

Names for KEL (ISBT 006) Blood Group Alleles

Intro

General description: The Kell blood group system consists of 38 antigens carried on a type II transmembrane glycoprotein of 732 amino acids (aka CD238). The Kell glycoprotein is a zinc-dependent metalloproteinase that has been shown to have endothelin-3-converting enzyme activity. A single disulfide bond (Kell Cys72 - XK Cys347) links the KEL protein to the XK membrane protein that carries the Kx antigen. Absence of XK leads to a reduction of expression of Kell antigens on the red blood cell membrane.

Gene name: *KEL*
 Number of exons: 19
 Initiation codon: Within exon 1
 Stop codon: Within exon 19
 Entrez Gene ID: 3792
 LRG: LRG_799
 LRG sequence: NG_007492.3 (genomic)
 NM_000420.3, ENST00000355265.7 (transcript)
 NP_000411.1, ENSP00000347409.2 (protein)

Reference allele: *KEL**02 (shaded)
 Acceptable: *k* if inferred by haemagglutination

Reference allele
*KEL**02 encodes: KEL2, KEL4, KEL5, KEL7, KEL11, KEL12, KEL13, KEL14, KEL16, KEL18, KEL19, KEL20, KEL22, KEL26, KEL27, KEL29, KEL30, KEL32, KEL33, KEL34, KEL35, KEL36, KEL37, KEL38, KEL40

Antithetical antigens: [KEL1 KEL2]; [KEL3 KEL4 KEL21]; [KEL6 KEL7]; [KEL11 KEL17]; [KEL14 KEL24]; [KEL31 KEL38]; [KEL37 KEL39]; [KEL40 KEL41]

Low frequency antigens: KEL3, KEL6, KEL10, KEL17, KEL21, KEL23, KEL24, KEL25, KEL28, KEL31, KEL39, KEL41

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon Intron	Predicted amino acid change	PMID (Reference nr)	Accession number	rs number	GRCh38
KEL:1,-2 or K+k-	<i>KEL*01.01</i>	c.578C>T	6	p.Thr193Met	PMID: 7849312	S76770.1	rs8176058	7:142957921
KEL:1weak or K+w	<i>KEL*01.02</i>	c.577A>T	6	p.Thr193Ser	PMID: 17076841	n.a.	rs61729031	7:142957922
KEL:1weak,3 or K+w, Kp(a+)	<i>KEL*01.03</i>	c.578C>T c.841C>T	6 8	p.Thr193Met p.Arg281Trp	PMID: 19347978	FM208212.1	rs8176058 rs8176059	7:142957921 7:142954267
KEL:2 or k+	<i>KEL*02</i>	c.578C	6	p.Thr193	PMID: 1712490	M64934 NM_000420.2	rs8176058	7:142957921
KEL:2 or k+	<i>KEL*02.02</i>	c.1546C>A	14	p.Arg516Arg	PMID: 24845979	HG512887.1	rs8176034	7:142943829
KEL:3,-4,-21 or Kp(a+b-c-)	<i>KEL*02.03</i>	c.841C>T	8	p.Arg281Trp	PMID: 8669078	AM085119	rs8176059	7:142954267
KEL:6,-7 or Js(a+b-)	<i>KEL*02.06</i>	c.1790T>C	17	p.Leu597Pro	PMID: 7570911	S80081.1	rs8176038	7:142943026
KEL:10 or UI(a+)	<i>KEL*02.10</i>	c.1481A>T	13	p.Glu494Val	PMID: 8669078	n.a.	rs61729032	7:142944333
KEL: -12	<i>KEL*02.-12</i>	c.1643A>G	15	p.His548Arg	PMID: 9426633	n.a.	rs61729033	7:142943546
KEL:-14,-24	<i>KEL*02.-14.1</i>	c.538C>T	6	p.Arg180Cys	PMID: 9354821	n.a.	rs747437444	7:142957961
KEL:-14	<i>KEL*02.-14.2</i>	c.539G>A	6	p.Arg180His	PMID: 9354821	n.a.	rs61729039	7:142957960
KEL: -11,17	<i>KEL*02.17</i>	c.905T>C	8	p.Val302Ala	PMID: 8669078	n.a.	rs61729034	7:142954203
KEL:-18	<i>KEL*02.-18.1</i>	c.388C>T	4	p.Arg130Trp	PMID: 9426633	n.a.	rs184131044	7:142960940
KEL:-18	<i>KEL*02.-18.2</i>	c.389G>A	4	p.Arg130Gln	PMID: 9426633	n.a.	rs201110152	7:142960939
KEL:-19	<i>KEL*02.-19</i>	c.1475G>A	13	p.Arg492Gln	PMID: 9426633	n.a.	rs61729035	7:142944339
KEL:-3,-4,21 or Kp(a-b-c+)	<i>KEL*02.21</i>	c.842G>A	8	p.Arg281Gln	PMID: 8669078	n.a.	rs61729036	7:142954266
KEL:-22	<i>KEL*02.-22</i>	c.965C>T	9	p.Ala322Val	PMID: 9426633	n.a.	rs61729037	7:142953916
KEL:23	<i>KEL*02.23</i>	c.1145A>G	10	p.Gln382Arg	PMID: 9269063	n.a.	rs61729038	7:142952567
KEL: -14,24	<i>KEL*02.24</i>	c.539G>C	6	p.Arg180Pro	PMID: 9354821	n.a.	rs61729039	7:142957960
KEL:25,-28 or VLAN+ VONG-	<i>KEL*02.25</i>	c.743G>A	8	p.Arg248Gln	PMID: 8837356	n.a.	rs61729040	7:142954365

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon Intron	Predicted amino acid change	PMID (Reference nr)	Accession number	rs number	GRCh38
KEL:-26 or TOU-	<i>KEL*02.-26</i>	c.1217G>A	11	p.Arg406Gln	PMID: 9426633	n.a.	rs61729041	7:142946304
KEL:-27 or RAZ-	<i>KEL*02.-27</i>	c.745G>A	8	p.Glu249Lys	PMID: 11904003	n.a.	rs61729042	7:142954363
KEL:-25,28 or VLAN- VONG+	<i>KEL*02.28</i>	c.742C>T	8	p.Arg248Trp	(1), Abstract	n.a.	rs61728832	7:142954366
KEL:-29 or KALT-	<i>KEL*02.-29</i>	c.1868G>A	17	p.Arg623Lys	PMID: 16934067 (13)	JN038574.1	rs61729043	7:142942948
KEL:-30 or KTIM-	<i>KEL*02.-30</i>	c.913G>A	8	p.Asp305Asn	PMID: 16934067 (13)	JN038575.1	rs61729044	7:142954195
KEL:31, -38 or KYO+, KYOR-	<i>KEL*02.31</i>	c.875G>A	8	p.Arg292Gln	(2), Abstract PMID: 23968329	n.a.	rs201698610	7:142954233
KEL:-32 or KUCI-	<i>KEL*02.-32</i>	c.1271C>T	11	p.Ala424Val	PMID: 23560718 (16)	JN020633.1	rs779011501	7:142946250
KEL:-33 or KANT-	<i>KEL*02.-33</i>	c.1283G>T	11	p.Arg428Leu	PMID: 23560718 (16)	JN038573.1	rs750806448	7:142946238
KEL:-34 or KASH-	<i>KEL*02.-34</i>	c.758A>G	8	p.Tyr253Cys	(3), Abstract	n.a.	n.a.	7:142954350
KEL:-35 or KELP-	<i>KEL*02.-35</i>	c.780G>T c.2024G>A	8 18	p.Leu260Phe p.Arg675Gln	(4), Abstract	n.a.	rs1235779167 rs760716472	7:142954328 7:142942447
KEL:-36 or KETI-	<i>KEL*02.-36</i>	c.1391C>T	12	p.Thr464Ile	(5), Abstract	n.a.	rs190890637	7:142944665
KEL:-37,39 or KHUL-,KEAL+	<i>KEL*02.39</i>	c.877C>T	8	p.Arg293Trp	PMID: 23968329 PMID: 27679424	KF366655.1	rs557358978	7:142954231
KEL:-40, 41 or KHIZ-, KHOZ+	<i>KEL*02.41</i>	c.1538G>A	14	p.Arg513Gln	(10), Abstract (11), Abstract	MG 818162	rs143144958	7:142943837

Null phenotypes

K ₀	<i>KEL*01N.01</i>	c.578C>T c.1678C>G	6 15	p.Thr193Met p.Pro560Ala	PMID: 25960716	n.a.	rs8176058 rs61729046	7:142957921 7:142943511
K ₀	<i>KEL*01N.02</i>	c.244T>C c.578C>T	4 6	p.Cys82Arg p.Thr193Met	PMID: 23581548	n.a.	rs369127636 rs8176058	7:142961084 7:142957921
K ₀	<i>KEL*01N.03</i>	c.578C>T c.1382_1385del	6 12	p.Thr193Met p.Asn461Argfs*25	PMID: 27861976	KX431940.1	n.a.	7:142957921 7:142944671- 142944674

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon Intron	Predicted amino acid change	PMID (Reference nr)	Accession number	rs number	GRCh38
K ₀	<i>KEL*01N.04</i>	c.578C>T c.821T>A	6 8	p.Thr193Met p.Leu274*	PMID: 23581578		rs8176058 n.a.	7:142957921 7:142954287
K ₀	<i>KEL*02N.01</i>	c.223+1G>C	i3	Aberrant splicing: p.Ser28AlafsTer113	PMID: 11134029	n.a.	rs369569464	7:142961359
K ₀	<i>KEL*02N.02</i> (See also <i>KEL*02N.26</i>)	c.382C>T c.1790T>C	4 17	p.Arg128* p.Leu597Pro	PMID: 11375401	n.a.	rs61729053 rs8176038	7:142960946 7:142943026
K ₀	<i>KEL*02N.03</i>	c.246T>A	4	p.Cys82*	PMID: 11375401	n.a.	rs61729058	7:142961082
K ₀	<i>KEL*02N.04</i>	c.1042C>T	9	p.Gln348*	PMID: 11375401 PMID: 17381630	AM085122.1	rs61729054	7:142953839
K ₀	<i>KEL*02N.05</i>	c.2027G>A	18	p.Ser676Asn	PMID: 11375401	n.a.	rs61729051	7:142942444
K ₀	<i>KEL*02N.06</i>	c.223+1G>A	i3	Aberrant splicing: p.Ser28AlafsTer113	PMID: 11375401 PMID: 17381630	AM085124.1	rs369569464	7:142961359
K ₀	<i>KEL*02N.07</i>	c.574C>T	6	p.Arg192*	PMID: 11375401	n.a.	rs200430183	7:142957925
K ₀	<i>KEL*02N.08</i>	c.526-2a>g	i5	Aberrant splicing: p.Leu176Alafs*9	PMID: 11918559	n.a.	n.a.	7:142957975
K ₀	<i>KEL*02N.09</i>	c.1377G>A	12	p.Trp459*	PMID: 11918559	n.a.	rs61729052	7:142944679
K ₀	<i>KEL*02N.10</i>	c.1420C>T	13	p.Gln474*	PMID: 15819675	DQ340982.1	rs61729056	7:142944394
K ₀	<i>KEL*02N.11</i>	c.904delG	8	p.Val302Serfs*28	PMID: 15819675	DQ340981.1	rs61729059	7:142954204
K ₀	<i>KEL*02N.12</i>	c.924+1G>A	i8	Aberrant splicing	PMID: 17381630	AM085117.1	rs568600999	7:142954183
K ₀	<i>KEL*02N.13</i>	c.924+1G>T	i8	Aberrant splicing	PMID: 17381630	AM085127.1	rs568600999	7:142954183
K ₀	<i>KEL*02N.14</i>	c.948G>A	9	p.Trp316*	PMID: 17381630	AM085128.1	rs61729049	7:142953933
K ₀	<i>KEL*02N.15</i>	c.1216C>T	11	p.Arg406*	PMID: 17381630	AM085114.1	rs61729045	7:142946305
K ₀	<i>KEL*02N.16</i>	c.1477C>T	13	p.Gln493*	PMID: 17381630	AM085125.1	rs61729050	7:142944337
K ₀	<i>KEL*02N.17</i>	c.1546C>T	14	p.Arg516*	PMID: 17381630	AM085126.1 AM183930.1	rs8176034	7:142943829
K ₀	<i>KEL*02N.18</i>	c.1678C>G	15	p.Pro560Ala	PMID: 17381630	AM085120.1	rs61729046	7:142943511

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon Intron	Predicted amino acid change	PMID (Reference nr)	Accession number	rs number	GRCh38
K ₀	<i>KEL*02N.19</i>	c.2023C>T	18	p.Arg675*	PMID: 17381630	AM085118.1	rs61729047	7:142942448
K ₀	<i>KEL*02N.20</i>	c.1596G>A	15	p.Trp532*	PMID: 12869119	n.a.	n.a.	7:142943593
K ₀	<i>KEL*02N.21</i>	c.1947C>G	18	p.Tyr649*	(1), Book	n.a.	rs902425813	7:142942524
K ₀	<i>KEL*02N.22</i>	c.736-1G>C	i7	Aberrant splicing	PMID: 20384970	bankit1316809	rs765075509	7:142954373
K ₀	<i>KEL*02N.23</i>	c.184dupT (published as 185insT)	3	p.Ser62Phefs*17	PMID: 19747286	EF208900.1	rs751207765	7:142961398
K ₀	<i>KEL*02N.24</i>	c.715G>T	7	p.Glu239*	PMID: 19747286	EF208901.1	rs766427535	7:142954485
K ₀	<i>KEL*02N.25</i>	c.1975delG	18	p.Glu659Argfs*22	PMID: 23581548	n.a.	rs1042359399	7:142942496
K ₀	<i>KEL*02N.26</i> (See also <i>KEL*02N.02</i>)	c.382C>T	4	p.Arg128*	PMID: 23581548	n.a.	rs61729053	7:142960946
K ₀	<i>KEL*02N.27</i>	c.730delG	7	p.Ala244Profs*8	PMID: 21707797	n.a.	n.a.	7:142954470
K ₀	<i>KEL*02N.28</i>	c.230G>T	4	p.Cys77Phe	PMID: 23968329	KF280266.1	n.a.	7:142961098
K ₀	<i>KEL*02N.29</i>	c.1664G>A	15	p.Gly555Glu	PMID: 23968329	KF366656.1	n.a.	7:142943525
K ₀	<i>KEL*02N.30</i>	c.71G>A	2	p.Trp24*	PMID: 24506314	n.a.	rs753369164	7:142961805
K ₀	<i>KEL*02N.31</i>	c.1771+1G>A	i16	Aberrant splicing	PMID: 24506314	n.a.	rs869025768	7:142943275
K ₀	<i>KEL*02N.32</i>	c.455A>G	5	p.Tyr152Cys	PMID: 25041236	n.a.	rs1228818924	7:142958374
K ₀	<i>KEL*02N.33</i>	c.1726G>C	16	p.Gly576Arg	PMID: 25041236	n.a.	rs201778033	7:142943321
K ₀	<i>KEL*02N.34</i>	c.841C>T c.2099G>A	8 19	p.Arg281Trp p.Arg700Gln	PMID: 24845979	HG512886.1	rs8176059 rs1268359042	7:142954267 7:142941352
K ₀	<i>KEL*02N.35</i>	c.398T>C	4	p.Leu133Pro	PMID: 25156717	KF993652.1	n.a.	7:142960930
K ₀	<i>KEL*02N.36</i>	c.436delG	5	p.Glu146Argfs*43	PMID: 25156717	KJ636457.1	rs1562964425	7:142958393
K ₀	<i>KEL*02N.37</i>	c.1253T>C	11	p.Phe418Ser	PMID: 25156717	KF993653.1	rs149225200	7:142946268

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon Intron	Predicted amino acid change	PMID (Reference nr)	Accession number	rs number	GRCh38
K ₀	<i>KEL*02N.38</i>	c.1832T>G	17	p.Leu611Arg	PMID: 25156717	KJ636456.1	n.a.	7:142942984
K ₀	<i>KEL*02N.39</i>	c.2098C>T	19	p.Arg700*	PMID: 25156717	KF993655.1	rs565926203	7:142941353
K ₀	<i>KEL*02N.40</i>	c.1474C>T	13	p.Arg492*	PMID: 25156717	KF993654.1	rs932456335	7:142944340
K ₀	<i>KEL*02N.41</i>	c.267C>G	4	p.Tyr89*	PMID: 27888518	n.a.	rs879327552	7:142961061
K ₀	<i>KEL*02N.42</i>	c.299G>C	4	p.Cys100Ser	PMID: 29280152	LC314159.1	rs 200268316	7:142961029
K ₀	<i>KEL*02N.43</i>	c.328delA	4	p.Arg110Glyfs*79	PMID: 29280152	LC314160.1	n.a.	7:142961000
K ₀	<i>KEL*02N.44</i>	c.2175delC	19	p.Ser726Profs*43	PMID: 29280152	LC314161.1	n.a.	7:142941273
K ₀	<i>KEL*02N.45</i>	c.937G>A c.1073G>C	9	p.Ala313Thr p.Arg358Thr possibly aberrant splicing	PMID: 29280152	LC314162.1	rs191311545 n.a.	7:142953944 7:142953808
K ₀	<i>KEL*02N.46</i>	c.160_161delATinsC TCC	3	p.Ile54Leufs*136	PMID: 29280152	LC314163.1	n.a.	7:142961422- 7:142961423
K ₀	<i>KEL*02N.47</i> (See <i>KEL*02M.18</i>)	c.1664G>T	15	p.Gly555Val	PMID: 29280152	LC314164.1	n.a.	7:142943525
K ₀	<i>KEL*02N.48</i>	c.481A>T	5	p.Ile161Phe	PMID: 29280152	LC314165.1	n.a.	7:142958348
K ₀	<i>KEL*02N.49</i>	c.997C>T	9	p.Gln333*	PMID: 29280152	LC314166.1	n.a.	7:142953884
K ₀	<i>KEL*02N.50</i>	c.2120delG	19	p.Ser707Thrfs*17	PMID: 29280152	LC314167.1	n.a.	7:142941331
K ₀	<i>KEL*02N.51</i>	c.1414-1G>C	i12	Aberrant splicing	PMID: 29280152	LC314168.1	rs906814829	7:142944401
K ₀	<i>KEL*02N.52</i>	c.1813_1814insC	17	p.Gln605Profs*18	PMID: 29280152	LC314169.1	n.a.	7:142943002- 7:142943003
K ₀	<i>KEL*02N.53</i>	c.371delA	4	p.Lys124Argfs*65	PMID: 27861976	KX431939.1	n.a.	7:142960957
K ₀	<i>KEL*02N.54</i>	c.201C>A	3	p.Tyr67*	PMID: 27861976	KX431938.1	n.a.	7:142961382
K ₀	<i>KEL*02N.55</i>	c.712C>T	7	p.Gln238*	PMID: 32598050	MT009034	rs753948889	7:142954488

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon Intron	Predicted amino acid change	PMID (Reference nr)	Accession number	rs number	GRCh38
K ₀	<i>KEL*02N.56</i>	c.1896_1897delCT	17	p.Leu633Argfs*50	PMID: 34137046	n.a.	n.a.	7:142942919-7:142942920
K ₀	<i>KEL*02N.57</i>	c.223+1G>T	i3	Aberrant splicing: p.Ser28AlafsTer113	PMID: 34310722	MW465351	rs369569464	7:142961359
K ₀	<i>KEL*02N.58</i>	c.184delT	3	p.Ser62Leufs*127	PMID: 23581578	n.a.	n.a.	7:142961399
K ₀	<i>KEL*02N.59</i>	c.1708G>A	16	p.Val570Met	PMID: 23581578	n.a.	rs766803262	7:142943339
K ₀	<i>KEL*02N.60</i>	c.1314+5G>A	i11	Aberrant splicing	PMID: 23581578	n.a.	n.a.	7:142946202
K ₀	<i>KEL*02N.61</i>	c.972delC	9	p.Phe324Leufs*6	PMID: 34554576	MZ322306	n.a.	7:142953909
K ₀	<i>KEL*02N.62</i>	c.1130T>C	10	p.Leu377Pro	PMID: 34554576	MF774805	rs1216525453	7:142952582
K ₀	<i>KEL*02N.63</i>	c.454_456delTAC	5	p.Tyr152del	PMID: 34554576	MZ322305	rs1241298894	7:142958374
K ₀	<i>KEL*02N.64</i>	c.523G>T	5	p.Glu175*	PMID: 34554576	MF774804	n.a.	7:142958306
K ₀	<i>KEL*02N.65</i>	c.2038-2A>G	i18	Splicing defect	PMID: 34554576	MF774806	n.a.	7:142941415
K ₀	<i>KEL*02N.66</i>	c.948G>T	9	p.Trp316Cys	PMID: 35852066	n.a.	rs61729049	7:142953933
K ₀	<i>KEL*02N.67</i>	c.841C>T c.1414-1G>T	8 i12	Aberrant splicing	PMID: 35932201	ERP124060	rs906814829	7:142944401

Mod phenotypes (weak expression KEL antigens)
Classification of a mod phenotype may depend on the reagents used

Kmod or KEL:1weak	<i>KEL*01M.01</i>	c.578C>G	6	p.Thr193Arg	(6), Abstract	n.a.	rs8176058	7:142957921
Kmod	<i>KEL*01M.02</i>	c.578C>T c.977C>T	6 9	p.Thr193Met p.Pro326Leu	PMID: 24588083	HG514448.1	rs8176058, rs751284993	7:142957921 7:142953904

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon Intron	Predicted amino acid change	PMID (Reference nr)	Accession number	rs number	GRCh38
Kmod	<i>KEL*01M.03</i>	c.578C>T c.1339C>T c.1680A>C	6 12 15	p.Thr193Met p.Arg447Trp p.Pro560Pro	PMID: 26996808	LN899832.1	rs8176058 rs142604829 rs8176036	7:142957921 7:142944717 7:142943509
Kmod	<i>KEL*01M.04</i>	c.578C>T c.1920G>C c.1921G>A	6 17 17	p.Thr193Met p.Gly640Gly p.Gly641Arg	PMID: 26996808	LN899833.1	rs8176058 rs542976466 n.a.	7:142957921 7:142942896 7:142942895
Kmod	<i>KEL*01M.05</i>	c.578C>T c.1899A>G c.1934C>T	6 17 17	p.Thr193Met p.Leu633Leu p.Ala645Val	PMID: 26996808	LN899834.1 LN680548	rs8176058 rs8176039 rs147851584	7:142957921 7:142942917 7:142942882
Kmod	<i>KEL*01M.06</i>	c.578C>T c.1680A>C c.2107G>C	6 15 19	p.Thr193Met p.Pro560Pro p.Gly703Arg	PMID: 26996808	LN899835.1	rs8176058 rs8176036 rs191330570	7:142957921 7:142943509 7:142941344
Kmod	<i>KEL*02M.01</i>	c.1088G>A	10	p.Ser363Asn	PMID: 11375401 PMID: 12869119	n.a.	rs61729055	7:142952624
Kmod	<i>KEL*02M.02</i>	c.2030A>G	18	p.Tyr677Cys	PMID: 12869119	AM085116.1	rs147464117	7:142942441
Kmod KEL:–13	<i>KEL*02M.03</i>	c.986T>C	9	p.Leu329Pro	PMID: 12869119	n.a.	rs61729057	7:142953895
Kmod	<i>KEL*02M.04</i>	c.2107G>A	19	p.Gly703Arg	PMID: 12869119	n.a.	rs191330570	7:142941344
K ₀ phenotype	<i>KEL*02M.05</i> (Only silent mutation)	c.1719C>T	16	p.Gly573Gly	PMID: 24795954	AM085115.1 KC922434.1	rs145850557	7:142943328
Kmod	<i>KEL*02M.06</i>	c.306C>A c.1298C>T	4 11	p.Asp102Glu p.Pro433Leu	PMID: 17381630	AM085123.1	rs758637202 rs143238294	7:142961022 7:142946223
Kmod	<i>KEL*02M.07</i>	c.1763A>G	16	p.Tyr588Cys	PMID: 17381630	AM085121.1	rs61729048	7:142943284
Kmod	<i>KEL*02M.08</i>	c.1490A>T	13	p.Asp497Val	(7), Abstract	AM183929.1	rs1286534156	7:142944324
Kmod	<i>KEL*02M.09</i>	c.1757T>G	16	p.Ile586Ser	(2), Book	n.a.	n.a.	7:142943290
Kmod	<i>KEL*02M.10</i>	c.787G>A	8	p.Gly263Arg	PMID: 20384970	EU362929	n.a.	7:142954321
Kmod	<i>KEL*02M.11</i>	c.1268C>T	11	p.Ala423Val	PMID: 9269063	n.a.	rs61728831	7:142946253
Kmod	<i>KEL*02M.12</i>	c.2111C>A	19	p.Pro704His	PMID: 25041236	FM208265	rs747806266	7:142941340

Phenotype	Allele name	Nucleotide change (NM_000420.2)	Exon Intron	Predicted amino acid change	PMID (Reference nr)	Accession number	rs number	GRCh38
Kmod	<i>KEL*02M.13</i>	c.257G>A c.841C>T	4 8	p.Arg86Gln p.Arg281Trp	PMID: 25156717	KF993651.1 AM183928.1	rs777011308 rs8176059	7:142961071 7:142954267
Kmod	<i>KEL*02M.14 (K0 phenotype)</i>	c.1084C>A	10	p.Gln362Lys	PMID: 23581578	n.a.	rs766310210	7:142952628
Kmod	<i>KEL*02M.15</i>	c.575G>C	6	p.Arg192Pro	PMID: 26996808	LN899836.1	rs754663945	7:142957924
Kmod	<i>KEL*02M.16</i>	c.788G>A	8	p.Gly263Glu	PMID: 26996808	LN899837.1	rs775889759	7:142954320
Kmod	<i>KEL*02M.17</i>	c.586C>G	6	p.Leu196Val	PMID: 30586164	MH136803.1	rs760539605	7:142957913
Kmod	<i>KEL*02M.18 (See KEL*02N.47)</i>	c.1664G>T	15	p.Gly555Val	PMID: 31077392	LC440557.1	n.a.	7:142943525
Kmod	<i>KEL*02M.19</i>	c.575G>A	6	p.Arg192Gln	(9), submitted	OU383835.1	rs754663945	7:142957924

Nucleotide 1 is the first nucleotide of the translation-initiating codon, which is 120 bp downstream of the traditional position for the first nucleotide in early reports.

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Track of changes		from	to
1	Version	v7.0 30-NOV-2021	v8.0 30-SEP-2023
2	Author	created: Barbera Veldhuisen	Barbera Veldhuisen
3	Reviewed	reviewed: Christoph Gassner	Christoph Gassner
4	Intro	Text changed	37 antigens
5	Intro	Text changed	38 antigens
6	Intro	LRG ID line added:	KEL 40 KHIZ added to reference allele
7	Intro	LRG sequence added:	[KEL40 KEL41] added to antithetical antigens
8	Intro	Antithetical Antigens line created in Intro:	KEL 41 KHOZ added to low frequency antigens
9	Allele Table	Antigen/allele added	<i>KEL*02.41</i> allele added 19-09-2023 KEL:-40, 41 or KHIZ-, KHOZ+
10	Allele Table	Antigen/allele added	<i>KEL*02N.67</i> added 28-04-2022
11	References	added	PMID: 35852066
12	References	added	PMID: 34910313
13	References	added	PMID: 35932201
14	References	added	added Abstract (10)
15	References	added	added Abstract (11)
29	End Version	v7.0 30-NOV-2021	v8.0 30-SEP-2023

Track of changes			from	to
1	Version		v6.0 21-June-2021	v7.0 30-NOV-2021
2	Author	created:	Barbera Veldhuisen	Barbera Veldhuisen
3	Reviewed	reviewed:	Christoph Gassner	Christoph Gassner
4	Allele Table	Antigen/allele added:	<i>KEL*02.-40</i> added 27-7-2020	<i>KEL*02N.61</i> added 09-07-2021
5	Allele Table	Antigen/allele added:	rs773975756 removed from <i>KEL*02N.44</i>	<i>KEL*02N.62</i> added 09-07-2021
6	Allele Table	Antigen/allele added:	<i>KEL*02N.55</i> added 12-3-2020	<i>KEL*02N.63</i> added 09-07-2021
7	Allele Table	Antigen/allele added:	<i>KEL*02N.56</i> added 28-9-2020	<i>KEL*02N.64</i> added 09-07-2021
8	Allele Table	Antigen/allele added:	<i>KEL*02N.57</i> added 08-1-2021	<i>KEL*02N.65</i> added 09-07-2021
9	Allele Table	Antigen/allele added:	<i>KEL*02N.58</i> added 23-1-2021	<i>KEL*02N.66</i> added 28-09-2021
10	Allele Table	Antigen/allele added:	<i>KEL*02N.59</i> added 23-1-2021	<i>KEL*02M.19</i> added 18-10-2021
11	Allele Table	Antigen/allele added:	<i>KEL*02N.60</i> added 23-1-2021	<i>KEL*01N.04</i> added 18-10-2021
12	Allele Table	Antigen/allele added:	<i>KEL*02.00.02</i> added 18-10-2021 (incorrectly published as <i>KEL*02.38</i>)	<i>KEL*02N.36</i> rs762799244 changed to rs1562964425
13	Allele Table	Antigen/allele added:		GRCh38 locations added
14	References	PMID unique		PMIDs instead of numbering
15	References	Abstracts renumbered		"(12), Abstract" renumbered to "(1), Abstract" "(14), Abstract" renumbered to "(2), Abstract" "(17), Abstract" renumbered to "(3), Abstract" "(18), Abstract" renumbered to "(4), Abstract" "(19), Abstract" renumbered to "(5), Abstract" "(37), Abstract" renumbered to "(6), Abstract" "(41), Abstract" renumbered to "(7), Abstract" "(53), Abstract" renumbered to "(8), Abstract" "(54), Abstract" renumbered to "(9), Abstract"
16	References	Books renumbered		"(30), Book" renumbered to "(1), Book" "(42), Book" renumbered to "(2), Book"
17	End Version		v6.0 21-June-2021	v7.0 30-NOV-2021

Track of changes		from	to
1	Version	v5.3 25-FEB-2020	v6.0 21-June-2021
2	Author	created: Barbera Veldhuisen	Barbera Veldhuisen
3	Reviewed	reviewed: Christoph Gassner	Christoph Gassner
4	General	First Excel map version. Spread-sheets "Intro", "Allele Table", "References", and "Versioning" created.	
5	Intro	LRG sequence added: NG_007492.2 (genomic) NM_000420.2 (transcript) NP_000411.1 (protein)	NG_007492.3 (genomic) NM_000420.3, ENST00000355265.7 (transcript) NP_000411.1, ENSP00000347409.2 (protein)
6	Intro	Antithetical Antigens line created in Intro: KEL13 and KEL21 added to reference allele on basis of high frequency (to be verified)	KEL 40 stays provisional, no official application (28-7-2020 Peyrard)
7	Allele Table	Antigen/allele added: <i>KEL*01N.03</i> added	<i>KEL*02.-40</i> added 27-7-2020
8	Allele Table	Antigen/allele added: <i>KEL*02.39</i> added	rs773975756 removed from <i>KEL*02N.44</i>
9	Allele Table	Antigen/allele added: <i>KEL*02.40</i> added	<i>KEL*02N.55</i> added 12-3-2020
10	Allele Table	Antigen/allele added: <i>KEL*01N.03</i> added	<i>KEL*02N.56</i> added 28-9-2020
11	Allele Table	Antigen/allele added: <i>KEL*02N.30</i> to <i>KEL*02N.54</i> added	<i>KEL*02N.57</i> added 08-1-2021
12	Allele Table	Antigen/allele added: <i>KEL*01M.02</i> to <i>KEL*01M.06</i> added	<i>KEL*02N.58</i> added 23-1-2021
13	Allele Table	Antigen/allele added: <i>KEL*02M.12</i> to <i>KEL*02M.18</i> added	<i>KEL*02N.59</i> added 23-1-2021
14	Allele Table	Antigen/allele added: <i>KEL*02N.26</i> and <i>KEL*02N.02</i> same null mutation (no expression of Kel antigens). Allele in cis with Jsa and Jsb respectively.	<i>KEL*02N.60</i> added 23-1-2021
15	Allele Table	Antigen/allele added: <i>KEL*02N.61</i> to <i>KEL*02N.65</i> added	<i>KEL*02.00.02</i> added 18-10-2021 (incorrectly published as <i>KEL*02.38</i>)
16	End Version	v5.3 25-FEB-2020	v6.0 21-June-2021

Track of changes		from	to
1	Version	v5.2 January 15, 2020	v5.3 25-FEB-2020
2	Author	created: Barbera Veldhuisen	Barbera Veldhuisen
3	Reviewed	reviewed: Christoph Gassner	Christoph Gassner
4	Intro	LRG sequence added: NP_000411.1 (protein)	NG_007492.2 (genomic) NM_000420.2 (transcript) NP_000411.1 (protein)
5	Intro	Antithetical Antigens line created in Intro: [KEL1 KEL2]; [KEL3 KEL4 KEL21]; [KEL6 KEL7]; [KEL11 KEL17]; [KEL14 KEL24]; [WT KEL25 KEL28]; [KEL31 KEL38]; [KEL37 KEL39]	KEL13 and KEL21 added to reference allele on basis of high frequency (to be verified)
6	Intro	Low frequency antigen line created in Intro: KEL3, KEL6, KEL10, KEL17, KEL21, KEL23, KEL24, KEL25, KEL28, KEL31, KEL39 (extra line created because LF antigens KEL10 and KEL23 were missing from Intro)	Reference allele line moved from Allele Table to Intro: reference allele with 24 antigens: KEL2, KEL4, KEL5, KEL7, KEL11, KEL12, KEL13, KEL14, KEL16, KEL18, KEL19, KEL20, KEL22, KEL26, KEL27, KEL29, KEL30, KEL32, KEL33, KEL34, KEL35, KEL36, KEL37, KEL38 [KEL1 KEL2]; [KEL3 KEL4 KEL21]; [KEL6 KEL7]; [KEL11 KEL17]; [KEL14 KEL24]; [WT KEL25 KEL28]; [KEL31 KEL38]; [KEL37 KEL39]

1	Version		v5.2 January 15, 2020	v5.3 25-FEB-2020
7	Reference allele		Reference allele line moved from Allele Table to Intro: reference allele with 24 antigens: KEL2, KEL4, KEL5, KEL7, KEL11, KEL12, KEL13, KEL14, KEL16, KEL18, KEL19, KEL20, KEL22, KEL26, KEL27, KEL29, KEL30, KEL32, KEL33, KEL34, KEL35, KEL36, KEL37, KEL38	KEL3, KEL6, KEL10, KEL17, KEL21, KEL23, KEL24, KEL25, KEL28, KEL31, KEL39 (extra line created since low frequency antigens KEL10 and KEL23 were missing in Intro)
8	Allele Table	Antigen/allele added:	<i>KEL*02N.41</i> added	<i>KEL*02.39</i> added
9	Allele Table	Antigen/allele added:	<i>KEL*02N.42</i> added	<i>KEL*02.40</i> added
10	Allele Table	Antigen/allele added:	<i>KEL*02N.43</i> added	<i>KEL*01N.03</i> added
11	Allele Table	Antigen/allele added:	<i>KEL*02N.44</i> added	<i>KEL*02N.30</i> to <i>KEL*02N.54</i> added
12	Allele Table	Antigen/allele added:	<i>KEL*02N.45</i> added	<i>KEL*01M.02</i> to <i>KEL*01M.06</i> added
13	Allele Table	Antigen/allele added:	<i>KEL*02N.46</i> added	<i>KEL*02M.12</i> to <i>KEL*02M.18</i> added
14	Allele Table	Antigen/allele added:	<i>KEL*02N.47</i> added	<i>KEL*02N.26</i> and <i>KEL*02N.02</i> same null mutation (no expression of Kel antigens). Allele in cis with Jsa and Jsb respectively. <i>KEL*02N.61</i> to <i>KEL*02N.65</i> added
15	Allele Table	Antigen/allele added:	<i>KEL*02N.48</i> added	
16	End Version		v5.2 January 15, 2020	v5.3 25-FEB-2020

Track of changes		from	to
1	Version	v5.1 190413-190513	v5.2 January 15, 2020
2	Author	created: Barbera Veldhuisen	Barbera Veldhuisen
3	Reviewed	reviewed: n.a.	Christoph Gassner
4	General	Not published online	First Excel map version. Spread-sheets "Intro", "Allele Table", "References", and "Versioning" created.
65	Intro	Text changed	n.a. Text added: "The protein links via a single disulfide bond to the XK membrane protein that carries the Kx antigen. Absence of XK leads to a reduction of expression of Kell antigens on the red blood cell membrane."
6	Intro	LRG sequence added:	NG_007492.2 (genomic), NM_000420.2 (transcript) NP_000411.1 (protein)
7	Intro	Antithetical Antigens line created in Intro:	n.a. [KEL1 KEL2]; [KEL3 KEL4 KEL21]; [KEL6 KEL7]; [KEL11 KEL17]; [KEL14 KEL24]; [WT KEL25 KEL28]; [KEL31 KEL38]; [KEL37 KEL39]
8	Intro	Low frequency antigen line created in Intro	n.a. KEL3, KEL6, KEL10, KEL17, KEL21, KEL23, KEL24, KEL25, KEL28, KEL31, KEL39 (extra line created because LF antigens KEL10 and KEL23 were missing from Intro)
9	Reference allele	KEL16 added to reference allele on basis of high frequency (check Nicole Thorton)	Reference allele line moved from Allele Table to Intro: reference allele with 24 antigens: KEL2, KEL4, KEL5, KEL7, KEL11, KEL12, KEL13, KEL14, KEL16, KEL18, KEL19, KEL20, KEL22, KEL26, KEL27, KEL29, KEL30, KEL32, KEL33, KEL34, KEL35, KEL36, KEL37, KEL38
10	Allele Table	Table column and header additions	References changed in PMID entries, column with rs numbers added, accession numbers added Table columns "(Reference No.) PMID" created and content added and column "Accession number" and "rs-number" updated

1	Version		v5.1 190413-190513	v5.2 January 15, 2020
11	Allele Table	Antigen/allele added:	<i>KEL*01.03</i> added	<i>KEL*01N.03</i> added
12	Allele Table	Antigen/allele added:	<i>KEL*02.39</i> added	<i>KEL*02N.41</i> added
13	Allele Table	Antigen/allele added:	<i>KEL*02.40</i> added	<i>KEL*02N.42</i> added
14	Allele Table	Antigen/allele added:	<i>KEL*02M.17</i> added	<i>KEL*02N.43</i> added
15	Allele Table	Antigen/allele added:	<i>KEL*02M.18</i> added	<i>KEL*02N.44</i> added
16	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.45</i> added
17	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.46</i> added
18	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.47</i> added
19	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.48</i> added
20	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.49</i> added
21	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.50</i> added
22	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.51</i> added
23	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.52</i> added
24	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.53</i> added
25	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02N.54</i> added
26	Allele Table	Remark added	n.a.	<i>KEL*02N.26</i> and <i>KEL*02N.02</i> same null mutation (no expression of Kel antigens). Allele in cis with Jsa and Jsb respectively.
27	End Version		v5.1 190413-190513	v5.2 January 15, 2020

Track of changes		from	to
1	Version	v5.0 180208	v5.1 190413-190513
2	Author created:	Barbera Veldhuisen	Barbera Veldhuisen
3	Reviewed reviewed:	n.a.	n.a.
4	Intro LRG ID line added:	n.a.	LRG_799
5	Intro LRG sequence added:	n.a.	NG_007492.2 (genomic), NM_000420.2 (transcript)
6	Reference allele	KEL13 and KEL21 added to reference allele on basis of high frequency (check Nicole Thorton)	KEL16 added to reference allele on basis of high frequency (check Nicole Thorton)
7	Allele Table Table column and header additions	Column with References added	References changed in PMID entries, column with rs numbers added, accession numbers added
8	Allele Table Antigen/allele added:	<i>KEL*02N.30</i> added	<i>KEL*01.03</i> added
9	Allele Table Antigen/allele added:	<i>KEL*02N.31</i> added	<i>KEL*02.39</i> added
10	Allele Table Antigen/allele added:	<i>KEL*02N.32</i> added	<i>KEL*02.40</i> added
11	Allele Table Antigen/allele added:	<i>KEL*02N.33</i> added	<i>KEL*02M.17</i> added
12	Allele Table Antigen/allele added:	<i>KEL*02N.34</i> added	<i>KEL*02M.18</i> added
13	End Version	v5.0 180208	v5.1 190413-190513

Track of changes		from	to
1	Version	v4.0 160701	v5.0 180208
2	Author	created: Masja de Haas	Barbera Veldhuisen
3	Reviewer	reviewed: n.a.	n.a.
4	General	Last word version publised on ISBT website	Not published online
5	Intro	Text changed	32 antigens
6	Reference allele	Reference allele 21 antigens	36 antigens KEL13 and KEL21 added to reference allele on basis of high frequency (check Nicole Thorton)
7	Allele Table	Table column and header additions	n.a. Column with References added
8	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.30</i> added
9	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.31</i> added
10	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.32</i> added
11	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.33</i> added
12	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.34</i> added
13	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.35</i> added
14	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.36</i> added
15	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.37</i> added
16	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.38</i> added
17	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.39</i> added
18	Allele Table	Antigen/allele added:	n.a. <i>KEL*02N.40</i> added
19	Allele Table	Antigen/allele added:	n.a. <i>KEL*01M.02</i> added
20	Allele Table	Antigen/allele added:	n.a. <i>KEL*01M.03</i> added
21	Allele Table	Antigen/allele added:	n.a. <i>KEL*01M.04</i> added
22	Allele Table	Antigen/allele added:	n.a. <i>KEL*01M.05</i> added

1	Version		v4.0 160701	v5.0 180208
23	Allele Table	Antigen/allele added:	n.a.	<i>KEL*01M.06</i> added
24	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02M.12</i> added
25	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02M.13</i> added
26	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02M.14</i> added
27	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02M.15</i> added
28	Allele Table	Antigen/allele added:	n.a.	<i>KEL*02M.16</i> added
29	End Version		v4.0 160701	v5.0 180208

Antigens of the Kel System

001	002	003	004	005	006	007	008	009	010	011	012	
K	k	Kpa	Kpb	Ku	Jsa	Jsb	Ula	K11	K12	10
013	014	015	016	017	018	019	020	021	022	023	024	
K13	K14	...	K16	K17	K18	K19	Km	Kpc	K22	K23	K24	11
025	026	027	028	029	030	031	032	033	034	035	036	
VLAN	TOU	RAZ	VONG	KALT	KTIM	KYO	KUCI	KANT	KASH	KELP	KETI	12
037	038	039	040	041								
KHUL	KYOR	KEAL	KHIZ	KHOZ								5
											total	38

Antigens in reference sequence