ASCII Phonetic Symbols for the World's Languages: Worldbet

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Abstract

A new ASCII encoding of the International Phonetic Alphabet (IPA) and additional symbols for speech database labeling has been designed for all languages. Many of the previous ASCII versions of the IPA were targeted at European languages and therefore left out many of the sounds of the other languages or used IPA symbols for non-European sounds like clicks, for plosive bursts. When an attempt was made to label a large number of languages with phonemic and phonetic symbols, these were found to be inadequate. The present scheme borrows on earlier work by George Allen, Ian Maddieson, John Wells, Laver et al. and Hieronymus et al. Wherever possible, the present scheme was made similar to the base IPA symbols, so that many of the symbols will seem to have obvious meanings. Many of the symbols are the same as other schemes. The underlying principle is that any spectrally and temporally distinct speech sound (not including pitch) which is phonemic in some language should have a separate base symbol. In most cases the base symbol consists of a concatination of an IPA symbol and diacritics. Thus it is easy to recognize the phonemic base symbols and compare the same broad phonetic sound across languages. Tone languages have diacritics applied to the vowel phoneme symbols to properly identify the phonemes in these languages. Allophonic variations due to contextural coarticulation and stress may be labelled by a diacritic attached to the base symbol. It is possible that some speech sounds which are phonemic in at least one of the world's languages, are missing from the present version. It is hoped that any oversights will be corrected in subsequent versions of Worldbet, and a standard method for constructing new symbols is presented.

Introduction

Many systems have been developed for writing the sounds of the world's languages. Many of the early workers made their own systems because there was no agreed standard or indeed knowledge of the complete speech sound inventory. The International Phonetic Alphabet was developed in 1888 and revised several times into its present form. It represents 105 years of experience with putting a symbol to each sound in all of the known languages in the world. The issues of economy of representation and the distinction between allophonic variation and true baseform sound have been worked out for many more languages since the IPA was originally formulated. Therefore it is a good place to begin for any multilanguage speech database labelling effort.

There are some sounds which are not normally included in the IPA which have been found to be useful in labelling large speech corpora like TIMIT, SCRIBE, BDSONS, and PHONDAT. These modern attempts at a standard ascii form of the IPA resulted in TIMITBET, MRPA, SAMPA, and SAMPA Extended to name a few of them. These phonetic alphabets were restricted to English or to European languages, and thus were too restricted in scope to be used in other major language families. The issue is whether or not the ascii representation is consistent, complete and logical for all of the IPA symbols.

Worldbet is an attempt to have a phonetic alphabet which covers all of the world's languages in a systematic fashion. It is an ascii version of the IPA plus a number of symbols which were found useful in database labelling, which are not currently in the official IPA set. This list of extra symbols may grow with time until all of the important phenomena have a coherent symbol representation.

This paper is organized to first cover the general principles of Worldbet, discuss earlier labeling sets, give specific symbol assignments, and discuss labeling methods. In Appendix A is an exhaustive list the Worldbet symbols and their corresponding labels in a few other systems, namely TIMITBET, SAMPA and JBET a phonetic alphabet used in speech synthesis. Appendix B is a table of place and manner of articulation v.s. Worldbet symbols. In Appendix C there are examples of Worldbet symbol inventories for several languages.

General Principles

Worldbet is an ASCII version of International Phonetic Alphabet (IPA) with additional broad phonetic symbols not presently in the IPA. It is designed for a large set of languages including Indian, Asian, African and European languages. Considerations of the special sounds in each of these languages lead to the principle that each base symbol will represent a speech sound with a spectrally distinct time sequence. Each type of /r/ will have its separate IPA like designation, rather than the more graphemic r used in some label sets. Allophones like aspirated plosives will have a separate base symbol from unaspirated plosives, if they are phonemic within the language in question, otherwise they will be marked using the base symbol plus diacritic). Distinct means to be so different spectrally or temporally as to be perceptually different, when the components are heard in isolation.

Vowels are classed into nominal place positions. It is recognized that the detailed vowel color may vary between languages for the same nominal vowel, yet separate symbols will be assigned only when the differences are large enough to constitute different phonemes. In actual labeling experience it has been found that most of the differences in phonetic labels between trained phoneticians were due to disagreements on the detailed vowel color, rather than the actual broad vowel color.

Therefore, Worldbet base symbols will represent phonemic distinctions in some language, as in the plosive example. The base symbols are thus meant to be broad phonetic, but can be used as surface phonemic symbols within a given language (as stated in the original principles of the IPA [1]). Since the IPA has been in use for over 100 years and has been actively developed and evolved over this period [2], it should have all of the phonemic distinctions observed in the world's languages to date. Therefore it is the natural starting point for any attempt to construct a phoneme set which is sufficient to cover all of the languages in the world.

Diacritics are used in general to modify the base symbols to deal with allophones which are due to coarticulation effects (i.e.: labialized /s/ in the environment of /w/), or phonological context effects. The diacritic allows the particular allophone to be marked, which has as its base character the phonemically based broad phone which is the origin of this allophone. Of course it is not always easy to determine what is an allophonic variation and what is a change of broad phonetic category. Normally the number of symbols to be used to label a particular language will be limited, to keep from having an overly large label inventory.

The motivating factor for Worldbet is to label speech for corpus driven speech research, phonological inventories, automatic language identification, multi-language speech recognition, and multi-language speech synthesis. It should also be useful in constructing multi-lingual dictionaries. In all of the above uses it is most convenient to have each sound labeled with a particular symbol closely resemble all other sounds with the same label, no matter in which language it is uttered.

Previous Label Sets

Past work on ascii to ipa symbol sets was reviewed including the Klatt phonbet (Allen et al. [3]), the PHONASCII system (Allen [4]), Arpabet used in the first ARPA Speech Understanding Project [5], TIMITBET used in labelling the DARPA Acoustic Phonetic Database which was collected by Texas Instruments and labelled by MIT [6], the Esprit Speech Assessment Methodology Phonetic Alphabet (SAMPA [7]), the Edinburgh Machine Readible Phonetic Alphabet (MRPA [8]), the Alvey Project Phonetic alphabet [9], and the SCRIBE project phonetic label set (SAMPA Extended) [10]. These were generally concerned with one or a few Indo-European Languages, and thus are missing a number of the symbols needed for other languages. For SAMPA some simpilifying assumptions were made because it was thought that they would be used for transcription within one language, not across languages. This leads to the same symbol being used for quite different sounds, most notably for /r/.

An effort for world wide ASCII to IPA coverage by Ian Maddieson [11] of UCLA was thought to be too complicated for the present application. It is a more detailed label set aimed at fine phonetic distinctions in all the world's languages. It does not distinguish between diacritics and baseforms. With the full set of diacritics in Worldbet it should be possible to have the same level of detail, with the proviso that phonemes with multiple places of articulation might have to have baseform symbols assembled using the Worldbet linking character . A new ascii version for the IPA which has been developed on the sci.lang email news group [12] has also been examined, but seems to suffer from too few languages being considered in detail. It is supposed to be used in email discussions of phonetics and phonology. It is a full encoding of the IPA and has some common symbols with Worldbet.

PHONASCII, the ascii IPA symbol set by George Allen [4] is the closest to having the symbols required, but has added symbols for studying speech disorders and child language acquisition. Some of the constructions of affricates had the wrong fricative symbol and some of the monophthong vowels had two character symbols, which makes the construction of diphthongs awkward. Otherwise it is a complete encoding of the IPA set.

In Worldbet each IPA baseform symbol is represented by two ASCII normal characters which may differ in case (giving around 2,900 possibilities). Currently we are using 299 symbols. One of these characters may be a space. This fixed length baseform allows a unique specification, and ease in computer processing. It is envisioned that Worldbet will be used in computer speech synthesis and recognition, as well as hand labelling of speech in many languages. It becomes very important in this context that each symbol represent only one type of sound and that phonemes which have different forms across languages have a unique symbol for each form. Keeping a two character baseform will in practice prove to be unattainable for rare phonemes, for example all double articulations constructed with the linking symbol -. In Worldbet there are some symbols which go beyond the IPA set in an attempt to attain this goal, particularly for plosives.

Specific Symbol Assignments

Generally the Worldbet symbol will be as close as possible to the corresponding IPA symbol. For the more unusual IPA symbols this is more difficult, and is sometimes only true in the most abstract sense. An effort has been made to consistantly assign vowel and consonant symbols. The collection of phonemes from the UCLA Phonological Segment Inventory Database (UPSID) was examined to make sure that Worldbet covered all those used by 10 or more languages listed in Patterns of Sound by Maddieson [11].

Monophthong vowels will have base symbols which are usual vowel symbols orthographically (i.e. a, A, o, O) and numbers (2, 3, 4, 5, 6, 7, and 8). Most of these will be single printing symbols. This is so that the base diphthongs and free and checked vowels can be constructed of two characters. Since phonologically free and checked vowels are supposed to differ only in length, and not in spectral properties in the various languages (e.g.: /i/ in English is free and usually written [i:] phonetically. But it is a checked vowel in Dutch and written [i] phonetically.) the simple addition of the symbol : for long, allows this distinction to be represented easily in two characters. The numerals 0 and 1 are not used for base symbols because of their confusibility with the letters o and l.

Diphthongs are constructed by concatenating the two monophthong symbols which represent the endpoint vowels. While the present list contains many of the diphthongs seen in European languages, this list is not presently exhaustive. New diphthongs can be constructed by concatinating the two vowel symbols corresponding to the beginning and ending vowels of the diphthong.

Consonants can be two characters, since they do not always come in long and short versions. Many long consonants are actually geminates. It is recommended that geminates be transcribed as two consonants. Items like nasalization, rhotization and aspiration will be explicity represented in the baseform, since they are phonemic in many languages. If it is found that consonant length is phonemic in some language, then _: will be added as a diacritic, as outlined below. See Table 1 for a comparison of IPA to Worldbet base symbols, and Table 2 for diacritics and suprasegmentals. Exhaustive symbol tables are shown in Appendix A. A phoneme set for 12 languages are shown in Appendix B. Presently Danish, Dutch, English, French, German, Hindi, Japanese, Mandarin Chinese, Russian, Castillian Spanish, and Tamil are listed.

CONSONANTS

The Worldbet representation of each IPA symbol is written below it. IPA symbols in parentheses are rare phonemes, for which no machine-readable coding has yet been proposed. (In these cases a coding employing diacritics is proposed.)

	Bi-labial	Labio-dental	Dental	Alveolar	Post-alveolar	Retro-flex	Palatal	Velar	Uvular	Pharyn-geal	Glottal
Plosive	p b p b			t d t d		ʈ ɖ tr dr	c ɟ c J	k ɡ k g	q ɢ q Q		ʔ ?
Nasal	m m	ɱ M		n n		ɳ nr	ɲ n∼	ŋ N	(ɴ) Nq		
Trill	ʙ B			r r					ʀ R		
Tap or Flap				$ɾ_t$ $ɾ_d$ t(d(	$ɾ_r$ r(	ɽ rr					
Fricative	ɸ β F V	f v f v	θ ð T D	s z s z	ʃ ʒ S Z	ʂ ʐ sr zr	ç (ʝ) C j∧	x ɣ x G	χ ʁ X K	ħ ʕ H !	h (ɦ) h hv
Lateral fricative				(ɬ) (ɮ) hl Zl							
Approxi-mant		(ʋ) V[		ɹ 9		ɻ 9r	j j	(ɰ) 4)			
Lateral approx.				l l		ɭ lr	ʎ L	(ʟ) Lg			
Ejective stop	p' p>			t' t>		ʈ' t>_r	c' c>	k' k>	q' q>		
Implosive	ɓ p<b<			ɗ t< d<			 c< J<	ƙ ɠ k< g<	 q<Q<		

VOWELS

	Front		Central		Back
Close	i y i y		ɨ ʉ ix ux		ɯ u 4 u
		ɪ ʏ I Y	ɪ̈† Ix	ʊ U	
Close-mid	e ø e 7				ɤ o 2 o
			ə ɵ & ox		
Open-mid	ɛ œ E 8				ʌ ɔ ∧ >
	æ @		ɐ ax		
Open	a ɶ a 6				ɑ ɒ A 5

†= ɪ̈is not an approved IPA symbol, but it is in such common use that we have propose Ix as the most natural ASCII representation for a "centralized ɪ".

TABLE 1: Worldbet Consonant and Vowel Symbols

DIACRITICS

The Worldbet representations are on the right of each column.

̥	Voiceless	0	(̹)	More rounded	(w)	ʷ	Labialized	w	̃	Nasalized	~
̬	Voiced	v	(̜)	Less rounded		ʲ	Palatalized	j	ⁿ	Nasal release	n
ʰ	Aspirated	h	̟	Advanced	+	ˠ	Velarized	2	ˡ	Lateral release	l
̤	Breathy voiced	Hv	̠	Retracted	-	ˤ	Pharyngealized	!	̚	No audible release	c
̰	Creaky voiced	?	̈	Centralized	x	(~)	Velarized or Pharyngealized ("emphatic")				
̼	Linguolabial	{	̽	Mid-centralized	x	̝	Raised	^		Velar place	g
̪	Dental	[	̩	Syllabic	=	̞	Lowered	/		Uvular place	q
̺	Apical	]	̯	Non-syllabic	(		Unaspirated	*	(̘)	Advanced Tongue Root	¿
̻	Laminal	}	˞	Rhoticity/retroflexion	r	ˀ	Glottalized	?	(̙)	Retracted Tongue Root	¡

SEGMENTAL TONE

Shown on the vowel e.

’e’	extra high tone	e_9
é	high tone	e_7
ē	mid tone	e_5
è	low tone	e_3
‘e‘	extra low tone	e_1

SUPRASEGMENTALS

Intonation and word-accents can be represented on a separate tier, using TOBI notation.

ˈ	Primary stress	‘
ˌ	Secondary stress	,
ː	Long	:
ˑ	Half-long	;
	Short	‘
˘	Extra-short	(
.	Syllable break	.
	Pause (non-IPA)	#
	Phrase boundary (non-IPA)	##

OTHER SYMBOLS

ʍ	W	ʘ	p|
w	w	|	|
(ɥ)	jw	!	t|
(ʜ)		ǂ	c|
(ʢ)		ǁ	l|
(ʡ)		ɺ	l)
ɕ	c}	(ɧ)	
ʑ	z}	ɜ	3

LINKING SYMBOL

‿ linking symbol -

TABLE 2: Worldbet Diacritic and Suprasegmental Symbols

For special allophones there will be a diacritic linked to the main symbol by an underscore. Underscore will not be used for any other purpose. Base symbols with diacritics generally will be used for allophonic variations, rather than for phonetic symbols of regular speech segments in the languages of the world. For example, a labialized allophone of /s/ which is due to a nearby /w/ would be written [s _w] and a rhoticized vowel /i/ will be i:_r. The diacritic symbols are letters, math symbols, numbers or punctuation symbols. Numbers with the exception of 2 and 0 as diacritics are reserved for tone designations in tone languages.

Suprasegmentals are shown in the diacritic table for syllable boundaries, primary and secondary stress. Making for intonation and pitch accent is also provided. In tone languages, the tone is marked by odd number diacritics attached to the vowel on the broad phonetic level, since the tone is phonemic. Strictly speaking the tone is attached to the syllable rather than the vowel, but this allows a consistent label attachment point across all syllables.

Additional Broad Phonetic Symbols beyond IPA

Several symbols were added to the IPA set which were found to be necessary to accurately label continuous speech databases which have been collected over the past 5 years. Some of these symbols have been used by phoneticians in the past, and some of the phenomena which they capture have been mentioned in the literature. The major departure is the inclusion of hyper aspiration for Indian languages and fricated plosives which were found in British English during the labeling of the SCRIBE database [10]. Hyper aspiration is meant to be a strong aspiration. This may be the property called breathy voiced aspiration in Hindi, but this is yet to be determined experimentally. It is used to denote strong aspiration, while h denotes ordinary aspiration. Another non-IPA symbol is the symbols for individual flaps t and d in order to allow the study of duration differences for the phonologically voiced or unvoiced flaps. In the tables which follow, the IPA column has square brackets around symbols which are not in the official IPA set, to mark them as pseudo IPA symbols.

Labeling Methods Using Worldbet

Worldbet can be used for three labeling methods. The basic form of Worldbet is just an ACSII representation of the IPA. As such it can be used in exactly the same way that IPA is used to do labeling in which the phonetic and phonological or surface phonemic level are kept separate. The usual set of IPA diacritics are provided to mark variations.

The second method for using Worldbet is as a single level broad phonetic labeling which is based on the phoneme inventory of each language plus diacritics.[14] This allows the recovery of most of the information in the two level labeling scheme from one level of labeling, by stripping the diacritics from the broad phonetic labeling to collapse all allophones into the base symbol. Since it takes almost twice as long to label two levels as one, the single level scheme saves considerable time and effort. Not all of the allophones are within the class of the broad phonetic label, so that not all of the surface phonemes are produced by diacritic stripping. However some 97% of them are (based on experience with the British English SCRIBE database), and for practical applications this is enough to warrent using one level of labeling.

The phoneme is by definition language specific, denoting the minimal set of phonological elements which is sufficient to represent a specific language. Once the phoneme inventory for a language is determined, a set of baseforms are constructed by taking the base symbol from Worldbet and concatinating diacritic symbols without the underscore. For example in Hindi there are unaspirated and heavily aspirated stop consonants, therefore these would be represented as p t k b d g pH tH kH bH dH gH. In American English aspiration is not phonemic but occurs as the default in voiceless stop consonants so the labels would be ph th kh b d g. The broad phonetic inventory of labels which are phonemically based is thus constructed for each language.

Speech is labeled at a broad phonetic level using these phoneme based symbols with diacritics to denote broad phonetic variations. For example, an aspirated d in English would be labeled d_h. When the labeling is finished, stripping the diacritics will then recover the surface phonemic labels for most cases. The cases in which this method fails is when the allophonic variant is in a different manner or place of articulation distant from the default phoneme. In Japanese, the phoneme /h/ has variants /f/ and /C/, which are sufficiently different from /h/ that they cannot be properly constucted from the baseform /h/. For Japanese these allophonic variants occur in a very specific context and the phonemic level can be corrected with rules after the diacritic stripping. With the difference between phonemic and allophonic variants labeled it would be possible to determine if b_h and bh are similar across languages or whether phonemic distinctions are more carefully produced and therefore aspiration in bh is more consistent in strength and length.

The third labeling method is called acoustic-phonetic segment labeling, which while using the phoneme based labels, attempts to label the actual regions of allophonic production. The part of a voiced fricative which is devoiced, z for example, with a separate diacritic, z_0 to show which section is voiced and which one is not. Similarly for labialized fricatives, the part during which the labialization is seen to have an effect is labeled s_w and the non-labialized part is labeled s. This detailed differentiation of voicing and coarticulation effects allows studies of the overlap of phonetic features and the study of durations of these segments. Often phonologically voiceless plosives like t are completely voiced in intervocalic position. Normally a voiced consonant would be shorter than a long one. Does the speech production mechanism require that the voiced voiceless consonant be longer? This can only be answered by studying speech labeled with this level of detail captured in the labels. The acoustic-phonetic segment labeling should correspond to multi-level labeling used in non-linear phonology. For example the nasalization of a vowel would be labeled as to its onset time and so the tier in non-linear phonology corresponding to nasalization would include the nasal consonant and the nasalize portion of the vowel. This allows the study of the direction of feature spreading, and the limits on duration and overlap which form the parameters of the speech production process. Acoustic-phonetic labeling can be done on a single tier, and the broad phonetic labels obtained by diacritic clumping. All of the labels with the same adjacent label are examined, the diacritic with the longest duration can be applied to the whole segment and the other diacritics removed. Finally the phonemic level can be recovered by stripping off all of the diacritics, and retaining the baseform symbols.

Phonological Inventories

Phonemes are, strictly speaking, defined only within a single language. The set of all observed phonemes from all the world's languages can be studied. Sets of these phonological elements across all languages are called phonological inventories. These have been collected by Greenberg and Ferguson at Stanford University and by Maddieson amd Ladefoged at UCLA [11]. The aim of Worldbet is to include as a baseform all of the elements in the phonological inventory of all the languages of the world. These symbols are created by concatinating the Worldbet ascii IPA set and diacritics to make a phoneme set for each language. Because these symbols are constructed in a principled fashion, it is always easy to see what a Worldbet symbol represents within the IPA equivalent set from which it is constructed.

Speech from many languages labeled with Worldbet symbols will allow the study of the detailed characteristics of similar phonemes in different languages. Studies have been done in the past comparing the same phonological elements, for example nasals in French and English. The existence of multilanguage speech databases labeled with Worldbet will allow quantification of the difference between phonemes across a spectrum of languages. Even speech databases which are not labeled in Worldbet can have their phonetic label set mapped to Worldbet in order to simplify the process of cross language studies.

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Appendix A: Worldbet Symbols

VOWELS

Monophthongs

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
i:	i:	iy	i:	E	beat*(high front long)*	English
i	i	-	i	-	vier*(high front short)*	Dutch
ĩ	i~	-	-	-	*(nasalized high front)*	
y	y	-	y	-	tu*(rounded high front)*	French
ɪ	I	ih	I	i	bit*(mid-high mid-front short)*	English
ɪ̃	I~	-	-	-	*(nasalized I)*	
ɪ:	I:	-	I:	-	*(long ɪ)*	
ʏ	Y	-	Y	-	fünf*(rounded ɪ)*	German
[ɪ̈]	Ix	ix	[	-	*(centralized ɪ)*	
[ɨ]	ix	-	-	-	*(high front mid unrounded)*	Russian
[ɪ̈̃]	Ix_~	-	-	-	*(nasalized centralized ɪ)*	
e	e	-	-	-	thé*(mid-high front)*	French
ẽ	e~	-	-	-	*(nasalized e)*	
ø	7	-	2	-	blöd*(mid-high front rounded)*	German
ɛ	E	eh	e	e	bet*(mid-low front short)*	English
ɛ̃	E~	-	E~	-	vin*(nasalized E)*	French
œ	8	-	9	-	plötzlich*(mid-low front rounded)*	German
œ̃	8~	-	9~	-	brun*(nasalized 8)*	French
æ	@	ae	{	a	bat*(mid-low front long)*	English
æ̃	@~	-	-	-	*(rounded @)*	
ɐ	ax	-	6	-	besser*(mid-low central)*	German
ɐ̃	ax_~	-	-	-	*(nasalized ax)*	
a	a	-	a	-	patte*(low front)*	French
ɶ	6	-	&	-	*(rounded open front)*	
ɑ	A	aa	A:	o and @	Bob*(low back)*	English
ɑ̃	A~	-	A~	-	vent*(nasalized A)*	French
ɒ	5	-	Q	-	pot*(low back rounded)*	Br. English
ʌ	⋀	ah	V	⋀	but*(mid-low back)*	English
ɔ	>	ao	O:	>	bought*(mid-low mid-back)*	English
ɔ̃	>~	-	O~	-	bon*(nasalized ⋀)*	French
ɤ	2	-	-	-	ge*(unrounded o)*	Chinese
o	o	-	o	-	lunge*(mid-high back)*	Danish
õ	o~	-	-	-	*(nasalized o)*	
ɤ	2	-	-	-	ge*(unrounded o)*	Chinese
ʊ	U	uh	U	u	book*(mid-high back short)*	English
ʊ̃	U~	-	-	-	*(nasalized U)*	
u	u	uw	u:	U	boot*(high back)*	English
ũ	u~	-	-	-	*(nasalized u)*	
ʉ	ux	ux	}	-	suit*(fronted u)*	English
ɯ	4	-	-	-	kutsu*(high back unrounded)*	Japanese
ɯ̃	4~	-	-	-	*(nasalized 4)*	
ə	&	ax	@	&	about*(central short)*	English
ə̃	&~	-	-	-	*(nasalized &)*	
ɵ	ox	-	-	-	*(rounded ə)*	
ɜ	3	-	@:	-	bird*(central long)*	Br. English
ə̥	&0	ax-h	@a	-	*(voiceless ə)*	Japanese
ɝ	3r	er	3r	R	bird*(central retroflexed)*	am.english
ɚ	&r	axr	=r	-	butter*(central retroflexed short)*	Am. English
ɯ˞	4r	-	-	-	*(retroflexed ɯ)*	Chinese shi (poetry)

Diphthongs

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
ia	ia	-	-	-	-	Saek
ie	ie	-	-	-	-	Armenian
iɒ	i5	-	iQ	-	kirke	Danish
iɐ	iax	-	-	-	Tier	German
yɐ	yax	-	-	-	Tür	German
øɐ	7ax	-	-	-	Gehör	German
ɛɐ	Eax	-	-	-	Gewähr	German
eɐ	eax	-	-	-	Gewehr	German
io	io	-	-	-	-	Kurdish
iu	iu	-	iu	-	ivrig	Dutch
iɯ	i4	-	-	-	-	Japanese
iə	i&	-	I@	-	here	Br. English
yu	yu	-	yu	-	syv	Danish
ɪe	ie	-	-	-	-	Gilyak
ei	ei	ey	eI	A	bait	Am. English
eɪ	eI	-	-	-	bait	Br. English
eo	eo	-	eo	-		
eu	eu	-	eu	-	peber	Danish
eə	e&	-	e@	-	there	Br. English
ɛi	Ei	-	-	-	fijn	Dutch
ɛɒ	E5	-	EQ	-	bær	Danish
ɛu	Eu	-	Eu	-	evne	Danish
æɒ	@5	-	{ Q	-	ør	Danish
æu	@u	-	{ u	-	stœvle	Danish
ɔi	>i	oy	-	Y	boy	Am. English
ɔɪ	>I	-	OI	-	boy	Irish English
ɔʏ	>Y	-	OY	-	Kreuz	German
ɔə	>&	-	O@	-	pore	Br. English
œy	8y	-	2y	-	huis	Dutch
œu	8u	-	2u	-	øvle	Danish
ai	ai	-	-	-	hegn	Dutch
aɪ	aI	ay	aI	I	buy	English
ae	ae	-	-	-		
eɐ	eax	-	-	-	Gewehr	German
aʊ	aU	aw	aU	W	down	English
aɯi	a4	-	-	-		
ao	ao	-	-	-		
au	au	-	-	-		
ɑu	Au	-	Au	-	goud	Dutch
oi	oi	-	-	-	noi	Italian
oɪ	oI	-	-	-	boy	Irish English
oʊ	oU	ow	@U	O	show	English
oa	oa	-	-	-		
oɐ	oax	-	-	-	Tor	German
oʊ	oU	-	-	-	gou	Mandarin
ou	ou	-	-	-		
oɒ	o5	-	oQ	-	morsom	Danish
ui	ui	-	ui	-	huj	Danish
ua	ua	-	-	-		
uɐ	uax	-	-	-	Ruhr	German
uɒ	u5	-	uQ	-	hurtig	Danish

uo	uo	-	-	-		
uə	u&	-	U@	-	poor	Br. English
ɯi	4i	-	-	-		
ɯa	4a	-	-	-		
əu	&u	-	-	-		

Approximants and Trills

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
ʋ	V[	-	-	-	*(labiodental approximant)*	English
j	j	j	j	y	you*(palatal approximant)*	English
ɥ	jw	-	H	-	juin*(voiced labial-palatal approximant)*	French
w	w	w	w	w	wit*(voiced labial velar approximant)*	English
ʍ	W	-	W	-	when*(voiceless w)*	Scottish
ɹ	9	r	r	r	rent	British English
ɻ	9r	-	-	-	rent*(retroflexed approximant)*	Am. English
ɰ	4)	-	-	-	*(velar approximant)*	
ʙ	B	-	-	-	*(labial trill)*	
ʀ	R	-	-	-	*(uvular trill)*	
r	r	-	rr	-	*(alveolar trill)*	
ɽ	rr	-	-	-	*(alveolar retroflexed tap)*	
ɾ$_r$	r(	-	-	-	*(r flap - not retroflexed)*	
ʁ	K	-	-	-	*(uvular fricative)*rond	French
l	l	l	l	l	let*(alveolar lateral approximant)*	
ʟ	Lg	-	-	-	*(velar lateral approximant)*	
ʎ	L	-	L	-	*(palatal lateral approximant)*	
ɭ	lr	-	-	-	*(retroflexed lateral approximant)*	
ɬ	hl	-	-	-	*(alveolar lateral fricative)*	
ɮ	Zl	-	-	-	*(alveolar lateral voiced fricative)*	

CONSONANTS

Plosives

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
p˺	pc	pcl	pc	sp	stop*(p closure)*	English
p	p	p	p	p	potholder*(labial voiceless plosive release)*	English
[p*]	p*	-	p!	-	*(p burst without aspiration)*	
[p^{f}]	pP	-	pf	-	*(fricated p)*	Irish English
p^{h}	ph	-	-	-	*(p aspirated release)*	
[p^{H}]	pH	-	-	-	*(p hyper-aspirated release)*	Hindi
p^{r}	pr	-	-	-	*(p retroflex release)*	
[p^{rH}]	pR	-	-	-	*(p hyper-aspirated retroflex release)*	Hindi
p^{n}	pn	-	-	-	*(p nasal release)*	Hindi
[p^{nH}]	pN	-	-	-	*(p hyper-aspirated nasal release)*	Hindi
p'	p>	-	-	-	*(p ejective release)*	
ƥ	p<	-	-	-	*(p implosive)*	
t̪˺	t[_c	-	-	-	*(t[with no release)*	English
t̪	t[	-	-	-	*(dental voiceless plosive release)*	
[t̪*]	t[_*	-	-	-	*(t[burst without aspiration)*	
t̪^{h}	t[_h	-	-	-	*(t[aspirated release)*	
t̪^{n}	t[_n	-	-	-	*(t[nasal release)*	
t̪'	t[_>	-	-	-	*(t[ejective release)*	
ƭ̪	t[_<	-	-	-	*(t[implosive)*	
t˺	tc	tcl	tc	st	streetcar*(t with no release)*	English
t	t	t	t	t	*(apico-alveolar voiceless plosive release)*	English
[t*]	t*	-	t!	-	*(t burst without aspiration)*	
[t^{f}]	tT	-	tf	-	*(fricated t)*	Irish English
[ɾ$_{t}$]	t(	dx	t<	-	*(flap or tap t)*	Am. English
t^{h}	th	-	-	-	*(t aspirated release)*	
[t^{H}]	tH	-	-	-	*(t hyper-aspirated release)*	Hindi
ʈ	tr	-	-	-	*(t retroflex release)*	
[ʈ^{H}]	tR	-	-	-	*(t hyper-aspirated retroflex release)*	Hindi
t^{n}	tn	-	-	-	*(t nasal release)*	
[t^{nH}]	tN	-	-	-	*(t hyper-aspirated nasal release)*	Hindi
t'	t>	-	-	-	*(t ejective release)*	
ƭ	t<	-	-	-	*(t implosive)*	
c˺	cc	-	-	-	*(c with no release)*	
c	c	-	-	-	*(palatal voiceless plosive release)*	
[c*]	c*	-	-	-	*(c burst without aspiration)*	
c^{h}	ch	-	-	-	*(c aspirated release)*	
c͡p˺	cp_c	-	-	-	*(cp with no release)*	
c͡p	cp	-	-	-	*(labial palatal voiceless plosive release)*	
[c͡p*]	cp_*	-	-	-	*(cp burst without aspiration)*	
c͡p^{h}	cp_h	-	-	-	*(cp aspirated release)*	
k˺	kc	kcl	-	sk	clockwork*(k with no release)*	English
k	k	k	k	k	cot*(velar voiceless plosive release)*	English
[k*]	k*	-	k!	-	*(k burst without aspiration)*	
[k^{f}]	kK	-	kf	-	*(fricated k)*	Irish English
k^{h}	kh	-	-	-	*(k aspirated release)*	
k^{n}	kn	-	-	-	*(k nasal release)*	
[k^{H}]	kH	-	-	-	*(k hyper-aspirated k release)*	Hindi
[k^{rH}]	kR	-	-	-	*(k hyper-aspirated retroflex release)*	Hindi

[k^{nH}]	kN	-	-	-	*(k hyper-aspirated nasal release)*	Hindi
k'	k>	-	-	-	*(k ejective release)*	
ƙ	k<	-	-	-	*(k implosive)*	
k͡p˺	kp_c	-	-	-	*(kp with no release)*	
k͡p	kp	-	-	-	*(labial velar voiceless plosive release)*	
[k͡p*]	kp_*	-	-	-	*(kp burst without aspiration)*	
k͡p^{h}	kp_h	-	-	-	*(kp aspirated release)*	
q˺	qc	-	-	-	*(q with no release)*	English
q	q	-	-	-	*(uvular voiceless plosive release)*	English
[q*]	q*	-	-	-	*(q burst without aspiration)*	English
q^{h}	qh	-	-	-	*(q aspirated release)*	
ʠ	q<	-	-	-	*(q implosive)*	
b˺	bc	bcl	bcv	sb	bobtail*(b with no release)*	English
b	b	b	b	b	boat*(labial voiced plosive release)*	English
[b*]	b*	-	b!	-	*(b burst without aspiration)*	
[b^{f}]	bB	-	bf	-	*(fricated b)*	Irish English
b^{h}	bh	-	bh	-	*(b aspirated release)*	
[b^{H}]	bH	-	-	-	*(b hyper-aspirated release)*	Hindi
b^{r}	br	-	-	-	*(b retroflex release)*	
[b^{rH}]	bR	-	-	-	*(b hyper-aspirated retroflex release)*	Hindi
b^{n}	bn	-	-	-	*(b nasal release)*	
[b^{nH}]	bN	-	-	-	*(b hyper-aspirated nasal release)*	Hindi
b'	b>	-	-	-	*(b ejective release)*	
ɓ	b<	-	-	-	*(b implosive)*	
[$ɾ_{b}$]	b(	-	-	-	*(flap or tap b)*	
d̪˺	d[_c	-	-	-	*(d[closure)*	English
d̪	d[	-	-	-	*(dental voiced plosive release)*	English
[d̪*]	d[_*	-	-	-	*(d[burst without aspiration)*	
d̪^{h}	d[_h	-	-	-	*(d[aspirated release)*	
ɗ̪	d[_<	-	-	-	*(d[implosive)*	
d˺	dc	dcl	dcv	sd	bloodclot*(d closure)*	English
d	d	d	d	d	dock*(d release)*	English
[d*]	d*	-	d!	-	*(d burst without aspiration)*	
[d^{f}]	dD	-	df	-	*(fricated d)*	Irish English
[$ɾ_{d}$]	d(	dx	$d<$	-	*(flap or tap d)* Am. English	
d^{h}	dh	-	-	-	*(d aspirated release)*	
[d^{H}]	dH	-	-	-	*(d hyper-aspirated release)*	Hindi
ɖ	dr	-	-	-	*(d retroflex release)*	
[d^{rH}]	dR	-	-	-	*(d hyper-aspirated retroflex release)*	Hindi
d^{n}	dn	-	-	-	*(d nasal release)*	
[d^{nH}]	dN	-	-	-	*(d hyper-aspirated nasal release)*	Hindi
d'	d>	-	-	-	*(d ejective release)*	
ɗ	d<	-	-	-	*(d implosive)*	
ɟ˺	Jc	-	-	-	*(J with no release)*	
ɟ	J	-	-	-	*(palatal voiced plosive release)*	
[ɟ*]	J*	-	-	-	*(J burst without aspiration)*	
ɟ^{h}	Jh	-	-	-	*(J aspirated release)*	
ɟ͡b˺	Jb_c	-	-	-	*(Jb with no release)*	
ɟ͡b	Jb	-	-	-	*(labial palatal voiced plosive release)*	
[ɟ͡b*]	Jb_*	-	-	-	*(Jb burst without aspiration)*	
ɟ͡b^{h}	Jb_h	-	-	-	*(Jb aspirated release)*	
g˺	gc	gcl	sg	g	game*(g with no release)*	English
g	g	g	g	g	game*(velar voiced plosive release)*	English

[g*]	g*	-	g!	-	*(g burst without aspiration)*	
[gf]	gG	-	gf	-	*(fricated g)*	Irish English
g^{h}	gh	-	-	-	*(g aspirated release)*	
[g^{H}]	gH	-	-	-	*(g hyper-aspirated release)*	Hindi
g^{r}	gr	-	-	-	*(g retroflex release)*	
[g^{rH}]	gR	-	-	-	*(g hyper-aspirated retroflex release)*	Hindi
g^{n}	gn	-	-	-	*(g nasal release)*	
[g^{nH}]	gN	-	-	-	*(g hyper-aspirated nasal release)*	Hindi
g'	g>	-	-	-	*(g ejective)*	
ɠ	g<	-	-	-	*(g implosive)*	
[$ɾ_{g}$]	g(	-	-	-	*(flap or tap g)*	
g͡b˺	gb_c	-	-	-	*(gb with no release)*	
g͡b	gb	-	-	-	*(labial velar voiced plosive release)*	
[g͡b*]	gb_*	-	-	-	*(gb burst without aspiration)*	
g͡bʰ	gb_h	-	-	-	*(gb aspirated release)*	
G˺	Q	-	-	-	*(Q with no release)*	
G	Q	-	-	-	*(uvular voiced plosive release)*	
[G*]	Q*	-	-	-	*(Q burst without aspiration)*	
Gʰ	Qh	-	-	-	*(Q aspirated release)*	
G	Q<	-	-	-	*(Q implosive)*	
ʡ	?H	-	-	-	*(epiglottal plosive)*	
ʔ	?	q	?	*	*(glottal stop)*	

Flaps and Taps

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
[ɾ$_b$]	b(	-	-	-	puraibe:tono*(voiced labial flap)*	Japanese
[ɾ$_d$]	d(	dx	*d* <	-	ladder*(voiced alveolar flap)*	English
[ɾ$_g$]	g(	-	-	-	*(voiced velar flap)*	Japanese
[ɾ$_t$]	t(	dx	*t* <	-	batter*(voiceless alveolar flap)*	English
[ɾ$_k$]	k(	-	-	-	*(voiceless velar flap)*	Japanese
ɾ̃	n(	nx	-	-	banter	English
ɺ	l(	-	-	-	*(alveolar lateral flap)*	
ɽ	rr	-	-	-	*(retroflex flap)*	
ɾ$_r$	r(	-	-	-	*(r flap - not retroflexed)*	

Fricatives

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
ɸ	F	-	-	-	*(labial voiceless fricative)*	
f	f	f	f	f	fat*(labio-dental voiceless fricative)*	English
θ	T	th	T	T	thing*(apico-alveolar voiceless fricative)*	English
s	s	s	s	s	sat*(alveolar voiceless fricative)*	English
ʂ	sr	-	-	-	*(retroflexed alveolar fricative)*	
ʃ	S	sh	S	S	shut*(postalveolar voiceless fricative)*	English
ɕ	c}	-	-	-	*(alveolo-palatal voiceless fricative)*	
ɬ	hl	-	-	-	*(alveolar lateral voiceless fricative)*	
β	V	-	B	-	*(labial voiced fricative)*	
v	v	v	v	v	vat*(labiodental voiced fricative)*	English
ð	D	dh	D	D	that*(dental voiced fricative)*	English
z	z	z	z	z	zoo*(alveolar voiced fricative)*	English
ʐ	zr	-	-	-	*(retroflexed voiced post-alveolar fricative)*	
ʒ	Z	zh	Z	zh	azure*(postalveolar voiced fricative)*	English
ɮ	Zl	-	-	-	*(alveolar lateral voiced fricative)*	
ʑ	z}	-	-	-	*(alveolo-palatal voiceless fricative)*	
ç	C	-	C	-	ich*(palatal voicelessfricative)*	German
ʝ	j-	-	-	-	*(palatal voiced fricative)*	
x	x	-	-	-	ach*(velar voiceless fricative)*	German
ɣ	G	-	G	-	koge*(velar voiced fricative)*	Danish
χ	X	-	-	-	*(uvular voiceless fricative)*	
ʁ	K	-	-	-	rond*(uvular voiced fricative)*	French
h	h	hh	-	-	head*(glottal voiceless fricative h)*	English
ɦ	hv	hv	hv	-	*(glottal voiced fricative h)*	
ħ	HH	-	-	-	*(pharyngeal voiceless fricative)*	
ʕ	HH_v	-	-	-	*(pharyngeal voiced fricative)*	
ʜ	H	-	-	-	*(epiglottal voiceless fricative)*	
ʢ	H_v	-	-	-	*(voiced epiglottal fricative)*	

Affricates

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
pɸ˺	pF_c	pcl	-	-	*(bilabial voiceless affricate closure)*	
pɸ	pF	-	-	-	*(pF affricate burst frication)*	
bβ˺	bVc	bcl	-	-	*(voiced bilabial affricate closure)*	
bβ	bV	-	-	-	*(bV affricate burst frication)*	
pf˺	pf_c	pcl	pfc	-	*(pf affricate closure)*	
pf	pf	-	pf	-	Pfahl	German
bv˺	bv_c	bcl	-	-	*(voiced labiodental affricate closure)*	
bv	bv	-	-	-	*(bv affricate closure)*	
ts˺	ts_c	tcl	tsc	-	*(ts closure)*	
ts	ts	-	ts	-	Zahl	German
tʂ˺	ts_r_c	-	-	-	*(alveolar retroflex affricate closure)*	Mandarin
tʂ	ts_r	-	-	-	-	Mandarin
dz˺	dz_c	dcl	-	-	*(voiced apicoalveolar affricate closure)*	
dz	dz	-	-	-	*(dz burst frication)*	
tʃ˺	tS_c	tcl	tSc	-	*(tS closure)*	
tʃ	tS	ch	tS	C	church	English
tʃ:	tS:	-	-	-	chatri(umbrella)	Hindi
dʒ˺	dZ_c	dcl	dZvc	-	*(dZ closure)*	
dʒ	dZ	jh	dZ	J	judge	English
dʒ:	dZ_:	-	-	-	jhari(stream)	Hindi
cç˺	cC_c	-	-	-	*(palatal voiceless affricate closure)*	
cç	cC	-	-	-	*(cC burst frication)*	
ɟʝ˺	Jj_c	-	-	-	*(palatal voiced affricate closure)*	
ɟʝ	Jj	-	-	-	*(Jj burst frication)*	
kx˺	kx_c	-	-	-	*(velar voiceless affricate closure)*	
kx	kx	-	-	-	*(velar voiceless affricate)*	
gɣ˺	gG_c	-	-	-	*(velar voiced affricate closure)*	
gɣ	gG	-	-	-	*(velar voiced affricate)*	
qχ˺	qX_c	-	-	-	*(uvular voiceless affricate closure)*	
qχ	qX	-	-	-	*(uvular voiceless affricate)*	
ɢχ˺	QK_c	-	-	-	*(uvular voiced affricate closure)*	
ɢχ	QK	-	-	-	*(uvular voiced affricate)*	

Clicks

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE
ʘ	p|	-	-	-	*(bilabial click)*
|	|	-	-	-	*(dental click)*
!	t|	-	-	-	*(alveolar click)*
||	l|	-	-	-	*(alveolar lateral click)*
ǂ	c|	-	-	-	*(palatal click)*

Nasals

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
m	m	m	m	m	met*(labial nasal)*	English
ɱ	M	-	-	-	*(labiodental nasal)*	
n̪	n[	-	-	-	*(dental nasal)*	
n	n	n	n	n	net*(alveolar nasal)*	English
r̃	n(	nx	-	-	*(nasal flap)*	
ɳ	nr	-	-	-	*(retroflexed nasal)*	
nʲ	nj	-	-	-	oignon*(palatalized alveolar nasal)*	French
ɲ	n~	-	J	-	caños *(palatal nasal)*	Spanish
ŋ	N	ng	N	ng	sing*(velar nasal)*	English
ɴ	Nq	-	-	-	*(uvular nasal)*	

Syllabics

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE	
l̩	l=	el	=l	ll	battle	English
m̩	m=	em	=m	mm	bottom	English
n̩	n=	en	=n	nn	button	English
ŋ̩	N=	eng	=ng	-	camping	French

Silences and Pauses

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE
-	+	.epi	+	*	*(epenthetic silence)*
-	#	.pau	#	*	[pause]
-	##	h#	##	%	[begin/end]

Non-speech Sounds

IPA	WORLD	TIMIT	SAMPA	JPO	EXAMPLE
-	.ls	.ls	-	-	*(lip smack)*
-	.br	.br	-	-	*(breath)*
-	.ct	.ct	-	-	*(clear throat)*
-	.laugh	.laugh	-	-	*(laughter)*
-	.tc	.tc	-	-	*(tongue click)*
-	.cough	.cough	-	-	*(cough)*
-	.sneeze	.sneeze	-	-	*(sneeze)*
-	.ln	.ln	-	-	*(telephone line noise)*
-	.ns	.ns	-	-	*(non-speech noise)*
-	.bn	.bn	-	-	*(background noise)*
-	.ring	.ring	-	-	*(telephone ring)*

Worldbet Charts:

CONSONANTS

<table>
<tr><th rowspan="3">Place</th><th colspan="19">Manner of Articulation</th></tr>
<tr><th colspan="6">Stop</th><th>Nas</th><th colspan="2">Fricative</th><th colspan="2">Affricate</th><th>Appr</th><th>Lat</th><th>Flap</th><th>Tril</th><th colspan="3">Glottal</th></tr>
<tr><th colspan="2">−Asp
−V +V</th><th colspan="2">+Asp
−V +V</th><th colspan="2">+HyAsp
−V +V</th><th></th><th>−V</th><th>+V</th><th>−V</th><th>+V</th><th></th><th></th><th></th><th></th><th>Ej</th><th>Im</th><th>Vel</th></tr>
<tr><td>labial</td><td>p</td><td>b</td><td>ph</td><td>bh</td><td>pH</td><td>bH</td><td>m</td><td>F</td><td>V</td><td>pF</td><td>bV</td><td>–</td><td>–</td><td>b(</td><td>B</td><td>b></td><td>b<</td><td>–</td></tr>
<tr><td></td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>p<</td><td>–</td></tr>
<tr><td>labiodent.</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>M</td><td>f</td><td>v</td><td>pf</td><td>bv</td><td>V[</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>dental</td><td>t[</td><td>d[</td><td>t[h</td><td>d[h</td><td>–</td><td>–</td><td>n[</td><td>T</td><td>D</td><td>–</td><td>–</td><td>–</td><td>ld</td><td>–</td><td>–</td><td>t[></td><td>t[<</td><td>|</td></tr>
<tr><td></td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>d[<</td><td>–</td></tr>
<tr><td>apicoalv.</td><td>t</td><td>d</td><td>th</td><td>dh</td><td>tH</td><td>dH</td><td>n</td><td>s</td><td>z</td><td>ts</td><td>dz</td><td>9</td><td>–</td><td>t(</td><td>r</td><td>t></td><td>d<</td><td>t|</td></tr>
<tr><td></td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>d(</td><td>–</td><td>–</td><td>d<</td><td>–</td></tr>
<tr><td>laminoalv.</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>s}</td><td>z}</td><td>–</td><td>–</td><td>–</td><td>–</td><td>l}</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>lateral alv.</td><td>tl</td><td>dl</td><td>–</td><td>–</td><td>–</td><td>–</td><td>nl</td><td>hl</td><td>Zl</td><td>ls</td><td>lz</td><td>l</td><td>–</td><td>l(</td><td>–</td><td>–</td><td>–</td><td>l|</td></tr>
<tr><td>retroflex</td><td>tr</td><td>dr</td><td>–</td><td>–</td><td>tR</td><td>dR</td><td>nr</td><td>sr</td><td>zr</td><td>–</td><td>–</td><td>9r</td><td>lr</td><td>r(</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>nasalized</td><td>tn</td><td>dn</td><td>–</td><td>–</td><td>tN</td><td>tN</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>n(</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>postalv.</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>nj</td><td>S</td><td>Z</td><td>tS</td><td>dZ</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>lam'pal'alv</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>S}</td><td>Z}</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>palatal</td><td>c</td><td>J</td><td>ch</td><td>Jh</td><td>–</td><td>–</td><td>n~</td><td>C</td><td>j-</td><td>cC</td><td>Jj</td><td>j</td><td>L</td><td>–</td><td>–</td><td>c></td><td>c<</td><td>c|</td></tr>
<tr><td></td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>J<</td><td>–</td></tr>
<tr><td>labial pal.</td><td>cp</td><td>Jb</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>jw</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>velar</td><td>k</td><td>g</td><td>kh</td><td>gh</td><td>kH</td><td>gH</td><td>N</td><td>x</td><td>G</td><td>kx</td><td>gG</td><td>Rg</td><td>–</td><td>k(</td><td>–</td><td>k></td><td>k<</td><td>k|</td></tr>
<tr><td></td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>g(</td><td>–</td><td>–</td><td>g<</td><td>–</td></tr>
<tr><td>labial vel.</td><td>kp</td><td>gb</td><td>–</td><td>–</td><td>–</td><td>–</td><td>nm</td><td>–</td><td>–</td><td>–</td><td>–</td><td>w</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>uvular</td><td>q</td><td>Q</td><td>qh</td><td>Qh</td><td>–</td><td>–</td><td>Nq</td><td>X</td><td>K</td><td>qX</td><td>QK</td><td>RR</td><td>–</td><td>–</td><td>R</td><td>q></td><td>q<</td><td>–</td></tr>
<tr><td>pharyngl.</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>HH</td><td>HH_v</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>glottal</td><td>?</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>h</td><td>hv</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>epiglottal</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>H</td><td>H_v</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
</table>

VOWELS

	Front				Central		Back		
Close	i	y			ix	ux		4	u
			I	Y	Ix		U		
Close-mid	e	7						2	o
					&	ox			
Open-mid	E	8						∧	>
	@				ax				
Open	a	6						A	5

Appendix B: Phonemic Sets for Some Languages

DANISH

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	pande	/panə/	p a n &
/b/	b	bande	/banə/	b a n &
/t/	t	tand	/tandʔ/	t a n ?
/d/	d	dan	/danʔ/	d a n ?
/k/	k	kalde	/kalə/	k a l &
/g/	g	galde	/galə/	g a l &

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	finde	/fenə/	f e n &
/s/	s	stand	/sdanʔ/	s d a n ?
/v/	v	vinde	/venə/	v e n &
/ð/	D	bide	/bi:ðə/	b i: D &
/j/	j-	Jul	/ɟu:ʔl/	j- u: ? l
/ɣ/	G	koge	/kɔ:ɣə/	k O: G &
/h/	h	hest	/hɛsd/	h E s d

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	mile	/mi:lə/	m i: l&
/n/	n	ny	/ny:ʔ/	n y: ?
/ŋ/	N	lunge	/loŋə/	l o N &

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	land	/lan?/	l a n ?
/ʁ/	K	ride	/ʁi:ðə/	K i: D&

Vowels

Monophthongs:

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i:/	i:	mile	/mi:lə/	m i: l &
/e:/	e:	mele	/me:lə/	m e: l &
/ɛ:/	E	mæle	/mɛ:lə/	m E: l &
/a:/	a:	male	/ma:lə/	m a: l &
/y:/	y:	byde	/by:ðə/	b y: th &
/ø:/	7:	bøde	/bø:ðə/	b 7: th &
/œ:/	8:	høne	/hœ:nə/	h 8: n &
/i/	i	ville	/vilə/	v i l &
/e/	e	visse	/visə/	v i s &
/ɛ/	E	thække	/tɛkə/	t E k &
/a/	a	hast	/hast/	h a s t
/y/	y	tyst	/tyst/	t y s t
/ø/	7	øst	/øst/	7 s t
/œ/	8	hønse	/hœnsə/	h 8 n s e
/u:/	u:	bude	/bu:ðə/	b u: th &
/o:/	o:	gode	/go:ðə/	g o: th &
/ɔ:/	>:	både	/bɔ:ðə/	b >: th &
/u/	u	kusk	/kusg/	k u s g
/o/	o	bunde	/bonə/	b o n &
/ɔ/	>	kop	/kɔp/	k > p

Diphthongs:

IPA	WORLDBET	Word	IPA word	WORLDBET word
/iu/	iu	ivrig	/iuʁi/	iu K i
/iɒ/	i5	kirke	/kiɒkə/	k i5 k &
/yu/	yu	syv	/syu/	s yu
/eu/	eu	peber	/peuvəʁ/	p eu v & K
/øu/	7u	døvstum	/døusdom/	d 7u s d o m
/ɛu/	Eu	evne	/ɛunə/	Eu n &
/ɛɒ/	E5	bær	/bɛɒ/	b E5
/ai/	ai	hegn	/haiʔn/	h ai ? n
/ɑu/	Au	havn	/haun/	h Au n
/ɒu/	5u	vogn	/vɒun/	v 5u n
/œu/	8u	støvle	/sdœulə/	s d 8u l &
/œɒ/	85	smœr	/smœɒ/	s m 85
/ɔi/	> i	/høj/	/hɔi/	h >i
/oɒ/	o5	morsom	/moɒsom/	m o5 s o m
/ou/	ou	søvn	/soun/	s ou n
/ui/	ui	huj	/hui/	h ui
/uɒ/	u5	hurtig	/huɒdi/	/h u5 d i/

DUTCH

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	pak	/pɑk/	p A k
/b/	b	bak	/bɑk/	b A k
/t/	t	tak	/tɑk/	t A k
/d/	d	dak	/dɑk/	d A k
/k/	k	kap	/kɑp/	k A p
/g/	g	goal	/go:l/	g o: l

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	fel	/fɛl/	f E l
/s/	s	sein	/sɛin/	s E n
/v/	v	vel	/vel/	v e l
/z/	z	zijn	/zɛin/	z Ei n
/ɣ/	G	goed	/ɣut,xut/	G u t
/x/	x	toch	/tɔx/	t > x
/h/	h	hond	/hɔnt/	h > nt
/ç/	C	sjaal	/ça:l/	C a: l
/ʃ/	S	sjaal	/ʃa:l/	S a: l

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	met	/mɛt/	mEt
/n/	n	net	/nɛt/	nEt
/ŋ/	N	bang	/bɑŋ/	b A N

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	land	/lɑt/	l A n t
/ʁ/	K	rand	/ʁɑnt/	R A n t
/r/	r	rand	/rɑnt/	r A n t
/ʋ/	V[	wit	/ʋɪt/	V[I t
/j/	j	ja	/ja:/	j a:

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/ɪ/	I	pit	/pɪt/	p I t
/ɛ/	E	pet	/pɛt/	p E t
/ɑ/	A	pat	/pɑt/	p A t
/ɔ:/	>:	pot	/pɔt/	p >: t
/ʉ/	ux	put	/pʉt/	p ux t
/ə/	&	gemakkelijk	/gəmɑkələk/	g & m A k & l & k
/i:/	i:	vier	/vi:r/	v i: r
/y/	y	vuur	/vyr/	v y r
/e:/	e:	veel	/ve:l/	v e: l
/a:/	a:	naam	/na:m/	n a: m
/ɔ:/	>:	roze	/rɔ:zə/	r >: z &
/ø:/	7:	deur	/dø:r/	d 7: r
/o:/	o:	voor	/vo:r/	v o: r
/u/	u	voer	/vur/	v u r

Diphthongs:

IPA	WORLDBET	Word	IPA word	WORLDBET word
/iu/	iu	nieuw	/niu/	n iu
/yu/	yu	duw	/dyu/	d yu
/eu/	eu	sneeuw	/sneu/	s s eu
/ɛi/	Ei	fijn	/fɛin/	f Ei n
/œy/	8y	huis	/hœys/	h 8 y s
/ai/	ai	draai	/drai/	d r ai
/ɑu/	Au	goud	/xɑut/	x Au t
/oi/	oi	mooi	/moi/	m oi
/ui/	ui	roeiboot	/r<u>ui</u>bo:t/	r ui b o: t

ENGLISH

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/pʰ/	ph	pan	/pʰæn/	ph @ n
/b/	b	ban	/bæn/	b @ n
/tʰ/	th	tan	/tʰæn/	th @ n
/d/	d	Dan	/dæn/	d @ n
/kʰ/	kh	can	/kʰæn/	kh @ n
/g/	g	gander	/gænder/	g @ n d e r

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	fan	/fæn/	f @ n
/v/	v	van	/væn/	v @ n
/θ/	T	thing	/θɪŋ/	T I ng
/ð/	D	that	/ðæt/	D @ t
/s/	s	seen	/si:n/	s i: n
/z/	z	zone	/zoʊn/	z oU n
/ʃ/	S	sheen	/ʃi:n/	S i: n
/ʒ/	Z	azure	/@ʒɚ/	@ Z 3r
/h/	h	hope	/hoʊp/	h oU p
/ɦ/	h_v	ahead	/əɦɛd/	& hv E d

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word
/tʃ/	tS	church	/tʃɚtʃ/	tS 3r tS
/dʒ/	dZ	gin	/dʒɪn/	dZ I n

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	me	/mi:/	m i:
/n/	n	knee	/ni:/	n i:
/ŋ/	N	weeping	/wi:piŋ/	w i: p i N

Taps

IPA	WORLDBET	Word	IPA word	WORLDBET word
/[ɾ$_d$]/	d_(	ladder	/læɾ$_d$ɚ/	/l @ d_(& r/
/[ɾ$_t$]/	t_(	batter	/bæɾ$_t$ɚ/	/b @ t_(& r/
/[ɾ̃]/	n_(	banter	/bæ˜ɾɚ/	/b @ n_(& r/

Syllabics

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l̩/	l=	battle	/bætl̩/	b @ t l=
/m̩/	m=	bottom	/bɑtm̩/	b A t m=
/n̩/	n=	button	/bʌtn̩/	b ⋀ t n=
/ŋ̍/	N=	gambling	/gæmlŋ̍	g @ m b l N=

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word	
/l/	l	long	/lɔ̃ŋ/	l O: N	
/ɹ̣/	9r	reed	/ɹ̣i:d/	9r i: d	
/ɹ/	9	rent	/ɹɛnt/	9 E n t	Some British
/j/	j	you	/ju/	j u	
/w/	w	we	/wi:/	w i:	

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word	
/i:/	i:	seek	/si:k/	s i: k	
/ɪ/	I	sick	/sɪk/	s I k	
/ᵻ/	I_x	equipment	/i:kwᵻpmənt	i: k w I_x p m & n t	
/ɛ/	E	set	/sɛt/	s E t	
/æ/	@	sat	/sæt/	s @ t	
/ɑ/	A	Bob	/bɑb/	b A b	
/ʌ/	⋀	but	/bʌt/	b ⋀ t	
/ɔ/	>	bought	/bɔt/	b > t	
/ɒ/	5	pot	/pɒt/	p 5 t	British
/ʊ/	U	book	/bʊk/	b U k	
/u/	u	due	/du/	d u	
/ʉ/	u_x	suit	/sʉt/	s u_x t	
/ə/	&	the	/ðə/	D &	
/ə̥/	&_0	to go	/tə̥goɛ/	t &_0 g oU	
/ɝ/	3r	bird	/bɝd/	b 3r d	
/ɚ/	&r	butter	/bʌtɚ/	b ⋀ t &r	

Diphthongs:

IPA	WORLDBET	Word	IPA word	WORLDBET word	
/iə/	i&	here	/hiə/	h i &	British
/iu/	iu	few	/fiu/	f iu	
/ei/	ei	bait	/beit/	b ei t	
/eə/	e&	there	/θeə/	T e &	British
/ɔi/	> i	boy	/bɔi/	b >i	
/aɪ/	aI	buy	/baɪ/	b aI	
/aʊ/	aU	down	/daʊn/	d aU n	
/oʊ/	oU	show	/ʃoʊ/	S oU	
/uə/	u&	poor	/puə/	p u&	Some British

FRENCH

Plosive

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	pont	/pɔ̃/	p O~
/b/	b	bon	/bɔ̃/	b O~
/t/	t	temps	/tã/	t A~
/d/	d	dans	/dã/	d A~
/k/	k	quand	/kã/	k A~
/g/	g	gant	/gã/	g A~

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	femme	/fam/	f a m
/v/	v	vent	/vã/	v A~
/s/	s	sans	/sã/	s A~
/z/	z	zone	/zon/	z o n
/ʃ/	S	champ	/ʃã/	S A~
/ʒ/	Z	gens	/ʒã/	Z A~
/j/	j-	ion	/j-ɔ̃/	j- >~
/χ/	X	jota	/χotə/	x o t &

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	mont	/mɔ̃/	m >~
/n/	n	non	/nɔ̃/	n >~
/ɲ/	nj	oignon	/ɔɲɔ̃/	>~ nj >~
/ŋ/	N	camping	/kã̆mpiŋ/	k A m p i N

Syllabics

IPA	WORLDBET	Word	IPA word	WORLDBET word
/ŋ̩/	N=	camp<u>ing</u>	/kã̆mpŋ̩/	k A m p N=

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	long	/lɔ̃/	l>~
/ʁ/	K	rond	/ʁɔ̃/	K >~
/j/	j	bien	/bjɛ̃/	b j E~
/w/	w	coin	/kwɛ̃/	k w E~
/ɥ/	jw	juin	/ʒɥɛ̃/	Z jw E~

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i/	i	si	/si/	s i
/e/	e	ses	/se/	s e
/ɛ/	E	seize	/sɛz/	s E z
/a/	a	patte	/pat/	p a t
/ɑ/	A	pâte	/pɑt/	p A t
/ɔ/	>	comme	/kɔm/	k > m
/o/	o	gros	/gʁo/	g K o
/u/	u	doux	/du/	d u
/y/	y	dû	/dy/	d y
/ø/	7	deux	/dø/	d 7
/œ/	8	seul	/sœl/	s 8 l
/ə/	&	justement	/ʒystəmɑ̃/	Z y s t & m A~

Nasalized Vowels (Phonemic Distinction)

IPA	WORLDBET	Word	IPA word	WORLDBET word
/ɛ̃/	E~	vin	/vɛ̃/	v E~
/ɑ̃/	A~	vent	/vɑ̃/	v A~
/ɔ̃/	>~	bon	/bɔ̃/	b >~
/œ̃/	8~	brun	/bʁœ̃/	b K 8~

GERMAN

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/pʰ/	ph	Pein	/pʰaɪn/	ph aI n
/b/	b	Bein	/baɪn/	b aI n
/tʰ/	th	Teich	/tʰaɪç/	th aI C
/d/	d	Deich	/daɪç/	d aI C
/kʰ/	kh	Kunst	/kʰʊnst/	kh U n s t
/g/	g	Gunst	/gʊnst/	g U n s t

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	fast	/fast/	f a s t
/v/	v	was	/vas/	v a s
/s/	s	Tasse	/tasə/	t a s&
/z/	z	Hase	/ha:zə/	h a: z &
/ʃ/	S	waschen	/vaʃn̩/	w a S n=
/ʒ/	Z	Genie	/ʒeni:/	Z e n i:
/ç/	C	sicher	/zɪçax/	z I C ax
/x/	x	Buch	/bu:x/	b u: x
/h/	h	Hand	/hant/	h a n t

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word
/pf/	pf	Pfahl	/pfa:l/	pf a: l
/ts/	ts	Zahl	/tsa:l/	ts a: l
/tʃ/	tS	Deutsch	/dɔʏtʃ/	d ~Y tS
/dʒ/	dZ	Dschungel	/dʒʊŋl̩/	dZ U N l=

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	mein	/maɪn/	m aI n
/n/	n	nein	/naɪn/	n aI n
/ŋ/	N	Ding	/dɪŋ/	d I N
/ɲ/	n~	Kognak	/kɔɲak/	k > n~ a k

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i:/	i:	Lied	/li:d/	l i: d
/y:/	y:	süss	/sy:s/	s y: s
/ɪ/	I	Sitz	/sɪts/	s I ts
/ʏ/	Y	hübsch	/hʏbʃ/	h Y b S
/ø/	7	Höhle	/hø:lə/	h 7: l &
/ɛ/	E	Bett	/bɛt/	b E t
/ɛ:/	E:	bäte	/bɛ:tə/	b E: t &
/œ/	8	Hölle	/hœlə/	h 8 l &
/e:/	e:	Beet	/be:t/	b e: t
/a/	a	Satz	/zats/	z a ts
/a:/	a:	Saat	/za:t/	z a: t
/ɔ/	>	Trotz	/tʁɔts/	tK > ts
/o/	o	Foto	/foto:/	foto:
/o:/	o:	rot	/ʁo:t/	K o: t
/ʊ/	U	Schutz	/ʃʊts/	S U ts
/u:/	u:	Blu:t	/blu:t/	b l u: t
/ə/	&	Gesetz	/gəsɛts/	g & s E ts
/ɐ/	ax	besser	/b ɛs ɐ/	b E s ɐ

Diphthongs:

IPA	WORLDBET	Word	IPA word	WORLDBET word
/iɐ/	iax	Tier	/t iɐ/	t iax
/yɐ/	yax	Tür	/t yɐ/	t yax
/øɐ/	7ax	Gehör	/gəhøɐ/	g & h 7ax
/ɛɐ/	Eax	Gewähr	/gəv ɛɐ/	g & v Eax
/eɐ/	eax	Gewehr	/gəveɐ/	g & v eax
/aɪ/	aI	Eis	/aɪs/	aI s
/aʊ/	aU	Haus	/haʊs/	h aU s
/aɐ/	aax	Jahr	/j aɐ/	j aax
/ɔʏ/	>Y	Kreuz	/kʁɔʏts/	k K >Y ts
/oɐ/	oax	Tor	/t oɐ/	t oax
/uɐ/	uax	Ruhr	/ʀuɐ/	R uax

Syllabics

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m̩/	m=	haben	/haːbm̩/	h a: b m=
/n̩/	n=	hatten	/hatn̩/	h a t n=
/n̩g/	N=	Haken	/haːkn̩g/	h a: k N=
/l̩/	l=	Kessel	/kɛsl̩/	k E s l=

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	Lein	/laɪn/	l aI n
/ʀ/	R	rein	/ʀaɪn/	R aI n
/ʁ/	K	waren	/vaːʁən/	v a: K & n
/ɽ/	rr	Traumhoff	/tɽɹaʊmhɔf/	t rr 9 aU m h ¿ f
/r/	r	Herr	/her/	h E r(Bavarian)
/j/	j	Jahr	/jaːʁ/	j a: K

HINDI

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	-	/-/	-
/p^{H}/	pH	-	/-/	-
/t̪/	t[	-	/-/	-
/t̪^{H}/	t[H	-	/-/	-
/ʈ/	tr	-	/-/	-
/ʈ^{H}/	tR	-	/-/	-
/k/	k	-	/-/	-
/k^{H}/	kH	-	/-/	-
/b/	b	-	/-/	-
/b^{H}/	bH	-	/-/	-
/d̪/	d[	-	/-/	-
/d̪^{H}/	dH	-	/-/	-
/ɖ/	dr	-	/-/	-
/ɖ^{H}/	dR	-	/-/	-
/g/	g	-	/-/	-
/g^{H}/	gH	-	/-/	-
/q/	q	-	/-/	-

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	-	/-/	-
/v/	v	-	/-/	-
/s/	s	-	/-/	-
/ʂ/	s_r	-	/-/	-
/z/	z	-	/-/	-
/S/	S	-	/-/	-
/Z/	Z	-	/-/	-
/ç/	C	-	/-/	-
/h/	h	-	/-/	-

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word
/tʃ/	tS	-	/-/	-
/tʃ^{H}/	tSH	-	/-/	-
/dʒ/	dZ	-	/-/	-
/dʒ^{H}/	dZH	-	/-/	-

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	-	/-/	-
/n̪/	n[	-	/-/	-
/ɳ/	nr	-	-	-
/ɲ/	n~	-	/-/	-
/ŋ/	N	-	/-/	-

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	-	/-/	-
/$ɾ_r$/	r(	-	/-/	-
/ɽ/	rr	-	/-/	-
/$ɽ^H$/	rrH	-	/-/	-
/$ɾ_r$/	r(	-	/-/	-
/j/	j	-	/-/	-
/w/	w	-	/-/	-

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i:/	i:	-	/-/	-
/I/	I	-	/-/	-
/ɪ/	Ix	-	/-/	-
/æ/	@	-	/-/	-
/ɛ/	E	-	/-/	-
/e:/	e:	-	/-/	-
/a/	a	-	/-/	-
/a:/	a:	-	/-/	-
/o:/	o:	-	/-/	-
/ɔ/	>	-	/-/	-
/u:/	u:	-	/-/	-
/u/	u	-	/-/	-
/ʊ/	U	-	/-/	-
/ə/	&	-	/-/	-

Diphthongs

IPA	WORLDBET	BLYin	Word	WORLDBET word
/ai/	ai	-	/-/	-
/aʊ/	aU	-	/-/	-

ITALIAN

Plosive

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	copia	/kopia/	kopia
/p:/	p:	coppia	/kop:ia/	kop:ia
/b/	b	bacio	/batʃo/	b a tS o
/b:/	b	babbo	/bab:o/	b a b: o
/t/	t	tana	/tana/	t a n a
/t:/	t	latte	/laT:e/	l a t: e
/d/	d	dito	/dito/	d I t o
/d:/	d:	cadde	/kad:e/	k a d: e
/k/	k	casa	/kasa/	k a s a
/k:/	k:	sacco	/sak:o/	s a k: o
/g/	g	ago	/ago/	a g o
/g:/	g:	leggo	/lɛg:o/	l E g: o

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	festa	/festa/	f e s t a
/f:/	f:	affetto	/af:et:o/	a f: e t: o
/v/	v	vino	/vino/	v i n o
/v:/	v:	ovvio	/ɔv:io/	> v: io
/s/	s	sette	sete	s e t e
/s:/	s:	osso	/os:o/	o s: o
/z/	z	rosa	/-/	rosa
/z:/	z:	zone	/zon/	z o n
/ʃ/	S	sci	/ʃi/	S i
/ʃ:/	S:	ascia	/a ʃ:ia/	a S ia

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word
/ts/	ts	zio	/tsio/	ts io
/ts:/	ts:	azione	/ats:ioni/	a ts: io m i
/tʃ/	tS	cinema	/tʃinema/	tS i n e m a
/tʃ:/	tS:	gocce	/gɔtʃe/	g > tS e
/dʒ/	dZ	giro	/dʒiro/	dZ i r o
/dʒ:/	dZ:	oggi	/ɔdʒ:i/	> dZ: i

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	mano	/mano/	m a n o
/m:/	m:	mamma	/mam:a/	m a m: a
/M/	M	inferno	/iMferno/	i M f e r n o
/n/	n	vano	/vano/	v a n o
/n:/	n:	vanno	/va:no/	v a n: o
/ŋ/	N	ancora	/aŋkora/	a N k o r a
/ɲ/	n∼	gnocco	/ɲok:o/	n∼ o k: o
/ɲ:/	n∼:	ogni	/oɲ:i/	o n∼: i

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	latte	lat:e	l a t: e
/l:/	l:	bello	/bɛl:o/	b E l: o
/r/	r	serata	/serata/	s e r a t a
/r:/	r:	serrata	/ser:ata/	s e r: a t a
/ʎ/	L	gli	ʎi	L i
/ʎ:/	L:	aglio	aʎ:io	a L: io
/j/	j	piu	/pju/	p j u
/w/	w	puo	/pwɔ	p w >

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i/	i	vino	/vino/	vino
/I/	I	vinacca	/vinatʃa	v I n a tS a
/e/	e	nero	/nero/	n e r o
/ɛ/	E	epoca	/ɛpoka/	E p o k a
/a/	a	case	/k a s e/	k a s e
/ɔ/	>	cosa	/kɔsa/	k > s a
/o/	o	volo	/volo/	v o l o
/u/	u	lumaca	/lumaka/	l u m a k a
/ʌ/	⋀	allora	/ʌl:ora/	⋀ l: o r a
/ə/	&			

Diphthongs

IPA	WORLDBET	BLYin	Word	WORLDBET word
/ie/	ie	fieno	/fieno/	f ie n o
/iɛ/	iE	piede	/piɛde/	p iE d e
/ia/	ia	iato	/iato/	ia t o
/io/	io	fiore	/fiore/	f io r e
/iɔ/	i>	ionio	/ionio/	io n io
/ei/	ei	deiscente	/deiɛente/	d ei S e n t e
/ɛi/	Ei	lei	/lɛi/	l Ei
/eu/	eu	neurologia	/neurolodʒia/	n eu r o l o dZ ia
/ɛu/	Eu	reuma	/rɛuma/	r Eu m a
/oi/	oi	noi	/noi/	n oi
/ai/	ai	farai	/farai/	f a r ai
/au/	au	causa	/kauza/	k au z a
/ui/	ui	altrui	/altrui/	a l t r ui
/ue/	ue	questo	/kuesto/	k ue s t o
/uɛ/	uE	querulo	/kuerulo/	k ue r u l o
/ua/	ua	quasi	/kuasi/	k ua s i
/uo/	uo	liquore	/likuore/	l i k uo r
/uɔ/	u>	cuore	/kuɔre/	k u> r e

JAPANESE

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	-	/-/	-
/p:/	p:	happa	/-/	-
/b/	b	-	/-/	-
/b:/	b:	mobbu	/-/	-
/t̪/	t[	-	/-/	-
/t̪:/	t[:	hatta	/-/	-
/d̪/	d[	-	/-/	-
/d̪:/	d[:	beddo	/-/	-
/k/	k	-	/-/	-
/k:/	k:	hakka	/-/	-
/g/	g	-	/-/	-
/g:/	g:	baggu	/-/	-

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/ɸ/	F	-	/-/	-
/f/	f	-	/-/	-
/s/	s	-	/-/	-
/s:/	s:	hasso	/-/	-
/z/	z	-	/-/	-
/ʃ/	S	-	/-/	-
/ʃ:/	S:	hassha	/-/	-
/x/	x	-	/-/	-
/h/	h	-	/-/	-
/ç/	C	-	/-/	-
/j/	j-	-	/-/	-

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word
/t̪s/	t[s	-	/-/	-
/tʃ/	t[S	-	/-/	-
/dʒ/	d[Z	-	/-/	-
/d̪z/	d[z	-	/-/	-

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	-	/-/	-
/m:/	m:	aNma	/-/	-
/n̪/	n[	-	/-/	-
/n̪:/	n[:	aNnai	/-/	-
/ŋ/	N	-	/-/	-

Syllabics

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m̩/	m=	-	-	-
/n̪̩/	n[=	-	-	-
/n̩g/	N=	-	-	-

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/j/	j	-	/-/	-
/w/	w	-	/-/	-
/ɹ/	9r	-	/-/	-

Taps and Flaps

IPA	WORLDBET	Word	IPA word	WORLDBET word
/ɺ/	*l*(	-	/-/	-
/ɾ$_r$/	*r*(	-	/-/	-
/[ɾ$_d$]/	d[_(	-	/-/	-
/[ɾ$_g$]/	g_(	-	/-/	-
/[ɾ$_k$]/	k_(	-	/-/	-

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/iː/	i:	-	/-/	-
/i/	i	-	/-/	-
/e/	e	-	/-/	-
/eː/	e:	-	/-/	-
/a/	a	-	/-/	-
/aː/	a:	-	/-/	-
/ʌ/	⋀	-	/-/	-
/o/	o	-	/-/	-
/oː/	o:	-	/-/	-
/ɯ/	4	-	/-/	-
/ɯː/	4:	-	/-/	-
/ə/	&	-	/-/	-
/ə̥/	&_0	-	/-/	-

Diphthongs:

IPA	WORLDBET	Word	IPA word	WORLDBET word
/aɪ/	aI	hi	/haɪ/	h aI
/eɪ/	eI	antei	/an̩ t eɪ/	a n= t eI
/oɪ/	oI	-	-	-
/iɯ/	i4	-	-	-

MANDARIN

Plosives

IPA	WORLDBET	PinYin	Word	WORLDBET word
/p/	p	b	bai	p ai
/t̪/	t[	d	dei	t[ei
/k/	k	g	gu	k u
/pʰ/	ph	p	pai	ph ai
/t̪ʰ/	t[h	t	tai	t[h ai
/kʰ/	kh	k	kæn	kh @ n

Fricatives

IPA	WORLDBET	BLYin	Word	WORLDBET word
/f/	f	f	fa	f A
/s/	s	s	sæn	s @ n
/ʂ/	sr	S	shæn	sr @ n
/ç/	C	x	xia	C A
/x/	x	h	hai	h ai
/v/	v	v	wei	v ei (North)

Affricates

IPA	WORLDBET	BLYin	Word	WORLDBET word
/ts/	ts	z	zong	ts > N
/tsʰ/	tsh	c	ci	tsh i
/tʂ/	thsr	Z	zhu	thsr u
/tʰʂ/	tsr	C	chi	tsr
/cç/	cC	j	jian	j ai n
/cʰç/	cCh	q	qian	cCh ai n

Nasals

IPA	WORLDBET	BLYin	Word	WORLDBET word
/m/	m	m	mei	m ei
/n/	n	n,N	neng	n E N
/ŋ/	N	G	zheng	thsr E N

Semi-vowels

IPA	WORLDBET	BLYin	Word	WORLDBET word
/l/	l	l	li	l i:
/ɹ/	r+	r	rang	r A N
/j/	j	y	xian	C j @ n
/w/	w	w	tuan	t[w A n
/ɥ/	jw	Y	xuan	C j w n

Vowels

IPA	WORLDBET	BLYin	PYWord	WORLDBET word
/i:/	i:	i	bi	p i:
/ɪ^f/	If	$	si	sr If
/ɪ/	I	-	Qing-1	cCh I N
/ɛ/	E	e	die	t[E
/æ/	@	@	dan	t[@ n
/y/	y	U	ju	j y
/ɑ/	A	a	pa	ph A
/ɔ/	>	o	duo	t[>
/ɤ/	2	$\bigwedge$	de	t[2
/u/	u	u	zhu	thsr u
/ə/	&	-	dun	t[u & n
/ɚ/	&r	R	er	&r
/ɯ˞/	4r	%	shi	sr 4r

Diphthongs and Glide-Vowels:

IPA	WORLDBET	BLYin	Word	WORLDBET word
/ai/	ai	I	pai	ph ai
/aʊ/	aU	W	gao	k aU
/ei/	ei	A	fei	f ei
/oʊ/	oU	O	gou	k oU

RUSSIAN

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	-	/-/	-
/p^j/	pj	-	/-/	-
/t̪/	t[	-	/-/	-
/t̪^{j}/	t[j	-	/-/	-
/k/	k	-	/-/	-
/k^j/	kj	-	/-/	-
/b/	b	-	/-/	-
/b^j/	bj	-	/-/	-
/d̪/	d[	-	/-/	-
/d̪^{j}/	dj	-	g	/-/ -
/g/	g	-	/-/	-
/g^j/	gj	-	/-/	-

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	-	/-/	-
/f^j/	fj	-	/-/	-
/v/	v	-	/-/	-
/v^j/	vj	-	/-/	-
/s/	s	-	/-/	-
/s^j/	sj	-	/-/	-
/z/	z	-	/-/	-
/z^j/	zj	-	/-/	-
/S/	S	-	/-/	-
/Z/	Z	-	/-/	-
/x/	x	-	/-/	-
/x^j/	xj	-	/-/	-

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word
/t̪s/	t[s	-	/-/	-
/tʃ^j/	tSj	-	/-/	-

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	-	/-/	-
/m^j/	mj	-	/-/	-
/n̪/	n[	-	/-/	-
/$n̪^j$/	n[j	-	/-/	-

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	-	/-/	-
/l^j/	lj	-	/-/	-
/r/	r	-	/-/	-
/r^j/	rj	-	/-/	-
/j/	j	-	/-/	-

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i:/	i:	-	/-/	-
/ɨ/	ix	-	/-/	-
/e:/	e:	-	/-/	-
/a:/	a:	-	/-/	-
/o:/	o:	-	/-/	-
/u:/	u:	-	/-/	-
/ə/	&	-	/-/	-

Diphthongs

IPA	WORLDBET	BLYin	Word	WORLDBET word
/-/	-	-	/-/	-
/-/	-	-	/-/	-

SPANISH (Castillian)

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	punto	/púnto/	p u n t o
/b/	b	baños	/báɲos/	b a n~ o s
/t/	t	tino	/tíno/	t i n o
/d/	d	donde	/dónde/	d o n d e
/k/	k	casa	/kása/	k a s a
/g/	g	ganga	/gáŋga/	g a N g a

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/β/	V	haba	/áβa/	aVa
/f/	f	falda	/fálda/	f a l d a
/s/	s	casa	/kása/	k a s a
/z/	z	mismo	/mízmo/	m i z m o
/θ/	T	luces	/lúθes/	l u T e s
/ð/	D	dedo	/déðo/	d e D o
/x/	x	jamás	/xamás/	x a m a s
/ɣ/	G	lago	/láɣo/	l a G o

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word
/tʃ/	tS	chato	/tʃáto/	tS a t o
/dʒ/	dZ	un yugo	/undʒúɣo/	dZ u G o

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	mano	/máno/	m a n o
/n/	n	nada	/náða/	n a D a
/ɲ/	n~	baño	/báɲo/	b a n~ o
/ŋ/	N	banco	/báŋko/	b a N k o

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	lado	/ládo/	l a d o
/ʎ/	L	pollo(older)	/póʎo/	p o L oD
/$ɾ_r$/	r(	pero	p é $ɾ_r$ o	p e r(o
/r/	r	perro	/p é r o	p e r o
/j/	j	mayo	/májo/	m a j o
/w/	w	cuento	/kwénto/	k w e n t o

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i/	i	piso	/píso/	p i s o
/e/	e	mesa	/mésa/	m e s a
/a/	a	caso	/káso/	k a s o
/o/	o	modo	/móðo/	m o D o
/u/	u	cura	/kú$ɾ_r$a/	k u r(a

TAMIL

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	-	/-/	-
/p/	p_v	-	/-/	-
/t̪̂/	t[	-	/-/	-
/t̪̬/	t[_v	-	/-/	-
/t/	t	-	/-/	-
/ʈ/	tr	-	/-/	-
/ʈ/	tr_v	-	/-/	-
/ç̂/	c	-	/-/	-
/ç/	c_v	-	/-/	-
/k̂/	k	-	/-/	-
/k̬/	k_v	-	/-/	-

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	-	/-/	-
/s/	s	-	/-/	-
/ʂ/	s_r	-	/-/	-
/ç/	C	-	/-/	-

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	-	/-/	-
/n̪/	n[	-	/-/	-
/ɳ/	nr	-	-	-
/ɲ/	n∼	-	/-/	-
/ŋ/	N	-	/-/	-

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l̪/	l[	-	/-/	-
/ɭ/	lr	-	/-/	-
/ɾ$_r$/	r(	-	/-/	-
/r/	9r	-	/-/	-
/j/	j	-	/-/	-
/w/	w	-	/-/	-
/ɰ/	4)	-	/-/	-

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i/	i	-	/-/	-
/i:/	i:	-	/-/	-
/e/	e	-	/-/	-
/e:/	e:	-	/-/	-
/a/	a	-	/-/	-
/a:/	a:	-	/-/	-
/o/	o	-	/-/	-
/o:/	o:	-	/-/	-
/u/	u	-	/-/	-
/u:/	u:	-	/-/	-
/ə/	&	-	/-/	-

Diphthongs

IPA	WORLDBET	BLYin	Word	WORLDBET word
/ai/	ai	-	/-/	-
/aʊ/	aU	-	/-/	-

VIETNAMESE

Plosives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/p/	p	-	/-/	final
/t/	t	-	/-/	-
/tʰ/	th	-	/-/	initial
/ʈ/	tr	-	/-/	initial
/ç/	c	-	/-/	-
/k/	k	-	/-/	initial
/b/	b	-	/-/	-
/ɓ/	b<	-	/-/	-
/d/	d	-	/-/	initial
/ɗ/	d<	-	/-/	-

Fricatives

IPA	WORLDBET	Word	IPA word	WORLDBET word
/f/	f	-	/-/	initial
/v/	v	-	/-/	initial
/s/	s	-	/-/	initial-
/z/	z	-	/-/	initial-
/x/	x	-	/-/	initial-
/ɣ/	G	-	/-/	initial-
/h/	h	-	/-/	initial-
/ç/	C	-	/-/	initial-

Affricates

IPA	WORLDBET	Word	IPA word	WORLDBET word
/dʒ/	dZ	-	-	-

Nasals

IPA	WORLDBET	Word	IPA word	WORLDBET word
/m/	m	-	/-/	-
/n/	n	-	/-/	-
/ɲ/	nj	-	/-/	initial
/ŋ/	N	-	/-/	-

Semi-vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/l/	l	-	/-/	initial-
/r/	9r	-	/-/	initial-
/j/	j	-	/-/	-
/w/	w	-	/-/	initial-

Vowels

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i/	i	-	/-/	-
/e/	e	-	/-/	-
/ɛ/	E	-	/-/	-
/ɑ/	A	-	/-/	-
/ʌ/	$\bigwedge$	-	/-/	-
/o/	o	-	/-/	-
/ɤ/	2	-	/-/	-
/ɔ/	>	-	/-/	-
/u/	u	-	/-/	-
/ɯ/	4	-	/-/	-
/ə/	&	-	/-/	-

Diphthongs

IPA	WORLDBET	Word	IPA word	WORLDBET word
/i&/	i&	-	/-/	-
/iu/	iu	-	/-/	-
/ai/	ai	-	/-/	-
/a4/	a4	-	/-/	-
/au/	au	-	/-/	-
/ei/	ei	-	/-/	-
/eo/	eo	-	/-/	-
/eu/	eu	-	/-/	-
/oi/	oi	-	/-/	-
/ʌi/	$\bigwedge$i	-	/-/	-
/aʊ/	aU	-	/-/	-
/ɔi/	>i	-	-	-
/ɔA/	>A	-	-	-
/ɔ&/	>&	-	-	-
/ui/	ui	-	/-/	-
/u&/	u&	-	/-/	-
/ɯi/	4i	-	/-/	-
/ɯ&/	4&	-	/-/	-