Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646

Anshuman Pandey  
Department of History  
University of Michigan  
Ann Arbor, Michigan, U.S.A.  
pandey@umich.edu

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1 Introduction

This is a proposal to encode the Zanabazar Square script in the Unicode standard / Universal Character Set (ISO/IEC 10646). It supersedes the following documents:

- N3956 L2/10-411 “Preliminary Proposal to Encode the Xawttaa Dorboljin Script in ISO/IEC 10646”
- N4041 L2/11-162 “Preliminary Proposal to Encode the Mongolian Square Script in ISO/IEC 10646”
- N4160 L2/11-379 “Revised Preliminary Proposal to Encode the Mongolian Square Script”
- N4413 L2/13-068 “Proposal to Encode the Mongolian Square Script in ISO/IEC 10646”
- N4471 L2/13-198 “Revised Proposal to Encode the Mongolian Square Script in ISO/IEC 10646”
- N4541 L2/14-024 “Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646”

The ‘Zanabazar Square’ script was referred to as ‘Mongolian Square’ in previous proposals. The name change is described in section 3.1. Other changes introduced after N4471 L2/13-198 include: the replacement of the generic ‘subjoiner’ for controlling conjunct stacks with a virama character (see sections 4.8 and 4.10); new names for several characters (see section 3.3); new head marks and ornaments (see section 4.11); the reordering of characters within the block; and the reallocation of the script block to a new range within the Supplementary Multilingual Plane (SMP). These changes are based upon feedback from experts and attempts to align the encoding model with that of other Brahmi-based scripts.

This revision of L2/14-024 contains editorial and informative changes suggested during a meeting with Mongolian experts in Tokyo, October 15–16, 2015. No substantive changes to the approved proposal or encoding are reflected in this revision. Such changes are described in L2/15-246.

2 Background

The Zanabazar Square Script is a syllabic alphabet based upon Tibetan and inspired by the Brahmi model. It was used for writing Mongolian, Sanskrit, and Tibetan. The script was invented by Zanabazar (1635–1723), one of the most important Buddhist leaders in Mongolia, who also developed the Soyombo script. The precise date is unknown, but it is believed that its creation preceded that of Soyombo. The Zanabazar
Square script bears similarities to Tibetan and Phags-pa (see tables 8–10). It is actively studied by scholars and academic works on the script continue to be published (see Shagdarsüürüng (2001); Ragchaa (2005); Bareja-Starzyńska and Ragchaa (2012)).

3 Proposal Details

3.1 Script name

The name for the script block is ‘Zanabazar Square’. It is known in Mongolian as ‘Хэвтээ Дөрвөлжин бичиг’ xewtee dörböljin bicig or ‘Хэвтээ Дөрвөлжин Усэг’ xewtee dörböljin üseg, both of which translate into English as “Horizontal Square Script”, but this is a technical name and is not commonly used. The name normalized Latin transliteration ‘Xewtee Dorboljin’ was used for the script in the preliminary proposal, but it was deemed too localized for usage in an international context. Therefore, the descriptor ‘Mongolian’ was added to the English translation to produce ‘Mongolian Horizontal Square’. However, this name proved a bit long and it was curtailed to ‘Mongolian Square’. Yet, ‘Mongolian Square’ is a generic name as it can also refer to Phags-pa, another Mongolian, or rather Central Asian, script that is also known as ‘Дөрвөлжин Усэг’ dörböljin üseg, or ‘Square Script’.

The script is commonly refered to as ‘Занабазарын Дөрвөлжин Усэг’ zanabazarin dörböljin üseg “Zanabazar Square Script” in the academic community (see Byambaa Ragchaagiin 2005). This name is used because it differentiates the two Central Asian ‘square’ scripts on the basis of the names of their inventors: ‘Phags-pa’ for the vertical and ‘Zanabazar’ for the horizontal script. For these reasons, ‘Zanabazar Square’ is a suitable and unique identifier for the script block in the UCS. The Mongolian and alternate English names have been added as aliases for the script in the names list.

3.2 Character repertoire

The Zanabazar Square block contains 69 characters. A code chart and names list are attached. The proposed repertoire contains elements that are not enumerated as separate characters in traditional arrangements of Zanabazar Square and in secondary sources. In some cases, the repertoire treats textual elements as sequences of characters instead of as atomic characters. For example, vowels such as 𑨀ā, 𑨋i, 𑨀ī, etc. are enumerated as independent characters in traditional charts, but they are to be represented in encoded text as combinations of a base letter and combining vowel sign. Mongolian syllable-final consonants such as 𑨀ag, 𑨀ə ang, etc. are also treated similarly. Redundant elements have been eliminated, such as the occurrence of 𑨀ā among both the vowels and codas, as well as the two instances of 𑨀 ha / va. These details are explained in section 4.7.1. The deviation from traditional perspectives regarding Zanabazar Square, or any other script, is a necessity for developing a character-encoding standard for the script in the UCS.

3.3 Character names

An attempt has been made to align names for Zanabazar Square characters with those in the Tibetan block. The names also correspond to characters of the Phags-pa block and those of the proposed encoding for Soyombo (see N4414 L2/13-069). The names also align with transliterated values given for Zanabazar Square characters in secondary sources, such as Tseveliin Shagdarsüürüng (2001) and Byambaa Ragchaagiin (2005), which have been normalized according to UCS naming conventions. In this proposal, names for proposed characters are given in small capitals and transliterated values in italics, eg. the character 𑨀 is referred to as ka and its transliterated values as Sanskrit / Tibetan ka and Mongolian ga (see section 4.7.3 for language-specific transliteration).
In previous versions of this proposal the names for consonant letters were based upon Mongolian sound values as given in the available secondary sources. However, the majority of these sources are Mongolian texts, which provide an analysis of the script from a Mongolian perspective. While this perspective is certainly valid, it does not provide distinctive values for all characters. For instance, in Mongolian sources  readdir is transliterated as 'ga' and is used for writing Mongolian g and 'γ', as well as Sanskrit and Tibetan 'ka'; however, readdir is also named 'ga', but this letter is used only in Sanskrit and Tibetan contexts. In order to accommodate this perspective, in previous versions of the proposal, letters used specifically for Tibetan and Sanskrit were distinguished using the descriptor 'galig' (Mongolian: гали), a term applied to letters used for the transcription of non-Mongolian sounds. As a result, readdir and readdir were named 'ga' and 'galig ga', respectively. However, as the Zanabazar Square script is based upon the Tibetan script and is intended for representing Mongolian as well as Sanskrit and Tibetan, the Mongolian analysis is somewhat limiting. Based upon feedback from experts such as Agata Bareja-Starzyńska and Andrew West, the names for Zanabazar Square consonants are now aligned with those of Tibetan. This approach removes the need to use the descriptor ‘galig’ and provides consonant letters with distinctive names that index their values according to the Tibetan model.

3.4 Representative glyphs

The representative glyphs for Zanabazar Square are illustrative. Although they resemble forms found in various sources, they are intended as serving as the standard or normative form. Users may design fonts in accordance with their preferred styles.

The Zanabazar Square font used here is based upon the font developed by Oliver Corff in November 2001 for the “Xäwtää Dörböljin for LATEX” package. The proposal author has made several modifications to Corff’s original font and has introduced several new glyphs.

3.5 Encoding order

The encoding order follows the pattern of the Tibetan block in the UCS. This order differs from that given in previous versions of the proposal, which was based upon the traditional Mongolian arrangement of the script. The Tibetan order is preferred because, as the script is modeled upon Tibetan, it offers a more natural order for the letters. In the Mongolian ordering system, ‘galig’ letters representing voiced and aspirated consonants were separated from their unvoiced and unaspirated counterparts. The new order provides for contiguous placement of related characters. Moreover, there are four letters ( readdir, readdir, readdir, readdir) that are not found in traditional charts of the script, so it is unclear where they should be placed in an encoding order based upon the traditional arrangement. The Tibetan order provides a method of accommodating these characters. Moreover, basing the encoding order of Zanabazar Square with that of Tibetan in the UCS will facilitate aligned encodings for these related scripts.

4 Script Details

4.1 Structure

The Zanabazar Square script is written from left to right. As indicated by its Mongolian name, xewtee dörböljin biceg, the script is written horizontally, but in some instances occurs in vertical environments.

Independent vowels are written using a vowel-carrier letter to which vowel signs are attached. Vowel length is indicated by a sign that is attached to a base letter or to a combination of a base letter and one or more dependent vowel signs.
Consonant letters possess the inherent vowel $a$. The phonetic value of a consonant letter is changed by the attachment of a vowel sign. In Mongolian contexts, the inherent vowel is suppressed by a final-consonant mark, which indicates both a syllable-final consonant and a syllabic boundary. In Sanskrit and Tibetan contexts, the inherent vowel of a consonant is silenced using the virama. There are no consonant clusters in Mongolian, but those of Sanskrit and Tibetan are rendered as conjuncts. Similar to other scripts in the UCS that are based upon the Brahmi model, a sequence of bare consonants marked by virama forms a cluster, which is represented as a conjunct and rendered as a vertical stack with non-initial letters placed beneath the initial letter. The consonants $ya, ra, la, va$ have different representations when they occur in Sanskrit and Tibetan conjuncts, therefore, contextual forms of these letters are provided as separate characters in order to facilitate the encoding model.

4.2 Orthographic syllables

The structure of an orthographic syllable in Zanabazar Square is dependent upon the language being represented. Shown below are the structures for Mongolian, Tibetan, and Sanskrit. The notation uses the following abbreviations: $V =$ vowel, $C =$ consonant, $M =$ mark, $P =$ punctuation.

The structures of vowel syllables are:

Mongolian: \[ V_{\text{carrier}} [V_{\text{sign}}] [M_{\text{length}}] [C \ M_{\text{final}}] \]

Tibetan: \[ V_{\text{carrier}} [V_{\text{sign}}] [M_{\text{length}}] [C \ M_{\text{final}}] \]

Sanskrit: \[ V_{\text{carrier}} [V_{\text{sign}}] [M_{\text{length}}] [M_{\text{anusvara}} \ | \ M_{\text{candrabindu}}] [M_{\text{visarga}}] \]

The structures of consonant syllables are:

Mongolian: \[ C [V_{\text{sign}}] [M_{\text{length}}] [C \ M_{\text{final}}] \]

Tibetan: \[ [C_{\text{cluster-initial}}] C [C^*] [C_{\text{cluster-final}}] [V_{\text{sign}}] [M_{\text{length}}] [C \ M_{\text{final}}] [P_{\text{tsheg}}] \]

Sanskrit: \[ [C_{\text{cluster-initial}}] C [C^*] [C_{\text{cluster-final}}] [V_{\text{sign}}] [M_{\text{length}}] [M_{\text{anusvara}} \ | \ M_{\text{candrabindu}}] [M_{\text{visarga}}] \]

4.3 Vowel letter

There is 1 vowel letter:

\[
\text{ün} \quad \text{ZANABAZAR SQUARE LETTER A}
\]

This letter represents the vowel $a$ and a zero vowel depending upon phonotactical conditions. When it occurs independently it has the value $a$. It assumes the value of a combined vowel sign.

4.4 Vowel signs and length mark

There are 9 dependent vowel signs:
and 1 vowel length mark:

○ ZANABAZAR SQUARE VOWEL LENGTH MARK

A long vowel is represented by placing the ○ VOWEL LENGTH MARK after a consonant or vowel sign. When combined with the letter 𑨀 a or a consonant letter it represents the lengthening of the inherent vowel a to ā.

The signs are written with base letters, ie. 𑨀 a and consonants. Multiple vowel signs may combine with a single base letter. Independent vowels are represented by attaching vowel signs to the carrier 𑨀 LETTER A. The independent forms of ○ VOWEL SIGN REVERSED I are written according to a different pattern.

The first 8 vowel signs, in conjunction with the VOWEL LENGTH MARK, are used for writing the basic 16 vowels given in traditional script charts:

a 𑨀 <𑨀 LETTER A>
ā 𑨀 𑨁 <𑨀 LETTER A, ○ VOWEL LENGTH MARK>
i 𑨀 <𑨀 LETTER A, ○ VOWEL SIGN I>
i̯ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN I, ○ VOWEL LENGTH MARK>
i̪ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN I, ○ VOWEL LENGTH MARK>
i̫ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN I, ○ VOWEL LENGTH MARK>
i̬ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN U>
i̬ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN U>
i̬ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN U>
i̬ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN U>
i̬ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN U>
i̬ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN U>
i̬ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN U>
i̬ 𑨀 𑨀 <𑨀 LETTER A, 𑨁 VOWEL SIGN U>
4.4.1 Diphthongs

The ◌ VOWEL SIGN AI and ◌ VOWEL SIGN AU represent the diphthongs ai and au, respectively. They also function as secondary vowel signs for i and u for producing additional diphthongs for Mongolian (see figures 43–45). These diphthongs are represented using combinations of signs:

- āi 𑃣 <𑃣 LETTER A, ◌ VOWEL LENGTH MARK, ◌ VOWEL SIGN AI>
- ii 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN I, ◌ VOWEL SIGN AI>
- iu 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN I, ◌ VOWEL SIGN AU>
- īi 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN U, ◌ VOWEL SIGN AI>
- ei 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN E, ◌ VOWEL SIGN AI>
- ēi 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN E, ◌ VOWEL LENGTH MARK, ◌ VOWEL SIGN AI>
- eī 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN E, ◌ VOWEL SIGN UE, ◌ VOWEL LENGTH MARK>
- oi 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN O, ◌ VOWEL SIGN AI>
- ēi 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN O, ◌ VOWEL SIGN UE, ◌ VOWEL LENGTH MARK>
- ou 𑃣 <𑃣 LETTER A, ◌ VOWEL SIGN O, ◌ VOWEL SIGN AU>

4.4.2 Vocalic letters

The ◌ VOWEL SIGN REVERSED I is used for writing the four Sanskrit vocalic letters (eg. Devanagari ऋ r̥, ऍ ृ, ए ँ). They are represented by combining ◌ VOWEL SIGN REVERSED I with the consonant letters 𑃣 RA and 𑃣 LA; the ◌ VOWEL LENGTH MARK is added for the long forms (see figure 17):

- r̥ 𑃣 𑁭 <𑃣 RA, ◌ VOWEL SIGN REVERSED I>
- 早晚 <consonant, ◌ CLUSTER FINAL RA, ◌ VOWEL SIGN REVERSED I>
As indicated by the independent forms, the Sanskrit vocalic sounds are approximated using the syllables \( \text{ri} \), \( \text{rī} \), \( \text{li} \), \( \text{lī} \). The dependent forms are actually conjuncts with \( \text{ra} \) and \( \text{la} \) as C\(_2\), occurring as subjoined forms \( \text{r̥} \), \( \text{rī} \), \( \text{l̥} \), \( \text{lī} \) (see section 4.10). The \( \text{r̥} \) is necessary for properly distinguishing the vowel \( \text{r̥} \) in \( \text{kr̥} \) from the consonant-vowel syllable \( \text{r̥} \) in \( \text{kri} \).

Kara (1972) shows the vocalic letters written using the full-arched variant form \( \text{r̥} \) instead of the half arch \( \text{r̥} \) of \( \text{r̥} \). The full-arched forms do not allow for distinctive representations of vocalic letters and consonant-\( \text{ra} \) or consonant-\( \text{la} \) syllables, eg. \( \text{kr̥} \) could be either \( \text{k̥r̥} \) or \( \text{k̥ri} \), and \( \text{kl̥} \) could be either \( \text{kl̥} \) or \( \text{k̥l̥} \). The Zanabazar Square orthography for Sanskrit vocalic sounds follows that of Tibetan, where \( \text{r̥} \) is reversed as \( \text{ྀ} \) when writing independent \( \text{r̥} \) and \( \text{l̥} \), as well as the dependent forms \( \text{r̥} \) and \( \text{l̥} \).

### 4.4.3 Variant forms of vowel signs

The following vowel signs have alternate representations, which are to be handled as glyphic variants:

<table>
<thead>
<tr>
<th>Regular</th>
<th>Variant</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOWEL SIGN I</td>
<td>( \text{r̥} )</td>
<td>( \text{r̥} ), ( \text{r̥} ) instead of ( \text{r̥} ), ( \text{r̥} )</td>
</tr>
<tr>
<td>VOWEL SIGN U</td>
<td>( \text{r̥} )</td>
<td>( \text{r̥} ), ( \text{r̥} ) instead of ( \text{r̥} ), ( \text{r̥} )</td>
</tr>
<tr>
<td>VOWEL SIGN OE</td>
<td>( \text{r̥} )</td>
<td>( \text{r̥} ), ( \text{r̥} ) instead of ( \text{r̥} ), ( \text{r̥} )</td>
</tr>
<tr>
<td>VOWEL SIGN AI</td>
<td>( \text{r̥} )</td>
<td>( \text{r̥} ), ( \text{r̥} ) instead of ( \text{r̥} ), ( \text{r̥} )</td>
</tr>
<tr>
<td>VOWEL SIGN AU</td>
<td>( \text{r̥} )</td>
<td>( \text{r̥} ), ( \text{r̥} ) instead of ( \text{r̥} ), ( \text{r̥} )</td>
</tr>
<tr>
<td>VOWEL LENGTH MARK</td>
<td>( \text{r̥} )</td>
<td>( \text{r̥} ), ( \text{r̥} ) instead of ( \text{r̥} ), ( \text{r̥} )</td>
</tr>
</tbody>
</table>

The \( \text{r̥} \) is most commonly written using a full arc \( \text{r̥} \) (see figure 9).

The variant form of \( \text{r̥} \) is \( \text{r̥} \), which is a reversal of \( \text{r̥} \).

The alternate form \( \text{r̥} \) of \( \text{r̥} \) is shown in several records (see figure 38).
The variant form of \( \text{อำเภอ} \) of VOWEL SIGN AI occurs in a single manuscript and shows the influence of Tibetan (see figure 48). Another variant \( \text{อำเภอ} \) is produced by turning the hook of the regular form \( \text{อำเภอ} \) upwards and towards the right instead of orienting it upwards. When VOWEL SIGN AI occurs with \( \text{อำเภอ} \) TASA and \( \text{อำเภอ} \) TSHA it may be represented as the looped form \( \text{อำเภอ} \).

The variant form of \( \text{อำเภอ} \) of VOWEL SIGN AU occurs in a single manuscript and shows the influence of Tibetan (see figure 49). Another variant \( \text{อำเภอ} \) is produced by turning the hook of the regular form upwards and \( \text{อำเภอ} \) towards the left instead of orienting it upwards.

The forms \( \text{อำเภอ} \) and \( \text{อำเภอ} \) are shown in secondary sources at the end of a list of syllable-final consonants (see figure 19). These are not distinctive letters, but variant forms of \( \text{อำเภอ} \); \( \text{อำเภอ} \) in which the \( \text{อำเภอ} \) VOWEL LENGTH MARK is written using the glyphic variants \( \text{อำเภอ} \) and \( \text{อำเภอ} \). The VOWEL LENGTH MARK is shown in some sources as attaching at the middle right edge of a letter instead of at the bottom: \( \text{อำเภอ} \).

4.5 Vowel modifiers

There are two vowel modifiers used for transliterating words of Sanskrit origin:

- \( \text{อำเภอ} \) ZANABAZAR SQUARE SIGN ANUSVARA
- \( \text{อำเภอ} \) ZANABAZAR SQUARE SIGN VISARGA

\( \text{อำเภอ} \) SIGN ANUSVARA indicates nasalization in Sanskrit words. It is transliterated as \( \text{อำเภอ} \), eg. \( \text{อำเภอ} \). The sign is not shown in traditional charts, but occurs in the word \( \text{อำเภอ} \) 'subham', which is written at the end of charts (see figure 2). When ANUSVARA occurs in a sequence with a vowel sign it is placed last, eg. \( \text{อำเภอ} \) hum \( \text{อำเภอ} \) HA, \( \text{อำเภอ} \) VOWEL SIGN U, \( \text{อำเภอ} \) ANUSVARA>. It corresponds to \( \text{อำเภอ} \) U+0F7E TIBETAN SIGN RUESU NGA RO.

\( \text{อำเภอ} \) SIGN VISARGA indicates post-vocalic aspiration in Sanskrit words. It is generally transliterated as \( \text{อำเภอ} \), eg. \( \text{อำเภอ} \). When the VISARGA occurs in a sequence with a vowel sign it is placed last, eg. \( \text{อำเภอ} \) aḥ <\( \text{อำเภอ} \) A, \( \text{อำเภอ} \) VOWEL LENGTH MARK, \( \text{อำเภอ} \) VISARGA>. It corresponds to \( \text{อำเภอ} \) U+0F7F TIBETAN SIGN RNAM BCAD.

4.6 Candrabindu and candra ornaments

There are 2 combining signs used as nasalization marks and ornaments for the head mark:

- \( \text{อำเภอ} \) ZANABAZAR SQUARE SIGN CANDRABINDU
- \( \text{อำเภอ} \) ZANABAZAR SQUARE SIGN CANDRABINDU WITH ORNAMENT

\( \text{อำเภอ} \) SIGN CANDRABINDU indicates nasalization in Sanskrit words. It is transliterated as \( \text{อำเภอ} \), eg. \( \text{อำเภอ} \) am. The CANDRABINDU does not appear in script charts and manuals, but it is attested in various manuscripts, eg. in the word \( \text{อำเภอ} \) 'hum' (see figure 29). It also occurs frequently in combination with \( \text{อำเภอ} \) INITIAL HEAD MARK (see section 4.11). When the CANDRABINDU occurs with a vowel sign, it is always placed after it, eg. \( \text{อำเภอ} \) hum <\( \text{อำเภอ} \) HA, \( \text{อำเภอ} \) VOWEL SIGN UE, \( \text{อำเภอ} \) CANDRABINDU>. The sign corresponds to \( \text{อำเภอ} \) U+0F83 TIBETAN SIGN SNA LDAN.

The \( \text{อำเภอ} \) SIGN CANDRABINDU WITH ORNAMENT and \( \text{อำเภอ} \) SIGN CANDRA WITH ORNAMENT are used in combination with the \( \text{อำเภอ} \) INITIAL HEAD MARK (see figure 40). They also occur as the variant, reversed forms \( \text{อำเภอ} \) and \( \text{อำเภอ} \). The SIGN CANDRA WITH ORNAMENT corresponds to \( \text{อำเภอ} \) U+0F82 TIBETAN SIGN NYI ZLA NAA DA.
4.7 Consonant letters

There are 40 consonant letters:

<table>
<thead>
<tr>
<th>ZANABAZAR SQUARE LETTER KA</th>
<th>ZANABAZAR SQUARE LETTER PHA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZANABAZAR SQUARE LETTER KHA</td>
<td>ZANABAZAR SQUARE LETTER BA</td>
</tr>
<tr>
<td>ZANABAZAR SQUARE LETTER GA</td>
<td>ZANABAZAR SQUARE LETTER BHA</td>
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<tr>
<td>ZANABAZAR SQUARE LETTER GHA</td>
<td>ZANABAZAR SQUARE LETTER MA</td>
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<tr>
<td>ZANABAZAR SQUARE LETTER NGA</td>
<td>ZANABAZAR SQUARE LETTER TSA</td>
</tr>
<tr>
<td>ZANABAZAR SQUARE LETTER CA</td>
<td>ZANABAZAR SQUARE LETTER TSHA</td>
</tr>
<tr>
<td>ZANABAZAR SQUARE LETTER CHA</td>
<td>ZANABAZAR SQUARE LETTER DZA</td>
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<tr>
<td>ZANABAZAR SQUARE LETTER JA</td>
<td>ZANABAZAR SQUARE LETTER DZHA</td>
</tr>
<tr>
<td>ZANABAZAR SQUARE LETTER NYA</td>
<td>ZANABAZAR SQUARE LETTER ZHA</td>
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<tr>
<td>ZANABAZAR SQUARE LETTER TTA</td>
<td>ZANABAZAR SQUARE LETTER ZA</td>
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<tr>
<td>ZANABAZAR SQUARE LETTER TTHA</td>
<td>ZANABAZAR SQUARE LETTER -A</td>
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<tr>
<td>ZANABAZAR SQUARE LETTER DDA</td>
<td>ZANABAZAR SQUARE LETTER YA</td>
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<td>ZANABAZAR SQUARE LETTER DDHA</td>
<td>ZANABAZAR SQUARE LETTER RA</td>
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<td>ZANABAZAR SQUARE LETTER NNA</td>
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<td>ZANABAZAR SQUARE LETTER SSA</td>
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<td>ZANABAZAR SQUARE LETTER SA</td>
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<tr>
<td>ZANABAZAR SQUARE LETTER NA</td>
<td>ZANABAZAR SQUARE LETTER HA</td>
</tr>
<tr>
<td>ZANABAZAR SQUARE LETTER PA</td>
<td>ZANABAZAR SQUARE LETTER KSSA</td>
</tr>
</tbody>
</table>

4.7.1 Consonant order

The original Mongolian arrangement and values of the consonant letters are as follows:

\[
\begin{array}{cccccccccccc}
g a & k a & ē a & j a & c a & ē a & d a & t a & n a & b a & p a & m a & y a & r a & v a \\
l a & s a & s a & h a & k s a & ŋ a & t a & t h a & d a & d h a & n a & z a & h a & ' a & g a & g h a \\
j a & j h a & v a & d a & d h a & b a & b h a
\end{array}
\]
This order does not contain letters that are attested in various sources, but that are not found in charts, eg. 𜇀 ca, 𜇇 cha, 𜇈 ja, 𜇋 ssa. It is not clear where these four letters would fit into the above order. The traditional order also includes two instances of the character 𜇉 ba, an issue which must be resolved for the proposed encoding. For this reason an arrangement that follows the Tibetan order has been adopted. Letters that are not part of the traditional repertoire are highlighted in red:

4.7.2 Notes on consonants

𜇀 ca, 𜇇 cha, 𜇈 ja These letters do not occur in traditional script charts, but they occur in manuscripts and secondary sources. It is unclear when they were introduced into the script or by whom. They correspond to the Tibetan characters 𑩐 ca, 𑩑 cha, 𑩒 ja.

𜇉 ba Traditional charts and secondary sources show two instances of the letter 𜇉. It occurs first after 𜇁 la and secondly before 𜇃 bha. Based upon the occurrences, it is clear that the first 𜇉 represents va in Mongolian, while the second 𜇉 is used for writing ba in Sanskrit and Tibetan (see figures 15 and 17). As va is represented distinctively using ཉ Va, the letter 𜇉 is named ba. It should be noted that 𜇉 is often used in place of ཉ Va in Tibetan contexts.

𑩗 dzha The letter dzha represents Sanskrit jha. It is named dzha instead of jha because of its graphical similarity to related characters: ཊ tsā, ཋ tsha, ཌ dza as opposed to 𑩐 ca, 𑩑 cha, 𑩒 ja. Also, in the traditional order of the script, ཉ dzha occurs between ཊ dza and ཉ va, which follows the Tibetan order and further suggests its value as dzha, corresponding to Tibetan 𑩗 U+0F60 TIBETAN LETTER DZHA.

𜁈 -a The letter -a corresponds to Tibetan 𑩐 a chung (𑩐 U+0F60 TIBETAN LETTER -A). It is used in some instances in place of ཉ vowel length mark for denote a long vowel (see figures 22 and 36). The letter -a also corresponds to ཊ U+A856 PHAGS-PA LETTER SMALL A, which however, is named differently on account of preferences in China.

𑩑 ssa The letter ssa is a reversed form of ཉ sha. It represents the Sanskrit retroflex sa. It is not shown in traditional script charts, but it is attested in manuscripts. It occurs, for example, in the Sanskrit invocation written above script charts: ཉ namsnyin rimpochee namo guru mañjughoṣāya “praise to the preceptor Mañjughoṣa” (see figures 10 and 26). The ssa was introduced into the script by Ugalzyn Lama; it is curious that Zanabazar did not provide a distinctive letter for writing sa in his square script as he did for Soyombo.

𑩉 kssa The ཉ ZANABAZAR SQUARE LETTER KSSA represents the Sanskrit cluster kṣa (/kṣa/). In the Zanabazar Square script, this letter represents a phoneme that is phonetically a consonant cluster, but it has the structure of an atomic letter. It is encoded as a letter because in all cases consonant clusters are written as conjunct stacks in Zanabazar Square, not as ligatures. While in some scripts the written form for /kṣa/ has an encoded representation as a character sequence, such an approach would not be consistent with this script.
### 4.7.3 Representation of Mongolian, Sanskrit, and Tibetan consonants

Zanabazar Square consonants possess different values based upon linguistic context. For Mongolian the letters for voiceless sounds (𑨋, 𑨌, 𑨑, 𑨒) are used for voiced stops, while letters for voiceless aspirated sounds (𑨌, 𑨑, 𑨒, 𑨛) are used for voiceless stops. The values of consonants for Mongolian (‘M’), Sanskrit (‘S’), and Tibetan (‘T’) are given below:

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>S</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>𑨊</td>
<td>𑨋</td>
<td>𑨌</td>
</tr>
<tr>
<td>S</td>
<td>ڂa</td>
<td>ڂa</td>
<td>ڂa</td>
</tr>
<tr>
<td>T</td>
<td>ڂa</td>
<td>ڂa</td>
<td>ڂa</td>
</tr>
<tr>
<td>M</td>
<td>𑨍</td>
<td>𑨎</td>
<td>𑨥</td>
</tr>
<tr>
<td>S</td>
<td>ڂa</td>
<td>ڂa</td>
<td>ڂa</td>
</tr>
<tr>
<td>T</td>
<td>ڂa</td>
<td>ڂa</td>
<td>ڂa</td>
</tr>
<tr>
<td>M</td>
<td>𑨐</td>
<td>𑨑</td>
<td>𑨡</td>
</tr>
<tr>
<td>S</td>
<td>ڂa</td>
<td>ڂa</td>
<td>ڂa</td>
</tr>
<tr>
<td>T</td>
<td>ڂa</td>
<td>ڂa</td>
<td>ڂa</td>
</tr>
<tr>
<td>M</td>
<td>𑨛</td>
<td>𑨜</td>
<td>𑨝</td>
</tr>
<tr>
<td>S</td>
<td>ڂa</td>
<td>ڂa</td>
<td>ڂa</td>
</tr>
<tr>
<td>T</td>
<td>ڂa</td>
<td>ڂa</td>
<td>ڂa</td>
</tr>
</tbody>
</table>

The consonants 𑨃 nya and 𑨄 nna may occur in Mongolian contexts.

### 4.7.4 Alternate representations of consonants

Alternate forms and glyphic variants are attested for some consonant letters:

<table>
<thead>
<tr>
<th>Regular</th>
<th>Variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHA</td>
<td>𑨎</td>
</tr>
<tr>
<td>DHA</td>
<td>𑨟</td>
</tr>
<tr>
<td>TTA</td>
<td>𑨟</td>
</tr>
<tr>
<td>NNA</td>
<td>𑨄</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regular</th>
<th>Variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>𑨄</td>
</tr>
<tr>
<td>TSA</td>
<td>𑨒</td>
</tr>
<tr>
<td>-A</td>
<td>𑨒</td>
</tr>
<tr>
<td>VA</td>
<td>𑨒</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Regular</th>
<th>Variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSSA</td>
<td>𑨒</td>
</tr>
</tbody>
</table>

11
The letters  and  are reversed forms of  ta and  na, which are used for representing the Sanskrit retroflex sounds ta and na. Figure 26 shows a subjoined form of  in the conjunct  sṭa; figure 27 shows  in the word 𑨗𑨝 mani. There exist distinctive letters for ta and na —  tta and  nna — however, the practice of reversing  ta and  na is borrowed from Tibetan, in which the letters for the dental consonants  ta,  tha,  da,  dha,  na are reversed for producing the retroflex consonants  tta,  tha,  da,  dha,  na; and the palatal sibilant  sā is reversed for the retroflex sibilant  sā. The use of reversed letters for representing sounds for which distinctive letters exist may be interpreted as scribal idiosyncrasies, which result from imprecise knowledge of the script by the writer, who nonetheless has knowledge of Tibetan. Although  ta and  na are distinct from the regular letters, their occurrence is limited to a single source. Until additional evidence of their usage is found, they are not proposed for encoding.

Scribal idiosyncrasy may also explain the use of the form  for writing མ-getStatusCode in figure 35. This form of -getStatusCode is based upon the Tibetan dbu med shape ཆ of the regular dbu can form ཇ 'a chung. Similarly, the reversed form  of -getStatusCode is used in figure 36.

Similarities between character glyphs may account for the usage of  for ཊ tsa for representing Mongolian ja in one manuscript. The form  is derived by attaching a hook to  bha. It is likely the result of the scribe writing the left vertical stroke of  as a curve from the left terminals instead of as a straight line.

Misinterpretation of glyph boundaries in traditional charts may explain the alternate form  of ཊ dha and the form  for ཊ va (see figure 38). In the traditional ordering of the script, the ཊ dha and ཊ va occur at the end of sequences of letters, eg. ཊ dha | and ཊ va |. In some manuscripts that show the repertoire of the script, the spacing between letters and the punctuation mark  shad is rather tight, so ཊ dha | and ཊ va | may be read incorrectly as ཊ dha | and ཊ va |, in which the shad is seen not as punctuation, but as part of the glyph (see figure 37).

Explanations for other alternate forms require further research. The source for the variant  of ཊ gha as shown in figure 9 is unidentified. The form  for ཊ na is shown in figure 28, where both forms are used simultaneously. There is no semantic distinction between  and . It is unclear why the scribe used two different forms of na in such close proximity in a single document.

4.8 Consonant modifiers

4.8.1 Final consonant mark

The following character is a combining mark:

⊰ ZANABAZAR SQUARE FINAL CONSONANT MARK

The ⊰ FINAL CONSONANT MARK is used in Mongolian contexts for marking syllable-final consonants. On account of this function, it also serves as a syllable-boundary mark, similar to ་ U+0F0B TIBETAN MARK INTERSYLLABIC TSHEG. It has no control properties. Although it can combine only with a single consonant, there is a single record written in Tibetan in which the FINAL CONSONANT MARK is used below conjuncts and after vowels. This usage is irregular and is likely the result of a scribe using the mark, not as a vowel silencer, as a generic syllable mark instead of specifically as a final-consonant mark. The FINAL CONSONANT MARK occurs in one Mongolian record as ⊰ (see figure 34), which is considered a glyphic variant of ⊰.
4.8.2 Virama

The ☰ VIRAMA is used in Sanskrit and Tibetan contexts for silencing the inherent vowel of a consonant letter. It can occur only with a consonant. It also specifies that if the bare consonant is followed by another consonant, then the bare consonant is part of a cluster involving the following consonant (see section 4.10). It does not mark syllabic boundaries.

Although VIRAMA is not part of the traditional repertoire of Zanabazar Square, it is attested in texts (see figure 30). It corresponds to the Lantsa, Wartu, and Tibetan sign halanta, as shown in figure 30. In addition to silencing the inherent vowel of a consonant, the Zanabazar Square VIRAMA is used for representing conjuncts in encoded text: a sequence of bare consonants marked by the sign will be displayed as conjunct stacks. Given the form and function of the character in Zanabazar Square, VIRAMA is an appropriate name for the sign as it corresponds to other VIRAMA characters in scripts in the UCS, such as ☰ u+094D DEVANAGARI SIGN VIRAMA. In previous versions of the proposal, the ☰ VIRAMA was called ☰ subjoiner. It was proposed as a character for controlling conjunct formation using a generic glyph. While the subjoiner was suitable, it was more appropriate to unify its function with that of the VIRAMA, which fits the graphical model of the script.

4.8.3 Necessity for two vowel-silencing marks

The ☰ FINAL CONSONANT MARK and ☰ VIRAMA may be considered graphical variants of a single vowel-silencing mark. However, as explained in the above descriptions of each mark, it is necessary to treat them as separate characters in the encoding on account of their language-specific semantics and behavior. The distinct semantics of both characters is is exhibited by the following encoded sequence, in which ☰ represents a single silencer mark for purposes of illustration:

<n sa, ☰ vowel sign e, ☰ tha, ☰ silencer, ☰ kha, ☰ vowel sign i, ☰ la, ☰ silencer, ☰ pa, ☰ vowel sign e, ☰ ra, ☰ silencer>

The above sequence would be rendered in a Mongolian context as НЗИОУО setkhilber and in a Sanskrit or Tibetan context as НИОУО setkhilber.

From a character-encoding perspective, although the silencer indicates bare consonants in both of the above cases, it also conveys additional details regarding the display of the consonants based upon linguistic context. In the Mongolian example, the silencer indicates that ☰ tha, ☰ la, and ☰ ra are bare consonants and that they occur at the end of a syllable. In the Sanskrit example, the silencer indicates that ☰ tha, ☰ la, and ☰ ra are bare consonants and are part of a cluster if followed by a consonant, and that the cluster should be rendered a as conjunct.

In plain-text environments, there is no means of instructing the silencer to behave as would be expected in different linguistic contexts. For this reason, it is necessary to separate the two functions of the silencer into separate characters: one that marks bare consonants in syllable-final position and the other that marks bare consonants in a consonant cluster: the FINAL CONSONANT MARK and VIRAMA, respectively. These two characters offer a feasible method of differentiating the representation of the example sequence in Mongolian and Sanskrit contexts:
4.9 Mongolian final consonants

Mongolian words may end with the following codas: g, k, ng, d, n, b, m, r, l, ñ, s. These are shown in charts as ᠤ蒙古 ag, ᠥ蒙古 ak, ᠥ蒙古 an, ᠥ蒙古 ab, ᠥ蒙古 am, ᠥ蒙古 ar, ᠥ蒙古 al, ᠥ蒙古 aš, ᠥ蒙古 as; the initial ᠤ蒙古 is used for illustrating a basic syllable. Syllable-final consonants are indicated by placing the ᠠFINAL CONSONANT MARK beneath a letter, as follows:

- **g**: ᠤ蒙古 <打猎 KA, ᠠFINAL CONSONANT MARK>
- **k**: ᠥ蒙古 <打猎 KHA, ᠠFINAL CONSONANT MARK>
- **ng**: ᠤ蒙古 <打猎 NGA, ᠠFINAL CONSONANT MARK>
- **d**: ᠥ蒙古 <打猎 TA, ᠠFINAL CONSONANT MARK>
- **n**: ᠤ蒙古 <打猎 NA, ᠠFINAL CONSONANT MARK>
- **b**: ᠥ蒙古 <打猎 PA, ᠠFINAL CONSONANT MARK>
- **m**: ᠤ蒙古 <打猎 MA, ᠠFINAL CONSONANT MARK>
- **r**: ᠥ蒙古 <打猎 RA, ᠠFINAL CONSONANT MARK>
- **l**: ᠥ蒙古 <打猎 LA, ᠠFINAL CONSONANT MARK>
- **š**: ᠥ蒙古 <打猎 SHA, ᠠFINAL CONSONANT MARK>
- **s**: ᠤ蒙古 <打猎 SA, ᠠFINAL CONSONANT MARK>

The ᠤ蒙古 ᠠa is shown at the end of the syllable-final letters. It is glossed as Tibetan བཏā in several manuscripts. Kara (1972) represents ᠤ蒙古 as ᠤ蒙古 ‘aṅ’, while Shagdarsürlüü (2001) represents it as ᠤ蒙古 ‘āṅ’. These transcriptions indicate that Kara and Shagdarsürlüü assign a nasal value to ᠤ蒙古, but they do not offer evidence for their claims. Moreover, such usage is not attested in the available sources. Byamba Ragchaagin (2005) equates the ᠤ蒙古 that occurs among the syllable-final letters with the vowel ᠠa. The manuscript sources suggest that the occurrence of ᠤ蒙古 here simply indicates that a Mongolian syllable may end with this long vowel.

4.10 Consonant conjuncts

Consonant clusters are written as conjuncts, which are rendered as vertical stacks with non-initial letters descending sequentially beneath the initial letter, eg. ᠤ蒙古 ᠠa + ᠤ蒙古 ‘aṅ’ is written as ᠤ蒙古 nda. Letters are displayed
using their regular shape, with the exception of four letters: 𑨪 YA, 𑨫 RA, 𑨬 LA, 𑨭 VA. The forms of these letters are determined by their position in a cluster and the linguistic context in which they occur. In general, the full forms of these letters are used for Sanskrit conjuncts, while contextual alternates are used for Tibetan, but variation does occur (see figures 24):

<table>
<thead>
<tr>
<th>Initial</th>
<th>Medial / Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanskrit</td>
<td>Tibetan</td>
</tr>
<tr>
<td>𑨪 YA</td>
<td>𑨪</td>
</tr>
<tr>
<td>𑨫 RA</td>
<td>𑨫</td>
</tr>
<tr>
<td>𑨬 LA</td>
<td>𑨬</td>
</tr>
<tr>
<td>𑨭 VA</td>
<td>𑨭</td>
</tr>
</tbody>
</table>

Given that only four consonants exhibit special shaping behavior in stacks, the encoded representation of conjuncts requires a subjoining model that utilizes 𑨴 virama for controlling stacking behavior, as well as 5 characters for the contextual forms of YA, RA, LA, VA:

- 𑨴 ZANABAZAR SQUARE LETTER CLUSTER INITIAL RA
- 𑨵 ZANABAZAR SQUARE LETTER CLUSTER FINAL YA
- 𑨵 ZANABAZAR SQUARE LETTER CLUSTER FINAL RA
- 𑨵 ZANABAZAR SQUARE LETTER CLUSTER FINAL LA
- 𑨵 ZANABAZAR SQUARE LETTER CLUSTER FINAL VA

The 𑨴 CLUSTER INITIAL RA can occur only at the head of a cluster and must be followed by consonant letter. By implication, it is the logical base letter of a conjunct and any following consonant letter is always subjoined, therefore virama is not to be used in conjunction with it.

The 𑨵 CLUSTER FINAL YA, 𑨵 CLUSTER FINAL RA, 𑨵 CLUSTER FINAL LA, 𑨵 CLUSTER FINAL VA may occur only in the penultimate and final positions in a cluster. They are combining characters and logically combine with the preceding consonant. As inherently subjoined forms, the virama is not used with these letters, either in a preceding or following position. These cluster-final letters may occur after each other in the penultimate and final positions in a cluster, but as inherently subjoined forms, these letters cannot be used medially.

### 4.10.1 Rationale for the encoding model for conjuncts

The visual model for encoding Zanabazar Square conjuncts provides for all stacks that may occur in Sanskrit and Tibetan. It also eliminates the need to adopt the Tibetan subjoined-letter model for Zanabazar Square, which would require the independent encoding of a full set of subjoined letters for each consonant letter, in addition to context-specific forms of YA, RA, LA, VA. The decision to encode a CLUSTER INITIAL RA instead of relying on the font to change the shape of RA from full-form to head-position is made in order to eliminate the need to encode two characters that have the same nominal appearance, but different conjoining behaviors, as is the case for Tibetan in the UCS, eg. 𑨫 U+0F62 TIBETAN LETTER RA and 𑨫 U+0FBC TIBETAN LETTER FIXED-FORM RA. The proposed model simply utilizes separate characters for each semantically distinctive
form of a consonant. All other consonants are rendered in stacks using the virama, which simply subjoins one letter beneath the other and does not initiate a shape change of a consonant.

4.10.2 Encoded representation of conjuncts

A conjunct stack is represented in encoded text by placing a virama after each consonant in a cluster except for the last: <consonant, \( \ddot{\text{v}} \) virama, [consonant, \( \ddot{\text{v}} \) virama,]* consonant>. The virama specifies that the consonant to which it is attached is a bare consonant and that the following letter is to be placed beneath it; the same rule applies to each subsequent consonant to which virama is attached. As virama behaves as a control character when it occurs between two consonants, it is not displayed visibly in the stack (see sections 4.10.3 and 4.17.5 for additional details on the rendering of stacks):

\[
\begin{align*}
\text{న} & \text{< న, విరామా>} \\
\text{ందా} & \text{< ందా, విరామా, ధా>} \\
\text{ండ్రా} & \text{< ండ్రా, విరామా, ధా, విరామా, రా>}
\end{align*}
\]

The exceptions to the usage of virama in producing conjuncts are చ CLUSTER INITIAL RA, వ CLUSTER FINAL YA, వ CLUSTER FINAL RA, వ CLUSTER FINAL LA, వ CLUSTER FINAL VA. The usage of these letters in stacks is shown in the examples below:

\[
\begin{align*}
\text{క్య} & \text{< కి, విరామా, యా>} \\
\text{క్య} & \text{< కి, విరామా, యా>} \\
\text{ర్క} & \text{< రా, విరామా, కా>} \\
\text{ర్క} & \text{< రా, విరామా, కా>} \\
\text{క్ర} & \text{< కి, విరామా, రా>} \\
\text{క్ర} & \text{< కి, విరామా, రా>} \\
\text{క్ల} & \text{< కి, విరామా, లా>} \\
\text{క్ల} & \text{< కి, విరామా, లా>} \\
\text{క్వ} & \text{< కి, విరామా, వా>} \\
\text{క్వ} & \text{< కి, విరామా, వా>}
\end{align*}
\]

Using virama with the 5 conjunct-specific letters will yield meaningless sequences:
Naturally, in a conjunct the only letter that can possess a vowel is the final letter in the cluster. Any vowel or other combining signs must be placed after the final letter in a conjunct:

\[
\text{ŋ} \text{ndi} <\text{ŋ}, \text{VIRAMA}, \text{SA}, \text{VOWEL SIGN I}>
\]

\[
\text{ŋ} \text{ndru} <\text{ŋ}, \text{VIRAMA}, \text{SA}, \text{CLUSTER FINAL RA}, \text{VOWEL SIGN U}>
\]

\[
\text{ŋ} \text{ndum} <\text{ŋ}, \text{VIRAMA}, \text{SA}, \text{VOWEL SIGN UE}, \text{SIGN ANUSVARA}>
\]

### 4.10.3 Controlling conjunct formation

As is the convention for conjunct models based upon \text{VIRAMA}, conjunct formation may be broken by placing the generic non-printing, control character \text{ZWNJ} after \text{VIRAMA}. This results in the display of a visible form of the sign, compare the following:

\[
\text{ŋ} \text{nda} <\text{ŋ}, \text{VIRAMA}, \text{SA}>
\]

\[
\text{ŋ} \text{nda} <\text{ŋ}, \text{VIRAMA}, \text{ZWNJ}>
\]

\[
\text{ŋ} \text{ndra} <\text{ŋ}, \text{VIRAMA}, \text{SA}, \text{VIRAMA}, \text{RA}>
\]

\[
\text{ŋ} \text{ndra} <\text{ŋ}, \text{VIRAMA}, \text{ZWNJ}>
\]

The use of \text{ZWNJ} is necessary for representing clusters like \text{msta}, which occurs in the phrase \text{msta} \text{subhamstu} and \text{rsa}, which occurs in the phrase \text{rsa} \text{kasyabar sarva} in figure 30. As shown below, if \text{ZWNJ} is not used, the \text{VIRAMA} will produce a stack instead of a consonant with a visible \text{VIRAMA}:

\[
\text{ŋ} \text{msta} <\text{ŋ}, \text{VIRAMA}, \text{SA}, \text{VIRAMA}, \text{TA}>
\]

\[
\text{ŋ} \text{msta} <\text{ŋ}, \text{VIRAMA}, \text{ZWNJ}>
\]

\[
\text{ŋ} \text{rsa} <\text{ŋ}, \text{VIRAMA}, \text{SA}>
\]

\[
\text{ŋ} \text{rsa} <\text{ŋ}, \text{VIRAMA}, \text{ZWNJ}, \text{SA}>
\]

As there are no half-forms of consonants in Zanabazar Square, the usage of \text{ZWNJ} does not produce any valid output.
4.10.4 Conjuncts shown in traditional script charts

The following conjuncts are shown in traditional script charts: 𑟃 kra, 𑟄 khya, 𑟅 gla, 𑟆 rka, 𑟇 ska, 𑟈 lka. They are not independent characters, but are ligatures that represent consonant conjuncts. They are represented in encoded text as follows:

- kra <𑟃 KA, 𑟄 CLUSTER FINAL RA>
- khya <𑟄 KHA, 𑟅 CLUSTER FINAL YA>
- gla <𑟅 GA, 𑟆 CLUSTER FINAL LA>
- rka < r CLUSTER INITIAL RA, 𑟄 KA>
- ska <𑟇 SA, 𑟈 VIRAMA, 𑟄 KA>
- lka <𑟈 LA, 𑟈 VIRAMA, 𑟄 KA>

It is likely that kra, khya, gla are presented for illustrating the cluster-final forms of YA, RA, LA and the cluster-initial form of RA. The presence of ska and lka in this list is intended for illustrating the representation of Tibetan ལ་མགོ la-mgo and ས་མགོ sa-mgo letters. The glyphs ska and lka are stylized ligatures of ལ་ and ཀ་, respectively.

4.10.5 Depth of conjunct stacks

Zanabazar Square stacks may consist of numerous consonants. The deepest stack shown in the available sources contains three consonants: 𑟉 mprā. However, as Zanabazar Square is used for representing Tibetan, the rendering engine must be able to manage stacks consisting of three or more consonants.

4.11 Head marks

Two characters are proposed for representing head marks:

- ZANABAZAR SQUARE INITIAL HEAD MARK
- ZANABAZAR SQUARE CLOSING HEAD MARK

Sources show the head marks 𑟊, 𑟌, 𑟍, 𑟎 at the beginning of texts (see figure 40 for more variants). Rather than encode one of these as the normative form or each separately, it is sensible to analyze these marks as a base character and a combining sign. The above forms may be represented using a bare head mark in combination with candrabindu signs described in section 4.6. Moreover, usage of a bare head mark is attested (see figure 40). The proposed base is 𑟊 INITIAL HEAD MARK. It corresponds to 𑟎 U+0FD3 TIBETAN MARK INITIAL BRDA RNYING YIG MGO MDUN MA.

The mark 𑟌 is also used. It may be encoded as a separate character, following 𑟌 U+875 PHAGS-PĂ DOUBLE HEAD MARK. However, the mark may be analyzed as consisting of an ‘initial’ 𑟊 and ‘closing’ 𑟌 element. The latter is proposed for encoding as 𑟌 CLOSING HEAD MARK. It corresponds to 𑟌 U+0FD4 TIBETAN CLOSING MARK BRDA RNYING YIG MGO MDUN MA. It is placed after 𑟊 INITIAL HEAD MARK for producing 𑟋, cf.
Tibetan དོདོ. The closing head mark may be used for producing extended head marks, such as ཁོར་, similar to Tibetan དོདོ.

The ཁོོ initial head mark, and a following ཉོ closing head mark, is typically followed by a ་ shad or ་ double shad.

The various forms of the initial head mark may be represented using the following sequences:

- ཁོོ < ཁོོ initial head mark, འོ sign Candrabindu>
- ཁོོ < ཁོོ initial head mark, ཡོ sign Candrabindu with ornament>
- ཁོོ < ཁོོ initial head mark, ངོ sign Candra with ornament>
- ཁོོ < ཁོོ initial head mark, བོ sign Anusvara>
- ཁོོ < ཁོོ initial head mark, མོ sign Candra with ornament, ་ shad>
- ཁོོ < ཁོོ initial head mark, མོ sign Candra with ornament, ་ double shad>
- ཁོོ < ཁོོ initial head mark, ་ closing head mark>
- ཁོོ < ཁོོ initial head mark, ་ closing head mark, ་ closing head mark>

Figure 41 shows a mark ཁོོ that corresponds to Tibetan ཁོོ. This mark is to be considered a glyphic variation of ཁོོ, where ཁོོ = ཁོོ initial head mark and ཉོ = ཉོ closing head mark. Although these forms are encoded as distinct characters for Tibetan (༅ U+0F04 TIBETAN MARK INITIAL YIG MO MDUN MA and ཉོ U+0F05 TIBETAN MARK CLOSING YIG MO SGAB MA), for Zanabazar Square it is appropriate to treat them as glyphic variants because of their limited occurrence.

4.12 Punctuation

Four punctuation marks are proposed for encoding:

- ZANABAZAR SQUARE TSHEG
- ZANABAZAR SQUARE SHAD
- ZANABAZAR SQUARE DOUBLE SHAD
- ZANABAZAR SQUARE LONG TSHEG

' TSHEG is used for indicating the end of a syllable in Tibetan contexts. It corresponds to ' U+0F0B TIBETAN MARK INTERSYLLABIC TSHEG. Although the ངོ FINAL CONSONANT MARK is generally used for marking syllabic boundaries, the tsheg is proposed for inclusion in the script block because of attested usage (see figures 46 and 47).
l shad indicates the end of a phrase or sentence. It corresponds to \texttt{U+0F0D TIBETAN MARK SHAD}.

double shad marks the end of a text section (see figure 23). It corresponds to \texttt{U+0F0E TIBETAN MARK NYIS SHAD}.

\begin{itemize}
\item LONG TSHEG behaves as a comma (see figure 41). It corresponds to \texttt{U+0F0E TIBETAN MARK GTER TSHEG}.
\end{itemize}

4.13 Digits

Digits are not attested. The available sources do not indicate the use of digits or number forms in the script.

4.14 Collation

The default sort order for Zanabazar Square is as follows:

\begin{verbatim}
 KA < KSSA < KHA < GA < GHA < NGA < CA < CHA <
 JA < NYA < TTA < TTHA < DDA < DDHA < NNA < TA <
 THA < DA < DHA < NA < PA < PHA < BA < BHA <
 MA < TSA < TSHA < DZA < DZHA < ZHA < ZA <
 -A < YA < CLUSTER FINAL YA < CLUSTER INITIAL RA < RA <
 CLUSTER FINAL RA < LA < CLUSTER FINAL LA < VA <
 CLUSTER FINAL YA < SHA < SSA < SA < HA < A <
 VOWEL SIGN I < VOWEL SIGN UE < VOWEL SIGN U < VOWEL SIGN E <
 VOWEL SIGN OE < VOWEL SIGN O < VOWEL SIGN AI < VOWEL SIGN AU <
 VOWEL SIGN REVERSED I < VOWEL LENGTH MARK < FINAL CONSONANT MARK
\end{verbatim}

The following characters have secondary weights:

\begin{verbatim}
 CANDRABINDU, CANDRABINDU WITH ORNAMENT, CANDRA WITH ORNAMENT, ANUSVARA,
 VISARGA
\end{verbatim}

4.15 Vertical text

Although Zanabazar Square was designed to be written horizontally, there are some instances in the available sources in which the script is oriented vertically, for example, the words \textit{haṃkṣamalavaraya} (see figure 21) and \textit{thalīṃ} (see figures 22 and 36):
The graphical representation of vertical text is identical to that of conjuncts: letters are written in their normal, upright shape and are positioned sequentially beneath the first letter of the word, and signs are positioned as they are in conjuncts (see section 4.17). Given this, \textit{haṃkṣamalavaraya} and \textit{thalīṃ} may be incorrectly parsed as the conjuncts *\textit{hkṣmlvryaṃ} and *\textit{thlˈɪm}, respectively.

Although the vertical orientation of \textit{haṃkṣamalavaraya} and \textit{thalīṃ} may be produced in encoded text as false conjuncts by placing \textit{virama} after each consonant letter, such an approach is not recommended because it obscures the semantic value of the words. For instance, in the correct encoded representation of \textit{haṃkṣamalavaraya} the $\textit{candrabindu}$ attaches to $\textit{hā}$, but an attempt to produce the desired output as a conjunct would require that the $\textit{candrabindu}$ be attached, incorrectly, to $\textit{ya}$; naturally, combining signs can attach only to the final consonant of a conjunct. Similarly, for \textit{thalīṃ}, both $\textit{vowel sign i}$ and $\textit{anusvara}$ combine logically with $\textit{nl}$, but if the word is encoded as a false conjunct, the signs would need to be combined with $\textit{th}$.

The word \textit{thalīṃ} is a special case. Byambaa Ragchaagiin states that the word is a Tantric \textit{mantra} and is always written vertically, as shown above, and does not occur horizontally as *\textit{bhūr}.

Vertical text is outside of the purview of the encoding, which is intended for the representation of plain text. Therefore, the display of vertical text must be managed at the presentation layer. It may be possible to control vertical orientation in OpenType fonts using the ‘vert’ feature. The basic rules for Zanabazar Square in vertical environments is that text must be set top-to-bottom, left-to-right, with upright glyphs. The recently published “Unicode Technical Report #50: Unicode Vertical Text Layout” describes the character property \texttt{Vertical\_Orientation(vo)} for specifying default character orientation (Ishii 2013). For Zanabazar Square, the property would be defined as $\texttt{Vertical\_Orientation=U(vo=U)}$, where the value ‘U’ indicates that the glyphs remain upright in both horizontal and vertical text layout, as shown in the code chart.

4.16 Combining behavior

Multiple signs may combine with a base letter. The example shown below is theoretical and does not occur in attested texts, but it is nonetheless a valid encoded sequence for Zanabazar Square and illustrates the textual and graphical possibilities that rendering engines and fonts must be able to process and display.
The above example, which could be transliterated as rktvṛyēuṃḥ, is produced using 13 characters. See section 4.17.3 for rules regarding the placement of vowel signs with conjuncts.

### 4.17 Glyph interactions

#### 4.17.1 Size of vowel signs for use with letter a

The widths of glyphs for Zanabazar Square consonant letters are uniform, however, the 𑁀 a is wider than the consonants. This width difference requires a separate set of extra-wide vowel signs for use with a, compare, 𑆺 and 𑆺, 𑆻 and 𑆻. With width variant forms, the combinations with a should resemble 𑆺 and 𑆺.

#### 4.17.2 Placement of multiple combining signs

When multiple signs occur combine with a base letter in the same position, it may be necessary to adjust the glyphs in order to prevent clashing. This may be achieved in various ways (signs are marked in red). One is to horizontally extend the anchor of the sign:

<𑆺 KA, 𑆺 VOWEL SIGN E, 𑆺 VOWEL SIGN AI (variant)> = 𑆺 kei

Another is to horizontally condense the shape of one sign and to place both laterally:

<𑆺 LA, 𑆺 VOWEL SIGN I, 𑆺 VOWEL LENGTH MARK, 𑆺 SIGN ANUSVARA> = 𑆺 līṃ

A third is to alter the vertical position of a sign:

<𑆺 A, 𑆺 VOWEL SIGN O, 𑆺 SIGN ANUSVARA> = 𑆺 om

<𑆺 NA, 𑆺 VIRAMA, 𑆻 DA, 𑆺 CLUSTER FINAL RA, 𑆻 VOWEL SIGN U> = 𑆺 ndru

#### 4.17.3 Placement of vowel signs in conjuncts

Although all vowel signs are combined with the final letter in the encoded representation of a conjunct, the placement of signs upon the stack is dependent upon the combining behavior of the sign (marked in red):

Above-base vowel signs are placed above the initial letter:

𑆺 ndi  <𑆺 NA, 𑆺 VIRAMA, 𑆻 DA, 𑆺 VOWEL SIGN I>

Below-base vowel signs (including VOWEL LENGTH MARK) are placed beneath the final letter:

𑆺 ndu  <𑆺 NA, 𑆺 VIRAMA, 𑆻 DA, 𑆺 VOWEL SIGN U>

𑆺 ndru  <𑆺 NA, 𑆺 VIRAMA, 𑆻 DA, 𑆺 CLUSTER FINAL RA, 𑆺 VOWEL SIGN U>

𑆺 ndru  <𑆺 NA, 𑆺 VIRAMA, 𑆻 DA, 𑆺 CLUSTER FINAL RA, 𑆺 VOWEL SIGN U, 𑆺 VOWEL LENGTH MARK>

Right and left spacing marks are positioned on the respective sides of the initial letter:
The above rules apply to cases where multiple vowel signs and modifiers occur at the end of a conjunct:

\[ \text{ndi} \quad < \text{NA, VIRAMA, DA, VOWEL SIGN I, VOWEL LENGTH MARK}> \]

\[ \text{ndauh} \quad < \text{NA, VIRAMA, DA, VOWEL SIGN AU, VISARGA}> \]

\[ \text{ndōm} \quad < \text{NA, VIRAMA, DA, VOWEL SIGN O, VOWEL LENGTH MARK, ANUSVARA}> \]

When the cluster initial RA occurs in a conjunct, above-base marks attach to it, while all other marks attach to the following consonant based upon the rules stated above:

\[ \text{rkai} \quad < \text{CLUSTER INITIAL RA, KA, VOWEL SIGN I} > \]

\[ \text{rkā} \quad < \text{CLUSTER INITIAL RA, KA, VOWEL SIGN AI} > \]

When VOWEL LENGTH MARK occurs with CLUSTER final YA, CLUSTER final RA, CLUSTER final LA, CLUSTER final VA, the mark attaches to the letter which the cluster-final letter combines:

\[ \text{krā} \quad < \text{KA, CLUSTER FINAL RA, VOWEL LENGTH MARK} > \]

### 4.17.4 Positioning of CLUSTER INITIAL RA

The CLUSTER INITIAL RA is positioned at the normal head height, not above it. For this reason, it may be necessary to adjust the height of the following consonant letter in order to accommodate fit:

\[ < \text{CLUSTER INITIAL RA, KA} > = \text{KA} \rightarrow \text{KR} \]

### 4.17.5 Subjoined glyphs for rendering conjuncts

A Zanabazar Square font must contain a full set of subjoined forms for each consonant letter. A conjunct stack will be produced by substituting each VIRAMA, consonant pair with a subjoined form of the letter. If the subjoined glyph is not available in the font, the VIRAMA will be displayed visibly along with the regular glyph of the letter whose subjoined form is missing. For example, if the subjoined form of DA is unavailable, then a sequence such as \( \text{NA, VIRAMA, DA} \) will be rendered as \( \text{NA} \) instead of the expected \( \text{DA} \).

### 4.17.6 Positioning and sizing of letters in conjunct stacks

There are no formal rules for sizing character glyphs within a stack. However, based upon an examination of conjunct styles in manuscripts, it is evident that scribes adjust the size of letters in stacks for visual uniformity with surrounding characters. Shown below is the word \( \text{dhumprāndhāḥ} \) rendered in three different ways:
The default method involves no size changes and uses the regular forms of letters (column ‘A’). In some sources, the regular size of the initial letter is used, while non-initial letters are compressed along the vertical axis so that their x-height is halved. (see figure 4 and column ‘B’). A third practice is to vertically condense the all letter glyphs so that the height of the stack matches the height of surrounding letters (see figure 23 and column ‘C’). Depending on x-height such size adjustments may be practical only for stacks of two letters.

5 Character Data

5.1 Character properties

In the format of UnicodeData.txt:

11A00;ZANABAZAR SQUARE LETTER A;Lo;0;L;;;;;N;;;;;
11A01;ZANABAZAR SQUARE VOWEL SIGN I;Mn;0;NSM;;;;;N;;;;;
11A02;ZANABAZAR SQUARE VOWEL SIGN UE;Mn;0;NSM;;;;;N;;;;;
11A03;ZANABAZAR SQUARE VOWEL SIGN U;Mn;0;NSM;;;;;N;;;;;
11A04;ZANABAZAR SQUARE VOWEL SIGN E;Mn;0;NSM;;;;;N;;;;;
11A05;ZANABAZAR SQUARE VOWEL SIGN OE;Mn;0;NSM;;;;;N;;;;;
11A06;ZANABAZAR SQUARE VOWEL SIGN O;Mn;0;NSM;;;;;N;;;;;
11A07;ZANABAZAR SQUARE VOWEL SIGN AI;Mc;0;L;;;;;N;;;;;
11A08;ZANABAZAR SQUARE VOWEL SIGN AU;Mc;0;L;;;;;N;;;;;
11A09;ZANABAZAR SQUARE VOWEL LENGTH MARK;Mc;0;L;;;;;N;;;;;
11A0A;ZANABAZAR SQUARE VOWEL SIGN REVERSED I;Mn;0;NSM;;;;;N;;;;;
11A0B;ZANABAZAR SQUARE VOWEL LENGTH MARK;Mc;0;L;;;;;N;;;;;
11A0C;ZANABAZAR SQUARE LETTER KA;Lo;0;L;;;;;N;;;;;
11A0D;ZANABAZAR SQUARE LETTER KA;Lo;0;L;;;;;N;;;;;
11A0E;ZANABAZAR SQUARE LETTER KHA;Lo;0;L;;;;;N;;;;;
11A0F;ZANABAZAR SQUARE LETTER KHA;Lo;0;L;;;;;N;;;;;
11A10;ZANABAZAR SQUARE LETTER GA;Lo;0;L;;;;;N;;;;;
11A11;ZANABAZAR SQUARE LETTER GA;Lo;0;L;;;;;N;;;;;
11A12;ZANABAZAR SQUARE LETTER KA;Lo;0;L;;;;;N;;;;;
11A13;ZANABAZAR SQUARE LETTER KA;Lo;0;L;;;;;N;;;;;
11A14;ZANABAZAR SQUARE LETTER TTA;Lo;0;L;;;;;N;;;;;
11A15;ZANABAZAR SQUARE LETTER TTA;Lo;0;L;;;;;N;;;;;
11A16;ZANABAZAR SQUARE LETTER DDA;Lo;0;L;;;;;N;;;;;
11A17;ZANABAZAR SQUARE LETTER DDHA;Lo;0;L;;;;;N;;;;;
11A18;ZANABAZAR SQUARE LETTER NNA;Lo;0;L;;;;;N;;;;;
11A19;ZANABAZAR SQUARE LETTER TA;Lo;0;L;;;;;N;;;;;
11A1A;ZANABAZAR SQUARE LETTER TA;Lo;0;L;;;;;N;;;;;
11A1B;ZANABAZAR SQUARE LETTER DA;Lo;0;L;;;;;N;;;;;
11A1C;ZANABAZAR SQUARE LETTER DA;Lo;0;L;;;;;N;;;;;
11A1D;ZANABAZAR SQUARE LETTER MA;Lo;0;L;;;;;N;;;;;
11A1E;ZANABAZAR SQUARE LETTER MA;Lo;0;L;;;;;N;;;;;
11A1F;ZANABAZAR SQUARE LETTER PHA;Lo;0;L;;;;;N;;;;;
11A20;ZANABAZAR SQUARE LETTER PHA;Lo;0;L;;;;;N;;;;;
11A21;ZANABAZAR SQUARE LETTER BHA;Lo;0;L;;;;;N;;;;;
11A22;ZANABAZAR SQUARE LETTER BHA;Lo;0;L;;;;;N;;;;;
11A23;ZANABAZAR SQUARE LETTER TSA;Lo;0;L;;;;;N;;;;;
11A24;ZANABAZAR SQUARE LETTER TSA;Lo;0;L;;;;;N;;;;;
5.2 Linebreaking

In the format of LineBreak.txt:

11A00; AL   # LETTER A
11A01..11A0A; CM # VOWEL SIGN I .. VOWEL LENGTH MARK
11A0B..11A32; AL # LETTER KA .. LETTER KSSA
11A33; CM # FINAL CONSONANT MARK
11A34; CM # SIGN VIRAMA
11A35..11A39; CM # SIGN CANDRABINDU .. SIGN VISARGA
11A3A; AL # LETTER CLUSTER INITIAL RA
11A3B..11A3E; CM # LETTER CLUSTER FINAL YA .. LETTER CLUSTER FINAL VA
11A3F..11A40; BB # INITIAL HEAD MARK .. CLOSING HEAD MARK
11A41; ZANABAZAR SQUARE TSHEG; Po; 0; L;;;;;N;;;;
11A42; ZANABAZAR SQUARE SHAD; Po; 0; L;;;;;N;;;;
11A43; ZANABAZAR SQUARE DOUBLE SHAD; Po; 0; L;;;;;N;;;;
11A44; ZANABAZAR SQUARE LONG TSHEG; Po; 0; L;;;;;N;;;;

5.3 ‘Confusable’ characters

Some Zanabazar Square letters resemble those found in other scripts encoded in the UCS:

11A0C LETTER KHA ; 0F41 TIBETAN LETTER KHA
11A0F LETTER NGA ; A843 PHAGS-PA LETTER NGA
11A12 LETTER JA ; A846 PHAGS-PA LETTER JA
11A12 LETTER DZA ; 0045 LATIN CAPITAL LETTER E
11A28 LETTER ZA ; 018E LATIN CAPITAL LETTER REVERSED E
11A28 LETTER ZA ; A855 PHAGS-PA LETTER ZA
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11A29 LETTER -A ; A855 PHAGS-PA LETTER SMALL A
11A2B LETTER RA ; A858 PHAGS-PA LETTER RA
11A2C LETTER LA ; A859 PHAGS-PA LETTER LA
11A2F LETTER SA ; 004E LATIN CAPITAL LETTER N
11A33 FINAL CONSONANT MARK ; 093C DEVANAGARI SIGN NUKTA
11A34 SIGN VIRAMA ; 0F84 TIBETAN MARK HALANTA
11A35 SIGN CANDRABINDU ; 0F83 TIBETAN SIGN SNA LDAN
11A3A LETTER CLUSTER INITIAL RA ; A872 PHAGS-PA SUPERFIXED LETTER RA
11A3C LETTER CLUSTER FINAL RA ; A871 PHAGS-PA SUBJOINED LETTER RA
11A3E LETTER CLUSTER FINAL VA ; A867 PHAGS-PA SUBJOINED LETTER WA
11A3F INITIAL HEAD MARK ; A874 PHAGS-PA SINGLE HEAD MARK
11A41 TSHEG ; 0F0B TIBETAN MARK INTERSYLLABIC TSHEG
11A42 SQUARE SHAD ; 0F0D TIBETAN MARK SHAD
11A43 SQUARE DOUBLE SHAD ; 0F0E TIBETAN MARK NYIS SHAD
11A44 SQUARE LONG TSHEG ; 0F14 TIBETAN MARK GTER TSHEG

There are two internal ‘confusable’ characters:

11A06 VOWEL SIGN OE ; 11A3A LETTER CONJUNCT INITIAL RA
11A20 LETTER PHA ; 11A3E INITIAL HEAD MARK

5.4 Syllabic categories

In the format of IndicSyllabicCategory.txt:

# Indic_Syllabic_Category=Bindu
11A35..11A38 ; Bindu # Mn [4] SIGN CANDRABINDU .. SIGN ANUSVARA

# Indic_Syllabic_Category=Visarga
11A39 ; Visarga # Mc SIGN VISARGA

# Indic_Syllabic_Category=Virama
11A33 ; Virama # Mn FINAL CONSONANT MARK
11A34 ; Virama # Mn SIGN VIRAMA

# Indic_Syllabic_Category=Vowel_Independent
11C00..11C0D ; Vowel_Independent # Lo LETTER A

# Indic_Syllabic_Category=Vowel_Dependent
11A01..11A06 ; Vowel_Dependent # Mn [6] VOWEL SIGN I .. VOWEL SIGN O
11A07..11A08 ; Vowel_Dependent # Mc [2] VOWEL SIGN AI .. VOWEL SIGN AU
11A09 ; Vowel_Dependent # Mn VOWEL SIGN REVERSED I
11A0A ; Vowel_Dependent # Mc VOWEL LENGTH MARK

# Indic_Syllabic_Category=Consonant
11A0B..11A32 ; Consonant # Lo [40] LETTER KA .. LETTER KSSA
11A3A ; Consonant # Lo LETTER CLUSTER INITIAL RA

# Indic_Syllabic_Category=Consonant_Subjoined
11A3B..11A3E ; Consonant_Subjoined # Mn [4] LETTER CLUSTER FINAL YA .. LETTER CLUSTER FINAL VA

5.5 Positional categories

In the format of IndicMatraCategory.txt:

# Indic_Matra_Category=Right
11A07 ; Right # Mc VOWEL SIGN AI
Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646

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11A0A ; Right # Mc VOWEL LENGTH MARK

# Indic_Matra_Category=Left
11A08 ; Left # Mc VOWEL SIGN AU

# Indic_Matra_Category=Top
11A01 ; Top # Mn VOWEL SIGN I
11A04..11A06 ; Top # Mn [3] VOWEL SIGN E .. VOWEL SIGN O
11A09 ; Top # Mn VOWEL SIGN REVERSED I

# Indic_Matra_Category=Bottom
11A02..11A03 ; Bottom # Mn [2] VOWEL SIGN UE .. VOWEL SIGN U
11A34 ; Bottom # Mn SIGN VIRAMA
11A39 ; Bottom # Mn FINAL CONSONANT MARK

6 References


Рагчааийн Бямбаа [Byambaa Ragchaagiin]. 2005. Занабазарын Дөрвөлжин Усег [Zanabazarin Dörböljin Üseg].


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The common Mongolian name for the script is Zanabazarin Dörboljin Useg. It is also known as Xewtee Dörboljin Bicig or in English as the Horizontal Square Script.

Vowel letter
11A00 𑨤 ZANABAZAR SQUARE LETTER A
- used for representing independent vowels in combination with vowel signs

Vowel signs
11A01 𑨥 ZANABAZAR SQUARE VOWEL SIGN I
11A02 𑨤 ZANABAZAR SQUARE VOWEL SIGN UE
11A03 𑨥 ZANABAZAR SQUARE VOWEL SIGN U
11A04 𑨤 ZANABAZAR SQUARE VOWEL SIGN E
11A05 𑨥 ZANABAZAR SQUARE VOWEL SIGN OE
11A06 𑨥 ZANABAZAR SQUARE VOWEL SIGN O
11A07 𑨤 ZANABAZAR SQUARE VOWEL SIGN AI
- also represents secondary vowel i
11A08 𑨤 ZANABAZAR SQUARE VOWEL SIGN AU
- also represents secondary vowel u

Reversed vowel sign
11A09 𑨥 ZANABAZAR SQUARE REVERSED VOWEL SIGN I
- used for Sanskrit vocalic sounds

Vowel length mark
11A0A 𑨤 ZANABAZAR SQUARE VOWEL LENGTH MARK

Consonants
11A0B 𑨤 ZANABAZAR SQUARE LETTER KA
- Mongolian ga, gamma
11A0C 𑨤 ZANABAZAR SQUARE LETTER KHA
- Mongolian ka, qa, xa
11A0D 𑨤 ZANABAZAR SQUARE LETTER GA
11A0E 𑨤 ZANABAZAR SQUARE LETTER GHA
11A0F 𑨤 ZANABAZAR SQUARE LETTER NGA
11A10 𑨤 ZANABAZAR SQUARE LETTER CA
11A11 𑨤 ZANABAZAR SQUARE LETTER CHA
11A12 𑨤 ZANABAZAR SQUARE LETTER JA
11A13 𑨤 ZANABAZAR SQUARE LETTER NYA
11A14 𑨤 ZANABAZAR SQUARE LETTER TTA
11A15 𑨤 ZANABAZAR SQUARE LETTER TTHA
11A16 𑨤 ZANABAZAR SQUARE LETTER DDA
11A17 𑨤 ZANABAZAR SQUARE LETTER DDHA
11A18 𑨤 ZANABAZAR SQUARE LETTER NNA
11A19 𑨤 ZANABAZAR SQUARE LETTER TA
- Mongolian da
11A1A 𑨤 ZANABAZAR SQUARE LETTER THA
- Mongolian ta
11A1B 𑨤 ZANABAZAR SQUARE LETTER DA
11A1C 𑨤 ZANABAZAR SQUARE LETTER DHA
11A1D 𑨤 ZANABAZAR SQUARE LETTER NA
11A1E 𑨤 ZANABAZAR SQUARE LETTER PA
- Mongolian ba
11A1F 𑨤 ZANABAZAR SQUARE LETTER PHA
- Mongolian pa
11A20 𑨤 ZANABAZAR SQUARE LETTER BA
- Mongolian va
- also used instead of non-initial 11A2D in conjuncts
11A21 𑨤 ZANABAZAR SQUARE LETTER BHA
11A22 𑨤 ZANABAZAR SQUARE LETTER MA
11A23 𑨤 ZANABAZAR SQUARE LETTER TSA
- Mongolian ja, Sanskrit ca

Final Consonant Mark
11A33 𑨤 ZANABAZAR SQUARE FINAL CONSONANT MARK
- used for marking a syllable-final consonant in Mongolian
- indicates a syllabic boundary in Mongolian

Virama
11A34 𑨤 ZANABAZAR SQUARE SIGN VIRAMA
- 0F84 𑨤 tibetan mark halanta
- indicates a bare consonant in Sanskrit and Tibetan
- used for producing subjoining conjuncts

Candrabindu and Candra Ornaments
11A35 𑨤 ZANABAZAR SQUARE SIGN CANDRABINDU
- indicates nasalization
- 0F83 𑨤 tibetan sign sna ldan
- 1880 𑦍 mongolian letter ali gali anusvara one
11A36 𑨤 ZANABAZAR SQUARE SIGN CANDRABINDU WITH ORNAMENT
- used primarily with 11A3F
11A37 𑨤 ZANABAZAR SQUARE SIGN CANDRA WITH ORNAMENT
- used primarily with 11A3F
- 0F82 𑨤 tibetan sign nyi zla naa da

Signs for Sanskrit
11A38 𑨤 ZANABAZAR SQUARE SIGN ANUSVARA
- indicates nasalization
- 0F7E 𑨤 tibetan sign rjes su nga ro
11A39 𑨤 ZANABAZAR SQUARE SIGN VISARGA
- indicates post-vocalic aspiration
- 0F7F 𑨤 tibetan sign mam bcad
Cluster-initial consonant

11A3A 𑩺 ZANABAZAR SQUARE LETTER CLUSTER
INITIAL RA
• initial form of 11A2B ཨ in Tibetan conjuncts

Cluster-final consonants

11A3B 𑩻 ZANABAZAR SQUARE LETTER CLUSTER
FINAL YA
• final form of 11A2A ི in Tibetan conjuncts
11A3C 𑩽 ZANABAZAR SQUARE LETTER CLUSTER
FINAL RA
• final form of 11A2B ཨ in Tibetan conjuncts
11A3D 𑩾 ZANABAZAR SQUARE LETTER CLUSTER
FINAL LA
• final form of 11A2C ཱི in Tibetan conjuncts
11A3E 𑩿 ZANABAZAR SQUARE LETTER CLUSTER
FINAL VA
• final form of 11A2D འ in Tibetan conjuncts

Head marks

11A3F 𑩭 ZANABAZAR SQUARE INITIAL HEAD MARK
→ 0FD3 ༊ tibetan mark initial brda rnying yig mgo mdun ma
→ 0F04 ད tibetan mark initial yig mgo mdun ma
→ 1800 ᠠ mongolian birga
11A40 𑩯 ZANABAZAR SQUARE CLOSING HEAD MARK
→ 0FD4 ་ tibetan mark closing brda rnying yig mgo sgab ma
→ 0F05 ཛ tibetan mark closing yig mgo sgab ma

Punctuation

11A41 𑩰 ZANABAZAR SQUARE TSHEG
→ 0F0B ༊ tibetan mark intersyllabic tsheg
11A42 𑩱 ZANABAZAR SQUARE SHAD
→ 0F0D ་ tibetan mark shad
11A43 𑩲 ZANABAZAR SQUARE DOUBLE SHAD
→ 0F0E ༌ tibetan mark nyis shad
11A44 𑩳 ZANABAZAR SQUARE LONG TSHEG
→ 0F14 ༄ tibetan mark gter tsheg
Figure 1: A block print of Zanabazar’s square script, from his collected works edited by the Khalkha Zaya Pandita Luvsanprinlei (1642–1715) (from Byambaa Ragchaagiin 2005: 33).
Figure 2: Folios 1a–2a of a treatise on Zanabazar Square by Ugalzyn Lama (from Byamba Ragchaagiin 2005: 49). Continued in figure 3.
Figure 3: Folios 3a–5a of a treatise on the Zanabazar Square script by Ugalzyn Lama (from Byambaa Ragchaagiin 2005: 50–51). Continued from figure 2.
Figure 4: A manuscript fragment containing text written in Ranjana (Lantsa), Soyombo, Zanabazar Square, and Tibetan scripts (from Tseveliin Shagdarsüürün 2001: 174).
Figure 5: A manuscript showing the Zanabazar Square script arranged according to the traditional Mongolian order (from Byambaa Ragchaagiin 2005: 36).
Figure 6: Folios 2a (top) and 2a (bottom) of a manuscript of the biography of Zanabazar (from Bareja-Starzyńska and Ragcha 2012; images used with permission of Byambaa Ragchool.
Figure 7: Zanabazar Square text at the bottom of a record written in Ranjana (from Tseveliin Shagdarsüreng 2001: 172).
Figure 8: Xylograph (block print) of a book cover with text in the Soyombo, Zanabazar Square, Mongolian, and Cyrillic scripts (from B. Boldsaikhan, et al. 2005: 330). The title is Sanskrit written in Soyombo: Mongal-svayambhu-jyoti-varṇa-lipiḥ. The Zanabazar Square represents Tibetan, the Mongolian represents Mongolian, and the Cyrillic represents Modern (Khalkha) Mongolian.
Figure 9: Characters of the Zanabazar Square script (from Kara 1972: 96). Note the variant form ◊ for ◇ VOWEL SIGN I and the variant form Ꞥ of Ꞥ GHA.
Figure 10: Characters of the Zanabazar Square script (from Kapaj 2002).
Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646
Anshuman Pandey

Figure 11: Description of Zanabazar Square letters (from Tsevelin Shagdarsüreng 2001: 160).

10 Р. Бямбов, Хэвтээ дөрөвлжин ёсэ, тууний дурсгалууд, Улаанбаатар, 1997, х.22-38.
13 Р. Бямбов, Хэвтээ дөрөвлжин ёсэ, тууний дурсгалуууд, Улаанбаатар, 1997, 90 х.
Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646

Anshuman Pandey

Figure 12: Description of Zanabazar Square letters (from Tseveliin Shagdarsüreng 2001: 161).
Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646  
Anshuman Pandey

Figure 13: Description of Zanabazar Square letters (from Tseveliin Shagdarsüreng 2001: 162).
Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646

Anshuman Pandey

Figure 14: Description of Zanabazar Square letters (from Tseveliin Shagdarsüreng 2001: 163).

7a.  第 14 任
    tc. mong. д. Энэ нь монгол хэлний урт б ээшихийн бие даасан буюу (IF) хэлбэр хэлбэр. Ур буюу уеийн эхинд тохиолдоно.

8.  第 14 任
    tc. mong. au (буюу diphtongue waw). Монгол хэлнэээ тохиолдоно. (Энэ хэлбэррийг жарсгаалтын No. 5-д дурдсан у ээшихий харьцуултаган).

9.  第 14 任
    tc. mong. ai (буюу diphtongue yod). Монгол хэлнэээ тохиолдоно. (Энэ хэлбэррийг жарсгаалтын No. 2-т дурдсан у ээшихий харьцуултаган).

10. 第 14 任
    tc. mong. G(a); тиб., санс.: K(a);
        tc. mong. ga; тиб., санс.: ka. Монгол хэлний ga, төвөө, самгард хэлний ka гийгүүлэхчийн бие даасан буюу (IF) хэлбэр.

11. 第 14 任
    tc. mong. K(a), тиб., санс.: KH(a);
        tc. mong. ka, тиб., санс.: kha. Монгол хэлний ka, төвөө, самгард хэлний kha гийгүүлэхчийн бие даасан буюу (IF) хэлбэр.

12. 第 14 任
    tc. mong. n, тиб., санс.: N(a);
        tc. mong., тиб., санс.: na. Монгол хэлнэээ улам буюу уеийн эхинд тохиолддогий. Төвөө, самгард хэлний la гийгүүлэхчийн бие даасан (IF) хэлбэр. Монгол хэлний тухайд зөвлөх гол буюу (MF) хэлбэрээр тохиолддог.

13. 第 14 任
    tc. mong. ja, тиб., санс.: ca. Монгол хэлний ja, төвөө, самгард хэлний sa гийгүүлэхчийн бие даасан буюу (IF) хэлбэр.

14. 第 14 任
    tc. mong. ca, тиб., санс.: cha. Монгол хэлний ca, төвөө, самгард хэлний cha гийгүүлэхчийн бие даасан буюу (IF) хэлбэр.

15. 第 14 任
    tc. тиб., санс.: Na. Төвөө, самгард хэлний па гийгүүлэхчийн бие даасан (IF) хэлбэр.

16. 第 14 任
    tc. mong. D(a), тиб., санс.: T(a);

17. 第 14 任
    tc. mong. T(a), тиб., санс.: TH(a);
        tc. mong. ta, тиб., санс.: tha. Монгол хэлний ta, төвөө, самгард хэлний tha гийгүүлэхчийн бие даасан буюу (IF) хэлбэр.
18. tl. mong., tib., sans. N(a);
tc. mong., tib., sans. na. Монгол, төвөө, самбард хэлний нь гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

19. tl. mong. ba, tib., sans.: P(a);
tc. mong. ba, tib., sans.: pa. Монгол хэлний ба, төвөө, самбард хэлний па гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

20. tl. mong. P(a), tib., sans. PH(a);
tc. mong. pa, tib., sans.: pha. Монгол хэлний па, төвөө, самбард хэлний пха гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

21. tl. mong., tib., sans. M(a);
tc. mong., tib., sans. ma. Монгол, төвөө, самбард хэлний май гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

22. tl. mong., tib.: Y(a), sans. (semi-vowel) Y(a);
tc. mong., tib.: ya, sans. (semi-vowel) ya. Монгол, төвөө хэлний я, самбард хэлний тал (буюу хагас) я гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

23. tl. mong., tib.: R(a), sans. (semi-vowel) R(a);
tc. mong., tib.: ra, sans.: (semi-vowel) ra. Монгол, төвөө хэлний ра, самбард хэлний тал (буюу хагас) ра гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

24. tl. mong., tib., l(a), sans.: (semi-vowel) L(a);
tc. mong., tib., la, sans.: (semi-vowel) la. Монгол, төвөө хэлний ла, самбард хэлний тал (буюу хагас) ла гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

25. tl. mong., tib., V(a), sans.: (semi-vowel) V(a);
tc. mong., tib., va, sans.: (semi-vowel) va. Монгол, төвөө хэлний ва, самбард хэлний тал (буюу хагас) ва гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

26. tl. mong. Š(a), tib., sans.: Č(a) / Š(a).
tc. mong. ša, tib., sans.: ča / sa. Монгол хэлний ša, төвөө, самбард хэлний čа / sa гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

27. tl. mong., tib., sans. S(a);
tc. mong., tib., sans. sa. Монгол, төвөө, самбард хэлний sa гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

28. tl. mong., tib. H(a), sans.: (semi-vowel) H(a);
tc. mong., tib., ha, sans.: (semi-vowel) ha. Монгол, төвөө хэлний ha, самбард хэлний тал (буюу хагас) ha гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

29. tl. sans. KS(a);
tc. sans. ksa. Самбард хэлний ksa гийгүүлэгчийн бие даясан буюу (IF) хэлбэр.

Figure 15: Description of Zanabazar Square letters (from Tseveliin Shagdarsüreng 2001: 164).
Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646

Anshuman Pandey

<table>
<thead>
<tr>
<th>Step</th>
<th>Transliteration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>tl. sans. T(a);</td>
<td>Samgard xelni tla giygulgeciin bie daasan buuoy (IF) xelbэр.</td>
</tr>
<tr>
<td>31</td>
<td>tl. sans. TH(a);</td>
<td>Samgard xelni tha giygulgeciin bie daasan buuoy (IF) xelbэр.</td>
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<tr>
<td>32</td>
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<td>Samgard xelni da giygulgeciin bie daasan buuoy (IF) xelbэр.</td>
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<td>Samgard xelni dha giygulgeciin bie daasan buuoy (IF) xelbэр.</td>
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<td>Samgard xelni na giygulgeciin bie daasan buuoy (IF) xelbэр.</td>
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<td>Teved xelni za giygulgeciin bie daasan buuoy (IF) xelbэр.</td>
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<td>Teved xelni za giygulgeciin bie daasan buuoy (IF) xelbэр.</td>
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</tbody>
</table>

Figure 16: Description of Zanabazar Square letters (from Tseveliin Shagdarsüürün 2001: 165).
tl. sans. D(a);
tc. sans. da. Самгард хэлний да гийгүүлэгчийн бие даасан буюу (IF) хэлбэр.

44. tl. sans. DH(a);
tc. sans. dha. Самгард хэлний dha гийгүүлэгчийн бие даасан буюу (IF) хэлбэр.

45. tl. sans. B(a) / P(a);
tc. sans. ba / pa. Самгард хэлний ba / pa гийгүүлэгчийн бие даасан буюу (IF) хэлбэр.

46. tl. sans. BH(a);
tc. sans. bha. Самгард хэлний bha гийгүүлэгчийн бие даасан буюу (IF) хэлбэр.

47. tl. sans. R / Ri;
tc. sans. r / ri. Самгард хэлний r / ri эгшигийн бие даасан буюу (IF) хэлбэр.

47.a. tl. sans. R / Ri;
tc. sans. r / ri. Самгард хэлний урт r / ri эгшигийн бие даасан буюу (IF) хэлбэр.

48. tl. sans. L / Li;
tc. sans. l / li. Самгард хэлний l / li эгшигийн бие даасан буюу (IF) хэлбэр.

48.a. tl. sans. L / Li;
tc. sans. l / li. Самгард хэлний урт l / li эгшигийн бие даасан буюу (IF) хэлбэр.

49. tl. tib., sans. Kr(a);
tc. tib., sans. kra. Төвед, самгард хэлний нийлэмэг (буюу га зүүлтэй) кө гийгүүлэгчийн бие даасан буюу (IF) хэлбэр.

Figure 17: Description of Zanabazar Square letters (from Tseveliin Shagdarsü burglary 2001: 166). Note the use of ◯ VOWEL SIGN REVERSED i for writing r, f, l, l.
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Figure 18: Description of Zanabazar Square letters (from Tseveliin Shagdarsüürün 2001: 167).
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Figure 19: Description of Zanabazar Square letters (from Tseveli in Shagdarsürgü 2001: 168).
Figure 20: Description of the letters $\text{DH}$ $\text{SSA}$, $\text{I} \text{CA}$, $\text{II} \text{CHA}$, $\text{E} \text{JA}$, which are not enumerated in traditional charts (from Byambaa Ragchaagiin 2005: 32).
Figure 21: Excerpt from a folio shown in figure 3 illustrating Zanabazar Square text written vertically. The text is *haṃksamalavaraya*, which may be incorrectly interpreted as a conjunct representing *hkṣmlvryaṃ*.

Figure 22: Seal showing the word ठालिम thalīṃ written vertically in the Zanabazar Square script (from Byambaa Ragehaagiiin 2005: 97). Note the use of ः-A instead of ◯, VOWEL LENGTH MARK for indicating *ī*. Also note the combining signs for ल LA placed above ढ THA.
Figure 23: A manuscript containing text in Soyombo and Zanabazar Square (from Tseveliin Shagdarsüriin 2001: 173). Note the sizing of consonant stacks, such that the letters are reduced so that the height of the stack matches the regular letter height.

Figure 24: Folio showing Sanskrit written in Zanabazar Square (from Byambaa Ragchaagiin 2005: 103). Conjuncts with the full forms of या, रा, and बा as C₂ are shown: या yā, रा brā, बा mba, रा mprā, ला lva. Also shown is the conjunct न्दḥa.
Figure 25: Folio showing the conjunct ㄪ sṭa (from Byambaa Ragchaagiin 2005: 103). Compare to the form of the conjunct shown in figure 26.

Figure 26: Detail of manuscript from figure 4 showing the conjunct sṭa written as ㄪ instead of the expected ㄪ. Here the ta is represented with a reversed form ㄵ of ㄵ ta instead of ㄵ tā. See section 4.7.4 for more information on the use of reversed letters in Zanabazar Square. The other conjunct involving ssa in this folio is ㄵ sṭa, which is written as expected.
Figure 27: The use of 𑙢, a reversed form of 𑙡 NA, instead of 𑙢 NNA for writing the Sanskrit retroflex ṇa in the word 𑙢𑙢𑙢 maṇi (excerpted from Bareja-Starzyńska and Ragchaa 2012: folio 7a).

Figure 28: Usage of the variant form 𑙢 (highlighted in red) of 𑙢 NA (highlighted in blue) (from Byambaa Ragchaagiiin 2005: 85). There is no semantic distinction between the variant and normative form; they both represent ṇa.

Figure 29: Excerpt from a folio shown in figure 3 illustrating the usage of SIGN CANDRABINDU.
In the top folio, **virama** occurs with \( \text{ ra } \) in \( \text{ kasyabar } \) (\( \text{ kasyapah } \) “Kasyapa” is likely intended). The expected representation of the phrase is \( \text{ kasyabar-sarva-kulādhipatyā } \) “Kasyapa, the sovereign of all clans”; the \( \text{ h } \) is written as \( \text{ r } \) due to incorrect application of sandhi. In the middle folio the **virama** occurs with \( \text{ ma } \) twice in the phrase \( \text{ śubhamstu-sarva-jagatam } \) “may there be auspiciousness in all the world”; the use of **virama** in \( \text{ śubham } \) is curious because in Sanskrit the word would join with the following \( \text{ stu } \) (correct: \( \text{ astu } \)) as \( \text{ śubhamastu } \). In the bottom folio the **virama** occurs with \( \text{ da } \) in the word \( \text{ hyavatad } \) (correct: \( \text{ hyavadat } \)) “thusly explained”.

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**Figure 30:** Folios showing usage of the **virama** (from Byambaa Ragchaagiin 2005: 113–114). In the top folio, **virama** occurs with \( \text{ ra } \) in \( \text{ kasyabar } \) (\( \text{ kasyapah } \) “Kasyapa” is likely intended). The expected representation of the phrase is \( \text{ kasyabar-sarva-kulādhipatyā } \) “Kasyapa, the sovereign of all clans”; the \( \text{ h } \) is written as \( \text{ r } \) due to incorrect application of sandhi. In the middle folio the **virama** occurs with \( \text{ ma } \) twice in the phrase \( \text{ śubhamstu-sarva-jagatam } \) “may there be auspiciousness in all the world”; the use of **virama** in \( \text{ śubham } \) is curious because in Sanskrit the word would join with the following \( \text{ stu } \) (correct: \( \text{ astu } \)) as \( \text{ śubhamastu } \). In the bottom folio the **virama** occurs with \( \text{ da } \) in the word \( \text{ hyavatad } \) (correct: \( \text{ hyavadat } \)) “thusly explained”.

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Figure 31: Usage of ◆ FINAL CONSONANT MARK for representing Mongolian final consonants (from Byambaa Ragchaagiin 2005: 63).

Figure 32: Excerpt from the last folio in figure 3 showing usage of ◆ FINAL CONSONANT MARK in Tibetan text. Here, its usage departs from its normative behavior in marking syllable-final consonants and occurs after conjuncts and vowels, functioning more like a below-base ’TSHEG than a final-consonant mark. For example it occurs with བེ bla (first syllable), དེ yi (third syllable), གྲ kyi (ninth syllable), among others. Agata Bareja-Starzyńska suggests that text (a Tibetan prayer) may have been added to the manuscript by another scribe, who did not fully know the Zanabazar Square script, as the usage of FINAL CONSONANT MARK here differs from that of the primary text of the original author.
Figure 33: Manuscript excerpt showing usage of the ◁ FINAL CONSONANT MARK with ᳝-a for indicating word-final ᳝ ’a (from Byambaa Ragchaagiin 2005: 51).

Figure 34: A seal showing the variant form ◁ of ◁ FINAL CONSONANT MARK for representing the Mongolian final consonant ng: ᳝ for ᳝ (from Byambaa Ragchaagiin 2005: 60).
Figure 35: Portion containing Zanabazar Square text from figure 8 showing usage of the variant form ꜁ for ꜂ -ə in the words ꜂ ꜁ pa’i and ꜂ ꜁ ’bri. Details courtesy of Agata Bareja-Starzyńska.

Figure 36: Zanabazar Square document showing the word thalīm written vertically with ꝁ, the reversed form of ꜂ -ə; see also figure 22 (from Byambaa Ragchaagiin 2005: 97).

Figure 37: Excerpt of the second folio from figure 5 showing the sequence “🏰.SaveChangesAsync” dza dzha va . da dha . in the traditional arrangement of the script. Note the appearance of “🏰” <va, shad> as ꝁ and “🏰” <dha, shad> as ꝃ.
Figure 38: Manuscript showing the variant form 𑙂 of 𑗬 va in the phrase 𑗬𑗦𑗟𑗟𑗟𑗦 𑗫𑗟𑗟𑗟𑗂 ha nu va ša va ra hi svā hā (from Byambaa Ragchaagiin 2005: 98). Note the variant form ◊ of ◊ VOWEL SIGN U in 𑗦 nu and the variant form ◊ of the subjoined form ◊ of 𑗬 va in the conjunct ◊ svā.

Figure 39: Manuscript showing the word 𑗬𑗦𑗦𑗦𑗦𑗦𑗦 sva (svāhā) written with the conjunct ◊ sba (from Byambaa Ragchaagiin 2005: 98).
Figure 40: Variations of the ँ INITIAL HEAD MARK written as a bare mark as well as with various ornaments. See section 4.11 for details.
Figure 41: Manuscript showing usage of the head mark ཙ (from Byambaa Ragchaagiin 2005: 97). This mark corresponds to the Tibetan ཉ. For purposes of the encoding, it is considered a glyphic variant of ཙ and is to be produced using ཙ INITIAL HEAD MARK, ཙ CLOSING HEAD MARK. Note also the usage of the ཙ LONG TSHEG, corresponding to the Tibetan $ mark.

Figure 42: Two manuscript excerpts showing elongation of the ཙ VOWEL SIGN AI at the end of a text (top from Bareja-Starzyńska and Ragcha 2012; bottom from Byambaa 2005: 87). In both excerpts, elongation occurs in the Mongolian word boltugai “let it be”, which is written at top as ཟུག སུལ སུལ སུལ boltugai and at bottom as ཟུག སུལ སུལ སུལ boltugai. This form of VOWEL SIGN AI is a stylistic variation. Details provided by Agata Bareja-Starzyńska.
Figure 43: Mongolian diphthongs (from Byambaa Ragchaagiin 2005: 85). Shown in red is Ꙙ kūi; in blue is ꙗ kui; in black is Ꙗ gei; in green is Ꙙ loi. See section 4.4 for details on the representation of these diphthongs. Note also the use of the variant form Ꙙ for Ꙙ VOWEL SIGN AI.

Figure 44: The Mongolian diphthong ĕū in Ꙙ theū (from Byambaa Ragchaagiin 2005: 86).

Figure 45: The Mongolian diphthong ĕi in Ꙙ gēi (from Bareja-Starzyńska and Ragcha 2012).
Figure 46: Detail of the specimen in figure 8 showing usage of ’tšheg for marking syllabic boundaries in the sentence ཕོབ་པའི་ཡི་གེ་སྲབས་ཡི་མོ bhu jyo ti ’bri tshul bzhugs so.

Figure 47: Detail of a folio showing usage of ’tšheg for marking syllabic boundaries in the Zanabazar Square phrase རྒྱ་དཀར་སྐད་དུ rgya gar skad du (from Byambaa Ragchaagiin 2005: 107).
Figure 48: Folio showing usage of a variant form of $\mathcal{O}$ VOWEL SIGN AI used for writing $\mathfrak{ma}$ (from Byambaa Ragchaagiin 2005: 113).

Figure 49: Folio showing usage of a variant form of $\mathcal{O}$ VOWEL SIGN AU used for writing $\mathfrak{trau}$ (from Byambaa Ragchaagiin 2005: 113).
<table>
<thead>
<tr>
<th>Zanabazar Square</th>
<th>Phags-pa</th>
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<th>Tibetan (dbu med)</th>
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Table 8: Comparison of consonant letters of Zanabazar Square, Phags-pa, and Tibetan.
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Table 9: Comparison of consonant letters of Zanabazar, Phags-pa, Soyombo, and Tibetan.
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</tbody>
</table>

Table 10: Comparison of vowels of Zanabazar Square, Phags-pa, Soyombo, and Tibetan.
PROPOSAL SUMMARY FORM TO ACCOMPANY SUBMISSIONS
FOR ADDITIONS TO THE REPERTOIRE OF ISO/IEC 10646

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


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 for latest Roadmaps.

A. Administrative

1. Title: Proposal to Encode the Zanabazar Square Script in ISO/IEC 10646

2. Requester's name: Script Encoding Initiative (SEI) / Anshuman Pandey (pandey@umich.edu)

3. Requester type (Member body/Liaison/Individual contribution): Liaison contribution


5. Requester's reference (if applicable): 

6. Choose one of the following:
   - This is a complete proposal: Yes
   - (or) More information will be provided later: 

B. Technical – General

1. Choose one of the following:
   - a. This proposal is for a new script (set of characters):
      - Proposed name of script: Zanabazar Square
   - b. The proposal is for addition of character(s) to an existing block:
      - Name of the existing block: 

2. Number of characters in proposal: 69

3. Proposed category (select one from below - see section 2.2 of P&P document):
   - A-Contemporary
   - B.1-Specialized (small collection)
   - B.2-Specialized (large collection)
   - C-Major extinct
   - D-Attested extinct
   - E-Minor extinct
   - F-Archaic Hieroglyphic or Ideographic
   - G-Obscure or questionable usage symbols

4. Is a repertoire including character names provided? Yes
   - a. If YES, are the names in accordance with the “character naming guidelines” in Annex L of P&P document? Yes
   - b. Are the character shapes attached in a legible form suitable for review? Yes

5. Fonts related:
   - a. Who will provide the appropriate computerized font to the Project Editor of 10646 for publishing the standard? Anshuman Pandey
   - b. Identify the party granting a license for use of the font by the editors (include address, e-mail, ftp-site, etc.): Anshuman Pandey (pandey@umich.edu)

6. References:
   - a. Are references (to other character sets, dictionaries, descriptive texts etc.) provided? Yes
   - b. Are published examples of use (such as samples from newspapers, magazines, or other sources) of proposed characters attached? No

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)? Yes

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 Unicode Character Database (http://www.unicode.org/reports/tr44/) and associated Unicode Technical Reports for information needed for consideration by the Unicode Technical Committee for inclusion in the Unicode Standard.

---

### C. Technical - Justification

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes/No</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has this proposal for addition of character(s) been submitted before?</td>
<td></td>
<td>Complete revision of N4471 L2/13-198; see “Introduction” for list of major changes.</td>
</tr>
<tr>
<td>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.)?</td>
<td></td>
<td>Agata Bareja-Starzyńska (University of Warsaw, Poland)</td>
</tr>
<tr>
<td>3. Information on the user community for the proposed characters (for example: size, demographics, information technology use, or publishing use) is included?</td>
<td></td>
<td></td>
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<tr>
<td>4. The context of use for the proposed characters (type of use; common or rare)</td>
<td></td>
<td>Rare</td>
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<tr>
<td>5. Are the proposed characters in current use by the user community?</td>
<td></td>
<td>By scholars of Mongolian culture, history, and linguistics</td>
</tr>
<tr>
<td>6. After giving due considerations to the principles in the P&amp;P document must the proposed characters be entirely in the BMP?</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>7. Should the proposed characters be kept together in a contiguous range (rather than being scattered)?</td>
<td>Yes</td>
<td></td>
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<tr>
<td>8. Can any of the proposed characters be considered a presentation form of an existing character or character sequence?</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9. Can any of the proposed characters be encoded using a composed character sequence of either existing characters or other proposed characters?</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>10. Can any of the proposed character(s) be considered to be similar (in appearance or function) to, or could be confused with, an existing character?</td>
<td>No</td>
<td></td>
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<tr>
<td>11. Does the proposal include use of combining characters and/or use of composite sequences?</td>
<td>Yes</td>
<td>Combining signs</td>
</tr>
<tr>
<td>12. Does the proposal contain characters with any special properties such as control function or similar semantics?</td>
<td>Yes</td>
<td>Virama; see text of the proposal</td>
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<tr>
<td>13. Does the proposal contain any Ideographic compatibility characters?</td>
<td>No</td>
<td></td>
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</tbody>
</table>