BS EN 4301:2009

Aerospace series — Identification marking methods for engine items — Engineering requirements

ICS 49.050

National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Série aérospatiale - Méthodes de marquage pour articles moteurs - Exigences techniques

Luft- und Raumfahrt - Kennzeichnungsverfahren für Triebwerkbauteile - Technische Anforderungen

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Foreword

This document (EN 4301:2009) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2009, and conflicting national standards shall be withdrawn at the latest by September 2009.

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1 Scope

This standard describes the coding system for marks, the processes used to produce these marks, as well as the general marking requirements for the identification of aerospace engine items.

This document is applicable to items whose engineering drawing or design folder refers to EN 4301 for all issues that are not in contradiction with specific indications appearing on the engineering drawing or in the design folder.

This document is not applicable to items requiring an identification plate.

2 Normative references

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

EN ISO 3098-2, *Technical product documentation — Lettering — Part 2: Latin alphabet, numerals and marks (ISO 3098-2:2000)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
marking
action of affixing one or more marks on a medium

3.2
mark
physical information, composed of legible characters on the item or its packaging

3.3
permanent mark
mark produced by means of a marking process whose characters can only be eliminated by removing material (machining)

3.4
temporary mark
mark produced by means of a marking process whose characters can be easily removed

3.5
character
each of the elements which compose the mark: letter, figure, symbol, separator, etc.

3.6
design authority
person or corporate body who is in charge of the design definition

3.7
design definition
creative activity which, starting from expressed needs, existing means, and technological possibilities, results in the design of a product meeting these needs and industrially feasible

3.8
manufacturer
person or corporate body who masters the design of a product and has complete control over the quality of each item or sample produced

3.9
supplier
person or corporate body party to a business venture, contract, or order they have accepted which commits them, with respect to the customer, to carrying out the provisions stated therein

3.10
production source
person or corporate body who is responsible, with respect to the manufacturer, for manufacturing and inspecting a cast or forged, pre-machined, finished item or material. This may involve a subcontractor or an accessory manufacturer. To the extend that he is given the order, he becomes a producer

3.11
subcontractor
person or corporate body who carries out, on behalf of and under the responsibility of a supplier, all or part of the business venture, contract, or order concluded by the customer

NOTE In the case of Public Contracts, a single subcontractor is not allowed to execute the entire contract entered into by the customer.

4 Symbols and abbreviations

O.C.R. Optical Character Recognition

5 Arrangement of marks

5.1 General

Marks are to be made in the same order as that shown by the combinations for the standard arrangements (alphabetical code) identified by numerical codes given in Table 2 or in accordance with a particular combination indicated in the note on the drawing.

5.2 General arrangement

— character height = h;

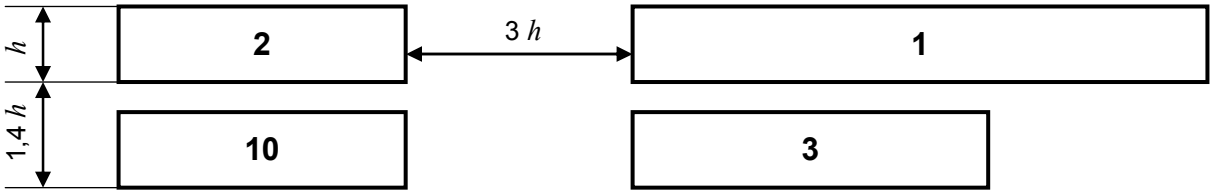
— minimum distance between two marks on the same line: 3 h;

— minimum distance between two successive lines: 1,4 h;

— first character on all lines: aligned on the left;

— any marking placed to the right of the manufacturer's identification number should be at a distance of at least 15 mm from it.

EXAMPLE



2 : Company code (Designer)
1 : Item identification number
10 : Production source's company code
3 : Serialization number

6 Coding system

6.1 Identification marking codes

Identification marking is in accordance with codes specified in Table 1.

Table 1

Code	Marking	Comments
1	Item identification number	Determined by the manufacturer and indicated in design documents, with change letter if applicable.
2	Company code (designer)	Manufacturer's or designer's company code indicated in item's design documents.
3	Serialization number	
4	Production batch number	
5	Material batch number	
6	Production source's company monogram	For small-sized items, can replace production source's company code. Manufacturer must keep the list of producer monograms up to date.
7	Curing date	For elastomer only, should be indicated as follows: year and quarter: 2Q95 or 2T95.
8	Casting number	For foundry only
9	Manufacturing date	With five characters unless otherwise indicated in design documents. Should be shown as follows: – year and week (recommended): 95W26 – or year and month: 9506.
10	Production source's company code	
11	Additional markings	Indicated in design documents.
–	Inspection marking	As this marking is systematic, it is not codified.
–	Concession marking	As this information does not appear in the design documents, it is not codified.

6.2 Standard combinations of identification marks

Standard combination is in accordance with codes specified in Table 2.

Table 2

Code	Combination	Comments
A	2 – 1 – 10 – 3 (1 line)	3 is replaced by 9 for non-serialized items
B	2 – 1 10 – 3 (2 lines)	
C	2 1 10 3 (4 lines)	
D	2 – 1 – 3 – 9 – 7	
E	2 – 1 – 9	
F	2 – 1 – 3 – 9	
G	1 – 3 – 9	
H	1 – 9	
J	2 – 1 – 9 – 7	

6.3 Indication on drawings

6.3.1 General

Codes for the marks to be made, usable marking processes, and notes if needed, are shown in a symbol (see Figure 1) placed on the drawing.

Marking processes or the process family (see Table 3) are preceded by the identification number of this standard, both separated by a dash.

The note or notes are optional and are written out in full on the drawing near the symbol or the title block and designated by one or more numbers.

MARKING Code combination
Process(es) EN4301
Note(s)

Figure 1 — Symbol

MARKING Code combination B
Process(es) EN4301-02F2
Note(s) 1 – 2

Figure 2 — Example of codified symbol

6.3.2 Meaning of codes given in example (Figure 2)

B : Marking arrangement on two lines (in accordance with combination in Table 2 and rules in 5.1).

02F2 : "Dots" marking process, depth of markings 0,03 mm to 0,10 mm (see Table 3).

6.3.3 Understanding Table 3

Examples of writing on drawing		Interpretation
EN4301-02	:	Permits each of the marking processes in the second column (02A to 02F) or each of the processes in the third column (02A1 to 02F3).
EN4301-02C	:	Permits marking processes 02C1 or 02C2.
EN4301-02B1	:	Permits the "shallow press" marking process.
EN4301-B	:	Permits each of the processes marked with an "X" in column B.
EN4301-02B1-D	:	Permits the 02B1 marking process and each of the processes marked with an "X" in column D.
EN4301-02B-DM5	:	Permits the 02B marking process with a character height of 3,20 mm, O.C.R. writing.

Table 3 — Marking method codes, class letter and depth

Method code			Compatibility	Marking method	Depth (mm)		Marking class letter														
1st tier	2nd tier	3rd tier	O.C.R.	See Clause 11.	min.	max.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
Permanent marking methods																					
01				**Integral**																	
	01A			light																	
		01A1		raised	0,13	0,25	X														
		01A2		depressed	0,13	0,25	X														
	01B			intermediate																	
		01B1		raised	0,20	0,89															
		01B2		depressed	0,20	0,89															
	01C			heavy (raised only)	0,8	3,3															
02				**Metal stamp**																	
	02A		X	Hammer																	
		02A1	X	shallow	0,03	0,15		X													
		02A2	X	deep	0,10	0,25	X		X												
	02B		X	Press																	
		02B1	X	shallow	0,03	0,15		X		X											
		02B2	X	deep	0,10	0,25	X		X		X										
	02C			Roll																	
		02C1		shallow	0,03	0,15		X		X		X	X	X							
		02C2		deep	0,10	0,25	X		X		X										
	02D			Vibro peen, manual																	
		02D1		shallow	0,03	0,15		X		X		X		X							
		02D2		deep	0,10	0,25	X		X		X										
	02E			Vibro peen, controlled																	
		02E1		shallow	Legible	0,05												X			
		02E2		deep	0,05	0,15		X	X	X		X		X							
	02F		X	Dot-peening matrix mode (5×7)																	
		02F1	X	shallow	Legible	0,05															
		02F2	X	intermediate	0,03	0,10				X		X	X								
		02F3	X	deep	0,05	0,15		X	X		X	X		X	X						

Table 3 *(continued)*

Method code			Compatibility	Marking method	Depth (mm)		Marking class letter														
1st tier	2nd tier	3rd tier	O.C.R.	See Clause 11.	min.	max.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
Permanent marking methods																					
03				**Engrave**																	
	03A			manual	0,013	0,15		X				X									
	03B			controlled																	
		03B1		shallow	0,013	0,08				X		X	X								
		03B2		deep	0,05	0,15		X	X		X	X		X	X						
07				**Electrochemical**																	
	07A			Etch																	
		07A1		shallow	Legible	0,008										X		X			
		07A2		intermediate	0,008	0,038				X		X	X	X			X				
		07A3		deep	0,03	0,08		X													
	07B			Deposit																	
				raised	Legible	0,010												X			
	07C			AC etch																	
		07C1		shallow	Legible	0,008										X		X			
		07C2		intermediate	0,008	0,038				X		X	X	X			X				
		07C3		deep	0,03	0,08		X													
	07D			AC etch – DC deposit	Legible	0,013												X			
08				**Blast**																	
	08A			shallow	Legible	0,013										X		X			
	08B			intermediate	0,008	0,03				X		X	X	X							
	08C			deep	0,03	0,08		X		X		X	X	X							
09				**Brand**	0,03	0,25															
	09A			hot press	0,03	0,25															
10				**Ceramic**																	
11				**Decalcomania**																	
13				**Band**																	
14				**Pressure sensitive label**																	

Table 3 *(concluded)*

Method code			Compatibility	Marking method	Depth (mm)		Marking class letter														
1st tier	2nd tier	3rd tier	O.C.R.	See Clause 11.	min.	max.	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
Permanent marking methods																					
15				**Laser**																	
	15A		X	Dot matrix mode (5×7)																	
		15A1	X	shallow	0,003	0,008															
		15A2	X	intermediate	0,010	0,03															
		15A3	X	deep	0,03	0,08															
	15B			Engrave mode																	
		15B1		shallow	0,003	0,015															
		15B2		intermediate	0,018	0,10															
		15B3		deep	0,10	0,25															
16				**Plastic laminate**																	
29				**Any temporary method**																	
30				**Ink**																	
31				**Dye**																	
32				**Paint**																	
	32A			silk-screen																	
33				**Chalk**																	
34				**Crayon**																	
35				**Tag**																	
	35A			non-metallic tag and string															X		
	35B			non-metallic tag and wire															X		
	35C			metallic tag and wire																X	
	35D			bag item and tag															X	X	
36				**Band or tape**																	
	36A			non-metallic															X		
	36B			metallic																X	
37				**Package**																	
50				**Non imposed process**																	

7 Character height

Character height is expressed in millimetres and is chosen from the range of preferred numbers:

0,8 – 1 – 1,25 – 1,6 – 2 – 2,5 – 3,15 – 4 – 5 – 6,3 – 8 – 10 – 12,5 – 16

It is recommended to use the greatest character height possible with respect to the space available.

8 Writing

The shape and relative position of the letters and numbers of a word are described in ISO 3098-2, type B character writing (straight capital).

Special characters such as O.C.R. characters may be used for purposes of automatic identification and recording.

Whenever possible, ISO characters should be replaced by 5×7 dot matrix characters as defined in Annex B.

9 Depth of marks

The depth of marks must be in accordance with the code(s) corresponding to the marking processes specified by the drawings (see Table 3).

10 General marking conditions

10.1 Introduction

Applicable unless otherwise stated in the design documents.

10.2 Process quality

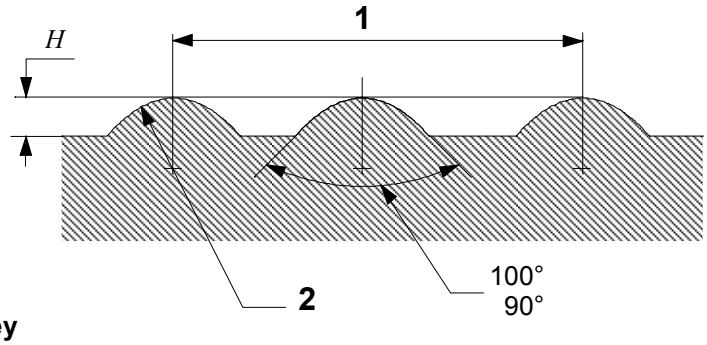
The marking processes used for making additional marks (inspection…) should be no more harmful to the items than those specified by the drawings for identification markings.

The marking products used (ink, label adhesive, wire, …) should remain neutral with respect to the item material, especially due to their halogen content with respect to titanium and titanium alloys.

Carbon and sulfide deposits are not allowed on metallic materials.

10.3 Marking quality

No burrs should remain after marking. The height and radius of the relief (beads) resulting from the tool used during the marking operation (Figure 3) must not have values exceeding those in Table 4.



Key

1 Character height

2 Radius

Figure 3

Table 4

Dimensions in millimetres

Character height	Radius	*H*
0,8	0,1	0,1
1,0	0,15	0,12
1,5	0,2	0,15
2,0	0,3	0,2
2,5	0,35	0,25
3,0	0,4	0,3
4,0	0,5	0,4

When a marking is to be removed, it is crossed through neatly with a solid line.

All markings must be legible, without enlargement, regardless of the marking process used.

The colour of the markings produced by depositing material must contrast with the color of the surface.

10.4 Surface treatment

Marking is carried out prior to any surface treatment.

Marking done on a protected surface implies restoring of the protection.

10.5 Cast/forged parts

The item identification number and the production source monogram or manufacturer's company code must not remain on the item ready for assembly, unless otherwise indicated in the design documents.

10.6 Temporary production mark

Temporary production marks must not remain on the item ready for assembly. They are made under the responsibility of the production department. The items are to be identified by process 50.

10.7 Re-marking

To avoid re-marking, location is preferably determined outside a machined area.

10.8 Final inspection mark

The final inspection mark should be placed on the finished item, in accordance with instructions from Quality, by means of a temporary process (ink, for example), following the identification marks.

For items carrying an identification plate, the final inspection mark is placed in the location provided on the plate.

For items having a small surface and/or those produced in large quantity, the inspection mark can be placed on an adjoining surface, by batch.

11 Marking methods

11.1 Permanent markings

11.1.1 Depressed or raised integral marking: characters are produced by casting, forging or moulding into or onto the item.

11.1.2 Metal stamp: characters are produced by forcible displacement of material.

11.1.2.1 Hammer: characters are produced individually or in groups by impact force applied mechanically or by hand.

11.1.2.2 Press: characters are produced individually or in groups with a controlled force applied without impact.

11.1.2.3 Roll: characters are produced by a rotating motion of either the item or the tool, or both, when in contact with each other under a controlled force.

11.1.2.4 Vibro peen, manual: characters are produced by a hand guided rapidly vibrating tool having a tip marking indentations on the item.

Tool characteristics: 60° profile and a radius of 0,35 mm to 0,6 mm to avoid incipient cracks.

11.1.2.5 Vibro peen, controlled: characters are produced by a mechanically guided rapidly vibrating tool having a tip. Multiple tipped tools may produce one or more complete characters simultaneously.

Tool characteristics: 60° profile and a radius of 0,35 mm to 0,6 mm to avoid incipient cracks.

11.1.2.6 Dot-peening matrix mode ((5×7) (number of dots – width × height)): characters are produced by a series of indentations or dots wherewith the spacing between dots and characters are controlled by a microprocessor (see Annex B):

— dots should not overlap;

— characteristics required for tool head to avoid incipient cracks:
  — tips rounded by a radius of 0,3 mm min,
  — scribe-angle of working section 90° to 120°, end rounded (0,35 mm $\leq R \leq$ 0,6 mm).

11.1.3 Engrave: characters are produced by a rotating cutter or grinder.

11.1.3.1 manual: characters are produced by a hand guided rotating cutter or grinder.

11.1.3.2 controlled: characters are produced by a mechanically guided rotating cutter or grinder.

11.1.4 Electrochemical process: characters are produced by use of a controlled pH electrolytic solution to facilitate electrolysis which is confined to the area of the characters by a stencil. After marking, the electrolyte shall be neutralized and corrosion preventative treatment applied.

11.1.4.1 Electrochemical etch: characters are produced by removing material with an electrolytic process. Characters shall be dark or of a sufficient contrast to assure good visibility.

11.1.4.2 Electrochemical deposit: characters are produced by adding material with an electrolytic process employing DC reverse polarity. Deposit marking does not have the durability or permanency of etch or other material removal or displacement methods, and should not be specified where the loss of identification under normal service condition is objectionable.

11.1.4.3 AC etch: characters are produced by removing material with an electrolytic process employing AC. When authorized, material may be removed by the use of DC straight polarity with the part positive electric charged.

11.1.4.4 AC etch – DC deposit: characters are produced by removing material by the AC etch method followed by the addition of material by applying DC reverse polarity.

11.1.5 Blast: characters are produced by the impingement of an abrasive substance confined to the area of the characters by a stencil.

11.1.6 Brand: characters are produced by burning or displacing material with a heated tool.

11.1.6.1 Hot press: characters are produced by controlled impression of coloured foil with a heated die.

11.1.7 Ceramic: characters are produced by a contrasting ceramic coating applied by any means prior to the initial firing.

11.1.8 Decalcomania: a pigmented film bearing the required identification applied by transfer from a suitable backing to the item. When dried, it is recommended that the film be coated with a clear lacquer. The marking shall be legible after the coating.

11.1.9 Band: a band bearing the required identification marking is permanently attached to the item.

11.1.10 Pressure sensitive label: an environment resisting label bearing the required identification, backed with pressure sensitive adhesive, is applied to the item.

11.1.11 Laser: characters are produced by displacing material with a laser beam. Depth is controlled by varying the pulse rate of the beam, the speed of advance, the focus and the power.

11.1.11.1 Dot matrix mode 5×7 (number of dots – width × height): characters are formed by a series of dot-like depressions in the material (see Annex B).

11.1.11.2 Engrave mode: characters are formed by a continuous depression in the material.

11.1.12 Plastic laminate: on laid-up plastic parts, the identification marking may be applied with ink or paint and then covered by a layer of the same resin used in the underlying laminate. Alternatively, the identification may be marked on a separate piece of fabric or paper which is bonded to the substrate with resin and then covered with resin. The ink or paint and the fabric or paper shall withstand the cure cycle, if applicable. The ink or paint and the resin shall have good adhesion to the composite substrate, shall be compatible with each other, shall withstand the cure cycle if applicable and be compatible with the service environment of the part. The marking shall be legible through the cured resin.

11.2 Temporary markings

11.2.1 Ink: characters are produced by applying an ink by any means which does not damage the surface. When a final marking is applied to a painted surface by ink stamping, it is recommended that a coating of clear lacquer be applied over the marking.

11.2.2 Dye: characters are produced by applying a dye by any means which does not damage the surface. It is recommended that a coating of clear lacquer be applied over the marking.

11.2.3 Paint: characters are produced by painting, with or without a stencil. It is recommended that a coating of clear lacquer be applied over the marking.

11.2.3.1 Silk-screen: characters are produced by forcing paint through a fabric stencil. It is recommended that a coating of clear lacquer be applied over the marking. This process is considered as "permanent" for materials in rubber.

11.2.4 Chalk: characters are produced by marking with chalk.

11.2.5 Crayon: characters are produced by marking with a wax crayon.

11.2.6 Tag: a tag bearing the required identification marking is attached to the item, or to a bag containing the item. The means of attachment and location shall be such that no damage shall be done to the item.

11.2.7 Band or tape: a band or tape bearing the required identification marking is temporarily attached to the item.

11.2.8 Package marking: the package bears the identification markings of the item(s) which is too small or otherwise impractical to be marked.

Annex A
(normative)

Optical Character Recognition (O.C.R.)

General requirements

In order to allow automatic character recognition, the following requirements in thick characters are required:

— straight writing;

— compliance with a minimum margin all around the mark (see Annex C);

— compliance with locations specified by the drawing;

— compliance with the writing direction specified by the drawing;

— compliance with the tool profile (see 11.1.2.4 to 11.1.2.6);

— masking of identification marks, if area is shot-peened, sand blasted, etc.;

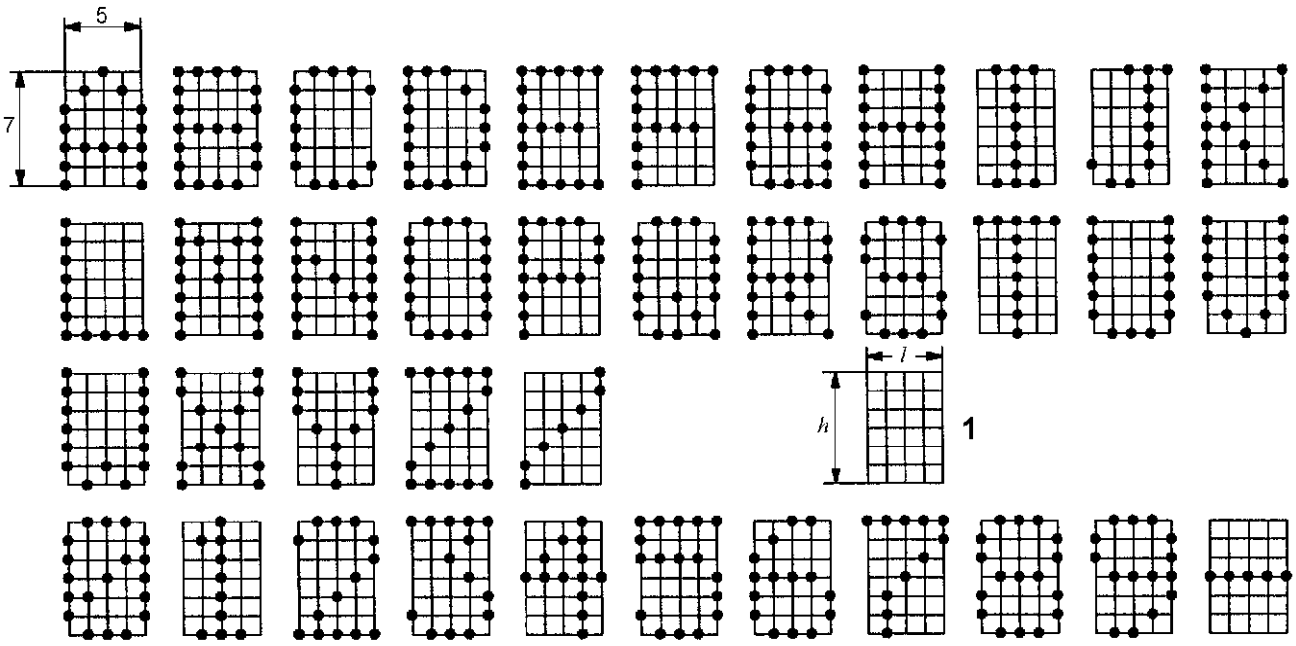
— compliance with the marking arrangement specified by the drawing;

— compliance with the fonts specified by the drawing.

Annex B
(normative)

Character shapes and optical character recognition requirements (O.C.R.) for 5×7 dot matrix method

See Figure B.1 and Table B.1.



Key

1 Spacing character

Figure B.1

Table B.1

Dimensions in millimetres

O.C.R. method	Character height h [a]	Character width l [b]	Character spacing [c]	Character maximum inclination $\alpha°$ [d]	Maximum deviation from alignment $\Delta 1$ [d]	Minimum line separation $\Delta 2$ [d]
DM1	1,19 ± 0,10	0,80 ± 0,10	1,19 ± 0,10	< 3°	0,20	0,60
DM2	1,50 ± 0,12	1,0 ± 0,12	1,50 ± 0,12		0,25	0,75
DM3	2,11 ± 0,17	1,41 ± 0,17	2,11 ± 0,17		0,35	1,05
DM4	2,39 ± 0,19	1,59 ± 0,19	2,39 ± 0,19		0,40	1,19
DM5	3,20 ± 0,26	2,13 ± 0,26	3,20 ± 0,26		0,53	1,60
DM6	3,81 ± 0,30	2,54 ± 0,30	3,81 ± 0,30		0,64	1,91

[a] The character height h is measured between the centers of the extreme top and bottom dots, except for the dash and space character.

[b] The character width l is measured between the centers of the extreme left and right dots, except for the digit "1" and the space character.

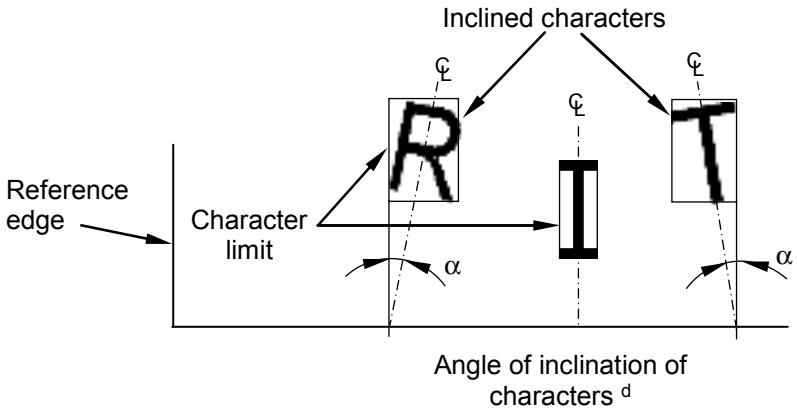
[c] See Annex C. The character spacing is the horizontal distance between the vertical axes of two adjacent characters.

[d] See Annex C. For the terms and definitions regarding the character presentation requirements, see Annex C. However, the angle of inclination is measured with respect to the average alignment of character bottoms for a complete line, rather than with respect to a document reference edge.

Annex C
(normative)

O.C.R. characters – Common characteristics

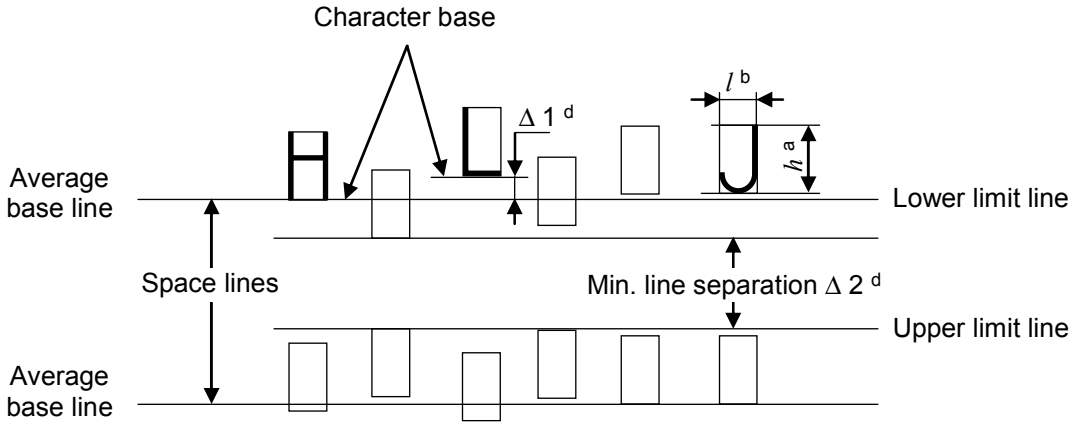
See Figures C.1, C.2 and C.3.



Key

d See Annex B, Table B.1.

Figure C.1 — Character limit and inclination



Key

a, b, d See Annex B, Table B.1.

Figure C.2 — Space and definition lines

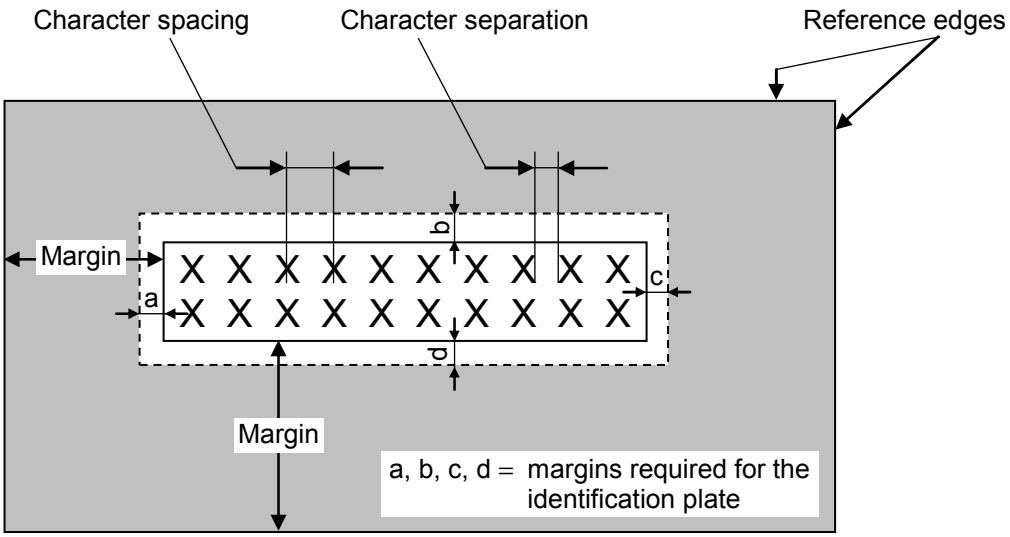


Figure C.3 — Margin — Character separation and spacing

IMPORTANT — The minimum margin required corresponds to 1,5 character separation.

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