



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 07:59 PM UTC

PDB ID : 3HR8 / pdb_00003hr8
Title : Crystal Structure of Thermotoga maritima RecA
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Deposited on : 2009-06-09
Resolution : 1.95 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	:	4-5-2 with Phenix2.0
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

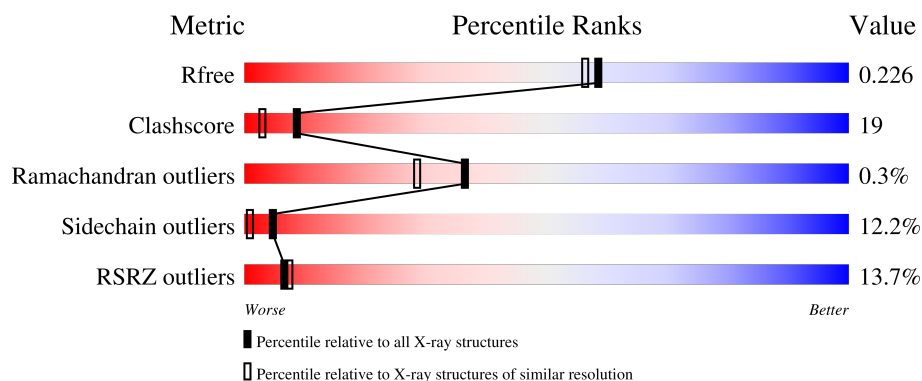
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.95 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	3494 (1.96-1.96)
Clashscore	190562	3612 (1.96-1.96)
Ramachandran outliers	187476	3587 (1.96-1.96)
Sidechain outliers	187428	3587 (1.96-1.96)
RSRZ outliers	180081	3495 (1.96-1.96)

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	356	13% 68% 21% 5% . .

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2918 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 recA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	342	Total	C	N	O	S	0	0	0
			2619	1658	452	500	9			

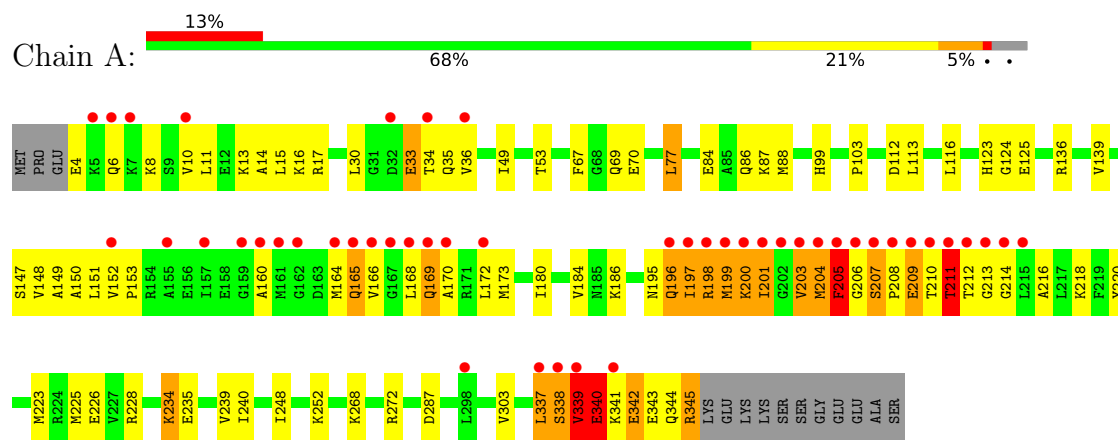
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	299	Total	O	0	0
			299	299		

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: Protein recA



4 Data and refinement statistics

Property	Value	Source
Space group	P 61	Depositor
Cell constants a, b, c, α , β , γ	102.14Å 102.14Å 81.51Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	23.49 – 1.95 23.49 – 1.95	Depositor EDS
% Data completeness (in resolution range)	99.7 (23.49-1.95) 99.6 (23.49-1.95)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.05	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.17 (at 1.95Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.195 , 0.230 0.192 , 0.226	Depositor DCC
R_{free} test set	1801 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å ²)	29.7	Xtriage
Anisotropy	0.053	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 45.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.049 for h,-h-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	2918	wwPDB-VP
Average B, all atoms (Å ²)	43.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.83% 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

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	0.63	0/2653	0.99	15/3571 (0.4%)

There are no bond length outliers.

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	206	GLY	N-CA-C	11.20	130.65	110.71
1	A	204	MET	N-CA-C	7.72	121.12	108.08
1	A	203	VAL	N-CA-C	7.26	118.58	108.12
1	A	340	GLU	N-CA-C	-7.24	104.05	113.17
1	A	211	THR	N-CA-C	6.98	119.74	110.53
1	A	213	GLY	N-CA-C	-6.74	104.42	113.24
1	A	197	ILE	N-CA-C	-6.25	106.68	112.43
1	A	33	GLU	N-CA-C	-6.24	102.00	110.68
1	A	204	MET	CB-CA-C	-6.23	109.40	116.63
1	A	205	PHE	N-CA-C	5.91	118.33	110.53
1	A	160	ALA	CA-C-N	-5.35	115.86	123.03
1	A	160	ALA	C-N-CA	-5.35	115.86	123.03
1	A	198	ARG	N-CA-C	5.20	117.88	109.40
1	A	164	MET	N-CA-C	5.06	117.45	111.33
1	A	199	MET	N-CA-C	5.05	118.59	111.52

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	2619	0	2704	100	0
2	A	299	0	0	12	0
All	All	2918	0	2704	100	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 19.

All (100) 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:A:200:LYS:HD3	1:A:200:LYS:C	1.65	1.20
1:A:195:ASN:OD1	1:A:210:THR:HG23	1.49	1.11
1:A:207:SER:OG	1:A:208:PRO:HD2	1.58	1.03
1:A:200:LYS:C	1:A:200:LYS:CD	2.34	1.00
1:A:211:THR:O	1:A:214:GLY:N	1.95	0.98
1:A:35:GLN:N	1:A:36:VAL:HA	1.78	0.95
1:A:204:MET:HG2	1:A:205:PHE:N	1.85	0.92
1:A:337:LEU:HD13	1:A:338:SER:N	1.86	0.90
1:A:337:LEU:HD13	1:A:338:SER:H	1.39	0.88
1:A:153:PRO:HB3	1:A:169:GLN:HG2	1.55	0.86
1:A:345:ARG:HH11	1:A:345:ARG:HG3	1.41	0.85
1:A:86:GLN:HE22	1:A:112:ASP:H	1.26	0.84
1:A:204:MET:HG2	1:A:205:PHE:H	1.40	0.83
1:A:211:THR:O	1:A:214:GLY:CA	2.29	0.81
1:A:70:GLU:H	1:A:198:ARG:HG3	1.42	0.80
1:A:200:LYS:HD3	1:A:201:ILE:N	1.98	0.79
1:A:338:SER:O	1:A:339:VAL:HG12	1.85	0.77
1:A:200:LYS:HD3	1:A:200:LYS:O	1.85	0.75
1:A:207:SER:CB	1:A:208:PRO:HD2	2.16	0.75
1:A:210:THR:HG21	2:A:417:HOH:O	1.89	0.72
1:A:211:THR:O	1:A:214:GLY:HA3	1.91	0.71
1:A:13:LYS:HD3	1:A:13:LYS:C	2.16	0.70
1:A:86:GLN:NE2	1:A:112:ASP:H	1.87	0.70
1:A:35:GLN:N	1:A:36:VAL:CA	2.55	0.69
1:A:197:ILE:O	1:A:197:ILE:HG22	1.92	0.68
1:A:165:GLN:HG3	1:A:168:LEU:HB2	1.75	0.68
1:A:153:PRO:HB3	1:A:169:GLN:CG	2.24	0.68
1:A:207:SER:OG	1:A:208:PRO:CD	2.39	0.67
1:A:209:GLU:H	1:A:209:GLU:CD	2.01	0.67
1:A:209:GLU:HA	2:A:491:HOH:O	1.95	0.66
1:A:123:HIS:HD2	1:A:125:GLU:HG2	1.61	0.65
1:A:148:VAL:HA	1:A:151:LEU:CD1	2.25	0.65

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:35:GLN:H	1:A:36:VAL:HA	1.60	0.63
1:A:169:GLN:HA	1:A:172:LEU:HB2	1.80	0.62
1:A:197:ILE:HG23	1:A:209:GLU:HB3	1.81	0.62
1:A:341:LYS:O	1:A:341:LYS:HG3	1.98	0.62
1:A:70:GLU:N	1:A:198:ARG:HG3	2.15	0.62
1:A:148:VAL:HA	1:A:151:LEU:HD12	1.79	0.62
1:A:4:GLU:HB2	2:A:577:HOH:O	2.00	0.61
1:A:337:LEU:CD1	1:A:338:SER:N	2.60	0.61
1:A:6:GLN:O	1:A:10:VAL:HG23	2.01	0.60
1:A:123:HIS:CD2	1:A:125:GLU:HG2	2.36	0.60
1:A:207:SER:CB	1:A:208:PRO:CD	2.79	0.59
1:A:337:LEU:CD1	1:A:337:LEU:C	2.75	0.59
1:A:165:GLN:HB2	2:A:651:HOH:O	2.01	0.59
1:A:204:MET:CG	1:A:205:PHE:H	2.03	0.59
1:A:147:SER:O	1:A:151:LEU:HG	2.02	0.59
1:A:200:LYS:HB3	2:A:547:HOH:O	2.04	0.57
1:A:165:GLN:HG2	1:A:165:GLN:O	2.04	0.57
1:A:207:SER:HG	1:A:208:PRO:HD2	1.66	0.57
1:A:345:ARG:HG3	1:A:345:ARG:NH1	2.18	0.56
1:A:195:ASN:HD22	1:A:196:GLN:H	1.51	0.56
1:A:124:GLY:HA3	1:A:173:MET:HE1	1.88	0.55
1:A:200:LYS:CD	1:A:200:LYS:O	2.48	0.55
1:A:195:ASN:ND2	1:A:196:GLN:H	2.04	0.55
1:A:339:VAL:O	1:A:339:VAL:HG13	2.07	0.54
1:A:99:HIS:HE1	2:A:399:HOH:O	1.90	0.54
1:A:268:LYS:HE3	2:A:482:HOH:O	2.08	0.54
1:A:53:THR:HB	1:A:223:MET:HE1	1.90	0.53
1:A:136:ARG:CZ	2:A:527:HOH:O	2.57	0.53
1:A:218:LYS:CE	2:A:634:HOH:O	2.58	0.52
1:A:345:ARG:HH11	1:A:345:ARG:CG	2.13	0.52
1:A:211:THR:C	1:A:214:GLY:H	2.14	0.51
1:A:86:GLN:HE22	1:A:112:ASP:N	2.03	0.51
1:A:218:LYS:HE2	2:A:634:HOH:O	2.10	0.51
1:A:148:VAL:O	1:A:151:LEU:HB2	2.11	0.51
1:A:180:ILE:O	1:A:184:VAL:HG13	2.11	0.50
1:A:204:MET:CG	1:A:205:PHE:N	2.57	0.50
1:A:204:MET:HE3	1:A:205:PHE:HB2	1.93	0.49
1:A:225:MET:HE2	1:A:248:ILE:HD12	1.93	0.49
1:A:169:GLN:O	1:A:170:ALA:C	2.53	0.48
1:A:340:GLU:O	1:A:342:GLU:OE1	2.30	0.48
1:A:345:ARG:NH1	1:A:345:ARG:CG	2.74	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:165:GLN:CG	1:A:168:LEU:HB2	2.44	0.48
1:A:67:PHE:CZ	1:A:226:GLU:HB2	2.49	0.48
1:A:216:ALA:HB1	1:A:220:TYR:CE2	2.50	0.47
1:A:234:LYS:HE2	1:A:234:LYS:HB3	1.57	0.46
1:A:150:ALA:O	1:A:152:VAL:HG23	2.15	0.46
1:A:139:VAL:O	1:A:139:VAL:HG12	2.16	0.46
1:A:49:ILE:CD1	1:A:77:LEU:HD11	2.46	0.45
1:A:34:THR:HA	1:A:35:GLN:HA	1.63	0.45
1:A:235:GLU:HB2	1:A:240:ILE:HD13	1.98	0.45
1:A:149:ALA:HB2	2:A:554:HOH:O	2.17	0.45
1:A:235:GLU:HG3	2:A:619:HOH:O	2.16	0.44
1:A:103:PRO:O	1:A:113:LEU:HD11	2.18	0.44
1:A:172:LEU:HD23	1:A:172:LEU:HA	1.82	0.43
1:A:216:ALA:O	1:A:220:TYR:CD2	2.72	0.43
1:A:69:GLN:HG2	1:A:198:ARG:HG2	2.00	0.43
1:A:16:LYS:HA	1:A:16:LYS:HD3	1.73	0.43
1:A:209:GLU:CD	1:A:209:GLU:N	2.72	0.43
1:A:87:LYS:HE3	1:A:87:LYS:HB2	1.95	0.42
1:A:84:GLU:O	1:A:88:MET:HG3	2.19	0.42
1:A:208:PRO:O	1:A:209:GLU:C	2.62	0.42
1:A:200:LYS:HD3	1:A:201:ILE:CA	2.50	0.42
1:A:13:LYS:HD3	1:A:14:ALA:N	2.34	0.41
1:A:272:ARG:HD3	1:A:272:ARG:C	2.45	0.41
1:A:8:LYS:HA	1:A:11:LEU:HB3	2.02	0.41
1:A:204:MET:HG2	1:A:205:PHE:HB2	2.03	0.41
1:A:210:THR:HG22	1:A:214:GLY:HA3	2.03	0.40
1:A:337:LEU:HA	1:A:337:LEU:HD22	1.84	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	340/356 (96%)	333 (98%)	6 (2%)	1 (0%)	36	28

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	339	VAL

5.3.2 Protein sidechains ⓘ

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	279/291 (96%)	245 (88%)	34 (12%)	5	1

All (34) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	15	LEU
1	A	17	ARG
1	A	30	LEU
1	A	33	GLU
1	A	77	LEU
1	A	116	LEU
1	A	165	GLN
1	A	166	VAL
1	A	169	GLN
1	A	186	LYS
1	A	196	GLN
1	A	199	MET
1	A	200	LYS
1	A	201	ILE
1	A	203	VAL
1	A	205	PHE
1	A	207	SER
1	A	209	GLU
1	A	211	THR
1	A	212	THR

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Mol	Chain	Res	Type
1	A	228	ARG
1	A	234	LYS
1	A	239	VAL
1	A	252	LYS
1	A	287	ASP
1	A	303	VAL
1	A	337	LEU
1	A	338	SER
1	A	339	VAL
1	A	340	GLU
1	A	342	GLU
1	A	343	GLU
1	A	344	GLN
1	A	345	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	21	ASN
1	A	86	GLN
1	A	99	HIS
1	A	123	HIS
1	A	195	ASN
1	A	196	GLN
1	A	311	ASN
1	A	319	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](#)

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

There are no ligands in this entry.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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	342/356 (96%)	0.52	47 (13%) 6 7	20, 35, 97, 118	0

All (47) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	201	ILE	9.4
1	A	205	PHE	6.6
1	A	166	VAL	6.5
1	A	339	VAL	6.1
1	A	211	THR	6.1
1	A	203	VAL	5.8
1	A	208	PRO	5.4
1	A	338	SER	5.0
1	A	210	THR	4.9
1	A	212	THR	4.3
1	A	198	ARG	4.3
1	A	202	GLY	4.2
1	A	199	MET	4.1
1	A	207	SER	3.8
1	A	161	MET	3.7
1	A	168	LEU	3.6
1	A	204	MET	3.5
1	A	160	ALA	3.4
1	A	213	GLY	3.2
1	A	159	GLY	3.2
1	A	5	LYS	3.1
1	A	337	LEU	3.1
1	A	169	GLN	3.0
1	A	200	LYS	3.0
1	A	197	ILE	3.0
1	A	172	LEU	2.9
1	A	298	LEU	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	155	ALA	2.8
1	A	167	GLY	2.8
1	A	341	LYS	2.8
1	A	215	LEU	2.8
1	A	170	ALA	2.7
1	A	152	VAL	2.6
1	A	209	GLU	2.6
1	A	164	MET	2.5
1	A	157	ILE	2.5
1	A	162	GLY	2.4
1	A	10	VAL	2.4
1	A	196	GLN	2.3
1	A	34	THR	2.3
1	A	36	VAL	2.3
1	A	32	ASP	2.3
1	A	206	GLY	2.2
1	A	6	GLN	2.2
1	A	165	GLN	2.2
1	A	214	GLY	2.1
1	A	7	LYS	2.0

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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.