

DIN EN 15433-4:2008-02 (E)

Transportation loads - Measurement and evaluation of dynamic mechanical loads - Part 4: Data evaluation

Contents		Page
Foreword		5
Introduction		6
1	Scope	7
2	Normative references	9
3	Measured signals	9
3.1	Instantaneous values	9
3.2	Average values	9
3.2.1	General	9
3.2.2	Instruments and software	10
3.2.3	Types of averaging	10
3.2.4	Averaging time and sampling errors	10
3.3	Synchronous averaging	11
3.3.1	General	11
3.3.2	Instruments and software	12
3.3.3	Triggering procedures	12
3.3.4	Signal-to-noise enhancement	12
3.4	Filtered signals	13
3.4.1	General	13
3.4.2	Analogue filtering	13
3.4.3	Digital filtering	14
4	Data classification	14
4.1	General	14
4.2	Time dependence	14
4.2.1	General	14
4.2.2	Stationary or steady-state data	14
4.2.3	Non-stationary data	15
4.2.4	Transient data	16
4.2.5	Physical considerations	16
4.3	Randomness	17
4.3.1	General	17
4.3.2	Identification of periodic components	17
4.3.3	Separation of random and periodic components	17
4.4	Normality	18
4.4.1	General	18
4.4.2	Test for normality	18
4.4.3	Spurious deviations from normality	18
5	Single channel spectral analysis/periodic and random data	18
5.1	FFT algorithms	19
5.1.1	General	19
5.1.2	Number of data values	19
5.1.3	Redundant components	19
5.1.4	Leakage and tapering	20
5.1.5	Spectral bandwidth	21
5.2	Periodic data	22
5.2.1	General	22

5.2.2	Instruments and software	22
5.2.3	Anti-aliasing filters	23
5.2.4	Leakage and tapering	23
5.2.5	Frequency resolution	23
5.2.6	Resolution error corrections	23
5.2.7	Statistical sampling errors	25
5.2.8	Plotting	25
5.3	Stationary random data	25
5.3.1	General	25
5.3.2	Instruments and software	27
5.3.3	Anti-aliasing filters	27
5.3.4	Leakage and tapering	27
5.3.5	Frequency resolution	27
5.3.6	Resolution error corrections	29
5.3.7	Statistical sampling errors	29
5.3.8	Overlapped processing	30
5.3.9	Zoom transforms	31
5.3.10	Plotting	31
5.4	Non-stationary data	31
5.4.1	General	31
5.4.2	Random signals	31
5.4.3	Time codes	32
5.5	Proportional bandwidth spectra	33
5.5.1	General	33
5.5.2	1/3-octave band spectra	33
5.5.3	Other proportional bandwidth spectra	33
6	Single channel spectral analysis/transient data	33
6.1	General	33
6.2	Fourier spectra	34
6.2.1	General	34
6.2.2	Instruments and software	34
6.2.3	Anti-aliasing filters	34
6.2.4	Leakage and tapering	34
6.2.5	Frequency resolution	35
6.2.6	Resolution error corrections	35
6.2.7	Statistical sampling errors	36
6.2.8	Plotting	36
6.3	Energy spectra	36
6.3.1	General	36
6.3.2	Instruments and software	37
6.3.3	Anti-aliasing filters	37
6.3.4	Leakage and tapering	37
6.3.5	Frequency resolution	37
6.3.6	Resolution error corrections	37
6.3.7	Statistical sampling errors	37
6.3.8	Plotting	37
6.4	Shock response spectra (SRS)	37
6.4.1	General	37
6.4.2	Interpretation of SRS results	40
6.4.3	Presentation of SRS results	40
6.4.4	Instruments and software	41
6.4.5	Anti-aliasing filters	41
6.4.6	Sampling rate	41
6.4.7	Truncation error	41
6.4.8	Initial conditions	41
6.4.9	Frequency resolution	41
6.4.10	Resolution error corrections	41
6.4.11	Statistical sampling errors	42
6.4.12	Plotting	42
6.4.13	Other SRS computations	42

7	Dual channel analysis	43
7.1	General	43
7.2	Cross-spectra	43
7.2.1	General	43
7.2.2	Instruments and software	44
7.2.3	Anti-aliasing filters	44
7.2.4	Leakage and tapering	44
7.2.5	Frequency resolution	45
7.2.6	Resolution error corrections	45
7.2.7	Time delay bias error	45
7.2.8	Multiple path (reverberation) bias error	46
7.2.9	Statistical sampling errors	46
7.2.10	Overlapped processing	47
7.2.11	Zoom transforms	47
7.2.12	Plotting	47
7.3	Coherence	47
7.3.1	General	47
7.3.2	Instruments and software	48
7.3.3	Anti-aliasing filters	48
7.3.4	Leakage and tapering	48
7.3.5	Frequency resolution	48
7.3.6	Time delay bias errors	48
7.3.7	Multiple path (reverberation) errors	49
7.3.8	Statistical sampling errors	49
7.3.9	Overlapped processing	50
7.3.10	Zoom transforms	50
7.3.11	Plotting	50
7.4	Frequency response	50
7.4.1	General	50
7.4.2	Instruments and software	51
7.4.3	Anti-aliasing filters	51
7.4.4	Leakage and tapering	51
7.4.5	Frequency resolution	51
7.4.6	Statistical sampling errors	51
7.4.7	Overlapped processing	52
7.4.8	Zoom transforms	52
7.4.9	Plotting	52
7.5	Cross-correlation	52
7.5.1	General	52
7.5.2	Instruments and software	53
7.5.3	Anti-aliasing filters	53
7.5.4	Leakage and tapering	53
7.5.5	Time resolution	53
7.5.6	Time delay bias error	53
7.5.7	Statistical sampling errors	54
7.5.8	Overlapped processing	54
7.5.9	Plotting	54
7.6	Correlation coefficient	54
7.7	Unit impulse response	55
8	Other analysis	55
8.1	General	55
8.2	Probability density	55
8.2.1	General	55
8.2.2	Instantaneous probability density	55
8.2.3	Peak probability density	56
	Bibliography	59