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Freight containers — Electronic seals —

Part 3: Environmental characteristics

Récipients de fret — Joints électroniques —

Partie 3: Caractéristiques environnementales

Reference number
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 104, *Freight containers*, Subcommittee SC 4, *Identification and communication*.

This second edition cancels and replaces the first edition (ISO 18185-3:2006), which has been technically revised.

ISO 18185 consists of the following parts, under the general title *Freight containers — Electronic seals*:

— *Par 1: Communication protocol*

— *Part 2: Application requirements*

— *Part 3: Environmental characteristics*

— *Part 4: Data protection*

— *Part 5: Physical layer*

Introduction

This part of ISO 18185 defines the environmental characteristics for compliant electronic seals.

Freight containers — Electronic seals —

Part 3: Environmental characteristics

1 Scope

This part of ISO 18185 specifies test methods and conditions for environmental characteristics of electronic seals.

This part of ISO 18185 describes the environmental requirements for the ISO 18185 series, for ISO 10374 and for ISO 17363 and for ISO 10891 since it is expected that the implementation of these International Standards will face the same international conditions. However, each of these International Standards has its own unique requirements other than environmental conditions.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 17712, *Freight containers — Mechanical seals*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
electronic seal
e-seal
read-only, non-reusable freight container seal conforming to the high-security seal defined in ISO 17712 and to this International Standard that electronically provides evidence of tampering or intrusion through the container doors

3.2
equipment under testing
EUT
any type of device that will undergo the tests described in this part of ISO 18185

3.3
interrogator identification
interrogator ID
code used to identify the source address during every communication session originated by the interrogator

3.4
operation test
short functional test by a suitably qualified person to confirm that the *electronic seal* (3.1) complies with the operational requirements including a check of survives and maintains the integrity of stored data

3.5
seal identification
seal ID
unique code used to identify each manufactured seal incorporating a combination of the serial number (i.e. tag ID) and the manufacturer ID

4 Environmental characteristics

4.1 General

This part of ISO 18185 shall be used in conjunction with other parts of ISO 18185.

This part of ISO 18185 applies to all electronic seals used on freight containers covered by the following International Standards: ISO 668, ISO 1496-1, ISO 1496-2, ISO 1496-3, ISO 1496-4, ISO 1496-5, and ISO 830. This part of ISO 18185 should also, wherever appropriate and practicable, be applied to freight containers other than those covered by the aforementioned International Standards.

This part of ISO 18185 establishes minimum operating parameters for environmental characteristics and the test used to measure those characteristics.

This part of ISO 18185 is designed to test container seal resistance to electrical and mechanical deterioration due to exposure to the shipboard environment or to the rigors of mishandling such as dropping, where appropriate, or transportation and installation. Container seals are typically subjected to the harsh environments of the marine, rail, and road transportation industries. Sand and dust, salt spray, grease, snow, ice, and grime can be expected to coat the tag and sensing equipment. Physical shock and vibration are commonly encountered as a result of handling and transport operations.

Normal ambient conditions are defined as any combination of the following:

— temperature: (15 to 35) °C;

— relative humidity: (20 to 75) %;

— air pressure: (86 to 106) kPa.

4.2 Low temperature

4.2.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunction occurs after being stored and during storage at cold temperatures for the low temperature testing.

4.2.2 Test requirement

EUT shall fully operate after having been stored at a minimum low temperature.

4.2.3 Test method for storage temperature testing

— Preconditioning: normal ambient conditions.

— The EUT shall be placed in the test chamber and the temperature cycle is started at normal ambient conditions. The EUT shall be kept at the test temperature for the test period (see Table 1).

Table 1 — Conditions of low storage temperature

Storage temperature	(−55 ± 2) °C
Duration	96 h (four days)

— The operation test shall be performed after bringing the EUT up to ambient temperature for 4 h prior to conducting the test.

4.2.4 Test method for operating temperature testing

— Preconditioning: normal ambient conditions

— The EUT (equipment under testing) shall be placed in the test chamber and the temperature cycle is started at normal ambient conditions. The EUT shall be kept at the test temperature for the period specified in Table 2.

Table 2 — Conditions of low operating temperature

Operating temperature	(−40 ± 2) °C
Duration	4 h

— The operation test shall be performed while conducting the test.

— Reference: IEC 60068-2-1, Test Ab and Ad (or MIL-STD-810G, Method 502.5), IEC 60721-3-2:1997, Table 1, Classes 2K4 and 2K5.

4.3 High temperature

4.3.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunction occurs after being stored and during storage at hot temperatures for the high temperature testing.

4.3.2 Test requirement

EUT shall fully operate after having been stored at a maximum high temperature.

4.3.3 Test method for storage temperature testing

— Preconditioning: normal ambient conditions

— The EUT shall be placed in the test chamber and the temperature cycle is started at normal ambient conditions. The EUT shall be kept at the test temperature for the period specified in Table 3.

Table 3 — Conditions of high storage temperature

Storage temperature	(85 ± 2) °C
Duration	96 h (4 days)

— The operation test shall be performed after bringing the EUT up to ambient temperatures for 4 h prior to conducting the test.

4.3.4 Test method for operating temperature testing

— Preconditioning: normal ambient conditions.

— The EUT shall be placed in the test chamber and the temperature cycle is started at normal ambient conditions. The EUT shall be kept at the test temperature for the period specified in Table 4.

Table 4 — Conditions of high operating temperature

Operating temperature	(70 ± 2) °C
Duration	4 h

— The operation test shall be performed while conducting the test.

— Reference: IEC 60068-2-2, Test Bb and Bd (or MIL-STD-810G, Method 501.5), IEC 60721-3-2:1997, Table 1, Classes 2K4 and 2K5.

4.4 Mechanical shock

4.4.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of mechanical shocks.

4.4.2 Test requirement

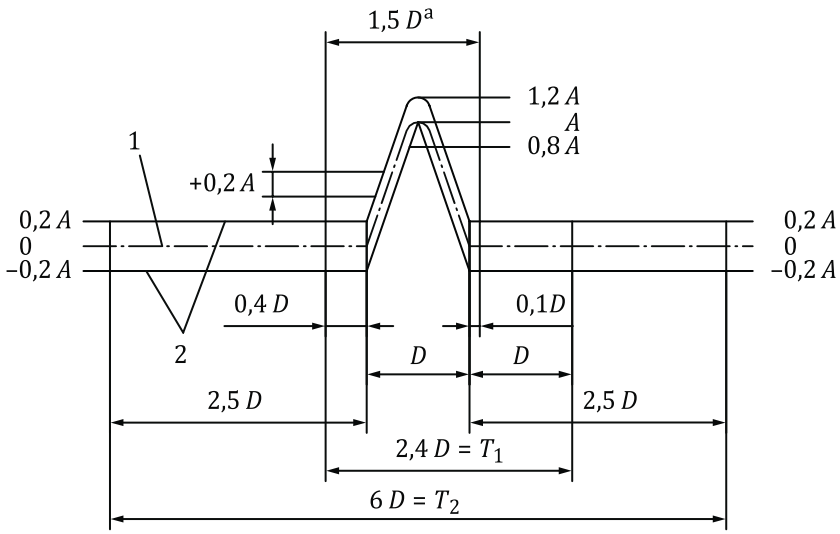
EUT shall fully operate during and after having been subject to a mechanical shock.

4.4.3 Test method

— Three successive shocks shall be applied in each direction of three mutually perpendicular axes of EUT for a total of 18 shocks.

Table 5 — Conditions of mechanical shocks

Peak acceleration	50 g[a] for 11 ms
Pulse shape (see Figure 1)	half-sine
The number of shock	18
Orientation	three mutually perpendicular axes
[a] 1g = 9,8 m/s^2 (equivalent 10 m/s^2).	



Key

1 nominal pulse

2 limits of tolerance

D duration of nominal pulse

A peak acceleration of nominal pulse

T_1 minimum time during which the pulse shall be monitored for shocks produced using a conventional shock-testing machine

T_2 minimum time during which the pulse shall be monitored for shocks produced using a vibration generator

Figure 1 — Pulse shape and limits of tolerance for half-sine pulse

— The operation test shall be performed after completion of the mechanical shock test.

— Reference: IEC 60068-2-27, Test Ea (or MIL-STD-810G, Method 516.6).

4.5 Vibration

4.5.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of broadband random vibrations.

4.5.2 Test requirement

EUT shall fully operate after having been subject to a vibration testing.

4.5.3 Test method

— This test shall be performed in accordance with IEC 60068-2-6.

Table 6 — Conditions of vibration test

Frequency range	(10 to 150) Hz
Acceleration	10 m/s^2
Number of sweep cycles	20
Endurance times	2 h 30 min
Orientation	three mutually perpendicular axes

— The operation test shall be performed after completion of the vibration test.

— Reference: IEC 60068-2-6, Test Fc (or MIL-STD-810G, Method 514.5).

4.6 Humidity

4.6.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of damp heat.

4.6.2 Test requirement

EUT shall fully operate during and after having been subjected to damp heat.

4.6.3 Test method

— Preconditioning: normal ambient conditions.

— The EUT shall be placed in the test chamber during the procedures below (see also Figure 1).

a) Prior to the temperature rise interval, the relative humidity shall be increased to (95 to 100) %, then maintained for the first (3 ± 0,5) h.

b) The temperature is raised from an initial (25 ± 3) °C to (55 ± 2) °C within the first (3 ± 0,5) h.

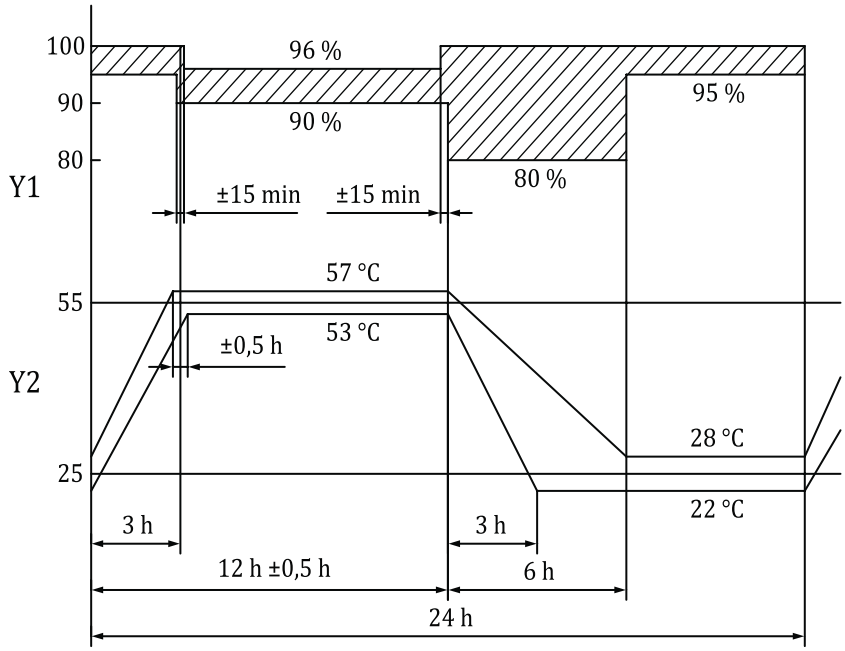
c) After the upper temperature is reached, it shall be maintained until (9 ± 0,5) h which is (12 ± 0,5) h from the start of the test.

d) The temperature shall be lowered to (25 ± 3) °C within (3 to 6) h (water vapour should occur during this cooling period).

e) Relative humidity shall be maintained between (80 to 100) % for 6 h.

f) The temperature shall then be maintained at 25 °C ± 3 °C with relative humidity of not less than 95 % until the 24 h cycle is completed.

g) Two cycles shall be carried out.



Key

Y1 relative humidity (%)

Y2 temperature (°C)

Figure 2 — Humidity test cycle

— The operation test shall be performed at the upper test temperature within the first 2 h of the first cycle of the upper test temperature and the last 2 h of the second cycle of the lower test temperature.

— Reference: IEC 60068-2-30, Test Db (or MIL-STD-810G, Method 507.5).

4.7 Rain and snow

4.7.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of water.

4.7.2 Test requirement

EUT shall fully operate after having been subjected to immersion in seawater.

4.7.3 Test method

— The EUT shall be placed in the chamber by spraying the EUT from all practicable directions with a stream of water from a test nozzle or hose.

Table 7 — Conditions of water jet

Internal diameter of nozzle	12,5 mm
Delivery rate	100 l/min ± 5 l/min
Water pressure	Approximately 100 kPa
Core of substantial stream	Circle of 120 mm diameter at distance 2,5 m from nozzle
Test duration	30 min

— The operation test shall be performed during and after completion of stream of water.

— Reference: IEC 60068-2-18, Test Rb (or MIL-STD-810G, Method 506.4/512.5).

4.8 Salt fog

4.8.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of a saline atmosphere.

4.8.2 Test requirement

EUT shall fully operate after having been subjected to salt fog.

4.8.3 Test method

— Salt solution shall be sprayed into the atmosphere surrounding the EUT in the chamber.

Table 8 — Conditions of salt fog

Number of spray	(10 to 150) Hz
Period of storage	Seven days after each spraying (total 28 days)
Temperature	(25 ± 10) °C
Saline solution	5 % NaCl, pH (6,5 to 7,2) at 20
Relative humidity	(90 to 95) %

— The operation test shall be performed during the 7th day of each cycle.

— Reference: IEC 60068-2-52, Test Kb (or MIL-STD-810G, Method 509.5).

4.9 Drop shock

4.9.1 Test purpose

The purpose of this test is to verify that no damage is caused to the electronic seal and no permanent or temporary malfunctions occur under the influence of a free fall.

4.9.2 Test requirement

EUT shall be visually examined and fully operated electrically and mechanically after having been subjected to a free fall.

4.9.3 Test method

— Test conditions are as specified in Table 9:

Table 9 — Conditions of free fall

Height of fall	1,2 m
Test surface	Steel or concrete
Number of falls	two times consecutively for each perpendicular axis

— The operation test shall be performed with status of bare unit after completion of two times consecutively for each perpendicular axis.

— Reference: IEC 60068-2-31.

4.10 Sand and dust

4.10.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of sand and dust.

4.10.2 Test requirement

EUT shall be visually examined and fully operated after finishing the test in 4.10.3.

4.10.3 Test method

— The EUT shall be placed in the test chamber. The chamber conditions are specified in Table 9.

Table 10 — Conditions of sand and dust

	Size of particle	**Velocity**	**Sand material**
Blowing dust	(2 to 75) µm	(3 ± 0,3) m/s	Silica flour 95 % by weight SiO_2
Blowing sand	(150 to 850) µm	(20 ± 2) m/s	Silica sand 95 % by weight SiO_2
Environmental conditions			
Temperature	Normal ambient conditions		
Relative humidity	Not exceed 25 %		
Duration	24 h		

— The operation test shall be performed after completion of the sand and dust test.

— Reference: IEC 60068-2-68, Test Lc (or MIL-STD-810G, Method 510.5).

4.11 Electromagnetic environment

4.11.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of electromagnetic fields and electrostatic discharge.

4.11.2 Test requirement

EUT shall survive and maintain the integrity of stored data during and after having been subjected to electromagnetic conditions.

4.11.3 Test method

— These tests shall be performed in accordance with IEC 61000-4-2 and IEC 61000-4-3.

Table 11 — Conditions of electromagnetic compatibility tests

Radiated electromagnetic field immunity		**Electrostatic discharge immunity**	
Frequency range	80 MHz to 2 GHz	Output voltage	Air: 8 kV
Electric field strength	10 V/m		Contact: 4 kV
Test signal (modulation)	AM 80 % at 1 kHz	Pulse interval	1 s
Max. sweep rate	$1{,}5 \times 10^{-3}$ decade/s or 1 % / 3 s	Number of pulses	10 individual discharge for ± polarity pulses

Table 12 — Conditions of emission limit for enclosure ports

Port	**Freq. Range/Limits**	**Limits**
Enclosure (radiated emission)	150 kHz to 300 kHz	80 dBµV/m to 50 dBµV/m
	300 kHz to 30 MHz	52 dBµV/m to 34 dBµV/m
	30 MHz to 2 GHz	54 dBµV/m
	Except 156 MHz to 165 MHz/ 24 dBµV/m	24 dBµV/m
NOTE Measured in a distance of 3 m.		

— The operation test shall be performed during and after each test.

— Reference: IEC 61000-6-2:2005, Table 1 (ESD immunity) sub-section 1.5 (Electrostatic discharge), IEC 61000-4-2, Method 1A, IEC 60533:1999, 10.1, Table 6 (Electromagnetic immunity).

4.12 Solar radiation

4.12.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of continuous solar radiation.

4.12.2 Test requirement

EUT shall fully operate after having been subjected to exposure of solar radiation.

4.12.3 Test method

— The EUT shall be placed on a suitable support and exposed continuously to a simulated solar radiation source as specified in Table 13 for 80 h. The intensity at the test point, which shall also include any radiation reflected from the test enclosure, shall be 1 120 W/m ± 10 % with a spectral distribution as given in Table 13.

Table 13 — Spectral energy distribution and permitted tolerances

Spectral region	Ultraviolet B[a]	Ultraviolet A	Visible			Infrared
Bandwidth (μm)	0,28 - 0,32	0,32 - 0,40	0,40 - 0,52	0,52 - 0,64	0,64 - 0,78	0,78 - 3,00
Irradiation (W/m^2)	5	63	200	186	174	492
Tolerance (%)	±35	±25	±10	±10	±10	±20
[a] Radiation shorter than 0,30 μm reaching the earth's surface is insignificant.						

— The operation test and visual check shall be performed after completion of the sand and dust test.

— Reference: IEC 60068-2-5, Test Sa (or MIL-STD-810G, Method 505.5).

4.13 Ice and frost

4.13.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of ice and frost.

4.13.2 Test requirement

EUT shall fully operate after having been subjected to exposure of sequential cold, low pressure, and damp heat test environment.

4.13.3 Test method

The EUT shall be placed on each sequential cold, low pressure, and damp heat test environment as described Table 14.

Table 14 — Test Specifications

Test type	Temperature	Pressure	Test duration
Sequential cold, low pressure and damp heat	−40 °C (−40 °F)	30 kPa	4 cycles

— The operation test and visual check shall be performed after completion of the ice and frost test.

— Reference: IEC 60721-1:1990, Table 1, IEC 60068-2-39, Method Z/AMD(sequential cold, low pressure, and damp heat).

4.14 Water-high pressure

4.14.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of water high pressure.

4.14.2 Test requirement

EUT shall fully operate after having been subjected to exposure of water high pressure.

4.14.3 Test method

— The EUT shall be placed in the chamber by spraying the EUT from all practicable directions with a stream of water from a test nozzle or hose.

Table 15 — Conditions of water high pressure

Diameter of nozzle	6,5 mm or 12,5 mm
Delivery rate	At least 100 l/min
Water pressure	At least 100 kPa or 1 000 kPa (using the small nozzle)
Distance from muzzle	2,5 m ± 0,5 m

— The operation test shall be performed during and after completion of stream of water.

— Reference: IEC 60721-3-5:1997, Table I, classification of climatic conditions, water from sources other than rain, Class 6K5, and table iii, classification of chemically active substances, substances in water, sea salts, class 6C3. Test protocol IEC 60068-2-18 (water) method Rb2 (impacting water: water jet).

4.15 Lightning strike

4.15.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of lightning strike.

4.15.2 Test requirement

EUT shall fully operate after having been subjected to exposure of lightning strike.

4.15.3 Test method

The EUT shall be placed on lightning strike test condition with 100 m distance and 30 kA peak current as described on Table 16 below.

Table 16 — Lightning strike test specification

Test type	Distance	Peak current	Transient magnetic field peak amplitude
Lightning strike	100 m	30 kA	50 A/m

— The operation test and visual check shall be performed after completion of the lightning strike test.

— Reference: IEC 61000-4-9 (pulse magnetic field immunity).

4.16 Thermal shock

4.16.1 Test purpose

The purpose of this test is to verify that no damage is caused to the EUT and no permanent or temporary malfunctions occur under the influence of thermal shock.

4.16.2 Test requirement

EUT shall fully operate after having been subjected to exposure of thermal shock.

4.16.3 Test method

— The EUT shall be placed on a thermal shock condition as described in Table 17 below.

Table 17 — Thermal shock test specification

Test type	Test conditions
Thermal shock	20 °C to −40 °C (68 °F to −40 °F) in 4 min (five cycles)
	−40 °C to 20 °C (−40 °F to 68 °F) in 4 min (five cycles)

— The operation test and visual check shall be performed after 4 h of completion of the thermal shock test.

— Reference:

  — Operating and storage temperature: IEC 60721-3-2:1997, Table 1, classes 2K4 and 2K5, low air temperature and high air temperature in unventilated enclosures; test protocol IEC 60068-2-1 and IEC 60068-2-2, tests A (cold) and B (dry heat), procedure Ae; and IEC 60068-2-14 (change of temperature) procedure Nb (specified rate of change).

  — Thermal shock: IEC 60721-3-2:1997, Table 1, class 2K4; test protocol IEC 60068-2-14, test N (change of temperature) procedure Na (rapid change with prescribed time of transition).

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