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Information technology — Radio frequency identification device performance test methods —

Part 4: Test methods for performance of RFID gates in libraries

Technologies de l'information — Méthodes d'essai des performances du dispositif d'identification par radiofréquence —

Partie 4: Méthodes d'essai de la performance des portes à RFID dans les bibliothèques

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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 document 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/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

ISO/IEC 18046 consists of the following parts, under the general title *Information technology — Radio frequency identification device performance test methods*:

— *Part 1: Test methods for system performance*

— *Part 2: Test methods for interrogator performance*

— *Part 3: Test methods for tag performance*

— *Part 4: Test methods for performance of RFID gates in libraries*

Introduction

This part of ISO/IEC 18046 covers test methods for the performance of HF RFID gates in libraries. The term HF RFID gate refers to an HF RFID interrogator that supports an arrangement of several HF RFID antennas utilizing multiplexers or splitters. Antenna pairs are usually placed on opposite sides of a so-called passage way through which tags are moved and captured. The positioning of such HF RFID gates at entrances, exits and transit positions within buildings thus permits the capturing of access and/or outward movement of objects/media or media stacks.

At the same time, the possibility of stack (bundle) detection permits the simultaneous recognition of several tags. HF RFID gates are available as permanently installed or mobile variants. The reading range of HF RFID gates is limited but can be set in the range of 0,5 m to 2 m for 13,56 MHz (inductive coupling) systems based on the size and number of antennas and/or of the tag properties.

The main purpose of the gates within a library lies in anti-theft protection of media using simple reading of security bits (AFI or EAS) on a tag. Aside from that, they also permit the capturing of the specific medium by reading out extended information that can be additionally stored in a tag. There are also hybrid systems, which additionally allow capturing of so-called EAS magnetic strips.

HF RFID gates within libraries are frequently used in combination with visitor counters (e.g. light barriers) which permit direction-dependent capturing of gate use. These visitor counters can be installed optionally or can alternatively be a fixed part of the gate.

Current gates can recognize tags in horizontal and vertical as well as diagonal positions. A few possess auto-tuning functions that automatically correct the magnetic field if there is a drop in performance.

The selected operating mode (AFI) is constant throughout the entire individual tests.

Figure 1 shows four essential processes that could be identified for HF RFID gates in libraries. These are, on the one hand, the registration of media security at the time of access/outward movement of objects and therewith the alarm functions. Then, there is the pure detection of media information of the tags that have been moved. Furthermore, there is the optional counting of visitors and finally, the communication with the backend systems of the library, though this is not compulsory. In its main function of media security, a gate should also function offline.

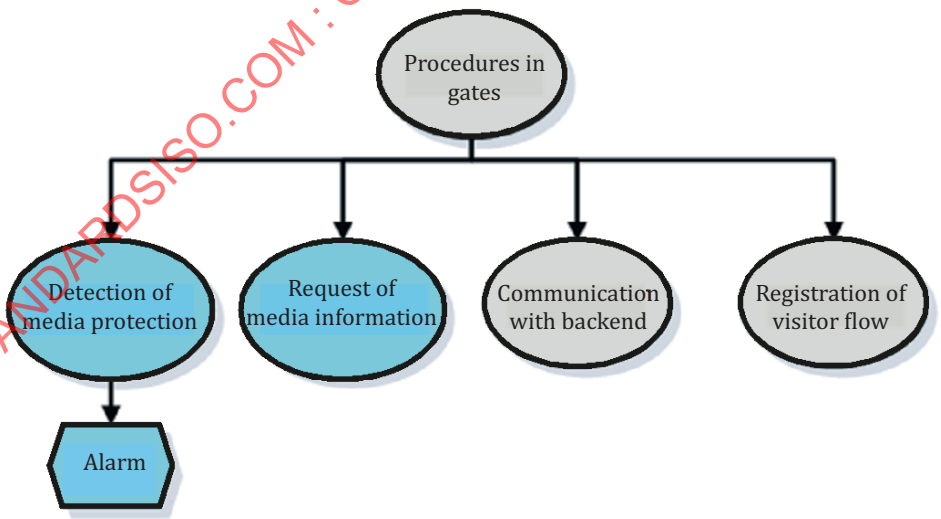


Figure 1 — Typical process flow at a gate

By increasing service demands in the area of opening times and increasing cost pressures at the same time, public and academic libraries increasingly rely on the use of automated accounting systems based on radio frequency technology. In addition to posting the media for lending and return, the technology also provides an anti-theft device. Core components for preventing burglary are sensor systems, which

are installed in the form of pass gates at the entry and exit. Prior to this part of ISO/IEC 18046, there were no requirements and test specifications that describe the performance of these sensor systems uniformly. With the present test methods for standardization of performance evaluation of HF RFID gates for use in libraries, this gap will be closed.

The RFID performance of the gates can be impaired if objects that have an influence on the magnetic fields are present in the direct vicinity of the gates. Materials such as metals, water and substances with a high density can influence transmission here. In libraries, it is mostly due to constructional and/or architectural reasons that such objects are present in the direct vicinity of HF RFID gates. These can be metallic door frames, staircase railings, floor heating as well as sign plates or metallic furniture. In many cases, it is not possible to maintain a minimum distance, resulting in possible performance losses of the antennas. Special influence is also exerted by power lines with high output or lines with power line telecommunication within the building which are laid into the floor or in the walls and are not visually identifiable as sources of interference.

Influences can be caused by active and passive sources. These include the RFID components themselves. The passive sources of interference include all kinds of furniture of a library composed of or containing metal which can possibly have an interfering influence and can distort the detection field. This also includes tags disposed in the vicinity of the gates which are positioned in a secured variant within the library. All kinds of electrical devices and machines that can exert an electro-magnetic influence on the gate in libraries, and/or buildings, in general, can be summed up as active interferers.

In this part of ISO/IEC 18046, references to HF RFID gates, interrogators, and tags usually assume HF RFID gates, HF interrogators, and HF tags.

Information technology — Radio frequency identification device performance test methods —

Part 4:
Test methods for performance of RFID gates in libraries

1 Scope

This part of ISO/IEC 18046 defines test methods for performance characteristics of HF RFID gates in libraries for item management and specifies the general requirements and test requirements for HF RFID gates in libraries which are applicable to the selection of the gates for an application. The summary of the test reports form a unified tag datasheet. It does not apply to testing in relation to regulatory or similar requirements.

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/IEC 18000-3, *Information technology — Radio frequency identification for item management — Part 3: Parameters for air interface communications at 13,56 MHz*

ISO/IEC 18046-3, *Information technology — Radio frequency identification device performance test methods — Part 3: Test methods for tag performance*

ISO/IEC 19762[1)], *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

EN 300330-1 V 1.8.0:2014-06, *Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Part 1: Technical characteristics and test methods*

3 Terms and definitions

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

3.1
walking speed
at a speed of 1 m/s

3.2
increased walking speed
at a speed of 2 m/s

3.3
direction of movement
<direction of movement through the gate> direction in which a gate is passed by persons in normal operation

1) To be published.

3.4
system interface
describes the interface, over which the system "Gate" exchanges information with a higher level IT system

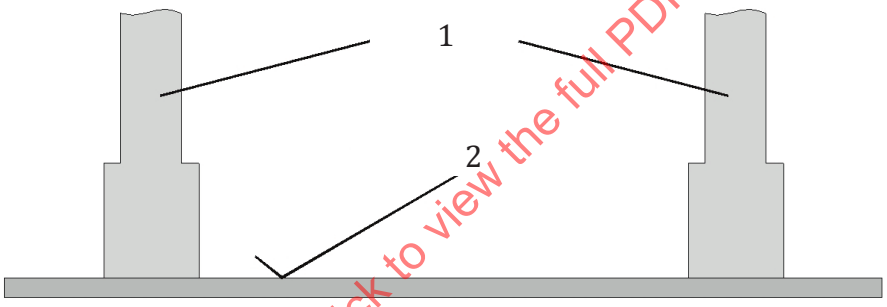
Note 1 to entry: The system interface is accessible from outside the object. Often, a proprietary, interrogator-specific, communication protocol is applied here.

3.5
rate of detection
represents the average number of detected tags per test set-up over three repetitions per distance travelled

3.6
travel distance
testing instruments such as tag, tag bundles or media stacks are moved on the travel distance through the gate (DUT)

Note 1 to entry: Its length is 3 m. At the same time, the centre point of the travelling distance lies at half depth of the gate. In cases, where the gate has an especially large depth, the travelling distance is extended such that its start and its end are securely at a distance at which no tag can be detected.

3.7
reference plane
plane to which all measures of altitude refer as shown in Figure 2



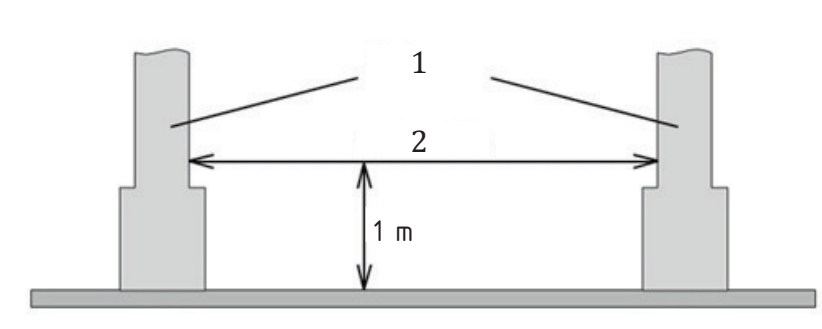
Key

1 antenna
2 reference plane

Figure 2 — Reference plane

Note 1 to entry: The reference plane corresponds to the plane on which persons pass through the gate when it is actually mounted. The gate is directly mounted on this plane. The reference plane is a part of the measurement apparatus. For ensuring stability, the gate is directly mounted on the mounting plate of the movement apparatus. It is at the height of the reference plane.

3.8
gate width
width that is of relevance for the persons passing through the gate as shown in Figure 3



Key

1 antenna

2 gate width

Figure 3 — Gate width

Note 1 to entry: The passage width refers to the distance between the antennas which is of relevance for the passage of persons through the gate. The gate width is measured at 1 m height above the reference plane.

3.9
detection range
right-angled slice plane of the passage way (route) between two gate antennas

Note 1 to entry: The detection range is restricted

— to the gate width of the gate in terms of width, and

— to the upper limit of the detection range (h) specified by the manufacturer or, if this information is missing, to the upper limit of the gate housing, and to the lower limit of the detection range (m) specified by the manufacturer or, if this information is missing, to the fixed dimension of m = 25 cm above the reference plane, in terms of height.

Note 2 to entry: The dimensions of the acquisition range are defined once and are identically applicable to all analyses.

3.10
operating mode
DUT is operated in the same operating mode during the tests

Note 1 to entry: That means that the detection is based on the AFI principle during all individual tests.

3.11
tag state "secured"
AFI byte possesses the value 07 (0x07)

Note 1 to entry: The address data refers to the data sheet of the chip used.

3.12
tag state "borrowed"
AFI byte possesses the value 194 (0xC2)

Note 1 to entry: The address data refers to the data sheet of the chip used.

3.13
tag Orientation
A plane of the tag antenna parallel to the planes of the gate antennas, main dimension of the tag antenna in walking direction

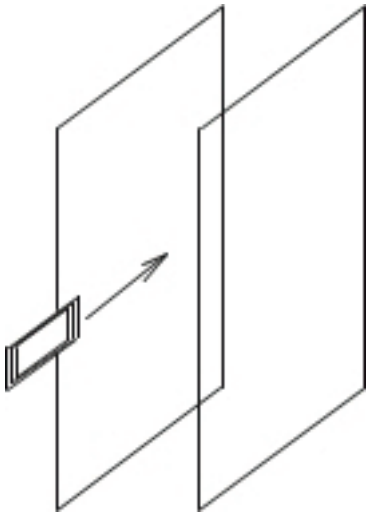


Figure 4 — Tag orientation A

B planes of the tag antenna rectangular to the planes of the gate antennas, main dimension of the tag antenna vertical

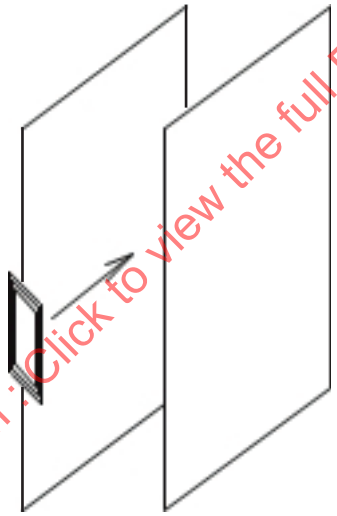


Figure 5 — Tag orientation B

C plane of the tag antenna horizontally, main dimension of the tag in walking direction

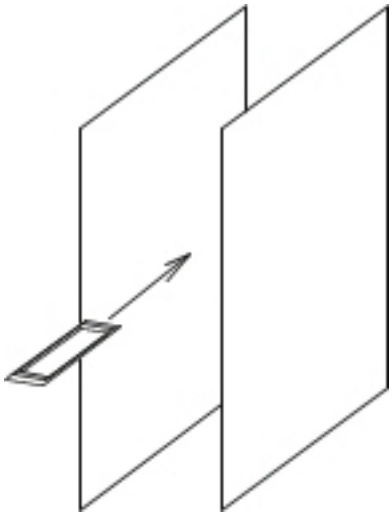


Figure 6 — Tag orientation C

D analogue to A, plane of the tag antenna 30° raked at the longitudinal axis of the main dimension

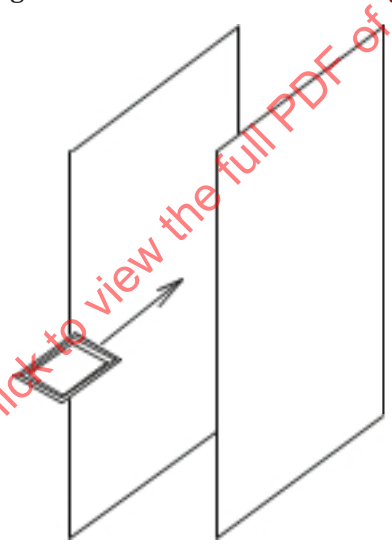


Figure 7 — Tag orientation D

E analogue C, plane of the tag antenna 30° raked at the axis in the antenna plane rectangular to the main dimension

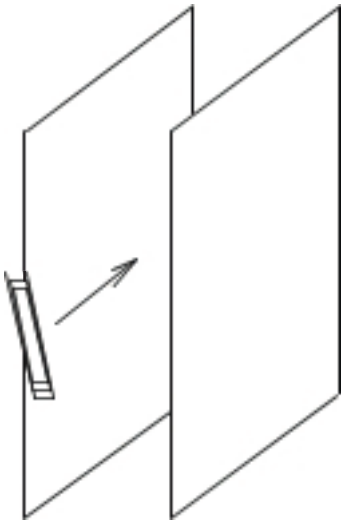


Figure 8 — Tag orientation E

F planes of the tag antenna parallel to the plans of the gate antennas, main direction of the tag antenna vertical

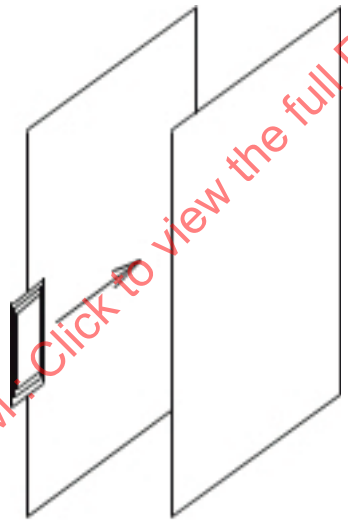


Figure 9 — Tag orientation F

4 Symbols and abbreviated terms

4.1 Symbols

For the purposes of this part of ISO/IEC 18046, the symbols found in ISO/IEC 19762 and the following apply.

b gate width (in m)

e travel plane spacing (in m)

f frequency (in Hz)

g antenna width (in m)

H magnetic field intensity (in A/m)

h upper limit of the detection range (in m)

k plane distance (in m)

l travel distance (in m)

m lower limit of the detection range (in m)

n distance from the antenna plane to the first measurement points (in m)

p workstation height (in m)

s distance between interferer and gate (in m)

u distance between the antennas of a tag (in m)

4.2 Abbreviated terms

For the purposes of this part of ISO/IEC 18046, the symbols found in ISO/IEC 19762 and the following apply.

AFI application family identifier

DUT device under test

EAS electronic article surveillance

UID unique identifier

NOTE ISO/IEC JTC 1 SC 31, in general, uses the term UII; however, as ISO/IEC 18000-3 Mode 1 directly refers to ISO/IEC 15693, the term UID applies in this case.

UII unique item identifier

5 Conditions applicable to the test methods

5.1 Number of interrogators to be tested

Unless otherwise specified, testing shall be performed on 1 randomly chosen interrogator or gate.

5.2 Test environment

Unless otherwise specified, testing shall take place in air environment of temperature 23 °C +/- 3 °C (73 °F +/- 5 °F) and of relative humidity 40 % to 60 %.

5.3 RF environment

The tests shall be performed in a known RF environment.

For measurement with operating frequencies below 30 MHz a typical laboratory environment is sufficient, where consideration is given to minimize the impact of electromagnetic sources that may influence the results.

5.4 Pre-conditioning

Where pre-conditioning is required by the test method, the identification tags to be tested shall be conditioned to the test environment for a period of 24 hours before testing.

5.5 Default tolerance

Unless otherwise specified, a default tolerance of +/- 1 % shall be applied to the quantity values given to specify the characteristics of the test equipment (e.g. linear dimensions) and the test method procedures (e.g. test equipment adjustments).

5.6 Total measurement uncertainty

The total measurement uncertainty for each quantity determined by these test methods shall be stated in the test report.

NOTE Basic information is given in ISO/IEC Guide 98-3:2008.

5.7 Test result reporting

Test result reporting is specified for each test in the test description.

5.8 Test communication parameters

All the tests may be done for various communication parameters (forward and return link) as selected by the vendor of the DUT. The tests conditions shall be recorded in the test report.

5.9 Test equipment limits

It shall be ensured that the test equipment is not limiting the performance of the measurement.

5.10 Human exposure to EMF

High magnetic or electromagnetic field strength may exceed the limits of maximum permissible human exposure to EMF, which should be considered accordingly. FCC guidelines for MPE and SAR or EC 1999/519/CE are examples for relevant documents.

6 Required auxiliary means for performance tests

6.1 Movement apparatus

This shall be an apparatus that permits the translatory movement of testing instruments within the gate at variously defined speeds. The vertical (height) and horizontal position for the movement shall be adjustable. In this way test movement tracks can be “traced” one after the other at defined positions in direction of travel. The length of the travel distance shall be at least 3 m. The speed shall be adjustable and it shall at least support 1 m/s and 2 m/s. The movement apparatus shall be essentially composed of non-metallic material.

6.2 PC with test software

The test software shall at the minimum visualize the UII (or UID as applicable) (unique item identifier according to ISO/IEC 18000-3 Mode 1) of the tag detected in the gate. Furthermore, it shall show for each tag the first 34 data bytes from the user memory. The process shall be realized in a way that this necessary information is simultaneously visible on a PC monitor for a minimum of 18 tags. This function shall be implemented in the DUT.

Furthermore it is recommended that the software additionally logs the detection of tag using log files. If a log file is maintained then the entry shall at least contain the time (hour, minute, second), UII (or UID as applicable) and the first 34 data bytes of the user memory.

The test laboratory shall have the possibility to automate the movement process flows of the test devices in the gate. This automation should if possible also include the assessment of the detected UIIs

(or UIDs as applicable). In order to permit this, the DUT vendor shall make available an interface of the RFID interrogator of the gate. The functional scope and/or the degree of automation are determined by the test laboratory.

6.3 Reference blocks

6.3.1 General

Reference blocks are devices which are used for checking the characteristics of the gates. Depending upon their purpose, they possess varying configurations and are essentially composed of a holder structure made of dry Plywood and definitively dimensioned and installed RFID Tags.

6.3.2 Tags

All tags used in the tests shall be from the same production batch. Tags shall be commercially available (on the market) tags with an antenna size of 76 mm x 45 mm (+/- 1 mm tolerance) with very little variation of their characteristics within the batch.

The selection of tags shall be done as follows:

a) Selection of a commercially available tag type with the same antenna type and chip type for each tag

b) Selection of tags with a resonance frequency between 13,96 MHz and 14,02 MHz (resulting in 13,56 MHz to 13,62 MHz when placed in the media stack), whereas the resonance frequency shall be measured as defined in ISO/IEC 18046-3.

c) Verification of the Hmin, identification < 56 mA/m (according ISO/IEC 18046-3) for each tag

d) Assembling of tags in test devices

Different to the other tags, the tags to be used for the media stack shall also be selected according to the 5 items above, however, the target resonance frequency range shall be achieved without any additional dielectric material.

6.3.3 Tag block

The reference tag block describes a test device. This is a block, composed of 5 tags, out of which 3 shall be respectively arranged on right angled planes to each other and 2 tags shall be arranged at an angle of 30°. They shall be fastened onto a holder material (i.e. dry Plywood) that only causes very low dielectric influence. The holder material should have fastening and/or take-up options, which facilitate fitting on the movement apparatus. For illustration, see Figure 10.

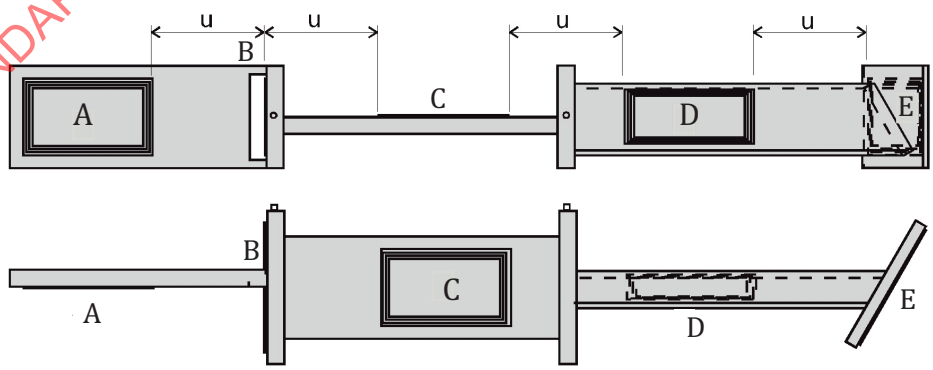


Figure 10 — Tag block

The tag block, which shall be used for the measurement of detection field homogeneity, shall be configured as follows:

— Tags glued on 10 mm dry Plywood

— The UIIs (or UIDs as applicable) of the various tags shall have different content in the last 4 bits

— Tags A, B and C shall be arranged in 3 layers at right angles to each other (A horizontal in longitudinal direction of the block, B vertical at right angle to the longitudinal direction of the block, C vertical in longitudinal direction of the block)

— Tag D shall be arranged analogous to A, though rotated by 30° around the longitudinal axis of the block as compared to A

— Tag E shall be arranged analogous to B, though inclined by 30° as compared to B

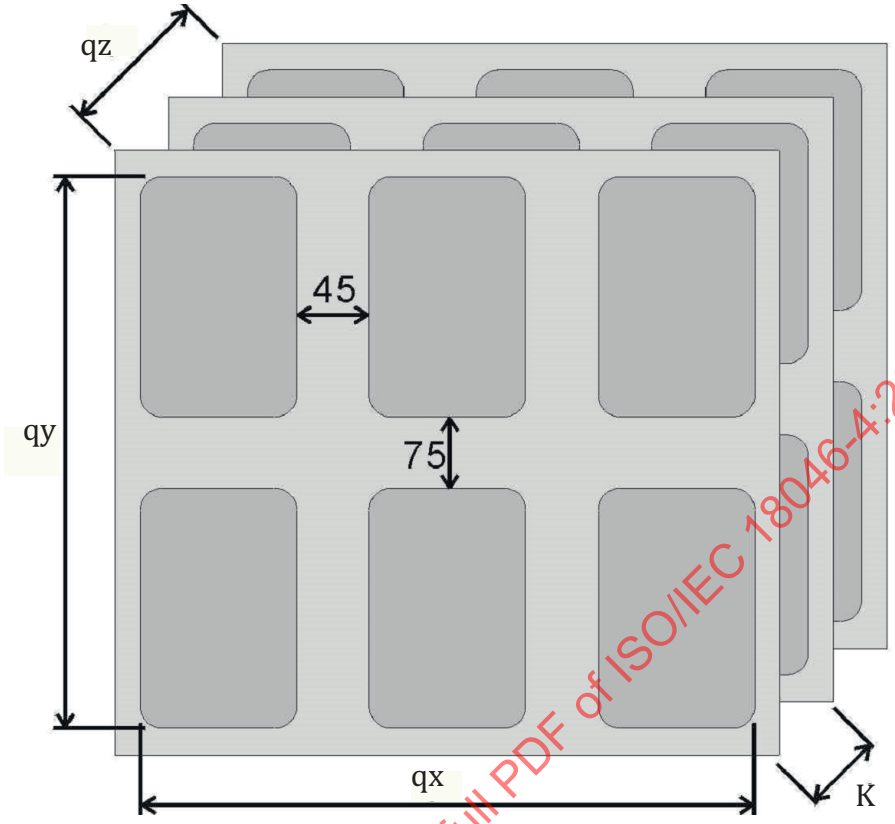
— The centre points of the tags shall be arranged such that they are located exactly one after another on the line of travel during the travel operation

— The distance between the antennas of the tags shall be u = 60 mm

6.3.4 Tag bundle

The tag bundle is a testing medium, which shall contain 18 tags in a bundle in identical orientation and well decoupled from each other. As represented in Figure 11 they shall be arranged on 3 levels of 6 pieces each. The value of the last half-byte of the tag UII (or UID as applicable) shall appear at most twice within the bundle.

The levels shall be spaced at a distance k = 100 mm from each other. In one plane, the distance of tag to tag in the horizontal direction shall be 45 mm and in the vertical direction it shall be 75 mm. These dimension data refer to the outer edge of the electrical conductor of the antenna loop of the tag. The tolerance shall be +/- 2 mm.



Key

K distance of planes

Figure 11 — Tag bundle

The active part of the tag bundle has the dimensions qx, qy, qz. These dimensions are based on the respective orientation of the outermost conductor loop of the external tags.

The tag bundle is utilized in the tests in the orientations F (see Figure 9), B (see Figure 5), C (see Figure 6) (5 Definitions).

6.3.5 Media stack

In order to have a generic definition for the test the media stack is defined by a stack of paper, where each sheet shall have the size of approximately ISO A5 (148 mm by 210 mm). The thickness of these books including book cover shall be replicated using multiple sheets of this paper.

In order to simulate a stack of books the 9 tags shall be affixed to sheets in the paper stack as defined in Table 1, where:

— The tag position (column 2) refers to the location of the tag on the page (see Figure 12);

— The tag height (column 3) refers to the position of the tagged sheet in the paper stack."

NOTE As shown in Annex B, a stack of real books has been used in the original tests. However, as global supply of identical books is difficulty, the paper replacement has been introduced fort the actual tests

For the development of the media stack really existing books, as shown in Annex B, have been taken.

Table 1 — Tag positioning in the reference stack

Tag Number	Tag Position	Tag height h in mm from zero level in reference stack
1	A	224
2	D	210
3	C	193
4	B	183
5	A	166
6	D	145
7	C	120
8	B	93
9	A	59

The overall height of the paper stack is 225 mm. The tag height has been evaluated by measuring the position of the tag when attached to the inside of the top cover of the book used.

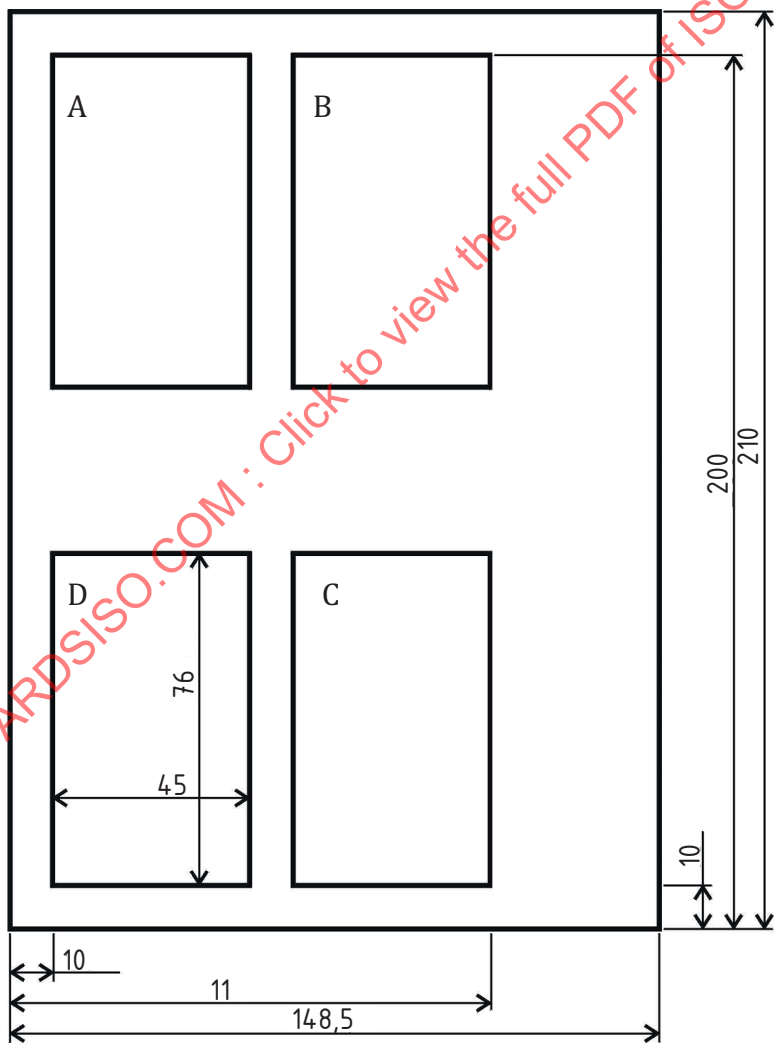


Figure 12 — Tag positioning within the paper stack

The created paper stack shall be fixed using dry Plywood. The dry Plywood body shall provide fasteners for fastening onto the movement apparatus in three different orientations.

The resonance frequency of the tags is mainly determined by the paper and the respective neighbouring tags, whereas tags selected according 6.3.2 shall be used. The AFI value shall be pre-set to “secure” (see definitions for value).

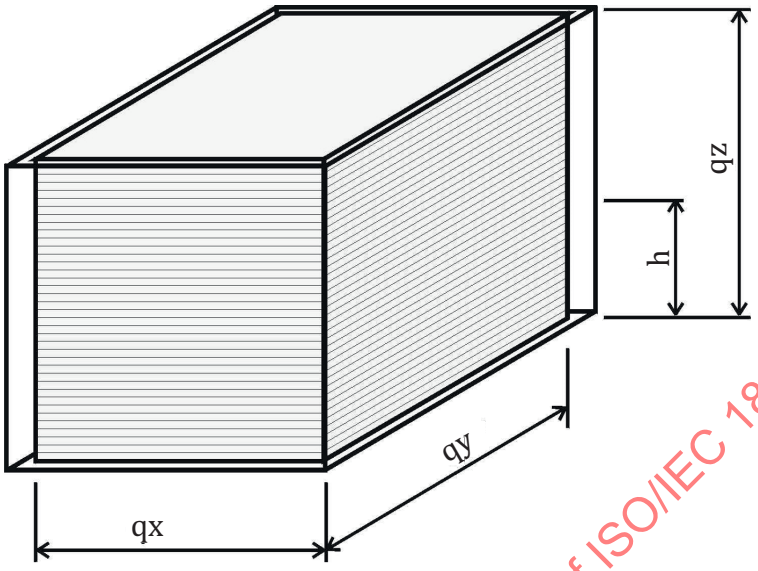


Figure 13 — Media stack

The media stack possesses the dimensions qx, qy, qz. These dimensions are based on the outermost edges of the paper block in the respective orientation.

The media stack bundle is utilised in the tests in the orientations F, B, C (See Clause 3).

6.4 Active interferer

The active interferer shall be a loop antenna (300 mm x 200 mm), where the long side is oriented towards the test device, in a horizontal arrangement. It shall be controlled by a separate RFID interrogator. For f = 13,56 MHz the magnetic field shall be H = 2,4 A/m at the antenna centre with 15 % modulation (ISO/IEC 18000-3 Mode 1) with the tag in the vicinity of the antenna (facing away from the test device). Figure 14 describes the measurement setup.

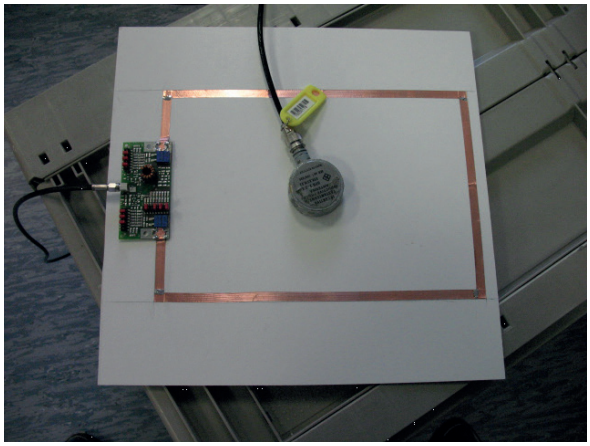


Figure 14 — Measurement setup for determining the magnetic field strength

6.5 Passive Interferer

The passive interferer (steel sheet) simulates a ferromagnetic object present at the client end, e.g. pillar. It shall be composed of 2 mm thick steel sheet with the dimensions 300 mm width and 2000 mm length. On the longitudinal sides, the sheet shall have a 100 mm folded edge. A foot shall be fastened onto the lower edge. The sheet steel shall always be used standing upright.

7 Performance tests

7.1 General remarks

All the described test procedures are regarded as a unit and shall only be done together.

The test result only applies for the tested configuration. The test result loses its validity in case of any changes performed on the tested product (DUT) as e.g. by exchange of individual components or decisive settings.

7.2 Measurement of transmitter carrier H-field level

The transmitted carrier H-field shall be measured. This may be done according to the local regulations. However, as the methods are globally very similar the definitions according to EN 300 330 are recommended to be used and this is described in detail in this subclause.

HF RFID gates, which work at 13,56 MHz, communicate with the tag for fulfilling their intended purpose using purely magnetic coupling. From this, it follows that any kind of radiation that leaves the direct environment of the system Gate – Tag is unwanted. The term interference radiation describes the radiated H-field, measured under certain conditions. (See EN 300 330-1, 7.2). The measurement setup and the procedure are shall be based on EN 300 330-1 as this describes that method very well and may be used for global regulations.

The purpose of this analysis has two focuses, which are:

a) Determining as to whether adjustment of the operating point of the transmission power is possible according to the equipment documentation, with the requirements of standard EN 300 330 being met.

b) Determining the magnetic field strength in the direct vicinity of the antenna in the operating point as reference value for the purpose of transfer to the other test super structural parts of this laboratory test and also to the acceptance test after the installation.

The interference radiation is determined only at the operating frequency of the DUT. Thus, this analysis represents only a very small extract from the test according to EN 300 330.

DUT: Gate, composed of 2 antennas, 1,0 m spacing, normal operating mode

Setup, auxiliary materials and limit values may be derived from EN 300 330-1 and/or -2. An H-field probe calibrated at 13,56 MHz is additionally needed. The representation of the test setup shown in Figure 16 is meant merely for the purpose of clarification. Decisive are the data given in EN 300 330.

Figure 15 shows ETSI EN 300 330-1 V.1.8.0 (2014-06), Annex G:

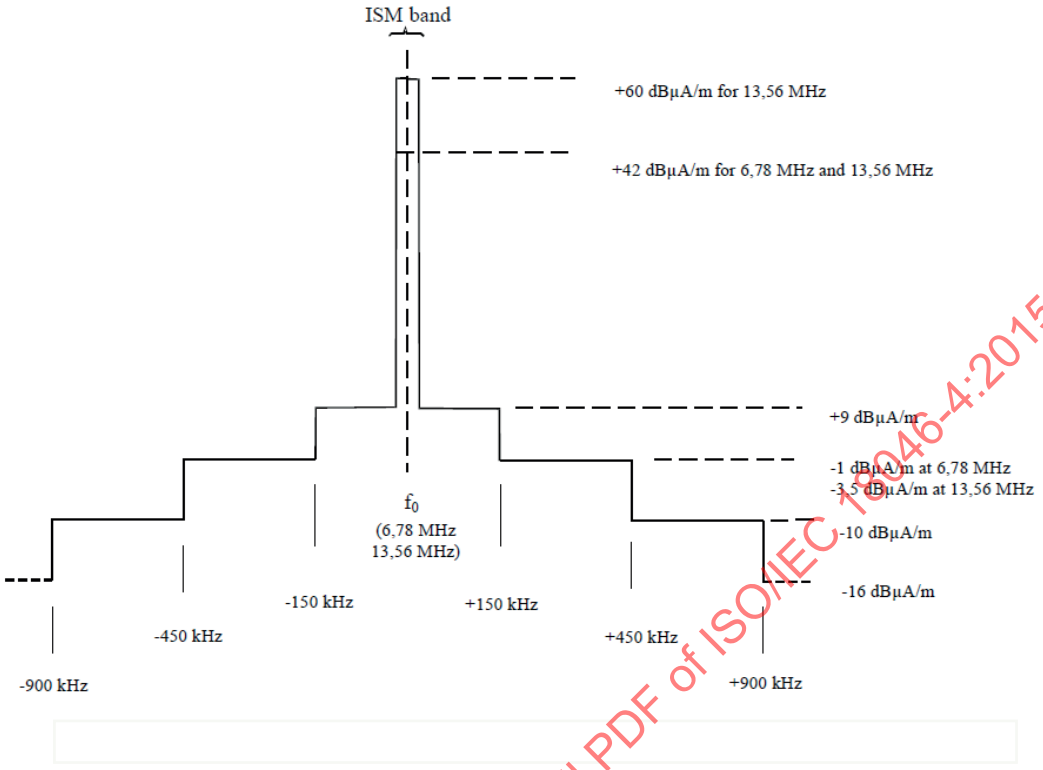
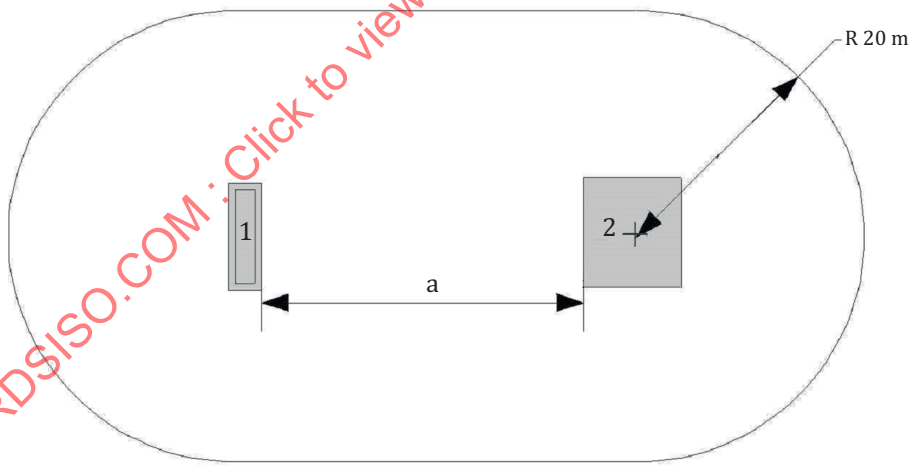


Figure 15 — Interference level limit value (Source: ETSI EN 300 330-1 V.1.8.0)



Key

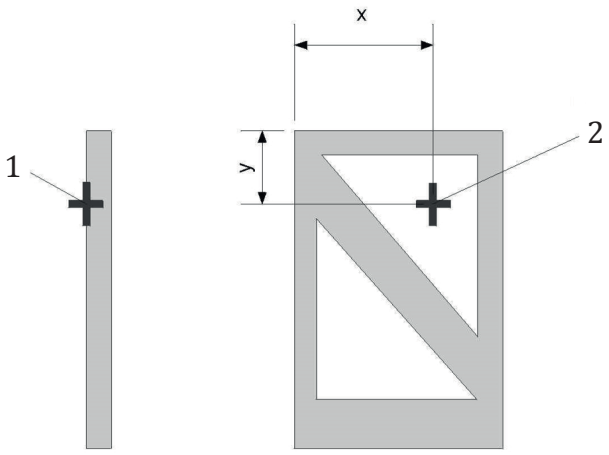
1 measurement antenna
2 DUT (2 antennas)
a 10 m
R 20 m, free field

Figure 16 — Measurement setup of interference radiation

Procedure:

The interference radiation shall be measured based on EN 300 330, whereas only the interference level at 13,56 MHz according to EN 300 330 shall be measured.

Based on Figure 17 the level of magnetic field strength shall be determined at a well reproducible point on the plane of both antennas, i.e. a point in an area in which the level exhibits a minimum position dependency.



Key

1 H-field probe on antenna surface

2 position of H-field probe

x,y evaluated position

Figure 17 — Acquisition of H-field level in the vicinity of the antenna

The measurement shall be continued with the following steps

— Rotate the test devices into the angle in which the largest interference level is registered

— Retune the transmission power as described at the outset

— Measurement of magnetic field strength (peak value) in the direct vicinity of each antenna, while determining a well reproducible position on the plane of the respective antenna using H-field probe

— The following shall be documented:

  — Measured values of H-field strength of both the antennas

  — Position of the H-field probe during measurement with a tolerance of x and y of max. +/- 1 mm (after determining an area with minimum position dependency of the level)

  — Test setup using a photo

Assessment:

a) The H-field spectrum mask (according to EN 300 330) of the gate configuration relevant for the test shall be recorded.

b) The value of the magnetic field strength in the direct vicinity of the antennas shall be recorded. In further analyses, this serves as the parameter for ensuring the comparability of gate configuration. After the installation of the gate in real environment, it serves as the measure by which the registration properties under real conditions are determined.

7.3 Detection field homogeneity

The test delivers detailed findings about the distribution of the detection capacity within the gate given various gate widths.

DUT:

The DUT shall be a gate, composed of 2 antennas, installed with the spacing specified by the manufacturer (multiple of 10 cm) and controlled as in real operation, but with 1 time slot

Auxiliary material:

The auxiliary material shall be:

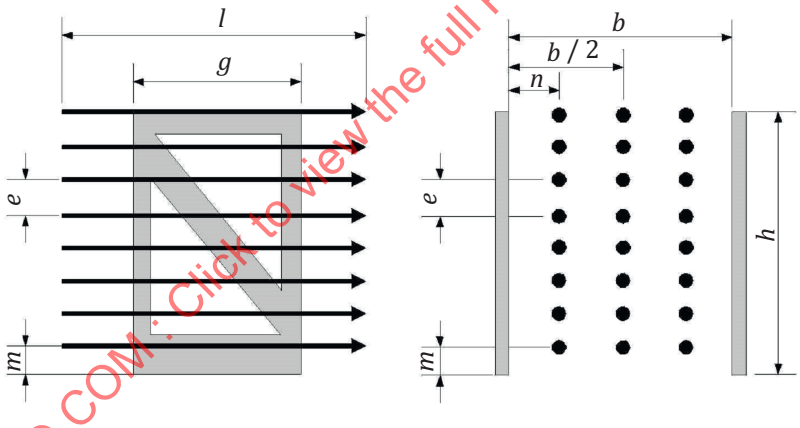
— A reference tag block (5 book tags), tags respectively "secured" with AFI value.

— Movement apparatus

— PC with test software

Configuration:

The gate shall be on an open area test site (without significant interfering influences, at a distance of min. 3 m from influencing structural installations). The movement apparatus shall be arranged so that it is in a position to move the reference tag according to Figure 18 on defined paths with narrow tolerances in direction of passage through the gate.



Key

b gate width
e travel plane spacing
g antenna width
l travel distance
h upper limit of the detection range
m lower limit of the detection range
n distance from the antenna plane to the first measurements points

Figure 18 — Representation of the lateral view of the planes of the travel paths

The distance n shall be 300 mm.

The plane of the lowermost lines of travel shall lie in the lower limit of the detection range (m). Its height shall be specified by the manufacturer. If this information is missing, then m shall be 25 cm.

The plane of the uppermost lines of travel shall lie in the upper limit of the detection range (m). The upper limit of the detection range (h) shall be specified by the manufacturer. If this information is missing, then h shall be specified at the upper edge of the antenna housing.

The measurement plane distance e depends upon h and m and shall be (h – m)/7. The tag block shall be moved on the travel path so that the midpoints of all five tags are always exactly located on the travel path.

Procedure:

The procedure shall be carried out with tag block. To begin with, the magnetic field strength of the gate antennas shall be monitored. At this juncture, the basis shall be the position and the measured value that has been determined during the measurement of interference radiation.

The reference tag block shall be moved with the movement apparatus at walking speed along 3 parallel paths on 8 planes each through the gate. Three tests per line of travel shall be performed.

Recording:

The detection of the three tags over all the tests shall be recorded.

At the request of the DUT vendor, the test may be performed with only one tag with activated AFI function. The travel paths shall then be traced five times with changed orientation of the tag in each case.

Assessment:

The result shall be expressed in percentage and shall be calculated based on the ratio of actual detections to the possible detections.

7.4 Reliability of detection

7.4.1 General

In this test, the detection rate is determined using the tag of the tag bundle in various positions depending upon movement speed. The test shall be conducted on the basis of AFI selection in the inventory command.

DUT:

The DUT shall be a gate, controlled as in real operation.

Auxiliary material:

The auxiliary material shall be:

— Tag bundle, AFI state in all tags: “secured”, Data bytes:
N1 N2 00 C3 81 18 87 78 F0 0F 80 08 40 04 20 02 10 01
5A A5 3C C3 18 81 78 87 0F F0 08 80 04 40 02 20 01 10
(N1 and N2 correspond to the last two bytes of the UII (or UID as applicable))

— Movement apparatus

— PC with test software

Configuration:

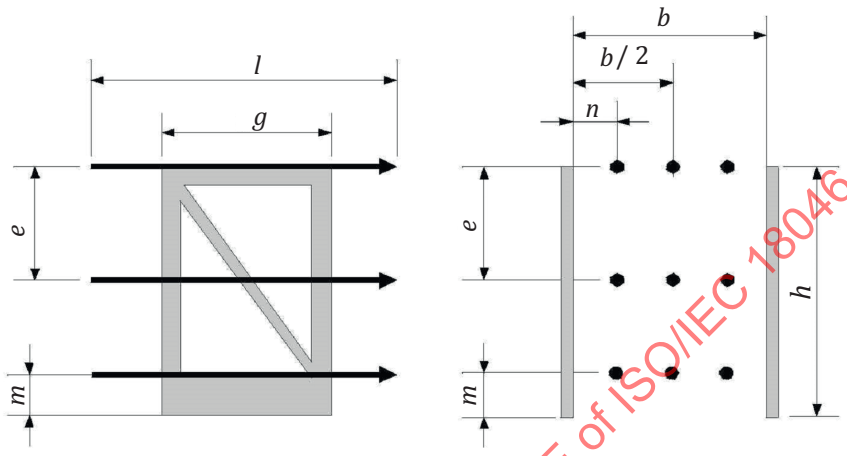
The gate shall be on an open area (without significant interfering influences, at a distance of min. 3 m from influencing structural installations). The movement apparatus shall be arranged so that it is in a position to move the tag bundle according to Figure 19 in direction of passage through the gate.

The distance n shall be 300 mm.

The plane of the lowermost lines of travel shall lie in the lower limit of the acquisition range (m) plus half the height of the active part of the test device.

The plane of the uppermost lines of travel shall lie in the upper limit of the acquisition range (h) minus half the height of the active part of the test device.

The measurement plane spacing e depends upon h and m and shall be (h – m-q)/2. The dimension q refers to the height of the tag bundle in the respective orientation according to Figure 19.



Key

b gate width
e travel plane spacing
g antenna width
l travel distance
h upper limit of the detection range
m lower limit of the detection range
n distance from the antenna plane to the first measurements points

Figure 19 — Setup of detection reliability test

7.4.2 Procedure (on the basis of AFI)

At the beginning, the magnetic field strength of the gate antennas shall be monitored. At this juncture, the basis shall be the position and the measured value that has been determined during the measurement of interference radiation.

The number of test paths within the gate is reduced as compared to the previous test due to the physical size of the tag bundle. The tag bundle shall be moved with the movement apparatus initially at walking speed along 3 parallel paths on 3 planes each through the gate. The midpoint of the test device always shall lie on the respective line of travel, with 3 tests per line of travel being conducted.

The procedure is repeated with 2 other orientations of the tag bundle. At the same time, the positions are in planes that are vertical to each other.

7.4.3 Procedure with increased walking speed

The procedure shall be repeated at an increased walking speed. This test is optional.

Assessment:

For the assessment the detection rate of all the tags over all the tests shall be logged. A tag shall be deemed to have been detected if the UIIs (or UIDs as applicable) have been received. In the process, it shall be not

distinguished as to which tag of the bundle has triggered the detection. The visualisation of the read data shall be done with product-specific software. The assessment shall be done separately for both speeds.

7.4.4 Procedure with 6 tags and read data of 34 bytes, walking speed (only on the basis of AFI)

The two inner tags of each plane shall possess the AFI value “secure”. This means that exactly 6 tags of the tag bundle have the AFI value “secure”. The process flows according to Step 1 shall be repeated. A tag shall be deemed to have been detected if, in addition to its UII (or UID as applicable), the first 34 bytes from the user memory of this tag are communicated as well. Visualisation shall be done with product-specific software.

Assessment shall be done analogous to 7.4.3 taking into consideration the low number of tags.

7.4.5 Procedure with 6 tags and read data of 34 bytes, increased walking speed (only on the basis of AFI)

The examination after 7.4.4 shall be repeated with increased walking speed.

7.5 Stack performance

The test delivers observations about the handling of the gate with many tags that are present in real media and at the same time in the gate.

DUT:

The DUT shall be a gate, composed of 2 antennas, spacing shall correspond to the spacing based on the measurement of “detection field homogeneity” and controlled as in real operation.

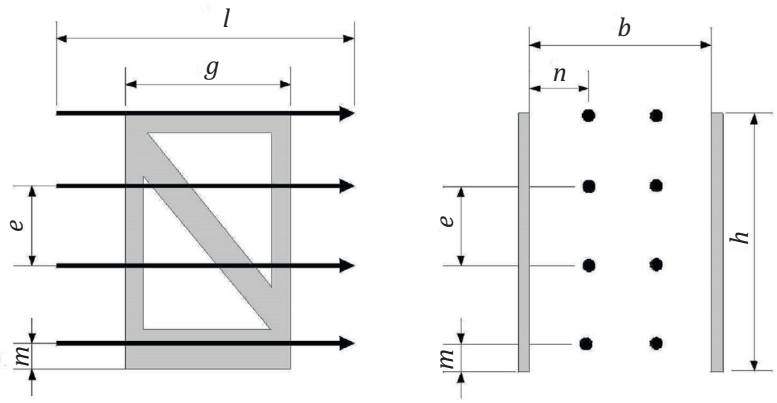
Pre-conditions:

Media stack, all tags with AFI value “secure”

Apparatus for uniform movement of the test device along the 8 test lengths within the gate

Setup:

The gate shall be in an environment without active interferers and shall have a minimum distance of 3 m to field-influencing structural installations. The movement apparatus shall be arranged such that it is in a position to move the media stack according to Figure 20 in direction of passage through the gate.



Key

b gate width
e travel plane spacing
g antenna width
l travel distance
h upper limit of the detection range
m lower limit of the detection range
n distance from the antenna plane to the first measurements points

Figure 20 — Test setup of stack performance

The distance n shall be 300 mm.

The plane of the lowermost lines of travel shall lie in the lower limit of the detection range (m) plus half the height of the test device in its respective orientation.

The plane of the uppermost lines of travel shall lie in the upper limit of the detection range (h) minus half the height of the test device in its respective orientation.

The measurement plane spacing e depends upon h and m and shall be (h – m – height of the test device in its respective orientation Figure 20)/3.

Procedure:

To begin with, the magnetic field strength of the gate antennas shall be monitored. At this juncture, the basis shall be the position and the measured value that has been determined during the measurement of interference radiation.

The media stack shall be moved based on 7.3 on 2 travel distances per plane on four planes at walking speed through the gate. The midpoint of the test device always shall lie on the respective line of travel. This shall be repeated 3 times per length of movement.

The test shall be repeated in the two other right-angled orientations of the media stack.

The tags shall be queried with AFI state “secure”.

Assessment:

The UIIs (or UIDs as applicable) displayed using the PC software belonging to the gate form the basis for the assessment. The number of identified tags as well as the alarm actuation shall be recorded.

7.6 Immunity to interferences

7.6.1 General

The analysis of the immunity of interference delivers observations about the change in detection rate depending upon the influencing of the antenna field by interferers. Used to this end shall be:

— An active interferer which simulates an RFID workplace located next to the gate and

— A passive interferer that simulates the presence of a massive metallic object.

In both cases, the interferers shall be located outside the open zone defined by the gate manufacturer.

To begin with, sensitivity to an active interferer shall be investigated.

DUT:

The DUT shall be a gate, composed of 2 antennas, 1 m spacing, normal operating mode

AUXILIARY MATERIAL:

Tag block, AFI byte: “secured”

Movement apparatus

PC with test software

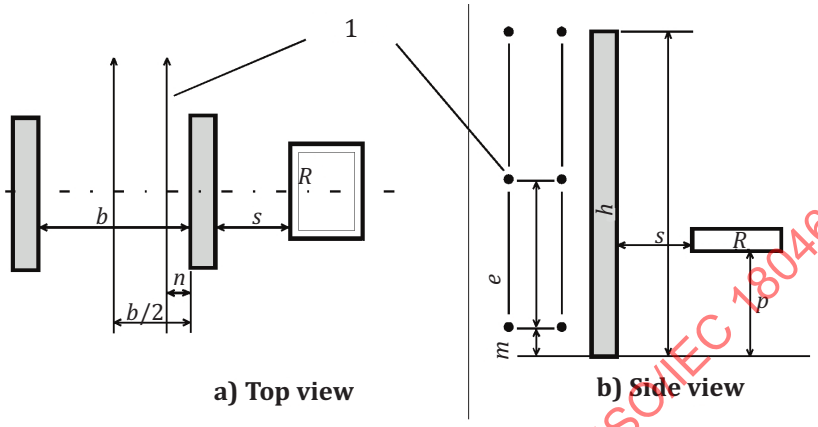
Active interferer

Passive interferer

SETUP:

The gate shall be in an environment without active interferers and has a minimum distance of 3 m to field-influencing structural installations. The movement apparatus shall be arranged such that it is in a position to move the tag block in direction of passage through the gate.

The setup shall be as represented in Figure 21 using an active interferer.



a) Top view **b) Side view**

Key

1 tracks
b gate width
e travel plane spacing
h upper limit of the detection range
m lower limit of the detection range
n distance from the antenna plane to the first measurements points
p workplace height
R interferer (loop antenna)
s spacing of the interferer

Figure 21 — Setup for determining the susceptibility to a passive interferer

The passage width b shall be 1 m. The height of the antenna of the interferer p shall be 730 mm above the reference plane. The spacing n shall be 200 mm.

The plane of the lowermost lines of travel shall lie in the lower limit of the detection range (m).

The plane of the uppermost lines of travel shall lie in the upper limit of the detection range (m).

The measurement plane spacing e depends upon h and m and shall be (h – m)/2.

Procedure:

To begin with, the magnetic field strength of the gate antennas shall be monitored. At this juncture, the basis shall be the position and the measured value that has been determined during the measurement of interference radiation.

7.6.2 Analysis 1 (active interferer)

a) Step 1:

1) The spacing between the antenna of the test device facing the interferer and the interferer is 4 m; the connected interrogator shall be switched off.

2) The interrogator of the test device shall be switched on.

3) The tag block shall be moved at walking speed one after the other at 3 heights centrally and at 20 cm distance to the antenna facing the interferer through the route. At the same time, the centre axis of the test device shall lie on the respective travel distance.

b) Step 2:

1) The 30 cm long leg of the horizontal loop antenna of the interferer shall be in parallel to the plane of the antenna of the test device. The interrogator of the interferer shall be switched on. A tag is situated on the side facing away from the test device in the field of the antenna of the interferer.

2) The interrogator of the test device shall be switched on.

3) The tag block shall be moved at walking speed consecutively at 3 heights centrally and at 20 cm distance to the antenna facing the interferer thrice through the route. At the same time, the centre axis of the test device shall lie on the respective travel distance.

4) The reading rate for the individual orientations of the tags of the tag block shall be determined and this shall be recorded as partial result 1.

c) Step 3:

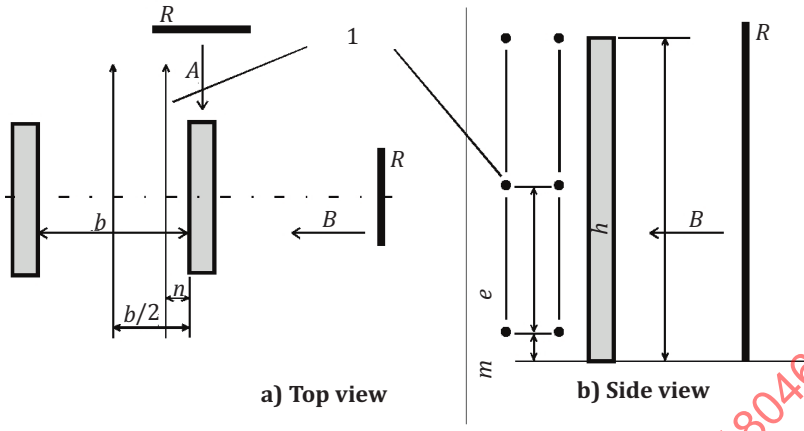
1) The spacing between the test device antenna facing the interferer and the interferer shall be reduced to 3 m and 2 m consecutively taking care that the distance does not fall below the minimum distance according to the operating instructions.

2) The procedure analogous to Step 2 shall be repeated in each case.

Assessment:

The spacing of the interferer, at which the sum of the detections does not fall below the specified limit value (see Annex A) as compared to the state when the interrogator is switched off, shall be determined. The result that has been determined with the interrogator switched off shall be taken as the reference value. The spacing of the interferer required to this end is documented.

7.6.3 Analysis 2 (passive metallic interferer)



Key

1	tracks
A, B	approach direction/distance
b	gate width
e	travel plane spacing
h	upper limit of the detection range
m	lower limit of the detection range
n	distance from the antenna plane to the first measurements points
R	interferer (steel sheet)

Figure 22 — Setup for determining the susceptibility to a passive interferer

a) Step 1 (similar to test with active interferer, Step 1):

1) The distance between test device antenna facing the interferer and the interferer shall be 1 m (→ out of range).

2) The test device shall work in normal operating mode.

3) The tag bundle shall be moved at walking speed consecutively at 3 heights centrally and at 20 cm distance to the antenna facing the interferer through both the routes. At the same time, the midpoint of the test device shall lie on the respective line of travel.

4) The reading rate for both the passages using tag bundle shall be determined and recorded as partial result 1.

b) Step 2 (approach from direction A):

1) The spacing between the test device antenna facing the interferer and the interferer shall be reduced to 0,4 m, 0,3 m, 0,2 m and 0,1 m consecutively, taking care that the distance does not fall below the minimum distance according to the operating instructions.

2) The antennas shall be tuned each time.

3) The procedure analogous to Step 1 shall be repeated.

c) Step 3 (approach from direction B):

1) The spacing between the test device antenna facing the interferer and the interferer shall be reduced to 0,4 m, 0,3 m, 0,2 m and 0,1 m consecutively, taking care that the distance does not fall below the minimum distance according to the operating instructions.

2) The antennas shall be tuned each time.

3) The procedure analogous to Step 1 shall be repeated.

The interferer is approached only on one of the external gate antennas.

Assessment:

The spacing of the interferer at which the sum of detections does not fall below the specified limit value (see Annex A) as compared to the state "interferer at 1 m distance" shall be determined. The result that has been determined with the interferer switched off shall be taken as the reference value. The distance of the interferer required to this end shall be documented.

8 Assessment of the complete product test

The assessment shall be done separately for each individual test in Clause 7. All the results shall be documented in a measurement report. The test record from Annex A (for AFI) shall be used. The DUT submitter may decide as to which detection principle shall be applied uniformly to all individual tests.

Additionally, a certificate verifying that the individual tests have been respectively passed or not shall be issued. To this end, the results of the individual tests with the limit values from Annex A shall be compared. If at least the limit value is achieved, then the respective test shall be certified as having been "passed". Different from the above, the measured value from "measurement of interference radiation" shall only be documented.

A certificate always refers only to one concrete detection principle (security function) according to ISO/IEC 18000-3 Mode 1, which is AFI for this document.

9 Certificate

Additional to the test record the test centre shall issue a certificate, which shall include the following information:

— Product name, type

— Manufacturer

— Operating mode

— Number of the test record

— Type of the tags used in the tests

— Passage width 1 m

— Applied limit to achieve the result "Passed"

A certificate shall only be issued if the all tests in 7.3 to 7.5 achieve at least 95 %, the tests on interference effects with active interferers (see 7.6.2) achieve at least 1 m and tests on interference effects with passive interferers (see 7.6.3) achieve at least (A and B) 10 cm.

Annex A
(normative)

Test Record (AFI)

A.1 General information

Date: _____

Location _____

Test facility: _____

Test engineer: _____

DUT vendor: _____

DUT

Type, serial number: _____

Special configuration: _____

Gate width: _____

Detection range

Upper height (h): _____

Lower height (m): _____

Detection principle applied in the test: AFI

A.2 Proof of conformity

The tables in this clause list the declarations of conformity that have been presented by the DUT vendor.

Table A.1 lists the directives and standards recommended for CEPT countries.

Table A.2 lists the directives and standards recommended for USA.

Table A.3 is a template for all other countries and regions.

Table A.1 — Directives and Standards for the proof of Conformity for CEPT countries

Directive/Standard	Declaration by manufacturer	Declaration by accredited Test Centre
2006/95/EC (Low voltage directive)		
2004/108/EC (EMC directive)		
1999/5/EC (Telecommunications directive)		
2002/95/EC (RoHS directive)		
EN 60950-1: _____[a]		
EN 50364: _____[a]		
EN 300 330-2: _____[a]		
EN 301 489-1: _____[a]		
[a] Insert date of current version.		

Table A.2 — Directives and Standards for the proof of Conformity for USA

Directive/Standard	Declaration by manufacturer	Declaration by accredited Test Centre
FCC 15		
IEC 60950-1: _____[a]		
EN 50364: _____[a]		
[a] Insert date of current version.		

Table A.3 — Directives and Standards for the proof of Conformity for all others

Directive / Standard	Declaration by manufacturer	Declaration by accredited Test Centre
[a] Insert date of current version.		

A.3 Measurement of interference radiation (7.1)

EN 300330-1, 7.2.1.3 limits the H-field for 13,56 MHz at 10 m to 42 dBµA/m and/or 60 dBµA/m (See 7.1 for details).

All values were measured with the loop antenna _____ K = _____

Table A.4 — Measurement of interference radiation — Benchmark

Measured value		
_____ dBµV	- _____ dB / (Ω • m) =	_____ dBµA/m

The magnetic field strength, measured at the point according to the diagram with probe antenna _____ (correction factor K= _____ dB) amounts to:

Antenna 1:

Table A.5 — Measurement of interference radiation — Antenna 1

Measured value		
_____ dBµV	(-51,5 dB + K) / (Ω • m)	_____ dBµA/m
10^(_____ dBµA/m / 20)	= _____ µA/m	= _____ mA/m

Antenna 2:

Table A.6 — Measurement of interference radiation — Antenna 2

Measured value		
_____ dBµV	(-51,5 dB + K) / (Ω • m)	_____ dBµA/m
10^(_____ dBµA/m / 20)	= _____ µA/m	= _____ mA/m

A.4 Detection field homogeneity (7.3)

The fields of Table A.8 correspond to the lines of movement. The number of detections per line (0, 1, 2 or 3) shall be noted in each case. This sheet may be copied as needed.

Gate width: _____cm,

Field strength (V-level) antenna 1: dBµV / **antenna 2**: _____dBµV,

Detection principle: **AFI**

Speed: **1 m/s**

Table A.7 — Detection field homogeneity — Bench mark

h = _____ cm, m = _____ cm			
Height plane 1:	h =		= _____ cm
Height plane 2:	m =		= _____ cm
Height plane 3:	(h- m) / 7	= (_____ -- _____) / 7	= _____ cm

Table A.8 — Detection field homogeneity — Orientation

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
4		| |	| |	| |	
5		| |	| |	| |	
6		| |	| |	| |	
7		| |	| |	| |	
8		| |	| |	| |	
				SUM TOTAL	

Rate of detection

Sum of detections / (3 runs • 3 lines • 8 planes • 5 orientations) = detection rate

Table A.9 — Detection field homogeneity — Rate of detection

_____	/360	•100%	= _____ %

A.5 Detection reliability (7.4)

A.5.1 Detection reliability (7.4.2)

The fields of the tables correspond to the lines of movement. The number of detections of the individual tags per line shall be noted in each case.

Gate width = _____ cm, Movement speed = **1 m/s** Detection principle = AFI

Field strength at V-level for antenna 1 = _____ dBµV and antenna 2 = _____ dBµV

Table A.10 — Detection reliability Test 1 — Specifications 1

h = _____ cm, m = ____ cm			
Height plane 1:	h - q_y / 2 =	____ - 22,7 / 2	= _____ cm
Height plane 2:	(h - m) / 2 + m =	(_____ - _____) / 2 + _____	= _____ cm
Height plane 3:	m + q_y /2	____ - 22,7 / 2	= _____ cm

Table A.11 — Detection reliability Test 1 — Orientation F

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Table A.12 — Detection reliability Test 1 — Orientation B

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Table A.13 — Detection reliability Test 1 — Specifications 2

h = _____ cm, m = ____ cm			
Height plane 1:	h - q_z / 2 =	____ - 22,5 / 2	= _____ cm
Height plane 2:	(h - m) / 2 + m =	(_____ - _____) / 2 + _____	= _____ cm
Height plane 3:	m + q_z / 2	____ - 22,5 / 2	= _____ cm

Table A.14 — Detection reliability Test 1 — Orientation C

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Rate of detection

Sum of detections / (3 runs • 3 lines • 3 planes • 3 orientations • 18 tags in the bundle) = detection rate

Table A.15 — Detection reliability Test 1 — rate of detection

(_____ +	_____ +	_____)/1458	•100%	= ___ %

A.6 Detection reliability (7.4.3)

The fields of the tables correspond to the lines of movement. The number of detections of the individual tags per line shall be noted in each case.

Gate width = _____ cm, Movement speed **= 2 m/s** Detection principle = AFI

Field strength at V-level for antenna 1 = _____ dBµV and antenna 2 = _____ dBµV

Table A.16 — Detection reliability Test 2 — Specifications 1

h = _____ cm, m = ____ cm			
Height plane 1:	h - q_y / 2 =	____ - 22,7 / 2	= _____ cm
Height plane 2:	(h - m) / 2 + m =	(_____ - _____) / 2 + _____	= _____ cm
Height plane 3:	m + q_y /2	____ - 22,7 / 2	= _____ cm

Table A.17 — Detection reliability Test 2 — Orientation F

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Table A.18 — Detection reliability Test 2 — Orientation B

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Table A.19 — Detection reliability Test 2 — Specifications 2

h = _____ cm, m = ____ cm			
Height plane 1:	h - q_z / 2 =	____ - 22,5 / 2	= _____ cm
Height plane 2:	(h - m) / 2 + m =	(_____ - _____) / 2 + _____	= _____ cm
Height plane 3:	m + q_z / 2	____ - 22,5 / 2	= _____ cm

Table A.20 — Detection reliability Test 2 — Orientation C

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Rate of detection

Sum of detections / (3 tests • 3 lines • 3 planes • 3 orientations • 18 tags in the bundle) = detection rate in %

Table A.21 — Detection reliability Test 1 — rate of detection

(_____ +	_____ +	_____)/1458	•100%	= _____ %

A.7 Detection reliability (7.4.4)

The fields of the tables correspond to the lines of movement. The number of detections of the individual tags per line shall be noted in each case.

Gate width = _____ cm, Movement speed = 1 m/s Detection principle = AFI (plus 34 data bytes)

Field strength at V-level for antenna 1 = _____ dBµV and antenna 2 = _____ dBµV

Table A.22 — Detection reliability Test 3 — Specifications 1

h = _____ cm, m = ____ cm			
Height plane 1:	h - q_y / 2 =	____ - 22,7 / 2	= _____ cm
Height plane 2:	(h - m) / 2 + m =	(_____ - _____) / 2 + _____	= _____ cm
Height plane 3:	m + q_y /2	____ - 22,7 / 2	= _____ cm

Table A.23 — Detection reliability Test 3 — Orientation F

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Table A.24 — Detection reliability Test 3 — Orientation B

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Table A.25 — Detection reliability Test 3 — Specifications 2

h = _____ cm, m = ____ cm			
Height plane 1:	h - q_z / 2 =	____ - 22,5 / 2	= _____ cm
Height plane 2:	(h - m) / 2 + m =	(_____ - _____) / 2 + _____	= _____ cm
Height plane 3:	m + q_z / 2	____ - 22,5 / 2	= _____ cm

Table A.26 — Detection reliability Test 3 — Orientation C

PLANE	HEIGHT/cm	LEFT	MIDDLE	RIGHT	SUM
1		| |	| |	| |	
2		| |	| |	| |	
3		| |	| |	| |	
				SUM TOTAL	

Rate of detection

Sum of detections / (3 runs • 3 lines • 3 planes • 3 orientations • 6 tags in the bundle) = detection rate in %

Table A.27 — Detection reliability Test 1 — rate of detection

(_____ +	_____ +	_____)/486	•100%	= _____ %

A.8 Detection reliability (7.4.5)

The fields of the tables correspond to the lines of movement. The number of detections of the individual tags per line shall be noted in each case.

Gate width = ____ cm, Movement speed = 2 m/s Detection principle = AFI (plus 34 data bytes)

Field strength at V-level for antenna 1 = _____ dBµV and antenna 2 = _____ dBµV

Table A.28 — Detection reliability Test 4 — Specifications 1

h = _____ cm, m = ____ cm			
Height plane 1:	h - q_y / 2 =	____ - 22,7 / 2	= _____ cm
Height plane 2:	(h - m) / 2 + m =	(_____ - _____) / 2 + _____	= _____ cm
Height plane 3:	m + q_y /2	____ - 22,7 / 2	= _____ cm