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Freight containers — Automatic identification

*Conteneurs pour le transport de marchandises — Identification
automatique*

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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.

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.

International Standard ISO 10374 was prepared by Technical Committee ISO/TC 104, *Freight containers*, Sub-Committee SC 4, *Identification and communication*.

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Annex A forms an integral part of this International Standard. Annex B is for information only.

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Introduction

This International Standard specifies a system for the automatic identification of freight containers and the electronic transfer of the identity of the container and permanent related information to third parties in a standard format. It is intended that the Automatic Equipment Identification (AEI) system will facilitate documentation, resource control, and communications (including electronic data processing systems). The visual container identification markings specified by ISO 6346 are not affected. Future additions to this International Standard will specify modulation, encoding and an open protocol.

Annex B, which is an informative annex only, describes the technical specification of a system that complies with the requirements of this International Standard. Parts of annex B are covered by patents held by

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The patent holder has stated that licences will be granted under reasonable terms and conditions.

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Freight containers — Automatic identification

1 Scope

This International Standard establishes

- a) a container identification system which allows the transfer of information from a freight container to an automatic processing system by electronic means,
- b) a data coding system for container identification and permanent related information which resides within an electronic device called a tag installed on a freight container,
- c) a data coding system for the electronic transfer of both container identification and permanent related information from an electronic device installed on a freight container to automatic data processing systems,
- d) the description of the data to be included in the tag for transmission to the sensing equipment,
- e) performance criteria necessary to ensure consistent and reliable operation of the automatic equipment identification (AEI) system within the international transportation community,
- f) requirements for the physical location of the electronic device on freight containers, and
- g) security features to inhibit malicious or unintentional alteration of the information content of the electronic device when installed on a freight container.

It specifies all necessary user requirements in order to permit international use of the tag without modification or adjustment.

This International Standard applies to freight containers as defined in ISO 668 (see 3.1).

The use of AEI systems and the equipping of containers for automatic identification is not mandatory. The purpose of this International Standard is to optimize the efficiency of equipment control systems.

For this reason, any AEI system used for identifying containers shall conform to and be compatible with this International Standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 646:1983, *Information processing — ISO 7-bit coded character set for information interchange*.

ISO 668:1988, *Series 1 freight containers — Classification, dimensions and ratings*.

ISO 6346:1984, *Freight containers — Coding, identification and marking*.

IEC 68-2 (all parts), *Environmental testing — Part 2: Tests*.

Economic Commission for Europe, *Customs convention on the international transport of goods under cover of TIR carnets (TIR convention)*, and its amendments and corrigendum. 1975 to 1991.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 freight container: An ISO freight container as specified in ISO 668.

3.2 “mandatory” and “optional”: The terms “mandatory” and “optional” are employed in this International Standard to indicate the status of requirements from the ISO standpoint, and not to im-

ply that a particular status does or does not result from intergovernmental agreement, legislation, etc.

3.3 physically and electronically secure: Capable of meeting the operational requirements specified in this International Standard (clause 4) after successfully completing the tests specified in A.1.

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 of electronically stored information by subjection to electromagnetic signals from commonly available electronic devices is not possible.

3.6 range: Distance between the sensing equipment and the tag.

3.7 passing speed: Speed at which a tag passes the sensing equipment.

3.8 container movement status: Information which indicates the position, speed or direction of the container relative to the sensing equipment.

3.9 AEI system reliability: Ability of an AEI system to capture mandatory information from every tag, which is mounted, programmed and presented in accordance with this International Standard and which enters its coverage area under environmental conditions as specified in A.3.

3.10 AEI system accuracy: For an AEI system for which it is assumed that the defined conditions for system reliability are met, the capability of the AEI system to detect any misinterpretation of mandatory information including bit errors.

4 Operational requirements

4.1 Basic components of the AEI system

The AEI system shall consist of two basic components, i.e.

- a) an electronic device (tag) installed on the freight container, and
- b) electronic sensing equipment located apart from the freight container.

4.1.1 The tag shall be capable of

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

- b) encoding its information into a form suitable for conveyance to sensing equipment,
- c) being programmed in the field; however, the permanent data shall not be reprogrammable while the tag is fixed to the container,
- d) being physically and electronically secure and tamper-proof,
- e) being fixed to a container in accordance with the provisions of the TIR convention,
- f) being mounted between the typical vertical ribbing of the freight container side — it shall have dimensions as small as possible but not exceeding 30 cm × 6 cm × 2 cm,
- g) a minimum life of 10 years normal operational use and shall not require periodic maintenance,
- h) providing, through the sensing equipment, an indication of impending battery failure if it contains a battery,
- i) being read when it is
 - 1) operated in the environmental conditions specified in 4.6.1,
 - 2) within range (see table 1),
 - 3) moving in relation to the sensing equipment at an acceptable speed (see table 1),
 - 4) sufficiently separated from adjacent similar tags to allow discrimination (see table 1), and
 - 5) suitably oriented (see 4.6.2), and
- j) international operation, without the necessity of licensing tags individually.

4.1.2 The sensing equipment shall be capable of

- a) reading information contained in the tag when it is properly presented, and
- b) decoding the information contained in the tag into a form suitable for transmission to automatic data processing systems.

4.2 Information content of the tag

The information contained in the tag is in one or more of the following categories:

- mandatory, permanent (non-changeable) information;
- optional, permanent (non-changeable) information;

- optional, non-permanent (changeable) information.

Optional information contained in a tag shall not adversely affect the operation of systems requiring only the mandatory information contained in the tag.

4.3 Tag requirements — Basic information

The tag shall provide, as a minimum, the basic information about the container so that reference to other tables or databases is unnecessary. The following tag basic information is mandatory and permanent:

- a) tag type;
- b) equipment identifier;
- c) owner code, in accordance with ISO 6346;
- d) serial number, in accordance with ISO 6346;
- e) check digit, in accordance with ISO 6346;
- f) length (in centimetres);
- g) height (in centimetres);
- h) width (in centimetres);
- i) container type code, in accordance with ISO 6346;
- j) maximum gross mass (in hundreds of kilograms);
- k) tare mass (in hundreds of kilograms).

4.4 Sensing equipment requirements

4.4.1 The sensing equipment shall be capable of providing the information conveyed by the tag, as presented in 4.3, to the automated processing system.

4.4.2 The sensing equipment shall be of a technology adaptable to accommodate fixed or mobile installations, or portable applications.

4.4.3 The sensing equipment and connected real-time electronic data processing (EDP) system shall be capable of adding to the tag data the following operational information:

- a) sensing equipment unit identification;
- b) date and time;
- c) freight container movement status.

4.5 Safety and regulatory considerations

The system when installed or operated in a particular country shall comply with national and local governmental safety and radio frequency (r.f.) regulations, and any other governmental rules and regulations which may apply, including those relating to human radiation exposure levels.

Automatic identification equipment systems will be used internationally in areas in which both occupational and non-occupational exposure limits apply for human exposure to radiated energy. In areas readily accessible to the general public, emission levels of radiated energy from electronic automatic identification equipment shall comply with standards for non-occupational exposure and shall not exceed the specified limits for non-occupational exposure depending on the country of use.

4.6 Performance specifications for the AEI system

4.6.1 Environmental conditions

AEI equipment is typically subject 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.

Substantial temperature variations are common in worldwide container operations, as well as prolonged exposure to sunlight, including ultraviolet rays. The tag shall operate satisfactorily at tag surface temperatures between $-50\text{ }^{\circ}\text{C}$ and $+80\text{ }^{\circ}\text{C}$ and shall maintain the integrity of stored data at temperatures from $-70\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$. The tag shall survive and maintain the integrity of stored data under (as a minimum) the severest of the environmental conditions covered by the test methods specified in A.1.

The system shall be capable of full operation in the electromagnetic environment typically found at transportation facilities. The tag shall survive and maintain the integrity of stored data in a maximum peak field strength of 50 V/m for 60 s, as may be encountered from any r.f. source such as a shipborne radar under normal operation or other such devices [see A.1, item j)].

4.6.2 "Proper presentation" of the tag

The orientation requirements for "proper presentation" of the tag to the sensing equipment are illustrated in figure 1, which shows four tags labelled A, B, C and D.

- 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 figure 1 (i.e. it is rotated about an axis perpendicular to the face of the tag by an amount not exceeding 20° to either side of the vertical) in addition to the angular displacement θ , as specified in table 1 for each type of combined system requirement.
- b) The requirements governing the angles marked ϕ_x and ϕ_y in figure 1 (the angles between the axis of the sensing equipment and the lines joining

the “effective” centre of the sensing equipment with the centres of the tags) will vary according to the circumstances under which the reading is required, e.g. at gate houses, between the legs of a quay crane, etc. and the design of sensing equipment. 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 illustrated for tag D in figure 1), the “window” within which a tag must be presented to a particular sensing equipment will vary with the design of the sensing equipment.

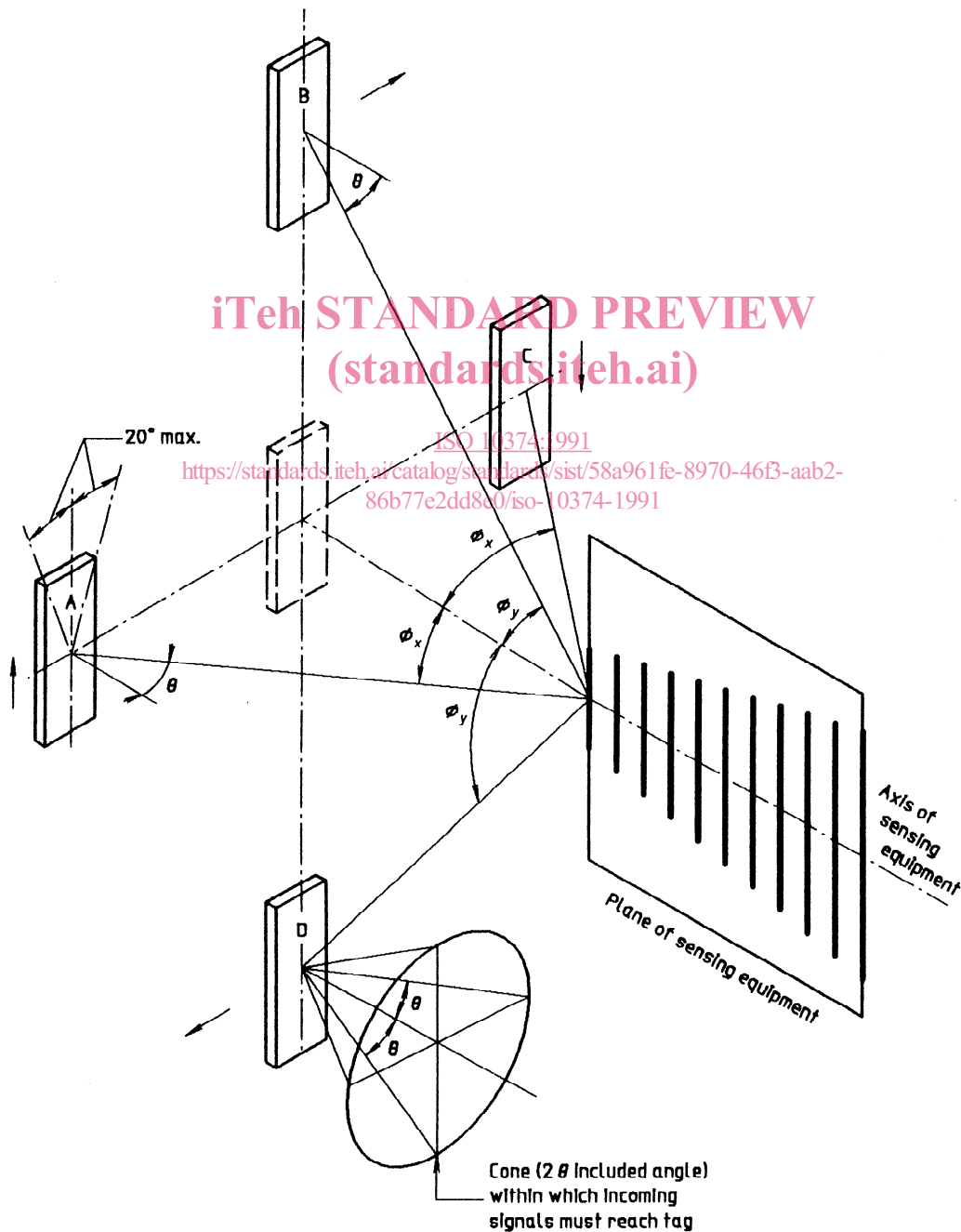


Figure 1 — Tag presentation requirements

4.6.3 Combined system requirements

The AEI system shall be capable of reading a tag on containers in accordance with all the combined requirements given in table 1 (see also figure 2).

Table 1 — Combined system requirements

Passing speed km/h	Range ¹⁾ m	Discrimination ²⁾ m	Presentation angle θ degrees
130	1 to 13	10	20
80	1 to 13	5	30
30	1 to 10	1,2	70
0	0,1 to 2	1,5	90

1) Tests shall be conducted at the minimum and maximum values of each range.
2) Discrimination: distance between two tags.

4.6.4 AEI system reliability and accuracy

Tags which are positioned, programmed and presented to the sensing equipment in accordance with the provisions of this International Standard shall have a minimum AEI system reliability of 99,99 %, i.e. no more than one no-read event in 10 000

readings, and an AEI system accuracy of 99,999 9 %, i.e. one undetected incorrect reading in 1 000 000 readings.

4.6.5 Tag positioning

The tag shall not protrude beyond the envelope of the freight container and shall have provisions for permanent mounting that will not render the structural or environmental integrity of the freight container below the service requirements.

Only a single tag shall be required to identify each freight container. The tag shall be located on the exterior surface of the right sidewall as seen from the door end of the container, approximately 0,3 m from the edge with the blind end, in the case of containers of length 12,2 m (40 ft) or less (recessed between the first and second sidewall corrugations, if applicable) or approximately 0,3 m to the rear of the lifting position, in the case of containers of length greater than 12,2 m (40 ft), but, in any case, not more than 5,94 m from the transverse centre-line of the container (see figures 3 and 4). The letter *h* indicates the overall container height.

In the case of non-box, smooth-skin and thermal containers, the tag may be located in proximity to the lower corner fittings as an alternative to the preferred location described above.

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Dimensions in metres

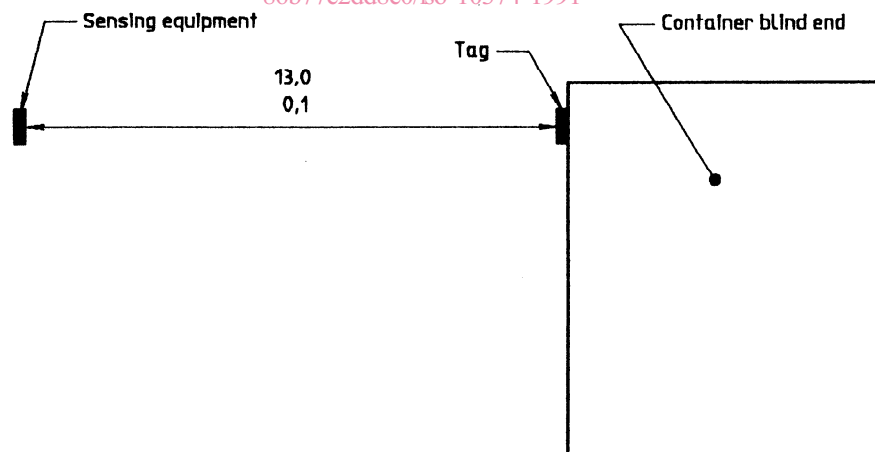


Figure 2 — Read range

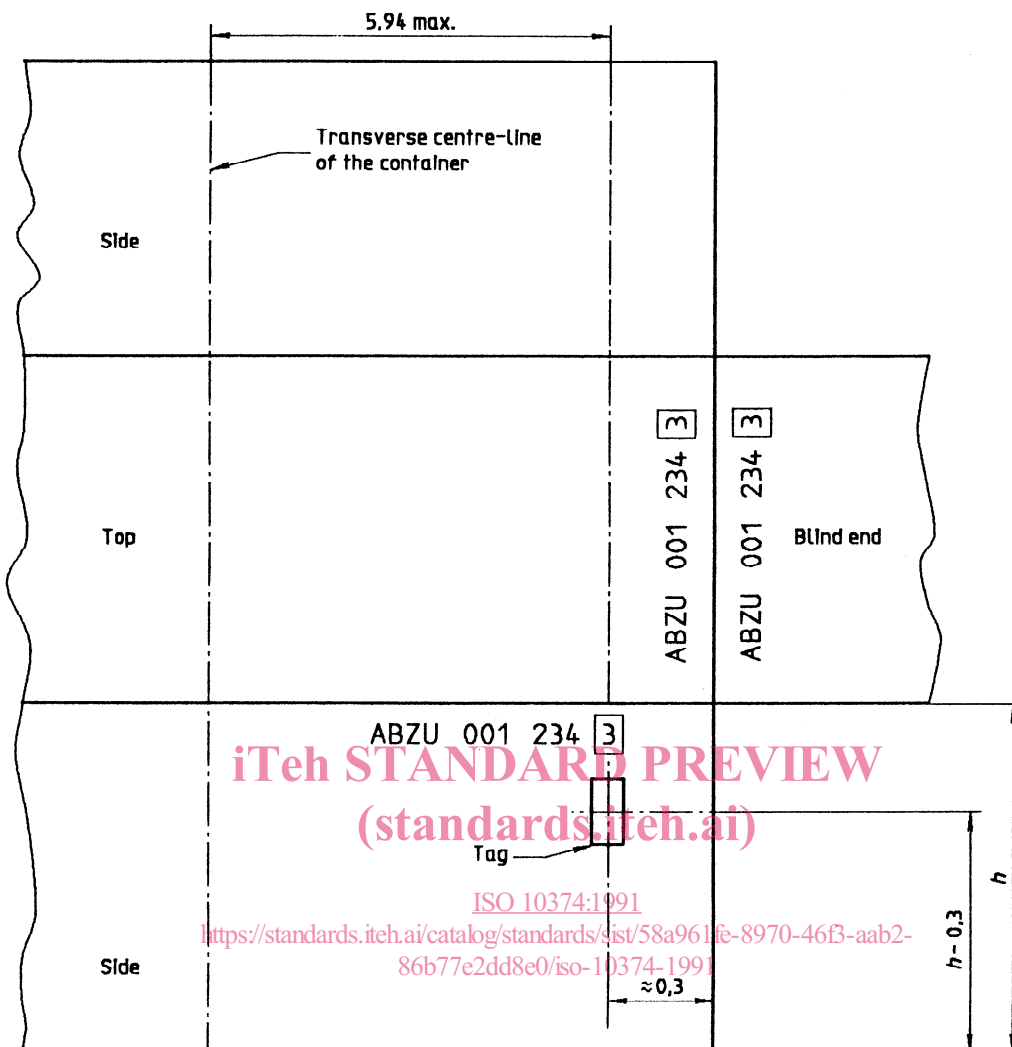


Figure 3 — Tag location for containers of length 12,2 m (40 ft) or less

Dimensions in metres

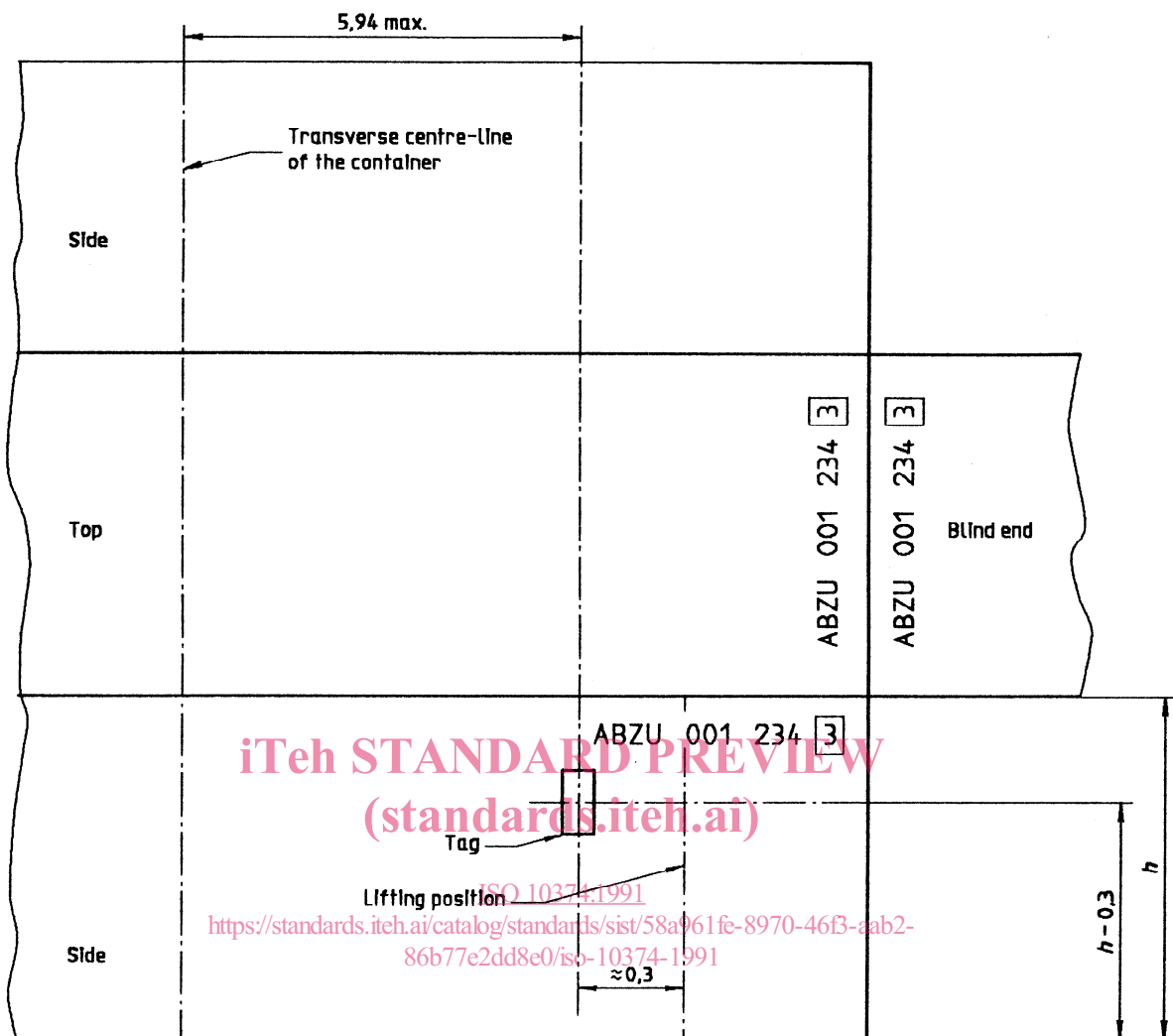


Figure 4 — Tag location for containers of length greater than 12,2 m (40 ft)