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Freight containers — Electronic seals —

Part 1: Communication protocol

Conteneurs pour le transport de marchandises — Scellés électroniques —

Partie 1: Protocole de communication

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18185-1 was prepared by Technical Committee ISO/TC 104, *Freight containers*, Subcommittee SC 4, *Identification and communication*.

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

— *Part 1: Communication protocol*

— *Part 2: Application requirements*

— *Part 3: Environmental characteristics*

— *Part 4: Data protection*

— *Part 5: Physical layer*

Introduction

The communication protocol for an electronic seal for freight containers has been developed by the committee to provide for the data link requirements related to the unambiguous interrogation and maintenance of the integrity of a freight container seal from point of sealing to point of opening.

Freight containers — Electronic seals —

Part 1: Communication protocol

1 Scope

This part of ISO 18185 provides a system for the identification and presentation of information about freight container electronic seals. The identification system provides an unambiguous and unique identification of the container seal, its status and related information.

The presentation of this information is provided through a radio-communications interface providing seal identification and a method for determining whether a freight container's seal has been opened.

This part of ISO 18185 specifies a read-only, non-reusable freight container seal identification system, with an associated system for verifying the accuracy of use, having

— a seal status identification system,

— a battery status indicator,

— a unique seal identifier including the identification of the manufacturer,

— the seal (tag) type.

This part of ISO 18185 is used in conjunction with the other parts of ISO 18185.

It applies to all electronic seals used on freight containers covered by ISO 668, ISO 1496-1 to ISO 1496-5, and ISO 8323. Wherever appropriate and practicable, it also applies to freight containers other than those covered by these International Standards.

2 Normative references

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

ISO/TS 14816, *Road transport and traffic telematics — Automatic vehicle and equipment identification — Numbering and data structure*

ISO 17712, Freight containers — Mechanical seals

ISO 18185-2, *Freight containers — Electronic seals — Part 2: Application requirements*

ISO 18185-5, *Freight containers — Electronic seals — Part 5: Sensor interface*

ISO/IEC 18000-7, *Information technology — Radio frequency identification for item management — Part 7: Parameters for active air interface communications at 433 MHz*

ISO/IEC 19762-1, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 1: General terms relating to AIDC*

ISO/IEC 19762-2, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 2: Optically readable media (ORM)*

ISO/IEC 24730-2, *Information technology — Real-time locating systems (RTLS) — Part 2: 2,4 GHz air interface protocol*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762-1, ISO/IEC 19762-2, ISO 17712 and the following apply.

3.1
electronic seal
eSeal
read-only, non-reusable freight container seal conforming to the high-security seal defined in ISO 17712 and conforming to ISO 18185 or revision thereof that electronically evidences tampering or intrusion through the container doors

3.2
seal identification
Seal ID
unique identification of each manufactured seal incorporating serial number (i.e. Tag ID) and manufacturer ID

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

3.4
low frequency transmitter
LF transmitter
device that emits a short range magnetically coupled signal

3.5
Short Range Link
SRL
low frequency link using the low frequency magnetically coupled signalling

3.6
Long Range Link
LRL
radio frequency link using 433,92 MHz or 2,4 GHz signalling

3.7
localization
capability in any operational scenario to associate an eSeal to the container onto which it is affixed

4 Common requirements

The seal shall be uniquely identified by the tag manufacturer ID and the tag ID (serial number) combination. This combination shall be called seal ID and shall be used in all point-to-point communication to uniquely identify a source (seal to interrogator) and destination address (interrogator to seal).

The seal ID is permanently programmed into the seal during manufacturing and cannot be modified.

The interrogator ID is a user configurable parameter and their assignment is not regulated by this International Standard.

The LF transmitter ID is a user configurable parameter.

The seal shall be verified by uniquely identifying the location of that specific seal during the communication exchange with the seal as defined in ISO 18185-2.

5 Seal data

5.1 The electronic seal mandatory data includes seal tag ID and manufacturer ID (which combine to make up the seal ID), date/time for sealing and opening, seal status, low battery status, protocol ID, and protocol version. Model ID and product version are optional data.

The seal status occupies two bits as follows:

— open and unsealed;

— closed and sealed;

— opened.

The following are definitions of the seal states (see Figure 1):

— open and unsealed: the initial state of the seal when the container is open and seal is still unsealed;

— closed and sealed: physically closed and sealed (cable connected, bolt inserted, etc.);

— opened: physically open and seal broken (cable disconnected, bolt removed).

5.2 The low battery status occupies one bit. For low battery status, “0” indicates that the battery state is above the threshold; “1” indicates a battery state at or below the threshold. For battery-less seals, this field is fixed to a value of “0”. The battery low state is defined to indicate that the battery left is insufficient for another trip as defined in ISO 18185-2.

5.3 The seal tag ID occupies 32 bits. This is the identification number (serial number) that the manufacturer assigned to the seal.

5.4 The tag manufacturer ID occupies 16 bits. This is the identification of the tag component manufacturer. This identification is assigned in accordance with ISO/TS 14816. The RF component manufacturer ID of the seal is programmed by the RF component manufacturer.

5.5 Date/time sealed occupies 32 bits. The eSeal will record the time of sealing from a real-time clock based on UTC time.

5.6 Date/time opened occupies 32 bits. The eSeal will record the time of opening from a real-time clock based on UTC time.

5.7 The protocol ID occupies eight bits. It indicates the protocol type.

5.8 The model ID occupies 16 bits. It indicates the manufacturer’s model number.

5.9 Product version occupies 16 bits. It indicates the version of the product (firmware version). The high byte is the major version number and the low byte is the minor version.

5.10 Protocol version occupies 16 bits. It indicates the version of the standard protocol (this International Standard) to which the seal adheres. The high byte is the major version number and the low byte is the minor version. For this version of the International Standard, this parameter shall be 0x0100 (i.e. version 1.0).

5.11 LF transmitter ID occupies 16 bits. It indicates the LF transmitter identification.

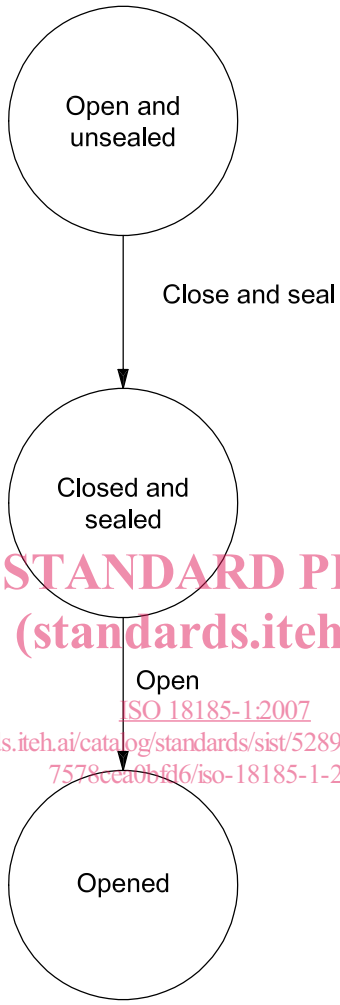

Figure 1 — Seal states

6 Data link layer protocol for electronic seal

There are two types of physical layers. Type A physical layer is the 433 MHz long range link and LF short range link. Type B physical layer is the 2,4 GHz long range link and FSK short range link. The eSeal shall support all the data link protocols. The data link protocols are different for each physical layer. Interrogators and reader devices may support one or both of the physical layers.

The eSeal shall be capable of communicating on both operational mode types A and B. The protocol for these type A long range links at 433 MHz is specified in 6.1. The protocol for the type A short range links using OOK is specified in 6.2. The protocol for these type B long range links at 2,4 GHz is specified in 6.3. The protocol for the type B short range links using FSK is specified in 6.4. Data may be transmitted from the LF transmitter to the eSeal(s) without acknowledgment (one-way link only).

6.1 433 MHz long range data link layer protocol for type A systems

This clause specifies the long range data link layer packet structure for 433 MHz communications.

6.1.1 Packet fields format and definition

6.1.1.1 Protocol ID

The Protocol ID field identifies the data link layers packet structures as defined by this International Standard. The protocol ID that complies with this International Standard is 0x80.

6.1.1.2 Argument Length

The Argument Length field represents the total number of argument bytes in the packet.

6.1.1.3 Min Command Duration

The Min Command Duration field represents the minimum duration in milliseconds from the end of the command to the following command. This field is optional and, if not specified, it is considered to be 0. When a seal is awake and receives this command, but realizes the command is not addressed to it, it may switch to Sleep mode for the duration specified by this field.

NOTE This field can be used for saving power consumption in scenarios where an interrogator must send a sequence of point-to-point commands to several tags. This way, each seal can be in Sleep mode between each command that is not addressed to it.

6.1.1.4 Max Command Duration

The Max Command Duration field represents the maximum duration in milliseconds from the end of the command to the following command. This field is optional and, if not specified, it is considered to be 30 000 ms (30 s). When a seal receives this command and the command is directed to it, it may switch to Sleep mode after this interval if it does not receive another command.

NOTE This field can be used for saving power consumption in scenarios where an interrogator does not have to send more commands to the seal.

6.1.1.5 Packet Options

The Packet Options field is defined as follows.

Table 1 — Packet Options field

Bit	Value = 0	Value = 1	Description
0	Reserved	Reserved	
1	Broadcast (Tag ID and manufacturer ID not present)	Point to Point (Tag ID and Manufacturer ID field present)	The command is either broadcast to all tags or only to the seal whose ID is present in the packet.
2	Min Command Duration not present	Min Command Duration present	
3	Max Command Duration not present	Max Command Duration present	
4	Reserved		
5 – 6	Reserved		
7	Reserved		

6.1.2 Protocol identification and field synchronization

In this subclause, the packet structure for the data link layer is defined. In the data link layer packet structure, the packet shall start with protocol identification. To comply with this International Standard, the protocol ID shall be 0x80.

Some of the data fields within the packet structure may use different length/fields depending on the commands. In the forward link (interrogator to seal), field synchronization is accomplished through the use of the Packet Options field. The Packet Options field is defined in 6.1.1. In the reverse link (seal to interrogator), field synchronization is accomplished through the use of the Mode field defined within the seal status word. The Mode field defines the type of the packet being received as specified within the given Protocol ID packet structure. The seal status word is defined in 6.1.3. The Mode field is defined in 6.1.3.

The Protocol ID specifies general packet structure as defined by this International Standard.

Table 2 — Interrogator to Seal Command Format (Point to Point)

Protocol ID	Packet Options	Tag Manu-facturer ID	Tag ID	Interrogator ID	Command Code	Min Command Duration[a]	Max Command Duration[a]	Argument Length	Command Arguments	CRC
1 byte 0x80	1 byte (8 bits)	2 bytes	4 bytes	2 bytes	1 byte	2 bytes	2 bytes	1 byte	N bytes	2 bytes
[a] This field is command-dependent; some commands may or may not need this field.										

Table 3 — Seal to Interrogator Response Format (Point to Point)

Protocol ID	Seal Status	Packet Length	Interrogator ID	Tag Manu-facturer ID	Tag ID	Command Code	Data[a]	CRC
0x80	2 bytes	1 byte	2 bytes	2 bytes	4 bytes	1 byte	N bytes	2 bytes
[a] This field is command-dependent; some commands may or may not need this field.								

Table 4 — Interrogators to Seal Command Format (Broadcast)

Protocol ID	Packet Options	Interrogator ID	Command Code	Argument Length	Command Arguments	CRC
0x80	8 bits	2 bytes	1 byte	1 byte	N bytes	2 bytes

Table 5 — Seal to Interrogator Response Format (Broadcast)

Protocol ID	Seal Status	Packet Length	Interrogator ID	Tag Manufacturer ID	Tag ID	Data[a]	CRC
0x80	2 bytes	1 byte	2 bytes	2 bytes	4 bytes	0 – N bytes	2 bytes
[a] This field is command-dependent; some commands may or may not need this field.							