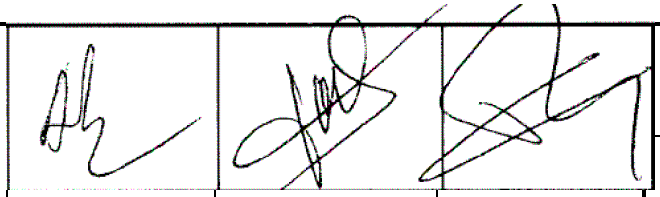
TECHNICAL MATERIAL SPECIFICATION

CONTACTLESS TICKETS (CT)

	SIGNATURE				THALES
-G0	13/01/10	I. MARCANO	M. AZZOUZI/	C. RAYNAL	**THALES TRANSPORTATION SYSTEMS**
IND	**DATE**	WRITTEN	VERIFIED	APPROVED	

INIT	**DATE**	**NOM**	**SIGNATURE**	**DEP**
WRITTEN	15/10/03	M. DANCYGIER	**********	
VERIFIED	20/10/03	G. DA SILVA	**********	**HWENG&SC**
APPROVED	20/10/03	J.-C. LEVERNE	**********	**Ref. : 460568000-G0**

EVOLUTIONS

Ind.	Date	§. Modified	Evolution reason	Established
A0	14/10/03	All	Creation	M. DANCYGIER
B0	03/05/04	All	Change into presentation of document, Added information about ticket construction	M. DANCYGIER
C0	27/12/06	All	Change into presentation of document, Added information about ticket construction New test method added	M. DANCYGIER
D0	5/5/09	7.18, 8.3 and 8.4	Change in bridges between ticket and cardboard material used to make boxes Clarifying storage condition	M. DANCYGIER
E0	09/11/09	All	Improved detailing of tickets characteristics to mitigate the risk of non-continuous quality of ticket delivery by CT supplier, measurements definition, compliance matrix definition	I. MARCANO
F0	13/01/10	7.44	Supplementary details in order to assure fanfolded tickets quality : spliced tickets, tickets non sticking, inseparable tickets	I. MARCANO
G0	16/02/10	5.4	Measurements after watering to be done after tickets drying out..	I. MARCANO

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1 Introduction

This specification is dedicated to contactless tickets definition. The ticket is compliant to special TFC 1 according to ISO 15457-1 standard. This document specifies all physical features of the tickets and therefore can be applied to any kind of manufactured tickets compliant to the ISO 14443 type A or B till part 2 partially.

Chip reference will be provided with the corresponding order.

2 Ticket Construction

2.1 Principle Construction A:

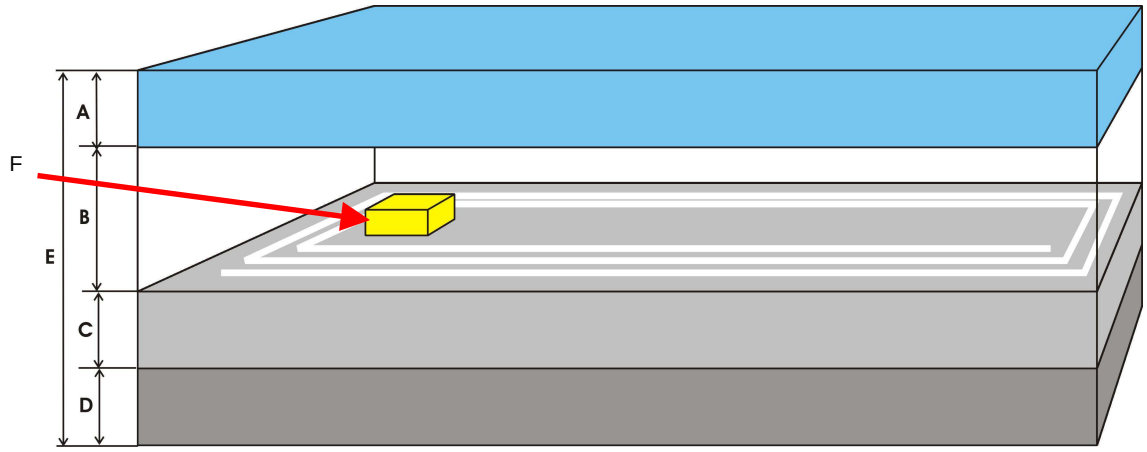


Figure 2.1: Principle Construction A

A:	80 µm	+ 44 % / – 5 %	Thermal Paper
B:	140 µm	± 5 %	Compensation Foil
C:	80 µm	± 5 %	Inlay (Antenna + µController)
D:	80 µm	+ 44 % / – 5 %	Paper
E:	380 - 480 µm		Ticket Thickness excluding chip over thickness
F	Chip	<100 µm	Over thickness on the chip

2.2 Principle Construction B

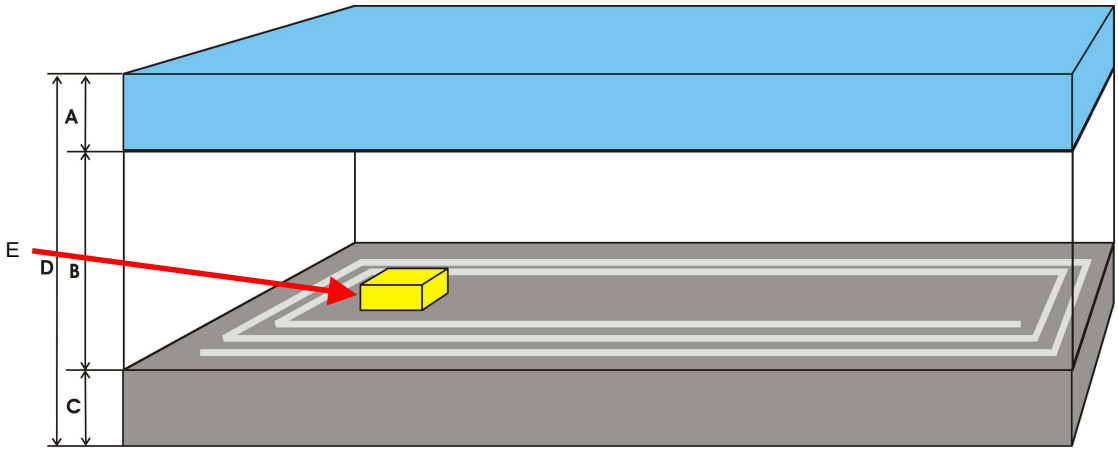


Figure 2.2: Principle Construction B

A:	90 µm	+ 39 % / – 5 %	Thermal Paper
B:	200 µm	± 5 %	Compensation Foil
C:	90 µm	+ 39 % / – 5 %	Paper with Printed Antenna and Bonded µController
D:	380 - 480 µm		Ticket Thickness excluding chip over thickness
E:	Chip	<100 µm	Over thickness on the chip

2.3 Principle Construction C

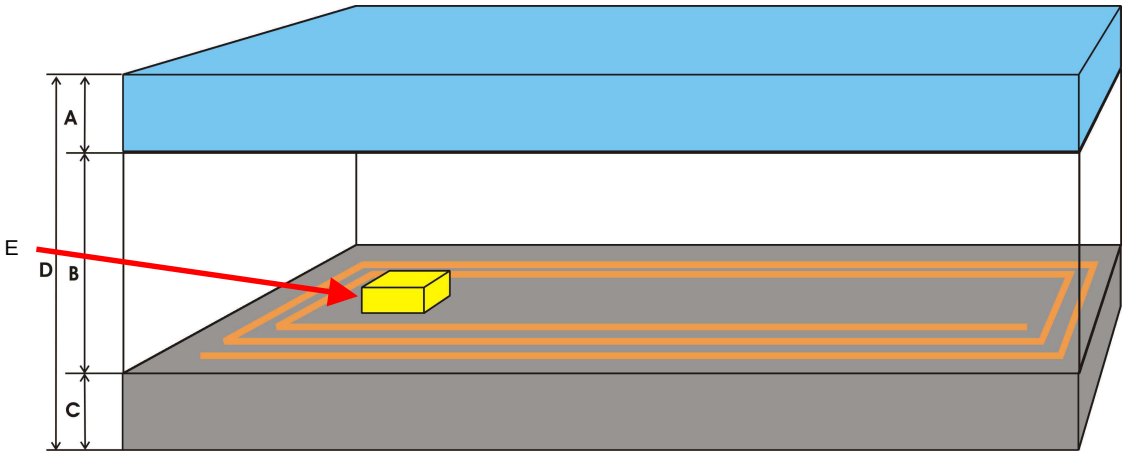


Figure 2.3: Principle Construction C

A:	90 µm	+ 39 % – 5 %	Thermal Paper
B:	200 µm	± 5 %	Compensation Foil
C:	90 µm	+ 39 % – 5 %	Paper with Wired Isolated Antenna and Bonded µController
D:	380 - 480 µm		Ticket Thickness excluding chip over thickness
E:	Chip	<100 µm	Over thickness on the chip

2.4 Principle Construction D

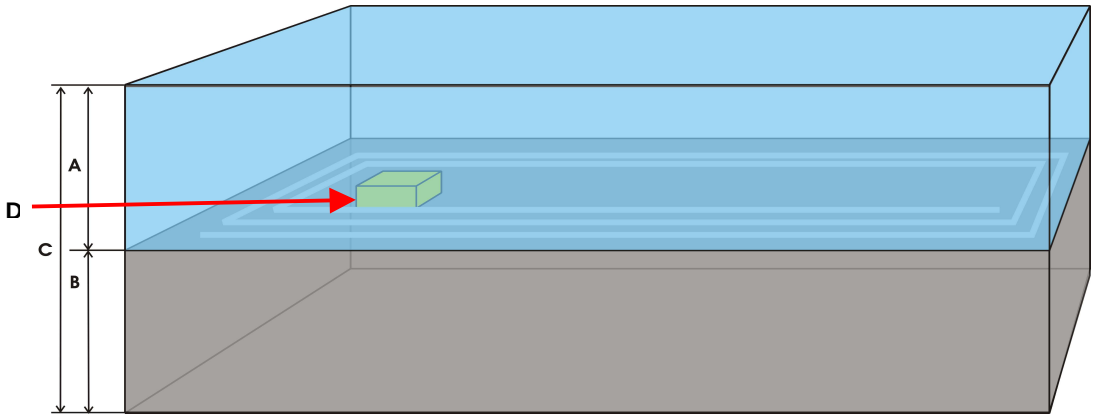


Figure 2.4: Principle Construction D

A:	190 µm	+ 39 % – 5 %	Thermal Paper
B:	190 µm	+ 39 % – 5 %	Paper with Wired Isolated Antenna and Bonded µController
C:	380 - 480 µm		Ticket Thickness excluding chip over thickness
D:	Chip	<100 µm	Over thickness on the chip

Remark:

Ticket constructions, not matching the specifications above, must be submitted to equipment manufacturer for specific qualification procedures.

3 Thermo-Sensitive Layer - Physical Characteristics

Characteristics:	TOP COATED
Printing Color	Black
Optical Density of the Paper and of the Printed Paper	Heating Temperature 70℃: D<0.2
	Heating Temperature 80℃: D<0.8
	Heating Temperature 90℃: D >1.2
Dynamic Thermal Printing	25℃, Energy 0,38 mJ/dot: D>1.2 25℃, Energy <0,15 mJ/dot: D must not exceed 0.25
Printing in High Humidity Conditions 85% RH	7 days, 35℃, Non-printed Area: D < 0.2 Printed Area: D > 1.2
Printing Lifetime Conditions: 0-35℃,50% RH	Non-printed Area: D < 0.25 Printed Area: D > 1.2
Withstand to Sticking Dot Temperature: 100℃	Heat Pressure to Paper: 40 N/cm² No Deposit must be seen on Printing Head
Dry Heat Withstanding 70℃	7 days, Non-printed Area: D<0.2 Printed Area: D<1.2
Withstanding of Thermal Layer to Light	750 W/m² à 35°during 2h (EN668-2-5); Non-printed Area: D<0.2 Printed Area: D>1.2
Withstanding to Water 15 h in Water without Minerals at 20℃	Non-printed Area: D<0.25 Printed Area: D>0.8
Withstanding to Fats Printed Area covered with Oil for 15 h at 20℃, 55% RH After Drying with Absorbing Paper	Vegetable Oil: Non-printed Area: D<0.2 Printed Area: D >1.2 Hand Lotion Non-printed Area: D<0.2 Printed Area: D >1.0
Alcohol Withstanding Printed Area covered with a 15% Ethylic Alcohol Solution for 1h	Printed Areas: D>1.0
Plasticizer withstanding Paper back and front Faces in set between two 500µm plasticized PVC sheets	30% DOP Minimum content with a 30.000 N/m² Pressure for 7 days Non printed Area: <0.25 Printed Area: 1.0

Figure 3.1: Physical Characteristics

4 Ticket Dimension

4.1 Introduction

This section is describing the ticket dimension.

4.2 Dimensions

Width: 85,6 mm -0,5/ +1,0 mm
Height: 53,85 mm -0,15/ +0,15 mm
Thickness: 380 - 480 µm excluding the chip over thickness

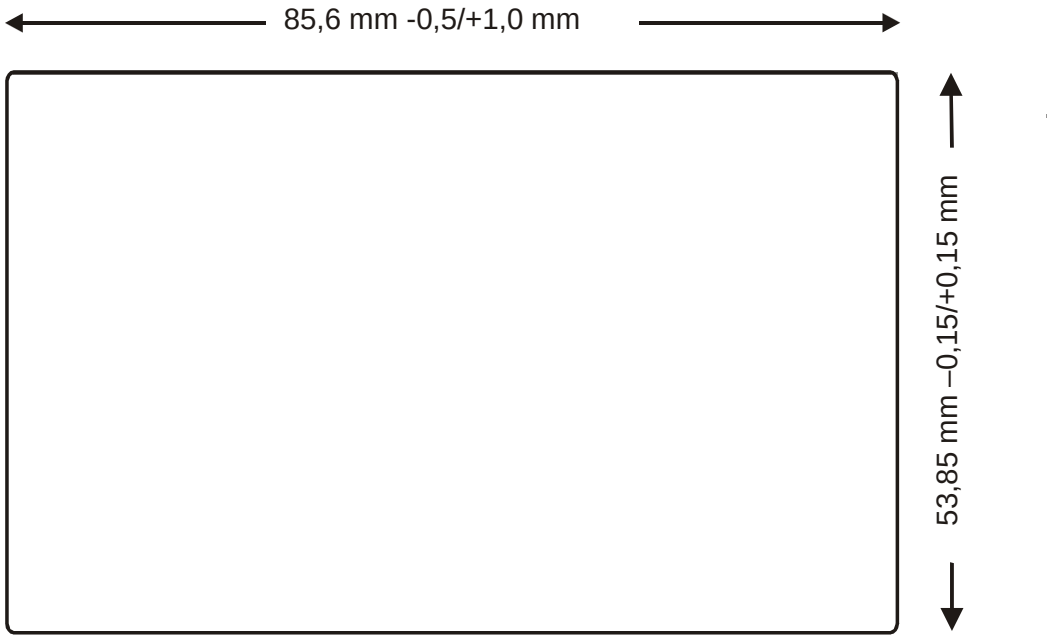
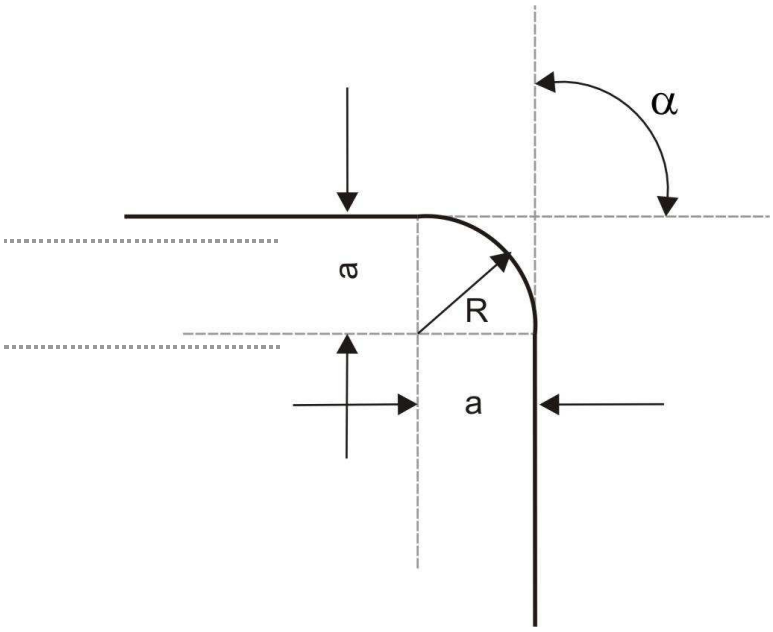


Figure 4.1: Ticket Dimensions

4.3 Round Corner Definition



- a = 3,00 mm ± 0,2 mm
- R = 3,00 mm ± 0,2 mm
- α = 90° ± 0,5°

Figure 4.2: Definition of Round Corner

4.4 Defects

The edges of the tickets must be parallel and the shift to parallelism must not exceed 0.1 mm on the whole length and height.
Any mismatch (barb) between a round corner and either of its adjacent sides must be limited to 0.1 mm maximum displacement of the side from the parallel tangent on the corner arc.
Discontinuities in any round corner (cut-in, fibre clusters, single fibres) must be limited to 0.1 mm maximum deviation from a smooth corner arc of the same radius.

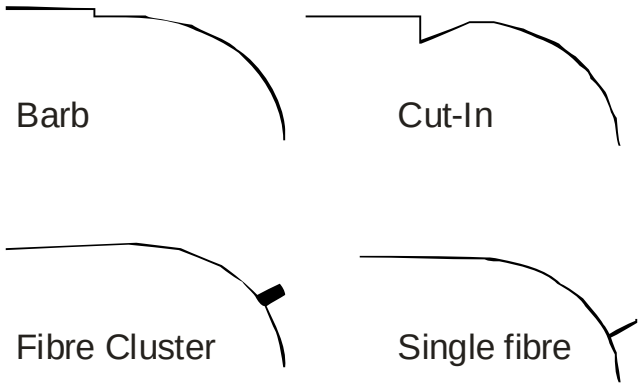


Figure 4.3: Round corner defects

4.5 Ticket Flatness

- Overall flatness : maximum distance to be measured between any point of the ticket surface and the plane made of any of the 3 corners of the ticket must not exceed 2 mm.
- Twist : maximum distance to be measured between any corner and the plane made of any of the 3 corners of the ticket must not exceed 1 mm.
- Transverse curl : maximum distance between any point of the small side of the ticket and the line defined by the two adjacent corners must not exceed 1 mm.

4.6 Antenna and chip location

The chip area should be compliant with the ISO/IEC 15457-1:2008.

5 Mechanical Characteristics

5.1 Curvature and Torsion Withstand

The tickets have to withstand static and dynamic curvature and torsion. These tests have to be accomplished according to the ISO 10373-1 standard. The reading distance is measured prior to the tests.
After the tests the deviation of the reading distance from the initial value must not exceed 10%.

5.2 Folding Withstand

Step 1: A ticket is folded in its middle with regards to its larger side (card frontside inside) in compliance to figure 5.0.
Step 2: A ticket is folded in its middle with regards to its larger side (card backside inside) in compliance to figure 5.0.

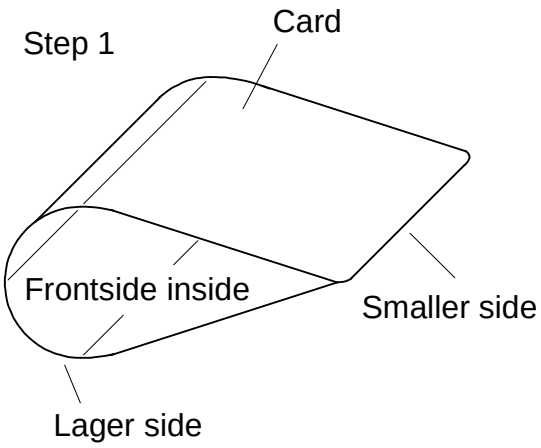


Figure 5.0: Step 1 of Folding Withstand Test

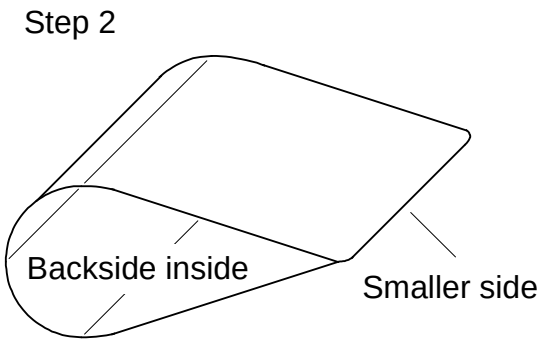


Figure 5.0: Step 2 of Folding Withstand Test

Step 3: Previously defined tests (steps 1 and 2) are made 10 times on each ticket.
After the tests the tickets have to be readable on same contactless reader. The variation of the maximum reading distance value must not exceed 10 %.

5.3 Rumpling Withstand

The tickets are rumpled in operator hand. The reading distance is measured prior to the test.
After the test the tickets have to be readable on same contactless reader. The variation of the maximum reading distance value must not exceed 10 %.

5.4 Water Withstand

The tickets are put into water for 2 hours. Measurements are made out of the water, prior to watering and after watering on the dried out tickets.
After watering the tickets have to be readable on same contactless reader. The variation of the maximum reading distance value must not exceed 10 %.

5.5 Overhang Withstand

A ticket is fixed in the overhanged area of the chip. The ticket is installed in holding device. The area around the chip is free to move. The free area has to be exposed to a 1.000 N strength.
The tickets have to be still functional after test.

5.6 Resistance to Delamination

No delamination has to occur during lifetime of the tickets.

5.7 Withstanding to Direct Thermal Writing

The tickets have to resist to direct thermal printing: there have to occur no failure related to the heating process during thermal printing: Chip, antenna and connection between antenna and chip have to be functional after printing.

5.8 Withstanding to Scratching

The purpose of this test is to check reliability of the connection between chip and antenna while scratching. The test is made along the length of the tickets on its front and back side.
This specific arrangement is designed in order to make the requested testing.

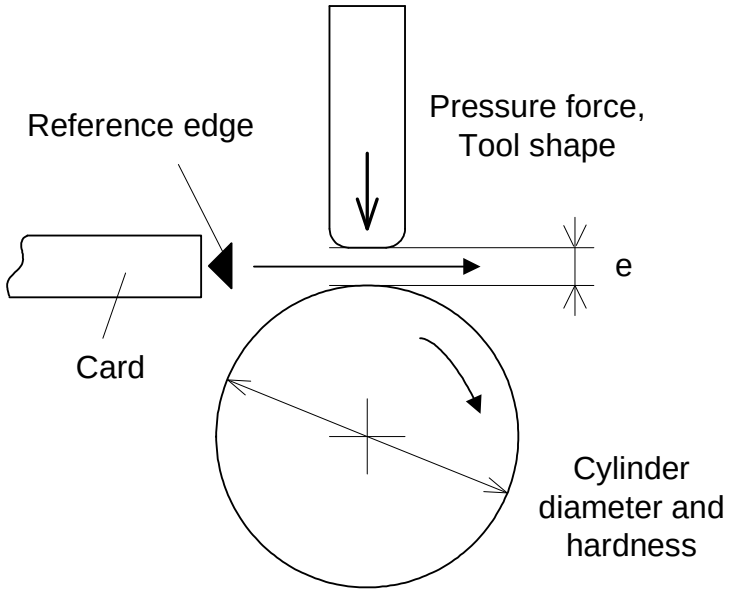


Figure 5.0: Principile Arrangement of the Scratch Test

Remark: The mechanism driving the ticket must not interfere with the area where the chip is located.
The test has to be made at ambient temperature 23℃ ±2℃ and 50%RH±10%.

- Pressure force: 7.5 ± 0,5 daN
- Distance e: 0,2 ± 0,05 mm
- Number of cycles: 50 on each side
- Speed: 10 to 20 cm/s on circumference

The equipment has the following characteristics:

- Steel cylinder diameter : 14 mm
- Surface cylinder hardness: stainless steel material
- Final cylinder diameter: 19 mm ± 0,05 mm
- Final cylinder hardness: Silicone 50 Shores
- Tool shape:
  - Blade 10 x 60 mm
  - Profile for thickness: 2.5 mm radius
  - Steel made

Prior to any measurement, the reading distance is measured for each ticket with a contactless reader. The test must be done on a sample including 10 tickets at least.
The tickets are installed on the device and 25 cycles are made on both sides of the ticket. *All tickets have to be readable on same contactless reader after the test. The variation of the maximum reading distance value must not exceed 10 %.*

5.9 Chip to Antenna Connection Reliability

The purpose of this test is to check reliability of the connection between chip and antenna. The test is based on bending the ticket in one direction and in the opposite one along the length of the ticket.

5.9.1 Single Ticket

This specific arrangement is designed in order to make the requested testing.

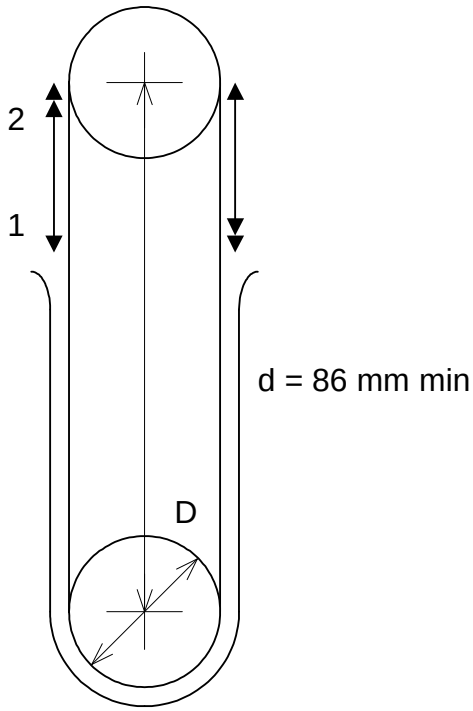


Figure 5.0: Principle Arrangement of the Scrath Test with Single Tickets

Remark: The mechanism driving the ticket must not interfere with area where chip is located

The equipment has the following characteristics:

- Cylinder diameter D : 40 mm,
- Surface cylinder hardness: POM[1] material
- Number for back and forth cycles: 50
- Speed: 30 +/- 20 cm/s

Prior to any measurement, reading distance is measured for each ticket with a contactless reader. Test must be done on a sample including 10 tickets at least. After installing the ticket on the device, 50 cycles are made.
All tickets have to be readable on same contactless reader after the test. The variation of the maximum reading distance value must not exceed 10 %.

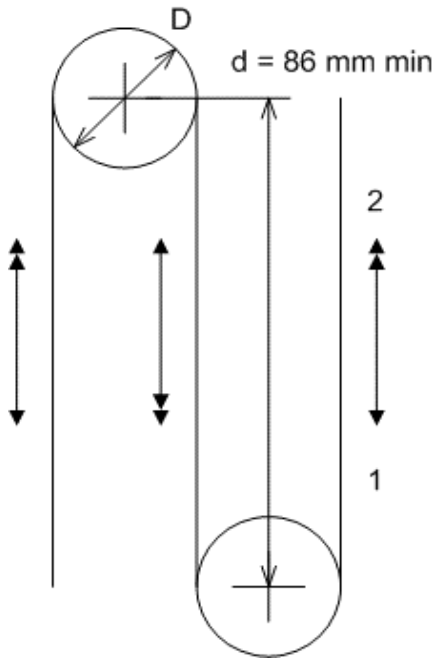


Figure 5.0: Principle Arrangement of the Connection Test for Fanfolded Tickets

5.9.2 Fanfold Tickets

This specific arrangement is designed in order to make the requested testing.

Remark: The mechanism driving the sample must not interfere with area where chip is located

The equipment has the following characteristics:

- Cylinder diameter D : 40 mm,
- Surface cylinder hardness: POM[2] material
- Number for backward and forward cycles: 50
- Speed: 30 +/- 20 cm/s

[1] Polyoxymethylene
[2] Polyoxymethylene

- The device must be designed in such a way that the ticket rests against the lateral surface of the roller without being damaged.

Prior to any measurement, reading distance is measured for each card with a contactless reader. Test must be done on a sample including 10 tickets at least. After installing the sample on the device, 50 cycles are made. *All tickets have to be readable on same contactless reader after the test. The variation of the maximum reading distance value must not exceed 10 %.*

6 Performances

6.1 Operating field

Tickets must operate continuously between a minimum field strength of 0,45 A/m and a maximum of 7.5 A/m.

6.2 Distance of work

Tickets must comply with a continuously working distance from 0 to 10 cm minimum from the proximity coupling device.

Thales provides, see conditions in the Technical Purchase Clause :

- a qualified reader, named CSC-KIT-POST, with a record chart including the working distance and the field strength value;
- a test software – able to select only or to read/write tickets.

6.3 Resonance frequency

Resonance frequency testing methods are compliant to ISO/IEC 10373-6:2001/AM2. Measured values are compliant to the Mifare IC requirements : values between 14Mhz to 18,5Mhz.

6.4 Functional test in a permanent field

Ticket is placed 5 cm over the antenna of the reader, this last one in function during the whole test. By using the test software, some data are written on the IC. After 20s in the antenna field, the data is read. Follows a new writing session and a check reading of the stored data.
The ticket must be still operational after test and must have no lost of data stored in EEPROM.
No black mark on the thermal layer side must be seen.

6.5 Encoding

Encoding of issuing features will be requested prior to delivery, and will be made on the ticket manufacturer facilities.
When requested, the pre-encoding is described in a document, which is provided to the manufacturer.

6.6 Ticket Lifetime

Functional lifetime must exceed 1 year.

6.7 Ticket Artwork

Artwork will be compliant to customer request. Any kind of printing can be requested.
No varnish is accepted on the tickets.

6.8 Ticket printed identification number

The card printed number must be unique, his exact number definition and location will be defined within the technical purchase clause. An inkjet printing technique will be used.

6.9 Finished Ticket Thickness

Finished tickets have a uniform thickness of 380 - 480 µm (excluding the over thickness of the chip). Maximum over thickness on the chip will be 100 µm.

6.10 Ticket Friction Coefficient

Static Friction Coefficient for the finished card is measured following ISO 8295 standard adapted to the reduced final dimension of the ticket. The same mass will be distributed on a same surface, but of 50 mm width and 80 mm length.

The friction coefficient is defined as:

- Ticket over stainless steel AISI316L **Ra=0,22-0,28 µm** (machine direction and on both sides)
  0,20 – 0,35
- Ticket face over ticket back
  0.3 to 0.45

6.11 Finished Ticket Transparency

Transparency is measured with the device defined in ISO 10373-1 standard and must be < 10 % .

6.12 Ticket Print Artwork Withstanding to Wear

6.12.1 Introduction

The artwork must resist to ticket issuing in the equipment. It is requested that ticket withstands to 100 passes in ticket issuer.

6.12.2 Tests at Room Temperature

A test is made with a ticket issuer. This equipment is cleaned prior to any test.
The ticket is checked at the end of the test.

- No visible deep scratch
- Artwork not modified
- No change in colours
- Any part in contact with the ticket must not be polluted by the artwork printing

6.12.3 Test at high Humidity and high Temperature

The same test is carried out for the following conditions:

- Temperature: 35℃
- Relative Humidity: 85 %

6.13 Abrasion

Tickets must not wear the thermal heads and must be in compliance to thermal head manufacturer recommendations.

6.14 Withstand of the Ticket to pass under Thermal Head

The chip must be located in an area, which does not damage the thermal head. The chip must also withstand heating of the thermal head.

6.15 Storage Conditions

Storage conditions are as follow :

- Store Flat Boxes must be stored in the direction of the arrow

- Store Dry Avoid damp conditions (humidity 30 to 70%)
- Store Moderate Avoid Extremes of temperature (min 0℃ max 40℃)
- Store Low Do not stack boxes more than 1 meter high
- Rotate Stock Use old stock first
- Handle with Care Do not drop

A label on each box must be set summarizing these mandatory requests.

6.16 Operation Conditions

- Temperature: -20℃ to 60℃
- Relative Humidity:
  - 15 to 90 % at 25℃
  - 85% at 35℃

7 Ticket packaging

7.1 Introduction

Tickets can be packed as single tickets or as fan-folded tickets.

7.2 Single Tickets Packaging

7.2.1 General Description

Tickets are packed in boxes, which contain 500 tickets. Cover of boxes is linked to the body of the box. A security adhesive tape closes the boxes. Each box is marked with a label.

7.2.2 Packing Instructions

Inner Carton:

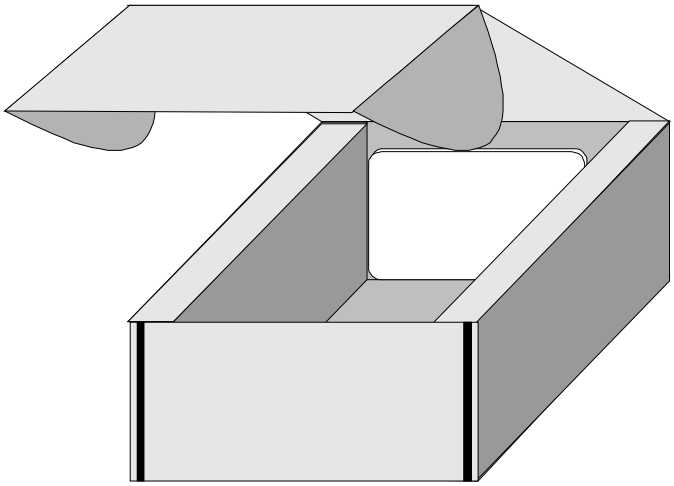


Figure 7.1: Inner Carton

Number of Tickets	*500 Tickets per Inner Carton*
Humidity Protection	*by Retractable Film*
Dimensions of Inner Carton (WxHxD)	*(88 x 56 x 225) mm (Minimum inner Dimension)* *(94 x 60 x 228) mm (Maximum outer Dimension)*

Outer Carton:

Number of Inner Cartons	*4 Inner Cartons per Outer Carton*
Number of Tickets	*4 x 500 Tickets per Outer Carton*

Dimensions of Outer Carton (WxHxD)	*(95 x 241 x 229) mm (Minimum inner Dimension)* *(115 x 271 x 239) mm (Maximum outer Dimension)*

7.2.3 Labelling

Labels are located in a position such as, when boxes are stacked label must remain visible.
These boxes are placed in a larger box, which contains 10 of the described boxes.
On these large boxes, a label is placed, which contains the following information:

- Manufacturer name
- Customer name
- Type of tickets
- Manufacturing date
- STM reference[1]
- First and last number of ticket for each box included in the box (if serial number is requested)
- A non functional ticket is placed on the box

Depending on destination or shipment other kinds of packaging could be requested.

A computer readable media will be also sanded with the mapping file required to initialise the card master database. The file name will reflect the order reference and will contain :

- the inner box ID
- the batch number
- the card artwork (graphical design ID)
- the media serial number (chip ID)
- the tickets engraved identifications
- the validity end date.

The file format (Excel, XML, etc.) and/or modifications of the containing of the mapping file will be written in the technical purchase clause.

7.3 Box material

It is requested to have a thin cardboard material to manufacture boxes for the fanfold tickets. Cardboard thickness must not exceed 0.9 mm.
Material used for ticket boxes must be submitted to approval in order to check whether it induces defects in ticket dispensing on Thales equipment.

[1] Specification Technical Material reference i.e. the document number of this document.

7.4 Fanfold Packaging

7.4.1 General Description

The tickets are linked by minimum 3 perforated ties, and fanfolded. up to 3 ticket per fold.

The bursting force (ticket separation force) limits must be between 30–70N with the following distribution, for the tickets of the batch :

- < 30 N 0%
- 30 N to 40 N ≤10%
- 40 N to 60 N ≥ 80%
- 60 N to 70 N ≤10%
- > 70 N 0%

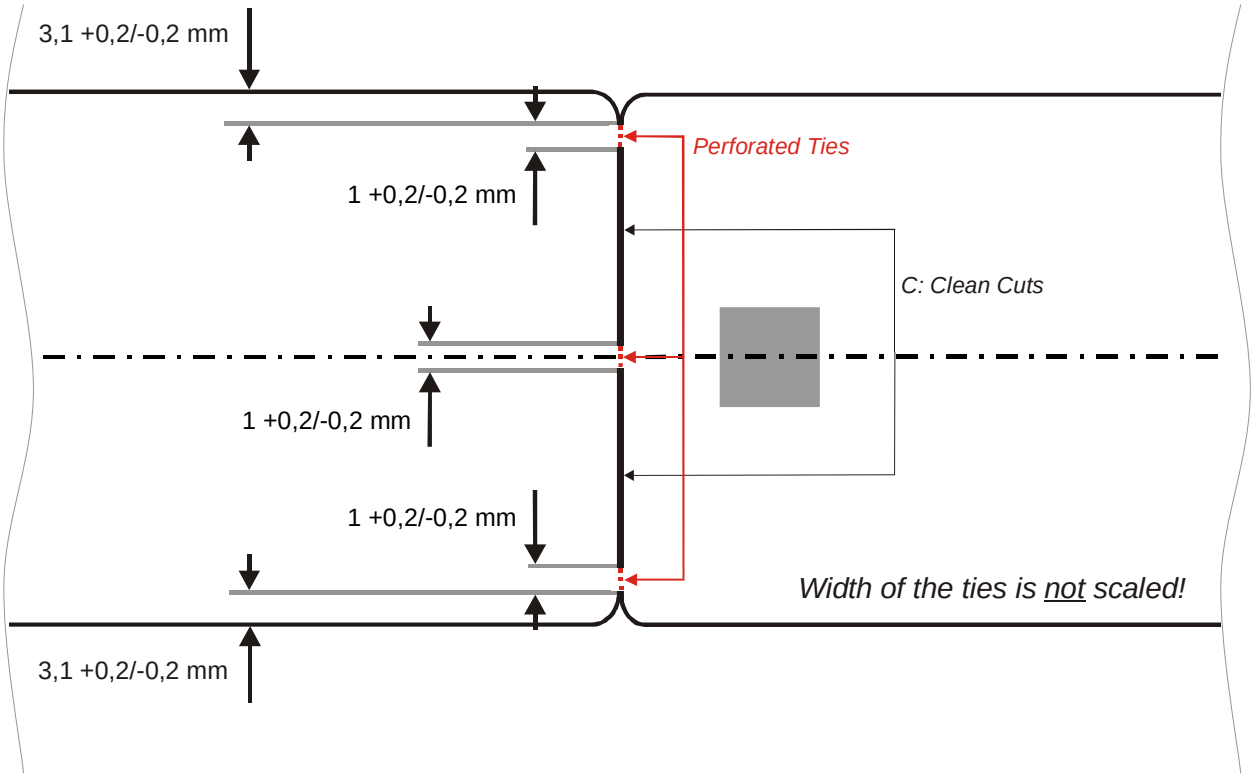


Figure 7.2: Example of perforation made to achieve requested specification for breaking force (no scaled drawing!)

REMARK: It is possible to have more then 3 bridges between tickets in order to reach the specified breaking force. In any case, sample tickets must be tested prior to any manufacturing for qualification approval.

Installation of tickets in the box is specified for each kind of tickets and specified within the technical purchase clause.

7.4.2 Packing Instructions

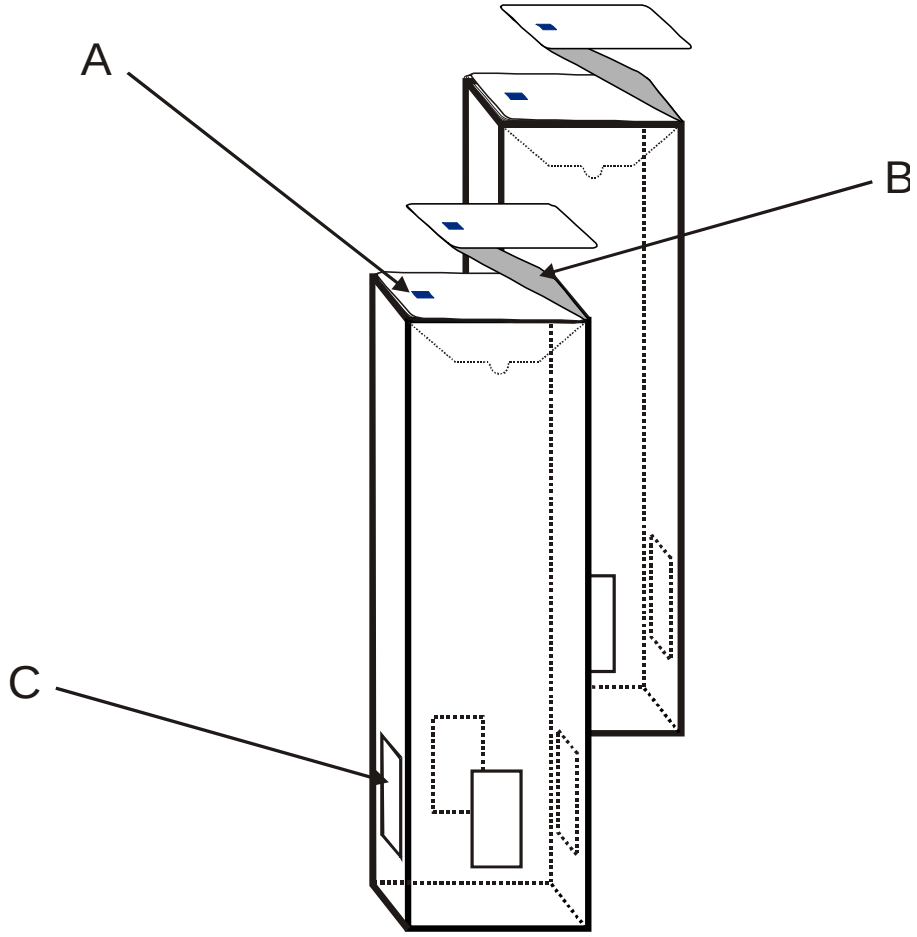


Figure 7.3: Inner Carton One in Line

7.4.2.1 One in Line

Inner Carton:

A = Chip Position	
B = Thermal Layer	
C = Windows	
Number of Tickets	*700 Good Tickets per Inner Carton*[1]
Humidity Protection	*by Retractable Film*
Dimensions of Inner Carton (WxHxD)	*(90 x 305 x 57) mm (Minimum inner Dimension)* *(95 x 310 x 60) mm (Maximum outer Dimension)*
Packaging	*2 Inner Cartons per Outer Carton*

[1] The quantity of the tickets depends on the final thickness inclusive tolerances of the tickets.

Outer Carton:

Number of Inner Cartons	*2 Inner Cartons per Outer Carton*
Number of Tickets	*2 x 700 Tickets per Outer Carton*[1]
Dimensions of Outer Carton (WxHxD)	*(96 x 311 x 121) mm (Minimum inner Dimension)* *(106 x 321 x 131) mm (Maximum outer Dimension)*

[1] The quantity of the tickets depends on the final thickness inclusive tolerances of the tickets.

7.4.2.2 Two in Line

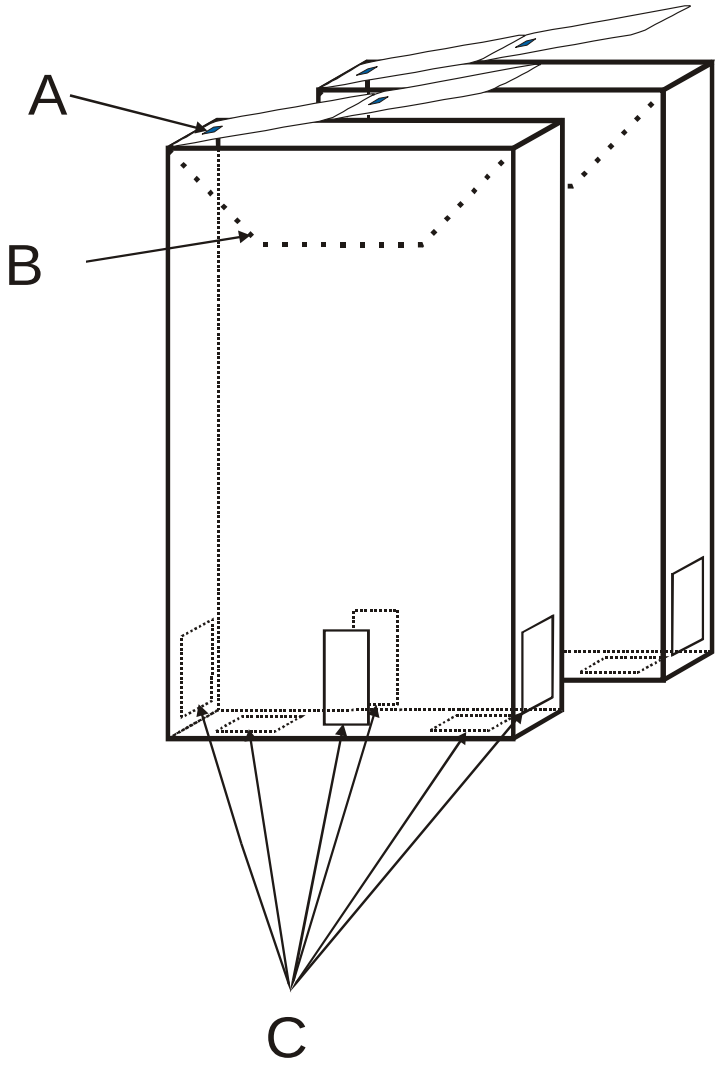


Figure 7.4: Inner Carton Two in Line

Inner Carton:

A = Chip Position	
B = Perforated tear-off edges on both sides	
C = Windows	
Number of Tickets	*1300 Good Tickets per Inner Carton*[1]
Humidity Protection	*by Retractable Film*
Dimensions of Inner Carton (WxHxD)	*(176 x 360 x 57) mm (Minimum inner Dimension)* *(181 x 370 x 60) mm (Maximum outer Dimension)*
Packaging	*2 Inner Cartons per Outer Carton*

[1] The quantity of the tickets depends on the final thickness inclusive tolerances of the tickets.

Outer Carton:

Number of Inner Cartons	*2 Inner Cartons per Outer Carton*
Number of Tickets	*2 x 1300 Tickets per Outer Carton*[1]
Dimensions of Outer Carton (WxHxD)	*(182 x 371 x 121) mm (Minimum inner Dimension)* *(192 x 381 x 131) mm (Maximum outer Dimension)*

[1] The quantity of the tickets depends on the final thickness inclusive tolerances of the tickets.

7.4.2.3 Three in Line

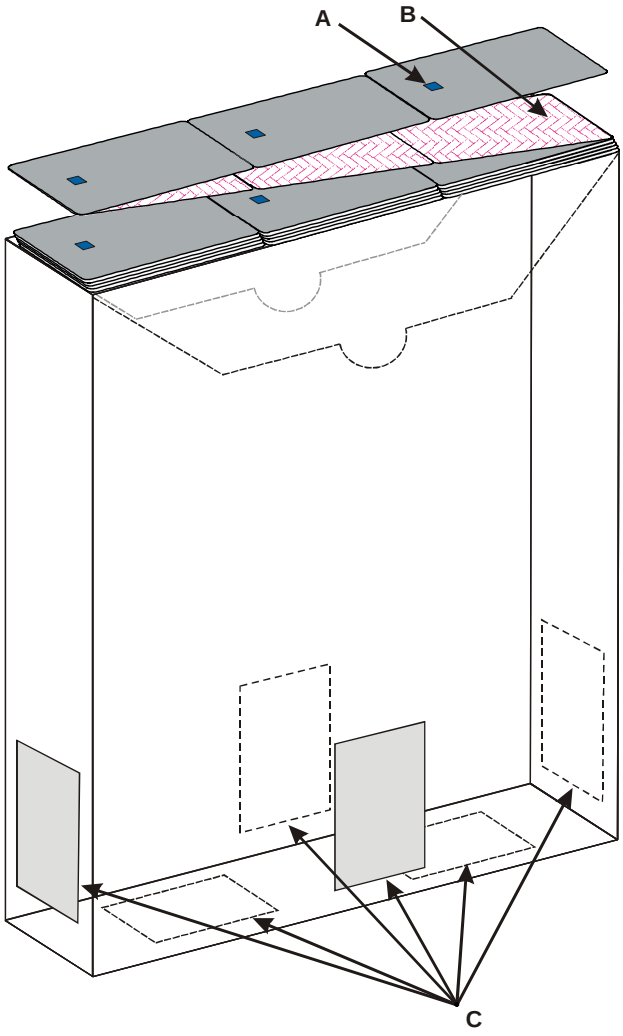


Figure 7.5: Inner Carton Three in Line

Inner Carton:

A = Chip Position	
B = Thermal Layer	
C = Windows	
Number of Tickets	*1700 Good Tickets per Inner Carton*[1]
Humidity Protection	*by Retractable Film*
Dimensions of Inner Carton (WxHxD)	*(263 x 320 x 55) mm (Minimum inner Dimension)* *(268 x 319 x 60) mm (Maximum outer Dimension)*
Packaging	*2 Inner Cartons per Outer Carton*

[1] The quantity of the tickets depends on the final thickness inclusive tolerances of the tickets.

Outer Carton:

Number of Inner Cartons	*2 Inner Cartons per Outer Carton*
Number of Tickets	*2 x 1700 Tickets per Outer Carton*[1]
Dimensions of Outer Carton (WxHxD)	*(275 x 322 x 128) mm (Minimum inner Dimension)* *(281 x 328 x 134) mm (Maximum outer Dimension)*

7.4.3 Labelling

Each box is identified by:

- Manufacturer name
- Customer name
- Type of tickets
- Manufacturing date
- STM reference[2] **(Thales specification reference)**
- First and last number of ticket included in the box
- A non functional ticket is placed on the box.

Depending on destination or shipment other kinds of packaging could be requested.

A computer readable media will be also sanded with the mapping file required to initialise the card master database. The file name will reflect the order reference and will contain :

- the inner box ID
- the batch number
- the card artwork (graphical design ID)
- the media serial number (chip ID)
- the tickets engraved identifications
- the validity end date.

The file format (Excel, XML, etc.) and/or modifications of the containing of the mapping file will be written in the technical purchase clause.

7.4.4 Acceptation of defective tickets when tickets in fan-fold

When tickets are provided in fan fold the following rules apply:

- maximum 3 consecutive defective tickets are allowed per box but the bursting of tickets must be assured. Inseparable tickets, e.g. third antenna between two tickets, are not allowed.
- 3 splices, not following each other, are accepted as a maximum per box. The tickets with a skew cut are jointed with a splicing tape TESA 4137 Aluminized Polyester. A specific type of tape could be required in function of the tickets operating conditions when ordered. The edges of the jointed tickets must be compliant with the conditions listed in the 4.4 paragraph : the shift to parallelism must not exceed 0,1mm on their whole length or height.
- ~~Defective chip tickets per box must not exceed 2% for 1000 tickets per box; less the 1000 tickets is 1%.~~
- The tickets must not be sticking together on their faces inside the boxes.

[2] Specification Technical Material reference i.e. the document number of this document.

8 Acceptance Test Principles

8.1 Instructions

Manufacturer must provide the following documents:

- Compliance certificates for the base materials and qualification parameters
- Acceptance test report including the compliance matrix for the finished ticket parameters, see example at the end of this document
- The tickets used for tests and a supplementary limited batch e.g.1 box of tickets for internal tests
- Compliance certificate for the entire manufactured batch.

8.2 Base materials qualification

The basic tickets properties like thermal paper characteristics, corner definition and the printing withstanding must be compliant to the specification and a qualification report provided.

8.3 Finished ticket parameters measurements

The measurements are done on a ambient temperature 23℃±2℃ and 50%RH±10%, except the artwork and the packaging testing. Also, the test equipment should be calibrated and calibration period not expired.

8.3.1 Measurement 1: Visual Aspect

Method: Visual check:
Tickets must have no defect on its surface:
- Hole
- Imperfection of surface
- Correct ticket printed ID , etc

Sampling: See section: Major defect
Compliance: No defect
Criteria: See section: Major defect

8.3.2 Measurement 2: Card Dimension

Used equipment: Calliper
Method: Results of measurement are registered and treated on a statistical base.
Sampling: See section: Major defect
Compliance: Width: 85,6 –0,5/+1,0 mm
Height: 53,85 –0,15/+0,15 mm
Criteria: See section: Major defect

8.3.3 Measurement 3: Defects

Used equipment: Calliper and template
Method: Parallelism between opposite side is measured, the round corners are checked
Sampling: See section: Major defect
Compliance: No defect
Criteria: See section: Major defect

8.3.4 Measurement 4: Finished Card Thickness (excluding Chip Area)

Used equipment: Digital micrometer
Method: Results of measurement are registered and treated on a statistical base. Measured points are on the ticket middle and on the antenna.
Sampling: See section: Major defect
Compliance: 380 - 480 µm
Criteria: Critical : Accepted = 0 / Rejected = 1

8.3.5 Measurement 5: Chip Over thickness

Used equipment: Digital micrometer
Method: Results of measurement are registered and treated on a statistical base
Sampling: See section: Major defect
Compliance: <100 µm
Criteria: See section: Major defect

8.3.6 Measurement 6: Tickets bursting force

Used equipment: Testing bench compliant to ISO 1924/2 with a constant rate of elongation method of 20±5mm/min.
Method: Results of measurement are registered and treated on a statistical base
Sampling: See section: Major defect
Compliance: < 30 N 0%
30 N to 40 N ≤10%
40 N to 60 N ≥ 80%
60 N to 70 N ≤10%
> 70 N 0%
Criteria: Critical : Accepted = 0 / Rejected = 1

8.3.7 Measurement 7: Static friction coefficient

Used equipment: Compliant to ISO 8295 on a stainless steel AISI316L plate **Ra=0,22-0,28 µm** and adapted to the ticket dimension (same mass distributed on the same surface formed by 50 mm width and 80 mm length)
Method: Results of measurement are registered and treated on a statistical base
Sampling: See section: Major defect
Compliance: Ticket over the stainless steel **0,20 – 0,35**
Ticket face over ticket back 0.3 to 0.45.
Criteria: See section: Major defect

8.3.8 Measurement 8: Ticket Flatness

Used equipment: Rule
Method: Flatness is measured for machine and transverse directions.
Sampling: 5 cards
Compliance: Overall flatness: ≤ 2 mm
Twist and transverse curl ≤ 1 mm
Criteria: Accepted = 0 / Rejected = 1

8.3.9 Measurement 9: Printed Ticket Transparency

Method: Measurement of transparency with dedicated equipment approved by the customer in printed and non-printed ticket areas.
Sampling: See section: Major defect
Compliance: Transparency <10%.

Criteria: See section: Major defect

8.3.10 Measurement 11: Working Distance with THALES Reference Equipment

Used equipment: THALES reference reading / writing contactless equipment with a PC test software.
Method: Tickets are on the antenna target
Sampling: See section: Major defect
Compliance: Card selection only or a read and write capability between 0 and 100 mm distance at least
Criteria: See section Major defect

8.3.11 Measurement 12: Encoding of issuing features – if requested only

Used equipment: THALES Reference equipment with a PC test software.
Method: Tickets are on the antenna target
Sampling: See section: Major defect
Compliance: Read is compliant to the specification
Criteria: See section: Major defect

8.3.12 Measurement 13: Folding test

Used equipment: None requested.
Method: Folding the ticket
Sampling: See section: Major defect
Compliance: Tickets compliant to specification after test
Criteria: See section: Major defect

8.3.13 Measurement 14: Withstanding to scratching

Used equipment: Dedicated mechanical device according description
Method: Tickets maximum reading distance is measured prior and after test
Sampling: See section: Major defect
Compliance: Ticket compliant to the sanction defined in specification
Criteria: See section: Major defect

8.3.14 Measurement 15: Chip to antenna connection reliability

Used equipment: Dedicated mechanical device according description
Method: Tickets maximum reading distance is measured prior and after test
Sampling: See section: Major defect
Compliance: Ticket compliant to the sanction defined in specification
Criteria: See section: Major defect

8.3.15 Measurement 16: Artwork

Used equipment: Visual check
Method: Check that ticket artworks are compliant to the sample artworks
Sampling: See section: Major defect
Compliance: Artwork must be compliant to customer specification.
Criteria: See section: Major defect

8.3.16 Measurement 17: Ticket Packaging and Labels

Method: Visual check

Method: Check that packaging and labels are compliant to the customer request.
Sampling: See section: Major defect
Compliance: Packaging must be compliant to customer request.
Criteria: See section: Major defect

8.4 Sampling plan - Normal Checking NF ISO 2859-1 Standard

Each measure is numbered and has it's own sample size and acceptance or rejection criteria.
The defects are classified in :

- critical : every tested sample has to be compliant
- major : which consequence causes problems in the normal use of the product and / or reduces its commercial value;
- minor : which does not influence the normal use of the product, but shows a non-compliant parameter.

For a given batch size the sampling number and the acceptance criterion, for the whole batch, are defined in tables 10.1 and 10.2.
The acceptation rules are :

- If the number of defective cards in the batch is equal or lower than the acceptance criterion, the batch is accepted
- If the number of defective cards in the batch is greater than the acceptance criterion, the batch is rejected.

Sampling is made by considering population as boxes. 10 to 15 tickets are sampled per box in order to reach the whole sampling size.

Major Defects (control level II):

		AQL	
Batch Size	**Sample Size**	**0.65**	
Tickets Number		**Accepted**	**Rejected**
2 to 8	2	0	1
9 to15	3	0	1
16 to 25	5	0	1
26 to 50	8	0	1
51 to 90	13	0	1
91 to150	20	0	1
151 to 280	32	0	1
281 to 500	50	0	1
501 to 1.200	80	1	2
1.201 to3.200	125	2	3
3.201 to10.000	200	3	4
10.001 to 35.000	315	5	6
35.001 to 150.000	500	7	8
150.001 to 500.000	800	10	11
500.001 and more	1.250	14	15

Figure 8.1: Control Level II

Minor Defects (control level III) :

		AQL	
Batch Size	**Sample Size**	**2.5 Minor**	
Ticket Number		**Accepted**	**Rejected**
2 to 15	2	0	1
16 to 50	3	0	1
51 to 150	5	0	1
151 to 500	8	0	1
501 to 3.200	13	1	2
3.201 to 35.000	20	1	2
35.001 to 500.000	32	2	3
≥ 500.001	50	3	4

Figure 8.2: Control Level III

ACCEPTANCE TEST REPORT

Customer Specification Reference: Acceptance Test Report Ref. : .....Index:....	Order Ref. : .....

Name of Customer Representative:	Name of Manufacturer Representative: .....

BATCH IDENTIFICATION

Kind of Ticket: Color/Printing:

Batch Size:	..... Tickets

RESULT OF THE ACCEPTANCE TESTS

ACCEPTED ☐ Subjected to the Compliance of All Qualification Parameters and compliance matrix
REJECTED ☐

VISAS

For Customer: Name: .....Date :	For Manufacturer: Name: .....Date: .....

OBSERVATIONS

COMPLIANCE MATRIX

Parameter	Compliance criterion	Measured value	Checking Method	Compliance	
				OK	NOK
External aspect	Hole, imperfections,… ticket printed ID	-	Visual check		
Ticket dimensions	W: 85,6-0,5/+1mm H: 53,85±0,15mm		Calliper		
Defects	ISO 15457-1		Calliper and template		
Thickness (excluding chip)	380 – 480 µm		Digital micrometer		
IC over thickness	<100 µm		Digital micrometer		
Ticket bursting force	< 30N 0% 30N - 40N ≤10% 40N - 60N ≥ 80% 60N - 70N ≤10% > 70N 0%		ISO 1924/2 constant elongation rate of 20mm/min		
Coefficient of friction at least one of the following according to the TPC : a) Ticket over stainless Steel AISI316L Ra=0,22-0,28 µm (Machine direction and both sides) b) Ticket face over ticket back	0,20 – 0,35 0,30 – 0,45		ISO 8295 adapted to ticket size		
Ticket flatness on both edges	< 2 mm /length < 1 mm /width		Rule		
Printed ticket transparency	< 10%		ISO 10373-1		
Working distance with Thales reference reader	Selection only or read/write from 0 to 10cm mini (see TPC)		Thales CSC-KIT-POST + PC software		
Resonance frequency	See TPC		ISO/IEC 10373-6:2001/AM2		
Functional test in a permanent field	See chapter 6.4		Thales CSC-KIT-POST + PC software		
Encoding	See TPC		Thales CSC-KIT-POST + PC software		
Folding test	See chapter 5.2		Test bench		
Withstanding to scratching	See chapter 5.8		Test bench		
Chip to antenna connection reliability	See chapter 5.9		Test bench		
Artwork	See TPC		Visual check		
Ticket packaging and labels	See TPC				

TPC = Technical Purchase Clause