



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 08:04 AM UTC

PDB ID : 5B87 / pdb_00005b87
Title : Crystal structure of a Cysteine Desulfurase from *Thermococcus onnurineus* NA1 in complex with alanine at 2.3 Angstrom resolution
Authors : Ho, T.-H.; Kang, L.-W.
Deposited on : 2016-06-13
Resolution : 2.28 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

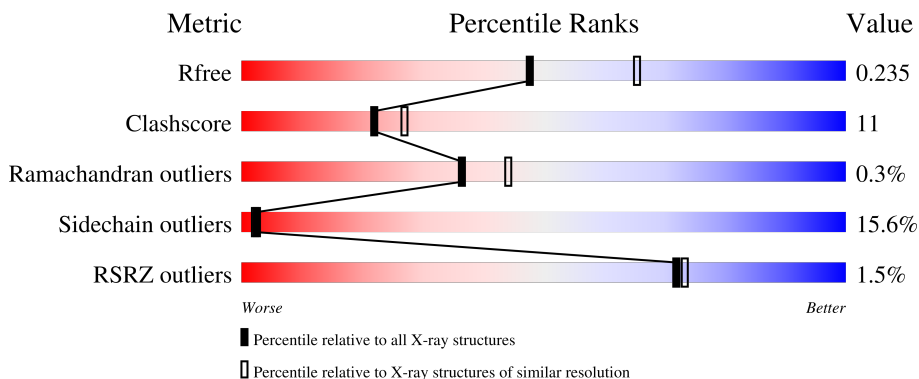
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.28 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	9078 (2.30-2.26)
Clashscore	190562	9802 (2.30-2.26)
Ramachandran outliers	187476	9690 (2.30-2.26)
Sidechain outliers	187428	9691 (2.30-2.26)
RSRZ outliers	180081	9085 (2.30-2.26)

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	419	
1	B	419	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	ALA	B	401	-	X	-	-

2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 6397 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 Cysteine desulfurase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	397	Total 3088	C 1967	N 535	O 577	S 9	0	0	0
1	B	401	Total 3130	C 1995	N 542	O 582	S 11	0	0	0

There are 40 discrepancies between the modelled and reference sequences:

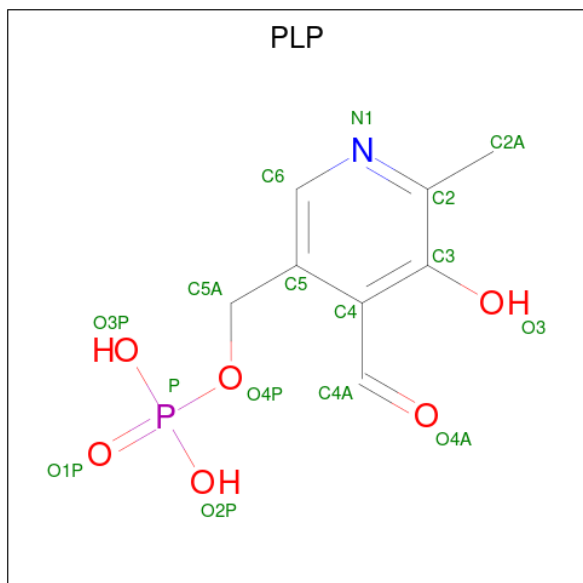
Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	expression tag	UNP B6YT87
A	-18	HIS	-	expression tag	UNP B6YT87
A	-17	HIS	-	expression tag	UNP B6YT87
A	-16	HIS	-	expression tag	UNP B6YT87
A	-15	HIS	-	expression tag	UNP B6YT87
A	-14	HIS	-	expression tag	UNP B6YT87
A	-13	HIS	-	expression tag	UNP B6YT87
A	-12	SER	-	expression tag	UNP B6YT87
A	-11	SER	-	expression tag	UNP B6YT87
A	-10	GLU	-	expression tag	UNP B6YT87
A	-9	ASN	-	expression tag	UNP B6YT87
A	-8	LEU	-	expression tag	UNP B6YT87
A	-7	TYR	-	expression tag	UNP B6YT87
A	-6	PHE	-	expression tag	UNP B6YT87
A	-5	GLN	-	expression tag	UNP B6YT87
A	-4	GLY	-	expression tag	UNP B6YT87
A	-3	HIS	-	expression tag	UNP B6YT87
A	-2	MET	-	expression tag	UNP B6YT87
A	-1	ALA	-	expression tag	UNP B6YT87
A	0	SER	-	expression tag	UNP B6YT87
B	-19	MET	-	expression tag	UNP B6YT87
B	-18	HIS	-	expression tag	UNP B6YT87
B	-17	HIS	-	expression tag	UNP B6YT87
B	-16	HIS	-	expression tag	UNP B6YT87
B	-15	HIS	-	expression tag	UNP B6YT87

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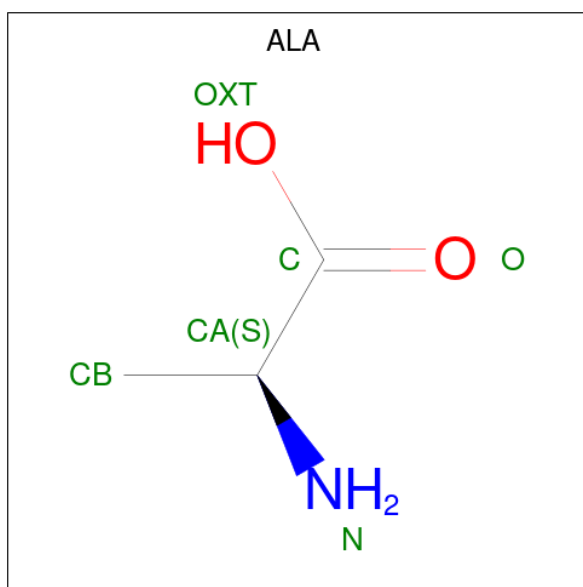
Chain	Residue	Modelled	Actual	Comment	Reference
B	-14	HIS	-	expression tag	UNP B6YT87
B	-13	HIS	-	expression tag	UNP B6YT87
B	-12	SER	-	expression tag	UNP B6YT87
B	-11	SER	-	expression tag	UNP B6YT87
B	-10	GLU	-	expression tag	UNP B6YT87
B	-9	ASN	-	expression tag	UNP B6YT87
B	-8	LEU	-	expression tag	UNP B6YT87
B	-7	TYR	-	expression tag	UNP B6YT87
B	-6	PHE	-	expression tag	UNP B6YT87
B	-5	GLN	-	expression tag	UNP B6YT87
B	-4	GLY	-	expression tag	UNP B6YT87
B	-3	HIS	-	expression tag	UNP B6YT87
B	-2	MET	-	expression tag	UNP B6YT87
B	-1	ALA	-	expression tag	UNP B6YT87
B	0	SER	-	expression tag	UNP B6YT87

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (CCD ID: PLP) (formula: C₈H₁₀NO₆P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	15	8	1	5	1	0	0
2	B	1	15	8	1	5	1	0	0

- Molecule 3 is ALANINE (CCD ID: ALA) (formula: C₃H₇NO₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			6	3	1	2		
3	B	1	Total	C	N	O	0	0
			6	3	1	2		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	68	Total	O	0	0
			68	68		
4	B	69	Total	O	0	0
			69	69		

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	67.28Å 93.81Å 145.53Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.40 – 2.28 49.40 – 2.28	Depositor EDS
% Data completeness (in resolution range)	95.9 (49.40-2.28) 95.9 (49.40-2.28)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.50 (at 2.29Å)	Xtrriage
Refinement program	REFMAC 5.8.0135	Depositor
R, R_{free}	0.183 , 0.232 0.194 , 0.235	Depositor DCC
R_{free} test set	2040 reflections (4.79%)	wwPDB-VP
Wilson B-factor (Å ²)	38.3	Xtrriage
Anisotropy	0.099	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 30.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	6397	wwPDB-VP
Average B, all atoms (Å ²)	42.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.22% 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: CSS, PLP

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	1.45	14/3147 (0.4%)	1.31	30/4257 (0.7%)
1	B	1.39	13/3189 (0.4%)	1.26	21/4308 (0.5%)
All	All	1.42	27/6336 (0.4%)	1.28	51/8565 (0.6%)

The worst 5 of 27 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	353	GLY	C-O	-8.27	1.18	1.24
1	A	28	THR	C-O	-6.64	1.17	1.24
1	B	110	THR	C-N	6.45	1.38	1.33
1	B	53	ARG	C-O	-6.18	1.16	1.24
1	A	110	THR	C-N	6.12	1.38	1.33

The worst 5 of 51 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	140	GLU	N-CA-C	9.42	125.23	112.90
1	B	247	ILE	N-CA-C	9.16	123.27	108.99
1	A	247	ILE	N-CA-C	8.62	121.20	108.96
1	B	113	GLU	N-CA-C	8.52	121.32	110.24
1	A	374	PHE	N-CA-C	8.42	122.69	109.81

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	3088	0	3067	94	0
1	B	3130	0	3140	45	0
2	A	15	0	7	1	0
2	B	15	0	7	1	0
3	A	6	0	4	1	0
3	B	6	0	4	1	0
4	A	68	0	0	6	0
4	B	69	0	0	0	0
All	All	6397	0	6229	134	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 11.

The worst 5 of 134 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:47:VAL:HG12	1:A:48:HIS:H	1.33	0.92
1:A:28:THR:HG22	4:A:521:HOH:O	1.70	0.92
1:A:140:GLU:O	1:A:316:GLY:HA2	1.70	0.92
1:A:178:LYS:HE2	1:A:206:HIS:HE1	1.36	0.90
1:A:157:LEU:HD12	1:A:186:ILE:HD11	1.55	0.86

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	394/419 (94%)	384 (98%)	9 (2%)	1 (0%)	36 44
1	B	398/419 (95%)	387 (97%)	10 (2%)	1 (0%)	36 44

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	792/838 (94%)	771 (97%)	19 (2%)	2 (0%)	36	44

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	47	VAL
1	B	47	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	326/350 (93%)	277 (85%)	49 (15%)	3	2
1	B	333/350 (95%)	279 (84%)	54 (16%)	2	2
All	All	659/700 (94%)	556 (84%)	103 (16%)	2	2

5 of 103 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	54	LEU
1	B	135	ILE
1	B	389	VAL
1	B	78	GLU
1	B	106	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 21 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	142	ASN
1	B	295	GLN
1	B	375	HIS
1	B	323	HIS
1	B	206	HIS

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
1	CSS	B	356	1	4,6,7	1.37	1 (25%)	2,6,8	0.67	0
1	CSS	A	356	1	4,6,7	1.07	0	2,6,8	1.79	1 (50%)

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	CSS	B	356	1	-	0/1/5/7	-
1	CSS	A	356	1	-	0/1/5/7	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	356	CSS	CB-SG	-2.15	1.74	1.81

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	356	CSS	CB-CA-C	2.52	117.64	110.80

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	356	CSS	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

4 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
3	ALA	A	401	2	5,5,5	3.35	2 (40%)	6,6,6	1.56	2 (33%)
2	PLP	B	400	1,3	15,15,16	1.69	1 (6%)	21,22,23	1.66	4 (19%)
2	PLP	A	400	1,3	15,15,16	2.03	5 (33%)	21,22,23	2.13	8 (38%)
3	ALA	B	401	2	5,5,5	3.14	1 (20%)	6,6,6	1.72	2 (33%)

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
3	ALA	A	401	2	-	0/4/4/4	-
2	PLP	B	400	1,3	-	0/6/6/8	0/1/1/1
2	PLP	A	400	1,3	-	0/6/6/8	0/1/1/1
3	ALA	B	401	2	-	3/4/4/4	-

The worst 5 of 9 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	401	ALA	OXT-C	-6.86	1.08	1.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	401	ALA	O-C	5.79	1.39	1.22
2	B	400	PLP	C5-C4	-5.56	1.34	1.40
2	A	400	PLP	C4A-C4	4.49	1.60	1.51
3	A	401	ALA	OXT-C	-4.33	1.16	1.30

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	400	PLP	C4A-C4-C5	4.54	125.62	120.94
2	A	400	PLP	O3-C3-C2	4.41	126.73	117.58
2	A	400	PLP	O3P-P-O4P	3.59	116.02	106.67
2	A	400	PLP	C4A-C4-C5	3.50	124.55	120.94
2	A	400	PLP	C4A-C4-C3	-2.77	115.90	120.52

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	401	ALA	OXT-C-CA-CB
3	B	401	ALA	O-C-CA-CB
3	B	401	ALA	OXT-C-CA-N

There are no ring outliers.

4 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	401	ALA	1	0
2	B	400	PLP	1	0
2	A	400	PLP	1	0
3	B	401	ALA	1	0

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	396/419 (94%)	0.15	6 (1%) 72 73	25, 41, 67, 108	0
1	B	400/419 (95%)	0.02	6 (1%) 72 73	23, 39, 63, 101	0
All	All	796/838 (94%)	0.08	12 (1%) 72 73	23, 40, 66, 108	0

The worst 5 of 12 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	397	LEU	6.0
1	A	48	HIS	3.9
1	B	48	HIS	3.9
1	A	252	LEU	3.8
1	A	398	LYS	3.1

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	CSS	B	356	7/8	0.88	0.12	36,46,54,55	0
1	CSS	A	356	7/8	0.92	0.11	35,35,40,40	0

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
3	ALA	B	401	6/6	0.90	0.15	51,56,58,63	0
3	ALA	A	401	6/6	0.93	0.10	39,47,49,52	0
2	PLP	A	400	15/16	0.97	0.06	24,29,44,44	0
2	PLP	B	400	15/16	0.98	0.06	24,30,37,44	0

6.5 Other polymers [i](#)

There are no such residues in this entry.