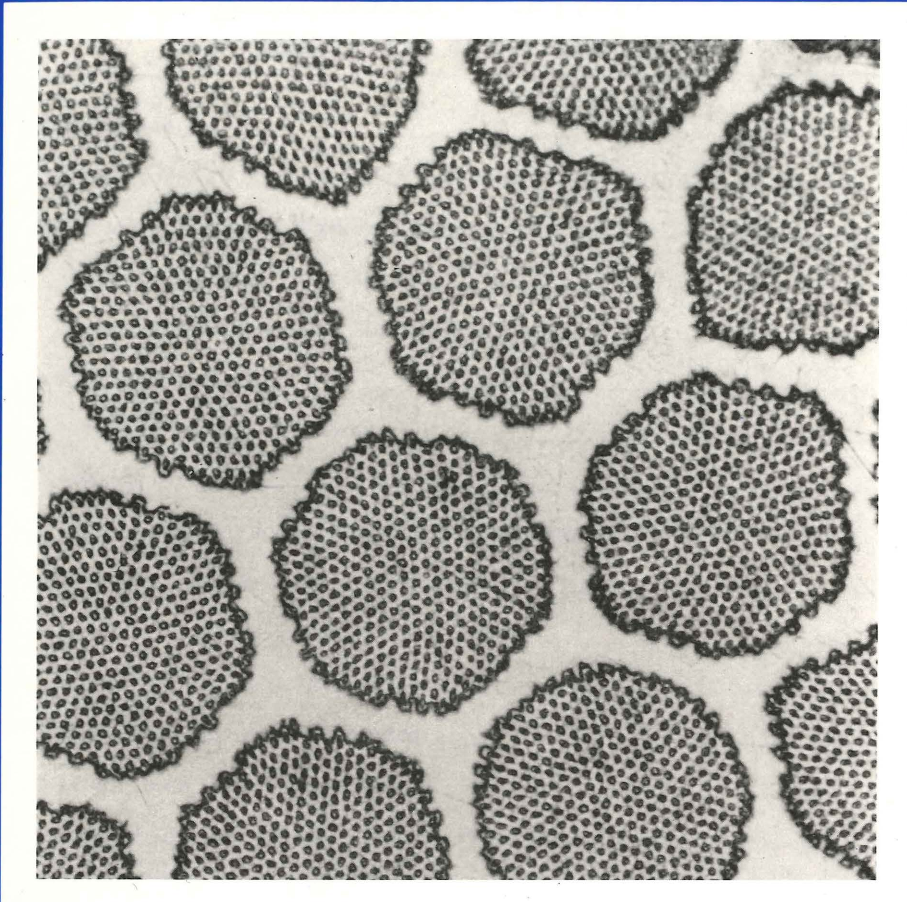
VAMAS



BULLETIN NO. 8

July 1988

Versailles Project on Advanced Materials and Standards
Canada • France • FR Germany • Italy • Japan • UK • USA • CEC

REF

[NPL COLLECTION]
GLASS CASE

Cover: Cross-section of Japanese Nb_3Sn multifilamentary wire being used in VAMAS round robin critical current measurements. The wire is composed of 11191 filaments, each 5 micrometres in diameter. Photograph courtesy of Prof. Tachikawa, Chairman of the Superconducting and Cryogenic Structural Materials Technical Working Party.

VAMAS

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EXPANDED VAMAS ACTIVITY ON MATERIALS DATABANKS

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During the past two years, VAMAS has been examining the issues related to developing standards for building and using materials databases. VAMAS Working Group 10 has issued (July 1987) a comprehensive report[1] that makes recommendations for action. This article briefly summarizes these recommendations and discusses three new projects being started by VAMAS in this area, namely:

1. An Inventory of Materials Designation Systems
2. An Interlaboratory Comparison of Data Evaluation Methods
3. The VAMAS Workshop on Standards for Materials Databanks

VAMAS Report on Factual Materials Databanks - The Need for Standards

Standards play an important role in building and accessing materials databanks for two key reasons:

1. The performance properties and designation of engineering materials are generally not defined simply by fundamental scientific laws and principles but also by procedures and practices that have been codified as standard tests. Consequently, information related to these standard tests must be adapted to computerization.
2. The interconnection of computer equipment and software has been so hampered by proprietary concerns that mutually agreeable practices have become necessary.

In a field as young and as dynamic as materials databanks, it is ironic that one must turn to standards so soon. But the little experience we have forces us down this course. Of the few publicly available materials databanks, no two are compatible in any respect—software, user interface, data representation, terminology, or databank commands. The lack of compatibility significantly decreases their utility.

Recommendations about standards actions have been divided according to the area of data activity impacted. These areas include data generation, data presentation or preparation, and data access. A summary of needed standards is given in Table 1.

1. Factual Materials Databanks - The Need for Standards, H. Kröckel, K. Reynard, and J. Rumble, VAMAS Technical Working Area 10, July 1987 (Available from National Bureau of Standards, A323 Physics Building, Gaithersburg, MD 20899)

Table 1. SUMMARY OF NEEDED STANDARDS FOR MATERIALS DATABANKS

DATA ACTIVITY	TYPES OF STANDARDS
Generation	Collection of materials data, full description of: material specimen microstructure heat treatment and other processing test methods and variations data purpose of data generation
Analysis	Analytical techniques, their description, and variations
Presentation	Materials databank building, complete description of all items including: materials, properties, test methods data representation (points, fits) data quality and error estimates data values and units tabular and graphical layouts
Access	Indexed information for each databank, based on allowed queries including: materials and their equivalency properties and equivalencies uniform units and autoconversion data location (across databanks) thesauri, definitions, and other metadata range of data values Computer networking and distributed databanks
Applications	Interfaces to other software, CAD, expert systems and simulators

As a prestandardization organization, VAMAS is in a unique position to encourage collaboration and consolidation of ideas and priorities held by different countries. Consequently, VAMAS has not been content simply to send its report on materials databank standards to potentially interested groups and step back. VAMAS has taken several actions to collaborate with standards-setting bodies and provide them with further background information crucial to quality standards. These are discussed below.

What Is a Material ?

The information in materials databanks is almost always keyed to a particular material, for example, the properties of stainless steel. Users of materials databanks must therefore be able to perform two important tasks: 1) locate a given material and 2) determine whether two materials are equivalent.

Locating a given material means that the user knows which specific material is involved. Determining materials equivalency is equally important because, if established, then different data sets can be combined, resulting in more useful information. Materials databases must allow users to enter and search for relevant pieces of information that go into materials designation and support these two functions.

Engineering materials are not a single pure phase with unique chemical constituents but rather are a complicated mixture that usually is not described completely on a microscopic level. Because of that, the macroscopic descriptions are used that instead cover a range of microscopic parameters.

Unfortunately, for different situations different macroscopic descriptions have been found useful. The result is that, for most engineering materials, multiple designation systems are in use. Databanks could in fact easily handle the translation between different description or designation systems if there were a unique correspondence between the different elements and if the level of detail were the same in every situation. But that is not usually the case. The situation is complicated by the fact that each country uses its own designation system. Moreover, systems for composites, ceramics, and polymers are much less developed than those for metals and alloys.

Materials Designation System - What VAMAS Is Doing

VAMAS has started a prestandardization project under the leadership of Dr. Keith Reynard of the U.K. to identify, catalogue, and describe the major designation systems for engineering materials. This first worldwide inventory of materials designation systems will then be made available to various standards organizations, both national and international, that are developing or reconciling these systems. Contributions to this catalog are welcome, and interested parties should contact Dr. Reynard directly.

Evaluating Materials Data - What Goes Into Databanks

Unlike most physical and chemical data, which correspond to intrinsic properties, data on engineering materials result from standardized tests that try to mimic the performance under a given set of service conditions. Further, because of the large number of independent variables involved in these tests, considerable data analysis is often necessary before data usable by designers and materials selectors can be obtained.

The same data can be analyzed in different ways and the same analyses can be implemented differently, for example, by different computer codes. If data are reported ostensibly resulting from the same analysis, but are, in fact, from different implementation of that analysis, then databanks users can easily be misled as to their validity. Interlaboratory comparison of data evaluation methods for materials databanks will become more important as more databanks are prepared.

Data Evaluation - What VAMAS Is Doing

A round-robin comparison of data evaluation methods for creep and fatigue data for steel alloys will be undertaken, led by S. Nishijima of Japan. The purpose of this international collaborative program is to point out and to quantify the potential problems and discrepancies of "well-accepted" data evaluation methods and the need to establish more standardized methods.

The National Research Institute for Metals will supply raw materials data, both well-balanced and ill-natured. Creep-rupture and strain-time data for a Cr-Mo steel and Alloy 800H will form one set. The other set will include large-cycle fatigue and crack propagation rate data for a welded joint and structural steel. For further information, please contact Dr. Nishijima.

The VAMAS Workshop on Standards for Materials Databanks

Other prestandardization work for materials databanks will be needed in the future. The above two projects have been started to determine how such projects can best be carried out on an international basis.

To determine other actions, a VAMAS Workshop on Standards for Materials Databanks will be held at the Joint Research Centre in Petten, The Netherlands, on November 15-17, 1988.

The purpose of this workshop is to determine practicable standardization actions needed to develop useful and compatible materials databanks. The meeting will bring together interested parties to draw a consensus on needs and priorities to be acted upon by new and existing international and national standards groups. Attendees will represent materials databank builders and networks, national standards organizations, and engineering users in industry and research.

The primary goal will be the development of an action plan as reached by a consensus of the attendees and the organizations they represent.

The meeting will cover the following topics:

- What refinement is needed for existing materials and materials testing standards because of database building?
- How will needed standards be generated?
- How can harmonization between existing and new standards be accomplished, on a national, regional, and international basis?

The means for achieving the above will also be discussed:

- How are national or industrial standards organizations to do this work?
- How can cooperation be fostered on an international basis, e.g., through ISO, CEN, CENELEC, ASTM, or other basis?
- What is the present activity on standards for materials databanks?

The purpose of standards is to make materials databank building easier, to promote compatibility between related databanks built by different groups, and to improve the usefulness to engineering users. Because every industrial country will have public and private groups building materials databanks, standards organizations in these countries will also be concerned with developing standards relevant to their country's interest. Materials are an international economy and materials databanks will also be. Therefore, the materials community must discourage the development of incompatible standards, which would confuse rather than resolve problems in trade.

It is hoped that this workshop will address these problems by promoting awareness and cooperation between different standards groups. Further information on these activities can be obtained by contacting the Working Group Chairman.

• TECHNICAL WORKING AREAS •

Technical Working Area 1

WEAR TEST METHODS

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Based on the results of the meeting of the National Representatives at BAM, Berlin, October 1987, a second round robin intercomparison was initiated. In this intercomparison, the friction and wear behavior of ceramics (silicon-nitride, alumina) and steel will be studied. Essentially the same operating conditions have been chosen as in the first round. Additionally, three wear track diameters have been specified in order to allow participants to perform experiments at a higher load (50N) and under varied relative humidity.

Fifty sets of specimens were sent to participating laboratories in all Economic Summit countries. In addition, upon special request, samples were also sent to laboratories in Denmark (member of the European Communities) and Finland. Following experience from the evaluation of the first round robin, the procedure of reporting the results has been facilitated by supplying an evaluation sheet. The idea for this evaluation sheet stemmed from an evaluation sheet of the Ceramics Technical Working Party.

During the forthcoming months results of the second round robin intercomparison will be evaluated. The results from the laboratories will be discussed and compared with those of the first round robin. The next meeting of the National Representatives is tentatively scheduled to take place at the National Physical Laboratory (NPL) in Teddington, UK, early in December 1988 in connection with a conference at NPL on "Wear Testing of Ceramics - Test Methods and Mechanisms".

Technical Working Area 2

SURFACE CHEMICAL ANALYSIS

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A major aspect of the construction and use of advanced materials involves the design and control of properties at materials surfaces and interfaces. Surface chemical analysis (SCA) therefore plays a major role in this sector in the VAMAS member states. The power of SCA in developing and assessing advanced materials is well understood and is illustrated by excellent results being obtained in the major laboratories. However, the full power of the techniques is not achieved even in the best laboratories; and most laboratories waste considerable time in developing their own in-house reference procedures, data and materials due to a lack of internationally accepted alternatives. Under VAMAS the SCA TWP has initiated co-ordinated activities, on a scale previously impossible, to remedy this situation.

The SCA activity does not presently address all of the possible surface methods but, instead, focuses on the three most widely used techniques for materials development: Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS) and secondary ion mass spectroscopy (SIMS) together with ion sputtering for depth profile analysis.

The activity currently encompasses 18 focal areas within surface chemical analysis, as shown on Table II, with projects led from all member states. The projects have been initiated throughout the period of existence of the TWP so that some projects, such as projects (1) and (10), are close to completion, whereas projects (2), (9), (16), and (17) are well-advanced and (7), (8) and (14) are in their early stages. In general, in their early stages, individual projects may develop in one member state or even one laboratory and then later on involve other states and other laboratories. Thus project (1) started in one laboratory but involved four member states; projects (2) and (9) again started in one laboratory but has been sent for interlaboratory tests in 90 laboratories throughout all member states; and project (10) has involved discussions with all manufacturers in member states. Some projects such as (7) and (8) make a very rapid transition from concept to main international activity rapidly, whereas others will require a longer gestation. It is in the nature of the overall problem that each project in this new and rapidly developing area will evolve in its own unique manner.

The essential coherence of the overall activity is shown in Fig. 1, which illustrates the way projects are mutually supportive so that the whole is much greater than the sum of the individual parts. Each project is, however, constructed by its leader to be mutually independent; so that no project relies on the successful completion of any other.

Figure 1. INTERACTION DIAGRAM FOR VAMAS SCA TWP PROJECTS

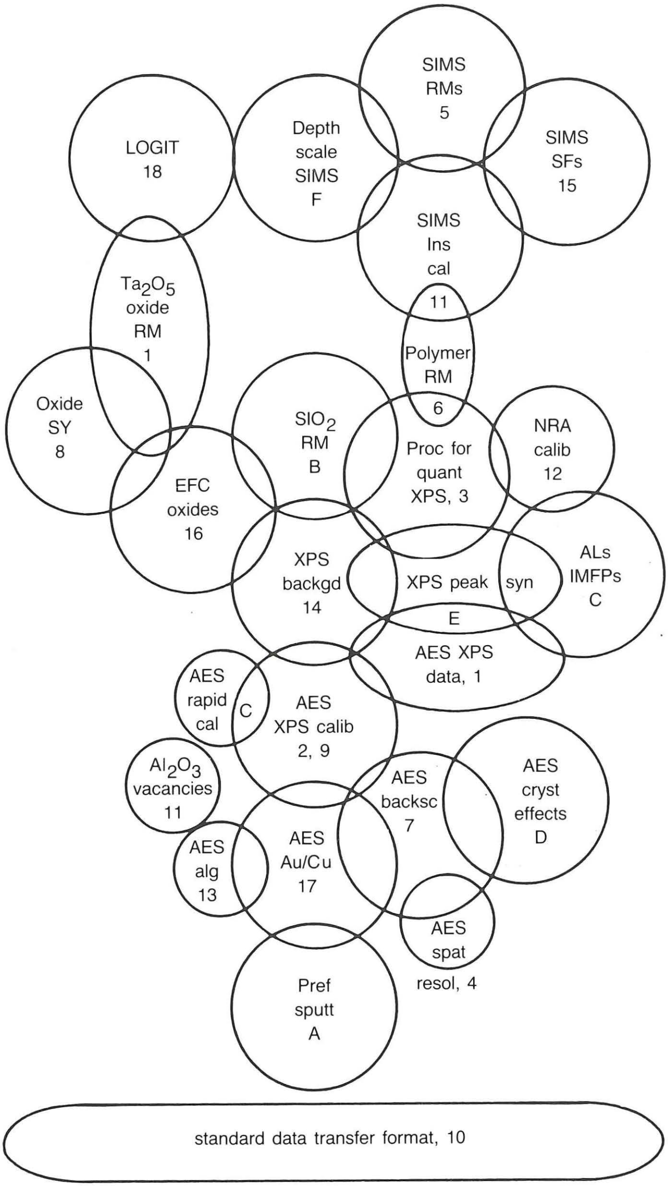

Table 2. PROJECTS IN SURFACE CHEMICAL ANALYSIS

Project No:

1. Development of thin oxide films as reference materials (Seah)

2. Development of calibration data for the energy scales of Auger-electron spectrometers (Seah, Powell)

3. Procedures for quantitative x-ray photoelectron spectroscopy. (Powell)

4. Measurement of spatial resolution in AES (Prutton)

5. Development of reference materials prepared by ion implantation (Gries, Gould)

6. Development of polymer reference materials (Le Gressus)

7. Correction methods for backscattering in AES (Landeron)

8. Reference data for sputtering rates in oxides (Grabke)

9. Intercomparison of Auger-electron energy and intensity measurements (Seah)

10. Development of a standard data transfer format (Seah)

11. Multitechnique characterization of vacancies in alumina (Le Gressus)

12. Calibration of surface layers by nuclear reaction analysis (Davies)

13. Tests of algorithms for data processing in AES (Underhill)

14. Tests of algorithms for data processing in XPS (Tougaard)

15. Evaluation of SIMS sensitivity factors (Anderle)

16. EFC Round Robin of Al/Mg oxides (Marcus)

17. Quantitative AES of Au/Cu alloys (Shimizu)

18. Evaluation of LOGIT, an algorithm for fitting sputter-depth-profile data, for the measurement of interface widths of an NBS thin-film reference material (Fine)

Possible or Proposed Multilateral Activities

Proposed SCA involvement in current CEC projects (Gould)

A. Reproducibility of ion beam sputtering (Seah)

B. Granular and planar SiO_2 reference material for XPS (Tran Minh Duc)

C. Multielement reference material for AES intensity calibration (Seah)

D. Magnitude and origins of crystallinity effects in AES (Bishop, Le Gressus, Morin, Viefhaus)

Projects Under Development

E. Tests of peak synthesis and deconvolution algorithms for data processing in XPS (Carley)

F. Development and test of a procedure to establish on depth scale in SIMS depth profiles (Dowsett)

G. Reference data for electron attenuation lengths and inelastic mean free paths (Powell)

H. Development of methods for instrument alignment and calibration in SIMS (Seah)

I. Databank for Auger-electron and x-ray photoelectron spectra (Powell, Seah)

Technical Working Area 3

CERAMICS

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Two interlaboratory studies have been completed. One study dealt with a characterization of environmental crack growth parameters (dynamic fatigue) and the other with hardness.

1. Interlaboratory Round Robin on Environmental Crack Growth Parameters. (organized by S. W. Freiman and E. R. Fuller, Jr. in NBS, USA)

The purpose of the round-robin activity is to assess methods of determining parameters related to environmentally enhanced crack propagation in advanced ceramic materials. These parameters are needed to assure the long-term reliability of ceramic materials used in structural applications.

The interlaboratory fracture studies measured the crack growth susceptibility, N, of an alumina ceramic to water-enhanced fracture by means of a constant stressing rate test, the so-called "dynamic fatigue" test. The test involved measuring the fracture strength of four-point flexure specimens in water over a wide range of stressing rates to failure. Tests were conducted both with specimens containing a controlled flaw, produced by Vickers indentation, and with "natural" specimens containing only their intrinsic flaw distributions. The alumina specimens were supplied by a French producer, Desmarquest, as flexure bars. A set of 40 specimens was distributed to each of approximately twenty participating laboratories in the USA, the UK, France, the Netherlands, and Japan. Results have been received from sixteen of these laboratories, and analyzed at NBS. Conclusions resulting from a preliminary analysis of the data suggest:

- Due to the extreme importance of testing over a wide range of stressing rates, at least three orders of magnitude are required, with four or more being desirable. Of the twenty participating laboratories only four covered more than three orders of magnitude in stressing rate range, with only one of these laboratories approaching four orders of magnitude. The average N value from these participants was approximately 47.
- Although it is important to test over a wide range of stressing rates, extreme care must be exercised with the faster rates. For most testing machines without a piezoelectric load cell, 100 MPa/s is a practical upper limit for the stressing rate.
- It is considered necessary to measure first the identation strength as a function of indentation load. This allows an indentation load to be chosen for which most of the failures occurred from the intentionally introduced cracks. In addition, fracture mechanics analysis of these pre-data will allow one to assess whether there are other stresses in the system that are not being considered.
- It is not possible to assess the agreement between indented and "natural" specimens because of the limited range of stressing rates used by the majority of participants. However, the consensus of the participants, with a few exemptions, is that indented specimens are preferred.

2. Hardness Testing of Ceramics Round Robin (organized by R. Morrell, in NPL-UK).

A preliminary analysis of the twenty sets of data from the round robin of testing on two alumina ceramics (supplied by British procedures) has been made. This shows that in microhardness testing there is a considerable scatter in mean results which would not be acceptable in a test against a specification. Typical differences in measurement of perceived indentation size between participants are about 5 percent in the means of ten results. The differences may be random or due to differences in measurement criterion. These differences contribute to at least 10 percent uncertainly in apparent mean hardness number.

In marcohardness testing using Vickers indentation, the percentage deviations were smaller, but limitations due to unacceptable cracking and fragmentation became more apparent, especially in the coarser grained of the materials. In Rockwell superficial HR45N testing, there were significant deviations in some test results. Since operator criteria are not involved, these deviations must be due to differences between machines, indicating the need for high-hardness reference materials to check on calibration.

In indentation fracture crack length measurement the wide range of measured mean crack lengths suggests that the criteria of measurement need to be fully speficied if the method is to be used for fracture toughness measurement.

In conclusion it is clear that standardized testing procedures should be only at macrohardness levels of 10 N load or greater and only on materials that do not suffer excessive fracture. Microhardness testing, although standardized for softer but more-homogeneous glasses, is not appropriate for high-hardness ceramics.

Technical Working Area 4

POLYMER BLENDS

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All commercially important blends are multiphase. A key to successful commercial blend is "predictability". The easiest way of assuring this is either generation of fine, stabilized dispersion of one polymer in another up to 30 vol% or creation of co-continuous morphology at about 50 vol%. However, an increasing number of new blends does not require stabilization (which usually leads to a homopolymer-like behavior) but predictable deformability of the dispersed phase which can lead to desired morphology (e.g. fibrillas, lamellas, platelets, etc.). In short, the morphology in commercial blends do not always involve a stable dispersion and may be compatibilized by, for example, chemical reaction (grafting) to unstable systems which, under specified processing conditions, lead to desired product performance (e.g. reinforcement, reduction of permeability, etc.).

Standardizing test methods for polymer blends poses specific problems. There is no simple test in national or international norms pertaining to this type of material, although there are standards for some graft and block copolymers. The task of the Technical Working Party is not extension of existing norms to accommodate new materials, but rather the foundation of a consensus on a set of new procedures that in their totality will adequately characterize immiscible blends. Five technical areas were selected in Phase I: melt rheology (processability), dynamic testing of solids, thermal analysis, morphology and mechanical properties. The Phase I program was designed to identify the most reliable test methods that provide complementarity of information.

The material selected for the Phase I program was: (i) to be centrally prepared from known ingredients (i.e. without secret compatibilizing agents), (ii) to cover a range of composition including the single-phase homopolymers as a reference, and (iii) to be based on immiscible pairs of polymers. From a list of two dozen of blend candidates, polycarbonate/linear low density polyethylene (PC/LLDPE) was selected. The blends contained an engineering resin; both ingredients were manufactured in large volume, and were of direct commercial interest. About 5 wt% of LLDPE was added to improve impact and stress cracking properties of commercial PC resins. On the other hand, to improve stiffness and rigidity at higher temperatures, LLDPE blends with up to 20 wt% PC are being prepared.

The standardization test for polymer alloys and blends must be applicable not only to well stabilized blends with homopolymer-like behavior but also to materials with processing-dependent, unstable morphology. The PC/LLDPE blends provided an opportunity to determine which of the tests can characterize both miscible and immiscible blends.

Evaluation of the results of the various tests is now underway and plans are being laid for a Phase II program based on the results of Phase I.

Technical Working Area 5

POLYMER COMPOSITES

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The aim of the VAMAS composites program is to evaluate the mechanical properties of composite materials by delamination and fatigue testing. Two round robins are under way.

1. Delamination Testing

In cooperation with ASTM D30.02.02 the VAMAS working group is developing a specimen specification and a testing method to determine toughness criteria in tension (Mode I) and in shear (Mode II). After beginning with monotonic loading, the program will extend later to cyclic loading.

Potential points for investigation are:

- Size of specimen and initial crack size
- Initiation of crack growth and methods of measuring
- Strain rate
- Means of measuring displacement and load
- Methods of analysis of results
- Presentation of results

Sets of unidirectional glass fiber epoxy composites and equilibrium woven composites were supplied by Vetrotex in March 1987. The first specimens were sent to the participants in May. In order to provide comparison with the data for another material, Toray supplied 240 specimens of T 300 epoxy composite (3601) at the same time. A similar number of specimens with T 800 H carbon fiber was supplied by Toray in July.

Laboratories in Canada, France, Japan, United Kingdom, and USA countries are now involved in this round robin. Sweden will be added shortly.

2. Fatigue Testing

A program on fatigue testing is being conducted in order to establish reliable specimen specification and testing methods for use in prediction of the fatigue limit of glass and carbon fiber composites. Several different comparisons between pure stress, tension, and flexure are being made.

The fatigue test parameters are:

- Applied conditions: frequency, wave type, R ratio
- Specimen design
- Mode of loading: tension and bending
- Load control or stroke control
- Environment

Specimens of unidirectional and equilibrium woven glass fiber epoxy composite are being supplied by Vetrotex; carbon fiber epoxy composite specimen are being provided by Toray. Laboratories in Canada, France, Japan and the United Kingdom are participating at this round robin.

3. Creep Testing

Several countries are interested in creep testing. An effort is being developed by Japan.

Technical Working Area 6

SUPERCONDUCTING AND CRYOGENIC STRUCTURAL MATERIALS

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An intercomparison of critical current measurements in Nb_3Sn superconducting wires has been recently completed. The Nb_3Sn wire is a practically important one, capable of generating strong magnetic fields of 10 - 16 Tesla. The European Community (EC), The United States (US), and Japan each supplied a different type of multifilamentary Nb_3Sn wire. Twelve EC, five US, and seven Japanese laboratories participated to the round robin test. The summarized result and a preliminary recommendation for critical current measurements were presented at a Technical Working Party meeting held on May 30 in Tokyo and another to be held in Southampton in July.

An intercomparison on AC loss measurement in Nb-Ti superconducting wires has been recently started. Four different type Nb-Ti multifilamentary wires with extremely small AC loss and relatively large AC loss were provided by the EC, the US and Japan. Seven EC, four US and six Japanese laboratories are participating in the intercomparison. The guidelines for the AC loss measurement of these wires have been distributed to the participant laboratories.

A technical meeting on the round robin test of cryogenic structural materials was held on March 7 at KfK. The round robin test on tensile testing at 4.2K using SUS 316LN and YUS 170 steels has been successfully completed with 16 participant laboratories. The result will be reported at the May TWP meeting in Tokyo. A round robin test on fracture toughness at 4.2K using the same steels is now in progress with 12 participant laboratories.

Technical Working Area 7

BIOENGINEERING MATERIALS

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An intercomparison of wear measurements on hydroxy apatite has just been initiated, with samples provided by Japan. Expansion of activity into other areas is under active consideration by the Technical Working Party.

Technical Working Area 8

HOT SALT CORROSION RESISTANCE

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The purpose of this activity is to define an agreed testing procedure for determination of the resistance of gas turbine materials to corrosion in aggressive environments at high temperatures. Rig testing procedures are the main focus of the program, and a test procedure has been agreed following inquiries within the relevant industrial organizations. The possibility of publishing this procedure is being investigated. The next phase of the work, involving an intercomparison exercise to probe the validity of the procedure, has been delayed due to difficulties with material supply.

Technical Working Area 9

WELD CHARACTERISTICS

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The purpose of this program is to carry out an intercomparison of TIG welding techniques from the point of view of assessing weld penetration in steels of different levels of sulphur. This work will be supported by surface tension measurements, since surface-tension-driven flow is believed to control penetration. Currently, materials (samples of two types of austenitic steel, types 304 and 306) have been distributed to participants; and work will now proceed within an agreed framework. The participants are in USA, UK, Japan, France and Germany.

Technical Working Area 10

MATERIALS DATABANKS

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During the past two years, VAMAS has been examining the issues related to developing standards for building and using databases. VAMAS Working Group 10 has issued (July 1987) a comprehensive report that makes recommendations for action. Summaries of these recommendations and descriptions of three new projects being started by VAMAS in this area, are included in a feature article earlier in this Bulletin.

Technical Working Area 11

CREEP CRACK GROWTH

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The purpose of this activity is to provide a basis for the joint assessment of data being produced by collaboration between major centers in USA, Europe, and Japan. Currently, data transfers have been arranged, and a comparison based on a uniform approach to the calculation of correlating parameters shows a good level of consistency. Data and interpretation have been discussed in detail at two workshop-style meetings; and a third in the series was held at Freiburg, Germany, in June. This will provide an opportunity for discussion of a draft "state-of-the-art" report being produced by the group and also for defining an agenda for a further phase of collaboration.

Technical Working Area 12

EFFICIENT TEST PROCEDURES FOR POLYMER PROPERTIES

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This project is concerned with developing and validating procedures that reduce the amount of time required to carry out certain materials tests. In the planning stage, attention concentrated on two areas:

1. Accelerated durability tests for polymers exposed to conditions of heat, light, and/or humidity.
2. Correlation between time, temperature and stress to provide reliable acceleration of mechanical tests or extrapolation of data.

Surveys of current procedures and of national preferences for research projects indicated that there is a wish for a collaborative project under VAMAS in the first area. The program on accelerated durability tests was finalized at a meeting in May 1988 and work has now commenced.

Similar surveys of the second area revealed that there is no consensus for a collaborative project, various proposals having been made for work on creep deformation, creep rupture, fatigue, dynamic stiffness, etc. Thus, no collaborative VAMAS project is proposed in this second area, although this VAMAS Technical Working Area will provide a forum for individual organizations to report their work if they so wish.

Technical Working Area 13

LOW CYCLE FATIGUE

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The objective of the project is to examine the effects of test variables upon the low cycle fatigue results for the various categories of materials normally met in practice. To this end an intercomparison has been initiated that requires participating laboratories to test combinations of strain-softening, strain-hardening and strain-stable materials using their normal specimen geometries and extensometers in accordance with specified guidelines.

The project has recently been joined by six industrial, one university and three national laboratories in Japan, which should finish their measurements this year. In the meantime early results from the 18 participating laboratories in Europe are both informative and encouraging with respect to the use of different specimen sizes and forms.

• VAMAS CALENDAR •

Superconducting and Cryogenics Structural Materials Technical Working Party, Southampton	July 1988
Steering Committee, Boulder,	September 22-23, 1988
Surface Chemical Analysis Technical Working Party, in conjunction with AVS and ASTM E-42, Atlanta	October 3-7, 1988
Workshop on Standards for Factual Materials Databanks, Petten	November 15-17, 1988
Surface Chemical Analysis Technical Working Party, in conjunction with Quantitative Surface Analysis, QSA5, Heathrow	November 15-18, 1988
Wear Technical Working Party in conjunction with Wear Testing of Ceramics - Test Methods and Mechanisms Conference, Teddington	December 1988
Polymer Blend Technical Working Party, Kyoto	April 15-16, 1989
Surface Chemical Analysis Technical Working Party, in conjunction with Eleventh International Vacuum Congress and Seventh International Conference on Solid Surfaces, Köln	September 25-29, 1989
Surface Chemical Analysis Technical Working Party, in conjunction with ECASIA 89, Antibes	October 24-27, 1989
Surface Chemical Analysis Technical Working Party, in conjunction with AVS Meeting, Boston	November 3-7, 1989

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