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**IMPLEMENTATION OF THE MILITARY HANDBOOK 17
FOR POLYMER MATRIX COMPOSITES AND
METAL MATRIX COMPOSITES**

24 September - 13 October 1993

and

1 March - 31 March 1994

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APR 29 1994

Contract No. DAAL01-93-C-4064

Technical Progress Report

MSC TPR 3417/CA07

5 April 1994

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U.S. Army Research Laboratory - Watertown, MA

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Attn: AMSRL-MA-S (Mr. Edward Clegg), 405 Arsenal Street, Watertown, MA 02172-0001.~~

Submitted By:

Crystal H. Newton
Principal Investigator



Prepared For:

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Materials Sciences Corporation

April 25, 1994

MSC TPR 3417/CA07

Army Research Laboratory
AMSRL-MA-S
405 Arsenal Street
Watertown, MA 02172-0001

RE: Item No. A001, Contractor's Progress, Status & Management Report, Implementation of the Military Handbook 17 for Polymer Matrix Composites and Metal Matrix Composites, Contract No. DAAL01-93-C-4064, Technical Progress Report, MSC TPR 3417/CA07

Enclosed are two copies of our Contractor's Progress Report. This is in accordance with CDRL A001.

If you have any questions or comments on the contents of this report, please let me know.

Sincerely,

Crystal H. Newton, Ph.D.
Project Engineer

CHN/mj

Enclosure (2/0)
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cc: AMSRL-OP-PR-WT (1/0)
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1. MILESTONE PROGRESS

The Support of 29th MIL-HDBK-17 meeting

Analysis and technical review of two data sets, presented to Data Review and approved as first data sets at fully-approved classification, with condition of data documentation completion.

One comment was received from Alex Segal, see Appendix 1. The comment was coordinated with the appropriate working groups. In addition, a letter inquiring as to the status of data for the handbook from Jay Yeakle was forwarded from ARL. Disposition of this letter will be determined during the next contracting period.

Analysis and technical review of two data sets, AS4 6k/3502 unidirectional tape and AS4 12k/3502 5-harness satin weave, was performed. These data sets meet most of the requirements for fully-approved data for most conditions. The results of the analysis and technical review were presented to the Data Review working group on 29 March 1994. The data were approved with the condition that the remaining data documentation be supplied.

Two data sets were formatted for input into STAT17 files for data analysis. The two materials involved were AS4 12k/E7K8, grade 280 unidirectional tape and AS4 3k/E7k8, grade 195, plain weave. Both of these data sets are one of two or more data sets for each material, such that data pooling concerns should be addressed. As part of this consideration of data pooling, experience was gained with Mark Vangel's regression analysis code, REGTOL. Data files were combined using STAT17 and a FORTRAN utility program (CONVERT) to change data files in STAT17 format to REGTOL format. Both STAT17 and REGTOL are being used to evaluate the impact of data pooling on different scenarios. This work will continue next month, when information will be presented to the task group established at the MIL-HDBK-17 meeting.

At the MIL-HDBK-17 meeting, the data sets which have not yet been approved, were subjected to an informal, preliminary prioritization. The resulting order of analysis is shown in Table 1. This prioritization was conducted by distributing a list of data sets to a small group of working group chairmen. Not all copies were returned and additional input is expected.

Crystal Newton attended the ASTM E-49 meeting and symposium in October 1993 to ensure that the computerization effort within MIL-HDBK-17 meets industry standards and recommendations.

2. PROGRESS ADDRESSING IDENTIFIED CONCERNS

At the MIL-HDBK-17 Coordination Group, a task group was established to address data pooling concerns. The task group plans to have a proposed resolution to data pooling concerns by the fall meeting. A task group meeting has been tentatively scheduled for May 10 at NIST.

3. MANAGEMENT CHANGES

During this reporting period, a stop work order was placed on 13 October 1993 due to a protest of the contract award. The program was started again effective 1 March 1994.

4. SCHEDULING CONCERNS

The practice for maintaining the archival files needs to be established. The working group files which are maintained as part of the contract need to be incorporated into previous archival files. If the previous files are to be involved, they need to be shipped from ARL to MSC.

The two major barriers for data analysis and review for the handbook continue to be lack of a data pooling procedure and difficulties obtaining adequate documentation.

5. COST ELEMENT CONCERNS

The need to stay within the travel budget has been clearly identified to MSC.

In the area of data availability and the computerized database, there are still several concerns which will affect both cost and scheduling elements. The policy for raw data availability is currently being reconsidered. The transfer of data to the High Temperature Materials Information and Analysis Center (HTMIAC) has been defined as the statistical parameters only (not raw data). As such, this is a relatively small task that can be considered as support for the working groups. Additional effort to transfer raw data to HTMIAC would need to be considered as outside of the scope of the contract.

6. COST STATUS

The cost status from the contract start date through this reporting period is shown in Figure 1.

7. COST REPORT

The costs incurred during this reporting period and the total contractual expenditures as of 31 March 1994 are shown in the following table:

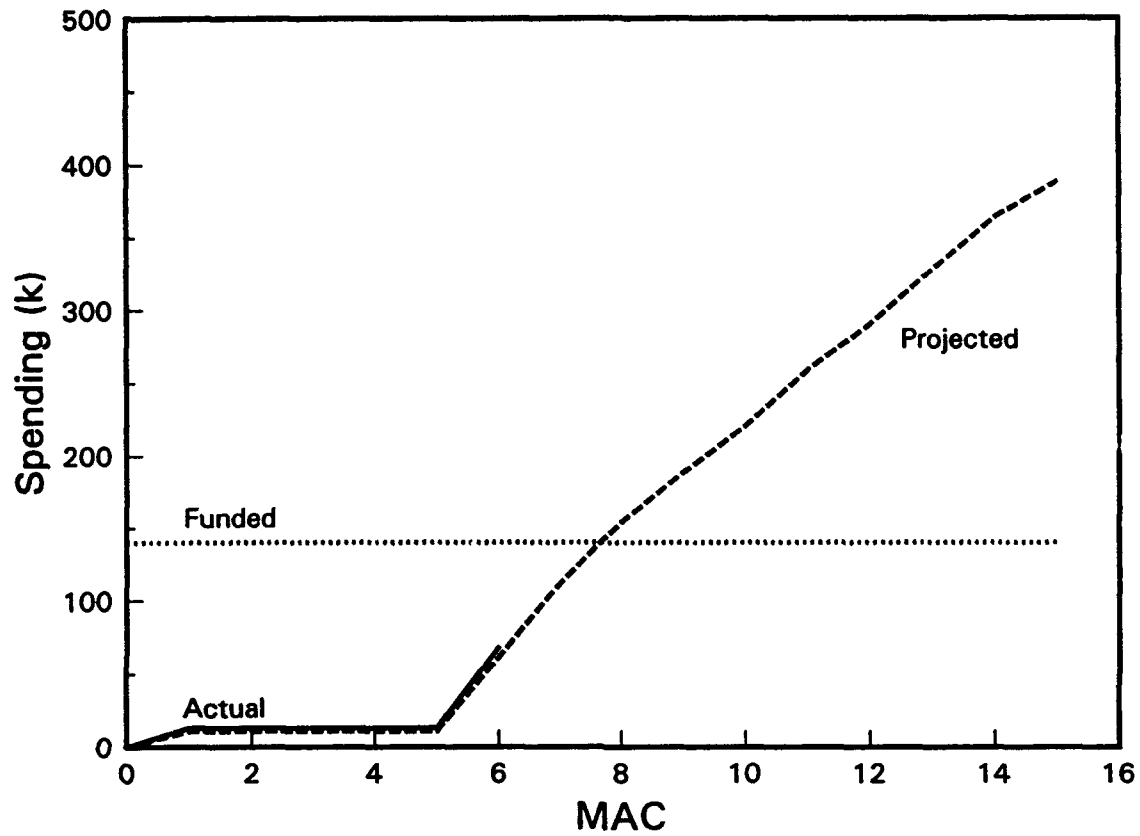


Figure 1. Actual and projected costs for contract to date.

TABLE 1. Contract Cost Chart

	28 Sept 1993 - 13 Oct 1993	1 March 1994 - 31 March 1994	Cumulative Costs
Labor	\$11,425	\$31,834	\$43,259
Travel	\$1,554	\$3,173	\$4,772
Subcontract	\$0	\$0	\$0
Other *	\$0	\$13,453	\$13,453
Total	\$12,979	\$48,460	\$61,439

* Equitable adjustment of Contract Modification 2.

8. LABOR

The hours incurred during this reporting period and the total contractual expenditures as of 31 March 1994 are shown in Table 2:

TABLE 2. Labor status

	28 Sept 1993 - 13 Oct 1993	1 March 1994 - 31 March 1994	Cumulative Costs
Hours	105	352	457

9. TRAVEL REPORT

The following trips were taken during this reporting period:

Kick-off meeting	ARL - Watertown, MA
ASTM E-49 Symposium and Meeting	NIST - Gaithersburg, MD
Briefing meeting	ARL - Watertown, MA
MIL-HDBK-17 meeting	Monterey, CA March 28-31

10. COMMUNICATIONS REPORT

a. Significant Letters

The following letters were received or sent during this reporting period:

MIL-HDBK-17 Project Letters (Sent) Log		
Date	Addressee(s)	Topic/Notes
1993-09-29	Sam Garbo Joe Soderquist Mark Vangel Joe Brennan	Alex Segal's comment forwarded to GWG/SWG Comment [93-01]
1993-09-29	Alex Segal	Comment receipt
1993-09-29	Ed Clegg	Travel request for E-49
1993-10-11	CDRL distrn	Minutes for the meeting 1 Oct 1993
1993-10-12	Ed Clegg	Questions on revision D
1993-10-12	Joe Brennan Ed Clegg	Diskettes for all data & V3CH4.D
1994-03-04	Gary Hagnauer Ed Clegg	Export control - materials in the system that need review
1994-03-04	Joe Brennan Ed Clegg	Request for working group distributions, minutes, and review material
1994-03-15	K.Wilcox	Progress report pages for program

MIL-HDBK-17 Project Letters (Received) Log		
Date	Sender(s)	Topic/Notes
1994-02-28	Joe Brennan	GWG distribution
1994-03-13	Joe Brennan	Proceedings
1994-03-16	Joe Soderquist	Response to John Pimm's comments
1994-03-18	Jay Yeakle	Inquiry re: data availability (forwarded from ARL)
1994-03-23	John Pimm	Vought data documentation package

b. Significant Telephone Contacts

The following significant telephone contacts occurred during this reporting period:

MIL-HDBK-17 Phone Log:		
Date	Contact(s)	Topic/Notes
1993-09-24	Gary Hagnauer	OK to get on SACMA agenda for Intersociety Forum
1993-09-24	John Banisaukas	"
1993-09-24	Tara (SACMA)	"
1993-09-27	Ray Bohlmann	Who to coordinate with on hot, wet section (Glenn Grimes)
1993-09-29	Ed Clegg	Kickoff meeting at ARL, approval for E-49 travel (CHN to fax)
1993-09-29	Joe Soderquist	Ray Bohlmann has HSCT data package, CHN should check to see if it meets MIL-HDBK-17 data requirements
1993-09-30	Ed Clegg	Kickoff meeting scheduled for 10/1
1993-09-30	Gary Hagnauer	Kickoff meeting, MMC people, MMC concern
1993-10-05	Ed Clegg	(message) Briefing meeting changed to 10/29
1993-10-07	Kathy Bamberg	Confirmed briefing meeting change
1993-10-08	Rich Fields Sam Garbo John Adelman Joe Soderquist	Schedule for working group agendas and distributions
1993-10-11	Magdy Riskalla	Vought data for submission (hoping for consideration at the next meeting) Files in STAT17 format, documentation according to 8.1.2, submit in duplicate to Ed Clegg, call Magdy with statistical questions, John Pimm with technical questions
1993-10-11	Alex Segal	Comment faxed in Sept; need connection to material specs.
1993-10-11	Ted Kruhmin	Schedule for w.g. agendas and distributions
1993-10-13	Paul Bebchick	Stop work order

MIL-HDBK-17 Phone Log:		
Date	Contact(s)	Topic/Notes
1994-03-15	J.Soderquist	Request to review responses to J.Pimm's handbook review. Urgent need for data pooling. X to contact Mark Vangel regarding data pooling and A-basis sample size
1994-03-15	K.Wilcox	Registration, e-mail, send outline/status pages by end of week
1994-03-16	J.Brennan	Vought data disk unreadable, Joe to transfer data
1994-03-16	J.Brennan	E-mail of pkzipped file not workable; go ahead to talk directly to Vought
1994-03-17	M.Riskalla	Will e-mail files and FedX documentation

c. Significant Electronic Mail Contacts

The following electronic mail was received or sent during this reporting period:

MIL-HDBK-17 Project E-Mail (Sent) Log		
Date	Addressee(s)	Topic/Notes
1994-03-17	J.Adelmann G.Camponeschi R.Fields S.Garbo G.Hagnauer B.Pasternak M.Vangel	Properties list
1994-03-22	G.Hagnauer	Barriers list; topics list, agenda item format

MIL-HDBK-17 Project E-Mail (Received) Log		
Date	Sender(s)	Topic/Notes
1994-03-17	Chris Buckman	Vought data for MIL-HDBK-17

d. **Significant Facsimile Contacts**

The following facsimiles were received or sent during this reporting period:

MIL-HDBK-17 Project FAX's (Sent) Log		
Date	Addressee(s)	Topic/Notes
1993-09-28	Alex Segal	Comment will be forwarded officially, e-mail or phone week of 10/11
1993-09-30	Ed Clegg	Kickoff meeting agenda and procedures
1994-03-16	Joe Brennan Ed Clegg Gary Hagnauer Bob Pasternak	Draft briefing minutes
1994-03-16	Gary Hagnauer	Exec agenda suggestions
1994-03-18	WGC	Property lists

MIL-HDBK-17 Project FAX's (Received) Log		
Date	Sender(s)	Topic/Notes
1993-09-27	Alex Segal	Comment on qualification, allowables, specs [93-01]
1993-09-30	Paul Bebchick Ed Clegg	Authorization to attend E-49
1994-03-16	Gary Hagnauer	Draft exec agenda

11. **ENGINEERING CHANGE PROPOSAL STATUS**

No engineering change proposals are out-standing at this time.

12. **CONTRACT SCHEDULE STATUS**

Schedule and requirements for the database for handbook data need to be resolved. The content of the database was established at a meeting with Gary Hagnauer, Ed Clegg, and Bob Pasternak in Monterey on 28 March 1994. The database will contain all raw data as submitted from the source. This will affect the schedule for entering all backlogged data into the database.

13. ACTIVITIES PLAN

The following activities are planned for the next reporting period:

- a. Loading database
- b. Data analysis
- c. Completing documentation of Vought data
- d. Communication with all sources of data submitted but not yet approved
- e. Addressing data pooling considerations

14. PREPARER

This report was prepared by Crystal H. Newton, Project Engineer

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15. APPENDICES

Comment from Alex Segal



APPENDIX

27, September, 1993

Miss Crystal Newton
Project Engineer
Material Sciences Corporation
Suite 250
500 Office Center Drive
Fort Washington, PA 19034, USA

Dear Crystal,

It is just about a year since we met in Amsterdam, Holland, at the Conference on Composites Testing & Standardisation. I enjoyed the Conference and the opportunity to exchange ideas with you and other colleagues but I must say that I was disappointed with the small number of participants, especially from the industry.

There is an issue in which I am involved and would, therefore, like to know if it is going to be treated in MIL-HDBK-17 and if so, what is the approach.

The issue is the relation between material qualification test values, design allowables, and the requirements for minimum average and minimum individual values in the corresponding material specifications.

When a qualification program is carried out, the results of the mechanical tests form the basis for the material design allowables (as per MIL-HDBK-17 Vol.1). The widespread approach throughout the industry is to use "B" values for the stresses and strains, and average test values for the moduli. The question is: now that the design allowables have been established what should the minimum average requirements for acceptance be, in the corresponding material specification, to ensure that each future incoming material lot will have moduli and strength values not lower than the design allowables.

The material suppliers obviously desire to get as wide a range as possible so as to have minimum rejects but we at the engineering end have to make sure that the soundness of the design is well kept..

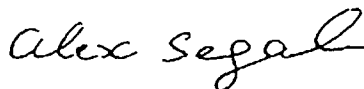
In the case of moduli, since the design value is the qualification tests average, using a lower value for acceptance, in the material specification, means that there is a 50% chance that material lots used for production shall have a lower modulus value than what was used in the design and the structural substantiation. When the design is stability critical the relation between the moduli design allowables and the minimum values for material acceptance becomes particularly sensitive. Surveying the situation in the industry I could not find a clear, well established, criterion for setting the minimum mechanical properties values for acceptance. There is sometimes a difference of approach from one M.S. to another within the same Company. I even found a case where the minimum values for acceptance were set lower than the "B" allowables!

My personal view is that the minimum average for acceptance should be taken as the qualification tests average minus one standard deviation.

It seems to me that this issue is important enough to be included in MIL-HDBK-17.

I would appreciate your comments and guidance in the issue. My phone number is 972-3-9353868 (home 972-3-9651864) and Fax No. 972-3-9355055.

Best Regards



Dr. Alex Segal
Manager, Advanced Technologies Structural Analysis
Dept. 2444.

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