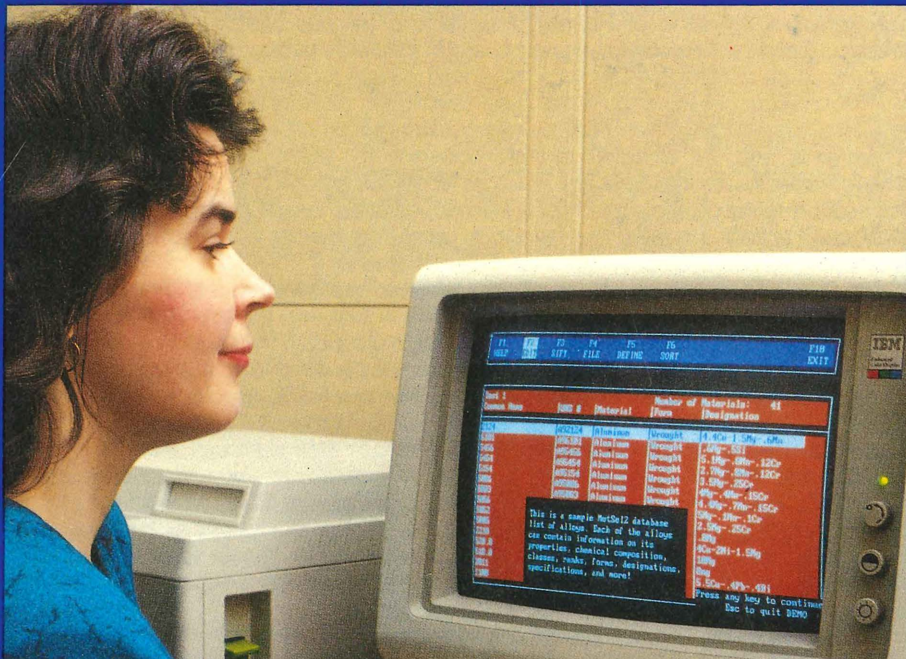
# VAMAS



# BULLETIN NO. 7

## January 1988

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

# VAMAS TECHNICAL NOTES

*This issue of the Bulletin contains a new section, VAMAS Technical Notes. Each of these Notes summarizes the experience of one of the VAMAS Technical Working Parties as it passes a milestone of interest to those who develop standards for advanced materials. Technical Notes are designed to assist standards bodies throughout the world in arriving at compatible standards for advanced materials based on local traditions.*

*VAMAS Technical Working Parties have established projects designed to accelerate the establishment of such standards. Involving joint research projects, measurement intercomparisons, and the establishment of consensus for action, the various Technical Working Parties survey measurement practices worldwide in order to identify those aspects most suitable to the characterization of advanced materials. On the basis of such reviews, collaborative activity is initiated and the results compared in order to draw conclusions on the achievement of satisfactory measurement agreement.*

*The results of VAMAS activity have been published exclusively as technical papers in the scientific literature. Such publication is important in furthering the scientific dialogue in the rapidly moving areas. However, in order to facilitate incorporation of these scientific results in compatible national and international standards, VAMAS has now established two additional publication vehicles of its own: a series of VAMAS Reports and this series of Technical Notes.*

*VAMAS Reports will provide more detailed information than previously available in the areas that they address. Some will present an analysis of the requirements for standards in areas where the formation of a consensus has proved elusive. Other reports will furnish participants in a given VAMAS activity with the detailed data required for further analysis. The success of each will be measured by the extent to which the various standards bodies find them useful in speeding and broadening the establishment of common technical practice.*

*VAMAS Technical Notes will provide a synopsis of these Reports. Where technical results of VAMAS activity may be of assistance to the various standards bodies, these Notes will summarize these results succinctly. Technical Note Number 1 does this. Where a consensus has been achieved on needs for standards for advanced materials, these Notes will summarize this consensus. Technical Note Number 2 is the first Note of this type.*

Cover: Databases, as shown on the front cover, will revolutionize the availability of data on engineering materials. Standards will greatly ease building and using these databases.

# • VAMAS TECHNICAL NOTES •

*VAMAS Technical Note #1*

## WEAR OF MATERIALS: CONDITIONS FOR DRY SLIDING WEAR TESTS WITH BALL-ON-DISK SYSTEMS

### 1. Purpose

This note, based on an international wear test round robin in which 31 laboratories in all VAMAS member countries participated[1], is intended to provide a methodology for improvements in the reproducibility and comparability of wear tests.

### 2. Definition of Wear

According to the OECD Glossary of Terms and Definitions in the Field of Tribology (OECD, Paris, 1969) wear is defined as "the progressive loss of substance from the operating surface of a body occurring as a result of relative motion at the surface." Wear results through interactions of contacting bodies. As illustrated in Figure 1, wear characteristics are "system-dependent" and are basically a function of:

- the operating variables (load, kinematics, temperature, time)
- the structure of the tribological system (body, counter body, interfacial medium, surrounding medium)

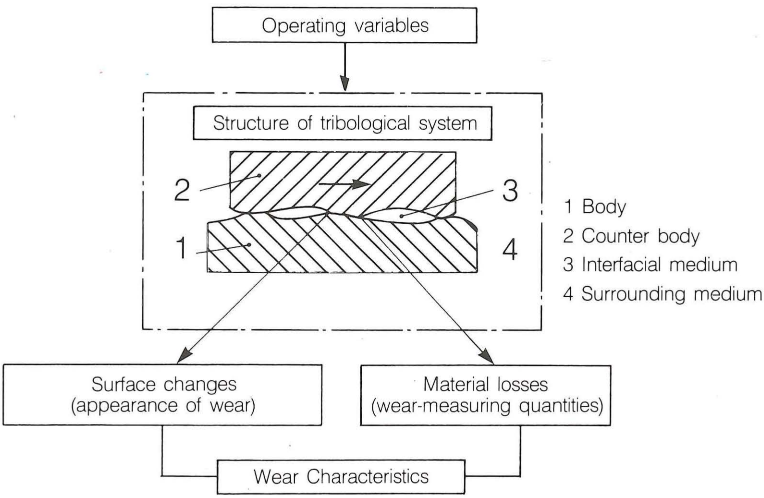



**FIGURE 1.** Definition of Wear

1. Czichos, H., Becker, S., Lexow, J., "Multilaboratory Tribotesting: Results from the Versailles Advanced Materials and Standards Programme on Wear Test Methods," Wear, **114**, 109-130 (1987).

## 3. Standardization Requirements in Wear Testing

It is suggested that at least the following tribological quantities should be properly specified and made equal in comparative tests in order to obtain reproducible friction and wear data.

### 3.1 Test System

Specification of the geometry (dimensions and surface finish) of the stationary and moving specimen including a specification of the wear track dimension.

### 3.2 Materials

Specification of chemical composition, microstructure, hardness and surface roughness.

### 3.3 Atmosphere

Specification of chemical nature and relative humidity.

### 3.4 Operating Variables

Specification of the type of motion, load, sliding velocity, temperature and sliding distance.

### 3.5 Surface Cleaning

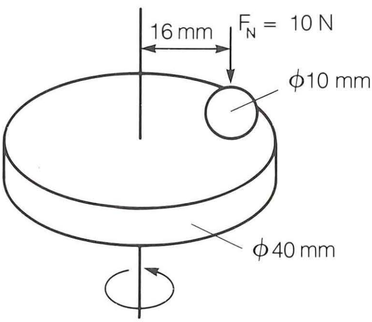
Application of an appropriate cleaning procedure for the specimen surfaces.

### 3.6 Measuring Quantities

Specification of the tribological quantities to be measured in terms of type (e.g., specimen wear or system wear) and physical dimension (e.g., length, mass or volume).

## 4. Numeric Wear Data of Materials

As a reference for the comparison of tribological characteristics of materials, the numeric data of steel and $\alpha$-alumina ceramic which were obtained in the international round robin investigation and are compiled in Table 1 may be used. For details of materials and the procedure of the tests see Wear, **114**, 109-130 (1987).




| Material pairings | | |
|---|---|---|
| disc \ ball | steel | alumina |
| steel | kit 1 | kit 2 |
| alumina | kit 3 | kit 4 |

**TABLE 1.** Results of the round robin tests (AISI 52100 steel, $\alpha$-$Al_2O_3$ ceramic, $F_N$ = 10 N, $\nu$ = 0.1 m $s^{-1}$, T = 23 °C, relative humidity 12% - 78%)

| | *Kit 1* | *Kit 2* | *Kit 3* | *Kit 4* |
|---|---|---|---|---|
| | *Steel-steel* | *Ceramic-steel* | *Steel-ceramic* | *Ceramic-ceramic* |
| **Coefficient of friction**[a] | 0.60 ± 0.11 | 0.76 ± 0.14 | 0.60 ± 0.12 | 0.41 ± 0.08 |
| Number of data | 109 | 75 | 64 | 76 |
| Number of laboratories | 26 | 26 | 23 | 26 |
| **Wear rate of system ($\mu$m $km^{-1}$)**[b] | 70 ± 20 | very small | 81 ± 29 | very small |
| Number of data | 47 | | 29 | |
| Number of laboratories | 11 | | 11 | |
| **Ball wear scar diameter (mm)**[a] | 2.11 ± 0.27 | [c] | 2.08 ± 0.35 | 0.3 ± 0.05 |
| Number of data | 102 | | 60 | 56 |
| Number of laboratories | 23 | | 21 | 19 |
| **Disc wear track width (mm)**[a] | [d] | 0.64 ± 0.13 | [d] | not measured |
| Number of data | | 54 | | |
| Number of laboratories | | 19 | | |

[a] At 1000 m sliding distance.

[b] Determined from the wear curve (steady state range between 300 and 1000 m sliding distance).

[c] Material transfer from disc to ball.

[d] Material transfer from ball to disc.

NOTE: This note resulted through the cooperation of 31 institutions in 7 countries with the help of the following National Representatives within the VAMAS Working Party on Wear Test Methods: J. Molgaard, Canada; M. Godet, France; H. Czichos, Germany (Chairman); A. G. Gandini, Italy; K. Matsumo, Japan, T. S. Eyre, UK; A. W. Ruff and S. Hsu, USA.

*VAMAS Technical Note #2*

# STANDARDS FOR FACTUAL MATERIALS DATABANKS

## 1. Purpose

The primary purpose of the VAMAS Task Group on Factual Materials Databanks has been to identify the areas where standards development would significantly and positively impact the building and dissemination of materials databanks. Materials databanks are becoming substantial elements of the computerized flow of information on materials properties from the generation of this information to its use. Their features and operational conditions will therefore be influenced by all standards related to any phase of this information flow.

Accordingly, this review includes aspects of data generation, data analysis, data presentation, access to data, and use of data; and the report presents sets of recommendations for the development of standards under four headings:

- Basic considerations for handling data
- Material data generation and reporting
- Materials databanks
- Access to materials data

These sets of recommendations are derived, in the body of the full VAMAS report[1], from the supporting background information presented in the corresponding chapter. They are summarized in a condensed form and include the indication of the specific organization(s) to which they are addressed.

These organizations (as listed in Appendix B of reference 1) include[2]:

- National standards bodies (National STB)
- International standards bodies (International STB)
- Engineering standards bodies (Engineering STB)
- Pre-standardization activity bodies (Pre STB)
- (Prototype) materials data systems (Networks)
- Versailles Project on Advanced Materials and Standards (VAMAS)
- Committee on Data of the International Council of Scientific Unions (CODATA)

## 2. Basic Considerations for Handling Materials Data

Basic data handling standards impact the whole of the materials data flow as they are related to general issues in the areas of materials designation and nomenclature systems, the conjunctive categories of terms, concepts, definitions, symbols and abbreviations, multilingual terminology, and the system of units.

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1. H. Kröckel., K. Reynard., J. Rumble, "The Need for Standards: The Report of a VAMAS Task Group," Factual Materials Databanks, July 1987.

2. The use of ISO 31 is encouraged as the source of a standard set of symbols. In addition, a special set of symbols for terminal screens and computer printers should be developed noting ISO 2955.

### Recommendations

- Existing systems for designating engineering materials should be fully catalogued. Systems for a given material type should be brought into equivalency as an international standard. (National STB, International STB)
- For materials types where no materials designation system has been developed, one should be. The first step should be information gathering sessions on proprietary, informal, manufacturer, or other systems that may exist. (National STB)
- Each of the separate national standards activities needs to have its definitions related to materials property data listed and scrutinized to produce an agreed multilingual list of equivalent definitions. (National STB, VAMAS, CODATA)
- VAMAS should encourage national cooperation in Europe with the CEC effort to build MAT-TERM 1, provide the links with ASTM E49.03 and the appropriate Japanese project. (VAMAS)
- Standards for creating indexes, thesauri, and related metadata guides are needed to characterize individual materials in order that standard data dictionaries can be constructed. (National STB, International STB)
- The use of ISO 31 is encouraged as the source of a standard set of symbols. In addition, a special set of symbols for terminal screens and computer printers should be developed noting ISO 2955. (National STB, International STB, Engineering STB)
- The use of SI units is strongly recommended in all phases of the work on materials databanks. (National STB, Engineering STB, Networks)

## 3. Standards for Materials Data Generation and Reporting

Recognizing that the definitions of engineering materials properties are largley conditioned by the procedures and practices that have been codified as standard tests, the standards for test methods must be considered. Computerization introduces an extension of the required standards covering conversion of test results to properties, comprehensive reporting of results (taking into account machine readability), and the full and adequate characterization of the materials.

### Recommendations

- A computerized directory of national and international test method standards should be established to identify the equivalences and differences between them for each material group and property. (VAMAS)
- A full listing of necessary metadata should be part of every materials testing standard. The lists should be standardized internationally. (National STB, International STB)
- Standards for derived data obtained by data analysis should be included in each test method standard. (National STB)
- To facilitate the computerization of data from publications, standards for the presentation of factual, numerical, and tabular data in the literature should be developed in parallel with data reporting standards. (National STB, International STB)

## 4. Standards for Materials Databanks

Standards for this subject do not cover databanks themselves as these are rapidly evolving and should not prematurely be restricted. Instead, the standards concern the environment of interaction and user interfaces. Many standards are already available in the general area of databanks and only the requirements that are specific for materials data systems are taken up here.

### Recommendations

- Metadata profiles and standard data items should be defined for specific applications for which databanks are being designed. For example, data banks for the evaluation of test results require data items describing test method, material, specimen, test condition, actual data, and data source. (Pre STB)
- When a databank derives its metadata from an established design code (e.g., ASME Boiler and Pressure Vessel Code), the metadata scope and output screens should be defined in conjunction with the respective application, and in important cases, adopted as a standard. (Engineering STB)
- Metadata profiles, file formats, and input and output formats should allow conversion to and from an international "Materials Data Interchange Format." (National STB, International STB, Engineering STB)
- Existing standard principles and standard elements for the format and syntax of query languages should be used wherever possible. (Networks)
- A review should be made of the immediate need for more specific computer software standards as related to building materials databanks. In particular, databank portability and modularity are areas of highest concern. (National STB, International STB)
- The functional specification of a general material databank log-on module including disconnection recovery, security provisions, user guidance, and systems messages should be standardized. (National STB, International STB)
- Guidelines or standards for the access administration module should be developed in order that the user information on accounting units, time, cost, etc., can be harmonized. (National STB, International STB)
- The presentation to the user of data dictionaries and on-line thesauri should be standard, if necessary, allowing for different types of databanks. (National STB, International STB)
- Guidelines for a user-friendly, harmonized design of data collection forms should be established. (Pre STB, National STB)

## 5. Standards for Data Access

Access to materials data is considered under the specific condition of access to computerized data systems which has three standardization aspects:

- Standards related to data
- Standards related to computer – man communication
- Standards related to computer – computer communication

The central issue for the material field is a suitable materials data interchange format and the features of distributed databanks (networks). The highly important issue of intelligent and user-friendly user interfaces is deliberately only briefly included in the standards review.

## Recommendations

- Standards and codes of practice related to distributed databank systems must be in place before such systems can be built for materials data. Groups for materials data standards should maintain close contact with computer standards groups such as ISO TC 97 and the CEC Materials Database Demonstrator Programme. (National STB, International STB)
- Groups working on standards for computerization of materials data should have working relationships with groups developing interface standards, in particular, in the areas of screen design, menu navigation, and interface commands. (National STB, International STB)
- Groups working on standards for computerization of materials data must keep close working relationships with standards groups for graphics, computer-aided design, computer modeling, and computer-aided manufacturing. (National STB, Engineering STB)
- Standards must be developed for the Materials Data Interchange Format to allow for compatibility with other networking standards such as those being developed under the OSI model. (National STB, International STB)
- Standards should be developed for well-established, verified, and widely accepted techniques for modeling materials behavior or for statistical methods applicable to materials test data to support computer-assisted engineering. (National STB, Engineering STB, CODATA)

# • TECHNICAL WORKING AREAS •

*Technical Working Area 1*

## WEAR TEST METHODS

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A VAMAS report "Technical Working Area 1: Wear Test Methods: Results of the First Round Robin Comparison," and a VAMAS Technical Note, "Wear of Materials: Conditions for Dry Sliding Wear Tests with Ball-on-Disk Systems" have been drafted and sent to paticipants for discussion. An oral report was presented to the VAMAS Steering Committee at its spring meeting in Pisa, May 1987. The Committee welcomed the accomplishments and congratulated the Working Party for their progress and success.

For the definition of further cooperative work, technical and organizational requirements were discussed during a meeting of National Representatives at the Federal Institute for Materials Research and Testing (BAM) in Berlin, October 9, 1987, with participants from Great Britain (Dr. Gee), Italy (Prof. Bassani), Japan (Dr. Matsuno), and Germany. No representatives from Canada, France, and the United States of America could be present, but submitted written suggestions.

In the next round robin intercomparison, the friction and wear behavior of ceramics (silicon-nitride, alumina) and steel will be studied. Essentially the same operating conditions will be chosen as in the first round. Additionally, the wear track diameter may be changed in order to allow participants to perform experiments at a higher load (50 N) and under varied relative humidity. Appropriate procedures for the statistical planning of experiments were discussed; and an evaluation sheet was presented, which will facilitate the experiments and evaluation of the results.

*Technical Working Area 2*

## SURFACE CHEMICAL ANALYSIS

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The principal objective of this Working Party is to produce by coordinated effort the reference procedures, reference data, and reference materials necessary to establish standards for surface chemical analysis. Three multinational projects were initiTted in Autumn, 1985, and an additional eleven projects in Autumn, 1986. Brief status reports on these projects are:

1. Development of thin oxide films as reference materials (work completed; report being written)
2. Development of calibration data for the energy scales of Auger-electron spectrometers (UK work completed; US work nearing completion)

3. Procedures for quantitative x-ray photoelectron spectroscopy (inactive until suitable specimens have been obtained)
4. Measurement of spatial resolution in Auger-electron spectroscopy (proposal under discussion)
5. Development of reference materials prepared by ion implantation (proposal under discussion)
6. Development of polymer reference materials (start delayed)
7. Correction methods for backscattering in Auger-electron spectroscopy (proposal under discussion)
8. Reference data for sputtering rates in oxides (proposal under discussion)
9. Intercomparison of Auger-electron energy and intensity measurements (protocol for measurements being developed)
10. Development of a standard data transfer format (first version of proposed format distributed for comment; revised version of format in preparation)
11. Multitechnique characterization of vacancies in alumina (proposal under discussion)
12. Calibration of surface layers by nuclear reaction analysis (proposal in preparation)
13. Tests of algorithms for data processing in Auger-electron spectroscopy (proposal in preparation)
14. Tests of algorithms for data processing in x-ray photoelectron spectroscopy (proposal under discussion)

It is expected that some additional projects will be initiated at the next meeting of national representatives to the Working Party to be held in Stuttgart, FRG on October 23, 1987.

The Working Party was a cosponsor of a successful two-day symposium on surface analysis held in conjunction with the annual meeting of the US Microbeam Analysis Society at Kona, Hawaii on July 13-17, 1987. Invited and contributed papers were presented by scientists from Japan, UK, and USA; and there was a discussion of Working Party activities and plans. The Working Party is also cosponsoring a two-day conference on Quantitative Surface Analysis at Monterey, California, October 30-31, 1987. A presentation on Working Party activities and plans will be given at the conference, and there will be presentations and discussion on needs for reference data, reference materials, and reference procedures in surface analysis.

# CERAMICS

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## 1. Environmentally Enhanced Fracture

The first effort in environmentally enhanced fracture, an intercomparison of fracture tests led by Dr. S. Freiman of NBS (USA) on alumina bars supplied by Desmarquest Co (France), is nearly completed. A similar test is being planned on $Si_3N_4$ bars supplied by NTK (Japan). Twelve hundred specimens (50 x 3 x 4 mm) will be available by the end of 1987. The difference in material will require some modification of the test procedure.

## 2. Hardness

The first effort in the determination of hardness, one led by Dr. R. Morrell of NPL (UK), is also progressing well. Hardness testing is a simple tool to study the basic character of many materials, but has significant problems of reproducibility and reliability for testing ceramics. Four different hardness tests are being evaluated in a round robin comparing results on two materials from a number of sources with different characteristics and testing difficulty. Assessment of the data allows examination of the reliability of the methods for standardization.

Test samples of two varieties of alumina in the form of 30 mm discs were purchased by The National Physical Laboratory (NPL), ground and polished, and then hardness-tested by NPL to provide a comparison between discs and a set of reference indentations for the participants. Twenty-five pairs of discs were supplied to participants. By mid-September 1987, nineteen pairs had been returned and analysis of the test results has commenced.

Principal factors being examined are the mean and range of hardness numbers compared with those recorded by a single operator at NPL. Correlations between NPL's and participants' measurement on single indentations are being calculated to establish whether the differences recorded are systematic or random. Correlations with eyesight of the operator are being examined.

To date nine laboratories in the UK are participating, six from Japan and one each from France, the Federal Republic of Germany, the U.S., and other European Community countries. Six more may participate.

Preliminary Conclusions Concerning the Hardness Testing

- The majority of participants making Rockwell Superficial HR45N indentations produced results that were very similar to those recorded by NPL. Only two results out of nine so far deviate significantly.

- For Vickers hardness at HV1.0, the range of mean results among participants was much larger than that among the test discs as recorded at NPL. The differences between NPL measurements and participants' measurements of the same indentations was small for a fine-grained dense high-purity alumina, but rather greater for a medium-grained 95% alumina, which suffers more damage during indentation. The correlation coefficient for the two sets of measurements was generally greater than 0.5, but in some cases was negative (i.e., anti-correlated, indicating that most of the differences are random).
- For Vickers microhardness at HV0.2 the range of mean results from the participants was much larger that that from the same discs recorded by one operator at NPL. Differences of over ± 10% were common, and similar results were obtained for participants reading NPL-made indentations. The correlation coefficients indicated a high degree of randomness of the data. It can be concluded that visual judgment of the measurement varies widely, and that the test is unsuited to any form of standardization.
- For Knoop microhardness at HK0.2 the same conclusions arise as for HV0.2.
- There is no correlation between eyesight and mean results.

Japan plans to supply 50 $Si_3N_4$ specimens for additional hardness testing before the end of 1987.

### 3. Thermal shock resistance

An effort in thermal shock resistance is being initiated. A procedure is presently being studied by France (ENSCI, Limoges) and Japan (JFCC, Nagoya). Formulation of a joint proposal is expected by next spring.

*Technical Working Area 4*

## POLYMER BLENDS

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The third annual meeting of the Technical Working Party on Polymer Blends (TWP-PB) was held in Bundesanstalt für Materialforschung und -prüfung (BAM) in Berlin on April 13-14, 1987, with Prof. Dr. G. Pastuska acting as the organizer and host. One part of the meeting was dedicated to internal discussions on organizational and policy issues and another to technical presentations and discussions open to anyone interested in these issues.

Currently there are 95 laboratories from the seven VAMAS member countries participating in TWP-PB test programs. The five selected technical areas of activity are coordinated by: **1** Melt Rheology, L. Choplin (Canada); **2** Dynamic Testing of Solids, C. Wippler (France); **3** Thermal Analysis, G. Pastuska (FRG); **4** Morphology, E. Butta (Italy) and **5** Mechanical Testing, I. K. Partridge (UK). Good progress was reported for all of them. On the basis of tests on centrally prepared polycarbonate/polyethylene (PC/PE) samples some methods valid for homogeneous polymers were shown to be invalid for blends, directing attention to the more promising ones.

The thermal analysis results are particularly encouraging. The results on ten PC/PE samples (5 compositions x 2 thicknesses) from 15 laboratories are repeatable and reproducible (as illustrated in Table I.) An article for *Polymer Engineering and Science* has been prepared, and conclusions for reliable testing conditions are being formulated.

**TABLE I** Summary of Thermal Analysis Results for PC/LLDPE Blends

| No | Composition (wt%) PC/LLDPE | Glass Transition $T_g$(°C) | Melting Point $T_m$(°C) | Heat of Melting per 1 g sample $\Delta H_m$(J/g) | Heat of Melting per 1 g LLDPE $\Delta H_m^*$(J/g) |
|---|---|---|---|---|---|
| 1 | 0/100 | --- | $122.5 \pm 1.0$ | $123.2 \pm 11.3$ | $123.2 \pm 11.3$ |
| 2 | 25/75 | $149.7 \pm 3.0$ | $122.0 \pm 1.2$ | $93.4 \pm 7.9$ | $124.5 \pm 10.5$ |
| 3 | 50/50 | $145.9 \pm 1.9$ | $122.1 \pm 1.6$ | $61.4 \pm 6.4$ | $122.8 \pm 12.8$ |
| 4 | 75/25 | $145.1 \pm 2.1$ | $121.7 \pm 1.6$ | $29.8 \pm 3.6$ | $119.2 \pm 14.4$ |
| 5 | 100/0 | $145.4 \pm 1.6$ | --- | --- | --- |

Dynamic shearing of molten blends was found to be rapid and repeatable. However, testing PC/PE blends in capillary rheometer resulted in poor inter-laboratory reproducibility. The mechanical tests on polymers can be divided into two groups: (a) those utilizing low strain, providing the principal designing parameters such as modulus and yield stress/strain, and (b) those at high strain level, giving information on ductility, impact, fracture, maximum strain at break, etc. The test procedures adopted for group (a) are tensile and plane strain compression. Preliminary results indicate good reproducibility in compressive testing and in tensile testing for some samples (numbers 1, 2, and 4 in Table I). The main difficulty in compressive test is identification of the yield. Methods for group (b) are Charpy impact and fracture-mechanical tests. Serious problems encountered in reproducibility may be due either to sample preparation or sample variability.

The results of morphological testing in eight laboratories are in good qualitative agreement. Methods to quantify the results will now be examined. There is an emerging consensus that for determination of morphology not one but several supplemental methods will be required.

*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 specimens 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.

A meeting of the international working group was held on July 21, 1987, at Imperial College.

*Technical Working Area 6*

## SUPERCONDUCTING AND CRYOGENIC STRUCTURAL MATERIALS

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The second TWP meeting was held on June 22-23 at the National Bureau of Standards, Boulder, CO, USA. The round robin test on critical current measurement is in progress among 24 participant laboratories using EC, US, and Japanese $Nb_3Sn$ wires. The preliminary result was reported at the TWP meeting, and the effect of stress on critical current was indicated. The measurement will be completed in the coming December.

The round robin test on AC loss measurement will be started soon among 16 participant laboratories using EC and Japanese ultra-fine filamentary Nb-Ti wires. The wires will be wound into test coils, and distributed to participant laboratories by the end of December.

The round robin test on tensile strength and fracture toughness measurements at 4.2K is also being carried out among 18 participant laboratories using Japanese 316LN and YUS170 steels. Another 316LN sample from EC will be added to the test. Japanese laboratories finished the tensile test, and the result was reported at the TWP meeting. The round robin test on Japanese samples will be completed by the end of March 1988. The third TWP meeting will be held on May 30-31, 1988, in Tsukuba, Japan.

*Technical Working Area 7*

## BIOENGINEERING MATERIALS

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In order to evaluate cytotoxicity of bioceramics such as hydroxyapatite and calcium phosphate, a joint evaluation program on optimum tissue culture method, cell type, and morphology of test pieces has been undertaken. The effort is coordinated by Dr. T. Tateishi of MITI (Japan), Prof. D. F. Williams (UK), and Prof. M. Jozefowicz (France). Prof. Y. Ikada and Prof. Aoki will participate in the activity. Japan will provide at no cost H.A.P. test pieces for any country willing to cooperate. Discussion about operative details among the participants is planned at the first Japan-UK Joint Conference on Biomaterials, Tokyo, October 29, 1987. The following Working Group meeting is planned at the Third World Biomaterials Congress, Kyoto, April 25, 1988.

*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 will provide the focus of the work and a draft test specification has been produced as a result of extensive enquiries within the relevant industrial organizations. The next phase of the work will involve an intercomparison exercise to probe the validity of the specification. Progress has been delayed somewhat due to difficulties with supply of materials. It is anticipated that the alloy samples should now be available around November 1987, and work should begin on the intercomparison in early 1988 and be completed by the end of the year. At a recent meeting of the AGARD Structure and Materials Panel, Dr. T. B. Gibbons coordinator of the Project gave a presentation on the aims and objectives of the VAMAS work in this area. In supporting the initiative it was suggested that a contribution from the VAMAS Group might be appropriate at the AGARD Specialists meeting on High Temperature Corrosion in Canada in 1989.

*Technical Working Area 9*

## WELD CHARACTERISTICS

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The round robin intercomparison program designed to test the consistency of the various methods used for assessing weld penetration in TIG Welding, has now commenced. The tests will be carried out on four well-characterized materials, two batches of both 304 and 310 with high and low sulphur contents. Test plates, purchased by NRIM, have been forwarded to Japanese and European participants; dispatch to the USA will take place when US import clearance is granted. A protocol for the measurement program has been sent to the various participants in USA (5), UK (4), France (1), and Japan (5).

*Technical Working Area 10*

# MATERIALS DATABANKS

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This program is designed to identify standardization activity related to the computerization of materials property data. The Task Group has identified many areas where national and international standards bodies need to take action so that the computer databanks of materials property data will be compatible and accessible in an easy to use manner.

The final report of this group has been completed and distributed to standards organizations throughout the world for action. Among the standards that are recommended for development are those for:

- Reporting the full description of engineering materials, test methods, and data reporting, harmonized on an international basis
- Creating harmonized compilations of terminology and definitions needed to support data systems allowing access to multiple databanks, whether distributed online or by personal computer
- Establishing a data interchange format (DIF) that is convenient and unambiguous. The DIF would address both contents (related to materials data) and computer-to-computer communications.

Steps are already underway to publicize the findings of this working group. K. Reynard of the U.K. will present a summary at the First International Symposium on Computerization and Networking of Materials Databases. Also, the report is being sent to standards organization in VAMAS countries for follow-up activity. Finally, it is hoped that other talks and articles about this VAMAS work will be forthcoming.

Several possibilities for future work have been identified including the holding of a workshop for national and international standards groups and their individual committee to foster cooperation and communication between their activities.

*Technical Working Area 11*

# CREEP CRACK GROWTH

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The purpose of this activity is to provide a basis for an intercomparison of data on creep crack growth being obtained by various international groups. The groups involved are:

Europe: European Group on Fracture
French National Program
United Kingdom Atomic Energy Authority

USA: ASTM, E24 Committee

Japan: Society for the Promotion of Science
National Research Institute for Metals

Results are now available from all the participating groups and a very successful workshop-style meeting was held in Atlanta, Georgia, in early July, hosted by Dr. Saxena in the Materials Department, Georgia Institute of Technology. The meeting provided an opportunity to discuss the basic mechanics principles on which the measurement of creep crack growth is based and also to present initial results from intercomparisons of the data generated within each of the groups.

There were various areas of difficulty regarding the details of interpretation of the validity of certain correlating parameters, but a basis of consensus was established nevertheless. Intercomparison of data produced on crack growth in CrMoV steel by the European Group correlated well with that from the ASTM program, and a similar level of agreement had been demonstrated in comparison of the results obtained in Japan with those from ASTM.

Plans were made for further batches of data to be compared to establish a realistic scatter-band for this alloy. Also, it was agreed that suitable data sets of 316 austenitic steel would be compared using the procedures adopted in the French National Program. A further opportunity for members of the Group to meet would be available at the time of the forthcoming international meeting at Dourdan, France in early October, and it was planned to present further results of intercomparisons of data at that time.

The members of the group also agreed on a draft format for a report that would be prepared to describe the work, and preliminary arrangements for providing appropriate input were established.

*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 has been 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 have indicated that there is a wish for a collaborative project under VAMAS in the first area. Final discussions are taking place with interested parties to define the details of the project. Similar surveys of the second area have 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. It is anticipated that the programme on accelerated durability tests will have been finalized by the time of the next Bulletin and that technical work will commence at that time.

*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. Materials are being tested in 18 European laboratories, and an official call for participation has been made to the members of the Committee on High Temperature Strength of the ISI of Japan. It is anticipated that the results of the project will be available in the summer of 1988.

# • VAMAS CALENDAR •

| | |
|---|---|
| Steering Committee Meeting, Brussels and Petten | 17-19 February 88 |
| Input material for Bulletin #8 due | 1 April 88 |
| Bioengineering Materials Technical Working Party Meeting, Kyoto | 25 April 88 |
| Superconducting and Cryogenic Structural Materials Technical Working Party Meeting, Tsukuba | 30-31 May 88 |
| Agenda fixed for September Steering Committee Meeting | 11 August 88 |
| Steering Committee Meeting, Chicago | 22-23 September 88 |

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