



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 17, 2026 – 06:37 PM UTC

PDB ID : 3D0C / pdb_00003d0c
Title : Crystal structure of dihydrodipicolinate synthase from *Oceanobacillus iheyensis* at 1.9 Å resolution
Authors : Satyanarayana, L.; Eswaramoorthy, S.; Sauder, J.M.; Burley, S.K.; Swaminathan, S.; New York SGX Research Center for Structural Genomics (NYS-GXRC)
Deposited on : 2008-05-01
Resolution : 1.90 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

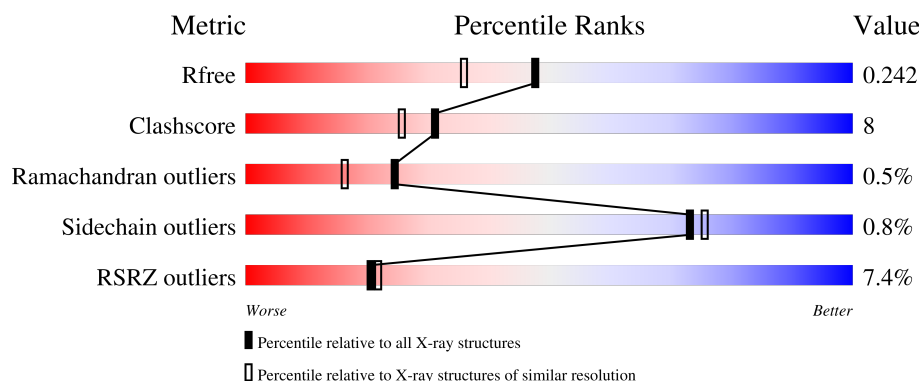
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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	314	5% 78% 18% ••
1	B	314	9% 72% 22% ••

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5147 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 Dihydrodipicolinate synthase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	302	Total	C	N	O	S	Se	0	0	0
			2361	1508	392	456	2	3			
1	B	300	Total	C	N	O	S	Se	0	0	0
			2344	1497	390	452	2	3			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	MSE	-	expression tag	UNP Q8EMJ7
A	0	SER	-	expression tag	UNP Q8EMJ7
A	1	LEU	-	expression tag	UNP Q8EMJ7
A	178	MSE	ILE	engineered mutation	UNP Q8EMJ7
A	305	GLU	-	expression tag	UNP Q8EMJ7
A	306	GLY	-	expression tag	UNP Q8EMJ7
A	307	HIS	-	expression tag	UNP Q8EMJ7
A	308	HIS	-	expression tag	UNP Q8EMJ7
A	309	HIS	-	expression tag	UNP Q8EMJ7
A	310	HIS	-	expression tag	UNP Q8EMJ7
A	311	HIS	-	expression tag	UNP Q8EMJ7
A	312	HIS	-	expression tag	UNP Q8EMJ7
B	-1	MSE	-	expression tag	UNP Q8EMJ7
B	0	SER	-	expression tag	UNP Q8EMJ7
B	1	LEU	-	expression tag	UNP Q8EMJ7
B	178	MSE	ILE	engineered mutation	UNP Q8EMJ7
B	305	GLU	-	expression tag	UNP Q8EMJ7
B	306	GLY	-	expression tag	UNP Q8EMJ7
B	307	HIS	-	expression tag	UNP Q8EMJ7
B	308	HIS	-	expression tag	UNP Q8EMJ7
B	309	HIS	-	expression tag	UNP Q8EMJ7
B	310	HIS	-	expression tag	UNP Q8EMJ7
B	311	HIS	-	expression tag	UNP Q8EMJ7
B	312	HIS	-	expression tag	UNP Q8EMJ7

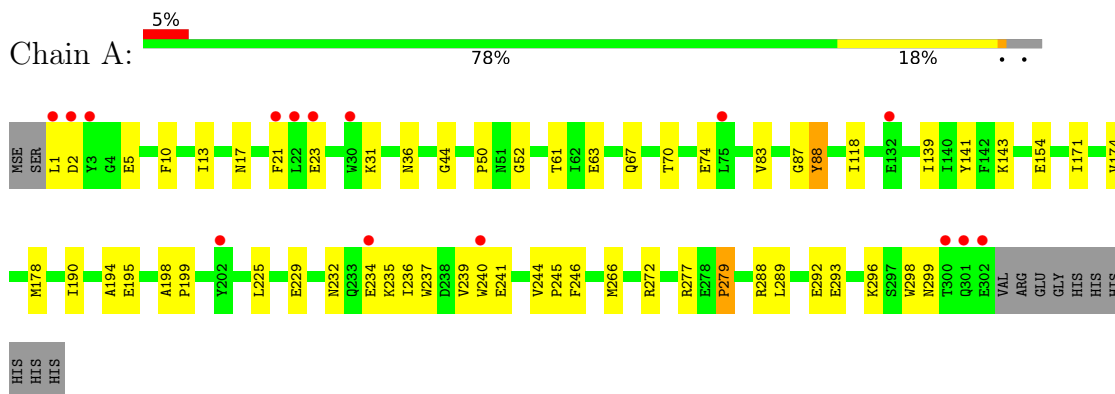
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	240	Total 240	O 240	0	0
2	B	202	Total 202	O 202	0	0

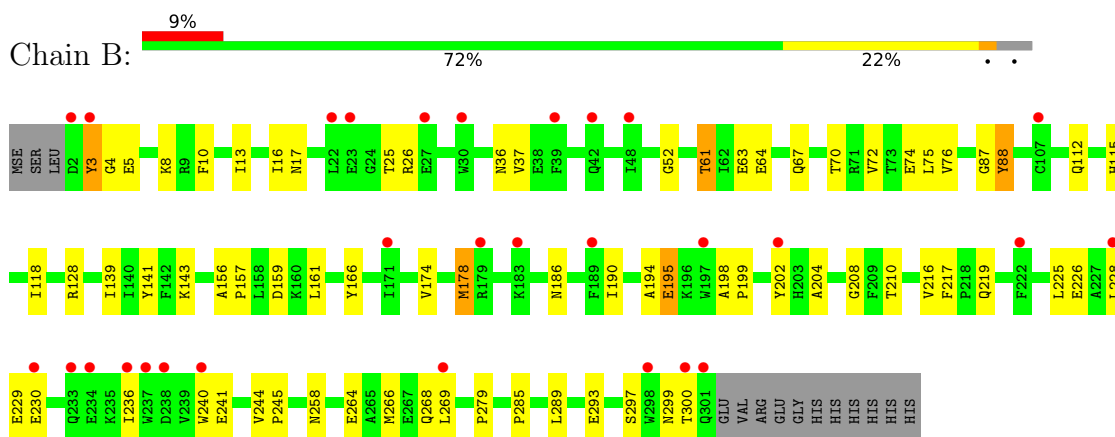
3 Residue-property plots [i](#)

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: Dihydrodipicolinate synthase



• Molecule 1: Dihydrodipicolinate synthase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	157.04Å 57.06Å 71.46Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 1.90 50.00 – 1.90	Depositor EDS
% Data completeness (in resolution range)	93.9 (50.00-1.90) 94.0 (50.00-1.90)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.32 (at 1.90Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.218 , 0.243 0.217 , 0.242	Depositor DCC
R_{free} test set	1946 reflections (3.89%)	wwPDB-VP
Wilson B-factor (Å ²)	21.9	Xtriage
Anisotropy	0.506	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 32.0	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	0.94	EDS
Total number of atoms	5147	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.04% 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	0.40	0/2407	0.87	5/3270 (0.2%)
1	B	0.40	0/2390	0.84	6/3247 (0.2%)
All	All	0.40	0/4797	0.86	11/6517 (0.2%)

There are no bond length outliers.

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	195	GLU	N-CA-C	6.77	119.52	111.33
1	B	258	ASN	N-CA-C	6.60	119.03	111.11
1	A	195	GLU	N-CA-C	6.35	119.01	111.33
1	A	52	GLY	N-CA-C	-6.34	101.67	112.51
1	B	52	GLY	N-CA-C	-6.18	103.14	112.60
1	A	61	THR	N-CA-C	-6.09	102.67	110.53
1	B	3	TYR	N-CA-C	5.59	117.06	110.97
1	B	61	THR	N-CA-C	-5.56	103.36	110.53
1	A	194	ALA	N-CA-C	5.37	122.24	110.80
1	B	299	ASN	N-CA-C	-5.25	105.45	111.07
1	A	44	GLY	N-CA-C	5.22	121.71	114.92

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	2361	0	2329	37	0
1	B	2344	0	2309	42	0
2	A	240	0	0	1	0
2	B	202	0	0	4	0
All	All	5147	0	4638	77	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 8.

All (77) 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:174:VAL:HG22	1:A:178:MSE:HE2	1.64	0.78
1:B:141:TYR:CE2	1:B:143:LYS:HD2	2.22	0.73
1:A:141:TYR:CE2	1:A:143:LYS:HD2	2.23	0.73
1:A:237:TRP:O	1:A:241:GLU:HG3	1.90	0.71
1:A:118:ILE:HG13	1:B:279:PRO:HB2	1.78	0.65
1:B:16:ILE:HD11	1:B:210:THR:HB	1.81	0.62
1:B:17:ASN:HB2	1:B:36:ASN:ND2	2.15	0.60
1:A:235:LYS:HE2	1:A:239:VAL:CG2	2.32	0.59
1:A:17:ASN:HB2	1:A:36:ASN:ND2	2.18	0.58
1:B:10:PHE:HB3	1:B:190:ILE:HD11	1.83	0.58
1:B:178:MSE:HE3	1:B:204:ALA:C	2.29	0.57
1:A:289:LEU:O	1:A:293:GLU:HG3	2.05	0.57
1:A:240:TRP:O	1:A:244:VAL:HG23	2.06	0.56
1:A:171:ILE:HA	1:A:174:VAL:HG12	1.88	0.55
1:B:228:LEU:HD23	1:B:236:ILE:HD13	1.89	0.54
1:A:266:MSE:HE3	2:A:346:HOH:O	2.08	0.53
1:B:10:PHE:CZ	1:B:139:ILE:HD11	2.43	0.53
1:A:1:LEU:C	1:A:1:LEU:HD23	2.33	0.53
1:B:115:HIS:H	1:B:115:HIS:CD2	2.26	0.53
1:A:10:PHE:CZ	1:A:139:ILE:HD11	2.43	0.53
1:A:234:GLU:CD	1:A:234:GLU:H	2.17	0.53
1:B:217:PHE:CZ	1:B:269:LEU:HD11	2.44	0.53
1:A:2:ASP:OD1	1:A:5:GLU:HB2	2.08	0.52
1:A:31:LYS:HB3	1:A:272:ARG:NH1	2.24	0.52
1:A:246:PHE:HB2	1:A:298:TRP:HH2	1.75	0.52
1:B:112:GLN:OE1	1:B:143:LYS:HD3	2.11	0.51
1:A:50:PRO:HD2	1:A:83:VAL:O	2.11	0.50
1:B:25:THR:O	1:B:26:ARG:HB2	2.11	0.50
1:B:4:GLY:HA2	1:B:186:ASN:HB3	1.93	0.50
1:A:234:GLU:CD	1:A:234:GLU:N	2.70	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:226:GLU:O	1:B:230:GLU:HG3	2.11	0.49
1:B:63:GLU:O	1:B:67:GLN:HG3	2.13	0.49
1:A:279:PRO:HB2	1:B:118:ILE:HG13	1.94	0.49
1:A:288:ARG:O	1:A:292:GLU:HG3	2.12	0.48
1:B:70:THR:O	1:B:74:GLU:HG3	2.13	0.48
1:B:37:VAL:HB	1:B:75:LEU:HD23	1.95	0.48
1:B:225:LEU:O	1:B:229:GLU:HG3	2.13	0.48
1:A:225:LEU:O	1:A:229:GLU:HG3	2.13	0.47
1:B:240:TRP:O	1:B:244:VAL:HG23	2.14	0.47
1:B:87:GLY:O	1:B:88:TYR:HB2	2.14	0.47
1:B:166:TYR:CD2	1:B:174:VAL:HG22	2.50	0.47
1:A:10:PHE:HB3	1:A:190:ILE:HD11	1.97	0.47
1:B:13:ILE:HG13	1:B:225:LEU:HD22	1.97	0.47
1:A:237:TRP:HA	1:A:237:TRP:CE3	2.50	0.46
1:B:198:ALA:HB3	1:B:199:PRO:HD3	1.97	0.46
1:B:194:ALA:HB1	1:B:195:GLU:OE1	2.15	0.46
1:B:264:GLU:O	1:B:268:GLN:HG3	2.14	0.46
1:A:70:THR:O	1:A:74:GLU:HG3	2.14	0.46
1:B:128:ARG:HD2	2:B:487:HOH:O	2.15	0.46
1:B:297:SER:O	1:B:300:THR:HB	2.15	0.46
1:A:246:PHE:HB2	1:A:298:TRP:CH2	2.51	0.45
1:B:156:ALA:HB3	1:B:157:PRO:HD3	1.97	0.45
1:A:13:ILE:HG13	1:A:225:LEU:HD22	1.98	0.45
1:B:72:VAL:O	1:B:76:VAL:HG23	2.17	0.45
1:B:61:THR:OG1	1:B:64:GLU:HG3	2.16	0.45
1:B:156:ALA:HA	1:B:161:LEU:HD23	1.98	0.45
1:B:244:VAL:N	1:B:245:PRO:CD	2.80	0.45
1:B:3:TYR:CD2	1:B:159:ASP:HB3	2.52	0.45
1:A:63:GLU:O	1:A:67:GLN:HG3	2.17	0.44
1:B:241:GLU:HG3	2:B:431:HOH:O	2.16	0.44
1:A:10:PHE:CE1	1:A:139:ILE:HD11	2.53	0.44
1:B:216:VAL:HG13	1:B:217:PHE:N	2.33	0.44
1:B:219:GLN:HB2	2:B:460:HOH:O	2.17	0.44
1:A:299:ASN:C	1:A:299:ASN:HD22	2.24	0.44
1:A:237:TRP:HA	1:A:237:TRP:HE3	1.83	0.43
1:A:244:VAL:N	1:A:245:PRO:CD	2.81	0.43
1:A:198:ALA:HB3	1:A:199:PRO:HD3	2.01	0.43
1:B:5:GLU:OE1	1:B:8:LYS:HE3	2.19	0.43
1:B:178:MSE:HE3	1:B:204:ALA:O	2.19	0.43
1:A:232:ASN:O	1:A:236:ILE:HG13	2.18	0.42
1:A:87:GLY:O	1:A:88:TYR:HB2	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:21:PHE:CD2	1:A:277:ARG:HG3	2.55	0.42
1:B:266:MSE:HE3	2:B:338:HOH:O	2.20	0.42
1:B:202:TYR:OH	1:B:208:GLY:HA2	2.20	0.41
1:B:285:PRO:O	1:B:289:LEU:HG	2.20	0.41
1:A:171:ILE:HD12	1:A:174:VAL:HG11	2.02	0.41
1:A:296:LYS:HD2	1:A:296:LYS:HA	1.83	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	300/314 (96%)	290 (97%)	8 (3%)	2 (1%)	18	10
1	B	298/314 (95%)	289 (97%)	8 (3%)	1 (0%)	36	29
All	All	598/628 (95%)	579 (97%)	16 (3%)	3 (0%)	24	16

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	23	GLU
1	B	88	TYR
1	A	88	TYR

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	254/261 (97%)	252 (99%)	2 (1%)	73	75
1	B	252/261 (97%)	250 (99%)	2 (1%)	73	75
All	All	506/522 (97%)	502 (99%)	4 (1%)	73	75

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	154	GLU
1	A	279	PRO
1	B	178	MSE
1	B	293	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	36	ASN
1	A	42	GLN
1	A	67	GLN
1	A	233	GLN
1	A	286	ASN
1	A	299	ASN
1	A	301	GLN
1	B	36	ASN
1	B	67	GLN
1	B	115	HIS
1	B	146	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

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	299/314 (95%)	0.42	15 (5%) 34 36	14, 24, 38, 57	0
1	B	297/314 (94%)	0.68	29 (9%) 13 13	16, 28, 43, 55	0
All	All	596/628 (94%)	0.55	44 (7%) 20 22	14, 26, 42, 57	0

All (44) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	301	GLN	5.7
1	A	301	GLN	5.5
1	A	23	GLU	4.5
1	A	30	TRP	4.2
1	B	30	TRP	4.2
1	B	240	TRP	4.0
1	A	3	TYR	4.0
1	B	300	THR	3.6
1	B	202	TYR	3.4
1	A	302	GLU	3.3
1	A	2	ASP	3.2
1	B	2	ASP	3.2
1	A	300	THR	3.1
1	A	1	LEU	3.0
1	B	237	TRP	2.9
1	A	240	TRP	2.8
1	A	21	PHE	2.8
1	B	189	PHE	2.7
1	B	236	ILE	2.7
1	B	197	TRP	2.7
1	B	3	TYR	2.7
1	B	22	LEU	2.6
1	B	171	ILE	2.6
1	A	22	LEU	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	269	LEU	2.5
1	B	222	PHE	2.5
1	B	230	GLU	2.5
1	B	233	GLN	2.5
1	B	42	GLN	2.4
1	B	298	TRP	2.4
1	B	48	ILE	2.4
1	B	107	CYS	2.4
1	B	228	LEU	2.3
1	B	183	LYS	2.3
1	B	27	GLU	2.3
1	A	75	LEU	2.3
1	B	23	GLU	2.2
1	B	238	ASP	2.2
1	B	179	ARG	2.2
1	A	202	TYR	2.2
1	A	132	GLU	2.2
1	B	234	GLU	2.1
1	A	234	GLU	2.1
1	B	39	PHE	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.