TECHNICAL SPECIFICATION

ISO/TS 10891

First edition
2009-02-01

Freight containers — Radio frequency identification (RFID) — Licence plate tag

Conteneurs pour le transport de marchandises — Identification par radiofréquence (RFID) — Étiquette de plaque de licence

Reference number
ISO/TS 10891:2009(E)

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Published in Switzerland

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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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 10891 was prepared by Technical Committee ISO/TC 104, *Freight containers*, Subcommittee SC 4, *Identification and communication*.

Introduction

This Technical Specification has been developed to be compatible with ISO 18185, *Freight containers — Electronic seals.* Due to differences in data structures and air interface parameters, equipment manufactured in compliance with these International Standards and this Technical Specification is not interchangeable and might not be interoperable. However, assurance is given that equipment compliant with ISO 17363, ISO 18185 or this Technical Specification is non-interfering and therefore operable in close proximity to each other.

With regard to ISO 18185 and this Technical Specification:

— supported air interface and communication protocol are specified in ISO/IEC 18000;

— supported commands and messages are specified in ISO/IEC 15961 and ISO/IEC 15962;

— semantics are defined in ISO/IEC 15418;

— syntax is defined in ISO/IEC 15434.

Though not used in this Technical Specification, recognition is given to the standardization work of

— ISO/IEC JTC 1/SC 31 in the area related to air interface, data semantic and syntax construction, and conformance;

— ISO/TC 104 in the area of freight container security, including electronic seals [(e-seals) ISO 18185], and container identification. This work is relevant and highly important since electronic seals are RF devices with their own air interface. Such International Standards ensure that electronic seals are compatible, or at least non-interfering, with tags described in this Technical Specification.

This Technical Specification provides a systemic approach for automatic identification and supply chain applications of RFID for freight containers. Each can be applied to a freight container independently of the other. They describe two different tag types with respectively different tag and application requirements. These are as follows.

a) Permanent container “license-plate” tag:

This tag, hereinafter referred to as the “container tag”, fully described in this Technical Specification, is a permanently affixed, read-only [write once read many (WORM)] tag containing limited data relating only to physical identification and description of the container to which it is affixed. This Technical Specification describes the use of two tags, permanently affixed by, or on behalf of, the container owner. These tags are permanently affixed to and should last the lifetime of their associated container (except possibly in situations where the container changes ownership or equipment ID or the tag is damaged).

b) Cargo shipment-specific tag:

This tag, hereinafter referred to as the “shipment tag”, is a read-write tag into which data specific to a containerized cargo shipment can be stored. Use of this type of tag and the data stored within it is at the discretion of the shipper. The tag may be affixed to the container by the shipper or, per the shipper's instructions, by the party that physically performs the loading (“stuffing”) of the container. Data capabilities are flexible and may, at the shipper's discretion, include destination, routing, conveyance or other transportation information, cargo information (including hazardous material information, where applicable) or other trip-specific information. A compliant tag performs reliably from the point of stuffing of the container to the container's final delivery to the consignee; it is removed by the consignee upon final delivery. The tag may be reusable.

This Technical Specification is one part of a three-part approach within the ISO system for the use of RFID applications on containers. The other related standards apply to e-seals (ISO 18185) and cargo shipment tags. ISO/TS 10891 replaces ISO 10374. ISO 10374 was used as a foundation for ISO 18185 and this Technical Specification [as well as for other (industrial) standards] and will remain active some years in order to provide additional support.

Freight containers — Radio frequency identification (RFID) — Licence plate tag

1 Scope

This Technical Specification establishes:

a) a set of requirements for container tags, which allow the transfer of information from a container to automatic processing systems by electronic means;

b) a data coding system for container identification and permanent related information which resides within a container tag;

c) a data coding system for the electronic transfer of both container identification and permanent related information from container tags to automatic data processing systems;

d) the description of data to be included in container tags for transmission to automatic data processing systems;

e) performance criteria necessary to ensure consistent and reliable operation of container tags within the international transportation community;

f) the physical location of container tags on containers;

g) features to inhibit malicious or unintentional alteration and/or deletion of the information content of container tags when installed on a freight container.

This Technical Specification is intended to be applicable to freight containers as defined in ISO 668 as well as to other containers not defined in ISO 668 and container ancillary equipment such as road and terminal chassis, generator sets and power packs (see 3.1).

The use of container tags and the equipping of containers for automatic identification are optional. The purpose of this Technical Specification is to optimise the efficiency of equipment control systems and to assist in container security initiatives and programs, including the optional usage of electronic seals in accordance with ISO 18185, and any subsequent International Standard. For this reason, any container tag system used for identifying containers shall be non-proprietary and conform to and be compatible with this Technical Specification.

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 668, *Series 1 freight containers — Classification, dimensions and ratings*

ISO 830, *Freight containers — Vocabulary*

ISO 6346, *Freight containers — Coding, identification and marking*

ISO/IEC 15961, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: application interface*

ISO/IEC 15962, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: data encoding rules and logical memory functions*

ISO/IEC 15963, *Information technology — Radio frequency identification for item management — Unique identification for RF tags*

ISO/IEC 18000-6, *Information technology — Radio frequency identification for item management — Part 6: Parameters for air interface communications at 860 MHz to 960 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 19762-3, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 3: Radio frequency identification (RFID)*

IEC 60068-2, *Environmental testing — Part 2: Tests.*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762-1, ISO/IEC 19762-3, ISO 830 and the following apply.

3.1
freight container
ISO freight container as specified in ISO 668 as well as other containers not specified ISO 668 and container ancillary equipment such as road and terminal chassis, generator sets and power packs

3.2
mandatory and optional
indication of the status of requirements from the ISO standpoint, and not to imply that a particular status does or does not result from intergovernmental agreement, legislation etc.

3.3
physically, electronically, and radiographically secure
capable of meeting the operational requirements specified in this Technical Specification after successfully completing the tests specified in Annex A

NOTE For operational requirements see Clause 4.

3.4
physically tamper-proof
designed such that malicious disassembly and re-assembly, using commonly available tools, will be detected upon visual inspection

3.5
electronically tamper-proof
designed such that malicious modification or deletion of electronically stored information by subjection to electromagnetic signals from commonly available electronic devices is not possible

3.6
reader
automatic identification device and its antennas

3.7
range
distance between the reader and the container tag

3.8
passing speed
speed at which a container tag passes the reader

3.9
localisation
capability in any operational scenario to associate a container tag to the container on to which it is affixed

3.10
system reliability
ability of reader to capture information from every passing container tag, which is mounted, programmed and presented in accordance with this Technical Specification, and which enters its reading area under environmental conditions specified in Annex A

3.11
system accuracy
within the defined conditions for system reliability, capability of a reader to detect any misinterpretation of container tag information, including bit errors

3.12
tag type
two-digit code describing the tag technology applied to the container

3.13
tag location code
one-digit code defining the tag mounting location

EXAMPLE T = top panel, S = side panel.

4 Operational requirements

4.1 Basic components of the identification system

The container identification RFID system shall consist of two basic components:

a) two container tags installed on the exterior of the freight container;

b) a reader located away from the freight container.

4.1.1 The container tags shall be capable of:

a) maintaining the integrity of the freight container identification and permanent related information;

b) encoding information into a form suitable for transmission to reader;

c) being physically, electronically and radiographically secure and tamper-proof;

d) being mounted onto the container in locations and manner as specified within this document;

e) having a minimum life of 20 years normal operational use without requiring any periodic maintenance;

f) having a minimum memory capacity of 256 bytes;

g) being read when properly oriented as described in 4.5.2;

h) being localised to a specific container and read as specified in the operational scenarios defined in 4.5.3;

i) being read when operated in the environmental conditions specified in Annex A;

j) being programmed via RF transmissions from a dedicated tag programmer. After programming, mandatory data in the tags must be permanently locked in a manner that prohibits modifying this data;

k) being deployed in international operation, without the necessity of licensing tags individually and/or in individual jurisdictions; and

l) being interrogated by a compatible, international standards-based reader.

4.1.2 The reader shall be capable of:

a) independently reading information contained in the container tags when properly presented; and

b) decoding the information contained in the tags into a form suitable for transmission to automatic data processing systems.

4.2 Container tag data content and format

4.2.1 Some information contained in the tags is mandatory, permanent (non-changeable) information. Remaining memory space is reserved for future use.

4.2.2 The container tags shall provide the following mandatory information about the container; reference to or reliance upon other tables or databases in external automatic data processing systems in order to obtain each of the various information elements shall not be required.

a) Tag manufacturer ID: 2 characters.

b) Tag type: 2 characters.

c) Tag location code: 1 character.

d) Conveyance and ancillary equipment type, e.g. ISO 668 container, chassis, genset: 2 characters:

   01 Intermodal maritime container;

   02 Chassis;

   03 Genset;

   04 Power pack;

   05 Reefer spare part kit;

   06 Truck;

   07 Swap body;

   08 Trailer;

   09 Other equipment.

e) For equipment type 01:

   1) An equipment identification number, in accordance with ISO 6346, which consists of 11 characters:

      i) owner code;

ii) equipment category identifier;

iii) serial number;

iv) check digit.

2) A 4 character size and type code, in accordance with ISO 6346.

3) A 20 character operational mark for maximum gross mass and tare mass, in accordance with ISO 6346.

f) For equipment types 02 to 09:

1) Information in accordance with UN/CFACT specifications.

2) The size and type codes, or other relevant codes.

3) Operational marks as required.

The tag shall be able to store data as defined within Table 1. Additional memory is reserved for future use.

Table 1 — Container ID tag data and values

Data	Value		Unit
	Minimum	Maximum	representation
Tag manufacturer ID			Alphanumerical
Tag type	00	99	Numerical
Tag location code	A	Z	Alphabetical
Equipment type	00	99	Numerical
Owner code	AAA	ZZZ	Alphabetical
Equipment category identifier	A	Z	Alphabetical
Serial number	000000	999999	Numerical
Check digit	0	9	Numerical
Size and type code			Alphanumerical
Gross mass (kilograms[a])	00000	99999	Numerical
Tare mass (kilograms[a])	00000	99999	Numerical
[a] In certain cases pounds are used instead of kilograms.			

The mandatory data above shall be written to tag memory, using radio frequency through a sealed tag case. Tags must be programmable in the field. After initial programming, WRITE access to memory prescribed for required mandatory data (above) must be disabled using a permanent lock of memory or other means.

4.2.3 Data protocol and unique tag identifier

The data protocol, i.e. commands and messages to and from container tags conforming to this Technical Specification shall support the requirements of ISO/IEC 15961 and ISO/IEC 15962.

For effective container tagging, it is necessary that each RFID container tag be unique worldwide. In order to uniquely identify RFID container tags, each tag shall be assigned a unique tag ID, as specified in ISO/IEC 15963. In tag memory bank MBO1, bit 0×17 shall be programmed to a “1” and bits 0×18 to 0×1F shall contain an ISO/IEC 15961 application family identifier (AFI).

4.3 Reader requirements

4.3.1 The reader shall be international standards-based and shall be compatible with the container tags in order that it can provide the information transmitted by the tags to the automated processing system.

4.3.2 The reader shall be of a technology adaptable to accommodate fixed, mobile or portable applications.

4.3.3 The reader and connected real time electronic data processing (EDP) system shall be capable of adding to the data captured from the container tags the following information:

a) reader unit identification;

b) date and time of interrogation of the container tags.

4.4 Safety and regulatory considerations

All container tags compliant with this Technical Specification, including their readers, shall meet the safety and regulatory requirements of the appropriate government regulations, to include power, duty cycle and electromagnetic radiation. In addition, such tags and their readers shall comply with the relevant safety and regulatory requirements, including radio frequency regulations, of the country where the technology is being used.

Container identification RFID systems may be used internationally in areas in which both occupational and non-occupational exposure limits apply for human exposure to radiated energy. All devices emitting RF (both electrical and magnetic) energy claiming conformance to this Technical Specification shall include a conformance statement noting: "Devices claiming conformance to this Technical Specification shall be self-certified by the device manufacturer that the emissions of said devices do not exceed the maximum permitted exposure limits given in IEC 60601-1-2 and IEEE C95.1".[1)]

Further, the use of container tags, and other RF emitting devices claiming performance to this Technical Specification shall be restricted in hazardous environments such as near or around explosives or flammable gasses unless these devices have been certified as safe for such use by appropriate authorities.

4.5 Performance specification for the container identification RFID system

4.5.1 Environmental conditions

The tags shall operate satisfactorily, meeting all environmental requirements as specified in Annex A.

4.5.2 Proper presentation of the container tags

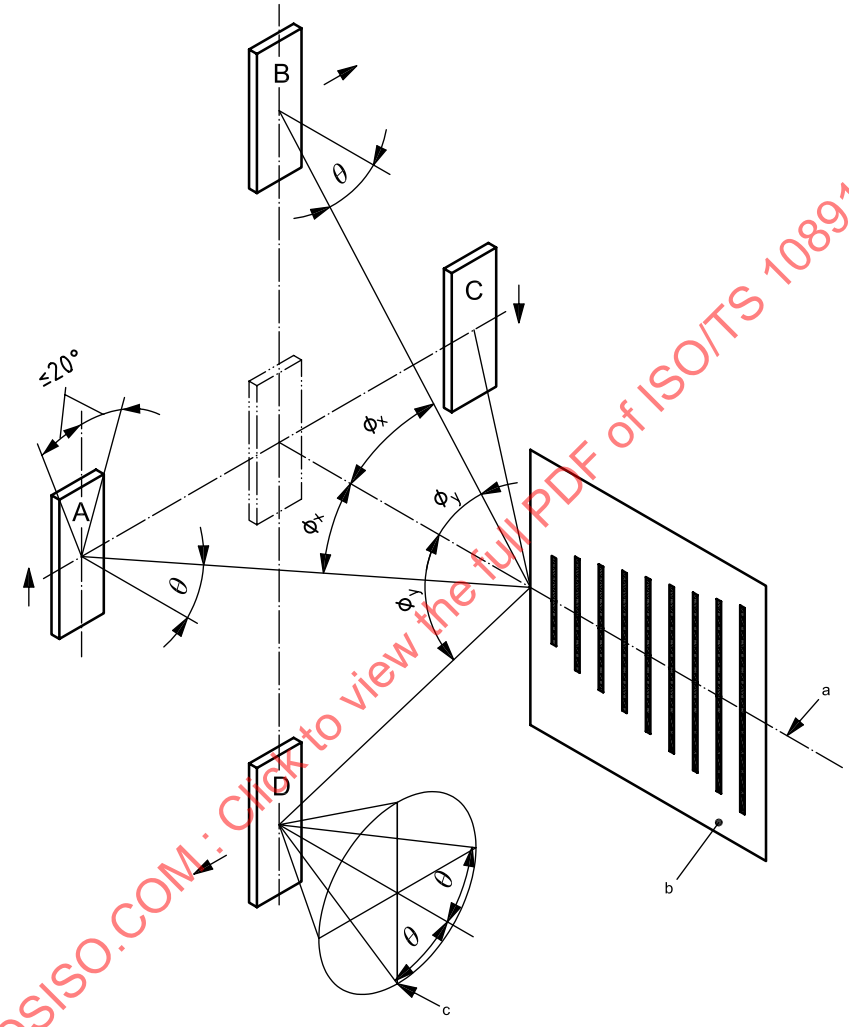
The orientation requirements for proper presentation of the container tags to the reader are given in Figures 1 and 2, which show four tags labelled A, B, C and D. Figure 1 shows a tag mounted vertically (as would be the case for a sidewall-mounted tag) and Figure 2 shows a tag mounted horizontally (as would be the case for a top-mounted tag).

The following apply to presentation of tags.

a) A tag shall be regarded as properly presented in terms of its orientation, even if it has an angular displacement such as illustrated for tag A in Figures 1 and 2 (i.e. it is rotated about an axis perpendicular to the face of the tag by an amount not exceeding 20 degrees to either side of the optimal) in addition to the angular displacement, θ, which may be up to 45 degrees, for each type of combined system requirement.

1) For further information related to exposure limits to radiated energy, see http://www.icnirp.de.

b) The requirements governing the angles marked "ϕ" in Figures 1 and 2 (the angles between the axis of the reader and the lines joining the "effective" centre of the reader with the centres of the tags) will vary according to the circumstances under which the reading is required, for example at gate houses or on a spreader, and the design of the reader. Hence, although the tag is required to perform satisfactorily if the interrogating signal reaches it from any direction within a cone of 2θ included angle (as for tag D in Figures 1 and 2), the "window" within which a tag must be presented to a particular reader will vary with the design of the reader.

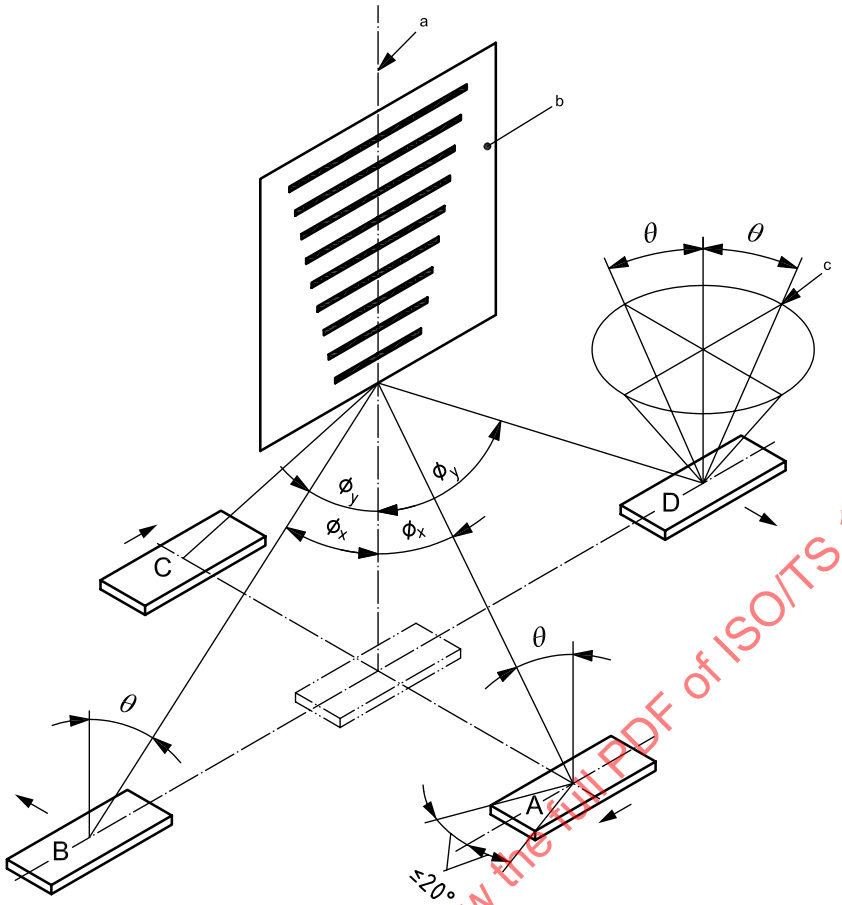


a Axis of sensing equipment.

b Plane of sensing equipment.

c Cone (2θ included angle) within which incoming signals must reach tag.

Figure 1 — Tag presentation requirements for side-panel-mounted tag



a Axis of sensing equipment.

b Plane of sensing equipment.

c Cone (2θ included angle) within which incoming signals must reach tag.

Figure 2 — Tag presentation requirements for top-panel-mounted tag

4.5.3 Combined system requirements

The container identification RFID system shall be capable of reading at least one of the two tags affixed to the container in all of the operational scenarios defined below. Current passive RFID technology does not support localization in all the scenarios. In situations where localization is not possible, the container identification RFID system shall have a system level capability to establish the relationship between a tag and the container onto which it is affixed.

EXAMPLE In multiple vertical lifts, that relationship could be established through readings of the tags as the containers are being assembled for the multiple vertical lift.

4.5.3.1 Container handling and moving equipment scenarios with spreader-mounted readers

4.5.3.1.1 General

This set of scenarios deal with reading container tags with spreader-mounted readers while the containers are being handled.

Container handling equipment covered by these scenarios includes top loaders, side loaders, reach stackers, straddle carriers (collectively known as “mobile equipment”), as well as rubber tyred gantry cranes (RTG), rail mounted gantry cranes (RMGC) and quay cranes.

The container travel speed (relative to the reader) will always be 0 km/h. The read range shall, within allowable power levels and in conformance with the characteristics of the spreader equipment used and the attendant restrictions on the actual mounting location of the reader, meet the operational requirements of the user of the container identification RFID system. However, the minimum read range shall be no less than 5 m.

In those situations, where spreader-mounting of readers is not feasible or is deemed undesirable, the reading of container tags can be done according to the “Restricted lane scenarios” discussed below in 4.5.3.2 or by using handheld readers as described in 4.5.3.3.

4.5.3.1.2 Moves with multiple containers simultaneously

Container handling equipment that moves single 1A containers or two 1C containers is often capable of moving more than one 1A or two 1C containers simultaneously. Any combination of container orientations is possible (i.e. doors left, right, both doors out or butted together).

Localization shall be ensured in all multiple horizontal lifts (e.g. two 1A containers side-by-side; two 1C butted; four 1C butted and side-by-side). For multiple vertical container lifts, the container tag identification system must have a system-level capability to establish the relationship between a tag and the container onto which it is affixed.

4.5.3.2 Restricted lane scenarios

This set of scenarios deals with reading container tags in restricted lanes. Containers could be pulled by road or yard trucks or travel on rail cars. Some kind of physical restriction assures movement in only one direction (i.e. forward/backward but not sideways) within a confined or defined space (e.g. lane or rail track). These scenarios may include container handling use cases, including container repositioning and “shifting” on a vessel, where the spreader mounting of readers is not feasible or is deemed undesirable.

Localization is a requirement for all restricted lanes scenarios.

4.5.3.2.1 Single-lane gates or portals

This scenario covers all situations where container traffic is reduced to a single lane. This includes truck gates, structured pre-gates, OCR portals and yard portals. Structures on either or both sides of the lane exist to restrict movement and for permanent installation of readers.

Lanes are assumed to be 3 m to 6 m wide and containers are assumed to travel at speeds ranging from 0 km/h to 50 km/h.

4.5.3.2.2 Multiple-lane gates or portals

This scenario covers all situations where containers travel in multiple parallel lanes. This includes truck gates, structured pre-gates, optical character recognition (OCR) portals and yard portals. Structures between lanes exist to restrict movement and for permanent installation of readers. Containers in adjacent lanes may travel in opposite directions.

Lanes are assumed to be 3 m to 6 m wide and containers are assumed to travel at speeds ranging from 0 km/h to 50 km/h.

4.5.3.2.3 Single-track train gates or portals

This scenario covers single-track rail gates. Structures on either side, both sides, or above the track exist or can be created for permanent installation of readers. Containers on rail cars travel at speeds of up to 50 km/h but can reach even higher speeds on trains in transit outside container handling facilities, border crossings, etc. Containers can be stacked up to two containers high. Lanes are assumed to be 3 m to 6 m wide.

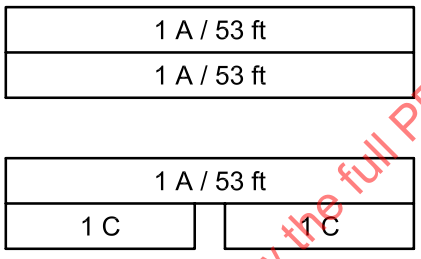
4.5.3.2.4 Multiple-track train gates or portals

This scenario covers rail gates with multiple parallel tracks. Structures on either side, between or above tracks exist or can be created for permanent installation of readers.

Containers on rail cars travel at speeds of up to 50 km/h and can be stacked up to two containers high. Lanes are assumed to be 3 m to 6 m wide.

4.5.3.2.5 Containers on rail cars

Containers can be stacked up to two high on rail cars but only the bottom containers can be 1C containers (e.g. four 1C containers shall not be loaded onto a single rail car).



Key

1A 40 ft container having an external length of 12192 mm

1C 20 ft container having an external length of 6058 mm

53ft non-ISO container having an external length of 16154,4 mm

Figure 3 — Containers stacked on rail cars

In cases where well cars are used to transport containers, the bottom 2,04 m of the lowest containers may be covered by the steel of the well on the left and right sides of the rail car.

4.5.3.3 Short-range hand-held scenarios

Reading of container tags may be done with hand-held readers. Examples for the use of hand-held devices are exception handling as well as locations that lack fixed infrastructure.

The short-range hand-held scenario assumes a person is able to walk up very close to the container sidewall to which one of the container tags is affixed. The hand-held reader shall be ergonomically viable and tag reading shall support situations where the person stands still or is walking at speeds of up to 5 km/h. The handheld device shall read container tags at a range of at least 5 m.

4.5.4 Reliability and accuracy requirements

Container identification RFID systems, where tags are positioned, programmed and presented to readers in accordance with the provisions of ISO/IEC 18046 and 4.1.1, 4.2, and 4.5 of this Technical Specification, shall have a minimum system reliability of 99,99 %, i.e. no more than one no-read in 10 000 readings, and a system accuracy of 99,998 %, i.e. no more than one undetected incorrect reading in 65 000 readings.

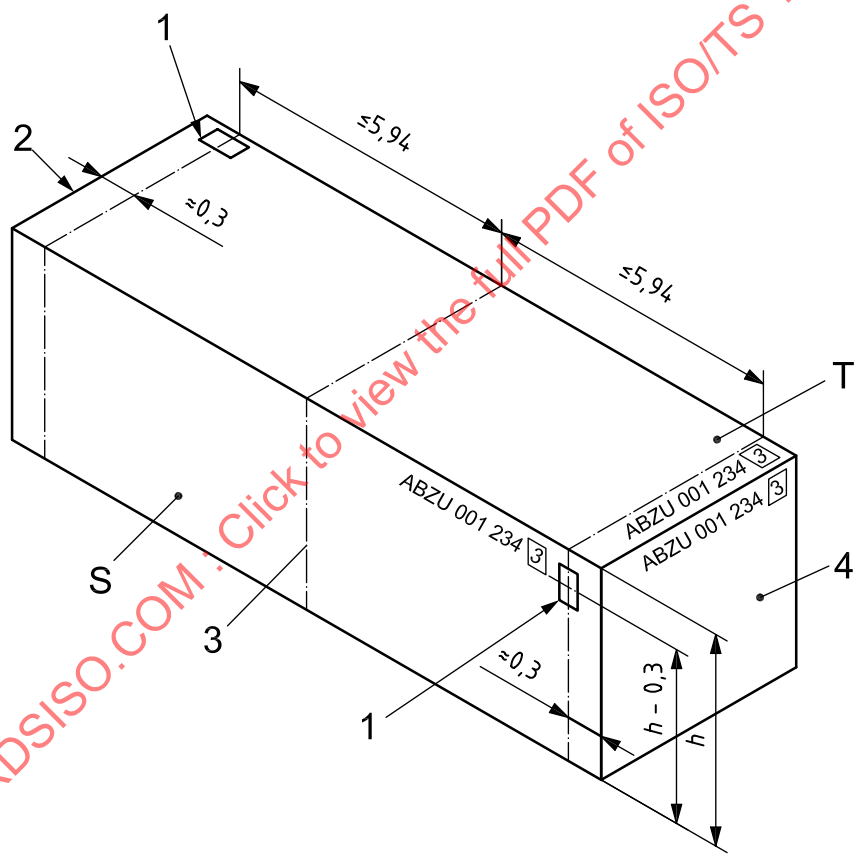
4.5.5 Container tag positioning

The container tags shall not protrude beyond the envelope/exterior frame of the freight container and shall have no provisions for permanent mounting that will render the structural or environmental integrity of the freight container below its service requirements.

Two tags shall be affixed to each container but it is only necessary to read one of these tags for successful operations.

One tag, designated the S (side panel) tag, shall be located on the exterior surface of the right side panel as seen from the door end of the container, approximately 0,3 m from the front end, in the case of containers of length 12,2 m or less (recessed between the first and second side panel corrugations, if available). For containers of length greater than 12,2 m, the tag shall be located approximately 0,3 m to the rear of the right front “40 ft. lifting position”, but in any case not more than 5,94 m from the transverse centre-line of the container. Figures 4 and 5 give these relationships.

Dimensions in metres

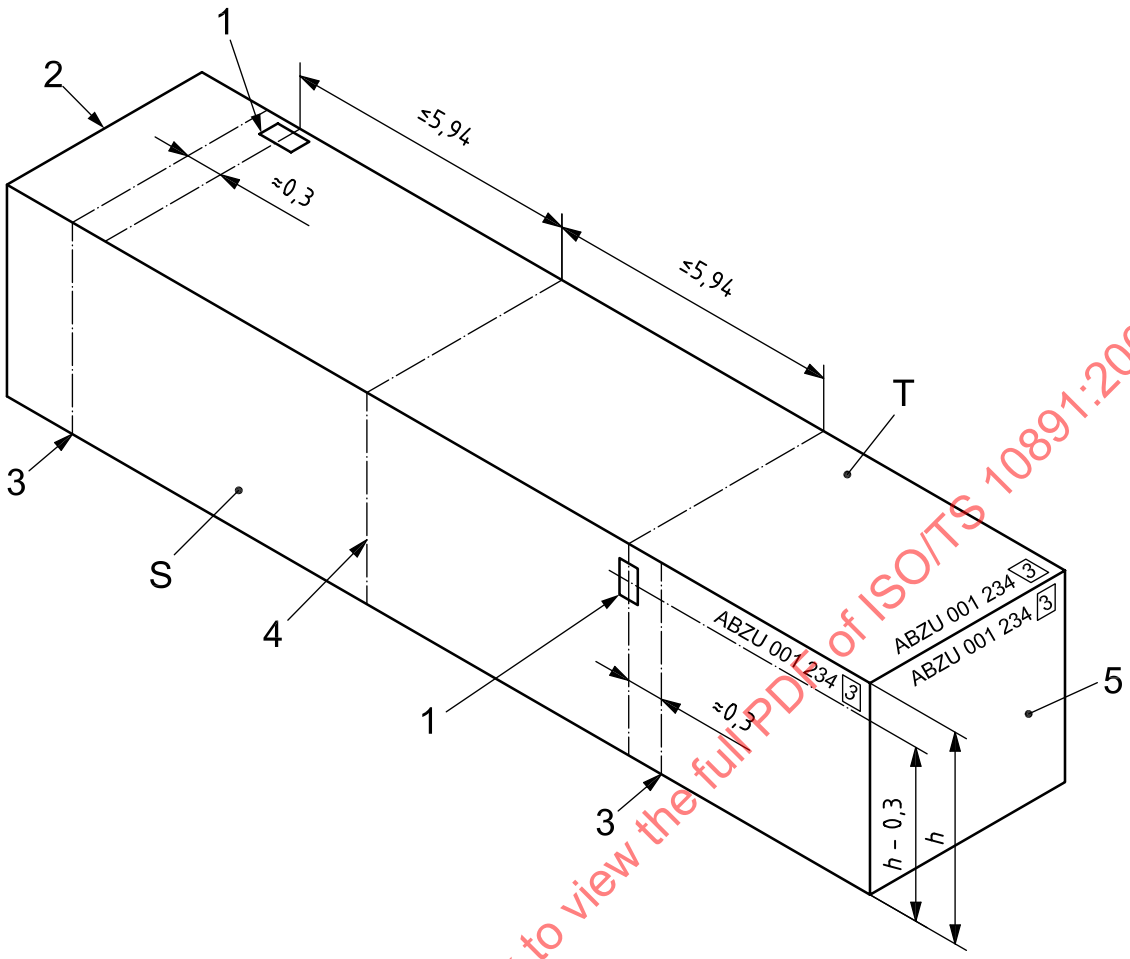


Key

1 tag
2 door end
3 transverse centre-line of container
4 front end
S side panel
T top panel

Figure 4 — Tag locations for containers of length 12,2 m or less

Dimensions in metres



Key

1 tag
2 door end
3 lifting position
4 transverse centre-line of container
5 frond end
S side panel
T top panel

Figure 5 — Tag locations for containers of length greater than 12,2 m

In the case of smooth-skin and thermal containers, the tags should be mounted as close as possible to the locations defined for standard corrugated containers, preferably within a recessed mounting pan. Special containers, along with non-box items (including road and terminal chassis, generator sets and power packs), should have tags located in positions as near as possible to those specified above, in keeping with the design of the equipment.

The container tags are intended to last the lifetime of the container, but may be replaced in situations where the container ownership or equipment ID changes.

4.5.6 Interoperability, compatibility and non-interference with other RF systems

All container identification RFID systems, including their container tags, antennas and readers, claiming conformance with this Technical Specification shall operate on a strict non-interference basis with all other RFID systems operating in the same spectrum, and shall be interoperable and compatible within the frequency bands defined in Clause 6.

5 Container tag frequency of operation and radiation characteristics

The container tags shall respond to an interrogating signal within the frequencies 860 MHz to 960 MHz in accordance with ISO/IEC 18000-6, Type C. Power levels and other operational parameters at these frequencies shall be in accordance with local regulations.

6 Container identification RFID system testing and requirements

6.1 The system's basic components shall be subjected to appropriate environmental tests as defined in Annex A. Tags shall meet all requirements without exception. Readers shall meet all requirements relevant to their intended location and use including, where applicable, mounting on spreaders.

6.2 When properly installed, the system shall meet the reliability and accuracy requirements specified in 4.5.4.