

# NCHLT 2013 PHONE SET

DESCRIPTION	IPA	SAMPA	LANGUAGE											COMMENTS
			ISIZULU	ISIXHOSA	SISWATI	ISINDEBELE	SEPEDI	SETSWANA	SESOTHO	XITSONGA	TSHIVENDA	AFRIKAANS	ENGLISH	Note that this phone set focuses on phonemic distinctions (rather than phonetic distinctions), in general.
<b>Affricates</b>														
Voiceless alveo-labial affricate	tʰ	tp\			intfutfu									
Ejective alveolar lateral affricate	tʰʼ	tK_>		intlahlā		lɬlawana								
Voiceless aspirated alveolar lateral affricate	tʰʰ	tK_h				tlhaga								
Voiced alveolar lateral affricate	dʰ	dK								dlala				
Voiced aspirated alveolar lateral affricate	dʰʰ	dK\								ndlhazi				
Post-alveolar affricate	tʃ	tS										tjank*	chin	*In Afrikaans dictionary tS currently modelled as "t S"
Ejective post-alveolar affricate	tʃʼ	tS_>	tshe	intsha		utjani	tšaka	ntša	tjōtja	cina				
Aspirated post-alveolar affricate	tʃʰ	tS_h		tshisa		itjhatjha	tšhaba	setšhaba	tjhaba	chukucha	mutshila			
Ejective alveolar affricate	tsʼ	ts_>	tsatsaza	intsimi	intsaba	itsikiri	tsela	tsela	tsela		kutsimu			
Aspirated alveolar affricate	tsʰ	ts_h			tsatsa	tshanya	tshadi	tshaba	tshêha					* For Siswati, ts_> and ts_h combined
Ejective velar affricate	kxʼ	kx_>		ikrele										
Voiceless velar affricate	kx	kx				kghupula*	kgama	kgama	kgama					* isiNdebele kx typically aspirated. (Can be modelled as separate kx_h but no kx/kx_h minimal pairs.)
Voiceless velo-alveolar lateral affricate	kʰ	kK_>	kleza		kleza									
Voiceless labio-alveolar ejective affricate	psʼ	ps_>					psila							
Aspirated labio-alveolar affricate	psʰ	ps_h					pshiò		pshiò					
Aspirated labio-palatal affricate	pʃʰ	pS_h					pšhatla		ptjhatla					
Voiceless labio-palatal ejective affricate	pʃʼ	pS_>					eupša		pjatla					
Voiced post-alveolar affricate	dʒ	d_0Z	inja*	inja	inja	jabula	ja	ja	ja	jaha	dzhena	kollege**	gin	* Depending on speaker, the isiZulu d_0Z can be realised as either d_0Z or Z ** Afrikaans d_0Z fairly rare, modelled as d Z
Voiced alveolar affricate	dz	dz	inzalo		indzaba	idzila					dzembe			
Voiced alveo-labial affricate	dβ	dB			indvodza									
Voiced retroflex affricate	dʒ	dz`								dzwi, dzaha				
Voiced aspirated retroflex affricate	dʒʰ	dz`h\								ndzhaku				
Voiced aspirated palatal affricate	dʒʰ	dZh								njhani				
<b>Fricatives</b>														
Voiceless labiodental fricative	f	f	fa	fa	fa	funa	fofa	fofa	fofa	famba	fana	fel,vel	fin	
Voiced labiodental fricative	v	v	vala	vala	vala	vula				vhlwa	vili	wat	vim	
Voiceless dental fricative	θ	T											thin	
Voiced dental fricative	ð	D											this	
Voiceless alveolar fricative	s	s	sala	sala	sala	susa	sesadi	sesadi	sesadi	sila	sala	sous	sin	
Voiced alveolar fricative	z	z	zama	zama	liza	Zala				muzumbi	zazamela	zulu	zing	
Voiceless post-alveolar fricative	ʃ	S	sha	shushu	sha		šala	šapa	shapa	xava	shavha	sjampoe	shin	
Voiced post-alveolar fricative	ʒ	Z									zhaka	genre	measure	
Voiceless velar fricative	x	x				rhonona		gana	gafa		xa	gat	loch	
Voiceless glottal fricative	h	h	ihhashi	huhuza	lihhashi	ihogo	hêma	hêma						
Voiced glottal fricative	ɦ	h\	hamba		hamba		lehodu		hana	huma	hana	hand	hit*	* English h includes voiced and unvoiced variations

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Voiceless alveolar lateral fricative	ɬ	K	hlala	hlala	hlala	hlala	hlaba		hlaba	hlamula				
Voiced alveolar lateral fricative	ɮ	K\	dlala	dlala	dlala	dlala								
Voiced velar fricative	ɣ	G		igronya			gôga							
Voiced bilabial fricative	β	B					baba			vona	vhavha			
Voiceless bilabial fricative	ɸ	p\									fhala			
Voiceless retroflex fricative	ɕ	s'								sweka				
Voiceless labialised alveolar fricative	sw	sw									swara			
Voiced retroflex fricative	zw	zw									zwifha			
Bilabial alveolar fricative	ɸs	p\ɬ					lefsifsi							
Voiceless bilabial postalveolar fricative	ɸS	p\ɬ					Bofša							
Voiced bilabial postalveolar fricative	βɜ	BZ					bjala		bjaratsa					
Labiodantal-postalveolar fricative	ff	fS							lefshwa					
<b>Clicks</b>														
Dental click														Note that all nasalised clicks are modelled as compound sounds, for example the nasalised dental click would be modelled as 'n  ɮ' and the nasalised voiced dental click would be modelled as 'N  g_0'.
		ɮ	cinga	caca	cinga	cima								
Voiced dental click	g	g_0	gcina	cangci		gcina								
Aspirated dental click	ʰ	ɮʰ	chita	chachambo		chacha								
Alveolar lateral click		ɮ	xoxo	xoxa										
Voiced alveolar lateral click	g	g_0	gxumeka	gxabeka										
Aspirated alveolar lateral click	ʰ	ɮʰ	xhaka	isixhosa										
Palatal click	!	!ɮ	qumba	qala	qumba	qina		qaqa	xiqoko					
Voiced palatal click	g!	!g_0	ggiba	iwagqiba		umgqomu								
Aspirated palatal click	!ʰ	!ɮʰ	qhuba	qhele		qhula								
<b>Stops</b>														
Voiceless bilabial plosive	p	p			impi					mpunga		pap	pin*	*English p includes aspirated and un-aspirated versions
Aspirated bilabial plosive	pʰ	p_h	pha	pha	pha	iphaphu	phela	phela	phela	phanga	phala			
Ejective bilabial plosive	p'	p_>	impi	pasa		iposo	pela	pela	pela		panda			
Voiceless palatalised bilabial ejective	pj'	pj_>								pyopya				
Voiceless aspirated palatalised bilabial plosive	pjʰ	pj_h								phya				
Voiced bilabial plosive	b	b	ibhasi	bhala**	imbuti, bhala	khamba, bhala		baba	baba	ba	bako	bas	bin*	* English b includes aspirated and un-aspirated versions ** isiXhosa b transcribed as b_h in dictionaries, for historic reasons.
Voiced bilabial implosive	ɓ	b_<	bona, ubaba	bona		bona				baba				
Voiced palatalised bilabial plosive	bj	bj								byala				
Voiceless alveolar plosive	t	t										tot	tin	
Aspirated alveolar plosive	tʰ	t_h	thata	theta	thandaza	thuta	thapo	thopa	thopa	thula	hula			
Ejective alveolar plosive	t'	t_>	taka	itakane	emanti	itafula	tôpa	tona	tôpa	tatana	tafuna takala			
Voiceless palatalised alveolar plosive	tj	tj								tyatyasa				
Voiceless aspirated palatalised alveolar plosive	tjʰ	tj_h								thyaka				
Voiced alveolar plosive	d	d	indoda	indoda	indishi	idada		dira	duma	dedeleka	da/daha	dag	din	

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Voiced palatalised alveolar plosive	dʒ	dʒ								dya				
Voiced aspirated alveolar plosive	dʰ	dʰ\								ndhambi				
Ejective palatal plosive	cʼ	c_>		ukutya										
Aspirated palatal plosive	cʰ	c_ h		ityhefu										
Voiced palatal plosive	ɟ	ɟ\		indyebo							dyelo			
Voiceless velar plosive	k	k	ukuhaba		inkomo	kela					kula		kyk	kin
Voiceless aspirated velar plosive	kʰ	k_ h	khokha	khoka	khokha	khamba	Khudu	khudu	sekhôna	khoma	khuhu			
Ejective velar plosive	kʼ	k_>		inkomo		inkomo	kudu	kubu	kula		kokodza			
Voiced velar plosive	g	g	ngena	ngena	ngena	igama					gamba	goga	gholf	give
Voiced aspirated velar plosive	gʰ	gʰ\									nghena			
Voiceless alveolar lateral ejective	tlʼ	tl_>					tla	tla	tla		tlanga			
Voiceless aspirated alveolar lateral plosive	tlʰ	tl_ h					tlhabô	tlhabô	tlhako	tlhari				
Nasals														
Bilabial nasal	m	m	mema	mema	mema	mina	êma	êma	êma	kuma	ima	man	mock	
Alveolar nasal	n	n	nona	nona	nona	nina	nama	nama	nama	manana	nona/ nama	net	knock	
Palatal nasal	ɲ	ɲ	inyama, intsha	inyama, intshuntshe	inyama	inyama	nyaka	nyala	nyala	nyoka	nyamalala			
Velar nasal	ŋ	N	ngakho, ingwe	inkomo	ingungu	nghala	ngwana	ngwana, nku	ngwana	ngulube	n'an'a	bang	thing	
Retroflex nasal	ɳ	nʼ								ndzhaku				
Voiced aspirated bilabial nasal	mʰ	m_ h		mhumha							mhaka			
Voiced aspirated alveolar nasal	nʰ	n_ h		isinhanha							nhamu			
Labiodental nasal	ɱ	m_ j					myemyela							
Voiced aspirated palatal nasal	ɲʰ	ɲ_ h		inyholoba										
Vowels														
Unrounded high front vowel	i	i	vimba	vimba	vimba	lima	dira	dira	pitsa	ribye	lisa	sien	happy, into	
Unrounded high front vowel with duration	i:	i:											ease	
Rounded high front vowel	y	y										nuwe		
Rounded high back vowel	u	u	vula	vula	vula	thunga	Pula	pula	pula	huma	luma	soek		
Rounded high back vowel with duration	u:	u:											lose	
Unrounded near-high near-front vowel	ɪ	ɪ					tsela*	tsela*	tsela*					* I/i and U/o rendered as single phone for all Sotho-Tswana languages
Rounded mid-high front vowel with duration	ø:	2:										museum		
Unrounded mid-low front vowel	ɛ	E	senga	senga	senga	sela	rêma	rêma	rema	hela	rema	pen	pet*	*English E also realised as e in SAE
Rounded mid-low central vowel with duration	ɜ:	3:											furs	
Rounded mid-low back vowel	ɔ	O	bola	bola	bola	bona	pôô	pôô	poho	songa	mboho	pol		
Rounded mid-low back vowel with duration	ɔ:	O:											cause	
Unrounded low front vowel	a	a	thanda	thanda	tsandza	lala	rata	rata	rata	aka	rafha	pas	cut*	*English a includes both a and V variants (found in SAE)
Unrounded low back vowel with duration	ɑ:	A:										maar	stars	
Central vowel (schwa)	ə	@										pit	another	
Unrounded mid-low front vowel	æ	{										hek	pat	
Rounded near-high near-back vowel	ɤ	U					motho*	motho*	motho*				into, put	* I/i and U/o rendered as single phone for all Sotho-Tswana languages
Rounded mid-low front vowel	œ	9										put		
Rounded low back vowel	ɒ	Q											pot	

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Diphthongs** (vowels as above)	əi	@i										peil/pyl	raise	Note that the standard tense/lax distinction not made for diphthongs in SAE
	œy	9y										uit		
	ai	ai											rise	** In Afrikaans, the following additional diphthongs are currently modeled as vowel sequences: a i, A: i, O i, @u i, u i, i u
	ɔi	Oi											noise	
	əu	@u										oud	nose	
	au	au											rouse	
	iə	i@										meet	fears	
	uə	u@										oor	poor	
	eə	e@											stairs	
Trills and Flaps														
Alveolar trill	r	r	uMarija	uMariya	uMariya	rara	rata	rata	rata	raha	ranga	raar		
Aspirated alveolar trill	rʰ	rh\								rhama				
Approximants														Note that in the audio phone set, a small segment of @ accompanies approximants where necessary, in order to make them clearly audible
Alveolar lateral approximant	l	l	lala	lala	lala	lila	lala	lala	lala	lomba	lifhata, lala	lol	long	
Alveolar approximant	ɹ	ɹ\											wrong	
Palatal approximant	j	j	ukuya	ukuya	leniyenta	yena	ya	ya	ya	yima	ya	jaar	yacht	
Voiced labio-velar approximant	w	w	wa	wa	wa	wona	wa	wa	wa	wa	wa	twee	wasp	
Retroflex lateral approximant	ɭ	ɭ'					dira*							*The Sepedi ɭ' only occurs before an 'i' or 'u' (except in a few exceptional cases, specifically words of foreign origin and words containing "ll") and can therefore be seen as a contextual variant of l. Here modelled as a separate phoneme.

This phone set is based on the phone set developed during the Lwazi project.

More information on the Lwazi project:

\* <http://www.meraka.org.za/lwazi/>

\* E. Barnard, M.H. Davel and G.B. van Huyssteen, "Speech technology for information access: a South African case study," in Proceedings of the AAAI Spring Symposium on Artificial Intelligence for Development (AI-D), Palo Alto, California, March 2010, pp. 8-13.

More information on the process to create the Lwazi phone set and original Lwazi dictionaries:

\* M. Davel and O. Martirosian, "Pronunciation dictionary development in resource-scarce environments," in Proceedings of Interspeech, Brighton, United Kingdom, September 2009, pp. 2851-2854.