



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 20, 2026 – 03:11 PM UTC

PDB ID : 7PBC / pdb_00007pbc
Title : Crystal structure of engineered TCR (796) complexed to HLA-A*02:01 presenting MAGE-A10 9-mer peptide
Authors : Simister, P.C.; Border, E.C.; Vieira, J.F.; Pumphrey, N.J.
Deposited on : 2021-08-02
Resolution : 2.04 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

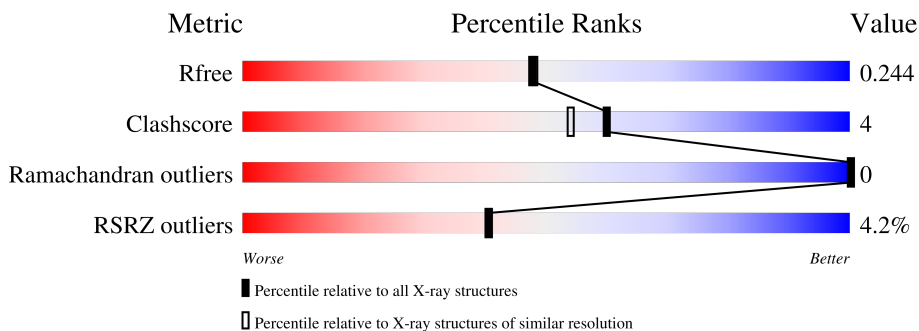
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.04 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	2260 (2.04-2.04)
Clashscore	190562	2333 (2.04-2.04)
Ramachandran outliers	187476	2318 (2.04-2.04)
RSRZ outliers	180081	2260 (2.04-2.04)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	CCC	277	
2	DDD	100	
3	AAA	206	
4	BBB	241	
5	EEE	9	

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 12927 atoms, of which 6101 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called MHC class I antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
1	CCC	276	4258	1383	2056	394	416	9	92	2	1

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
CCC	1	MET	-	initiating methionine	UNP Q861F7

- Molecule 2 is a protein called Beta-2-microglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
2	DDD	99	1538	507	748	134	146	3	40	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
DDD	1	MET	-	initiating methionine	UNP P61769

- Molecule 3 is a protein called T-cell receptor (TRAV/TRAC).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
3	AAA	201	2970	953	1437	257	315	8	58	1	0

- Molecule 4 is a protein called T-cell receptor (TRBV/TRBC).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
4	BBB	240	3634	1182	1770	318	355	9	68	0	0

- Molecule 5 is a protein called Melanoma-associated antigen 10.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	H	N	O				S
5	EEE	9	138	45	66	11	15	1	3	0	0

- Molecule 6 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	H	O		
6	CCC	1	14	3	8	3	2	0
6	CCC	1	14	3	8	3	2	0
6	CCC	1	14	3	8	3	2	0

- Molecule 7 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	BBB	1	Total Cl 1 1	0	0

- Molecule 8 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	CCC	118	Total O 118 118	0	0
8	DDD	26	Total O 26 26	0	0

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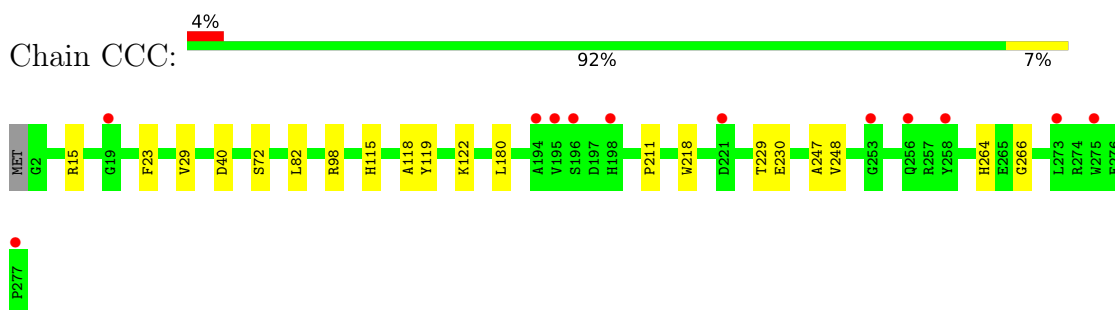
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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	AAA	95	Total O 95 95	0	0
8	BBB	100	Total O 100 100	0	0
8	EEE	7	Total O 7 7	0	0

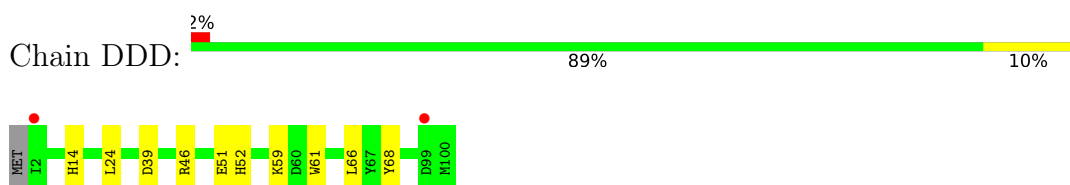
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

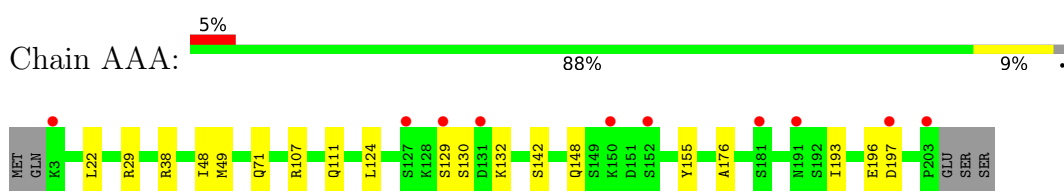
- Molecule 1: MHC class I antigen



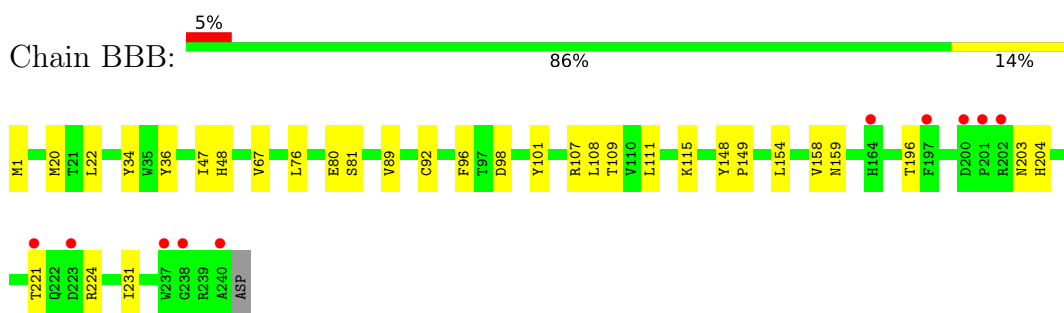
- Molecule 2: Beta-2-microglobulin



- Molecule 3: T-cell receptor (TRAV/TRAC)



- Molecule 4: T-cell receptor (TRBV/TRBC)



- Molecule 5: Melanoma-associated antigen 10

Chain EEE:  100%

There are no outlier residues recorded for this chain.

4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	54.33Å 77.50Å 115.12Å 90.00° 102.88° 90.00°	Depositor
Resolution (Å)	63.85 – 2.04 63.85 – 2.04	Depositor EDS
% Data completeness (in resolution range)	99.3 (63.85-2.04) 92.4 (63.85-2.04)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.32 (at 2.03Å)	Xtrriage
Refinement program	REFMAC 5.8.0267, REFMAC 5.8.0267	Depositor
R, R_{free}	0.186 , 0.236 (Not available) , 0.244	Depositor DCC
R_{free} test set	2817 reflections (4.60%)	wwPDB-VP
Wilson B-factor (Å ²)	27.9	Xtrriage
Anisotropy	0.556	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.43 , 40.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.027 for h,-k,-h-l	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	12927	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.12% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CL, GOL

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# $ Z > 5$	RMSZ	# $ Z > 5$
1	CCC	1.04	0/2276	1.32	0/3097
2	DDD	0.98	0/813	1.20	0/1107
3	AAA	1.02	0/1568	1.28	0/2130
4	BBB	1.01	0/1916	1.27	2/2616 (0.1%)
5	EEE	1.19	0/73	1.50	0/95
All	All	1.02	0/6646	1.28	2/9045 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	BBB	96	PHE	CA-CB-CG	-5.24	108.56	113.80
4	BBB	98	ASP	CA-CB-CG	5.11	117.71	112.60

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	CCC	2202	2056	2013	11	1
2	DDD	790	748	719	7	0
3	AAA	1533	1437	1417	15	0
4	BBB	1864	1770	1743	21	1

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	EEE	72	66	65	0	0
6	CCC	18	24	24	0	0
7	BBB	1	0	0	0	0
8	AAA	95	0	0	2	0
8	BBB	100	0	0	3	0
8	CCC	118	0	0	0	0
8	DDD	26	0	0	2	0
8	EEE	7	0	0	0	0
All	All	6826	6101	5981	53	1

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

The worst 5 of 53 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:AAA:38:ARG:HB2	3:AAA:48:ILE:HD11	1.71	0.73
3:AAA:29:ARG:HH21	3:AAA:71:GLN:HE21	1.45	0.65
1:CCC:98:ARG:HE	1:CCC:115:HIS:HE1	1.47	0.62
3:AAA:48:ILE:HG22	3:AAA:49:MET:HG2	1.81	0.61
1:CCC:82:LEU:HD13	1:CCC:119:TYR:CD1	2.36	0.60

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:CCC:122:LYS:HZ1	4:BBB:81:SER:HG[2_856]	1.10	0.50

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	CCC	276/277 (100%)	267 (97%)	9 (3%)	0	100	100
2	DDD	97/100 (97%)	92 (95%)	5 (5%)	0	100	100
3	AAA	200/206 (97%)	190 (95%)	10 (5%)	0	100	100
4	BBB	238/241 (99%)	232 (98%)	6 (2%)	0	100	100
5	EEE	7/9 (78%)	7 (100%)	0	0	100	100
All	All	818/833 (98%)	788 (96%)	30 (4%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

There are no protein residues with a non-rotameric sidechain to report in this entry.

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 1 is monoatomic - leaving 3 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
6	GOL	CCC	302	-	5,5,5	0.12	0	5,5,5	0.22	0
6	GOL	CCC	301	-	5,5,5	0.12	0	5,5,5	0.19	0
6	GOL	CCC	303	-	5,5,5	0.11	0	5,5,5	0.33	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
6	GOL	CCC	302	-	-	0/4/4/4	-
6	GOL	CCC	301	-	-	2/4/4/4	-
6	GOL	CCC	303	-	-	4/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
6	CCC	301	GOL	C1-C2-C3-O3
6	CCC	303	GOL	C1-C2-C3-O3
6	CCC	303	GOL	O2-C2-C3-O3
6	CCC	301	GOL	O2-C2-C3-O3
6	CCC	303	GOL	O1-C1-C2-C3

There are no ring outliers.

No monomer is involved in short contacts.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	CCC	276/277 (99%)	0.03	12 (4%) 40 40	14, 30, 70, 88	2 (0%)
2	DDD	99/100 (99%)	0.28	2 (2%) 65 67	23, 39, 66, 76	0
3	AAA	201/206 (97%)	0.11	10 (4%) 34 34	20, 32, 67, 85	1 (0%)
4	BBB	240/241 (99%)	0.03	11 (4%) 37 37	18, 33, 62, 82	0
5	EEE	9/9 (100%)	-0.97	0 100 100	18, 21, 23, 24	0
All	All	825/833 (99%)	0.07	35 (4%) 40 40	14, 33, 67, 88	3 (0%)

The worst 5 of 35 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	CCC	195	VAL	4.4
1	CCC	277	PRO	3.9
1	CCC	275	TRP	3.9
4	BBB	238	GLY	3.5
4	BBB	240	ALA	3.5

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum,

median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
6	GOL	CCC	303	6/6	0.89	0.11	56,57,65,66	2
6	GOL	CCC	302	6/6	0.92	0.10	45,53,57,58	2
6	GOL	CCC	301	6/6	0.92	0.11	49,50,55,56	2
7	CL	BBB	301	1/1	0.99	0.07	31,31,31,31	0

6.5 Other polymers [i](#)

There are no such residues in this entry.