



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 04:01 AM UTC

PDB ID : 3E96 / pdb_00003e96
Title : Crystal structure of dihydrodipicolinate synthase from bacillus clausii
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Deposited on : 2008-08-21
Resolution : 1.80 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
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

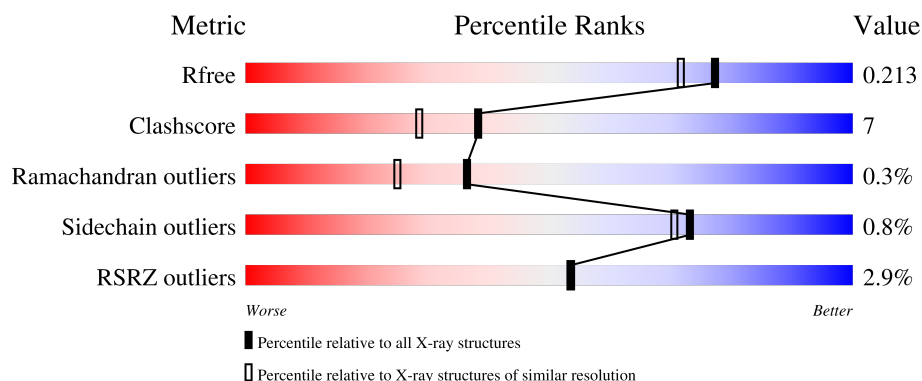
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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	316	
1	B	316	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5136 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	296	Total	C	N	O	S	0	0	0
			2325	1491	395	432	7			
1	B	300	Total	C	N	O	S	0	0	0
			2358	1512	401	438	7			

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	expression tag	UNP Q5WDL1
A	2	SER	-	expression tag	UNP Q5WDL1
A	3	LEU	-	expression tag	UNP Q5WDL1
A	309	GLU	-	expression tag	UNP Q5WDL1
A	310	GLY	-	expression tag	UNP Q5WDL1
A	311	HIS	-	expression tag	UNP Q5WDL1
A	312	HIS	-	expression tag	UNP Q5WDL1
A	313	HIS	-	expression tag	UNP Q5WDL1
A	314	HIS	-	expression tag	UNP Q5WDL1
A	315	HIS	-	expression tag	UNP Q5WDL1
A	316	HIS	-	expression tag	UNP Q5WDL1
B	1	MET	-	expression tag	UNP Q5WDL1
B	2	SER	-	expression tag	UNP Q5WDL1
B	3	LEU	-	expression tag	UNP Q5WDL1
B	309	GLU	-	expression tag	UNP Q5WDL1
B	310	GLY	-	expression tag	UNP Q5WDL1
B	311	HIS	-	expression tag	UNP Q5WDL1
B	312	HIS	-	expression tag	UNP Q5WDL1
B	313	HIS	-	expression tag	UNP Q5WDL1
B	314	HIS	-	expression tag	UNP Q5WDL1
B	315	HIS	-	expression tag	UNP Q5WDL1
B	316	HIS	-	expression tag	UNP Q5WDL1

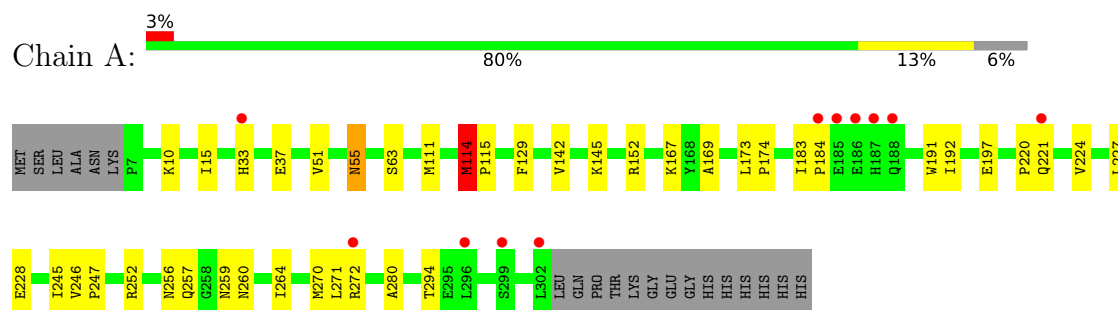
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	217	Total 217	O 217	0	0
2	B	236	Total 236	O 236	0	0

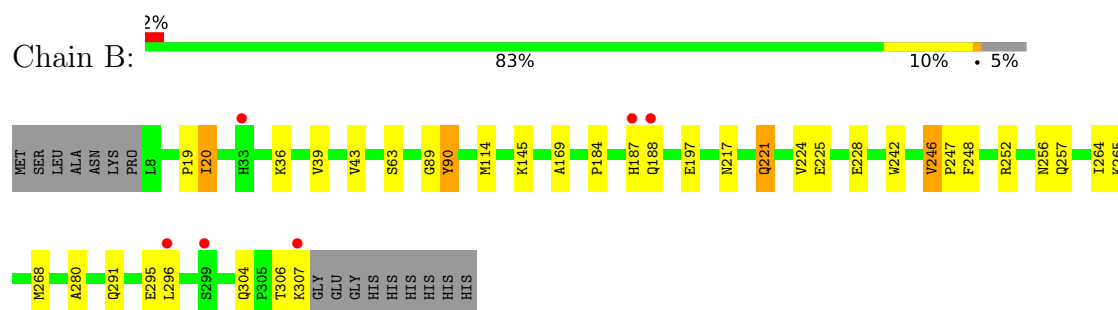
3 Residue-property plots

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: 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	98.77Å 80.94Å 93.17Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	24.69 – 1.80 24.69 – 1.80	Depositor EDS
% Data completeness (in resolution range)	96.9 (24.69-1.80) 97.0 (24.69-1.80)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.16 (at 1.81Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.193 , 0.213 0.193 , 0.213	Depositor DCC
R_{free} test set	3426 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	17.6	Xtriage
Anisotropy	0.551	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 46.7	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	0.95	EDS
Total number of atoms	5136	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.55% 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	0.41	1/2380 (0.0%)	0.88	6/3241 (0.2%)
1	B	0.37	0/2413	0.88	6/3286 (0.2%)
All	All	0.39	1/4793 (0.0%)	0.88	12/6527 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	114	MET	CG-SD	-8.22	1.60	1.80

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	197	GLU	N-CA-C	7.19	120.03	111.33
1	A	197	GLU	N-CA-C	6.51	120.08	111.75
1	A	280	ALA	N-CA-C	-6.46	100.86	109.84
1	B	280	ALA	N-CA-C	-6.39	100.96	109.84
1	A	245	ILE	N-CA-C	6.18	118.14	111.58
1	A	63	SER	N-CA-C	-6.08	102.51	110.53
1	A	260	ASN	N-CA-C	5.93	118.22	111.11
1	B	63	SER	N-CA-C	-5.67	103.22	110.53
1	B	114	MET	N-CA-C	-5.58	102.74	109.83
1	A	114	MET	CA-CB-CG	-5.55	103.01	114.10
1	B	246	VAL	CB-CA-C	-5.51	108.46	113.70
1	B	20	ILE	CB-CA-C	-5.14	105.94	111.59

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	2325	0	2308	33	0
1	B	2358	0	2346	31	0
2	A	217	0	0	3	0
2	B	236	0	0	3	0
All	All	5136	0	4654	64	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 7.

All (64) 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:114:MET:HG2	1:A:115:PRO:HD2	1.20	1.15
1:B:264:ILE:HG22	1:B:268:MET:HE2	1.29	1.11
1:B:265:LYS:HA	1:B:268:MET:HE3	1.53	0.90
1:B:20:ILE:HD13	1:B:268:MET:HE1	1.55	0.86
1:B:221:GLN:O	1:B:225:GLU:HG3	1.86	0.76
1:A:114:MET:CG	1:A:115:PRO:HD2	2.08	0.75
1:B:221:GLN:NE2	1:B:221:GLN:H	1.87	0.72
1:B:221:GLN:H	1:B:221:GLN:HE21	1.37	0.72
1:B:291:GLN:O	1:B:295:GLU:HG3	1.90	0.70
1:A:111:MET:HE2	1:A:167:LYS:HZ1	1.56	0.70
1:B:304:GLN:HG2	2:B:506:HOH:O	1.91	0.70
1:A:114:MET:HG2	1:A:115:PRO:CD	2.12	0.69
1:A:111:MET:HE2	1:A:167:LYS:NZ	2.09	0.68
1:A:114:MET:HG3	1:A:129:PHE:HZ	1.58	0.68
1:B:248:PHE:HA	1:B:296:LEU:HD21	1.75	0.67
1:B:265:LYS:HA	1:B:268:MET:CE	2.24	0.67
1:B:19:PRO:HA	1:B:217:ASN:HD21	1.61	0.65
1:B:264:ILE:HG22	1:B:268:MET:CE	2.18	0.65
1:B:247:PRO:HB2	1:B:296:LEU:HD11	1.79	0.63
1:A:55:ASN:HB2	2:A:455:HOH:O	1.99	0.61
1:A:51:VAL:HG11	1:A:111:MET:HE3	1.81	0.61
1:A:183:ILE:HD12	1:A:191:TRP:HZ2	1.67	0.60
1:A:270:MET:HE1	1:A:294:THR:HA	1.86	0.58
1:A:221:GLN:H	1:A:221:GLN:CD	2.12	0.57
1:B:248:PHE:CA	1:B:296:LEU:HD21	2.36	0.56
1:A:51:VAL:HG11	1:A:111:MET:CE	2.36	0.56
1:A:129:PHE:CE1	1:A:142:VAL:HG23	2.41	0.56

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:224:VAL:O	1:B:228:GLU:HG3	2.06	0.55
1:B:242:TRP:O	1:B:246:VAL:HG23	2.06	0.55
1:A:246:VAL:CG1	1:A:247:PRO:HD3	2.37	0.54
1:B:256:ASN:O	1:B:257:GLN:HB2	2.09	0.53
1:A:246:VAL:HG12	1:A:247:PRO:HD3	1.91	0.52
1:A:129:PHE:CZ	1:A:142:VAL:HG23	2.45	0.52
1:B:252:ARG:CZ	1:B:264:ILE:HD11	2.40	0.52
1:A:152:ARG:HH11	1:A:152:ARG:HG2	1.75	0.51
1:B:20:ILE:HD13	1:B:268:MET:CE	2.34	0.50
1:A:252:ARG:CZ	1:A:264:ILE:HD11	2.42	0.49
1:A:167:LYS:HD3	1:A:192:ILE:HB	1.92	0.49
1:B:39:VAL:O	1:B:43:VAL:HG22	2.12	0.49
1:A:247:PRO:HD2	2:A:532:HOH:O	2.12	0.49
1:A:145:LYS:HB3	1:A:169:ALA:HB3	1.95	0.48
1:B:306:THR:O	1:B:307:LYS:HG3	2.13	0.48
1:A:271:LEU:O	1:A:272:ARG:HB2	2.13	0.48
1:A:111:MET:CE	1:A:167:LYS:NZ	2.77	0.46
1:B:221:GLN:HB2	2:B:538:HOH:O	2.15	0.46
1:A:224:VAL:O	1:A:228:GLU:HG3	2.15	0.46
1:B:20:ILE:H	1:B:217:ASN:HD21	1.63	0.46
1:A:183:ILE:HD12	1:A:191:TRP:CZ2	2.49	0.46
1:A:10:LYS:HG2	2:A:513:HOH:O	2.16	0.45
1:B:36:LYS:NZ	2:B:470:HOH:O	2.40	0.45
1:B:248:PHE:HA	1:B:296:LEU:CD2	2.46	0.45
1:A:33:HIS:O	1:A:37:GLU:HG3	2.16	0.45
1:A:256:ASN:O	1:A:257:GLN:HB2	2.18	0.44
1:A:15:ILE:HG13	1:A:227:LEU:HD22	2.00	0.43
1:B:89:GLY:O	1:B:90:TYR:HB2	2.18	0.43
1:A:220:PRO:HG2	1:A:221:GLN:NE2	2.34	0.43
1:A:173:LEU:HB2	1:A:174:PRO:HD3	2.00	0.42
1:B:145:LYS:HB3	1:B:169:ALA:HB3	2.00	0.42
1:A:183:ILE:HA	1:A:184:PRO:HD3	1.95	0.41
1:B:264:ILE:O	1:B:268:MET:HG3	2.18	0.41
1:B:20:ILE:H	1:B:217:ASN:ND2	2.19	0.41
1:A:152:ARG:HG2	1:A:152:ARG:NH1	2.36	0.40
1:B:184:PRO:HG2	1:B:187:HIS:CD2	2.56	0.40
1:B:248:PHE:HD1	1:B:296:LEU:HD23	1.86	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	294/316 (93%)	286 (97%)	8 (3%)	0	100	100
1	B	298/316 (94%)	290 (97%)	6 (2%)	2 (1%)	18	8
All	All	592/632 (94%)	576 (97%)	14 (2%)	2 (0%)	36	25

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	188	GLN
1	B	90	TYR

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	246/263 (94%)	243 (99%)	3 (1%)	63	57
1	B	250/263 (95%)	249 (100%)	1 (0%)	84	83
All	All	496/526 (94%)	492 (99%)	4 (1%)	73	70

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

Mol	Chain	Res	Type
1	A	55	ASN
1	A	114	MET
1	A	259	ASN
1	B	221	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (16) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	33	HIS
1	A	55	ASN
1	A	100	ASN
1	A	187	HIS
1	A	233	ASN
1	A	259	ASN
1	A	291	GLN
1	B	45	ASN
1	B	100	ASN
1	B	161	GLN
1	B	162	ASN
1	B	217	ASN
1	B	221	GLN
1	B	235	ASN
1	B	256	ASN
1	B	274	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](#)

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 ⓘ

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	296/316 (93%)	-0.03	11 (3%) 45 45	11, 17, 31, 38	0
1	B	300/316 (94%)	-0.12	6 (2%) 65 65	11, 17, 28, 36	0
All	All	596/632 (94%)	-0.08	17 (2%) 53 53	11, 17, 29, 38	0

All (17) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	307	LYS	5.0
1	A	188	GLN	4.0
1	A	185	GLU	3.4
1	A	186	GLU	3.3
1	A	187	HIS	3.3
1	B	299	SER	3.3
1	A	296	LEU	3.1
1	A	184	PRO	2.8
1	B	187	HIS	2.6
1	A	302	LEU	2.6
1	A	221	GLN	2.3
1	B	188	GLN	2.2
1	B	296	LEU	2.2
1	A	299	SER	2.2
1	B	33	HIS	2.1
1	A	272	ARG	2.0
1	A	33	HIS	2.0

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

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.