



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 03:18 AM UTC

PDB ID : 5T3E / pdb_00005t3e
Title : Crystal structure of a nonribosomal peptide synthetase heterocyclization domain.
Authors : Bloudoff, K.; Schmeing, T.M.
Deposited on : 2016-08-25
Resolution : 2.30 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
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

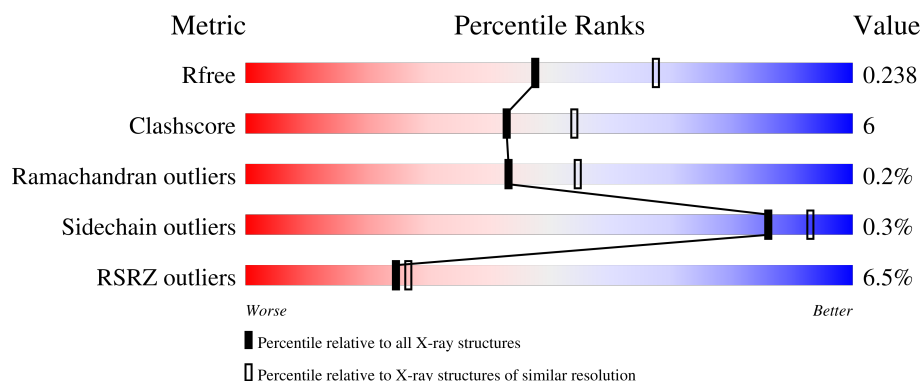
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	445	
1	B	445	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 7230 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.

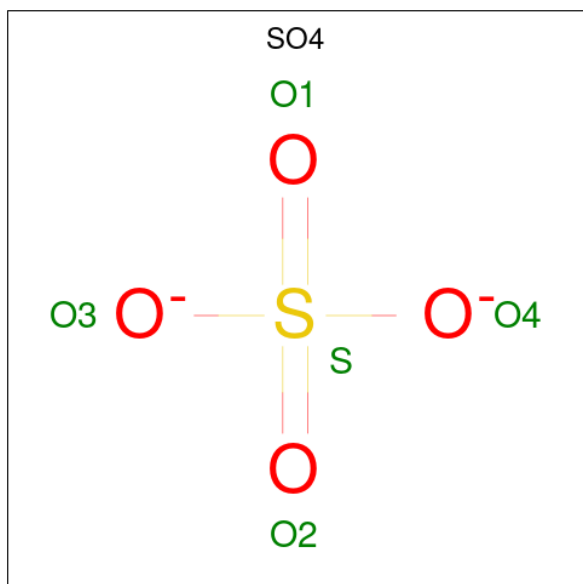
- Molecule 1 is a protein called Bacillamide synthetase heterocyclization domain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	432	Total	C	N	O	S	0	0	0
			3516	2262	579	657	18			
1	B	430	Total	C	N	O	S	0	0	0
			3487	2244	574	652	17			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	843	GLY	-	expression tag	UNP A0A0N0Y601
B	843	GLY	-	expression tag	UNP A0A0N0Y601

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	O S	0	0
			5	4 1		

Continued on next page...

Continued from previous page...

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	B	1	Total	O	S	0	0
			5	4	1		

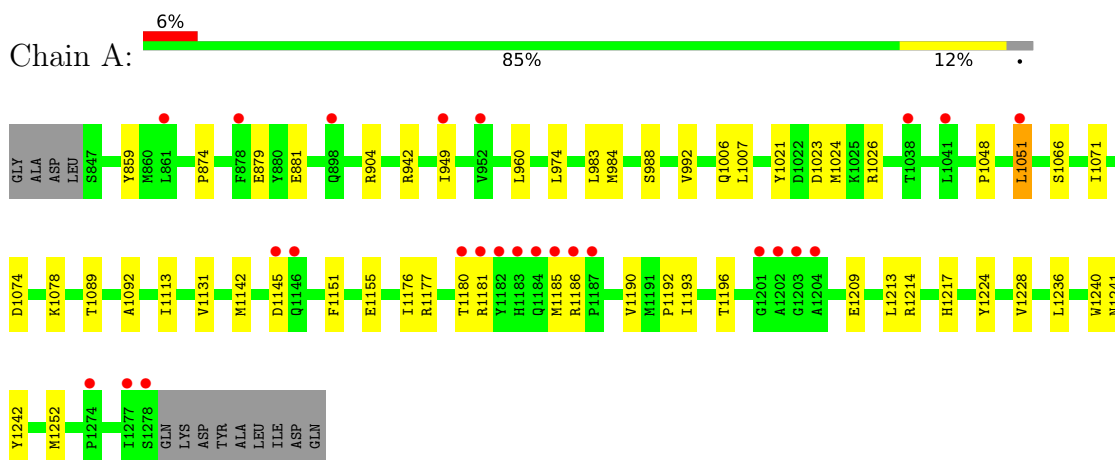
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	132	Total	O	0	0
			132	132		
3	B	85	Total	O	0	0
			85	85		

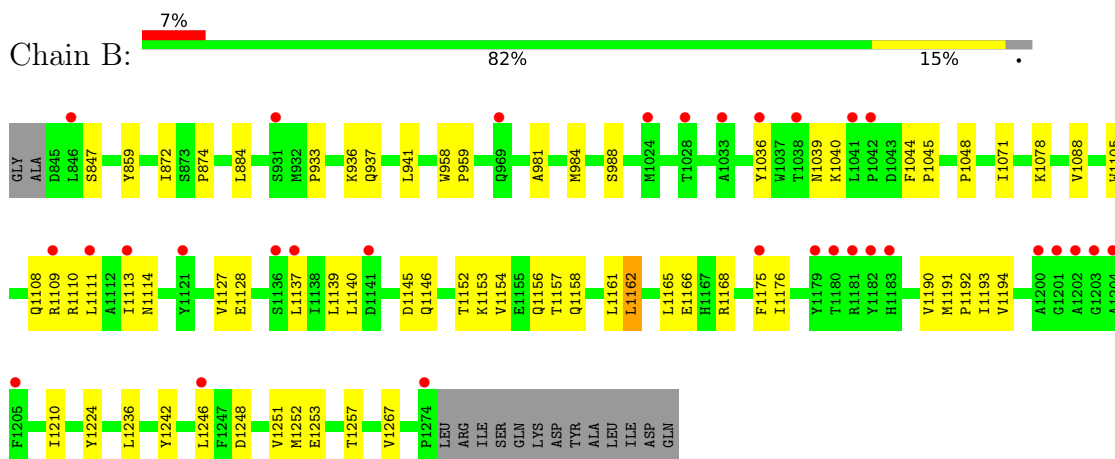
3 Residue-property plots [i](#)

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: Bacillamide synthetase heterocyclization domain



- Molecule 1: Bacillamide synthetase heterocyclization domain



4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	139.69Å 124.94Å 68.92Å 90.00° 95.66° 90.00°	Depositor
Resolution (Å)	39.89 – 2.30 39.89 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.3 (39.89-2.30) 93.9 (39.89-2.30)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.32 (at 2.29Å)	Xtriage
Refinement program	PHENIX (1.10.1_2155: ???)	Depositor
R, R_{free}	0.201 , 0.237 0.203 , 0.238	Depositor DCC
R_{free} test set	2623 reflections (0.42%)	wwPDB-VP
Wilson B-factor (Å ²)	48.7	Xtriage
Anisotropy	0.391	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 42.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7230	wwPDB-VP
Average B, all atoms (Å ²)	62.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.94% 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: SO4

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	0.18	0/3607	0.42	0/4905
1	B	0.21	0/3578	0.45	0/4869
All	All	0.20	0/7185	0.43	0/9774

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1185	MET	Peptide

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	3516	0	3421	37	0
1	B	3487	0	3379	48	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
3	A	132	0	0	3	0
3	B	85	0	0	0	0
All	All	7230	0	6800	85	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 6.

All (85) 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:1180:THR:HG22	1:A:1190:VAL:HG21	1.56	0.86
1:B:1109:ARG:HH12	1:B:1146:GLN:H	1.23	0.85
1:A:1006:GLN:NE2	1:A:1007:LEU:O	2.16	0.77
1:B:1048:PRO:HB3	1:B:1111:LEU:HD22	1.67	0.75
1:A:1089:THR:HG23	1:A:1092:ALA:H	1.55	0.72
1:B:1048:PRO:HG2	1:B:1193:ILE:HG13	1.74	0.70
1:A:1048:PRO:HG2	1:A:1193:ILE:HG13	1.73	0.69
1:B:1109:ARG:HH22	1:B:1146:GLN:HB2	1.58	0.69
1:A:1240:TRP:HE3	1:A:1252:MET:HE1	1.59	0.67
1:B:1114:ASN:OD1	1:B:1137:LEU:HD23	1.94	0.67
1:B:1162:LEU:O	1:B:1166:GLU:HG3	1.95	0.66
1:B:1040:LYS:O	1:B:1044:PHE:HB2	1.97	0.65
1:B:1139:LEU:HD11	1:B:1176:ILE:HG13	1.79	0.64
1:B:1248:ASP:HB3	1:B:1251:VAL:HG12	1.78	0.64
1:B:1045:PRO:HB3	1:B:1110:ARG:HB3	1.80	0.63
1:A:1074:ASP:OD1	1:A:1078:LYS:NZ	2.31	0.63
1:A:983:LEU:HD23	1:A:984:MET:HG2	1.81	0.62
1:B:1161:LEU:O	1:B:1165:LEU:HD22	2.00	0.60
1:B:1036:TYR:O	1:B:1039:ASN:OD1	2.21	0.57
1:B:1071:ILE:HB	1:B:1236:LEU:HB3	1.87	0.57
1:A:1021:TYR:HA	1:A:1024:MET:HE2	1.87	0.56
1:A:984:MET:HE3	1:A:1131:VAL:HG13	1.87	0.56
1:B:1156:GLN:H	1:B:1156:GLN:CD	2.13	0.56
1:B:1108:GLN:NE2	1:B:1110:ARG:O	2.39	0.54
1:A:859:TYR:CG	1:A:874:PRO:HG3	2.43	0.54
1:A:960:LEU:HB2	1:A:983:LEU:HD13	1.90	0.53
1:A:1023:ASP:OD2	1:A:1026:ARG:NH2	2.39	0.53
1:A:983:LEU:HD23	1:A:984:MET:CG	2.39	0.52

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:1158:GLN:O	1:B:1162:LEU:HD13	2.10	0.52
1:A:1051:LEU:HD23	1:A:1051:LEU:H	1.73	0.51
1:A:1176:ILE:O	1:A:1180:THR:HG23	2.11	0.51
1:B:1253:GLU:O	1:B:1257:THR:HG23	2.10	0.51
1:B:1192:PRO:HB2	1:B:1224:TYR:H	1.76	0.51
1:B:1152:THR:O	1:B:1156:GLN:NE2	2.44	0.51
1:A:879:GLU:HB3	1:A:974:LEU:HD11	1.94	0.50
1:B:1153:LYS:O	1:B:1157:THR:HG23	2.12	0.50
1:B:1190:VAL:HG12	1:B:1191:MET:HG2	1.93	0.50
1:B:884:LEU:HD11	1:B:1210:ILE:HA	1.92	0.49
1:B:874:PRO:HG2	1:B:981:ALA:HB3	1.94	0.49
1:A:904:ARG:NH2	3:A:1409:HOH:O	2.46	0.49
1:B:1109:ARG:NH1	1:B:1145:ASP:HA	2.28	0.49
1:B:1088:VAL:HG11	1:B:1154:VAL:HG12	1.95	0.48
1:B:984:MET:HB2	1:B:988:SER:HB2	1.95	0.48
1:A:942:ARG:NH1	3:A:1405:HOH:O	2.42	0.48
1:A:1192:PRO:HB2	1:A:1224:TYR:H	1.78	0.48
1:A:1242:TYR:CD1	1:A:1252:MET:HE2	2.48	0.48
1:B:1113:ILE:HB	1:B:1140:LEU:HB2	1.95	0.47
1:B:872:ILE:HD12	1:B:872:ILE:O	2.14	0.47
1:A:859:TYR:CD1	1:A:874:PRO:HG3	2.51	0.46
1:A:1113:ILE:HD12	1:A:1142:MET:SD	2.55	0.46
1:A:949:ILE:HD13	1:A:1217:HIS:CG	2.50	0.46
1:B:1109:ARG:HH12	1:B:1146:GLN:N	2.04	0.46
1:A:984:MET:HE1	1:A:992:VAL:CG2	2.46	0.45
1:B:1139:LEU:HD12	1:B:1175:PHE:CD2	2.52	0.45
1:A:1151:PHE:O	1:A:1155:GLU:HG3	2.17	0.44
1:A:1180:THR:OG1	1:A:1181:ARG:N	2.51	0.44
1:B:1105:TRP:CZ3	1:B:1251:VAL:HG23	2.51	0.44
1:B:847:SER:O	1:B:847:SER:OG	2.33	0.43
1:B:1127:VAL:HG13	1:B:1128:GLU:HG2	2.00	0.43
1:A:1023:ASP:HA	1:A:1026:ARG:NH2	2.33	0.43
1:B:1045:PRO:CB	1:B:1110:ARG:HB3	2.47	0.43
1:B:1153:LYS:HA	1:B:1156:GLN:OE1	2.18	0.43
1:A:879:GLU:O	1:A:1213:LEU:HD12	2.18	0.43
1:B:859:TYR:CD1	1:B:874:PRO:HG3	2.54	0.43
1:A:1071:ILE:HB	1:A:1236:LEU:HB3	2.01	0.42
1:A:1209:GLU:OE1	3:A:1401:HOH:O	2.21	0.42
1:B:937:GLN:O	1:B:941:LEU:HG	2.19	0.42
1:B:1165:LEU:HA	1:B:1168:ARG:HG3	2.01	0.42
1:B:933:PRO:HG2	1:B:936:LYS:HD3	2.02	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:1078:LYS:HD2	1:B:1267:VAL:HG13	2.02	0.42
1:A:1066:SER:OG	1:A:1241:ASN:OD1	2.36	0.42
1:A:1196:THR:HB	1:A:1228:VAL:HG22	2.01	0.41
1:B:1039:ASN:OD1	1:B:1040:LYS:HG2	2.21	0.41
1:B:1114:ASN:HB3	1:B:1194:VAL:HG22	2.02	0.41
1:A:960:LEU:HB2	1:A:983:LEU:CD1	2.50	0.41
1:B:859:TYR:CG	1:B:874:PRO:HG3	2.56	0.41
1:A:881:GLU:OE1	1:A:1214:ARG:NH1	2.53	0.41
1:B:958:TRP:CE2	1:B:959:PRO:HB3	2.56	0.41
1:B:1165:LEU:O	1:B:1168:ARG:HD3	2.20	0.41
1:B:1242:TYR:CD1	1:B:1252:MET:HG2	2.55	0.41
1:A:984:MET:HE2	1:A:988:SER:C	2.46	0.41
1:A:1177:ARG:HA	1:A:1180:THR:HG23	2.03	0.40
1:A:984:MET:HE1	1:A:992:VAL:HG21	2.04	0.40
1:B:1156:GLN:CD	1:B:1156:GLN:N	2.80	0.40
1:B:1246:LEU:HD12	1:B:1246:LEU:HA	1.97	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	430/445 (97%)	419 (97%)	9 (2%)	2 (0%)	24	31
1	B	428/445 (96%)	418 (98%)	10 (2%)	0	100	100
All	All	858/890 (96%)	837 (98%)	19 (2%)	2 (0%)	43	55

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	1186	ARG
1	A	1145	ASP

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	384/400 (96%)	383 (100%)	1 (0%)	86	93
1	B	379/400 (95%)	378 (100%)	1 (0%)	86	93
All	All	763/800 (95%)	761 (100%)	2 (0%)	86	93

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1051	LEU
1	B	1162	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	898	GLN
1	A	1039	ASN
1	A	1119	ASN
1	A	1129	GLN
1	A	1215	HIS
1	A	1222	GLN
1	B	898	GLN
1	B	971	HIS
1	B	990	ASN
1	B	994	GLN
1	B	1063	ASN
1	B	1169	HIS
1	B	1273	ASN

5.3.3 RNA ⓘ

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](#)

2 ligands 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	SO4	B	1301	-	4,4,4	0.24	0	6,6,6	0.07	0
2	SO4	A	1301	-	4,4,4	0.24	0	6,6,6	0.07	0

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	432/445 (97%)	0.36	25 (5%) 29 31	35, 55, 84, 100	0
1	B	430/445 (96%)	0.59	31 (7%) 21 23	43, 64, 96, 117	0
All	All	862/890 (96%)	0.47	56 (6%) 25 27	35, 59, 93, 117	0

All (56) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1202	ALA	4.0
1	B	1041	LEU	3.8
1	A	1203	GLY	3.6
1	A	1187	PRO	3.6
1	B	1204	ALA	3.5
1	A	1278	SER	3.4
1	B	1203	GLY	3.4
1	A	1145	ASP	3.3
1	B	1202	ALA	3.2
1	B	1274	PRO	3.2
1	A	1182	TYR	3.0
1	A	952	VAL	3.0
1	B	1200	ALA	2.9
1	A	1201	GLY	2.9
1	A	1185	MET	2.9
1	B	1113	ILE	2.9
1	A	1038	THR	2.8
1	B	1038	THR	2.8
1	A	1277	ILE	2.8
1	A	1204	ALA	2.8
1	B	1175	PHE	2.8
1	B	1033	ALA	2.7
1	B	1205	PHE	2.7
1	A	1180	THR	2.7

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	1111	LEU	2.7
1	A	1184	GLN	2.6
1	B	1042	PRO	2.6
1	B	846	LEU	2.6
1	B	1201	GLY	2.6
1	B	1181	ARG	2.5
1	A	1051	LEU	2.5
1	A	1186	ARG	2.5
1	B	1180	THR	2.4
1	A	1041	LEU	2.4
1	A	1146	GLN	2.4
1	B	1182	TYR	2.3
1	B	1179	TYR	2.3
1	B	1036	TYR	2.3
1	B	1024	MET	2.3
1	A	949	ILE	2.3
1	A	898	GLN	2.2
1	B	1121	TYR	2.2
1	B	1136	SER	2.2
1	A	878	PHE	2.2
1	A	1183	HIS	2.2
1	B	969	GLN	2.2
1	B	931	SER	2.2
1	B	1141	ASP	2.1
1	B	1028	THR	2.1
1	A	861	LEU	2.1
1	B	1246	LEU	2.1
1	B	1137	LEU	2.1
1	A	1274	PRO	2.1
1	A	1181	ARG	2.0
1	B	1183	HIS	2.0
1	B	1109	ARG	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](#)

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($\text{\AA}^2$)	Q<0.9
2	SO4	A	1301	5/5	0.92	0.07	68,70,86,94	0
2	SO4	B	1301	5/5	0.92	0.07	78,83,90,102	0

6.5 Other polymers [i](#)

There are no such residues in this entry.