



Heidelberg University Hospital  
 Institute of Immunology  
 Transplantation Immunology  
 Im Neuenheimer Feld 305  
 69120 Heidelberg - Germany  
 Phone: +49 6221 564013  
 Fax: +49 6221 564200  
 www.ctstransplant.org

Manual No.	28
Revision	April 12, 2023
Product No.	128
Lot No.	DQB13-4 DQA10-3

**CTS** Collaborative Transplant Study

**WORKING INSTRUCTION**  
**HLA-DQB1\*/-DQA1\* low resolution**  
**CTS-PCR-SSP TRAY KIT**  
**LOCUS- AND LOT-SPECIFIC MANUAL**

To be applied to the following product:

Product No.	Description
128	HLA-DQB1*/-DQA1* low resolution CTS-PCR-SSP Tray Kit  

**1. Main differences**

**HLA-DQB1**

- **Between lot DQB13-4 (the current lot) and lot DQB13-3:**  
 The kit was updated to cover new alleles included in the IMGT/HLA Database of January 2023. Deleted and renamed alleles were taken into consideration.

**HLA-DQA1**

- **Between lot DQA10-3 (the current lot) and lot DQA10-2:**  
 The kit was updated to cover new alleles included in the IMGT/HLA Database of January 2023. Deleted and renamed alleles were taken into consideration.

**2. Introduction**

- Intended use: This kit reveals a low/intermediate resolution typing of HLA-DQB1\* and a low resolution typing of HLA-DQA1\* by the PCR-SSP method.
- Allele coverage: IMGT/HLA Sequence Database Release 3.51.0, January 2023 for HLA-DQB1 and HLA-DQA1, except:
  - **HLA-DQB1\*02:25/02:35/02:40/02:72/02:147, DQB1\*03:05:02/03:05:05/03:17:02/03:61/03:72/03:100/03:181/03:226/03:262/03:346, DQB1\*04:02:02/04:02:08/04:02:22-04:02:23/04:31/04:48, DQB1\*05:01:14/05:03:10/05:21/05:60/05:72-05:73/05:82/05:98/05:105/05:116/05:175/05:207/05:218/05:258/05:300, DQB1\*06:09:04/06:22:01/06:22:03/06:69:02/06:153:01-06:153:02/06:167/06:231/06:247/06:260/06:301/06:318/06:332/06:342/06:415/06:417/06:441**
  - **HLA-DQA1\*01:20/03:29**
  - These alleles are considered to be rare.
- This manual is only valid for **Lot No. DQB13-4 DQA10-3.**
- This manual should be used together with the Main Manual (General Information) which is the 'Working instruction for the CTS-PCR-SSP TRAY and MINITRAY KITS' (Manual No. 100A).

### 3. Content

1. Main differences .....	1
2. Introduction .....	1
3. Content.....	2
4. Kit Composition .....	3
5. Materials, Reagents and Equipment not supplied .....	3
6. Sample Requirements, PCR and Gel Electrophoresis .....	3
7. Result Evaluation .....	3
8. Interpretation Hints .....	3
9. Special notes .....	3
10. Troubleshooting .....	4
11. Precaution .....	4
12. Contact .....	4
13. Appendix .....	5
14. Certificate of Analysis.....	22
Table 1: Allele specificities and sizes of the PCR products of each HLA-DQB1* CTS-PCR-SSP primer mix (Lot-No DQB13-4) based on IMGT/HLA Sequence Database Release 3.51.0, January 2023 .....	5
Table 2: Allele specificities and sizes of the PCR products of each HLA-DQA1* CTS-PCR-SSP primer mix (Lot-No DQA10-3) based on IMGT/HLA Sequence Database Release 3.51.0, January 2023 .....	13
Table 3: Amplification patterns of HLA-DQB1* alleles detected by the HLA-DQB1* CTS-PCR-SSP primer mixes (Lot No. DQB13-4) based on IMGT/HLA Sequence Database Release 3.51.0, January 2023 .....	15
Table 4: Amplification patterns for HLA-DQA1* alleles detected by the HLA-DQA1* CTS-PCR-SSP primer mixes (Lot-No DQA10-3) based on IMGT/HLA Sequence Database Release 3.51.0, January 2023 .....	20

#### 4. Kit Composition

- Number of PCR primer mixes per test: 24:
  - 13 HLA-specific mixes for HLA-DQB1 typing
  - 10 HLA-specific mixes for HLA-DQA1 typing
  - 1 negative control mix
- Number of tests per tray: 4
- Number of trays per kit: 10
- The primer mixes are aliquoted and dried in PCR-Trays.
- PCR buffer: 3.0 ml of Mastermix SSP (without Taq polymerase).

For storage condition, please refer to Section 1 of the 'Working instruction for the CTS-PCR-SSP TRAY and MINITRAY KITS' (Manual No. 100A) supplied along with this product.

#### 5. Materials, Reagents and Equipment not supplied

Please refer to Section 2 of the 'Working instruction for the CTS-PCR-SSP TRAY and MINITRAY KITS' (Manual No. 100A) supplied along with this product.

#### 6. Sample Requirements, PCR and Gel Electrophoresis

Please refer to Section 3 to 6 of the 'Working instruction for the CTS-PCR-SSP TRAY and MINITRAY KITS' (Manual No. 100A) supplied along with this product.

#### 7. Result Evaluation

- Check the approximate size of the PCR product against the Primer Mix Specificity Tables (Appendix / Table 1 and 2) to confirm the correct product size.
- Use the Amplification Pattern Tables (Appendix / Table 3 and 4) to make the allele assignments or use the SCORE Software for detailed result interpretation.

#### 8. Interpretation Hints

- Weak or false positive reactions can occur if you use a different Taq polymerase. Also the quality and quantity of DNA is a crucial factor that can affect the mix reactivities. Under suboptimal test conditions, some mixes could give rise to false positive reactions (if there are any potentially false positive reactions when using this specific lot, they are indicated in Section 9).
- Alleles that are known to amplify weakly are listed with "w" (= weak) in the tables (Appendix).
- Please refer to Section 7 and 8 of the 'Working instruction for the CTS-PCR-SSP TRAY and MINITRAY KITS' (Manual No. 100A) supplied along with this product.

#### 9. Special notes

- **HLA-DQB1\* locus:**
  - Differentiation of HLA-DQB1\*03 serological equivalents: Mix 6 and 7 mainly detect HLA-DQB1\*03 alleles which belong to the serological group of HLA-DQ7(3). Mix 8 and 9 react positively with HLA-DQB1\*03 alleles of the HLA-DQ8(3) serological group, whereas mix 10 and 11 amplify HLA-DQB1\*03 alleles which can serologically be defined as HLA-DQ9(3). Some other less common alleles are amplified by these mixes in addition.
  - HLA-DQB1\*03:02 (DQ8) reacts positively with mix 8 and mix 9. In case of a positive reaction in mix 8, mix 9 must be checked carefully, since the reaction may be weak.
  - HLA-DQB1\*03:03 (DQ9) reacts positively with mix 10 and mix 11. In case of a positive reaction in mix 11, mix 10 must be checked carefully, since the reaction may be weak.
  - Some mixes contain specific primers which may give rise to PCR fragments of **two** different sizes simultaneously (see Table 1).
- **HLA-DQA1\* locus:**
  - HLA-DQA1\*05:04 generates two PCR fragments with Mix 9.
  - Potentially false positive reactions: Mix 5

## **10. Troubleshooting**

Please refer to Section 8 of the 'Working instruction for the CTS-PCR-SSP TRAY and MINITRAY KITS' (Manual No. 100A) supplied along with this product.

## **11. Precaution**

Please refer to Material Safety Data Sheet for the CTS-PCR-SSP TRAY and MINITRAY KITS (Manual No. 100B) supplied along with this product.

## **12. Contact**

If you have any particular questions concerning this kit, which are not answered in this or the Main Manual, please do not hesitate to contact us at:

Phone: +49 6221 564013

Fax: +49 6221 564200

E-mail: [dna.labor@med.uni-heidelberg.de](mailto:dna.labor@med.uni-heidelberg.de)

### 13. Appendix

**Table 1:** Allele specificities and sizes of the PCR products of each **HLA-DQB1\*** CTS-PCR-SSP primer mix (**Lot-No DQB13-4**) based on IMGT/HLA Sequence Database Release 3.51.0, January 2023

Position				Mix	Allele	Serology	Size
H1	H4	H7	H10	Mix 1	DQB1*04:10w, DQB1*05:01:01:01-05:01:13/05:01:15/05:01:16w/05:01:17-05:01:18/05:01:19w/05:01:20-05:03:09/05:03:11-05:03:24/05:03:25w/05:03:26-05:20:02/05:22-05:25/05:26w/05:27-05:33/05:34w/05:35-05:43:02/05:44w/05:45-05:59/05:61-05:71/05:74-05:81/05:83-05:97/05:99-05:104/05:106-05:112/05:113w/05:114-05:115/05:117-05:127/05:128Nw/05:129/05:130w/05:131-05:170/05:171w/05:172-05:174/05:176-05:206N/05:208N-05:217/05:219-05:227/05:228w/05:229-05:257/05:259-05:299/05:301/05:302w/05:303-05:318, DQB1*06:23/06:156/06:162/06:169/06:325	-, DQ5(1), Null	see below
					DQB1*04:10w, DQB1*05:03:02/05:43:02/05:301, DQB1*06:23/06:156/06:162/06:169	-, DQ5(1)	135 bp
					DQB1*05:01:01:01-05:01:13/05:01:15/05:01:16w/05:01:17-05:01:18/05:01:19w/05:01:20-05:03:09/05:03:11-05:03:24/05:03:25w/05:03:26-05:20:02/05:22-05:25/05:26w/05:27-05:33/05:34w/05:35-05:43:02/05:44w/05:45-05:59/05:61-05:71/05:74-05:81/05:83-05:97/05:99-05:104/05:106-05:112/05:113w/05:114-05:115/05:117-05:127/05:128Nw/05:129/05:130w/05:131-05:170/05:171w/05:172-05:174/05:176-05:206N/05:208N-05:217/05:219-05:227/05:228w/05:229-05:257/05:259-05:299/05:301/05:302w/05:303-05:318, DQB1*06:325	DQ5(1), -, Null	225 bp

Position				Mix	Allele	Serology	Size
G1	G4	G7	G10	Mix 2	DQB1*03:194/03:408, DQB1*06:01:01:01-06:01:29/06:01:30?/06:01:31-06:01:34/06:02:07/06:03:01:01-06:03:06/06:03:08-06:03:18/06:03:20-06:03:46/06:08:01-06:08:03/06:11:02-06:12/06:14:01/06:14:03/06:17/06:21/06:26N/06:28/06:30-06:31/06:35/06:40-06:45/06:53:01-06:57:02/06:59-06:65/06:67/06:82/06:87/06:90-06:92:02/06:98-06:105/06:108/06:110/06:120/06:128/06:132-06:134/06:140-06:145:02/06:148/06:149w/06:154/06:157/06:165/06:168/06:170/06:177/06:181/06:184-06:185/06:187/06:190:01-06:191/06:194-06:196/06:199/06:203/06:205/06:209-06:210/06:214/06:218/06:221-06:223/06:229-06:230/06:233-06:234/06:238-06:239/06:243-06:246/06:248/06:250-06:251/06:253/06:257w/06:258-06:259/06:263/06:268-06:269/06:272/06:274-06:275/06:276w/06:277-06:279/06:285/06:302/06:305/06:307/06:309-06:310/06:312/06:316/06:319:01/06:321/06:323/06:327-06:331/06:334/06:336/06:340/06:345N-06:346/06:350/06:352/06:359-06:360/06:362/06:365/06:367/06:371/06:373/06:378/06:382/06:385/06:391-06:392/06:394N/06:396/06:399?/06:400/06:403/06:410/06:418-06:419/06:421/06:423N-06:425/06:427-06:428/06:433/06:435/06:440/06:443/06:450/06:453-06:455/06:459-06:460/06:462-06:463/06:464?/06:466	-, DQ6(1), DQ1, Null	see below
					DQB1*03:408, DQB1*06:01:01:01-06:01:29/06:01:30?/06:01:31-06:01:34/06:35/06:43/06:45/06:53:01-06:57:02/06:98-06:105/06:108/06:120/06:132/06:140/06:142/06:157/06:168/06:177/06:181/06:194/06:205/06:209/06:214/06:229/06:239/06:243/06:245-06:246/06:251/06:257w/06:258/06:263/06:268/06:274/06:277/06:285/06:305/06:307/06:309-06:310/06:312/06:321/06:323/06:330N/06:359/06:382/06:418-06:419/06:421/06:427/06:435/06:462-06:463/06:464?/06:466	-, DQ6(1), Null	160 bp
					DQB1*03:194/06:02:07/06:03:01:01-06:03:06/06:03:08-06:03:18/06:03:20-06:03:46/06:08:01-06:08:03/06:11:02-06:12/06:14:01/06:14:03/06:17/06:21/06:26N/06:28/06:30-06:31/06:40-06:42/06:44/06:59-06:65/06:67/06:82/06:87/06:90-06:92:02/06:110/06:128/06:133-06:134/06:141/06:143-06:145:02/06:148/06:149w/06:154/06:165/06:170/06:184-06:185/06:187/06:190:01-06:191/06:195-06:196/06:199/06:203/06:210/06:218/06:221-06:223/06:230/06:233/06:234/06:238/06:244/06:248/06:250/06:253/06:259/06:269/06:272/06:275/06:276w/06:278-06:279/06:302/06:316/06:319:01/06:327-06:329/06:331/06:334/06:336/06:340/06:345N-06:346/06:350/06:352/06:360/06:362/06:365/06:367/06:371/06:373/06:378/06:385/06:391-06:392/06:394N/06:396/06:399?/06:400/06:403/06:410/06:423N-06:425/06:428/06:433/06:440/06:443/06:450/06:453-06:455/06:459-06:460	-, DQ6(1), DQ1, Null	170 bp

Position				Mix	Allele	Serology	Size
F1	F4	F7	F10	Mix 3	DQB1*03:08/03:23:01-03:23:02/03:137/03:217/03:228, DQB1*05:43:02, DQB1*06:02:01:01-06:03:03/ 06:03:05w/06:03:06-06:03:07/06:03:11-06:03:13/06:03:15/06:03:17-06:03:25/06:03:27-06:03:29/06:03:31- 06:03:33/06:03:35-06:03:46/06:07:01/06:08:01/06:10-06:11:03/06:13:01-06:14:02/06:15:01-06:16/06:19:01- 06:20/06:23-06:24/06:26N/06:28-06:32:01/06:33/06:37/06:40-06:41:01:03/06:44/06:46-06:50/06:51:02/ 06:60-06:63/06:65w/06:67-06:68/06:70-06:84:01:02/06:87/06:90/06:92:02/06:95-06:97/06:106-06:107/ 06:109-06:118:01/06:118:03/06:119/06:122-06:128/06:130-06:131/06:133-06:134/06:136-06:138/06:141/ 06:143-06:144N/06:146:01-06:148/06:150-06:152/06:154/06:156/06:159/06:161-06:163/06:165-06:166/ 06:169-06:170/06:173-06:176/06:178-06:179N/06:182-06:185/06:187-06:188/06:191-06:192/06:195/06:197- 06:201/06:203/06:206:01-06:206:02/06:208:01-06:208:02/06:210-06:211/06:213/06:215-06:216N/06:218- 06:219/06:221-06:228/06:230/06:232-06:238/06:240/06:242/06:244/06:248-06:250/06:253/06:255-06:256/ 06:262/06:264/06:269-06:273/06:276/06:278-06:279/06:284/06:286/06:289-06:290/06:293-06:298/06:300/ 06:304N/06:306N/06:308N/06:311/06:314-06:317N/06:319:02/06:322:01-06:322:03/06:324/06:326-06:329/ 06:333-06:338/06:340-06:341N/06:344-06:347/06:350/06:352/06:354-06:357/06:360/06:362-06:367/ 06:370/06:372-06:374/06:376/06:378-06:380/06:383N-06:386/06:388-06:397N/06:399-06:406/06:408- 06:413/06:416Q/06:422N-06:425/06:428/06:430-06:431/06:433/06:436-06:438/06:440/06:442-06:443/ 06:445-06:448/06:450-06:451/06:453-06:457/06:459-06:461	-, DQ6(1), DQ1, Null	see below
					DQB1*03:23:01-03:23:02/03:217, DQB1*06:02:01:01-06:02:06/06:02:08-06:02:10/06:02:12-06:02:42/ 06:02:44-06:02:59/06:03:07/06:11:01:01-06:11:01:02/06:14:02/06:15:01-06:16/06:19:01-06:20/06:24/06:33/ 06:37/06:46-06:50/06:51:02/06:68/06:70-06:74/06:76-06:81/06:83-06:84:01:02/06:95/06:96:02-06:97/ 06:107/06:109/06:111-06:117/06:118:03/06:122/06:124/06:127/06:131/06:137-06:138/06:146:01-06:147/ 06:150/06:152/06:159/06:161/06:163/06:173/06:175-06:176/06:178-06:179N/06:183/06:188/06:192/06:197- 06:198/06:200-06:201/06:208:01-06:208:02/06:211/06:213/06:215-06:216N/06:219/06:224-06:228/06:232/ 06:235-06:237/06:240/06:242/06:249/06:255-06:256/06:262/06:270:01-06:271/06:273/06:284/06:286/ 06:289-06:290/06:293-06:298/06:300/06:304N/06:306N/06:308N/06:311/06:314-06:315/06:317N/06:322:03/ 06:324/06:326/06:333/06:335/06:338/06:341N/06:344/06:347/06:354-06:357/06:363-06:364/06:366/06:370/ 06:372/06:376/06:379N-06:380/06:384/06:386/06:388/06:390/06:395/06:397N/06:401-06:402/06:404- 06:406/06:409/06:411-06:413/06:416Q/06:422N/06:430-06:431/06:436-06:438/06:442/06:445-06:448/ 06:451/06:457/06:461	-, DQ6(1), DQ1, Null	130 bp

Position			Mix	Allele	Serology	Size
				DQB1*03:08/03:137/03:228, DQB1*06:02:01:01-06:02:06/06:02:09-06:02:59/06:03:07/06:10-06:11:01:02/ 06:13:01-06:13:03/06:14:02/06:16/06:19:01-06:20/06:24/06:29/06:33/06:46-06:47/06:49-06:50/06:68/06:70- 06:81/06:83-06:84:01:02/06:95-06:97/06:106-06:107/06:109/06:111-06:117/06:119/06:122-06:125/06:127/ 06:130-06:131/06:136-06:138/06:146:01-06:147/06:150/06:152/06:159/06:161/06:163/06:166/06:173/ 06:175-06:176/06:178-06:179N/06:182-06:183/06:188/06:192/06:197-06:198/06:200-06:201/06:206:01- 06:206:02/06:208:01-06:208:02/06:211/06:213/06:215-06:216N/06:219/06:224-06:228/06:232/06:235- 06:237/06:240/06:242/06:249/06:255-06:256/06:262/06:264/06:270:01-06:271/06:273/06:284/06:286/ 06:289-06:290/06:293-06:298/06:300/06:304N/06:306N/06:308N/06:311/06:314-06:315/06:317N/06:319:02/ 06:322:01-06:322:03/06:324/06:326/06:333/06:335/06:337-06:338/06:341N/06:344/06:347/06:354-06:357/ 06:363-06:364/06:366/06:370/06:372/06:374/06:376/06:379N-06:380/06:384/06:386/06:388/06:390/06:395/ 06:397N/06:401/06:404-06:406/06:408-06:409/06:411-06:413/06:416Q/06:422N/06:430-06:431/06:436- 06:438/06:442/06:445-06:448/06:451/06:461	-, DQ6(1), DQ1, Null	165 bp
				DQB1*03:23:01, DQB1*05:43:02, DQB1*06:02:01:01-06:02:02/06:02:04/06:02:06-06:02:09/06:02:12- 06:02:13/06:02:15/06:02:17-06:02:18/06:02:20-06:02:42/06:02:44-06:02:57/06:02:59-06:03:03/06:03:05w/ 06:03:06-06:03:07/06:03:11-06:03:12/06:03:15/06:03:17-06:03:25/06:03:27-06:03:29/06:03:31-06:03:32/ 06:03:35-06:03:38/06:03:40-06:03:46/06:07:01/06:11:01:01-06:11:03/06:14:01-06:14:02/06:15:01-06:16/ 06:19:02-06:20/06:23-06:24/06:26N/06:28/06:30-06:32:01/06:33/06:37/06:40-06:41:01:03/06:44/06:46- 06:50/06:51:02/06:60-06:62/06:65w/06:67-06:68/06:70-06:74/06:76-06:79:01/06:80-06:84:01:02/06:87/ 06:90/06:92:02/06:95/06:96:02/06:107/06:109-06:113/06:115-06:118:01/06:118:03/06:122/06:124/06:126- 06:128/06:131/06:133-06:134/06:137/06:141/06:143-06:144N/06:146:01-06:148/06:151/06:154/06:156/ 06:159/06:161-06:163/06:165/06:169/06:173-06:176/06:178-06:179N/06:183-06:185/06:187-06:188/06:191- 06:192/06:195/06:197-06:201/06:203/06:210-06:211/06:213/06:216N/06:218-06:219/06:221/06:223-06:228/ 06:230/06:232-06:238/06:240/06:244/06:248-06:250/06:253/06:255-06:256/06:262/06:269-06:273/06:276/ 06:278-06:279/06:284/06:286/06:289-06:290/06:293-06:298/06:300/06:304N/06:306N/06:308N/06:311/ 06:314-06:317N/06:322:03/06:324/06:326-06:329/06:333-06:336/06:338/06:340-06:341N/06:344-06:347/ 06:350/06:352/06:354-06:357/06:360/06:362-06:367/06:370/06:372-06:373/06:376/06:378-06:380/06:383N- 06:386/06:388/06:390-06:397N/06:399-06:406/06:409-06:413/06:416Q/06:422N-06:425/06:428/06:430- 06:431/06:433/06:436-06:438/06:440/06:442-06:443/06:445-06:446/06:448/06:450-06:451/06:453-06:454N/ 06:456N-06:457/06:459-06:461	-, DQ6(1), DQ1, Null	65 bp



Position				Mix	Allele	Serology	Size
					DQB1*06:02:01:01-06:02:02/06:02:04/06:02:06-06:02:07/06:02:09/06:02:11-06:02:13/06:02:15/06:02:17-06:02:18/06:02:20-06:02:57/06:02:59-06:03:03/06:03:05w/06:03:06-06:03:07/06:03:11-06:03:13/06:03:15/06:03:17-06:03:25/06:03:27-06:03:29/06:03:31-06:03:33/06:03:35-06:03:46/06:08:01/06:10-06:11:03/06:13:01/06:14:01-06:14:02/06:16/06:19:02-06:20/06:23-06:24/06:26N/06:28-06:31/06:33/06:40-06:41:01:03/06:44/06:46-06:47/06:49-06:50/06:60-06:63/06:65w/06:67-06:68/06:70-06:79:01/06:80-06:84:01:02/06:87/06:90/06:92:02/06:95-06:96:02/06:106-06:107/06:109-06:113/06:115-06:117/06:122/06:124-06:128/06:130-06:131/06:133-06:134/06:136-06:137/06:141/06:143-06:144N/06:146:01-06:148/06:151/06:154/06:156/06:159/06:161-06:163/06:165-06:166/06:169-06:170/06:173-06:176/06:178-06:179N/06:182-06:185/06:187-06:188/06:191-06:192/06:195/06:197-06:201/06:203/06:206:01/06:210-06:211/06:213/06:216N/06:218-06:219/06:221-06:228/06:230/06:232-06:238/06:240/06:244/06:248-06:250/06:253/06:255-06:256/06:262/06:264/06:269-06:273/06:276/06:278-06:279/06:284/06:286/06:289-06:290/06:293-06:298/06:300/06:304N/06:306N/06:308N/06:311/06:314-06:317N/06:322:01/06:322:03/06:324/06:326-06:329/06:333-06:336/06:338/06:340-06:341N/06:344-06:347/06:350/06:352/06:354-06:357/06:360/06:362-06:367/06:370/06:372-06:374/06:376/06:378-06:380/06:383N-06:386/06:388-06:397N/06:399-06:401/06:403-06:406/06:408-06:413/06:416Q/06:422N-06:425/06:428/06:430-06:431/06:433/06:436-06:438/06:440/06:442-06:443/06:445-06:446/06:448/06:450-06:451/06:453-06:456N/06:459-06:461	DQ6(1), -, DQ1, Null	105 bp
E1	E4	E7	E10	Mix 4	DQB1*06:04:01:01-06:07:02/06:09:01:01-06:09:03/06:09:05/06:09:06w/06:09:07-06:09:12/06:18:01-06:18:02/06:22:02/06:25/06:27:01-06:27:02/06:32:01-06:32:02/06:34/06:36/06:38-06:39/06:52/06:58/06:66/06:69:01/06:85-06:86/06:88:01:01-06:89/06:93-06:94/06:118:01-06:118:02/06:118:04/06:121w/06:129/06:135/06:142/06:155/06:158N/06:160/06:164/06:168/06:171-06:172/06:180/06:186/06:189/06:193N/06:202/06:204/06:207/06:212w/06:217/06:241/06:252N/06:254/06:261/06:265-06:267/06:280-06:283/06:287-06:288/06:291-06:292/06:299/06:303N/06:313/06:320/06:339/06:343/06:348-06:349/06:351/06:353/06:358/06:361/06:368-06:369/06:375/06:381/06:387/06:398/06:407/06:414N/06:420/06:426/06:429/06:432/06:434/06:439Q/06:444/06:449/06:452N/06:458N/06:465	DQ6(1), -, Null	170 bp
D1	D4	D7	D10	Mix 5	DQB1*02:01:01:01-02:01:09/02:01:11-02:01:13/02:01:15-02:01:23/02:01:24w/02:01:25-02:24/02:26-02:34/02:36/02:37w/02:38-02:39/02:41-02:45/02:46w-02:47w/02:48-02:71/02:73-02:89:02/02:90w/02:91-02:146/02:148-02:211	DQ2, -, Null	200 bp

Position				Mix	Allele	Serology	Size
C1	C4	C7	C10	Mix 6	DQB1*03:01:01:01-03:01:01:12/03:01:01:14-03:01:58/03:04:01:01-03:04:04/03:09-03:10:03/03:13-03:14:02/ 03:16/03:19:01:01-03:19:06/03:21-03:23:02/03:24/03:27-03:29/03:35/03:36w/03:42/03:44/03:46-03:60/ 03:69/03:71/03:73/03:75-03:77/03:80/03:82-03:84N/03:92-03:94/03:101-03:103/03:108-03:109/03:114- 03:116/03:118N-03:121/03:122w/03:127-03:131/03:133-03:135/03:138-03:140/03:142-03:144/03:147/ 03:150/03:151w/03:152/03:154/03:157-03:160/03:162-03:167/03:169-03:170/03:171w/03:172-03:173/ 03:180/03:182-03:183/03:186-03:188/03:191-03:198:02/03:201-03:202/03:206-03:208/03:216-03:219/ 03:231-03:232/03:235-03:236/03:241-03:243/03:246/03:252-03:257/03:260/03:264/03:266-03:268/03:271/ 03:275-03:276N/03:281/03:284-03:286/03:288/03:290-03:294/03:297/03:302-03:303N/03:305-03:307/ 03:309:01-03:309:02/03:311-03:312/03:317:01-03:318/03:326-03:331/03:335/03:338N/03:340N-03:342/ 03:347/03:350/03:353-03:355/03:358N/03:360-03:361/03:366/03:370/03:372-03:373/03:376N-03:378/ 03:380-03:381/03:385N/03:387/03:389-03:391/03:394/03:396/03:399N-03:401/03:404/03:407N-03:408/ 03:417-03:421/03:423-03:428/03:430-03:432/03:434-03:436/03:438-03:439/03:443/03:448-03:449/03:451/ 03:454-03:455/03:458/03:460/03:465/03:467-03:470/03:472-03:476/03:480Q/03:482-03:483/03:485- 03:486/03:488N/03:491-03:492/03:496-03:497/03:499N/03:503/03:506/03:508, DQB1*04:10, DQB1*05:03:02?, DQB1*06:35/06:53:01-06:53:02	DQ7(3), -, Null, DQ3, DQ5(1)	see below
					DQB1*03:01:01:01-03:01:01:12/03:01:01:14-03:01:37/03:01:39-03:01:58/03:04:01:01-03:04:01:02/03:04:03- 03:04:04/03:09/03:13/03:16/03:19:01:01-03:19:06/03:21-03:22:02/03:24/03:27-03:29/03:35/03:36w/03:42/ 03:44/03:46-03:60/03:69/03:71/03:73/03:75/03:77/03:82-03:84N/03:92-03:94/03:101-03:103/03:108-03:109/ 03:114-03:116/03:118N-03:120/03:122w/03:127/03:129-03:130/03:133-03:135/03:140/03:142-03:144/ 03:147/03:150/03:151w/03:152/03:154/03:157-03:160/03:162-03:165/03:167/03:169-03:170/03:171w/ 03:172-03:173/03:182/03:186-03:188/03:191-03:194/03:196-03:198:02/03:201-03:202/03:206-03:208/ 03:216/03:218-03:219/03:231-03:232/03:235-03:236/03:241-03:243/03:246/03:252-03:254/03:256/03:260/ 03:264/03:266-03:268/03:271/03:275-03:276N/03:281/03:284-03:286/03:288/03:290-03:294/03:297/03:302- 03:303N/03:305-03:307/03:309:01-03:309:02/03:311-03:312/03:317:01-03:318/03:326/03:328-03:331/ 03:335/03:338N/03:340N-03:342/03:347/03:350/03:354N-03:355/03:358N/03:360-03:361/03:370/03:372- 03:373/03:376N-03:378/03:380-03:381/03:385N/03:387/03:389-03:391/03:394/03:396/03:399N-03:401/ 03:404/03:407N-03:408/03:417-03:421/03:423-03:428/03:430-03:432/03:434-03:436/03:439/03:443/03:448- 03:449/03:451/03:454-03:455/03:458/03:460/03:465/03:467-03:470/03:472-03:473N/03:476/03:480Q/ 03:482-03:483/03:485-03:486/03:488N/03:491-03:492/03:496-03:497/03:499N/03:503/03:506/03:508, DQB1*06:35/06:53:01-06:53:02	DQ7(3), -, Null	100 bp

Position				Mix	Allele	Serology	Size
					DQB1*03:01:01:01-03:01:01:12/03:01:01:14-03:01:58/03:04:01:01-03:04:04/03:09-03:10:03/03:13-03:14:02/03:16/03:19:01:01-03:19:06/03:21-03:22:02/03:24/03:27-03:29/03:35/03:36w/03:42/03:44/03:46-03:60/03:69/03:71/03:73/03:75-03:77/03:80/03:82-03:84N/03:92-03:94/03:101-03:103/03:108-03:109/03:114-03:116/03:118N-03:121/03:122w/03:127-03:131/03:133-03:135/03:138-03:140/03:142-03:144/03:147/03:150/03:151w/03:152/03:154/03:157-03:160/03:162-03:167/03:169-03:170/03:171w/03:172-03:173/03:180/03:182-03:183/03:186-03:188/03:191-03:198:02/03:201-03:202/03:206-03:207/03:216/03:218-03:219/03:231-03:232/03:235-03:236/03:241-03:243/03:246/03:252-03:257/03:260/03:264/03:266-03:268/03:271/03:275-03:276N/03:281/03:284-03:286/03:288/03:290-03:294/03:297/03:302-03:303N/03:305-03:307/03:309:01-03:309:02/03:311-03:312/03:317:01-03:318/03:326-03:331/03:335/03:338N/03:340N-03:342/03:347/03:350/03:353-03:355/03:358N/03:360-03:361/03:366/03:370/03:372-03:373/03:376N-03:378/03:380-03:381/03:385N/03:387/03:389-03:391/03:394/03:396/03:400N-03:401/03:404/03:407N-03:408/03:417-03:421/03:423-03:428/03:430-03:432/03:434/03:436/03:438-03:439/03:448-03:449/03:451/03:454-03:455/03:458/03:460/03:465/03:467-03:470/03:472-03:476/03:480Q/03:482-03:483/03:485-03:486/03:488N/03:491-03:492/03:496-03:497/03:499N/03:503/03:506/03:508	DQ7(3), -, Null, DQ3	215 bp
					DQB1*03:23:01-03:23:02/03:217/03:355, DQB1*04:10, DQB1*05:03:02?	-, DQ5(1)	120 bp
B1	B4	B7	B10	Mix 7	DQB1*03:04:01:01-03:04:04/03:14:01-03:14:02/03:70/03:80/03:179w/03:318/03:327/03:443/03:474w, DQB1*06:246w	DQ7(3), -	175 bp
A1	A4	A7	A10	Mix 8	DQB1*03:02:01:01-03:02:09/03:02:11-03:02:15/03:02:16w/03:02:17-03:02:37/03:07-03:08/03:11/03:32/03:37/03:45:01-03:45:02/03:62-03:64/03:66N-03:68/03:70/03:81/03:85/03:106-03:107/03:125/03:146/03:153/03:161/03:174-03:175/03:178-03:179/03:184-03:185/03:189-03:190/03:199/03:203-03:205/03:210-03:211/03:213N-03:215/03:220-03:221/03:223-03:224/03:225w/03:228-03:229/03:233/03:237N/03:240/03:245/03:247/03:251/03:261/03:263:01:01-03:263:01:02/03:265/03:269N/03:273-03:274/03:277-03:279/03:287/03:289/03:295-03:296/03:298-03:301/03:308/03:310N/03:315/03:320-03:324/03:333-03:334N/03:339N/03:343-03:345/03:348-03:349/03:352/03:362/03:364/03:367-03:369/03:371/03:379/03:383/03:386/03:388/03:392/03:403N/03:409-03:410/03:412-03:413/03:415-03:416/03:422N/03:429/03:433/03:437w/03:440N-03:442/03:444/03:446-03:447/03:450/03:452/03:456-03:457/03:459/03:462-03:464/03:466/03:471/03:479/03:481/03:484/03:490/03:493/03:495/03:498/03:500-03:502/03:504, DQB1*06:29/06:123/06:139/06:246/06:337	DQ8(3), -, Null	130 bp
H2	H5	H8	H11	Mix 9 †	DQB1*03:02:01:01-03:02:01:10/03:02:01:12-03:02:03/03:02:09/03:02:12/03:02:21-03:02:24/03:02:32-03:02:33/03:02:36-03:02:37/03:05:01/03:05:03-03:05:04/03:08/03:11/03:37/03:68/03:211/03:245/03:247/03:250-03:251/03:263:01:01-03:263:01:02/03:289/03:415-03:416/03:422N/03:442/03:464/03:481/03:484/03:493/03:498/03:500-03:502/03:504	DQ8(3), -, Null	190 bp

Position				Mix	Allele	Serology	Size
G2	G5	G8	G11	Mix 10	DQB1*02:03:01/02:77/02:180, DQB1*03:03:02:01-03:03:05/03:03:06w/03:03:07-03:03:16/03:03:17w/03:03:18-03:03:25/03:03:27-03:03:29/03:06w/03:12/03:15/03:20/03:23:03/03:25:01w-03:25:02w/03:26/03:30-03:31/03:33-03:34/03:38:01-03:41/03:43/03:65/03:74/03:79/03:86-03:91Q/03:95N-03:99Q/03:104-03:105/03:111-03:113/03:117/03:123-03:124/03:126w/03:136-03:137/03:141/03:145w/03:155-03:156/03:168/03:176-03:177/03:200/03:209/03:212/03:222/03:227/03:230/03:234/03:238-03:239/03:248-03:249/03:258/03:270/03:280/03:282N-03:283/03:304/03:313/03:316/03:319/03:332/03:336-03:337/03:351/03:356N-03:357N/03:359/03:363/03:365/03:374-03:375N/03:382/03:384/03:393/03:395/03:397-03:398/03:402/03:405-03:406/03:411N/03:414/03:445/03:453/03:461/03:477-03:478/03:487/03:489/03:494/03:505/03:507/03:509N, DQB1*04:03:01w-04:03:03w, DQB1*06:02:43/06:03:10/06:03:33/06:51:01/06:66/06:96:01/06:118:04/06:168/06:172/06:322:01-06:322:02/06:377	DQ2, -, DQ9(3), DQ3, Null	135 bp
F2	F5	F8	F11	Mix 11 †	DQB1*03:02:01:11/03:03:02:01-03:03:04/03:03:11/03:25:01/03:31/03:40/03:126/03:195/03:239/03:248-03:249/03:414/03:445/03:453/03:505/03:507	-, DQ9(3)	175 bp
E2	E5	E8	E11	Mix 12	DQB1*03:01:01:01-03:01:01:12/03:01:01:14-03:01:01:55/03:01:03-03:01:05/03:01:06w/03:01:07-03:01:52/03:01:54-03:02:02:02/03:02:04w/03:02:05-03:02:12/03:02:13w/03:02:14-03:02:22/03:02:24-03:03:02:11/03:03:04-03:04:04/03:05:03-03:05:04/03:07-03:17:01/03:18-03:19:06/03:21-03:22:02/03:23:02-03:24/03:25:02-03:36/03:38:01/03:39-03:53/03:54w/03:55-03:60/03:62-03:71/03:74/03:76-03:99Q/03:101-03:111/03:113-03:117/03:119-03:128/03:130-03:131/03:133-03:135/03:137-03:155/03:157-03:161/03:163-03:174/03:176-03:180/03:182/03:184-03:203/03:204w/03:205-03:222/03:224-03:225/03:227-03:236/03:239-03:249/03:251/03:253-03:261/03:263:01:01-03:268/03:269Nw/03:270-03:290/03:292-03:324/03:326-03:335/03:336w/03:337-03:345/03:347-03:350/03:352w/03:353/03:355-03:370/03:372-03:390/03:391w/03:392-03:440N/03:441w/03:442-03:487/03:488N?/03:489-03:509N, DQB1*05:11:01/05:240, DQB1*06:02:02/06:03:02/06:03:34/06:04:08/06:09:07/06:145:02/06:208:02	DQ7(3), -, Null, DQ8(3), DQ9(3), DQ6(1)	160 bp
D2	D5	D8	D11	Mix 13	DQB1*03:132, DQB1*04:01:01:01-04:01:05/04:01:06?/04:02:01:01/04:02:01:04-04:02:01:20/04:02:03-04:02:07/04:02:09-04:02:21/04:02:23?/04:02:24-04:03:01/04:04-04:30/04:32-04:47/04:49-04:66/04:67w/04:68N-04:90/04:91?/04:92-04:95	-, DQ4, Null	210 bp

**Amplification control (internal positive control):** 440 base pairs (bp)

w = weak

? = nucleotide sequence information not available for the primer matching sequence or alleles with unknown reactivities

**Bold:** mixes which result in PCR fragments of different sizes (the specificities are first indicated all in one row, then split into several groups in the subsequent rows depending on the fragment size)

**Mix 6, HLA-DQB1\*03:10:** a rare allele according to Mack SJ et al., Tissue Antigens 2013, serological equivalent is controversially discussed (DQ3, DQ7 or DQ8).

† **ATTENTION!** Alleles which are not sequenced in the primer binding sites of mixes 9 and 11 (according to the IMGT/HLA Database of January 2023) have been excluded from the list of allele specificities of these mixes.

**Table 2:** Allele specificities and sizes of the PCR products of each **HLA-DQA1\*** CTS-PCR-SSP primer mix (**Lot-No DQA10-3**) based on IMGT/HLA Sequence Database Release 3.51.0, January 2023

Position				Mix	Allele	Serology	Size
C2	C5	C8	C11	Mix 1	DQA1*01:01:01:01-01:01:01:03/01:01:01:05-01:01:11/01:04:01:01-01:05:04/01:07Q/01:12/01:18/01:22/01:26-01:27/01:29w/01:34-01:35/01:37/01:43/01:49/01:53/01:55-01:56/01:59-01:61/01:64/01:66-01:67/01:74/01:77/01:80/01:83/01:86/01:88N-01:90/01:95-01:96/01:98-01:99/01:107/01:110	-, Null	145 bp
B2	B5	B8	B11	Mix 2	DQA1*01:02:01:01-01:03:08/01:06/01:08-01:11/01:13-01:17/01:19/01:21/01:23-01:25/01:28/01:30-01:33/01:36/01:38:01:01-01:42/01:44-01:48/01:50-01:52/01:54/01:57-01:58/01:62-01:63:01:02/01:65/01:68-01:73/01:75-01:76/01:78-01:79/01:81-01:82/01:84-01:85/01:87:01:01-01:87:01:02/01:91/01:92?/01:93-01:94/01:97/01:100-01:106/01:108-01:109/01:111	-, Null	145 bp
A2	A5	A8	A11	Mix 3	DQA1*01:01:01:01-01:01:01:03/01:01:01:05-01:02:18/01:04:01:01-01:04:05/01:04:06?-01:04:07?/01:04:08-01:09/01:11-01:13/01:16N/01:18-01:19/01:21-01:23/01:25-01:28/01:31-01:32/01:34-01:43/01:46/01:48-01:49/01:51:01:01-01:56/01:58-01:59/01:60?/01:61-01:64/01:66-01:67/01:69/01:71-01:74/01:75?/01:77/01:80-01:81/01:83/01:85-01:86/01:88N-01:91/01:92?/01:93-01:96/01:98-01:100/01:103-01:107/01:109-01:111	-, Null	170 bp
H3	H6	H9	H12	Mix 4	DQA1*01:03:01:01-01:03:08/01:10/01:14-01:15N/01:17/01:24/01:30/01:33/01:44-01:45/01:47/01:50/01:57/01:65/01:68/01:70/01:76/01:78-01:79/01:82/01:84?/01:87:01:01-01:87:01:02/01:97/01:102/01:108	-, Null	170 bp
G3	G6	G9	G12	Mix 5	DQA1*01:03:02?-01:03:03?/01:03:05?/01:04:01:01-01:04:02:02/01:04:03?-01:04:04?/01:04:05-01:05:04/01:06?/01:07Q/01:08?-01:09?/01:12?-01:13?/01:15N?/01:17?-01:18?/01:20?/01:22?/01:26?/01:28?-01:29?/01:31?-01:37?/01:40Q?/01:42?/01:46?-01:47?/01:50?/01:52?-01:53?/01:55?-01:56?/01:59?-01:62?/01:64/01:67?-01:75?/01:77?-01:79?/01:80/01:81?/01:83?/01:85?/01:86/01:90?-01:98?/01:100/01:101?/01:103?/01:108?-01:111?, DQA1*02:01:02?/02:18?-02:24?, DQA1*03:01:03?/03:19?/03:22?-03:27N?/03:29?-03:30?, DQA1*04:01:04?-04:01:05?/04:03N?-04:04?/04:09?-04:12N?, DQA1*05:02?/05:04?/05:10?/05:32?/05:34?-05:35:01?/05:37?/05:39?-05:46?/05:50?/05:52?, DQA1*06:01:02?-06:04?	-, Null	200 bp
F3	F6	F9	F12	Mix 6	DQA1*02:01:01:01-02:05/02:06/02:07-02:31	-, Null	105 bp
E3	E6	E9	E12	Mix 7	DQA1*03:01:01:01/03:01:01:03/03:01:03-03:28/03:29?/03:30-03:44	-, Null	130 bp
D3	D6	D9	D12	Mix 8	DQA1*01:02:12, DQA1*04:01:01:01-04:17	-, Null	215 bp
C3	C6	C9	C12	Mix 9	<b>DQA1*05:01:01:01-05:01:02/05:01:04-05:09:01:02/05:10w/05:11:01:01-05:33/05:34?/05:35:01-05:48/05:49?/05:50-05:74</b>	-, Null	<b>see below</b>
					DQA1*05:04	-	205 bp
					DQA1*05:01:01:01-05:01:02/05:01:04-05:09:01:02/05:10w/05:11:01:01-05:33/05:34?/05:35:01-05:48/05:49?/05:50-05:74	-, Null	190 bp
B3	B6	B9	B12	Mix 10	DQA1*06:01:01:01-06:04	-	105 bp
A3	A6	A9	A12	Mix 11	-	-	None (440bp)

**Amplification control (internal positive control):** 440 base pairs (bp)

w = weak

? = nucleotide sequence information not available for the primer matching sequence

**Bold:** mixes which result in PCR fragments of different sizes (the specificities are first indicated all in one row, then split into several groups in the subsequent rows depending on the fragment size)

**Table 3:** Amplification patterns of **HLA-DQB1\*** alleles detected by the HLA-DQB1\* CTS-PCR-SSP primer mixes (**Lot No. DQB13-4**) based on IMGT/HLA Sequence Database Release 3.51.0, January 2023

Allele	Serology	1	2	3	4	5	6	7	8	9	10	11	12	13
DQB1*02:01:01:01-02:01:09/02:01:11-02:01:13/02:01:15-02:01:23/02:01:25-02:01:24/02:26-02:34/02:36/02:38-02:39/02:41-02:45/02:48-02:71/02:73-02:76/02:78-02:89/02:91-02:146/02:148-02:179/02:181-02:211	DQ2, -, Null					5								
DQB1*02:01:24/02:37/02:46-02:47/02:90	-					w								
DQB1*02:77/02:180	-					5					10			
DQB1*03:01:01:01-03:01:01:12/03:01:01:14-03:01:01:55/03:01:03-03:01:05/03:01:07-03:01:52/03:01:54-03:01:58/03:09-03:10:03/03:13/03:16/03:19:01:01-03:19:06/03:21-03:22:02/03:24/03:27-03:29/03:35/03:42/03:44/03:46-03:53/03:55-03:60/03:69/03:71/03:76-03:77/03:82-03:84N/03:92-03:94/03:101-03:103/03:108-03:109/03:114-03:116/03:119-03:121/03:127-03:128/03:130-03:131/03:133-03:135/03:138-03:140/03:142-03:144/03:147/03:150/03:152/03:154/03:157-03:160/03:163-03:167/03:169-03:170/03:172-03:173/03:180/03:182/03:186-03:188/03:191-03:193/03:196-03:198:02/03:201-03:202/03:206-03:208/03:216/03:218-03:219/03:231-03:232/03:235-03:236/03:241-03:243/03:246/03:253-03:257/03:260/03:264/03:266-03:268/03:271/03:275-03:276N/03:281/03:284-03:286/03:288/03:290/03:292-03:294/03:297/03:302-03:303N/03:305-03:307/03:309:01-03:309:02/03:311-03:312/03:317:01-03:317:02/03:326/03:328-03:331/03:335/03:338N/03:340N-03:342/03:347/03:350/03:353/03:355/03:358N/03:360-03:361/03:366/03:370/03:372-03:373/03:376N-03:378/03:380-03:381/03:385N/03:387/03:389-03:390/03:394/03:396/03:399N-03:401/03:404/03:407N/03:417-03:421/03:423-03:428/03:430-03:432/03:434-03:436/03:438-03:439/03:448-03:449/03:451/03:454-03:455/03:458/03:460/03:465/03:467-03:470/03:472-03:473N/03:475-03:476/03:480Q/03:482-03:483/03:485-03:486/03:491-03:492/03:496-03:497/03:499N/03:503/03:506/03:508	DQ7(3), -, Null, DQ3						6						12	
DQB1*03:01:02/03:01:53/03:73/03:75/03:118N/03:129/03:162/03:183/03:252/03:291/03:354N	DQ7(3), -, Null						6							
DQB1*03:01:06/03:54/03:391	-						6						w	
DQB1*03:02:01:01-03:02:01:10/03:02:01:12-03:02:02:02/03:02:09/03:02:12/03:02:21-03:02:22/03:02:24/03:02:32-03:02:33/03:02:36-03:02:37/03:11/03:68/03:211/03:245/03:247/03:251/03:263:01:01-03:263:01:02/03:289/03:415-03:416/03:422N/03:442/03:464/03:481/03:484/03:493/03:498/03:500-03:502/03:504	DQ8(3), -, Null								8	9			12	
DQB1*03:02:01:11	-								8			11	12	
DQB1*03:02:03/03:02:23/03:37	DQ8(3), -								8	9				
DQB1*03:02:04/03:02:13/03:204/03:269N/03:352/03:441	DQ8(3), -, Null								8				w	

Allele	Serology	1	2	3	4	5	6	7	8	9	10	11	12	13
DQB1*03:02:05-03:02:08/03:02:11/03:02:14-03:02:15/03:02:17-03:02:20/03:02:25-03:02:31/03:02:34-03:02:35/03:07/03:32/03:45:01-03:45:02/03:62-03:64/03:66N-03:67/03:81/03:85/03:106-03:107/03:125/03:146/03:153/03:161/03:174/03:178/03:184-03:185/03:189-03:190/03:199/03:203/03:205/03:210/03:213N-03:215/03:220-03:221/03:224/03:229/03:233/03:240/03:261/03:265/03:273-03:274/03:277-03:279/03:287/03:295-03:296/03:298-03:301/03:308/03:310N/03:315/03:320-03:324/03:333-03:334N/03:339N/03:343-03:345/03:348-03:349/03:362/03:364/03:367-03:369/03:379/03:383/03:386/03:388/03:392/03:403N/03:409-03:410/03:412-03:413/03:429/03:433/03:440N/03:444/03:446-03:447/03:450/03:452/03:456-03:457/03:459/03:462-03:463/03:466/03:471/03:479/03:490/03:495	-, Null								8				12	
DQB1*03:02:10/03:03:26/03:17:01/03:18/03:78/03:110/03:148-03:149/03:244/03:259/03:272/03:314	-												12	
DQB1*03:02:16/03:225/03:437	-								w				12	
DQB1*03:03:02:01-03:03:02:11/03:03:04/03:03:11/03:31/03:40/03:239/03:248-03:249/03:414/03:445/03:453/03:505/03:507	DQ9(3), -										10	11	12	
DQB1*03:03:03:01-03:03:03:02	DQ9(3), -										10	11		
DQB1*03:03:05/03:03:07-03:03:10/03:03:12-03:03:16/03:03:18-03:03:25/03:03:27-03:03:29/03:12/03:15/03:23:03/03:26/03:30/03:33-03:34/03:38:01/03:39/03:41/03:43/03:65/03:74/03:79/03:86-03:91Q/03:95N-03:99Q/03:104-03:105/03:111/03:113/03:117/03:123-03:124/03:141/03:155/03:168/03:176-03:177/03:200/03:209/03:212/03:222/03:227/03:230/03:234/03:258/03:270/03:280/03:282N-03:283/03:304/03:313/03:316/03:319/03:332/03:337/03:356N-03:357N/03:359/03:363/03:365/03:374-03:375N/03:382/03:384/03:393/03:395/03:397-03:398/03:402/03:405-03:406/03:411N/03:461/03:477-03:478/03:487/03:489/03:494/03:509N	-, Null										10		12	
DQB1*03:03:06/03:03:17/03:25:02/03:145	-										w		12	
DQB1*03:04:01:01-03:04:04/03:14:01-03:14:02/03:80/03:318/03:327/03:443	DQ7(3), -						6	7					12	
DQB1*03:05:01/03:250	DQ8(3), -									9				
DQB1*03:05:03-03:05:04	DQ8(3)									9			12	
DQB1*03:06, DQB1*04:03:02-04:03:03	DQ3, -										w			
DQB1*03:08	-			3					8	9			12	
DQB1*03:20/03:38:02/03:112/03:136/03:156/03:238/03:351, DQB1*06:51:01/06:377	-										10			
DQB1*03:23:01	-			3			6							
DQB1*03:23:02/03:217	-			3			6						12	
DQB1*03:25:01	-										w	11		
DQB1*03:36/03:122/03:151/03:171	-						w						12	
DQB1*03:70	-							7	8				12	
DQB1*03:126	-										w	11	12	



Allele	Serology	1	2	3	4	5	6	7	8	9	10	11	12	13
DQB1*03:132, DQB1*04:01:01:01-04:01:05/04:02:01:01/04:02:01:04-04:02:01:20/04:02:03-04:02:07/04:02:09-04:02:21/04:02:24/04:04-04:09/04:11-04:30/04:32-04:47/04:49-04:66/04:68N-04:90/04:92-04:95	-, DQ4, Null													13
DQB1*03:137	-			3							10		12	
DQB1*03:175/03:223/03:237N/03:371, DQB1*06:139	-, Null								8					
DQB1*03:179	-							w	8				12	
DQB1*03:194/03:408	-		2				6						12	
DQB1*03:195	-						6					11	12	
DQB1*03:228	-			3					8				12	
DQB1*03:336	-										10		w	
DQB1*03:474	-						6	w					12	
DQB1*03:488N	Null						6						?	
DQB1*04:01:06/04:02:23/04:91	-													?
DQB1*04:03:01	-										w			13
DQB1*04:10	-	w					6							13
DQB1*04:67	-													w
DQB1*05:01:01:01-05:01:13/05:01:15/05:01:17-05:01:18/05:01:20-05:03:01:09/05:03:03-05:03:09/05:03:11-05:03:24/05:03:26-05:10/05:11:02-05:20:02/05:22-05:25/05:27-05:33/05:35-05:43:01/05:45-05:59/05:61-05:71/05:74-05:81/05:83-05:97/05:99-05:104/05:106-05:112/05:114-05:115/05:117-05:127/05:129/05:131-05:170/05:172-05:174/05:176-05:206N/05:208N-05:217/05:219-05:227/05:229-05:239/05:241-05:257/05:259-05:299/05:301/05:303-05:318, DQB1*06:325	DQ5(1), -, Null	1												
DQB1*05:01:16/05:01:19/05:03:25/05:26/05:34/05:44/05:113/05:128N/05:130/05:171/05:228/05:302	-, Null	w												
DQB1*05:03:02	DQ5(1)	1					?							
DQB1*05:11:01/05:240	-	1											12	
DQB1*05:43:02, DQB1*06:23/06:156/06:162/06:169	-	1		3										
DQB1*06:01:01:01-06:01:29/06:01:31-06:01:34/06:03:04/06:03:08-06:03:09/06:03:14/06:03:16/06:03:26/06:03:30/06:08:02-06:08:03/06:11:04-06:12/06:14:03/06:17/06:21/06:42-06:43/06:45/06:54N-06:57:02/06:59/06:64/06:91/06:98-06:105/06:108/06:120/06:132/06:140/06:145:01/06:157/06:177/06:181/06:190:01-06:190:02/06:194/06:196/06:205/06:209/06:214/06:229/06:239/06:243/06:245/06:251/06:258-06:259/06:263/06:268/06:274-06:275/06:277/06:285/06:302/06:305/06:307/06:309-06:310/06:312/06:319:01/06:321/06:323/06:330N-06:331/06:359/06:371/06:382/06:418-06:419/06:421/06:427/06:435/06:462-06:463/06:466	DQ6(1), -, DQ1, Null		2											
DQB1*06:01:30/06:464	-		?											

Allele	Serology	1	2	3	4	5	6	7	8	9	10	11	12	13
DQB1*06:02:01:01-06:02:01:31/06:02:03-06:02:06/06:02:08-06:02:42/06:02:44-06:02:59/06:03:07/ 06:03:19/06:10-06:11:01:02/06:13:01-06:13:03/06:14:02/06:15:01-06:16/06:19:01-06:20/06:24/06:33/ 06:37/06:46-06:50/06:51:02/06:68/06:70-06:81/06:83-06:84:01:02/06:95/06:96:02-06:97/06:106- 06:107/06:109/06:111-06:117/06:118:03/06:119/06:122/06:124-06:127/06:130-06:131/06:136-06:138/ 06:146:01-06:147/06:150-06:152/06:159/06:161/06:163/06:166/06:173-06:176/06:178-06:179N/ 06:182-06:183/06:188/06:192/06:197-06:198/06:200-06:201/06:206:01-06:206:02/06:208:01/06:211/ 06:213/06:215-06:216N/06:219/06:224-06:228/06:232/06:235-06:237/06:240/06:242/06:249/06:255- 06:256/06:262/06:264/06:270:01-06:271/06:273/06:284/06:286/06:289-06:290/06:293-06:298/06:300/ 06:304N/06:306N/06:308N/06:311/06:314-06:315/06:317N/06:319:02/06:322:03/06:324/06:326/ 06:333/06:335/06:338/06:341N/06:344/06:347/06:354-06:357/06:363-06:364/06:366/06:370/06:372/ 06:374/06:376/06:379N-06:380/06:383N-06:384/06:386/06:388-06:390/06:393/06:395/06:397N/ 06:401-06:402/06:404-06:406/06:408-06:409/06:411-06:413/06:416Q/06:422N/06:430-06:431/06:436- 06:438/06:442/06:445-06:448/06:451/06:456N-06:457/06:461	DQ6(1), -, DQ1, Null			3										
DQB1*06:02:02/06:208:02	DQ6(1), -			3									12	
DQB1*06:02:07/06:03:01:01-06:03:01:21/06:03:03/06:03:06/06:03:11-06:03:13/06:03:15/06:03:17- 06:03:18/06:03:20-06:03:25/06:03:27-06:03:29/06:03:31-06:03:32/06:03:35-06:03:46/06:08:01/ 06:11:02-06:11:03/06:14:01/06:26N/06:28/06:30-06:31/06:40-06:41:01:03/06:44/06:60-06:63/06:67/ 06:82/06:87/06:90/06:92:02/06:110/06:128/06:133-06:134/06:141/06:143-06:144N/06:148/06:154/ 06:165/06:170/06:184-06:185/06:187/06:191/06:195/06:199/06:203/06:210/06:218/06:221-06:223/ 06:230/06:233-06:234/06:238/06:244/06:248/06:250/06:253/06:269/06:272/06:278-06:279/06:316/ 06:327-06:329/06:334/06:336/06:340/06:345N-06:346/06:350/06:352/06:360/06:362/06:365/06:367/ 06:373/06:378/06:385/06:391-06:392/06:394N/06:396/06:400/06:403/06:410/06:423N-06:425/ 06:428/06:433/06:440/06:443/06:450/06:453-06:455/06:459-06:460	-, DQ6(1), DQ1, Null		2	3										
DQB1*06:02:43/06:96:01/06:322:01-06:322:02	-			3							10			
DQB1*06:03:02	DQ6(1)		2	3									12	
DQB1*06:03:05/06:65	-		2	w										
DQB1*06:03:10	-		2								10			
DQB1*06:03:33	-		2	3							10			
DQB1*06:03:34/06:145:02	-		2										12	
DQB1*06:04:01:01-06:04:07/06:04:09-06:06/06:07:02/06:09:01:01-06:09:03/06:09:05/06:09:08- 06:09:12/06:18:01-06:18:02/06:22:02/06:25/06:27:01-06:27:02/06:32:02/06:34/06:36/06:38-06:39/ 06:52/06:58/06:69:01/06:85-06:86/06:88:01:01-06:89/06:93-06:94/06:118:02/06:129/06:135/06:155/ 06:158N/06:160/06:164/06:171/06:180/06:186/06:189/06:193N/06:202/06:204/06:207/06:217/ 06:241/06:252N/06:254/06:261/06:265-06:267/06:280-06:283/06:287-06:288/06:291-06:292/06:299/ 06:303N/06:313/06:320/06:339/06:343/06:348-06:349/06:351/06:353/06:358/06:361/06:368-06:369/ 06:375/06:381/06:387/06:398/06:407/06:414N/06:420/06:426/06:429/06:432/06:434/06:439Q/ 06:444/06:449/06:452N/06:458N/06:465	DQ6(1), -, Null				4									

Allele	Serology	1	2	3	4	5	6	7	8	9	10	11	12	13
DQB1*06:04:08/06:09:07	-				4								12	
DQB1*06:07:01/06:32:01/06:118:01	-			3	4									
DQB1*06:09:06/06:121/06:212	-				w									
DQB1*06:29/06:123/06:337	-			3					8					
DQB1*06:35/06:53:01-06:53:02	-		2				6							
DQB1*06:66/06:118:04/06:172	-				4						10			
DQB1*06:142	-		2		4									
DQB1*06:149/06:257	-		w											
DQB1*06:168	-		2		4						10			
DQB1*06:246	-		2					w	8					
DQB1*06:276	-		w	3										
DQB1*06:399	-		?	3										

w = weak

? = nucleotide sequence information not available for the primer matching sequence or alleles with unknown reactivities

**ATTENTION!** Alleles which are not sequenced in the primer binding sites of mixes 9 and 11 (according to the IMGT/HLA Database of January 2023) have been excluded from the list of allele specificities of these mixes.

**Table 4:** Amplification patterns for **HLA-DQA1\*** alleles detected by the HLA-DQA1\* CTS-PCR-SSP primer mixes (**Lot-No DQA10-3**) based on IMGT/HLA Sequence Database Release 3.51.0, January 2023

Allele	Serology	1	2	3	4	5	6	7	8	9	10
DQA1*01:01:01:01-01:01:01:03/01:01:01:05-01:01:11/01:27/01:43/01:49/01:66/01:88N-01:89/01:99/01:107	-, Null	1		3							
DQA1*01:02:01:01-01:02:11/01:02:13-01:01:02:18/01:11/01:16N/01:19/01:21/01:23/01:25/01:38:01:01-01:39/01:41/01:48/01:51:01:01-01:51:01:02/01:54/01:58/01:63:01:01-01:63:01:02/01:104-01:106	-, Null		2	3							
DQA1*01:02:12	-		2	3					8		
DQA1*01:03:01:01-01:03:01:13/01:03:04/01:03:06-01:03:08/01:10/01:14/01:24/01:30/01:44-01:45/01:57/01:65/01:76/01:82/01:87:01:01-01:87:01:02/01:102	-		2		4						
DQA1*01:03:02-01:03:03/01:03:05/01:15N/01:17/01:33/01:47/01:50/01:68/01:70/01:78-01:79/01:97/01:108	-, Null		2		4	?					
DQA1*01:04:01:01-01:04:02:02/01:04:05/01:04:08-01:05:04/01:07Q/01:64/01:80/01:86	-	1		3		5					
DQA1*01:04:03-01:04:04/01:12/01:18/01:22/01:26/01:34-01:35/01:37/01:53/01:55-01:56/01:59/01:61/01:67/01:74/01:77/01:83/01:90/01:95-01:96/01:98/01:110	-	1		3		?					
DQA1*01:04:06-01:04:07	-	1		?		5					
DQA1*01:06/01:08-01:09/01:13/01:28/01:31-01:32/01:36/01:40Q/01:42/01:46/01:52/01:62/01:69/01:71-01:73/01:81/01:85/01:91/01:93-01:94/01:103/01:109/01:111	-		2	3		?					
DQA1*01:20	-					?					
DQA1*01:29	-	w				?					
DQA1*01:60	-	1		?		?					
DQA1*01:75	-		2	?		?					
DQA1*01:84	-		2		?						
DQA1*01:92	-		?	?		?					
DQA1*01:100	-		2	3		5					
DQA1*01:101	-		2			?					
DQA1*02:01:01:01-02:01:01:05/02:01:03-02:05/02:07-02:17/02:25-02:31	-, Null						6				
DQA1*02:01:02/02:18-02:24	-					?	6				
DQA1*03:01:01:01/03:01:01:03/03:01:04-03:18/03:20-03:21/03:28/03:31-03:44	-, Null							7			
DQA1*03:01:03/03:19/03:22-03:27N/03:30	-, Null					?		7			
DQA1*03:29	-					?		?			

Allele	Serology	1	2	3	4	5	6	7	8	9	10
DQA1*04:01:01:01-04:01:03/04:01:06-04:02/04:05-04:08/04:13-04:17	-, Null								8		
DQA1*04:01:04-04:01:05/04:03N-04:04/04:09-04:12N	-, Null					?			8		
DQA1*05:01:01:01-05:01:02/05:01:04-05:01:11/05:03:01:01-05:03:02/ 05:05:01:01-05:09:01:02/05:11:01:01-05:31/05:33/05:35:02-05:36N/05:38/05:47- 05:48/05:51/05:53-05:74	-, Null									9	
DQA1*05:02/05:04/05:32/05:35:01/05:37/05:39-05:46/05:50/05:52	-					?				9	
DQA1*05:10	-					?				w	
DQA1*05:34	-					?				?	
DQA1*05:49	-									?	
DQA1*06:01:01:01-06:01:01:04	-										10
DQA1*06:01:02-06:04	-					?					10

w = weak

? = nucleotide sequence information not available for the primer matching sequence

## 14. Certificate of Analysis



**HEIDELBERG**  
UNIVERSITY  
HOSPITAL

Heidelberg University Hospital  
Institute of Immunology  
Transplantation Immunology  
Im Neuenheimer Feld 305  
69120 Heidelberg – Germany

Phone: +49 6221 564013

Fax: +49 6221 564200

[www.ctstransplant.org](http://www.ctstransplant.org)

**CTS** Collaborative Transplant Study

# Certificate of Analysis

## HLA-DQB1\* CTS-PCR-SSP Tray Kit

Product number	119
Lot number	DQB13-4
Number of HLA-specific primer mixes per test	13

### Mix specifications

The specificity of each primer pair has been tested against a panel of well characterized DNAs.

### Result

No false positive or false negative amplifications were obtained under our test conditions of the bulk reagents.

Date of approval	12.04.2023
Approved by	H. Tran, M.D. Quality Control, Supervisor



**HEIDELBERG**  
UNIVERSITY  
HOSPITAL

Heidelberg University Hospital  
Institute of Immunology  
Transplantation Immunology  
Im Neuenheimer Feld 305  
69120 Heidelberg – Germany

Phone: +49 6221 564013

Fax: +49 6221 564200

[www.ctstransplant.org](http://www.ctstransplant.org)

**CTS** Collaborative Transplant Study

## Certificate of Analysis

### HLA-DQA1\* CTS-PCR-SSP Tray Kit

Product number	127
Lot number	DQA10-3
Number of HLA-specific primer mixes per test	10

#### Mix specifications

The specificity of each primer pair has been tested against a panel of well characterized DNAs.

#### Result

No false positive or false negative amplifications were obtained under our test conditions of the bulk reagents.

Date of approval	09.03.2023
Approved by	H. Tran, M.D. Quality Control, Supervisor