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**Environmental Engineering (EE);
Environmental conditions and environmental tests for
telecommunications equipment;
Part 2-2: Specification of environmental tests;
Transportation**

Reference

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Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Environmental Engineering (EE).

The present document is part 2, sub-part 2 of a multi-part deliverable. Full details of the entire series can be found in part 2, sub-part 0 [4].

National transposition dates	
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1 Scope

The present document specifies test severities and methods for verification of the required resistibility of equipment according to the relevant environmental class.

The tests defined in the present document apply to transportation of equipment covering the environmental conditions stated in EN 300 019-1-2 [1].

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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2.1 Normative references

The following referenced documents are necessary for the application of the present document.

- [1] ETSI EN 300 019-1-2: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation".
- [2] IEC 60068-2-1 (03/2007): "Environmental testing, Part 2-1: Tests - Test A: Cold".
- [3] ISO 4180:2009: "Packaging -- Complete, filled transport packages -- General rules for the compilation of performance test schedules".
- [4] ETSI EN 300 019-2-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-0: Specification of environmental tests; Introduction".
- [5] IEC 60068-2-2 (07/2007): "Environmental testing, Part 2-2: Tests - Test B: Dry heat".
- [6] IEC 60068-2-14 (01/2009): "Environmental testing - Part 2-14: Tests - Test N: Change of temperature".
- [7] IEC 60068-2-78 (08/2001): "Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state".
- [8] IEC 60068-2-30 (08/2005): "Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)".
- [9] IEC 60068-2-64 (04/2008): "Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance".
- [10] IEC 60068-2-27 (02/2008): "Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock".
- [11] IEC 60068-2-31 (05/2008): "Environmental testing - Part 2-31: Tests - Test Ec: Rough handling shocks, primarily for equipment-type specimens".
- [12] IEC 60068-2-18 (10/2000): "Environmental testing - Part 2-18: Tests - Test R and guidance: Water".

- [13] IEC 60068-2-68 (8/1994): "Environmental testing - Part 2: Tests - Test L: Dust and sand".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI EN 300 019-1-0: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-0: Classification of environmental conditions; Introduction".

3 Definitions

For the purposes of the present document, the terms and definitions given in EN 300 019-1-0 [i.1] apply.

4 Environmental test specifications

The detailed descriptions of the environmental conditions are given in clauses 4 and 5 of EN 300 019-1-2 [1].

EN 300 019-2-0 [4] forms a general overview of the present document.

If the equipment is normally transported in a packed state then it shall be tested in its packaging.

4.1 Specification T 2.1: Very careful transportation

Specification T 2.1 applies to transportation by air and by road on good quality road surfaces where special care has been taken with respect to low temperatures, handling and type of vehicle. See tables 1 and 2.

Table 1: Test specification T 2.1: Very careful transportation - climatic tests

Environmental parameter			Environmental Class 2.1	Environmental test specification T 2.1: Very careful transportation					
Type	Parameter	Detail parameter	Characteristic Severity	Test severity	Duration	Reference	Method	Notes	
Air temperature	low	(°C)	-25	-25	6 h	IEC 60068-2-1 [2]	Ab: Cold	1	
	high	unventilated (°C)	+70	+70	6 h	IEC 60068-2-2 [5]	Bb: Dry heat		
		ventilated or outdoors (°C)	+40	None					
	change	air/air (°C)	-25/+30	-25/+30	5 cycles	t1 = 3h	IEC 60068-2-14 [6]	Nb: Change of temperature	3a
air/water (°C)		+40/+5	None		3b				
Humidity	relative	slow temperature change (%)	95	93	4 d	IEC 60068-2-78 [7]	Cab: Damp heat steady state	4	
		rapid temperature change (%)	+40	+30					
	absolute	rapid temperature change (°C)	-25/+30	95	90-100	2 cycles	IEC 60068-2-30 [8]	Db: Damp heat cyclic Variant 1	5
		change (g/m ³)	+70/+15	60	none				
Air	pressure	low (kPa)	70	none				6	
		change	no						
	speed	(m/s)	20	none				7	
Water	rain	intensity (mm/min)	6	none				8	
		low temperature (°C)	no						
	other sources	(m/s)	1					7	
	wetness		wet surfaces					9	
Radiation	solar	(W/m ²)	1 120					10	
	heat	(W/m ²)	600					10	

Environmental parameter			Environmental Class 2.1	Environmental test specification T 2.1: Very careful transportation					
Type	Parameter	Detail parameter	Characteristic Severity	Test severity	Duration	Reference	Method	Notes	
Chemically active substances	sulphur	SO ₂ (mg/m ³)	1,0	none				11	
		H ₂ S (mg/m ³)	0,5	none				11	
	chlorine	salt	sea and road salt mist		none				11
		Cl ₂ (mg/m ³)	no						11
		HCl (mg/m ³)	0,5	none					11
	nitrogen	NO _x (mg/m ³)	1,0	none					11
		NH ₃ (mg/m ³)	3,0	none					11
	hydrogen fluoride HF	(mg/m ³)	0,03	none					11
ozone O ₃	(mg/m ³)	0,1	none					11	
Mechanically active substances	dust	sedimentation (mg/(m ² h))	3,0	none				12	
		suspension (mg/m ³)	no						
	sand	(mg/m ³)	100	none				12	
Flora and fauna	micro organisms		mould, fungus, etc.	none				13	
	rodents, insects		rodents, etc.	none				13	

NOTE 1: no = this condition does not occur in this class.
NOTE 2: none = verification is required only in special cases.
NOTE 3: n = number of note, see clause 4.4.

Table 2: Test specification T 2.1: Very careful transportation - mechanical tests

Environmental parameter			Environmental Class 2.1	Environmental test specification T 2.1: Very careful transportation				
Type	Parameter	Detail parameter	Characteristic Severity	Test severity	Duration	Reference	Method	Notes
Vibration	sinusoidal	displacement (mm)	3,5	none				14
		acceleration (m/s ²)	10 15					
		frequency range (Hz)	2-9 9-200 200-500					
	random	ASD (m ² /s ³)	1 0,3	1,0	3 x 30 minutes	IEC 60068-2-64 [9]	Fh: Vibration, broad-band random (digital control)	15
		frequency range (Hz)	10-200 200-2 000	5-20 20-200				
		axes of vibration		3				

Environmental parameter			Environmental Class 2.1	Environmental test specification T 2.1: Very careful transportation				
Type	Parameter	Detail parameter	Characteristic Severity	Test severity	Duration	Reference	Method	Notes
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s ²) mass (kg) number of shocks direction of shocks	no					
Fall	free fall	height (mm) mass (kg) attitude	no					
	toppling around	mass (kg) edges	no					
Acceleration	steady state	(m/s ²)	20	none				19
Load	static load	(kPa)	5	none				20
Miscellaneous	rolling and pitching	angle (deg) period (s)	no					
NOTE 1: no = this condition does not occur in this class. NOTE 2: none = verification is required only in special cases. NOTE 3: n = number of note, see clause 4.4.								

4.2 Specification T 2.2: Careful transportation

Specification T 2.2 applies to transportation by air, by road on good quality road surfaces, by ship and by train with specially designed shock-reducing buffers and where special care has been taken with respect to low temperatures and handling. See tables 3, 4 and 7.

Table 3: Test specification T 2.2: Careful transportation - climatic tests

Environmental parameter			Environmental Class 2.2	Environmental test specification T 2.2: Careful transportation					
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes	
Air temperature	low	(°C)	-25	-25	72 h	IEC 60068-2-1 [2]	Ab: Cold	1	
	high	unventilated	(°C)	+70	+70	72 h	IEC 60068-2-2 [5]	Bb: Dry heat	
		ventilated or outdoors	(°C)	+40	none				
	change	air/air	(°C)	-25/+30	-25/+30	5 cycles t1 = 3h	IEC 60068-2-14 [6]	Nb: Change of temperature	3a
		air/water	(°C)	+40/+5	none				

Environmental parameter			Environmental Class 2.2	Environmental test specification T 2.2: Careful transportation				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Humidity	relative	slow temperature change (%) (°C)	95 +40	93 +40	4 d	IEC 60068-2-78 [7]	Cab: Damp heat steady state	4
		rapid temperature change (%) (°C)	95 -25/+30	90-100 +40	2 cycles	IEC 60068-2-30 [8]	Db: Damp heat cyclic Variant 1	
	absolute	rapid temperature change (°C) (g/m ³)	+70/+15 60	none				5
Air	pressure	low (kPa)	70	none				6
		change	no					
	speed	(m/s)	20	none				7
Water	rain	intensity (mm/min)	6	none				8
		low temperature (°C)	no					
	other sources	(m/s)	1					7
	wetness		wet surfaces					9
Radiation	solar	(W/m ²)	1 120					10
	heat	(W/m ²)	600					10
Chemically active substances	sulphur	SO ₂ (mg/m ³)	1,0	none				11
		H ₂ S (mg/m ³)	0,5	none				11
	chlorine	Salts	sea and road salt mist	none				11
		Cl ₂ (mg/m ³)	no					
	nitrogen	HCl (mg/m ³)	0,5	none				11
		NO _x (mg/m ³)	1,0	none				11
		NH ₃ (mg/m ³)	3,0	none				11
hydrogen fluoride HF	(mg/m ³)	0,03	none				11	
ozone O ₃	(mg/m ³)	0,1	none				11	
Mechanically active substances	dust	sedimentation (mg/(m ² h))	3,0	none				12
		suspension (mg/m ³)	no					
	sand	(mg/m ³)	100	none				12
Flora and Fauna	micro organisms		mould, fungus, etc.	none				13
	rodents, insects		rodents, etc.	none				13

NOTE 1: no = this condition does not occur in this class.

NOTE 2: none = verification is required only in special cases.

NOTE 3: n = number of note, see clause 4.4.

Table 4: Test specification T 2.2: Careful transportation - mechanical tests

Environmental parameter			Environmental Class 2.2			Environmental test specification T 2.2: Careful transportation					
Type	Parameter	Detail parameter	Characteristic severity			Test severity		Duration	Reference	Method	Notes
Vibration	sinusoidal	displacement (mm)	3,5			none					14
		acceleration (m/s ²)	10	15							
		frequency range (Hz)	2-9	9-200	200-500						
		axes of vibration									
	random	ASD (m ² /s ³)	1,0		0,3	1,0			IEC 60068-2-64 [9]	Fh: Vibration, broad-band random (digital control)	15
		frequency range (Hz)	10-200		200-2 000	5-20	20-200	3 x 30 minutes			
		axes of vibration				3					
Shocks	shocks	shock spectrum	Type I			half sine			IEC 60068-2-27 [10]	Ea: shocks	16
		duration (ms)	11			6	11				
		acceleration (m/s ²)	100			100	50				
		mass (kg)				≤ 50	> 50				
		number of shocks						100 in each direction			
		direction of shocks				6					
Fall	free fall	height (m)	0,25	0,25	0,1				IEC 60068-2-31 [11]	Ec: Procedure 1	17
		mass (kg)	< 20	20 to 100	> 100	see table 7					
	toppling around	mass (kg)	< 20	20 to 100	> 100	none					18
		edges	any	no	no						
Acceleration	steady state	(m/s ²)	20			none					19
Load	static load	(kPa)	5			none					20
Miscellaneous	rolling and pitching	angle (deg)	no								
		period (s)									

NOTE 1: no = this condition does not occur in this class.
NOTE 2: none = verification is required only in special cases.
NOTE 3: n = number of note, see clause 4.4.

4.3 Specification T 2.3: Public transportation

Specification T 2.3 applies to transportation by air, by road on all qualities of road surface, by ship and by train and where some care has been taken with respect to low temperatures. See tables 5 to 7.

Table 5: Test specification T 2.3: Public transportation - climatic tests

Environmental parameter			Environmental Class 2.3	Environmental test specification T 2.3: Public transportation				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Air temperature	low	(°C)	-40	-40	72 h	IEC 60068-2-1 [2]	Ab: Cold	1
	high	unventilated (°C)	+70	+70 (and +85)	72 h (6 h)	IEC 60068-2-2 [5]	Bb: Dry heat	2
		ventilated or outdoors(°C)	+40	none				
	change	air/air (°C) (°C/min)	-40/+30	-40/+30 1,0		5 cycles t1 = 3 h	IEC 60068-2-14 [6]	Nb: Change of temperature
air/water (°C)		+40/+5	none					3b
Humidity	relative	slow temperature change (%) (°C)	95 +45	93 +40	4 d	IEC 60068-2-78 [7]	Cab: Damp heat steady state	4
		rapid temperature change (%) (°C)	95 -40/+30	90-100 +40	2 cycles	IEC 60068-2-30 [8]	Db: Damp heat cyclic Variant 1	
	absolute	rapid temperature change (°C) (g/m ³)	+70/+15 60	none				5
Air	pressure	low (kPa)	70	none				6
		Change	no					
	speed	(m/s)	20	none				7
Water	rain	intensity	6 mm/min	0,01 m ³ /min, 90 kPa	3 min/m ² or 15 min	IEC 60068-2-18 [12]	Rb: Impacting water, Method 2	8
		low temperature (°C)	no					
	other sources	(m/s)	1					7
	wetness		wet surfaces					9
Radiation	solar	(W/m ²)	1 120					10
	heat	(W/m ²)	600					10

Environmental parameter			Environmental Class 2.3	Environmental test specification T 2.3: Public transportation				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Chemically active substances	sulphur	SO ₂ (mg/m ³)	1,0	none				11
		H ₂ S (mg/m ³)	0,5	none				11
		salts	sea and road salt mist	none				11
	chlorine	Cl ₂ (mg/m ³)	no					11
		HCl (mg/m ³)	0,5	none				11
	nitrogen	NO _x (mg/m ³)	1,0	none				11
		NH ₃ (mg/m ³)	3,0	none				11
	hydrogen fluoride HF	(mg/m ³)	0,03	none				11
ozone O ₃	(mg/m ³)	0,1	none				11	
Mechanically active substances	dust	sedimentation (mg/(m ² h))	3,0	none				12
		suspension (mg/m ³)	no					
	sand	(mg/m ³)	100	none				12
Flora and fauna	micro organisms		mould, fungus, etc.	none				13
	rodents, insects		rodents, etc.	none				13

NOTE 1: no = this condition does not occur in this class.
NOTE 2: none = verification is required only in special cases.
NOTE 3: n = number of note, see clause 4.4.

Table 6: Test specification T 2.3: Public transportation - mechanical tests

Environmental parameter			Environmental Class 2.3	Environmental test specification T 2.3: Public transportation				
Type	Parameter	Detail parameter	Characteristic severity	Test severity	Duration	Reference	Method	Notes
Vibration	sinusoidal	displacement (mm)	3,5	none				14
		acceleration (m/s ²)	10 15					
		frequency range (Hz)	2-9 9-200 200-500					
		axes of vibration						
	random	ASD (m ² /s ³)	1 0,3	1,0	3 x 30 minutes	IEC 60068-2-64 [9]	Fh: Vibration, broad-band random (digital control)	15
		(dB/oct)		-3				
		frequency range (Hz)	10-200 200-2 000	5-20 20-200				
		axes of vibration		3				

Environmental parameter			Environmental Class 2.3		Environmental test specification T 2.3: Public transportation				
Type	Parameter	Detail parameter	Characteristic severity		Test severity	Duration	Reference	Method	Notes
Shocks	shocks	shock spectrum	Type I	Type II	half sine	100 in each direction	IEC 60068-2-27 [10]	Ea: shocks	16
		duration (ms)	11	6	6				
		acceleration (m/s ²)	100	300	180	100			
		mass (kg)			≤ 50	> 50			
		number of shocks							
		direction of shocks			6				
Fall	free fall	height (m)	1,2	1,0	0,25	see table 7	IEC 60068-2-31 [11]	Ec: Procedure 1	17
		mass (kg)	< 20	20 to 100	> 100				
	toppling around	mass (kg)	< 20	20 to 100	> 100	none			18
		edges	any	any	any				
Acceleration	steady state	(m/s ²)	20			none			19
Load	static load	(kPa)	10			none			20
Miscellaneous	rolling and pitching	angle (deg)	±35			none			
		period (s)	8						

NOTE 1: none = verification is required only in special cases.
NOTE 2: n = number of note, see clause 4.4.

Table 7: Free fall test severities for test specifications T 2.2 and T 2.3

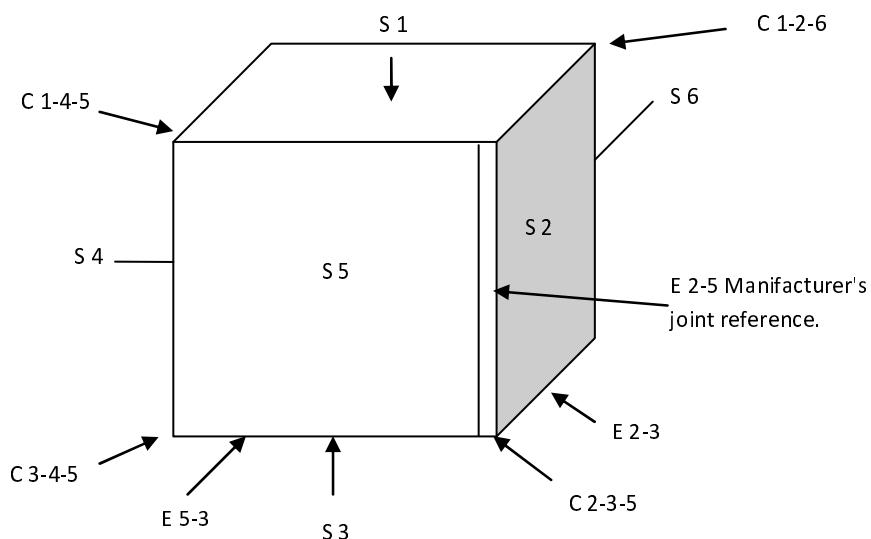
Mass [kg]	Free fall test height [m]	
	Class T 2.2	Class T 2.3
< 10	0,8	1,0
< 15	0,6	1,0
< 20	0,6	0,8
< 30	0,5	0,6
< 40	0,4	0,5
< 50	0,3	0,4
< 100	0,2	0,3
> 100	0,1	0,1

NOTE 1: Packaged equipment with mass < 100 kg and without pallet is subjects to free-fall drop tests on each of the following, see figure 1:

- - Surface S1, S2, S3, S4, S5, S6 (every surface).
- - Edge E2-3, E2-5, E5-3.
- - Corner C1-2-6, C1-4-5, C2-3-5, C3-4-5.

Allow 1 minute between drops for the cushioning to recover its shape. Packaged equipment with mass \geq 100 kg or with pallet the package is subjects to free-fall drop tests. Two drops shall be performed to the normal rest surface (e.g. side with the pallet).

NOTE 2: Values specified in ISO 4180 [3].



Legend:

C: Corner.
E: Edge.

Figure 1

4.4 Notes to tables

4.4.1 General note

The present document applies to transportation of equipment covering environmental conditions stated in EN 300 019-1-2 [1]. The notes have been added to explain the main reasons for recommended tests or to explain why no test has been recommended even if there is a characteristic severity given.

The equipment should be tested in the state in which it is normally transported if possible. For example, if the equipment is in a packed state, then it should be tested in its packaging. If the equipment is transported both with and without its packaging it may be necessary to perform tests for both configurations. For some tests and equipment, the test may be more severe for the packaged rather than the unpacked equipment.

4.4.2 Notes to tables 1 to 6

NOTE 1: (Air temperature, low)

- If the equipment is tested without any package or if the equipment is small the duration may be decreased.

NOTE 2: (Air temperature, high)

- An additional test at 85 °C for 6 h shall be conducted on unpacked equipment only. The additional test includes solar radiation effects.

NOTE 3: (Air temperature, change)

- **3a)** (air/air)
 - The change of temperature test is normally used to check design tolerance and the range is not important. However in this class condensation may occur. The lowest recommended test values of IEC 60068-2-14 [6] Test Nb have been chosen. For unpacked equipment with a mass < 5 kg test Na is applied.
- **3b)** (air/water)
 - The effect of rapid temperature change experienced by the equipment when it rains on a warm day is considered to be less severe than those experienced during the change of temperature (air/air; Test Nb) and therefore no additional test is needed.

NOTE 4: (Humidity, relative, slow temperature change)

- Test required for unpacked equipment only.

NOTE 5: (Humidity, absolute, rapid temperature change)

- Condensation is included in IEC 60068-2-30 [8] Test Db and temperature change is partly included in IEC 60068-2-14 [6] Test Nb.

NOTE 6: (Air pressure, low)

- For normal applications where the effect of air pressure is evaluated at the component level therefore no test is recommended.

NOTE 7: There is no IEC 60068-2 [2] test for this parameter.

NOTE 8: (Water, rain)

- The water test may be omitted in tables 2.1 and 2.2 because in these classes the equipment will be exposed to rain only for short duration. IEC 60068-2-18 [12] Test Rb method 2 "Water jet" has been chosen even if it does not imitate normal rain. It is a simple hand held shower test, easy to perform and can demonstrate that the specimen design is adequately toleranced to survive this condition.

NOTE 9: (Water, other sources, wet surfaces)

- If the equipment is in contact with wet surface the corrosion effect and degeneration effect has to be considered.

NOTE 10: (Radiation, solar, heat)

- The effect of direct sun radiation is included in the higher test value in IEC 60068-2-2 [5] Test Bb, as described in note 2. Photochemical tests can be made separately for components and materials.

NOTE 11: (Chemically active substances)

- For chemically active substances the characteristic severity should be considered when choosing components and materials. No test is recommended in this standard. Characteristic severities of chemically active substances are max. values.

NOTE 12: (Mechanically active substances)

- For mechanical substances the packaging is supposed to protect the equipment against dust and sand, therefore no test is recommended. The Levels of dust both sedimentation and suspension are far lower than the lowest severity recommended in IEC 60068-2-68 [13] Test Lb.

NOTE 13: (Flora, fauna)

- The characteristic severity should be considered when choosing component and materials.

NOTE 14: (Vibration, sinusoidal)

- Random vibration is considered to be a more realistic test for this condition, therefore no sinusoidal test is recommended. The severities are given as peak values.

NOTE 15: (Vibration, random)

- The most energy is in low frequencies and therefore the most realistic test has been described with a:
 - -3 dB/oct slope from 20 Hz to 200 Hz;
- ASD (Acceleration Spectral Density) vibrations are of greatest significance in the vertical direction. If normal attitude during transportation is specified, then the severity for the horizontal axes ASD is reduced by a factor 10.
- Acceleration RMS (for information only):
 - 7,83 m/s².
 - 2,47 m/s², when the test severity is reduced by a factor 10.

NOTE 16: (Shocks)

- During transportation, the number of shocks is expected to be high, so the shock test is more adequate for testing. The severities are given as peak values. For masses > 500 Kg no shock test is required. Test severity values not specified in IEC 60068-2-27 [10].
- The specified test severities for $m < 50$ kg and $m > 50$ kg have been chosen to have the same energy per mass unit for both situations. Shocks are of greatest significance in the vertical direction. If normal attitude during transportation is specified, 100 shocks have to be applied along that direction only.

NOTE 17: (Free Fall)

- ISO severities are chosen because they are considered to be more realistic.

NOTE 18: (Toppling around)

- No test is required because the effect is included in IEC 60068-2-31 [11] Test Ed, free fall.

NOTE 19: (Acceleration, steady state)

- This characteristic severity is considered to be insignificant and therefore no test is recommended.

NOTE 20: (Load)

- This condition is for packaged equipment only. Packaging should be designed with this requirement in mind.

Annex A (informative): Bibliography

- ETSI ETR 035: "Equipment Engineering (EE); Environmental engineering; Guidance and terminology".
- IEC 60068-1: "Environmental testing - Part 1: General and guidance".

History

Document history		
Edition 1	May 1994	Publication as ETS 300 019-2-2
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