



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 24, 2024 – 08:27 AM EDT

PDB ID : 2QUG
Title : Crystal structure of alpha-1-antitrypsin, crystal form A
Authors : Hansen, G.; Morton, C.J.; Pearce, M.C.; Feil, S.C.; Adams, J.J.; Parker, M.W.;
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Deposited on : 2007-08-05
Resolution : 2.00 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 : 2022.3.0, CSD as543be (2022)
Xtrriage (Phenix) : 1.20.1
EDS : 3.0
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4 : 9.0.003 (Gargrove)
Density-Fitness : 1.0.11
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.39

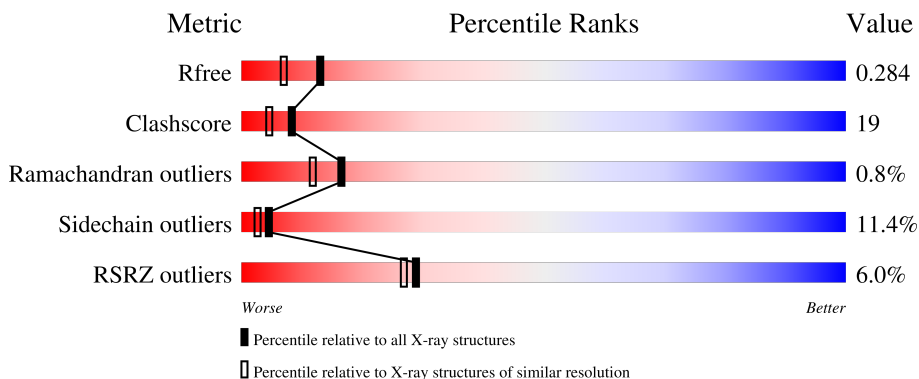
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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}	164625	9409 (2.00-2.00)
Clashscore	180529	10737 (2.00-2.00)
Ramachandran outliers	177936	10628 (2.00-2.00)
Sidechain outliers	177891	10627 (2.00-2.00)
RSRZ outliers	164620	9409 (2.00-2.00)

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	394	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2974 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 Alpha-1-antitrypsin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	369	2928	1884	477	557	10	0	0	0

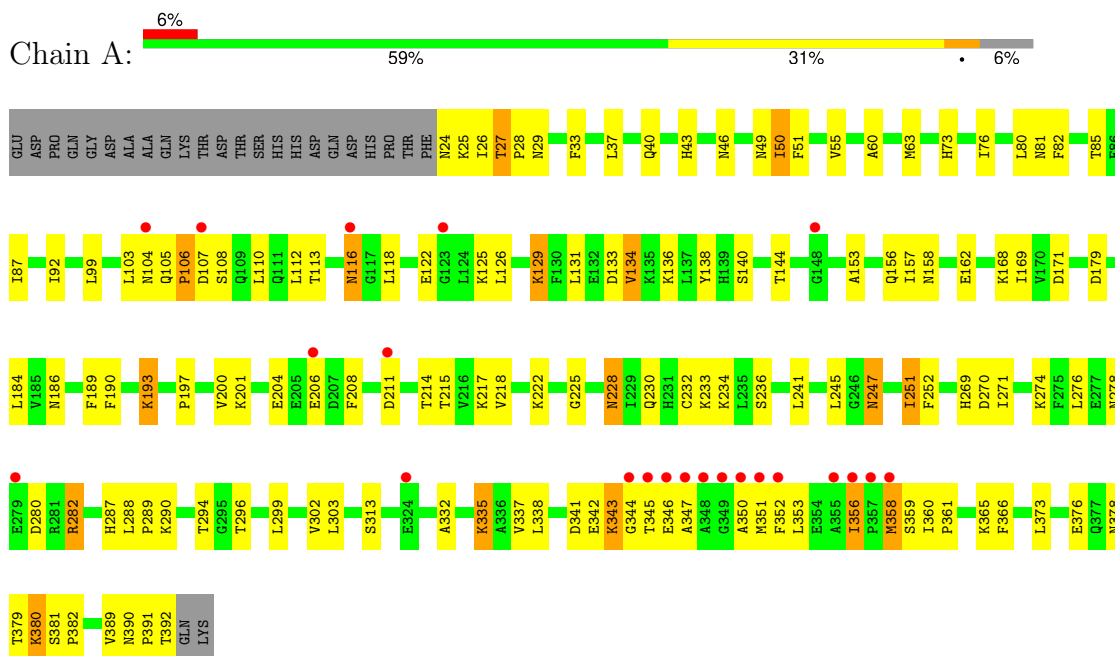
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	46	Total	O	0	0
			46	46		

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: Alpha-1-antitrypsin



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	113.37Å 39.39Å 90.15Å 90.00° 104.61° 90.00°	Depositor
Resolution (Å)	87.37 – 2.00 87.24 – 2.00	Depositor EDS
% Data completeness (in resolution range)	91.9 (87.37-2.00) 91.9 (87.24-2.00)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	0.14	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.85 (at 2.00Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.215 , 0.275 0.240 , 0.284	Depositor DCC
R_{free} test set	1225 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	28.5	Xtrriage
Anisotropy	0.105	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 43.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	2974	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.54% 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: CSD

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	0.72	0/2980	0.71	0/4028

There are no bond length outliers.

There are no bond angle outliers.

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	A	2928	0	2943	111	0
2	A	46	0	0	6	0
All	All	2974	0	2943	111	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 (111) 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:282:ARG:HH11	1:A:282:ARG:HG2	1.18	1.09
1:A:225:GLY:HA2	1:A:356:ILE:HD12	1.45	0.98

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:345:THR:HG22	1:A:346:GLU:H	1.31	0.95
1:A:345:THR:HG22	1:A:346:GLU:N	1.84	0.91
1:A:282:ARG:HH11	1:A:282:ARG:CG	1.90	0.83
1:A:73:HIS:HE1	2:A:436:HOH:O	1.62	0.81
1:A:118:LEU:HD23	1:A:184:LEU:HD13	1.63	0.81
1:A:37:LEU:HD11	1:A:302:VAL:HG11	1.63	0.80
1:A:345:THR:CG2	1:A:346:GLU:H	1.94	0.79
1:A:122:GLU:HB3	1:A:144:THR:HG23	1.65	0.79
1:A:37:LEU:HD11	1:A:302:VAL:CG1	2.12	0.79
1:A:352:PHE:CZ	2:A:438:HOH:O	2.36	0.78
1:A:87:ILE:HD13	1:A:92:ILE:HD13	1.63	0.78
1:A:49:ASN:ND2	1:A:389:VAL:H	1.81	0.78
1:A:60:ALA:HB2	1:A:116:ASN:OD1	1.84	0.78
1:A:60:ALA:CB	1:A:116:ASN:OD1	2.32	0.78
1:A:112:LEU:HD12	1:A:190:PHE:HD1	1.49	0.77
1:A:225:GLY:HA2	1:A:356:ILE:CD1	2.14	0.77
1:A:282:ARG:HG2	1:A:282:ARG:NH1	1.85	0.74
1:A:342:GLU:O	1:A:343:LYS:HB2	1.85	0.74
1:A:153:ALA:O	1:A:157:ILE:HG13	1.89	0.73
1:A:352:PHE:CE2	2:A:438:HOH:O	2.39	0.72
1:A:269:HIS:HD2	2:A:429:HOH:O	1.74	0.71
1:A:49:ASN:HD21	1:A:390:ASN:H	1.39	0.71
1:A:122:GLU:HB3	1:A:144:THR:CG2	2.20	0.70
1:A:87:ILE:HD13	1:A:92:ILE:CD1	2.22	0.69
1:A:252:PHE:HB3	1:A:366:PHE:CE2	2.28	0.69
1:A:105:GLN:CG	1:A:106:PRO:HD2	2.23	0.68
1:A:112:LEU:HD12	1:A:190:PHE:CD1	2.29	0.68
1:A:105:GLN:HG3	1:A:106:PRO:HD2	1.78	0.64
1:A:118:LEU:CD2	1:A:184:LEU:HD13	2.27	0.64
1:A:211:ASP:HB2	1:A:214:THR:HB	1.81	0.63
1:A:358:MET:N	1:A:358:MET:SD	2.72	0.62
1:A:122:GLU:CB	1:A:144:THR:HG23	2.29	0.62
1:A:87:ILE:CD1	1:A:92:ILE:HD13	2.31	0.61
1:A:278:ASN:ND2	1:A:280:ASP:H	1.98	0.61
1:A:99:LEU:HD11	1:A:381:SER:OG	2.00	0.61
1:A:197:PRO:HB3	1:A:343:LYS:CD	2.30	0.61
1:A:169:ILE:HG23	1:A:335:LYS:HE2	1.84	0.59
1:A:342:GLU:OE1	1:A:342:GLU:N	2.30	0.59
1:A:241:LEU:HG	1:A:251:ILE:HG23	1.83	0.59
1:A:379:THR:O	1:A:380:LYS:HB2	2.03	0.58
1:A:390:ASN:HD21	1:A:392:THR:HB	1.69	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:343:LYS:HG2	1:A:344:GLY:H	1.68	0.57
1:A:222:LYS:HD3	2:A:415:HOH:O	2.06	0.56
1:A:288:LEU:HD12	1:A:289:PRO:HD2	1.88	0.56
1:A:37:LEU:CD1	1:A:302:VAL:CG1	2.83	0.55
1:A:197:PRO:HB3	1:A:343:LYS:HD2	1.88	0.55
1:A:51:PHE:CZ	1:A:338:LEU:HB2	2.42	0.54
1:A:345:THR:CG2	1:A:346:GLU:N	2.53	0.54
1:A:46:ASN:HA	2:A:418:HOH:O	2.09	0.53
1:A:211:ASP:HB2	1:A:214:THR:CB	2.39	0.53
1:A:27:THR:HG22	1:A:28:PRO:HD3	1.90	0.52
1:A:105:GLN:HG2	1:A:106:PRO:HD2	1.91	0.52
1:A:252:PHE:HB3	1:A:366:PHE:HE2	1.74	0.52
1:A:129:LYS:HE3	1:A:133:ASP:OD2	2.10	0.51
1:A:184:LEU:O	1:A:332:ALA:HA	2.10	0.51
1:A:116:ASN:ND2	1:A:186:ASN:HB2	2.26	0.50
1:A:234:LYS:HE3	1:A:271:ILE:CD1	2.42	0.50
1:A:206:GLU:O	1:A:217:LYS:HA	2.12	0.50
1:A:63:MET:HG3	1:A:138:TYR:CB	2.42	0.49
1:A:218:VAL:HG11	1:A:391:PRO:HG2	1.93	0.49
1:A:76:ILE:O	1:A:80:LEU:HG	2.12	0.49
1:A:126:LEU:HD13	1:A:131:LEU:HD21	1.94	0.49
1:A:345:THR:HG22	1:A:347:ALA:H	1.77	0.49
1:A:112:LEU:CD1	1:A:190:PHE:CD1	2.96	0.49
1:A:82:PHE:CD1	1:A:92:ILE:HD12	2.48	0.48
1:A:116:ASN:HD21	1:A:186:ASN:HB2	1.78	0.48
1:A:87:ILE:HG23	1:A:92:ILE:HD11	1.96	0.47
1:A:228:ASN:C	1:A:228:ASN:HD22	2.17	0.47
1:A:179:ASP:OD2	1:A:179:ASP:N	2.48	0.47
1:A:247:ASN:OD1	1:A:247:ASN:N	2.47	0.47
1:A:24:ASN:OD1	1:A:25:LYS:N	2.49	0.46
1:A:169:ILE:HG23	1:A:335:LYS:CE	2.46	0.46
1:A:290:LYS:HD2	1:A:342:GLU:OE2	2.15	0.46
1:A:287:HIS:HB2	1:A:365:LYS:HA	1.96	0.46
1:A:252:PHE:HB2	1:A:366:PHE:CZ	2.51	0.46
1:A:208:PHE:CE1	1:A:391:PRO:HD3	2.51	0.45
1:A:278:ASN:HD21	1:A:280:ASP:H	1.63	0.45
1:A:33:PHE:HA	1:A:81:ASN:ND2	2.32	0.45
1:A:204:GLU:CD	1:A:222:LYS:HZ1	2.20	0.45
1:A:376:GLU:OE1	1:A:378:ASN:HB2	2.16	0.45
1:A:200:VAL:O	1:A:200:VAL:CG1	2.60	0.45
1:A:381:SER:HA	1:A:382:PRO:HD3	1.80	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:204:GLU:HG2	1:A:222:LYS:NZ	2.31	0.45
1:A:193:LYS:H	1:A:193:LYS:HG2	1.69	0.44
1:A:206:GLU:OE1	1:A:365:LYS:HE2	2.18	0.44
1:A:276:LEU:HD13	1:A:380:LYS:HE2	1.99	0.44
1:A:37:LEU:O	1:A:40:GLN:HB3	2.18	0.43
1:A:105:GLN:CG	1:A:106:PRO:CD	2.94	0.43
1:A:169:ILE:HG12	1:A:335:LYS:HE3	1.99	0.43
1:A:360:ILE:HA	1:A:361:PRO:HD3	1.87	0.43
1:A:27:THR:HG22	1:A:28:PRO:CD	2.48	0.43
1:A:294:THR:HG22	1:A:337:VAL:HG22	2.00	0.42
1:A:158:ASN:O	1:A:162:GLU:HB2	2.19	0.42
1:A:134:VAL:HG13	1:A:140:SER:HB2	2.01	0.42
1:A:168:LYS:HG2	1:A:189:PHE:CD1	2.55	0.41
1:A:379:THR:O	1:A:380:LYS:CB	2.66	0.41
1:A:55:VAL:HG13	1:A:99:LEU:CD2	2.51	0.41
1:A:204:GLU:OE1	1:A:222:LYS:NZ	2.52	0.41
1:A:299:LEU:O	1:A:303:LEU:HB2	2.20	0.41
1:A:252:PHE:CB	1:A:366:PHE:CZ	3.04	0.41
1:A:278:ASN:HD21	1:A:280:ASP:CB	2.34	0.41
1:A:50:ILE:N	1:A:50:ILE:CD1	2.83	0.41
1:A:296:THR:OG1	1:A:335:LYS:HD3	2.20	0.41
1:A:278:ASN:HD21	1:A:280:ASP:HB2	1.85	0.40
1:A:341:ASP:HB2	1:A:342:GLU:OE1	2.21	0.40
1:A:26:ILE:HA	1:A:29:ASN:HD22	1.86	0.40
1:A:342:GLU:H	1:A:342:GLU:CD	2.21	0.40
1:A:350:ALA:C	1:A:351:MET:HG2	2.41	0.40
1:A:63:MET:HG3	1:A:138:TYR:HB2	2.02	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	366/394 (93%)	345 (94%)	18 (5%)	3 (1%)	16 12

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	106	PRO
1	A	343	LYS
1	A	134	VAL

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	325/347 (94%)	288 (89%)	37 (11%)	4 3

All (37) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	27	THR
1	A	43	HIS
1	A	50	ILE
1	A	85	THR
1	A	103	LEU
1	A	104	ASN
1	A	107	ASP
1	A	108	SER
1	A	110	LEU
1	A	113	THR
1	A	116	ASN
1	A	125	LYS
1	A	129	LYS
1	A	136	LYS
1	A	156	GLN
1	A	171	ASP
1	A	193	LYS
1	A	201	LYS

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Mol	Chain	Res	Type
1	A	215	THR
1	A	228	ASN
1	A	230	GLN
1	A	233	LYS
1	A	236	SER
1	A	245	LEU
1	A	247	ASN
1	A	251	ILE
1	A	270	ASP
1	A	274	LYS
1	A	282	ARG
1	A	313	SER
1	A	335	LYS
1	A	353	LEU
1	A	356	ILE
1	A	358	MET
1	A	359	SER
1	A	373	LEU
1	A	380	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	29	ASN
1	A	44	GLN
1	A	49	ASN
1	A	73	HIS
1	A	81	ASN
1	A	104	ASN
1	A	228	ASN
1	A	230	GLN
1	A	269	HIS
1	A	278	ASN
1	A	378	ASN
1	A	390	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](#)

1 non-standard protein/DNA/RNA residue is 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	$\# Z > 2$
1	CSD	A	232	1	4,7,8	4.34	2 (50%)	1,8,10	0.37	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
1	CSD	A	232	1	-	1/2/6/8	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	232	CSD	OD1-SG	-8.34	1.40	1.47
1	A	232	CSD	CB-SG	-2.35	1.66	1.79

There are no bond angle outliers.

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	232	CSD	CA-CB-SG-OD1

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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

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	368/394 (93%)	0.21	22 (5%) 29 27	4, 15, 27, 51	0

All (22) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	351	MET	6.0
1	A	349	GLY	5.4
1	A	350	ALA	5.3
1	A	348	ALA	4.8
1	A	345	THR	3.7
1	A	347	ALA	3.3
1	A	355	ALA	3.2
1	A	344	GLY	3.0
1	A	116	ASN	2.9
1	A	356	ILE	2.7
1	A	352	PHE	2.7
1	A	279	GLU	2.7
1	A	358	MET	2.6
1	A	324	GLU	2.6
1	A	211	ASP	2.4
1	A	107	ASP	2.4
1	A	148	GLY	2.4
1	A	123	GLY	2.3
1	A	104	ASN	2.2
1	A	346	GLU	2.1
1	A	357	PRO	2.1
1	A	206	GLU	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
1	CSD	A	232	8/9	0.94	0.07	11,14,21,28	0

6.3 Carbohydrates [i](#)

There are no monosaccharides 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.