Minutes of the Technical Advisory Board for Mechanical Environments of the Confederation for European Environmental Engineering Societies
Held on 17th February 2005, Brussels, Belgium

Present at the Meeting of the Technical Advisory Board for Mechanical Environments (TABME) were;

Dr Ulrich Braunmiller GUS
Mr Ton Geise PLOT
Mr Markku Juntunen KOTEL
Mr. David Richards SEE (Chairman)
Mr Thomas Trost SEES
Dr Karl Zieghan GUS

Matters Arising

Apologies were received from Mr D. Corben (PLOT) and Mr M. Dumelin (SSEE). A list of TABME members, including corresponding members, was circulated. As usual this list is attached to the minutes as Attachment No 1. The chairman also apologised that he had missed Mr Corben of the list of attendee’s at the previous minutes. His details are also now included in Attachment No 1.

CEEES Website – TABME Content

A brief description of each of the TABME members had been circulated previously with the intended that this should go on the CEEES website. It was agreed that this should be passed to the CEEES secretariat for inclusion. Currently the website does not include any real information on the individual TAB’s. A discussion ensued on topics that could be included. It was agreed that it would be appropriate for the minutes of the TABME to be included (although the group had concerns that it was not appropriate to include the CEEES council minutes). The discussion identified a number of reports / documents that could be included these are listed below along with a few subsequent thoughts.

- Members – Existing membership list
- Meetings – last and historic meeting minutes
- TABME Studies – Reports on the two round robins, data files used for RRI & II.
- TABME Reports – Methodology papers etc.
- Studies supported by TABME – SRETS, EG 8
- Methodologies Championed – FDS / MRS such as references and workshop notes.

Systematisation of Measurement Methodologies

STANAG 4370. The group was reminded that version 3 was made available for CEN WS 10 EG8. Although this has since been made publicly available copies can be obtained from the chairman. It was reported that work on version 4 was underway.

Mil Std 810F Karl reported on a presentation to be made by Skip Connon on the future of Mil Std 810, at a recent GUS workshop at Karlshrue. Skip discussed the future of 810 and it was indicated that the kick off meeting for 810G would occur within a few weeks of the CEEES meeting. Skips presentation on 810 is attached as Attachment No 3.

Def Stan 00-35. The chairman reported that work on Def Stan 00-35 version 4 was nearing completion. With regard the TABME’s area of interest it was reported that the vibration and shock test severities were been revised. The chairman reported that the basic pulse shock test, which previously allowed half sine, trailing edge saw tooth and trapezoidal pulse shapes (in line with IEC 60068) had been modified to include a decaying sinusoidal waveform. This was mostly to facilitate testing for transportation shocks along side vibration tests on vibration excitation equipment. Three figures were shown of the new test pulse shape and two severities to be recommended. These are attached as Attachment No 4.
IEC TC104. The chairman reported that a list of procedures to be reviewed in 2005 had recently been published. The documents to be reviewed are:

<table>
<thead>
<tr>
<th>Document Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>60068-2-14 Ed.5</td>
<td>Part 2-14: Test N: Change of temperature</td>
</tr>
<tr>
<td>60068-2-33 Ed.1</td>
<td>Part 2-33: Guidance on change of temperature tests</td>
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<tr>
<td>60068-2-38 Ed.1</td>
<td>Part 2-38: Test Z/AD: Composite temperature/humidity cyclic test</td>
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<td>0068-3-1 Ed.1</td>
<td>Part 3: Section One: Cold and dry heat tests</td>
</tr>
<tr>
<td>60068-3-1A</td>
<td>Part 3: Guidance. Seismic test methods for equipment</td>
</tr>
<tr>
<td>60068-3-3 Ed.1</td>
<td>Part 3-3: Guidance. Seismic test methods for equipment</td>
</tr>
<tr>
<td>60068-2-45 Ed.1</td>
<td>Part 2-45: Test XA and guidance: Immersion in cleaning solvents</td>
</tr>
</tbody>
</table>

It was reported that the last main meeting of TC104 had part 4 of 60721 was to be issued a standard rather than as currently a technical report. A discussion followed which indicated that part 4 may not have been translated into German. However, a subsequent review of the information that Ulrich had been looking for suggested that the particular information was not actually published, but rather in an addition to the published parts that was never completed. The information was, however, in Part 3.

DIN 30786/7. The 30787 part of this publication had been sent to CEN. It was still uncertain as to whether this would be accepted due to the lack of proposed technical experts. Karl presented the data in the latest version of 30786-2 and some discussion occurred.

CEN TC 261 SC5 WG14 – Test Methods & Test Schedules. The Din Std had been offered to this group at its meeting in January 2005. However, not sufficient countries had voted YES with a technical expert. Because of the lack of experts acceptance of the DIN as a PAS was on hold. Ulrich gave a presentation he had previously made to WG14 regarding vibration test severities. A discussion on his proposals ensued specifically on;

a. whether the road types encompassed by the original SRETS severities were representative of road types in Eastern Europe (since SRETS most of the long distance routes had been significantly improved and were effectively at western European standards).

b. whether improvements in trucks will bring low frequency component down and how & when existing component should be included.

c. Why it is unrealistic to envelope higher frequency components.

The sequence of tests and levels schedules in ISO 4180 Parts 1 & 2 have been proposed to be used.

CEN TC 261 SC5 WG14 Revolving Drum Test. Thomas made a presentation on the revolving drum test to elicit the groups view on the applicability of this test method which is from CEN 126 WG14. The existing TAPPI revolving hexagonal drum method s proposed. This is a 4.2 m diameter drum which rotates at 2 rpm and has wooden slats to simulate rough handling. The following discussion addressed whether this method or theISTA (Internal Safe Transit Association) alternative for postal services was preferable.

UN Orange Book. At the last meeting it was observed that once again it is rumoured that the US / Spanish proposal for the inclusion of a vibration test had been accepted by the responsible technical group. No information was available at this meeting.

CEN WS 10 EG 8 (Workshop on Defence Procurement). It was reported that work was on-going with the due date for the final report moved to end of June 2005 from end of December 2004.

Miscellaneous – Transmissabilities. The Chairman informed the meeting that Dave Corben had written a paper which was referenced in comments on the recently updated test & fixtures chapter of IEC 60068. The comments related to an annex on computing shock responses across AV mounts. The chairman said he had produced the approach for the authors of the chapter, however, the only portion of the method actually used only adopted assumed transmissabilities. The comment / paper questioned one of the assumptions in the method. The Chairman had invited Dave Corben to discuss this at the next TABME. The chairman also
indicated that the use of assumed transmissibilities had been removed from the latest version of Def Stan 00-35, rather measured transmissibilities are required. (copies of the section of the IEC chapter and the associated comments can be obtained from the chairman).

**Miscellaneous – Force Limiting.** The discussion moved on to the absence of force limiting in most of the current standards on vibration testing. The chairman passed around information on force limiting extracted from NASA Hdbk 7005, which was been looked at for inclusion in the UK Def Stan 00-35. Karl indicated that a GUS had a working group on force limiting which he thought was close to finishing its deliberations. He agreed to determine the status / results of the work.

**Overview** At a previous meeting the group had generated an overview of European and International work currently underway relating to transportation stresses. That overview was included as an attachment in the minutes of the last meeting. This meeting reviewed and updated the chart. The updated version is include here as attachment No 2.

**Technical Papers - Working Practices**

During previous discussions it became apparent that the paper needed an overview. It was agreed and the working practices would need an overview of the larger process. It was further suggested that this could follow the same process as that of a paper by Markku viz. Environmental Test Tailoring Management plan, Life Cycle, Environmental Conditions, Derivation of Test Specification. Markku had undertaken to prepare an overview for the paper, he passed this over at the meeting. It is intended that this be circulated for review at the next TABME meeting.

Karl had obtained a paper by Skip Connon which was quite similar to that been prepared by the TABME. In order to complete the current work it was proposed that the existing paper be completed in its current form as soon as possible. In order to include a useful example to the paper, the chairman had been considering several options. It was proposed that data from (a UK operated) C17 aircraft could form an appropriate database from which examples could be extracted. A presentation of the available data was made to the TABME by the chairman (as data is extensive is supplied separately) . It was possible that the database of the C17 analysis could be put into the public domain.

The Chairman suggested the possibility of using the C17 data as the basis for a TABME exercise in deriving test severities. It was agreed that this could be a possibility.

The chairman undertook to prepare a modified version of the existing paper and circulate for additional input.

**Presentation**

Markku gave a presentation on a new Kotel project which is attached as Attachment 5.

**Topics for Future Consideration**

The members of the TABME had previously identified a number of potential future topics for future consideration;

- Basic techniques for data collection / analysis.
- FDS / MRS - Potential variations between different methods.
- Test tailoring – “How do other people do it?"

An addition possible topic “lean testing” was proposed and discussed - this approach attempts to combine tests, which traditionally have been undertaken separately viz. investigatory, qualification tests, reliability tests etc. “The lean design process” is currently a common topic, but less so “lean testing”.

Page 3 of 4
Any Other Business

Karl reminded the meeting about the 3rd Nuremberg conference scheduled for May 11th/ 12th 2005. Fliers for this are now available.

A discussion then occurred on the use of the COST programme as a possible means of obtaining to obtain EU funding for some of the CEEES activities. A presentation on the COST programmes was scheduled as part of the main CEEES meeting in the afternoon. For this reason the COST discussion is not repeated here excepting that Marrku indicated he had experience of the COST programme.

Next Meeting

The date of the next meeting of the TABME is planned for Monday 24th October 2005 in Paris.

Attachments

1. Names and Addresses of TAMBE Members
2. An Overview of European and International work
3. Skip Connon Presentation to GUS Workshop on Future of Mil Std 810
4. New shock waveform intended for Def Stan 00-35 for transportation shock
5. Presentation from Markku Juntunen
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Fax No: 49 42 06 29 97 28  
E-Mail: schneider-eckhard@t-online.de
An Overview of European and International work

<table>
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<tr>
<th>Group / Standard</th>
<th>Connection with CEEES Working Group</th>
<th>Other Connections</th>
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<td>ISO – TC 108 wg 26 &amp; 27</td>
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<td>Kjell Ahlin</td>
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<tr>
<td>ISO – TC 122</td>
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<td>ISO - Railway</td>
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<td>Aad Van Dorp</td>
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<td>CEN TC 261</td>
<td>Ulrich Braunmiller</td>
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<tr>
<td>CEN TC 320 Transportation Services</td>
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<td>Soren Ostergaard</td>
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<tr>
<td>DIN 30787 NAVP 1.4</td>
<td>Ulrich Braunmiller</td>
<td>Ed Furrer</td>
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<td>UN Orange Book</td>
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<tr>
<td>Mil Std 810</td>
<td></td>
<td>Skip Connon</td>
</tr>
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<td>Nato Standard - AC310</td>
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<td>Nato Standard - AC301</td>
<td>Markus Dumelin</td>
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<tr>
<td>IEC Railways</td>
<td></td>
<td>Odd Sylwan</td>
</tr>
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Comments on MIL-STD-810

Skip Connon
US Army Aberdeen Test Center
RECENT HISTORY

MIL-STD-810F Published 1 Jan 2000

Many Schedules Were Removed (from 810E)
  Mainly Detail Schedules for Tracklaying Vehicles

ITOPs are NOT Public Release Documents
RECENT HISTORY

Change Notice 1 Issued 17 Oct 2000
No changes to Method 514

Change Notice 2 Issued 30 Aug 2002
Some technical changes to Method 514

Change Notice 3 Issued 5 May 2003
Some technical changes to Method 514
MIL-STD-810G is Anticipated

US Air Force is the Preparing Activity and is Responsible for Overall Management

US Army Developmental Test Command (DTC) is the Lead Standardization Activity

No Formal Committee Currently Exists
Extracts from Def Stan 00-35 Test M3 Relating to the Inclusion of Decaying Sinusoidal Pulse for Simulating Transportation Shocks

2.3 Compensation Pulses

2.3.1 The classic shock waveforms were originally intended for use with drop and impact shock generators. Whilst, these classic shock waveforms can be implemented on electro-dynamic or servo-hydraulic actuators, a compensation pulse may be needed to ensure that the final velocity and displacement are zero. Utilising such an adjustment is permissible provided the compensation pulse has a duration of at least three times that of the required pulse duration. The combined classic shock waveform and the compensation pulse should be within the waveform tolerances specified in the Environmental Test Requirement. Exceedance of the specified test tolerance may be permissible with the agreement of the Test Specifier.

2.3.2 When using a damped sinusoidal waveform the final velocity and displacement may not be zero. In order to overcome potential problems with the electro-dynamic or servo-hydraulic actuators a compensation pulse is normally added to the synthesized time history. In some proprietary shock synthesis programs this compensation pulse is added without user intervention. However, in other programs the compensation pulse frequency and decay rate must be selected. Generally, a compensation pulse should be applied with a frequency of approximately one-half to one-third the minimum frequency of the damped sinusoidal waveform, with a decay rate approaching 100% of critical damping.

2.3.3 Using suitable values of compensation pulse frequency ($\omega_c$) and decay rate ($\zeta_c$), the compensation pulse amplitude ($A_c$) and delay time ($t_c$), can be computed (using Equations 1 and 2) to control residual velocity and displacement respectively. In this case the delay time is the time between initiation of the compensation pulse and the subsequent start of the decaying sinusoids.

\[
\frac{A_i}{\omega_i (\zeta_i^2 + 1)} = -\frac{A_i}{\omega_i (\zeta_i^2 + 1)} \quad \text{Equation 1}
\]

\[
\frac{A_i t_c}{\omega_i (\zeta_i^2 + 1)} = \frac{2\zeta_i A_i}{\omega_i^2 (\zeta_i^2 + 1)^2} + \frac{2\zeta_i A_i}{\omega_i^2 (\zeta_i^2 + 1)^2} \quad \text{Equation 2}
\]

$A_i$, $\omega_i$, $\zeta_i$ are the amplitude, cyclic frequency, and decay rate of the specified sinusoidal component.
Table 2: Shock severities associated with the simulation of actual operational shock conditions

<table>
<thead>
<tr>
<th>On-road vehicles</th>
<th>Decaying Sinusoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half Sine Pulse</td>
<td>45 Hz</td>
</tr>
<tr>
<td>OR Duration 11 ms Duration (T): 0.6 s</td>
<td>0.6 s</td>
</tr>
<tr>
<td>Frequency (F): 45 Hz</td>
<td>45 Hz</td>
</tr>
<tr>
<td>Number of complete cycles (N): 27</td>
<td>27</td>
</tr>
<tr>
<td>Damping factor: 3% of critical</td>
<td>3%</td>
</tr>
<tr>
<td>Amplitude (g pk)</td>
<td>Number of Repetitions</td>
</tr>
<tr>
<td>4.0</td>
<td>42</td>
</tr>
<tr>
<td>5.0</td>
<td>21</td>
</tr>
<tr>
<td>6.0</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Off-road vehicles</th>
<th>Decaying Sinusoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half Sine Pulse</td>
<td>100 Hz</td>
</tr>
<tr>
<td>OR Duration 5 ms Duration (T): 0.3 s</td>
<td>0.3 s</td>
</tr>
<tr>
<td>Frequency (F): 100 Hz</td>
<td>100 Hz</td>
</tr>
<tr>
<td>Number of complete cycles (N): 27</td>
<td>27</td>
</tr>
<tr>
<td>Damping factor: 3% of critical</td>
<td>3%</td>
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<tr>
<td>Amplitude (g pk)</td>
<td>Number of Repetitions</td>
</tr>
<tr>
<td>8.0</td>
<td>42</td>
</tr>
<tr>
<td>10.0</td>
<td>21</td>
</tr>
<tr>
<td>12.0</td>
<td>3</td>
</tr>
</tbody>
</table>

The above tabulated values may be considered for both restrained cargo and installed materiel on wheeled and tracked vehicles.

The shock test schedule set out in Table 2 can be undertaken using either half sine pulses applied in each sense of each orthogonal axis or a single decaying sinusoidal pulse encompassing both senses in a single test.
Figure 4: Damped Sinusoidal Shock Pulse Waveform

Key to Figure 4

- - - = normal pulse

= limits of tolerance

F = Frequency of Sinusoid (ω = 2πF)
A = peak amplitude of first peak
ζ = exponential damping factor
T = the total duration of waveform (number of cycles N = F x T)
T1 = minimum time during which the waveform shall be monitored (2T before waveform and 3T after waveform viz. 6T in total)

\[
an(t) = \frac{A \times \sin(\omega t) \times e^{-\zeta \omega t}}{e^{-\frac{\pi \zeta}{\omega}}}\]
Required Waveform and Combined with Compensation Pulse and Tolerances

Decaying Sinusoid
Frequency 45 Hz
(equiv. 11 ms pulse)
Damping 3\% of Critical

Assumed Compensation Waveform Parameters
Frequency 10 Hz
Damping 30 \% of Critical

Computed Compensation Waveform Parameters
Initial Amplitude: -1.522 g
Delay 0.00927 s
Required Waveform and Combined with Compensation Pulse and Tolerances

Decaying Sinusoid
Frequency 100 Hz
(equiv. 5 ms pulse)
Damping 3% of Critical

Assumed Compensation Waveform Parameters
Frequency 20 Hz
Damping 30% of Critical

Computed Compensation Waveform Parameters
Initial Amplitude: -2.74 g
Delay 0.004588 s
"A practical tailored test/design problem: the product specifications for environmental loads - on many occasions you have only limited information and for subsystems nothing”

Markku Juntunen
KOTEL, Finland
Goal

• Discussion of some practical experiences and current views
“Playground”: a problem set-up

NEW PRODUCT

SUBSTURCTURE

ENVIRONMENT?
- real-life/ std. tests
- end user, statistics

ISOLATOR

EQUIPMENT
- subsystems

DESIGN?
- early stage
- simulation

DURABILITY?
- specifications
- COTS
“The Players”

- END USER
- CUSTOMER
- MANUFACTURER
- STANDARDS
- DESIGN TOOLS
- TESTING FACILITIES
- CONSULT
- SUB-CONTRACTOR
- EXPERTS
TAILORING IS AN ANSWER?

BUT IS IT TOO COMPLICATED TO BE EFFICIENT?

IS IT TOO DIFFICULT TO BE ECONOMICAL?

WHICH OF TAILORING AND ANALYSIS PROCESS DO WE USE?
CAN WE MAKE IT SIMPLER?

Environmental Test Tailoring
Management Plan

Environmental Life Cycle Profile

Environmental Condition
Identification

Derivation of Test Specifications
BUT TAILORING IS ONLY A PART OF THE GAME?

• ISN’T THE PRODUCT DEVELOPMENT THE KEY ISSUE?

• THE BOSS SHOULD UNDERSTAND US, TOO?

• HOW TO PUT THE TAILORING INTO THE LARGER PICTURE?
COULD THIS WORK?

Control of reliability with life-cycle management

- methodology
- integration
- base and structure for co-operation
YOU COULD DO IT VIRTUALLY?

SIMULATION GETTING REALLY COST-EFFICIENT?

WOULDN’T IT BE FUN?

YOU WOULD NEED REAL EXPERTS IN TESTING AND VERIFICATION?

THIS IS GOOD NEWS?!