



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 02:29 PM UTC

PDB ID : 2WFD / pdb_00002wfd
Title : Structure of the human cytosolic leucyl-tRNA synthetase editing domain
Authors : Seiradake, E.; Mao, W.; Hernandez, V.; Baker, S.J.; Plattner, J.J.; Alley, M.R.K.; Cusack, S.
Deposited on : 2009-04-03
Resolution : 3.25 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

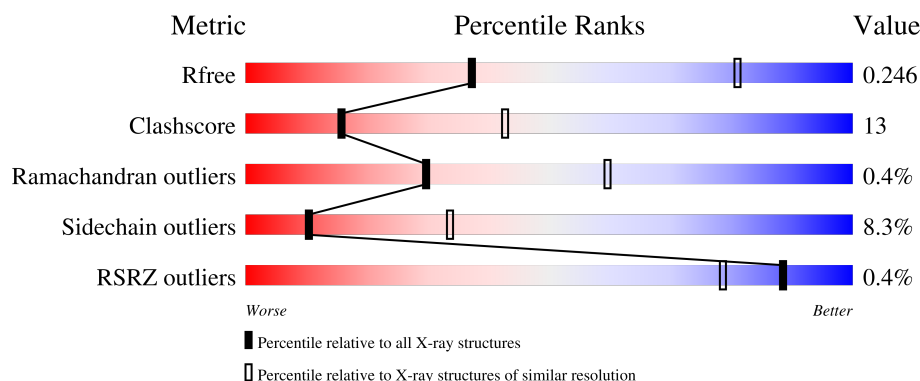
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.25 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	1605 (3.30-3.22)
Clashscore	190562	1660 (3.30-3.22)
Ramachandran outliers	187476	1630 (3.30-3.22)
Sidechain outliers	187428	1629 (3.30-3.22)
RSRZ outliers	180081	1605 (3.30-3.22)

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	252	 69% 27% .
1	B	252	 69% 27% .

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 3922 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.

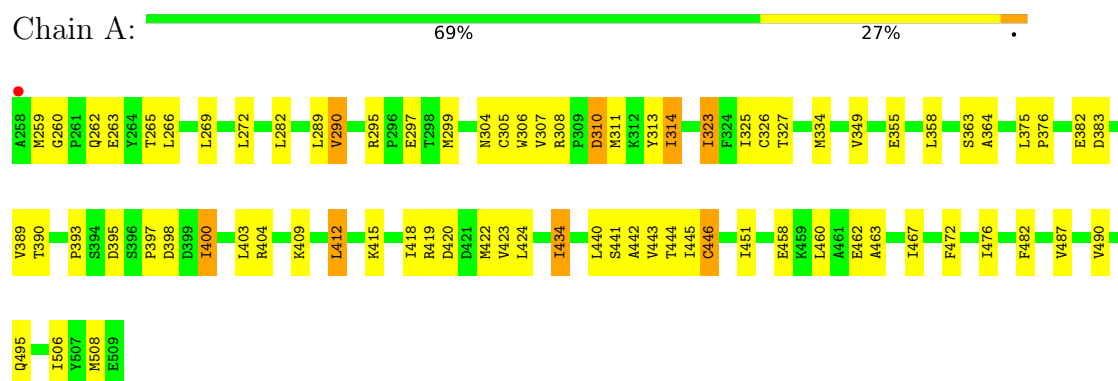
- Molecule 1 is a protein called LEUCYL-TRNA SYNTHETASE, CYTOPLASMIC.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	252	Total	C	N	O	S	Se	0	0	0
			1961	1262	318	368	3	10			
1	B	252	Total	C	N	O	S	Se	0	0	0
			1961	1262	318	368	3	10			

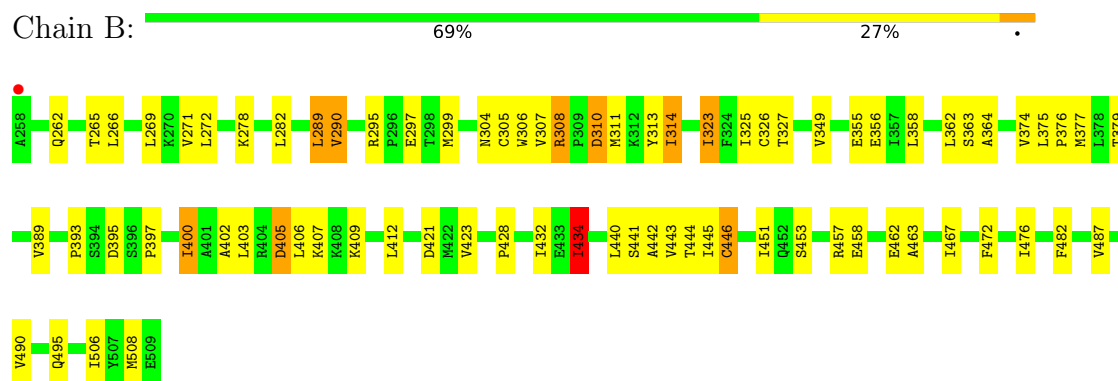
3 Residue-property plots

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: LEUCYL-TRNA SYNTHETASE, CYTOPLASMIC



• Molecule 1: LEUCYL-TRNA SYNTHETASE, CYTOPLASMIC



4 Data and refinement statistics

Property	Value	Source
Space group	P 65	Depositor
Cell constants a, b, c, α , β , γ	94.54Å 94.54Å 148.82Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	29.24 – 3.25 29.24 – 3.25	Depositor EDS
% Data completeness (in resolution range)	100.0 (29.24-3.25) 99.2 (29.24-3.25)	Depositor EDS
R_{merge}	0.15	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	104.84 (at 3.00Å)	Xtriage
Refinement program	REFMAC 5.5.0070	Depositor
R, R_{free}	0.202 , 0.240 0.207 , 0.246	Depositor DCC
R_{free} test set	769 reflections (5.12%)	wwPDB-VP
Wilson B-factor (Å ²)	51.3	Xtriage
Anisotropy	0.150	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 29.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.40$, $\langle L^2 \rangle = 0.23$	Xtriage
Estimated twinning fraction	0.113 for h,-h-k,-l	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	3922	wwPDB-VP
Average B, all atoms (Å ²)	59.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.97% 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	0.61	0/1985	0.89	2/2658 (0.1%)
1	B	0.60	0/1985	0.91	5/2658 (0.2%)
All	All	0.60	0/3970	0.90	7/5316 (0.1%)

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	434	ILE	CA-C-N	5.49	126.71	119.84
1	A	434	ILE	C-N-CA	5.49	126.71	119.84
1	B	308	ARG	CA-C-N	5.46	125.54	119.32
1	B	308	ARG	C-N-CA	5.46	125.54	119.32
1	B	434	ILE	CA-C-N	5.42	126.61	119.84
1	B	434	ILE	C-N-CA	5.42	126.61	119.84
1	B	289	LEU	N-CA-C	-5.11	103.29	110.50

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	1961	0	2035	56	0
1	B	1961	0	2035	60	0
All	All	3922	0	4070	106	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 13.

All (106) 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:400:ILE:HG21	1:B:443:VAL:HG22	1.58	0.86
1:B:375:LEU:HD23	1:B:406:LEU:HD12	1.60	0.83
1:A:400:ILE:HG21	1:A:443:VAL:HG22	1.62	0.79
1:B:375:LEU:HD23	1:B:406:LEU:CD1	2.12	0.79
1:A:440:LEU:O	1:A:444:THR:HG23	1.83	0.78
1:B:440:LEU:O	1:B:444:THR:HG23	1.82	0.78
1:A:375:LEU:HD21	1:A:423:VAL:HG22	1.74	0.70
1:B:403:LEU:HD21	1:B:407:LYS:HE3	1.76	0.68
1:B:308:ARG:HH11	1:B:311:MSE:HE3	1.62	0.65
1:A:262:GLN:CD	1:B:262:GLN:CD	2.66	0.64
1:A:472:PHE:CE2	1:B:508:MSE:HE3	2.33	0.63
1:A:262:GLN:HB2	1:B:262:GLN:HE22	1.65	0.62
1:B:265:THR:OG1	1:B:495:GLN:NE2	2.33	0.61
1:A:308:ARG:HH11	1:A:311:MSE:HE3	1.65	0.61
1:B:375:LEU:HD21	1:B:423:VAL:HG22	1.83	0.61
1:A:260:GLY:O	1:B:295:ARG:HD2	2.01	0.60
1:B:282:LEU:HD21	1:B:349:VAL:HG11	1.85	0.59
1:B:269:LEU:HD22	1:B:364:ALA:CB	2.33	0.58
1:B:297:GLU:HG3	1:B:487:VAL:HG13	1.86	0.58
1:B:304:ASN:HB2	1:B:375:LEU:HD13	1.86	0.58
1:A:304:ASN:HB2	1:A:375:LEU:HD13	1.85	0.57
1:B:393:PRO:HB2	1:B:400:ILE:HG23	1.87	0.57
1:A:297:GLU:HG3	1:A:487:VAL:HG13	1.86	0.57
1:B:272:LEU:HD11	1:B:363:SER:HB3	1.85	0.56
1:A:395:ASP:C	1:A:442:ALA:HB2	2.30	0.55
1:B:506:ILE:HG21	1:B:508:MSE:HE2	1.88	0.55
1:A:446:CYS:HB3	1:A:451:ILE:HD12	1.88	0.55
1:A:472:PHE:CZ	1:B:508:MSE:HE3	2.41	0.55
1:A:313:TYR:O	1:A:314:ILE:HD12	2.07	0.54
1:B:313:TYR:O	1:B:314:ILE:HD12	2.07	0.54
1:A:282:LEU:HD22	1:A:323:ILE:HD13	1.90	0.54
1:A:376:PRO:HD3	1:A:418:ILE:CD1	2.38	0.53
1:A:272:LEU:HD11	1:A:363:SER:HB3	1.91	0.53
1:A:282:LEU:HD21	1:A:349:VAL:HG11	1.90	0.53
1:A:393:PRO:HB2	1:A:400:ILE:HG23	1.90	0.53
1:B:395:ASP:C	1:B:442:ALA:HB2	2.34	0.53
1:B:403:LEU:C	1:B:403:LEU:HD23	2.34	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:265:THR:OG1	1:A:495:GLN:NE2	2.41	0.53
1:B:376:PRO:HD2	1:B:406:LEU:HD11	1.90	0.52
1:A:397:PRO:HA	1:A:400:ILE:HD11	1.93	0.51
1:B:506:ILE:CG2	1:B:508:MSE:HE2	2.40	0.51
1:A:269:LEU:HD22	1:A:364:ALA:CB	2.41	0.50
1:B:400:ILE:HD11	1:B:442:ALA:HB1	1.93	0.50
1:A:506:ILE:HG21	1:A:508:MSE:HE2	1.93	0.50
1:B:289:LEU:HD23	1:B:325:ILE:HD12	1.92	0.50
1:B:397:PRO:HA	1:B:400:ILE:HD11	1.94	0.49
1:B:446:CYS:HB3	1:B:451:ILE:HD12	1.95	0.48
1:A:445:ILE:HD12	1:A:463:ALA:HB1	1.95	0.48
1:A:400:ILE:HD11	1:A:442:ALA:HB1	1.94	0.48
1:B:445:ILE:HD12	1:B:463:ALA:HB1	1.95	0.48
1:A:419:ARG:NH2	1:A:422:MSE:HE3	2.29	0.48
1:B:393:PRO:O	1:B:400:ILE:HD12	2.13	0.48
1:A:262:GLN:CD	1:B:262:GLN:NE2	2.71	0.47
1:A:420:ASP:HB3	1:A:424:LEU:HD12	1.97	0.47
1:A:299:MSE:HE1	1:A:390:THR:HG21	1.97	0.47
1:B:374:VAL:C	1:B:375:LEU:HD12	2.40	0.47
1:A:259:MSE:HE3	1:B:299:MSE:HE1	1.97	0.47
1:B:282:LEU:HD22	1:B:323:ILE:HD13	1.96	0.46
1:B:282:LEU:HD21	1:B:349:VAL:CG1	2.45	0.46
1:B:445:ILE:CD1	1:B:463:ALA:HB1	2.45	0.46
1:A:295:ARG:NE	1:A:297:GLU:OE2	2.47	0.46
1:A:306:TRP:HB2	1:A:389:VAL:HB	1.97	0.46
1:A:266:LEU:HG	1:A:290:VAL:HG22	1.97	0.46
1:A:355:GLU:HA	1:A:358:LEU:HD12	1.97	0.46
1:B:400:ILE:H	1:B:400:ILE:HD13	1.80	0.46
1:A:310:ASP:OD2	1:A:310:ASP:N	2.47	0.46
1:B:290:VAL:HG12	1:B:326:CYS:HB3	1.98	0.46
1:B:405:ASP:OD1	1:B:453:SER:HA	2.17	0.45
1:B:266:LEU:HG	1:B:290:VAL:HG22	1.98	0.45
1:A:282:LEU:HD22	1:A:323:ILE:CD1	2.47	0.45
1:A:445:ILE:CD1	1:A:463:ALA:HB1	2.46	0.45
1:B:306:TRP:HB2	1:B:389:VAL:HB	1.99	0.45
1:A:412:LEU:HD22	1:A:415:LYS:NZ	2.32	0.45
1:B:295:ARG:NE	1:B:297:GLU:OE2	2.48	0.45
1:B:310:ASP:OD2	1:B:310:ASP:N	2.50	0.45
1:A:289:LEU:HD23	1:A:325:ILE:HD12	1.97	0.45
1:A:290:VAL:HG12	1:A:326:CYS:HB3	1.99	0.44
1:B:377:MSE:HE2	1:B:402:ALA:HB2	1.98	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:412:LEU:HD23	1:A:412:LEU:N	2.33	0.44
1:A:508:MSE:HE3	1:B:472:PHE:CZ	2.53	0.43
1:A:290:VAL:HG11	1:A:334:MSE:HE1	2.00	0.43
1:A:400:ILE:HD13	1:A:400:ILE:H	1.82	0.43
1:A:266:LEU:CD2	1:A:334:MSE:HE2	2.49	0.43
1:A:409:LYS:HB3	1:A:412:LEU:HG	2.00	0.43
1:B:432:ILE:HG22	1:B:434:ILE:CG2	2.49	0.43
1:A:398:ASP:OD1	1:A:460:LEU:HD13	2.18	0.43
1:A:506:ILE:CG2	1:A:508:MSE:HE2	2.49	0.42
1:B:428:PRO:HB2	1:B:440:LEU:HD22	2.01	0.42
1:A:282:LEU:HD21	1:A:349:VAL:CG1	2.49	0.42
1:A:393:PRO:O	1:A:400:ILE:HD12	2.19	0.42
1:B:403:LEU:HD23	1:B:403:LEU:O	2.19	0.42
1:A:262:GLN:CG	1:B:262:GLN:NE2	2.83	0.41
1:B:355:GLU:HA	1:B:358:LEU:HD12	2.02	0.41
1:B:379:THR:HG21	1:B:457:ARG:HH21	1.86	0.41
1:A:263:GLU:HA	1:A:508:MSE:SE	2.71	0.41
1:B:363:SER:O	1:B:363:SER:OG	2.39	0.41
1:A:419:ARG:CZ	1:A:422:MSE:HE3	2.51	0.41
1:B:289:LEU:HD23	1:B:325:ILE:HB	2.02	0.41
1:B:269:LEU:HD22	1:B:364:ALA:HB2	2.00	0.40
1:B:271:VAL:HA	1:B:362:LEU:HD23	2.02	0.40
1:B:409:LYS:HD3	1:B:412:LEU:HD12	2.02	0.40
1:A:262:GLN:NE2	1:B:262:GLN:CG	2.84	0.40
1:A:403:LEU:O	1:A:404:ARG:C	2.65	0.40
1:A:311:MSE:HE2	1:A:382:GLU:HB3	2.03	0.40
1:B:278:LYS:HG3	1:B:356:GLU:HB3	2.03	0.40
1:B:282:LEU:HD13	1:B:323:ILE:HD11	2.04	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	250/252 (99%)	231 (92%)	18 (7%)	1 (0%)	30	59
1	B	250/252 (99%)	228 (91%)	21 (8%)	1 (0%)	30	59
All	All	500/504 (99%)	459 (92%)	39 (8%)	2 (0%)	30	59

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	421	ASP
1	A	383	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	216/206 (105%)	198 (92%)	18 (8%)	10	34
1	B	216/206 (105%)	198 (92%)	18 (8%)	10	34
All	All	432/412 (105%)	396 (92%)	36 (8%)	10	34

All (36) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	290	VAL
1	A	305	CYS
1	A	307	VAL
1	A	310	ASP
1	A	314	ILE
1	A	323	ILE
1	A	327	THR
1	A	400	ILE
1	A	412	LEU
1	A	434	ILE
1	A	441	SER
1	A	446	CYS
1	A	458	GLU
1	A	462	GLU

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Mol	Chain	Res	Type
1	A	467	ILE
1	A	476	ILE
1	A	482	PHE
1	A	490	VAL
1	B	290	VAL
1	B	305	CYS
1	B	307	VAL
1	B	310	ASP
1	B	314	ILE
1	B	323	ILE
1	B	327	THR
1	B	400	ILE
1	B	405	ASP
1	B	434	ILE
1	B	441	SER
1	B	446	CYS
1	B	458	GLU
1	B	462	GLU
1	B	467	ILE
1	B	476	ILE
1	B	482	PHE
1	B	490	VAL

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	262	GLN
1	A	302	GLN
1	A	343	ASN
1	A	452	GLN
1	A	488	GLN
1	A	495	GLN
1	B	262	GLN
1	B	302	GLN
1	B	343	ASN
1	B	452	GLN
1	B	488	GLN
1	B	495	GLN

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 [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 [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	242/252 (96%)	-0.22	1 (0%) 88 78	34, 53, 80, 100	0
1	B	242/252 (96%)	-0.09	1 (0%) 88 78	30, 59, 102, 117	0
All	All	484/504 (96%)	-0.15	2 (0%) 88 78	30, 55, 94, 117	0

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	258	ALA	3.5
1	B	258	ALA	3.4

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.