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A Materials Information Data Bank

Keith E. Mead



Sandia Laboratories

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A MATERIALS INFORMATION DATA BANK

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ABSTRACT

A major concern in the design of weapons systems is compatibility of materials with each other and with the enclosed environment. Usually these systems require long-term storage and must have high reliability at the end of this storage period. Materials selection is thus based on past experience and on laboratory-accelerated testing to assure this long-term reliability.

To assist in materials selection, a computerized materials data bank has been established. In addition to references on personnel and documents, this data bank provides annotated information on materials so that the designer and materials engineer can draw on it for guidance in selecting materials. The primary purpose of the data bank is to provide materials compatibility data. However, the structure of the system permits the data bank to be used for storage and retrieval of general materials information.

The data bank storage and information retrieval philosophy is discussed and procedures for information gathering are outlined. Examples of data entries and a list of search routines are presented to demonstrate the usefulness and versatility of the system.

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A MATERIALS INFORMATION DATA BANK

I - INTRODUCTION

Background

The materials in many current designs must be sufficiently compatible to assure proper system function after very long storage. The weapons systems must provide immediate and satisfactory performance on demand even at the end of storage life. Design organizations have the prime responsibility for selecting materials and processes used in their designs; the materials organization supports them in selecting these materials and in verifying their compatibility. The quality assurance organization is responsible for determining that quality remains satisfactory during storage. A computerized data bank has been initiated to provide a common data storage location and a retrieval source of materials data; emphasis is on compatibility information for the laboratory staff.

Purpose

This document is an interim guide to the materials information data bank. It is interim because evolution of input and retrieval capabilities is expected with expanded content and use of the bank.

The materials data bank makes available to materials specialists, designers, and Quality Assurance engineers data on materials compatibility testing as well as data on individual materials. Its operation and use will be a cooperative effort between Quality Assurance, Materials, and Design personnel. A major goal for the data bank is to accumulate references to materials compatibility data developed from design investigations and from stockpile experience. Although emphasis will be on compatibility, the data bank will contain general materials information and will be referred to as a Materials Information Data Bank.

Past Experience

In the past, materials compatibility information was gathered by design engineers through document research, telephone inquiries with those who might have the information, and consultations with material specialists. Sometimes experimental evaluations have been carried out but most of them have applied to single weapon systems. No standard practice has been used for documenting weapons evaluations or research, nor has there been a central information source.

Improvement

The materials data bank is an improvement in information control and dissemination because it will

1. Enable one to retrieve copies of memoranda and documents which pertain to materials evaluations contained in the bank and which have been entered by participating organizations
2. Provide a materials data record that spans personnel changes
3. Provide a list of material combinations that should not be used under certain, also specified, conditions
4. Assist in selection by providing properties of single materials and compatibility data for material combinations
5. Aid in the search for groups of materials with the same generic characteristics
6. Provide a list of material combinations that have been successfully applied
7. Allow, as the bank grows, direct interrogation of its contents
8. Provide access to materials data pertinent to Sandia's needs but which are generated outside the Laboratories; as is practical, outside data will be acquired and placed in the bank

II - GENERAL THEORY OF OPERATION

Gathering and preparing input information into a uniform format requires the efforts of many members of the staff: Designers, Quality Assurance engineers, and Materials Laboratory personnel. A uniform material nomenclature system and entry forms are described in detail below. The mechanics of data accumulation and entry into the bank are summarized in Figure 1. This data bank is a service to the staff; the staff is not to be the slave of the bank. Therefore, to provide versatility in recovering information from the data bank, input, to be described in detail later, has been made as simple as practical.

The three boxes labeled A in Figure 1 represent central control of the data bank in the Materials Laboratory by way of the compatibility coordinators. Persons represented by circles B are the primary sources for input information. The Materials Liaison Engineer theoretically works with the designer from design inception. The Quality Assurance Engineer also work with the designer from the early stages of the design on through stockpile life. These people guide the evolution of the design, plan environmental and compatibility tests, and evaluate results used to

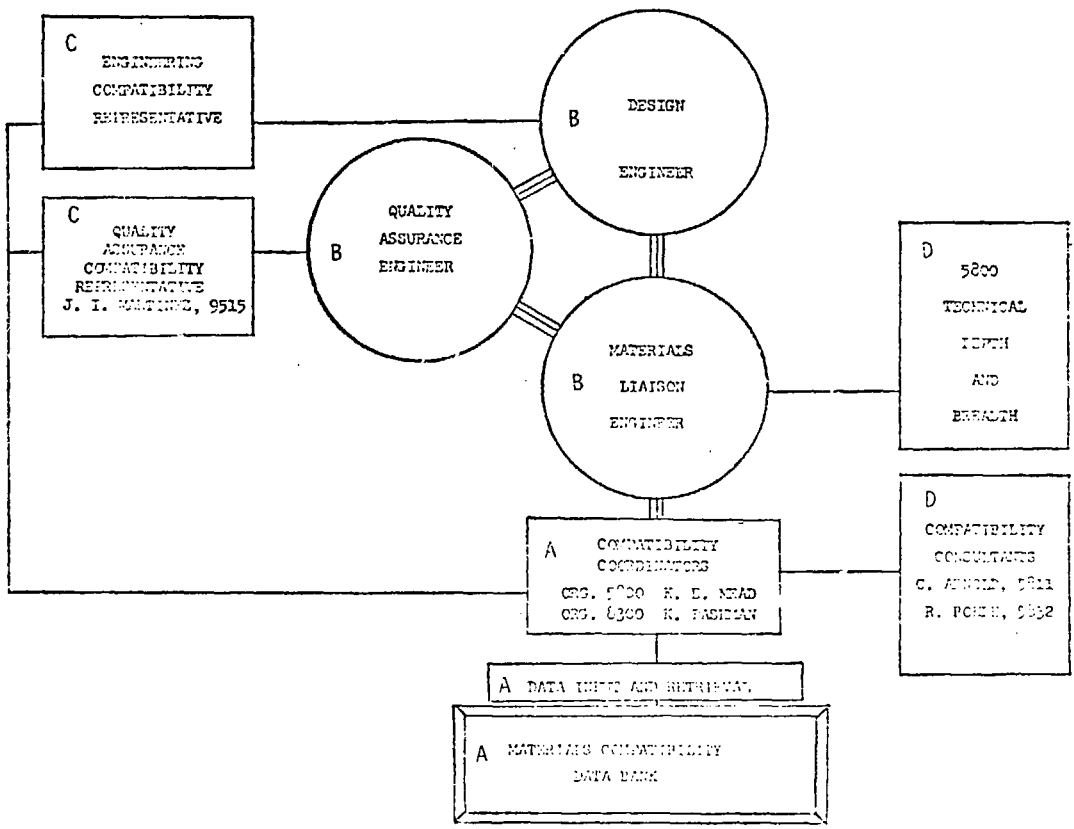


Figure 1. Mechanics of Data Accumulation and Entry

qualify materials choices and predict stockpile health. Boxes labeled C represent Quality Assurance and Design personnel who have been specifically assigned compatibility responsibility. Their function is to cooperate with the Materials Laboratory Compatibility Coordinators to feed information into and retrieve it from the data bank. Boxes labeled D represent technical support from various material disciplines.

An important function not shown in the diagram will be liaison engineers from the Materials and Processes Directorate, 5800 helping Quality Assurance select materials evaluation techniques used in stockpile examinations. The 5800 liaison engineers will do this by obtaining support from materials specialists in the most practical quantitative evaluation techniques.

It is important that materials be examined for any change in characteristics due to aging so that compatibility problems can be identified. Results will determine where study is needed to assure materials compatibility, and the data would be entered into the bank to aid future design.

The important idea in this scheme is that Design engineers, Quality Assurance engineers, and Materials engineers will be personally reviewing information and putting it into the proper format to enter into a data bank. This bank can then help them build better weapons systems.

The data bank does not contain detailed data; rather, it contains a searchable, comprehensive index of summarized results of material tests. Each test results document is assigned a reference number. When queried, the data bank recovers reference numbers which represent documents containing test results. Copies of the documents themselves are available when requested. To enter information, prepared input, along with a copy of the document containing the data, is submitted to the Materials Compatibility Coordinating Group (representatives from 5800, 8310, 9500, and Design Organizations, boxes A and C in Figure 1). With the assistance of people knowledgeable in appropriate disciplines, this group will review prepared entries to assure technical clarity and conformance to nomenclature. The entries will then be placed in the bank.

The data bank is not open to the public; classified material names and applications will be coded before entry. The code will be controlled by coordinators to minimize its dispersion and potential compromise.

The following records will be maintained by the Materials Compatibility Coordinating Group:

1. A log of reference numbers and titles
2. An alphabetized index of all material names in the bank
3. A file copy of each reference with microfiche for reproduction

Operational administration of data input to the Materials Information Data Bank is the responsibility of Data Planning Division 9625 and Data Operations Division 9626; programming and maintenance is done by Engineering Support Systems Development Division 2622.

III - OPERATIONAL PROCEDURE

Preparation of Input Information

Entries are prepared by entering appropriate information in the two forms described in detail in SAND77-0735 - Supplement A. The titles of the forms are:

1. SA7195-VFC (12-77) NEW MATERIAL RECORD (prepared only by Materials Laboratory personnel).
2. SA7195-VFB (2-78) TEST SUMMARY RECORD and ADDITIONS TO DATA IN FILE (prepared by the test engineer or author).

The NEW MATERIAL RECORD defines a material by four entries that include the material name and synonyms, the material category or generic descriptors, material contents, and, where applicable, the material formula. Figure 2 is an example of a NEW MATERIAL RECORD. This record is prepared by Materials Laboratory personnel.

The second form involves two sets of information and is prepared by the author of the document which is being entered into the bank. One side of this form, ADDITIONS TO DATA IN FILE, identifies the application of the materials referred to in the document being entered and the form or functional use of each material. The other side of this form, TEST SUMMARY RECORD, identifies the DOE laboratory, test organization, test engineer, the prime materials involved, and an abstract of the document. Figure 3 is an example of ADDITIONS TO DATA IN FILE and Figure 4 shows a TEST SUMMARY RECORD.

Organization 5811, which controls the data bank, assigns the material and reference numbers shown in the sample entries. These numbers are the means by which the computer organizes the input and searches for output.

Procedure for Information Retrieval

During the early life of the data bank, retrieval will be by request through compatibility coordinators. As data becomes extensive and the probability of retrieving useful information increases along with confidence in the program, direct retrieval by engineers will be permitted.

date:

to: Materials Compatibility Coordinating Group (MCCG) - 5810

from:

re: New Material Record (one-time entry)

Test Report Title

and Date: 4/20/77

Please note that shaded areas are for MCCG use.

Complete instructions for entries are printed on reverse side.

	material prime name and synonyms
11	NM05502 TITANIUM: 6AL-6V-2SN; DUPLEX ANNEAL, TI
	6AL-6V-2SN, TI 6-6-2,
12	
	material category - generic description
21	NM05502 INORGANIC, SOLID, METAL, CRYSTALLINE, ALL
	TY, ELECTRICAL COND., STRUCTURE,
22	
	formula - pure material only
31	NM05502 N/A.
32	
	contents - alloys and mixtures only
41	NM05502 TI, 6AL, 6V, 2SN,
42	

Figure 2. Sample Entries: NEW MATERIAL RECORD

date:

to: Materials Compatibility Coordinating Group (MCCG) - 5810

from:

re: Test Reference Additions to Data in File,

Sheet **1** of **1**

Test report title **B77 Structural Design Materials**
and date: **Review Meeting, Sept. 8-10, 1976**

Please note that shaded areas are for MCCG use.
Complete instructions for entries are printed on reverse side.

1. Material name: **TITANIUM: 6AL-6V-2SN; DUPLEX ANNEAL,**

material number	test reference number	material application (final as'y, subassy)
51NM05502R	770329CCMHWTT,	
form or functional use of the material as tested	MID CASE,	

2. Material name: **NICKEL**

51NM04501	keypunch: repeat from entry for material no. 1.
form or functional use of the material as tested	WIRE

3. Material name: **STAINLESS STEEL: 304; 0.5H,**

51NM01001	keypunch: repeat from entry for material no. 1.
form or functional use of the material as tested	ROD,

4. Material name: **GOLD,**

51NM07001	keypunch: repeat from entry for material no. 1.
form or functional use of the material as tested	

5. Material name: **COPPER,**

51NM07003	keypunch: repeat from entry for material no. 1.
form or functional use of the material as tested	

6. Material name: **IRON: 9NI-AC0-0.2C,**

51NM00002	keypunch: repeat from entry for material no. 1.
form or functional use of the material as tested	SHEET,

Figure 3. Sample Entries: ADDITIONS TO DATA IN FILE

date:

to: Materials Compatibility Coordinating Group (MCCG) - 5810

from:

re: Test Summary Record

Test Report Title **B77 Structural Design & Materials**
and Date: **Review Meeting, Sept. 8-10, 1976**

Please note that shaded areas are for MCCG use.

Complete instructions for entries are printed on reverse side.

test reference number				yr	mo	da	+	month	day	year	ordr	lab	org.	engineer (last name, first, initial)
61	W	R	7											
61	W	R	7	70	3	29	C	C	M	S	L	A	5831	POHLMAN, S.L.
Comment on test status.														
PRELIM DESIGN														
List each of the materials or conditions included in this test. Use the remaining space for comment(s) on test result.														
62	TITANIUM: 6AL-6V-2SN; DUPLEX ANNEAL													
63	, NICKEL, STAINLESS STEEL: 304; 0.5N													
64	GOLD: ELECTROPLATE, COPPER, IRON: 9N													
65	I-ACD-0.2C,													
	SALT SPRAY TEST IN 5 PCT NACL AT													
	32 DEG C,													

NOTE:

List pertinent Material and Process Specification numbers below.

Please identify each specification number with the material it controls.

1. Ti-6Al-6V-2Sn - ASTM B381
2. Ni per 7900303
3. 304SS per 7340422
4. Gold electroplate MIL-G-45204
5. Copper per QQ-C-502
6. Steel 9-4-20 AMS 62CF or 65CD
- 7.
- 8.
- 9.
- 10.

Figure 4. Sample Entries: TEST SUMMARY RECORD

Retrieval will be either interactive for small amounts of information or batch for more lengthy output. Information retrieved from the data bank should be interpreted cautiously. A reference indicating that materials are either compatible or incompatible represents the conclusion of the test engineer and then only under the conditions and environment of his test. Interpreting information with respect to particular needs may require consulting with Materials Laboratory personnel.

Table 1 is a listing of information retrieval routines. The list provides a versatile set of routines for directing retrieval toward either broad or specific interests; all routines listed are functional. Examples of retrieved information are included in Supplement A to this document: SAND77-0735 - Supplement A.

TABLE 1
Information Retrieval Routines

<u>Program Name</u>	<u>Priority</u>	<u>Program Function</u>	<u>Prg Mode*</u>	<u>Processing Frequency</u>
FILEIT	1	Edit changes; update MCSIS data base; create backup magnetic tape.	B	Weekly
RESTORE	2	Recover MCSIS data base from backup magnetic.	B	As required
ALLDUMP	3	Dump entire MCSIS data base on printer.	I/B	As required
MENU	4	Provide menu of query programs with callup capabilities.	I	Daily
DUMPTT	5	For a specific material name, list one or more levels of information (including test summaries).	I	As required
DUMPAIR	6	For specific pairs of materials, retrieve common test summaries.	I	As required
DUMPNON	7	For specific material, list all associated noncompatible material and properties.	I	As required
ALLNAME	8	Generate a listing of all material prime names (alphabetic order) with associated material control number.	I/B	As required
ALLBAD-1	9	List by material prime name (alphabetic order) all nonconforming tests.	I/B	As required
ALLBAD-2	10	List all noncompatible tests (test reference number order) with associated material prime names.	I/B	As required
ALLAPPL	11	List all material prime names associated with each application.	I/B	As required
ALLTEST	12	List all test summaries in MCSIS data base (test reference number order).	I/B	As required
DUMPCAT	13	For specific material category, list associated material names (alphabetic order).	I	As required
DUMPUSE	14	Given a specific material form or use, list all associated material names (alphabetic order).	I	As required
DUMPCON	15	Given a specific Content, list all materials (alphabetic order) containing that Contents.	I	As required
DUMPAPL	16	Given a specific application, list all associated material names (alphabetic order) and test reference numbers.	I	As required
DUMPTR	17	Given Lab/organization/engineer, list all associated test reference numbers.	I	As required

*B - Batch, I - Interactive, I/B - Initiate batch from I term

The supplement contains the following detailed information.

1. Forms and Instructions for the Preparation and Entry of Materials Information; Sample Entries.
2. Information Retrieval Routines.
3. Examples of Information Retrieval Routines.
4. MATERIALS COMPATIBILITY INFORMATION SYSTEM (Includes a Data Input Flow Chart and Systems Procedure.)