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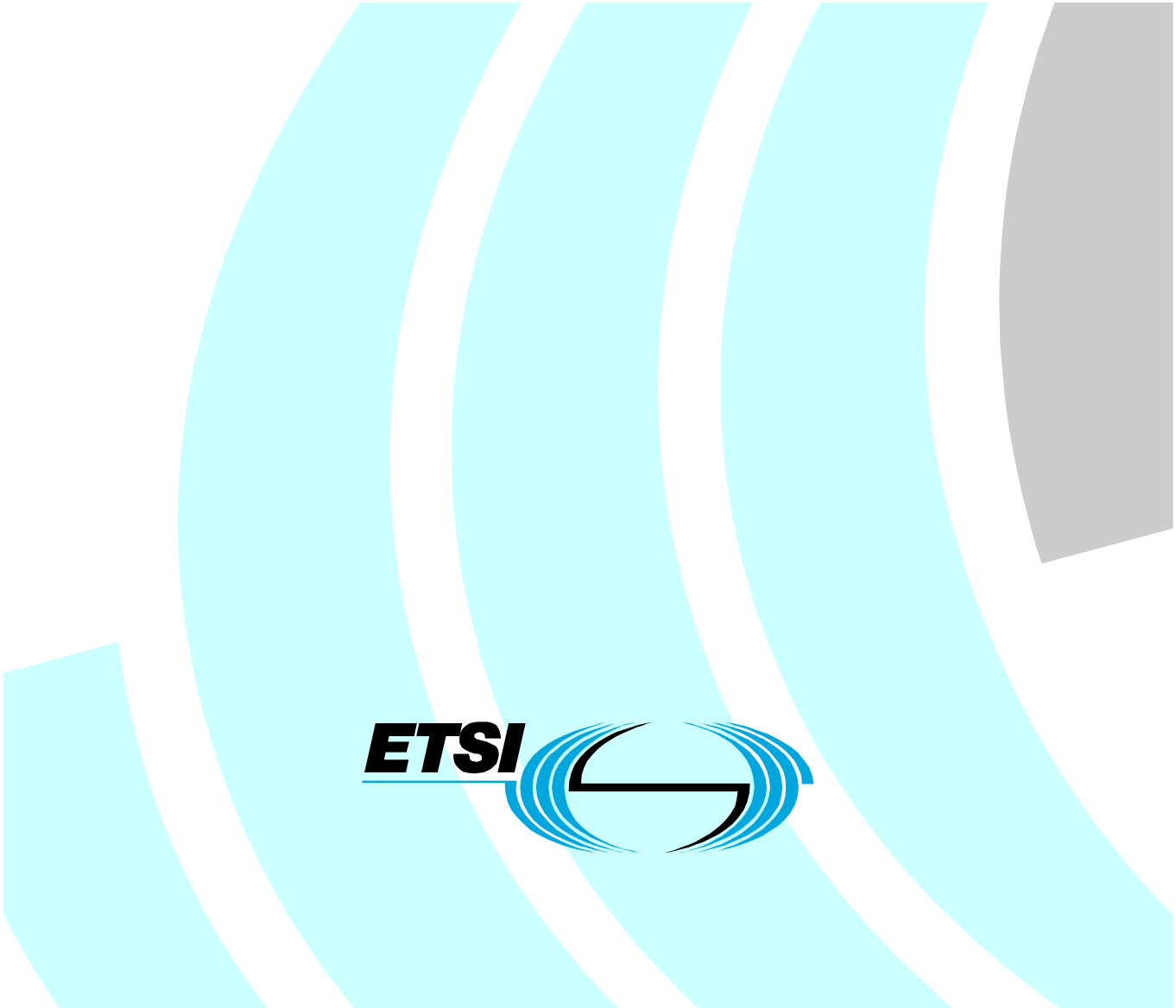
European Standard (Telecommunications series)

Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-5: Specification of environmental tests; Ground vehicle installations



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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Environmental Engineering (EE), and is now submitted for the ETSI standards One-step Approval Procedure.

The present document is part 2, sub-part 5 of a multi-part deliverable covering environmental conditions and environmental tests for telecommunications equipment, as identified below:

Part 1: "Classification of environmental conditions";

Part 2: "Specification of environmental tests"

Sub-part 0: "Introduction";

Sub-part 1: "Storage";

Sub-part 2: "Transportation";

Sub-part 3: "Stationary use at weatherprotected locations";

Sub-part 4: "Stationary use at non-weatherprotected locations";

Sub-part 5: "Ground vehicle installations";

Sub-part 6: "Ship environments";

Sub-part 7: "Portable and non-stationary use";

Sub-part 8: "Stationary use at underground locations".

Part 1 specifies different standardized environmental classes covering climatic and biological conditions, chemically and mechanically active substances and mechanical conditions during storage, transportation and in use.

Part 2 specifies the recommended test severities and test methods for the different environmental classes.

Part 2-0 forms a general overview of part 2. The present document deals with ground vehicle installations.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

1 Scope

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

The tests in the present document apply to the use of equipment installed permanently or temporarily in ground vehicles and cover the vehicles and the environmental conditions stated in EN 300 019-1-5 [1].

The tests cover installations in vehicles powered by electric motors and combustion engines. Applications in combustion engine compartments are excluded.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] ETSI EN 300 019-1-5: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-5: Classification of environmental conditions; Ground vehicle installations".

[2] IEC 60068-2: "Environmental testing - Part 2: Tests".

[3] 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".

3 Environmental test specifications

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

EN 300 019-2-0 [3] forms a general overview of part 2 of the present document.

The equipment under test is assumed to be in its operational state throughout the test conditions described in this part unless otherwise stated. The required performance before, during and after the test needs to be specified in the product specification. Input and load conditions of the equipment shall be chosen to obtain full utilization of the equipment under test. The heat dissipation shall be maximized, except for the steady state, low temperature test, where it shall be minimized.

3.1 Specification T 5.1: Protected installation

This specification applies to use in weatherprotected heated locations in vehicles which are used in areas with or without well developed road systems depending on the selected IEC mechanical class. See tables 1, 2 and 2a.

Table 1: Test specification T 5.1: Protected installation - climatic tests

Environmental parameter			Environmental Class 5.1	Environmental test specification T5.1: Vehicle, protected installation				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Notes**
Air temperature	low	(°C)	-25	-25	16 h	IEC 60068-2-1 [2]	Ab/Ad: Cold	1
	high	(°C)	+40 a), e)	+40 or +55	16 h	IEC 60068-2-2 [2]	Bb/Bd: Dry heat	2
		(°C)	+70 b), c)	+70 or +85	16 h	IEC 60068-2-2 [2]	Bb/Bd: Dry heat	2
	change	rapid (°C)	-25/+30	none				3a
		(°C)	-25/+30	-25/+30	5 cycles	IEC 60068-2-14 [2]	Na: Change of temperature	3b
		gradual (°C/min)	5 not c)		t_1 = 3 h			
		(°C)	-25/+60					
		(°C/min)	10 c)					
Temperature	change	air/water (°C)	no not c)					
		air/water (°C)	+60/+5 c)	none				4
		air/snow (°C)	+60/-5 c)					
Humidity	relative	slow temperature (%)	95	93	96 h	IEC 60068-2-56 [2]	Cb: Damp heat, steady state	5
		change (°C)	+40	+40				
		(%)	95	90-100	2 cycles	IEC 60068-2-30 [2]	Db: Damp heat, cyclic, Variant 2	6
		rapid temperature (°C)	-25/+30 not d)	+40				
		change (%)	95	90-100	2 cycles	IEC 60068-2-30 [2]	Db: Damp heat, cyclic, Variant 2	6
		(°C)	+10/+70 d)	+55				
		low (%)	10	none				8
		(°C)	+30					
	absolute	rapid temperature (g/m^3)	60	none				7
		change (°C)	+70/+15					
Air	pressure	low (kPa)	70	none				9
	speed	(m/s)	20	none				8
Water	rain	Intensity (mm/min)	no					
	other sources	velocity (m/s)	0,3	none				8
	wetness		wet surfaces	none				8,12
Radiation	solar	(W/m^2)	700					13
	heat	(W/m^2)	600					13

Environmental parameter			Environmental Class 5.1	Environmental test specification T5.1: Vehicle, protected installation				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Notes**
Chemically active substance	sulphur	SO_2 (mg/m^3)	0,3/1,0	none				14
		H_2S (mg/m^3)	0,1/0,5	none				14
	chlorine	sea salts	salt mist	none				14
		road salts	solid salt, salt water	none				14
		HCl (mg/m^3)	0,1/0,5	none				14
	nitrogen	NO_x (mg/m^3)	0,5/1,0	none				14
		NH_3 (mg/m^3)	1,0/3,0	none				14
	hydrogen fluoride	HF (mg/m^3)	0,01/0,03	none				14
	ozone	O_3 (mg/m^3)	0,05/0,1	none				14
Mechanically active substances	dust (Sedimentation)	other than cabin ($mg/(m^2h)$) cabin only ($mg/(m^2h)$)	3,0 1,0	none				15 15
	sand	(mg/m^3)	0,1	none				15
Flora and Fauna	micro organism		mould, fungus, etc.	none				16
	rodents, insects		rodents, etc.	none				16
Contaminating fluids	oil	motor	no					
		gearbox	no					
		hydraulic	Electrical engine compartment only	none				17
		transformer		none				17
	fluid	brake		none				17
		cooling		none				17
	grease			none				17
	battery electrolyte			none				17
	fuel		no					

no: This condition does not occur in this class.
none: Verification is required only in special cases.
NOTES: Number of note, see clause 4.2.

Key:
a) Ventilated compartment;
b) Unventilated compartment;
c) Engine compartment;
d) Near refrigerated air conditioning;
e) Outdoor air.

Table 2: Test specification T5.1: Protected installation - mechanical tests (IEC Class 5M2)
Test specification T5.2: Partly protected installation - mechanical tests (IEC Class 5M2)

Environmental parameter			Environmental Class 5.1	Environmental test specification T5.1 and 5.2: Vehicle, protected and partly protected installations				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Notes**
Vibration	sinusoidal	displacement (mm) acceleration (m/s^2) frequency range (Hz)	3,3 3 2-9 9-200 200-500	none				18
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration	1 0,3 10-200 200-500	1 -3 5-20 20-500 3	3 x 30 min	IEC 60068-2-64 [2]	Fh: Vibration, broad-band random (digital control)	19
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s^2) number of shocks directions shocks	Type I Type II 11 6 100 300	half sine 6 300 6	3 in each direction	IEC 60068-2-27 [2]	Ea: Shock	20
	bump	acceleration (m/s^2) duration (ms) number of bumps directions of bumps	no	100 11 6	100 in each direction	IEC 60068-2-29 [2]	Eb: Bump	21

no: This condition does not occur in this class.
none: Verification is required only in special cases.
NOTES: Number of note, see clause 4.2.

Table 2a: Test specification T5.1: Protected installation - mechanical tests (IEC Class 5M3)
Test specification T5.2: Partly protected installation - mechanical tests (IEC Class 5M3)

Environmental parameter			Environmental Class 5.1 & 5.2	Environmental test specification T5.1 and 5.2: Vehicle, protected and partly protected installations				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Notes**
Vibration	sinusoidal	displacement (mm) acceleration (m/s^2) frequency range (Hz)	7,5 20 50 2-8 8-200 200-500	none				18
	random	ASD (m^2/s^3) (dB/oct) frequency range (Hz) axes of vibration	3 1 10-200 200-500	2 -3 5-20 20-500 3	3 × 30 min	IEC 60068-2-64 [2]	Fh: Vibration, broad-band random (digital control)	19
Shocks	shocks	shock spectrum duration (ms) acceleration (m/s^2) number of shocks directions of shocks	Type I Type II 11 6 300 1 000	half sine 6 1 000 6	3 in each direction	IEC 60068-2-27 [2]	Ea: Shock	20
	bump	acceleration (m/s^2) duration (ms) number of bumps directions of bumps	no	100 11 6	100 in each direction	IEC 60068-2-29 [2]	Eb: Bump	21

no: This condition does not occur in this class.
none: Verification is required only in special cases.
NOTES: Number of note, see clause 4.2.

3.2 Specification T 5.2: Partly protected installation

This specification applies to use in vehicles in areas with or without developed road systems depending on the selected IEC mechanical class excluding only non-weatherprotected use in unheated vehicles at extremely low temperature conditions, see tables 2 and 3.

Table 3: Test specification T 5.2: Partly protected installation - climatic tests

Environmental parameter			Environmental Class 5.2	Environmental test specification T 5.2: Vehicle, partly protected installations				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Notes**
Air temperature	low	(°C)	-40	-40	16 h	IEC 60068-2-1 [2]	Ab/Ad: Cold	1
	high	(°C)	+40 a), e)	+40 or +55	16 h	IEC 60068-2-2 [2]	Bb/Bd: Dry heat	2
		(°C)	+70 b), c)	+70 or +85	16 h	IEC 60068-2-2 [2]	Bb/Bd: Dry heat	2
	change	rapid (°C)	-40/+30					3a
		gradual (°C)	-40/+30	-40/+30	5 cycles t_1 = 3 h	IEC 60068-2-14 [2]	Na: Change of temperature	3b
		(°C/min)	5 not c)					
		(°C)	-40/+70					
		(°C/min)	10 c)					
Temperature	change	air/water (°C)	-40/+5 not c)					4
		air/water (°C)	+70/+5 c)					
		air/ snow (°C)	+70/-5 c)					
Humidity	relative	slow temperature change (%)	95	93	96 h	IEC 60068-2-56 [2]	Cb: Damp heat, steady state	5
		(°C)	+45	+40				
		rapid temperature change (%)	95	90 - 100	2 cycles	IEC 60068-2-30 [2]	Db: Damp heat, cyclic, variant 2	6
		(°C)	-45/+30	+40				
		(%)	95	90 - 100	2 cycles	IEC 60068-2-30 [2]	Db: Damp heat, cyclic, variant 2	6
		(°C)	+10/+70	+55				
		low (%)	10					8
		(°C)	+30					
	absolute	rapid temperature change (g/m^3)	60					7
		(°C)	+70/+15					
Air	pressure	low (kPa)	70	none				9
	speed	(m/s)	20	none				8
Water	rain	intensity mm/min	6	0,01 m^3/min; 90 kPa	3 min/m^2 or 15 min	IEC 60068-2-18 [2]	Rb: Impacting water Method 1.2	10
	other sources	velocity (m/s)	1					11
	wetness		wet surfaces					8,12

Environmental parameter			Environmental Class 5.2	Environmental test specification T 5.2: Vehicle, partly protected installations				
Type	**Parameter**	**Detail parameter**	**Characteristic severity**	**Test severity**	**Duration**	**Reference**	**Method**	**Notes**
Radiation	solar	(W/m^2)	1 120					13
	heat	(W/m^2) (W/m^2)	600 not c) 1 120 c)					13
Chemically active substances	sulphur	SO_2 (mg/m^3)	0,3/1,0	none				14
		H_2S (mg/m^3)	0,1/0,5	none				14
	chlorine	sea salts	salt mist	none				14
		road salts	solid salt salt water	none				14
		HCl (mg/m^3)	0,1/0,5	none				14
	nitrogen	NO_x (mg/m^3)	0,5/1,0	none				14
		NH_3 (mg/m^3)	1,0/3,0	none				14
	hydrogen fluoride	HF (mg/m^3)	0,01/0,03	none				14
	ozone	O_3 (mg/m^3)	0,05/0,1	none				14
Mechanically active substances	dust (Sedimentation)	other than cabin ($mg/(m^2h)$) cabin only ($mg/(m^2h)$)	3,0 1,0					15 15
	sand	other than cabin (mg/m^3) cabin only	0,1 no					15 15
Flora and Fauna	micro organisms		mould, fungus, etc	none				16
	rodents, insects		rodents, etc.	none				16
Contaminating fluids	oil	motor	no					
		gearbox	no					
		hydraulic	Electrical engine compartment only					17
		transformer						17
	fluid	brake						17
		cooling						17
	grease							17
	battery electrolyte							17
	fuel		no					

no: This condition does not occur in this class.
none: Verification is required only in special cases.
NOTES: Number of note, see clause 4.2.

Key:
a) Ventilated compartment;
b) Unventilated compartment;
c) Engine compartment;
d) Near refrigerated air conditioning;
e) Outdoor air.

4 Notes to tables

4.1 General note

The present document applies to use of equipment installed permanently or temporally in ground vehicles and cover the vehicles and the environmental conditions stated in EN 300 019-1-5 [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 relevant specification should specify when, during the environmental test programme, the equipment is in its operational state, and which performance requirements should be measured before, during and after the test, together with the appropriate pass/fail criteria.

4.2 Notes to tables 1 to 3

NOTE 1: (Air temperature, low).

The characteristic severity can be used as a cold start up temperature, but it may be modified by the product specification. The equipment under test shall remain operational throughout this test, except for the cold start up test which shall commence once low temperature stability is achieved.

NOTE 2: (Air temperature, high).

In a) and e) condition (ventilated compartment and outdoor air) the lower test temperature is equal to the characteristic severity and refers to equipment to be protected against solar and heat radiation. The higher test temperature includes solar radiation.

In b) and c) (unventilated and engine compartment) the higher test temperature is equal to the characteristic severity and refers to equipment to be protected against solar and heat radiation. The higher test temperature includes heat trap effect of direct solar radiation.

The equipment under test shall remain operational throughout this test, except for the start up test at high temperature which shall commence once high temperature stability is achieved.

NOTE 3: (Air temperature, change).

3a) (rapid)

The rapid change of temperature test is normally used to check design tolerancing. This effect is included in IEC 60068-2-14 [2] Test Na.

3b) (gradual)

The IEC 60068-2-14 [2] Test Na has been chosen since the rapid temperature change is considered to be more severe than gradual temperature change. For engine compartment the test temperature change near upper limit is considered to be less severe and this effect is covered by test Bb.

NOTE 4: (Temperature, change; air/water; air/snow).

Temperature change is partly included in IEC60068-2-14 [2] Test Na. The characteristic severity should be considered when designing the equipment and when choosing components and materials.

NOTE 5: (Humidity, relative, slow temperature change).

These severities are the nearest preferred values in IEC 60068-2-56 [2] Test Cb and the minor differences in humidity condition is considered to be insignificant and within normal measurement tolerances.

NOTE 6: (Humidity, relative, rapid temperature change).

Variant 2 has been chosen rather than variant 1 due to the high temperature/absolute humidity involved and the difficulty in maintaining tolerances in most chambers with heat producing specimen.

NOTE 7: (Humidity, absolute, rapid temperature change).

This effect is partly included in IEC 60068-2-30 [2] Test Db.

NOTE 8: There is no IEC 60068-2 [2] test method for this parameter.

NOTE 9: (Air pressure, low).

No test is recommended for normal applications, because the effect of air pressure is evaluated at the component level.

NOTE 10: (Water, rain).

IEC 60068-2-18 [2] Test Rb method 1.2 has been chosen even though it does not imitate normal rain. It is a simple hand held shower test, which is easy to perform and can demonstrate that the specimen design is adequately toleranced to survive this condition. The greater of the two given durations should be chosen.

NOTE 11: (Water, other sources).

No test is recommended because the effect is already included in IEC 60068-2-18 [2] Test Rb.

NOTE 12: (Water, wetness).

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

NOTE 13: (Radiation, solar, heat).

Heating effect of all sources is included in high temperature test. Photochemical tests can be made separately for components and materials.

NOTE 14: (Chemically active substances).

For chemically active substances the characteristic severity should be considered when choosing components and materials. No test is recommended in the present document. Characteristic severities of chemically active substances are mean/maximum values.

NOTE 15: (Mechanically active substances).

The characteristic severities are much lower than lowest test severity in IEC 60068-2-68 [2] Test Lb and therefore no test is recommended. This condition should be considered when designing the equipment and when choosing components and materials.

NOTE 16: (Flora, fauna).

The characteristic severity should be considered when designing the equipment and when choosing components and materials.

NOTE 17: (Contaminating fluids).

Appropriate for electrical engine compartment only. The characteristic severity should be considered when designing the equipment and when choosing components and materials.

NOTE 18: (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 19: (Vibration, random).

ASD (Acceleration Spectral Density).

	IEC class 5M2	**IEC class 5M3**
Acceleration RMS (m/s^2) (for information only)	8,76	12,63

NOTE 20: (Shock).

The severities are given as peak values.

NOTE 21: (Bump).

The severities are given as peak values. Bump test is recommended in addition to shocks as the number of expected shocks is high. Bumps are of greatest significance in the vertical direction. If only one operational position is specified, 100 bumps have to be applied along that direction only.

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".
- IEC 60721-3-3: "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weatherprotected locations".

History

Document history		
Edition 1	May 1994	Publication as ETS 300 019-2-5
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