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SURFACE VEHICLE STANDARD

SAE J2623

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Standard Rainflow File Format

1. ***Scope—***This SAE Standard provides a definition of a rainflow file format. This type of simple text file would contain all relevant information about the rainflow cycle content of a time history. Included information are Comments, Signal Range, Signal Mean, Number of Cycles, Signal Maximum, Signal Minimum.

Rainflow cycle counting has become the most accepted procedure for identifying material fatigue relevant cycles in complex variable amplitude load time histories. The cycle counting methods account for the effects of material plasticity and material memory of prior deformation, and the resulting compressed history information is used by durability analysts to estimate the effects of a given service or test history. Standardization of the rainflow counting methods output files, which is the format addressed by the present standard, is important for reliable information transfer between test and design groups, or different calculation software packages, and thus forms a critical step in the evaluation of components and vehicles. Further background information can be found in the SAE publication AE-10 cited in 2.1.1.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

The following publication lists a computer program for rainflow cycle counting.

SAE AE-10—"Fatigue Design Handbook," 2nd edition 1988 pages 126-132.

2.1.2 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

The following publication defines how rainflow cycles are counted.

ASTM E 1049, 1996—Standard Practices for Cycle, Counting in Fatigue Analysis

3. ***Definitions—***See ASTM E 1045.

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4. ***Rationale***—A standard rainflow file is proposed to facilitate easy exchange of information of the rainflow content of a time history. Various vendor specific formats exist, but this document would allow users to exchange information without the use of commercial file translators.

PREPARED BY THE SAE ROAD LOAD DATA ACQUISITION SUBCOMMITTEE OF THE SAE FATIGUE DESIGN AND EVALUATION COMMITTEE

APPENDIX A

SAE STANDARD RAINFLOW TEXT FILE EXAMPLE

A.1 Standard Rainflow File—The first part of the file is a comment section like this section of text.

Anything can go in this section except the word **BEGIN** or **"#BEGIN"** at the front of a line. Users can add special flags, switches and operators if they wish, but no standards are set about what is in this comment section.

Examples of user specific comments:

#FileType= rainflow
#DataType= raw #"raw"= measured, as opposed to "fitted"

#This is a S A E STANDARD RAINFLOW DATA TEXT FILE

Examples of user specific program switches:

!MIDDLE OF BAND ZERO:0!
!UNITS/LEVEL:100!
sptv 1 5 25.0000
start T: 0 5700 22700
end T: 5600 22000 37000
.rain 800.000 -800.000
#Emod= 201000.

If you see text like this in a file supplied to you, it would be prudent to ask your supplier as to their meaning or intent. It is recommended that such flags, or switches not be or used in an SAE standard rainflow file if possible because they can mislead an inexperienced user. It is preferable that the data should be adjusted by the supplier program to reduce the reliance on switches.

A.1.1 End of Comments, Beginning of Data—The comment section is ended by the following line, after which the data follows:

#BEGIN DATA

A.1.2 Data Section—The data can be in any units for the signal, but must use CYCLES (rather than reversals) as the event counter. Numbers are to be read (and therefore can be written) in "free format", i.e.: separated by one or more blanks. Note that blank lines are allowed amongst the data lines. In normal practice the SIGNAL values will be read by computers into REAL (Floating Point) storage locations. CYCLES are generally expected to be INTEGERS, but some rainflow counting methods create fractional cycles, and in consequence give a cycle count such as "1050.5" for example. Thus the cycle numbers should be read as REAL*8 or DOUBLE PRECISION. The write format can be REAL OR INTEGER depending on the algorithm used to count the cycles. See Table A1:

TABLE A1—DATA COLUMN CODE

Col.1	Col.2	Col.3	Col.4	Col.5
Signal Range	Signal Mean	No. of Cycles	Signal Maximum	Signal Minimum

A.1.3 End of Data Section

No special delimiters are used as “End-of-File”(EOF); it is up to the reading program to detect the EOF by itself. (On some machines it may be wise to place an extra blank line as the last line, otherwise the last data line may not be read.)

A.1.4 Example of Data Section

```
 #BEGIN     DATA
0.103E+04    232.   1     748.     -284.
826.         232.   1     645.     -181.
877.         258.   1     697.     -181.
51.6    -103.        17    -77.4    -129.

103. -77.4 5 -25.8 -129.
155. -51.6 3 25.8 -129.
206. -25.8 1 77.4 -129.
258. 0.305E-04 2 129. -129.
310. 25.8 3 181. -129.
361. 51.6 2 232. -129.
465. 103. 2 335. -129.


516. 129. 1 387. -129.
568. 155. 4 439. -129.
619. 181. 3 490. -129.
671. 206. 2 542. -129.
723. 232. 5 594. -129.
774. 258. 4 645. -129.
826. 284. 1 697. -129.
51.6 -51.6 61 -25.8 -77.4
103. -25.8 29 25.8 -77.4
155. 0. 27 77.4 -77.4
206. 25.8 23 129. -77.4
258. 51.6 6 181. -77.4
310. 77.4 8 232. -77.4
361. 103. 3 284. -77.4
413. 129. 7 335. -77.4
619. 232. 1 542. -77.4
671. 258. 2 594. -77.4
51.6 0. 287 25.8 -25.8
103. 25.8 125 77.4 -25.8
155. 51.6 61 129. -25.8
206. 77.4 14 181. -25.8
```