



Full wwPDB X-ray Structure Validation Report ⓘ

Jun 24, 2024 – 02:14 PM EDT

PDB ID : 9BC3
Title : Transglutaminase 2 - Alternate state
Authors : Mathews, I.I.; Sewa, A.S.; Khosla, C.
Deposited on : 2024-04-07
Resolution : 2.52 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtrriage (Phenix) : 1.13
EDS : 2.37.1
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.37.1

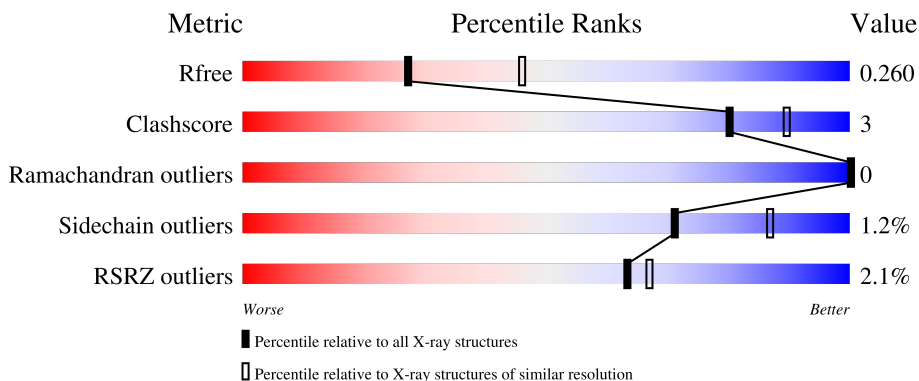
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.52 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}	130704	5743 (2.54-2.50)
Clashscore	141614	6463 (2.54-2.50)
Ramachandran outliers	138981	6335 (2.54-2.50)
Sidechain outliers	138945	6337 (2.54-2.50)
RSRZ outliers	127900	5630 (2.54-2.50)

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	A	687	 2% 59% 37%
1	B	687	 2% 56% 6% 37%
2	C	7	 29% 71%
2	D	7	 29% 71%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 7215 atoms, of which 0 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 Protein-glutamine gamma-glutamyltransferase 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	431	3433	2170	595	649	19	0	0	0
1	B	431	3433	2170	595	649	19	0	0	0

- Molecule 2 is a protein called HB-225 (gluten peptidomimetic TG2 inhibitor).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	C	7	50	36	7	7	0	0	1
2	D	7	50	36	7	7	0	0	1

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	Ca	0	0
			2	2		
3	B	2	Total	Ca	0	0
			2	2		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	114	Total	O	0	3
			117	117		
4	B	117	Total	O	0	7
			124	124		
4	C	2	Total	O	0	0
			2	2		
4	D	2	Total	O	0	0
			2	2		

THR VAL GLU ILE PRO ASP PRO VAL GLU ALA GLY GLU VAL LYS VAL ARG MET ASP LEU PRO HIS MET GLY LEU LYS LEU VAL VAL ASN PHE SER ASP LYS LEU LYS ALA VAL LYS PHE ARG ASN VAL ILE ILE GLY PRO ALA

- Molecule 2: HB-225 (gluten peptidomimetic TG2 inhibitor)

Chain C:  29% 71%

ACE1
P2
A1ALE3
L4
P5
F6
NH27

- Molecule 2: HB-225 (gluten peptidomimetic TG2 inhibitor)

Chain D:  29% 71%

ACE1
P2
A1ALE3
L4
P5
F6
NH27

4 Data and refinement statistics i

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	46.45Å 71.42Å 77.47Å 90.81° 107.19° 94.43°	Depositor
Resolution (Å)	39.11 – 2.52 39.07 – 2.52	Depositor EDS
% Data completeness (in resolution range)	83.5 (39.11-2.52) 83.5 (39.07-2.52)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.26 (at 2.51Å)	Xtrriage
Refinement program	REFMAC 5.8.0425	Depositor
R, R_{free}	0.205 , 0.265 0.208 , 0.260	Depositor DCC
R_{free} test set	1418 reflections (5.31%)	wwPDB-VP
Wilson B-factor (Å ²)	28.8	Xtrriage
Anisotropy	0.138	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 39.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.000 for -h,-k,h+1	Xtrriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	7215	wwPDB-VP
Average B, all atoms (Å ²)	29.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.77% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ACE, CA, NH2, A1ALE

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	A	0.29	0/3518	0.56	0/4784
1	B	0.29	0/3518	0.56	0/4784
2	C	4.51	8/35 (22.9%)	1.22	0/47
2	D	4.51	8/35 (22.9%)	1.26	0/47
All	All	0.53	16/7106 (0.2%)	0.57	0/9662

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	2	PRO	N-CD	-12.49	1.30	1.47
2	D	2	PRO	N-CD	-12.09	1.30	1.47
2	C	2	PRO	CA-CB	-11.57	1.30	1.53
2	D	2	PRO	CA-CB	-11.57	1.30	1.53
2	D	5	PRO	CA-CB	-11.27	1.31	1.53
2	C	5	PRO	CA-CB	-11.20	1.31	1.53
2	C	2	PRO	N-CA	9.41	1.63	1.47
2	D	2	PRO	N-CA	9.38	1.63	1.47
2	D	4	LEU	C-N	6.50	1.46	1.34
2	C	4	LEU	C-N	6.22	1.46	1.34
2	D	5	PRO	N-CA	5.96	1.57	1.47
2	C	5	PRO	N-CA	5.66	1.56	1.47
2	D	1	ACE	C-N	5.56	1.44	1.34
2	C	5	PRO	C-N	5.43	1.46	1.34
2	D	5	PRO	C-N	5.38	1.46	1.34
2	C	1	ACE	C-N	5.22	1.44	1.34

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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	A	3433	0	3302	14	0
1	B	3433	0	3302	23	0
2	C	50	0	37	0	0
2	D	50	0	37	0	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	117	0	0	0	0
4	B	124	0	0	2	0
4	C	2	0	0	0	0
4	D	2	0	0	0	0
All	All	7215	0	6678	37	0

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 3.

All (37) 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)
1:B:433:ARG:HH11	1:B:433:ARG:HG3	1.55	0.72
1:B:433:ARG:HH11	1:B:433:ARG:CG	2.12	0.62
1:B:304:ALA:HB1	1:B:313:ILE:HD11	1.85	0.58
1:B:210:ASP:HA	4:B:802:HOH:O	2.06	0.56
1:B:202:LYS:HB3	1:B:209:ARG:HH22	1.72	0.55
1:B:38:PRO:HA	1:B:104:LEU:O	2.10	0.51
1:A:139:PHE:HB3	1:A:148:VAL:HG21	1.92	0.51
1:B:304:ALA:HB1	1:B:313:ILE:CD1	2.41	0.50
1:A:88:TRP:CZ3	1:A:106:THR:HG22	2.46	0.50
1:B:40:TRP:O	1:B:41:LEU:HD23	2.12	0.50
1:A:3:GLU:OE1	1:A:3:GLU:N	2.42	0.48
1:B:167:ILE:HG21	1:B:278:TRP:HB2	1.96	0.47
1:A:390:ALA:N	1:A:391:PRO:CD	2.78	0.47
1:A:79:LEU:HD11	1:A:102:LEU:HD22	1.96	0.47
1:A:167:ILE:HG21	1:A:278:TRP:HB2	1.97	0.46
1:B:390:ALA:N	1:B:391:PRO:CD	2.79	0.46
1:B:88:TRP:CZ3	1:B:106:THR:HG22	2.51	0.45

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:236:VAL:HA	1:B:264:TRP:CD1	2.52	0.45
1:A:41:LEU:HD11	1:A:117:LEU:HD21	1.99	0.45
1:B:149:TYR:CZ	1:B:151:ASP:HB3	2.52	0.45
1:A:154:GLU:HG3	1:A:431:VAL:CG1	2.46	0.45
1:A:295:THR:HA	1:A:339:GLU:O	2.18	0.43
1:B:273:LYS:HA	1:B:274:TYR:HA	1.82	0.43
1:B:213:ARG:HB2	4:B:802:HOH:O	2.18	0.43
1:B:21:HIS:CE1	1:B:39:PHE:HB3	2.54	0.43
1:A:348:GLN:HG3	1:A:349:PRO:HD2	2.00	0.42
1:B:338:VAL:HG23	1:B:357:LEU:HB2	2.02	0.42
1:A:196:LEU:HD11	1:A:227:MET:HB3	2.01	0.42
1:B:62:VAL:HG12	1:B:74:LYS:HD3	2.00	0.41
1:B:107:PRO:HG2	1:B:110:ALA:HB2	2.02	0.41
1:B:96:GLN:HB2	1:B:99:THR:OG1	2.21	0.41
1:A:38:PRO:HA	1:A:104:LEU:O	2.21	0.41
1:B:387:LYS:HA	1:B:388:TYR:HA	1.78	0.41
1:A:35:ARG:HA	1:A:137:LEU:HD11	2.03	0.40
1:B:374:VAL:HB	1:B:388:TYR:O	2.21	0.40
1:B:358:ASP:HB3	1:B:371:CYS:HB3	2.04	0.40
1:A:146:ASP:OD1	1:A:148:VAL:HG22	2.22	0.40

There are no symmetry-related clashes.

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	A	425/687 (62%)	413 (97%)	12 (3%)	0	100	100
1	B	425/687 (62%)	407 (96%)	18 (4%)	0	100	100
2	C	4/7 (57%)	4 (100%)	0	0	100	100
2	D	4/7 (57%)	4 (100%)	0	0	100	100
All	All	858/1388 (62%)	828 (96%)	30 (4%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain 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 sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	375/597 (63%)	372 (99%)	3 (1%)	81	92
1	B	375/597 (63%)	369 (98%)	6 (2%)	62	82
2	C	4/4 (100%)	4 (100%)	0	100	100
2	D	4/4 (100%)	4 (100%)	0	100	100
All	All	758/1202 (63%)	749 (99%)	9 (1%)	71	87

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	91	THR
1	A	200	ASN
1	A	271	ARG
1	B	3	GLU
1	B	15	GLU
1	B	87	ASP
1	B	200	ASN
1	B	206	ASN
1	B	433	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	21	HIS
1	B	206	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues are modelled in this entry.

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
2	A1ALE	C	3	2,1	11,12,13	3.36	3 (27%)	9,14,16	0.77	0
2	A1ALE	D	3	2,1	11,12,13	3.38	2 (18%)	9,14,16	0.72	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
2	A1ALE	C	3	2,1	-	1/12/13/15	-
2	A1ALE	D	3	2,1	-	1/12/13/15	-

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	3	A1ALE	CZ-N7	10.55	1.47	1.34
2	C	3	A1ALE	CZ-N7	10.46	1.47	1.34
2	C	3	A1ALE	CA-N	-2.13	1.41	1.48
2	C	3	A1ALE	CE-CZ	2.06	1.55	1.51
2	D	3	A1ALE	CA-N	-2.01	1.42	1.48

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	D	3	A1ALE	CG-CD-CE-CZ
2	C	3	A1ALE	CG-CD-CE-CZ

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

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	A	431/687 (62%)	-0.07	7 (1%) 72 74	16, 25, 43, 83	0
1	B	431/687 (62%)	0.00	11 (2%) 56 59	19, 30, 50, 72	0
2	C	4/7 (57%)	0.15	0 100 100	24, 30, 34, 37	0
2	D	4/7 (57%)	0.41	0 100 100	25, 29, 36, 41	0
All	All	870/1388 (62%)	-0.03	18 (2%) 63 67	16, 27, 48, 83	0

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1	MET	5.6
1	B	2	ALA	4.0
1	B	1	MET	4.0
1	B	3	GLU	3.9
1	B	130	PHE	3.9
1	B	97	ASP	3.6
1	B	129	SER	3.3
1	B	132	LEU	2.7
1	A	126	GLN	2.6
1	B	126	GLN	2.6
1	A	408	ASP	2.6
1	A	2	ALA	2.5
1	B	408	ASP	2.5
1	B	411	SER	2.4
1	B	70	GLU	2.2
1	A	411	SER	2.2
1	A	413	HIS	2.1
1	A	127	GLY	2.1

6.2 Non-standard residues in protein, DNA, RNA chains [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
2	A1ALE	C	3	13/14	0.93	0.18	21,22,25,25	0
2	A1ALE	D	3	13/14	0.94	0.15	20,21,25,25	0

6.3 Carbohydrates [i](#)

There are no monosaccharides 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
3	CA	B	702	1/1	0.97	0.07	34,34,34,34	0
3	CA	B	701	1/1	0.98	0.07	22,22,22,22	0
3	CA	A	702	1/1	0.98	0.05	28,28,28,28	0
3	CA	A	701	1/1	0.99	0.05	23,23,23,23	0

6.5 Other polymers [i](#)

There are no such residues in this entry.