

Universal Multiple-Octet Coded Character Set
International Organization for Standardization
Organisation Internationale de Normalisation
Международная организация по стандартизации

Doc Type: Working Group Document

Title: Proposal to encode Duodecimal Digit Forms in the UCS

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Status: Individual Contribution

Action: For consideration by JTC1/SC2/WG2 and UTC

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1. Introduction

The duodecimal system (also called dozenal) is a positional numbering system using 12 as its base, similar to the well-known decimal (base 10) and hexadecimal (base 16) systems. Thus, it needs 12 digits, instead of ten digits like the decimal system.

It is used by teachers to explain the decimal system by comparing it to an alternative, by hobbyists (see e.g. fig. 1), and by propagators who claim it being superior to the decimal system (mostly because thirds can be expressed by a finite number of digits in a "duodecimal point" presentation).

- Besides mathematical and hobbyist publications, the duodecimal system has appeared as subject in the press (see e.g. [Bellos 2012] in the English newspaper "The Guardian" from 2012-12-12, where the lack of types to represent these digits correctly is explicitly stated). Such examples emphasize the need of the encoding of the digit forms proposed here.

While it is common practice to represent the extra six digits needed for the hexadecimal system by the uppercase Latin capital letters A,B,C,D,E,F, there is no such established convention regarding the duodecimal system. Some proponents use the Latin letters T and E as the first letters of the English names of "ten" and "eleven" (which obviously is directly perceivable only for English speakers). Only recently, the Latin letters A and B are found in analogy to the hexadecimal digits.

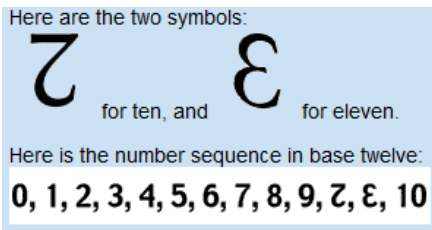
Most proponents, however, have invented special forms for the extra two digits which are needed beyond the ten decimal digits (see [deVlieger 2010], table 1 on p.24).

It is, of course, not the task of the Unicode committee to standardize the forms of duodecimal digits as such. On the contrary, people who want to write duodecimal digits are to be supplied with the characters they need to write duodecimal numbers, without being forced to decide for a special convention. While people wanting to use T/E or A/B are served by the existing Latin capital letters, as it was decided for the hexadecimal numbers, the common digit forms which do not exactly resemble an encoded character are proposed here.

It is emphasized that digit *forms* are proposed here, rather than digits as a semantic concept. Thus, it is possible to encode more than one form for each of the digit values (as it already is the case, as the Latin letters used by some are already encoded), instead of deciding for one of the existing symbols as representative glyph for a single digit per value.

1.1 The digit forms propagated by the *Dozenal Society of Great Britain*

The *Dozenal Society of Great Britain* is an organization propagating duodecimal numbers in the UK since 1959 (see [Dozenal-GB 2013]) and has published several works using duodecimal numbers since that time. They use forms which simply are a "turned two" for the value ten, and a "turned three" for the value eleven (see [Dozenal-GB2 2013]):



These forms are included in common LaTeX distributions (see [Pakin 2009]):

```
ε \textturnthree
ζ \textturntwo
```

As seen on this excerpt from the LaTeX documentation, the digit form for eleven is sometimes made a little bit more distinctive by making the lower bow considerably smaller than the upper bow, resembling a turned three from a font where the x-height is considerably larger than half cap height.

These digit forms are proposed as:

DIGIT FORM TURNED TWO
DIGIT FORM TURNED THREE

1.2 The digit forms propagated by the *Dozenal Society of America*

The *Dozenal Society of America* is an organization propagating duodecimal numbers in the US since 1944 and has published several works using duodecimal numbers since that time. They use forms introduced in 1932 by William Addison Dwiggins (1880–1956; see [Dozenal-US 2013]):

0 1 2 3 4 5 6 7 8 9 χ ε

The digit ten is possibly a modification of the Roman numeral ten, resembling a raised Greek small chi.

The digit eleven is a modification of a turned three, resembling a turned 3 (0187 U+0187 LATIN CAPITAL LETTER EZH). This form is far more distinctive as the turned three itself, which also resembles a mirrored three and therefore is confusable too easy with a three to the untrained eye.

It is possible that Dwiggins knew the Pitman form from 1860 (see below).

These digit forms are proposed as:

DIGIT FORM RAISED CHI
DIGIT FORM TURNED EZH

If it were proposed to encode duodecimal digits as a semantic concept, the latter digit form could be considered as a glyph variant of the turned 3. However, as here the characters are proposed as number *forms*, to be used as duodecimal digits or whatever the user wants to, the clearly different form is proposed as a different character. This enables e.g. to discuss the different digit sets of the *Dozenal Society of Great Britain* and the *Dozenal Society of America* in the same text.

1.3 The digit forms propagated by Isaac Pitman in the 1860s

Sir Isaac Pitman (1813–1897, known as the inventor of Pitman Shorthand) propagated and used the duodecimal system together with his English Phonotypic Alphabet (an extension of the Latin alphabet adapted to the phonology of the English language) in his publications for some years around 1860 ([Pitman 1860], fig. 3). He described the digits in [Pitman 1860] (p. 8) as follows:

de n̄mber *twelv* and its m̄ltipelz. Æe seinz “*Ʒ*,
Ʒ” reпреzent de n̄mberz *ten* and *eleven*, and “*10*”
reпреzents w̄sn d̄ezen; “*16*,” w̄sn d̄ezen and

... The signs “*Ʒ, Ʒ*” represent the numbers *ten* and *eleven*, and “*10*” represents *one dozen*; ...

As digit form for the value ten, he used a turned two, as the *Dozenal Society of Great Britain* did later.

As digit form for the value eleven, however, he used the same modified form as the *Dozenal Society of America* did later. The example in fig. 3 shows a true digit three (with common round forming) besides the digit eleven, proving that the modified form of the latter was introduced deliberately.

It is noted that the open E “*Ʒ*” (including its capital form) is a common letter in EPA, and thus the duodecimal digit eleven had to have a shape clearly distinguishable from the open E. This was an additional reason to create the more distinctive turned-ezh-shaped form.

2. Proposed characters

Block: Number Forms

Digit forms for duodecimal notation

Ʒ	U+218A	DIGIT FORM TURNED TWO · used as duodecimal digit ten by some user groups
Ʒ	U+218B	DIGIT FORM TURNED THREE → 0190 latin capital letter open e → A72A latin capital letter tresillo · used as duodecimal digit eleven by some user groups
χ	U+218C	DIGIT FORM RAISED CHI → 03C7 greek small letter chi · used as duodecimal digit ten by some user groups
Σ	U+218D	DIGIT FORM TURNED EZH → 0187 latin capital letter ezh · used as duodecimal digit eleven by some user groups

2.1 Properties for the proposed characters

218A;DIGIT FORM TURNED TWO;No;0;ON;;;10;N;;;;;
218B;DIGIT FORM TURNED THREE;No;0;ON;;;11;N;;;;;
218C;DIGIT FORM RAISED CHI ;No;0;ON;;;10;N;;;;;
218D;DIGIT FORM TURNED EZH;No;0;ON;;;11;N;;;;;

2.2 Confusability issues

The DIGIT FORM TURNED THREE is similar to U+0190 LATIN CAPITAL LETTER OPEN E and U+A72A LATIN CAPITAL LETTER TRESILLO.

3. References

- [Bellos 2012] Alex Bellos: Dozenalists of the world unite! – Column "Alex' Adventures in Numberland", The Guardian, issue 2012-12-12, online at:
<http://www.guardian.co.uk/science/alexs-adventures-in-numberland/2012/dec/12/dozenalists-world-unite-tyranny-ten>
- [deVlieger 2010] Michael deVlieger: The DozensOnline Forum Symbols Debate
http://www.dozenal.org/drupal/sites/default/files/db4b120_0.pdf (2010)
- [Dozenal-GB 2013] Website of *The Dozenal Society of Great Britain (DSGB)*
<http://www.dozenalsociety.org.uk/> (retrieved 2013-03-29)
- [Dozenal-GB2 2013] The Dozenal Society of Great Britain: *How Base Twelve works*
<http://www.dozenalsociety.org.uk/basicstuff/basics.html> (retrieved 2013-03-29)
- [Dozenal-US 2013] Website of *The Dozenal Society of America*
<http://www.dozenal.org/drupal/> (retrieved 2013-03-29)
- [Pakin 2009] Scott Pakin: The Comprehensive LATEX Symbol List.
<http://www.tex.ac.uk/tex-archive/info/symbols/comprehensive/symbols-a4.pdf> (2009-11-09)
- [Pitman 1860] A triple (twelve gross) Gems of Wisdom (ed. Isaac Pitman); London 1860

4. Examples and figures

Fig. 1: Logo of a hobbyist website, using duodecimal digits in the logo design:
<http://z13.invisionfree.com/DozensOnline/index.php?act=site> , retrieved 2013-03-29).

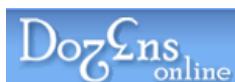


Fig. 2: A clock with duodecimal digits, displayed on [Dozenal-GB 2013]. The lower bow of the turned three is smaller than the upper bow.



Fig. 3: Excerpt from [Pitman 1860], p.40.

The marked duodecimal number "1ε3" (decimal 279) shows clearly that the shape of the duodecimal digit eleven, as it differs from a pure turned three, is intentional, as the following digit (an "ordinary" unturned digit three) is not ezh-shaped.

ov de Lord.
→ 1ε3. Wi kanot ge heier in nderstanding dan wi ar in
biij.
1ε4. De trejurz ov de dip ar not se preçrs

**ISO/IEC JTC 1/SC 2/WG 2
PROPOSAL SUMMARY FORM TO ACCOMPANY SUBMISSIONS
FOR ADDITIONS TO THE REPERTOIRE OF ISO/IEC 10646¹**

Please fill all the sections A, B and C below.

Please read Principles and Procedures Document (P & P) from <http://www.dkuug.dk/JTC1/SC2/WG2/docs/principles.html> for guidelines and details before filling this form.

Please ensure you are using the latest Form from <http://www.dkuug.dk/JTC1/SC2/WG2/docs/summaryform.html>.

See also <http://www.dkuug.dk/JTC1/SC2/WG2/docs/roadmaps.html> for latest Roadmaps.

A. Administrative

1. Title:	<i>Proposal to encode Duodecimal Digit Forms in the UCS</i>
2. Requester's name:	<i>Karl Pentzlin</i>
3. Requester type (Member body/Liaison/Individual contribution):	<i>Individual contribution</i>
4. Submission date:	<i>2013-03-30</i>
5. Requester's reference (if applicable):	
6. Choose one of the following:	
This is a complete proposal:	<input checked="" type="checkbox"/> <i>Yes</i>
(or) More information will be provided later:	<input type="checkbox"/>

B. Technical – General

1. Choose one of the following:	
a. This proposal is for a new script (set of characters):	<input type="checkbox"/> <i>No</i>
Proposed name of script:	
b. The proposal is for addition of character(s) to an existing block:	<input checked="" type="checkbox"/> <i>Yes</i>
Name of the existing block:	<i>Number Forms</i>
2. Number of characters in proposal:	<input checked="" type="checkbox"/> <i>4</i>
3. Proposed category (select one from below - see section 2.2 of P&P document):	
A-Contemporary <input type="checkbox"/> B.1-Specialized (small collection) <input checked="" type="checkbox"/> B.2-Specialized (large collection) <input type="checkbox"/>	
C-Major extinct <input type="checkbox"/> D-Attested extinct <input type="checkbox"/> E-Minor extinct <input type="checkbox"/>	
F-Archaic Hieroglyphic or Ideographic <input type="checkbox"/> G-Obscure or questionable usage symbols <input type="checkbox"/>	
4. Is a repertoire including character names provided?	<input checked="" type="checkbox"/> <i>Yes</i>
a. If YES, are the names in accordance with the "character naming guidelines" in Annex L of P&P document?	<input checked="" type="checkbox"/> <i>Yes</i>
b. Are the character shapes attached in a legible form suitable for review?	<input checked="" type="checkbox"/> <i>Yes</i>
5. Fonts related:	
a. Who will provide the appropriate computerized font to the Project Editor of 10646 for publishing the standard?	<i>The author, on request</i>
b. Identify the party granting a license for use of the font by the editors (include address, e-mail, ftp-site, etc.):	<i>The author, on request</i>
6. References:	
a. Are references (to other character sets, dictionaries, descriptive texts etc.) provided?	<input checked="" type="checkbox"/> <i>Yes</i>
b. Are published examples of use (such as samples from newspapers, magazines, or other sources) of proposed characters attached?	<input checked="" type="checkbox"/> <i>Yes</i>
7. Special encoding issues:	
Does the proposal address other aspects of character data processing (if applicable) such as input, presentation, sorting, searching, indexing, transliteration etc. (if yes please enclose information)?	<input type="checkbox"/> <i>No</i>

8. Additional Information:

Submitters are invited to provide any additional information about Properties of the proposed Character(s) or Script that will assist in correct understanding of and correct linguistic processing of the proposed character(s) or script. Examples of such properties are: Casing information, Numeric information, Currency information, Display behaviour information such as line breaks, widths etc., Combining behaviour, Spacing behaviour, Directional behaviour, Default Collation behaviour, relevance in Mark Up contexts, Compatibility equivalence and other Unicode normalization related information. See the Unicode standard at <http://www.unicode.org> for such information on other scripts. Also see <http://www.unicode.org/Public/UNIDATA/UCD.html> and associated Unicode Technical Reports for information needed for consideration by the Unicode Technical Committee for inclusion in the Unicode Standard.

¹ Form number: N3702-F (Original 1994-10-14; Revised 1995-01, 1995-04, 1996-04, 1996-08, 1999-03, 2001-05, 2001-09, 2003-11, 2005-01, 2005-09, 2005-10, 2007-03, 2008-05, 2009-11)

C. Technical - Justification

1. Has this proposal for addition of character(s) been submitted before? If YES explain	No
2. Has contact been made to members of the user community (for example: National Body, user groups of the script or characters, other experts, etc.)? If YES, with whom? If YES, available relevant documents:	n/a <i>There is no confined user community, thus the author himself is a member of it</i>
3. Information on the user community for the proposed characters (for example: size, demographics, information technology use, or publishing use) is included? Reference:	Yes <i>Anybody interested in mathematics</i>
4. The context of use for the proposed characters (type of use; common or rare) Reference:	see text
5. Are the proposed characters in current use by the user community? If YES, where? Reference:	Yes <i>see text</i>
6. After giving due considerations to the principles in the P&P document must the proposed characters be entirely in the BMP? If YES, is a rationale provided? If YES, reference:	Yes <i>To keep them in line with related characters</i>
7. Should the proposed characters be kept together in a contiguous range (rather than being scattered)?	Yes
8. Can any of the proposed characters be considered a presentation form of an existing character or character sequence? If YES, is a rationale for its inclusion provided? If YES, reference:	No
9. Can any of the proposed characters be encoded using a composed character sequence of either existing characters or other proposed characters? If YES, is a rationale for its inclusion provided? If YES, reference:	No
10. Can any of the proposed character(s) be considered to be similar (in appearance or function) to an existing character? If YES, is a rationale for its inclusion provided? If YES, reference:	No
11. Does the proposal include use of combining characters and/or use of composite sequences? If YES, is a rationale for such use provided? If YES, reference: Is a list of composite sequences and their corresponding glyph images (graphic symbols) provided? If YES, reference:	No
12. Does the proposal contain characters with any special properties such as control function or similar semantics? If YES, describe in detail (include attachment if necessary)	No
13. Does the proposal contain any Ideographic compatibility character(s)? If YES, is the equivalent corresponding unified ideographic character(s) identified? If YES, reference:	No