9,346	--	8,847	22,627	15,086	1,941
Magnesium	8,981	3,024	846	586	--	842	1,684	282	2
Cobalt	6,770	558	457	472	--	3,253	--	92	10
Copper	2,454	49	68	--	--	504	1,014	420	--
Lead or Tin	449	--	152	--	--	--	--	574	--
Silver	93	--	--	--	--	--	--	29	--
Zinc	40	--	--	--	--	--	--	130	--
Tungsten	4,235	74	12	7	--	1,131	11	--	--
Plutonium or Uranium Base	267	106	--	--	--	--	--	174	--
Tantalum	4,310	78	211	--	--	1,191	22	--	--
Columbium	9,081	58	529	21	--	2,295	122	--	40
Molybdenum	10,674	171	228	48	--	2,192	88	630	48
Beryllium	8,463	528	246	121	--	446	567	482	--
Zirconium	425	6	--	--	21	125	--	11	--
Hafnium	7	--	--	--	--	--	--	--	--
Palladium	25	--	--	--	--	--	--	--	--
Carbon	184	--	--	--	--	12	--	--	--
Vanadium	510	8	6	--	--	5	--	--	--
Dissimilar Metal Joints	1,753	--	358	--	--	60	--	--	--

SUPPLEMENTARY DESCRIPTIVE INFORMATION AND RESULTS

Alloy Composition	105,456	Heat Treat Details	79,248
Alloy Cross Index	12,862	Plastic Data Cards	10,869
Alloy Reference Cards	19,425	Supplementary Test Results	58,640
Fatigue Cross Index	392	Title, Author, Source Cards	51,330
Fatigue Trailer Cards	9,152		

* Fatigue data for this Material Type are combined with those of Low Alloy Steels.

** " " " " " " " " " " " Super Alloys & Maraging Steels.

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Appendix I. Figure 1 presents a graphic display of search activity, by calendar quarters, since 1963. Government use of the Center is at the lowest level ever, however, use by non-government organizations during the last few quarters shows a definite upward trend. Although this use does not approach the levels experienced prior to initiation of service charges in March 1966, the trend seems to indicate that more commercial-industrial organizations are becoming aware of the economies offered by the services. This trend may also indicate that since all the DoD sponsored IAC's are now obligated to charge for some or all of their output, the users have free access to a very limited number of outside data-information sources.

Aerospace Structural Metals Handbook - Fifteen new or revised chapters were published and added to the Aerospace Structural Metals Handbook during this contract period. In addition to the chapters, several hundred pages consisting of revised appendices, covers, insertion-maintenance instructions, acknowledgements and notices were published to supplement the Handbook.

With the 1st quarterly distribution of the 1972 Revision Service (Supplement V) a fourth volume was added to the then existing three volume Handbook set. The addition of the fourth volume was necessitated by the increase in page count. In 1968, when the Center assumed responsibility for the production of the ASMH, the Handbook consisted of 179 chapters and related material in 1,517 pages. Through the second quarterly distribution of the 1972 Revision Service (Supplement V) the total chapter count is 205 and the page count is 2,627.

In the four quarterly distributions of this contract, 15 chapters were added to the Handbook. The schedule of distribution is shown below:

3rd Quarter 1971

<u>Alloy</u>	<u>Chapter Code</u>	<u>New/Revised</u>
TD Ni Cr	4120	New
Type 403, 410 & 416 Stainless	1401	Revised
HM 31A	3505	Revised

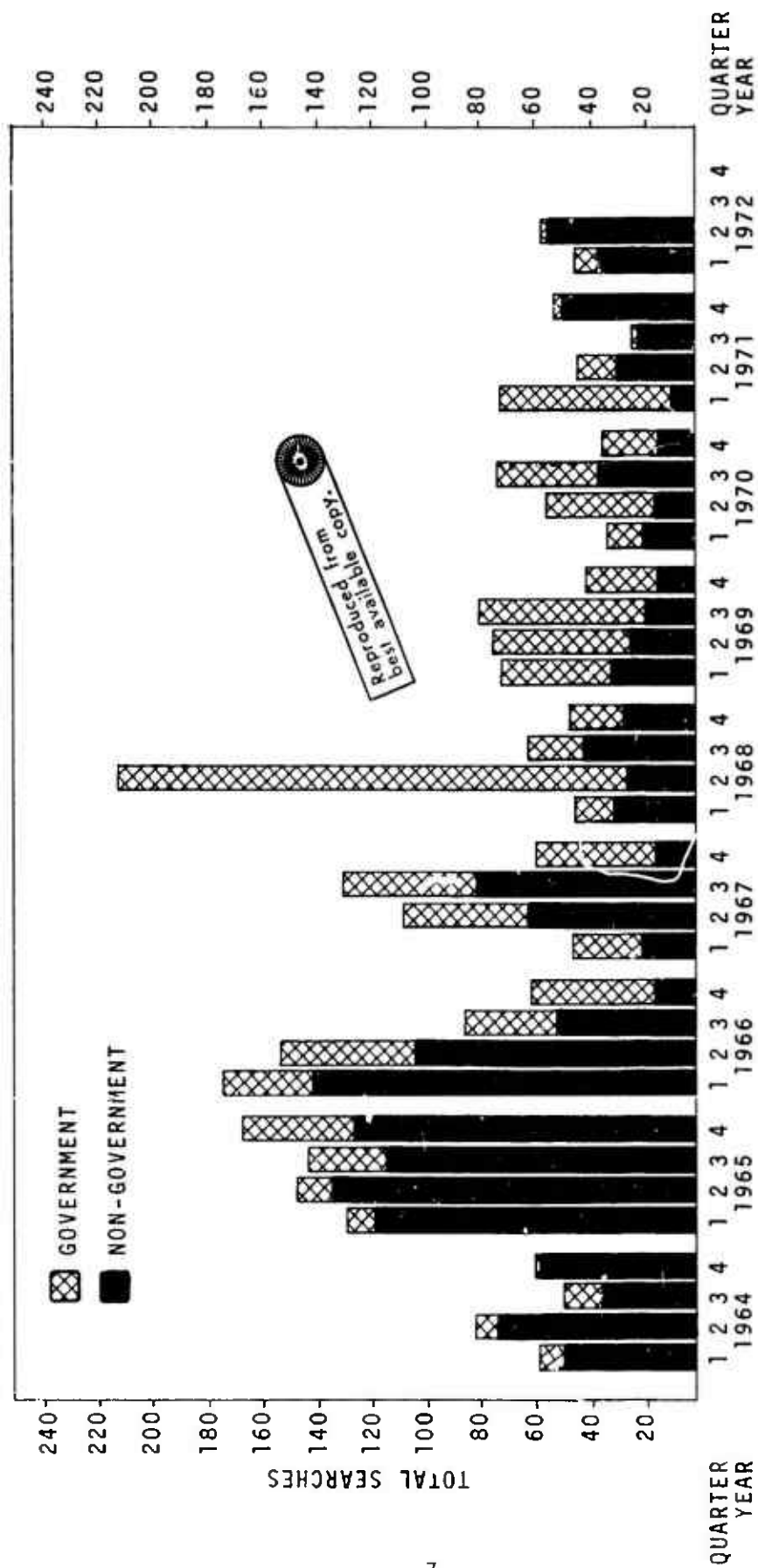


FIG. 1 SEARCH ACTIVITY BY CALENDAR QUARTERS

4th Quarter 1971

<u>Alloy</u>	<u>Chapter Code</u>	<u>New/Revised</u>
Cb 132/132M	5210	New
EZ 33A	3404	Revised
HK 31A	3503	Revised
Mar M 200	4211	Revised

1st Quarter 1972

Type 303 & 303Se Stainless	1302	Revised
Type 305 Stainless	1305	Revised
7049 Aluminum	3217	Revised
Zk 60A	3506	Revised

2nd Quarter 1972

410Cb Stainless	1410	New
RA 330	1611	New
B-1900	4213	New
300M	1217	Revised

Figure 2 displays distribution quantities for each annual revision service since the fourth quarter of 1969. The unbroken line represents the quantity of quarterly distribution at the time (quarter) of distribution and the broken line represents the total of annual revisions distributed to date. The difference in quantities is due to delayed distribution (orders) of annual revisions. Since 1969 the total distribution of revisions has leveled off at 700-725 copies annually, however, the actual number of Handbooks in use has steadily increased. The annual sale of complete Handbooks in 1968, 1969 and 1970 averaged over 300 copies per year which more than covered the loss by attrition and in fact accounted for the growth of total revisions distributed from 1967 through 1970.

Chapters in preparation for the completion of the 1972 Revision Service (supplement) are cited below with a tentative schedule by quarters. The present status of each chapter is also indicated.

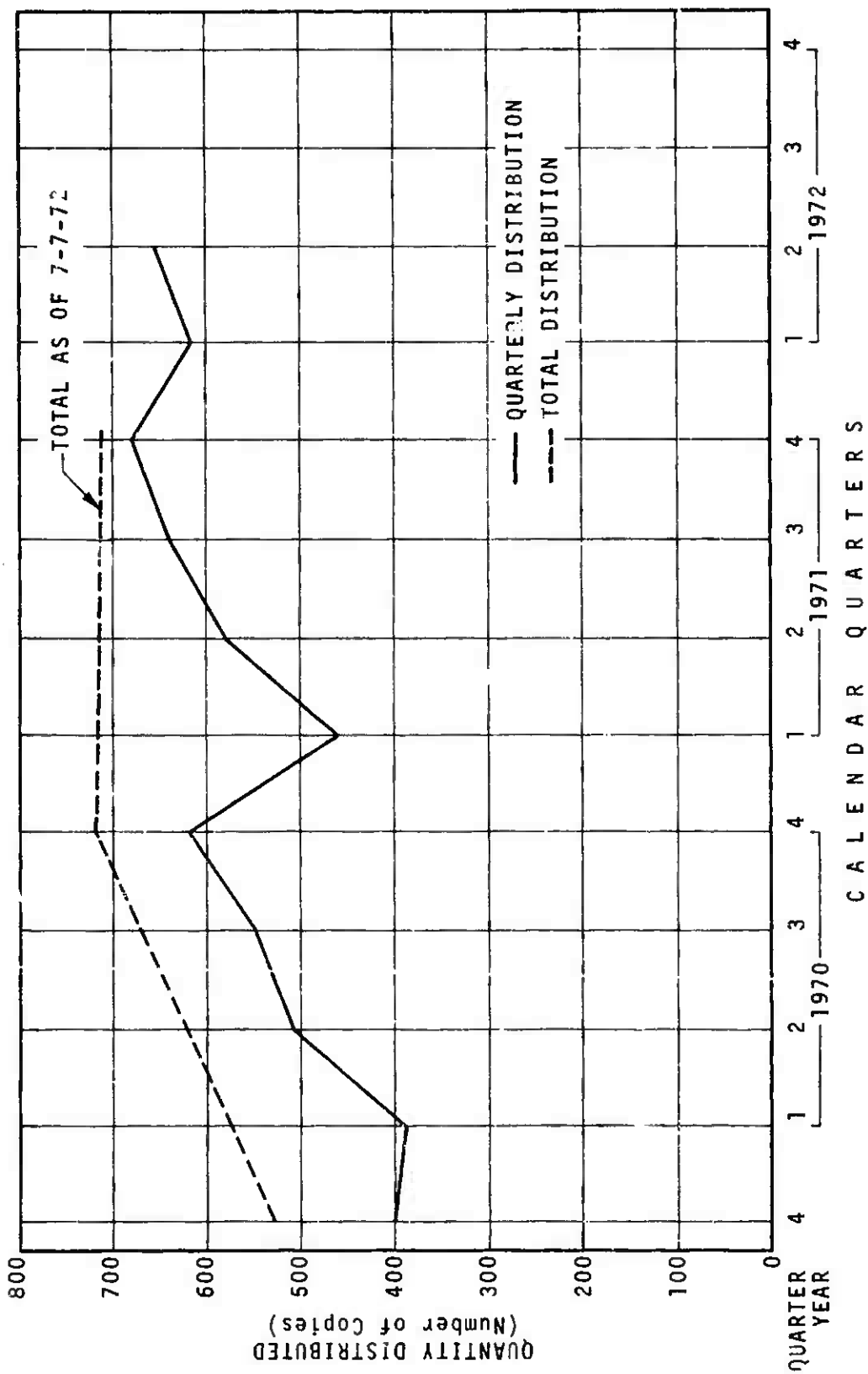


FIG. 2 AEROSPACE STRUCTURAL METALS HANDBOOK

Third Quarter 1972 (Tentative)

<u>Alloy</u>	<u>Chapter Code</u>	<u>Status</u>
7175 Al	3219	Printer ready
Ti6-2-4-6	3714	" "
Beta III Ti	3722	" "
HS 188	4310	" "

Fourth Quarter 1972 (tentative)

21Cr-6Ni-9Mn	1314	Transcribed & back to author
Custom 455	1410	" " " "
6061 Al	3206	" " " "
Rene' 41	4205	" " " "

The following chapters (new and revised) will be included in the Handbook in the future. Since these chapters are all in early stages of generation no definite schedule of publication and distribution has been established.

<u>Alloy</u>	<u>Chapter Code</u>
T-1 Steel	1103
4130 Steel	1201
4140 Steel	1203
304, 304L Stainless	1303
440A, B & C Stainless	1404
PH 13-8Mo Stainless	1510
2014 Al	3201
2024 Al	3203
Ti-3Al-8V-6Cr-4-4	37XX
Rene' 95	42XX
AF2-1Da	42XX
W1 52	4308
Cb-129-Y	5211

Structural Alloys Handbook - The need for continued development of products and services has been emphasized by the directive to establish a marketing-sales program that will produce income to satisfy a continually increasing goal. The Center, in its search for such products and services,

has been obligated to consider potential markets other than those in the aerospace and defense related activities. After consulting several major publishers of scientific and technical information it became apparent that a handbook containing common metals and alloys, similar in format and subject to the same continual updating practices as the Aerospace Structural Metals Handbook, would find a ready market among non-aero, non-defense fabricators and manufacturers. Belfour Stulen, Inc., independent of DoD support, initiated a program to develop such a handbook. This effort has now been incorporated in the scope of the Mechanical Properties Data Center and the first edition of the Structural Alloys Handbook is scheduled for publication early in 1973. Table III shows the progress to date and additional material to be included in the first edition.

In addition to the usual graphic and tabular data the Structural Alloys Handbook will include two features not normally found in materials properties handbooks. The first of these is Selector Charts designed to facilitate a preliminary comparison of several materials of the same type on the basis of from five to 25 typical properties, and/or other characteristics. Each material type section in the handbook is preceded by such a selector covering from 20 to 85 of the most important materials of that type. Not all of the materials covered by the selectors will necessarily be represented with detailed chapters, however, those of greatest importance to industry will ultimately be covered in detail.

A second new feature of the handbook is a section within each chapter which summarizes verbally the most significant conclusions of the programs reviewed during the generation of the chapter. The summaries of each alloy (chapter) will provide a qualitative characterization which is essential to the total material selection process. As a further convenience to the users of the Structural Alloys Handbook, the reference citations will include accession numbers when available. These numbers implement accession from DDC, NASA or the National Technical Information Service (NTIS).

Special Reports - In October 1971 and May 1972 inventory reports were published and distributed to over 600 addressees. The October report (inventory Report 716) presented a total inventory of the data file in a test

TABLE III

CONTENTS - STRUCTURAL ALLOYS HANDBOOK

Item	No. of Final Pages	No. of Tables	No. of Figures	No. of References	Status
Forward	1	-	-	-	H
Introduction	1	-	-	-	H
The MPDC - data center concept	5	-	-	-	A
- data acquisition and storage					
- sample sheet from alloy cross index					
- search and retrieval service					
<u>Cast iron selector chart (56 alloys)</u>	4	-	-	-	C
gray cast iron chapter	30	28	64	27	F
ductile cast iron chapter	15	13	56	24	F
white & high alloy cast iron chapter	8	12	13	20	F
malleable cast iron chapter	12	30	48	10	F
<u>Cast steel and cast stainless steel selector chart</u>	4	-	-	-	A
cast 316 stainless steel chapter	10				A
<u>Cast aluminum, magnesium, brass & bronze selector chart</u>	4	-	-	-	A
cast aluminum 195 and B195 chapter	10				A
<u>Wrought aluminum selector chart (30 alloys)</u>	4	-	-	-	E
2024 chapter	20				A
2219 chapter	10				A
3003 and 3004 chapter	10	31	25	34	F
5052 chapter	10				A
5456 chapter	10				A
6061 chapter	15				A
7075 chapter	20				A
<u>Wrought stainless steel selector chart</u>	8	-	-	-	A
201 and 202 chapter	10	16	25	37	H
301 and 302 chapter	20				A
304 chapter	15				A
316 chapter	15				A
410 chapter	15				A
440 chapter	15				A
17-4PH chapter	15				A
PH15-7Mo chapter	15				A
<u>Wrought carbon steel and alloy steel selector chart</u>	4				A
Low carbon steel chapter (1005 - 1030)	12	12	18	50	F
Medium carbon steel chapter (1033 - 1055)	12				A
High carbon steel chapter (1060 - 1095)	10	14	18	20	F
4140 chapter	15	11	54	51	H
4340 chapter	80	90	300	237	F
<u>High strength low alloy structural steel selector chart (85 alloys)</u>	6				E
A242 chapter	12	22	17	18	D
A572, A588 chapter	5	8	4	4	D
A440 chapter	3	5	0	4	D
A441 chapter	7	13	10	8	D
A527 chapter	9	11	26	9	D
A514, A517 chapter					B
<u>Ultra high strength steel selector chart</u> (see ASMH for these chapters)	6				A
Appendix A List of Symbols	2				C
Appendix B Heat treat terms	2				C
Appendix C Fabrication, primary and secondary operation, welding and other terms	4				C
Appendix D Test types					
- describe all 25 types of testing					
- sketch of specimens, notches, etc.					
- sample of how to use each type of data	12				C
Appendix E Conversion tables and plots F to C, psi to Kg/cm ² , hardness, etc.	4				A

STATUS KEY

A	B	C	D	E	F	G	H	I	J
Proposed	Document review and evaluation	Rough Manuscript	Initial Tables and Figures	Final Manuscript	Final Tables	Final Figures	Rough Layout	Final Edit	Printer Ready

type/material type matrix. Inventory Report 730, distributed in May, was a more detailed accounting, by test type and temperature, of the test data available in storage on Inconel 718. Also included were recommended heat treat schedules, fabricating procedures and graphic displays of typical properties. These reports are distributed free of charge to users and potential users of Center services.

SYSTEM DEVELOPMENT

The Center is continually reviewing and evaluating available data processing equipment, processing techniques, test data formats in an effort to optimize data handling operations. Since the Mechanical Properties Data Center obtains computer time from the Belfour Stulen Computer Services Group, which serves the total Belfour Stulen operation on a 24 hour basis, many computer features, conveniences and services are provided which would not be possible if based on Center funding alone.

Hardware - The current computer equipment, the IBM 360 Model 25 system, includes the following:

- 1052 Printer keyboard
- 1403 Printer
- 2025 Processing unit
- 2314 Disk storage units (3)
- 2415 Magnetic tape unit
- 2540 Card Read-punch
- 1287 Optical character reader

Recent system improvements include upgrading of the 1403 Printer from 600 to 1100 lines per minute, four 2311 disk storage units were replaced by three 2314 units which increased disk storage capacity from 29 million to 87.5 million bytes and the acquisition of the IBM 1287 OCR offers the potential to eliminate the keypunch and verifying operations in the data input process.

Software and Formats - With the addition of data storage afforded by the IBM 2314 storage units, the Center is able to utilize the added flexibility

and speeded data storage and retrieval. Programs are now being developed to implement this mode of storage and processing. These programs are expected to be operational by January 1973. Figure 3 presents an updated schematic of the data flow in the modified system.

Since the last annual report the Center has revised one existing test data format and developed two new formats. The fracture toughness format was revised to reflect the standardized specimens, procedures and reporting requirements of ASTM E-399-70 (Test for Plane Strain Fracture Toughness). Formats for recording the conditions and results of crack propagation tests and stress corrosion tests were designed and utilized during the reporting period.

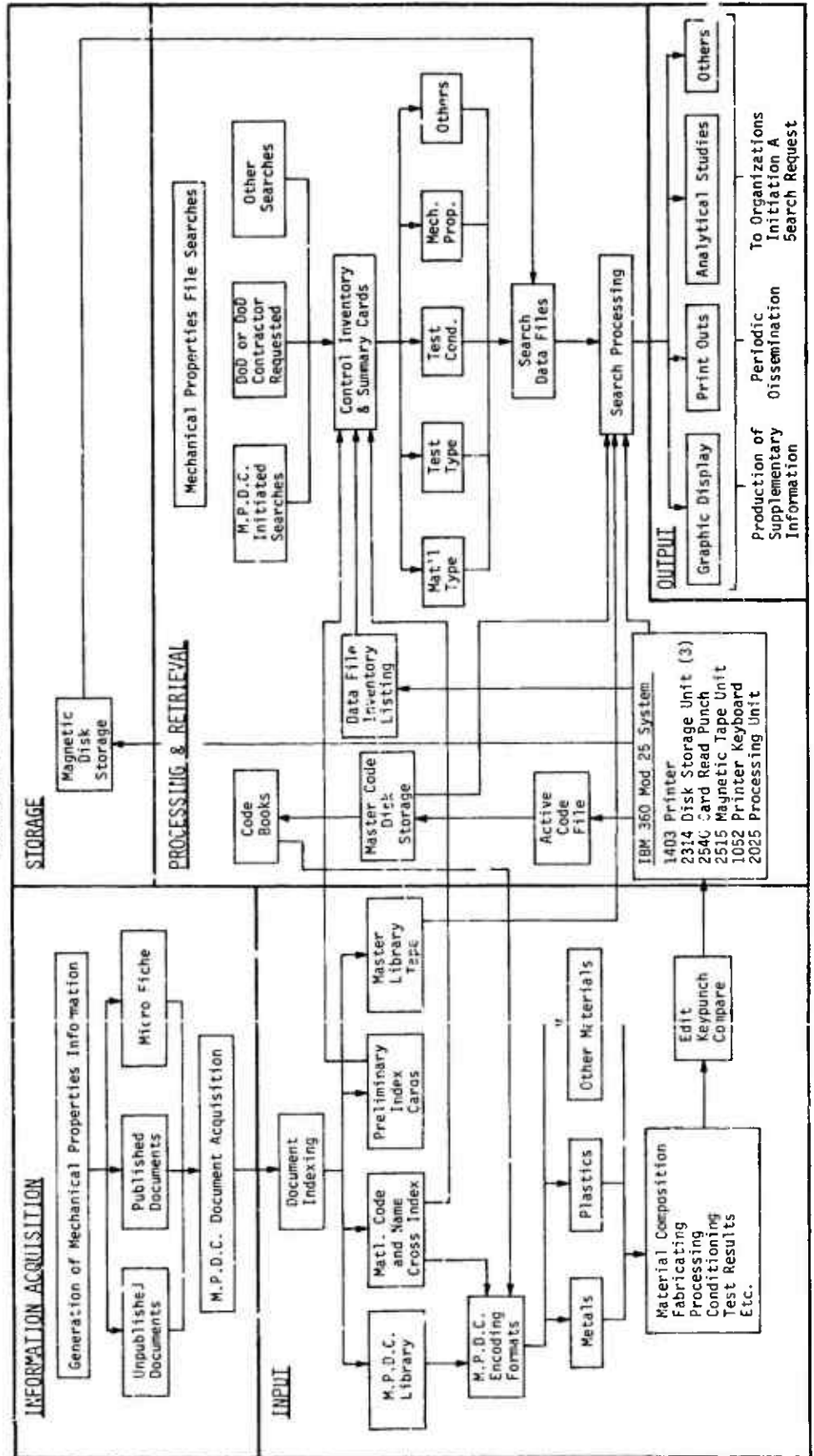
MANAGEMENT

Marketing and Sales - The increased emphasis by DoD that the Information Analysis Centers develop marketing-sales programs to satisfy increasingly higher rates of reimbursement is not difficult to comprehend, however, the implementation of a significant promotional effort can be sustained only if it produces sales immediately since current budgets are fixed or decreasing.

This Center had as its goal "a rate of reimbursement equal to at least 50% of the initial contract funding". This goal was met and exceeded. As previously stated, sales amounted to nearly 60% of initial funding and receipts of 57%. The difference between sales and receipts is made up of delayed payments, proforma billings and bad debts. Sales included funds received from NASA for partial support of the Aerospace Structural Metals Handbook effort, the balance came from the sale of Handbooks and data services.

The Center investigated several methods of marketing products and services, including the National Technical Information Service, commercial publishers of technical information and an in-house effort. The decision to retain and upgrade the in-house marketing effort was reached with considerable difficulty. NTIS and the commercial technical publishers are

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obviously organized for the sole purpose of distributing technical information and must be seriously considered. However, normal publishing and distribution practices including cost of distribution, length of response time, distribution schedules and user-publisher contacts are not compatible with established Data Center procedures. Further, an estimate of the Handbook market, by publishers, indicates that MPDC is presently serving 70-80% of the potential market. Since most publishers expect exclusive sales rights the advantages to MPDC of such an arrangement are marginal, at best. A pending agreement with National Technical Information Service appears to provide a satisfactory working arrangement to supplement the in-house marketing effort for published information (handbooks), however, it is unlikely that search services can benefit appreciably from any middleman participation other than referral to the Center. The necessity for quick response and discussion of specific needs between user and searcher (materials technician) are essential.

The in-house marketing program included a manned display at the ASM Metals Show (Detroit, October 1971) and a regular mail campaign. Ten promotional mailings were accomplished: 4 to handbook holders, 1 to a purchased list (metallurgists), 2 to previous users of the search service and one each to mailing lists developed from the Dissemination Authority List (DDC-DAL), Materials Engineering - Materials Selector Buyers Guide and the World Aviation Directory. Five different mailing pieces were utilized separately and in combination for the promotional mailings. These pieces included ASMH sales brochures, Inventory Reports 716 and 730, MPDC Search Service User Guide and form letters. Approximately 9,700 individual mailings were made. Additionally, 50 management level people in aerospace or defense contractor organizations were contacted by special letters to encourage the establishment of deposit accounts with MPDC for the convenience of their engineering groups. A 36% response was received. Most respondents indicated that they preferred to pay for products and services at the time the costs are incurred. No deposit accounts were established.

Other Activities - MPDC is constantly seeking new applications for the existing data information base. Among those organizations with which we

have been in contact are Atomic Energy Commission, Computing and Software, Inc., Japan Society for Promotion of Machine Industry, National Aeronautics and Space Administration, National Bureau of Standards, National Technical Information Service (NTIS), Plenum Press, and Wiley Interscience. Of these, NTIS and Computing and Software, Inc. are continuing discussions regarding new and existing products. Both organizations are extremely interested in the new Structural Alloys Handbook. Computing and Software, Inc. is also evaluating the market potential of an alloy cross-index based on over 12,000 structural metals and alloys identified and classified in the MPDC data system.

Distribution of Effort - Table IV presents the distribution of effort in major work areas and the distribution by classification. The distribution does not include effort expended in the development of the new Structural Alloys Handbook.

CONCLUSIONS AND RECOMMENDATIONS

The Mechanical Properties Data Center did meet or exceed all the requirements of the contract including the sales goal. Although search activity has not returned to the levels attained prior to the initiation of service charges (March 1966), use by non-government organizations is increasing. The mechanics of purchasing seems to be the biggest deterrent to use of the search service by government organizations.

The availability of a new handbook to serve another segment of industry provides additional potential to increase the income from sales and expand the measure of self-support.

TABLE IV
DISTRIBUTION OF EFFORT

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<u>Classification</u>	<u>Man Hours Expended</u>	<u>% of Total</u>
Engineering & Management	2,244.5	15.5
Materials Technician	8,352.0	57.8
Data Processing Technician	2,276.5	15.7
Clerical	1,594.8	11.0
	14,467.8	100.0

<u>Major Work Area</u>	<u>Man Hours Expended</u>	<u>% of Total</u>
Data Acquisition & Input	6,048.7	41.8
Data File Maintenance	1,646.5	4.5
Data & Information Output	5,201.6	36.0
Systems Development	175.0	1.0
Management	1,831.0	12.7
Marketing & Sales	565.0	4.0
	14,467.8	100.0

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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>
August 1971	10	12	7
September 1971	4	5	5
October 1971	11	17	7
November 1971	6	15	6
December 1971	5	20	19
January 1972	13	21	8
February 1972	3	5	7
March 1972	5	17	13
April 1972	6	6	7
May 1972	10	30	4
June 1972	5	20	7
July 1972	<u>5</u>	<u>12</u>	<u>8</u>
	83	180	99

APPENDIX I

A Summary of Inquiry
and
Search Responses
Part II

<u>Organization</u>	<u>Inquiries</u>	<u>Searches</u>
Aerojet Liquid Rocket Sacramento, California 95813	1	1
American Weld & Mfg. Company Warren, Ohio	1	2
Ampex Corporation Redwood City, California 94063	1	1
Atlas Crankshaft Corporation Fostoria, Ohio 44830	1	1
Atomic Energy Commission Roskilde, Denmark	1	1
Babcock & Wilcox Alliance, Ohio 44601	4	21
B.F. Goodrich Avon Lake, Ohio 44012	1	1
Bomco, Inc. Cloucester, Mass. 01930	1	1
Cameron Iron Works Houston, Texas 77001	1	6
Chrysler Defense Engineering Centerline, Michigan 48015	1	1
Detroit Diesel Allison Division of General Motors Indianapolis, Indiana 46206	2	3
Douglas Aircraft Long Beach, California 90801	2	4

Part II (continued)

<u>Organization</u>	<u>Inquiries</u>	<u>Searches</u>
Dresser Industries Dallas, Texas 75224	1	2
Engis Corporation Morton Grove, Illinois 60053	1	1
General Dynamics Fort Worth, Texas 76101	1	6
General Electric Company Erie, Pennsylvania 16501	1	1
General Electric Company Gas Turbine Products Div. Schenectady, New York 12345	1	3
General Electric Company Sunnyvale, California 94086	1	1
Gleason Works Rochester, New York 14650	1	1
Honeywell, Inc. Hopkins, Minn. 55343	1	6
Hughes Aircraft Culver City, California 90230	1	1
IBM Rochester, Minnesota	1	2
Kaman Aerospace Corporation Bloomfield, Connecticut 06095	1	1
Northrup Corporation Hawthorne, California 90250	1	1
Pechiney Development New York, New York 10022	2	2
Pressure Science Inc. Beltsville, Maryland 20705	2	2
Raytheon Company Burlington, Massachusetts 01803	1	2
Rocketdyne Canoga Park, California 91304	2	2

Part II (continued)

<u>Organization</u>	<u>Inquiries</u>	<u>Searches</u>
Rocket Research Corporation Redmond, Washington 98033	1	1
Sikorsky Aircraft Stratford, Connecticut 06602	5	9
T.R.W. Systems Redondo Beach, California 90278	1	1
Technology, Inc. Dayton, Ohio 45431	1	1
Thomas & Betts Company Elizabethtown, New Jersey 07207	1	1
University of Cincinnati Cincinnati, Ohio 45221	1	8
Vought Aeronautics Company LTV Aerospace Corporation Dallas, Texas 75222	1	1
Xaloy, Inc. New Brunswick, New Jersey 08903	1	1

Part II (continued)

GOVERNMENT AGENCIES & NON-PROFIT ORGANIZATIONS

<u>Organization</u>	<u>Inquiries</u>	<u>Searches</u>
Air Force Materials Laboratory		
Dugger	1	3
Horne	1	1
AFFDL/FYS	1	2
Wright Patterson AFB, Ohio 45433		
Army Aviation Systems Command	1	1
St. Louis, Missouri 36166		
Arnold Research Organization	1	1
Arnold AFB, Tenn. 37389		
Battelle Northwest	1	1
Richland, Washington		
Department of Army	1	1
Army Materials & Mechanics Research Center		
Watertown, Massachusetts 02172		
Lawrence Radiation Lab	1	5
Livermore, California 94550		
Metals & Ceramics Information Center	2	35
Battelle Columbus		
Columbus, Ohio 43201		
Redstone Arsenal	1	1
Huntsville, Alabama 35809		
Thermophysical Properties Research Center	1	1
W. Lafayette, Indiana		
<u>MECHANICAL PROPERTIES DATA CENTER</u>		
Aerospace Structural Metals Handbook	19	23
Inventory, Belfour Stulen, Inc.	2	2
Metals Show, Mechanical Properties	2	3
Data Center		